V23990-P640-G20-PM
datasheet

***flow*CON 0** | **1600 V / 75 A**

Topology features

- Three-phase Rectifier
- 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

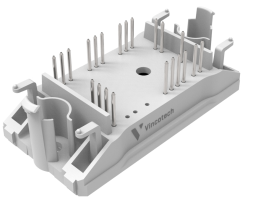
Target applications

- Motor drives
- Servo drives
- UPS

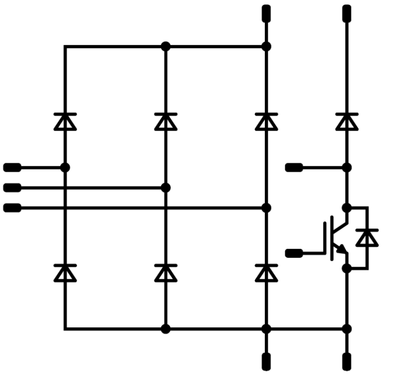
Types

- V23990-P640-G20-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	51	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	121	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 800 V	T_j = 150 °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	29	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	55	W
Maximum junction temperature	T_{jmax}			175	°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	18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			175	°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	69	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	600	A
Surge current capability	I^2t	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	1800	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	84	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				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			≥ 200	

*100 % tested in production

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 Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0017	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 150	1,58	1,88 2,26	2,07(1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			1	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							4		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		2800		pF
Reverse transfer capacitance	C_{res}	f = 1 Mhz	0	25		25		100		pF
Gate charge	Q_g		±15		0	25		380		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	600	35	25 125 150		32 31,4 31,4		ns
Rise time	t_r	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	600	35	25 125 150		17,4 20,4 20,8		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	600	35	25 125 150		372 458,8 481,6		ns
Fall time	t_f	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	600	35	25 125 150		69,36 109,53 121,46		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=2,99 µC Q_{rFWD}=5,05 µC Q_{rFWD}=5,48 µC	0/15	600	35	25 125 150		1,34 1,85 1,98		mWs
Turn-off energy (per pulse)	E_{off}		0/15	600	35	25 125 150		2,16 3,38 3,71		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	25 150	1,35	1,85 1,81	2,05(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			5,2	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,73		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=2725 A/µs d*i*/d*t*=2779 A/µs d*i*/d*t*=2565 A/µs	0/15	600	35	25 125 150		56,24 63,1 63,67		A
Reverse recovery time	t_{rr}					25 125 150		143,44 216,47 259,62		ns
Recovered charge	Q_r					25 125 150		2,99 5,05 5,48		µC
Reverse recovered energy	E_{rec}					25 125 150		1,29 2,25 2,44		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		3694 2204 2005		A/µs

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 Sw. Protection Diode										
Static										
Forward voltage	V_F				10	25 150	1,35	1,86 1,81	2,05(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			2,7	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,14		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				33	25 125		1,05 0,987	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)						0,84		K/W

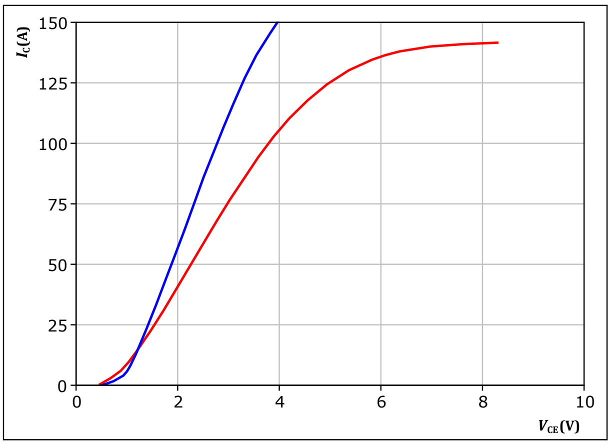
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

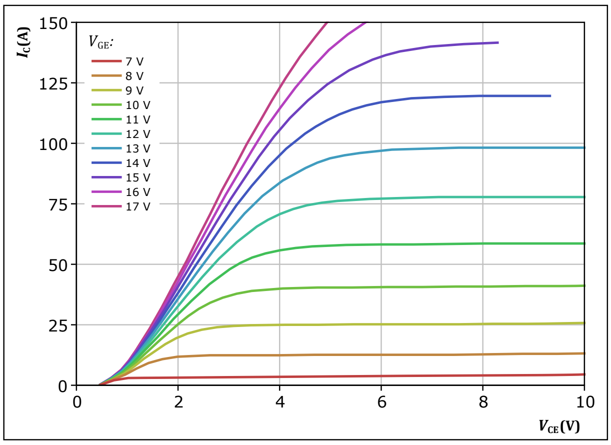


t_p =	250	µs	T_j:	25 °C
V_{GE} =	15	V		150 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



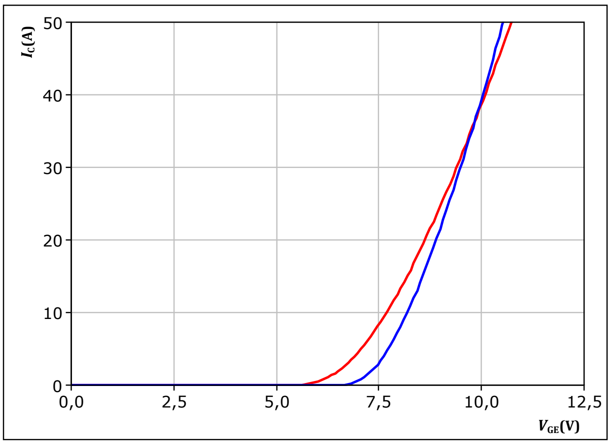
t_p =	250	µs
T_j =	150	°C

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

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})

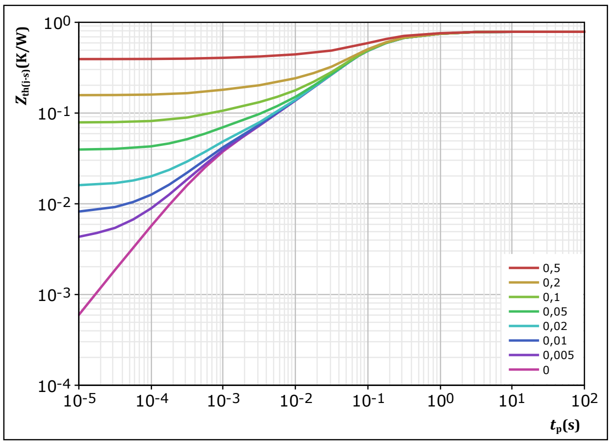


t_p =	250	µs	T_j:	25 °C
V_{CE} =	10	V		150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,787	K/W

IGBT thermal model values

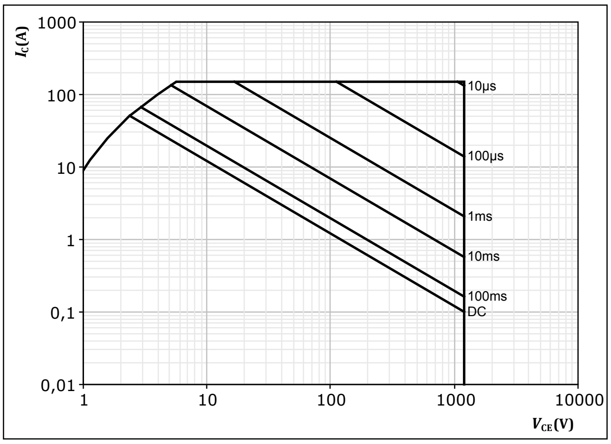
R (K/W)	τ (s)
9,90E-02	1,04E+00
3,13E-01	1,52E-01
3,01E-01	5,53E-02
4,49E-02	5,11E-03
2,87E-02	6,58E-04

Brake Switch Characteristics

figure 5.	**IGBT**

Safe operating area

I_C = f(V_{CE})



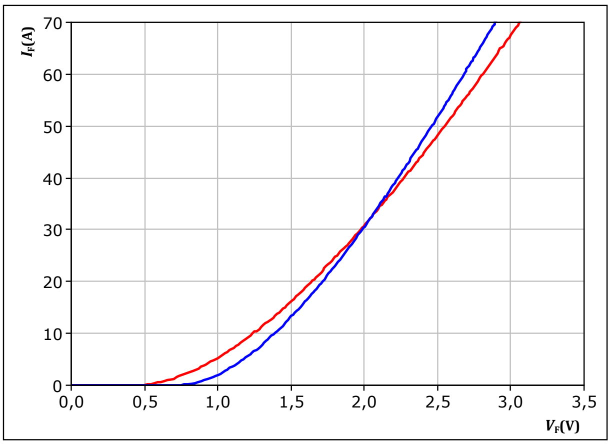
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



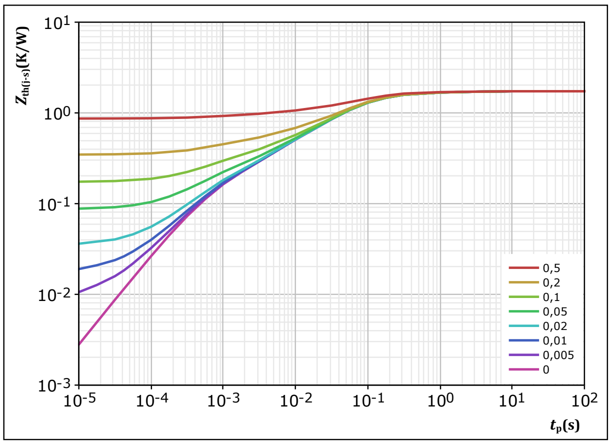
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 1,732 K/W

FWD thermal model values

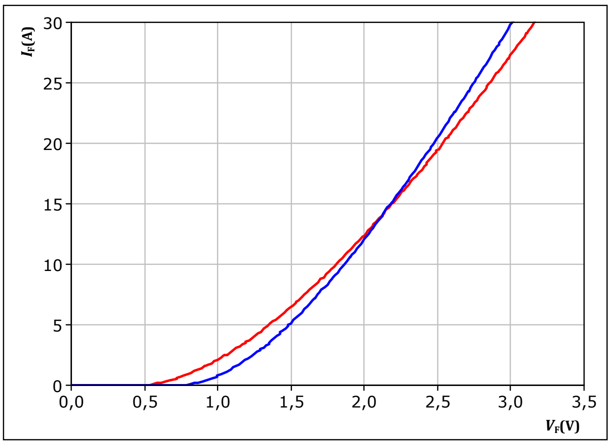
R (K/W)	τ (s)
6,42E-02	2,64E+00
2,01E-01	3,47E-01
9,46E-01	6,90E-02
2,52E-01	1,59E-02
1,45E-01	3,95E-03
1,23E-01	5,74E-04

Brake Sw. Protection Diode Characteristics

figure 8. FWD

Typical forward characteristics

I_F = f(V_F)



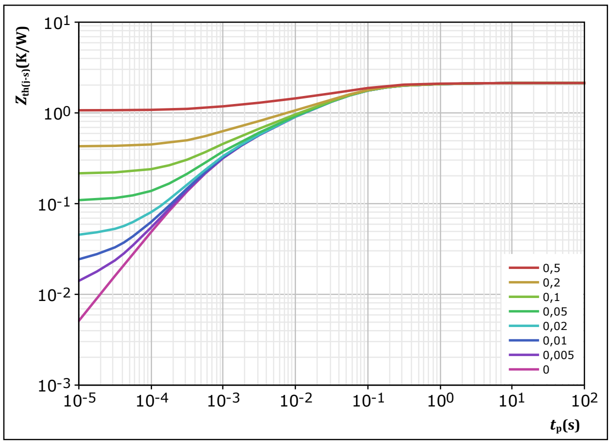
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 9. FWD

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,136 K/W

FWD thermal model values

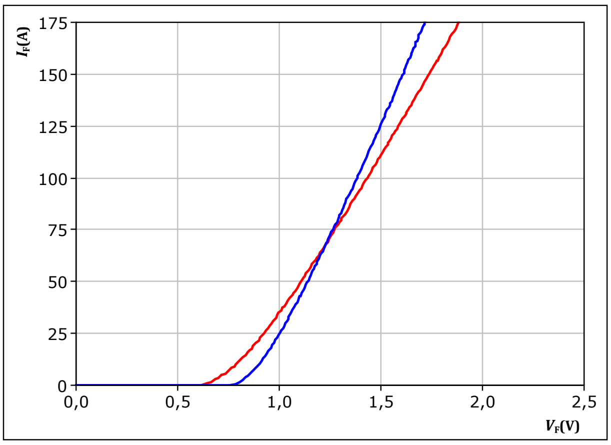
R (K/W)	τ (s)
7,63E-02	2,45E+00
1,98E-01	2,73E-01
8,62E-01	6,00E-02
4,41E-01	1,39E-02
3,11E-01	3,40E-03
2,49E-01	6,61E-04

Rectifier Diode Characteristics

figure 10. Rectifier

Typical forward characteristics

I_F = f(V_F)



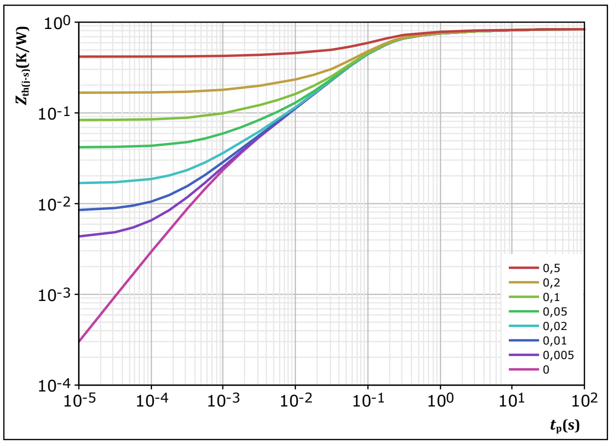
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,835 K/W

Rectifier thermal model values

R (K/W)	τ (s)
5,53E-02	9,71E+00
1,20E-01	7,83E-01
4,61E-01	1,28E-01
1,46E-01	4,84E-02
3,83E-02	4,40E-03
1,42E-02	9,66E-04

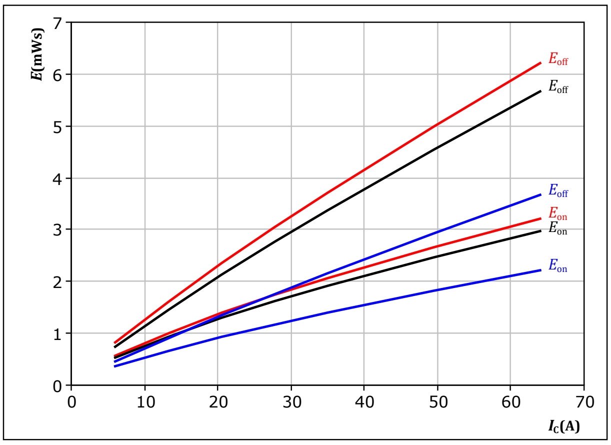
Vincotech

Brake Switching Characteristics

figure 12. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



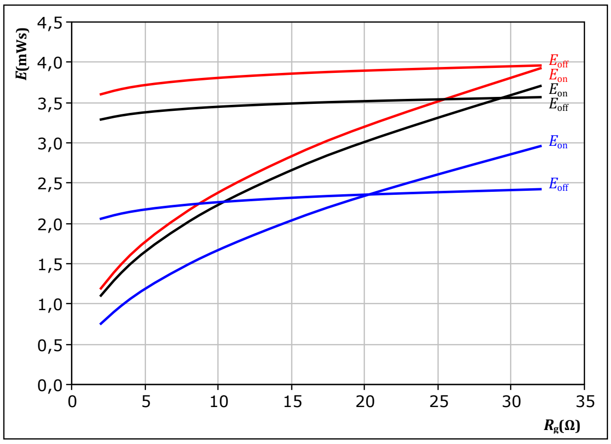
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C
R_{goff} =	8	Ω		

figure 13. **IGBT**

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

$E = f(R_g)$



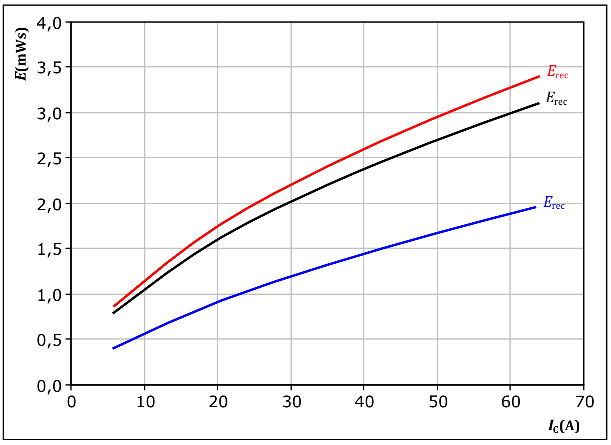
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

figure 14. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



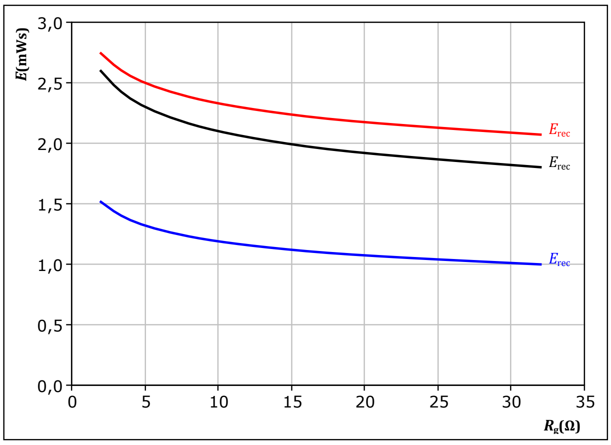
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 15. **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

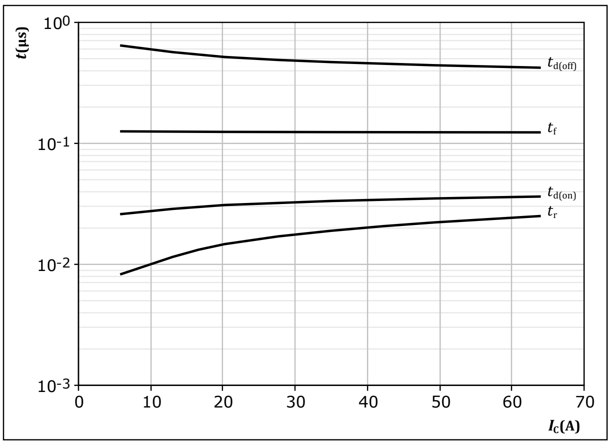
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

Brake Switching Characteristics

figure 16. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



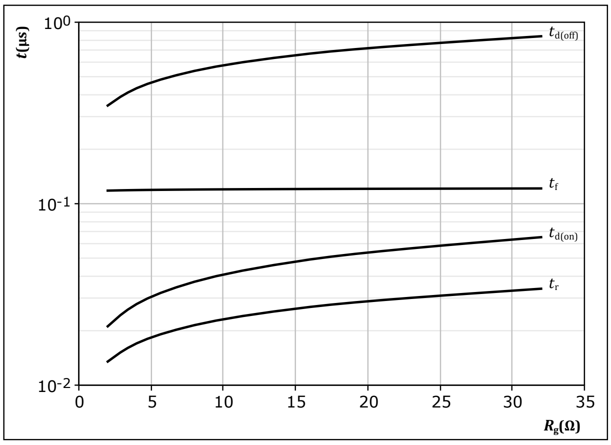
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	0/15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 17. **IGBT**

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

t = f(R_g)



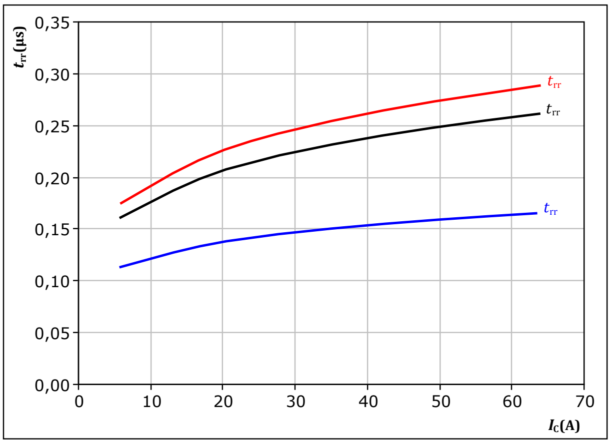
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	0/15	V
I_C =	35	A

figure 18. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

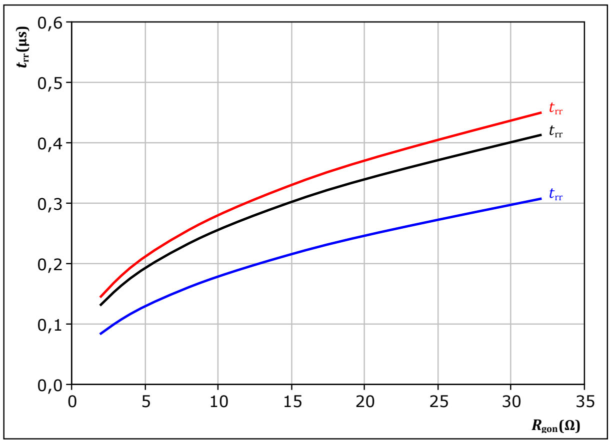
V_{CE} =	600	V
V_{GE} =	0/15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 19. **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} =	600	V
V_{GE} =	0/15	V
I_C =	35	A

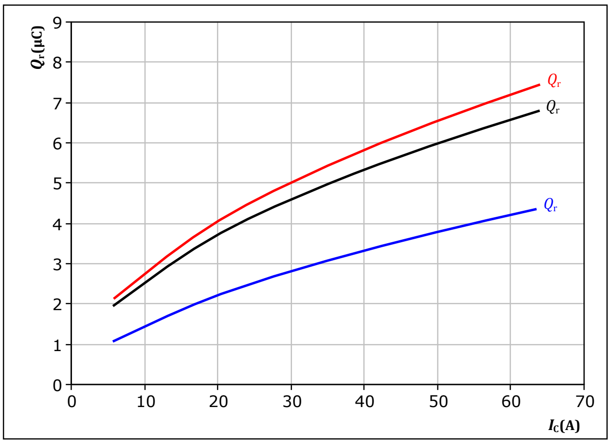
T_j: 25 °C, 125 °C, 150 °C

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

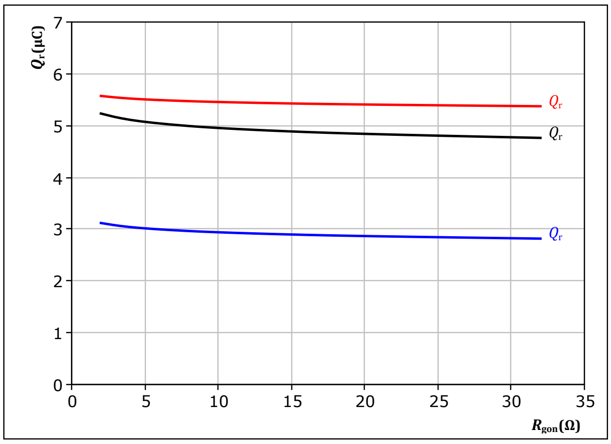
V_{CE} =	600	V	
V_{GE} =	0/15	V	
R_{gon} =	8	Ω	

T_j: 25 °C, 125 °C, 150 °C

figure 21. FWD

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

Q_r = f(R_{gon})



With an inductive load at

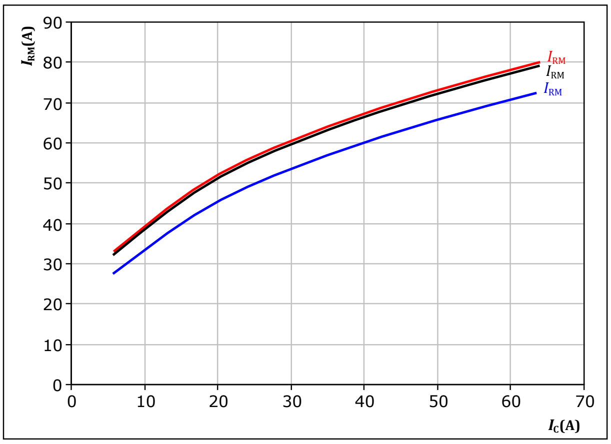
V_{CE} =	600	V
V_{GE} =	0/15	V
I_C =	35	A

T_j: 25 °C, 125 °C, 150 °C

figure 22. FWD

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



With an inductive load at

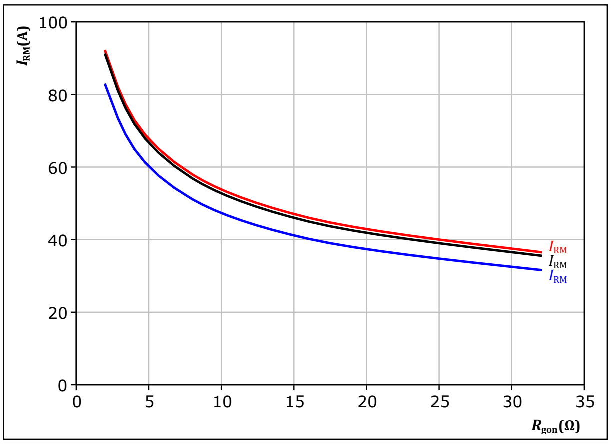
V_{CE} =	600	V
V_{GE} =	0/15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 23. 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
V_{GE} =	0/15	V
I_C =	35	A

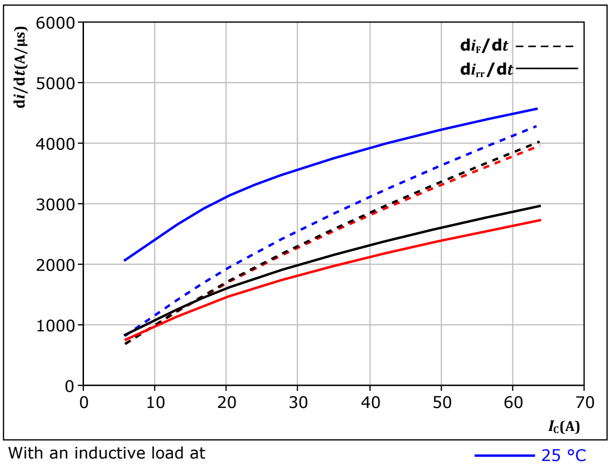
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 24. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt,\ di_{rr}/dt = f(I_C)$



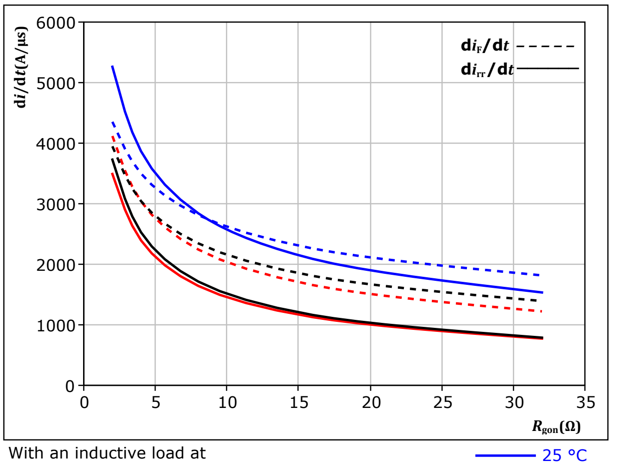
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 25. **FWD**

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

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



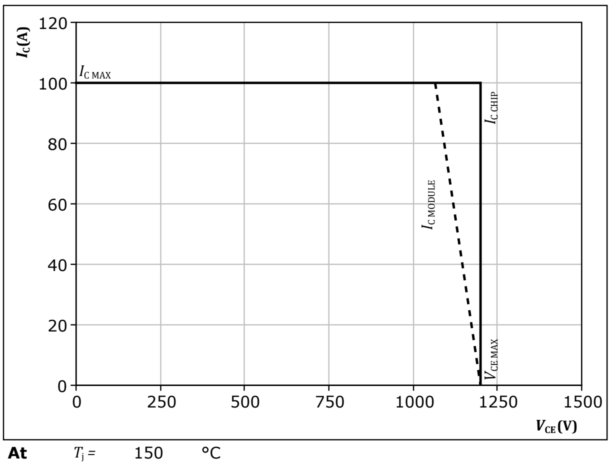
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	35	A		150 °C

figure 26. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

Brake Switching Definitions

figure 27. **IGBT**

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

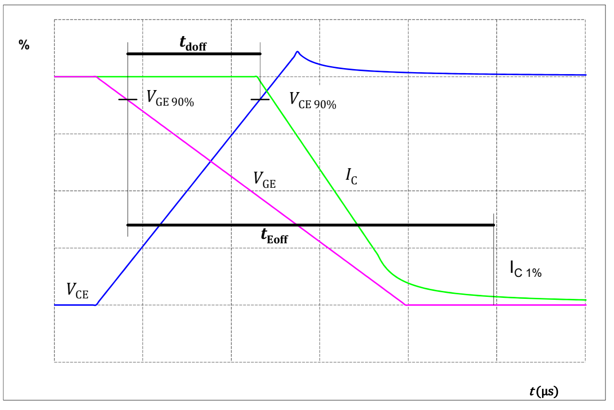


figure 28. **IGBT**

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

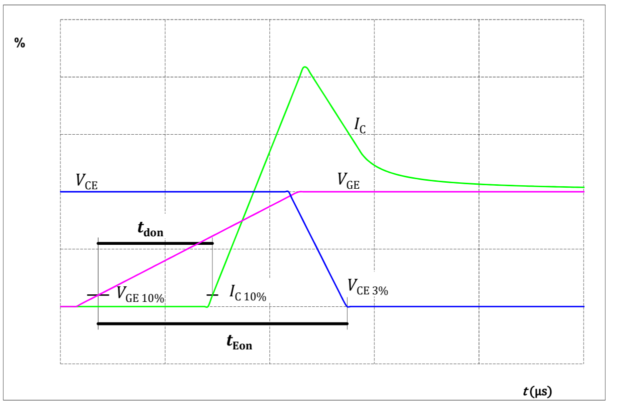


figure 29. **IGBT**

Turn-off Switching Waveforms & definition of t_f

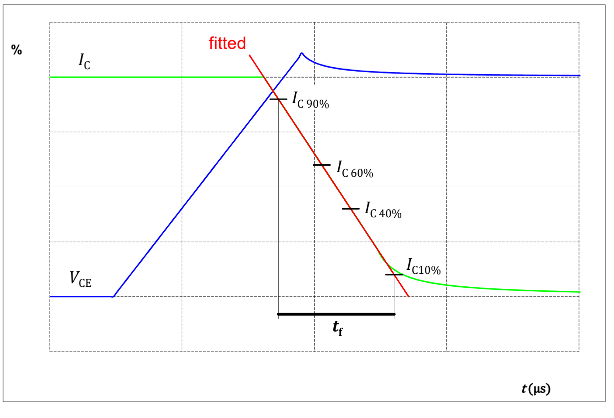
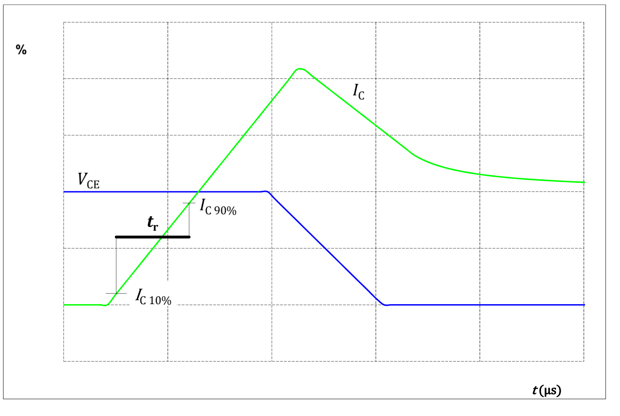


figure 30. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 31.	FWD

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

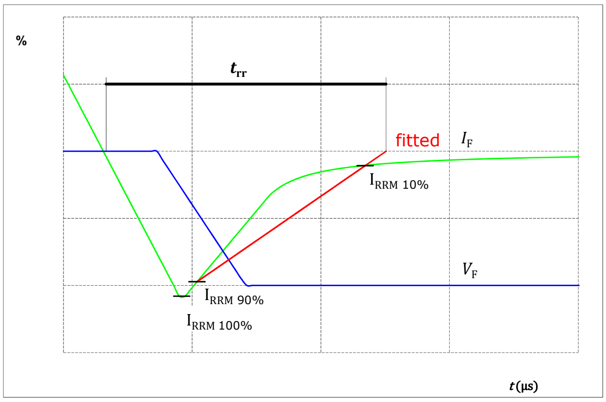
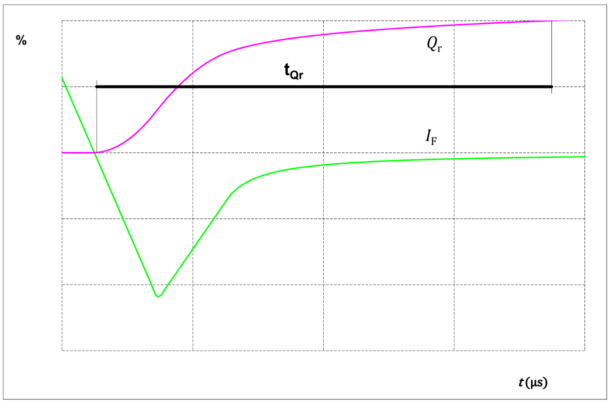


figure 32.	FWD

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

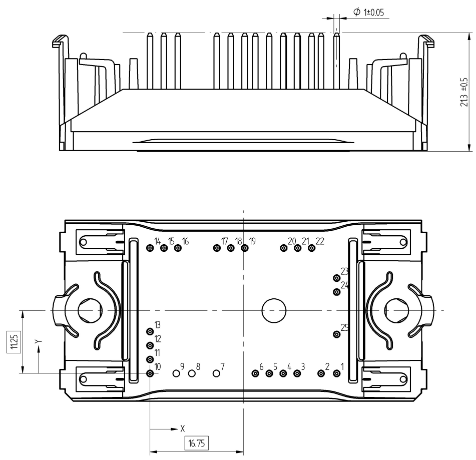


Ordering Code	
Version	**Ordering Code**
Without thermal paste	V23990-P640-G20-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P640-G20-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P640-G20-/3/-PM

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		

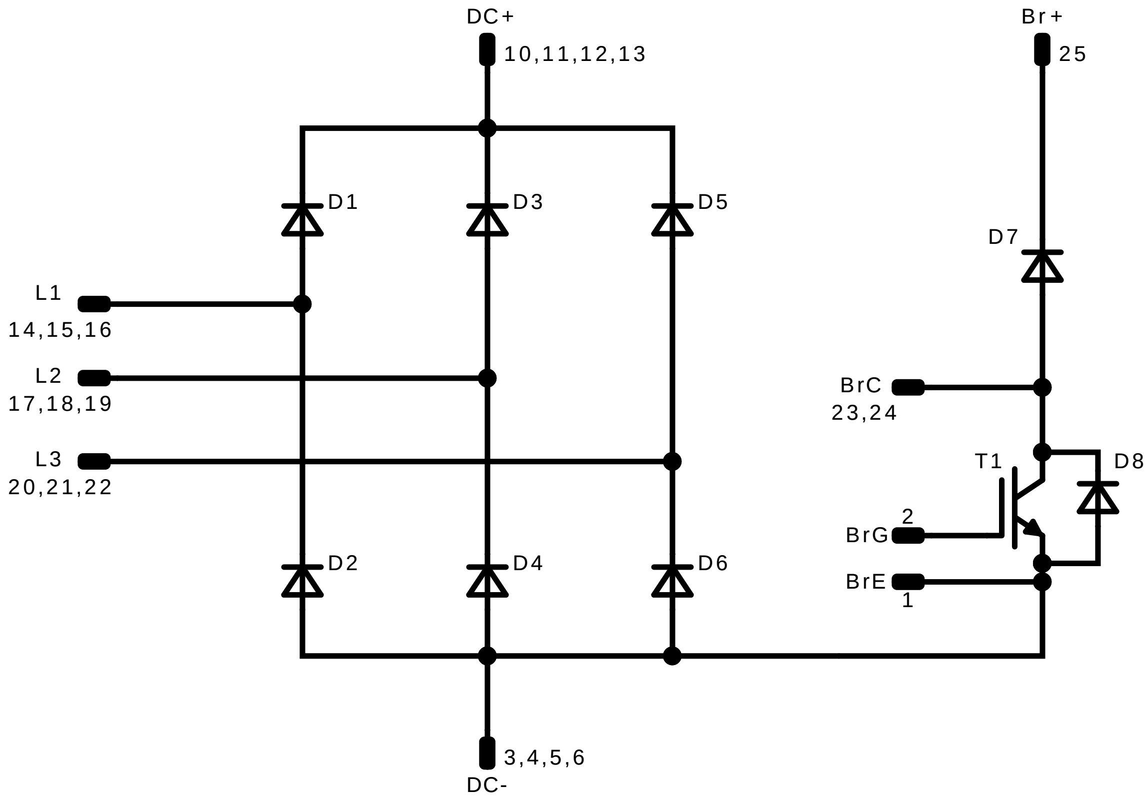
Outline

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	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
T1	IGBT	1200 V	50 A	Brake Switch	
D7	FWD	1200 V	25 A	Brake Diode	
D8	FWD	1200 V	10 A	Brake Sw. Protection Diode	
D2, D1, D4, D3, D6, D5	Rectifier	1600 V	65 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-G20-PM-D3-14	5 May. 2022	New Datasheet format, module is unchanged	