Vincotech

10-FY12PMA035M7-P589A78
10-PY12PMA035M7-P589A78Y
10-F112PMA035M7-P589A79
datasheet

flow **PIM 1** — **1200 V / 35 A**

Features

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

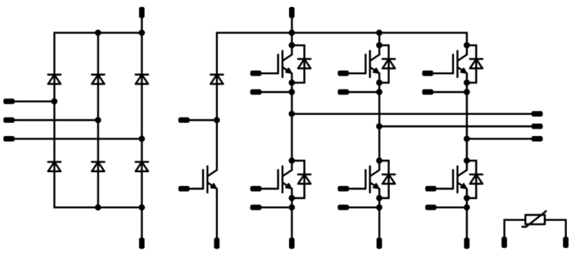
flow 1 housing

12 mm housing solder pins | 12 mm housing press-fit pins | 17 mm housing solder pins

Target applications

- Industrial Drives

Schematic



Types

- 10-FY12PMA035M7-P589A78
- 10-PY12PMA035M7-P589A78Y
- 10-F112PMA035M7-P589A79

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			45	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	350	A
Surge current capability	I^2t			610	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	65	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		35	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	107	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		35	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	75	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		25	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	50	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	82	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		15	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	45	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		12 mm housing with solder pins / press-fit pins		7,91 / 7,96	mm
		17 mm housing with solder pins		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				45	25 125 150		1,15 1,12 1,15	1,6	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)						1,08		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	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0035	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125 150		1,48 1,64 1,68	1,75	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			0,08	mA
Gate-emitter leakage current	I_{GES}		20	0		25			0,5	μA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}		0	10		25		8000		pF
Output capacitance	C_{oes}							280		
Reverse transfer capacitance	C_{res}							95		
Gate charge	Q_g		15	600	35	25		300		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,89		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	600	35	25 125 150		124 122 121		ns
Rise time	t_r					25 125 150		14 17 18		
Turn-off delay time	$t_{d(off)}$					25 125 150		179 203 208		
Fall time	t_f					25 125 150		95 118 119		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 4,3 μC Q_{rFWD} = 6,2 μC Q_{rFWD} = 6,9 μC				25 125 150		1,45 1,92 2,09		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		2,40 3,17 3,42		

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				35	25 125 150		1,66 1,76 1,75	2,1	V
Reverse leakage current	I_R			1200		25			40	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,27		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2681 A/µs di/dt = 2670 A/µs di/dt = 2690 A/µs	±15	600	35	25 125 150		77 76 77		A
Reverse recovery time	t_{rr}					25 125 150		157 284 311		ns
Recovered charge	Q_r					25 125 150		4,34 6,18 6,90		µC
Reverse recovered energy	E_{rec}					25 125 150		1,96 2,82 3,13		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		2734 2205 2101		A/µs

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0025	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		25	25 125 150		1,65 1,89 1,95	1,95	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			70	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		4800		pF
Output capacitance	C_{oes}							170		
Reverse transfer capacitance	C_{res}							57		
Gate charge	Q_g		15	600	25	25		180		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,16		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 16 Ω R_{gon} = 16 Ω	15/0	700	25	25 125 150		71 67 65		ns
Rise time	t_r					25 125 150		48 50 51		
Turn-off delay time	$t_{d(off)}$					25 125 150		262 290 296		
Fall time	t_f					25 125 150		101 117 119		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,9 µC Q_{rFWD} = 2,9 µC Q_{rFWD} = 3,2 µC				25 125 150		2,60 3,11 3,24		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		2,03 2,65 2,81		

Characteristic Values

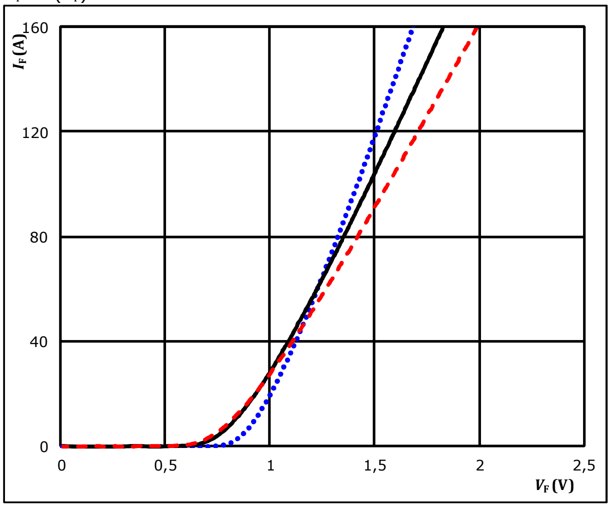
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Brake Diode										
Static										
Forward voltage	V_F				15	25 125 150		1,63 1,74 1,73	2,1	V
Reverse leakage current	I_R			1200		25			30	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,11		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 394 A/µs di/dt = 319 A/µs di/dt = 403 A/µs	15/0	700	25	25 125 150		14 15 15		A
Reverse recovery time	t_{rr}					25 125 150		264 375 413		ns
Recovered charge	Q_r					25 125 150		1,92 2,90 3,15		µC
Reverse recovered energy	E_{rec}					25 125 150		0,78 1,28 1,41		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		111 85 72		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. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



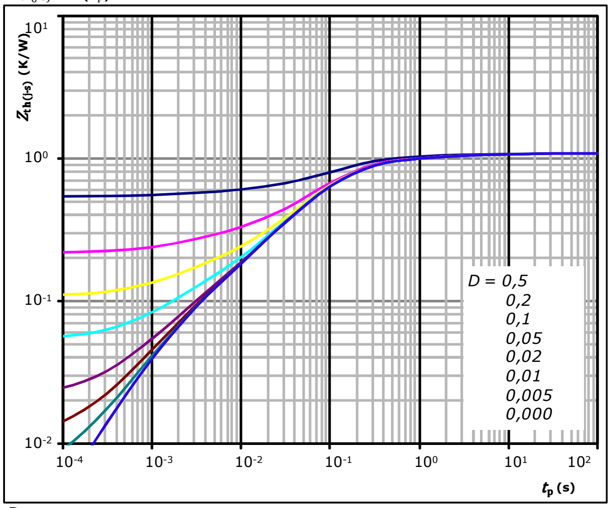
t_p = 250 µs

T_j: 25 °C; 125 °C; 150 °C

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,08 K/W

Diode thermal model values

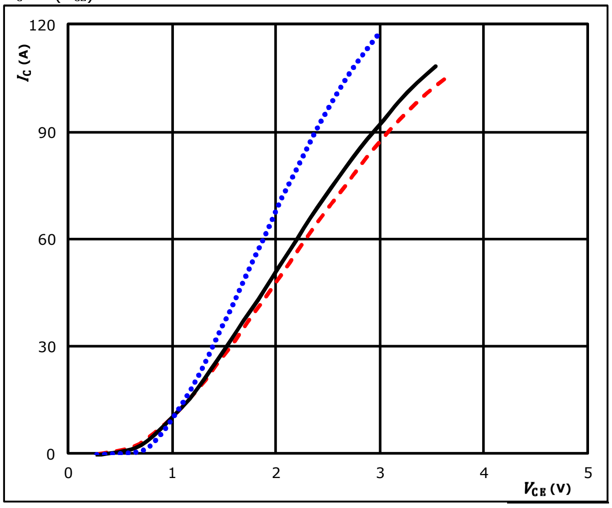
R (K/W)	τ (s)
4,60E-02	9,93E+00
1,23E-01	1,00E+00
4,58E-01	1,51E-01
3,31E-01	5,61E-02
7,76E-02	9,34E-03
4,64E-02	1,55E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

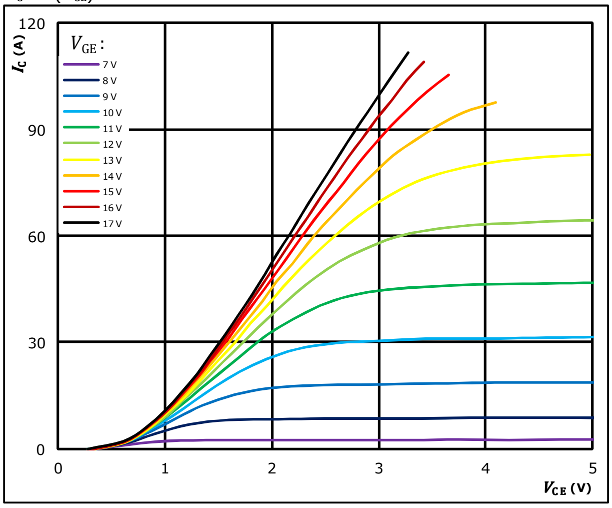


t_p =	250	μs		25 °C	dotted
V_{GE} =	15	V	T_j:	125 °C	solid
				150 °C	dashed

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

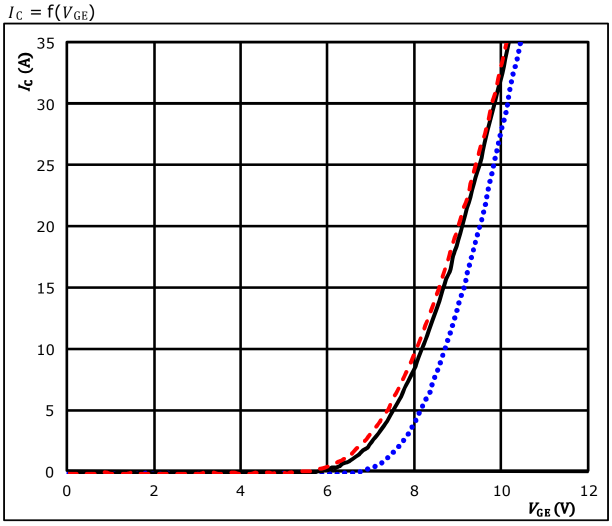


t_p = 250 μs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

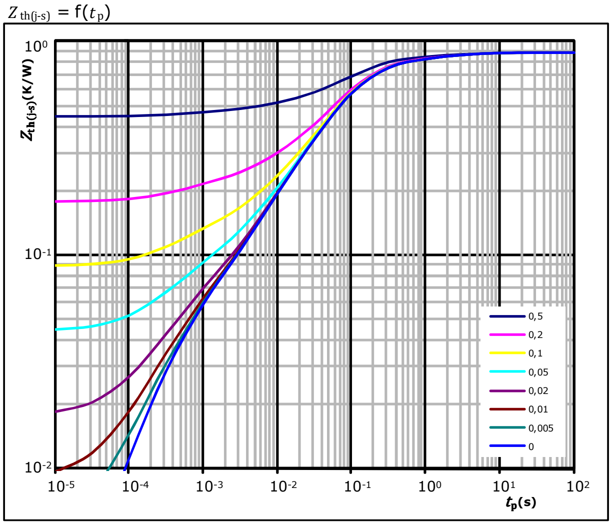


t_p =	100	μs		25 °C	dotted
V_{CE} =	10	V	T_j:	125 °C	solid
				150 °C	dashed

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j-s)}$ = 0,89 K/W

IGBT thermal model values

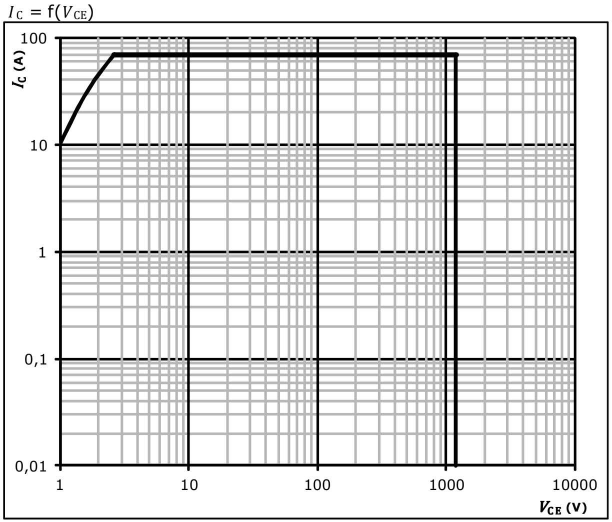
R (K/W)	τ (s)
4,56E-02	3,89E+00
8,84E-02	7,65E-01
3,30E-01	1,35E-01
2,86E-01	4,71E-02
8,94E-02	7,49E-03
3,24E-02	8,15E-04
1,67E-02	2,52E-04

Inverter Switch Characteristics

figure 5.	IGBT

Safe operating area

$I_C = f(V_{CE})$



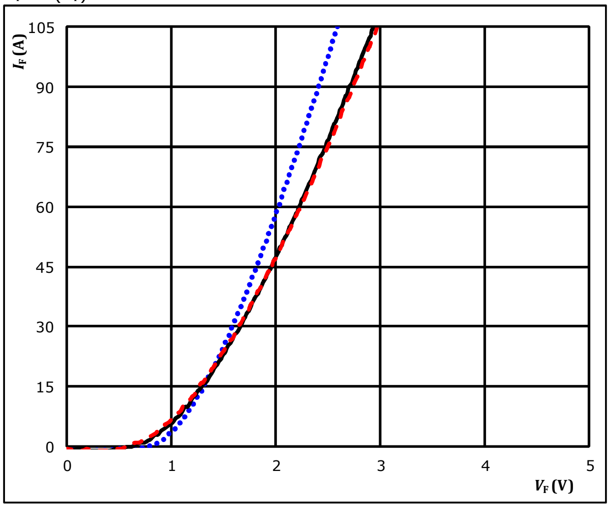
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



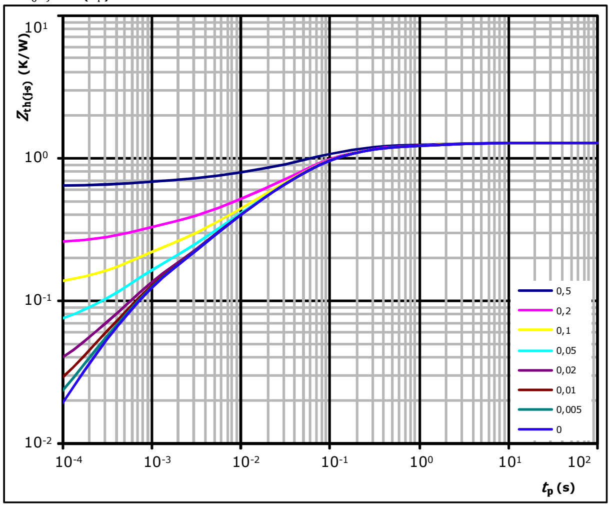
t_p = 250 µs

T_j: 25 °C; 125 °C; 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,27 K/W

FWD thermal model values

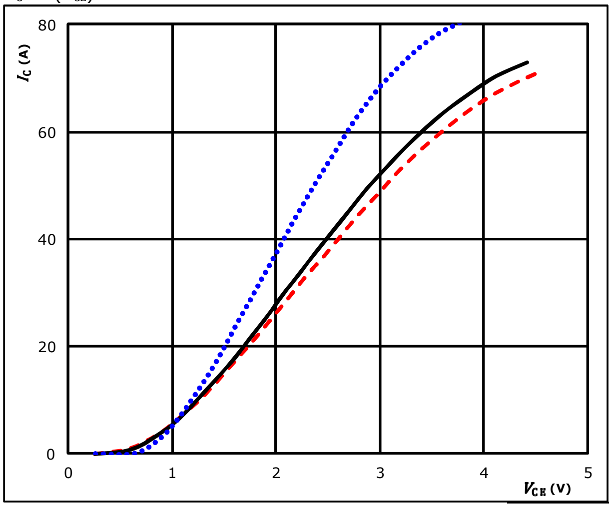
R (K/W)	τ (s)
5,82E-02	3,40E+00
1,11E-01	5,24E-01
4,63E-01	9,20E-02
3,72E-01	2,94E-02
1,72E-01	5,46E-03
9,36E-02	6,17E-04

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

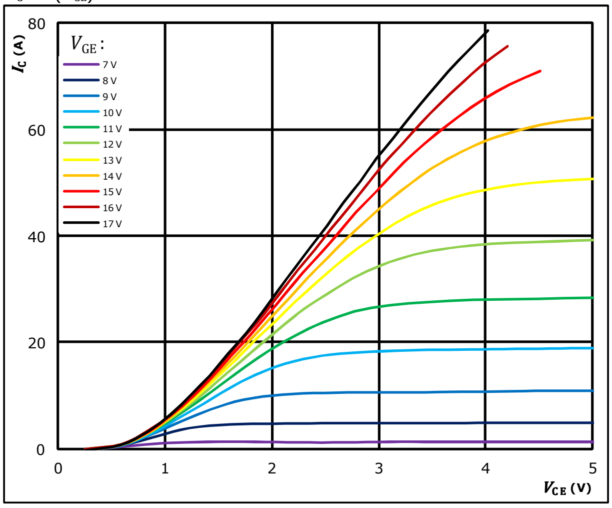


t_p =	250	µs		25	°C
V_{GE} =	15	V	T_j:	125	°C
				150	°C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

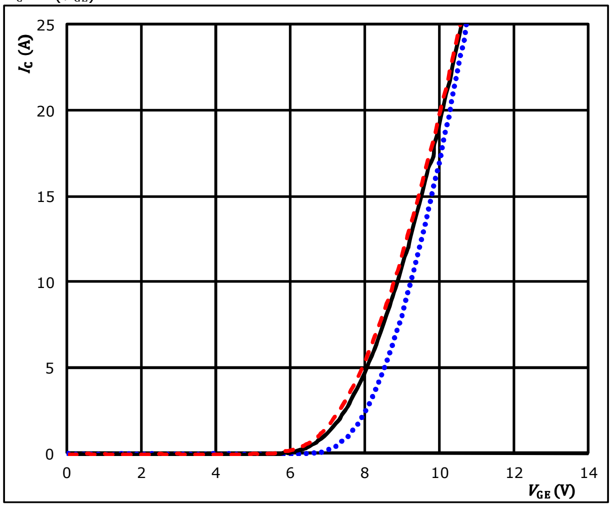


t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

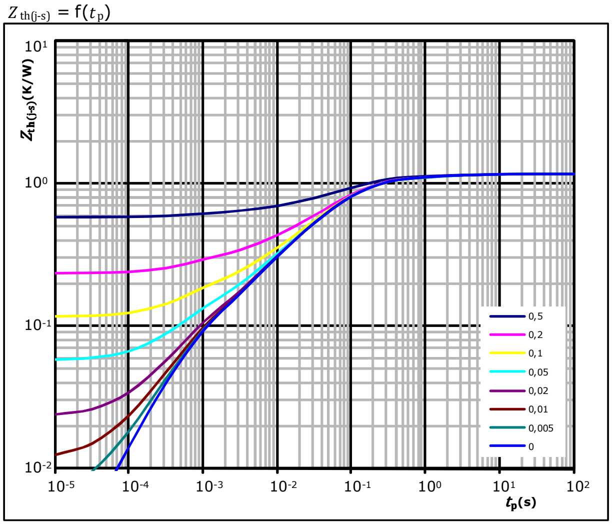


t_p =	100	µs		25	°C
V_{CE} =	10	V	T_j:	125	°C
				150	°C

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	1,16	K/W

IGBT thermal model values

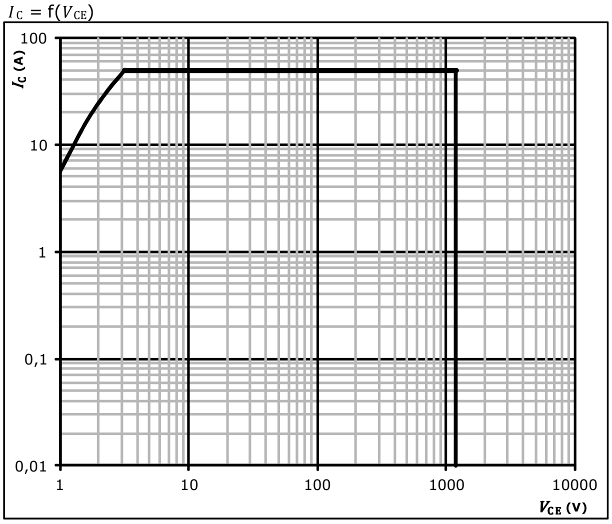
R (K/W)	τ (s)
5,33E-02	3,54E+00
1,07E-01	5,75E-01
5,05E-01	1,04E-01
2,68E-01	3,30E-02
1,51E-01	7,35E-03
7,80E-02	6,52E-04

Brake Switch Characteristics

figure 6.	IGBT

Safe operating area

$I_C = f(V_{CE})$



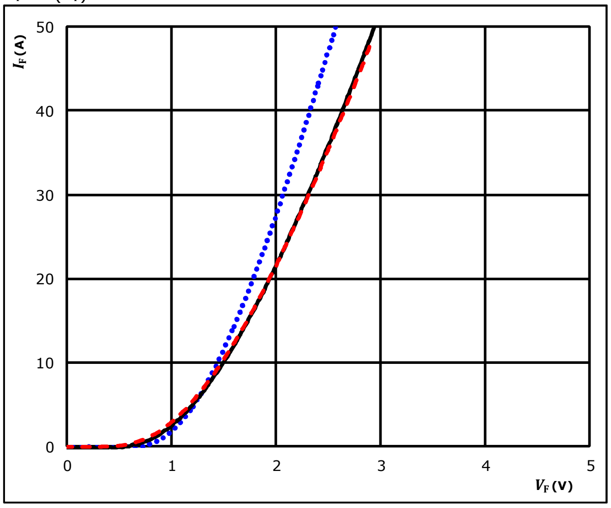
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



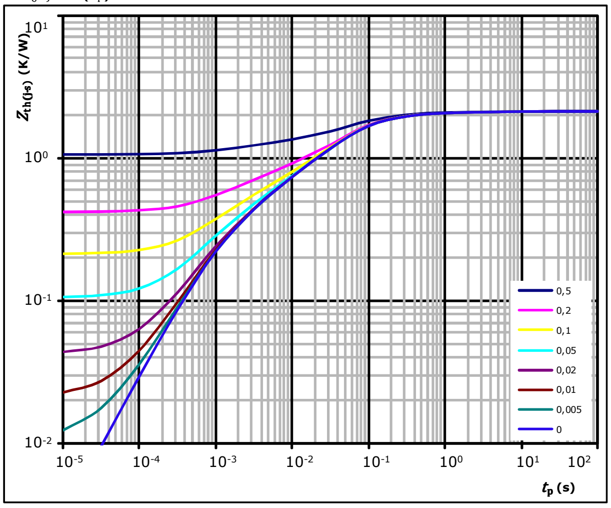
t_p = 250 μs

T_j: 25 °C, 125 °C, 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 2,11 K/W

FWD thermal model values

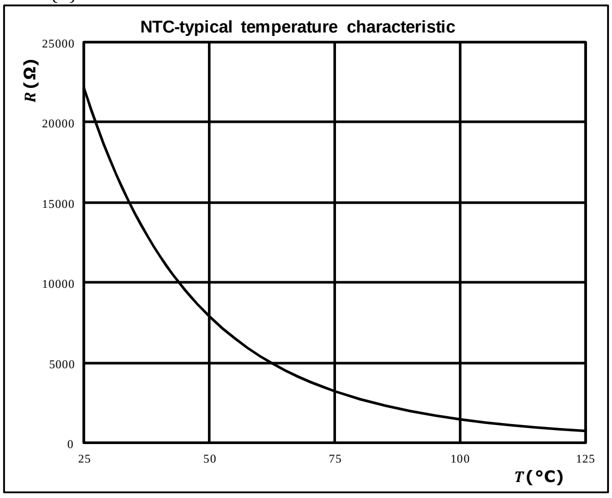
R (K/W)	τ (s)
8,99E-02	2,33E+00
4,04E-01	1,91E-01
1,05E+00	4,49E-02
3,39E-01	6,08E-03
2,29E-01	1,02E-03

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

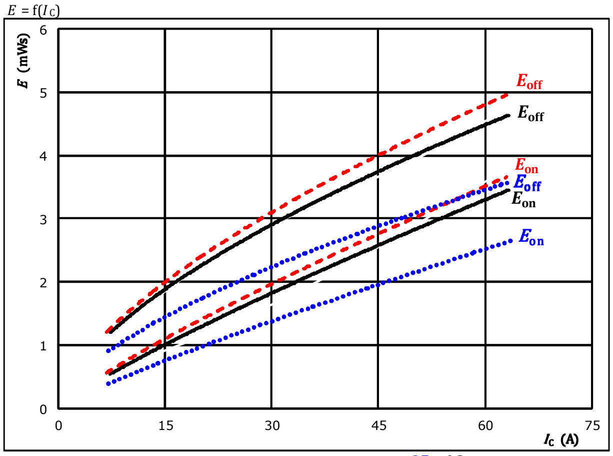


Inverter Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



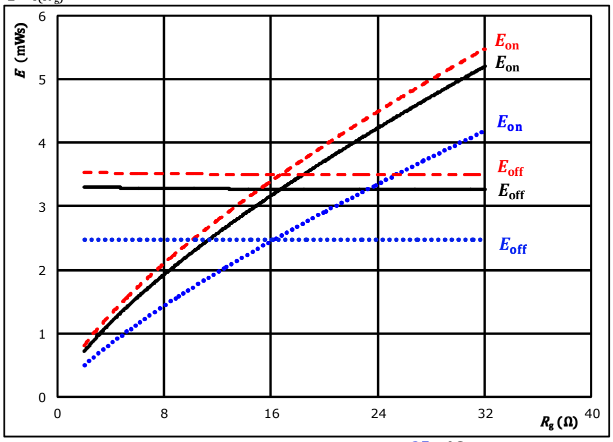
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	8	Ω		150 °C	dashed
R_{goff} =	8	Ω			

figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



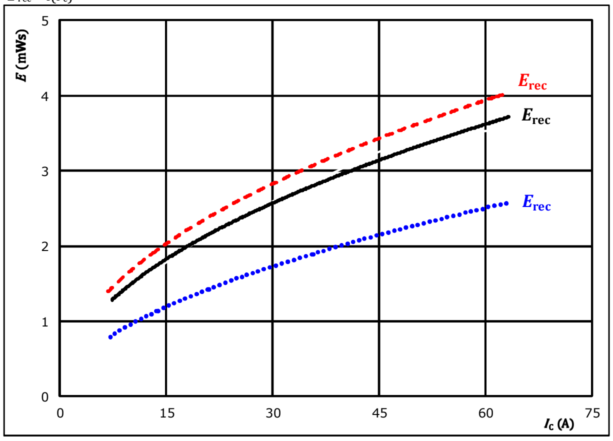
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C =	35	A		150 °C	dashed

figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



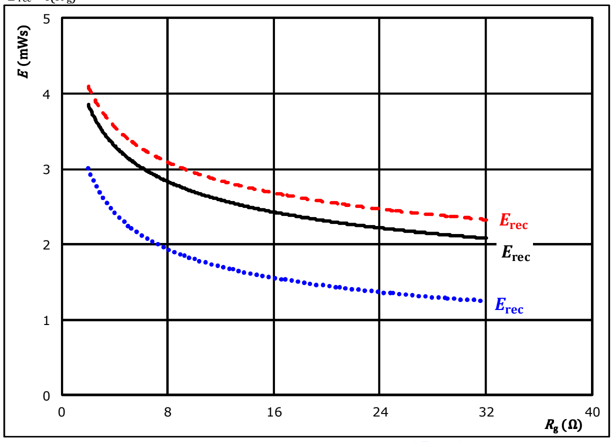
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	8	Ω		150 °C	dashed

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

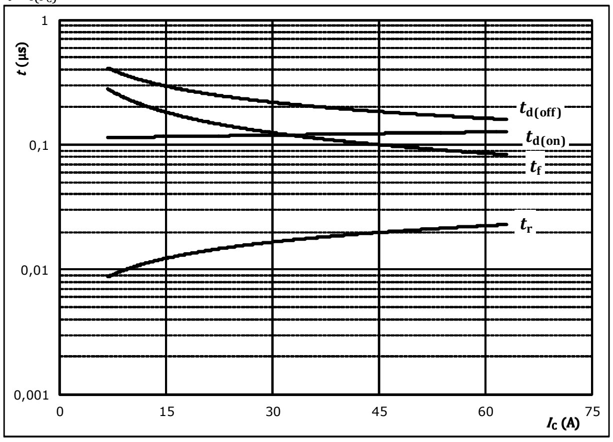
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C =	35	A		150 °C	dashed

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



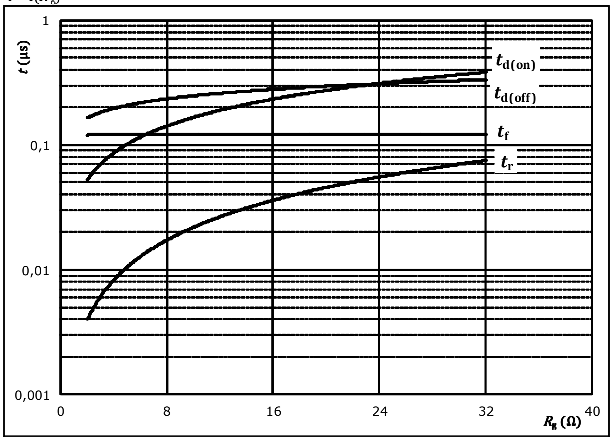
With an inductive load at

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

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



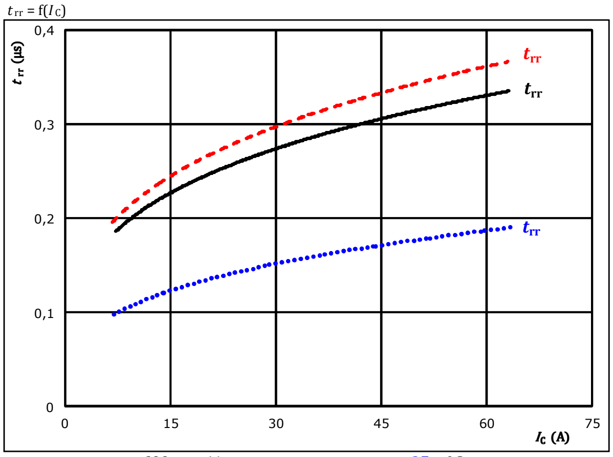
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

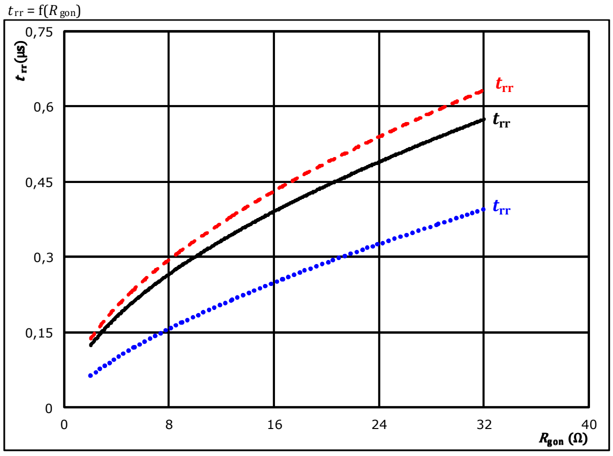


At						
V_{CE} =	600	V		25	°C	···········
V_{GE} =	±15	V	T_j:	125	°C	———
R_{gon} =	8	Ω		150	°C	– – –

figure 8. **FWD**

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

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



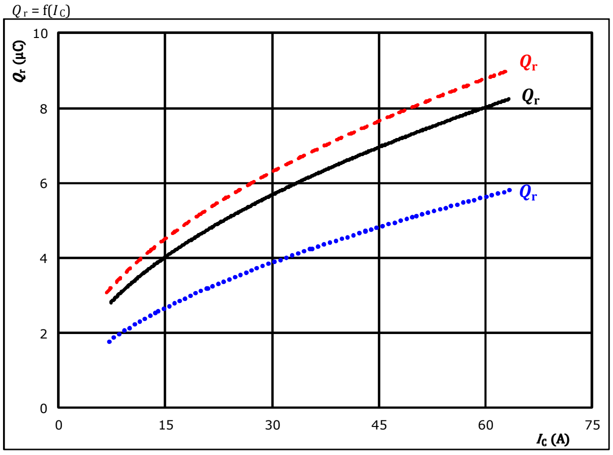
At						
V_{CE} =	600	V		25	°C	···········
V_{GE} =	±15	V	T_j:	125	°C	———
I_C =	35	A		150	°C	– – –

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

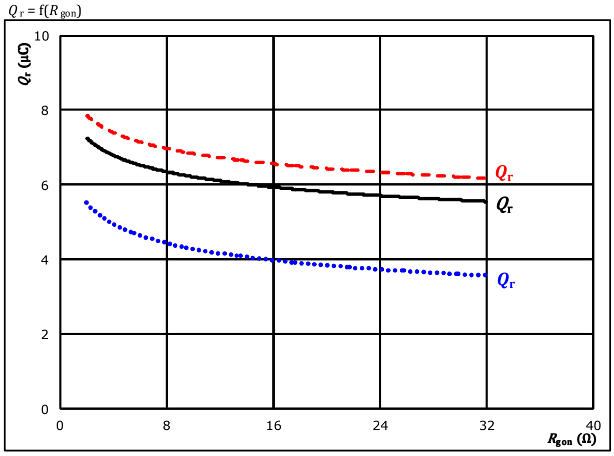


At					
V_{CE} =	600	V		25 °C	dotted
V_{GE} =	±15	V	T_j:	125 °C	solid
R_{gon} =	8	Ω		150 °C	dashed

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

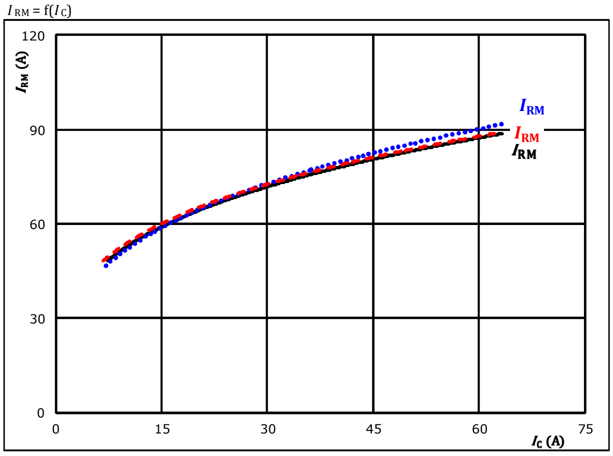


At					
V_{CE}=	600	V		25 °C	dotted
V_{GE} =	±15	V	T_j:	125 °C	solid
I_C=	35	A		150 °C	dashed

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

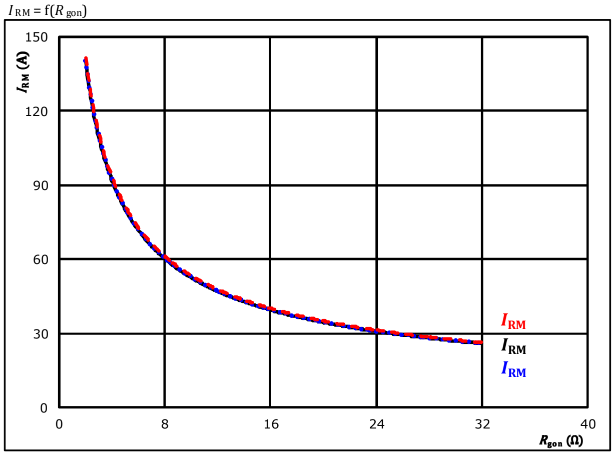


At					
V_{CE}:	600	V		25 °C	dotted
V_{GE} =	±15	V	T_j:	125 °C	solid
R_{gon} =	8	Ω		150 °C	dashed

figure 12. **FWD**

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

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



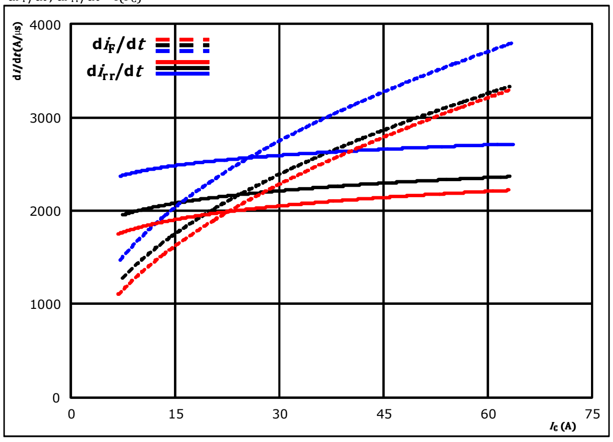
At					
V_{CE} =	600	V		25 °C	dotted
V_{GE} =	±15	V	T_j:	125 °C	solid
I_C =	35	A		150 °C	dashed

Inverter Switching Characteristics

figure 13. FWD

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

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

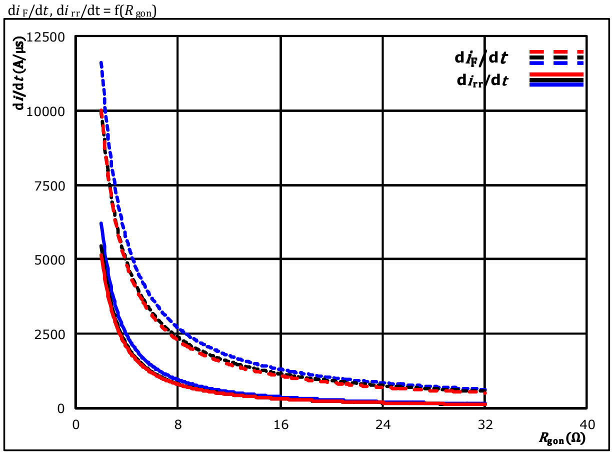


At						
V_{CE} =	600	V		25	°C	
V_{GE} =	±15	V	T_j:	125	°C	
R_{gon} =	8	Ω		150	°C	

figure 14. FWD

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

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

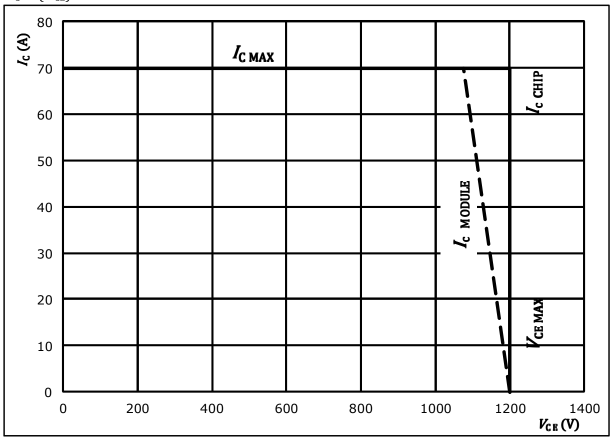


At						
V_{CE} =	600	V		25	°C	
V_{GE} =	±15	V	T_j:	125	°C	
I_C=	35	A		150	°C	

figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At		
T_j =	175	°C
R_{gon} =	8	Ω
R_{goff} =	8	Ω

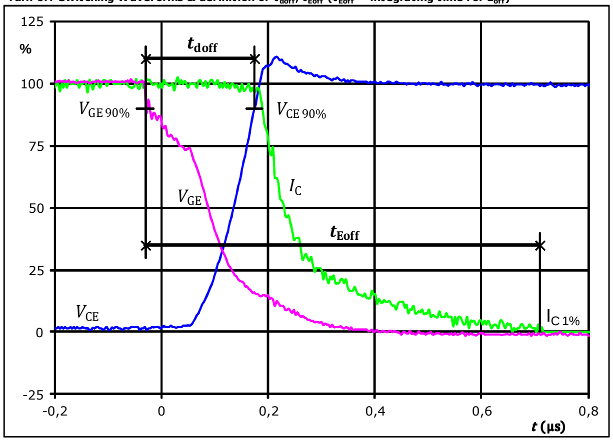
Inverter Switching Definitions

General conditions

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

figure 1. IGBT

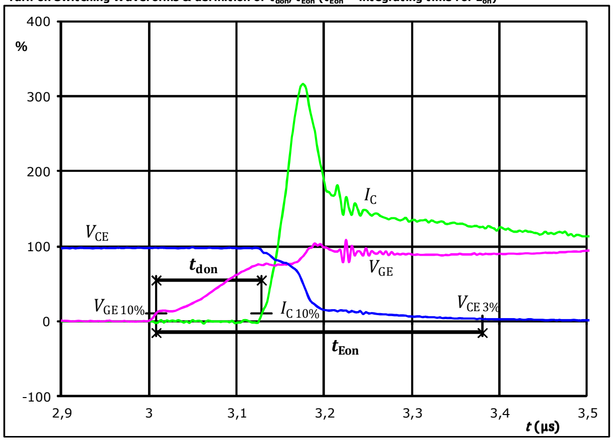
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE}(0%) =	-15	V
V_{GE}(100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	35	A
t_{doff} =	0,203	µs
t_{Eoff} =	0,739	µs

figure 2. IGBT

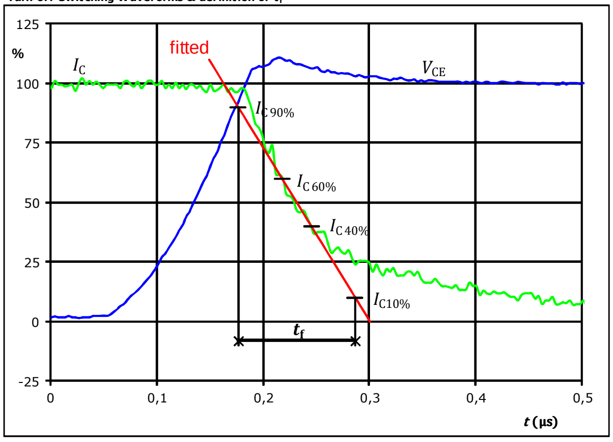
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE}(0%) =	-15	V
V_{GE}(100%) =	15	V
V_C(100%) =	600	V
I_C(100%) =	35	A
t_{don} =	0,122	µs
t_{Eon} =	0,372	µs

figure 3. IGBT

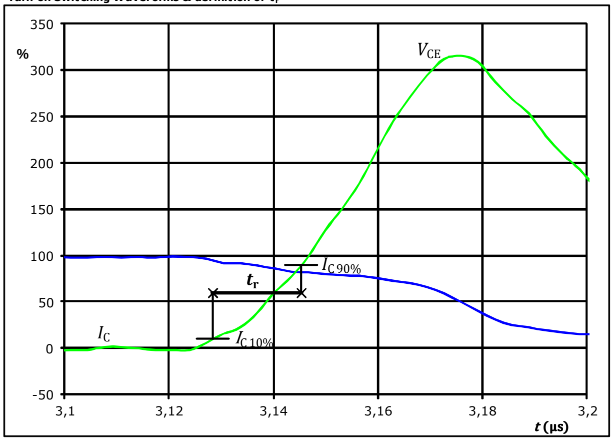
Turn-off Switching Waveforms & definition of t_f



V_C(100%) =	600	V
I_C(100%) =	35	A
t_f =	0,118	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

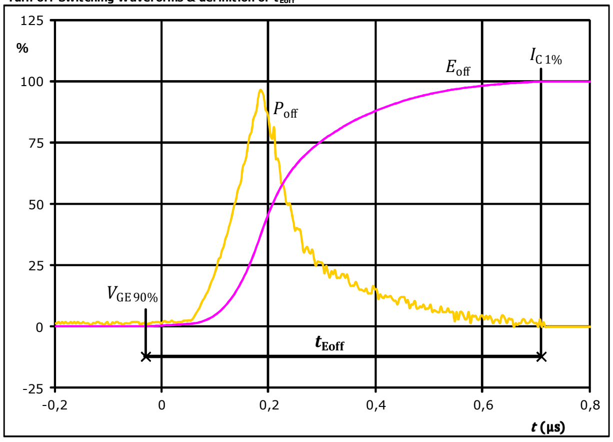


V_C(100%) =	600	V
I_C(100%) =	35	A
t_r =	0,017	µs

Inverter Switching Characteristics

figure 5. **IGBT**

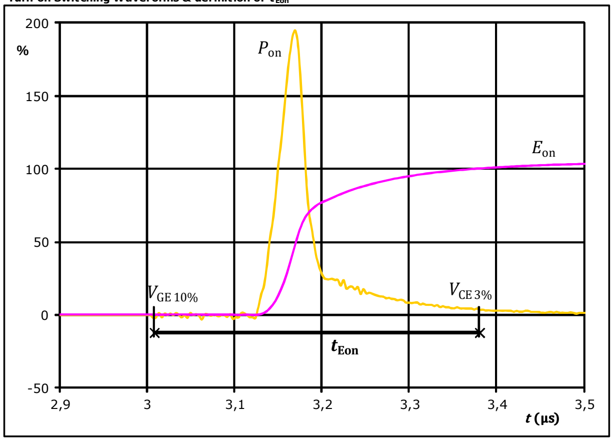
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	20,99	kW
E_{off} (100%) =	3,17	mJ
t_{Eoff} =	0,74	µs

figure 6. **IGBT**

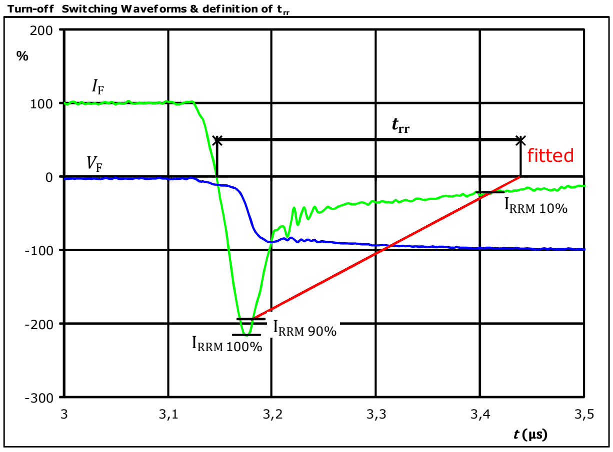
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	20,99	kW
E_{on} (100%) =	1,92	mJ
t_{Eon} =	0,37	µs

figure 7. **FWD**

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

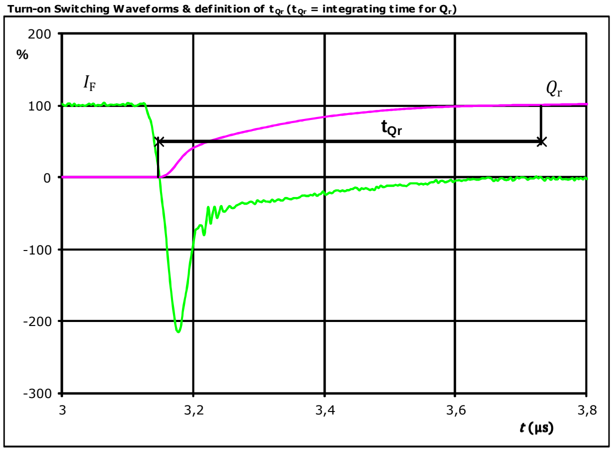


V_F (100%) =	600	V
I_F (100%) =	35	A
I_{RRM} (100%) =	-76	A
t_{rr} =	0,284	µs

Inverter Switching Characteristics

figure 8. **FWD**

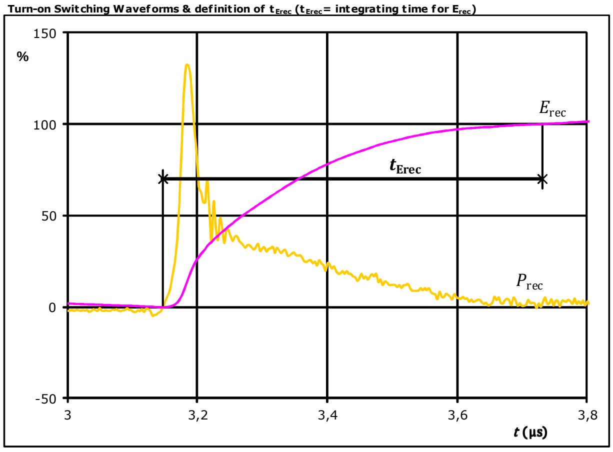
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	35	A
Q_r (100%) =	6,18	µC
t_{Qr} =	0,58	µs

figure 9. **FWD**

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



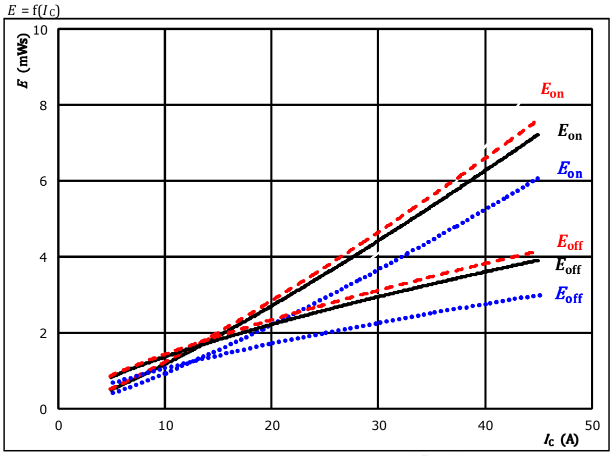
P_{rec} (100%) =	20,99	kW
E_{rec} (100%) =	2,82	mJ
t_{Erec} =	0,58	µs

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



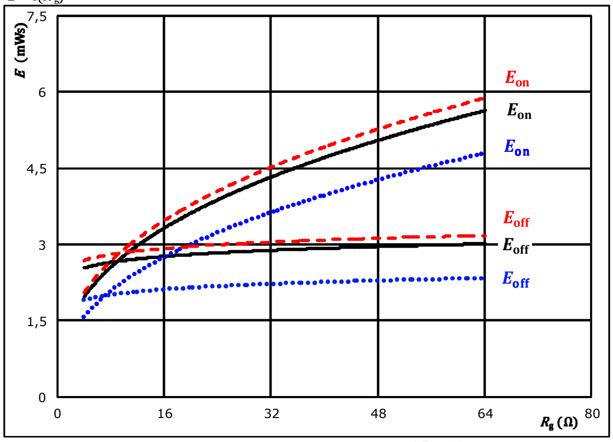
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted blue
V_{GE} =	15/0	V		125 °C	solid black
R_{gon} =	16	Ω		150 °C	dashed red
R_{goff} =	16	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



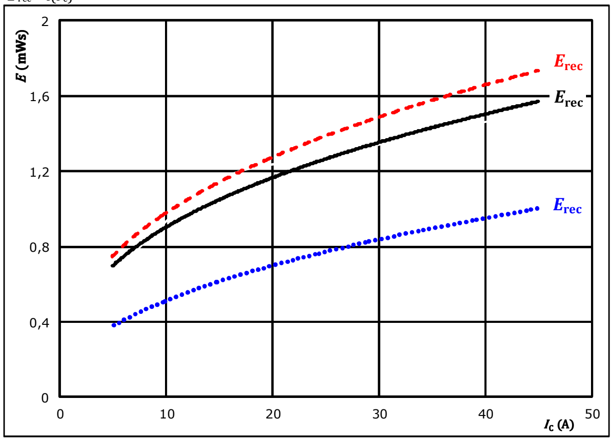
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted blue
V_{GE} =	15/0	V		125 °C	solid black
I_C =	25	A		150 °C	dashed red

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



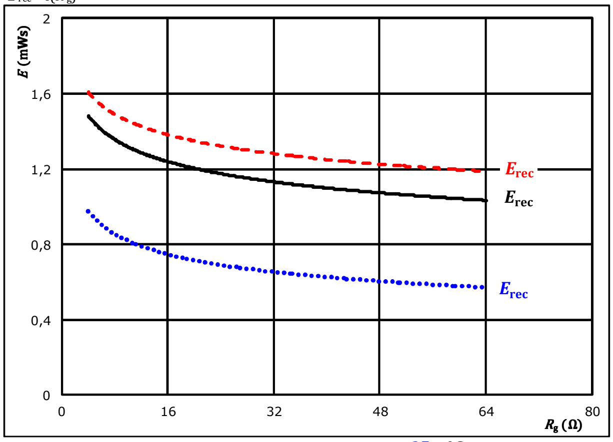
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted blue
V_{GE} =	15/0	V		125 °C	solid black
R_{gon} =	16	Ω		150 °C	dashed red

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

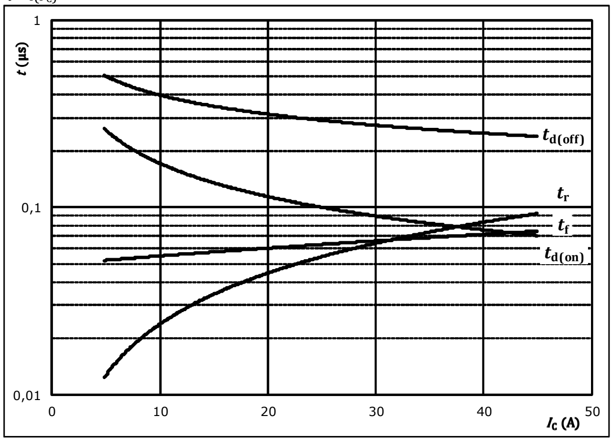
V_{CE} =	700	V	T_j:	25 °C	dotted blue
V_{GE} =	15/0	V		125 °C	solid black
I_C =	25	A		150 °C	dashed red

Brake Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



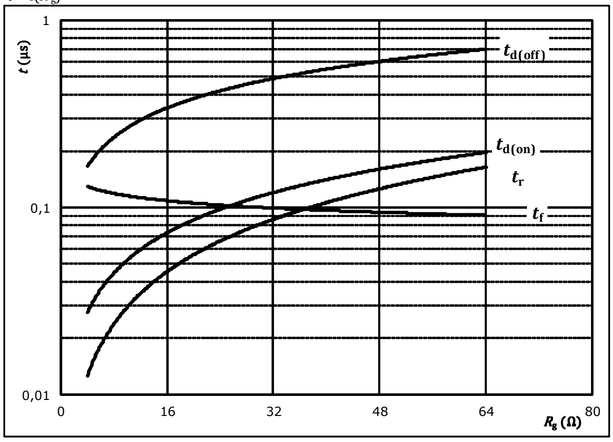
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	15/0	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$t = f(R_g)$



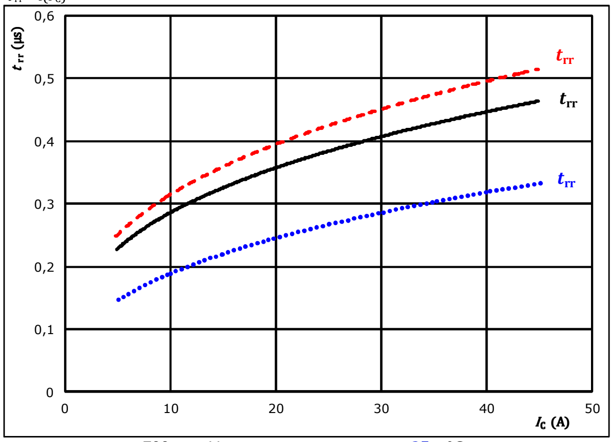
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	15/0	V
I_C =	25	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

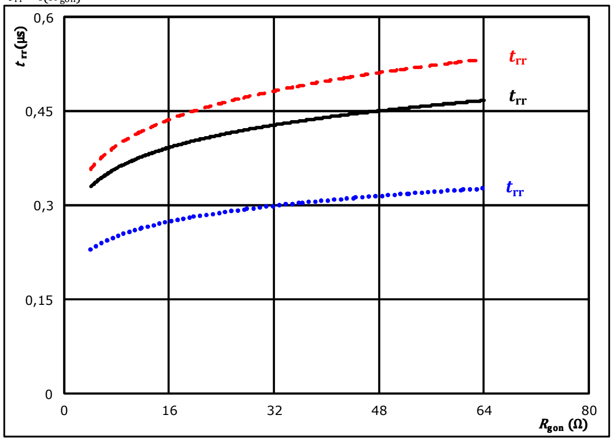


At					
V_{CE} =	700	V		25	°C
V_{GE} =	15/0	V	T_j:	125	°C
R_{gon} =	16	Ω		150	°C

figure 8. FWD

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

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



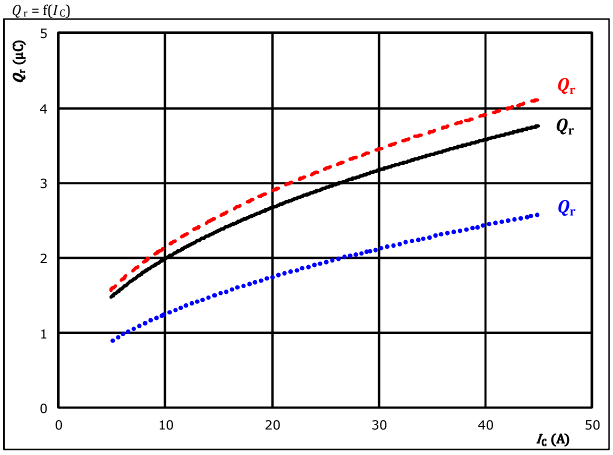
At					
V_{CE} =	700	V		25	°C
V_{GE} =	15/0	V	T_j:	125	°C
I_C =	25	A		150	°C

Brake Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

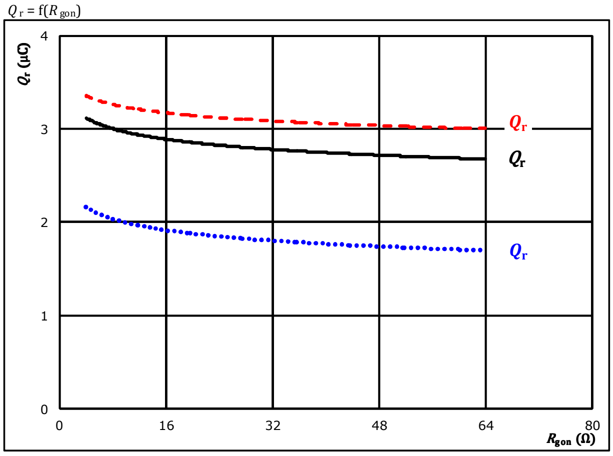


At					
V_{CE} =	700	V		25 °C	
V_{GE} =	15/0	V	T_j:	125 °C	
R_{gon} =	16	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

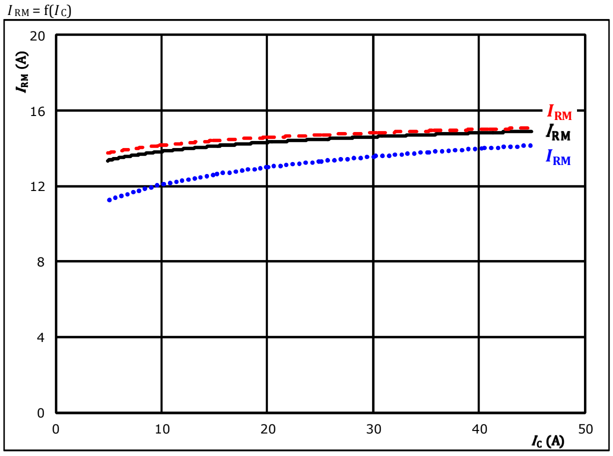


At					
V_{CE}=	700	V		25 °C	
V_{GE} =	15/0	V	T_j:	125 °C	
I_C=	25	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

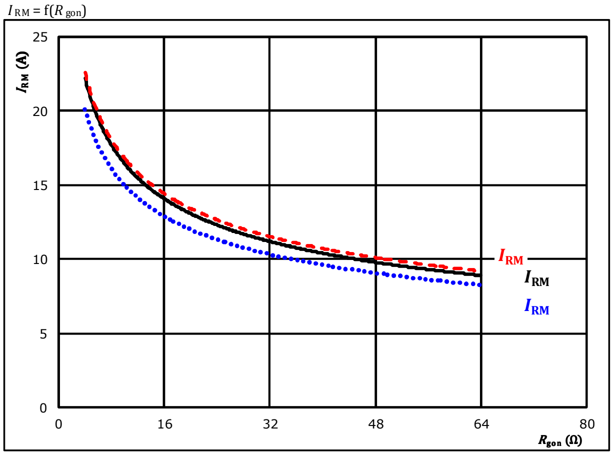


At					
V_{CE}:	700	V		25 °C	
V_{GE} =	15/0	V	T_j:	125 °C	
R_{gon} =	16	Ω		150 °C	

figure 12. **FWD**

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

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



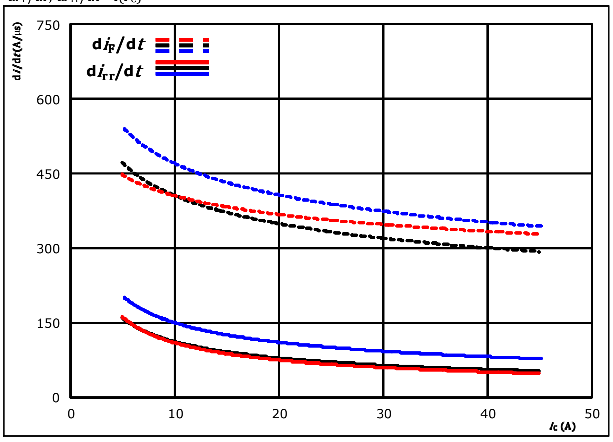
At					
V_{CE} =	700	V		25 °C	
V_{GE} =	15/0	V	T_j:	125 °C	
I_C =	25	A		150 °C	

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)

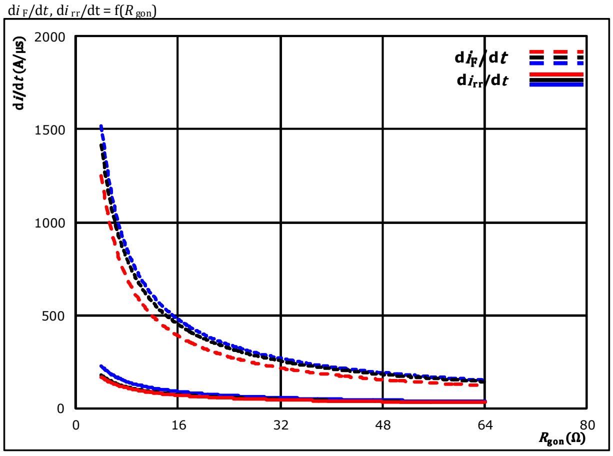


At V_{CE} = 700 V; V_{GE} = 15/0 V; R_{gon} = 16 Ω; T_j: 25 °C, 125 °C, 150 °C

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})

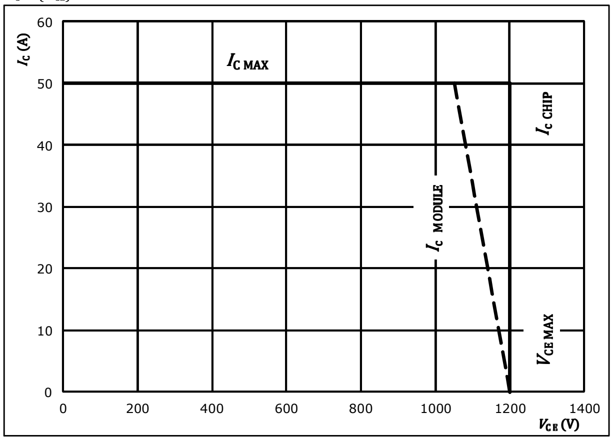


At V_{CE} = 700 V; V_{GE} = 15/0 V; I_C = 25 A; T_j: 25 °C, 125 °C, 150 °C

figure 15. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j = 175 °C
R_{gon} = 16 Ω
R_{goff} = 16 Ω

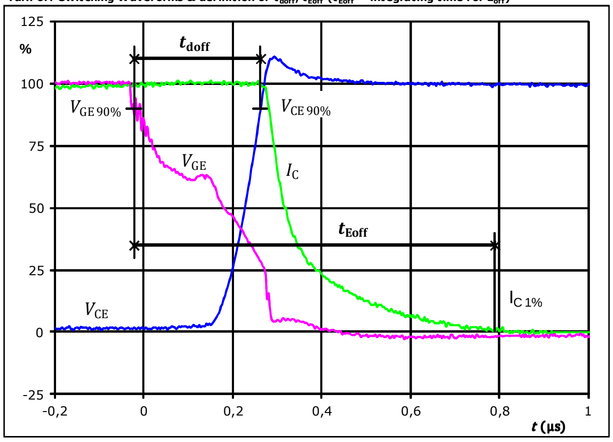
Brake Switching Definitions

General conditions

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

figure 1. IGBT

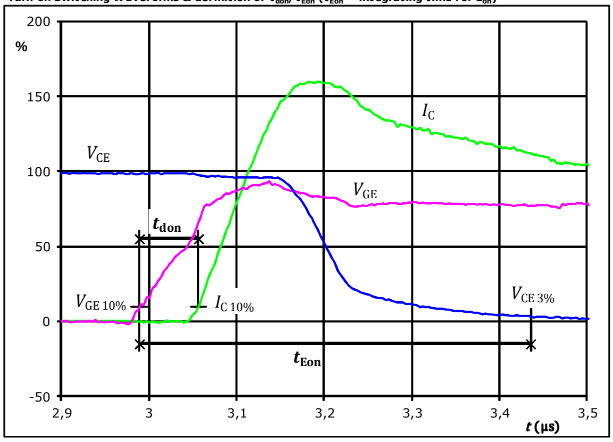
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_{doff} =	0,290	µs
t_{Eoff} =	0,812	µs

figure 2. IGBT

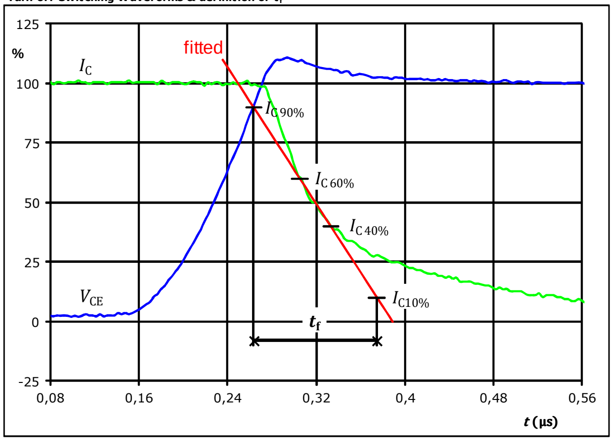
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_{don} =	0,067	µs
t_{Eon} =	0,446	µs

figure 3. IGBT

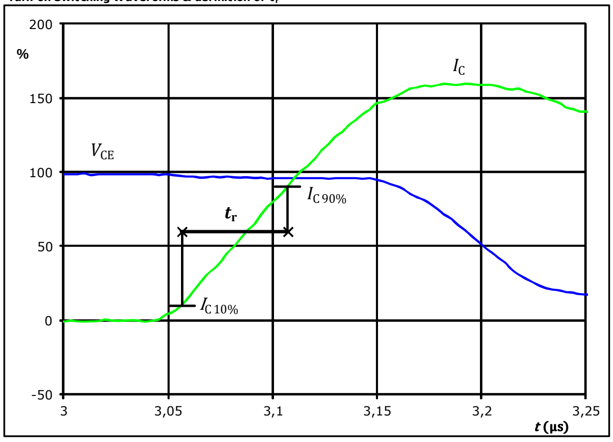
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_f =	0,117	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

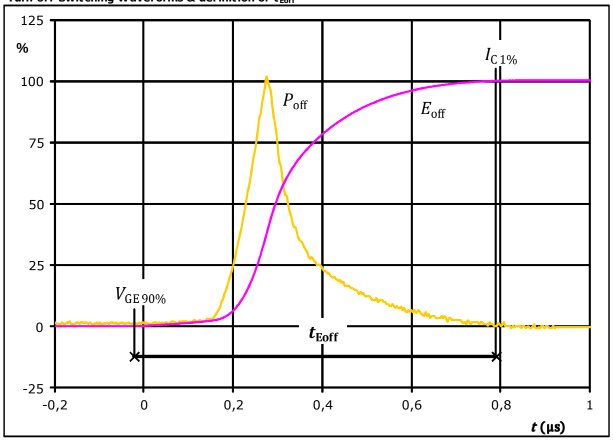


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_r =	0,050	µs

Brake Switching Characteristics

figure 5. **IGBT**

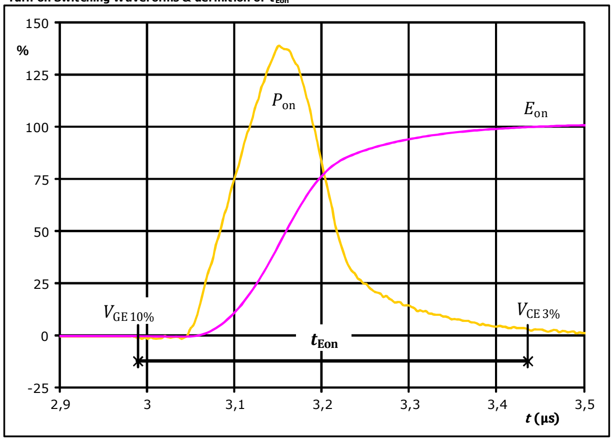
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	17,58	kW
E_{off} (100%) =	2,65	mJ
t_{Eoff} =	0,81	µs

figure 6. **IGBT**

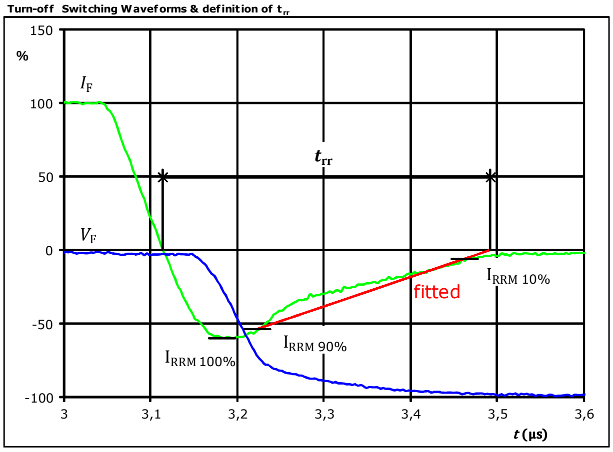
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	17,58	kW
E_{on} (100%) =	3,11	mJ
t_{Eon} =	0,45	µs

figure 7. **FWD**

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

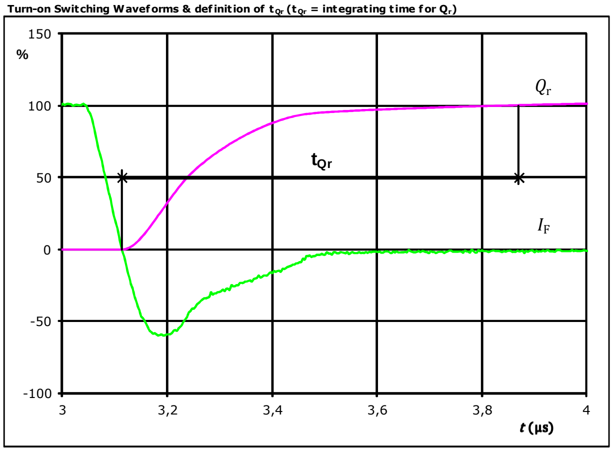


V_F (100%) =	700	V
I_F (100%) =	25	A
I_{RRM} (100%) =	-15	A
t_{rr} =	0,375	µs

Brake Switching Characteristics

figure 8. FWD

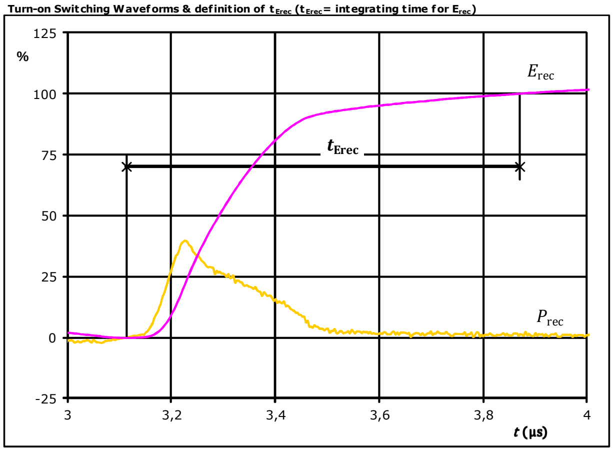
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	25	A
Q_r (100%) =	2,90	µC
t_{Qr} =	0,76	µs

figure 9. FWD

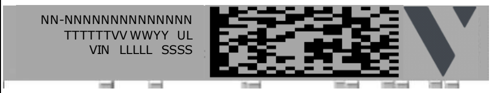
Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	17,58	kW
E_{rec} (100%) =	1,28	mJ
t_{Erec} =	0,76	µs

Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing with solder pins	10-FY12PMA035M7-P589A78
with thermal paste 12 mm housing with press-fit pins	10-PY12PMA035M7-P589A78Y-/3/
without thermal paste 17 mm housing with solder pins	10-F112PMA035M7-P589A79

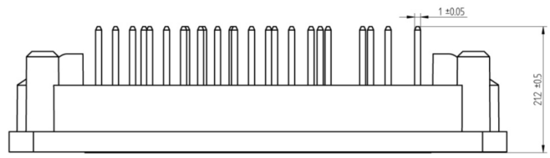


	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	Type&Ver	**Lot number**	**Serial**	**Date code**		
Datamatrix	TTTTTTTVV	LLLLL	SSSS	WWYY		

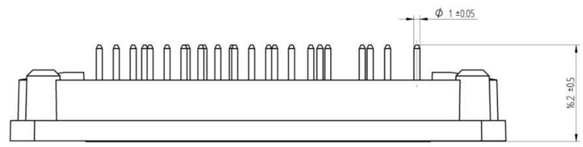
Outline

Pin	X	Y	Function
1	52,55	0	G27
2	47,7	0	DC-Rect
3	44,8	0	DC-Rect
4	37,8	0	DC+Rect
5	37,8	2,8	DC+Rect
6	35	0	DC+Inv
7	35	2,8	DC+Inv
8	28	0	Therm1
9	25,2	0	Therm2
10	22,4	0	DC-3
11	19,6	0	G15
12	16,8	0	S15
13	14	0	DC-2
14	11,2	0	G13
15	8,4	0	S13
16	5,6	0	DC-1
17	2,8	0	G11
18	0	0	S11
19	0	28,5	Ph1
20	2,8	28,5	G12
21	7,5	28,5	S12
22	14,5	28,5	Ph2
23	17,3	28,5	G14
24	22	28,5	S14
25	29	28,5	Ph3
26	31,8	28,5	G16
27	36,5	28,5	S16
28	43,5	28,5	ACIn1
29	52,55	25	ACIn2
30	52,55	16,9	ACIn3
31	52,55	8,6	Br
32	52,55	2,8	DC-Br

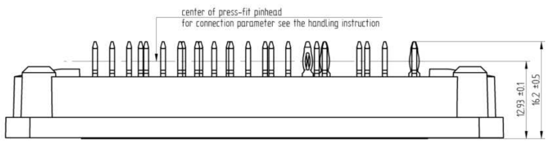
P589A79

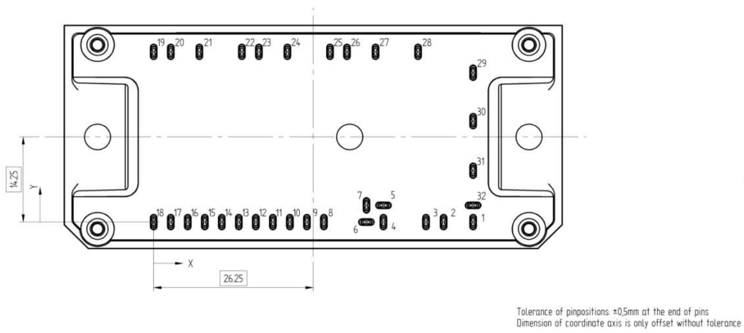


P589A78

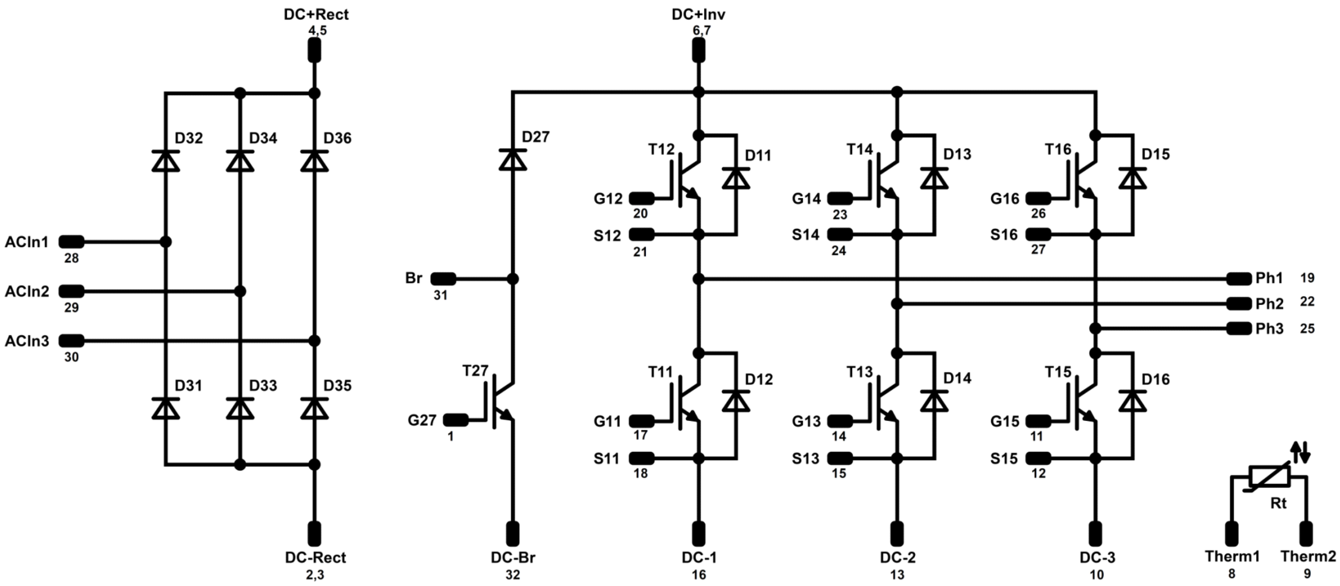


P589A78Y





Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	45 A	Rectifier Diode	
T11, T12, T13, T14, T15, T16	IGBT	1200 V	35 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	35 A	Inverter Diode	
T27	IGBT	1200 V	25 A	Brake Switch	
D27	FWD	1200 V	15 A	Brake Diode	
Rt	NTC			Thermistor	

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

Handling instruction
Handling instructions for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 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-xx12PMA035M7-P589A7xx-D2-14	07 Dec. 2017		