



Vincotech

V23990-P860-F49-PM

datasheet

flowPACK 0

1200 V / 35 A

Features

- Trench Fieldstop IGBT4 technology
- Compact and low inductance design
- Built-in NTC

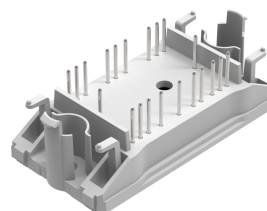
Target applications

- Motor Drives
- Power Generation
- UPS

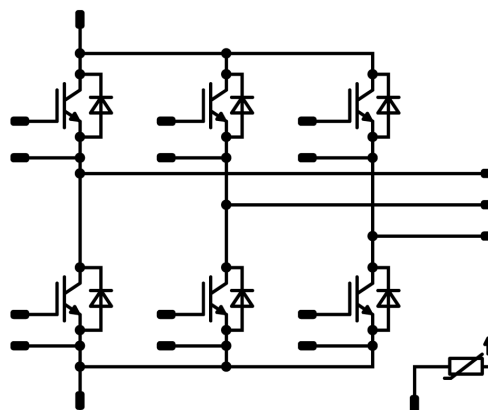
Types

- V23990-P860-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}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	39	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	105	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	101	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	42	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	80	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



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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 150	1,58	1,9 2,33	2,07 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			5	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25	25			2000		pF
Reverse transfer capacitance	C_{res}							70		pF
Gate charge	Q_g		15		0	25		270		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						0,94		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16 \text{ } \Omega$ $R_{goff} = 16 \text{ } \Omega$	± 15	600	35	25 150		85,4 88,6		ns
Rise time	t_r					25 150		21,6 25,8		ns
Turn-off delay time	$t_{d(off)}$					25 150		199 258,8		ns
Fall time	t_f					25 150		73,35 115,18		ns
Turn-on energy (per pulse)	E_{on}					25 150		2,48 3,71		mWs
Turn-off energy (per pulse)	E_{off}					25 150		1,84 2,91		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	25 150	1,35	1,79 1,76	2,05 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25			7,7	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,19		K/W
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Dynamic

Peak recovery current	I_{RRM}	$di/dt=1463$ A/μs $di/dt=1493$ A/μs	± 15	600	35	25 150		30,39 34,47		A
Reverse recovery time	t_{rr}					25 150		298,4 492,81		ns
Recovered charge	Q_r					25 150		3,79 7		μC
Reverse recovered energy	E_{rec}					25 150		1,48 2,81		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		121,56 104,89		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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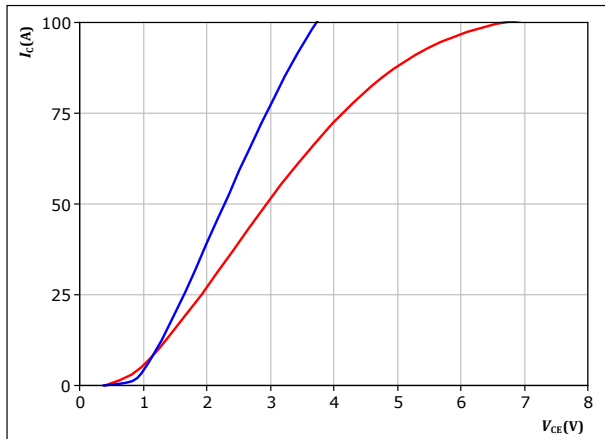
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Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

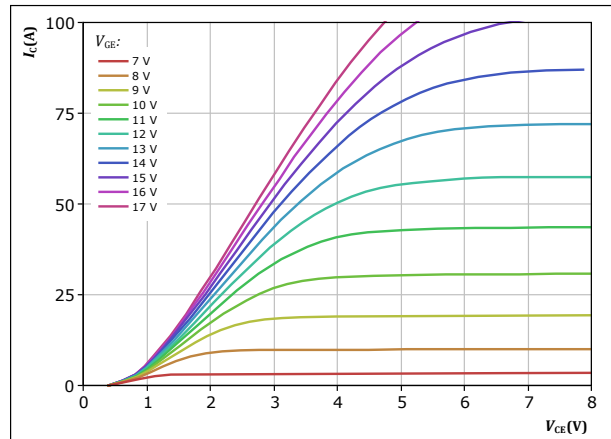


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_J: 25 ^\circ C$
 $150 ^\circ C$

figure 2. IGBT

Typical output characteristics

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

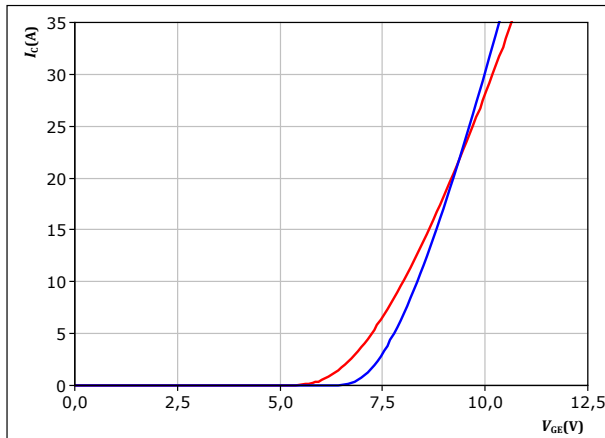


$t_p = 250 \mu s$
 $T_J = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

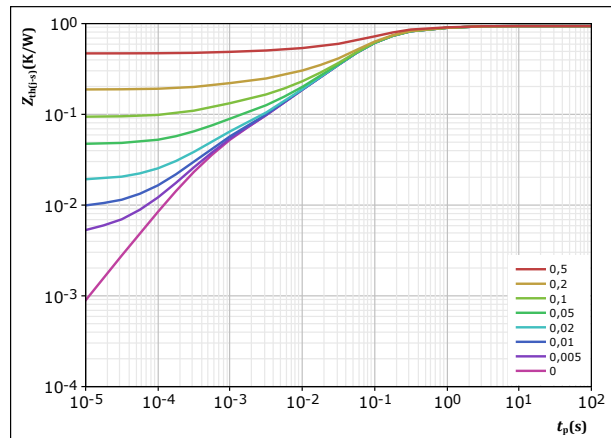


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_J: 25 ^\circ C$
 $150 ^\circ C$

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 0,938 K/W$
IGBT thermal model values

$R (K/W)$	$\tau (s)$
1,15E-01	9,47E-01
4,15E-01	1,24E-01
2,99E-01	4,81E-02
7,22E-02	5,86E-03
3,82E-02	5,62E-04



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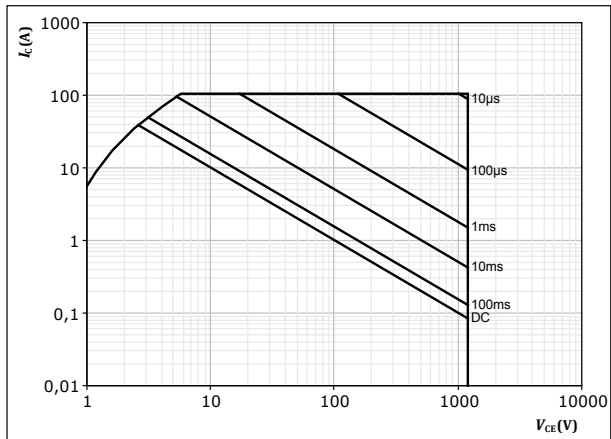
Inverter Switch Characteristics

figure 5.

IGBT

Safe operating area

$I_C = f(V_{CE})$



$D = \text{single pulse}$

$T_s = 80 \text{ } ^\circ\text{C}$

$V_{GE} = 15 \text{ V}$

$T_j = T_{jmax}$



Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

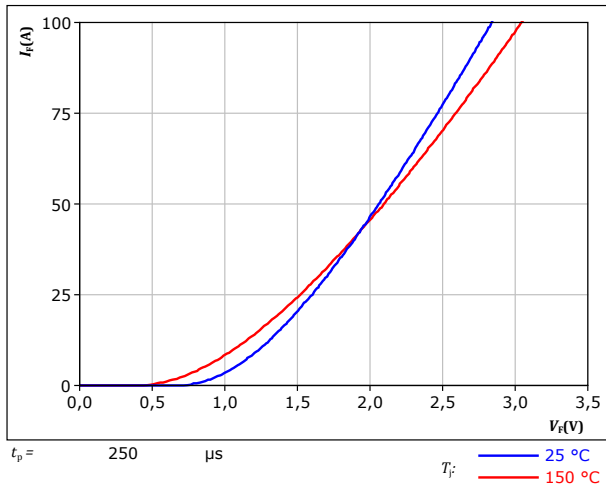
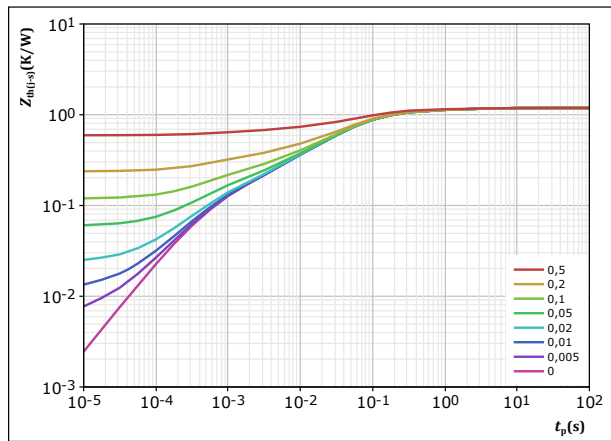


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	1,187	K/W
FWD thermal model values		
R (K/W)	τ (s)	
6,30E-02	2,93E+00	
1,30E-01	4,06E-01	
5,50E-01	7,36E-02	
2,26E-01	2,16E-02	
1,15E-01	4,46E-03	
9,49E-02	5,82E-04	
8,50E-03	2,11E-04	



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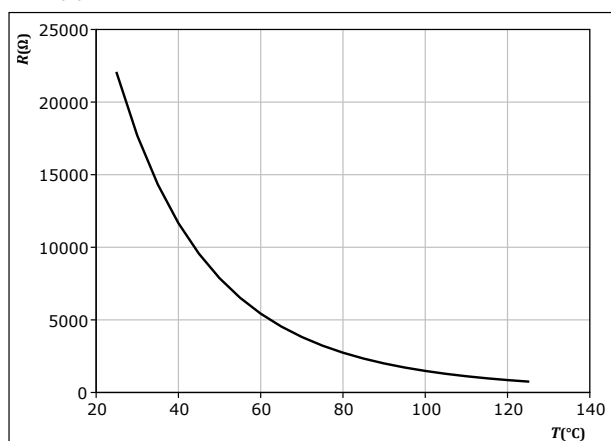
Thermistor Characteristics

figure 8.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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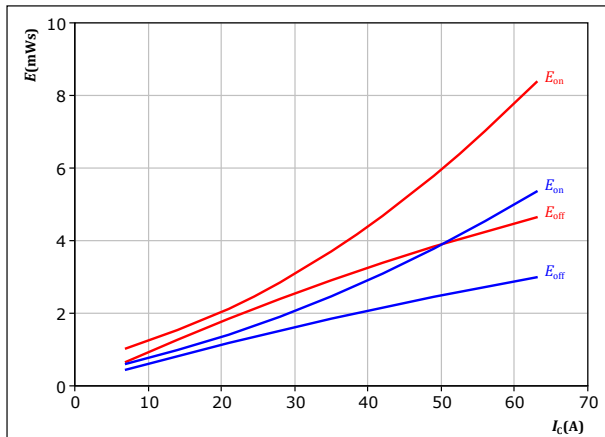
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Inverter Switching Characteristics

figure 9. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

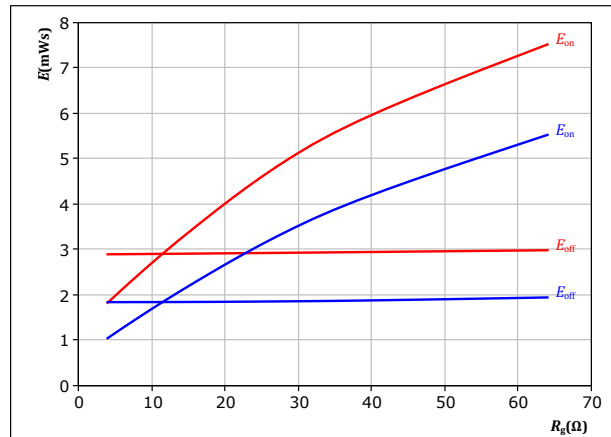
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 16$ Ω

T_j : 25 °C (blue)
150 °C (red)

figure 10. IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

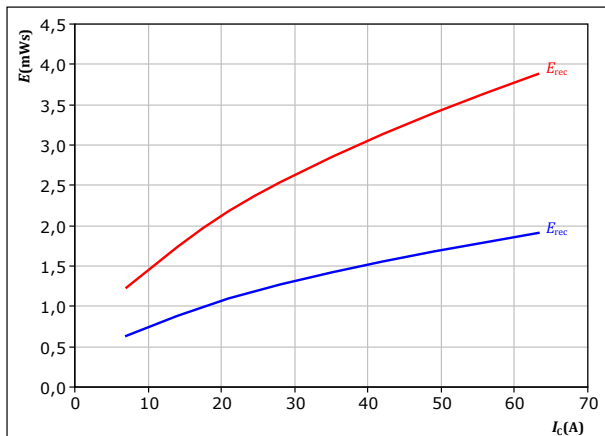
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 35$ A

T_j : 25 °C (blue)
150 °C (red)

figure 11. FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

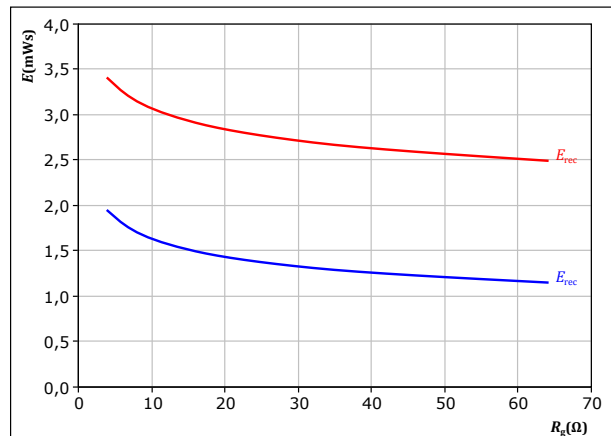
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω

T_j : 25 °C (blue)
150 °C (red)

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
 $I_c = 35$ A

T_j : 25 °C (blue)
150 °C (red)



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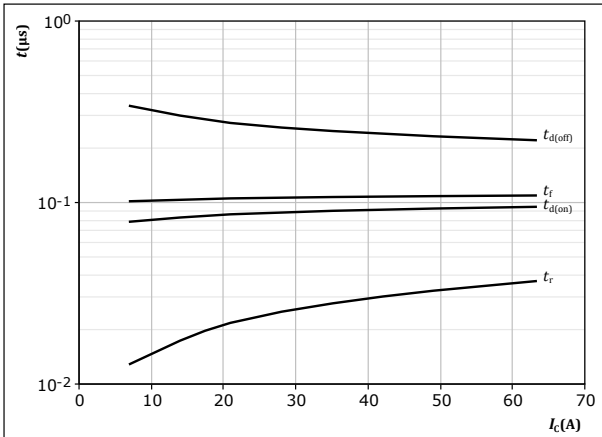
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Inverter Switching Characteristics

figure 13.

IGBT

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



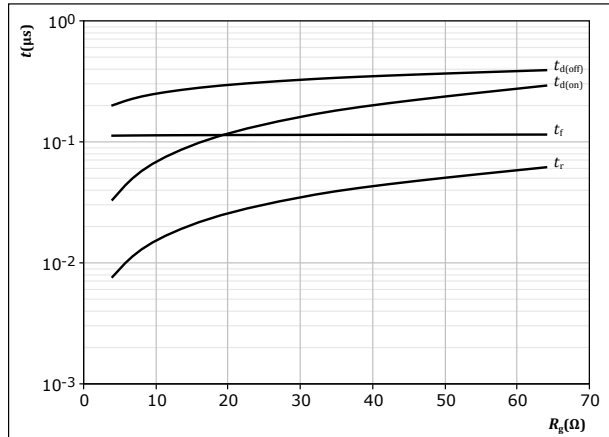
With an inductive load at

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

figure 14.

IGBT

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



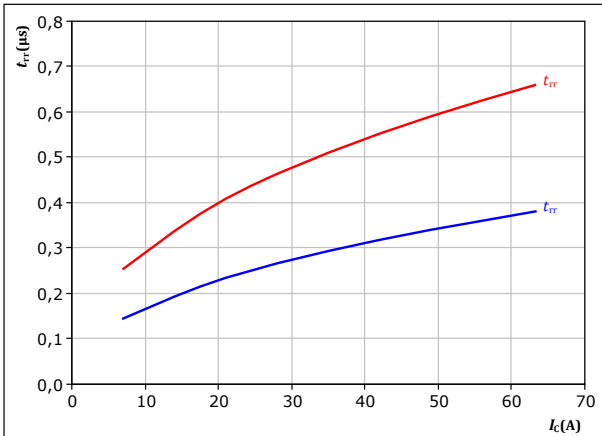
With an inductive load at

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

figure 15.

FWD

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



With an inductive load at

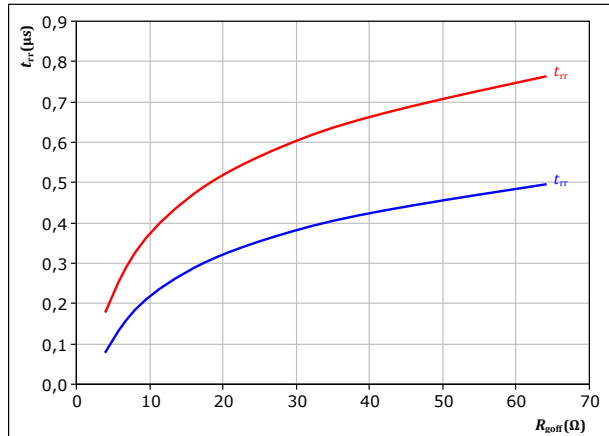
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω

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
 $V_{GE} = \pm 15$ V
 $I_C = 35$ A

T_j : — 25 °C
— 150 °C



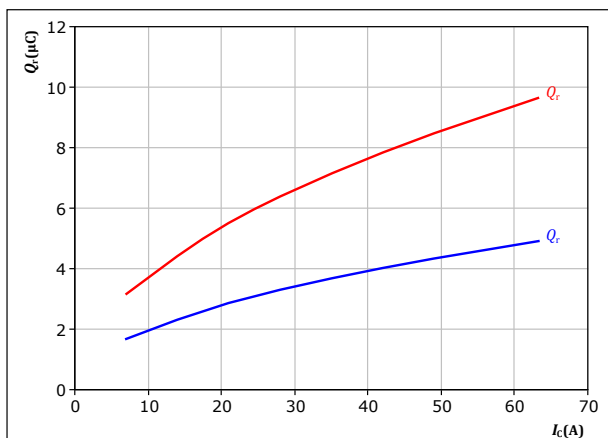
Inverter Switching Characteristics

figure 17.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ R_{gon} &= 16 \text{ } \Omega \end{aligned}$$

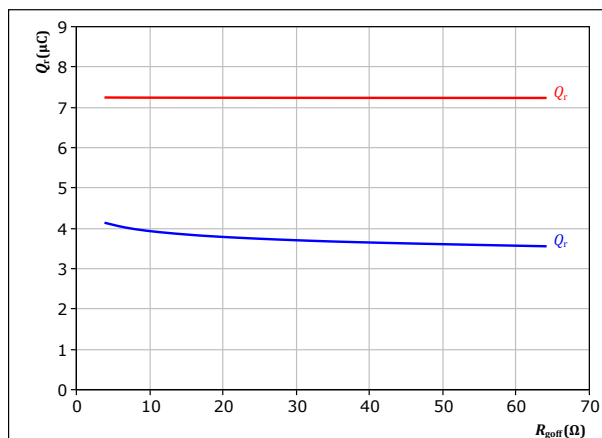
$$T_j: \begin{aligned} &\text{— } 25 \text{ } ^\circ\text{C} \\ &\text{— } 150 \text{ } ^\circ\text{C} \end{aligned}$$

figure 18.

FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ I_c &= 35 \text{ A} \end{aligned}$$

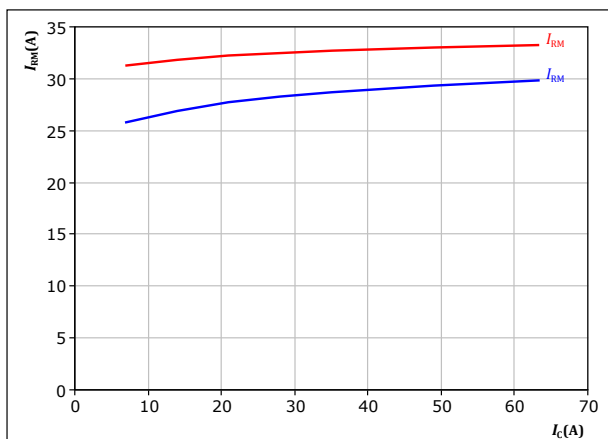
$$T_j: \begin{aligned} &\text{— } 25 \text{ } ^\circ\text{C} \\ &\text{— } 150 \text{ } ^\circ\text{C} \end{aligned}$$

figure 19.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ R_{gon} &= 16 \text{ } \Omega \end{aligned}$$

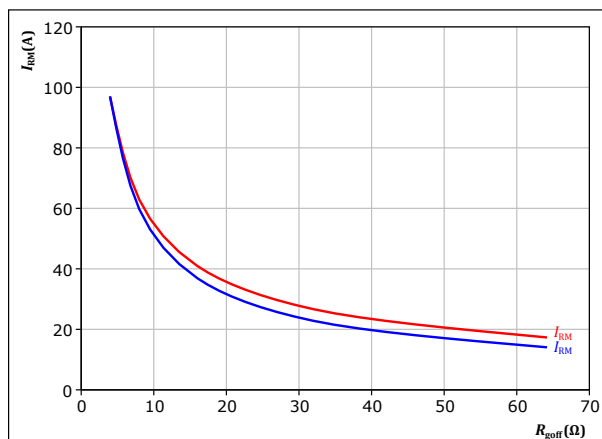
$$T_j: \begin{aligned} &\text{— } 25 \text{ } ^\circ\text{C} \\ &\text{— } 150 \text{ } ^\circ\text{C} \end{aligned}$$

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

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ I_c &= 35 \text{ A} \end{aligned}$$

$$T_j: \begin{aligned} &\text{— } 25 \text{ } ^\circ\text{C} \\ &\text{— } 150 \text{ } ^\circ\text{C} \end{aligned}$$



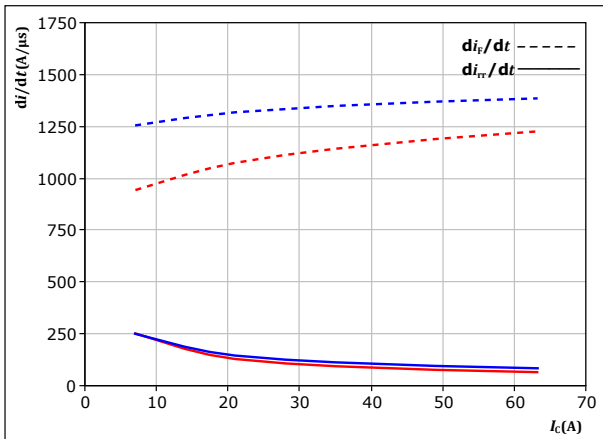
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Inverter Switching Characteristics

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

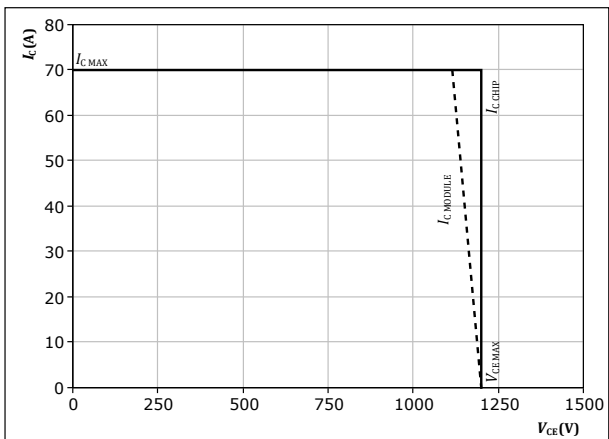
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω

T_j : 25 °C
150 °C

figure 23. IGBT

Reverse bias safe operating area

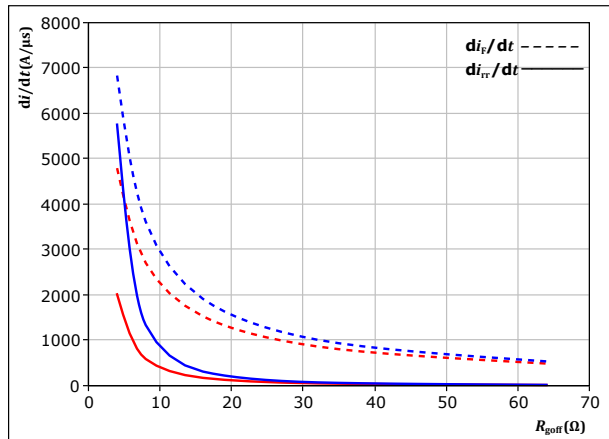
$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{gon} = 16$ Ω
 $R_{goff} = 16$ Ω

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
 $I_C = 35$ A

T_j : 25 °C
150 °C



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datasheet

Inverter Switching Definitions

figure 24. IGBT

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

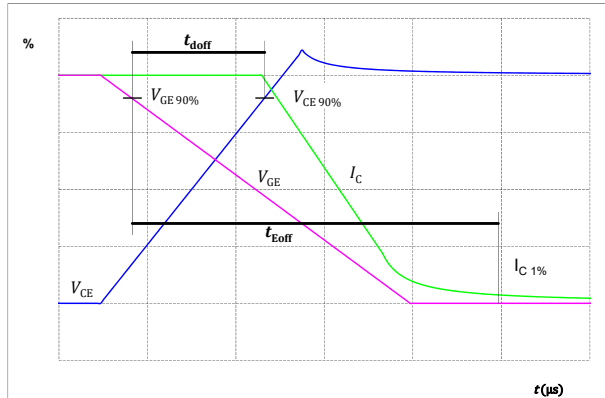


figure 25. IGBT

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

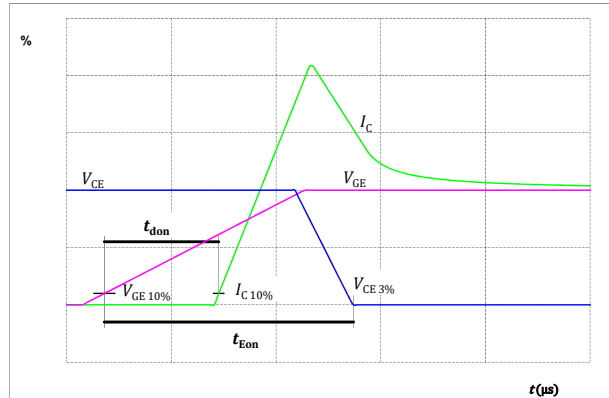


figure 26. IGBT

Turn-off Switching Waveforms & definition of t_f

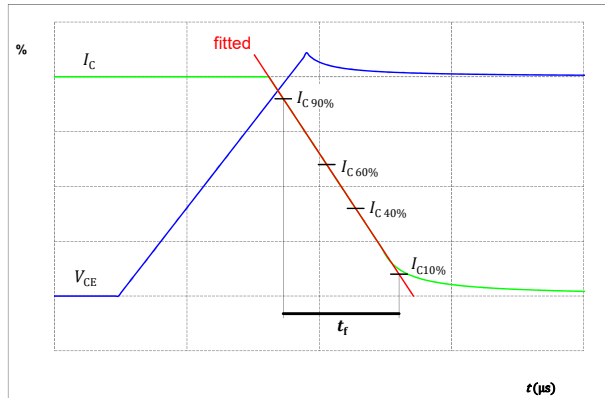
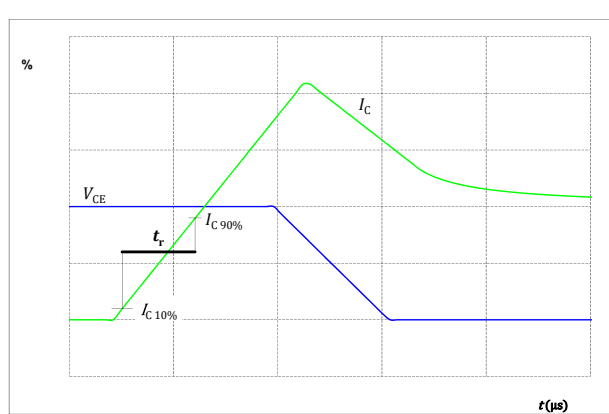


figure 27. IGBT

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}

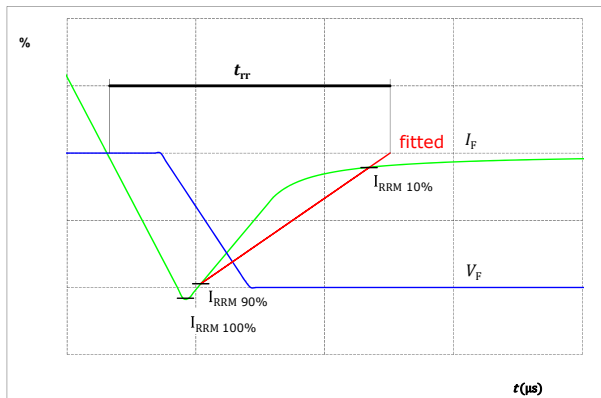
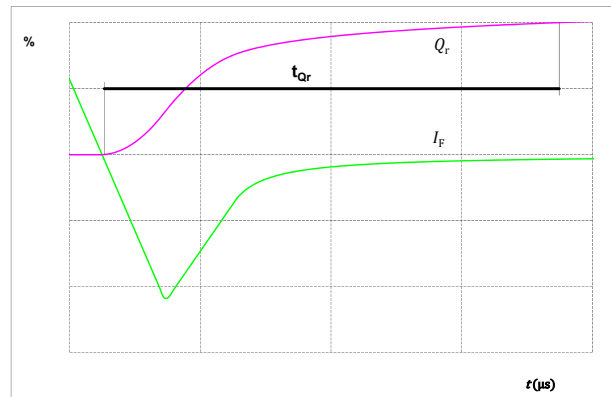


figure 29.

FWD

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






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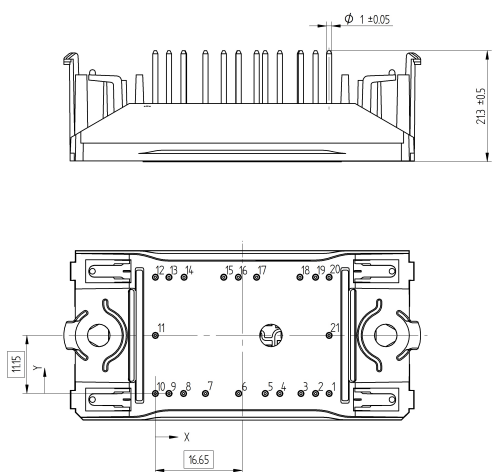
V23990-P860-F49-PM

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P860-F49-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P860-F49-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P860-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		

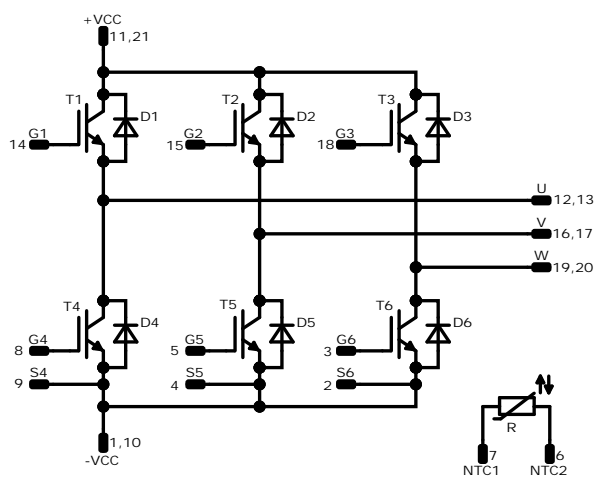
Outline				
Pin table [mm]				
Pin	X	Y	Function	
1	33,3	0	-Vcc	
2	30,7	0	S6	
3	27,9	0	G6	
4	23,85	0	S5	
5	21,05	0	G5	
6	15,95	0	NTC2	
7	9,6	0	NTC1	
8	5,4	0	G4	
9	2,6	0	S4	
10	0	0	-Vcc	
11	0	11,15	+Vcc	
12	0	22,3	U	
13	2,6	22,3	U	
14	5,5	22,3	G1	
15	13,1	22,3	G2	
16	15,9	22,3	V	
17	19,4	22,3	V	
18	27,7	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	1200 V	35 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	1200 V	35 A	Inverter Diode	
R	NTC			Thermistor	



Vincotech

V23990-P860-F49-PM
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
V23990-P860-F49-PM-D5-14	10 Sep. 2021	Introduce Rth values with PSX-P7 TIM Separate datasheet for 17 mm housing solder pin version New datasheet format, module is unchanged	

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