Vincotech

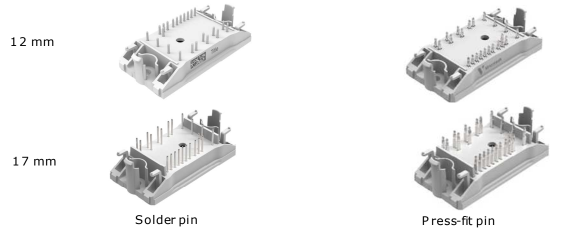
10-xZ12PMA010M7-P849A28x
10-x012PMA010M7-P849A29x
datasheet

***flow* PIM 0** **1200 V / 10 A**

Features

- IGBT M7 with low V_{CEsat} and improved EMC behavior
- Open emitter configuration
- Compact and low inductive design
- Builtin NTC

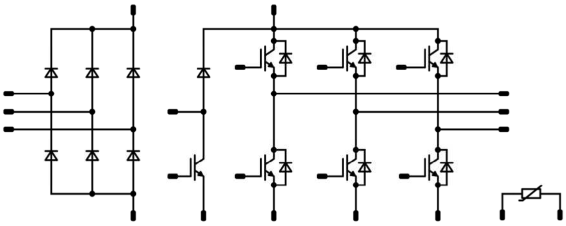
flow 0 housing



Target applications

- Industrial Drives

Schematic



Types

- 10-FZ12PMA010M7-P849A28
- 10-F012PMA010M7-P849A29
- 10-PZ12PMA010M7-P849A28Y
- 10-P012PMA010M7-P849A29Y

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		25	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms T_j = 150 °C	200	A
Surge current capability	I^2t		200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	44	W
Maximum Junction Temperature	T_{jmax}		150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		10	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	55	W
Gate-emitter voltage	V_{GES}		±20	V
Maximum junction temperature	T_{jmax}		175	°C
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		10	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	50	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		5	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	41	W
Gate-emitter voltage	V_{GES}		±20	V
Maximum junction temperature	T_{jmax}		175	°C
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		5	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	27	W
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	**Symbol**	**Condition**	**Value**	**Unit**
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 s	6000	V
		AC Voltage t_p = 1 min	2500	V
Creepage distance			min. 12,7	mm
Clearance		Solder pin 12 mm housing / 17 mm housing	9,29 / min. 12,7	mm
		Press-fit pin 12 mm housing / 17 mm housing	9,48 / min. 12,7	
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

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**	
Rectifier Diode										
Static										
Forward voltage	V_F				30	25 125		1,22 1,21	1,8	V
Reverse leakage current	I_r			1600		25 145			50 1100	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,59		K/W

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 Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,001	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 125 150		1,66 1,90 1,96	1,95	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			55	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}		0	10		25		2000		pF
Output capacitance	C_{oes}							86		
Reverse transfer capacitance	C_{res}							23		
Gate charge	Q_g		15	600	10	25		80		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,72		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 32 Ω R_{gon} = 32 Ω	±15	600	10	25 125 150		128 126 123		ns
Rise time	t_r					25 125 150		29 32 34		
Turn-off delay time	$t_{d(off)}$					25 125 150		145 179 182		
Fall time	t_f					25 125 150		98 108 117		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,1 µC Q_{rFWD} = 1,7 µC Q_{rFWD} = 1,8 µC				25 125 150		0,883 1,125 1,189		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,656 0,860 0,908		

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}				10	25 125 150		1,61 1,69 1,69	2,1	V
Reverse leakage current	I_{R}			1200		25			25	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,91		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 278 A/µs di/dt = 270 A/µs di/dt = 272 A/µs	±15	600	10	25 125 150		9 9 9		A
Reverse recovery time	t_{rr}					25 125 150		254 373 409		ns
Recovered charge	Q_{r}					25 125 150		1,088 1,664 1,808		µC
Reverse recovered energy	E_{rec}					25 125 150		0,374 0,620 0,680		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		85 54 49		A/µs

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	
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		5	25 125 150		1,62 1,83 1,89	1,95	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			50	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}		0	10		25		1100		pF
Output capacitance	C_{oes}							57		
Reverse transfer capacitance	C_{res}							11		
Gate charge	Q_g		15	600	5	25		40		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,30		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 64 Ω R_{gon} = 64 Ω	15/0	600	5	25 125 150		79 73 72		ns
Rise time	t_r					25 125 150		45 48 49		
Turn-off delay time	$t_{d(off)}$					25 125 150		234 262 270		
Fall time	t_f					25 125 150		101 114 117		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,6 µC Q_{rFWD} = 0,8 µC Q_{rFWD} = 0,9 µC				25 125 150		0,480 0,609 0,634		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,345 0,454 0,474		

Characteristic Values

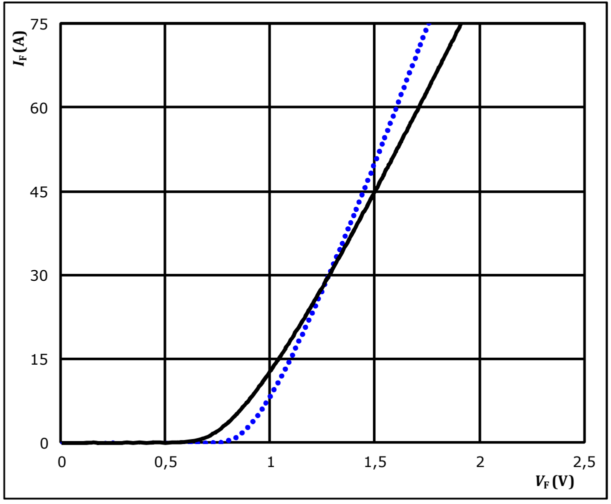
Parameter	**Symbol**	**Conditions**					**Value**			**Unit**
			V_{GE} **[V]** V_{GS} **[V]**	V_{CE} **[V]** V_{DS} **[V]** V_F **[V]**	I_C **[A]** I_D **[A]** I_F **[A]**	T_j **[°C]**	**Min**	**Typ**	**Max**	
Brake Diode										
Static										
Forward voltage	V_F				5	25 125 150		1,57 1,65 1,65	2,1	V
Reverse leakage current	I_R			1200		25			20	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						3,50		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 85 A/µs di/dt = 102 A/µs di/dt = 87 A/µs	15/0	600	5	25 125 150		4 4 4		A
Reverse recovery time	t_{rr}					25 125 150		259 386 431		ns
Recovered charge	Q_r					25 125 150		0,558 0,833 0,935		µC
Reverse recovered energy	E_{rec}					25 125 150		0,200 0,314 0,363		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		37 24 20		A/µs
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P					25		5		mW
Power dissipation constant						25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %				25		3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %				25		4000		K
Vincotech NTC Reference									I	

Rectifier Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

I_F = f(V_F)



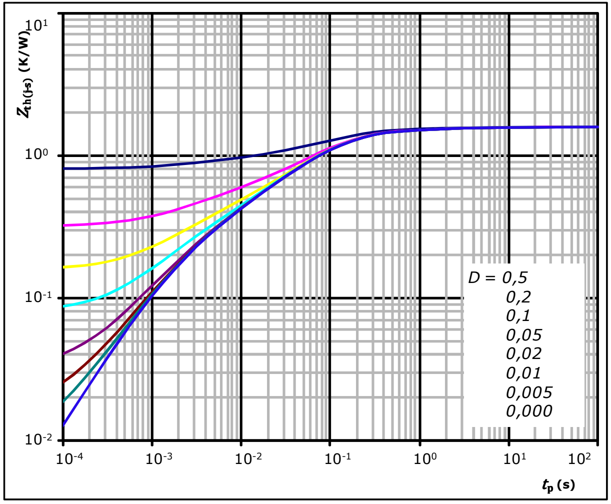
t_p = 250 µs

T_j: 25 °C ••••••••••
125 °C ━━━━

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,59 K/W

Diode thermal model values

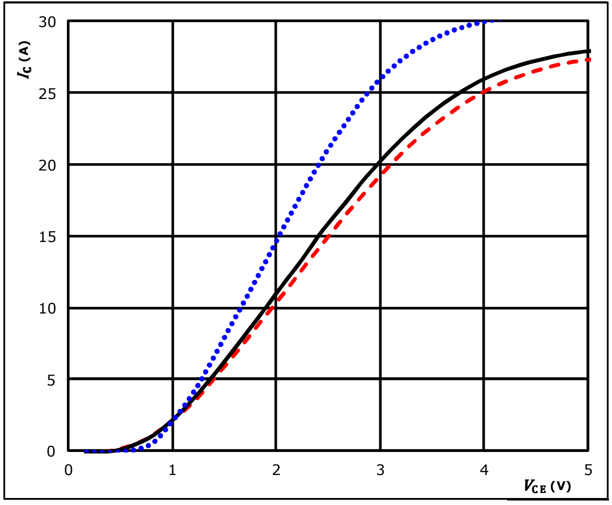
R (K/W)	τ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,22E-01	1,79E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

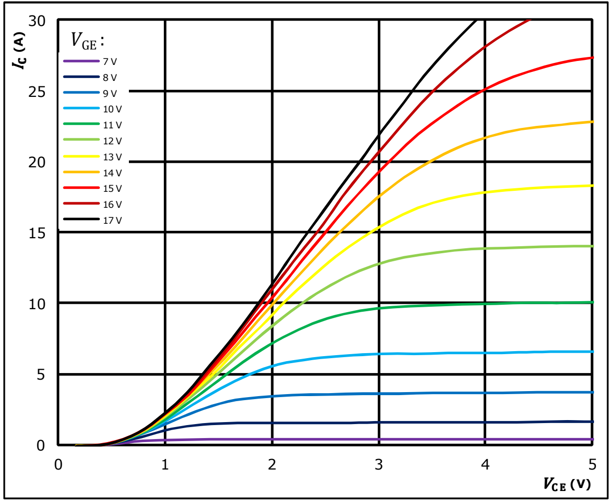


t_p = 250 µs 25 °C ⋯⋯
V_{GE} = 15 V T_j: 125 °C ——
150 °C – – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

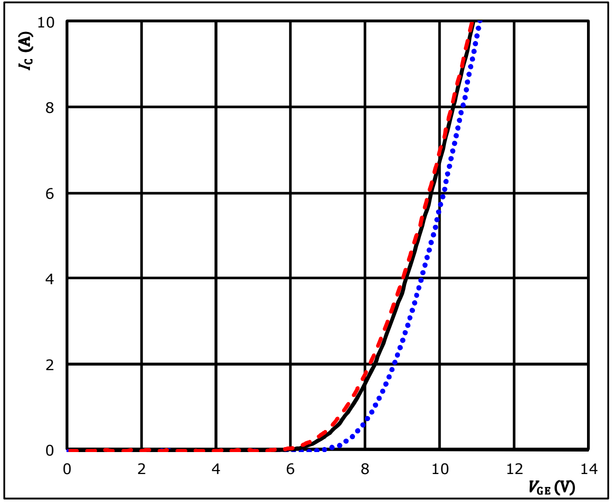


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

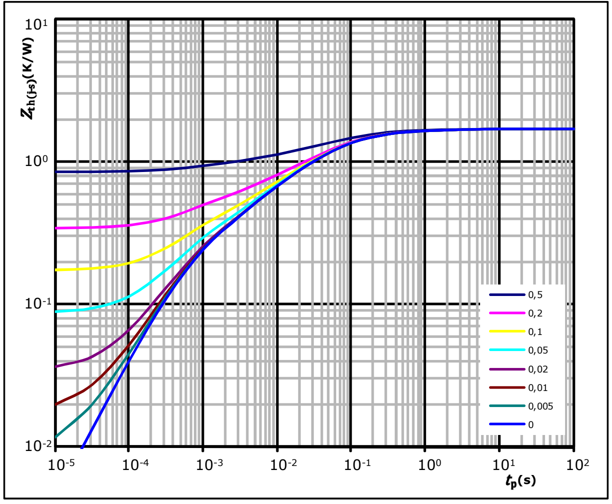


t_p = 100 µs 25 °C ⋯⋯
V_{CE} = 10 V T_j: 125 °C ——
150 °C – – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j\text{-}s)}$ = 1,72 K/W

IGBT thermal model values

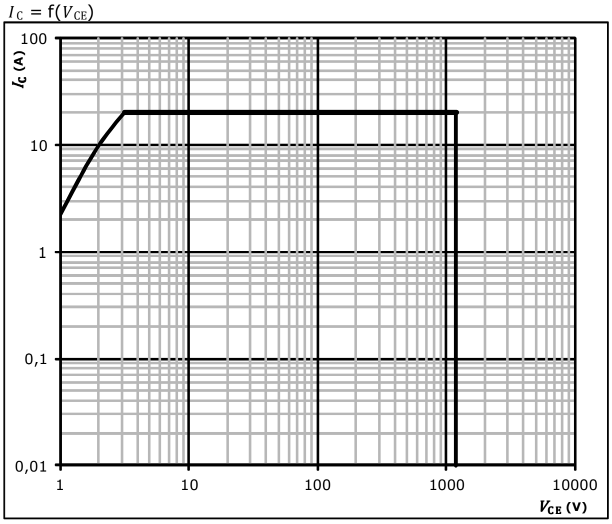
R (K/W)	τ (s)
8,08E-02	2,32E+00
2,21E-01	2,45E-01
6,51E-01	6,03E-02
3,93E-01	1,33E-02
1,95E-01	3,15E-03
1,82E-01	5,45E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



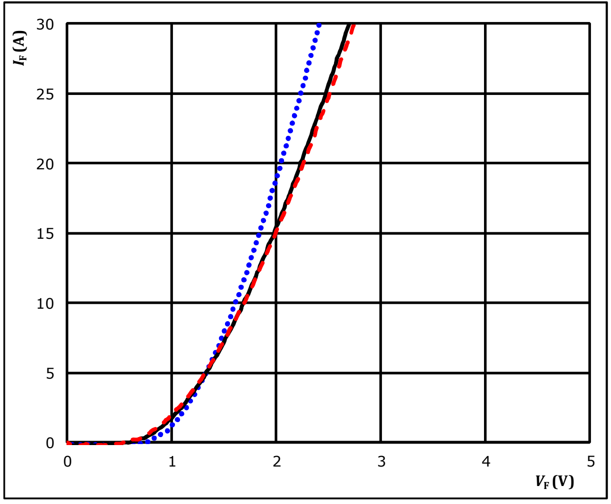
D = single pulse
T_s = 80 ºC
V_{GE} = ±15 V
T_j = T_{jmax}

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

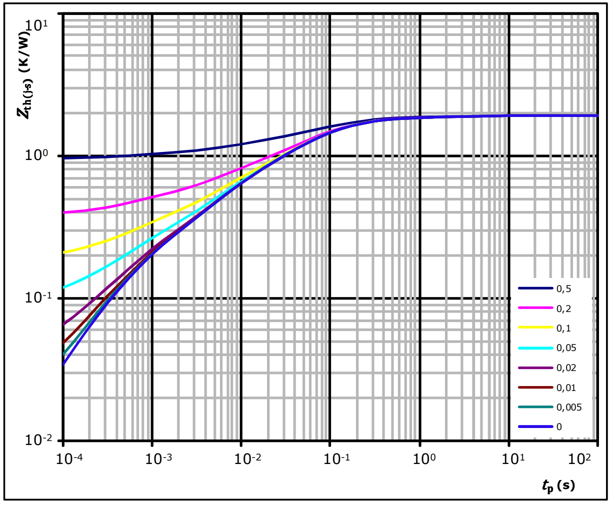
T_j:

25	°C	········
125	°C	━━━
150	°C	‒ ‒ ‒

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 1,91 K/W

FWD thermal model values

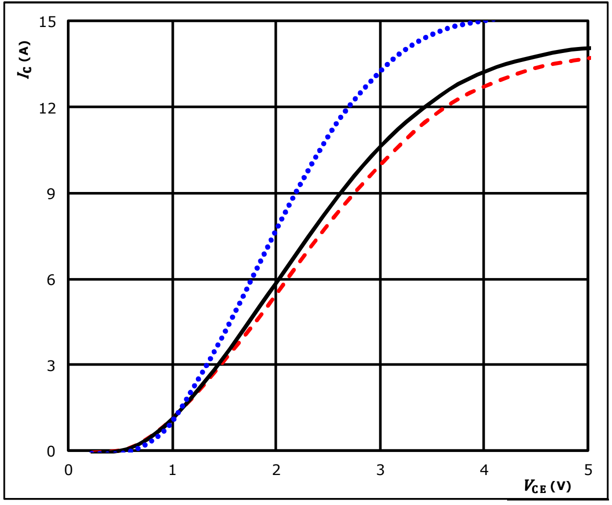
R (K/W)	τ (s)
9,38E-02	2,25E+00
3,43E-01	2,12E-01
8,53E-01	5,82E-02
3,59E-01	9,80E-03
1,37E-01	2,88E-03
1,26E-01	4,78E-04

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

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



t_p = 250 µs

V_{GE} = 15 V

T_j: 25 °C ••••••••••••

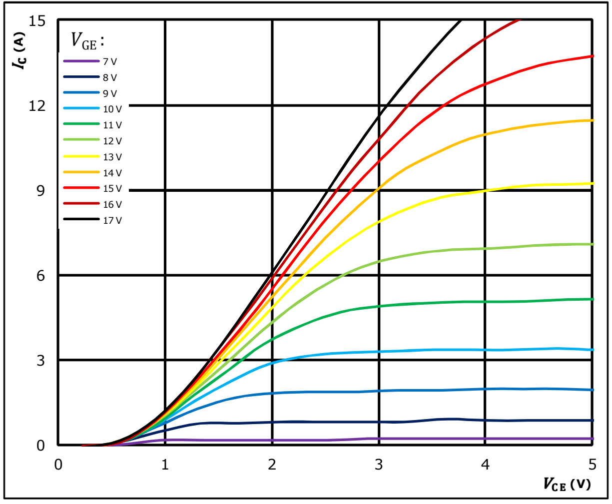
125 °C ━━━━━━

150 °C ━ ━ ━ ━

figure 2. **IGBT**

Typical output characteristics

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



t_p = 250 µs

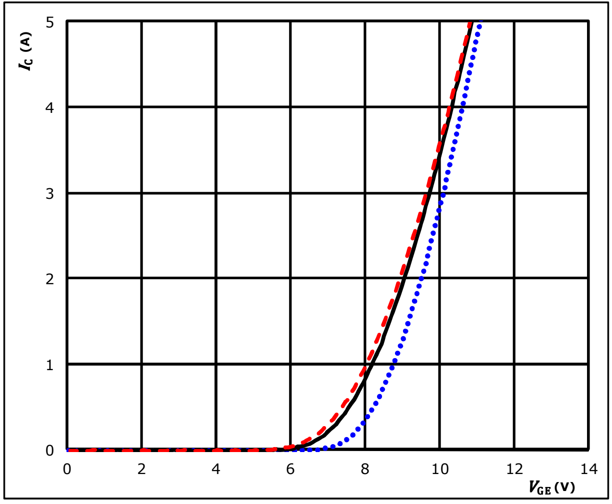
T_j = 150 °C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

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



t_p = 100 µs

V_{CE} = 10 V

T_j: 25 °C ••••••••••••

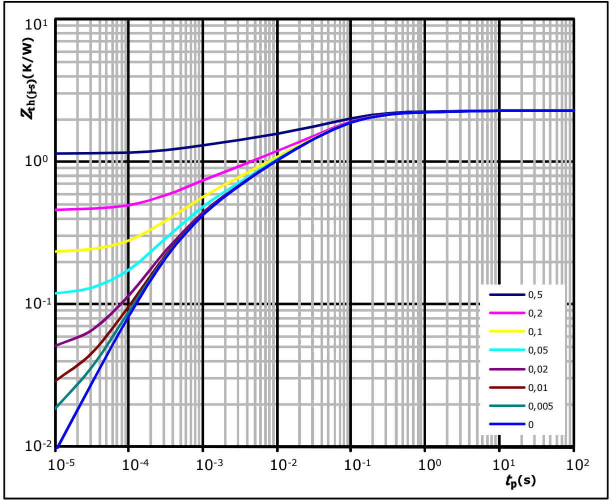
125 °C ━━━━━━

150 °C ━ ━ ━ ━

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 2,30 K/W

IGBT thermal model values

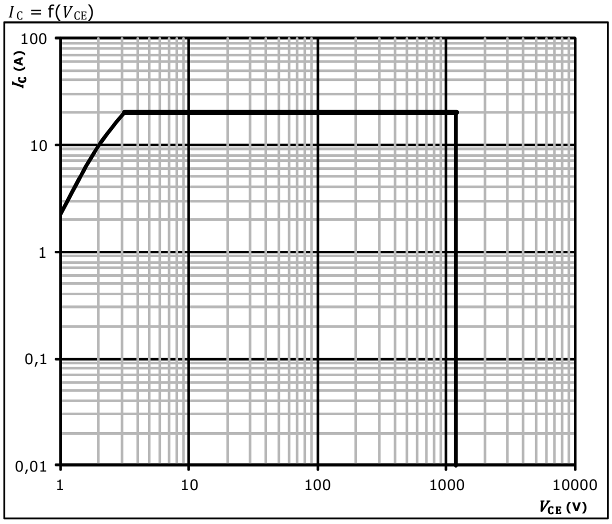
R (K/W)	τ (s)
6,25E-02	3,48E+00
1,37E-01	5,00E-01
7,38E-01	8,11E-02
5,28E-01	2,49E-02
3,84E-01	5,54E-03
2,39E-01	1,24E-03
2,13E-01	3,29E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



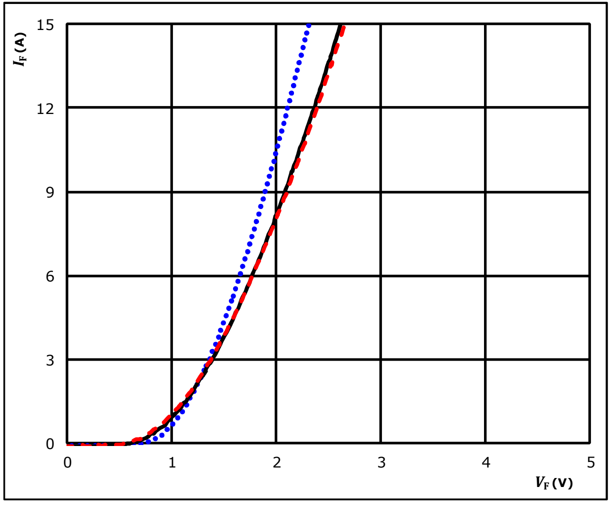
D = single pulse
T_s = 80 ºC
V_{GE} = ±15 V
T_j = T_{jmax}

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

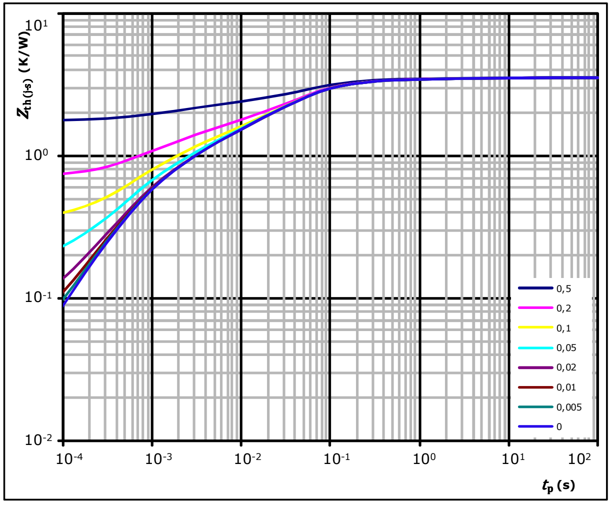
T_j:

25	°C	········
125	°C	━━━
150	°C	- - -

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)} =$ 3,50 K/W

FWD thermal model values

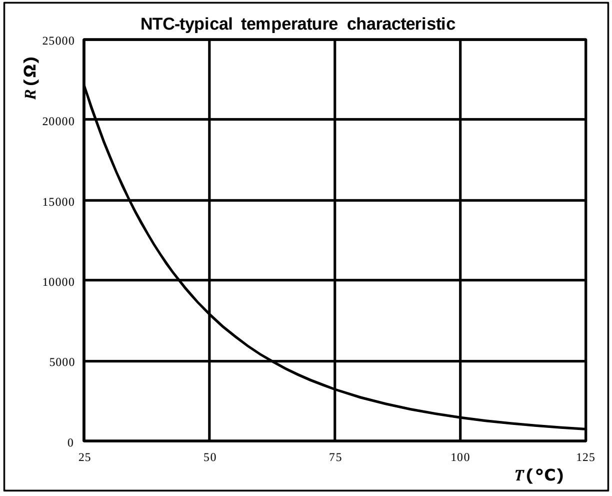
R (K/W)	τ (s)
8,03E-02	7,23E+00
2,34E-01	4,70E-01
1,33E+00	6,36E-02
7,92E-01	2,24E-02
5,71E-01	3,34E-03
4,85E-01	7,05E-04

NTC Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

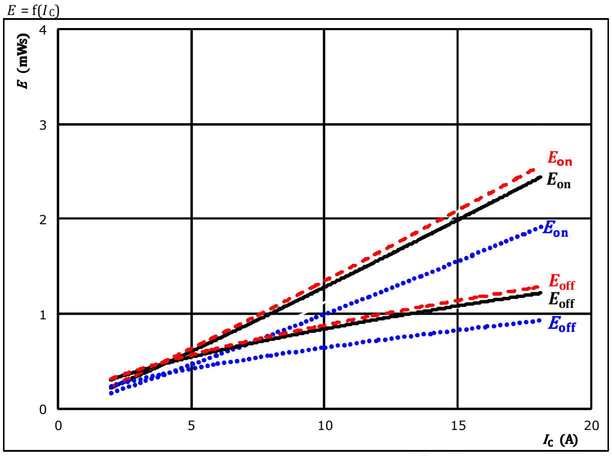


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



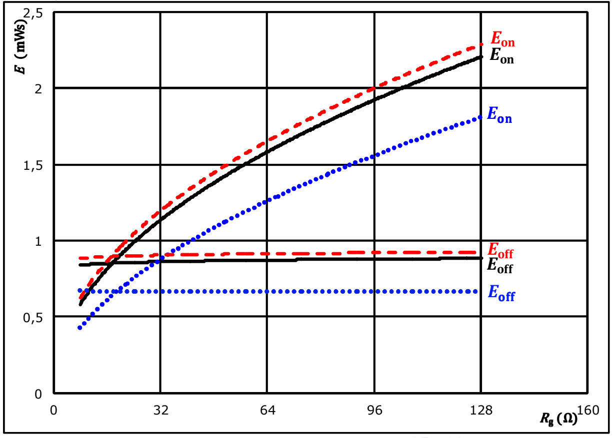
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	••••••••••••
V_{GE} =	±15	V		125 °C	――――
R_{gon} =	32	Ω		150 °C	– – – –
R_{goff} =	32	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



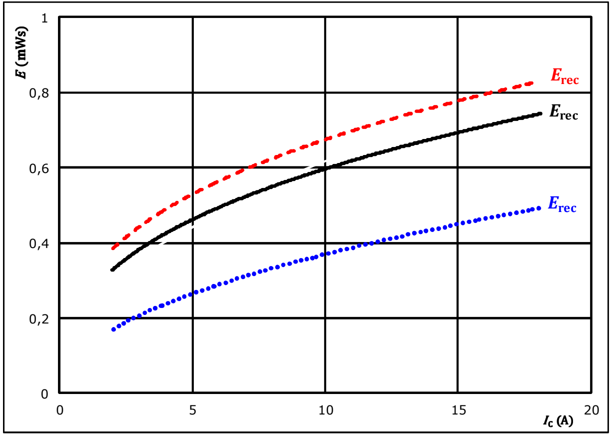
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	••••••••••••
V_{GE} =	±15	V		125 °C	――――
I_C =	10	A		150 °C	– – – –

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



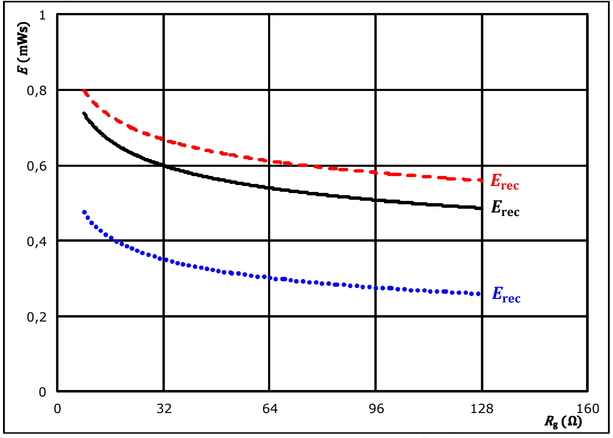
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	••••••••••••
V_{GE} =	±15	V		125 °C	――――
R_{gon} =	32	Ω		150 °C	– – – –

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

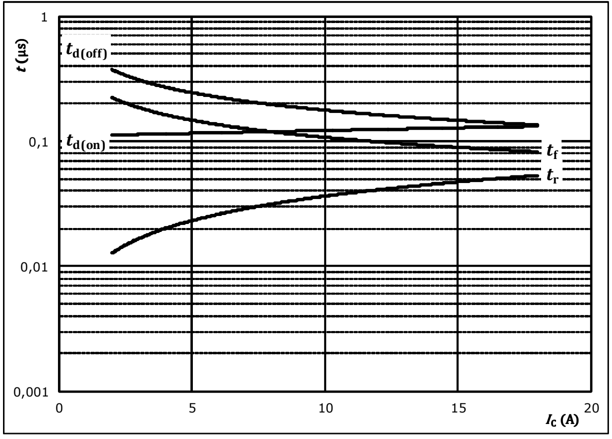
V_{CE} =	600	V	T_j:	25 °C	••••••••••••
V_{GE} =	±15	V		125 °C	――――
I_C =	10	A		150 °C	– – – –

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



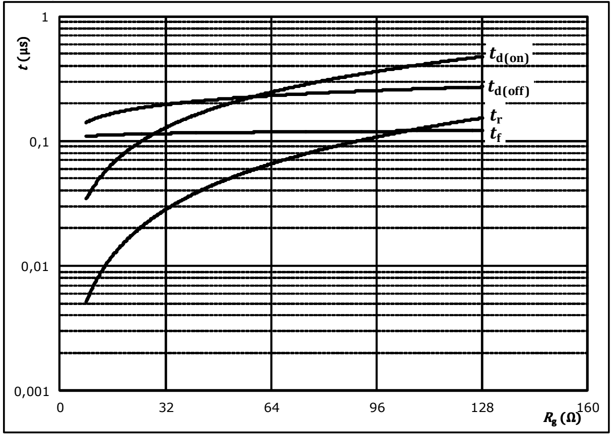
With an inductive load at

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

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



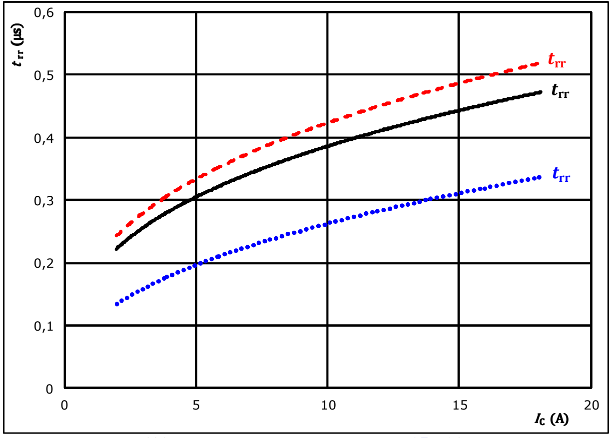
With an inductive load at

$T_j =$ 150 °C
$V_{CE} =$ 600 V
$V_{GE} =$ ±15 V
$I_C =$ 10 A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



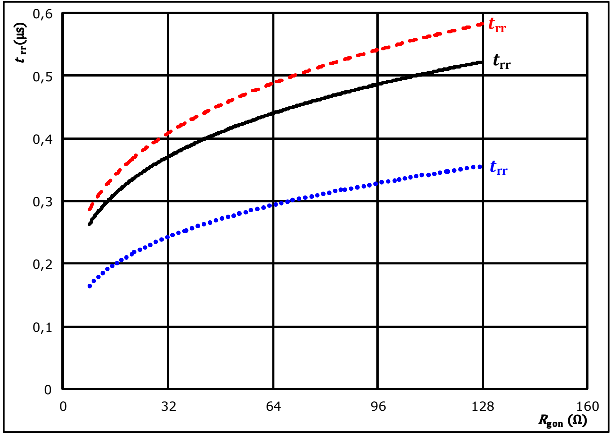
At
$V_{CE} =$ 600 V
$V_{GE} =$ ±15 V
$R_{gon} =$ 32 Ω

T_j:
25 °C ••••••••••••
125 °C ———
150 °C – – – –

figure 8. **FWD**

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

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



At
$V_{CE} =$ 600 V
$V_{GE} =$ ±15 V
$I_C =$ 10 A

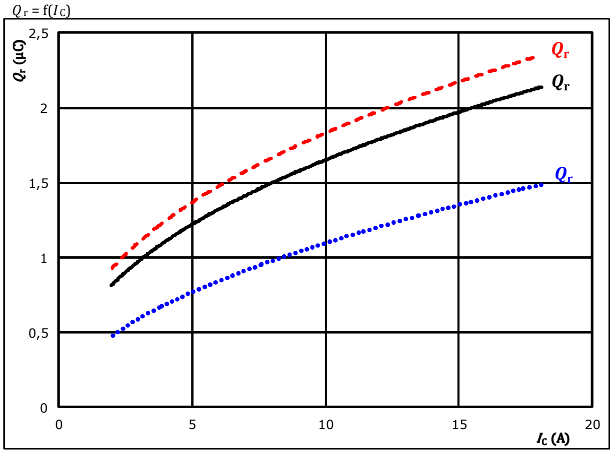
T_j:
25 °C ••••••••••••
125 °C ———
150 °C – – – –

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

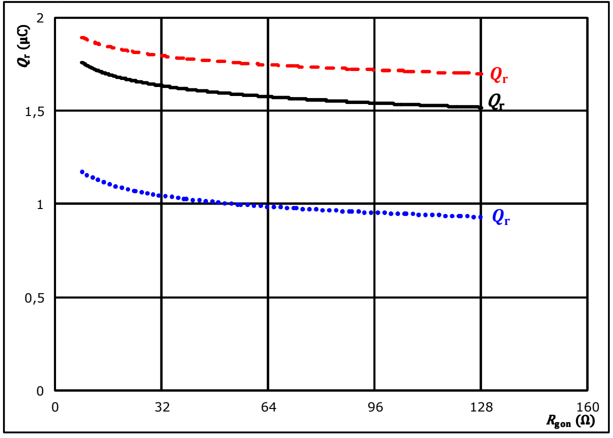


At	V_{CE} =	600	V		25 °C	••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	32	Ω		150 °C	— — —

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

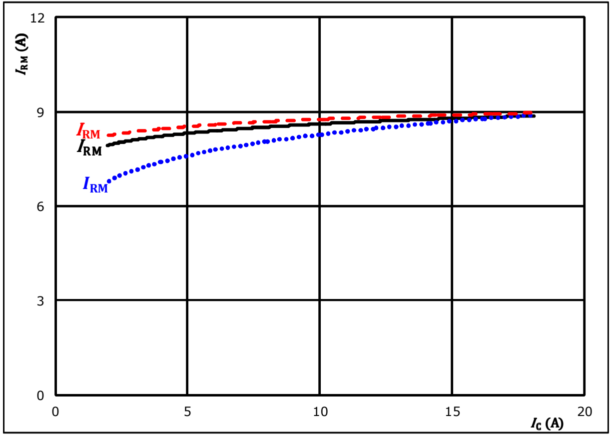


At	V_{CE}=	600	V		25 °C	••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C=	10	A		150 °C	— — —

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

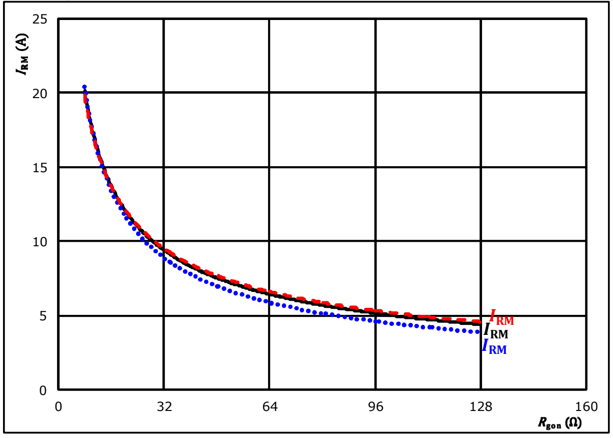


At	V_{CE} :	600	V		25 °C	••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	32	Ω		150 °C	— — —

figure 12. **FWD**

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

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



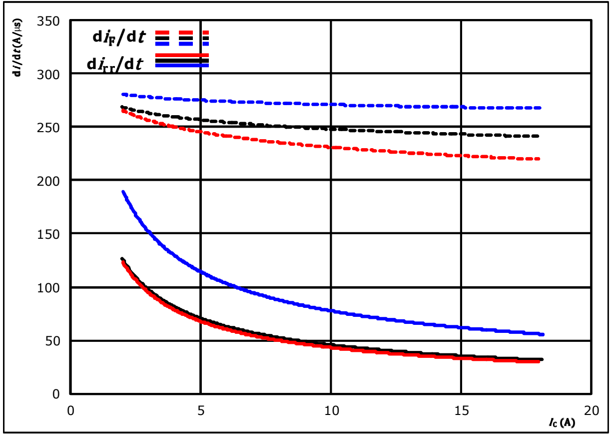
At	V_{CE} =	600	V		25 °C	••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C =	10	A		150 °C	— — —

Inverter Switching Characteristics

figure 13. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt,\ di_{rr}/dt = f(I_C)$

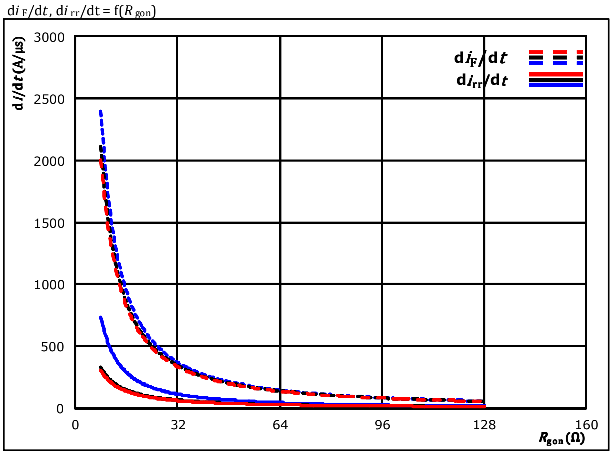


At
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 32 Ω
T_j: 25 °C ••••••••••••••
125 °C ————
150 °C – – – –

figure 14. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$di_F/dt,\ di_{rr}/dt = f(R_{gon})$

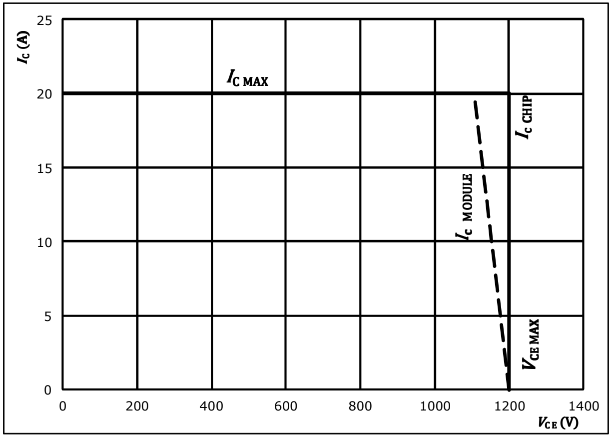


At
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 10 A
T_j: 25 °C ••••••••••••••
125 °C ————
150 °C – – – –

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At
T_j = 175 °C
R_{gon} = 32 Ω
R_{goff} = 32 Ω

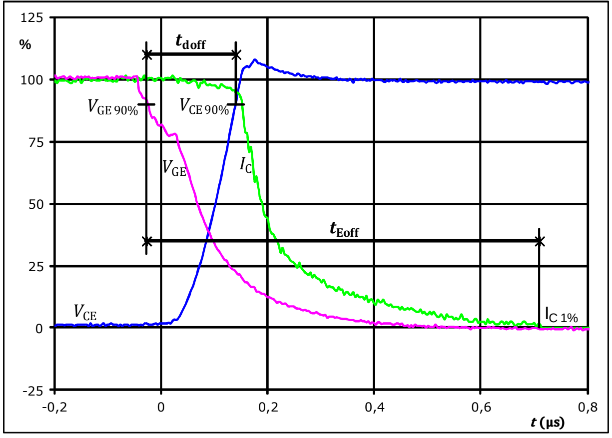
Inverter Switching Definitions

General conditions

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

figure 1. **IGBT**

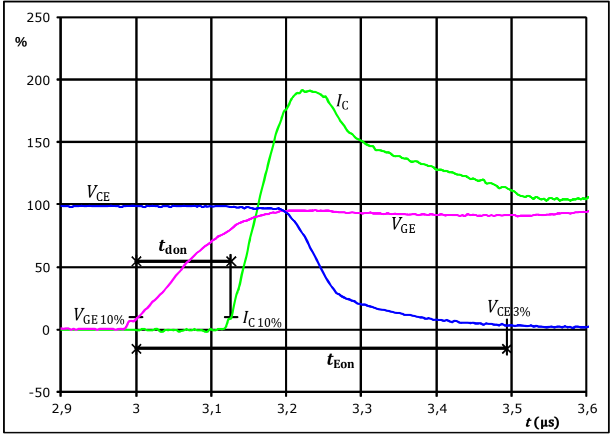
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE}(0%) =	-15	V
V_{GE}(100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	10	A
t_{doff} =	0,179	µs
t_{Eoff} =	0,737	µs

figure 2. **IGBT**

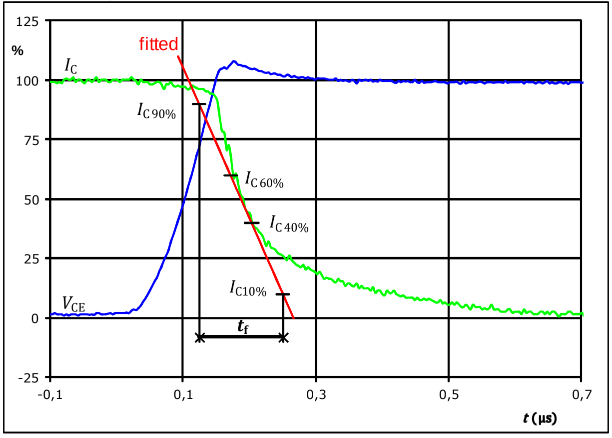
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE}(0%) =	-15	V
V_{GE}(100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	10	A
t_{don} =	0,126	µs
t_{Eon} =	0,493	µs

figure 3. **IGBT**

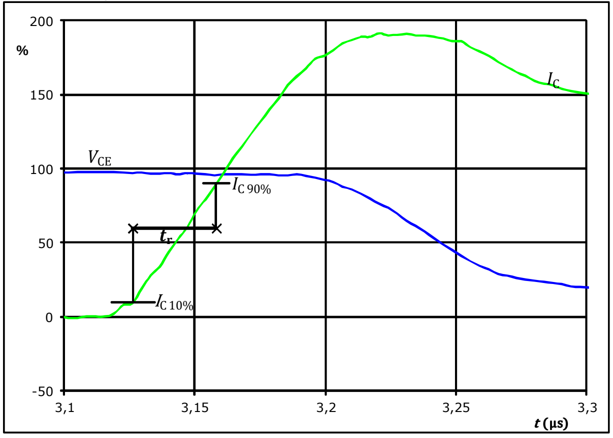
Turn-off Switching Waveforms & definition of t_f



V_C(100%) =	600	V
I_C(100%) =	10	A
t_f =	0,108	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

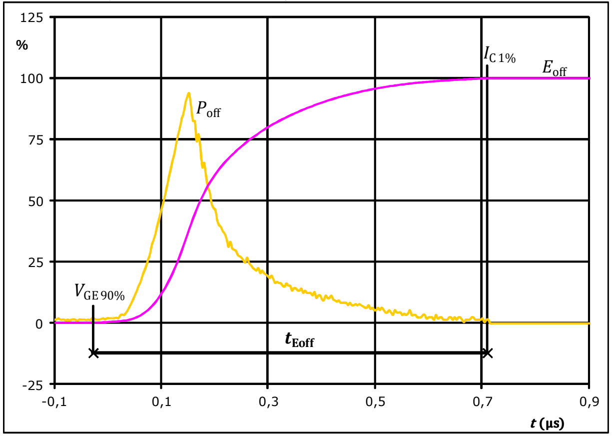


V_C(100%) =	600	V
I_C(100%) =	10	A
t_r =	0,032	µs

Inverter Switching Characteristics

figure 5. **IGBT**

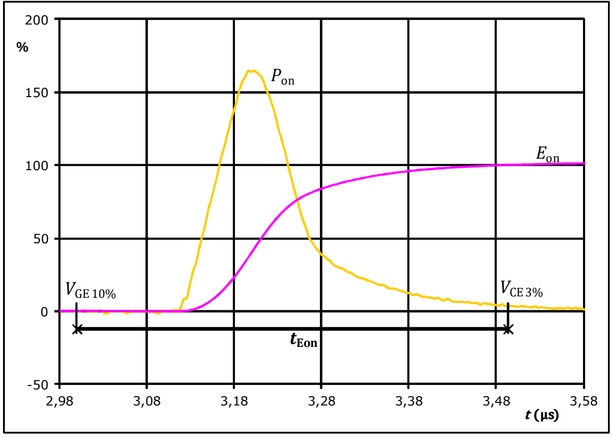
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	6,02	kW
E_{off} (100%) =	0,86	mJ
t_{Eoff} =	0,74	µs

figure 6. **IGBT**

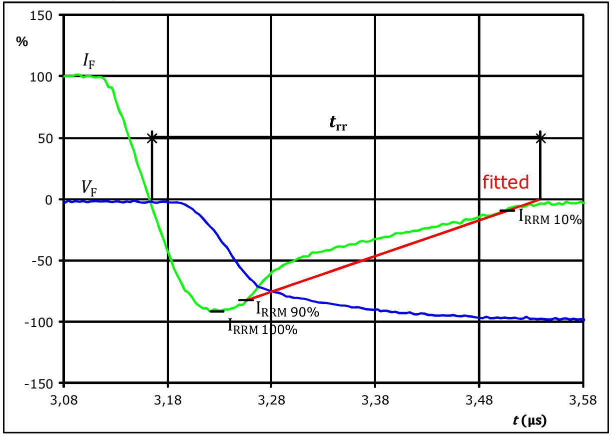
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	6,02	kW
E_{on} (100%) =	1,13	mJ
t_{Eon} =	0,49	µs

figure 7. **FWD**

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

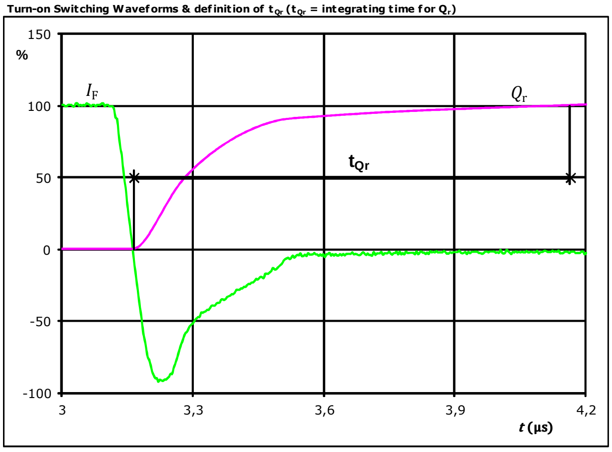


V_F (100%) =	600	V
I_F (100%) =	10	A
I_{RRM} (100%) =	-9	A
t_{rr} =	0,373	µs

Inverter Switching Characteristics

figure 8. **FWD**

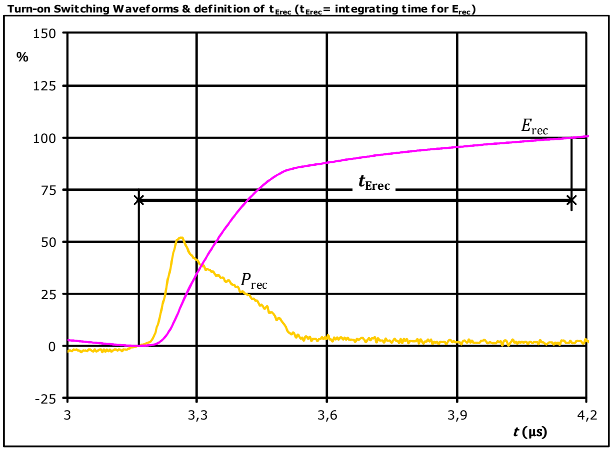
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) = 10 A
Q_r (100%) = 1,66 µC
t_{Qr} = 1,00 µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec}= integrating time for E_{rec})



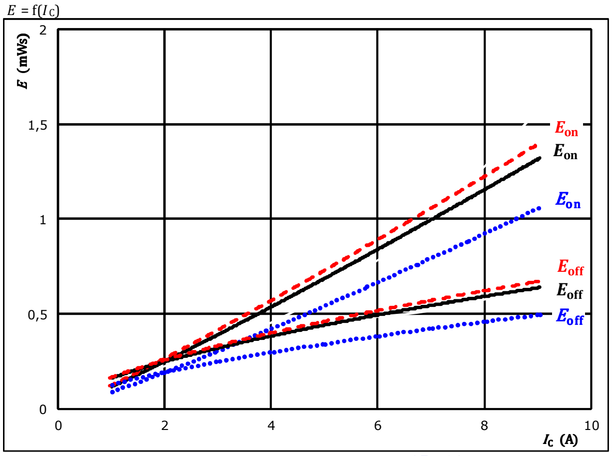
P_{rec} (100%) = 6,02 kW
E_{rec} (100%) = 0,62 mJ
t_{Erec} = 1,00 µs

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

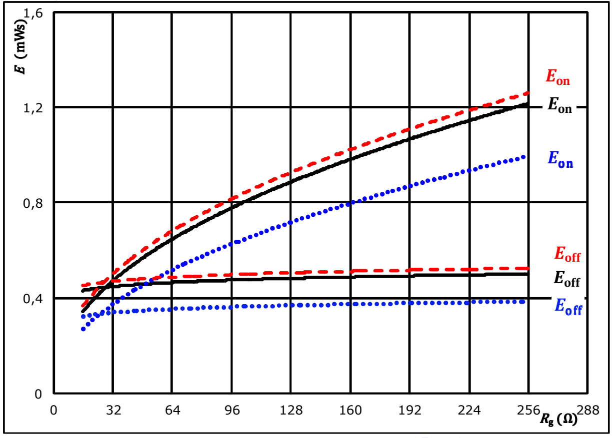
V_{CE} = 600 V
V_{GE} = 15/0 V
R_{gon} = 64 Ω
R_{goff} = 64 Ω

T_j:
25 °C ••••••••••••
125 °C ——
150 °C – – – –

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

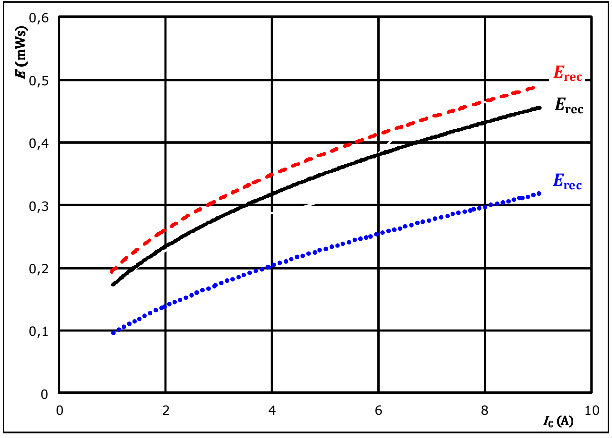
V_{CE} = 600 V
V_{GE} = 15/0 V
I_C = 5 A

T_j:
25 °C ••••••••••••
125 °C ——
150 °C – – – –

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



With an inductive load at

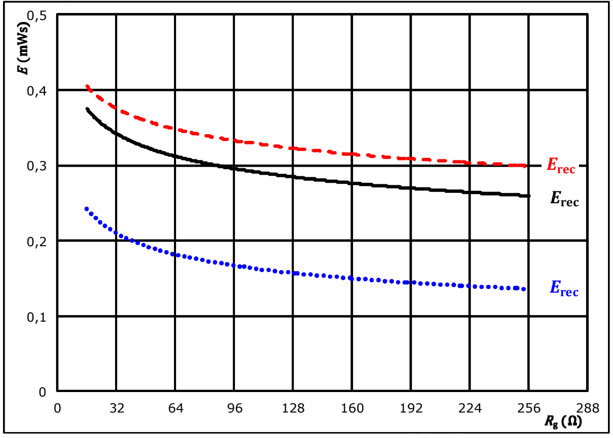
V_{CE} = 600 V
V_{GE} = 15/0 V
R_{gon} = 64 Ω

T_j:
25 °C ••••••••••••
125 °C ——
150 °C – – – –

figure 4. **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} = 15/0 V
I_C = 5 A

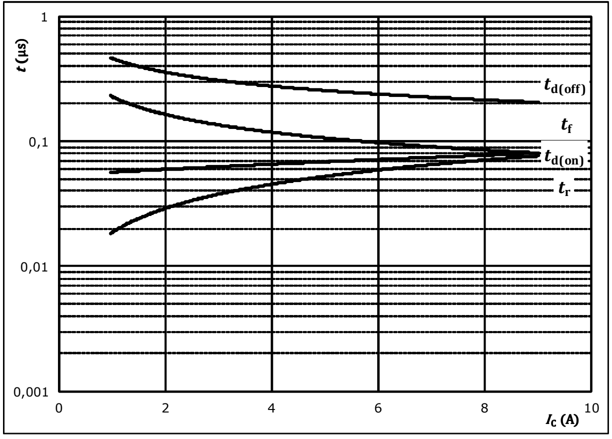
T_j:
25 °C ••••••••••••
125 °C ——
150 °C – – – –

Brake Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



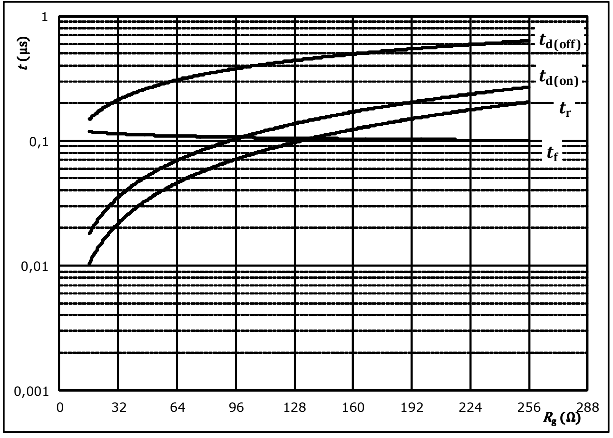
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = 15/0 V
R_{gon} = 64 Ω
R_{goff} = 64 Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



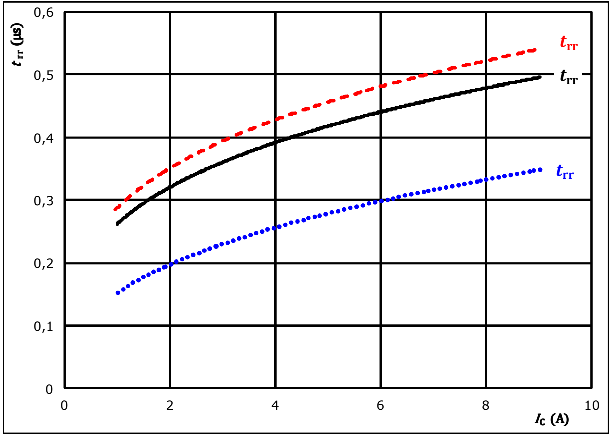
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = 15/0 V
I_C = 5 A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

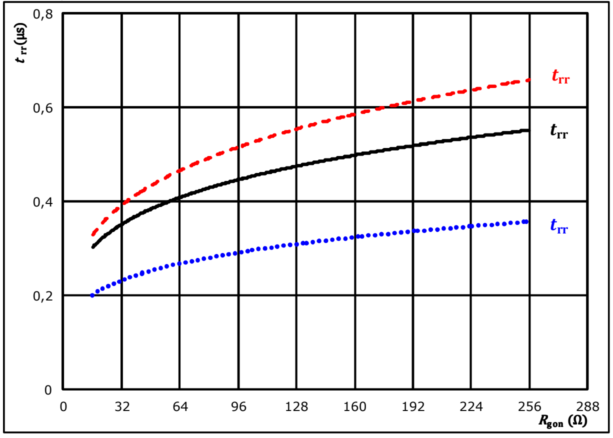
V_{CE}= 600 V
V_{GE} = 15/0 V
R_{gon} = 64 Ω

T_j:
25 °C ••••••••••••
125 °C ———
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} = 600 V
V_{GE} = 15/0 V
I_C = 5 A

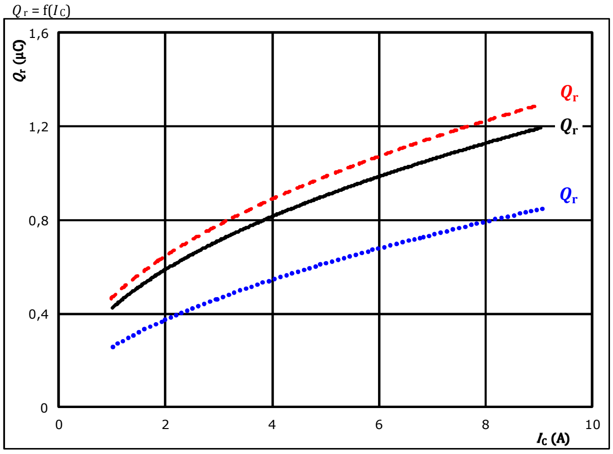
T_j:
25 °C ••••••••••••
125 °C ———
150 °C – – –

Brake Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

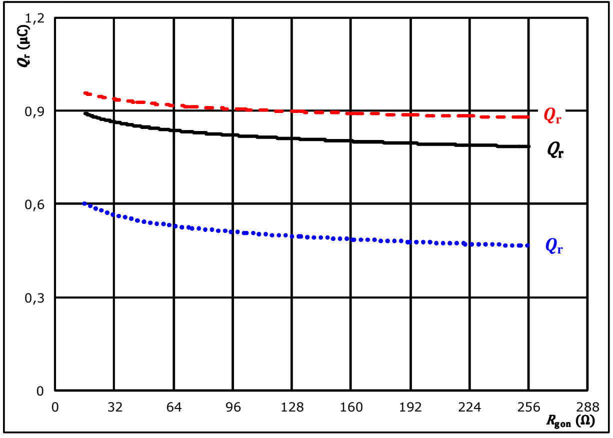


At	V_{CE} =	600	V		25	°C	••••••••••••
	V_{GE} =	15/0	V	T_j:	125	°C	———
	R_{gon} =	64	Ω		150	°C	– – – –

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

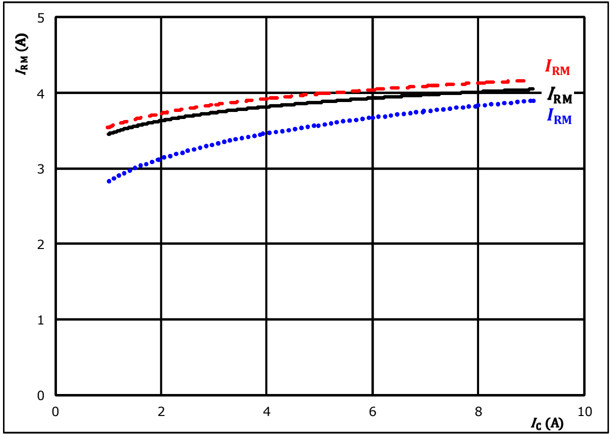


At	V_{CE}=	600	V		25	°C	••••••••••••
	V_{GE} =	15/0	V	T_j:	125	°C	———
	I_C=	5	A		150	°C	– – – –

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

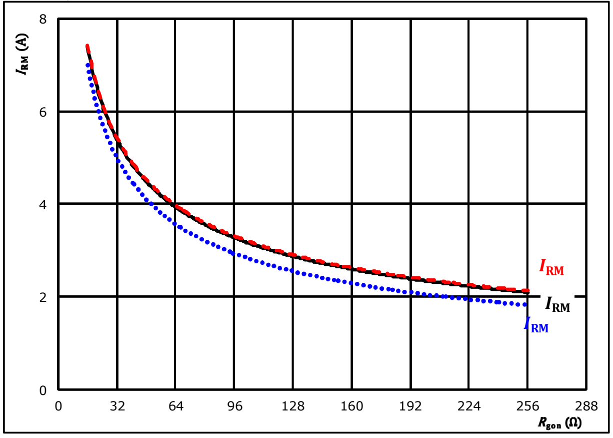


At	V_{CE}:	600	V		25	°C	••••••••••••
	V_{GE} =	15/0	V	T_j:	125	°C	———
	R_{gon} =	64	Ω		150	°C	– – – –

figure 12. **FWD**

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

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



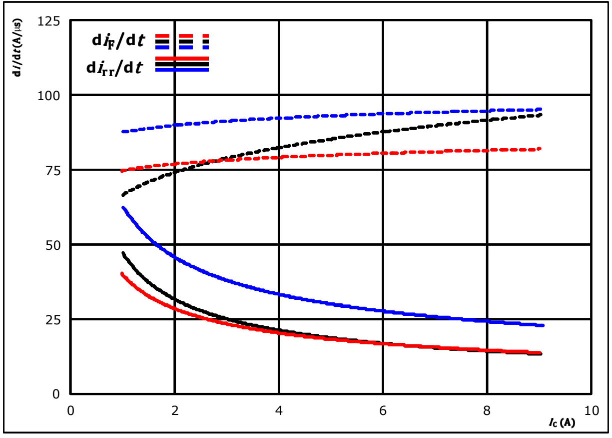
At	V_{CE} =	600	V		25	°C	••••••••••••
	V_{GE} =	15/0	V	T_j:	125	°C	———
	I_C =	5	A		150	°C	– – – –

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

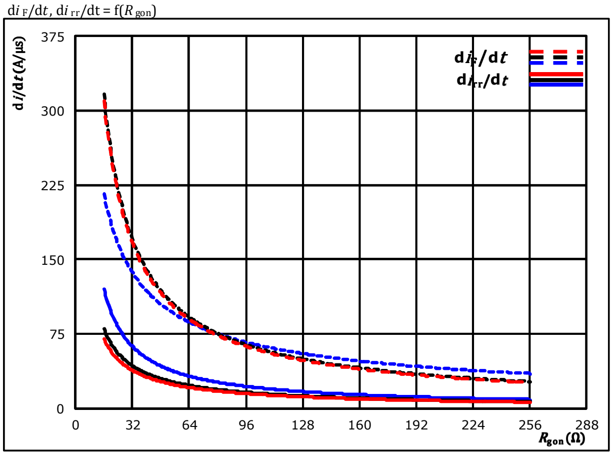
V_{CE} = 600 V
V_{GE} = 15/0 V
R_{gon} = 64 Ω

T_j: 25 °C ••••••••••••••
125 °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, $di_{rr}/dt = f(R_{gon})$



At

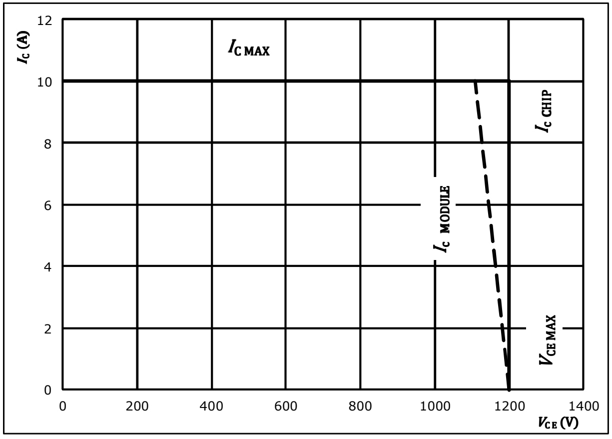
V_{CE} = 600 V
V_{GE} = 15/0 V
I_C= 5 A

T_j: 25 °C ••••••••••••••
125 °C ———
150 °C – – –

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 175 °C
R_{gon} = 64 Ω
R_{goff} = 64 Ω

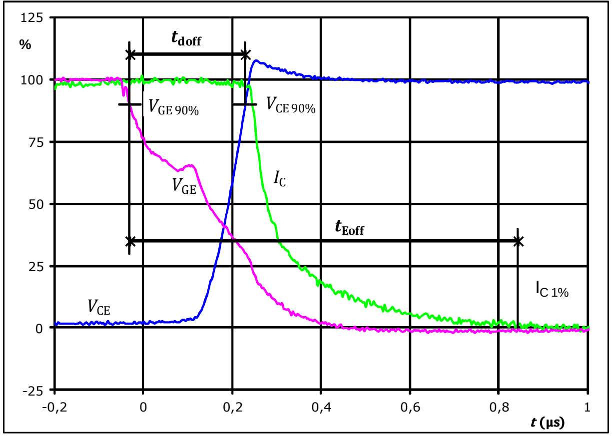
Brake Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	64 Ω
R_{goff}	=	64 Ω

figure 1. **IGBT**

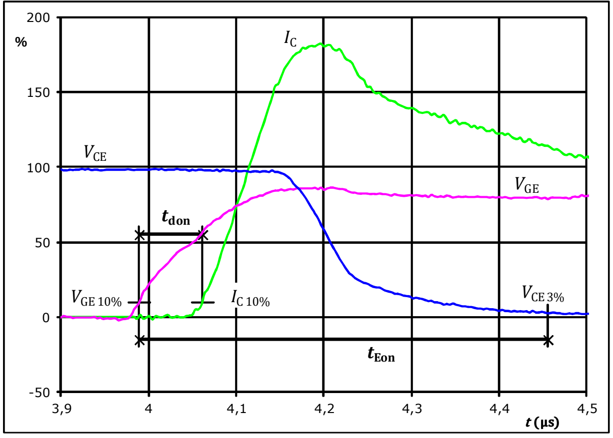
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	5	A
t_{doff} =	0,262	µs
t_{Eoff} =	0,874	µs

figure 2. **IGBT**

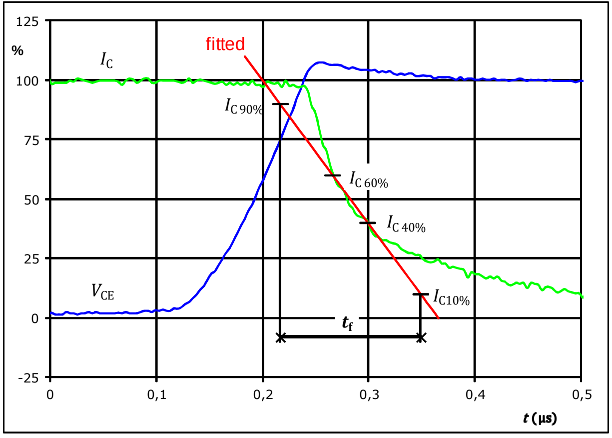
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	5	A
t_{don} =	0,073	µs
t_{Eon} =	0,467	µs

figure 3. **IGBT**

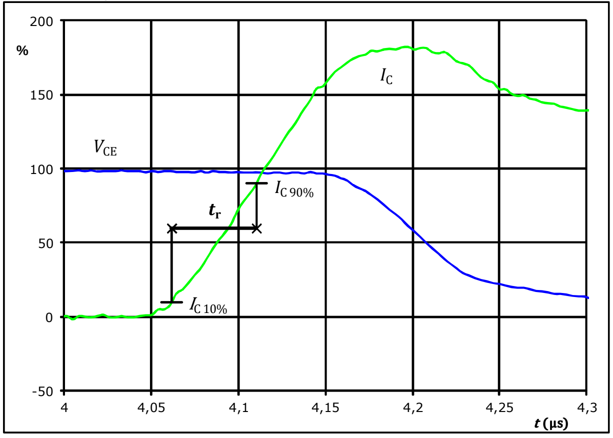
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	5	A
t_f =	0,114	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

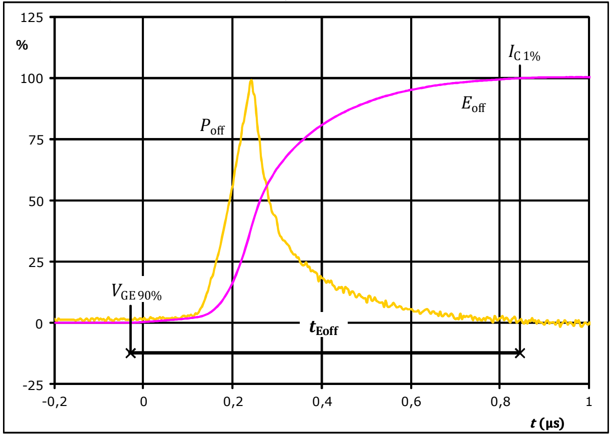


V_C (100%) =	600	V
I_C (100%) =	5	A
t_r =	0,048	µs

Brake Switching Characteristics

figure 5. **IGBT**

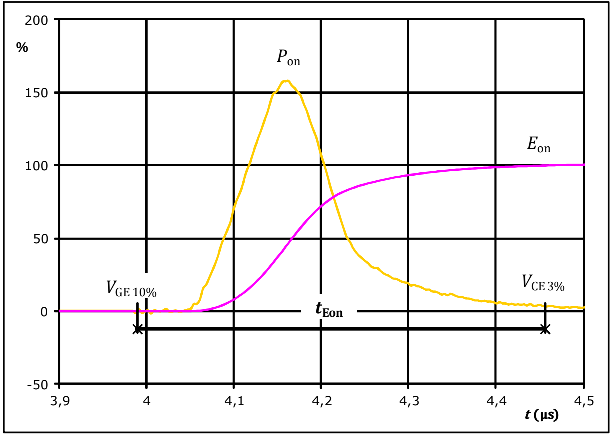
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) = 3,03 kW
E_{off} (100%) = 0,45 mJ
t_{Eoff} = 0,87 µs

figure 6. **IGBT**

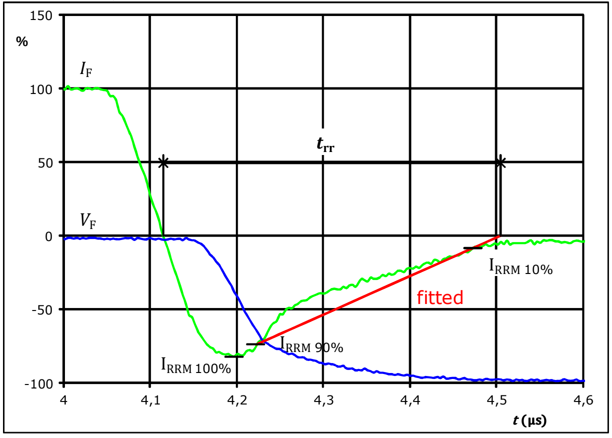
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) = 3,03 kW
E_{on} (100%) = 0,61 mJ
t_{Eon} = 0,47 µs

figure 7. **FWD**

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

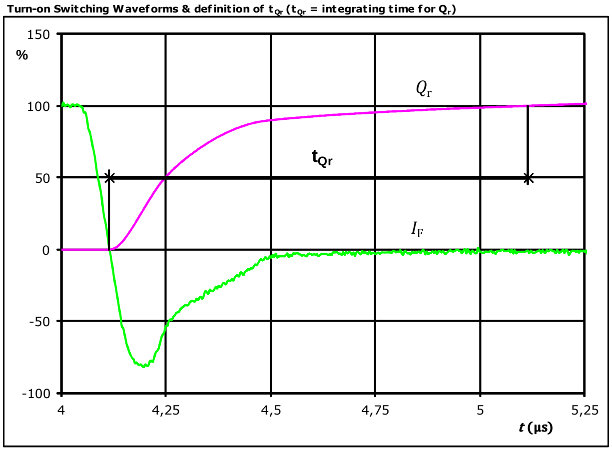


V_F (100%) = 600 V
I_F (100%) = 5 A
I_{RRM} (100%) = -4 A
t_{rr} = 0,386 µs

Brake Switching Characteristics

figure 8. **FWD**

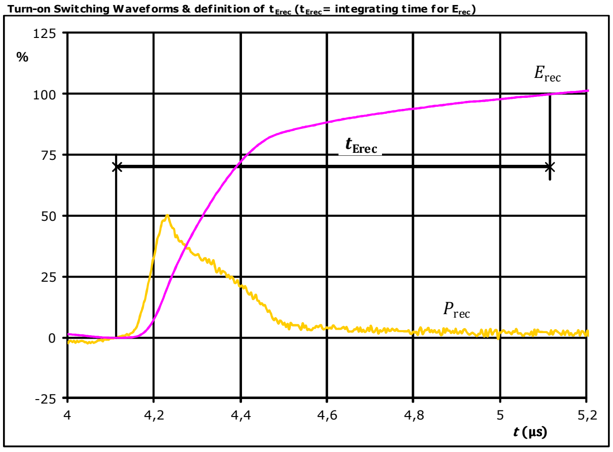
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	5	A
Q_r (100%) =	0,83	µC
t_{Qr} =	1,00	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	3,03	kW
E_{rec} (100%) =	0,31	mJ
t_{Erec} =	1,00	µs

Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing with solder pins	10-FZ12PMA010M7-P849A28
without thermal paste 17 mm housing with solder pins	10-F012PMA010M7-P849A29
without thermal paste 12 mm housing with Press-fit pins	10-PZ12PMA010M7-P849A28Y
without thermal paste 17 mm housing with Press-fit pins	10-P012PMA010M7-P849A29Y

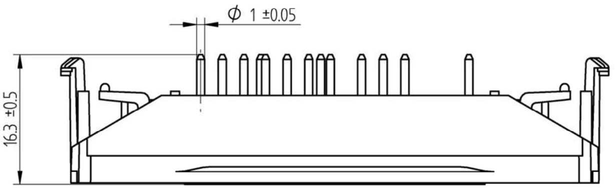
<table>
<tr><td rowspan="4"></td><td rowspan="2">Text</td><td colspan="2">Name</td><td>Date code</td><td>UL & VIN</td><td>Lot</td><td>Serial</td></tr>
<tr><td colspan="2">NN-NNNNNNNNNNNNNN-TTTTTTVV</td><td>WWYY</td><td>UL VIN</td><td>LLLLL</td><td>SSSS</td></tr>
<tr><td rowspan="2">Datamatrix</td><td>Type&Ver</td><td>Lot number</td><td>Serial</td><td>Date code</td><td></td><td></td></tr>
<tr><td>TTTTTTVV</td><td>LLLLL</td><td>SSSS</td><td>WWYY</td><td></td><td></td></tr>
</table>

Outline

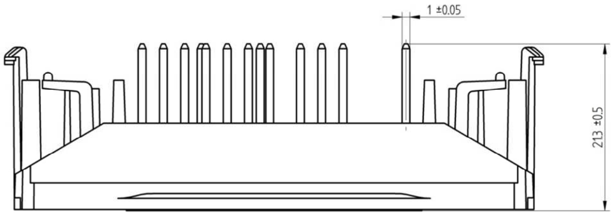
Pin table

Pin	X	Y	Function
1	25,5	2,7	Therm1
2	25,5	0	Therm2
3	22,8	0	DC-Rect
4	20,1	0	G27
5	16,2	0	DC-Br
6	13,5	0	G15
7	10,8	0	DC-3
8	8,1	0	G13
9	5,4	0	DC-2
10	2,7	0	G11
11	0	0	DC-1
12	0	19,8	G12
13	0	22,5	Ph1
14	7,5	19,8	G14
15	7,5	22,5	Ph2
16	15	19,8	G16
17	15	22,5	Ph3
18	22,8	22,5	DC+Inv
19	25,5	22,5	DC+Rect
20	33,5	22,5	Br
21	33,5	15	ACIn1
22	33,5	7,5	ACIn2
23	33,5	0	ACIn3

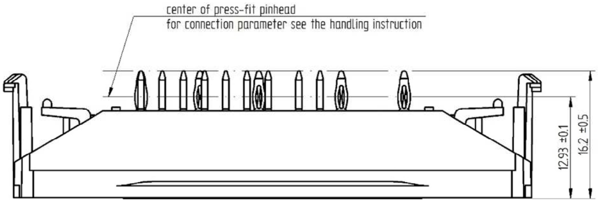
P849A28



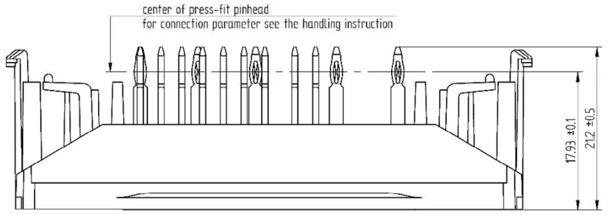
P849A29

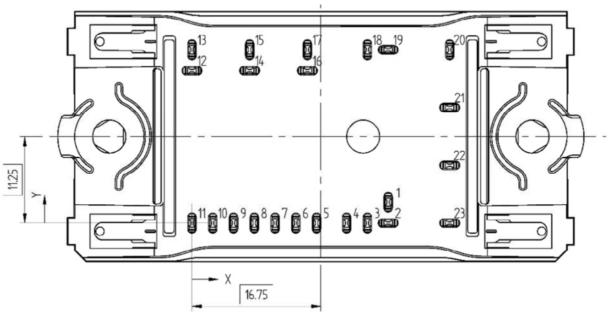


P849A28Y



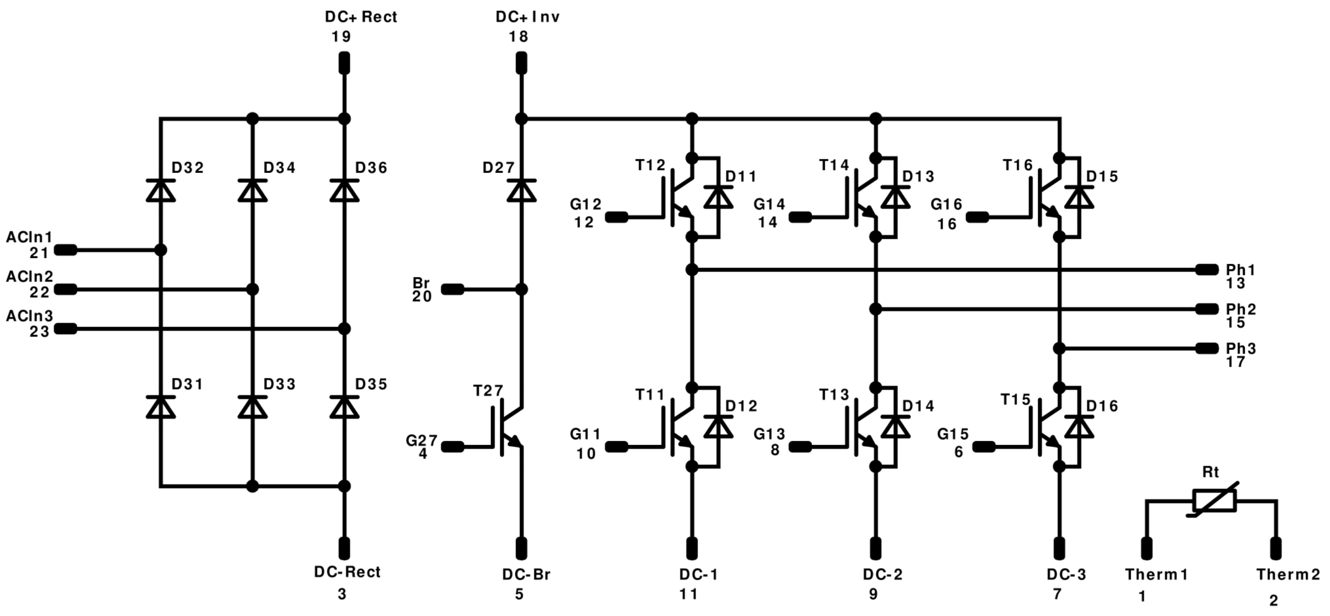
P849A29Y





Tolerance of pinpositions ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	25 A	Rectifier Diode	
T11, T12, T13, T14, T15, T16	IGBT	1200 V	10 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	10 A	Inverter Diode	
T27	IGBT	1200 V	5 A	Brake Switch	
D27	FWD	1200 V	5 A	Brake Diode	
Rt	NTC			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 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-xx12PMA010M7-P849A2xx-D2-14	14 Nov. 2018	Added Press-fit options	1,3,30

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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.