



flowPIM E1

1200 V / 15 A

### Topology features

- Open Emitter configuration
- Temperature sensor
- Converter+Brake+Inverter

### Component features

- Easy paralleling
- Low turn-off losses
- Low collector emitter saturation voltage
- Positive temperature coefficient
- Short tail current
- Switching optimized for EMC

### Housing features

- Base isolation: Al<sub>2</sub>O<sub>3</sub>
- Convex shaped substrate for superior thermal contact
- Compact housing
- CTI600 housing material
- Thermo-mechanical push-and-pull force relief
- Solder pin

### Target applications

- Industrial Drives

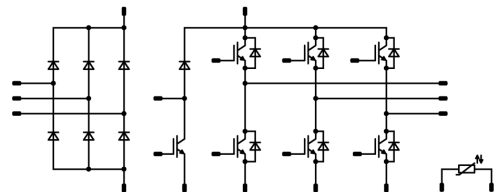
### Types

- 10-E112PMA015M7-L928A78Z

### flow E1 12 mm housing



### Schematic





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## 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)	$I_C$	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	30 <sup>(1)</sup>	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	30	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	64	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	9,5	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

<sup>(1)</sup> limited by  $I_{CRM}$

## Inverter Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	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	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	51	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Brake Switch

Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	30 <sup>(2)</sup>	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	30	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	64	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	9,5	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

<sup>(2)</sup> limited by  $I_{CRM}$



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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	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	20 <sup>(3)</sup>	A
Repetitive peak forward current	$I_{FRM}$	$I_p$ limited by $T_{jmax}$	20	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	43	W
Maximum junction temperature	$T_{jmax}$		175	°C

<sup>(3)</sup> limited by  $I_{FRM}$

## 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
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
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	

#### Inverter Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,0015	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	25 125 150		1,7 1,95 2,01	2,1 <sup>(4)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			60	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			200	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							2900		pF
Output capacitance	$C_{oes}$		0	10		25		120		pF
Reverse transfer capacitance	$C_{res}$							34		pF
Gate charge	$Q_g$	$V_{CC} = 600$ V	0/15		15	25		110		nC

##### Thermal

Thermal resistance junction to sink <sup>(5)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,48		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		196,2 191,2 189,6		ns
Rise time	$t_r$					25 125 150		59,6 63,2 64,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		181,4 206,2 211,4		ns
Fall time	$t_f$					25 125 150		94,66 113,14 114,01		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1,5$ μC $Q_{tFWD} = 2,46$ μC $Q_{tFWD} = 2,68$ μC				25 125 150		1,68 2,11 2,21		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		0,987 1,33 1,41		mWs



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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			
<b>Inverter Diode</b>											
<b>Static</b>											
Forward voltage	$V_F$			15	25 125 150		1,63 1,74 1,73	1,9 <sup>(4)</sup>		V	
Reverse leakage current	$I_R$	$V_r = 1200$ V			25			30		μA	
<b>Thermal</b>											
Thermal resistance junction to sink <sup>(5)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					1,88			K/W	
<b>Dynamic</b>											
Peak recovery current	$I_{RM}$	$di/dt=181$ A/μs $di/dt=205$ A/μs $di/dt=175$ A/μs	±15	600	15	25		9,46		A	
						125		10,72			
						150		10,9			
Reverse recovery time	$t_{rr}$					25		285,73			ns
						125		421,73			
						150		470,63			
Recovered charge	$Q_r$					25		1,5		μC	
						125		2,46			
						150		2,68			
Reverse recovered energy	$E_{rec}$					25		0,497		mWs	
						125		0,913			
						150		1			
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25		76,99		A/μs	
						125		48,52			
						150		43,64			



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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	$V_{GE(th)}$			10	0,0015	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	25 125 150		1,7 1,95 2,01	2,1 <sup>(4)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			60	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			200	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							2900		pF
Output capacitance	$C_{oes}$		0	10		25		120		pF
Reverse transfer capacitance	$C_{res}$							34		pF
Gate charge	$Q_g$	$V_{CC} = 600$ V	0/15		15	25		110		nC

##### Thermal

Thermal resistance junction to sink <sup>(5)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,48		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		299,8 261,6 252,6		ns
Rise time	$t_r$					25 125 150		193,8 204,6 209,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		387,8 427,8 438,2		ns
Fall time	$t_f$					25 125 150		66,52 86,69 88,96		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1,11$ μC $Q_{tFWD} = 1,78$ μC $Q_{tFWD} = 2,04$ μC				25 125 150		2,5 3 3,19		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		1,12 1,44 1,54		mWs



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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		
<b>Brake Diode</b>										
<b>Static</b>										
Forward voltage	$V_F$			10	25 125 150		1,61 1,69 1,7	1,9 <sup>(4)</sup>		V
Reverse leakage current	$I_R$	$V_r = 1200$ V			25			25		μA
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(5)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					2,19			K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RM}$	$di/dt=74$ A/μs $di/dt=65$ A/μs $di/dt=62$ A/μs	0/15	600	15	25		5,91		A
						125		6,68		
						150		6,84		
Reverse recovery time	$t_{rr}$					25		317,36		ns
						125		472,66		
						150		542,16		
Recovered charge	$Q_r$					25		1,11		μC
						125		1,78		
						150		2,04		
Reverse recovered energy	$E_{rec}$					25		0,368		mWs
						125		0,644		
						150		0,753		
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25		40,15		A/μs
						125		27,59		
						150		23,82		



### 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	$V_F$				28	25 125		1,15 1,1	1,5 <sup>(4)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1600$ V				25 150			100 1000	μA

##### Thermal

Thermal resistance junction to sink <sup>(5)</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 R100	$\Delta_{R/R}$	$R_{100} = 493$ 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>(4)</sup> Value at chip level

<sup>(5)</sup> Only valid with pre-applied Vincotech thermal interface material.



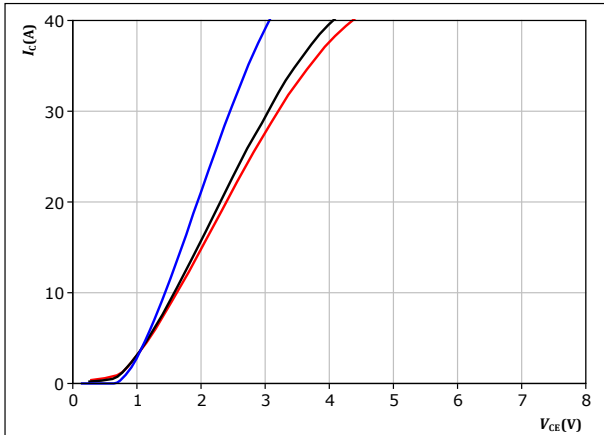


## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

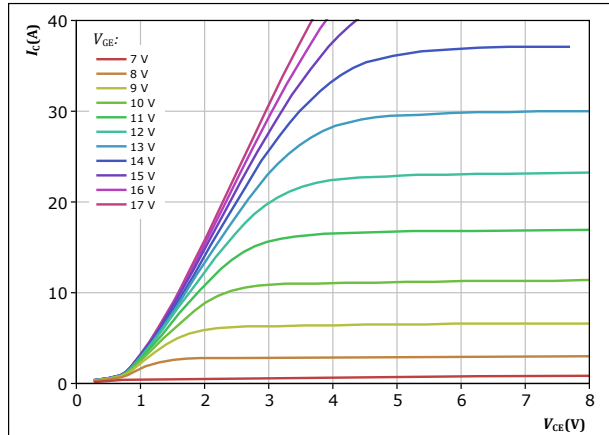


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j$ : 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

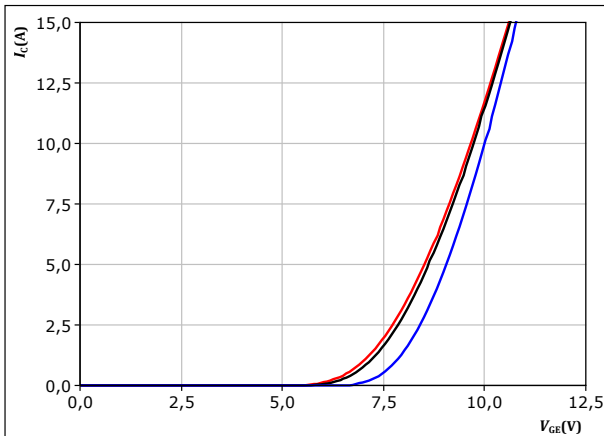


$t_p = 250 \mu s$   
 $T_j = 150 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

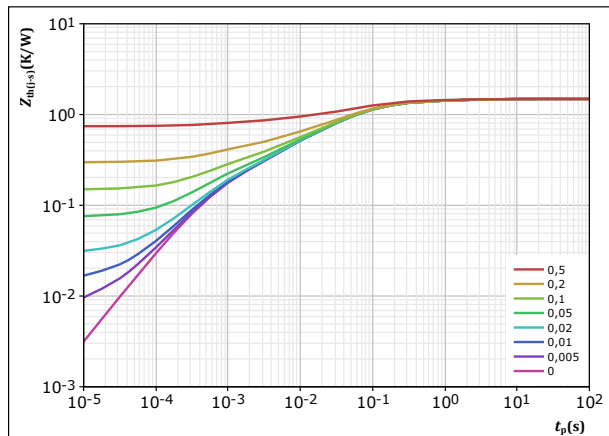


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j$ : 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,485 \text{ K/W}$   
IGBT thermal model values

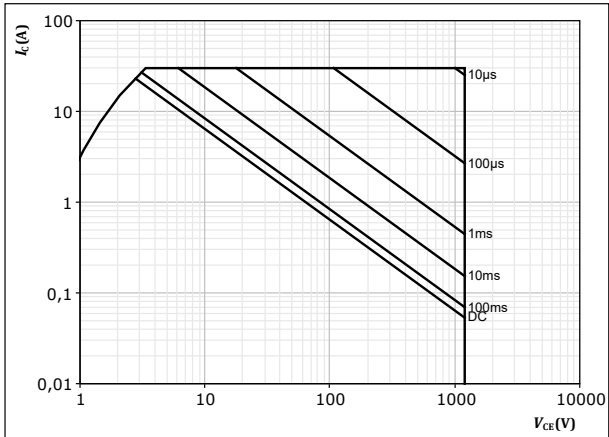
$R$ (K/W)	$\tau$ (s)
4,90E-02	3,61E+00
1,10E-01	6,54E-01
4,70E-01	1,09E-01
4,98E-01	2,97E-02
2,21E-01	4,73E-03
1,37E-01	5,51E-04



## Inverter Switch Characteristics

**figure 5.** IGBT

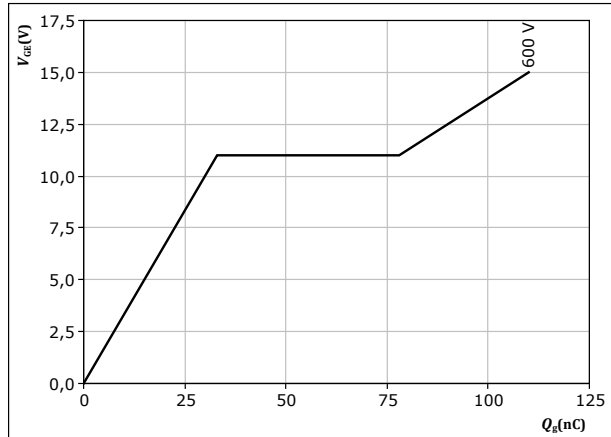
Safe operating area  
 $I_C = f(V_{CE})$



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

**figure 6.** IGBT

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



$I_C = 15$  A  
 $T_j = 25$  °C



### Inverter Diode Characteristics

figure 7. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

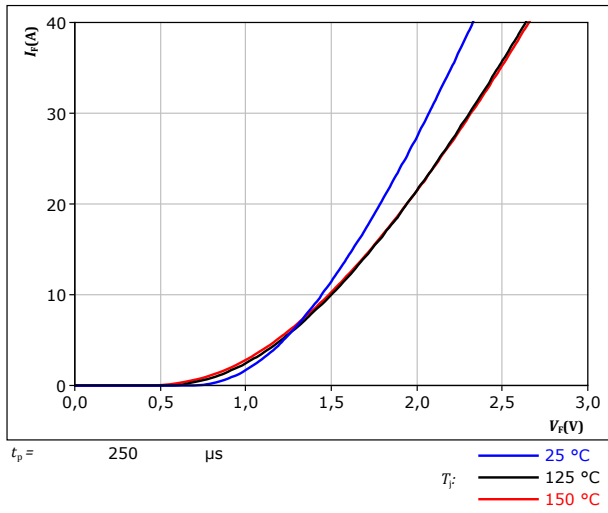
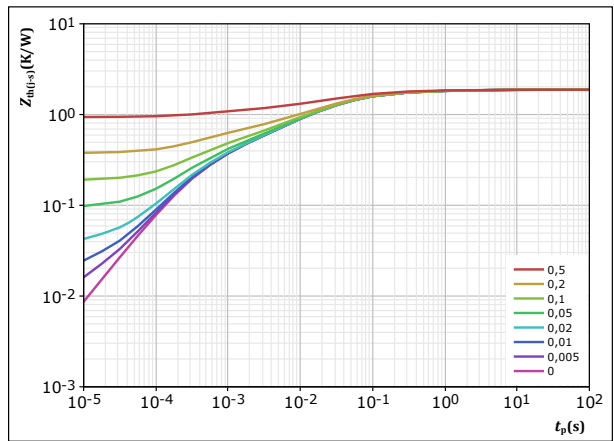


figure 8. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 1,875 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
7,31E-02	2,45E+00
1,93E-01	2,55E-01
6,27E-01	4,97E-02
4,83E-01	1,15E-02
2,56E-01	2,33E-03
2,42E-01	3,41E-04

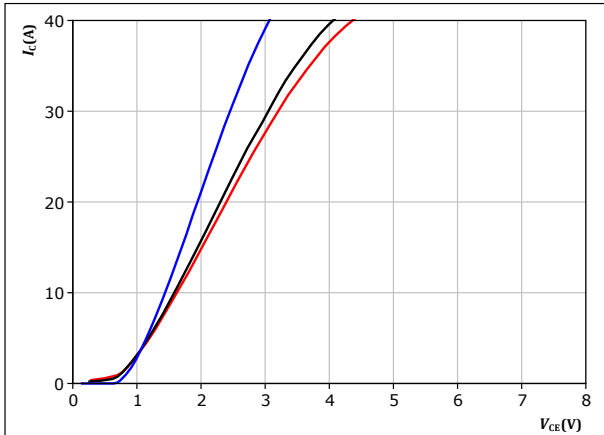


### Brake Switch Characteristics

figure 9. IGBT

Typical output characteristics

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

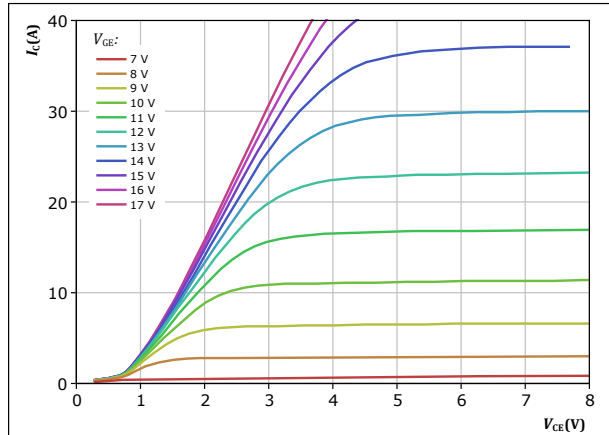


$t_p = 250\ \mu\text{s}$   
 $V_{GE} = 15\ \text{V}$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 10. IGBT

Typical output characteristics

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

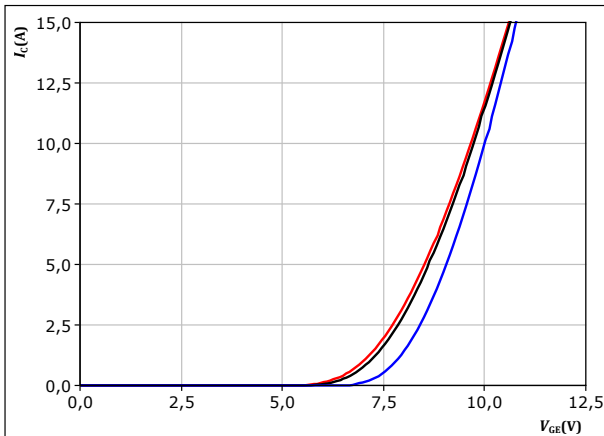


$t_p = 250\ \mu\text{s}$   
 $T_j = 150\text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 11. IGBT

Typical transfer characteristics

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

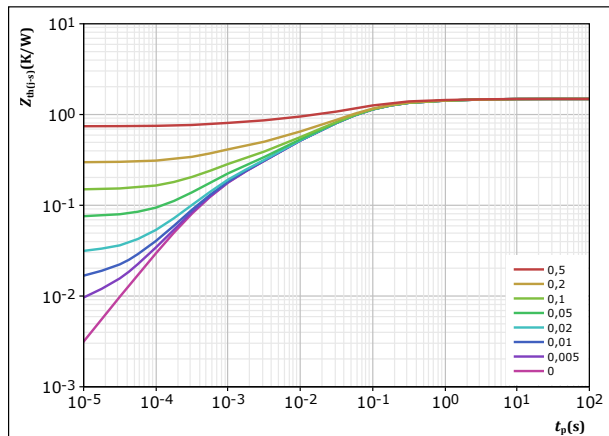


$t_p = 250\ \mu\text{s}$   
 $V_{CE} = 10\ \text{V}$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 12. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,485\ \text{K/W}$   
IGBT thermal model values

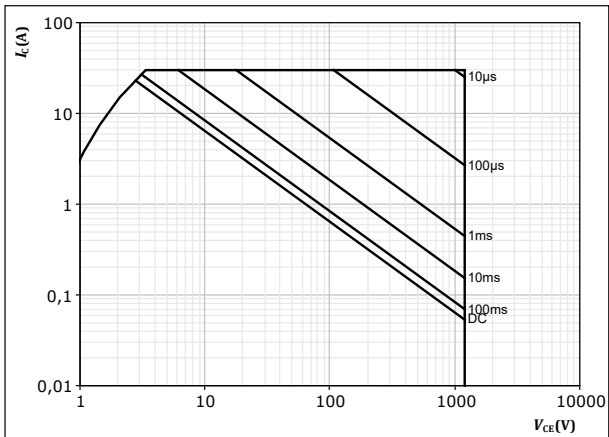
$R$ (K/W)	$\tau$ (s)
4,90E-02	3,61E+00
1,10E-01	6,54E-01
4,70E-01	1,09E-01
4,98E-01	2,97E-02
2,21E-01	4,73E-03
1,37E-01	5,51E-04



### Brake Switch Characteristics

figure 13. IGBT

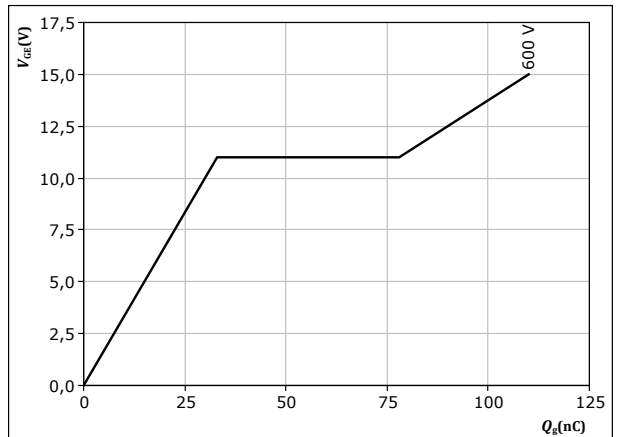
Safe operating area  
 $I_C = f(V_{CE})$



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

figure 14. IGBT

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



$I_C = 15$  A  
 $T_j = 25$  °C



### Brake Diode Characteristics

figure 15. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

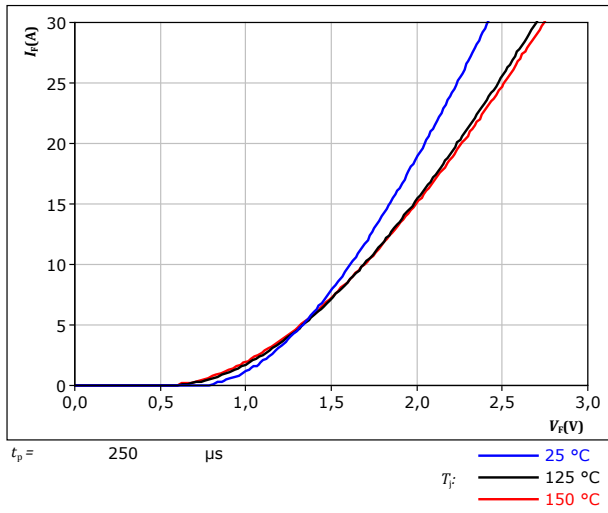
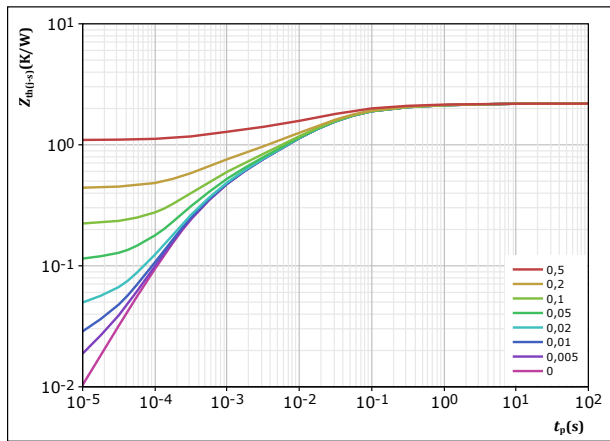


figure 16. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 2,189 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
8,09E-02	3,20E+00
2,08E-01	2,82E-01
6,85E-01	4,41E-02
5,92E-01	1,02E-02
3,27E-01	2,02E-03
2,95E-01	3,64E-04



## Rectifier Diode Characteristics

figure 17. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

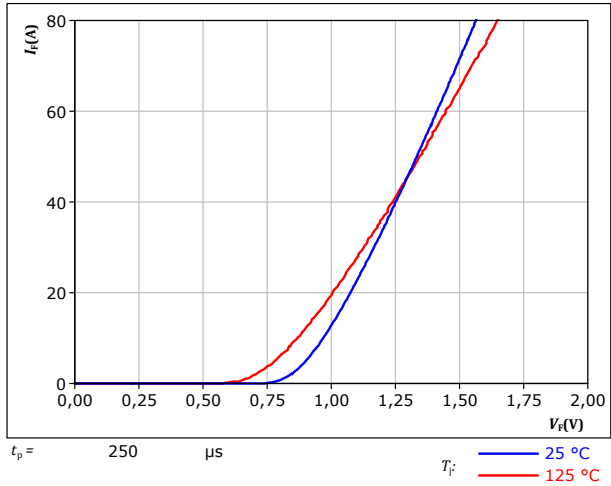
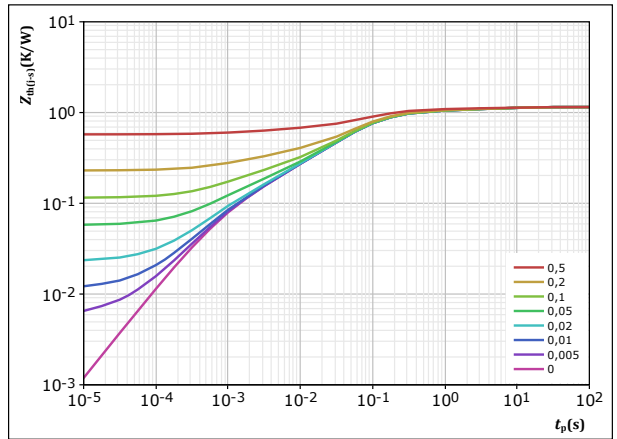


figure 18. Rectifier

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

$R$ (K/W)	$\tau$ (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

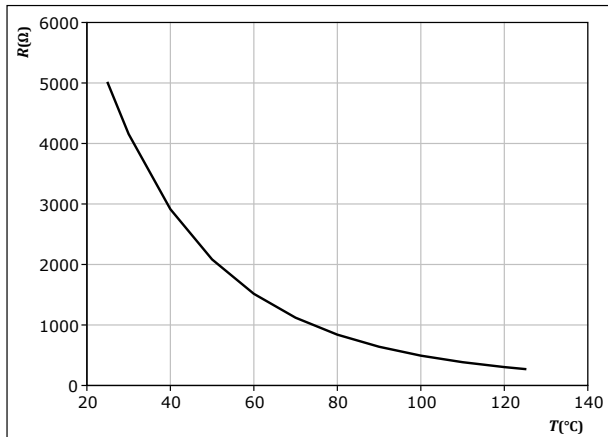


## Thermistor Characteristics

figure 19. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$



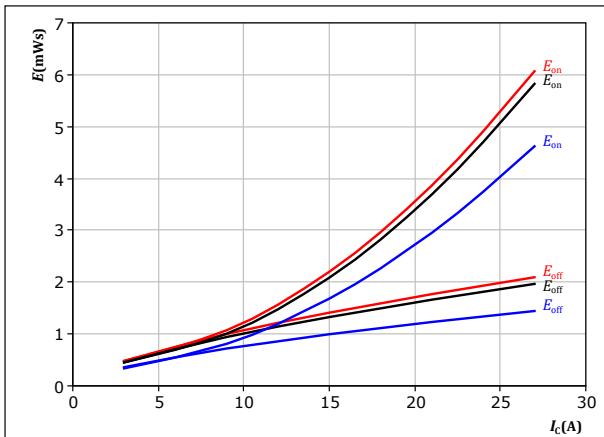




## Inverter Switching Characteristics

figure 20. IGBT

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

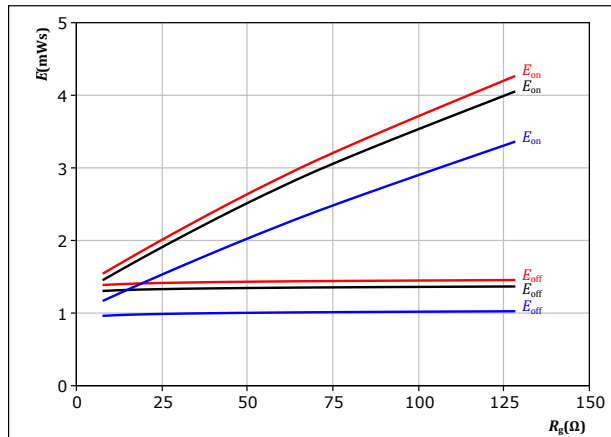


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C
$R_{g(on)} = 32$ Ω	$T_j = 150$ °C
$R_{g(off)} = 32$ Ω	

figure 21. IGBT

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

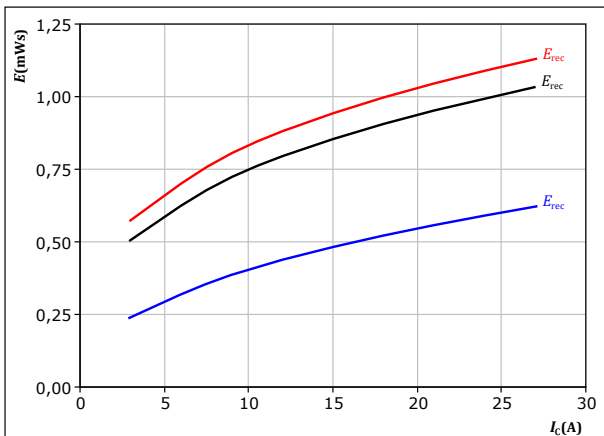


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C
$I_c = 15$ A	$T_j = 150$ °C

figure 22. FWD

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

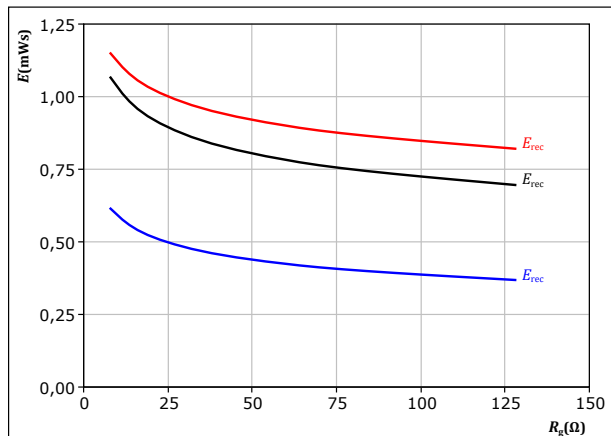


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C
$R_{g(on)} = 32$ Ω	$T_j = 150$ °C

figure 23. FWD

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



With an inductive load at

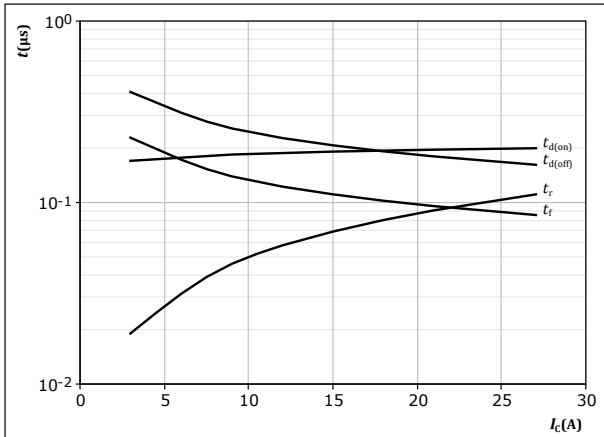
$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C
$I_c = 15$ A	$T_j = 150$ °C



## Inverter Switching Characteristics

**figure 24.** IGBT

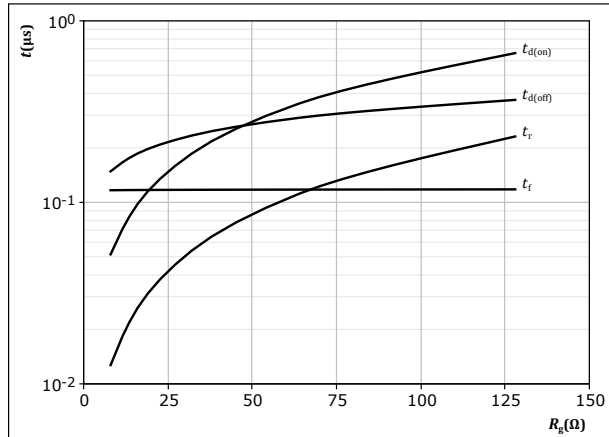
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 32 \text{ } \Omega$   
 $R_{goff} = 32 \text{ } \Omega$

**figure 25.** IGBT

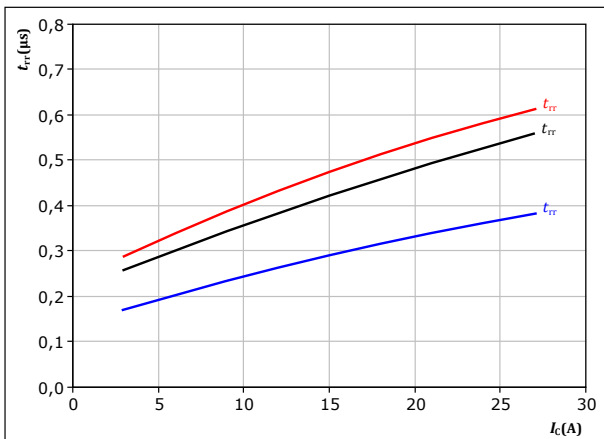
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



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

**figure 26.** FWD

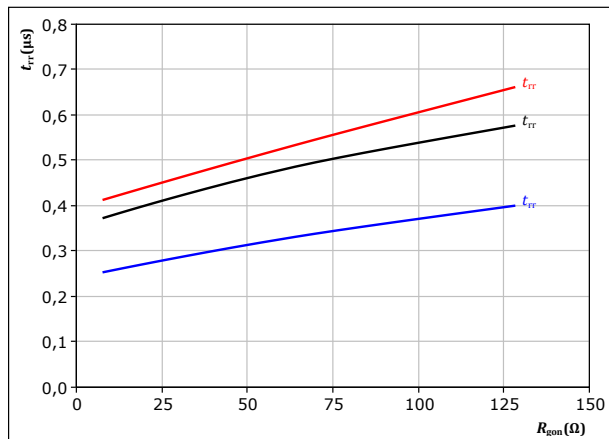
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



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  
           — 150 °C

**figure 27.** FWD

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



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

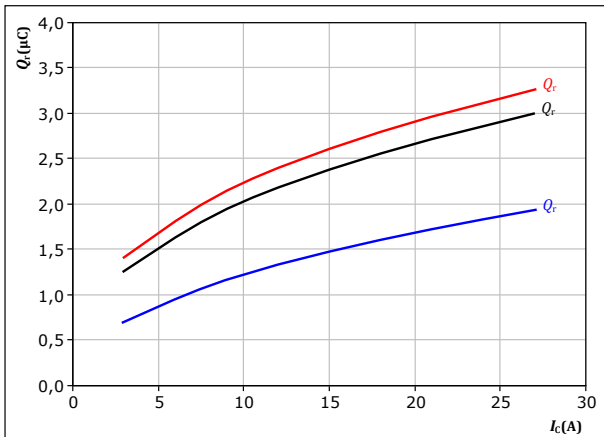


## Inverter Switching Characteristics

**figure 28.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

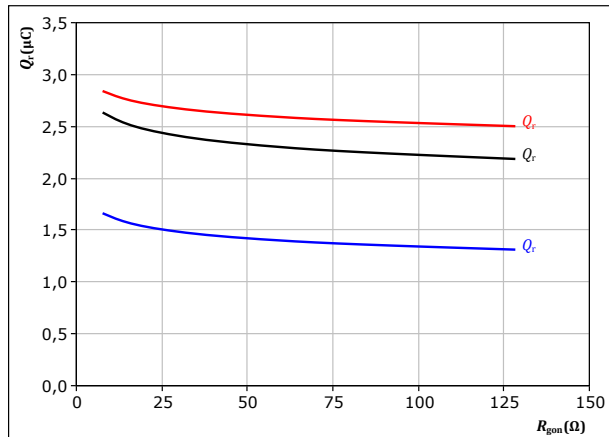
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 32 \ \Omega$

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

**figure 29.** FWD

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

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



With an inductive load at

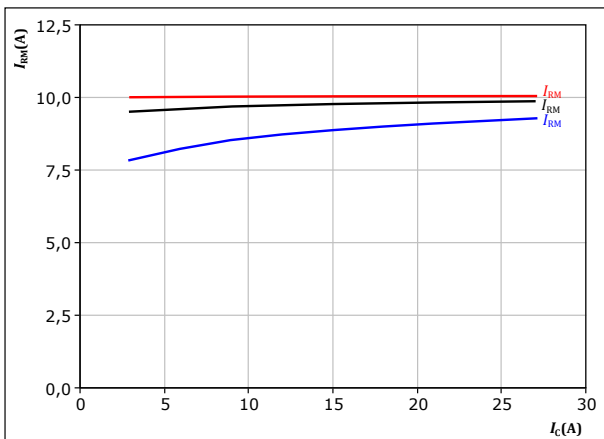
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 15 \text{ A}$

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

**figure 30.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

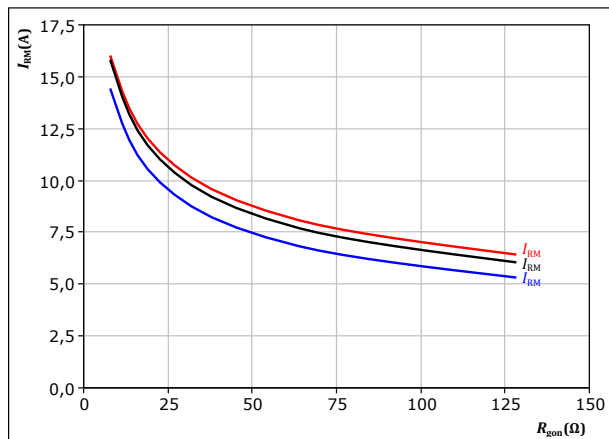
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 32 \ \Omega$

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

**figure 31.** FWD

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

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



With an inductive load at

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

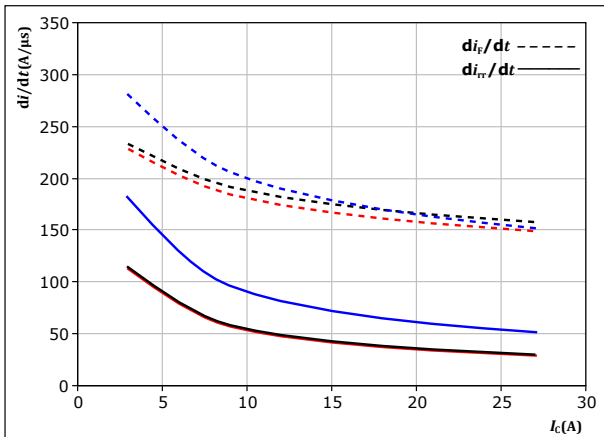
$T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C



## Inverter Switching Characteristics

**figure 32.** FWD

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

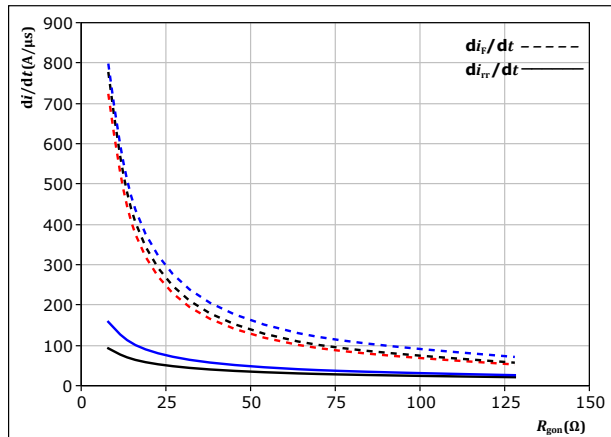


With an inductive load at

$V_{CE} = 600 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$T_j = 125 \text{ }^\circ\text{C}$
$R_{gon} = 32 \text{ } \Omega$	$T_j = 150 \text{ }^\circ\text{C}$

**figure 33.** FWD

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

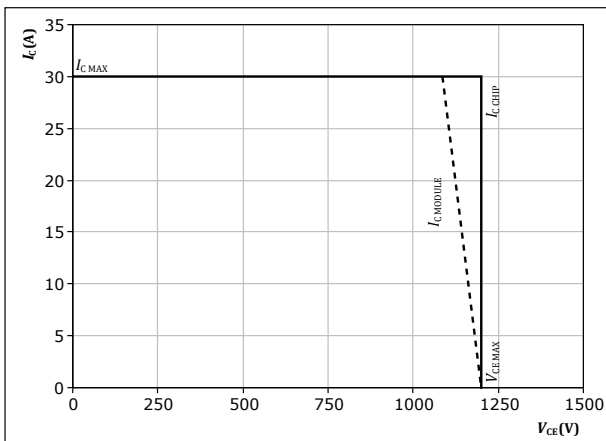


With an inductive load at

$V_{CE} = 600 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$T_j = 125 \text{ }^\circ\text{C}$
$I_c = 15 \text{ A}$	$T_j = 150 \text{ }^\circ\text{C}$

**figure 34.** IGBT

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



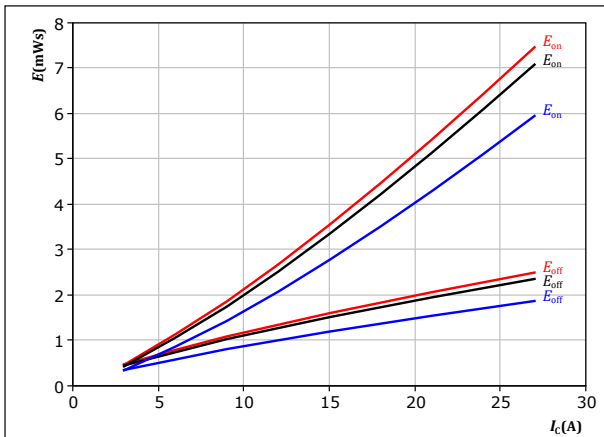
At  $T_j = 150 \text{ }^\circ\text{C}$   
 $R_{gon} = 32 \text{ } \Omega$   
 $R_{goff} = 32 \text{ } \Omega$



## Brake Switching Characteristics

**figure 35.** IGBT

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

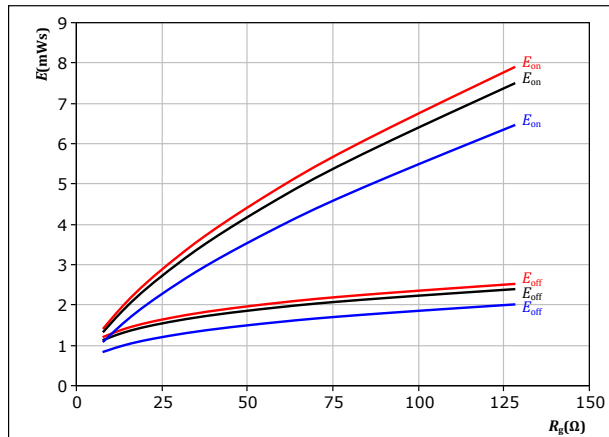


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$R_{g(on)} = 32$ Ω	$T_j = 150$ °C
$R_{g(off)} = 32$ Ω	

**figure 36.** IGBT

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

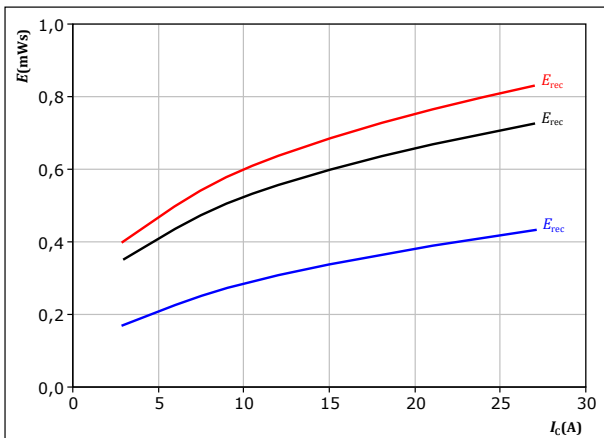


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$I_c = 15$ A	$T_j = 150$ °C

**figure 37.** FWD

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

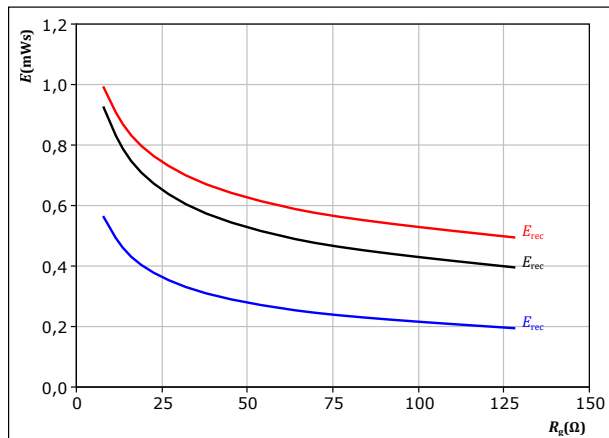


With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$R_{g(on)} = 32$ Ω	$T_j = 150$ °C

**figure 38.** FWD

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



With an inductive load at

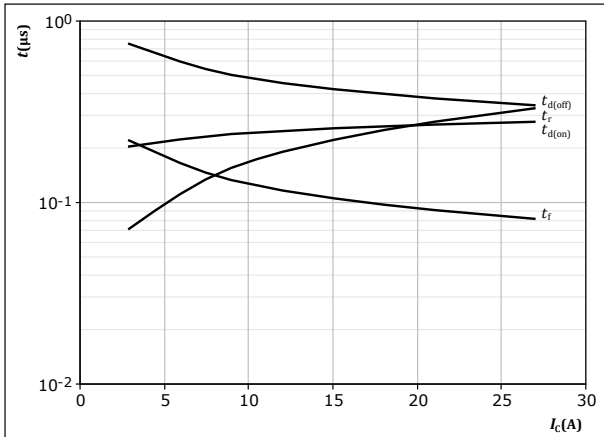
$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = 0/15$ V	$T_j = 125$ °C
$I_c = 15$ A	$T_j = 150$ °C



## Brake Switching Characteristics

**figure 39.** IGBT

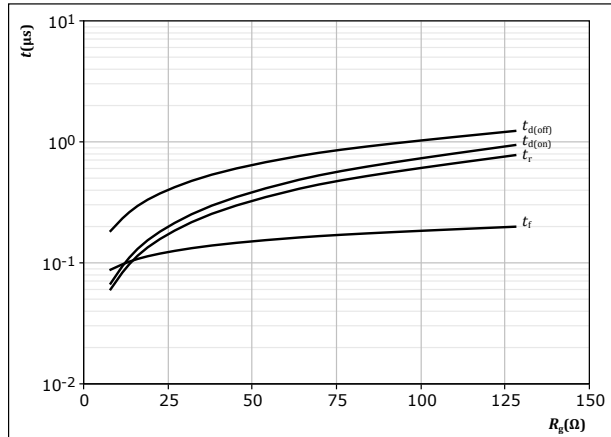
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$  Ω  
 $R_{goff} = 32$  Ω

**figure 40.** IGBT

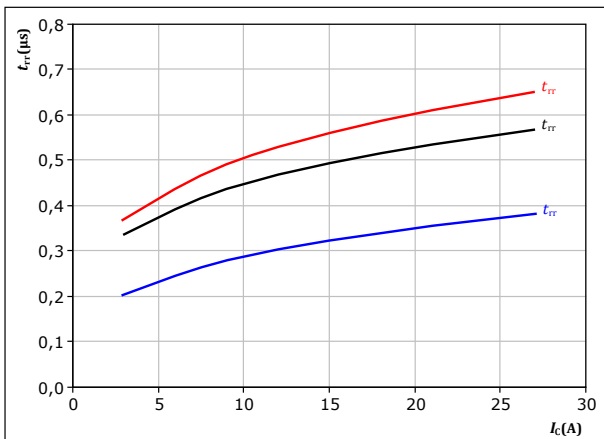
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A

**figure 41.** FWD

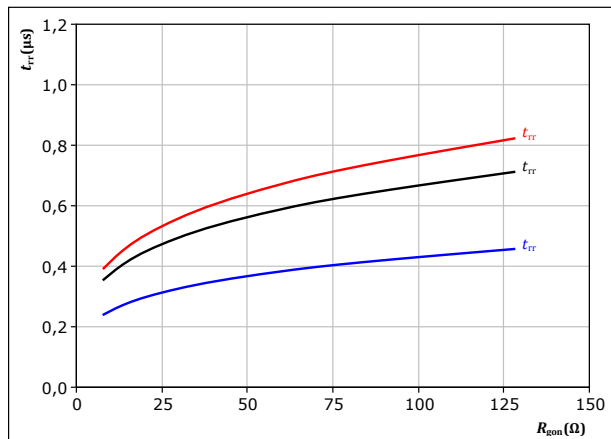
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$  Ω  
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 42.** FWD

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



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A  
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

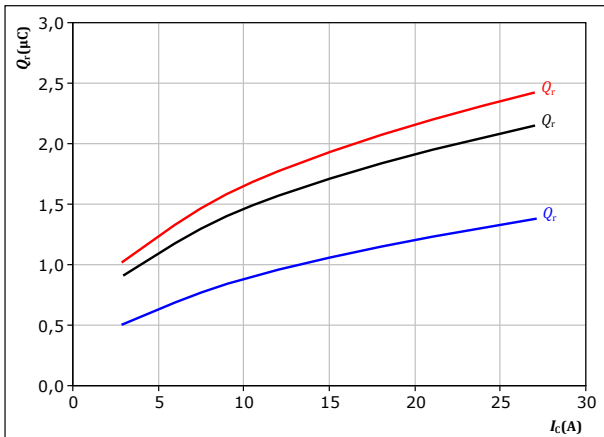


## Brake Switching Characteristics

figure 43. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

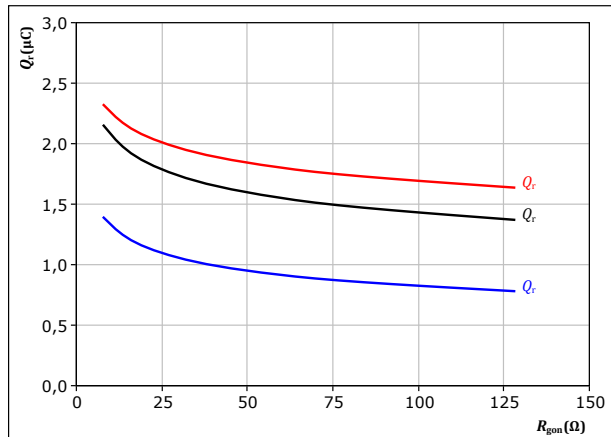
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{gon} = 32 \ \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 44. FWD

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

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



With an inductive load at

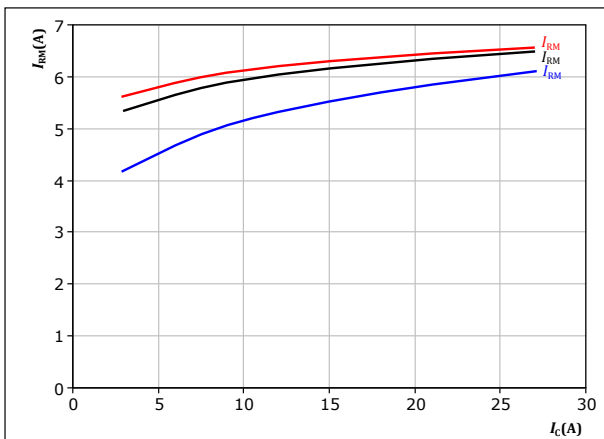
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 15 \text{ A}$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 45. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

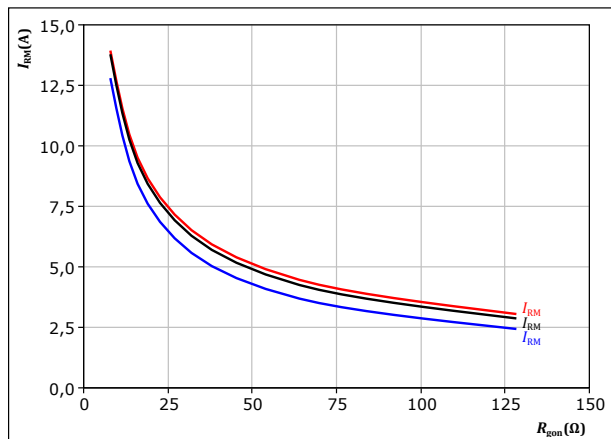
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $R_{gon} = 32 \ \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 46. FWD

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

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = 0/15 \text{ V}$   
 $I_c = 15 \text{ A}$

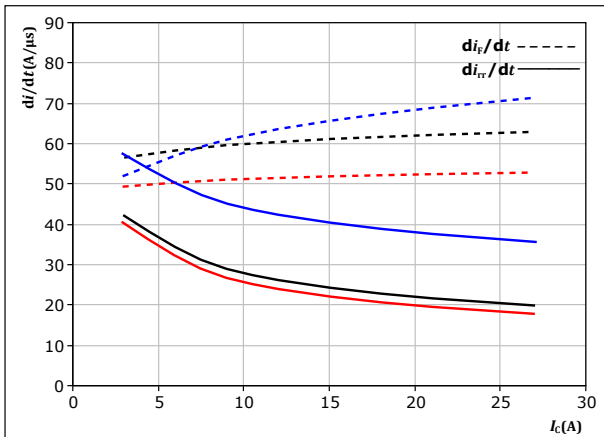
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



## Brake Switching Characteristics

**figure 47.** FWD

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



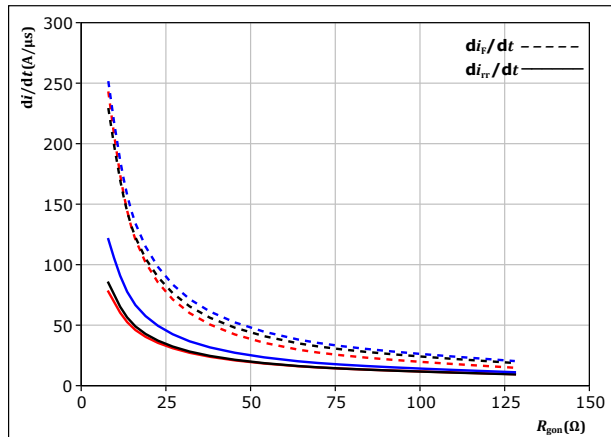
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$  Ω

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

**figure 48.** FWD

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



With an inductive load at

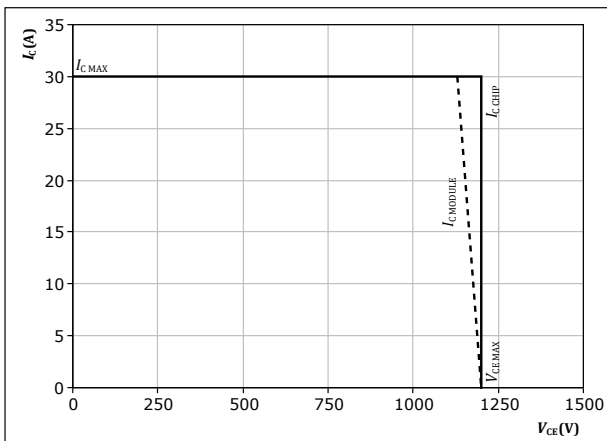
$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A

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

**figure 49.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 150$  °C  
 $R_{gon} = 32$  Ω  
 $R_{goff} = 32$  Ω





## Switching Definitions

figure 50. IGBT

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

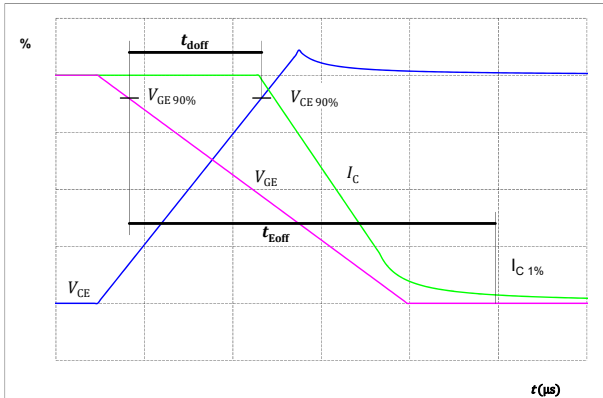


figure 51. IGBT

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



figure 52. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

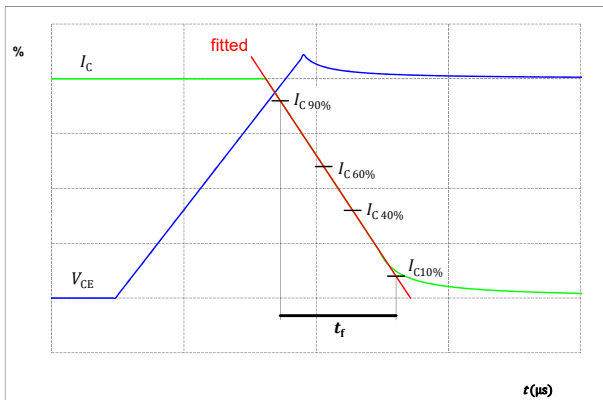
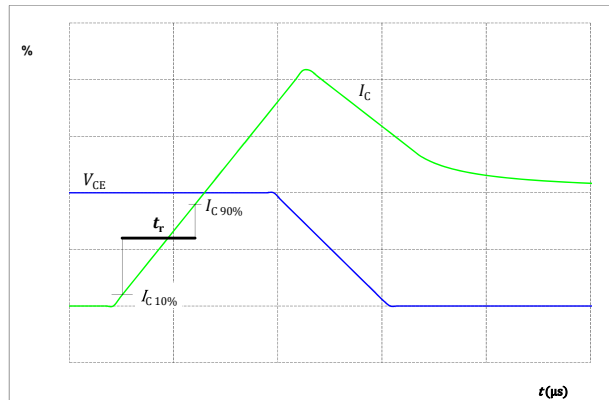


figure 53. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Switching Definitions

figure 54. FWD

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

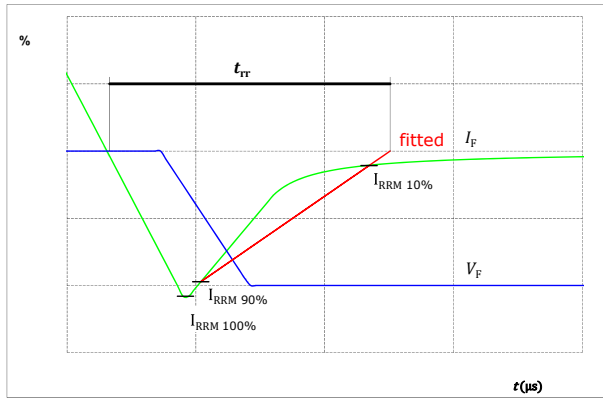
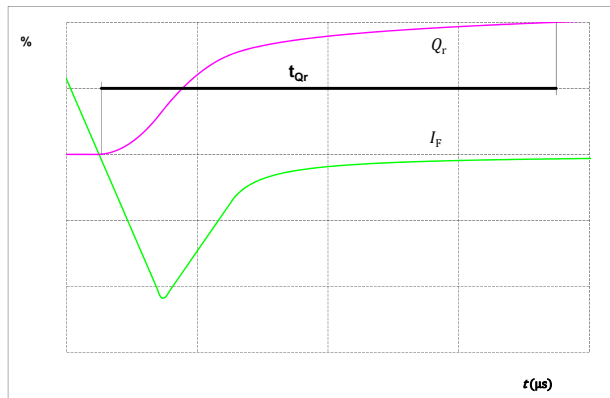


figure 55. FWD

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





# 10-E112PMA015M7-L928A78Z

datasheet

Vincotech

Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	10-E112PMA015M7-L928A78Z
With thermal paste (5,2 W/mK, PTM6000HV)	10-E112PMA015M7-L928A78Z-/7/

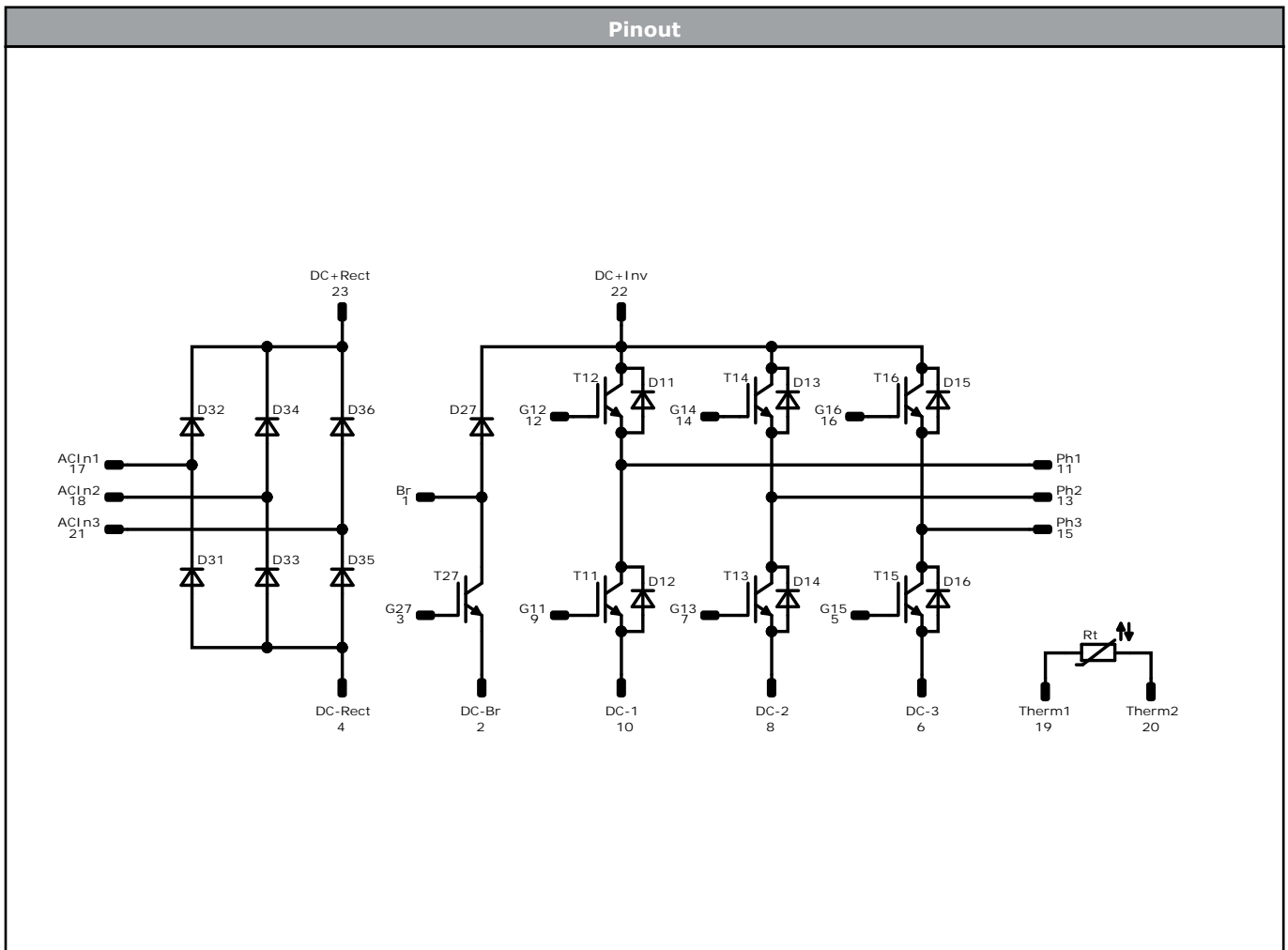
Marking							
	<b>Text</b>	<b>Name</b>		<b>Date code</b>	<b>UL &amp; VIN</b>	<b>Lot</b>	<b>Serial</b>
		NN-NNNNNNNNNNNNNNNN- TTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b>	<b>Lot number</b>	<b>Serial</b>	<b>Date code</b>		
		TTTTTVV	LLLLL	SSSS	WWYY		

Outline				
Pin table [mm]				
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 pinposition: ±0,1mm at the end of pins  
Dimension of coordinate axis is only of fact without tolerance



Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	15 A	Inverter Diode	
T27	IGBT	1200 V	15 A	Brake Switch	
D27	FWD	1200 V	10 A	Brake Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	28 A	Rectifier Diode	
Rt	NTC			Thermistor	



Vincotech

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 UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,sw}=175^{\circ}\text{C}$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.



Document No.:	Date:	Modification:	Pages
10-E112PMA015M7-L928A78Z-D5-14	16 Mar. 2021	New Datasheet format Update characteristics of Rectifier Diode	
10-E112PMA015M7-L928A78Z-D6-14	3 Dec. 2024	Update Main Page and Ordering Codes	

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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.