



Vincotech

V23990-P588-A41-PM

datasheet

flowPIM 1

1200 V / 15 A

Features

- Three-phase rectifier, optional BRC, Inverter, NTC
- Very compact housing, easy to route
- IGBT4 / EmCon4 technology for low saturation losses and improved EMC behaviour

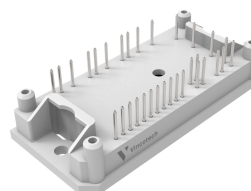
Target applications

- Industrial drives
- Embedded drives

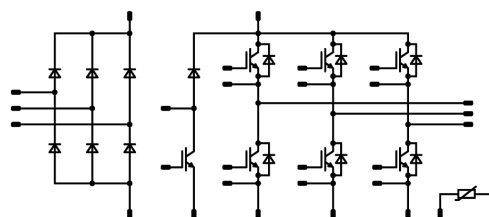
Types

- V23990-P588-A41-PM

flow 1 17 mm housing



Schematic





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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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	23	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	71	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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	23	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	52	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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	16	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	24	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	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	$^{\circ}\text{C}$



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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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	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	°C

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	46	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t		370	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	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			>12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0005	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,58	1,84 2,24	2,07 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2	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		890		pF
Reverse transfer capacitance	C_{res}							30		pF
Gate charge	Q_g		20		0	25		120		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,35		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \text{ } \Omega$ $R_{goff} = 32 \text{ } \Omega$	± 15	600	15	25 150		85,2 84,8		ns
Rise time	t_r					25 150		17 21,8		ns
Turn-off delay time	$t_{d(off)}$					25 150		200,8 264,2		ns
Fall time	t_f					25 150		82,07 123,1		ns
Turn-on energy (per pulse)	E_{on}					25 150		0,817 1,25		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,878 1,36		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				15	25 150		1,35	1,86 1,79	2,05 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25				3,5	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							1,83		K/W
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Dynamic

Peak recovery current	I_{RRM}	$di/dt=1293$ A/μs $di/dt=949$ A/μs	±15	600	15	25 150		24,57 25,93		A
Reverse recovery time	t_{rr}					25 150		152,87 312,55		ns
Recovered charge	Q_r					25 150		1,34 2,98		μC
Reverse recovered energy	E_{rec}					25 150		0,518 1,26		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		1700 776,27		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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00015	25		5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		8	25 150		1,58	1,82 2,23	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								None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25		25			490		pF
Reverse transfer capacitance	C_{res}								30		pF

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)							1,57		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	± 15	600	8	25 150		53 54,8		ns
Rise time	t_r					25 150		17,8 22,6		ns
Turn-off delay time	$t_{d(off)}$					25 150		169,4 231		ns
Fall time	t_f					25 150		82,04 119,14		ns
Turn-on energy (per pulse)	E_{on}					25 150		0,467 0,754		mWs
Turn-off energy (per pulse)	E_{off}					25 150		0,44 0,683		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	

Brake Diode

Static

Forward voltage	V_F				10	25 150	1,35	1,85 1,77	2,05 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25			2,7	μA

Thermal

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

Peak recovery current	I_{RRM}	$di/dt=447$ A/μs $di/dt=378$ A/μs	± 15	600	8	25 150		8,2 9,94		A
Reverse recovery time	t_{rr}					25 150		272,66 414,89		ns
Recovered charge	Q_r					25 150		0,92 1,69		μC
Reverse recovered energy	E_{rec}					25 150		0,384 0,696		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		67,88 65,23		A/μs

Rectifier Diode

Static

Forward voltage	V_F				13	25 125		0,988 0,899	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⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,25		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	

⁽¹⁾ Value at chip level

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



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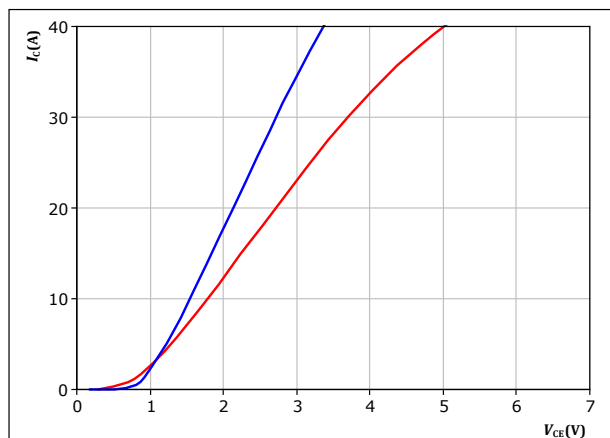
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Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

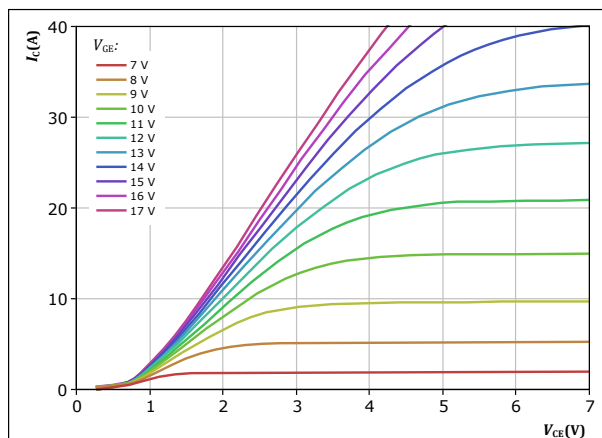


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25 \text{ } ^\circ C$
 $150 \text{ } ^\circ C$

figure 2. IGBT

Typical output characteristics

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

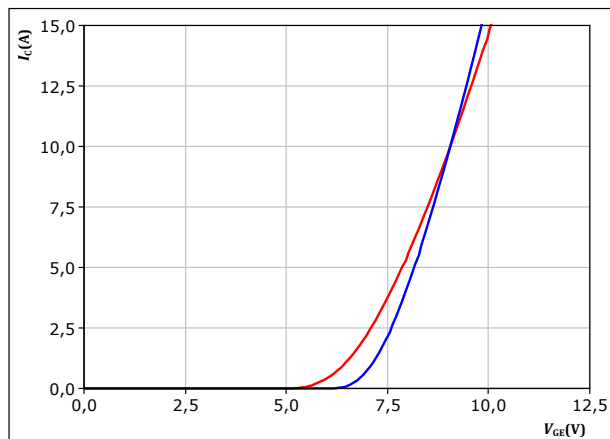


$t_p = 250 \mu s$
 $T_j = 150 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

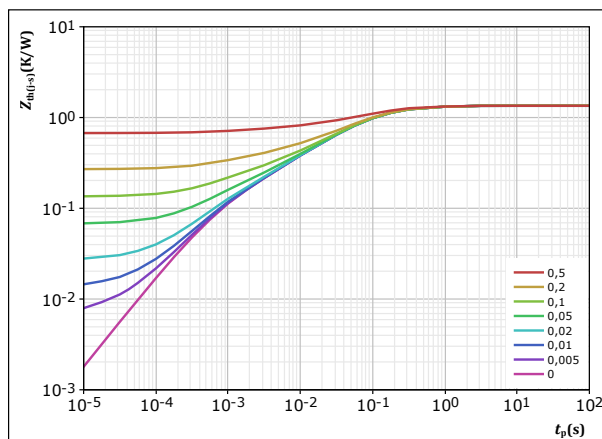


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25 \text{ } ^\circ C$
 $150 \text{ } ^\circ C$

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,347 \text{ K/W}$
IGBT thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
1,62E-01	5,85E-01
6,34E-01	9,42E-02
2,82E-01	2,85E-02
1,64E-01	6,73E-03
8,75E-02	9,43E-04
1,75E-02	3,79E-04



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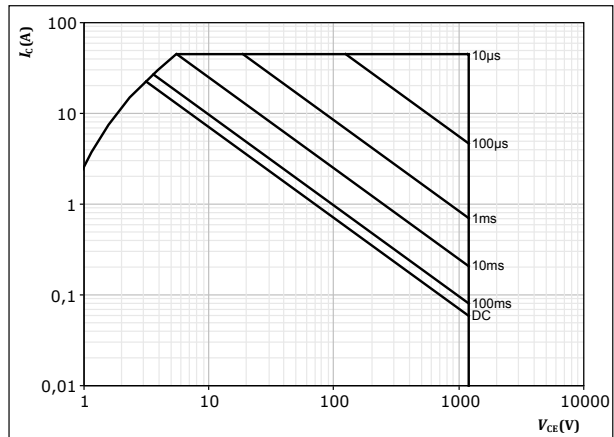
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datasheet

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

$T_j = T_{jmax}$



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Inverter Diode Characteristics

figure 6.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

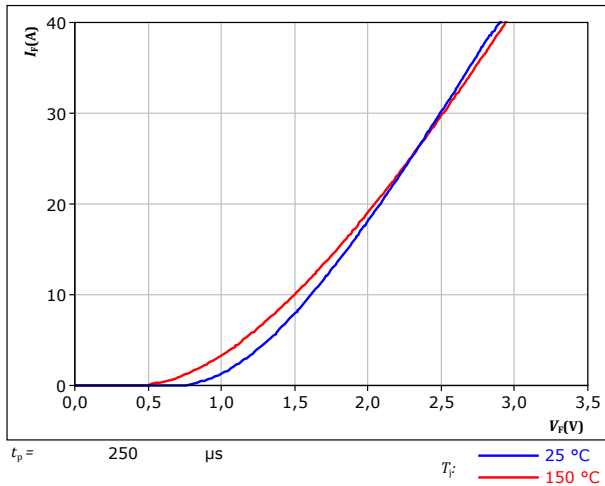
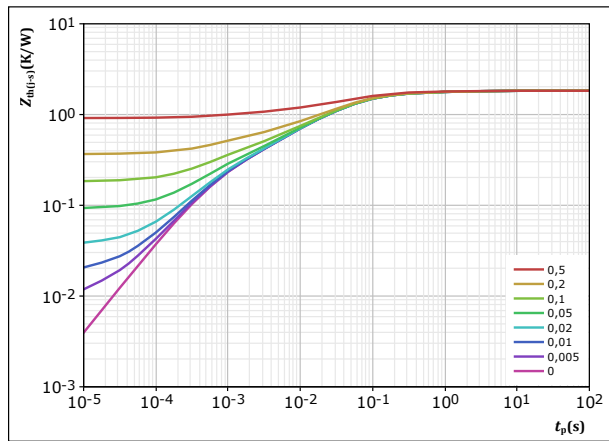


figure 7.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	1,829	K/W
FWD thermal model values		
R (K/W)	τ (s)	
6,16E-02	2,79E+00	
1,40E-01	3,93E-01	
7,06E-01	6,76E-02	
4,97E-01	1,96E-02	
2,49E-01	4,04E-03	
1,76E-01	5,86E-04	



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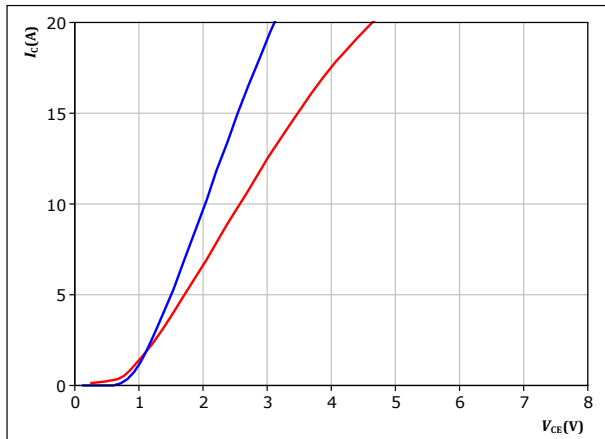
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Brake Switch Characteristics

figure 8. IGBT

Typical output characteristics

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

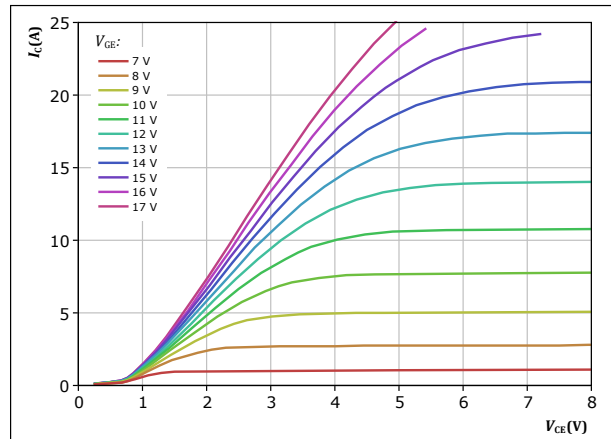


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 9. IGBT

Typical output characteristics

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

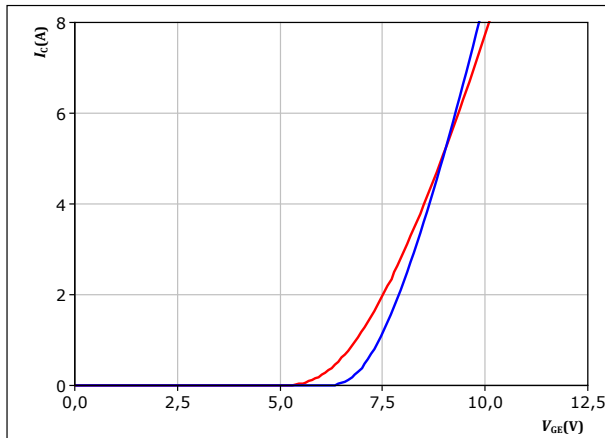


$t_p = 250 \mu s$
 $T_J = 150 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 10. IGBT

Typical transfer characteristics

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

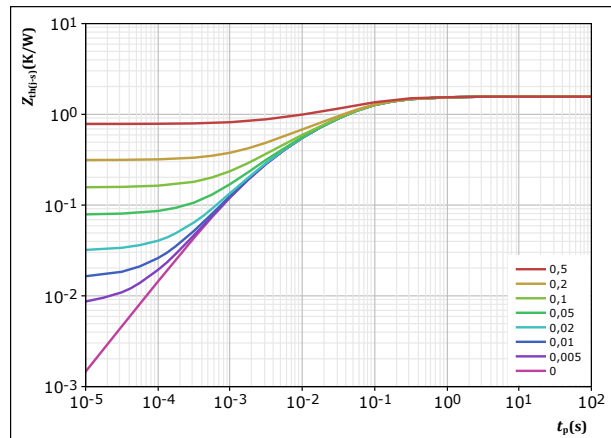


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_J: 25 ^\circ C$ (blue line)
 $150 ^\circ C$ (red line)

figure 11. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,566 K/W$
IGBT thermal model values

$R (K/W)$	$\tau (s)$
1,42E-01	5,98E-01
6,32E-01	7,71E-02
3,98E-01	2,43E-02
2,86E-01	6,16E-03
1,08E-01	1,44E-03



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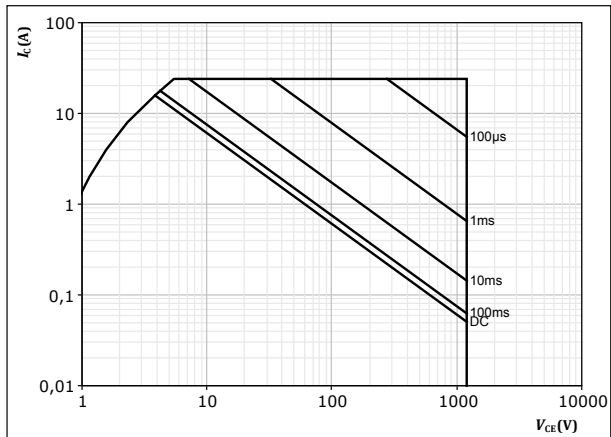
Brake Switch Characteristics

figure 12.

IGBT

Safe operating area

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



D = single pulse

$T_s = 80$ °C

$V_{GE} = 15$ V

$T_j = T_{jmax}$



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Brake Diode Characteristics

figure 13.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

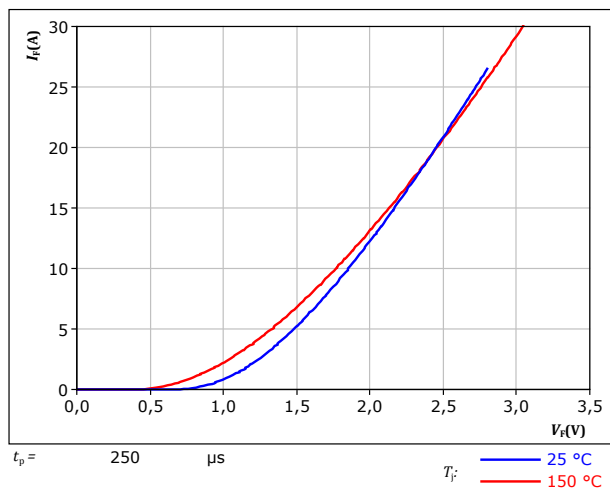
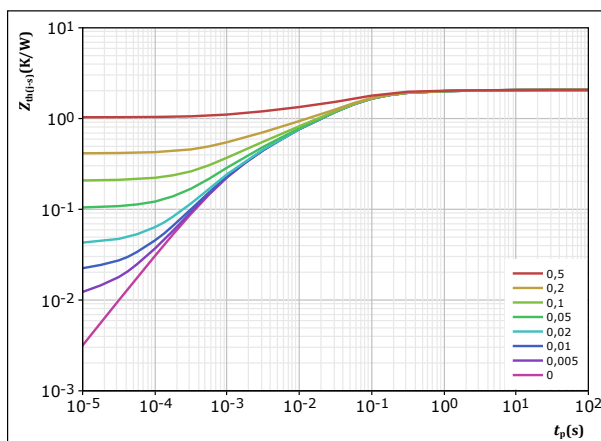


figure 14.

FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	2,066	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	



Rectifier Diode Characteristics

figure 15.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

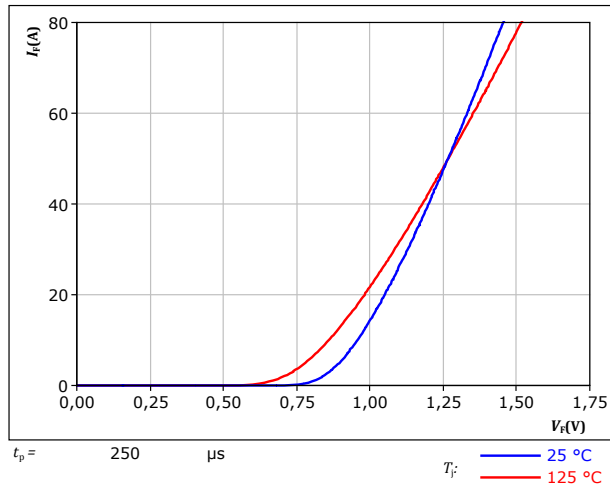
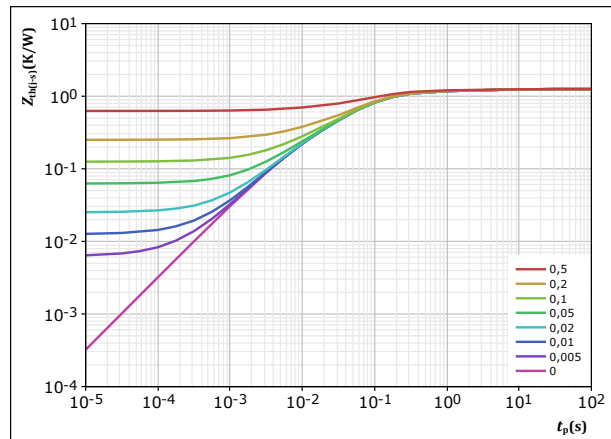


figure 16.

Rectifier

Transient thermal impedance as a function of pulse width

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



Rectifier thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
8,00E-02	5,22E+00
1,56E-01	4,18E-01
6,95E-01	8,82E-02
2,23E-01	3,07E-02
9,97E-02	5,99E-03



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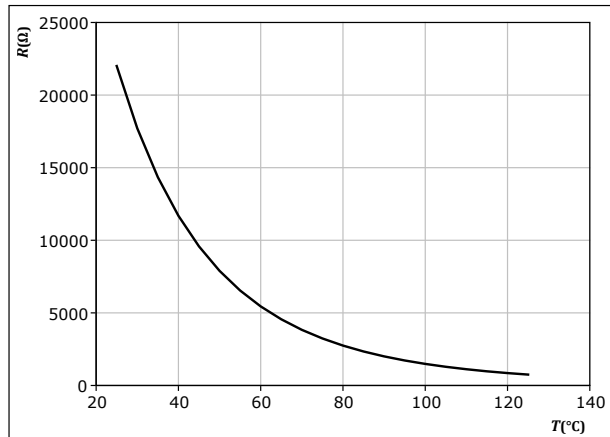
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Thermistor Characteristics

figure 17. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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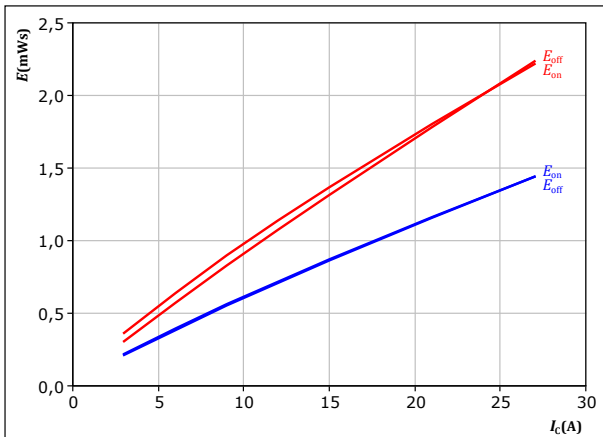
Inverter Switching Characteristics

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
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

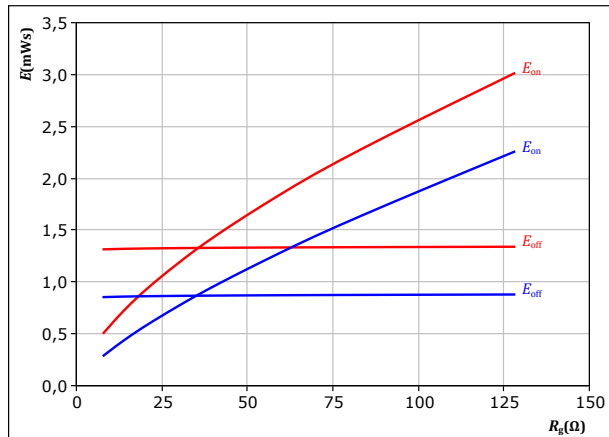
T_j : — 25 °C
— 150 °C

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
 $I_C = 15$ A

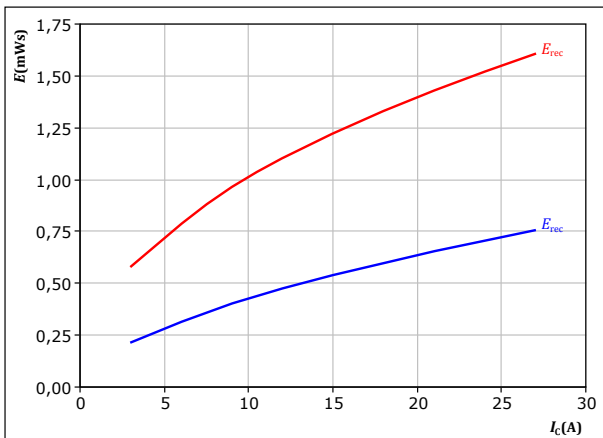
T_j : — 25 °C
— 150 °C

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
 $R_{gon} = 32$ Ω

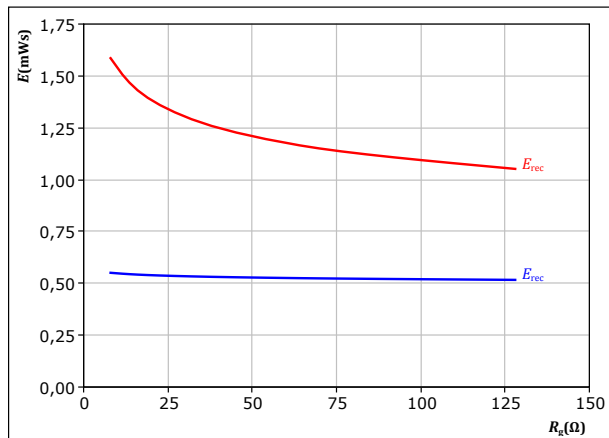
T_j : — 25 °C
— 150 °C

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
 $I_C = 15$ A

T_j : — 25 °C
— 150 °C



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Inverter Switching Characteristics

figure 22.

IGBT

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

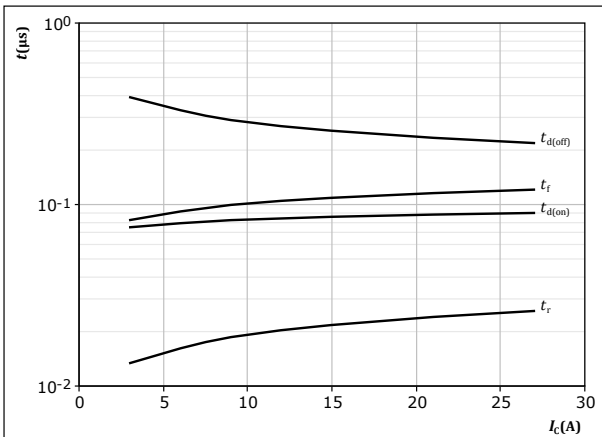


figure 23.

IGBT

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

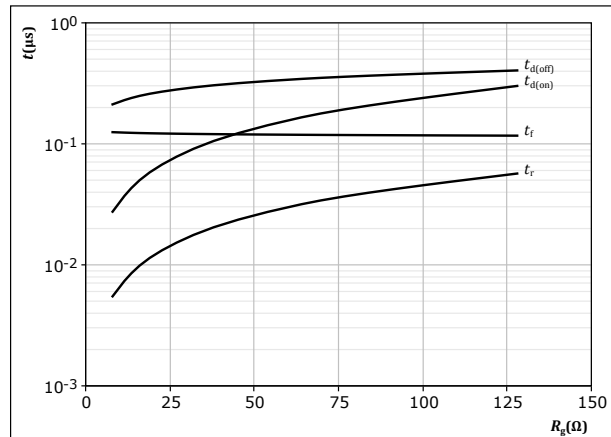


figure 24.

FWD

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

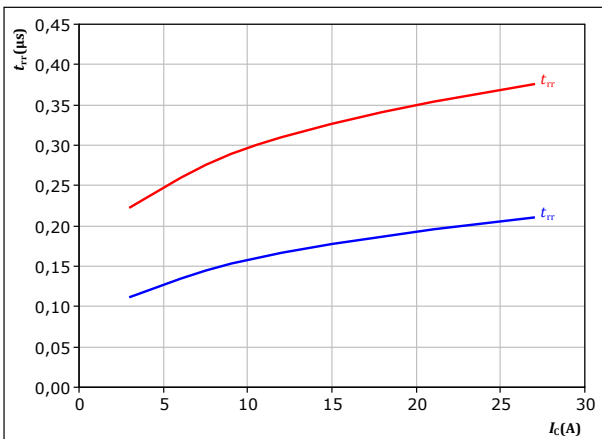
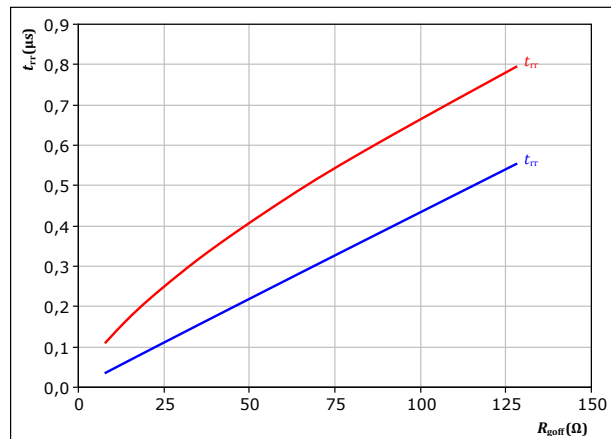


figure 25.

FWD

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





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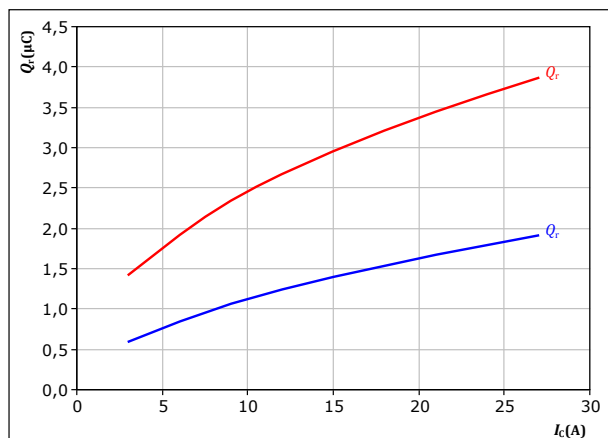
Inverter Switching Characteristics

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
 $R_{gon} = 32$ Ω

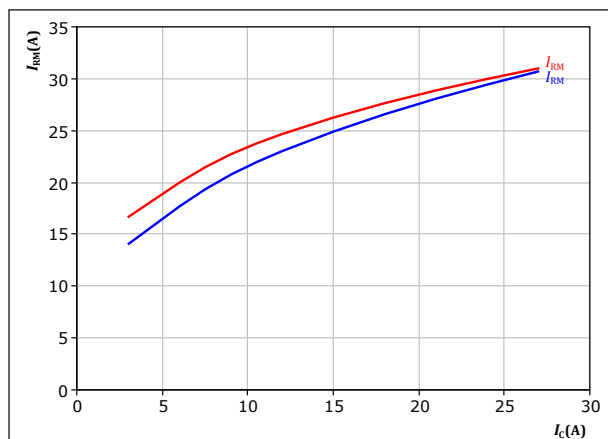
T_j : — 25 °C
— 150 °C

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
 $R_{gon} = 32$ Ω

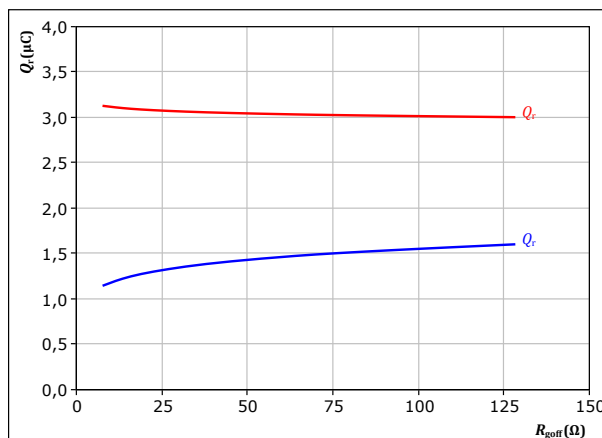
T_j : — 25 °C
— 150 °C

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
 $I_c = 15$ A

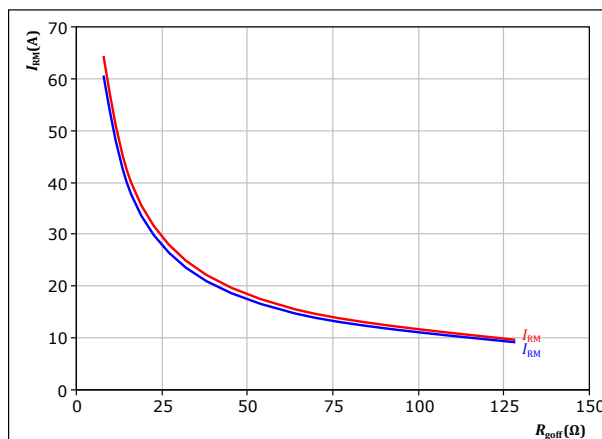
T_j : — 25 °C
— 150 °C

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
 $I_c = 15$ A

T_j : — 25 °C
— 150 °C



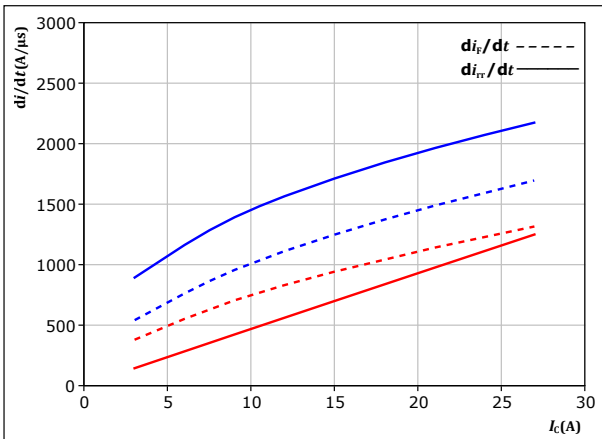
Vincotech

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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

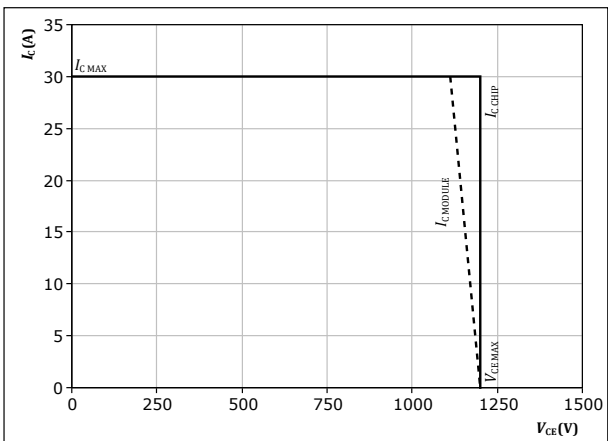
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$

T_j : — 25 °C
— 150 °C

figure 32. IGBT

Reverse bias safe operating area

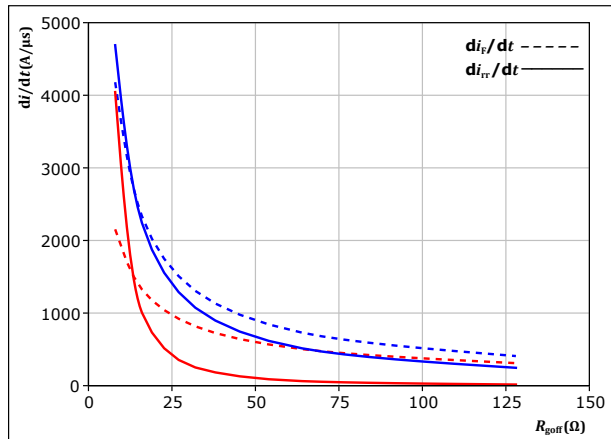
$I_c = f(V_{CE})$



At $T_j = 150 \text{ } ^\circ\text{C}$
 $R_{gon} = 32 \text{ } \Omega$
 $R_{goff} = 32 \text{ } \Omega$

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

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

T_j : — 25 °C
— 150 °C



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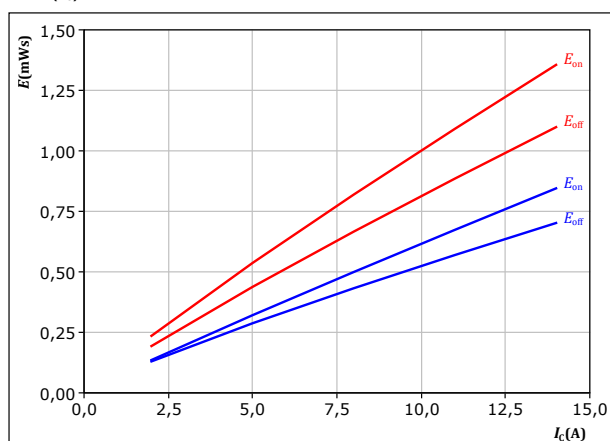
Brake Switching Characteristics

figure 33.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

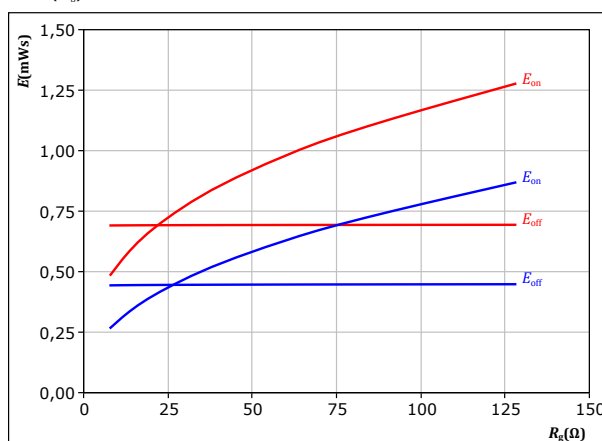
T_j : — 25 °C
— 150 °C

figure 34.

IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 8$ A

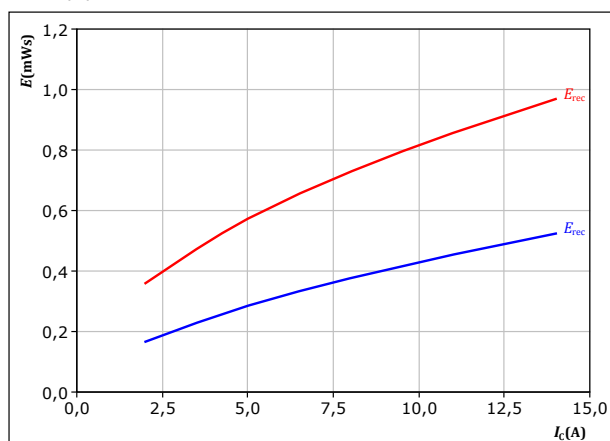
T_j : — 25 °C
— 150 °C

figure 35.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

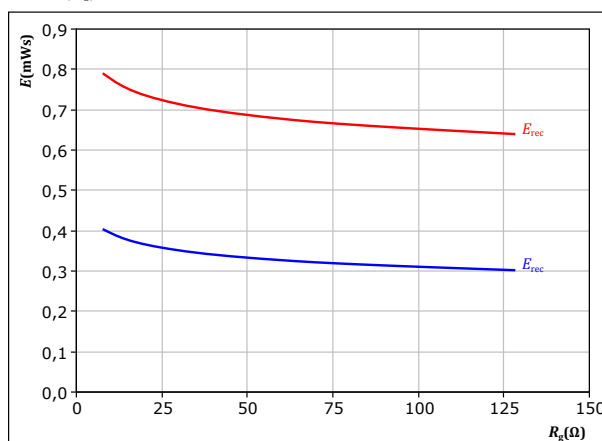
T_j : — 25 °C
— 150 °C

figure 36.

FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 8$ A

T_j : — 25 °C
— 150 °C



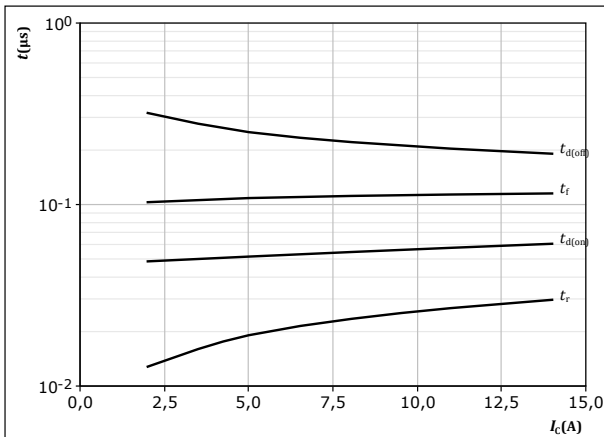
Brake Switching Characteristics

figure 37.

IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



With an inductive load at

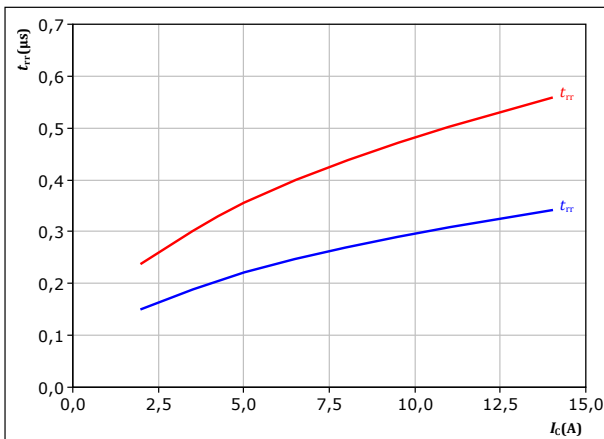
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω
$R_{goff} =$	32	Ω

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
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω

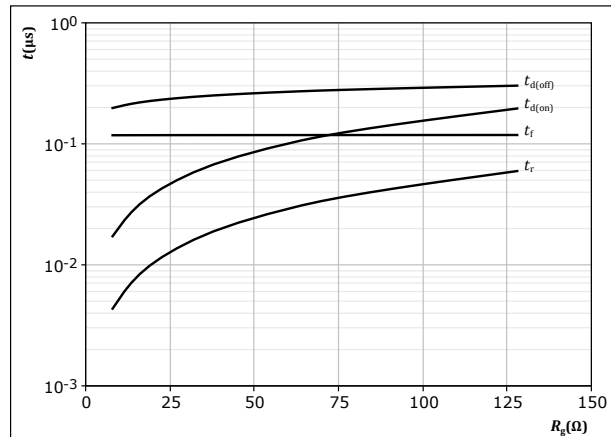
T_j : — 25 °C
— 150 °C

figure 38.

IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



With an inductive load at

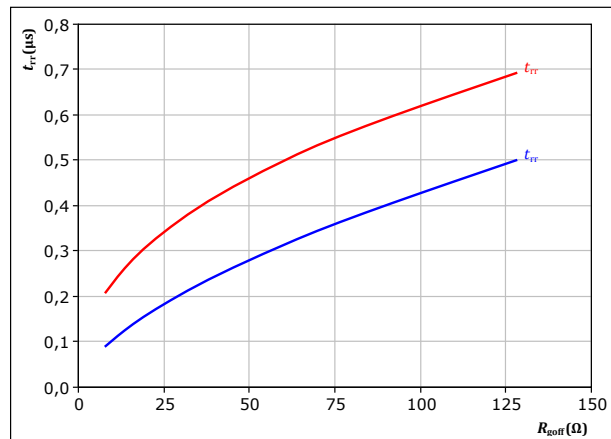
$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	8	A

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
$V_{GE} =$	±15	V
$I_C =$	8	A

T_j : — 25 °C
— 150 °C



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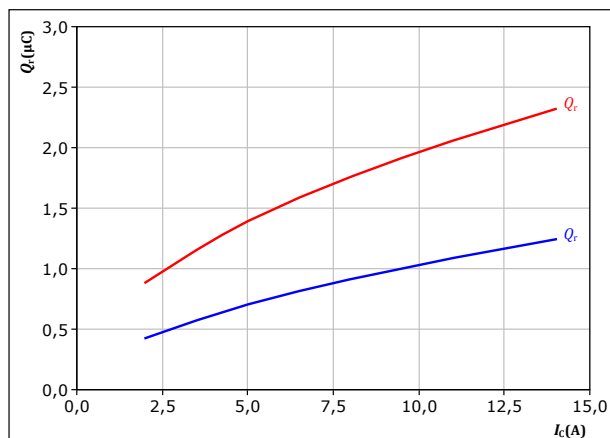
Brake Switching Characteristics

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
 $R_{gon} = 32$ Ω

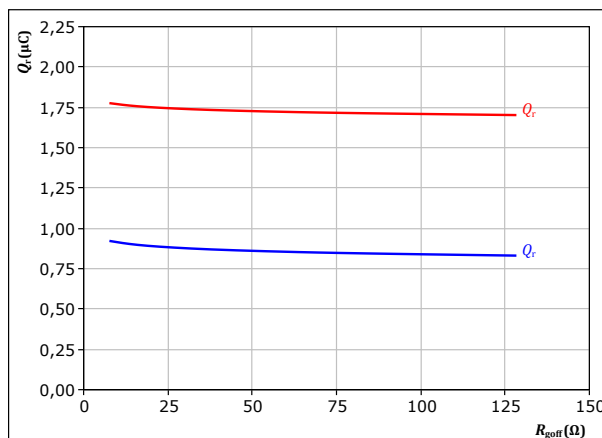
T_j : — 25 °C
— 150 °C

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
 $I_C = 8$ A

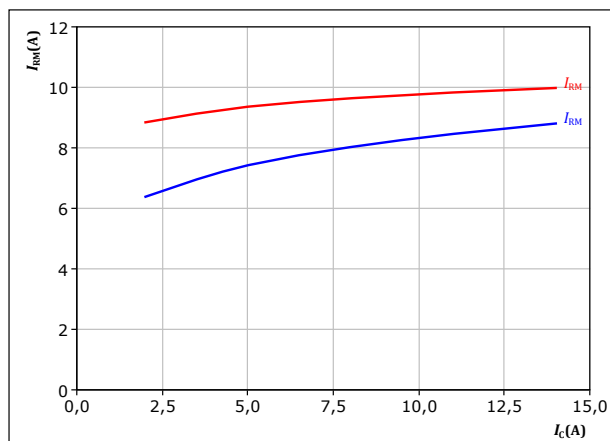
T_j : — 25 °C
— 150 °C

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
 $R_{gon} = 32$ Ω

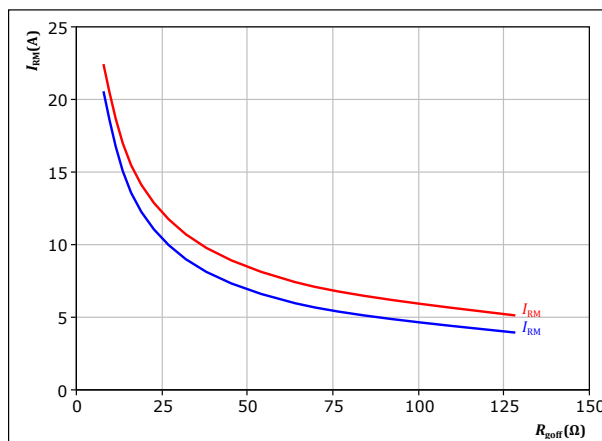
T_j : — 25 °C
— 150 °C

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
 $I_C = 8$ A

T_j : — 25 °C
— 150 °C



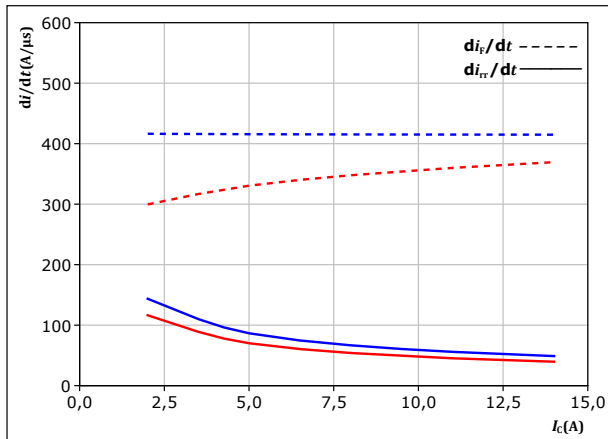
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datasheet

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

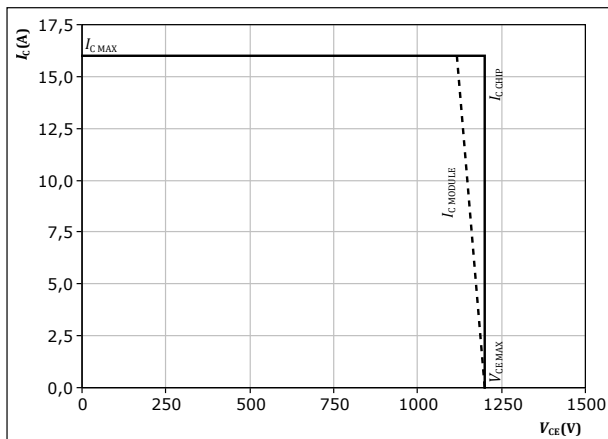
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

T_j : 25 °C
150 °C

figure 47. IGBT

Reverse bias safe operating area

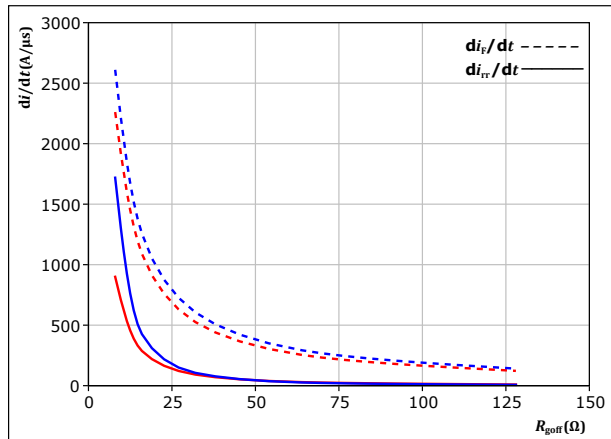
$I_C = f(V_{CE})$



At $T_j = 150$ °C
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

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

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 8$ A

T_j : 25 °C
150 °C



Switching Definitions

figure 48. IGBT

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

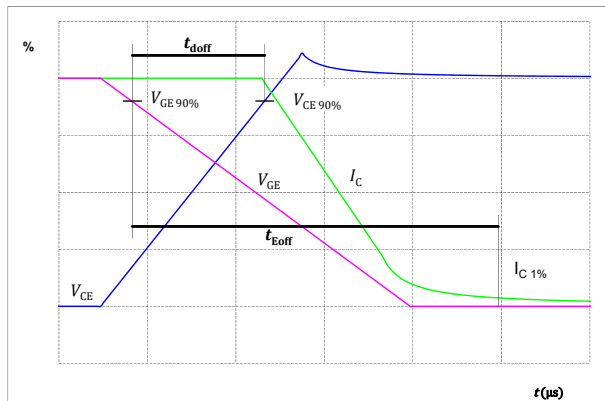


figure 49. IGBT

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

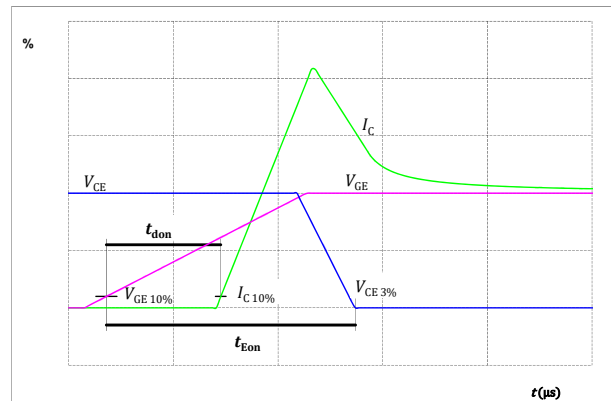


figure 50. IGBT

Turn-off Switching Waveforms & definition of t_f

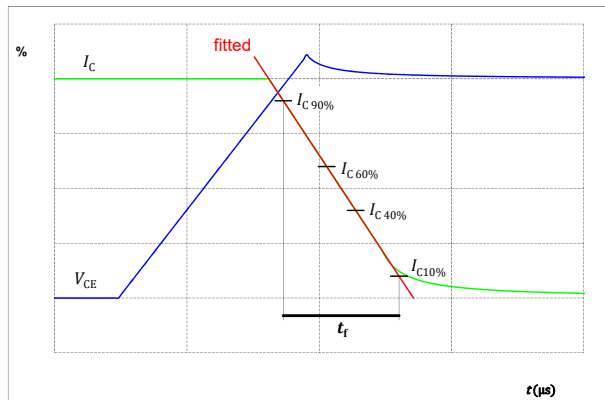
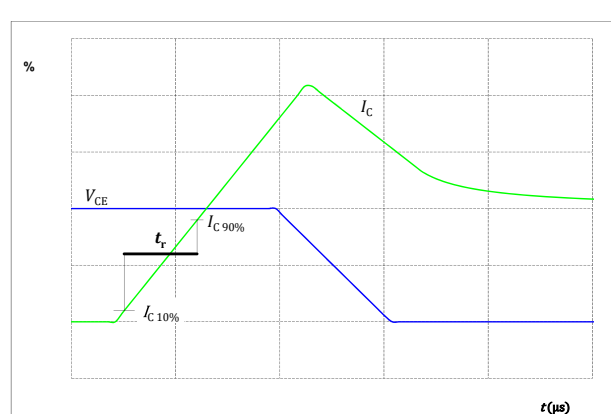


figure 51. IGBT

Turn-on Switching Waveforms & definition of t_r





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Switching Definitions

figure 52.

FWD

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

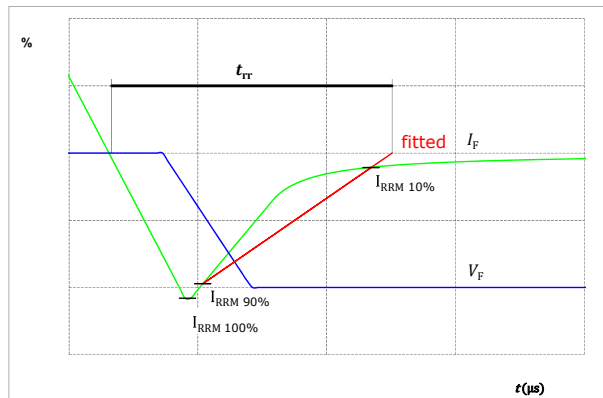
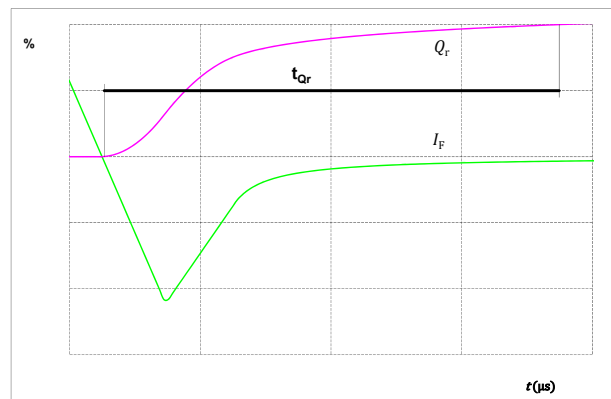


figure 53.

FWD


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





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Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P588-A41-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P588-A41-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P588-A41-/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		

Pin table [mm]

Pin	X	Y	Function
1	52,55	0	BrG
2	47,7	0	DC-
3	44,8	0	DC-
4	37,8	0	DC+
5	37,8	2,8	DC+
6	35	0	Inv+
7	35	2,8	Inv+
8	28	0	R1
9	25,2	0	R2
10	22,4	0	N6
11	19,6	0	G6
12	16,8	0	S6
13	14	0	N4
14	11,2	0	G4
15	8,4	0	S4
16	5,6	0	N2
17	2,8	0	G2
18	0	0	S2
19	0	28,5	U
20	2,8	28,5	G1
21	7,5	28,5	S1
22	14,5	28,5	V
23	17,3	28,5	G3
24	22	28,5	S3
25	29	28,5	W
26	31,8	28,5	G5
27	36,5	28,5	S5
28	43,5	28,5	L1
29	52,55	25	L2
30	52,55	16,9	L3
31	52,55	8,6	BrC
32	52,55	2,8	BrE

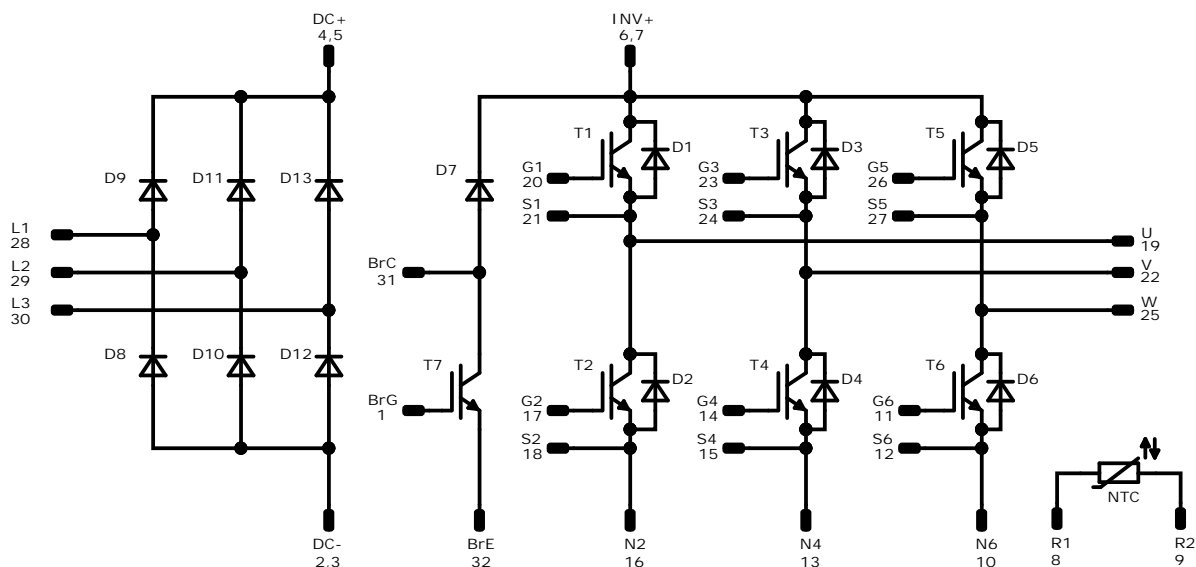
Technical drawing of the connector showing a side view and a top view. The side view shows a row of pins with a diameter of 0.85mm and a height of 2.02-2.05mm. The top view shows the layout of the pins on a rectangular board with dimensions 26.25mm by 14.25mm. Pins are numbered 1 through 32, corresponding to the pin table.

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



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Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	15 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	15 A	Inverter Diode	
T7	IGBT	1200 V	8 A	Brake Switch	
D7	FWD	1200 V	10 A	Brake Diode	
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	35 A	Rectifier Diode	
NTC	NTC			Thermistor	



Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample
Handling instruction				
Handling instructions for <i>flow</i> 1 packages see vincotech.com website.				
Package data				
Package data for <i>flow</i> 1 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-P588-A41-PM-D7-14	22 Sep. 2021	Rectifier maximum ratings is updated The characteristic values are updated Separated datasheet New datasheet format, module is unchanged	

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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.