



Vincotech

V23990-P848-A48-PM

datasheet

flowPIM 0

1200 V / 4 A

Features

- 2 Clips housing in 12 mm height
- Trench Fieldstop Technology IGBT4
- Integrated BRC

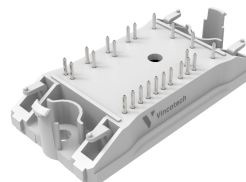
Target applications

- Industrial Drives

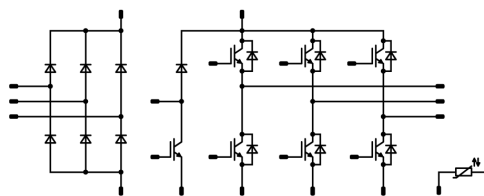
Types

- V23990-P848-A48-PM

flow 0 12 mm housing



Schematic





Vincotech

Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	9	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	12	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Inverter Diode

Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	19	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	46	W
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Switch

Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	9	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	12	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$



Vincotech

Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	9	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	6	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	25	W
Maximum junction temperature	T_{jmax}		150	°C

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	I^2t		200	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	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* $t_p = 2\text{ s}$	6000	V
Isolation voltage	V_{isol}	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			9,29	mm
Comparative Tracking Index	CTI		≥ 200	

*100 % tested in production



Vincotech

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	

Inverter Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		4	25 150	1,58	1,95 2,28	2,02 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			0,5	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25		25		250		pF
Reverse transfer capacitance	C_{res}							15		pF

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						2,58		K/W
--	---------------	---	--	--	--	--	--	------	--	-----

Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 64 \Omega$ $R_{goff} = 64 \Omega$	± 15	600	4	25 150		76,8 74,8		ns
Rise time	t_r					25 150		18,4 23,4		ns
Turn-off delay time	$t_{d(off)}$					25 150		176,4 226,4		ns
Fall time	t_f					25 150		82,49 109,54		ns
Turn-on energy (per pulse)	E_{on}					25 150		0,324 0,563		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,208 0,315		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	

Inverter Diode

Static

Forward voltage	V_F				10	25 125 150		1,35	1,79 1,77 1,73	2,05 ⁽¹⁾	V
Reverse leakage current	I_R	$V_i = 1200$ V				25				2,7	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							2,07		K/W
--	---------------	---------------------------------------	--	--	--	--	--	--	------	--	-----

Dynamic

Peak recovery current	I_{RRM}	$di/dt=200$ A/μs $di/dt=167$ A/μs	±15	600	4	25 150		5,24 6,35		A
Reverse recovery time	t_{rr}					25 150		248,36 431,13		ns
Recovered charge	Q_r					25 150		0,579 1,24		μC
Reverse recovered energy	E_{rec}					25 150		0,209 0,47		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		95,21 48,92		A/μs



Vincotech

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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		4	25 150	1,58	1,95 2,28	2,02 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			0,5	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25		25		250		pF
Reverse transfer capacitance	C_{res}							15		pF

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						2,58		K/W
--	---------------	---	--	--	--	--	--	------	--	-----

Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 64 \text{ } \Omega$ $R_{goff} = 64 \text{ } \Omega$	± 15	600	4	25 150		77,6 74,6		ns
Rise time	t_r					25 150		18 23,8		ns
Turn-off delay time	$t_{d(off)}$					25 150		170,4 217		ns
Fall time	t_f					25 150		80,76 102,93		ns
Turn-on energy (per pulse)	E_{on}					25 150		0,242 0,362		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,217 0,326		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				3	25 150	1,23	1,71 1,6	1,97 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25			27	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,8		K/W
--	---------------	---------------------------------------	--	--	--	--	--	-----	--	-----

Dynamic

Peak recovery current	I_{RRM}	$di/dt=224$ A/μs $di/dt=168$ A/μs	± 15	600	4	25 150		4,03 4,52		A
Reverse recovery time	t_{rr}					25 150		276,09 484,87		ns
Recovered charge	Q_r					25 150		0,431 0,873		μC
Reverse recovered energy	E_{rec}					25 150		0,173 0,382		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		37,31 31,45		A/μs



Vincotech

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				8	25 125 150		0,976 0,879 0,85	1,21 ⁽¹⁾ 1,1 ⁽¹⁾		V
Reverse leakage current	I_R	$V_i = 1600$ V				25			50		μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,59			K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	--	-----

Thermistor

Static

Rated resistance	R					25		22			kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1484$ Ω				100	-5		5		%
Power dissipation	P							5			mW
Power dissipation constant	d					25		1,5			mW/K
B-value	$B_{(25/50)}$	Tol. ± 1 %						3962			K
B-value	$B_{(25/100)}$	Tol. ± 1 %						4000			K
Vincotech Thermistor Reference									I		

⁽¹⁾ Value at chip level

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



Vincotech

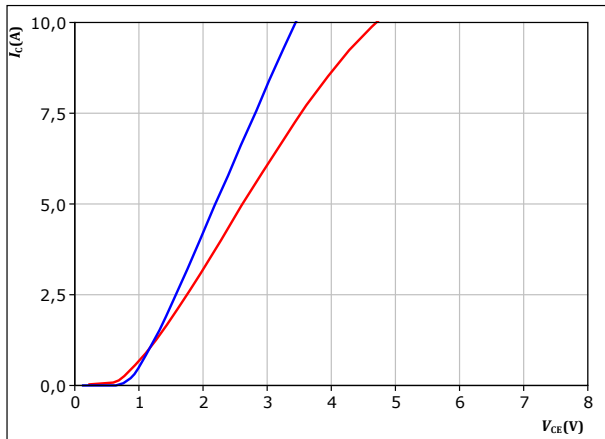
V23990-P848-A48-PM
datasheet

Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

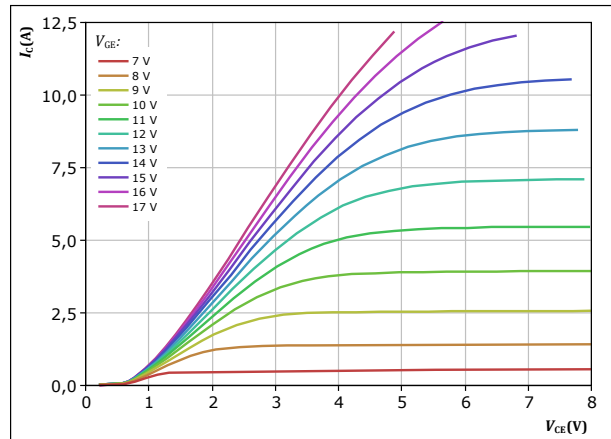


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 2. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

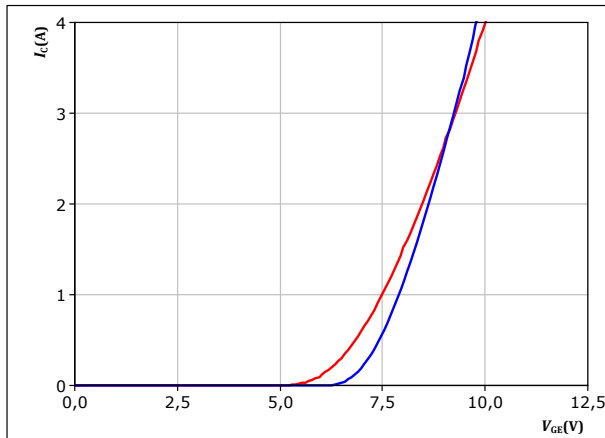


$t_p = 250 \mu s$
 $T_J = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$

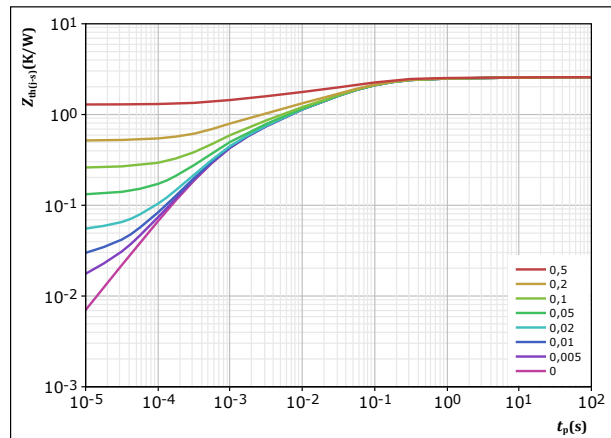


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 2,577 K/W$
IGBT thermal model values

$R (K/W)$	$\tau (s)$
8,49E-02	6,59E+00
1,97E-01	3,69E-01
1,01E+00	6,94E-02
4,64E-01	1,61E-02
4,43E-01	4,16E-03
3,82E-01	6,88E-04



Vincotech

V23990-P848-A48-PM
datasheet

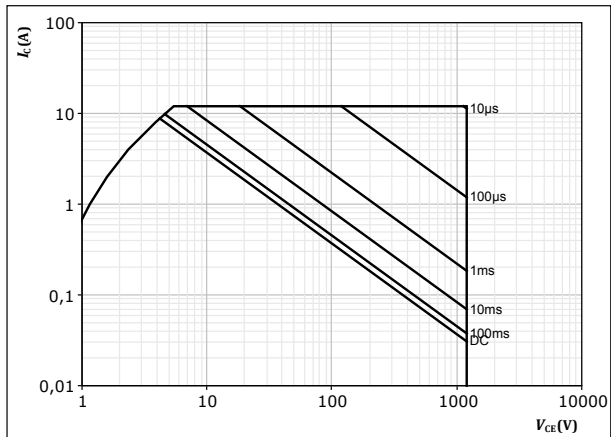
Inverter Switch Characteristics

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}



Vincotech

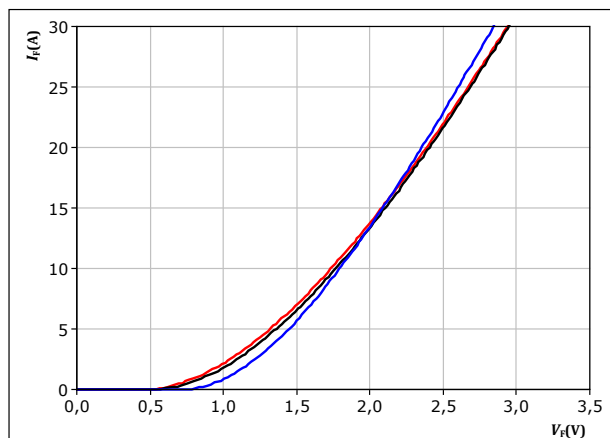
Inverter Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

$T_j:$

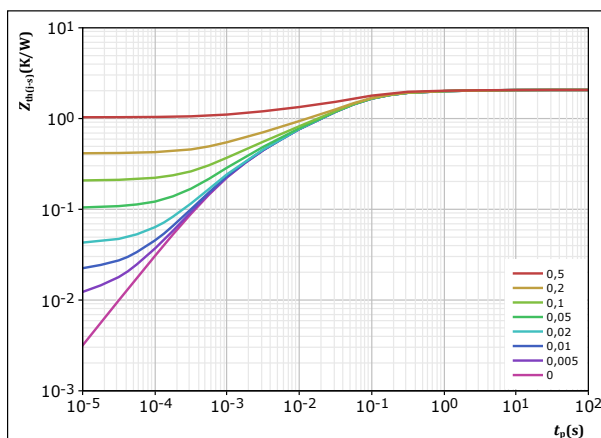
- 25 °C
- 125 °C
- 150 °C

figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 2,066 \text{ K/W}$

FWD thermal model values

R (K/W)	τ (s)
5,09E-02	4,26E+00
1,55E-01	5,03E-01
7,75E-01	7,89E-02
5,33E-01	2,68E-02
3,54E-01	5,03E-03
1,97E-01	9,09E-04



Vincotech

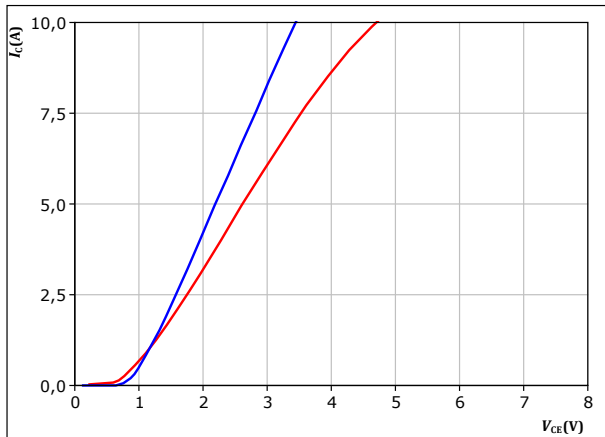
V23990-P848-A48-PM
datasheet

Brake Switch Characteristics

figure 8. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

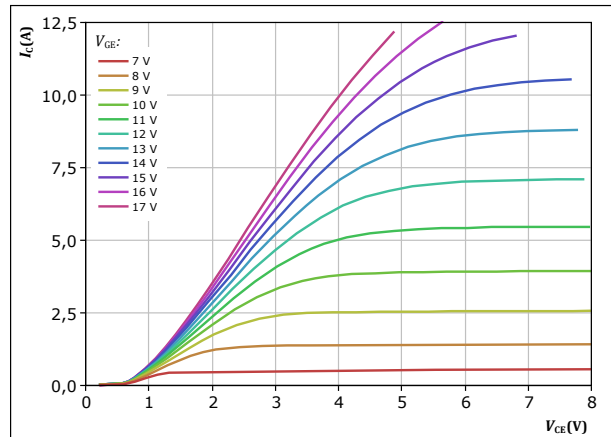


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 9. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

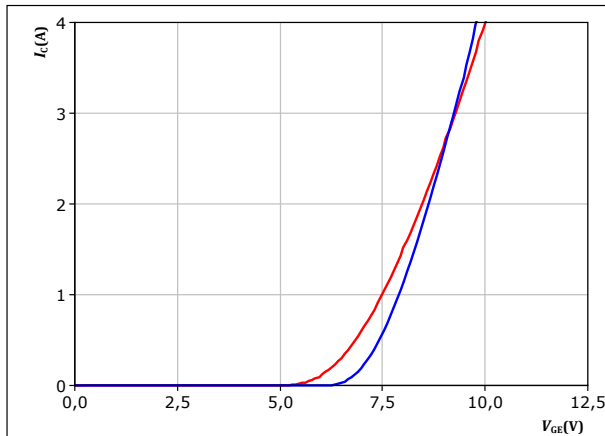


$t_p = 250 \mu s$
 $T_J = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 10. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$

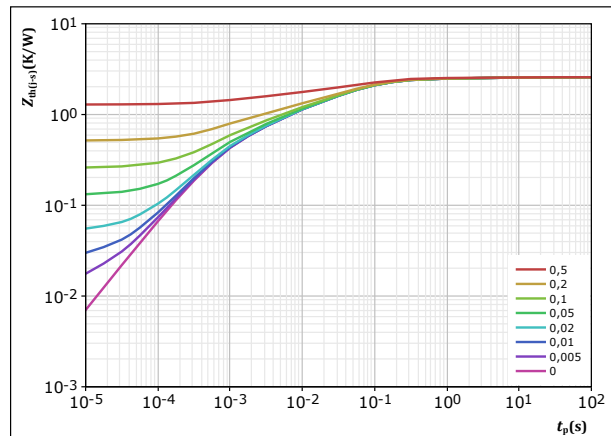


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 11. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 2,577 K/W$
IGBT thermal model values

$R (K/W)$	$\tau (s)$
8,49E-02	6,59E+00
1,97E-01	3,69E-01
1,01E+00	6,94E-02
4,64E-01	1,61E-02
4,43E-01	4,16E-03
3,82E-01	6,88E-04



Vincotech

V23990-P848-A48-PM
datasheet

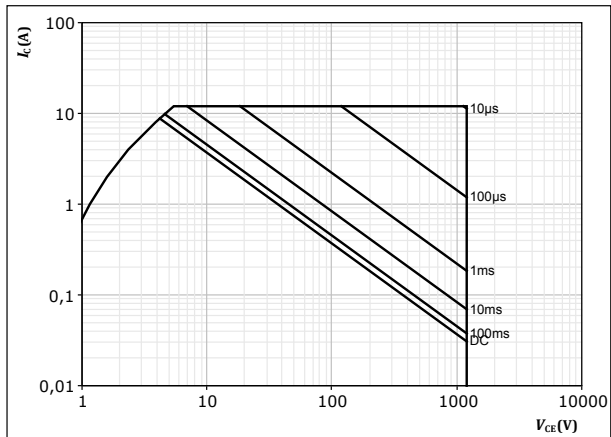
Brake Switch Characteristics

figure 12.

IGBT

Safe operating area

$$I_C = f(V_{CE})$$



D = single pulse

T_s = 80 °C

V_{GE} = 15 V

T_j = T_{jmax}



Vincotech

V23990-P848-A48-PM
datasheet

Brake Diode Characteristics

figure 13.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

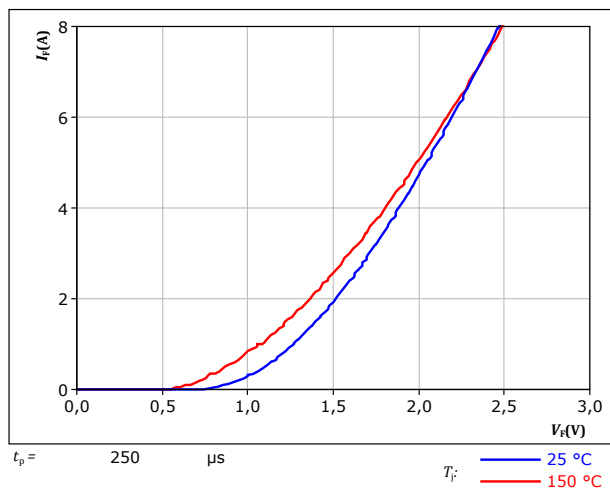
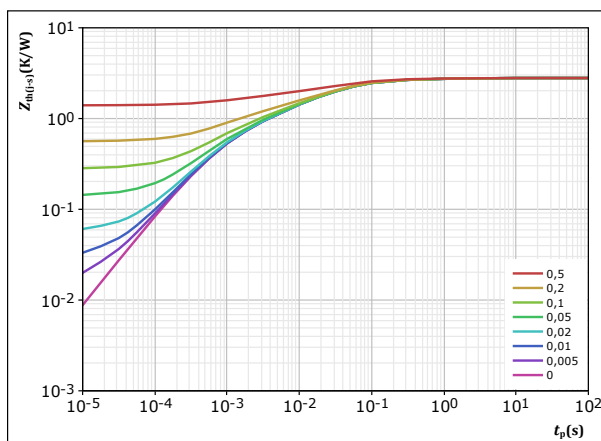


figure 14.

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	



Vincotech

V23990-P848-A48-PM
datasheet

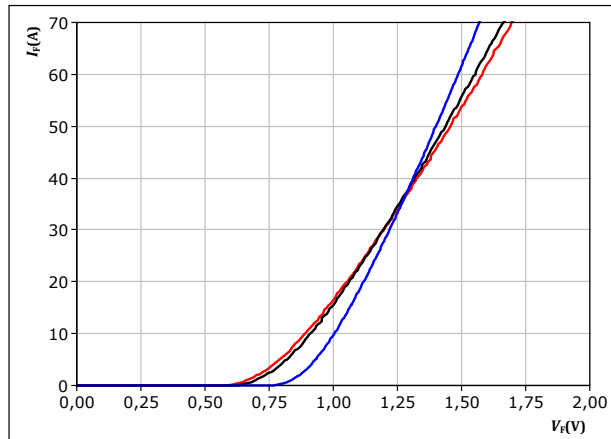
Rectifier Diode Characteristics

figure 15.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

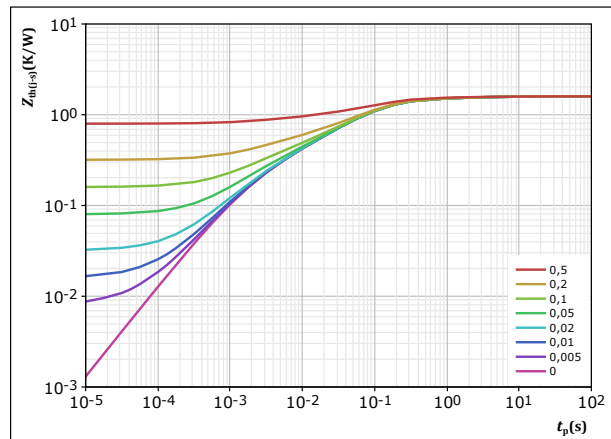
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 16.

Rectifier

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,594 \text{ K/W}$

Rectifier thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,81E-02	7,88E-04



Vincotech

V23990-P848-A48-PM
datasheet

Thermistor Characteristics

figure 17.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





Vincotech

V23990-P848-A48-PM
datasheet

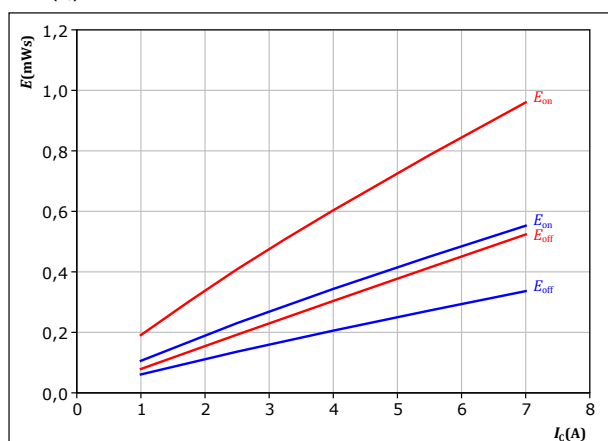
Inverter Switching Characteristics

figure 18.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

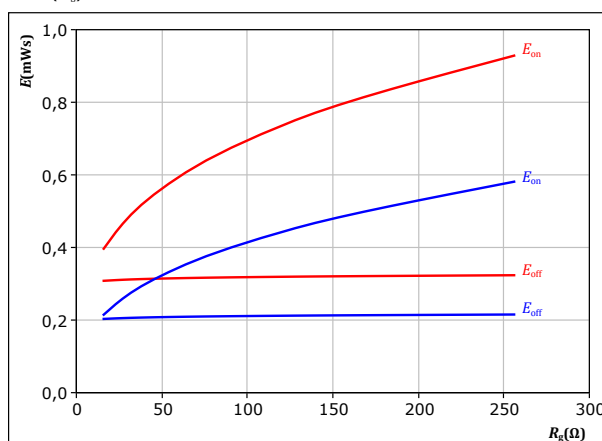
T_j : — 25 °C
— 150 °C

figure 19.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

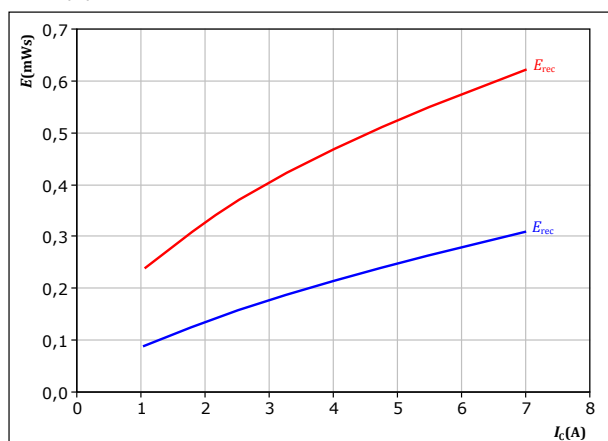
T_j : — 25 °C
— 150 °C

figure 20.

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
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

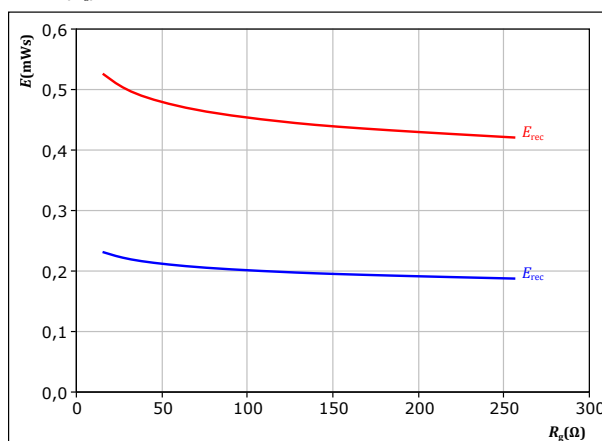
T_j : — 25 °C
— 150 °C

figure 21.

FWD

Typical reverse recovered energy loss as a function of gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

T_j : — 25 °C
— 150 °C



Vincotech

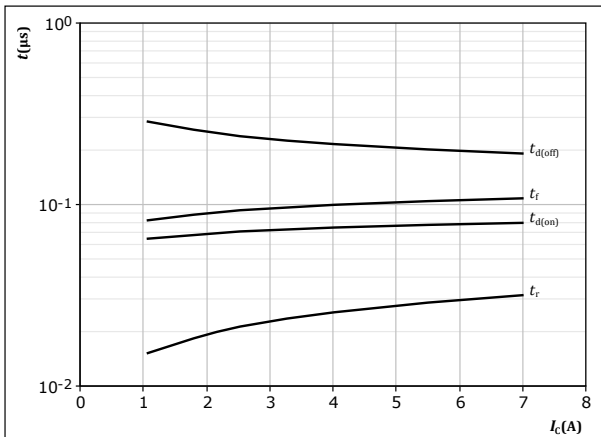
V23990-P848-A48-PM
datasheet

Inverter Switching Characteristics

figure 22.

IGBT

Typical switching times as a function of collector current
 $t = f(I_C)$



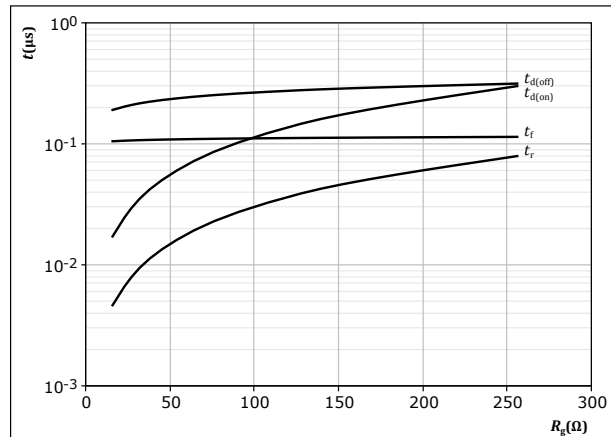
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

figure 23.

IGBT

Typical switching times as a function of gate resistor
 $t = f(R_g)$



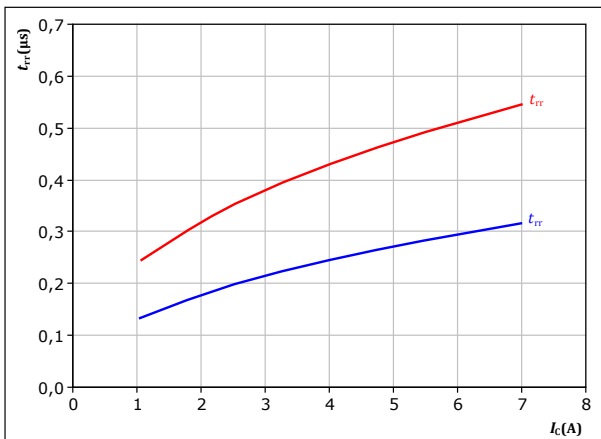
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

figure 24.

FWD

Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_C)$



With an inductive load at

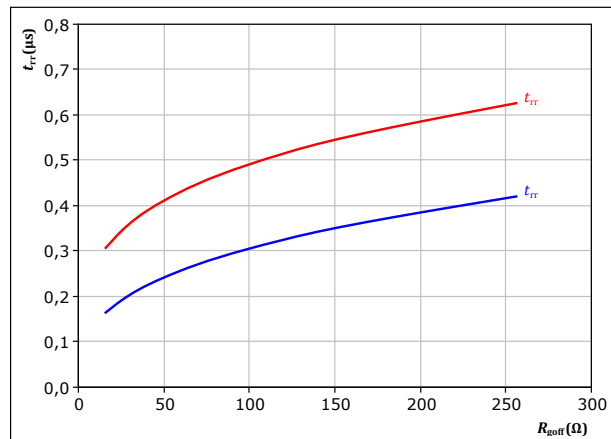
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

T_j : — 25 °C
— 150 °C

figure 25.

FWD

Typical reverse recovery time as a function of IGBT turn off gate resistor
 $t_{rr} = f(R_{goff})$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

T_j : — 25 °C
— 150 °C



Vincotech

V23990-P848-A48-PM
datasheet

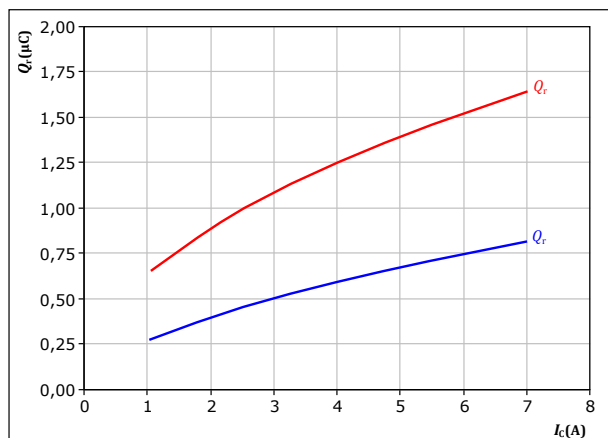
Inverter Switching Characteristics

figure 26.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

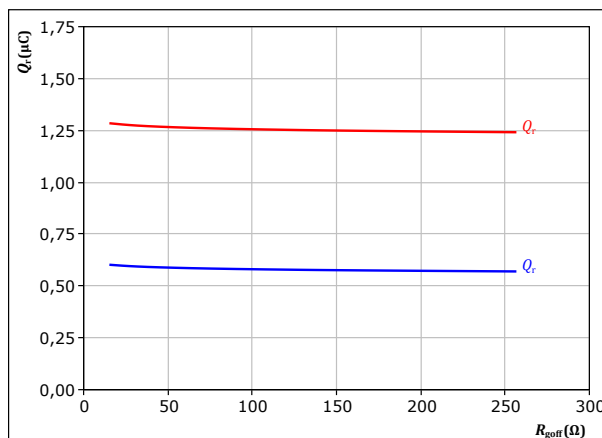
T_j : — 25 °C
— 150 °C

figure 27.

FWD

Typical recovered charge as a function of turn off gate resistor

$$Q_r = f(R_{goff})$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 4$ A

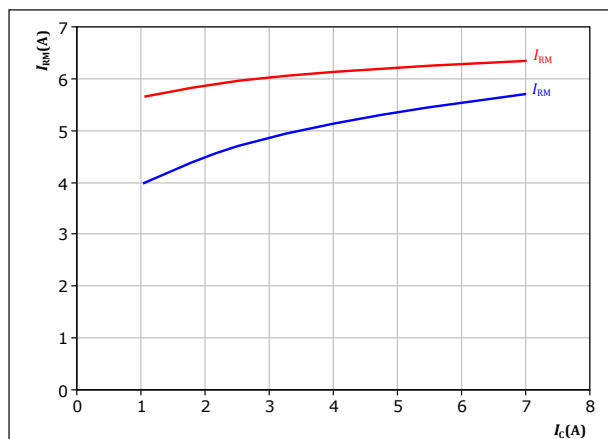
T_j : — 25 °C
— 150 °C

figure 28.

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
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

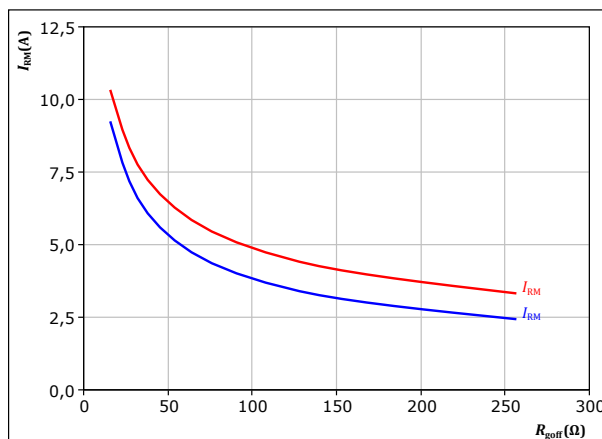
T_j : — 25 °C
— 150 °C

figure 29.

FWD

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

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



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 4$ A

T_j : — 25 °C
— 150 °C



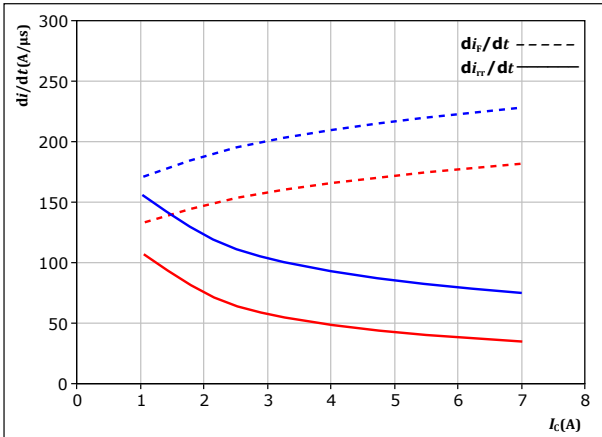
Vincotech

V23990-P848-A48-PM
datasheet

Inverter Switching Characteristics

figure 30. FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_r/dt = f(I_C)$



With an inductive load at

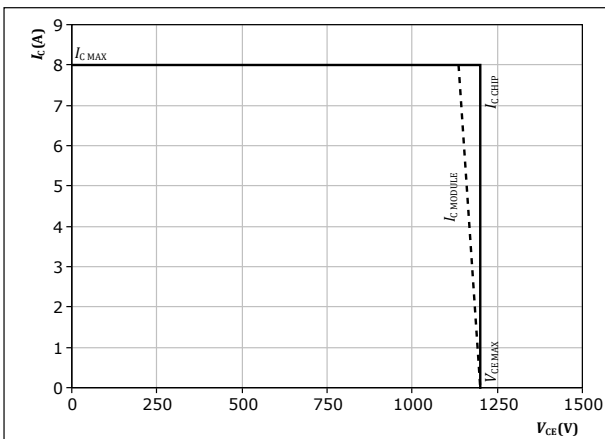
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{goff} = 64$ Ω

T_j : — 25 °C
— 150 °C

figure 32. IGBT

Reverse bias safe operating area

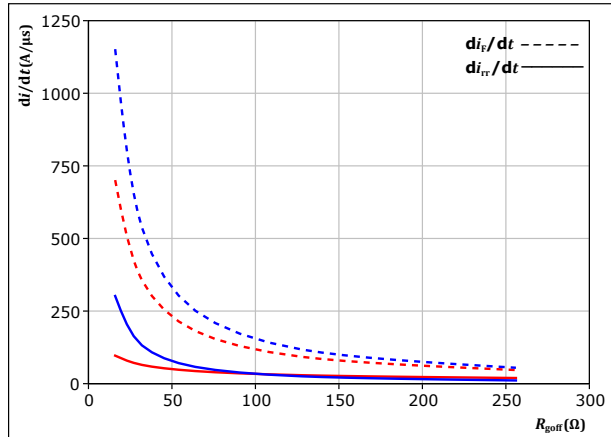
$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{goff} = 64$ Ω
 $R_{goff} = 64$ Ω

figure 31. FWD

Typical rate of fall of forward and reverse recovery current as a function of turn off gate resistor
 $di_f/dt, di_r/dt = f(R_{goff})$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

T_j : — 25 °C
— 150 °C



Vincotech

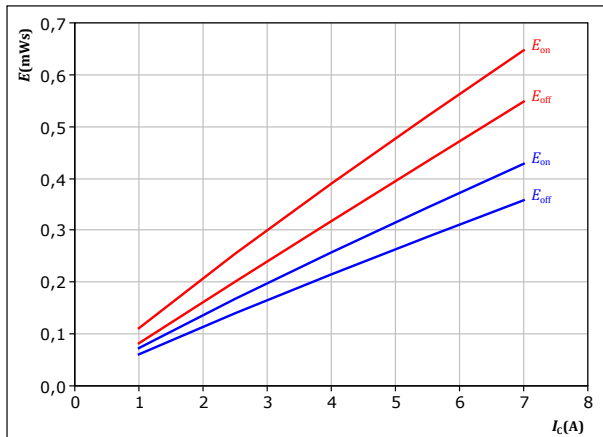
V23990-P848-A48-PM
datasheet

Brake Switching Characteristics

figure 33. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

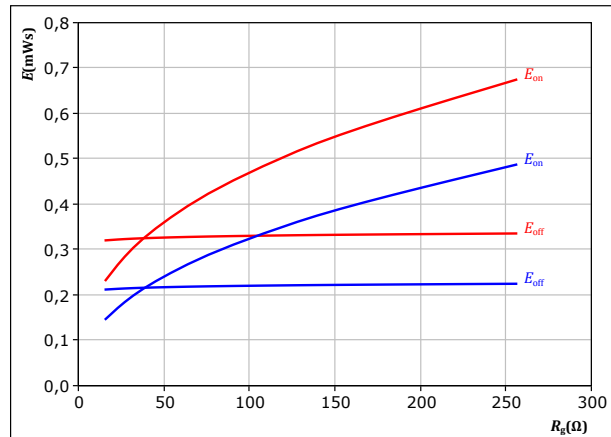
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 64 \text{ } \Omega$
 $R_{goff} = 64 \text{ } \Omega$

T_j : — 25 °C
— 150 °C

figure 34. IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

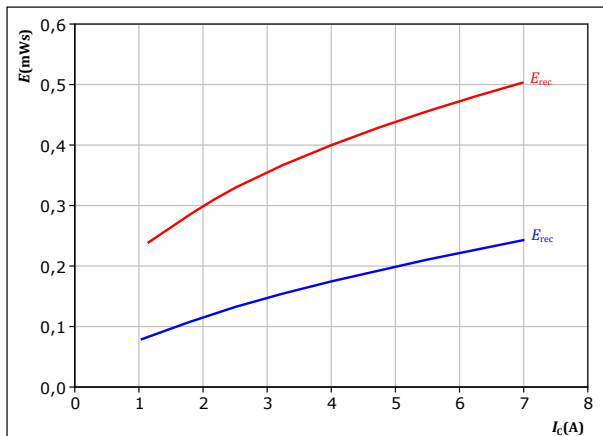
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_C = 4 \text{ A}$

T_j : — 25 °C
— 150 °C

figure 35. FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_C)$$



With an inductive load at

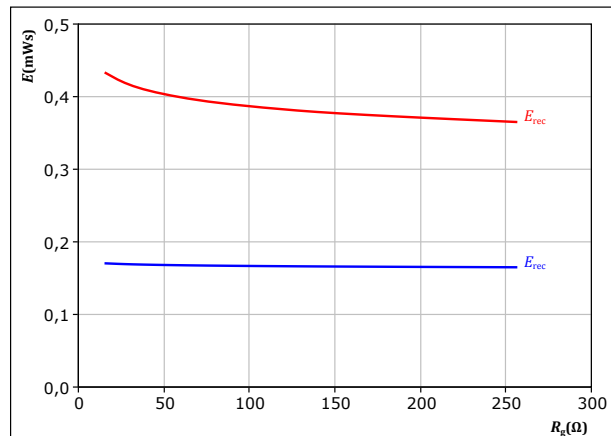
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 64 \text{ } \Omega$

T_j : — 25 °C
— 150 °C

figure 36. FWD

Typical reverse recovered energy loss as a function of gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_C = 4 \text{ A}$

T_j : — 25 °C
— 150 °C



Vincotech

V23990-P848-A48-PM
datasheet

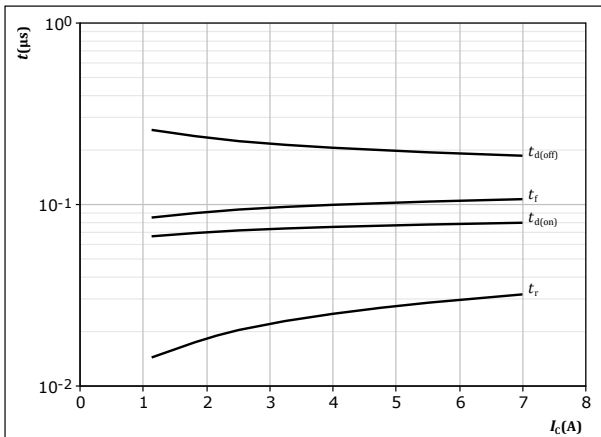
Brake Switching Characteristics

figure 37.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

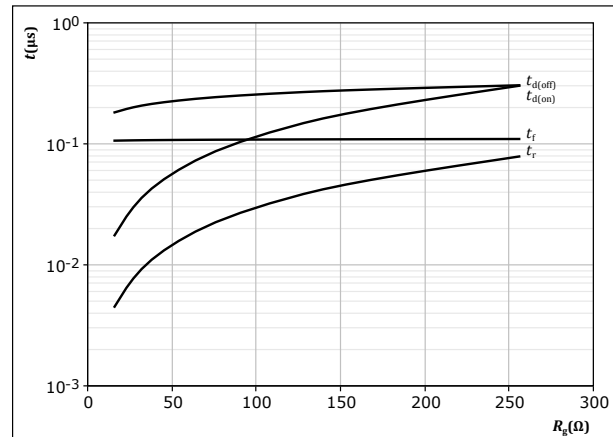
$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

figure 38.

IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



With an inductive load at

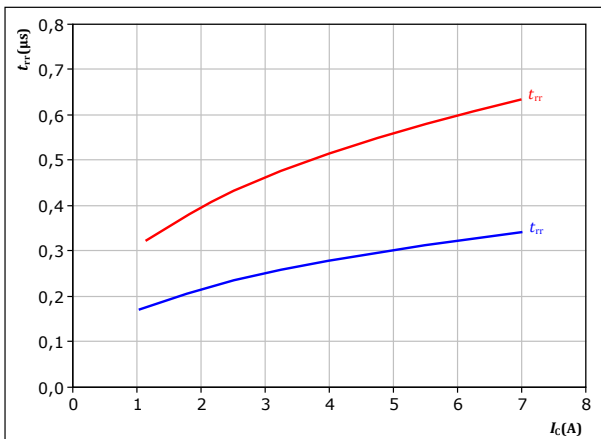
$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

figure 39.

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
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

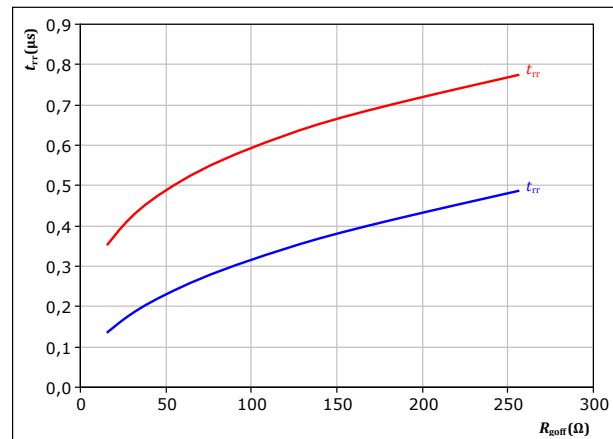
T_j : — 25 °C
— 150 °C

figure 40.

FWD

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

$$t_{rr} = f(R_{goff})$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

T_j : — 25 °C
— 150 °C



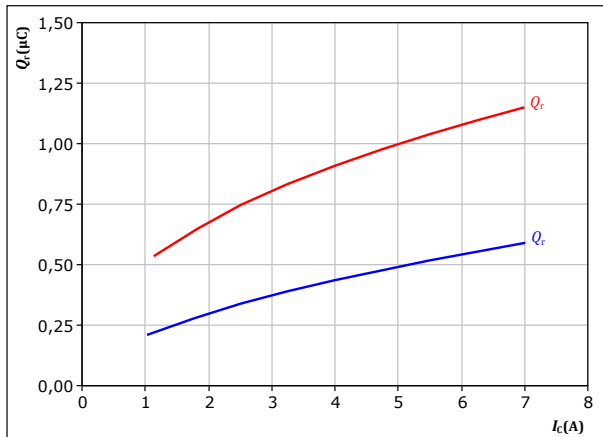
Brake Switching Characteristics

figure 41.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_C)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{goff} = 64$ Ω

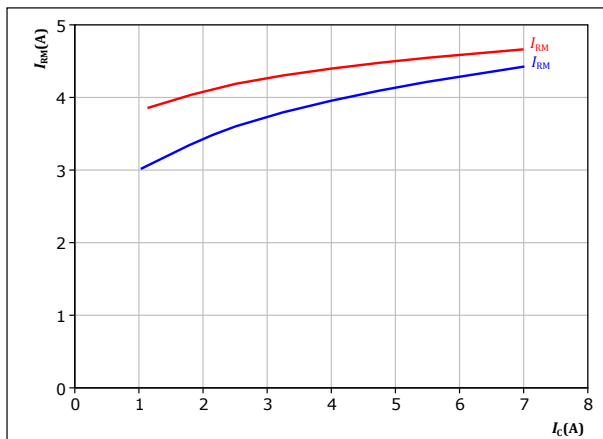
T_j : — 25 °C
— 150 °C

figure 43.

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
 $V_{GE} = \pm 15$ V
 $R_{goff} = 64$ Ω

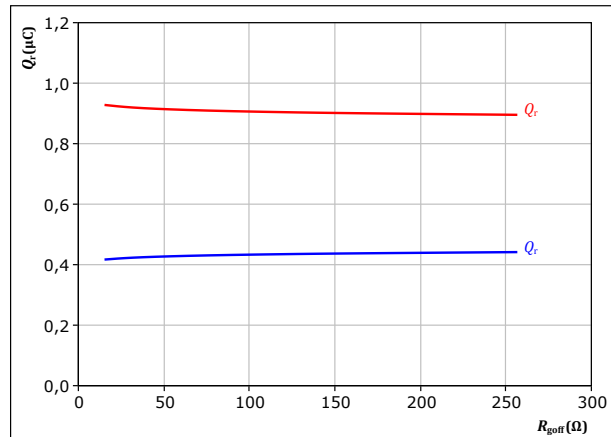
T_j : — 25 °C
— 150 °C

figure 42.

FWD

Typical recovered charge as a function of turn off gate resistor

$$Q_r = f(R_{goff})$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

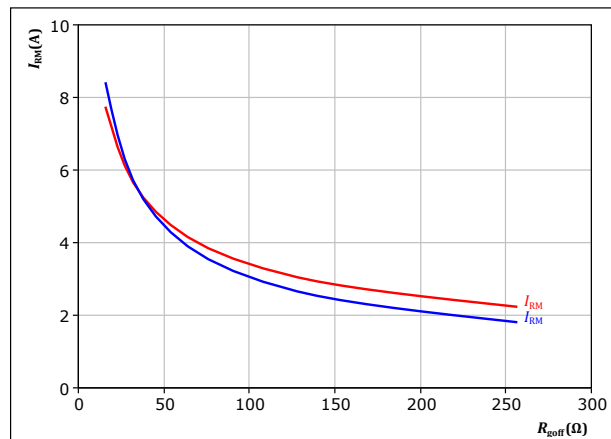
T_j : — 25 °C
— 150 °C

figure 44.

FWD

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

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



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 4$ A

T_j : — 25 °C
— 150 °C



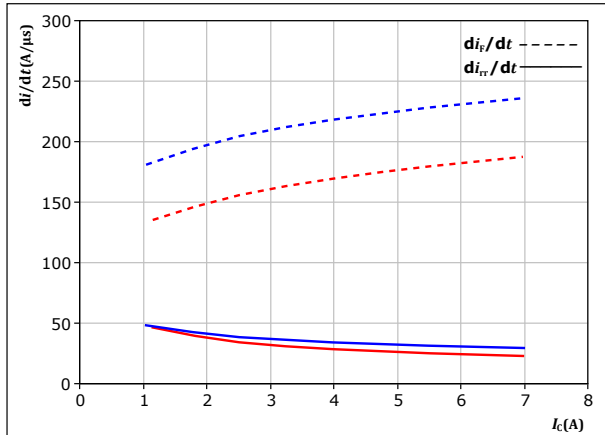
Vincotech

V23990-P848-A48-PM
datasheet

Brake Switching Characteristics

figure 45. FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_r/dt = f(I_C)$



With an inductive load at

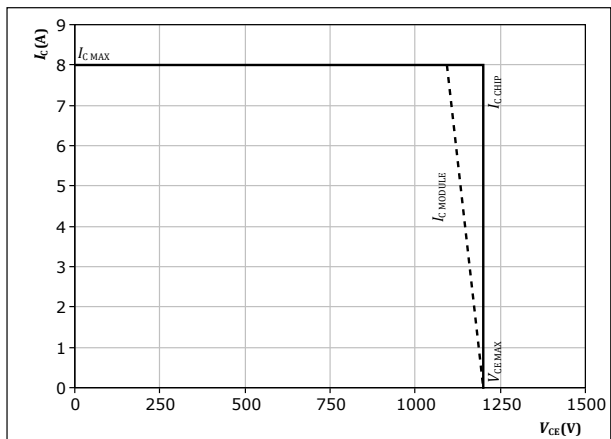
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{goff} = 64 \text{ } \Omega$

T_j : — 25 °C
— 150 °C

figure 47. IGBT

Reverse bias safe operating area

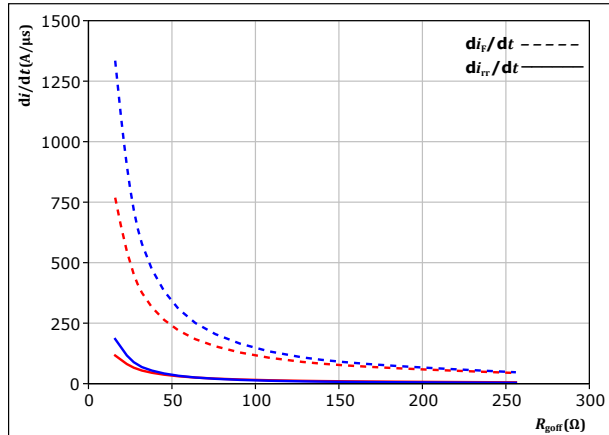
$I_C = f(V_{CE})$



At $T_j = 150 \text{ } ^\circ\text{C}$
 $R_{goff} = 64 \text{ } \Omega$
 $R_{goff} = 64 \text{ } \Omega$

figure 46. FWD

Typical rate of fall of forward and reverse recovery current as a function of turn off gate resistor
 $di_f/dt, di_r/dt = f(R_{goff})$



With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_C = 4 \text{ A}$

T_j : — 25 °C
— 150 °C



Vincotech

Switching Definitions

figure 48. IGBT

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



figure 49. IGBT

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



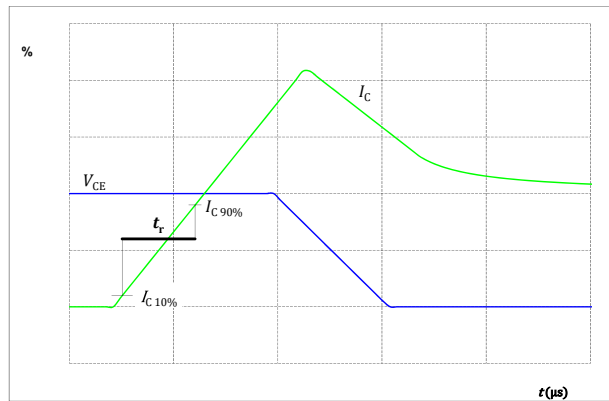
figure 50. IGBT

Turn-off Switching Waveforms & definition of t_f



figure 51. IGBT

Turn-on Switching Waveforms & definition of t_r





Switching Definitions

figure 52.

FWD

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

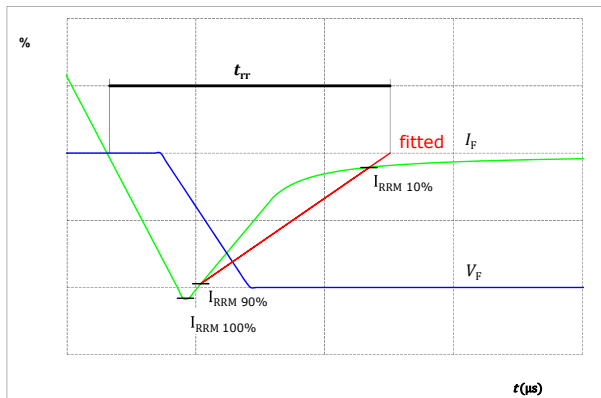
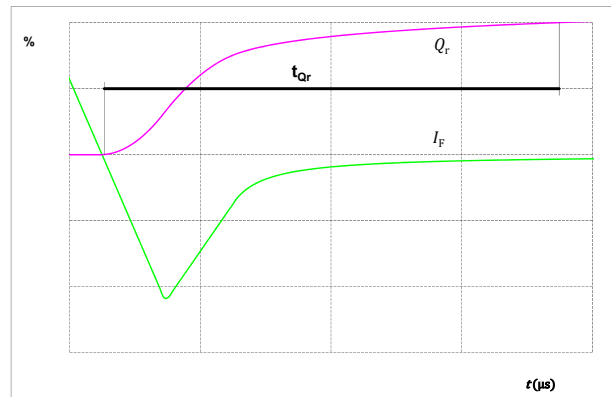


figure 53.

FWD


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





Vincotech

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P848-A48-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P848-A48-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P848-A48-/3/-PM

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
		VIN	WWYY	TTTTITVV	UL	LLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTITVV	LLLL	SSSS	WWYY		

Outline

Pin table [mm]			
Pin	X	Y	Function
1	25,5	2,7	NTC1
2	25,5	0	NTC2
3	22,8	0	-DC
4	20,1	0	BRCG
5	16,2	0	BRCE
6	13,5	0	G6
7	10,8	0	E6
8	8,1	0	G5
9	5,4	0	E5
10	2,7	0	G4
11	0	0	E4
12	0	19,8	G1
13	0	22,5	U
14	7,5	19,8	G2
15	7,5	22,5	V
16	15	19,8	G3
17	15	22,5	W
18	22,8	22,5	+INV
19	25,5	22,5	+DC
20	33,5	22,5	BRC+
21	33,5	15	L1
22	33,5	7,5	L2
23	33,5	0	L3

Top view of the battery pack showing 23 pins. Dimensions: Pin diameter $\phi 1.05$, Pin pitch 16.75 , Pin offset 1.25 .

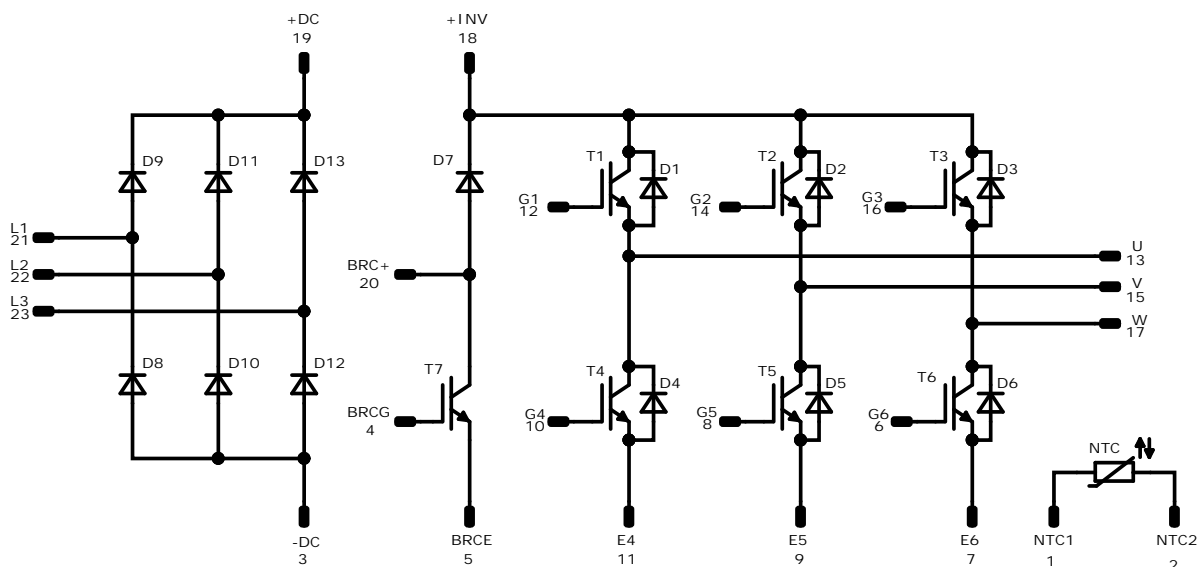
Side view of the battery pack showing height 18.145 and pin offset 1.25 .

Tolerance of pinpositions: $\pm 0.5\text{mm}$ at the end of pins.
Dimension of coordinate axis is only offset without tolerance.



Vincotech


Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T4, T1, T5, T2, T6, T3	IGBT	1200 V	4 A	Inverter Switch	
D4, D1, D5, D2, D6, D3	FWD	1200 V	10 A	Inverter Diode	
T7	IGBT	1200 V	4 A	Brake Switch	
D7	FWD	1200 V	3 A	Brake Diode	
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	25 A	Rectifier Diode	
NTC	Thermistor			Thermistor	



Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample
Handling instruction				
Handling instructions for <i>flow 0</i> packages see vincotech.com website.				
Package data				
Package data for <i>flow 0</i> 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-P848-A48-PM-D8-14	30 Sep. 2021	New Datasheet format, module is unchanged Correct Thermal values of Inverter Switch, Brake Switch Correct Static values of Rectifier Diode, Inverter Diode, Brake Diode Separate datasheet	

DISCLAIMER

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

LIFE SUPPORT POLICY

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.