flowPIM 0 **600V/20A**

Features

- Vincotech clip-in housing
- Trench Fieldstop IGBT's for low saturation losses
- Optional w/o BRC

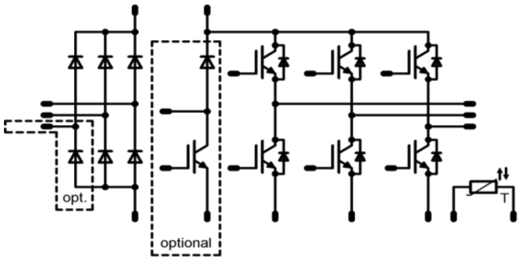
flowPIM 0 housing

12mm housing 17mm housing

Target Applications

- Industrial drives
- Embedded drives

Schematic



Types

- V23990-P545-A28-PM
- V23990-P545-A29-PM
- V23990-P545-C28-PM w/o BRC
- V23990-P545-C29-PM w/o BRC

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	T_j=$T_j$max	T_h=80°C T_c=80°C	28 37	A
Surge forward current	I_{FSM}	t_p=10ms 50 Hz half sine wave	T_j=25°C	200	A
I2t-value	I^2t			200	A^2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	33 50	W
Maximum Junction Temperature	$T_j$max			150	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	23 30	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		60	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		60	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	47 72	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		6 360	µs V
Maximum Junction Temperature	$T_j$max			175	°C

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℃	27 35	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		40	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	36 55	W
Maximum Junction Temperature	$T_j$max			175	℃
Brake Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80℃ T_c=80℃	17 22	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		45	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		45	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	37 56	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	℃
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℃	16 21	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		30	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80℃ T_c=80℃	28 43	W
Maximum Junction Temperature	$T_j$max			175	℃
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	℃
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	℃
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
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	Min	Typ	Max	Unit
Input Rectifier Diode										
Forward voltage	V_F				30	Tj=25°C Tj=125°C	0,8	1,26 1,24	1,45	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0,92 0,82		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		11 14		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=145°C			1,1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,10		K/W
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00029	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		20	Tj=25°C Tj=150°C	1	1,55 1,75	2,2	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,0011	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=16 Ω	±15	300	20	Tj=25°C Tj=150°C		15 14		ns
Rise time	t_r					Tj=25°C Tj=150°C		12 16		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		198 212		
Fall time	t_f					Tj=25°C Tj=150°C		100 104		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,31 0,43		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,55 0,65		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1100		pF
Output capacitance	C_{oss}							71		
Reverse transfer capacitance	C_{rss}							32		
Gate charge	Q_{Gate}		±15	480	20	Tj=25°C		120		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,01		K/W
Inverter Diode										
Diode forward voltage	V_F				20	Tj=25°C Tj=150°C	1,25	1,81 1,76	1,95	V
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω	±15	300	20	Tj=25°C Tj=150°C		19 21		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		33 192		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0,45 1,35		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		1454 1052		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0,06 0,27		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,63		K/W

Characteristic Values

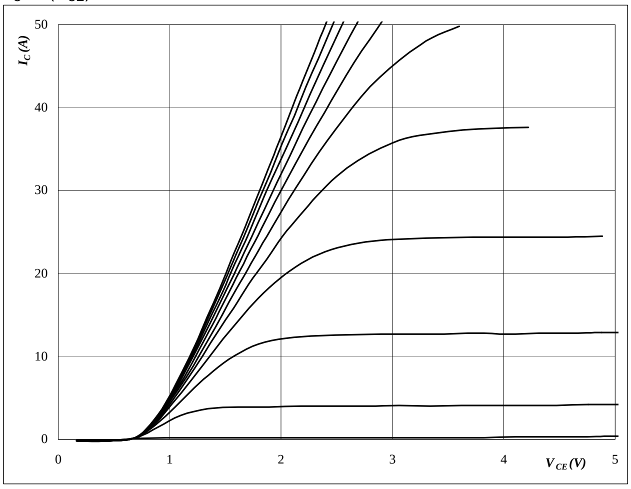
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
Brake Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00021	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		15	Tj=25℃ Tj=150℃	1,1	1,64 1,86	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25℃ Tj=150℃			0,00085	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=16 Ω	±15	300	15	Tj=25℃ Tj=150℃		15 14		ns
Rise time	t_r					Tj=25℃ Tj=150℃		11 14		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		128 145		
Fall time	t_f					Tj=25℃ Tj=150℃		91 94		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		0,20 0,28		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		0,32 0,40		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		860		pF
Output capacitance	C_{oss}							55		
Reverse transfer capacitance	C_{rss}							24		
Gate charge	Q_{Gate}		±15	480	15	Tj=25℃		87		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						2,55		K/W
Brake Diode										
Diode forward voltage	V_F				15	Tj=25℃ Tj=150℃	1,25	1,86 1,75	1,95	V
Reverse leakage current	I_r	Rgon=16 Ω		600		Tj=25℃ Tj=150℃			27	µA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω	±15	300	15	Tj=25℃ Tj=150℃		14 15		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		128 201		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		0,52 0,52		µC
Peak rate of fall of recovery current	di(rec)max/dt					Tj=25℃ Tj=150℃		1307 657		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=150℃		0,10 0,21		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ = 1 W/mK						3,35		K/W
Thermistor										
Rated resistance	R					Tj=25℃		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				Tc=100℃	-5		5	%
Power dissipation	P					Tc=100℃		210		mW
Power dissipation constant						Tj=25℃		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25℃				K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25℃		4000		K
Vincotech NTC Reference						Tj=25℃			A	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



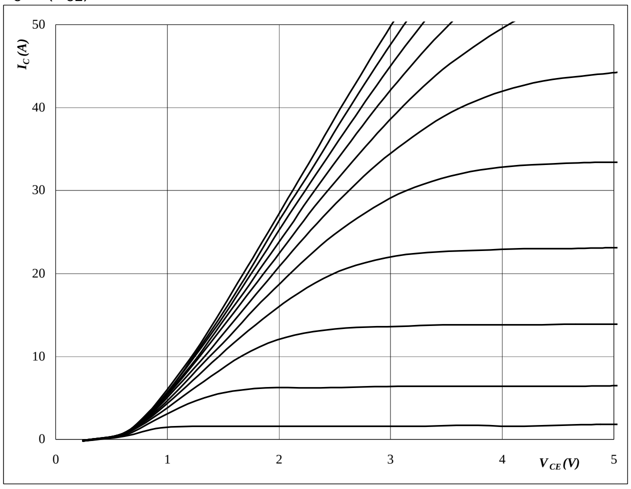
At

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

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



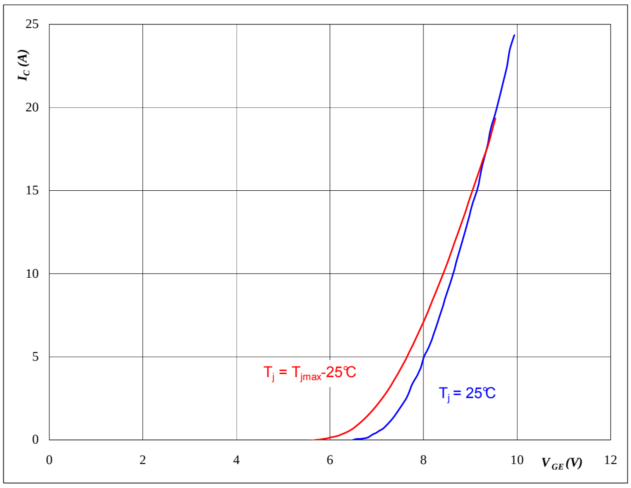
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



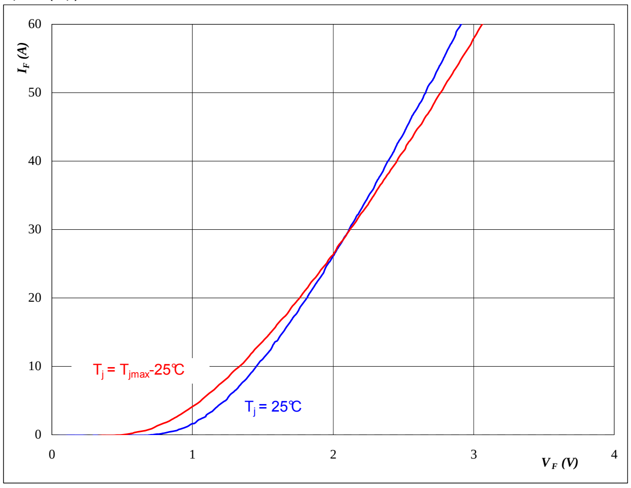
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



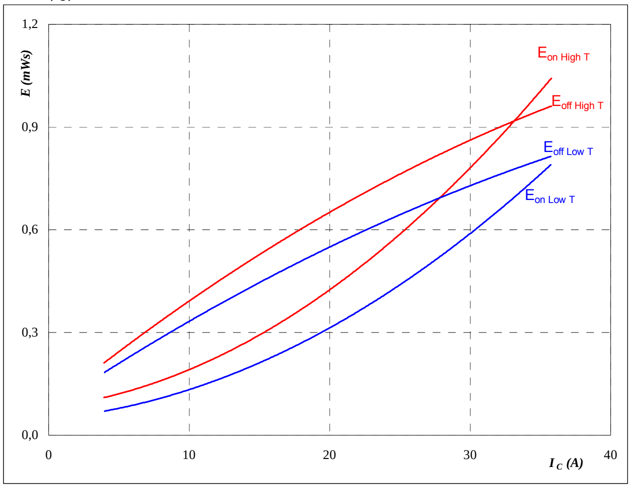
At

t_p =	250	μs

Output Inverter

Figure 5 — Output inverter IGBT

Typical switching energy losses
as a function of collector current
$E = f(I_C)$

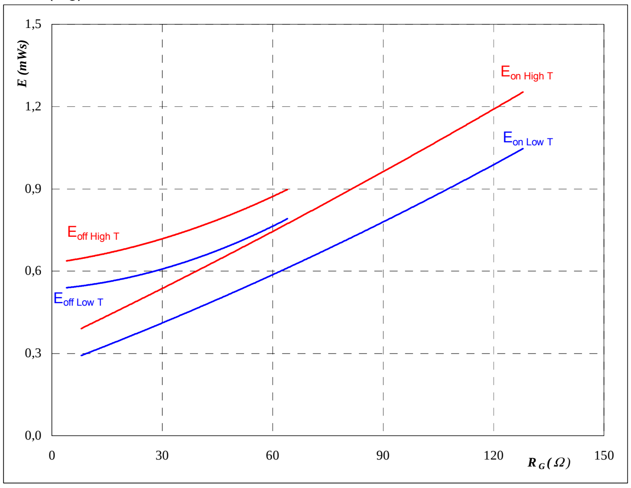


With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 6 — Output inverter IGBT

Typical switching energy losses
as a function of gate resistor
$E = f(R_G)$

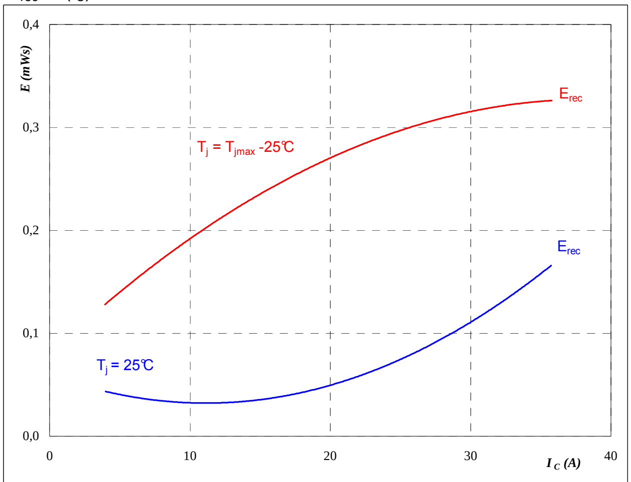


With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	20	A

Figure 7 — Output inverter FWD

Typical reverse recovery energy loss
as a function of collector current
$E_{rec} = f(I_C)$

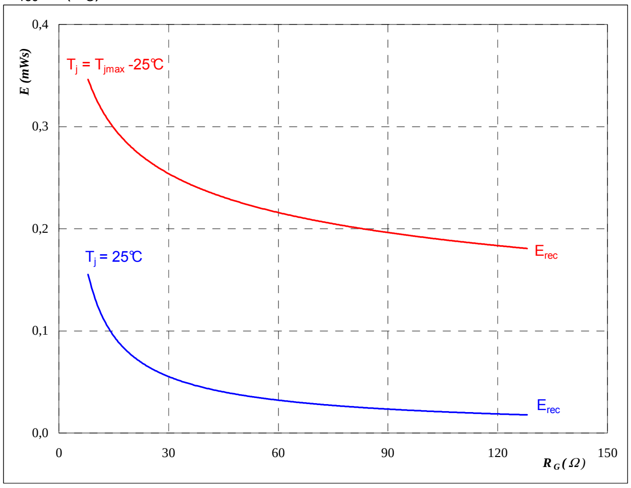


With an inductive load at

T_j =	25/125	℃
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

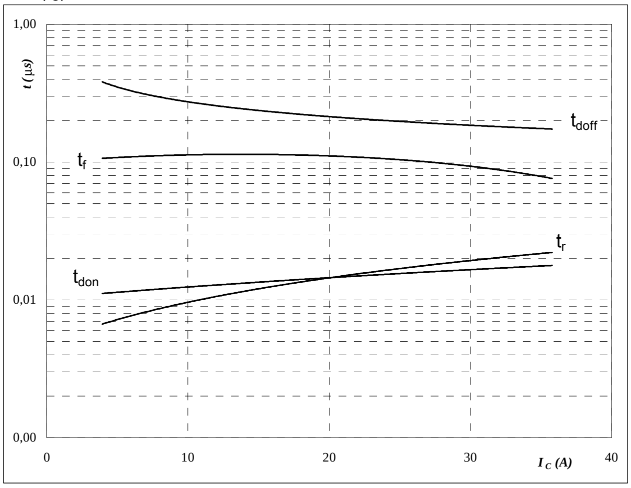
T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	20	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



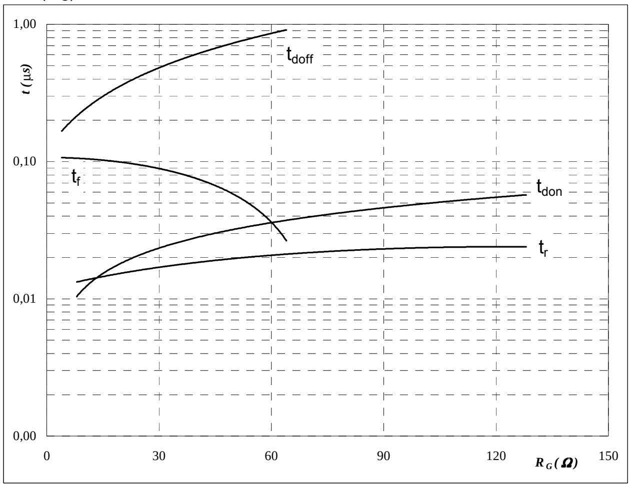
With an inductive load at

T_j =	125	℃
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



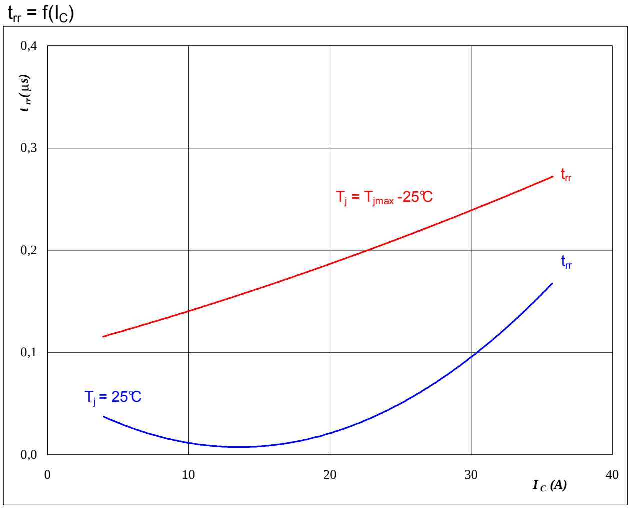
With an inductive load at

T_j =	125	℃
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	20	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



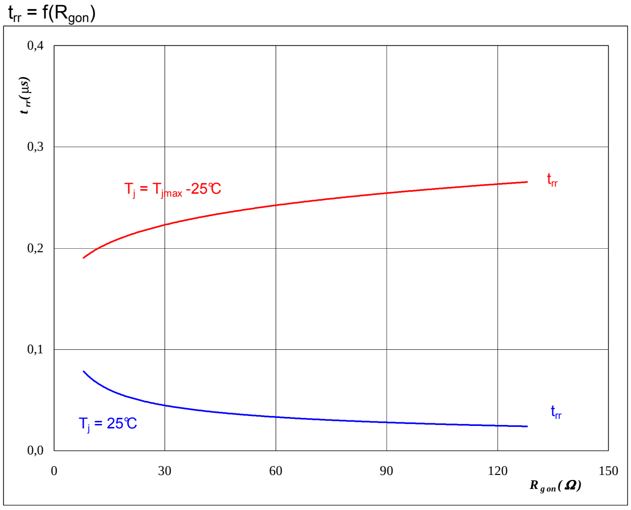
At

T_j =	25/125	℃
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

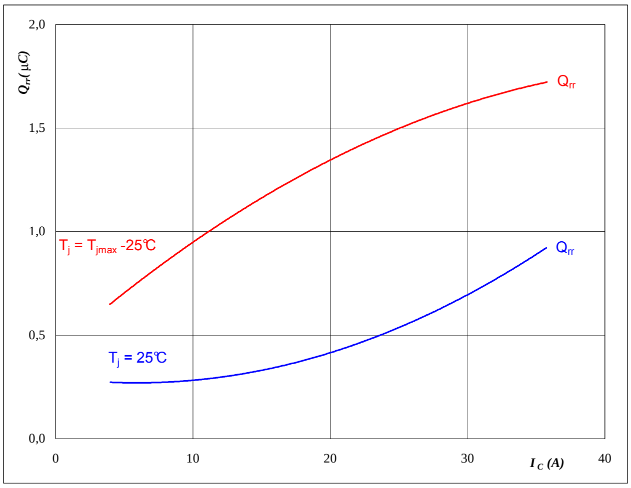
T_j =	25/125	℃
V_R =	300	V
I_F =	20	A
V_{GE} =	15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



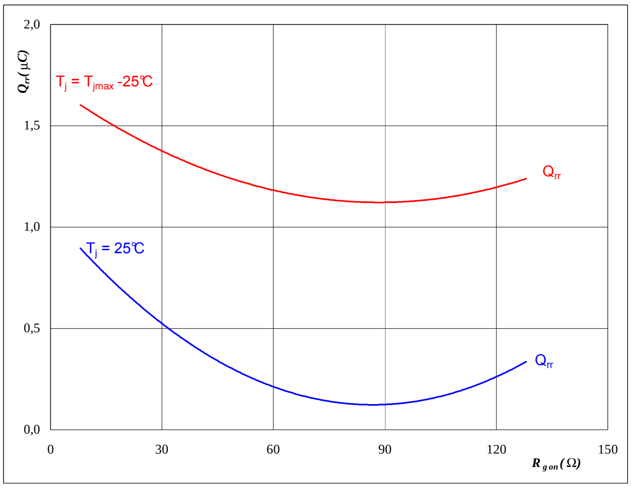
At

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

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



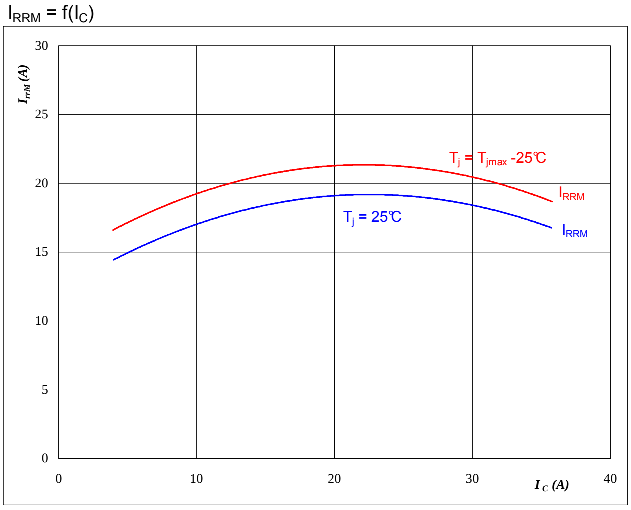
At

T_j =	25/125	℃
V_R =	300	V
I_F =	20	A
V_{GE} =	15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



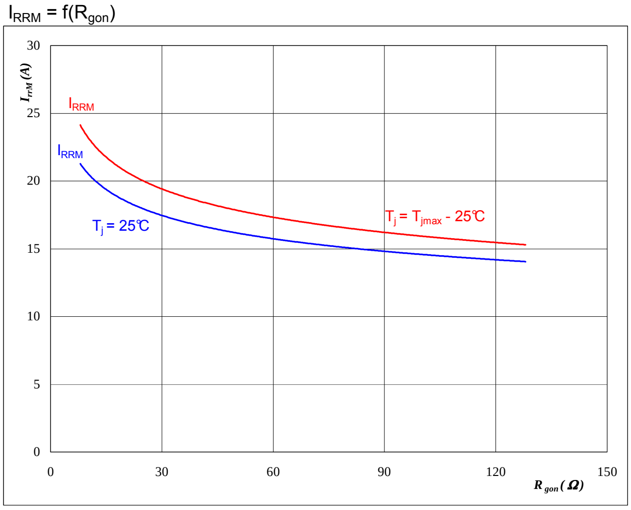
At

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

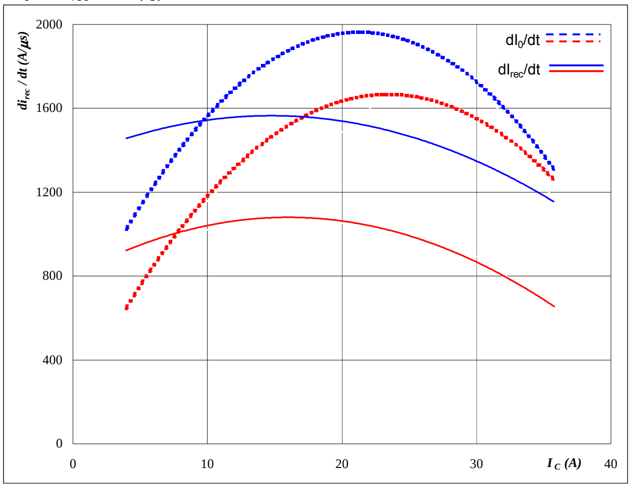
T_j =	25/125	℃
V_R =	300	V
I_F =	20	A
V_{GE} =	15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



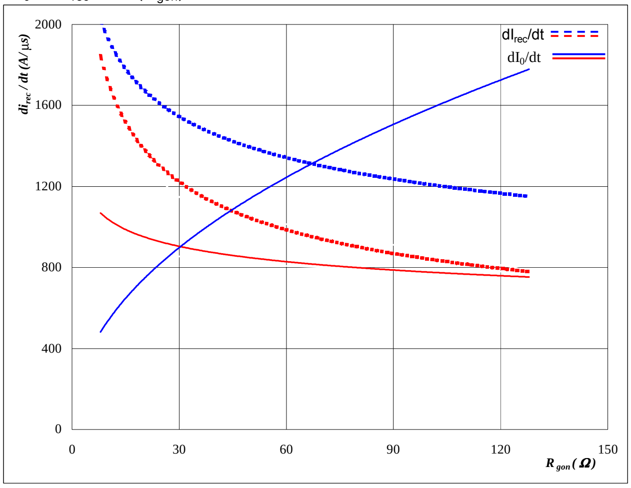
At

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

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



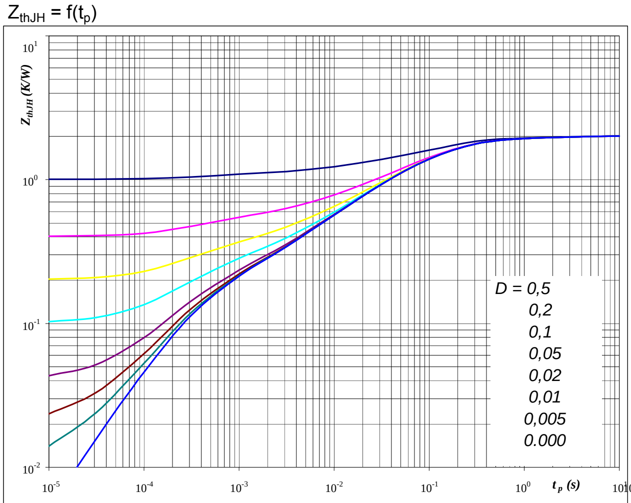
At

T_j =	25/125	℃
V_R =	300	V
I_F =	20	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} =	2,01	K/W

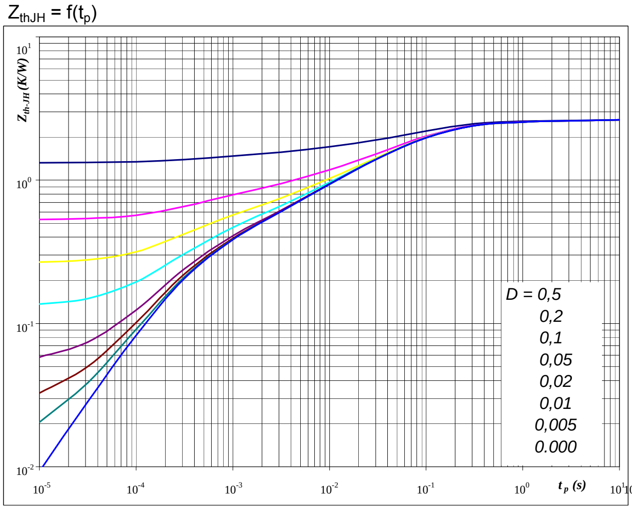
IGBT thermal model values

Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,09	2,9E+00	0,07	2,4E+00
0,31	3,5E-01	0,25	2,9E-01
0,94	8,8E-02	0,76	7,1E-02
0,38	1,6E-02	0,31	1,3E-02
0,14	2,9E-03	0,11	2,4E-03
0,14	3,3E-04	0,12	2,7E-04

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	2,63	K/W

FWD thermal model values

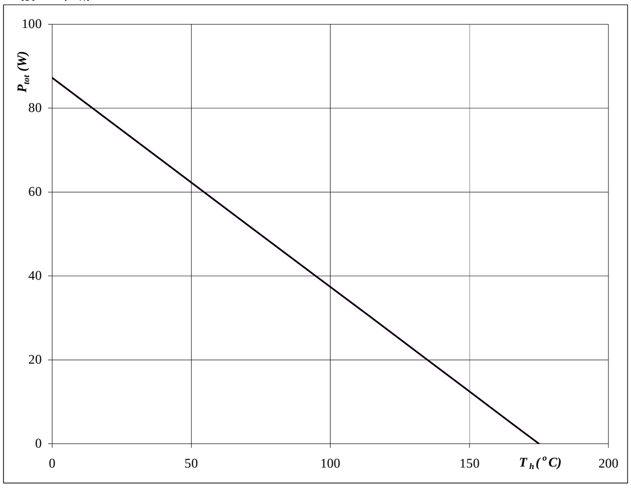
Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,10	3,6E+00	0,08	2,9E+00
0,31	3,6E-01	0,25	3,0E-01
1,14	8,0E-02	0,92	6,5E-02
0,52	1,7E-02	0,42	1,4E-02
0,31	2,9E-03	0,25	2,3E-03
0,26	3,3E-04	0,21	2,7E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



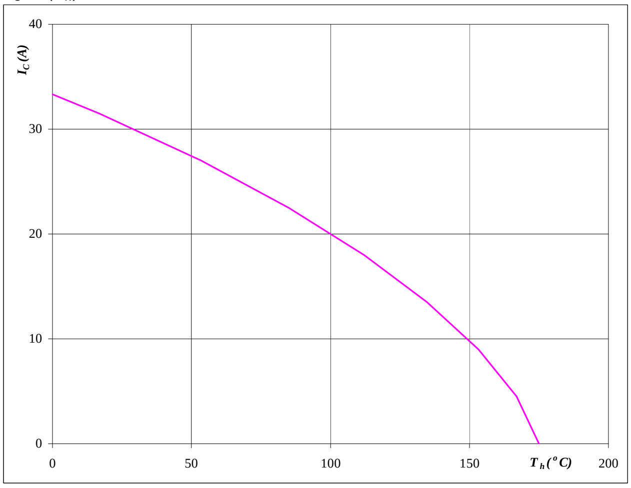
At

T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

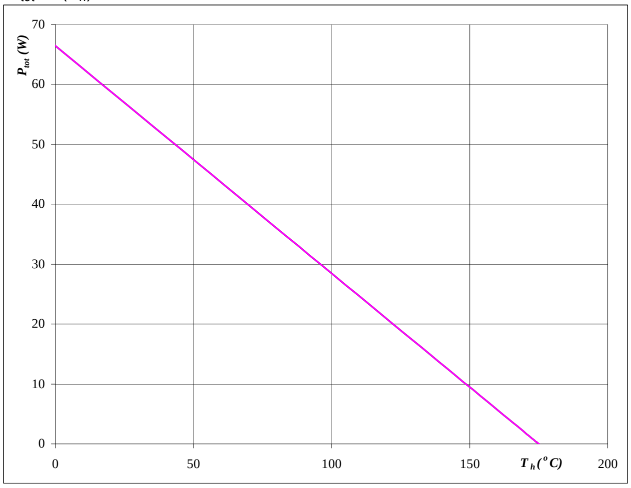
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



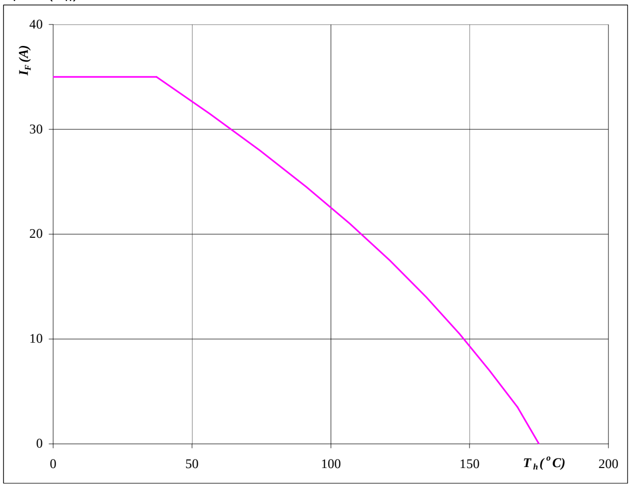
At

T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

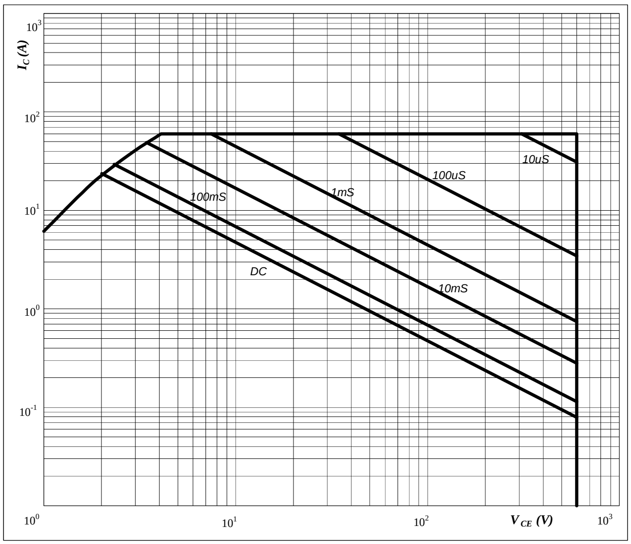
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



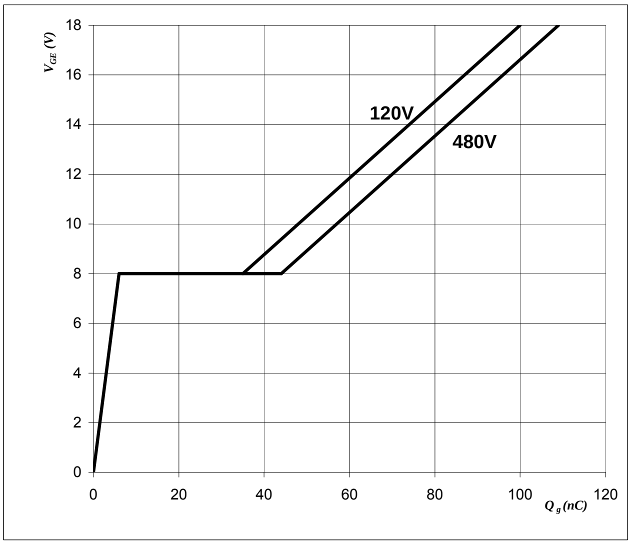
At

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

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



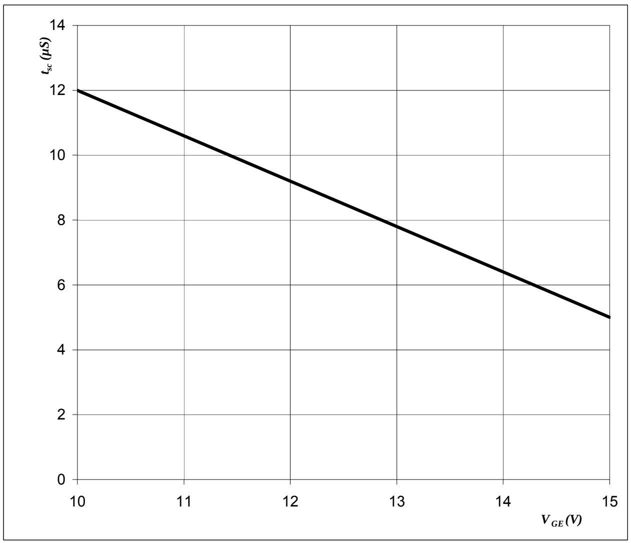
At

I_C =	20	A

Figure 27 Output inverter IGBT

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

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



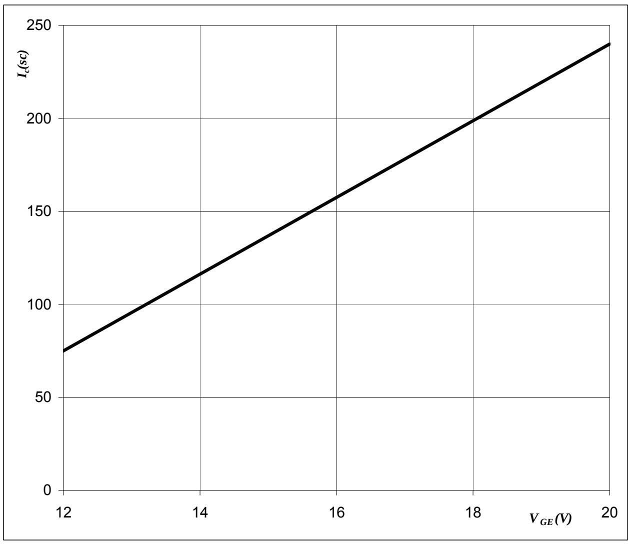
At

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

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



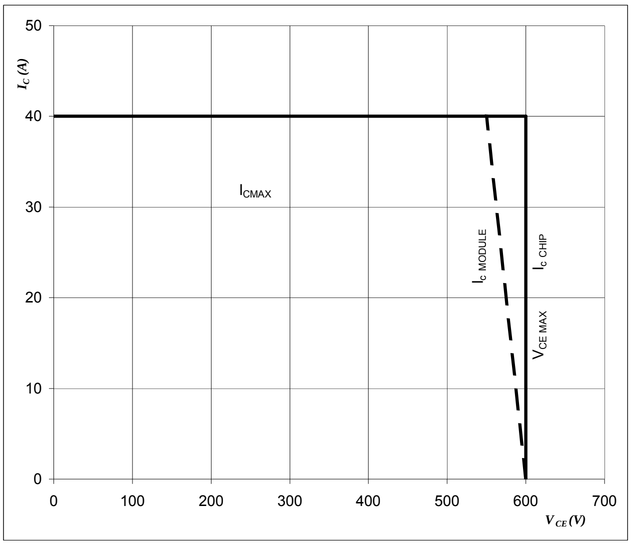
At

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}

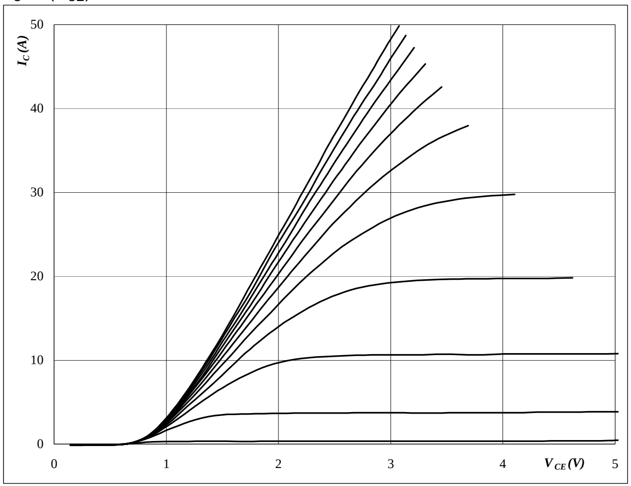
Switching mode : 3 level switching

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



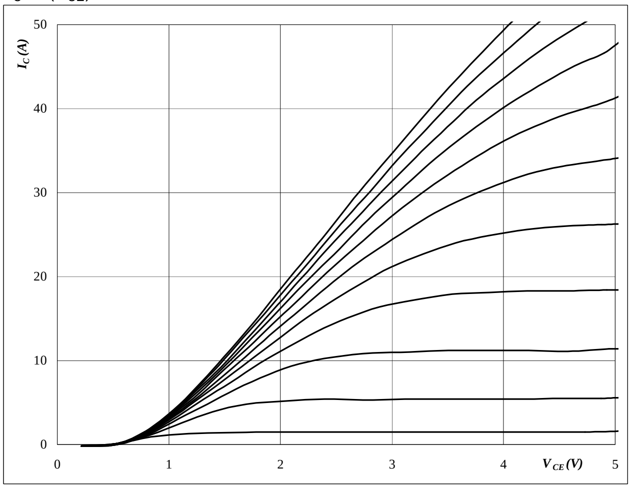
At

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

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



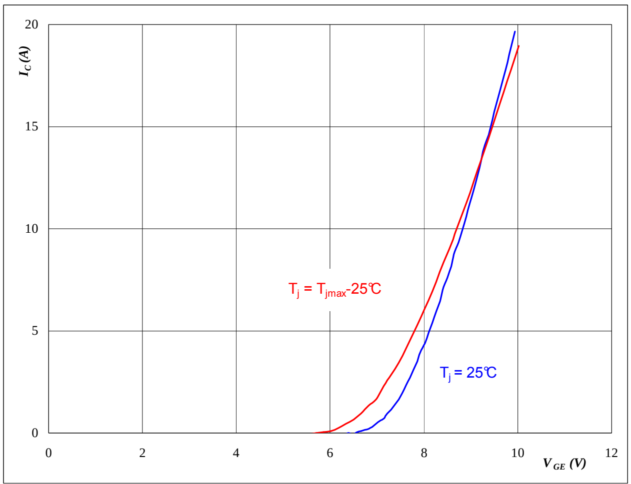
At

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

$I_C = f(V_{GE})$



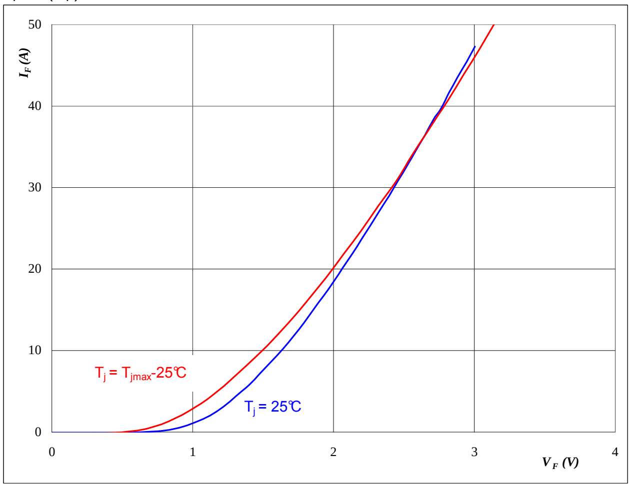
At

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

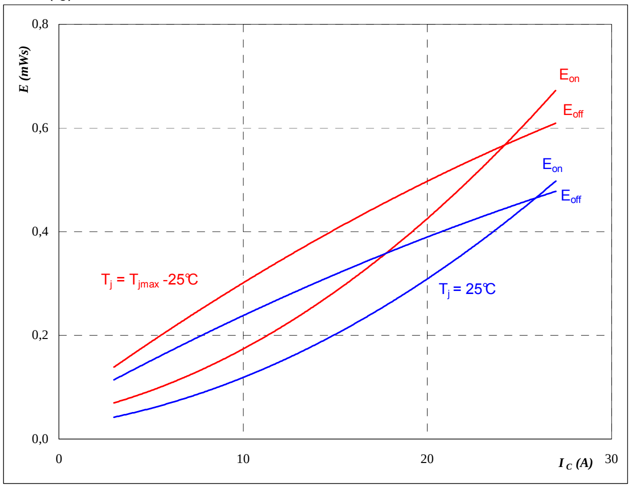
t_p =	250	µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



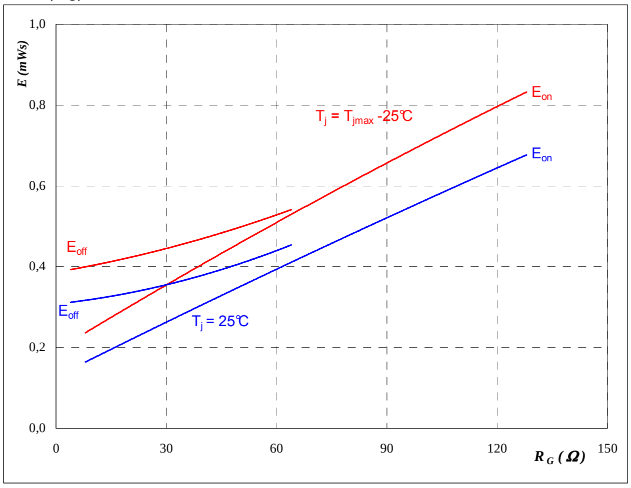
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



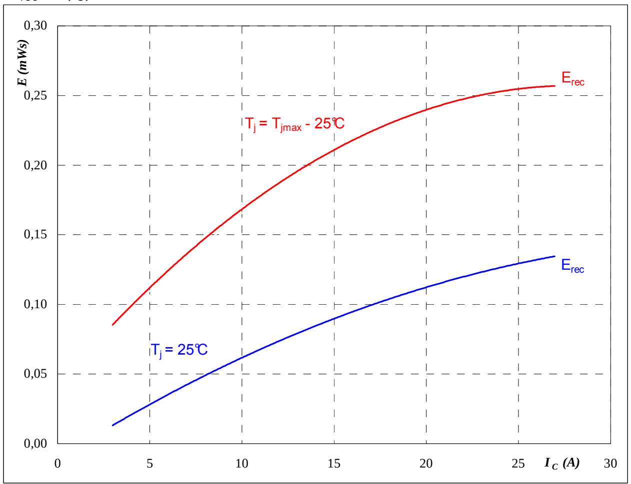
With an inductive load at

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

Figure 7 Brake FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_C)



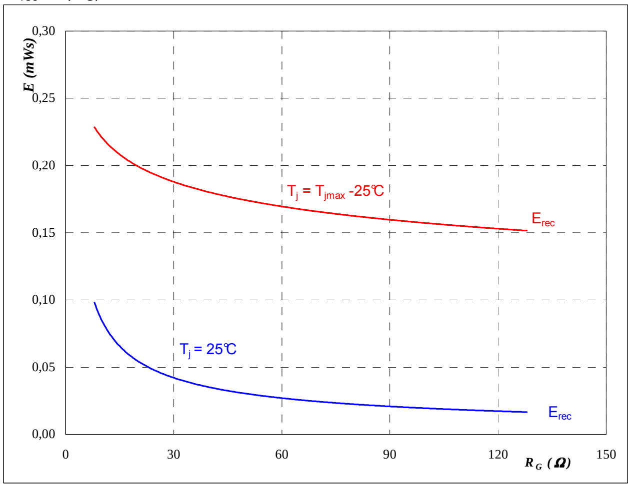
With an inductive load at

T_j =	25/125	°C
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

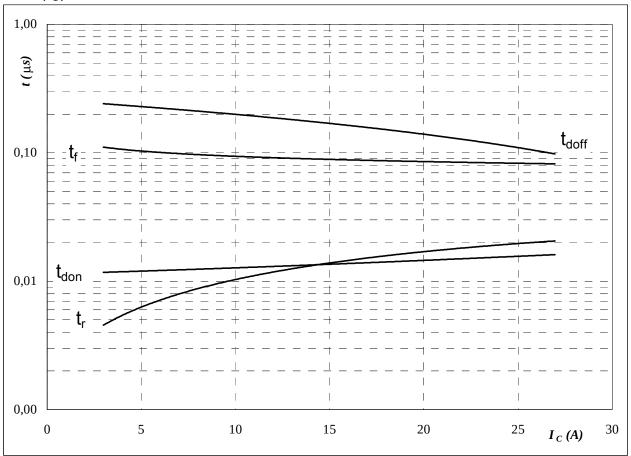
T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	15	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



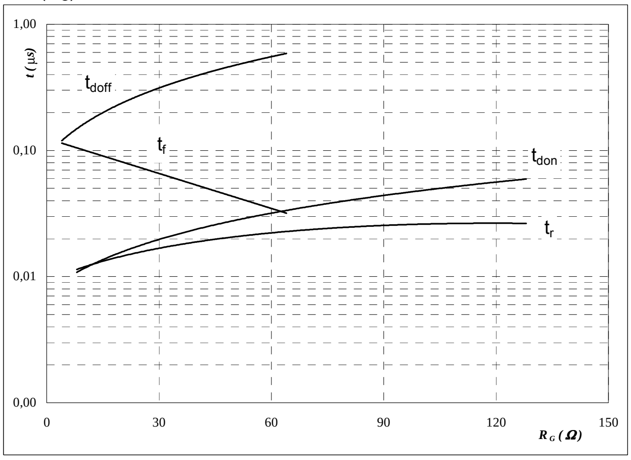
With an inductive load at

T_j =	25/125	℃
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



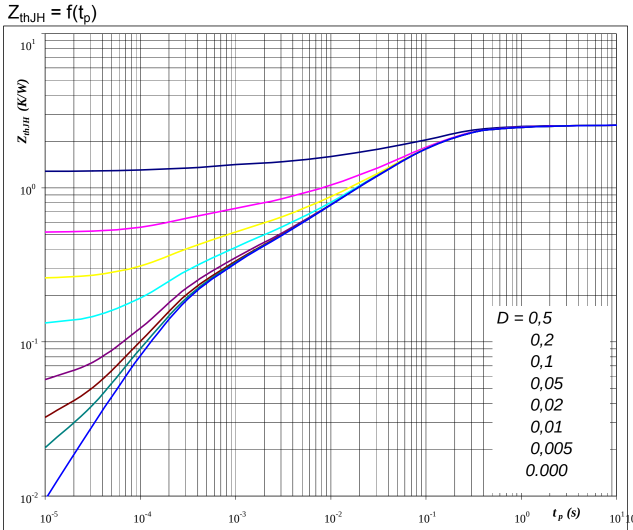
With an inductive load at

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

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

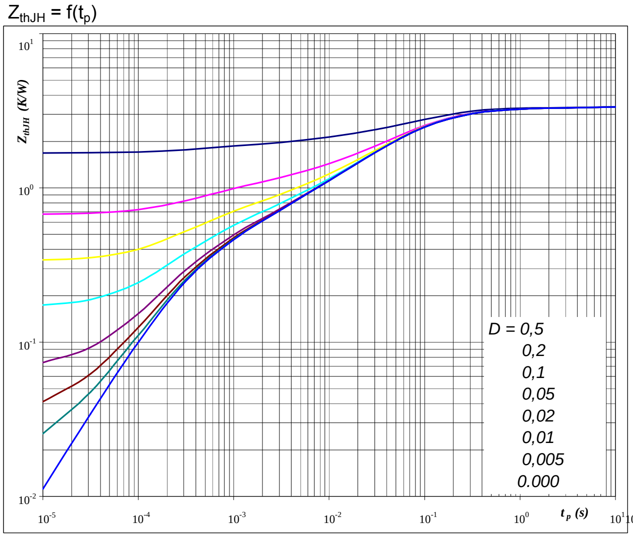


At		D =	tp / T		
Thermal grease			Phase change interface		
R_{thJH} =	2,55	K/W	R_{thJH} =	0,60	K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



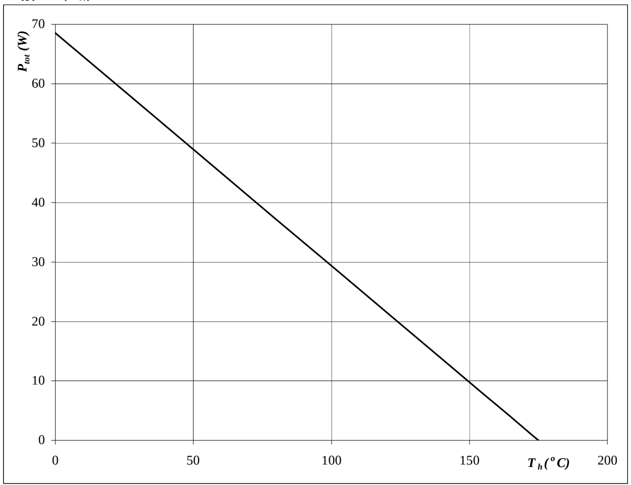
At		D =	tp / T		
Thermal grease			Phase change interface		
R_{thJH} =	3,35	K/W	R_{thJH} =	1,27	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



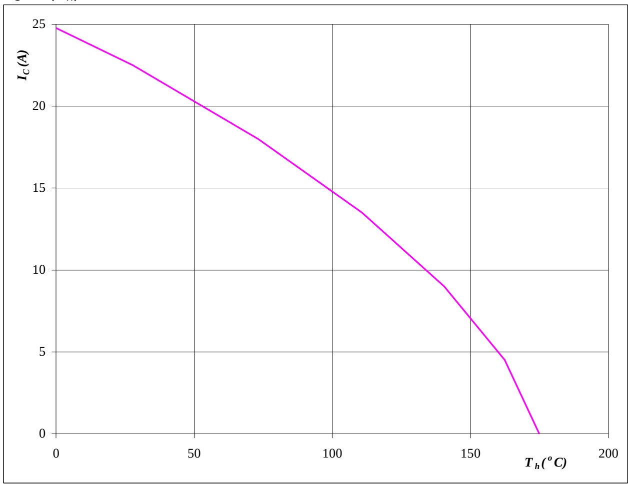
At

T_j = 175 °C

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

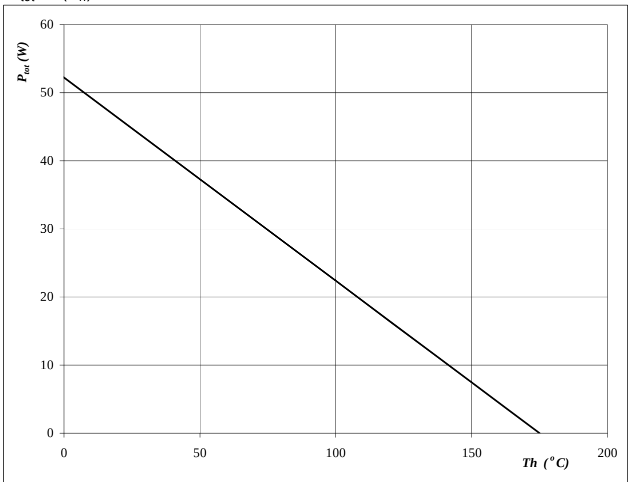
T_j = 175 °C

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



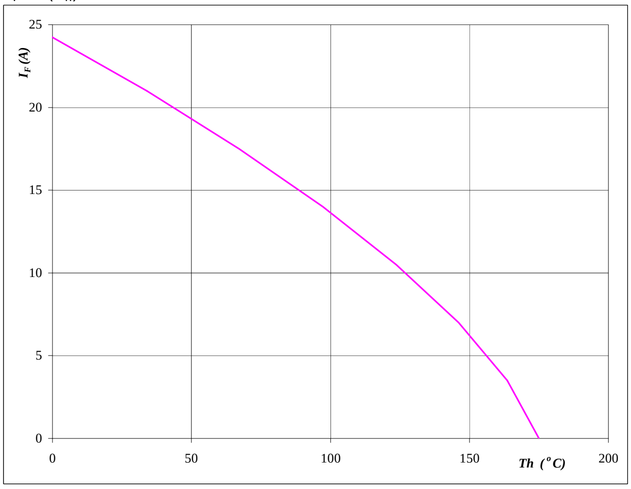
At

T_j = 175 °C

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

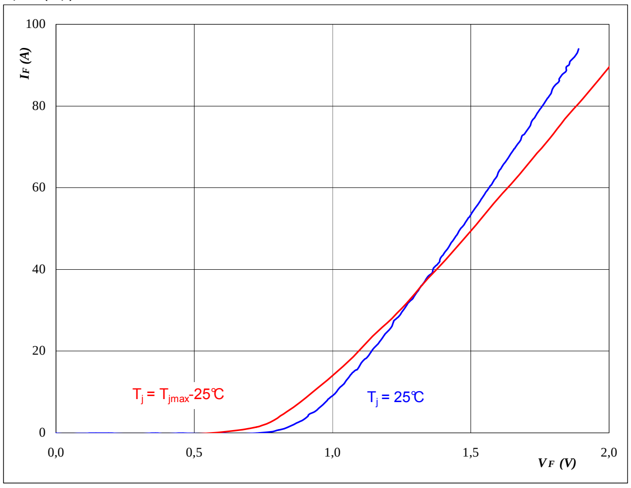
T_j = 175 °C

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



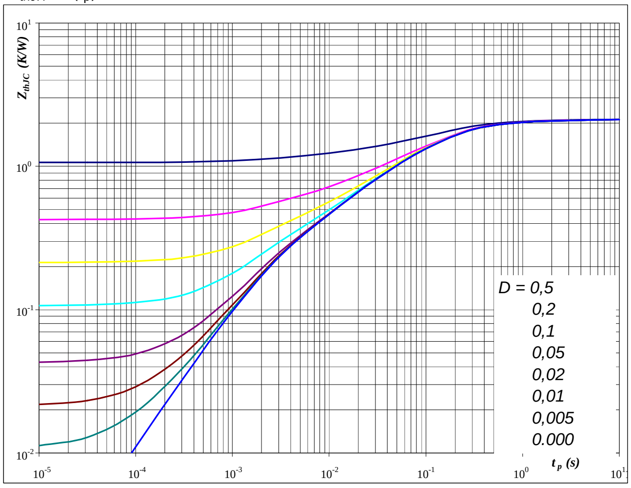
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

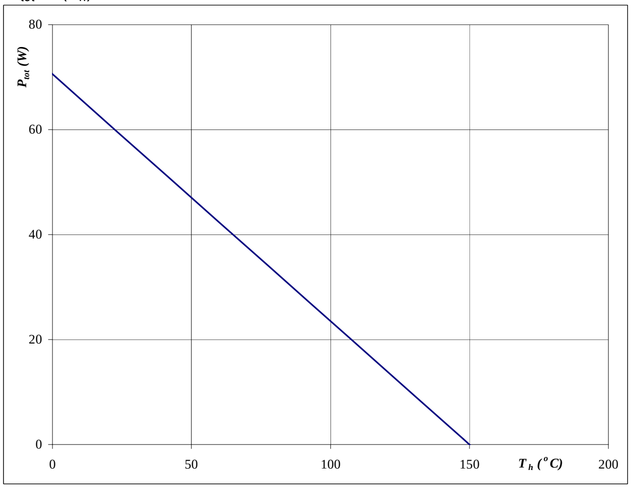
D = t_p / T

R_{thJH} = 2,1 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



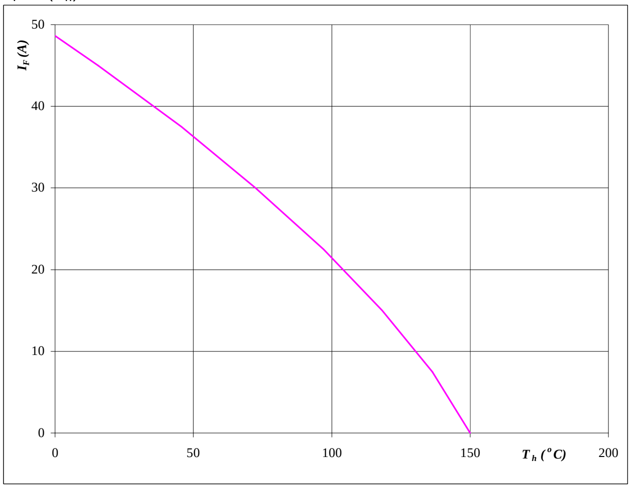
At

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

$R_T = f(T)$

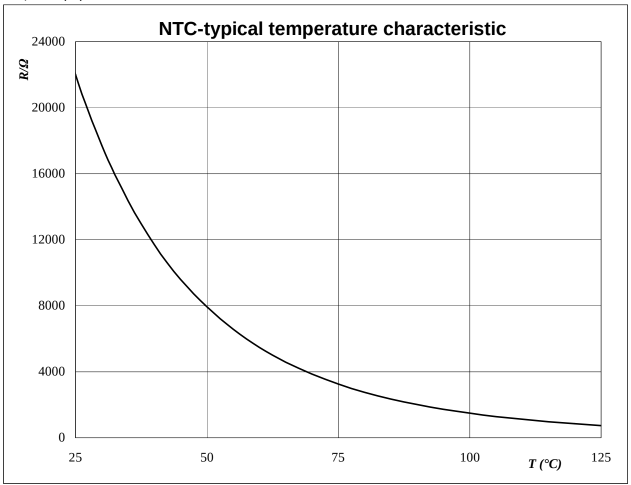


Figure 2 Thermistor

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

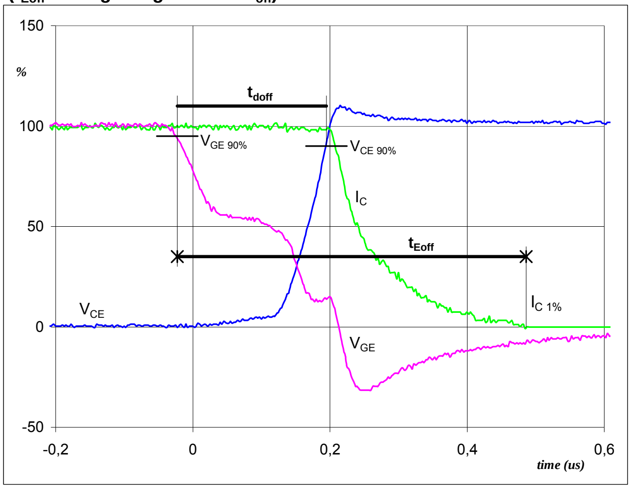
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	8 Ω

Figure 1 Output inverter IGBT

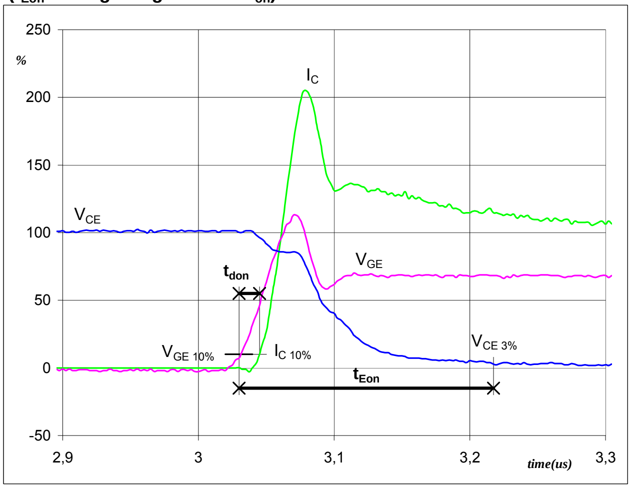
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	20	A
t_{doff} =	0,21	μs
t_{Eoff} =	0,51	μs

Figure 2 Output inverter IGBT

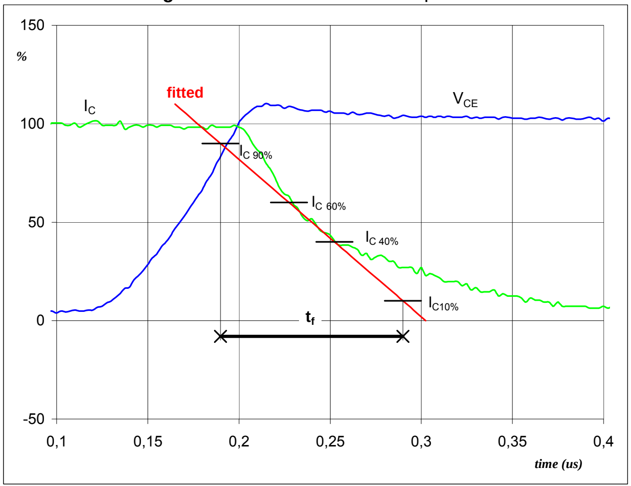
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	20	A
t_{don} =	0,01	μs
t_{Eon} =	0,19	μs

Figure 3 Output inverter IGBT

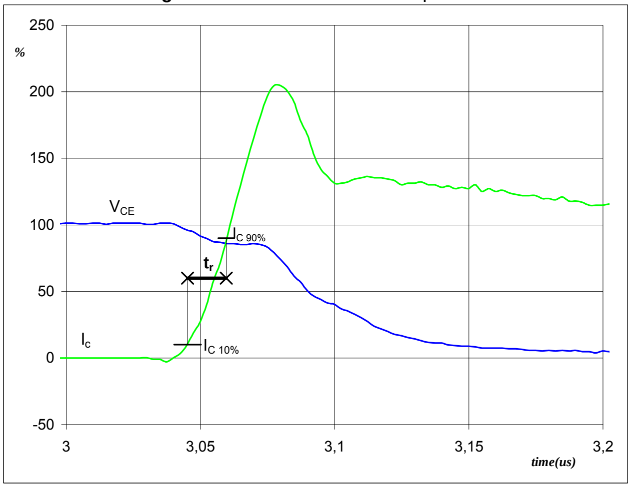
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	20	A
t_f =	0,10	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

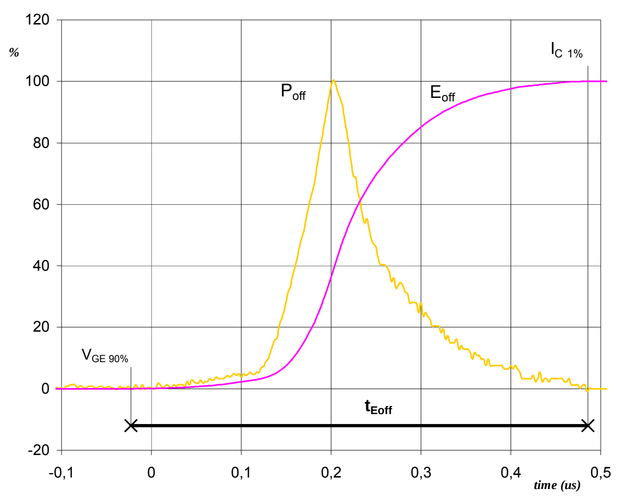


V_C (100%) =	300	V
I_C (100%) =	20	A
t_r =	0,02	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

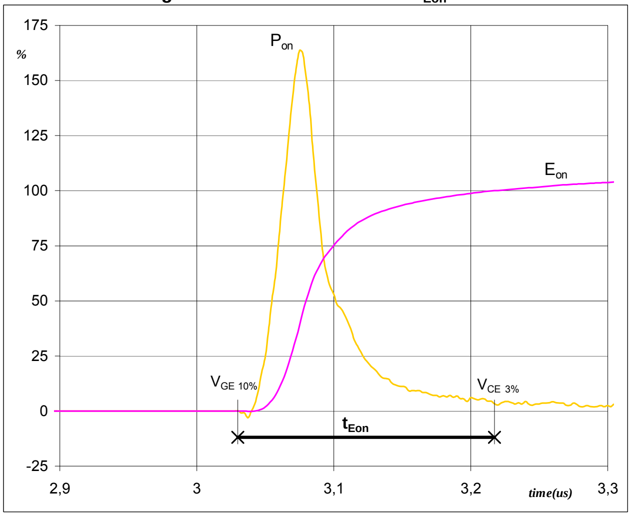
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	5,99	kW
E_{off} (100%) =	0,65	mJ
t_{Eoff} =	0,51	μs

Figure 6 Output inverter IGBT

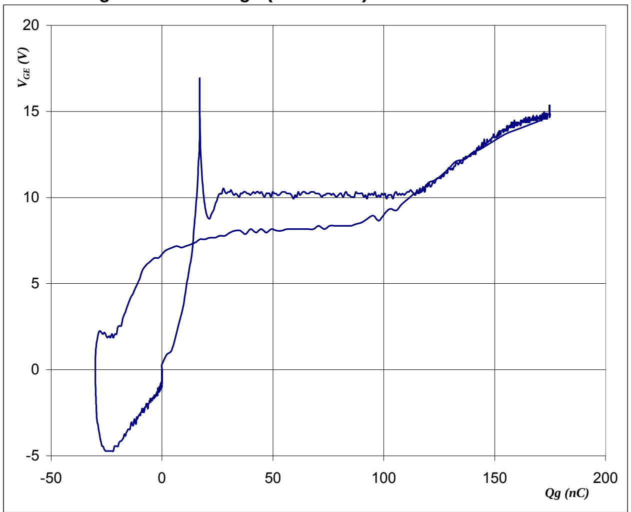
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	5,99	kW
E_{on} (100%) =	0,43	mJ
t_{Eon} =	0,19	μs

Figure 7 Output inverter FWD

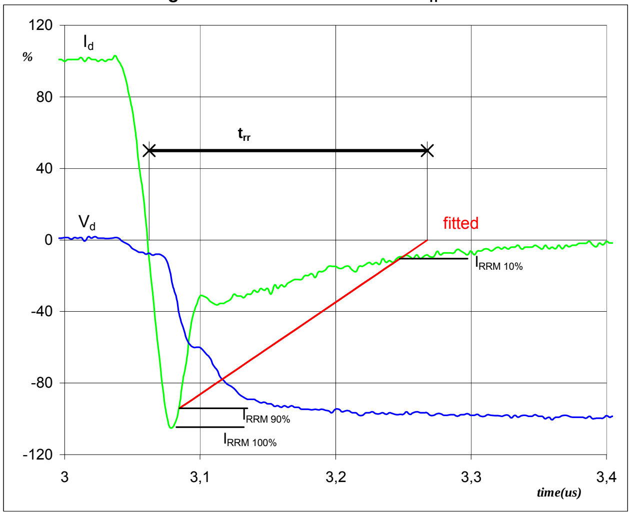
Gate voltage vs Gate charge (measured)



V_{GEoff} =	0	V
V_{GEon} =	15	V
V_C (100%) =	300	V
I_C (100%) =	20	A
Q_g =	174,72	nC

Figure 8 Output inverter IGBT

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

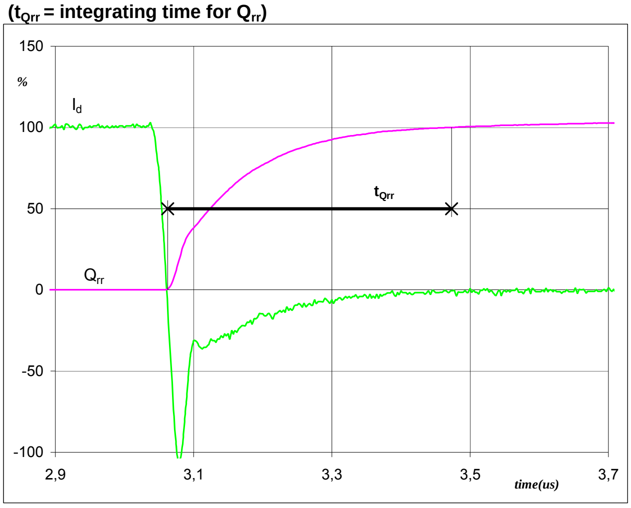


V_d (100%) =	300	V
I_d (100%) =	20	A
I_{RRM} (100%) =	21	A
t_{rr} =	0,19	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FWD

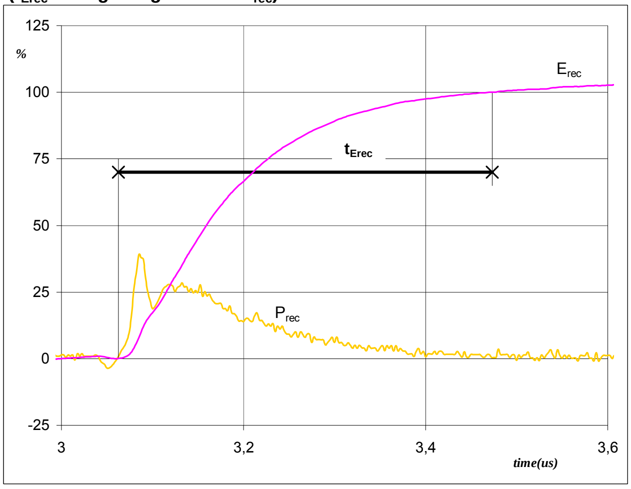
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	20	A
Q_{rr} (100%) =	1,35	µC
t_{Qrr} =	0,41	µs

Figure 10 Output inverter FWD

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



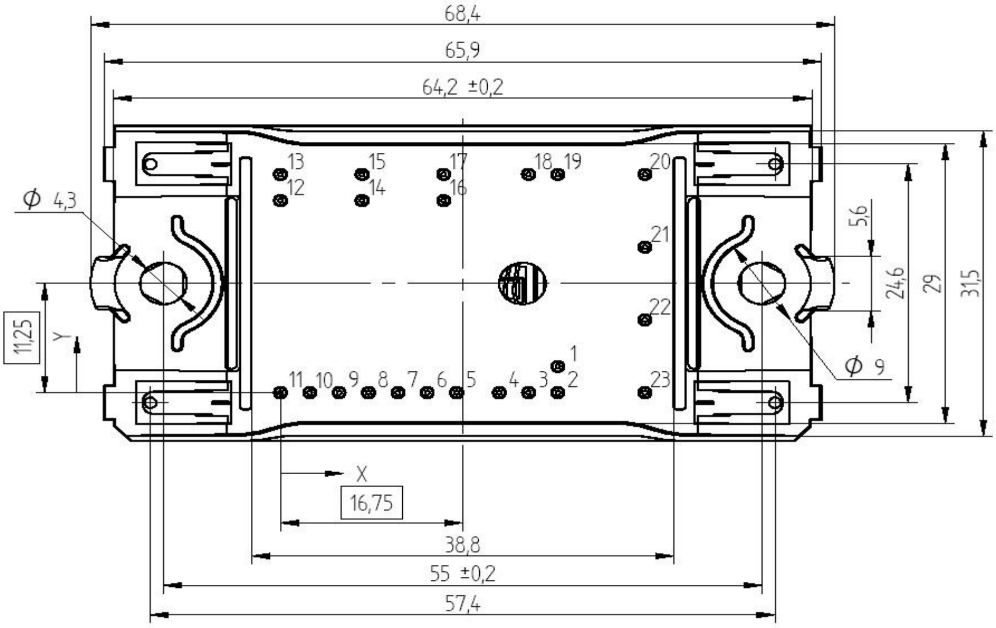
P_{rec} (100%) =	5,99	kW
E_{rec} (100%) =	0,27	mJ
t_{Erec} =	0,41	µs

Ordering Code and Marking - Outline - Pinout

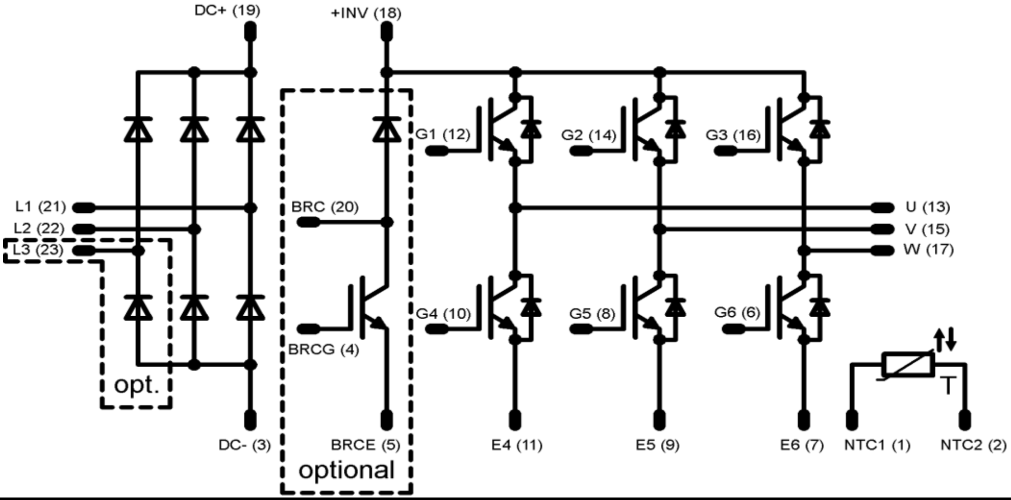
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm 2 clips housing	V23990-P545-A28-PM	P545-A28	P545-A28
without thermal paste 17mm 2 clips housing	V23990-P545-A29-PM	P545-A29	P545-A29
without thermal paste 12mm 2 clips housing	V23990-P545-C28-PM	P545-C28	P545-C28
without thermal paste 17mm 2 clips housing	V23990-P545-C29-PM	P545-C29	P545-C29

7	10.8	0
8	8.1	0
9	5.4	0
10	2.7	0
11	0	0
12	0	19.8
13	0	22.5
14	7.5	19.8
15	7.5	22.5
16	15	19.8
17	15	22.5
18	22.8	22.5
19	25.5	22.5
20	33.5	22.5
21	33.5	15
22	33.5	7.5
23	33.5	0



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.