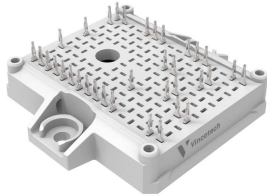
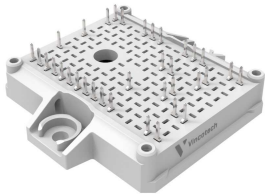
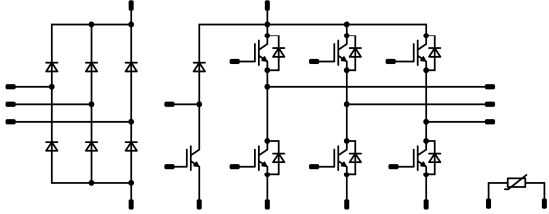




<i>flowPIM E2</i>	<b>1200 V / 25 A</b>
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Features</b></p> <ul style="list-style-type: none"> <li>IGBT M7 with low <math>V_{CEsat}</math> and improved EMC behavior</li> <li>Standard industrial housing</li> <li>Optimized <math>R_{th(j-s)}</math> with Phase Change Material</li> <li>Built-in NTC</li> </ul> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Target applications</b></p> <ul style="list-style-type: none"> <li>Industrial Drives</li> </ul> </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Types</b></p> <ul style="list-style-type: none"> <li>10-EY12PMA025M7-L187A78T</li> <li>10-E212PMA025M7-L187A78Z</li> </ul> </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><i>flow E2 12 mm housing</i></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>Press-fit pin</span> <span>Solder pin</span> </div> </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Schematic</b></p>  </div>

## Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current	$I_C$		25	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	96	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C



## Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
<b>Inverter Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Continuous (direct) forward current	$I_F$		25	A
Repetitive peak forward current	$I_{FRM}$	$T_j$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	71	W
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Brake Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current	$I_C$		25	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	96	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Brake Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Continuous (direct) forward current	$I_F$		10	A
Repetitive peak forward current	$I_{FRM}$	$T_j$ 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
<b>Rectifier Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Continuous (direct) forward current	$I_F$		45	A
Surge (non-repetitive) forward current	$I_{FSM}$	50 Hz Single Half Sine Wave $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	350	A
Surge current capability	$I^2t$		610	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	60	W
Maximum junction temperature	$T_{jmax}$		150	°C



### Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
-----------	--------	-----------	-------	------

#### Module Properties

##### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature under switching condition	$T_{top}$		-40...(T <sub>max</sub> - 25)	°C

##### Isolation Properties

Isolation voltage	$V_{isol}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance		Press-fit pin / Solder pin	8,83 / 8,85	mm
Comparative Tracking Index	CTI		≥ 600	

\*100 % tested in production



## Characteristic Values

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

### Inverter Switch

#### Static

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$		10		0,0025	25	5,4	6,0	6,6	V
Collector-emitter saturation voltage	$V_{CESat}$	15			25	25 125 150		1,65 1,89 1,95	2,15	V
Collector-emitter cut-off current	$I_{CES}$	0		1200		25			70	μA
Gate-emitter leakage current	$I_{GES}$	20	0			25			500	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							4800		pF
Output capacitance	$C_{oes}$	0	10		25			170		
Reverse transfer capacitance	$C_{res}$							57		
Gate charge	$Q_g$	15	600	25	25	25		180		nC

#### Thermal

Parameter	Symbol	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	K/W

#### Dynamic

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$					25 125 150		147 149 145		ns
Rise time	$t_r$					25 125 150		29 33 34		
Turn-off delay time	$t_{d(off)}$					25 125 150		171 191 196		
Fall time	$t_f$					25 125 150		95 110 115		
Turn-on energy (per pulse)*	$E_{on}$					25 125 150		2,06 2,66 2,82		
Turn-off energy (per pulse)*	$E_{off}$					25 125 150		1,67 2,18 2,29		mWs

\*  $L_s = 10$  nH



### Characteristic Values

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

#### Inverter Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			25	25 125 150		1,63 1,70 1,69	2,1	V
Reverse leakage current	$I_R$			1200	25			35	μA

##### Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	1,34	K/W

##### Dynamic

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Peak recovery current	$I_{RRM}$			25	25 125 150		21 23 23		A
Reverse recovery time	$t_{rr}$			25	25 125 150		254 367 404		ns
Recovered charge	$Q_r$			±15	600	25	2,54 3,88 4,28		μC
Reverse recovered energy	$E_{rec}$					25	0,884 1,45 1,61		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25	217 134 132		A/μs



## Characteristic Values

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

### Brake Switch

#### Static

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$		10		0,0025	25	5,4	6,0	6,6	V
Collector-emitter saturation voltage	$V_{CESat}$	15			25	25 125 150		1,65 1,89 1,95	2,15	V
Collector-emitter cut-off current	$I_{CES}$	0		1200		25			70	μA
Gate-emitter leakage current	$I_{GES}$	20	0			25			500	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							4800		pF
Output capacitance	$C_{oes}$	0		10		25		170		
Reverse transfer capacitance	$C_{res}$							57		
Gate charge	$Q_g$	15		600	25	25		180		nC

#### Thermal

Parameter	Symbol	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	K/W

#### Dynamic

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$					25 125 150		403 389 382		ns
Rise time	$t_r$					25 125 150		109 117 120		
Turn-off delay time	$t_{d(off)}$					25 125 150		208 233 240		
Fall time	$t_f$					25 125 150		81 93 96		
Turn-on energy (per pulse)	$E_{on}$					25 125 150		3,05 3,62 3,79		
Turn-off energy (per pulse)	$E_{off}$					25 125 150		1,67 2,23 2,39		



### Characteristic Values

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

#### Brake Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			10	25 125 150		1,61 1,69 1,69	2,1	V
Reverse leakage current	$I_R$		1200		25			25	µA

##### Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	2,19	K/W

##### Dynamic

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Peak recovery current	$I_{RRM}$				25 125 150		9 10 10		A
Reverse recovery time	$t_{rr}$				25 125 150		317 448 499		ns
Recovered charge	$Q_r$	$di/dt = 207$ A/µs $di/dt = 210$ A/µs $di/dt = 196$ A/µs	±15	600	25		1,54 2,34 2,61		µC
Reverse recovered energy	$E_{rec}$				25 125 150		0,518 0,867 0,980		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$				25 125 150		52 38 38		A/µs

#### Rectifier Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			45	25 125		1,15 1,12		V
Reverse leakage current	$I_R$		1600		25 150			50	µA

##### Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	1,17	K/W



Vincotech

**10-EY12PMA025M7-L187A78T**  
**10-E212PMA025M7-L187A78Z**  
 datasheet

## Characteristic Values

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

### Thermistor

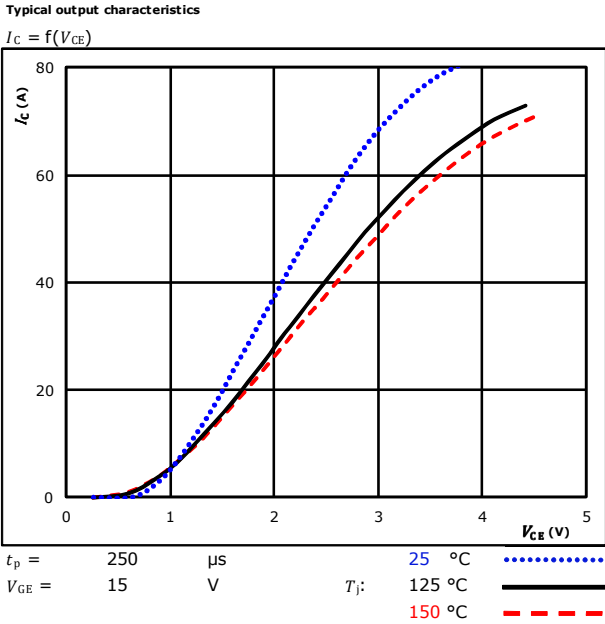
Rated resistance	$R$					25		5		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 493 \Omega$				100	-5		+5	%
Power dissipation	$P$					25		245		mW
Power dissipation constant						25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 2$ %				25		3375		K
B-value	$B_{(25/100)}$	Tol. $\pm 2$ %				25		3437		K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



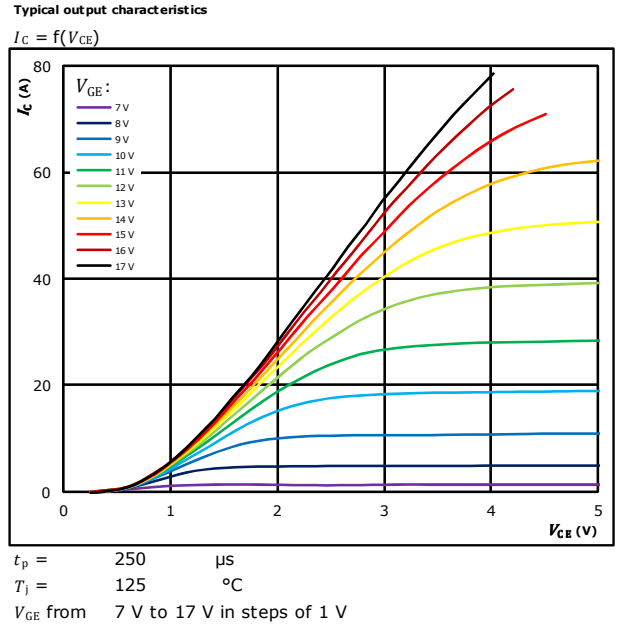


## Inverter Switch Characteristics

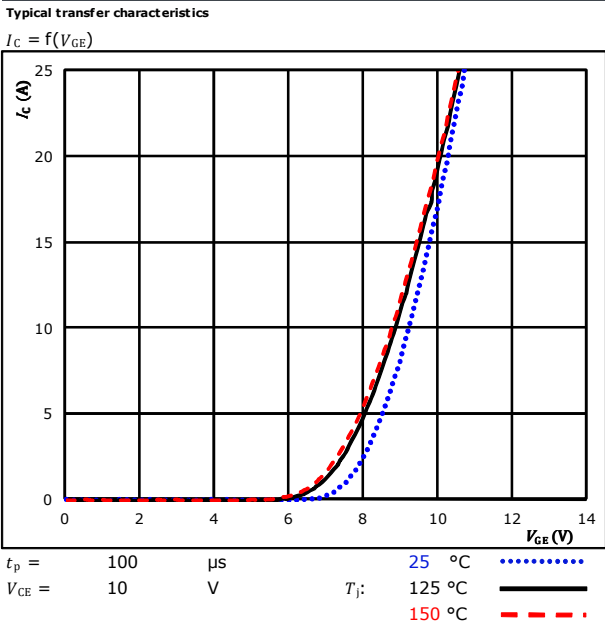
**figure 1.** IGBT



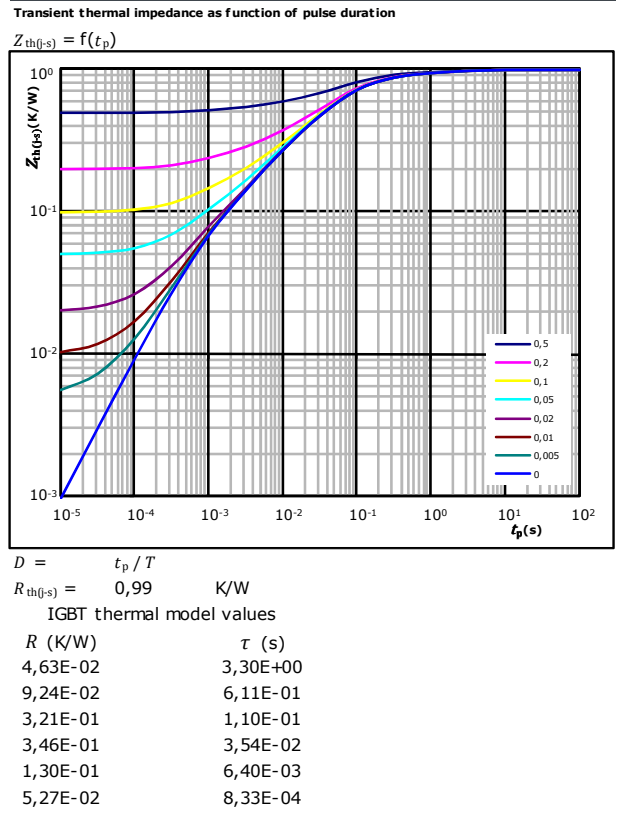
**figure 2.** IGBT



**figure 3.** IGBT



**figure 4.** IGBT



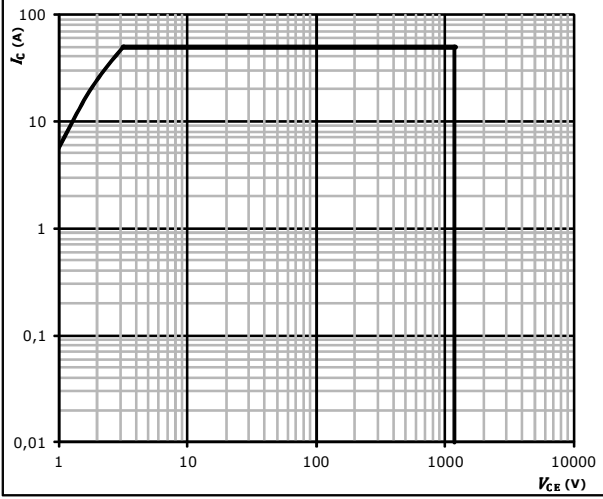


### Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



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

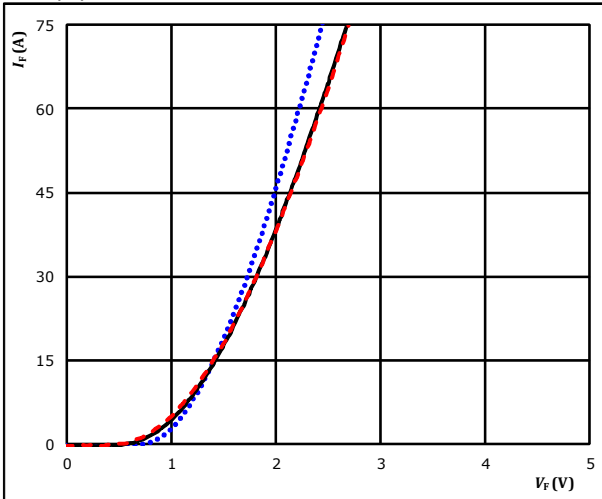


## Inverter Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

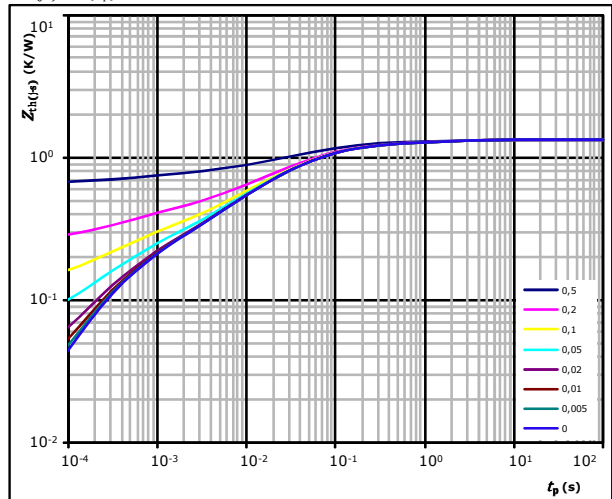


$t_p =$  250 μs  
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 1,34$  K/W

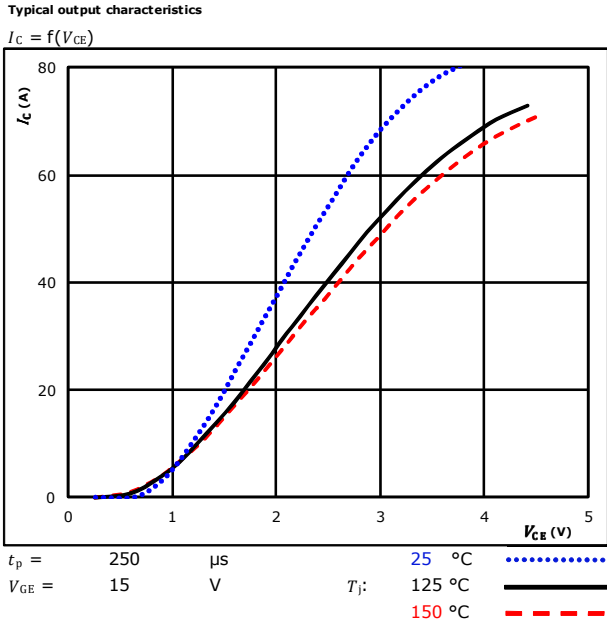
FWD thermal model values

$R$ (K/W)	$\tau$ (s)
7,90E-02	2,29E+00
1,38E-01	2,89E-01
5,15E-01	5,53E-02
3,34E-01	1,22E-02
1,30E-01	2,48E-03
1,40E-01	3,42E-04

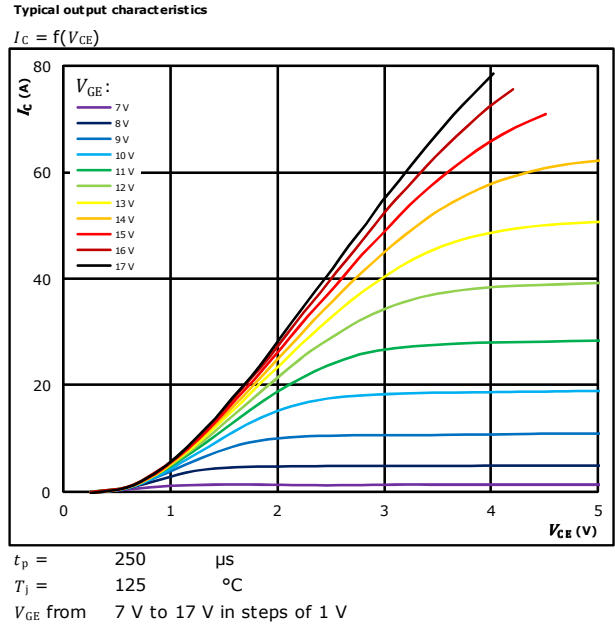


## Brake Switch Characteristics

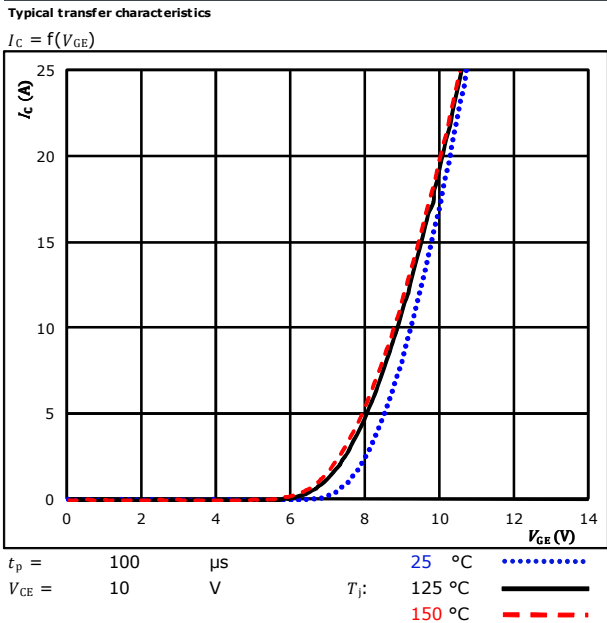
**figure 1.** IGBT



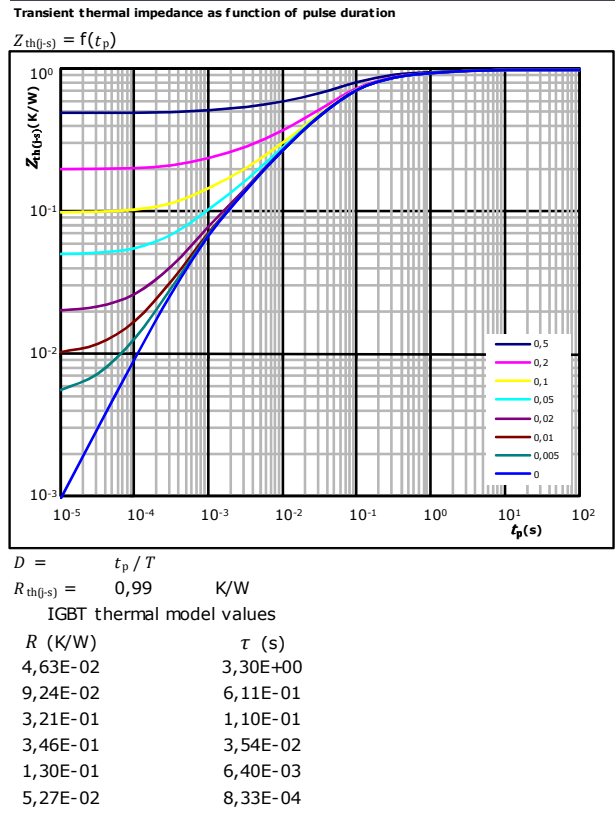
**figure 2.** IGBT



**figure 3.** IGBT



**figure 4.** IGBT



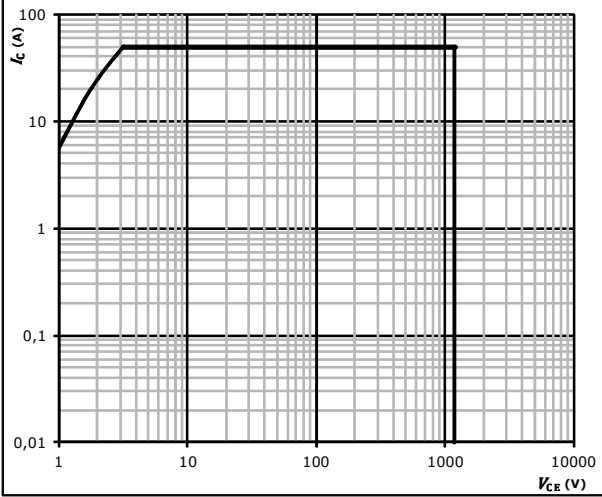


### Brake Switch Characteristics

figure 5. IGBT

Safe operating area

$I_C = f(V_{CE})$



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

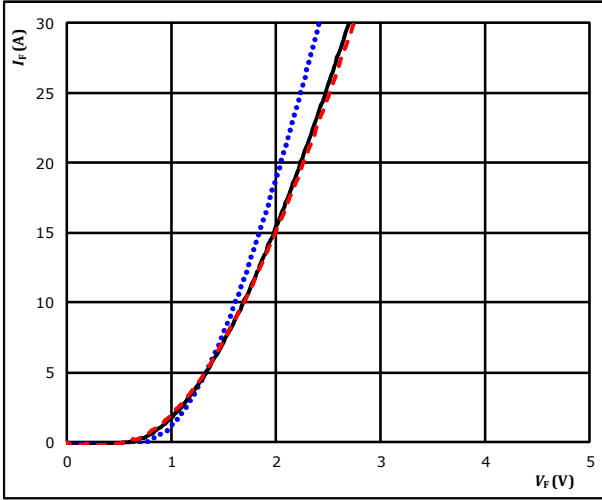


## Brake Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$



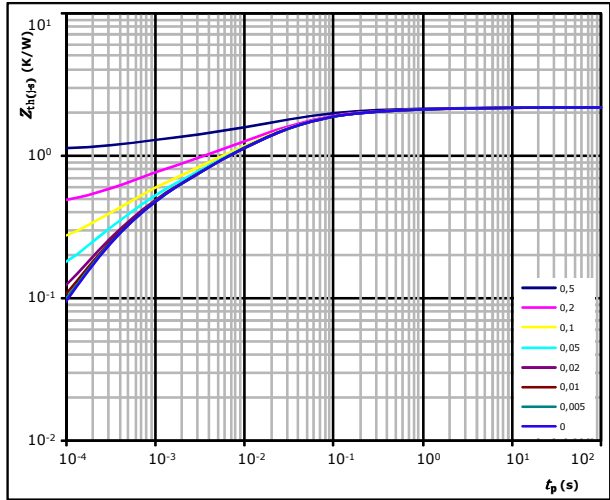
$t_p = 250 \mu s$

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

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 2,19 \text{ K/W}$

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

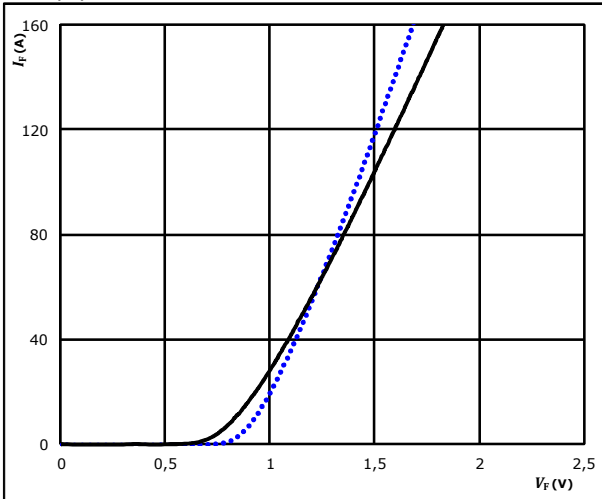


## Rectifier Diode Characteristics

**figure 1. Rectifier Diode**

Typical forward characteristics

$$I_F = f(V_F)$$

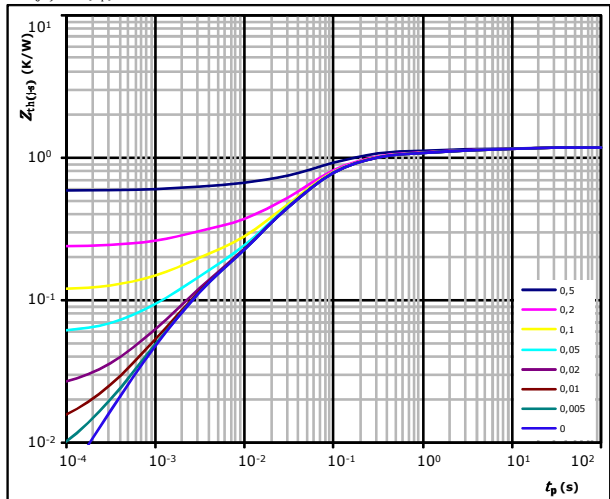


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ\text{C}$  (dotted blue line)  $125 \text{ }^\circ\text{C}$  (solid black line)

**figure 2. Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,17 \text{ K/W}$   
 Diode thermal model values

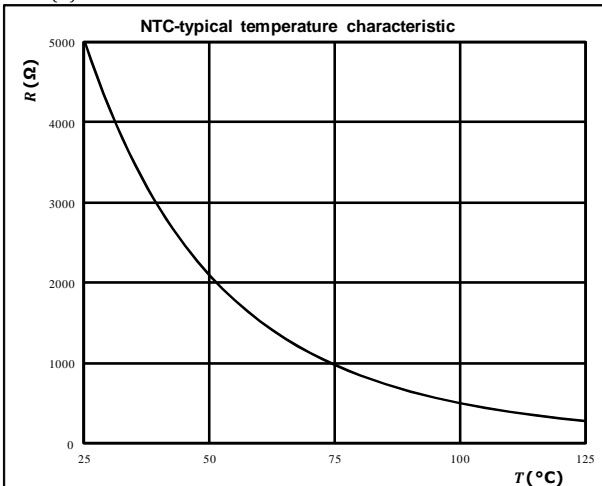
$R \text{ (K/W)}$	$\tau \text{ (s)}$
7,71E-02	9,00E+00
1,19E-01	7,09E-01
4,99E-01	1,03E-01
3,97E-01	3,61E-02
8,19E-02	2,07E-03

## Thermistor Characteristics

**figure 1. Thermistor**

Typical NTC characteristic as a function of temperature

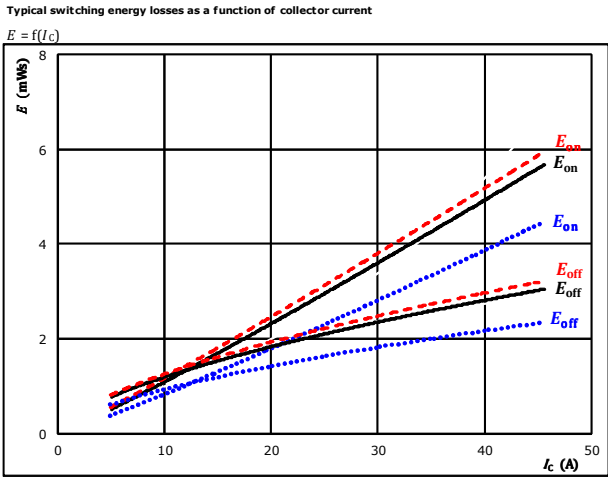
$$R = f(T)$$





## Inverter Switching Characteristics

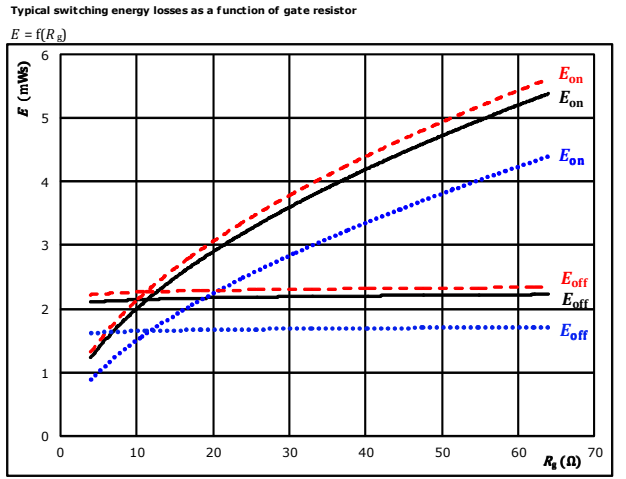
**figure 1.** IGBT



With an inductive load at

$V_{CE} = 600$ V	$T_j = 125$ °C	.....
$V_{GE} = \pm 15$ V	$T_j = 150$ °C	-----
$R_{gon} = 16$ Ω		
$R_{goff} = 16$ Ω		

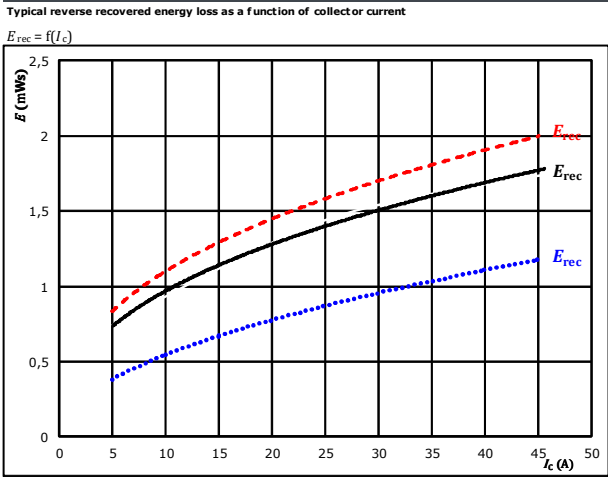
**figure 2.** IGBT



With an inductive load at

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

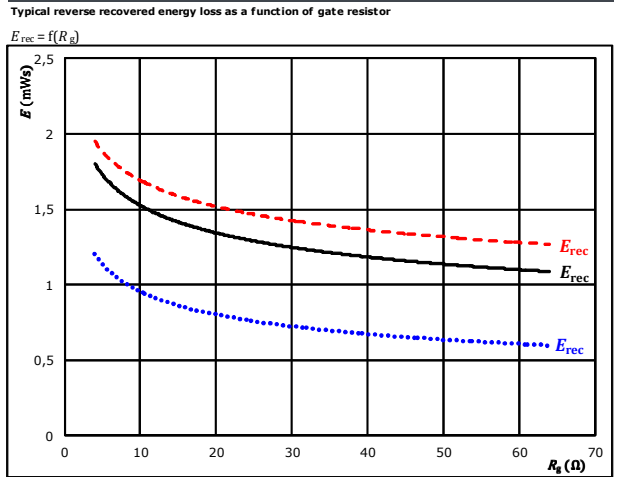
**figure 3.** FWD



With an inductive load at

$V_{CE} = 600$ V	$T_j = 125$ °C	.....
$V_{GE} = \pm 15$ V	$T_j = 150$ °C	-----
$R_{gon} = 16$ Ω		

**figure 4.** FWD



With an inductive load at

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



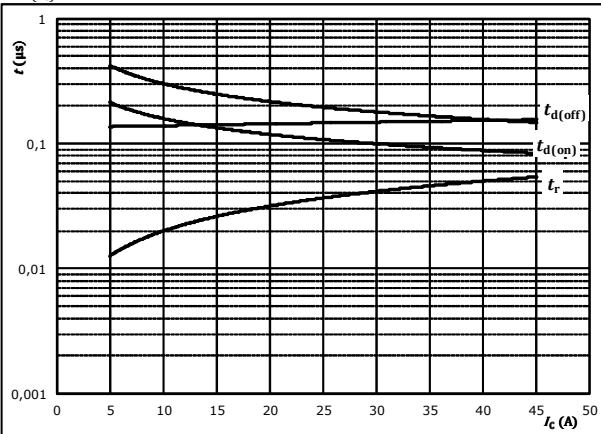


## Inverter Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



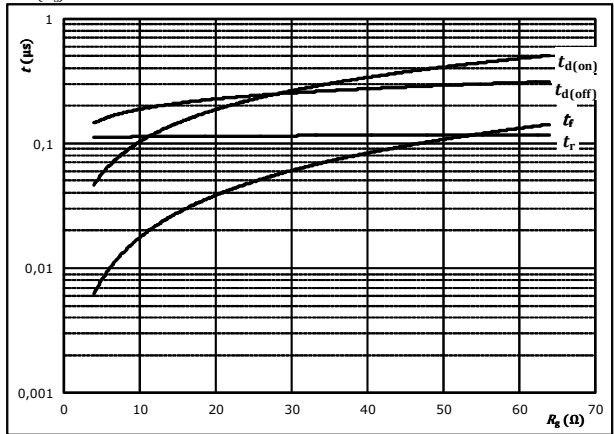
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	16	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



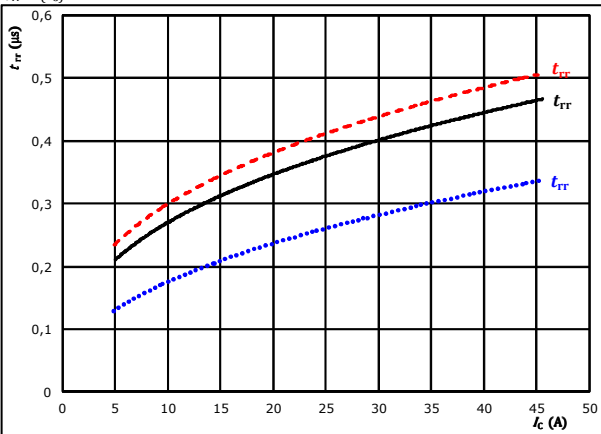
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	25	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

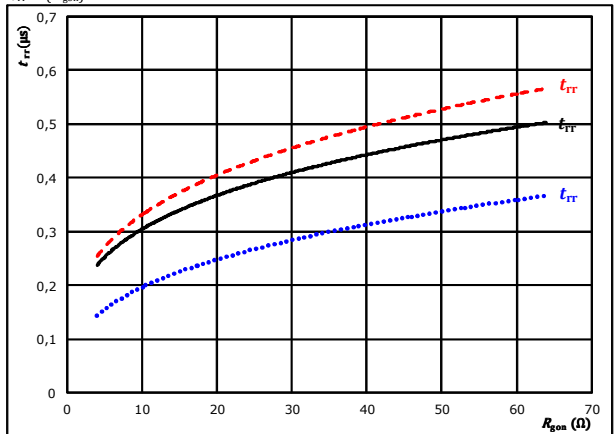


At	$V_{CE} =$	600	V	$T_j:$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	16	Ω		150 °C	-----

**figure 8.** FWD

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

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

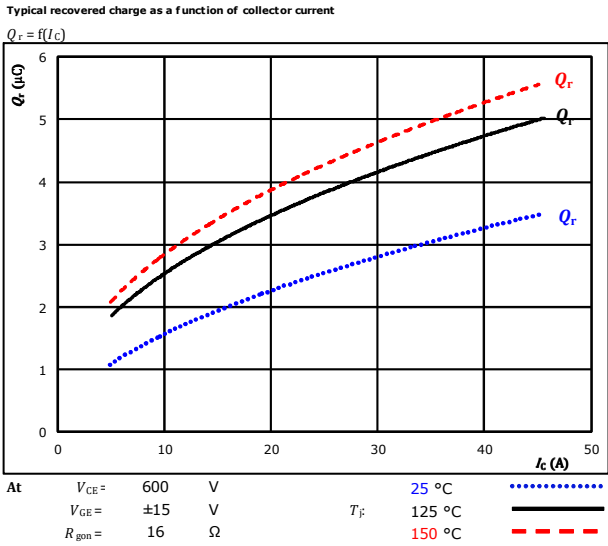


At	$V_{CE} =$	600	V	$T_j:$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$I_C =$	25	A		150 °C	-----

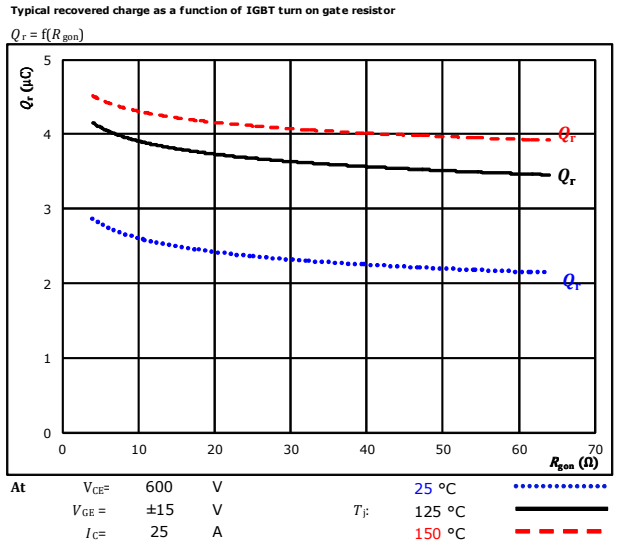


## Inverter Switching Characteristics

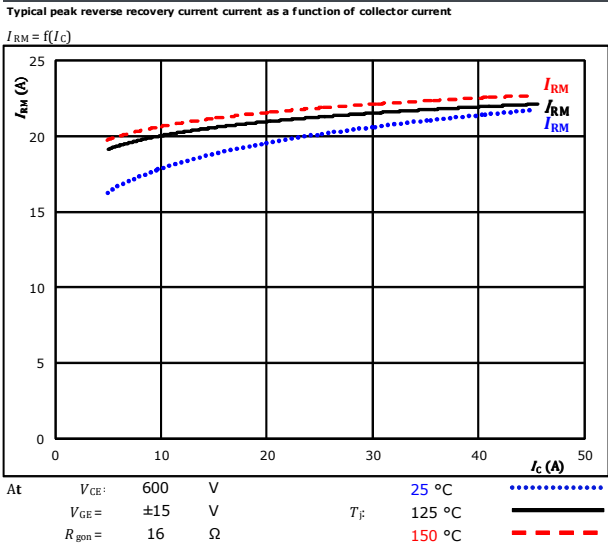
**figure 9.** FWD



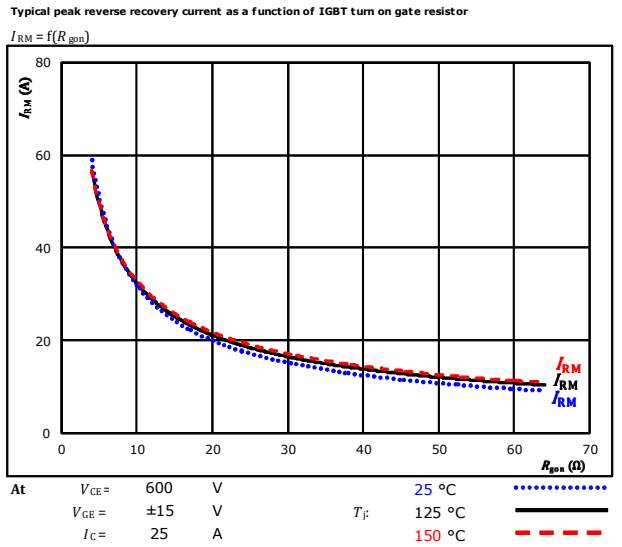
**figure 10.** FWD



**figure 11.** FWD



**figure 12.** FWD

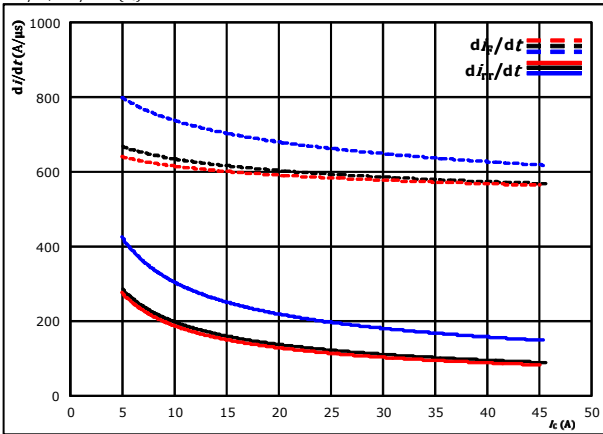




## Inverter Switching Characteristics

**figure 13.** FWD

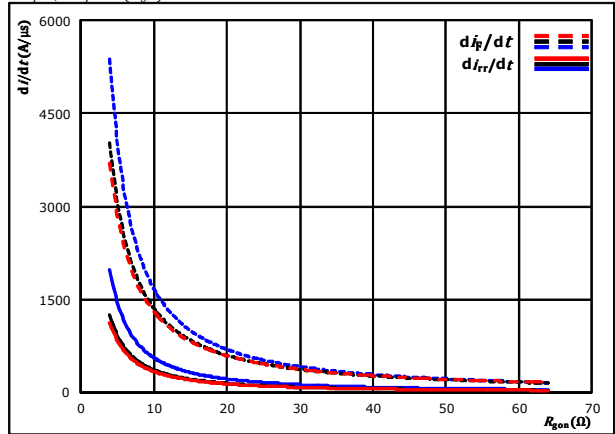
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 600$  V  $T_j = 25$  °C  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C  
 $R_{gpn} = 16$  Ω  $T_j = 150$  °C

**figure 14.** FWD

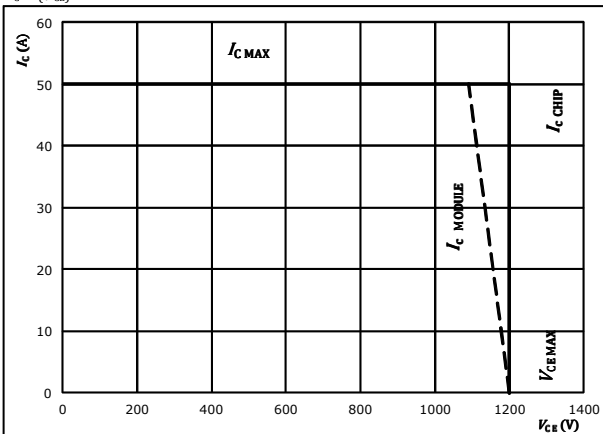
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{gon})$



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

**figure 15.** IGBT

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



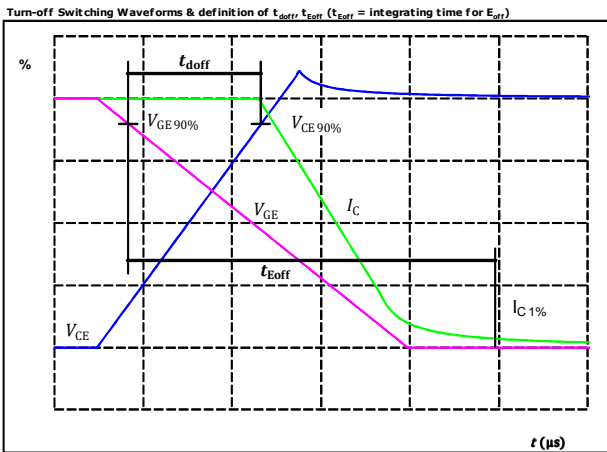
At  $T_j = 125$  °C  
 $R_{gpn} = 16$  Ω  
 $R_{goff} = 16$  Ω



## Inverter Switching Definitions

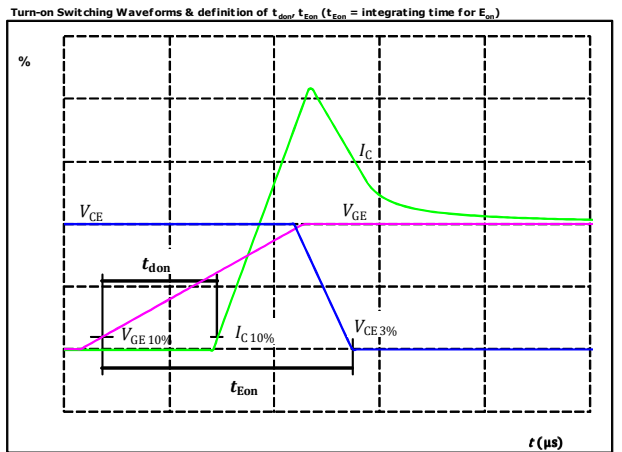
General conditions		
$T_j$	=	125 °C
$R_{gon}$	=	16 $\Omega$
$R_{goff}$	=	16 $\Omega$

**figure 1.** IGBT



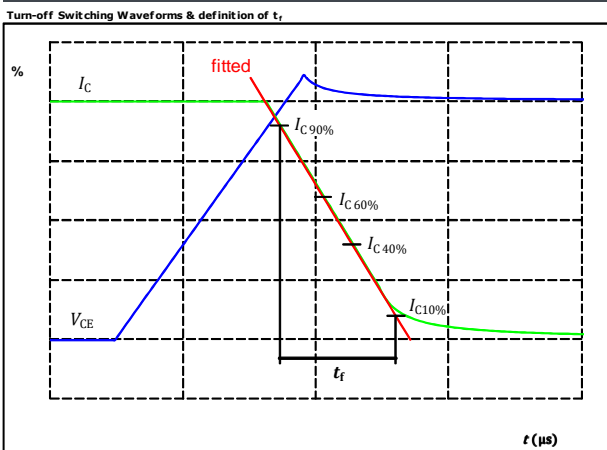
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_{doff} =$	191	ns

**figure 2.** IGBT



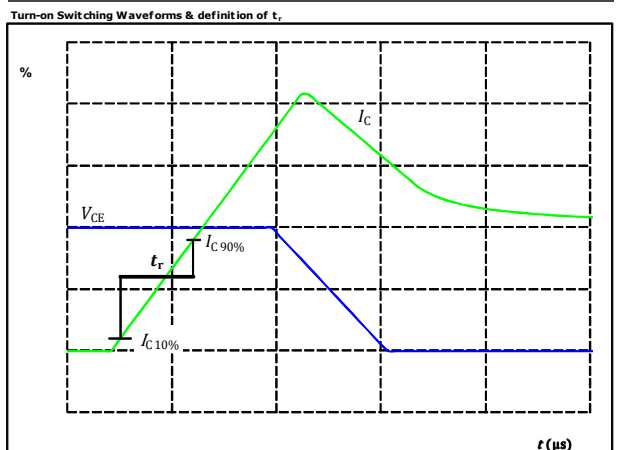
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_{don} =$	149	ns

**figure 3.** IGBT



$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_r =$	110	ns

**figure 4.** IGBT



$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_r =$	33	ns

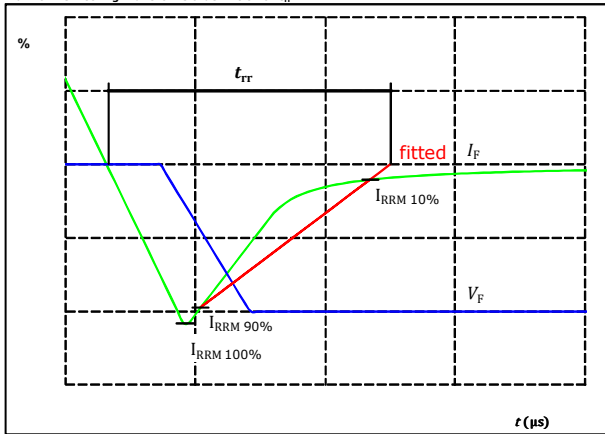


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**10-EY12PMA025M7-L187A78T**  
**10-E212PMA025M7-L187A78Z**  
 datasheet

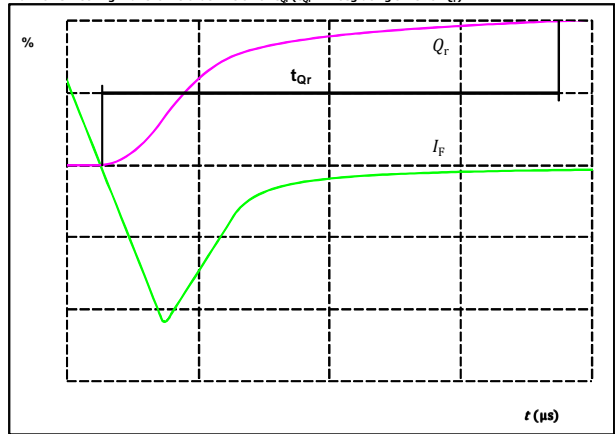
## Inverter Switching Characteristics

**figure 5.** FWD  
 Turn-off Switching Waveforms & definition of  $t_{rr}$



$V_F(100\%) =$	600	V
$I_F(100\%) =$	25	A
$I_{RRM}(100\%) =$	23	A
$t_{rr} =$	367	ns

**figure 6.** FWD  
 Turn-on Switching Waveforms & definition of  $t_{qr}$  ( $t_{qr}$  = integrating time for  $Q_r$ )



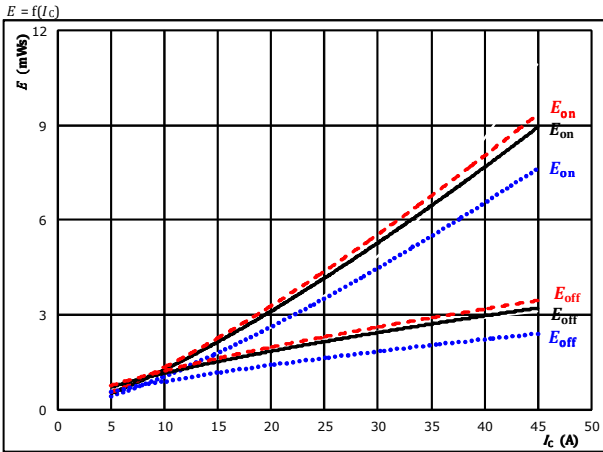
$I_F(100\%) =$	25	A
$Q_r(100\%) =$	3,88	$\mu\text{C}$



## Brake Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

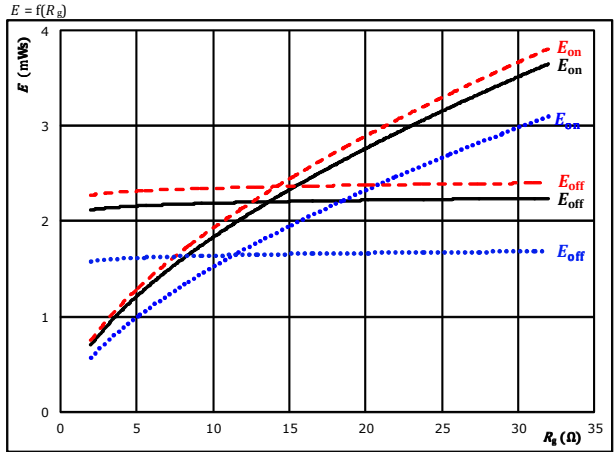


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 32$   $\Omega$

$T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

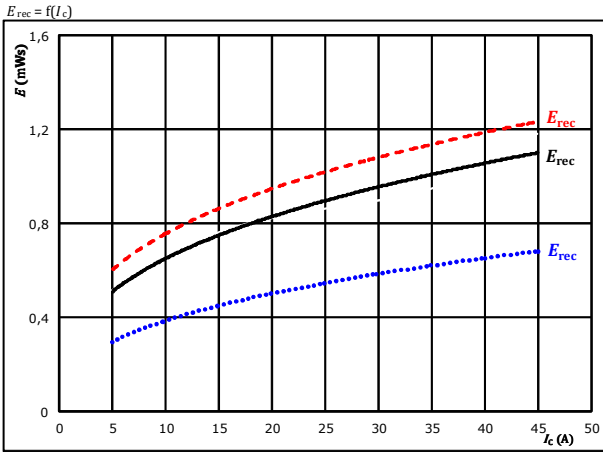


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 25$  A

$T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

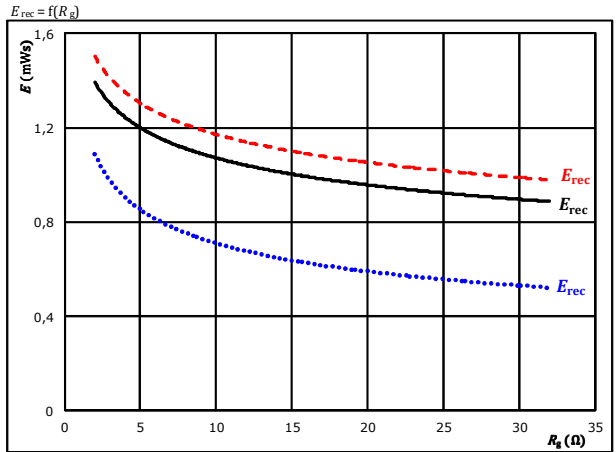


With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 32$   $\Omega$

$T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 25$  A

$T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)



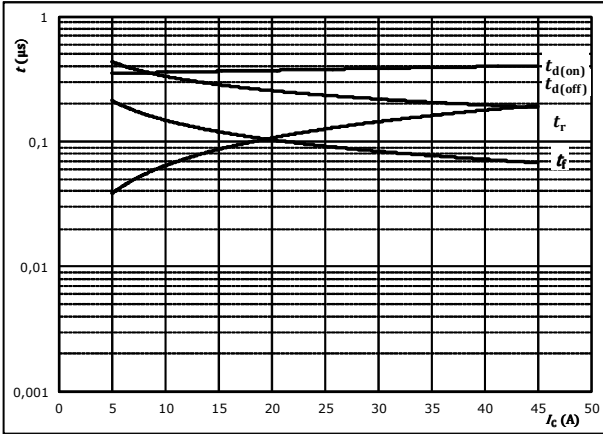
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## Brake Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



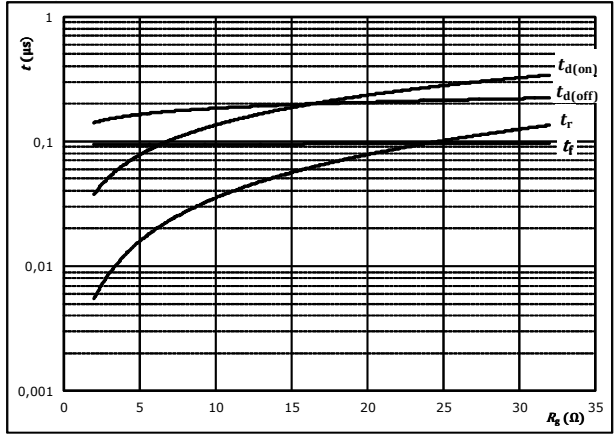
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω
$R_{goff} =$	32	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



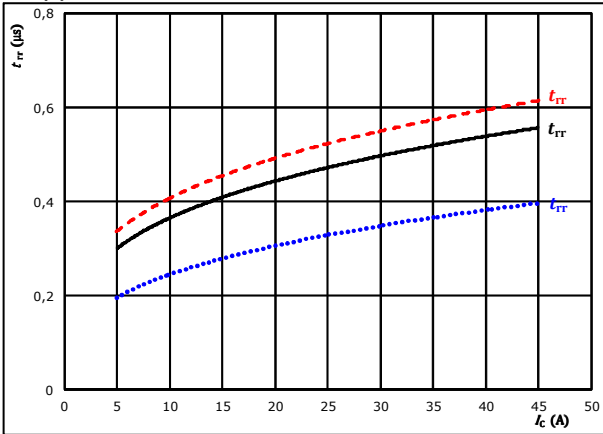
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	25	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

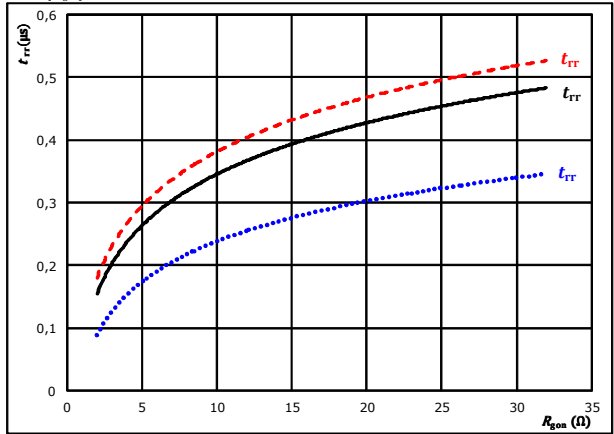


At	$V_{CE} =$	600	V	$T_j:$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	32	Ω		150 °C	-----

**figure 8.** FWD

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

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



At	$V_{CE} =$	600	V	$T_j:$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$I_C =$	25	A		150 °C	-----

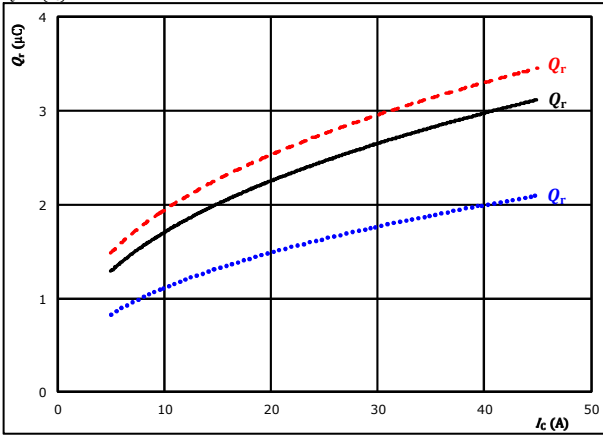


## Brake Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

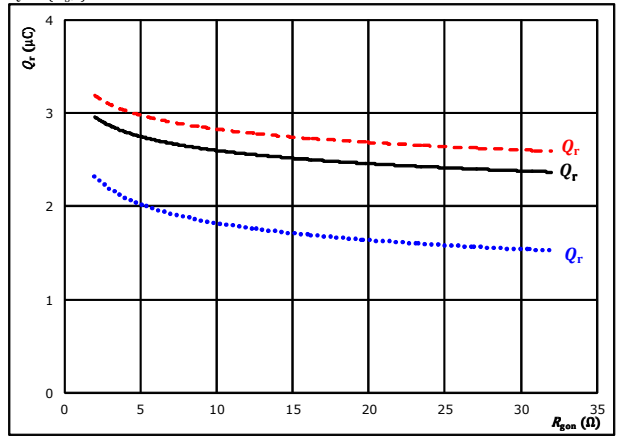


At  $V_{CE} = 600$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C (solid black)  
 $R_{gdn} = 32$  Ω  $T_j = 150$  °C (dashed red)

**figure 10.** FWD

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

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

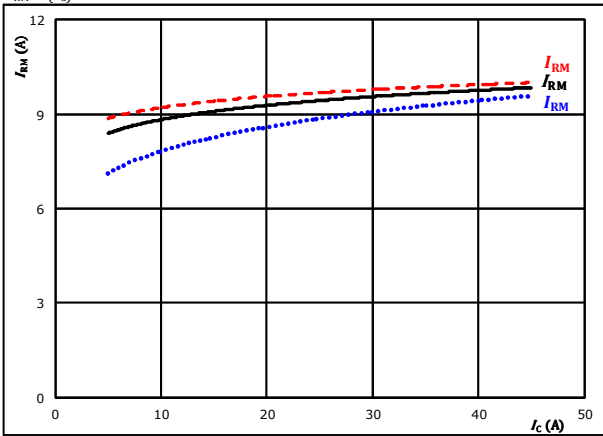


At  $V_{CE} = 600$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C (solid black)  
 $I_c = 25$  A  $T_j = 150$  °C (dashed red)

**figure 11.** FWD

Typical peak reverse recovery current as a function of collector current

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

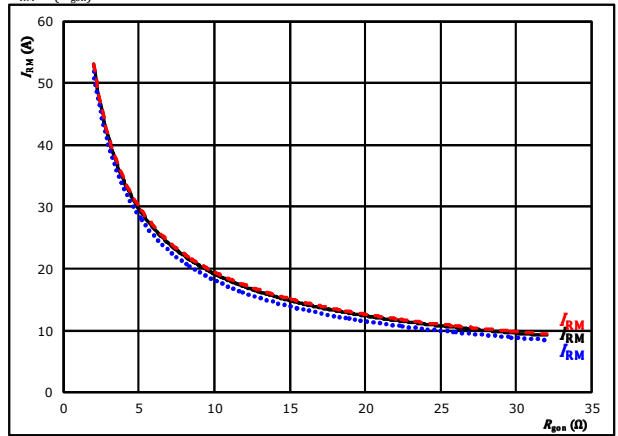


At  $V_{CE} = 600$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C (solid black)  
 $R_{gdn} = 32$  Ω  $T_j = 150$  °C (dashed red)

**figure 12.** FWD

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

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



At  $V_{CE} = 600$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C (solid black)  
 $I_c = 25$  A  $T_j = 150$  °C (dashed red)

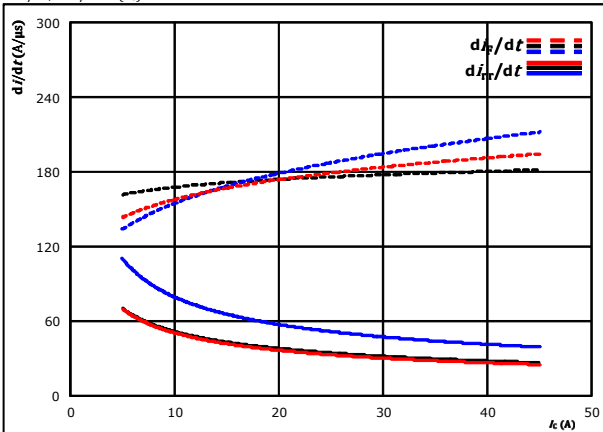




## Brake Switching Characteristics

**figure 13.** FWD

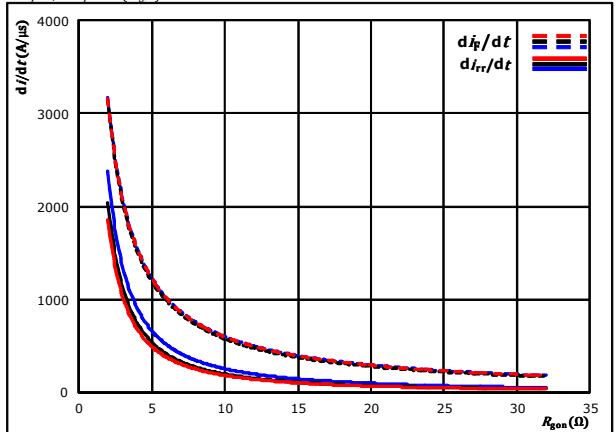
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



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

**figure 14.** FWD

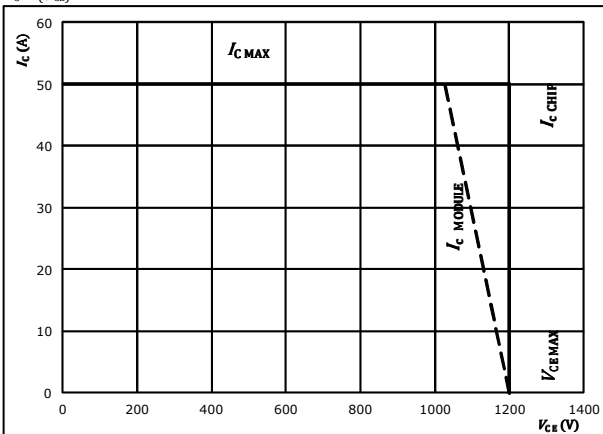
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



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

**figure 15.** IGBT

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



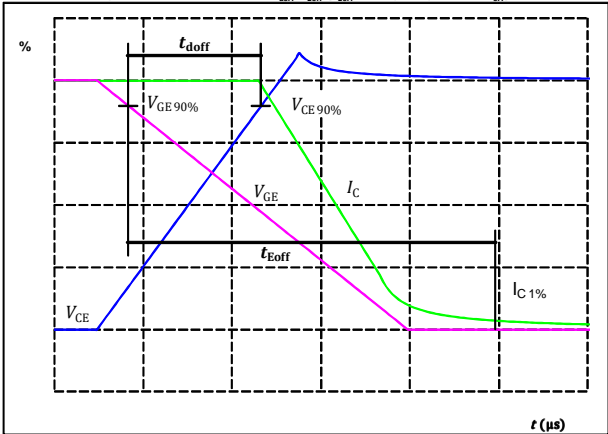
At  $T_j = 125$  °C  
 $R_{g(on)} = 32$  Ω  
 $R_{g(off)} = 32$  Ω



### Brake Switching Definitions

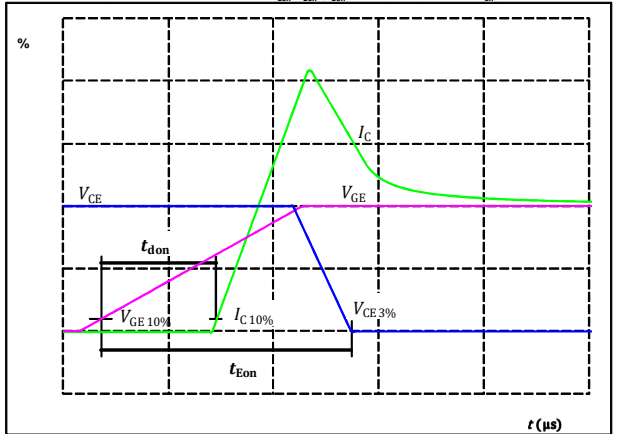
General conditions		
$T_j$	=	125 °C
$R_{gon}$	=	32 $\Omega$
$R_{goff}$	=	32 $\Omega$

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



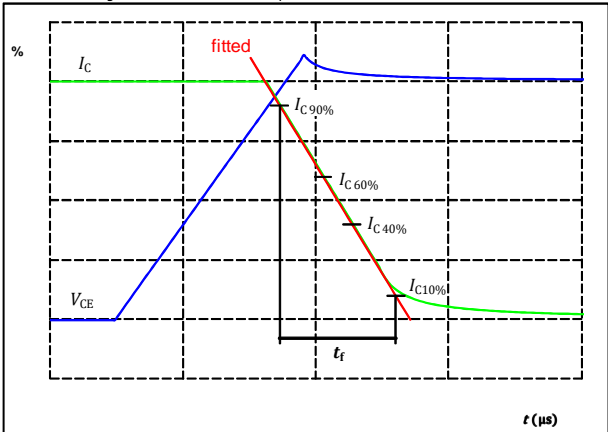
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_{doff} =$	233	ns

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



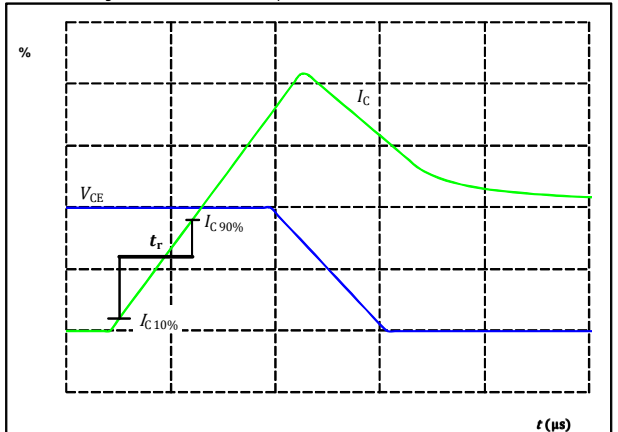
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_{don} =$	389	ns

figure 3. IGBT  
 Turn-off Switching Waveforms & definition of  $t_r$



$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_r =$	93	ns

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

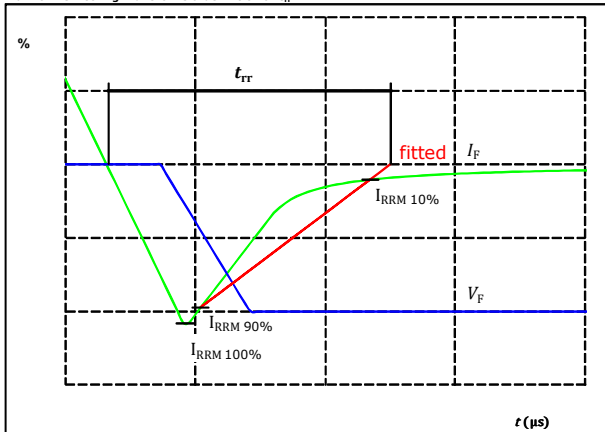


$V_C(100\%) =$	600	V
$I_C(100\%) =$	25	A
$t_r =$	117	ns



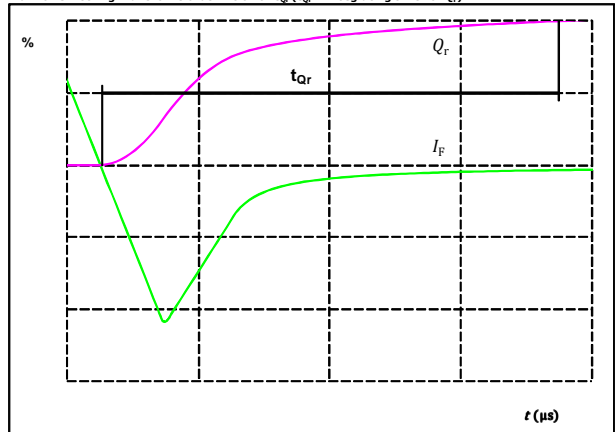
## Brake Switching Characteristics

**figure 5.** FWD  
 Turn-off Switching Waveforms & definition of  $t_{rr}$



$V_F(100\%) =$	600	V
$I_F(100\%) =$	25	A
$I_{RRM}(100\%) =$	10	A
$t_{rr} =$	448	ns

**figure 6.** FWD  
 Turn-on Switching Waveforms & definition of  $t_{qr}$  ( $t_{qr} =$  integrating time for  $Q_r$ )



$I_F(100\%) =$	25	A
$Q_r(100\%) =$	2,34	$\mu\text{C}$



Ordering Code & Marking								
Version			Ordering Code					
without thermal paste 12 mm housing with press-fit pins			10-EY12PMA025M7-L187A78T					
with thermal paste 12 mm housing with press-fit pins			10-EY12PMA025M7-L187A78T-/3/					
without thermal paste 12 mm housing with Solder pins			10-E212PMA025M7-L187A78Z					
with thermal paste 12 mm housing with Solder pins			10-E212PMA025M7-L187A78Z-/3/					
NN-NNNNNNNNNNNN TTTTWW WWYY UL VIN LLLL SSSS			Text	Name	Date code	UL & VIN	Lot	Serial
				NN-NNNNNNNNNNNN-TTTTWW	WWYY	UL VIN	LLLLL	SSSS
			Datamatrix	Type&Ver	Lot number	Serial	Date code	
			TTTTTWW	LLLLL	SSSS	WWYY		

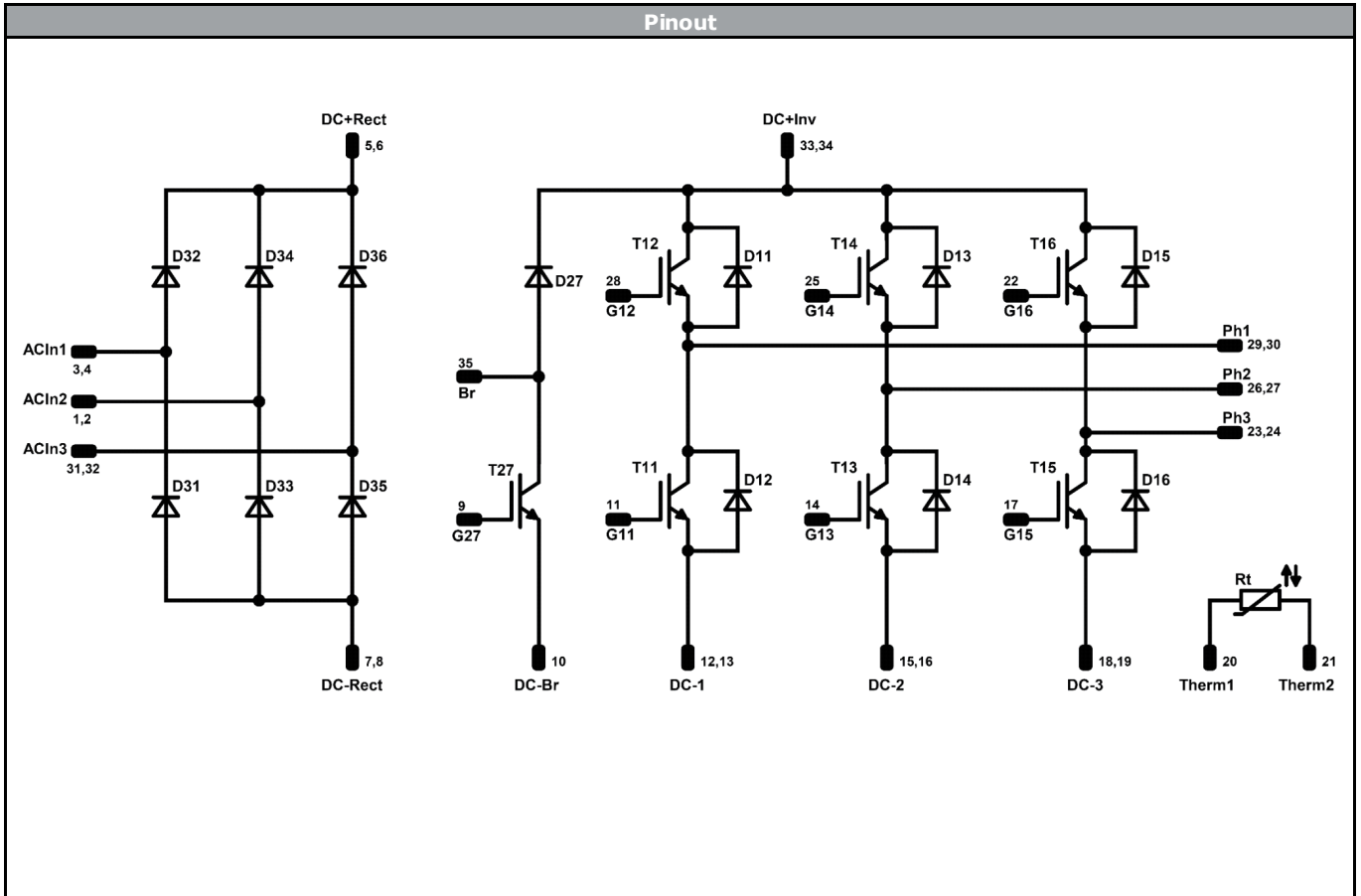
Pin table				Outline	
Pin	X	Y	Function		
1	25,6	6,4	ACIn2		L187F78Z
2	22,4	6,4	ACIn2		
3	16	9,6	ACIn1		
4	12,8	9,6	ACIn1		
5	9,6	0	DC+Rect		
6	9,6	3,2	DC+Rect		
7	0	0	DC-Rect		
8	0	3,2	DC-Rect		
9	0	16	G27		L187F78T
10	0	19,2	DC-Br		
11	0	22,4	G11		
12	0	25,6	DC-1		
13	0	28,8	DC-1		
14	0	32	G13		
15	0	35,2	DC-2		
16	0	38,4	DC-2		
17	0	41,6	G15		
18	0	44,8	DC-3		
19	0	48	DC-3		
20	9,6	48	Therm1		
21	19,2	48	Therm2		
22	28,8	48	G16		
23	32	48	Ph3		
24	32	44,8	Ph3		
25	32	35,2	G14		
26	32	32	Ph2		
27	32	28,8	Ph2		
28	32	19,2	G12		
29	32	16	Ph1		
30	32	12,8	Ph1		
31	32	3,2	ACIn3		
32	32	0	ACIn3		
33	22,4	19,2	DC+Inv		
34	22,4	16	DC+Inv		
35	9,6	19,2	Br		

center of press-fit pinhead  
for connection parameter see the handling instruction

Tolerance of pinpositions: ±0.4mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance



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<b>Identification</b>					
<b>ID</b>	<b>Component</b>	<b>Voltage</b>	<b>Current</b>	<b>Function</b>	<b>Comment</b>
T11, T12, T13, T14, T15, T16	IGBT	1200 V	25 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	25 A	Inverter Diode	
T27	IGBT	1200 V	25 A	Brake Switch	
D27	FWD	1200 V	10 A	Brake Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	45 A	Rectifier Diode	
Rt	NTC			Thermistor	




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

Handling instruction
Handling instructions for <i>flow</i> E2 packages see vincotech.com website.

Package data
Package data for <i>flow</i> E2 packages see 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-Ex12PMA025M7-L187A78x-D2-14	17 Oct. 2018	Added Z option to ordering code	All

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Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

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.