



flowCON 0

600 V / 50 A

**Topology features**

- Three-phase Rectifier
- Brake Chopper
- Temperature sensor

**Component features**

- High inrush current capability

**Housing features**

- Base isolation: Al<sub>2</sub>O<sub>3</sub>
- Clip-in, reliable mechanical connection, qualified for wave soldering
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

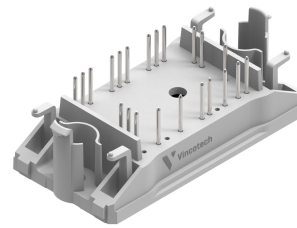
**Target applications**

- Industrial Drives

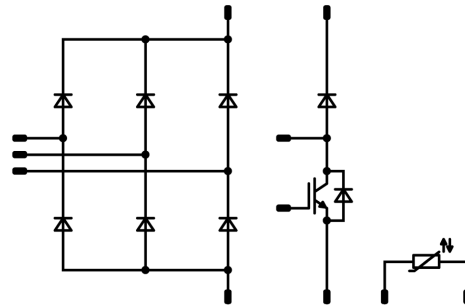
**Types**

- 10-F0166RA050SC-M920G29

**flow 0 17 mm housing**



**Schematic**





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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Brake Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	51	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	150	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	122	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Brake Diode

Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	27	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 8,3\text{ ms}$ $T_j = 25\text{ °C}$	150	A
Surge current capability	$I^2t$		112	$\text{A}^2\text{s}$
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	34	W
Maximum junction temperature	$T_{jmax}$		150	$^{\circ}\text{C}$

## Brake Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	8	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	6	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	19	W
Maximum junction temperature	$T_{jmax}$		150	$^{\circ}\text{C}$



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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Rectifier Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	88	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	600	A
Surge current capability	$I^2t$		1800	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	105	W
Maximum junction temperature	$T_{jmax}$		150	°C

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

\*100 % tested in production



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### Characteristic Values

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

#### Brake Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0017	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	25 125 150	1,58	1,87 2,18 2,3	2,07 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			1	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			120	nA
Internal gate resistance	$r_g$							4		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		2800		pF
Reverse transfer capacitance	$C_{res}$									
Gate charge	$Q_g$		±15		0	25		380		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						0,78		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 8 \Omega$ $R_{goff} = 8 \Omega$	0/15	700	25	25		27,83		ns
						125		27,24		
Rise time	$t_r$					25		18,87		
						125		20,55		
Turn-off delay time	$t_{d(off)}$					25		401,92		
						125		535,59		
Fall time	$t_f$	25		72,66						
		125		121,53						
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 26,74 \mu\text{C}$				25		13,34		mWs
		$Q_{tFWD} = 27,3 \mu\text{C}$				125		14,48		
Turn-off energy (per pulse)	$E_{off}$					25		2,14		mWs
						125		3,76		



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### 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		

### Brake Diode

#### Static

Forward voltage	$V_F$				7	25 125 150		1,01 0,922	1,11 <sup>(1)</sup> 1,01 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1600$ V				25 150			5 700	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,03		K/W
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#### Dynamic

Peak recovery current	$I_{RM}$	$di/dt=1687$ A/μs $di/dt=1604$ A/μs	0/15	700	25	25 125		128,33 119,56		A
Reverse recovery time	$t_{rr}$					25 125		531,86 566,34		ns
Recovered charge	$Q_r$					25 125		26,74 27,3		μC
Reverse recovered energy	$E_{rec}$					25 125		8,37 8,08		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25		581,2		A/μs
						125		480,33		



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### 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		

#### Brake Sw. Protection Diode

##### Static

Forward voltage	$V_F$				3	25 125	1,23	1,66 1,59	1,97 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25			27	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						3,72		K/W
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#### Rectifier Diode

##### Static

Forward voltage	$V_F$				33	25 125 150		1,02 0,927 0,906	1,21 <sup>(1)</sup> 1,1 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1600$ V				25			50	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,67		K/W
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### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$V_{CE}$ [V]	$T_j$ [°C]	Min	Typ	Max	

### Thermistor

#### Static

Rated resistance	$R$					25		22		kΩ
Deviation of $R_{100}$	$A_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	$P$					25		130		mW
Power dissipation constant	$d$					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$						4000		K
Vincotech Thermistor Reference									I	

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.

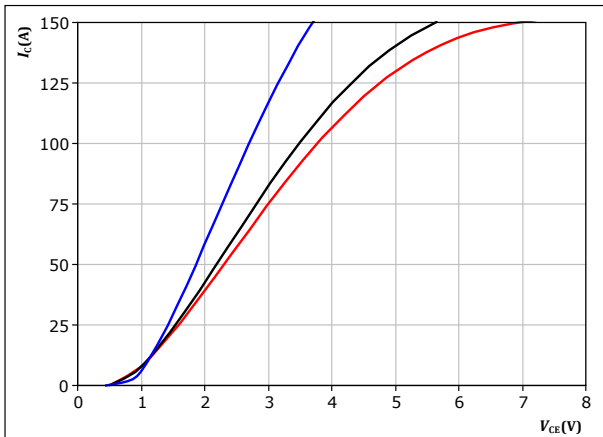


## Brake Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$



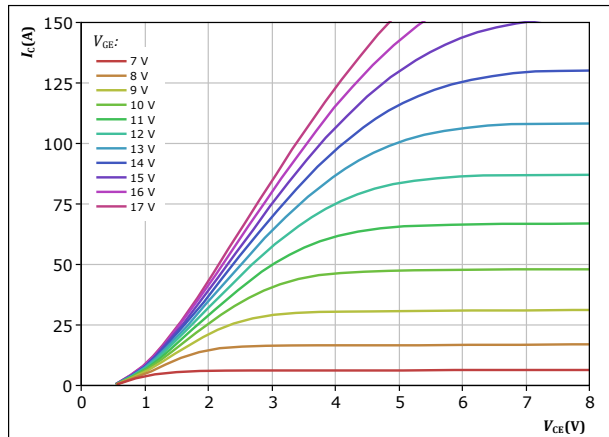
$t_p = 250 \mu\text{s}$   
 $V_{GE} = 15 \text{ V}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 2.** IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

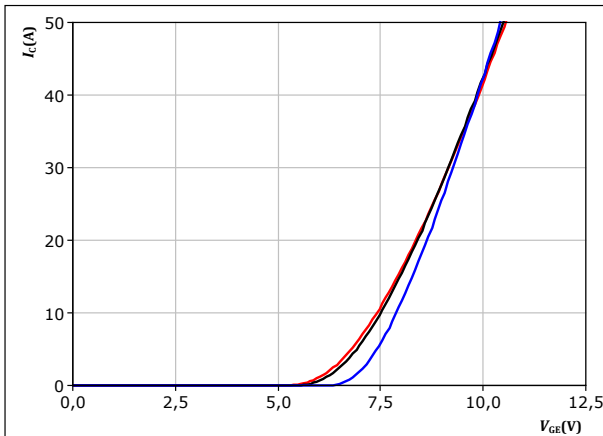


$t_p = 250 \mu\text{s}$   
 $T_j = 150 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$



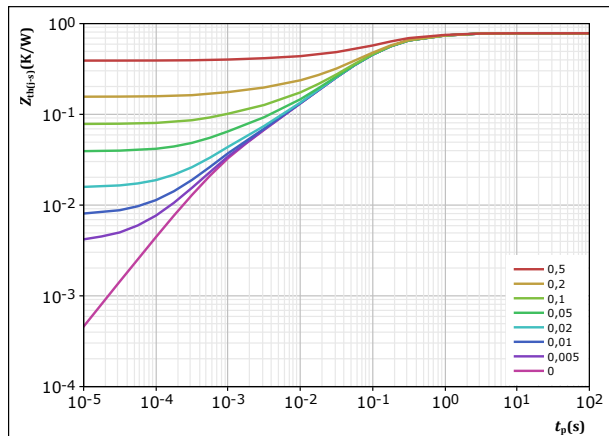
$t_p = 250 \mu\text{s}$   
 $V_{CE} = 10 \text{ V}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

**figure 4.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,782 \text{ K/W}$

IGBT thermal model values

$R$ (K/W)	$\tau$ (s)
1,24E-01	9,17E-01
3,94E-01	1,41E-01
1,70E-01	4,90E-02
6,32E-02	9,18E-03
3,04E-02	9,28E-04



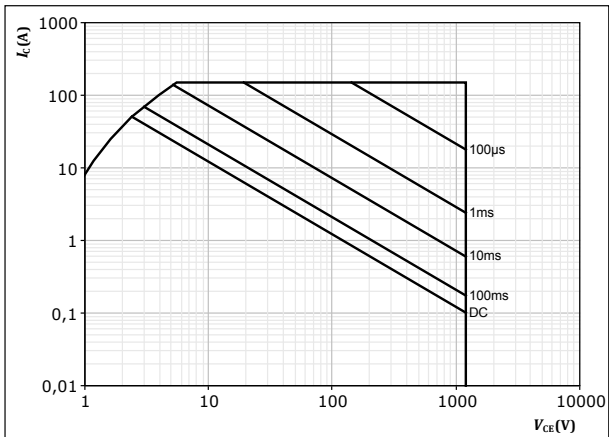


### Brake Switch Characteristics

figure 5. IGBT

Safe operating area

$I_C = f(V_{CE})$



$D =$  single pulse  
 $T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$   
 $T_j = T_{jmax}$

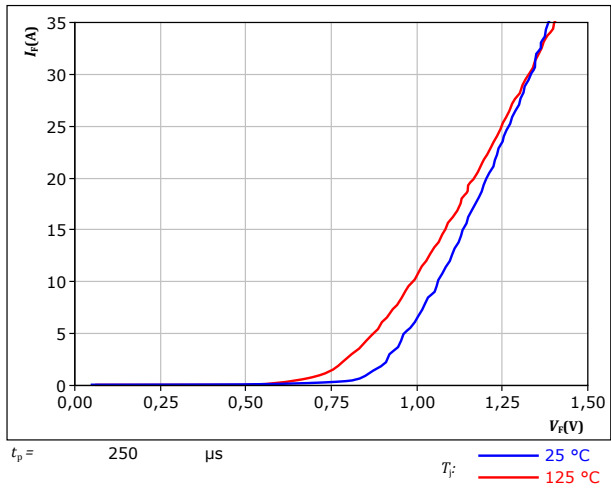


### Brake Diode Characteristics

**figure 6.** Rectifier

Typical forward characteristics

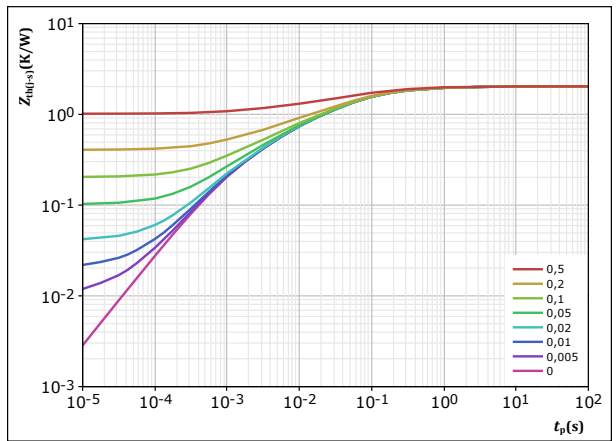
$$I_F = f(V_F)$$



**figure 7.** Rectifier

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 2,032 \text{ K/W}$   
 Rectifier thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
1,06E-01	2,32E+00
4,93E-01	2,00E-01
7,85E-01	4,15E-02
4,66E-01	6,59E-03
1,83E-01	9,43E-04

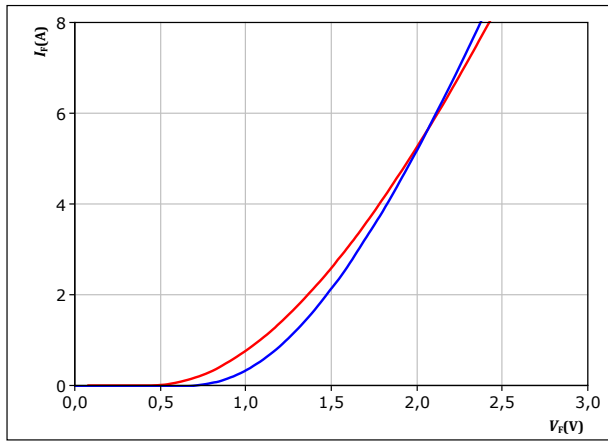


## Brake Sw. Protection Diode Characteristics

figure 8. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

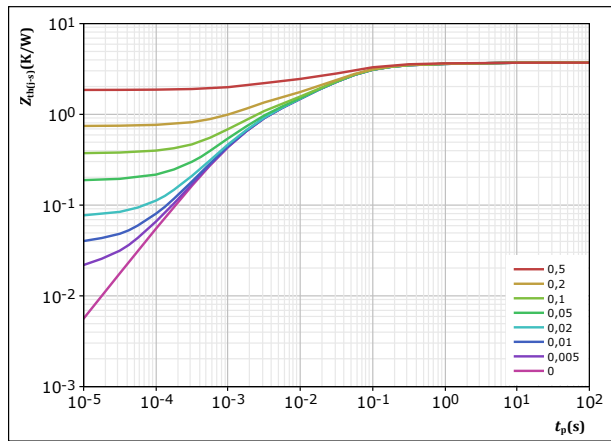


$t_p = 250\ \mu\text{s}$   
 $T_j: \text{— } 25\text{ °C}$   
 $\text{— } 125\text{ °C}$

figure 9. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 3,715\ \text{K/W}$   
FWD thermal model values  

$R$ (K/W)	$\tau$ (s)
1,58E-01	3,25E+00
5,74E-01	1,68E-01
1,74E+00	4,01E-02
5,91E-01	8,37E-03
6,54E-01	1,47E-03



## Rectifier Diode Characteristics

figure 10. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

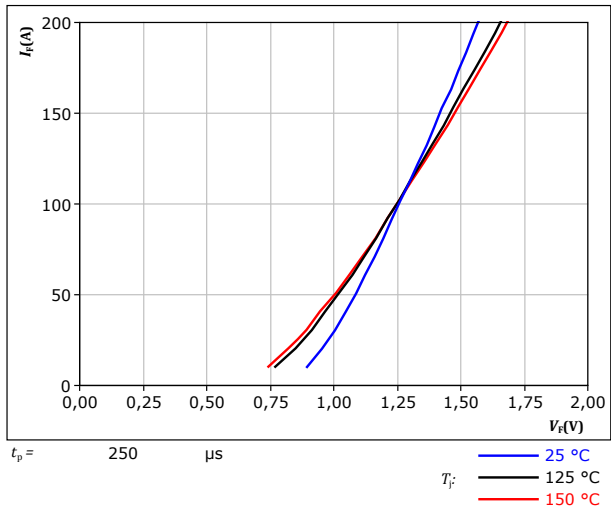
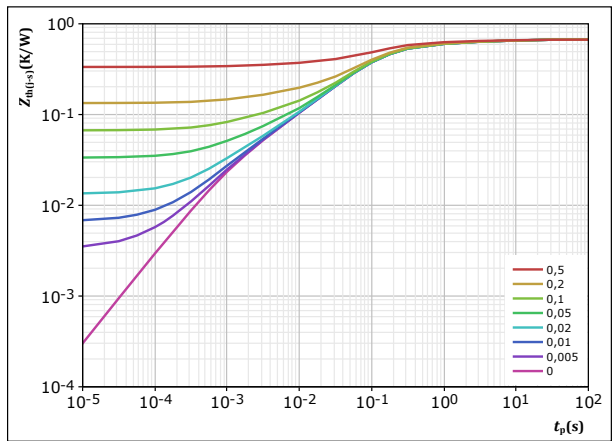


figure 11. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 0,669 \text{ K/W}$   
 Rectifier thermal model values

$R$ (K/W)	$\tau$ (s)
4,15E-02	9,04E+00
7,27E-02	1,12E+00
1,99E-01	1,91E-01
2,89E-01	6,88E-02
4,54E-02	7,76E-03
2,21E-02	1,16E-03

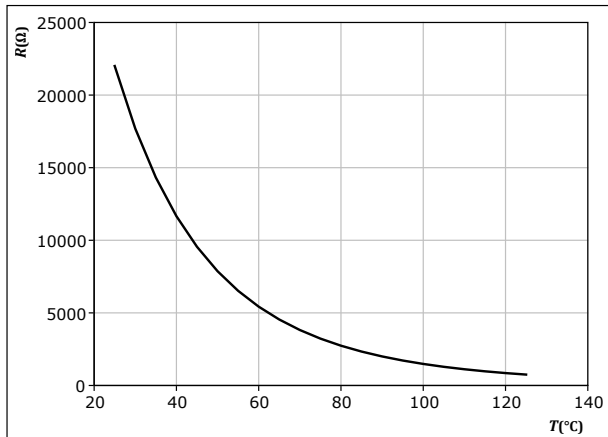


## Thermistor Characteristics

figure 12. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

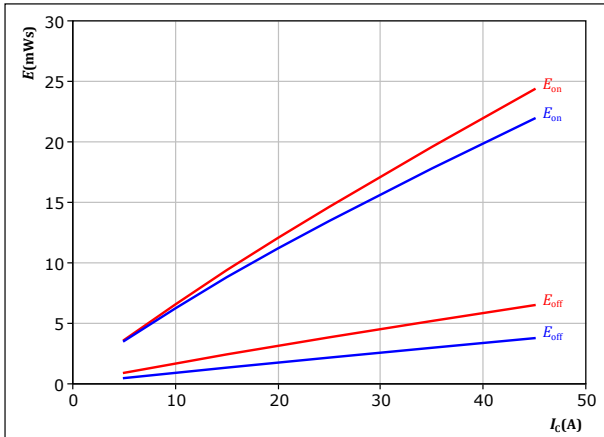




## Brake Switching Characteristics

**figure 13.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$



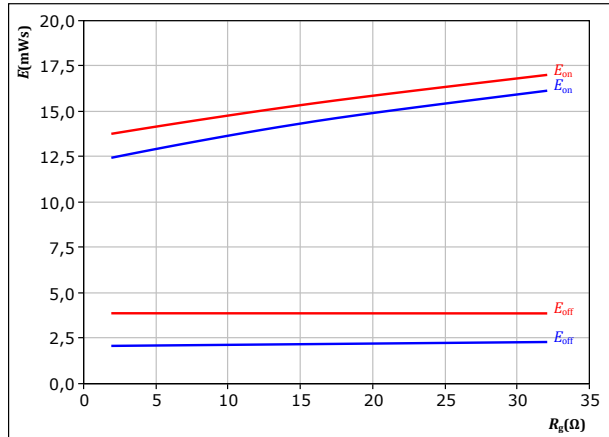
With an inductive load at

$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $R_{g(on)} = 8$   $\Omega$   
 $R_{g(off)} = 8$   $\Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 14.** IGBT

Typical switching energy losses as a function of IGBT turn on gate resistor  
 $E = f(R_g)$



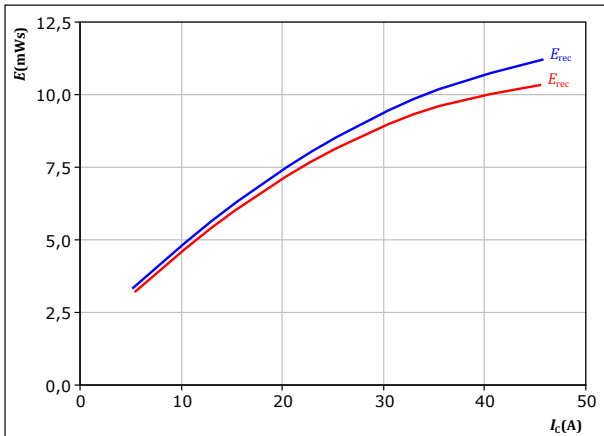
With an inductive load at

$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 25$  A

$T_j$ : — 25 °C  
 — 125 °C

**figure 15.** Rectifier

Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$



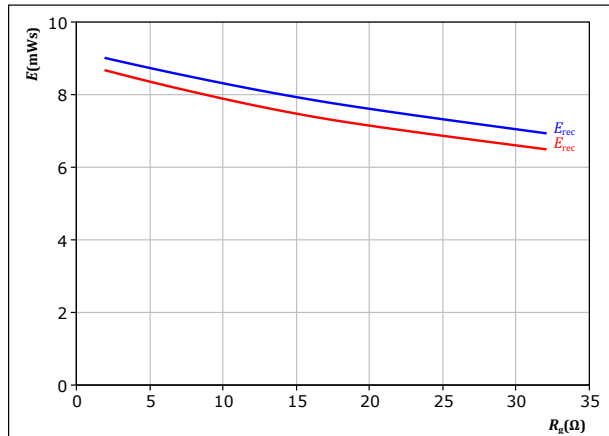
With an inductive load at

$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $R_{g(on)} = 8$   $\Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 16.** Rectifier

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at

$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 25$  A

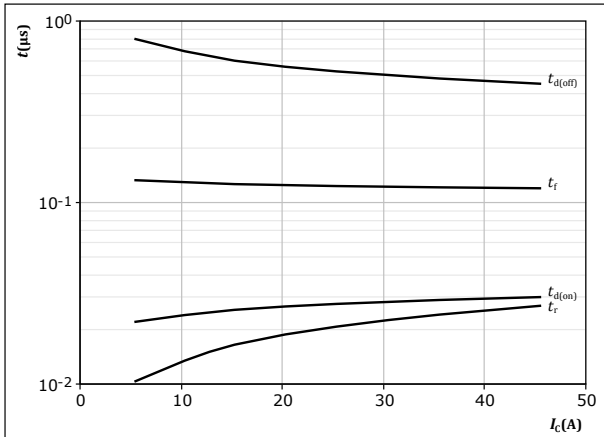
$T_j$ : — 25 °C  
 — 125 °C



## Brake Switching Characteristics

**figure 17.** IGBT

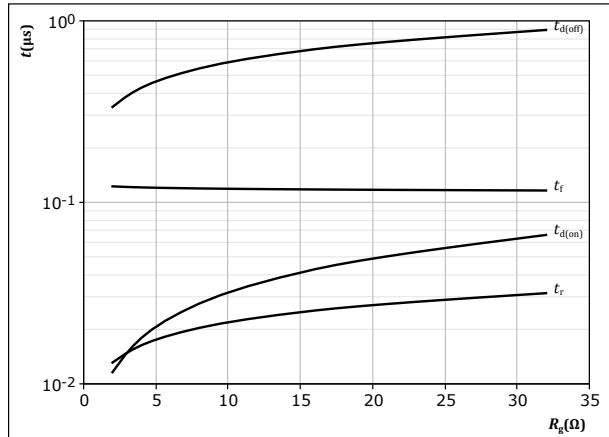
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $R_{goff} = 8 \text{ } \Omega$

**figure 18.** IGBT

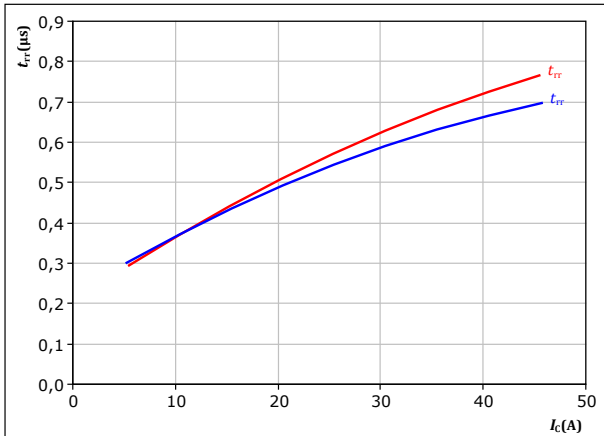
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 25 \text{ A}$

**figure 19.** Rectifier

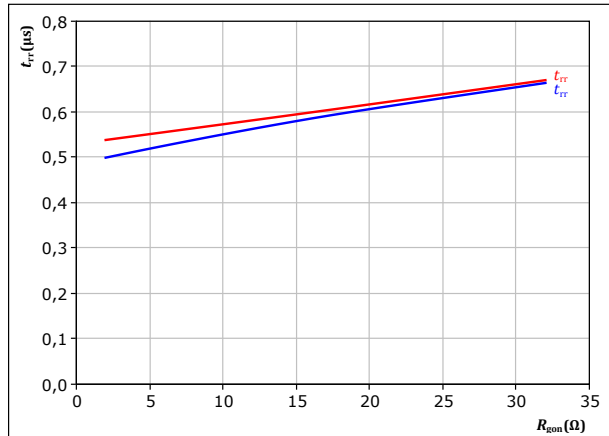
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $T_j: \text{ — } 25 \text{ }^\circ\text{C}$   
 $\text{ — } 125 \text{ }^\circ\text{C}$

**figure 20.** Rectifier

Typical reverse recovery time as a function of IGBT turn on gate resistor  
 $t_{rr} = f(R_{gon})$



With an inductive load at  
 $V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 25 \text{ A}$   
 $T_j: \text{ — } 25 \text{ }^\circ\text{C}$   
 $\text{ — } 125 \text{ }^\circ\text{C}$

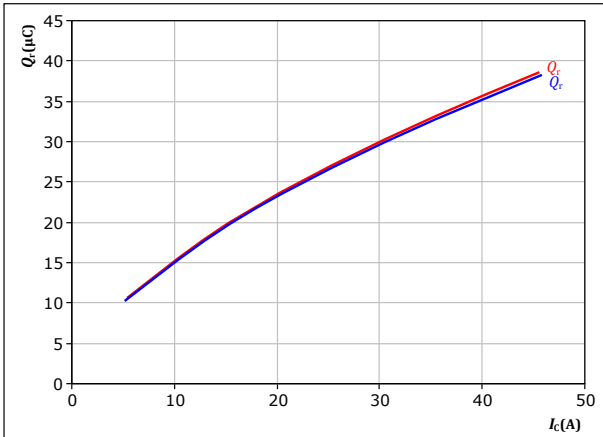


## Brake Switching Characteristics

**figure 21.** Rectifier

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

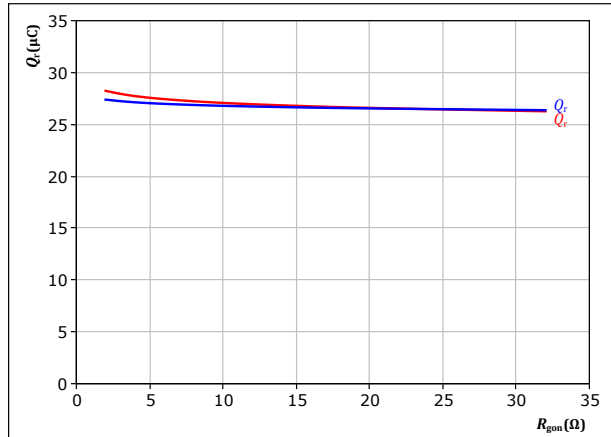
$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 8$   $\Omega$

$T_j$ : — 25 °C  
— 125 °C

**figure 22.** Rectifier

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

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



With an inductive load at

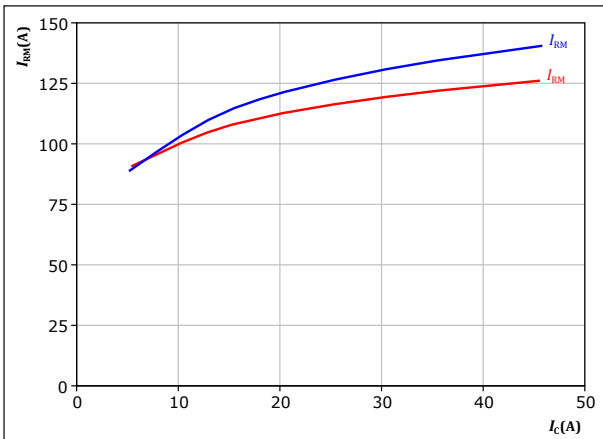
$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 25$  A

$T_j$ : — 25 °C  
— 125 °C

**figure 23.** Rectifier

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

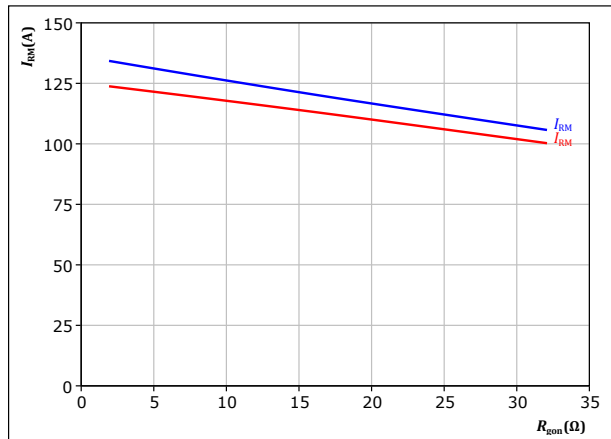
$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 8$   $\Omega$

$T_j$ : — 25 °C  
— 125 °C

**figure 24.** Rectifier

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

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



With an inductive load at

$V_{CE} = 700$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 25$  A

$T_j$ : — 25 °C  
— 125 °C

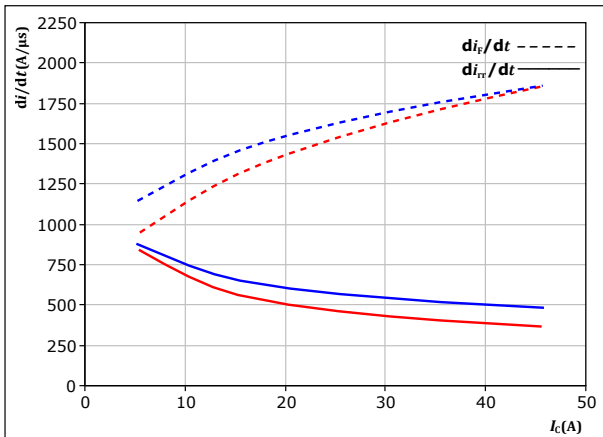




## Brake Switching Characteristics

**figure 25.** Rectifier

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



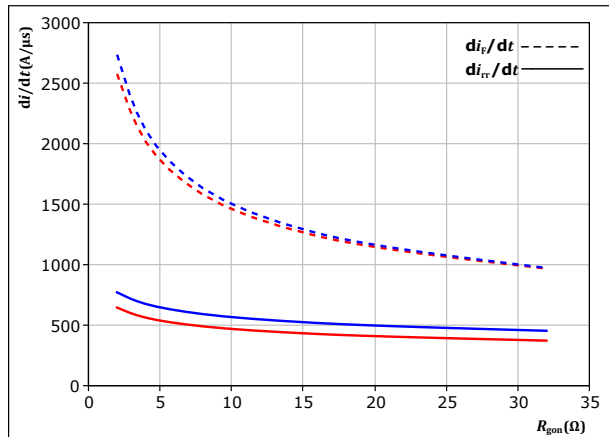
With an inductive load at

$V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 26.** Rectifier

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

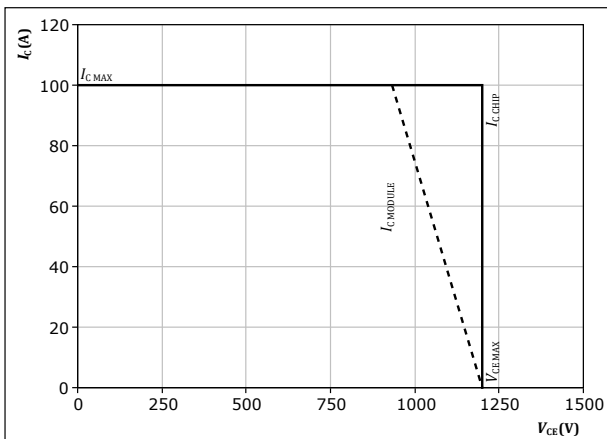
$V_{CE} = 700 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_C = 25 \text{ A}$

$T_j$ : — 25 °C  
 — 125 °C

**figure 27.** IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 125 \text{ } ^\circ\text{C}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $R_{goff} = 8 \text{ } \Omega$



## Brake Switching Definitions

figure 28. IGBT

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

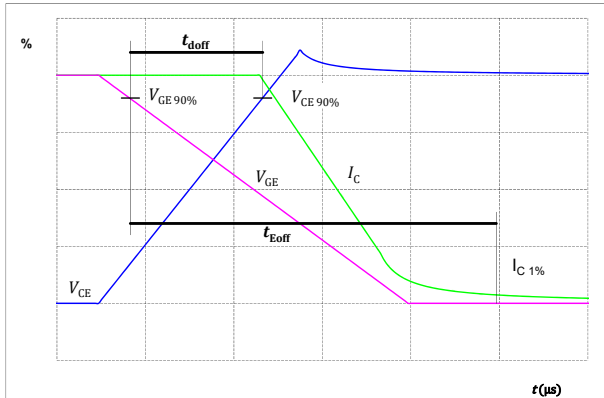


figure 29. IGBT

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

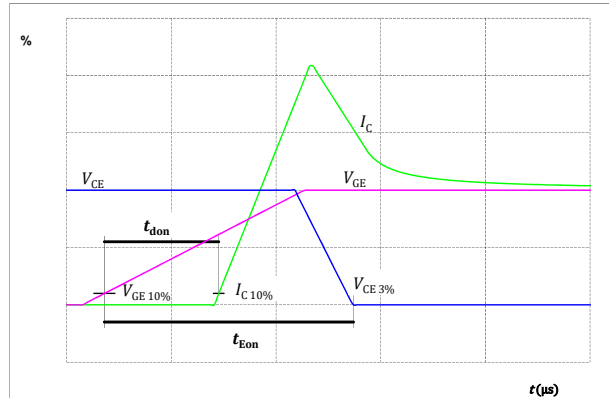


figure 30. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

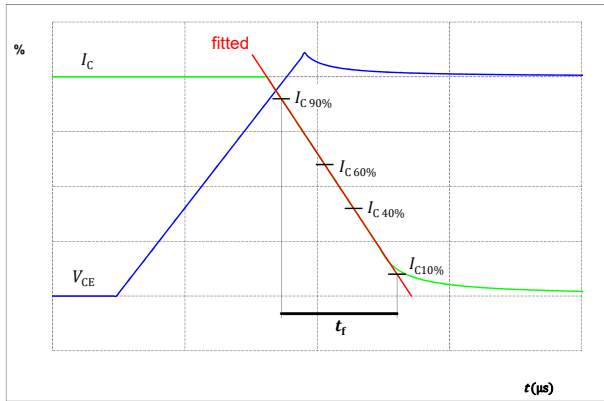
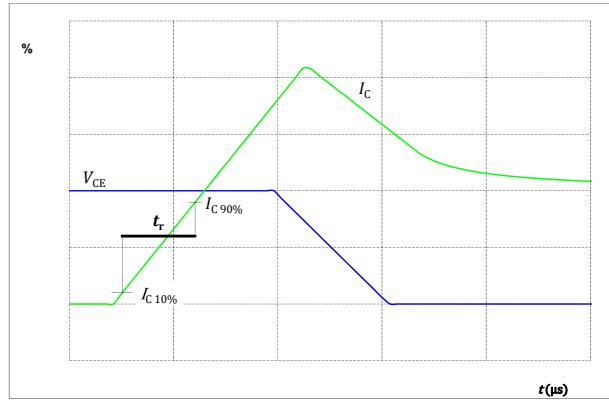


figure 31. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Brake Switching Definitions

figure 32. FWD

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

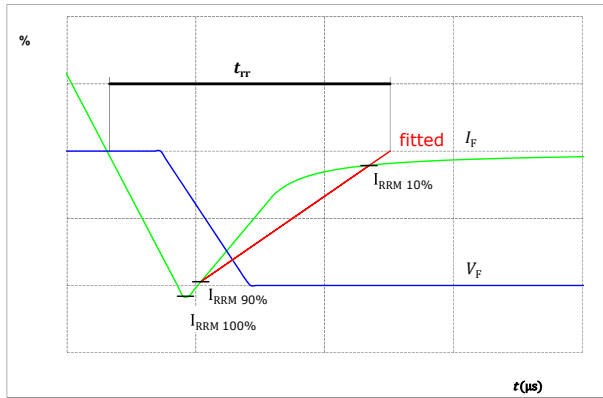
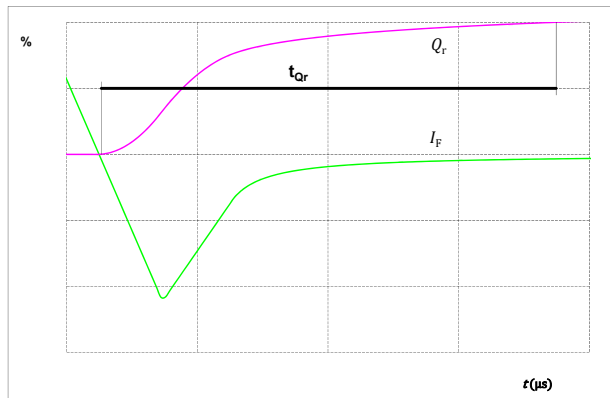


figure 33. FWD

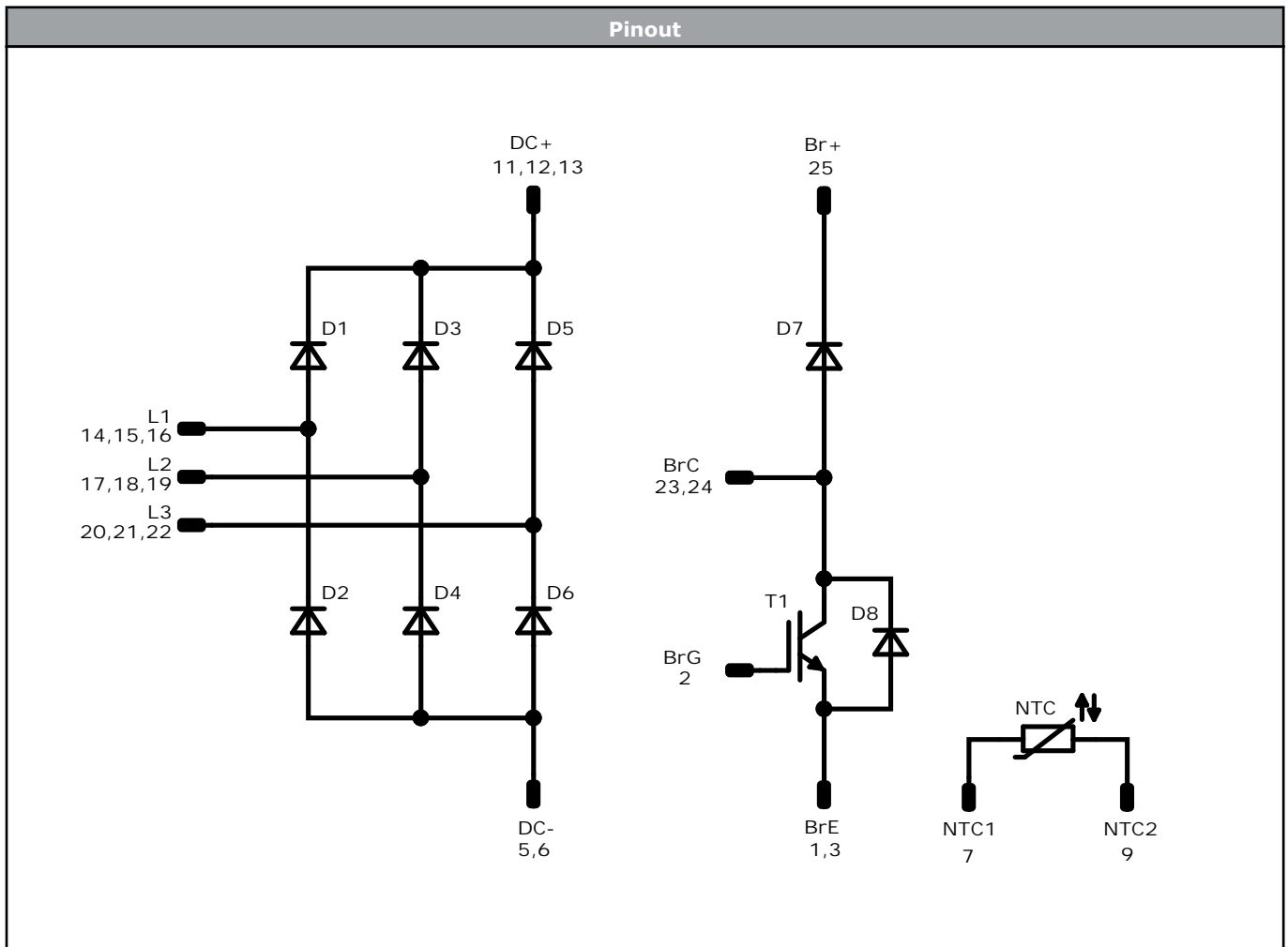
Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr}$  = integrating time for  $Q_r$ )







Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
T1	IGBT	1200 V	50 A	Brake Switch	
D7	Rectifier	1600 V	12 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Sw. Protection Diode	
D1, D2, D3, D4, D5, D6	Rectifier	1600 V	65 A	Rectifier Diode	
NTC	NTC			Thermistor	




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

Handling instruction
Handling instructions for <i>flow 0</i> packages see vincotech.com website.

Package data
Package data for <i>flow 0</i> 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-F0166RA050SC-M920G29-D1-14	12 Aug. 2022		

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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.