



flowPIM E1

1200 V / 25 A

Topology features

- Converter+Inverter
- Open Emitter configuration
- Temperature sensor

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
- Press-fit pin
- Reliable cold welding connection

Target applications

- Embedded Drives
- Heat Pumps
- HVAC

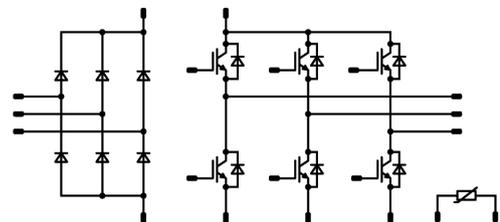
Types

- 10-EZ12PNB025M701-PS09C78T

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)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	34	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	83	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	$^{\circ}\text{C}$
<b>Inverter Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	62	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$
<b>Rectifier Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	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	$I^2t$		365	$\text{A}^2\text{s}$
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	83	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$



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**10-EZ12PNB025M701-PS09C78T**  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
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### 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
		$V_{GE}$ [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	$V_{GE(th)}$			10	0,0025	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		25	25 125 150		1,64 1,89 1,95	2,1 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			70	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			200	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							4800		pF
Output capacitance	$C_{oes}$		0	10		25		170		pF
Reverse transfer capacitance	$C_{res}$							57		pF
Gate charge	$Q_g$	$V_{CC} = 600$ V	0/15		25	25		180		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,14		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		167,94 166,16 165,53		ns
Rise time	$t_r$					25 125 150		49,56 54,18 55,87		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		168,76 196,56 202,54		ns
Fall time	$t_f$					25 125 150		112,71 150,28 156,16		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1,78$ μC $Q_{tFWD} = 2,74$ μC $Q_{tFWD} = 3,07$ μC				25 125 150		2,35 2,9 3,07		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,05 2,96 3,2		mWs



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10-EZ12PNB025M701-PS09C78T  
datasheet

### 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	$V_F$				25	25 125 150		1,63 1,7 1,69	2,1 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25			35	μA
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,52		K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RM}$	$di/dt=370$ A/μs $di/dt=346$ A/μs $di/dt=363$ A/μs	±15	600	25	25 125 150		15,24 16,49 17,02		A
Reverse recovery time	$t_{rr}$					25 125 150		241,75 359,34 394,88		ns
Recovered charge	$Q_r$					25 125 150		1,78 2,74 3,07		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,566 0,95 1,08		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		178,38 106,89 109,16		A/μs



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### Characteristic Values

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

#### Rectifier Diode

##### Static

Forward voltage	$V_F$				28	25 125 150		1,13 1,07 1,06	1,5 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1600$ V				25 150			50 1000	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,14		K/W
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#### Thermistor

##### Static

Rated resistance	$R$					25		5		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 499$ Ω				100	3,2		3,3	%
Power dissipation	$P$					25		130		mW
Power dissipation constant	$d$					25		1,3		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %						3380		K
Vincotech Thermistor Reference									V	

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

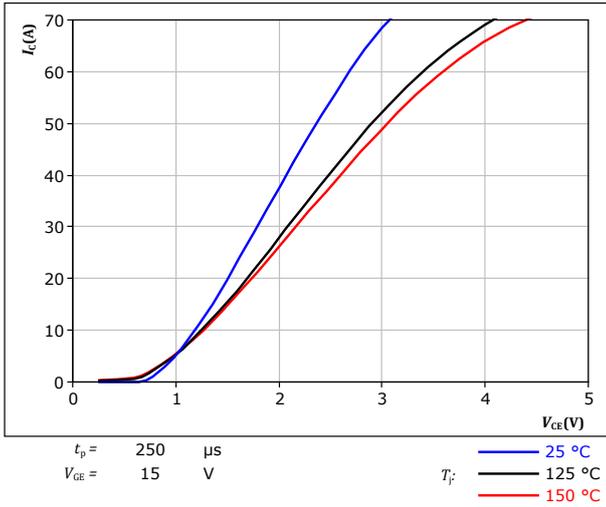
<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.



## Inverter Switch Characteristics

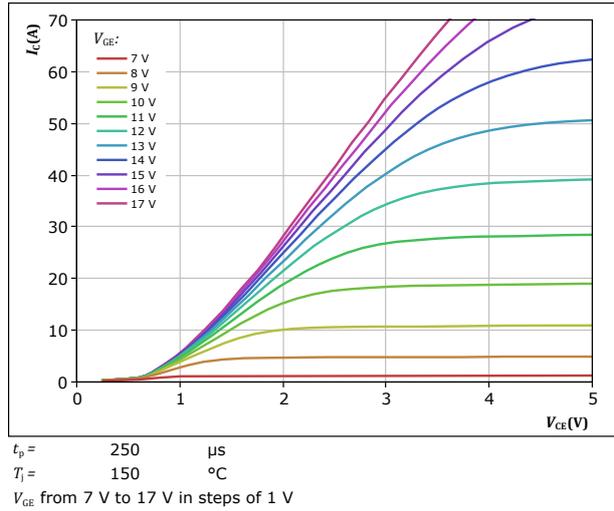
**figure 1.** IGBT

Typical output characteristics  
 $I_C = f(V_{CE})$



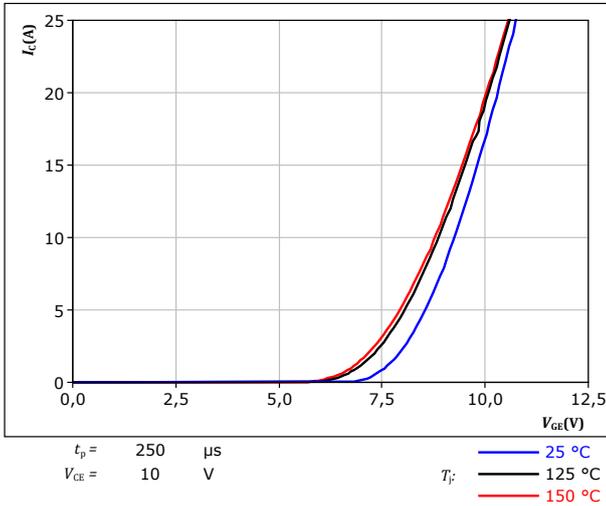
**figure 2.** IGBT

Typical output characteristics  
 $I_C = f(V_{CE})$



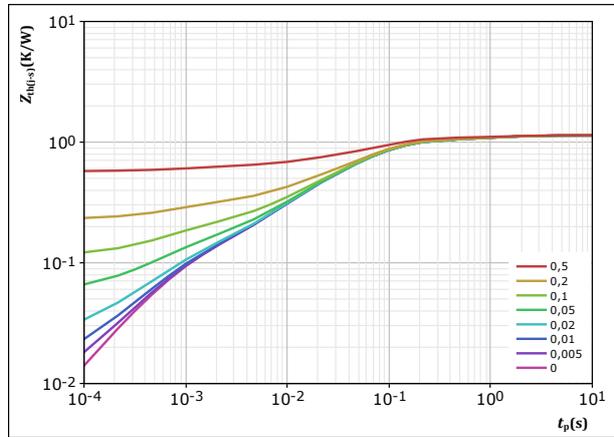
**figure 3.** IGBT

Typical transfer characteristics  
 $I_C = f(V_{GE})$



**figure 4.** IGBT

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,14 \text{ K/W}$

IGBT thermal model values

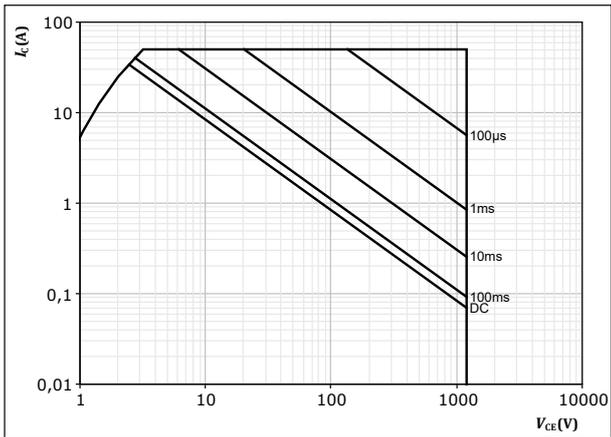
$R$ (K/W)	$\tau$ (s)
1,05E-02	5,09E+01
1,29E-01	9,55E-01
7,00E-01	6,73E-02
2,16E-01	1,18E-02
8,86E-02	7,42E-04



### Inverter Switch Characteristics

figure 5. IGBT

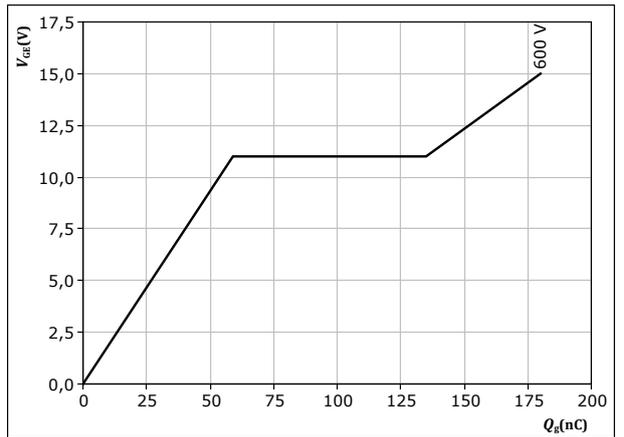
Safe operating area  
 $I_C = f(V_{CE})$



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

figure 6. IGBT

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



$I_C = 25 \text{ A}$   
 $T_j = 25 \text{ } ^\circ\text{C}$



### Inverter Diode Characteristics

figure 7. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

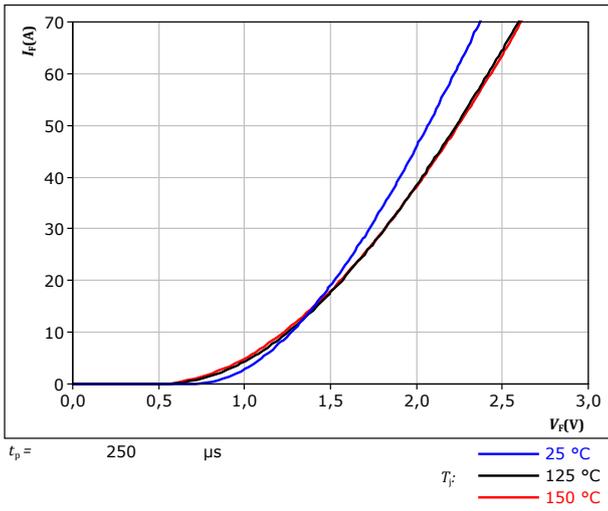
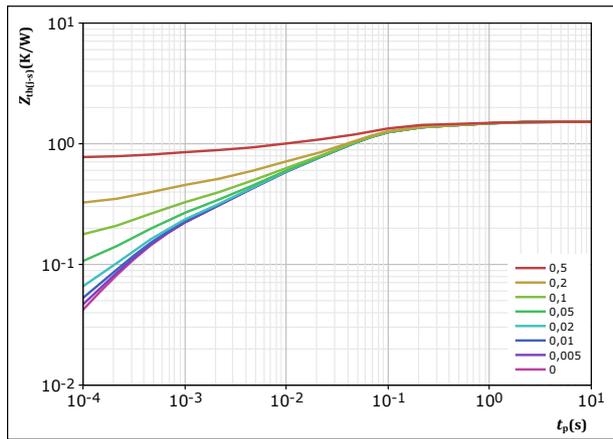


figure 8. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,521 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
1,48E-02	3,86E+01
1,93E-01	6,07E-01
8,65E-01	4,72E-02
2,90E-01	4,79E-03
1,65E-01	4,29E-04



## Rectifier Diode Characteristics

figure 9. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

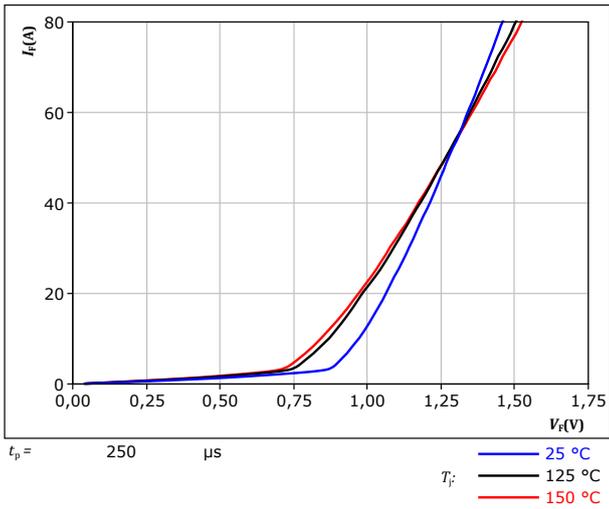
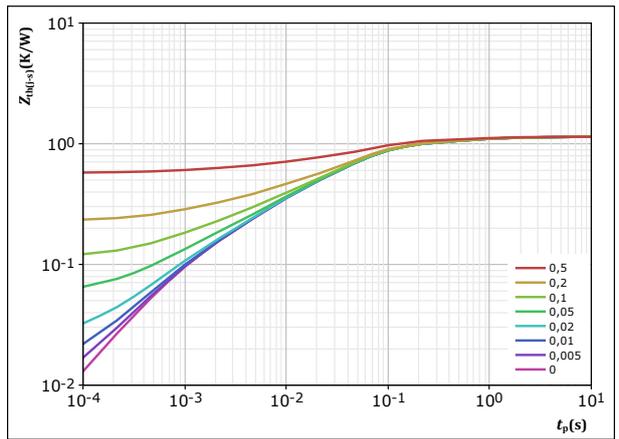


figure 10. Rectifier

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	1,144	K/W
Rectifier thermal model values		
$R$ (K/W)	$\tau$ (s)	
2,95E-02	5,91E+00	
1,75E-01	4,94E-01	
6,73E-01	5,14E-02	
1,96E-01	6,18E-03	
7,54E-02	8,36E-04	

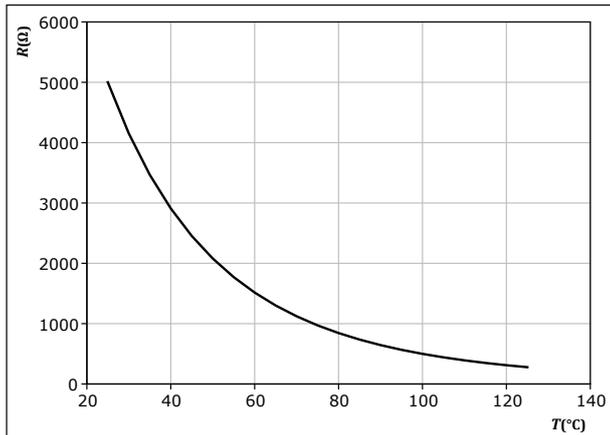


## Thermistor Characteristics

figure 11. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

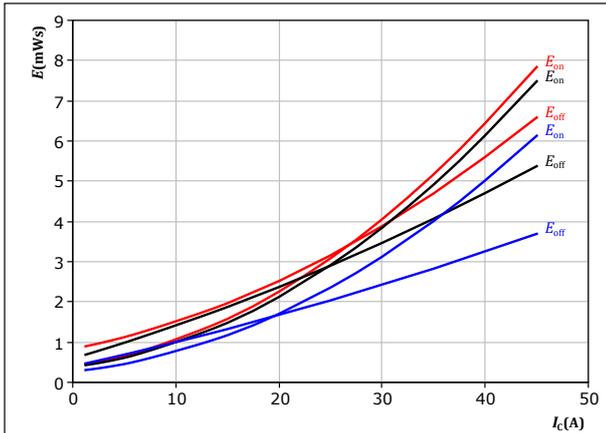




## Inverter Switching Characteristics

**figure 12.** IGBT

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

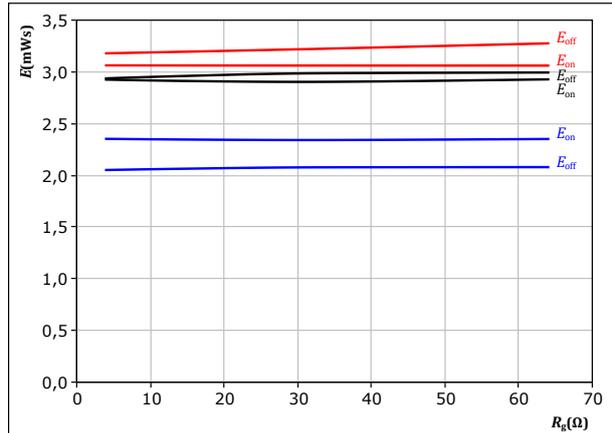


With an inductive load at

$V_{CE} =$	600	V	$T_j:$	25 °C
$V_{GE} =$	±15	V		125 °C
$R_{g(on)} =$	16	Ω		150 °C
$R_{g(off)} =$	16	Ω		

**figure 13.** IGBT

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

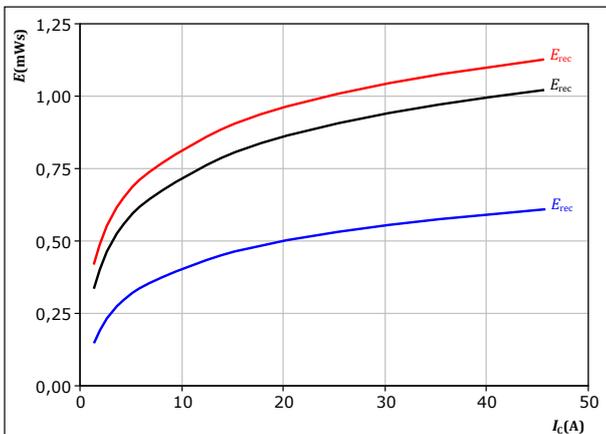


With an inductive load at

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

**figure 14.** FWD

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

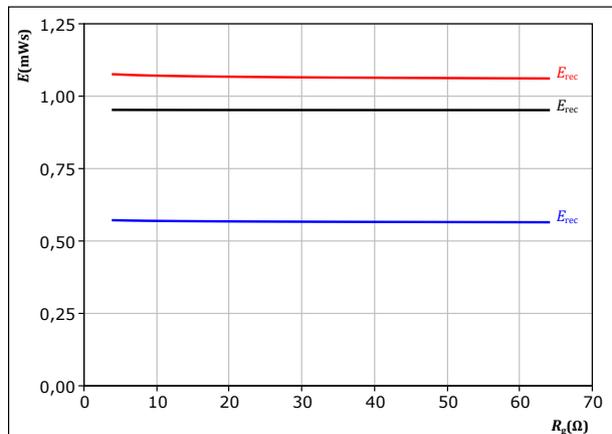


With an inductive load at

$V_{CE} =$	600	V	$T_j:$	25 °C
$V_{GE} =$	±15	V		125 °C
$R_{g(on)} =$	16	Ω		150 °C

**figure 15.** 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

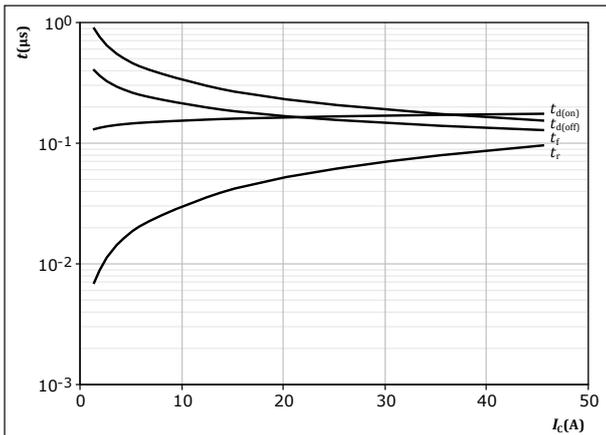
$V_{CE} =$	600	V	$T_j:$	25 °C
$V_{GE} =$	±15	V		125 °C
$I_c =$	25	A		150 °C



## Inverter Switching Characteristics

**figure 16.** IGBT

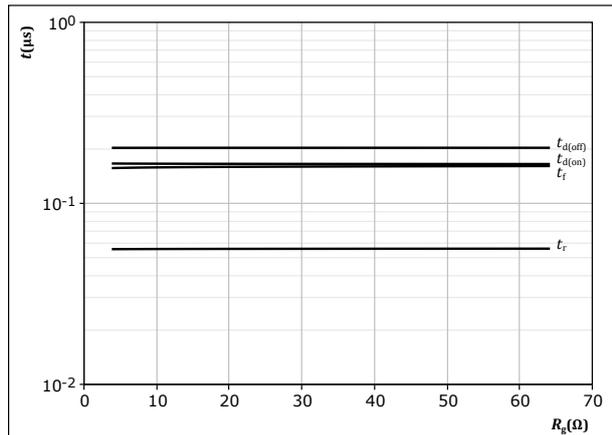
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 16 \text{ } \Omega$   
 $R_{g(off)} = 16 \text{ } \Omega$

**figure 17.** IGBT

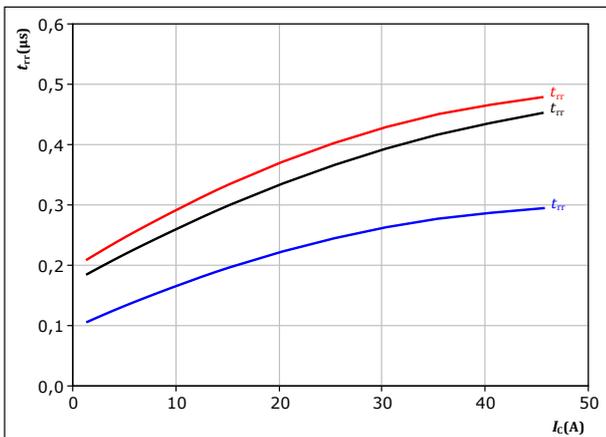
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



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

**figure 18.** FWD

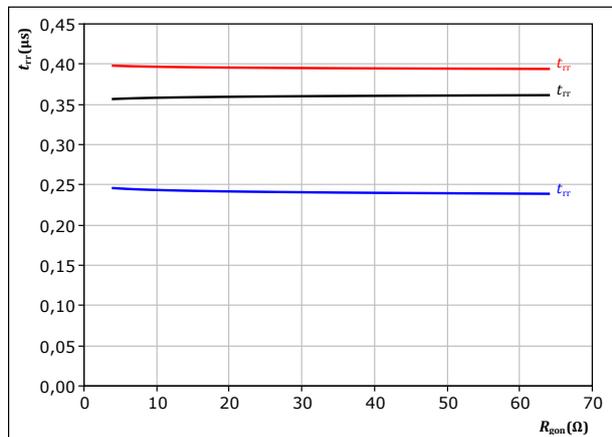
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 16 \text{ } \Omega$   
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 19.** FWD

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



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

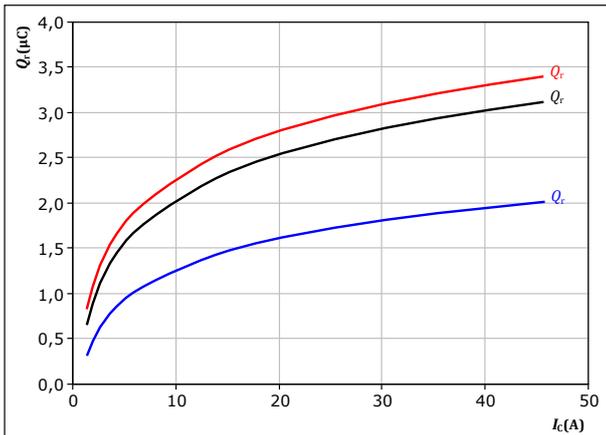


## Inverter Switching Characteristics

figure 20. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

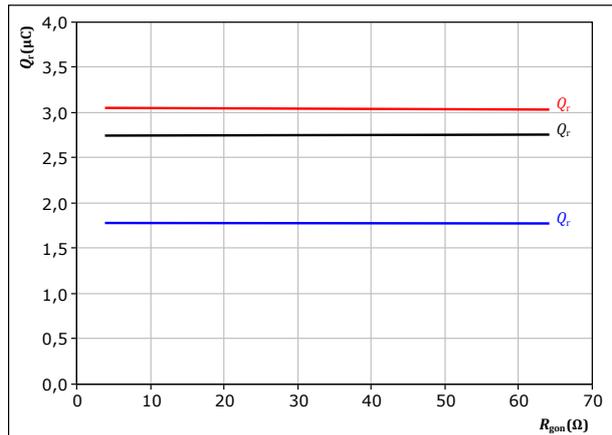
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \ \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 21. FWD

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

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



With an inductive load at

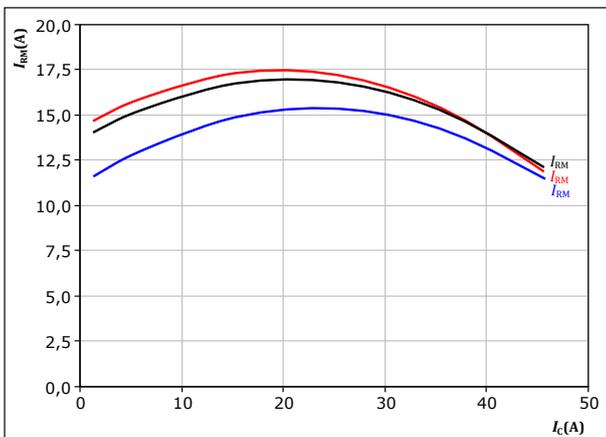
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 25 \text{ A}$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 22. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

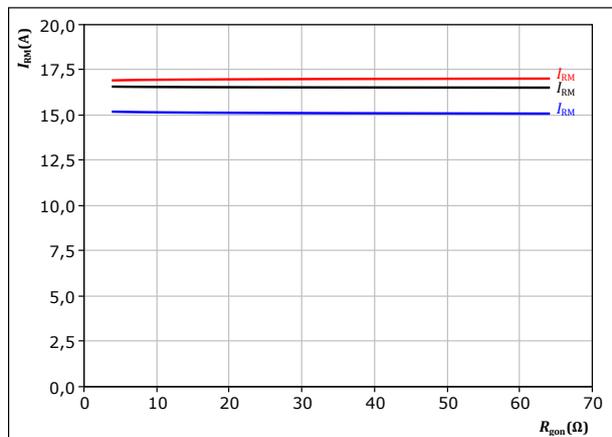
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \ \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 23. 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

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 25 \text{ A}$

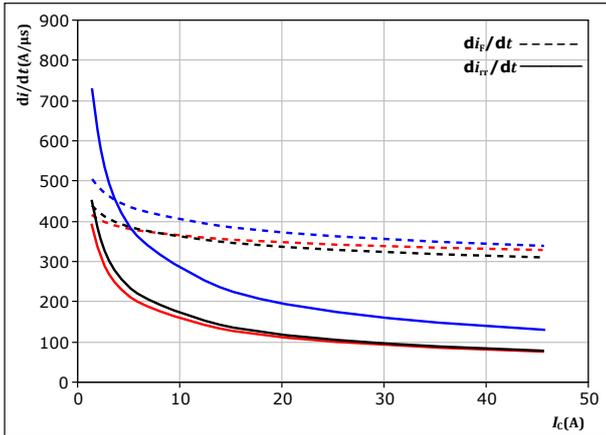
$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



## Inverter Switching Characteristics

figure 24. FWD

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



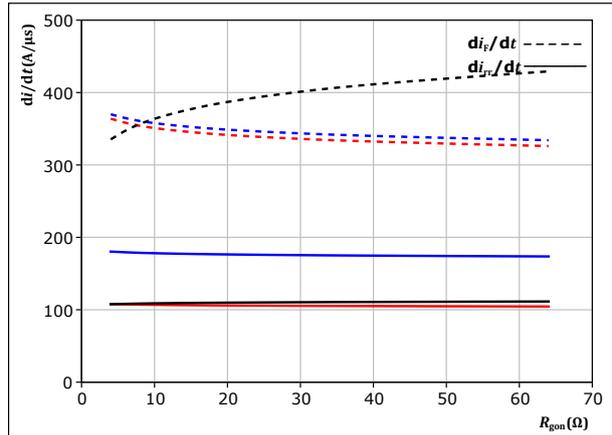
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \ \Omega$

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

figure 25. 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

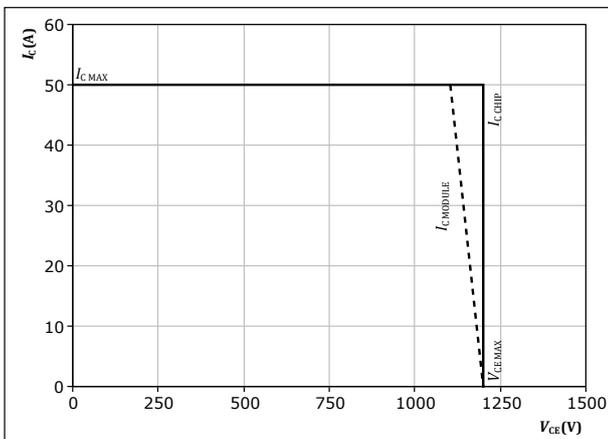
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 25 \text{ A}$

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

figure 26. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



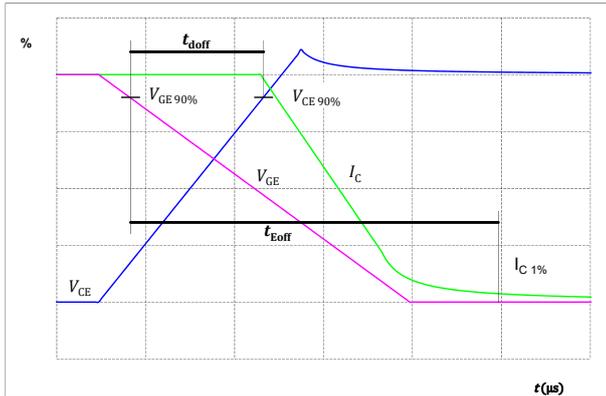
At  $T_j = 150 \text{ °C}$   
 $R_{gon} = 16 \ \Omega$   
 $R_{goff} = 16 \ \Omega$



## Inverter Switching Definitions

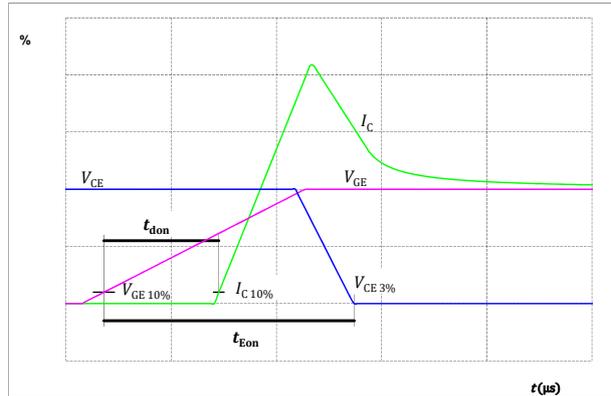
**figure 27.** IGBT

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



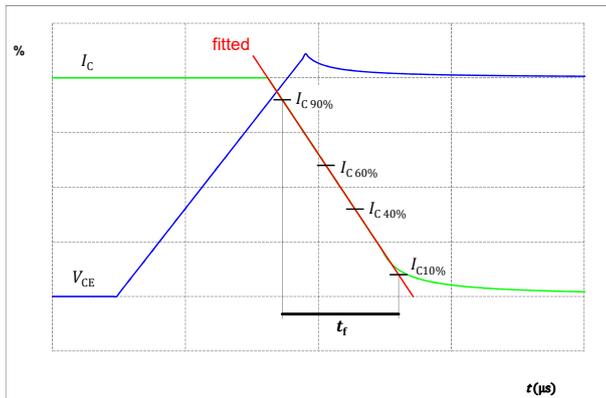
**figure 28.** IGBT

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



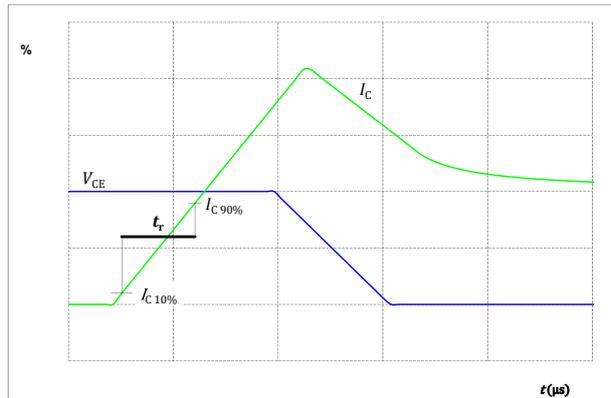
**figure 29.** IGBT

Turn-off Switching Waveforms & definition of  $t_f$



**figure 30.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Inverter Switching Definitions

figure 31. FWD

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

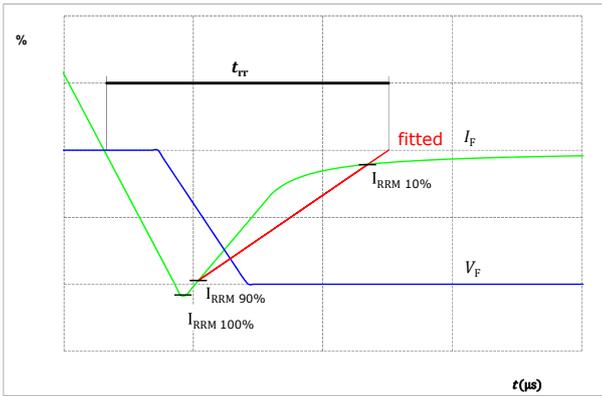
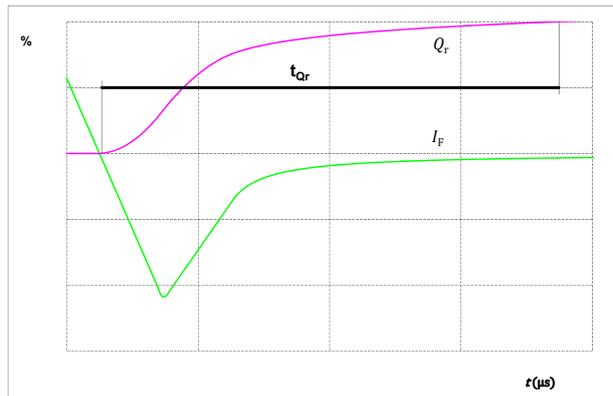


figure 32. FWD

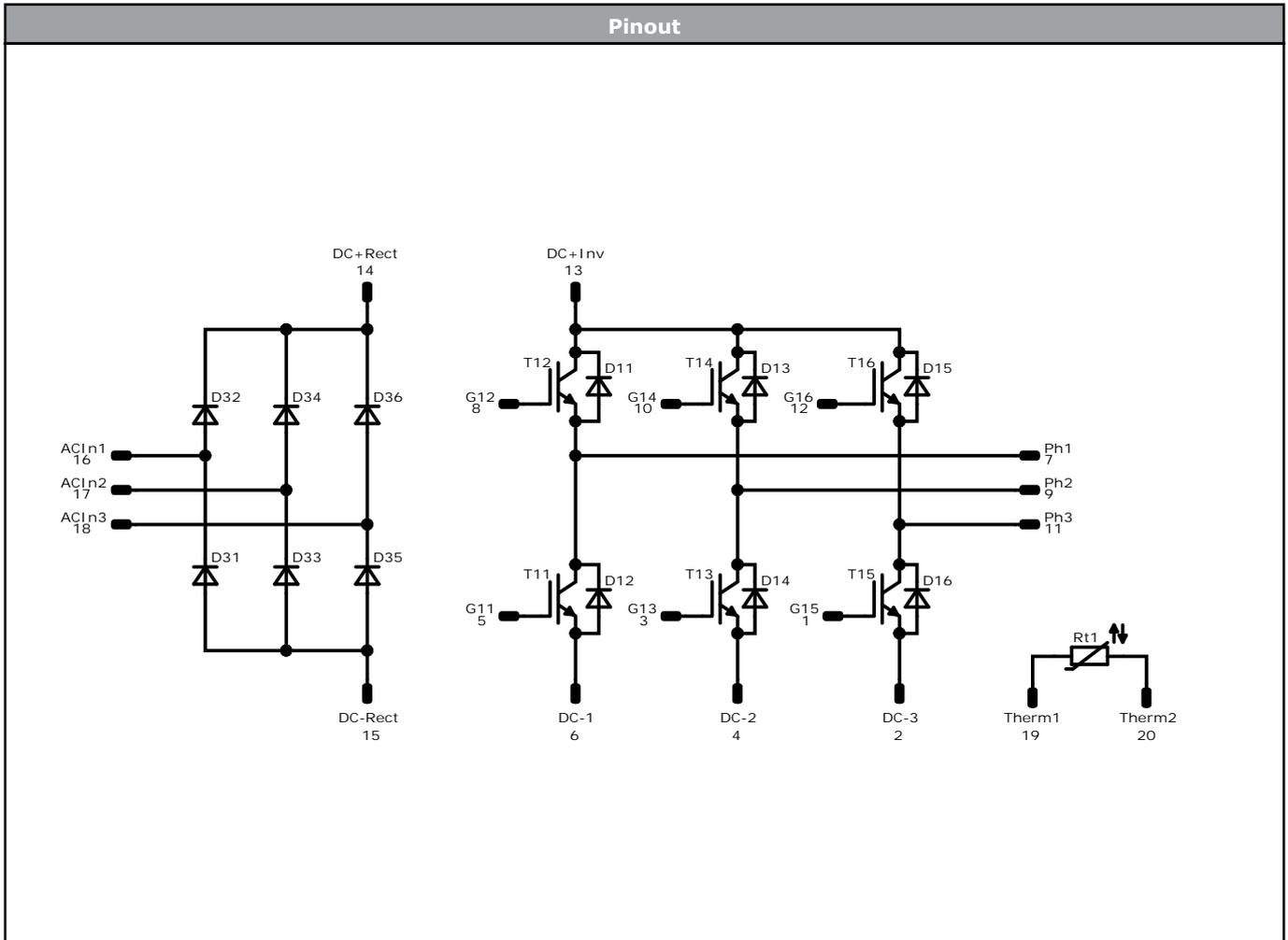
Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr}$  = integrating time for  $Q_r$ )







Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
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	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	28 A	Rectifier Diode	
Rt1	Thermistor			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 UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}=175^{\circ}C$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.



Document No.:	Date:	Modification:	Pages
10-EZ12PNB025M701-PS09C78T-D1-14	9 Oct. 2025	Initial Release	

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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.