V23990-P769-A60-PM
V23990-P769-A60Y-PM

datasheet

Vincotech

flow PIM 2	1200 V / 75 A

Features

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

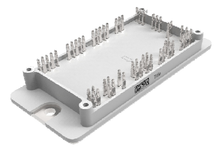
Target Applications

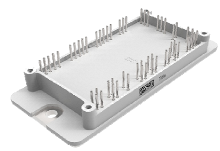
- Motor Drives
- Power Generation

Types

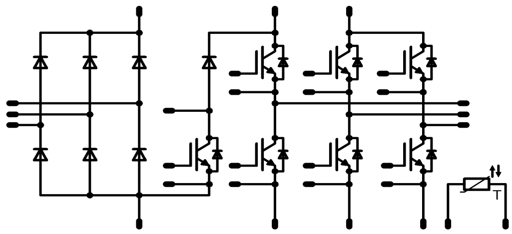
- V23990-P769-A60-PM
- V23990-P769-A60Y-PM

flow 2 housing





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	92	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	890	A
I2t-value	I^2t			3960	A^2s
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C	126	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	76	A
Pulsed collector current	I_{CRM}	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°C	172	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 850	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}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	67	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		150	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C	141	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	60	A
Pulsed collector current	I_{CRM}	t_p limited by $T_j$max		100	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		100	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C	150	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 850	μs V
Maximum Junction Temperature	T_{jmax}			175	°C
Brake Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	16	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		20	A
Brake Inverse Diode	P_{tot}	T_j=$T_j$max	T_h=80°C	69	W
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	28	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°C	86	W
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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				75	Tj=25°C Tj=125°C	1	1,24 1,26	1,8	V
Threshold voltage (for power loss calc. only)	V_{to}				75	Tj=25°C Tj=125°C		0,89 0,73		V
Slope resistance (for power loss calc. only)	r_t				75	Tj=25°C Tj=125°C		5 7		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,1	mA
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,55		K/W
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0075	Tj=25°C Tj=150°C	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		75	Tj=25°C Tj=150°C		1,82 2,18	2,15	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			260	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			500	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	600	75	Tj=25°C Tj=150°C		82,6 81,8		ns
Rise time	t_r					Tj=25°C Tj=150°C		15 18		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		157 203,8		
Fall time	t_f					Tj=25°C Tj=150°C		60,4 96,4		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		3,292 5,733		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		4,074 6,784		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		7500		pF
Output capacitance	C_{oss}							1500		
Reverse transfer capacitance	C_{rss}							130		
Gate charge	Q_G		±15			Tj=25°C		175		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,55		K/W
Inverter Diode										
Diode forward voltage	V_F				75	Tj=25°C Tj=150°C		2,67 2,18	3,3	V
Peak reverse recovery current	I_{RRM}	Rgoff=8 Ω	±15	600	75	Tj=25°C Tj=150°C		54,431 73,406		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		275,9 601,9		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		5,46 15,613		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=150°C		1767 625		A/µs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		2,378 7,286		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,67		K/W

Characteristic Values

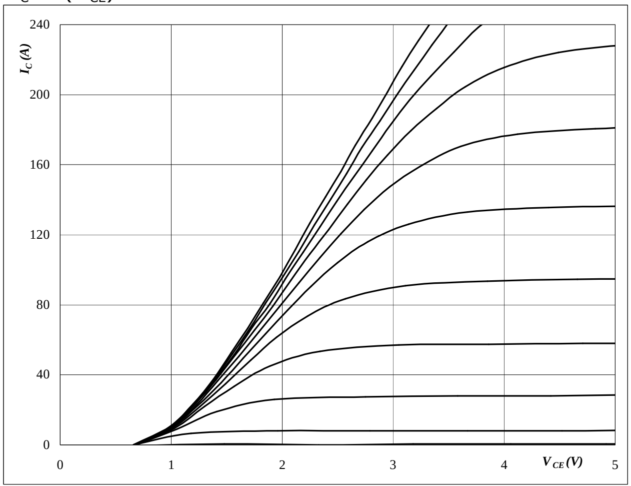
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Brake Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$		10	0,005	Tj=25°C Tj=150°C	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	Tj=25°C Tj=150°C	1,4	1,77 2,12	2,3	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			300	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			500	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	600	50	Tj=25°C Tj=150°C		60 60,8		ns
Rise time	t_r					Tj=25°C Tj=150°C		9,8 12,6		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		124 176		ns
Fall time	t_f					Tj=25°C Tj=150°C		47 80		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1,79 2,8		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		2,37 4,04		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		5000		pF
Output capacitance	C_{oss}							1000		pF
Reverse transfer capacitance	C_{rss}							80		pF
Gate charge	Q_G		15	600	50	Tj=25°C		117		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material ʎ=3,4W/mK						0,63		K/W
Brake Inverse Diode										
Diode forward voltage	V_F				10	Tj=25°C Tj=150°C	1,2	1,80 1,76	2,2	V
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material ʎ=3,4W/mK						1,38		K/W
Brake Diode										
Diode forward voltage	V_F				25	Tj=25°C Tj=150°C	1	2,24 2,36	2,9	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=150°C			60	µA
Peak reverse recovery current	I_{RRM}	Rgoff=16 Ω Rgoff=16 Ω	±15	600	50	Tj=25°C Tj=150°C		58 59,8		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		119 276		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		3,4 3,4		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=150°C		2926 1546		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		1,42 2,86		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material ʎ=3,4W/mK						1,1		K/W
Thermistor										
Rated resistance	R					T=25°C		21511		Ω
Deviation of R100	$\Delta_{R/R}$	R100=1486 Ω				T=25°C	-4,5		+4,5	%
Power dissipation	P					T=25°C		210		mW
Power dissipation constant						T=25°C		3,5		mW/K
B-value	$B_{(25/50)}$					T=25°C		3884		K
B-value	$B_{(25/100)}$					T=25°C		3964		K
Vincotech NTC Reference									F	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



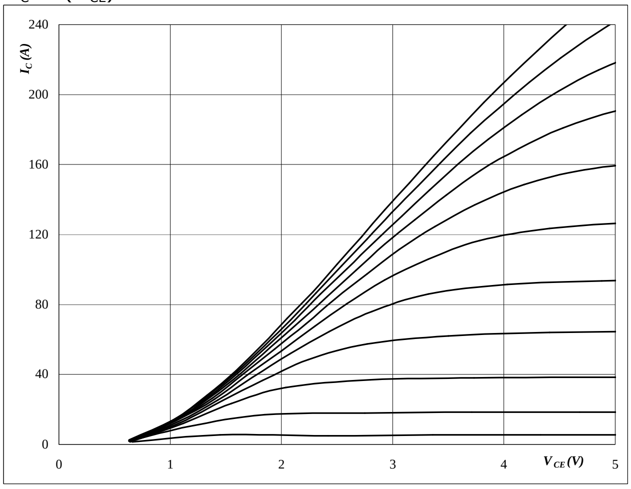
At

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

$I_C = f(V_{CE})$



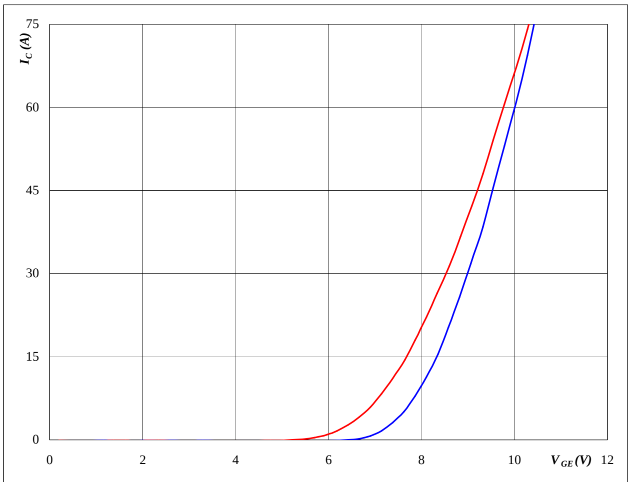
At

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

$I_C = f(V_{GE})$



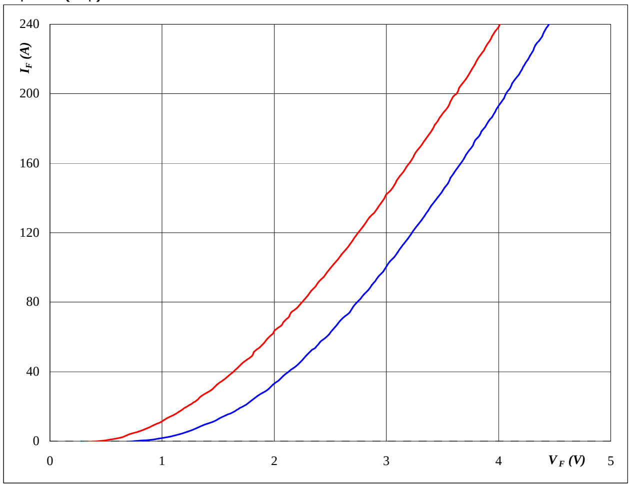
At

T_j =	25/150	°C
t_p =	250	µs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

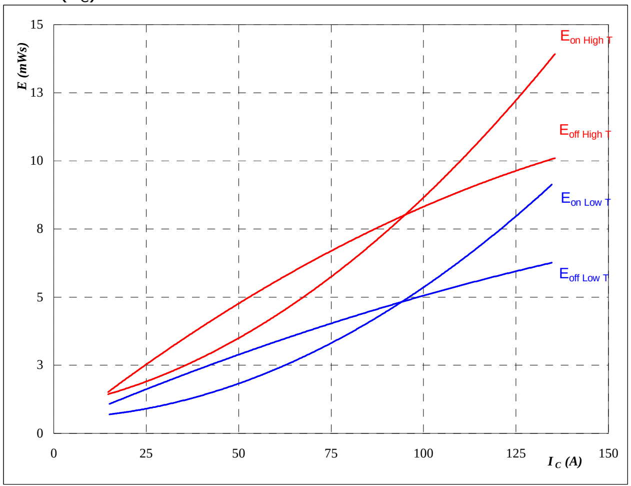
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



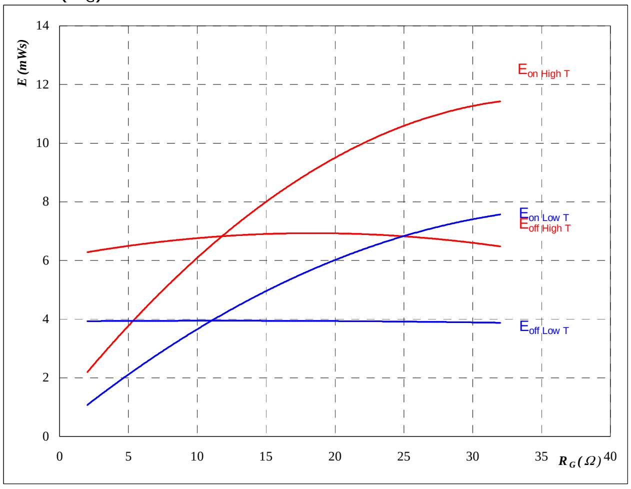
With an inductive load at

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

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



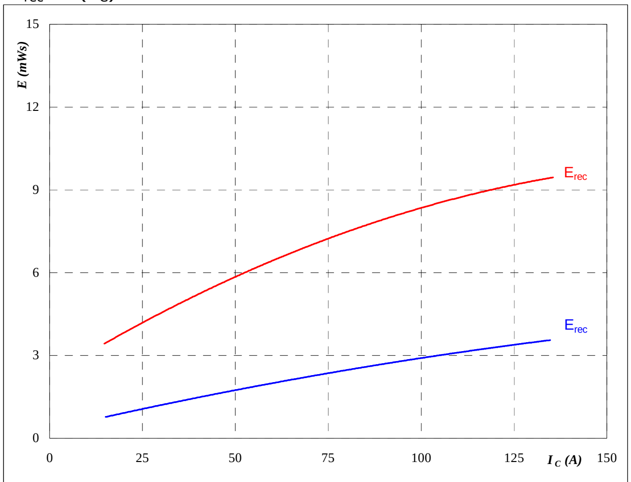
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	75	A

Figure 7 Output inverter FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



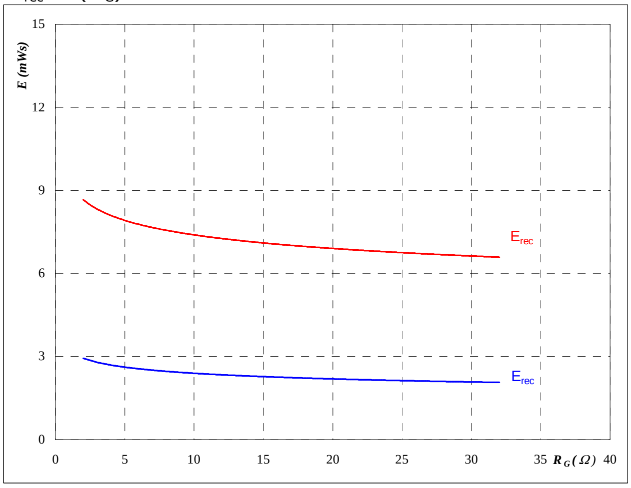
With an inductive load at

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

Figure 8 Output inverter FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

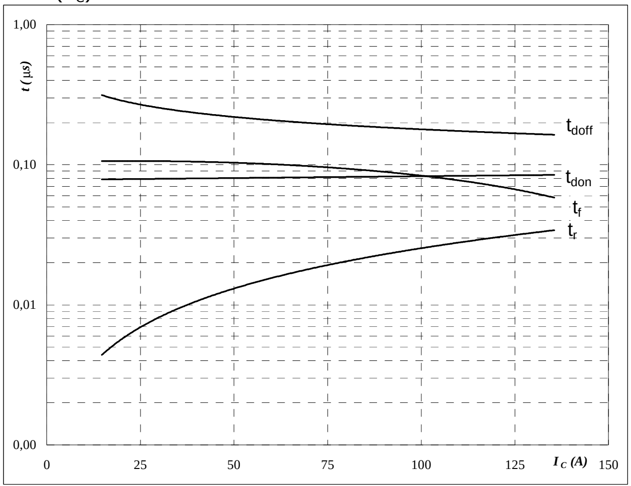
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	75	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



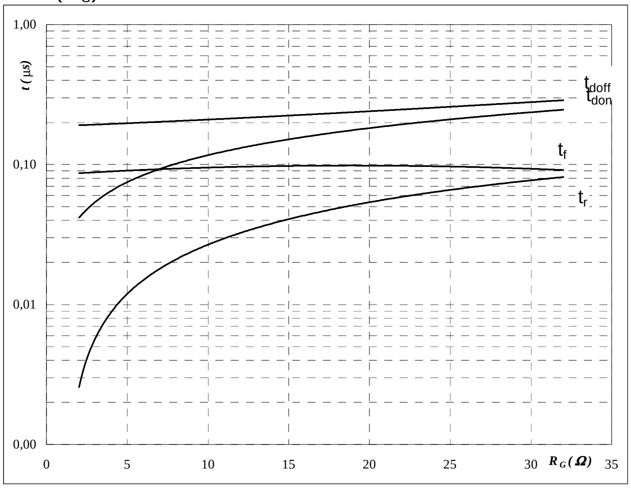
With an inductive load at

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

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



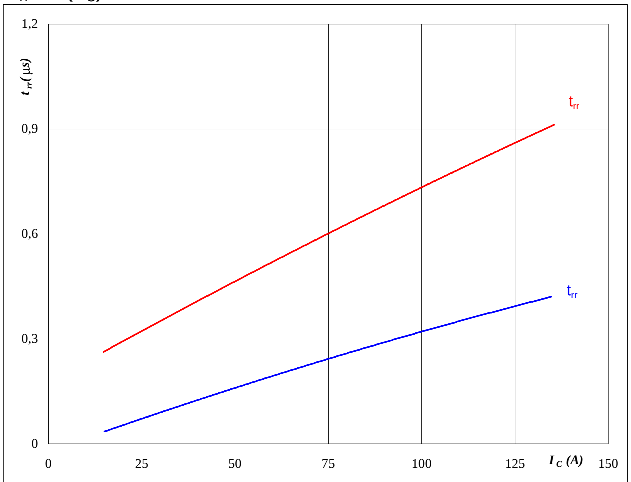
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	75	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



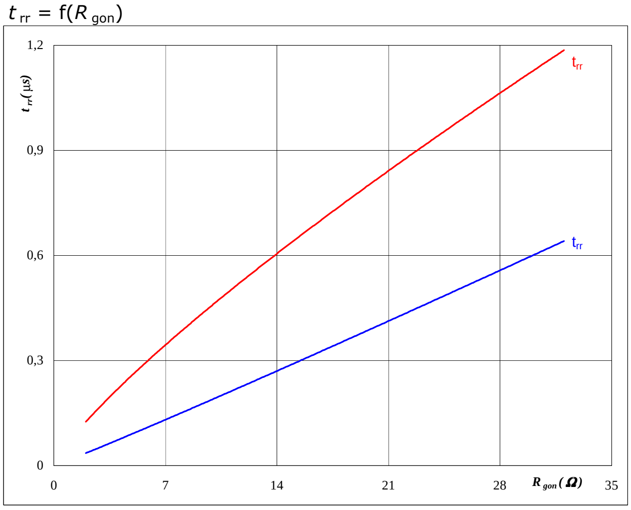
At

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

Figure 12 Output inverter FWD

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

t_{rr} = f(R_{gon})



At

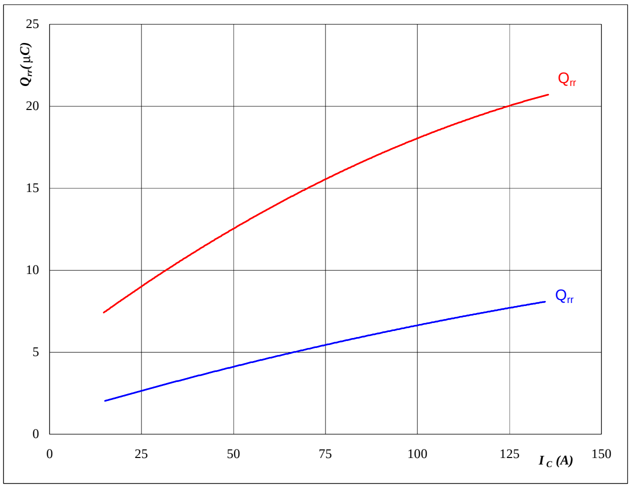
T_j =	25/150	°C
V_R =	600	V
I_F =	75	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



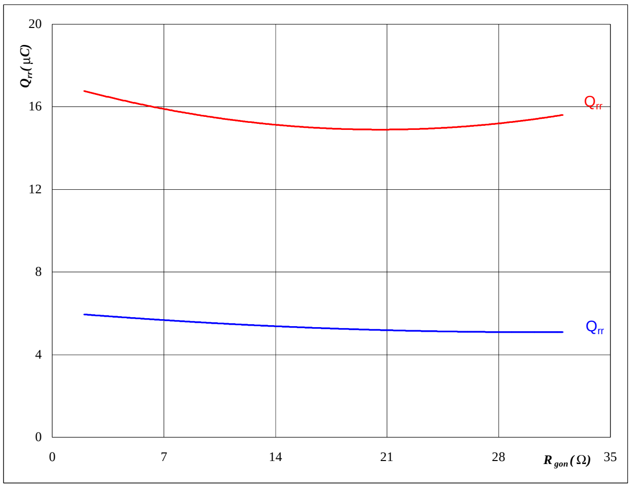
At

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

Figure 14 Output inverter FWD

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

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



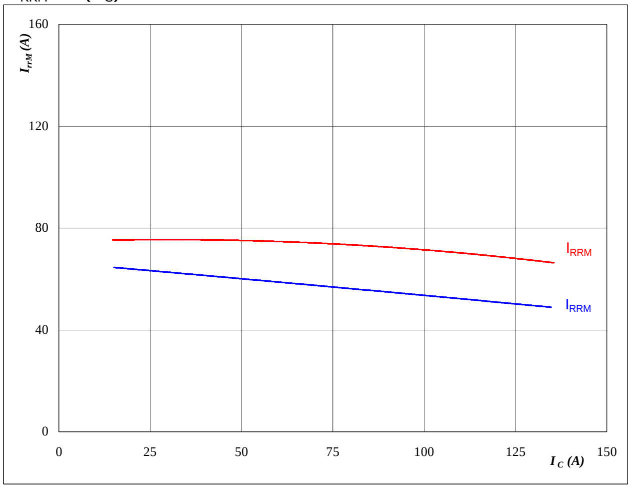
At

T_j =	25/150	°C
V_R =	600	V
I_F =	75	A
V_{GE} =	±15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



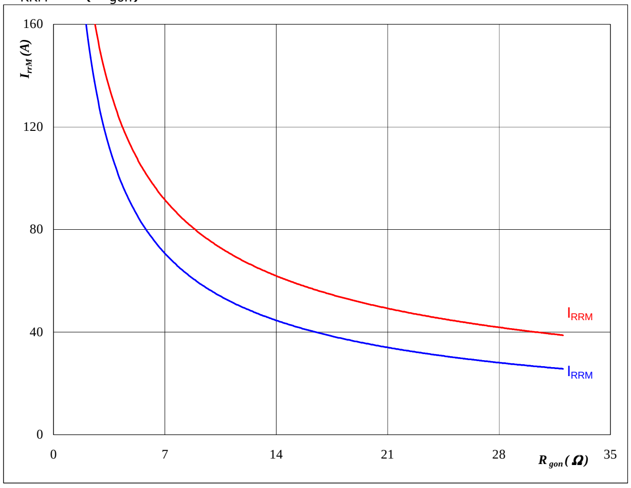
At

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

Figure 16 Output inverter FWD

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

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



At

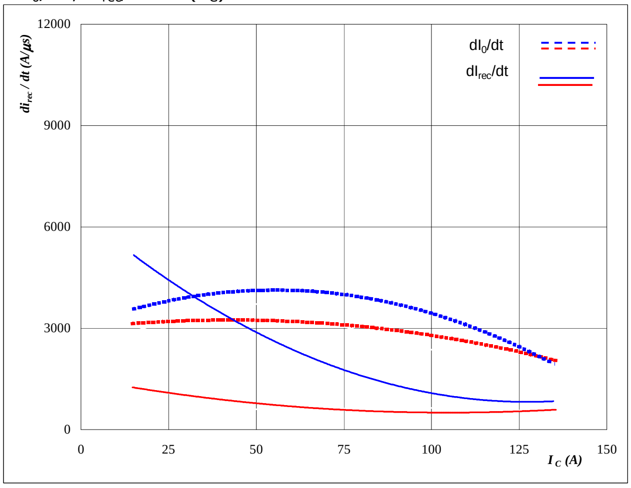
T_j =	25/150	°C
V_R =	600	V
I_F =	75	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



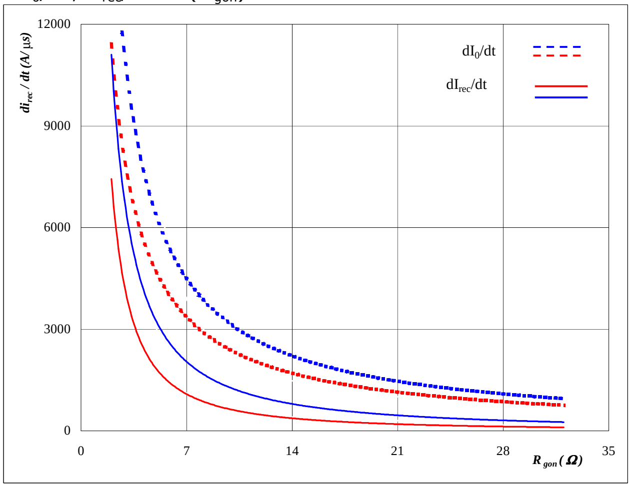
At

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

Figure 18 Output inverter FWD

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

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



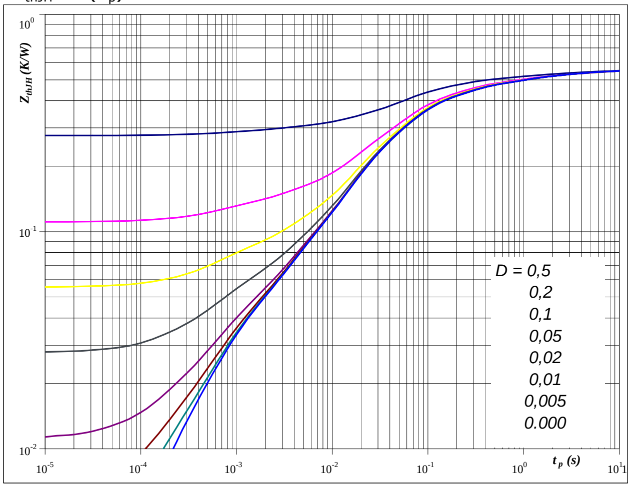
At

T_j =	25/150	°C
V_R =	600	V
I_F =	75	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,55	K/W

IGBT thermal model values

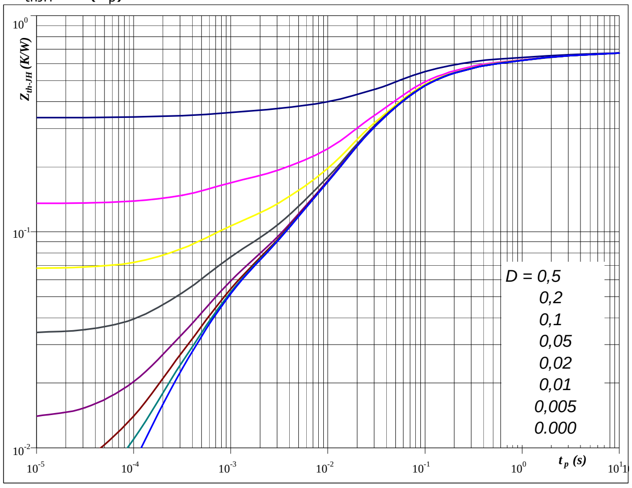
Phase Change Materi

R (K/W)	Tau (s)
0,05	3,6E+00
0,07	7,0E-01
0,15	1,3E-01
0,22	3,3E-02
0,03	8,1E-03
0,03	7,8E-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} =	0,67	K/W

FWD thermal model values

Phase Change Materi

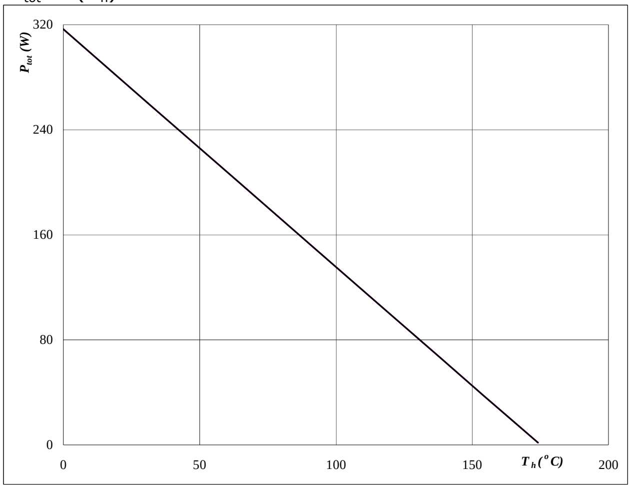
R (K/W)	Tau (s)
0,05	3,9E+00
0,08	6,6E-01
0,20	1,1E-01
0,28	3,0E-02
0,04	4,4E-03
0,04	5,5E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



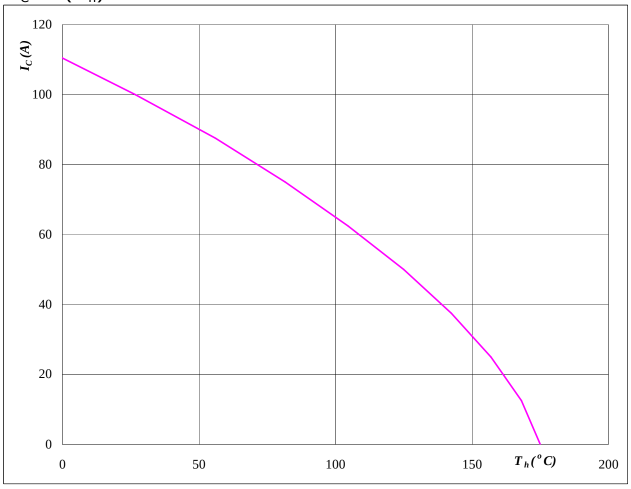
At

T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

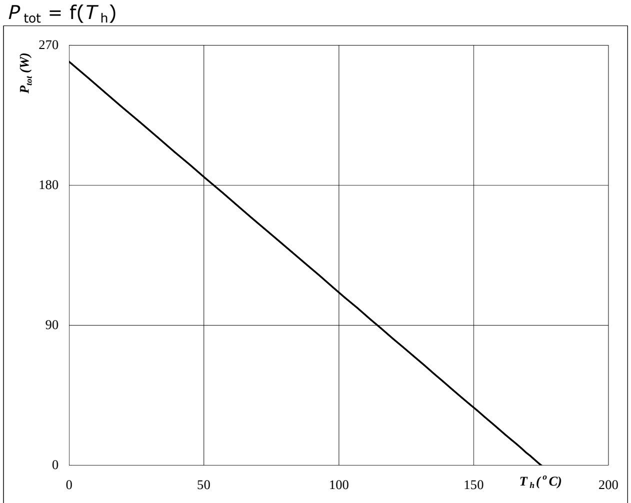
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



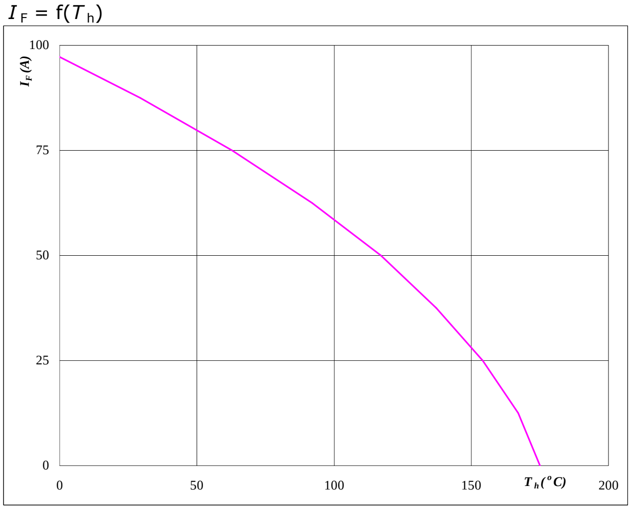
At

T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

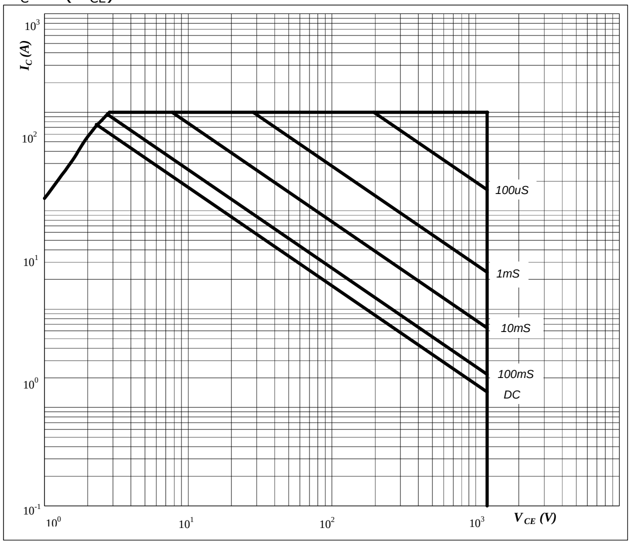
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



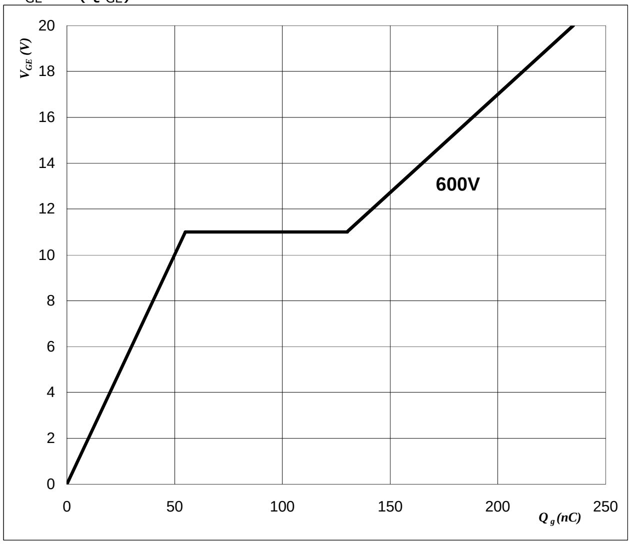
At

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

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



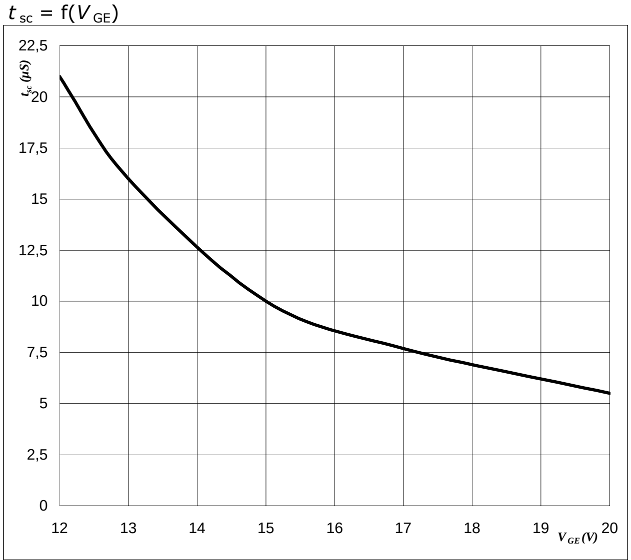
At

I_C =	75	A

Figure 27 Output inverter IGBT

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

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



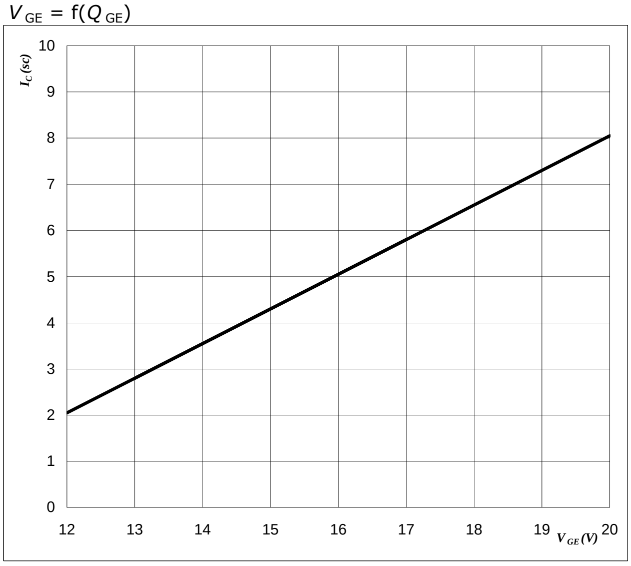
At

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

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



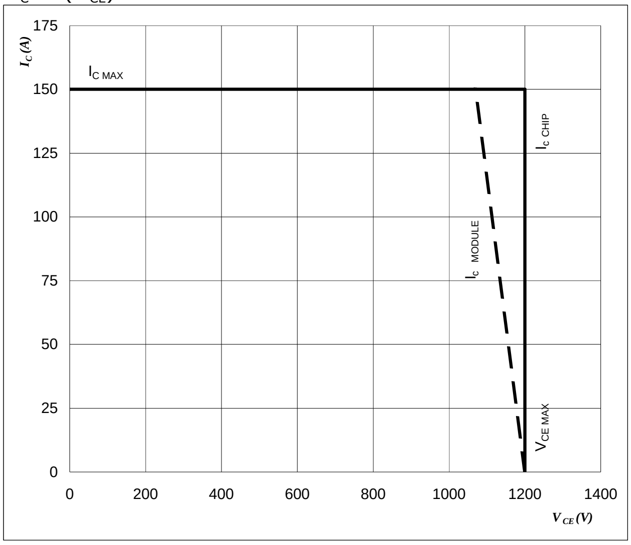
At

V_{CE} ≤	1200	V
T_j =	175	ºC

Figure 29 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 150 °C

R_{gon} = 7,9 Ω

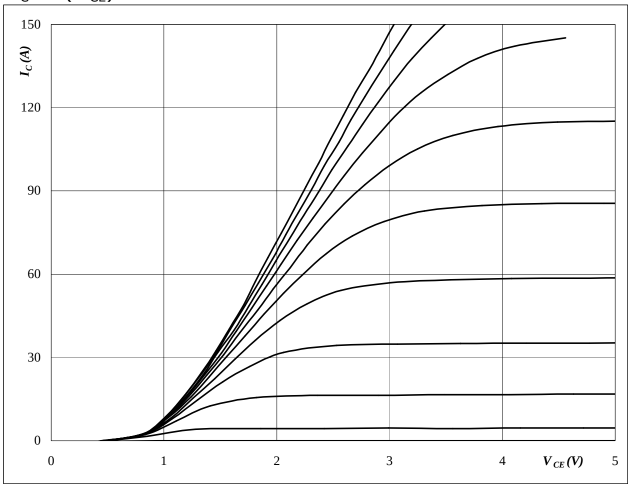
R_{goff} = 8 Ω

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

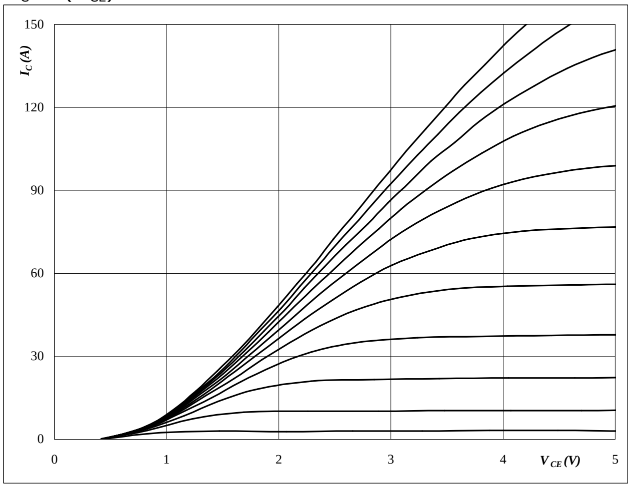
T_j = 25 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

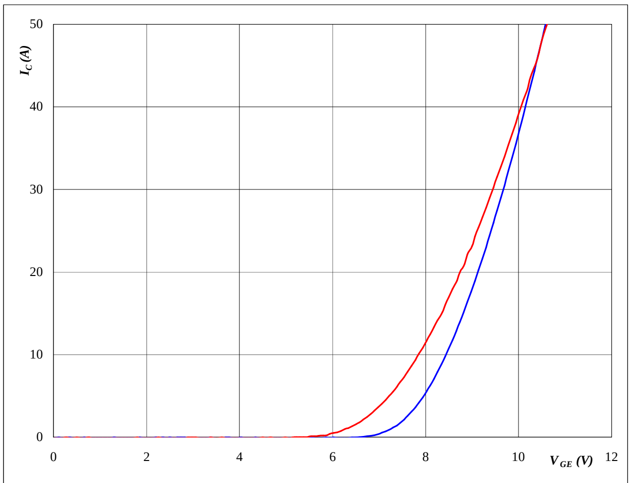
T_j = 149 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

T_j = 25/150 °C

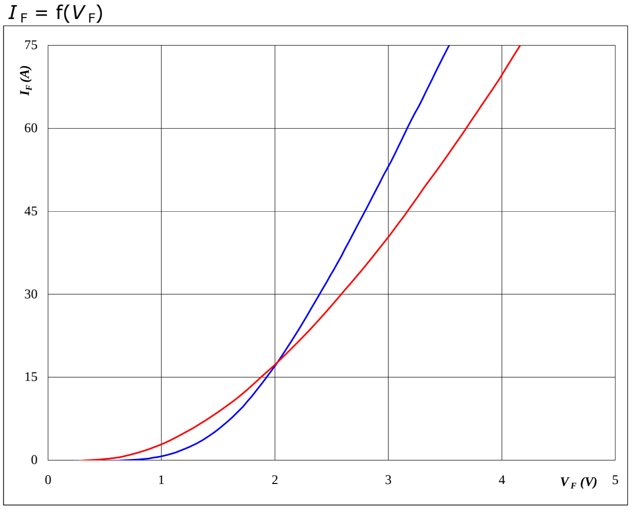
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

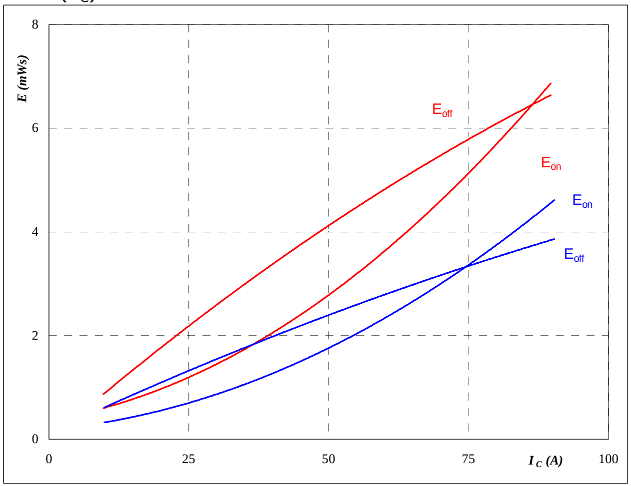
t_p = 250 µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



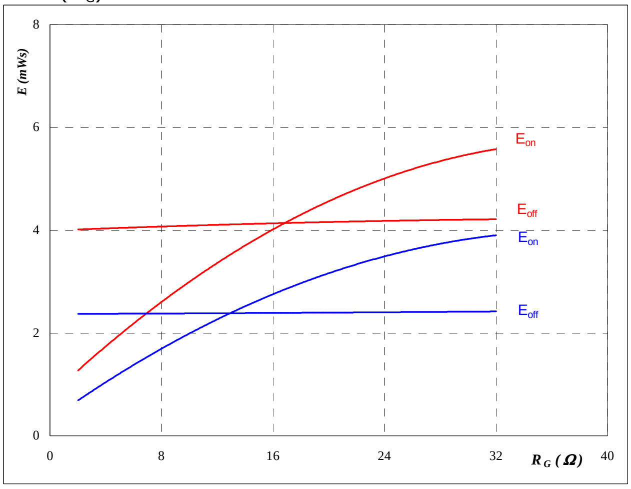
With an inductive load at

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

Figure 6 Brake IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



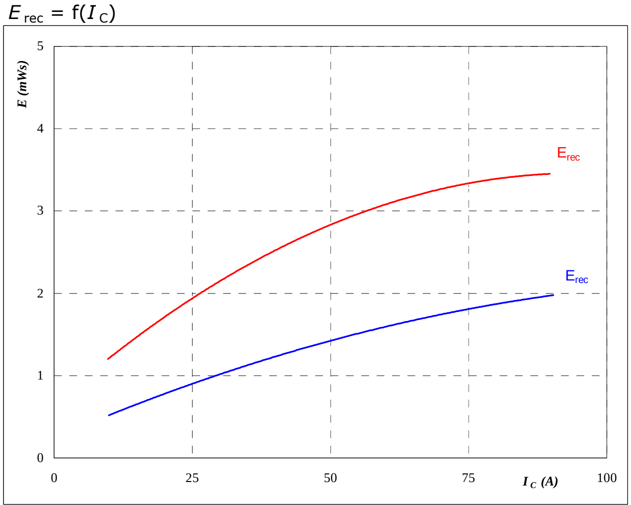
With an inductive load at

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

Figure 7 Brake FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



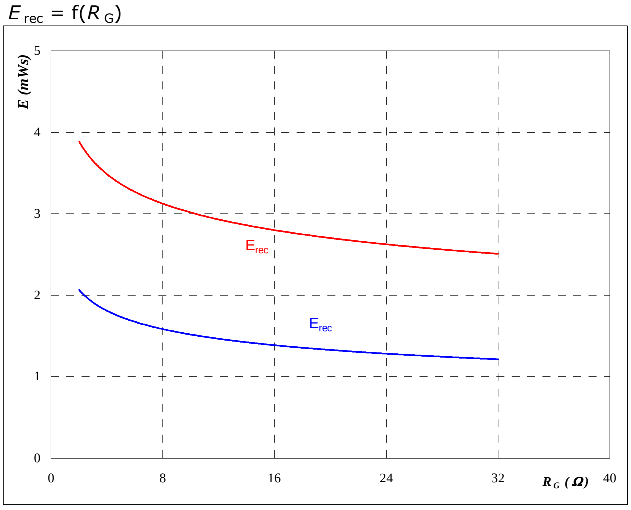
With an inductive load at

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

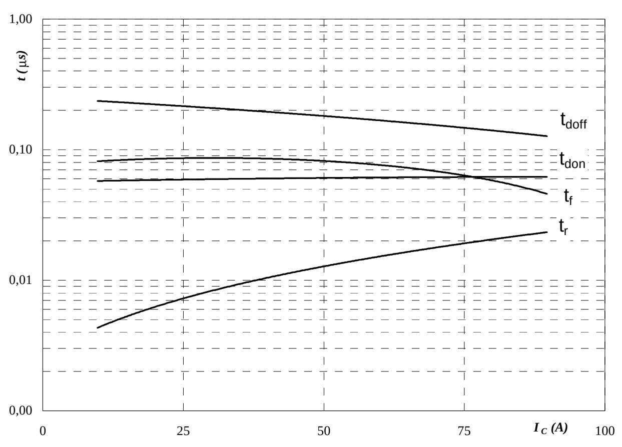
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



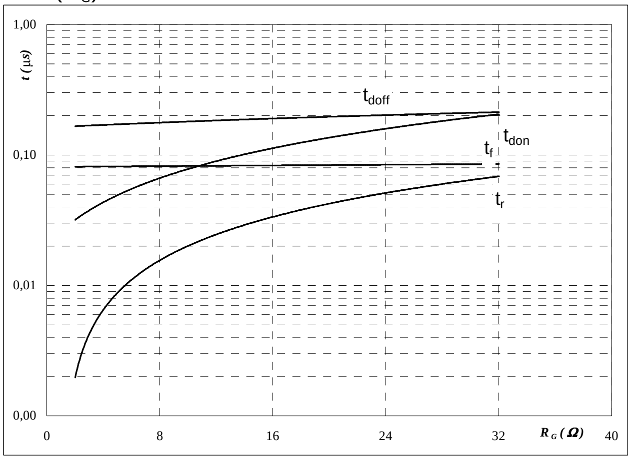
With an inductive load at

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

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



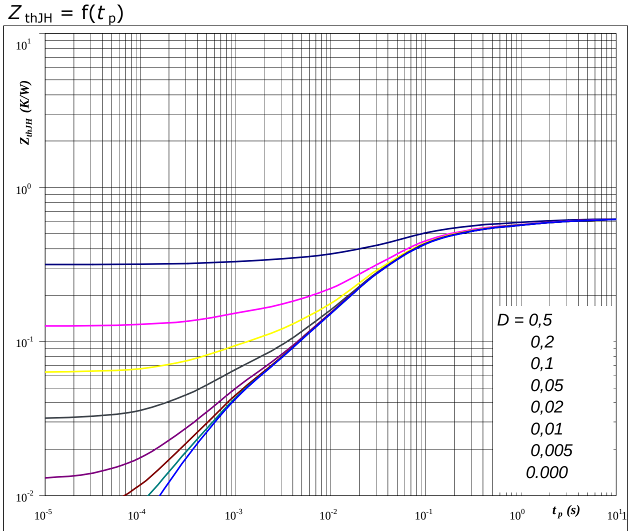
With an inductive load at

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

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

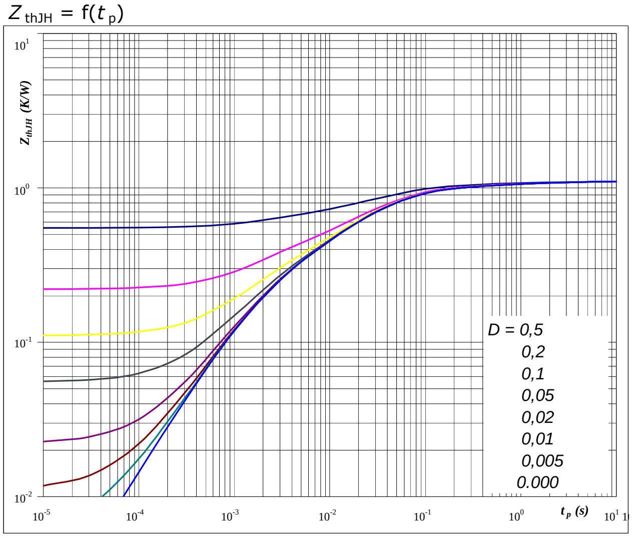


At	D =	t_p / T
Phase Change Material		
R_{thJH} =	0,63	K/W

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



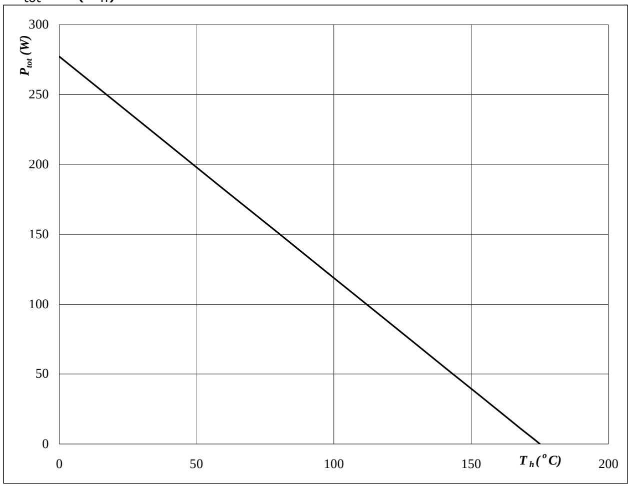
At	D =	t_p / T
Phase Change Material		
R_{thJH} =	1,10	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



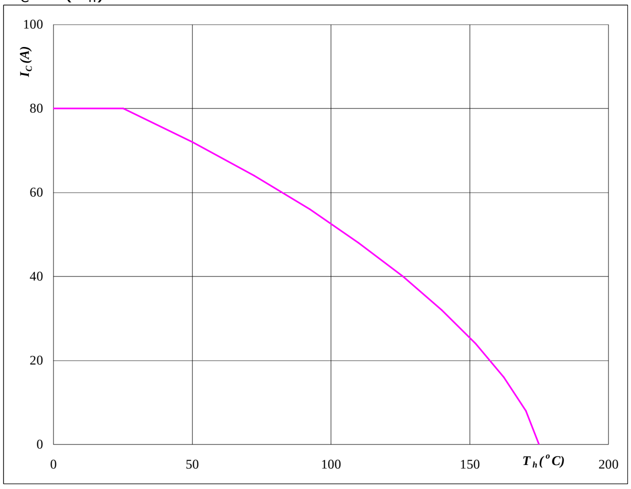
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

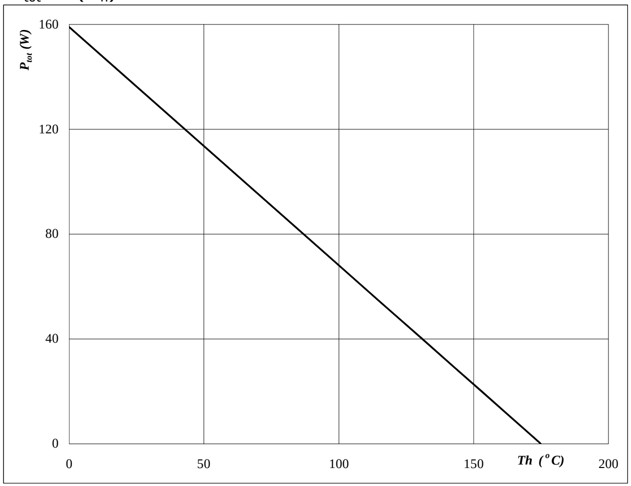
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



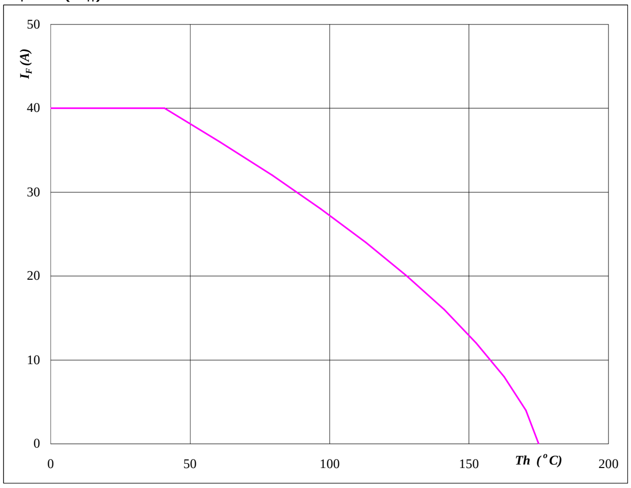
At

T_j = 175 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

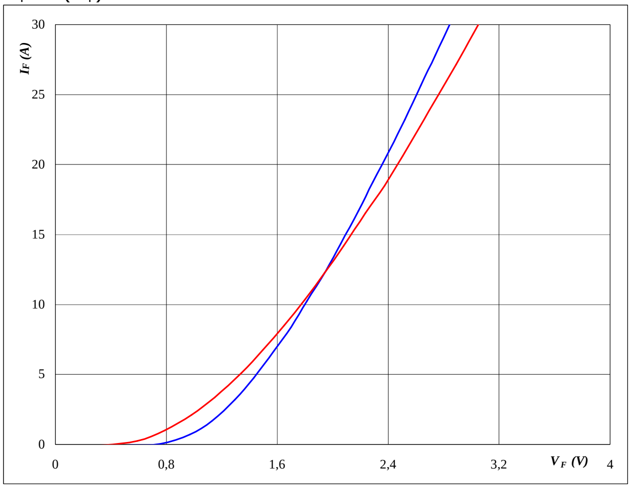
T_j = 175 ºC

Brake Inverse Diode

Figure 1 Brake inverse diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



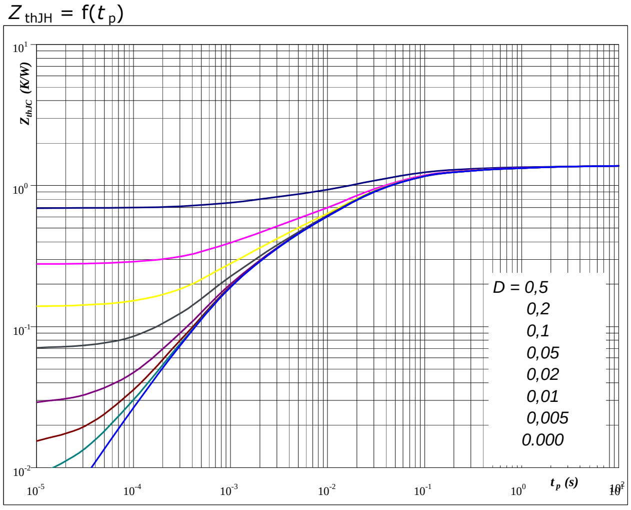
At

T_j =	25/150	°C
t_p =	250	μs

Figure 2 Brake inverse diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At $D = t_p / T$

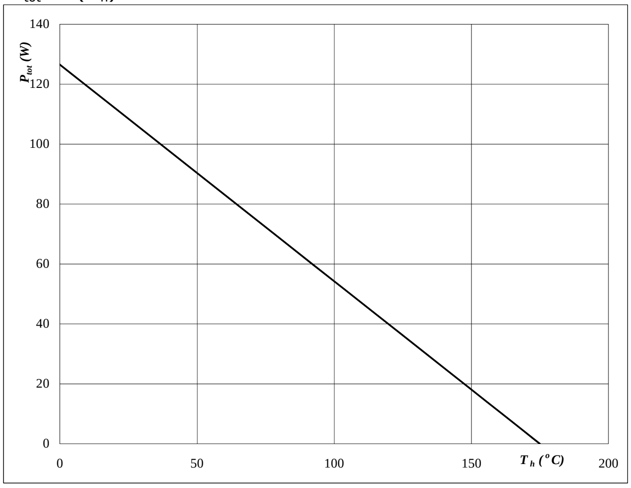
Phase Change Materia

R_{thJH} =	1,38	K/W

Figure 3 Brake inverse diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



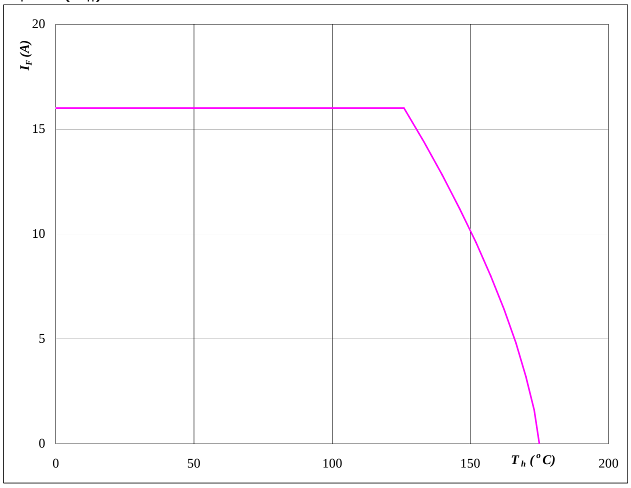
At

T_j =	150	ºC

Figure 4 Brake inverse diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

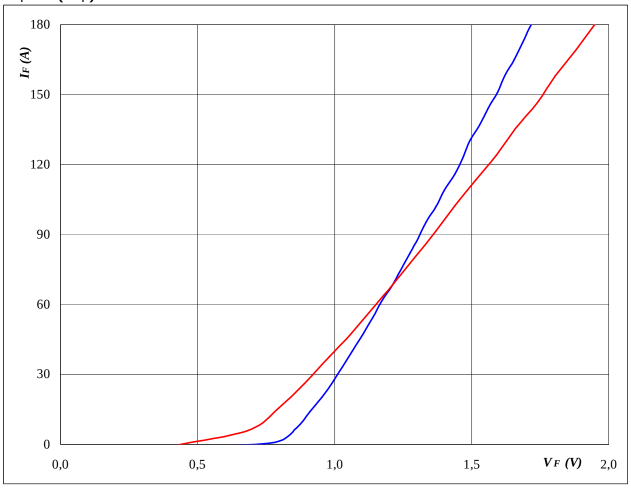
T_j =	150	ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

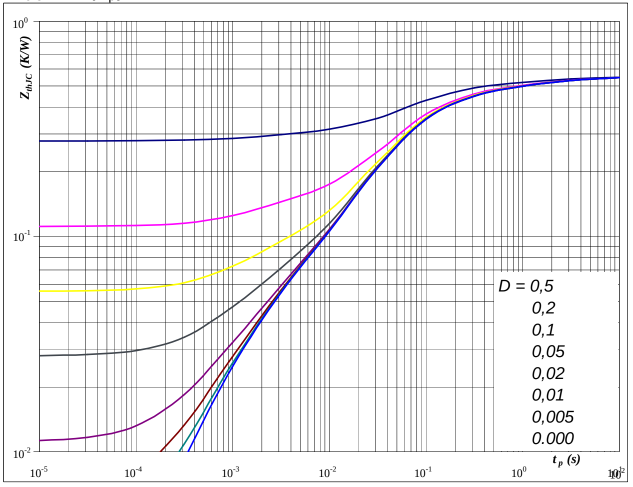
T_j = 25/125 °C

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

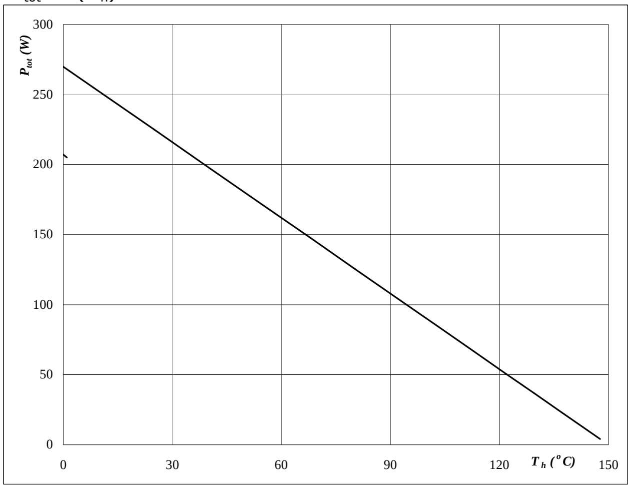
$D = t_p / T$

R_{thJH} = 0,56 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



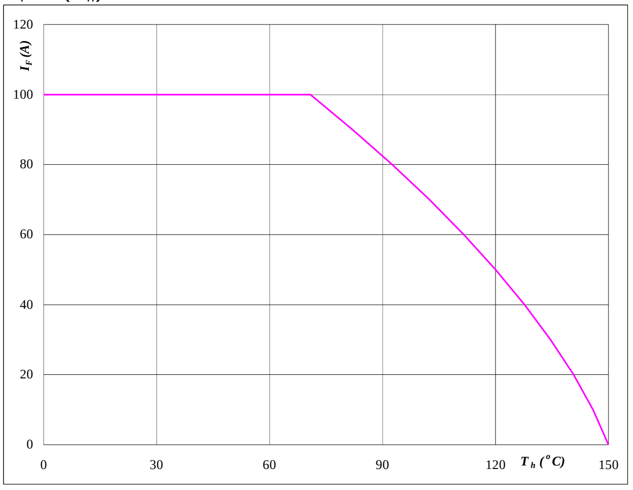
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$

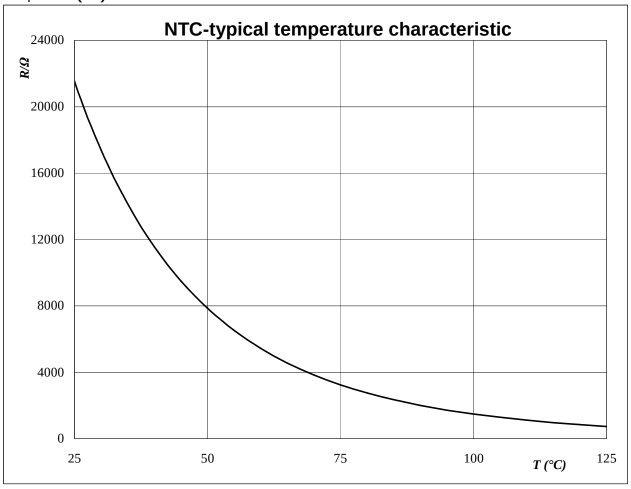


Figure 2 Thermistor

Typical NTC resistance values

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

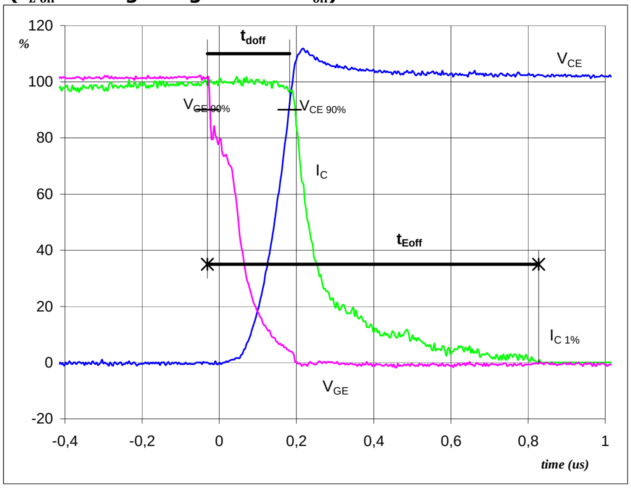
Switching Definitions Output Inverter

General conditions

T_j	=	**150 °C**
R_{gon}	=	**7,9 Ω**
R_{goff}	=	**8 Ω**

Figure 1 Output inverter IGBT

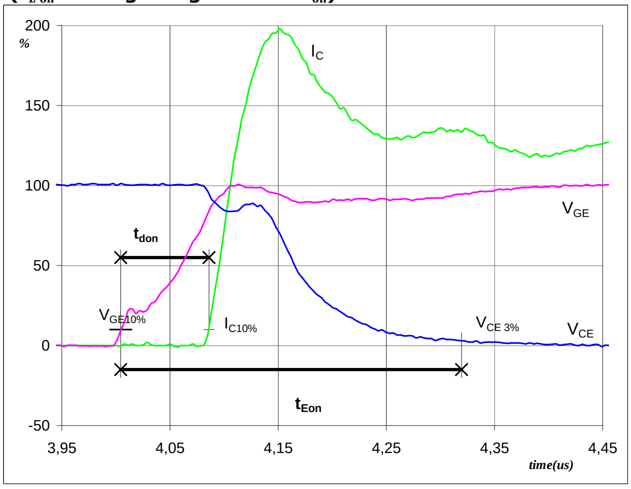
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\ off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	75	A
t_{doff} =	0,20	µs
$t_{E\ off}$ =	0,86	µs

Figure 2 Output inverter IGBT

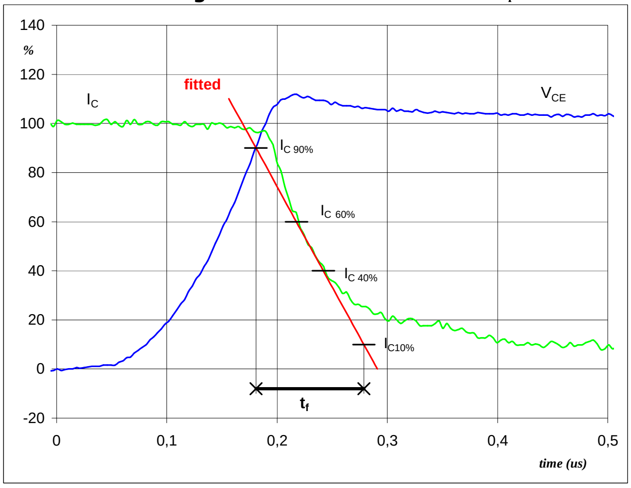
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\ on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	75	A
t_{don} =	0,08	µs
$t_{E\ on}$ =	0,31	µs

Figure 3 Output inverter IGBT

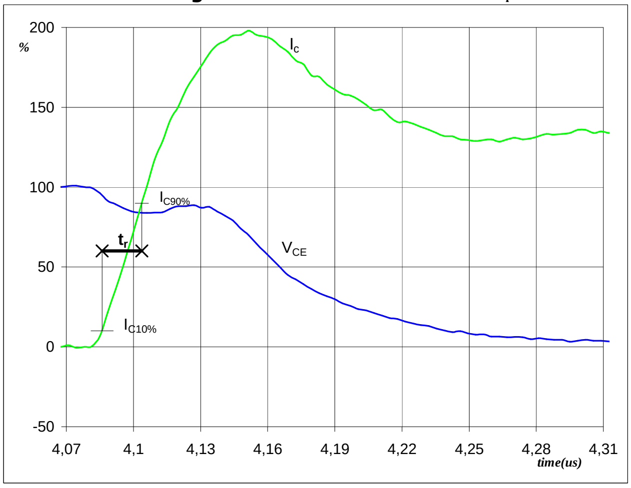
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	75	A
t_f =	0,096	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

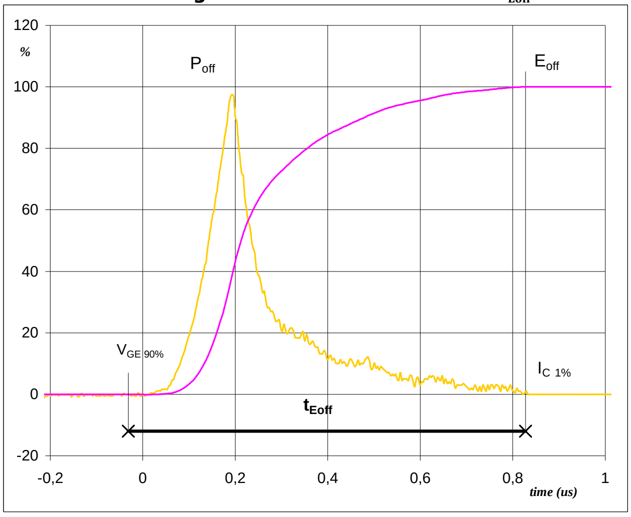


V_C (100%) =	600	V
I_C (100%) =	75	A
t_r =	0,018	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

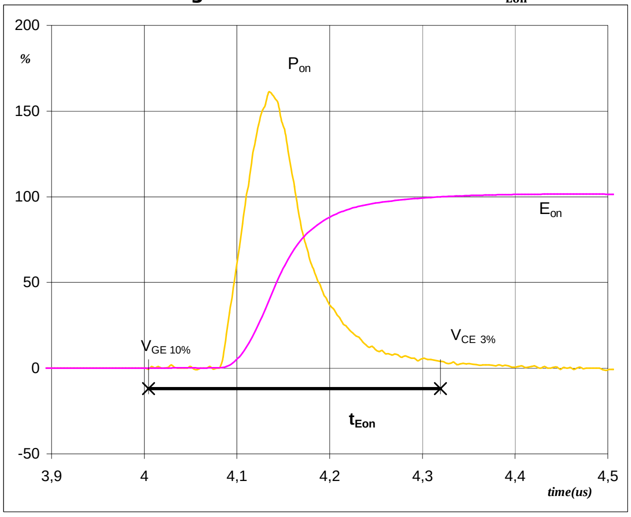
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	44,94	kW
E_{off} (100%) =	6,78	mJ
$t_{E\ off}$ =	0,86	μs

Figure 6 Output inverter IGBT

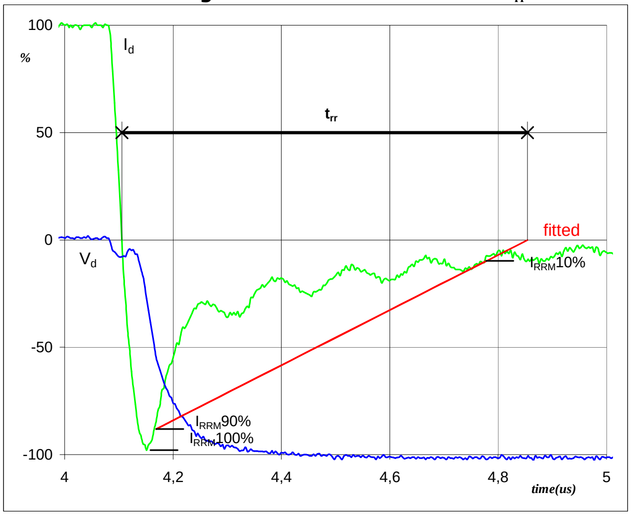
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	44,94	kW
E_{on} (100%) =	5,73	mJ
$t_{E\ on}$ =	0,31	μs

Figure 7 Output inverter FWD

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

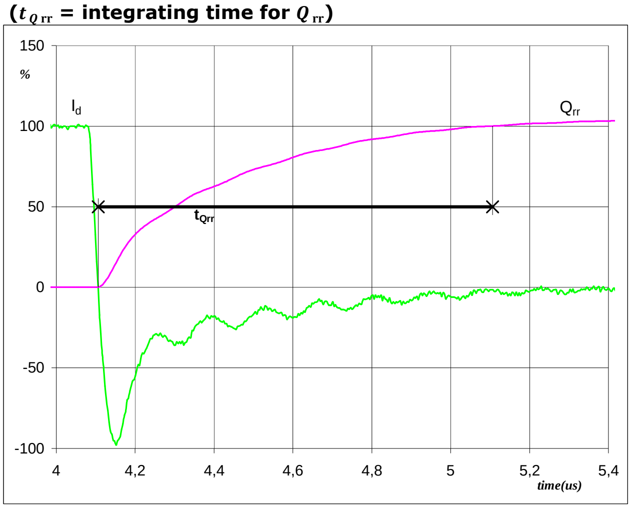


V_d (100%) =	600	V
I_d (100%) =	75	A
I_{RRM} (100%) =	-73	A
t_{rr} =	0,60	μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

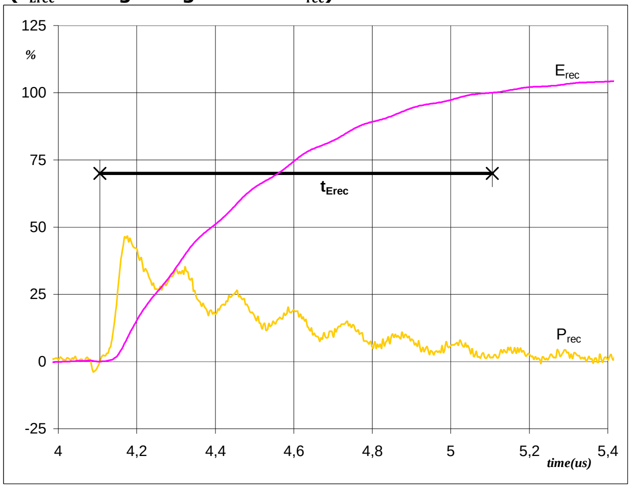
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	75	A
Q_{rr} (100%) =	15,61	µC
$t_{Q\,rr}$ =	1,00	µs

Figure 9 Output inverter FWD

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



P_{rec} (100%) =	44,94	kW
E_{rec} (100%) =	7,29	mJ
$t_{E\,rec}$ =	1,00	µs

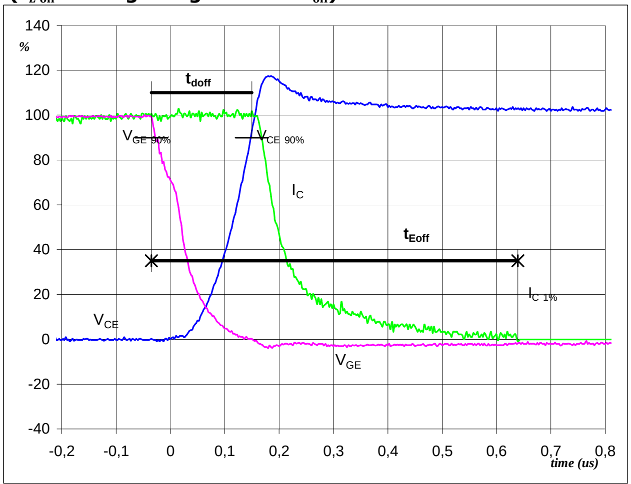
Switching Definitions Brake

General conditions

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

Figure 1 PFC MOSFET / IGBT

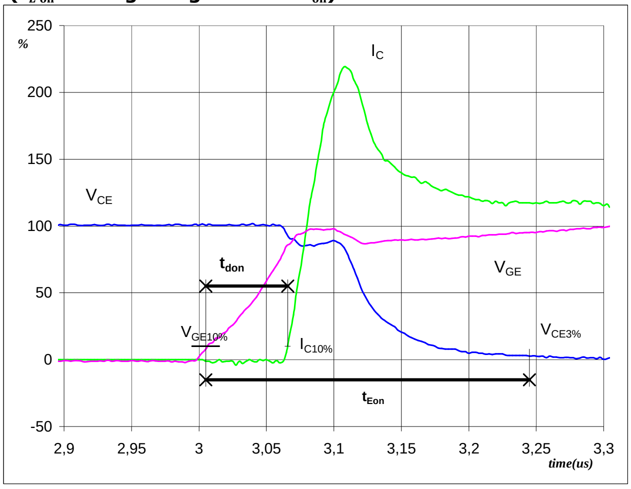
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} ($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,18	µs
$t_{E\,off}$ =	0,67	µs

Figure 2 PFC MOSFET / IGBT

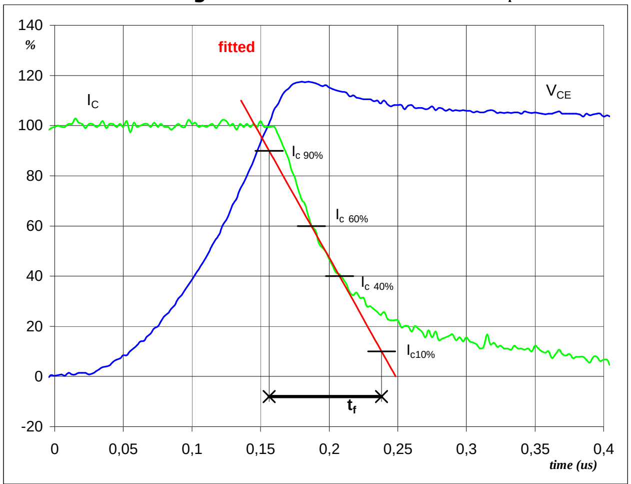
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} ($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{don} =	0,06	µs
$t_{E\,on}$ =	0,24	µs

Figure 3 PFC MOSFET / IGBT

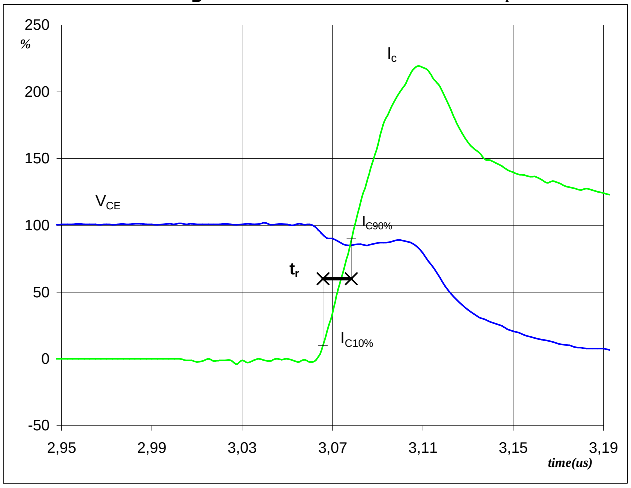
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	50	A
t_f =	0,08	µs

Figure 4 PFC MOSFET / IGBT

Turn-on Switching Waveforms & definition of t_r

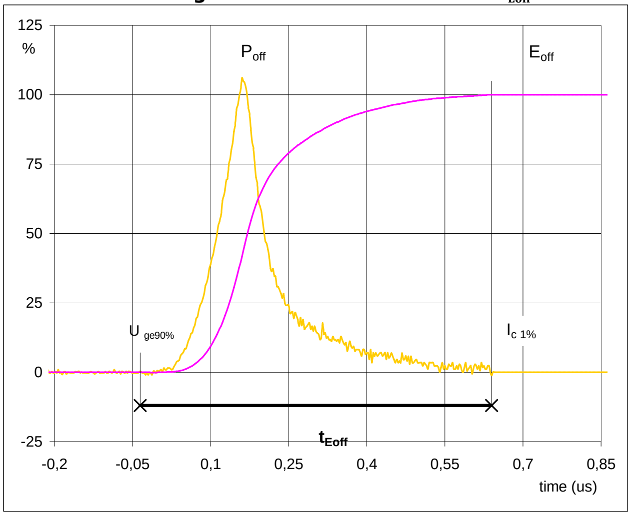


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,01	µs

Switching Definitions Brake

Figure 5 PFC MOSFET / IGBT

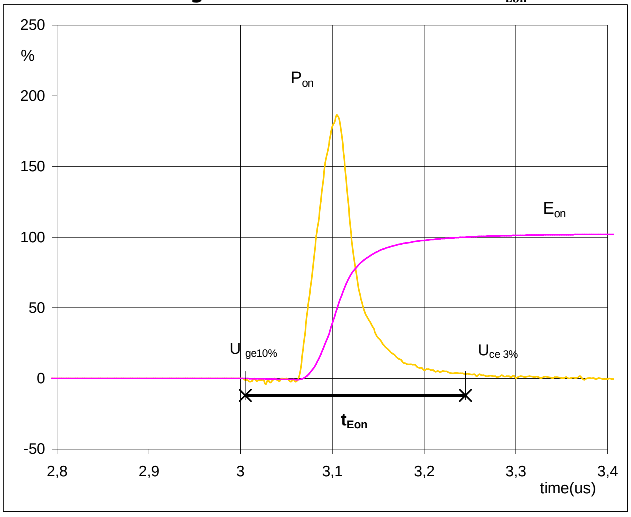
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	30,05	kW
E_{off} (100%) =	4,04	mJ
$t_{E\,off}$ =	0,67	μs

Figure 6 PFC MOSFET / IGBT

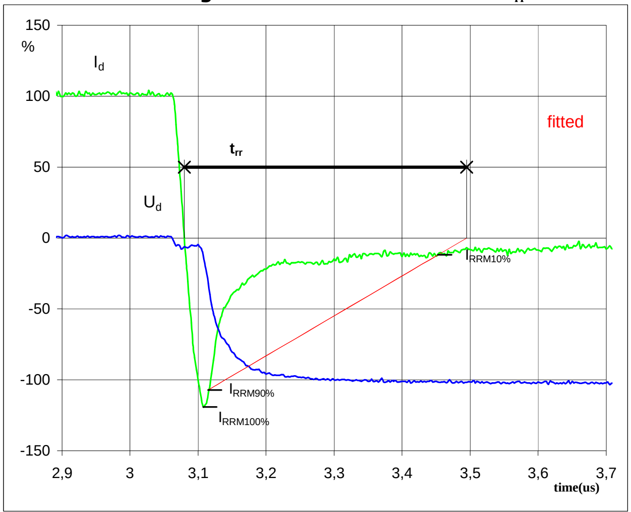
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	30,0456	kW
E_{on} (100%) =	2,80	mJ
$t_{E\,on}$ =	0,24	μs

Figure 7 PFC FWD

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

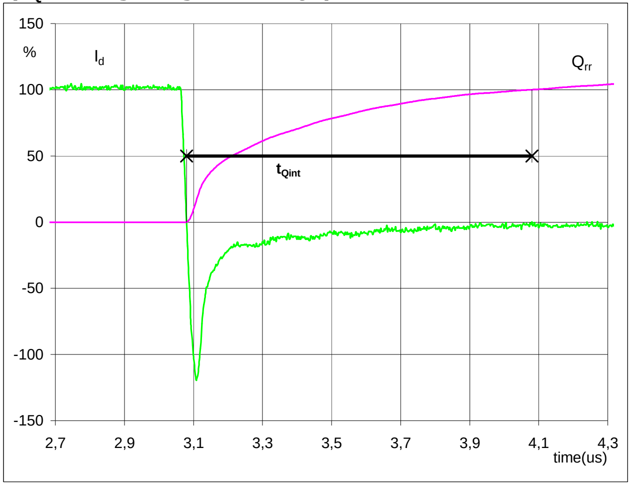


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-60	A
t_{rr} =	0,28	μs

Switching Definitions Brake

Figure 8 PFC FWD

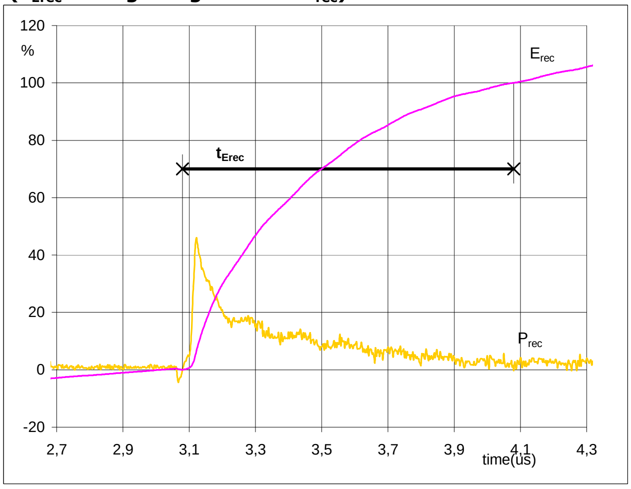
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	6,52	µC
t_{Qint} =	1,00	µs

Figure 9 PFC FWD

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



P_{rec} (100%) =	30,05	kW
E_{rec} (100%) =	2,86	mJ
$t_{E\,rec}$ =	1,00	µs

Ordering Code and Marking - Outline - Pinout

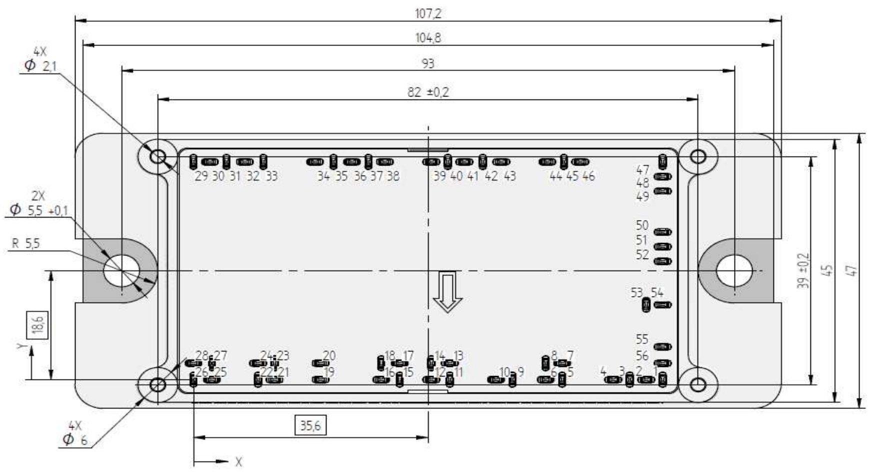
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste with solder pins	V23990-P769-A60-PM	P769A60	P769A60
without thermal paste with Press-fit pins	V23990-P769-A60Y-PM	P769A60Y	P769A60Y
with thermal paste and solder pins	V23990-P769-A60-/3/-PM	P769A60	P769A60-/3/
with thermal paste and Press-fit pins	V23990-P769-A60Y-/3/-PM	P769A60Y	P769A60Y-/3/

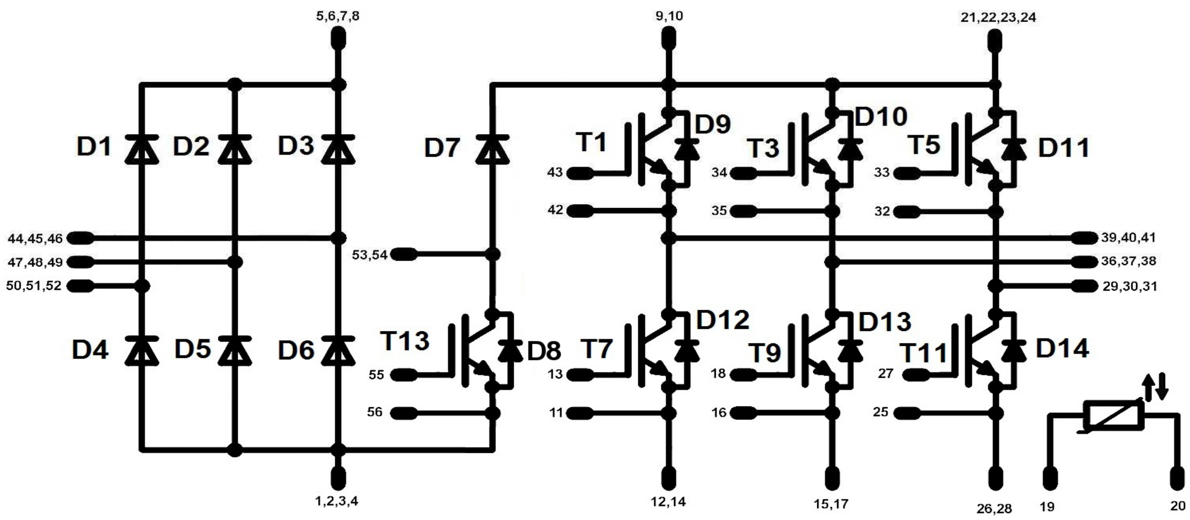
Outline

Pin table

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



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1, T3, T5, T7, T9, T11	IGBT	1200V	75A	Inverter Switch	
D9, D10, D11, D12, D13, D14	FWD	1200V	75A	Inverter Diode	
T13	IGBT	1200V	50A	Brake Switch	
D7	FWD	1200V	25A	Brake Diode	
D1, D2, D3,D4, D5, D6	Diode	1600V	60A	Rectifier	
NTC	NTC			Thermistor	

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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.