



Vincotech

V23990-P545-A29-PM

datasheet

flowPIM 0

600 V / 20 A

Topology features

- Open Emitter configuration
- Temperature sensor
- Converter+Brake+Inverter

Component features

- Easy paralleling
- Low turn-off losses
- Low collector emitter saturation voltage
- Positive temperature coefficient
- Short tail current

Housing features

- Base isolation: Al_2O_3
- Clip-in, reliable mechanical connection, qualified for wave soldering
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

Extra features

- with three-phase standard rectifier

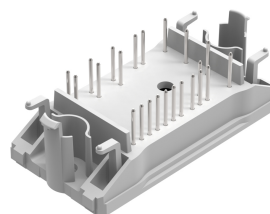
Target applications

- Industrial drives
- Embedded drives

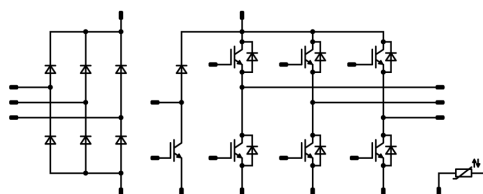
Types

- V23990-P545-A29-PM

flow 0 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}		600	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	26	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Inverter Diode

Peak repetitive reverse voltage	V_{RRM}		600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	40	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	W
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Switch

Collector-emitter voltage	V_{CES}		600	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	21	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	52	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	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}		600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	35	W
Maximum junction temperature	T_{jmax}		175	°C

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	34	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			min 12,7	mm
Clearance			min 12,7	mm
Comparative Tracking Index	CTI		≥ 200	

*100 % tested in production



Characteristic Values

Parameter	Symbol	Conditions						Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max		

Inverter Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00029	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		20	25 125	1,1	1,55 1,75	1,9 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	600		25			1,1	µA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25	25			1100		pF
Output capacitance	C_{oes}							71		pF
Reverse transfer capacitance	C_{res}							32		pF
Gate charge	Q_g	$V_{CC} = 480 \text{ V}$	0/15		20	25		120		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,7		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16 \Omega$ $R_{goff} = 8 \Omega$	0/15	300	20	25 125		15 14		ns
Rise time	t_r					25 125		12,2 15,5		ns
Turn-off delay time	$t_{d(off)}$					25 125		198 212		ns
Fall time	t_f					25 125		100 104		ns
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD}=0,454 \mu\text{C}$ $Q_{tFWD}=1,35 \mu\text{C}$				25 125		0,314 0,427		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,548 0,649		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				20	25 125	1,25	1,81 1,76	1,95 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 600$ V				25			27	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						2,6		K/W
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Dynamic

Peak recovery current	I_{RM}	$di/dt=2170$ A/μs $di/dt=1490$ A/μs	0/15	300	20	25 125		19 21,1		A
Reverse recovery time	t_{rr}					25 125		33 192		ns
Recovered charge	Q_r					25 125		0,454 1,35		μC
Reverse recovered energy	E_{rec}					25 125		0,06 0,271		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125		1450 1050		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 Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	1,1	1,64 1,87	1,9 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	600		25			0,85	µA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25	25			800		pF
Output capacitance	C_{oes}							55		pF
Reverse transfer capacitance	C_{res}							24		pF
Gate charge	Q_g		0/15		0	25		87		nC

Thermal

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

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16 \Omega$ $R_{goff} = 8 \Omega$	0/15	300	15	25 125		14,5 13,5		ns
Rise time	t_r					25 125		10,8 13,8		ns
Turn-off delay time	$t_{d(off)}$					25 125		128 145		ns
Fall time	t_f					25 125		91 94,4		ns
Turn-on energy (per pulse)	E_{on}					25 125		0,201 0,282		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,317 0,4		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				15	25 125	1,25	1,86 1,76	1,95 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 600$ V				25			27	μA

Thermal

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

Peak recovery current	I_{RM}	$di/dt=1300$ A/μs $di/dt=1220$ A/μs	0/15	300	15	25 125		13,7 15,1		A
Reverse recovery time	t_{rr}					25 125		128 201		ns
Recovered charge	Q_r					25 125		0,518 1,02		μC
Reverse recovered energy	E_{rec}					25 125		0,103 0,215		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125		1310 657		A/μs

Rectifier Diode

Static

Forward voltage	V_F				8	25 125		0,983 0,889	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)						1,59		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}	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	P					25		130		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$						4000		K
Vincotech Thermistor Reference									I	

⁽¹⁾ Value at chip level

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



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Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

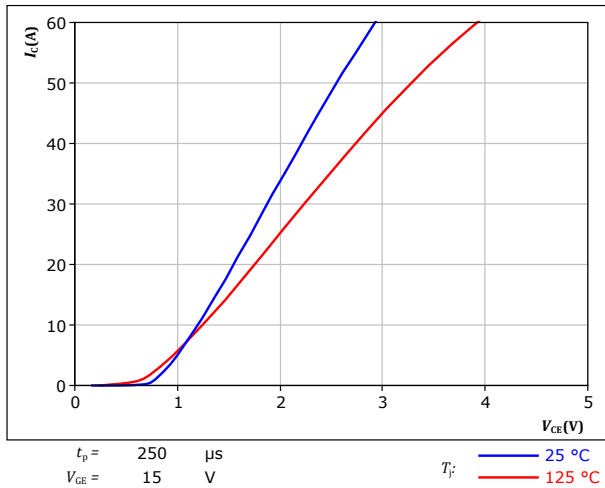


figure 2. IGBT

Typical output characteristics

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

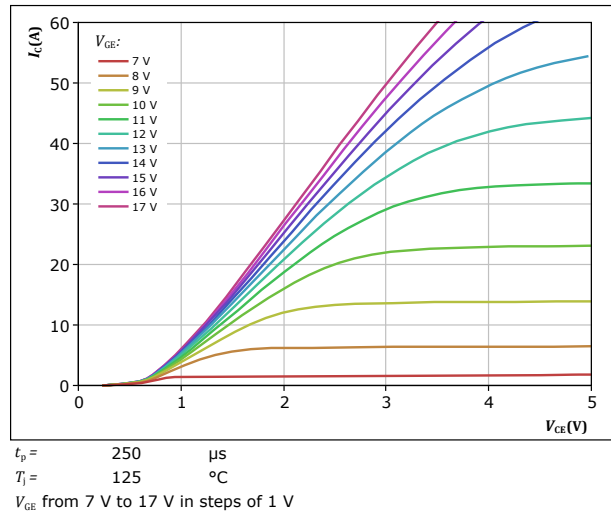


figure 3. IGBT

Typical transfer characteristics

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

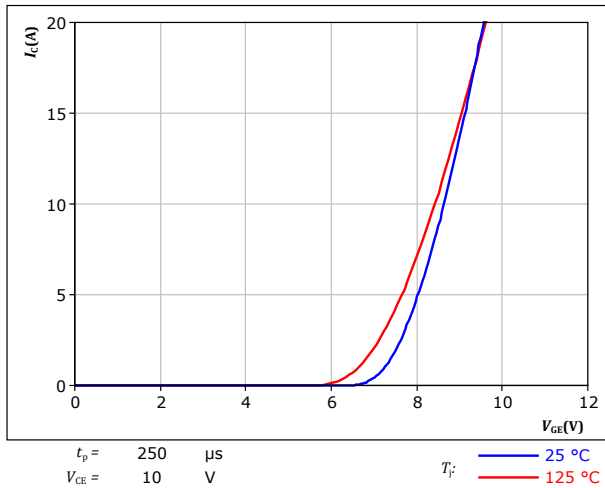
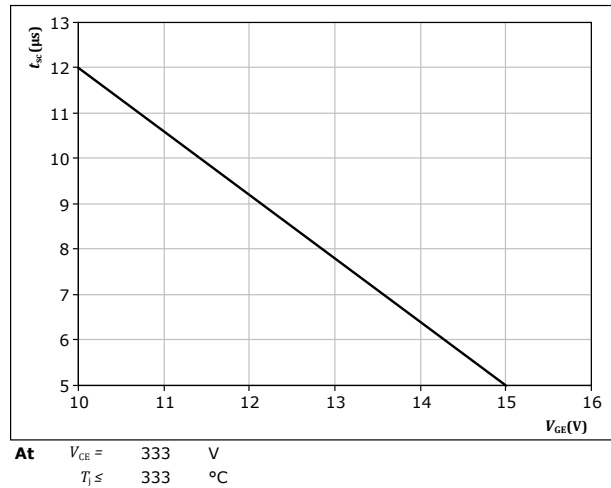


figure 4. IGBT

Short circuit withstand time as a function of V_{GE}

$$t_{sc} = f(V_{GE})$$





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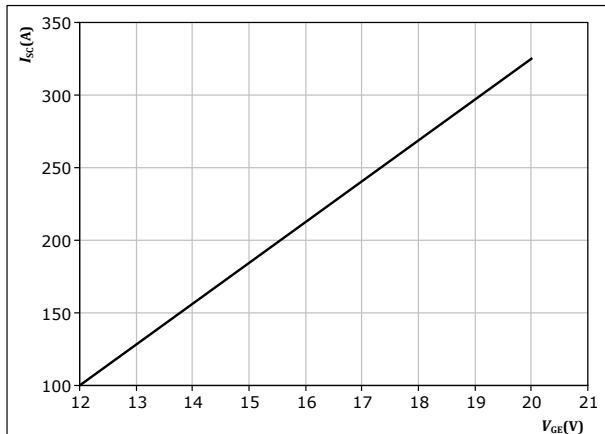
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Inverter Switch Characteristics

figure 5.

IGBT

Typical short circuit current as a function of V_{GE}
 $I_{SC} = f(V_{GE})$

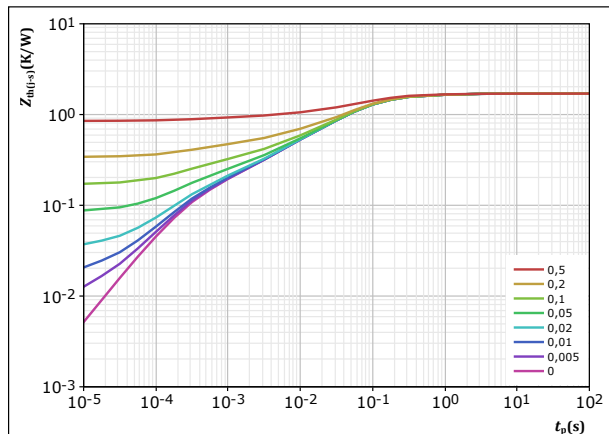


At $V_{CE} = 333$ V
 $T_j \leq 333$ °C

figure 6.

IGBT

Transient thermal impedance as a function of pulse width
 $Z_{th(j-s)} = f(t_p)$



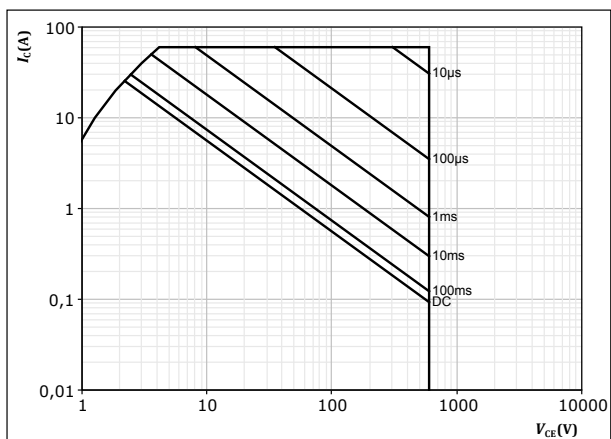
$D = t_p / T$
 $R_{th(j-s)} = 1,701$ K/W
IGBT thermal model values

R (K/W)	τ (s)
9,97E-02	1,34E+00
3,46E-01	1,70E-01
8,15E-01	5,34E-02
2,54E-01	7,74E-03
7,70E-02	1,33E-03
1,09E-01	2,63E-04

figure 7.

IGBT

Safe operating area
 $I_C = f(V_{CE})$

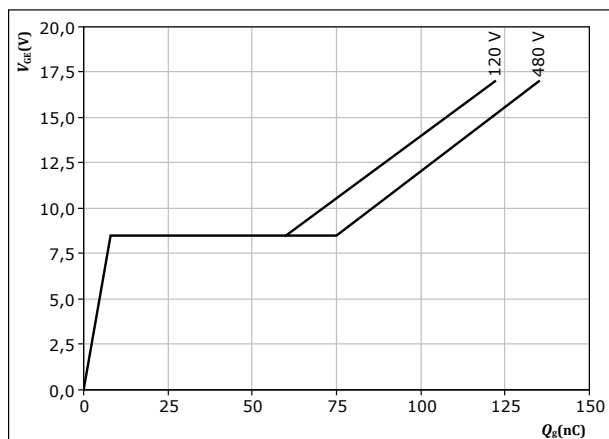


$D = \text{single pulse}$
 $T_s = 80$ °C
 $V_{GE} = 15$ V
 $T_j = T_{jmax}$

figure 8.

IGBT

Gate voltage vs gate charge
 $V_{GE} = f(Q_g)$



$I_C = 33$ A
 $T_j = 25$ °C



Inverter Diode Characteristics

figure 9. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

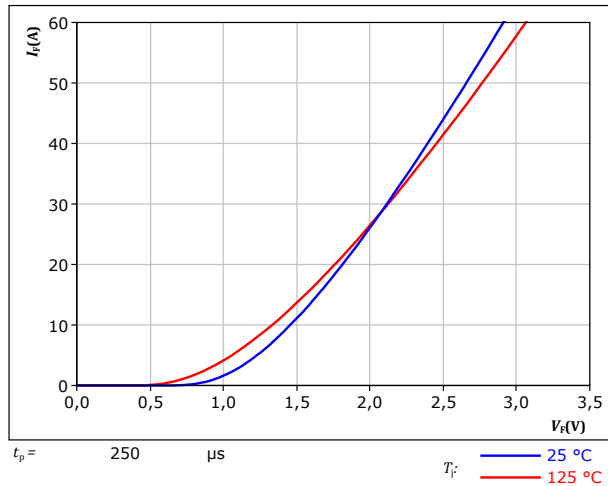
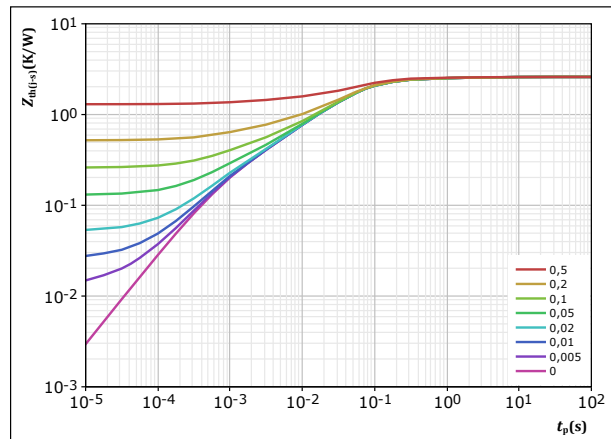


figure 10. FWD

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T	
$R_{th(j-s)} =$	2,598	K/W
FWD thermal model values		
R (K/W)	τ (s)	
6,56E-02	4,59E+00	
1,58E-01	5,68E-01	
8,97E-01	8,41E-02	
1,05E+00	3,28E-02	
2,75E-01	4,96E-03	
1,51E-01	7,65E-04	



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Brake Switch Characteristics

figure 11. IGBT

Typical output characteristics

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

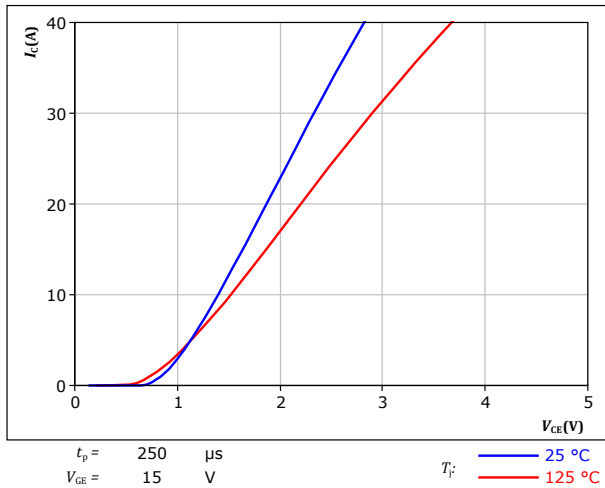


figure 12. IGBT

Typical output characteristics

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

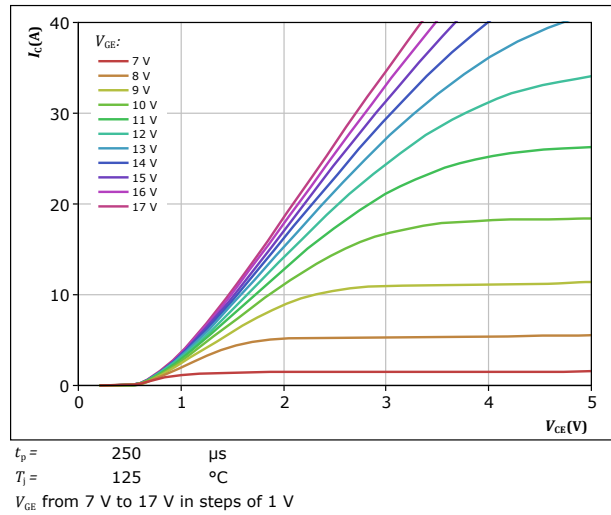


figure 13. IGBT

Typical transfer characteristics

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

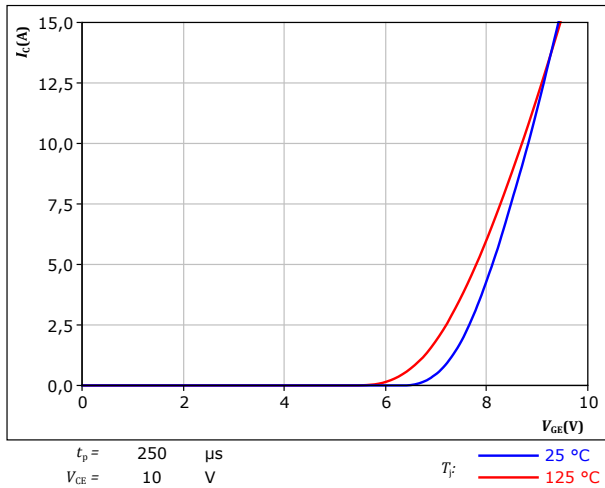
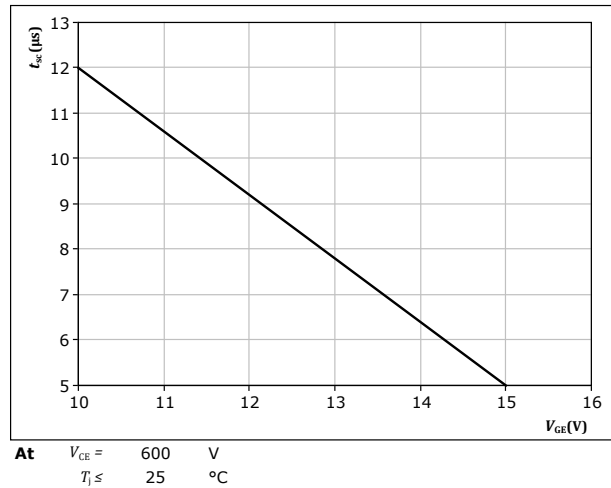


figure 14. IGBT

Short circuit withstand time as a function of V_{GE}

$$t_{sc} = f(V_{GE})$$





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Brake Switch Characteristics

figure 15.

IGBT

Typical short circuit current as a function of V_{GE}
 $I_{SC} = f(V_{GE})$

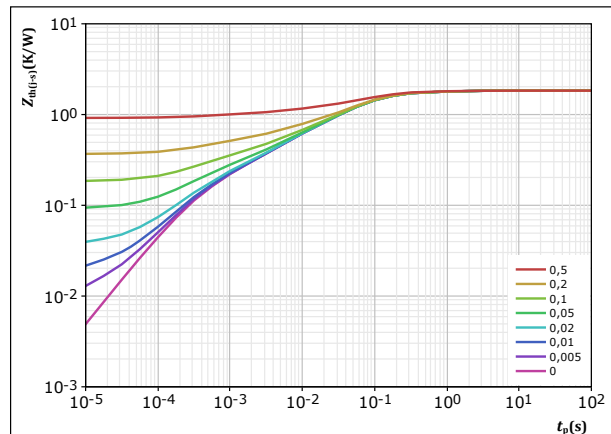


At $V_{CE} = 400$ V
 $T_j \leq 150$ °C

figure 16.

IGBT

Transient thermal impedance as a function of pulse width
 $Z_{th(j-s)} = f(t_p)$



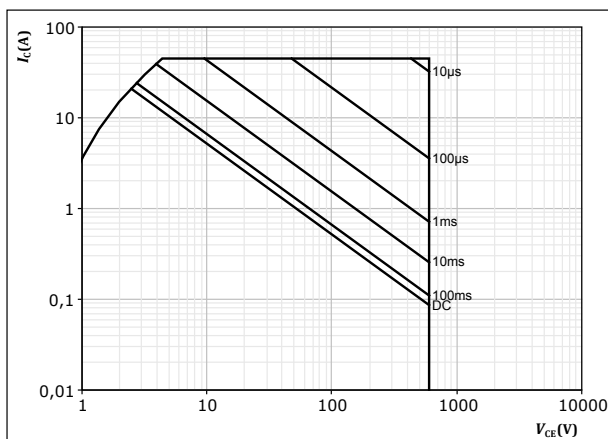
$D = t_p / T$
 $R_{th(j-s)} = 1,834$ K/W
IGBT thermal model values

R (K/W)	τ (s)
8,30E-02	1,29E+00
3,76E-01	1,56E-01
8,46E-01	5,15E-02
2,81E-01	8,16E-03
1,16E-01	2,04E-03
1,32E-01	3,43E-04

figure 17.

IGBT

Safe operating area
 $I_C = f(V_{CE})$

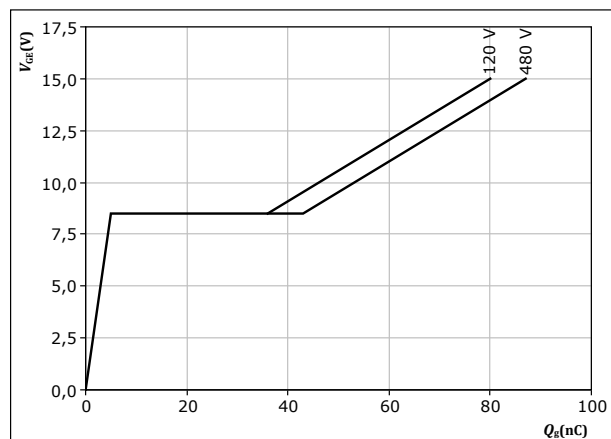


$D = \text{single pulse}$
 $T_s = 80$ °C
 $V_{GE} = 15$ V
 $T_j = T_{jmax}$

figure 18.

IGBT

Gate voltage vs gate charge
 $V_{GE} = f(Q_g)$



$I_C = 15$ A
 $T_j = 25$ °C



Brake Diode Characteristics

figure 19.

FWD

Typical forward characteristics

$$I_F = f(V_F)$$

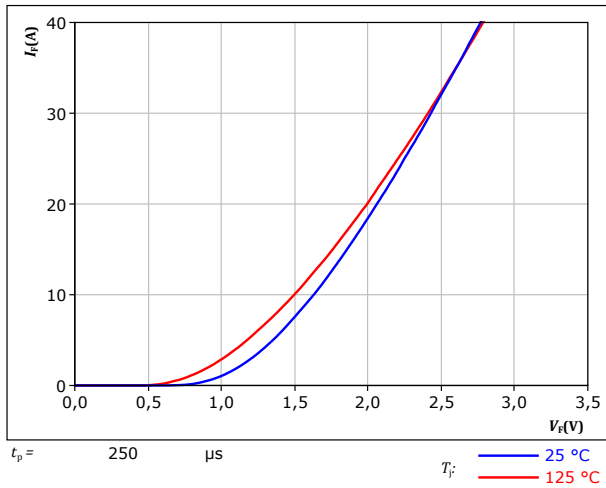
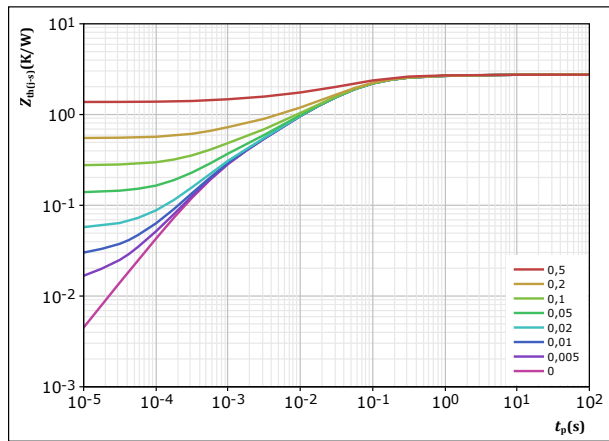


figure 20.

FWD

Transient thermal impedance as a function of pulse width

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





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Rectifier Diode Characteristics

figure 21.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

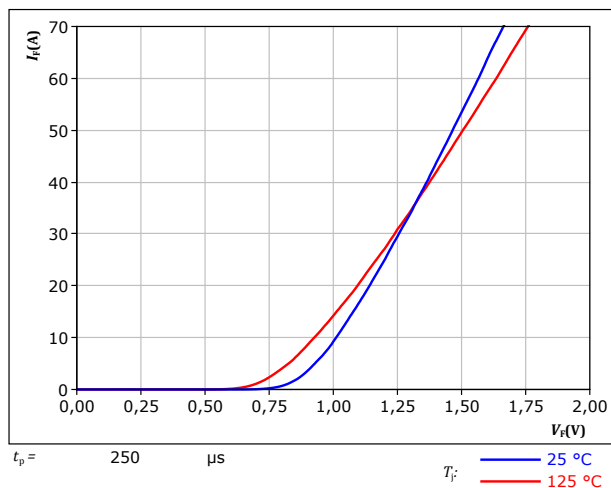
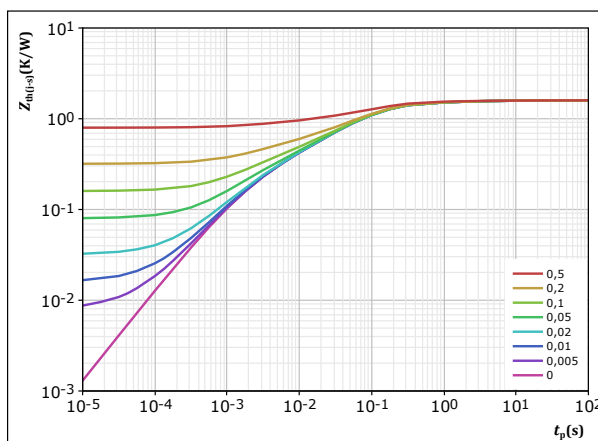


figure 22.

Rectifier

Transient thermal impedance as a function of pulse width

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



$$D = \frac{t_p}{T}$$

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

Rectifier thermal model values

R (K/W)	τ (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



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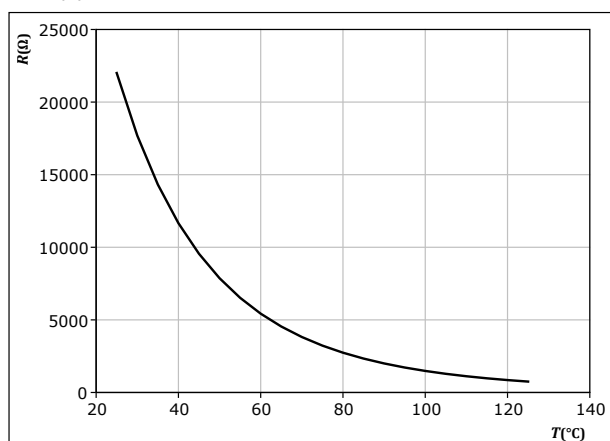
Thermistor Characteristics

figure 23.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





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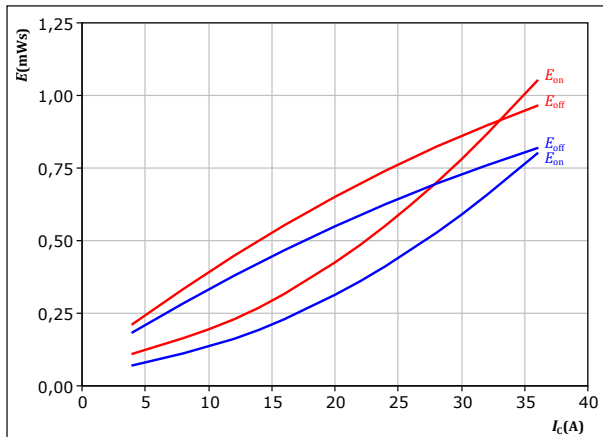
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Inverter Switching Characteristics

figure 24. IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

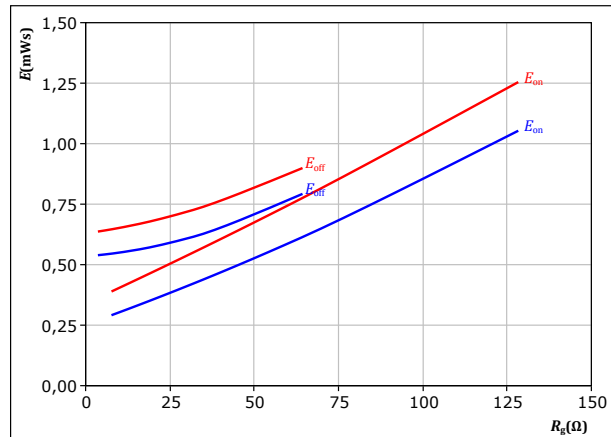
$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 8$ Ω

T_j : — 25 °C
— 125 °C

figure 25. IGBT

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

$$E = f(R_g)$$



With an inductive load at

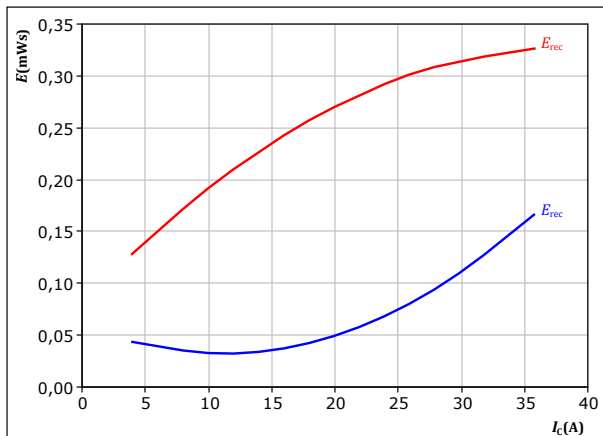
$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

T_j : — 25 °C
— 125 °C

figure 26. FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

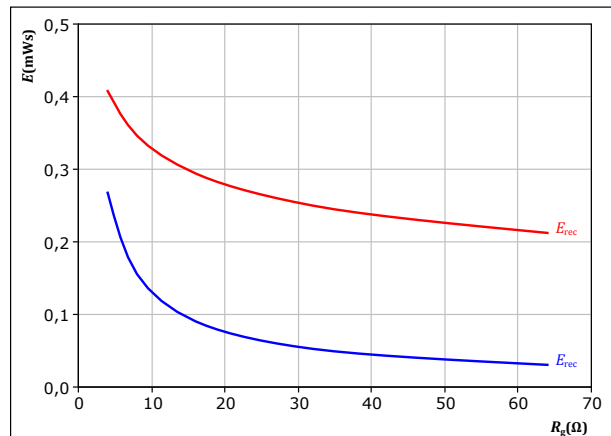
$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

T_j : — 25 °C
— 125 °C

figure 27. FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

T_j : — 25 °C
— 125 °C



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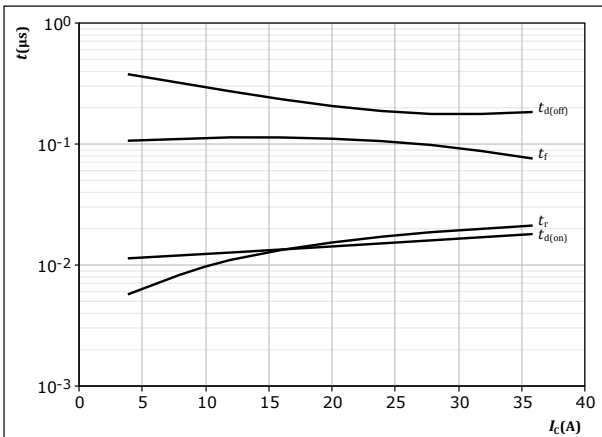
Inverter Switching Characteristics

figure 28.

IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



With an inductive load at

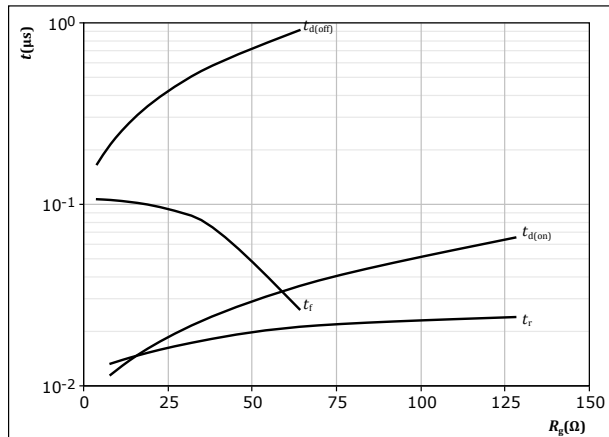
$T_j = 125$ °C
 $V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 8$ Ω

figure 29.

IGBT

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

$$t = f(R_g)$$



With an inductive load at

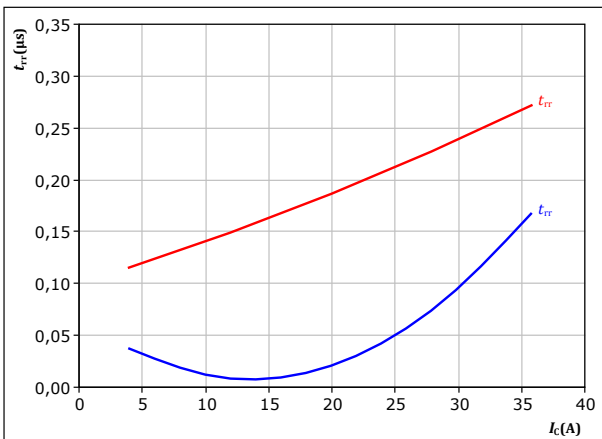
$T_j = 125$ °C
 $V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

figure 30.

FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_c)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

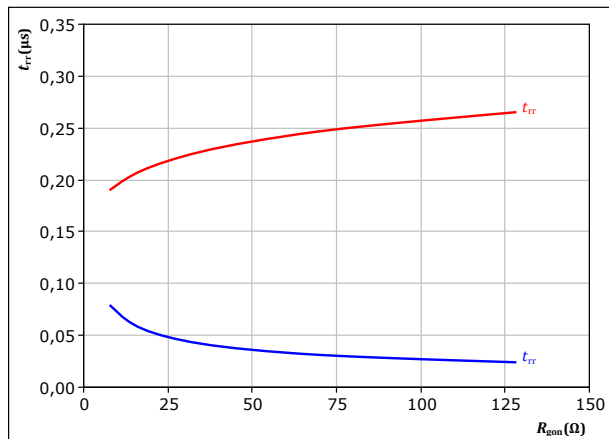
T_j : — 25 °C
— 125 °C

figure 31.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

T_j : — 25 °C
— 125 °C



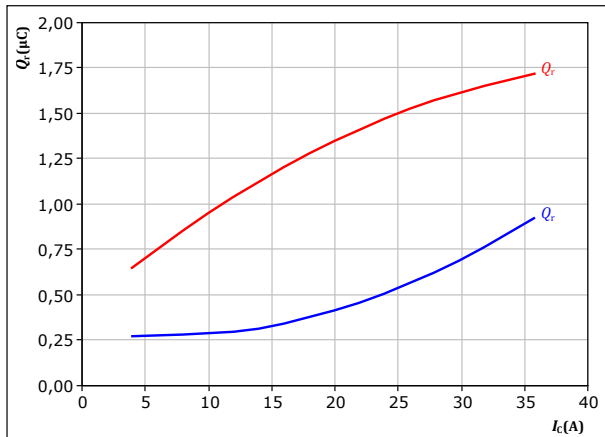
Inverter Switching Characteristics

figure 32.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

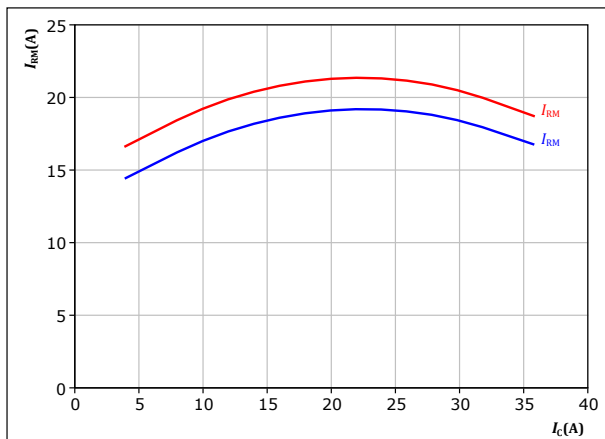
T_j : — 25 °C
— 125 °C

figure 34.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

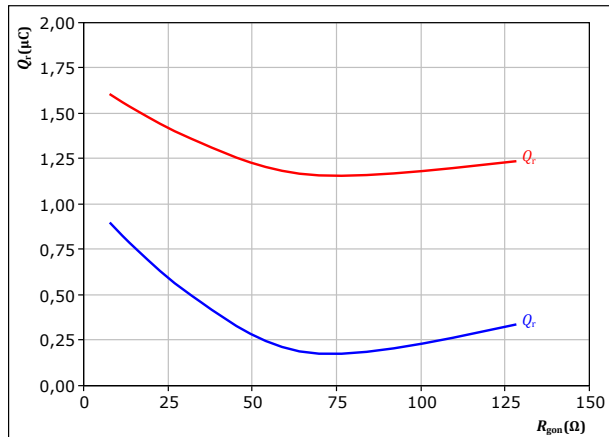
T_j : — 25 °C
— 125 °C

figure 33.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

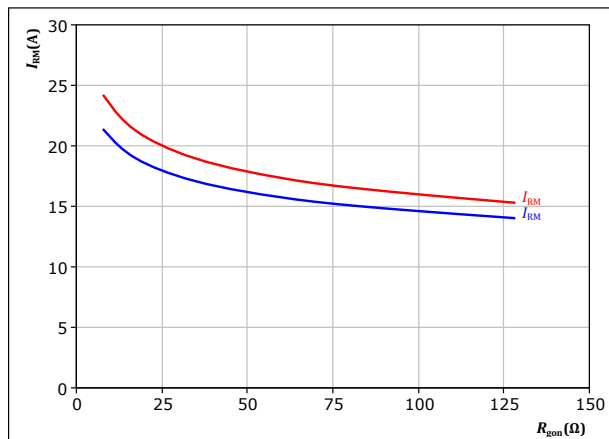
T_j : — 25 °C
— 125 °C

figure 35.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 20$ A

T_j : — 25 °C
— 125 °C



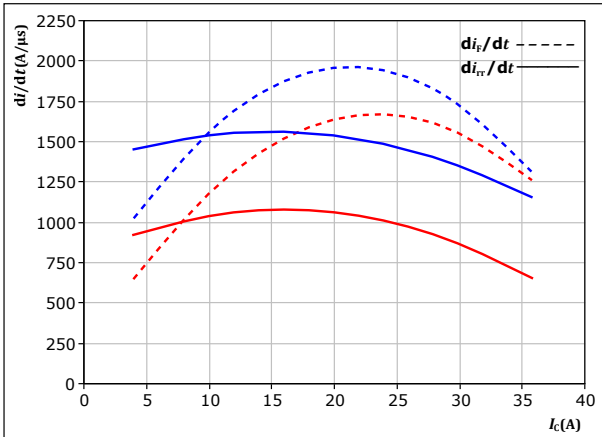
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Inverter Switching Characteristics

figure 36. 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

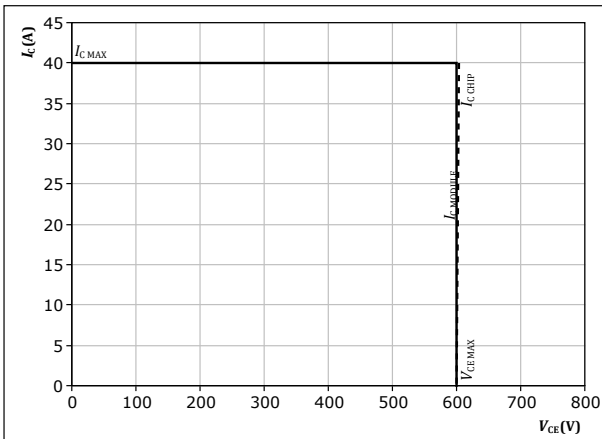
$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

T_j : — 25 °C
 — 125 °C

figure 38. IGBT

Reverse bias safe operating area

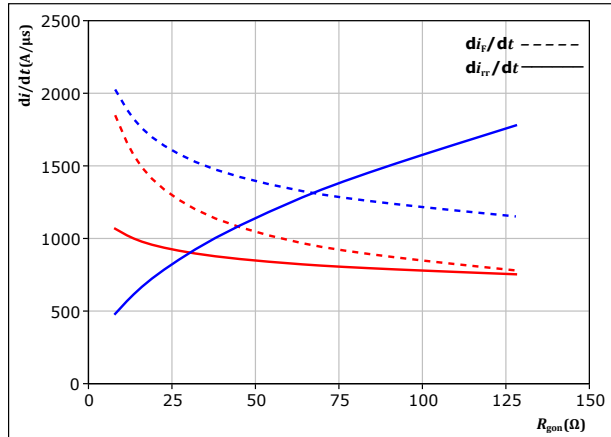
$I_C = f(V_{CE})$



At $T_j = 125$ °C
 $R_{gon} = 16$ Ω
 $R_{goff} = 8$ Ω

figure 37. FWD

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_C = 20$ A

T_j : — 25 °C
 — 125 °C



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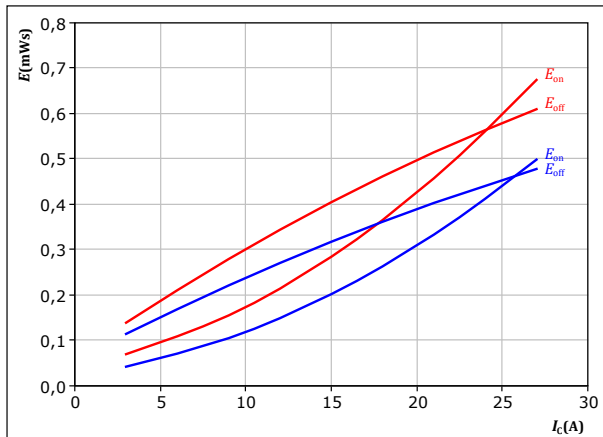
Brake Switching Characteristics

figure 39.

IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 8$ Ω

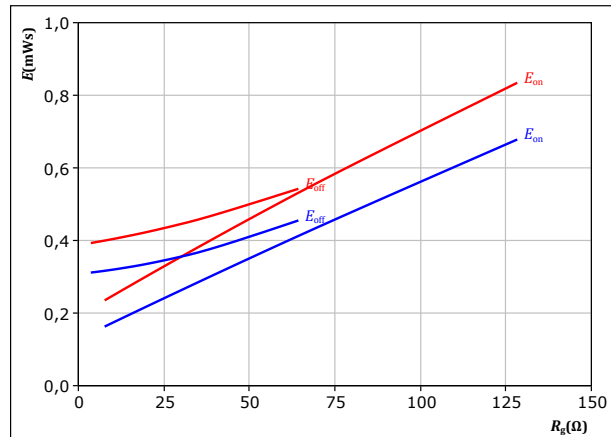
T_j : — 25 °C
— 125 °C

figure 40.

IGBT

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

$$E = f(R_g)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_C = 15$ A

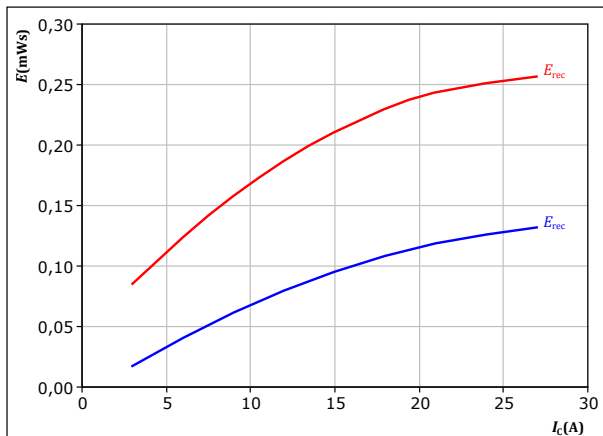
T_j : — 25 °C
— 125 °C

figure 41.

FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

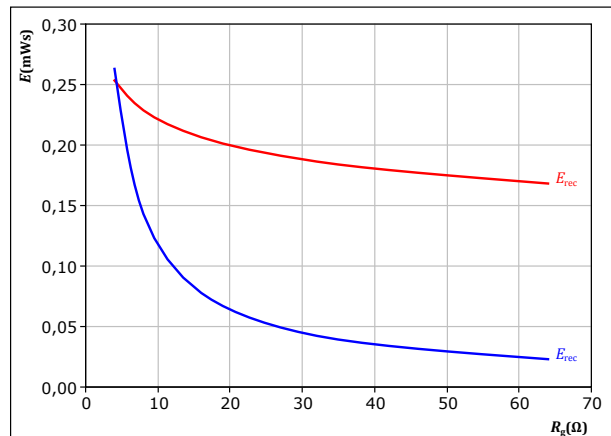
T_j : — 25 °C
— 125 °C

figure 42.

FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_C = 15$ A

T_j : — 25 °C
— 125 °C



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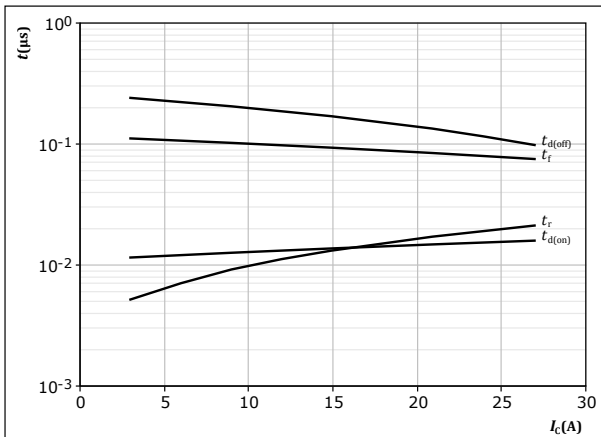
Brake Switching Characteristics

figure 43.

IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



With an inductive load at

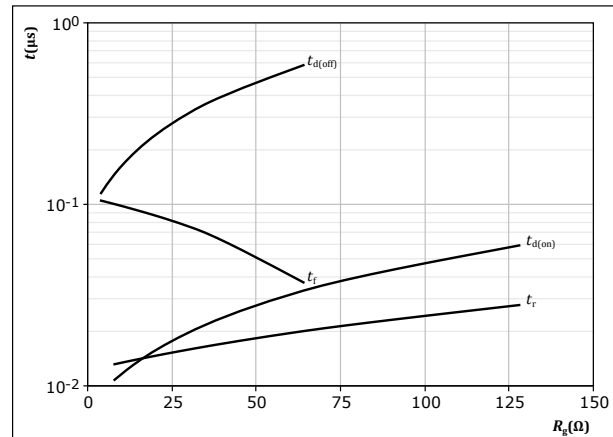
$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	0/15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	8	Ω

figure 44.

IGBT

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

$$t = f(R_g)$$



With an inductive load at

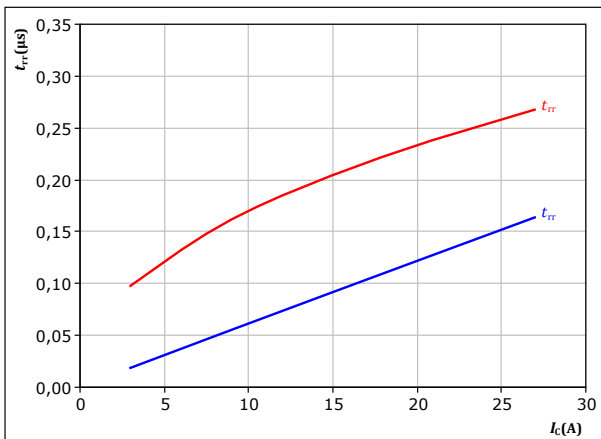
$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	0/15	V
$I_c =$	15	A

figure 45.

FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_c)$$



With an inductive load at

$V_{CE} =$	300	V
$V_{GE} =$	0/15	V
$R_{gon} =$	16	Ω

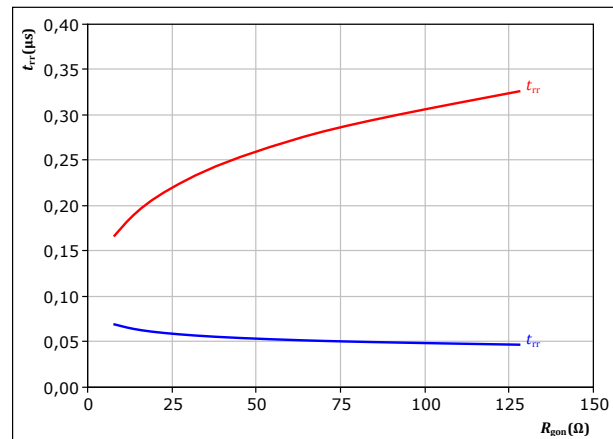
T_j : — 25 °C
— 125 °C

figure 46.

FWD

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

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



With an inductive load at

$V_{CE} =$	300	V
$V_{GE} =$	0/15	V
$I_c =$	15	A

T_j : — 25 °C
— 125 °C



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datasheet

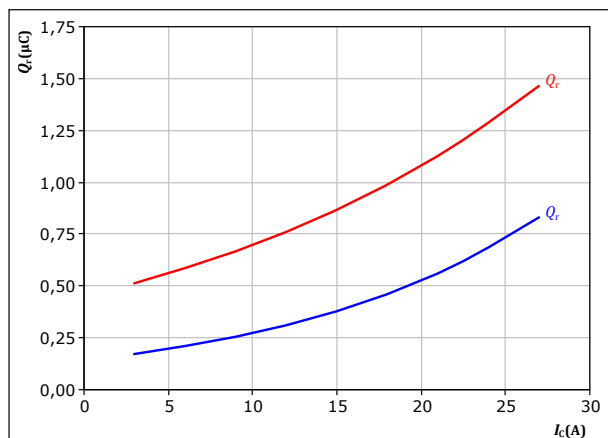
Brake Switching Characteristics

figure 47.

FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

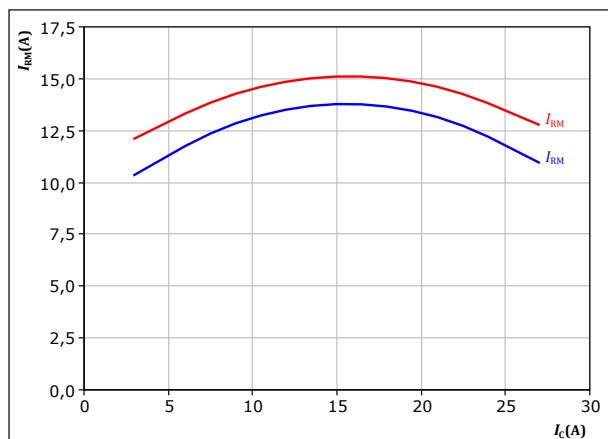
T_j : — 25 °C
— 125 °C

figure 49.

FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

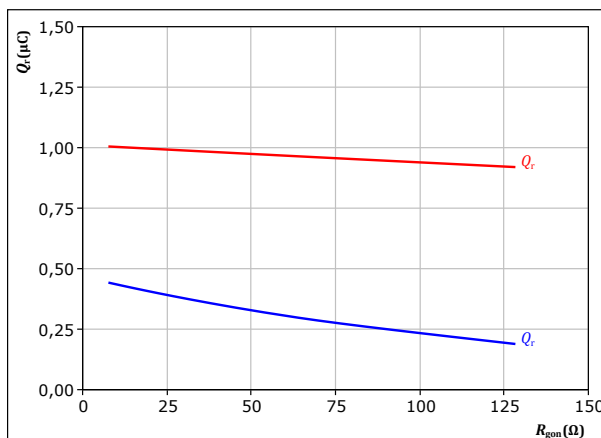
T_j : — 25 °C
— 125 °C

figure 48.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 15$ A

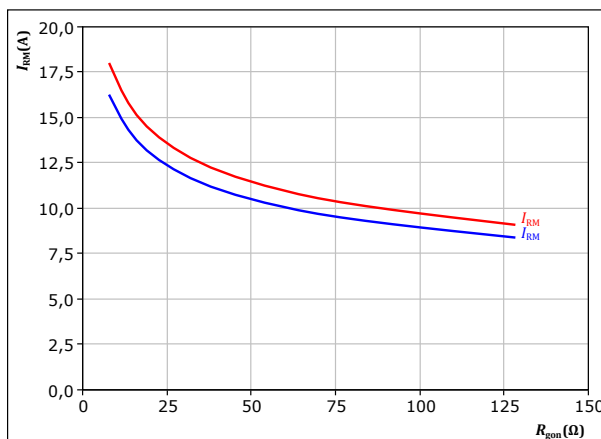
T_j : — 25 °C
— 125 °C

figure 50.

FWD

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

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



With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_c = 15$ A

T_j : — 25 °C
— 125 °C



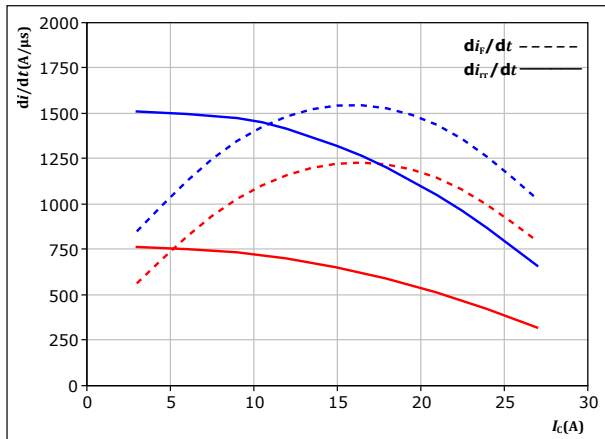
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datasheet

Brake Switching Characteristics

figure 51. FWD

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



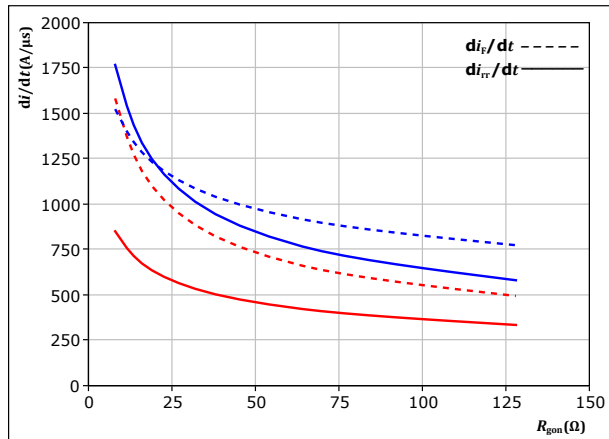
With an inductive load at

$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 16$ Ω

T_j : — 25 °C
— 125 °C

figure 52. FWD

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



With an inductive load at

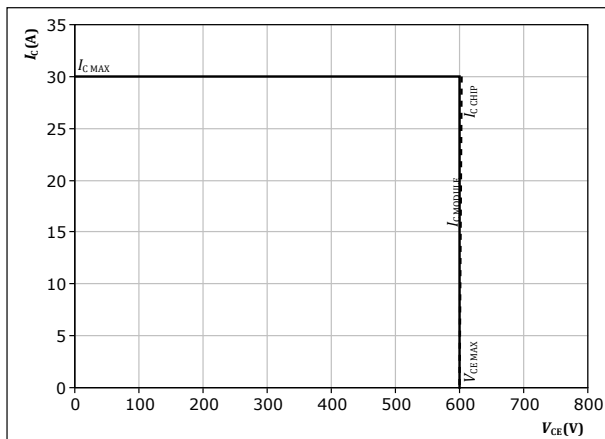
$V_{CE} = 300$ V
 $V_{GE} = 0/15$ V
 $I_C = 15$ A

T_j : — 25 °C
— 125 °C

figure 53. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 125$ °C
 $R_{gon} = 16$ Ω
 $R_{goff} = 8$ Ω



Switching Definitions

figure 54. IGBT

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

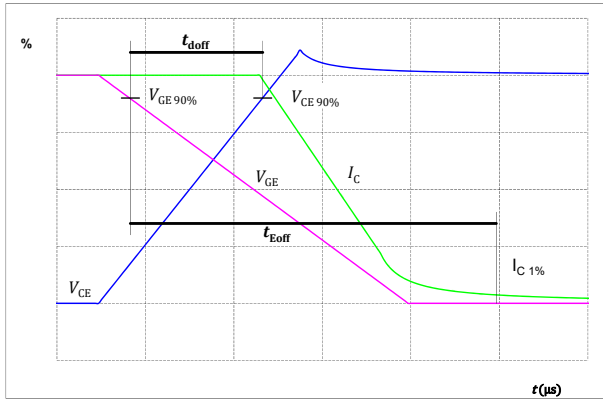


figure 55. IGBT

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

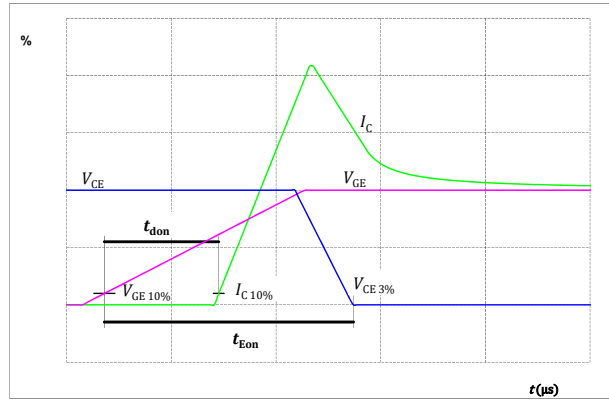


figure 56. IGBT

Turn-off Switching Waveforms & definition of t_f

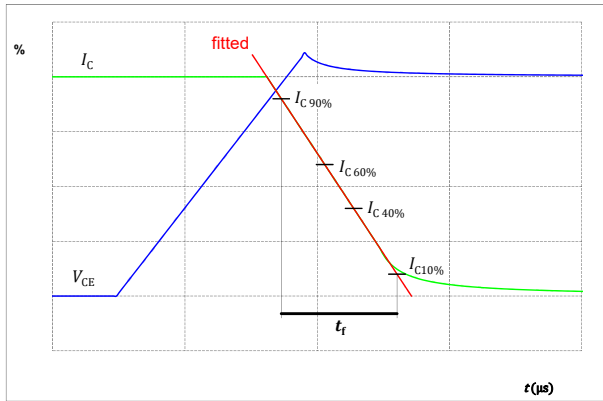
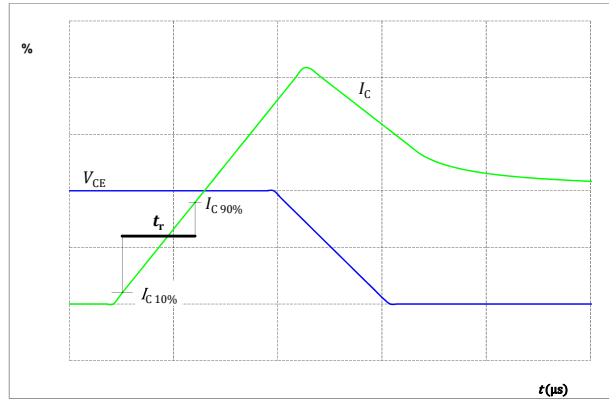


figure 57. IGBT

Turn-on Switching Waveforms & definition of t_r





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Switching Definitions

figure 58.

FWD

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

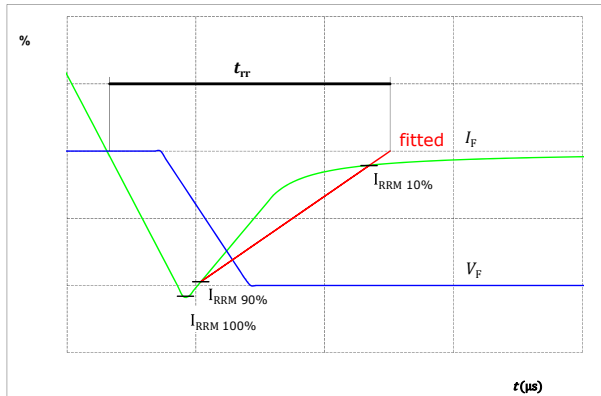
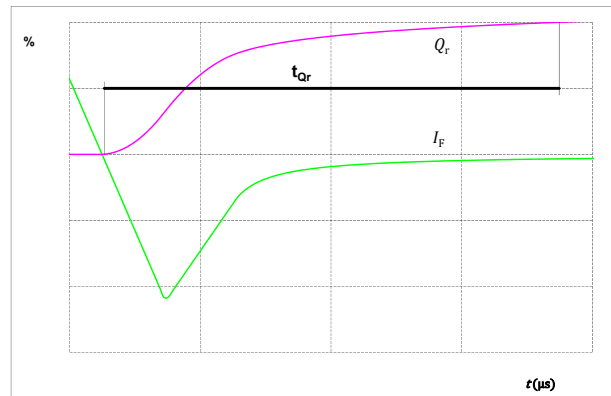


figure 59.

FWD

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





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datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	V23990-P545-A29-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P545-A29-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P545-A29-/3/-PM

Marking							
VIN WMYW TTTTTTVV UL LLLL SSSS  	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		

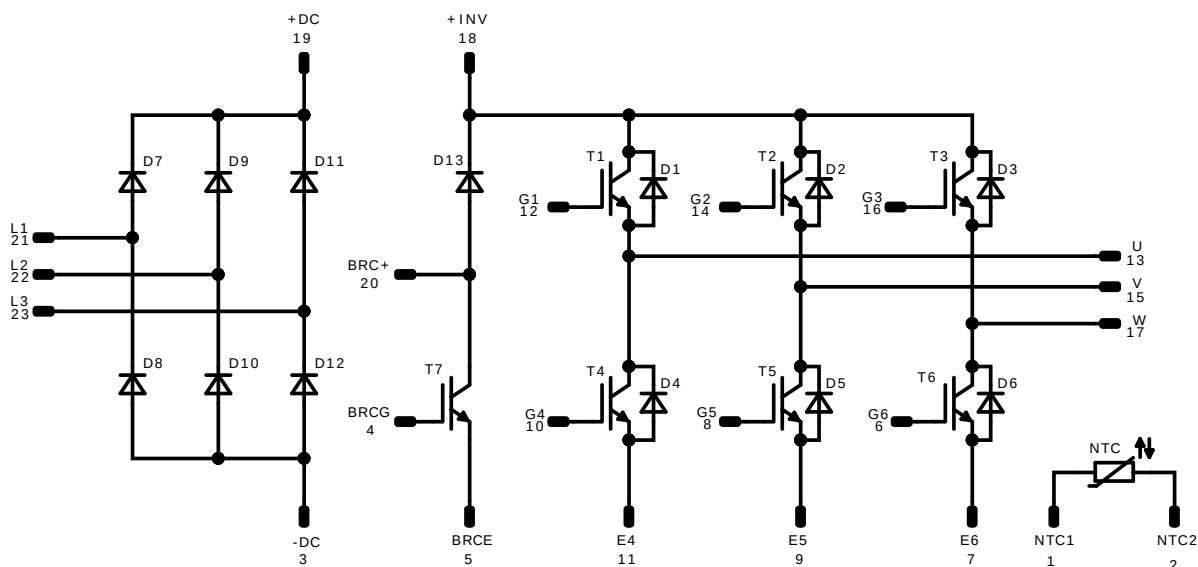
Outline

Pin table [mm]			
Pin	X	Y	Function
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

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



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T4, T1, T5, T2, T6, T3	IGBT	600 V	20 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	600 V	20 A	Inverter Diode	
T7	IGBT	600 V	15 A	Brake Switch	
D13	FWD	600 V	15 A	Brake Diode	
D8, D7, D10, D9, D12, D11	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-P545-A29-PM-D10-14	25 Sep. 2022	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.