



### flowPACK E1

1200 V / 35 A

#### Topology features

- Open Emitter configuration
- Temperature sensor
- Inverter
- Low side Kelvin Emitter for improved switching performance

#### 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:  $\text{Al}_2\text{O}_3$
- 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

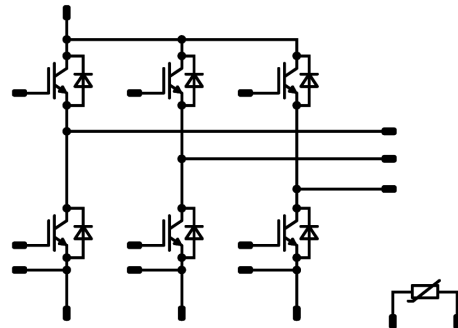
#### Types

- 10-E1126PA035M7-L859F78Z

#### 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
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	51	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	70	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	108	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	9,5	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Inverter Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	70	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	78	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Module Properties

### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	$^{\circ}\text{C}$
Operation temperature under switching condition	$T_{jop}$		-40...+( $T_{jmax} - 25$ )	$^{\circ}\text{C}$

### Isolation Properties

Isolation voltage	$V_{isol}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
Creepage distance			>12,7	mm
Clearance			8,62	mm
Comparative Tracking Index	CTI		$\geq 600$	

\*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	0,0035	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		35	25 125 150		1,47 1,64 1,68	1,85 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			80	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		7900		pF
Output capacitance	$C_{oes}$							270		pF
Reverse transfer capacitance	$C_{res}$							97		pF
Gate charge	$Q_g$	$V_{CC} = 600$ V	0/15		35	25		260		nC

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,88		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16$ Ω $R_{goff} = 16$ Ω	±15	600	35	25 125 150		223,4 240,2 233		ns
Rise time	$t_r$					25 125 150		28 34 35,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		227 252,2 259,4		ns
Fall time	$t_f$					25 125 150		96,87 114,26 122,62		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 3,8$ µC $Q_{tFWD} = 5,84$ µC $Q_{tFWD} = 6,39$ µC				25 125 150		2,45 3,23 3,44		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,46 3,24 3,46		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	$V_F$				35	25 125 150		1,66 1,76 1,75	2,1 <sup>(1)</sup>		V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25			40		µA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,22			K/W
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#### Dynamic

Peak recovery current	$I_{RM}$	$di/dt=1364$ A/µs $di/dt=1192$ A/µs $di/dt=1157$ A/µs	$\pm 15$	600	35	25 125 150		41,09 40,2 40,64			A
Reverse recovery time	$t_{rr}$					25 125 150		266,56 425,38 450,01			ns
Recovered charge	$Q_r$					25 125 150		3,8 5,84 6,39			µC
Reverse recovered energy	$E_{rec}$					25 125 150		1,48 2,39 2,6			mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		485,16 353,08 342,83			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	

### Thermistor

#### Static

Rated resistance	$R$					25		5		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 493 \Omega$				100	-5		5	%
Power dissipation	$P$							245		mW
Power dissipation constant	$d$					25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 2 \%$						3375		K
B-value	$B_{(25/100)}$	Tol. $\pm 2 \%$						3437		K
Vincotech Thermistor Reference									K	

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.



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datasheet

## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

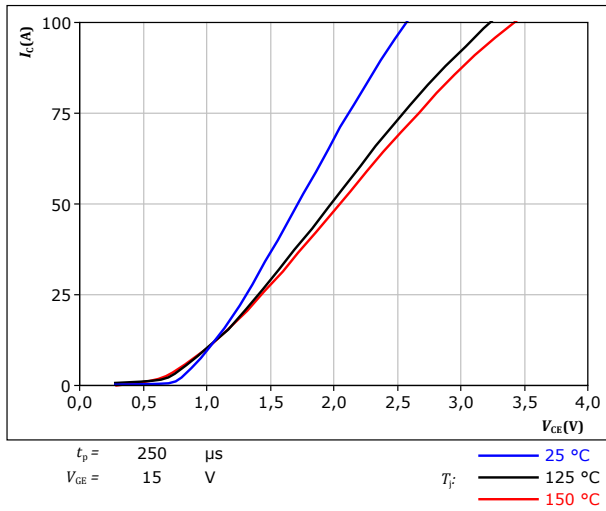


figure 2. IGBT

Typical output characteristics

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

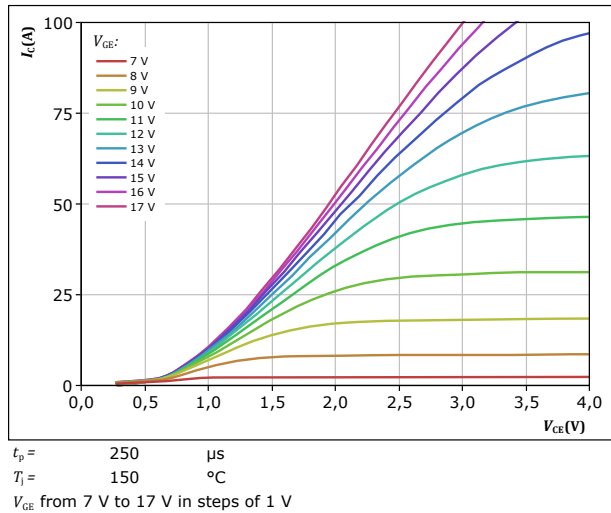


figure 3. IGBT

Typical transfer characteristics

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

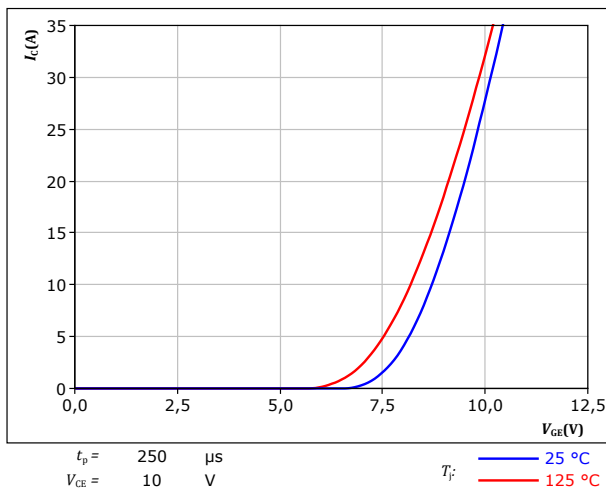
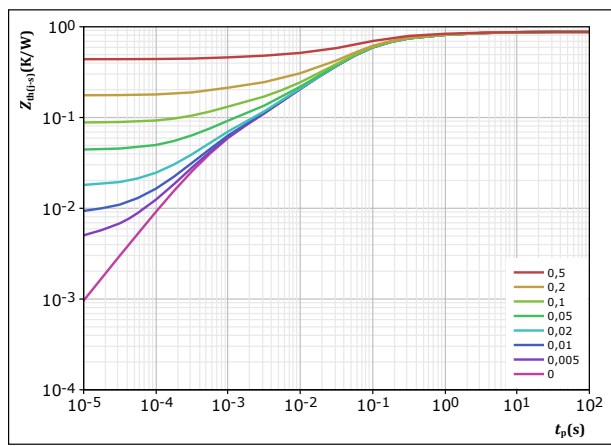


figure 4. IGBT

Transient thermal impedance as a function of pulse width

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





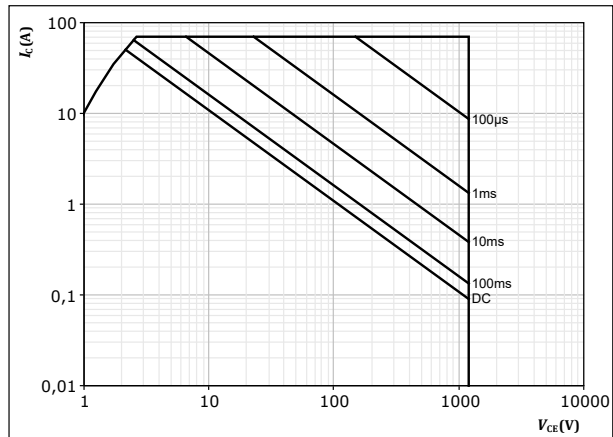
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## Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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

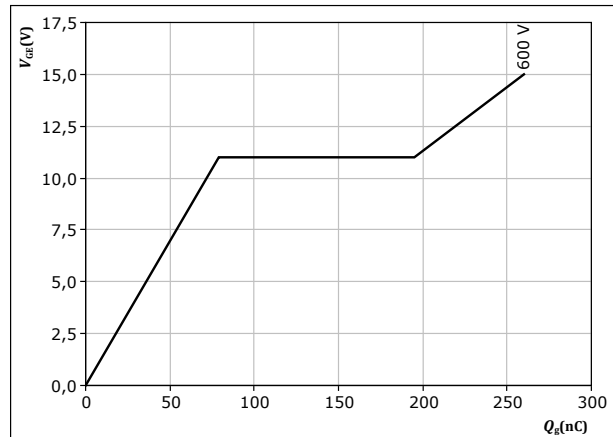


$D$  = single pulse  
 $T_s$  = 80 °C  
 $V_{GE}$  = 15 V  
 $T_j$  =  $T_{jmax}$

figure 6. IGBT

Gate voltage vs gate charge

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



$I_C$  = 35 A  
 $T_j$  = 25 °C



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Inverter Diode Characteristics

figure 7. FWD

Typical forward characteristics

$I_F = f(V_F)$

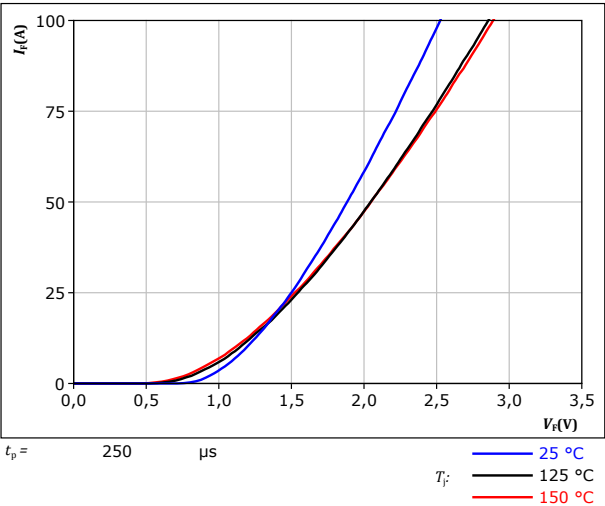
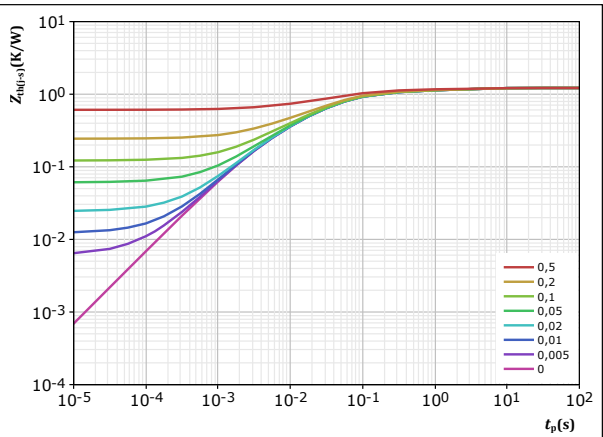


figure 8. FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	1,219	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
1,07E-01	3,56E+00	
1,60E-01	2,77E-01	
5,76E-01	5,00E-02	
2,75E-01	1,24E-02	
1,01E-01	2,87E-03	





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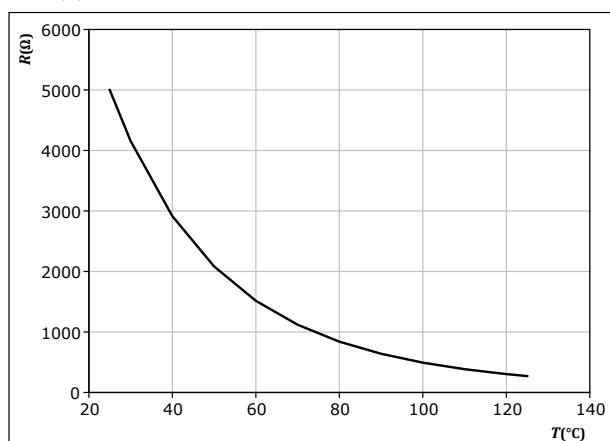
## Thermistor Characteristics

figure 9.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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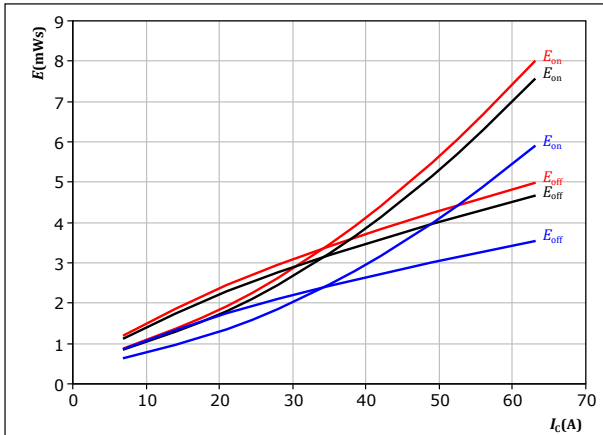
## Inverter Switching Characteristics

figure 10.

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  
 $R_{gon} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

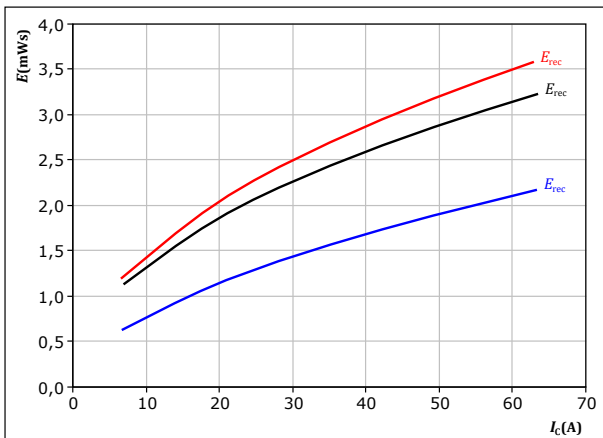
$T_j$ : 25 °C  
125 °C  
150 °C

figure 12.

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  
 $R_{gon} = 16$   $\Omega$

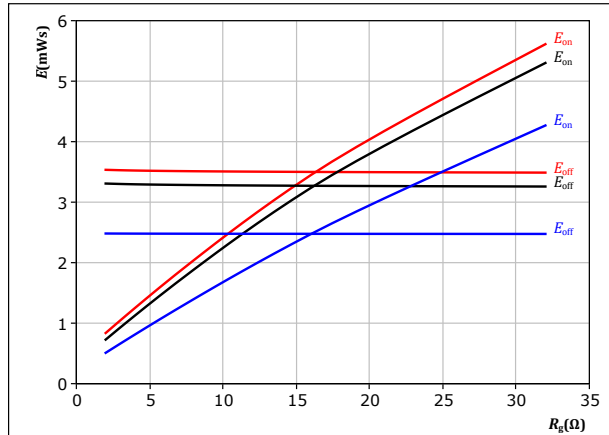
$T_j$ : 25 °C  
125 °C  
150 °C

figure 11.

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  
 $I_c = 35$  A

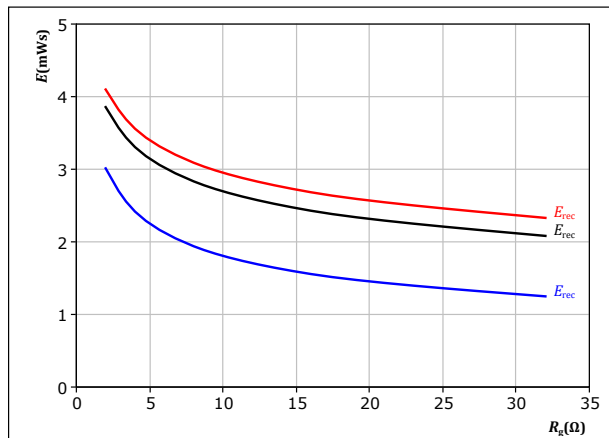
$T_j$ : 25 °C  
125 °C  
150 °C

figure 13.

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  
 $I_c = 35$  A

$T_j$ : 25 °C  
125 °C  
150 °C



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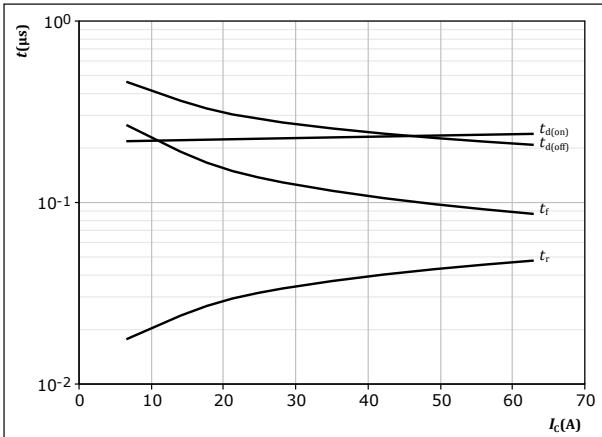
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datasheet

## Inverter Switching Characteristics

figure 14.

IGBT

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



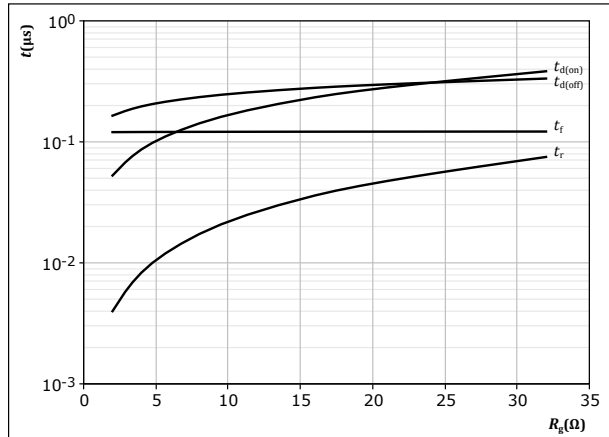
With an inductive load at

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

figure 15.

IGBT

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



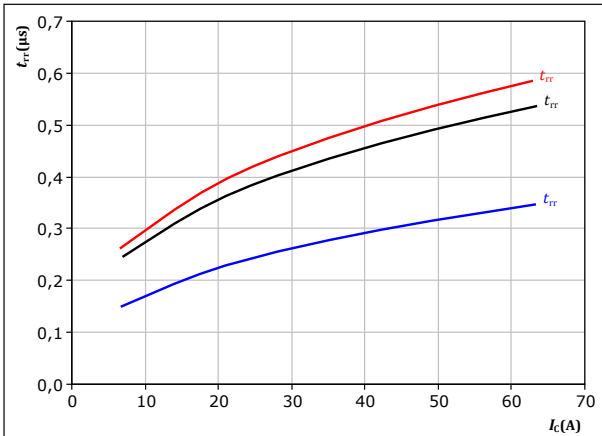
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 35$  A

figure 16.

FWD

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



With an inductive load at

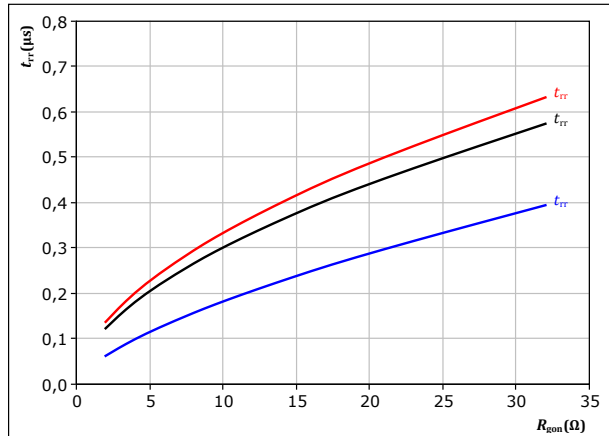
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

figure 17.

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  
 $I_C = 35$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



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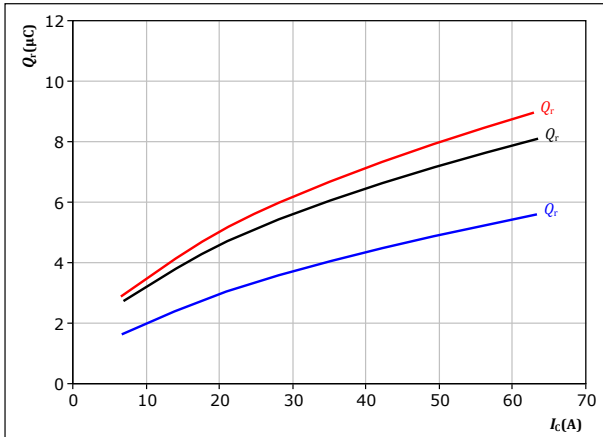
## Inverter Switching Characteristics

figure 18.

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  
 $R_{gon} = 16$   $\Omega$

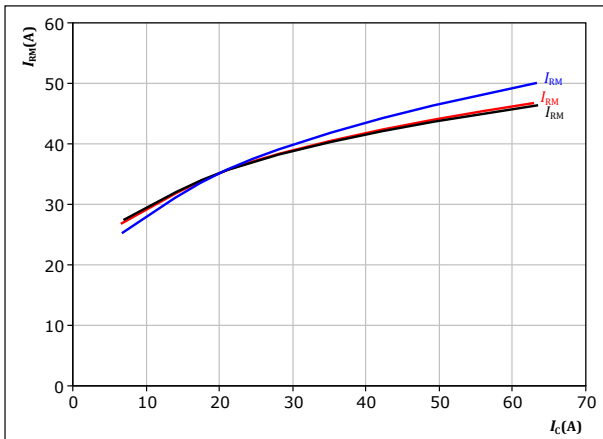
$T_j$ : 25 °C  
125 °C  
150 °C

figure 20.

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  
 $R_{gon} = 16$   $\Omega$

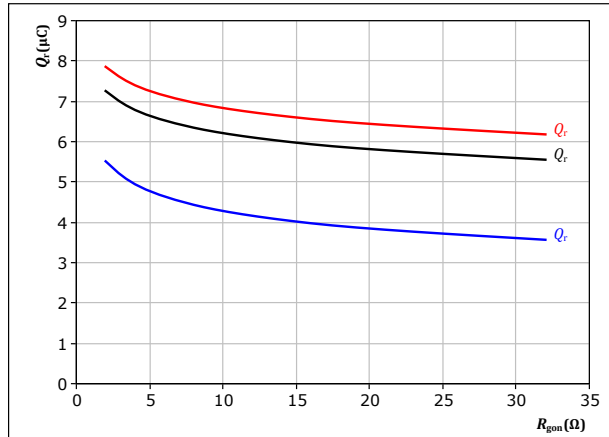
$T_j$ : 25 °C  
125 °C  
150 °C

figure 19.

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  
 $I_c = 35$  A

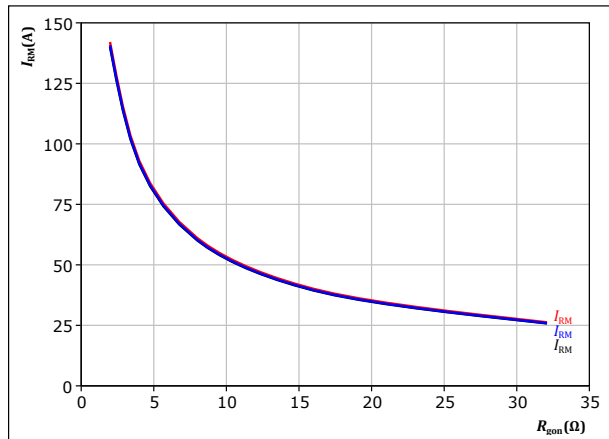
$T_j$ : 25 °C  
125 °C  
150 °C

figure 21.

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  
 $I_c = 35$  A

$T_j$ : 25 °C  
125 °C  
150 °C



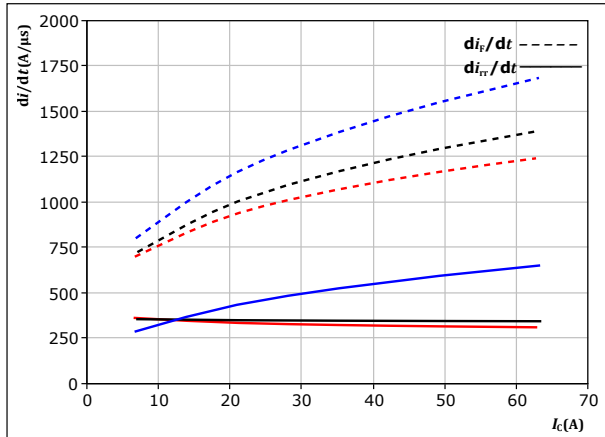
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## Inverter Switching Characteristics

figure 22. FWD

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

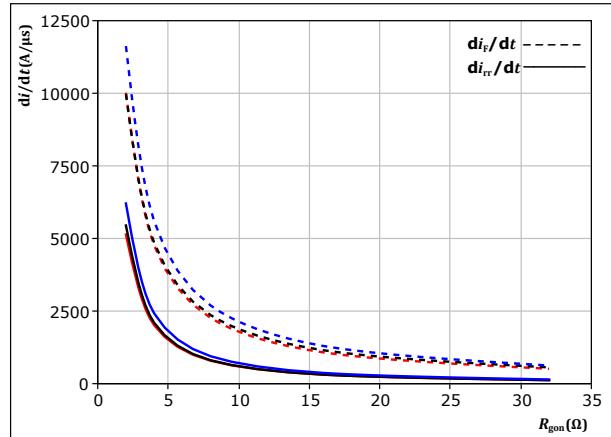


With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j: 25^\circ\text{C}$   
 $125^\circ\text{C}$   
 $150^\circ\text{C}$

figure 23. FWD

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



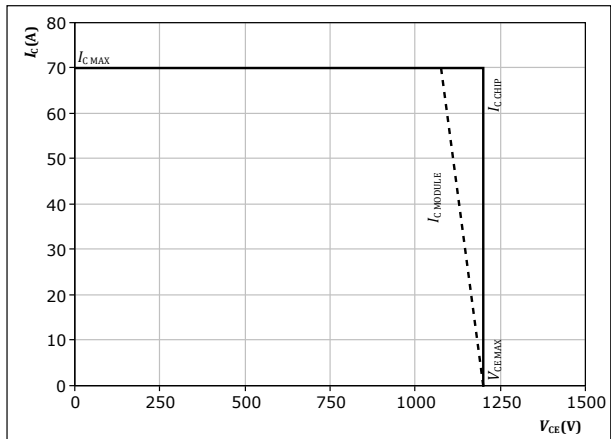
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 35$  A  
 $T_j: 25^\circ\text{C}$   
 $125^\circ\text{C}$   
 $150^\circ\text{C}$

figure 24. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 150^\circ\text{C}$   
 $R_{gon} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$



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## Inverter Switching Definitions

figure 25. IGBT

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

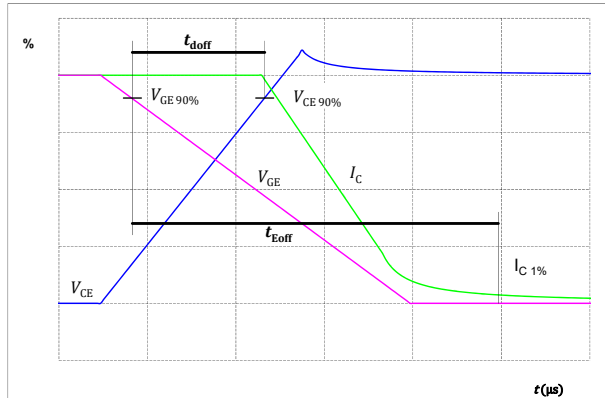


figure 26. IGBT

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

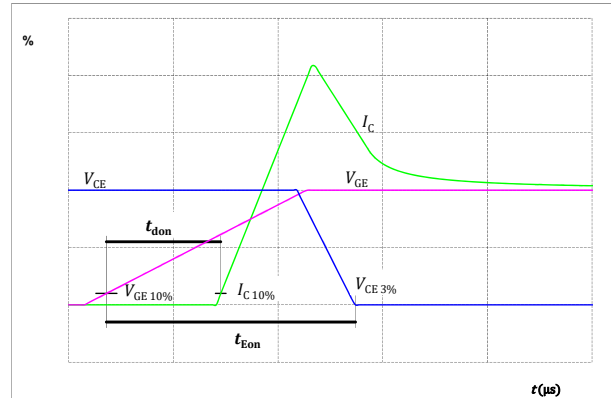


figure 27. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

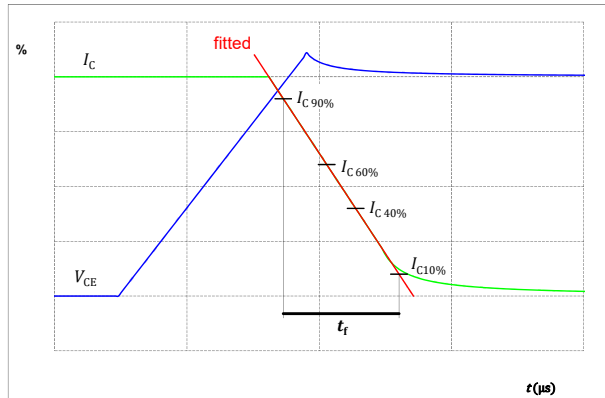
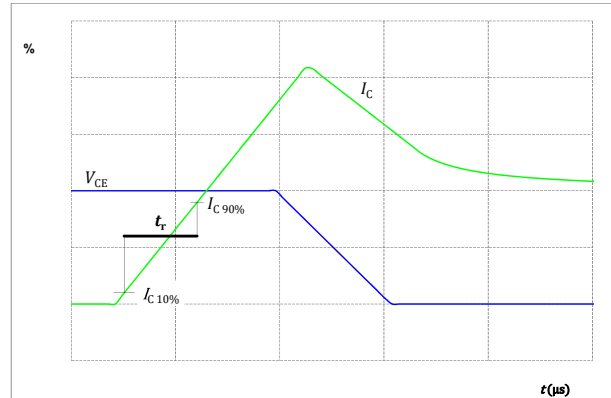


figure 28. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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## Inverter Switching Definitions

figure 29.

FWD

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

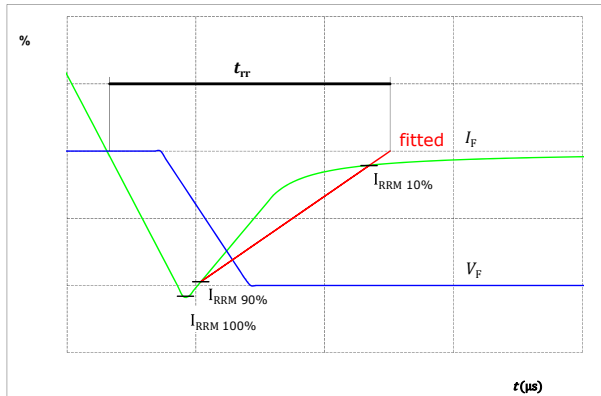
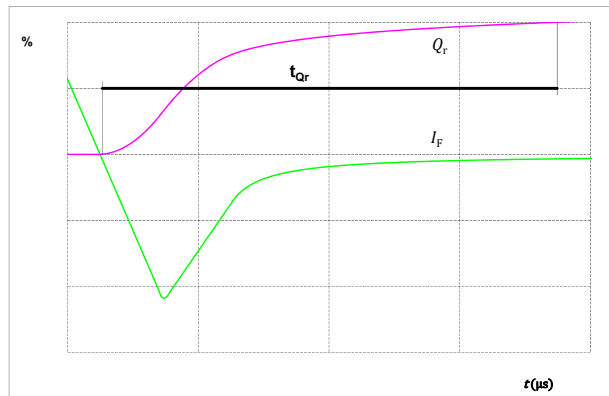


figure 30.

FWD

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





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# 10-E1126PA035M7-L859F78Z

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-E1126PA035M7-L859F78Z
With thermal paste (5,2 W/mK, PTM6000HV)	10-E1126PA035M7-L859F78Z-/7/

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

# Outline

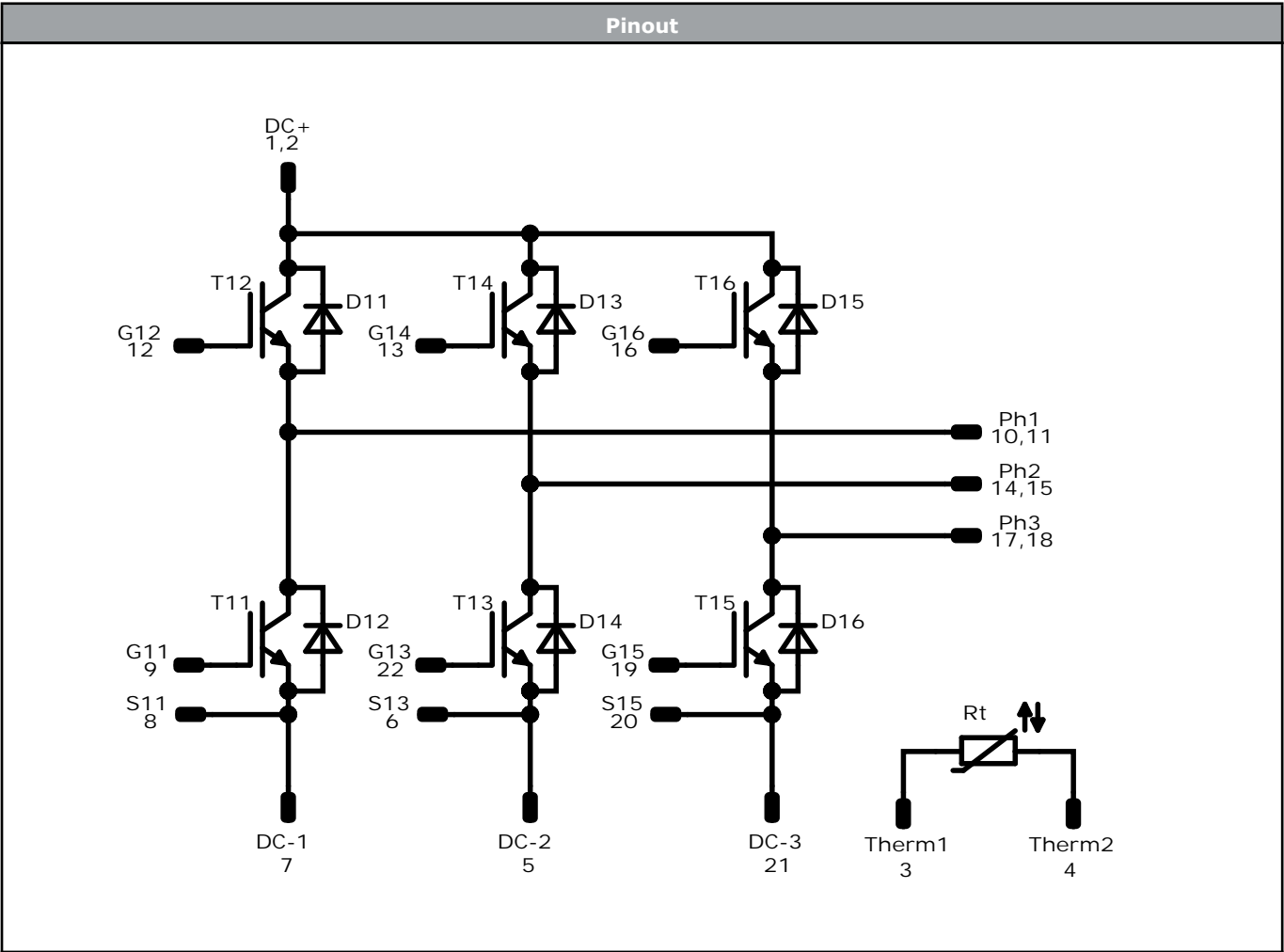
Pin table [mm]

Pin	X	Y	Function
1	12,8	9,6	DC+
2	16	9,6	DC+
3	22,4	9,6	Therm1
4	25,6	9,6	Therm2
5	32	9,6	DC-2
6	32	6,4	S13
7	32	3,2	DC-1
8	32	0	S11
9	28,8	0	G11
10	6,4	0	Ph1
11	3,2	0	Ph1
12	0	0	G12
13	0	6,4	G14
14	0	16	Ph2
15	0	19,2	Ph2
16	0	25,6	G16
17	3,2	25,6	Ph3
18	6,4	25,6	Ph3
19	28,8	25,6	G15
20	32	25,6	S15
21	32	22,4	DC-3
22	32	16	G13

Technical drawing of the component showing top and bottom views. The top view shows a rectangular package with pins on the left and right sides. The bottom view shows the component with mounting holes and internal features. Dimensions are given in mm. A note indicates: Tolerance of pinpositions 40µm at the end of pins. Dimension of coordinate axis is only offset without tolerance.

Tolerance of pinpositions 40µm at the end of pins  
Dimension of coordinate axis is only offset without tolerance






Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	35 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	35 A	Inverter Diode	
Rt	NTC			Thermistor	



Vincotech

10-E1126PA035M7-L859F78Z  
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-E1126PA035M7-L859F78Z-D5-14	6 Dec. 2024	Add option code /7/	

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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.