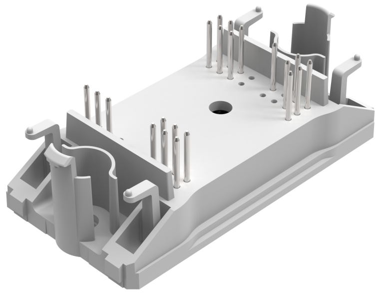
V23990-P600-I09-PM
datasheet

***flow*CON 0** **1600 V / 105 A**

Features

- modular Input Rectifier & BRC-Circuit for 30kW Motor Drive
- 1 or 3 phase rectifier (optional half controlled)
- 3 phase rectifier with breake
- compatible with 3 x *flow* PHASE 0

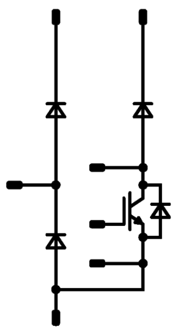
flow 0 17 mm housing



Target applications

- Industrial Drives

Schematic



Types

- V23990-P600-I09-PM

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	80	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		225	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	174	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 900 V	T_j = 125 °C	10	µs
Maximum junction temperature	T_{jmax}			175	°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	43	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	75	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	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	32	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	109	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 125 °C	1380	A
Surge current capability	I^2t			9520	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	139	W
Maximum junction temperature	T_{jmax}			150	°C

Module Properties

Thermal Properties

Parameter	Symbol	Conditions		Value	Unit
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{jop}			-40…+(T_{jmax} - 25)	°C

Isolation Properties

Parameter	Symbol	Conditions		Value	Unit
Isolation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	4000	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
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,003	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		75	25 125	1,4	1,71 1,97	2,1[1]	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			10,1	µA
Gate-emitter leakage current	I_{GES}		20	0		25			600	nA
Internal gate resistance	r_g							10		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	20		25		5345		pF
Reverse transfer capacitance	C_{res}							242		pF
Gate charge	Q_g		15		0	25		700		nC
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,55		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	0/15	700	75	25 125		62,08 62,08		ns
Rise time	t_r					25 125		27,84 30,72		ns
Turn-off delay time	$t_{d(off)}$					25 125		631,36 756,16		ns
Fall time	t_f					25 125		58,98 153,87		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=6,03 µC Q_{rFWD}=10,78 µC				25 125		6,07 8,03		mWs
Turn-off energy (per pulse)	E_{off}					25 125		5,77 9,42		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				50	25 125	1,23	1,85 1,89	1,95(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)						0,93		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=3083 A/µs d*i*/d*t*=2859 A/µs	0/15	700	75	25 125		66,32 81,03		A
Reverse recovery time	t_{rr}					25 125		285,17 430,61		ns
Recovered charge	Q_r					25 125		6,03 10,78		µC
Reverse recovered energy	E_{rec}					25 125		2,64 4,98		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		2221 1483		A/µs
Brake Sw. Protection Diode										
Static										
Forward voltage	V_F				7,5	25 125	1,23	1,66 1,62	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)						2,2		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				77	25 125		1,2 1,11	1,21[1] 1,1[1]	V
Reverse leakage current	I_R	V_r = 1600 V				25			50	µA
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,5		K/W

[1] Value at chip level

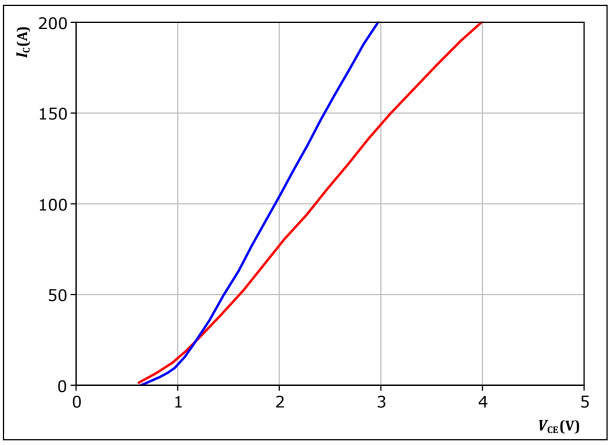
[2] Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1.	IGBT

Typical output characteristics

$I_C = f(V_{CE})$



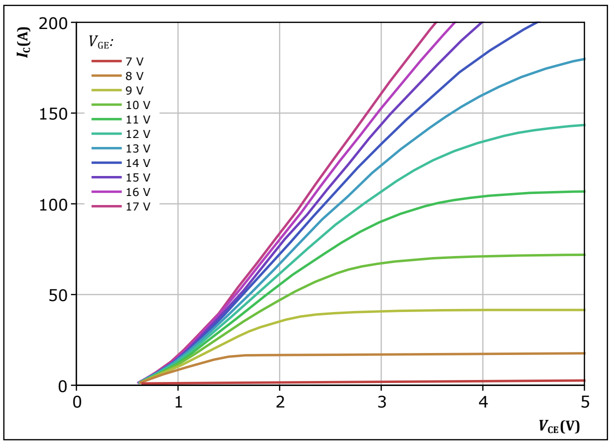
t_p =	250	µs
V_{GE} =	15	V

T_j: 25 °C, 125 °C

figure 2.	IGBT

Typical output characteristics

$I_C = f(V_{CE})$



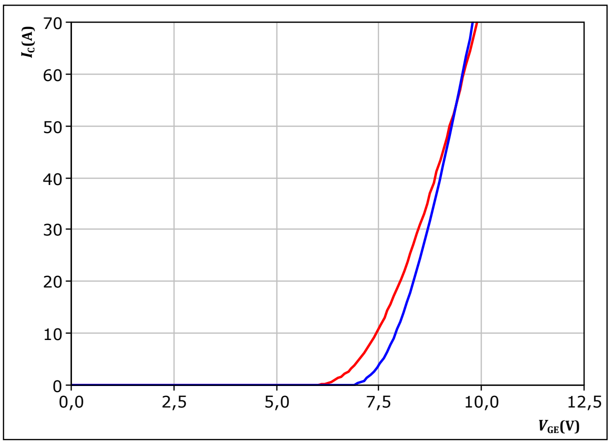
t_p =	250	µs
T_j =	125	°C

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

figure 3.	IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



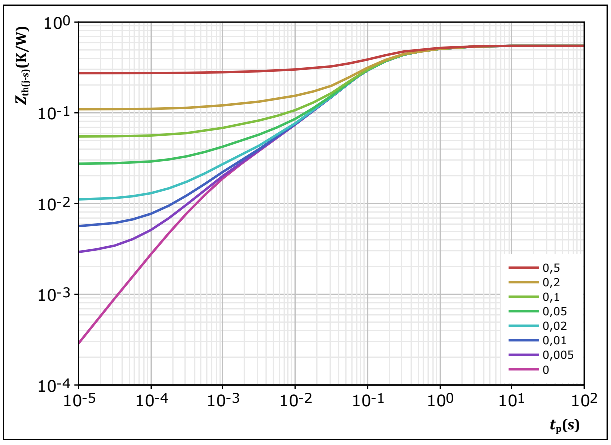
t_p =	250	µs
V_{CE} =	10	V

T_j: 25 °C, 125 °C

figure 4.	IGBT

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	0,547	K/W

IGBT thermal model values

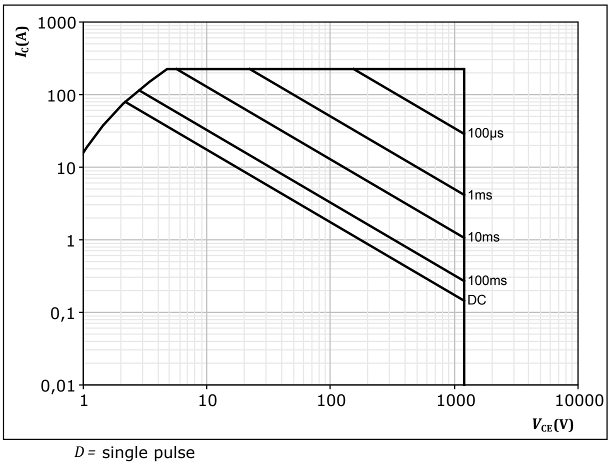
R (K/W)	τ (s)
7,87E-02	1,38E+00
1,57E-01	2,43E-01
2,74E-01	7,84E-02
2,46E-02	4,30E-03
1,24E-02	6,52E-04

Brake Switch Characteristics

figure 5.	IGBT

Safe operating area

$I_C = f(V_{CE})$



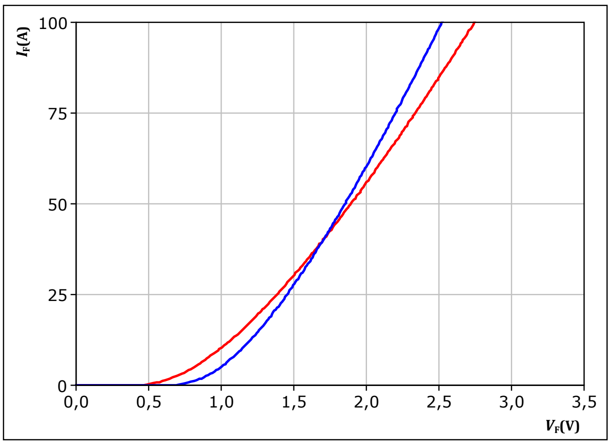
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

I_F = f(V_F)



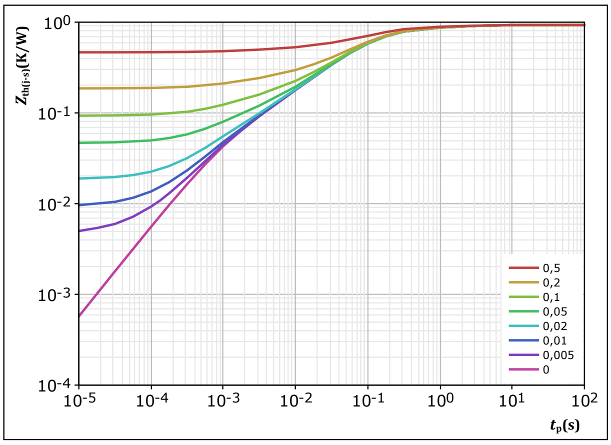
t_p = 250 μs

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

$R_{th(j-s)}$ = 0,93 K/W

FWD thermal model values

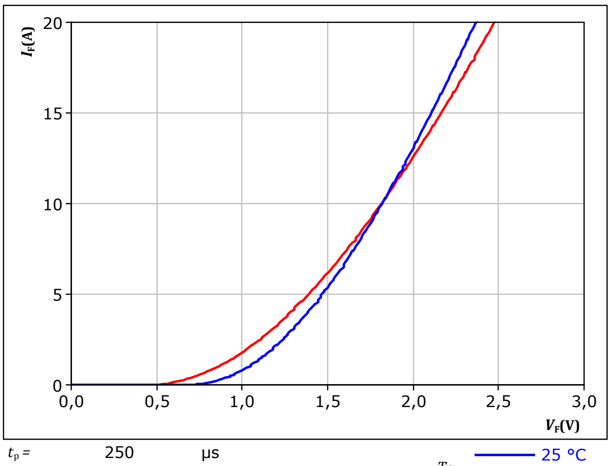
R (K/W)	τ (s)
5,72E-02	2,80E+00
1,20E-01	5,37E-01
4,66E-01	1,06E-01
1,66E-01	3,81E-02
7,82E-02	8,59E-03
4,25E-02	1,08E-03

Brake Sw. Protection Diode Characteristics

figure 8. **FWD**

Typical forward characteristics

I_F = f(V_F)



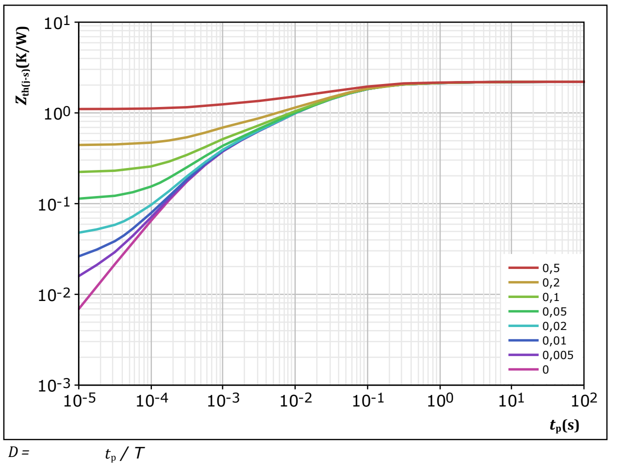
t_p = 250 µs

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

$R_{th(j-s)}$ = 2,202 K/W

FWD thermal model values

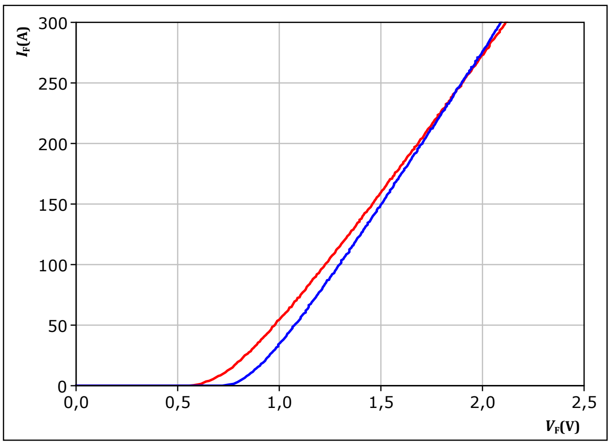
R (K/W)	τ (s)
4,63E-02	5,76E+00
1,60E-01	5,24E-01
7,96E-01	7,03E-02
5,50E-01	1,58E-02
3,61E-01	3,60E-03
2,88E-01	5,25E-04

Rectifier Diode Characteristics

figure 10. **Rectifier**

Typical forward characteristics

I_F = f(V_F)



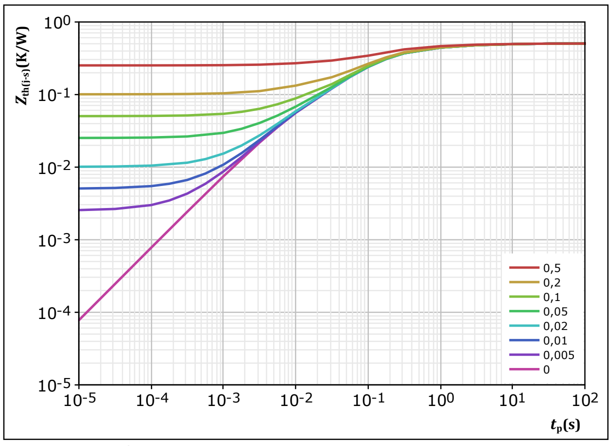
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 11. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,504 K/W

Rectifier thermal model values

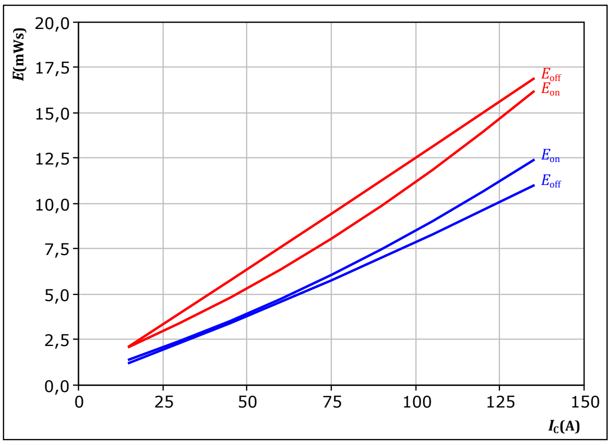
R (K/W)	τ (s)
2,79E-02	9,21E+00
7,78E-02	1,20E+00
1,49E-01	2,49E-01
2,15E-01	8,46E-02
3,51E-02	7,65E-03

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

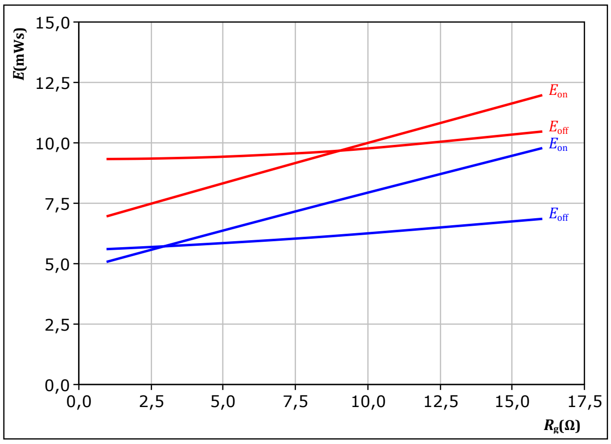
T_j: 25 °C / 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 13. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

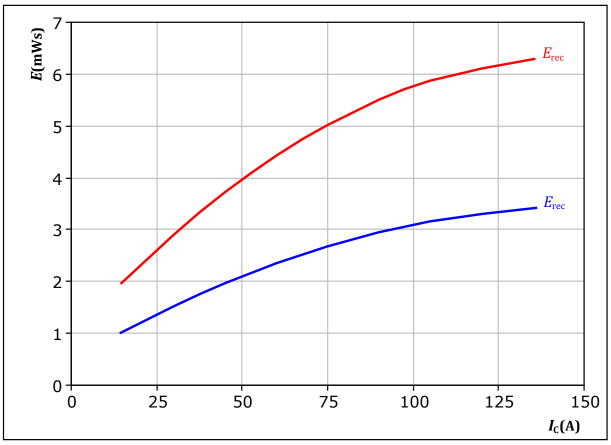
T_j: 25 °C / 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

figure 14. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

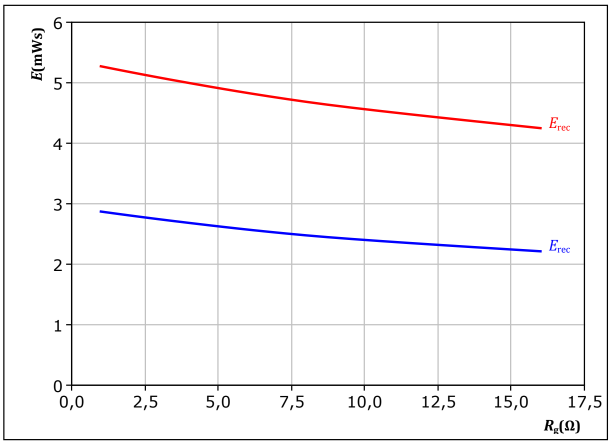
T_j: 25 °C / 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

figure 15. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

T_j: 25 °C / 125 °C

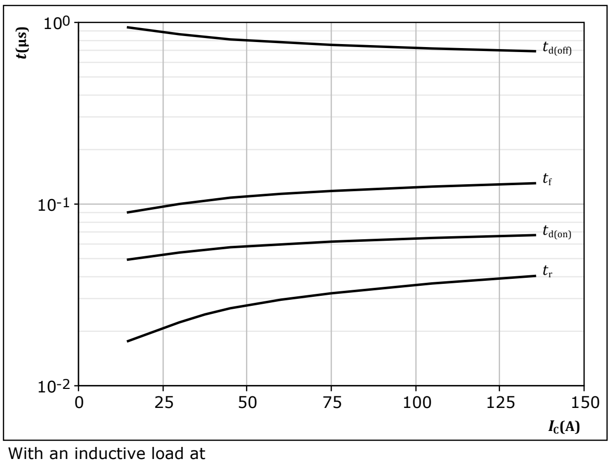
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

Brake Switching Characteristics

figure 16. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



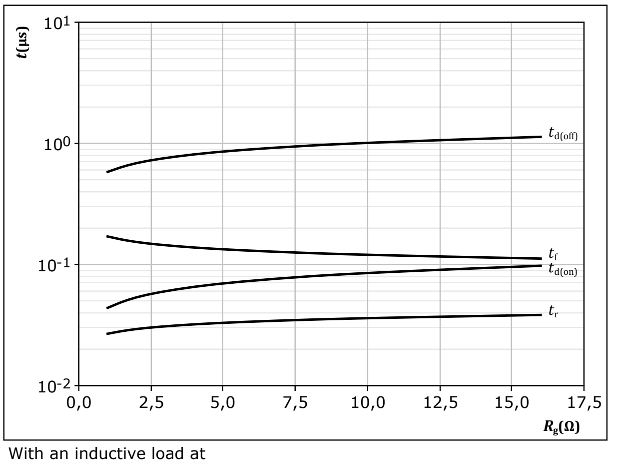
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 17. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



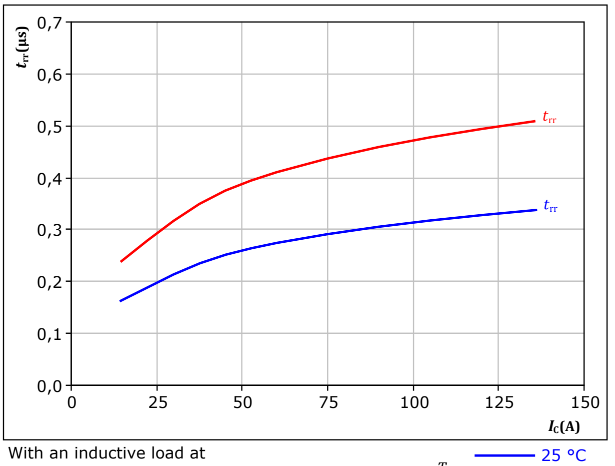
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

figure 18. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



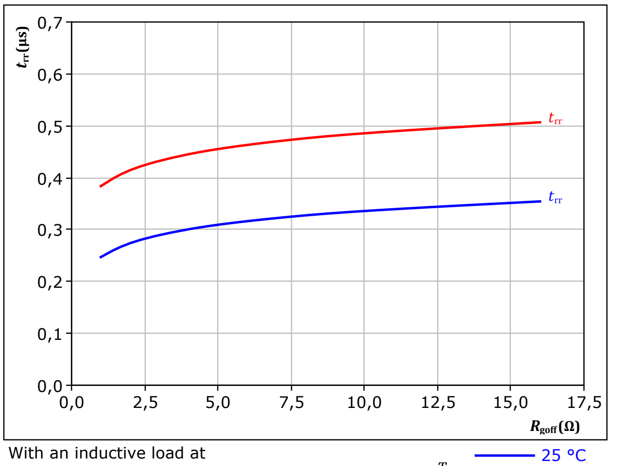
With an inductive load at

V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

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

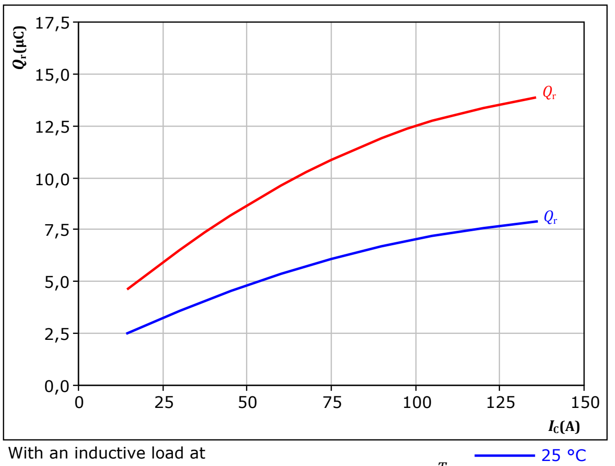
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

Brake Switching Characteristics

figure 20. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



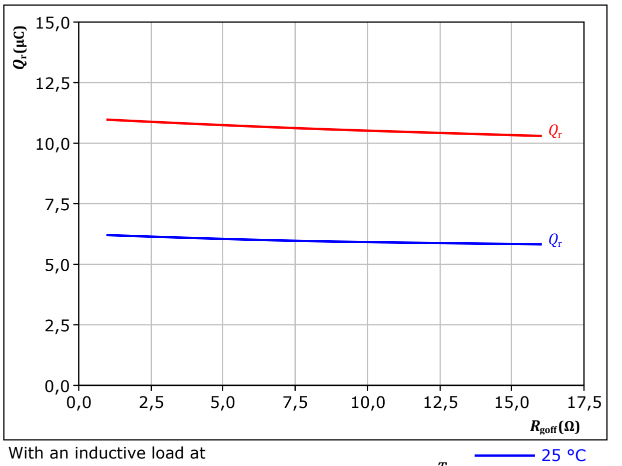
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
R_{gon} =	4	Ω	

figure 21. **FWD**

Typical recovered charge as a function of turn off gate resistor

Q_r = f(R_{goff})



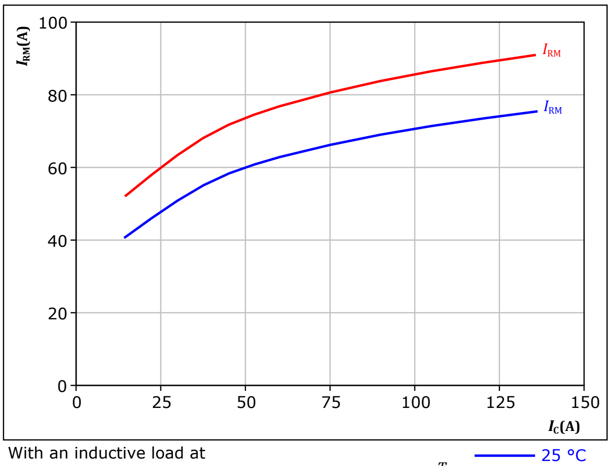
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
I_C =	75	A	

figure 22. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



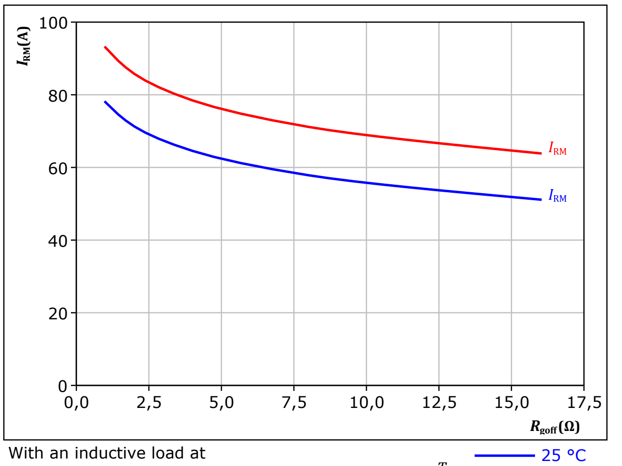
With an inductive load at

V_{CE} =	700	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
R_{gon} =	4	Ω	

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

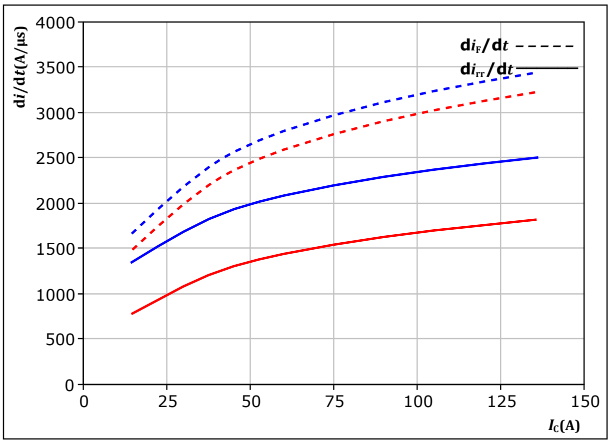
V_{CE} =	700	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
I_C =	75	A	

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_{rr}/dt = f(I_C)



With an inductive load at

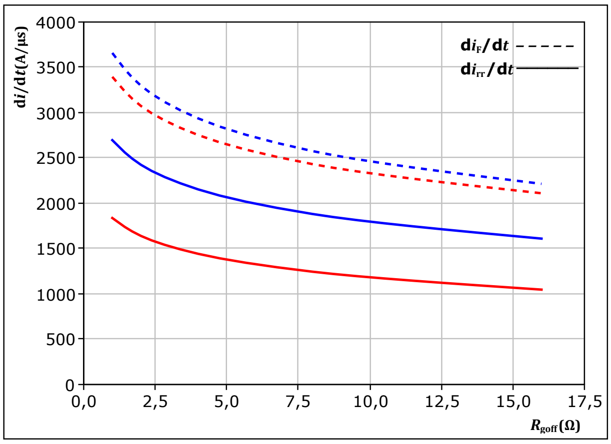
T_j: 25 °C, 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

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_{rr}/dt = f(R_{goff})



With an inductive load at

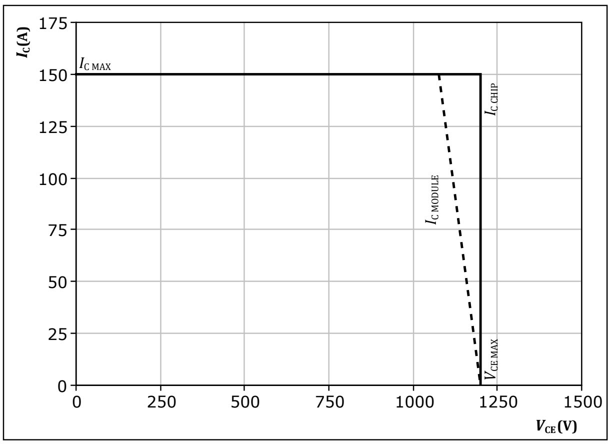
T_j: 25 °C, 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	75	A

figure 26. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At			
	T_j =	125	°C
	R_{gon} =	4	Ω
	R_{goff} =	4	Ω

Brake Switching Definitions

figure 27. **IGBT**

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

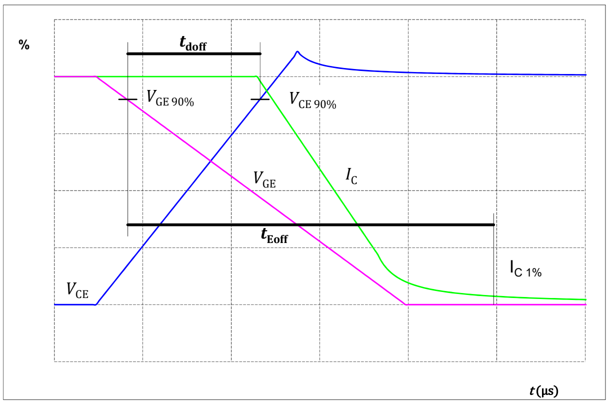


figure 28. **IGBT**

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

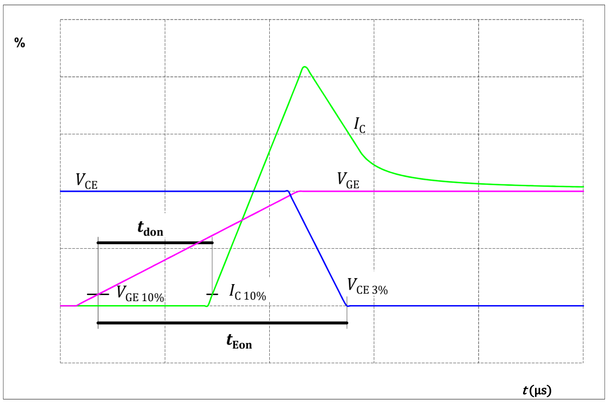


figure 29. **IGBT**

Turn-off Switching Waveforms & definition of t_f

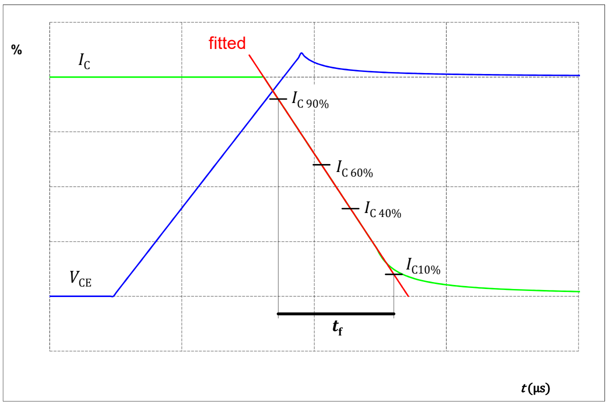
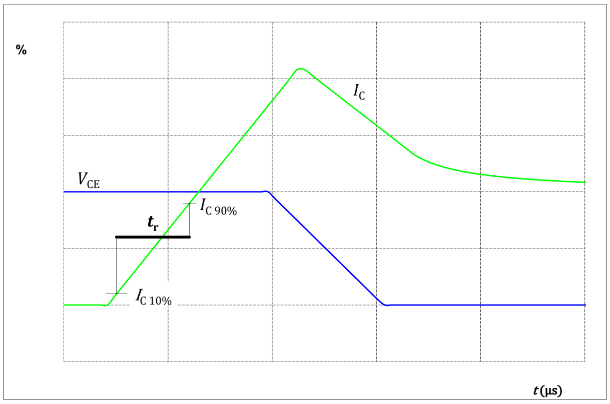


figure 30. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 31.	FWD

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

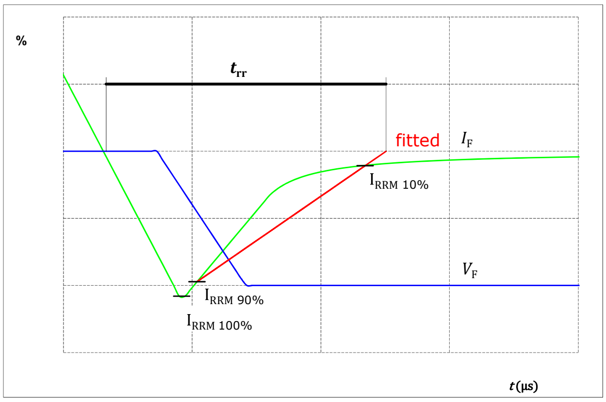
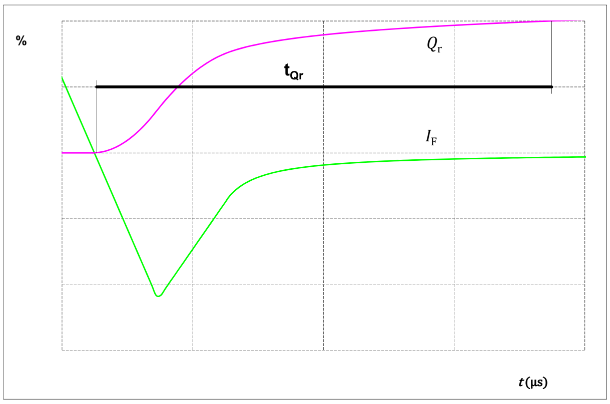


figure 32.	FWD

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



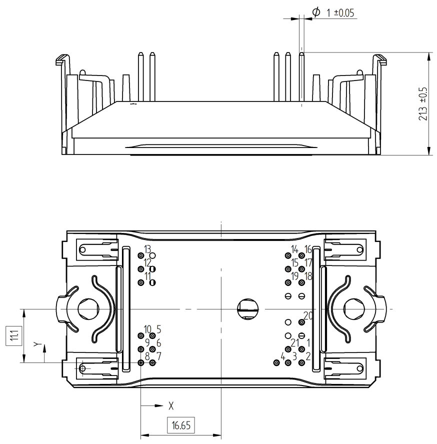
Ordering Code	
Version	**Ordering Code**
Without thermal paste	V23990-P600-I09-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P600-I09-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P600-I09-/3/-PM

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		

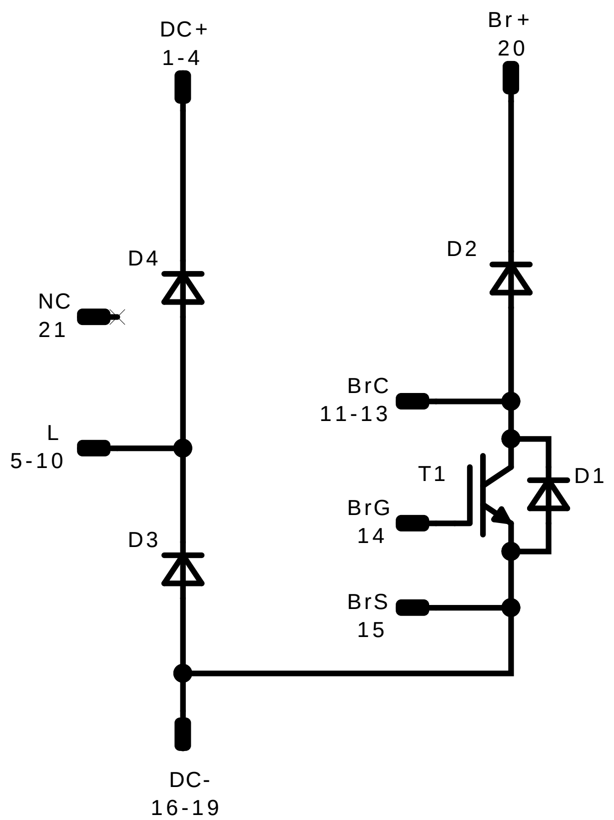
Outline

Pin table [mm]			
Pin	X	Y	Function
1	33,3	2,8	DC+
2	33,3	0	DC+
3	30,5	0	DC+
4	28,1	0	DC+
5	2,4	5,6	L
6	2,4	2,8	L
7	2,4	0	L
8	0	0	L
9	0	2,8	L
10	0	5,6	L
11	0	16,6	BrC
12	0	19,4	BrC
13	0	22,2	BrC
14	30,5	22,2	BrG
15	30,5	19,4	BrS
16	33,3	22,2	DC-
17	33,3	19,4	DC-
18	33,3	16,6	DC-
19	30,5	16,6	DC-
20	33,3	8,4	Br+
21	30,5	2,8	NC



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
T1	IGBT	1200 V	75 A	Brake Switch	
D2	FWD	1200 V	50 A	Brake Diode	
D1	FWD	1200 V	7,5 A	Brake Sw. Protection Diode	
D3, D4	Rectifier	1600 V	140 A	Rectifier Diode	

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-P600-I09-PM-D3-14	18 Sep. 2021	New Datasheet format, module is unchanged Separate datasheet for BRC version Update Dynamic measurements	