



flowPIM 1

1200 V / 10 A

Features

- IGBT M7 with low VCEsat and improved EMC behavior
- Standard industrial housing
- Optimized Rth(j-s) with Phase Change Material
- Built-in NTC

Target applications

- Industrial Drives

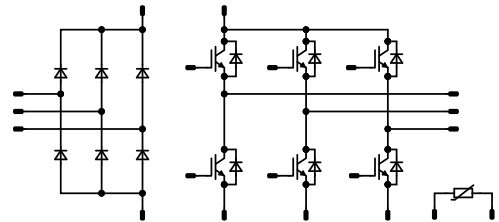
Types

- 10-E112PNA010M7-L927C78Z

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
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Inverter Switch

Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	18	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 0\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	9,5	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Inverter Diode

Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	19	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	43	W
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	47	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t		370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	W
Maximum junction temperature	T_{jmax}		150	$^{\circ}\text{C}$



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10-E112PNA010M7-L927C78Z
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
Isolation voltage	V_{isol}	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			>12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*100 % tested in production



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Characteristic Values

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

Inverter Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,001	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		10	25 125 150		1,66 1,9 1,96	2,15 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			35	μA
Gate-emitter leakage current	I_{GES}		0	0		25			500	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}							2000		pF
Output capacitance	C_{oes}		0	10		25		86		pF
Reverse transfer capacitance	C_{res}							23		pF
Gate charge	Q_g	$V_{CC} = 600$ V	15		10	25		80		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,69		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		127,8 125,6 123,4		ns
Rise time	t_r					25 125 150		29 32,2 33,8		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		145,2 179,2 182		ns
Fall time	t_f					25 125 150		98,1 107,57 116,71		ns
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD} = 1,09$ μC $Q_{tFWD} = 1,66$ μC $Q_{tFWD} = 1,81$ μC				25 125 150		0,883 1,12 1,19		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,656 0,86 0,908		mWs



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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		
Inverter Diode										
Static										
Forward voltage	V_F				10	25 125 150		1,61 1,69 1,7	2,1 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25			25	μA
Thermal										
Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,19		K/W
Dynamic										
Peak recovery current	I_{RRM}					25 125 150		8,67 9,25 9,34		A
Reverse recovery time	t_{rr}					25 125 150		254,4 372,9 409		ns
Recovered charge	Q_r	$di/dt=278$ A/μs $di/dt=270$ A/μs $di/dt=272$ A/μs	±15	600	10	25 125 150		1,09 1,66 1,81		μC
Reverse recovered energy	E_{rec}					25 125 150		0,374 0,62 0,68		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		84,75 53,58 49,28		A/μs



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Characteristic Values

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

Rectifier Diode

Static

Forward voltage	V_F				28	25 125		1,15 1,11	1,5 ⁽¹⁾	V
Reverse leakage current	I_R	$V_i = 1600$ V				25 150			100 1000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,15		K/W
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Thermistor

Static

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

⁽¹⁾ Value at chip level

⁽²⁾ Only valid with pre-applied Vincotech thermal interface material.

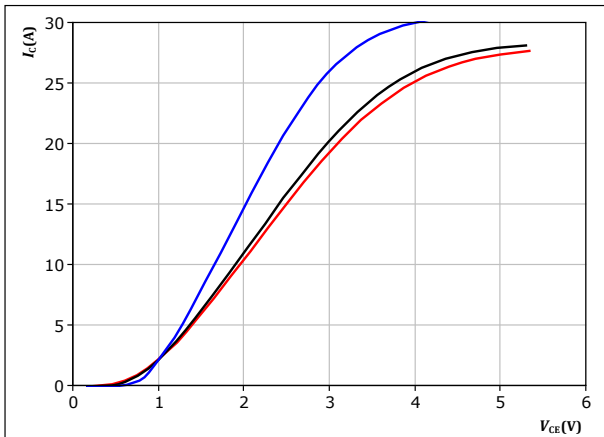


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

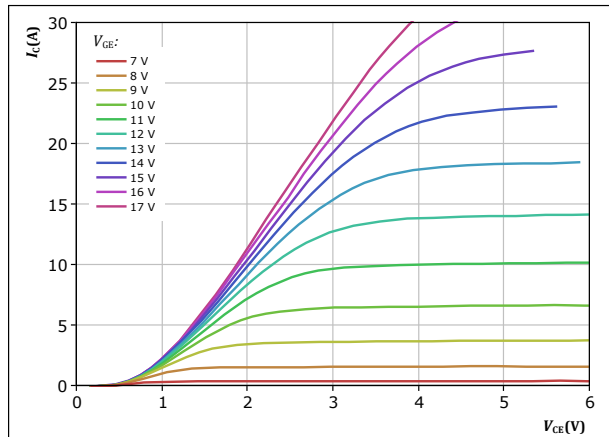


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j:$ 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

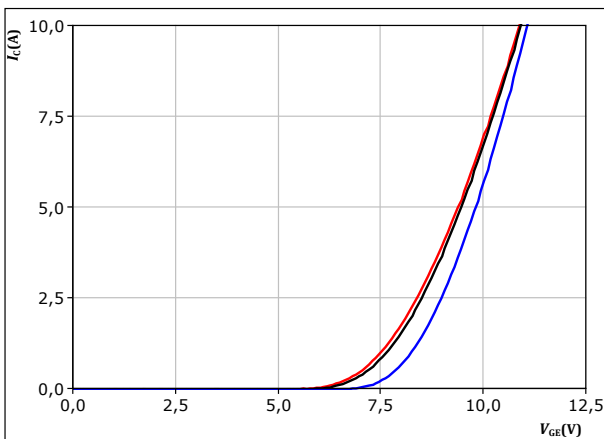


$t_p = 250 \mu s$
 $T_j = 150 \text{ °C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

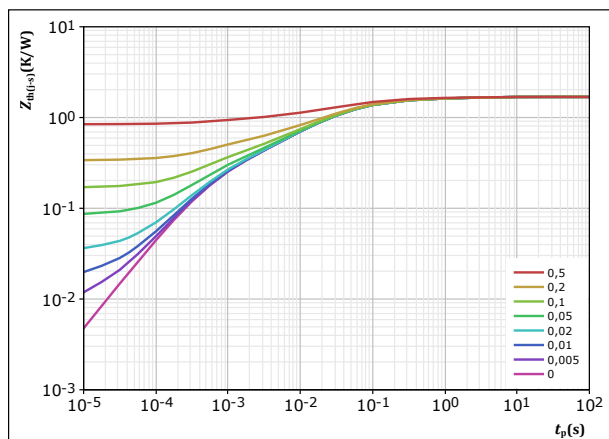


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j:$ 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,687 \text{ K/W}$
IGBT thermal model values

R (K/W)	τ (s)
8,19E-02	2,69E+00
1,67E-01	3,26E-01
5,87E-01	5,94E-02
4,55E-01	1,53E-02
2,18E-01	3,12E-03
1,79E-01	4,83E-04



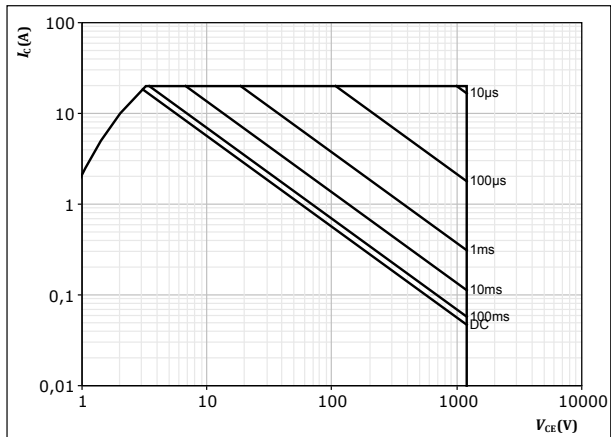
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Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$ single pulse

$T_s = 80$ °C

$V_{GE} = 15$ V

$T_j = T_{jmax}$



Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

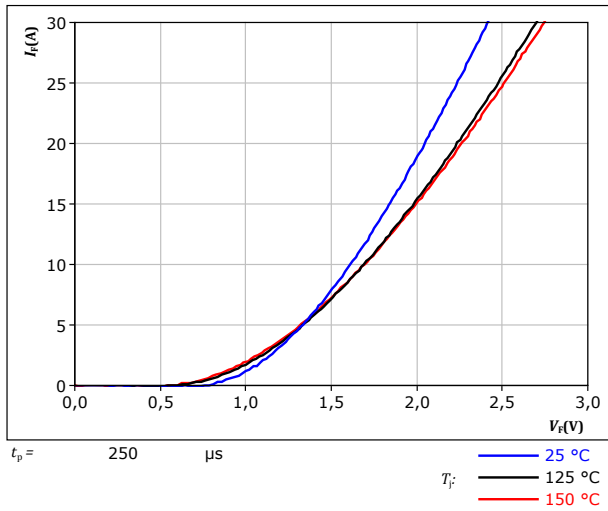
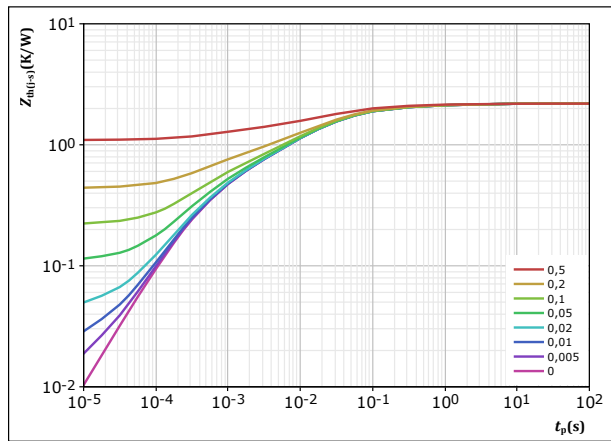


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	2,189	K/W
FWD thermal model values		
R (K/W)	τ (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 8. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

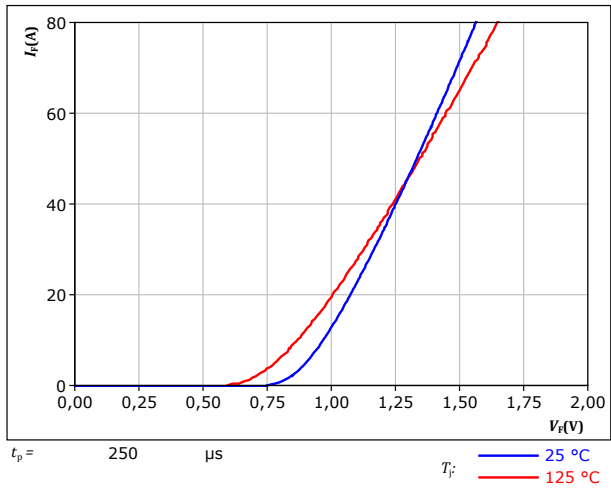
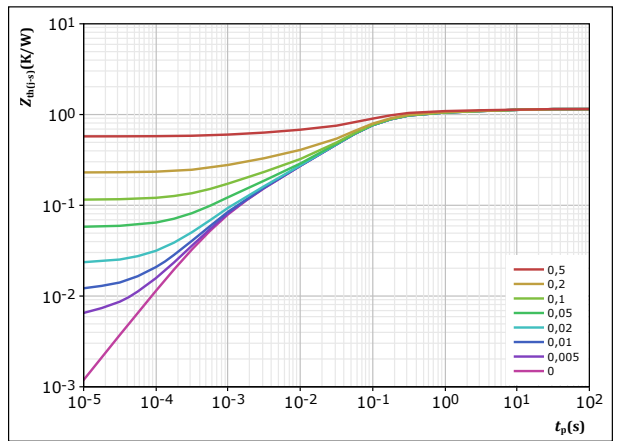


figure 9. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,149$ K/W

Rectifier thermal model values

R (K/W)	τ (s)
8,29E-02	7,59E+00
1,02E-01	6,72E-01
4,20E-01	1,19E-01
3,78E-01	4,22E-02
1,08E-01	4,04E-03
5,78E-02	7,21E-04

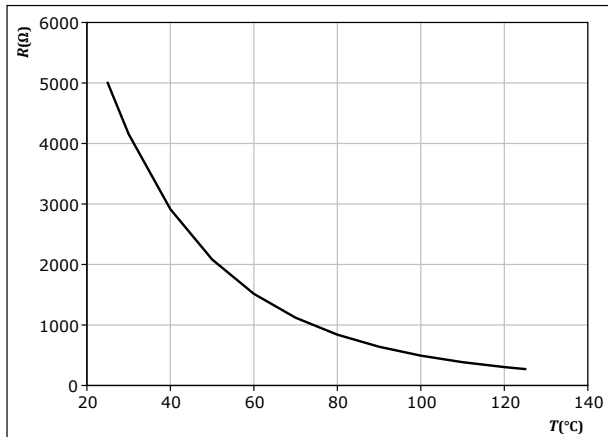


Thermistor Characteristics

figure 10. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

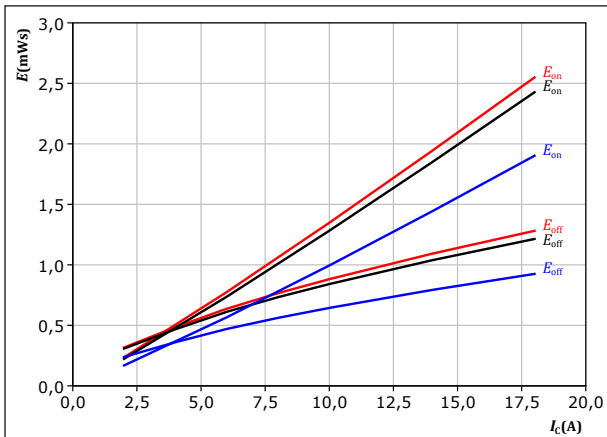




Inverter Switching Characteristics

figure 11. IGBT

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

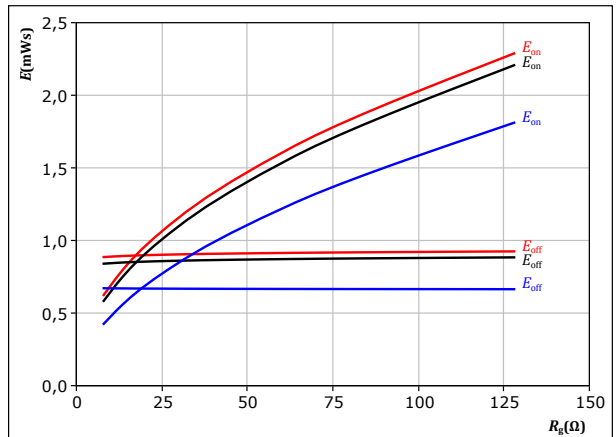


With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$
 $R_{goff} = 32 \text{ } \Omega$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 12. IGBT

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

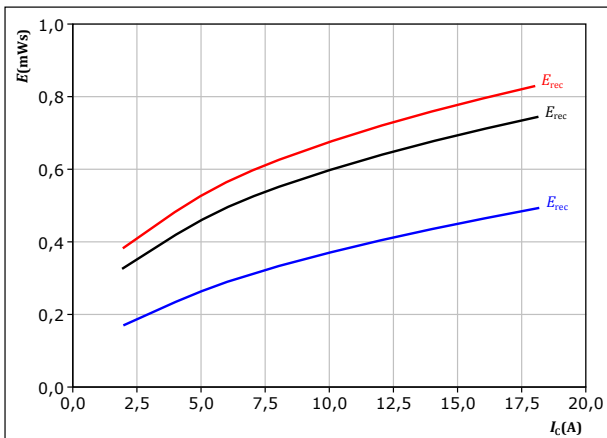


With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 10 \text{ A}$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 13. FWD

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

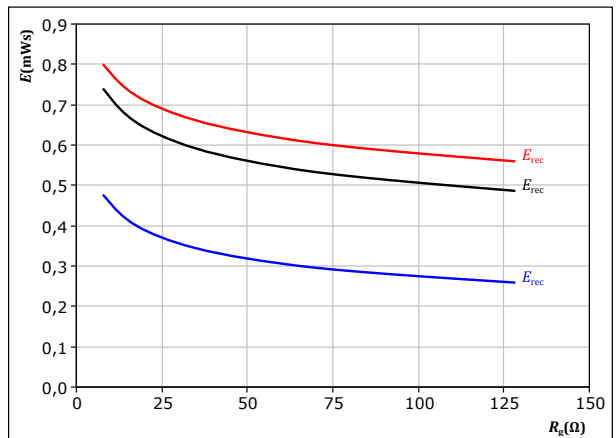


With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 14. FWD

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



With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 10 \text{ A}$

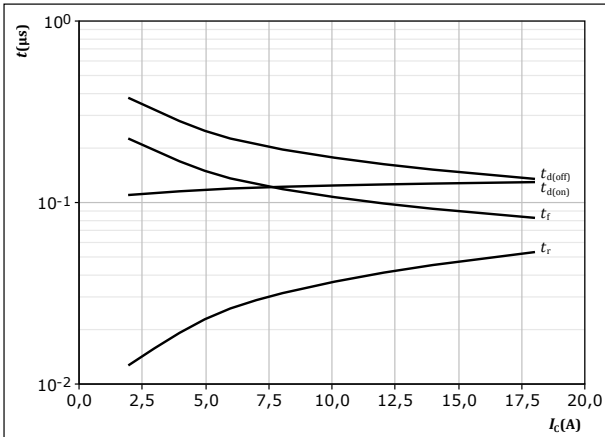
T_j :
— 25 °C
— 125 °C
— 150 °C



Inverter Switching Characteristics

figure 15. IGBT

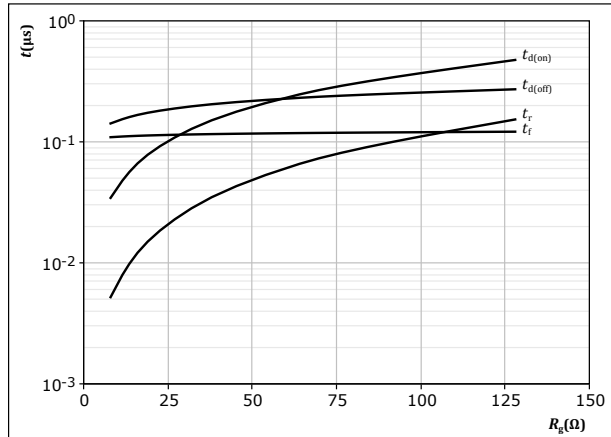
Typical switching times as a function of collector current
 $t = f(I_c)$



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

figure 16. IGBT

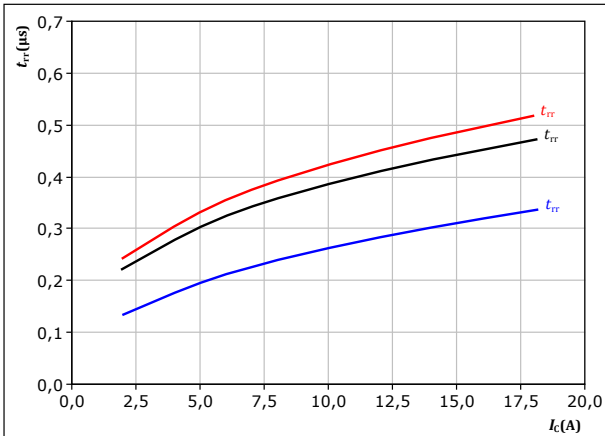
Typical switching times as a function of gate resistor
 $t = f(R_g)$



With an inductive load at
 $T_j = 150 \text{ }^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 10 \text{ A}$

figure 17. FWD

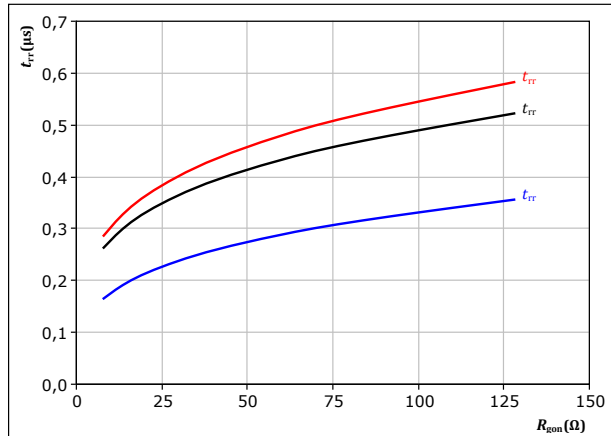
Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_c)$



With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$
 $T_j:$ — 25 °C
 — 125 °C
 — 150 °C

figure 18. FWD

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



With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 10 \text{ A}$
 $T_j:$ — 25 °C
 — 125 °C
 — 150 °C

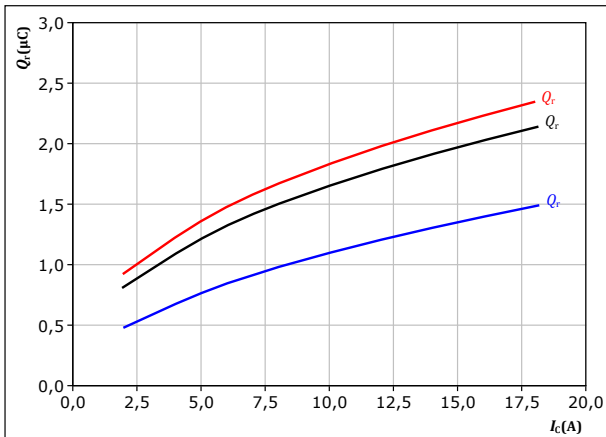


Inverter Switching Characteristics

figure 19. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



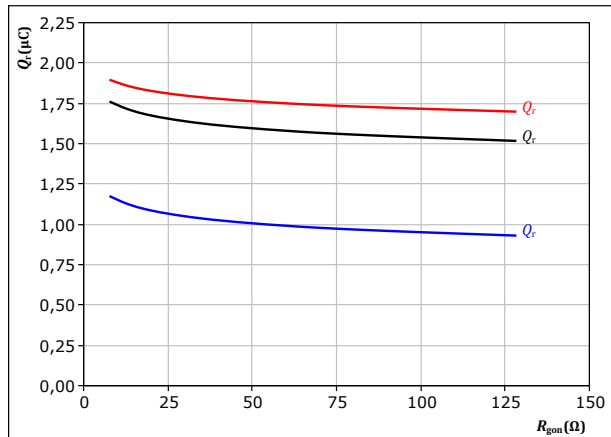
With an inductive load at

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

figure 20. FWD

Typical recovered charge as a function of turn on gate resistor

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



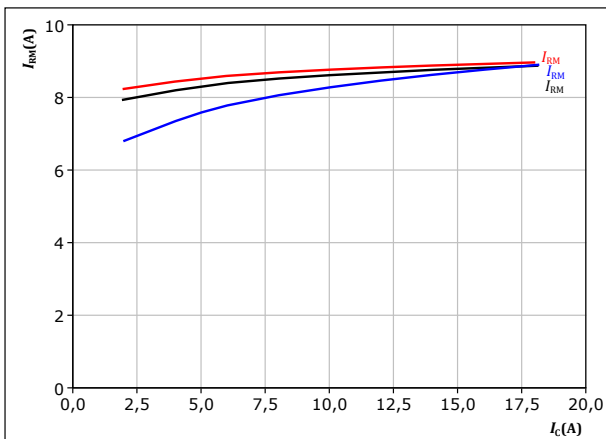
With an inductive load at

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

figure 21. FWD

Typical peak reverse recovery current as a function of collector current

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



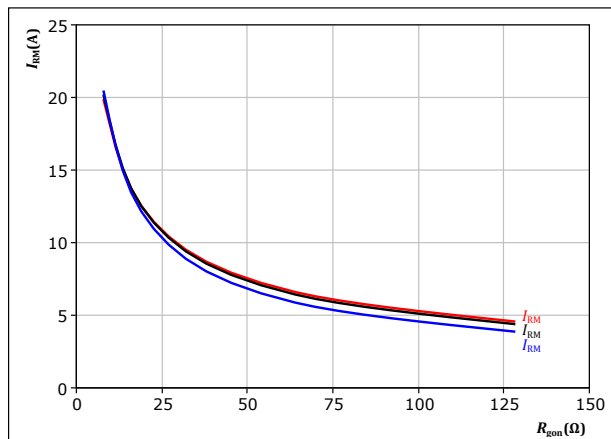
With an inductive load at

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

figure 22. FWD

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

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



With an inductive load at

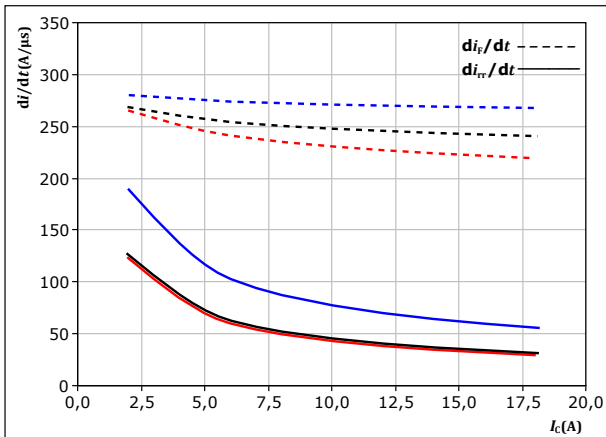
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 10$ A
 T_j : 25 °C (blue), 125 °C (black), 150 °C (red)



Inverter Switching Characteristics

figure 23. FWD

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



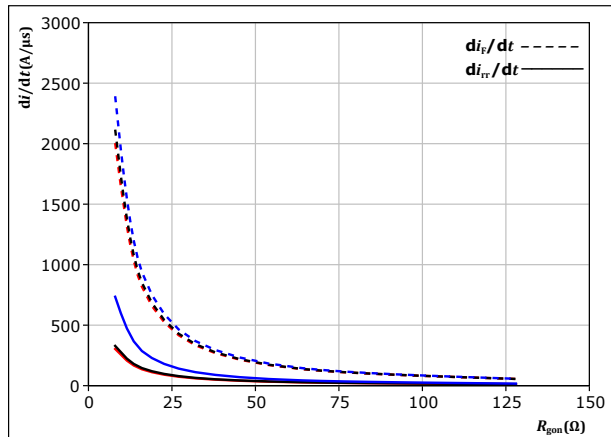
With an inductive load at

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

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 24. FWD

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



With an inductive load at

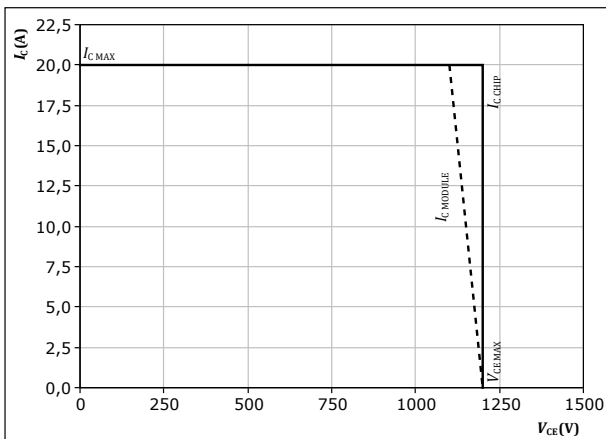
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 10 \text{ A}$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 25. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



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



Inverter Switching Definitions

figure 26. IGBT
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})

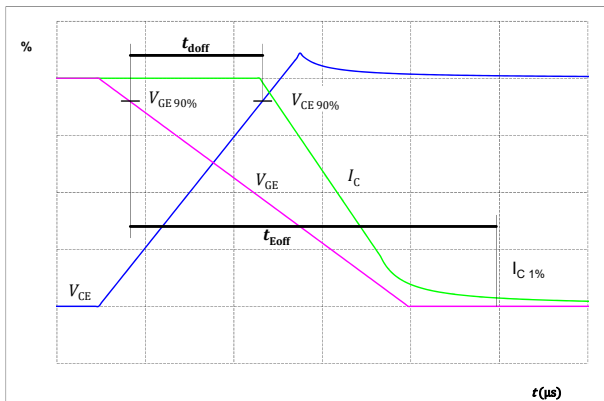


figure 27. IGBT
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})

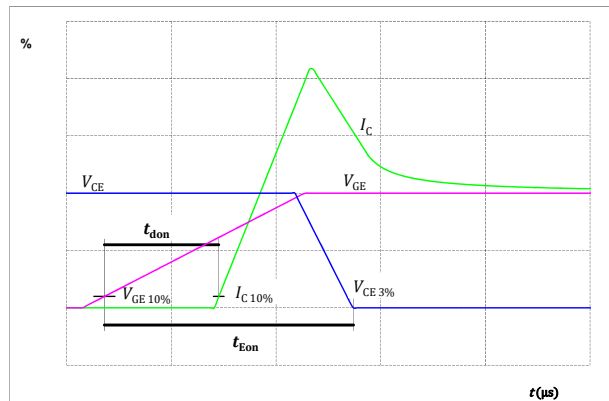


figure 28. IGBT
Turn-off Switching Waveforms & definition of t_f

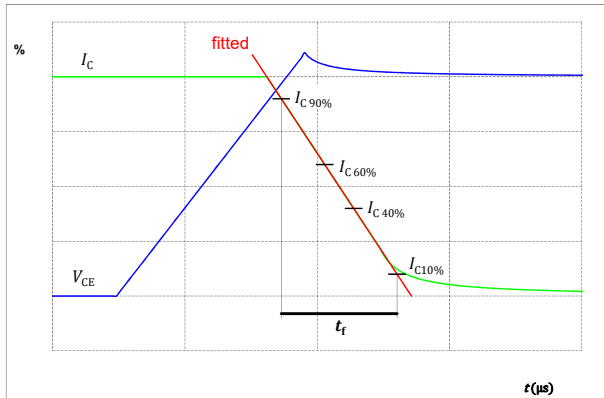
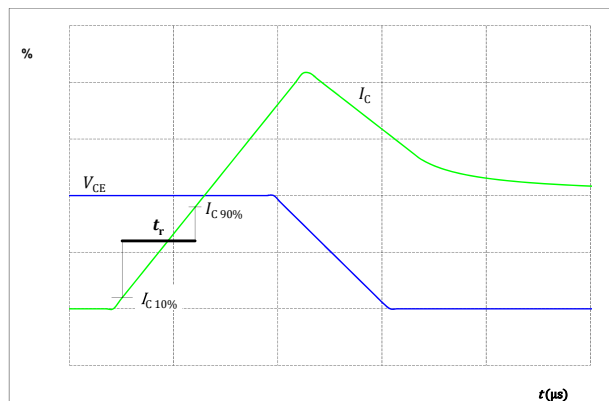


figure 29. IGBT
Turn-on Switching Waveforms & definition of t_r





Inverter Switching Definitions

figure 30. FWD

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

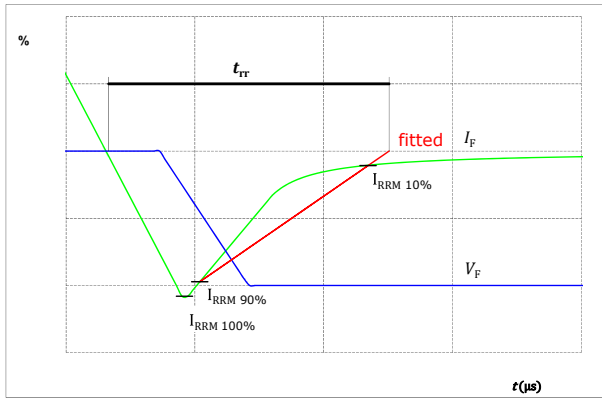
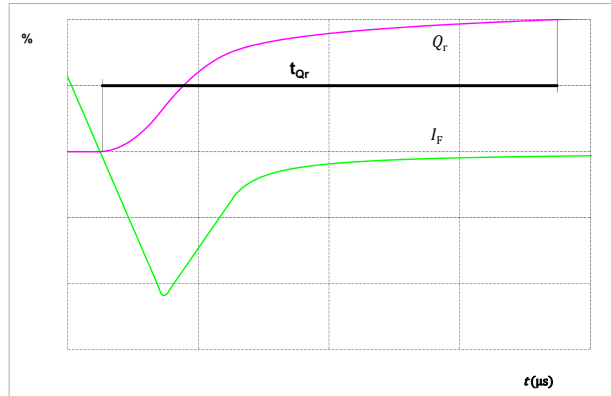


figure 31. FWD

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






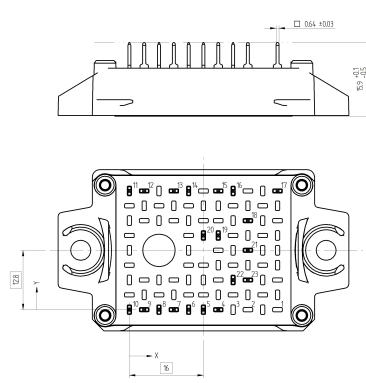
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10-E112PNA010M7-L927C78Z
datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-E112PNA010M7-L927C78Z
With thermal paste	10-E112PNA010M7-L927C78Z-/3/

Marking							
	Text	Name NN-NNNNNNNNNNNNNN- TTTTVV		Date code WWYY	UL & VIN UL VIN	Lot LLLLL	Serial SSSS
		Datamatrix	Type&Ver TTTTVV	Lot number LLLLL	Serial SSSS	Date code WWYY	

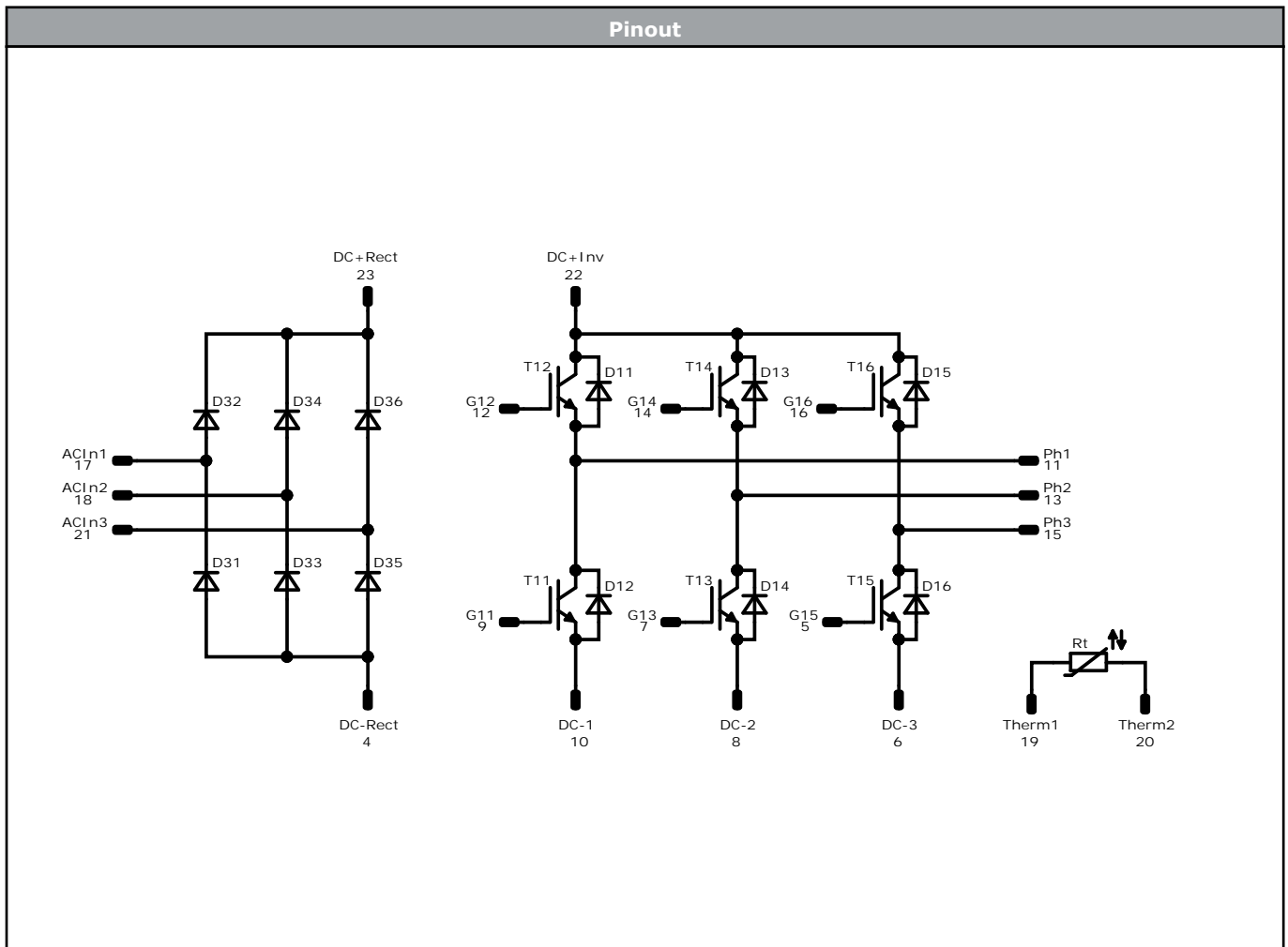
Outline				
Pin table [mm]				
Pin	X	Y	Function	
1			not assembled	
2			not assembled	
3			not assembled	
4	19,2	0	DC-Rect	
5	16	0	G15	
6	12,8	0	DC-3	
7	9,6	0	G13	
8	6,4	0	DC-2	
9	3,2	0	G11	
10	0	0	DC-1	
11	0	25,6	Ph1	
12	3,2	25,6	G12	
13	9,6	25,6	Ph2	
14	12,8	25,6	G14	
15	19,2	25,6	Ph3	
16	22,4	25,6	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	



Tolerance of pinposition: +0,05mm at the end of pins
Dimension of coordinate axis to axis of feet without tolerance



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

Vincotech thermistor reference
See Vincotech thermistor reference table at 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-E112PNA010M7-L927C78Z-D4-14	19 Mar. 2021	New datasheet format, separate solder and pressfit pin variant Update characteristics of rectifier diode, leakage current max value from 50 -> 100 uA	

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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.