V23990-P640-G10-PM
datasheet

***flow*CON 0** — **1600 V / 42 A**

Topology features

- Three-phase Half Controlled Converter
- Brake Chopper

Component features

- High inrush current capability

Housing features

- Base isolation: Al_2O_3
- Clip-in, reliable mechanical connection, qualified for wave soldering
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

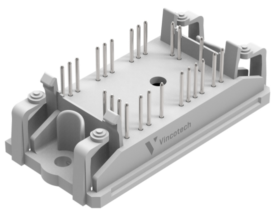
Target applications

- Industrial Drives
- Embedded Drives
- UPS

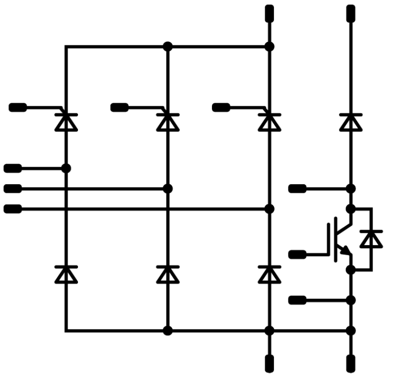
Types

- V23990-P640-G10-PM

flow 0 17 mm 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	35	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	72	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	23	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		50	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	41	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	6 (1)	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	19	W
Maximum junction temperature	T_{jmax}			150	°C

(1) limited by I_{FRM}

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Maximum RMS on-state current	I_{TRMSM}	$T_j = T_{jmax}$	T_s = 80 °C	55	A
Surge on-state current	I_{TSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 130 °C	450	A
I2t value	I^2t	Single Half Sine Wave, t_p = 10 ms	T_j = 130 °C	1010	A^2s
Mean total power loss	$P_{tot}(AV)$	$T_j = T_{jmax}$	T_s = 80 °C	67	W
Maximum Junction Temperature	T_{jmax}			130	°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	78	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	740	A
Surge current capability	I^2t			2740	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	88	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
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
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0015	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125	1,35	1,74 1,98	2,05(2)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			250	µA
Gate-emitter leakage current	I_{GES}		30	0		25			600	nA
Internal gate resistance	r_g							6		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		2530		pF
Output capacitance	C_{oes}							132		pF
Reverse transfer capacitance	C_{res}							115		pF
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,97		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 32 Ω R_{goff} = 16 Ω	0/15	700	35	25 125		87 84		ns
Rise time	t_r					25 125		20 22		ns
Turn-off delay time	$t_{d(off)}$					25 125		521 615		ns
Fall time	t_f					25 125		50,22 141,88		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=2,75 µC Q_{rFWD}=5,03 µC				25 125		3,49 4,47		mWs
Turn-off energy (per pulse)	E_{off}					25 125		2,68 4,32		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				25	25 125	1,23	1,78 1,8	1,97(2)	V
Reverse leakage current	I_R	V_r = 1200 V				25			20	µA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,72		K/W
Dynamic										
Peak recovery current	I_{RM}	d*i*/d*t*=2239 A/µs d*i*/d*t*=2068 A/µs	0/15	700	35	25 125		37,42 45,3		A
Reverse recovery time	t_{rr}					25 125		301,34 419,53		ns
Recovered charge	Q_r					25 125		2,75 5,03		µC
Reverse recovered energy	E_{rec}					25 125		1,04 2,06		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		2619 1765		A/µs
Brake Sw. Protection Diode										
Static										
Forward voltage	V_F				3	25 125	1,23	1,66 1,59	1,97(2)	V
Reverse leakage current	I_R	V_r = 1200 V				25			27	µA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						3,72		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										
Direct reverse current	I_{RD}	V_r = 1600 V				25			200	µA
Holding current	I_H	I_T = A				25			165	mA
Latching current	I_L	t_p = µs I_G = A di_G/dt = A/µs				25			330	mA
Gate trigger voltage	V_{GT}					25			1,98	V
Gate trigger current	I_{GT}					25			100	mA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,75		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				80	25 125 150		1,18 1,15	1,23(2) 1,17(2)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			50 1500	µA
Thermal										
Thermal resistance junction to sink(3)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W

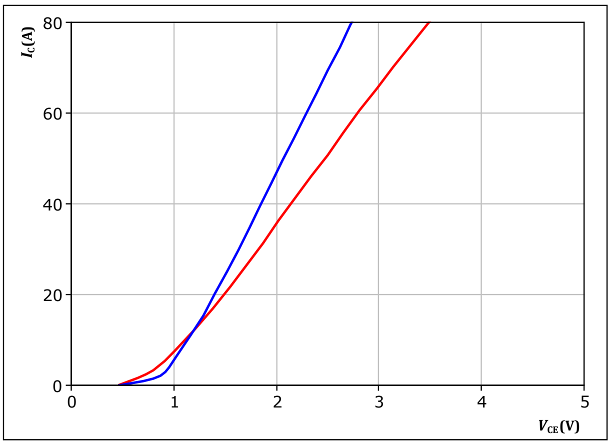
(2) Value at chip level
(3) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

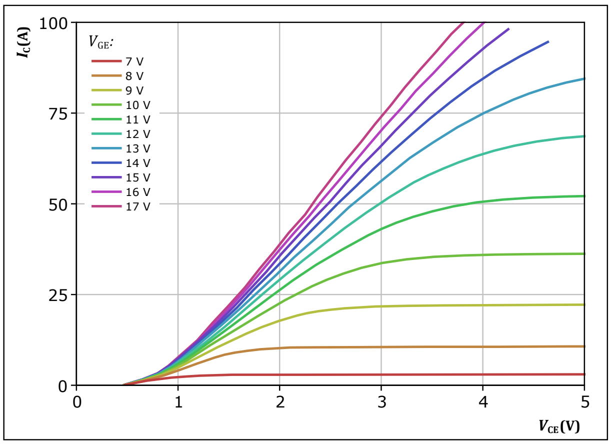


t_p =	250	µs	T_j:	25 °C
V_{GE} =	15	V		125 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



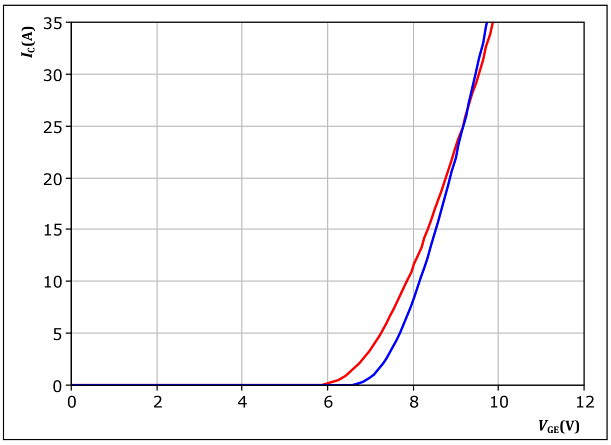
t_p =	250	µs
T_j =	125	°C

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

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})

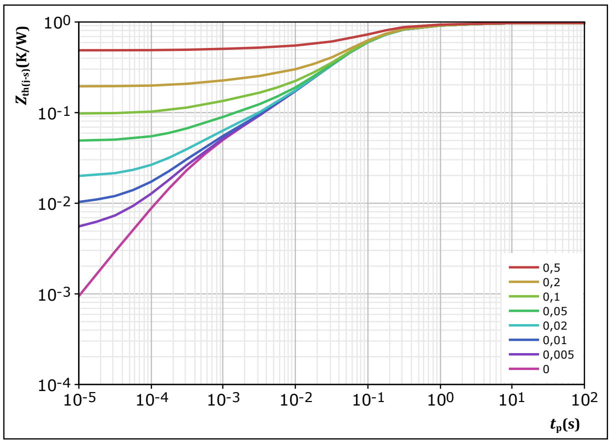


t_p =	250	µs	T_j:	25 °C
V_{CE} =	10	V		125 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,974	K/W

IGBT thermal model values

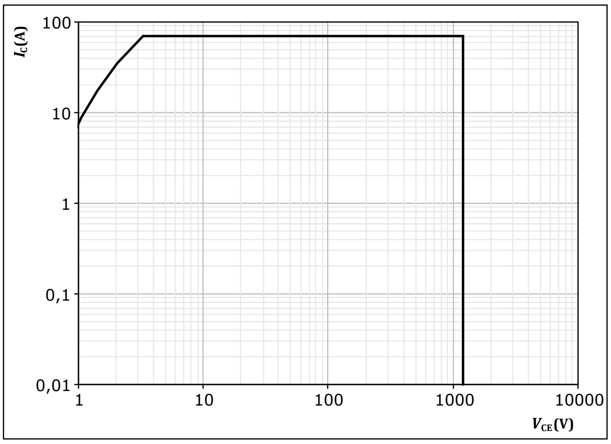
R (K/W)	τ (s)
6,59E-02	3,01E+00
1,61E-01	3,99E-01
6,07E-01	8,47E-02
7,79E-02	1,42E-02
3,57E-02	2,31E-03
2,73E-02	4,08E-04

Brake Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



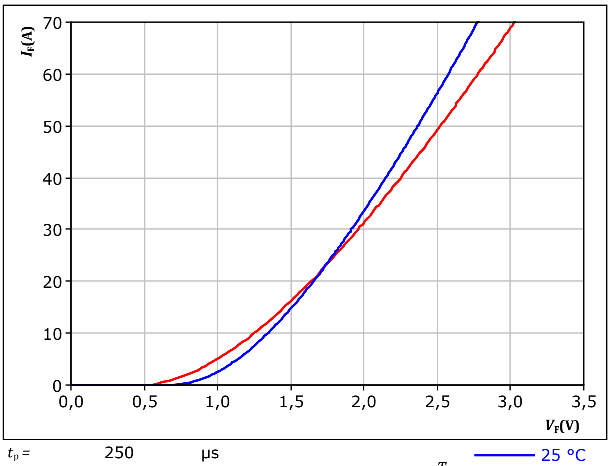
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



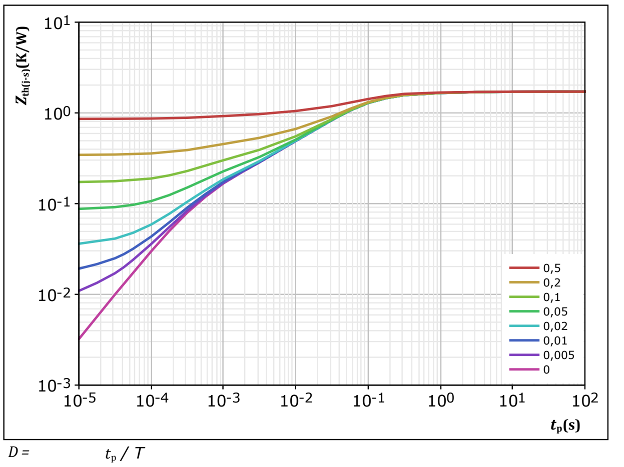
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,717 K/W

FWD thermal model values

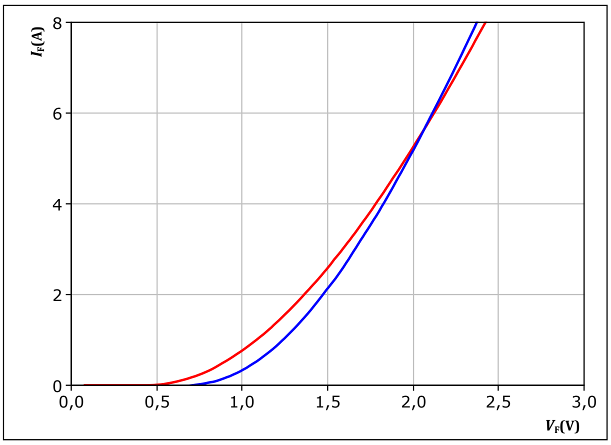
R (K/W)	τ (s)
5,74E-02	3,42E+00
1,85E-01	4,11E-01
9,45E-01	7,07E-02
2,69E-01	1,95E-02
1,43E-01	3,59E-03
1,19E-01	4,63E-04

Brake Sw. Protection Diode Characteristics

figure 8. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



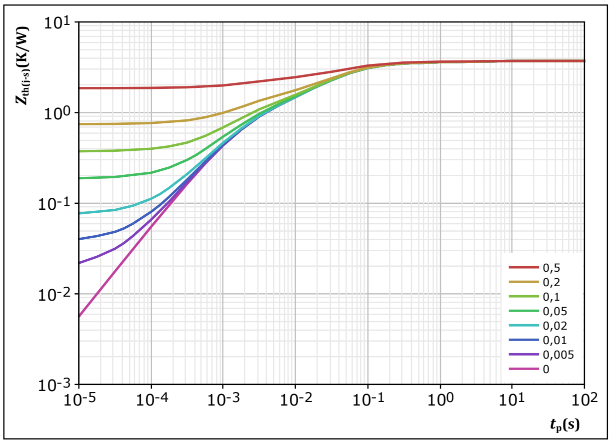
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 9. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 3,715 K/W

FWD thermal model values

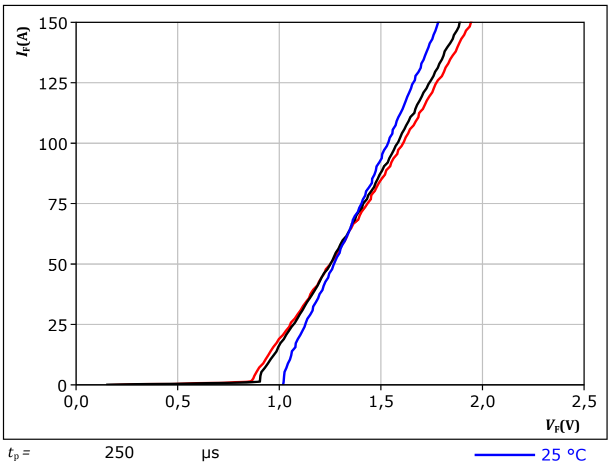
R (K/W)	τ (s)
1,58E-01	3,25E+00
5,74E-01	1,68E-01
1,74E+00	4,01E-02
5,91E-01	8,37E-03
6,54E-01	1,47E-03

Rectifier Thyristor Characteristics

figure 10. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



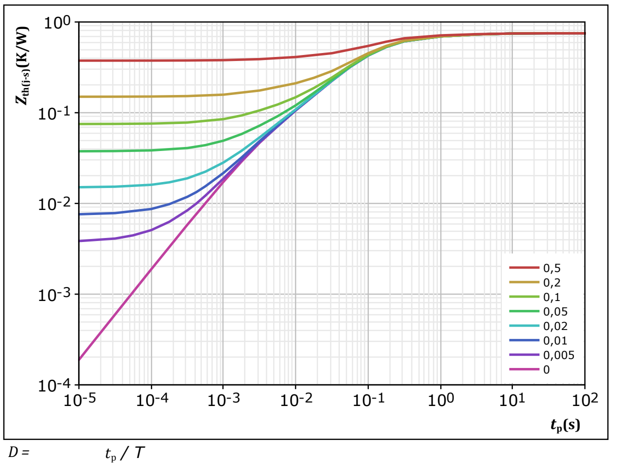
t_p = 250 µs

T_j: 25 °C, 100 °C, 125 °C

figure 11. **Thyristor**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 0,75 K/W

Thyristor thermal model values

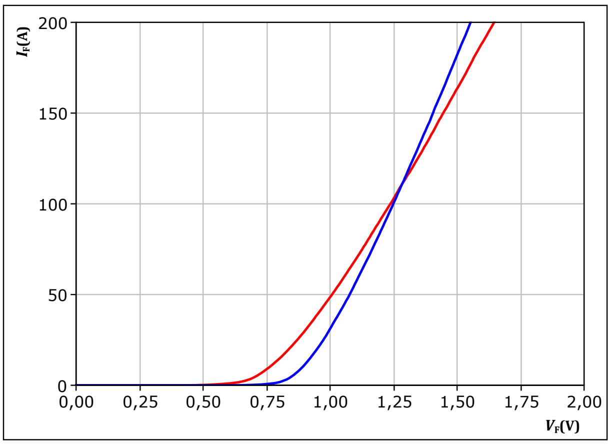
R (K/W)	τ (s)
5,49E-02	3,39E+00
1,27E-01	4,99E-01
4,30E-01	1,03E-01
1,02E-01	3,06E-02
3,72E-02	3,32E-03

Rectifier Diode Characteristics

figure 12. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



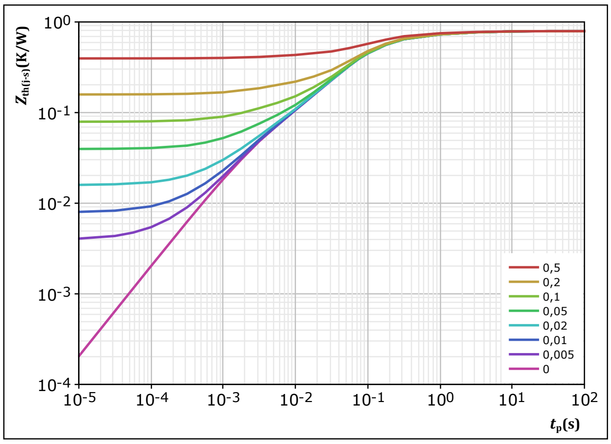
t_p =	250	µs

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	
$R_{th(j-s)}$ =	0,792	K/W

Rectifier thermal model values

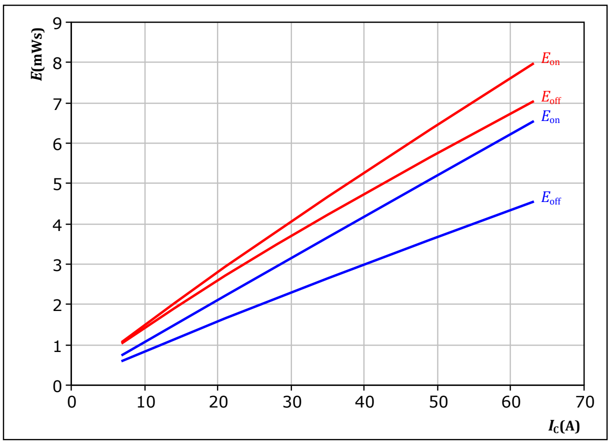
R (K/W)	τ (s)
3,05E-02	5,90E+00
8,93E-02	1,13E+00
2,82E-01	1,79E-01
3,51E-01	6,17E-02
3,93E-02	3,00E-03

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

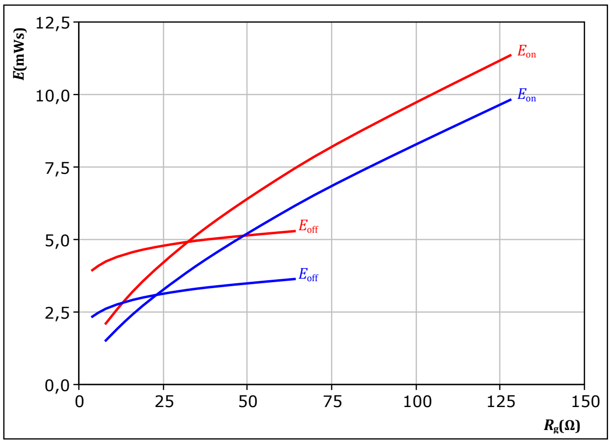
V_{CE} =	700	V	
V_{GE} =	0/15	V	
R_{gon} =	32	Ω	
R_{goff} =	16	Ω	

T_j: 25 °C, 125 °C

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

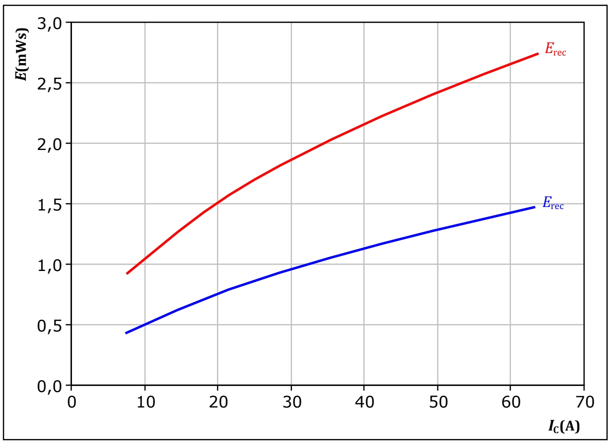
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

T_j: 25 °C, 125 °C

figure 16. **FWD**

Typical reverse recovered energy loss as a function of collector current

E_{rec} = f(I_C)



With an inductive load at

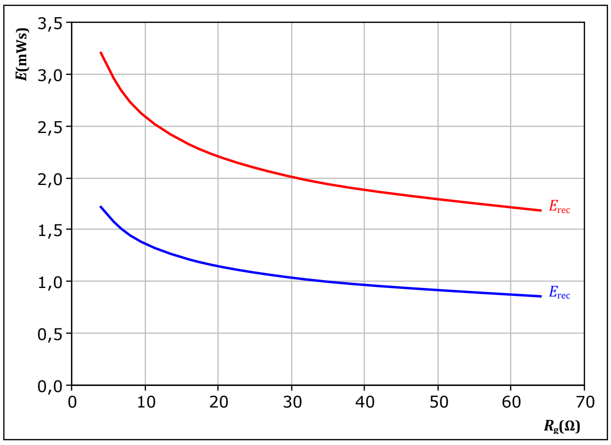
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	32	Ω

T_j: 25 °C, 125 °C

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

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

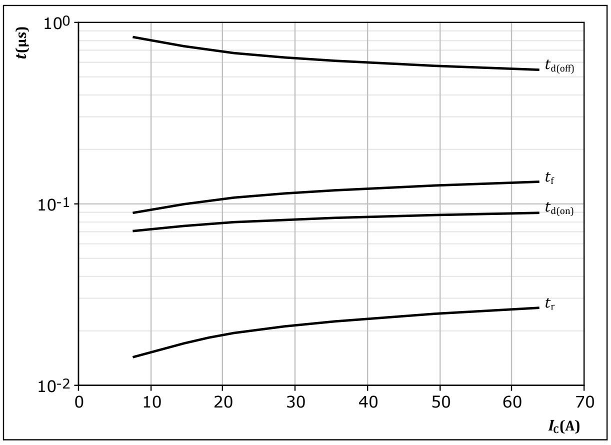
T_j: 25 °C, 125 °C

Brake Switching Characteristics

figure 18. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



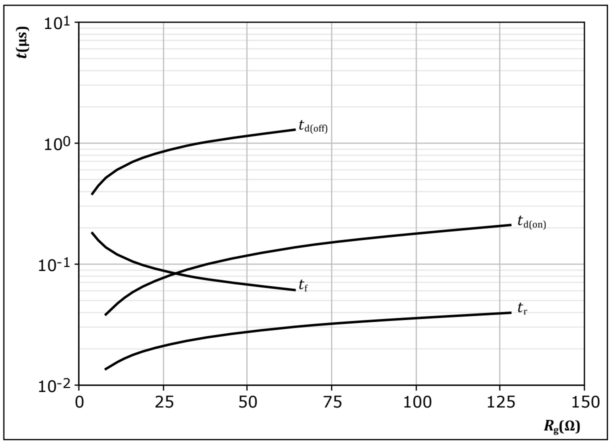
With an inductive load at

T_j =	125	°C
V_{CE} =	700	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)



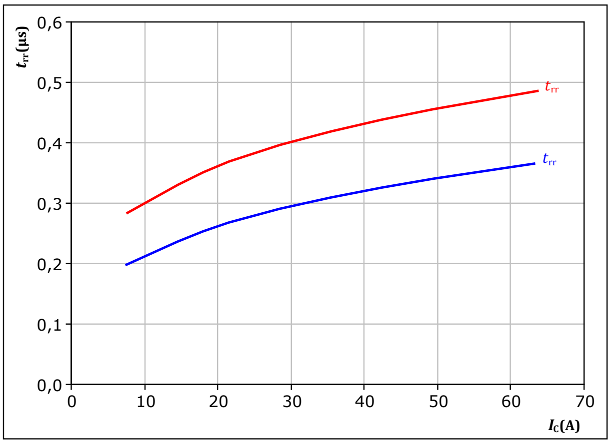
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

figure 20. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

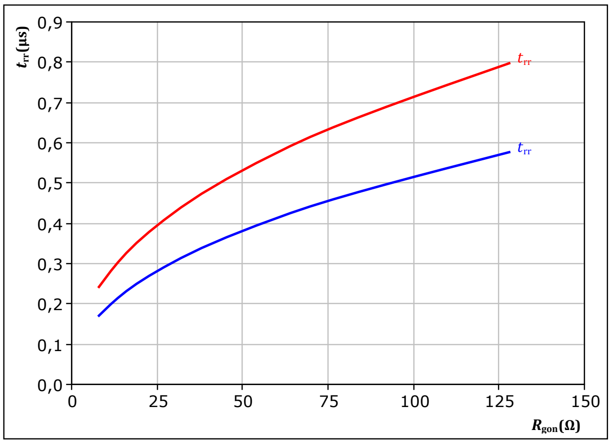
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	32	Ω

T_j: 25 °C, 125 °C

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

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

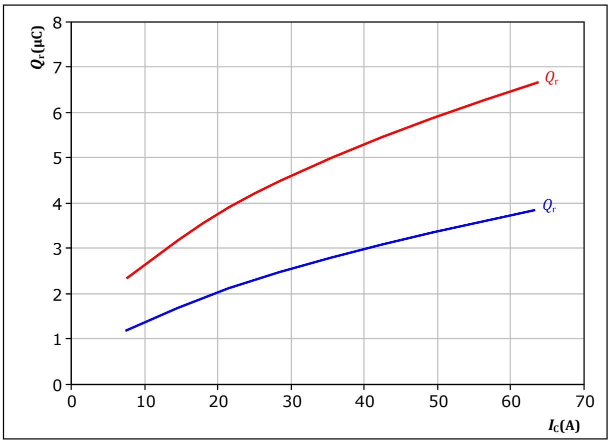
T_j: 25 °C, 125 °C

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

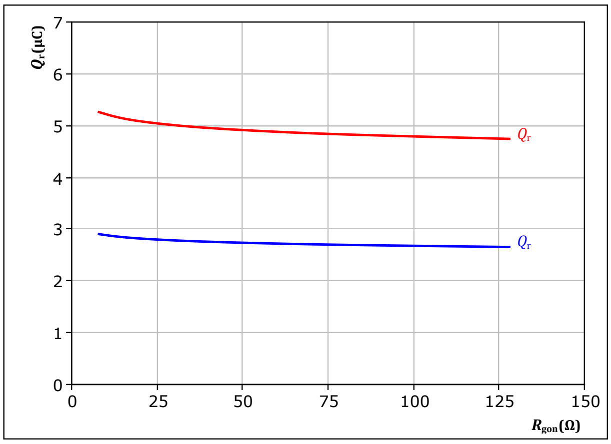
T_j: 25 °C, 125 °C

V_{CE} =	700	V
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

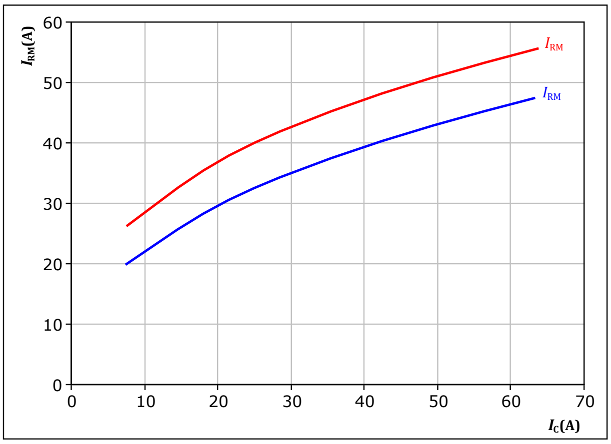
T_j: 25 °C, 125 °C

V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	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

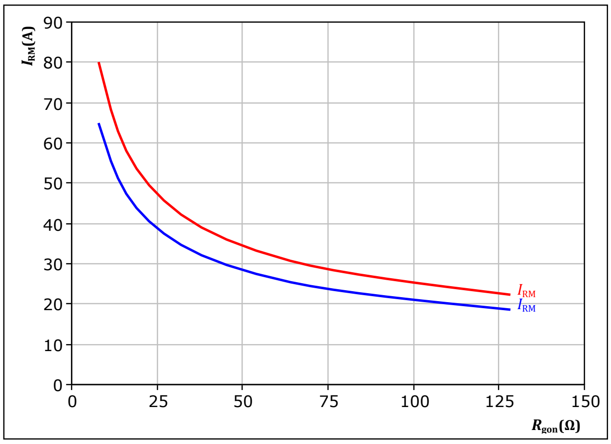
T_j: 25 °C, 125 °C

V_{CE} =	700	V
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

T_j: 25 °C, 125 °C

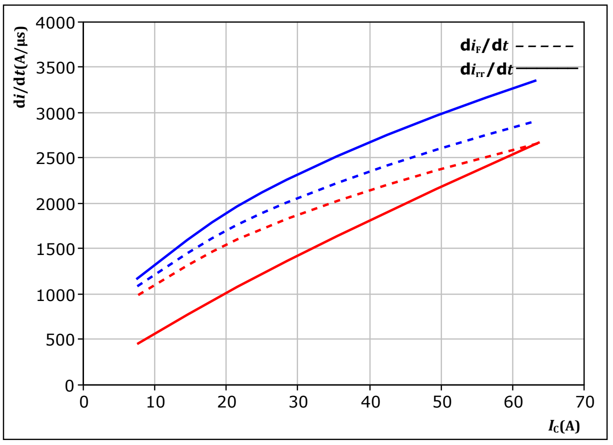
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	35	A

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

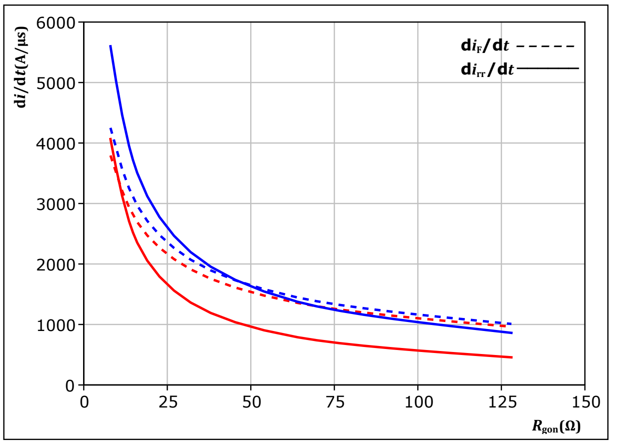
V_{CE} =	700	V	
V_{GE} =	0/15	V	
R_{gon} =	32	Ω	

T_j: 25 °C, 125 °C

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

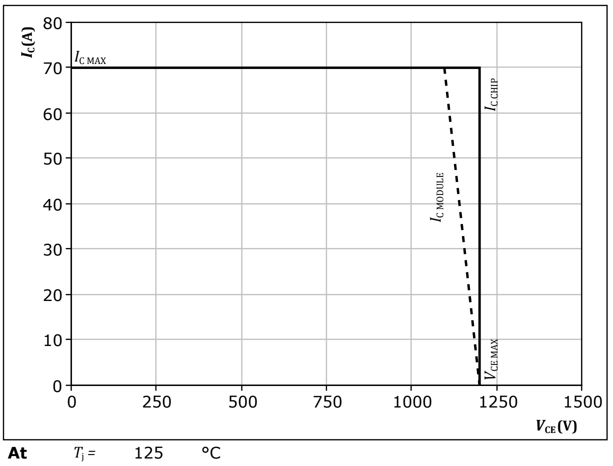
V_{CE} =	700	V	
V_{GE} =	0/15	V	
I_C =	35	A	

T_j: 25 °C, 125 °C

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})

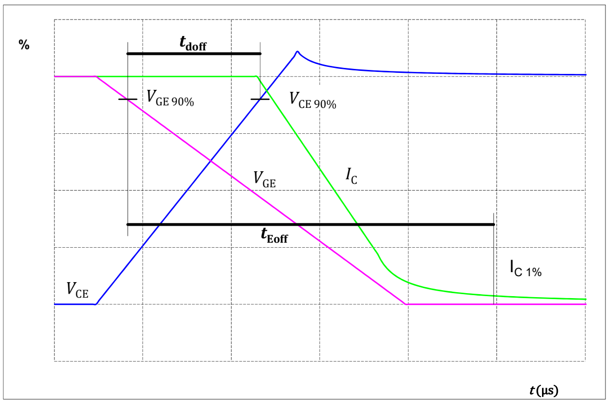


figure 30. **IGBT**

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

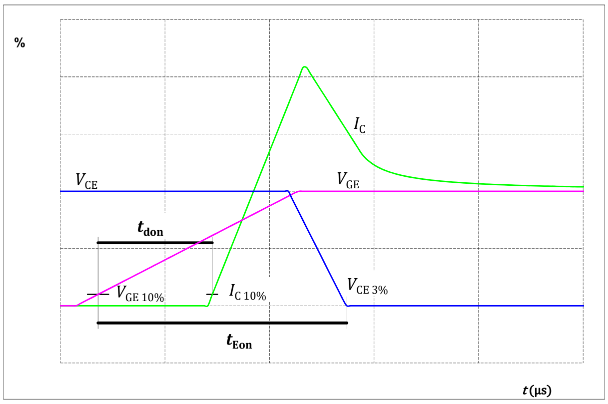


figure 31. **IGBT**

Turn-off Switching Waveforms & definition of t_f

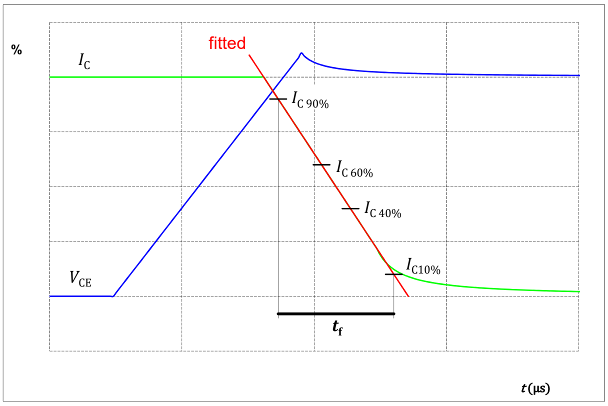
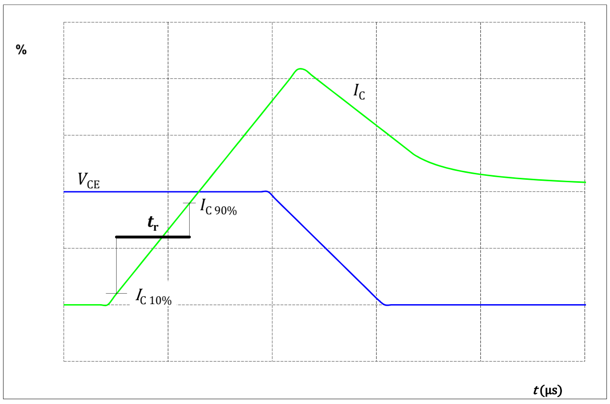


figure 32. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 33. **FWD**

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

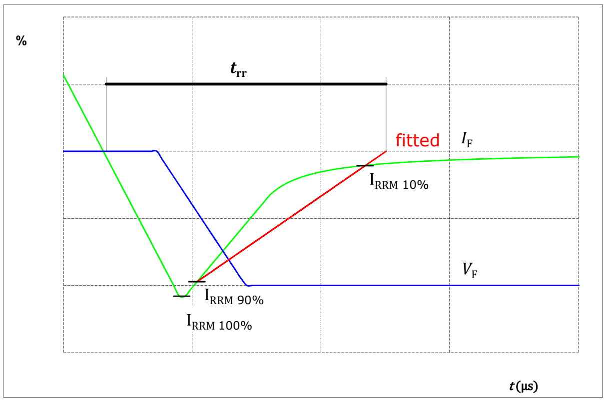
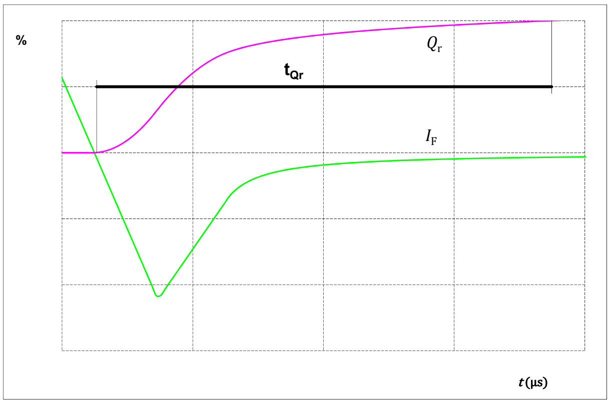


figure 34. **FWD**

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



Ordering Code

Version	Ordering Code
Without thermal paste	V23990-P640-G10-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P640-G10-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P640-G10-/3/-PM

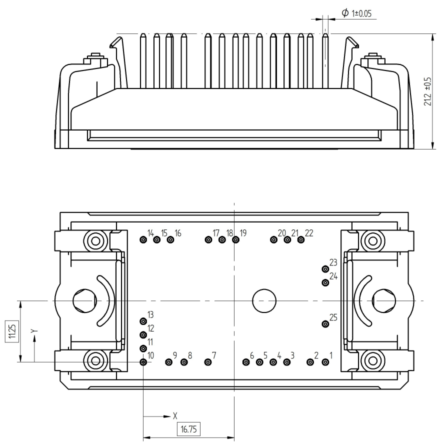
Marking

	**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

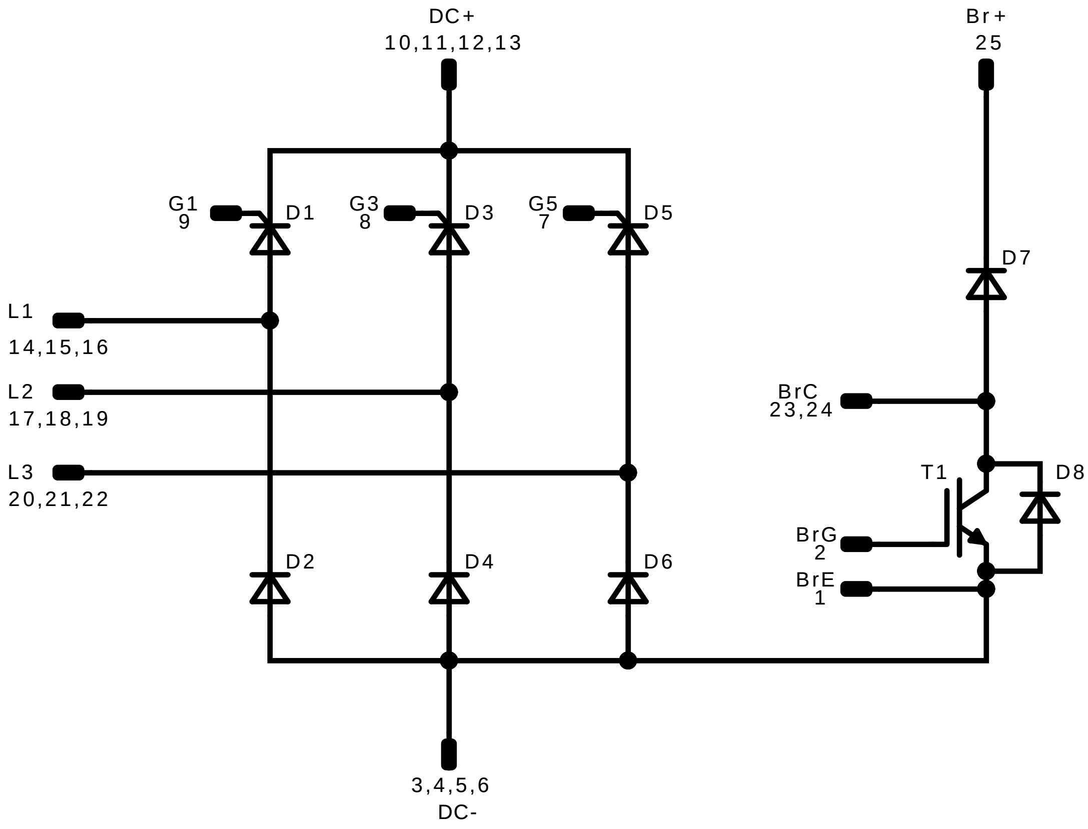
Pin table [mm]

Pin	X	Y	Function
1	33,5	0	BrE
2	30,7	0	BrG
3	26,4	0	DC-
4	23,9	0	DC-
5	21,4	0	DC-
6	18,9	0	DC-
7	11,9	0	G5
8	7,5	0	G3
9	4,7	0	G1
10	0	0	DC+
11	0	2,5	DC+
12	0	5	DC+
13	0	7,5	DC+
14	0	22,5	L1
15	2,5	22,5	L1
16	5	22,5	L1
17	12	22,5	L2
18	14,5	22,5	L2
19	17	22,5	L2
20	24	22,5	L3
21	26,5	22,5	L3
22	29	22,5	L3
23	33,5	17,1	BrC
24	33,5	14,6	BrC
25	33,5	7	Br+



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	35 A	Brake Switch	
D7	FWD	1200 V	25 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Sw. Protection Diode	
D1, D3, D5	Thyristor	1600 V	55 A	Rectifier Thyristor	
D2, D4, D6	Rectifier	1600 V	80 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-P640-G10-PM-D3-14	7 May. 2023	New Datasheet format, module is unchanged Updated Rectifier Thyristor characteristic	