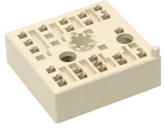
MiniSKiiP® 1 PACK **1200V/8A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology

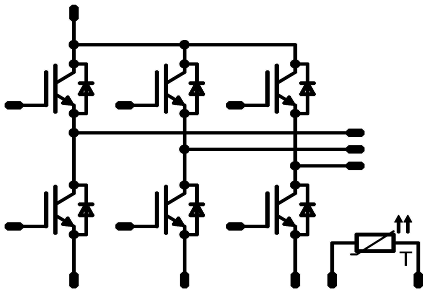
MiniSKiiP® 1 housing



Target Applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K218-F40-PM

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
T1,T2,T3,T4,T5,T6					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	T_h=80℃	10	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		24	A
Turn off safe operating area		V_{CE}≤1200V, $T_j≤T_{op}$max		16	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80℃	51	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 800	µs V
Maximum Junction Temperature	$T_j$max			175	℃
D1,D2,D3,D4,D5,D6					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_j$max	T_h=80℃	10	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		24	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80℃	38	W
Maximum Junction Temperature	$T_j$max			175	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	℃
Operation temperature under switching condition	T_{op}		-40…+(Tjmax - 25)	℃
Insulation Properties				
Insulation voltage	V_{is}	t=2s DC voltage	4000	V
Creepage distance			min 12.7	mm
Clearance			min 12.7	mm

Characteristic Values

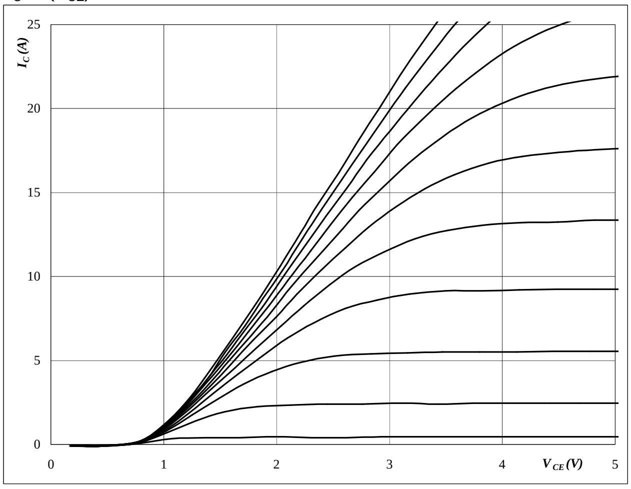
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
T1,T2,T3,T4,T5,T6										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0003	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		8	Tj=25℃ Tj=150℃	1,6	1,85 2,25	2,15	V
Collector-emitter cut-off current incl. diode	I_{CES}		0	1200		Tj=25℃ Tj=150℃			0,06	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			200	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=64Ω Rgon=64Ω	±15	600	8	Tj=25℃ Tj=150℃		109 108		ns
Rise time	t_r					Tj=25℃ Tj=150℃		30 36		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		225 292		
Fall time	t_f					Tj=25℃ Tj=150℃		91 121		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		0,54 0,85		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		0,49 0,79		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		490		pF
Output capacitance	C_{oss}							50		
Reverse transfer capacitance	C_{rss}							30		
Gate charge	Q_{Gate}		±15			Tj=25℃		90		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ=1W/mK						1,84		K/W
D1,D2,D3,D4,D5,D6										
Diode forward voltage	V_F				8	Tj=25℃ Tj=150℃	1,3	2,3 2,26	2,8	V
Peak reverse recovery current	I_{RRM}	Rgon=64Ω	±15	600	8	Tj=25℃ Tj=150℃		4,52 6,68		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		269 581		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		0,56 1,51		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		38 28		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=150℃		0,21 0,64		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ=1W/mK						2,53		K/W
Thermistor										
Rated resistance	R					T=25℃		1000		Ω
Deviation of R100	ΔR/R	R100=1670 Ω				T=100℃	-3		3	%
R100	R					T=100℃		1670,313		Ω
A-value	B(25/50)	Tol. %				T=25℃		7,635*10-3		1/K
B-value	B(25/100)	Tol. %				T=25℃		1,731*10-5		1/K²
Vincotech NTC Reference									E	

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

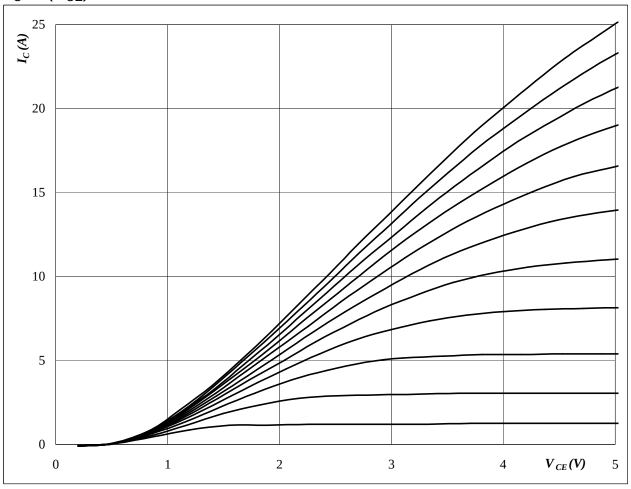
T_j = 25 ℃

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

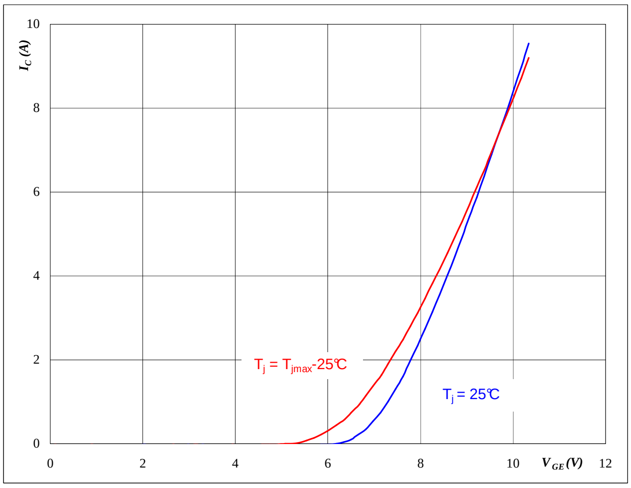
T_j = 150 ℃

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

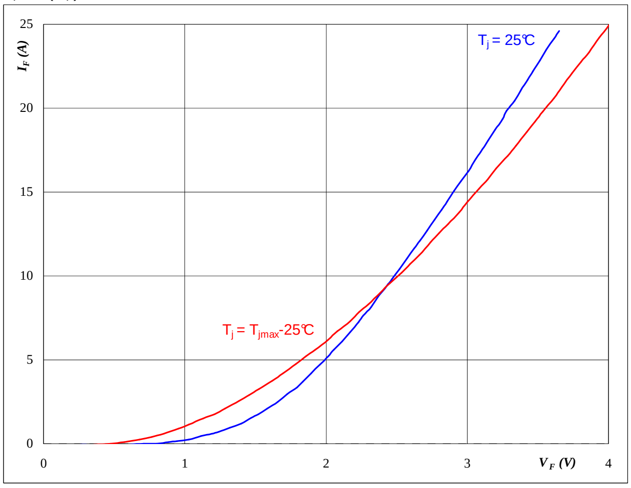
t_p = 250 µs

V_{CE} = 10 V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

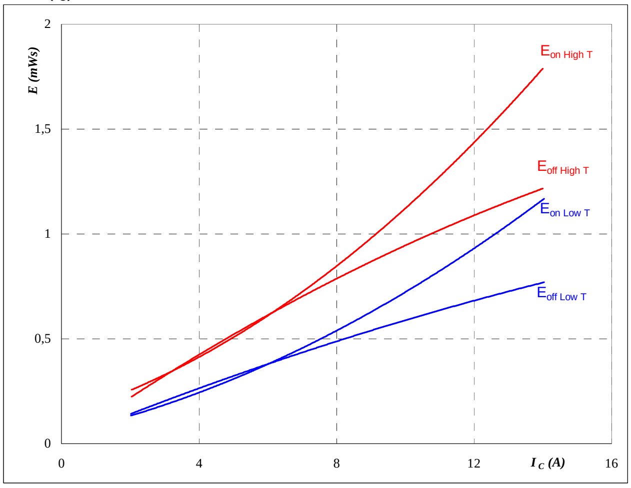
t_p = 250 µs

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



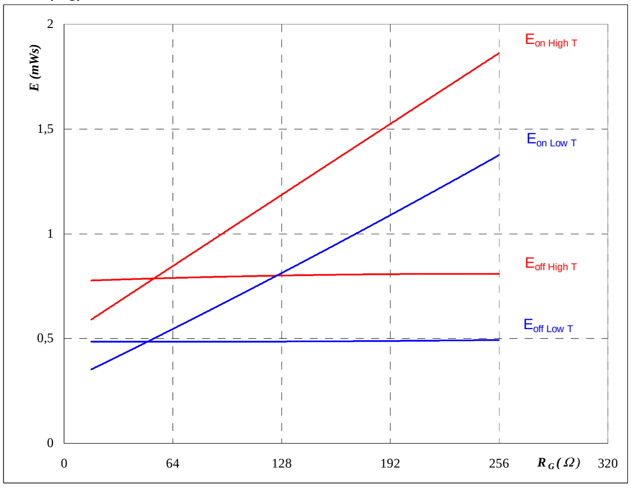
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



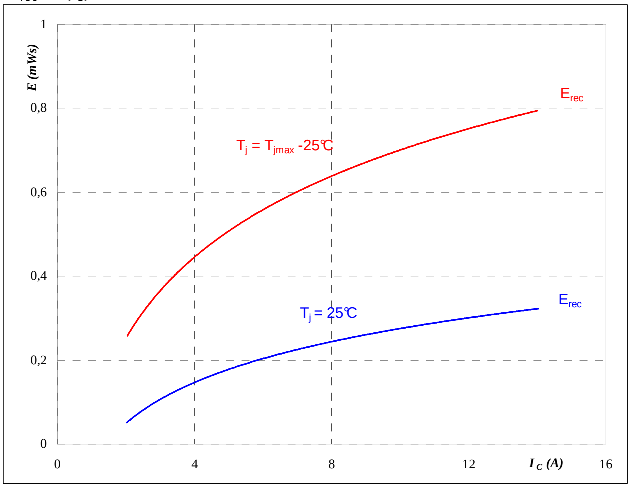
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 7 IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



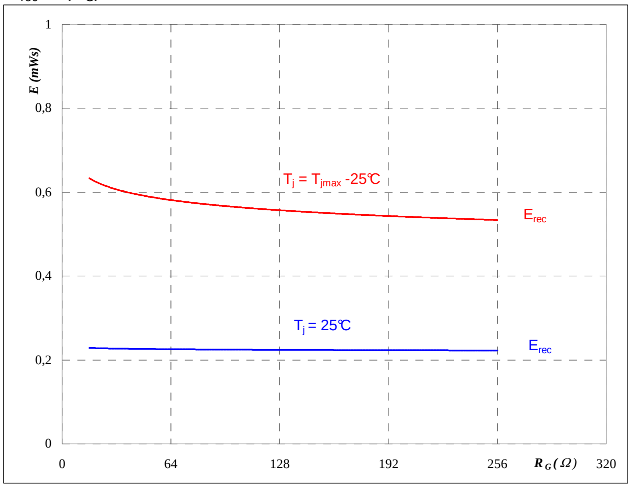
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 8 IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

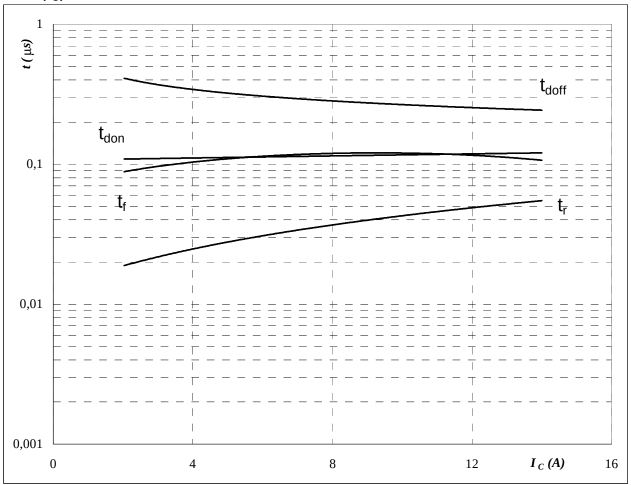
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



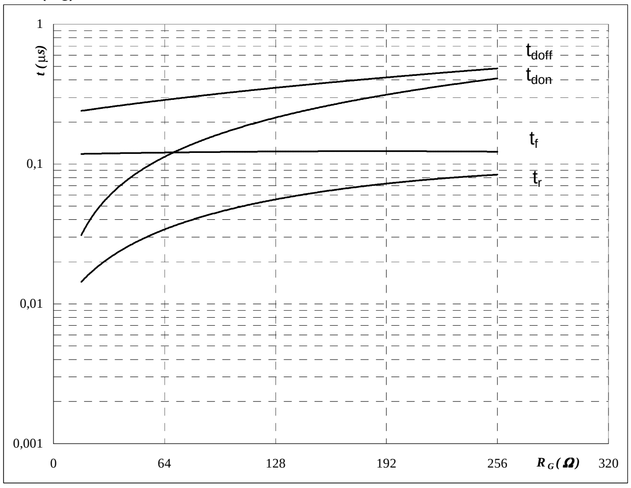
With an inductive load at

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

Figure 10 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



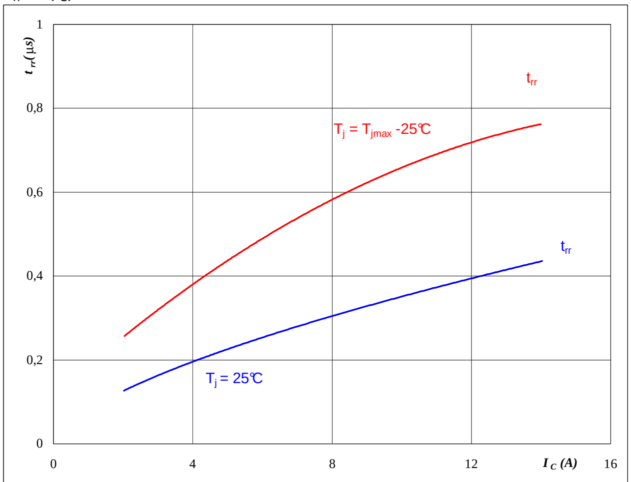
With an inductive load at

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

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



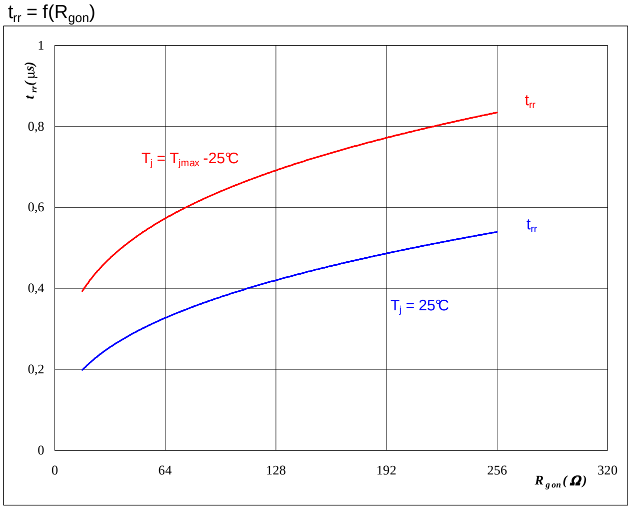
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 12 FWD

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

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



At

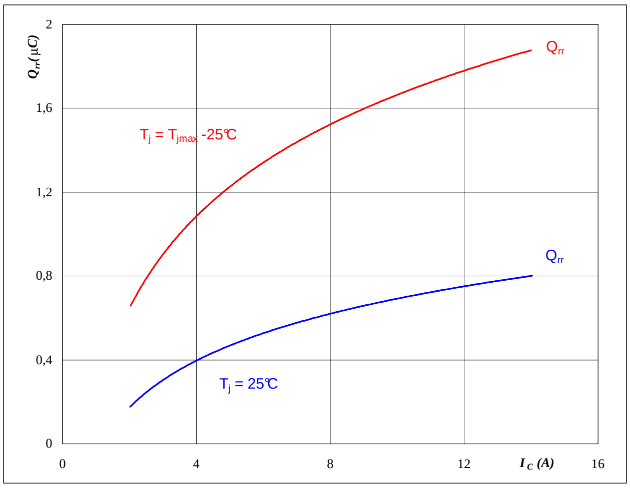
T_j =	25/150	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



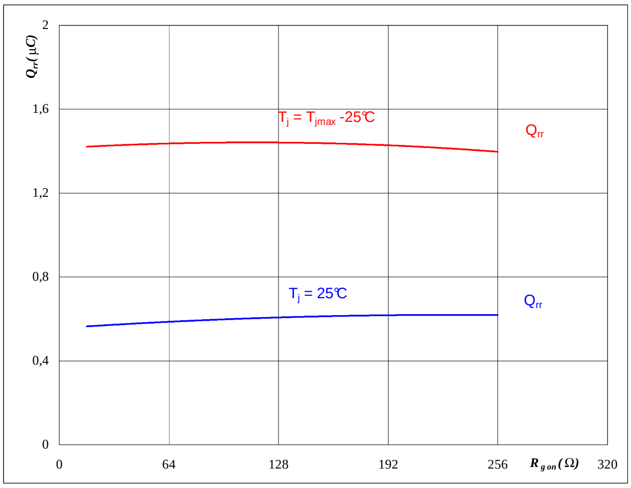
At

T_j =	25/150	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 14 FWD

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

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



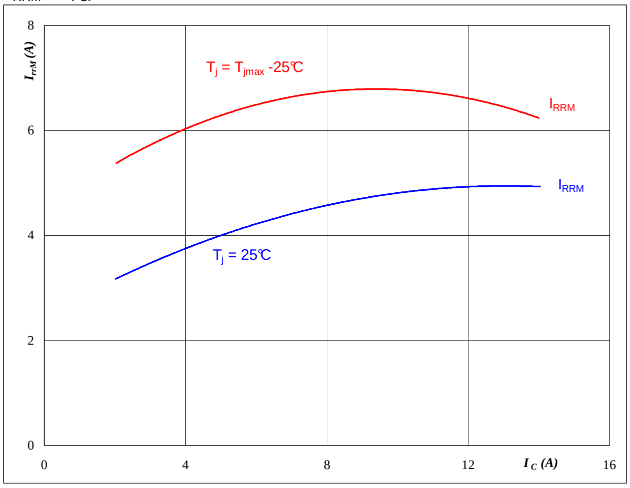
At

T_j =	25/150	℃
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



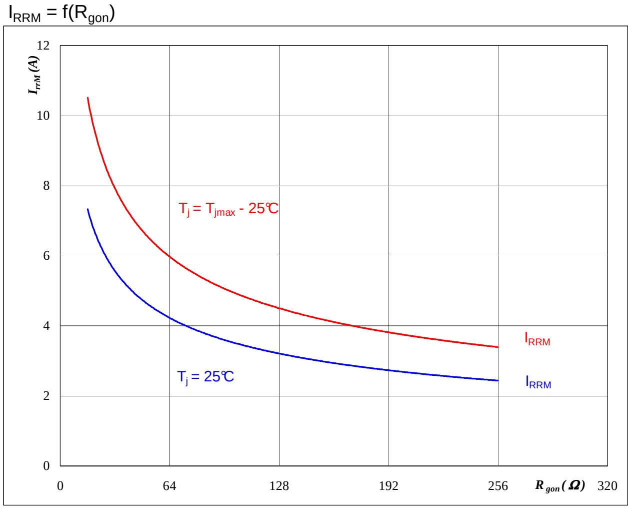
At

T_j =	25/150	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 16 FWD

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

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



At

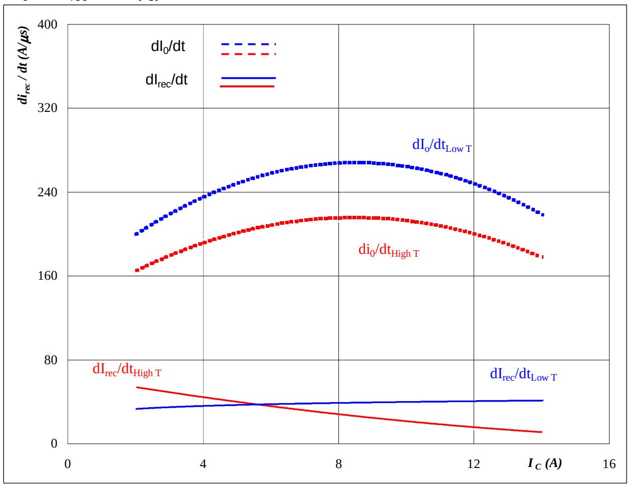
T_j =	25/150	℃
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 17 — FWD

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

$dI_0/dt, dI_{rec}/dt = f(I_C)$



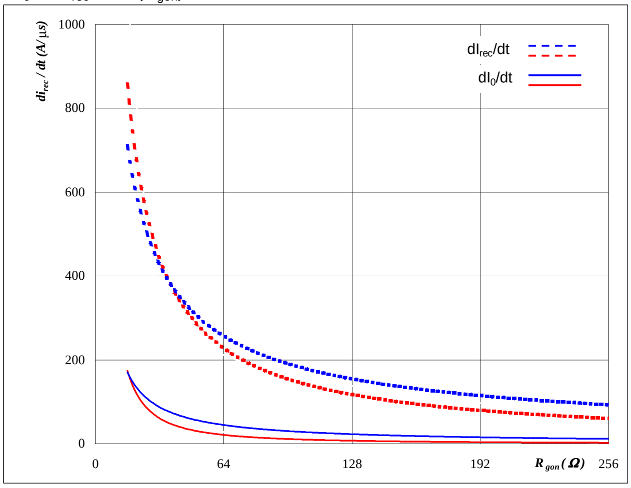
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 18 — FWD

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



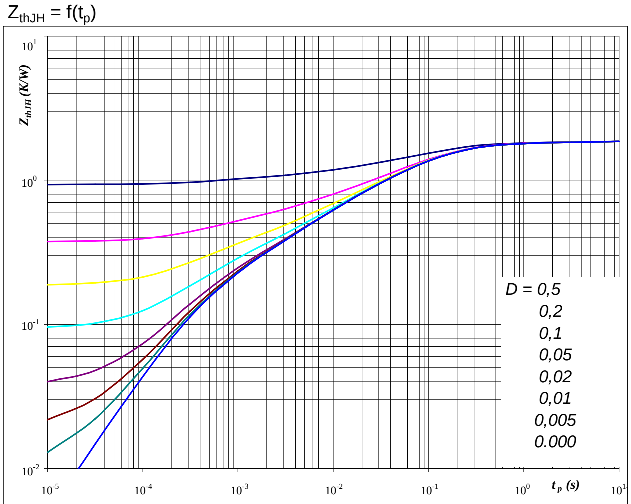
At

T_j =	25/150	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 19 — IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1,84	K/W

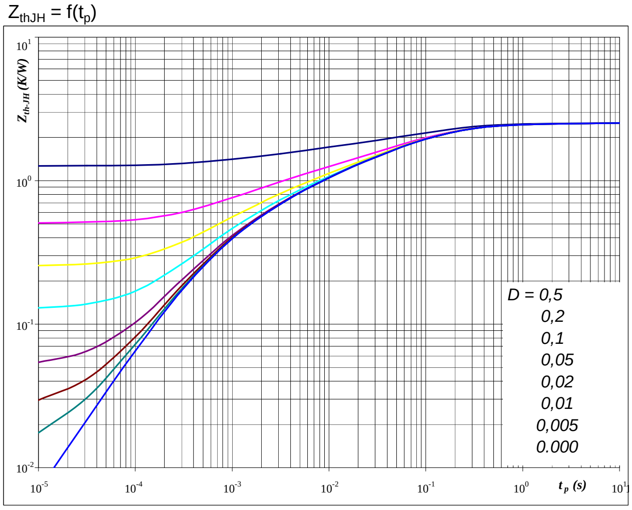
IGBT thermal model values

R (C/W)	Tau (s)
0,05	4,8E+00
0,15	5,9E-01
0,66	1,2E-01
0,45	3,8E-02
0,29	8,5E-03
0,13	1,7E-03

Figure 20 — FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	2,53	K/W

FWD thermal model values

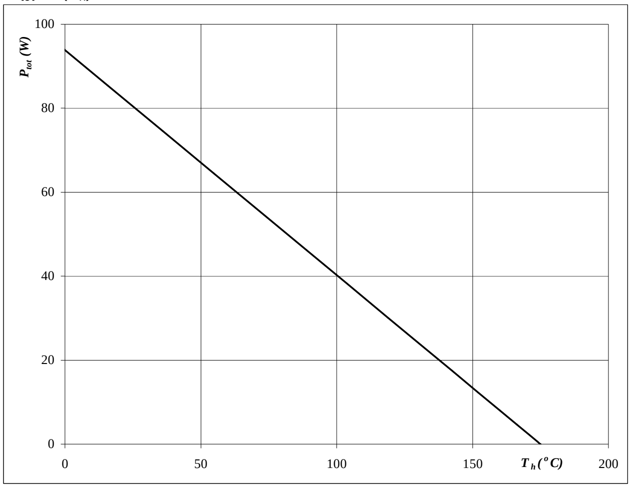
R (C/W)	Tau (s)
0,06	5,7E+00
0,33	4,5E-01
1,12	8,6E-02
0,63	1,7E-02
0,54	2,8E-03
0,29	5,0E-04

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



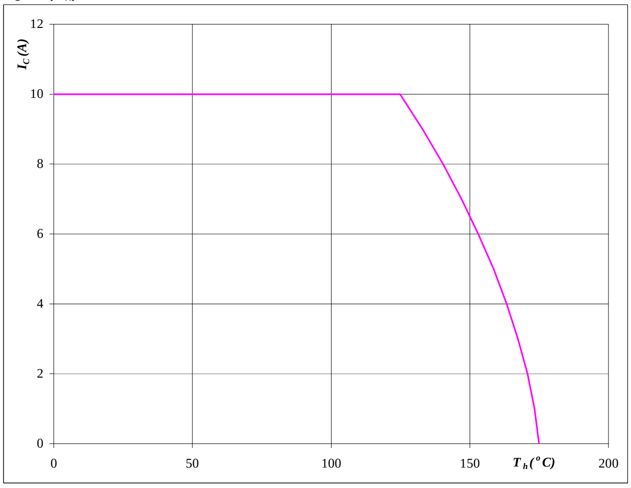
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

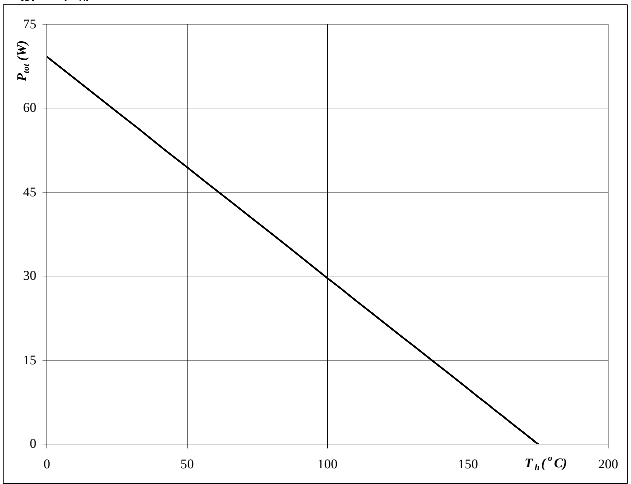
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



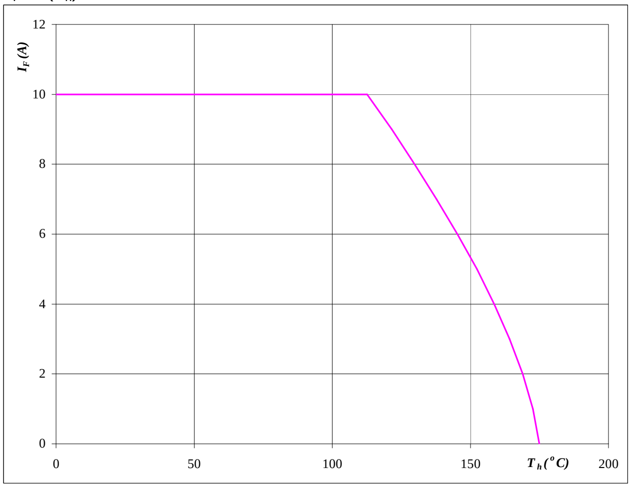
At

T_j = 175 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

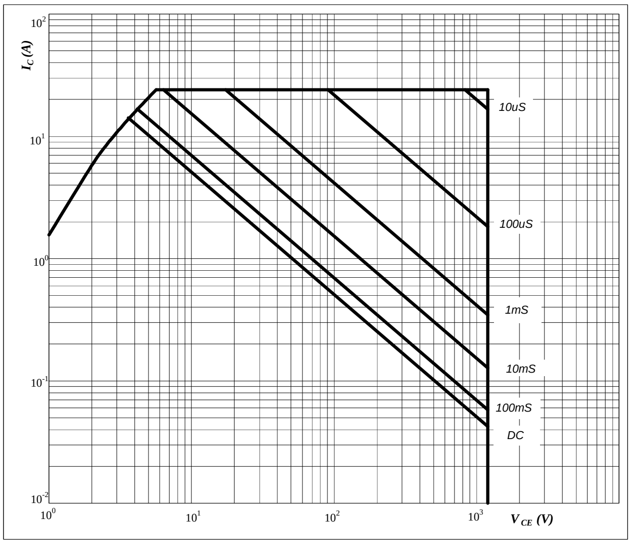
T_j = 175 ℃

T1,T2,T3,T4,T5,T6 / D1,D2,D3,D4,D5,D6

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



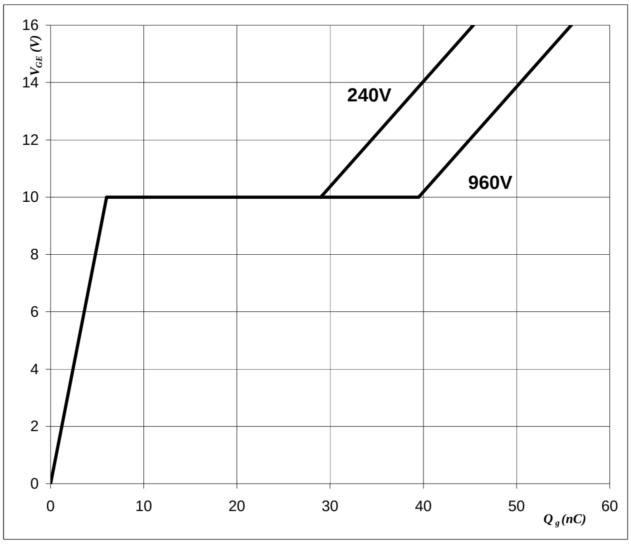
At

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

Figure 26 IGBT

Gate voltage vs Gate charge

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



At

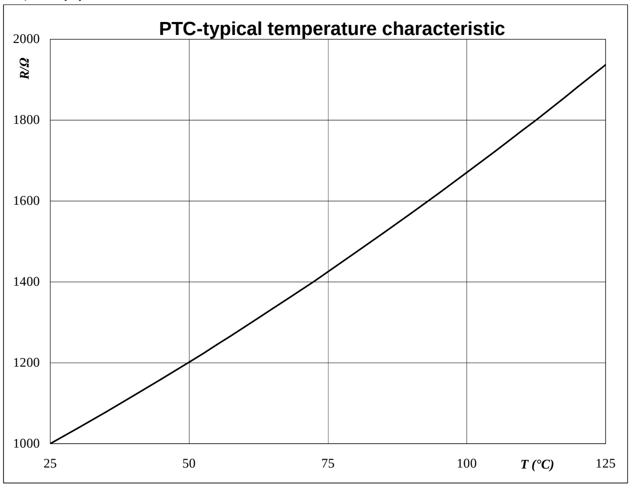
I_C =	8	A

Thermistor

Figure 1 Thermistor

Typical PTC characteristic as a function of temperature

$R_T = f(T)$



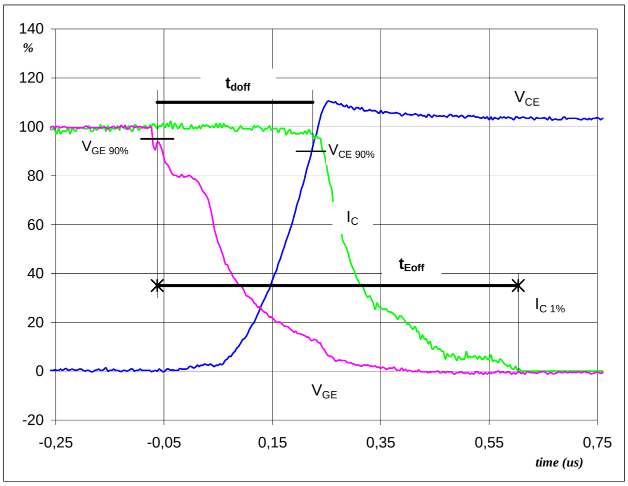
Switching Definitions Output Inverter

General conditions

T_j	=	150 ℃
R_{gon}	=	64 Ω
R_{goff}	=	64 Ω

Figure 1 Output inverter IGBT

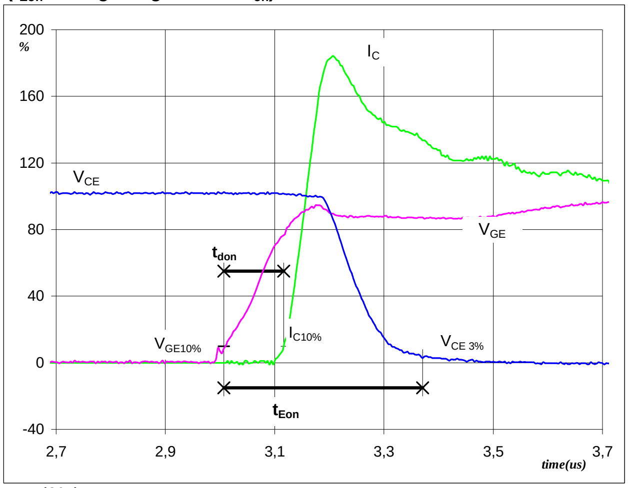
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{doff} =	0,29	μs
t_{Eoff} =	0,67	μs

Figure 2 Output inverter IGBT

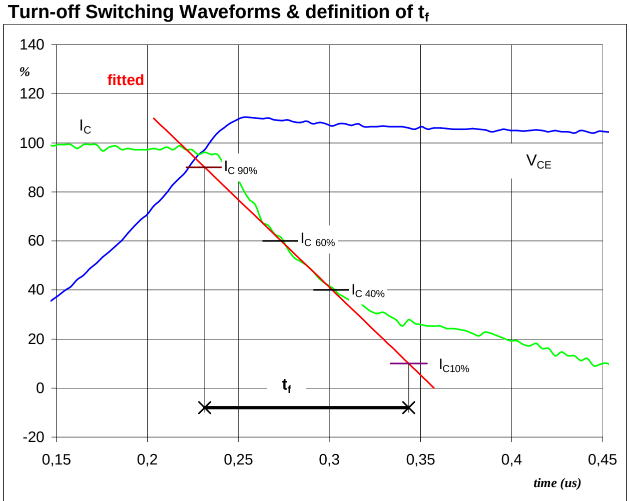
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{don} =	0,11	μs
t_{Eon} =	0,36	μs

Figure 3 Output inverter IGBT

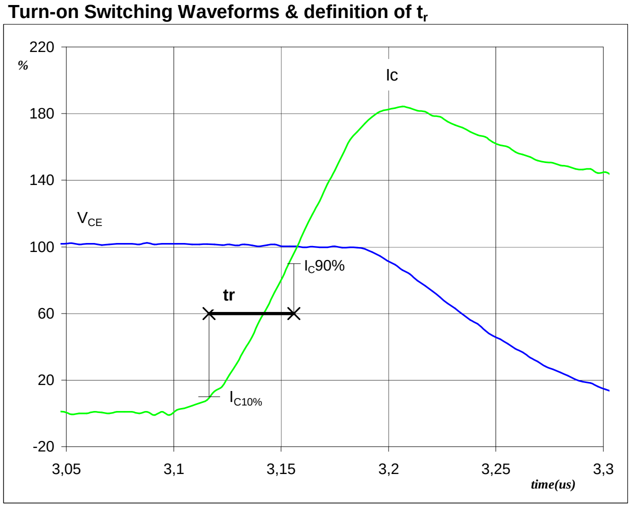
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	8	A
t_f =	0,12	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

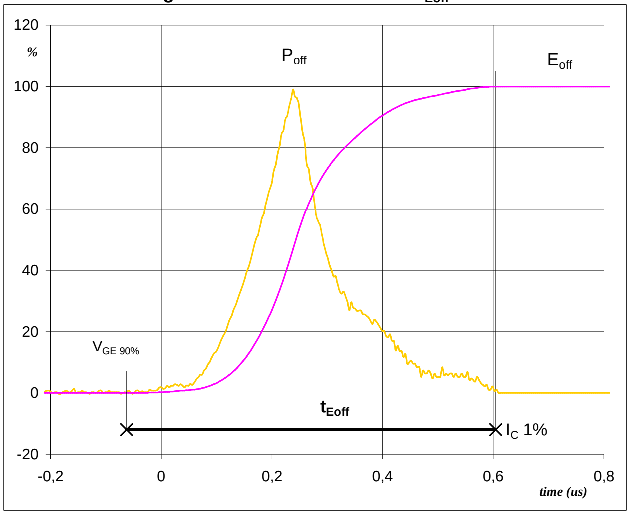


V_C (100%) =	600	V
I_C (100%) =	8	A
t_r =	0,04	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

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



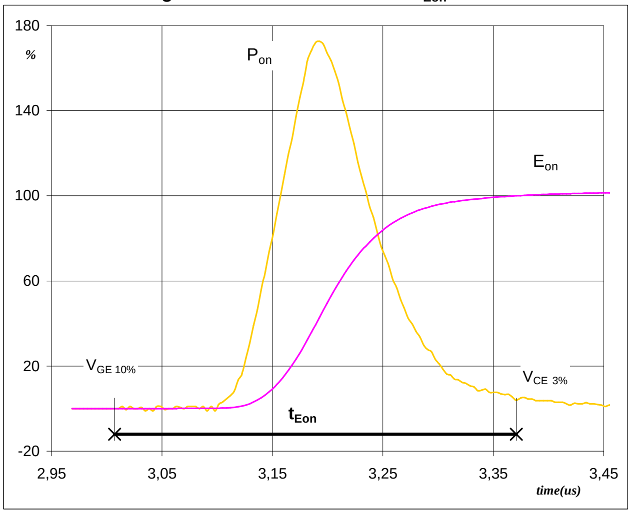
P_{off} (100%) = 4,79 kW

E_{off} (100%) = 0,79 mJ

t_{Eoff} = 0,67 μs

Figure 6 Output inverter IGBT

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



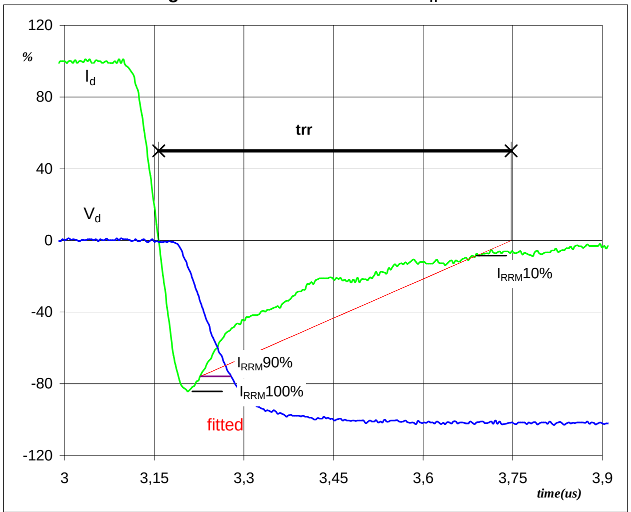
P_{on} (100%) = 4,79 kW

E_{on} (100%) = 0,85 mJ

t_{Eon} = 0,36 μs

Figure 7 Output inverter FWD

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



V_d (100%) = 600 V

I_d (100%) = 8 A

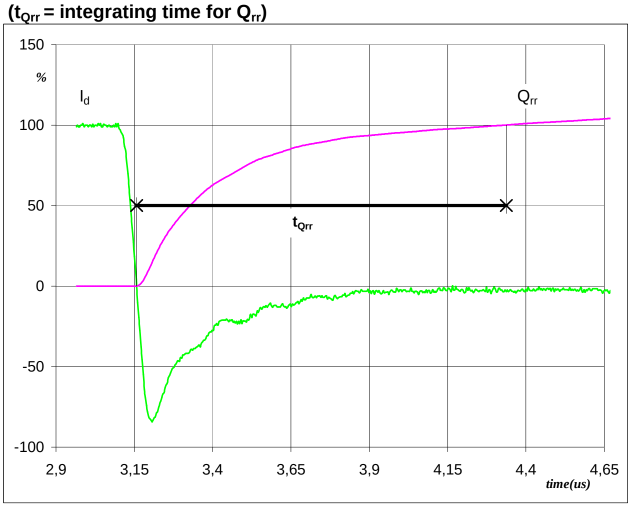
I_{RRM} (100%) = -7 A

t_{rr} = 0,58 μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

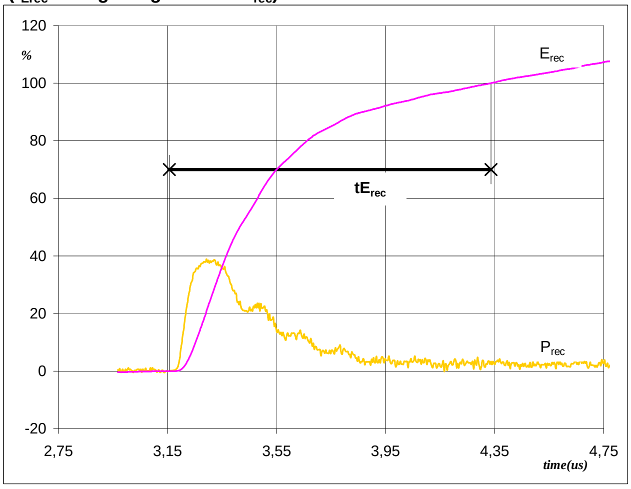
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	8	A
Q_{rr} (100%) =	1,51	μC
t_{Qrr} =	1,18	μs

Figure 9 Output inverter FWD

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



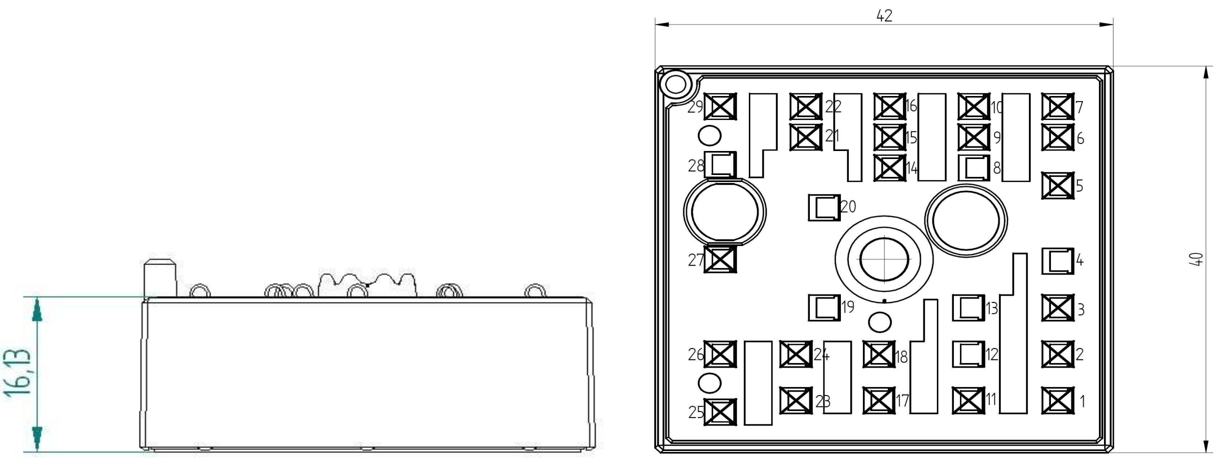
P_{rec} (100%) =	4,79	kW
E_{rec} (100%) =	0,64	mJ
t_{Erec} =	1,18	μs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

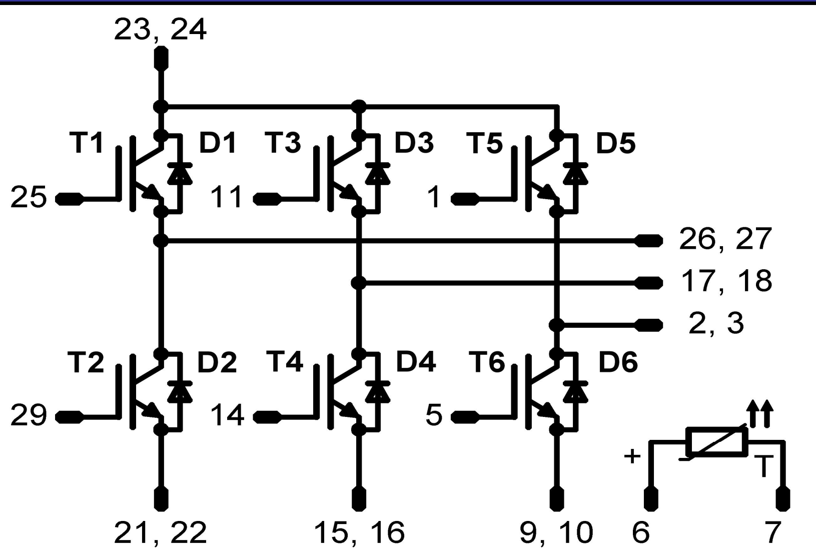
Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K12-T-PM)	V23990-K218-F40-/0A/-PM	K218F40	K218F40-/0A/
with std lid (black V23990-K12-T-PM) and P12	V23990-K218-F40-/1A/-PM	K218F40	K218F40-/1A/
with thin lid (white V23990-K13-T-PM)	V23990-K218-F40-/0B/-PM	K218F40	K218F40-/0B/
with thin lid (white V23990-K13-T-PM) and P12	V23990-K218-F40-/1B/-PM	K218F40	K218F40-/1B/

Outline



X = assembled pin position

Pinout



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