



Vincotech

V23990-P862-F49-PM

datasheet

flowPACK 0

600 V / 15 A

Features

- Trench Fieldstop IGBT3 technology
- Compact and low inductance design
- Built-in NTC

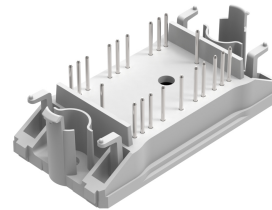
Target applications

- Motor Drives
- Power Generation
- UPS

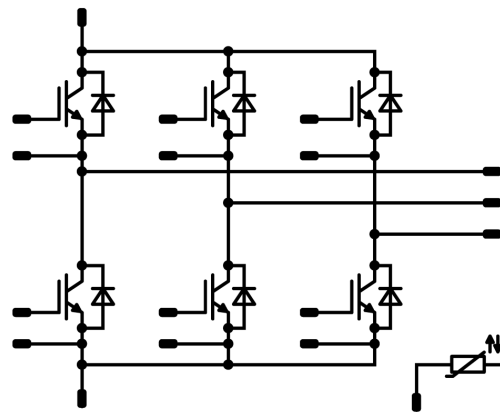
Types

- V23990-P862-F49-PM

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}		600	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	22	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	52	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Inverter Diode

Peak repetitive reverse voltage	V_{RRM}		600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	26	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	48	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			>12,7	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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,1	1,6 1,85	1,9 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	600		25			0,85	µA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25	25			800		pF
Output capacitance	C_{oes}							55		pF
Reverse transfer capacitance	C_{res}							24		pF
Gate charge	Q_g		15		0	25		87		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,83		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	± 15	300	15	25 150		106,2 104,6		ns
Rise time	t_r					25 150		15 18		ns
Turn-off delay time	$t_{d(off)}$					25 150		134 154,6		ns
Fall time	t_f					25 150		92,02 109,06		ns
Turn-on energy (per pulse)	E_{on}					25 150		0,276 0,38		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,345 0,459		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				15	25 150	1,25	1,6 1,51	1,95 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 600$ V				25			27	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,99		K/W
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Dynamic

Peak recovery current	I_{RRM}	$di/dt=1184$ A/μs $di/dt=1026$ A/μs	± 15	300	15	25 150		11,27 16,06		A
Reverse recovery time	t_{rr}					25 150		180,19 272,04		ns
Recovered charge	Q_r					25 150		0,715 1,44		μC
Reverse recovered energy	E_{rec}					25 150		0,159 0,306		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		469,5 193,76		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	

Thermistor

Static

Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	P							5		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	

⁽¹⁾ Value at chip level

⁽²⁾ Only valid with pre-applied Vincotech thermal interface material.



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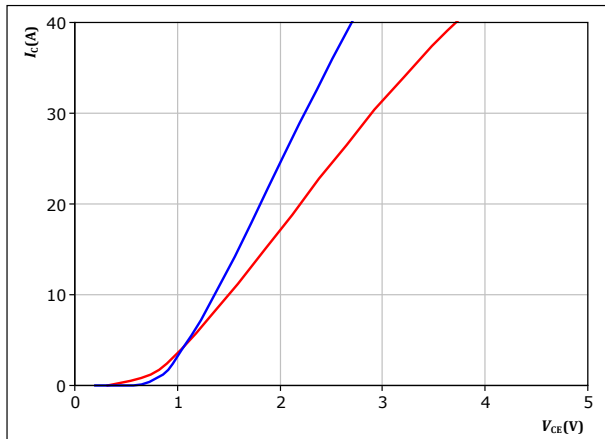
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datasheet

Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

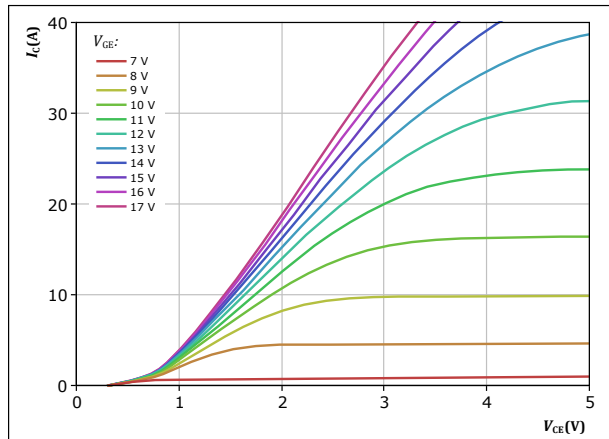


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25 ^\circ C$
 $150 ^\circ C$

figure 2. IGBT

Typical output characteristics

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

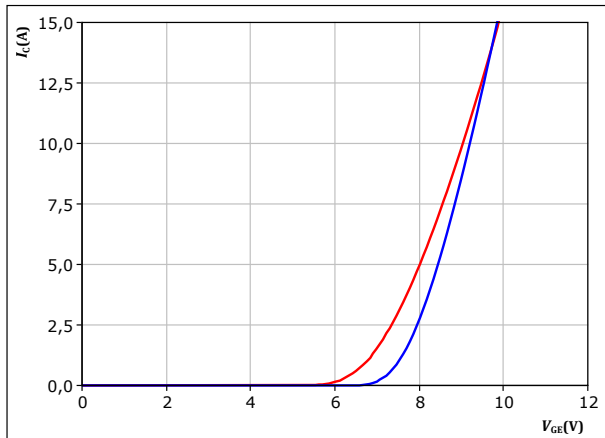


$t_p = 250 \mu s$
 $T_j = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

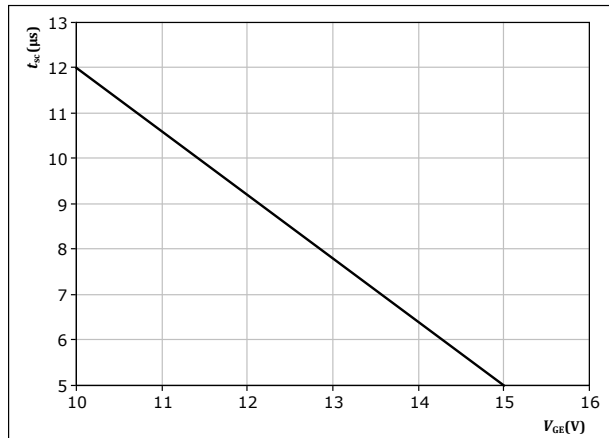


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25 ^\circ C$
 $150 ^\circ C$

figure 4. IGBT

Short circuit withstand time as a function of V_{GE}

$$t_{sc} = f(V_{GE})$$



At $V_{CE} = 600 V$
 $T_j \leq 25 ^\circ C$



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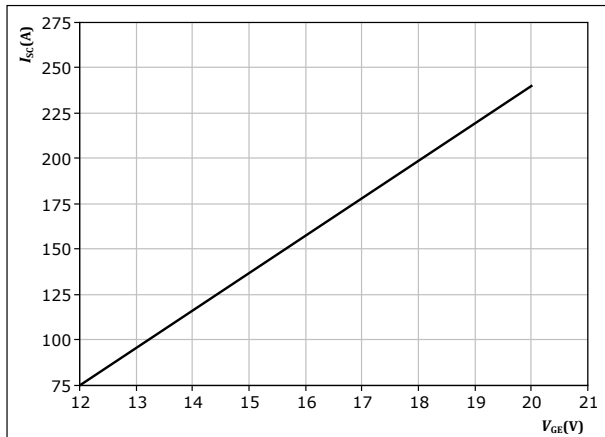
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Inverter Switch Characteristics

figure 5.

IGBT

Typical short circuit current as a function of V_{GE}
 $I_{SC} = f(V_{GE})$

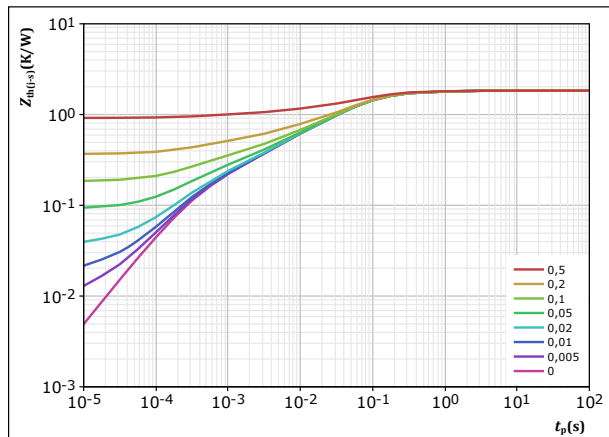


At $V_{CE} = 400$ V
 $T_j \leq 150$ °C

figure 6.

IGBT

Transient thermal impedance as a function of pulse width
 $Z_{th(j-s)} = f(t_p)$



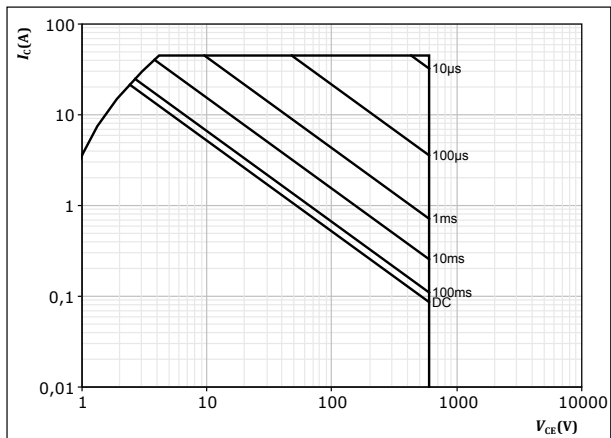
$D = t_p / T$
 $R_{th(j-s)} = 1,834$ K/W
IGBT thermal model values

R (K/W)	τ (s)
8,30E-02	1,29E+00
3,76E-01	1,56E-01
8,46E-01	5,15E-02
2,81E-01	8,16E-03
1,16E-01	2,04E-03
1,32E-01	3,43E-04

figure 7.

IGBT

Safe operating area
 $I_C = f(V_{CE})$

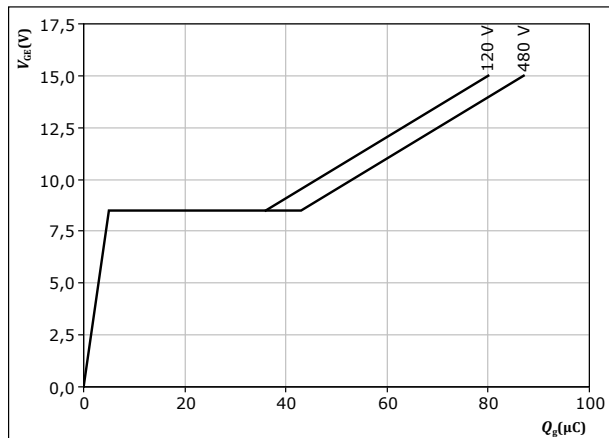


$D = \text{single pulse}$
 $T_s = 80$ °C
 $V_{GE} = 15$ V
 $T_j = T_{jmax}$

figure 8.

IGBT

Gate voltage vs gate charge
 $V_{GE} = f(Q_g)$



$I_C = 15$ A
 $T_j = 25$ °C



Inverter Diode Characteristics

figure 9.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

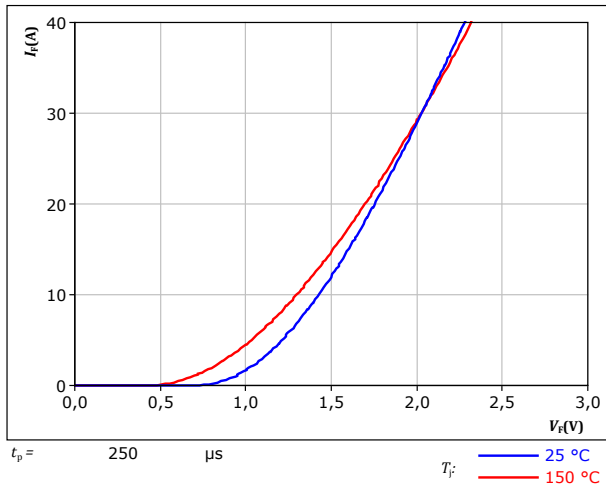
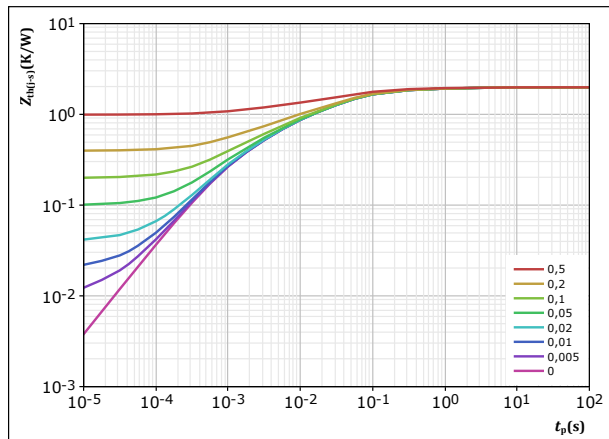


figure 10.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	1,985	K/W
FWD thermal model values		
R (K/W)	τ (s)	
8,91E-02	2,42E+00	
2,69E-01	2,03E-01	
8,60E-01	4,06E-02	
5,20E-01	6,04E-03	
2,47E-01	9,13E-04	



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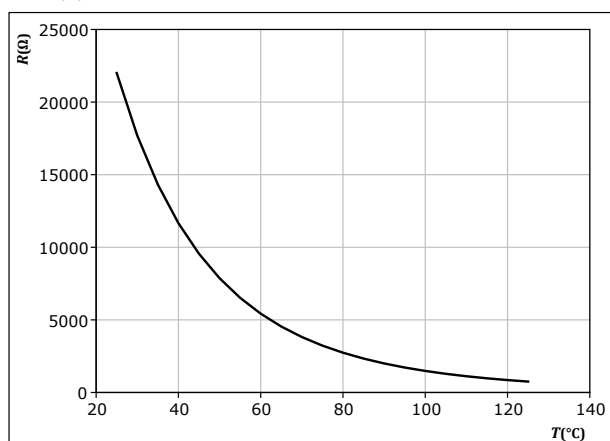
Thermistor Characteristics

figure 11.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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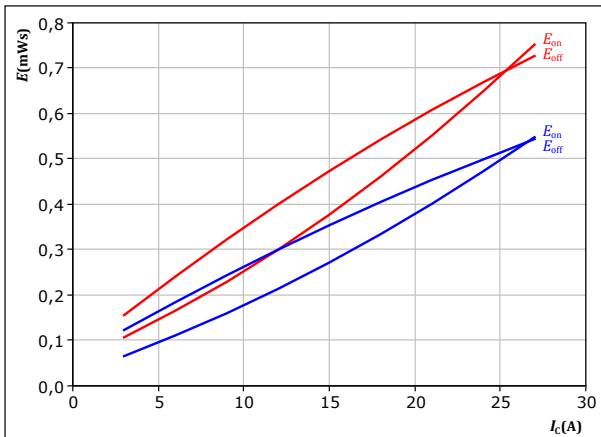
Inverter Switching Characteristics

figure 12.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

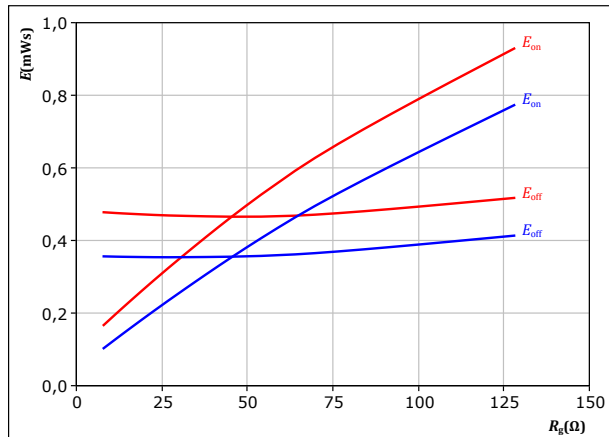
T_j : — 25 °C
— 150 °C

figure 13.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

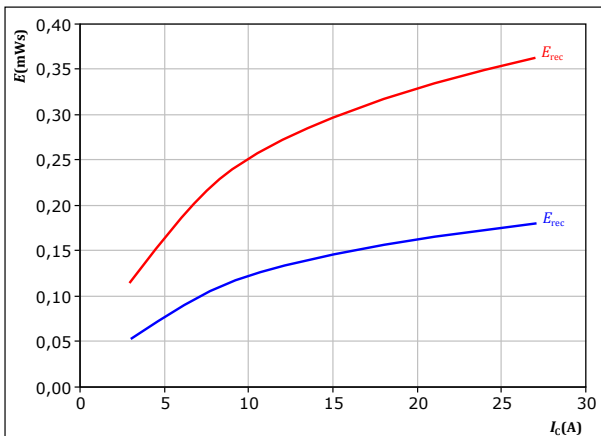
T_j : — 25 °C
— 150 °C

figure 14.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

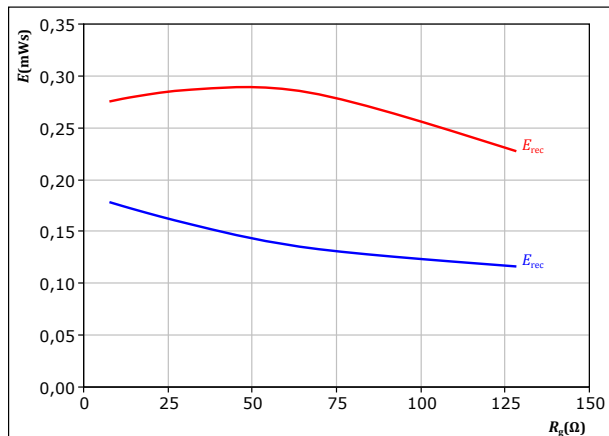
T_j : — 25 °C
— 150 °C

figure 15.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

T_j : — 25 °C
— 150 °C



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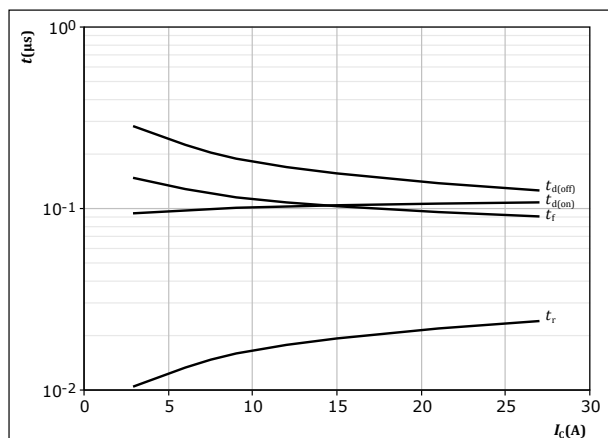
Inverter Switching Characteristics

figure 16.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

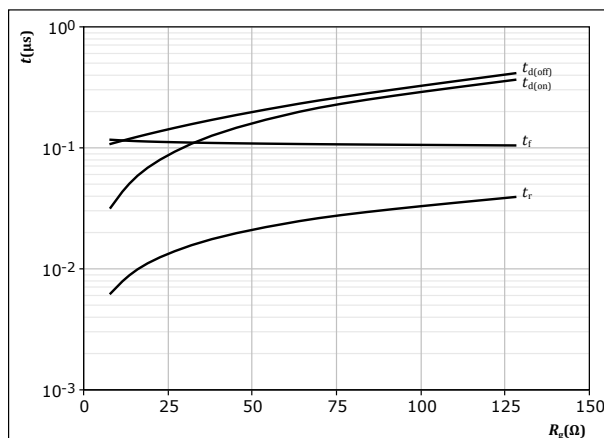
$T_j = 150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

figure 17.

IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



With an inductive load at

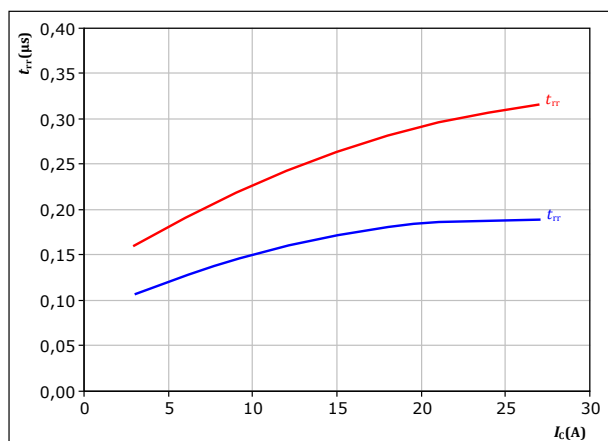
$T_j = 150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

figure 18.

FWD

Typical reverse recovery time as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

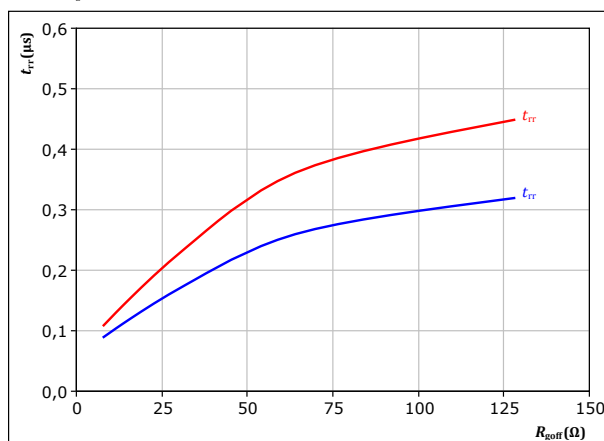
T_j : — 25 °C
— 150 °C

figure 19.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

T_j : — 25 °C
— 150 °C



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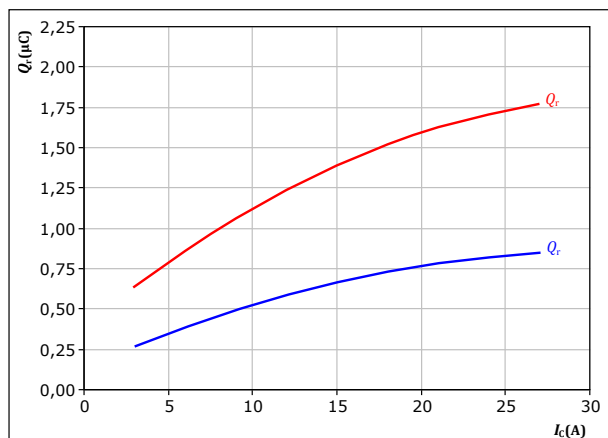
Inverter Switching Characteristics

figure 20.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

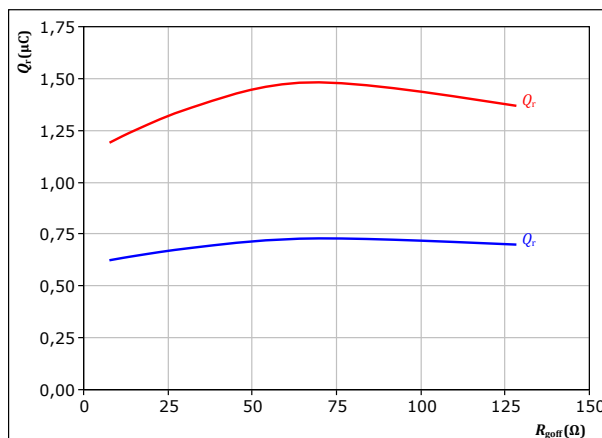
T_j : — 25 °C
— 150 °C

figure 21.

FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_c = 15$ A

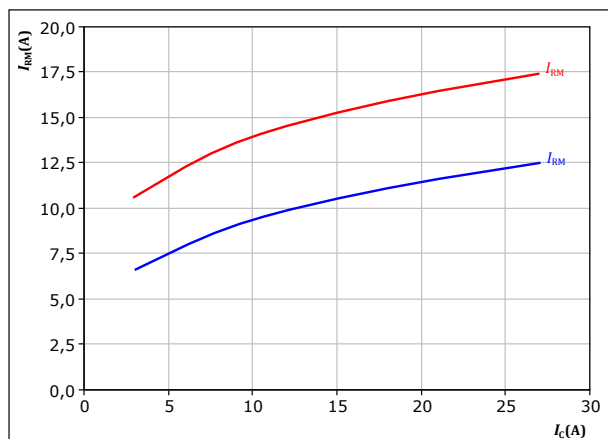
T_j : — 25 °C
— 150 °C

figure 22.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

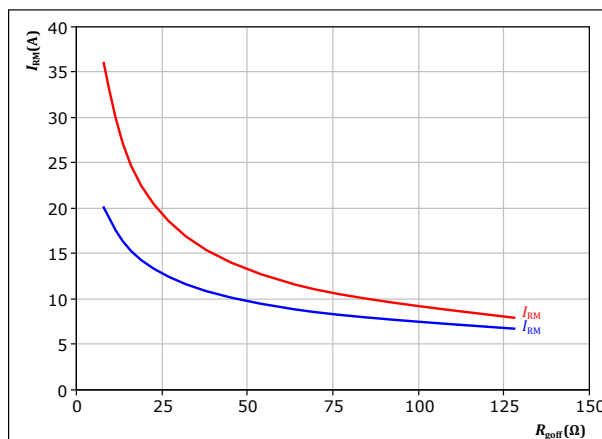
T_j : — 25 °C
— 150 °C

figure 23.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_c = 15$ A

T_j : — 25 °C
— 150 °C



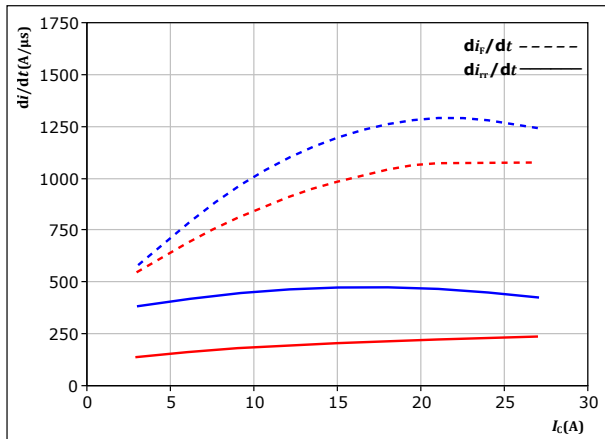
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Inverter Switching Characteristics

figure 24. FWD

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



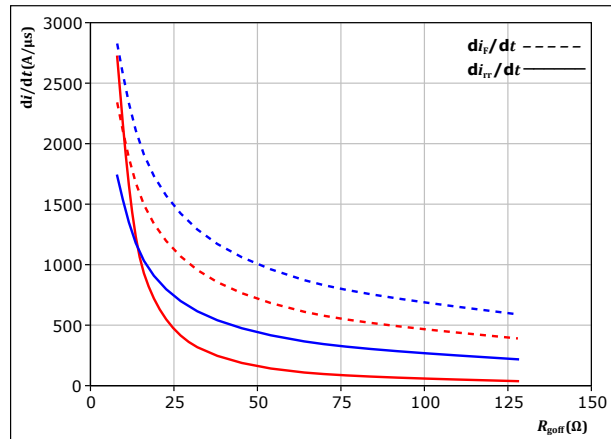
With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{goff} = 32$ Ω

T_j : — 25 °C
— 150 °C

figure 25. 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

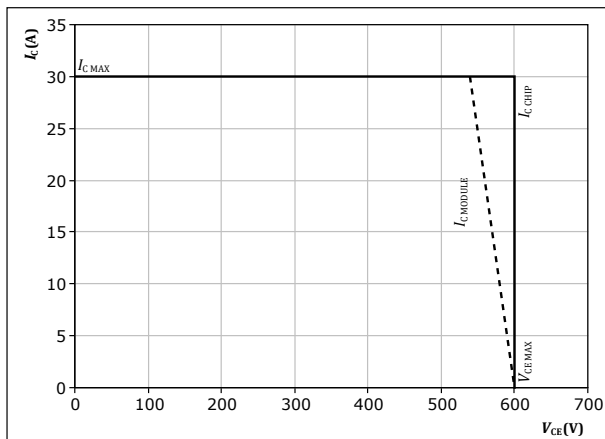
$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 15$ A

T_j : — 25 °C
— 150 °C

figure 26. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{goff} = 32$ Ω
 $R_{goff} = 32$ 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})

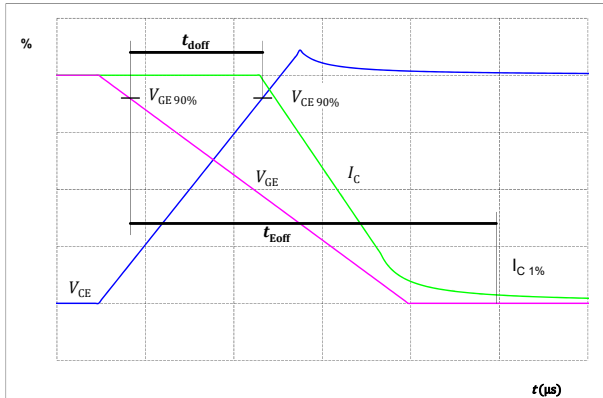


figure 28. IGBT

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

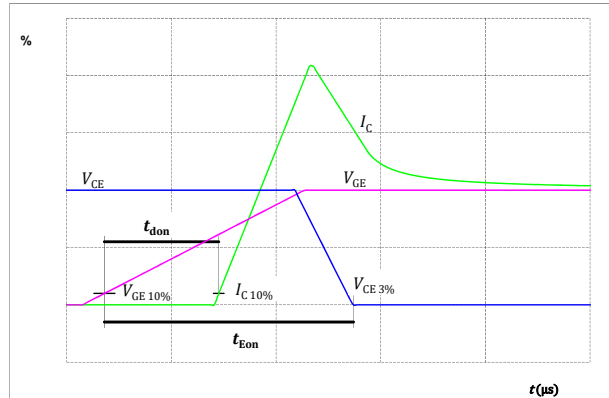


figure 29. IGBT

Turn-off Switching Waveforms & definition of t_f

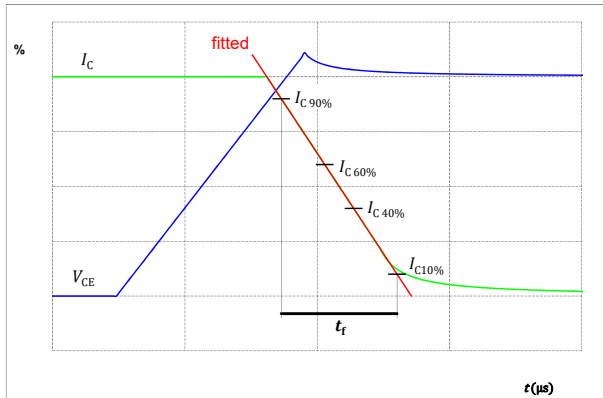
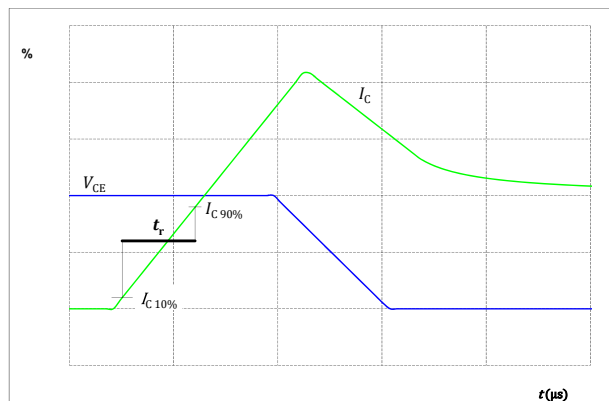


figure 30. IGBT

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}

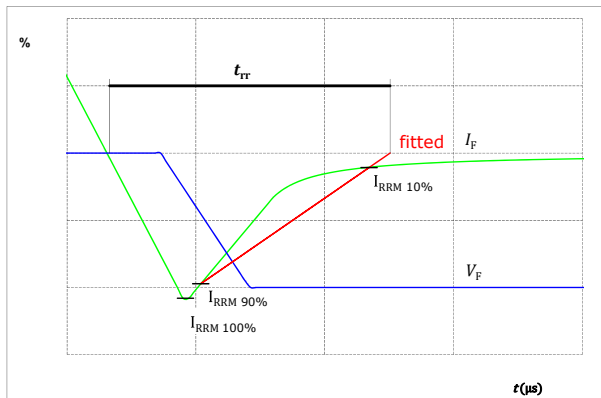
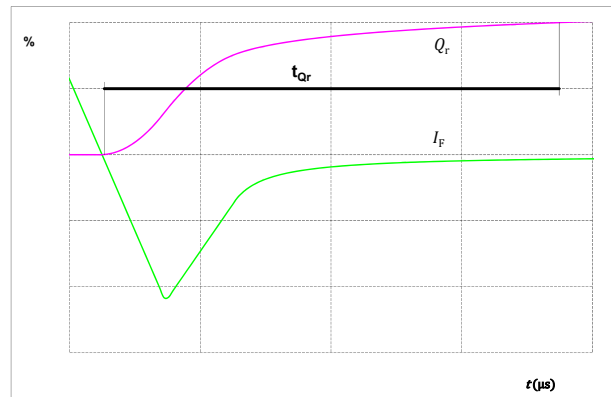


figure 32.

FWD

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






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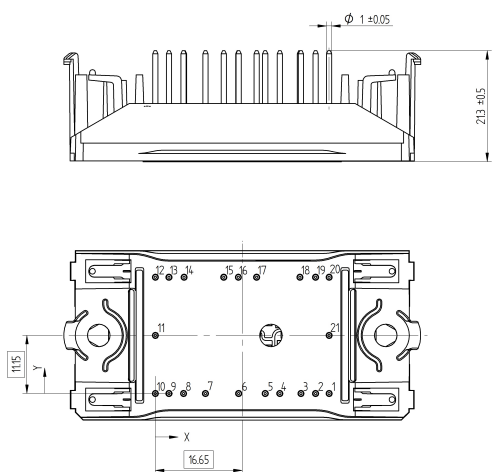
V23990-P862-F49-PM

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P862-F49-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P862-F49-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P862-F49-/3/-PM

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
		VIN	WWYY	TTTTTTTV	UL	LLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTTV	LLLL	SSSS	WWYY		

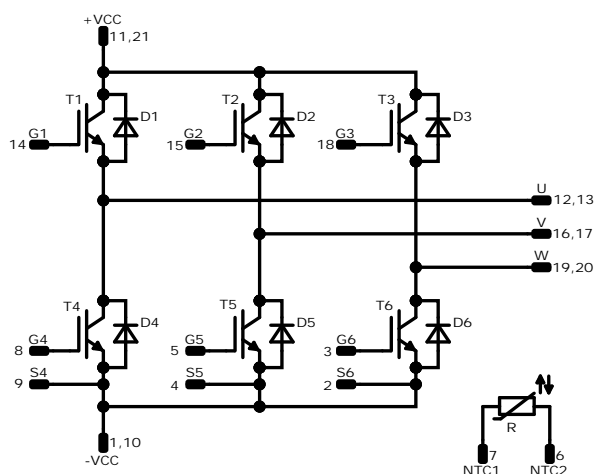
Outline				
Pin table [mm]				
Pin	X	Y	Function	
1	33,3	0	-Vcc	
2	30,7	0	S6	
3	27,9	0	G6	
4	23,85	0	S5	
5	21,05	0	G5	
6	15,95	0	NTC2	
7	9,6	0	NTC1	
8	5,4	0	G4	
9	2,6	0	S4	
10	0	0	-Vcc	
11	0	11,15	+Vcc	
12	0	22,3	U	
13	2,6	22,3	U	
14	5,5	22,3	G1	
15	13,1	22,3	G2	
16	15,9	22,3	V	
17	19,4	22,3	V	
18	27,7	22,3	G3	
19	30,7	22,3	W	
20	33,3	22,3	W	
21	33,3	11,15	+Vcc	



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




Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T4, T1, T5, T2, T6, T3	IGBT	600 V	15 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	600 V	15 A	Inverter Diode	
R	Thermistor			Thermistor	



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
V23990-P862-F49-PM-D5-14	10 Sep. 2021	Updated characteristic values of inverter switch and thermistor Introduce Rth values with PSX-P7 TIM Separate datasheet for 17 mm housing solder pin New datasheet format, module is unchanged	

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