
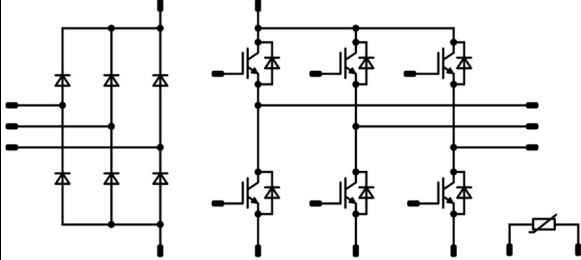




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<i>flow PIM E1</i>	1200 V / 10 A
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Features</p> <ul style="list-style-type: none"> Trenchstop™ IGBT4 technology Standard industrial housing Optimized $R_{th(j-s)}$ with Phase Change Material Built-in NTC </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Target applications</p> <ul style="list-style-type: none"> Industrial Drives </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Types</p> <ul style="list-style-type: none"> 10-EZ12PNA010SC-L927C08T </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;"><i>flow E1 12 mm housing</i></p>  </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Schematic</p>  </div>

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	14	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	59	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$ $V_{CE} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
Maximum junction temperature	T_{jmax}		175	°C



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Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	14	A
Repetitive peak forward current	I_{FRM}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	50	W
Maximum junction temperature	T_{jmax}		175	°C

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	47	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t	$t_p = 10\text{ ms}$	370	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	58	W
Maximum junction temperature	T_{jmax}		150	°C

Module Properties

General Properties

Stray inductance	L_P		30	nH
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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
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			min. 12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*100 % tested in production



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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	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$				0,00035	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15			10	25 125 150	1,58	1,78 2,06 2,10	2,07	V
Collector-emitter cut-off current	I_{CES}		0	1200			25			1,2	μA
Gate-emitter leakage current	I_{GES}		20	0			25			120	nA
Internal gate resistance	r_g								none		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25			25		625		pF
Reverse transfer capacitance	C_{res}								40		

Thermal

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)							1,60		K/W

Dynamic

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	±15	600		10	25 125 150		62		ns
Rise time	t_r								61		
Turn-off delay time	$t_{d(off)}$								60		
Fall time	t_f								24		
Turn-on energy (per pulse)*	E_{on}								186		
Turn-off energy (per pulse)*	E_{off}								243		
									259		
		97									
		155									
		162									
		0,591									
		0,848									
		0,931									
		0,637									
		0,979									
		1,11									

* $L_S = 14 \text{ nH}$



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Characteristic Values

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

Inverter Diode

Static

Forward voltage	V_F				10	25 150		1,77 1,68	2,05	V
Reverse leakage current	I_R			1200		25			2,7	μA

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,91		K/W
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Dynamic

Peak recovery current	I_{RRM}					25 125 150		8 10 11		A
Reverse recovery time	t_{rr}					25 125 150		261 403 436		ns
Recovered charge	Q_r	$di/dt = 425$ A/μs $di/dt = 421$ A/μs $di/dt = 405$ A/μs	±15	600	10	25 125 150		0,908 1,69 1,92		μC
Reverse recovered energy	E_{rec}					25 125 150		0,358 0,684 0,782		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		64 62 55		A/μs

Rectifier Diode

Static

Forward voltage	V_F				35	25 125		1,17 1,13		V
Reverse leakage current	I_R			1600		25			50	μA

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,20		K/W
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Thermistor

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



Inverter Switch Characteristics

figure 1. IGBT

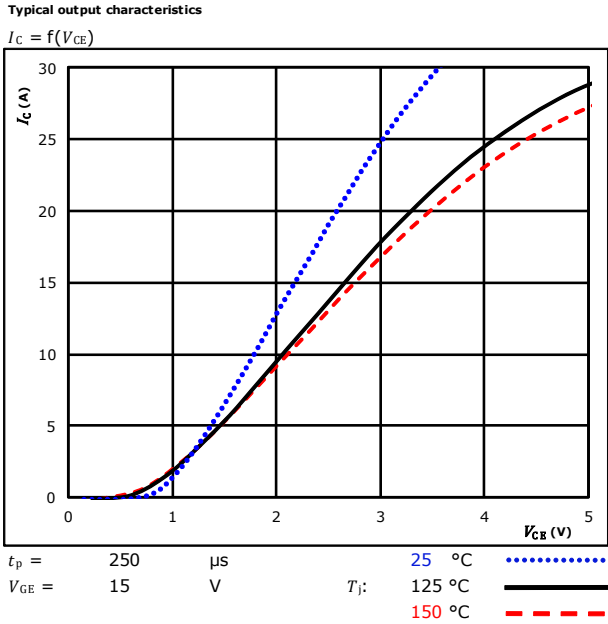


figure 2. IGBT

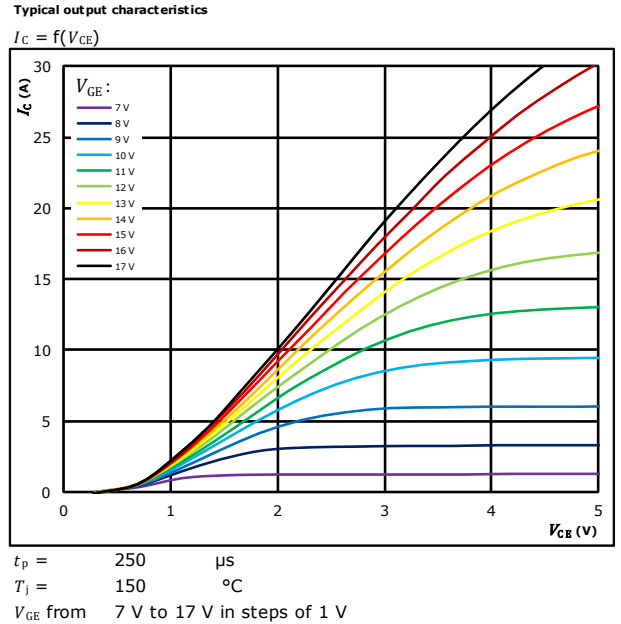


figure 3. IGBT

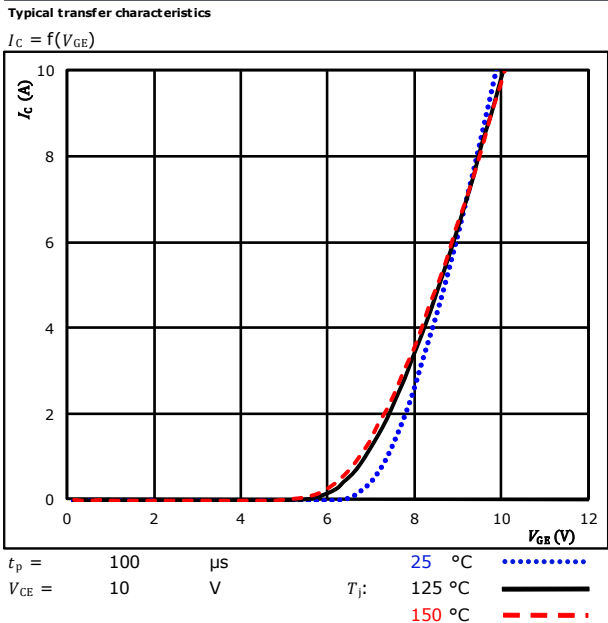
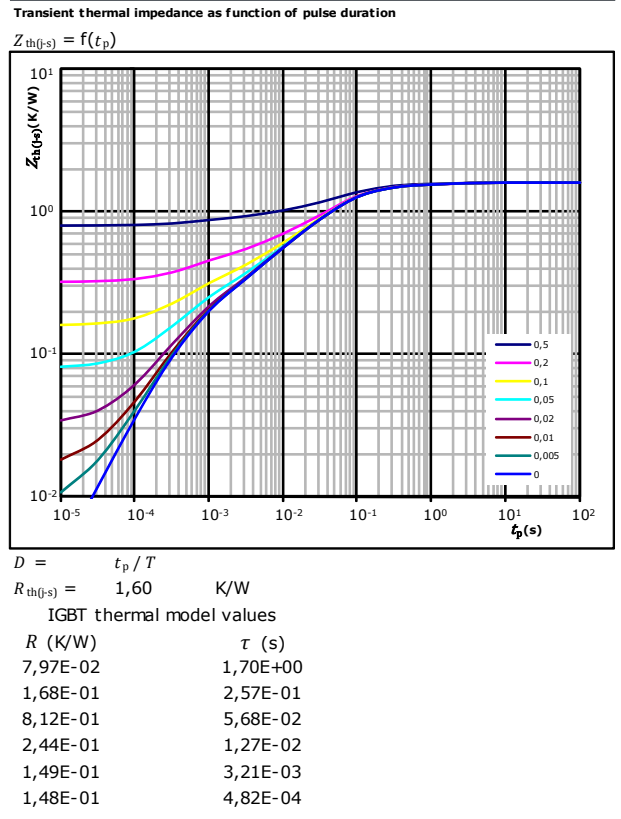


figure 4. IGBT





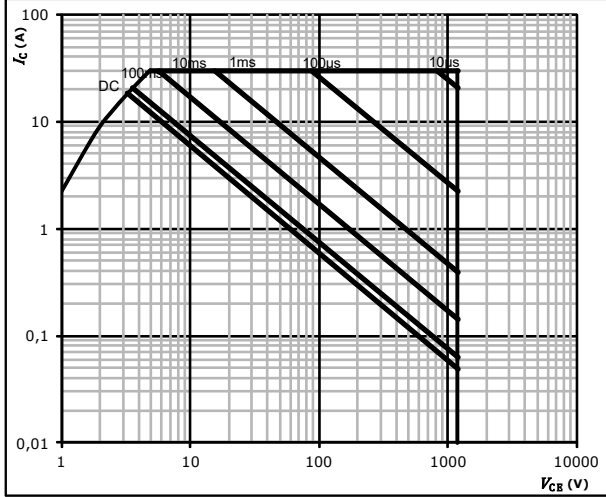
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Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



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



Inverter Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

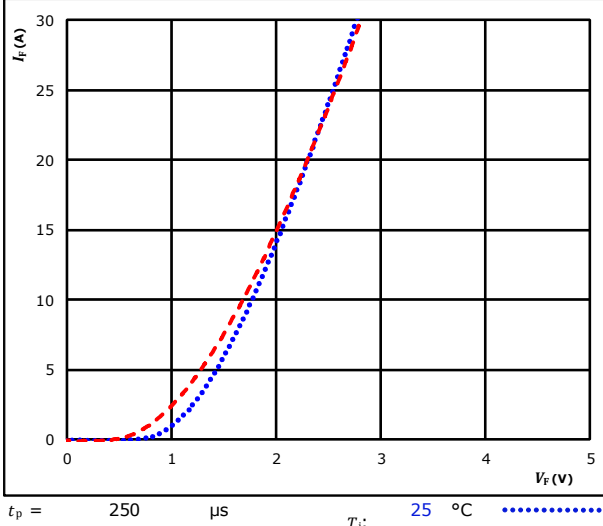
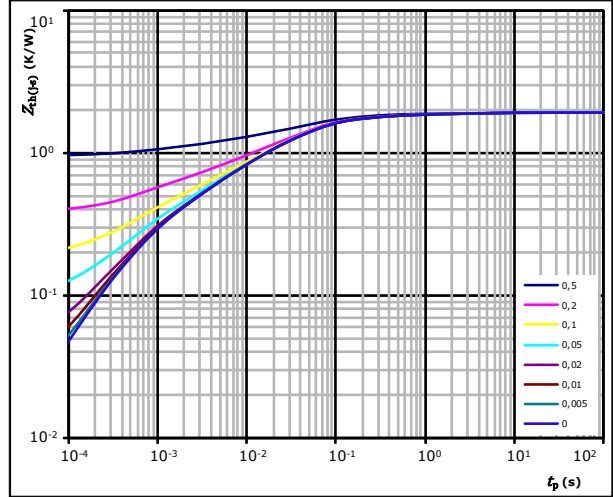


figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$$D = \frac{t_p}{T}$$

$$R_{th(j-s)} = 1,91 \text{ K/W}$$

FWD thermal model values

R (K/W)	τ (s)
6,90E-02	3,61E+00
1,74E-01	3,07E-01
8,07E-01	4,87E-02
3,70E-01	1,36E-02
2,79E-01	3,22E-03
2,10E-01	5,68E-04

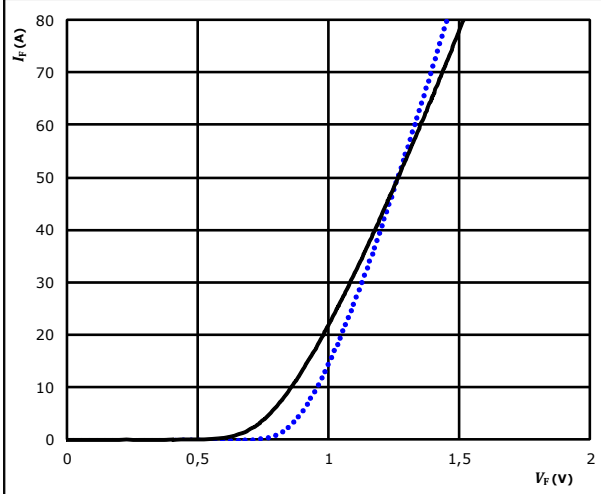


Rectifier Diode Characteristics

figure 1. Rectifier Diode

Typical forward characteristics

$$I_F = f(V_F)$$

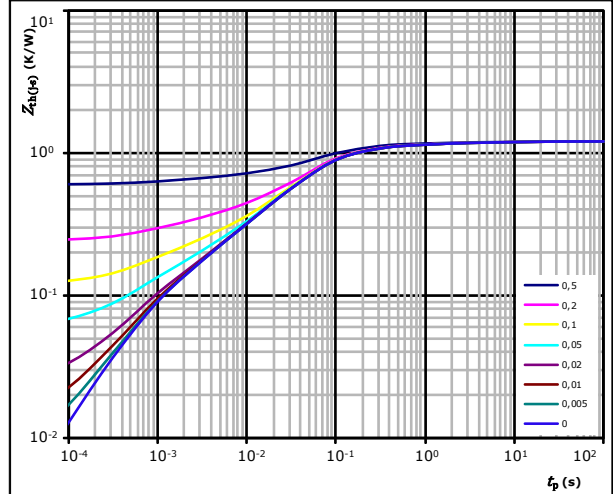


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line) $125 \text{ }^\circ\text{C}$ (solid black line)

figure 2. Rectifier Diode

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,20 \text{ K/W}$

Diode thermal model values

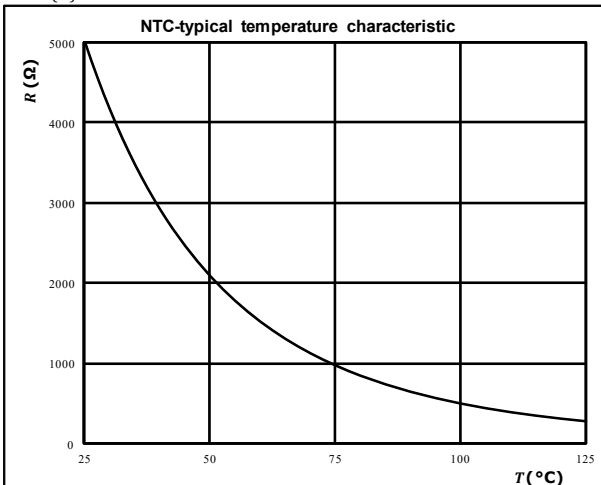
R (K/W)	τ (s)
3,54E-02	9,31E+00
8,09E-02	9,99E-01
2,12E-01	1,71E-01
6,76E-01	4,85E-02
1,19E-01	5,88E-03
7,98E-02	8,33E-04

Thermistor Characteristics

figure 1. Thermistor

Typical NTC characteristic
as a function of temperature

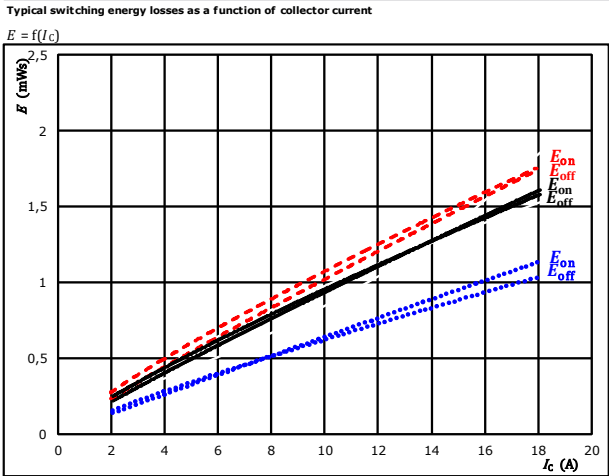
$$R = f(T)$$





Inverter Switching Characteristics

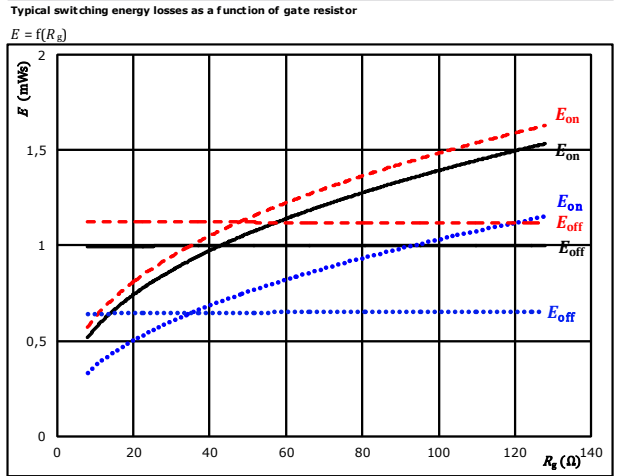
figure 1. IGBT



With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C	————
$R_{gon} = 32$ Ω	$T_j = 150$ °C	-----
$R_{goff} = 32$ Ω		

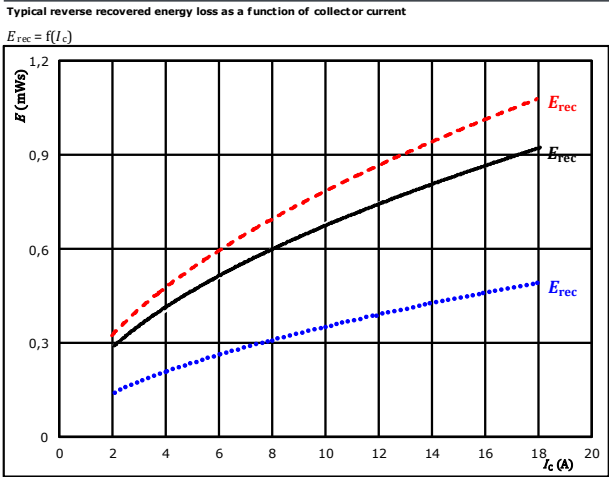
figure 2. IGBT



With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C	————
$I_C = 10$ A	$T_j = 150$ °C	-----

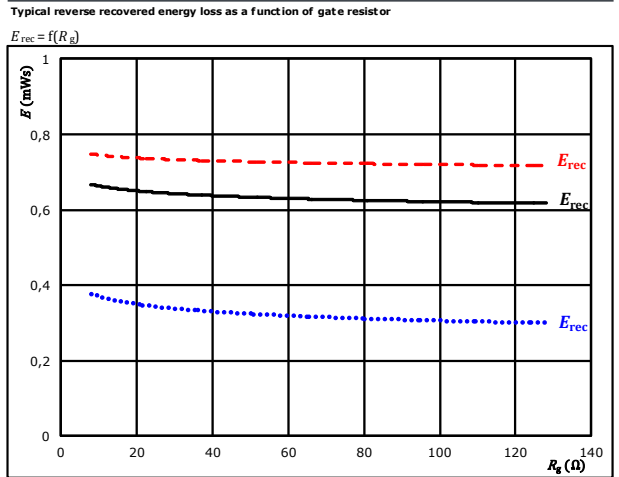
figure 3. FWD



With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C	————
$R_{gon} = 32$ Ω	$T_j = 150$ °C	-----

figure 4. FWD



With an inductive load at

$V_{CE} = 600$ V	$T_j = 25$ °C
$V_{GE} = \pm 15$ V	$T_j = 125$ °C	————
$I_C = 10$ A	$T_j = 150$ °C	-----

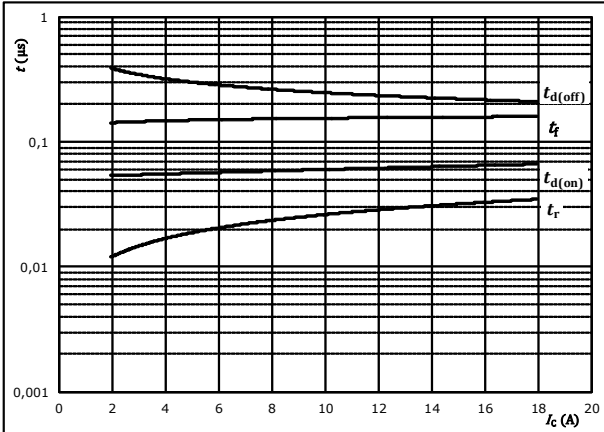


Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



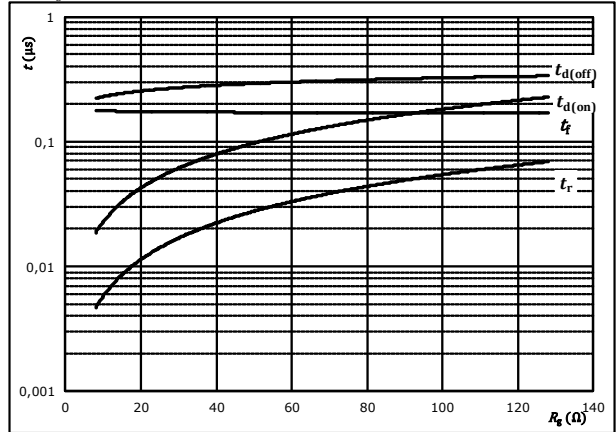
With an inductive load at

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

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



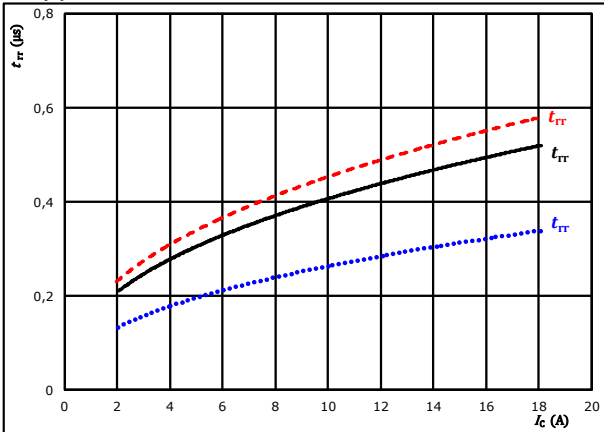
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_c =$	10	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

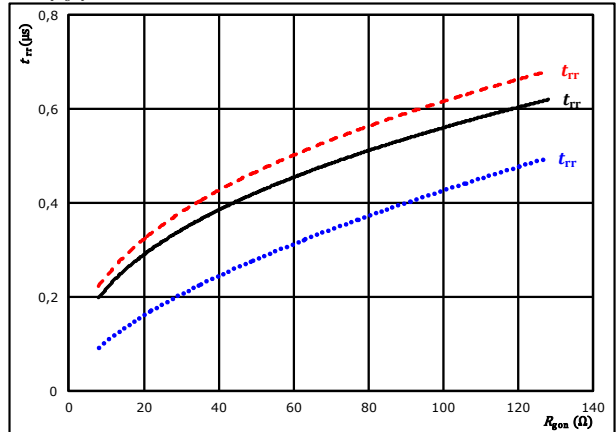


At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	32	Ω		150 °C	-----

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	————
	$I_c =$	10	A		150 °C	-----

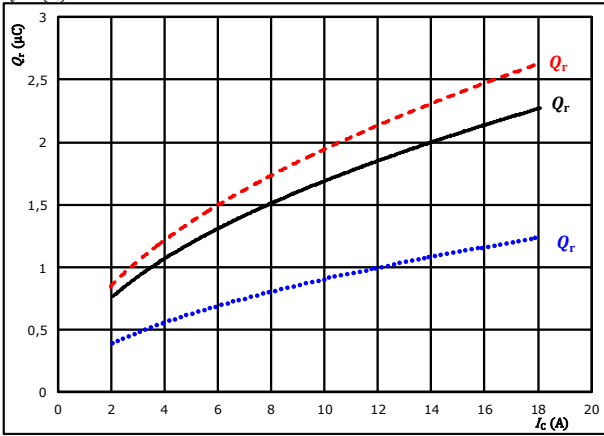


Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

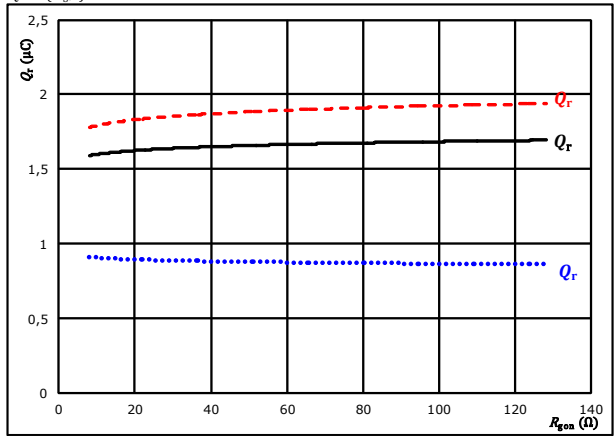


At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 125$ °C (solid black)
 $R_{gdn} = 32$ Ω $T_j = 150$ °C (dashed red)

figure 10. FWD

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

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

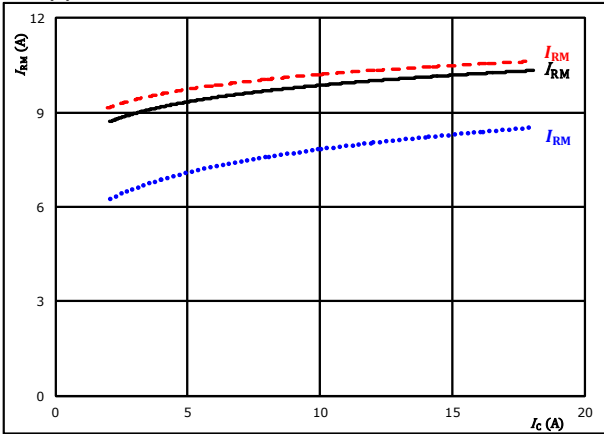


At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 125$ °C (solid black)
 $I_c = 10$ A $T_j = 150$ °C (dashed red)

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

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

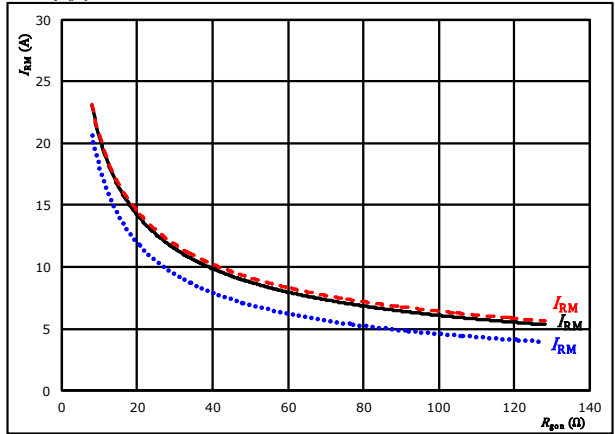


At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 125$ °C (solid black)
 $R_{gdn} = 32$ Ω $T_j = 150$ °C (dashed red)

figure 12. FWD

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

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



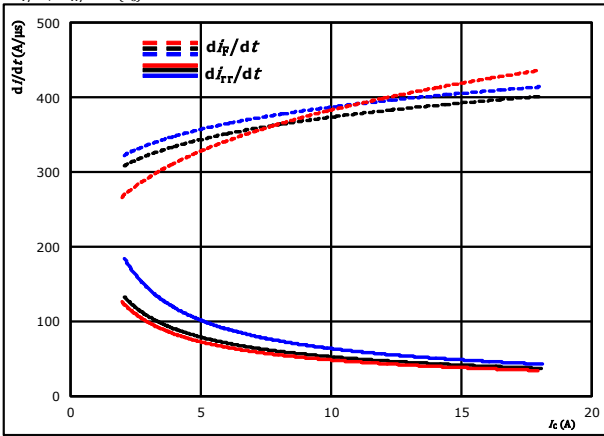
At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 125$ °C (solid black)
 $I_c = 10$ A $T_j = 150$ °C (dashed red)



Inverter Switching Characteristics

figure 13. FWD

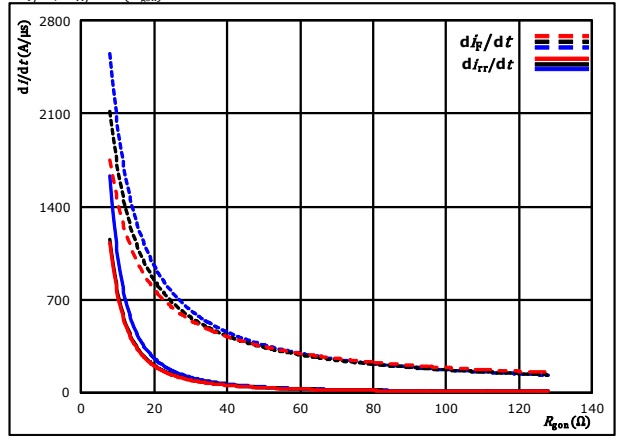
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_{f}/dt, di_{rr}/dt = f(I_C)$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C
 $R_{g0n} = 32$ Ω $T_j = 150$ °C

figure 14. FWD

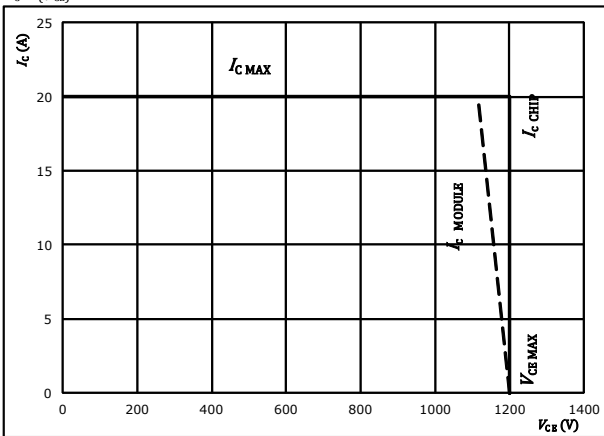
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_{f}/dt, di_{rr}/dt = f(R_{g0n})$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C
 $I_C = 10$ A $T_j = 150$ °C

figure 15. IGBT

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



At $T_j = 125$ °C
 $R_{g0n} = 32$ Ω
 $R_{g0ff} = 32$ Ω



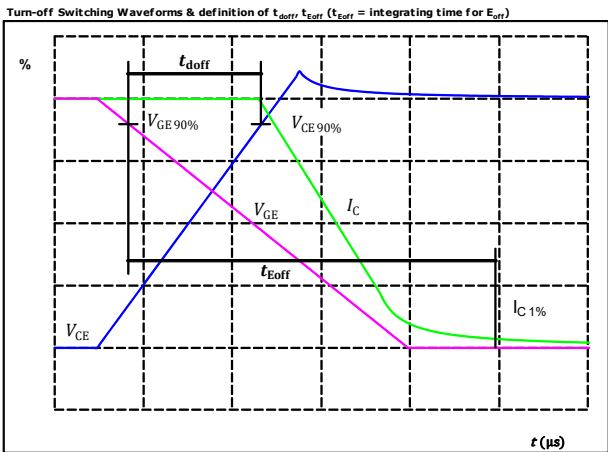
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Inverter Switching Definitions

General conditions

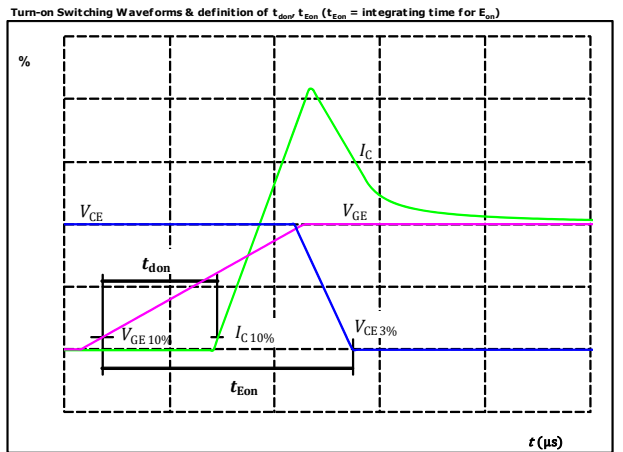
T_j	=	125 °C
$R_{g\text{on}}$	=	32 Ω
$R_{g\text{off}}$	=	32 Ω

figure 1. IGBT



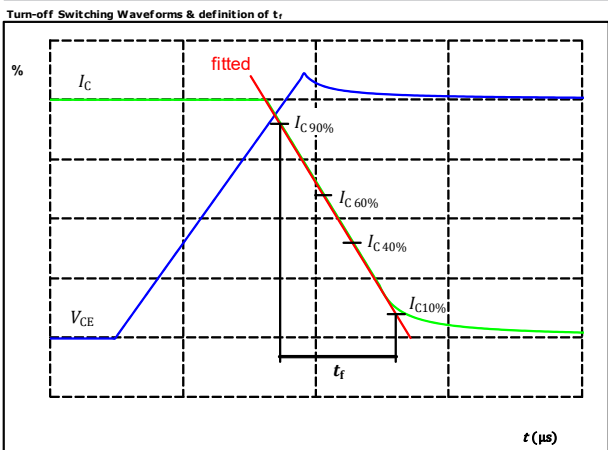
$V_{\text{CE}}(0\%) =$	-15	V
$V_{\text{GE}}(100\%) =$	15	V
$V_{\text{C}}(100\%) =$	600	V
$I_{\text{C}}(100\%) =$	10	A
$t_{\text{doff}} =$	243	ns

figure 2. IGBT



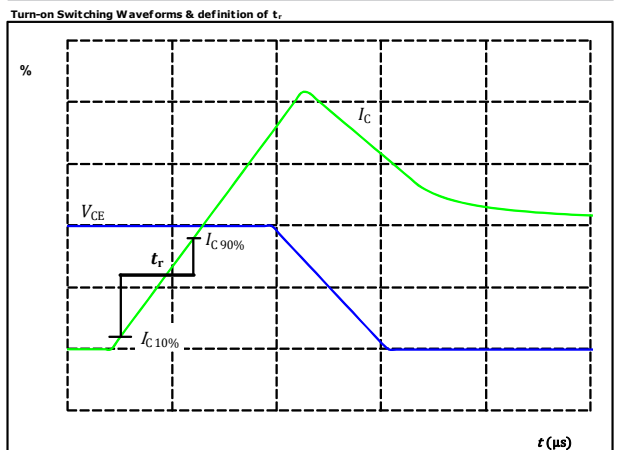
$V_{\text{CE}}(0\%) =$	-15	V
$V_{\text{GE}}(100\%) =$	15	V
$V_{\text{C}}(100\%) =$	600	V
$I_{\text{C}}(100\%) =$	10	A
$t_{\text{don}} =$	61	ns

figure 3. IGBT



$V_{\text{C}}(100\%) =$	600	V
$I_{\text{C}}(100\%) =$	10	A
$t_r =$	155	ns

figure 4. IGBT



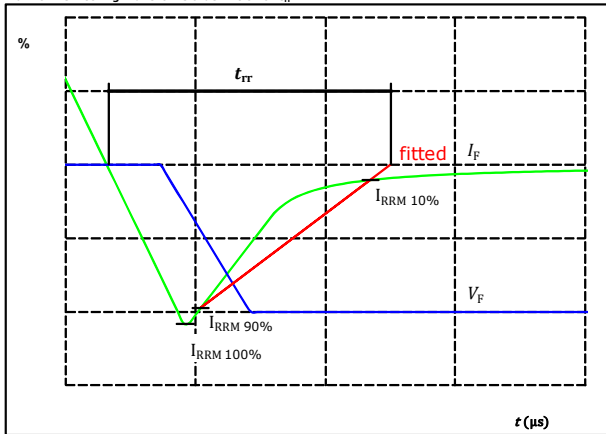
$V_{\text{C}}(100\%) =$	600	V
$I_{\text{C}}(100\%) =$	10	A
$t_r =$	24	ns



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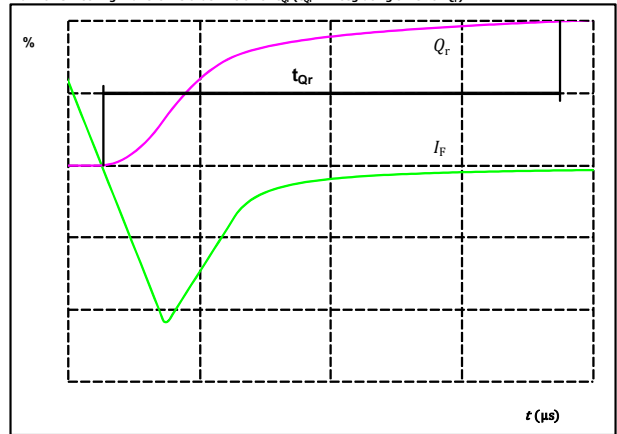
Inverter Switching Characteristics

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



$V_F(100\%) =$	600	V
$I_F(100\%) =$	10	A
$I_{RRM}(100\%) =$	10	A
$t_{rr} =$	403	ns

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



$I_F(100\%) =$	10	A
$Q_r(100\%) =$	1,69	μC



Vincotech

Ordering Code & Marking																										
Version			Ordering Code																							
without thermal paste 12 mm housing with press-fit pins			10-EZ12PNA010SC-L927C08T																							
with thermal paste 12 mm housing with press-fit pins			10-EZ12PNA010SC-L927C08T-/3/																							
<table border="1"> <thead> <tr> <th rowspan="2">Text</th> <th colspan="2">Name</th> <th>Date code</th> <th>UL & VIN</th> <th>Lot</th> <th>Serial</th> </tr> <tr> <th>Type&Ver</th> <th>Lot number</th> <th>Serial</th> <th>Date code</th> <td></td> <td></td> </tr> </thead> <tbody> <tr> <td>NN-NNNNNNNNNNNN TTTTTTVV WWYY UL VIN LLLLL SSSS</td> <td>NN-NNNNNNNNNNNN-TTTTTTVV</td> <td>TTTTTTVV</td> <td>SSSS</td> <td>WWYY</td> <td>LLLLL</td> <td>SSSS</td> </tr> </tbody> </table>							Text	Name		Date code	UL & VIN	Lot	Serial	Type&Ver	Lot number	Serial	Date code			NN-NNNNNNNNNNNN TTTTTTVV WWYY UL VIN LLLLL SSSS	NN-NNNNNNNNNNNN-TTTTTTVV	TTTTTTVV	SSSS	WWYY	LLLLL	SSSS
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Pin table			
Pin	X	Y	Function
1			Not assembled
2			Not assembled
3			Not assembled
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

Outline

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

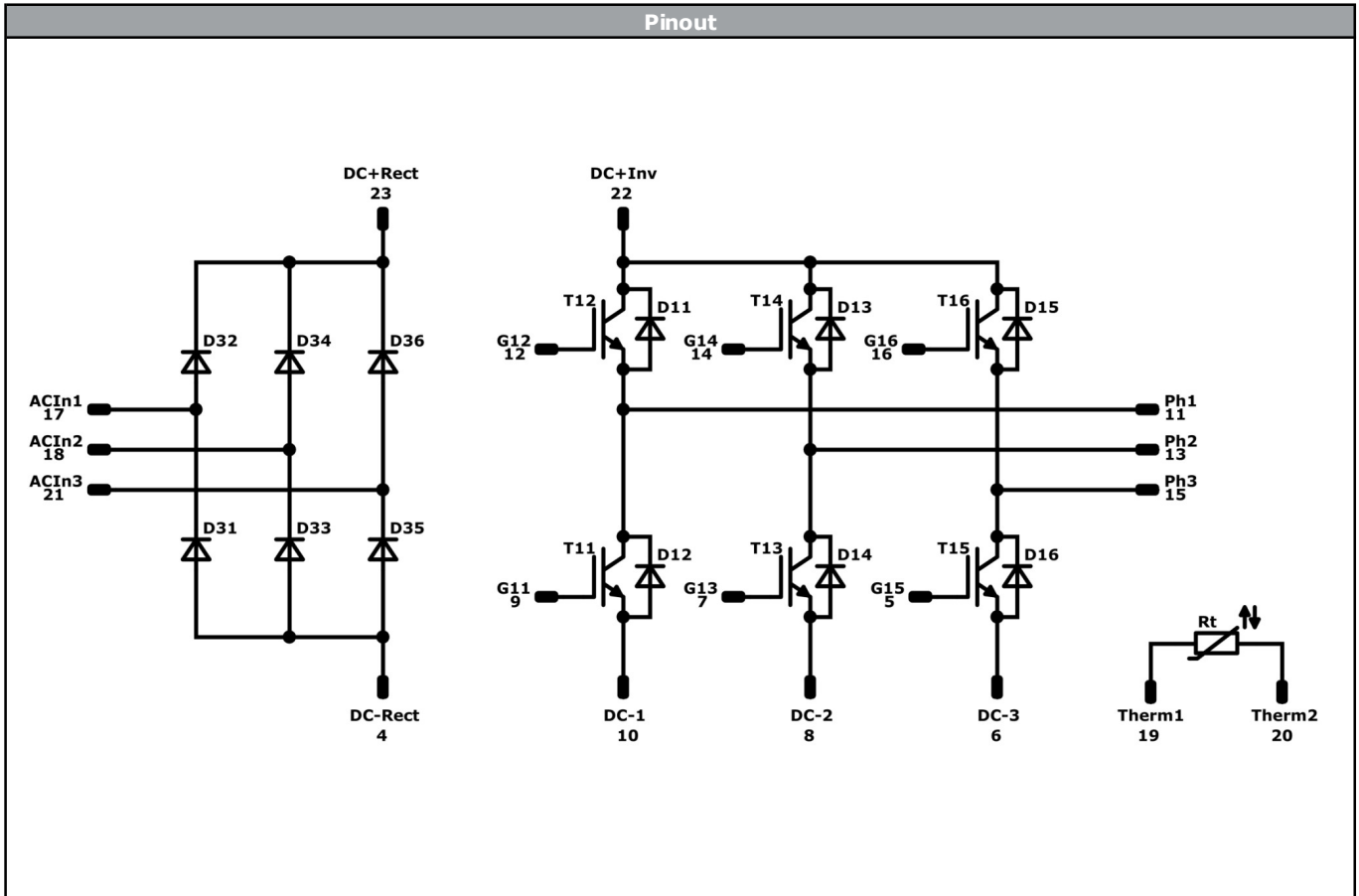
13,08 ±0,1
16,4 ±0,5

12,8
16
16

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



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Identification					
ID	Component	Voltage	Current	Function	Comment
T11-T16	IGBT	1200 V	10 A	Inverter Switch	
D11-D16	FWD	1200 V	10 A	Inverter Diode	
D31-D36	Rectifier	1600 V	35 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> E1 packages see vincotech.com website.

Package data
Package data for <i>flow</i> E1 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-EZ12PNA010SC-L927C08T-D2-14	22 Mar. 2019	Correction of I_c/I_f values	1,2

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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.