flow PIM 0 3rdgen — 1200 V / 4 A

Features

- 2 Clips housing in 12 and 17mm height
- Trench Fieldstop Technology IGBT4
- Optional w/o BRC

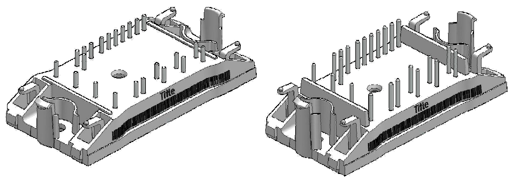
Target Applications

- Industrial Drives
- Embedded Generation

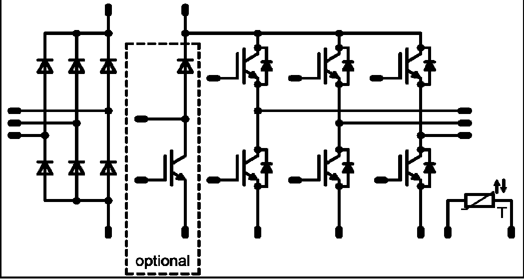
Types

- V23990-P848-A48-PM 12mm height
- V23990-P848-A49-PM 17mm height
- V23990-P848-C48-PM 12mm height; w/o BRC
- V23990-P848-C49-PM 17mm height; w/o BRC

flow PIM 0 3rdgen



Schematic



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	27 30	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	220	A
I2t-value	I^2t			200	A^2s
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	33 50	W
Maximum Junction Temperature	T_{jmax}			150	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	9 10	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		12	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		8	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	38 57	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	μs V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j=T_j$max T_h=80°C T_c=80°C	10 10	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	32	A
Power dissipation	P_{tot}	$T_j=T_j$max T_h=80°C T_c=80°C	37 56	W
Maximum Junction Temperature	T_{jmax}		175	°C
Brake Transistor				
Collector-emitter break down voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j=T_j$max T_h=80°C T_c=80°C	8 10	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max	12	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max	8	A
Power dissipation	P_{tot}	$T_j=T_j$max T_h=80°C T_c=80°C	32 49	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V	10 800	μs V
Maximum Junction Temperature	T_{jmax}		175	°C
Brake Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j=T_j$max T_h=80°C T_c=80°C	6 6	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	6	A
Power dissipation	P_{tot}	$T_j=T_j$max T_h=80°C T_c=80°C	18 28	W
Maximum Junction Temperature	T_{jmax}		175	°C
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation temperature under switching condition	T_{op}		-40…+(Tjmax - 25)	°C
Insulation Properties				
Insulation voltage	V_{is}	t=2s DC voltage	4000	V
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm
Comparative tracking index	CTI		>200	

Characteristic Values

Parameter	**Symbol**	**Conditions**					**Value**			**Unit**
			V_{GE} [V] or V_{GS} [V]	**V_r [V] or V_{CE} [V] or V_{DS} [V]**	**I_C [A] or I_F [A] or I_D [A]**	**T_j**	**Min**	**Typ**	**Max**	
Input Rectifier Diode										
Forward voltage	V_F				30	Tj=25°C Tj=125°C		1,2 1,17	1,8	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0,93 0,8		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		11 15		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,1	mA
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,13		K/W
Thermal resistance chip to heatsink	R_{thJH}	Phase-Change Material λ=3,4W/mK						1,84		K/W
Inverter Transistor										
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		1,95 2,28		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=64 Ω Rgon=64 Ω	±15	600	4	Tj=25°C Tj=125°C		77 75		ns
Rise time	t_r					Tj=25°C Tj=125°C		18 23		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		176 226		
Fall time	t_f					Tj=25°C Tj=125°C		83 110		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		0,32 0,56		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		0,21 0,31		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		250		pF
Output capacitance	C_{oss}							25		
Reverse transfer capacitance	C_{rss}							15		
Gate charge	Q_G		±15	960	4	Tj=25°C		25		nC
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,51		K/W
Thermal resistance chip to heatsink	R_{thJH}	Phase-Change Material λ=3,4W/mK						2,18		K/W
Inverter Diode										
Diode forward voltage	V_F				10	Tj=25°C Tj=125°C	1,35	1,41 1,25	2,2	V
Peak reverse recovery current	I_{RRM}	Rgon=64 Ω	15	600	10	Tj=25°C Tj=125°C		5 6		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		248 431		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,58 1,24		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		95 49		A/μs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		0,21 0,47		mWs
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,56		K/W
Thermal resistance chip to heatsink	R_{thJH}	Phase-Change Material λ=3,4W/mK						2,23		K/W

Characteristic Values

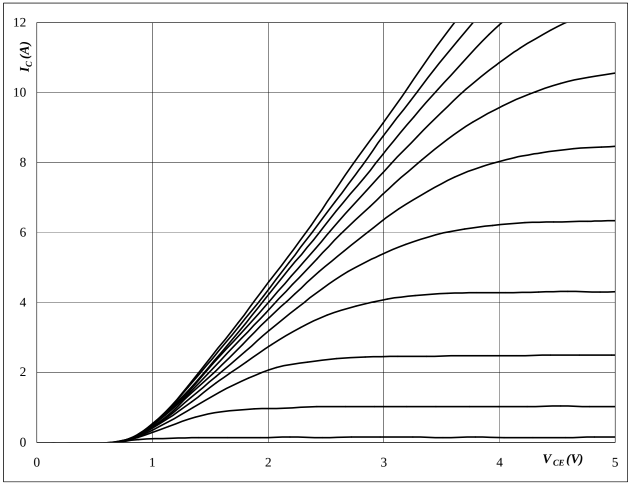
Parameter	**Symbol**	**Conditions**					**Value**			**Unit**
			V_{GE} **[V] or** V_{GS} **[V]**	V_r **[V] or** V_{CE} **[V] or** V_{DS} **[V]**	I_C **[A] or** I_F **[A] or** I_D **[A]**	T_j	**Min**	**Typ**	**Max**	
Brake Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00015	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		4	Tj=25°C Tj=125°C		1,96 2,27		V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=64 Ω Rgon=64 Ω	±15	600	4	Tj=25°C Tj=125°C		78 75		ns
Rise time	t_r					Tj=25°C Tj=125°C		18 24		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		170 217		
Fall time	t_f					Tj=25°C Tj=125°C		81 103		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		0,24 0,36		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		0,22 0,33		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		250		pF
Output capacitance	C_{oss}							25		
Reverse transfer capacitance	C_{rss}							15		
Gate charge	Q_G		15	960	4	Tj=25°C		25		nC
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,95		K/W
Thermal resistance chip to heatsink	R_{thJH}	Phase-Change Material λ=3,4W/mK						2,56		K/W
Brake Diode										
Diode forward voltage	V_F				4	Tj=25°C Tj=125°C	1	1,88 1,79	2,35	V
Reverse leakage current	I_r		15	600	4	Tj=25°C Tj=125°C			250	μA
Peak reverse recovery current	I_{RRM}	Rgon=64 Ω Rgon=64 Ω	15	600	4	Tj=25°C Tj=125°C		4 5		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		276 485		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,43 0,43		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		37 31		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,17 0,38		mWs
Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,86		K/W
Thermal resistance chip to heatsink	R_{thJH}	Phase-Change Material λ=3,4W/mK						3,38		K/W
Thermistor										
Rated resistance	R					T=25°C		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100°C	-5		5	%
Power dissipation	P					T=25°C		210		mW
Power dissipation constant						T=25°C		3,5		mW/K
B-value	B(25/50)	Tol. ±3%				T=25°C		3940		K
B-value	B(25/100)	Tol. ±3%				T=25°C		4000		K
Vincotech NTC Reference									A	

Output Inverter

Figure 1 **Output inverter IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



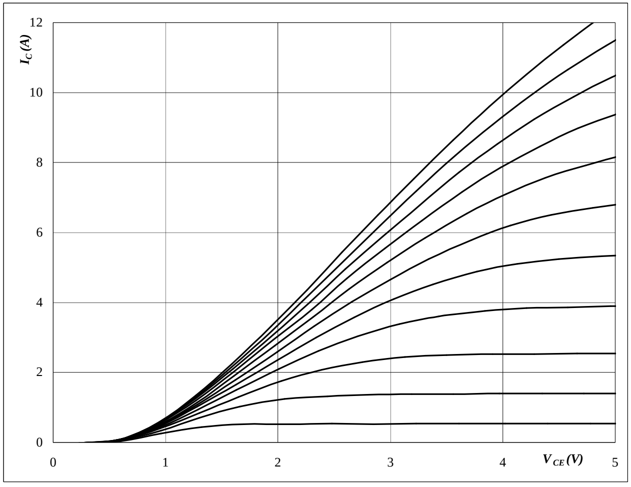
At

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

$I_C = f(V_{CE})$



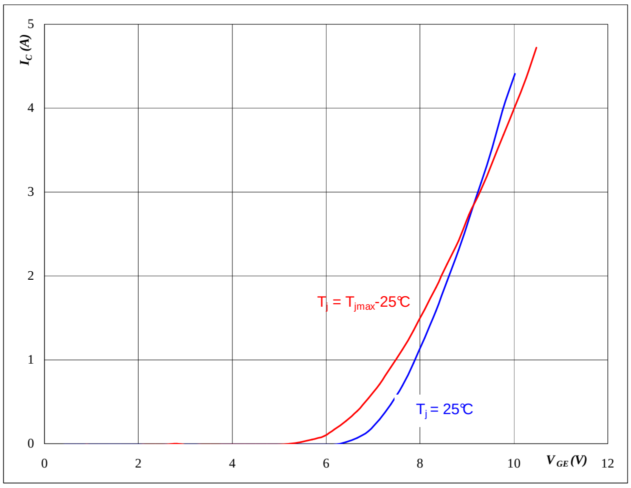
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



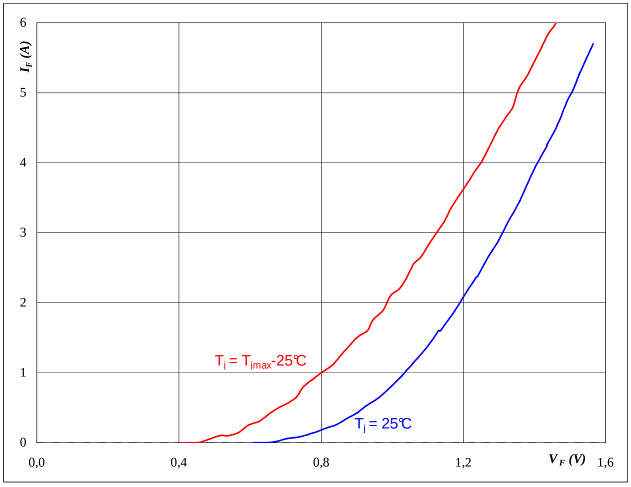
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

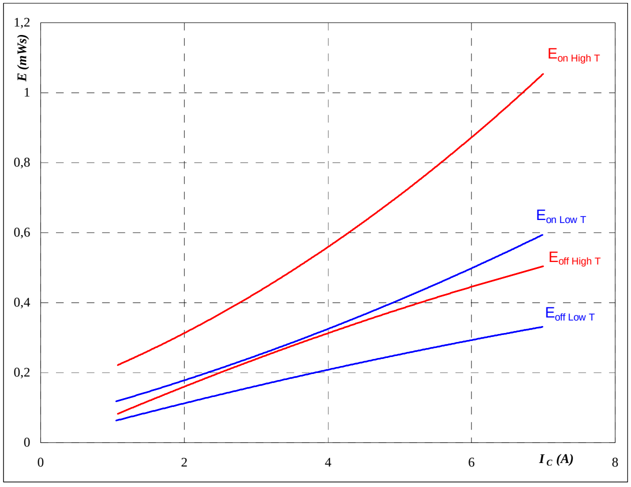
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



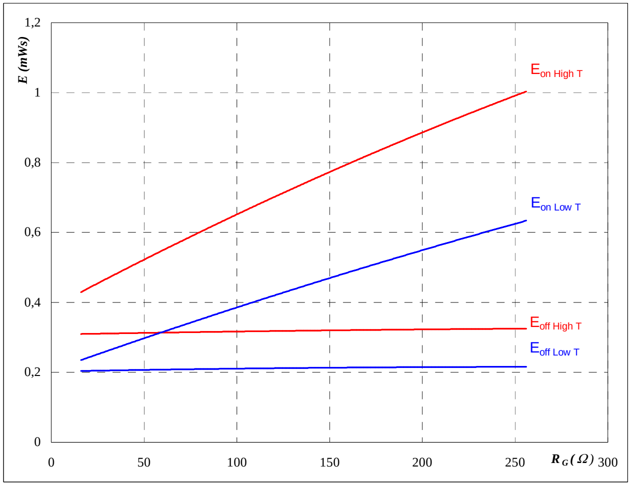
With an inductive load at

T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 64 Ω
R_{goff} = 64 Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



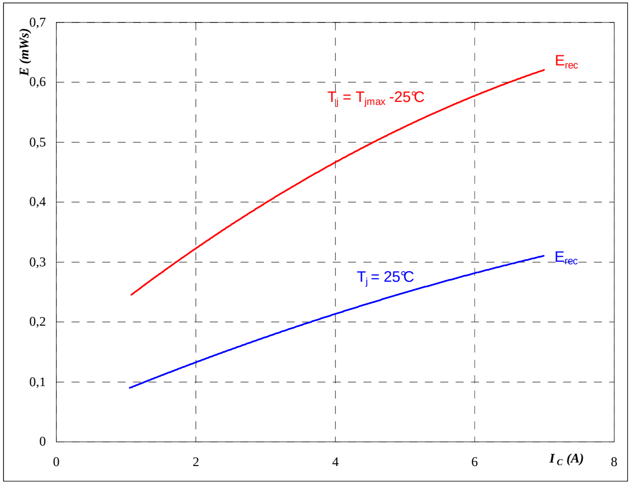
With an inductive load at

T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 4 A

Figure 7 Output inverter FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



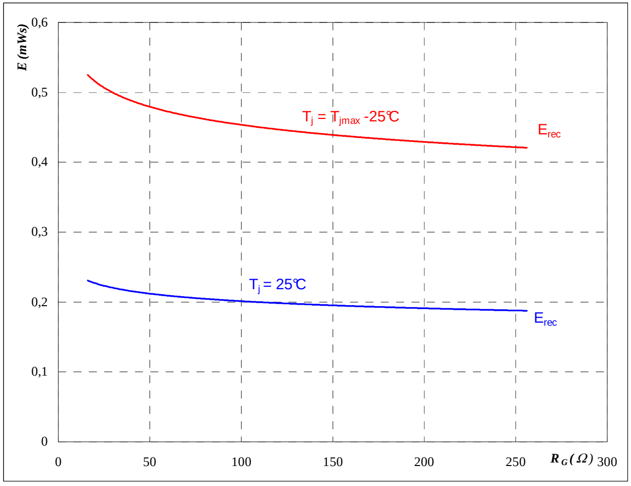
With an inductive load at

T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 64 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

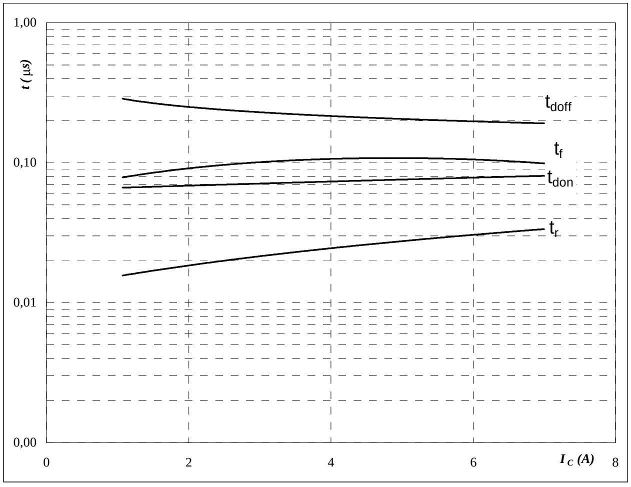
T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 4 A

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

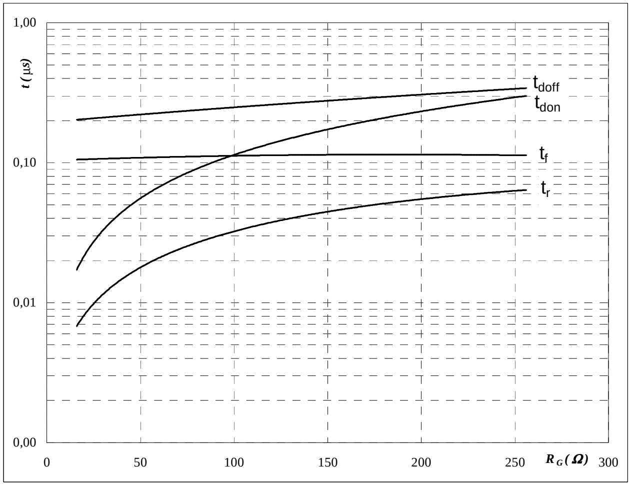
R_{gon} = 64 Ω

R_{goff} = 64 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

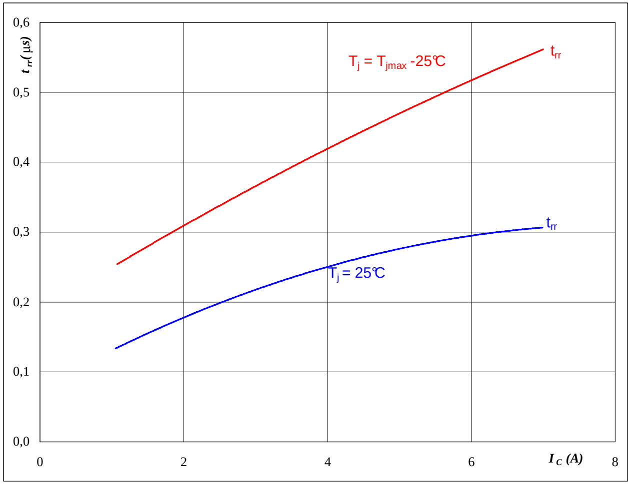
V_{GE} = ±15 V

I_C = 4 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

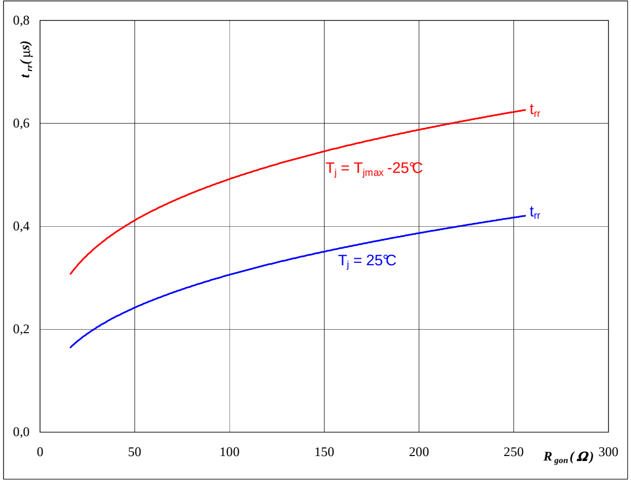
V_{GE} = ±15 V

R_{gon} = 64 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 = 4 A

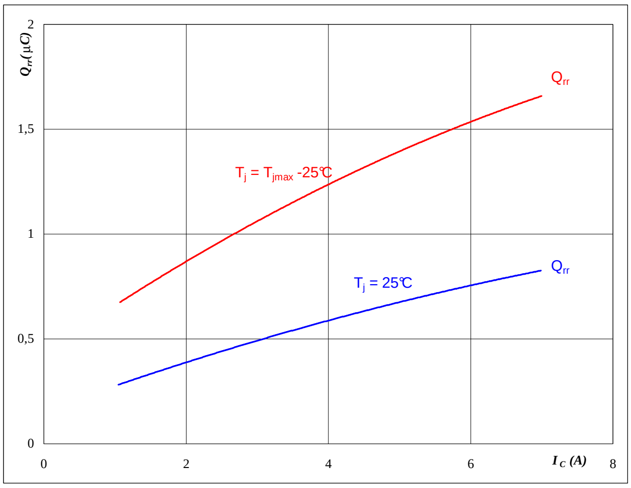
V_{GE} = ±15 V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



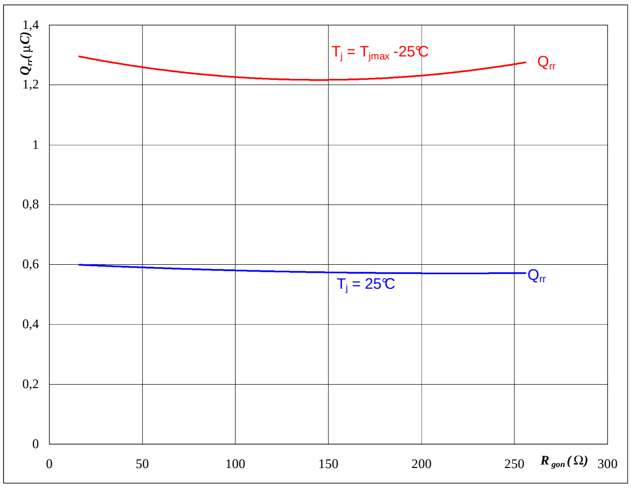
At

T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 64 Ω

Figure 14 Output inverter FWD

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

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



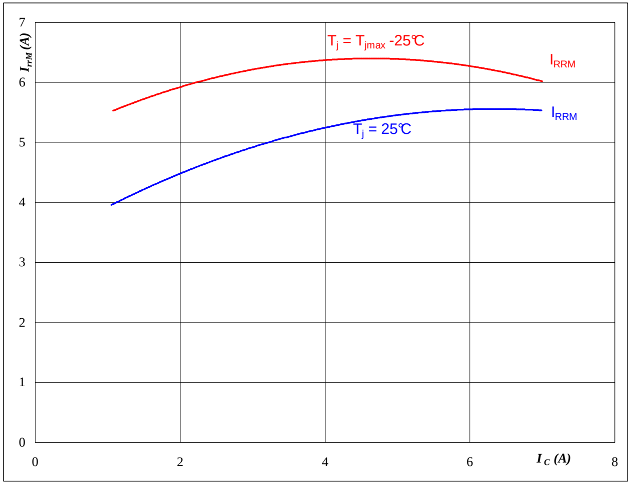
At

T_j = 25/150 °C
V_R = 600 V
I_F = 4 A
V_{GE} = ±15 V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



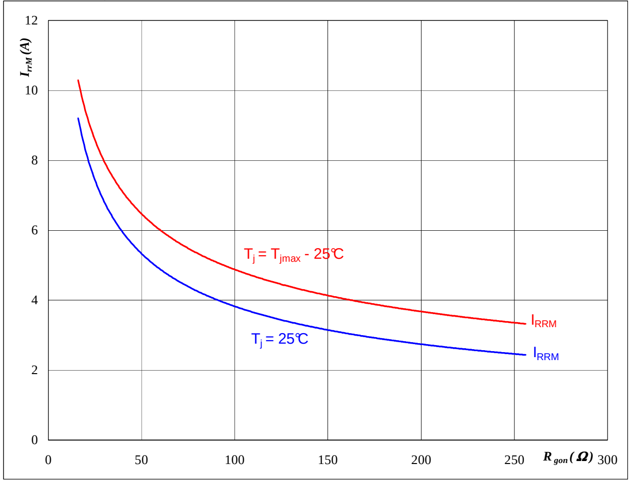
At

T_j = 25/150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 64 Ω

Figure 16 Output inverter FWD

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

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



At

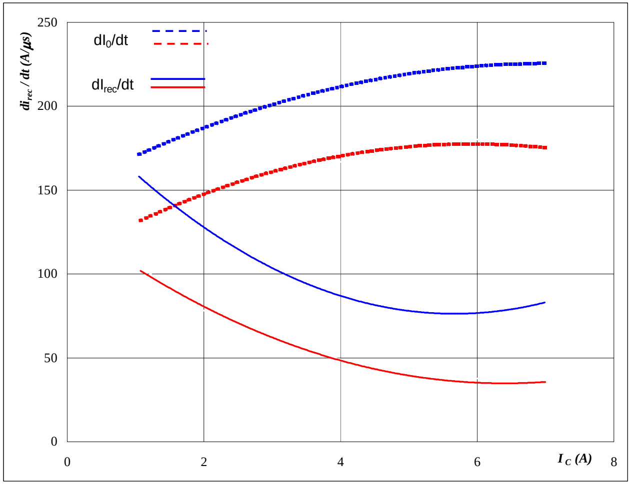
T_j = 25/150 °C
V_R = 600 V
I_F = 4 A
V_{GE} = ±15 V

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

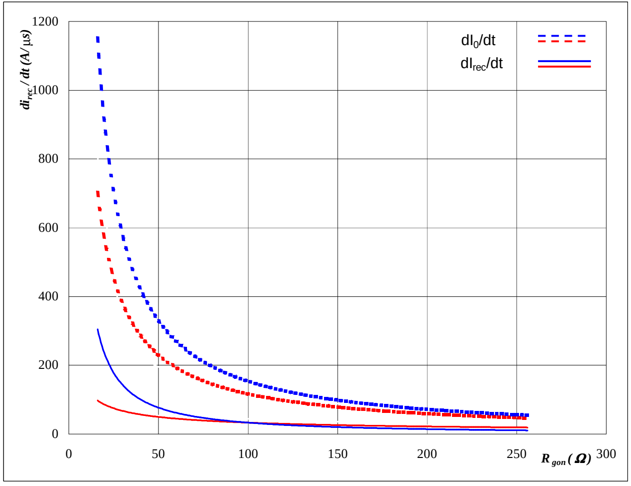
V_{GE} = ±15 V

R_{gon} = 64 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

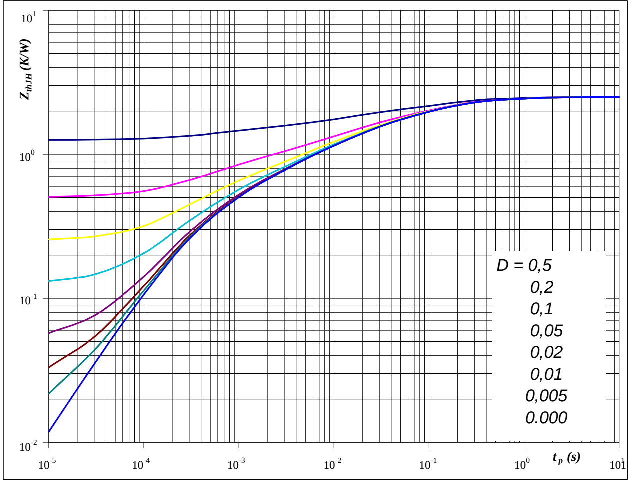
I_F = 4 A

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

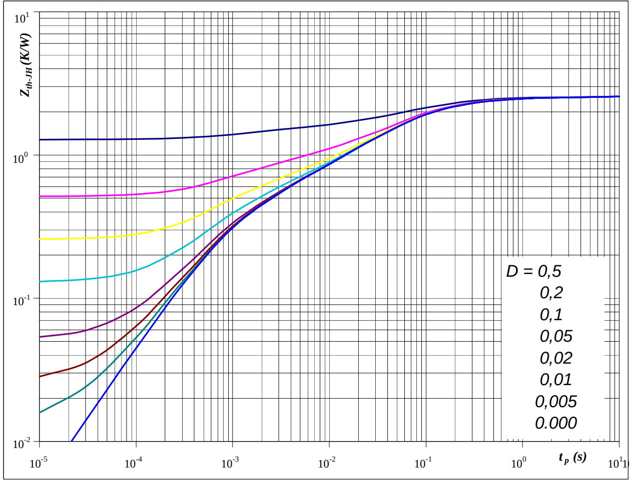
$D = t_p / T$

R_{thJH} = 2,51 K/W R_{thJH} = 2,18 K/W

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} = 2,56 K/W R_{thJH} = 2,23 K/W

IGBT thermal model values

Thermal grease		Phase change material	
R (K/W)	Tau (s)	R (K/W)	Tau (s)
0,05	6,2E+00	0,04	6,2E+00
0,26	4,9E-01	0,23	4,9E-01
0,85	8,6E-02	0,74	8,6E-02
0,64	1,3E-02	0,56	1,3E-02
0,38	2,2E-03	0,33	2,2E-03
0,33	3,4E-04	0,28	3,4E-04

FWD thermal model values

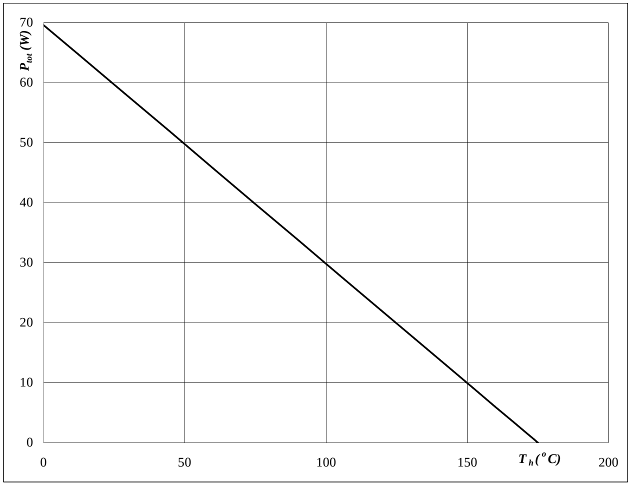
Thermal grease		Phase change material	
R (K/W)	Tau (s)	R (K/W)	Tau (s)
0,12	2,8E+00	0,11	2,8E+00
0,62	2,1E-01	0,54	2,1E-01
1,10	4,8E-02	0,95	4,8E-02
0,37	7,2E-03	0,33	7,2E-03
0,35	8,8E-04	0,30	8,8E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



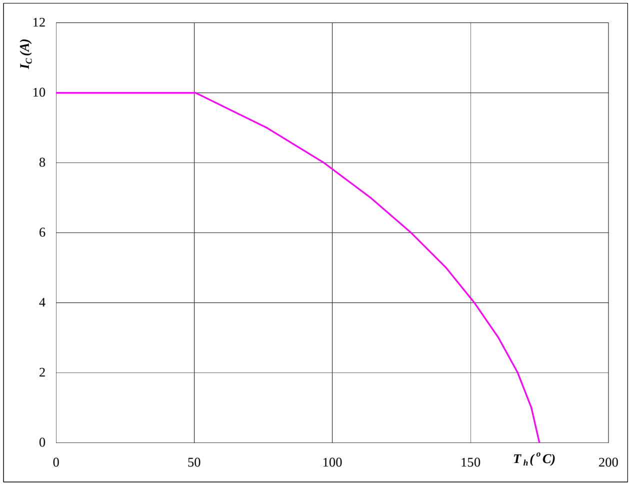
At

T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

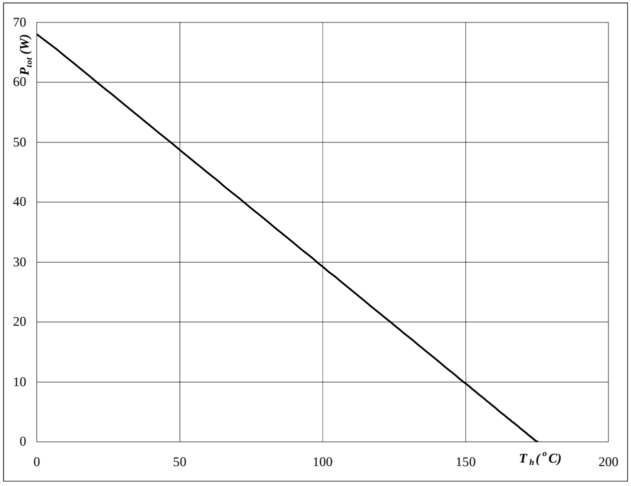
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



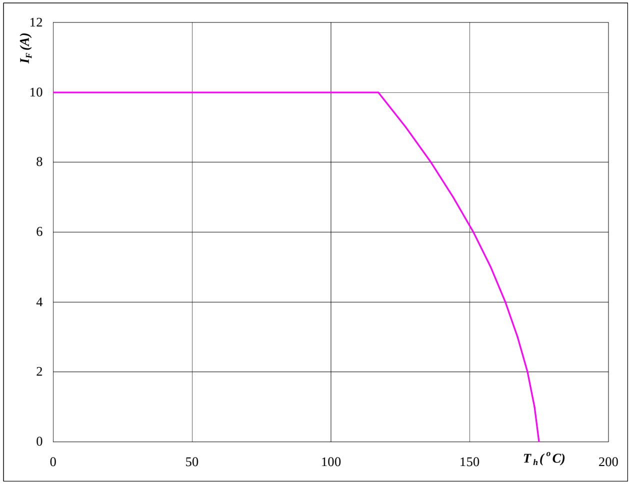
At

T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

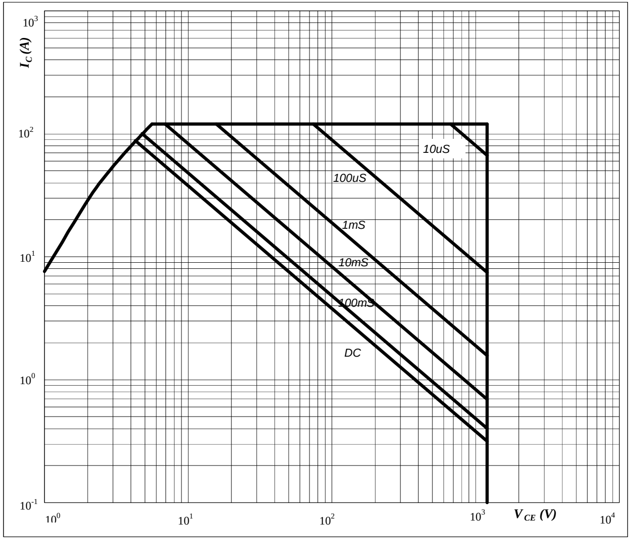
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



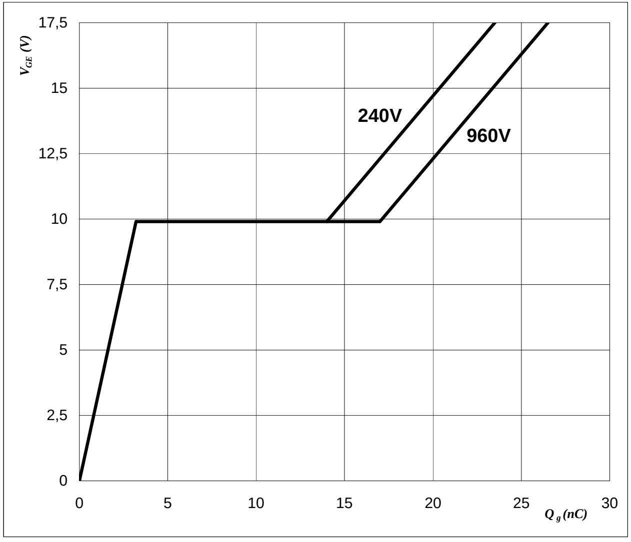
At

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

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



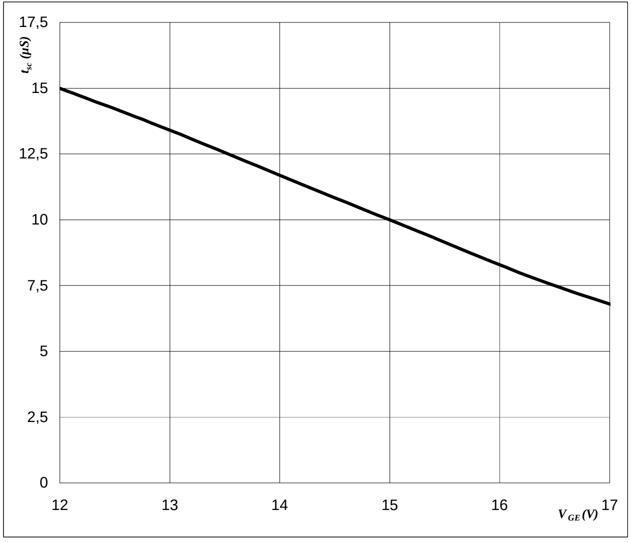
At

I_C = 4 A

Figure 27 Output inverter IGBT

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

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



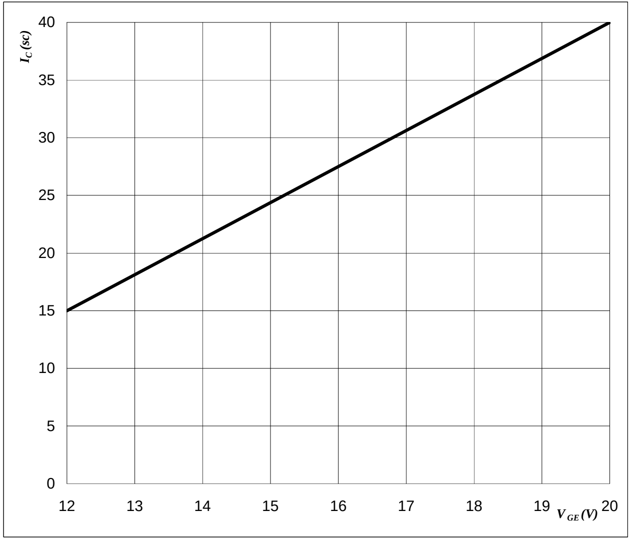
At

V_{CE} = 1200 V
T_j ≤ 175 ºC

Figure 28 Output inverter IGBT

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

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



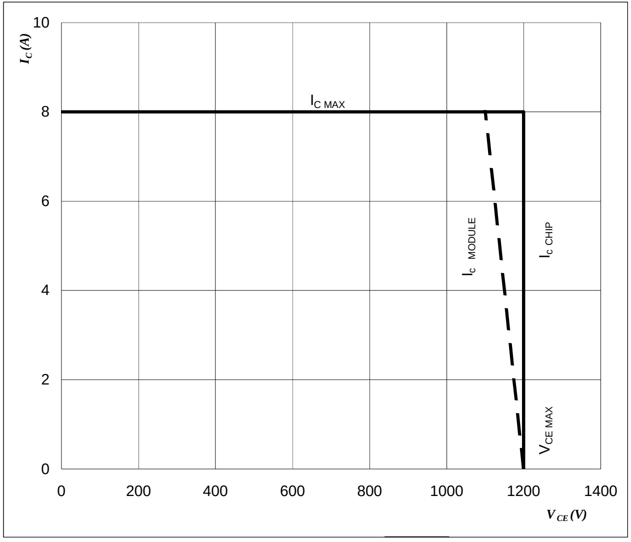
At

V_{CE} ≤ 1200 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

Uccminus=Uccplus

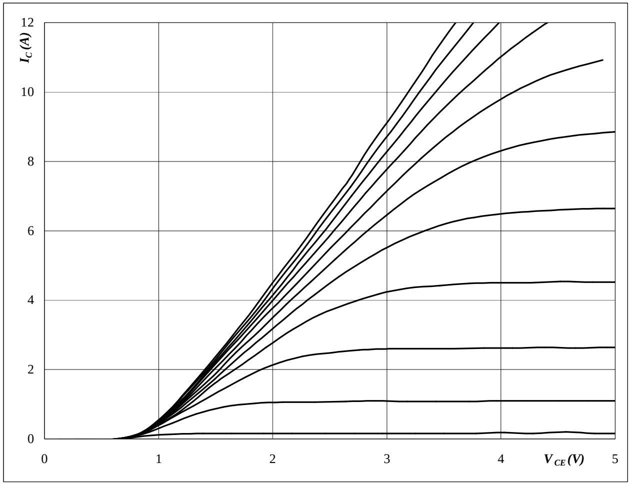
Switching mode : 3 level switching

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

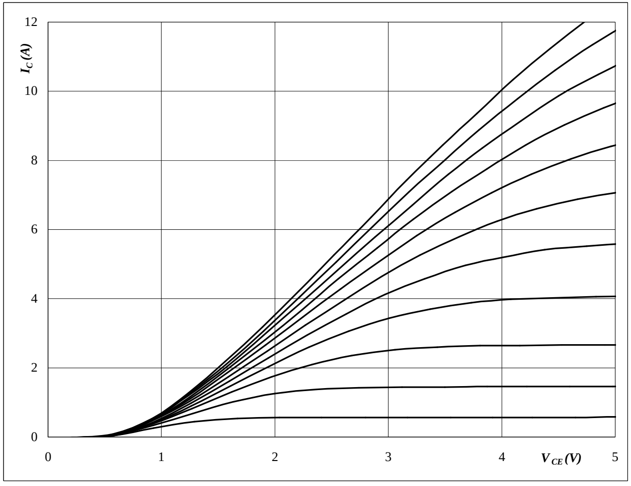
T_j = 25 °C

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

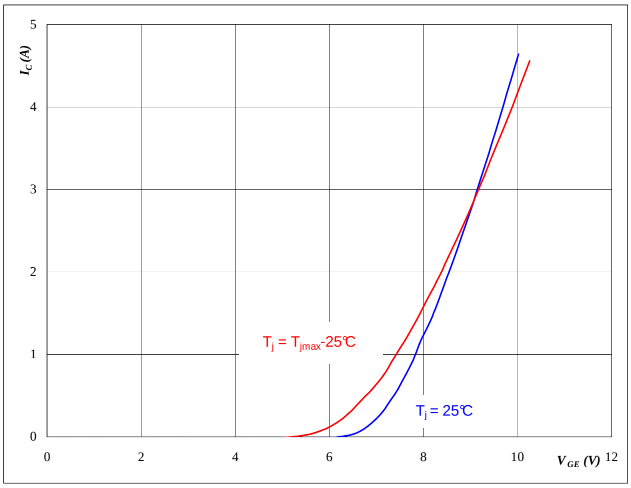
T_j = 150 °C

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

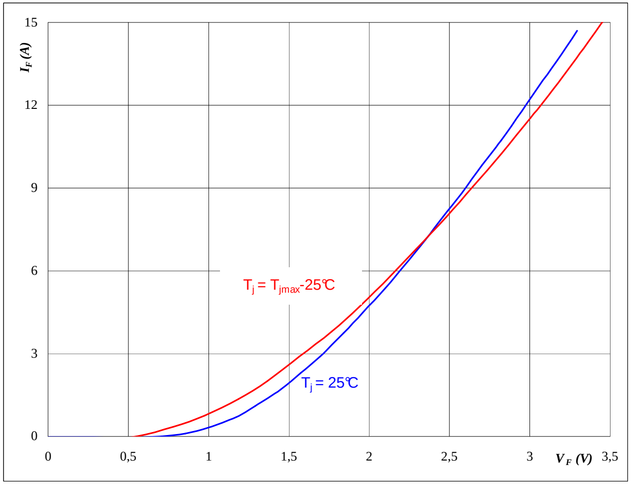
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

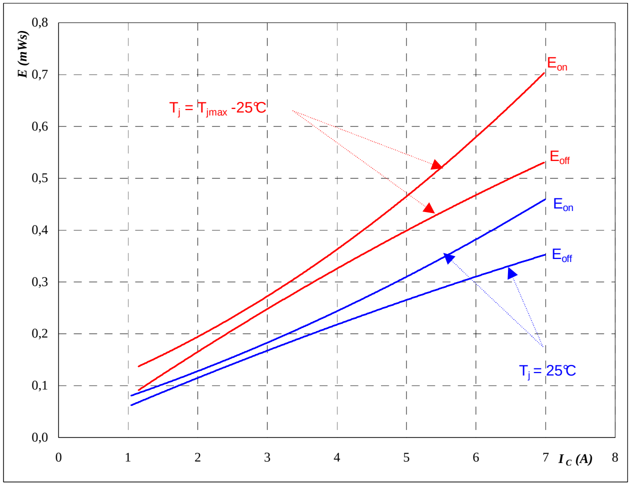
t_p = 250 µs

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

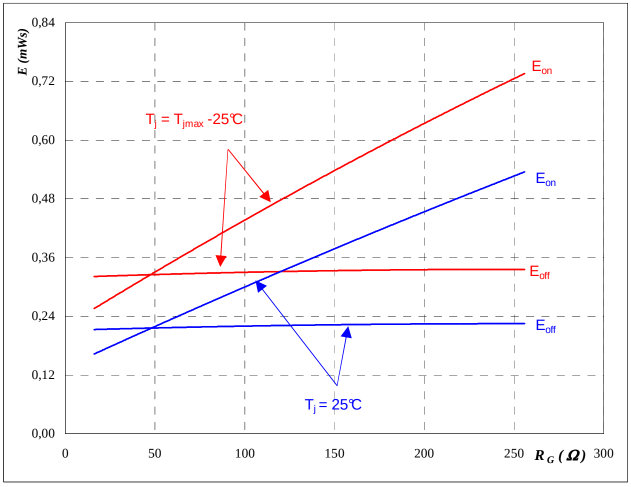
R_{gon} = 64 Ω

R_{goff} = 64 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

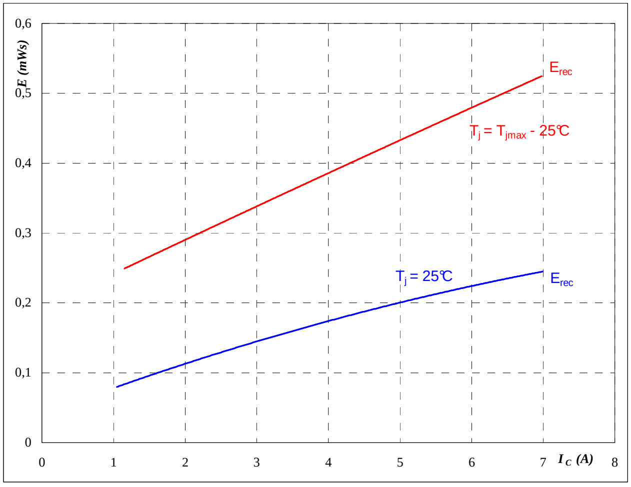
V_{GE} = ±15 V

I_C = 4 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

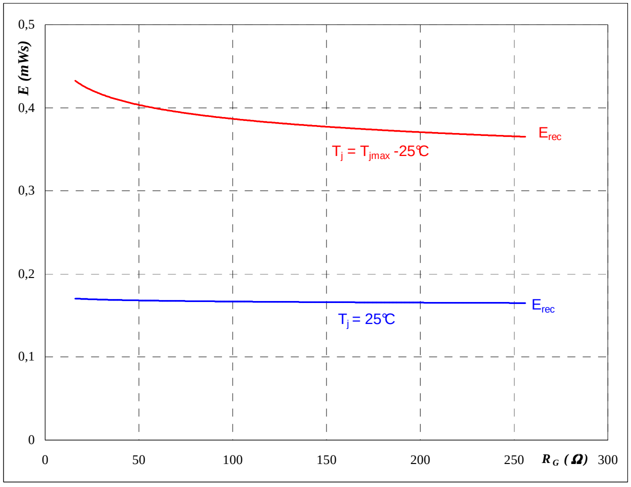
V_{GE} = ±15 V

R_{gon} = 64 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

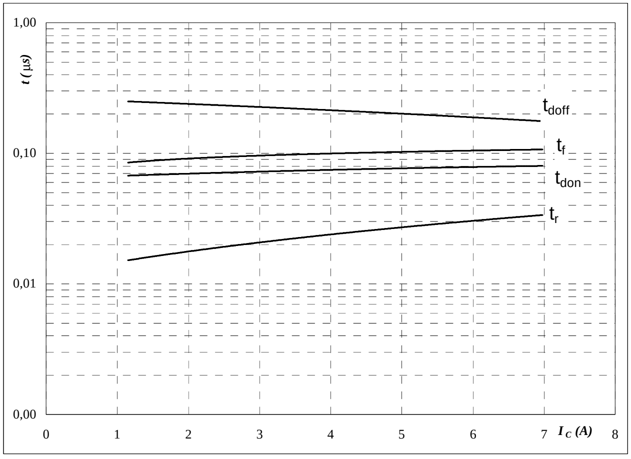
I_C = 4 A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



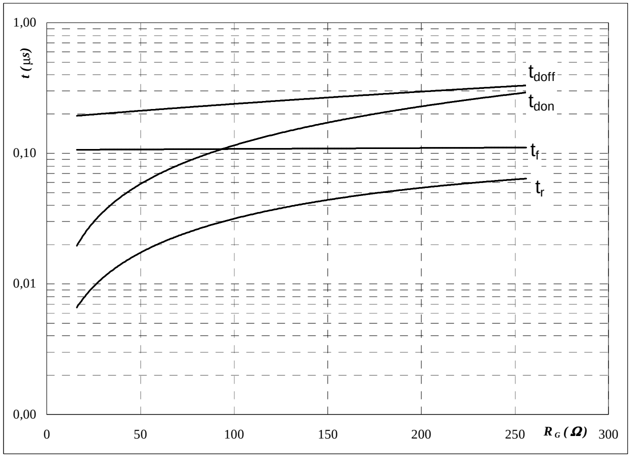
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 64 Ω
R_{goff} = 64 Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



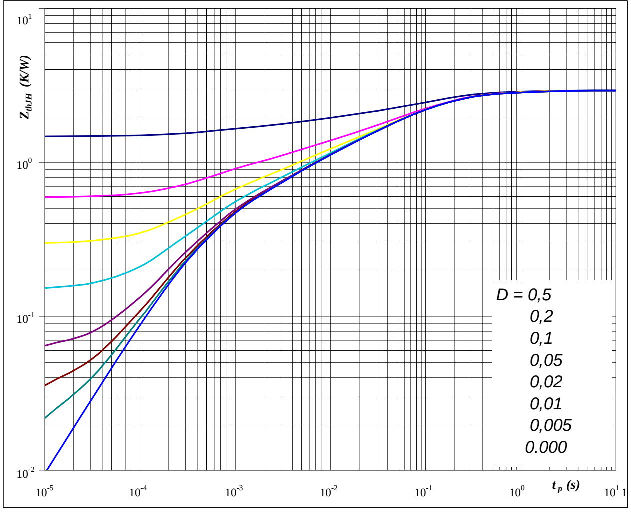
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 4 A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At $D = t_p / T$

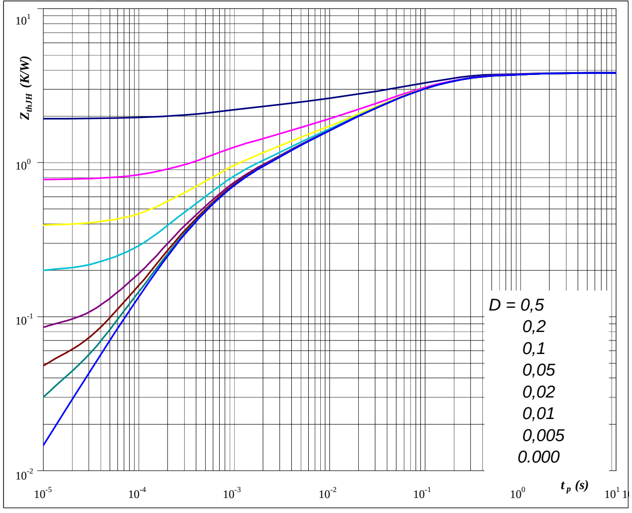
Thermal grease
R_{thJH} = 2,95 K/W

Phase change material
R_{thJH} = 2,56 K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At $D = t_p / T$

Thermal grease
R_{thJH} = 3,86 K/W

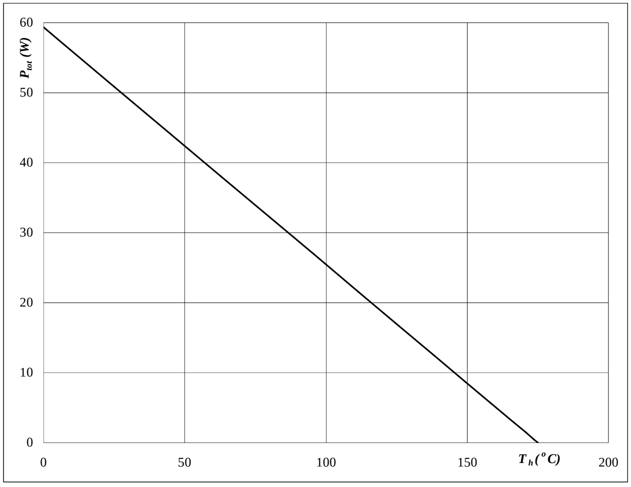
Phase change material
R_{thJH} = 3,38 K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



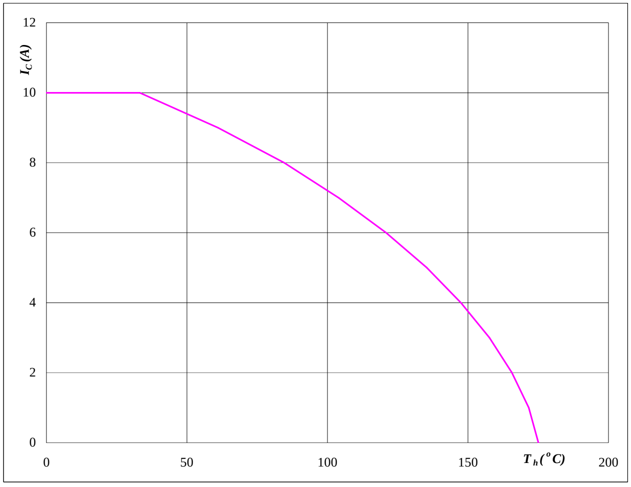
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

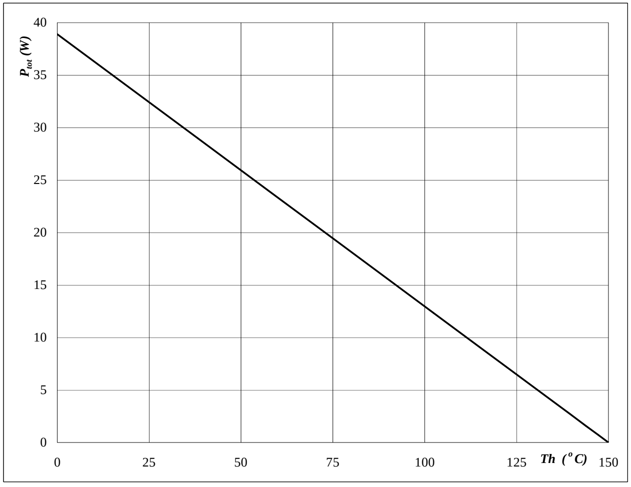
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



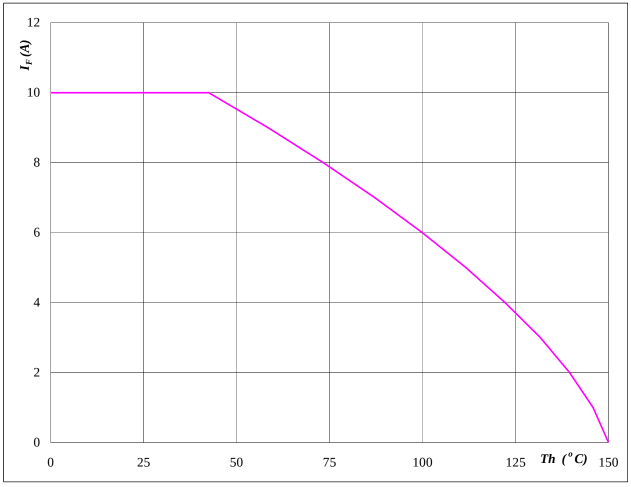
At

T_j = 150 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

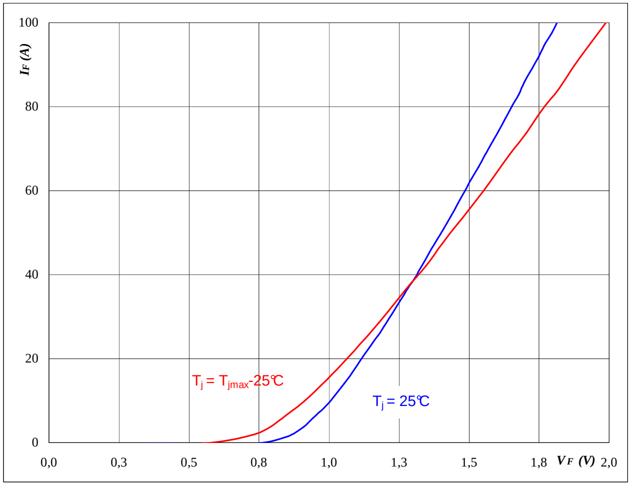
T_j = 150 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



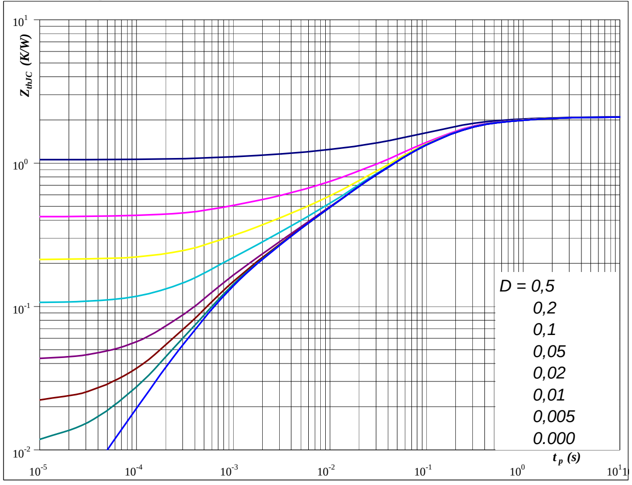
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



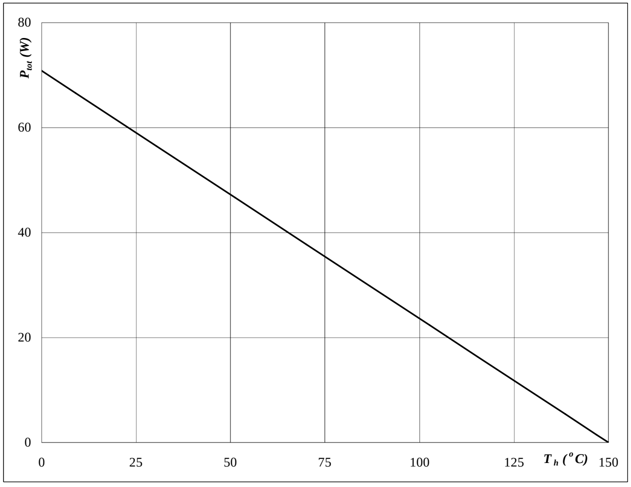
At $D = t_p / T$

Thermal grease			Phase change material		
R_{thJH} =	2,13	K/W	R_{thJH} =	1,83	K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



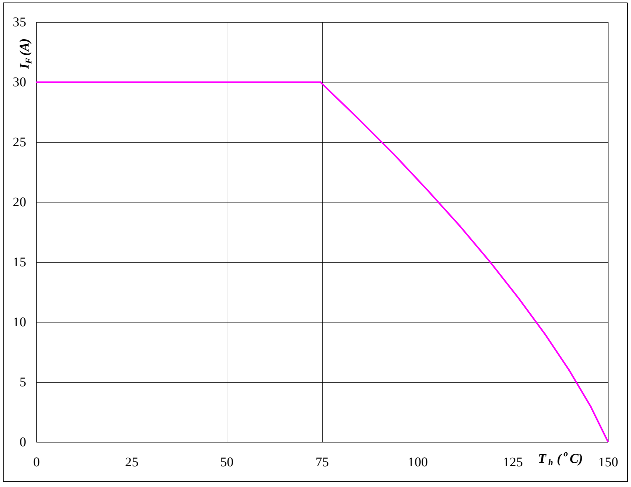
At

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
$R_T = f(T)$

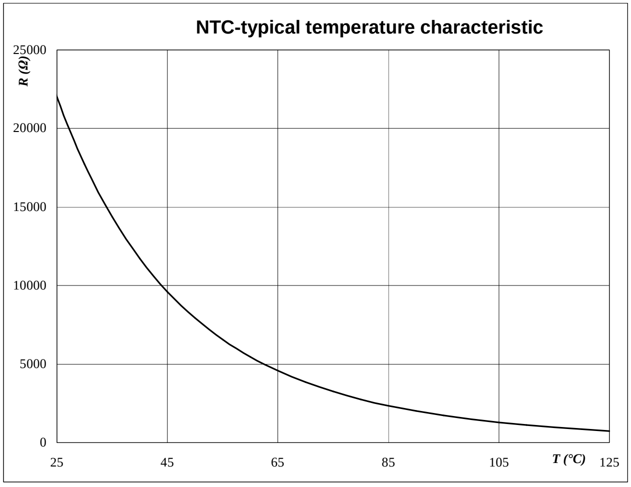


Figure 2 Thermistor

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

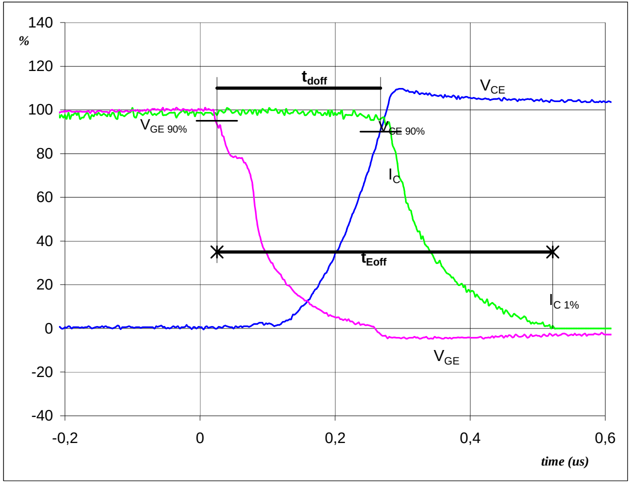
Switching Definitions Output Inverter

General conditions

T_j = 125 °C
R_{gon} = 32 Ω
R_{goff} = 32 Ω

Figure 1 Output inverter IGBT

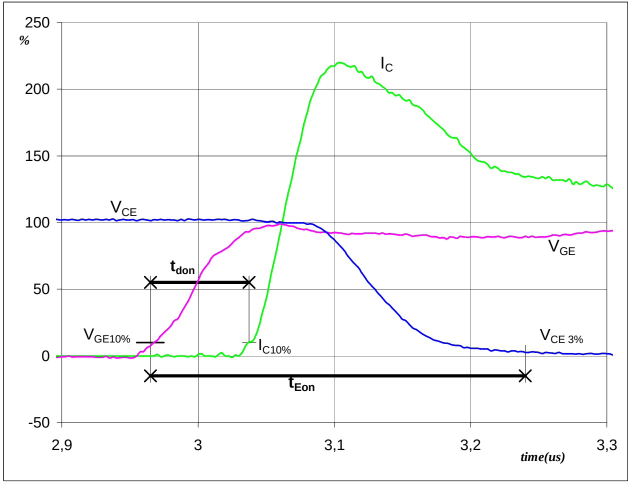
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) = -15 V
V_{GE} (100%) = 15 V
V_C (100%) = 600 V
I_C (100%) = 8 A
t_{doff} = 0,24 µs
$t_{E\,off}$ = 0,50 µs

Figure 2 Output inverter IGBT

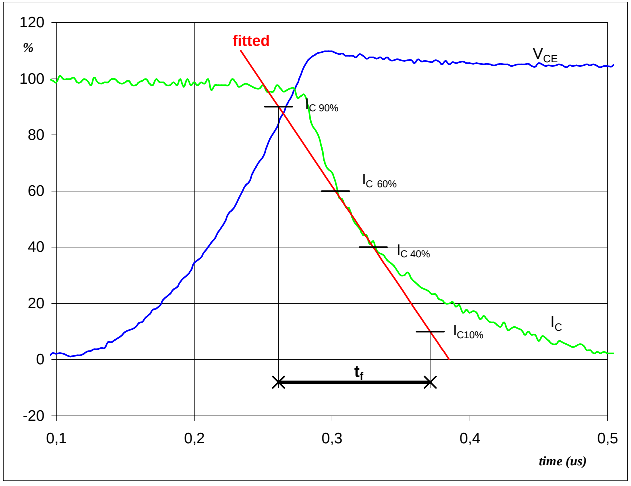
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) = -15 V
V_{GE} (100%) = 15 V
V_C (100%) = 600 V
I_C (100%) = 8 A
t_{don} = 0,07 µs
$t_{E\,on}$ = 0,27 µs

Figure 3 Output inverter IGBT

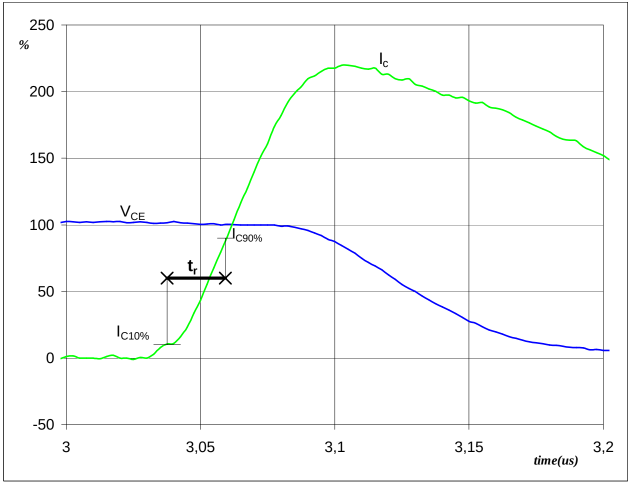
Turn-off Switching Waveforms & definition of t_f



V_C (100%) = 600 V
I_C (100%) = 8 A
t_f = 0,11 µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

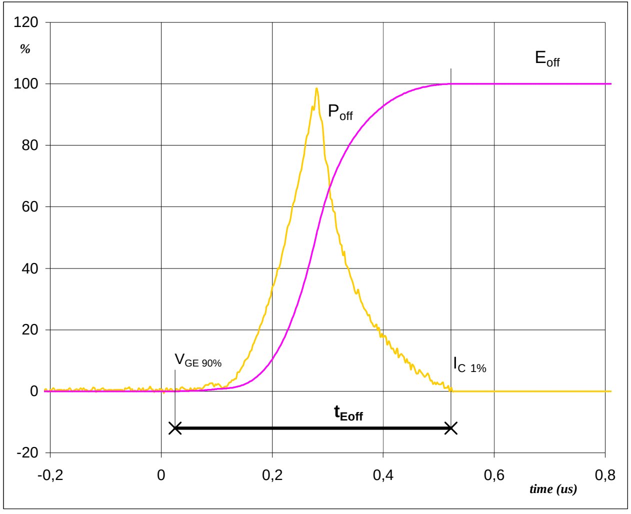


V_C (100%) = 600 V
I_C (100%) = 8 A
t_r = 0,02 µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

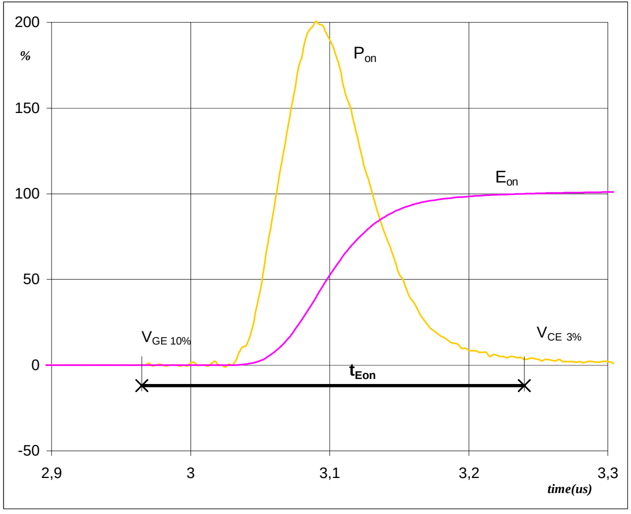
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) = 4,93 kW
E_{off} (100%) = 0,62 mJ
$t_{E\,off}$ = 0,50 μs

Figure 6 Output inverter IGBT

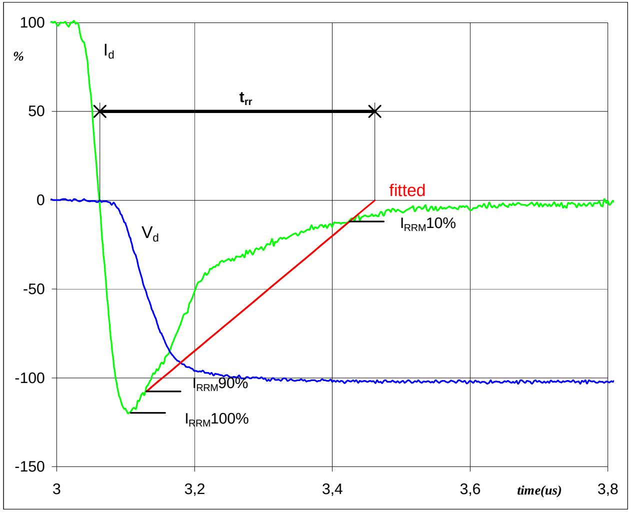
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) = 4,93 kW
E_{on} (100%) = 0,75 mJ
$t_{E\,on}$ = 0,27 μs

Figure 7 Output inverter FWD

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

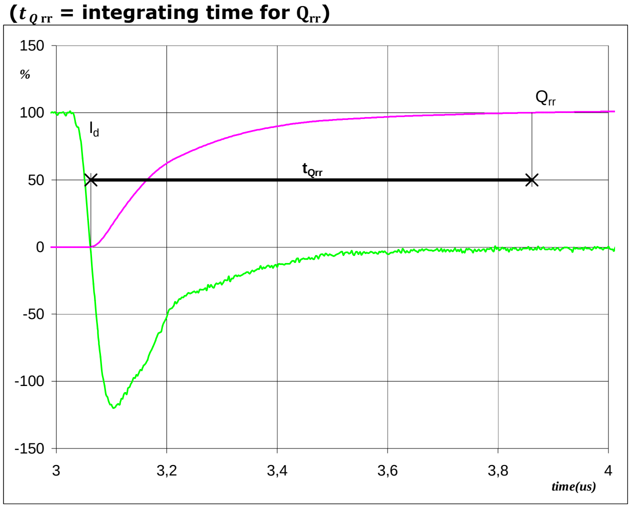


V_d (100%) = 600 V
I_d (100%) = 8 A
I_{RRM} (100%) = -10 A
t_{rr} = 0,38 μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

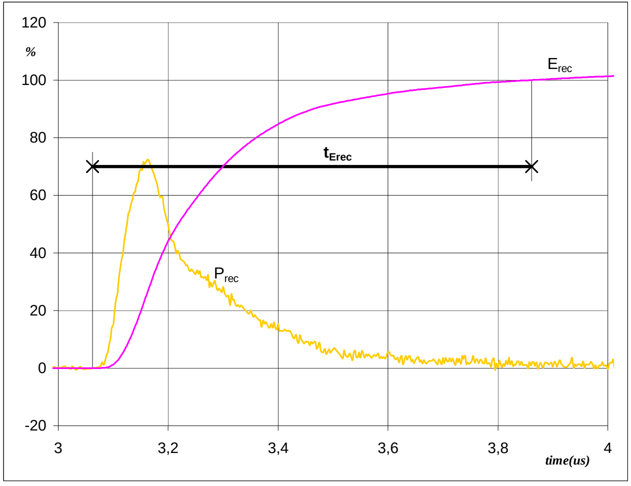
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) = 8 A
Q_{rr} (100%) = 1,57 µC
$t_{Q\,rr}$ = 0,80 µs

Figure 9 Output inverter FWD

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



P_{rec} (100%) = 4,93 kW
E_{rec} (100%) = 0,63 mJ
$t_{E\,rec}$ = 0,80 µs

Ordering Code and Marking - Outline - Pinout

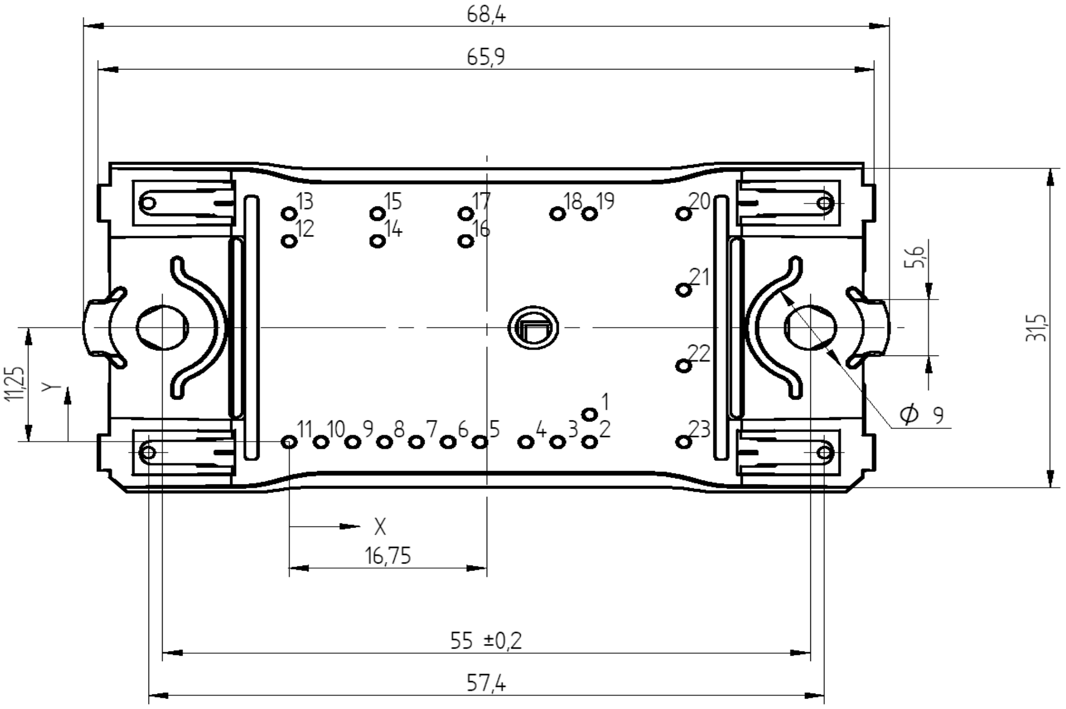
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	V23990-P849-A58-(opt.)-PM	P848-A58	P848-A58
without thermal paste 17mm housing	V23990-P848-A59-(opt.)-PM	P848-A59	P848-A59
without thermal paste 12mm housing	V23990-P848-C58-(opt.)-PM	P848-C58	P848-C58
without thermal paste 17mm housing	V23990-P848-C59-(opt.)-PM	P848-C59	P848-C59

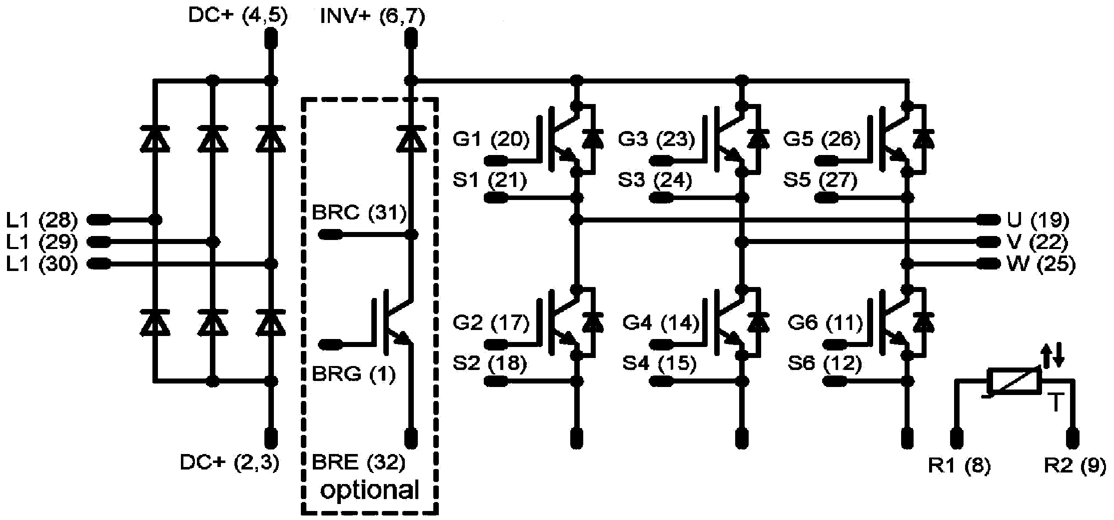
Outline

Pin table

Pin	X	Y
1	25,5	2,7
2	25,5	0
3	22,8	0
4	20,1	0
5	16,2	0
6	13,5	0
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.