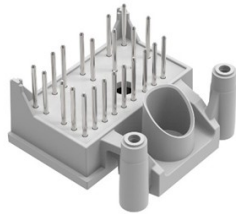
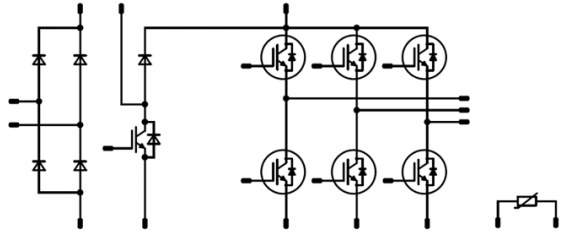




Vincotech

<i>flowPIM 0B + PFC</i>	600 V / 10 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Features</b></div> <ul style="list-style-type: none"> <li>Converter, PFC, inverter in one housing</li> <li>High speed IGBT for PFC</li> <li>One screw heatsink mounting</li> </ul>	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><i>flow 0B 17 mm housing</i></div> <div style="text-align: center;">  </div>
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Target applications</b></div> <ul style="list-style-type: none"> <li>Embedded Drives</li> </ul>	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Schematic</b></div> <div style="text-align: center;">  </div>
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Types</b></div> <ul style="list-style-type: none"> <li>10-0B06PPA010RC-L025A09</li> </ul>	

## Maximum Ratings

$T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
<b>Rectifier Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ }^\circ\text{C}$	18	A
Repetitive peak forward current	$I_{FRM}$	60 Hz Single Half Sine Wave	150	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ }^\circ\text{C}$	34	W
Maximum junction temperature	$T_{jmax}$		150	°C



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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		600	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	14	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	30	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ $V_{ce} = 400\text{ V}$ $T_j = 150\text{ °C}$	5	$\mu s$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}C$
<b>Inverter Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		600	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	14	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}C$
<b>PFC Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	29	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	90	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	55	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}C$
<b>PFC Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak forward current	$I_{FRM}$		60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	45	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}C$



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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
<b>PFC Sw. Protection Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	6	A
Repetitive peak forward current	$I_{FRM}$		12	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	32	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Module Properties

### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature under switching condition	$T_{top}$		-40...(T <sub>jmax</sub> - 25)	°C

### Isolation Properties

Isolation voltage	$V_{isol}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			min. 12,7	mm
Comparative Tracking Index	CTI		> 200	

\*100 % tested in production



Vincotech

## Characteristic Values

Parameter	Symbol	Conditions					Value			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		

### Rectifier Diode

#### Static

Forward voltage	$V_F$				7	25 125		1,04 0,97	1,14	V
Reverse leakage current	$I_R$			1600		25			20	μA

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,09		K/W
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### Inverter Switch

#### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00017	25	4,4	5	5,6	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		10	25 125 150	1,88	2,19 2,28 2,30	2,62	V
Collector-emitter cut-off current	$I_{CES}$		0	600		25			2	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			120	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							655		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		37		
Reverse transfer capacitance	$C_{res}$							22		
Gate charge	$Q_g$		15	480	10	25		64		nC

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,15		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125		74 71		ns
Rise time	$t_r$	$R_{gon} = 32$ Ω $R_{goff} = 32$ Ω				25 125		18 22		
Turn-off delay time	$t_{d(off)}$		±15	400	10	25 125		97 105		
Fall time	$t_f$					25 125		5 35		
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 0,5$ μC $Q_{tFWD} = 0,9$ μC				25 125		0,244 0,357		
Turn-off energy (per pulse)	$E_{off}$					25 125		0,122 0,181		



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## Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max		

### Inverter Diode

#### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			10	25 125 150		2,16 2,04 2,02	2,8	V

#### Thermal

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)		2,15		K/W

#### Dynamic

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Peak recovery current	$I_{RRM}$				25 125		7 10		A
Reverse recovery time	$t_{rr}$				25 125		174 233		ns
Recovered charge	$Q_r$			$\pm 15$	400	10	0,451 0,893		$\mu$ C
Reverse recovered energy	$E_{rec}$				25 125		0,121 0,243		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$				25 125		93 83		A/ $\mu$ s



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## Characteristic Values

Parameter	Symbol	Conditions					Value			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	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0003	25	3,3	4	4,7	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		30	25 125 150		1,67 1,80 1,84	2,22	V
Collector-emitter cut-off current	$I_{CES}$		0	650		25			40	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			120	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$	$f = 1$ Mhz	0	25		25		2100		pF
Reverse transfer capacitance	$C_{res}$							7,7		
Gate charge	$Q_g$		15	520	30	25		70		nC

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,74		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16$ Ω $R_{goff} = 16$ Ω	0 / 15	400	30	25		28		ns
Rise time	$t_r$					125		25		
						150		26		
						25		9		
Turn-off delay time	$t_{d(off)}$					125		10		
		150		10						
		25		147						
Fall time	$t_f$	125		167						
		150		172						
		25		9						
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1$ μC $Q_{tFWD} = 1,8$ μC $Q_{tFWD} = 2$ μC				25		0,594		mWs
						125		0,722		
						150		0,744		
Turn-off energy (per pulse)	$E_{off}$					25		0,154		
						125		0,284		
						150		0,324		



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## Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GE}$ [V] $V_{GS}$ [V]	$V_{CE}$ [V] $V_{DS}$ [V]	$I_C$ [A] $I_D$ [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 1,40 1,37	1,92	V
Reverse leakage current	$I_R$			650		25			1,6	$\mu$ A

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,09		K/W
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#### Dynamic

Peak recovery current	$I_{RRM}$					25 125 150		22 31 34		A
Reverse recovery time	$t_{rr}$					25 125 150		78 90 99		ns
Recovered charge	$Q_r$	$di/dt = 3590$ A/ $\mu$ s $di/dt = 3352$ A/ $\mu$ s $di/dt = 3244$ A/ $\mu$ s	0 / 15	400	30	25 125 150		0,970 1,798 2,047		$\mu$ C
Reverse recovered energy	$E_{rec}$					25 125 150		0,220 0,448 0,523		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		494 466 356		A/ $\mu$ s

### PFC Sw. Protection Diode

#### Static

Forward voltage	$V_F$				6	25 125 150		1,73 1,59 1,54	1,87	V
Reverse leakage current	$I_R$			650		25			0,1	$\mu$ A

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						3,01		K/W
-------------------------------------	---------------	---------------------------------------	--	--	--	--	--	------	--	-----



Vincotech

### Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	

#### Thermistor

Rated resistance	$R$					25		22		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	$P$					25		5		mW
Power dissipation constant						25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$				25		3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$				25		4000		K
Vincotech NTC Reference									I	



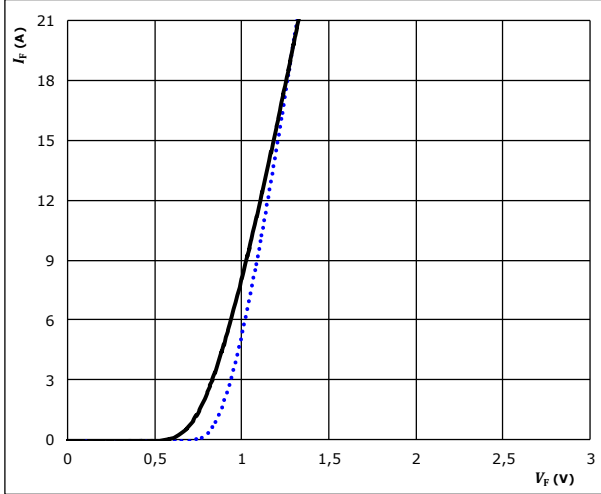


## Rectifier Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

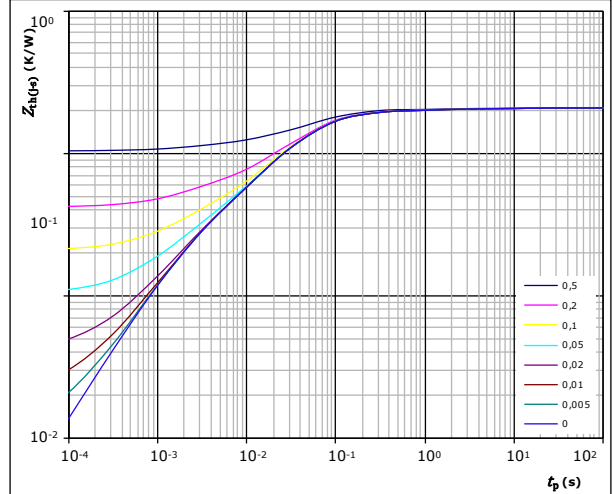


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ\text{C}$  (dotted blue line)  $125 \text{ }^\circ\text{C}$  (solid black line)

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,09 \text{ K/W}$

FWD thermal model values

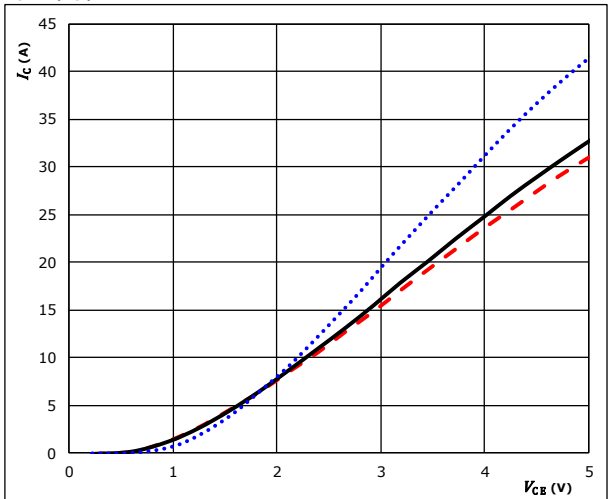
$R$ (K/W)	$\tau$ (s)
4,86E-02	1,03E+01
1,45E-01	6,91E-01
1,18E+00	6,09E-02
5,40E-01	1,88E-02
1,74E-01	1,96E-03



## Inverter Switch Characteristics

**figure 1.** IGBT

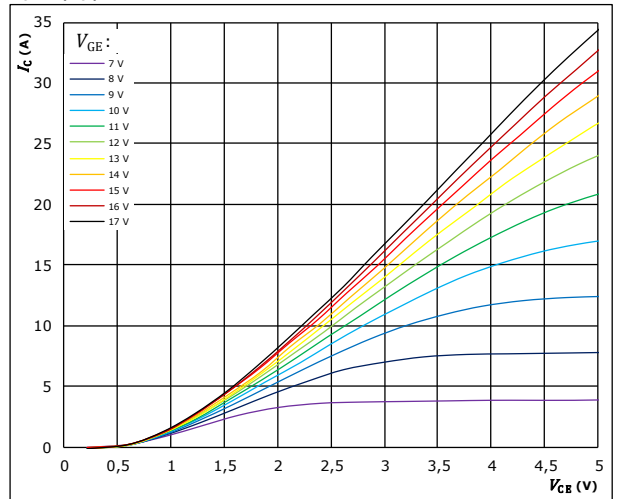
Typical output characteristics  
 $I_C = f(V_{CE})$



$t_p = 250 \mu s$        $T_j: 25 \text{ }^\circ C$       .....  
 $V_{GE} = 15 \text{ V}$        $T_j: 125 \text{ }^\circ C$       ———  
                           $T_j: 150 \text{ }^\circ C$       - - - -

**figure 2.** IGBT

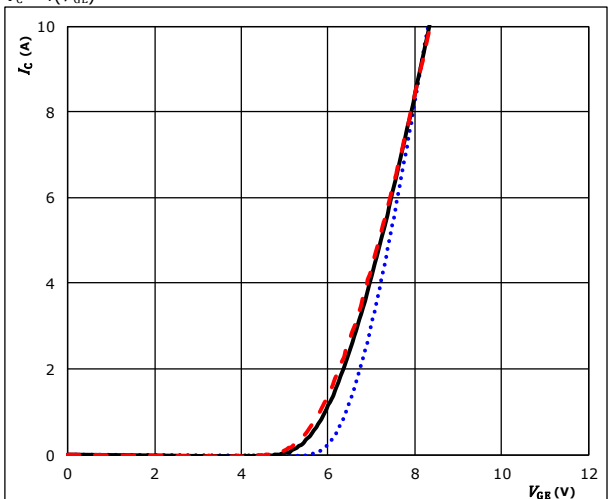
Typical output characteristics  
 $I_C = f(V_{CE})$



$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

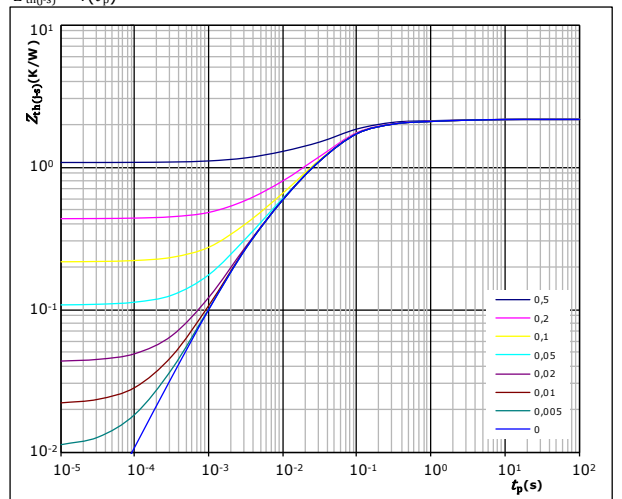
Typical transfer characteristics  
 $I_C = f(V_{GE})$



$t_p = 100 \mu s$        $T_j: 25 \text{ }^\circ C$       .....  
 $V_{CE} = 10 \text{ V}$        $T_j: 125 \text{ }^\circ C$       ———  
                           $T_j: 150 \text{ }^\circ C$       - - - -

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration  
 $Z_{th(j-s)} = f(t_p)$



$D = t_p / T$   
 $R_{th(j-s)} = 2,15 \text{ K/W}$

IGBT thermal model values

$R$ (K/W)	$\tau$ (s)
7,60E-02	2,82E+00
1,59E-01	4,19E-01
1,01E+00	6,63E-02
6,48E-01	2,63E-02
2,57E-01	3,72E-03

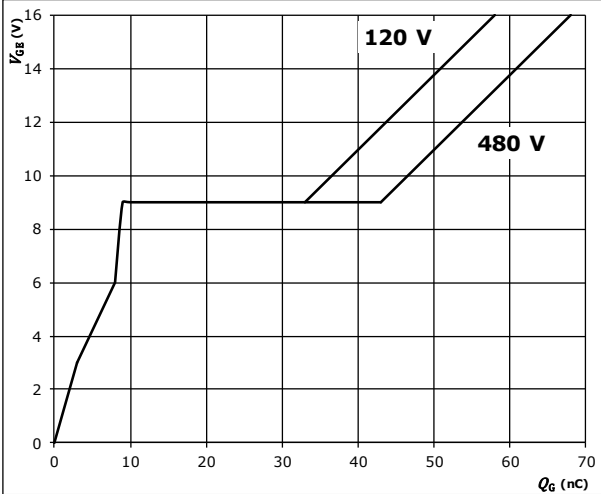


### Inverter Switch Characteristics

**figure 5.** IGBT

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

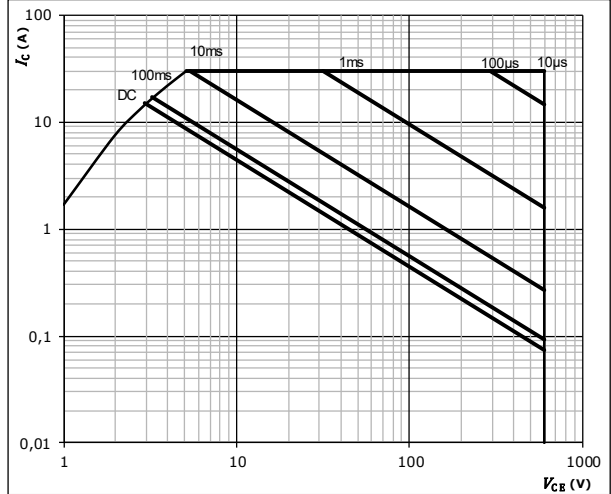


$I_C = 10$  A

**figure 6.** IGBT

Safe operating area

$I_C = f(V_{CE})$

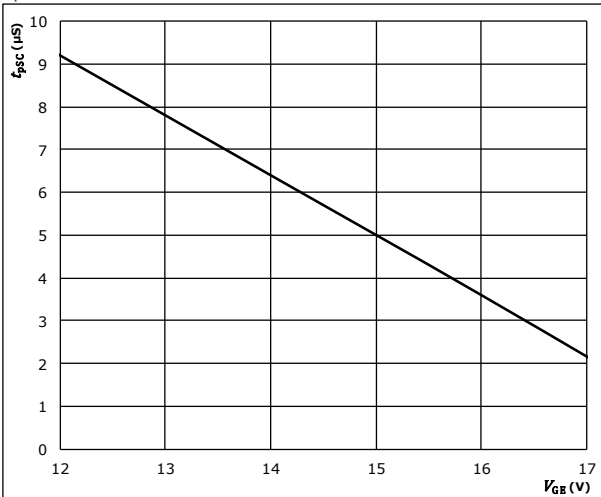


$D =$  single pulse  
 $T_s = 80$  °C  
 $V_{GE} = \pm 15$  V  
 $T_j = T_{jmax}$

**figure 7.** IGBT

Short circuit duration as a function of  $V_{GE}$

$t_{pSC} = f(V_{GE})$

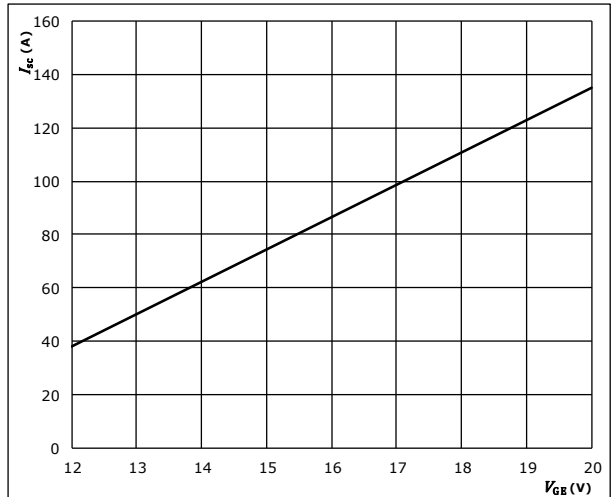


$V_{CE} = 400$  V  
 $T_j \leq 150$  °C

**figure 8.** IGBT

Typical short circuit current as a function of  $V_{GE}$

$I_{SC} = f(V_{GE})$



$V_{CE} \leq 400$  V  
 $T_j \leq 25$  °C

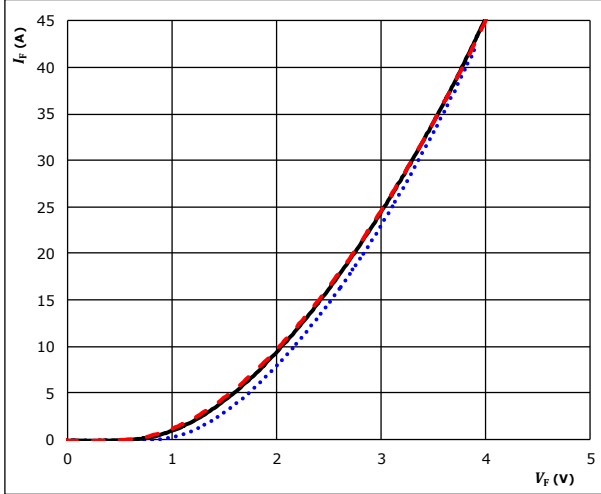


### Inverter Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

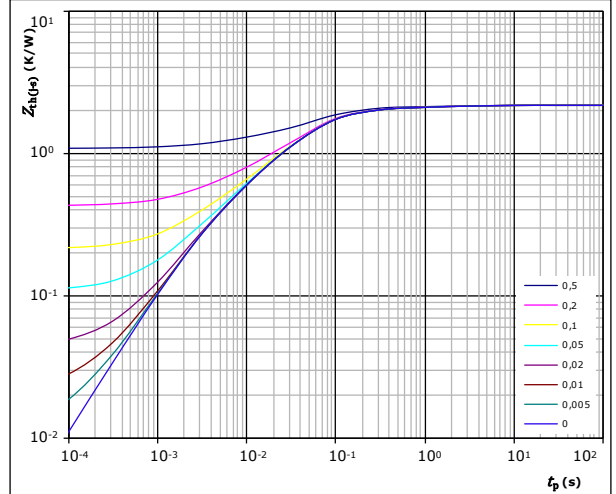


$t_p = 250 \mu s$   
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,15 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
7,60E-02	2,82E+00
1,59E-01	4,19E-01
1,01E+00	6,63E-02
6,48E-01	2,63E-02
2,57E-01	3,72E-03

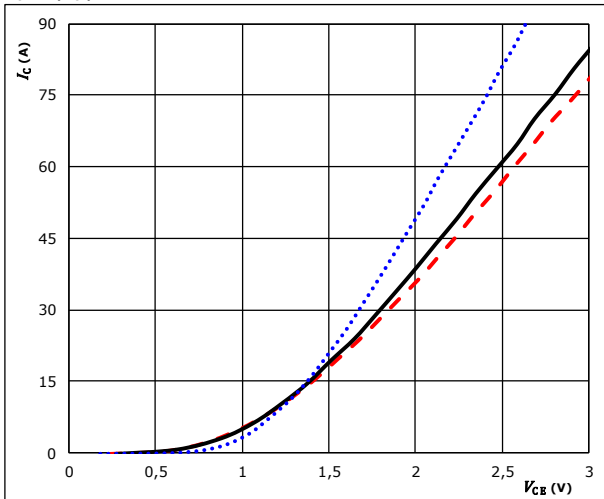


### PFC Switch Characteristics

**figure 1. IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

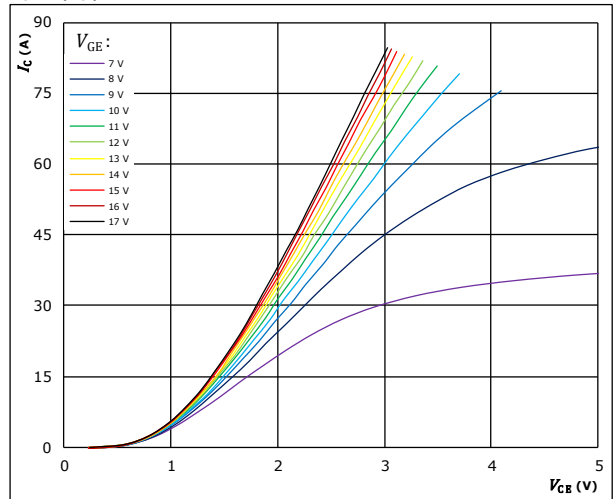


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ C$  (dotted blue)  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ C$  (solid black)  
 $T_j: 150 \text{ }^\circ C$  (dashed red)

**figure 2. IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

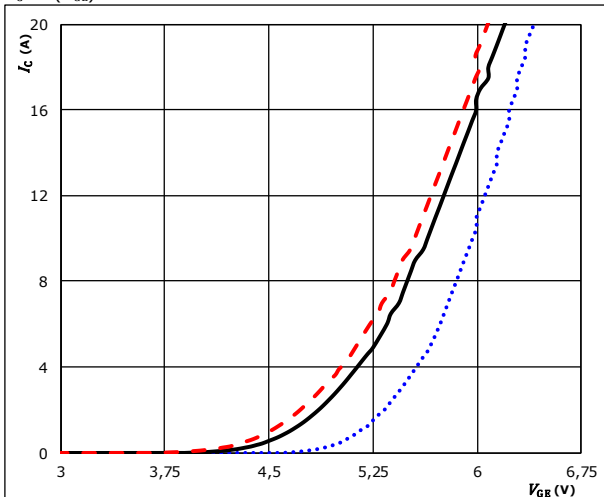


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3. IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

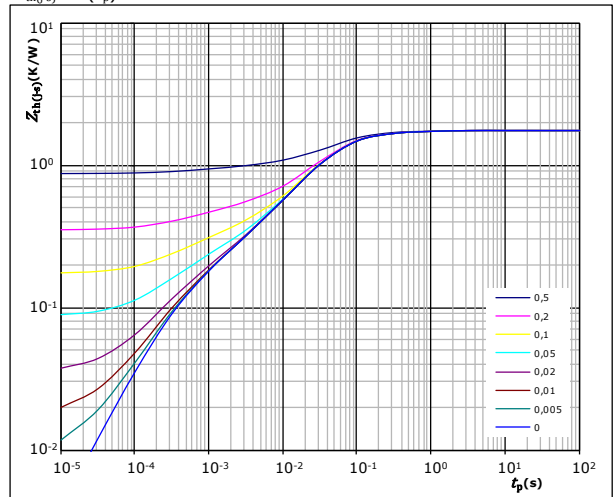


$t_p = 100 \mu s$   $T_j: 25 \text{ }^\circ C$  (dotted blue)  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ C$  (solid black)  
 $T_j: 150 \text{ }^\circ C$  (dashed red)

**figure 4. IGBT**

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,74 \text{ K/W}$   
 IGBT thermal model values

R (K/W)	$\tau$ (s)
1,29E-01	5,83E-01
7,29E-01	6,38E-02
6,55E-01	2,28E-02
1,29E-01	2,24E-03
9,92E-02	3,38E-04

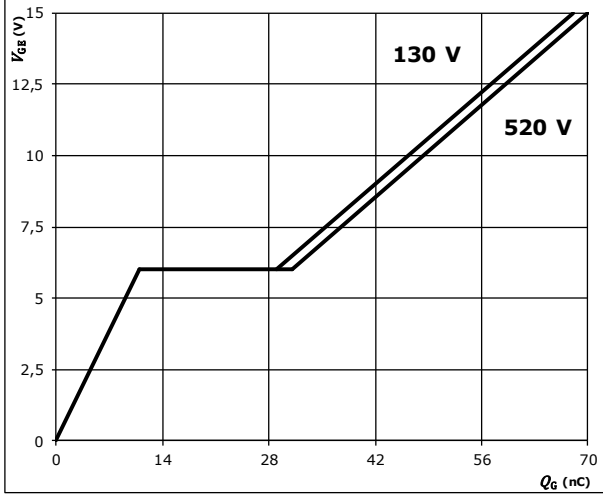


### PFC Switch Characteristics

**figure 5. IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

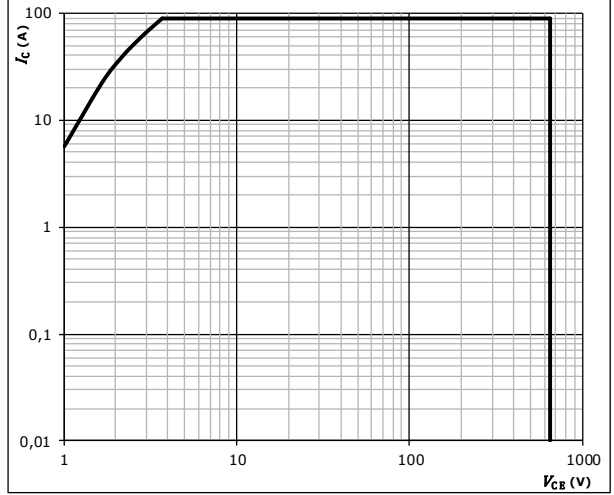


$I_C = 30$  A

**figure 6. IGBT**

Safe operating area

$I_C = f(V_{CE})$



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

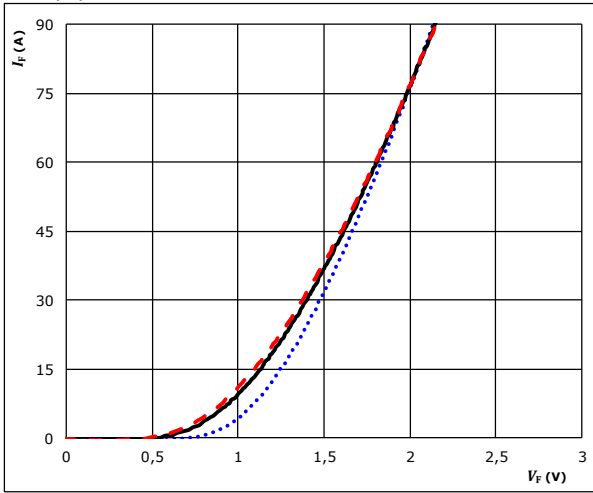


### PFC Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

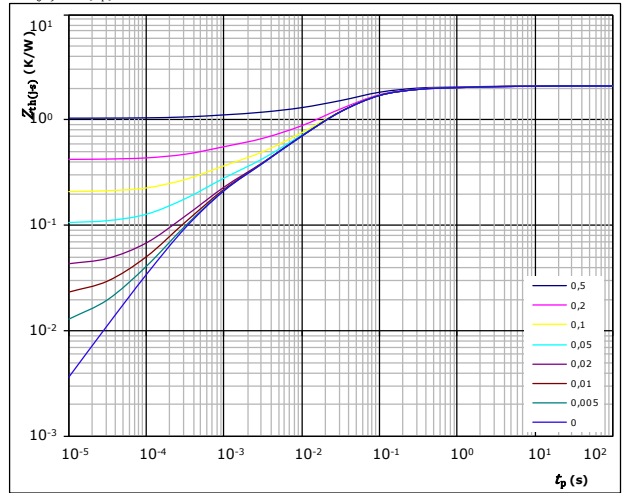


$t_p = 250 \mu s$   
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,09 \text{ K/W}$

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
4,06E-02	7,59E+00
1,41E-01	7,59E-01
6,53E-01	8,62E-02
8,80E-01	2,66E-02
2,25E-01	4,54E-03
1,55E-01	5,55E-04

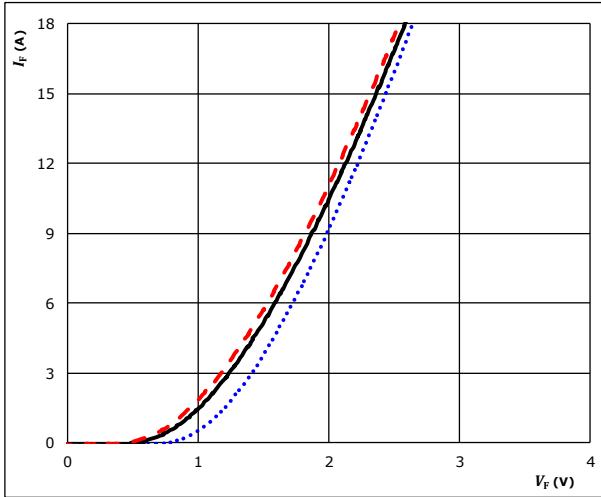


## PFC Sw. Protection Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

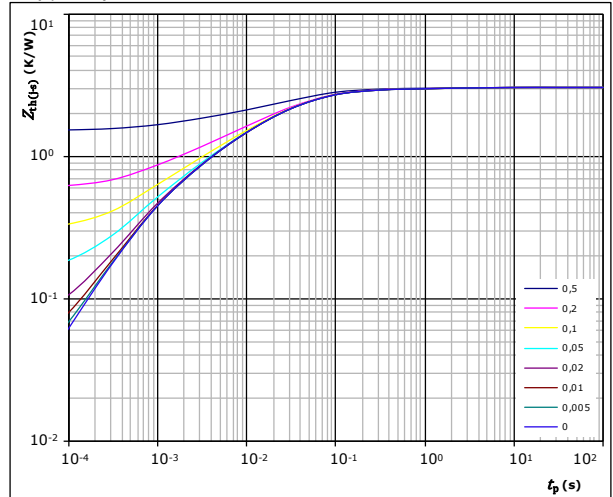


$t_p = 250 \mu s$   
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 3,01 \text{ K/W}$   
 FWD thermal model values

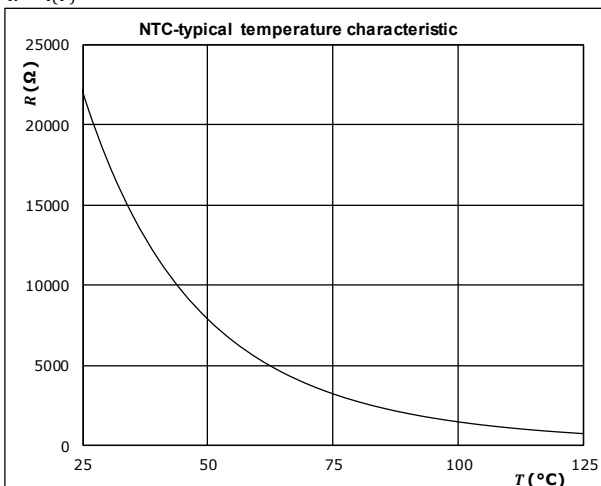
$R \text{ (K/W)}$	$\tau \text{ (s)}$
5,15E-02	9,38E+00
9,53E-02	8,91E-01
3,22E-01	1,25E-01
1,35E+00	2,97E-02
8,32E-01	8,19E-03
3,58E-01	1,78E-03

## Thermistor Characteristics

**figure 1.** Thermistor

Typical NTC characteristic as a function of temperature

$$R = f(T)$$

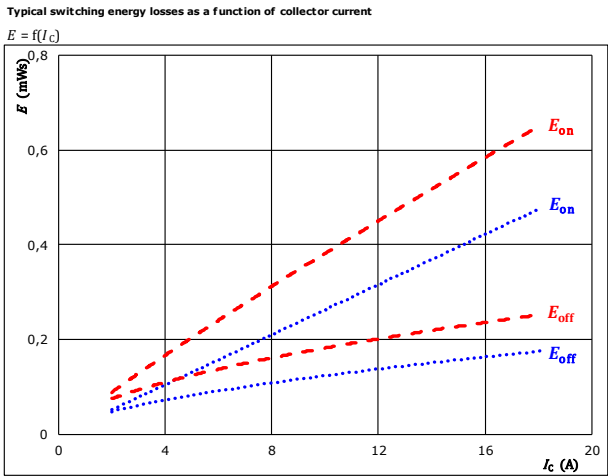






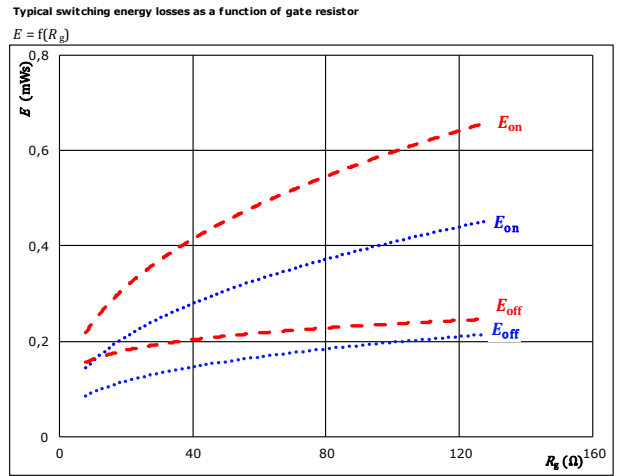
## Inverter Switching Characteristics

**figure 1.** IGBT



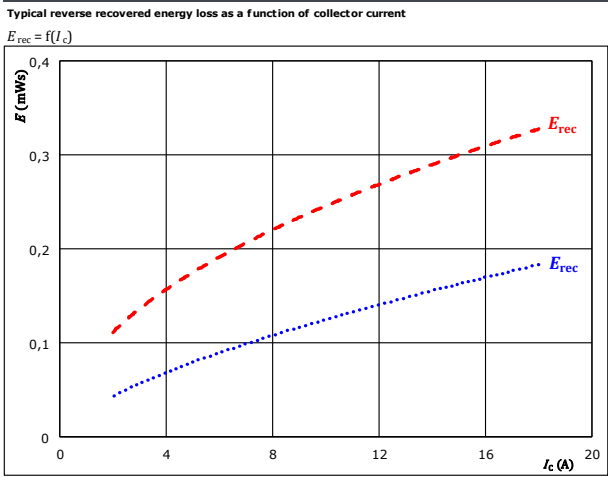
With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $R_{g(on)} = 32$   $\Omega$   
 $R_{g(off)} = 32$   $\Omega$   
 $T_j: 25$  °C (blue dotted),  $125$  °C (red dashed)

**figure 2.** IGBT



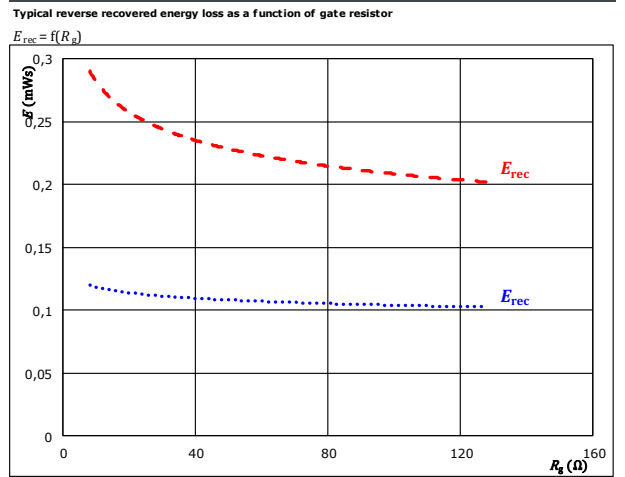
With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 10$  A  
 $T_j: 25$  °C (blue dotted),  $125$  °C (red dashed)

**figure 3.** FWD



With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $R_{g(on)} = 32$   $\Omega$   
 $T_j: 25$  °C (blue dotted),  $125$  °C (red dashed)

**figure 4.** FWD



With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 10$  A  
 $T_j: 25$  °C (blue dotted),  $125$  °C (red dashed)

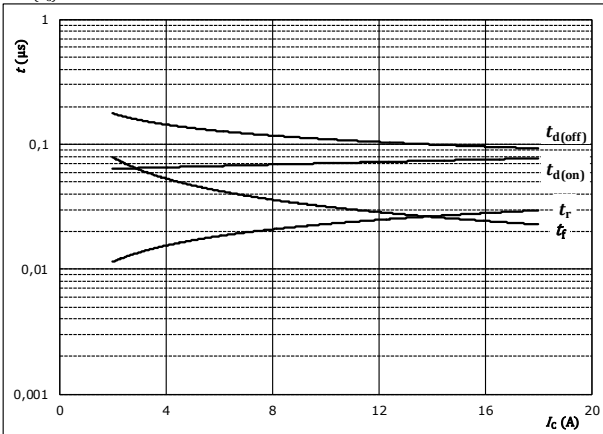


## Inverter Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



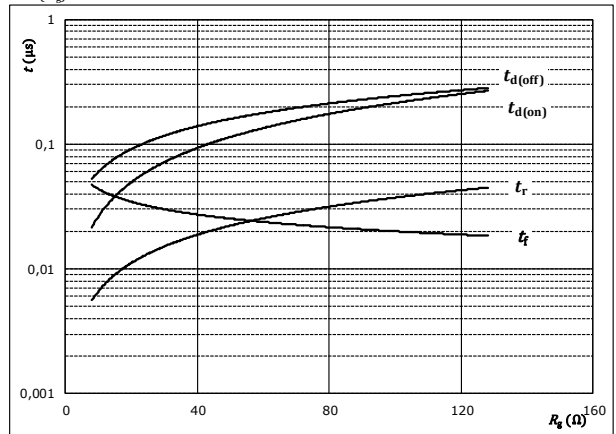
With an inductive load at

- $T_j = 125 \text{ } ^\circ\text{C}$
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 32 \text{ } \Omega$
- $R_{goff} = 32 \text{ } \Omega$

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



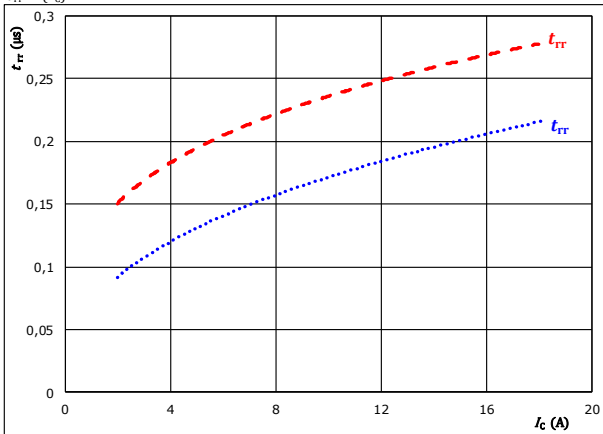
With an inductive load at

- $T_j = 125 \text{ } ^\circ\text{C}$
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 10 \text{ A}$

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



With an inductive load at

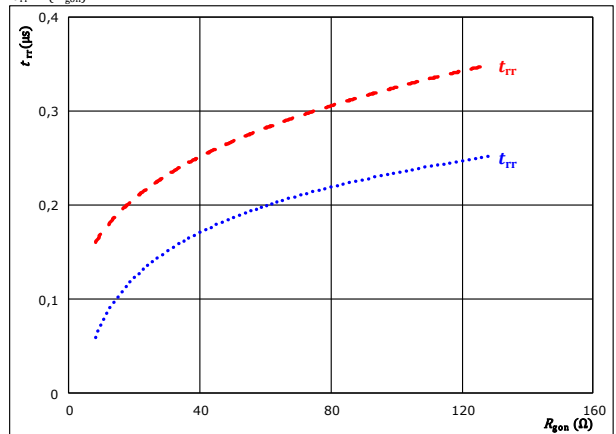
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 32 \text{ } \Omega$

- $T_j: 25 \text{ } ^\circ\text{C}$  (dotted blue line)
- $125 \text{ } ^\circ\text{C}$  (dashed red line)

**figure 8.** FWD

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

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



With an inductive load at

- $V_{CE} = 400 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 10 \text{ A}$

- $T_j: 25 \text{ } ^\circ\text{C}$  (dotted blue line)
- $125 \text{ } ^\circ\text{C}$  (dashed red line)

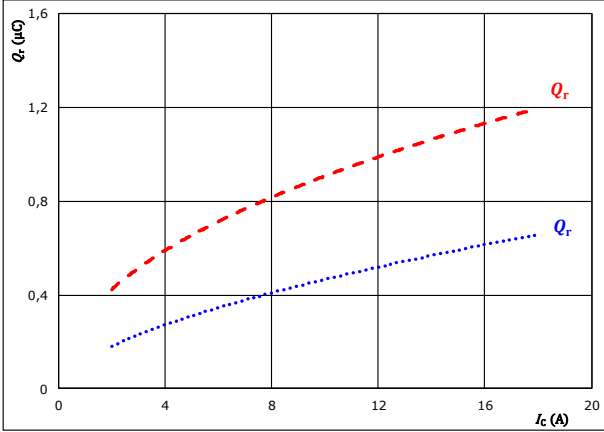


## Inverter Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



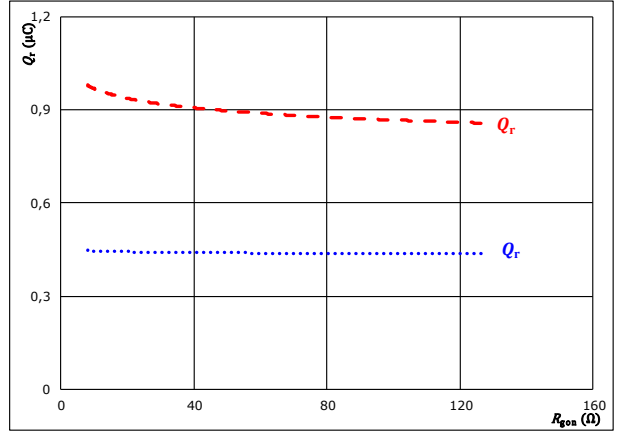
With an inductive load at  $T_j$ : 25 °C (dotted line) / 125 °C (dashed line)

$V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$  Ω

**figure 10.** FWD

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

$$Q_r = f(R_{gon})$$



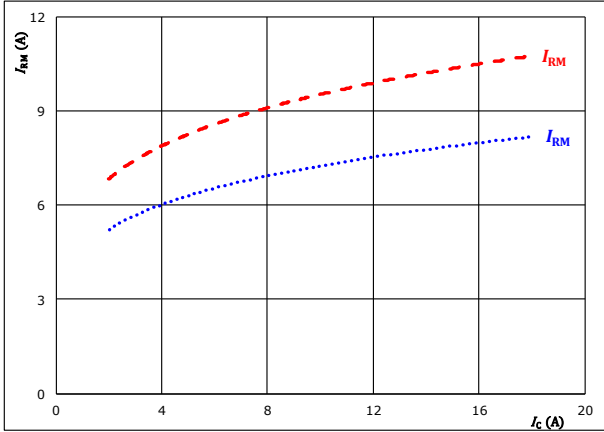
With an inductive load at  $T_j$ : 25 °C (dotted line) / 125 °C (dashed line)

$V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 10$  A

**figure 11.** FWD

Typical peak reverse recovery current current as a function of collector current

$$I_{RM} = f(I_c)$$



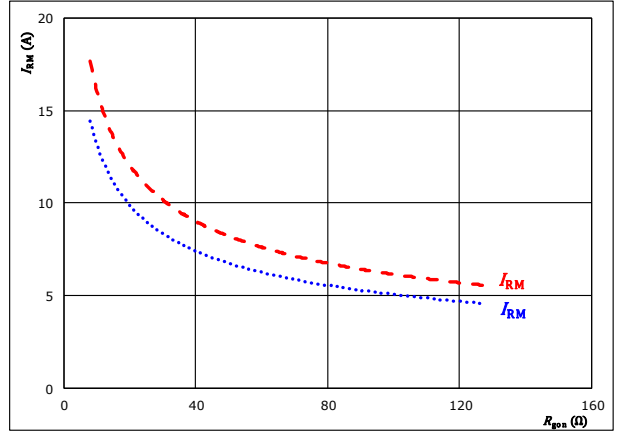
With an inductive load at  $T_j$ : 25 °C (dotted line) / 125 °C (dashed line)

$V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$  Ω

**figure 12.** FWD

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

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



With an inductive load at  $T_j$ : 25 °C (dotted line) / 125 °C (dashed line)

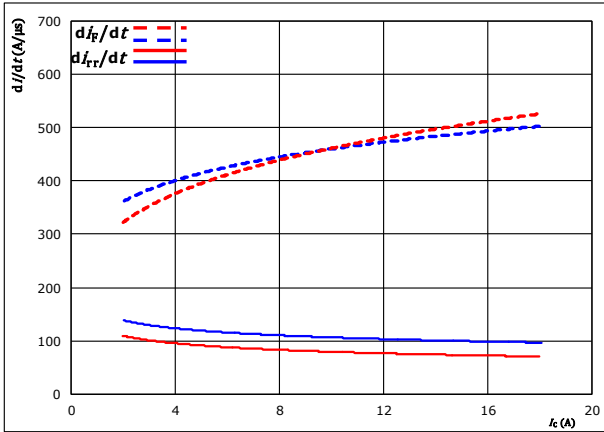
$V_{CE} = 400$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 10$  A



## Inverter Switching Characteristics

**figure 13.** FWD

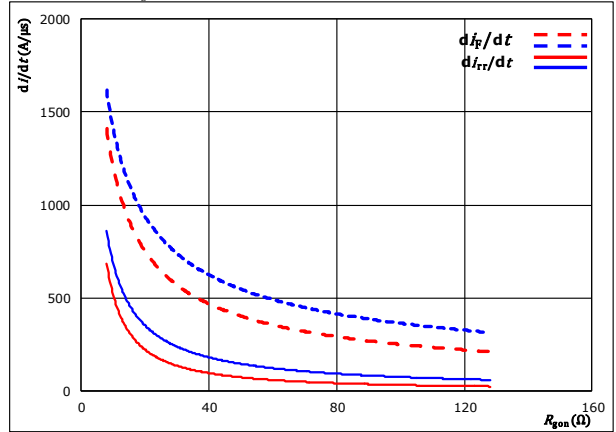
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_C)$



With an inductive load at  
 $V_{CE} = 400 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g\text{on}} = 32 \text{ }\Omega$   
 $T_j: 25 \text{ }^\circ\text{C}$   
 $125 \text{ }^\circ\text{C}$

**figure 14.** FWD

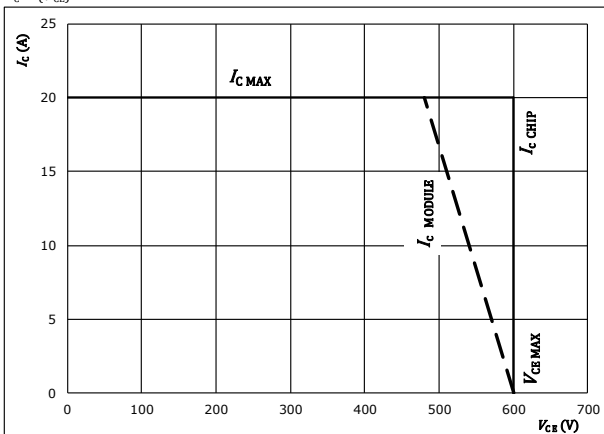
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g\text{on}})$



With an inductive load at  
 $V_{CE} = 400 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 10 \text{ A}$   
 $T_j: 25 \text{ }^\circ\text{C}$   
 $125 \text{ }^\circ\text{C}$

**figure 15.** IGBT

Reverse bias safe operating area  
 $I_C = f(V_{CE})$



At  
 $T_j = 125 \text{ }^\circ\text{C}$   
 $R_{g\text{on}} = 32 \text{ }\Omega$   
 $R_{g\text{off}} = 32 \text{ }\Omega$

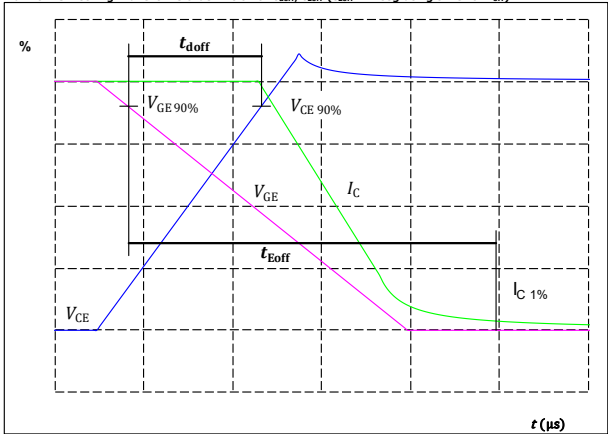


## Inverter Switching Definitions

General conditions		
$T_j$	=	125 °C
$R_{gon}$	=	32 $\Omega$
$R_{goff}$	=	32 $\Omega$

**figure 1.** IGBT

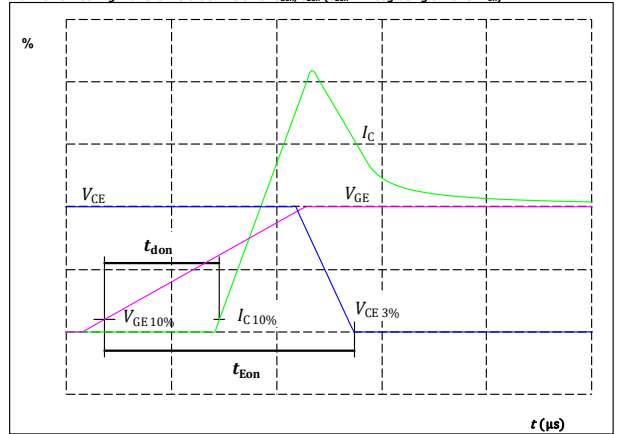
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



$V_{CE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	10	A
$t_{doff} =$	105	ns

**figure 2.** IGBT

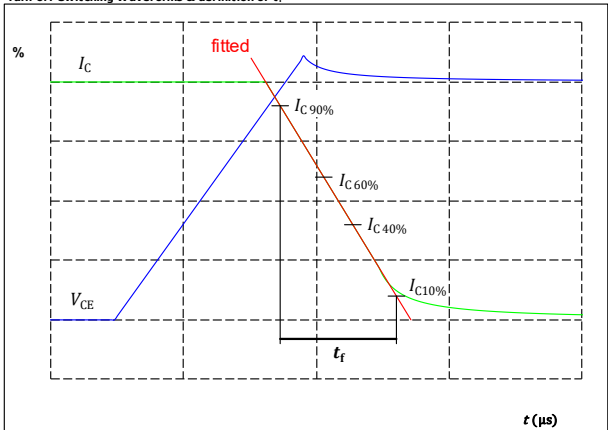
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



$V_{CE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	10	A
$t_{don} =$	71	ns

**figure 3.** IGBT

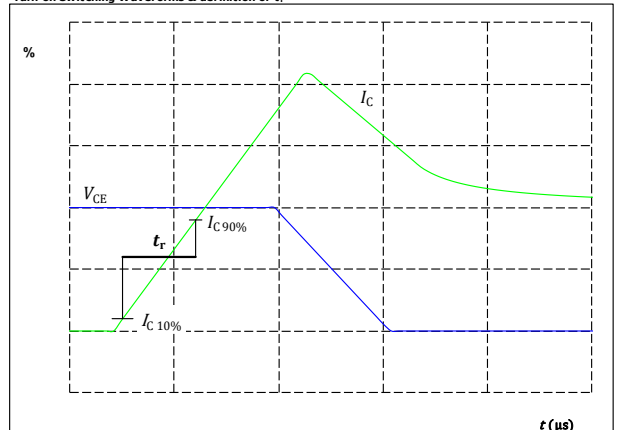
Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	400	V
$I_C(100\%) =$	10	A
$t_f =$	35	ns

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$



$V_C(100\%) =$	400	V
$I_C(100\%) =$	10	A
$t_r =$	22	ns

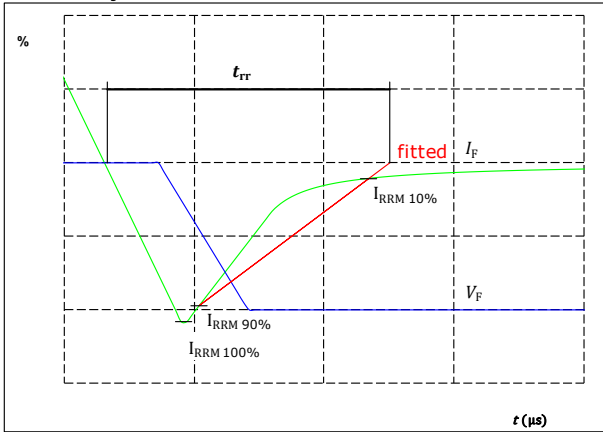


Vincotech

## Inverter Switching Characteristics

**figure 5.** FWD

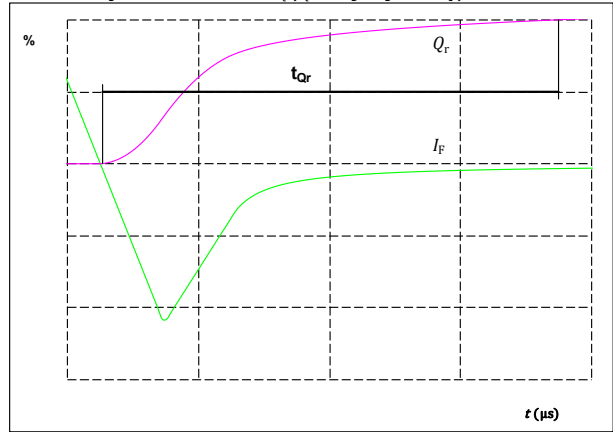
Turn-off Switching Waveforms & definition of  $t_{rr}$



$V_F(100\%) =$	400	V
$I_F(100\%) =$	10	A
$I_{RRM}(100\%) =$	10	A
$t_{rr} =$	233	ns

**figure 6.** FWD

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



$I_F(100\%) =$	10	A
$Q_r(100\%) =$	0,89	$\mu\text{C}$

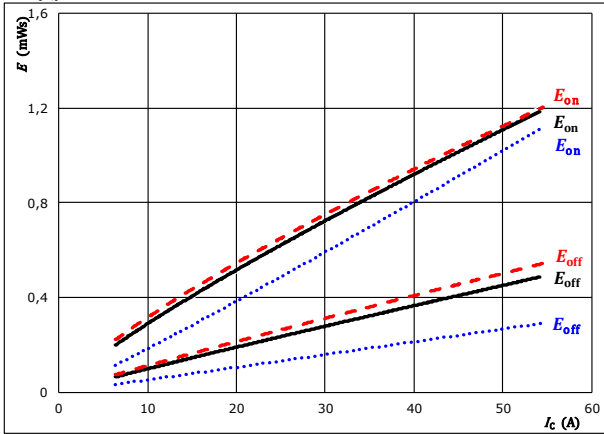


### PFC Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$

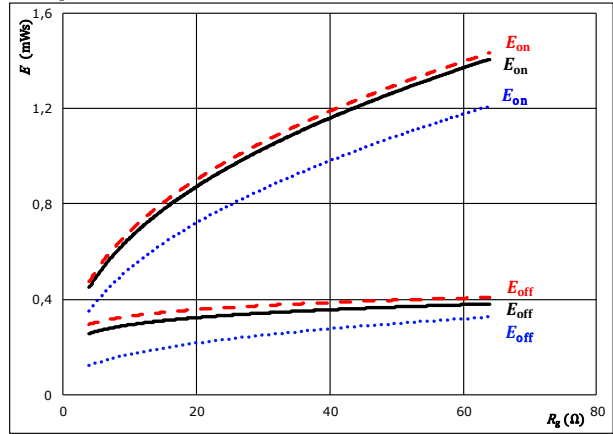


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$

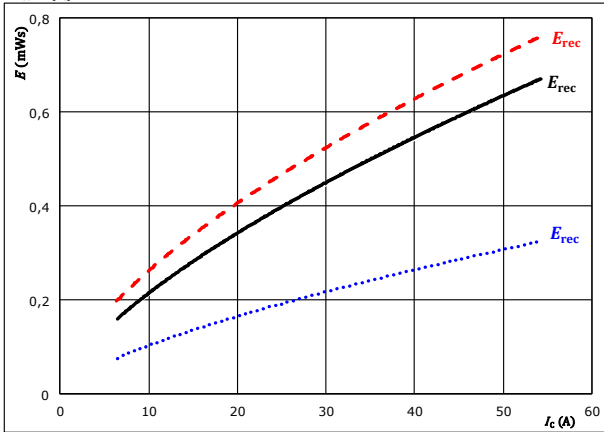


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_c)$$

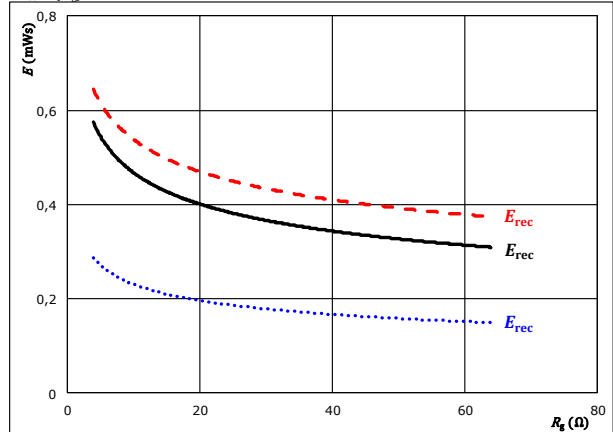


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 4.** 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  
 $V_{GE} = 0 / 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

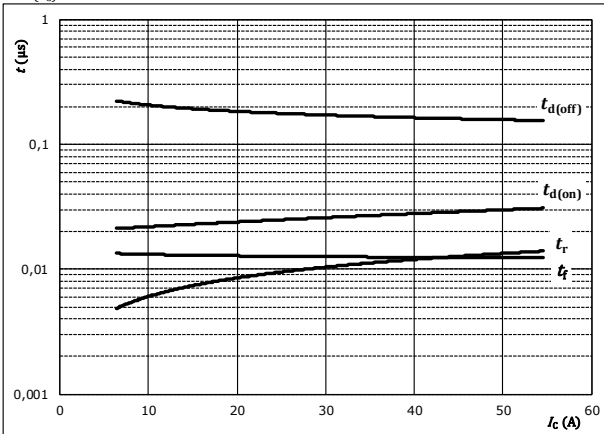


### PFC Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



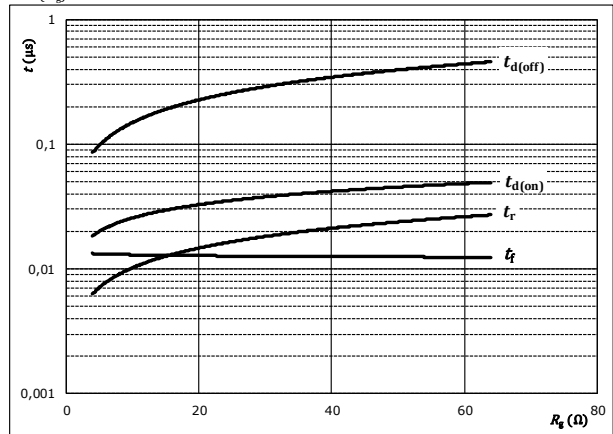
With an inductive load at

- $T_j = 150 \text{ }^\circ\text{C}$
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = 0 / 15 \text{ V}$
- $R_{g(on)} = 16 \text{ } \Omega$
- $R_{g(off)} = 16 \text{ } \Omega$

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



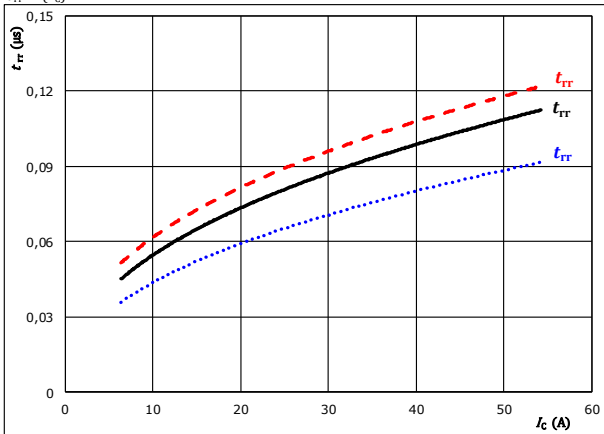
With an inductive load at

- $T_j = 150 \text{ }^\circ\text{C}$
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = 0 / 15 \text{ V}$
- $I_C = 30 \text{ A}$

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



With an inductive load at

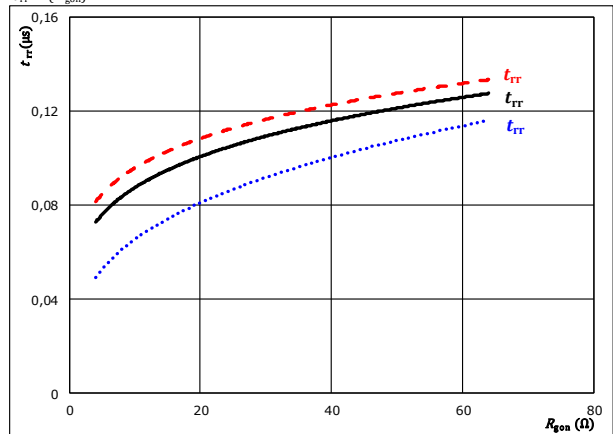
- $V_{CE} = 400 \text{ V}$
- $V_{GE} = 0 / 15 \text{ V}$
- $R_{g(on)} = 16 \text{ } \Omega$

- $T_j: 25 \text{ }^\circ\text{C}$  (dotted blue line)
- $125 \text{ }^\circ\text{C}$  (solid black line)
- $150 \text{ }^\circ\text{C}$  (dashed red line)

**figure 8.** FWD

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

$$t_{rr} = f(R_{g(on)})$$



With an inductive load at

- $V_{CE} = 400 \text{ V}$
- $V_{GE} = 0 / 15 \text{ V}$
- $I_C = 30 \text{ A}$

- $T_j: 25 \text{ }^\circ\text{C}$  (dotted blue line)
- $125 \text{ }^\circ\text{C}$  (solid black line)
- $150 \text{ }^\circ\text{C}$  (dashed red line)



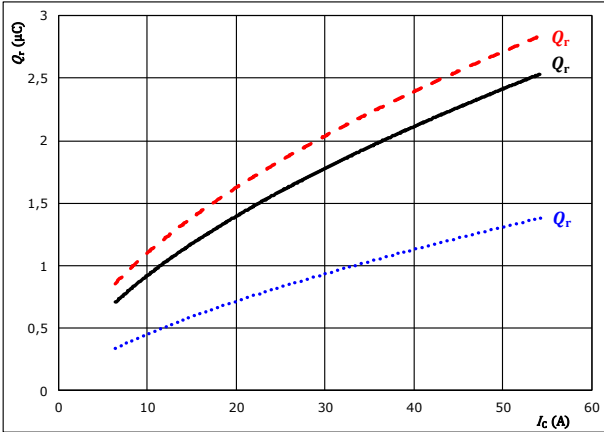


## PFC Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

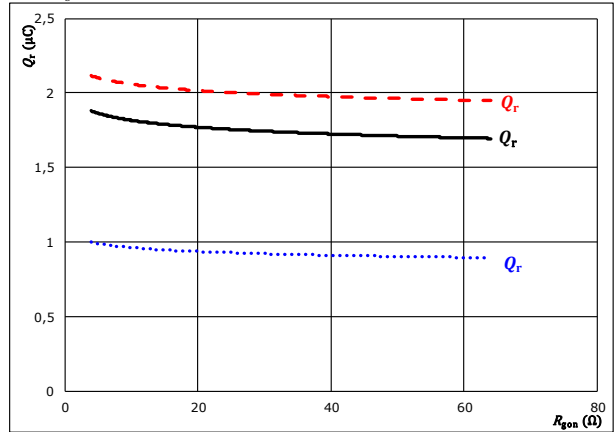


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 16$  Ω  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

figure 10. FWD

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

$$Q_r = f(R_{gon})$$

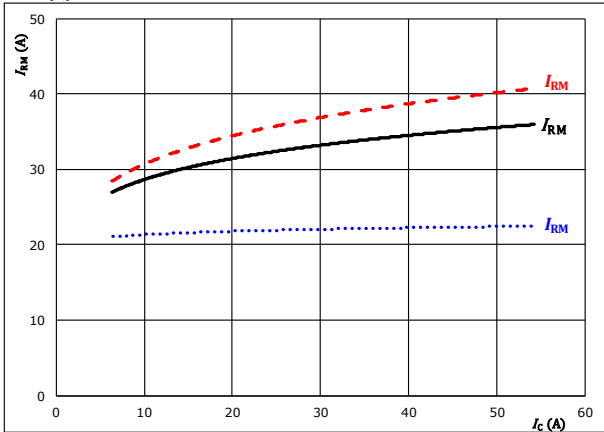


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

$$I_{RM} = f(I_c)$$

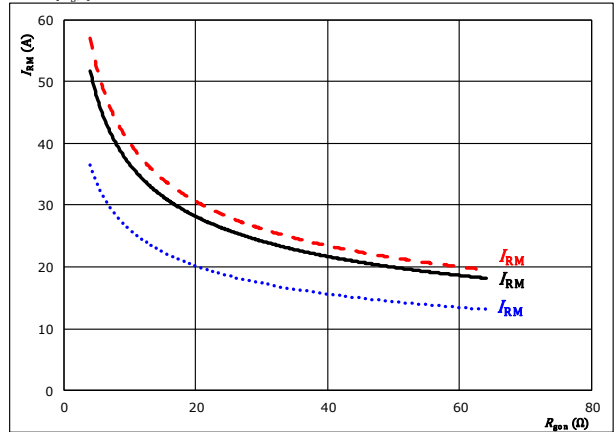


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 16$  Ω  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

figure 12. FWD

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

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



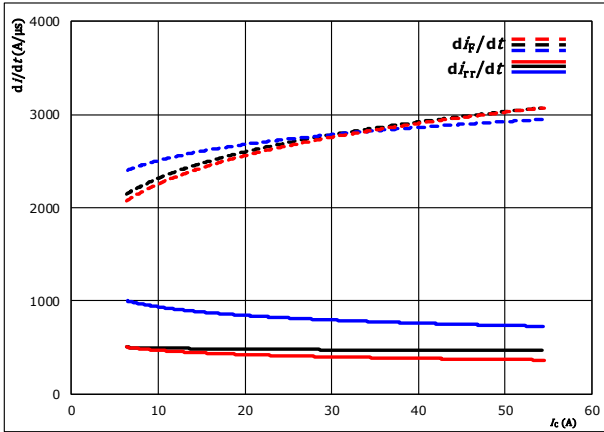
With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)



### PFC Switching Characteristics

**figure 13.** FWD

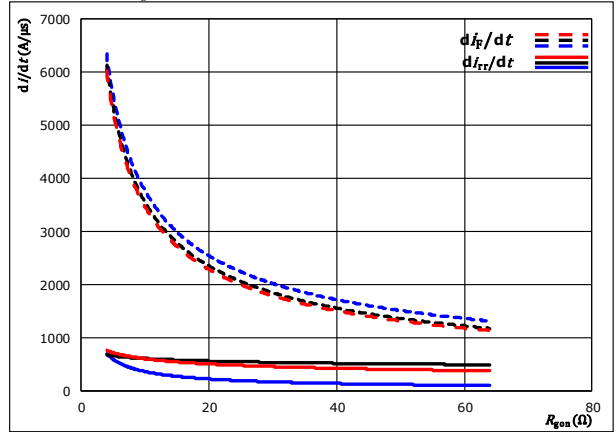
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_C)$



With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gpn} = 16$   $\Omega$   
 $T_j: 25$  °C  
 $125$  °C  
 $150$  °C

**figure 14.** FWD

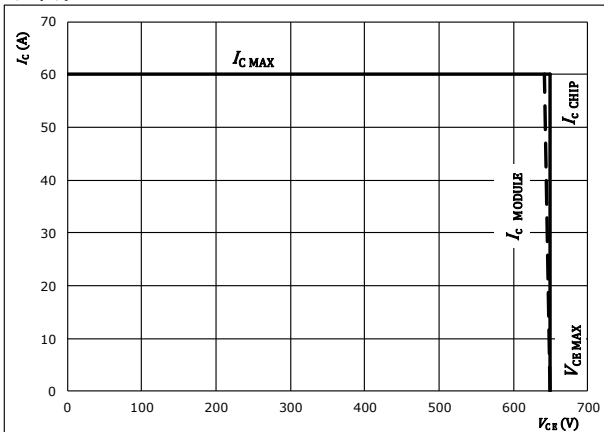
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{gpn})$



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

**figure 15.** IGBT

Reverse bias safe operating area  
 $I_C = f(V_{CE})$



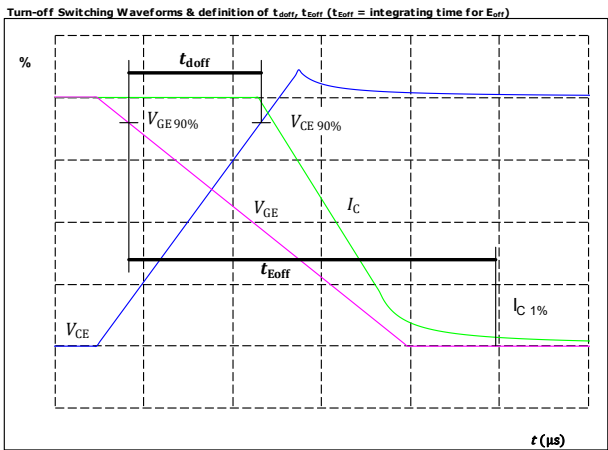
At  
 $T_j = 125$  °C  
 $R_{gpn} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$



### PFC Switching Definitions

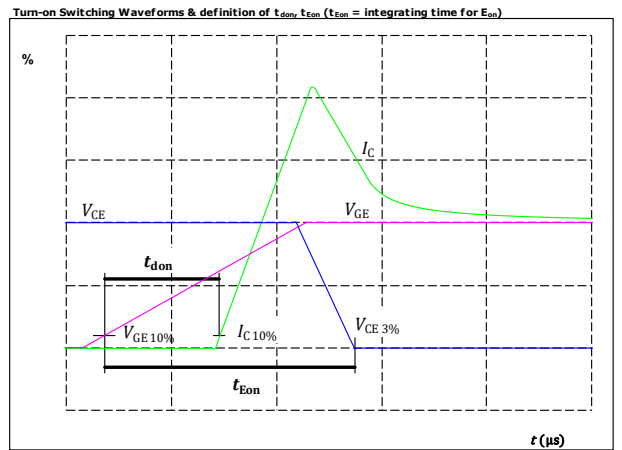
General conditions		
$T_j$	=	125 °C
$R_{gon}$	=	16 $\Omega$
$R_{goff}$	=	16 $\Omega$

figure 1. IGBT



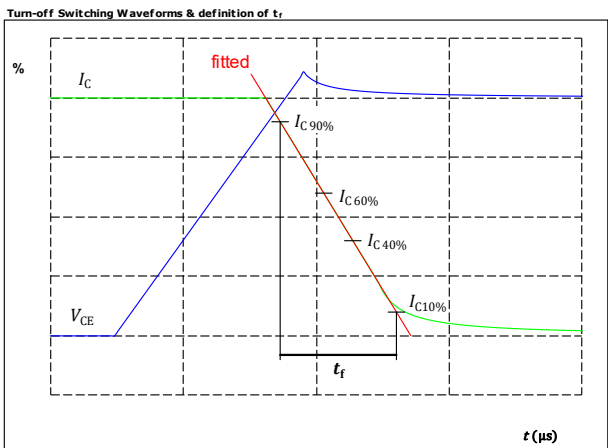
$V_{CE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	30	A
$t_{doff} =$	167	ns

figure 2. IGBT



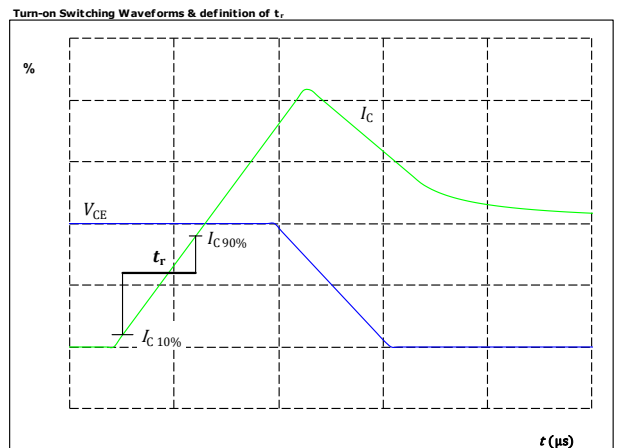
$V_{CE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	30	A
$t_{don} =$	25	ns

figure 3. IGBT



$V_C(100\%) =$	400	V
$I_C(100\%) =$	30	A
$t_f =$	12	ns

figure 4. IGBT



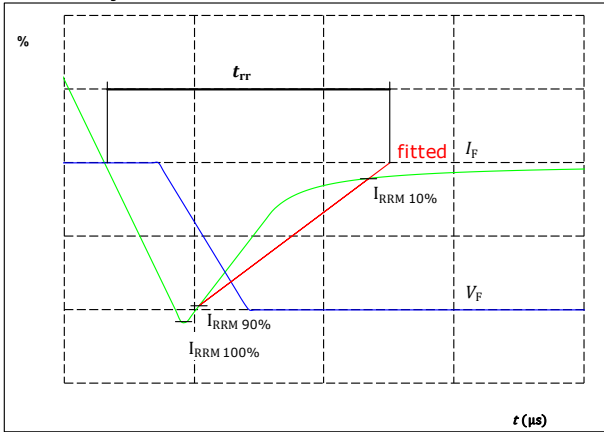
$V_C(100\%) =$	400	V
$I_C(100\%) =$	30	A
$t_r =$	10	ns



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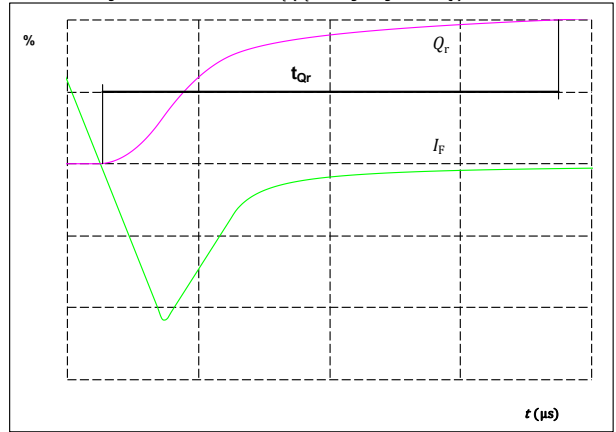
### PFC Switching Characteristics

**figure 5.** FWD  
Turn-off Switching Waveforms & definition of  $t_{rr}$



$V_F(100\%) =$	400	V
$I_F(100\%) =$	30	A
$I_{RRM}(100\%) =$	31	A
$t_{rr} =$	90	ns


**figure 6.** FWD  
Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr} =$  integrating time for  $Q_r$ )



$I_F(100\%) =$	30	A
$Q_r(100\%) =$	0	$\mu\text{C}$

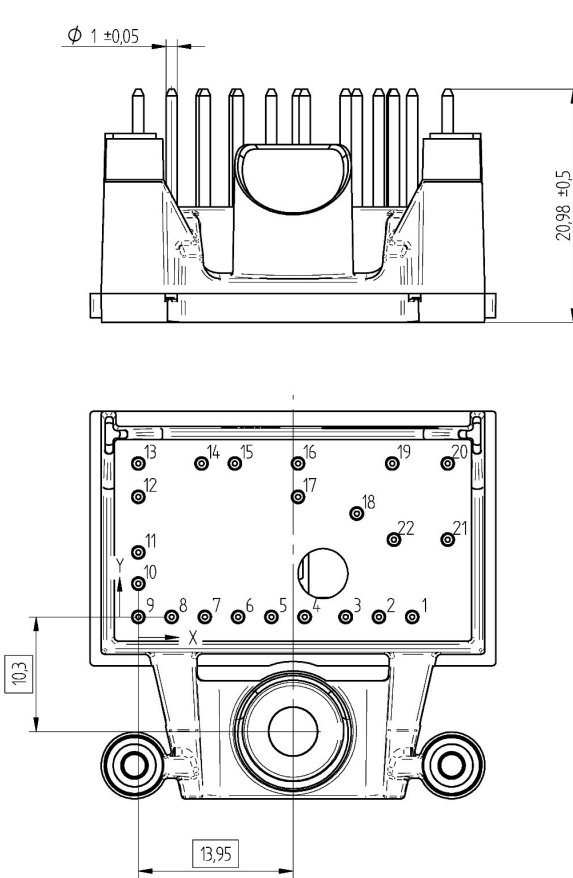


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Ordering Code & Marking						
<b>Version</b>			<b>Ordering Code</b>			
without thermal paste 17mm housing with solder pins			10-0B06PPA010RC-L025A09			
with thermal paste 17mm housing with solder pins			10-0B06PPA010RC-L025A09-/3/			
NN-NNNNNNNN NNNN-TTTTTTVV VIN LLLLL WWYY SSSS UL						
<b>Text</b>	<b>Name</b>		<b>Type&amp;Ver</b>	<b>Date code</b>	<b>VIN &amp; Lot</b>	<b>Serial&amp;UL</b>
	NN-NNNNNNNNNNNNNN		TTTTTTTVV	WWYY	VIN LLLLL	SSSS UL
<b>Datamatrix</b>	<b>Type&amp;Ver</b>	<b>Lot number</b>	<b>Serial</b>	<b>Date code</b>		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Pin table			
Pin	X	Y	Function
1	24,7	0	DC-Rect
2	21,7	0	DC-PFC
3	18,7	0	G27
4	15	0	DC-3
5	12	0	G15
6	9	0	DC-2
7	6	0	G13
8	3	0	DC-1
9	0	0	G11
10	0	3	Therm2
11	0	5,8	Therm1
12	0	10,8	G12
13	0	13,8	Ph1
14	5,7	13,8	G14
15	8,7	13,8	Ph2
16	14,4	13,8	Ph3
17	14,4	10,8	G16
18	19,7	9,3	DC+
19	22,9	13,8	PFC
20	27,9	13,8	ACIn1
21	27,9	6,95	ACIn2
22	23,05	6,95	DC+Rect

**Outline**

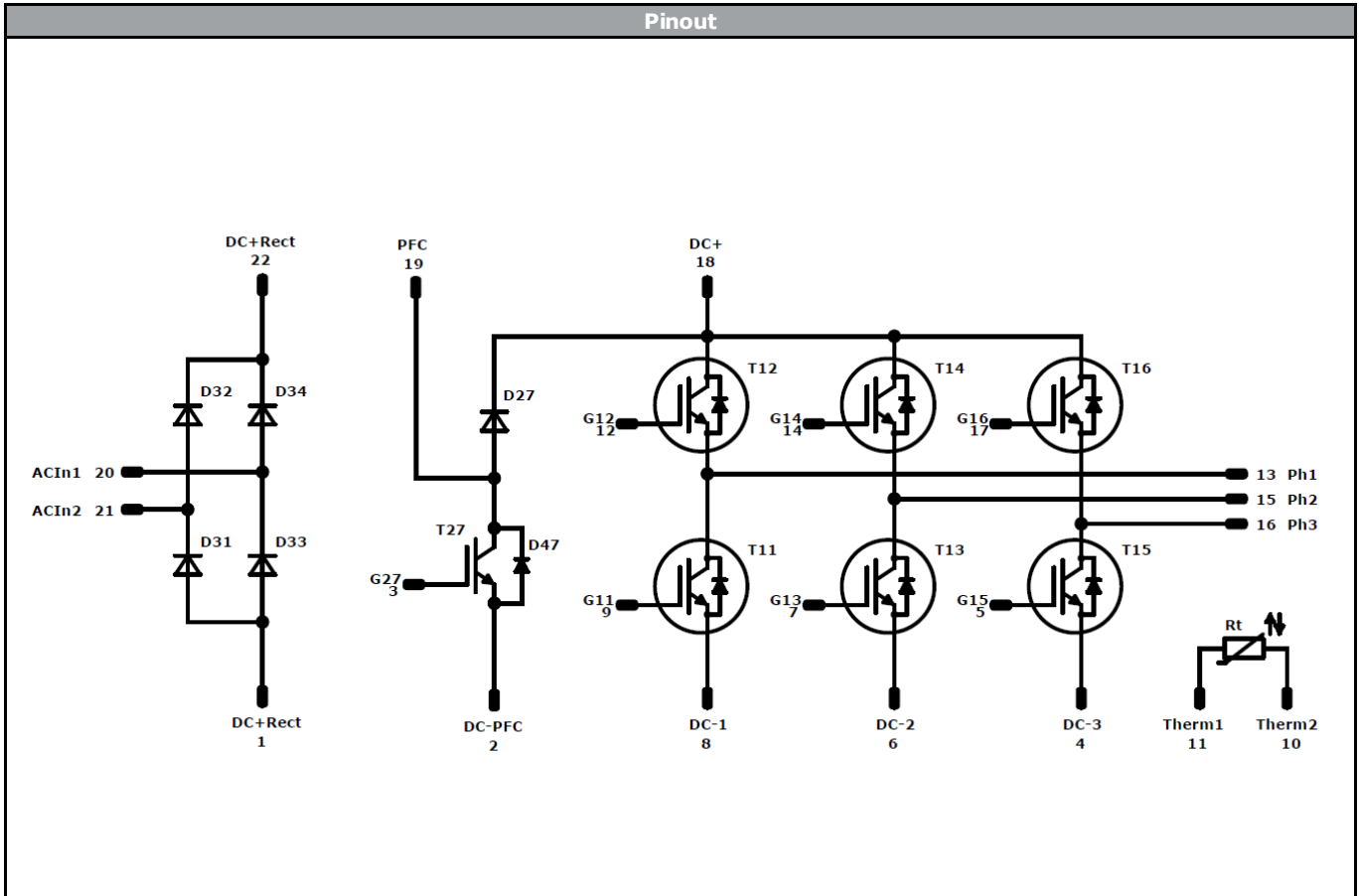


Tolerance of pinpositions: ±0,5mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance



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**Pinout**



**Identification**

ID	Component	Voltage	Current	Function	Comment
D31, D32, D33, D34	Rectifier	1600 V	13 A	Rectifier Diode	
T11, T12, T13, T14, T15, T16	RC-IGBT	600 V	10 A	Inverter Switch	
T27	IGBT	650 V	30 A	PFC Switch	
D27	FWD	650 V	30 A	PFC Diode	
D47	FWD	650 V	6 A	PFC Sw. Protection Diode	
Rt	NTC			Thermistor	




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Packaging instruction			
Standard packaging quantity (SPQ) 160	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow0</i> B packages see vincotech.com website.

Package data
Package data for <i>flow0</i> B 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
10-0B06PPA010RC-L025A09-D4-14	15 Feb. 2019	PCN implementation: IFX Rapid1-> Rapid1Solar PCN implementation: Tateyama NTC	6,7,15,23-28 8,16

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.