V23990-P717-G10-PM
datasheet

*flow*90CON 1 | 1600 V / 36 A

Topology features

- Three-phase Half Controlled Converter
- Open Emitter configuration
- Brake Chopper

Component features

- High inrush current capability

Housing features

- Base isolation: Al_2O_3
- 90° mounting angle between heatsink and PCB
- Screw-on heatsink mounting
- Clip-in PCB mounting
- Thermo-mechanical push-and-pull force relief
- Solder pin

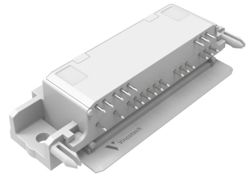
Target applications

- Motor drives
- Servo drives

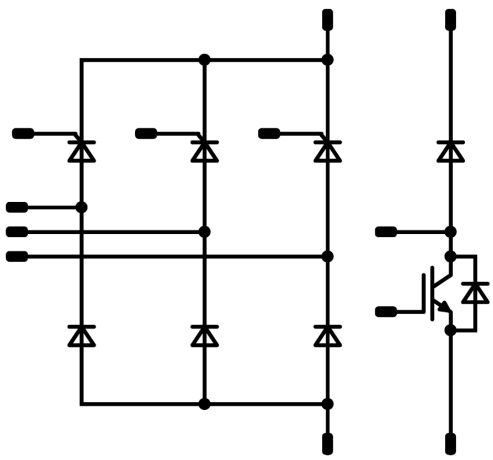
Types

- V23990-P717-G10-PM

*flow*90 1 housing



Schematic



Maximum Ratings

T_j = 25 °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 °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 °C	65	W
Gate-emitter voltage	V_{GES}			±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 °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 °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 °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 °C	25	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1200	V
Maximum RMS on-state current	I_{TRMSM}	$T_j = T_{jmax}$	T_s = 80 °C	45	A
Surge on-state current	I_{TSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	360	A
I2t value	I^2t	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	650	A^2s
Mean total power loss	$P_{tot}(AV)$	$T_j = T_{jmax}$	T_s = 80 °C	68	W
Maximum Junction Temperature	T_{jmax}			150	°C
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	63	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	520	A
Surge current capability	I^2t			1350	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °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 s	6000	V
Creepage distance				>12,7	mm
Clearance				11,84	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
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(1)	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 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 (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,08		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 32 Ω R_{goff} = 16 Ω	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}	Q_{rFWD}=1,09 µC Q_{rFWD}=2,02 µC				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(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			27	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,12		K/W
Dynamic										
Peak recovery current	I_{RM}	d*i*/d*t*=548 A/µs d*i*/d*t*=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	$(di_{rf}/dt)_{max}$					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(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			27	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{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 Thyristor										
Static										
On-state voltage	V_T				45	25 125		1,54 1,66	1,4(1) 1,45(1)	V
Direct reverse current	I_{RD}	V_r = 1200 V				25 150			50 8000	µA
Holding current	I_H			6		25		100		mA
Latching current	I_L	t_p = 10 µs I_G = 0,3 A di_G/dt = 0,3 A/µs				25		150		mA
Gate trigger voltage	V_{GT}			6		25			1,5	V
Gate trigger current	I_{GT}			6		25			55	mA
Gate non-trigger current	I_{GD}					25			3000	nA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,02		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				80	25 125 150		1,27 1,27	1,33(1) 1,31(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			20 1500	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,96		K/W

(1) Value at chip level

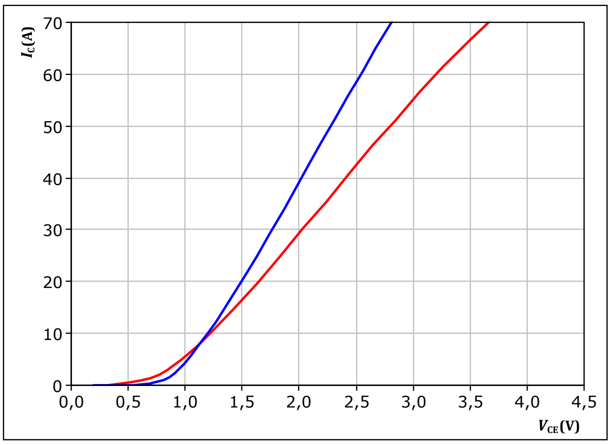
(2) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$



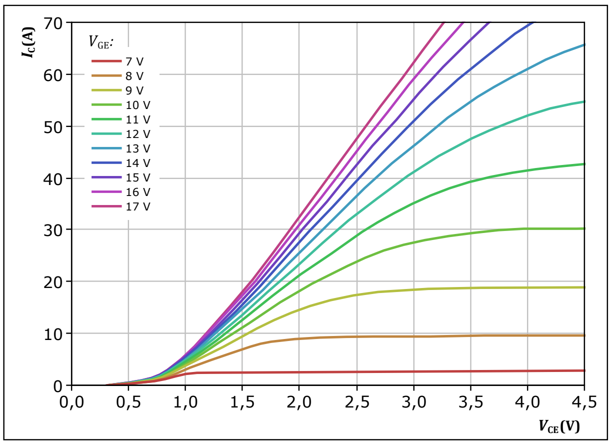
t_p =	250	µs
V_{GE} =	15	V

T_j: 25 °C, 125 °C

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$



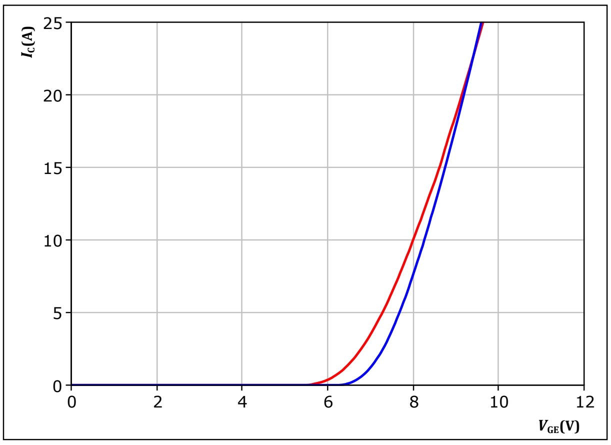
t_p =	250	µs
T_j =	125	°C

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

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



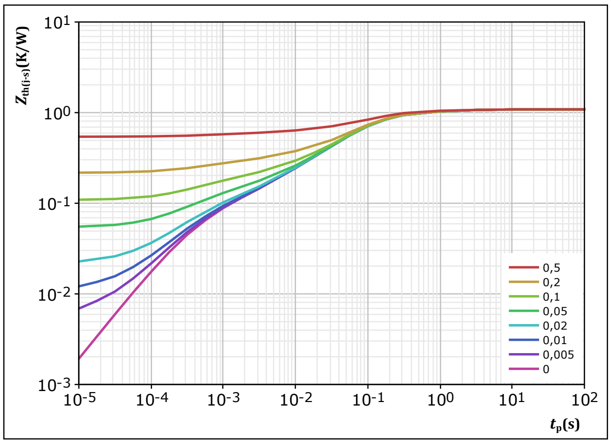
t_p =	250	µs
V_{CE} =	10	V

T_j: 25 °C, 125 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,084 K/W

IGBT thermal model values

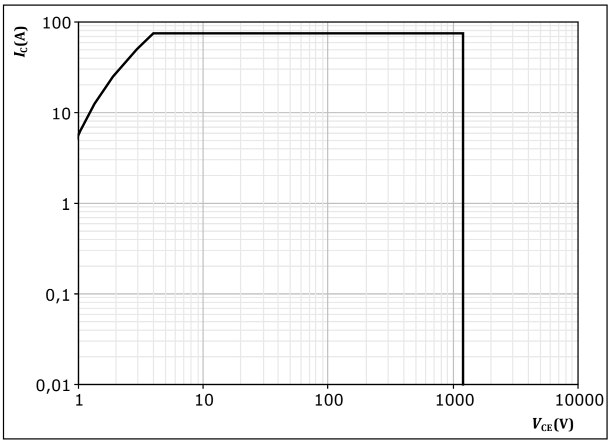
R (K/W)	τ (s)
8,51E-02	1,82E+00
2,15E-01	2,53E-01
5,88E-01	7,31E-02
1,01E-01	9,54E-03
4,27E-02	1,52E-03
5,22E-02	3,55E-04

Brake 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}	

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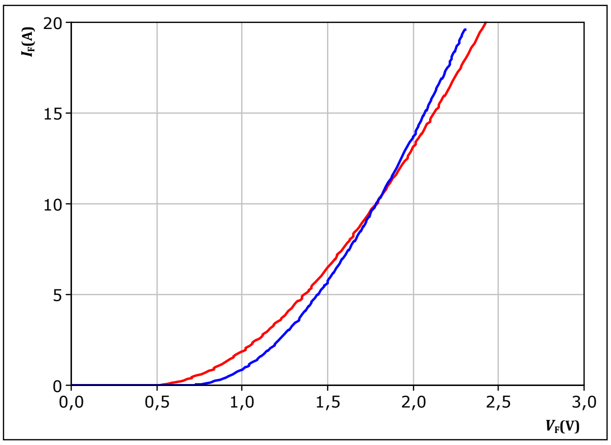
Brake Diode Characteristics

figure 6. FWD

Typical forward characteristics

$I_F = f(V_F)$



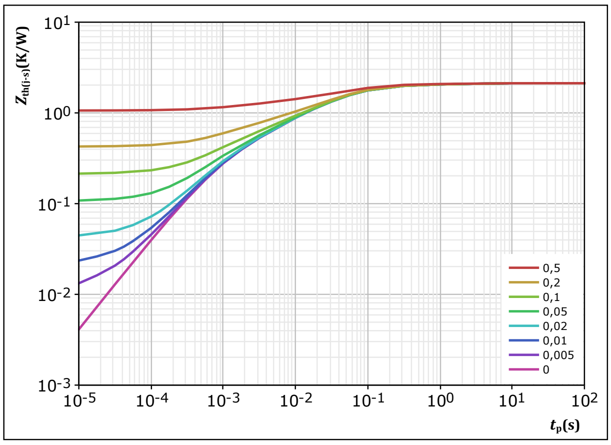
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,124 K/W

FWD thermal model values

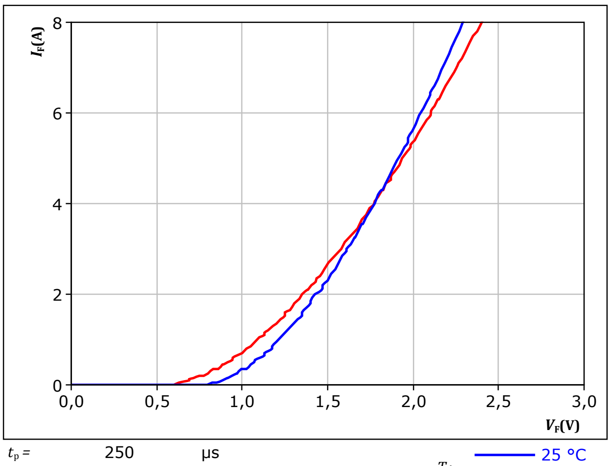
R (K/W)	τ (s)
7,00E-02	3,23E+00
1,48E-01	4,03E-01
7,34E-01	6,67E-02
5,90E-01	2,04E-02
3,47E-01	4,32E-03
2,36E-01	8,05E-04

Brake Sw. Protection Diode Characteristics

figure 8. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



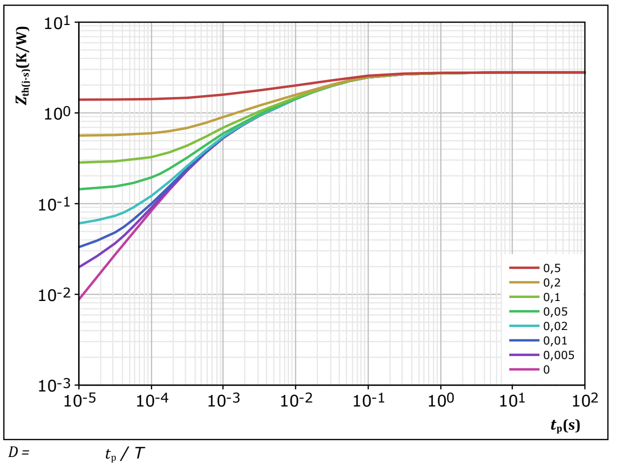
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 9. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,796 K/W

FWD thermal model values

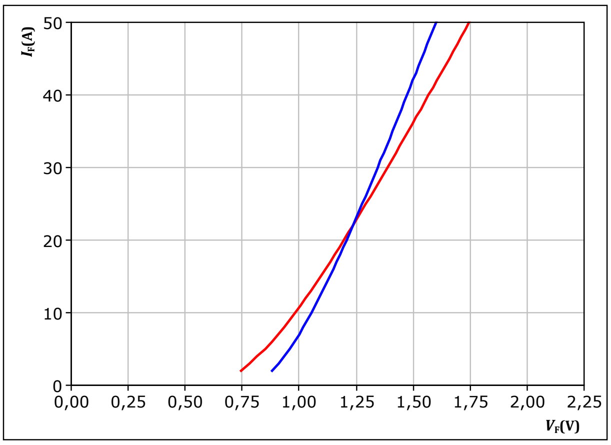
R (K/W)	τ (s)
7,82E-02	2,45E+00
1,95E-01	2,65E-01
9,84E-01	4,77E-02
6,58E-01	1,23E-02
5,09E-01	2,70E-03
3,71E-01	5,98E-04

Rectifier Thyristor Characteristics

figure 10. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



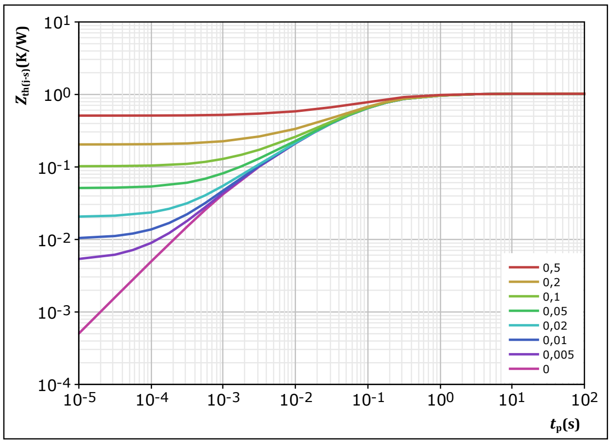
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 11. **Thyristor**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 1,022 K/W

Thyristor thermal model values

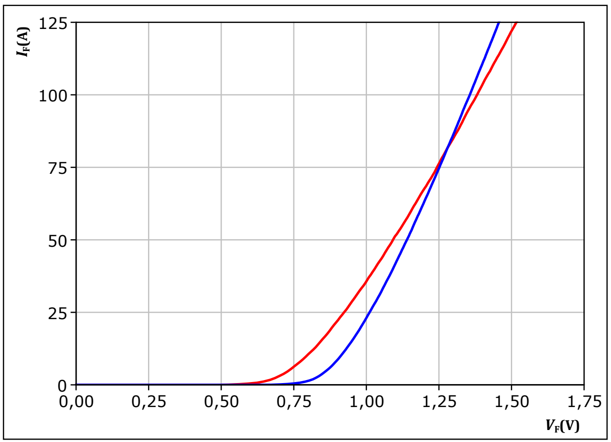
R (K/W)	τ (s)
1,01E-01	1,45E+00
2,12E-01	2,65E-01
4,76E-01	7,87E-02
1,89E-01	1,28E-02
4,45E-02	1,54E-03

Rectifier Diode Characteristics

figure 12. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



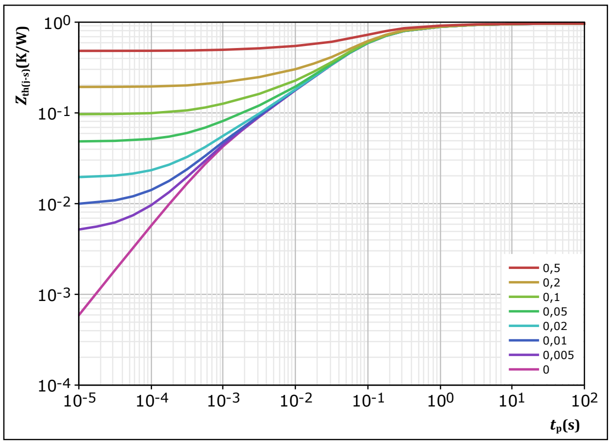
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 13. **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

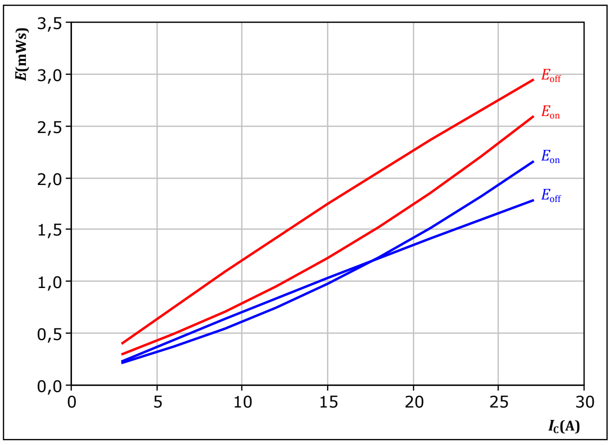
R (K/W)	τ (s)
3,98E-02	7,88E+00
1,29E-01	8,64E-01
4,20E-01	1,32E-01
2,76E-01	4,24E-02
6,63E-02	5,80E-03
3,37E-02	8,90E-04

Brake Switching Characteristics

figure 14. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

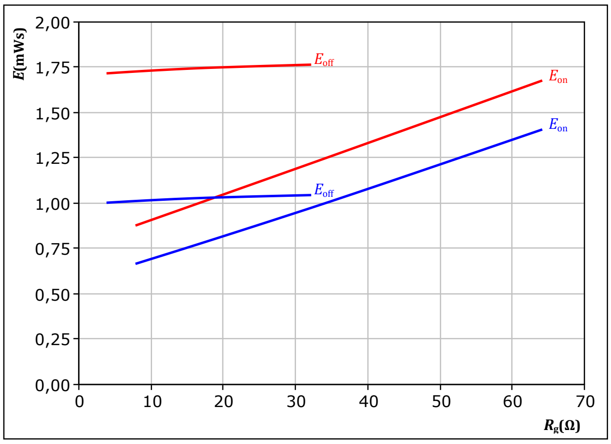
T_j: 25 °C (blue), 125 °C (red)

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

figure 15. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



With an inductive load at

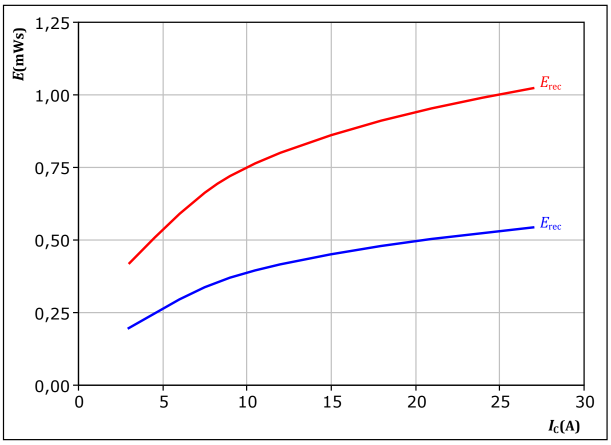
T_j: 25 °C (blue), 125 °C (red)

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

figure 16. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

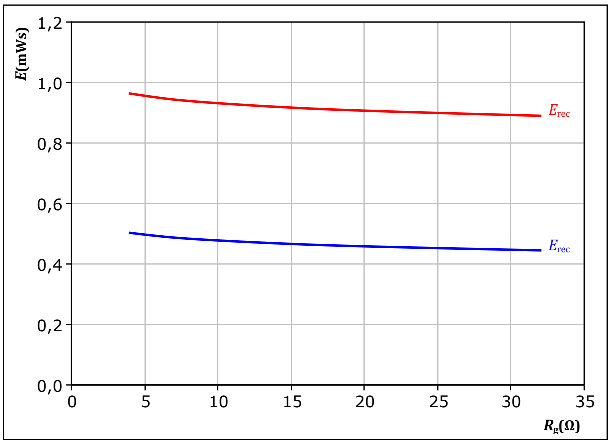
T_j: 25 °C (blue), 125 °C (red)

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

figure 17. **FWD**

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

T_j: 25 °C (blue), 125 °C (red)

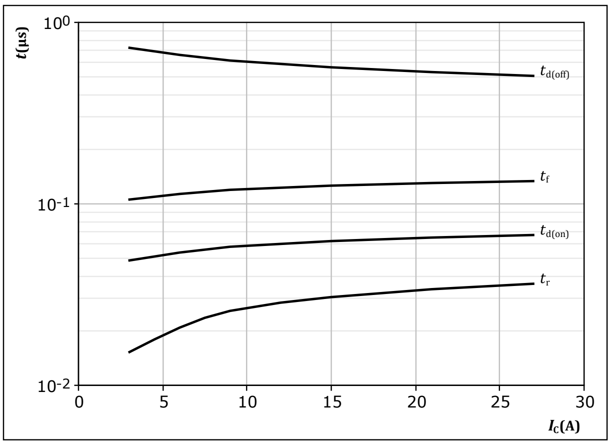
V_{CE} =	600	V
V_{GE} =	0/15	V
I_C =	15	A

Brake Switching Characteristics

figure 18. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



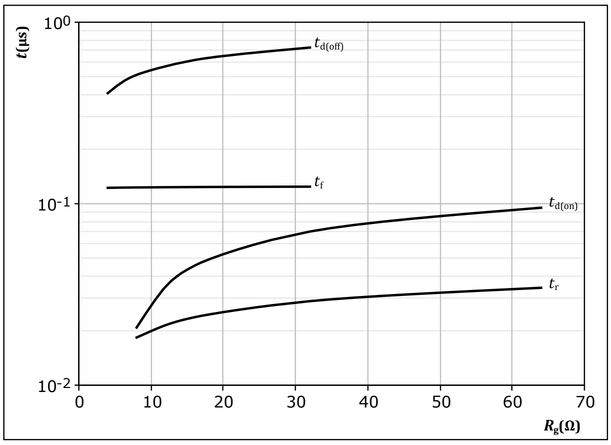
With an inductive load at

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

figure 19. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

t = f(R_g)



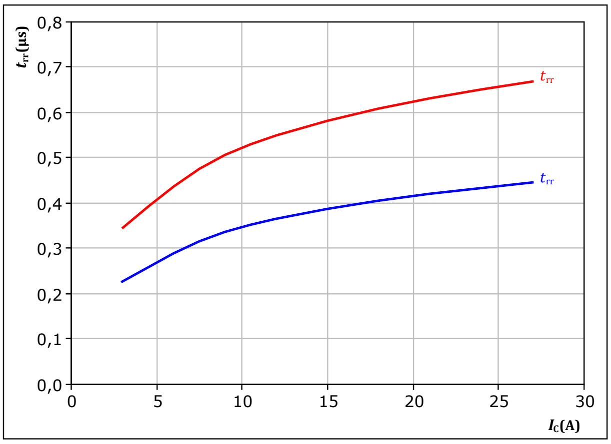
With an inductive load at

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

figure 20. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

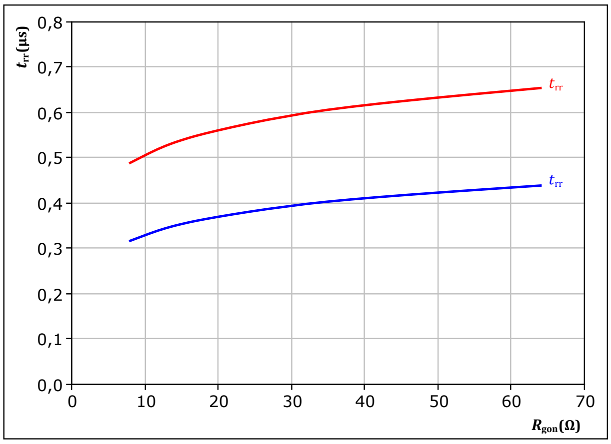
T_j: 25 °C / 125 °C

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

figure 21. **FWD**

Typical reverse recovery time as a function of IGBT turn on gate resistor

t_{rr} = f(R_{gon})



With an inductive load at

T_j: 25 °C / 125 °C

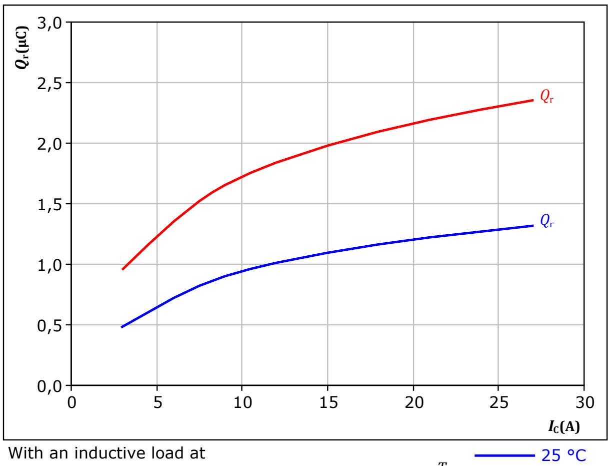
V_{CE} =	600	V
V_{GE} =	0/15	V
I_C =	15	A

Brake Switching Characteristics

figure 22. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



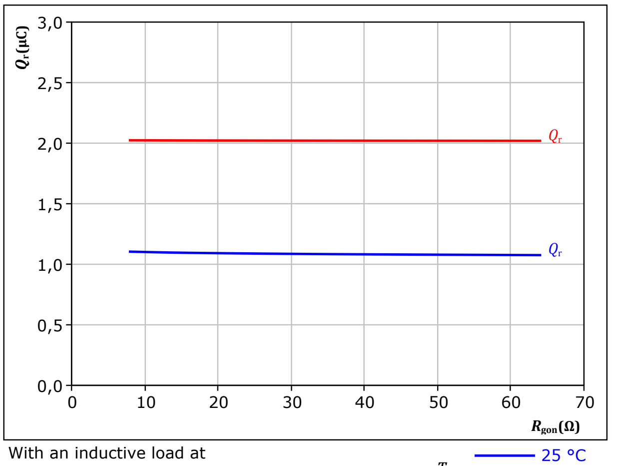
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C / 125 °C
V_{GE} =	0/15	V	
R_{gon} =	32	Ω	

figure 23. **FWD**

Typical recovered charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$



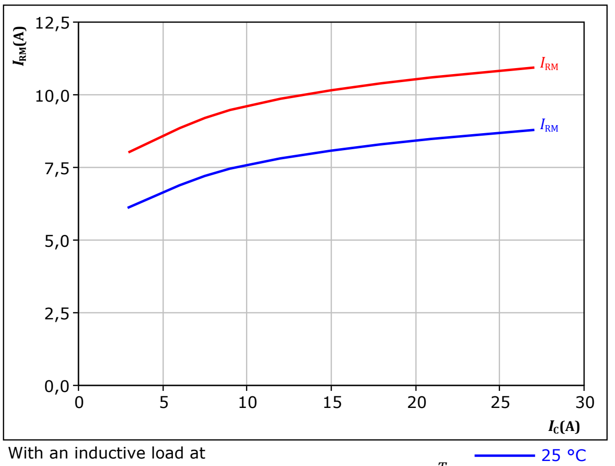
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C / 125 °C
V_{GE} =	0/15	V	
I_C =	15	A	

figure 24. **FWD**

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$



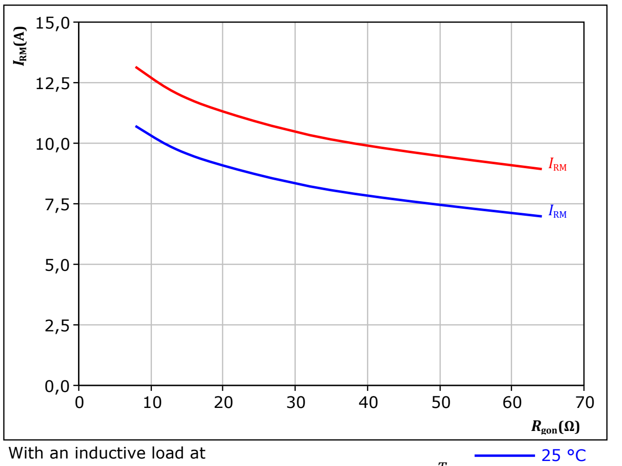
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C / 125 °C
V_{GE} =	0/15	V	
R_{gon} =	32	Ω	

figure 25. **FWD**

Typical peak reverse recovery current as a function of IGBT turn on gate resistor

$I_{RM} = f(R_{gon})$



With an inductive load at

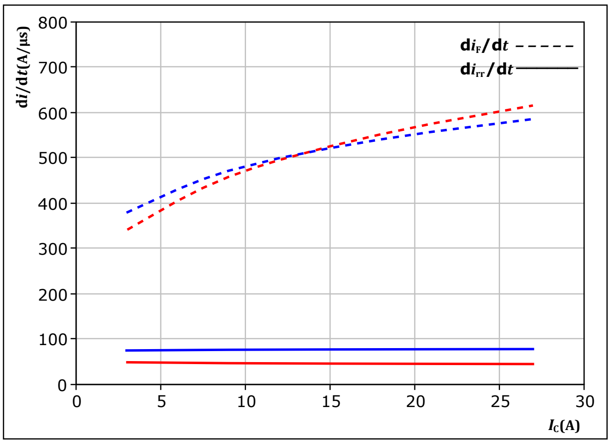
V_{CE} =	600	V	T_j: 25 °C / 125 °C
V_{GE} =	0/15	V	
I_C =	15	A	

Brake Switching Characteristics

figure 26. **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)



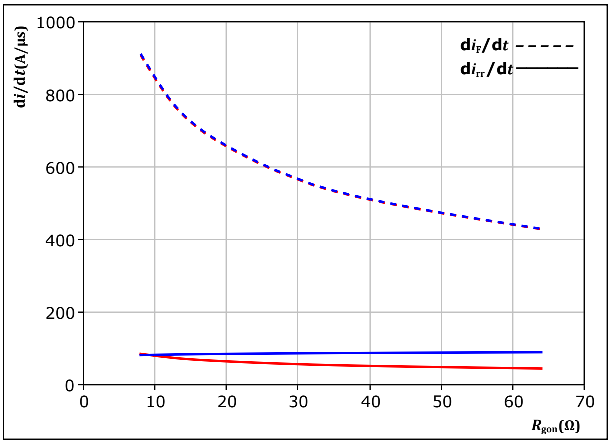
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C
V_{GE} =	0/15	V	125 °C
R_{gon} =	32	Ω	

figure 27. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor

di_F/dt, di_{rr}/dt = f(R_{gon})



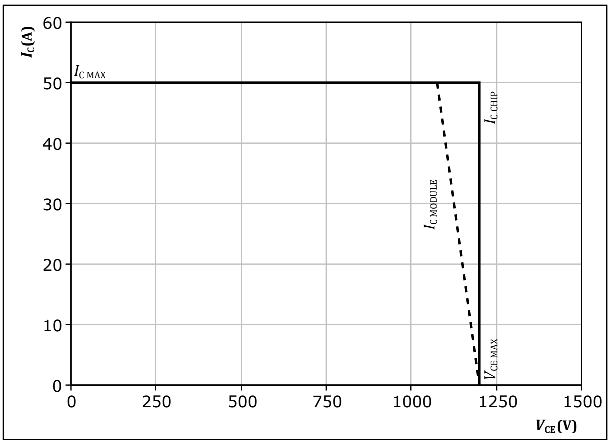
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C
V_{GE} =	0/15	V	125 °C
I_C =	15	A	

figure 28. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



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

Brake Switching Definitions

figure 29. **IGBT**

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

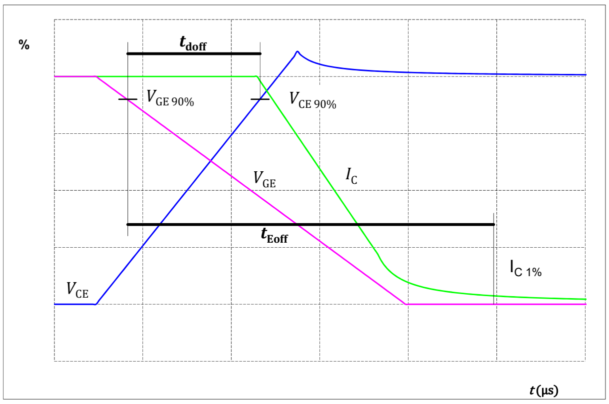


figure 30. **IGBT**

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

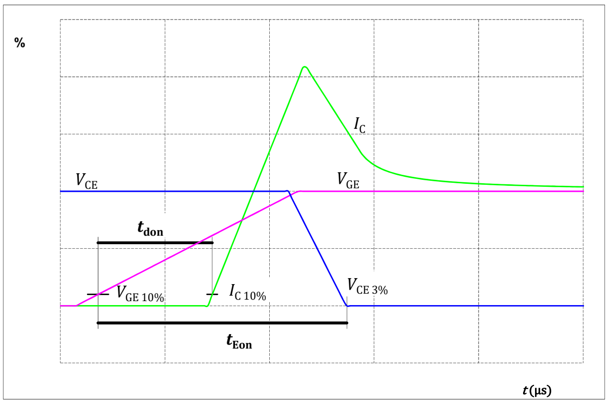


figure 31. **IGBT**

Turn-off Switching Waveforms & definition of t_f

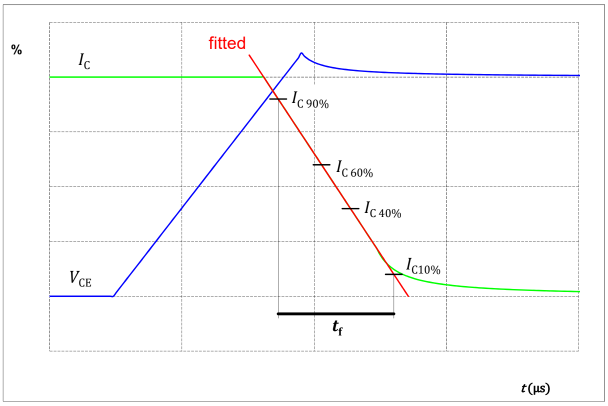
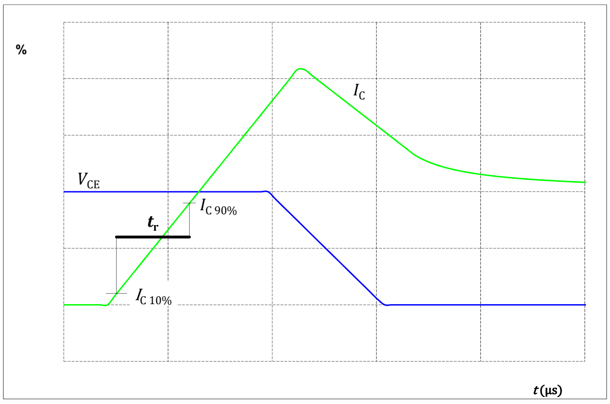


figure 32. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 33. **FWD**

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

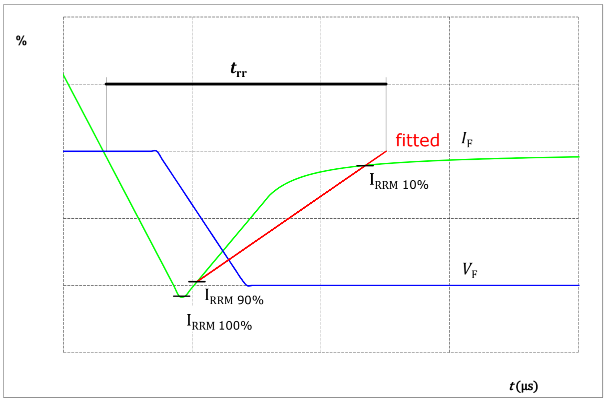
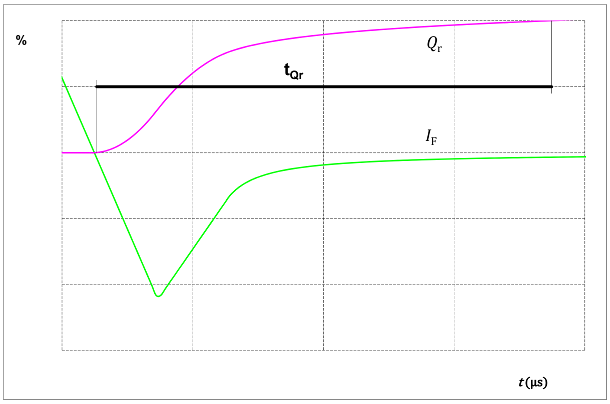


figure 34. **FWD**

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



V23990-P717-G10-PM
datasheet

Ordering Code

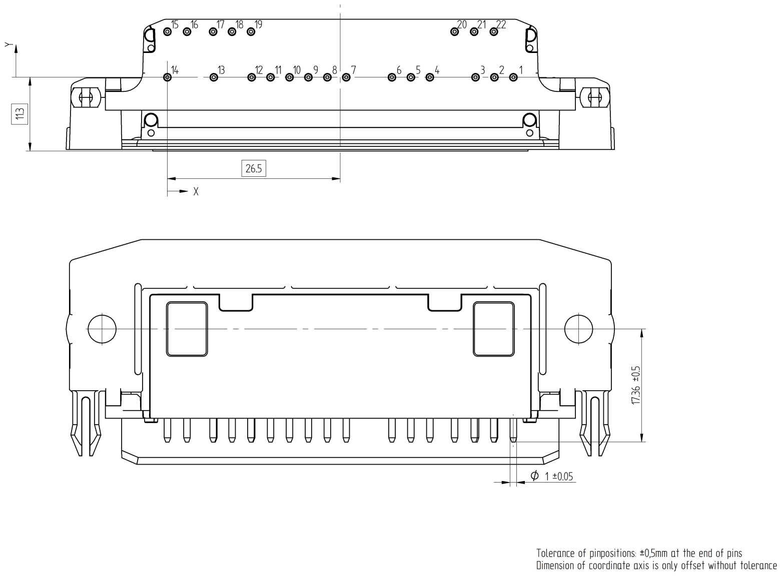
Version	Ordering Code
Without thermal paste	V23990-P717-G10-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P717-G10-/3/-PM

Marking

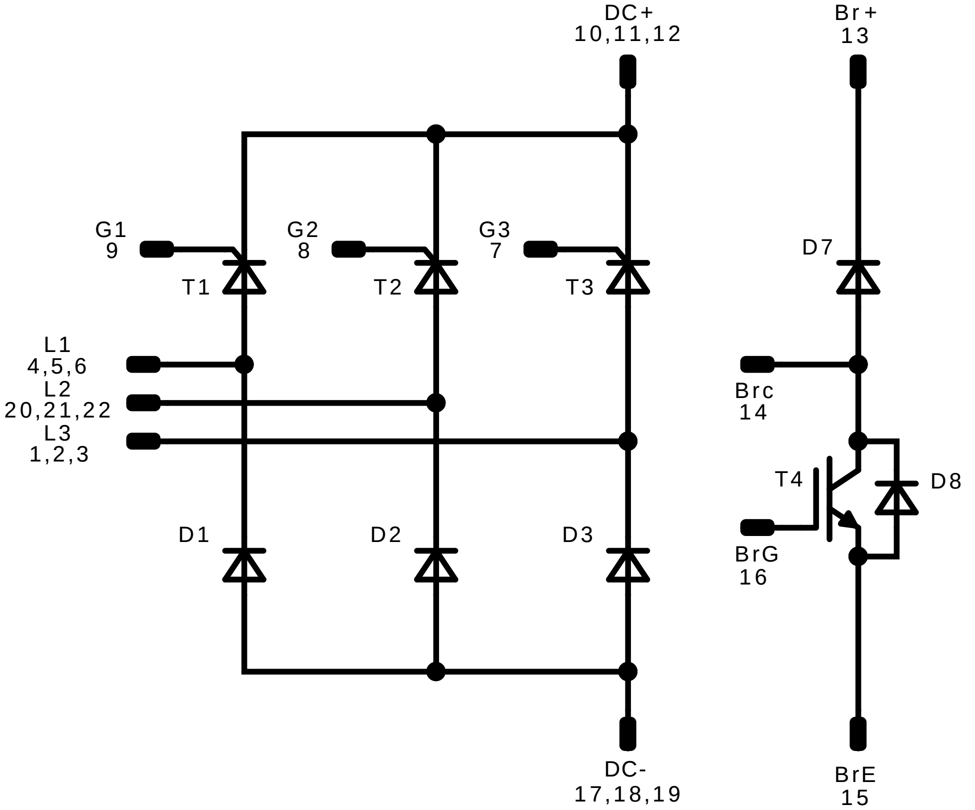
		VIN	Date code	Type&Ver	UL	Lot	Serial
	**Text**	VIN	WWYY	TTTTTTTVV	UL	LLLLL	SSSS
	Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
		TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]			
Pin	X	Y	Function
1	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



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	
T1, T2, T3	Thyristor	1200 V	45 A	Rectifier Thyristor	
D1, D2, D3	Rectifier	1600 V	42 A	Rectifier 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.

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-G10-PM-D5-14	13 Aug. 2022	New Datasheet format, module is unchanged Introduce Rth values with PSX-P7 Updated dynamic characteristic Separate datasheet	