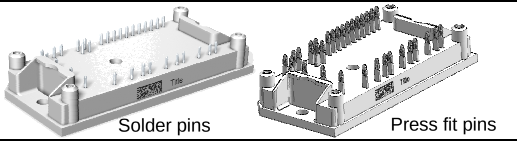
flow **PIM 1**	**600V/50A**

Features

- 3~rectifier, optional BRC, Inverter, NTC
- Very compact housing, easy to route
- IGBT! / EmCon4 technology for low saturation losses and improved EMC behaviour

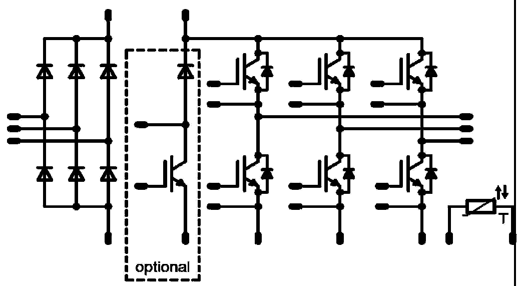
flow 1 housing



Target Applications

- Industrial drives
- Embedded drives

Schematic



Types

- V23990-P586-A20-PM
- V23990-P586-A20Y-PM
- V23990-P586-A208-PM
- V23990-P586-A208Y-PM
- V23990-P586-C20-PM
- V23990-P586-C20Y-PM

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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℃	33 47	A
Surge (non-repetitive) forward current	I_{FSM}	t_p=10ms 50 Hz half sine wave	T_j=25℃	250	A
I2t-value	I^2t			310	A^2s
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	37 60	W
Maximum Junction Temperature	$T_j$max			150	℃
Inverter Switch					
Collector-emitter breakdown voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	38 48	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		150	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		150	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	70 106	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		6 360	µs V
Maximum Junction Temperature	$T_j$max			175	℃

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Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80℃ T_c=80℃	36 48	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		100	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	58 87	W
Maximum Junction Temperature	$T_j$max			175	℃
Brake Switch					
Collector-emitter breakdown voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80℃ T_c=80℃	26 33	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		90	A
Turn off safe operating area		$V_{CE} \leq$ 1200V, $T_j \leq T_{op}$ max		90	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	46 70	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$150℃ V_{GE}=15V		6 360	µs V
Maximum Junction Temperature	$T_j$max			175	℃
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80℃ T_c=80℃	13 18	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		40	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	20 30	W
Maximum Junction Temperature	$T_j$max			175	℃
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	℃
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	℃
Isolation Properties					
Isolation 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	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Rectifier Diode										
Forward voltage	V_F				30	Tj=25°C Tj=125°C	0,8	1,16 1,13	1,6	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0,90 0,78	 0,83	V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		8 11		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=150°C			 2	mA
Thermal resistance junction to sink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,89		K/W
Thermal resistance junction to sink	R_{thJH}	phase-change material λ = 3,4 W/mK						1,19		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0008	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=125°C		1,76 2,06		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,04 1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			600	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	300	50	Tj=25°C Tj=125°C		168 171		ns
Rise time	t_r					Tj=25°C Tj=125°C		23 27		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		213 228		
Fall time	t_f					Tj=25°C Tj=125°C		84 100		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		1,19 1,60		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		1,20 1,55		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_{Gate}		±15			Tj=25°C		310		nC
Thermal resistance junction to sink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,25		K/W
Thermal resistance junction to sink	R_{thJH}	phase-change material λ = 3,4 W/mK						1,06		K/W
Inverter Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=125°C	1,2	1,85 1,94	1,9	V
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω				Tj=25°C Tj=125°C		37 42		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		144 217		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		1,9 3,4		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		1568 1145		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,31 0,60		mWs
Thermal resistance junction to sink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,65		K/W
Thermal resistance junction to sink	R_{thJH}	phase-change material λ = 3,4 W/mK						1,4		K/W

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Characteristic Values

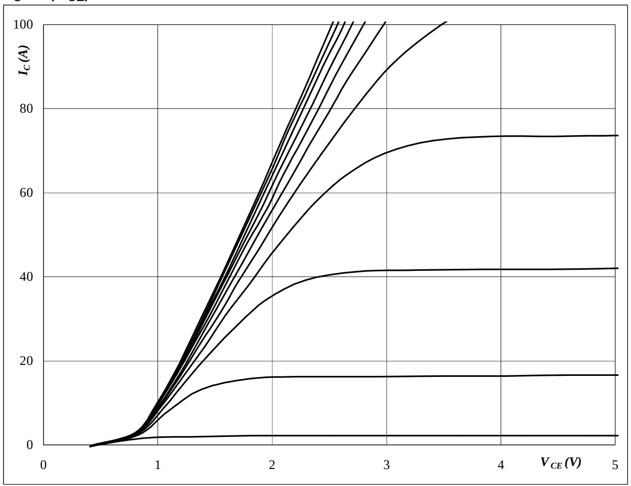
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00043	Tj=25℃ Tj=125℃	4,1	4,9	5,7	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		30	Tj=25℃ Tj=125℃	1,1	1,55 1,74	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25℃ Tj=125℃		0,04 1,00		mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			300	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	300	30	Tj=25℃ Tj=125℃		95 95		ns
Rise time	t_r					Tj=25℃ Tj=125℃		16 19		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		141 157		
Fall time	t_f					Tj=25℃ Tj=125℃		86 99		
Turn-on energy loss	E_{on}					Tj=25℃ Tj=125℃		0,50 0,72		mWs
Turn-off energy loss	E_{off}					Tj=25℃ Tj=125℃		0,63 0,85		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		1630		pF
Output capacitance	C_{oss}							108		
Reverse transfer capacitance	C_{rss}							50		
Gate charge	Q_{Gate}					Tj=25℃		167		nC
Thermal resistance junction to sink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,07		K/W
Thermal resistance junction to sink	R_{thJH}	phase-change material λ = 3,4 W/mK						1,78		K/W
Brake Diode										
Diode forward voltage	V_F				20	Tj=25℃ Tj=125℃	1,25	1,42 1,28	1,95	V
Reverse leakage current	I_r			600		Tj=25℃ Tj=125℃			27	µA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω Rgon=16 Ω	15	300	20	Tj=25℃ Tj=125℃		19 20		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		33 237		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		0,81 0,81		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		1684 920		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		0,14 0,30		mWs
Thermal resistance junction to sink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,58		K/W
Thermal resistance junction to sink	R_{thJH}	phase-change material λ = 3,4 W/mK						3,11		K/W
Thermistor										
Rated resistance	R					Tj=25℃		22000		Ω
Deviation of R100	ΔR/R					T=25℃	-5		5	%
Power dissipation	P					T=25℃		200		mW
Power dissipation constant						Tj=25℃		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25℃		3950		K
B-value	$B_{(25/100)}$					Tj=25℃		3996		K
Vincotech NTC Reference						Tj=25℃			B	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



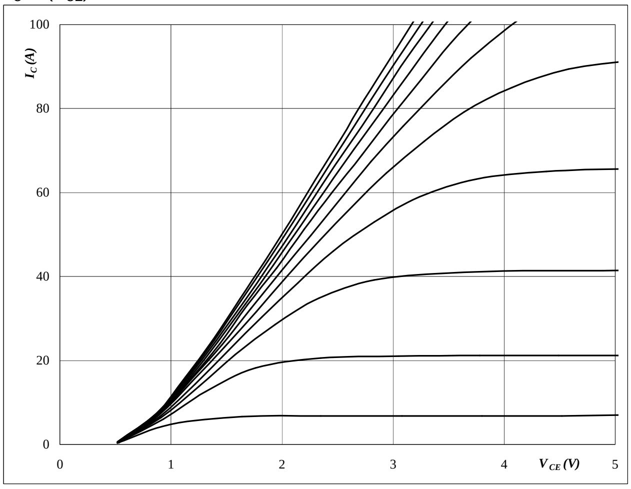
At

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

$I_C = f(V_{CE})$



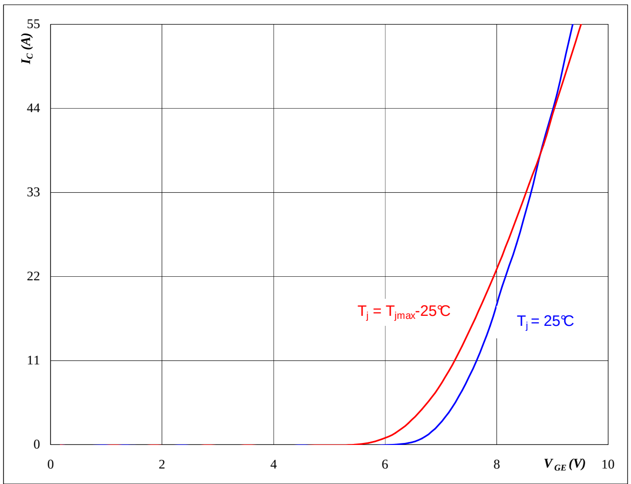
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



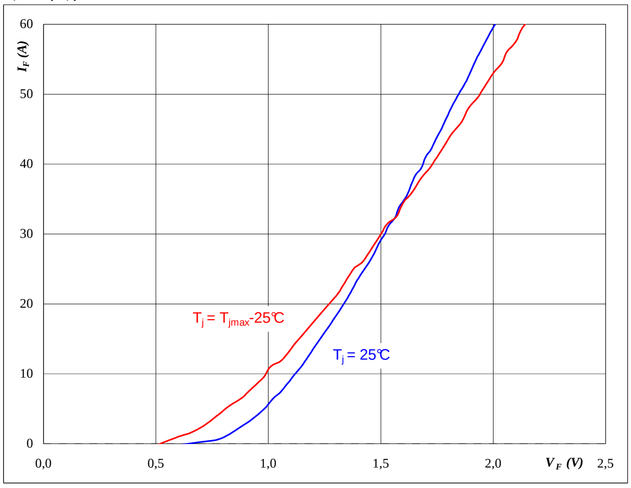
At

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

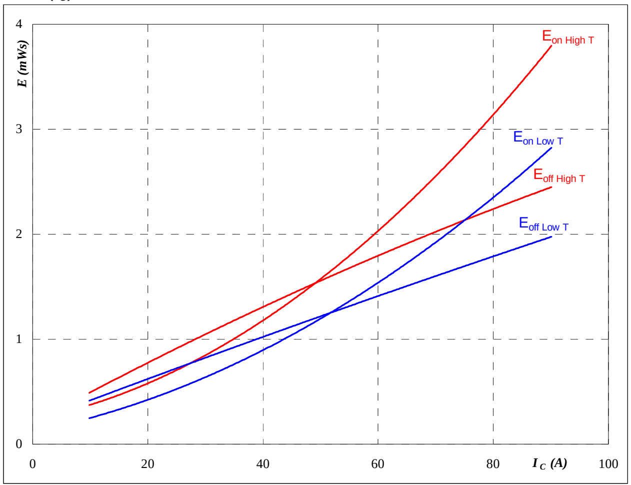
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



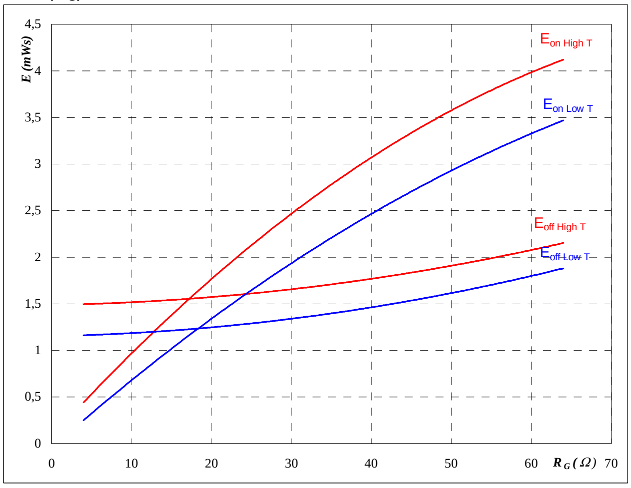
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	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

$E = f(R_G)$



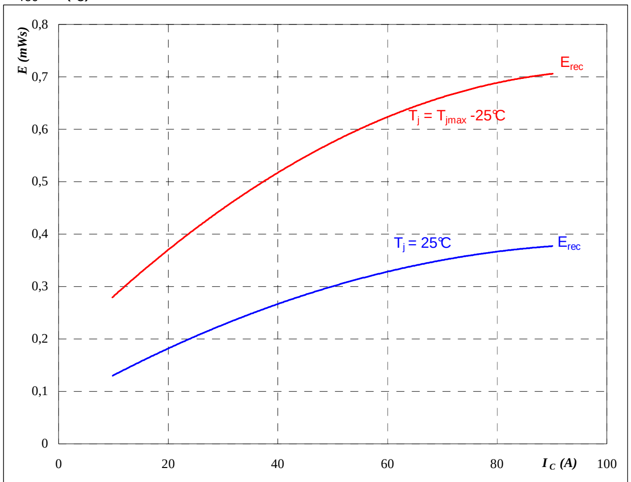
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	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

$E_{rec} = f(I_C)$



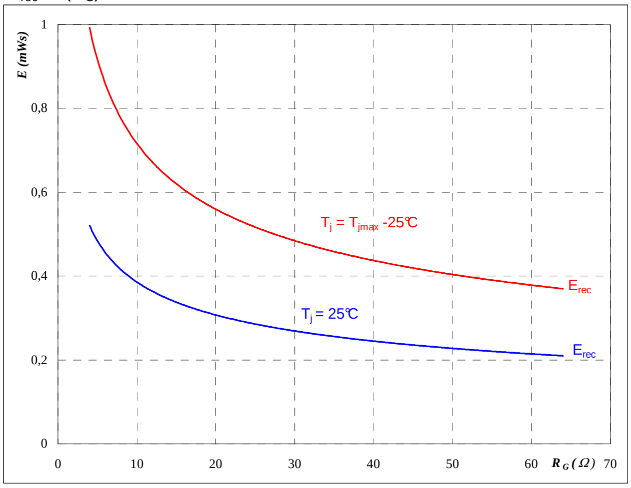
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	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

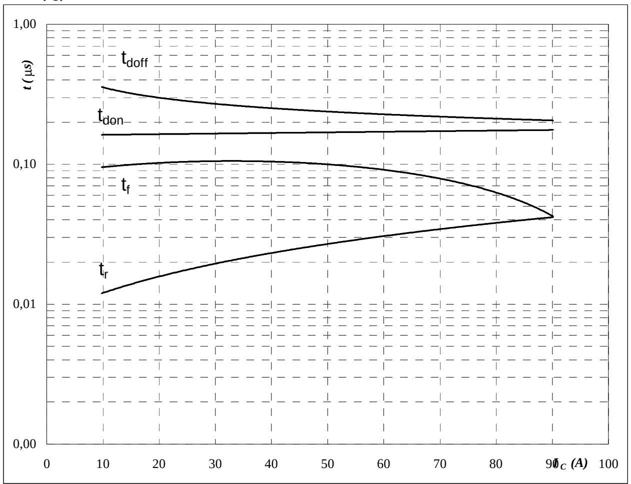
T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



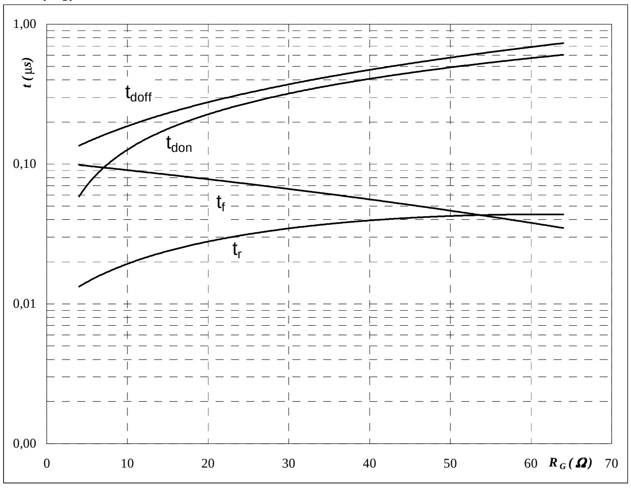
With an inductive load at

T_j =	125	°C
V_{CE} =	300	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)



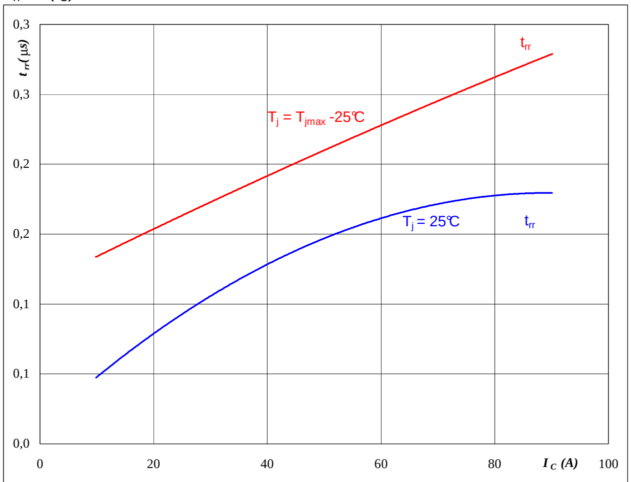
With an inductive load at

T_j =	125	°C
V_{CE} =	300	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)



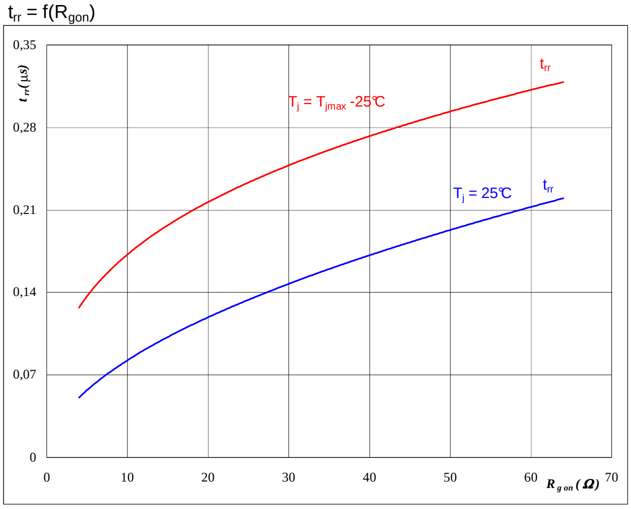
At

T_j =	25/125	°C
V_{CE} =	300	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

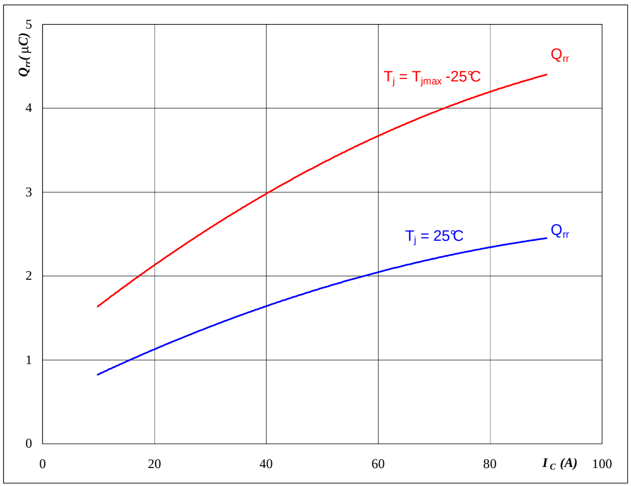
T_j =	25/125	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



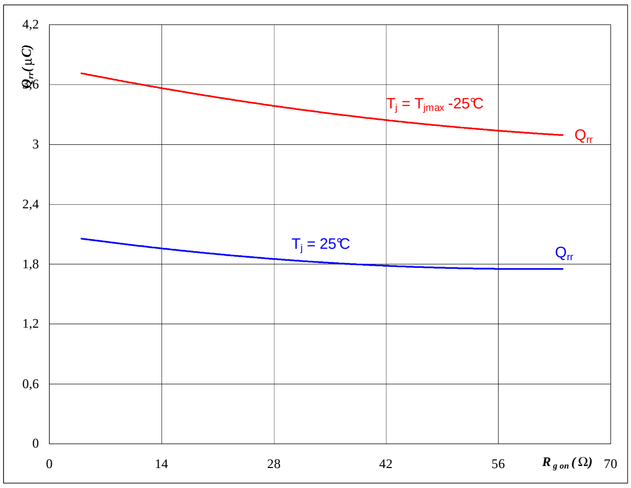
At

T_j =	25/125	℃
V_{CE} =	300	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

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



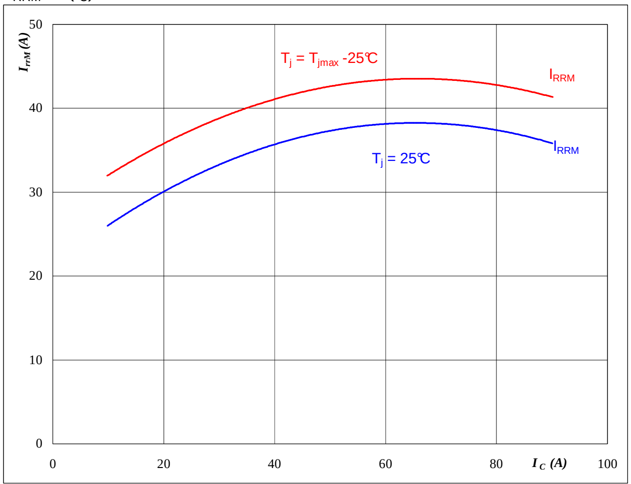
At

T_j =	25/125	℃
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



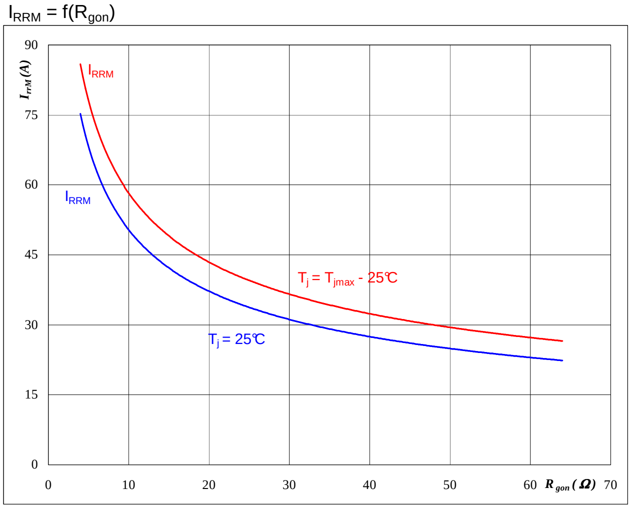
At

T_j =	25/125	℃
V_{CE} =	300	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

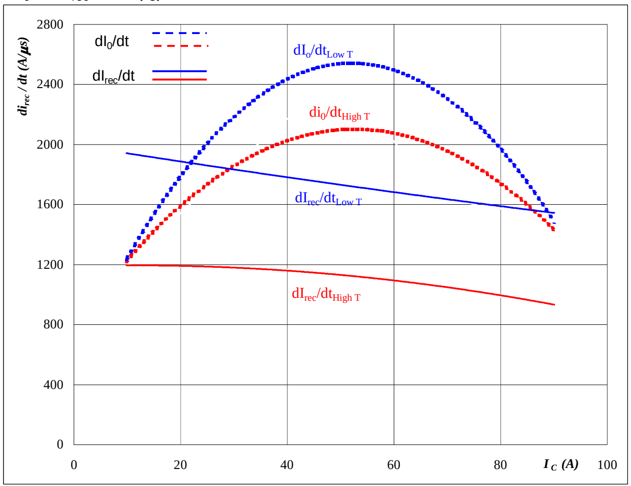
T_j =	25/125	℃
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 17	Output inverter FWD

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

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



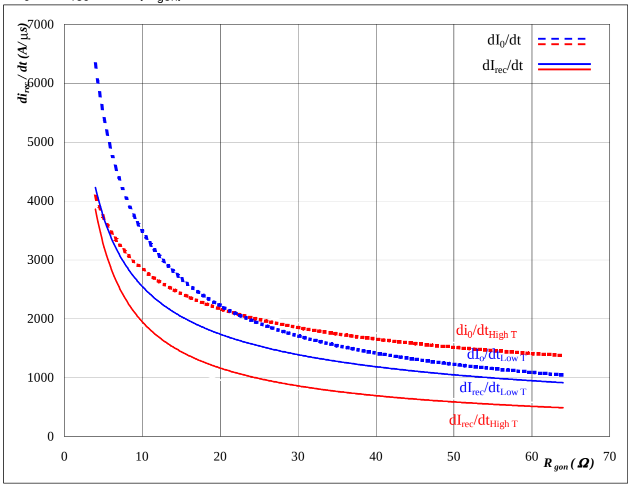
At

T_j =	25/125	℃
V_{CE} =	300	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

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



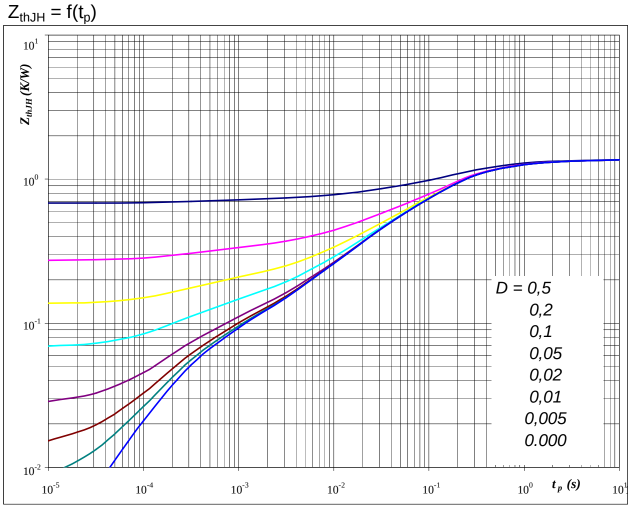
At

T_j =	25/125	℃
V_R =	300	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		Phase change material		
R_{thJH} =	1,25	K/W	RthJH =	1,06	K/W

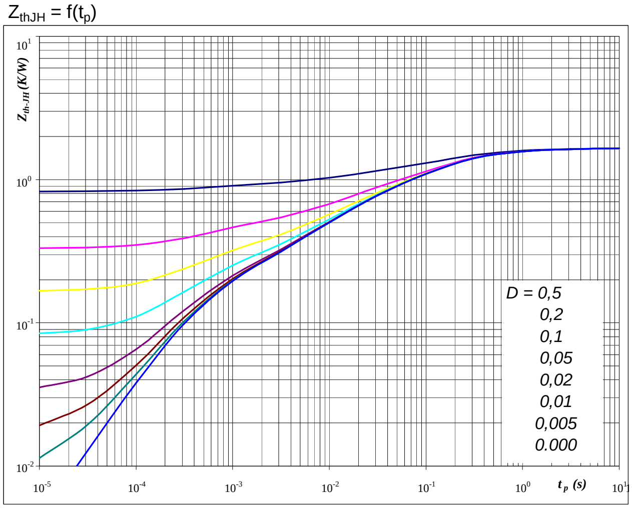
IGBT thermal model values

Thermal grease		Phase change material	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,07	3,7E+00	0,11	1,1E+00
0,25	5,5E-01	0,36	1,5E-01
0,61	1,4E-01	0,38	4,7E-02
0,22	1,9E-02	0,12	7,7E-03
0,05	2,9E-03	0,05	6,5E-04
0,06	3,0E-04	0,04	1,6E-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		Phase change material		
R_{thJH} =	1,65	K/W	RthJH =	1,40	K/W

FWD thermal model values

Thermal grease		Phase change material	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,08	3,2E+00	0,07	3,1E+00
0,28	4,6E-01	0,18	3,5E-01
0,62	1,1E-01	0,67	7,1E-02
0,39	1,8E-02	0,27	1,8E-02
0,14	3,2E-03	0,14	4,1E-03
0,14	4,1E-04	0,08	5,1E-04

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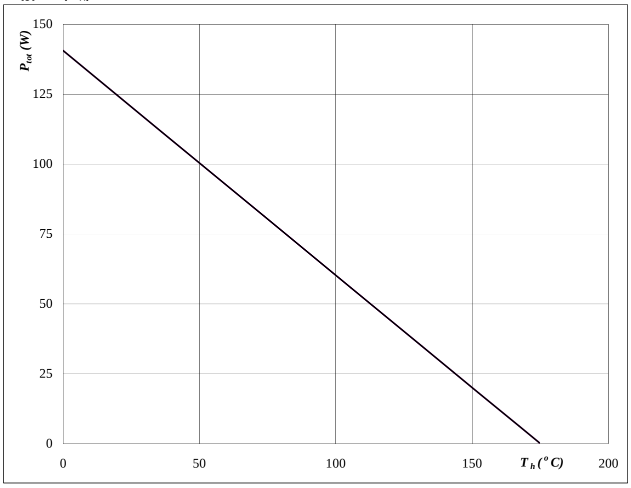
Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



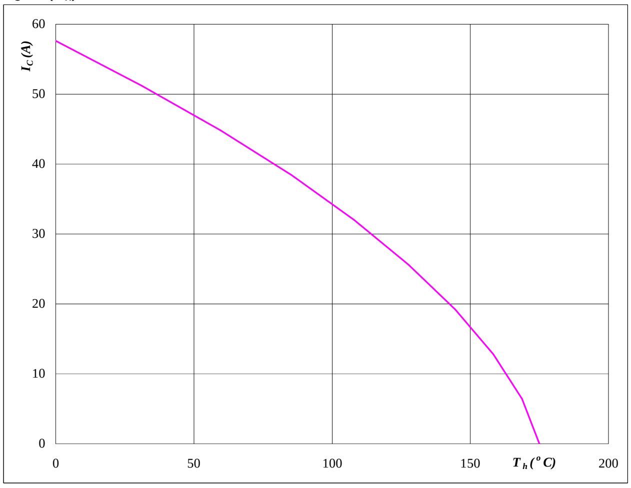
At

T_j = 175 ℃

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

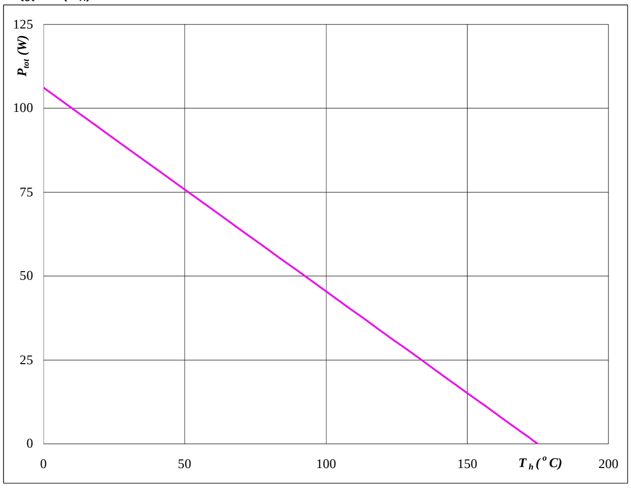
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



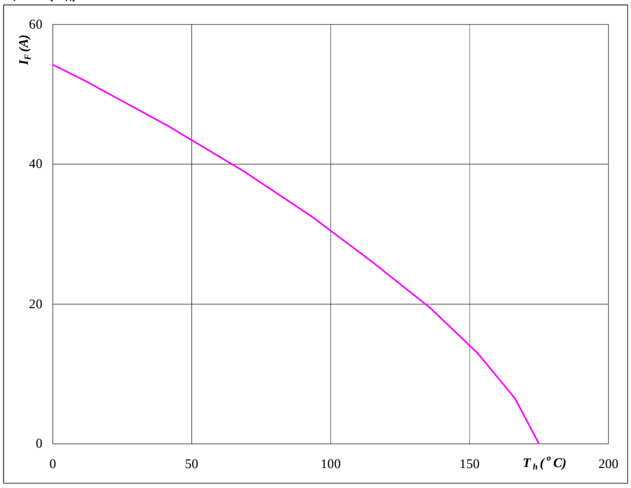
At

T_j = 175 ℃

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

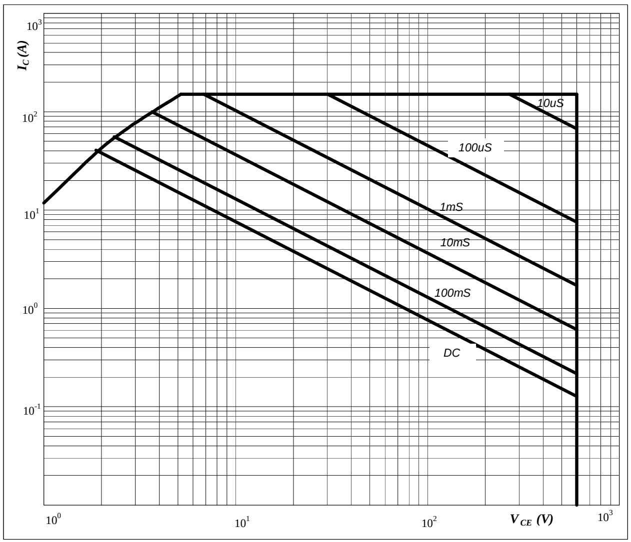
T_j = 175 ℃

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



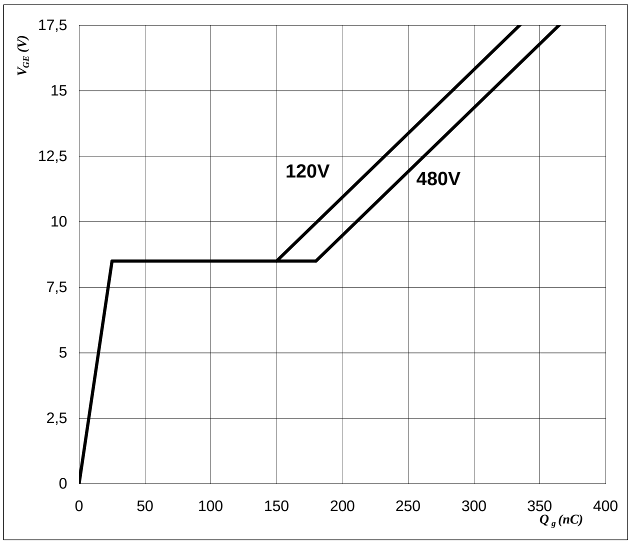
At

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

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



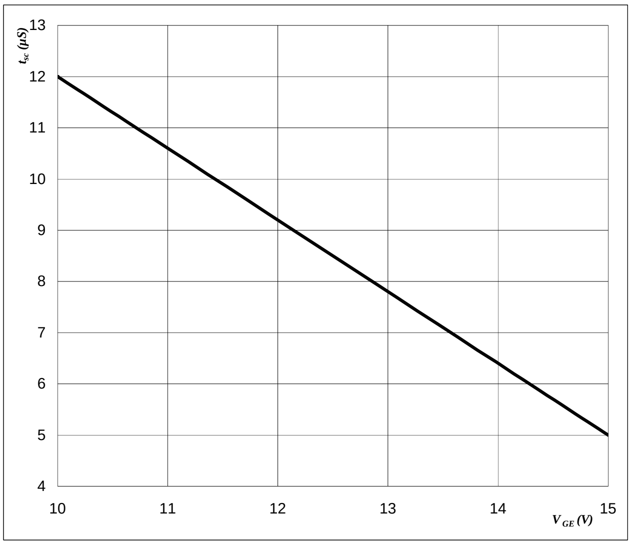
At

I_C =	50	A

Figure 27 Output inverter IGBT

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

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



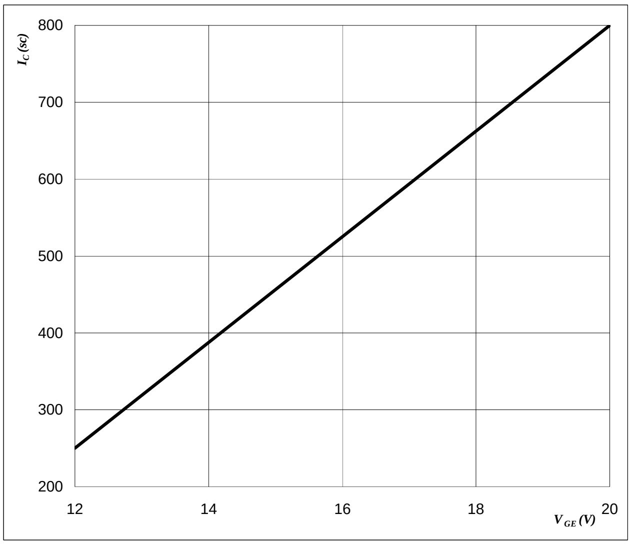
At

V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28 Output inverter IGBT

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

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



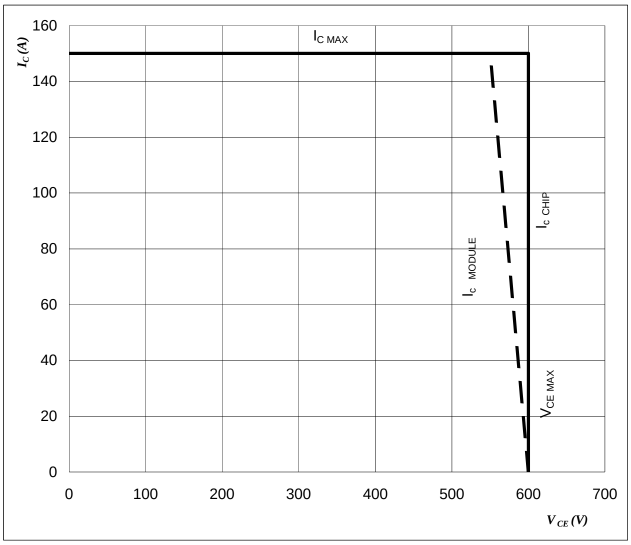
At

V_{CE} ≤	600	V
T_j =	175	ºC

Figure 29 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

$U_{ccminus}$=U_{ccplus}

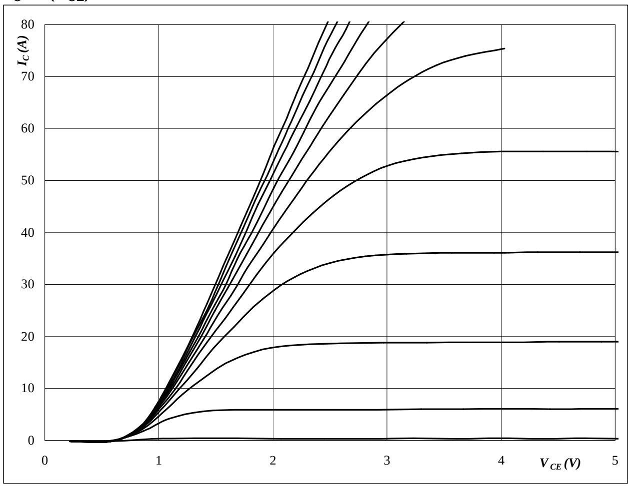
Switching mode : 3 level switching

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



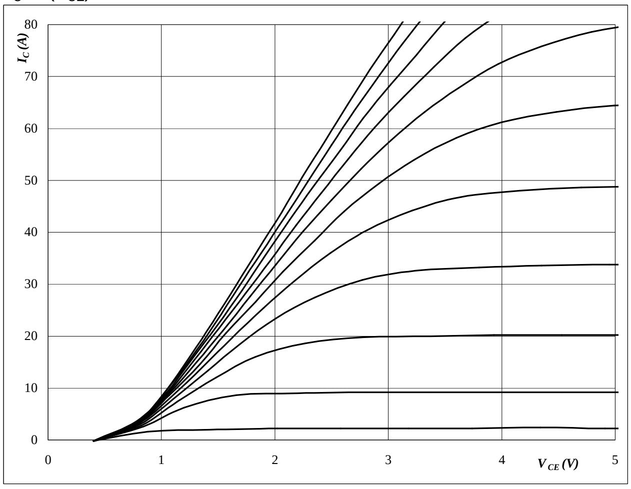
At

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

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



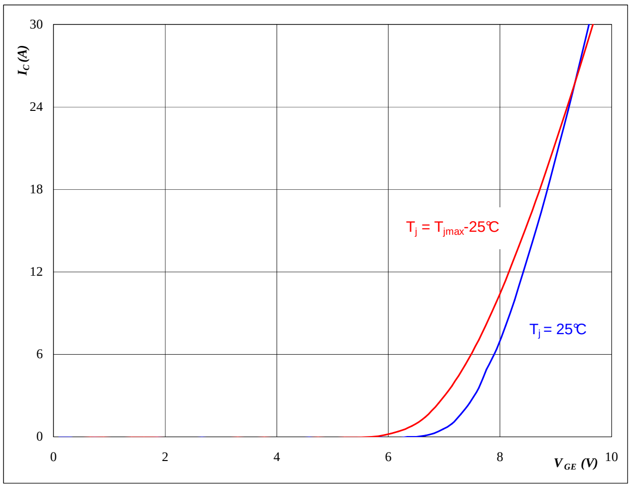
At

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



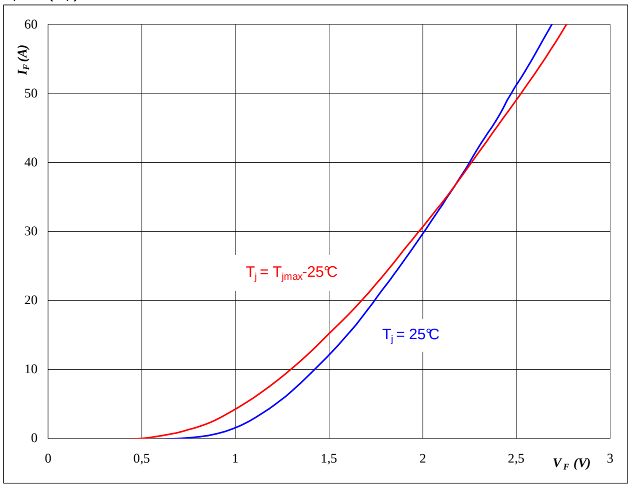
At

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

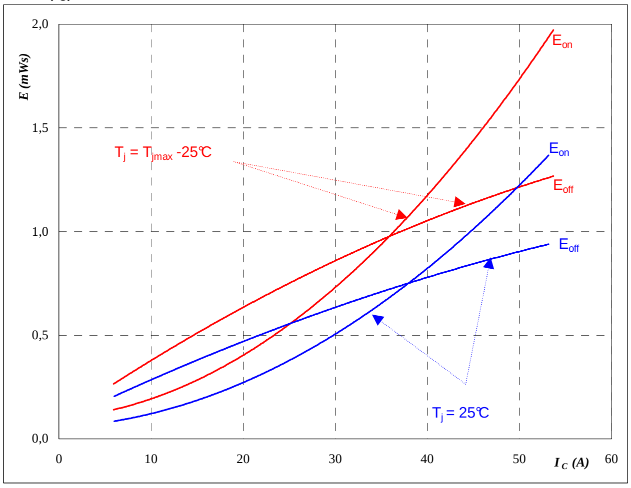
t_p =	250	µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



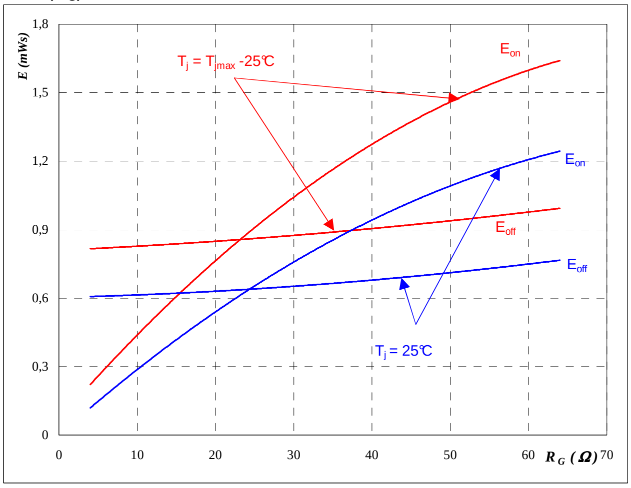
With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	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)



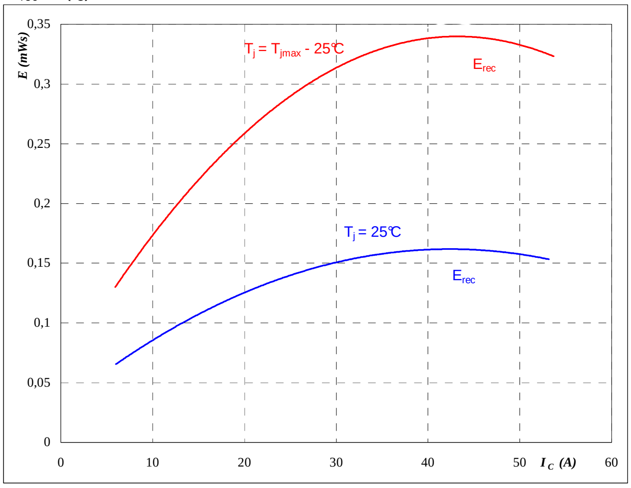
With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	29	A

Figure 7 Brake FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_C)



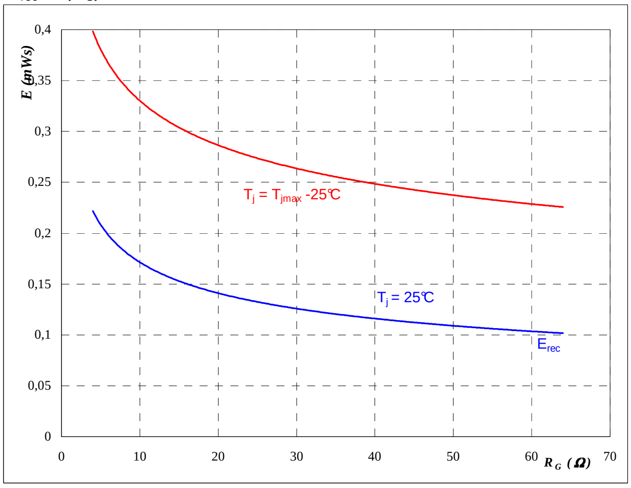
With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	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

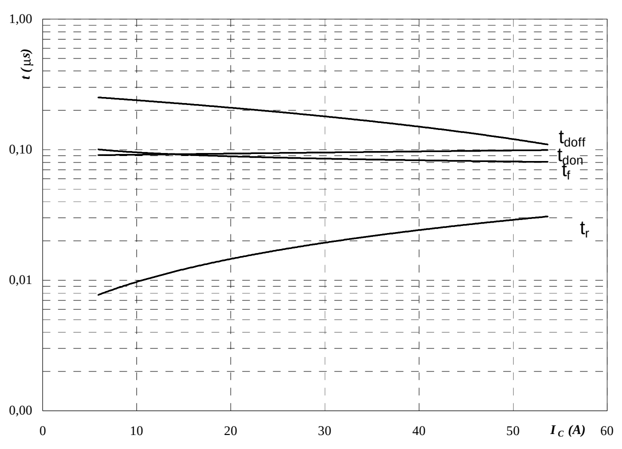
T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	29	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



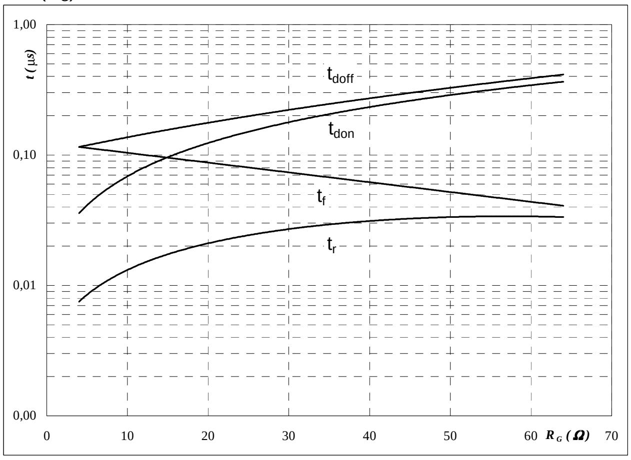
With an inductive load at

T_j =	125	°C
V_{CE} =	300	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)



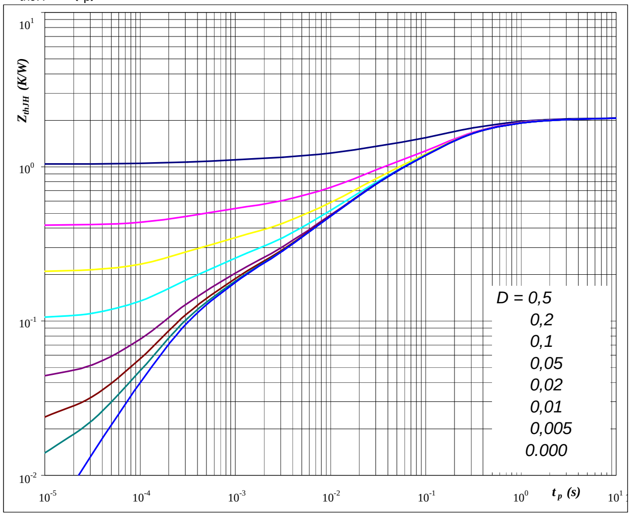
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	29	A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



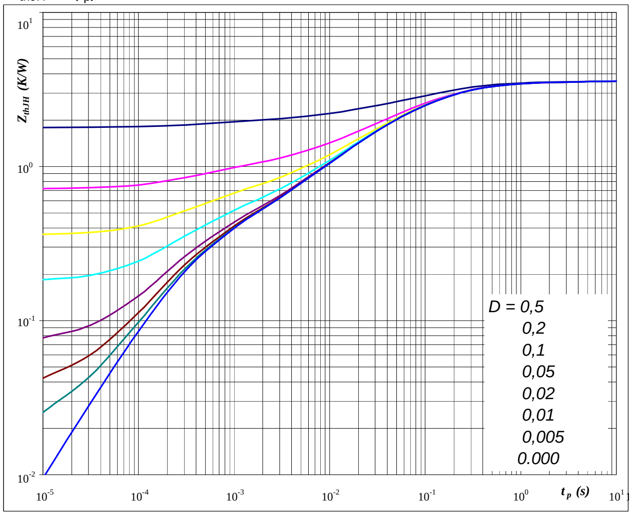
At D = tp / T

Thermal grease			Phase change material		
R_{thJH} =	2,07	K/W	R_{thJH} =	1,78	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

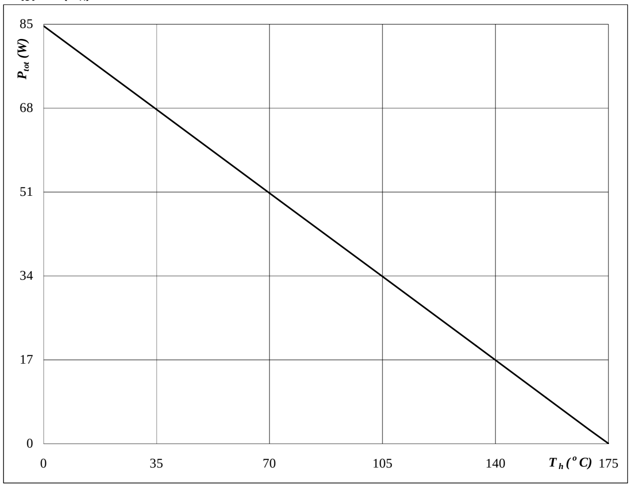
Thermal grease			Phase change material		
R_{thJH} =	3,58	K/W	R_{thJH} =	3,11	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



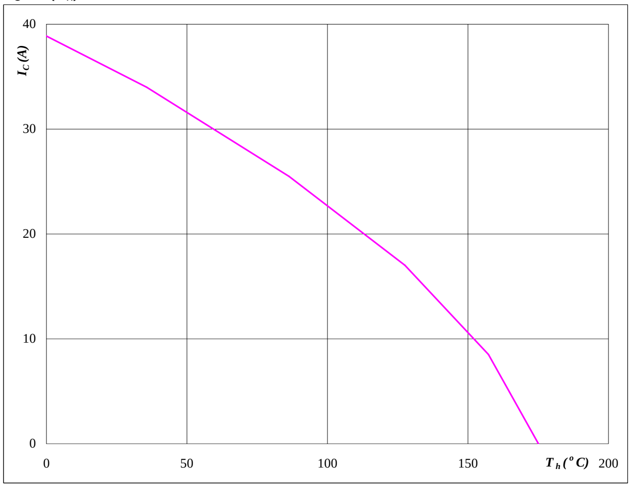
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

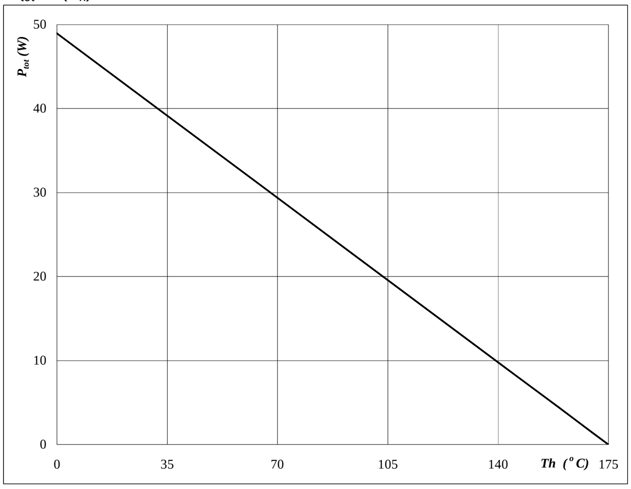
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



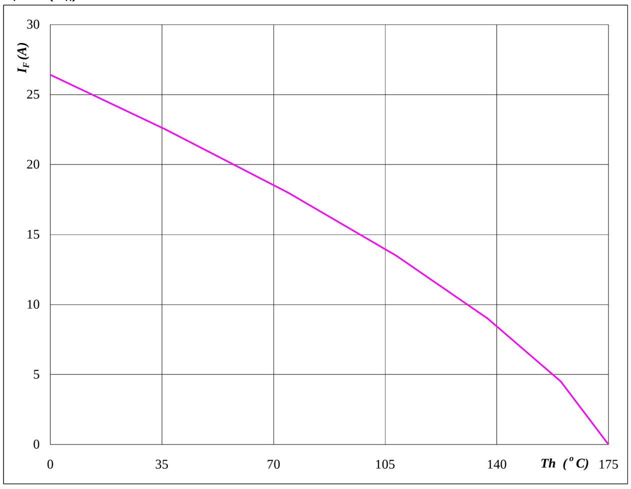
At

T_j = 175 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

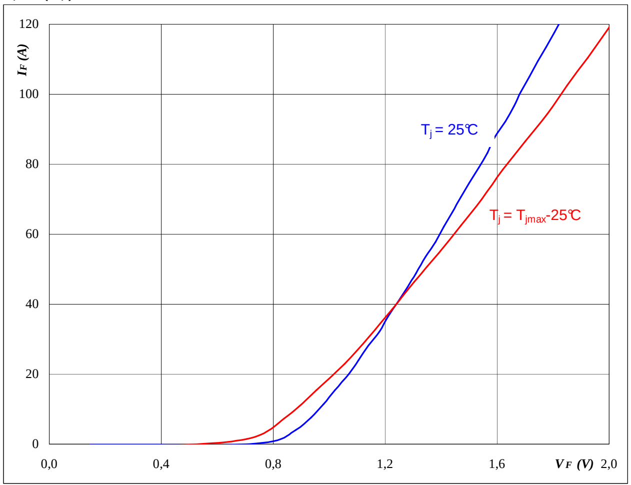
T_j = 175 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



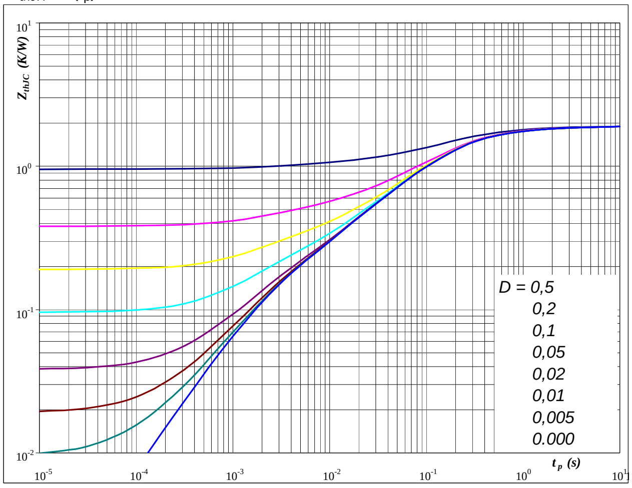
At

t_p = 250 μs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

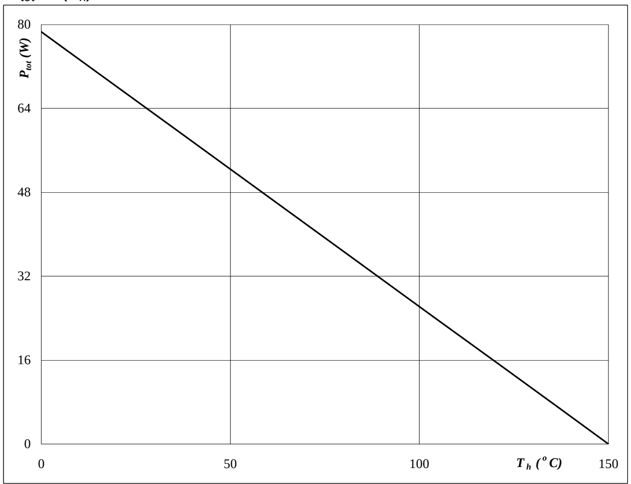
D = t_p / T

Thermal grease			Phase change material		
R_{thJH} =	1,89	K/W	R_{thJH} =	1,62	K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



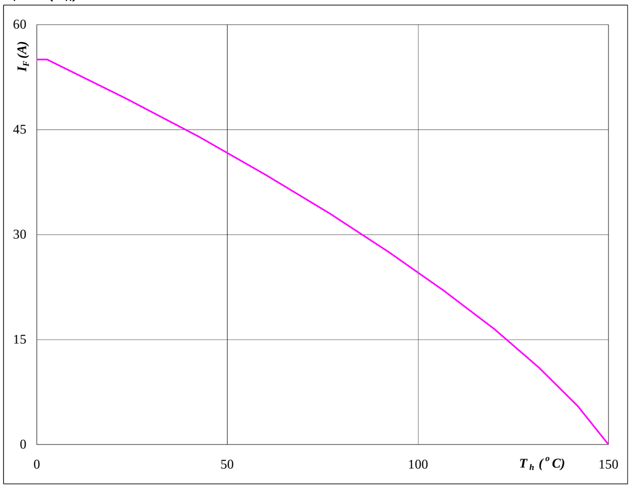
At

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
$R_T = f(T)$

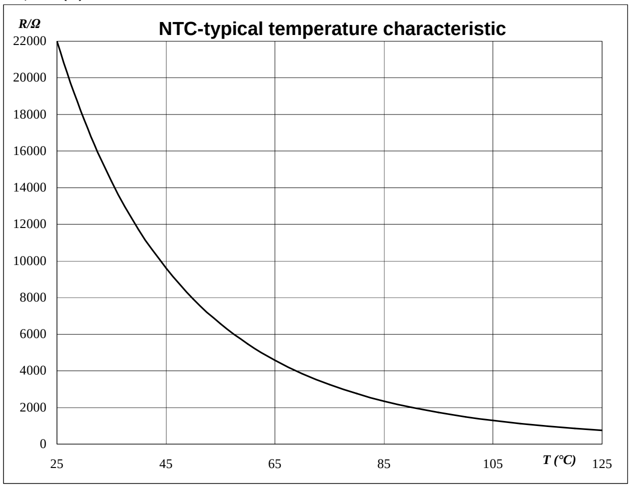


Figure 2 Thermistor

Typical NTC resistance values

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

T [°C]	R_{nom} [Ω]	R_{min} [Ω]	R_{max} [Ω]	△R/R [±%]
-55	2089434,5	1506495,4	2672373,6	27,9
0	71804,2	59724,4	83884	16,8
10	43780,4	37094,4	50466,5	15,3
20	27484,6	23684,6	31284,7	13,8
25	22000	19109,3	24890,7	13,1
30	17723,3	15512,2	19934,4	12,5
60	5467,9	4980,6	5955,1	8,9
70	3848,6	3546	4151,1	7,9
80	2757,7	2568,2	2947,1	6,9
90	2008,9	1889,7	2128,2	5,9
100	**1486,1**	**1411,8**	**1560,4**	**5**
150	400,2	364,8	435,7	8,8

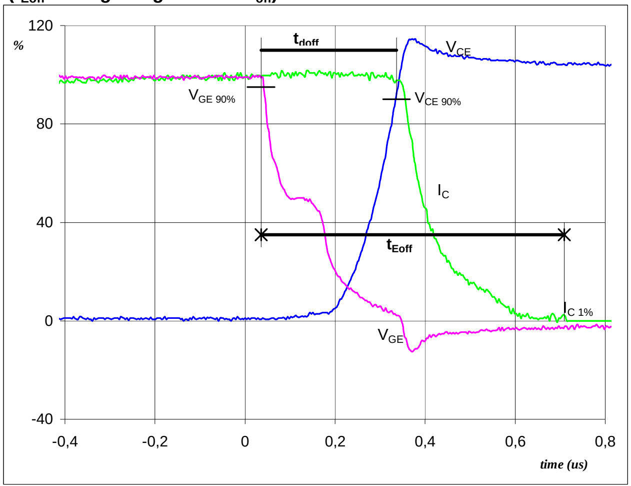
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

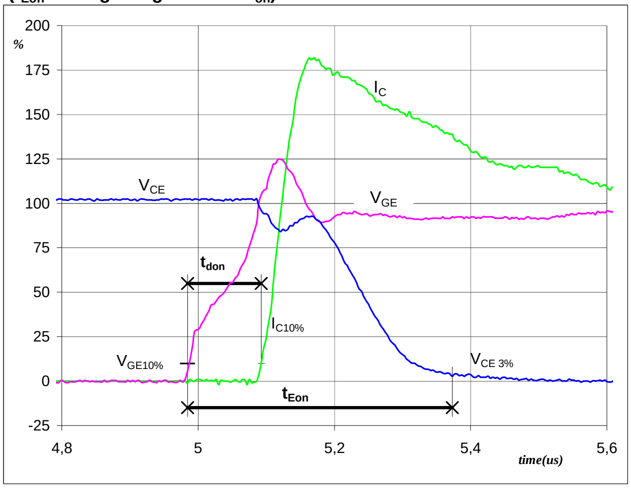
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



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

Figure 2 Output inverter IGBT

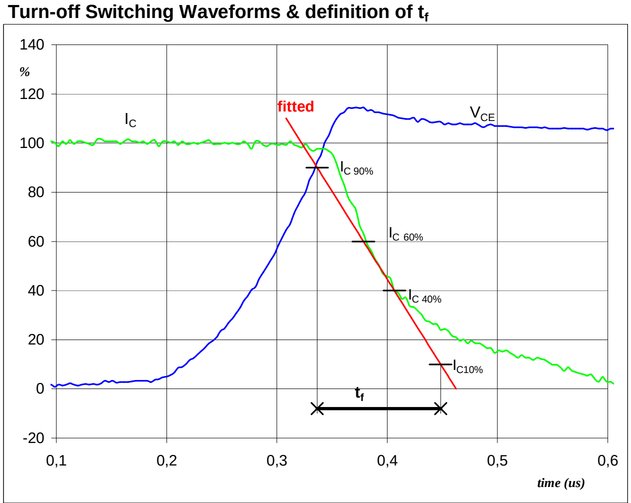
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



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

Figure 3 Output inverter IGBT

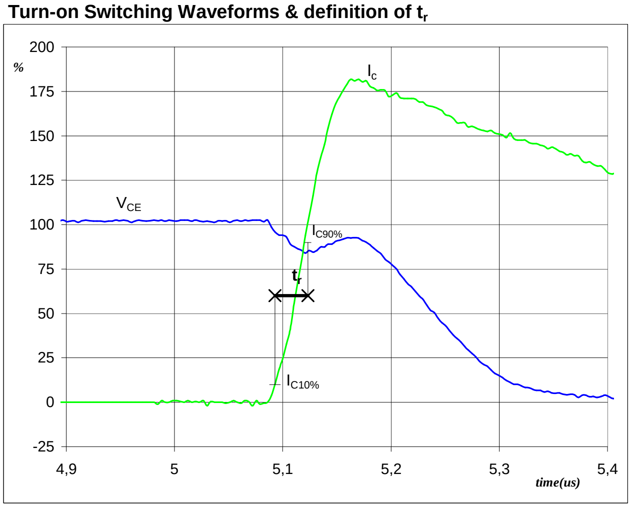
Turn-off Switching Waveforms & definition of t_f



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

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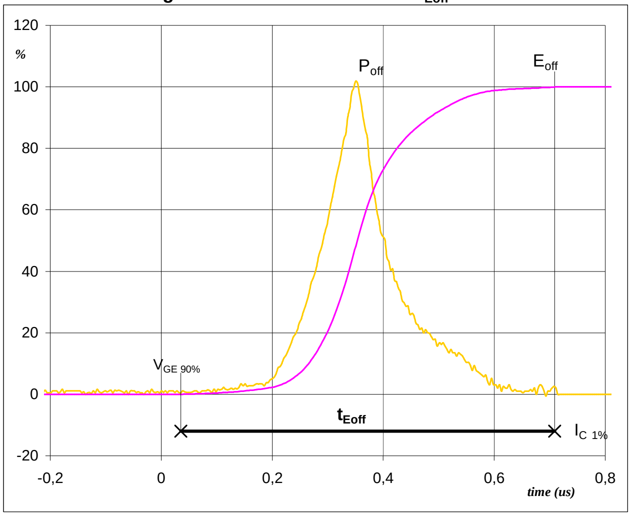
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

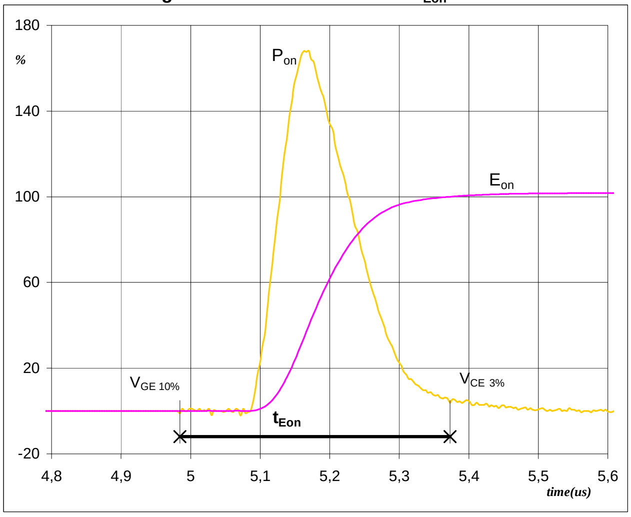
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 Output inverter IGBT

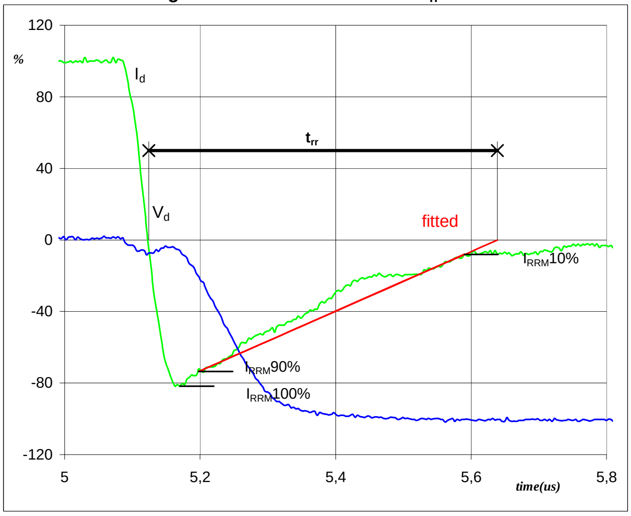
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Output inverter IGBT

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

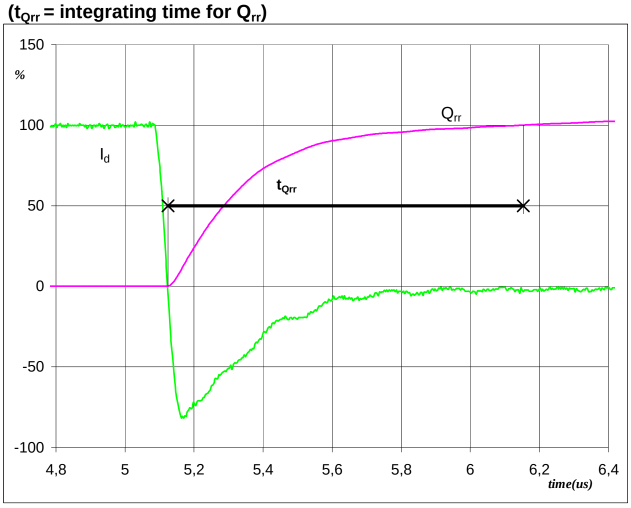


V_d (100%) =	600	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-83	A
t_{rr} =	0,51	µs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

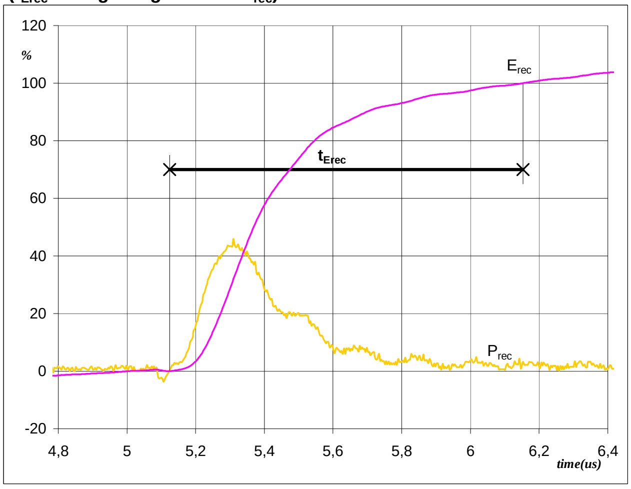
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

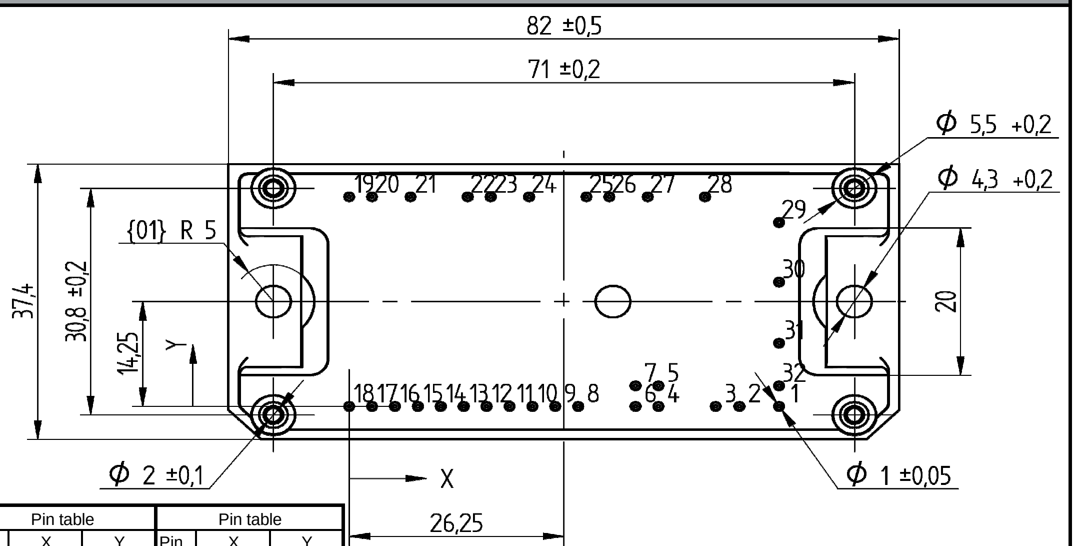
Version	Ordering Code	in DataMatrix as	in packaging barcode as
17mm housing with solder pins and breake	V23990-P586-A20-PM	P586-A20-PM	P586-A20-PM
17mm housing with pressfit pins and breake	V23990-P586-A20Y-PM	P586-A20Y-PM	P586-A20Y-PM
12mm housing with solder pins and breake	V23990-P586-A208-PM	P586-A208-PM	P586-A208-PM
12mm housing with pressfit pins and breake	V23990-P586-A208Y-PM	P586-A208Y-PM	P586-A208Y-PM
12mm housing with pressfit pins and breake	V23990-P586-A208Y-/3/-PM	P586-A208Y-PM	P586-A208Y-PM
17mm housing with solder pins w/o breake	V23990-P586-C20-PM	P586-C20-PM	P586-C20-PM
17mm housing with pressfit pins w/o breake	V23990-P586-C20Y-PM	P586-C20Y-PM	P586-C20Y-PM

Features

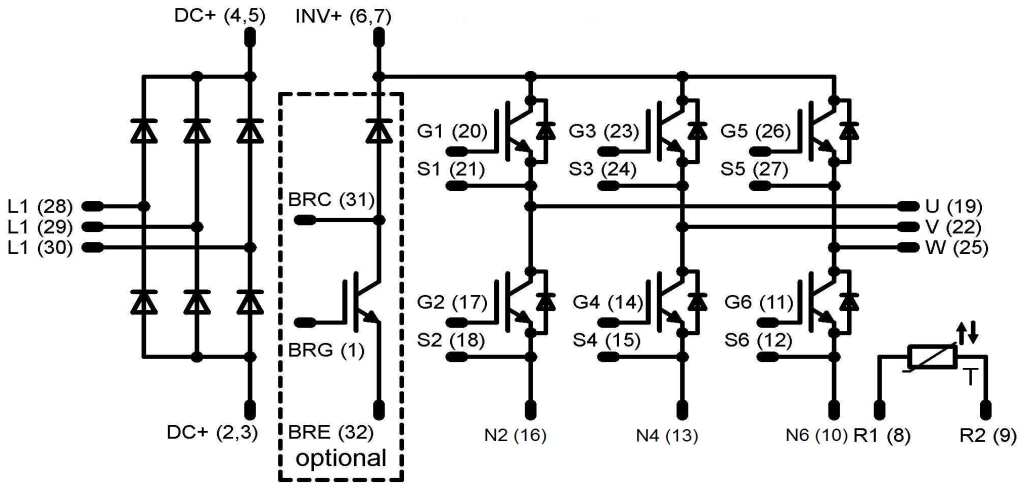
	A version	C version
Rectifier	3-leg	3-leg
Break IGBT	✓	w/o pin 1,31,32
Break FWD	✓	
Inverter IGBT	✓	✓
Inverter FWD	✓	✓

Outline

Pin table		
Pin	X	Y
1	52,55	0
2	47,7	0
3	44,8	0
4	37,8	0
5	37,8	2,8
6	35	0
7	35	2,8
8	28	0
9	25,2	0
10	22,4	0
11	19,6	0
12	16,8	0
13	14	0
14	11,2	0
15	8,4	0
16	5,6	0
17	2,8	0
18	0	0
19	0	28,5
20	2,8	28,5
21	7,5	28,5
22	14,5	28,5
23	17,3	28,5
24	22	28,5
25	29	28,5
26	31,8	28,5
27	36,5	28,5
28	43,5	28,5
29	52,55	25
30	52,55	16,9
31	52,55	8,6
32	52,55	2,8



Pinout



DISCLAIMER

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.

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.