V23990-P640-G-PM
datasheet

Vincotech

***flow*CON 0** — **1600 V / 75 A**

Features

- Three-phase input rectifier
- Brake chopper

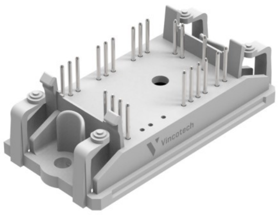
Target applications

- Industrial Drives
- Embedded Drives
- UPS

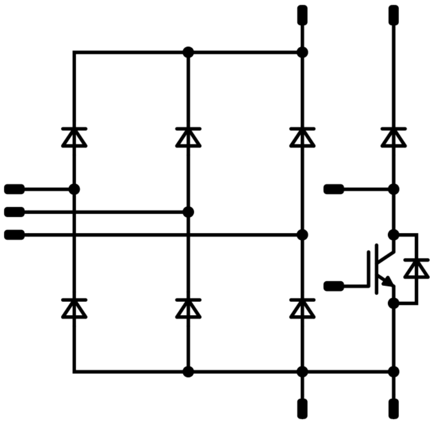
Types

- V23990-P640-G-PM

flow 0 17 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	78	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz 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

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Brake Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector 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
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	23	A
Repetitive peak forward current	I_{FRM}			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
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	4	A
Repetitive peak forward current	I_{FRM}			6	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	19	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min. 12,7	mm
Clearance				min. 12,7	mm
Comparative Tracking Index	CTI			> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			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		1,18 1,15	1,23	V
Reverse leakage current	I_R			1600		25 150			50 1500	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			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	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		
Reverse transfer capacitance	C_{res}							115		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	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		
Turn-off delay time	$t_{d(off)}$					25 125		521 615		
Fall time	t_f					25 125		50 142		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 2,8 µC Q_{rFWD} = 5 µC				25 125		3,49 4,47		mWs
Turn-off energy (per pulse)	E_{off}					25 125		2,68 4,32		

Characteristic Values

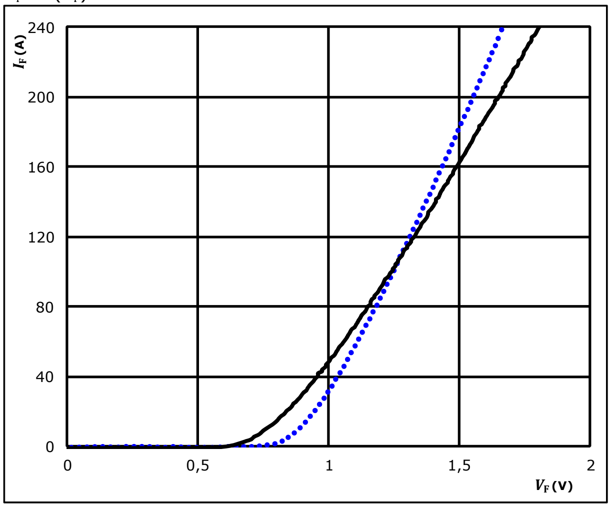
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Brake Diode										
Static										
Forward voltage	V_F				25	25 125		1,79 1,80		V
Reverse leakage current	I_R			1200		25			27	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,72		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		37 45		A
Reverse recovery time	t_{rr}					25 125		301 420		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		1,66 1,59		V
Reverse leakage current	I_R			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						3,72		K/W

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 μs

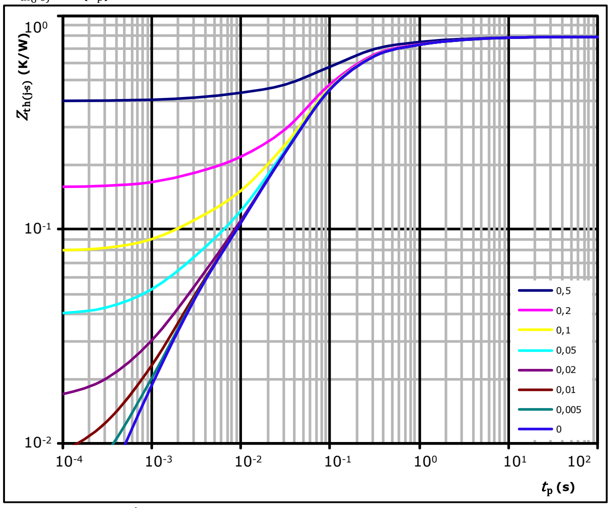
T_j: 25 °C (dotted)

125 °C (solid)

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 0,79 K/W

Diode thermal model values

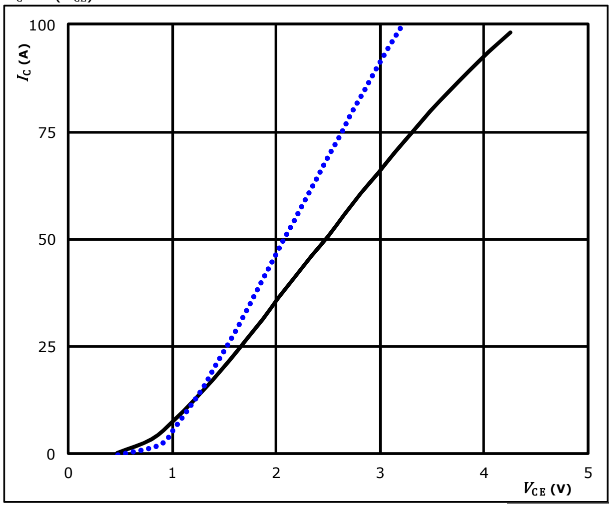
R (K/W)	τ (s)
3,05E-02	5,20E+00
8,93E-02	9,97E-01
2,82E-01	1,58E-01
3,51E-01	5,43E-02
3,93E-02	2,64E-03

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

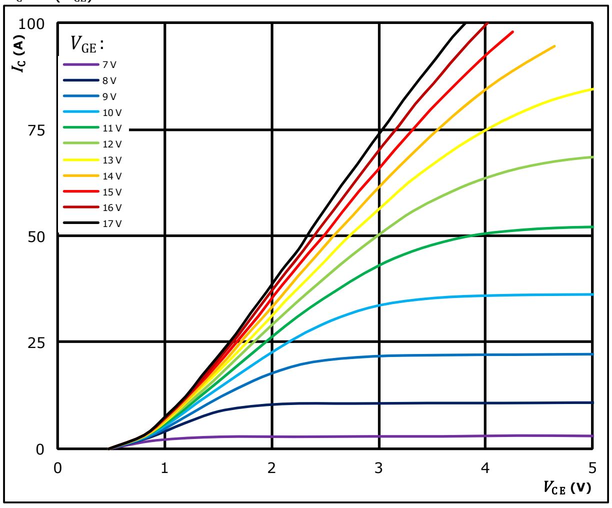


t_p =	250	µs	T_j:	25 °C	dotted
V_{GE} =	15	V		125 °C	solid

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



t_p = 250 µs

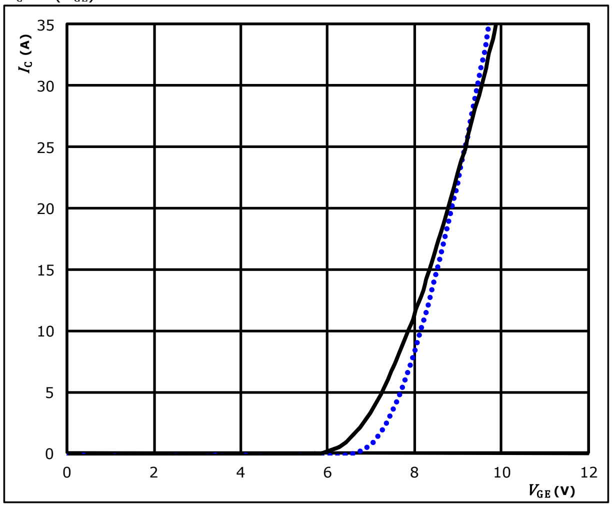
T_j = 125 °C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

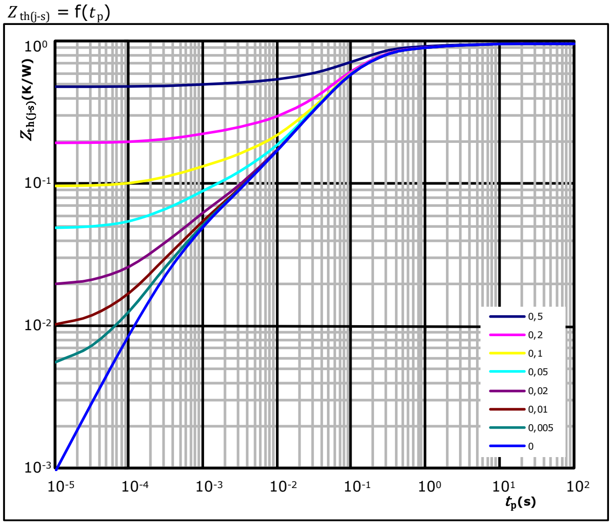


t_p =	100	µs	T_j:	25 °C	dotted
V_{CE} =	10	V		125 °C	solid

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 0,97 K/W

IGBT thermal model values

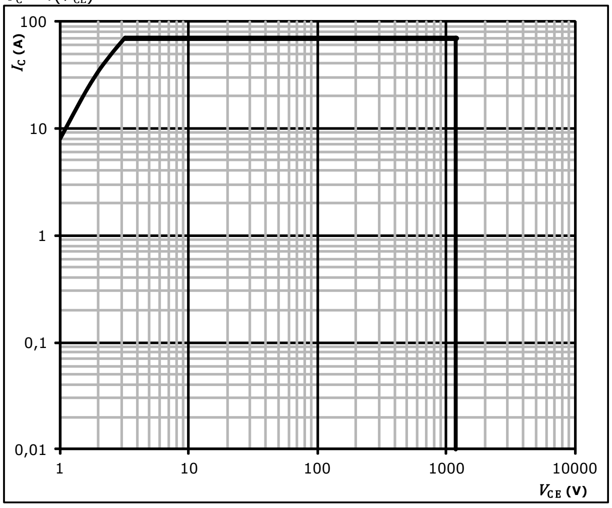
R (K/W)	τ (s)
6,59E-02	3,01E+00
1,61E-01	3,99E-01
6,07E-01	8,47E-02
7,79E-02	1,42E-02
3,57E-02	2,31E-03
2,73E-02	4,08E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



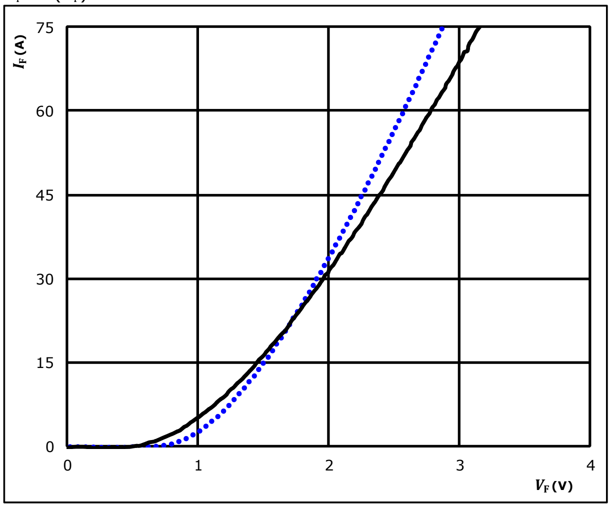
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



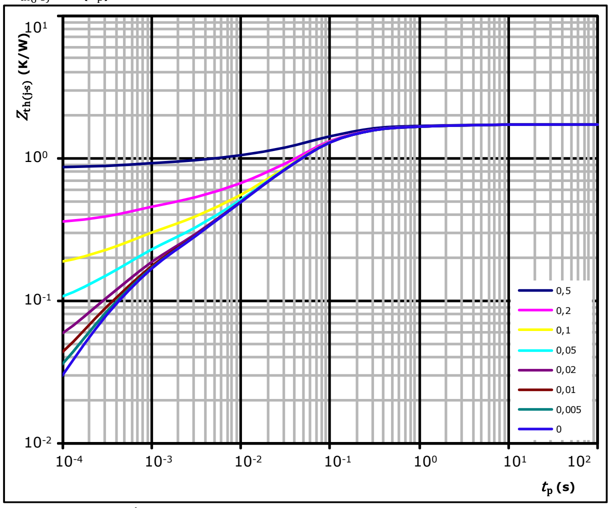
t_p = 250 µs

T_j: 25 °C (dotted); 125 °C (solid)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,72 K/W

FWD thermal model values

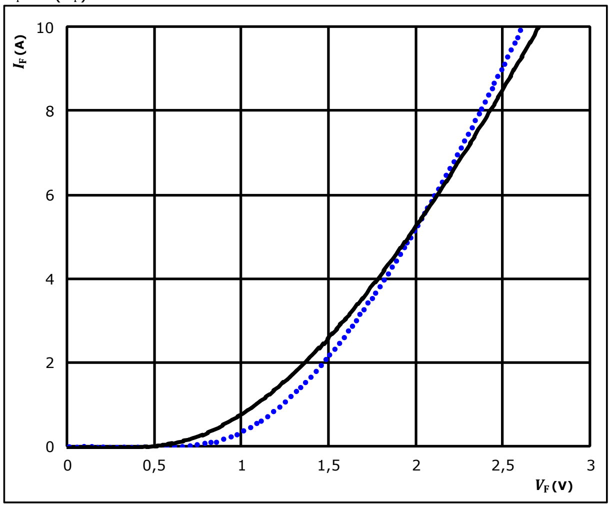
R (K/W)	τ (s)
5,74E-02	3,42E+00
1,85E-01	4,11E-01
9,45E-01	7,07E-02
2,69E-01	1,95E-02
1,43E-01	3,59E-03
1,19E-01	4,63E-04

Brake Sw. Protection Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



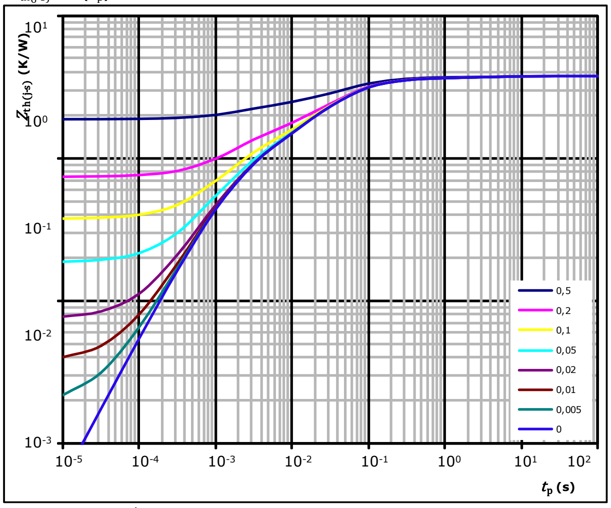
t_p = 250 µs

T_j: 25 °C (dotted), 125 °C (solid)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 3,72 K/W

FWD thermal model values

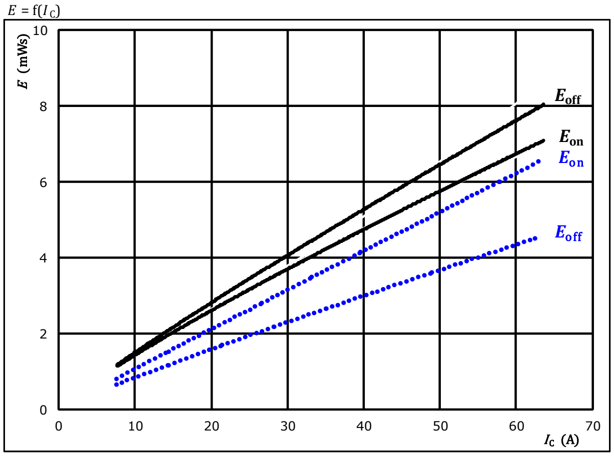
R (K/W)	τ (s)
1,58E-01	3,25E+00
5,74E-01	1,68E-01
1,74E+00	4,01E-02
5,91E-01	8,37E-03
6,54E-01	1,47E-03

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



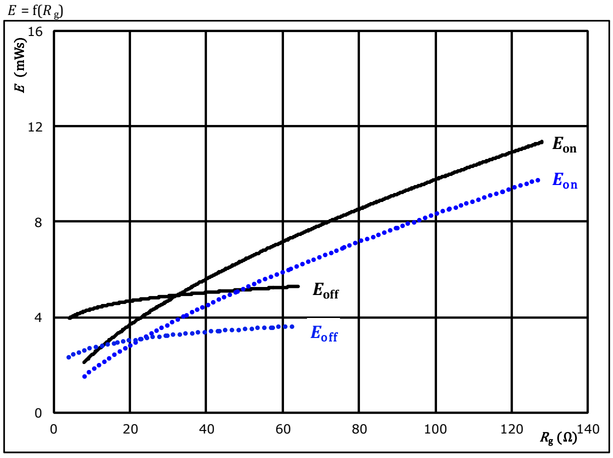
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	32	Ω			
R_{goff} =	16	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



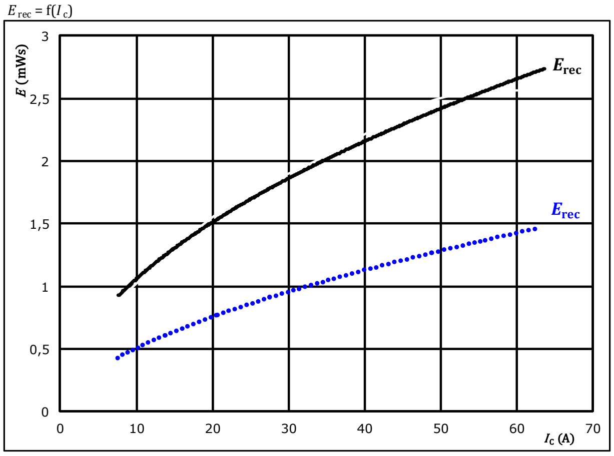
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
I_C =	35	A			

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



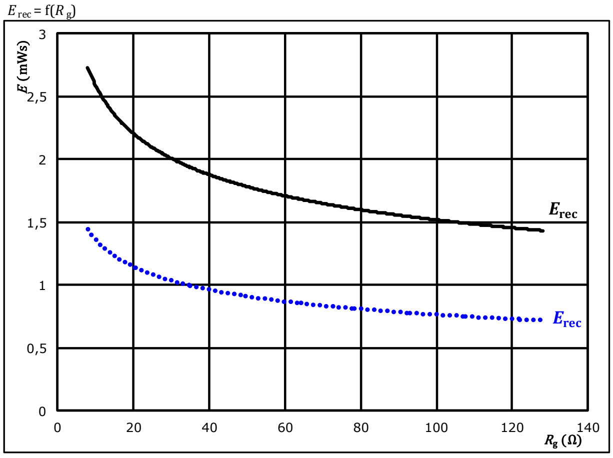
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	32	Ω			

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

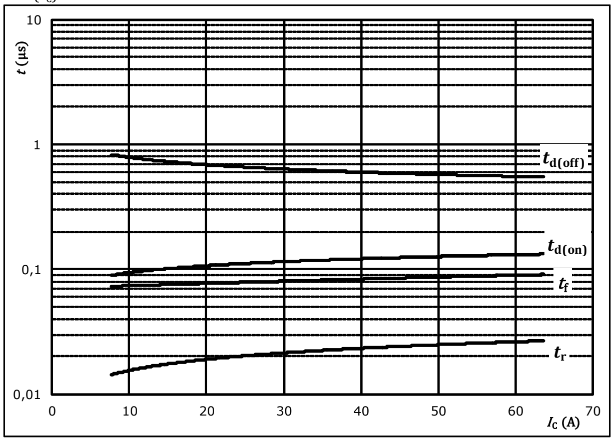
V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
I_C =	35	A			

Brake Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



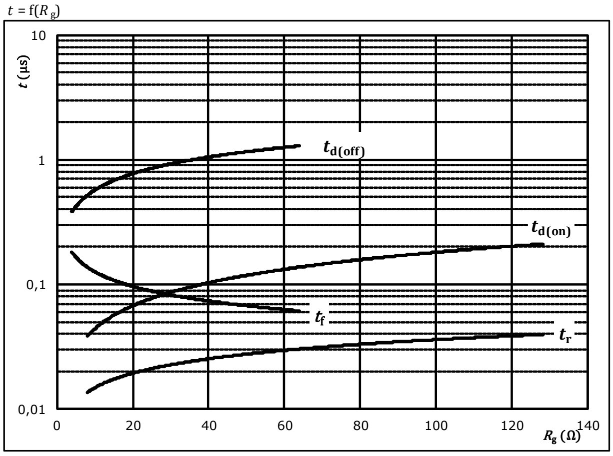
With an inductive load at

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

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



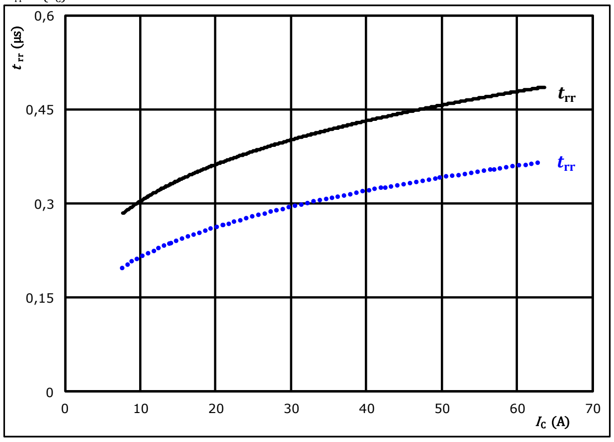
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

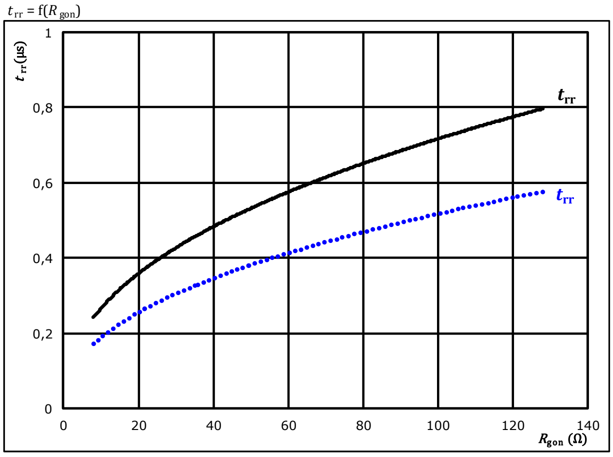
V_{CE} =	700	V
V_{GE} =	0 / 15	V
R_{gon} =	32	Ω

T_j: 25 °C (dotted), 125 °C (solid)

figure 8. **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

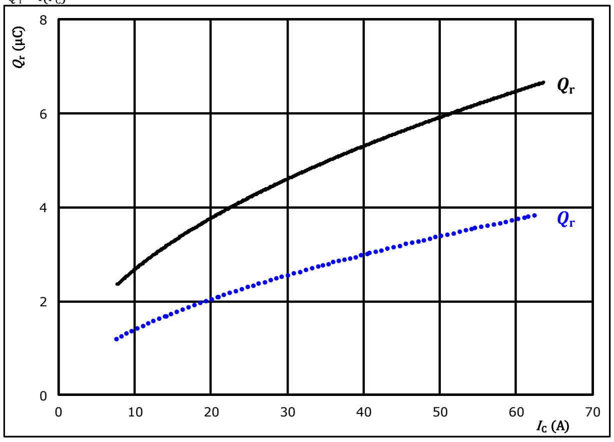
T_j: 25 °C (dotted), 125 °C (solid)

Brake Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



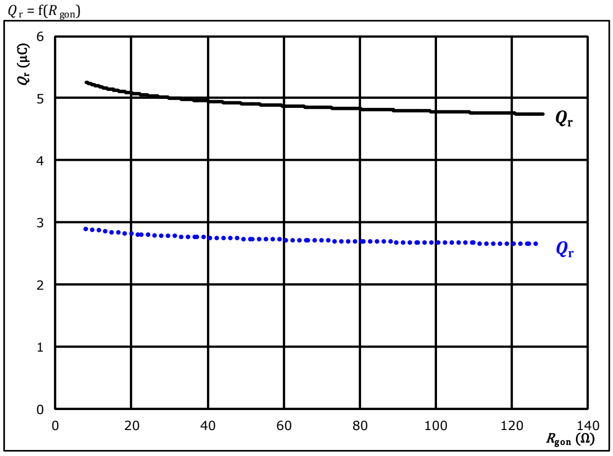
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	32	Ω		

figure 10. FWD

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

$Q_r = f(R_{gon})$



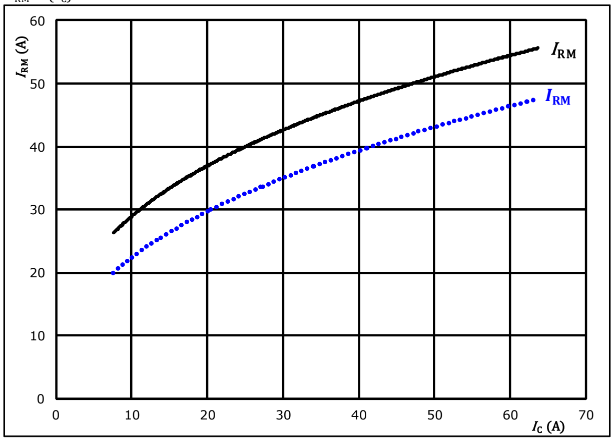
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C =	35	A		

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$



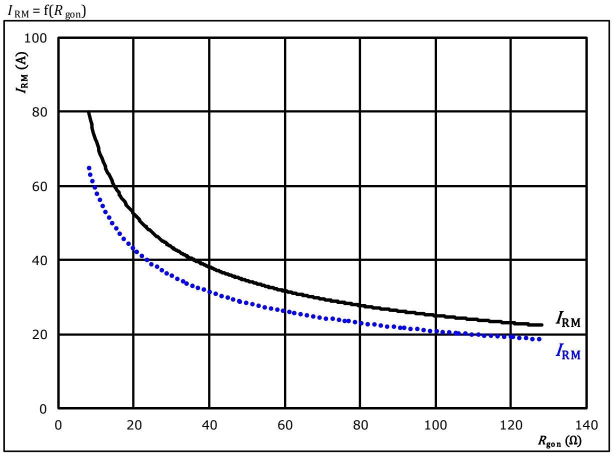
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	32	Ω		

figure 12. 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

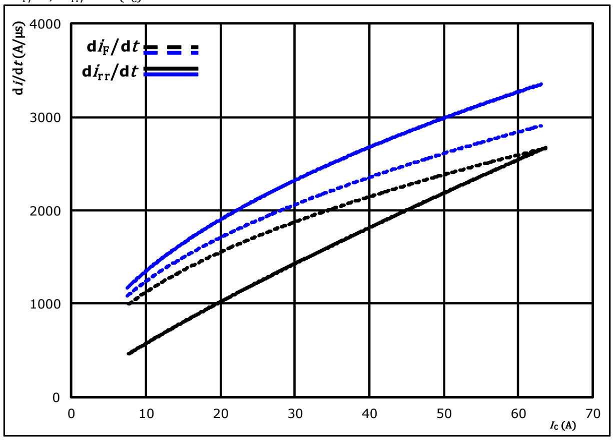
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C =	35	A		

Brake Switching Characteristics

figure 13. **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

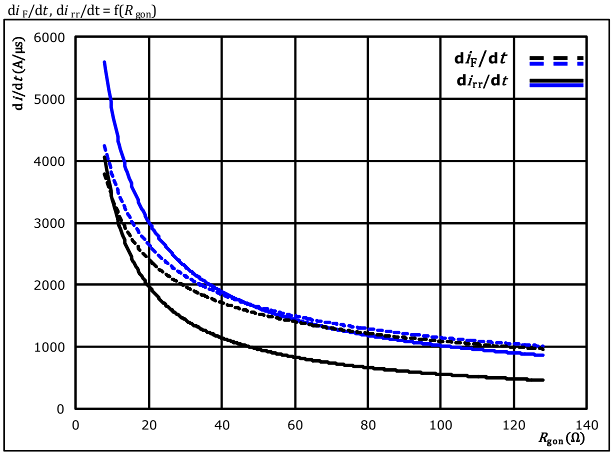
T_j: 25 °C, 125 °C

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

figure 14. **FWD**

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

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



With an inductive load at

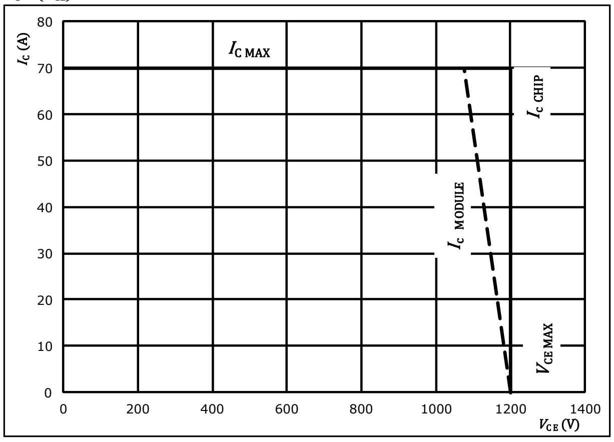
T_j: 25 °C, 125 °C

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

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

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

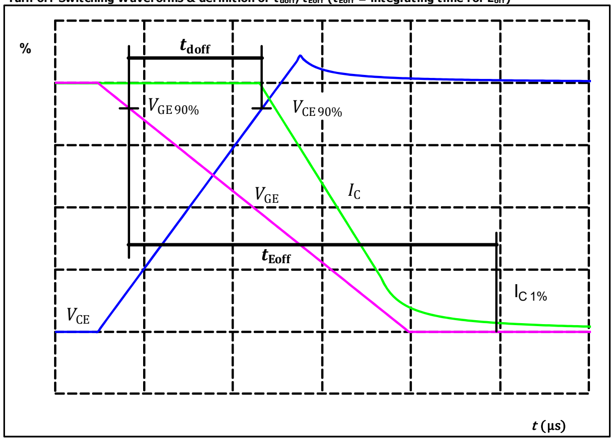
Brake Switching Definitions

General conditions

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

figure 1. IGBT

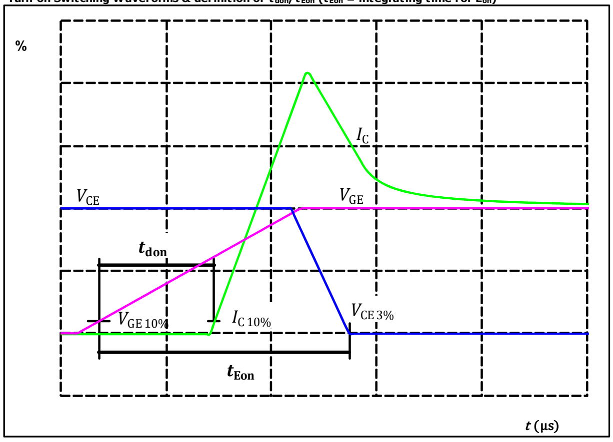
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_{doff} =	615	ns

figure 2. IGBT

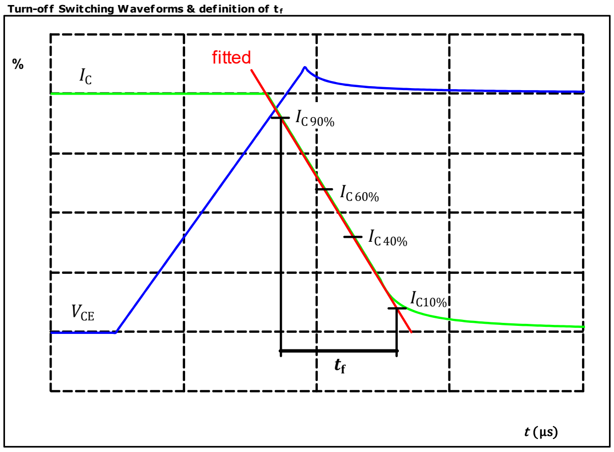
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_{don} =	84	ns

figure 3. IGBT

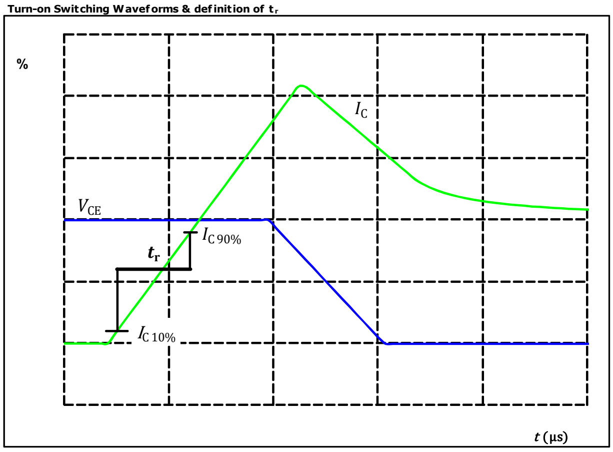
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_f =	142	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

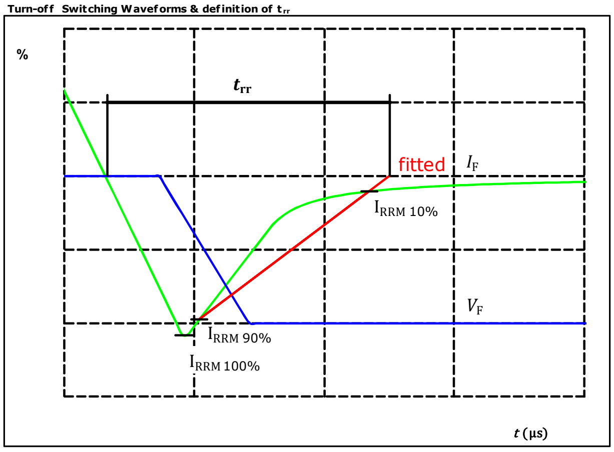


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_r =	22	ns

Brake Switching Characteristics

figure 5.	FWD

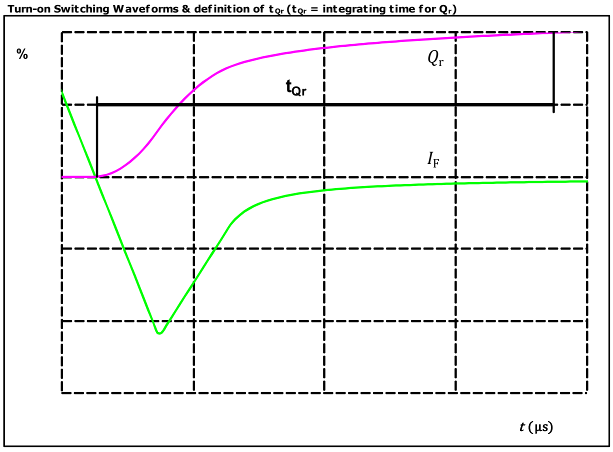
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	700	V
I_F (100%) =	35	A
I_{RRM} (100%) =	45	A
t_{rr} =	420	ns

figure 6.	FWD

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



I_F (100%) =	35	A
Q_r (100%) =	5,03	µC

Vincotech

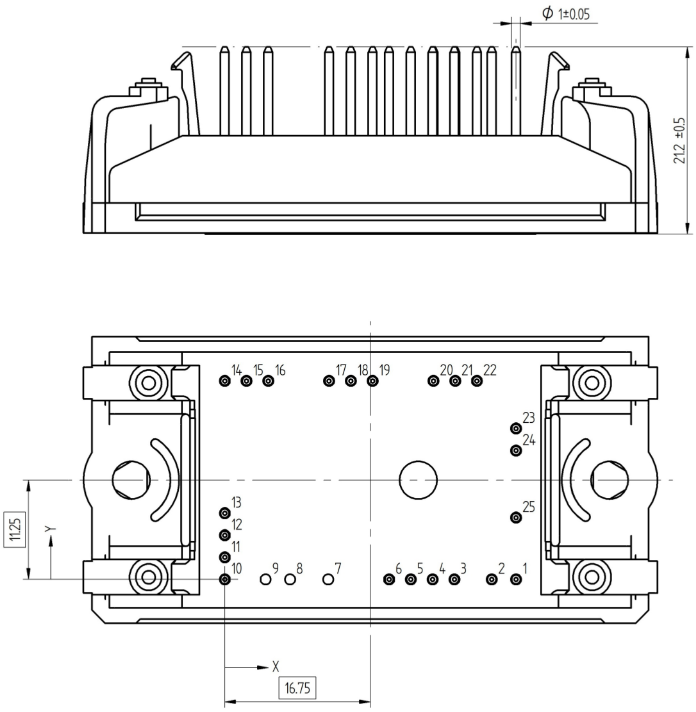
Ordering Code & Marking

Version	Ordering Code
without thermal paste 17 mm housing with solder pins	V23990-P640-G-PM
with thermal paste 17 mm housing with solder pins	V23990-P640-G-/3/-PM

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

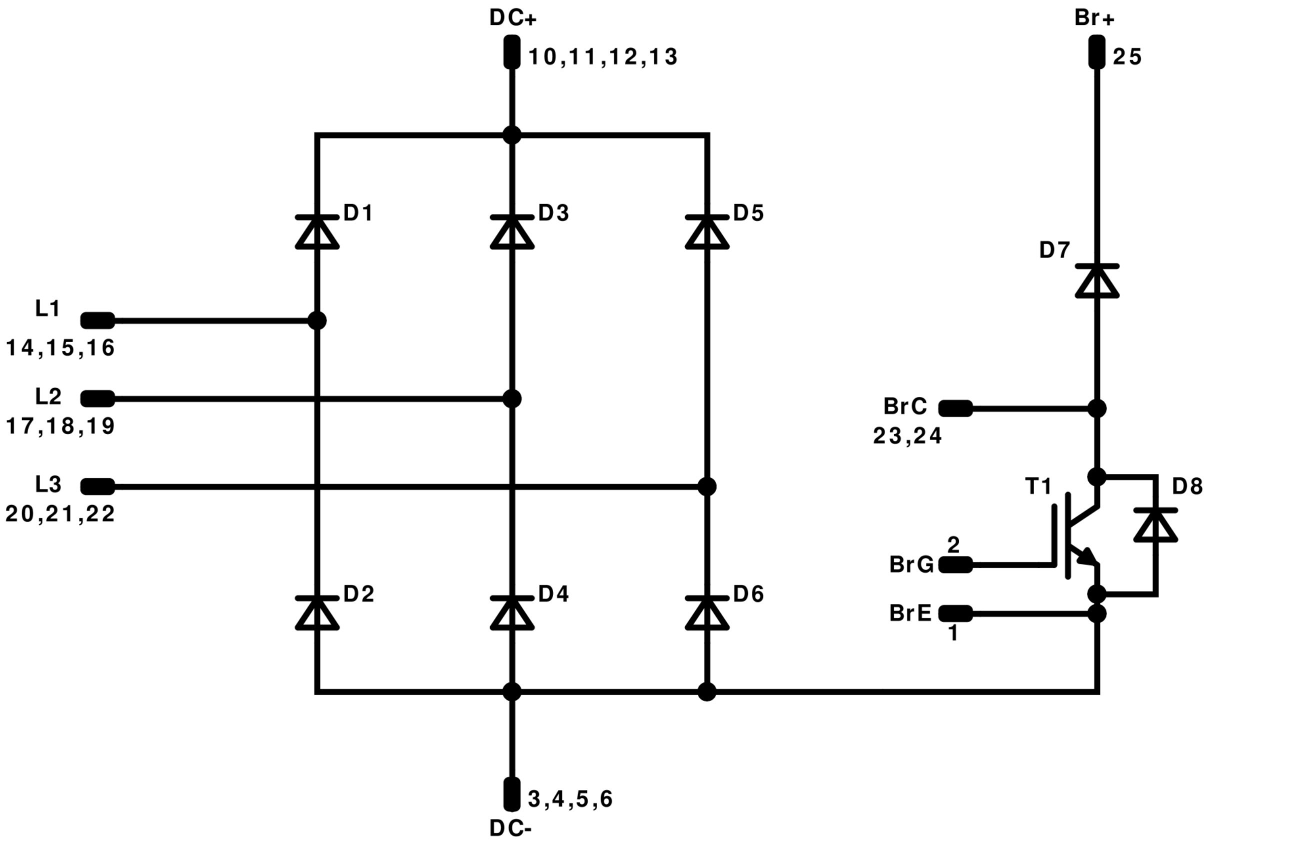
Outline

Pin table			
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	Not assembled		
8	Not assembled		
9	Not assembled		
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
D1, D2, D3, D4, D5, D6	Rectifier	1600 V	80 A	Rectifier Diode	
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	

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.

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-G-D3-14	18 Feb. 2020	Outline correction	1, 17