



Vincotech

10-FX12PNA005M7-P848C27

datasheet

flowPIM 0

1200 V / 5 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
- Thermo-mechanical push-and-pull force relief
- Solder pin

Extra features

- With three-phase standard rectifier

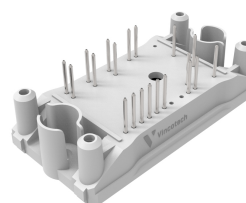
Target applications

- Embedded Drives
- Industrial Drives

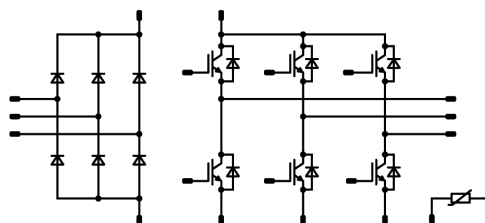
Types

- 10-FX12PNA005M7-P848C27

flow 0 17 mm housing



Schematic





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Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	10 ⁽¹⁾	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	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	°C

⁽¹⁾ limited by I_{CRM}

Inverter Diode

Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	10 ⁽²⁾	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	27	W
Maximum junction temperature	T_{jmax}		175	°C

⁽²⁾ limited by I_{FRM}

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	I^2t		200	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	W
Maximum junction temperature	T_{jmax}		150	°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
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		≥ 200	

*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	0,0005	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		5	25 125 150		1,63 1,83 1,9	1,95 ⁽³⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			20	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			1100		pF
Output capacitance	C_{oes}							57		pF
Reverse transfer capacitance	C_{res}							11		pF
Gate charge	Q_g	$V_{CC} = 600$ V	15		5	25		40		nC

Thermal

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

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 64$ Ω $R_{goff} = 64$ Ω	±15	600	5	25 125 150		153,2 148,8 147		ns
Rise time	t_r					25 125 150		38,6 43 43		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		153,6 176 181		ns
Fall time	t_f					25 125 150		88,88 114,69 111,02		ns
Turn-on energy (per pulse)	E_{on}					25 125 150		0,48 0,601 0,643		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,333 0,44 0,473		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				5	25 125 150		1,57 1,66 1,65	2,1 ⁽³⁾	V
Reverse leakage current	I_R	$V_i = 1200$ V				25			20	μA

Thermal

Thermal resistance junction to sink ⁽⁴⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						3,5		K/W
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Dynamic

Peak recovery current	I_{RM}	$di/dt=83$ A/μs $di/dt=99$ A/μs $di/dt=92$ A/μs	± 15	600	5	25 125 150		4,12 4,33 4,49		A
Reverse recovery time	t_{rr}					25 125 150		258,97 386,93 434,02		ns
Recovered charge	Q_r					25 125 150		0,551 0,873 0,985		μC
Reverse recovered energy	E_{rec}					25 125 150		0,186 0,33 0,378		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		46,42 24,56 24,53		A/μs



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				8	25 125		0,996 0,907	1,21 ⁽³⁾ 1,1 ⁽³⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25			50	μA

Thermal

Thermal resistance junction to sink ⁽⁴⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,59		K/W
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Thermistor

Static

Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 1484$ Ω				100	-5		5	%
Power dissipation	P					25		130		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ± 1 %						3962		K
B-value	$B_{(25/100)}$	Tol. ± 1 %						4000		K
Vincotech Thermistor Reference									I	

⁽³⁾ Value at chip level

⁽⁴⁾ Only valid with pre-applied Vincotech thermal interface material.



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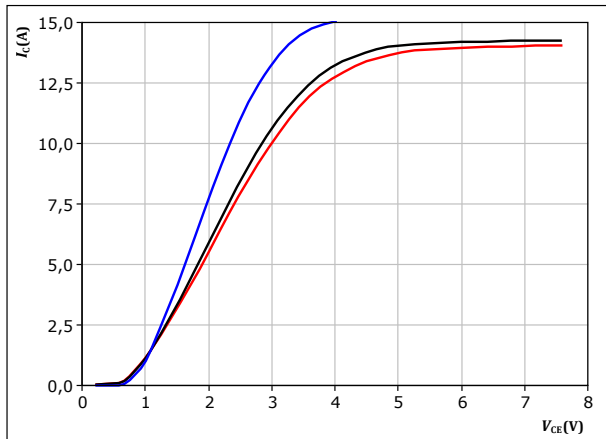
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Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

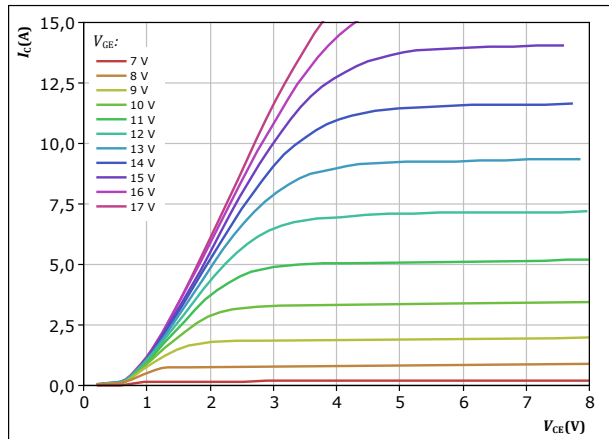


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j:$ 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

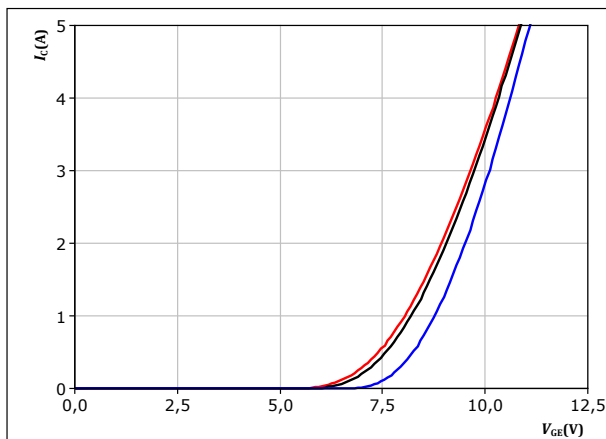


$t_p = 250 \mu s$
 $T_j = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

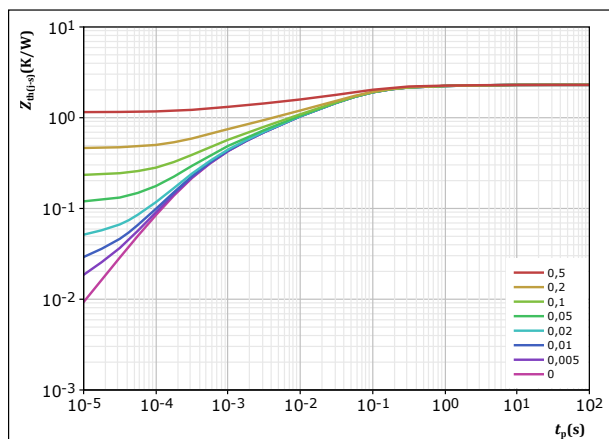


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j:$ 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-a)} = 2,301 K/W$
IGBT thermal model values

$R (K/W)$	$\tau (s)$
6,25E-02	3,48E+00
1,37E-01	5,00E-01
7,38E-01	8,11E-02
5,28E-01	2,49E-02
3,84E-01	5,54E-03
2,39E-01	1,24E-03
2,13E-01	3,29E-04



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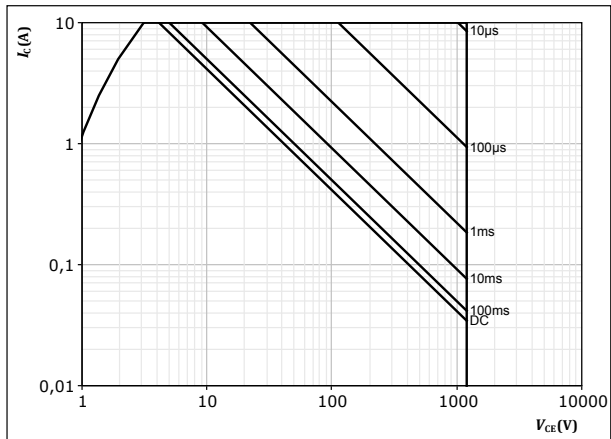
Inverter Switch Characteristics

figure 5.

IGBT

Safe operating area

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



$D =$ single pulse

$T_s = 80$ °C

$V_{GE} = 15$ V

$T_j = T_{jmax}$



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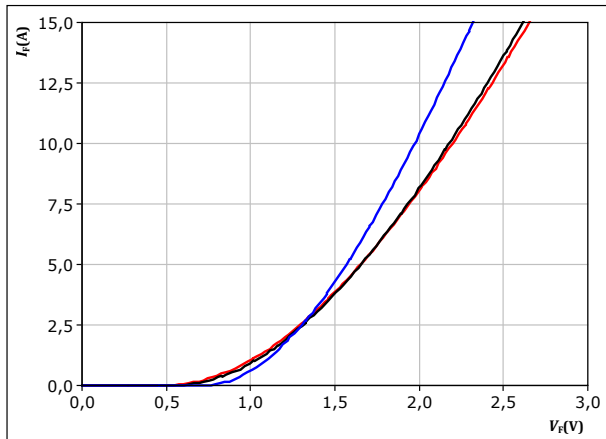
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Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$



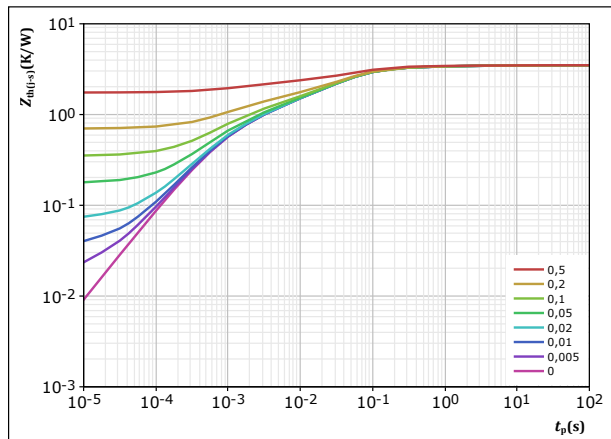
$t_p = 250 \mu s$

T_j : 25 °C (blue line), 125 °C (black line), 150 °C (red line)

figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 3,495 \text{ K/W}$

FWD thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
8,03E-02	7,23E+00
2,34E-01	4,70E-01
1,33E+00	6,36E-02
7,92E-01	2,24E-02
5,71E-01	3,34E-03
4,85E-01	7,05E-04



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Rectifier Diode Characteristics

figure 8.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

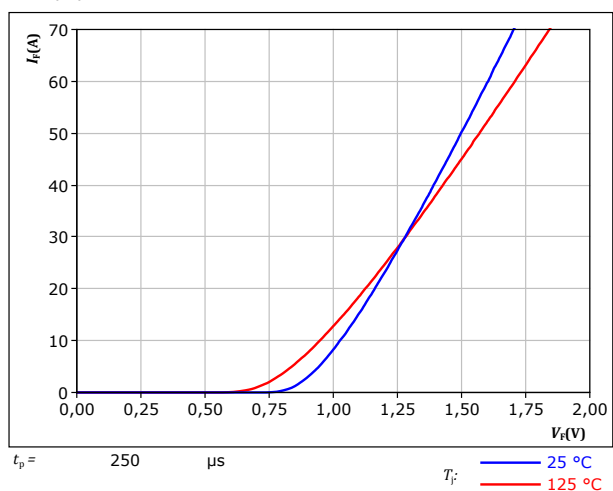
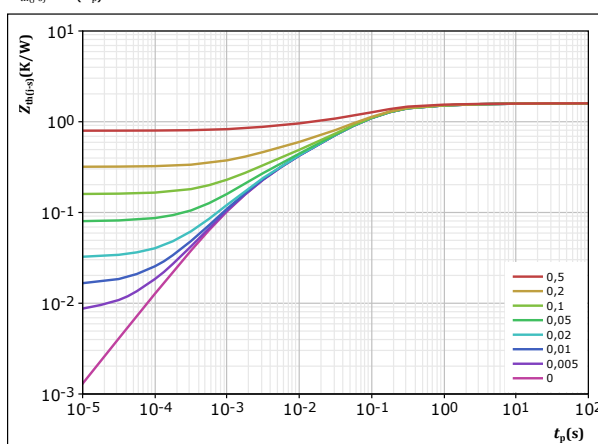


figure 9.

Rectifier

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	1,594	K/W
Rectifier thermal model values		
R (K/W)	τ (s)	
3,44E-02	9,66E+00	
1,12E-01	1,22E+00	
5,81E-01	1,45E-01	
4,89E-01	5,05E-02	
2,38E-01	9,26E-03	
1,22E-01	1,79E-03	
1,81E-02	7,88E-04	



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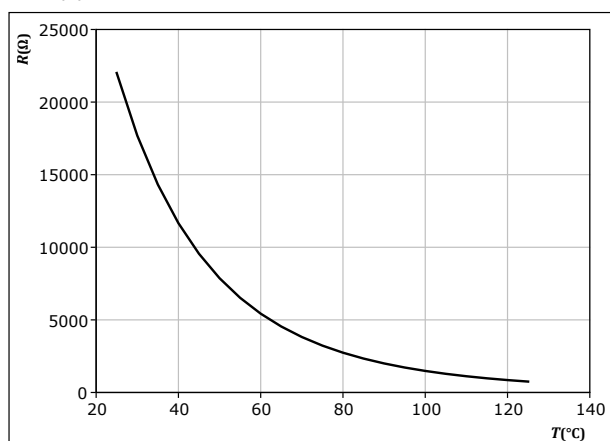
Thermistor Characteristics

figure 10.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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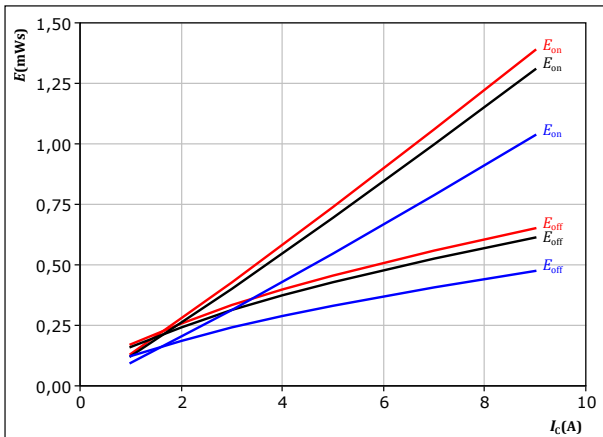
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Inverter Switching Characteristics

figure 11. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

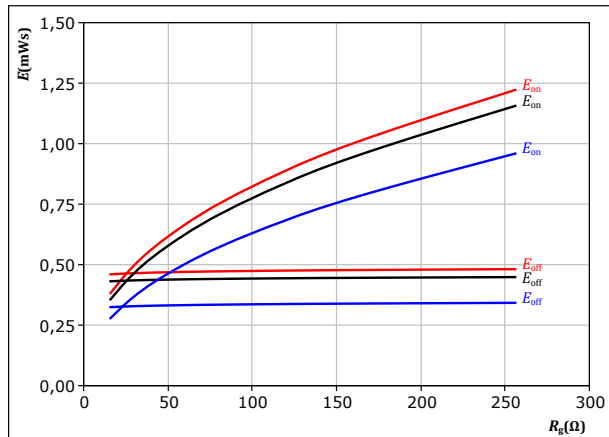
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 12. IGBT

Typical switching energy losses as a function of IGBT turn on gate resistor

$$E = f(R_g)$$



With an inductive load at

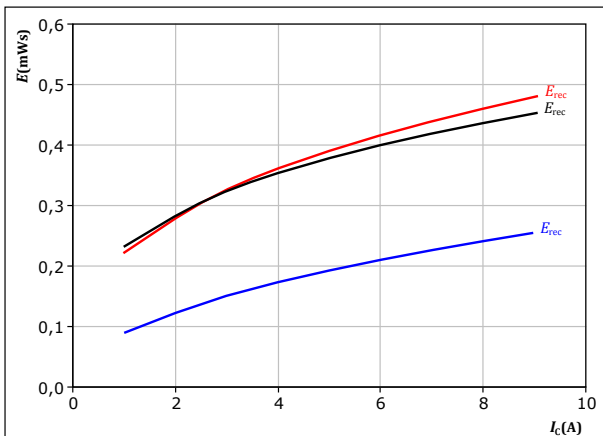
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 5$ A

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

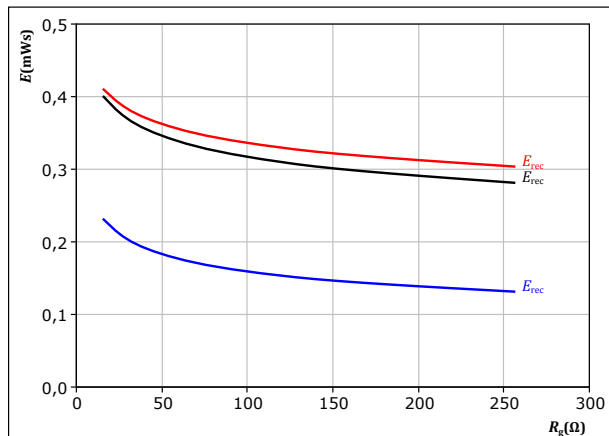
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 14. 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
 $V_{GE} = \pm 15$ V
 $I_C = 5$ A

T_j :
— 25 °C
— 125 °C
— 150 °C



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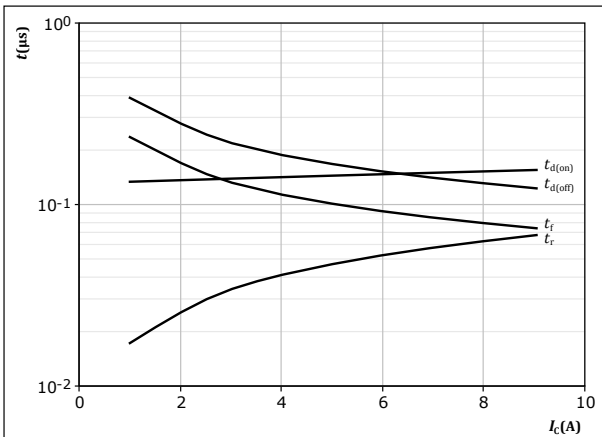
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Inverter Switching Characteristics

figure 15.

IGBT

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



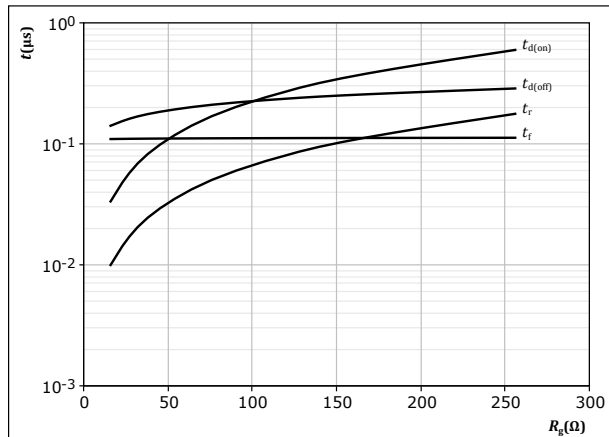
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

figure 16.

IGBT

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



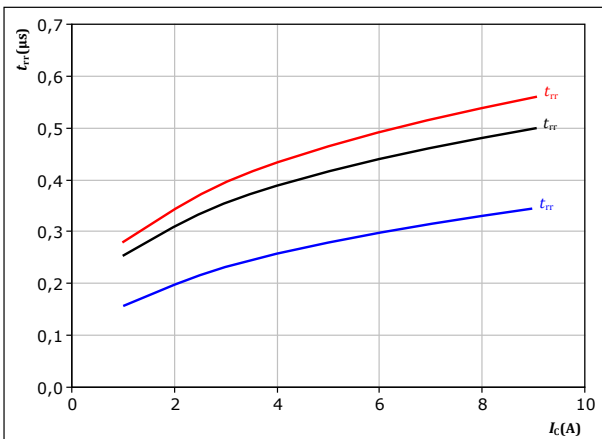
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 5$ A

figure 17.

FWD

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



With an inductive load at

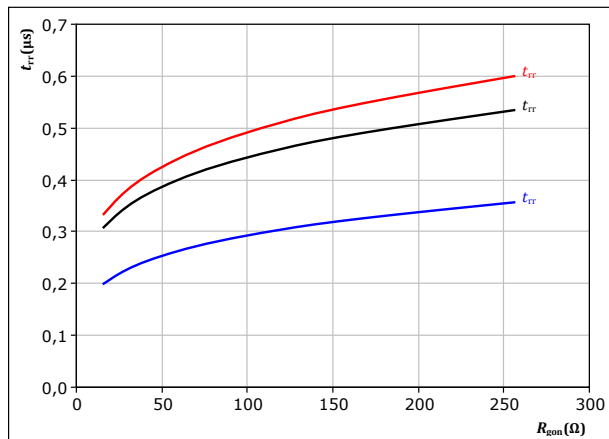
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

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

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 5$ A

T_j :
— 25 °C
— 125 °C
— 150 °C



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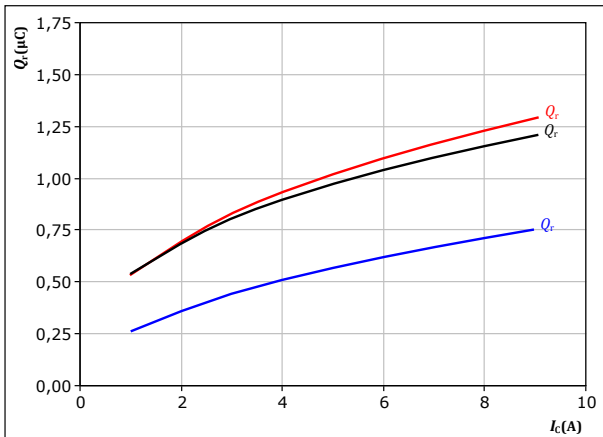
Inverter Switching Characteristics

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
 $R_{gon} = 64$ Ω

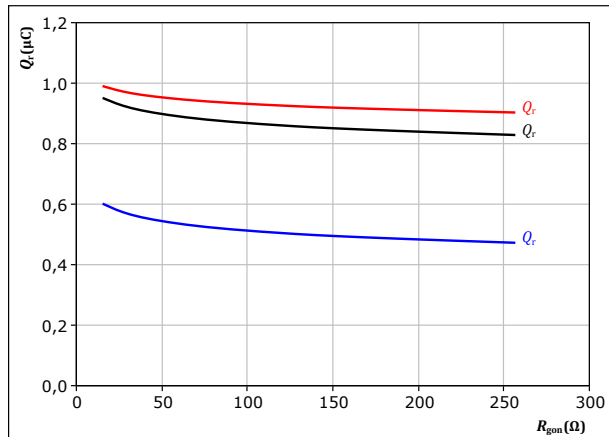
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 20.

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
 $I_c = 5$ A

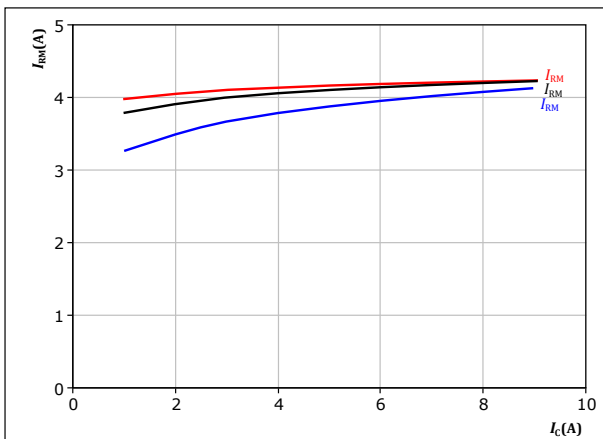
T_j :
— 25 °C
— 125 °C
— 150 °C

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
 $R_{gon} = 64$ Ω

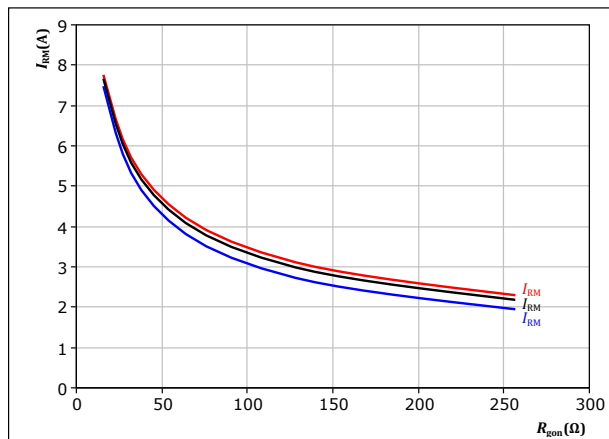
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 22.

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
 $I_c = 5$ A

T_j :
— 25 °C
— 125 °C
— 150 °C



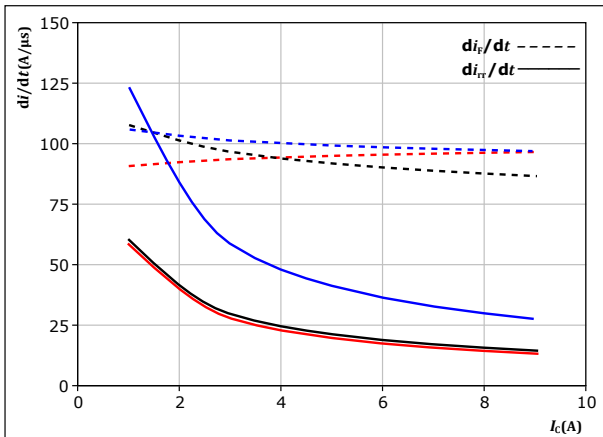
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Inverter Switching Characteristics

figure 23. FWD

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

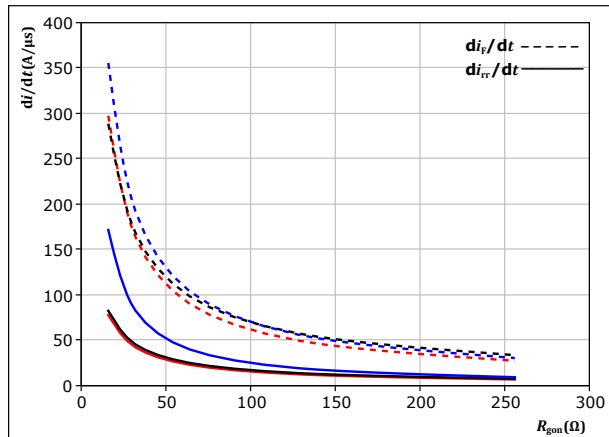


With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $T_j = 25$ °C
 $T_j = 125$ °C
 $T_j = 150$ °C

figure 24. FWD

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



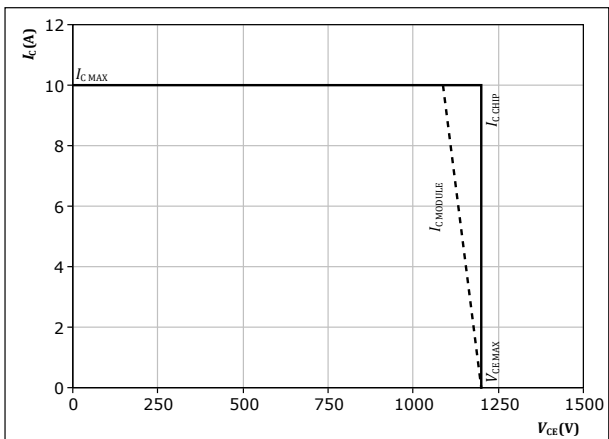
With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 5$ A
 $T_j = 25$ °C
 $T_j = 125$ °C
 $T_j = 150$ °C

figure 25. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω



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Inverter Switching Definitions

figure 26. IGBT

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

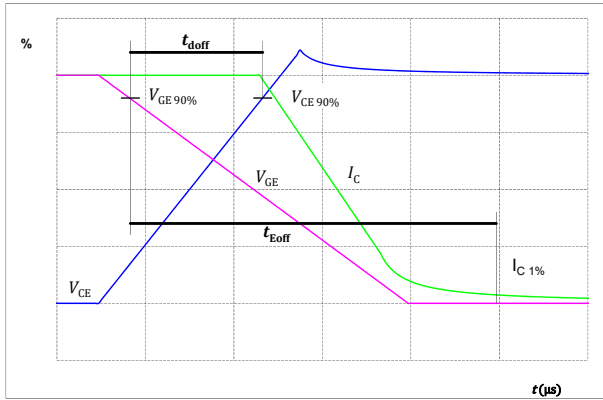


figure 27. IGBT

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

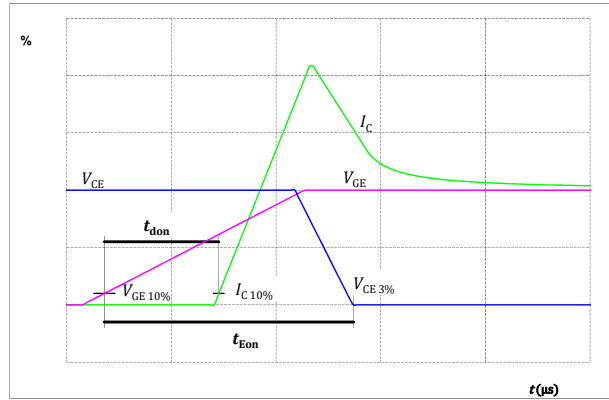


figure 28. IGBT

Turn-off Switching Waveforms & definition of t_f

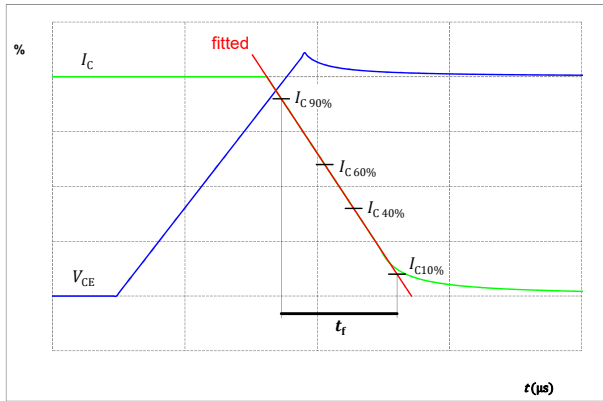
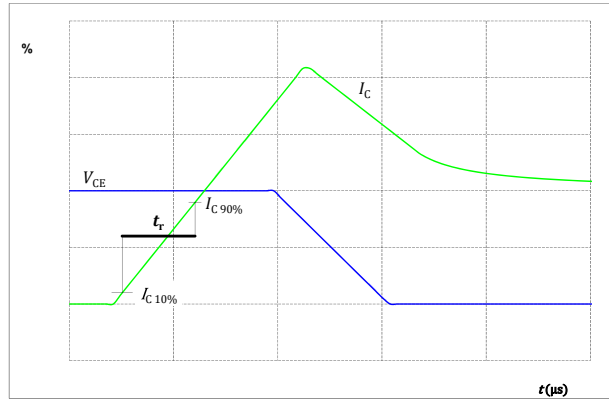


figure 29. IGBT

Turn-on Switching Waveforms & definition of t_r





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Inverter Switching Definitions

figure 30.

FWD

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

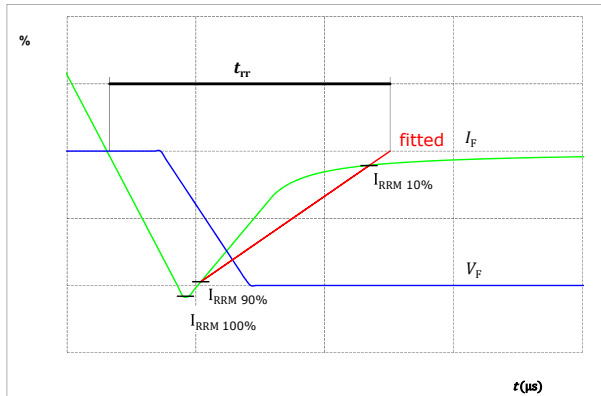
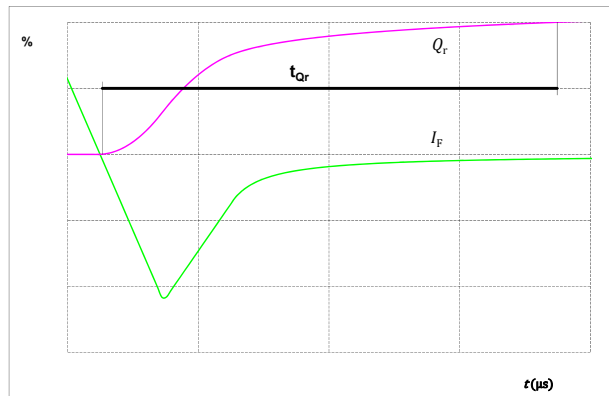


figure 31.

FWD

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





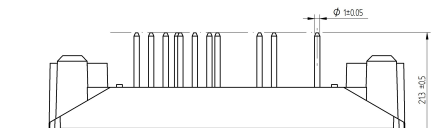
datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-FX12PNA005M7-P848C27
With thermal paste (5,2 W/mK, PTM6000HV)	10-FX12PNA005M7-P848C27-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-FX12PNA005M7-P848C27-/3/

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

Outline

Pin table [mm]			
Pin	X	Y	Function
1	25,5	2,7	Therm1
2	25,5	0	Therm2
3	22,8	0	DC-Rect
4	not assembled		
5	not assembled		
6	13,5	0	G15
7	10,8	0	DC-3
8	8,1	0	G13
9	5,4	0	DC-2
10	2,7	0	G11
11	0	0	DC-1
12	0	19,8	G12
13	0	22,5	Ph1
14	7,5	19,8	G14
15	7,5	22,5	Ph2
16	15	19,8	G16
17	15	22,5	Ph3
18	22,8	22,5	DC+Inv
19	25,5	22,5	DC+Rect
20	not assembled		
21	33,5	15	ACIn1
22	33,5	7,5	ACIn2
23	33,5	0	ACIn3

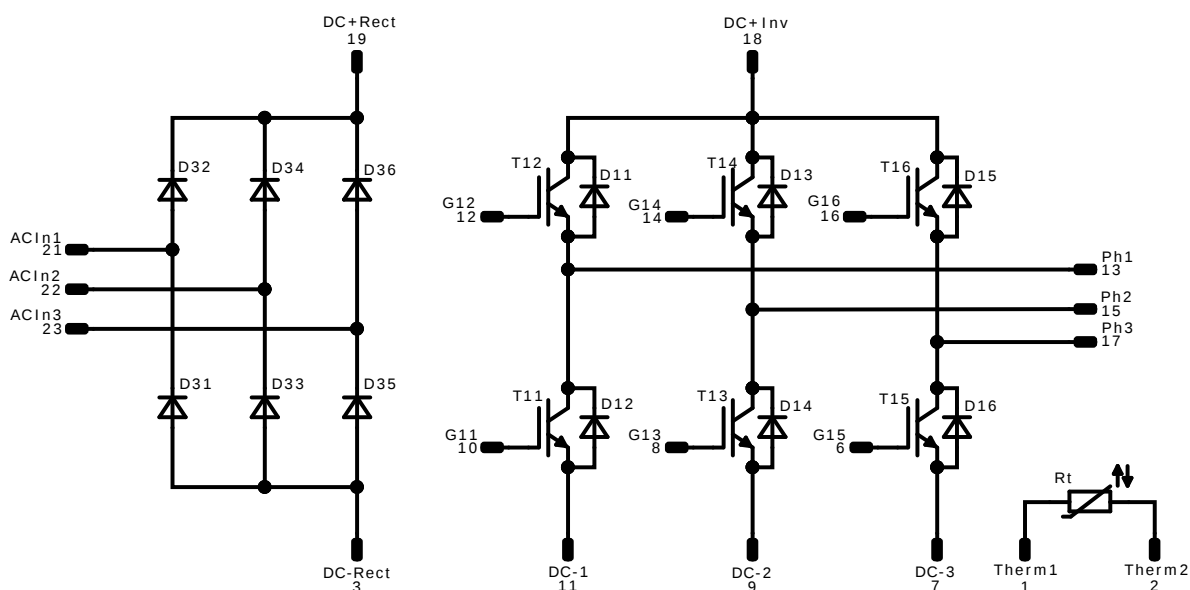


Tolerance of positions: $\pm 0,5\text{mm}$ at the end of pins
 Dimension of coordinate axis is only offset without tolerance



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Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	5 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	5 A	Inverter Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	25 A	Rectifier Diode	
Rt	Thermistor			Thermistor	



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10-FX12PNA005M7-P848C27
datasheet

Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow 0</i> packages see vincotech.com website.

Package data
Package data for <i>flow 0</i> 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-FX12PNA005M7-P848C27-D1-14	19 Dec. 2022		

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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.