



Vincotech

# V23990-P717-G-PM

datasheet

*flow90CON 1*

1600 V / 42 A

## Features

- 3~ phase input rectifier with BRC
- Compatible with *flow 90PACK 1*
- Support designs with 90° mounting angle between heatsink and PCB
- Clip-in PCB mounting

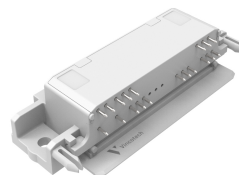
## Target applications

- Motor drives
- Servo drives

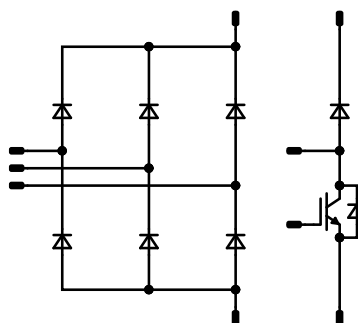
## Types

- V23990-P717-G-PM

## *flow90 1* housing



## Schematic





Vincotech

**V23990-P717-G-PM**  
datasheet

## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
-----------	--------	------------	-------	------

### Brake Switch

Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	31	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	75	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	65	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Maximum junction temperature	$T_{jmax}$		150	°C

### Brake Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	15	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	15	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	W
Maximum junction temperature	$T_{jmax}$		150	°C

### Brake Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	10	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	6	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	25	W
Maximum junction temperature	$T_{jmax}$		150	°C



Vincotech

## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
<b>Rectifier Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	62	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	520	A
Surge current capability	$I^2t$		1350	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	73	W
Maximum junction temperature	$T_{jmax}$		150	°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* $t_p = 2\text{ s}$	4000	V
Creepage distance			>12,7	mm
Clearance			11,84	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	

### Brake Switch

#### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,001	25	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		25	25 125	1,35	1,63 1,84	2,05 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			150	µA
Gate-emitter leakage current	$I_{GES}$		20	0		25			600	nA
Internal gate resistance	$r_g$							8		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		1808		pF
Output capacitance	$C_{oes}$							95		pF
Reverse transfer capacitance	$C_{res}$							82		pF

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,08		K/W
--	---------------	---	--	--	--	--	--	------	--	-----

#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 16 \Omega$	0/15	600	15	25 125		64,64 62,08		ns
Rise time	$t_r$					25 125		26,24 27,52		ns
Turn-off delay time	$t_{d(off)}$					25 125		461,44 579,52		ns
Fall time	$t_f$					25 125		60,79 122,42		ns
Turn-on energy (per pulse)	$E_{on}$					25 125		0,972 1,22		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125		1,03 1,74		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	

### Brake Diode

#### Static

Forward voltage	$V_F$				7,5	25 125	1,23	1,63 1,59	1,97 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25			27	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,12		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

#### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=548$ A/μs $di/dt=567$ A/μs	0/15	600	15	25 125		8,34 10,54		A
Reverse recovery time	$t_{rr}$					25 125		383,53 582,52		ns
Recovered charge	$Q_r$					25 125		1,09 2,02		μC
Reverse recovered energy	$E_{rec}$					25 125		0,457 0,902		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125		95,78 51,87		A/μs

### Brake Sw. Protection Diode

#### Static

Forward voltage	$V_F$				3	25 125	1,23	1,61 1,58	1,97 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25			27	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,8		K/W
--	---------------	---------------------------------------	--	--	--	--	--	-----	--	-----



## 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	

### Rectifier Diode

#### Static

Forward voltage	$V_F$				80	25 125 150		1,27 1,27	1,33 <sup>(1)</sup> 1,31 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1600$ V				25 150			20 1500	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,96		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

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

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



Vincotech

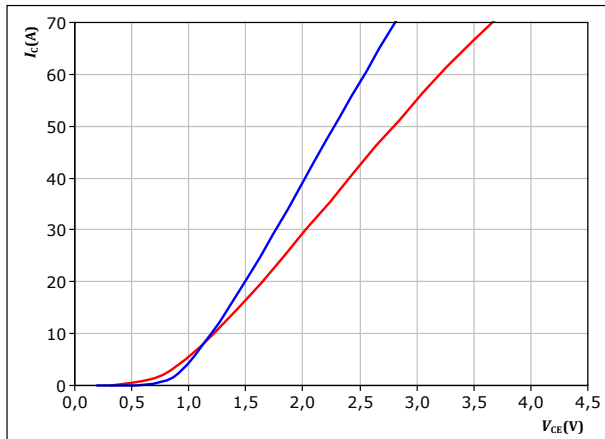
V23990-P717-G-PM  
datasheet

## Brake Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

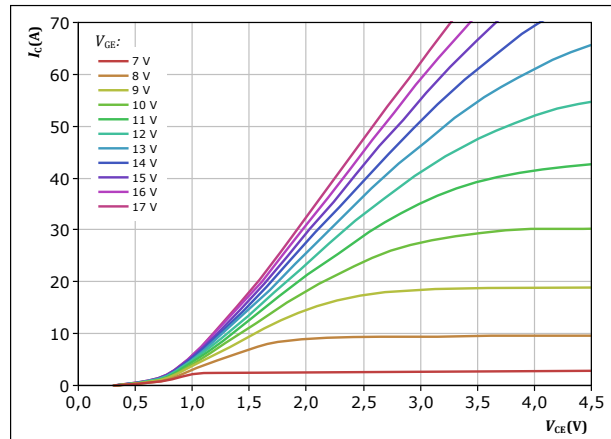


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j: 25 ^\circ C$   
 $125 ^\circ C$

figure 2. IGBT

Typical output characteristics

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

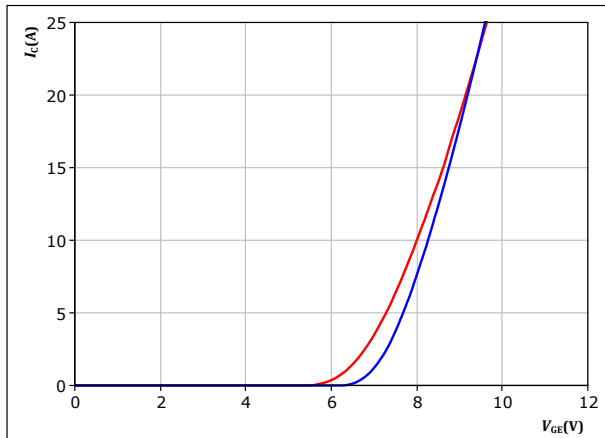


$t_p = 250 \mu s$   
 $T_j = 125 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

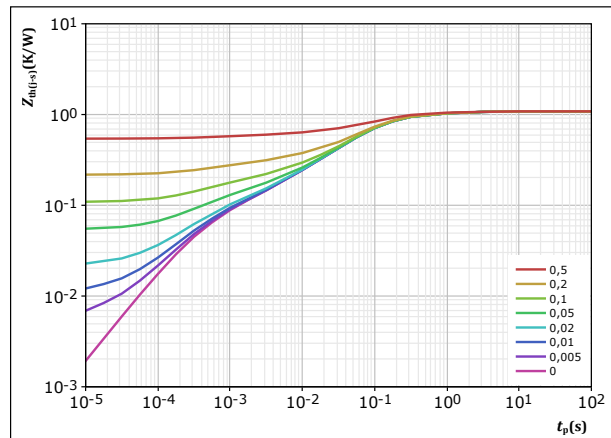


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j: 25 ^\circ C$   
 $125 ^\circ C$

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,084 K/W$   
IGBT thermal model values  

$R (K/W)$	$\tau (s)$
8,51E-02	1,82E+00
2,15E-01	2,53E-01
5,88E-01	7,31E-02
1,01E-01	9,54E-03
4,27E-02	1,52E-03
5,22E-02	3,55E-04



Vincotech

**V23990-P717-G-PM**  
datasheet

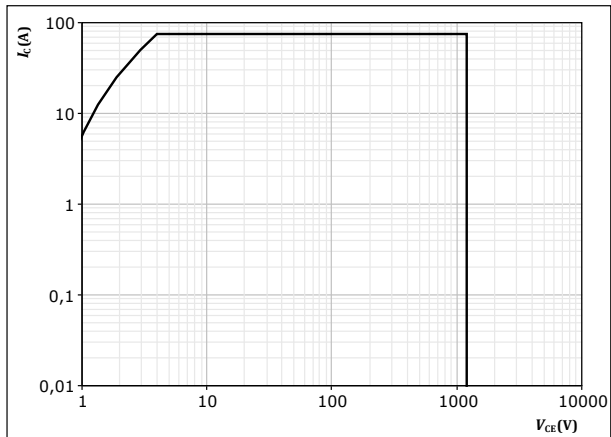
## Brake Switch Characteristics

figure 5.

IGBT

Safe operating area

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



$D = \text{single pulse}$

$T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$   
 $T_j = T_{jmax}$





Vincotech

**V23990-P717-G-PM**  
datasheet

## Brake Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

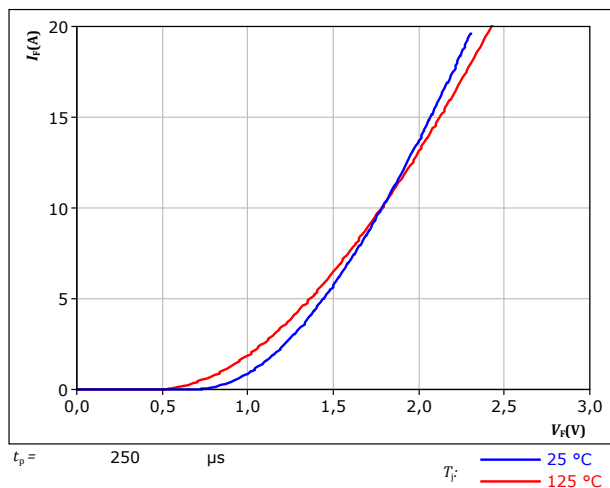
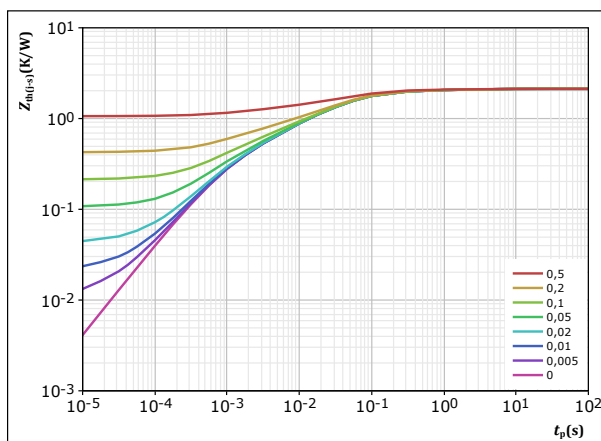


figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	2,124	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
7,00E-02	3,23E+00	
1,48E-01	4,03E-01	
7,34E-01	6,67E-02	
5,90E-01	2,04E-02	
3,47E-01	4,32E-03	
2,36E-01	8,05E-04	



Vincotech

V23990-P717-G-PM  
datasheet

## Brake Sw. Protection Diode Characteristics

figure 8.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

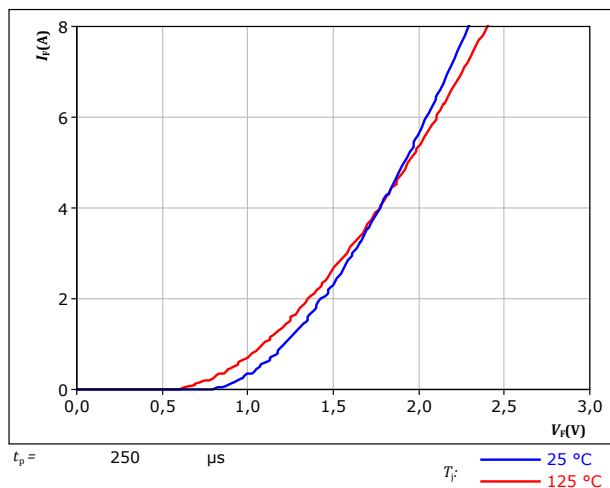
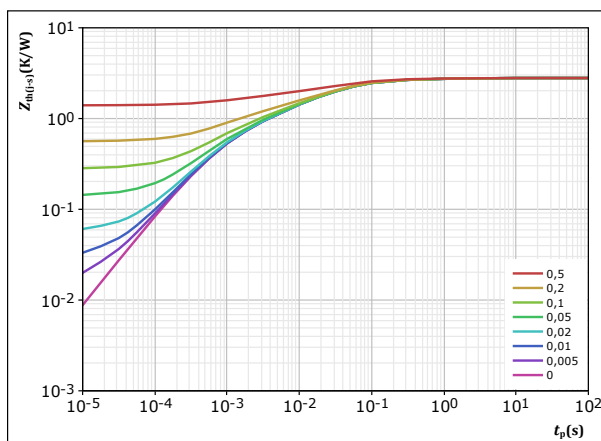


figure 9.

FWD

Transient thermal impedance as a function of pulse width

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





Vincotech

V23990-P717-G-PM  
datasheet

## Rectifier Diode Characteristics

figure 10.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

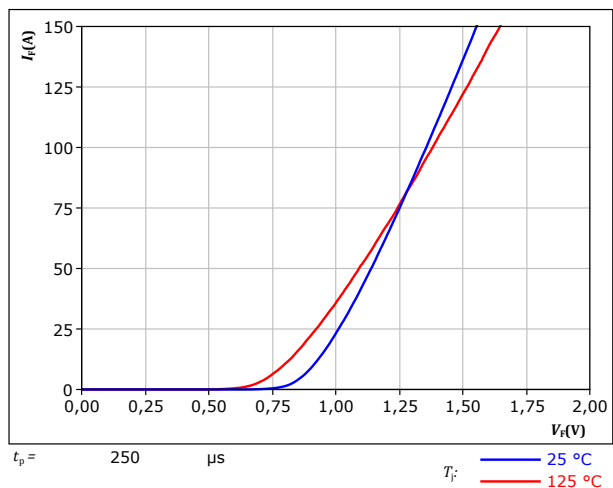
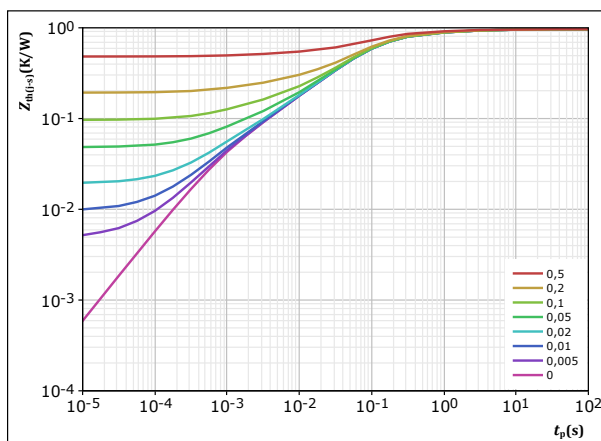


figure 11.

Rectifier

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	0,965	K/W
Rectifier thermal model values		
$R$ (K/W)	$\tau$ (s)	
3,98E-02	7,88E+00	
1,29E-01	8,64E-01	
4,20E-01	1,32E-01	
2,76E-01	4,24E-02	
6,63E-02	5,80E-03	
3,37E-02	8,90E-04	



Vincotech

V23990-P717-G-PM  
datasheet

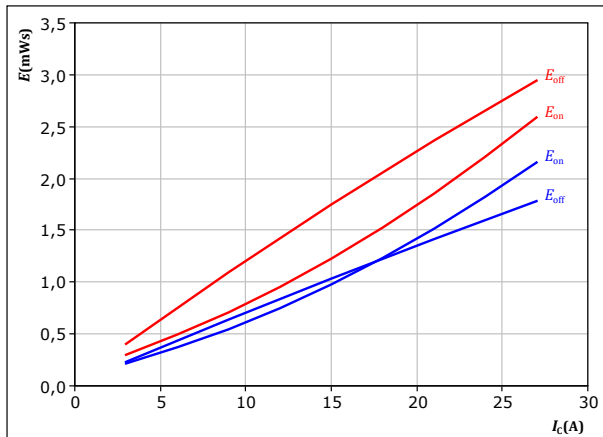
## Brake Switching Characteristics

figure 12.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

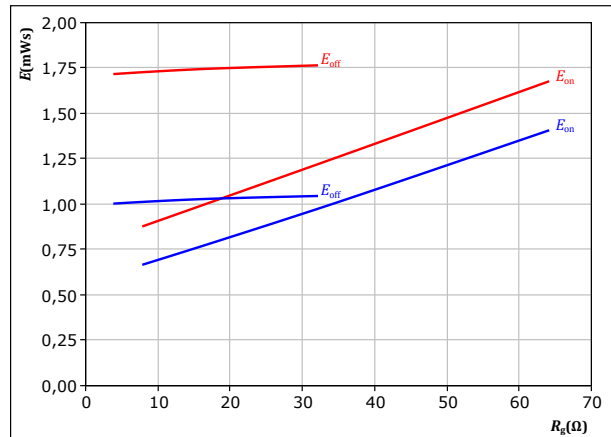
$T_j$ : — 25 °C  
— 125 °C

figure 13.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_C = 15$  A

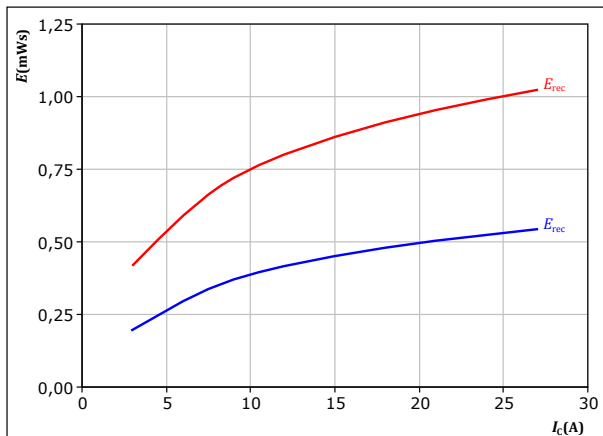
$T_j$ : — 25 °C  
— 125 °C

figure 14.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$   $\Omega$

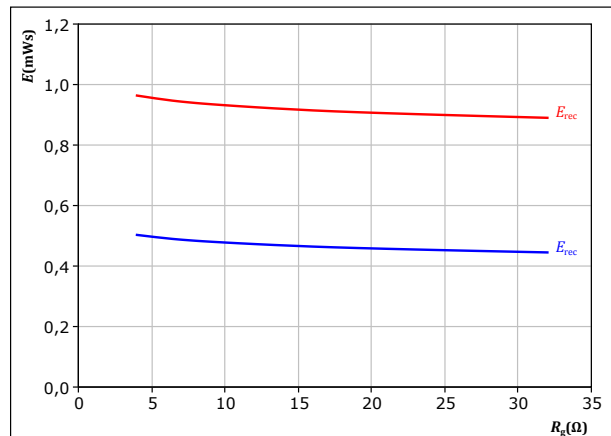
$T_j$ : — 25 °C  
— 125 °C

figure 15.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_C = 15$  A

$T_j$ : — 25 °C  
— 125 °C



Vincotech

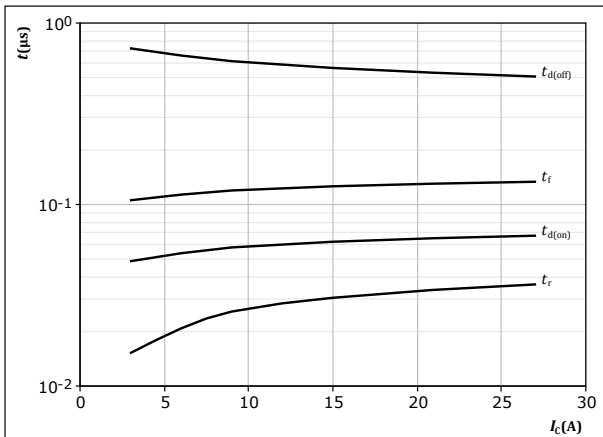
V23990-P717-G-PM  
datasheet

## Brake Switching Characteristics

figure 16.

IGBT

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



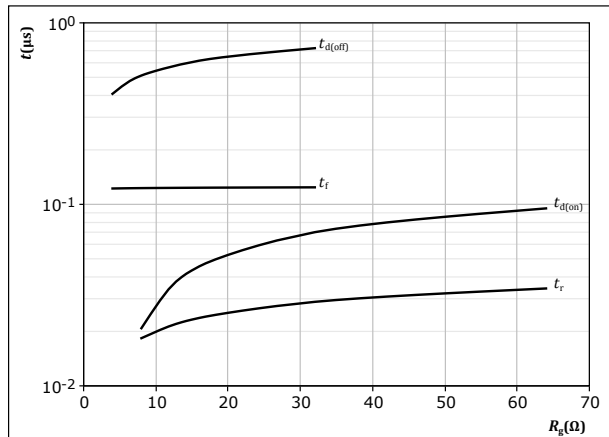
With an inductive load at

$T_j = 125$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

figure 17.

IGBT

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



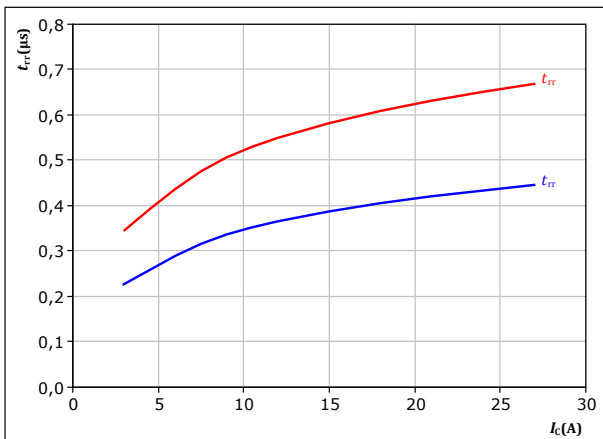
With an inductive load at

$T_j = 125$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = 0/15$  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

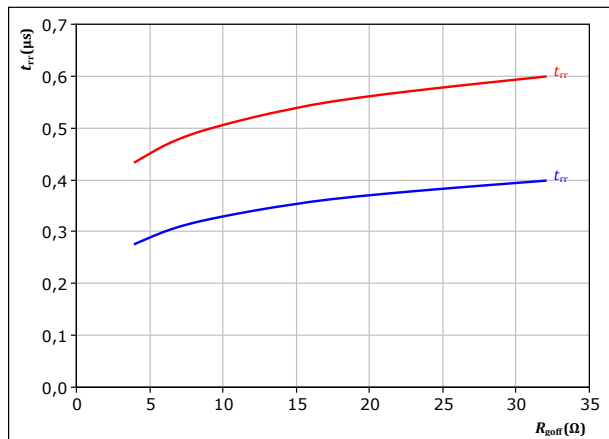
$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$   $\Omega$

$T_j$ : — 25 °C  
— 125 °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

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_c = 15$  A

$T_j$ : — 25 °C  
— 125 °C



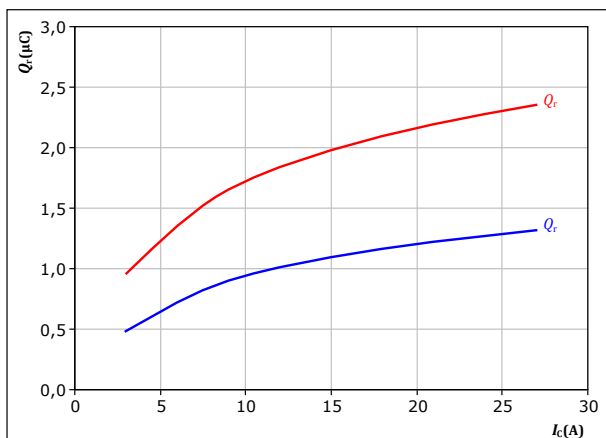
## Brake Switching Characteristics

figure 20.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_C)$$



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$  Ω

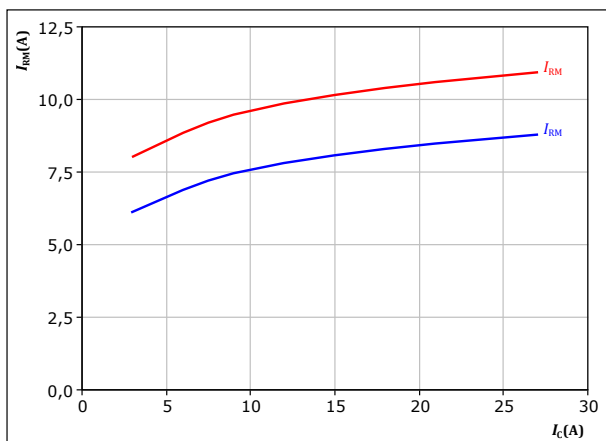
$T_j$ : — 25 °C  
— 125 °C

figure 22.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{gon} = 32$  Ω

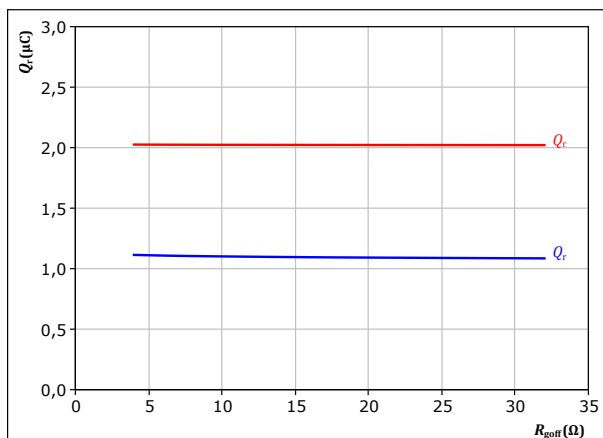
$T_j$ : — 25 °C  
— 125 °C

figure 21.

FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_C = 15$  A

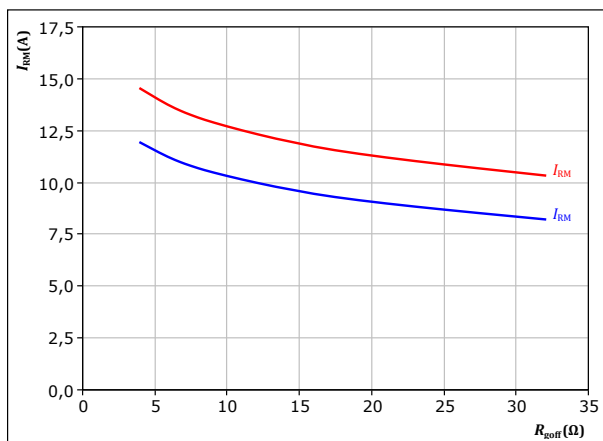
$T_j$ : — 25 °C  
— 125 °C

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

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_C = 15$  A

$T_j$ : — 25 °C  
— 125 °C



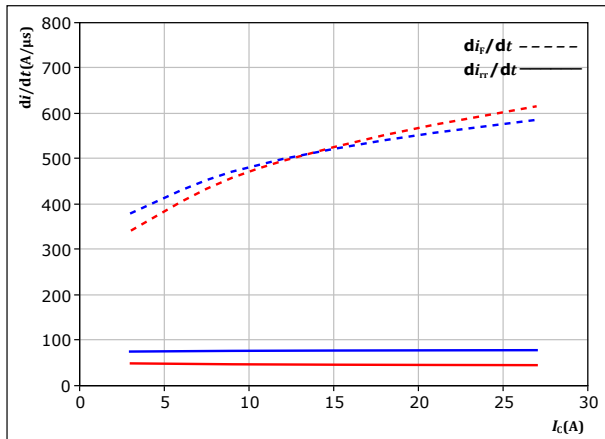
Vincotech

**V23990-P717-G-PM**  
datasheet

## Brake Switching Characteristics

**figure 24.** FWD

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



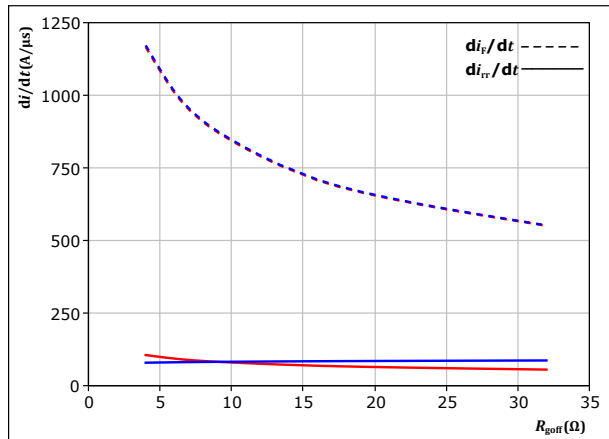
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $R_{goff} = 32$  Ω

$T_j$ : — 25 °C  
— 125 °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

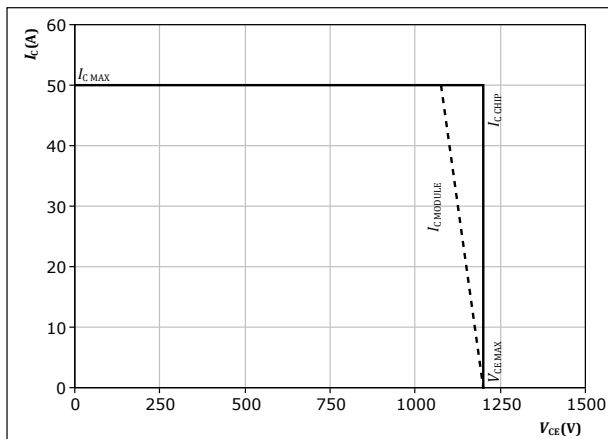
$V_{CE} = 600$  V  
 $V_{GE} = 0/15$  V  
 $I_C = 15$  A

$T_j$ : — 25 °C  
— 125 °C

**figure 26.** IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At  $T_j = 125$  °C  
 $R_{goff} = 32$  Ω  
 $R_{goff} = 16$  Ω



## Brake Switching Definitions

figure 27. IGBT

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

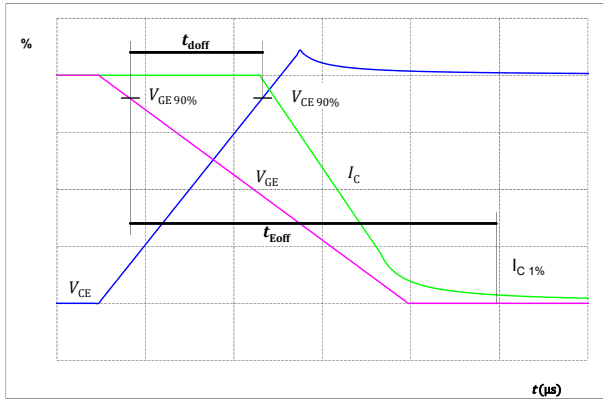


figure 28. IGBT

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

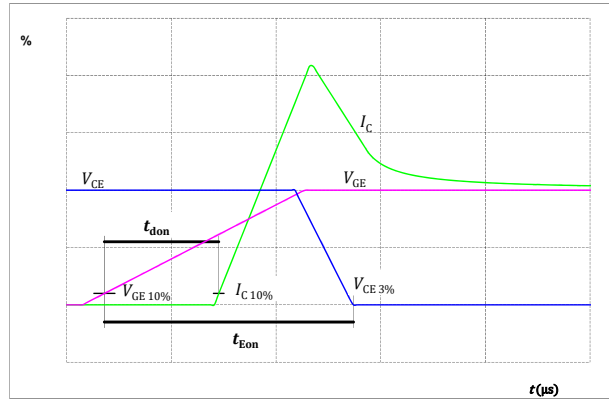


figure 29. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

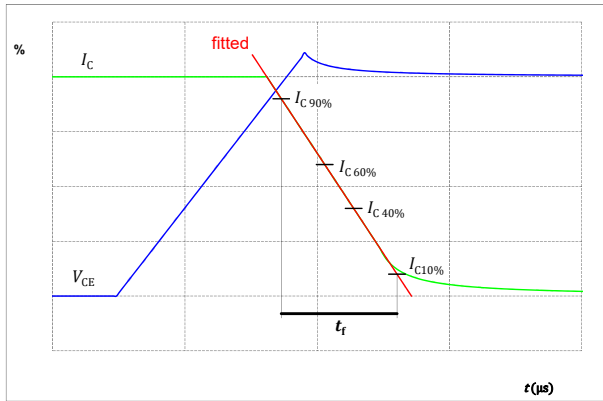
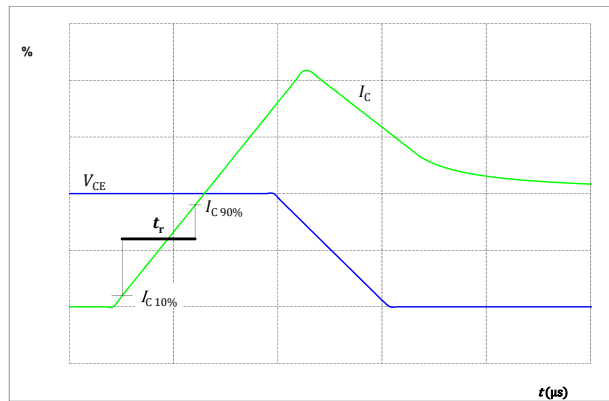


figure 30. IGBT

Turn-on Switching Waveforms & definition of  $t_r$







Vincotech

**V23990-P717-G-PM**  
datasheet

## Brake Switching Definitions

figure 31.

FWD

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

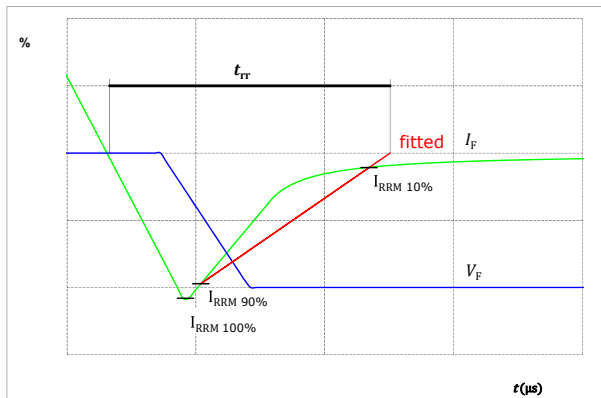
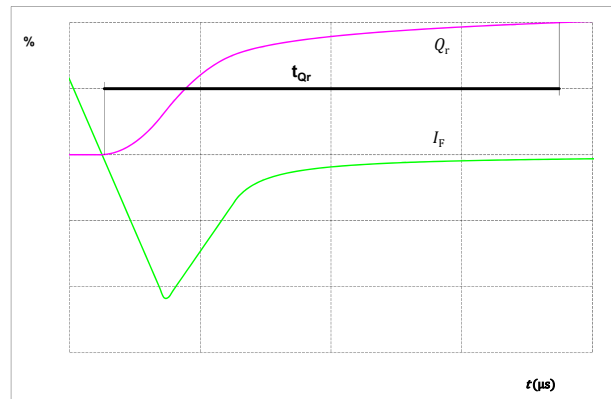


figure 32.

FWD

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





Vincotech

# V23990-P717-G-PM

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P717-G-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P717-G-/3/-PM

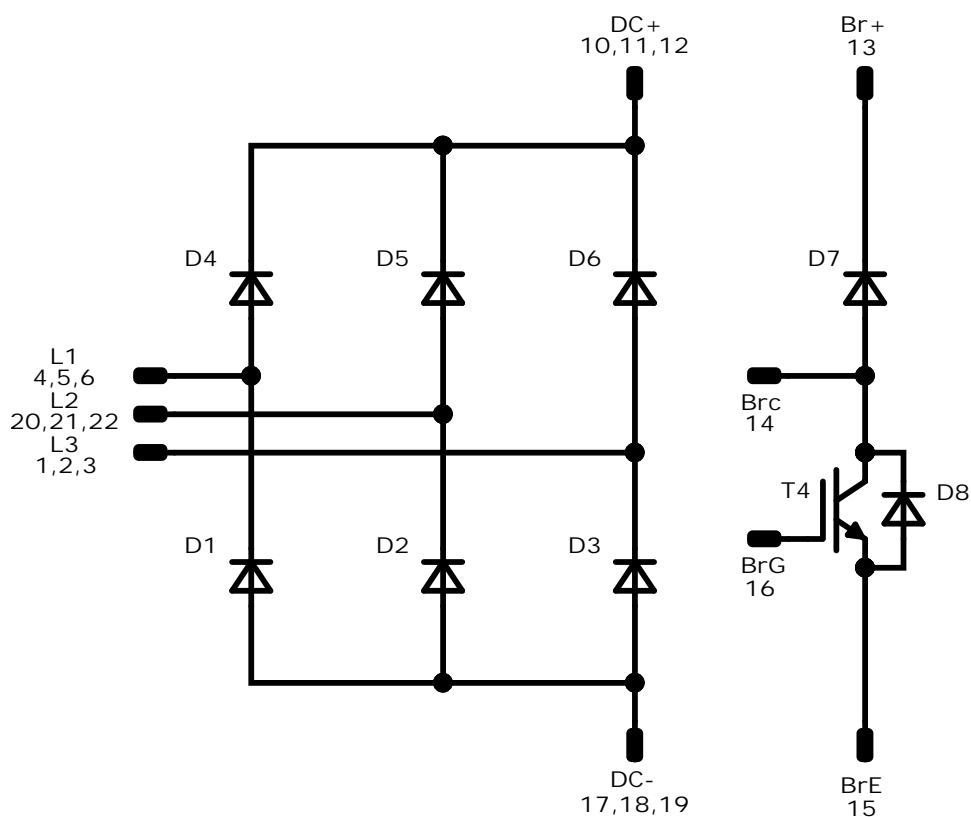
Marking						
	Text	VIN	Date code	Type&Ver	UL	Lot
		VIN	WWYY	TTTTITTV	UL	LLLL
	Datamatrix	Type&Ver	Lot number	Serial	Date code	
		TTTTITTV	LLLL	SSSS	WWYY	

Outline				
Pin table [mm]				
Pin	X	Y	Function	
1	53	0	L3	
2	50,1	0	L3	
3	47,2	0	L3	
4	40,2	0	L1	
5	37,3	0	L1	
6	34,4	0	L1	
7	27,4	0	NA	
8	24,5	0	NA	
9	21,6	0	NA	
10	18,7	0	DC+	
11	15,8	0	DC+	
12	12,9	0	DC+	
13	7,1	0	Br+	
14	0	0	BrC	
15	0	7	BrE	
16	3	7	BrG	
17	7	7	DC-	
18	9,9	7	DC-	
19	12,8	7	DC-	
20	44	7	L2	
21	47	7	L2	
22	50	7	L2	

Tolerance of pin positions: ±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	IGBT	1200 V	25 A	Brake Switch	
D7	FWD	1200 V	7,5 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Sw. Protection Diode	
D1, D4, D2, D5, D3, D6	Rectifier	1600 V	42 A	Rectifier Diode	



Packaging instruction				
Standard packaging quantity (SPQ) 80	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow90</i> 1 packages see vincotech.com website.

Package data
Package data for <i>flow90</i> 1 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-P717-G-PM-D1-14	15 Jun. 2021		

#### DISCLAIMER

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

#### LIFE SUPPORT POLICY

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

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.