
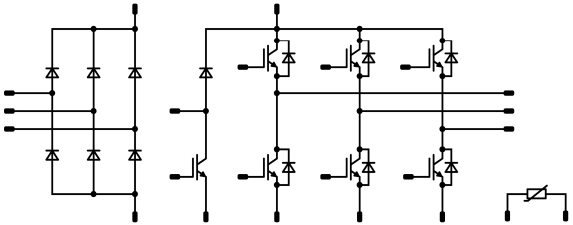




Vincotech

<i>flowPIM E1</i>	600 V / 15 A
<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;">Features</div> <ul style="list-style-type: none"> Trenchstop™ IGBT3 technology Standard industrial housing Optimized $R_{th(j-s)}$ with Phase Change Material Built-in NTC <div style="background-color: #eee; padding: 5px; margin-bottom: 10px;">Target applications</div> <ul style="list-style-type: none"> Industrial Drives <div style="background-color: #eee; padding: 5px;">Types</div> <ul style="list-style-type: none"> 10-EZ06PMA015SA-L924A38T 	<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;">flow E1 12 mm housing</div> <div style="text-align: center;">  </div> <div style="background-color: #eee; padding: 5px; margin-bottom: 10px;">Schematic</div> <div style="text-align: center;">  </div>

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		600	V
Collector current	I_C		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$ $V_{CE} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	μs
Maximum junction temperature	T_{jmax}		175	°C



Vincotech

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F		15	A
Repetitive peak forward current	I_{FRM}		30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	48	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter voltage	V_{CES}		600	V
Collector current	I_C		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$ $V_{ce} = 360\text{ V}$ $T_j = 150\text{ °C}$	6	µs
Maximum junction temperature	T_{jmax}		175	°C
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F		10	A
Repetitive peak forward current	I_{FRM}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	W
Maximum junction temperature	T_{jmax}		175	°C
Rectifier Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		35	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave	270	A
Surge current capability	I^2t	$t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	370	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	58	W
Maximum junction temperature	T_{jmax}		150	°C



Vincotech

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
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Module Properties

General Properties

Stray inductance	L_P		30	nH
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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
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			min. 12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*100 % tested in production



Vincotech

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	

Inverter Switch

Static

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$				0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CESat}		15			15	25 150	1,1	1,59 1,85	1,9	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}								860		pF
Output capacitance	C_{oes}	$f = 1$ Mhz	0	25		25			55		
Reverse transfer capacitance	C_{res}								24		

Thermal

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							1,66		K/W

Dynamic

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 16$ Ω $R_{goff} = 16$ Ω					25 150		56 52		ns
Rise time	t_r						25 150		11 12		
Turn-off delay time	$t_{d(off)}$		±15	300	15		25 150		104 124		
Fall time	t_f						25 150		98 121		
Turn-on energy (per pulse)*	E_{on}	$Q_{FWD} = 0,6$ μC					25 150		0,181 0,258		mWs
Turn-off energy (per pulse)*	E_{off}	$Q_{FWD} = 1,3$ μC					25 150		0,364 0,484		

* $L_s = 14$ nH



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Characteristic Values

Parameter	Symbol	Conditions					Value			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		1,60 1,51	1,95	V
Reverse leakage current	I_R			600		25			27	μA

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,99		K/W
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Dynamic

Peak recovery current	I_{RRM}					25 150		14 22		A
Reverse recovery time	t_{rr}					25 150		135 179		ns
Recovered charge	Q_r	$di/dt = 1807$ A/μs $di/dt = 1328$ A/μs	±15	300	15	25 150		0,625 1,28		μC
Reverse recovered energy	E_{rec}					25 150		0,154 0,282		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150		865 780		A/μs



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Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,1	1,59 1,85	1,9	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}							860		pF
Output capacitance	C_{oes}	$f = 1 \text{ Mhz}$	0	25		25		55		
Reverse transfer capacitance	C_{res}							24		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,66		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		30 31 28		ns
Rise time	t_r	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$				25 125 150		34 35 35		
Turn-off delay time	$t_{d(off)}$		0 / 15	400	15	25 125 150		314 341 346		
Fall time	t_f					25 125 150		14 115 122		
Turn-on energy (per pulse)	E_{on}	$Q_{t-FWD} = 0,5 \mu\text{C}$ $Q_{t-FWD} = 1 \mu\text{C}$ $Q_{t-FWD} = 1,2 \mu\text{C}$				25 125 150		0,516 0,680 0,718		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,499 0,616 0,648		



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max		

Brake Diode

Static

Parameter	Symbol	V_{GS} [V]	V_{DS} [V]	I_D [A]	I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F			10		25 150		1,61 1,56	1,95	V
Reverse leakage current	I_R		600			25			27	µA

Thermal

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)		2,33		K/W

Dynamic

Parameter	Symbol	dI/dt	I_C	I_D	I_F	T_j [°C]	Min	Typ	Max	Unit
Peak recovery current	I_{RRM}					25 125 150		5 7 7		A
Reverse recovery time	t_{rr}					25 125 150		226 311 332		ns
Recovered charge	Q_r	$dI/dt = 348$ A/µs $dI/dt = 432$ A/µs $dI/dt = 422$ A/µs	0 / 15	400	15	25 125 150		0,521 1,03 1,18		µC
Reverse recovered energy	E_{rec}					25 125 150		0,137 0,273 0,314		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		20 34 36		A/µs

Rectifier Diode

Static

Parameter	Symbol	V_{GS} [V]	V_{DS} [V]	I_D [A]	I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F			35		25 125		1,17 1,13		V
Reverse leakage current	I_R		1600			25			50	µA

Thermal

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)		1,20		K/W

Thermistor

Parameter	Symbol	Conditions	T_j [°C]	Min	Typ	Max	Unit
Rated resistance	R		25		5		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 493$ Ω	100	-5		+5	%
Power dissipation	P		25		245		mW
Power dissipation constant			25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. ±2 %	25		3375		K
B-value	$B_{(25/100)}$	Tol. ±2 %	25		3437		K
Vincotech NTC Reference						K	

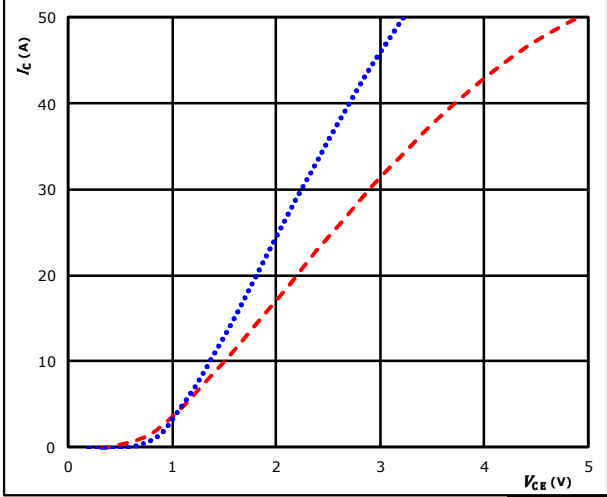


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

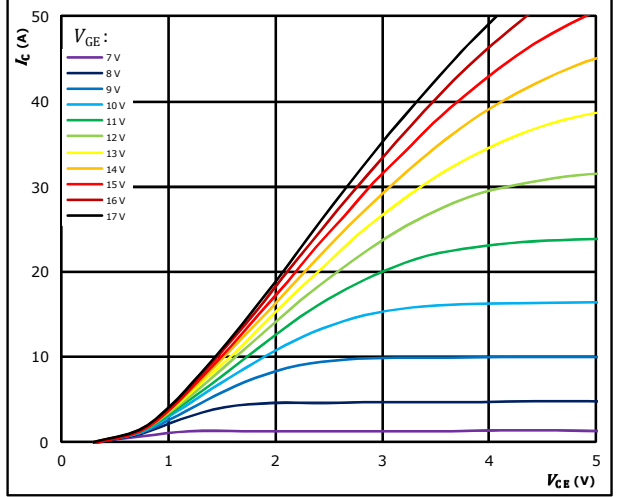


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25 \text{ }^\circ C$ (blue dotted line)
 $150 \text{ }^\circ C$ (red dashed line)

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

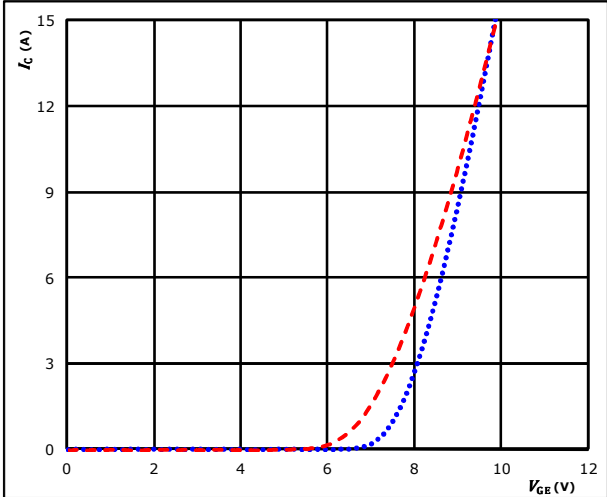


$t_p = 250 \mu s$
 $T_j = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

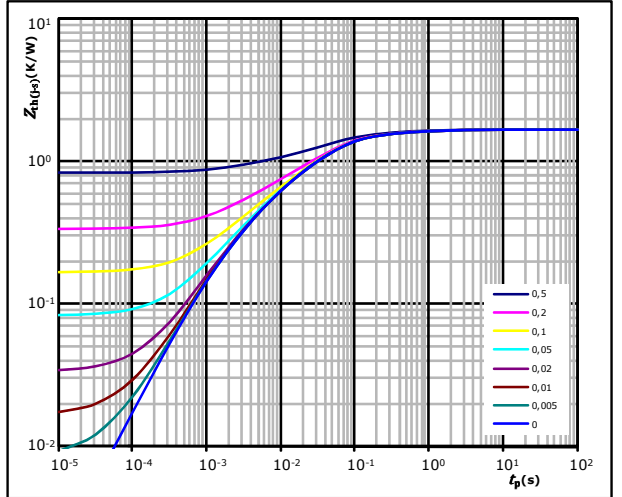


$t_p = 100 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25 \text{ }^\circ C$ (blue dotted line)
 $150 \text{ }^\circ C$ (red dashed line)

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 1,66 \text{ K/W}$

IGBT thermal model values

R (K/W)	τ (s)
9,65E-02	1,16E+00
2,18E-01	1,85E-01
8,07E-01	4,32E-02
3,94E-01	8,04E-03
1,48E-01	1,43E-03



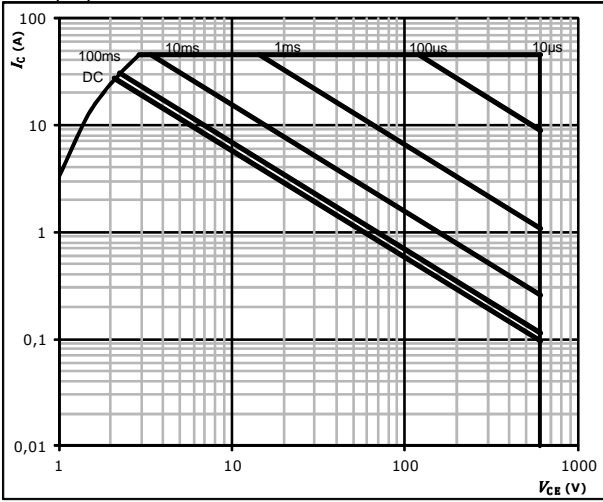
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Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



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

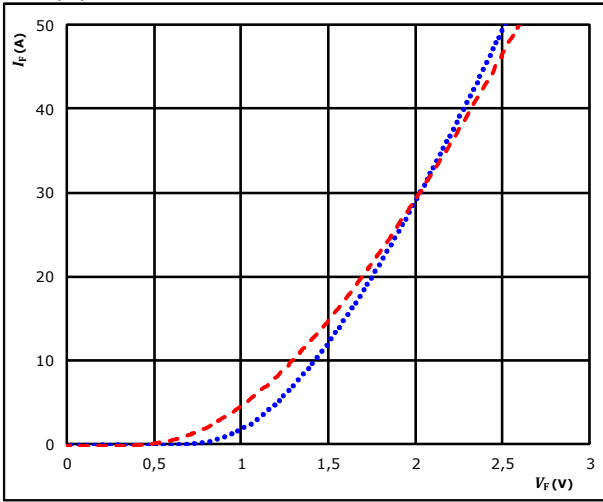


Inverter Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

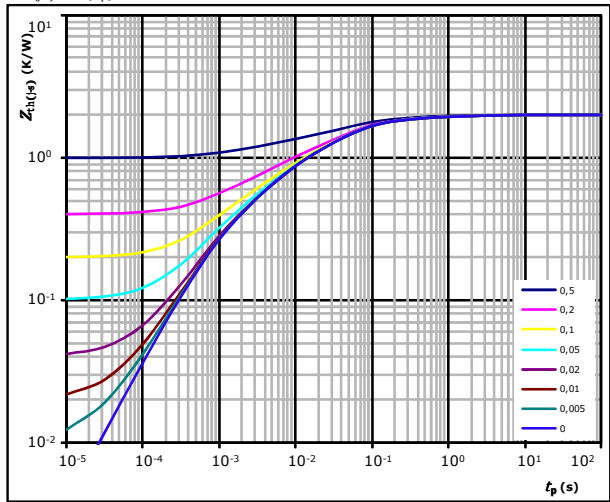


$t_p = 250 \mu s$
 T_j : 25 °C (blue dotted line)
 150 °C (red dashed line)

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,99 \text{ K/W}$

FWD thermal model values

R (K/W)	τ (s)
8,91E-02	2,40E+00
2,69E-01	2,02E-01
8,60E-01	4,04E-02
5,20E-01	6,01E-03
2,47E-01	9,08E-04

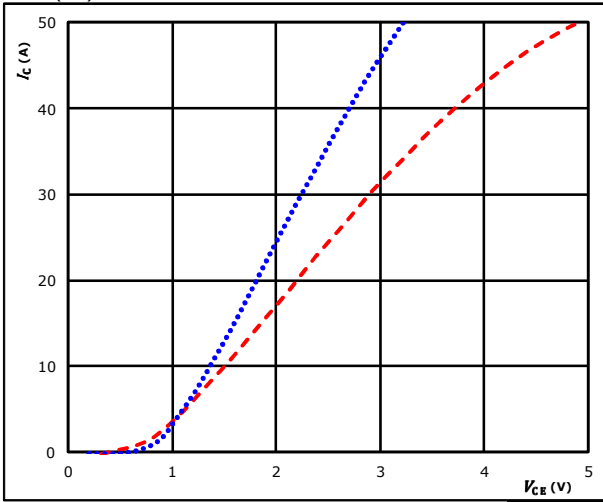


Brake Switch Characteristics

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

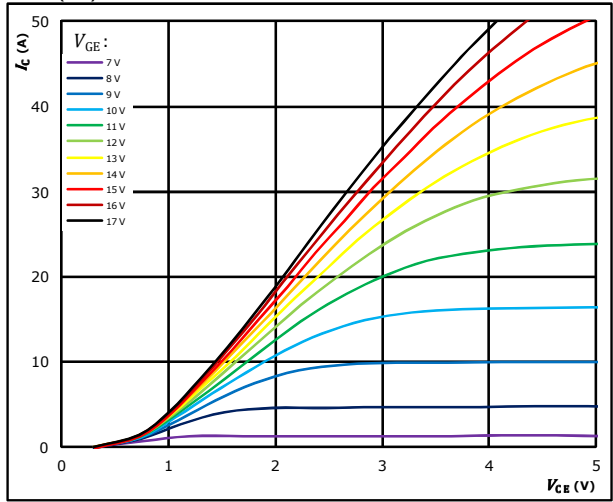


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25 \text{ } ^\circ C$ (blue dotted line)
 $150 \text{ } ^\circ C$ (red dashed line)

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

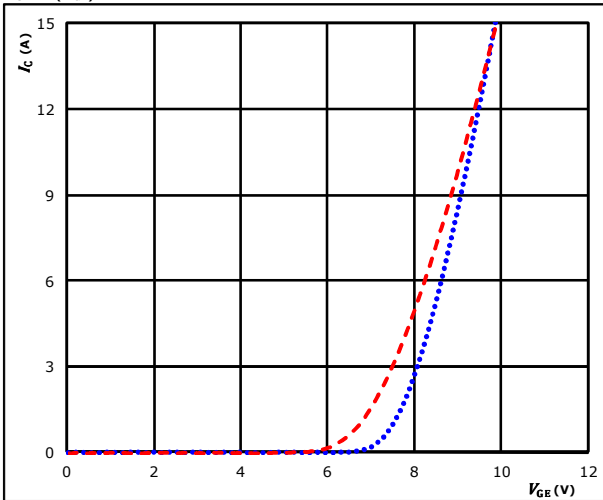


$t_p = 250 \mu s$
 $T_j = 150 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

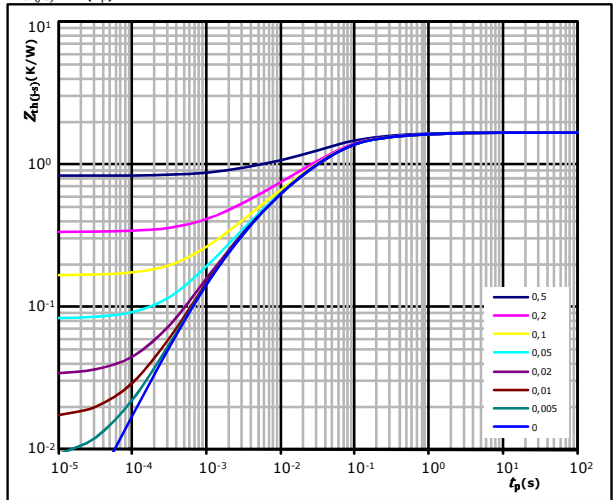


$t_p = 100 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25 \text{ } ^\circ C$ (blue dotted line)
 $150 \text{ } ^\circ C$ (red dashed line)

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(\theta-s)} = 1,66 \text{ K/W}$
 IGBT thermal model values

R (K/W)	τ (s)
9,65E-02	1,16E+00
2,18E-01	1,85E-01
8,07E-01	4,32E-02
3,94E-01	8,04E-03
1,48E-01	1,43E-03

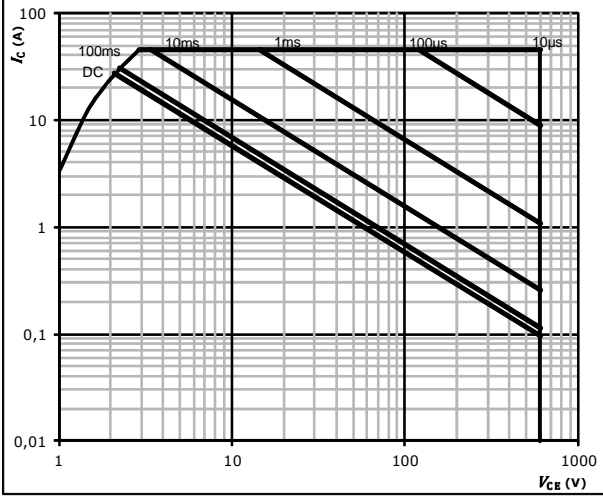


Brake Switch Characteristics

figure 5. IGBT

Safe operating area

$I_C = f(V_{CE})$



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

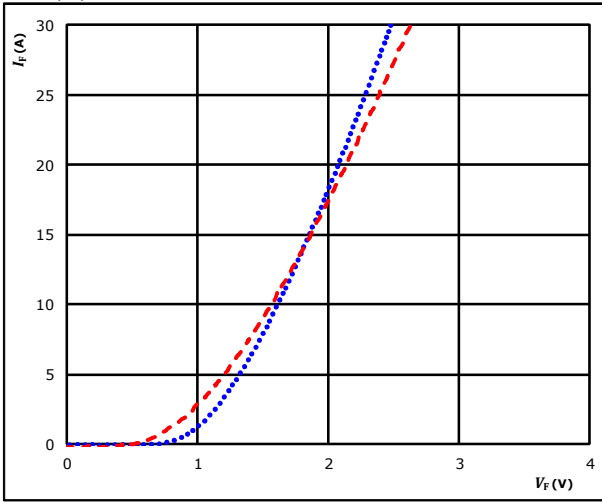


Brake Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

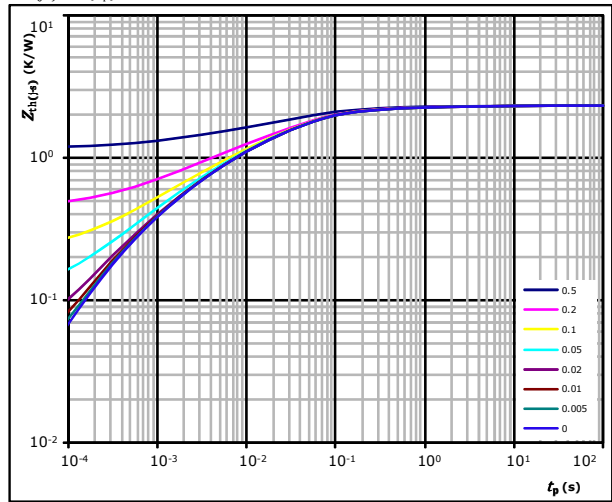


$t_p = 250 \mu s$
 T_j : 25 °C
 150 °C - - - -

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 2,33 \text{ K/W}$

FWD thermal model values

R (K/W)	τ (s)
8,21E-02	3,70E+00
2,22E-01	2,65E-01
9,31E-01	4,46E-02
5,61E-01	8,56E-03
3,70E-01	1,89E-03
1,62E-01	3,41E-04

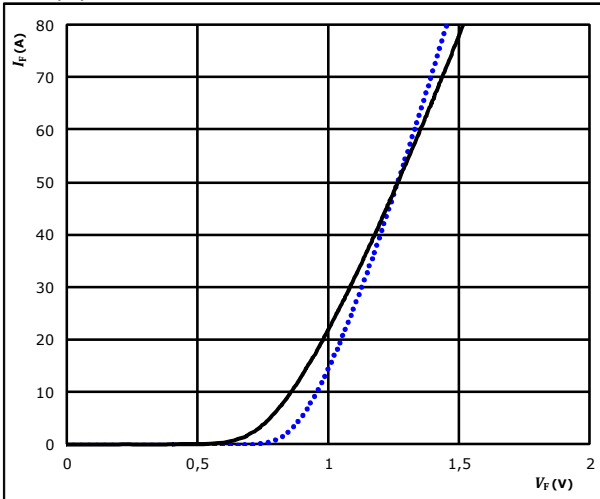


Rectifier Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

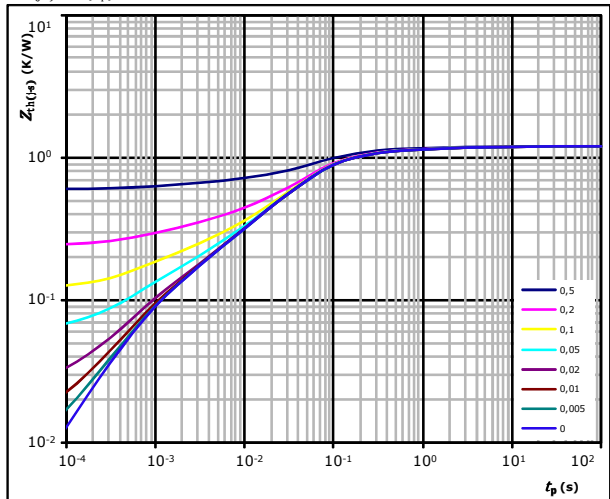


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line) $125 \text{ }^\circ\text{C}$ (solid black line)

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,20 \text{ K/W}$
 FWD thermal model values

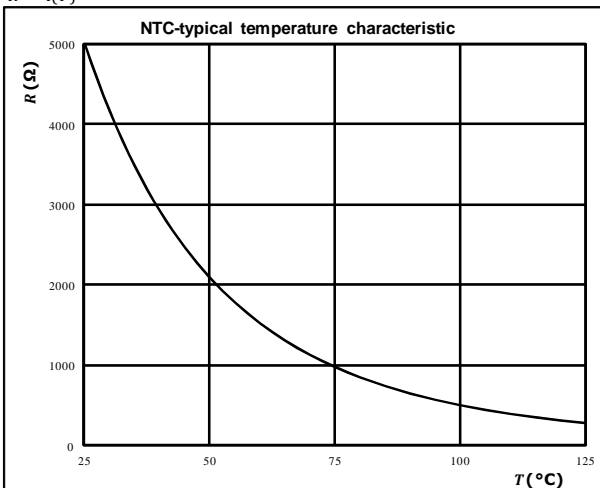
$R \text{ (K/W)}$	$\tau \text{ (s)}$
3,54E-02	9,31E+00
8,09E-02	9,99E-01
2,12E-01	1,71E-01
6,76E-01	4,85E-02
1,19E-01	5,88E-03
7,98E-02	8,33E-04

Thermistor Characteristics

figure 1. Thermistor

Typical NTC characteristic
as a function of temperature

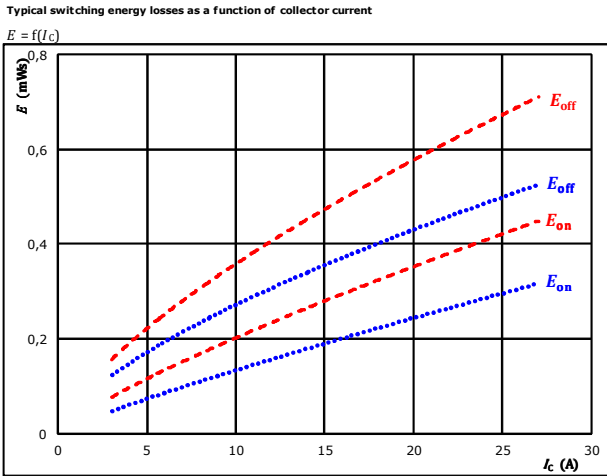
$$R = f(T)$$





Inverter Switching Characteristics

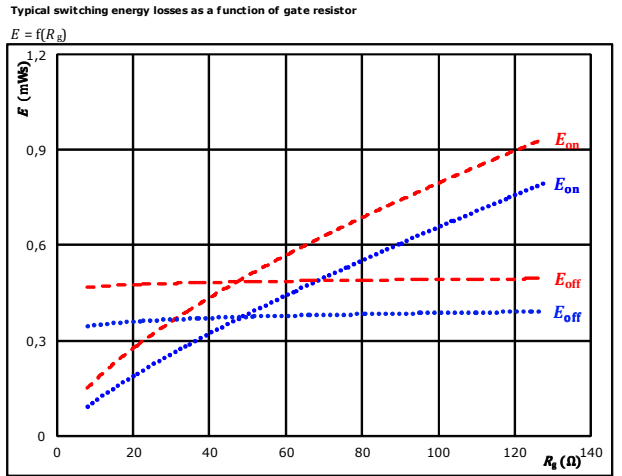
figure 1. IGBT



With an inductive load at

$V_{CE} =$	300 V	$T_j:$	25 °C
$V_{GE} =$	±15 V		150 °C	-----
$R_{gon} =$	16 Ω			
$R_{goff} =$	16 Ω			

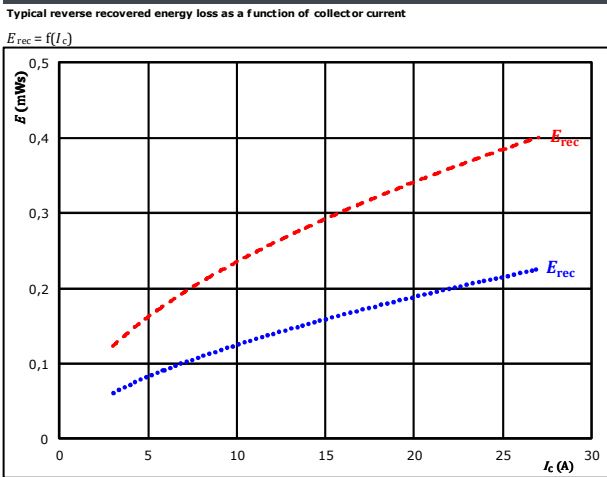
figure 2. IGBT



With an inductive load at

$V_{CE} =$	300 V	$T_j:$	25 °C
$V_{GE} =$	±15 V		150 °C	-----
$I_c =$	15 A			

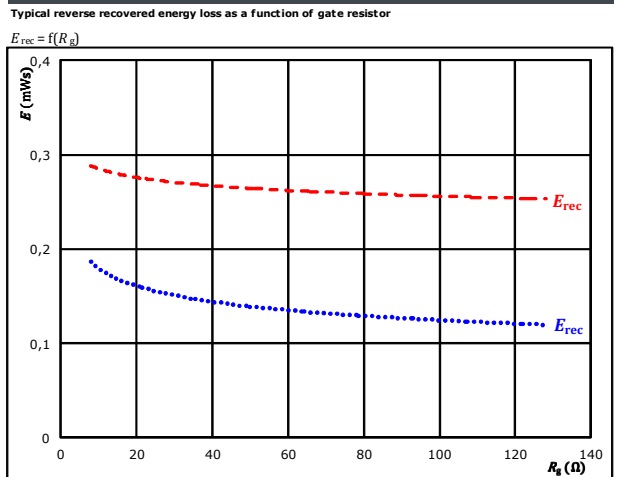
figure 3. FWD



With an inductive load at

$V_{CE} =$	300 V	$T_j:$	25 °C
$V_{GE} =$	±15 V		150 °C	-----
$R_{gon} =$	16 Ω			

figure 4. FWD



With an inductive load at

$V_{CE} =$	300 V	$T_j:$	25 °C
$V_{GE} =$	±15 V		150 °C	-----
$I_c =$	15 A			

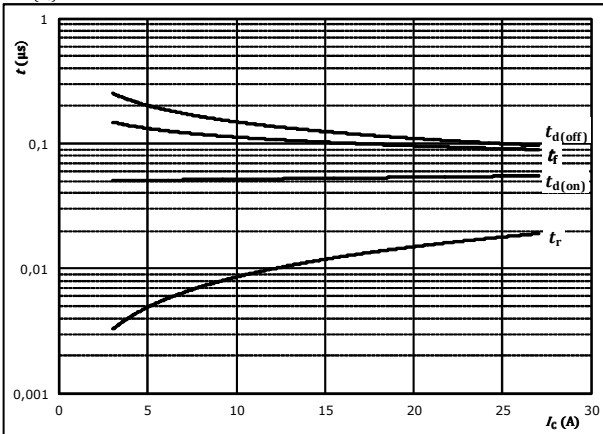


Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



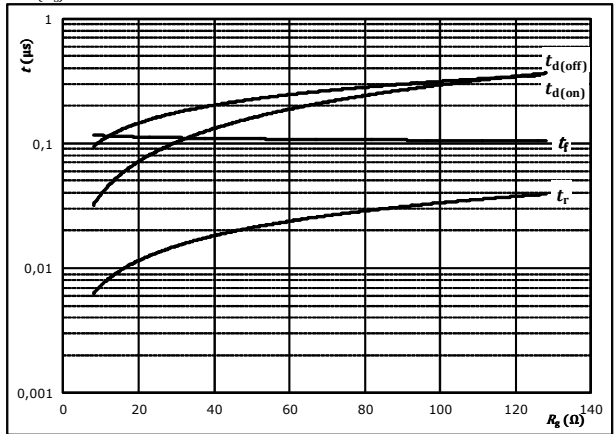
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	16	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



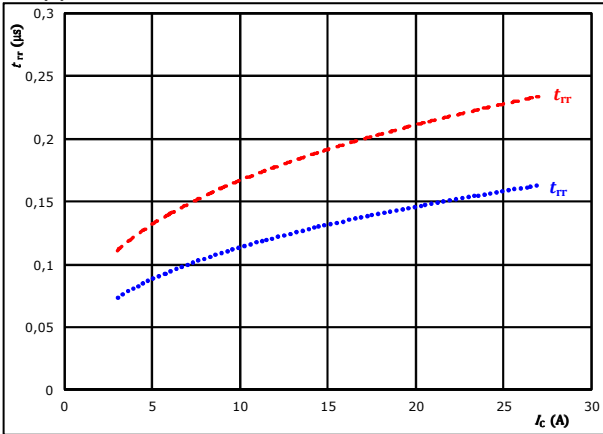
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	15	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

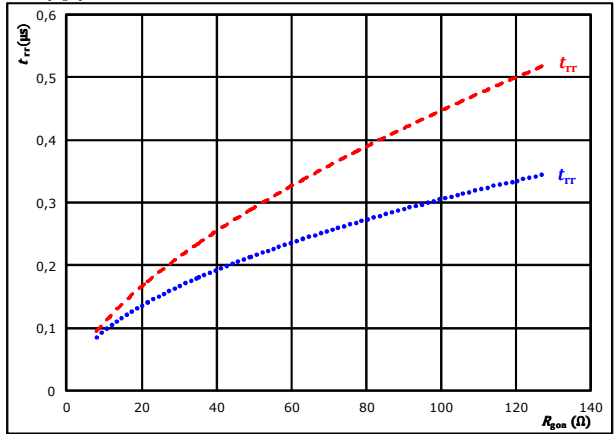


At	$V_{CE} =$	300	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		150 °C	-----
	$R_{gon} =$	16	Ω			

figure 8. FWD

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

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



At	$V_{CE} =$	300	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		150 °C	-----
	$I_C =$	15	A			

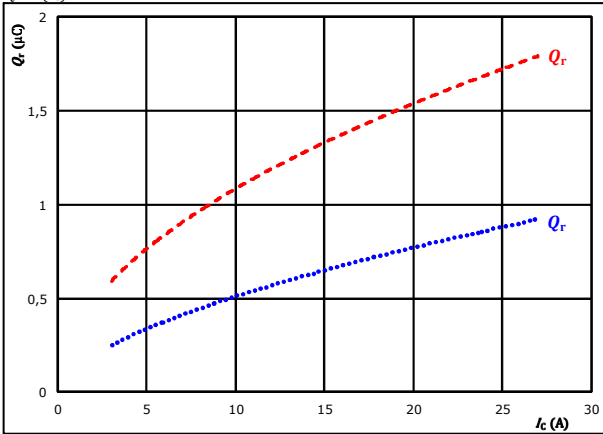


Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

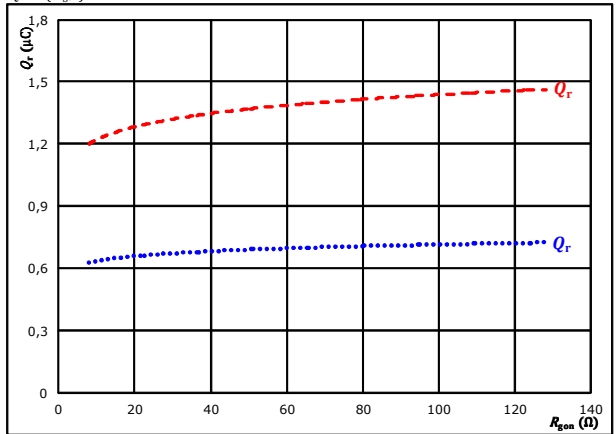


At $V_{CE} = 300$ V $T_j = 25$ °C (blue dotted line)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (red dashed line)
 $R_{gpn} = 16$ Ω

figure 10. FWD

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

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

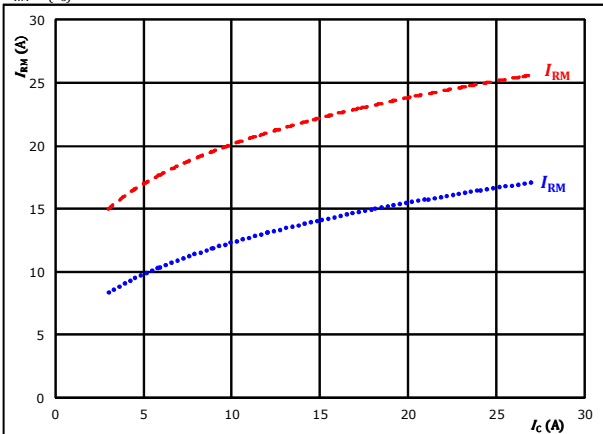


At $V_{CE} = 300$ V $T_j = 25$ °C (blue dotted line)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (red dashed line)
 $I_c = 15$ A

figure 11. FWD

Typical peak reverse recovery current as a function of collector current

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

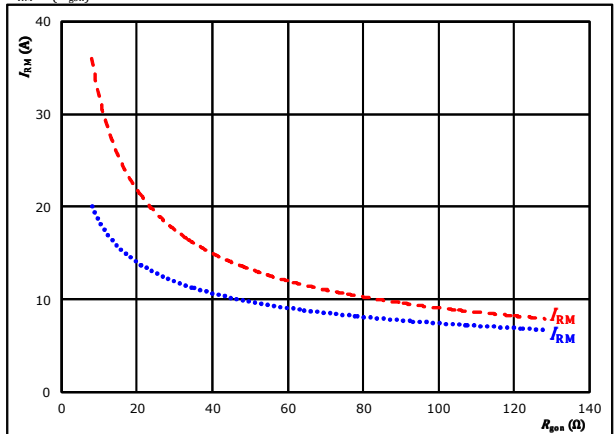


At $V_{CE} = 300$ V $T_j = 25$ °C (blue dotted line)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (red dashed line)
 $R_{gpn} = 16$ Ω

figure 12. FWD

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

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



At $V_{CE} = 300$ V $T_j = 25$ °C (blue dotted line)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (red dashed line)
 $I_c = 15$ A

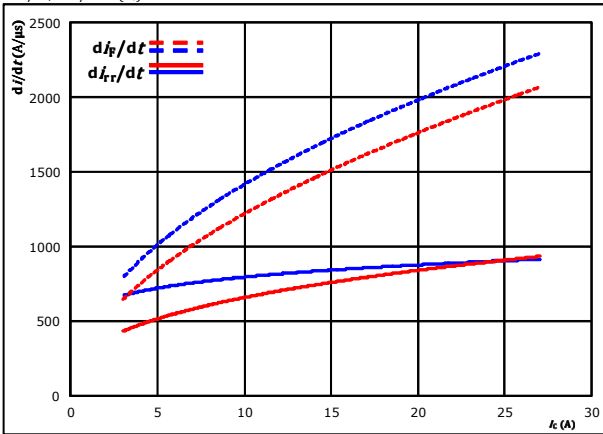


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Inverter Switching Characteristics

figure 13. FWD

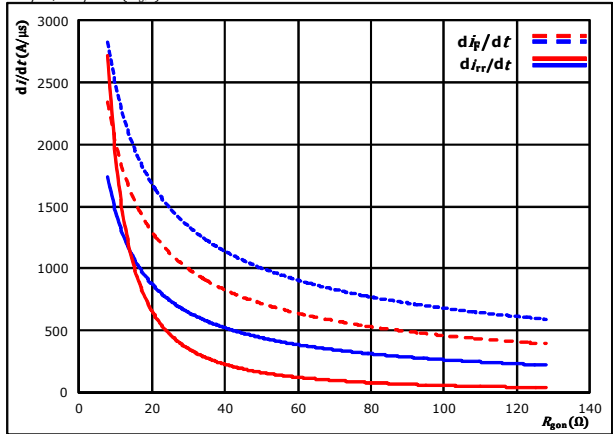
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{g(on)} = 16$ Ω
 $T_j = 25$ °C
 150 °C

figure 14. FWD

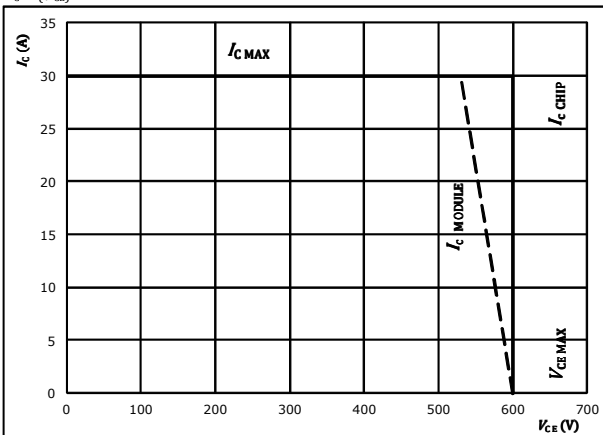
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_c = 15$ A
 $T_j = 25$ °C
 150 °C

figure 15. IGBT

Reverse bias safe operating area
 $I_c = f(V_{CE})$



At $T_j = 150$ °C
 $R_{g(on)} = 16$ Ω
 $R_{g(off)} = 16$ Ω

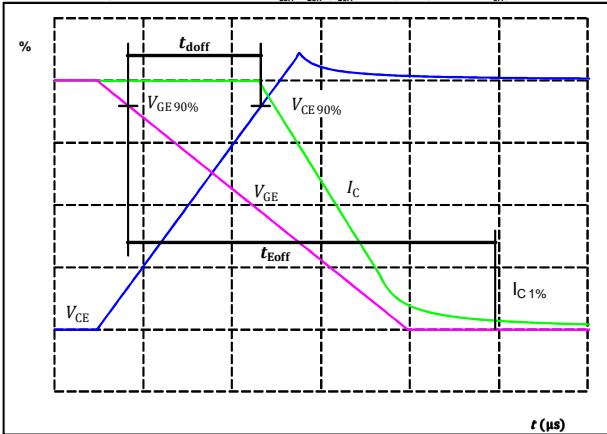


Inverter Switching Definitions

General conditions		
T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

figure 1. IGBT

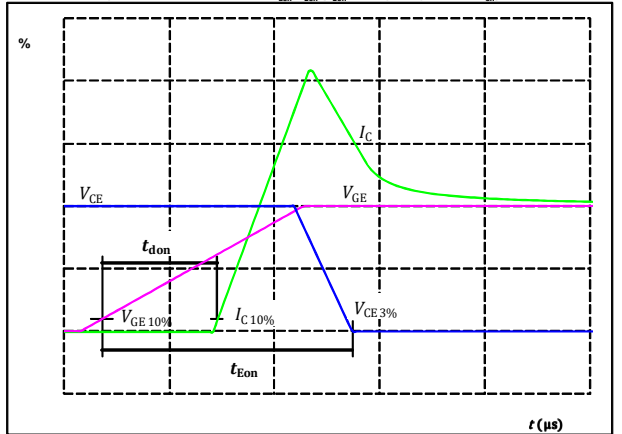
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_{doff} =$	124	ns

figure 2. IGBT

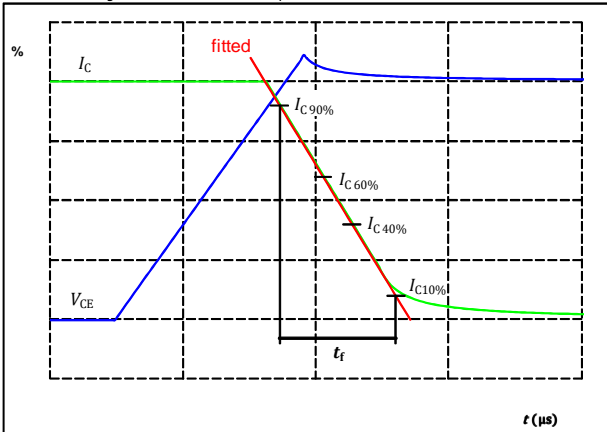
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_{don} =$	52	ns

figure 3. IGBT

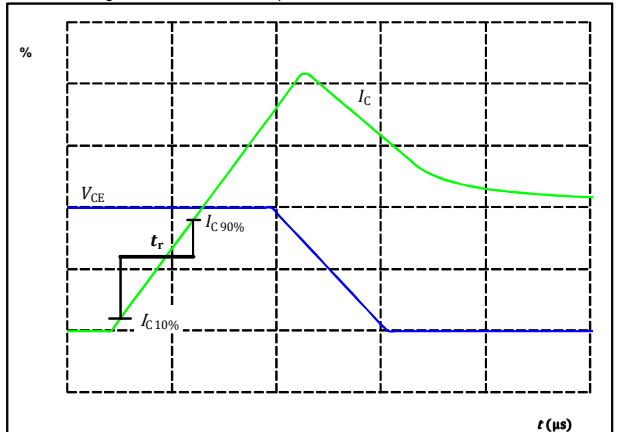
Turn-off Switching Waveforms & definition of t_r



$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_r =$	121	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



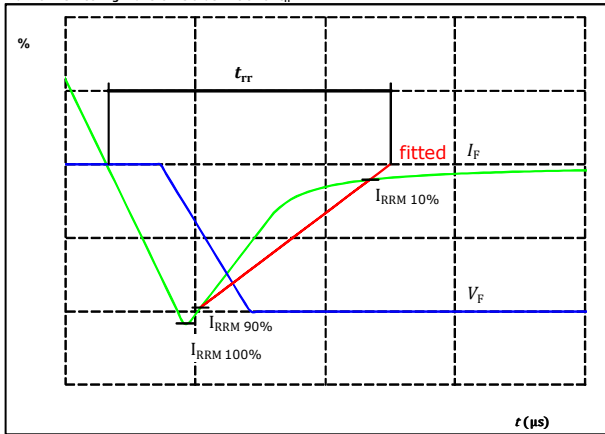
$V_C(100\%) =$	300	V
$I_C(100\%) =$	15	A
$t_r =$	12	ns



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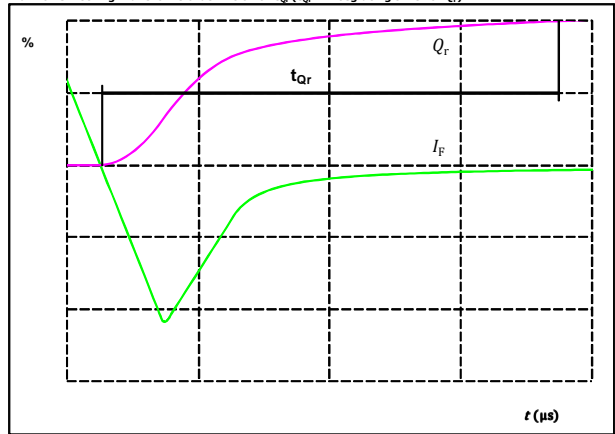
Inverter Switching Characteristics

figure 5. FWD
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%) =$	300	V
$I_F(100\%) =$	15	A
$I_{RRM}(100\%) =$	22	A
$t_{rr} =$	179	ns

figure 6. FWD
Turn-on Switching Waveforms & definition of t_{qr} ($t_{qr} =$ integrating time for Q_r)



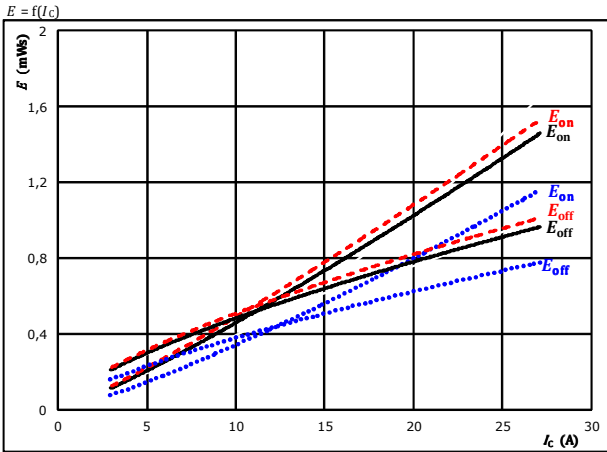
$I_F(100\%) =$	15	A
$Q_r(100\%) =$	1,28	μC



Brake Switching Characteristics

figure 1. IGBT

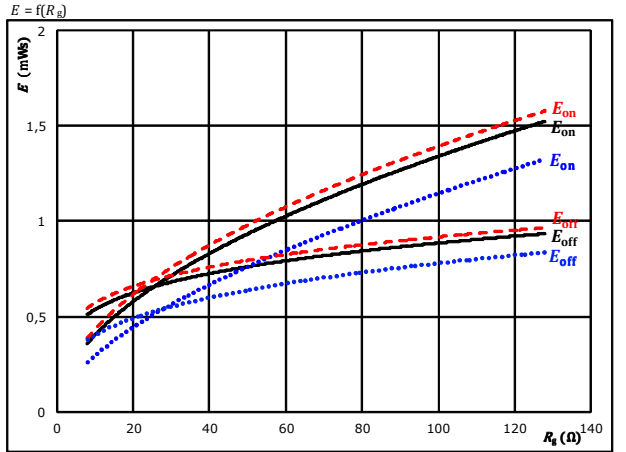
Typical switching energy losses as a function of collector current



With an inductive load at
 $V_{CE} = 400$ V
 $V_{GE} = 0 / 15$ V
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω
 $T_j: 25$ $^{\circ}\text{C}$ (blue dotted line)
 125 $^{\circ}\text{C}$ (black solid line)
 150 $^{\circ}\text{C}$ (red dashed line)

figure 2. IGBT

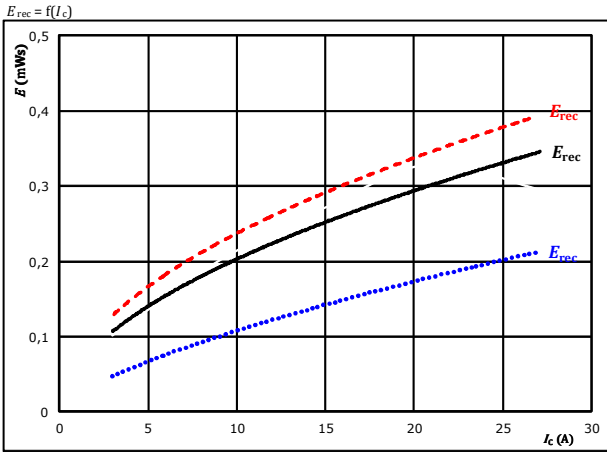
Typical switching energy losses as a function of gate resistor



With an inductive load at
 $V_{CE} = 400$ V
 $V_{GE} = 0 / 15$ V
 $I_C = 15$ A
 $T_j: 25$ $^{\circ}\text{C}$ (blue dotted line)
 125 $^{\circ}\text{C}$ (black solid line)
 150 $^{\circ}\text{C}$ (red dashed line)

figure 3. FWD

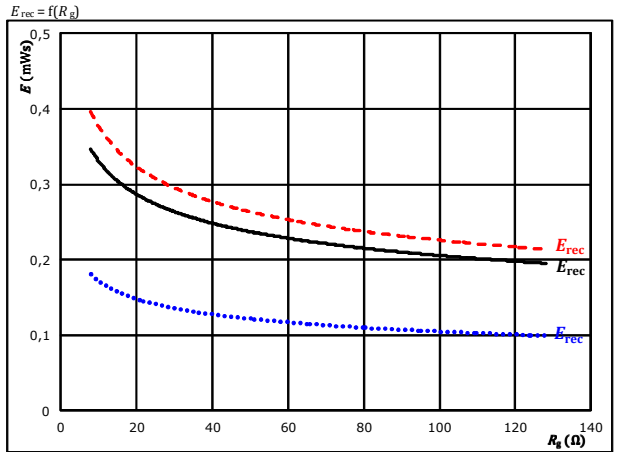
Typical reverse recovered energy loss as a function of collector current



With an inductive load at
 $V_{CE} = 400$ V
 $V_{GE} = 0 / 15$ V
 $R_{gon} = 32$ Ω
 $T_j: 25$ $^{\circ}\text{C}$ (blue dotted line)
 125 $^{\circ}\text{C}$ (black solid line)
 150 $^{\circ}\text{C}$ (red dashed line)

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at
 $V_{CE} = 400$ V
 $V_{GE} = 0 / 15$ V
 $I_C = 15$ A
 $T_j: 25$ $^{\circ}\text{C}$ (blue dotted line)
 125 $^{\circ}\text{C}$ (black solid line)
 150 $^{\circ}\text{C}$ (red dashed line)

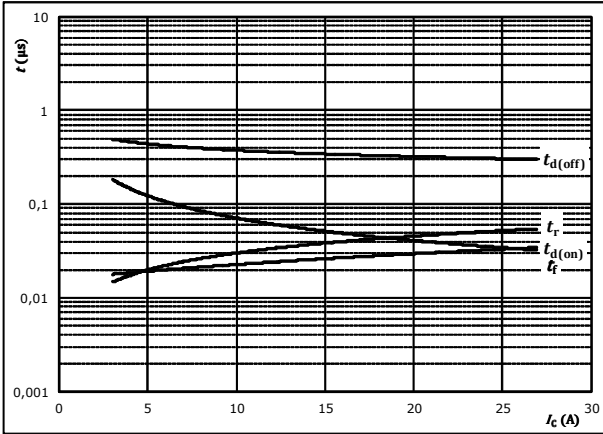


Brake Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



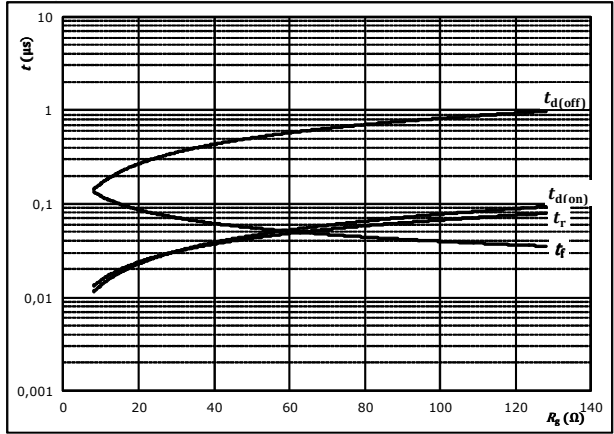
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	400	V
$V_{GE} =$	0 / 15	V
$R_{gon} =$	32	Ω
$R_{goff} =$	32	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



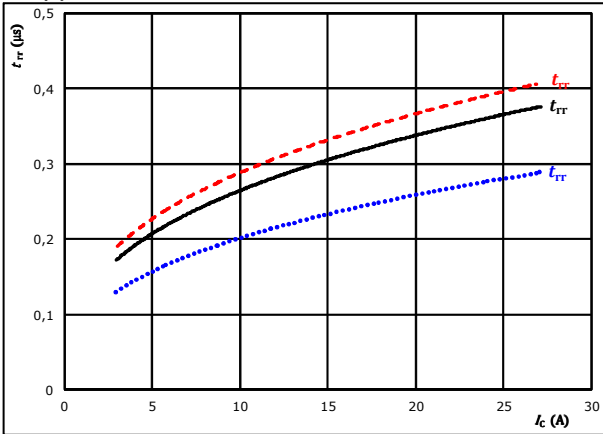
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	400	V
$V_{GE} =$	0 / 15	V
$I_C =$	15	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

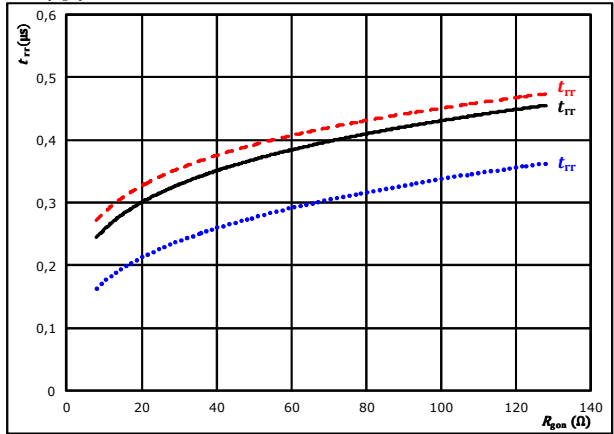


At	$V_{CE} =$	400	V	$T_j:$	25 °C
	$V_{GE} =$	0 / 15	V		125 °C	————
	$R_{gon} =$	32	Ω		150 °C	-----

figure 8. FWD

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

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



At	$V_{CE} =$	400	V	$T_j:$	25 °C
	$V_{GE} =$	0 / 15	V		125 °C	————
	$I_C =$	15	A		150 °C	-----

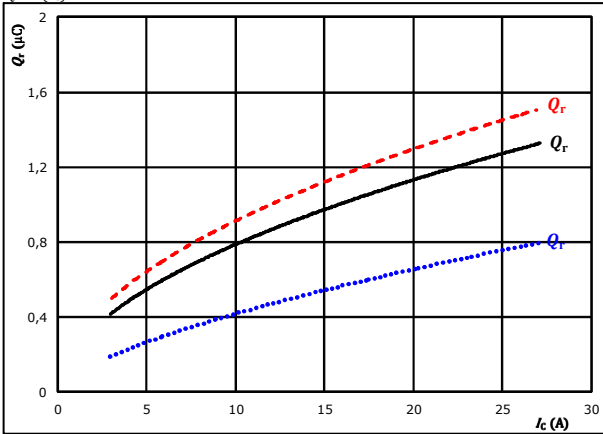


Brake Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

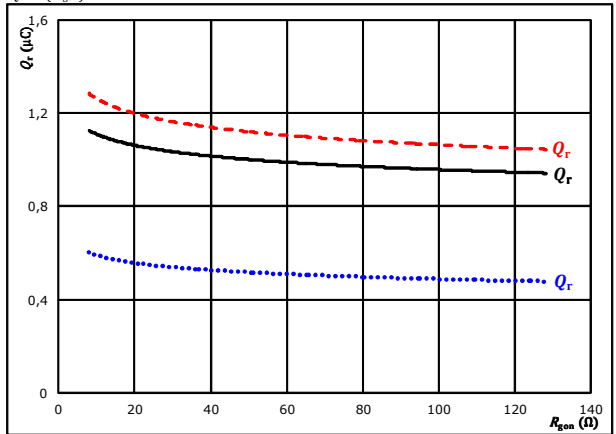


At $V_{CE} = 400$ V $T_j = 25$ °C $I_c = 15$ A
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $R_{gdn} = 32$ Ω $T_j = 150$ °C

figure 10. FWD

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

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

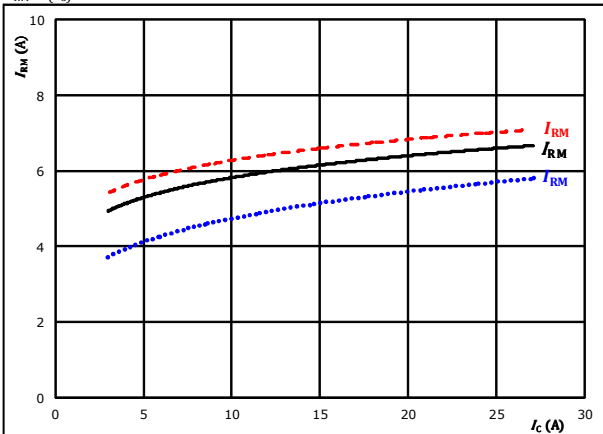


At $V_{CE} = 400$ V $T_j = 25$ °C $I_c = 15$ A
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $I_c = 15$ A $T_j = 150$ °C

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

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

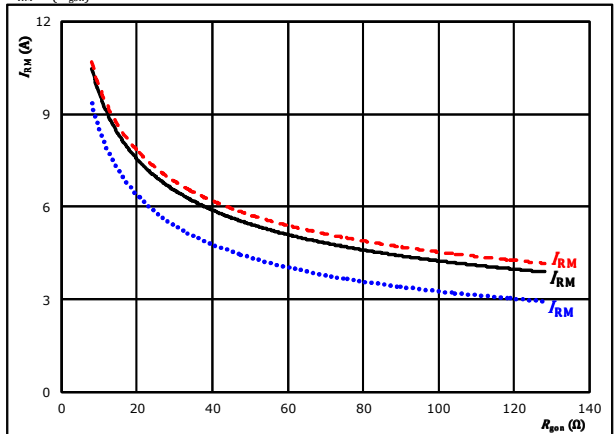


At $V_{CE} = 400$ V $T_j = 25$ °C
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $R_{gdn} = 32$ Ω $T_j = 150$ °C

figure 12. FWD

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

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



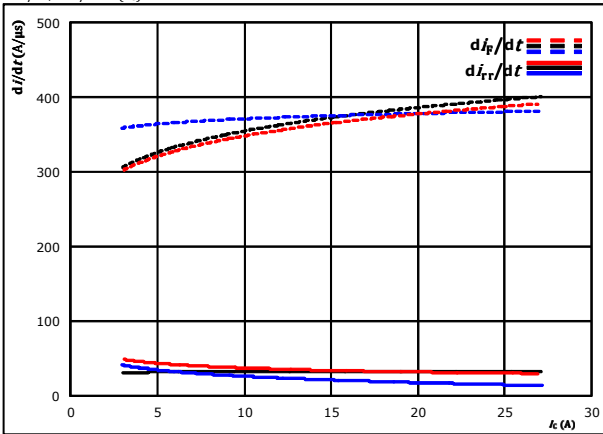
At $V_{CE} = 400$ V $T_j = 25$ °C $I_c = 15$ A
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $I_c = 15$ A $T_j = 150$ °C



Brake Switching Characteristics

figure 13. FWD

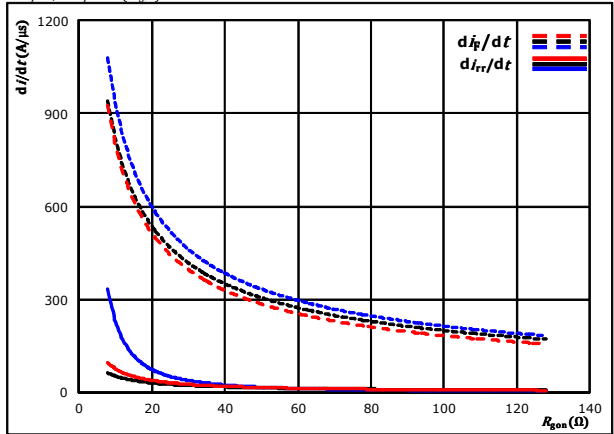
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 400$ V $T_j = 25$ °C
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $R_{g(on)} = 32$ Ω $T_j = 150$ °C

figure 14. FWD

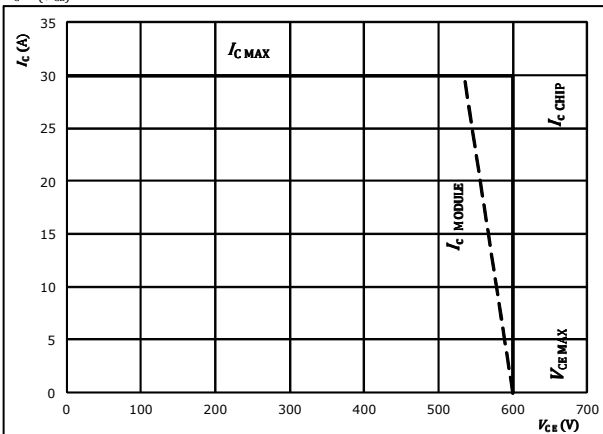
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At $V_{CE} = 400$ V $T_j = 25$ °C
 $V_{GE} = 0 / 15$ V $T_j = 125$ °C
 $I_c = 15$ A $T_j = 150$ °C

figure 15. IGBT

Reverse bias safe operating area
 $I_c = f(V_{CE})$



At $T_j = 125$ °C
 $R_{g(on)} = 32$ Ω
 $R_{g(off)} = 32$ Ω



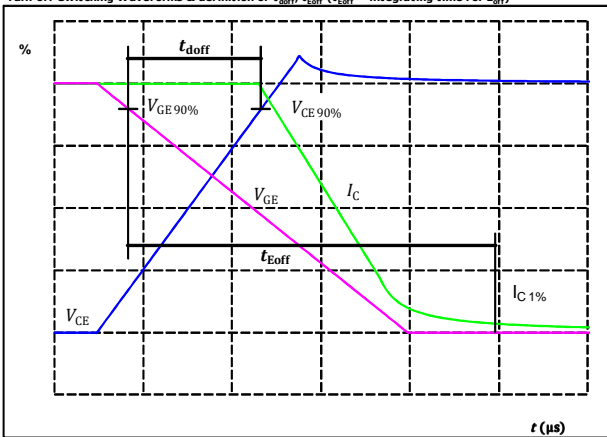
Brake Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

figure 1. IGBT

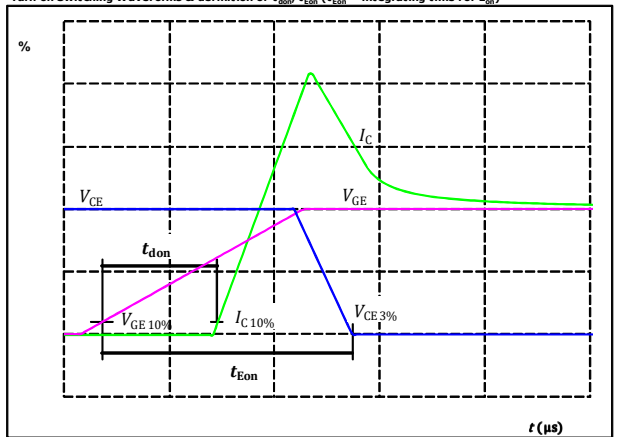
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	15	A
$t_{doff} =$	341	ns

figure 2. IGBT

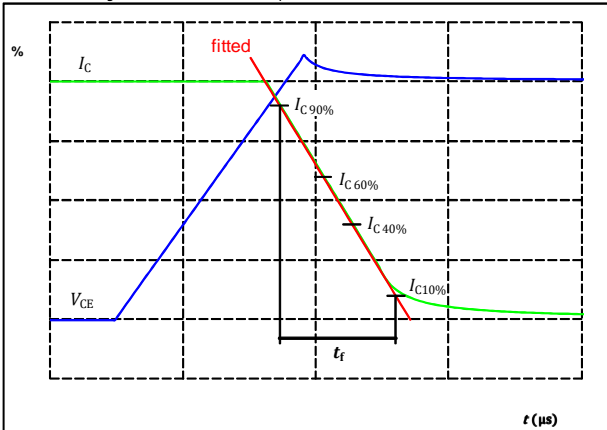
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	15	A
$t_{don} =$	31	ns

figure 3. IGBT

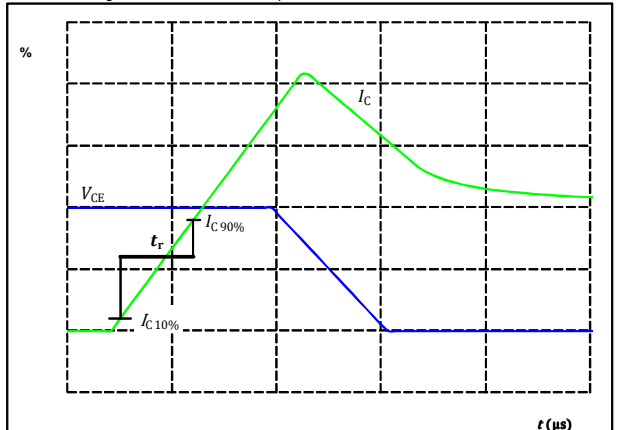
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	400	V
$I_C(100\%) =$	15	A
$t_f =$	115	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

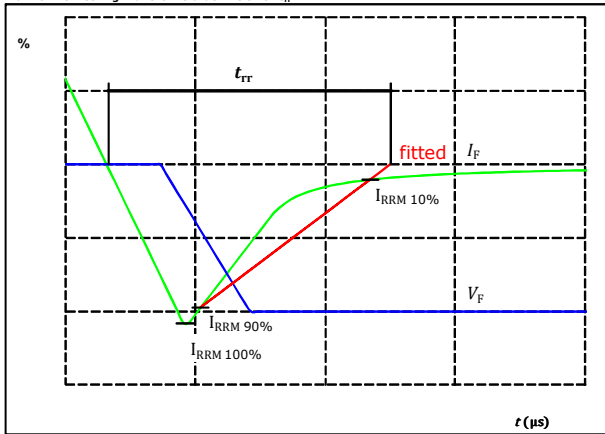


$V_C(100\%) =$	400	V
$I_C(100\%) =$	15	A
$t_r =$	35	ns



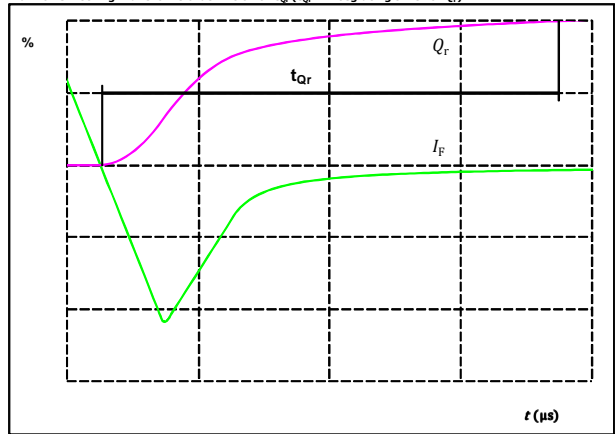
Brake Switching Characteristics

figure 5. FWD
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%) =$	400	V
$I_F(100\%) =$	15	A
$I_{RRM}(100\%) =$	7	A
$t_{rr} =$	311	ns

figure 6. FWD
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



$I_F(100\%) =$	15	A
$Q_r(100\%) =$	1,03	μC



Vincotech

Ordering Code & Marking							
Version			Ordering Code				
without thermal paste 12 mm housing with press-fit pins			10-EZ06PMA015SA-L924A38T				
with thermal paste 12 mm housing with press-fit pins			10-EZ06PMA015SA-L924A38T-/3/				
NN-NNNNNNNNNNNN TTTTUV WWYY UL VIN LLLLL SSSS			Name	Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNN-TTTTUV		WWYY	UL VIN	LLLLL	SSSS	
Datamatrix	TTTTTUV	LLLLL	SSSS	WWYY			

Pin table			
Pin	X	Y	Function
1	32	0	Br
2	25,6	0	DC-Br
3	22,4	0	G27
4	19,2	0	DC-Rect
5	16	0	G15
6	12,8	0	DC-3
7	9,6	0	G13
8	6,4	0	DC-2
9	3,2	0	G11
10	0	0	DC-1
11	0	25,6	Ph1
12	3,2	25,6	G12
13	9,6	25,6	Ph2
14	12,8	25,6	G14
15	19,2	25,6	Ph3
16	22,4	25,6	G16
17	32	25,6	ACIn1
18	25,6	19,2	ACIn2
19	19,2	16	Therm1
20	16	16	Therm2
21	25,6	12,8	ACIn3
22	22,4	6,4	DC+Inv
23	25,6	6,4	DC+Rect

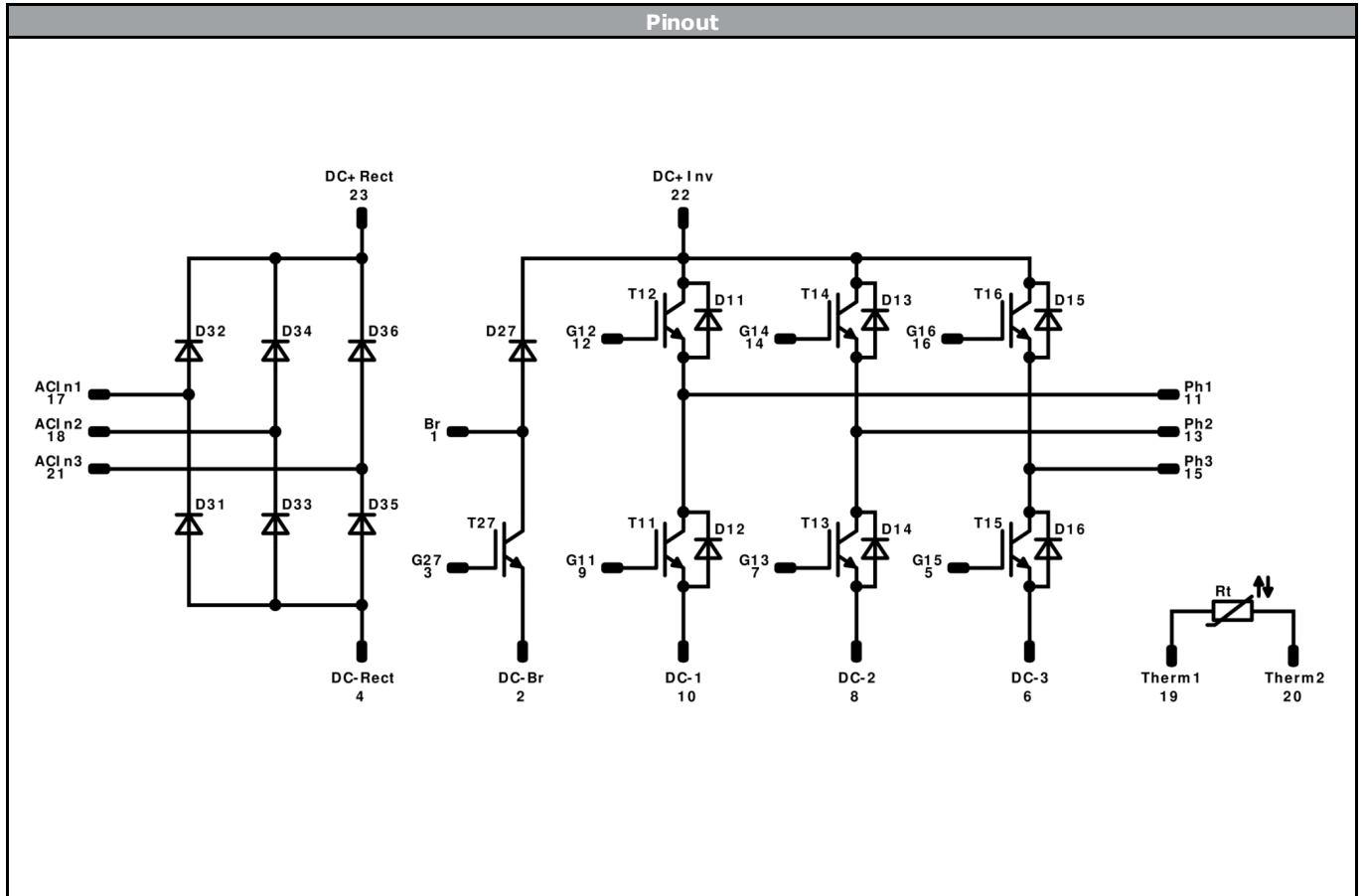
Outline

center of press-fit pinhead
For connection parameter see the handling instruction

Tolerance of pinpositions: ±0,4mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	600 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	600 V	15 A	Inverter Diode	
T27	IGBT	600 V	15 A	Brake Switch	
D27	FWD	600 V	10 A	Brake Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	35 A	Rectifier Diode	
Rt	NTC			Thermistor	




Vincotech

Packaging instruction			
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow</i> E1 packages see vincotech.com website.

Package data
Package data for <i>flow</i> E1 packages see 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
10-EZ06PMA015SA-L924A38T-D1-14	25 Jun. 2018		

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As used herein:

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