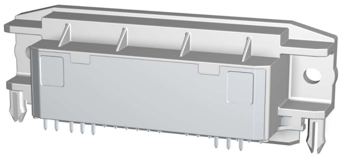
***flow* 90CON 1**	**1600 V / 35 A**

Features

- 3~ phase input rectifier with or without BRC
  *optional half controlled
- Compatible with flow 90PACK 1
- Support designs with 90° mounting angle between heatsink and PCB
- Clip-in PCB mounting

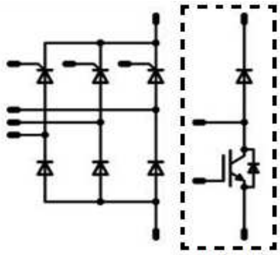
flow 90 housing



Target Applications

- Motor drives
- Servo drives

Schematic



Types

- V23990-P717-G-PM
- V23990-P717-G10-PM
- V23990-P717-H-PM
- V23990-P717-H10-PM

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward current	I_{FAV}	DC current	T_s=80°C T_c=80°C	39 53	A
Surge (non-repetitive) forward current	I_{FSM}	t_p=10ms	T_j=45°C	600	A
I2t-value	I^2t			1800	A^2s
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	44 67	W
Maximum Junction Temperature	T_{jmax}			150	°C
Input Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Mean forward current	I_{FAV}	sine,d=0.5 $T_j=T_{jmax}$	T_s=80°C T_c=80°C	36 48	A
Surge (non-repetitive) forward current	I_{FSM}	t_p=10ms	T_j=45°C	360	A
I2t-value	I^2t			650	A^2s
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	56 84	W
Maximum Junction Temperature	T_{jmax}			150	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Brake Switch					
Collector-emitter Break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	18 23	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		75	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	47 66	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 1200	μs V
Maximum Junction Temperature	T_{jmax}			150	°C
Brake Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	8 8	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		6	A
Brake Inverse Diode	P_{tot}	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	20 30	W
Maximum Junction Temperature	T_{jmax}			150	°C
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	13 17	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		15	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C T_c=80°C	26 40	W
Maximum Junction Temperature	T_{jmax}			150	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				11,84	mm

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Input Rectifier Diode										
Forward voltage	V_F				42	25 125	0,8	1,21 1,18	1,5	V
Threshold voltage (for power loss calc. only)	V_{to}				42	25 125		0,92 0,82		V
Slope resistance (for power loss calc. only)	r_t				42	25 125		0,01 0,01		Ω
Reverse current	I_r			1600		25 125			0,02	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,58		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,04		
Input Rectifier Thyristor										
Forward voltage	V_F				35	25 125	1	1,41 1,48	1,8	V
Threshold voltage (for power loss calc. only)	V_{to}		V_D=6 V		35	25 125		0,97 0,85		V
Slope resistance (for power loss calc. only)	r_t				35	25 125		12,49 17,85		mΩ
Reverse current	I_r			1200		25 150			0,05 8	mA
Gate controlled delay time	t_{GD}	I_G=0,5A V_D=1/2 V_{DRM}				25 125			2	µs
Gate controlled rise time	t_{GR}					25 125		tbd.		µs
Critical rate of rise of off-state voltage	$(dv/dt)_{cr}$	V_D=2/3 V_{DRM} linear voltage rise				150			1000	V/µs
Critical rate of rise of on-state current	$(di/dt)_{cr}$	V_D=2/3 V_{DRM} I_G=0,3A; f=50Hz	t_p=200 µs		40	150			500	A/µs
Circuit commutated turn-off time	t_q	V_D=2/3 V_{DRM}	t_p=200 µs	100	27	25 125		200		µs
Holding current	I_H		V_D=6 V			25 125			100	mA
Latching current	I_L	I_G=0,3A t_p=10 µs				25 125			150	mA
Gate trigger voltage	V_{GT}		V_D=6			25 125			1,5	V
Gate trigger current	I_{GT}		V_D=6			25 125			55	mA
Gate non-trigger voltage	V_{GD}	V_D=2/3 V_{DRM}				25 125			0,2	V
Gate non-trigger current	I_{GD}	V_D=2/3 V_{DRM}				25 125			3	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,26		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,83		
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	V_{CE}=V_{GE}			0,001	25 125	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		25	25 125	1,3	2,17 2,65	2,2	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		25 125			0,25	mA
Gate-emitter leakage current	I_{GES}		20	0		25 125			650	nA
Integrated Gate resistor	R_{gint}							8		Ω
Turn-on delay time	$t_{d(on)}$	R_{gon}=32 Ω R_{goff}=16 Ω	±15	600	25	25 125		20,8 25,2		ns
Rise time	t_r					25 125		16,7 18		
Turn-off delay time	$t_{d(off)}$					25 125		193 335		
Fall time	t_f					25 125		112 170		
Turn-on energy loss	E_{on}					25 125		1,80 1,16		mWs
Turn-off energy loss	E_{off}					25 125		1,77 1,52		
Input capacitance	C_{ies}	f=1MHz	0	25		25		1808		pF
Output capacitance	C_{oss}							95		
Reverse transfer capacitance	C_{rss}							82		
Gate charge	Q_G		15	960	25	25		155		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,6		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,06		

Characteristic Values

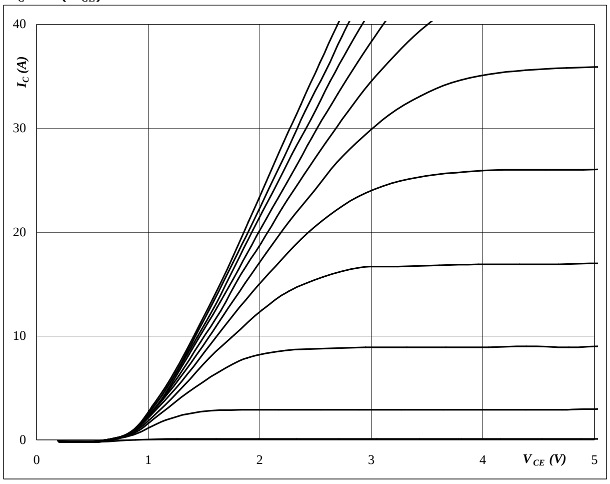
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max	
Brake Inverse Diode										
Diode forward voltage	V_F				3	25 125	1	1,6 1,57	2,2	V
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						3,49		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							2,30		K/W
Brake Diode										
Diode forward voltage	V_F				7,5	25 125	1	1,62 1,67	2,2	V
Reverse leakage current	I_r		±15	300	7,5	25 125			250	µA
Peak reverse recovery current	I_{RRM}	R_{gon}=32 Ω R_{gon}=32 Ω	±15	600	7,5	25 125		17 17		A
Reverse recovery time	t_{rr}					25 125		332 505		ns
Reverse recovered charge	Q_{rr}					25 125		1,79 2,78		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		495 210		A/µs
Reverse recovery energy	E_{rec}					25 125		1,79 2,78		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						2,65		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,75		K/W

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

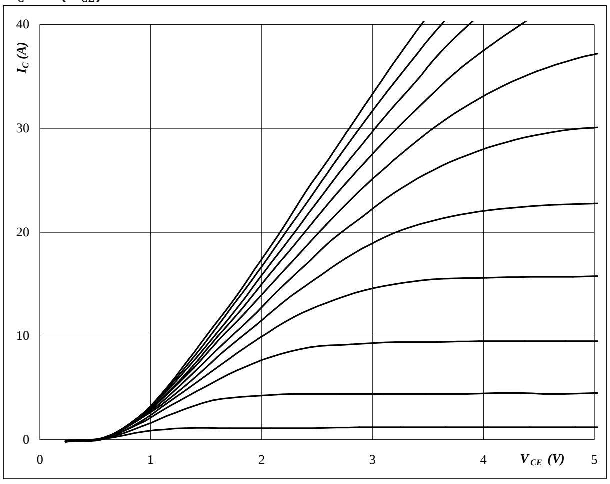
T_j = 25 °C

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

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

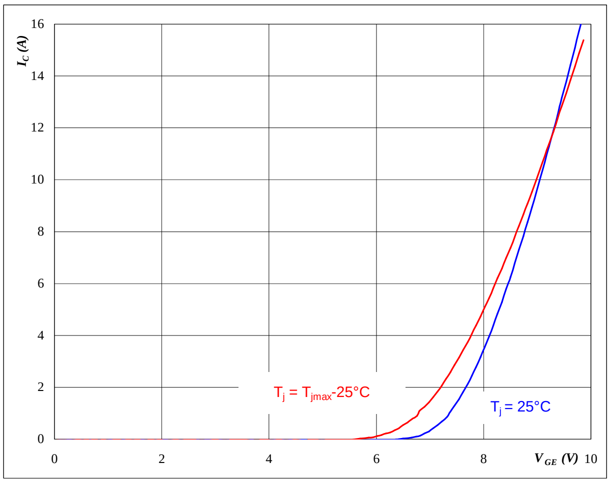
T_j = 125 °C

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

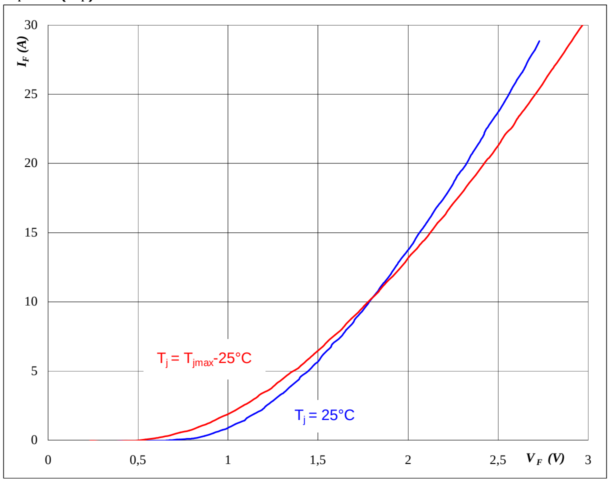
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

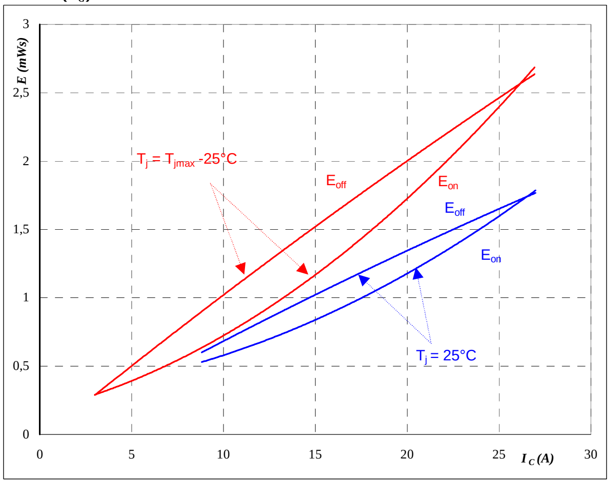
t_p = 250 µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



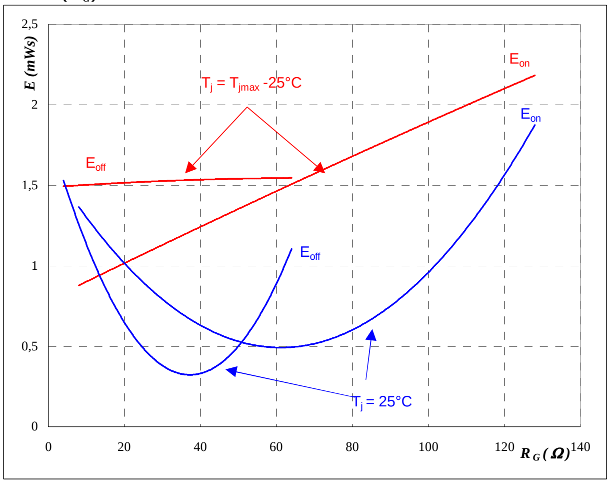
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



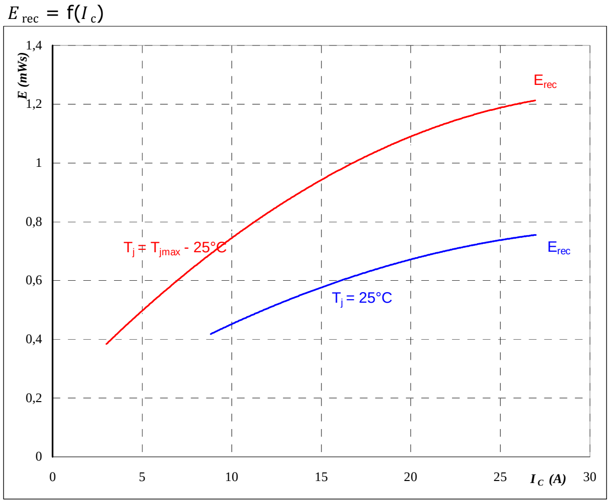
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
I_C =	15	A

Figure 7 Brake IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



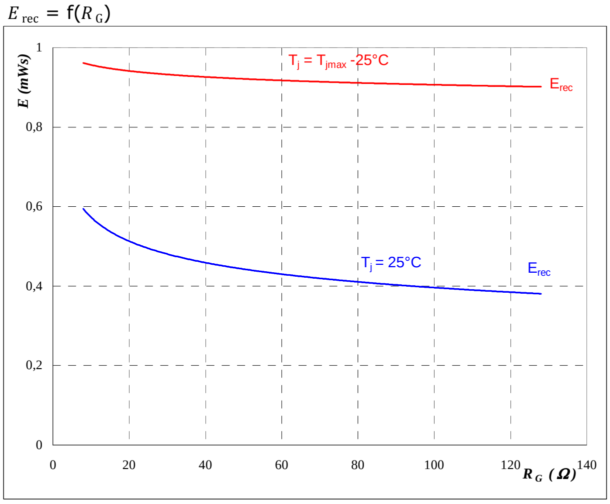
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	32	Ω

Figure 8 Brake IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

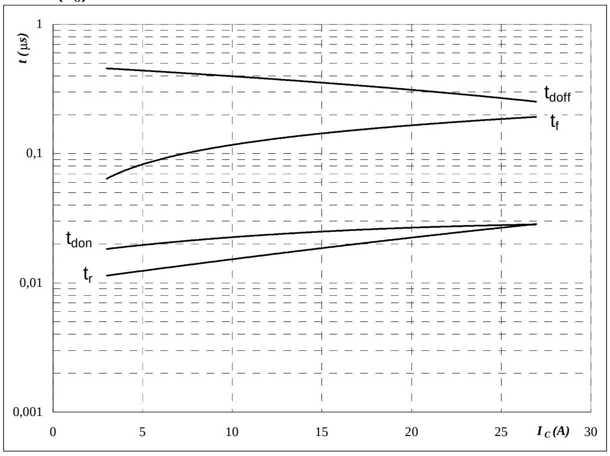
T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
I_C =	15	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



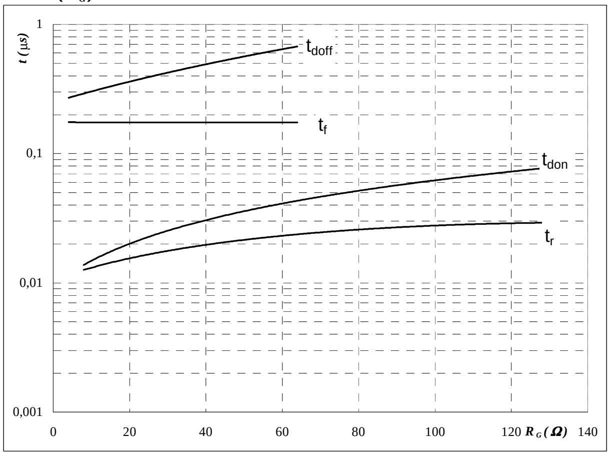
With an inductive load at

T_j = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
R_{gon} = 32 Ω
R_{goff} = 16 Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



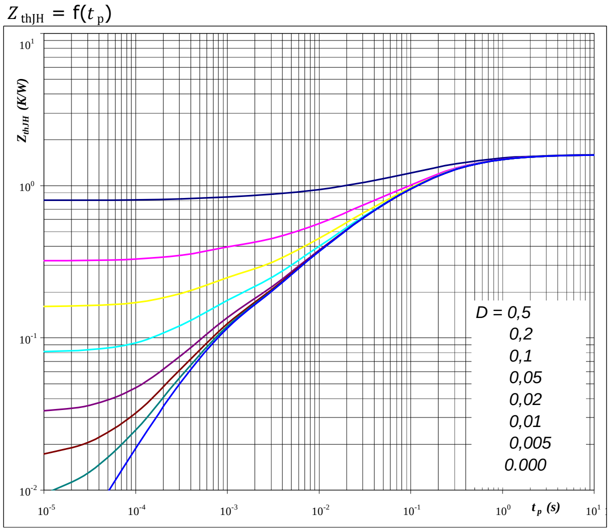
With an inductive load at

T_j = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
I_C = 15 A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



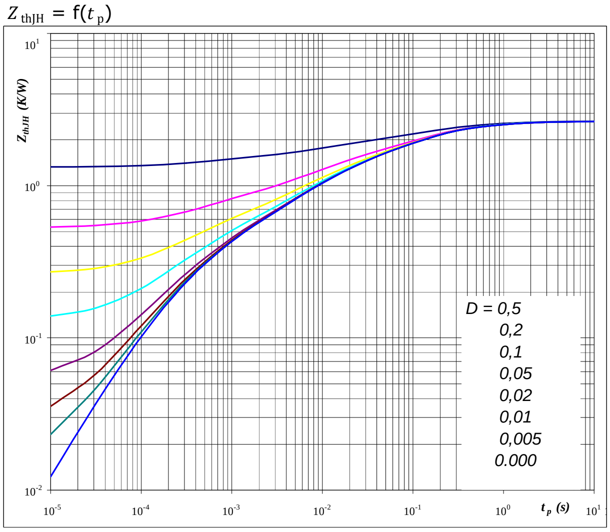
At

D = t_p / T
R_{thJH} = 1,60 K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

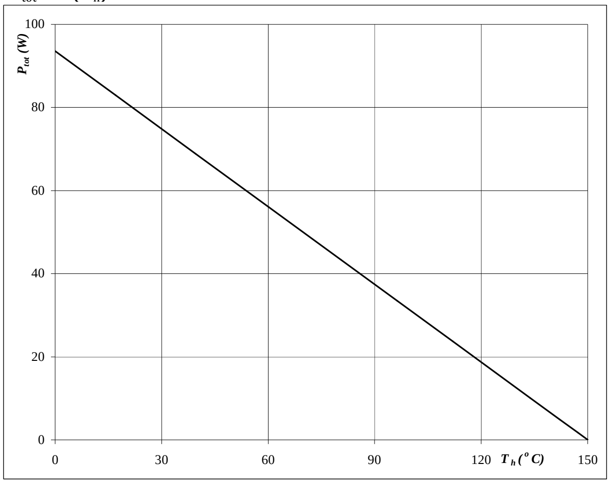
D = t_p / T
R_{thJH} = 2,65 K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



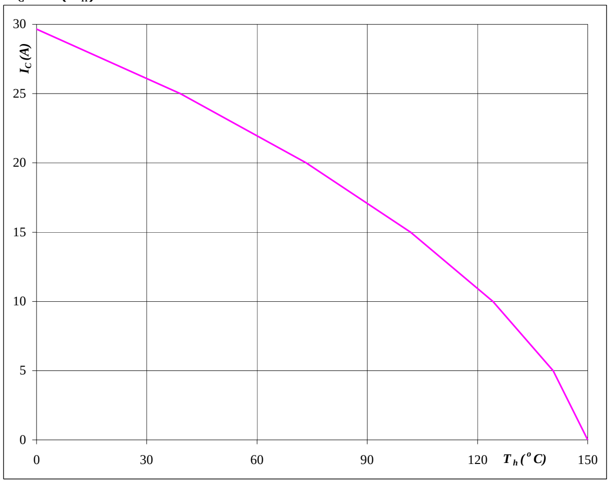
At

T_j = 150 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

T_j = 150 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

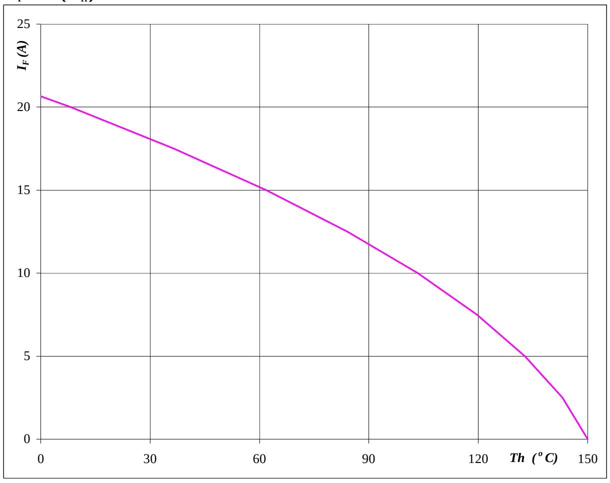
At

T_j = 150 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

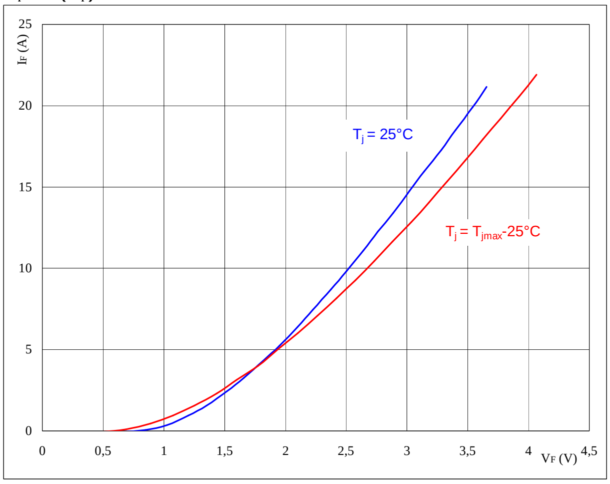
T_j = 150 ºC

Brake Inverse Diode

Figure 1 Brake inverse diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



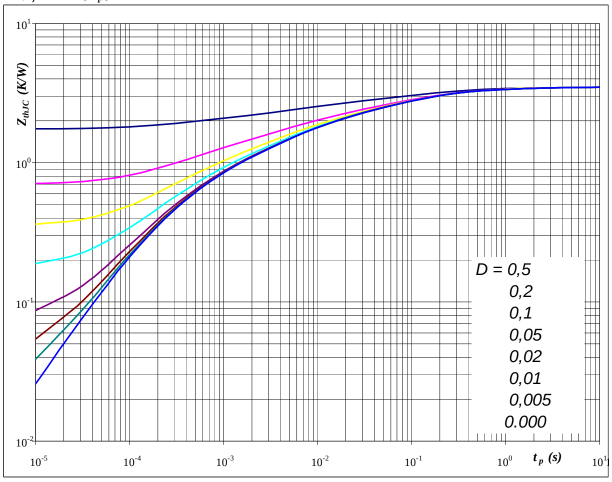
At

t_p = 250 µs

Figure 2 Brake inverse diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

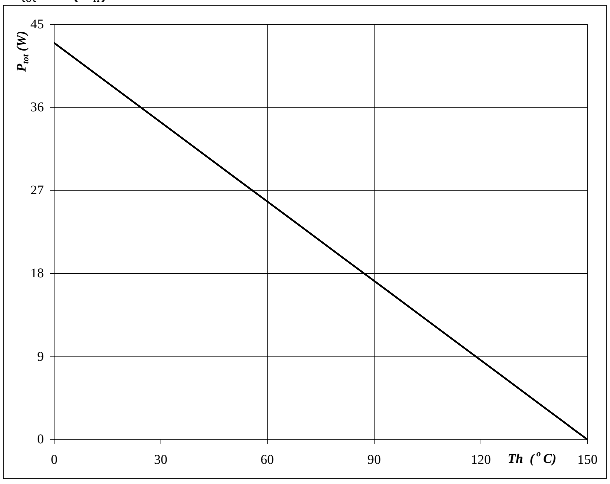
D = t_p / T

R_{thJH} = 3,49 K/W

Figure 3 Brake inverse diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



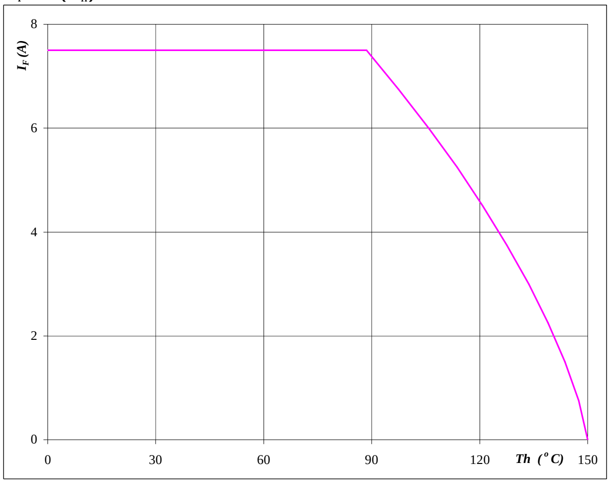
At

T_j = 150 ºC

Figure 4 Brake inverse diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

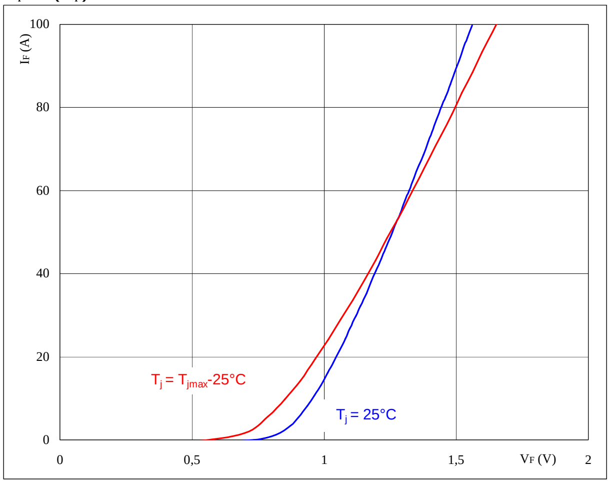
T_j = 150 ºC

Input Rectifier Diode

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



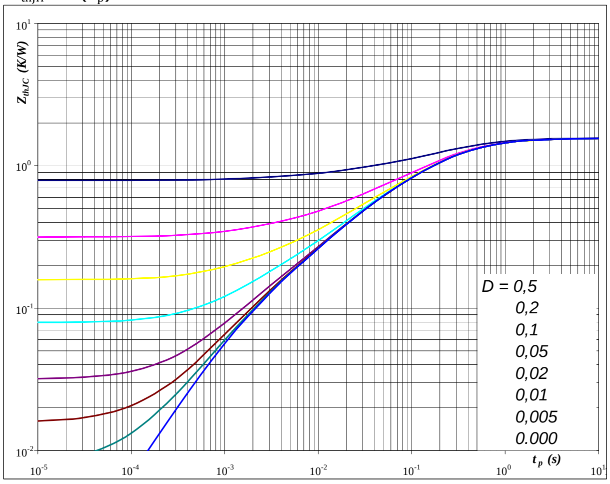
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

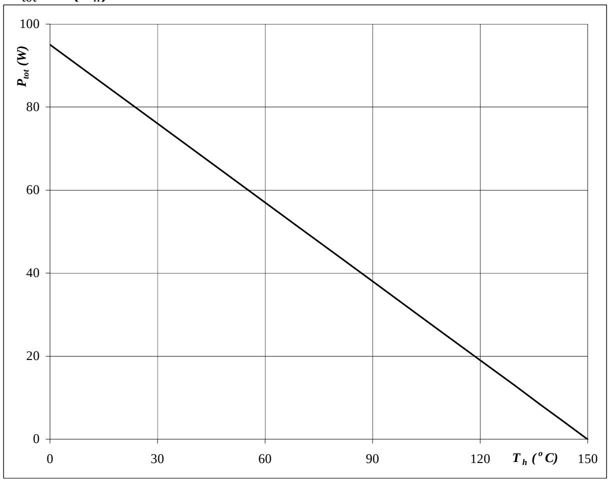
D = t_p / T

R_{thJH} = 1,58 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



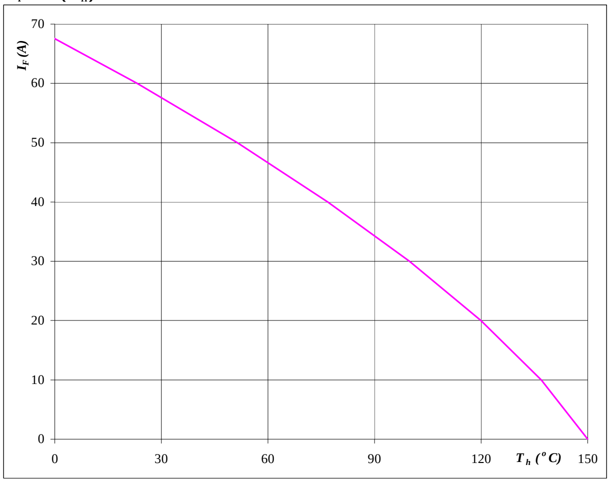
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

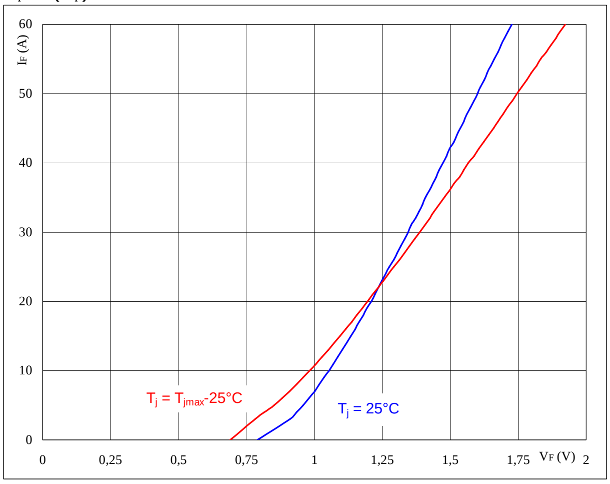
T_j = 150 ºC

Thyristor

Figure 1 Thyristor

Typical thyristor forward current as a function of forward voltage

$I_F = f(V_F)$



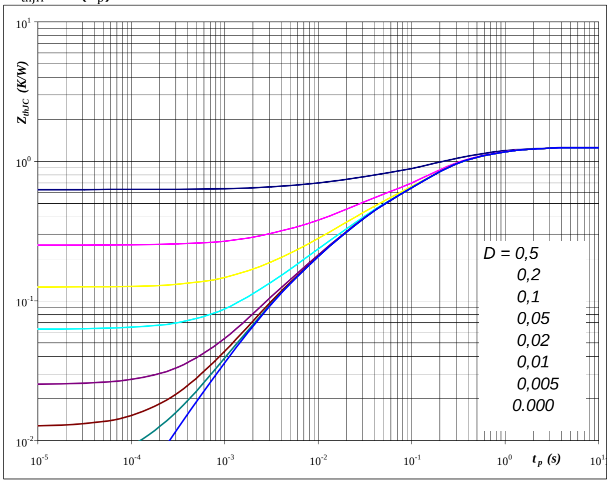
At

t_p = 250 μs

Figure 2 Thyristor

Thyristor transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

$D = t_p / T$

R_{thJH} = 1,26 K/W

Figure 3 Thyristor

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

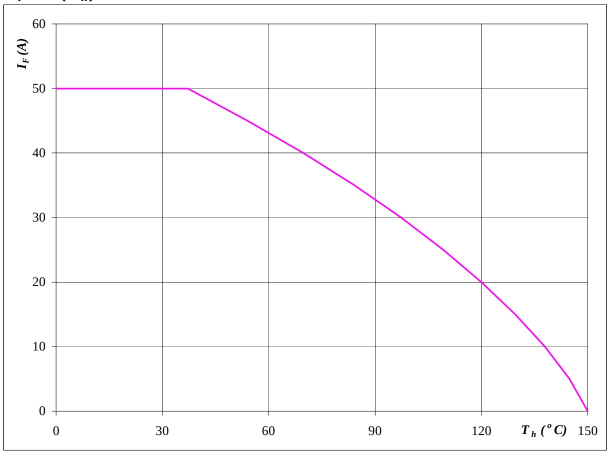
At

T_j = 150 ºC

Figure 4 Thyristor

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



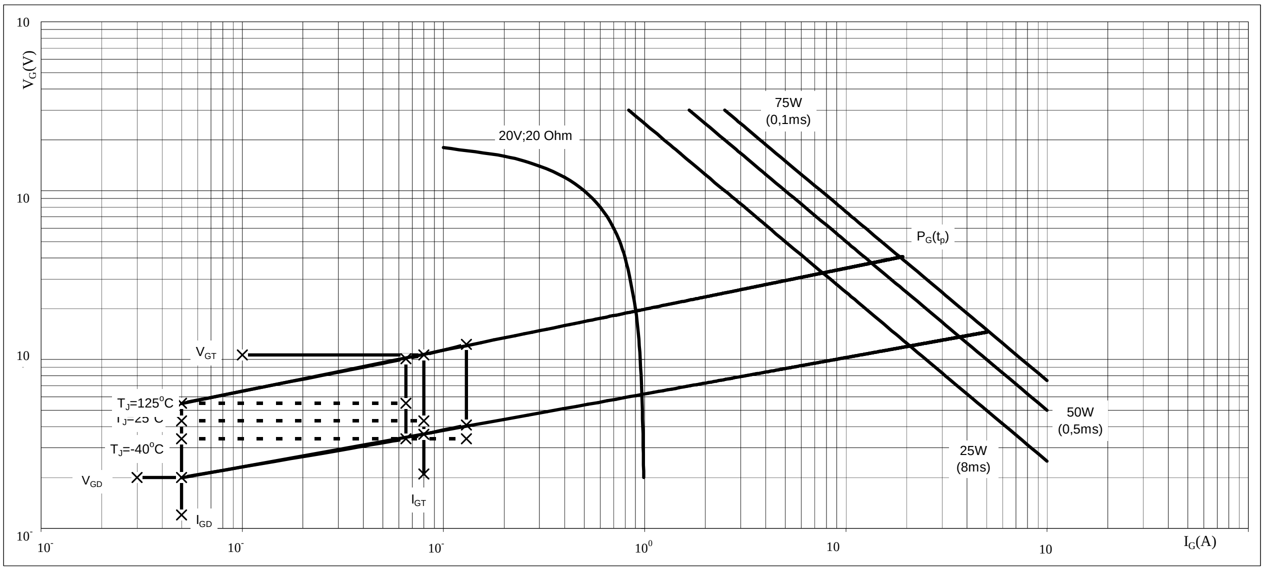
At

T_j = 150 ºC

Thyristor

Figure 5	Thyristor

Gate trigger characteristics



Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

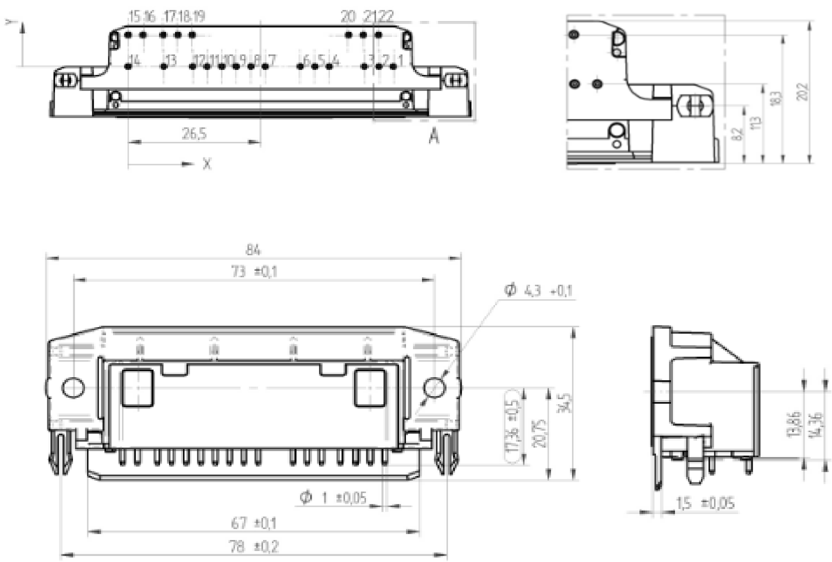
Version	Ordering Code
without thermal paste *flow* 90 1 housing	V23990-P717-G-PM
without thermal paste *flow* 90 1 housing half controlled	V23990-P717-G10-PM
without thermal paste *flow* 90 1 housing w/o BRC	V23990-P717-H-PM
without thermal paste *flow* 90 1 housing half controlled w/o BRC	V23990-P717-H10-PM

Text	**VIN**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	NNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Name&Ver**	**Lot number**	**Serial**	**Date code**		
	NNNNNNVV	LLLLL	SSSS	WWYY		

Outline

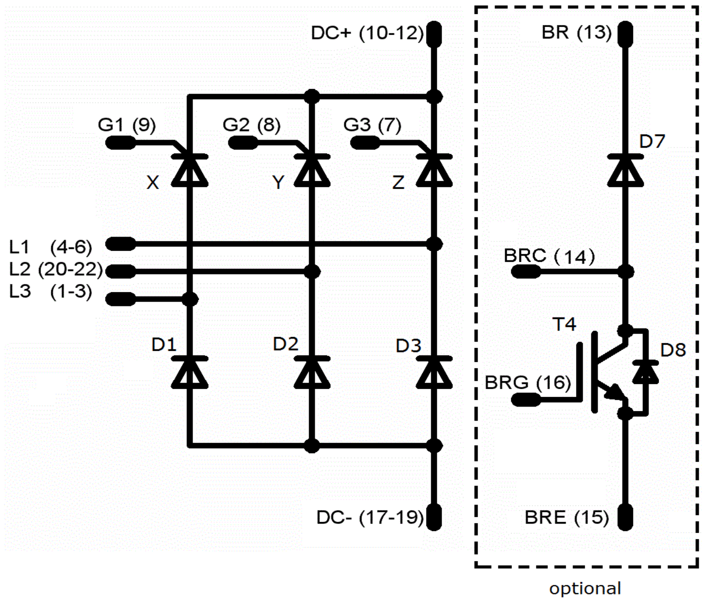
Pin table

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	G3
8	24,5	0	G2
9	21,6	0	G1
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



Ordering Code and Marking - Outline - Pinout

Pinout



Type	Half controlled	X	Y	Z	Note
P717G	-	D4	D5	D6	diodes
P717G10	x	T1	T2	T3	thyristors
P717H	-	D4	D5	D6	diodes
P717H10	x	T1	T2	T3	thyristors

Identification

ID	Component	Voltage	Current	Function	Comment
D1,D2,D3,D4,D5,D6	FWD	1600 V	42 A	Input Rectifier Diodes	
T1,T2,T3	Thyristor	1600 V	45 A	Input Rectifier Thyristor	
T4	IGBT	1200 V	25 A	Brake Switch	
D7	FWD	1200 V	7,5 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Inverse Diode	

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

Handling instruction
Handling instructions for *flow* 90 1 packages see vincotech.com website.

Package data
Package data for *flow* 90 1 packages see 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-x-D4-14	19 May. 2016	New brand	all