



Vincotech

# V23990-P768-AY-PM

datasheet

flowPIM 2

1200 V / 50 A

## Features

- 3~rectifier, BRC, Inverter, NTC
- Very Compact housing, easy to route
- IGBT4/ EmCon4 technology for low saturation a losses and improved EMC behavior

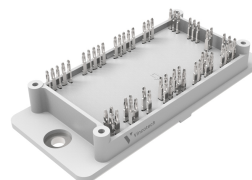
## Target applications

- Motor Drives
- Power Generation

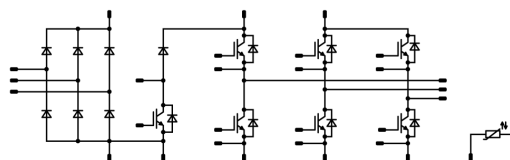
## Types

- V23990-P768-AY-PM

## flow 2 17 mm housing



## Schematic





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**V23990-P768-AY-PM**  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	63	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	150	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	174	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	$\mu s$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Inverter Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	66	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	100	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	127	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Brake Switch

Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	46	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	105	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	135	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	$\mu s$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$



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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Brake Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	38	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	50	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	87	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Brake Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	20	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	20	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Rectifier Diode

Peak repetitive reverse voltage	$V_{RRM}$		1600	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	86	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	490	A
Surge current capability	$I^2t$		1200	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	106	W
Maximum junction temperature	$T_{jmax}$		150	°C



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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
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## Module Properties

### Thermal Properties

Storage temperature	$T_{\text{stg}}$		-40...+125	°C
Operation temperature under switching condition	$T_{\text{jop}}$		-40...+( $T_{\text{jmax}}$ - 25)	°C

### Isolation Properties

Isolation voltage	$V_{\text{isol}}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
Isolation voltage	$V_{\text{isol}}$	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			11,72	mm
Comparative Tracking Index	CTI		≥ 200	

\*100 % tested in production





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## 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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0017	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		50	25 125 150	1,58	1,87 2,18 2,3	2,07 <sup>(1)</sup>	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	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		2800		pF
Reverse transfer capacitance	$C_{res}$							100		pF
Gate charge	$Q_g$		15		0	25		380		nC

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						0,54		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 8 \Omega$ $R_{goff} = 8 \Omega$	$\pm 15$	600	50	25 150		104 100,4		ns
Rise time	$t_r$					25 150		19 23,8		ns
Turn-off delay time	$t_{d(off)}$					25 150		220,4 294,6		ns
Fall time	$t_f$					25 150		77,68 117,7		ns
Turn-on energy (per pulse)	$E_{on}$					25 150		2,86 4,5		mWs
Turn-off energy (per pulse)	$E_{off}$					25 150		2,69 4,48		mWs



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## 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	$V_F$				50	25 125 150	1,35	1,75 1,74 1,71	2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25			10	µA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,75		K/W
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#### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=3364$ A/µs $di/dt=2466$ A/µs	$\pm 15$	600	50	25 150		64,81 81,66		A
Reverse recovery time	$t_{rr}$					25 150		161,48 313,01		ns
Recovered charge	$Q_r$					25 150		4,62 9,95		µC
Reverse recovered energy	$E_{rec}$					25 150		1,92 3,98		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		2298 1106		A/µs



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## 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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		35	25 125 150	1,58	1,91 2,26 2,37	2,07 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			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		2000		pF
Reverse transfer capacitance	$C_{res}$							70		pF
Gate charge	$Q_g$		15		0	25		270		nC

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						0,7		K/W
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#### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16 \Omega$ $R_{goff} = 16 \Omega$	$\pm 15$	600	35	25 150		92,4 83,8		ns
Rise time	$t_r$					25 150		21,4 24,4		ns
Turn-off delay time	$t_{d(off)}$					25 150		182,4 253,4		ns
Fall time	$t_f$					25 150		76,01 116,46		ns
Turn-on energy (per pulse)	$E_{on}$					25 150		1,86 2,64		mWs
Turn-off energy (per pulse)	$E_{off}$					25 150		1,78 2,95		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	25 125 150		1,35	1,9 1,9 1,88	2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_i = 1200$ V				25				5,2	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							1,09		K/W
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#### Dynamic

Peak recovery current	$I_{RRM}$	$di/dt=2061$ A/μs $di/dt=1652$ A/μs	±15	600	35	25 150		27,41 41,04		A
Reverse recovery time	$t_{rr}$					25 150		299,73 321,75		ns
Recovered charge	$Q_r$					25 150		2,68 5,19		μC
Reverse recovered energy	$E_{rec}$					25 150		1,22 2,15		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		253,9 258,56		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	25 125 150		1,35	1,89 1,92 1,9	2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25				2,7	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							1,68		K/W
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### Rectifier Diode

#### Static

Forward voltage	$V_F$				25	25 125			0,987 0,901	1,21 <sup>(1)</sup> 1,1 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1600$ V				25				50	μA

#### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							0,66		K/W
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## 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	

## Thermistor

### Static

Rated resistance	$R$					25		22		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 1486 \Omega$				100	-12		14	%
Power dissipation	$P$							200		mW
Power dissipation constant	$d$					25		2		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 3 \%$						3950		K
B-value	$B_{(25/100)}$	Tol. $\pm 3 \%$						3998		K
Vincotech Thermistor Reference									B	

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.



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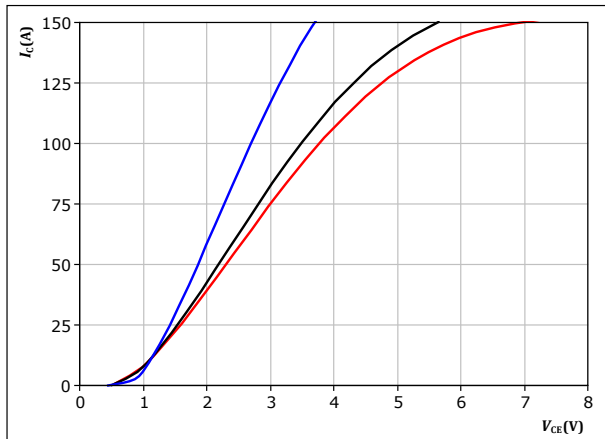
V23990-P768-AY-PM  
datasheet

## Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

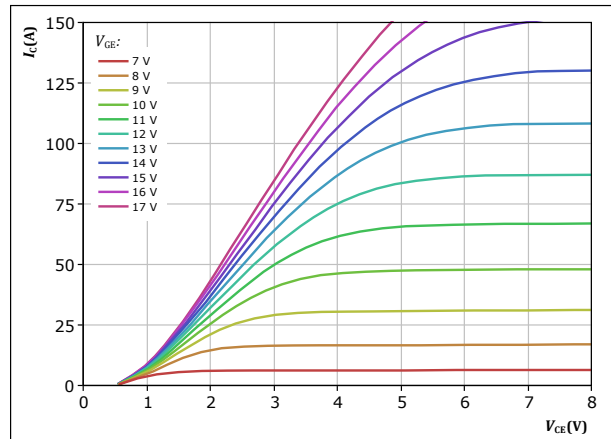


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

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

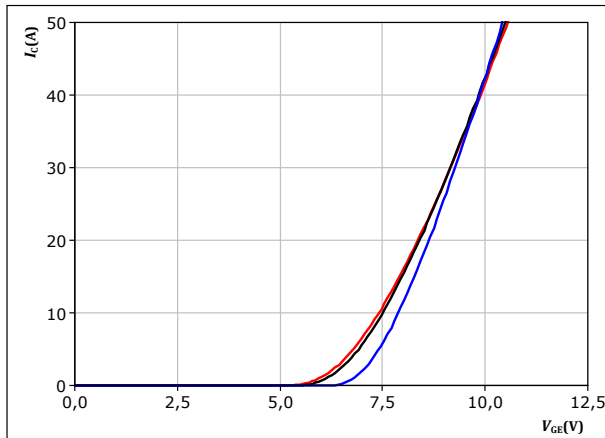


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

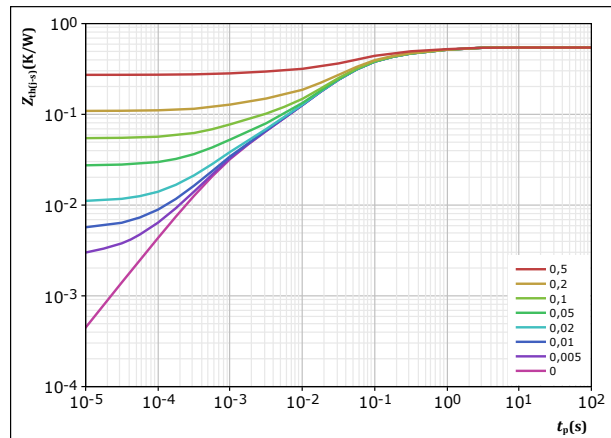


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,545 K/W$   
IGBT thermal model values  

$R (K/W)$	$\tau (s)$
8,76E-02	9,10E-01
1,41E-01	1,40E-01
2,51E-01	3,71E-02
3,49E-02	7,85E-03
3,12E-02	9,56E-04



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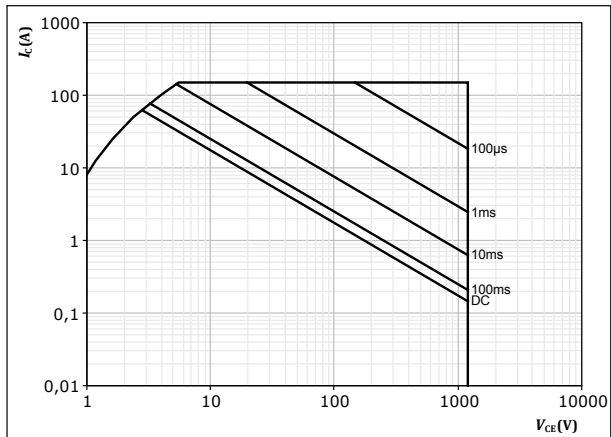
## Inverter Switch Characteristics

figure 5.

IGBT

Safe operating area

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



$D = \text{single pulse}$

$T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$   
 $T_j = T_{jmax}$



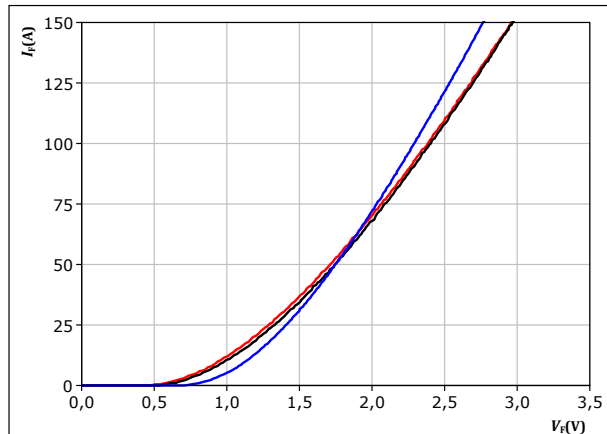


## Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

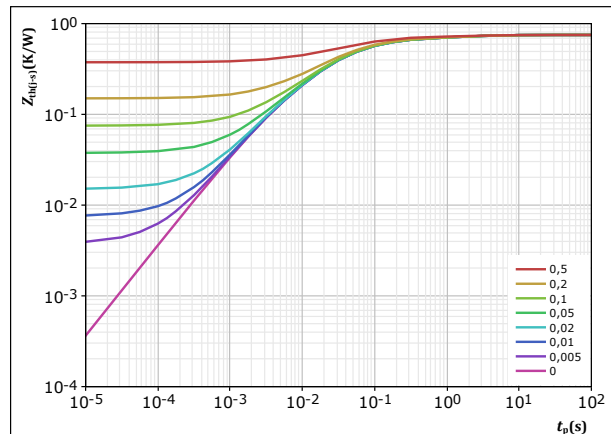
$T_j:$

- 25 °C
- 125 °C
- 150 °C

figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

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

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
4,27E-02	3,64E+00
6,77E-02	6,18E-01
2,53E-01	8,65E-02
3,24E-01	2,11E-02
6,25E-02	3,47E-03



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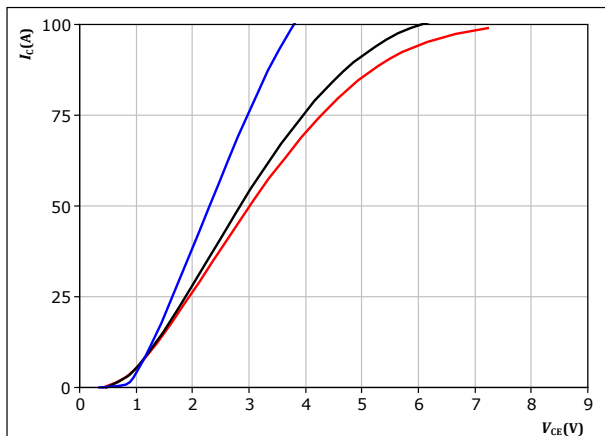
**V23990-P768-AY-PM**  
datasheet

## Brake Switch Characteristics

**figure 8.** IGBT

Typical output characteristics

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

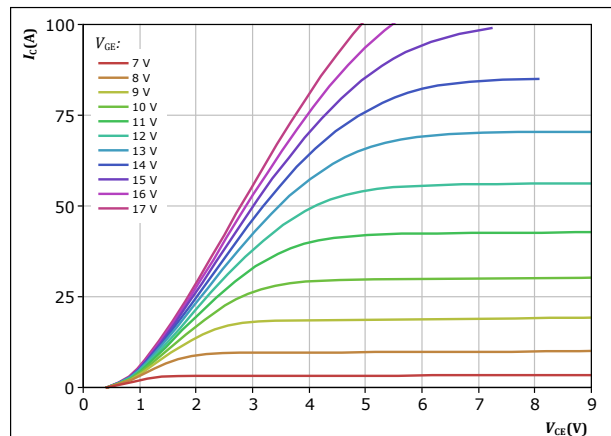


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

**figure 9.** IGBT

Typical output characteristics

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

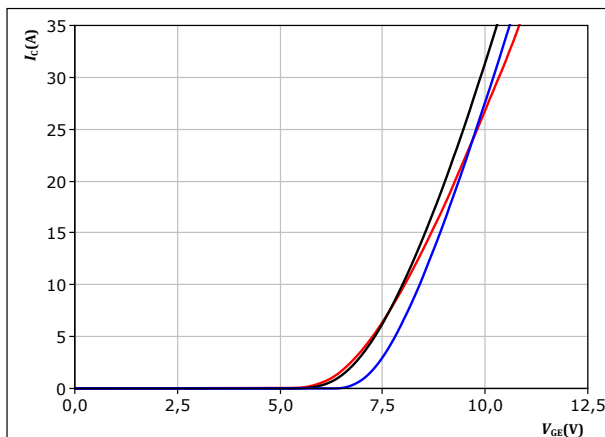


$t_p = 250 \mu s$   
 $T_j = 150 ^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 10.** IGBT

Typical transfer characteristics

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

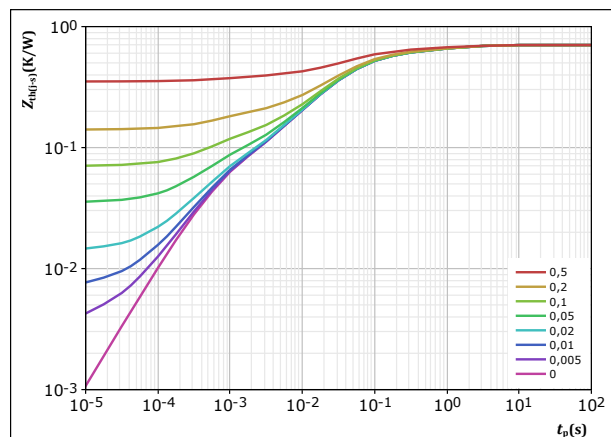


$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j:$  25 °C, 125 °C, 150 °C

**figure 11.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,704 K/W$   
IGBT thermal model values  

$R (K/W)$	$\tau (s)$
8,05E-02	1,62E+00
1,47E-01	1,81E-01
3,23E-01	3,75E-02
9,88E-02	9,21E-03
5,47E-02	6,24E-04



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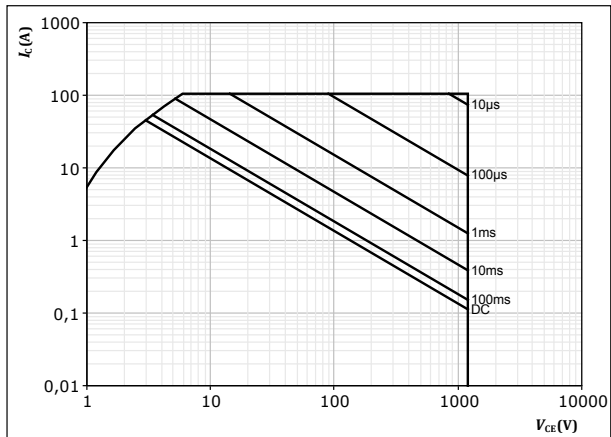
## Brake Switch Characteristics

figure 12.

IGBT

Safe operating area

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



D = single pulse

T<sub>s</sub> = 80 °C

V<sub>GE</sub> = 15 V

T<sub>j</sub> = T<sub>jmax</sub>



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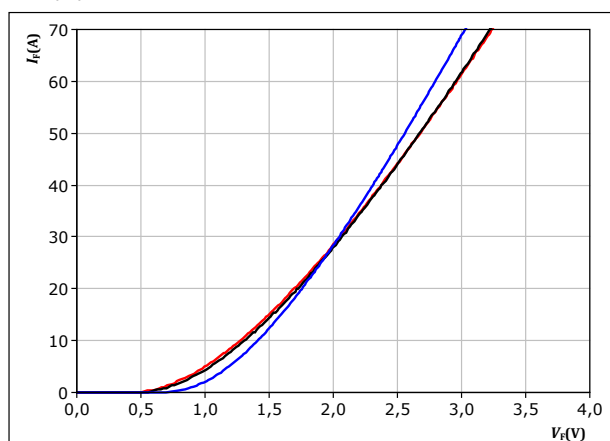
## Brake Diode Characteristics

figure 13.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

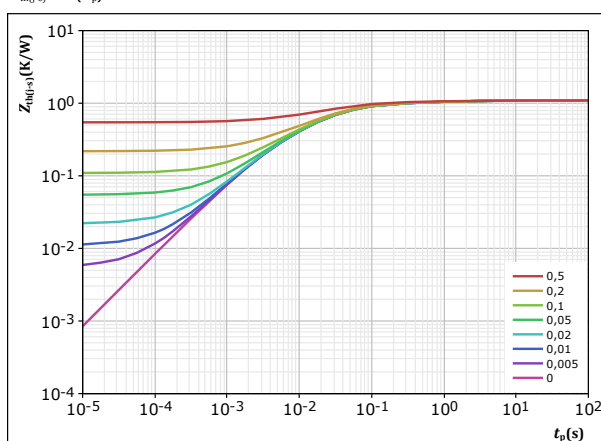
$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 14.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$	
$R_{th(j-s)} =$	1,091	K/W
FWD thermal model values		
$R$ (K/W)	$\tau$ (s)	
5,34E-02	2,93E+00	
9,71E-02	3,59E-01	
4,43E-01	4,79E-02	
3,93E-01	1,21E-02	
1,05E-01	2,46E-03	



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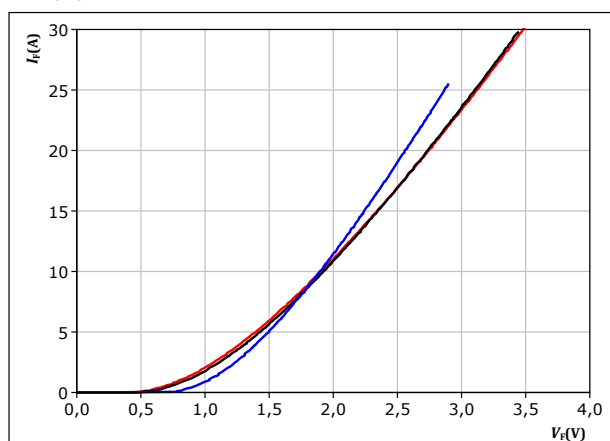
## Brake Sw. Protection Diode Characteristics

figure 15.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

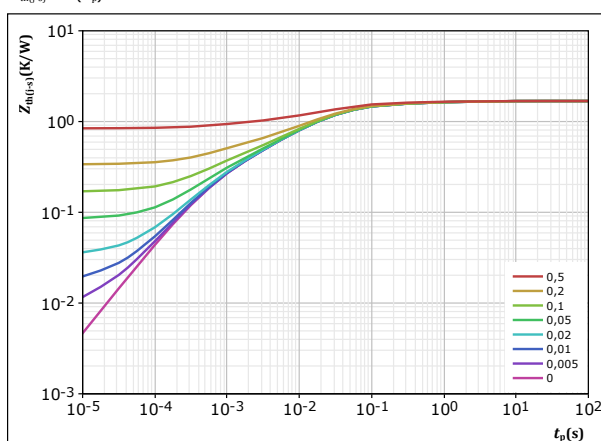
$T_j:$   
— 25 °C  
— 125 °C  
— 150 °C

figure 16.

FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,683 \text{ K/W}$   
FWD thermal model values  

$R$ (K/W)	$\tau$ (s)
6,27E-02	2,99E+00
1,53E-01	2,72E-01
5,57E-01	4,10E-02
4,90E-01	1,29E-02
2,45E-01	3,00E-03
1,75E-01	5,24E-04



## Rectifier Diode Characteristics

figure 17.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

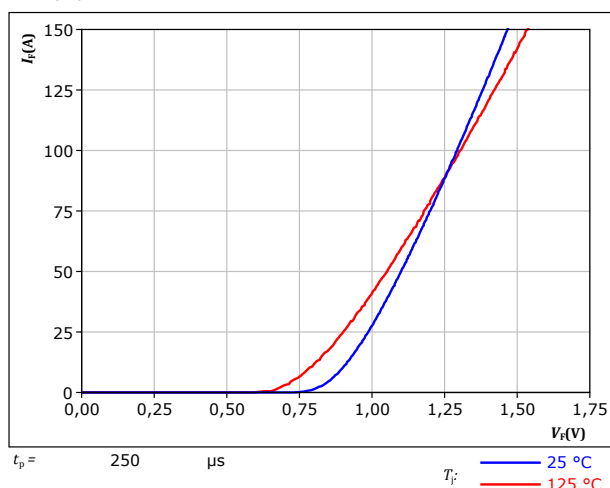
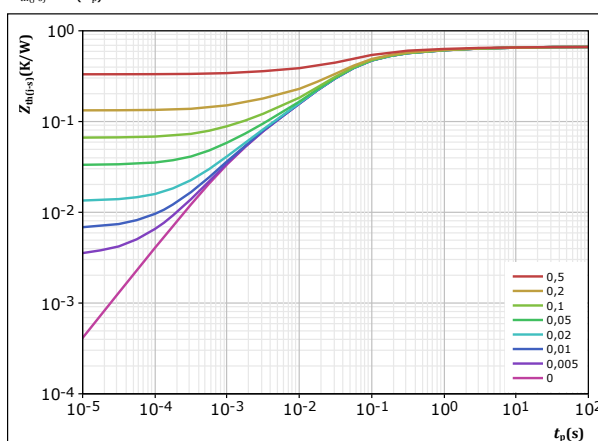


figure 18.

Rectifier

Transient thermal impedance as a function of pulse width

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



$D =$	$t_p / T$
$R_{th(j-s)} =$	0,664 K/W
Rectifier thermal model values	
$R$ (K/W)	$\tau$ (s)
2,64E-02	1,18E+01
6,63E-02	1,18E+00
1,36E-01	1,65E-01
3,29E-01	4,29E-02
6,63E-02	1,04E-02
3,95E-02	1,49E-03



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datasheet

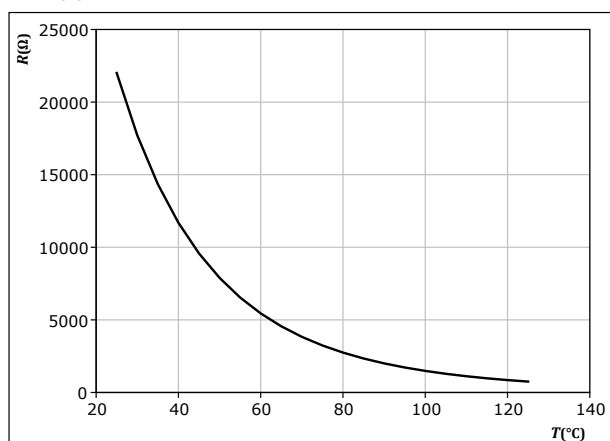
## Thermistor Characteristics

figure 19.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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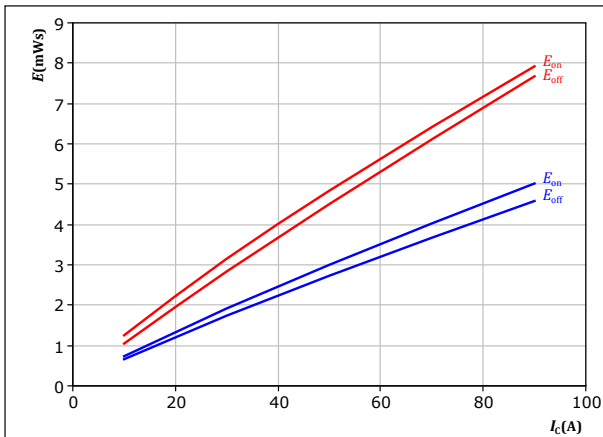
V23990-P768-AY-PM  
datasheet

## Inverter Switching Characteristics

figure 20. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

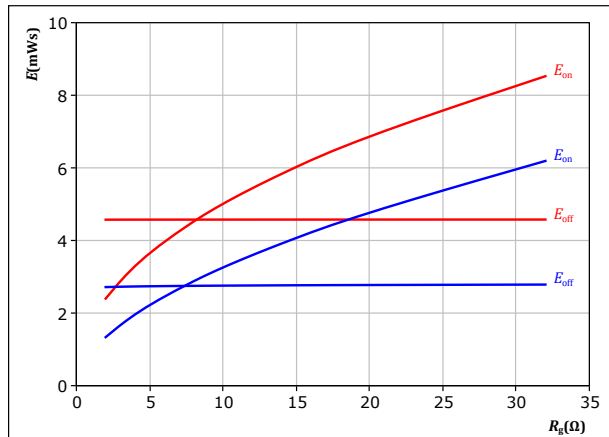
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$   
 $R_{goff} = 8$   $\Omega$

$T_j$ : — 25 °C  
— 150 °C

figure 21. IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

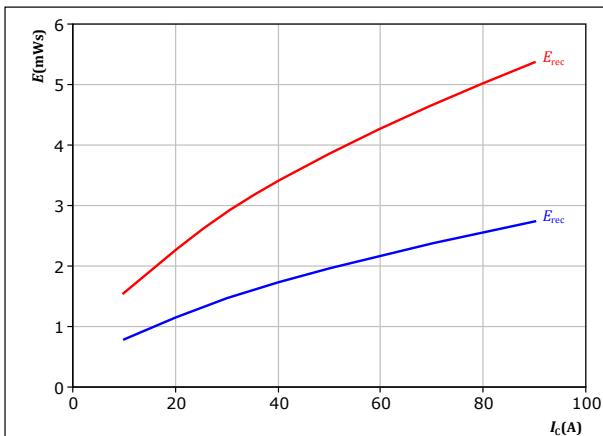
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 50$  A

$T_j$ : — 25 °C  
— 150 °C

figure 22. FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

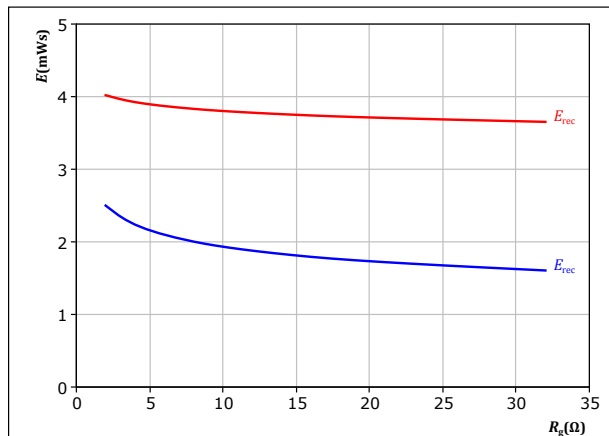
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$

$T_j$ : — 25 °C  
— 150 °C

figure 23. 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  
 $I_C = 50$  A

$T_j$ : — 25 °C  
— 150 °C





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datasheet

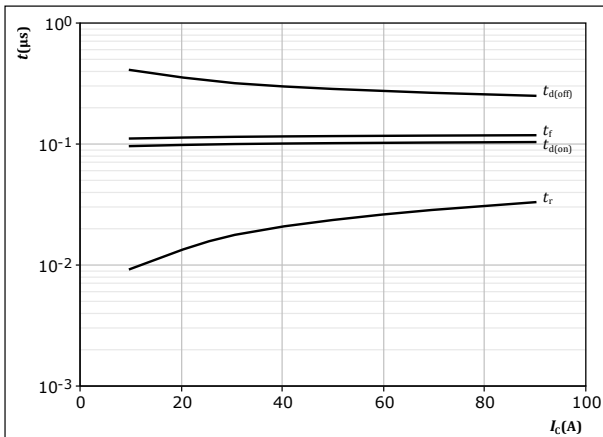
## Inverter Switching Characteristics

figure 24.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

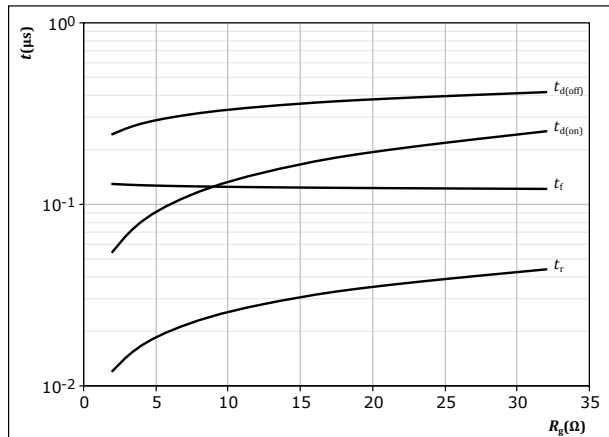
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

figure 25.

IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



With an inductive load at

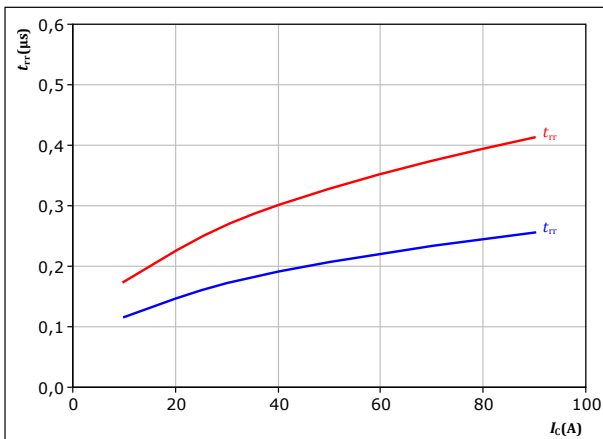
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

figure 26.

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
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

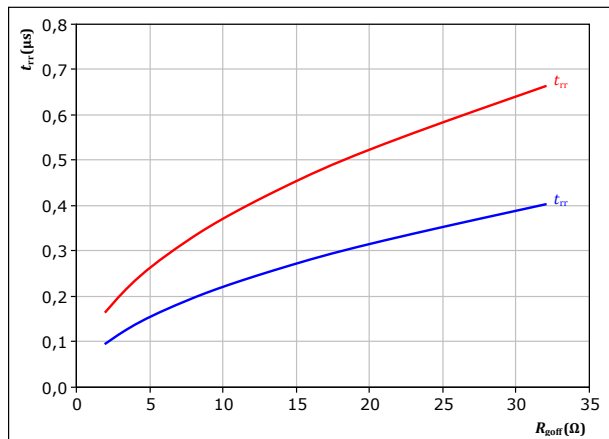
$T_j$ : — 25 °C  
— 150 °C

figure 27.

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
$V_{GE} =$	±15	V
$I_C =$	50	A

$T_j$ : — 25 °C  
— 150 °C



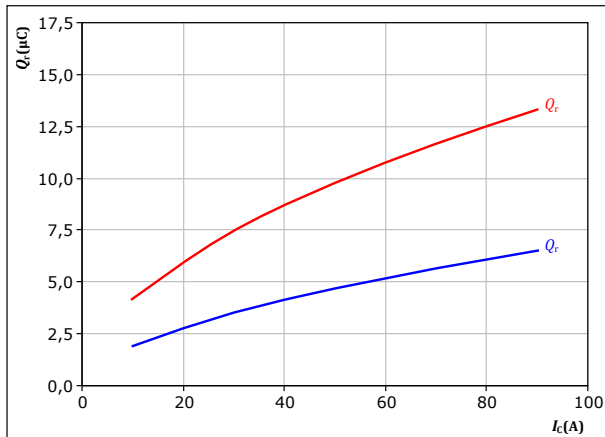
## Inverter Switching Characteristics

figure 28.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ R_{gon} &= 8 \text{ } \Omega \end{aligned}$$

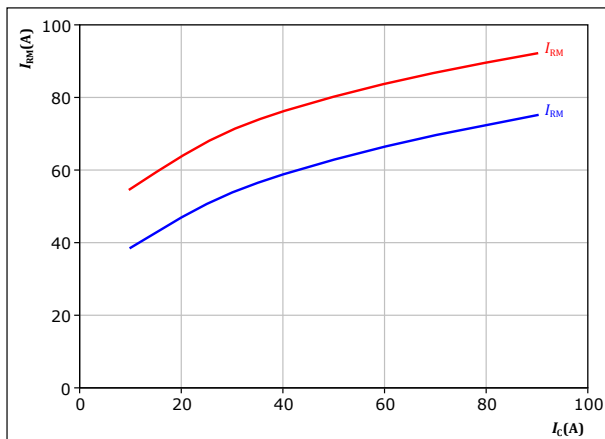
$T_j$ : — 25 °C  
— 150 °C

figure 30.

FWD

Typical peak reverse recovery current as a function of collector current

$$I_{RM} = f(I_c)$$



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ R_{gon} &= 8 \text{ } \Omega \end{aligned}$$

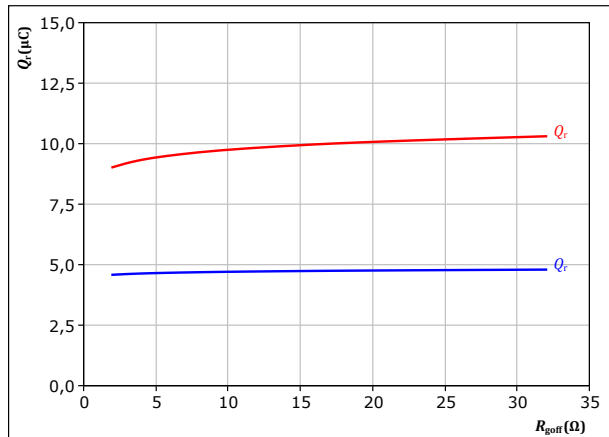
$T_j$ : — 25 °C  
— 150 °C

figure 29.

FWD

Typical recovered charge as a function of turn off gate resistor

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



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ I_c &= 50 \text{ A} \end{aligned}$$

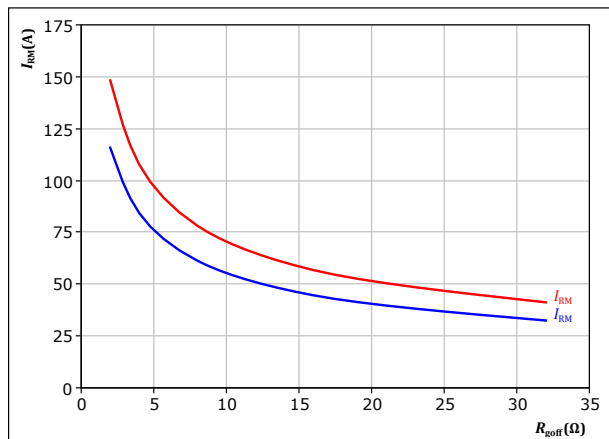
$T_j$ : — 25 °C  
— 150 °C

figure 31.

FWD

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

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



With an inductive load at

$$\begin{aligned} V_{CE} &= 600 \text{ V} \\ V_{GE} &= \pm 15 \text{ V} \\ I_c &= 50 \text{ A} \end{aligned}$$

$T_j$ : — 25 °C  
— 150 °C



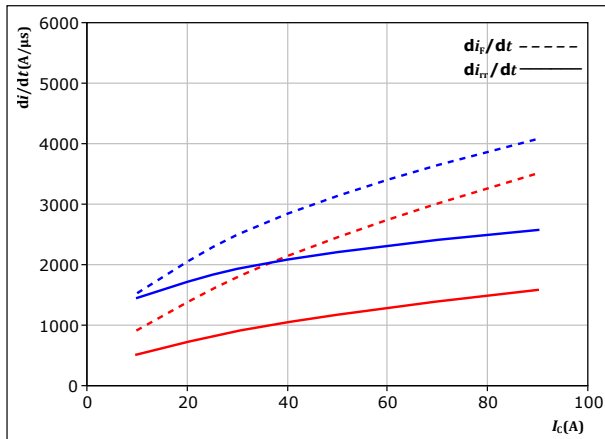
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datasheet

## Inverter Switching Characteristics

figure 32. 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

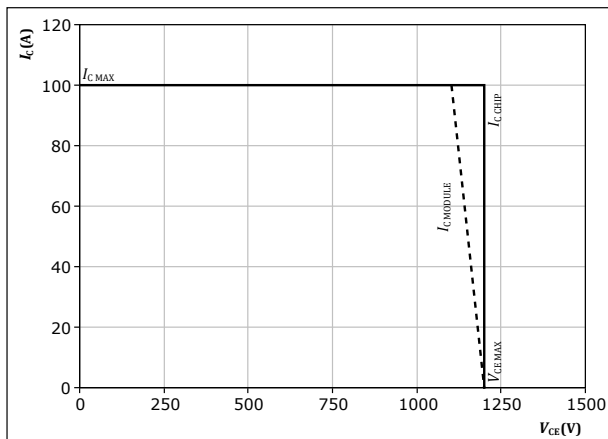
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$  Ω

$T_j$ : 25 °C  
150 °C

figure 34. IGBT

Reverse bias safe operating area

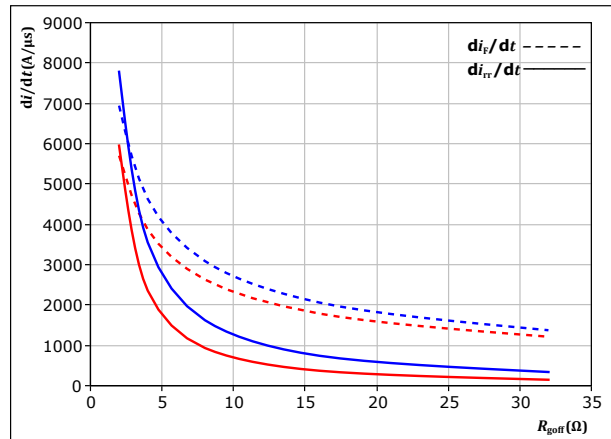
$I_C = f(V_{CE})$



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

figure 33. 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  
 $I_C = 50$  A

$T_j$ : 25 °C  
150 °C



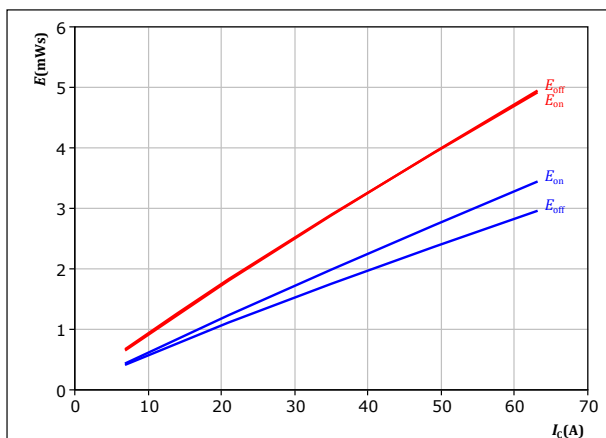
## Brake Switching Characteristics

figure 35.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \text{ } \Omega$   
 $R_{goff} = 16 \text{ } \Omega$

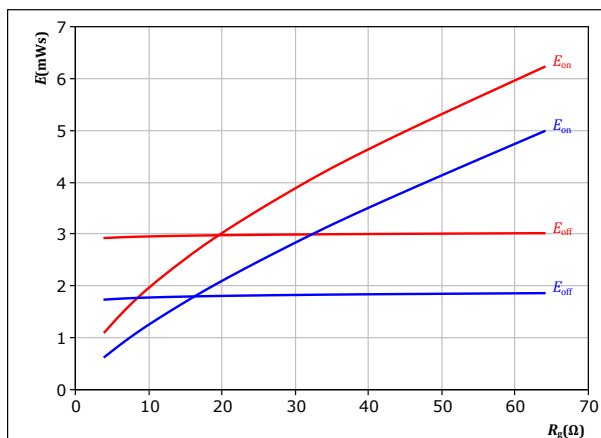
$T_j$ : — 25 °C  
— 150 °C

figure 36.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 35 \text{ A}$

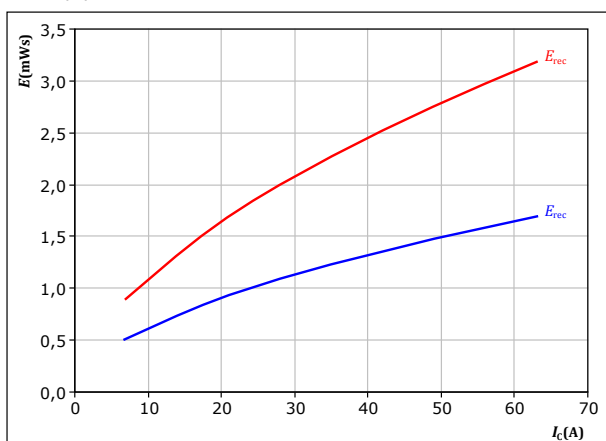
$T_j$ : — 25 °C  
— 150 °C

figure 37.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \text{ } \Omega$

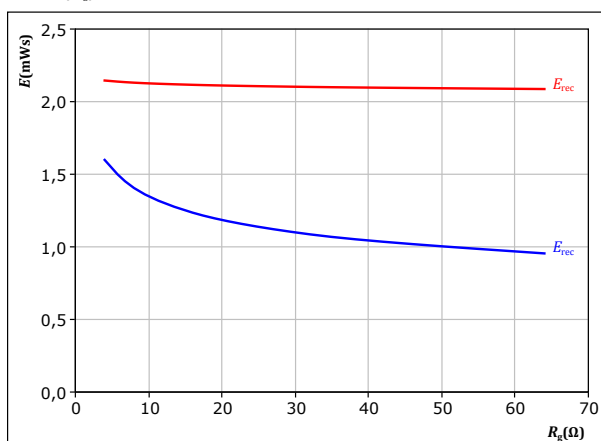
$T_j$ : — 25 °C  
— 150 °C

figure 38.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 35 \text{ A}$

$T_j$ : — 25 °C  
— 150 °C



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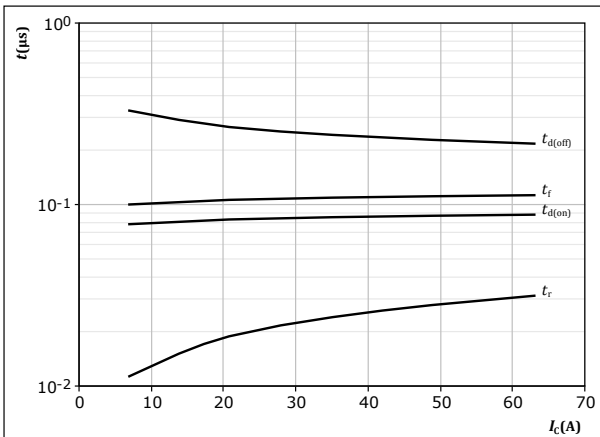
V23990-P768-AY-PM  
datasheet

## Brake Switching Characteristics

figure 39.

IGBT

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



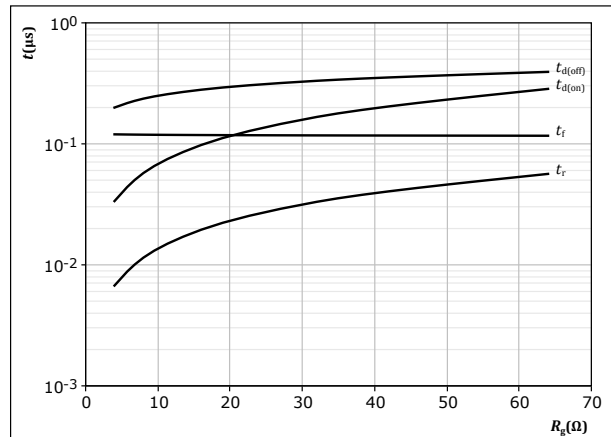
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$  Ω  
 $R_{goff} = 16$  Ω

figure 40.

IGBT

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



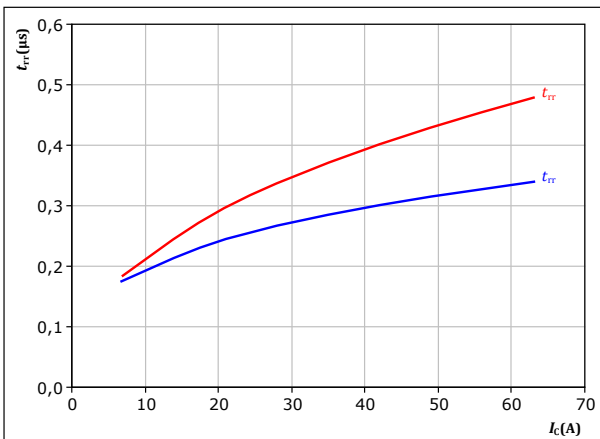
With an inductive load at

$T_j = 150$  °C  
 $V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 35$  A

figure 41.

FWD

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



With an inductive load at

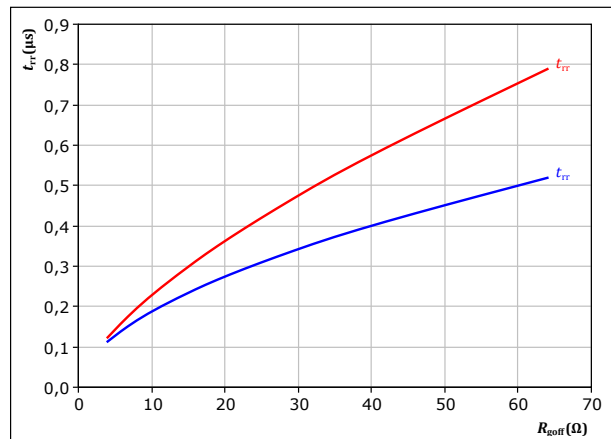
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$  Ω

$T_j$ : — 25 °C  
— 150 °C

figure 42.

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  
 $I_C = 35$  A

$T_j$ : — 25 °C  
— 150 °C



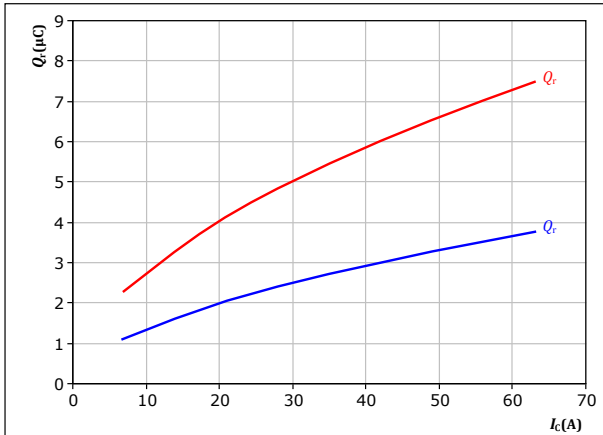
## Brake Switching Characteristics

figure 43.

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  
 $R_{gon} = 16$  Ω

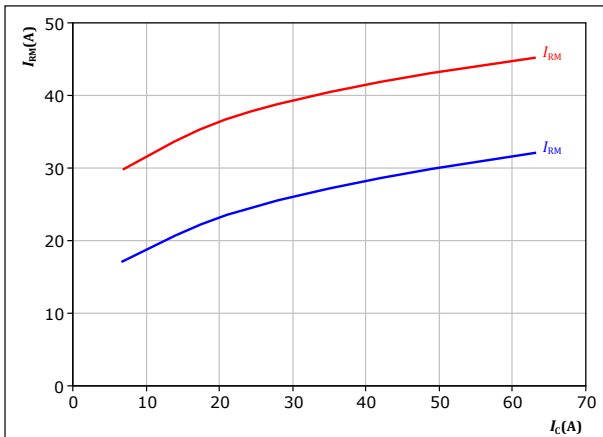
$T_j$ : — 25 °C  
— 150 °C

figure 45.

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  
 $R_{gon} = 16$  Ω

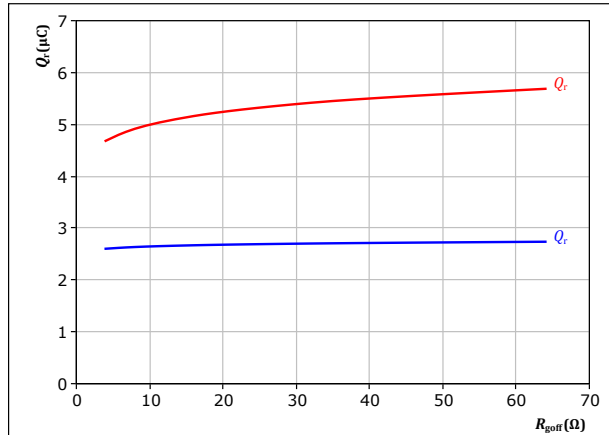
$T_j$ : — 25 °C  
— 150 °C

figure 44.

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  
 $I_c = 35$  A

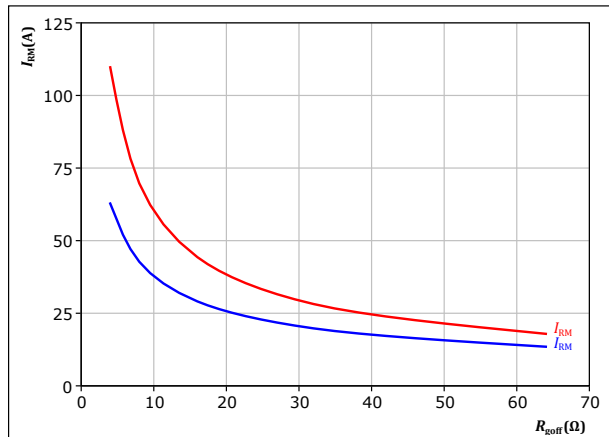
$T_j$ : — 25 °C  
— 150 °C

figure 46.

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  
 $I_c = 35$  A

$T_j$ : — 25 °C  
— 150 °C



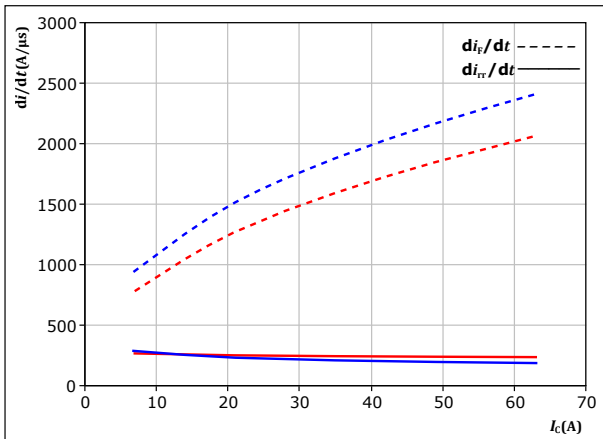
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datasheet

## Brake Switching Characteristics

figure 47. FWD

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



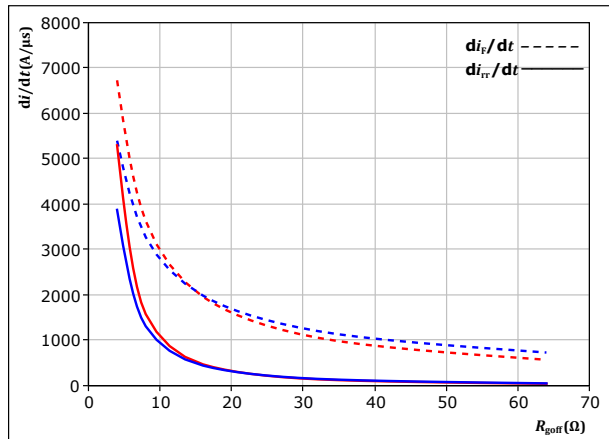
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 16 \text{ } \Omega$

$T_j$ : — 25 °C  
— 150 °C

figure 48. 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

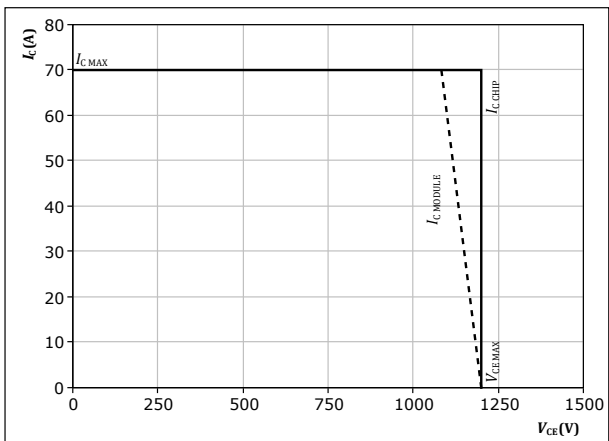
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 35 \text{ A}$

$T_j$ : — 25 °C  
— 150 °C

figure 49. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At  $T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{gon} = 16 \text{ } \Omega$   
 $R_{goff} = 16 \text{ } \Omega$



## Switching Definitions

figure 50.

IGBT

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

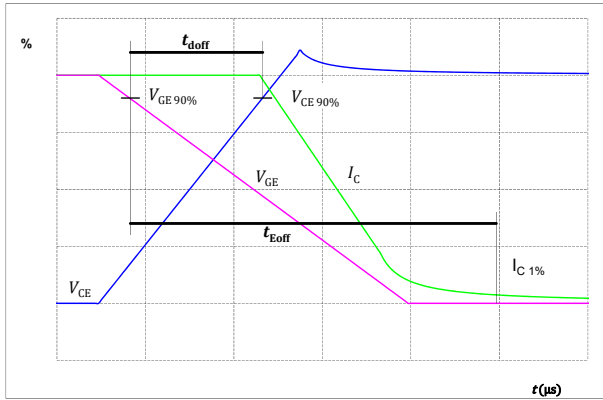


figure 51.

IGBT

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

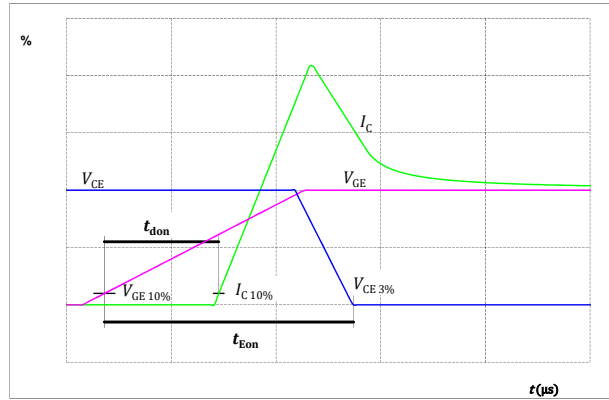


figure 52.

IGBT

Turn-off Switching Waveforms & definition of  $t_f$

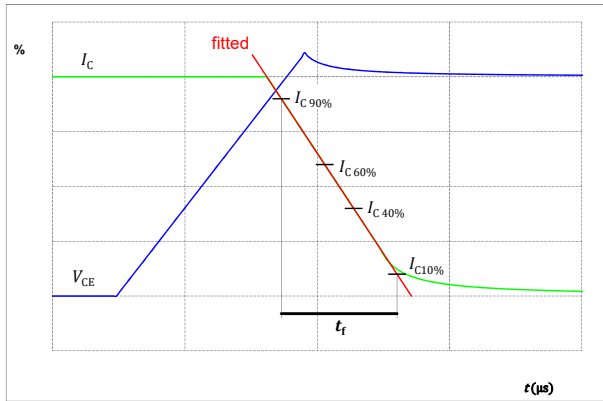
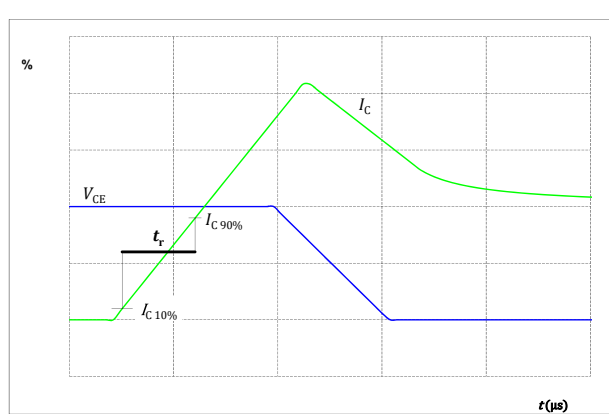


figure 53.

IGBT

Turn-on Switching Waveforms & definition of  $t_r$







## Switching Definitions

figure 54.

FWD

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

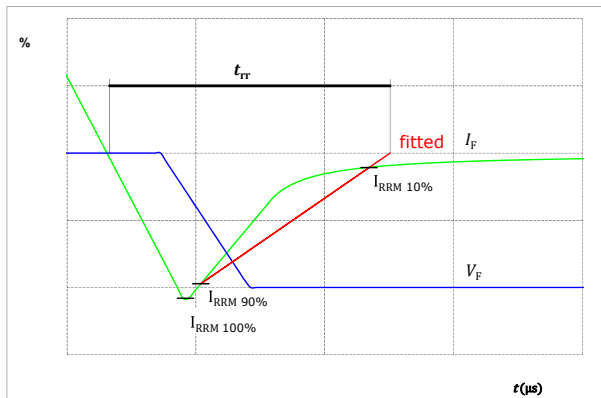
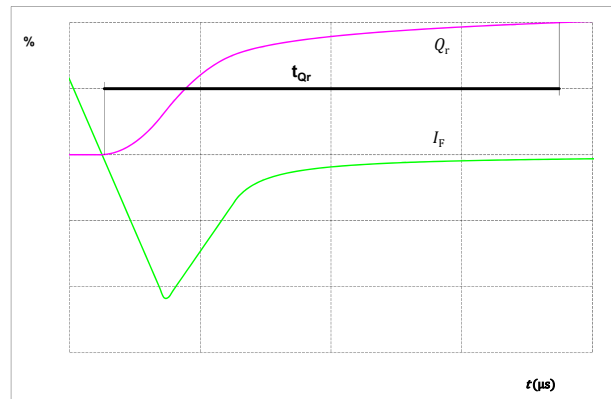


figure 55.

FWD

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






Vincotech

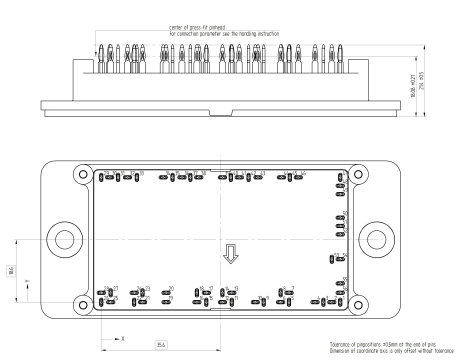
# V23990-P768-AY-PM

datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P768-AY-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P768-AY-/3/-PM

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
		VIN	WWYY	TTTTTTVV	UL	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTVV	LLLLL	SSSS	WWYY		

Outline							
Pin table [mm]							
Pin	X	Y	Function	29	0	37,2	U
1	71,2	0	DC-	30	2,5	37,2	U
2	68,7	0	DC-	31	5	37,2	U
3	66,2	0	DC-	32	7,8	37,2	E
4	63,7	0	DC-	33	10,6	37,2	G
5	55,95	0	DC+	34	18,45	37,2	G
6	53,45	0	DC+	35	21,25	37,2	E
7	55,95	2,8	DC+	36	24,05	37,2	V
8	53,45	2,8	DC+	37	26,55	37,2	V
9	48,4	0	DC+	38	29,05	37,2	V
10	45,9	0	DC+	39	36,1	37,2	W
11	38,9	0	E	40	38,6	37,2	W
12	36,1	0	DC-	41	41,1	37,2	W
13	38,9	2,8	G	42	43,9	37,2	E
14	36,1	2,8	DC-	43	46,7	37,2	G
15	31,3	0	DC-	44	53,7	37,2	L1
16	28,5	0	E	45	56,2	37,2	L1
17	31,3	2,8	DC-	46	58,7	37,2	L1
18	28,5	2,8	G	47	71,2	37,2	L2
19	19,3	0	R2	48	71,2	34,7	L2
20	19,3	2,8	R1	49	71,2	32,2	L2
21	12,3	0	DC+	50	71,2	25,2	L3
22	9,8	0	DC+	51	71,2	22,7	L3
23	12,3	2,8	DC+	52	71,2	20,2	L3
24	9,8	2,8	DC+	53	68,7	12,8	BrC
25	2,8	0	E	54	71,2	12,8	BrC
26	0	0	DC-	55	71,2	5,6	BrG
27	2,8	2,8	G	56	71,2	2,8	BrE
28	0	2,8	DC-				



Top view of the package showing dimensions: 71,2 mm (total width), 37,2 mm (pin pitch), 2,8 mm (pin offset), 12,3 mm (pin offset), 9,8 mm (pin offset), 5,6 mm (pin offset), 2,8 mm (pin offset), 12,8 mm (pin offset), 12,8 mm (pin offset), 20,2 mm (pin offset), 22,7 mm (pin offset), 25,2 mm (pin offset), 32,2 mm (pin offset), 34,7 mm (pin offset), 37,2 mm (pin offset), 38,6 mm (pin offset), 39,3 mm (pin offset), 41,1 mm (pin offset), 43,9 mm (pin offset), 46,7 mm (pin offset), 53,7 mm (pin offset), 56,2 mm (pin offset), 58,7 mm (pin offset), 71,2 mm (pin offset).

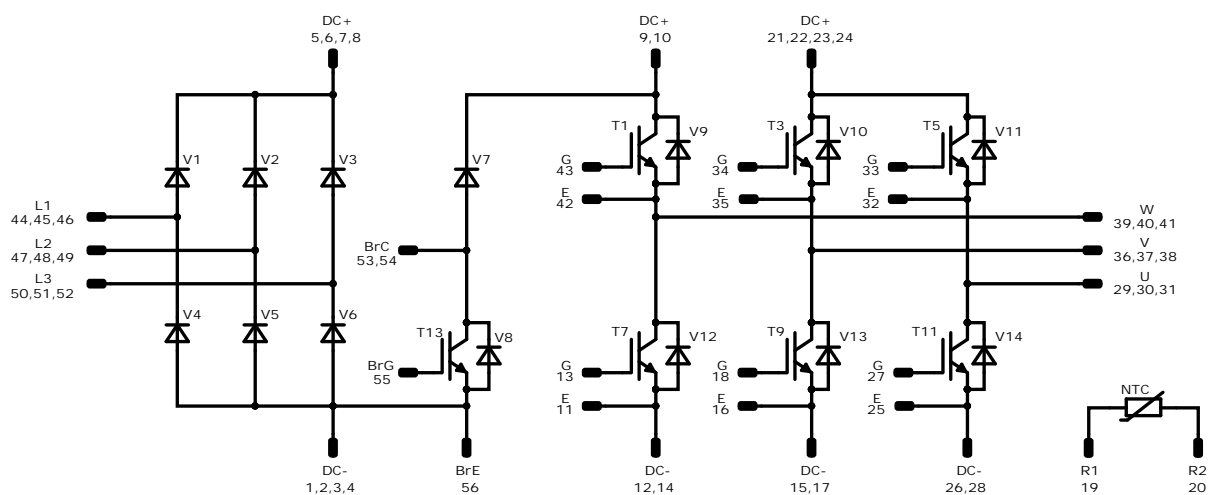
Bottom view of the package showing dimensions: 71,2 mm (total width), 37,2 mm (pin pitch), 2,8 mm (pin offset), 12,3 mm (pin offset), 9,8 mm (pin offset), 5,6 mm (pin offset), 2,8 mm (pin offset), 12,8 mm (pin offset), 12,8 mm (pin offset), 20,2 mm (pin offset), 22,7 mm (pin offset), 25,2 mm (pin offset), 32,2 mm (pin offset), 34,7 mm (pin offset), 37,2 mm (pin offset), 38,6 mm (pin offset), 39,3 mm (pin offset), 41,1 mm (pin offset), 43,9 mm (pin offset), 46,7 mm (pin offset), 53,7 mm (pin offset), 56,2 mm (pin offset), 58,7 mm (pin offset), 71,2 mm (pin offset).

Distance of pins from the edge of the package is 0,5 mm.



Vincotech


Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T7, T1, T9, T3, T11, T5	IGBT	1200 V	50 A	Inverter Switch	
V9, V12, V10, V13, V11, V14	FWD	1200 V	50 A	Inverter Diode	
T13	IGBT	1200 V	35 A	Brake Switch	
V7	FWD	1200 V	25 A	Brake Diode	
V8	FWD	1200 V	10 A	Brake Sw. Protection Diode	
V4, V1, V5, V2, V6, V3	Rectifier	1600 V	50 A	Rectifier Diode	
NTC	Thermistor			Thermistor	



Packaging instruction				
Standard packaging quantity (SPQ) 36	>SPQ	Standard	<SPQ	Sample
Handling instruction				
Handling instructions for <i>flow 2</i> packages see vincotech.com website.				
Package data				
Package data for <i>flow 2</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-P768-AY-PM-D9-14	8 Sep. 2021	Rectifier maximum ratings is updated Clearance value is corrected Isolation voltage is updated Static characteristics of rectifier, inverter switch, brake switch, brake switch protection diode is updated Thermal characteristics of rectifier, inverter diode, brake switch, brake diode, brake switch protection diode is updated Separate datasheet for pressfit pin version New datasheet format, module is unchanged	

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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.