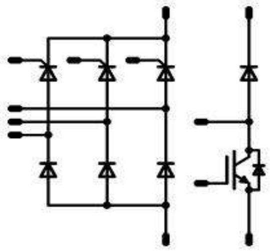
***flow* 90CON 1** | **1600V/50A**

Features
- 3~ phase input rectifier with or withot BRC
  *optional half controlled
- Compatible with flow 90PACK 1
- Support designs with 90° mounting angle between heatsink and PCB
- Clip-in PCB mounting

flow 90 housing


Target Applications
- Motor drives
- Servo drives

Schematic


Types
- V23990-P718-G-PM
- V23990-P718-G10-PM half controlled
- V23990-P718-H-PM w/o brake
- V23990-P718-H10-PM half controlled, w/o brake

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward current per diode	I_{FAV}	DC current	T_h=80℃ T_c=80℃	52 71	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=45℃	850	A
I^2t-value	I^2t			3610	A^2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	61 92	W
Maximum Junction Temperature	$T_j$max			150	℃
Input Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward average current	I_{FAV}	sine,d=0.5 T_j=$T_j$max	T_h=80℃ T_c=80℃	43 50	A
Surge forward current	I_{FSM}	t_p=10ms	Tj=45℃	620	A
I^2t-value	I^2t			1920	A^2s
Power dissipation per Thyristor	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	60 91	W
Maximum Junction Temperature	$T_j$max			150	℃

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Brake IGBT					
Collector-emitter Break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	31 40	A
Pulsed collector current	I_{Cpuls}	t_p limited by T_jmax		105	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	73 110	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j≤150℃$ $V_{GE}=15V$		10 1200	µs V
Maximum Junction Temperature	T_jmax			150	℃
Brake Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	8 8	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		6	A
Brake Inverse Diode	P_{tot}	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	20 30	W
Maximum Junction Temperature	T_jmax			150	℃
Brake FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	14 19	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		30	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	$T_h=80℃$ $T_c=80℃$	29 44	W
Maximum Junction Temperature	T_jmax			150	℃
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	
Input Rectifier Diode										
Forward voltage	V_F				59	Tj=25°C Tj=125°C	0,8	1,23 1,21	1,5	V
Threshold voltage (for power loss calc. only)	V_{to}				59	Tj=25°C Tj=125°C		0,92 0,81		V
Slope resistance (for power loss calc. only)	r_t				59	Tj=25°C Tj=125°C		5,0 6,8		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,15		K/W
Input Rectifier Thyristor										
Forward voltage	V_F				0,048	Tj=25°C Tj=125°C	1	1,36 1,38	1,9	V
Threshold voltage (for power loss calc. only)	V_{to}		V_D=6 V		35	Tj=25°C Tj=125°C		1,00 0,89		V
Slope resistance (for power loss calc. only)	r_t				35	Tj=25°C Tj=125°C		0,01 0,01		mΩ
Reverse current	I_r			1200		Tj=25°C Tj=125°C			0,05 5	mA
Gate controlled delay time	t_{GD}	I_G=0,5A V_D=1/2 V_{DRM}				Tj=25°C Tj=125°C			2	µs
Gate controlled rise time	t_{GR}					Tj=25°C Tj=125°C		tbd.		µs
Critical rate of rise of off-state voltage	(dv/dt)cr	V_D=2/3 V_{DRM} linear voltage rise				Tj=150°C			1000	V/µs
Critical rate of rise of on-state current	(di/dt)cr	V_D=2/3 V_{DRM} I_G=0,45A; f=50Hz	tp=200 µs		42	Tj=150°C			500	A/µs
Circuit commutated turn-off time	t_q	V_D=2/3 V_{DRM}	tp=200 µs	100	42	Tj=25°C Tj=125°C		150		µs
Holding current	I_H		V_D=6 V			Tj=25°C Tj=125°C		75		mA
Latching current	I_L	I_G=0,45A tp=10 µs				Tj=25°C Tj=125°C		125		mA
Gate trigger voltage	V_{GT}		V_D=6 V			Tj=25°C Tj=125°C			1,5	V
Gate trigger current	I_{GT}		V_D=6 V			Tj=25°C Tj=125°C			50	mA
Gate non-trigger voltage	V_{GD}	V_D=2/3 V_{DRM}				Tj=150°C			0,2	V
Gate non-trigger current	I_{GD}	V_D=2/3 V_{DRM}				Tj=150°C			5	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,16		K/W
Brake IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	V_{CE}=V_{GE}			0,0015	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		35	Tj=25°C Tj=125°C	1,3	2,11 2,40	2,25	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,25	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			650	nA
Integrated Gate resistor	R_{gint}							6		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=32 Ω Rgoff=16 Ω	±15	600	35	Tj=25°C Tj=125°C		56 56		ns
Rise time	t_r					Tj=25°C Tj=125°C		19 26		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		492 577		
Fall time	t_f					Tj=25°C Tj=125°C		109 167		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		2,06 2,42		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		1,79 2,79		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		2530		pF
Output capacitance	C_{oss}							132		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_{Gate}					Tj=25°C		205		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						0,96		K/W

Characteristic Values

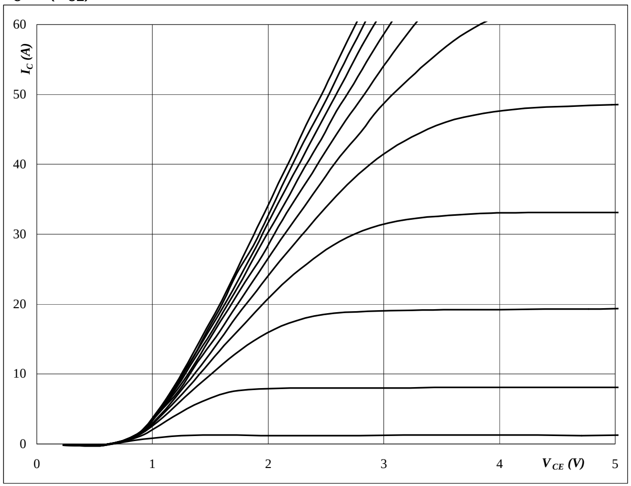
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Brake Inverse Diode										
Diode forward voltage	V_F				3	Tj=25°C Tj=125°C	1	1,60 1,57	2,2	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						3,22		K/W
Brake FWD										
Diode forward voltage	V_F				15	Tj=25°C Tj=125°C	1	2,07 2,45	2,3	V
Reverse leakage current	I_r		±15	300	25	Tj=25°C Tj=125°C			250	μA
Peak reverse recovery current	I_{RRM}	Rgon=32 Ω	±15	300	25	Tj=25°C Tj=125°C		16,77 17,11		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		332 505		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		1,79 2,78		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		495 210		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		1,79 2,78		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,40		K/W

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



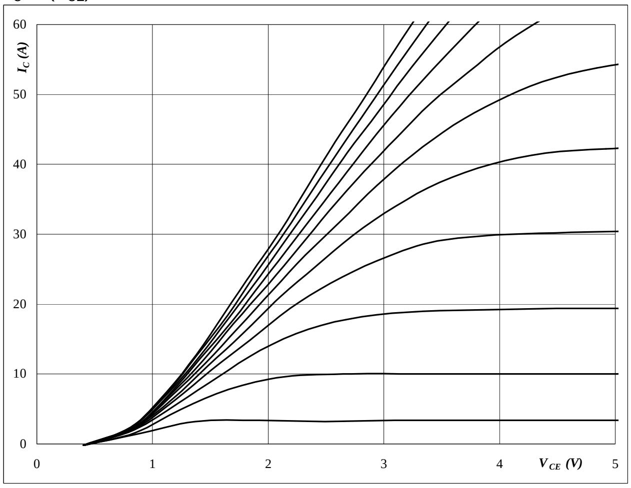
At

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

$I_C = f(V_{CE})$



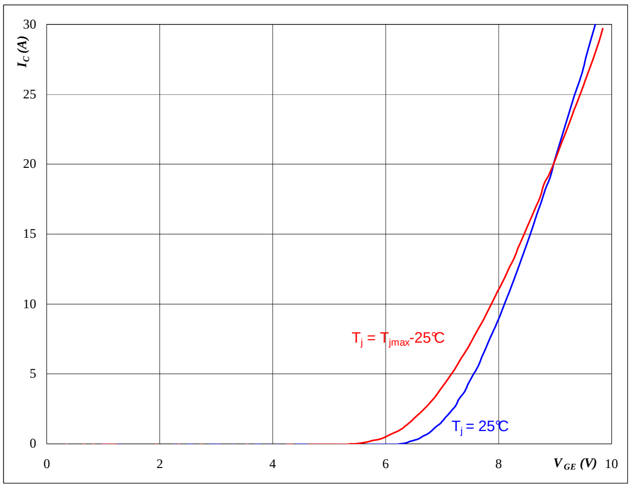
At

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



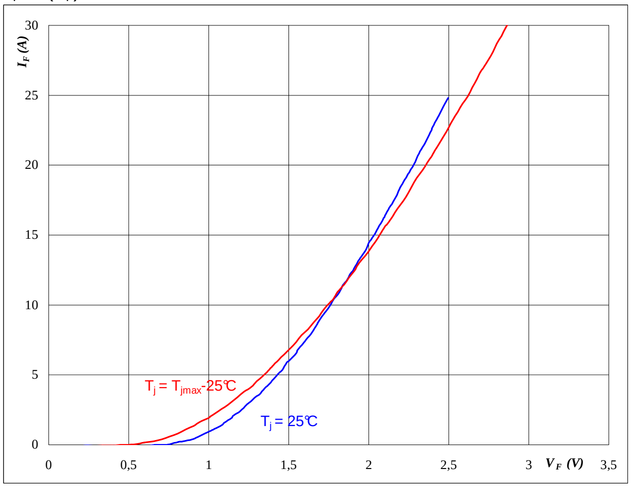
At

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

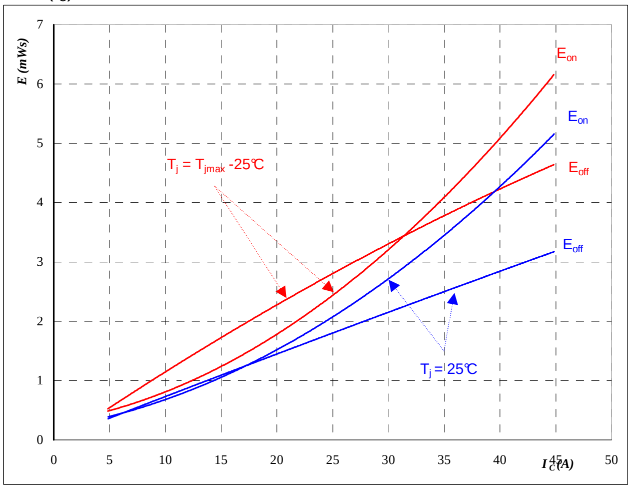
t_p =	250	µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



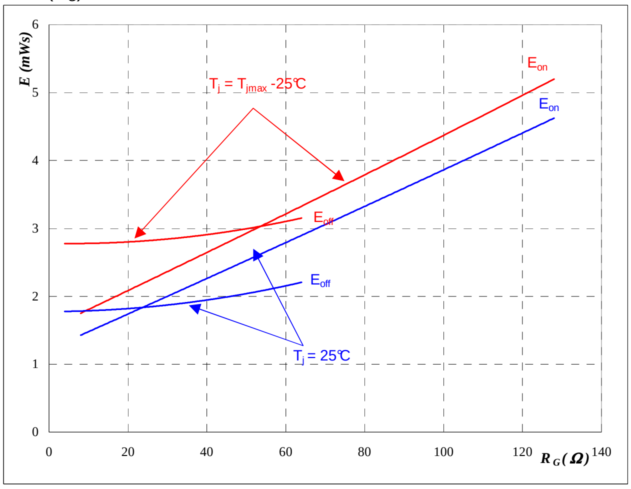
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Figure 6 Brake IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



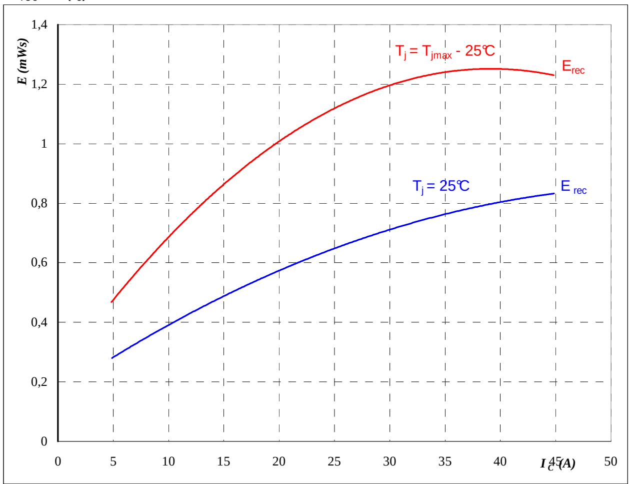
With an inductive load at

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

Figure 7 Brake IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



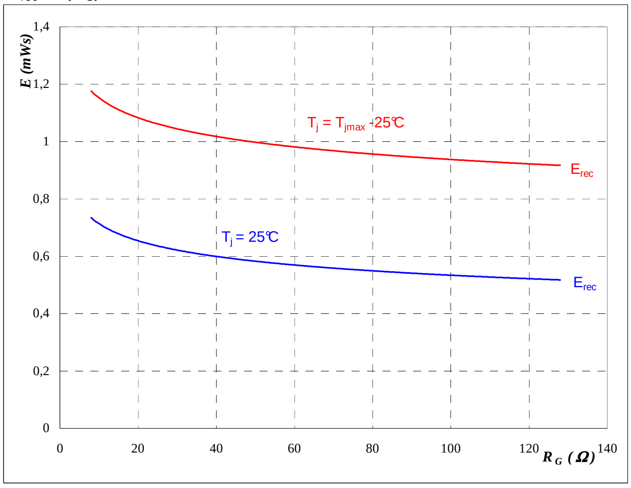
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	32	Ω

Figure 8 Brake IGBT

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

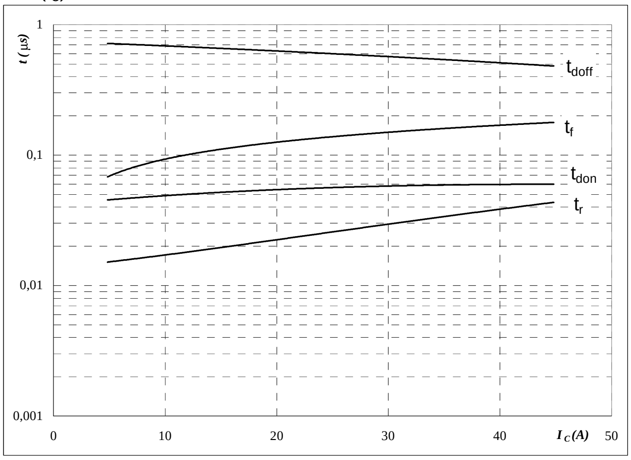
T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
I_C =	25	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



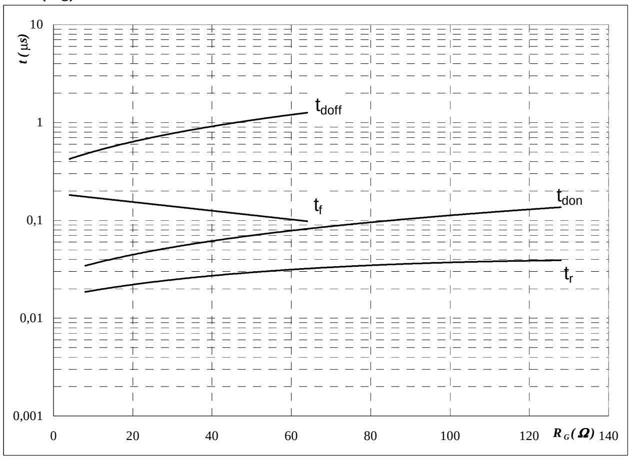
With an inductive load at

T_j =	125	℃
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



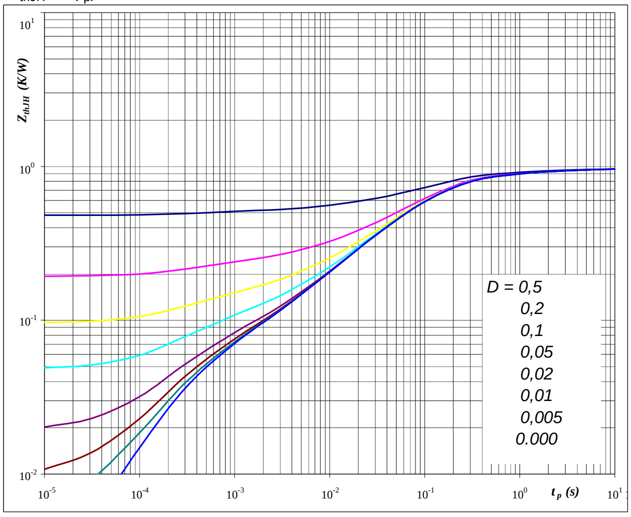
With an inductive load at

T_j =	125	℃
V_{CE} =	600	V
V_{GE} =	15	V
I_C =	25	A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



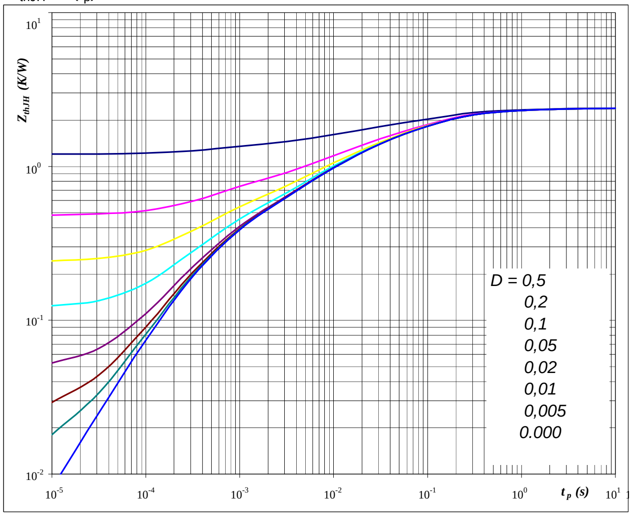
At

D =	tp / T	
R_{thJH} =	0,96	K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



At

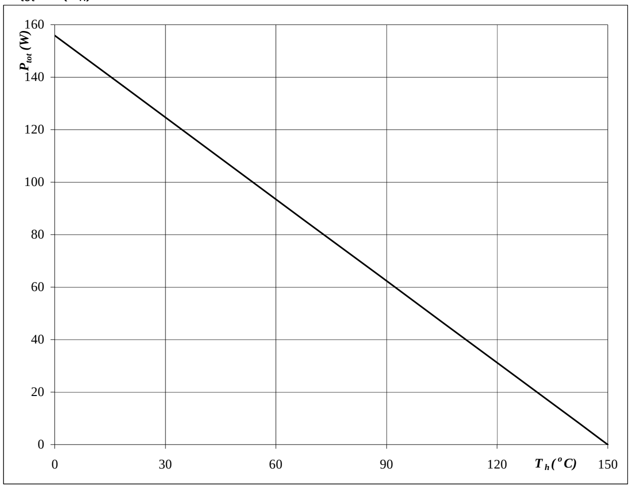
D =	tp / T	
R_{thJH} =	2,40	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



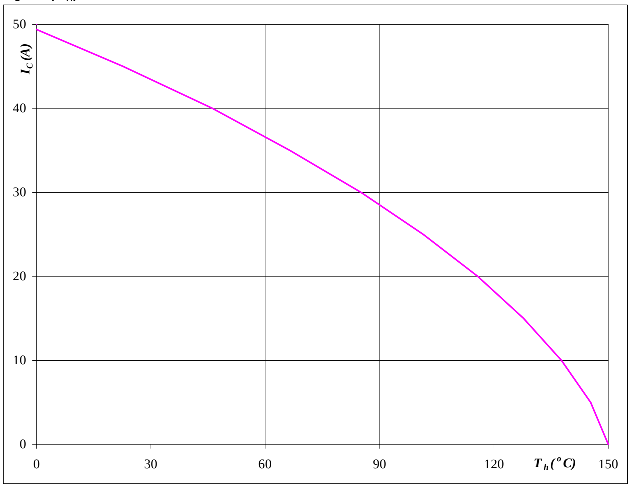
At

T_j = 150 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

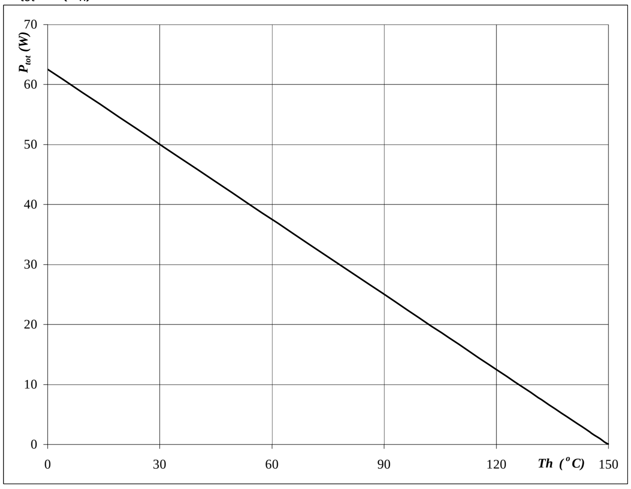
T_j = 150 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



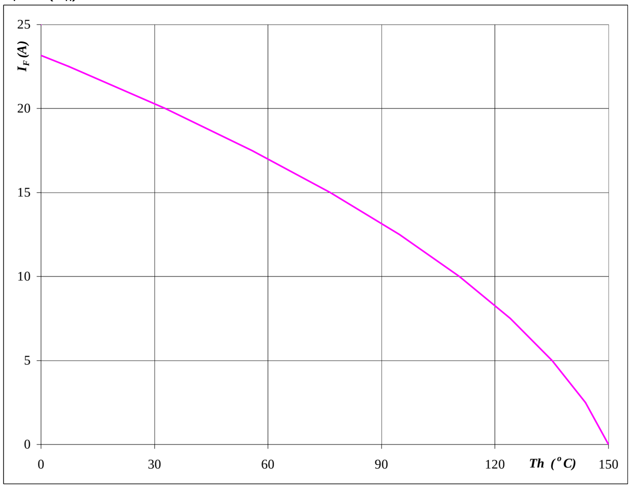
At

T_j = 150 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

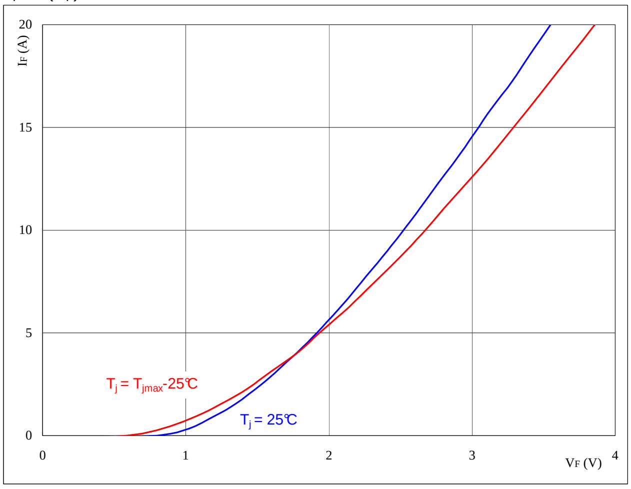
T_j = 150 ºC

Brake Inverse Diode

Figure 1 Brake inverse diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



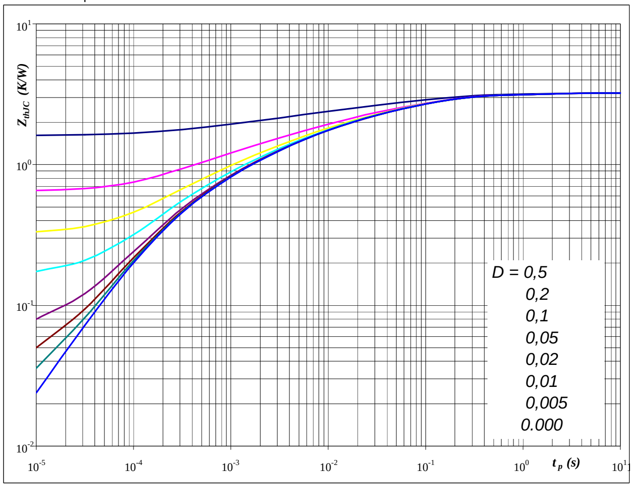
At

t_p =	250	µs

Figure 2 Brake inverse diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



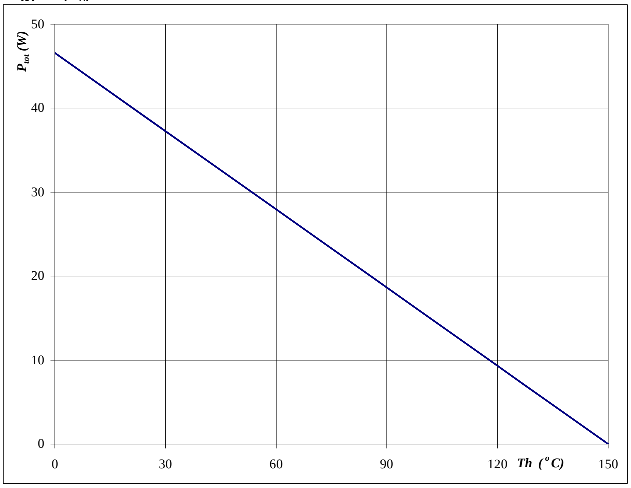
At

D =	tp / T	
R_{thJH} =	3,22	K/W

Figure 3 Brake inverse diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



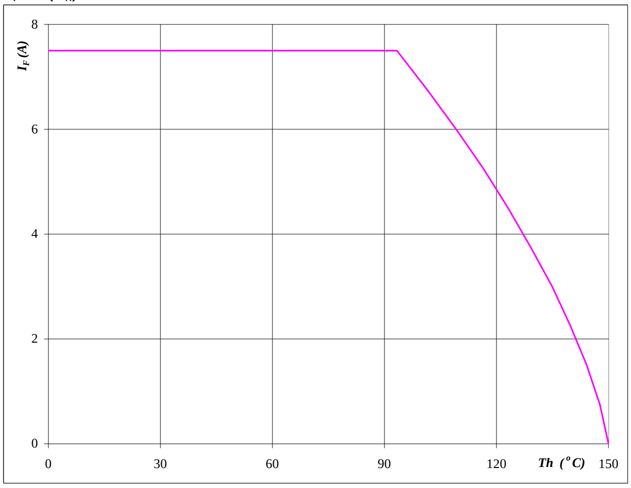
At

T_j =	150	ºC

Figure 4 Brake inverse diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

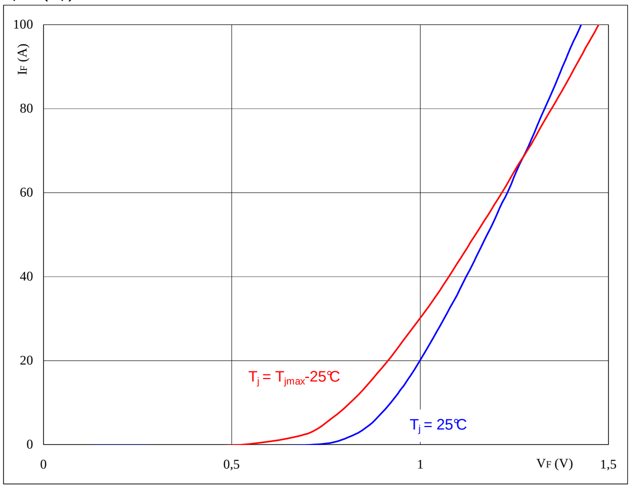
T_j =	150	ºC

Input Rectifier Diode

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



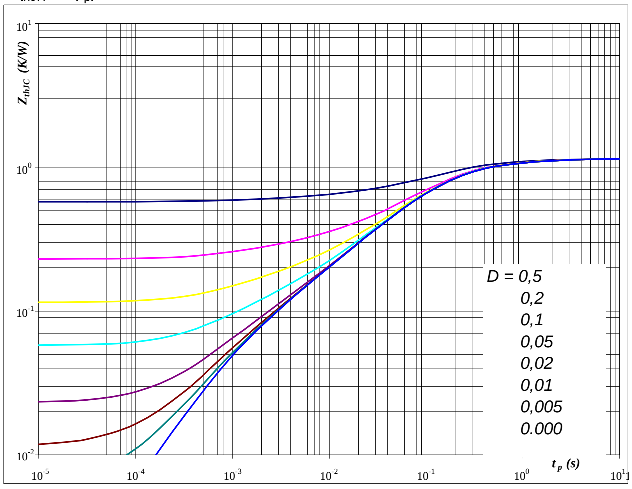
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

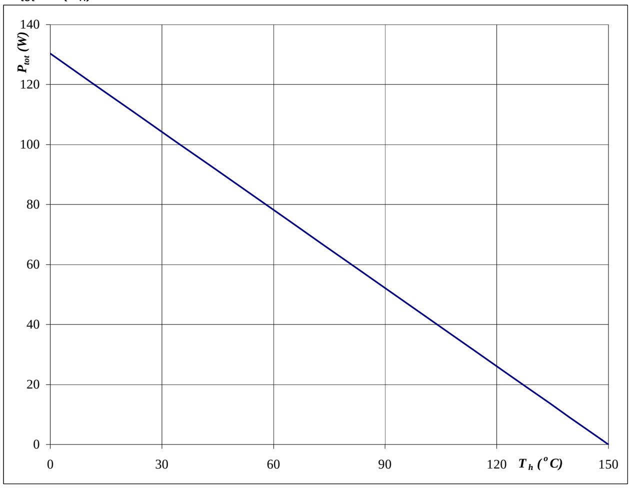
D = t_p / T

R_{thJH} = 1,15 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



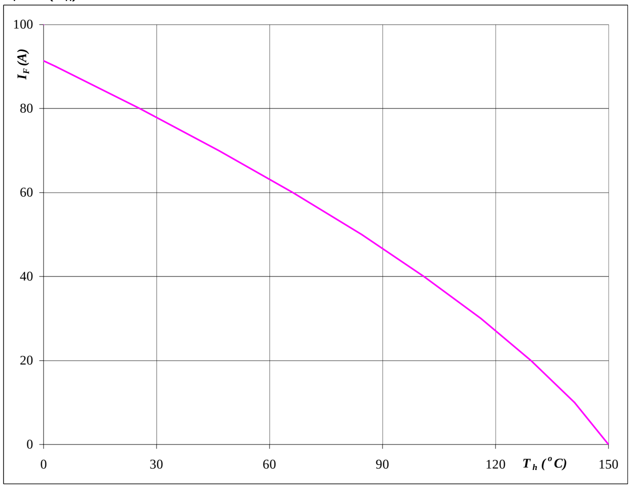
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

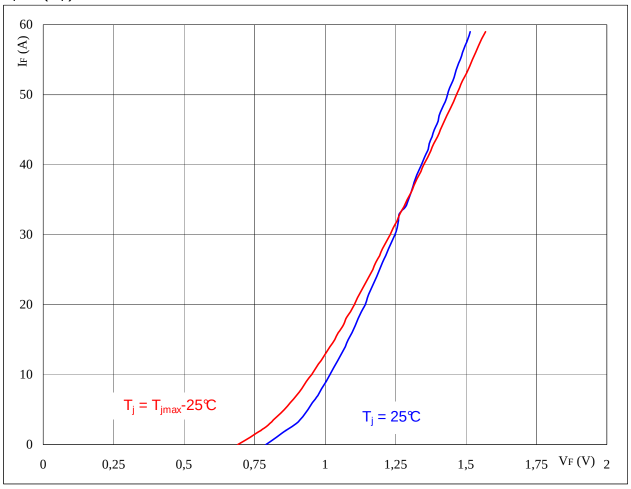
T_j = 150 ºC

Thyristor

Figure 1 Thyristor

Typical thyristor forward current as a function of forward voltage

$I_F = f(V_F)$



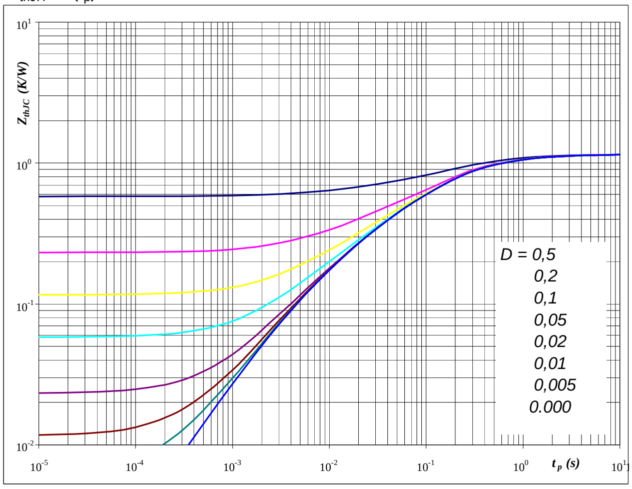
At

t_p = 250 µs

Figure 2 Thyristor

Thyristor transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

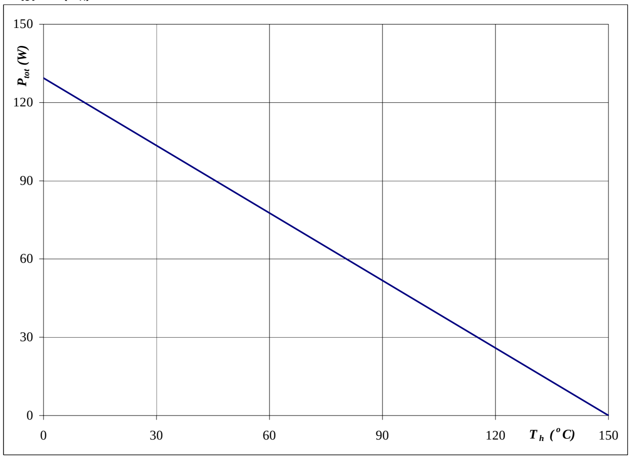
D = t_p / T

R_{thJH} = 1,16 K/W

Figure 3 Thyristor

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



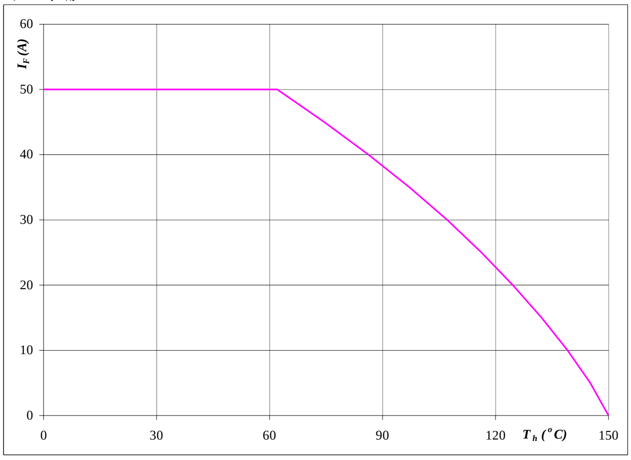
At

T_j = 150 ºC

Figure 4 Thyristor

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



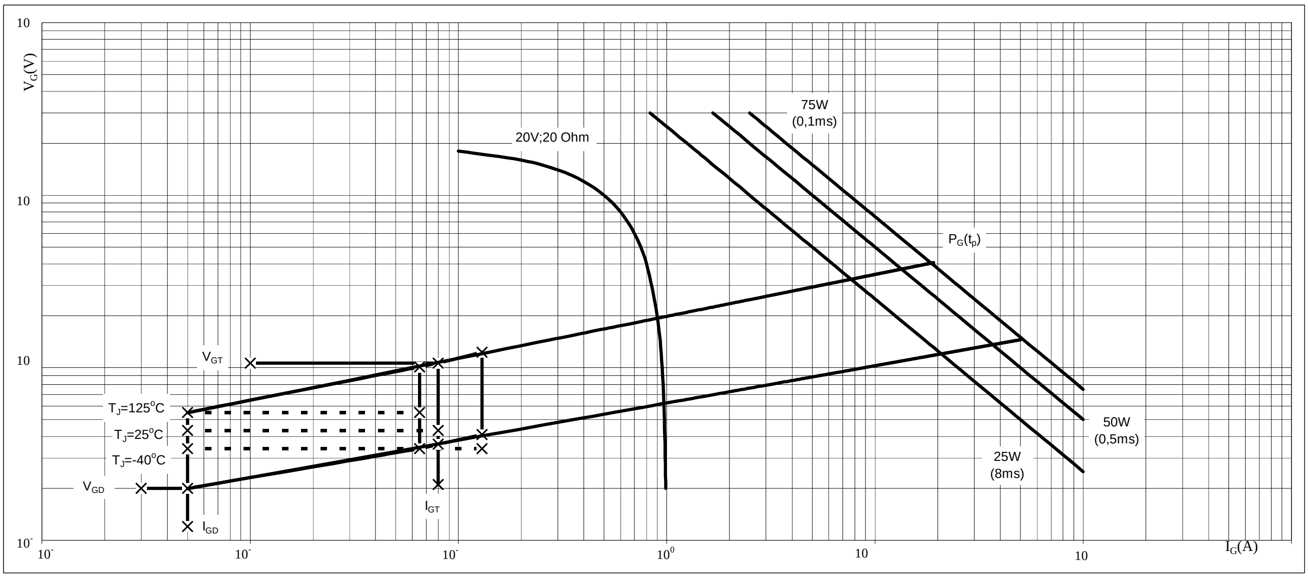
At

T_j = 150 ºC

Thyristor

Figure 5	Thyristor

Gate trigger characteristics



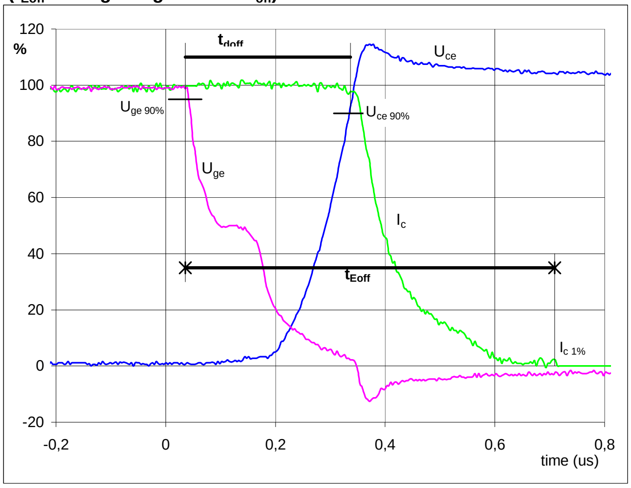
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Output inverter IGBT

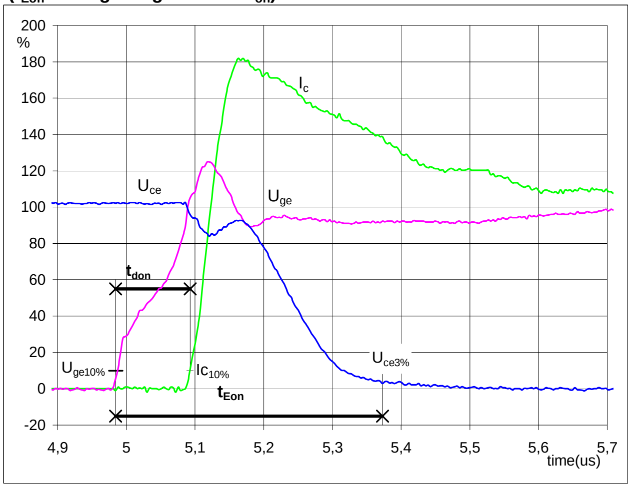
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



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

Figure 2 Output inverter IGBT

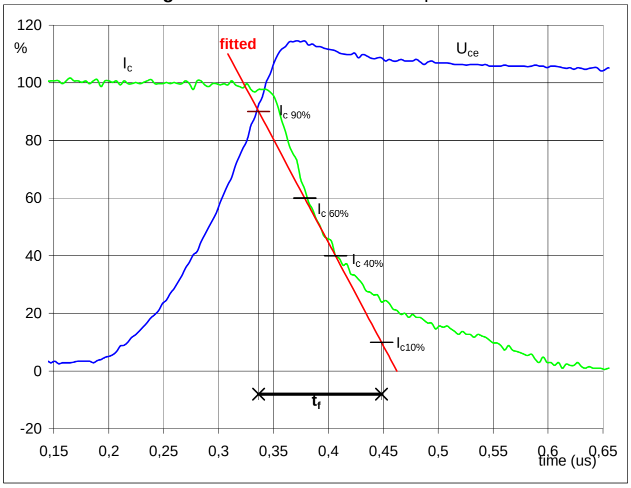
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	100	A
t_{don} =	0,11	µs
t_{Eon} =	0,39	µs

Figure 3 Output inverter IGBT

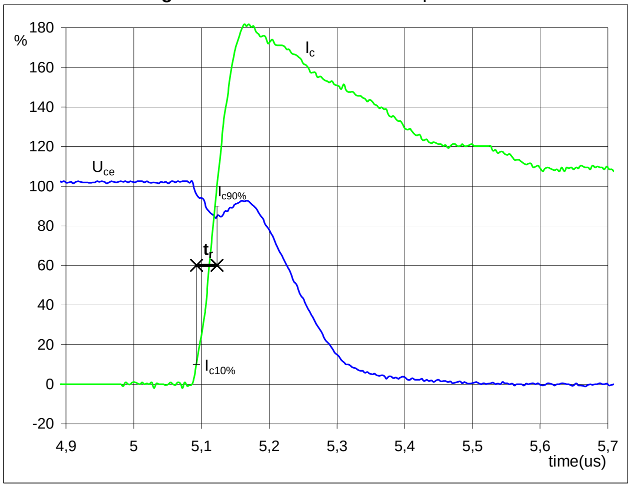
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	100	A
t_f =	0,11	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

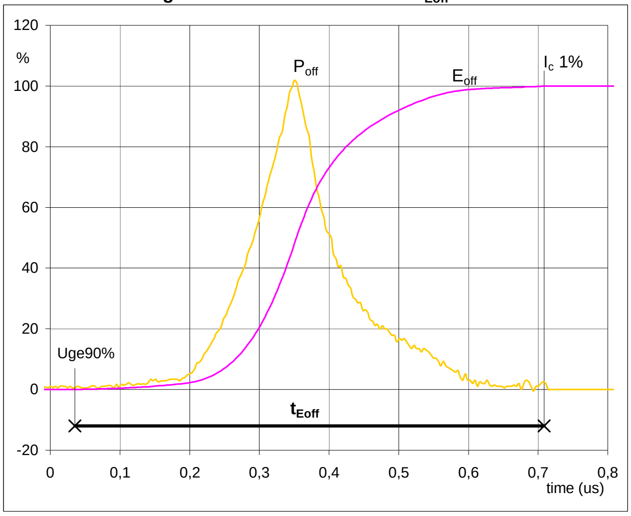


V_C (100%) =	600	V
I_C (100%) =	100	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

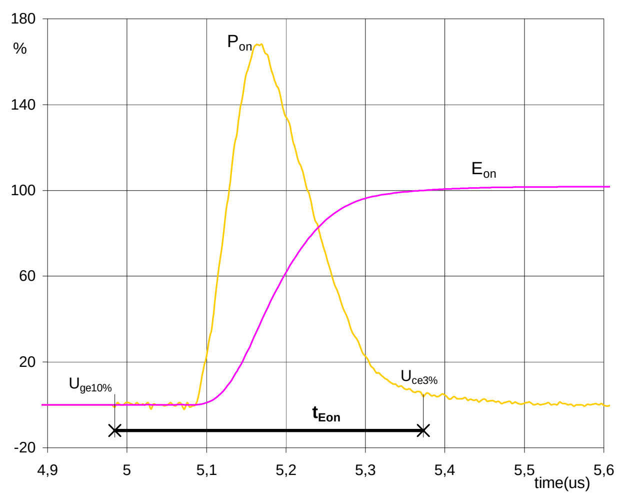
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	59,91	kW
E_{off} (100%) =	8,87	mJ
t_{Eoff} =	0,67	μs

Figure 6 Output inverter IGBT

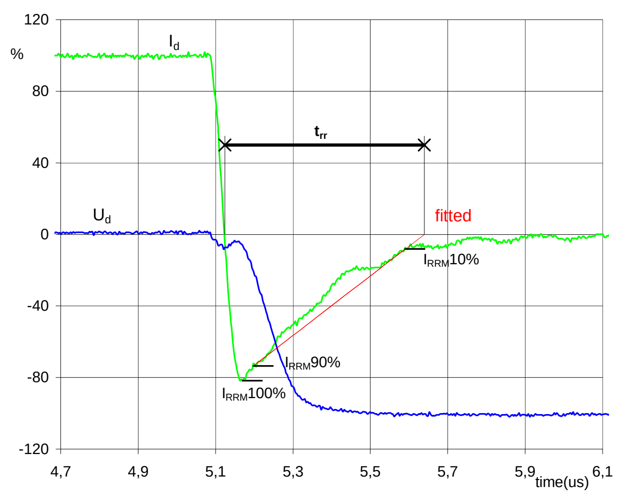
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	59,91	kW
E_{on} (100%) =	12,48	mJ
t_{Eon} =	0,39	μs

Figure 7 Output inverter FWD

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

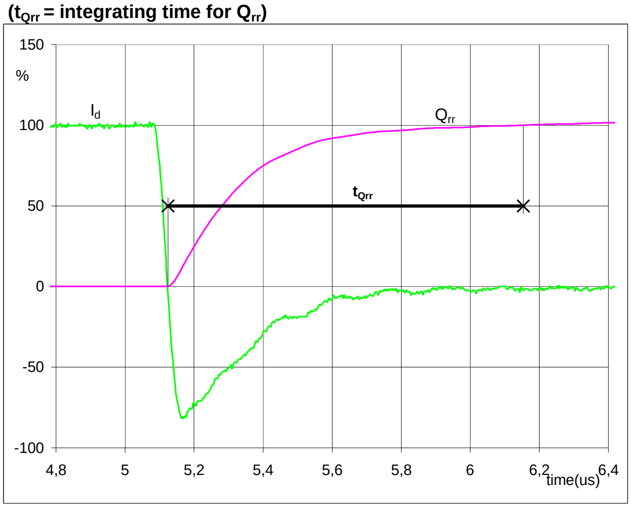


V_d (100%) =	600	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-83	A
t_{rr} =	0,51	μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

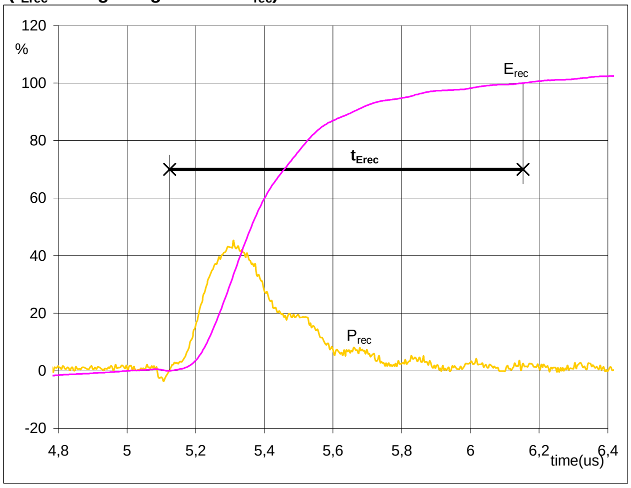
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	20,73	µC
t_{Qrr} =	1,03	µs

Figure 9 Output inverter FWD

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



P_{rec} (100%) =	59,91	kW
E_{rec} (100%) =	7,85	mJ
t_{Erec} =	1,03	µs

Ordering Code and Marking - Outline - Pinout

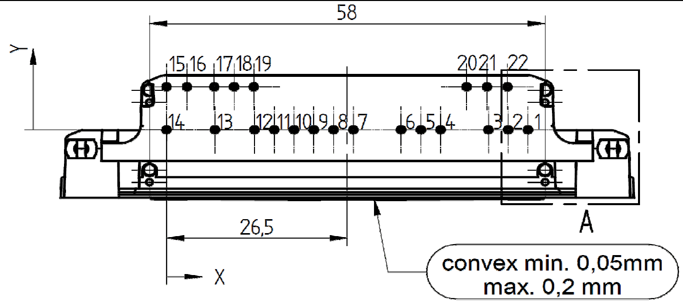
Ordering Code & Marking

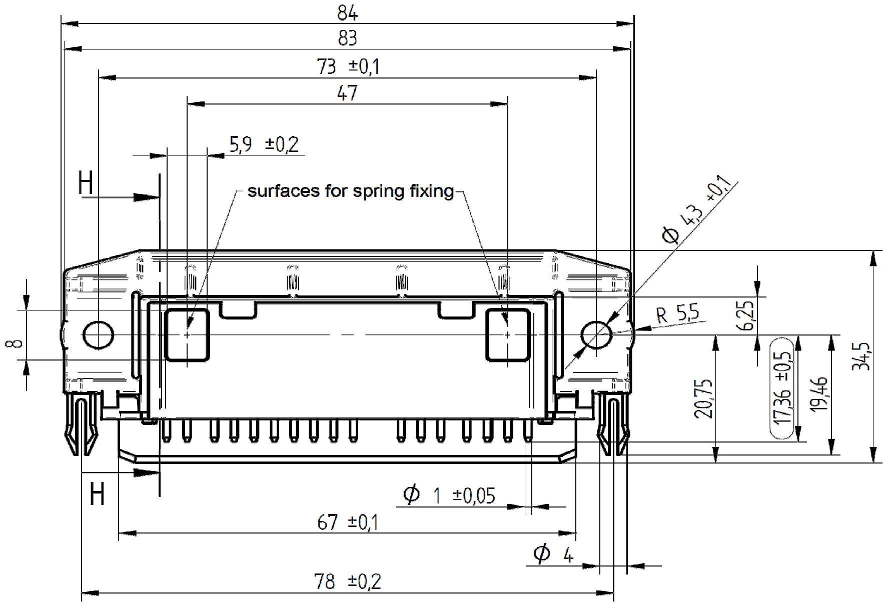
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	V23990-P718-G-PM	P718-G	P718-G
without thermal paste 12mm housing	V23990-P718-G10-PM	P718-G10	P718-G10
without thermal paste 12mm housing	V23990-P718-H-PM	P718-H	P718-H
without thermal paste 12mm housing	V23990-P718-H10-PM	P718-H10	P718-H10

Outline

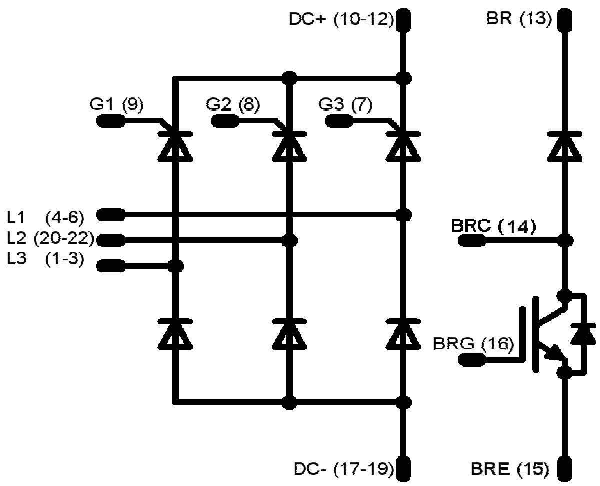
Pin table

Pin	X	Y
1	53	0
2	50,1	0
3	47,2	0
4	40,2	0
5	37,3	0
6	34,4	0
7	27,4	0
8	24,5	0
9	21,6	0
10	18,7	0
11	15,8	0
12	12,9	0
13	7,1	0
14	0	0
15	0	7
16	3	7
17	7	7
18	9,9	7
19	12,8	7
20	44	7
21	47	7
22	50	7





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.