



Vincotech

# V23990-P829-F10-PM

datasheet

flowPACK 1

1200 V / 50 A

## Features

- Compact *flow1* housing
- Trenchstop™ IGBT4 Technology
- Compact and Low Inductance Design
- Built-in NTC

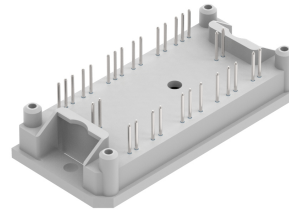
## Target applications

- Motor Drive
- Power Generation
- UPS

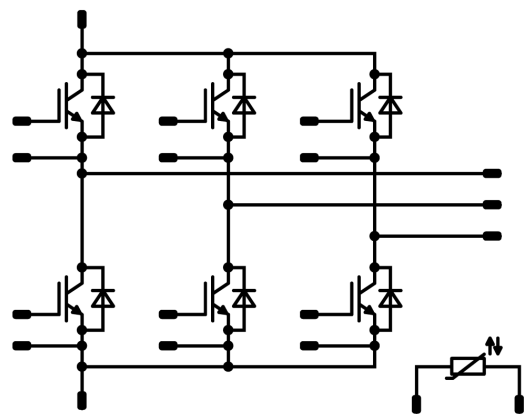
## Types

- V23990-P829-F10-PM

## flow 1 17 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 $T_{jmax}$	150	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	122	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	$\mu s$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Inverter Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	53	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	100	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	90	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			12,64	mm
Comparative Tracking Index	CTI		$\geq 200$	

\*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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0017	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		50	25 125 150	1,58	1,87 2,18 2,3	2,07 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			1	µA
Gate-emitter leakage current	$I_{GES}$		20	0		25			120	nA
Internal gate resistance	$r_g$							4		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		2800		pF
Reverse transfer capacitance	$C_{res}$							100		pF
Gate charge	$Q_g$		15		0	25		380		nC

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						0,78		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	25 150		96,2 100,8		ns
Rise time	$t_r$					25 150		17,2 23,6		ns
Turn-off delay time	$t_{d(off)}$					25 150		214 281,4		ns
Fall time	$t_f$					25 150		86,48 121,84		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD}=4,8 \mu\text{C}$ $Q_{tFWD}=9,71 \mu\text{C}$				25 150		2,7 4,21		mWs
Turn-off energy (per pulse)	$E_{off}$					25 150		2,74 4,53		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	1,35	1,73 1,7 1,68	2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25			10	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,06		K/W
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#### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=3866$ A/μs $di/dt=2820$ A/μs	±15	600	50	25 150		81,08 84,75		A
Reverse recovery time	$t_{rr}$					25 150		139,07 315,77		ns
Recovered charge	$Q_r$					25 150		4,8 9,71		μC
Reverse recovered energy	$E_{rec}$					25 150		1,79 3,97		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		4803 1209		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		4,7		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 401 \Omega$				100	-5		5	%
Power dissipation	$P$							5		mW
Power dissipation constant	$d$					25		1,3		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 3 \%$						3612		K
B-value	$B_{(25/100)}$	Tol. $\pm 3 \%$						3650		K

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

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



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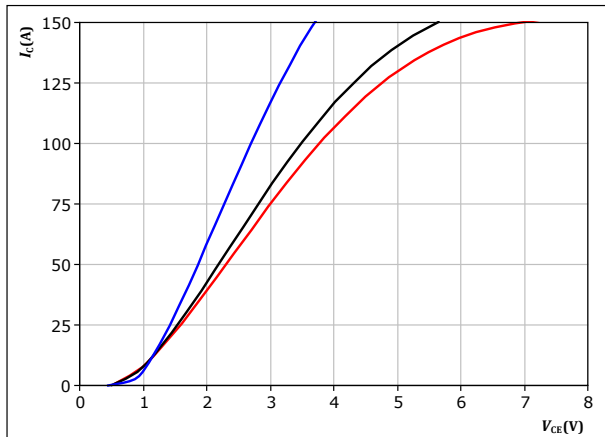
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datasheet

## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

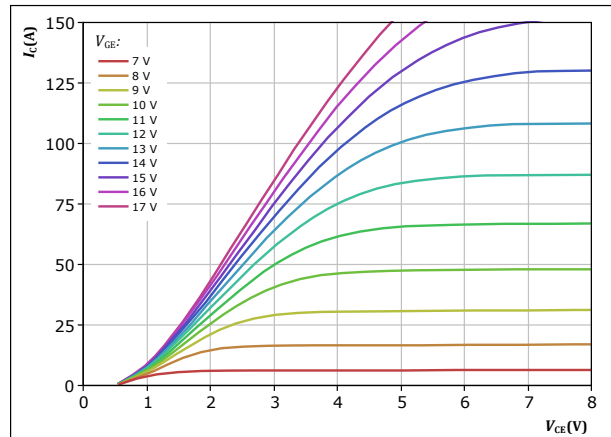


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

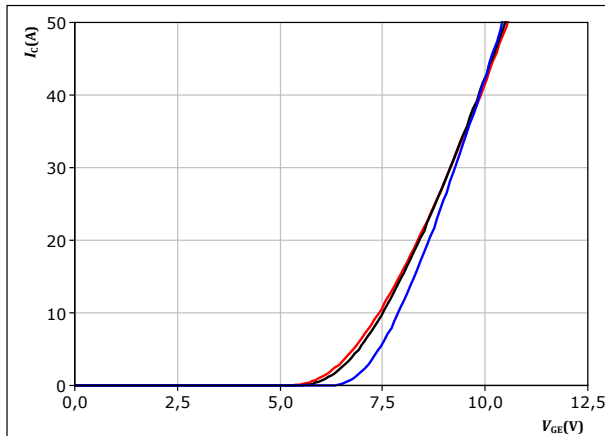


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

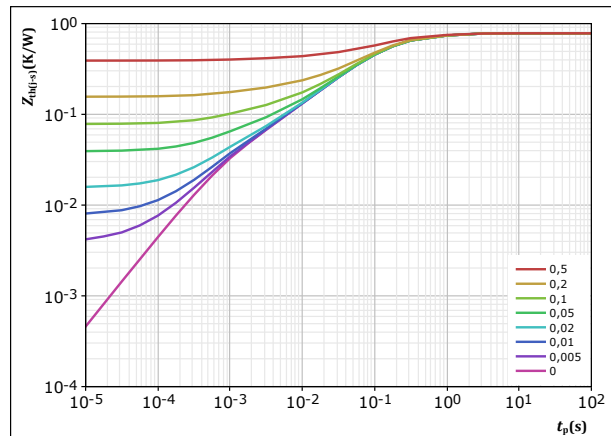


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,782 K/W$   
IGBT thermal model values  

$R (K/W)$	$\tau (s)$
1,24E-01	9,17E-01
3,94E-01	1,41E-01
1,70E-01	4,90E-02
6,32E-02	9,18E-03
3,04E-02	9,28E-04



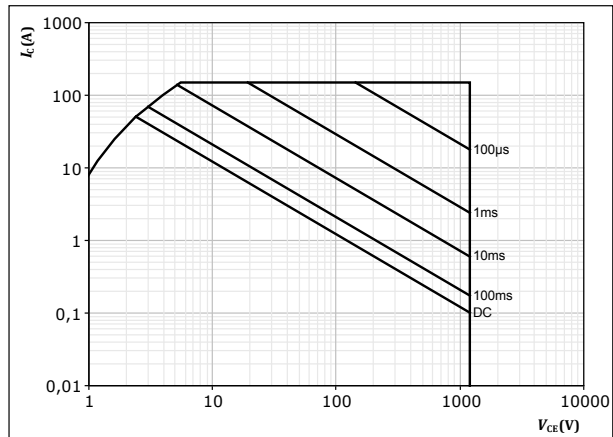
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## Inverter Switch Characteristics

**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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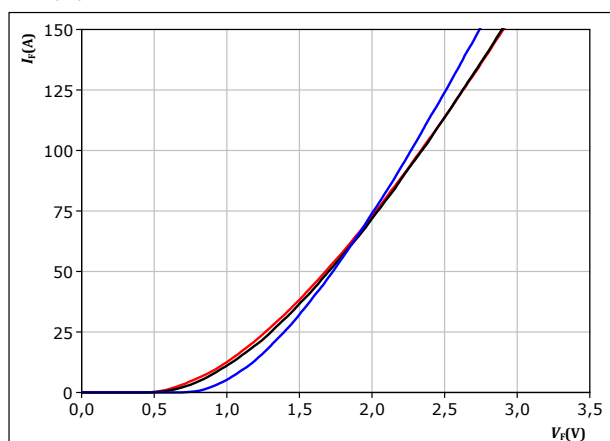
## Inverter Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

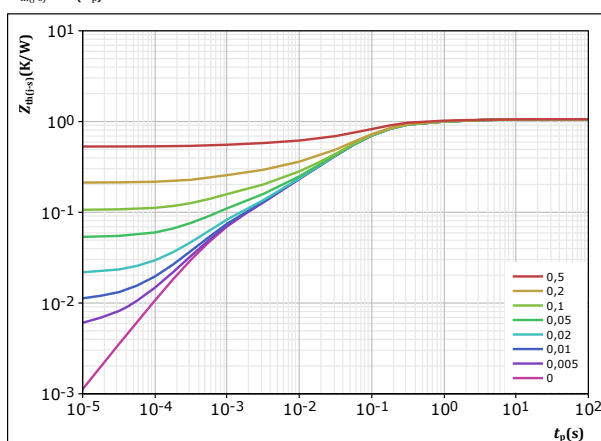
$T_j:$   
— 25 °C  
— 125 °C  
— 150 °C

figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	1,061	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
4,19E-02	4,68E+00	
8,50E-02	8,80E-01	
4,99E-01	1,21E-01	
2,83E-01	4,12E-02	
9,28E-02	6,53E-03	
5,92E-02	6,76E-04	





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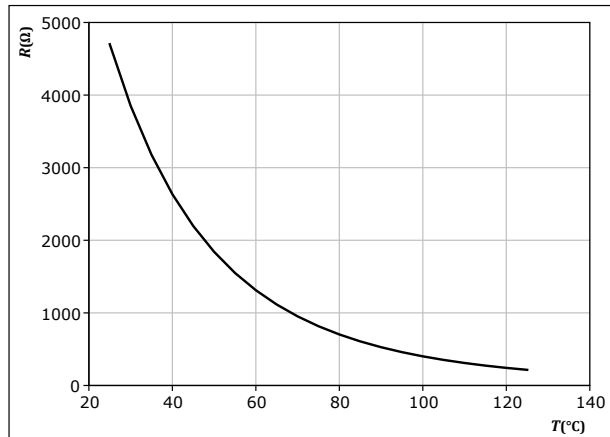
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## Thermistor Characteristics

**figure 8.** Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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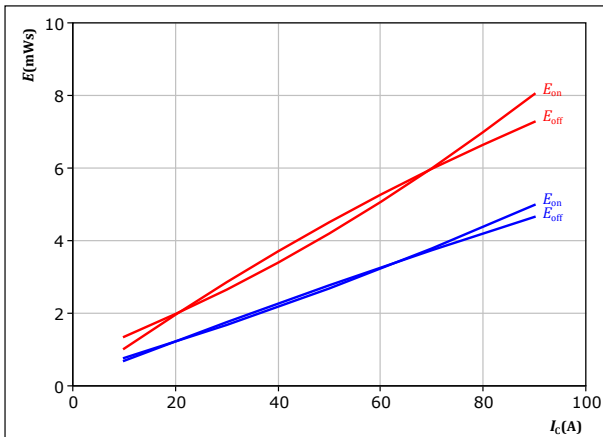
## Inverter Switching Characteristics

figure 9.

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

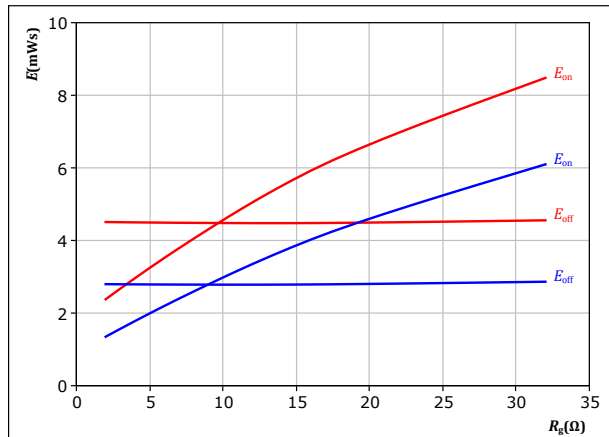
$T_j$ : — 25 °C  
— 150 °C

figure 10.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

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

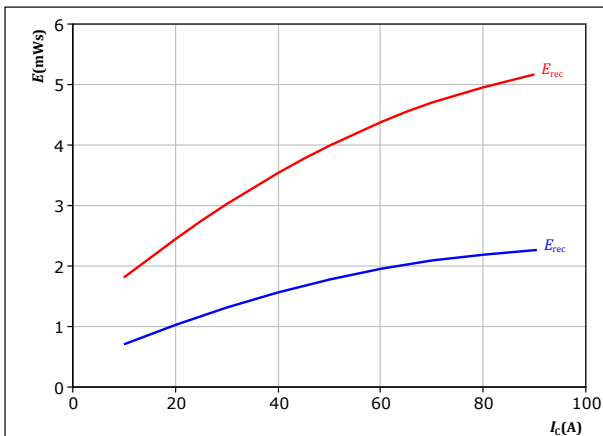
$T_j$ : — 25 °C  
— 150 °C

figure 11.

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

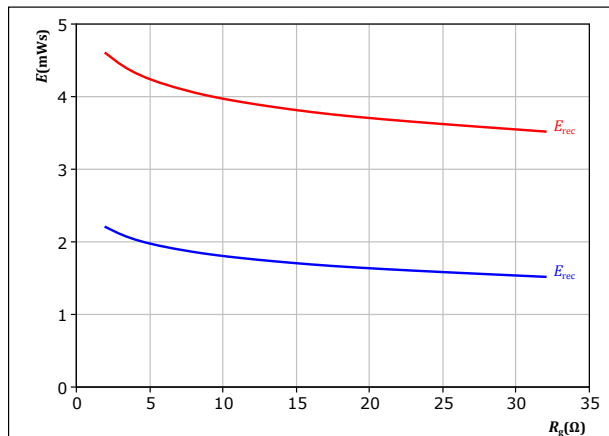
$T_j$ : — 25 °C  
— 150 °C

figure 12.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

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

$T_j$ : — 25 °C  
— 150 °C



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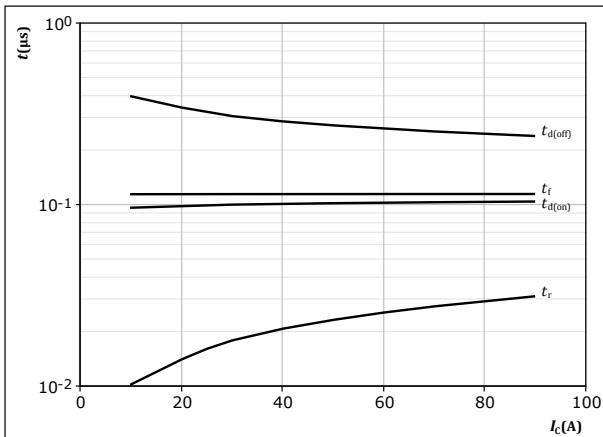
## Inverter Switching Characteristics

figure 13.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

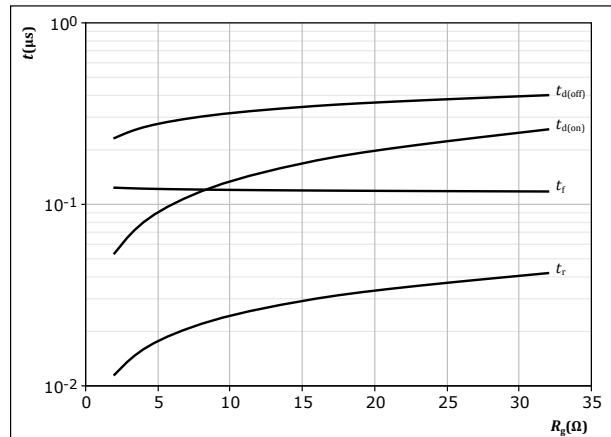
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

figure 14.

IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



With an inductive load at

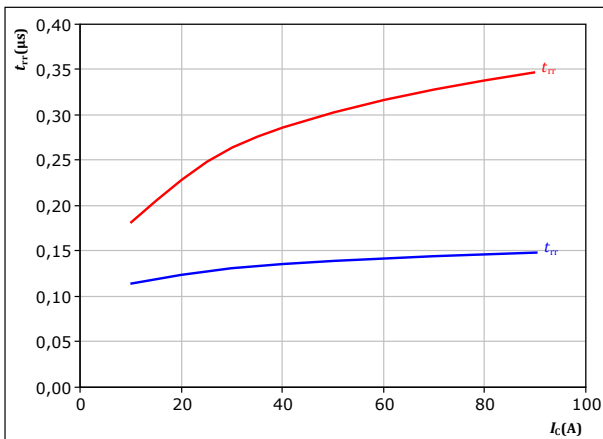
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

figure 15.

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
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

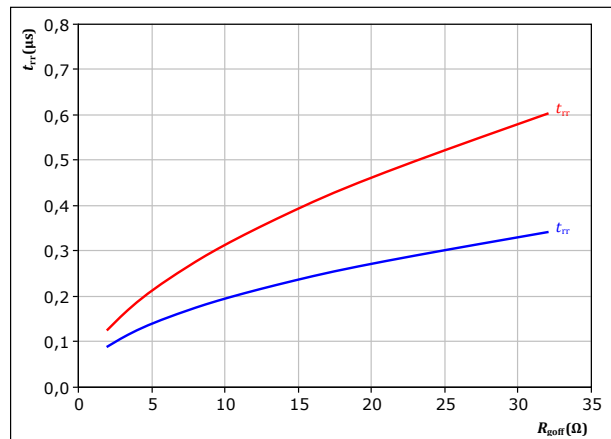
$T_j$ : — 25 °C  
— 150 °C

figure 16.

FWD

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

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



With an inductive load at

$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

$T_j$ : — 25 °C  
— 150 °C



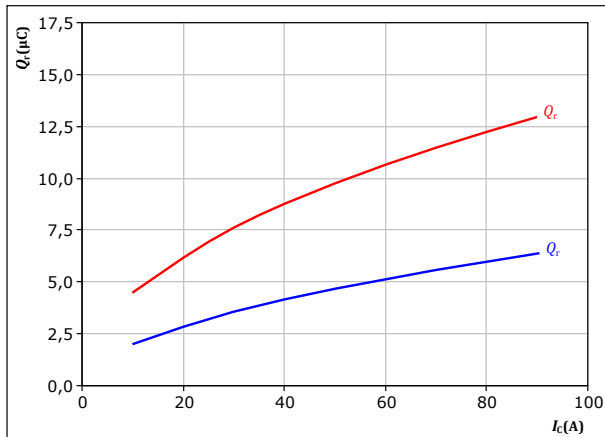
## Inverter Switching Characteristics

figure 17.

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

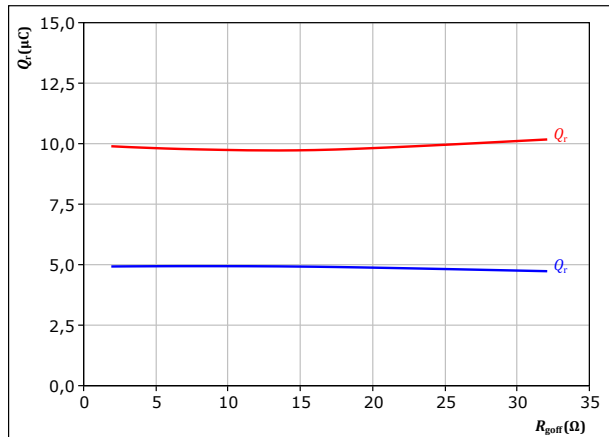
$T_j$ : — 25 °C  
— 150 °C

figure 18.

FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

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

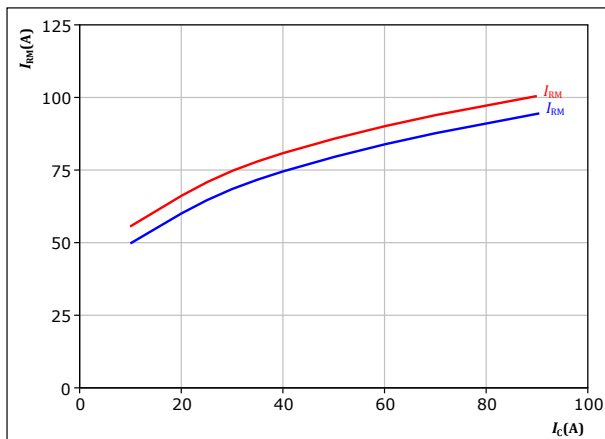
$T_j$ : — 25 °C  
— 150 °C

figure 19.

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

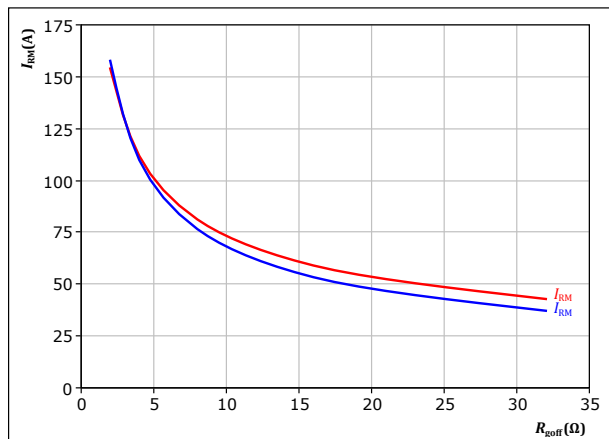
$T_j$ : — 25 °C  
— 150 °C

figure 20.

FWD

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

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



With an inductive load at

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

$T_j$ : — 25 °C  
— 150 °C



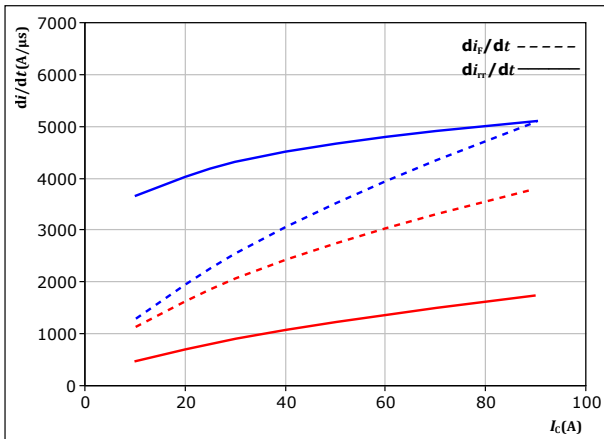
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## Inverter Switching Characteristics

figure 21. FWD

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



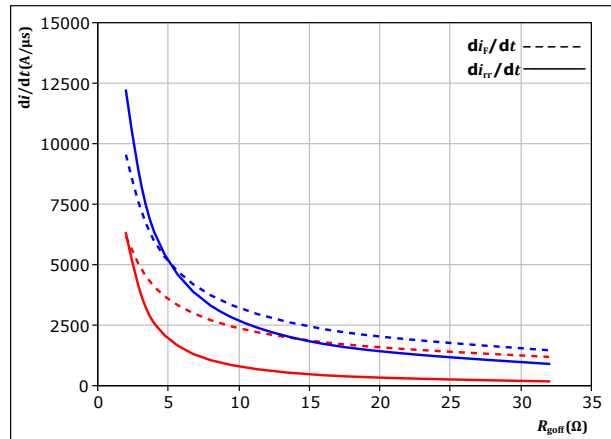
With an inductive load at

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

$T_j$ : 25 °C  
150 °C

figure 22. FWD

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



With an inductive load at

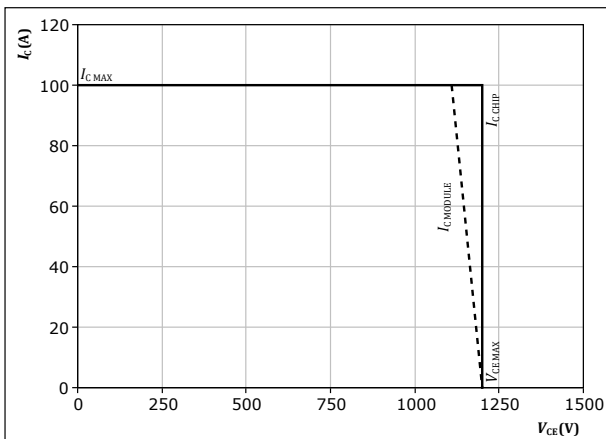
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 50$  A

$T_j$ : 25 °C  
150 °C

figure 23. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 150$  °C  
 $R_{goff} = 8$   $\Omega$   
 $R_{goff} = 8$   $\Omega$



## Inverter Switching Definitions

figure 24. IGBT

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

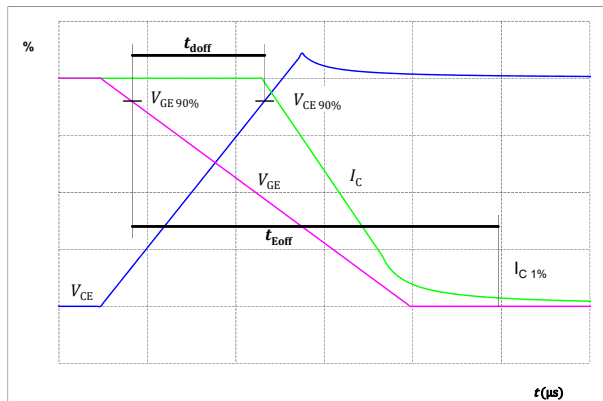


figure 25. IGBT

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

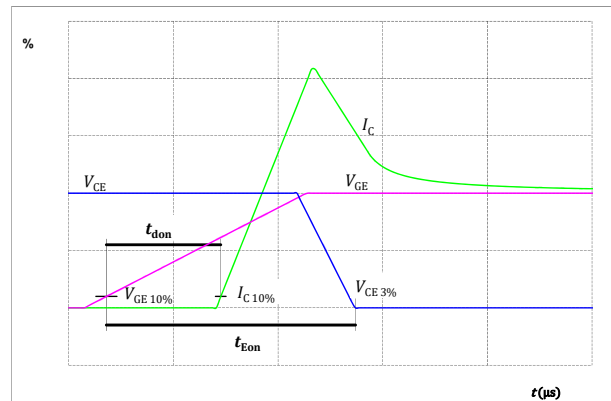


figure 26. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

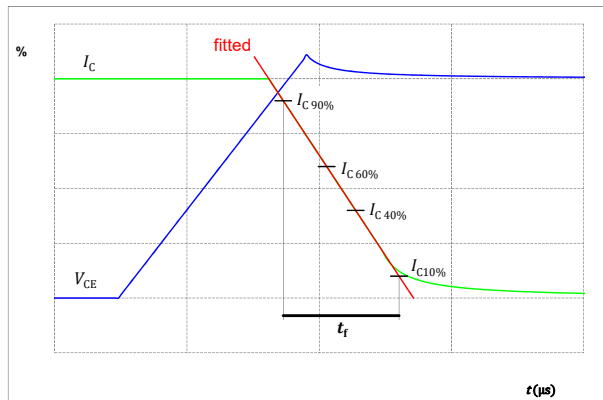
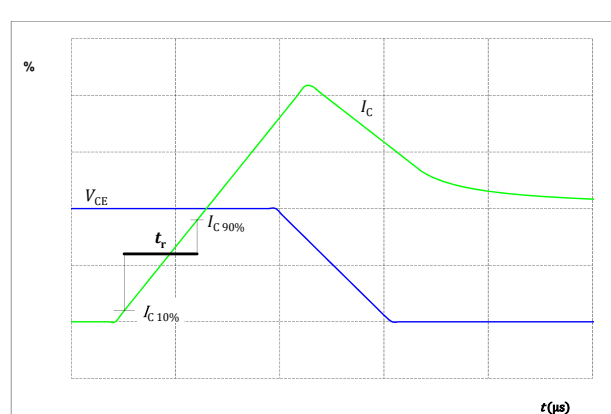


figure 27. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





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## Inverter Switching Definitions

figure 28.

FWD

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

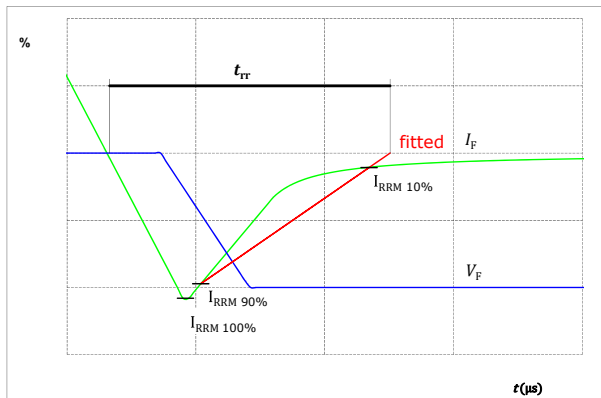
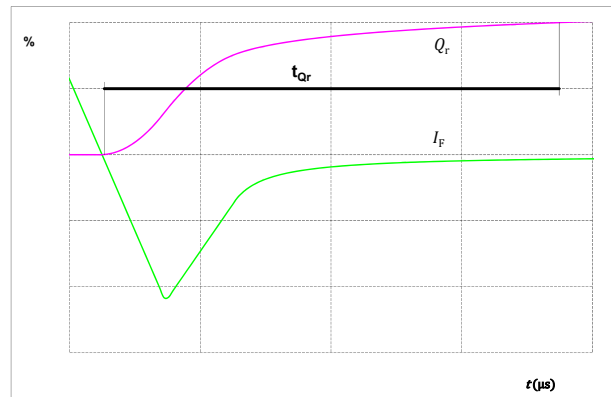


figure 29.

FWD


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





**V23990-P829-F10-PM**  
datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P829-F10-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P829-F10-/-7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P829-F10-/-3/-PM

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
		VIN	WWYY	TTTTTTVV	UL	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-
2	49,9	0	DC-
3	42,65	0	G6
4	39,65	0	S6
5	35,15	0	NTC1
6	28,4	0	NTC2
7	24	0	G4
8	21	0	S4
9	12,2	0	G2
10	9,2	0	S2
11	2,7	0	DC-
12	0	0	DC-
13	0	14,65	DC+
14	2,7	14,65	DC+
15	0	28,6	U
16	2,7	28,6	U
17	5,4	28,6	U
18	9,6	28,6	S1
19	12,6	28,6	G1
20	19,6	28,6	V
21	22,3	28,6	V
22	25	28,6	V
23	29,7	28,6	S3
24	32,7	28,6	G3
25	39,7	28,6	S5
26	42,7	28,6	G5
27	47,2	28,6	W
28	49,9	28,6	W
29	52,6	28,6	W
30	52,6	14,65	DC+
31	49,9	14,65	DC+

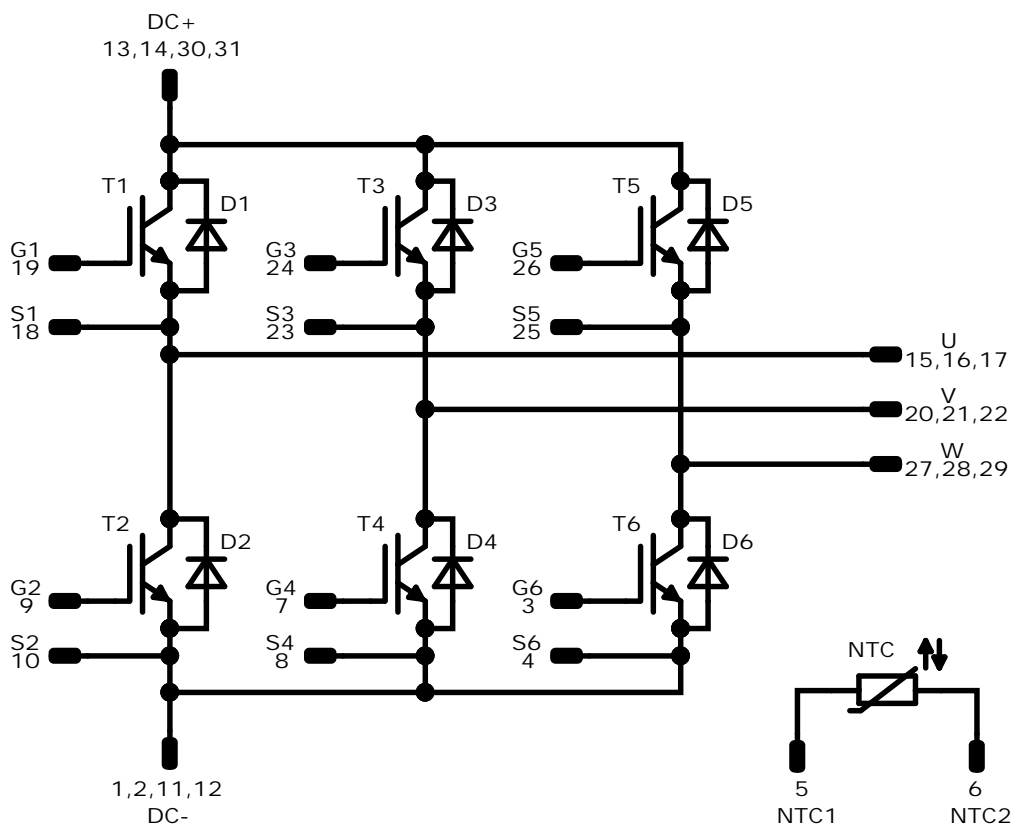
Tolerance of pinpositions:  $\pm 0,5\text{mm}$  at the end of pins  
Dimension of coordinate axis is only offset without tolerance





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Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	50 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	50 A	Inverter Diode	
NTC	Thermistor			Thermistor	



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
V23990-P829-F10-PM-D5-14	12 Sep. 2021	New Datasheet format, module is unchanged Introduce Rth values with PSX-P7 TIM Separate datasheet for 17mm housing version	

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As used herein:

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.