V23990-P861-F49-PM

datasheet

***flow*PACK 0**	**600 V / 10 A**

Features

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

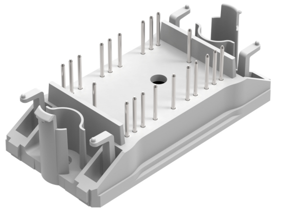
Target applications

- Motor Drives
- Power Generation
- UPS

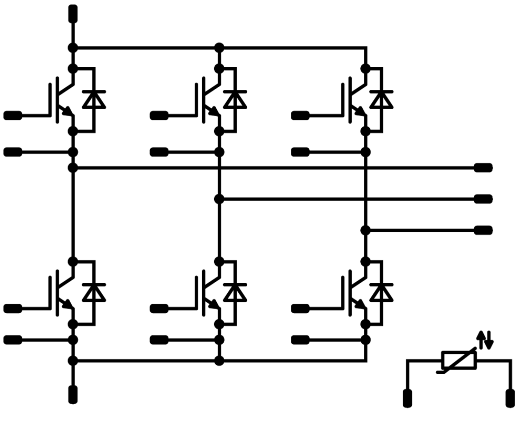
Types

- V23990-P861-F49-PM

flow 0 17 mm housing



Schematic



Maximum Ratings

T_j = 25 °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 °C	17	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 360 V	T_j = 150 °C	6	μs
Maximum junction temperature	T_{jmax}			175	°C
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	16	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	32	W
Maximum junction temperature	T_{jmax}			175	°C
Module Properties					
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{jop}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	6000	V
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 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}			0,00015	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 150	1,1	1,5 1,8	1,9(1)	V
Collector-emitter cut-off current	I_{CES}		0	600		25			0,6	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 Mhz	0	25		25		551		pF
Output capacitance	C_{oes}							40		pF
Reverse transfer capacitance	C_{res}							17		pF
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,15		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 32 Ω R_{goff} = 32 Ω	±15	300	10	25 150		73,6 73,2		ns
Rise time	t_r					25 150		11,6 17,2		ns
Turn-off delay time	$t_{d(off)}$					25 150		109,4 129,4		ns
Fall time	t_f					25 150		100,24 118,41		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,485 µC Q_{rFWD}=0,905 µC				25 150		0,156 0,212		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,231 0,303		mWs

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				10	25 150	1,25	1,61 1,56	1,95(1)	V
Reverse leakage current	I_R	V_r = 600 V				25			27	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,99		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=1006 A/µs d*i*/d*t*=816 A/µs	±15	300	10	25 150		9,69 11,53		A
Reverse recovery time	t_{rr}					25 150		143,23 158,09		ns
Recovered charge	Q_r					25 150		0,485 0,905		µC
Reverse recovered energy	E_{rec}					25 150		0,104 0,195		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		401,89 120,39		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 Ω				100	-5		5	%
Power dissipation	P							5		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %						3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %						4000		K
Vincotech Thermistor Reference									I	

(1) Value at chip level

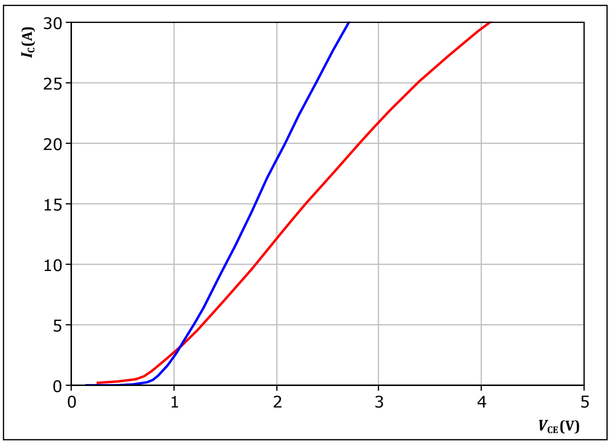
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



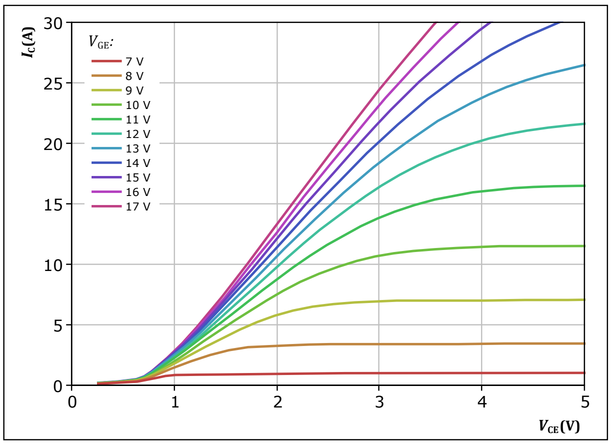
t_p =	250	µs	
V_{GE} =	15	V	

T_j: 25 °C / 150 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



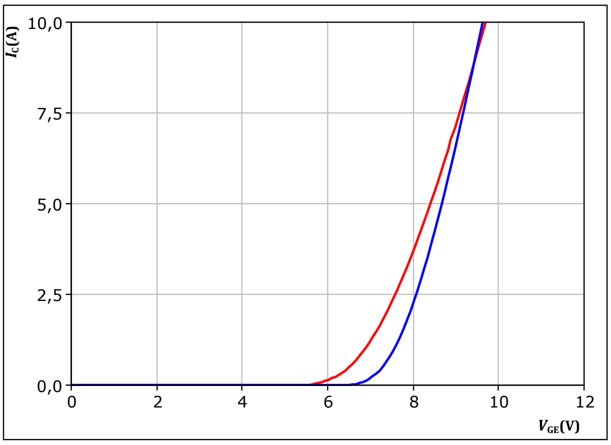
t_p =	250	µs
T_j =	150	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})



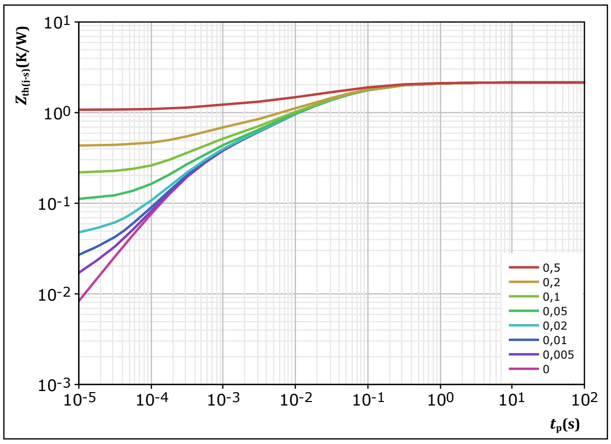
t_p =	250	µs
V_{CE} =	10	V

T_j: 25 °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	
$R_{th(j-s)}$ =	2,149	K/W

IGBT thermal model values

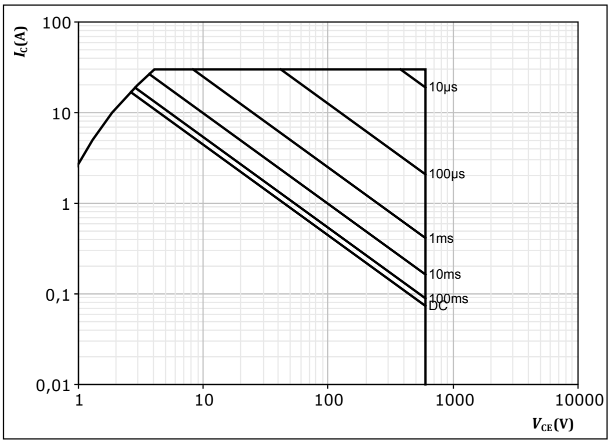
R (K/W)	τ (s)
1,04E-01	1,37E+00
2,88E-01	2,01E-01
6,99E-01	5,27E-02
4,91E-01	1,22E-02
3,07E-01	2,97E-03
2,60E-01	3,80E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



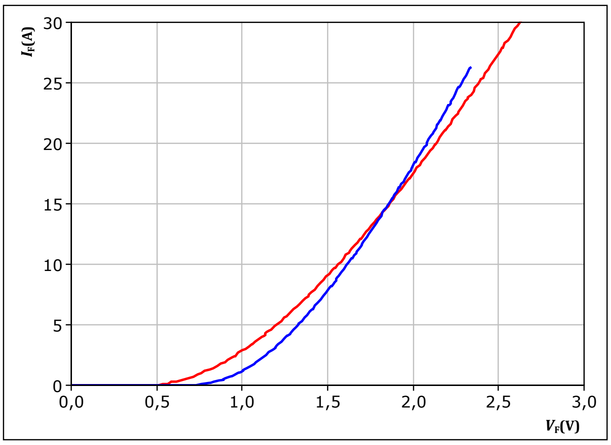
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

I_F = f(V_F)



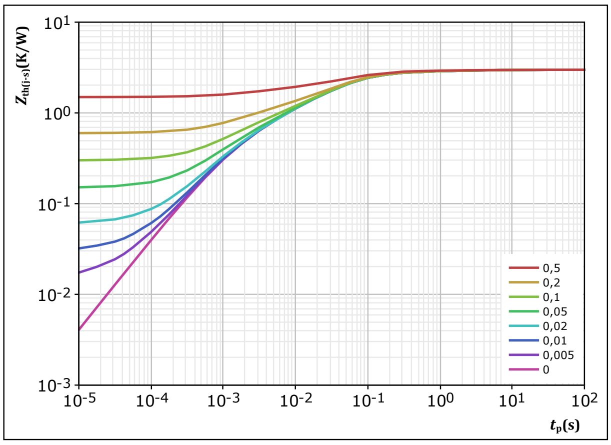
t_p = 250 µs

T_j: 25 °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

$R_{th(j-s)}$ = 2,988 K/W

FWD thermal model values

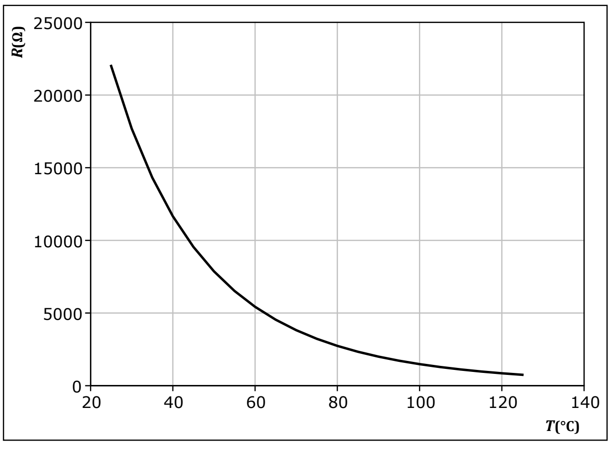
R (K/W)	τ (s)
8,74E-02	5,59E+00
2,41E-01	4,60E-01
1,22E+00	6,53E-02
6,89E-01	2,20E-02
4,52E-01	5,14E-03
2,99E-01	1,11E-03

Thermistor Characteristics

figure 8.	Thermistor

Typical NTC characteristic as function of temperature

$R_T = f(T)$

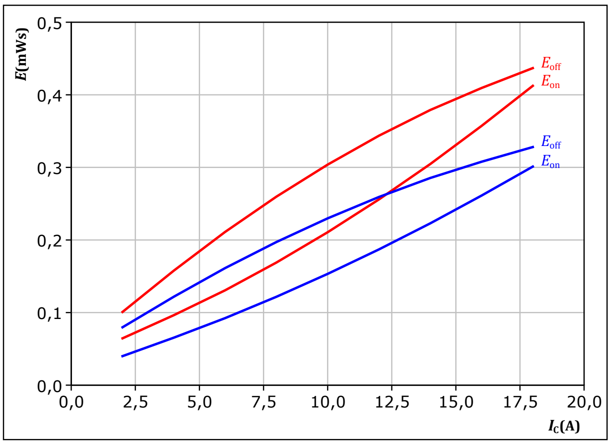


Inverter Switching Characteristics

figure 9. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

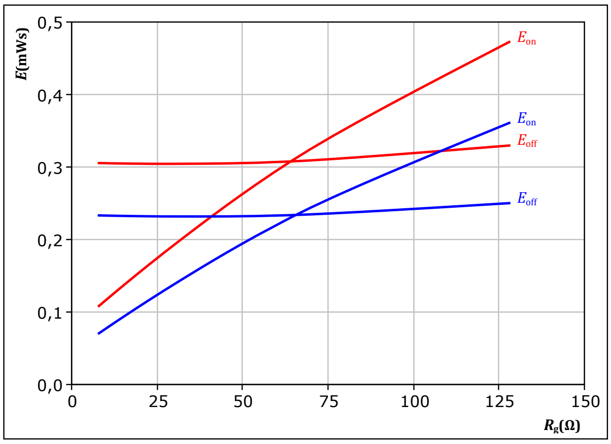
V_{CE} =	300	V	
V_{GE} =	±15	V	
R_{gon} =	32	Ω	
R_{goff} =	32	Ω	

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

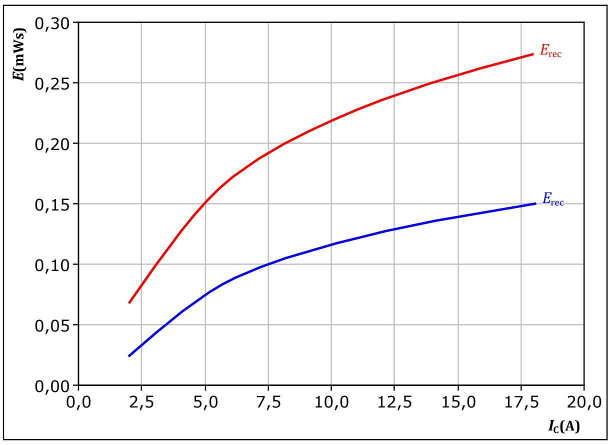
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

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

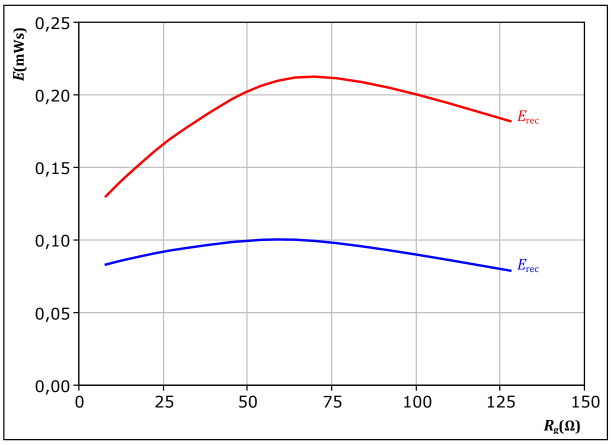
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

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} =	300	V
V_{GE} =	±15	V
I_C =	10	A

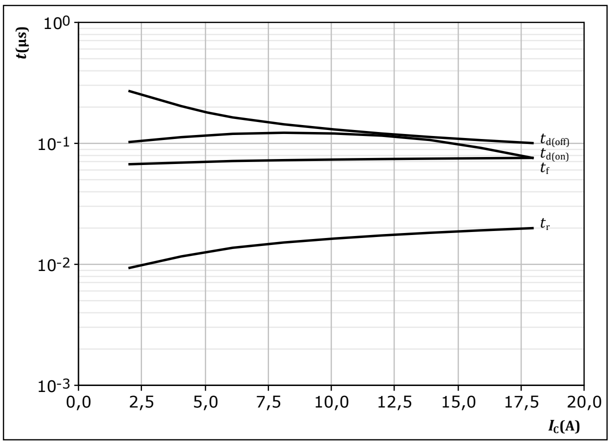
T_j: 25 °C (blue), 150 °C (red)

Inverter Switching Characteristics

figure 13. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



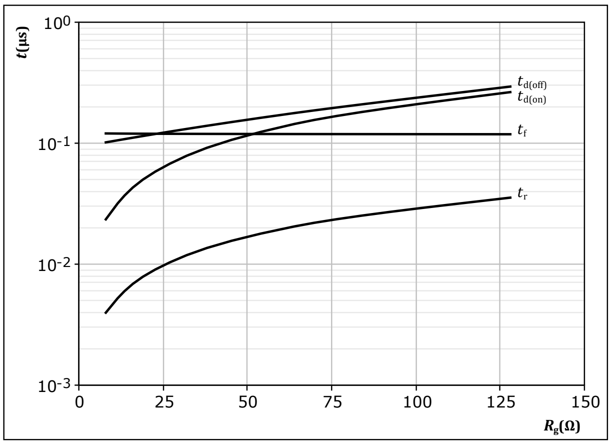
With an inductive load at

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

figure 14. **IGBT**

Typical switching times as a function of gate resistor

t = f(R_g)



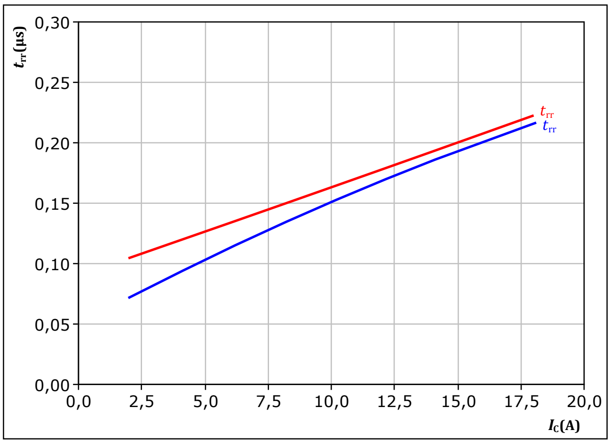
With an inductive load at

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

figure 15. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

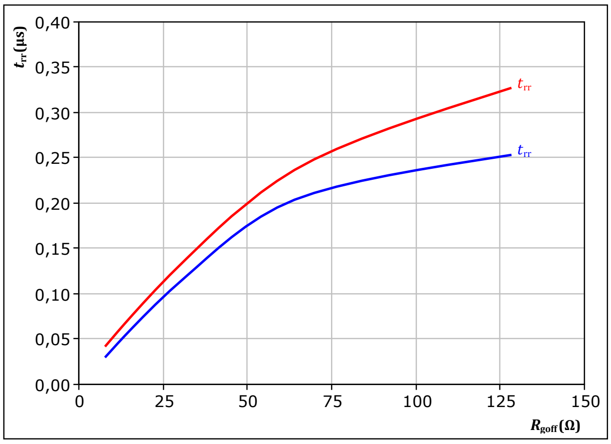
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

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} =	300	V
V_{GE} =	±15	V
I_C =	10	A

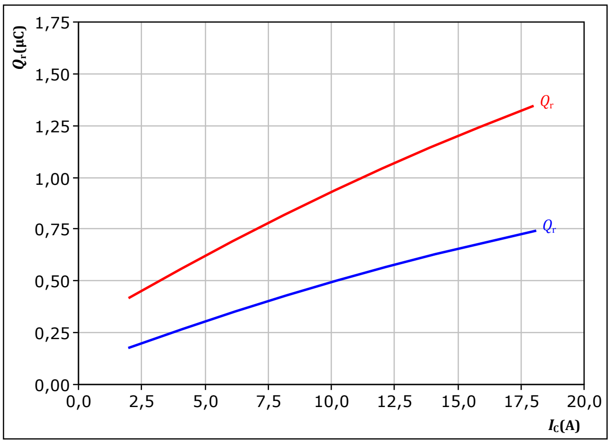
T_j: 25 °C, 150 °C

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

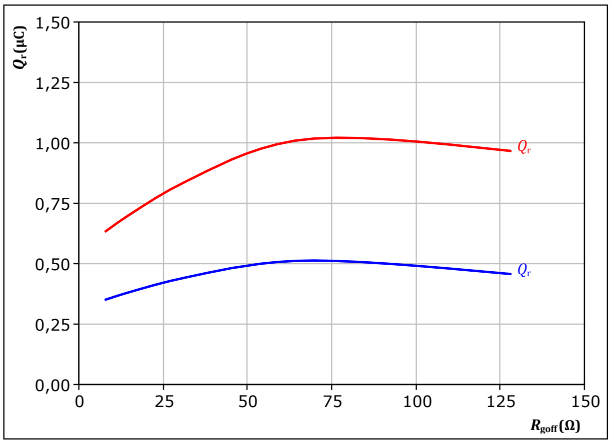
T_j: 25 °C / 150 °C

V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

figure 18. **FWD**

Typical recovered charge as a function of turn off gate resistor

Q_r = f(R_{goff})



With an inductive load at

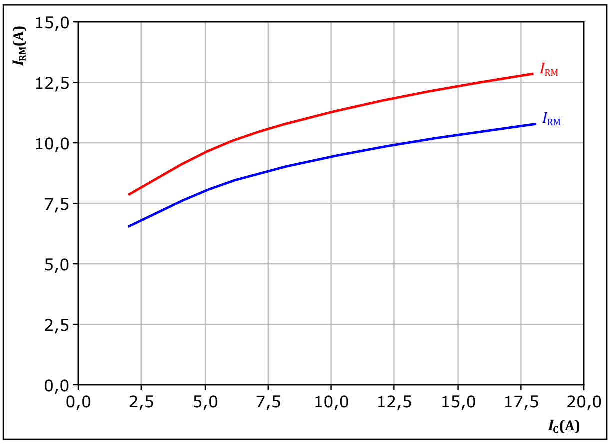
T_j: 25 °C / 150 °C

V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

figure 19. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



With an inductive load at

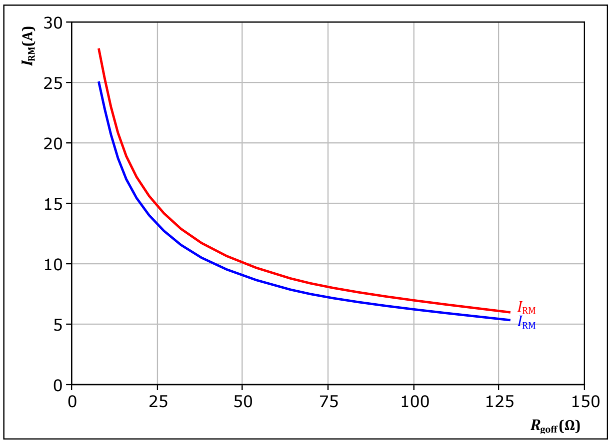
T_j: 25 °C / 150 °C

V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

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

T_j: 25 °C / 150 °C

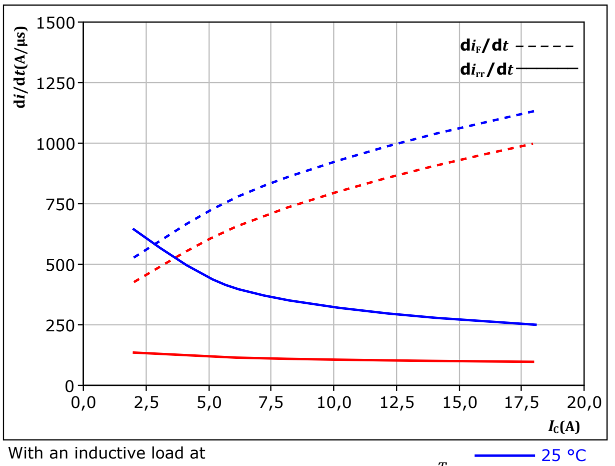
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

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_{rr}/dt = f(I_C)



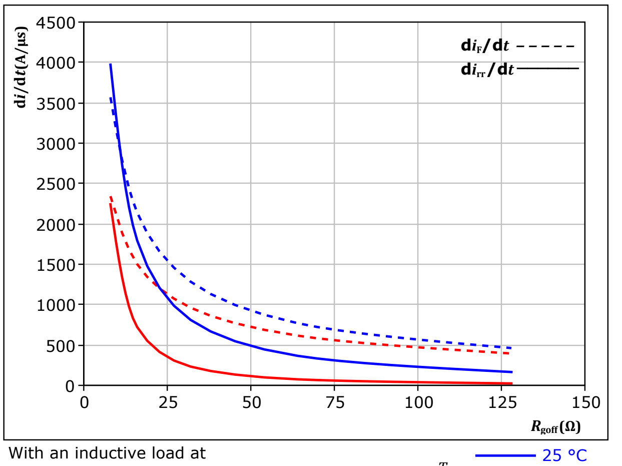
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
R_{gon} =	32	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_{rr}/dt = f(R_{goff})



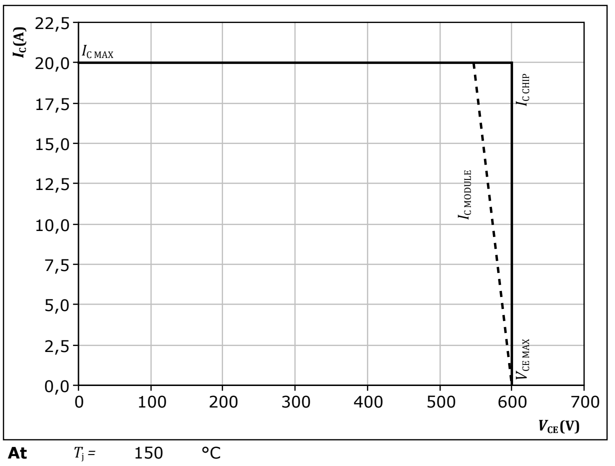
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
I_C =	10	A		

figure 23. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



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

Inverter Switching Definitions

figure 24.	IGBT

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

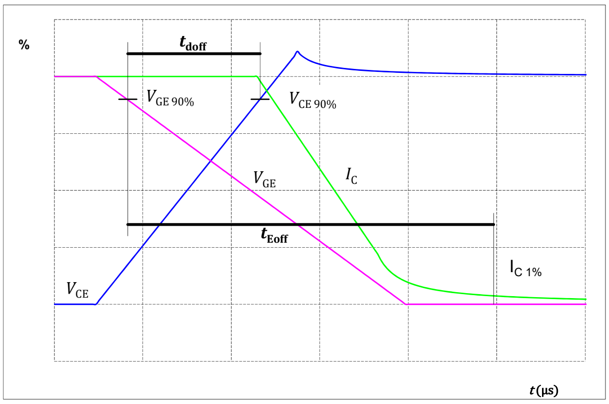


figure 25.	IGBT

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

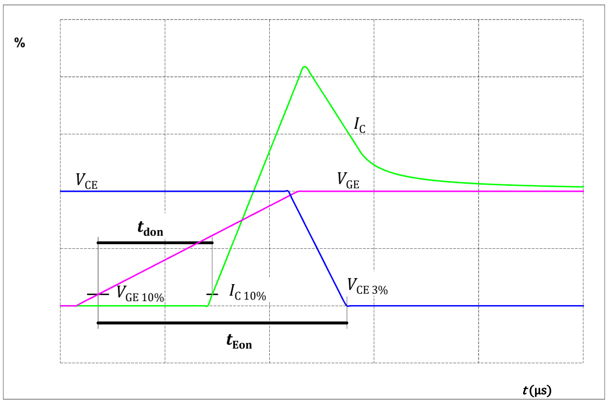


figure 26.	IGBT

Turn-off Switching Waveforms & definition of t_f

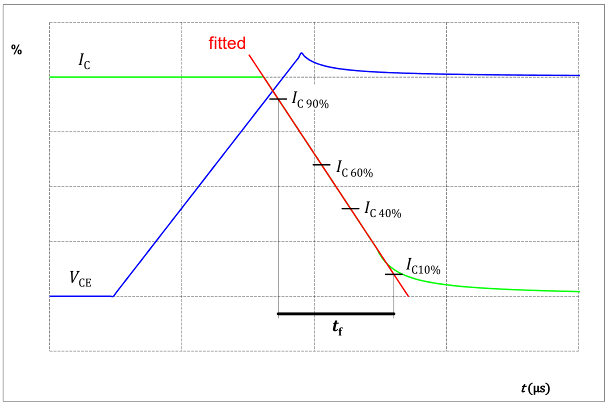
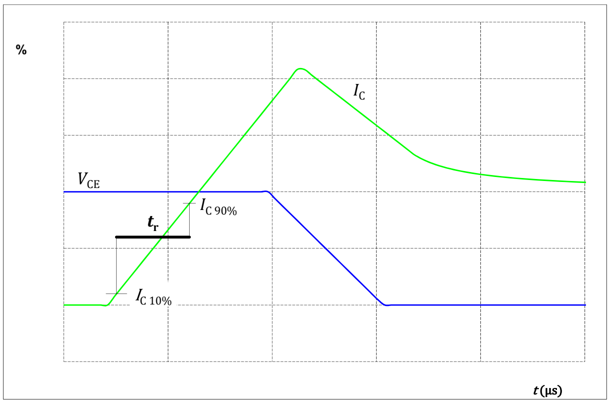


figure 27.	IGBT

Turn-on Switching Waveforms & definition of t_r



Inverter Switching Definitions

figure 28. **FWD**

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

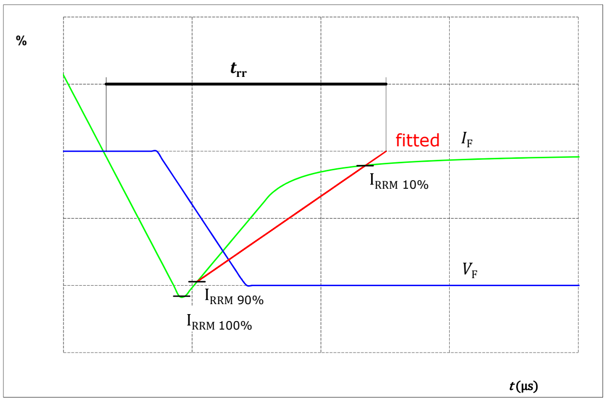
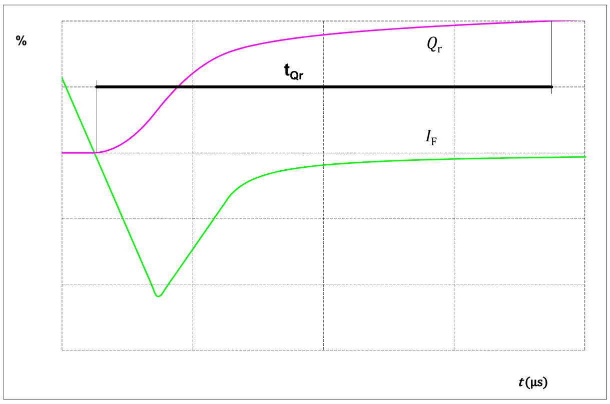


figure 29. **FWD**

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



V23990-P861-F49-PM
datasheet

Ordering Code

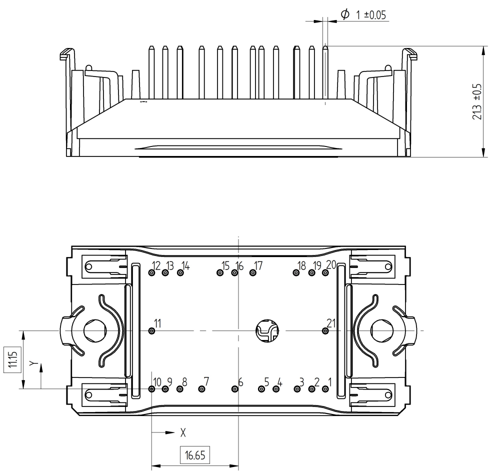
Version	Ordering Code
Without thermal paste	V23990-P861-F49-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P861-F49-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P861-F49-/3/-PM

Marking

Text	**VIN**	**Date code**	**Type&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	TTTTTTTVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

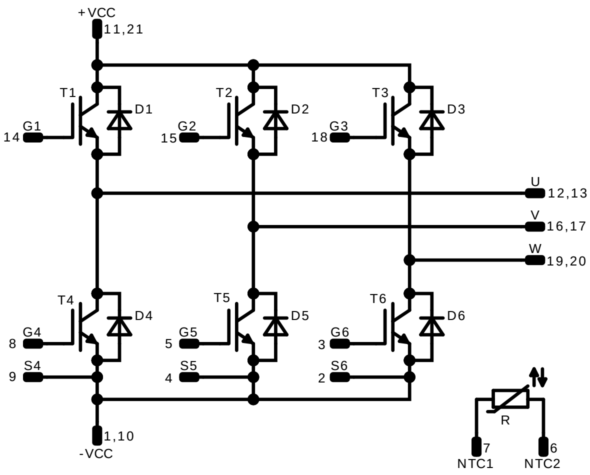
Outline

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	10 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	600 V	10 A	Inverter Diode	
R	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 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-P861-F49-PM-D4-14	10 Sep. 2021	Updated characteristic value of inverter switch and thermistor Introduce Rth values with PSX-P7 TIM Separate datasheet for 17 mm housing press-fit pin New datasheet format, module is unchanged	