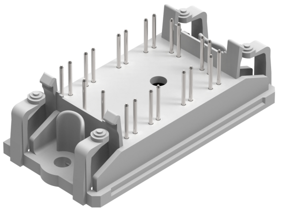
V23990-P623-F59-PM
datasheet

fastPACK 0 H **650 V / 50 A**

Features

- High efficient H-bridge
- High-speed IGBT
- High-switching frequency
- Low inductive design

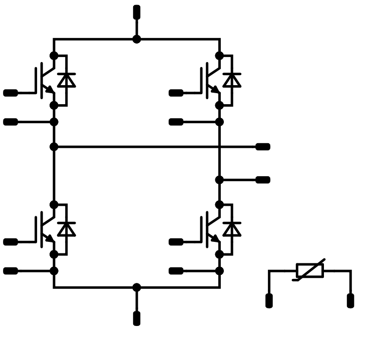
flow 0 17 mm housing



Target applications

- SMPS
- Welding
- UPS
- Solar

Schematic



Types

- V23990-P623-F59-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
H-Bridge Switch					
Collector-emitter voltage	V_{CES}			650	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	43	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 °C	84	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			175	°C
H-Bridge Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	46	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	83	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	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	Unit
H-Bridge Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0005	25	3,3	4	4,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125		1,83 2,01	2,22(1)	V
Collector-emitter cut-off current	I_{CES}		0	650		25			40	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 Mhz	0	25		25		3000		pF
Output capacitance	C_{oes}							50		pF
Reverse transfer capacitance	C_{res}							11		pF
Gate charge	Q_g		15	520	50	25		120		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,13		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	±15	300	50	25 125 150		61,2 62,8 62,6		ns
Rise time	t_r					25 125 150		9 10,2 11		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		66,4 77,8 80,4		ns
Fall time	t_f					25 125 150		4,53 7,71 8,6		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,776 µC Q_{rFWD}=1,55 µC Q_{rFWD}=1,82 µC				25 125 150		0,454 0,569 0,606		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,171 0,302 0,334		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	
H-Bridge Diode										
Static										
Forward voltage	V_F				60	25 125 150		1,94 1,97 1,95	2,22(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			3,2	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,14		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt=3540 A/µs di/dt=4127 A/µs di/dt=4560 A/µs	±15	300	50	25 125 150		44,07 58,29 63,12		A
Reverse recovery time	t_{rr}					25 125 150		28,05 41,86 47,23		ns
Recovered charge	Q_r					25 125 150		0,776 1,55 1,82		µC
Reverse recovered energy	E_{rec}					25 125 150		0,084 0,235 0,288		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		2585 2673 2525		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

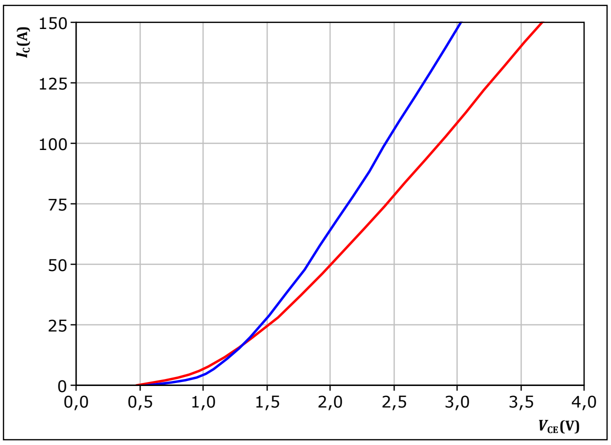
(2) Only valid with pre-applied Vincotech thermal interface material.

H-Bridge Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



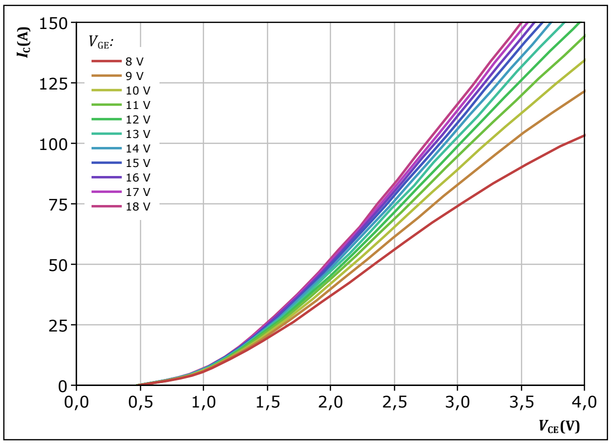
t_p =	250	μs
V_{GE} =	15	V

T_j: 25 °C / 125 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



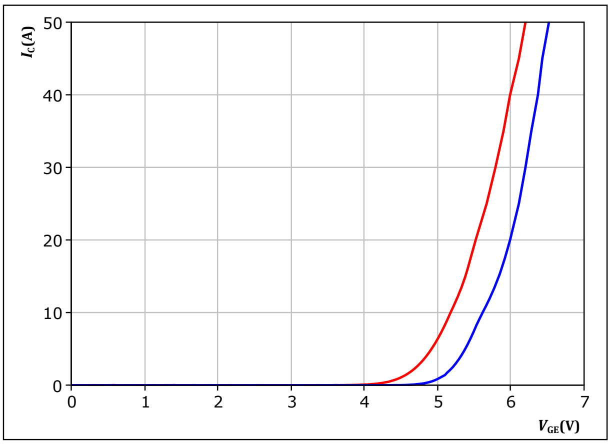
t_p =	250	μs
T_j =	125	°C

V_{GE} from 8 V to 18 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})



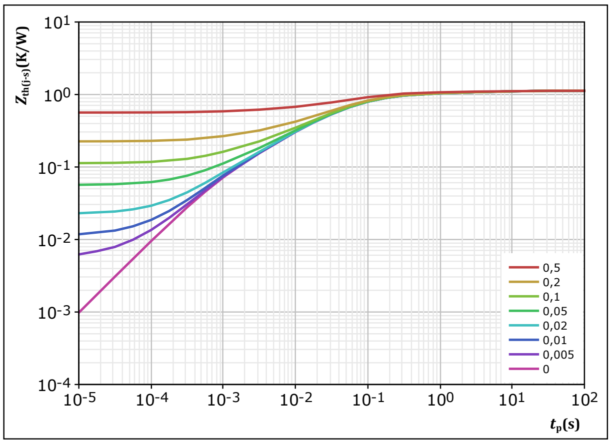
t_p =	250	μs
V_{CE} =	10	V

T_j: 25 °C / 125 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,126	K/W

IGBT thermal model values

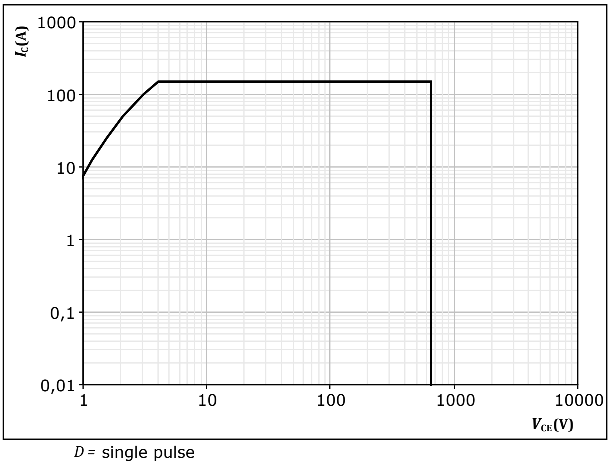
R (K/W)	τ (s)
7,12E-02	8,15E+00
1,29E-01	6,00E-01
4,31E-01	9,13E-02
3,15E-01	2,59E-02
1,31E-01	5,80E-03
5,02E-02	8,53E-04

H-Bridge Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



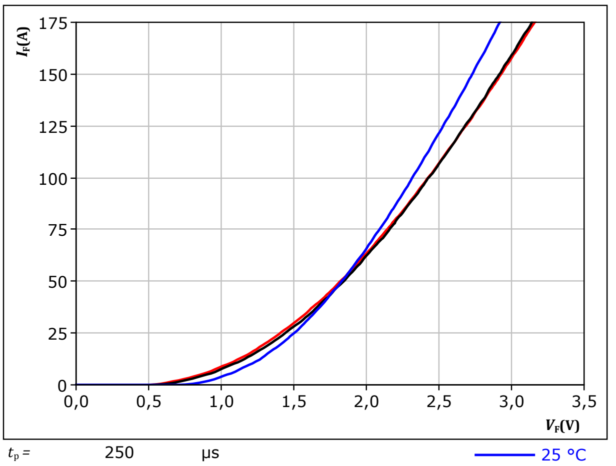
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

H-Bridge Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



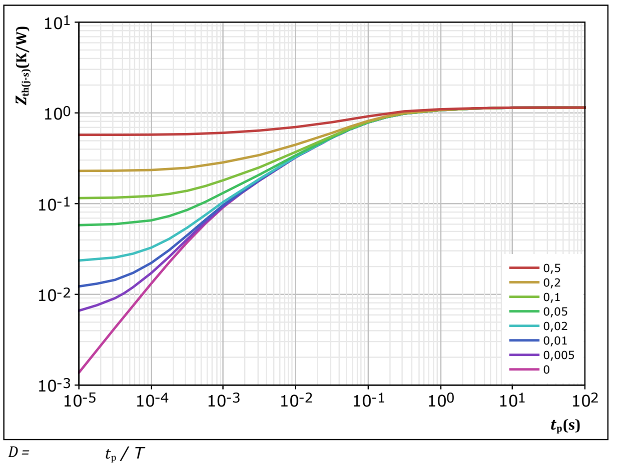
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,145 K/W

FWD thermal model values

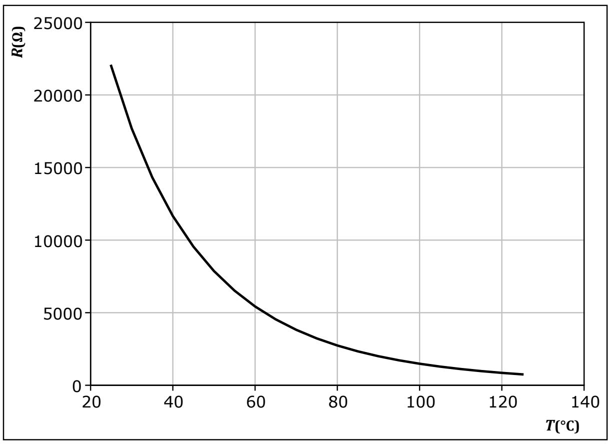
R (K/W)	τ (s)
7,96E-02	2,71E+00
1,58E-01	4,48E-01
4,60E-01	9,11E-02
2,26E-01	2,44E-02
1,52E-01	5,42E-03
6,96E-02	7,31E-04

Thermistor Characteristics

figure 8.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

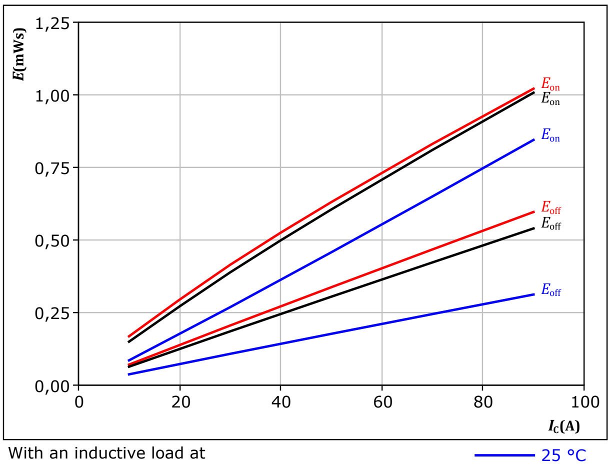


H-Bridge Switching Characteristics

figure 9. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



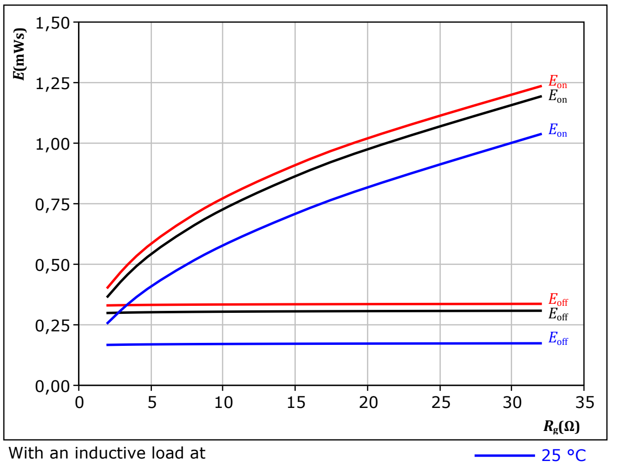
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		150 °C
R_{goff} =	8	Ω		

figure 10. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



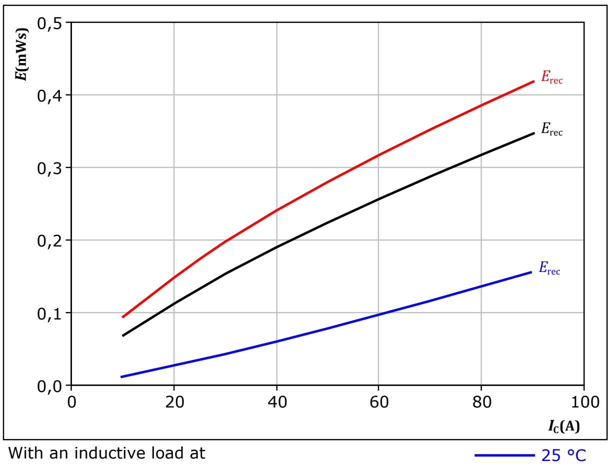
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

figure 11. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



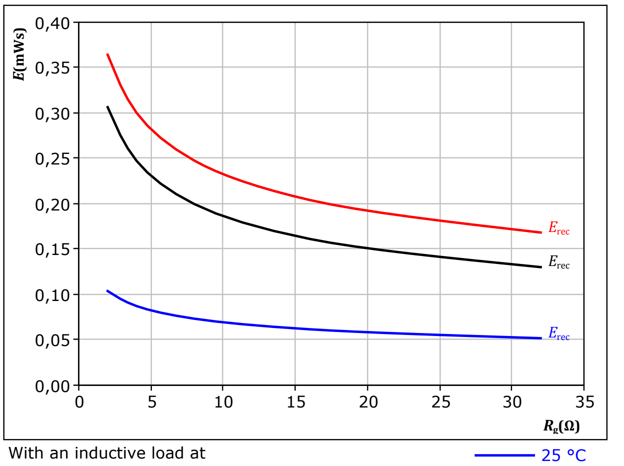
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		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

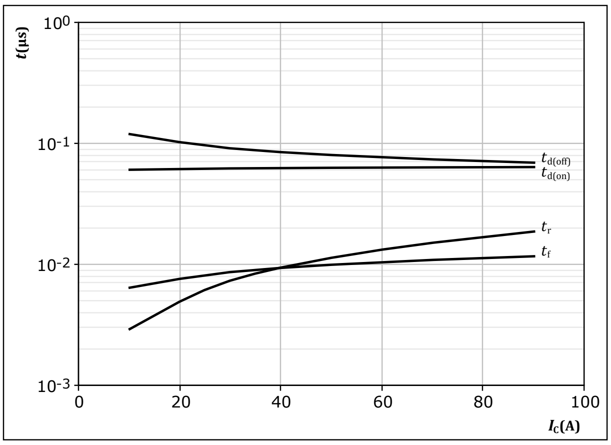
V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

H-Bridge Switching Characteristics

figure 13. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



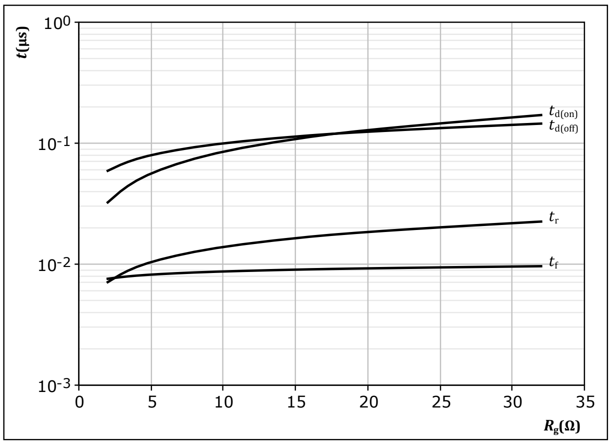
With an inductive load at

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 14. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



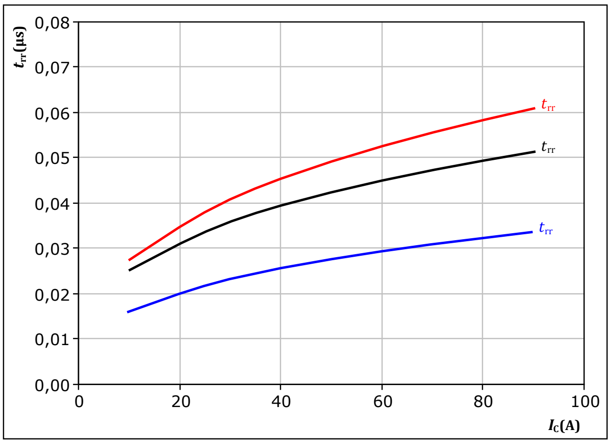
With an inductive load at

T_j =	150	°C
V_{CE} =	300	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

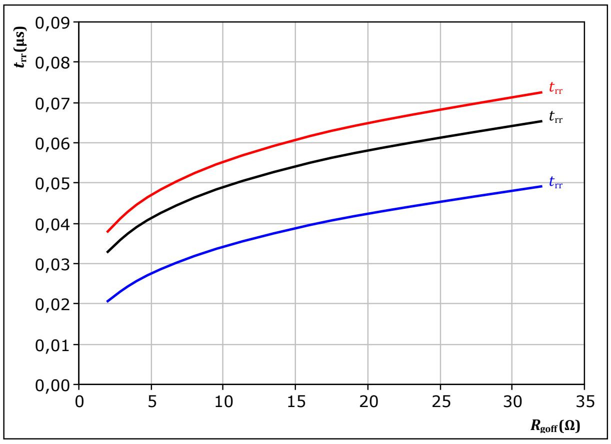
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °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 =	50	A

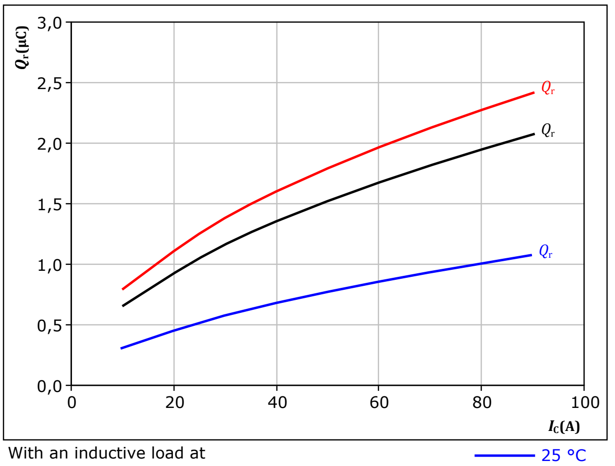
T_j: 25 °C, 125 °C, 150 °C

H-Bridge Switching Characteristics

figure 17. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



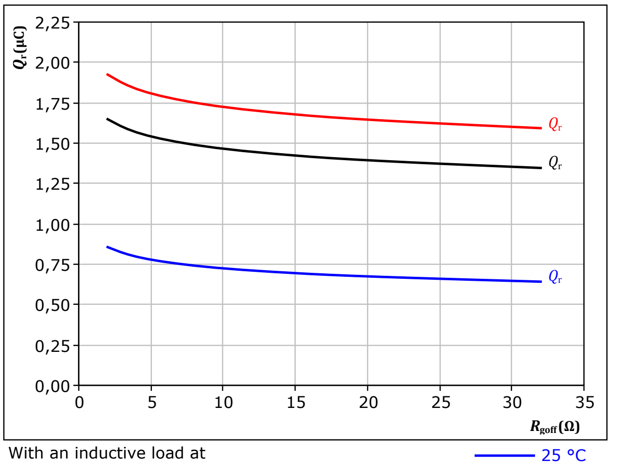
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 18. **FWD**

Typical recovered charge as a function of turn off gate resistor

$Q_r = f(R_{goff})$



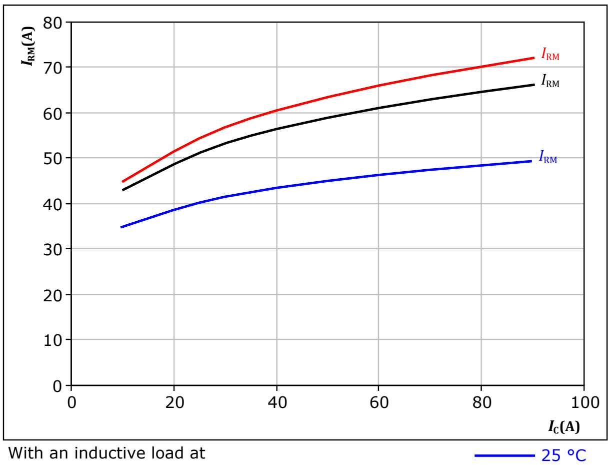
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

figure 19. **FWD**

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$



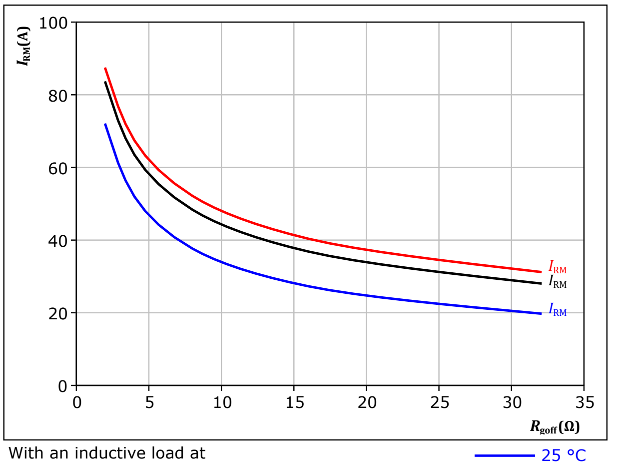
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		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

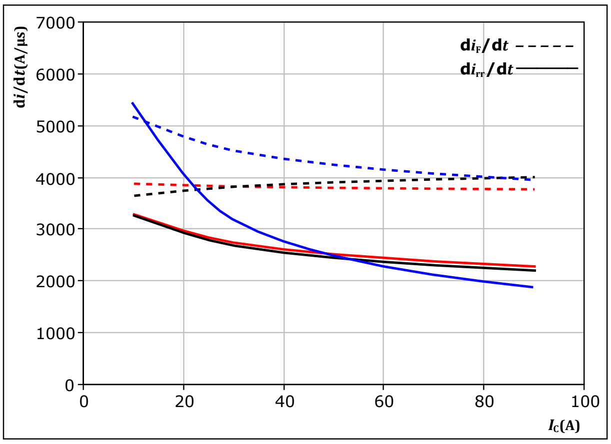
V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

H-Bridge 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)



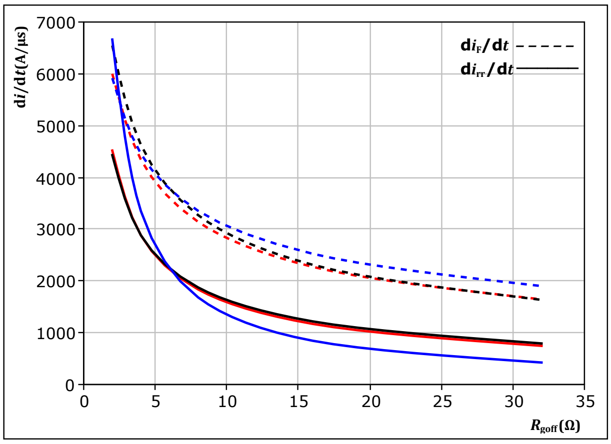
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		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_{rr}/dt = f(R_{goff})



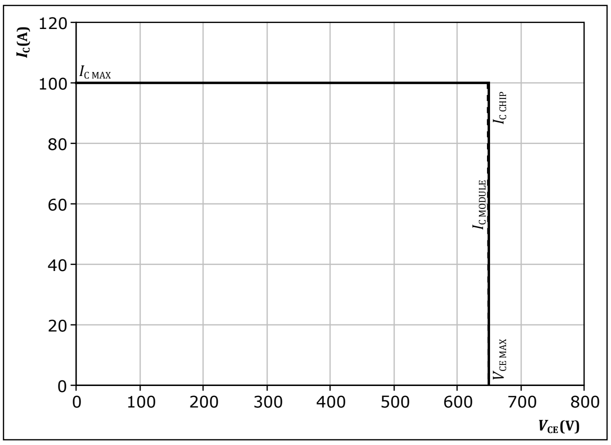
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

figure 23. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

H-Bridge Switching Definitions

figure 24. **IGBT**

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

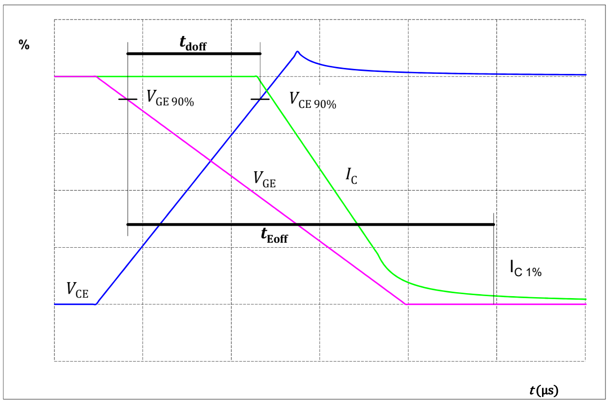


figure 25. **IGBT**

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

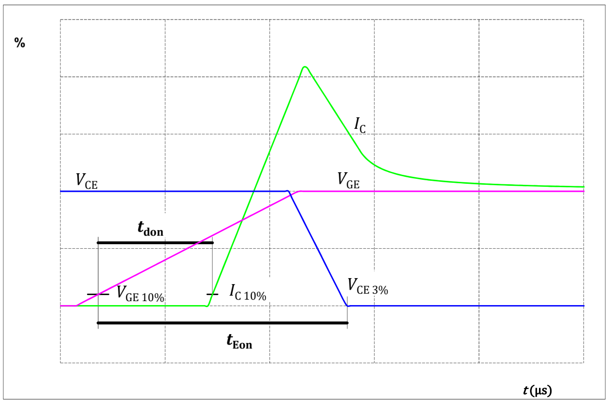


figure 26. **IGBT**

Turn-off Switching Waveforms & definition of t_f

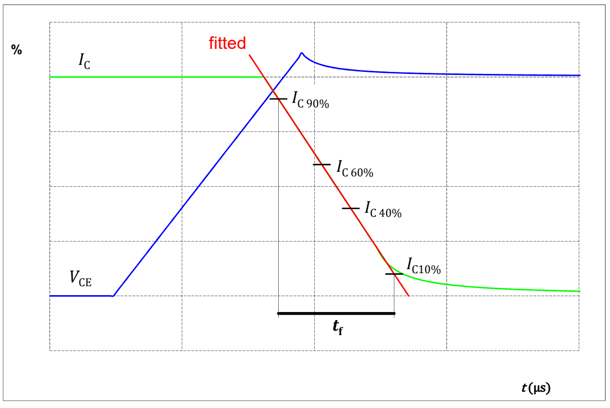
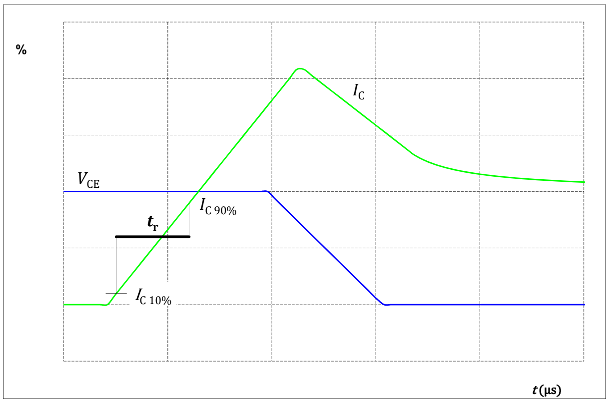


figure 27. **IGBT**

Turn-on Switching Waveforms & definition of t_r



H-Bridge Switching Definitions

figure 28. **FWD**

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

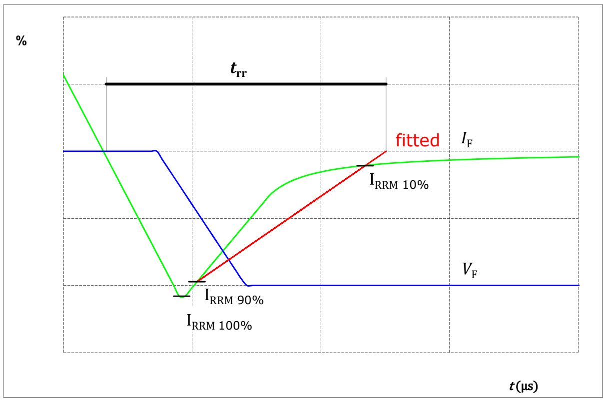
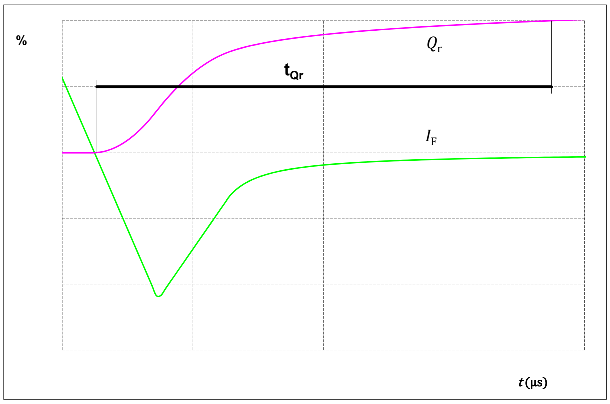


figure 29. **FWD**

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



Ordering Code

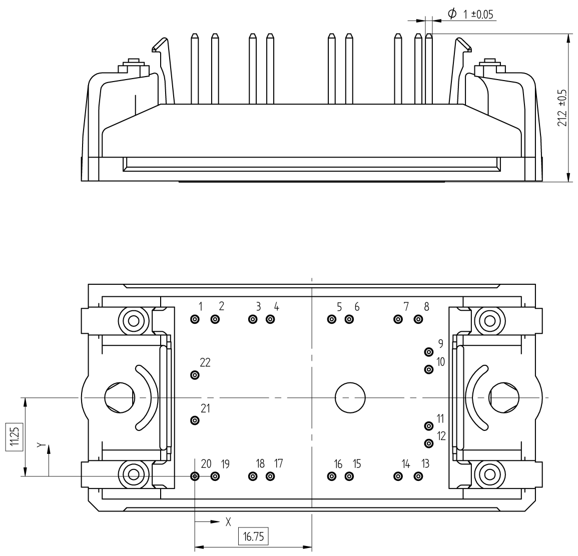
Version	Ordering Code
Without thermal paste	V23990-P623-F59-PM
With thermal paste	V23990-P623-F59-/3/-PM

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		

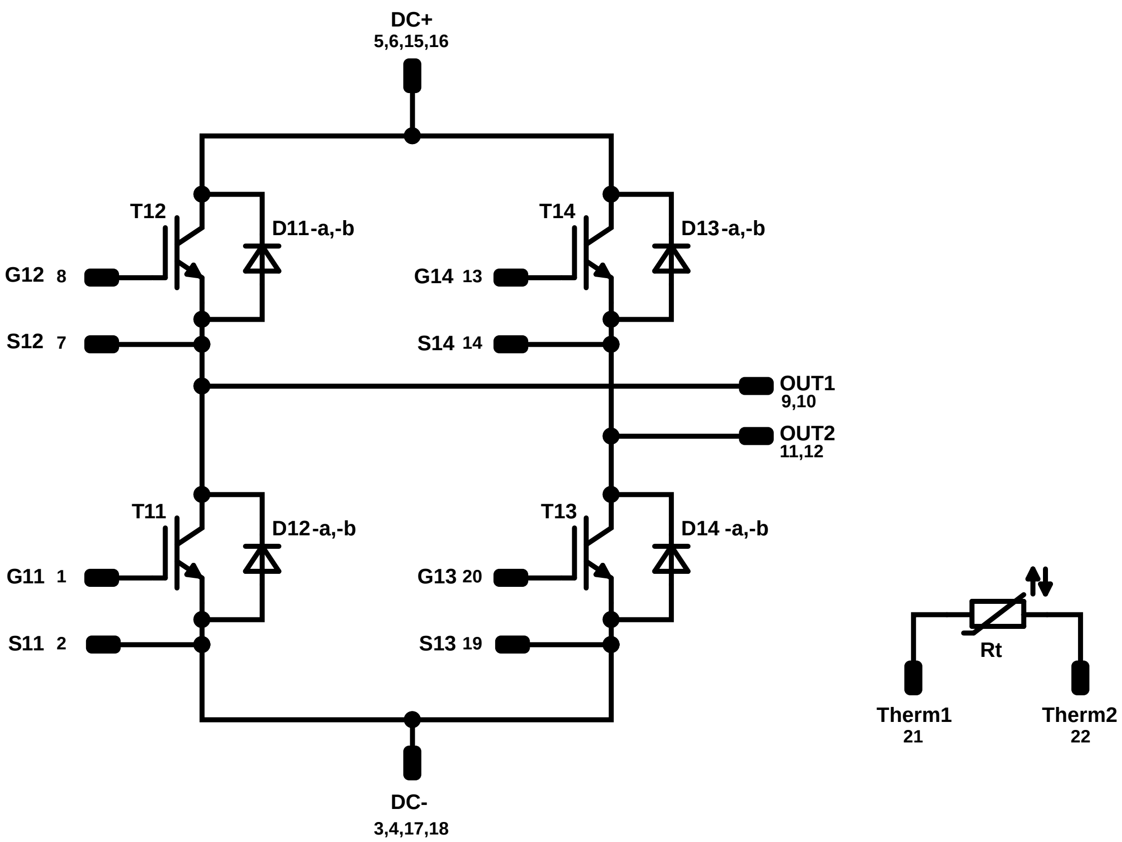
Outline

Pin table [mm]			
Pin	X	Y	Function
1	0	22,5	G11
2	2,9	22,5	S11
3	8,3	22,5	DC-
4	10,8	22,5	DC-
5	19,6	22,5	DC+
6	22,1	22,5	DC+
7	29,1	22,5	S12
8	32	22,5	G12
9	33,5	17,8	OUT1
10	33,5	15,3	OUT1
11	33,5	7,2	OUT2
12	33,5	4,7	OUT2
13	32	0	G14
14	29,1	0	S14
15	22,1	0	DC+
16	19,6	0	DC+
17	10,8	0	DC-
18	8,3	0	DC-
19	2,9	0	S13
20	0	0	G13
21	0	8	Therm1
22	0	14,5	Therm2



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
T11, T12, T13, T14	IGBT	650 V	50 A	H-Bridge Switch	
D11, D12, D13, D14	FWD	650 V	60 A	H-Bridge Diode	
Rt	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-P623-F59-PM-D2-14	19 Apr. 2021	New Datasheet format Update Thermistor	