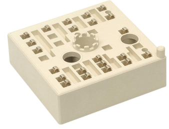
V23990-K200-A-PM
datasheet

MiniSKiiP® 1 PIM — **1200 V / 15 A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT3 technology

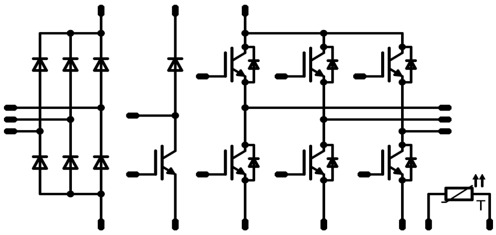
MiniSKiiP® 1 housing



Target Applications

- Industrial drives

Schematic



Types

- V23990-K200-A-PM

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
D8,D9,D10,D11,D12,D13					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j=T_jmax$	T_h=80℃	29	A
Surge forward current	I_{FSM}	t_p=10ms half sine wave	T_j=25℃	220	A
I^2t-value	I^2t			240	A^2s
Power dissipation	P_{tot}	$T_j=T_jmax$	T_h=80℃	46	W
Maximum Junction Temperature	T_jmax			150	℃
T1,T2,T3,T4,T5,T6,T7					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_jmax$	T_h=80℃	20	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_jmax		45	A
Power dissipation	P_{tot}	$T_j=T_jmax$	T_h=80℃	83	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 900	µs V
Maximum Junction Temperature	T_jmax			175	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
D1,D2,D3,D4,D5,D6,D7				
Repetitive peak reverse voltage	V_{RRM}		1200	V
DC forward current	I_F	T_j=$T_j$max T_h=80℃	20	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	42	A
Power dissipation	P_{tot}	T_j=$T_j$max T_h=80℃	49	W
Maximum Junction Temperature	$T_j$max		175	℃
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

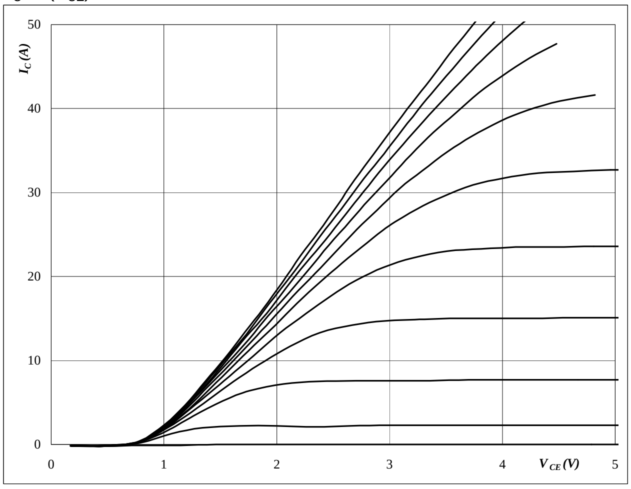
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
D8,D9,D10,D11,D12,D13										
Forward voltage	V_F				25	Tj=25°C Tj=125°C		1,51 1,42		V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0,86 0,79		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		0,0300 0,0300		Ω
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,05	mA
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um						1,5		K/W
T1,T2,T3,T4,T5,T6,T7										
Gate emitter threshold voltage	$V_{GE(th)}$	V_{CE}=V_{GE}			0,0006	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	Tj=25°C Tj=150°C	1,4	1,86 2,11	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0,0022	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			120	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=36 Ω Rgon=36 Ω	±15	600	15	Tj=25°C Tj=150°C		48 46		ns
Rise time	t_r					Tj=25°C Tj=150°C		27 33		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		348 424		
Fall time	t_f					Tj=25°C Tj=150°C		121 221		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1,54 2,04		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1,06 1,66		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1100		pF
Output capacitance	C_{oss}							100		
Reverse transfer capacitance	C_{rss}							50		
Gate charge	Q_{Gate}		±15			Tj=25°C		108		nC
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um						1,15		K/W
D1,D2,D3,D4,D5,D6,D7										
Diode forward voltage	V_F				15	Tj=25°C Tj=150°C		1,80 1,87		V
Peak reverse recovery current	I_{RRM}	diF/dt=tbd A/us	15	600	15	Tj=25°C Tj=150°C		12 14		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		477 651		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		2,03 3,38		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		91 36		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0,77 1,35		mWs
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um						1,95		K/W
PTC										
Rated resistance	R					T=25°C		1000		Ω
Deviation of R100	ΔR/R	R100=1670 Ω				T=100°C	-3		3	%
R100	P					T=100°C		1670,313		Ω
Power dissipation constant						T=25°C				mW/K
A-value	B(25/50)	Tol. %				T=25°C		7,635*10-3		1/K
B-value	B(25/100)	Tol. %				T=25°C		1,731*10-5		1/K²
Vincotech NTC Reference									E	

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



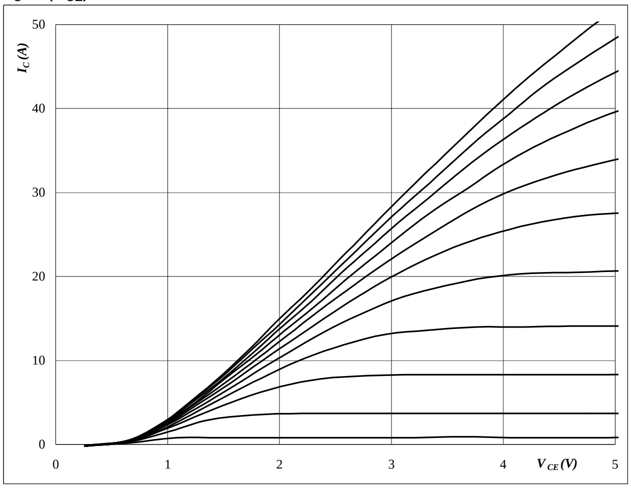
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



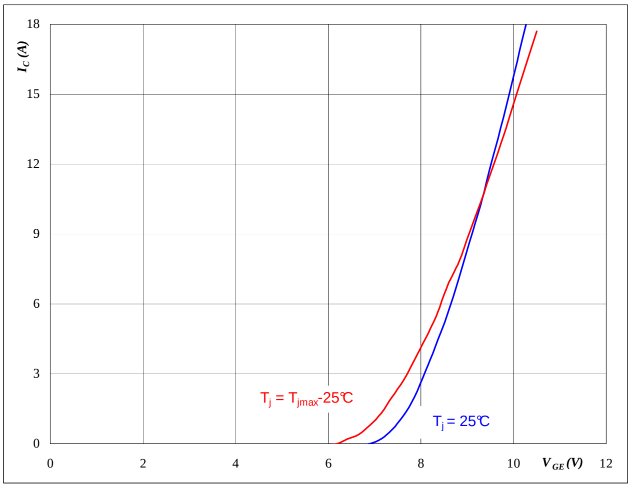
At

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



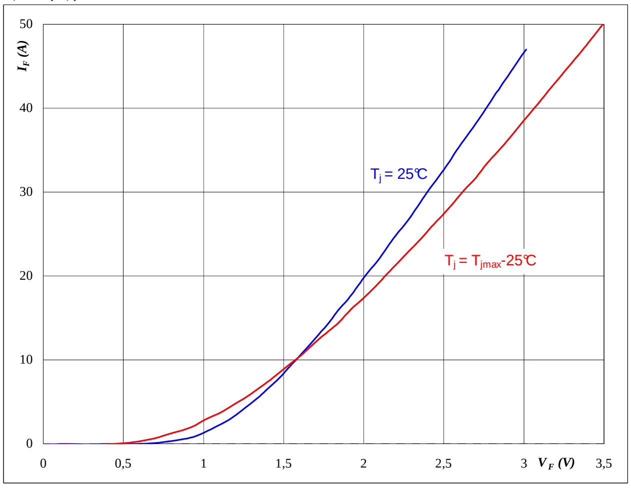
At

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

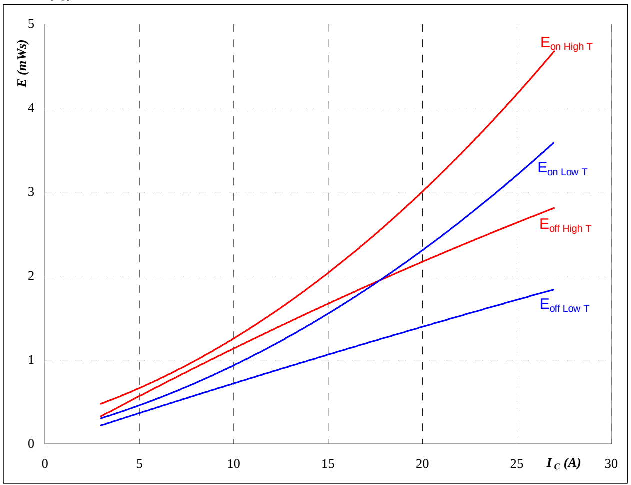
t_p =	250	μs

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



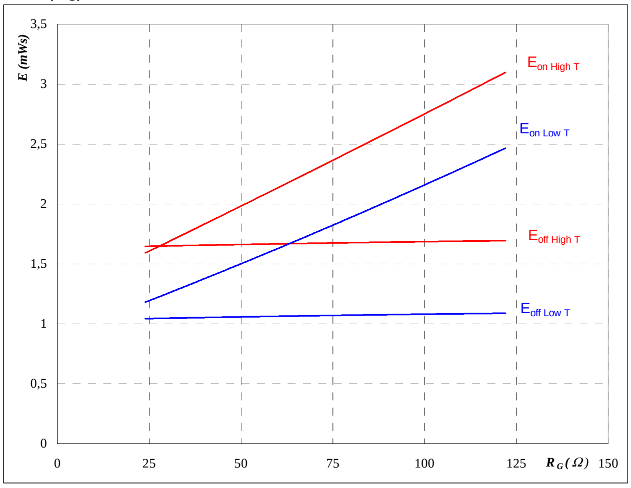
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω
R_{goff} =	54	Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



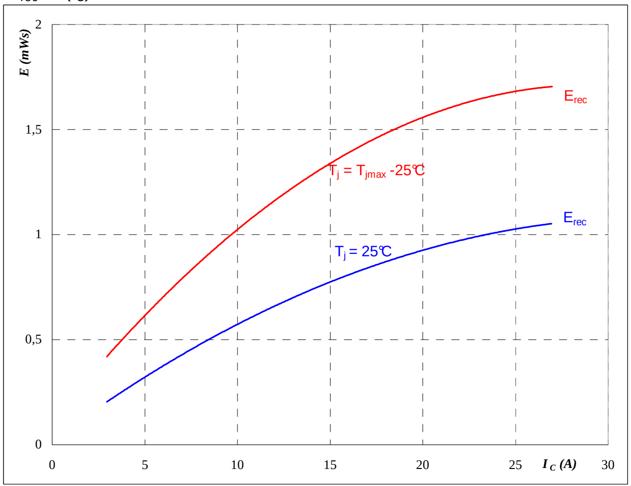
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Figure 7 IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



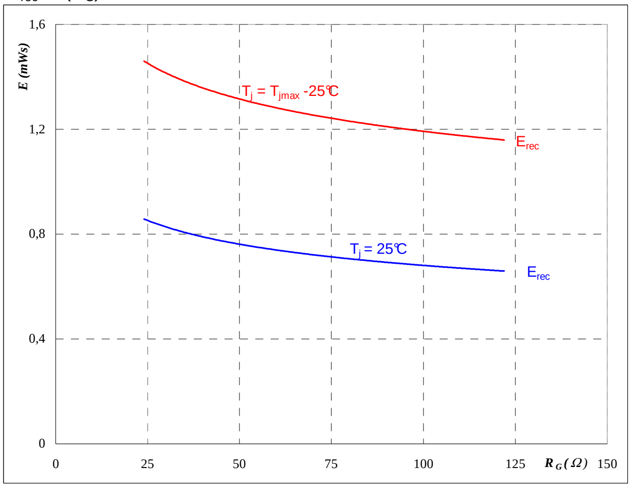
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	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

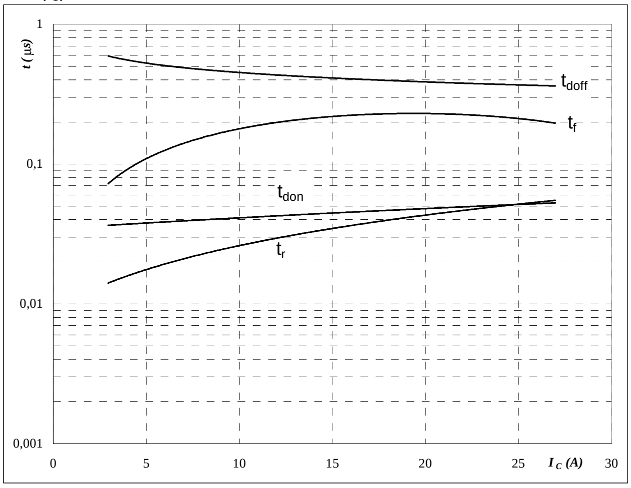
T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



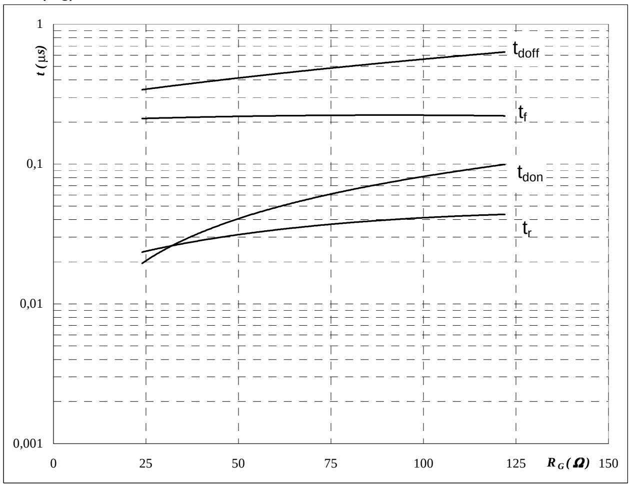
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω
R_{goff} =	54	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



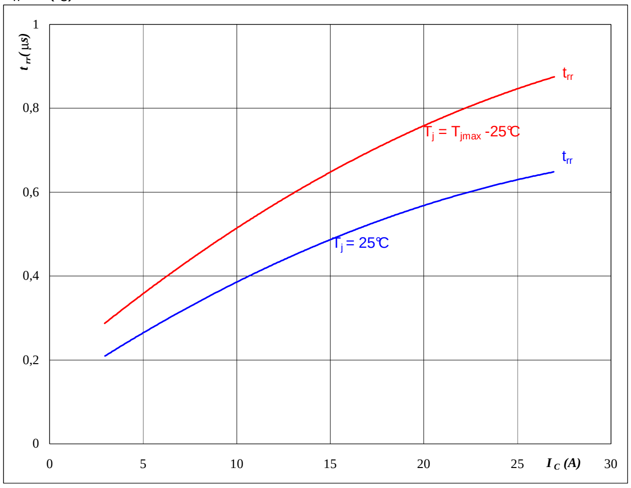
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



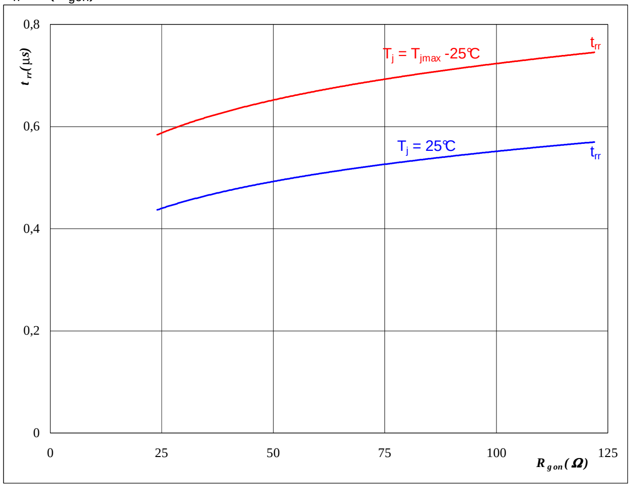
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

Figure 12 FWD

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

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



At

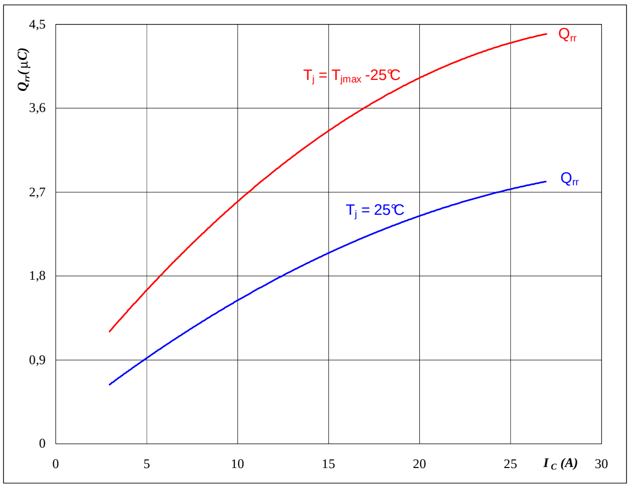
T_j =	25/125	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



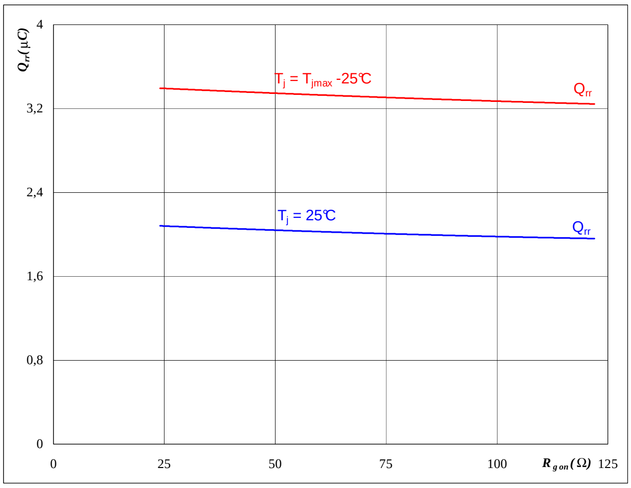
At

T_j =	25/125	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

Figure 14 FWD

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

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



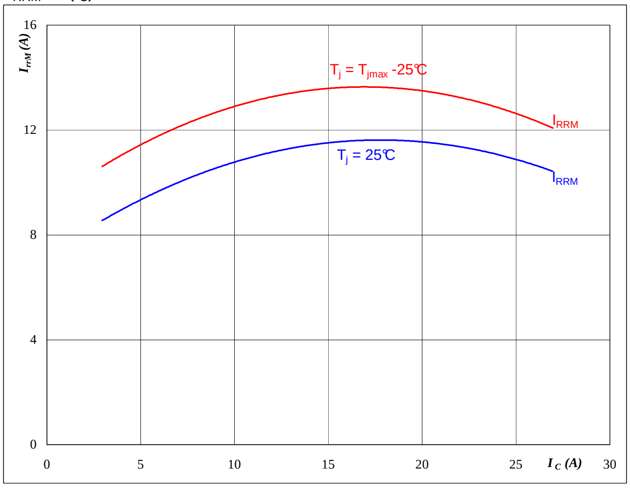
At

T_j =	25/125	℃
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



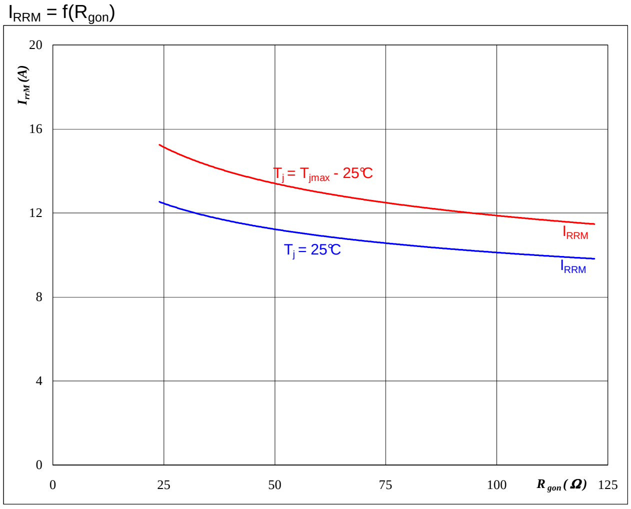
At

T_j =	25/125	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

Figure 16 FWD

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

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



At

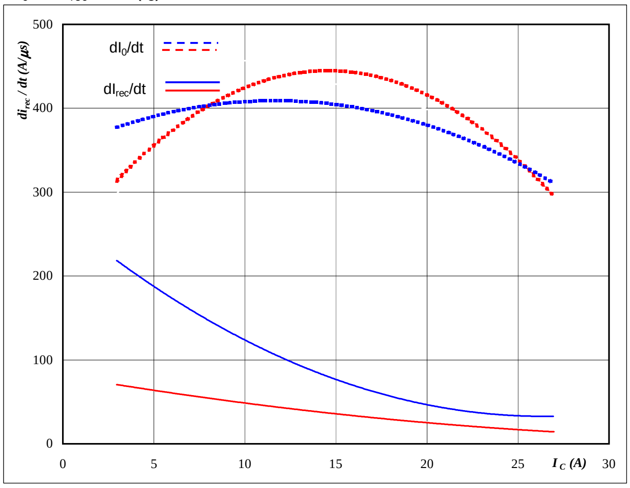
T_j =	25/125	℃
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 17 FWD

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

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



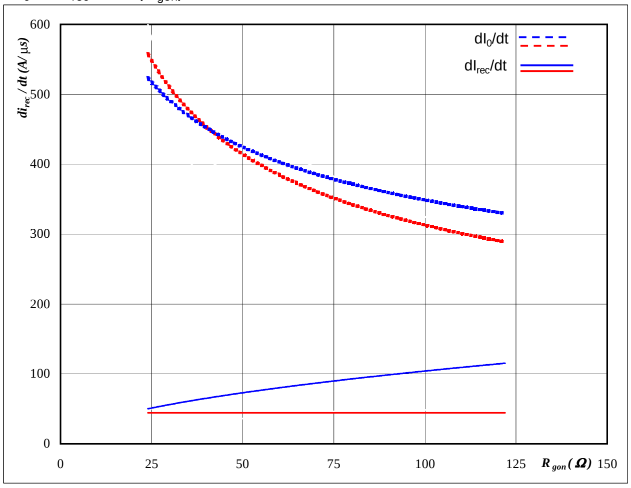
At

T_j =	25/125	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

Figure 18 FWD

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

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



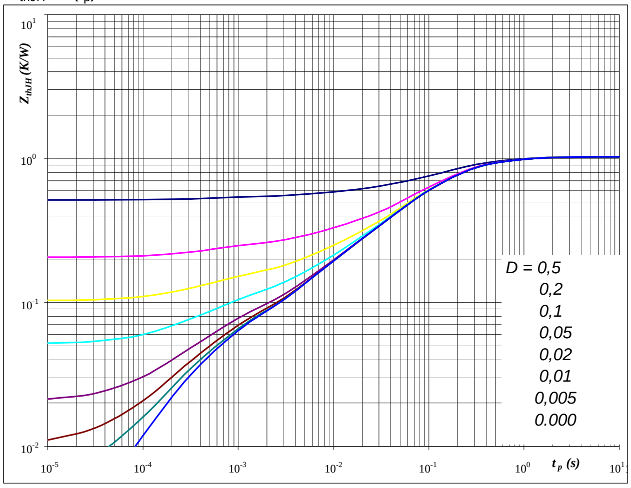
At

T_j =	25/125	℃
V_R =	600	V
I_F =	15	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} =	1,15	K/W

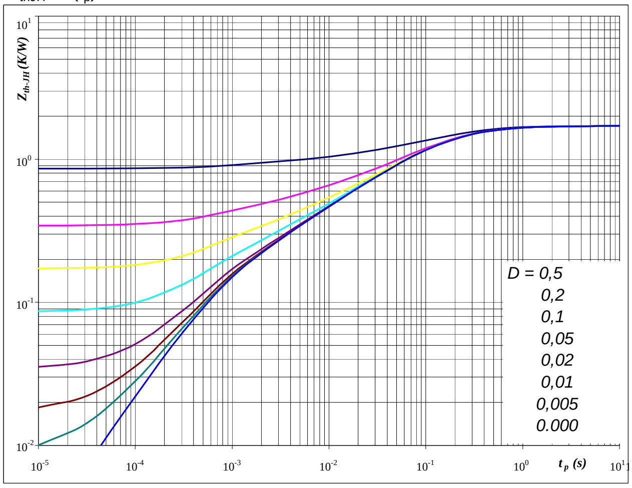
IGBT thermal model values

R (K/W)	Tau (s)
0,08	1,3E+00
0,48	2,0E-01
0,32	5,9E-02
0,09	7,3E-03
0,05	4,5E-04

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} =	1,95	K/W

FWD thermal model values

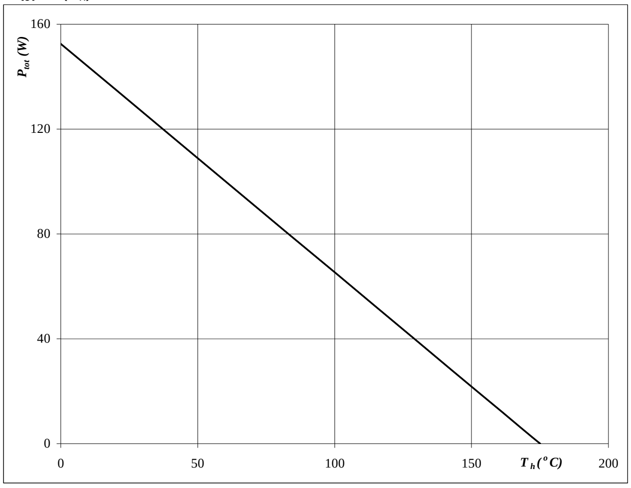
R (K/W)	Tau (s)
0,09	2,0E+00
0,60	2,1E-01
0,61	5,6E-02
0,26	8,0E-03
0,15	8,1E-04

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



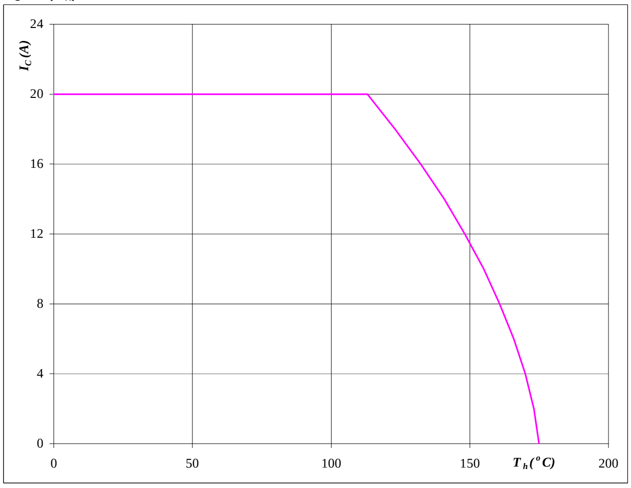
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

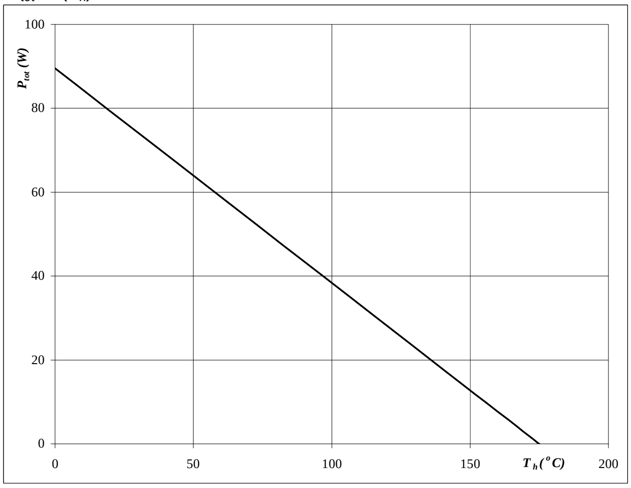
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



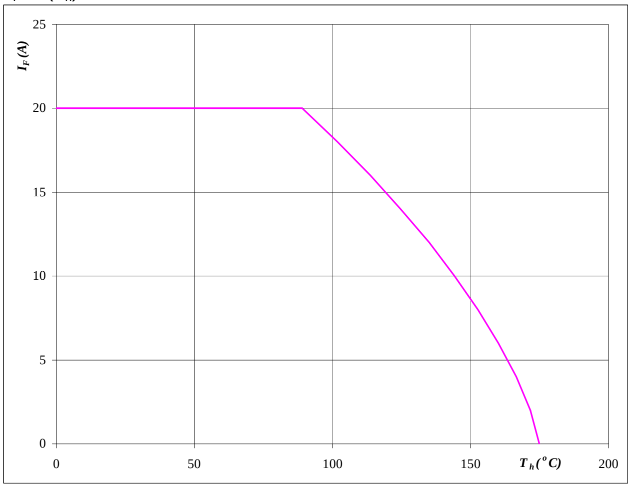
At

T_j = 175 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

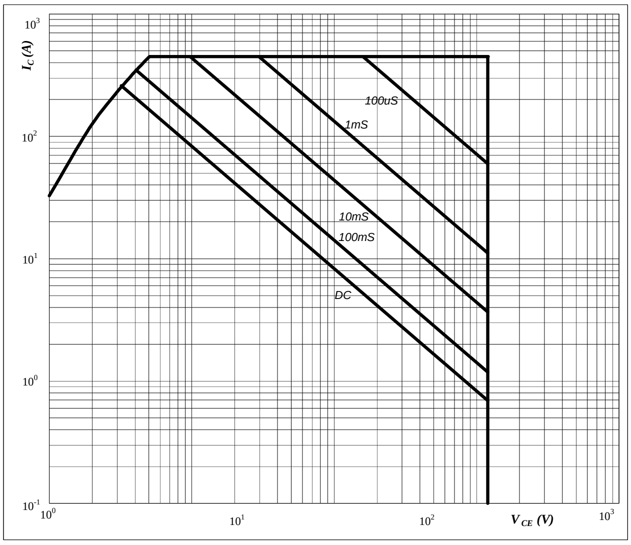
T_j = 175 ℃

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



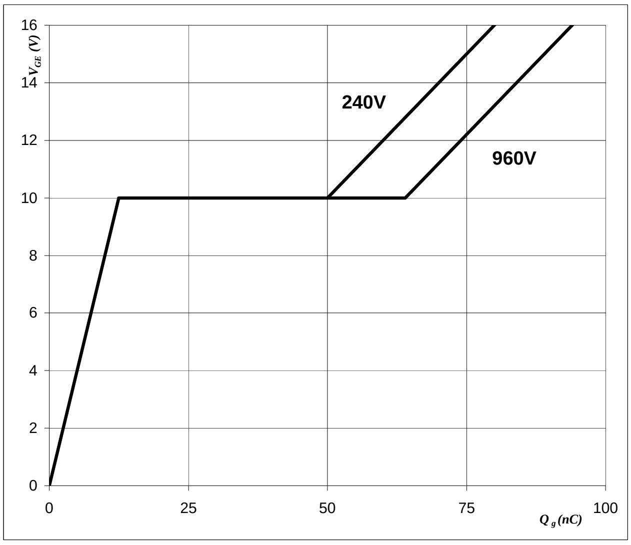
At

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

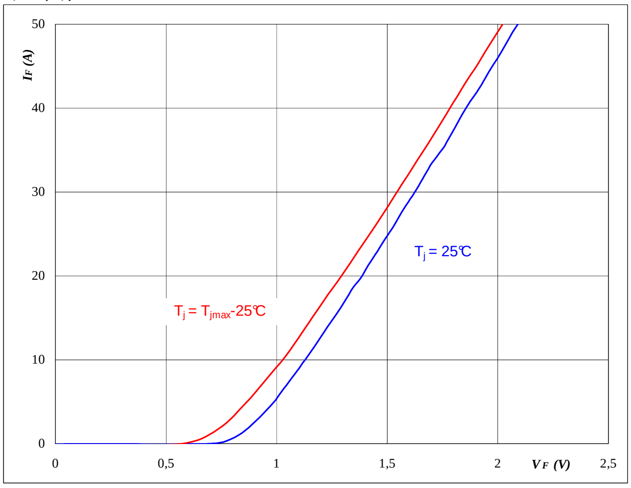
I_C =	15	A

D8,D9,D10,D11,D12,D13

Figure 1 Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



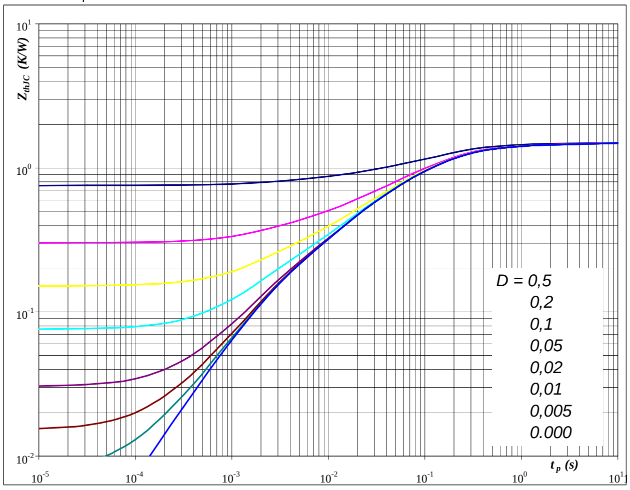
At

t_p =	250	μs

Figure 2 Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



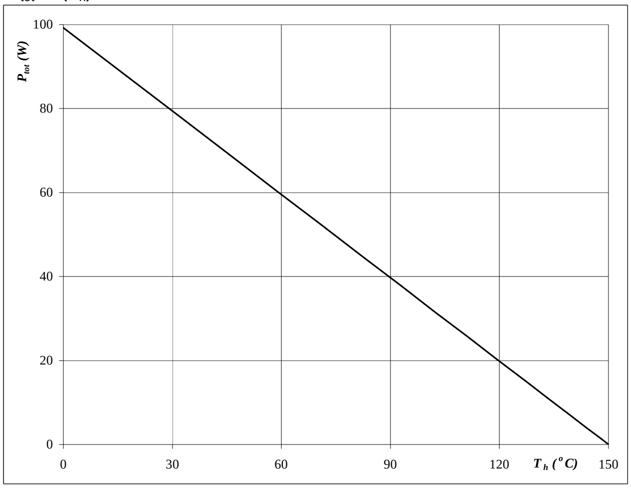
At

D =	t_p / T	
R_{thJH} =	1,5	K/W

Figure 3 Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



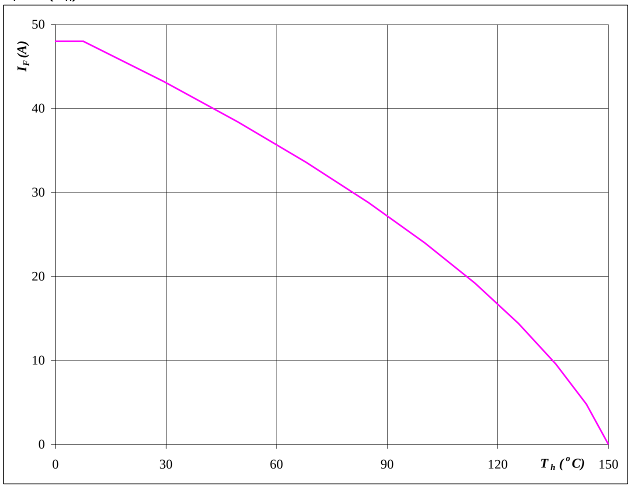
At

T_j =	150	ºC

Figure 4 Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



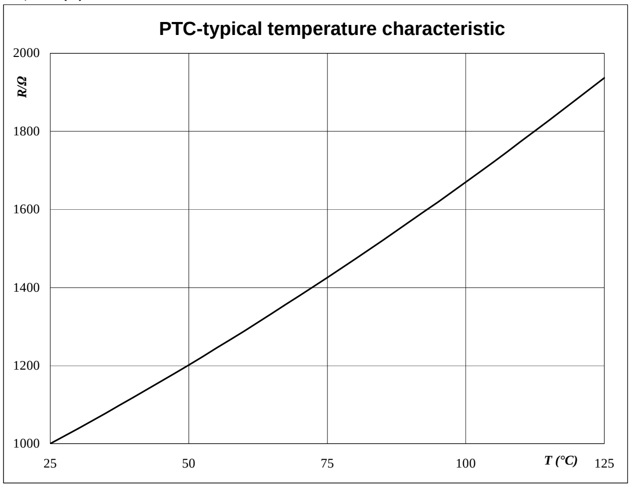
At

T_j =	150	ºC

Thermistor

Figure 1	Thermistor

Typical PTC characteristic
as a function of temperature
$R_T = f(T)$



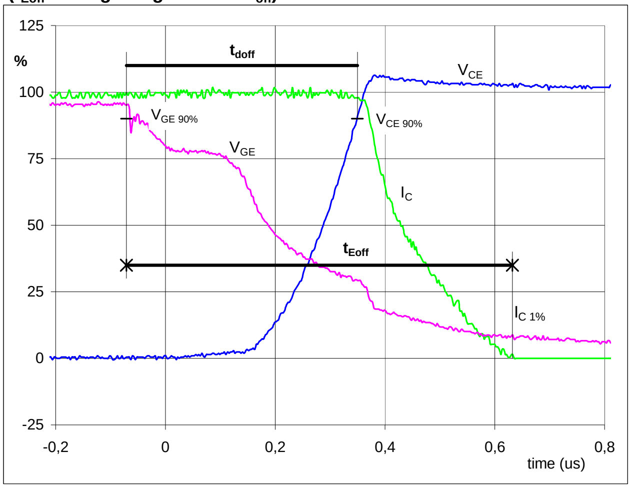
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

Figure 1 Output inverter IGBT

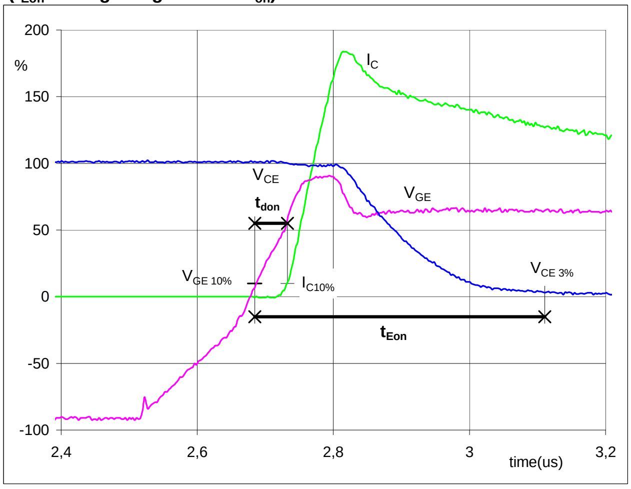
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{doff} =	0,42	µs
t_{Eoff} =	0,70	µs

Figure 2 Output inverter IGBT

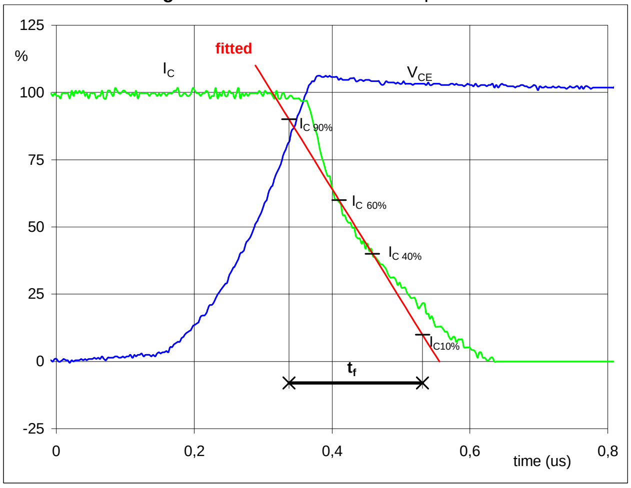
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (-100%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{don} =	0,05	µs
t_{Eon} =	0,43	µs

Figure 3 Output inverter IGBT

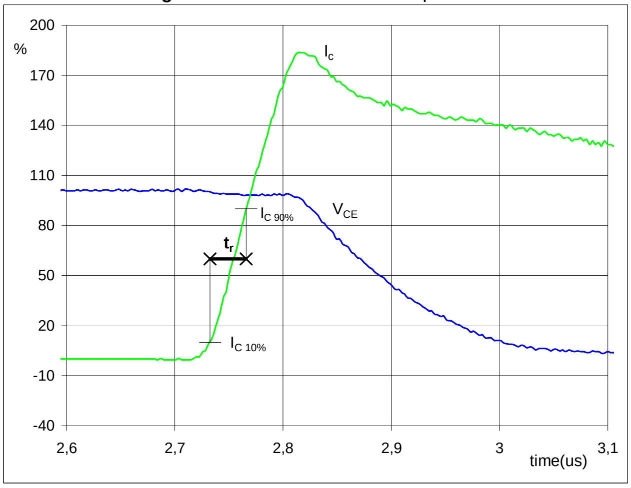
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	15	A
t_f =	0,22	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

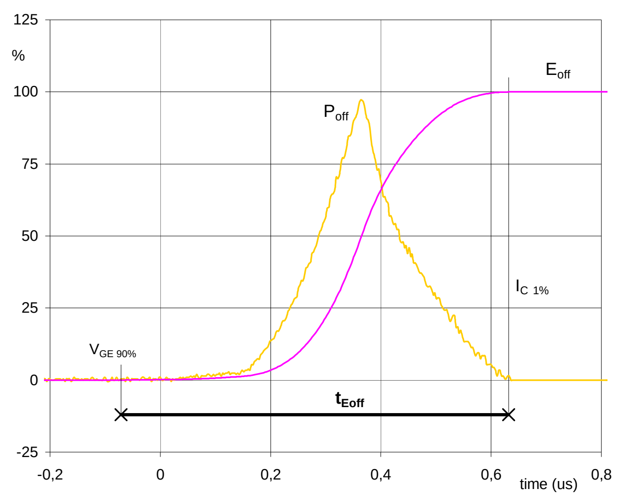


V_C (100%) =	600	V
I_C (100%) =	15	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

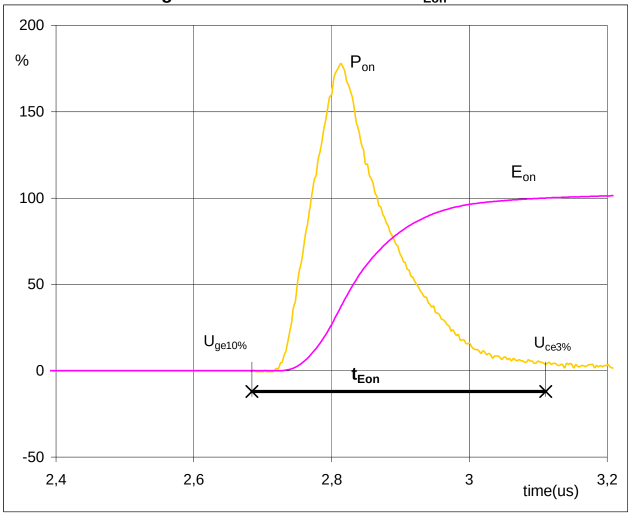
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	8,95	kW
E_{off} (100%) =	1,66	mJ
t_{Eoff} =	0,70	μs

Figure 6 Output inverter IGBT

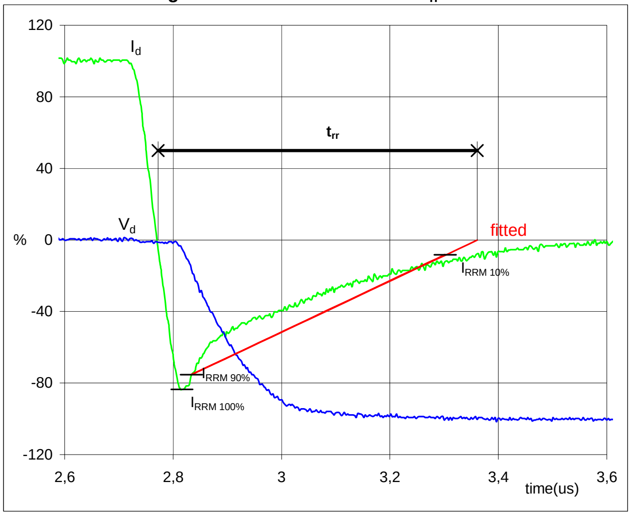
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	8,95	kW
E_{on} (100%) =	2,04	mJ
t_{Eon} =	0,43	μs

Figure 7 Output inverter IGBT

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

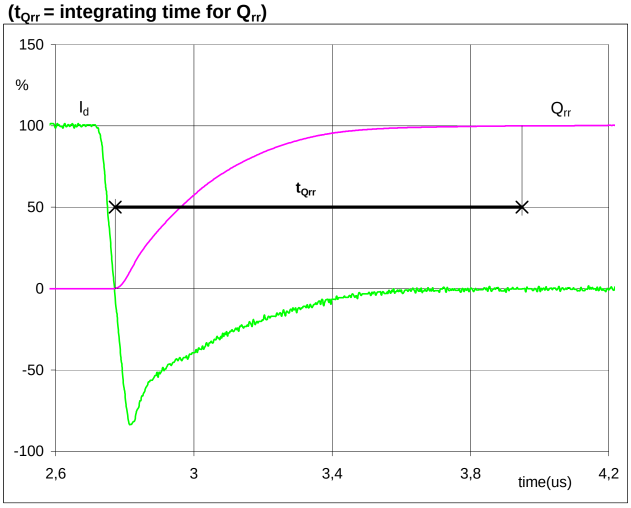


V_d (100%) =	600	V
I_d (100%) =	15	A
I_{RRM} (100%) =	14	A
t_{rr} =	0,65	μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

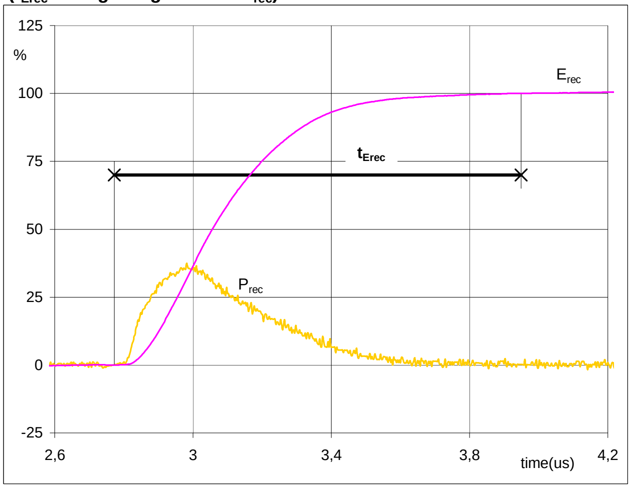
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	3,38	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})



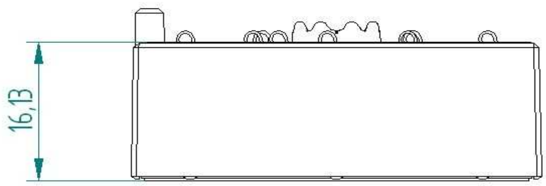
P_{rec} (100%) =	8,95	kW
E_{rec} (100%) =	1,35	mJ
t_{Erec} =	1,18	μs

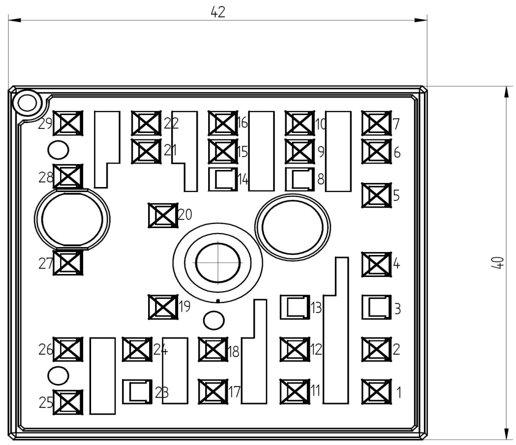
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K12-T-PM)	V23990-K200-A-/0A/-PM	K200A	K200A-/0A/
with std lid (black V23990-K12-T-PM) and P12	V23990-K200-A-/1A/-PM	K200A	K200A-/1A/
with thin lid (white V23990-K13-T-PM)	V23990-K200-A-/0B/-PM	K200A	K200A-/0B/
with thin lid (white V23990-K13-T-PM) and P12	V23990-K200-A-/1B/-PM	K200A	K200A-/1B/

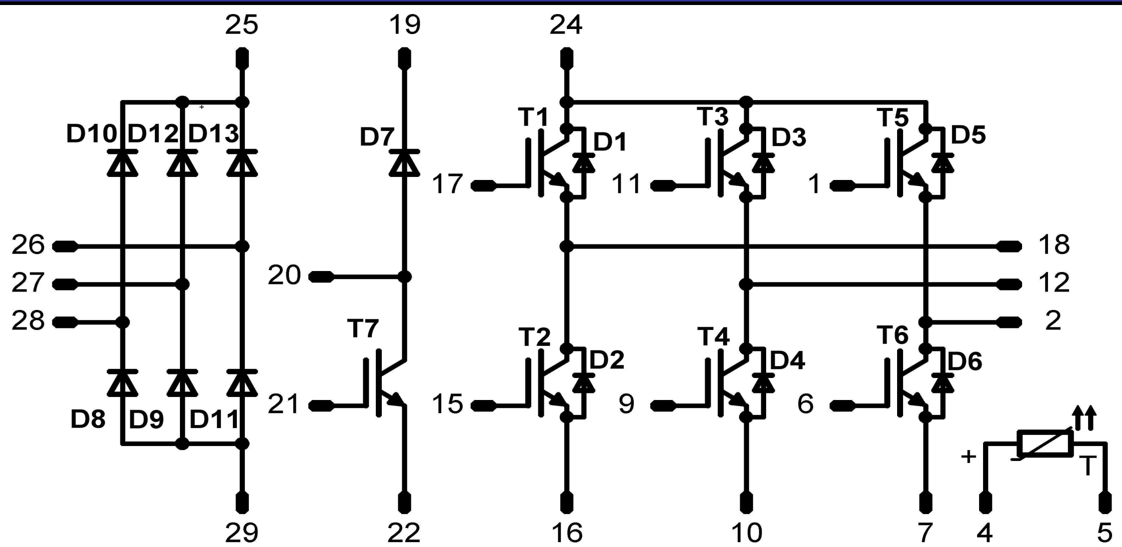
Outline





X = assembled pin position

Pinout



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