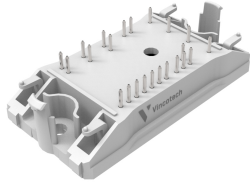
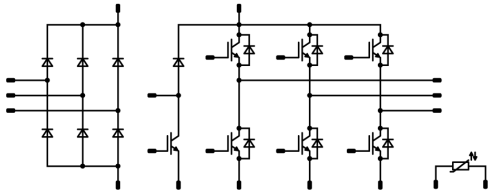




<b>flowPIM 0</b>		<b>1200 V / 8 A</b>	
<b>Features</b>		<b>flow 0 12 mm housing</b>	
<ul style="list-style-type: none"><li>• 2 Clips housing in 12 mm height</li><li>• Trench Fieldstop Technology IGBT4</li><li>• Integrated BRC</li></ul>			
<b>Target applications</b>		<b>Schematic</b>	
<ul style="list-style-type: none"><li>• Industrial Drives</li></ul>			
<b>Types</b>			
<ul style="list-style-type: none"><li>• V23990-P849-A48-PM</li></ul>			



Vincotech

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	16	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	24	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	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	$^{\circ}\text{C}$

<b>Inverter Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	19	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	20	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	46	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

<b>Brake Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	9	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	12	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	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	$^{\circ}\text{C}$



Vincotech

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Brake Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	9	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	6	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	25	W
Maximum junction temperature	$T_{jmax}$		150	°C

## Rectifier Diode

Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	35	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	$I^2t$		200	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	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			9,29	mm
Comparative Tracking Index	CTI		≥ 200	

\*100 % tested in production



### Characteristic Values

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

#### Inverter Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$				0,00015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CEsat}$		15			8	25 125	1,58	1,87 2,21	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	$r_g$								None		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25			25		490		pF
Reverse transfer capacitance	$C_{res}$										
Gate charge	$Q_g$	$V_{CC} = 960 \text{ V}$	15			8	25		53		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)							1,57		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	$\pm 15$	600	8	25		71,4		ns
Rise time	$t_r$					125		70,6		
						25		18,6		
Turn-off delay time	$t_{d(off)}$					125		22,8		
						25		194,4		
Fall time	$t_f$					125		236,4		
						25		78,46		
Turn-on energy (per pulse)	$E_{on}$	125		108,16						
		25		0,499						
Turn-off energy (per pulse)	$E_{off}$	125		0,748						
		25		0,435						
						125		0,624		mWs



### Characteristic Values

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

#### Inverter Diode

##### Static

Forward voltage	$V_F$				10	25 150	1,35	1,85 1,77	2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25			2,7	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,07		K/W
----------------------------------------------------	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

##### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=452$ A/μs $di/dt=399$ A/μs	±15	600	8	25		8,46		A
						125		9,88		
Reverse recovery time	$t_{rr}$					25		250,51		ns
						125		382,73		
Recovered charge	$Q_r$					25		0,885		μC
						125		1,57		
Reverse recovered energy	$E_{rec}$	25		0,345		mWs				
		125		0,634						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	25		83,99		A/μs				
		125		69,05						



### 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 Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		4	25 125	1,58	1,95 2,17	2,02 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			0,5	µA
Gate-emitter leakage current	$I_{GES}$		20	0		25			120	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		250		pF
Reverse transfer capacitance	$C_{res}$							15		pF

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						2,58		K/W
----------------------------------------------------	---------------	-----------------------------------------------	--	--	--	--	--	------	--	-----

##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 64 \Omega$ $R_{goff} = 64 \Omega$	$\pm 15$	600	4	25		93		ns				
						125		89,8						
						150		90,6						
Rise time	$t_r$									25		18,8		ns
										125		24		
										150		24,2		
Turn-off delay time	$t_{d(off)}$									25		184,4		ns
						125		226						
						150		235						
Fall time	$t_f$					25		71,34		ns				
						125		98,45						
						150		101,98						
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 0,442 \mu\text{C}$ $Q_{tFWD} = 0,76 \mu\text{C}$ $Q_{tFWD} = 0,871 \mu\text{C}$				25		0,253		mWs				
						125		0,339						
						150		0,366						
Turn-off energy (per pulse)	$E_{off}$					25		0,221		mWs				
						125		0,303						
						150		0,324						



### 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	$V_F$				3	25 125	1,23	1,73 1,64	1,97 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25			27	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,8		K/W
----------------------------------------------------	---------------	---------------------------------------	--	--	--	--	--	-----	--	-----

#### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=204$ A/μs $di/dt=202$ A/μs $di/dt=191$ A/μs	±15	600	4	25		4,22		A
Reverse recovery time	$t_{rr}$					125		4,65	ns	
						150		4,74		
						25		268,29		
Recovered charge	$Q_r$					125		0,76	μC	
						150		0,871		
		25		0,176						
Reverse recovered energy	$E_{rec}$	125		0,324	mWs					
		150		0,378						
		25		44,17						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	125		39,91	A/μs					
		150		36,33						
		25								



### 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		

#### Rectifier Diode

##### Static

Forward voltage	$V_F$			8	25 125 150		0,976 0,879 0,85	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)					1,59		K/W
----------------------------------------------------	---------------	---------------------------------------	--	--	--	--	------	--	-----

#### Thermistor

##### Static

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

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

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



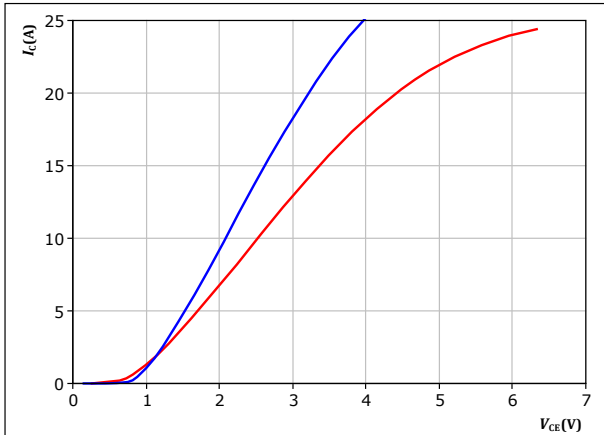


## Inverter Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

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

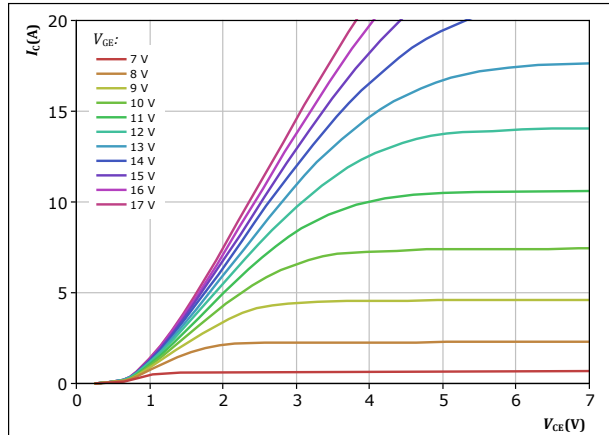


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  — 25 °C  
— 125 °C

**figure 2.** IGBT

Typical output characteristics

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

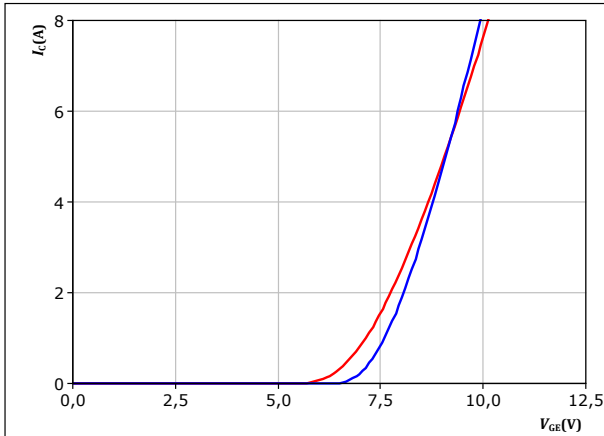


$t_p = 250 \mu s$   
 $T_j = 125 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

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

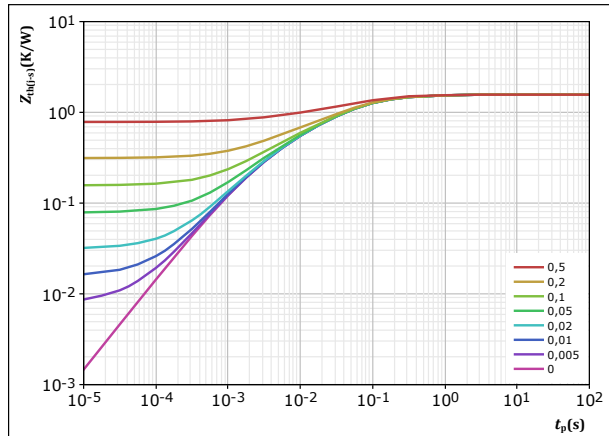


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  — 25 °C  
— 125 °C

**figure 4.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,566 \text{ K/W}$   
IGBT thermal model values

R (K/W)	$\tau$ (s)
1,42E-01	5,98E-01
6,32E-01	7,71E-02
3,98E-01	2,43E-02
2,86E-01	6,16E-03
1,08E-01	1,44E-03

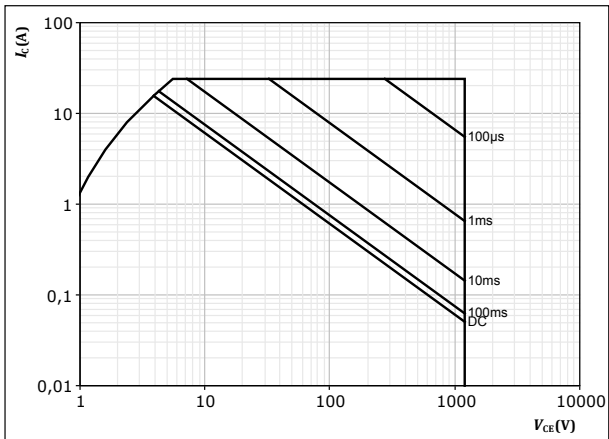


### Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



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



## Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

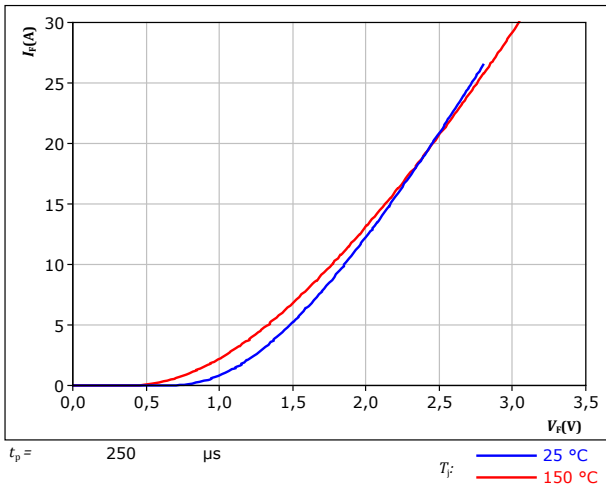
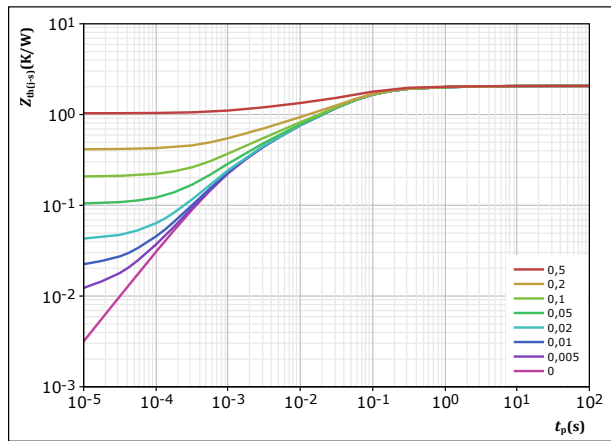


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	2,066	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
5,09E-02	4,26E+00	
1,55E-01	5,03E-01	
7,75E-01	7,89E-02	
5,33E-01	2,68E-02	
3,54E-01	5,03E-03	
1,97E-01	9,09E-04	

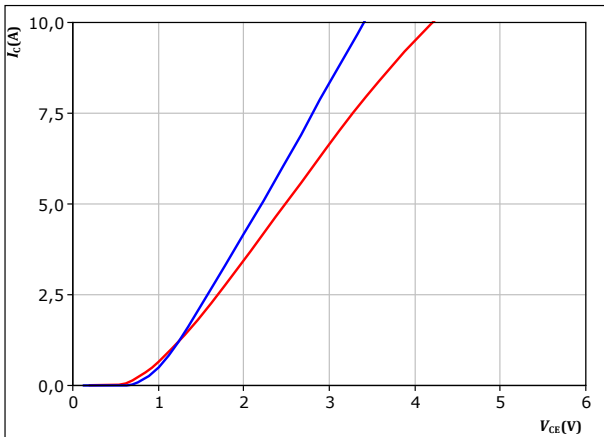


### Brake Switch Characteristics

**figure 8.** IGBT

Typical output characteristics

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

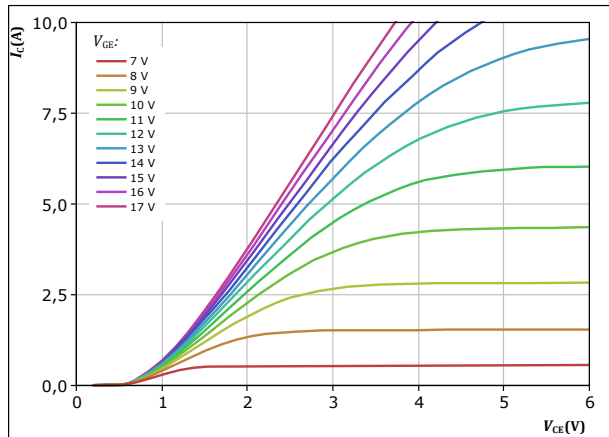


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  — 25 °C  
— 125 °C

**figure 9.** IGBT

Typical output characteristics

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

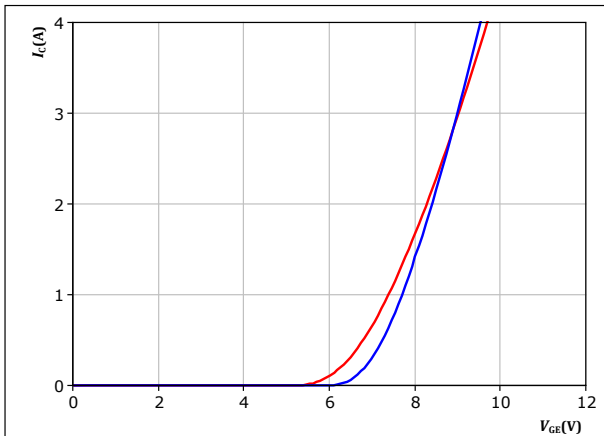


$t_p = 250 \mu s$   
 $T_j = 125 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 10.** IGBT

Typical transfer characteristics

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

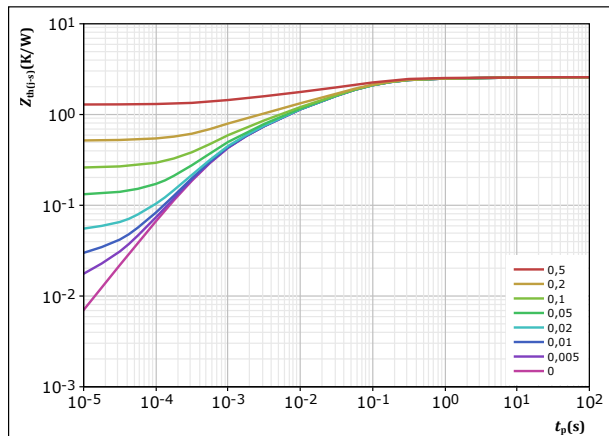


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  — 25 °C  
— 125 °C

**figure 11.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,577 \text{ K/W}$

IGBT thermal model values

R (K/W)	$\tau$ (s)
8,49E-02	6,59E+00
1,97E-01	3,69E-01
1,01E+00	6,94E-02
4,64E-01	1,61E-02
4,43E-01	4,16E-03
3,82E-01	6,88E-04

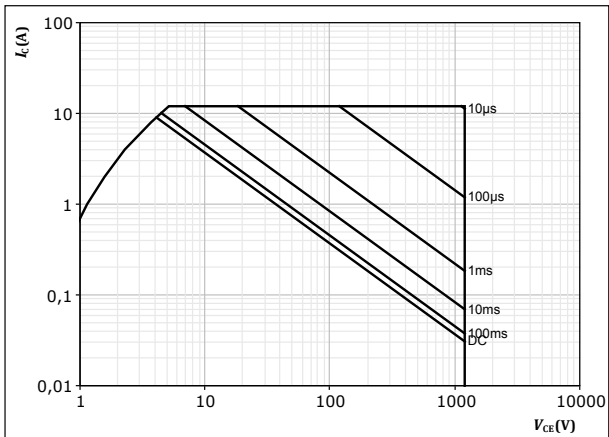


### Brake Switch Characteristics

figure 12. IGBT

Safe operating area

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



D = single pulse  
T<sub>s</sub> = 80 °C  
V<sub>CE</sub> = 15 V  
T<sub>j</sub> = T<sub>jmax</sub>

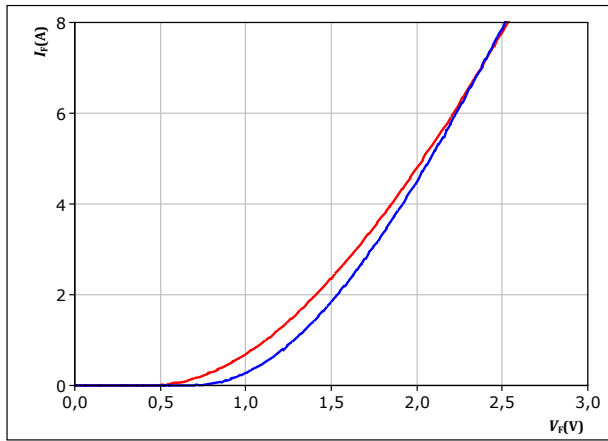


### Brake Diode Characteristics

figure 13. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

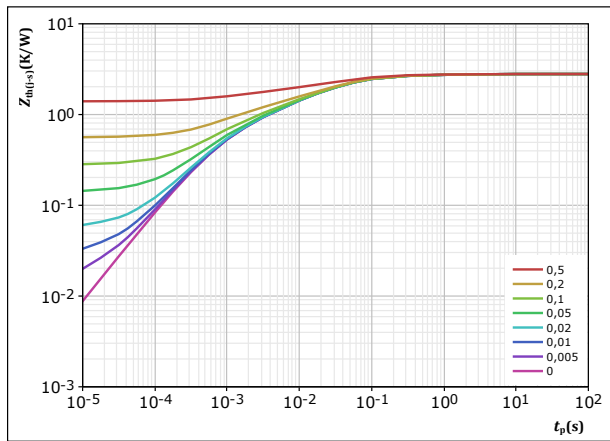


$t_p = 250 \mu s$   
 $T_j$ : — 25 °C  
 — 125 °C

figure 14. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,796 \text{ K/W}$   
 FWD thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
7,82E-02	2,45E+00
1,95E-01	2,65E-01
9,84E-01	4,77E-02
6,58E-01	1,23E-02
5,09E-01	2,70E-03
3,71E-01	5,98E-04



## Rectifier Diode Characteristics

figure 15. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

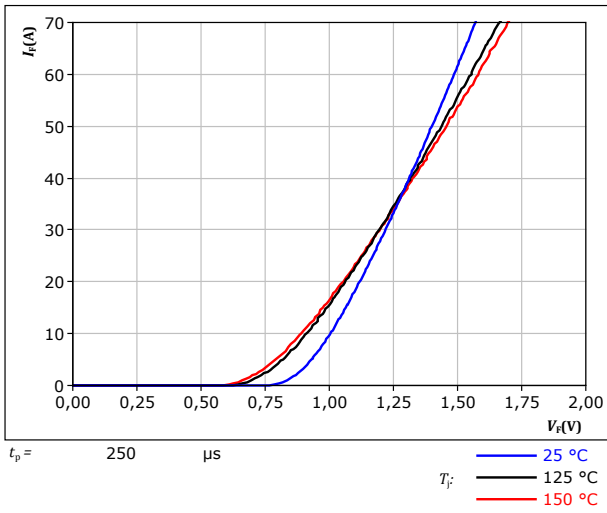
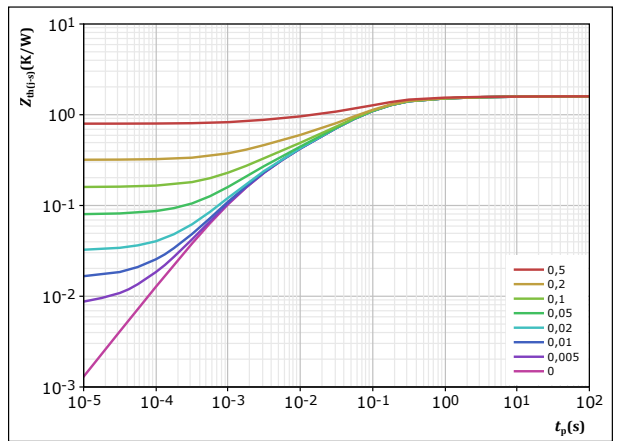


figure 16. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 1,594 \text{ K/W}$

Rectifier thermal model values

$R$ (K/W)	$\tau$ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,81E-02	7,88E-04

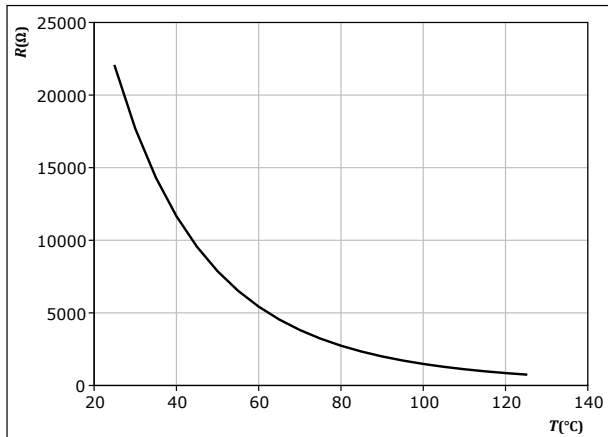


## Thermistor Characteristics

figure 17. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$



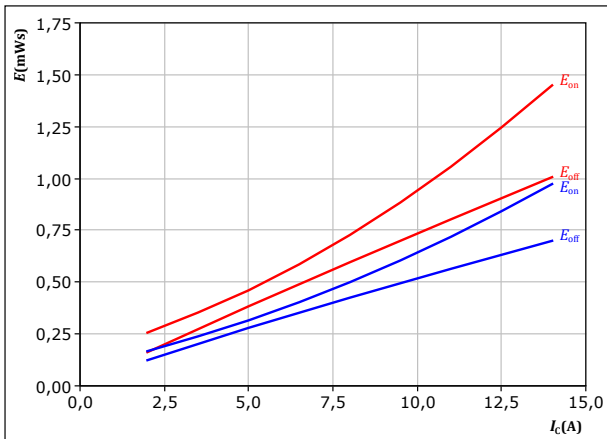




## Inverter Switching Characteristics

**figure 18.** IGBT

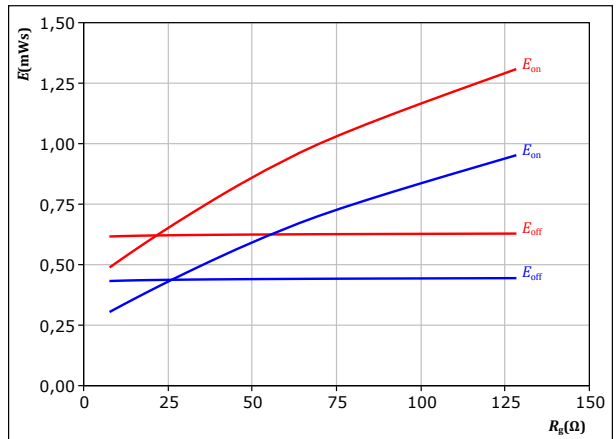
Typical switching energy losses as a function of collector current  
 $E = f(I_c)$



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 32$   $\Omega$   
 $T_j$ : — 25 °C  
— 125 °C

**figure 19.** IGBT

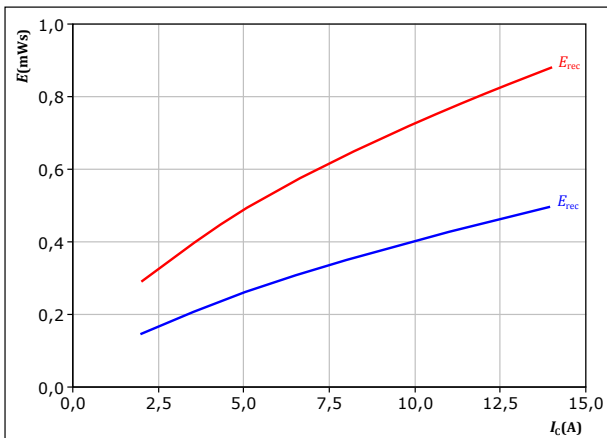
Typical switching energy losses as a function of gate resistor  
 $E = f(R_g)$



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 8$  A  
 $T_j$ : — 25 °C  
— 125 °C

**figure 20.** FWD

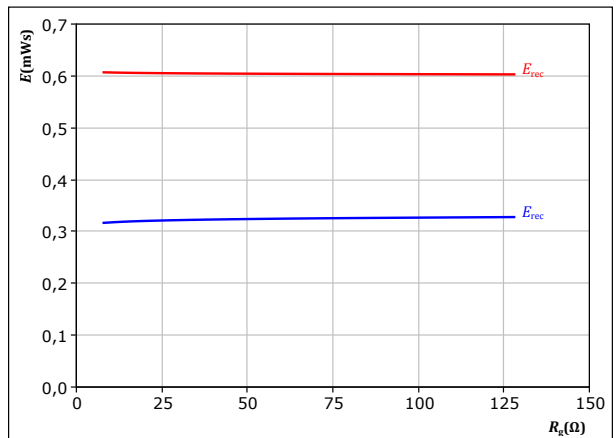
Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$   $\Omega$   
 $T_j$ : — 25 °C  
— 125 °C

**figure 21.** FWD

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



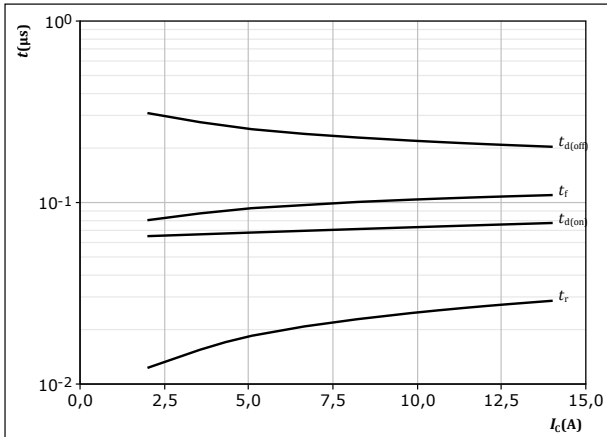
With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 8$  A  
 $T_j$ : — 25 °C  
— 125 °C



## Inverter Switching Characteristics

**figure 22.** IGBT

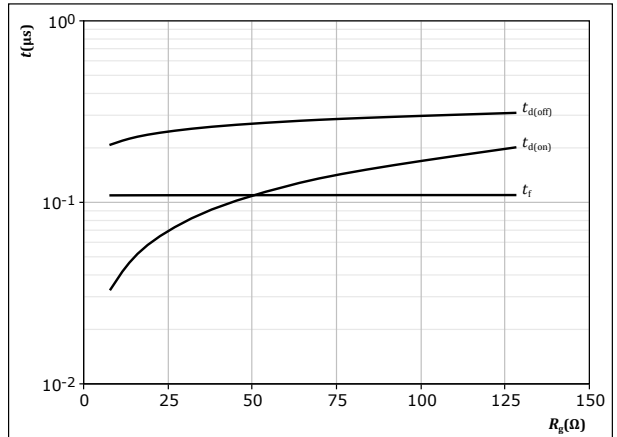
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 32 \text{ } \Omega$   
 $R_{goff} = 32 \text{ } \Omega$

**figure 23.** IGBT

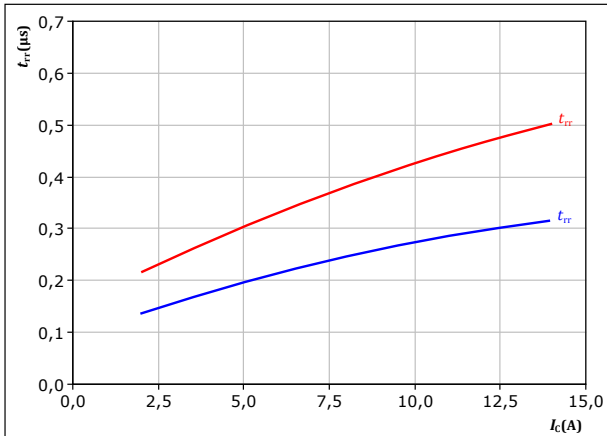
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 8 \text{ A}$

**figure 24.** FWD

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

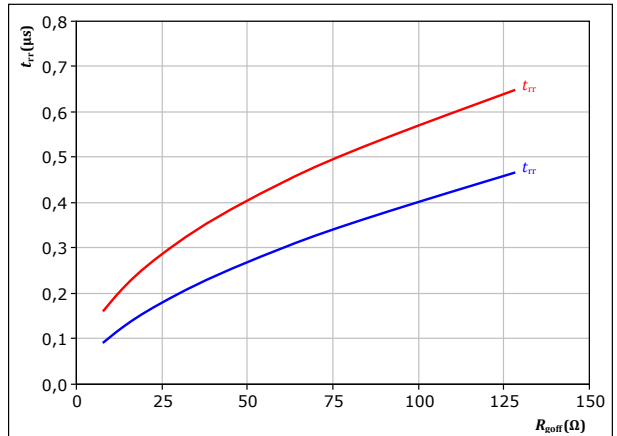


With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 32 \text{ } \Omega$

$T_j$ : — 25 °C  
— 125 °C

**figure 25.** FWD

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



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 8 \text{ A}$

$T_j$ : — 25 °C  
— 125 °C

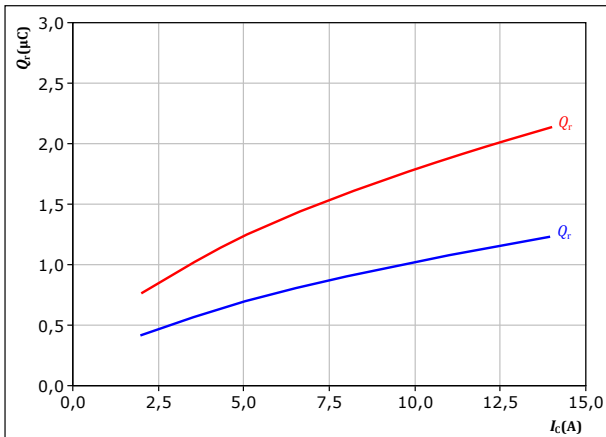


## Inverter Switching Characteristics

**figure 26.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

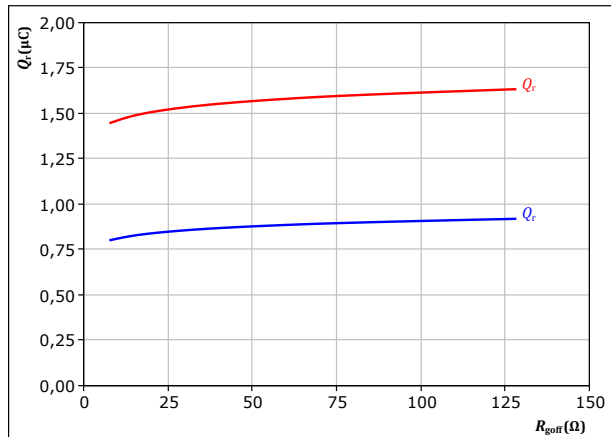
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{goff} = 32 \ \Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 27.** FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

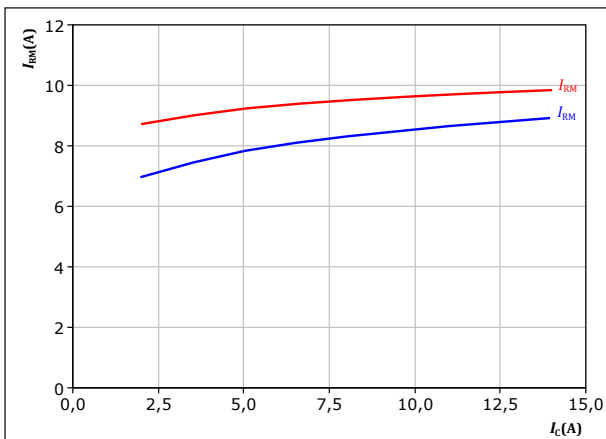
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 8 \text{ A}$

$T_j$ : — 25 °C  
 — 125 °C

**figure 28.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

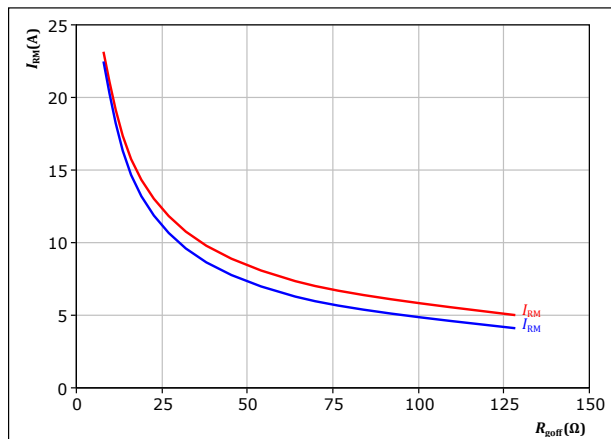
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{goff} = 32 \ \Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 29.** FWD

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

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 8 \text{ A}$

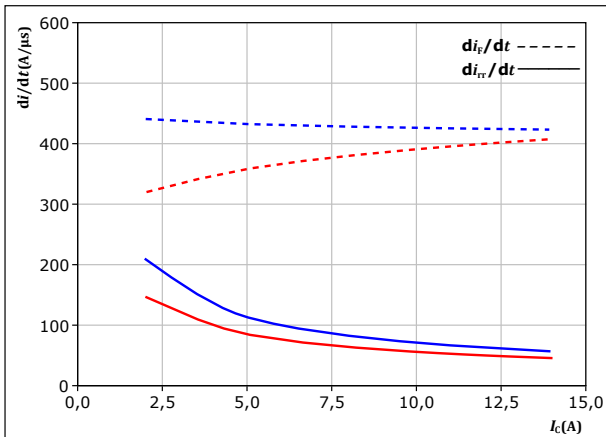
$T_j$ : — 25 °C  
 — 125 °C



## Inverter Switching Characteristics

**figure 30.** FWD

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



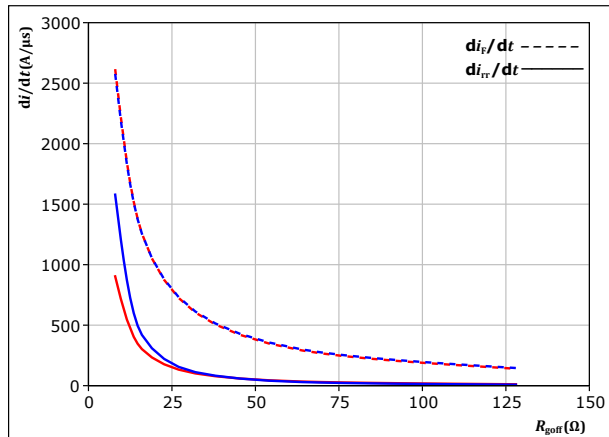
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{goff} = 32 \ \Omega$

$T_j$ : — 25 °C  
 — 125 °C

**figure 31.** FWD

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



With an inductive load at

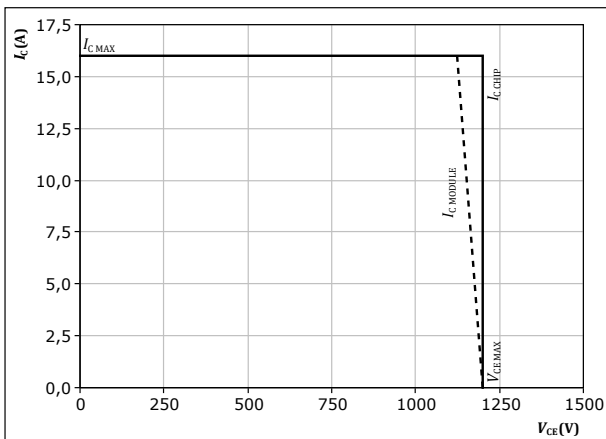
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 8 \text{ A}$

$T_j$ : — 25 °C  
 — 125 °C

**figure 32.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 125 \text{ °C}$   
 $R_{goff} = 32 \ \Omega$   
 $R_{goff} = 32 \ \Omega$

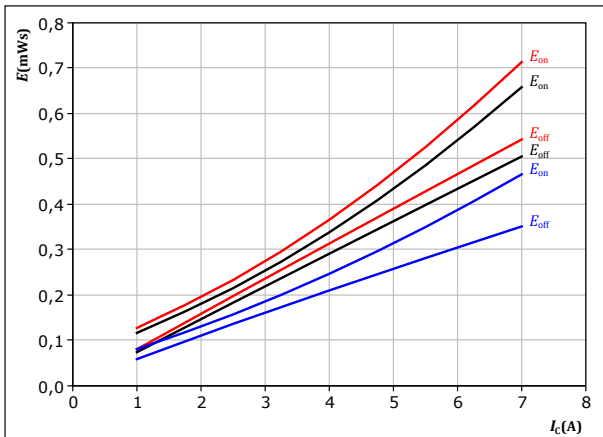


## Brake Switching Characteristics

**figure 33.** IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



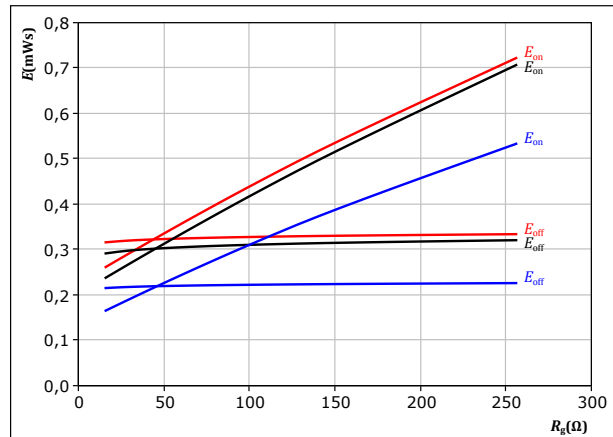
With an inductive load at

$V_{CE} =$	600	V	$T_j:$	— 25 °C
$V_{GE} =$	±15	V		— 125 °C
$R_{g(on)} =$	64	Ω		— 150 °C
$R_{g(off)} =$	64	Ω		

**figure 34.** IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



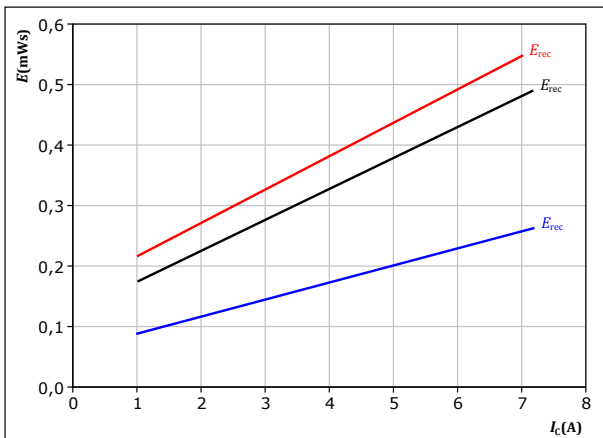
With an inductive load at

$V_{CE} =$	600	V	$T_j:$	— 25 °C
$V_{GE} =$	±15	V		— 125 °C
$I_c =$	4	A		— 150 °C

**figure 35.** FWD

Typical reverse recovered energy loss as a function of collector current

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



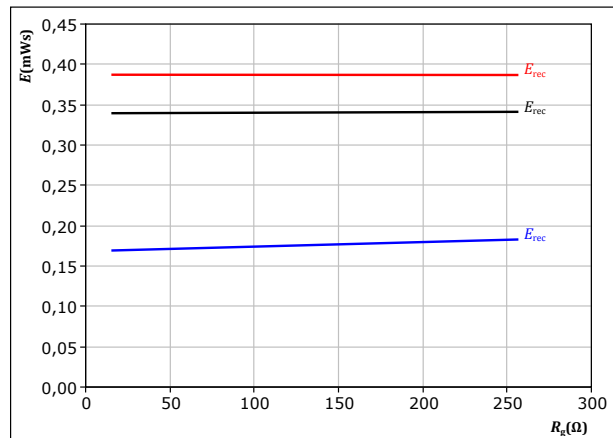
With an inductive load at

$V_{CE} =$	600	V	$T_j:$	— 25 °C
$V_{GE} =$	±15	V		— 125 °C
$R_{g(on)} =$	64	Ω		— 150 °C

**figure 36.** FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

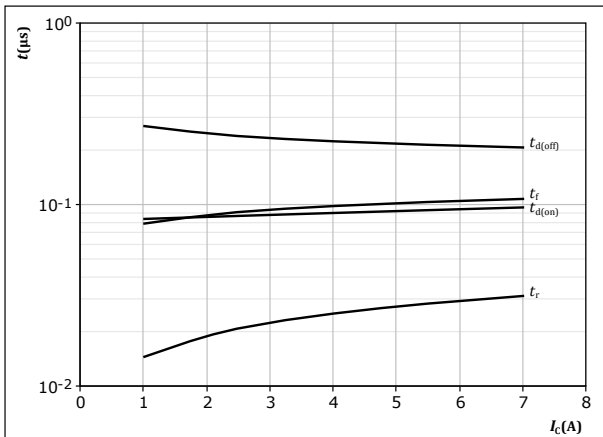
$V_{CE} =$	600	V	$T_j:$	— 25 °C
$V_{GE} =$	±15	V		— 125 °C
$I_c =$	4	A		— 150 °C



## Brake Switching Characteristics

**figure 37.** IGBT

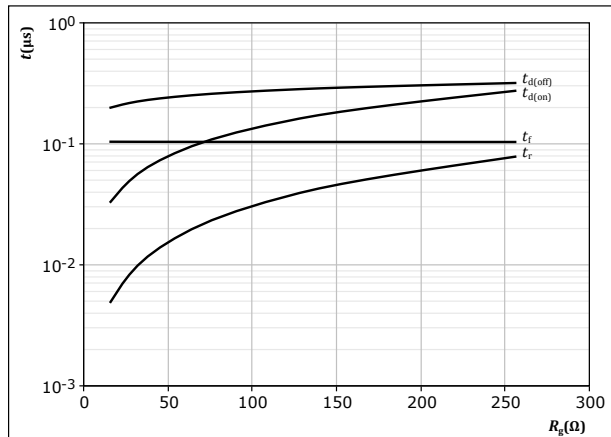
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 64$  Ω  
 $R_{goff} = 64$  Ω

**figure 38.** IGBT

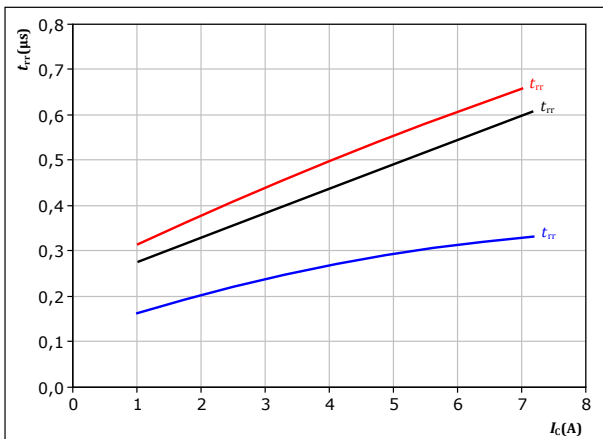
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 4$  A

**figure 39.** FWD

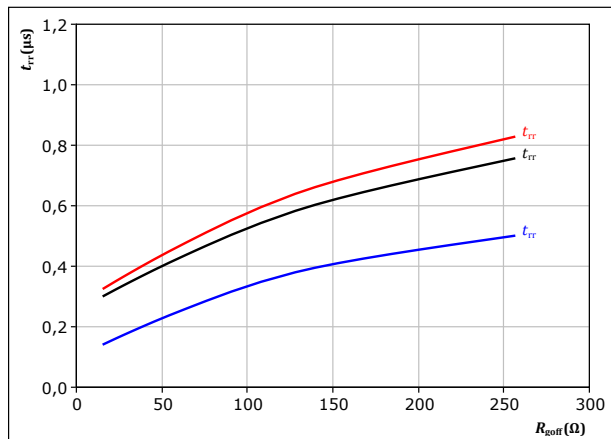
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 64$  Ω  
 $T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 40.** FWD

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



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 4$  A  
 $T_j$ : — 25 °C  
— 125 °C  
— 150 °C

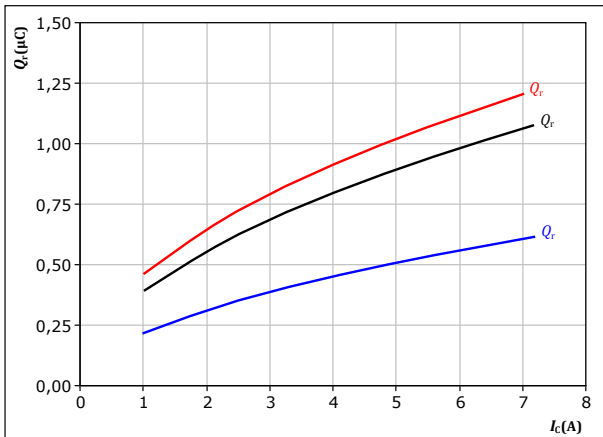


## Brake Switching Characteristics

**figure 41.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



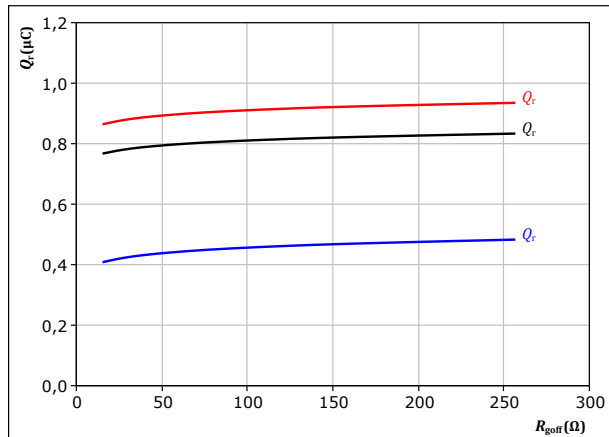
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 64$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 42.** FWD

Typical recovered charge as a function of turn off gate resistor

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



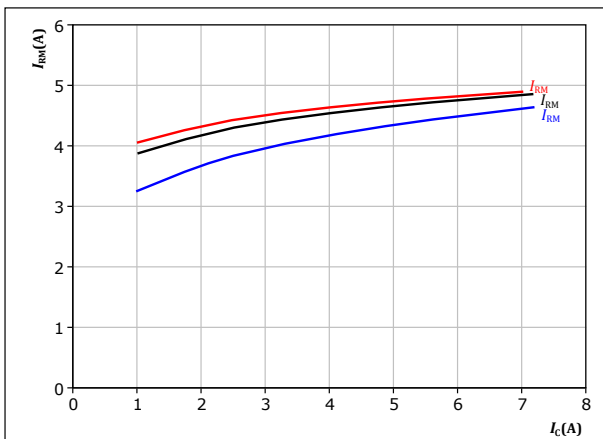
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 4$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 43.** FWD

Typical peak reverse recovery current as a function of collector current

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



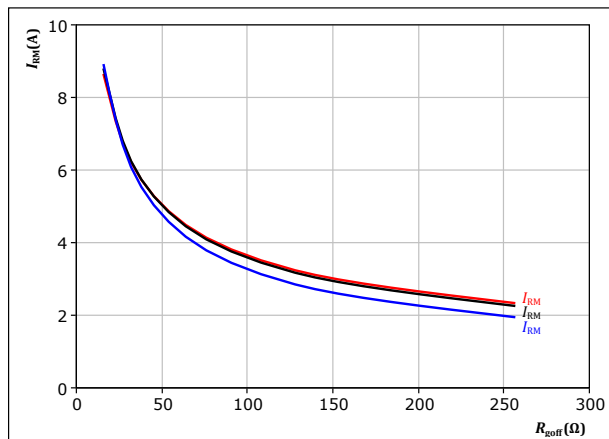
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 64$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 44.** FWD

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

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



With an inductive load at

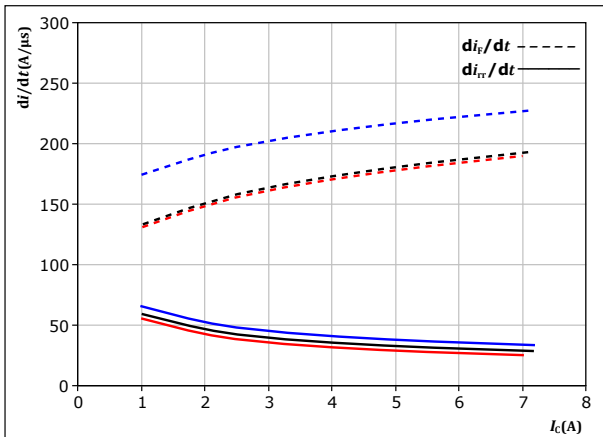
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 4$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## Brake Switching Characteristics

**figure 45.** FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_r/dt = f(I_c)$



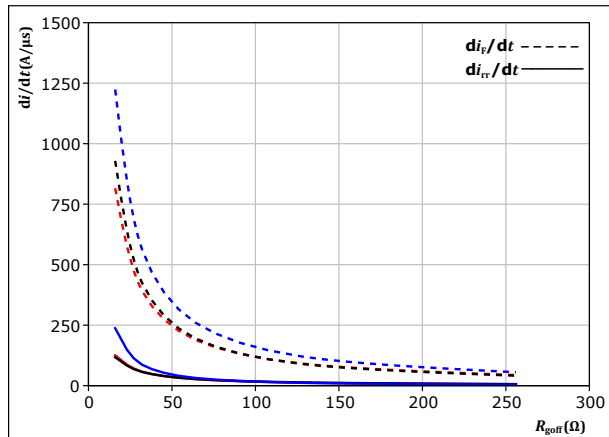
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 64$   $\Omega$

$T_j = 25$  °C  
 125 °C  
 150 °C

**figure 46.** FWD

Typical rate of fall of forward and reverse recovery current as a function of turn off gate resistor  
 $di_f/dt, di_r/dt = f(R_{goff})$



With an inductive load at

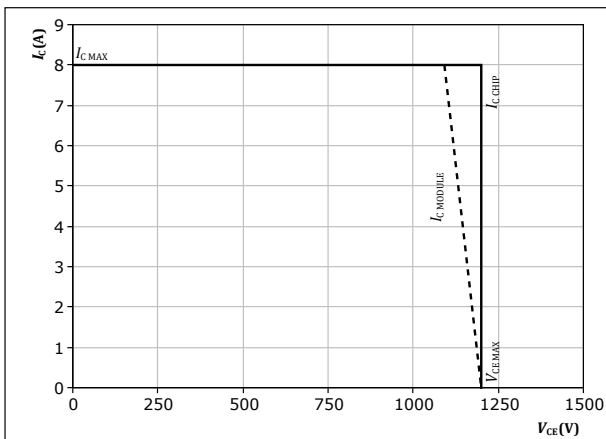
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 4$  A

$T_j = 25$  °C  
 125 °C  
 150 °C

**figure 47.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 150$  °C  
 $R_{goff} = 64$   $\Omega$   
 $R_{goff} = 64$   $\Omega$

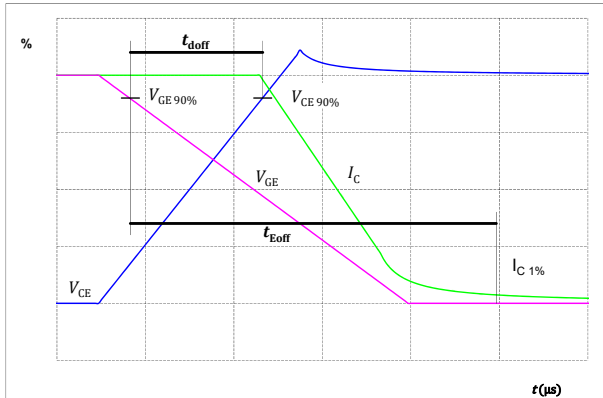




## Switching Definitions

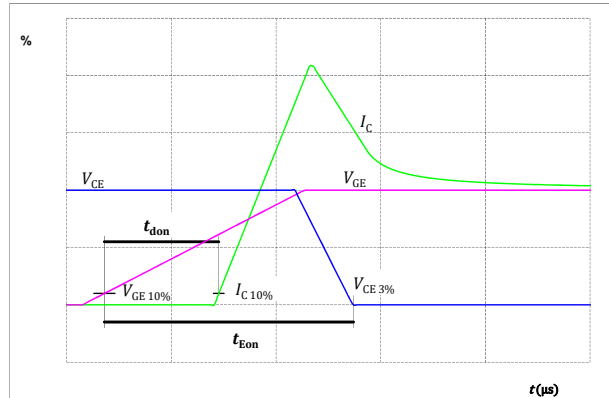
**figure 48.** IGBT

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



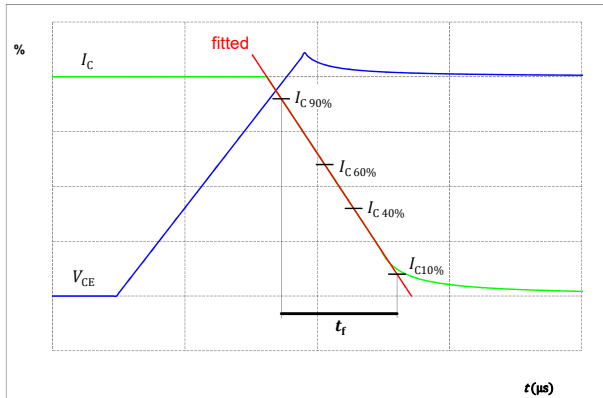
**figure 49.** IGBT

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



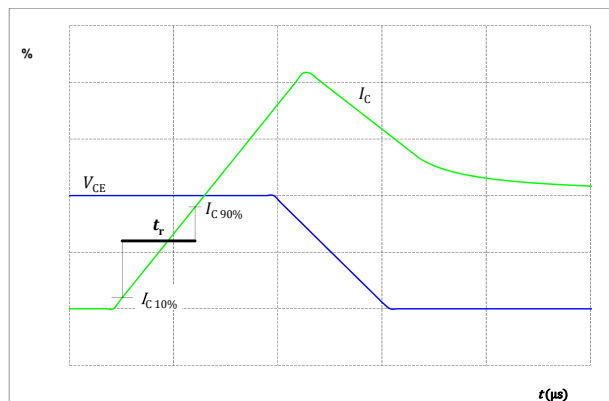
**figure 50.** IGBT

Turn-off Switching Waveforms & definition of  $t_f$



**figure 51.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$





## Switching Definitions

figure 52. FWD

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

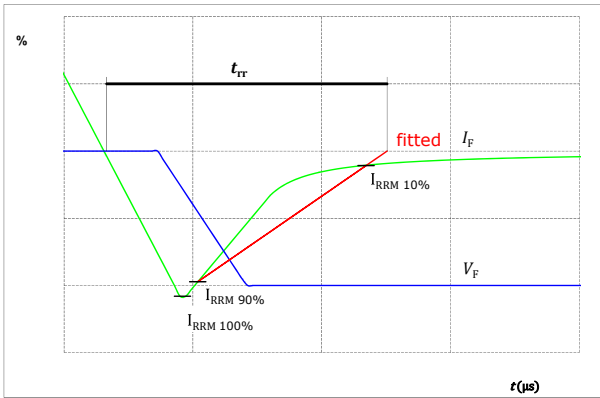
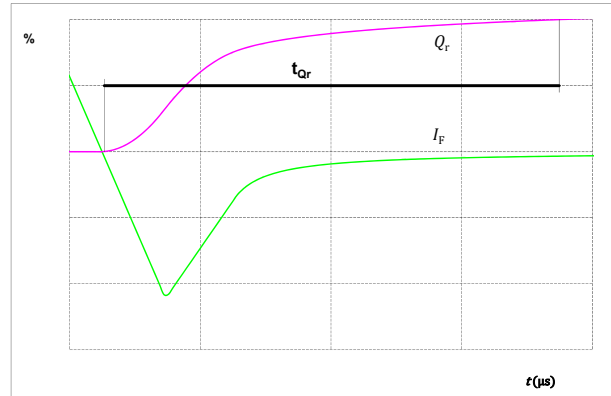


figure 53. FWD

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



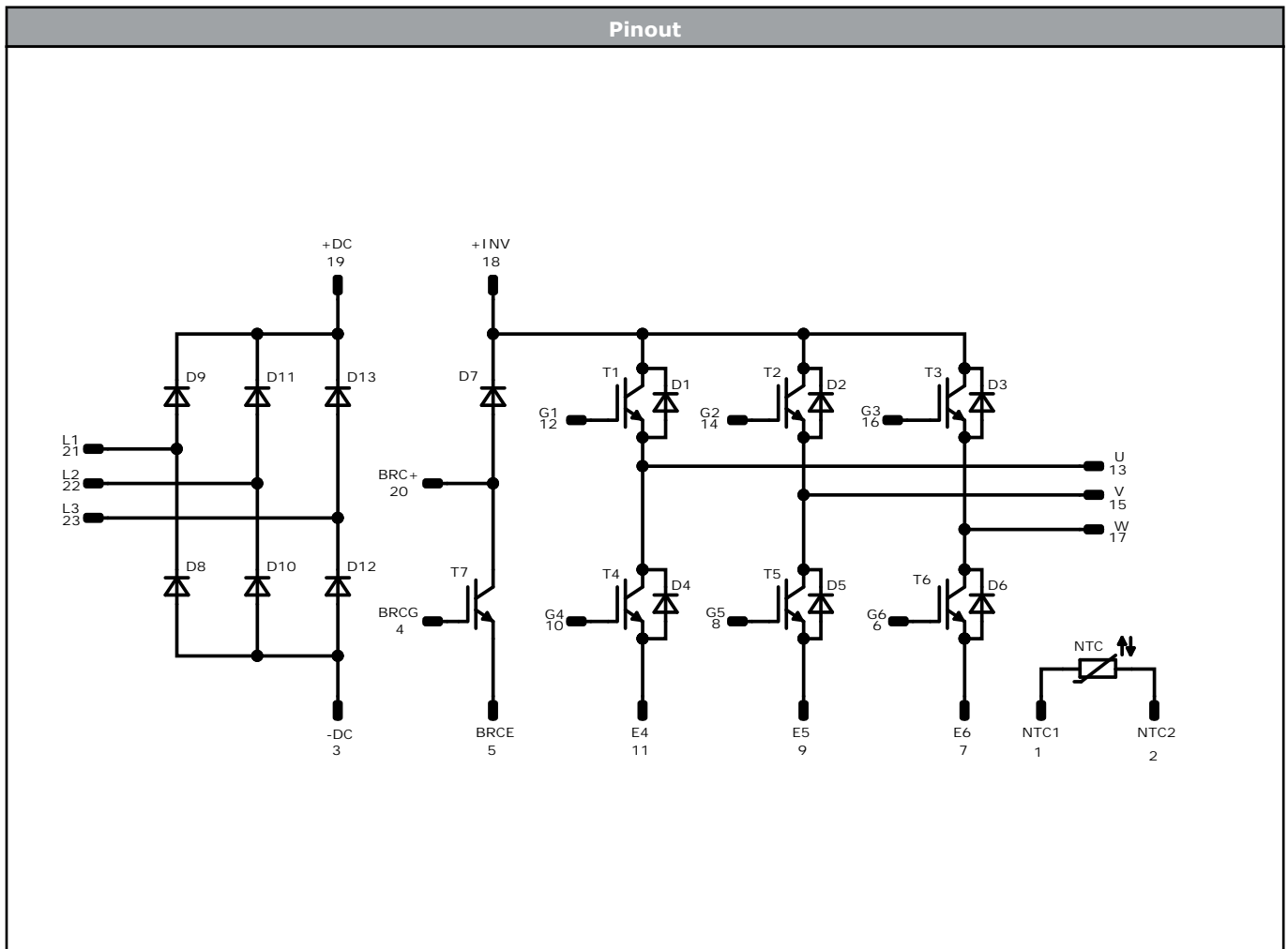


Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	V23990-P849-A48-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P849-A48-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P849-A48-/3/-PM

Marking							
	<b>Text</b>	<b>VIN</b>	<b>Date code</b>	<b>Type&amp;Ver</b>	<b>UL</b>	<b>Lot</b>	<b>Serial</b>
		VIN	WWYY	TTTTTTVV	UL	LLLLL	SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b>	<b>Lot number</b>	<b>Serial</b>	<b>Date code</b>		
		TTTTTTVV	LLLLL	SSSS	WWYY		

Pin table [mm]				Outline
Pin	X	Y	Function	
1	25,5	2,7	NTC1	
2	25,5	0	NTC2	
3	22,8	0	-DC	
4	20,1	0	BRCG	
5	16,2	0	BRCE	
6	13,5	0	G6	
7	10,8	0	E6	
8	8,1	0	G5	
9	5,4	0	E5	
10	2,7	0	G4	
11	0	0	E4	
12	0	19,8	G1	
13	0	22,5	U	
14	7,5	19,8	G2	
15	7,5	22,5	V	
16	15	19,8	G3	
17	15	22,5	W	
18	22,8	22,5	+INV	
19	25,5	22,5	+DC	
20	33,5	22,5	BRC+	
21	33,5	15	L1	
22	33,5	7,5	L2	
23	33,5	0	L3	

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



Identification					
ID	Component	Voltage	Current	Function	Comment
T4, T1, T5, T2, T6, T3	IGBT	1200 V	8 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	1200 V	10 A	Inverter Diode	
T7	IGBT	1200 V	4 A	Brake Switch	
D7	FWD	1200 V	3 A	Brake Diode	
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	25 A	Rectifier Diode	
NTC	Thermistor			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
V23990-P849-A48-PM-D9-14	30 Sep. 2021	New Datasheet format, module is unchanged Correct Static values of Inverter Diode, Brake Diode, Rectifier Diode Correct Thermal values of Brake Switch, Brake Diode Separate datasheet	

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
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.