



*flowPIM E1*

**600 V / 15 A**

**Features**

- Trench Fieldstop IGBT3 technology
- Standard industrial housing
- Optimized  $R_{th(j-s)}$  with Phase Change Material
- Built-in NTC

**Target applications**

- Industrial Drives

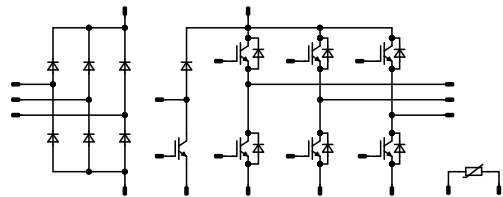
**Types**

- 10-EZ06PMA015SA-L924A38T

*flow E1 12 mm housing*



**Schematic**





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10-EZ06PMA015SA-L924A38T  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		600	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	23	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	45	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Inverter Diode

Peak repetitive reverse voltage	$V_{RRM}$		600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	24	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	30	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	48	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Brake Switch

Collector-emitter voltage	$V_{CES}$		600	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	23	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	45	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$



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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Brake Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		600	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	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Rectifier Diode

Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	47	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	$I^2t$		370	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	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		≥ 600	

\*100 % tested in production



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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		

#### Inverter Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	25 150	1,1	1,6 1,85	1,9 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	600		25			0,85	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			300	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							800		pF
Output capacitance	$C_{oes}$	$f = 1 \text{ Mhz}$	0	25		25		55		pF
Reverse transfer capacitance	$C_{res}$									24
Gate charge	$Q_g$		15		0	25		87		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,66		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	±15	300	15	25		106,2		ns
						150		104,6		
Rise time	$t_r$					25		15		
						150		18		
Turn-off delay time	$t_{d(off)}$					25		134		
						150		154,6		
Fall time	$t_f$					25		92,02		
		150		109,06						
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 0,715 \mu\text{C}$ $Q_{tFWD} = 1,44 \mu\text{C}$				25		0,276		mWs
						150		0,38		
Turn-off energy (per pulse)	$E_{off}$					25		0,345		mWs
						150		0,459		



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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		

#### Inverter Diode

##### Static

Forward voltage	$V_F$				15	25 125 150	1,25	1,76 1,66 1,61	1,95 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_T = 600$ V				25			27	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,99		K/W
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##### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=1184$ A/μs $di/dt=1026$ A/μs	±15	300	15	25		11,27		A
						150		16,06		
Reverse recovery time	$t_{rr}$					25		180,19		
						150		272,04		
Recovered charge	$Q_r$					25		0,715		
		150		1,44						
Reverse recovered energy	$E_{rec}$	25		0,159						
		150		0,306						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	25		469,5						
		150		193,76						



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### Characteristic Values

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

#### Brake Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	25 150	1,1	1,6 1,85	1,9 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	600		25			0,85	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			300	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							800		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25			55	pF
Reverse transfer capacitance	$C_{res}$								24	pF
Gate charge	$Q_g$		15		0	25		87		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,66		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16$ Ω $R_{goff} = 16$ Ω	0/15	400	15	25		16,6		ns
						125		17		
						150		16,6		
Rise time	$t_r$					25		21,4	ns	
						125		22,4		
						150		22		
Turn-off delay time	$t_{d(off)}$	25		183,6	ns					
		125		204,6						
		150		208,4						
Fall time	$t_f$	25		51,99	ns					
		125		99,58						
		150		110,09						
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 0,572$ μC				25		0,38	mWs	
		$Q_{tFWD} = 1,07$ μC				125		0,497		
		$Q_{tFWD} = 1,22$ μC				150		0,529		
Turn-off energy (per pulse)	$E_{off}$					25		0,438	mWs	
						125		0,577		
						150		0,61		



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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	$V_F$				10	25 150	1,25	1,61 1,56	1,95 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 600$ V				25			27	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,33		K/W
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##### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=614$ A/μs $di/dt=445$ A/μs $di/dt=439$ A/μs	0/15	400	15	25		6,72		A
Reverse recovery time	$t_{rr}$					125		8,02	ns	
						150		8,51		
						25		198,52		
Recovered charge	$Q_r$					125		283,88	μC	
						150		309,17		
		25		0,572						
Reverse recovered energy	$E_{rec}$	125		1,07	mWs					
		150		1,22						
		25		0,161						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	125		0,306	A/μs					
		150		0,347						
		25		32,31						
						125		51,18		
						150		57,12		



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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	

#### Rectifier Diode

##### Static

Forward voltage	$V_F$				28	25 125		1,15 1,11	1,5 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1600$ V				25 150			100 1000	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,15		K/W
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#### Thermistor

##### Static

Rated resistance	$R$					25		5		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 493$ Ω				100	-5		5	%
Power dissipation	$P$							245		mW
Power dissipation constant	$d$					25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. ±2 %						3375		K
B-value	$B_{(25/100)}$	Tol. ±2 %						3437		K
Vincotech Thermistor Reference									K	

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

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



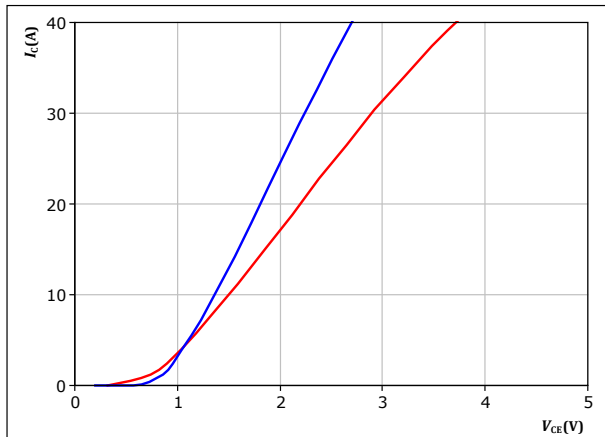


## Inverter Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

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

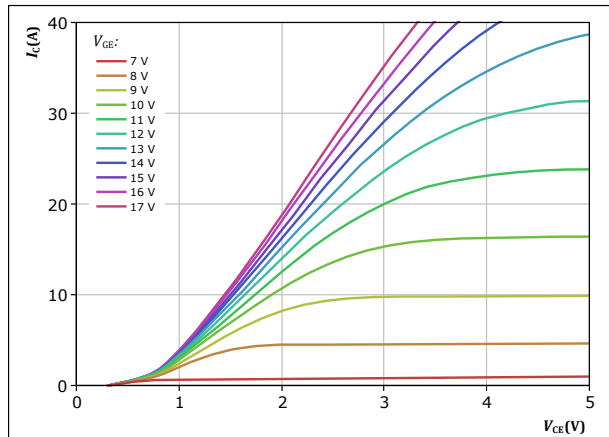


$t_p = 250\ \mu\text{s}$   
 $V_{GE} = 15\ \text{V}$   
 $T_j: \text{ — } 25\text{ }^\circ\text{C}$   
 $\text{ — } 150\text{ }^\circ\text{C}$

**figure 2.** IGBT

Typical output characteristics

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

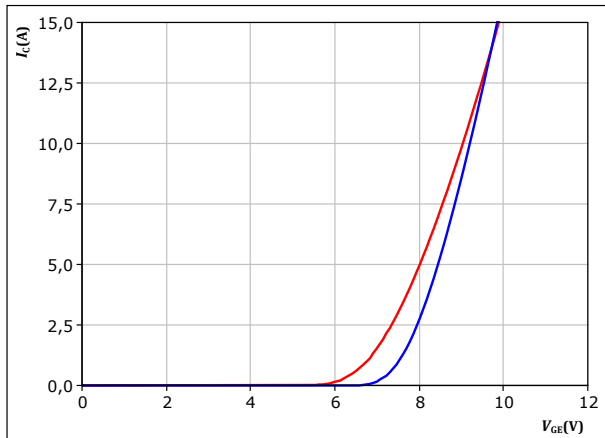


$t_p = 250\ \mu\text{s}$   
 $T_j = 150\text{ }^\circ\text{C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

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

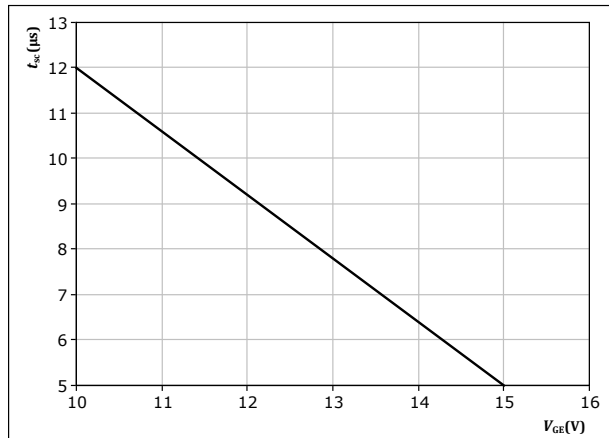


$t_p = 250\ \mu\text{s}$   
 $V_{CE} = 10\ \text{V}$   
 $T_j: \text{ — } 25\text{ }^\circ\text{C}$   
 $\text{ — } 150\text{ }^\circ\text{C}$

**figure 4.** IGBT

Short circuit withstand time as a function of  $V_{GE}$

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



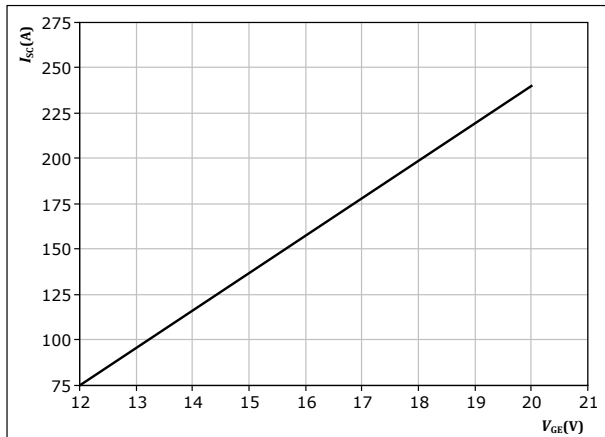
At  $V_{CE} = 600\ \text{V}$   
 $T_j \leq 25\text{ }^\circ\text{C}$



## Inverter Switch Characteristics

**figure 5.** IGBT

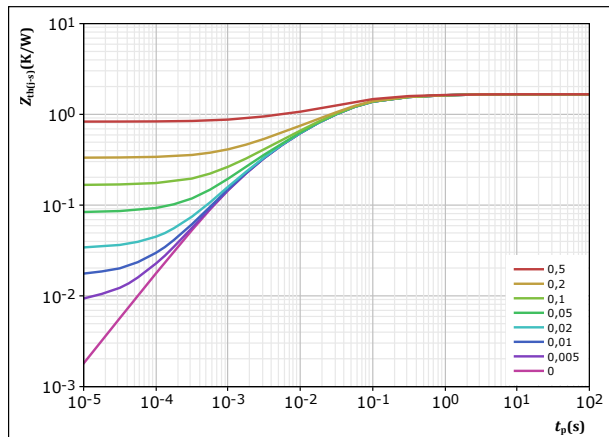
Typical short circuit current as a function of  $V_{GE}$   
 $I_{SC} = f(V_{GE})$



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

**figure 6.** IGBT

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

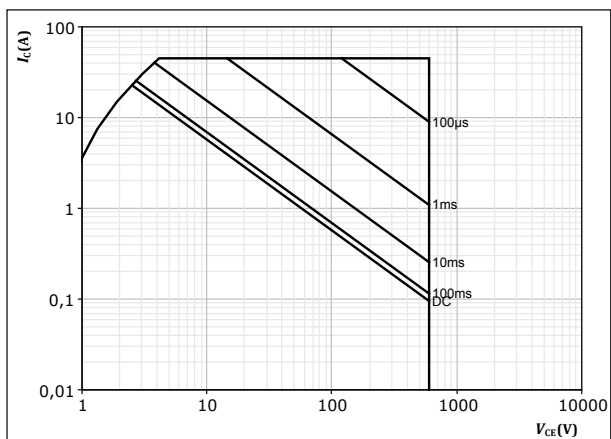


$D = t_p / T$   
 $R_{th(j-s)} = 1,664$  K/W  
IGBT thermal model values  

$R$ (K/W)	$\tau$ (s)
9,65E-02	1,11E+00
2,18E-01	1,77E-01
8,07E-01	4,13E-02
3,94E-01	7,68E-03
1,48E-01	1,36E-03

**figure 7.** IGBT

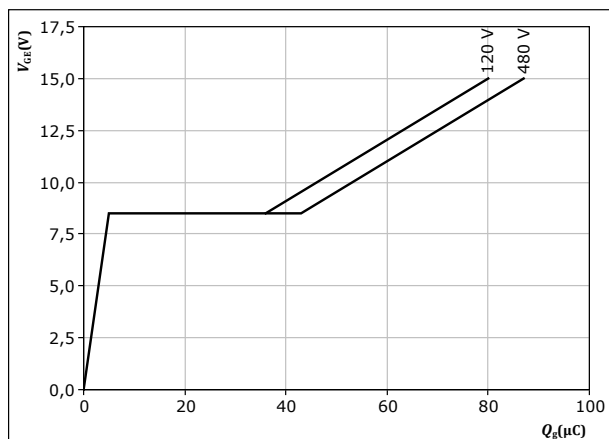
Safe operating area  
 $I_C = f(V_{CE})$



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

**figure 8.** IGBT

Gate voltage vs gate charge  
 $V_{GE} = f(Q_g)$



$I_C = 15$  A  
 $T_j = 25$  °C



### Inverter Diode Characteristics

figure 9. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

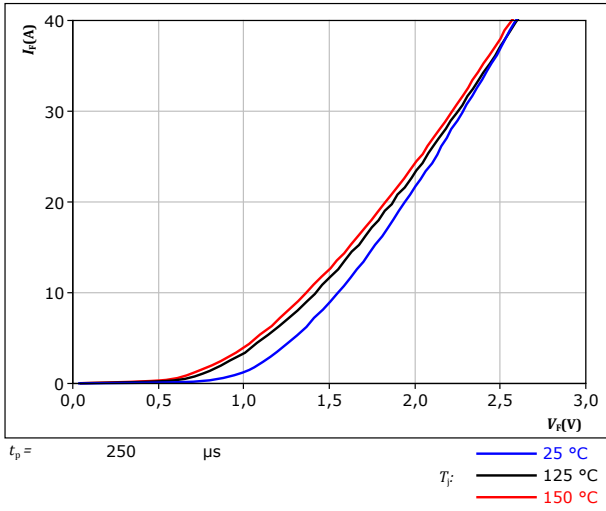
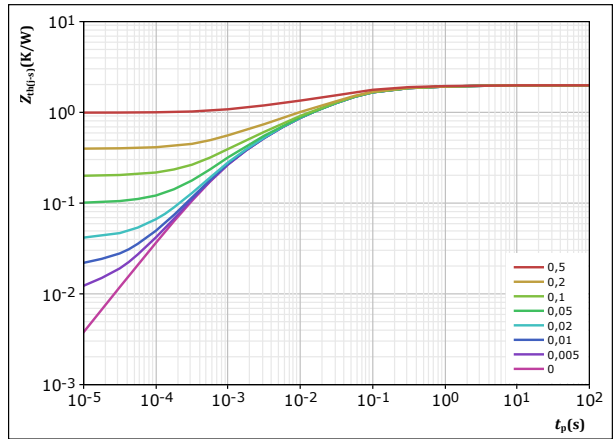


figure 10. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 1,985 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
8,91E-02	2,42E+00
2,69E-01	2,03E-01
8,60E-01	4,06E-02
5,20E-01	6,04E-03
2,47E-01	9,13E-04

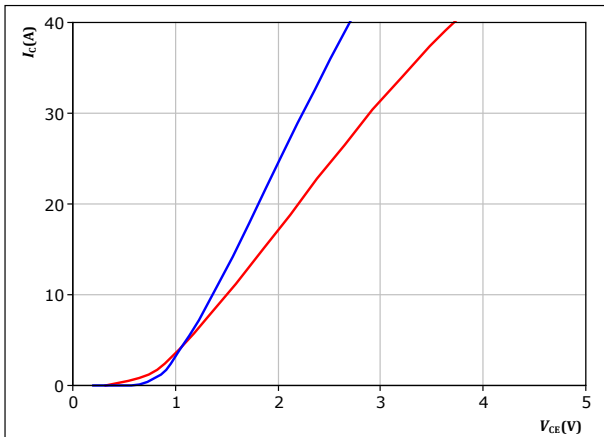


### Brake Switch Characteristics

**figure 11.** IGBT

Typical output characteristics

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

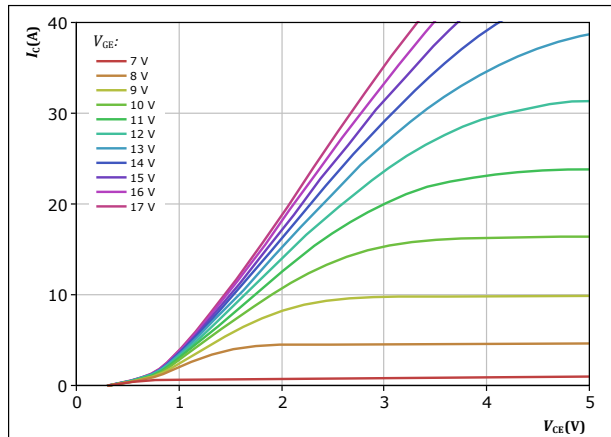


$t_p = 250\ \mu\text{s}$   
 $V_{GE} = 15\ \text{V}$   
 $T_j: 25\text{ °C}$  (blue),  $150\text{ °C}$  (red)

**figure 12.** IGBT

Typical output characteristics

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

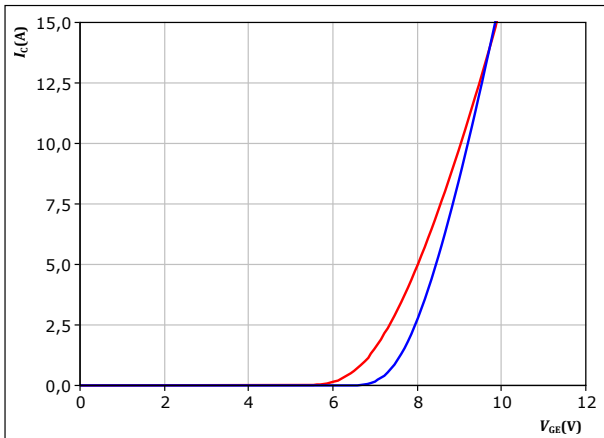


$t_p = 250\ \mu\text{s}$   
 $T_j = 150\text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 13.** IGBT

Typical transfer characteristics

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

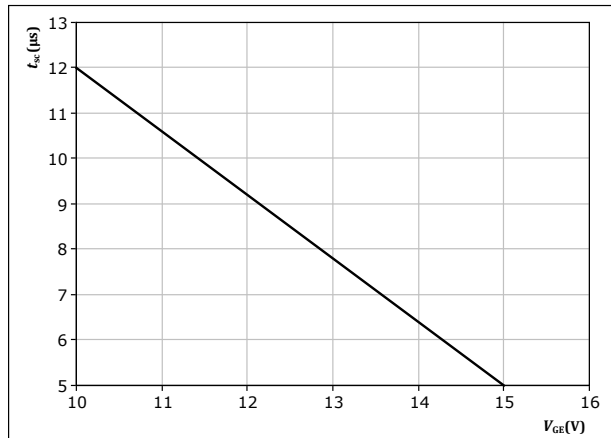


$t_p = 250\ \mu\text{s}$   
 $V_{CE} = 10\ \text{V}$   
 $T_j: 25\text{ °C}$  (blue),  $150\text{ °C}$  (red)

**figure 14.** IGBT

Short circuit withstand time as a function of  $V_{GE}$

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



At  $V_{CE} = 600\ \text{V}$   
 $T_j \leq 25\text{ °C}$



## Brake Switch Characteristics

figure 15. IGBT

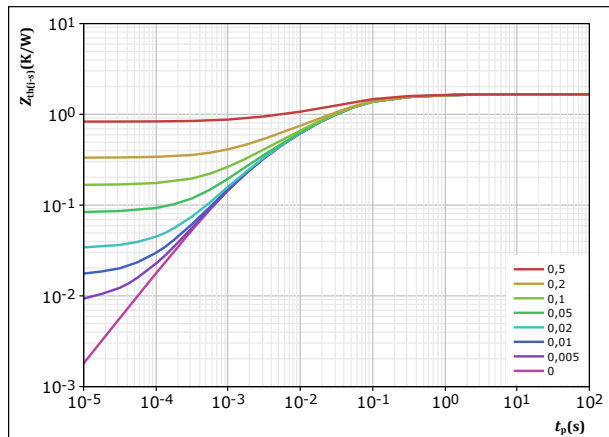
Typical short circuit current as a function of  $V_{GE}$   
 $I_{SC} = f(V_{GE})$



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

figure 16. IGBT

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

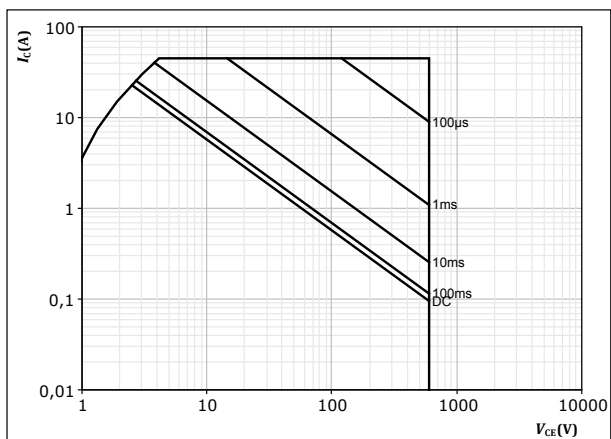


$D = t_p / T$   
 $R_{th(j-s)} = 1,664$  K/W  
IGBT thermal model values  

$R$ (K/W)	$\tau$ (s)
9,65E-02	1,11E+00
2,18E-01	1,77E-01
8,07E-01	4,13E-02
3,94E-01	7,68E-03
1,48E-01	1,36E-03

figure 17. IGBT

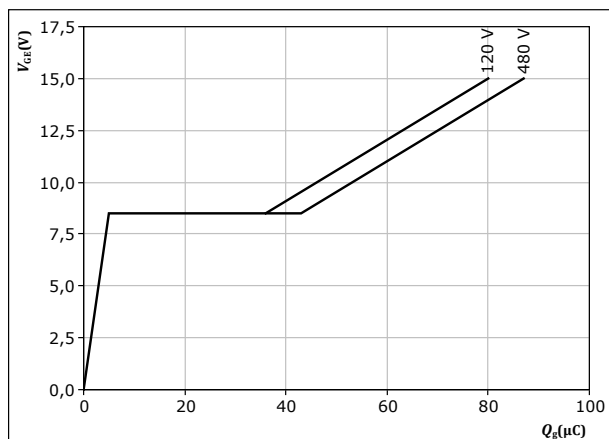
Safe operating area  
 $I_C = f(V_{CE})$



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

figure 18. IGBT

Gate voltage vs gate charge  
 $V_{GE} = f(Q_g)$



$I_C = 15$  A  
 $T_j = 25$  °C



### Brake Diode Characteristics

figure 19. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

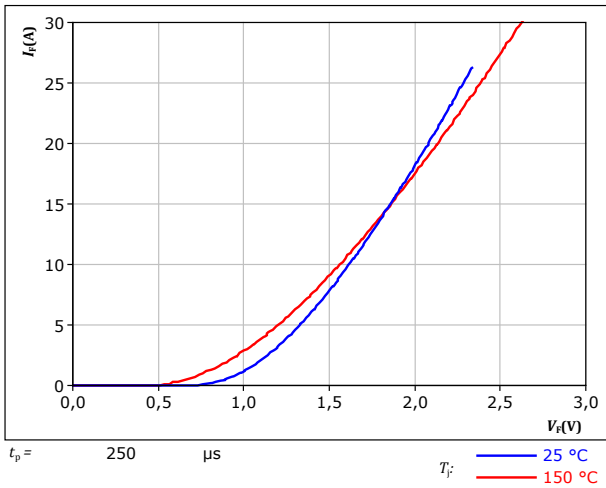
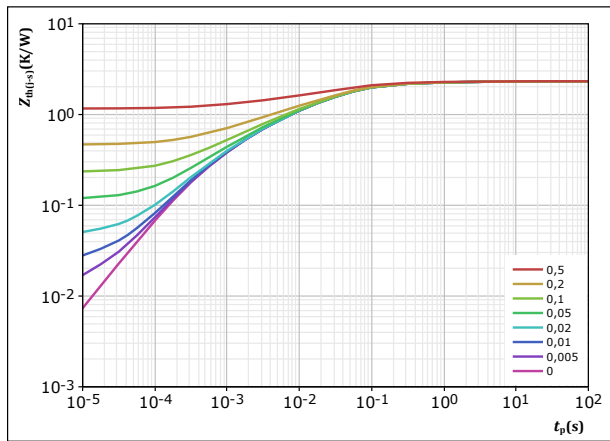


figure 20. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 2,328 \text{ K/W}$   
 FWD thermal model values

$R$ (K/W)	$\tau$ (s)
8,21E-02	3,78E+00
2,22E-01	2,71E-01
9,31E-01	4,55E-02
5,61E-01	8,74E-03
3,70E-01	1,93E-03
1,62E-01	3,48E-04



## Rectifier Diode Characteristics

figure 21. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

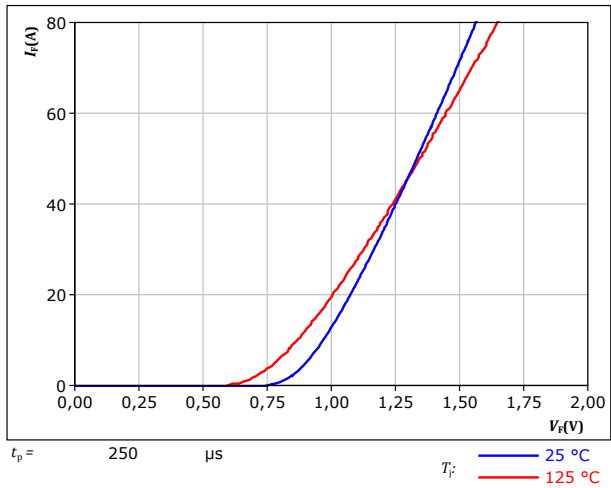
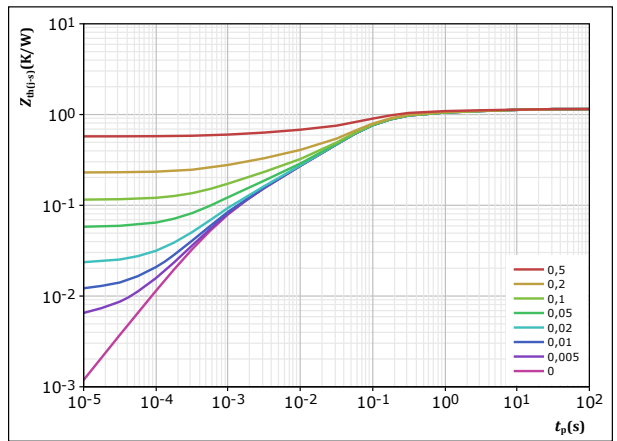


figure 22. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 1,149 \text{ K/W}$

Rectifier thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
8,29E-02	7,59E+00
1,02E-01	6,72E-01
4,20E-01	1,19E-01
3,78E-01	4,22E-02
1,08E-01	4,04E-03
5,78E-02	7,21E-04

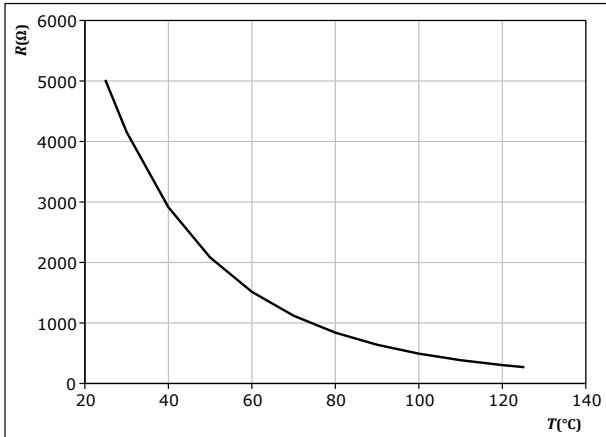


### Thermistor Characteristics

figure 23. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$



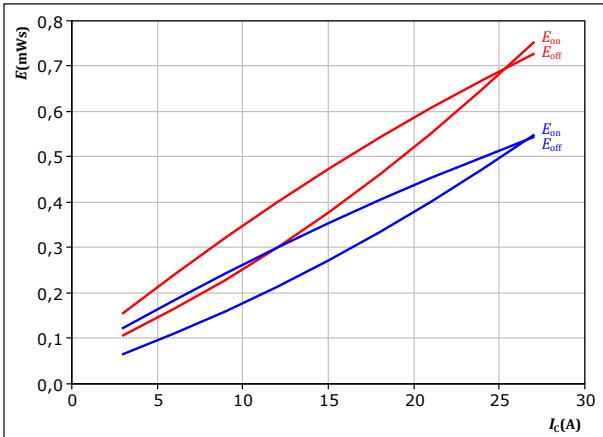




## Inverter Switching Characteristics

**figure 24.** IGBT

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



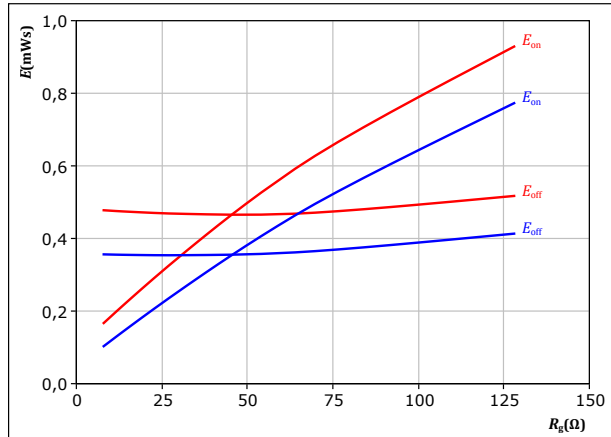
With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{g(on)} = 32$   $\Omega$   
 $R_{g(off)} = 32$   $\Omega$

$T_j$ : — 25 °C  
 — 150 °C

**figure 25.** IGBT

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



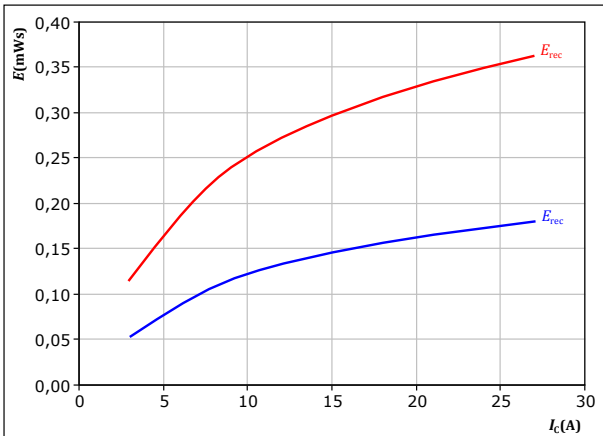
With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 15$  A

$T_j$ : — 25 °C  
 — 150 °C

**figure 26.** FWD

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



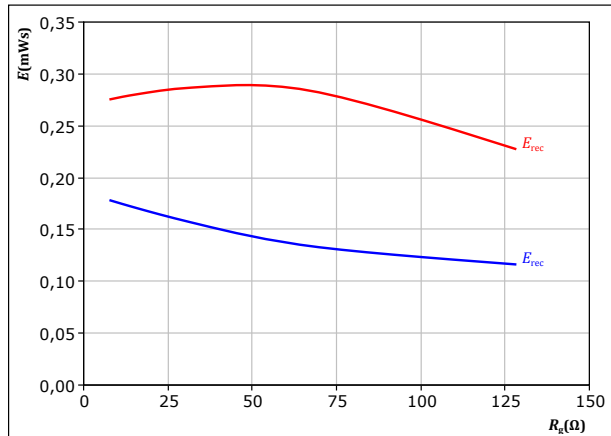
With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{g(on)} = 32$   $\Omega$

$T_j$ : — 25 °C  
 — 150 °C

**figure 27.** FWD

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 15$  A

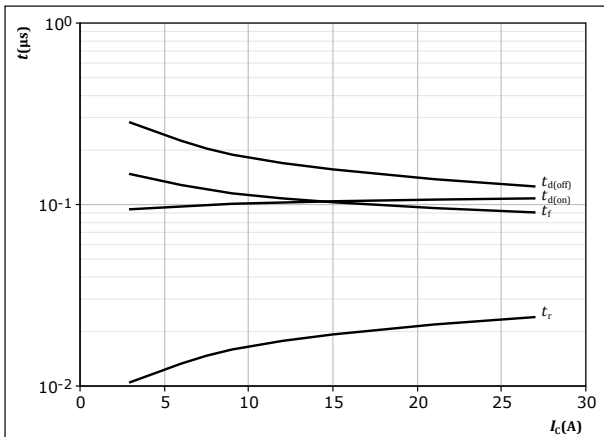
$T_j$ : — 25 °C  
 — 150 °C



## Inverter Switching Characteristics

**figure 28.** IGBT

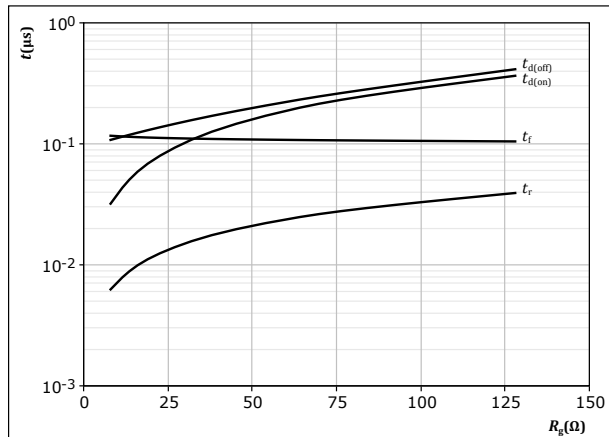
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 32 \text{ } \Omega$   
 $R_{g(off)} = 32 \text{ } \Omega$

**figure 29.** IGBT

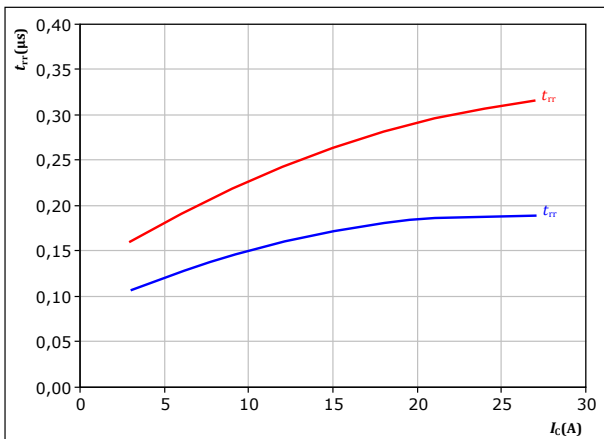
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 15 \text{ A}$

**figure 30.** FWD

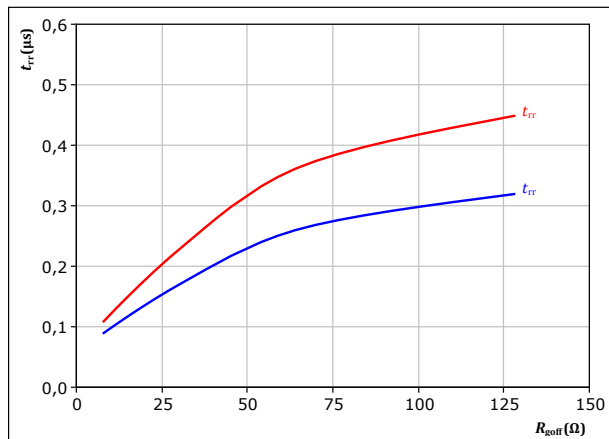
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 32 \text{ } \Omega$   
 $T_j: \text{ — } 25 \text{ } ^\circ\text{C}$   
 $\text{ — } 150 \text{ } ^\circ\text{C}$

**figure 31.** FWD

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



With an inductive load at  
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 15 \text{ A}$   
 $T_j: \text{ — } 25 \text{ } ^\circ\text{C}$   
 $\text{ — } 150 \text{ } ^\circ\text{C}$

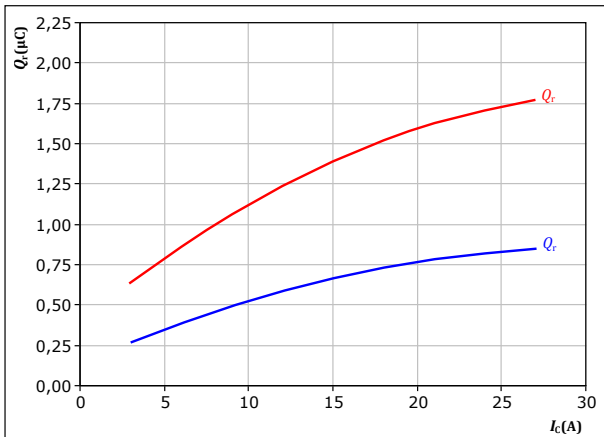


## Inverter Switching Characteristics

figure 32. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

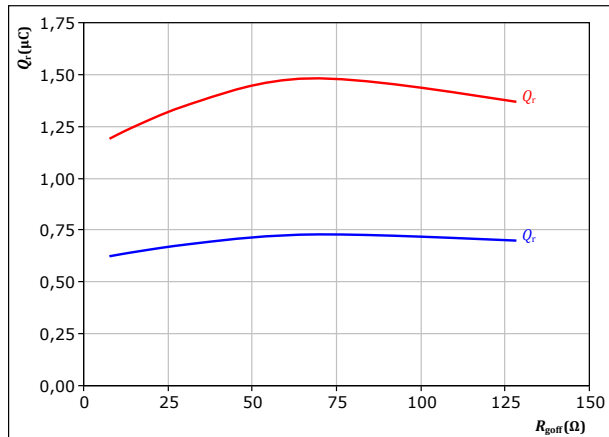
$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 32$  Ω

$T_j$ : — 25 °C  
— 150 °C

figure 33. FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

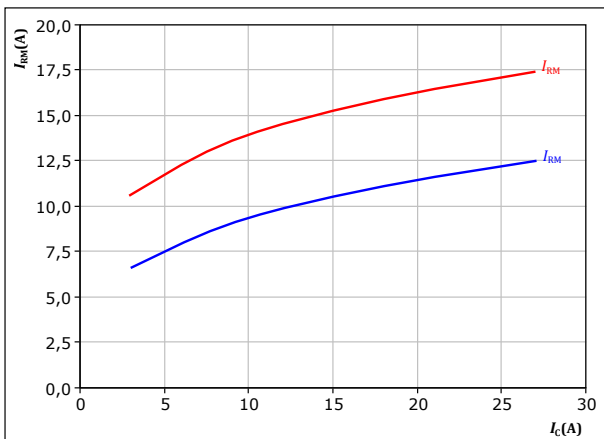
$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 15$  A

$T_j$ : — 25 °C  
— 150 °C

figure 34. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

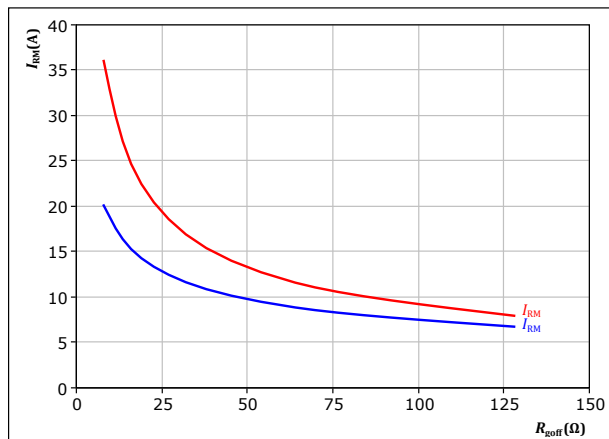
$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 32$  Ω

$T_j$ : — 25 °C  
— 150 °C

figure 35. FWD

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

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



With an inductive load at

$V_{CE} = 300$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 15$  A

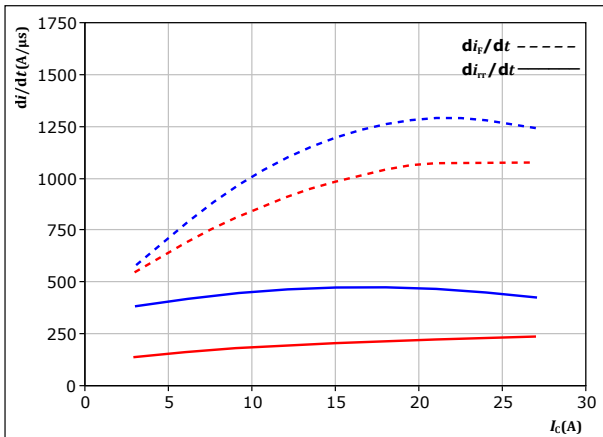
$T_j$ : — 25 °C  
— 150 °C



## Inverter Switching Characteristics

**figure 36.** FWD

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

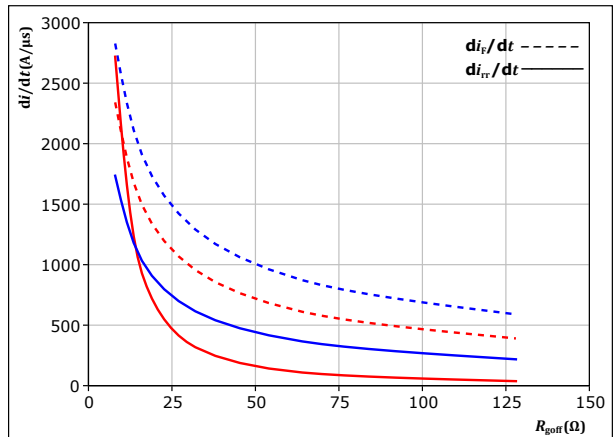


With an inductive load at  
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{goff} = 32 \text{ } \Omega$

$T_j$ : — 25 °C  
— 150 °C

**figure 37.** FWD

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

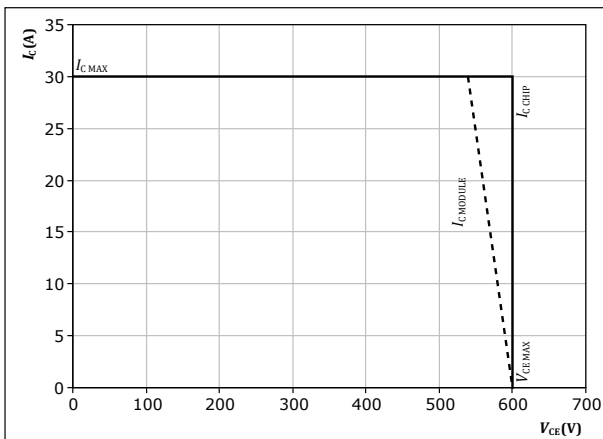


With an inductive load at  
 $V_{CE} = 300 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 15 \text{ A}$

$T_j$ : — 25 °C  
— 150 °C

**figure 38.** IGBT

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



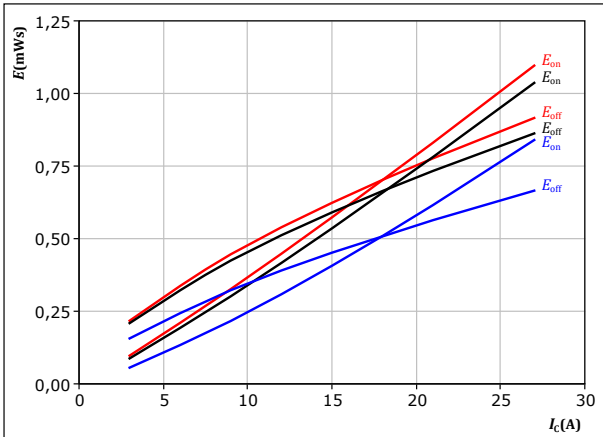
At  $T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{goff} = 32 \text{ } \Omega$   
 $R_{goff} = 32 \text{ } \Omega$



## Brake Switching Characteristics

**figure 39.** IGBT

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

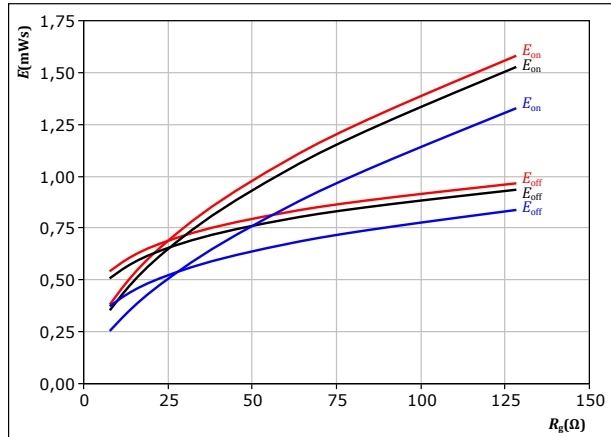


With an inductive load at

$V_{CE} = 400$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$R_{gon} = 16$ Ω	$T_j = 150$ °C
$R_{goff} = 16$ Ω	

**figure 40.** IGBT

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

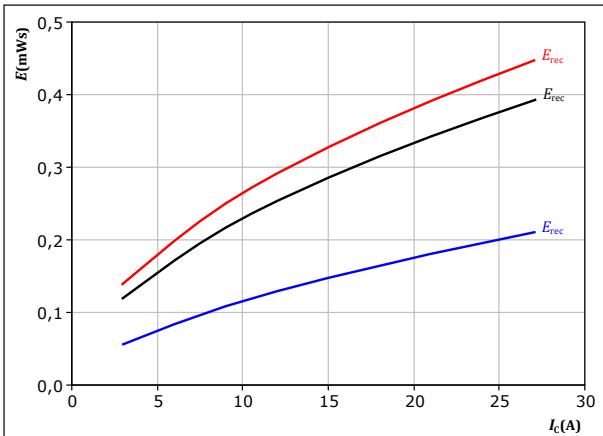


With an inductive load at

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

**figure 41.** FWD

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

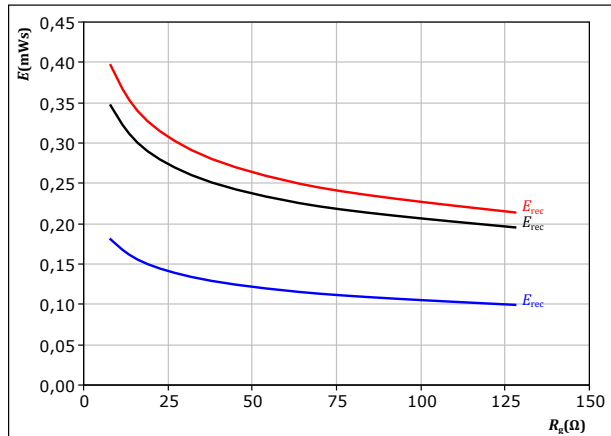


With an inductive load at

$V_{CE} = 400$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$R_{gon} = 16$ Ω	$T_j = 150$ °C

**figure 42.** FWD

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



With an inductive load at

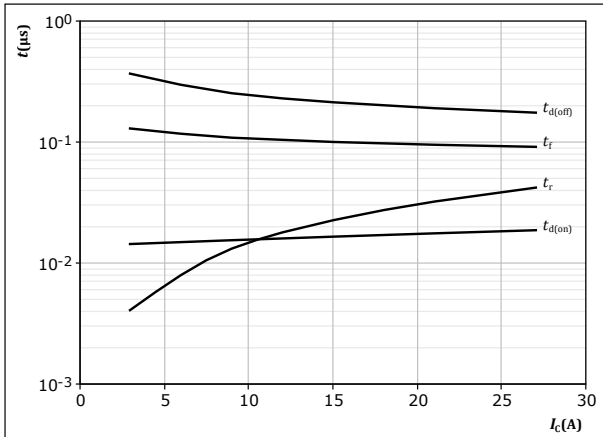
$V_{CE} = 400$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$I_c = 15$ A	$T_j = 150$ °C



## Brake Switching Characteristics

figure 43. IGBT

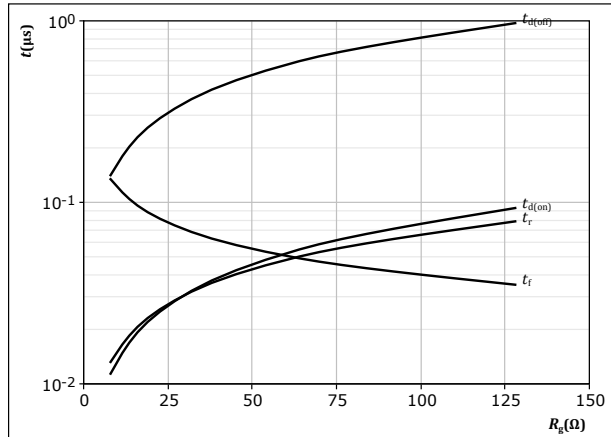
Typical switching times as a function of collector current  
 $t = f(I_c)$



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

figure 44. IGBT

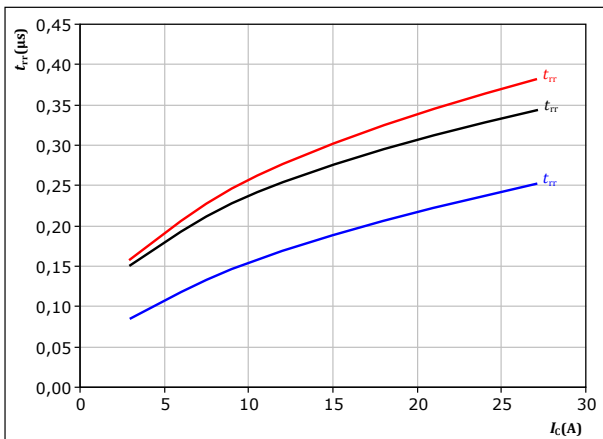
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 400 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 15 \text{ A}$

figure 45. FWD

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

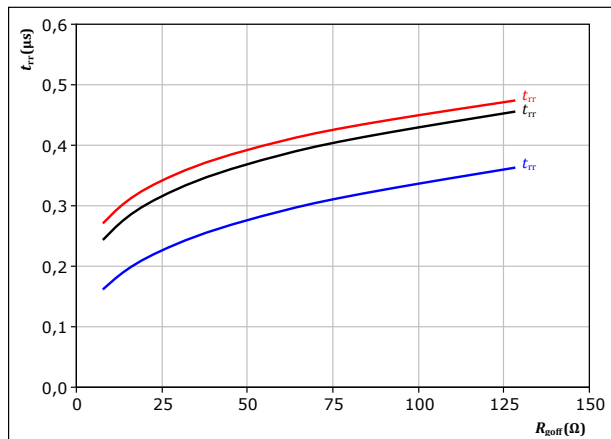


With an inductive load at  
 $V_{CE} = 400 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{g(on)} = 16 \text{ } \Omega$

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

figure 46. FWD

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



With an inductive load at  
 $V_{CE} = 400 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 15 \text{ A}$

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

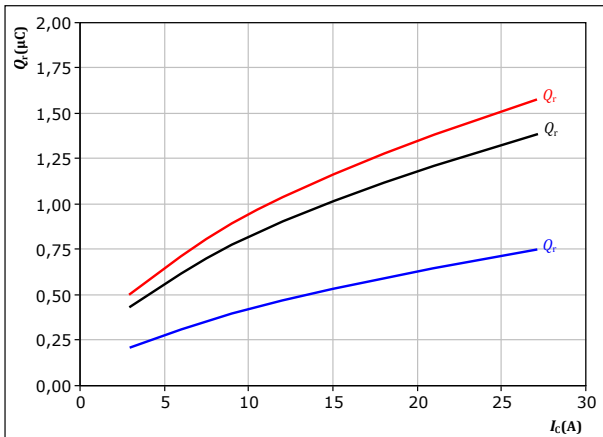


## Brake Switching Characteristics

figure 47. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



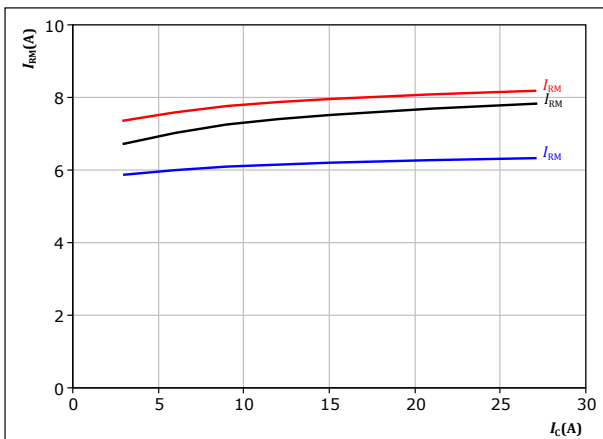
With an inductive load at

$V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $R_{goff} = 16$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 49. FWD

Typical peak reverse recovery current as a function of collector current

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



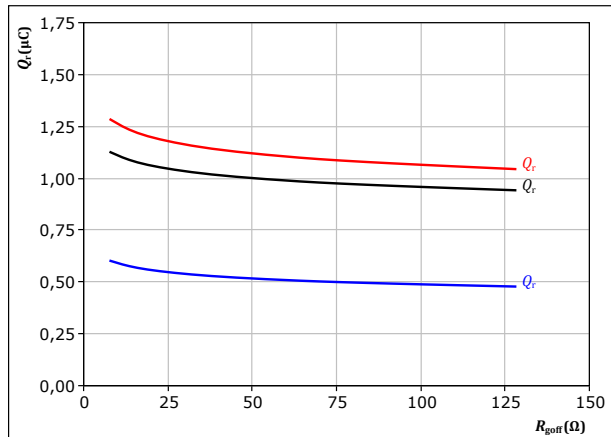
With an inductive load at

$V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $R_{goff} = 16$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 48. FWD

Typical recovered charge as a function of turn off gate resistor

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



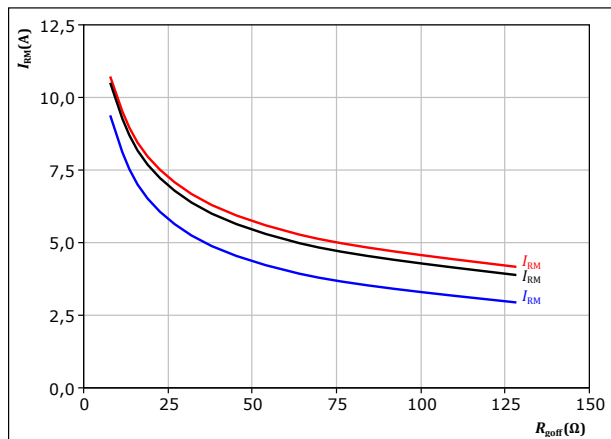
With an inductive load at

$V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 50. FWD

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

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



With an inductive load at

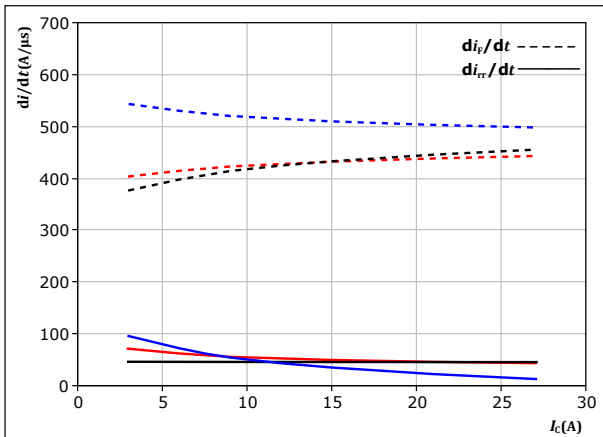
$V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## Brake Switching Characteristics

**figure 51.** FWD

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

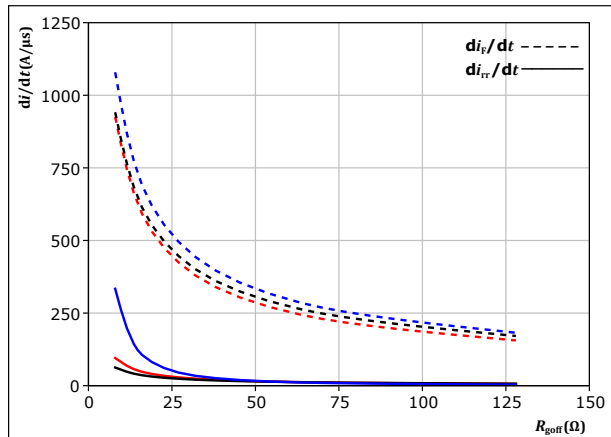


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $R_{goff} = 16$   $\Omega$

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

**figure 52.** FWD

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

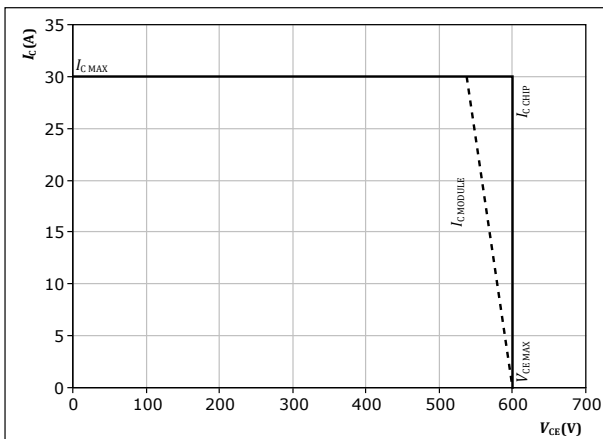


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A

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

**figure 53.** IGBT

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



At  $T_f = 150$  °C  
 $R_{goff} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$





## Switching Definitions

figure 54. IGBT

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

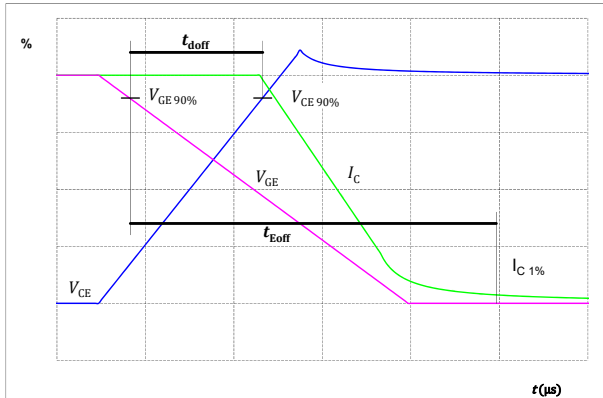


figure 55. IGBT

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



figure 56. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

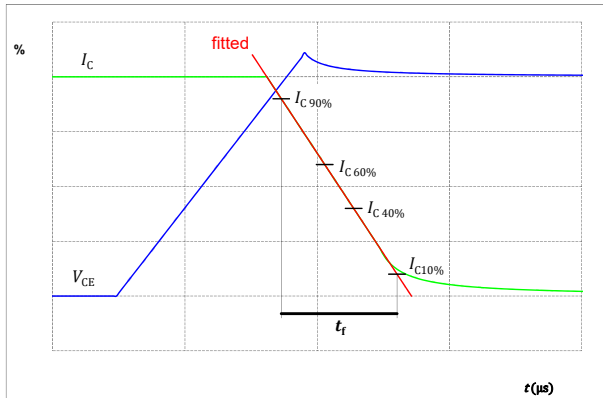
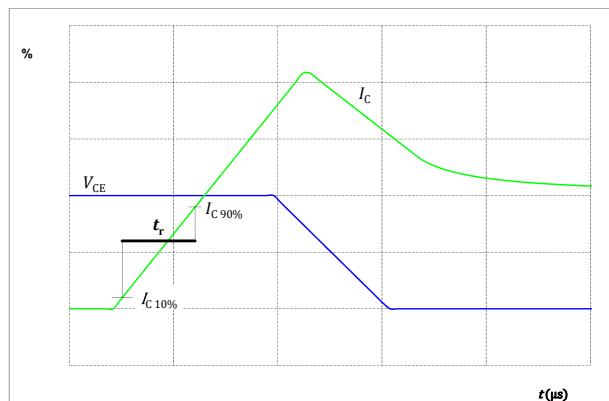


figure 57. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Switching Definitions

figure 58. FWD

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

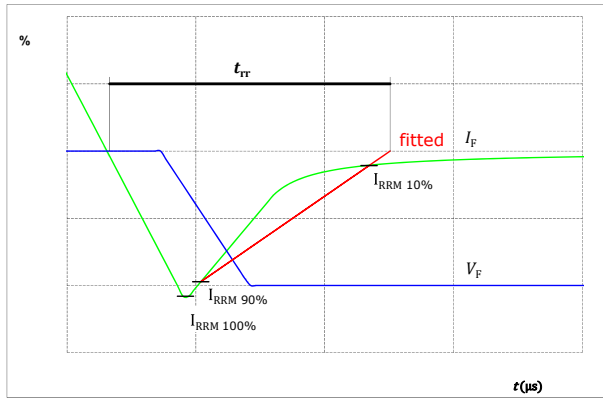
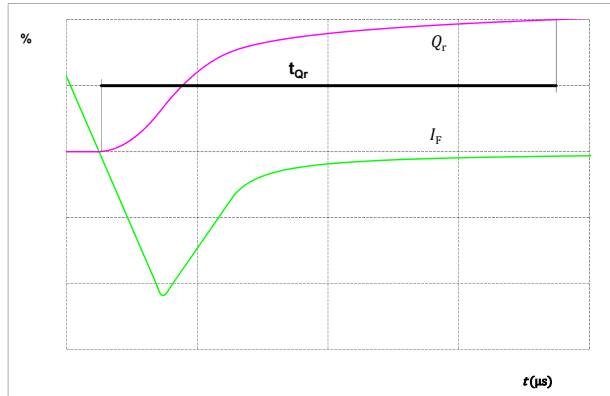


figure 59. FWD

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






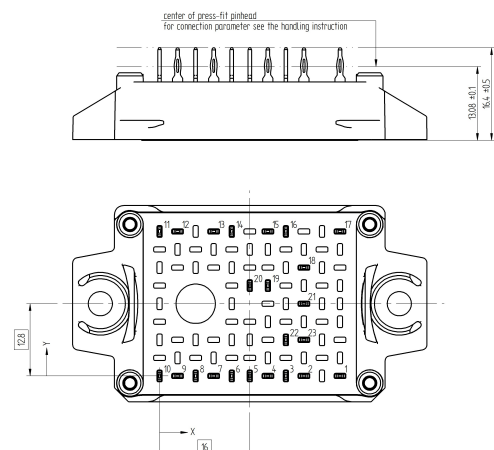
Vincotech

**10-EZ06PMA015SA-L924A38T**  
datasheet

Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	10-EZ06PMA015SA-L924A38T
With thermal paste (3,4 W/mK, PSX-P7)	10-EZ06PMA015SA-L924A38T-/3/

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

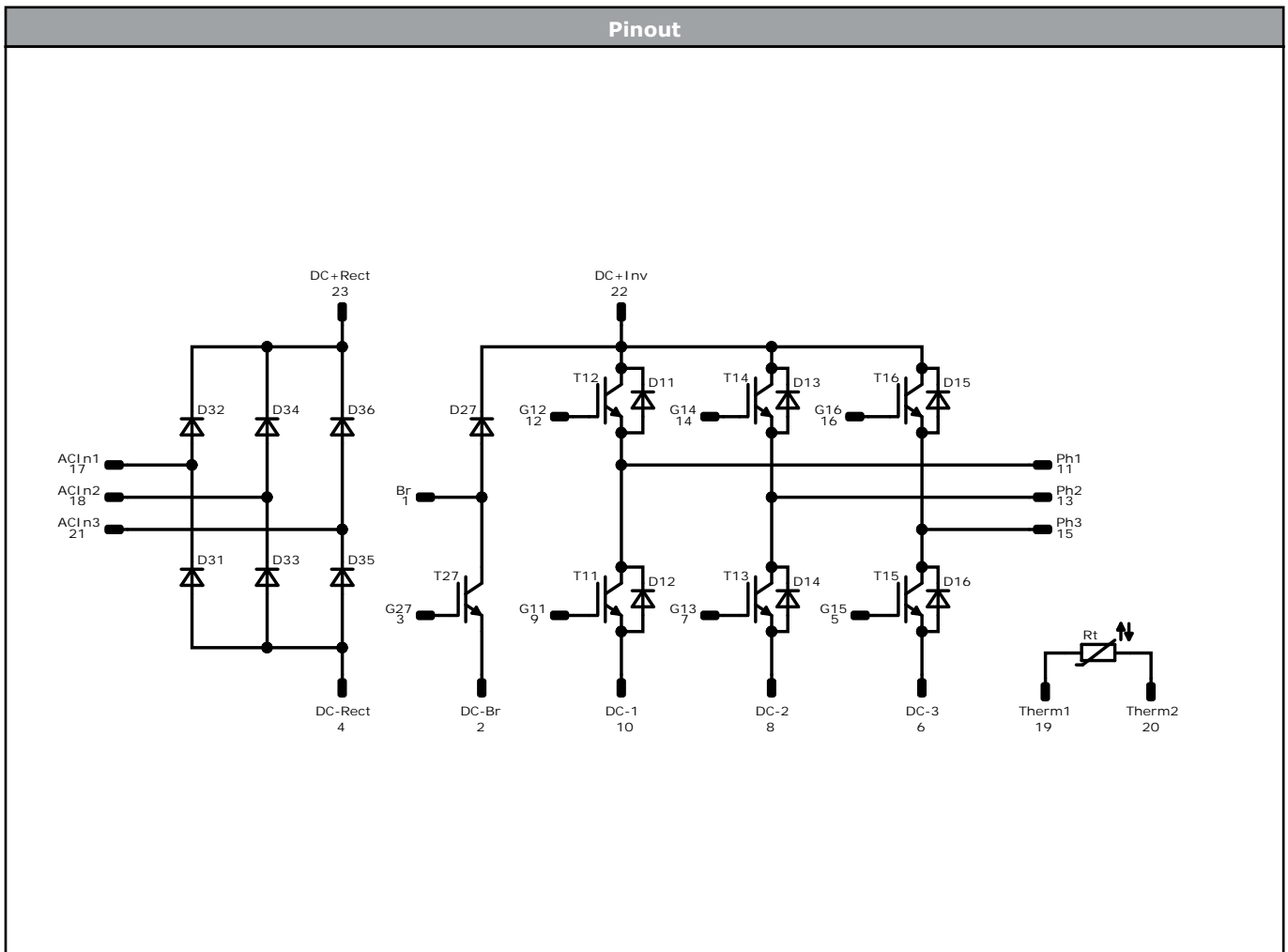
Pin table [mm]				Outline
Pin	X	Y	Function	
1	32	0	Br	
2	25,6	0	DC-Br	
3	22,4	0	G27	
4	19,2	0	DC-Rect	
5	16	0	G15	
6	12,8	0	DC-3	
7	9,6	0	G13	
8	6,4	0	DC-2	
9	3,2	0	G11	
10	0	0	DC-1	
11	0	25,6	Ph1	
12	3,2	25,6	G12	
13	9,6	25,6	Ph2	
14	12,8	25,6	G14	
15	19,2	25,6	Ph3	
16	22,4	25,6	G16	
17	32	25,6	ACIn1	
18	25,6	19,2	ACIn2	
19	19,2	16	Therm1	
20	16	16	Therm2	
21	25,6	12,8	ACIn3	
22	22,4	6,4	DC+Inv	
23	25,6	6,4	DC+Rect	



Tolerance of pinpositions: ±0,4mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance



Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	600 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	600 V	15 A	Inverter Diode	
T27	IGBT	600 V	15 A	Brake Switch	
D27	FWD	600 V	10 A	Brake Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	28 A	Rectifier Diode	
Rt	NTC			Thermistor	




Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow</i> E1 packages see vincotech.com website.

Package data
Package data for <i>flow</i> E1 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-EZ06PMA015SA-L924A38T-D3-14	7 Jun. 2021	New Datasheet format Update characteristics of rectifier diode, leakage current max value from 50 -> 100 uA	

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