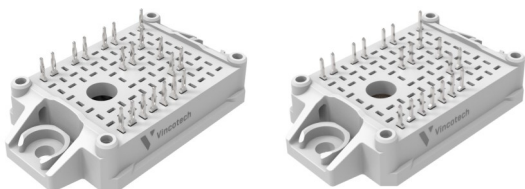
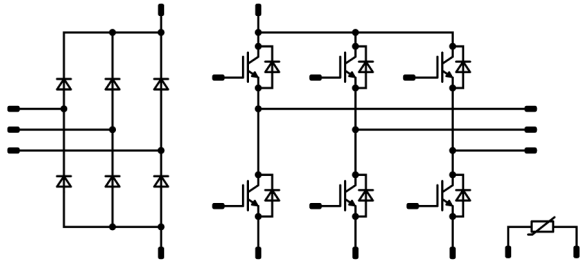




Vincotech

10-EZ12PNA015M7-L928C78T 10-E112PNA015M7-L928C78Z

datasheet

flowPIM E1		1200 V / 15 A
Features • IGBT M7 with low V_{CEsat} and improved EMC behavior • Standard industrial housing • Optimized $R_{th(j-s)}$ with Phase Change Material • Built-in NTC		flow E1 12 mm housing  Press-fit pin Solder pin
Target applications • Industrial Drives		Schematic 
Types • 10-EZ12PNA015M7-L928C78T • 10-E112PNA015M7-L928C78Z		

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		15	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}		± 20	V
Maximum junction temperature	T_{jmax}		175	°C



Vincotech

10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
 datasheet

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		15	A
Repetitive peak forward current	I_{FRM}	T_j 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	°C

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		35	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t		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

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



Vincotech

10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
 datasheet

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 Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,0015	25	5,4	6,0	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125 150		1,70 1,95 2,01	2,15	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			60	μA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	0	10	25				2900		pF
Output capacitance	C_{oes}							120		
Reverse transfer capacitance	C_{res}							34		
Gate charge	Q_g		15	600	15	25		110		nC

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,49		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	± 15	600	15	25 125 150		196 191 190		ns
Rise time	t_r					25 125 150		60 63 64		
Turn-off delay time	$t_{d(off)}$					25 125 150		181 206 211		
Fall time	t_f					25 125 150		95 113 114		
Turn-on energy (per pulse)*	E_{on}					25 125 150		1,69 2,11 2,21		mWs
Turn-off energy (per pulse)*	E_{off}					25 125 150		0,987 1,33 1,41		

* $L_s = 14 \text{ nH}$



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10-E112PNA015M7-L928C78Z
 datasheet

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				15	25 125 150		1,63 1,74 1,73	2,1	V
Reverse leakage current	I_R			1200		25			30	μA

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK (PSX)}$						1,88		K/W
-------------------------------------	---------------	--	--	--	--	--	--	------	--	-----

Dynamic

Peak recovery current	I_{RRM}	$di/dt = 181 \text{ A/}\mu\text{s}$ $di/dt = 205 \text{ A/}\mu\text{s}$ $di/dt = 175 \text{ A/}\mu\text{s}$	± 15	600	15	25 125 150		9 11 11		A
Reverse recovery time	t_{rr}					25 125 150		286 422 471		ns
Recovered charge	Q_r					25 125 150		1,50 2,46 2,68		μC
Reverse recovered energy	E_{rec}					25 125 150		0,497 0,913 1,00		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		77 49 44		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	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK (PSX)}$						1,20		K/W
-------------------------------------	---------------	--	--	--	--	--	--	------	--	-----



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10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
 datasheet

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	

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	



Vincotech

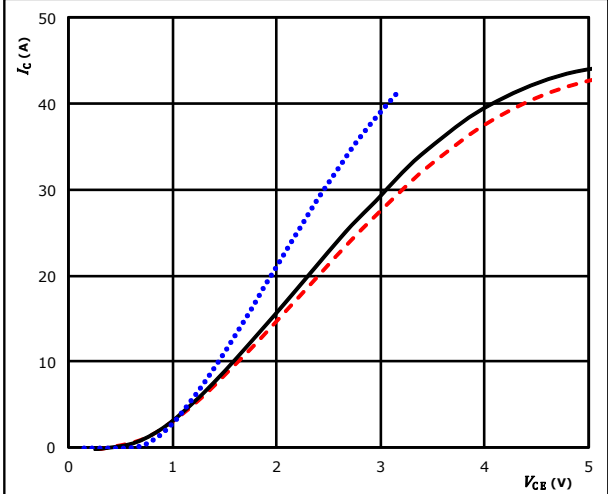
10-EZ12PNA015M7-L928C78T 10-E112PNA015M7-L928C78Z datasheet

Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

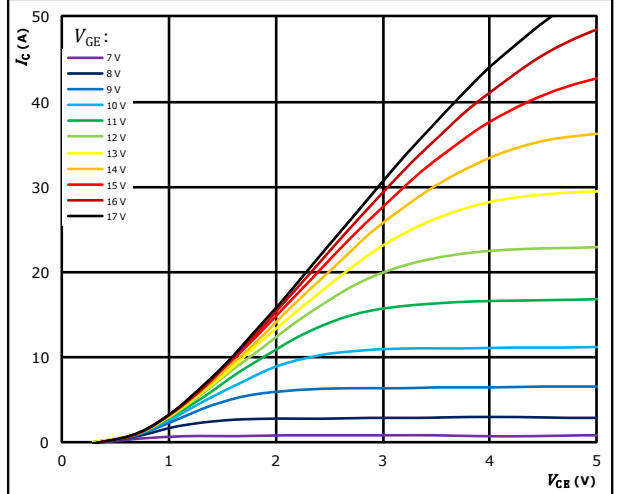


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25 \text{ } ^\circ C$ (blue dotted)
 $125 \text{ } ^\circ C$ (black solid)
 $150 \text{ } ^\circ C$ (red dashed)

figure 2. IGBT

Typical output characteristics

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

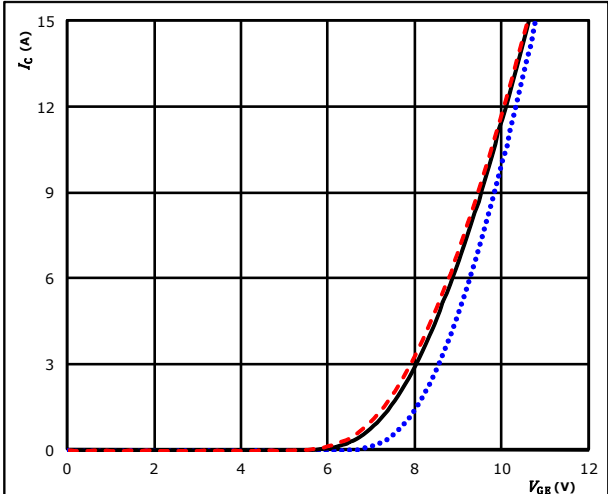


$t_p = 250 \mu s$
 $T_j = 150 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

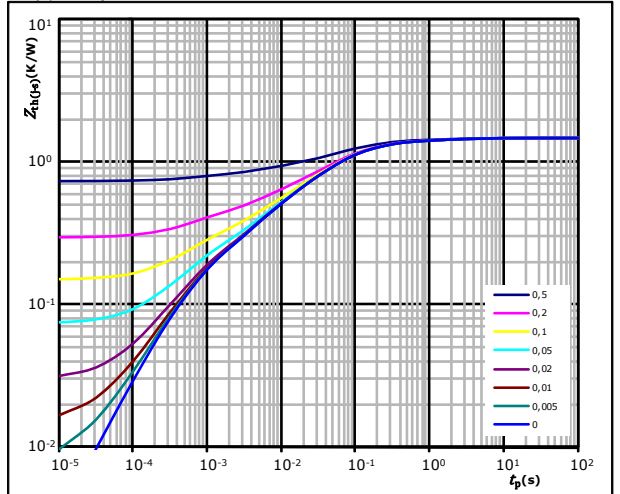


$t_p = 100 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25 \text{ } ^\circ C$ (blue dotted)
 $125 \text{ } ^\circ C$ (black solid)
 $150 \text{ } ^\circ C$ (red dashed)

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 1,49 \text{ K/W}$
IGBT thermal model values

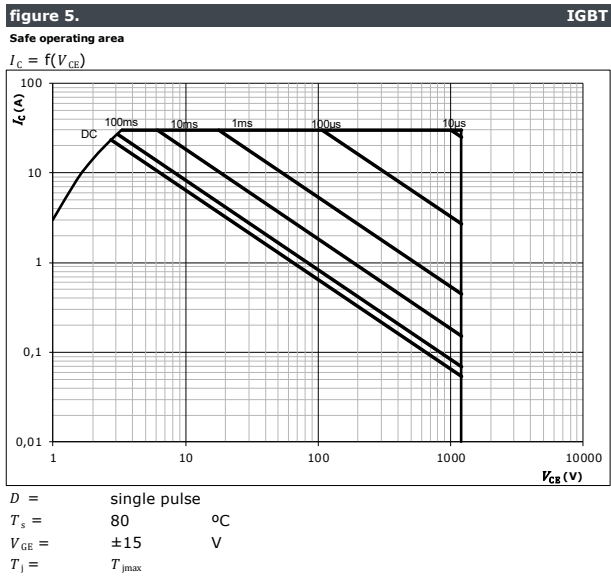
$R \text{ (K/W)}$	$\tau \text{ (s)}$
4,90E-02	3,61E+00
1,10E-01	6,54E-01
4,70E-01	1,09E-01
4,98E-01	2,97E-02
2,21E-01	4,73E-03
1,37E-01	5,51E-04



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datasheet

Inverter Switch Characteristics





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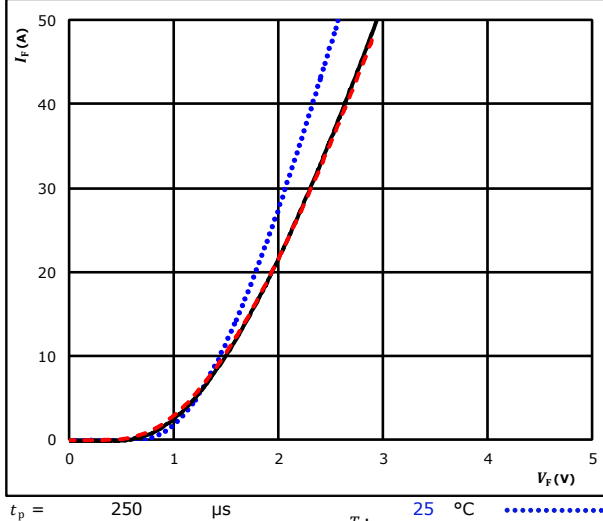
10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
 datasheet

Inverter Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

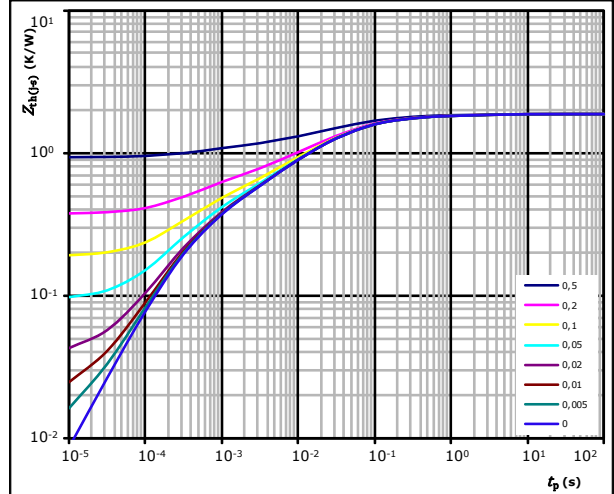


$t_p =$ 250 μ s
 T_j : 25 °C
 125 °C ———
 150 °C - - - -

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1.88$ K/W
 FWD thermal model values

R (K/W)	τ (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



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 datasheet

Rectifier Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

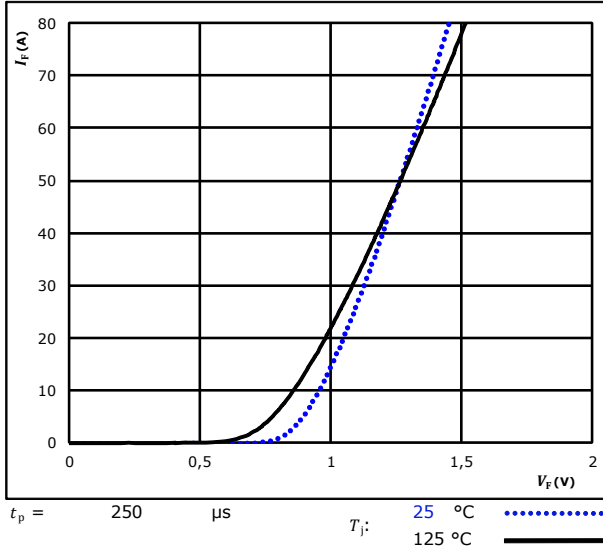
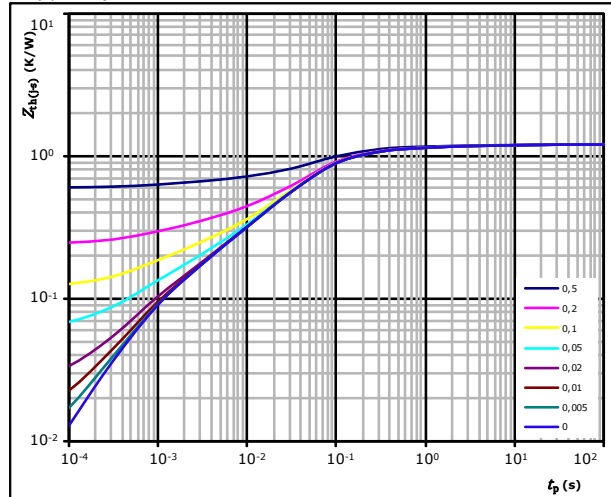


figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$$D = t_p / T$$

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

FWD thermal model values

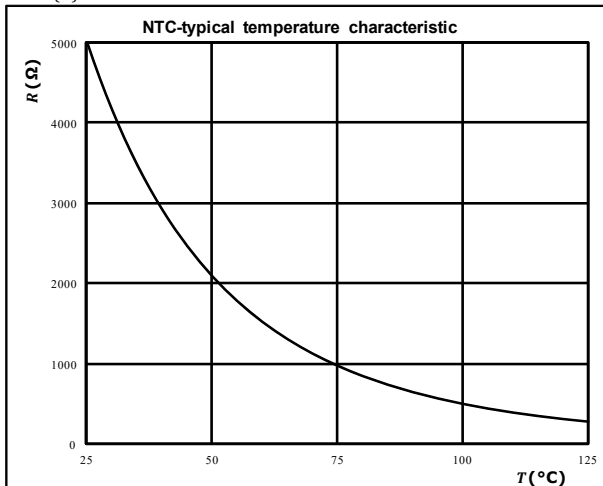
R (K/W)	τ (s)
3,54E-02	9,31E+00
8,09E-02	9,99E-01
2,12E-01	1,71E-01
6,76E-01	4,85E-02
1,19E-01	5,88E-03
7,98E-02	8,33E-04

Thermistor Characteristics

figure 1. Thermistor

Typical NTC characteristic
 as a function of temperature

$$R = f(T)$$





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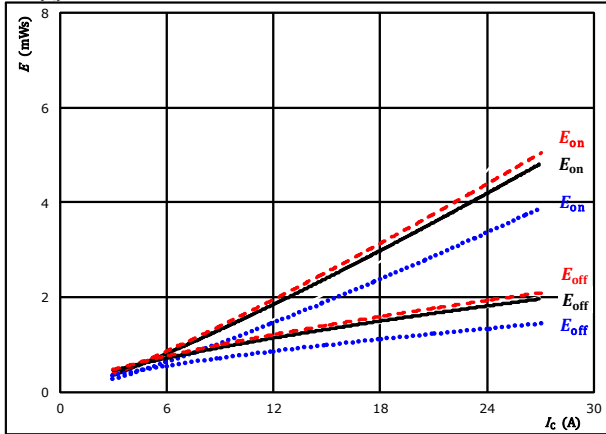
datasheet

Inverter Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

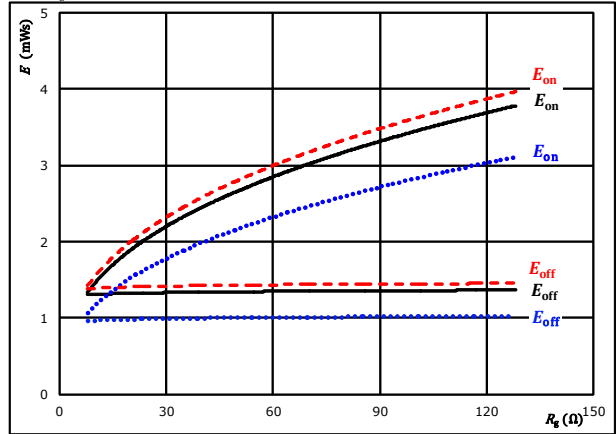
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{g(on)} = 32$ Ω
 $R_{g(off)} = 32$ Ω

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

figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

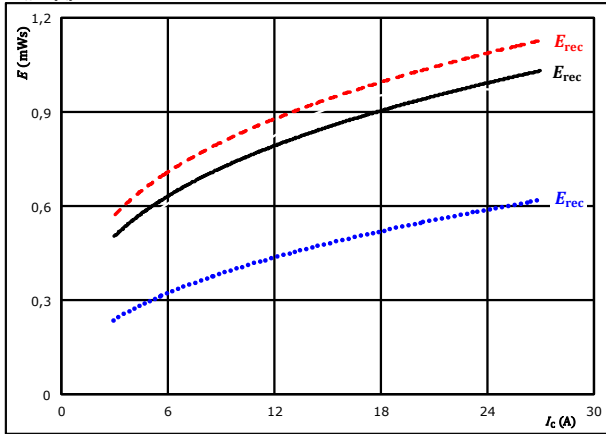
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

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

figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_C)$$



With an inductive load at

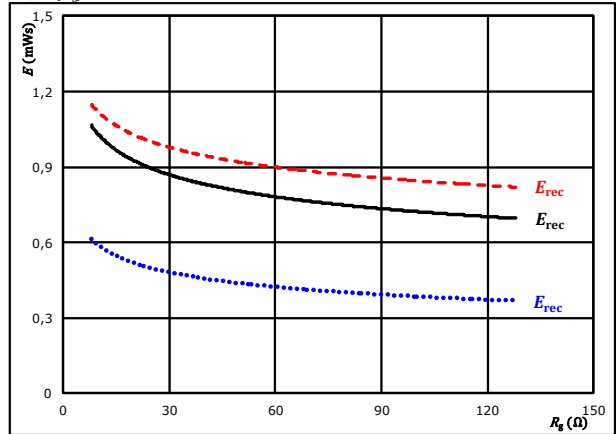
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{g(on)} = 32$ Ω

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

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

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

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



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10-EZ12PNA015M7-L928C78T 10-E112PNA015M7-L928C78Z

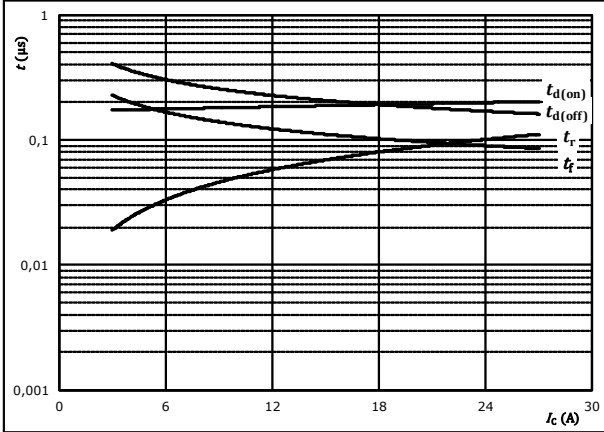
datasheet

Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



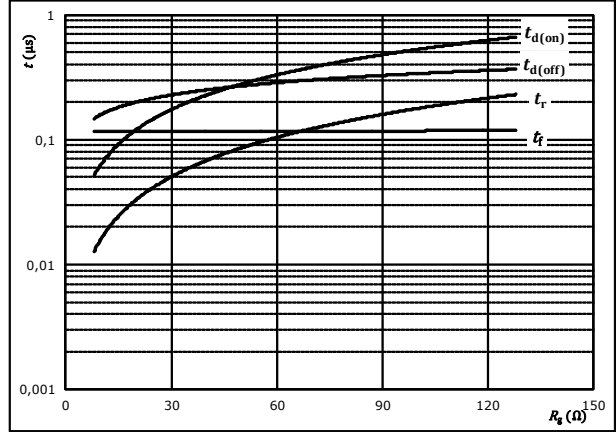
With an inductive load at

$T_j =$	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

$$t = f(R_g)$$



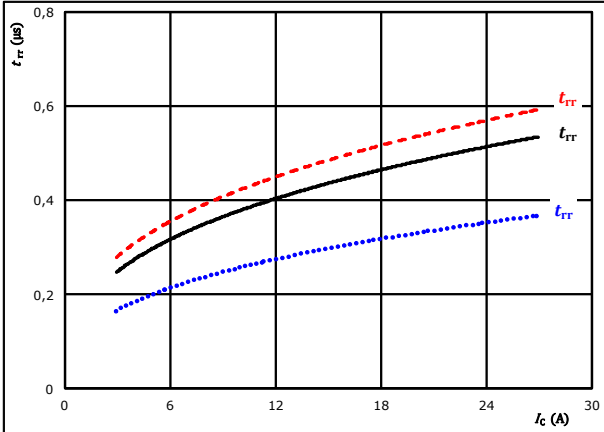
With an inductive load at

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

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

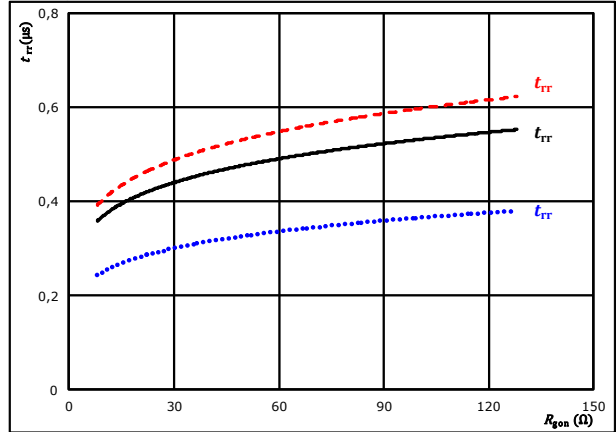


At	$V_{CE} =$	600	V	$T_j:$	25 °C	
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	32	Ω		150 °C	-----

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	————
	$I_C =$	15	A		150 °C	-----



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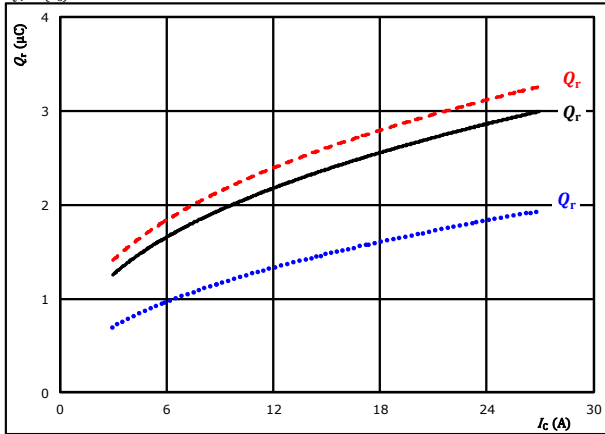
10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
datasheet

Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_C)$$

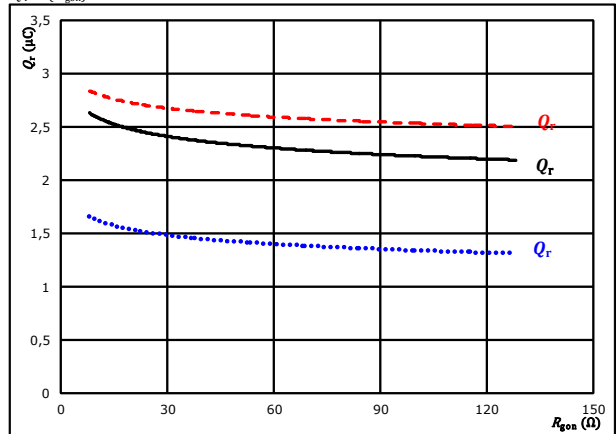


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $T_j = 25$ °C (blue dotted)
 125 °C (black solid)
 150 °C (red dashed)

figure 10. FWD

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

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

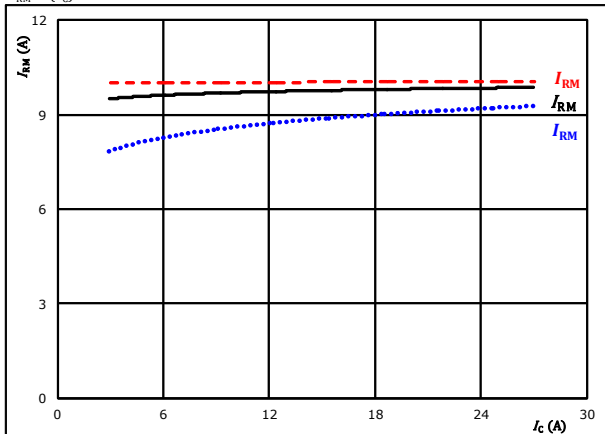


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A
 $T_j = 25$ °C (blue dotted)
 125 °C (black solid)
 150 °C (red dashed)

figure 11. FWD

Typical peak reverse recovery current as a function of collector current

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

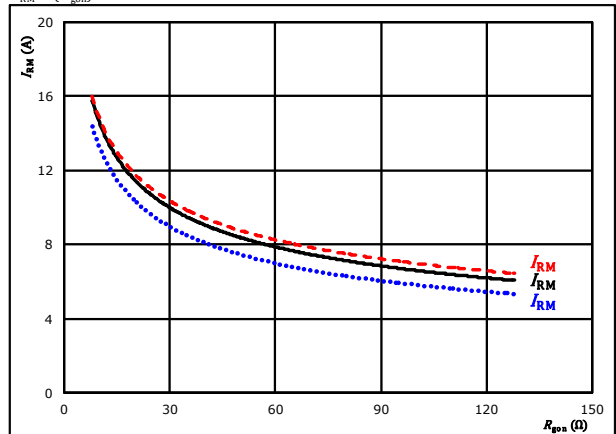


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $T_j = 25$ °C (blue dotted)
 125 °C (black solid)
 150 °C (red dashed)

figure 12. FWD

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

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



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



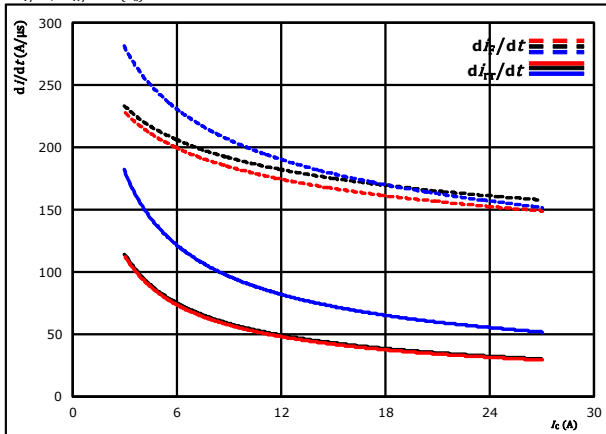
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10-E112PNA015M7-L928C78Z
 datasheet

Inverter Switching Characteristics

figure 13. FWD

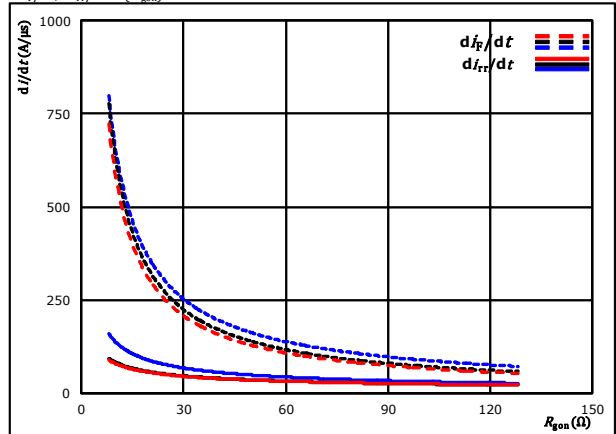
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_C)$



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

figure 14. FWD

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

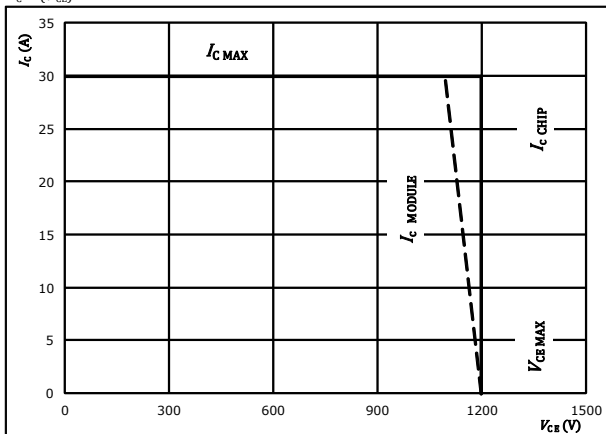


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A
 $T_j = 25$ °C
 125 °C
 150 °C

figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 175$ °C
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω



Vincotech

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10-E112PNA015M7-L928C78Z
 datasheet

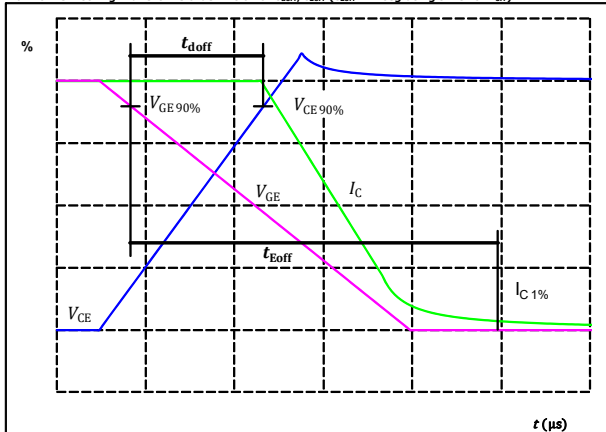
Inverter Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

figure 1. IGBT

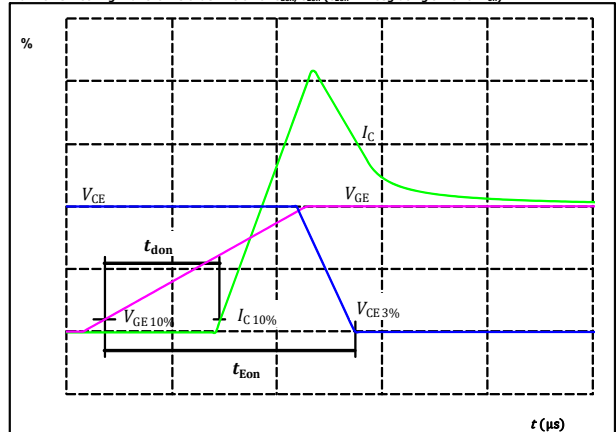
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_{doff} =$	206	ns

figure 2. IGBT

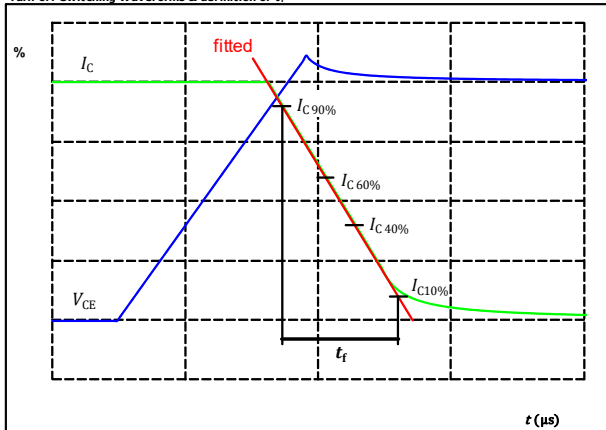
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



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

figure 3. IGBT

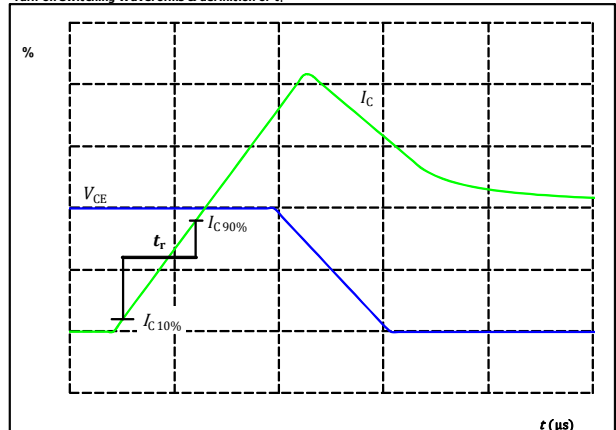
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_f =$	113	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_r =$	63	ns

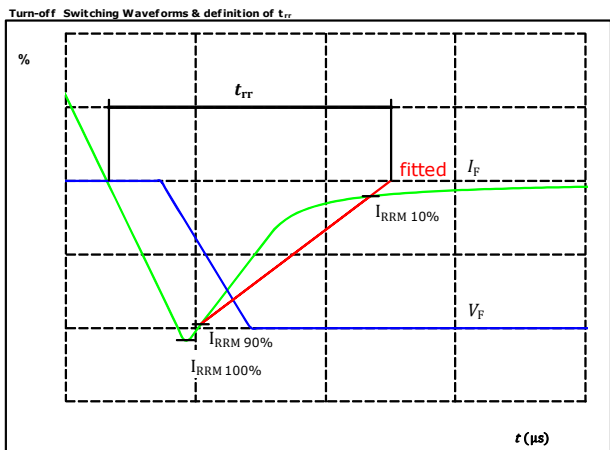


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 datasheet

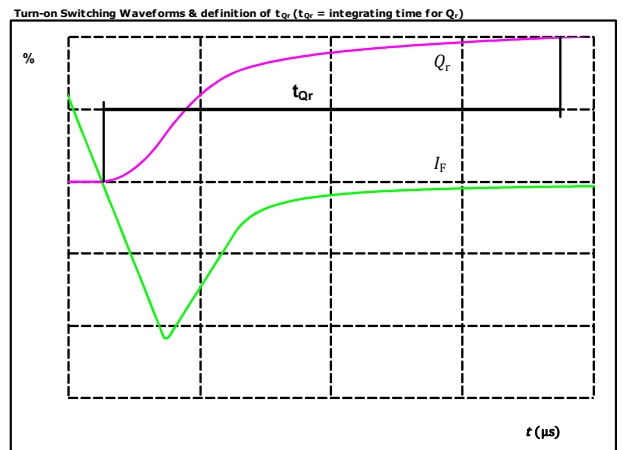
Inverter Switching Characteristics

figure 5. FWD



$V_F(100\%) =$	600	V
$I_F(100\%) =$	15	A
$I_{RRM}(100\%) =$	11	A
$t_{rr} =$	422	ns

figure 6. FWD



$I_F(100\%) =$	15	A
$Q_r(100\%) =$	2,46	μC



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datasheet

Ordering Code & Marking								
Version			Ordering Code					
without thermal paste 12 mm housing with Press-fit pins			10-EZ12PNA015M7-L928C78T					
with thermal paste 12 mm housing with Press-fit pins			10-EZ12PNA015M7-L928C78T-/3/					
without thermal paste 12 mm housing with solder pins			10-E112PNA015M7-L928C78Z					
with thermal paste 12 mm housing with solder pins			10-E112PNA015M7-L928C78Z-/3/					
NN-NNNNNNNNNNNNNN TTTTTWW WWYY UL VIN LLLLL SSSS 			Text	Name	Date code	UL & VIN	Lot	Serial
				NN-NNNNNNNNNNNNNN-TTTTTWW	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			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		

Solder pin

Press-fit pin

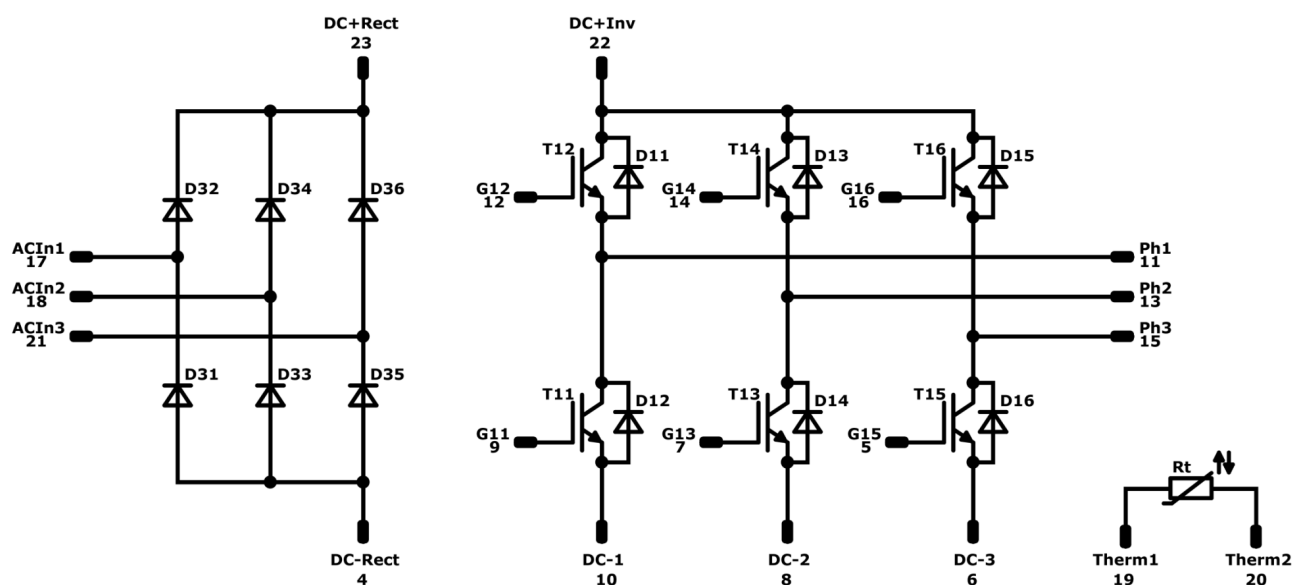
Tolerance of pinpositions: ±0.4mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



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datasheet

Pinout



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	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	35 A	Rectifier Diode	
Rt	NTC			Thermistor	



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datasheet

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-Ex12PNA015M7-L928C78x-D3-14	27 May. 2019	Outline updated	16

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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.