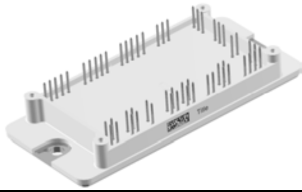
flow2 1200V/50A

Features

- 3~rectifier,BRC,Inverter, NTC
- Very Compact housing, easy to route
- Mitsubishi IGBT and FWD

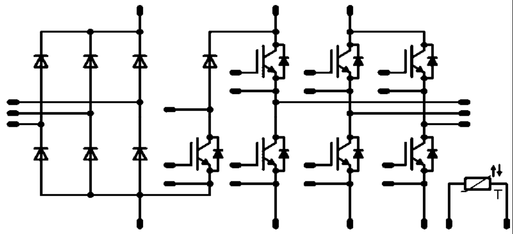
flow2



Target Applications

- Motor Drives
- Power Generation

Schematic



Types

- V23990-P768-A50

Maximum Ratings

T_j=25℃, 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=$T_j$max	T_h=80℃ T_c=80℃	80 80	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=150℃	490	A
I2t-value	I^2t			1200	A^2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	95 144	W
Maximum Junction Temperature	$T_j$max			150	℃
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	60 77	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		100	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		100	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	155 235	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 850	µs V
Maximum Junction Temperature	$T_j$max			175	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25℃		1200	V
DC forward current	I_F	$T_j=T_jmax$	T_h=80℃ T_c=80℃	82 106	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		100	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	T_h=80℃ T_c=80℃	126 191	W
Maximum Junction Temperature	T_jmax			175	℃
Brake Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_jmax$	T_h=80℃ T_c=80℃	45 56	A
Pulsed collector current	I_{Cpuls}	t_p limited by T_jmax		135	A
Turn off safe operating area		V_{CE} ≤ 1200V, Tj ≤ Top max		70	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	T_h=80℃ T_c=80℃	137 208	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_jmax			175	℃
Brake Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_c=25℃		1200	V
DC forward current	I_F	$T_j=T_jmax$	T_h=80℃ T_c=80℃	16 16	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		20	A
Brake Inverse Diode	P_{tot}	$T_j=T_jmax$	T_h=80℃ T_c=80℃	69 98	W
Maximum Junction Temperature	T_jmax			175	℃
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25℃		1200	V
DC forward current	I_F	$T_j=T_jmax$	T_h=80℃ T_c=80℃	28 35	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		50	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	T_h=80℃ T_c=80℃	72 109	W
Maximum Junction Temperature	T_jmax			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
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	1,1 1,05	1,8	V
Threshold voltage (for power loss calc. only)	V_{to}				50	Tj=25°C Tj=125°C		0,89 0,78		V
Slope resistance (for power loss calc. only)	r_t				50	Tj=25°C Tj=125°C		4 5		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,74		K/W
Thermal resistance chip to heatsink per chip	R_{thJC}							0,49		
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	V_{CE}=V_{GE}		10	0,005	Tj=25°C Tj=150°C	5,4	6	6,6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C	1,4	1,80 2,18	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			300	µA
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=8 Ω Rgon=8 Ω	±15	600	50	Tj=25°C Tj=150°C		65,4 64,8		ns
Rise time	t_r					Tj=25°C Tj=150°C		9,8 11,6		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		137 189		
Fall time	t_f					Tj=25°C Tj=150°C		58,6 99,8		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1,994 3,311		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		2,564 4,317		
Input capacitance	C_{ies}	f=1MHz	0	10		Tj=25°C		5000		pF
Output capacitance	C_{oss}							1000		
Reverse transfer capacitance	C_{rss}							80		
Gate charge	Q_{Gate}		15	600	50	Tj=25°C		117		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,61		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,41		
Inverter Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,4	1,21 1,2	2,2	V
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	600	50	Tj=25°C Tj=150°C		80 81		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		156 470		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		6,95 12,53		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		4237 1162		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		3,314 6,025		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,75		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,5		

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	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0012	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		35	Tj=25℃ Tj=150℃	1,5	1,92 2,37	2,3	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25℃ Tj=150℃			250	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	600	35	Tj=25℃ Tj=150℃		82,8 89		ns
Rise time	t_r					Tj=25℃ Tj=150℃		27 27		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		191,4 269		
Fall time	t_f					Tj=25℃ Tj=150℃		54,3 124,9		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		2 2,92		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		1,74 3,18		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		1950		pF
Output capacitance	C_{oss}							155		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_{Gate}		15	960	35	Tj=25℃		160		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,69		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,46		
Brake Inverse Diode										
Diode forward voltage	V_F				10	Tj=25℃ Tj=150℃	1,2	1,80 1,76	2,2	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						1,38		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,91		
Brake Diode										
Diode forward voltage	V_F				25	Tj=25℃ Tj=150℃	1	2,24 2,36	2,9	V
Reverse leakage current	I_r			1200		Tj=25℃ Tj=150℃			60	µA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω Rgon=16 Ω	±15	600	35	Tj=25℃ Tj=150℃		30,8 39,2		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		146,4 423,1		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		2,32 4,84		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		1749 917		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=150℃		0,91 1,98		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						1,32		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,87		

Characteristic Values

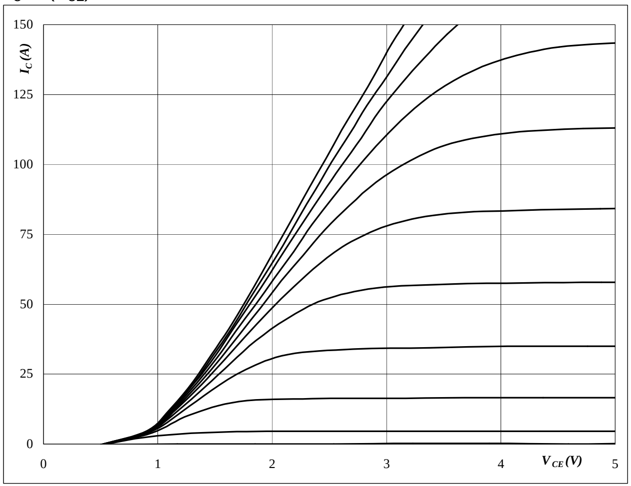
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Thermistor										
Rated resistance	R					T=25℃		21511		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=25℃	-4,5		+4,5	%
Power dissipation	P					T=25℃		210		mW
Power dissipation constant						T=25℃		3,5		mW/K
B-value	$B_{(25/50)}$					T=25℃		3884		K
B-value	$B_{(25/100)}$					T=25℃		3964		K
Vincotech NTC Reference									F	
Module Properties										
Thermal resistance, case to heatsink	R_{thCH}							tbd.		K/W
Module stray inductance	L_{sCE}							5		nH
Chip module lead resistance, terminals -chip	$R_{cc'1+EE'}$							tbd.		mΩ
Mounting torque	M						3,8	4	4,2	Nm
Terminal connection torque	M						6,7	7	7,4	Nm
Weight	G							tbd.		g

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



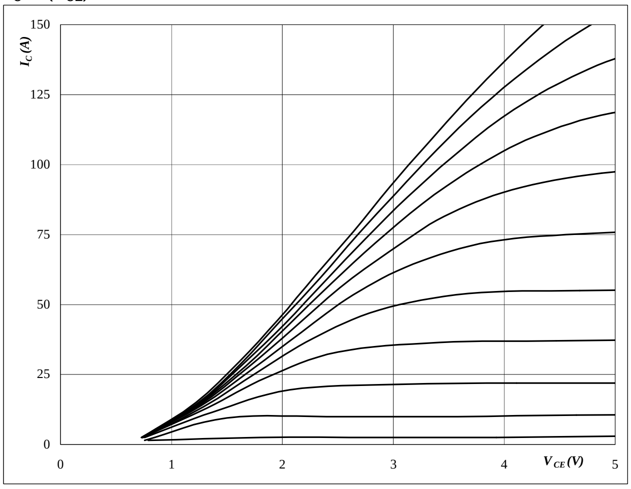
At

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

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



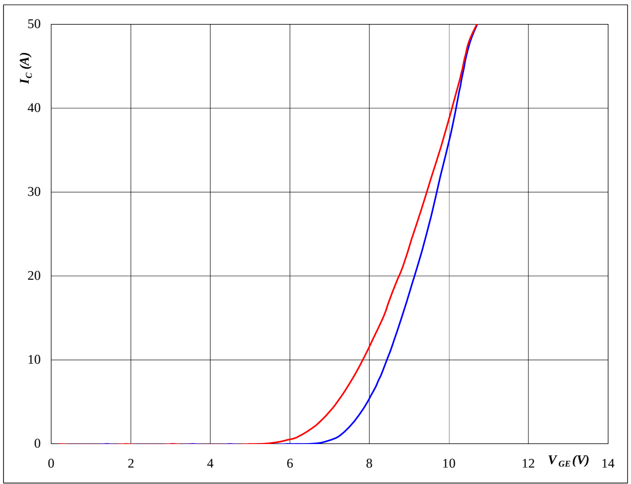
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



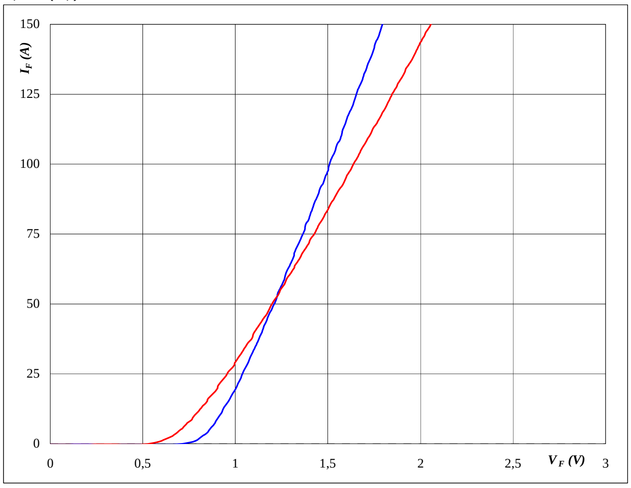
At

T_j =	25/150	℃
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

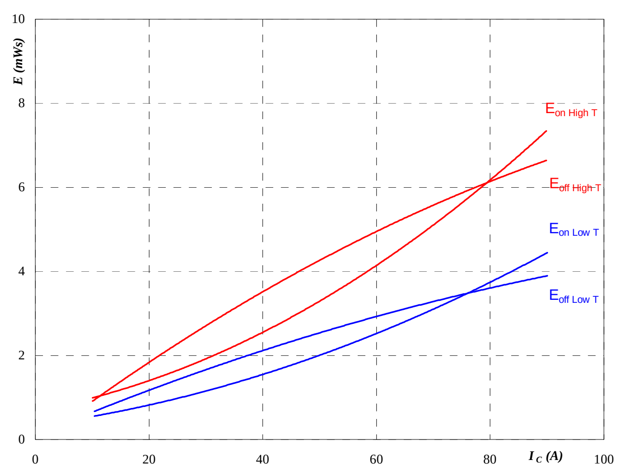
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



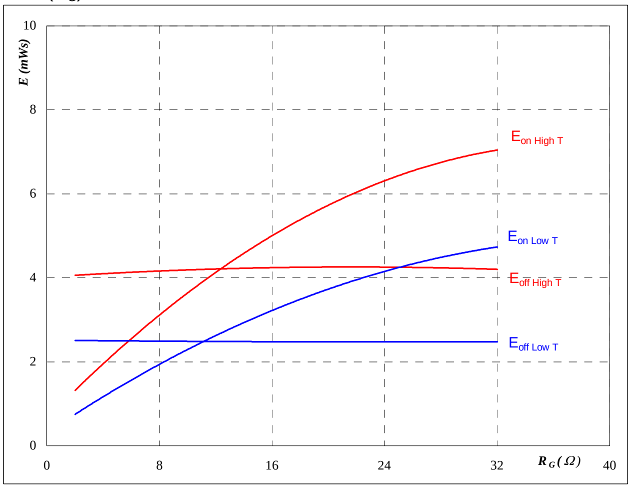
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



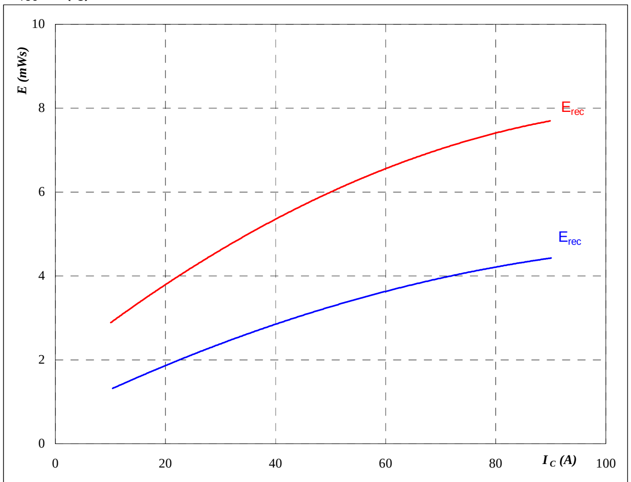
With an inductive load at

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)



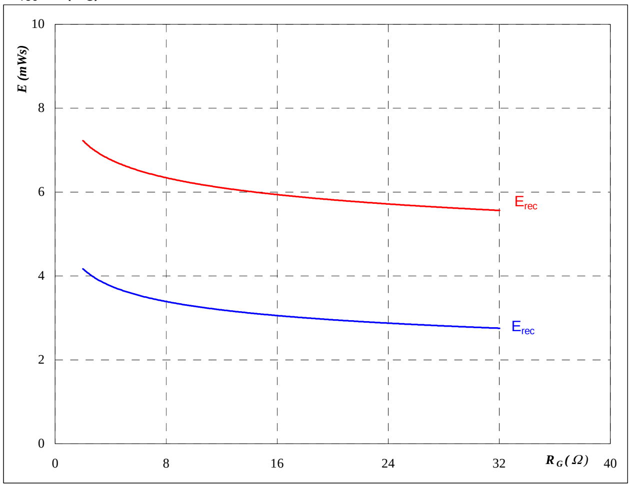
With an inductive load at

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

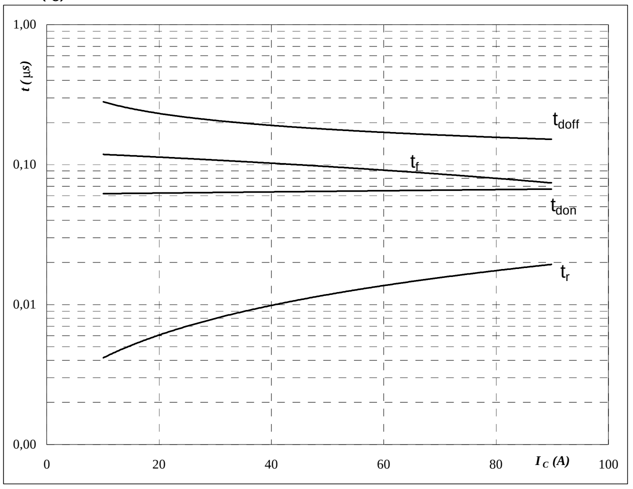
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



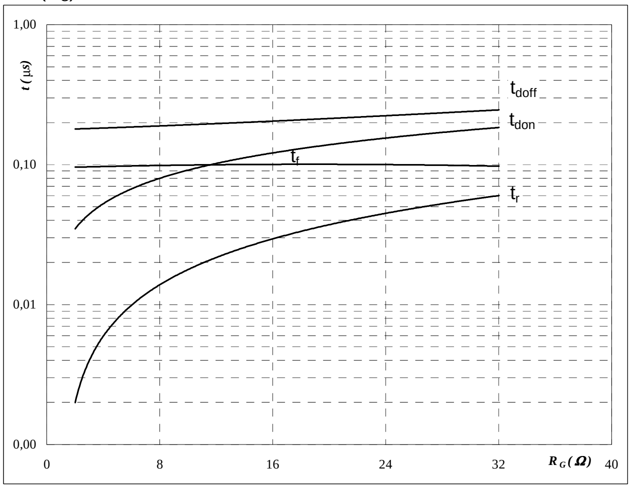
With an inductive load at

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

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



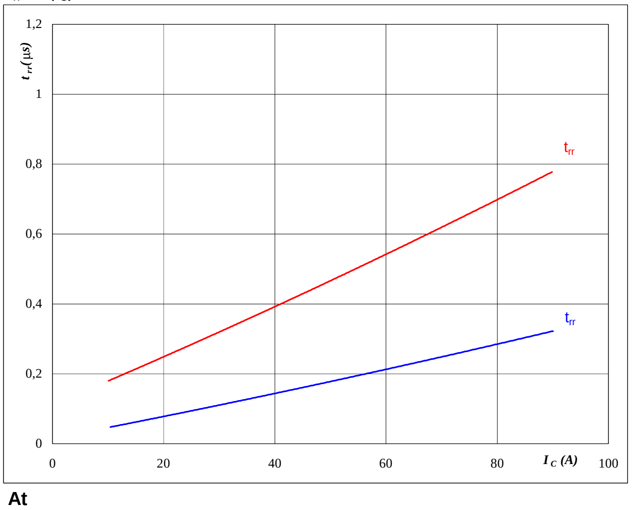
With an inductive load at

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

$t_{rr} = f(I_C)$



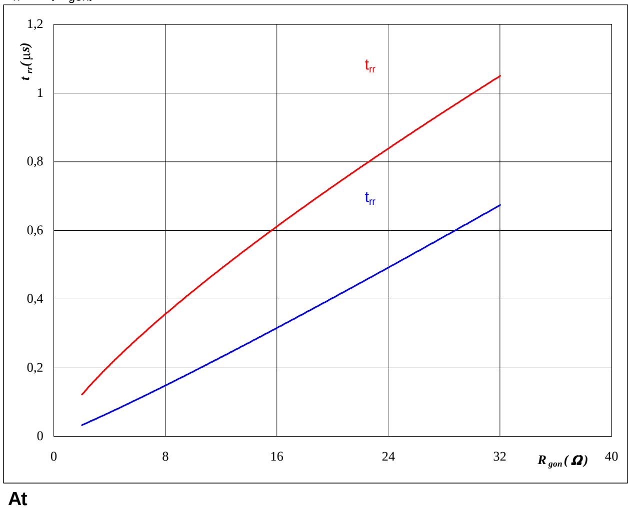
At

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

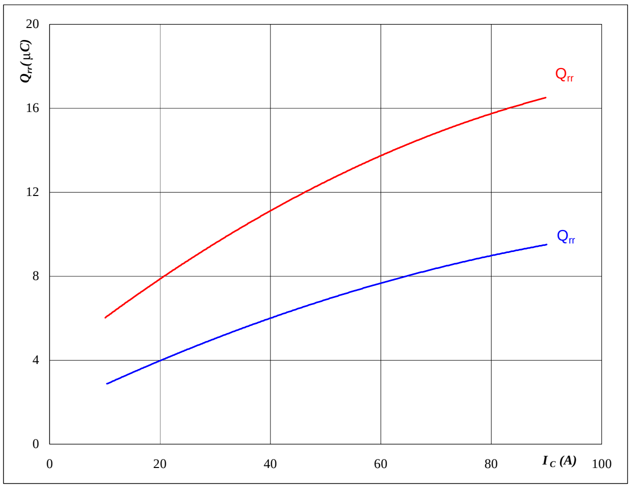
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



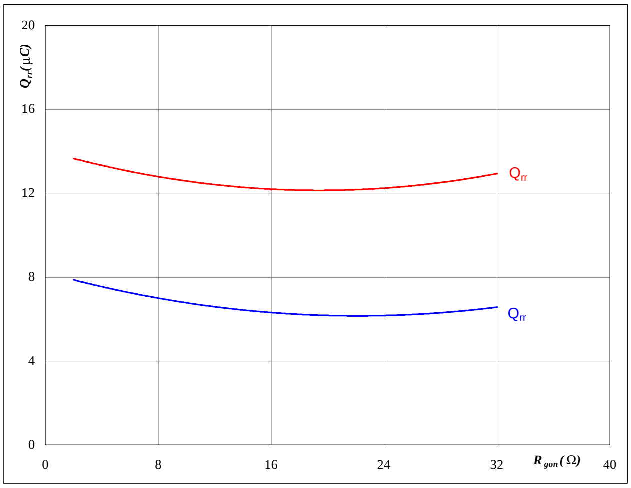
At

T_j =	25/150	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 14 Output inverter FWD

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

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



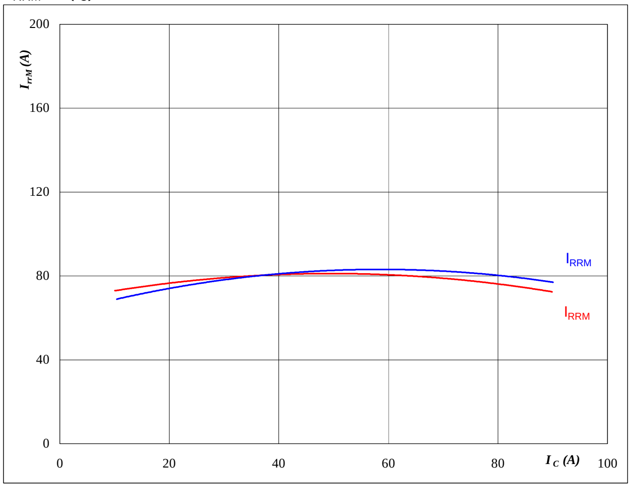
At

T_j =	25/150	℃
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

$I_{RRM} = f(I_C)$



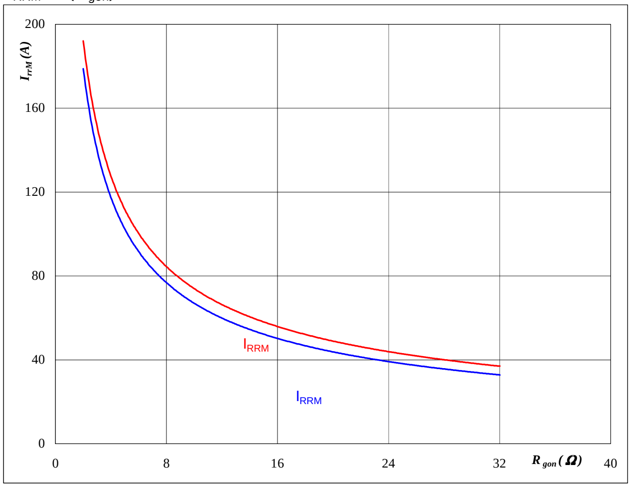
At

T_j =	25/150	℃
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	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

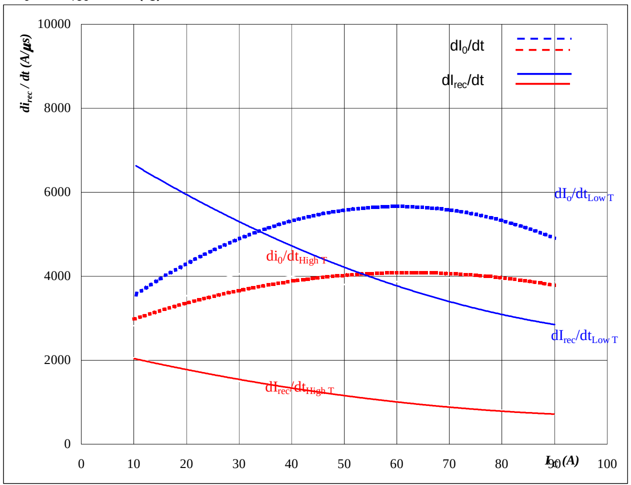
T_j =	25/150	℃
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



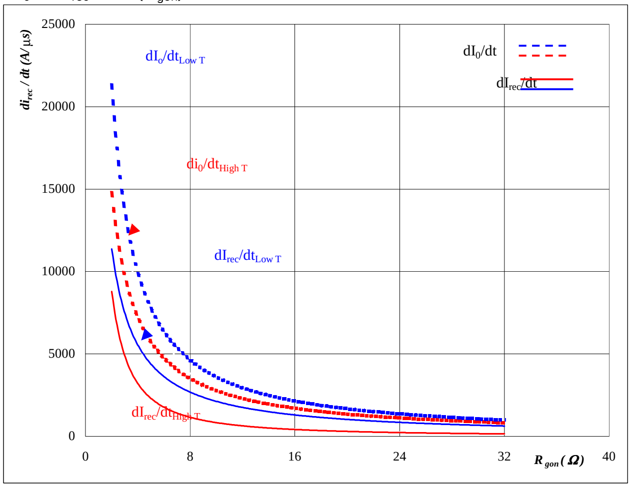
At

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

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



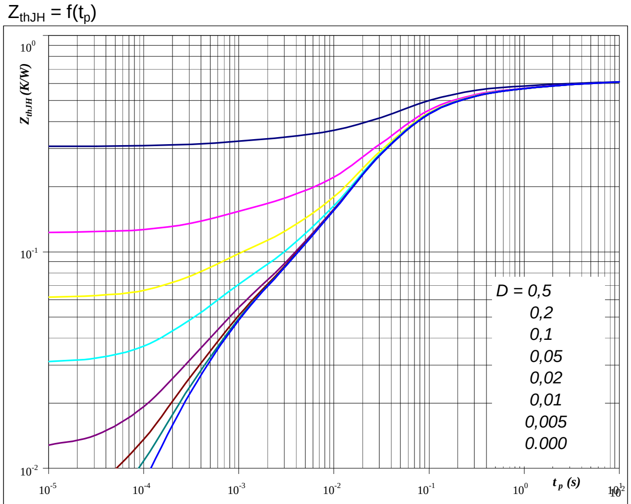
At

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} =	0,61	K/W	RthJH =	0,60	K/W

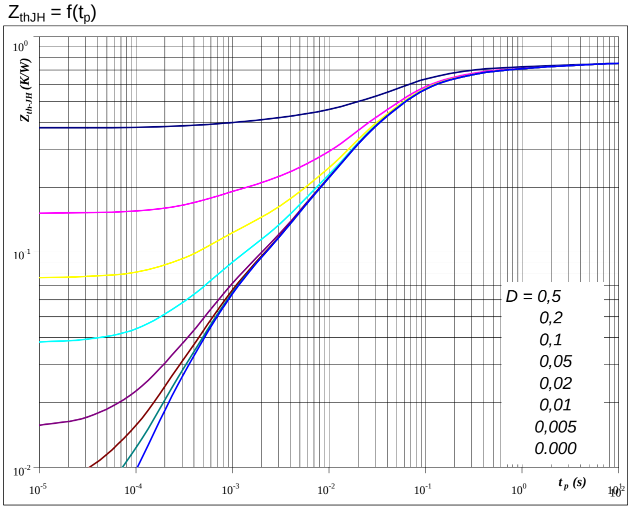
IGBT thermal model values

Psx7p		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,04	4,0E+00	0,04	3,9E+00
0,05	7,8E-01	0,05	7,6E-01
0,13	1,5E-01	0,12	1,5E-01
0,26	4,5E-02	0,25	4,4E-02
0,08	1,3E-02	0,08	1,2E-02
0,03	1,4E-03	0,03	1,3E-03
0,02	3,8E-04	0,00	0,0E+00

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} =	0,75	K/W	RthJH =	0,73	K/W

FWD thermal model values

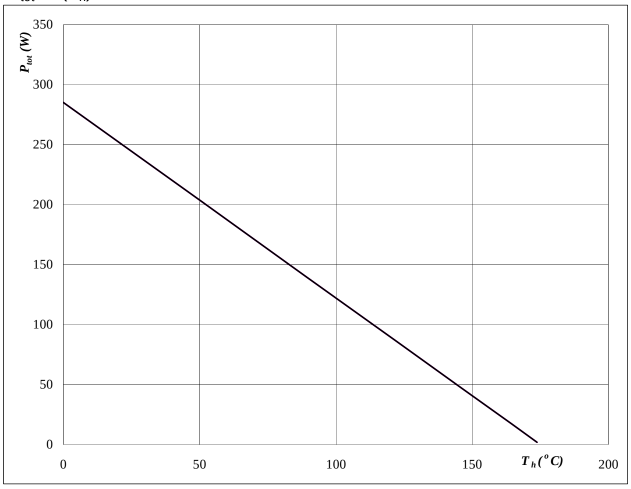
Psx7p		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,04	3,7E+00	0,04	3,6E+00
0,07	5,6E-01	0,06	5,5E-01
0,21	9,7E-02	0,21	9,4E-02
0,31	2,9E-02	0,30	2,8E-02
0,07	6,0E-03	0,07	5,8E-03
0,05	6,6E-04	0,05	6,4E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



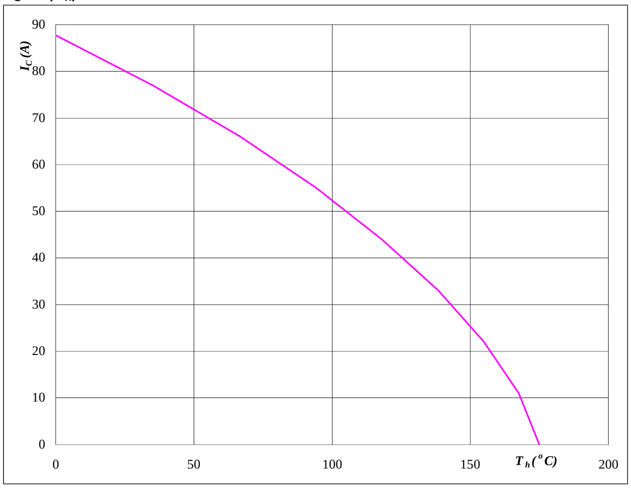
At

T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

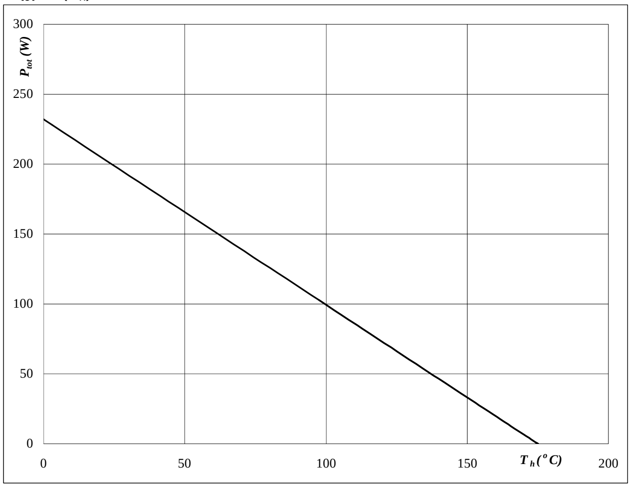
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



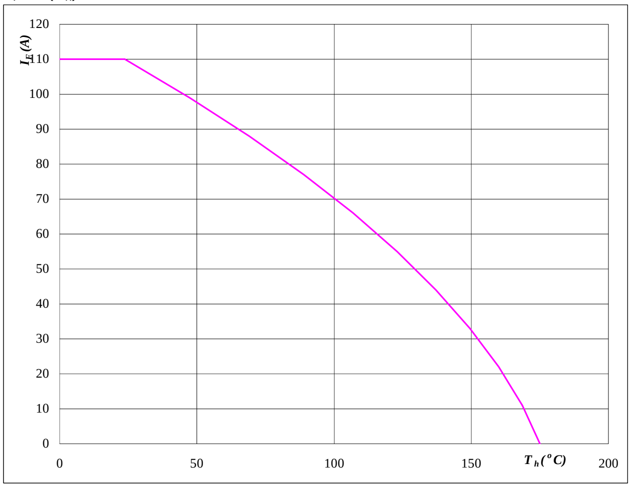
At

T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

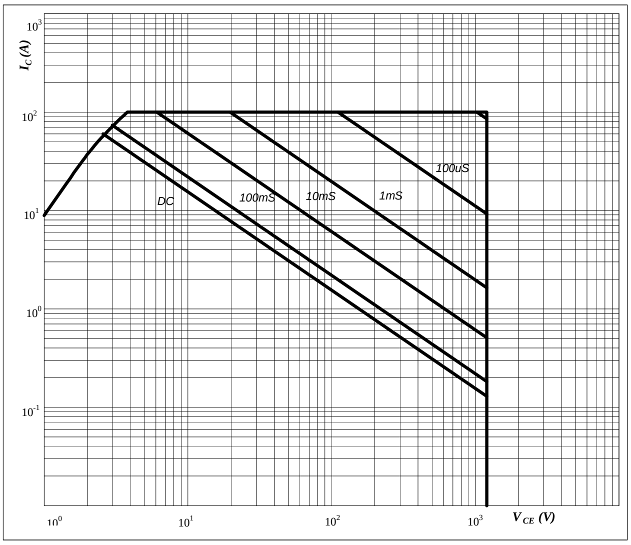
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



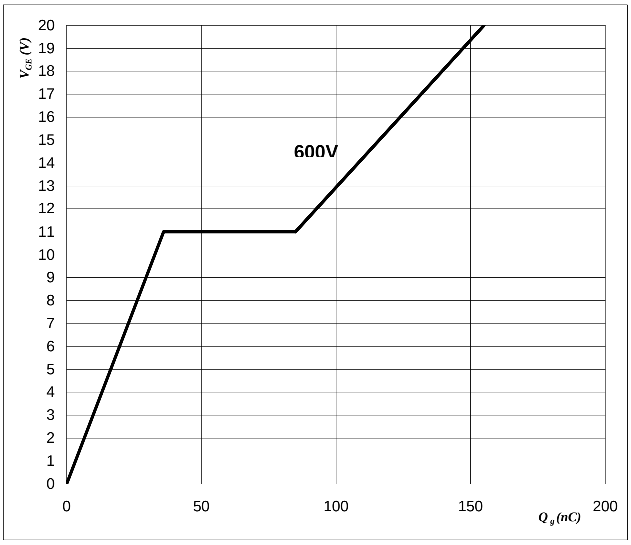
At

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

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



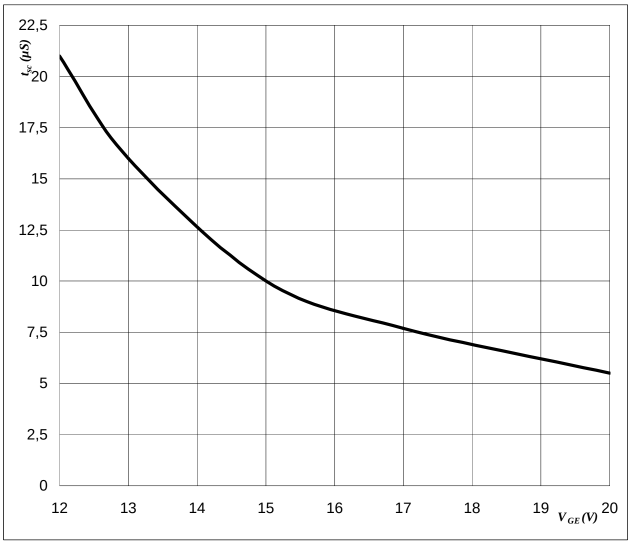
At

I_C =	50	A
T_j =	25	ºC

Figure 27 Output inverter IGBT

Short circuit withstand time as a function of gate-emitter voltage

$t_{sc} = f(V_{GE})$



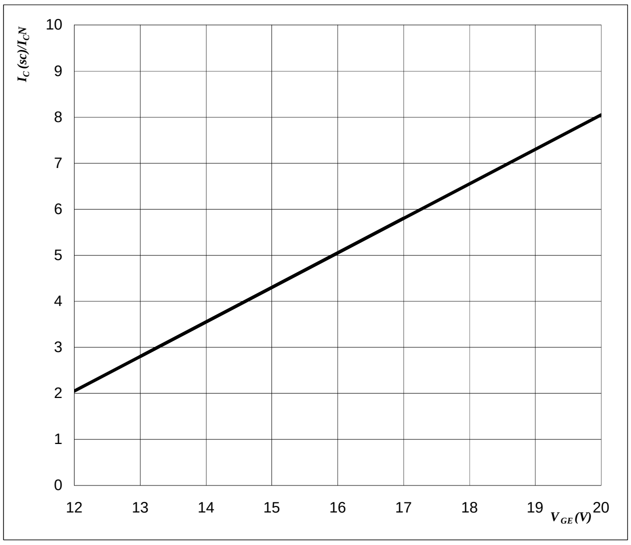
At

V_{CE} =	1200	V
T_j ≤	175	ºC

Figure 28 Output inverter IGBT

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

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



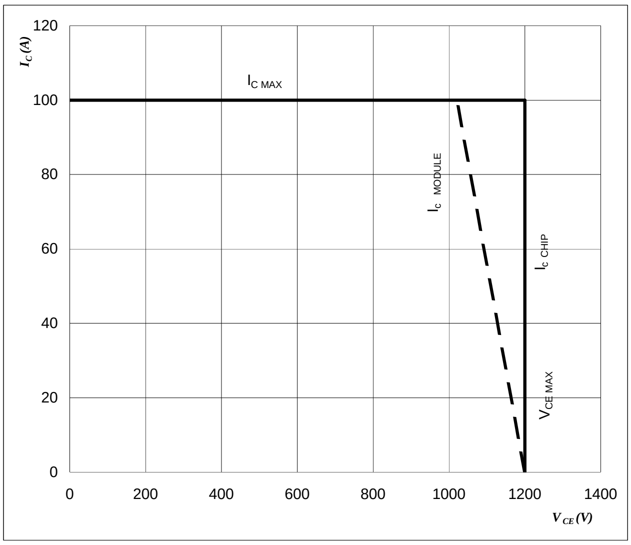
At

V_{CE} ≤	800	V
T_j =	150	ºC

Figure 29 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 150 ℃

Rgon = 8 Ω

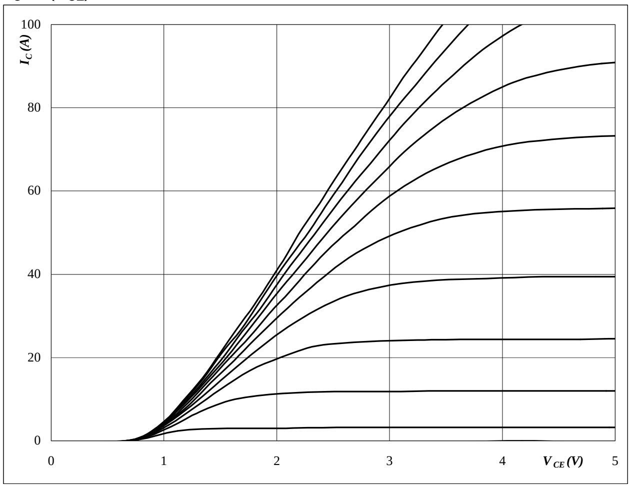
Rgoff = 8 Ω

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

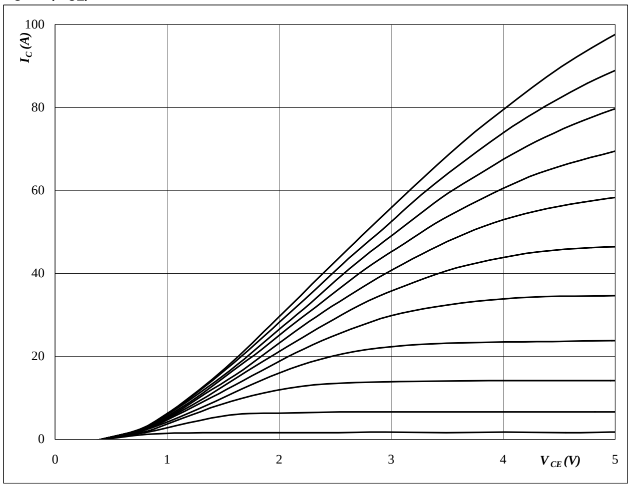
T_j = 25 °C

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

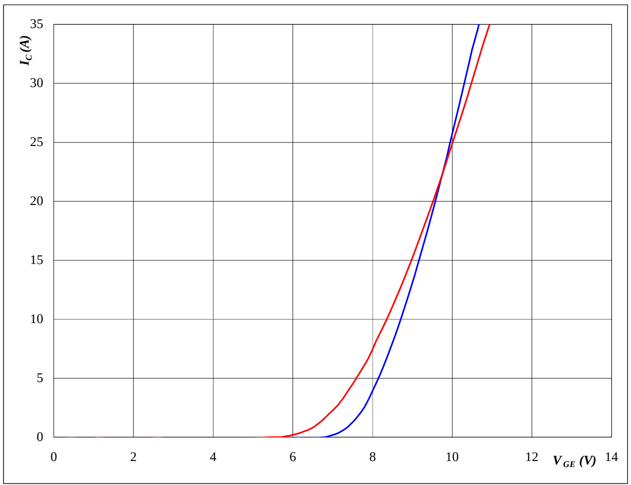
T_j = 150 °C

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_j = 25/150 °C

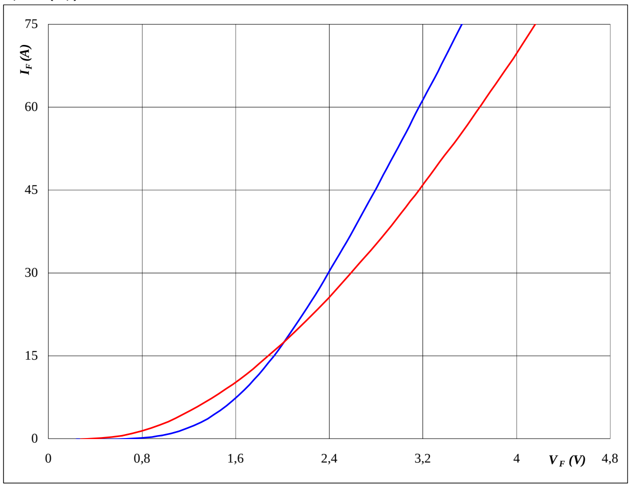
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

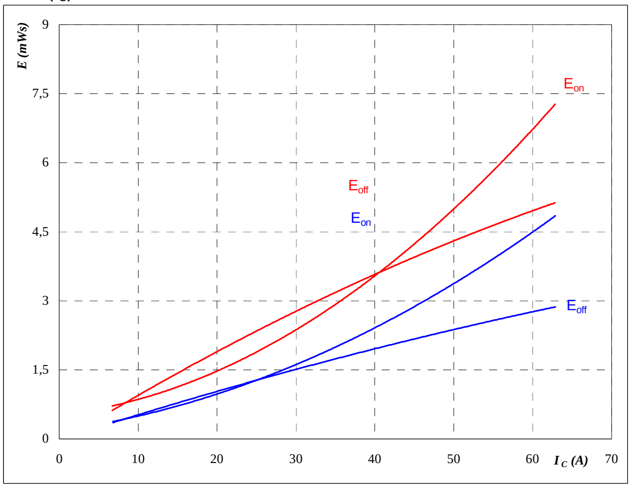
t_p = 250 µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



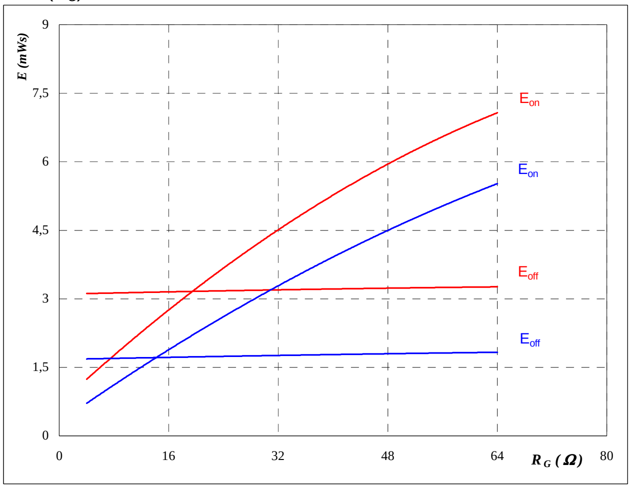
With an inductive load at

T_j =	25/150	°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

$E = f(R_G)$



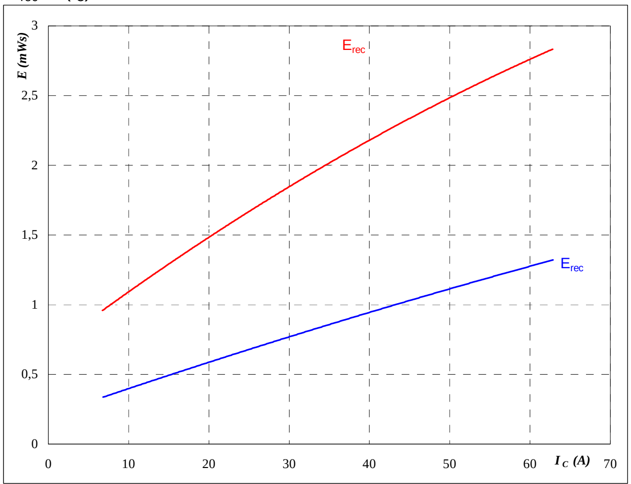
With an inductive load at

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

Figure 7 Brake FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



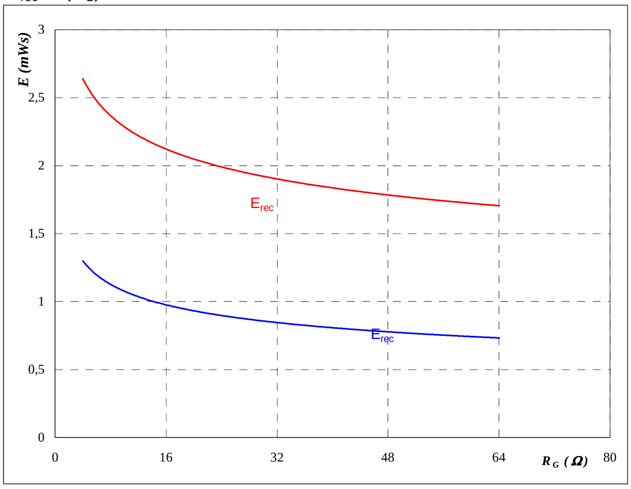
With an inductive load at

T_j =	25/150	°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

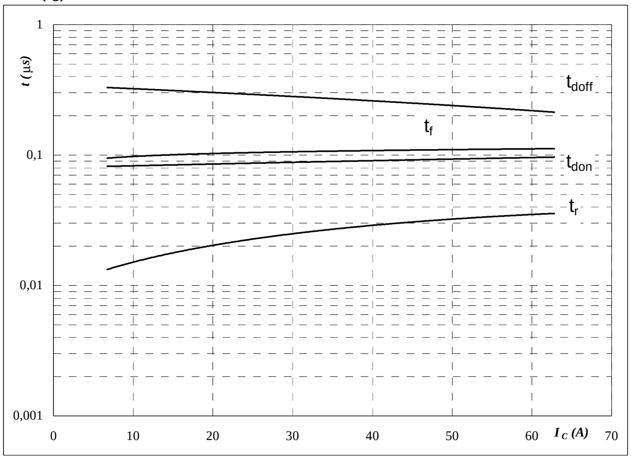
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Brake

Figure 9	Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



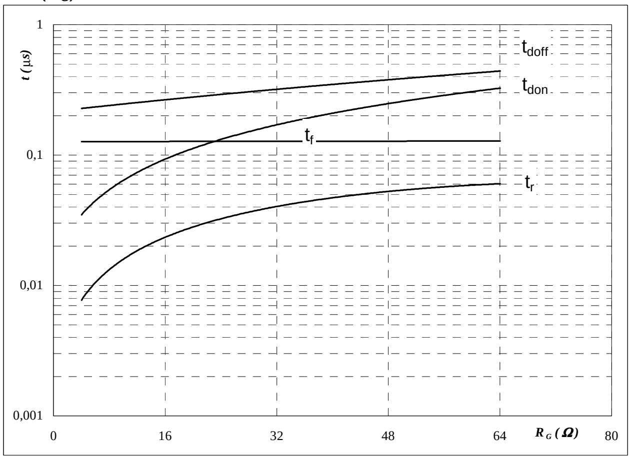
With an inductive load at

T_j =	150	°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)



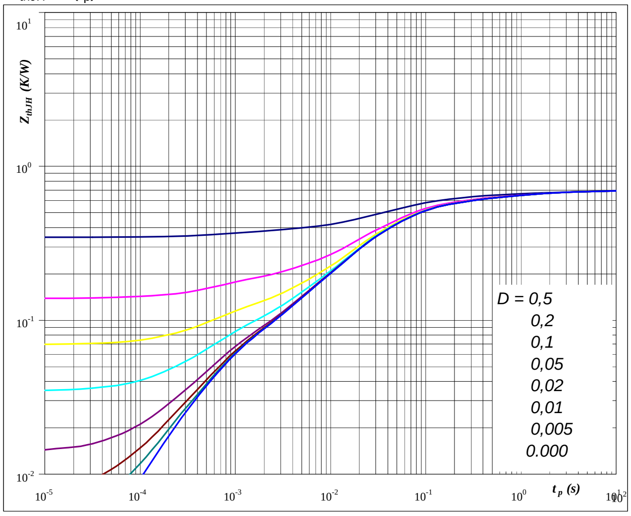
With an inductive load at

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

Figure 11	Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)

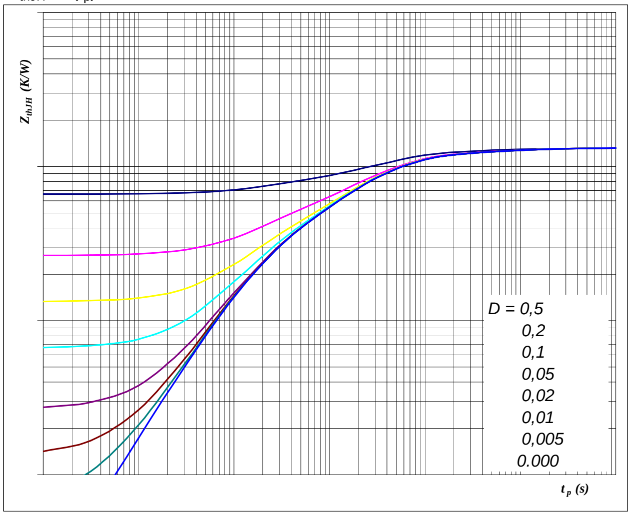


At		D =	tp / T		
Psx7p			Phase change interface		
R_{thJH} =	0,692	K/W	R_{thJH} =	0,67	K/W

Figure 12	Brake FWD

FWD transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



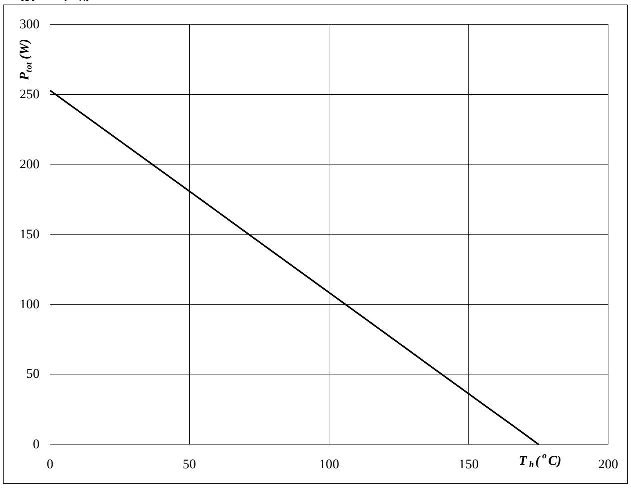
At		D =	tp / T		
Psx7p			Phase change interface		
R_{thJH} =	1,32	K/W	R_{thJH} =	1,28	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



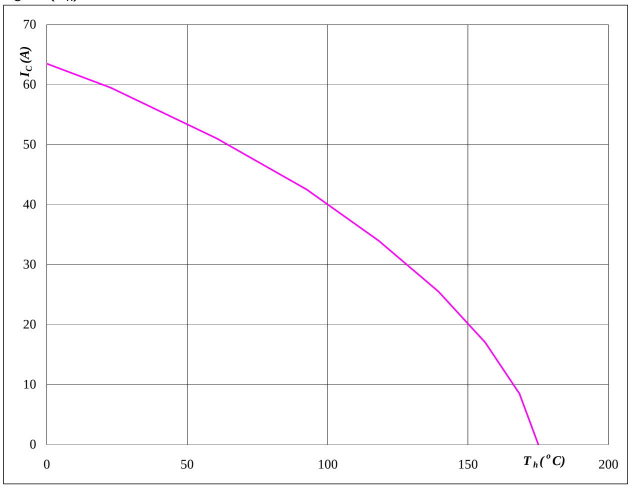
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

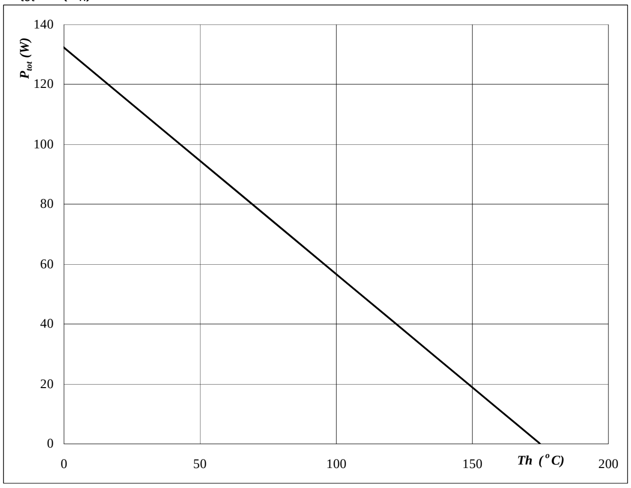
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



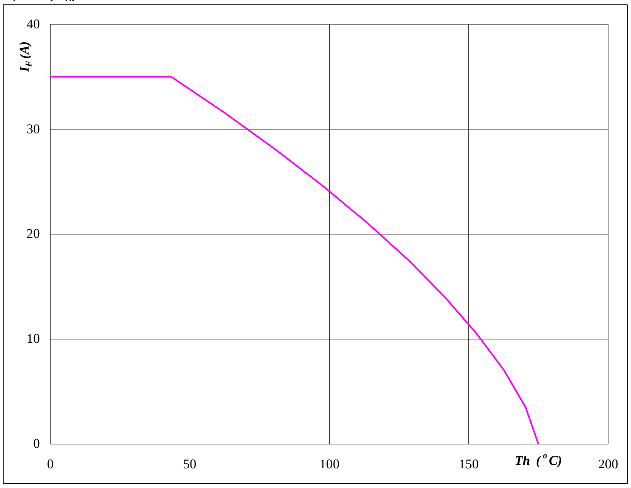
At

T_j = 175 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

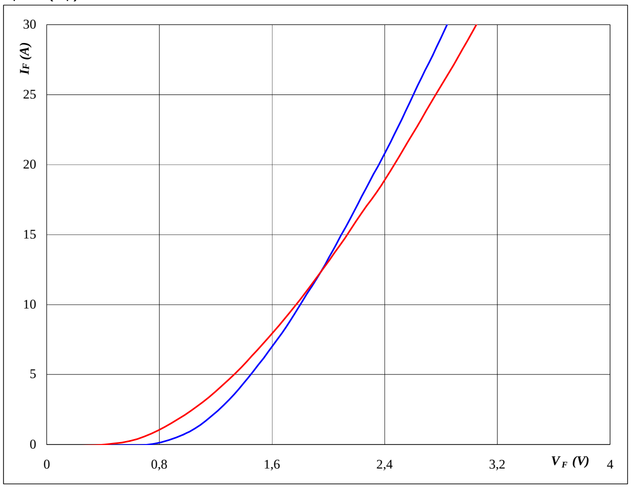
T_j = 175 ºC

Brake Inverse Diode

Figure 1 Brake inverse diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



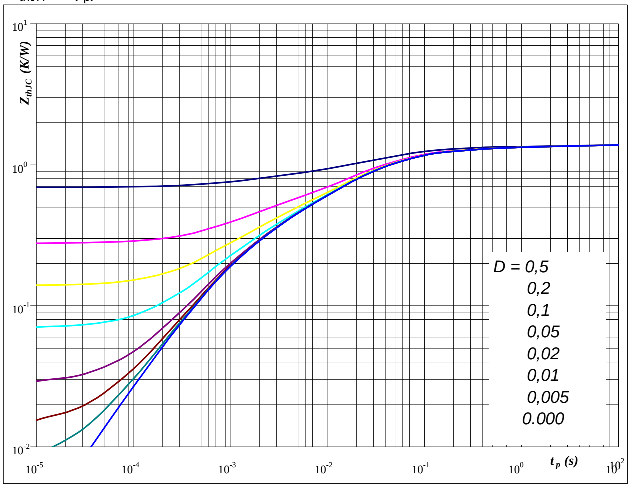
At

T_j =	25/150	°C
t_p =	250	µs

Figure 2 Brake inverse diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



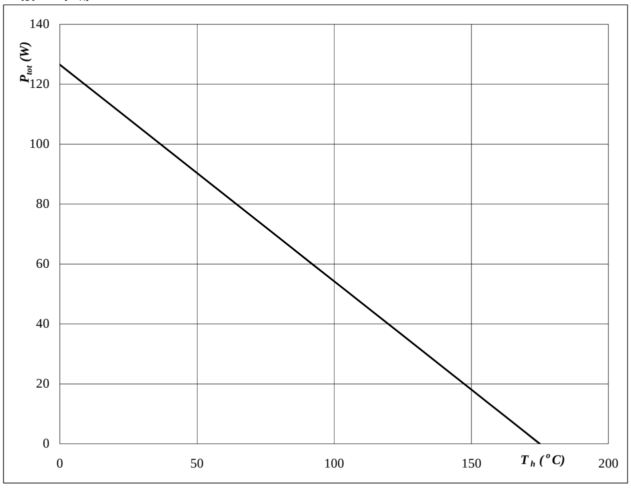
At

		D =	tp / T		
Psx7p			Phase change interface		
R_{thJH} =	1,38	K/W	R_{thJH} =	1,34	K/W

Figure 3 Brake inverse diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



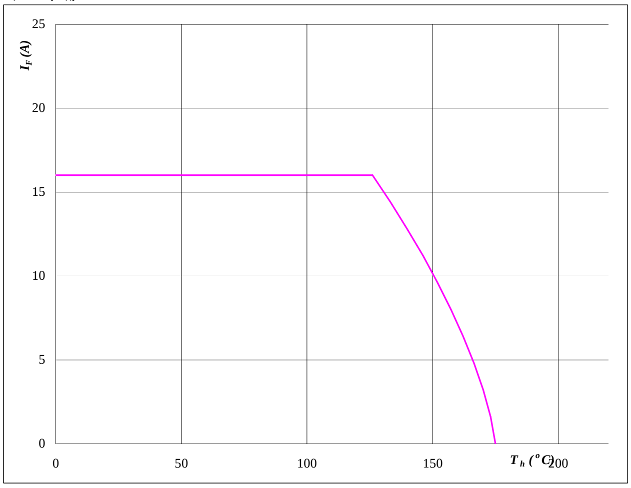
At

T_j = 150 ºC

Figure 4 Brake inverse diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

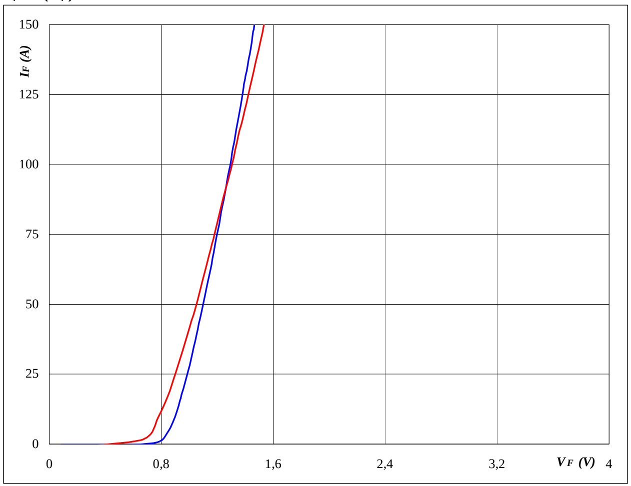
T_j = 150 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

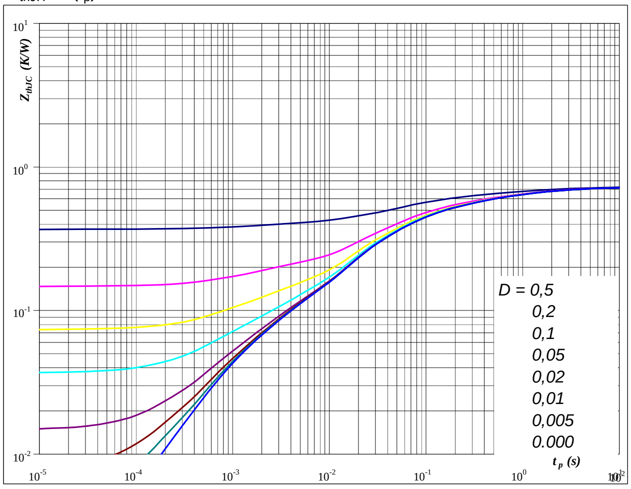
T_j = 25/125 ℃

t_p = 250 μs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

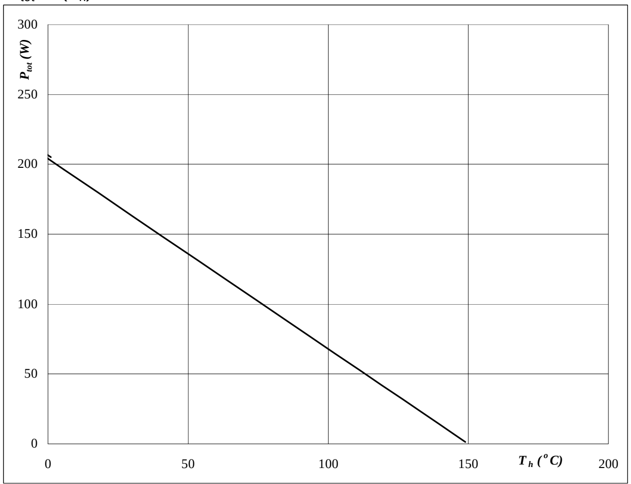
D = t_p / T

R_{thJH} = 0,74 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



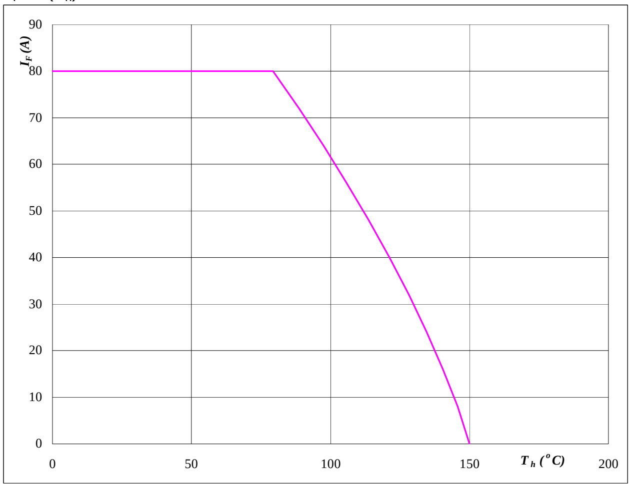
At

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

$R_T = f(T)$

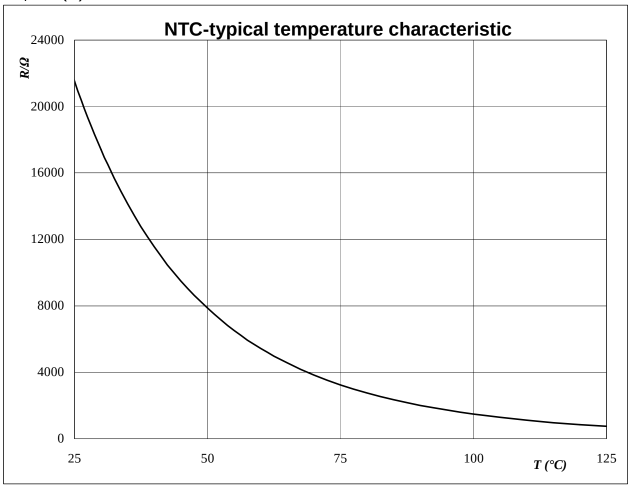


Figure 2 Thermistor

Typical NTC resistance values

$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \cdot \left(\frac{1}{T} - \frac{1}{T_{25}}\right)\right)} \quad [\Omega]$$

Switching Definitions Output Inverter

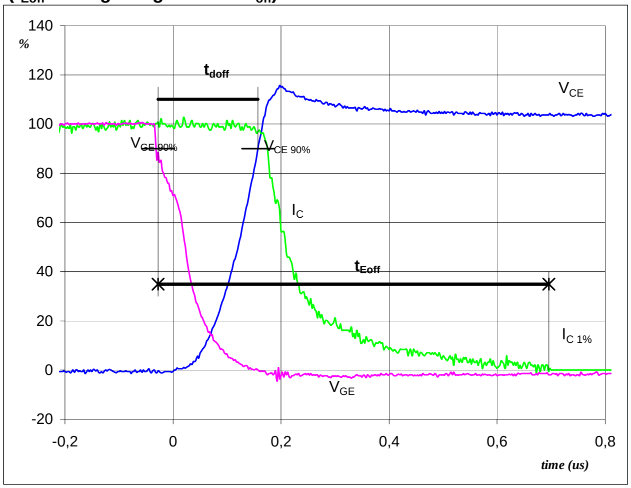
General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 Output inverter IGBT

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

(t_{Eoff} = integrating time for E_{off})

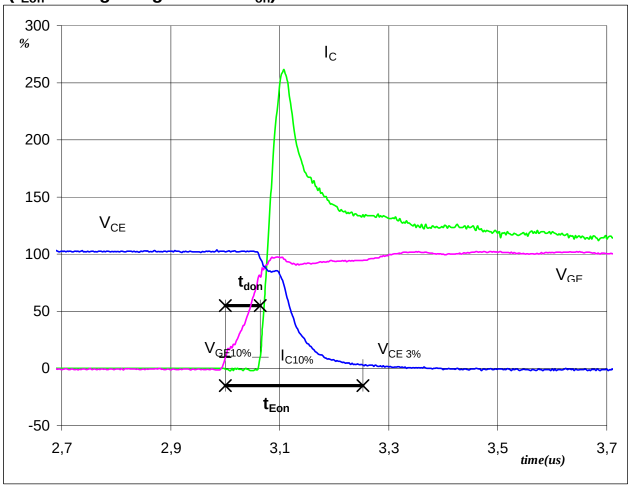


V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,19	μs
t_{Eoff} =	0,72	μs

Figure 2 Output inverter IGBT

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

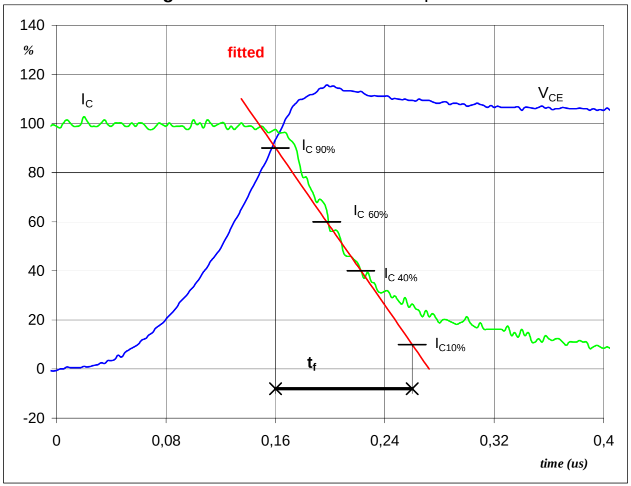
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{don} =	0,07	μs
t_{Eon} =	0,25	μs

Figure 3 Output inverter IGBT

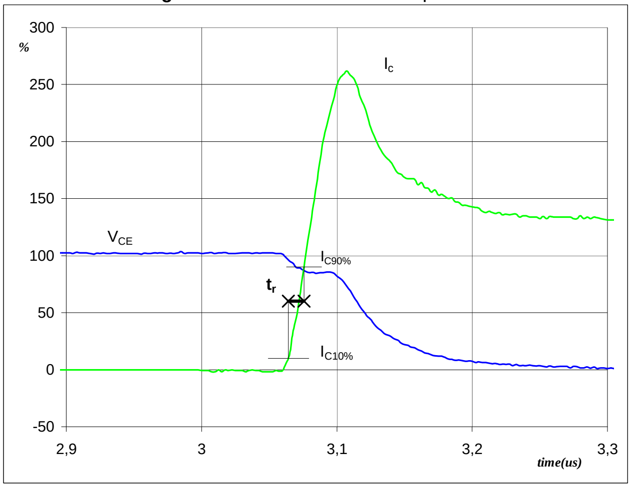
Turn-off Switching Waveforms & definition of t_f



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

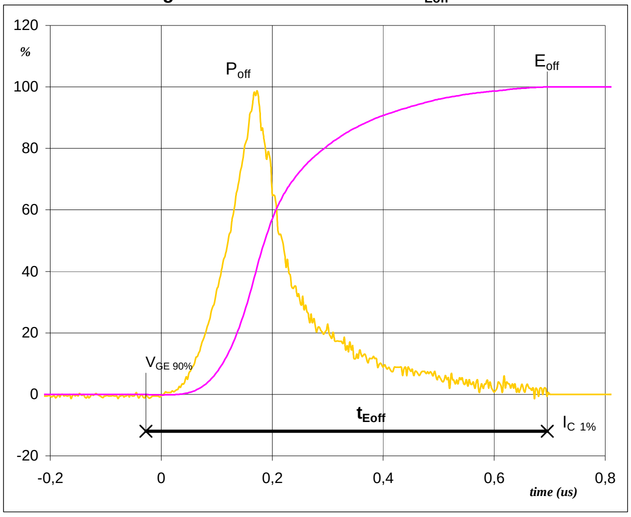


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,01	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

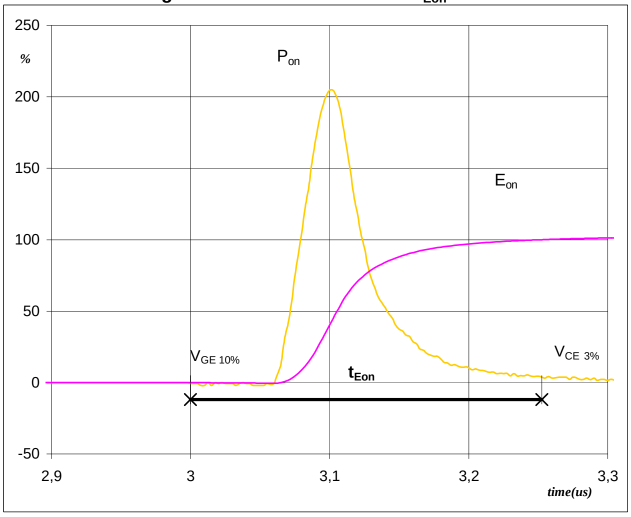
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	30,08	kW
E_{off} (100%) =	4,32	mJ
t_{Eoff} =	0,72	μs

Figure 6 Output inverter IGBT

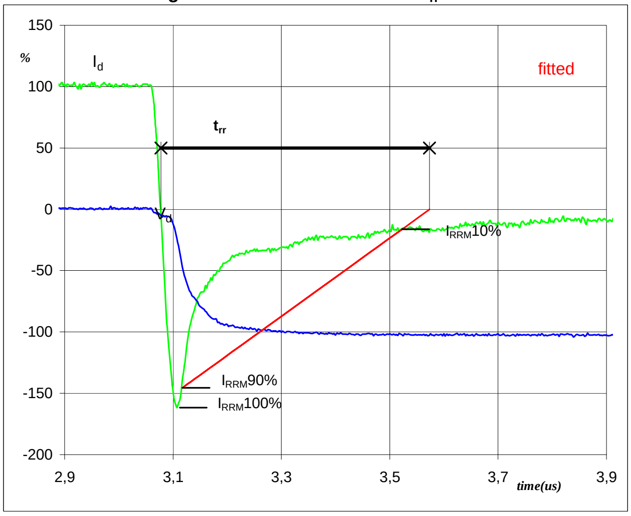
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	30,08	kW
E_{on} (100%) =	3,31	mJ
t_{Eon} =	0,25	μs

Figure 7 Output inverter FWD

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

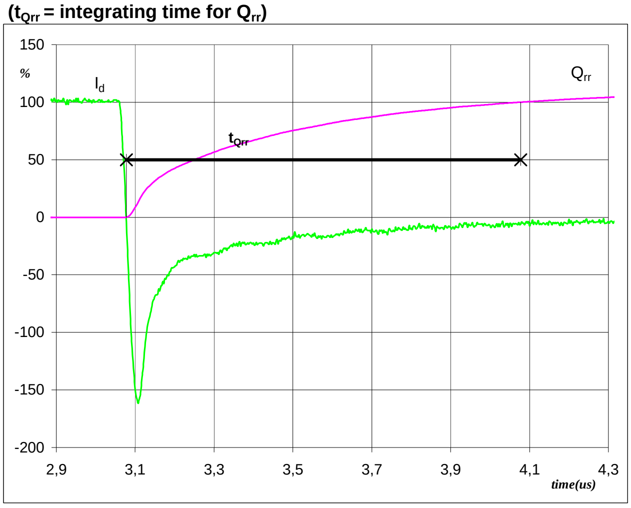


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-81	A
t_{rr} =	0,47	μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

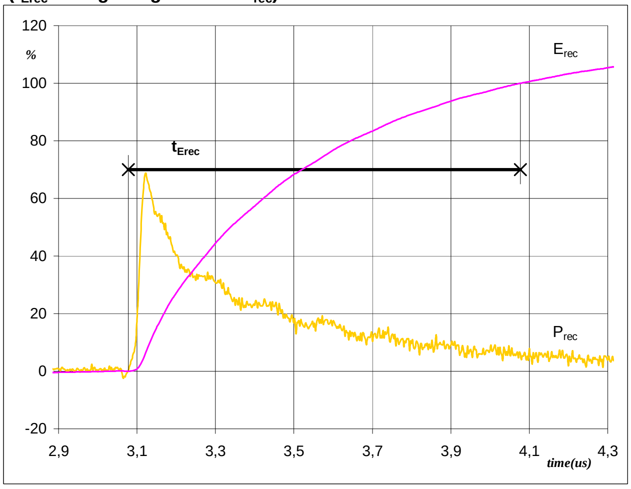
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	12,53	μC
t_{Qrr} =	1,00	μs

Figure 9 Output inverter FWD

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



P_{rec} (100%) =	30,08	kW
E_{rec} (100%) =	6,03	mJ
t_{Erec} =	1,00	μs

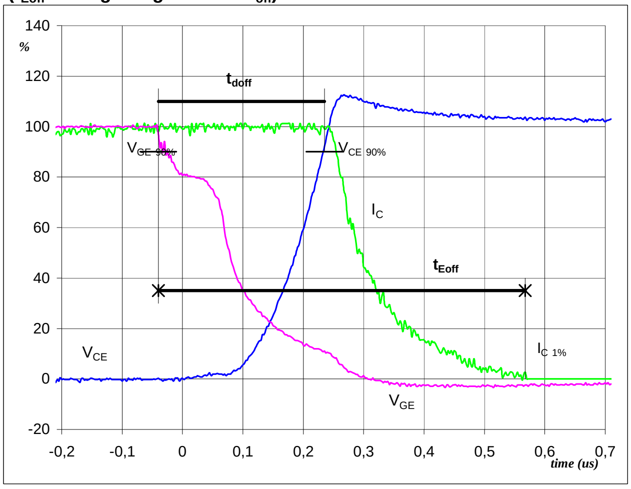
Switching Definitions Brake

General conditions

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

Figure 1 IGBT

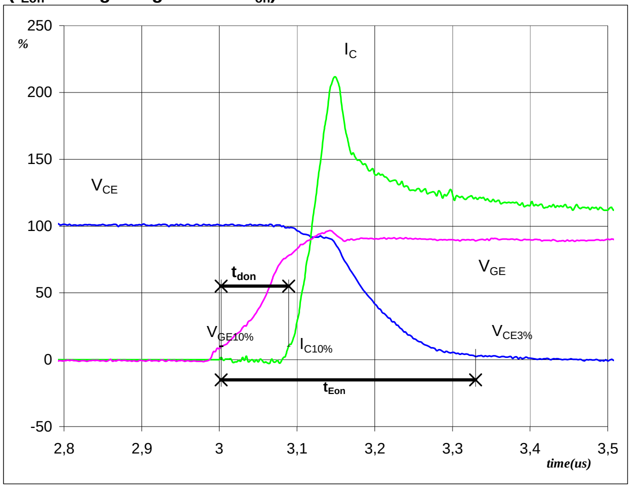
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0,27	μs
t_{Eoff} =	0,61	μs

Figure 2 IGBT

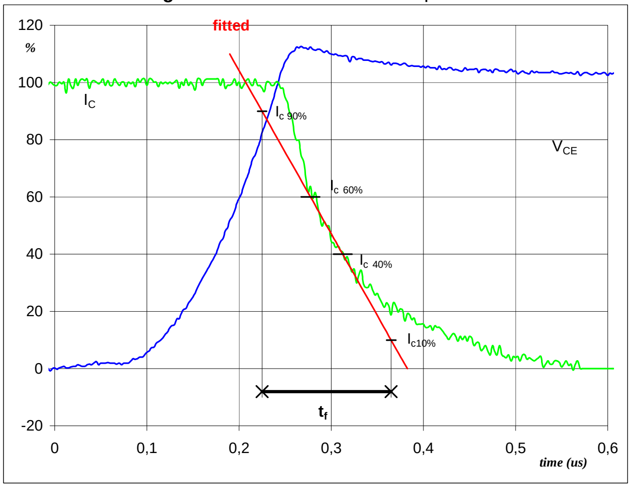
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0,09	μs
t_{Eon} =	0,33	μs

Figure 3 IGBT

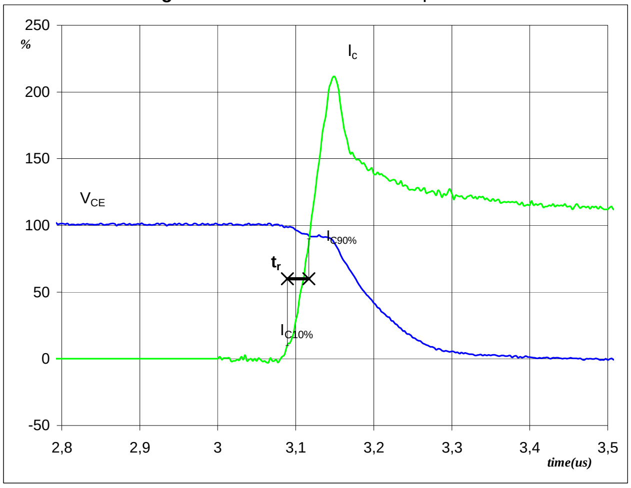
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0,13	μs

Figure 4 IGBT

Turn-on Switching Waveforms & definition of t_r

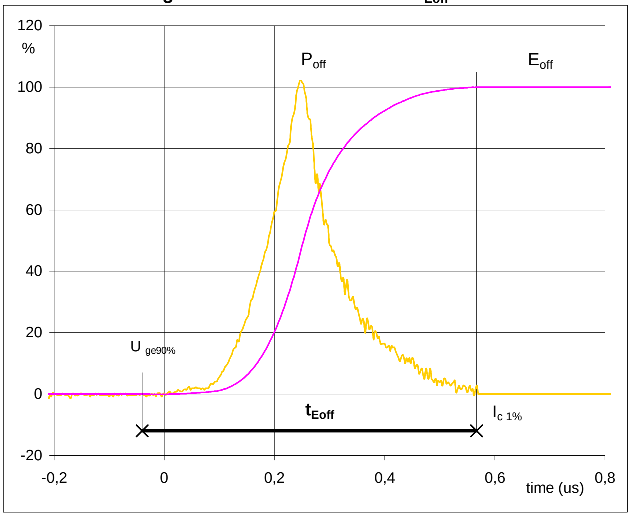


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,03	μs

Switching Definitions Brake

Figure 5 IGBT

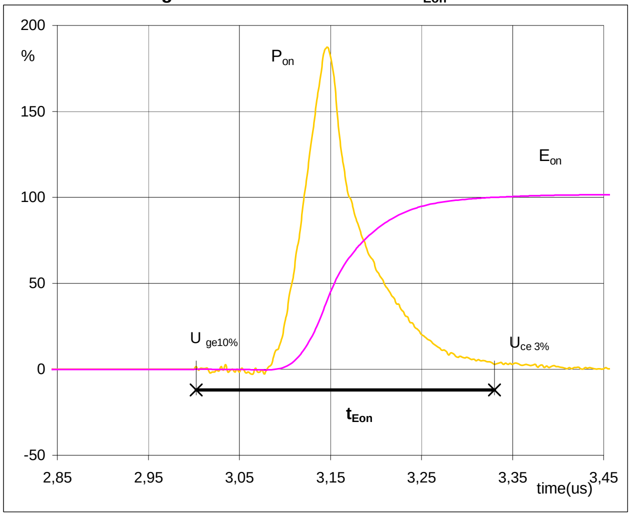
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	20,96	kW
E_{off} (100%) =	3,18	mJ
t_{Eoff} =	0,61	µs

Figure 6 IGBT

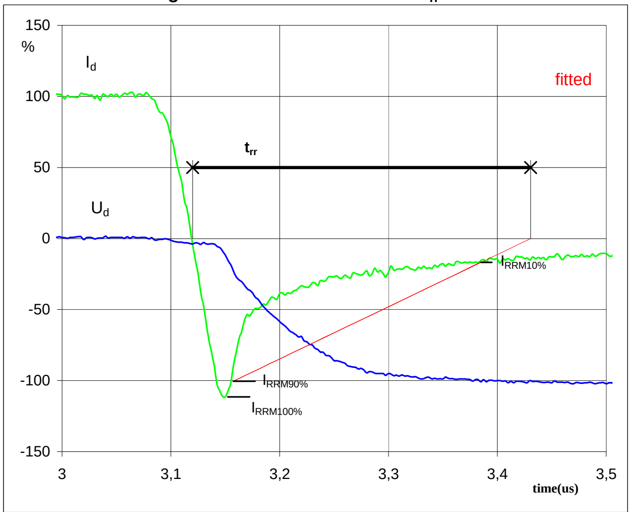
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	20,9586	kW
E_{on} (100%) =	2,92	mJ
t_{Eon} =	0,3275	µs

Figure 7 PFC FWD

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

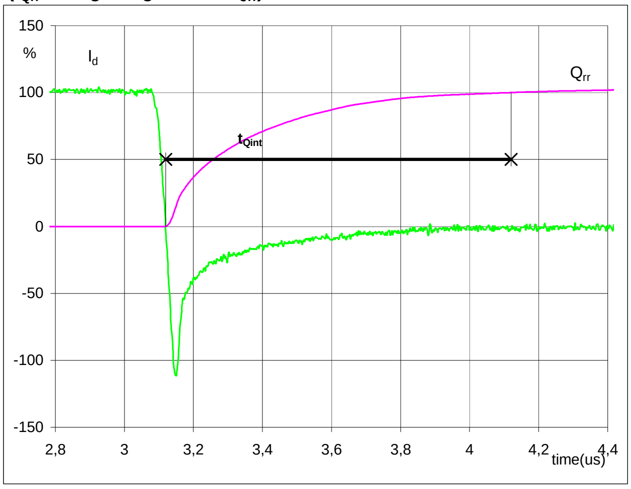


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-39	A
t_{rr} =	0,42	µs

Switching Definitions Brake

Figure 8 PFC FWD

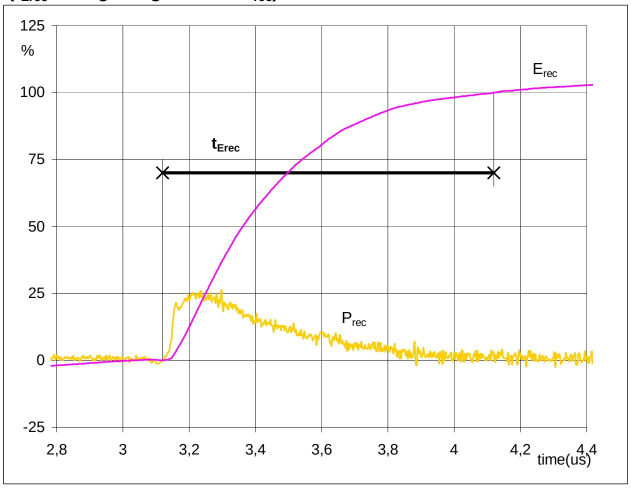
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	4,84	µC
t_{Qint} =	1,00	µs

Figure 9 PFC FWD

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



P_{rec} (100%) =	20,96	kW
E_{rec} (100%) =	1,98	mJ
t_{Erec} =	1,00	µs

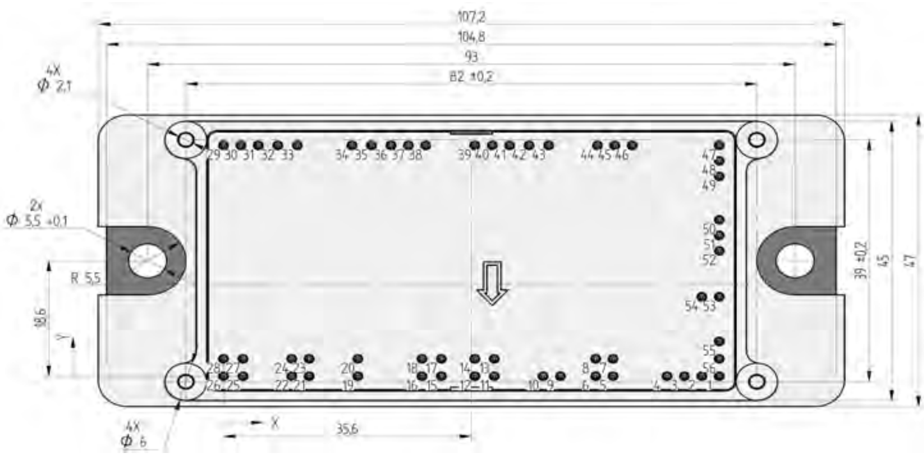
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

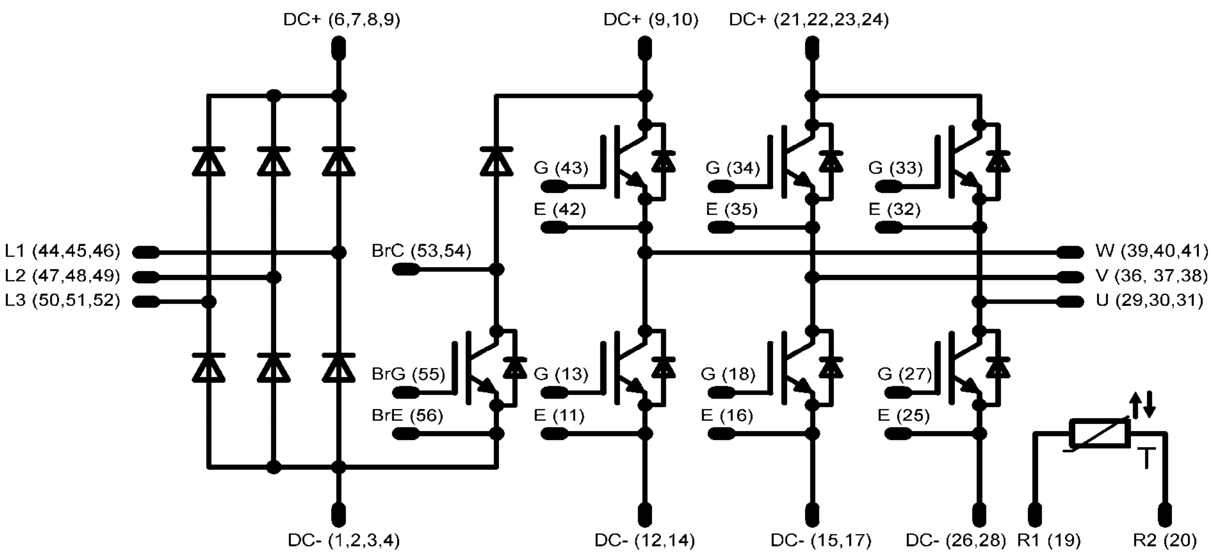
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 17mm housing	V23990-P768-A50	P768-A50	P768-A50

Outline

Pin table				Pin table			
Pin		X	Y	Pin		X	Y
1	DC -	71,2	0	29	U	0	37,2
2	DC -	68,7	0	30	U	2,5	37,2
3	DC -	66,2	0	31	U	5	37,2
4	DC -	63,7	0	32	E	7,8	37,2
5	DC +	55,95	0	33	G	10,6	37,2
6	DC +	53,45	0	34	G	18,45	37,2
7	DC +	55,95	2,8	35	E	21,25	37,2
8	DC +	53,45	2,8	36	V	24,05	37,2
9	DC +	48,4	0	37	V	26,55	37,2
10	DC +	45,9	0	38	V	29,05	37,2
11	E	38,9	0	39	W	36,1	37,2
12	DC -	36,1	0	40	W	38,6	37,2
13	G	38,9	2,8	41	W	41,1	37,2
14	DC -	36,1	2,8	42	E	43,9	37,2
15	DC -	31,3	0	43	G	46,7	37,2
16	E	28,5	0	44	L1	53,7	37,2
17	DC -	31,3	2,8	45	L1	56,2	37,2
18	G	28,5	2,8	46	L1	58,7	37,2
19	R2	19,3	0	47	L2	71,2	37,2
20	R1	19,3	2,8	48	L2	71,2	34,7
21	DC +	12,3	0	49	L2	71,2	32,2
22	DC +	9,8	0	50	L3	71,2	25,2
23	DC +	12,3	2,8	51	L3	71,2	22,7
24	DC +	9,8	2,8	52	L3	71,2	20,2
25	E	2,8	0	53	BrC	68,7	12,8
26	DC -	0	0	54	BrC	71,2	12,8
27	G	2,8	2,8	55	BrG	71,2	5,6
28	DC -	0	2,8	56	BrE	71,2	2,8



Pinout



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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.