



Vincotech

10-E112PNA025M7-L929C78Z

datasheet

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_2O_3
- Convex shaped substrate for superior thermal contact
- Compact housing
- CTI600 housing material
- Thermo-mechanical push-and-pull force relief
- Solder pin

Target applications

- Industrial Drives

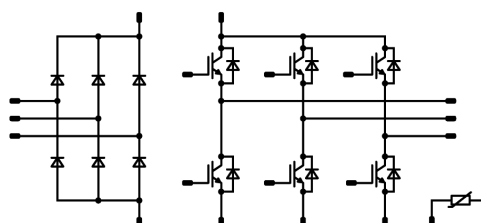
Types

- 10-E112PNA025M7-L929C78Z

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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	50	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	79	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	36	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	50	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	71	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^2_t		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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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_{CEsat}		15		25	25 125 150		1,64 1,89 1,95	2,1 ⁽¹⁾	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}		0	10		25		4800		pF
Output capacitance	C_{oes}							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 ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,2		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16$ Ω $R_{goff} = 16$ Ω	±15	600	25	25 125 150		147,2 149,2 145,2		ns
Rise time	t_r					25 125 150		28,6 33,4 34		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		170,6 191,4 195,6		ns
Fall time	t_f					25 125 150		95,03 109,96 114,76		ns
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD}=2,54$ µC $Q_{tFWD}=3,88$ µC $Q_{tFWD}=4,28$ µC				25 125 150		2,06 2,66 2,82		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		1,67 2,18 2,29		mWs



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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 Diode

Static

Forward voltage	V_F				25	25 125 150		1,63 1,7 1,69	2,1 ⁽¹⁾	V
Reverse leakage current	I_R	$V_i = 1200$ V				25			35	µA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,34		K/W
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Dynamic

Peak recovery current	I_{RM}	$di/dt=645$ A/µs $di/dt=673$ A/µs $di/dt=633$ A/µs	± 15	600	25	25 125 150		20,99 22,6 23,21		A
Reverse recovery time	t_{rr}					25 125 150		254,14 367,32 404,24		ns
Recovered charge	Q_r					25 125 150		2,54 3,88 4,28		µC
Reverse recovered energy	E_{rec}					25 125 150		0,884 1,45 1,61		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		217,37 134,32 132,01		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] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	

Rectifier Diode

Static

Forward voltage	V_F				5	25 125		0,901 0,78	1,1 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1600$ 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 R100	$\Delta_{R/R}$	$R_{100} = 493$ 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.



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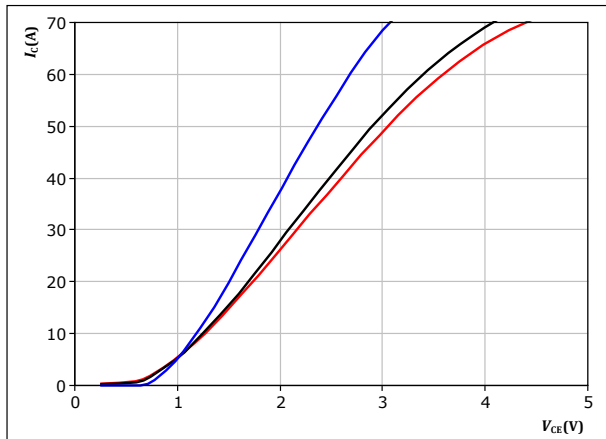
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Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

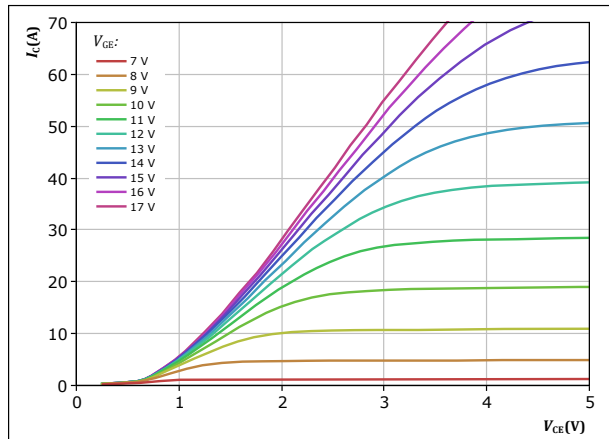


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 T_j : 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

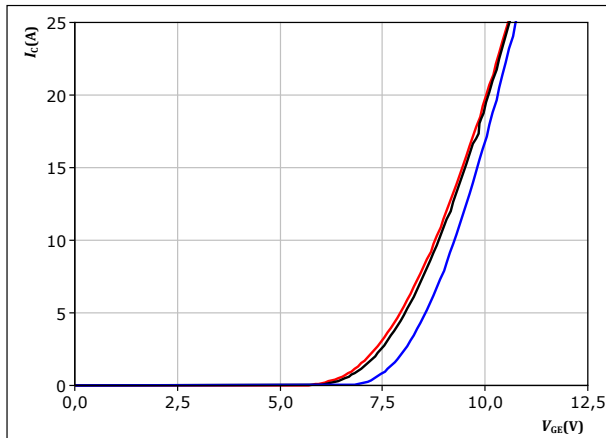


$t_p = 250 \mu s$
 $T_j = 150 \text{ °C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

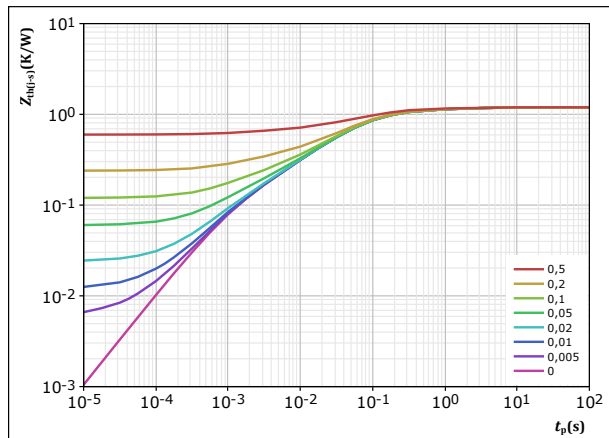


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 T_j : 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,196 \text{ K/W}$
IGBT thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
7,19E-02	2,96E+00
1,76E-01	3,16E-01
6,46E-01	6,48E-02
2,16E-01	1,08E-02
8,54E-02	1,15E-03



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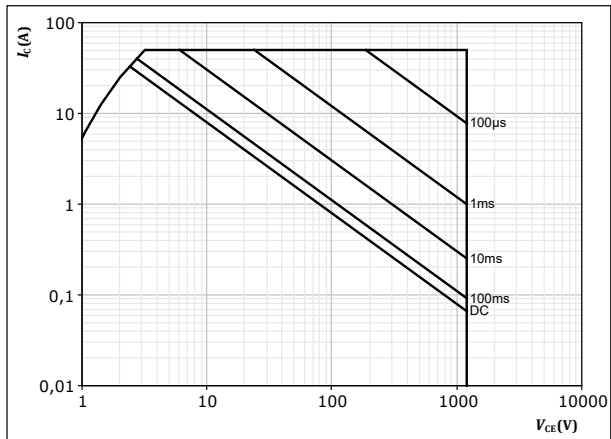
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Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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

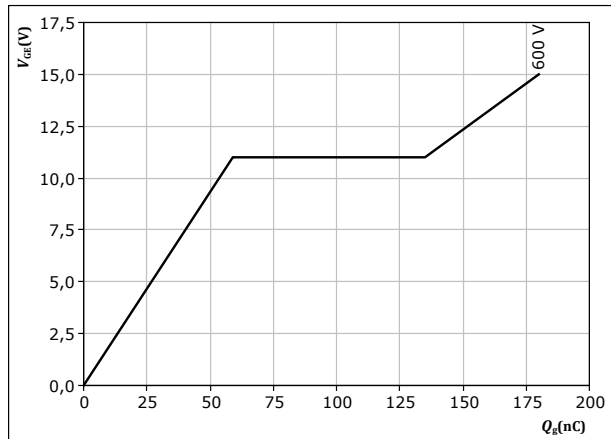


$D =$ single pulse
 $T_s = 80$ °C
 $V_{GE} = 15$ V
 $T_j = T_{jmax}$

figure 6. IGBT

Gate voltage vs gate charge

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



$I_C = 25$ A
 $T_j = 25$ °C



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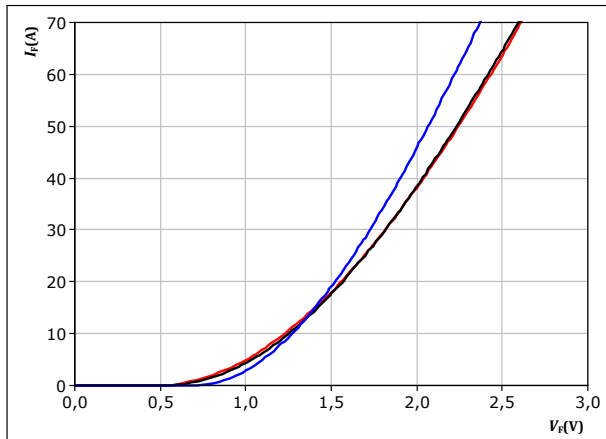
Inverter Diode Characteristics

figure 7.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

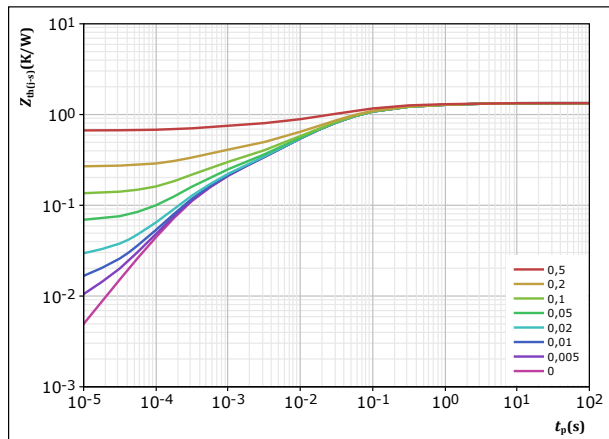
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 8.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	1,335	K/W
FWD thermal model values		
R (K/W)	τ (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	



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Rectifier Diode Characteristics

figure 9. Rectifier

Typical forward characteristics

$I_F = f(V_F)$

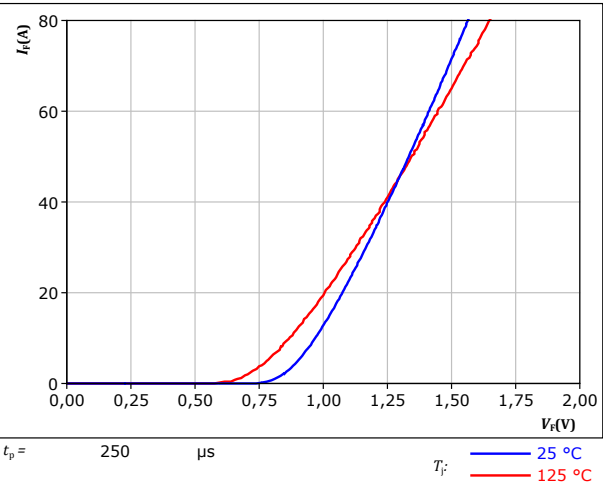
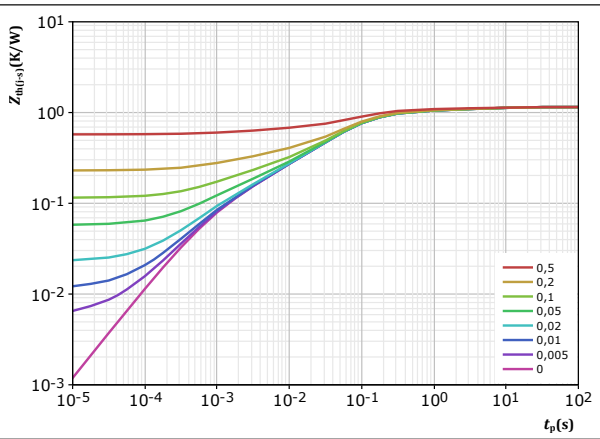


figure 10. Rectifier

Transient thermal impedance as a function of pulse width

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



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



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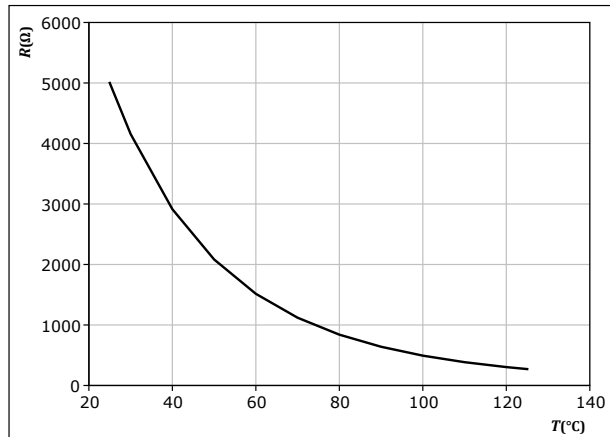
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Thermistor Characteristics

figure 11. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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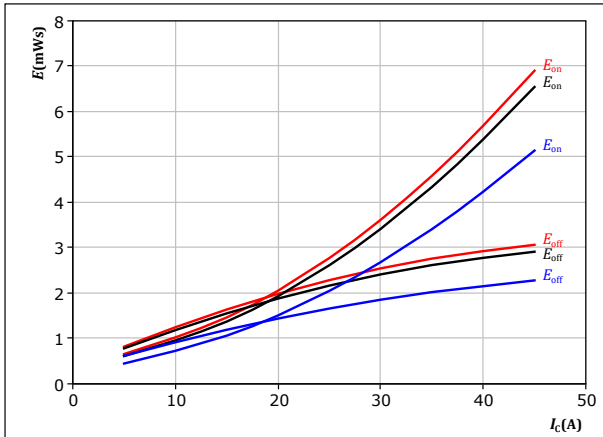
Inverter Switching Characteristics

figure 12.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

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

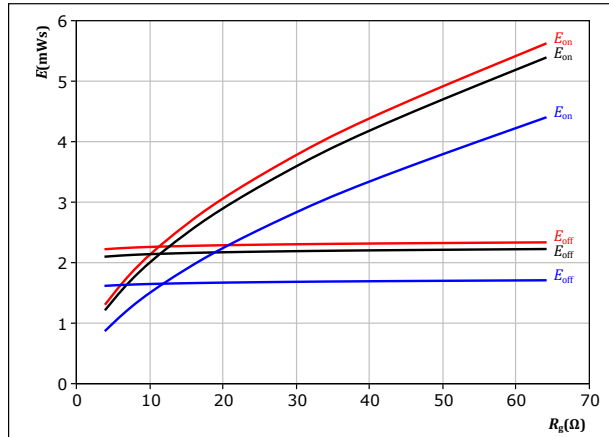
T_j :
— 25 °C
— 125 °C
— 150 °C

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

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

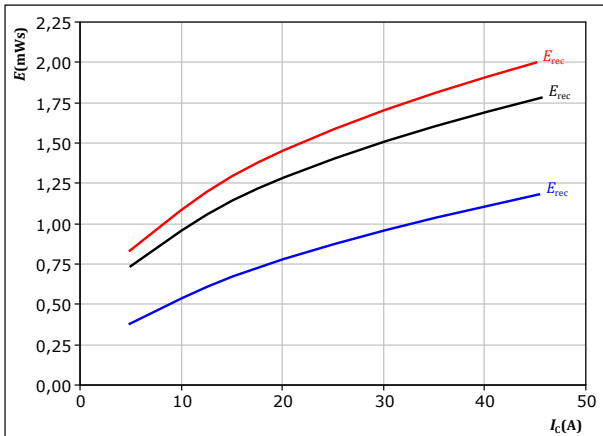
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 14.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

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

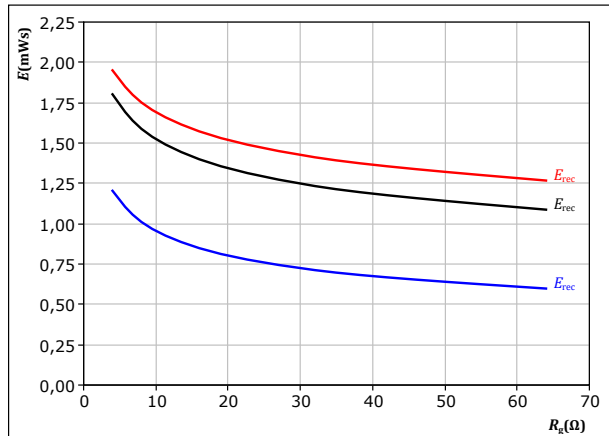
T_j :
— 25 °C
— 125 °C
— 150 °C

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

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

T_j :
— 25 °C
— 125 °C
— 150 °C



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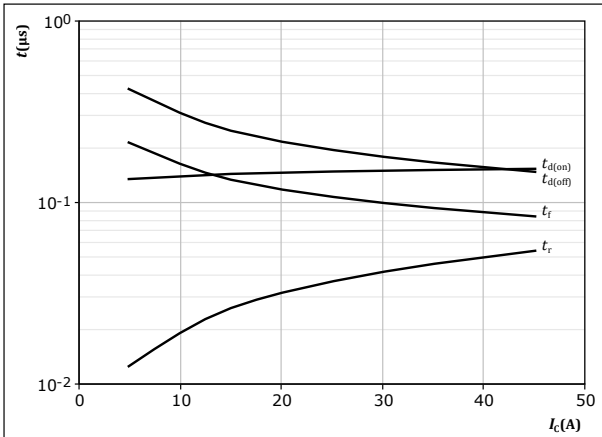
Inverter Switching Characteristics

figure 16.

IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



With an inductive load at

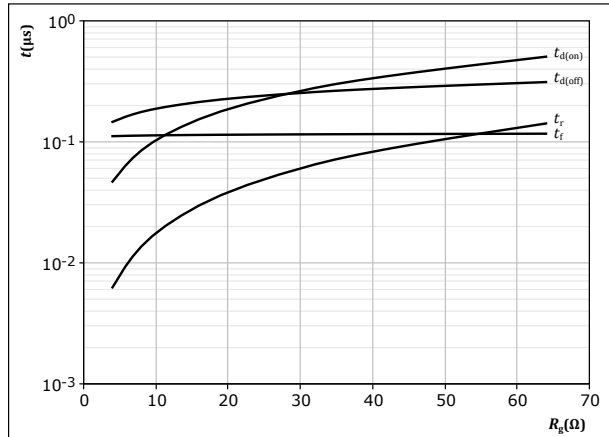
$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 16$ Ω

figure 17.

IGBT

Typical switching times as a function of IGBT turn on gate resistor

$$t = f(R_g)$$



With an inductive load at

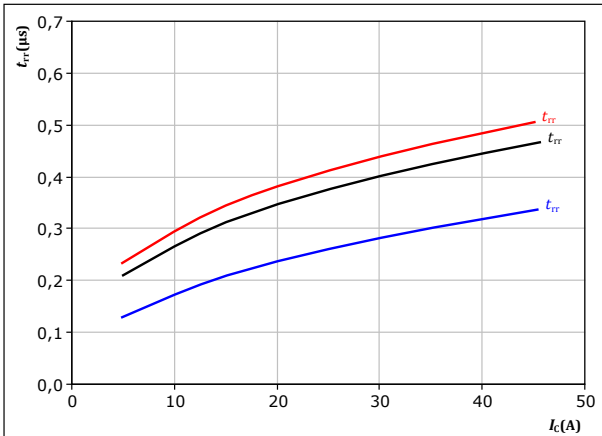
$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 25$ A

figure 18.

FWD

Typical reverse recovery time as a function of collector current

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



With an inductive load at

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

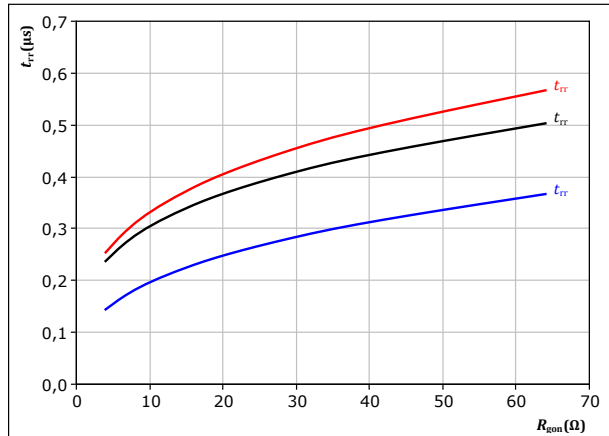
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 19.

FWD

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

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



With an inductive load at

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

T_j :
— 25 °C
— 125 °C
— 150 °C



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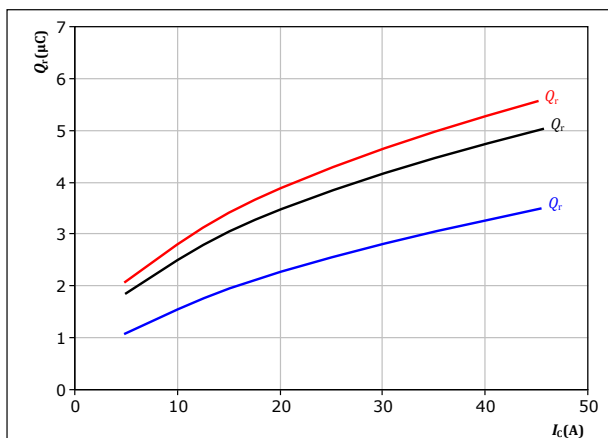
Inverter Switching Characteristics

figure 20.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

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

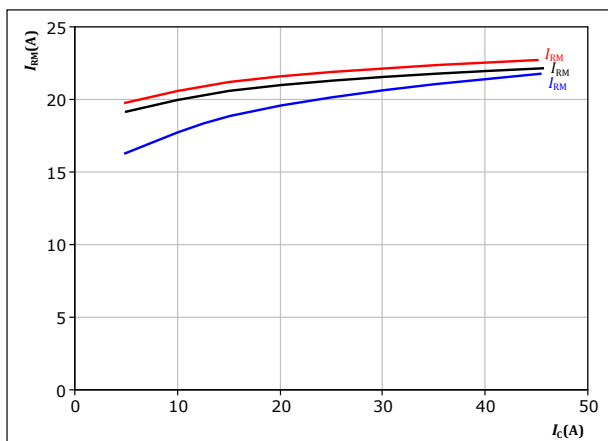
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 22.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

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

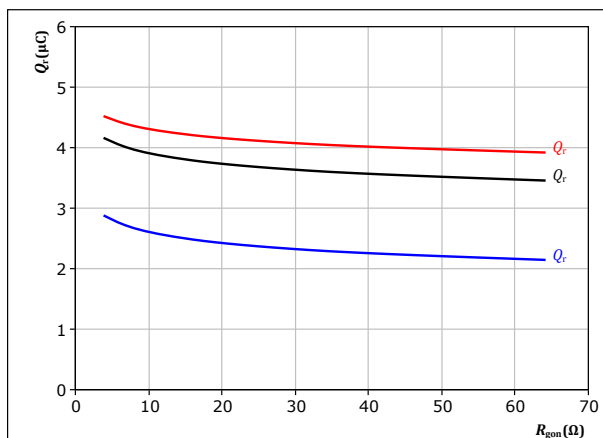
T_j :
— 25 °C
— 125 °C
— 150 °C

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

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

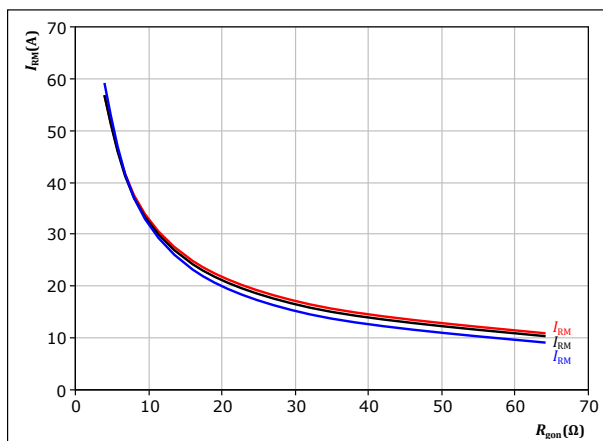
T_j :
— 25 °C
— 125 °C
— 150 °C

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

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

T_j :
— 25 °C
— 125 °C
— 150 °C



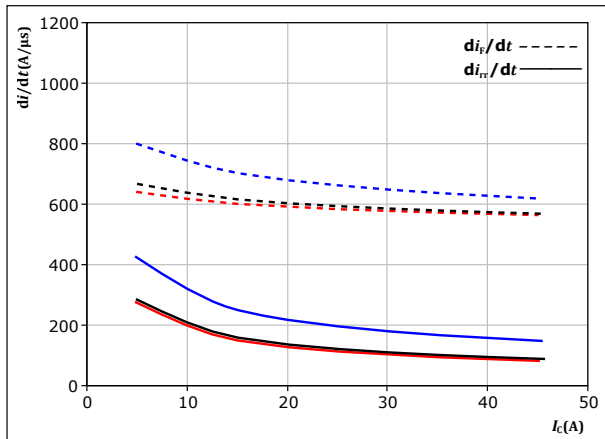
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Inverter Switching Characteristics

figure 24. FWD

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

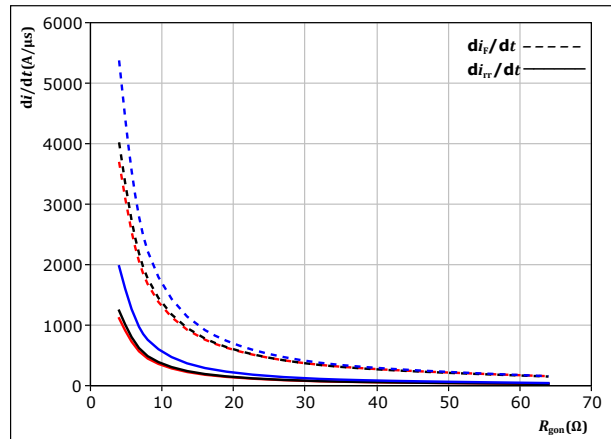


With an inductive load at

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

figure 25. FWD

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



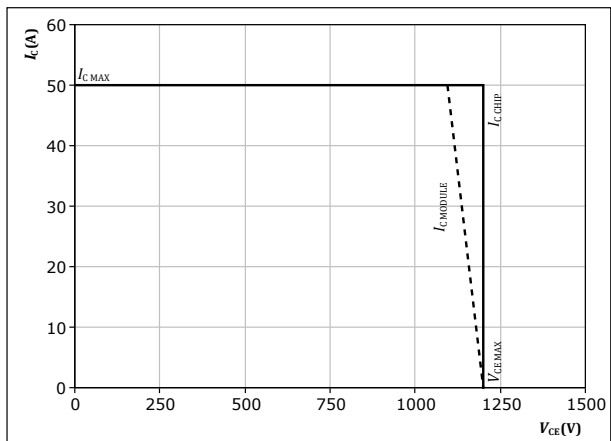
With an inductive load at

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

figure 26. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{gon} = 16$ Ω
 $R_{goff} = 16$ Ω



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Inverter Switching Definitions

figure 27. IGBT

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

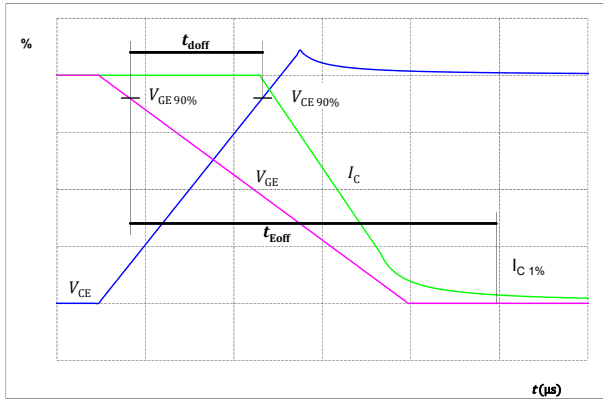


figure 28. IGBT

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

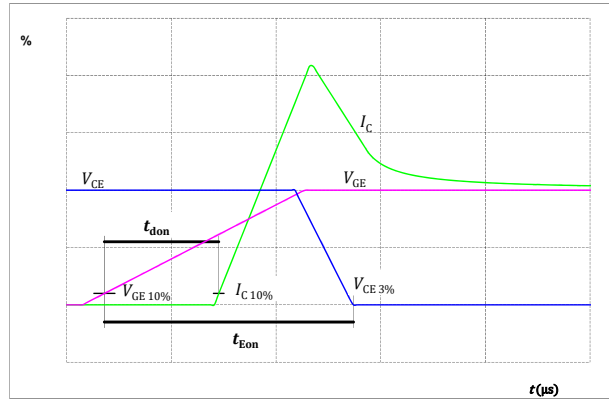


figure 29. IGBT

Turn-off Switching Waveforms & definition of t_f

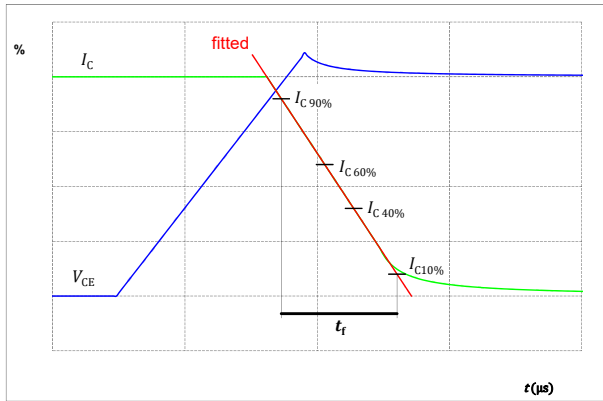
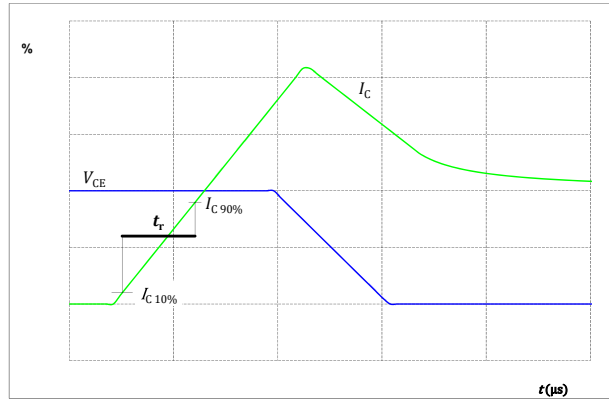


figure 30. IGBT

Turn-on Switching Waveforms & definition of t_r





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Inverter Switching Definitions

figure 31.

FWD

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

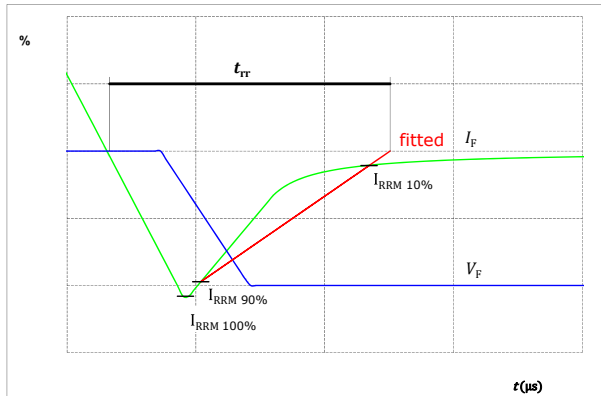
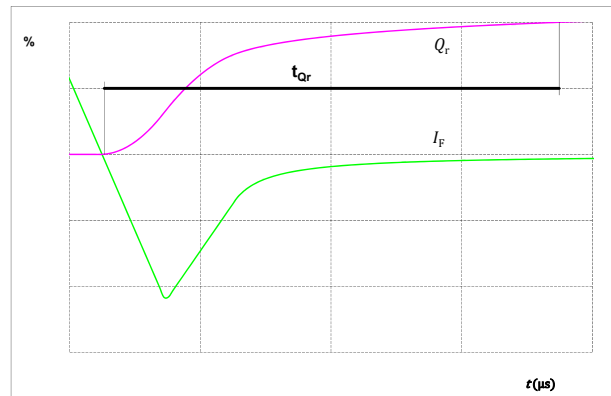


figure 32.

FWD

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





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10-E112PNA025M7-L929C78Z

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-E112PNA025M7-L929C78Z
With thermal paste (3,4 W/mK, PSX-P7)	10-E112PNA025M7-L929C78Z-/3/

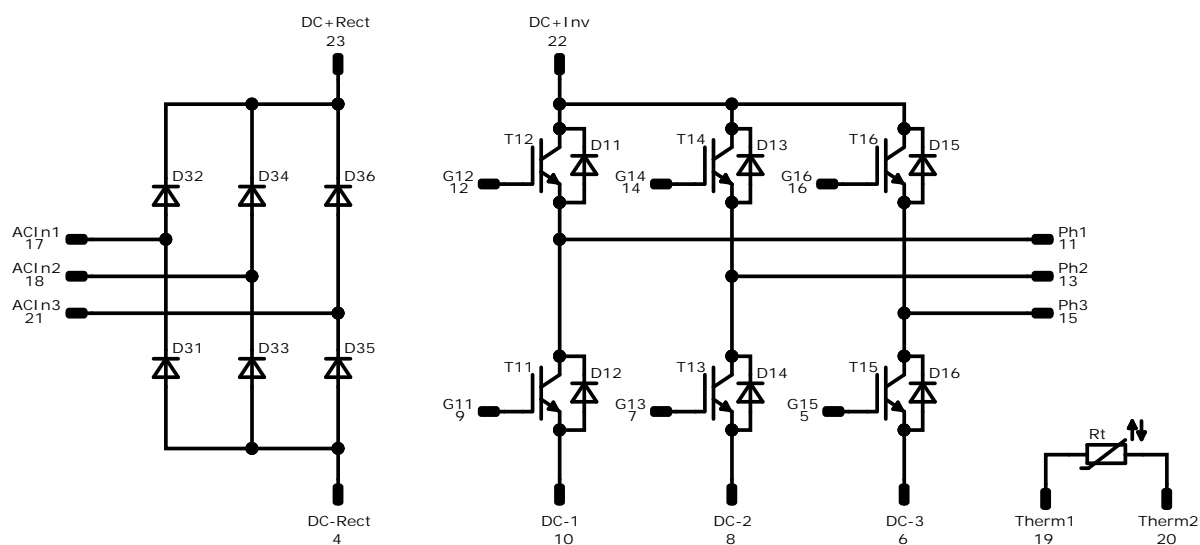
Marking						
	Text	Name	Date code	UL & VIN	Lot	Serial
		NN-NNNNNNNNNNNNNNNN- TTTTIVV	WWYY	UL VIN	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code	
		TTTTTIVV	LLLLL	SSSS	WWYY	

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	



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Pinout



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	
Rt	NTC			Thermistor	



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10-E112PNA025M7-L929C78Z
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.

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 $T_{j,sp}=175^{\circ}\text{C}$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.



Document No.:	Date:	Modification:	Pages
10-E112PNA025M7-L929C78Z-D1-14	5 Jun. 2024	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.