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# 10-FY126PA050M703-L828F03

datasheet

flowPACK 1

1200 V / 50 A

## Topology features

- Inverter
- Kelvin Emitter for improved switching performance
- 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:  $\text{Al}_2\text{O}_3$
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

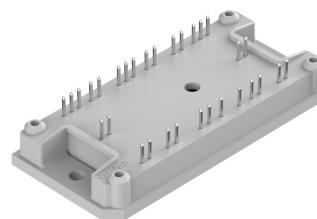
## Target applications

- Heat Pumps

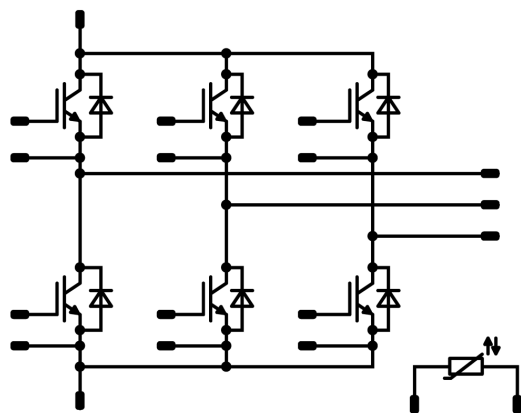
## Types

- 10-FY126PA050M703-L828F03

## flow 1 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)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	100	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	115	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)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	45	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	100	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
Isolation voltage	$V_{isol}$	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			7,81	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	0,005	25	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	25 125 150		1,55 1,77 1,83	1,9 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			0,09	mA
Gate-emitter leakage current	$I_{GES}$		20	0		25			0,5	µA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$	0	10	25				10000		pF
Output capacitance	$C_{oes}$							350		pF
Reverse transfer capacitance	$C_{res}$							130		pF
Gate charge	$Q_g$	$V_{CC} = 600$ V	0/15		50	25		380		nC

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,82		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 8 \Omega$ $R_{goff} = 8 \Omega$	$\pm 15$	600	50	25 125 150		176 176 190		ns
Rise time	$t_r$					25 125 150		52 58 60		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		206 229 241		ns
Fall time	$t_f$					25 125 150		92,14 124,72 122,14		ns
Turn-on energy (per pulse)	$E_{on}$					25 125 150		4,82 6,38 6,25		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,98 4,25 5,03		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	$V_F$				50	25 125 150		1,66 1,78 1,79	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	$I_{RM}$	$di/dt=338$ A/µs $di/dt=450$ A/µs $di/dt=498$ A/µs	$\pm 15$	600	50	25 125 150		28,72 32,83 32,97		A
Reverse recovery time	$t_{rr}$					25 125 150		339,05 434,87 511,31		ns
Recovered charge	$Q_r$					25 125 150		4,93 7,08 8,04		µC
Reverse recovered energy	$E_{rec}$					25 125 150		1,79 2,59 3,33		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		194,94 128,35 114,47		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		22		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	$P$					25		130		mW
Power dissipation constant	$d$					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$						4000		K
Vincotech Thermistor Reference									I	

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

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



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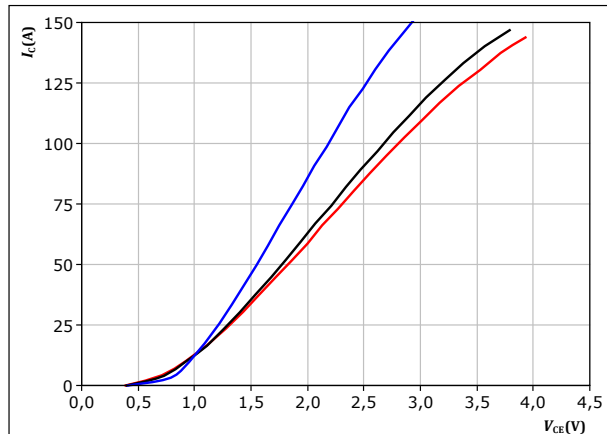
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## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

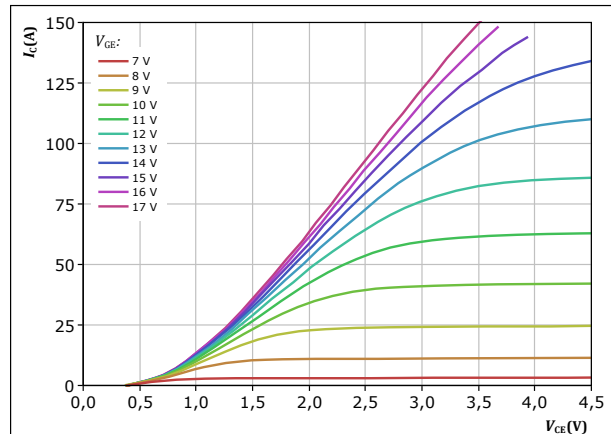


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j: 25 ^\circ C$   
 $125 ^\circ C$   
 $150 ^\circ C$

figure 2. IGBT

Typical output characteristics

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

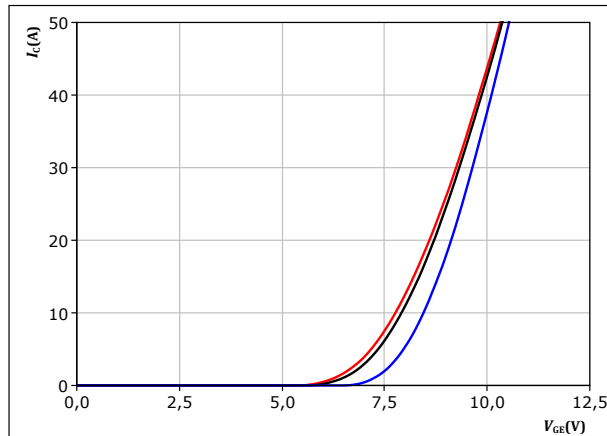


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

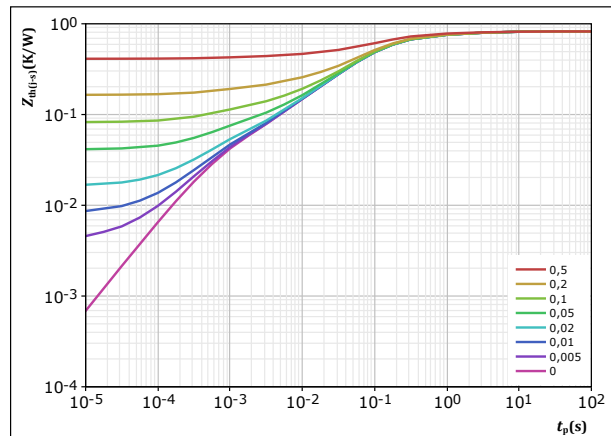


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j: 25 ^\circ C$   
 $125 ^\circ C$   
 $150 ^\circ C$

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,823 K/W$   
IGBT thermal model values  

$R (K/W)$	$\tau (s)$
4,05E-02	5,17E+00
8,54E-02	1,03E+00
3,18E-01	1,67E-01
2,80E-01	5,49E-02
6,47E-02	7,32E-03
3,43E-02	6,46E-04



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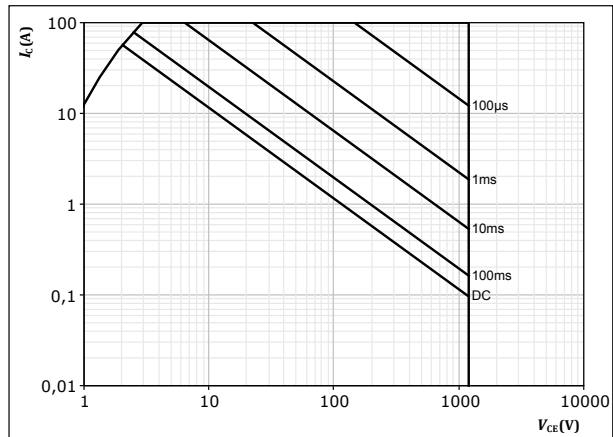
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## Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$  single pulse

$T_s = 80$  °C

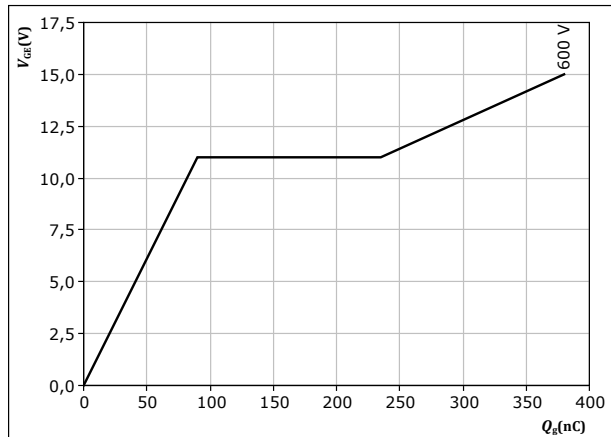
$V_{GE} = 15$  V

$T_j = T_{jmax}$

figure 6. IGBT

Gate voltage vs gate charge

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



$I_C = 50$  A

$T_j = 25$  °C



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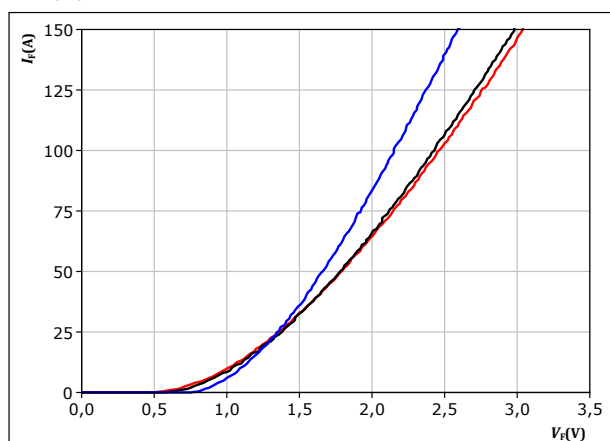
## Inverter Diode Characteristics

figure 7.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

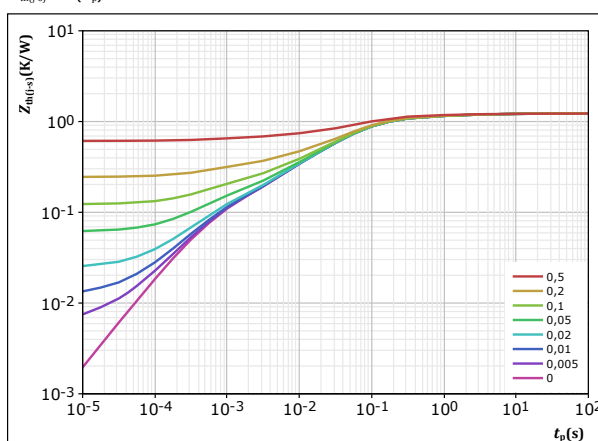
$T_F$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 8.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	1,224	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
3,84E-02	6,82E+00	
9,89E-02	9,92E-01	
3,93E-01	1,28E-01	
4,67E-01	3,75E-02	
1,41E-01	5,65E-03	
8,52E-02	5,44E-04	





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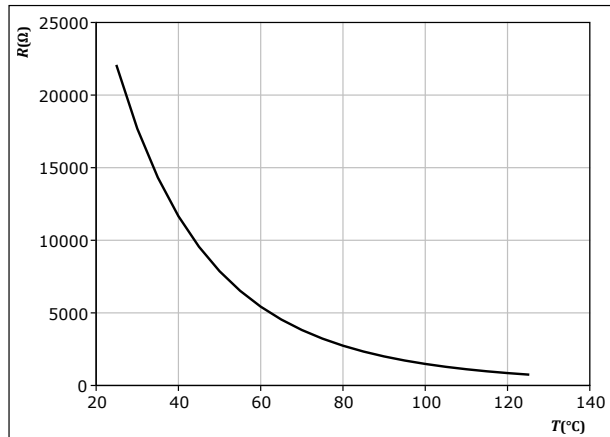
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datasheet

## Thermistor Characteristics

**figure 9.** Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





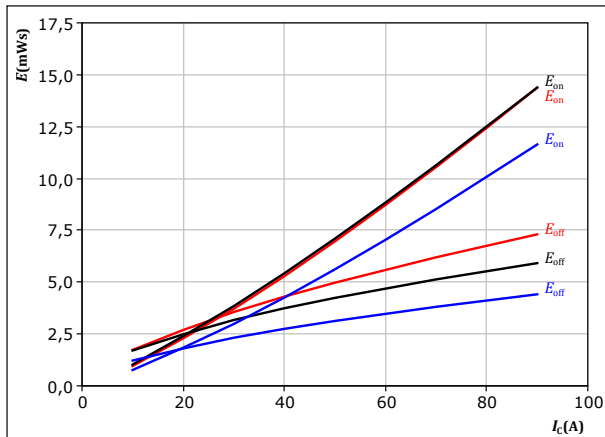
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## Inverter Switching Characteristics

figure 10. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

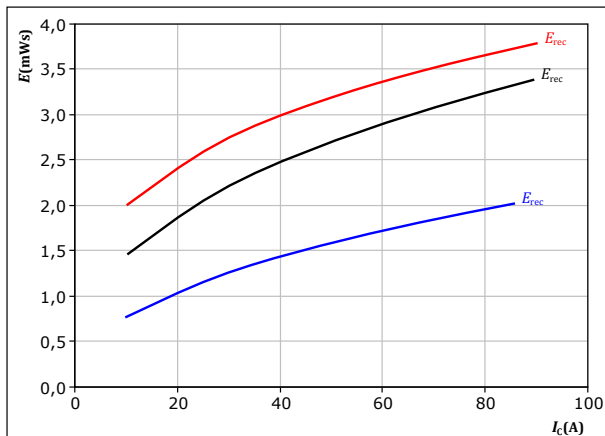
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $R_{goff} = 8 \text{ } \Omega$

$T_j$ :  
— 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

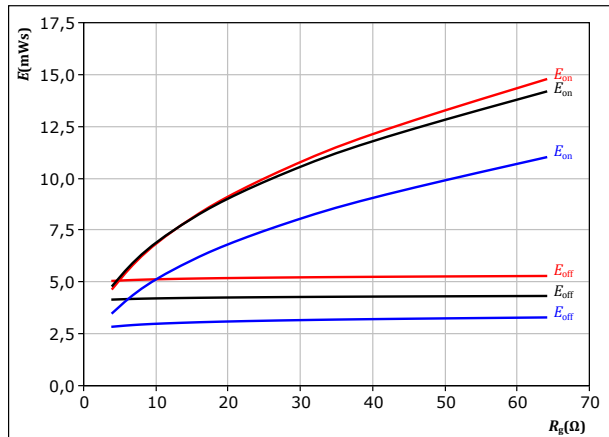
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$

$T_j$ :  
— 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

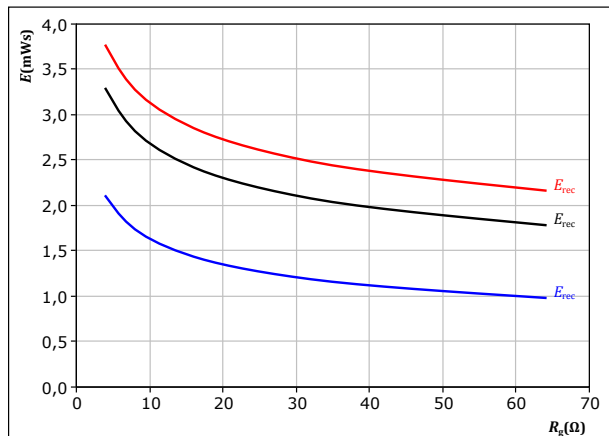
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 50 \text{ A}$

$T_j$ :  
— 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

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 50 \text{ A}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C



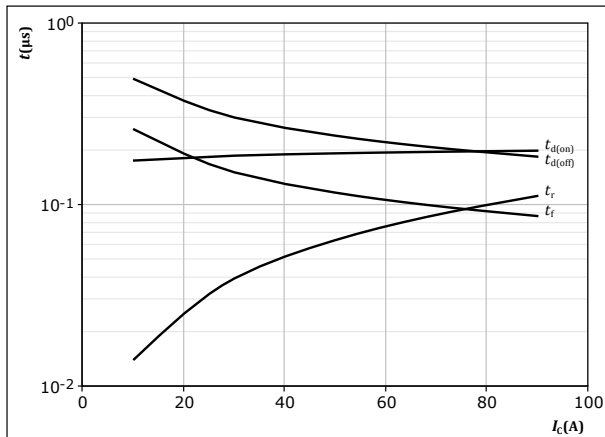
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## Inverter Switching Characteristics

figure 14. IGBT

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

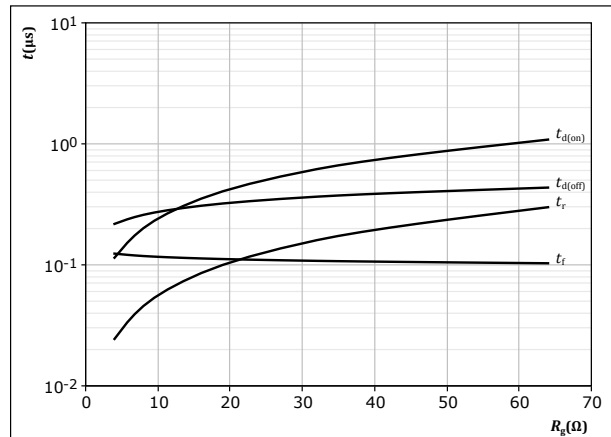


With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$   
 $R_{goff} = 8$   $\Omega$

figure 15. IGBT

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

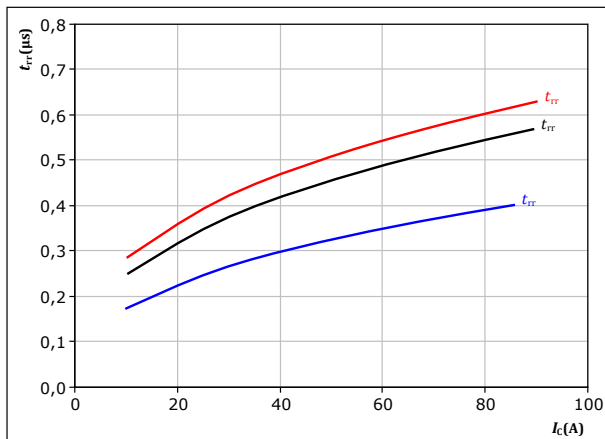


With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 50$  A

figure 16. FWD

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



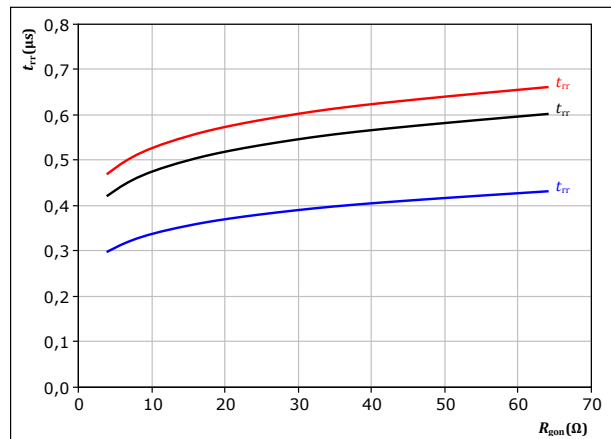
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$

$T_j$ : — 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  
 $I_C = 50$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C



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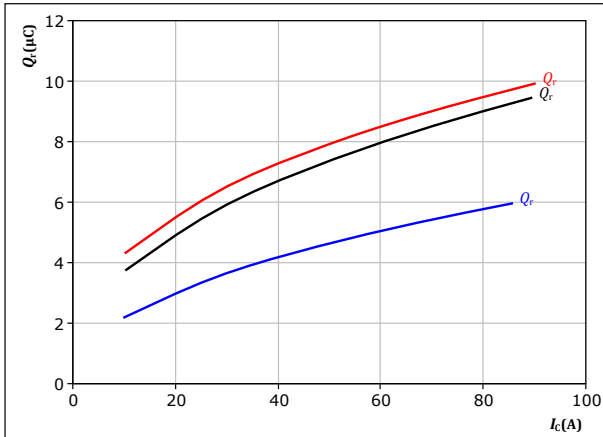
## Inverter Switching Characteristics

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  
 $R_{gon} = 8$   $\Omega$

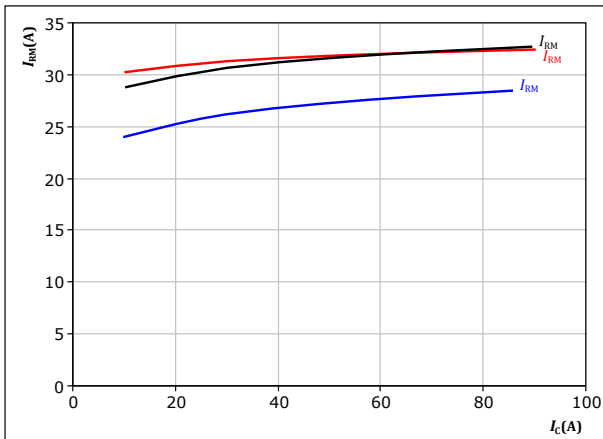
$T_j$ : 25 °C  
125 °C  
150 °C

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  
 $R_{gon} = 8$   $\Omega$

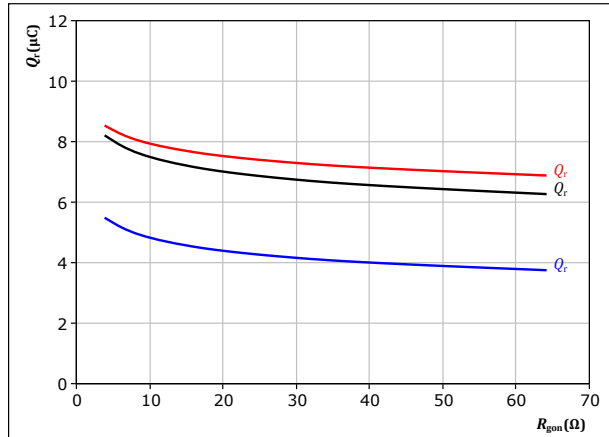
$T_j$ : 25 °C  
125 °C  
150 °C

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  
 $I_c = 50$  A

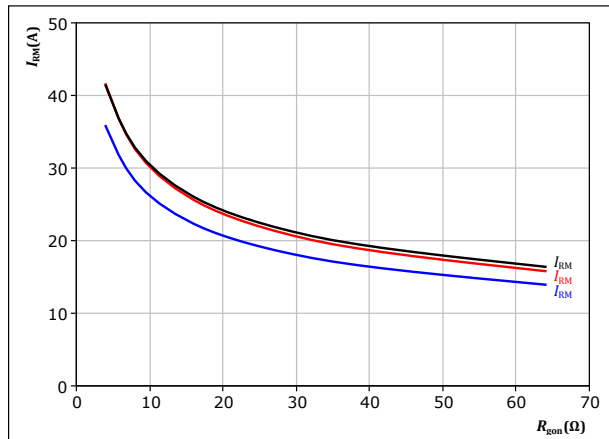
$T_j$ : 25 °C  
125 °C  
150 °C

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  
 $I_c = 50$  A

$T_j$ : 25 °C  
125 °C  
150 °C



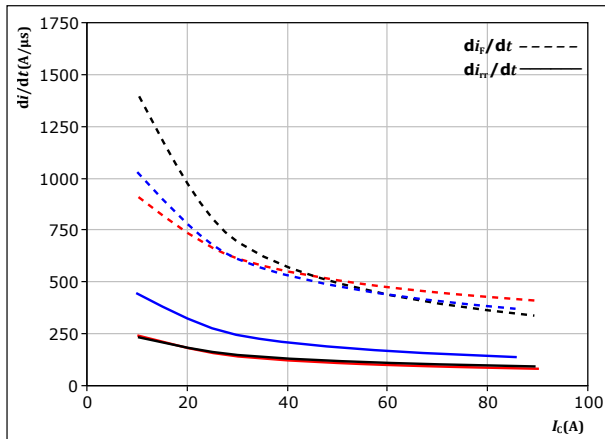
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## Inverter Switching Characteristics

figure 22. FWD

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



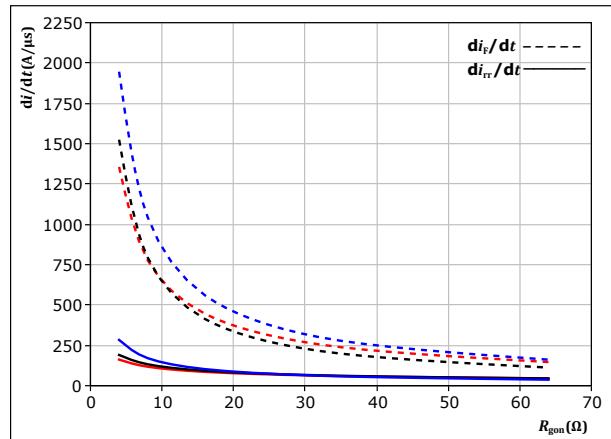
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 8 \text{ } \Omega$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °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

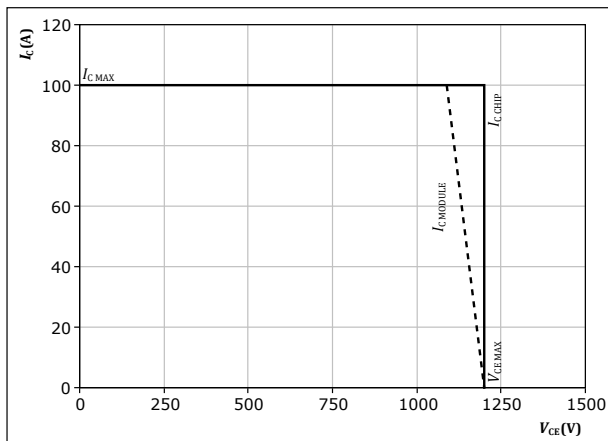
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 50 \text{ A}$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 24. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{gon} = 8 \text{ } \Omega$   
 $R_{goff} = 8 \text{ } \Omega$



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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  $E_{off}$ )

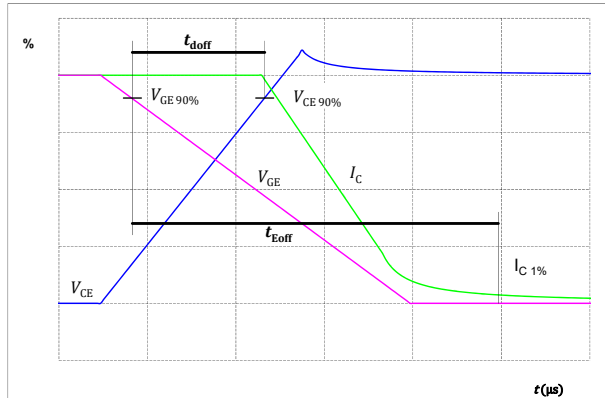


figure 26. IGBT

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

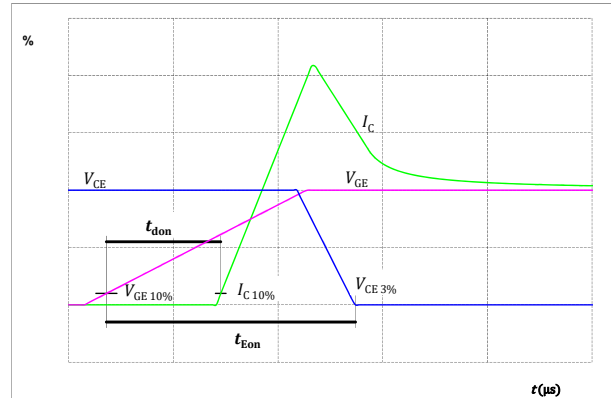


figure 27. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

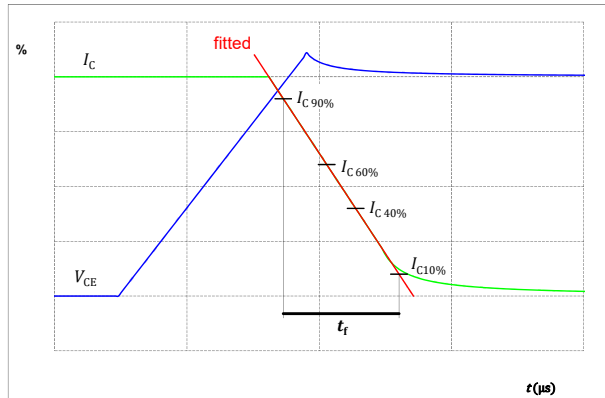
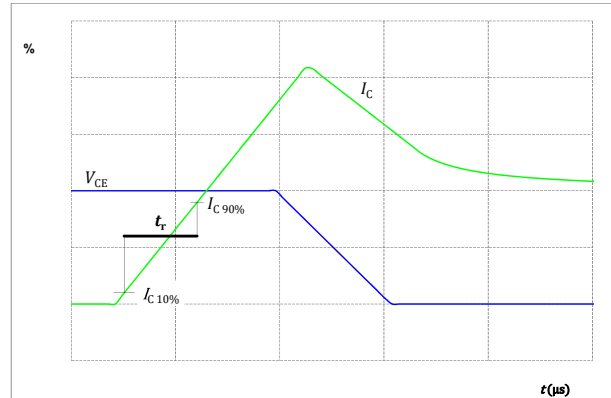


figure 28. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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## Inverter Switching Definitions

figure 29.

FWD

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

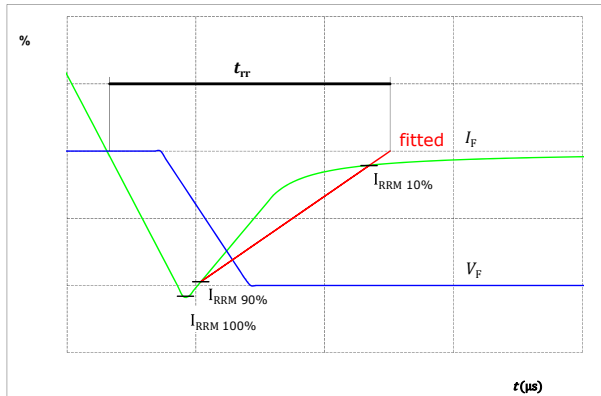
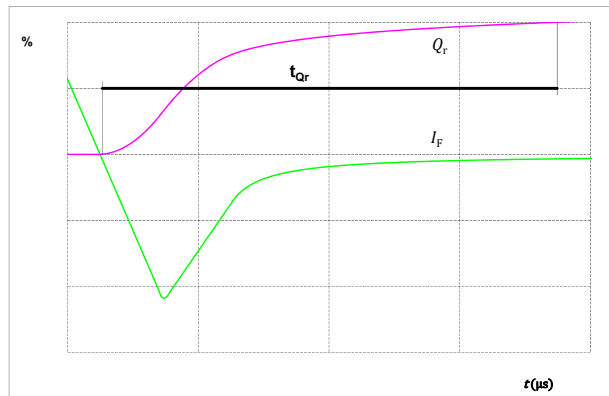


figure 30.

FWD


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





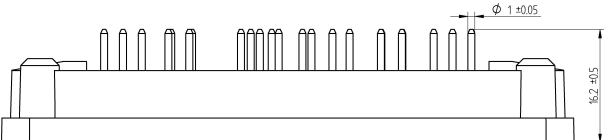
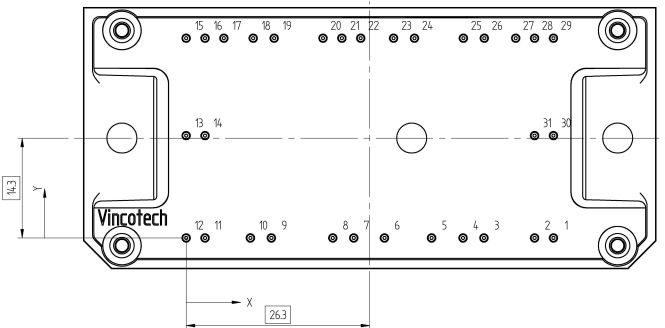
datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-FY126PA050M703-L828F03
With thermal paste (5,2 W/mK, PTM6000HV)	10-FY126PA050M703-L828F03-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-FY126PA050M703-L828F03-/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	52,6	0	DC-123
2	49,9	0	DC-123
3	42,65	0	G15
4	39,65	0	S15
5	35,15	0	Therm1
6	28,4	0	Therm2
7	24	0	G13
8	21	0	S13
9	12,2	0	G11
10	9,2	0	S11
11	2,7	0	DC-123
12	0	0	DC-123
13	0	14,65	DC+123
14	2,7	14,65	DC+123
15	0	28,6	Ph1
16	2,7	28,6	Ph1
17	5,4	28,6	Ph1
18	9,6	28,6	S12
19	12,6	28,6	G12
20	19,6	28,6	Ph2
21	22,3	28,6	Ph2
22	25	28,6	Ph2
23	29,7	28,6	S14
24	32,7	28,6	G14
25	39,7	28,6	S16
26	42,7	28,6	G16
27	47,2	28,6	Ph3
28	49,9	28,6	Ph3
29	52,6	28,6	Ph3
30	52,6	14,65	DC+123
31	49,9	14,65	DC+123

Tolerance of pinpositions: ±0.5mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance

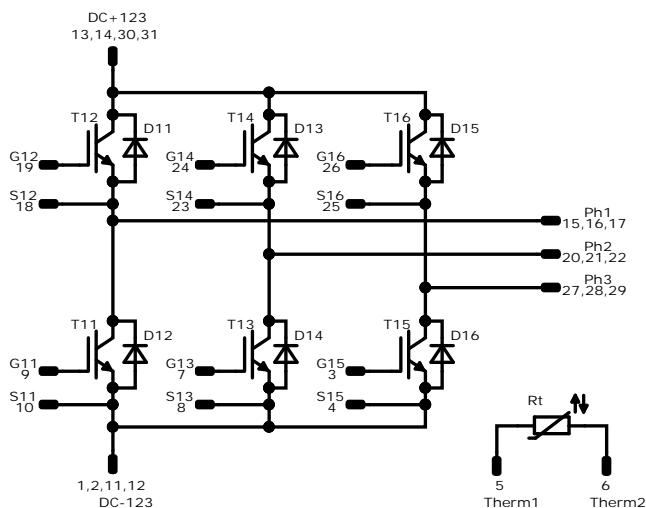




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datasheet

**Pinout**




**Identification**

ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	50 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	50 A	Inverter Diode	
Rt	Thermistor			Thermistor	TFT6GEF223F400 (Tateyama)



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datasheet

Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample
Handling instruction				
Handling instructions for <i>flow 1</i> packages see vincotech.com website.				
Package data				
Package data for <i>flow 1</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-FY126PA050M703-L828F03-D1-14	25 May. 2023		

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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.