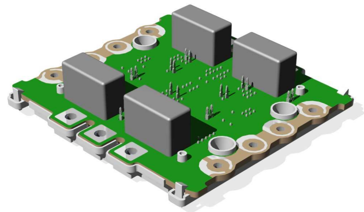
70-W212NMC400SH01-M709P
datasheet

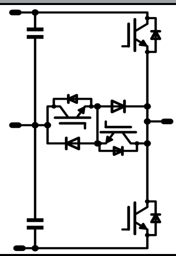
flow MNPC 4w — 1200 V / 400 A

Features
- Mixed voltage NPC
- Low inductive
- High power screw interface

Target Applications
- Solar inverter
- UPS
- High speed motor drive

Types
- 70-W212NMC400SH01-M709P

flow SCREW 4w housing


Schematic


Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
half bridge IGBT (T1 , T4)					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=Tjmax	T_c=80°C	405	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		1200	A
Power dissipation	P_{tot}	T_j=Tjmax	T_c=80°C	1105	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
Turn off safe operating area (RBSOA)	I_{cmax}	V_{CE} max = 1200V T_{vj} max= 175°C		1200	A
Maximum Junction Temperature	T_{jmax}			175	°C
neutral point FWD (D2 , D3)					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=Tjmax	T_c=80°C	282	A
Repetitive peak forward current	I_{FRM}	tP = 1 ms	T_{vj} < 150°C	800	A
Power dissipation per FWD	P_{tot}	T_j=Tjmax	T_c=80°C	389	W
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
neutral point IGBT (T2 , T3)					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	T_j=Tjmax	T_c=80°C	355	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		1200	A
Power dissipation	P_{tot}	T_j=Tjmax	T_c=80°C	645	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
Turn off safe operating area (RBSOA)	I_{cmax}	V_{CE} max = 1200V T_{vj} max= 150°C		1200	A
Maximum Junction Temperature	T_{jmax}			175	°C
half bridge FWD (D1 , D4)					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=Tjmax	T_c=80°C	234	A
Surge forward current	I_{FSM}	t_p=10ms , sin 180°	T_j=150°C	1800	A
I^2t-value	I^2t			8100	A2s
Power dissipation per FWD	P_{tot}	T_j=Tjmax	T_c=80°C	468	W
Maximum Junction Temperature	T_{jmax}			175	°C
General Module Properties					
Material of module baseplate				Cu	
Material of internal isulation				Al2O3	
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	
half bridge IGBT (T1 , T4)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0136	Tj=25°C Tj=125°C	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		400	Tj=25°C Tj=125°C	1,78	2,10 2,48	2,42	V
Collector-emitter cut-off current incl. FWD	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,8	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			960	nA
Integrated Gate resistor	R_{gint}							0,5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=1 Ω Rgon=1 Ω	±15	350	406	Tj=25°C Tj=125°C		202 210		ns
Rise time	t_r					Tj=25°C Tj=125°C		28 33		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		260 305		
Fall time	t_f					Tj=25°C Tj=125°C		29 53		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		5,28 9,85		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		9,84 15,78		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		22160		pF
Output capacitance	C_{oss}							1520		
Reverse transfer capacitance	C_{rss}							1280		
Gate charge	Q_G		15	960	400	Tj=25°C		1840		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4 W/mK						0,09		K/W
neutral point FWD (D2 , D3)										
FWD forward voltage	V_F				600	Tj=25°C Tj=125°C	1,2	1,75 1,64	1,9	V
Peak reverse recovery current	I_{RRM}	Rgon=1 Ω	±15	350	406	Tj=25°C Tj=125°C		294 341		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		67 242		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		14 32		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=125°C		8524 4659		A/μs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		3,49 8,01		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4 W/mK						0,24		K/W
neutral point IGBT (T2 , T3)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0064	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		400	Tj=25°C Tj=125°C	1,05	1,57 1,78	1,85	V
Collector-emitter cut-off incl FWD	I_{CES}		0	600		Tj=25°C Tj=125°C			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			2400	nA
Integrated Gate resistor	R_{gint}							0,5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=1 Ω Rgon=1 Ω	±15	350	407	Tj=25°C Tj=125°C		198 199		ns
Rise time	t_r					Tj=25°C Tj=125°C		27 30		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		267 288		
Fall time	t_f					Tj=25°C Tj=125°C		28 59		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		3,29 4,45		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		11,22 15,22		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		24640		pF
Output capacitance	C_{oss}							1536		
Reverse transfer capacitance	C_{rss}							732		
Gate charge	Q_G		±15	480	400	Tj=25°C		2480		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4 W/mK						0,15		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	
half bridge FWD (D1 , D4)										
FWD forward voltage	V_F				300	Tj=25°C Tj=125°C		2,18 2,18	2,46	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			360	µA
Peak reverse recovery current	I_{RRM}	Rgon=1 Ω	±15	350	407	Tj=25°C Tj=125°C		436 511		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		56 75		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		15 31		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=125°C		23815 22850		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		4,00 8,74		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4 W/mK						0,20		K/W
Thermistor										
Rated resistance	R					Tj=25°C		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R100=1486 Ω				Tj=100°C	-5		+5	%
Power dissipation	P					Tj=25°C		200		mW
Power dissipation constant						Tj=25°C		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3996		K
Vincotech NTC Reference						Tj=25°C			B	

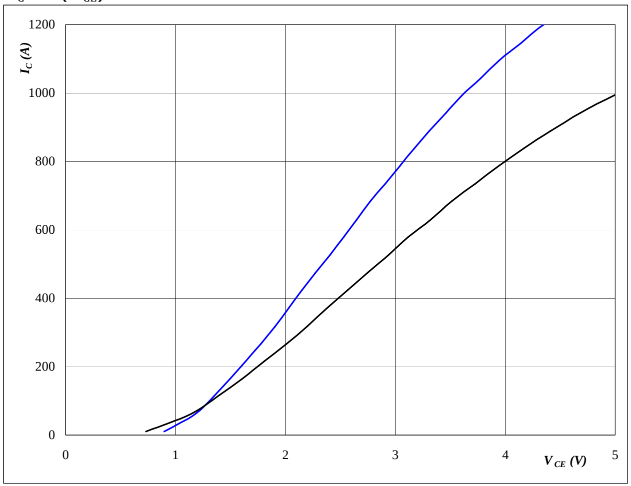
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 1 IGBT

Typical output characteristics Vge=15V

$I_C = f(V_{CE})$



At

t_p = 350 µs

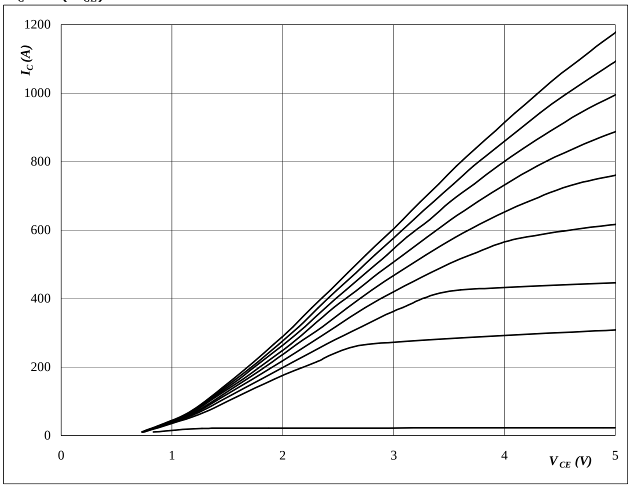
T_j = 25/125/150 °C

V_{GE}= 15 V

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 350 µs

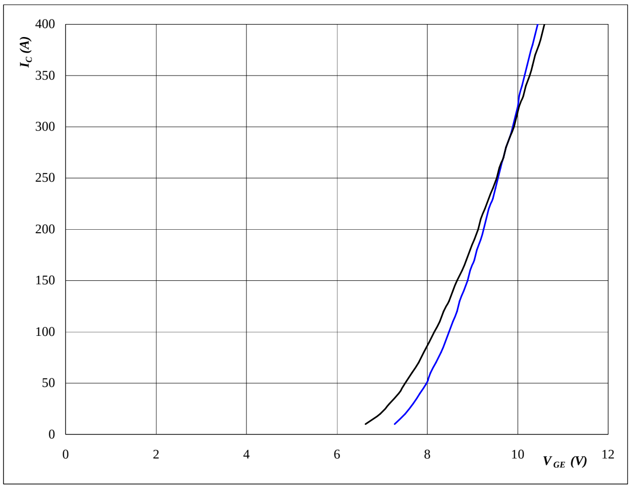
T_j = 150 °C

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

t_p = 350 µs

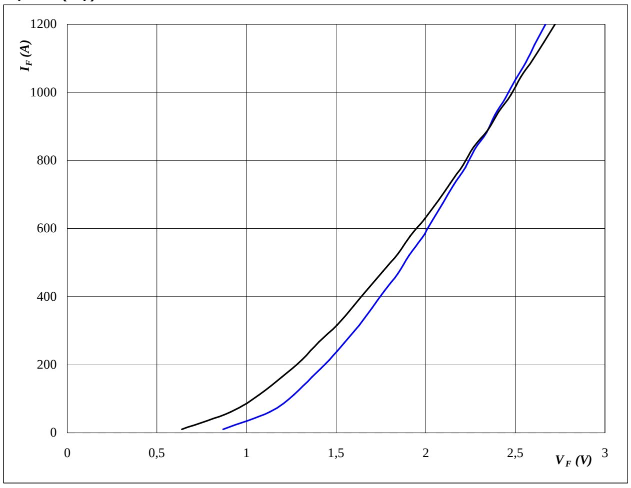
V_{CE} = 10 V

T_j= 25/125/150 °C

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p = 350 µs

T_j= 25/125/150 °C

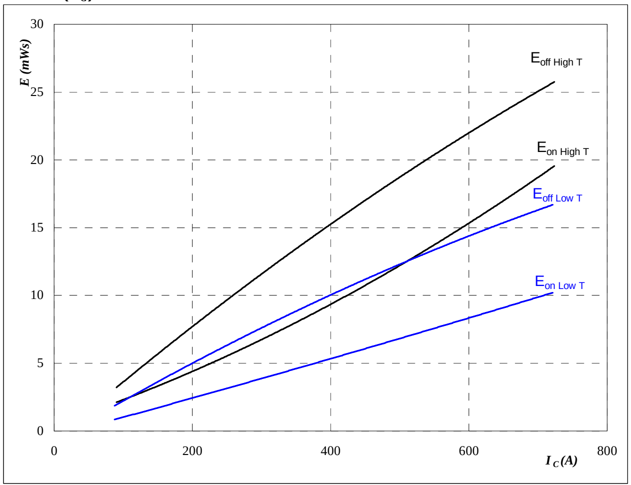
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 5 — IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



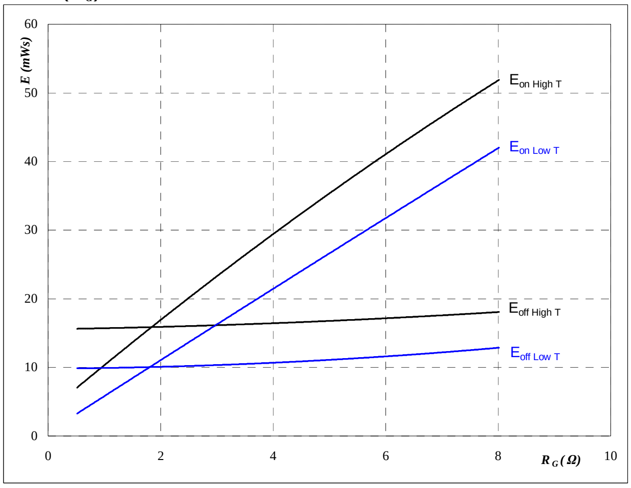
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω
R_{goff} =	1,0	Ω

Figure 6 — IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



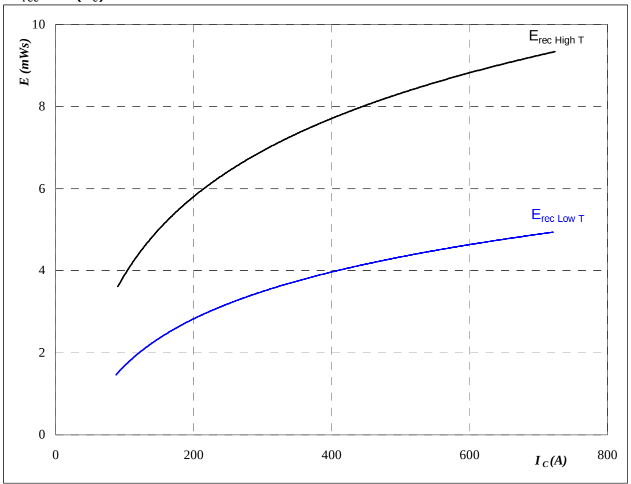
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	406	A

Figure 7 — FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



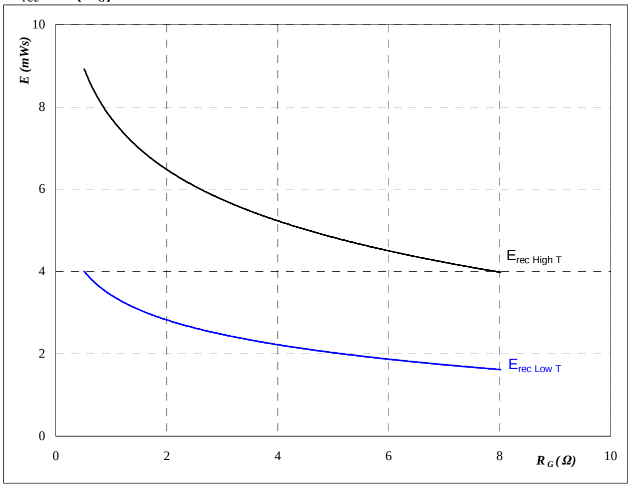
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω

Figure 8 — FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	406	A

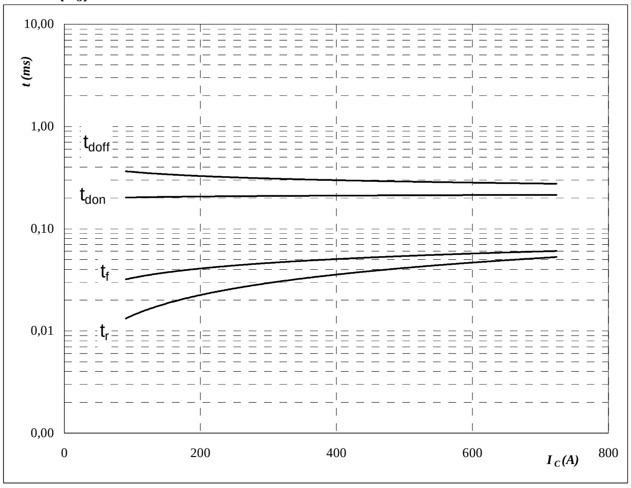
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



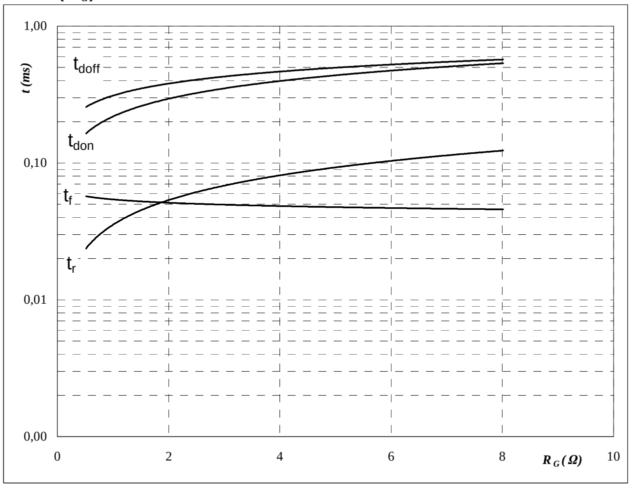
With an inductive load at

T_j =	124	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω
R_{goff} =	1,0	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



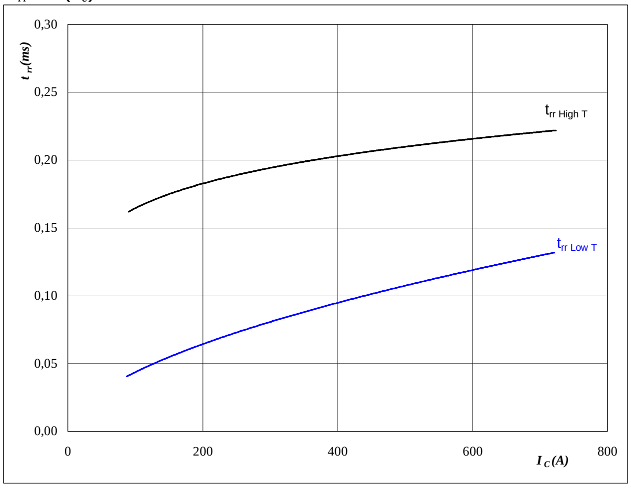
With an inductive load at

T_j =	124	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	406	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



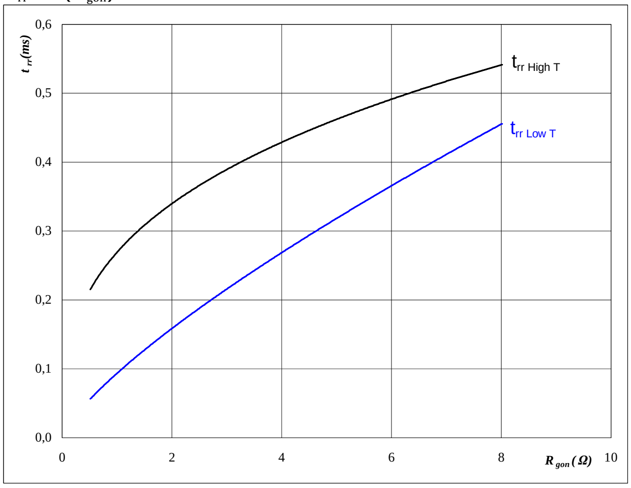
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω

Figure 12 FWD

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

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



At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	406	A
V_{GE} =	±15	V

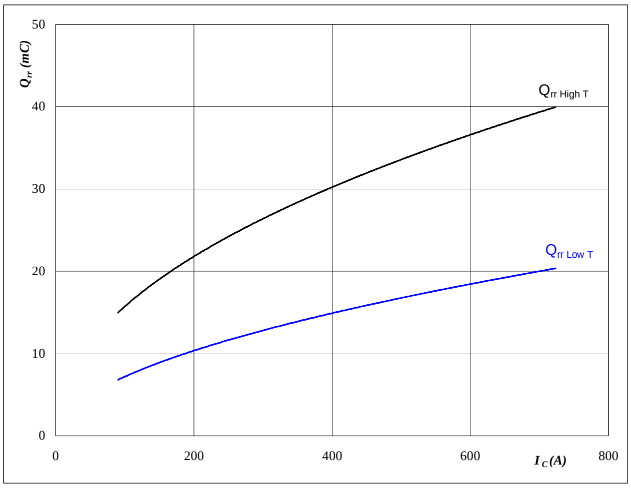
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



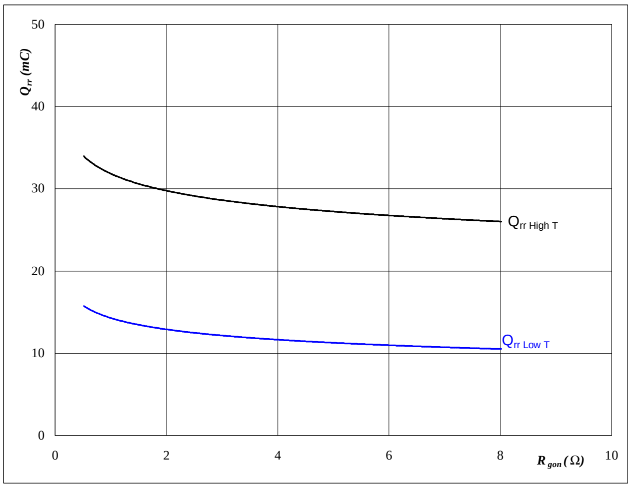
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω

Figure 14 FWD

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

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



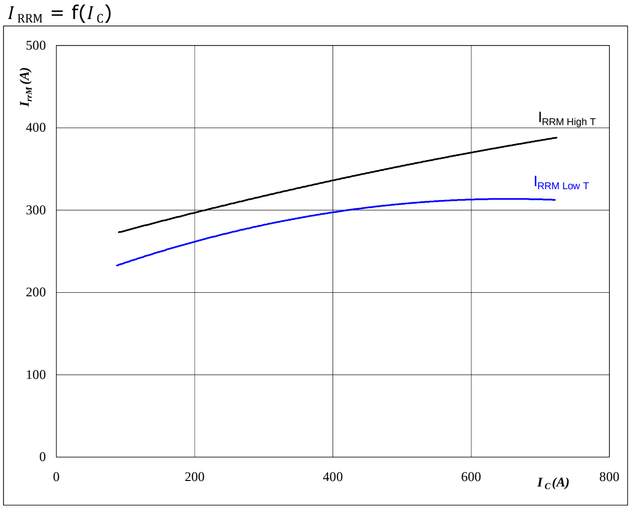
At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	406	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



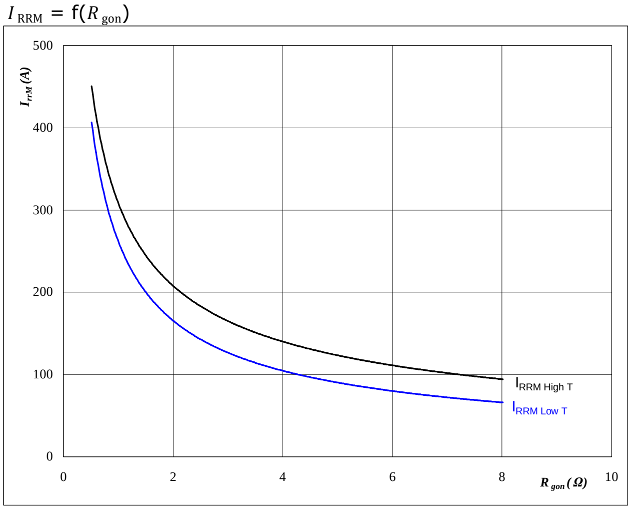
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω

Figure 16 FWD

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

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



At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	406	A
V_{GE} =	±15	V

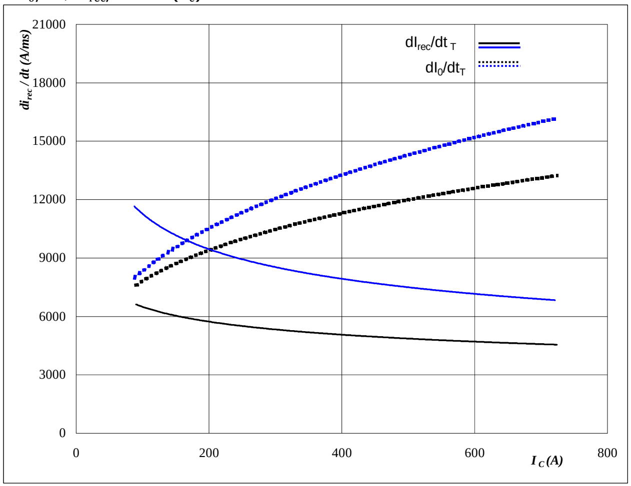
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 17 FWD

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

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



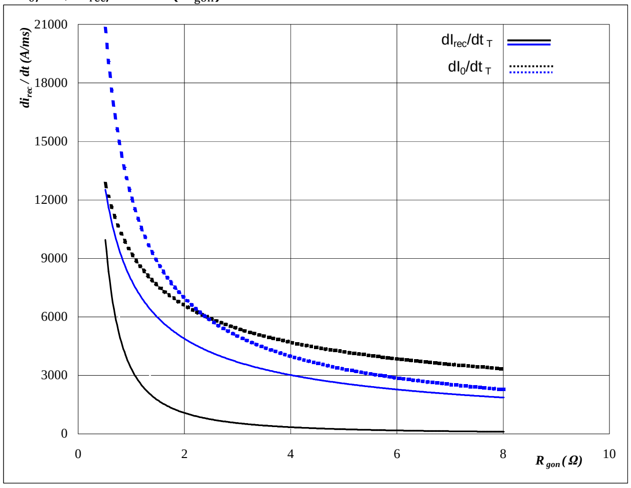
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1,0	Ω

Figure 18 FWD

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

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



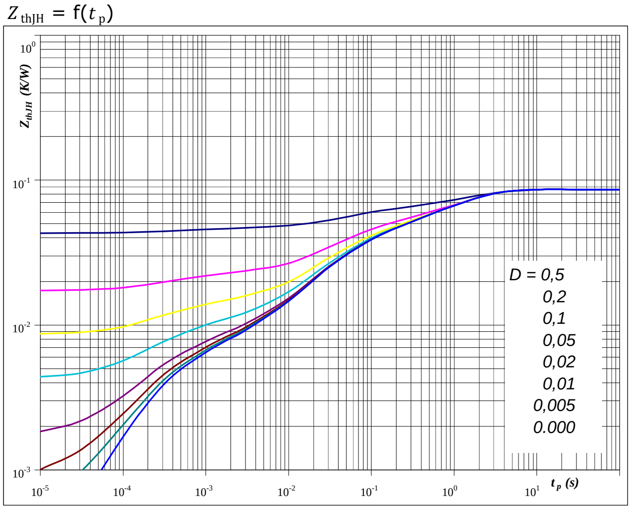
At

T_j =	25/125	°C
V_R =	350	V
I_F =	406	A
V_{GE} =	±15	V

Figure 19 IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,09	K/W

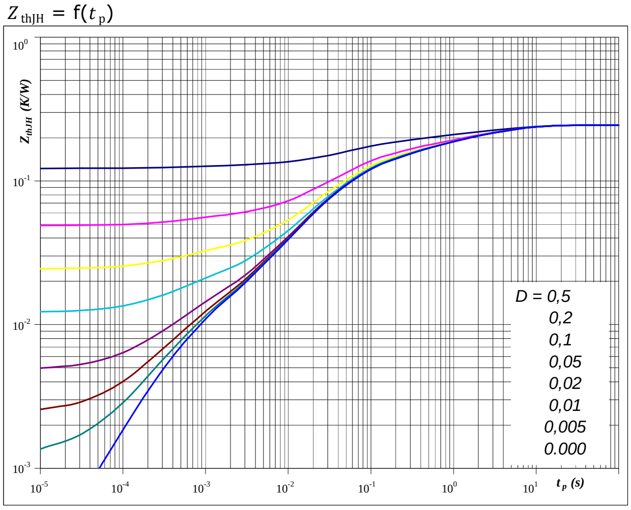
IGBT thermal model values

R (K/W)	Tau (s)
0,037	1,555
0,019	0,210
0,023	0,031
0,003	0,002
0,005	0,0003

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,24	K/W

FWD thermal model values

R (K/W)	Tau (s)
0,046	5,114
0,048	1,051
0,046	0,196
0,074	0,043
0,018	0,014

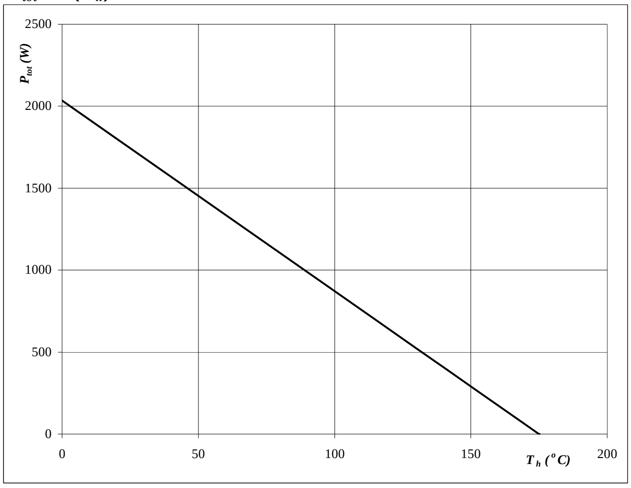
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



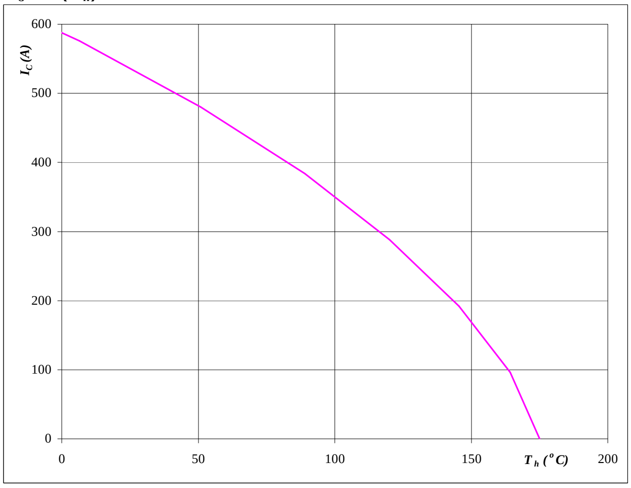
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

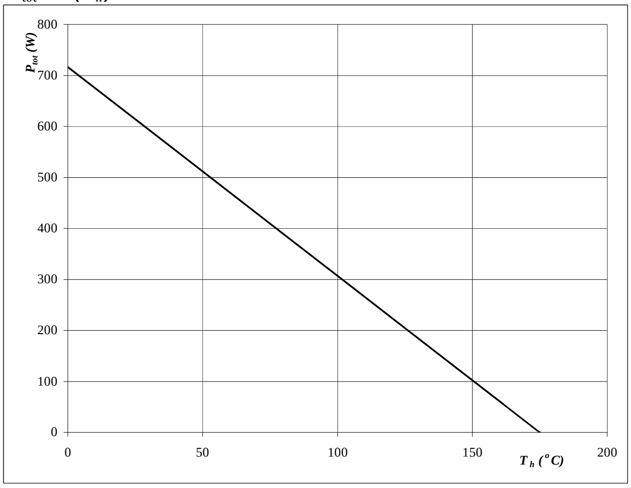
T_j = 175 °C

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



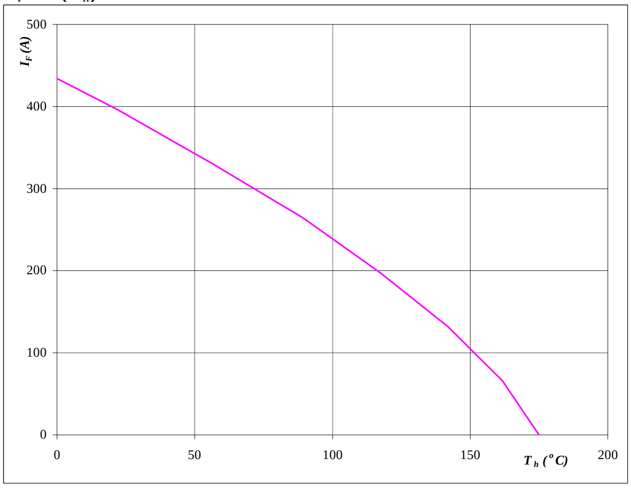
At

T_j = 175 °C

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 175 °C

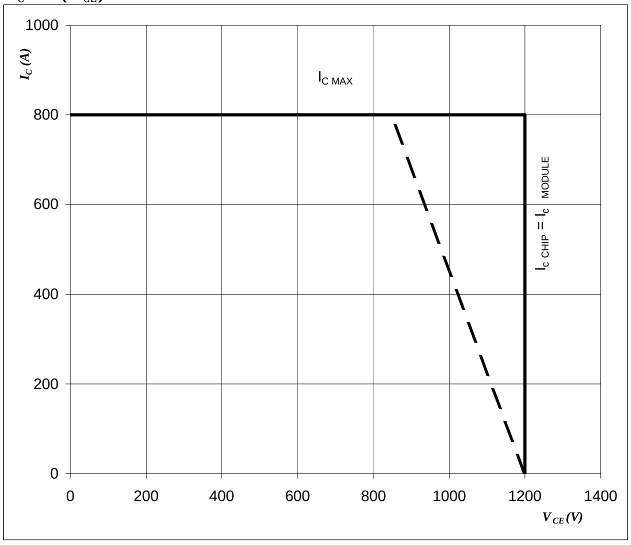
Buck operation

half bridge IGBT (T1,T4) and neutral point FWD (D2,D3)

Figure 25 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 150 ºC

$U_{ccminus}=U_{ccplus}=U_{cc}/2$

V_{GE} = ±15 V

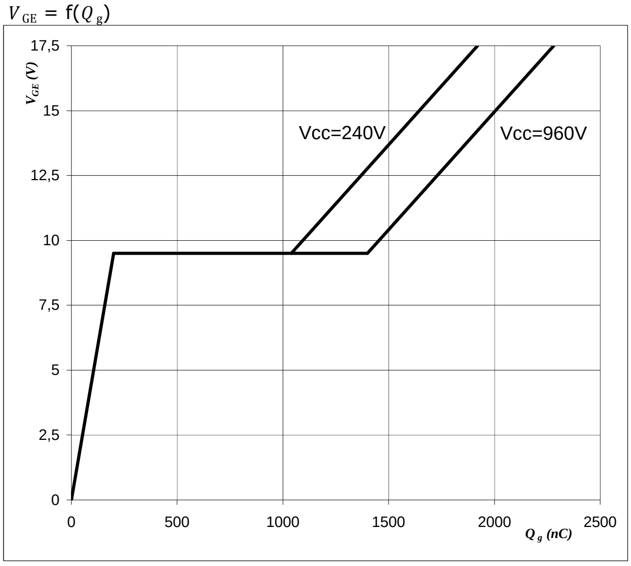
R_{gon} = 1,0 Ω

Switching mode: 3 level

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

I_C = 400 A

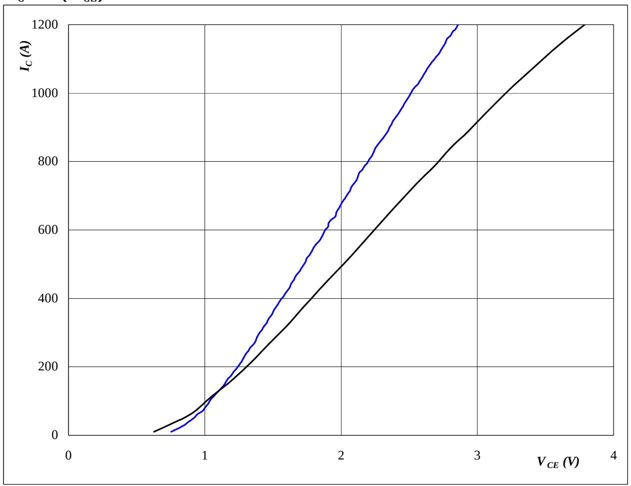
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 1 IGBT

Typical output characteristics Vge=15V

$I_C = f(V_{CE})$



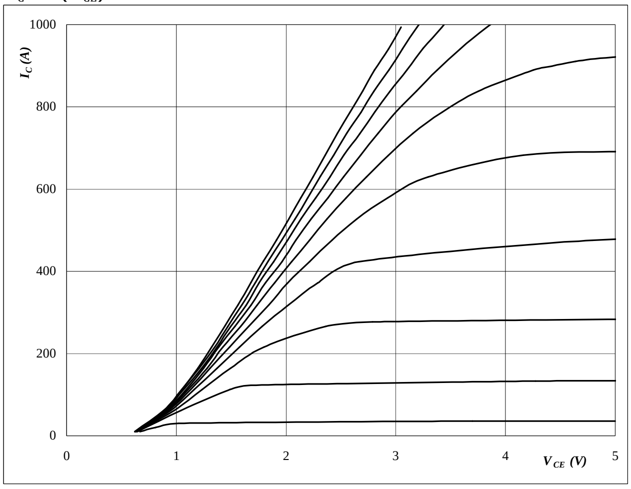
At

t_p =	350	µs
T_j =	25/125/150	°C
V_{GE}=	15	V

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



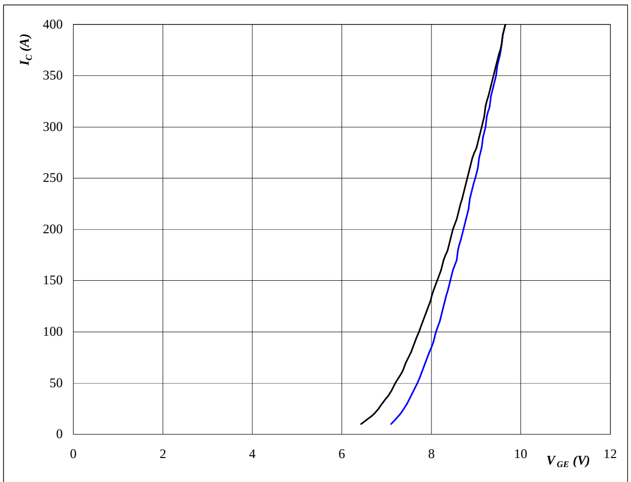
At

t_p =	350	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



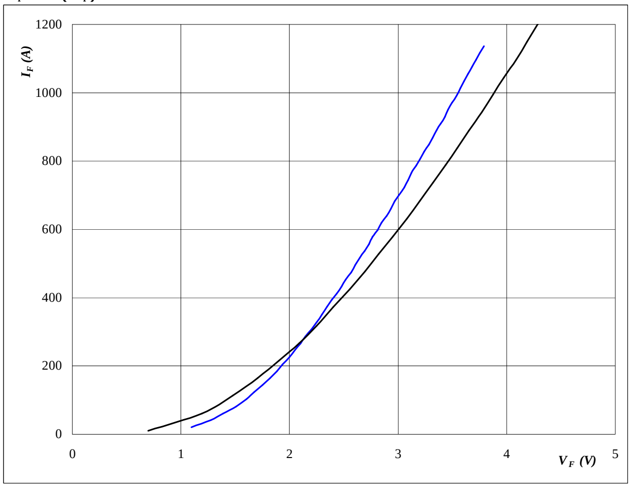
At

t_p =	350	µs
V_{CE} =	10	V
T_j =	25/125/150	°C

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	350	µs
T_j =	25/125/150	°C

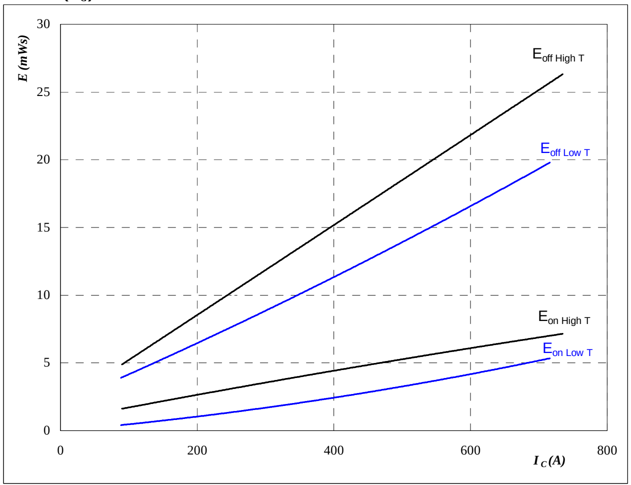
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 5	IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



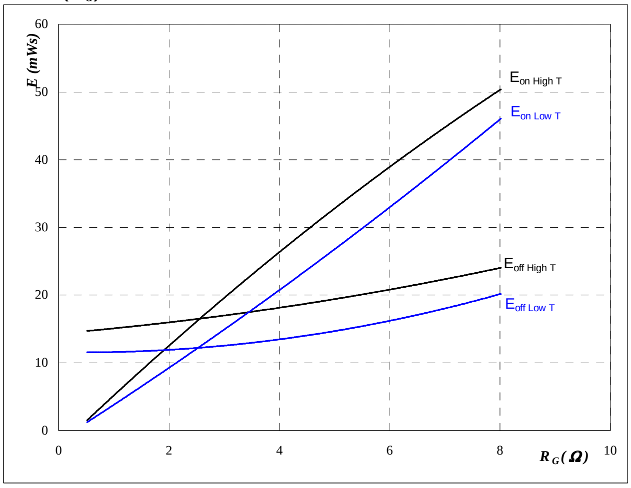
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω
R_{goff} =	1	Ω

Figure 6	IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



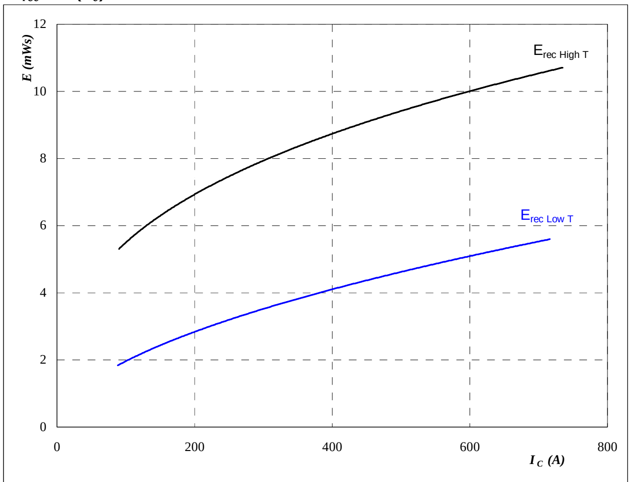
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	407	A

Figure 7	FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



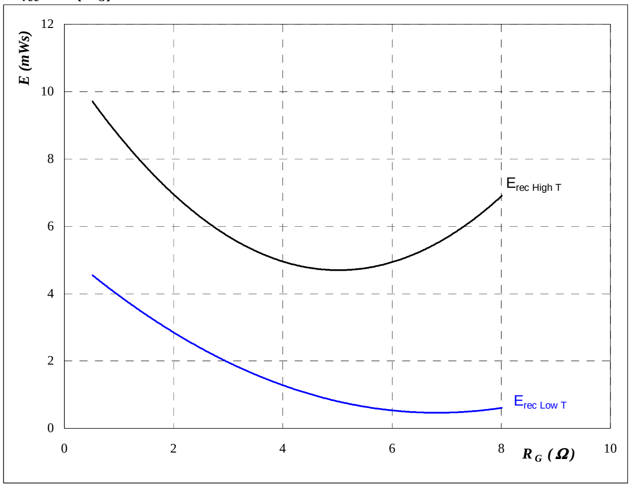
With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

Figure 8	FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	407	A

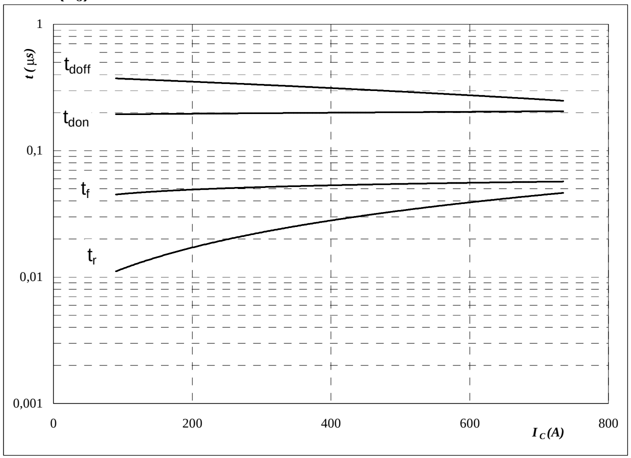
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



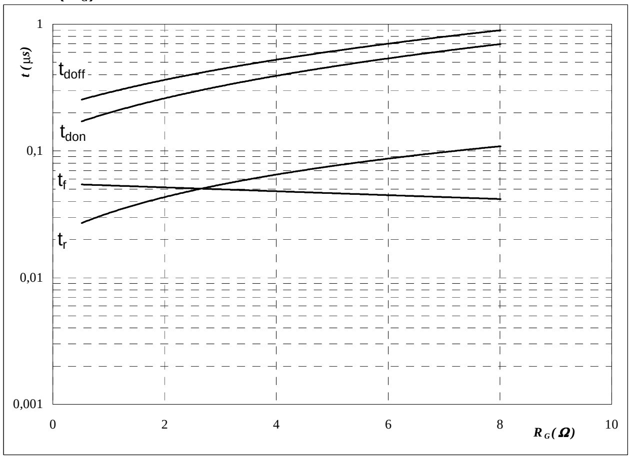
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω
R_{goff} =	1	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



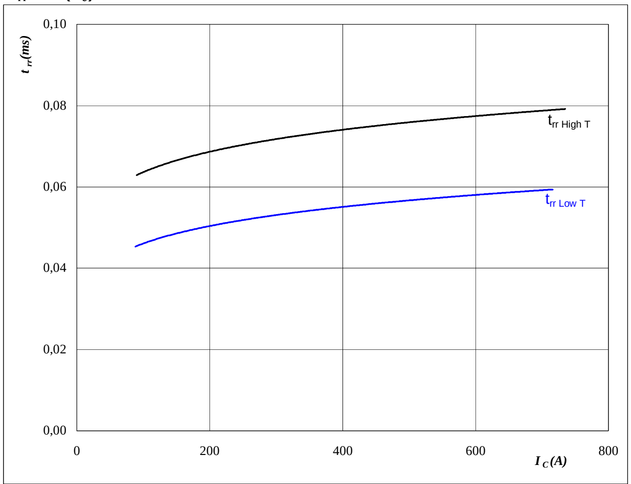
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	407	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



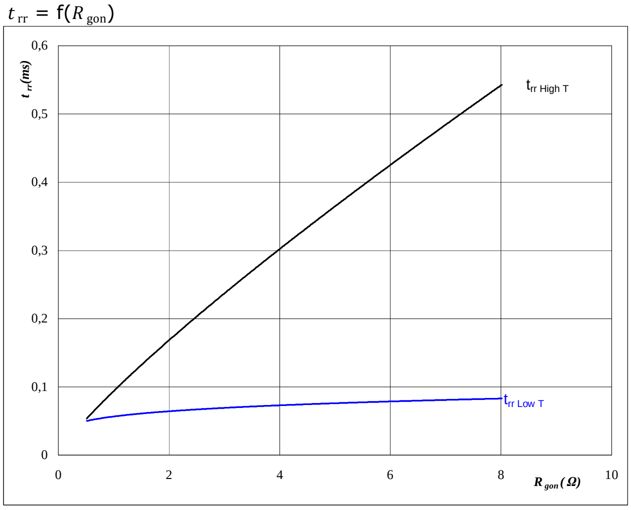
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

Figure 12 FWD

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

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



At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	407	A
V_{GE} =	±15	V

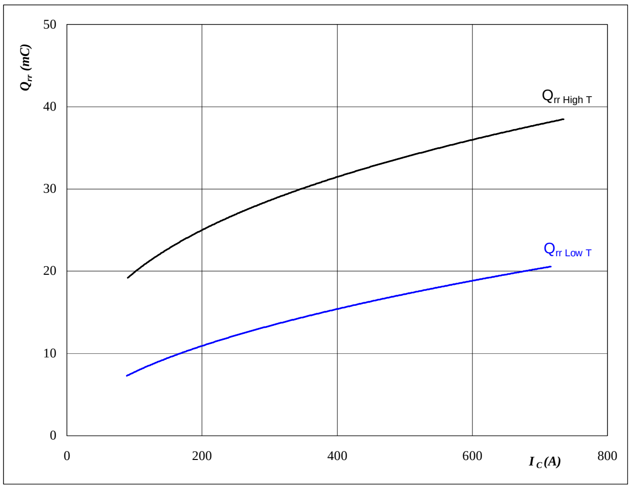
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



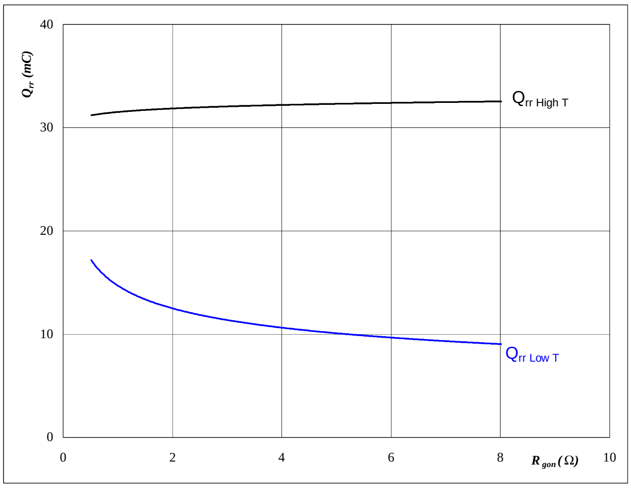
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

Figure 14 FWD

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

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



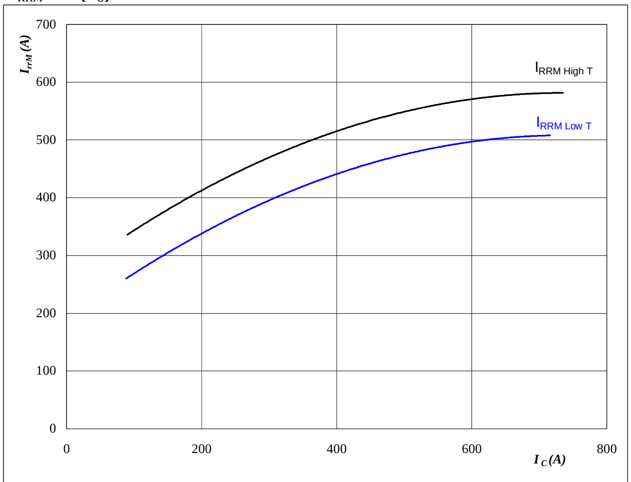
At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	407	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



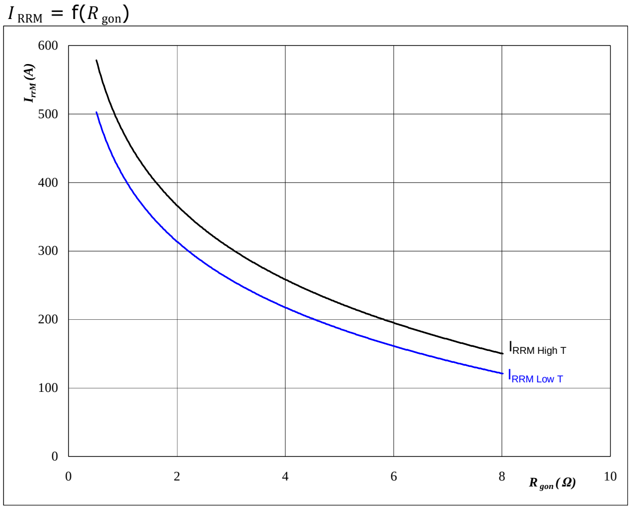
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

Figure 16 FWD

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

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



At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	407	A
V_{GE} =	±15	V

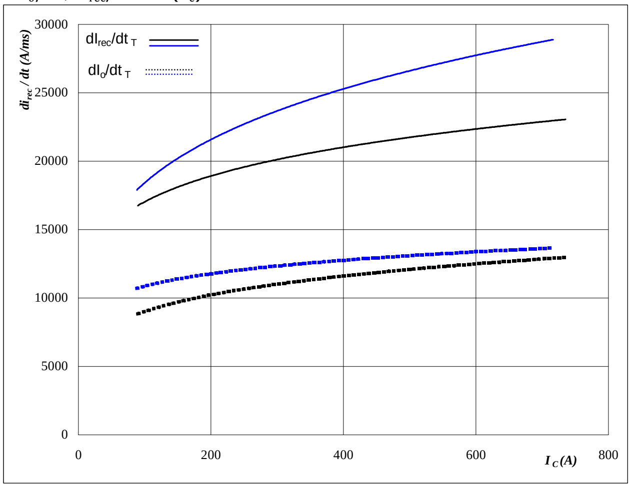
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 17 — FWD

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

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



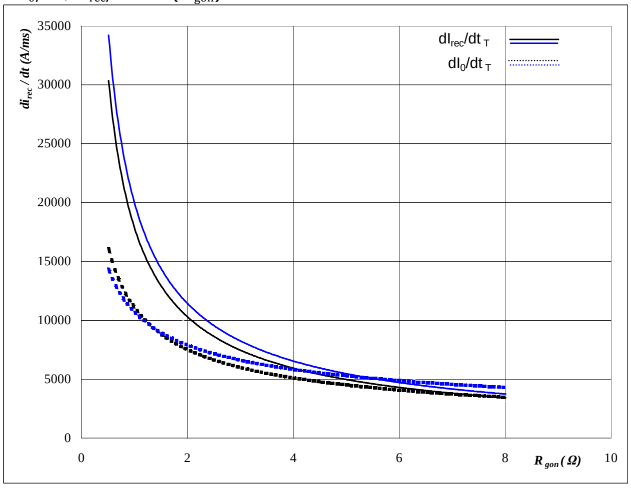
At

T_j =	25/125/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

Figure 18 — FWD

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

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



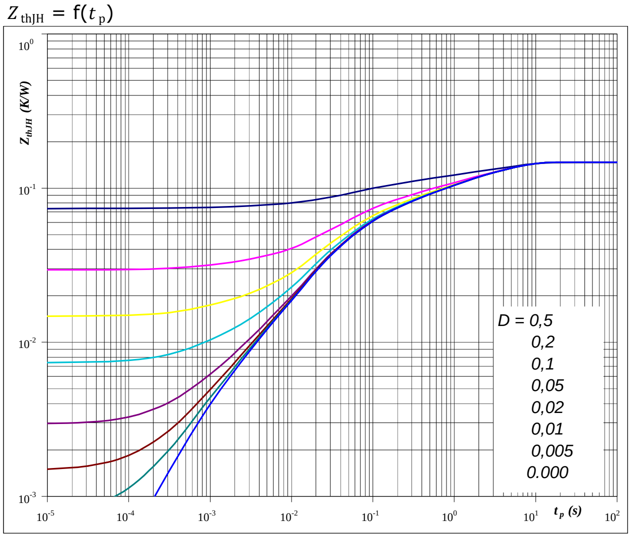
At

T_j =	25/125/150	°C
V_R =	350	V
I_F =	407	A
V_{GE} =	±15	V

Figure 19 — IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,15	K/W

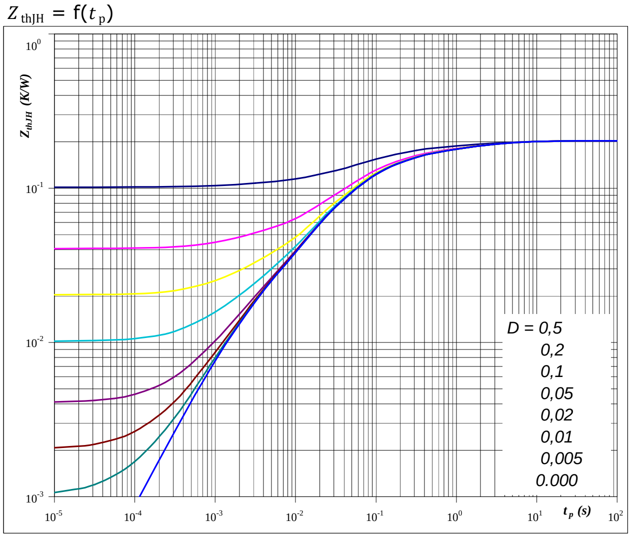
IGBT thermal model values

R (K/W)	Tau (s)
0,05	3,58
0,02	0,74
0,03	0,18
0,03	0,04
0,01	0,01

Figure 20 — FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,20	K/W

FWD thermal model values

R (K/W)	Tau (s)
0,02	4,55
0,03	0,92
0,05	0,19
0,07	0,05
0,03	0,02

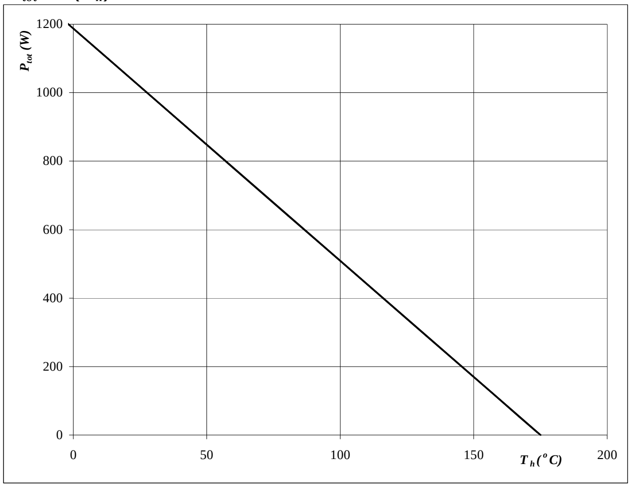
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



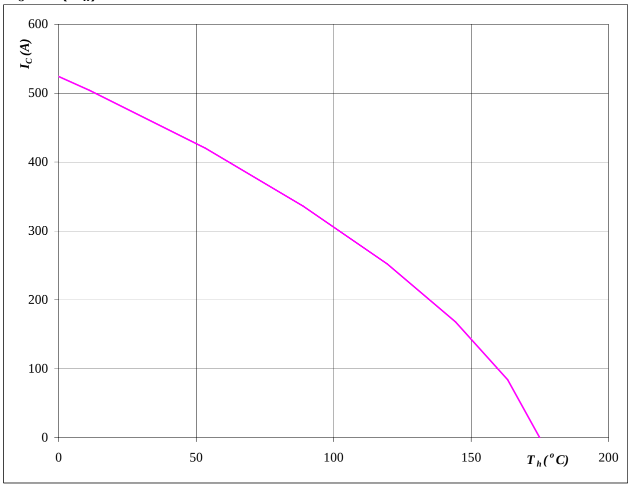
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

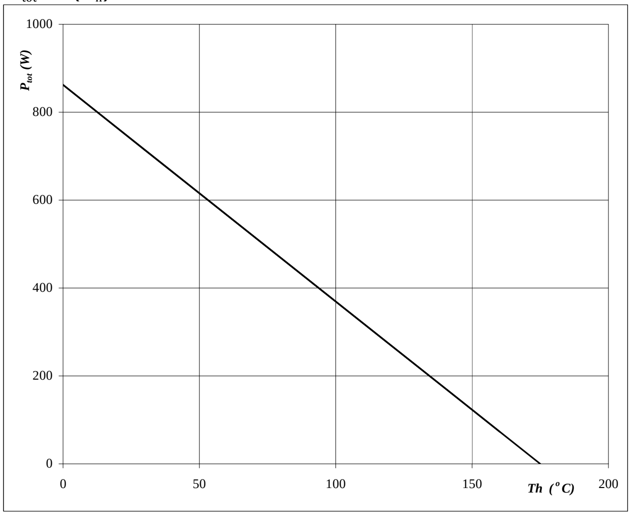
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



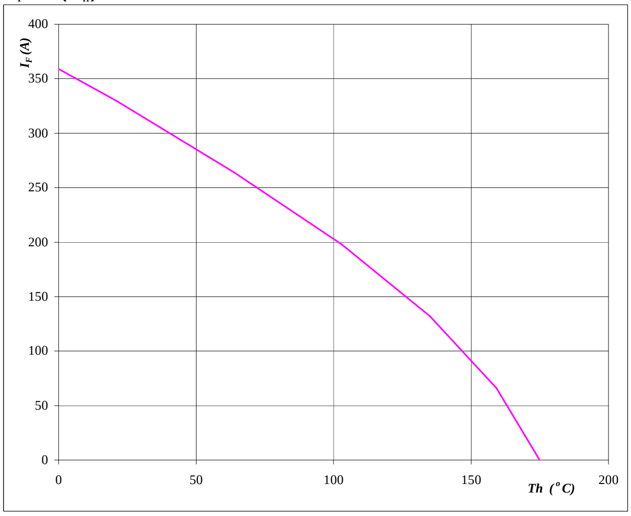
At

T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 175 ºC

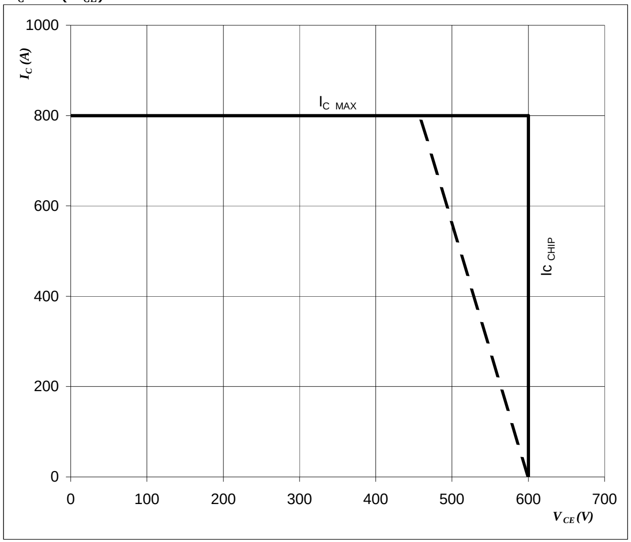
Boost operation

neutral point IGBT (T2,T3) and half bridge FWD (D1,D2)

Figure 25 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 25,150 ºC

$U_{ccminus}$=U_{ccplus}=Uc$_c$/2

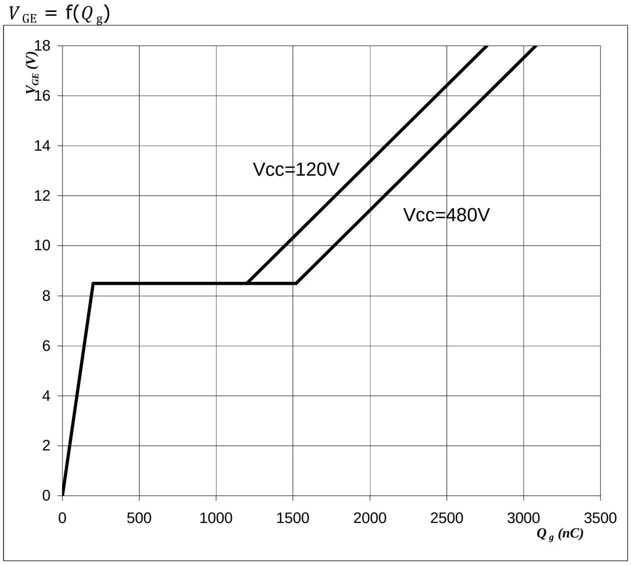
VGE = ±15 V

Rgon = 1 Ω

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

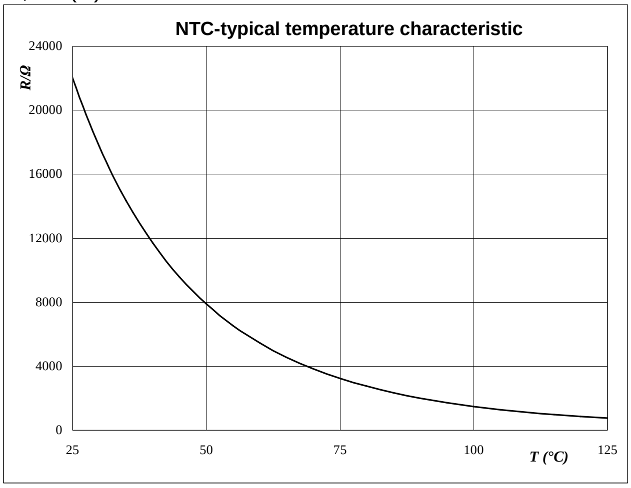
I_C = 400 A

Thermistor

Figure 1 Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$



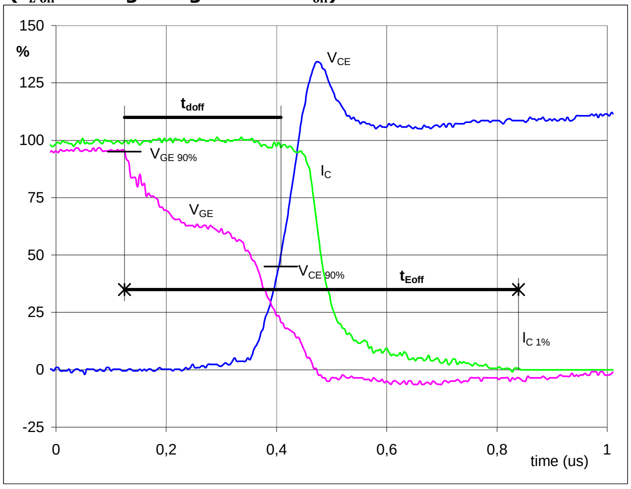
Switching Definitions Half Bridge

General conditions

T_j	=	125 °C
R_{gon}	=	1 Ω
R_{goff}	=	1 Ω

Figure 1 Half Bridge IGBT

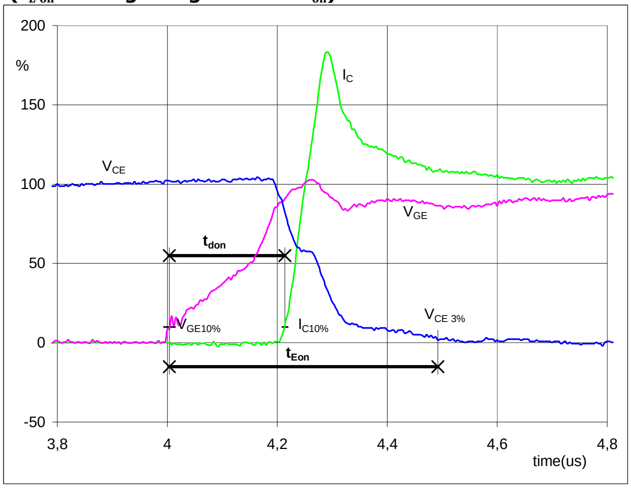
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} ($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	407	A
t_{doff} =	0,305	µs
$t_{E\,off}$ =	0,715	µs

Figure 2 Half Bridge IGBT

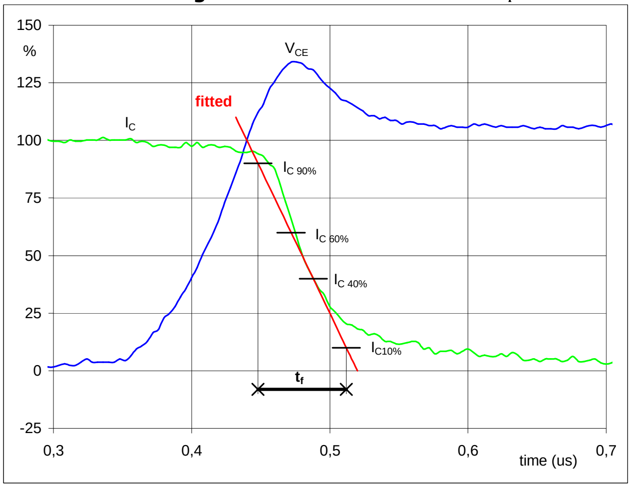
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} ($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	407	A
t_{don} =	0,210	µs
$t_{E\,on}$ =	0,488	µs

Figure 3 Half Bridge IGBT

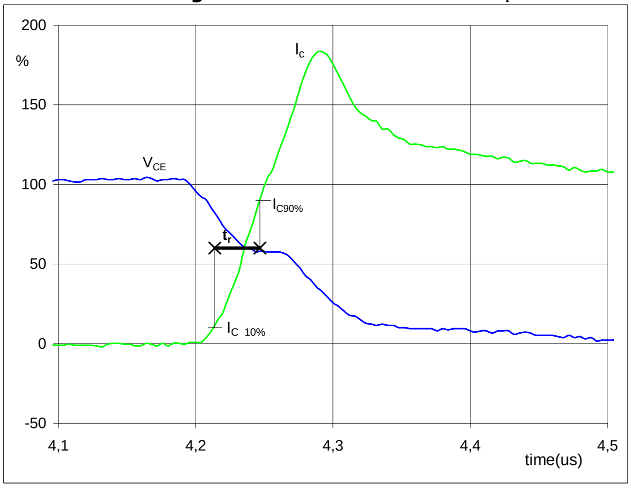
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	407	A
t_f =	0,053	µs

Figure 4 Half Bridge IGBT

Turn-on Switching Waveforms & definition of t_r

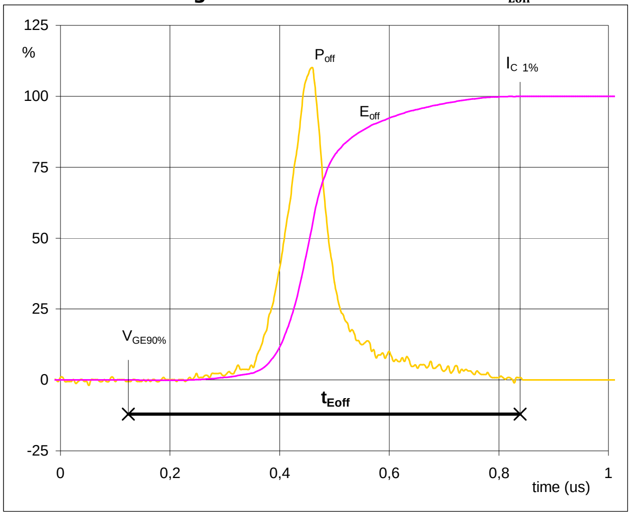


V_C (100%) =	700	V
I_C (100%) =	407	A
t_r =	0,033	µs

Switching Definitions Half Bridge

Figure 5	Half Bridge IGBT

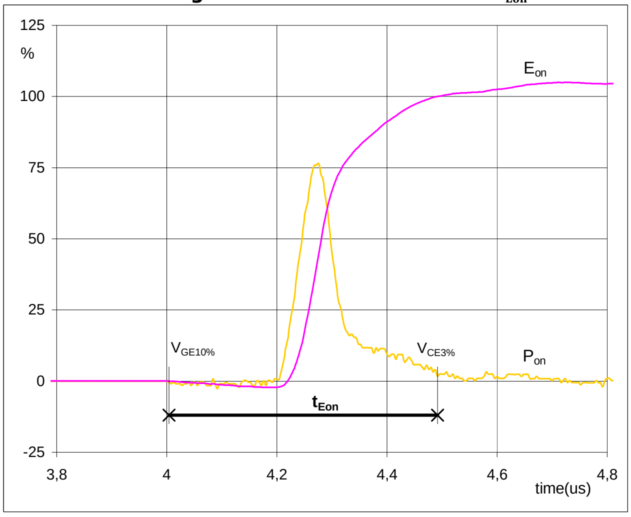
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	284,95	kW
E_{off} (100%) =	15,78	mJ
$t_{E\ off}$ =	0,715	µs

Figure 6	Half Bridge IGBT

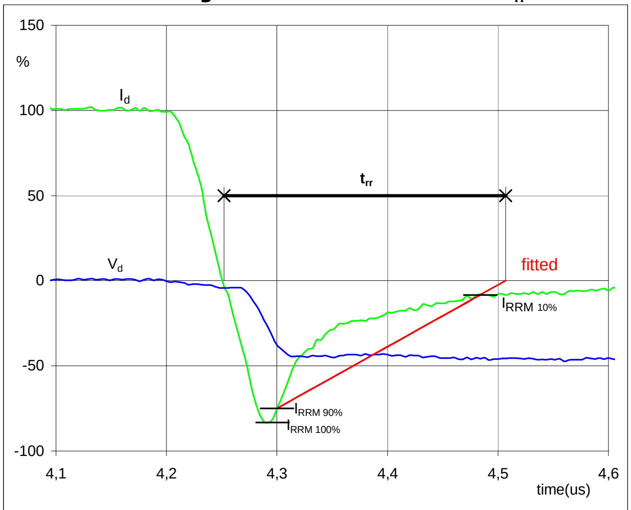
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	284,95	kW
E_{on} (100%) =	9,85	mJ
$t_{E\ on}$ =	0,488	µs

Figure 7	Neutral Point FWD

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

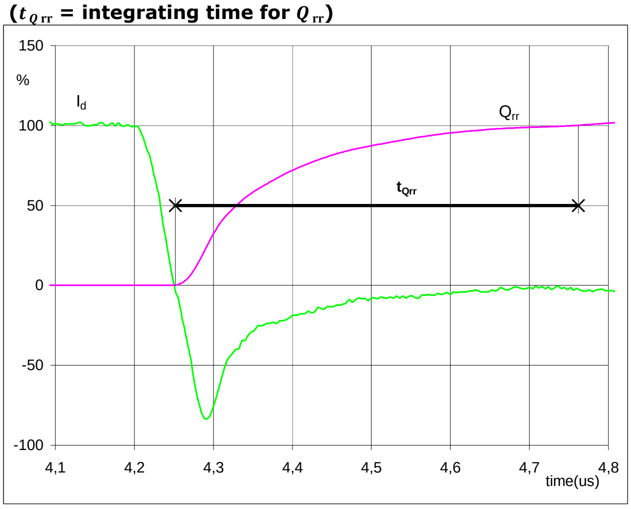


V_d (100%) =	700	V
I_d (100%) =	407	A
I_{RRM} (100%) =	-341	A
t_{rr} =	0,242	µs

Switching Definitions Half Bridge

Figure 8 Neutral Point FWD

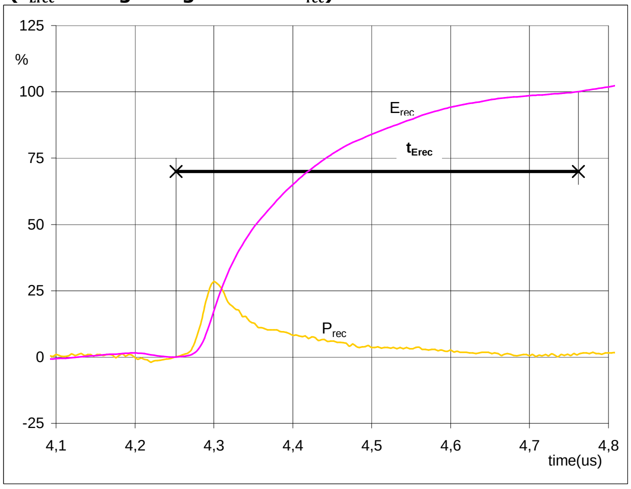
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	407	A
Q_{rr} (100%) =	31,93	μC
$t_{Q\,rr}$ =	0,51	μs

Figure 9 Neutral Point FWD

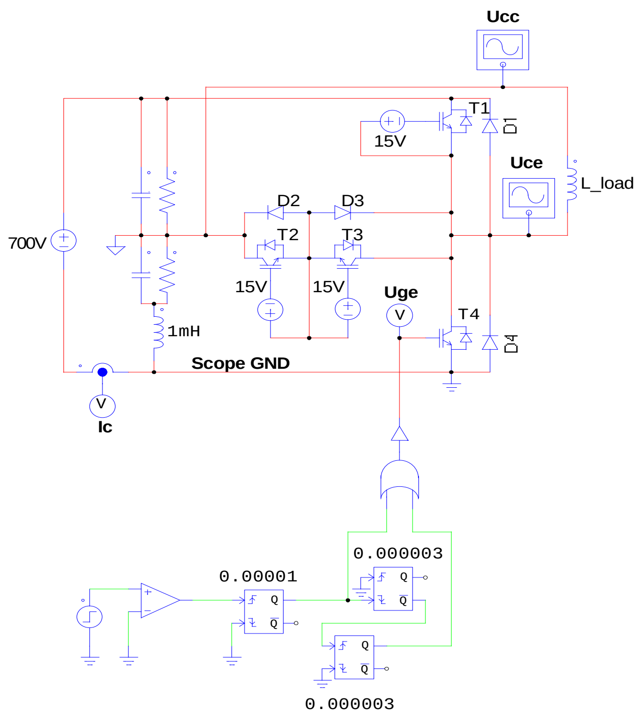
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	284,95	kW
E_{rec} (100%) =	8,01	mJ
$t_{E\,rec}$ =	0,51	μs

Half Bridge switching measurement circuit

Figure 10



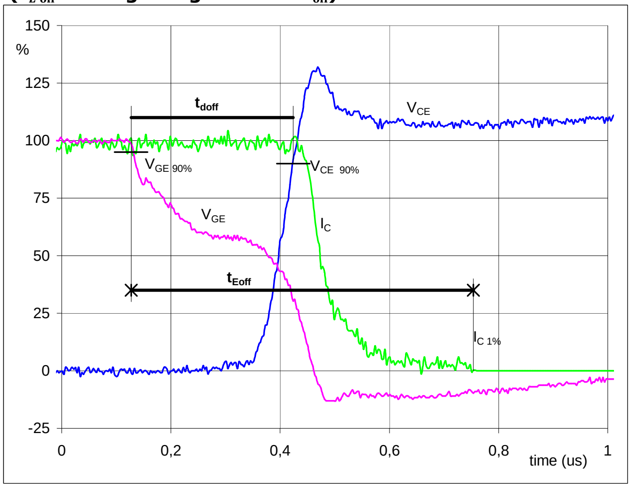
Switching Definitions Neutral Point

General conditions

T_j	=	125 °C
R_{gon}	=	1 Ω
R_{goff}	=	1 Ω

Figure 1 Neutral Point IGBT

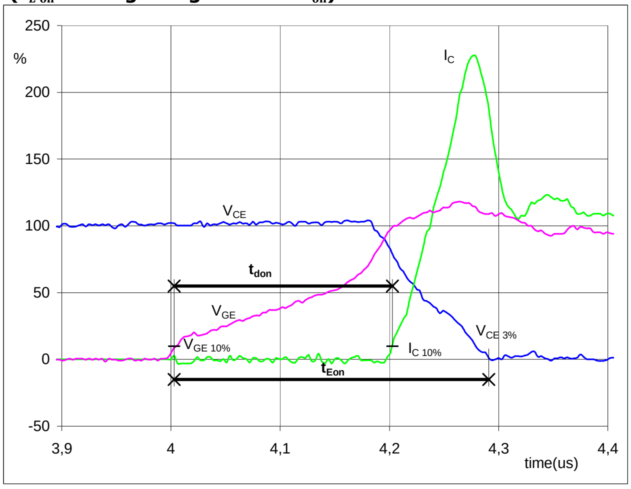
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} ($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	403	A
t_{doff} =	0,23	µs
$t_{E\,off}$ =	0,58	µs

Figure 2 Neutral Point IGBT

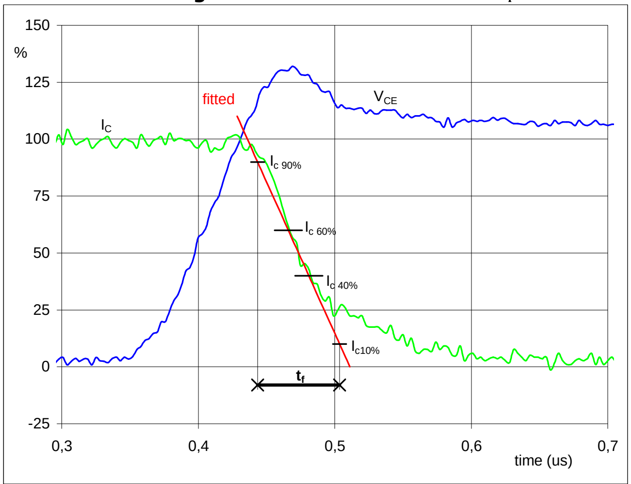
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} ($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	403	A
t_{don} =	0,199	µs
$t_{E\,on}$ =	0,38	µs

Figure 3 Neutral Point IGBT

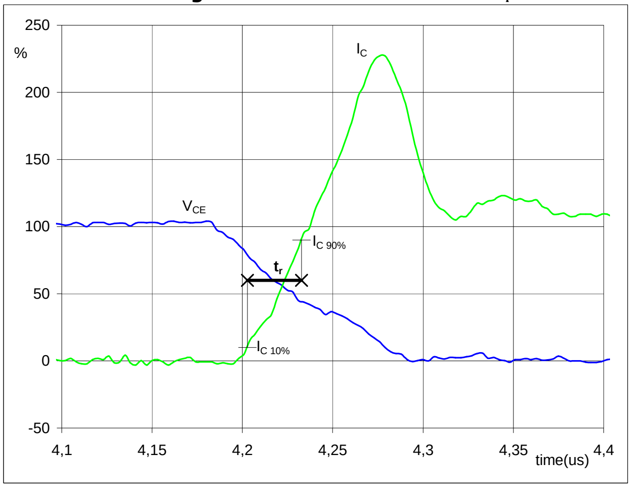
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	403	A
t_f =	0,06	µs

Figure 4 Neutral Point IGBT

Turn-on Switching Waveforms & definition of t_r

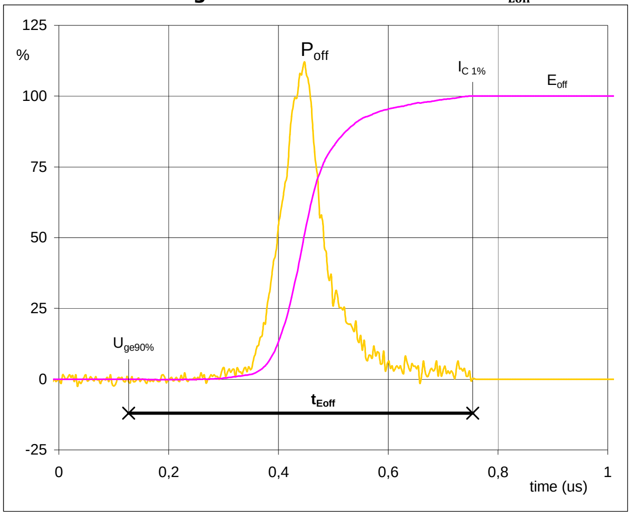


V_C (100%) =	350	V
I_C (100%) =	403	A
t_r =	0,030	µs

Switching Definitions Neutral Point

Figure 5 Neutral Point IGBT

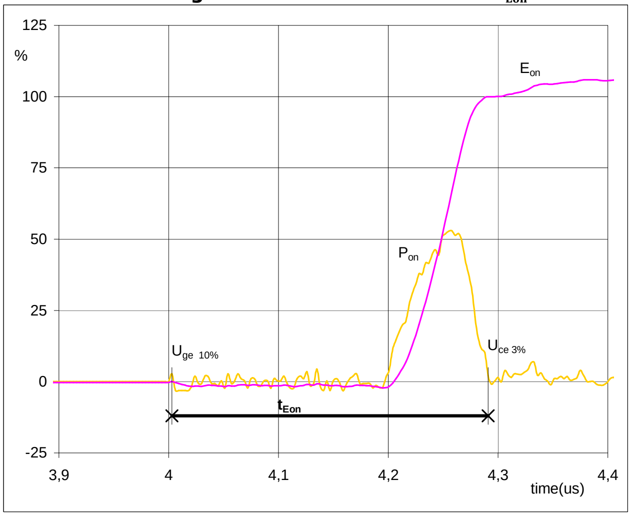
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) = 140,97 kW
E_{off} (100%) = 15,22 mJ
$t_{E\,off}$ = 0,58 μs

Figure 6 Neutral Point IGBT

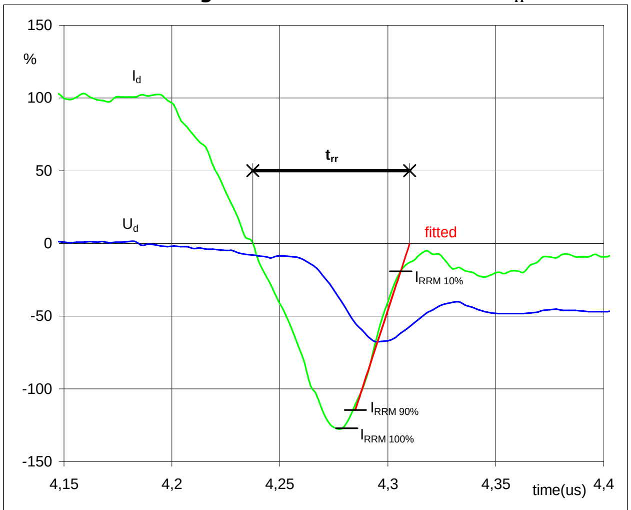
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) = 140,9653 kW
E_{on} (100%) = 13,39 mJ
$t_{E\,on}$ = 0,38 μs

Figure 7 Half Bridge FWD

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

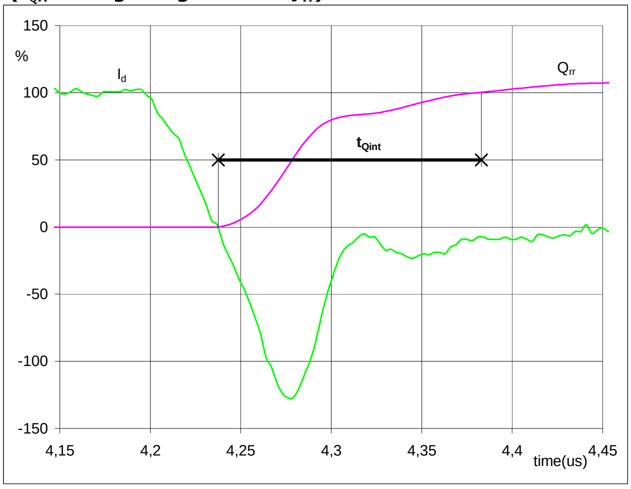


V_d (100%) = 350 V
I_d (100%) = 403 A
I_{RRM} (100%) = -511 A
t_{rr} = 0,08 μs

Switching Definitions Neutral Point

Figure 8 Half Bridge FWD

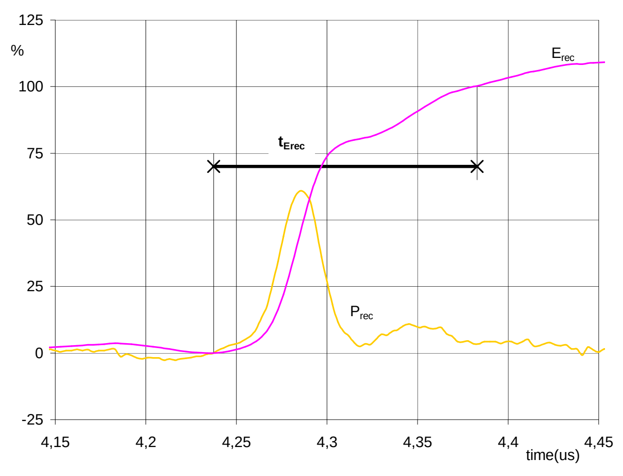
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	403	A
Q_{rr} (100%) =	31,37	µC
t_{Qint} =	0,33	µs

Figure 9 Half Bridge FWD

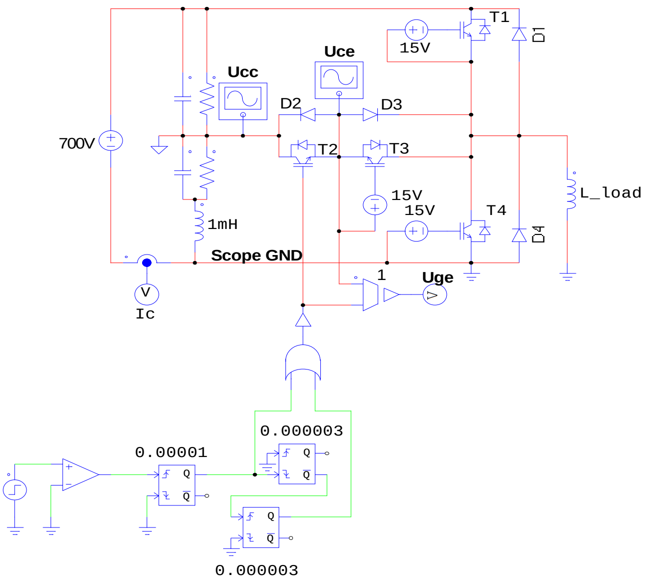
Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	140,97	kW
E_{rec} (100%) =	8,74	mJ
$t_{E\,rec}$ =	0,33	µs

Neutral Point switching measurement circuit

Figure 10



Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
Standard	70-W212NMC400SH01-M709P	M709P	M709P

Outline

Driver pins

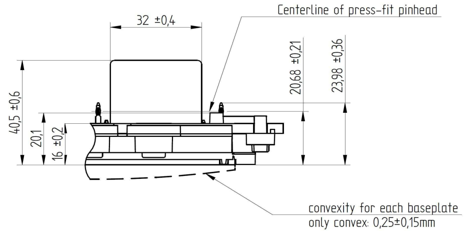
Pin	X1	Y1	Function	Group
1.1	-0,2	81,6	G1-1	T1
1.2	2,8	81,6	E1-1	T1
1.3	44,2	81,6	G1-2	T1
1.4	41,2	81,6	E1-2	T1
1.5	1,85	68,5	E2-1	T2
1.6	4,85	67,5	G2-1	T2
1.7	42,2	68,5	E2-2	T2
1.8	39,2	67,5	G2-2	T2
1.9	-5,4	46,6	G3-1	T3
1.10	-5,4	49,6	E3-1	T3
1.11	49,4	46,6	G3-2	T3
1.12	49,4	49,6	E3-2	T3
1.13	-3,45	30,7	E4-1	T4
1.14	-0,45	30,7	G4-1	T4
1.15	47,5	30,7	E4-2	T4
1.16	44,5	30,7	G4-2	T4
1.17	19,5	16	Desat-DC+	
1.18	24,6	16	Desat-DC+	
1.19	19,5	50,8	Desat-GND	
1.20	24,6	50,8	Desat-GND	
1.21	67,7	86,7	NTC	
1.22	67,7	89,8	NTC	

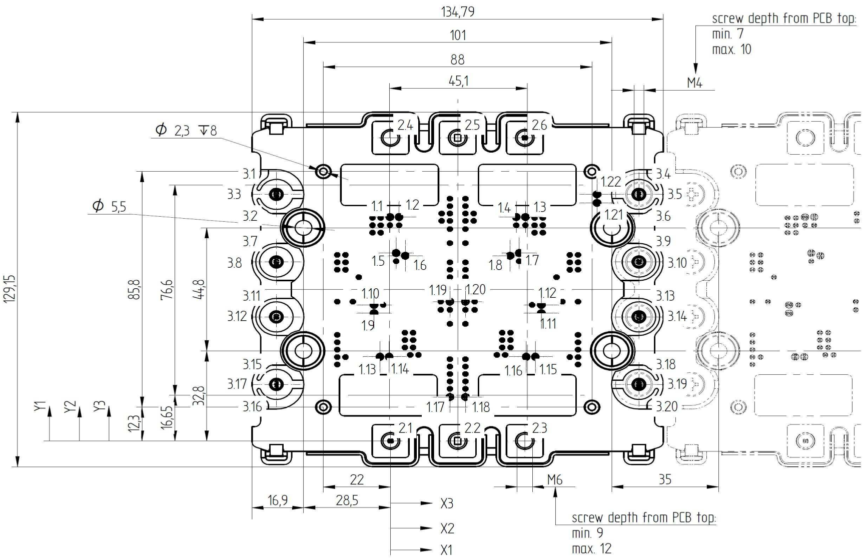
Low current connections

M4 screw	X3	Y3	Function
3.1	-37	89,8	TR+
3.2	-37	89,8	DC+
3.3	-37	89,8	Neutral
3.4	81,4	89,8	TR+
3.5	81,4	89,8	Neutral
3.6	81,4	89,8	DC+
3.7	-37	65,2	CE
3.8	-37	65,2	Neutral
3.9	81,4	65,2	CE
3.10	81,4	65,2	Neutral
3.11	-37	45,2	Phase
3.12	-37	45,2	Neutral
3.13	81,4	45,2	Phase
3.14	81,4	45,2	Neutral
3.15	-37	20,6	DC-
3.16	-37	20,6	TR-
3.17	-37	20,6	Neutral
3.18	81,4	20,6	DC-
3.19	81,4	20,6	Neutral
3.20	81,4	20,6	TR-

Power connections

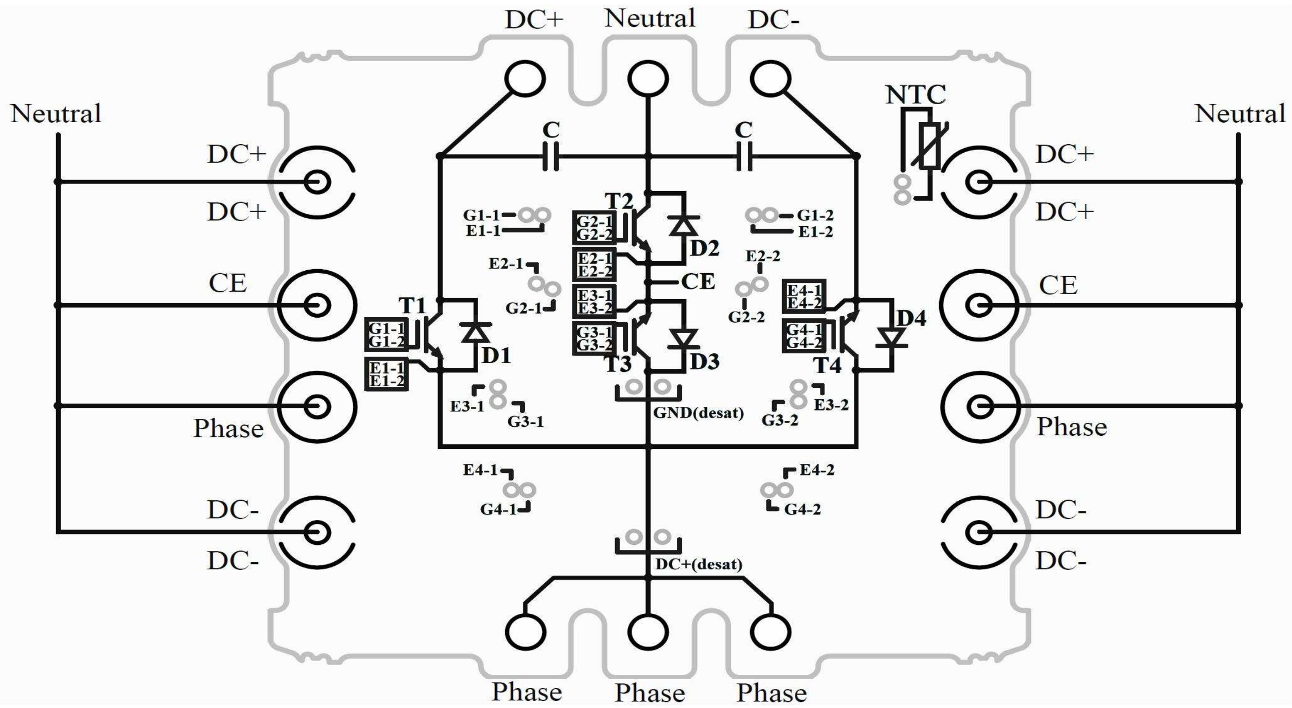
M6 screw	X2	Y2	Function
2.1	0	0	Phase
2.2	22	0	Phase
2.3	44	0	Phase
2.4	0	110	DC+
2.5	22	110	Neutral
2.6	44	110	DC-





Ordering Code and Marking - Outline - Pinout

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1, T4	IGBT	1200V	400A	Half Bridge Switch	
D1, D4	FWD	1200V	300A	Half Bridge Diode	
T2, T3	IGBT	600V	400A	Neutral Point Switch	
D2, D3	FWD	600V	400A	Neutral Point Diode	
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.