MiniSKiiP® 3 PIM 1200V/50A

Features

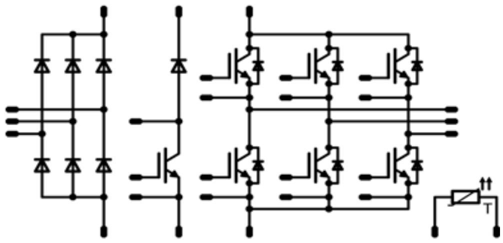
- Solderless interconnection
- Mitsubishi Generation 6 technology

MiniSKiiP® 3 housing

Target Applications

- Industrial Motor Drives

Schematic



Types

- V23990-K428-A50-PM

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Input Rectifier Diode				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}	$T_j=T_jmax$ T_h=80°C T_c=80°C	74 102	A
Surge forward current	I_{FSM}	t_p=10ms T_c=25°C	500	A
I^2t-value	I^2t	T_c=150°C	1200	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$ T_h=80°C T_c=80°C	79 120	W
Maximum Junction Temperature	T_jmax		150	°C
Inverter Transistor				
Collector-emitter break down voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j=T_jmax$ T_h=80°C T_c=80°C	40 55	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_jmax	100	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$ T_h=80°C T_c=80°C	100 152	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V	10 800	μs V
Maximum Junction Temperature	T_jmax		175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	42 60	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		100	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	83 125	W
Maximum Junction Temperature	$T_j$max			175	°C
Brake Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	55 57	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		100	A
Turn off safe operating area		VCE ≤ 850V, Tj ≤ Top max		100	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	105 159	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	μs V
Maximum Junction Temperature	$T_j$max			175	°C
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	46 64	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		100	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	81 123	W
Maximum Junction Temperature	$T_j$max			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

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	
Input Rectifier Diode										
Forward voltage	V_F				50	Tj=25°C Tj=125°C		1,07 0,98	1,59	V
Threshold voltage (for power loss calc. only)	V_{to}				50	Tj=25°C Tj=125°C		0,88 0,74		V
Slope resistance (for power loss calc. only)	r_t				50	Tj=25°C Tj=125°C		4 6		mΩ
Reverse current	I_r			1600		Tj=25°C Tj=125°C			0,1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,88		K/W
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$				0,0008	Tj=25°C Tj=150°C	5,4	6	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C	1,6	1,86 2,23	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			500	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C		119 116		ns
Rise time	t_r					Tj=25°C Tj=150°C		32 37		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		155 206		
Fall time	t_f					Tj=25°C Tj=150°C		62 96		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		3,86 6,08		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		2,66 4,51		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3210		nF
Output capacitance	C_{oss}							280		
Reverse transfer capacitance	C_{rss}							37		
Gate charge	Q_{Gate}		±15			Tj=25°C		117		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,95		K/W
Inverter Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,35	1,75 1,75	2,05	V
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C		42 50		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		271 465		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		4,98 10,08		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		355 155		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		1,89 3,95		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,15		K/W

Characteristic Values

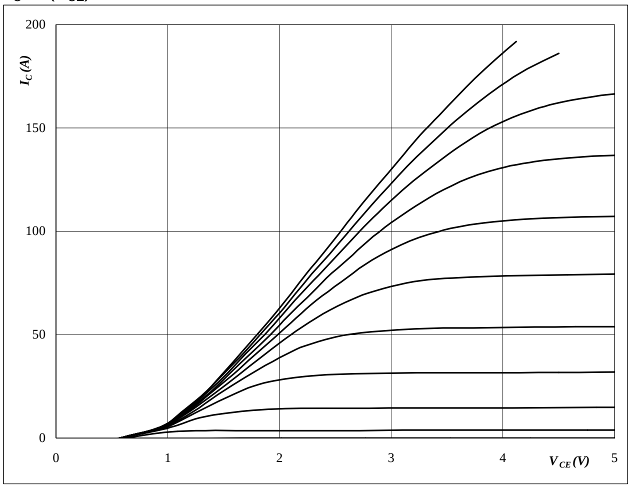
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Brake Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0008	Tj=25°C Tj=150°C	5,5	6	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C	1,6	1,83 2,17	2,4	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			500	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C		120 116		ns
Rise time	t_r					Tj=25°C Tj=150°C		51 56		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		147 195		
Fall time	t_f					Tj=25°C Tj=150°C		54 94		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		4,78 7,34		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		2,61 4,37		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3210		pF
Output capacitance	C_{oss}							280		
Reverse transfer capacitance	C_{rss}							37		
Gate charge	Q_{Gate}		±15			Tj=25°C		117		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,91		K/W
Brake Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,35	1,66 1,61	2,05	V
Reverse leakage current	I_r	Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C			10	μA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C		31 40		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		307 511		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		4,75 4,75		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		226 126		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		1,81 3,83		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,17		K/W
Thermistor										
Rated resistance	R					Tj=25°C		1000		Ω
Deviation of R100	ΔR/R	R100=1670 Ω				Tc=100°C	-3		3	%
Power dissipation	P					Tc=100°C		1670,313		Ω
Power dissipation constant						Tj=25°C				mW/K
B-value	$B_{(25/50)}$					Tj=25°C		7,635*10-3		1/K
B-value	$B_{(25/100)}$					Tj=25°C		1,731*10-5		1/K²
Vincotech PTC Reference						Tj=25°C			E	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



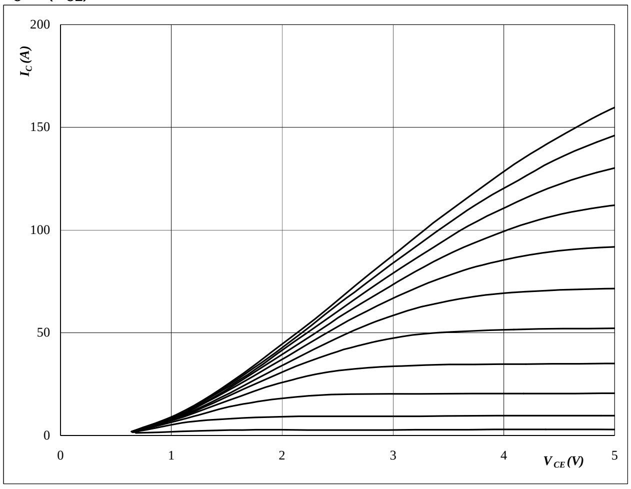
At

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

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



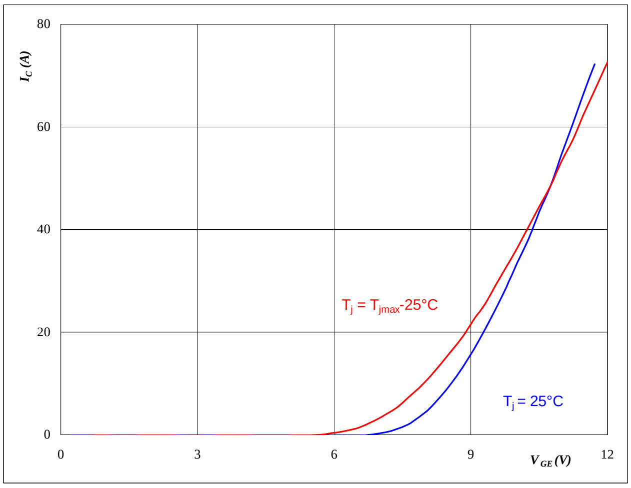
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



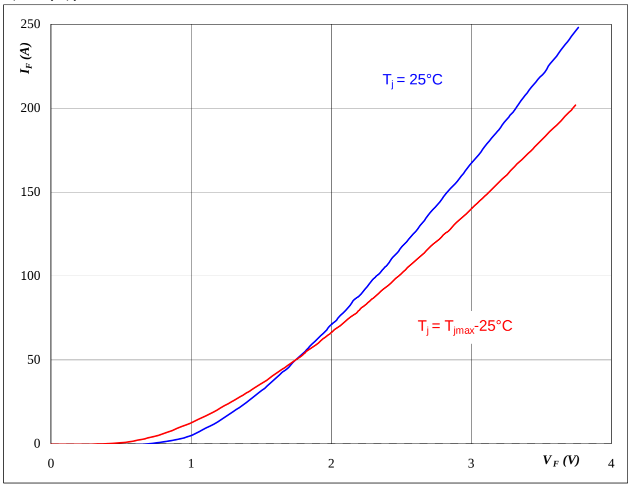
At

t_p =	250	µs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

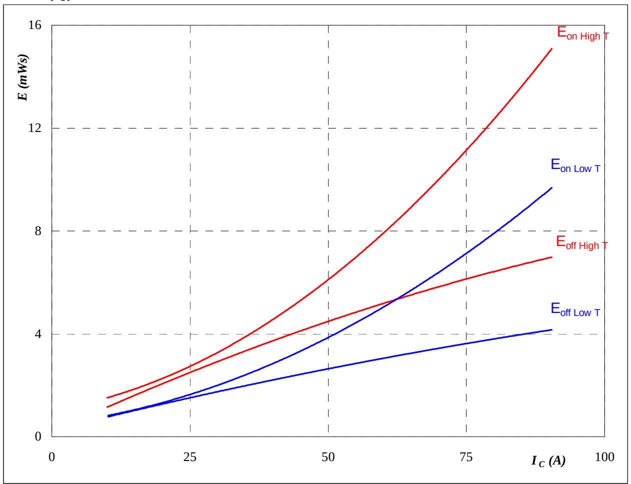
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



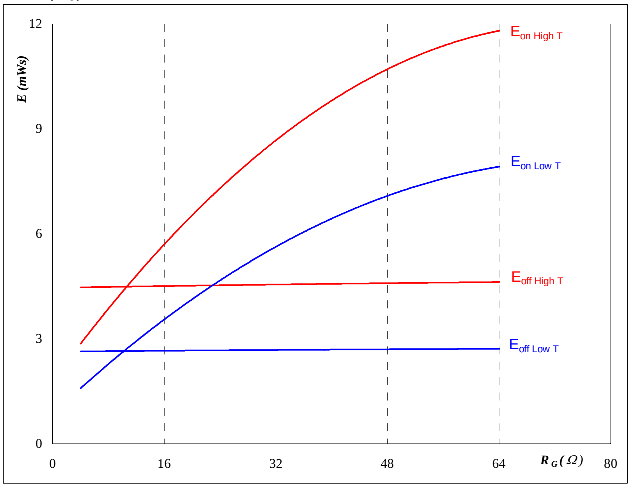
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



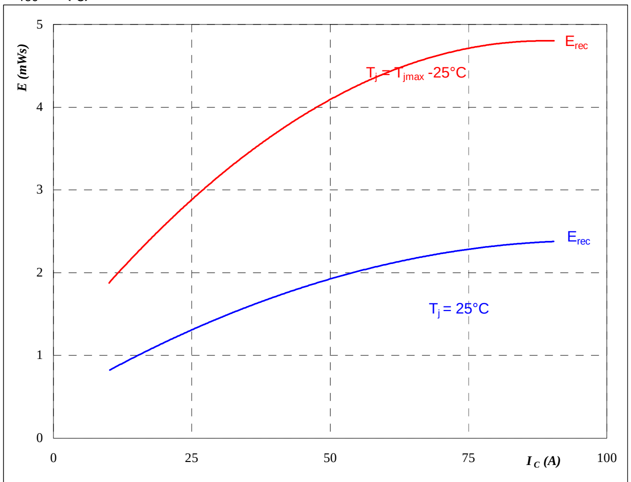
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7 Output inverter FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



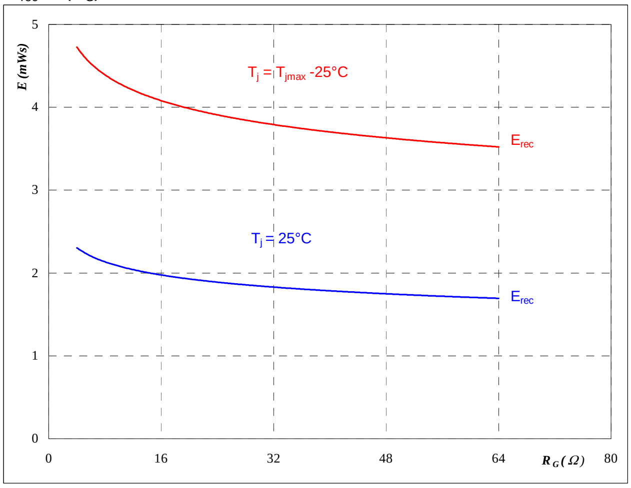
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 8 Output inverter FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

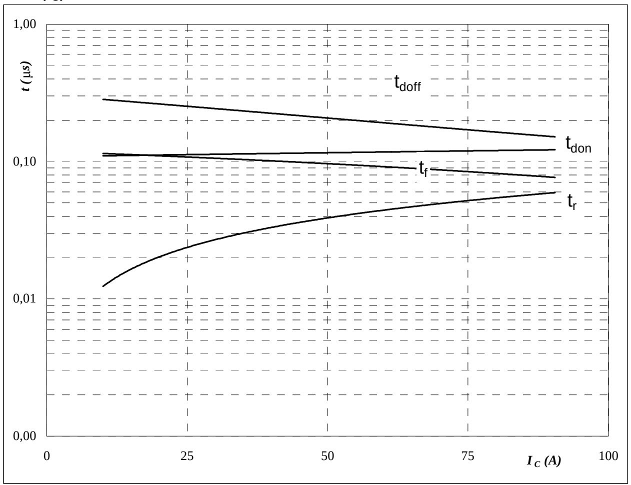
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



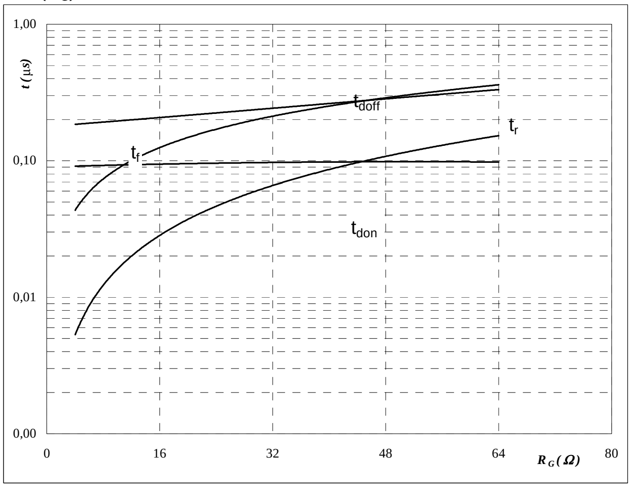
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



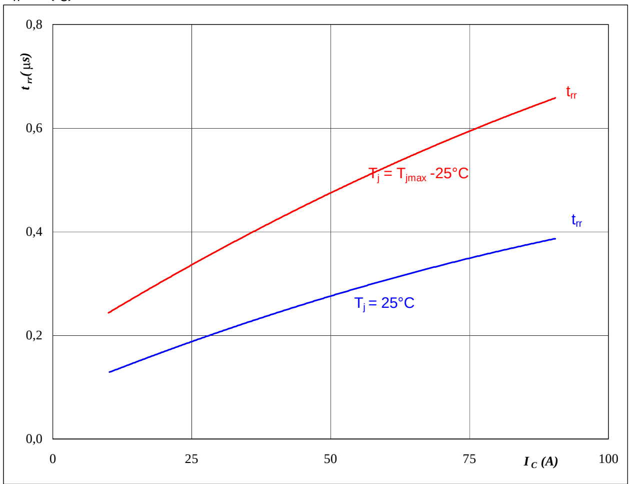
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



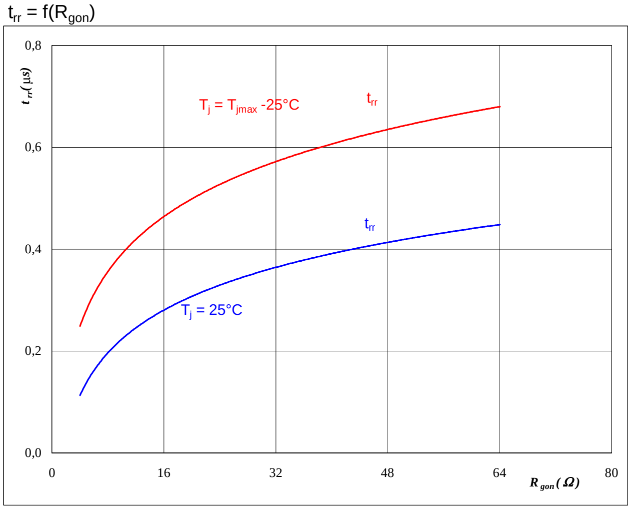
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 12 Output inverter FWD

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

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



At

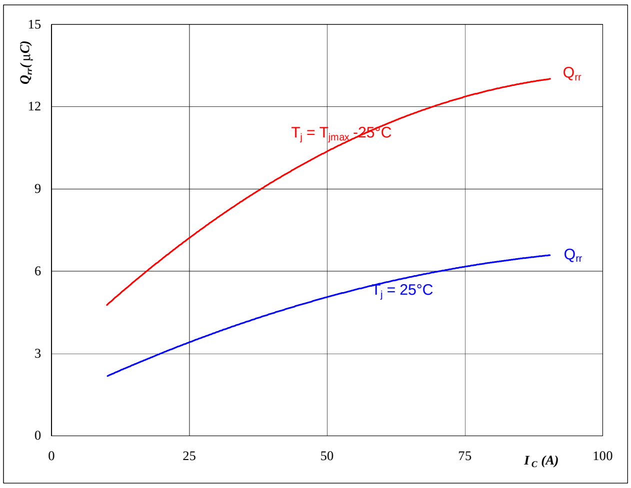
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



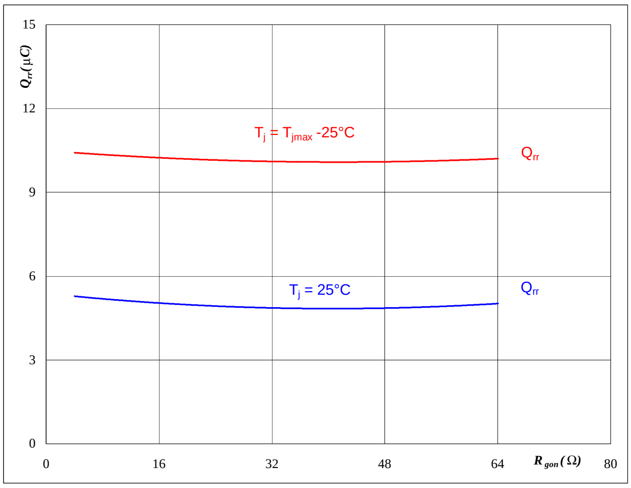
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 14 Output inverter FWD

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

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



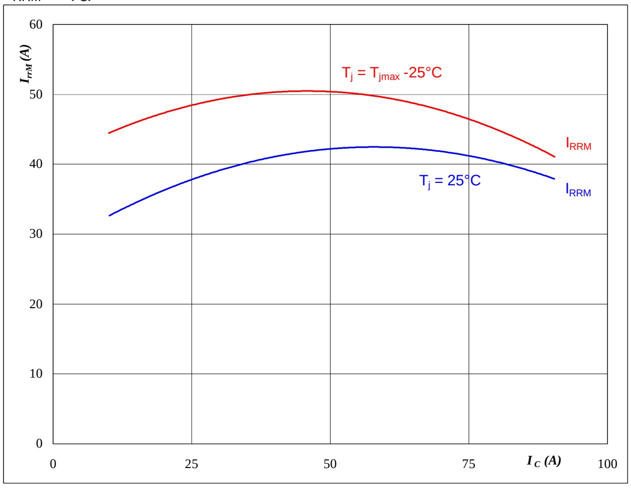
At

T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



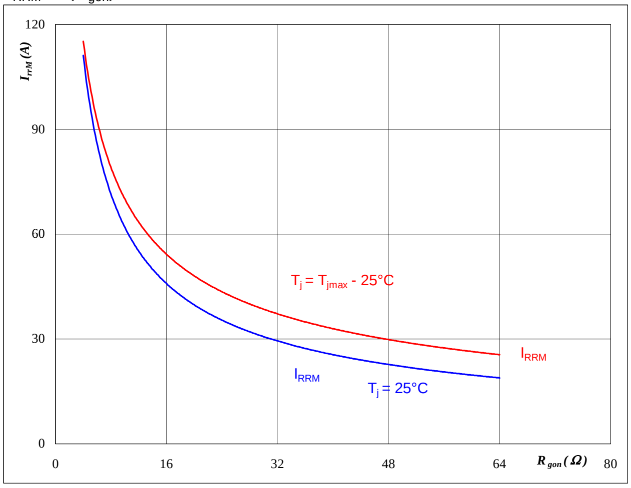
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 16 Output inverter FWD

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

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



At

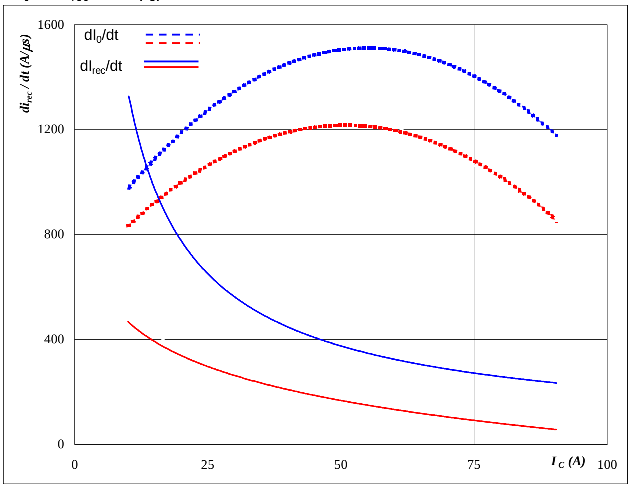
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



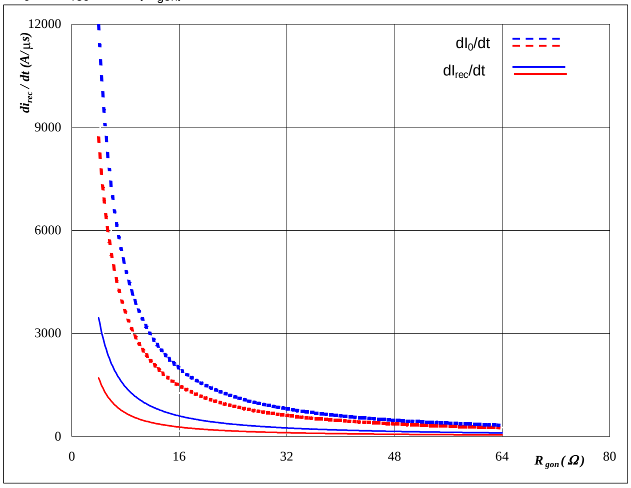
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 18 Output inverter FWD

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

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



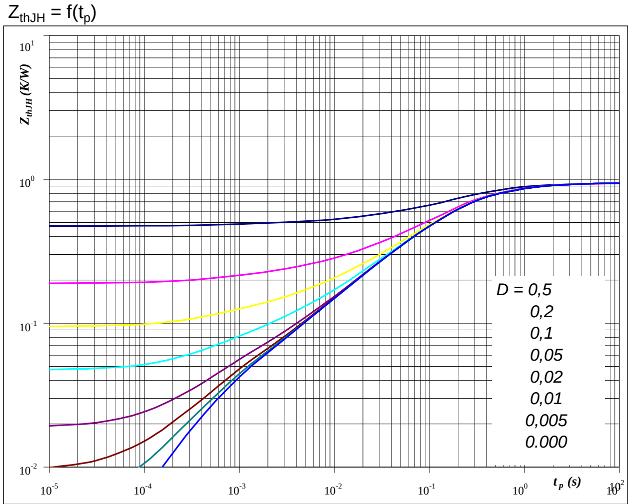
At

T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T				
R_{thJH} =	0,95	K/W	R_{thJH} =	0,92	K/W

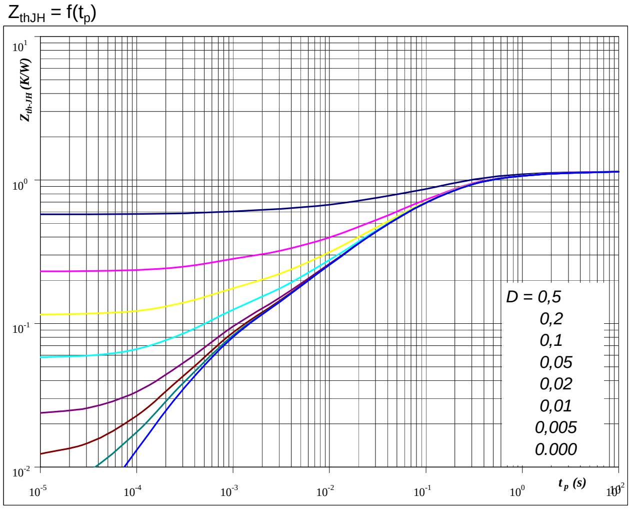
IGBT thermal model values

Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,03	5,8E+00	0,03	4,7E+00
0,12	1,2E+00	0,10	9,5E-01
0,44	2,3E-01	0,36	1,8E-01
0,22	6,9E-02	0,18	5,6E-02
0,10	1,1E-02	0,08	8,7E-03
0,03	1,0E-03	0,02	8,5E-04

Figure 20 Output inverter FWD

FWD 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	R_{thJH} =	0,93	K/W

FWD thermal model values

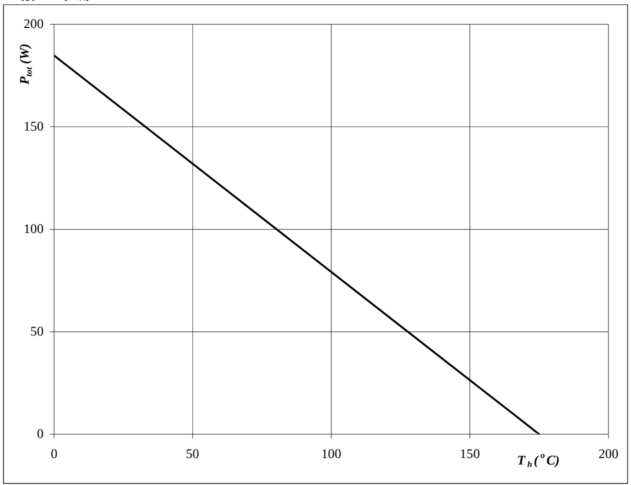
Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,04	6,0E+00	0,03	4,9E+00
0,12	1,0E+00	0,09	8,1E-01
0,37	2,1E-01	0,30	1,7E-01
0,34	7,1E-02	0,27	5,8E-02
0,17	1,6E-02	0,13	1,3E-02
0,06	4,5E-03	0,05	3,7E-03

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



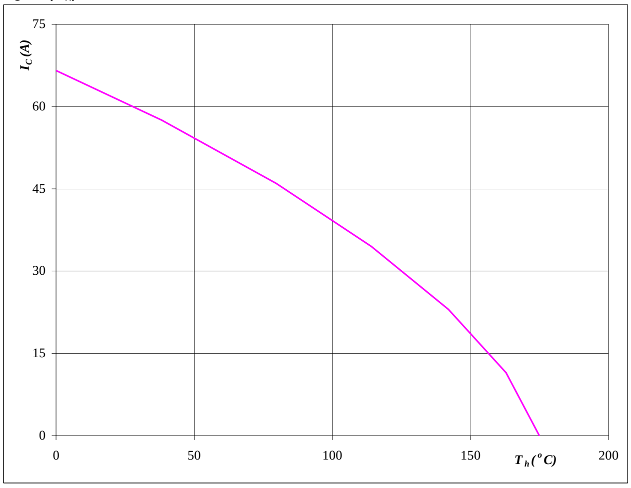
At

T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

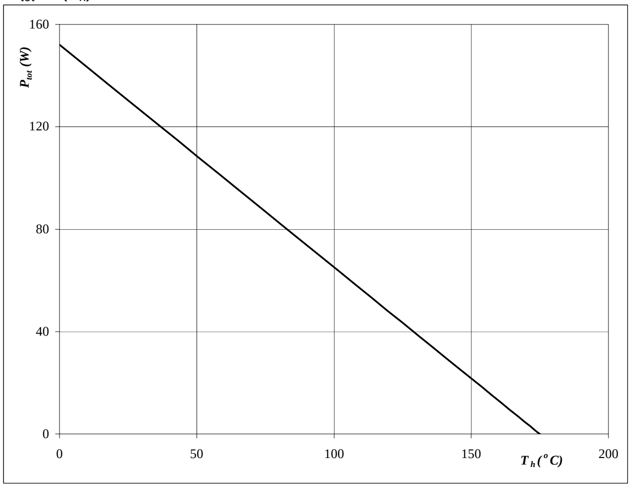
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



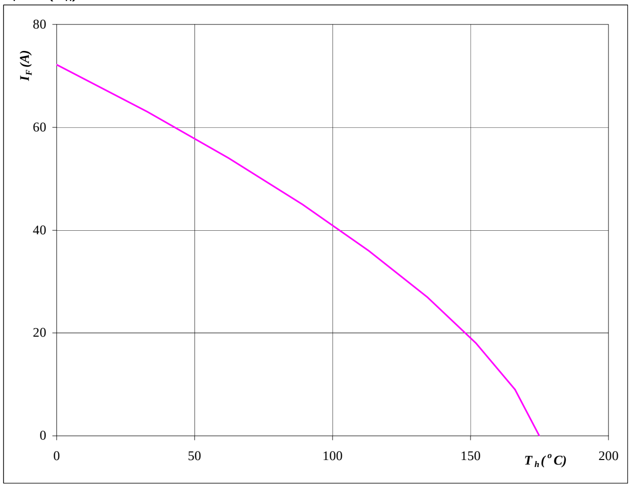
At

T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

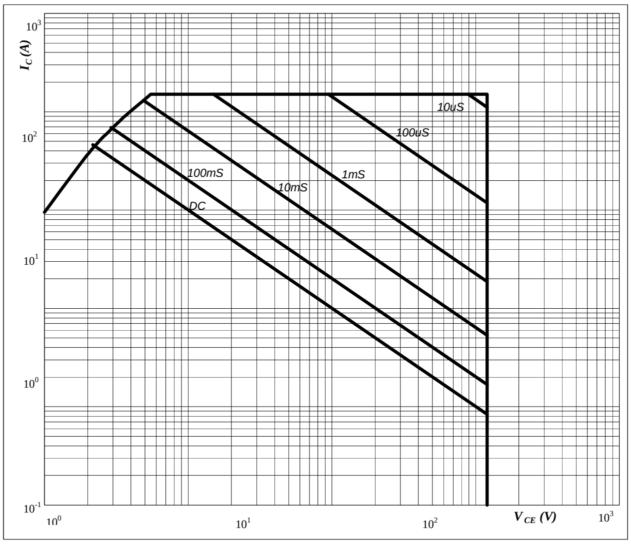
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



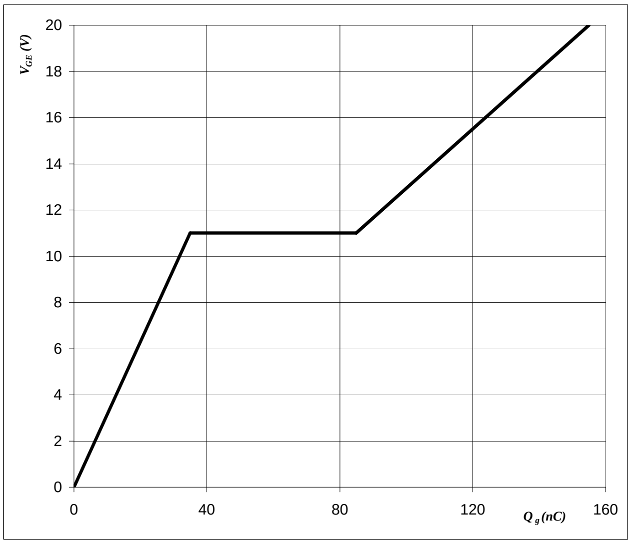
At

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

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

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



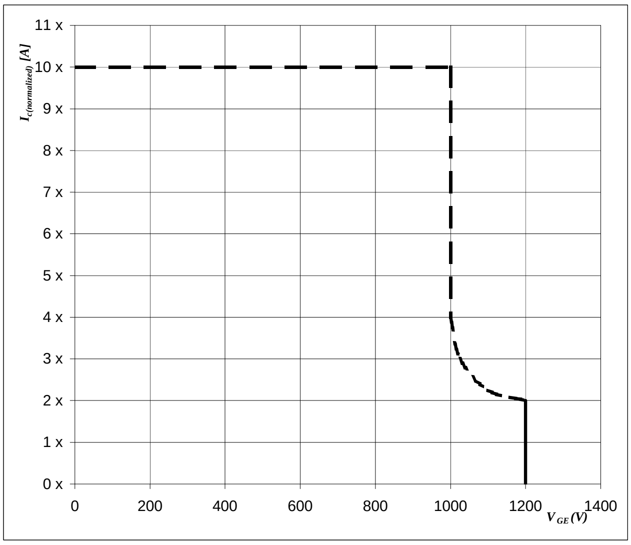
At

I_C =	50	A

Figure 27 Output inverter IGBT

Short circuit safe operating area (SCSOA)

$I_c = f(V_{CE})$

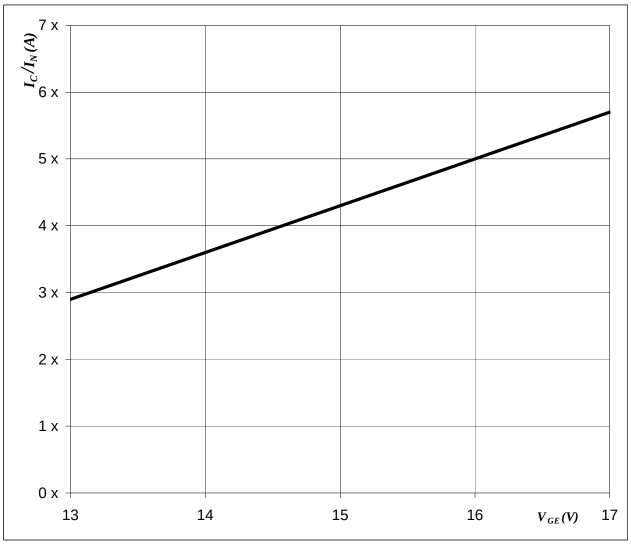


At

V_{CC} ≤	850	V	t_W≤	10	uS
T_j ≤	150	ºC			

Figure 28 Output inverter IGBT

Typical short circuit collector current as a function of gate-emitter voltage



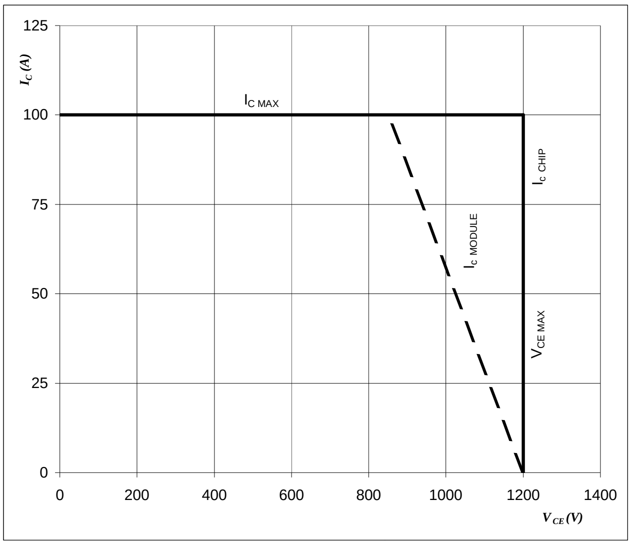
At

V_{CE} ≤	1200	V	V_{CC}=	800	V
T_j =	150	ºC			

Figure 29 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	T_{jmax}-25	ºC	V_{CC}≤	850	V

$U_{ccminus}$=U_{ccplus}

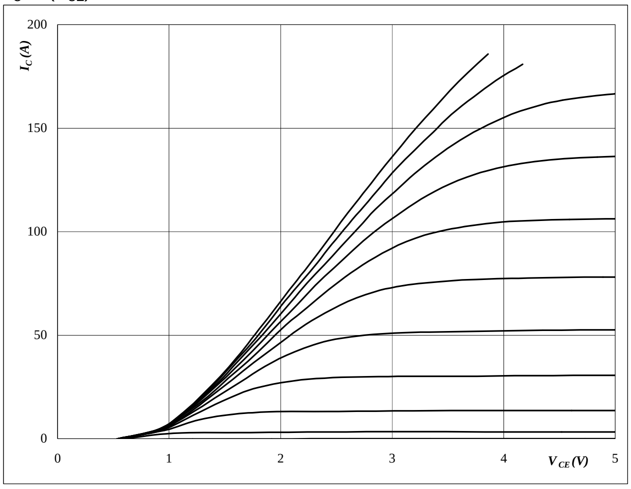
Switching mode : 3 level switching

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

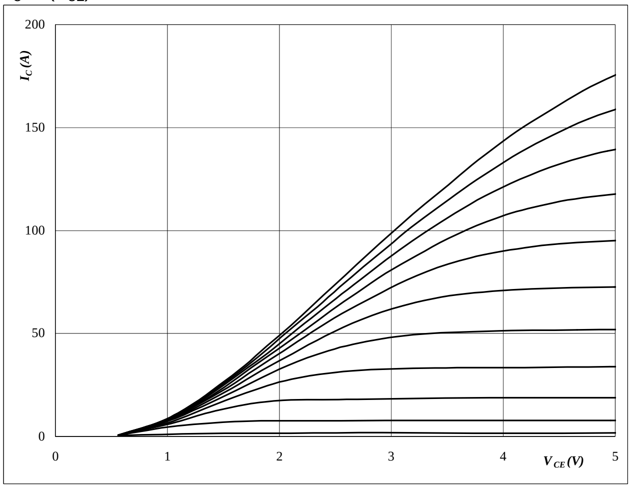
T_j = 25 °C

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

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

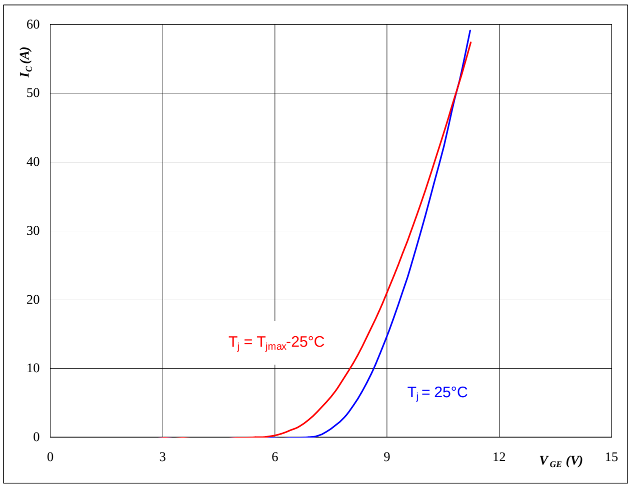
T_j = 151 °C

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

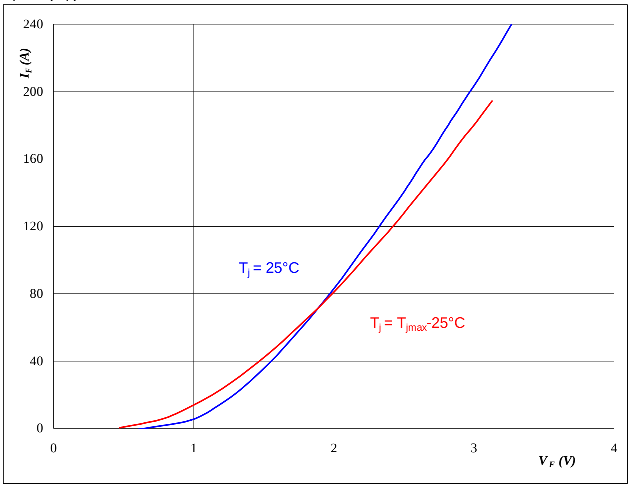
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

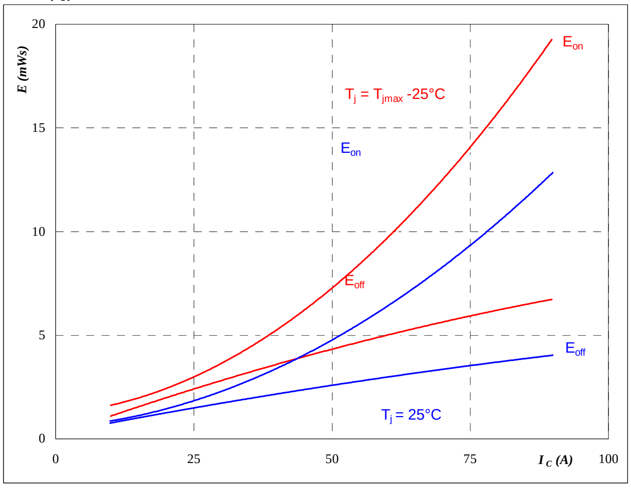
t_p = 250 µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



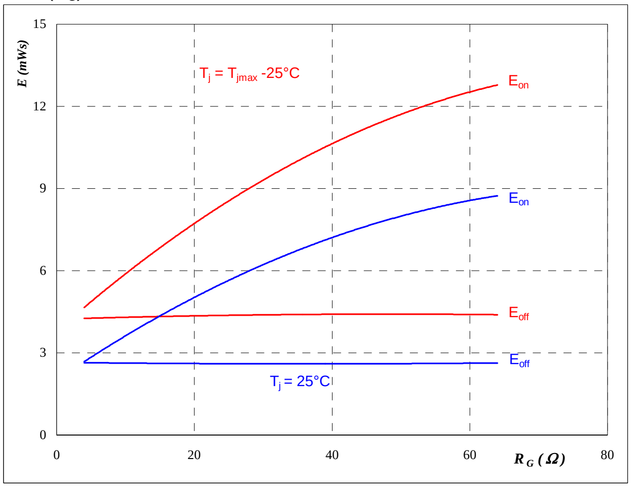
With an inductive load at

T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 6 Brake IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



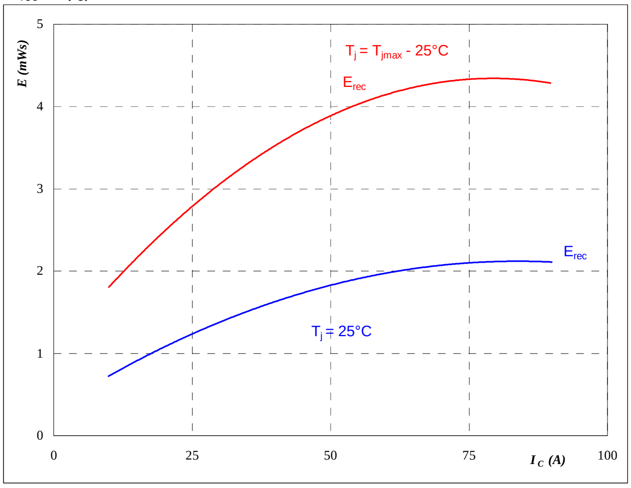
With an inductive load at

T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7 Brake FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



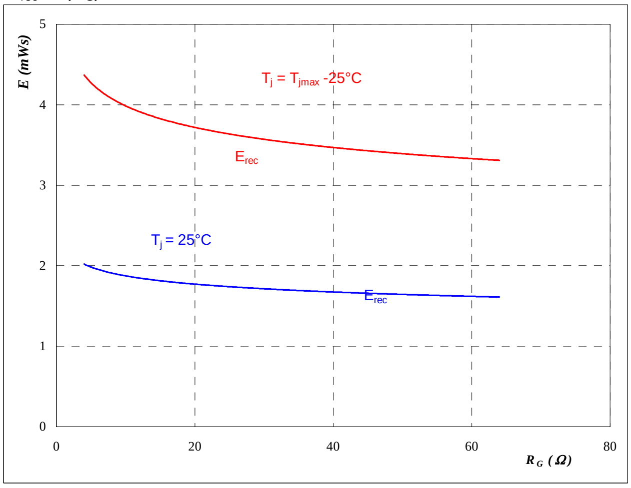
With an inductive load at

T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 8 Brake FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

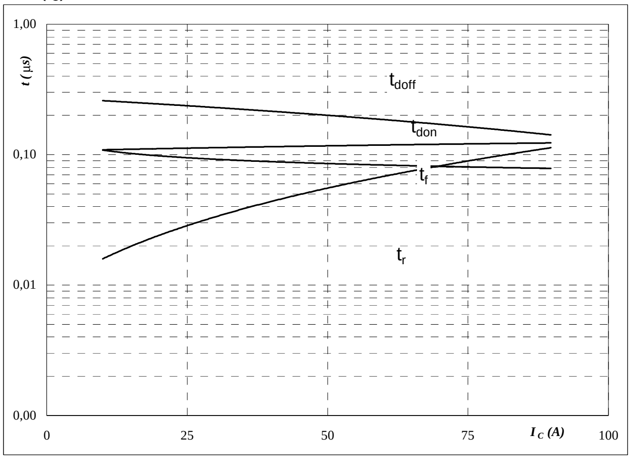
T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



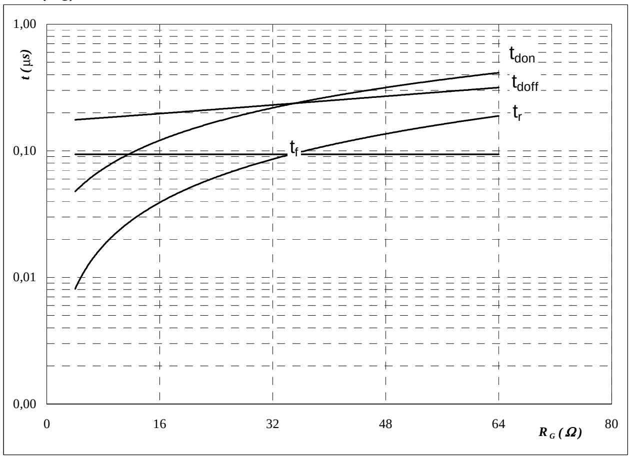
With an inductive load at

T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



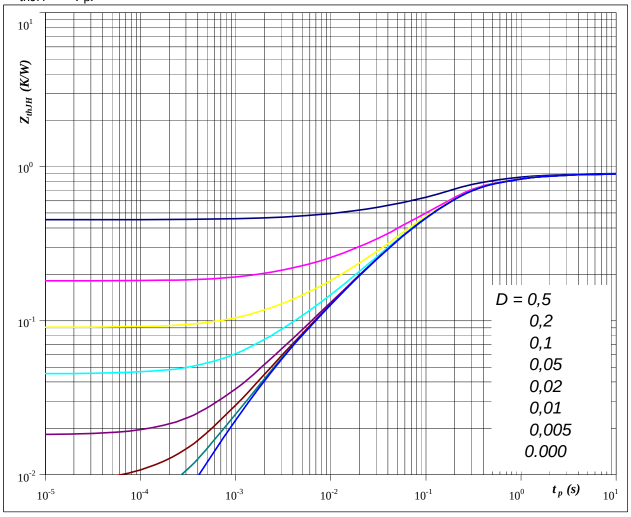
With an inductive load at

T_j =	25/151	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)

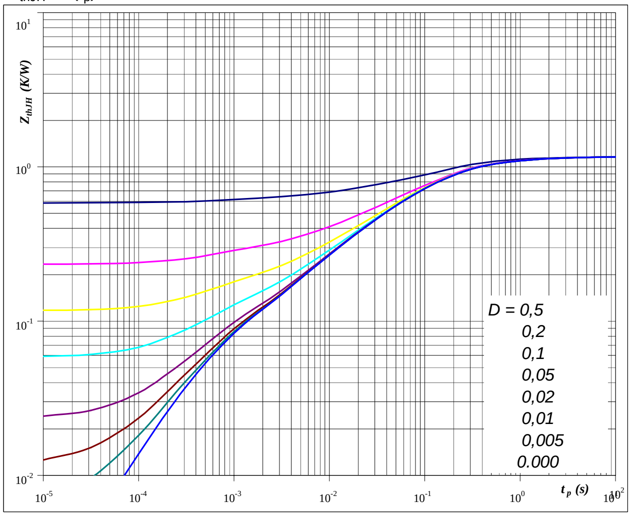


At		D =	tp / T		
Thermal grease			Phase change interface		
R_{thJH} =	0,91	K/W	R_{thJH} =	0,73	K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



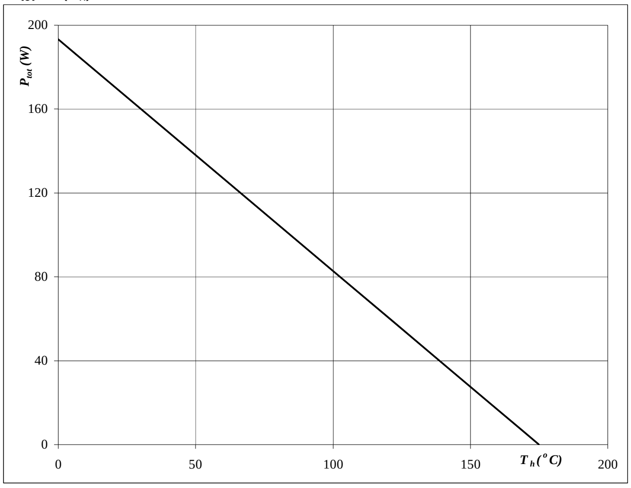
At		D =	tp / T		
Thermal grease			Phase change interface		
R_{thJH} =	1,17	K/W	R_{thJH} =	0,95	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



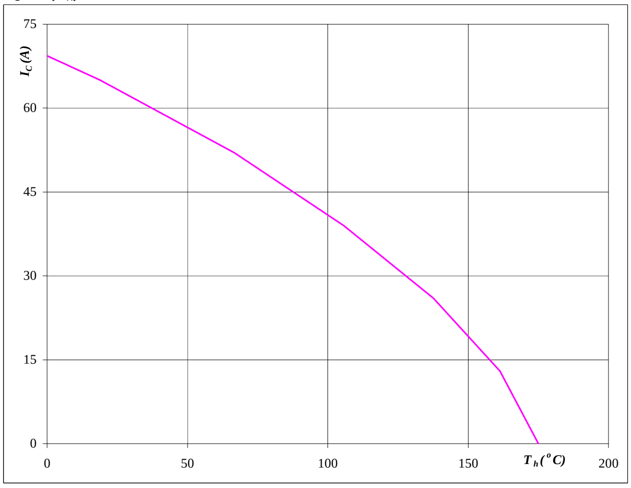
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

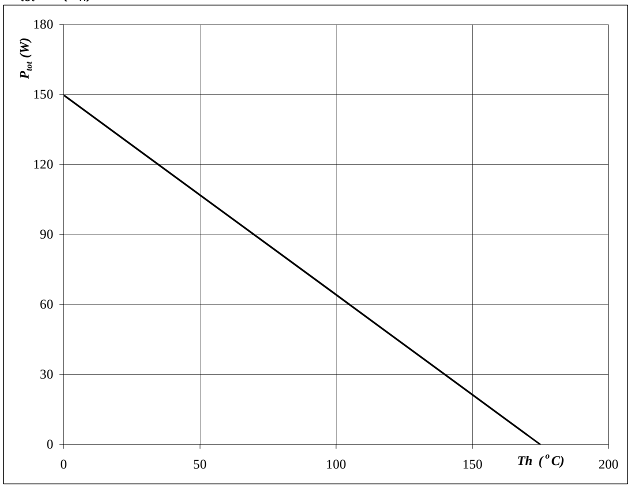
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



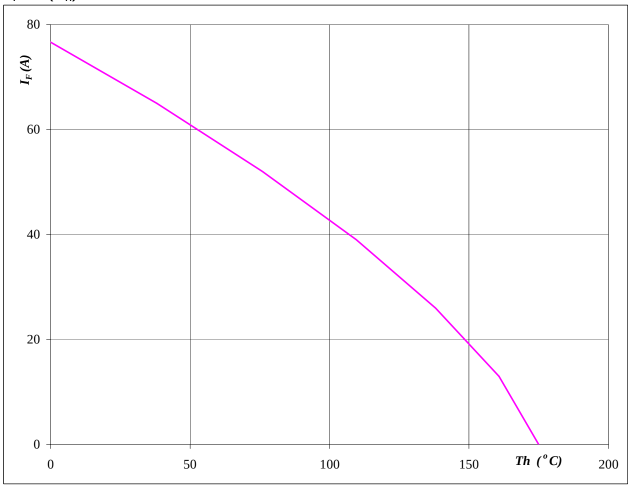
At

T_j = 175 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

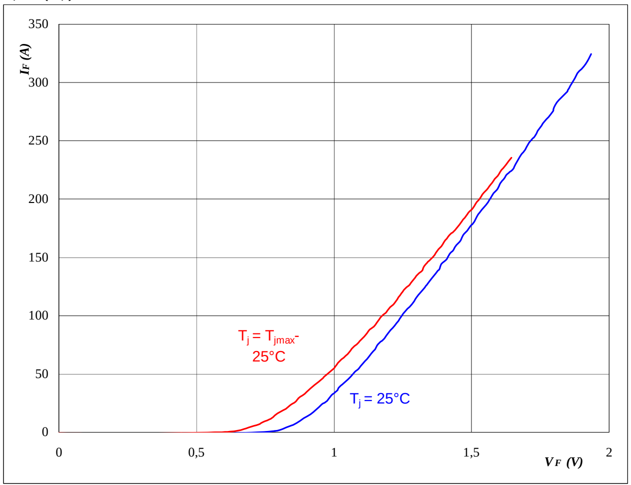
T_j = 175 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



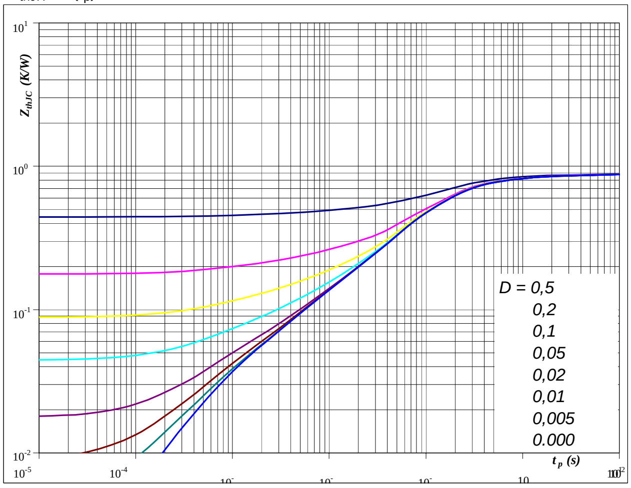
At

t_p = 250 μs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

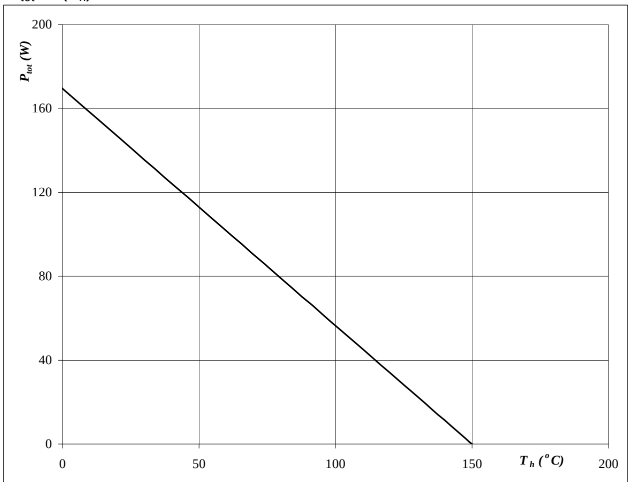
D = t_p / T

R_{thJH} = 0,88 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



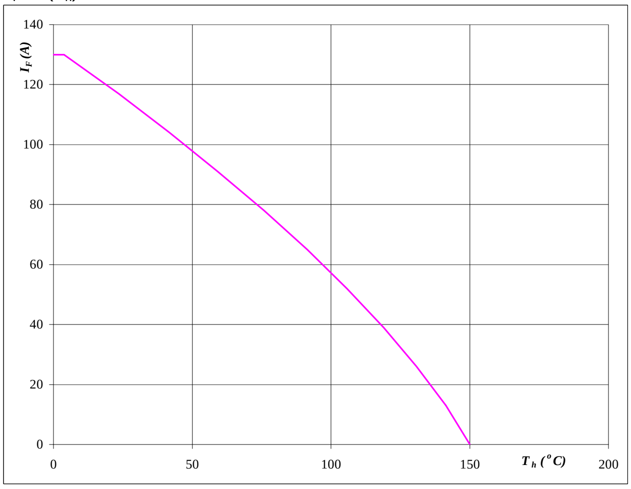
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

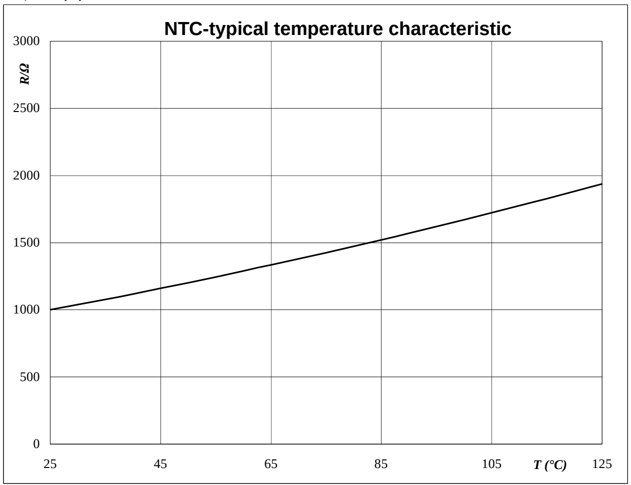
T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$



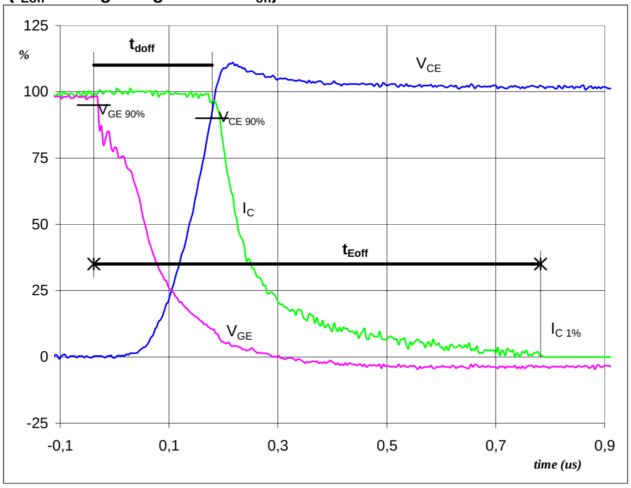
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 Output inverter IGBT

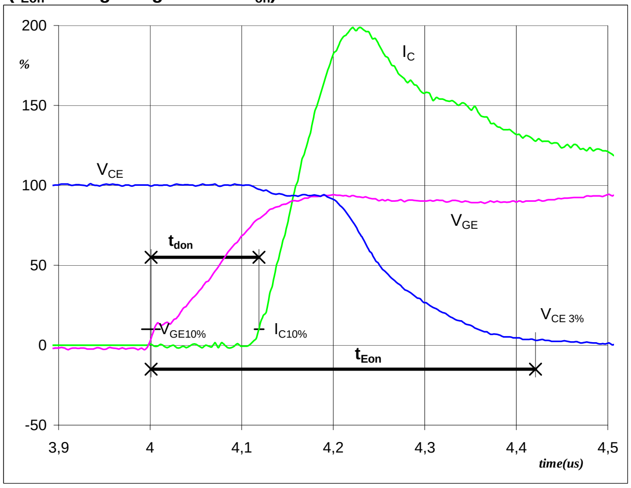
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,21	µs
t_{Eoff} =	0,82	µs

Figure 2 Output inverter IGBT

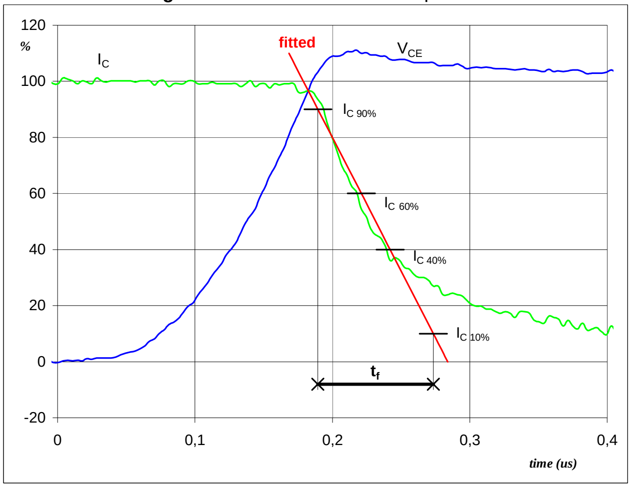
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{don} =	0,12	µs
t_{Eon} =	0,42	µs

Figure 3 Output inverter IGBT

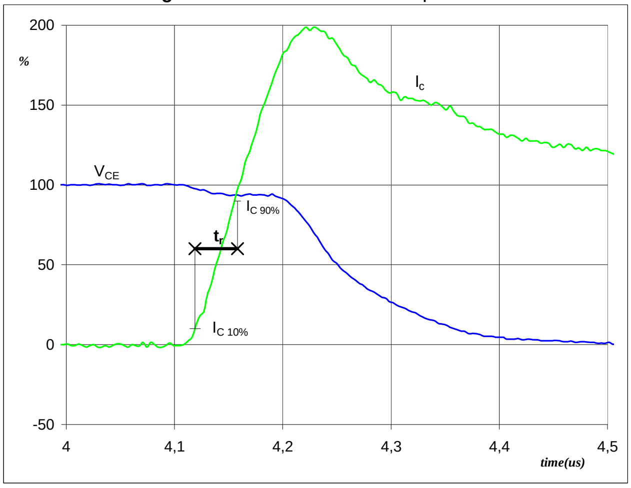
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	50	A
t_f =	0,10	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

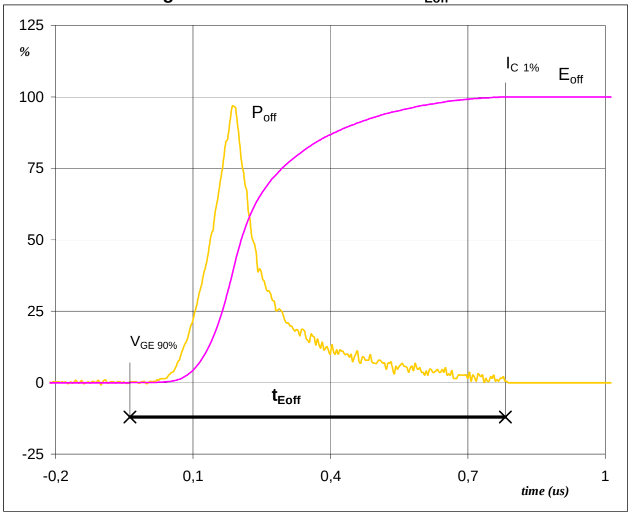


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,04	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

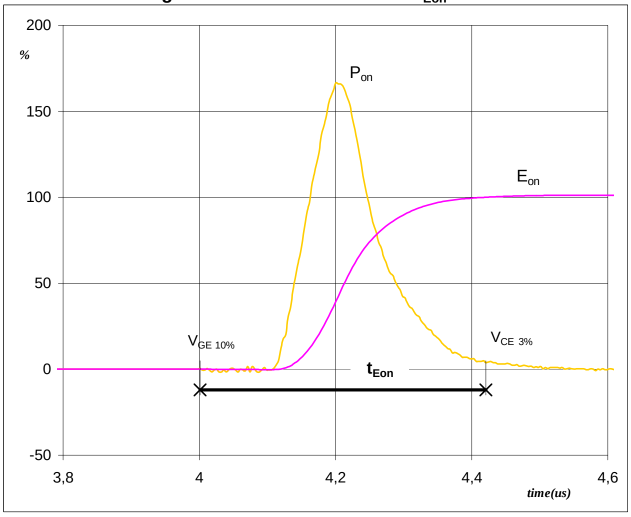
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	29,97	kW
E_{off} (100%) =	4,51	mJ
t_{Eoff} =	0,82	μs

Figure 6 Output inverter IGBT

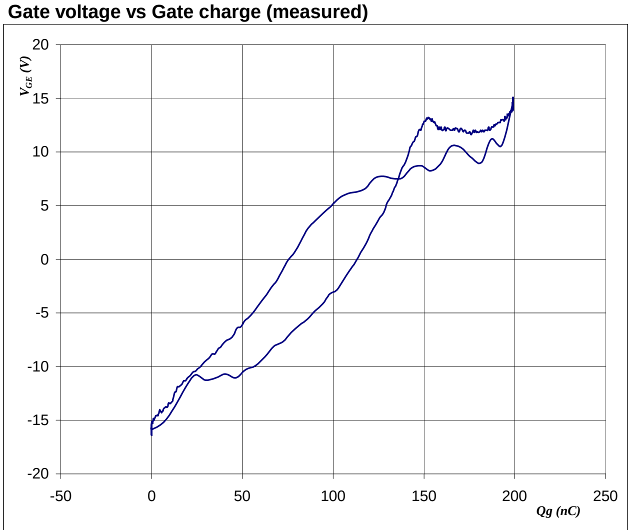
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	29,97	kW
E_{on} (100%) =	6,08	mJ
t_{Eon} =	0,42	μs

Figure 7 Output inverter FWD

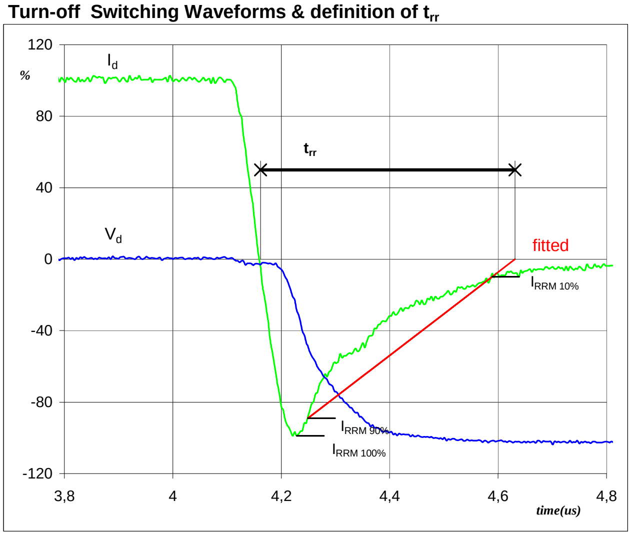
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
Q_g =	199,06	nC

Figure 8 Output inverter IGBT

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

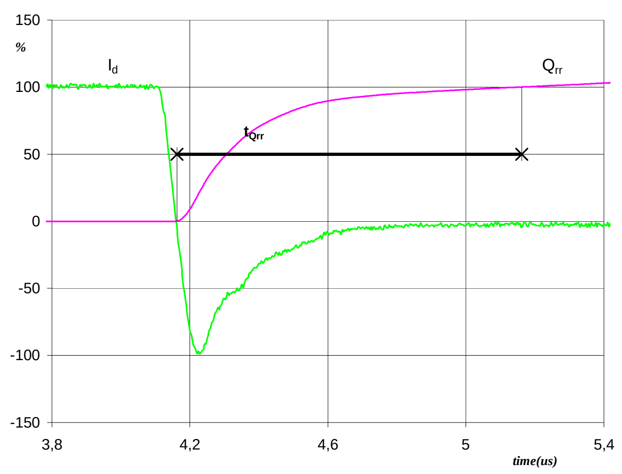


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-50	A
t_{rr} =	0,47	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FWD

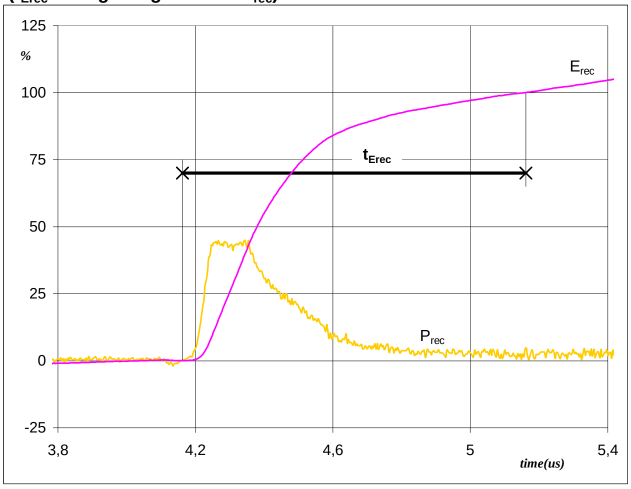
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	10,08	µC
t_{Qrr} =	1,00	µs

Figure 10 Output inverter FWD

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



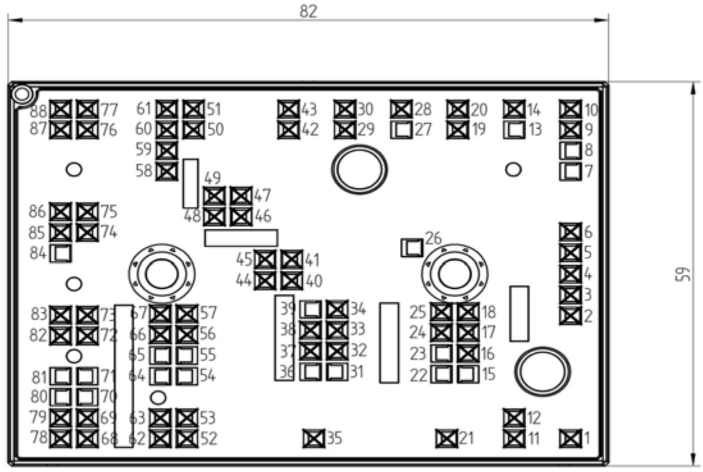
P_{rec} (100%) =	29,97	kW
E_{rec} (100%) =	3,95	mJ
t_{Erec} =	1,00	µs

Ordering Code and Marking - Outline - Pinout

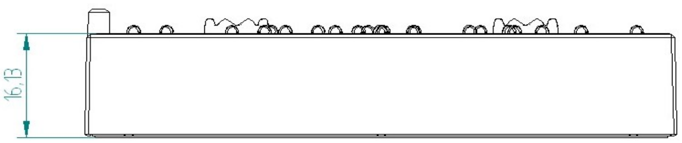
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K12-T-PM)	V23990-K428-A50-/0A/-PM	K428A50	K428A50-/0A/
with std lid (black V23990-K12-T-PM) and P12	V23990-K428-A50-/1A/-PM	K428A50	K428A50-/1A/
with thin lid (white V23990-K13-T-PM)	V23990-K428-A50-/0B/-PM	K428A50	K428A50-/0B/
with thin lid (white V23990-K13-T-PM) and P12	V23990-K428-A50-/1B/-PM	K428A50	K428A50-/1B/

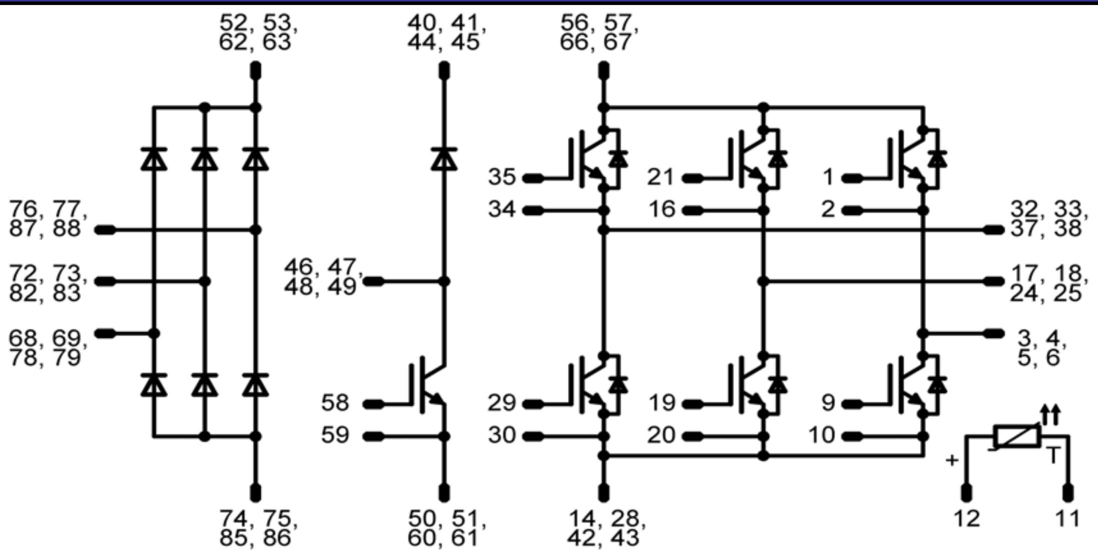
Outline



X = assembled pin position



Pinout



PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
Final	Full Production	This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.