
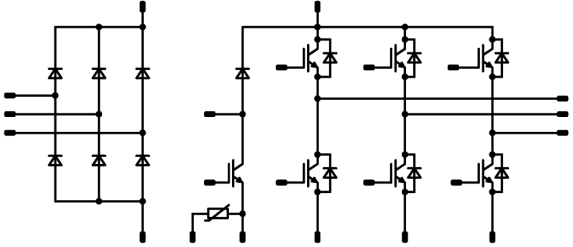

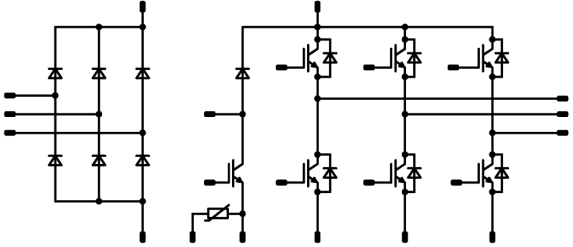

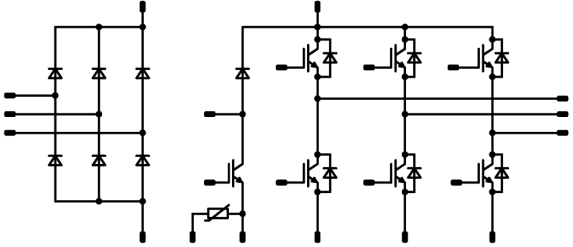




<i>flow90PIM 1</i>	<b>600 V / 20 A</b>										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #ccc;"> <th style="text-align: center; padding: 2px;">Features</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;"> <ul style="list-style-type: none"> <li>Trench Fieldstop Technology IGBT3 for low saturation loss</li> <li>Supports design with 90° mounting angle between heatsink and PCB</li> <li>Clip-in PCB mounting</li> <li>Clip or screw on heatsink mounting</li> </ul> </td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #ccc;"> <th style="text-align: center; padding: 2px;">Target applications</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;"> <ul style="list-style-type: none"> <li>Industrial drives</li> </ul> </td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #ccc;"> <th style="text-align: center; padding: 2px;">Types</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;"> <ul style="list-style-type: none"> <li>V23990-P634-A-PM</li> </ul> </td> </tr> </tbody> </table>	Features	<ul style="list-style-type: none"> <li>Trench Fieldstop Technology IGBT3 for low saturation loss</li> <li>Supports design with 90° mounting angle between heatsink and PCB</li> <li>Clip-in PCB mounting</li> <li>Clip or screw on heatsink mounting</li> </ul>	Target applications	<ul style="list-style-type: none"> <li>Industrial drives</li> </ul>	Types	<ul style="list-style-type: none"> <li>V23990-P634-A-PM</li> </ul>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #ccc;"> <th style="text-align: center; padding: 2px;"><i>flow 90 housing</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 10px;">  </td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #ccc;"> <th style="text-align: center; padding: 2px;">Schematic</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 10px;">  </td> </tr> </tbody> </table>	<i>flow 90 housing</i>		Schematic	
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<i>flow 90 housing</i>											
											
Schematic											
											

## Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
<b>Inverter switch</b>				
Collector-emitter voltage	$V_{\text{CES}}$		600	V
Collector current	$I_{\text{C}}$	$T_j=T_{j\text{max}}$ $T_s=80^{\circ}\text{C}$	24	A
Repetitive peak collector current	$I_{\text{CRM}}$	$t_p$ limited by $T_{j\text{max}}$	60	A
Total power dissipation	$P_{\text{tot}}$	$T_j=T_{j\text{max}}$ $T_s=80^{\circ}\text{C}$	53	W
Gate-emitter voltage	$V_{\text{GES}}$		±20	V
Short circuit ratings	$t_{\text{SC}}$ $V_{\text{CC}}$	$T_j \leq 150^{\circ}\text{C}$ $V_{\text{CE}} = 15\text{V}$	6 360	μs V
Maximum Junction Temperature	$T_{j\text{max}}$		175	°C



Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Diode</b>				
Peak Repetitive Reverse Voltage	$V_{RRM}$		600	V
Continuous (direct) forward current	$I_F$	$T_j=T_{jmax}$ $T_h=80^{\circ}C$	24	A
Repetitive peak forward current	$I_{FRM}$		40	A
Total power dissipation	$P_{tot}$	$T_j=T_{jmax}$ $T_h=80^{\circ}C$	40	W
Maximum Junction Temperature	$T_{jmax}$		175	$^{\circ}C$

Parameter	Symbol	Condition	Value	Unit
<b>Brake switch</b>				
Collector-emitter voltage	$V_{CES}$		600	V
Collector current	$I_C$	$T_j=T_{jmax}$ $T_s=80^{\circ}C$	20	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	45	A
Total power dissipation	$P_{tot}$	$T_j=T_{jmax}$ $T_s=80^{\circ}C$	47	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$ $V_{CC}$	$T_j \leq 150^{\circ}C$ $V_{GE} = 15V$	6 360	$\mu s$ V
Maximum Junction Temperature	$T_{jmax}$		175	$^{\circ}C$

Parameter	Symbol	Conditions	Value	Unit
<b>Brake Diode</b>				
Peak Repetitive Reverse Voltage	$V_{RRM}$		600	V
Continuous (direct) forward current	$I_F$	$T_j=T_{jmax}$ $T_h=80^{\circ}C$	17	A
Repetitive peak forward current	$I_{FRM}$		20	A
Total power dissipation	$P_{tot}$	$T_j=T_{jmax}$ $T_h=80^{\circ}C$	34	W
Maximum Junction Temperature	$T_{jmax}$		175	$^{\circ}C$



Parameter	Symbol	Conditions	Value	Unit
<b>Rectifier Diode</b>				
Repetitive peak reverse voltage	$V_{RRM}$		1600	V
Mean forward current	$I_{FAV}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Surge (non-repetitive) forward current	$I_{FSM}$	50 Hz Single Half Sine Wave	200	A
Surge current capability	$I^2t$	$t_p = 10\text{ ms}$ 50 Hz sine $T_j = 150\text{ °C}$	200	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	43	W
Maximum Junction Temperature	$T_{jmax}$		150	°C

Parameter	Symbol	Conditions	Value	Unit
<b>Module Properties</b>				
<b>Thermal Properties</b>				
Storage temperature	$T_{stg}$		-40...+125	°C
Operation Junction Temperature	$T_{jop}$		-40...+( $T_{jmax} - 25$ )	°C

<b>Isolation Properties</b>					
Isolation voltage	$V_{isol}$	DC voltage	$t_p=2s$	4000	V
Creepage distance				min 12,7	mm
Clearance				min 11,84	mm
Comparative Tracking Index	CTI			>200	



## Characteristic Values

### Inverter Switch

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

#### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{CE}$			0,00029	25 125	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		20	25 125 150	1,1	1,52 -	1,9	V
Collector-emitter cut-off current	$I_{CES}$		0	600		25 125			1,1	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25 125			300	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							1100		pF
Output capacitance	$C_{oes}$	f=1 MHz	0	25	25			71		
Reverse transfer capacitance	$C_{res}$							32		
Gate charge	$Q_g$		15	480	20	25		120		nC

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material $\lambda=3,4W/mK$						1,81		K/W
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#### IGBT Switching

Turn-on delay time	$t_{d(on)}$					25 150		71 70		ns
Rise time	$t_r$	$R_{goff} = 16 \Omega$ $R_{gon} = 16 \Omega$				25 150		11 16		
Turn-off delay time	$t_{d(off)}$		±15	300	20	25 150		122 143		
Fall time	$t_f$					25 150		91 111		
Turn-on energy (per pulse)	$E_{on}$	$Q_{rFWD} = 0,8 \mu C$ $Q_{rFWD} = 1,7 \mu C$				25 150		0,259 0,380		mWs
Turn-off energy (per pulse)	$E_{off}$					25 150		0,448 0,613		



# Vincotech

## Inverter Diode

Parameter	Symbol	Conditions					Value			Unit
				$V_r$ [V]	$I_F$ [A]	$T_j$ [°C]	Min	Typ	Max	

### Static

Forward voltage	$V_F$				20	25 125 150		1,70 1,58 -	1,95	V
Reverse leakage current	$I_r$			600		25 150			27 -	μA

### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material $\lambda=3,4W/mK$						2,37		K/W
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### FWD Switching

Peak recovery current	$I_{RRM}$	$di/dt = 2072 A/\mu s$ $di/dt = 1922 A/\mu s$	$\pm 15$	300	20	25		22		A
	150						26			
Reverse recovery time	$t_{rr}$					25		125		ns
	150						204			
Recovered charge	$Q_r$					25		0,809		μC
	150		1,713							
Reverse recovered energy	$E_{rec}$	25		0,171		mWs				
	150		0,373							
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	25		2050		A/μs				
		150		741						



# Vincotech

## Brake Switch

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

### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{CE}$			0,00021	25 125	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		15	25 125 150	1,1	1,59 -	1,9	V
Collector-emitter cut-off current	$I_{CES}$		0	600		25 125			0,85	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25 125			300	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							860		pF
Output capacitance	$C_{oes}$	f=1 MHz	0	25	25			55		
Reverse transfer capacitance	$C_{res}$							24		
Gate charge	$Q_g$		15	480	15	25		87		nC

### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material $\lambda=3,4W/mK$						2,03		K/W
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### IGBT Switching

Turn-on delay time	$t_{d(on)}$	$R_{goff} = 16 \Omega$ $R_{gon} = 32 \Omega$	15/0	300	15	25		19		ns
Rise time	$t_r$					125		21		
Turn-off delay time	$t_{d(off)}$					25		16		
Fall time	$t_f$					125		20		
Turn-on energy (per pulse)	$E_{on}$	$Q_{rFWD} = 0,5 \mu C$				25		186		mWs
Turn-off energy (per pulse)	$E_{off}$					125		202		
						25		89		
						125		94		
						25		0,334		
						125		0,408		
						25		0,318		
						125		0,402		



# Vincotech

## Brake Diode

Parameter	Symbol	Conditions					Value			Unit
				$V_r$ [V]	$I_F$ [A]	$T_j$ [°C]	Min	Typ	Max	

### Static

Forward voltage	$V_F$				10	25 150		1,60 1,56	1,95	V
Reverse leakage current	$I_r$			600		25 150			27 -	$\mu$ A

### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material $\lambda=3,4\text{W/mK}$						2,79		K/W
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### FWD Switching

Peak recovery current	$I_{RRM}$	$R_{gon} = 32 \Omega$	15/0	300	15	25		8		A
						125		9		
Reverse recovery time	$t_{rr}$					25		198		ns
						125		276		
Recovered charge	$Q_r$					25		0,514		$\mu$ C
		125		0,935						
Reverse recovered energy	$E_{rec}$	25		0,094		mWs				
		125		0,187						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	25		411		A/ $\mu$ s				
		125		78						



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## Rectifier Diode

Parameter	Symbol	Conditions					Value			Unit
				$V_f$ [V]	$I_F$ [A]	$T_j$	Min	Typ	Max	

### Static

Forward voltage	$V_F$				25	25°C 125°C 150°C		1,22 1,21 -	1,9	V
Reverse leakage current	$I_R$			1600		25°C 150°C			50 1100	μA

### Thermal

Thermal resistance junction to case	$R_{th(j-c)}$	Phase-Change Material $\lambda=3,4W/mK$						1,61		K/W
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## Thermistor

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

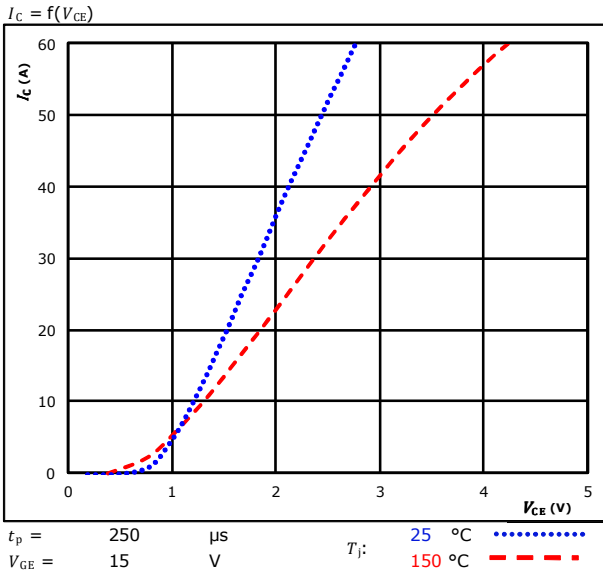
Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	R100=1486 Ω				100	-12		+12	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3998		K
Vincotech NTC Reference									B	



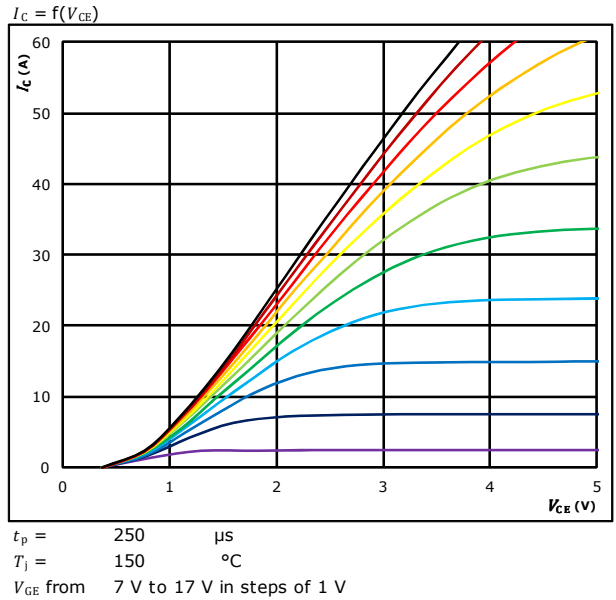


### Inverter Switch Characteristics

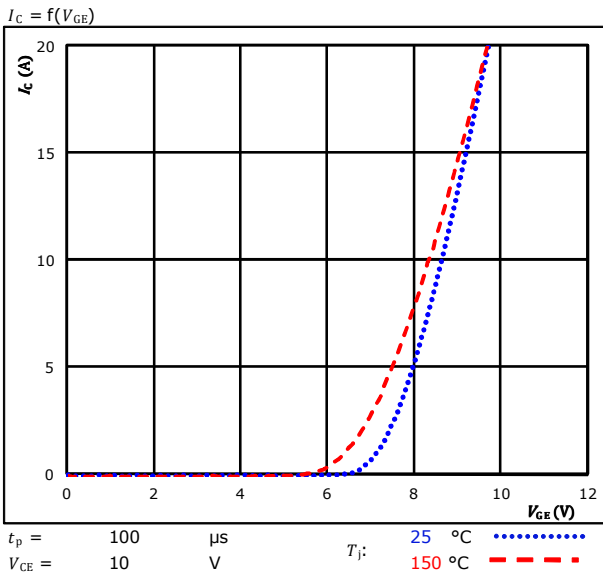
Typical output characteristics IGBT



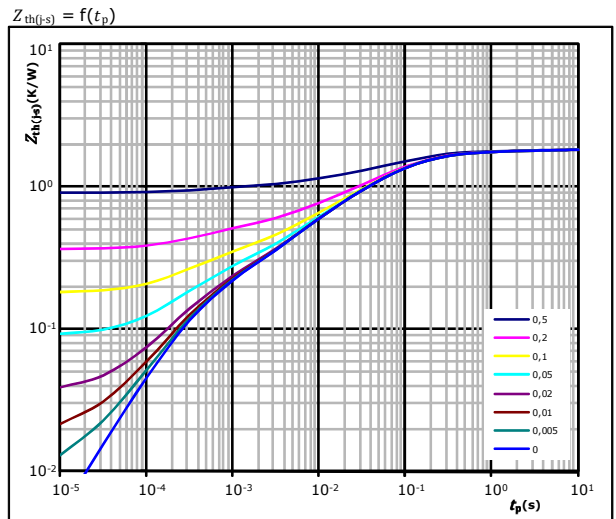
Typical output characteristics IGBT



Typical transfer characteristics IGBT



Transient Thermal Impedance as function of Pulse duration IGBT



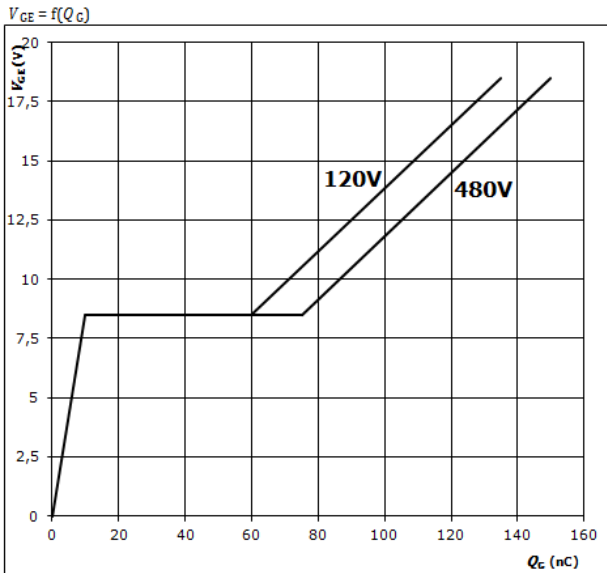
IGBT thermal model values

R (K/W)	$\tau$ (s)
6,63E-02	3,68E+00
1,83E-01	4,61E-01
8,24E-01	8,38E-02
3,93E-01	1,82E-02
1,96E-01	3,57E-03
1,49E-01	3,52E-04



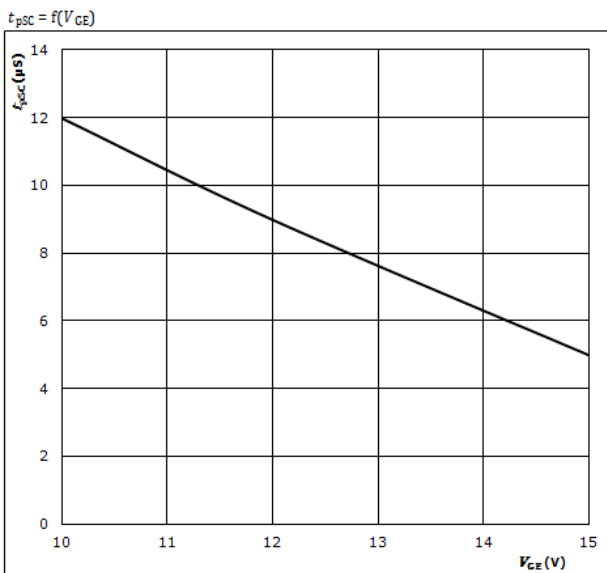
**Inverter Switch Characteristics**

**Gate voltage vs Gate charge IGBT**



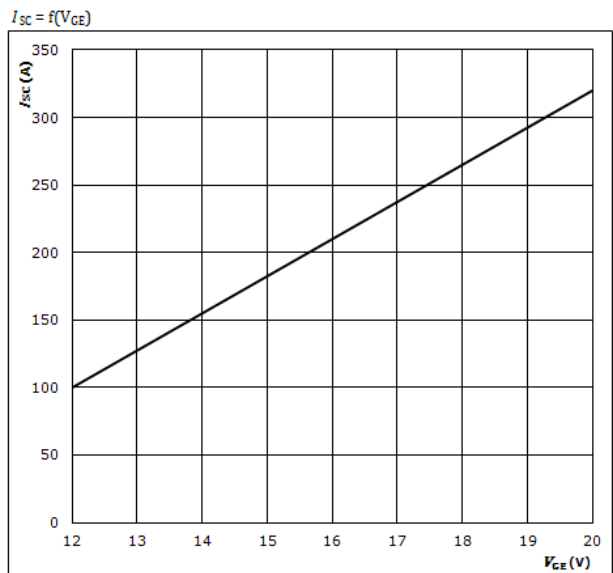
**At**  
 $I_C = 20$  A

**Short circuit duration as a function of  $V_{CE}$  IGBT**



**At**  
 $V_{CE} = 600$  V  
 $T_j \leq 175$  °C

**Typical short circuit current as a function of  $V_{CE}$  IGBT**

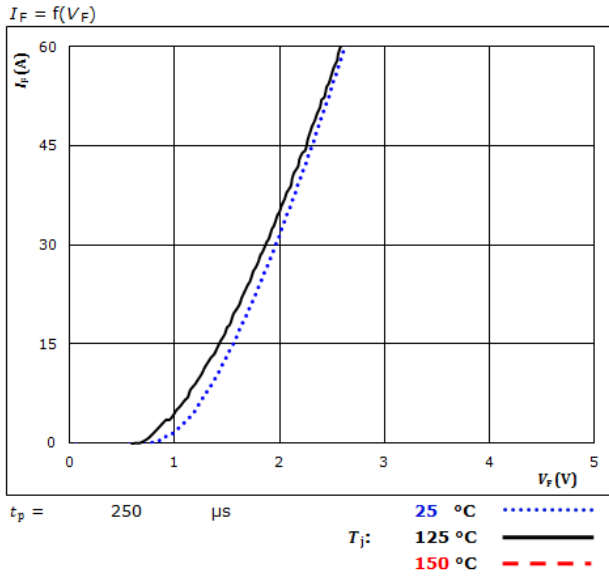


**At**  
 $V_{CE} \leq 600$  V  
 $T_j \leq 175$  °C

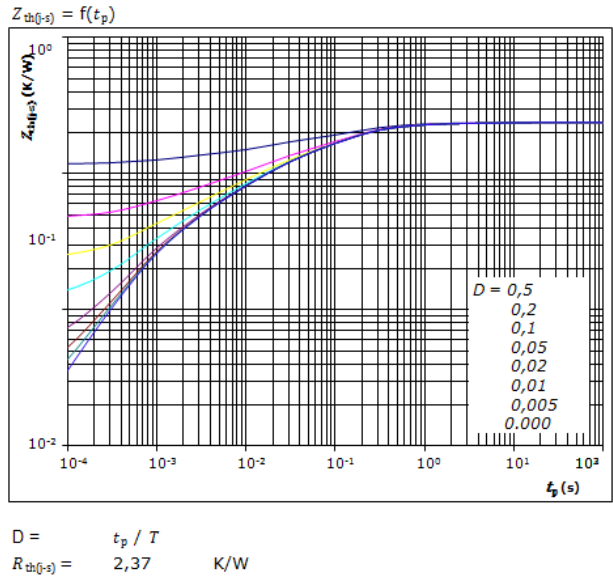


### Inverter Diode Characteristics

Typical forward characteristics FWD



Transient thermal impedance as a function of pulse width FWD



FWD thermal model values

R (K/W)	$\tau$ (s)
4,62E-02	8,95E+00
1,39E-01	1,10E+00
6,93E-01	1,96E-01
5,75E-01	6,44E-02
6,19E-01	9,95E-03
2,95E-01	1,01E-03

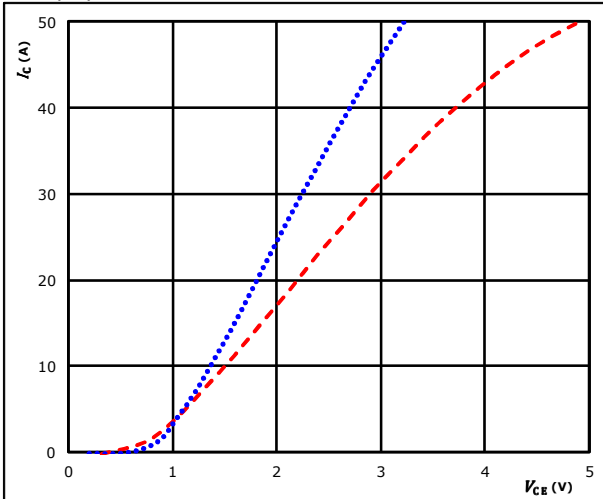


### Brake Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

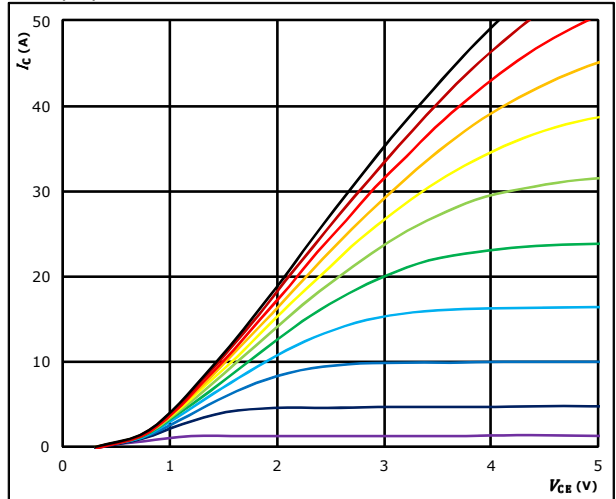


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j: 25 \text{ } ^\circ C$  (blue dotted line)  
 $150 \text{ } ^\circ C$  (red dashed line)

**figure 2.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

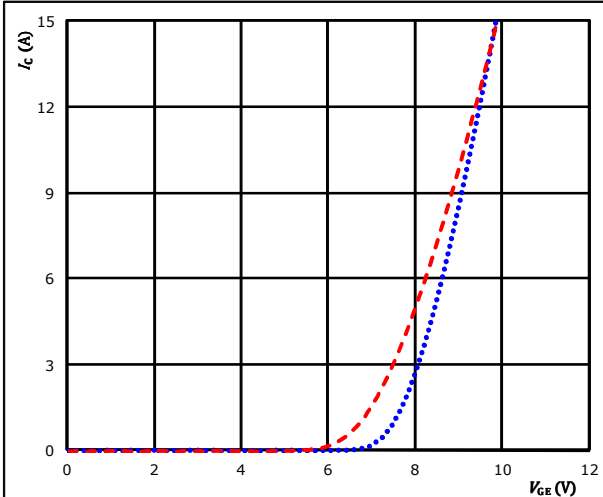


$t_p = 250 \mu s$   
 $T_j = 150 \text{ } ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

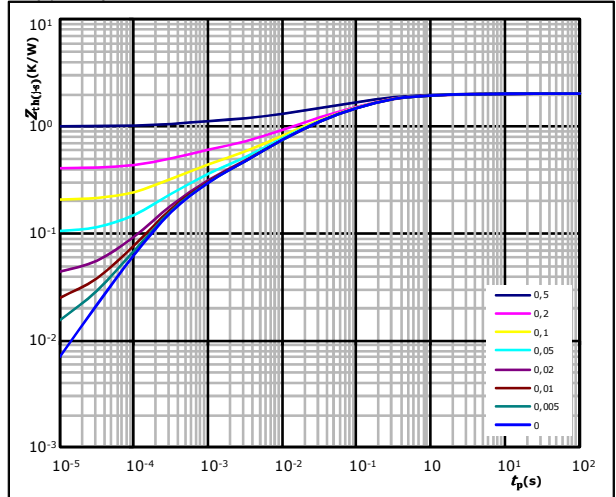


$t_p = 100 \mu s$   
 $V_{CE} = 10 V$   
 $T_j: 25 \text{ } ^\circ C$  (blue dotted line)  
 $150 \text{ } ^\circ C$  (red dashed line)

**figure 4.** IGBT

Transient Thermal Impedance as function of Pulse duration

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



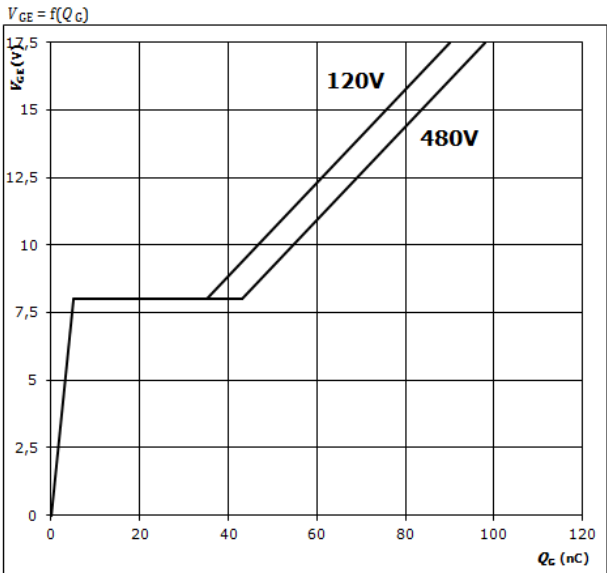
$D = t_p / T$   
 $R_{th(j-s)} = 2,03 \text{ K/W}$   
IGBT thermal model values

$R$ (K/W)	$\tau$ (s)
3,94E-02	6,65E+00
2,08E-01	7,06E-01
7,57E-01	1,14E-01
5,53E-01	1,86E-02
2,62E-01	3,35E-03
2,07E-01	3,46E-04



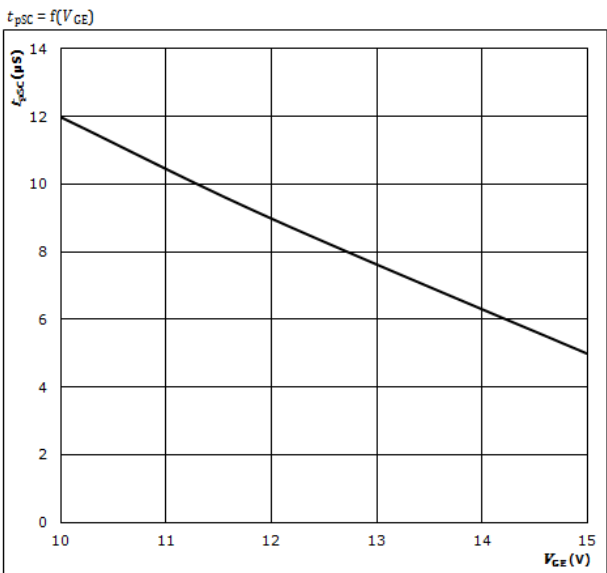
### Brake Switch Characteristics

Gate voltage vs Gate charge IGBT



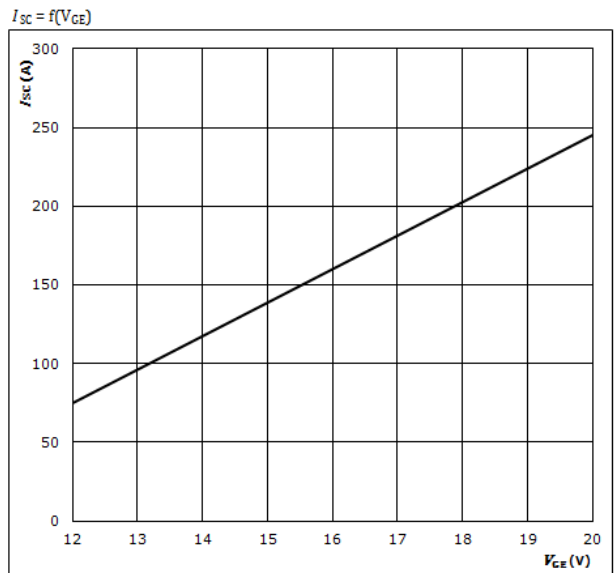
At  
I<sub>C</sub> = 15 A

Short circuit duration as a function of V<sub>CE</sub> IGBT



At  
V<sub>CE</sub> = 600 V  
T<sub>j</sub> ≤ 175 °C

Typical short circuit current as a function of V<sub>CE</sub> IGBT

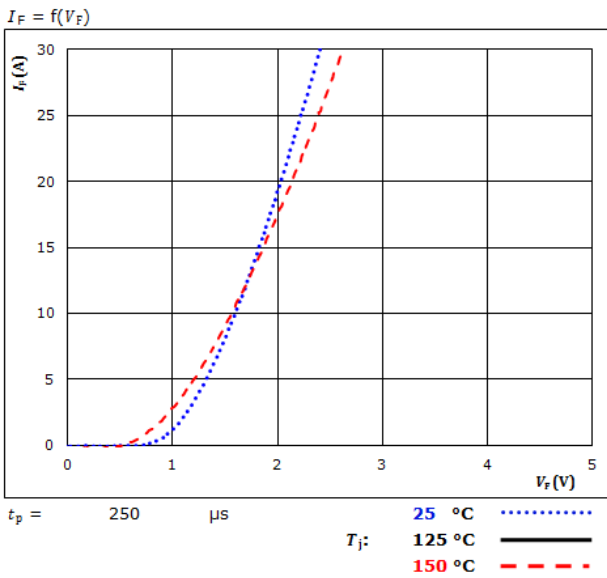


At  
V<sub>CE</sub> ≤ 600 V  
T<sub>j</sub> ≤ 175 °C

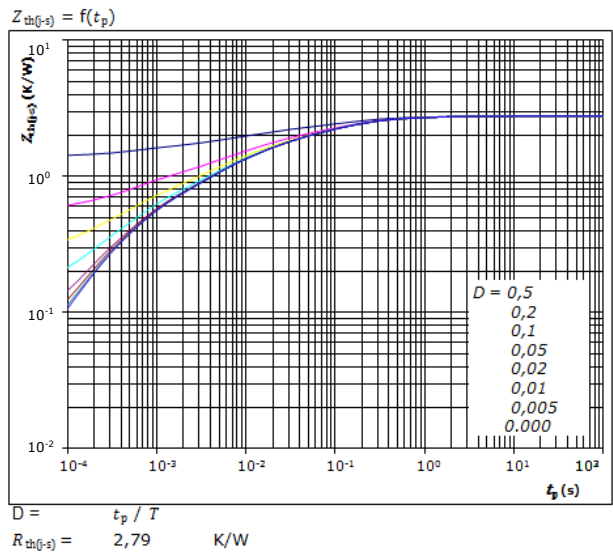


### Brake Diode Characteristics

Typical forward characteristics FWD



Transient thermal impedance as a function of pulse width FWD



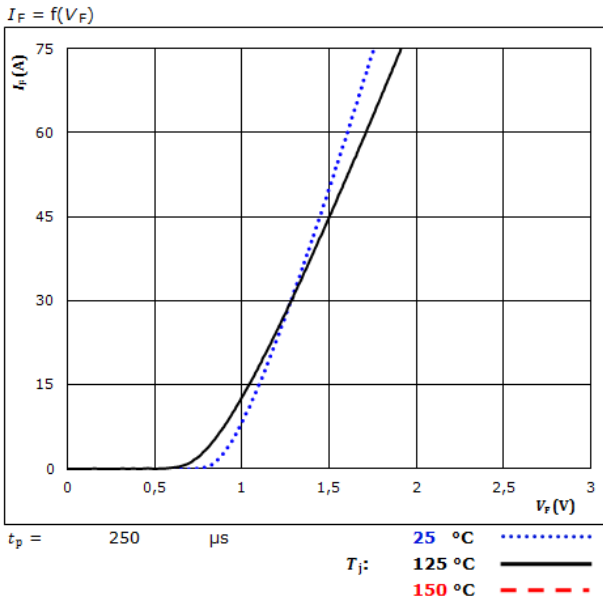
FWD thermal model values

R (K/W)	$\tau$ (s)
3,61E-02	8,54E+00
2,58E-01	5,80E-01
8,01E-01	1,03E-01
7,36E-01	1,63E-02
5,56E-01	3,27E-03
3,99E-01	4,24E-04

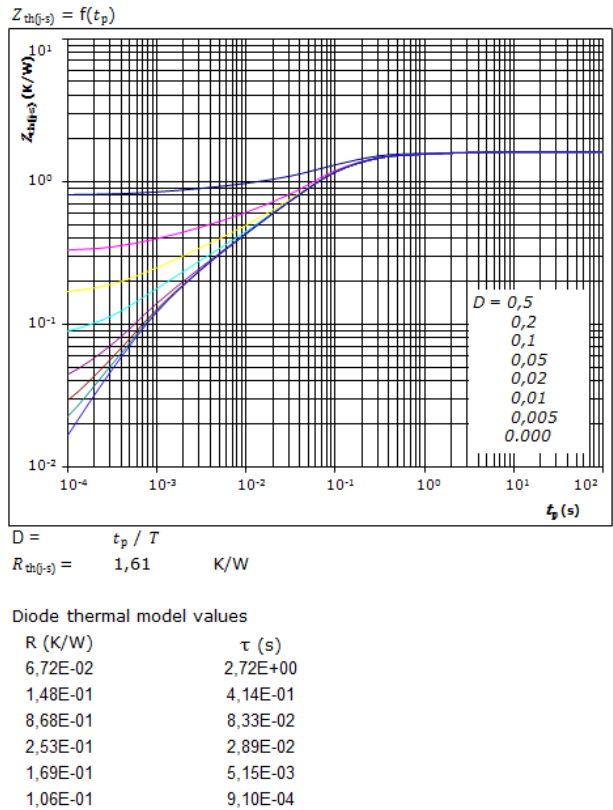


## Rectifier Diode Characteristics

Typical forward characteristics Rectifier Diode



Transient thermal impedance as a function of pulse width Rectifier Diode

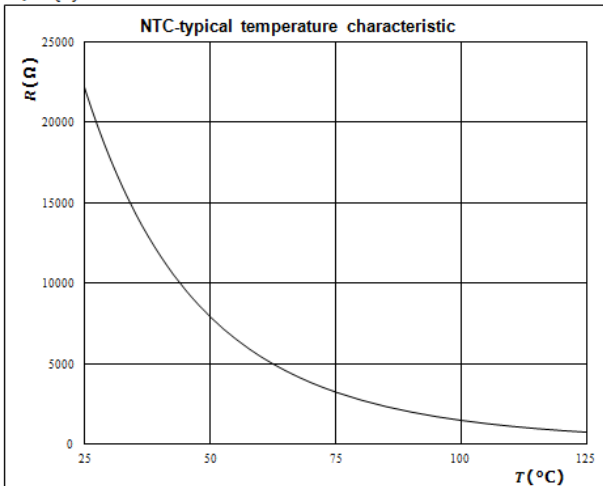


## Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic  
as a function of temperature

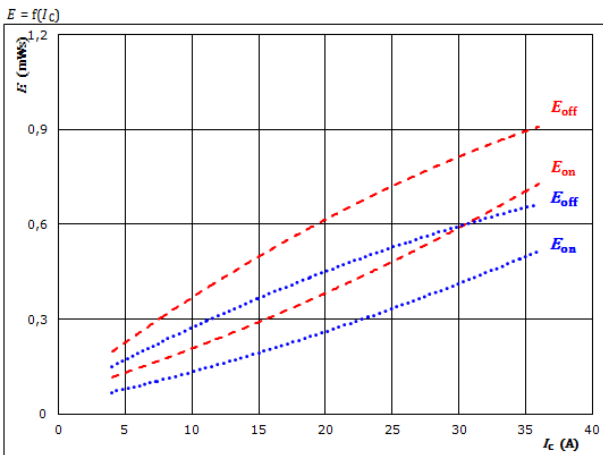
$R_T = f(T)$





## Inverter Switching Characteristics

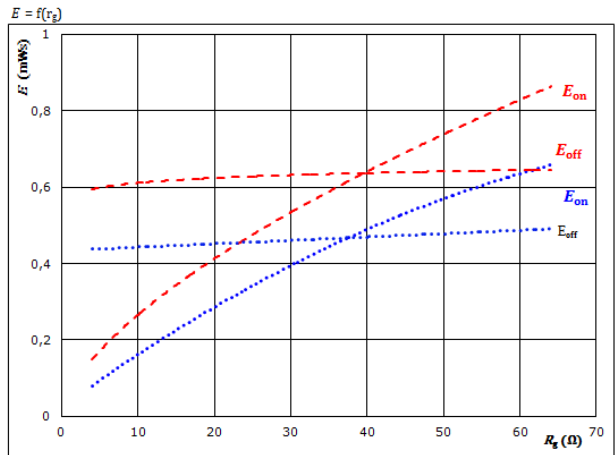
**Figure 1.** IGBT  
Typical switching energy losses as a function of collector current



With an inductive load at

$V_{CE} =$ 300 V	$T_j:$ 25 °C	.....
$V_{CE} =$ ±15 V	125 °C	————
$R_{gon} =$ 16 Ω	150 °C	-----
$R_{goff} =$ 16 Ω		

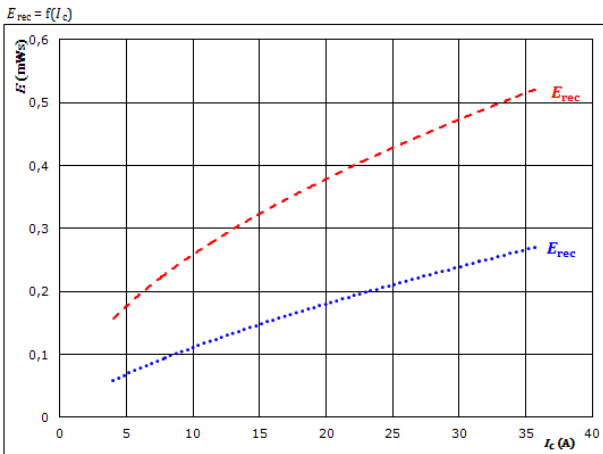
**Figure 2.** IGBT  
Typical switching energy losses as a function of gate resistor



With an inductive load at

$V_{CE} =$ 300 V	$T_j:$ 25 °C	.....
$V_{CE} =$ ±15 V	125 °C	————
$I_C =$ 20 A	150 °C	-----

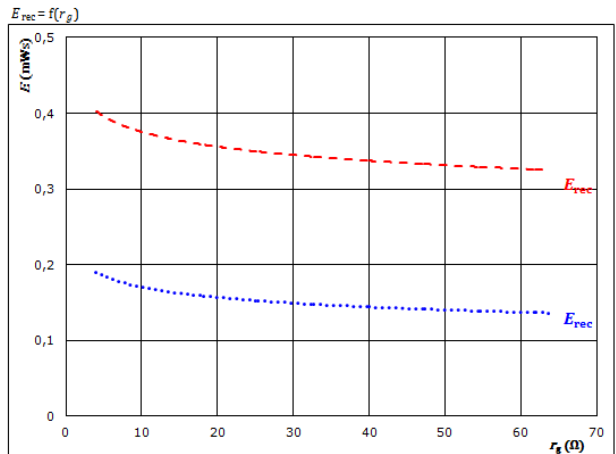
**Figure 3.** FWD  
Typical reverse recovered energy loss as a function of collector current



With an inductive load at

$V_{CE} =$ 300 V	$T_j:$ 25 °C	.....
$V_{CE} =$ ±15 V	125 °C	————
$R_{gon} =$ 16 Ω	150 °C	-----

**Figure 4.** FWD  
Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at

$V_{CE} =$ 300 V	$T_j:$ 25 °C	.....
$V_{CE} =$ ±15 V	125 °C	————
$I_C =$ 20 A	150 °C	-----

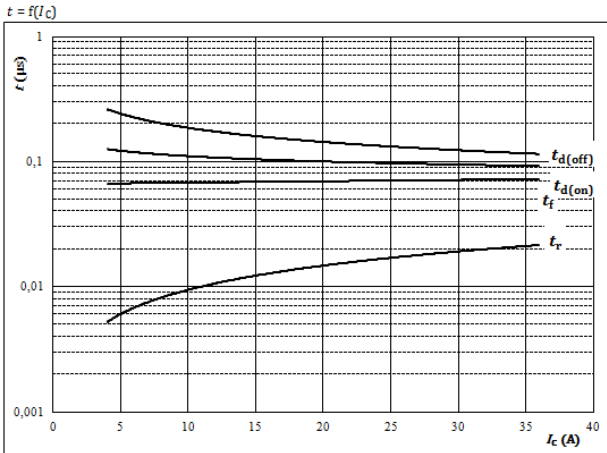




## Inverter Switching Characteristics

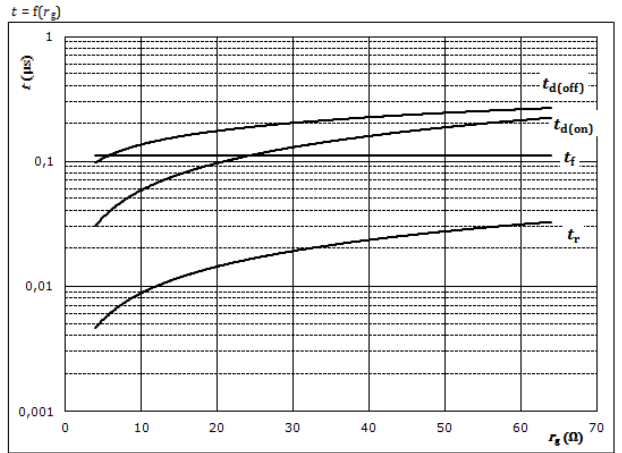
**Figure 5.** IGBT

Typical switching times as a function of collector current



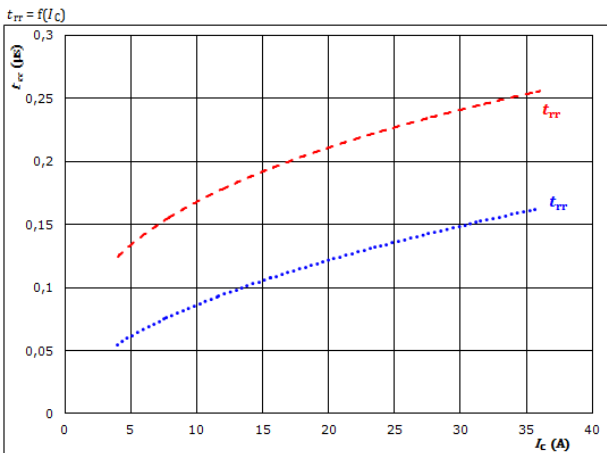
**Figure 6.** IGBT

Typical switching times as a function of gate resistor



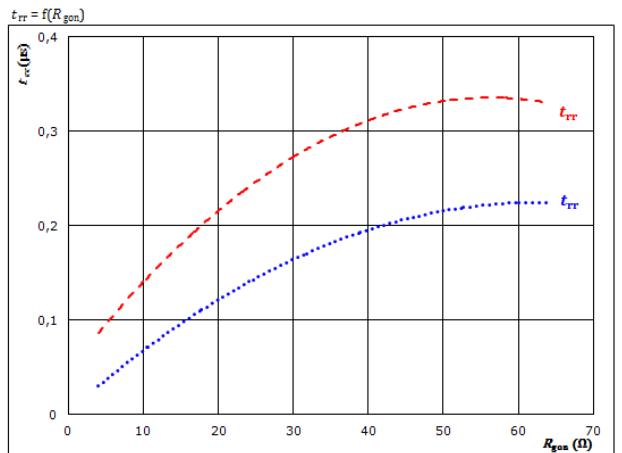
**Figure 7.** FWD

Typical reverse recovery time as a function of collector current



**Figure 8.** FWD

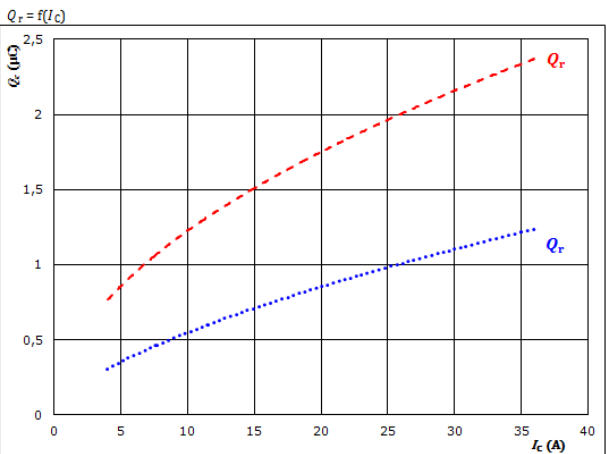
Typical reverse recovery time as a function of IGBT turn on gate resistor





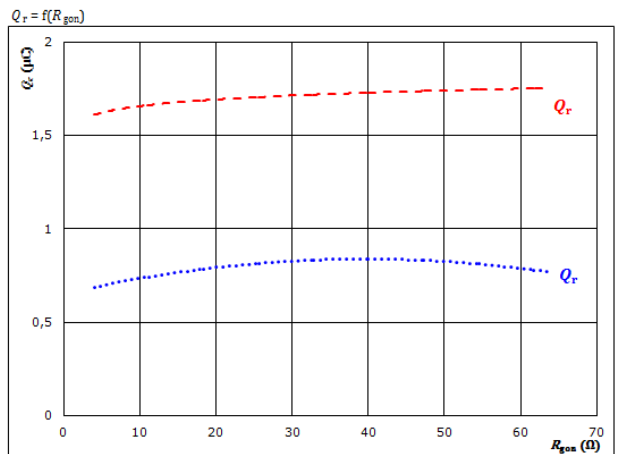
## Inverter Switching Characteristics

Figure 9. FWD  
Typical recovered charge as a function of collector current



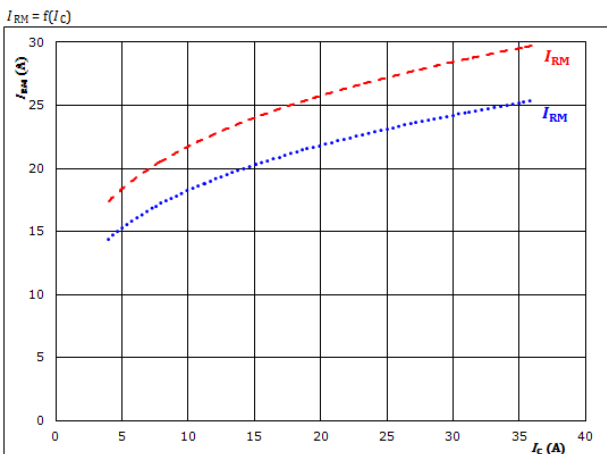
At  $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted), 125 °C (solid), 150 °C (dashed)

Figure 10. FWD  
Typical recovered charge as a function of IGBT turn on gate resistor



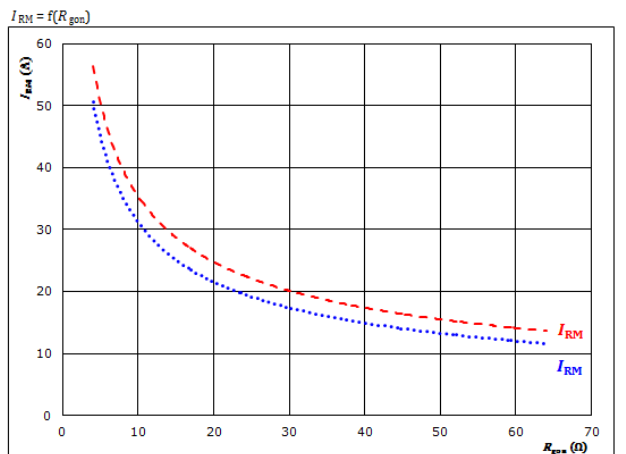
At  $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 20$  A  
 $T_j$ : 25 °C (dotted), 125 °C (solid), 150 °C (dashed)

Figure 11. FWD  
Typical peak reverse recovery current as a function of collector current



At  $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted), 125 °C (solid), 150 °C (dashed)

Figure 12. FWD  
Typical peak reverse recovery current as a function of IGBT turn on gate resistor



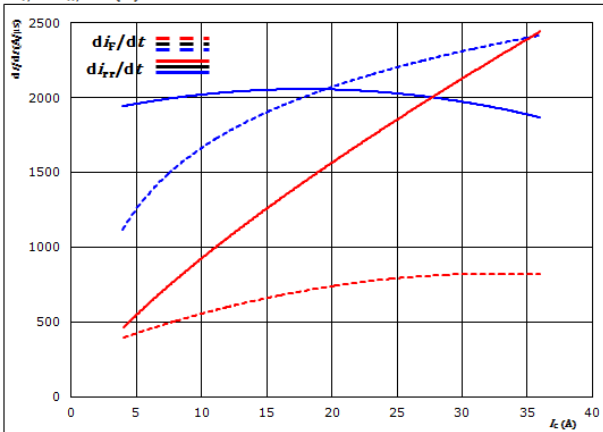
At  $V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 20$  A  
 $T_j$ : 25 °C (dotted), 125 °C (solid), 150 °C (dashed)



## Inverter Switching Characteristics

Figure 13. FWD

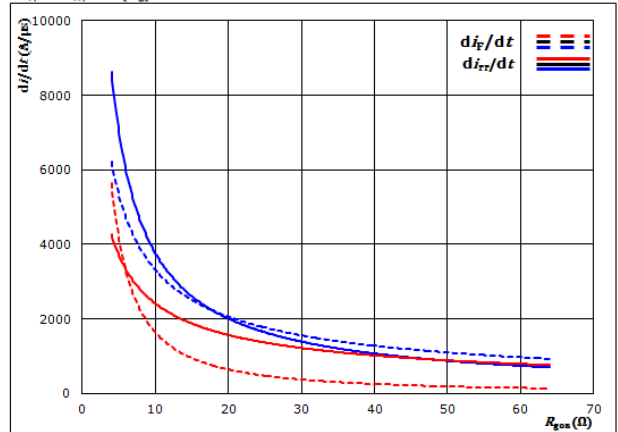
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_F/dt, di_{rr}/dt = f(I_C)$



At  $V_{CE} = 300$  V  
 $V_{CE} = \pm 15$  V  
 $R_{gon} = 16$  Ω  
 $T_j = 25$  °C  
 $T_j = 125$  °C  
 $T_j = 150$  °C

Figure 14. FWD

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

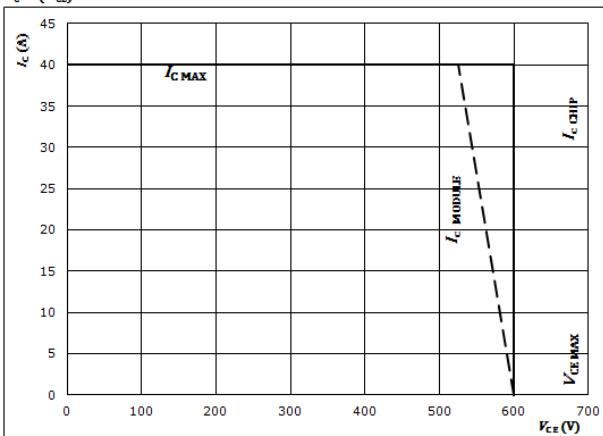


At  $V_{CE} = 300$  V  
 $V_{CE} = \pm 15$  V  
 $I_C = 20$  A  
 $T_j = 25$  °C  
 $T_j = 125$  °C  
 $T_j = 150$  °C

Figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 175$  °C  
 $R_{gon} = 16$  Ω  
 $R_{goff} = 16$  Ω

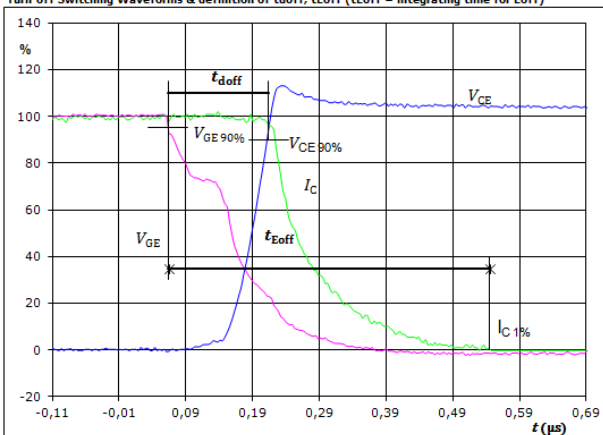


## Inverter Switching Characteristics

General conditions

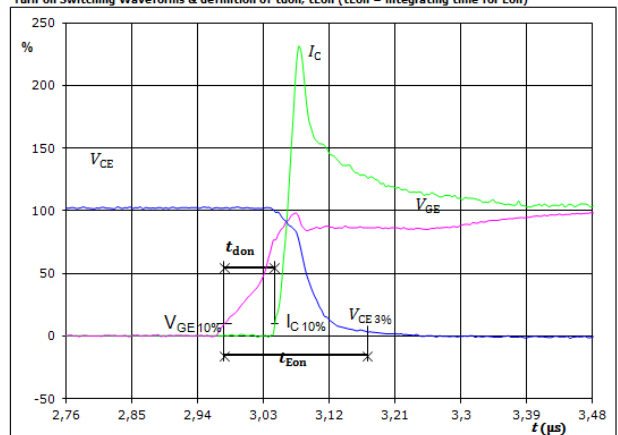
$T_j$	=	150 °C
$R_{gon}$	=	16 $\Omega$
$R_{goff}$	=	16 $\Omega$

Figure 1. IGBT  
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



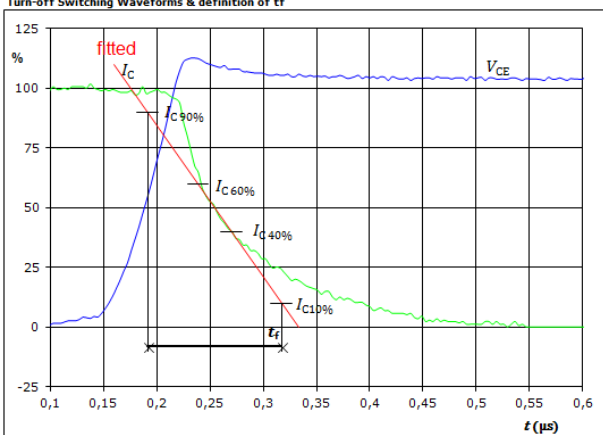
$V_{CE}(0\%) =$	-15	V
$V_{CE}(100\%) =$	15	V
$I_C(100\%) =$	300	A
$t_{doff} =$	0,143	$\mu s$
$t_{Eoff} =$	0,482	$\mu s$

Figure 2. IGBT  
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



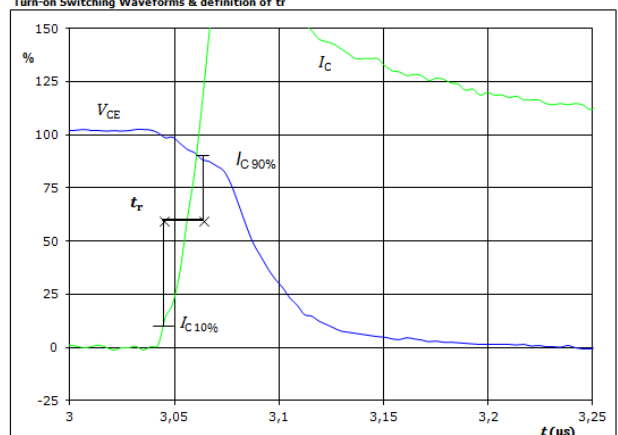
$V_{CE}(0\%) =$	-15	V
$V_{CE}(100\%) =$	15	V
$I_C(100\%) =$	300	A
$t_{don} =$	0,070	$\mu s$
$t_{Eon} =$	0,196	$\mu s$

Figure 3. IGBT  
Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	300	V
$I_C(100\%) =$	20	A
$t_f =$	0,110	$\mu s$

Figure 4. IGBT  
Turn-on Switching Waveforms & definition of  $t_r$

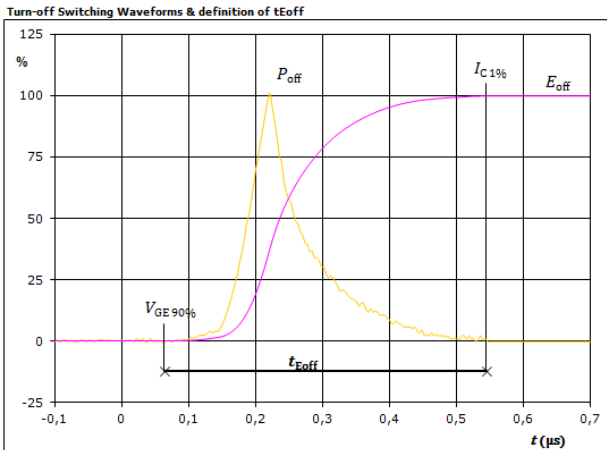


$V_C(100\%) =$	300	V
$I_C(100\%) =$	20	A
$t_r =$	0,016	$\mu s$



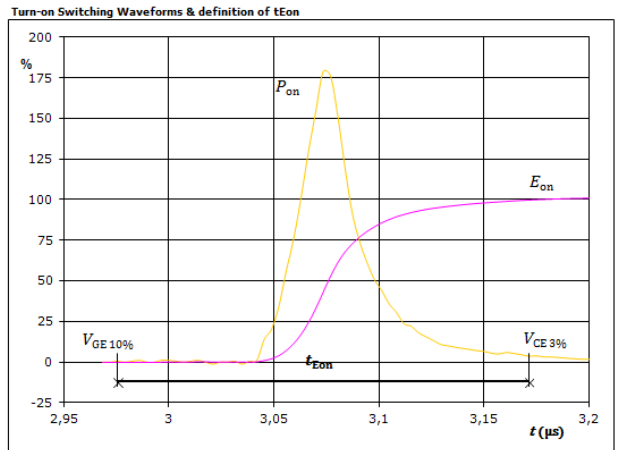
## Inverter Switching Characteristics

**Figure 5.** IGBT



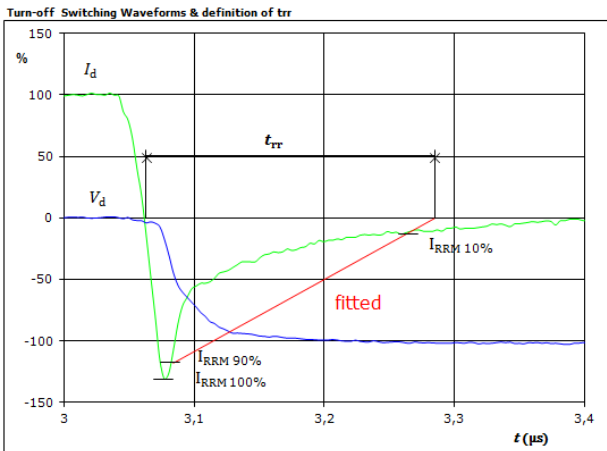
$P_{off}(100\%) =$	5,98	kW
$E_{off}(100\%) =$	0,61	mJ
$t_{Eoff} =$	0,48	μs

**Figure 6.** IGBT



$P_{on}(100\%) =$	5,98	kW
$E_{on}(100\%) =$	0,38	mJ
$t_{Eon} =$	0,20	μs

**Figure 7.** FWD

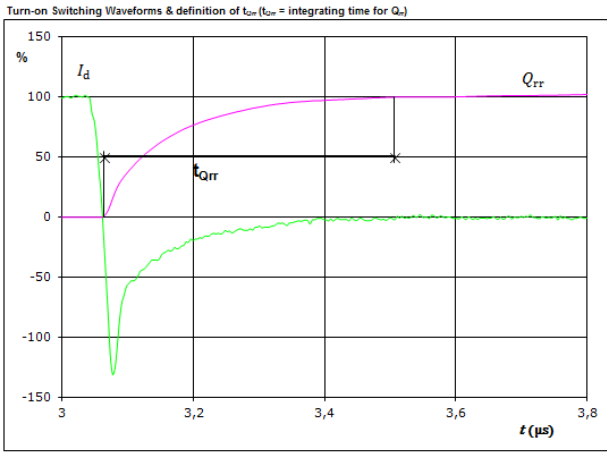


$V_d(100\%) =$	300	V
$I_d(100\%) =$	20	A
$I_{RRM}(100\%) =$	-26	A
$t_{rr} =$	0,204	μs



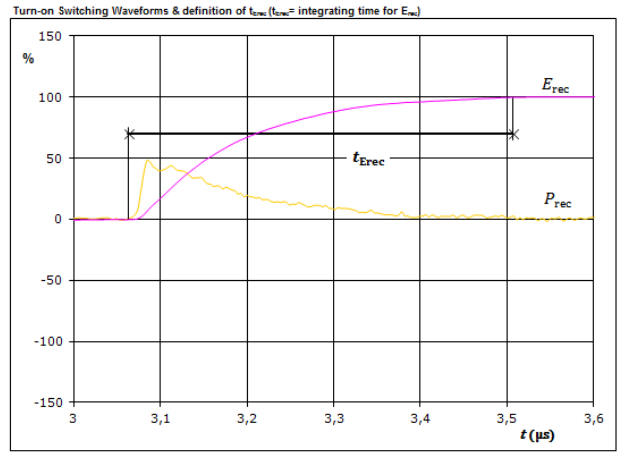
### Inverter Switching Characteristics

**Figure 8.** FWD



$I_d(100\%) =$	20	A
$Q_{rr}(100\%) =$	1,71	$\mu\text{C}$
$t_{Qrr} =$	0,44	$\mu\text{s}$

**Figure 9.** FWD

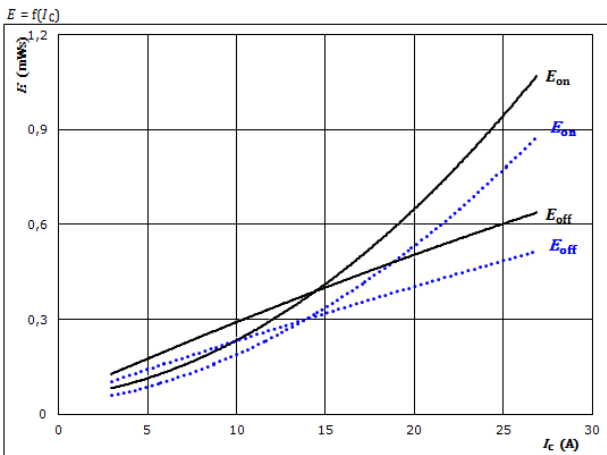


$P_{rec}(100\%) =$	5,98	kW
$E_{rec}(100\%) =$	0,37	mJ
$t_{Erec} =$	0,44	$\mu\text{s}$



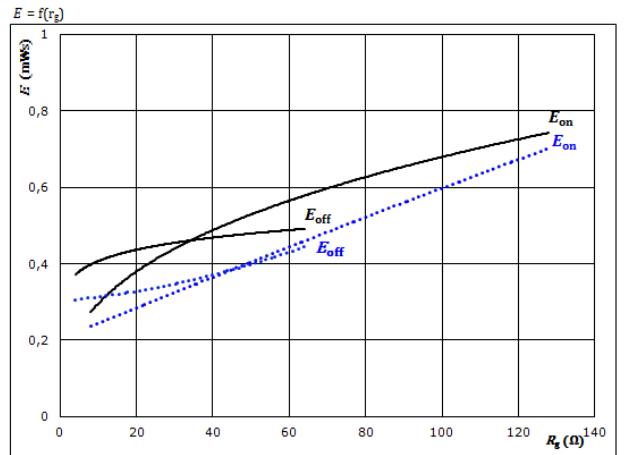
### Brake Switching Characteristics

**Figure 1.** IGBT  
Typical switching energy losses as a function of collector current



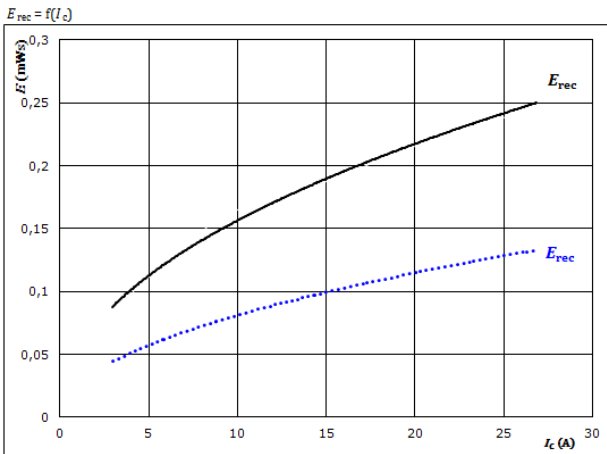
With an inductive load at  
 $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**Figure 2.** IGBT  
Typical switching energy losses as a function of gate resistor



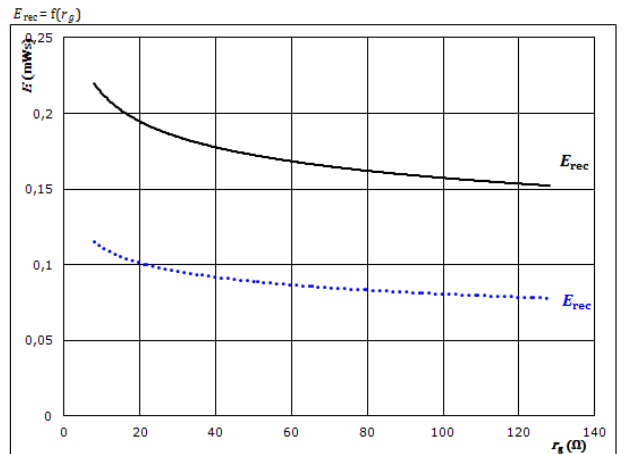
With an inductive load at  
 $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $I_C = 15$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**Figure 3.** FWD  
Typical reverse recovered energy loss as a function of collector current



With an inductive load at  
 $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $R_{gon} = 32$   $\Omega$   
 $T_j$ : 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



With an inductive load at  
 $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $I_C = 15$  A  
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

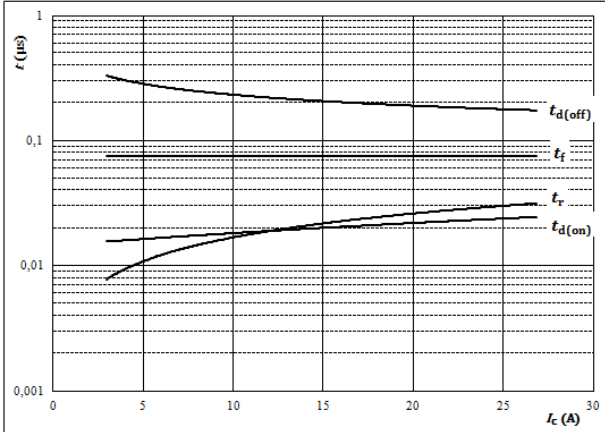


## Brake Switching Characteristics

**Figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



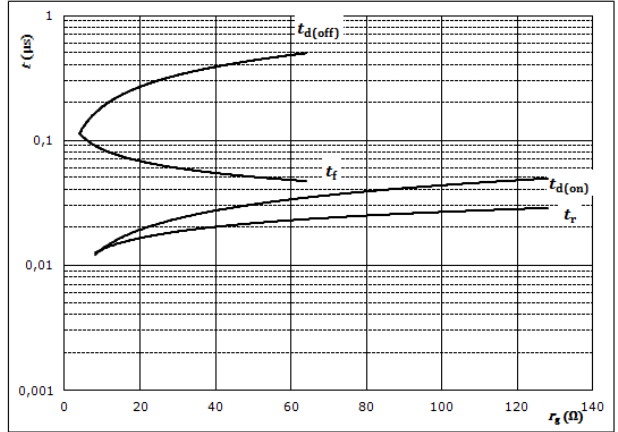
With an inductive load at

$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	15/0	V
$R_{gon} =$	32	Ω
$R_{goff} =$	16	Ω

**Figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(r_g)$$



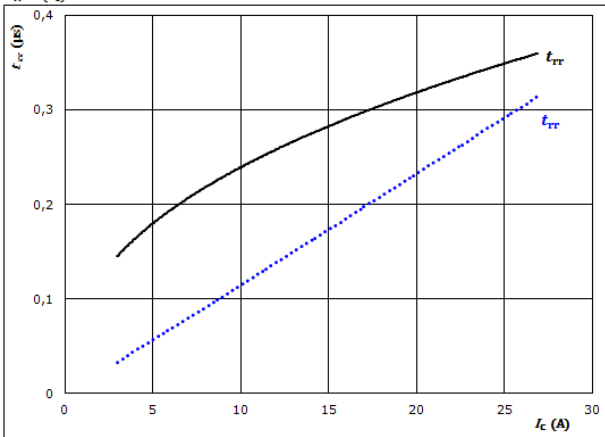
With an inductive load at

$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	15/0	V
$I_C =$	15	A

**Figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

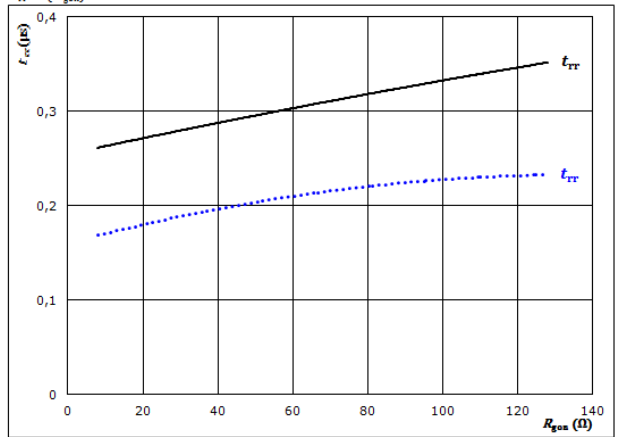


At	$V_{CE} =$	300	V	$T_j:$	25 °C	.....
	$V_{GE} =$	15/0	V		125 °C	————
	$R_{gon} =$	32	Ω		150 °C	----

**Figure 8.** FWD

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

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



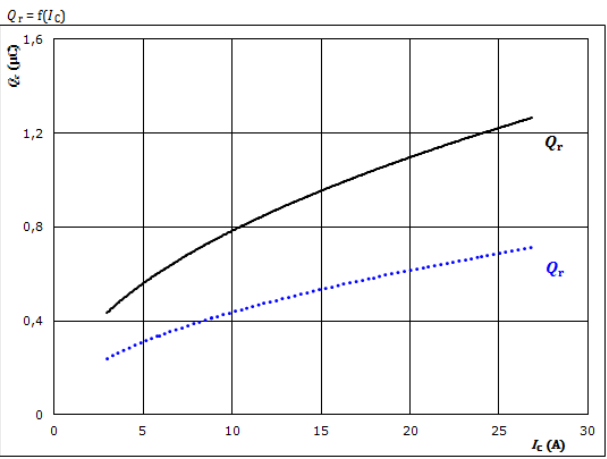
At	$V_{CE} =$	300	V	$T_j:$	25 °C	.....
	$V_{GE} =$	15/0	V		125 °C	————
	$I_C =$	15	A		150 °C	----





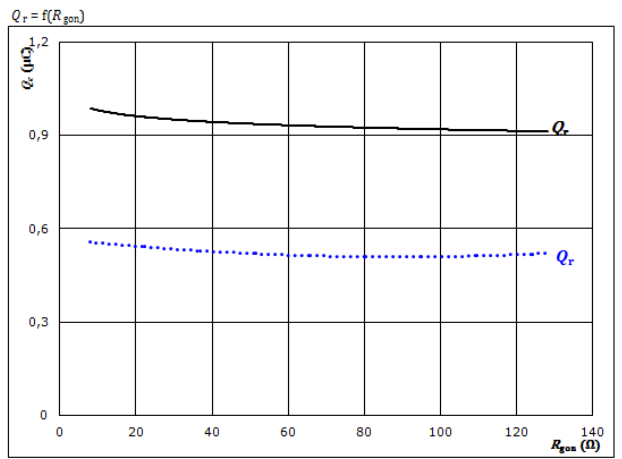
### Brake Switching Characteristics

Figure 9. FWD  
Typical recovered charge as a function of collector current



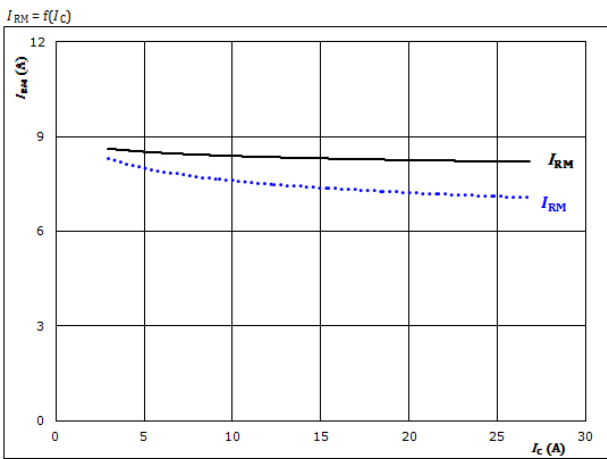
At  $V_{CE} = 300$  V  
 $V_{CE} = 15/0$  V  
 $R_{gon} = 32$   $\Omega$   
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

Figure 10. FWD  
Typical recovered charge as a function of IGBT turn on gate resistor



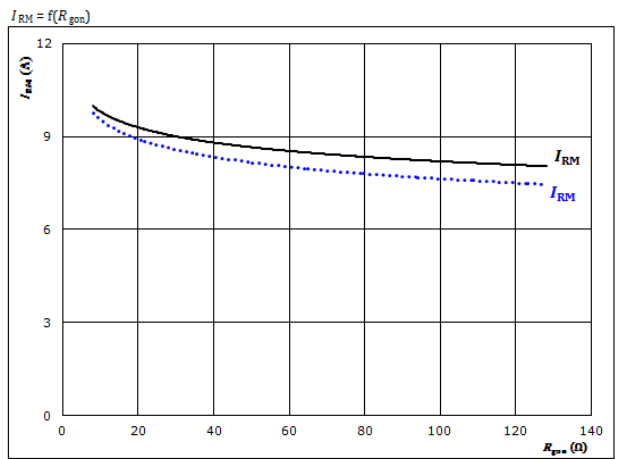
At  $V_{CE} = 300$  V  
 $V_{CE} = 15/0$  V  
 $I_c = 15$  A  
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

Figure 11. FWD  
Typical peak reverse recovery current as a function of collector current



At  $V_{CE} = 300$  V  
 $V_{CE} = 15/0$  V  
 $R_{gon} = 32$   $\Omega$   
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

Figure 12. FWD  
Typical peak reverse recovery current as a function of IGBT turn on gate resistor



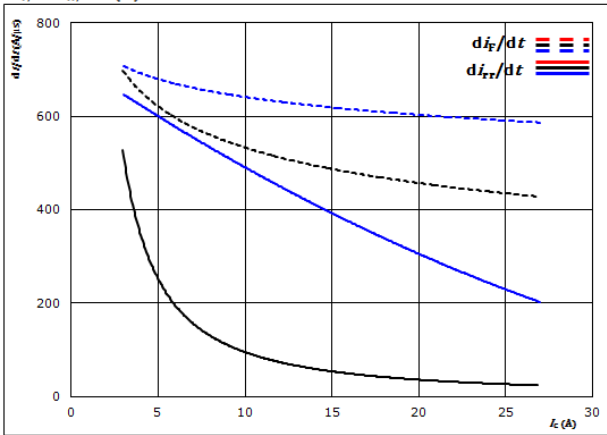
At  $V_{CE} = 300$  V  
 $V_{CE} = 15/0$  V  
 $I_c = 15$  A  
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)



### Brake Switching Characteristics

Figure 13. FWD

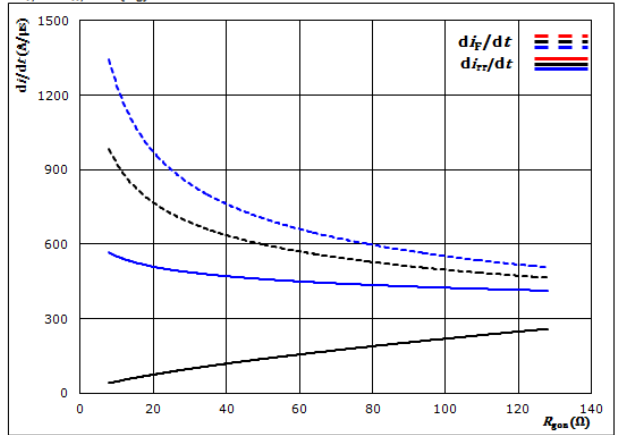
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_F/dt, di_{rr}/dt = f(I_C)$



At  $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $R_{gon} = 32$   $\Omega$   
 $T_j = 25$  °C (dotted blue)  
 $125$  °C (solid black)  
 $150$  °C (dashed red)

Figure 14. FWD

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

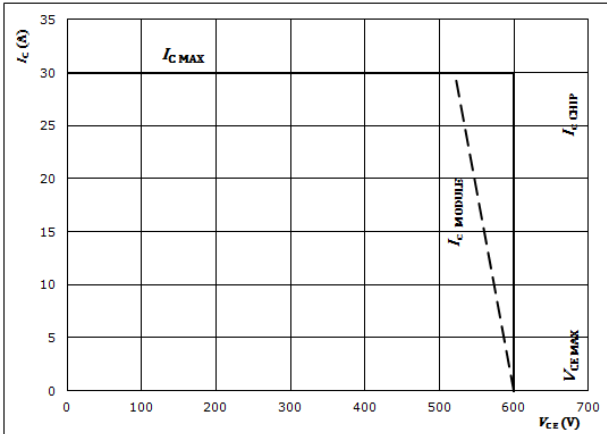


At  $V_{CE} = 300$  V  
 $V_{GE} = 15/0$  V  
 $I_C = 15$  A

Figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 175$  °C  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

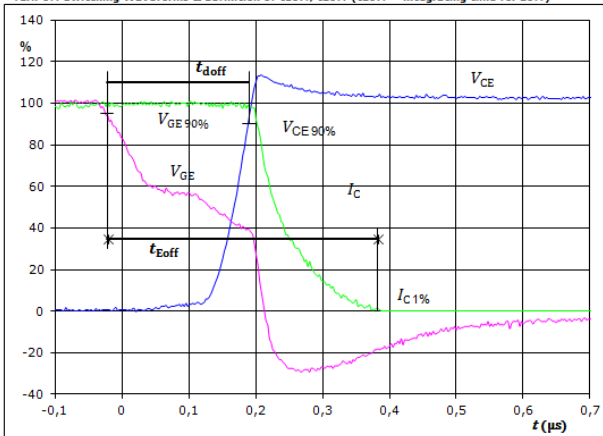


## Brake Switching Characteristics

General conditions

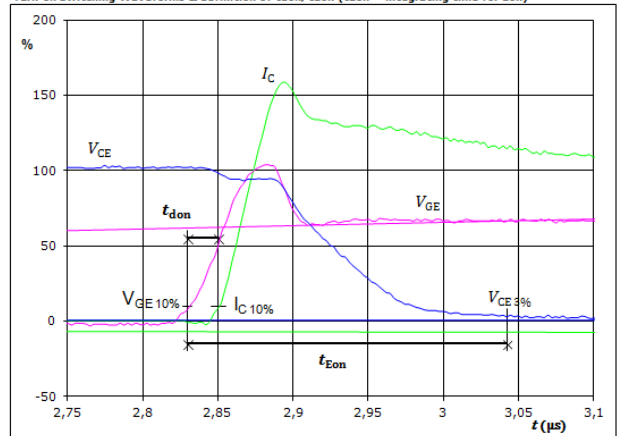
$T_j$	=	125 °C
$R_{\theta on}$	=	32 Ω
$R_{\theta off}$	=	16 Ω

Figure 1. IGBT  
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for Eoff)



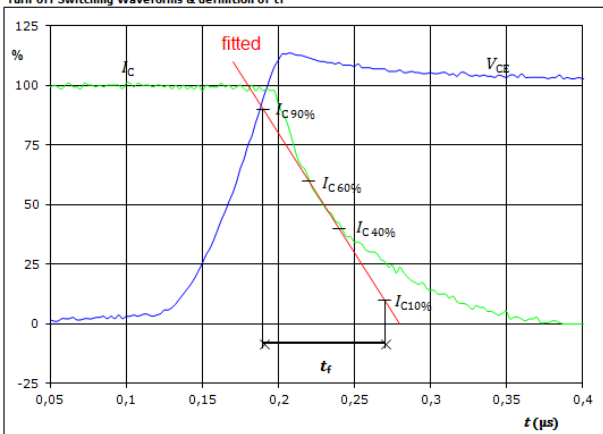
$V_{CE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_{doff} =$	0,203	μs
$t_{Eoff} =$	0,405	μs

Figure 2. IGBT  
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for Eon)



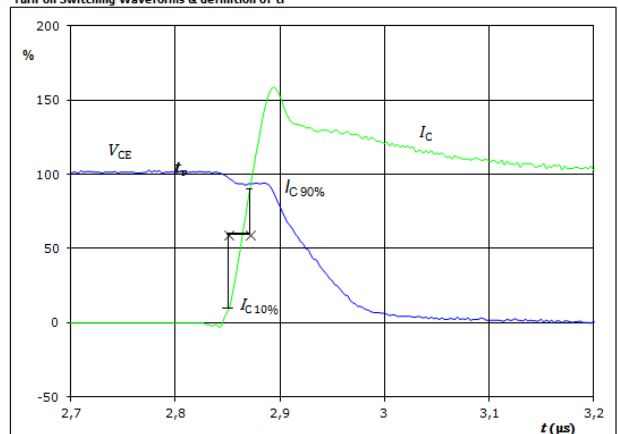
$V_{CE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_{don} =$	0,020	μs
$t_{Eon} =$	0,213	μs

Figure 3. IGBT  
Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_f =$	0,091	μs

Figure 4. IGBT  
Turn-on Switching Waveforms & definition of  $t_r$

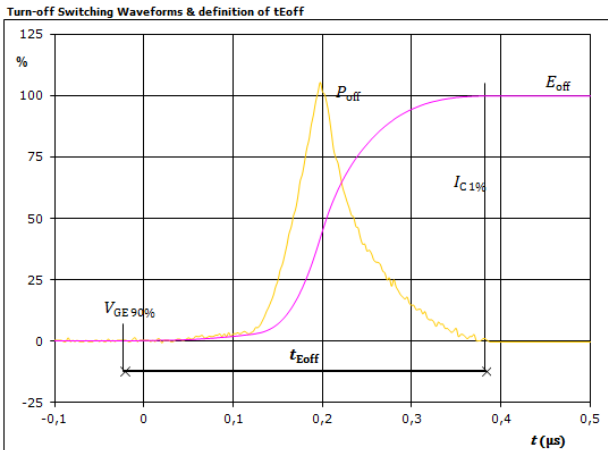


$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_r =$	0,021	μs



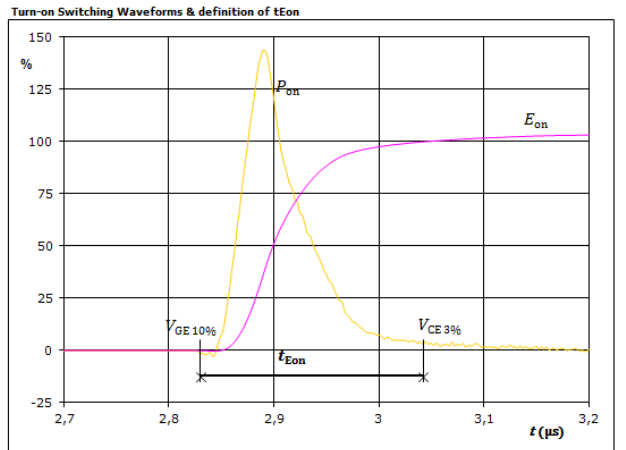
## Brake Switching Characteristics

**Figure 5.** IGBT



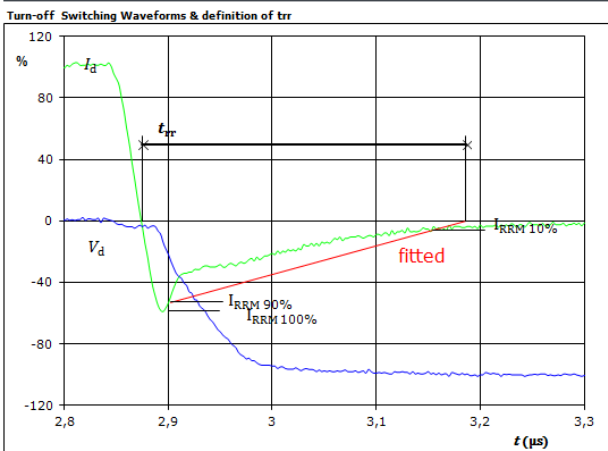
$P_{off}(100\%) =$	4,49	kW
$E_{off}(100\%) =$	0,40	mJ
$t_{Eoff} =$	0,40	μs

**Figure 6.** IGBT



$P_{on}(100\%) =$	4,49	kW
$E_{on}(100\%) =$	0,41	mJ
$t_{Eon} =$	0,21	μs

**Figure 7.** FWD

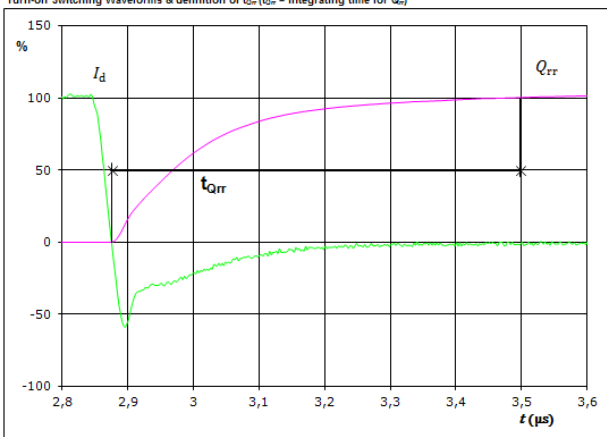


$V_d(100\%) =$	300	V
$I_d(100\%) =$	15	A
$I_{RRM}(100\%) =$	9	A
$t_{rr} =$	0,279	μs



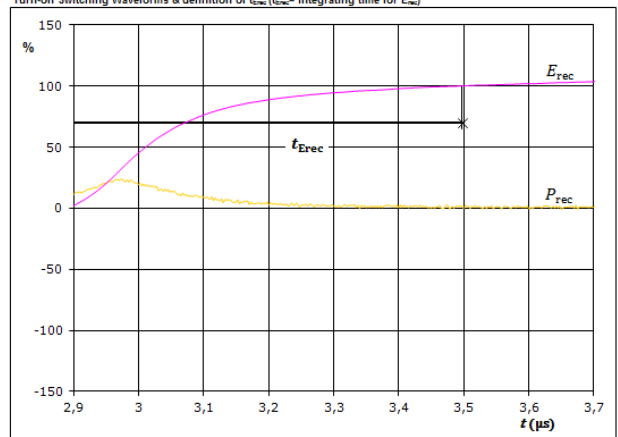
### Brake Switching Characteristics

**Figure 8.** FWD  
Turn-on Switching Waveforms & definition of  $t_{Qrr}$  ( $t_{Qrr}$  = integrating time for  $Q_{rr}$ )




$I_d$ (100%) =	15	A
$Q_{rr}$ (100%) =	0,96	$\mu\text{C}$
$t_{Qrr}$ =	0,62	$\mu\text{s}$

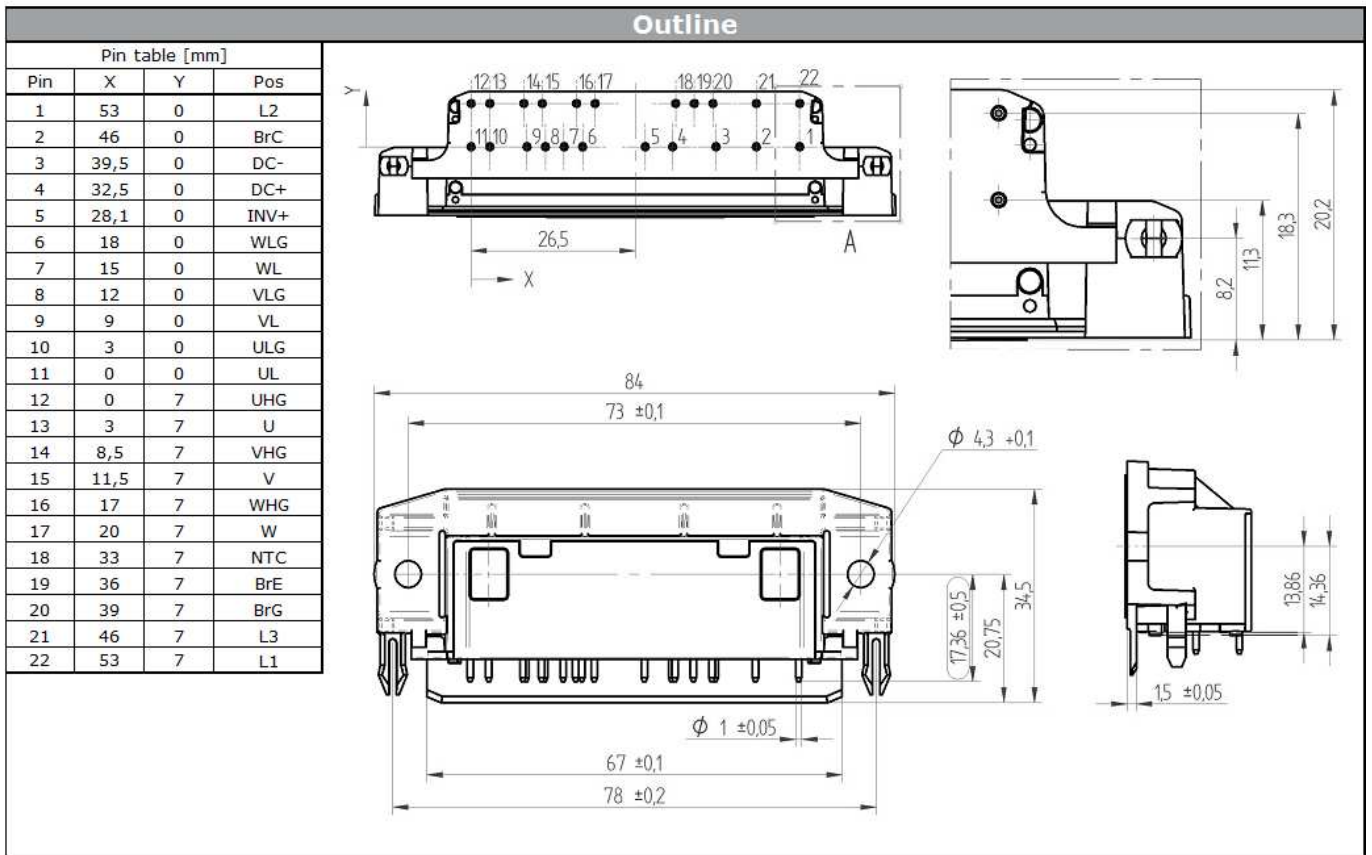
**Figure 9.** FWD  
Turn-on Switching Waveforms & definition of  $t_{Erec}$  ( $t_{Erec}$  = integrating time for  $E_{rec}$ )



$P_{rec}$ (100%) =	4,49	kW
$E_{rec}$ (100%) =	0,20	mJ
$t_{Erec}$ =	0,62	$\mu\text{s}$

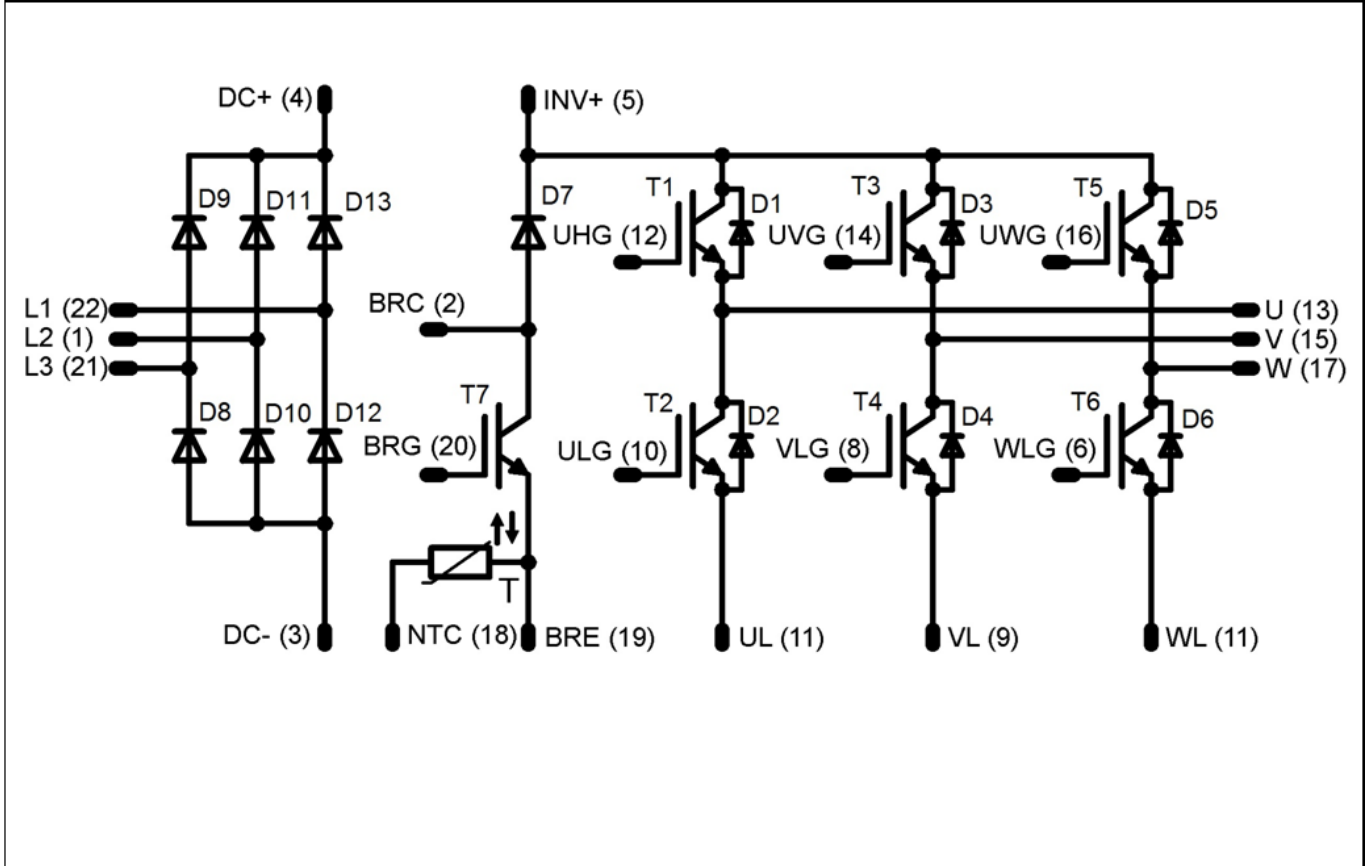


Ordering Code & Marking							
Version	Ordering Code	in DataMatrix as		in packaging barcode as			
without thermal paste with solder pins	V23990-P634-A-PM	P634-A		P634-A			
with thermal paste with solder pins	V23990-P634-A-/3/-PM	P634-A		P634-A-/3/			
 Vinco WWYY TTTTTTTTTL LLLLL SSSS	Text	Vinco	Date code	Type	UL	Lot number	Serial
		Vinco	WWYY	TTTTTTTT	UL	LLLLL	SSSS
	Datamatrix	Type	Lot number	Serial	Date code		
		TTTTTTTT	LLLLL	SSSS	WWYY		





**Pinout**



**Identification**

ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	600V	20A	Inverter switch	
D1,D2,D3,D4,D5,D6	FWD	600V	20A	Inverter Diode	
T7	IGBT	600V	15A	Brake switch	
D7	FWD	600V	10A	Brake Diode	
D8,D9,D10, D11,D12,D13	Diode	1600V	18A	Rectifier	
T	NTC			Thermistor	



Packaging instruction					
Standard packaging quantity (SPQ)	80	>SPQ	Standard	<SPQ	Sample

Handling instruction	
Handling instructions for <i>flow</i> 90 1 packages see vincotech.com website.	

Document No.:	Date:	Modification:	Pages
V23990-P634-A-D5k1-14	23 Mar. 2018		

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