VINcoMNPC X4 **1200 V/400 A**

Features

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

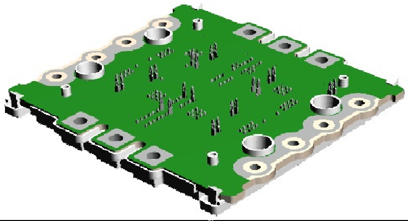
Target Applications

- Solar inverter
- UPS
- High speed motor drive

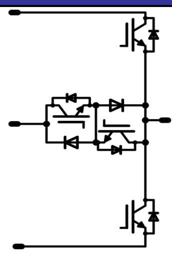
Types

- 70-W212NMA400NB02-M209P62

VINco X4 housing



Schematic



Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
half bridge IGBT (T1, T4)				
Collector-emitter break down voltage	V_{CES}		1200	V
DC collector current	I_C	$T_j=T_j$max T_h=80℃	358	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max	800	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max T_h=80℃	864	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V	10 800	µs V
Maximum Junction Temperature	$T_j$max		175	℃
neutral point FWD (D2, D3)				
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25℃	650	V
DC forward current	I_{FAV}	$T_j=T_j$max T_h=80℃	232	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	600	A
Power dissipation per FWD	P_{tot}	$T_j=T_j$max T_h=80℃	306	W
Maximum Junction Temperature	$T_j$max		175	℃

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
neutral point IGBT (T2, T3)				
Collector-emitter break down voltage	V_{CES}		650	V
DC collector current	I_C	$T_j=T_j max$ $T_h=80$℃	260	A
Pulsed collector current	I_{Cpuls}	t_p limited by $T_j max$	900	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j max$ $T_h=80$℃	500	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j≤150$℃ $V_{GE}=15V$	10 360	µs V
Maximum Junction Temperature	$T_j max$		175	℃
half bridge FWD (D1, D4)				
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25$℃	1200	V
DC forward current	I_{FAV}	$T_j=T_j max$ $T_h=80$℃	252	A
Surge forward current	I_{FSM}	$t_p=10ms$, sin 180° $T_j=25$℃	1720	A
I^2t-value	I^2t	$t_p=10ms$, sin 180° $T_j=150$℃	3700	A^2s
Power dissipation per FWD	P_{tot}	$T_j=T_j max$ $T_h=80$℃	528	W
Maximum Junction Temperature	$T_j max$		175	℃
General Module Properties				
Material of module baseplate			Cu	
Material of internal isulation			Al2O3	
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	℃
Operation temperature under switching condition	T_{op}		-40…+(Tjmax - 25)	℃
Insulation Properties				
Insulation voltage	V_{is}	t=2s DC voltage	4000	V
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm
Comparative tracking index	CTI		>200	

Characteristic Values

Parameter	Symbol	Conditions					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	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,04	Tj=25°C Tj=125°C	5,5	6	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		400	Tj=25°C Tj=125°C	1	1,90 2,21	3	V
Collector-emitter cut-off current incl. FWD	I_{CES}		0	1200		Tj=25°C Tj=150°C			2	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			3000	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=1 Ω Rgon=1 Ω	±15	350	400	Tj=25°C Tj=125°C		120 121		ns
Rise time	t_r					Tj=25°C Tj=125°C		22 23		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		160 193		ns
Fall time	t_f					Tj=25°C Tj=125°C		45 69		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		2,96 5,40		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		12,25 17,66		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C			40000	pF
Output capacitance	C_{oss}								8000	pF
Reverse transfer capacitance	C_{rss}								680	pF
Gate charge	Q_{Gate}		±15	600	400	Tj=25°C		932		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	100um preapplied PCM						0,11		K/W
Thermal resistance chip to case per chip	R_{thJC}	100um grease 1W/mK						0,13		K/W
neutral point FWD (D2, D3)										
FWD forward voltage	V_F				300	Tj=25°C Tj=125°C	1,2	1,59 1,48	2,26	V
Peak reverse recovery current	I_{RRM}	Rgon=1 Ω	±15	350	400	Tj=25°C Tj=125°C		245 320		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		132 267		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		16 31		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		8684 3334		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		4,06 7,81		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	100um preapplied PCM						0,31		K/W
Thermal resistance chip to case per chip	R_{thJC}	100um grease 1W/mK						0,36		K/W

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
neutral point IGBT (T2, T3)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0048	Tj=25℃ Tj=125℃	5,1	5,80	6,4	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		300	Tj=25℃ Tj=125℃	1,08	1,61 1,85	2,3	V
Collector-emitter cut-off incl FWD	I_{CES}		0	650		Tj=25℃ Tj=125℃			2,2	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			3000	nA
Integrated Gate resistor	R_{gint}					Tj=25℃ Tj=125℃		none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=2 Ω Rgon=2 Ω	±15	700	300	Tj=25℃ Tj=125℃		191 192		ns
Rise time	t_r					Tj=25℃ Tj=125℃		32 34		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		239 262		
Fall time	t_f					Tj=25℃ Tj=125℃		89 123		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		4,29 6,19		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		10,19 14,03		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		18480		pF
Reverse transfer capacitance	C_{rss}							548		
Gate charge	Q_{Gate}		15	480	75			3000		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	100um preapplied PCM						0,19		K/W
Thermal resistance chip to case per chip	R_{thJC}	100um grease 1W/mK						0,22		

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℃ Tj=125℃		2,21 2,25	2,76	V
Reverse leakage current	I_r			650		Tj=25℃ Tj=125℃			0,48 56	mA
Peak reverse recovery current	I_{RRM}					Tj=25℃ Tj=125℃		309 441		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		66 136		ns
Reverse recovered charge	Q_{rr}	Rgon=2 Ω	±15	350	300	Tj=25℃ Tj=125℃		19 38		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		14653 14438		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		4,36 9,72		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	100um preapplied PCM						0,18		K/W
Thermal resistance chip to case per chip	R_{thJC}	100um grease 1W/mK						0,20		
Thermistor										
Rated resistance	R					Tj=25℃		22000		Ω
Deviation of R_{100}	ΔR/R	R100=1486 Ω				Tj=100℃	-12		+14	%
Power dissipation	P					Tj=25℃		200		mW
Power dissipation constant						Tj=25℃		2		mW/K
B-value	B(25/50)	Tol. ±3%				Tj=25℃		3950		K
B-value	B(25/100)	Tol. ±3%				Tj=25℃		3996		K
Vincotech NTC Reference									B	

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	
Module Properties										
Module inductance (from chips to PCB)	L_{sCE}							5		nH
Module inductance (from PCB to PCB using Intercon board)	$L_{sCE\ C\text{-}PCB}$							3		nH
Resistance of Intercon boards (from PCB to PCB using Intercon board)	$Rcc_{'1+EE'}$	Tc=25℃, per switch						1,5		mΩ
Mounting torque	M	Screw M4 - mounting according FSWB1-4TY-M-*-HI					2		2,2	Nm
Mounting torque	M	Screw M5 - mounting according to valid application note FSWB1-4TY-M-*-HI					4		6	Nm
Terminal connection torque	M	Screw M6 - mounting according to valid application note FSWB1-4TY-M-*-HI					2,5		5	Nm
Weight	G								710	g

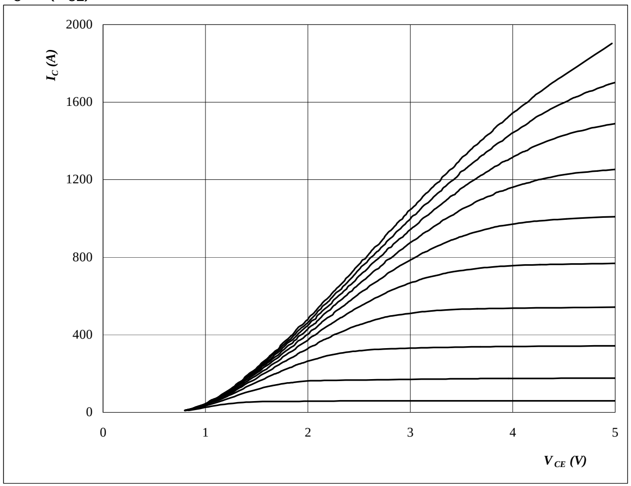
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



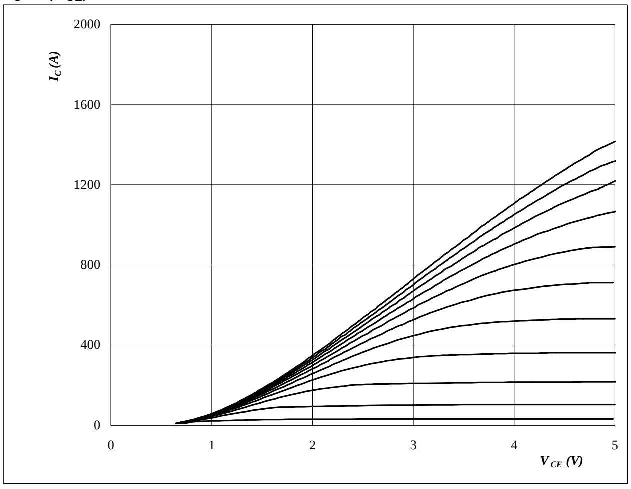
At

t_p =	350	μs
T_j =	25	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



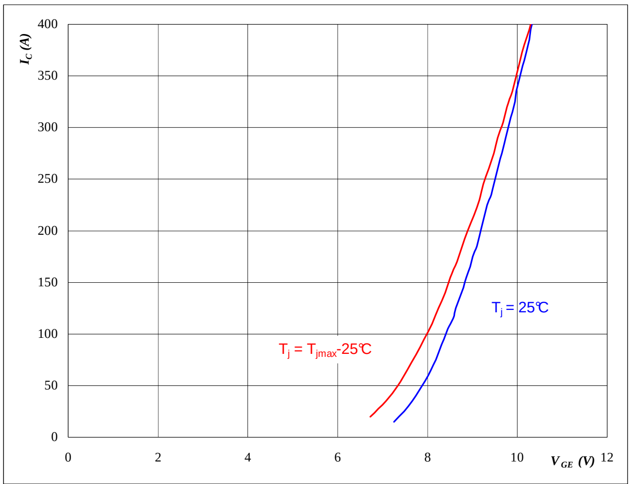
At

t_p =	350	μs
T_j =	125	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



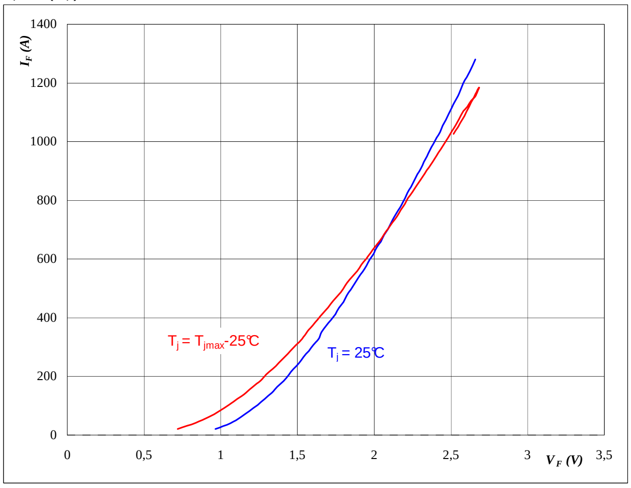
At

t_p =	350	μs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	350	μs

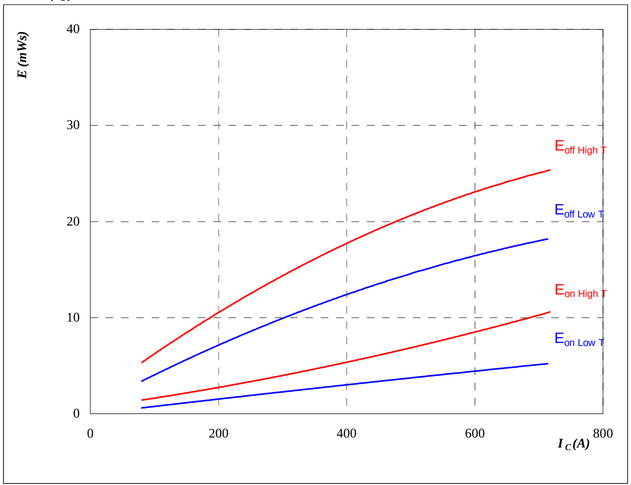
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



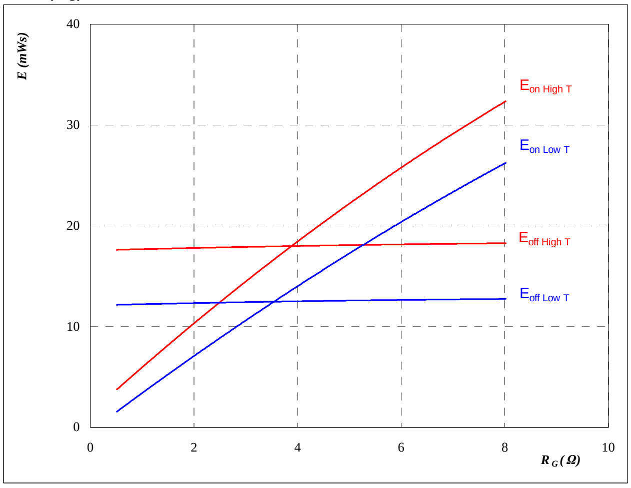
With an inductive load at

T_j =	25 / 125	°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

$E = f(R_G)$



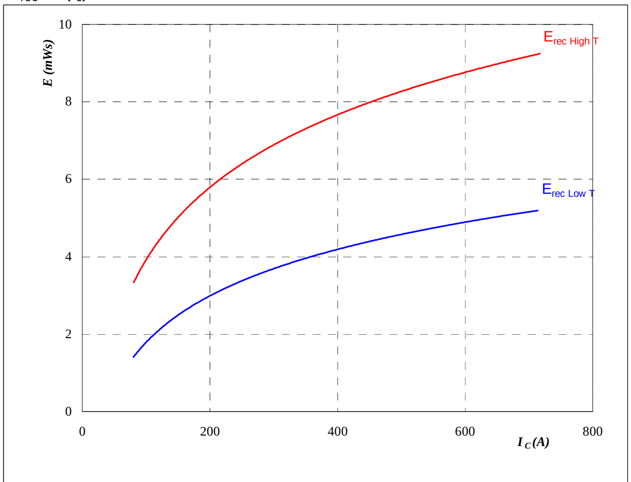
With an inductive load at

T_j =	25 / 125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	400	A

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



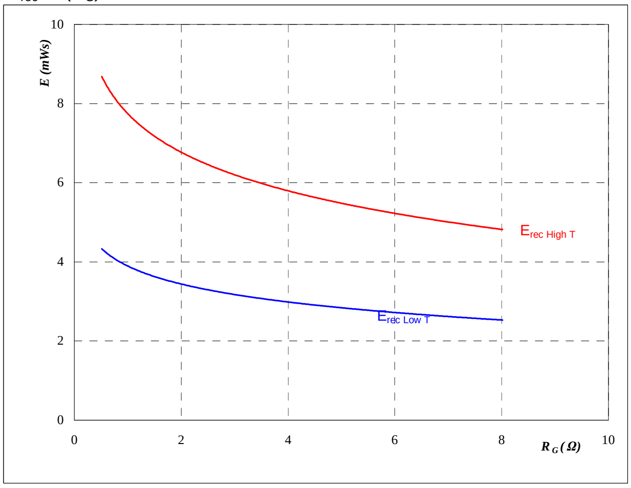
With an inductive load at

T_j =	25 / 125	°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	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	400	A

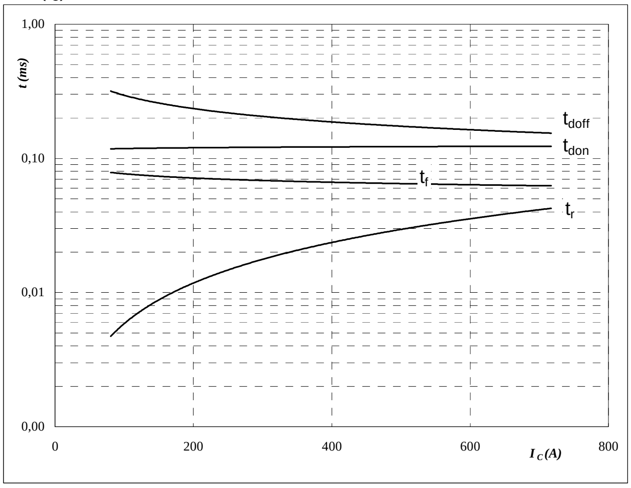
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



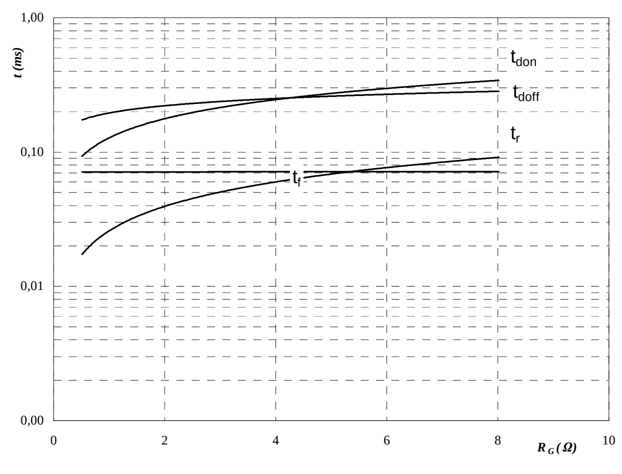
With an inductive load at

T_j =	125	℃
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)



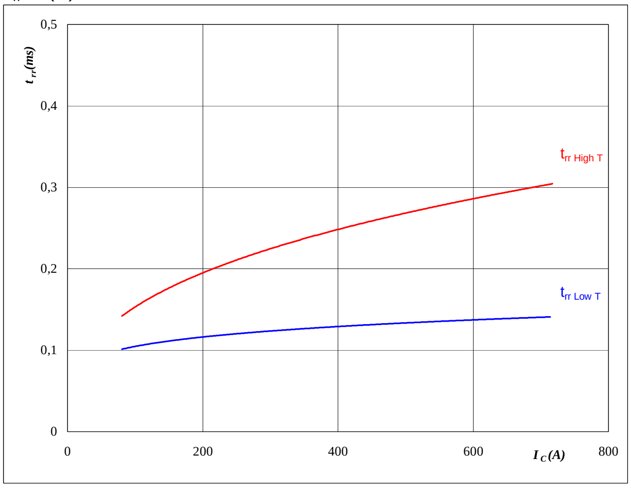
With an inductive load at

T_j =	125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	400	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



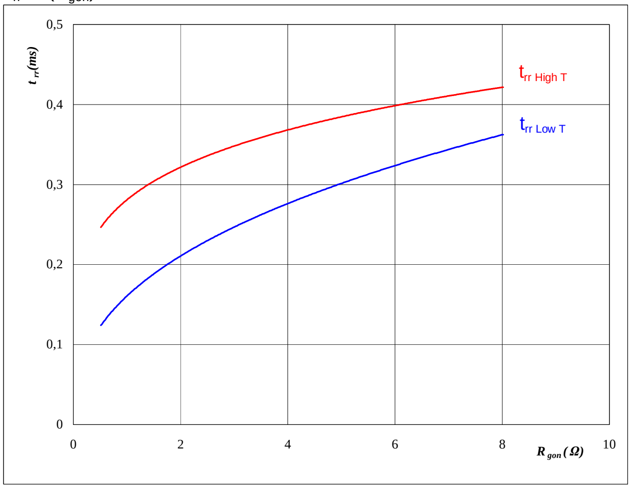
At

T_j =	25 / 125	℃
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	℃
V_R =	350	V
I_F =	400	A
V_{GE} =	±15	V

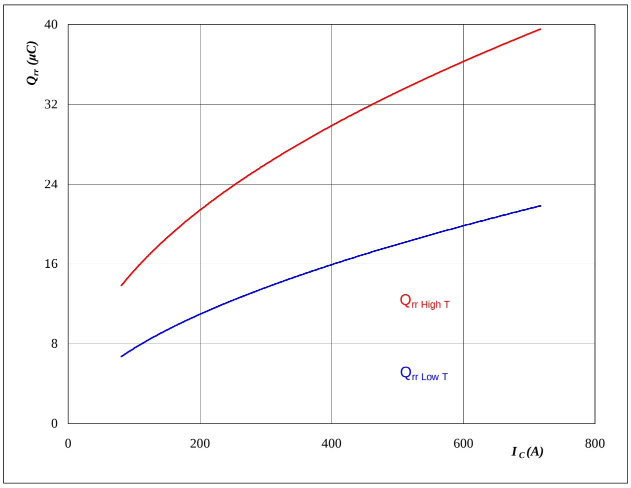
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



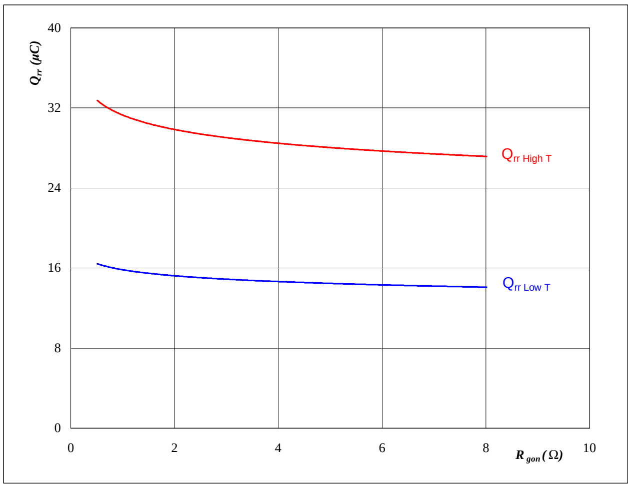
At

T_j =	25 / 125	℃
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

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



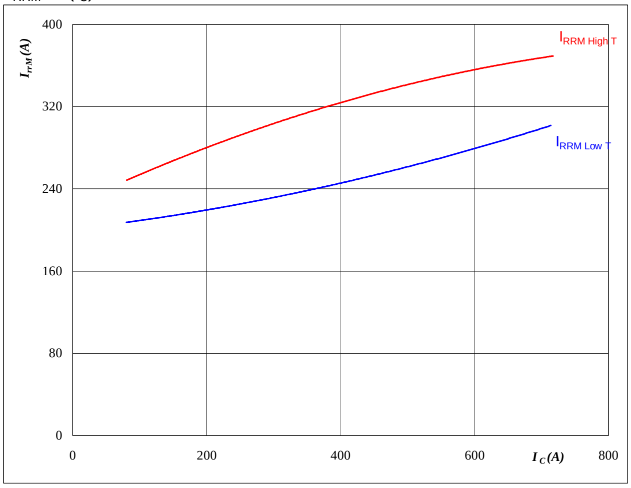
At

T_j =	25 / 125	℃
V_R =	350	V
I_F =	400	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



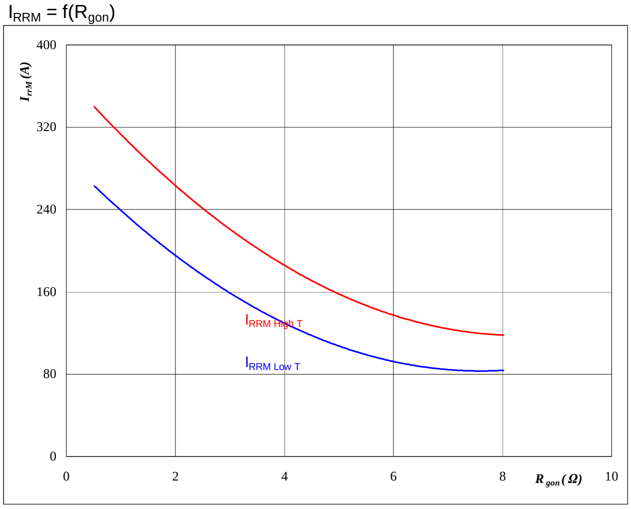
At

T_j =	25 / 125	℃
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	℃
V_R =	350	V
I_F =	400	A
V_{GE} =	±15	V

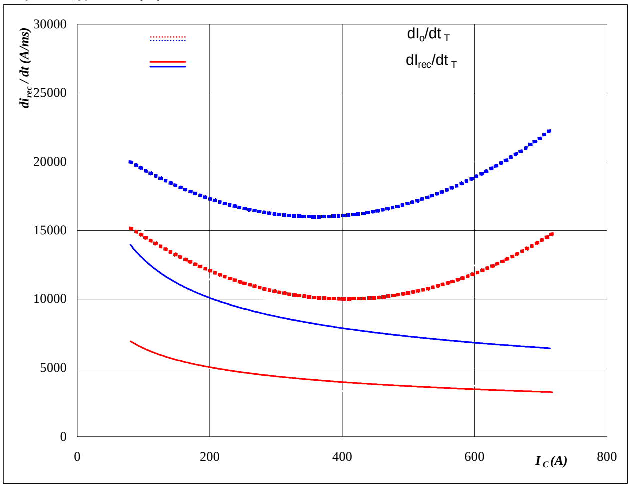
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 17 FWD

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

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



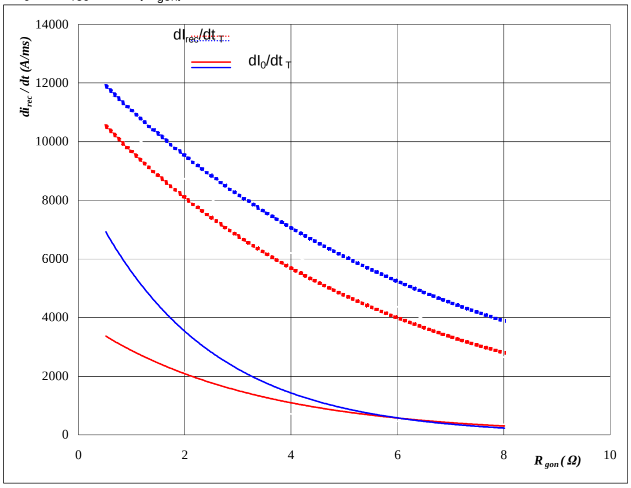
At

T_j =	25 / 125	℃
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

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



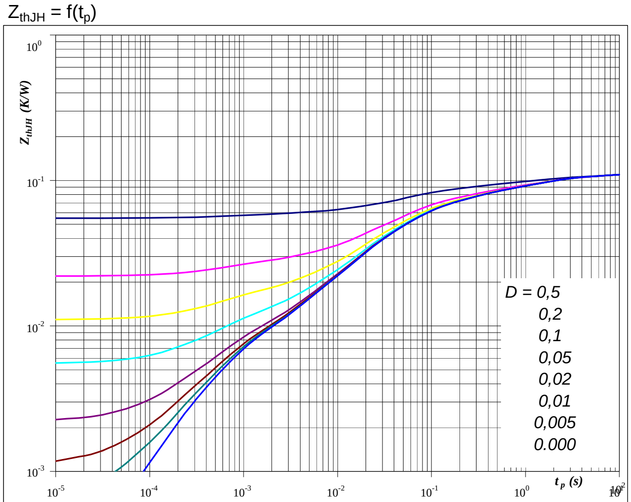
At

T_j =	25 / 125	℃
V_R =	350	V
I_F =	400	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} =	0,11	K/W

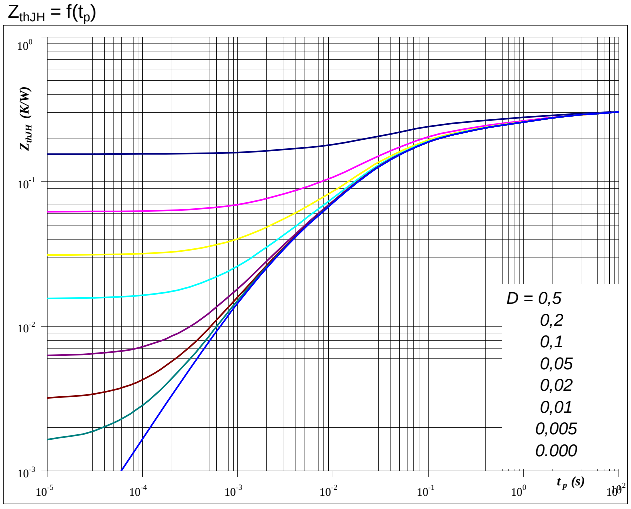
IGBT thermal model values

R (C/W)	Tau (s)
0,02	2,9E+00
0,02	6,6E-01
0,02	1,3E-01
0,04	3,1E-02
0,01	5,0E-03
0,01	5,6E-04

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} =	0,31	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,04	5,1E+00
0,04	1,1E+00
0,06	1,8E-01
0,11	3,7E-02
0,04	1,1E-02
0,02	1,8E-03

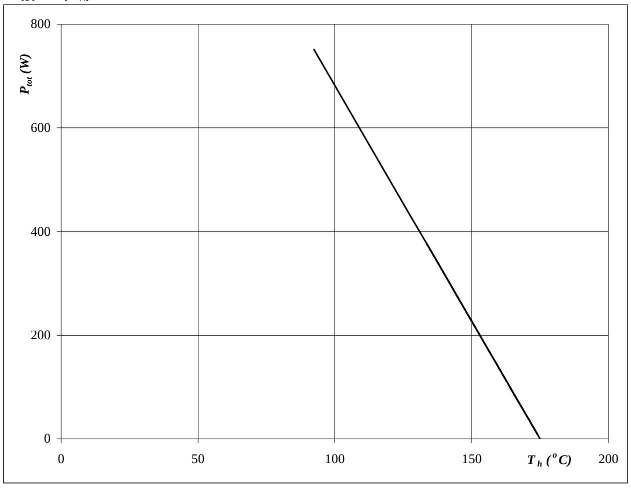
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



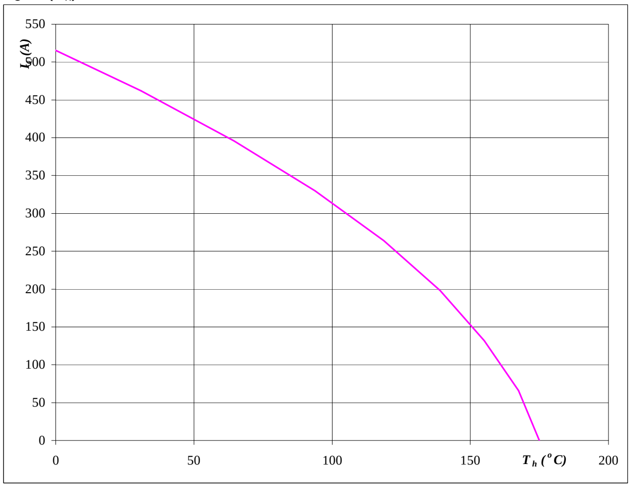
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

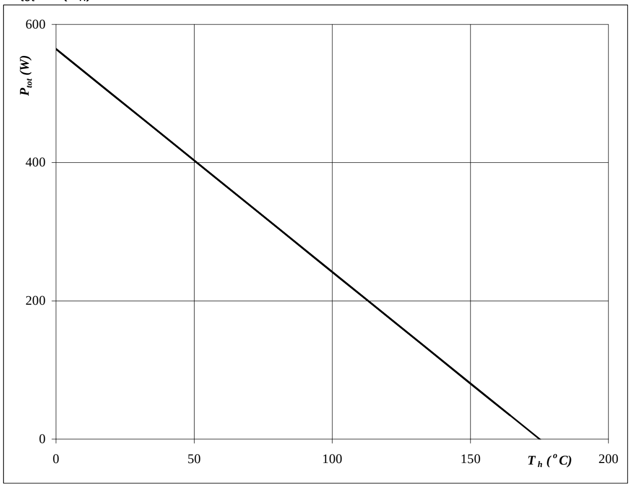
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



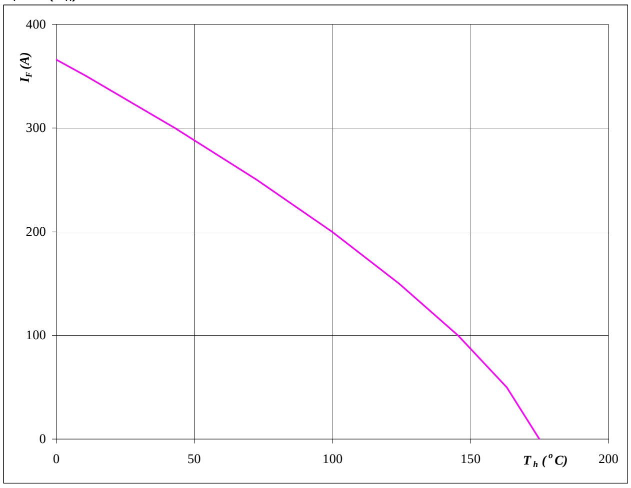
At

T_j = 175 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 175 ℃

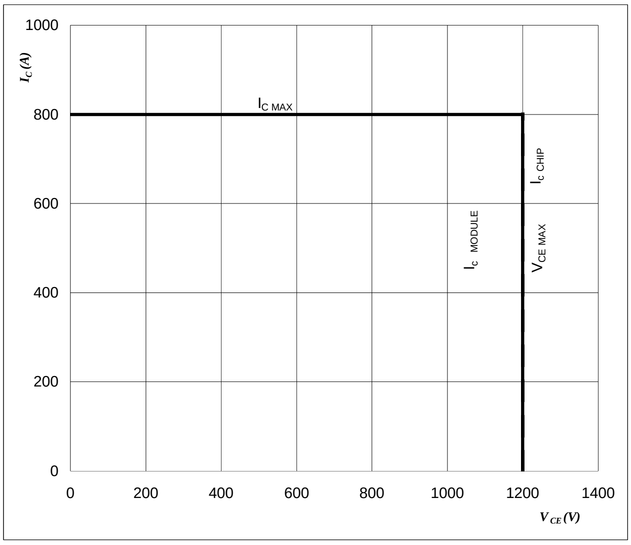
Buck operation

Half Bridge IGBT (T1, T4) & Neutral Point FWD (D2, D3)

Figure 29	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	125 ℃	
R_{gon} =	1	Ω
R_{goff} =	1	Ω

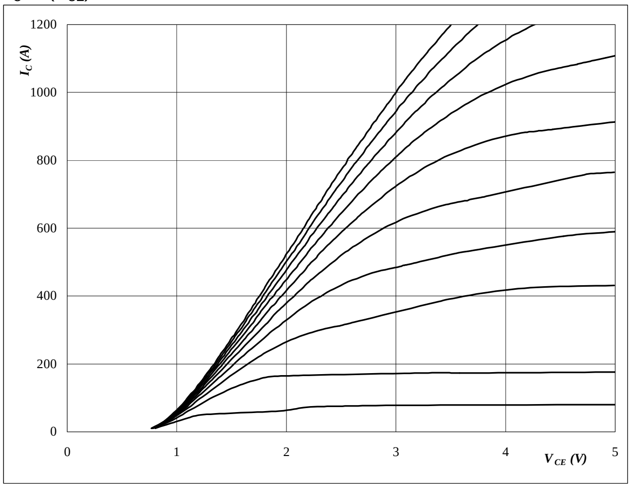
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



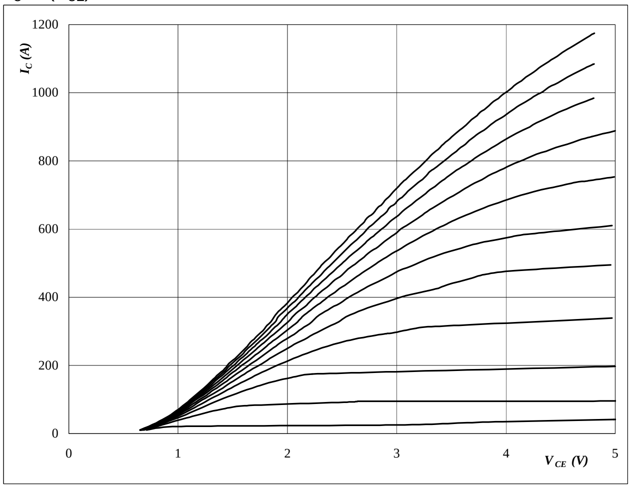
At

t_p =	350	µs
T_j =	25	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



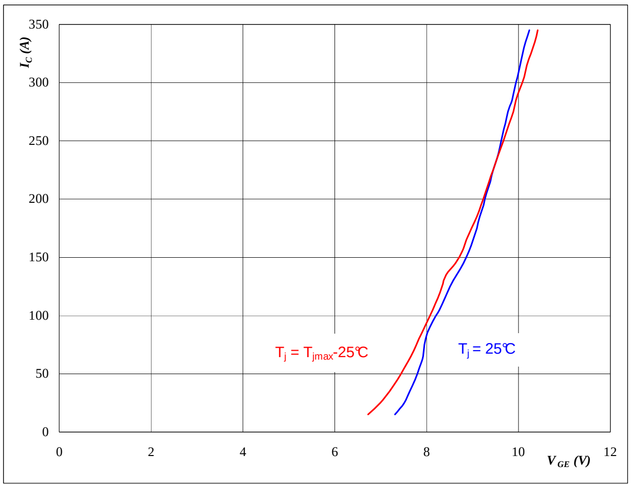
At

t_p =	350	µs
T_j =	125	℃
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



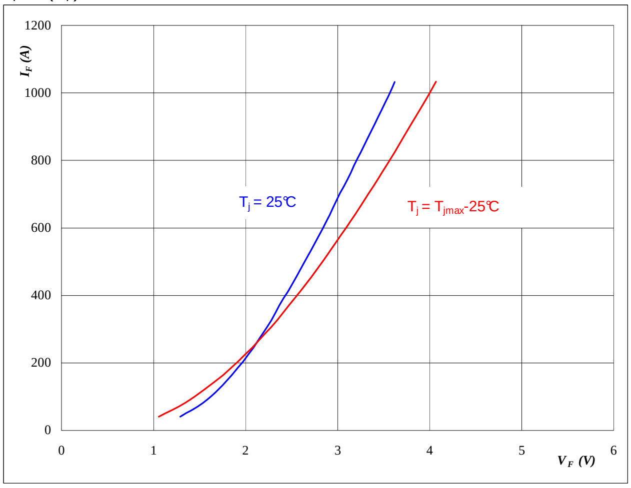
At

t_p =	350	µs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as
a function of forward voltage

$I_F = f(V_F)$



At

t_p =	350	µs

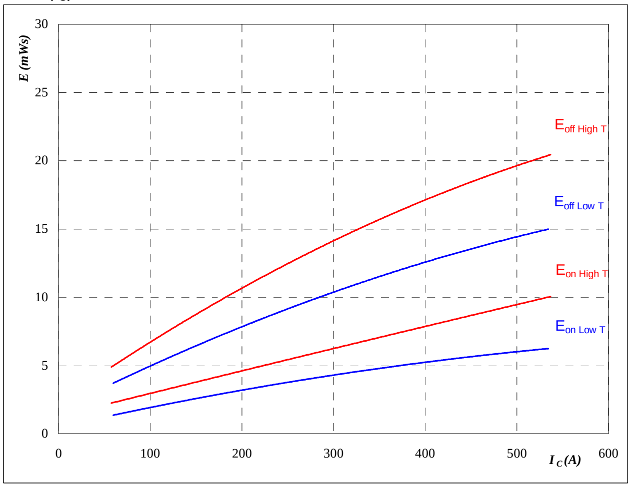
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 5 IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



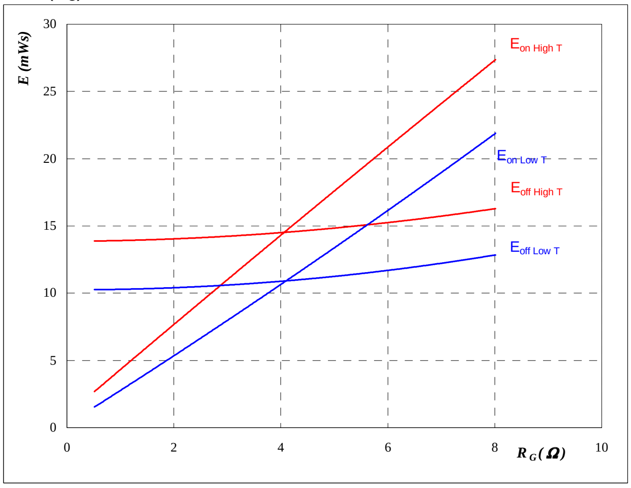
With an inductive load at

T_j =	25 / 125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



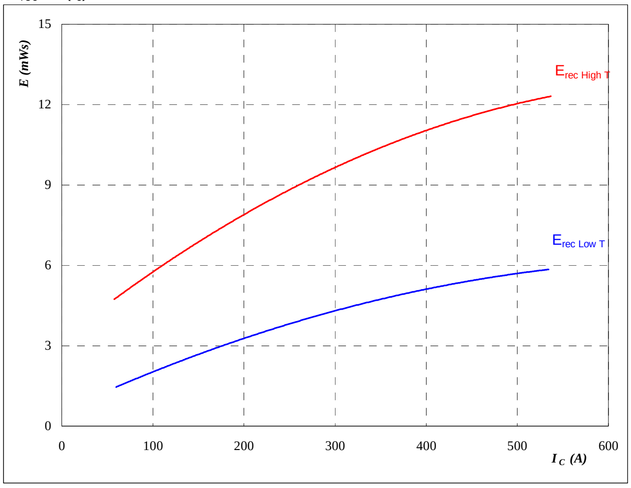
With an inductive load at

T_j =	25 / 125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	300	A

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



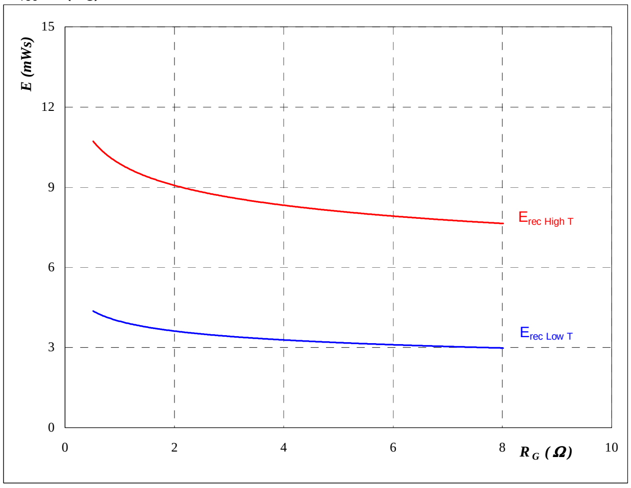
With an inductive load at

T_j =	25 / 125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	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	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	300	A

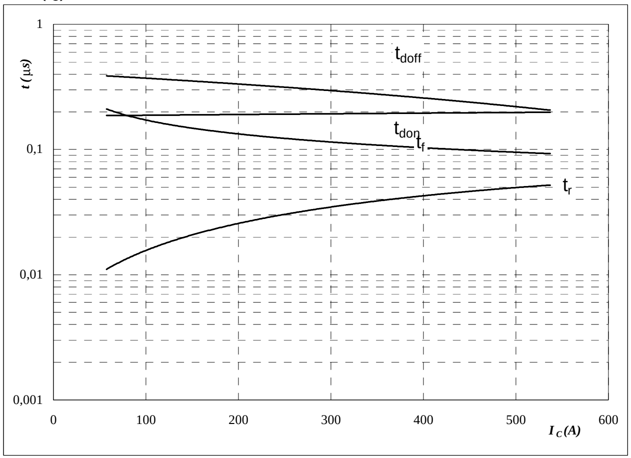
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



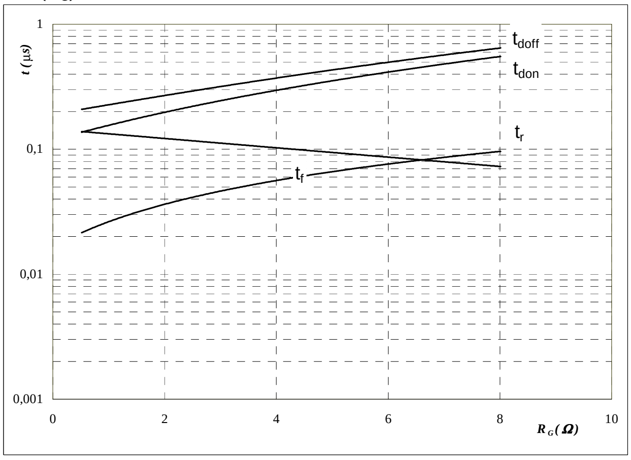
With an inductive load at

T_j =	125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



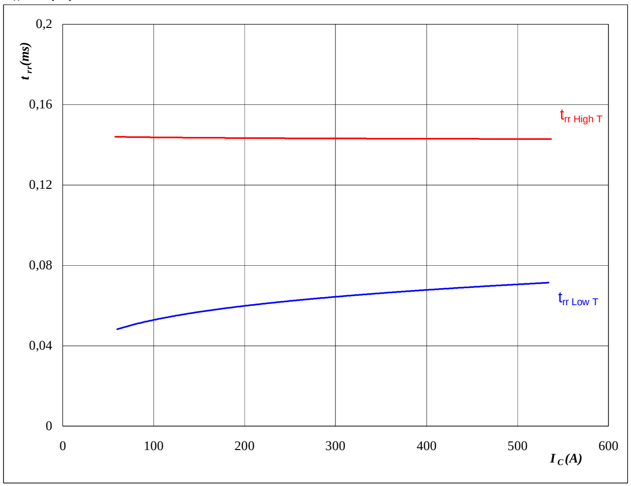
With an inductive load at

T_j =	125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	300	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



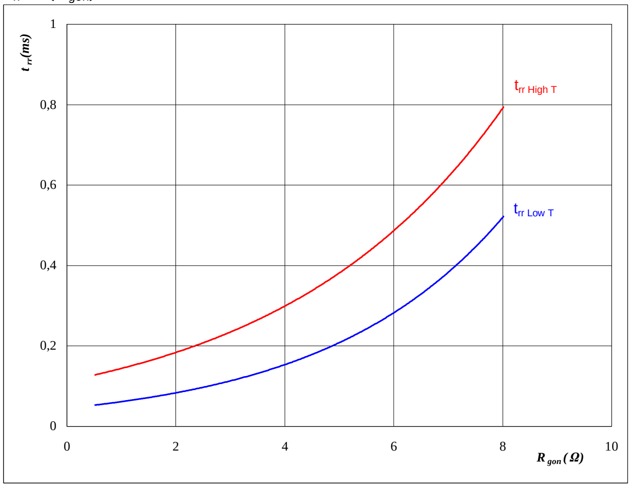
At

T_j =	25 / 125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	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	℃
V_R =	350	V
I_F =	300	A
V_{GE} =	±15	V

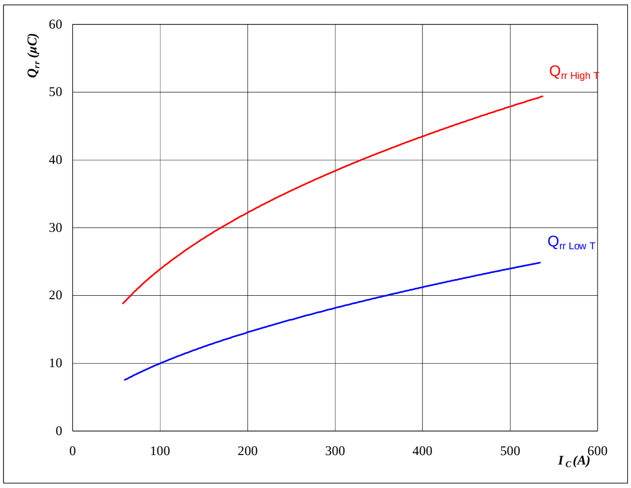
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



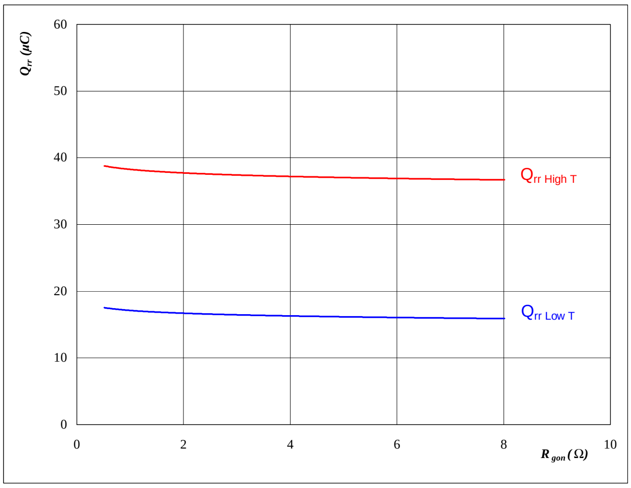
At

T_j =	25 / 125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 14 FWD

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

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



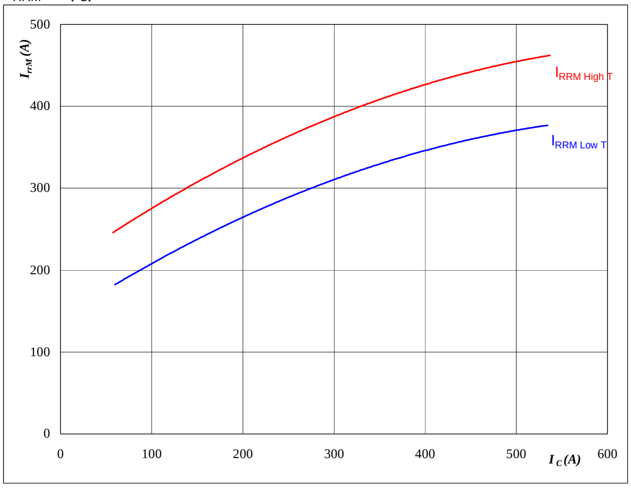
At

T_j =	25 / 125	℃
V_R =	350	V
I_F =	300	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



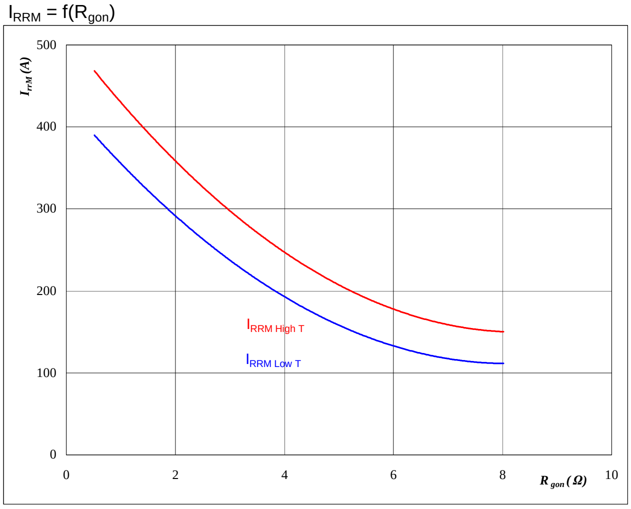
At

T_j =	25 / 125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	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	℃
V_R =	350	V
I_F =	300	A
V_{GE} =	±15	V

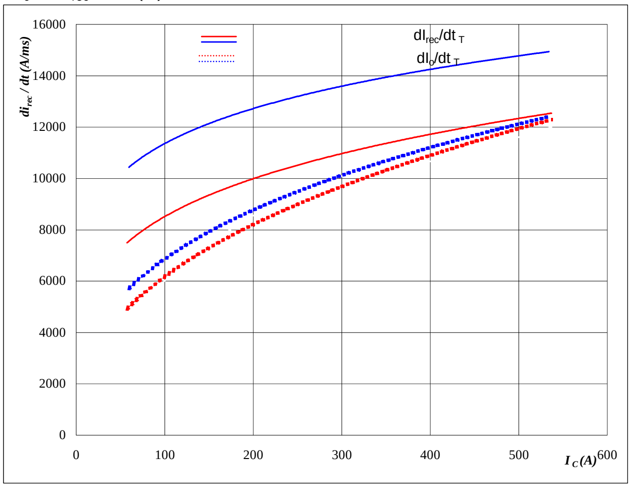
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 17 FWD

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

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



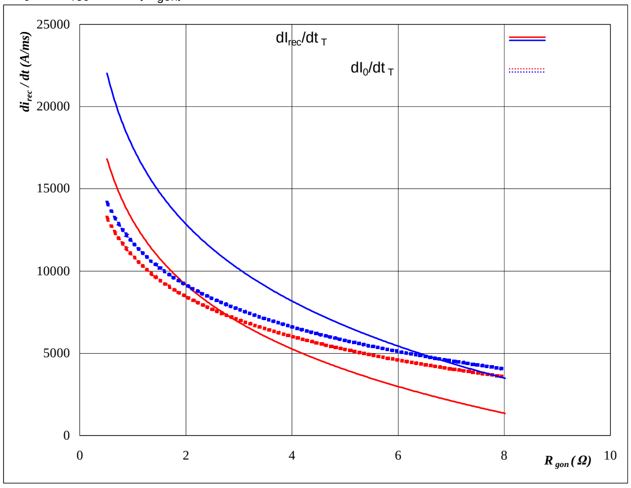
At

T_j =	25 / 125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 18 FWD

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

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



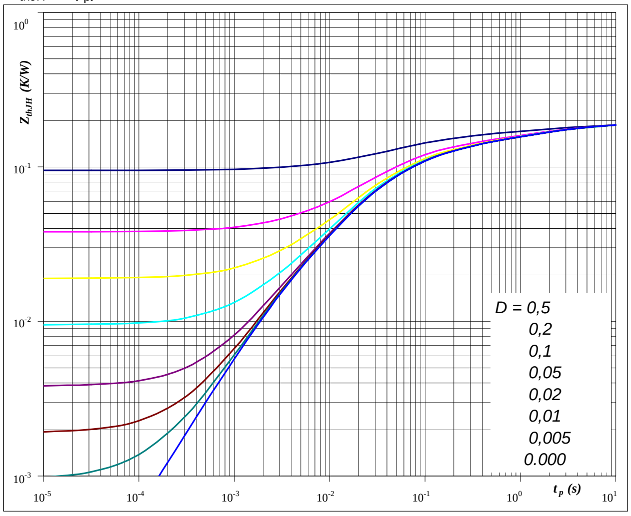
At

T_j =	25 / 125	℃
V_R =	350	V
I_F =	300	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 =	tp / T	
R_{thJH} =	0,19	K/W

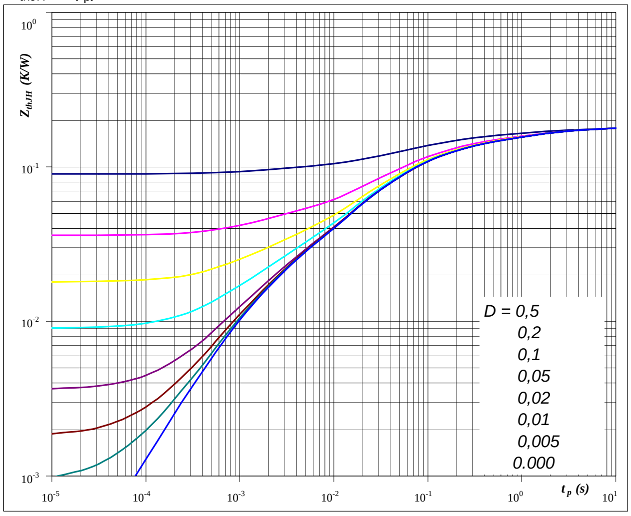
IGBT thermal model values

R (C/W)	Tau (s)
0,02	5,05
0,03	1,19
0,03	0,24
0,06	0,05
0,04	0,02
0,01	0,00

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	0,18	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,02	4,17
0,03	0,86
0,05	0,15
0,06	0,03
0,01	0,01
0,01	0,00

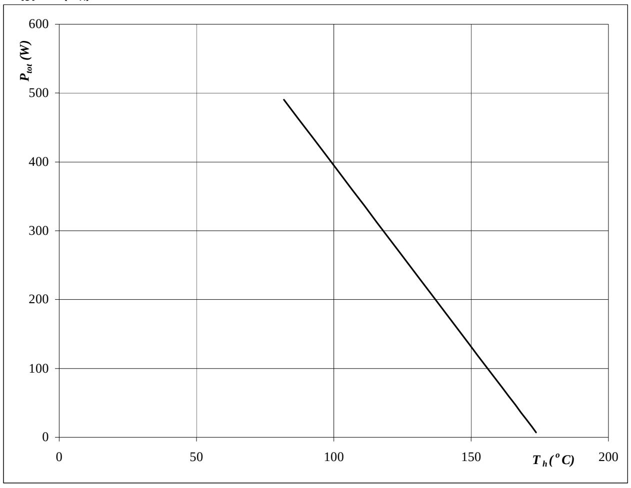
Boost operation

Neutral Point IGBT (T2, T3) & Half Bridge FWD ((D1, D4)

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



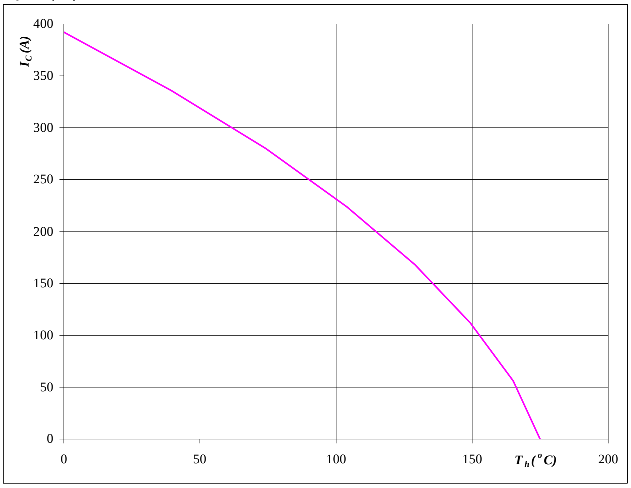
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

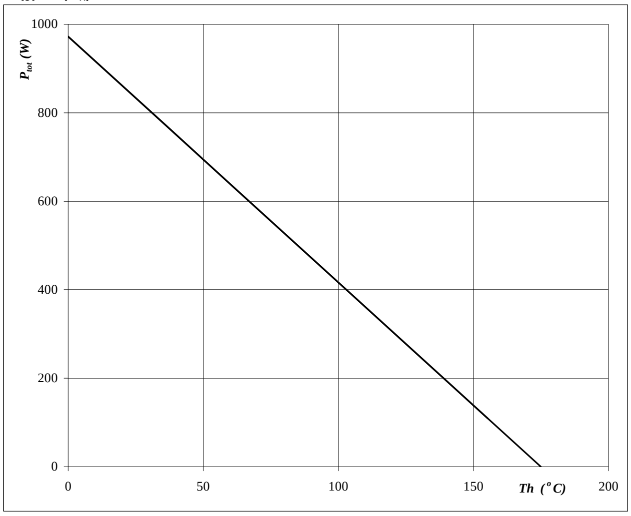
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



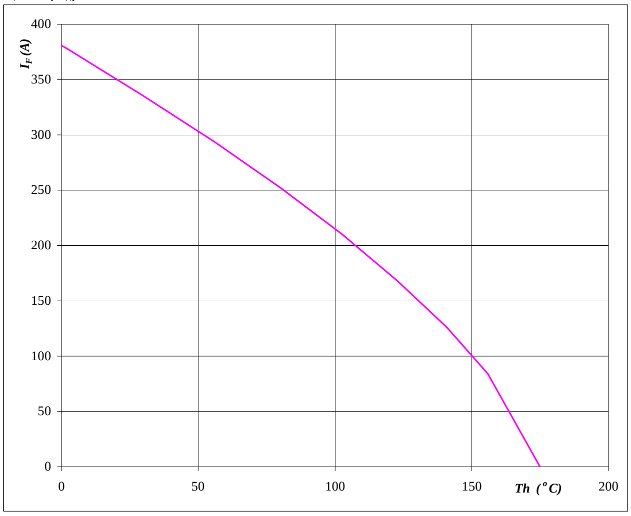
At

T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

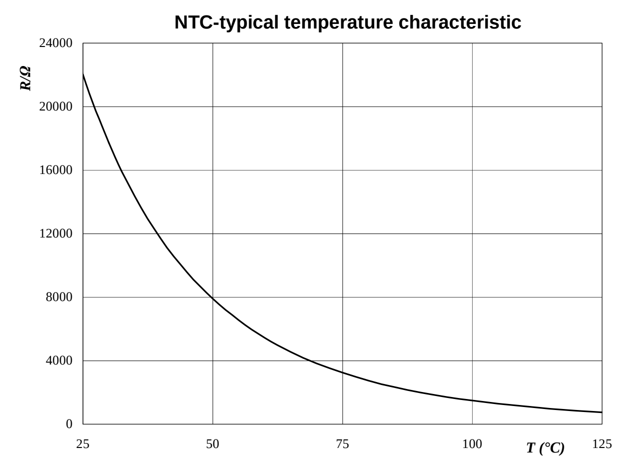
T_j = 175 ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



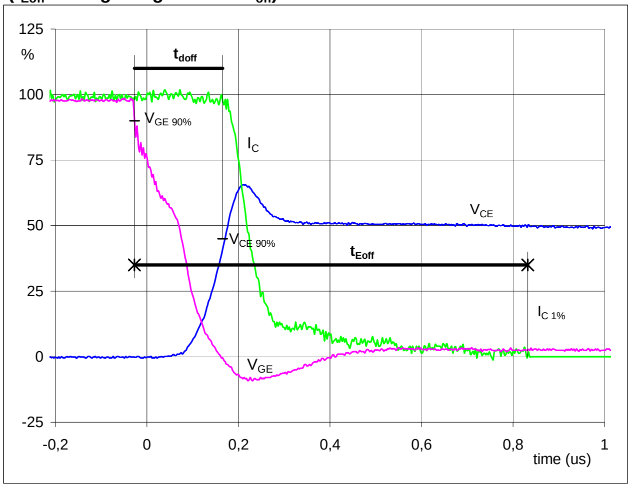
Switching Definitions Half Bridge

General conditions

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

Figure 1 Half Bridge IGBT

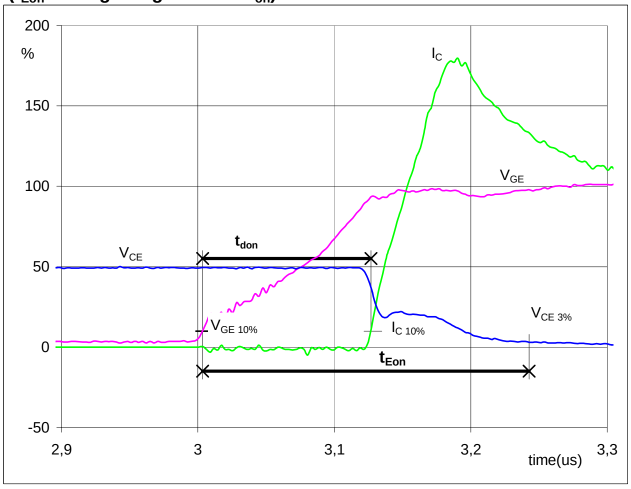
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	400	A
t_{doff} =	0,19	μs
t_{Eoff} =	0,86	μs

Figure 2 Half Bridge IGBT

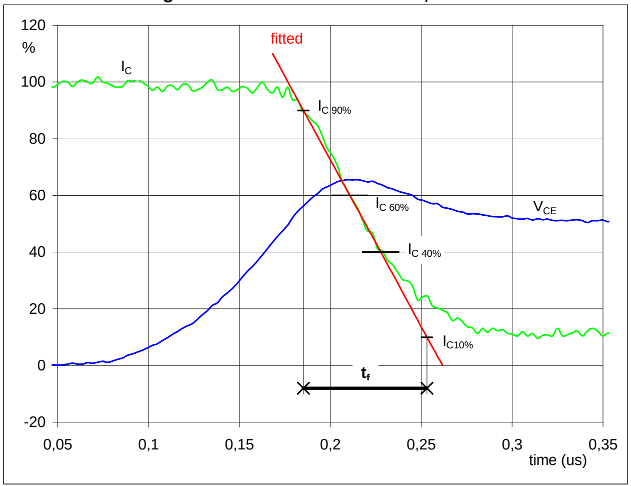
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	400	A
t_{don} =	0,12	μs
t_{Eon} =	0,24	μs

Figure 3 Half Bridge IGBT

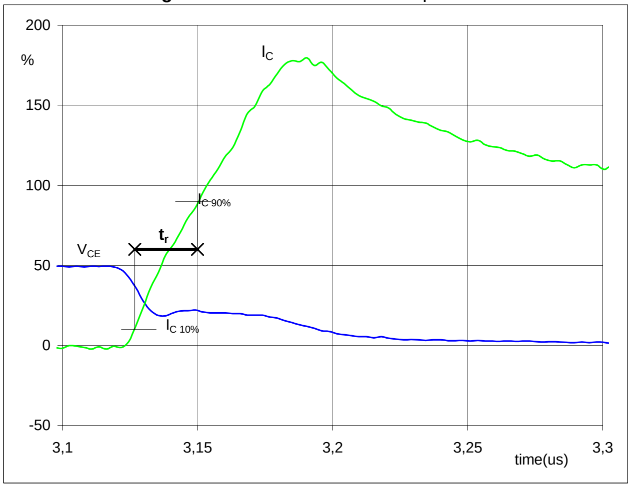
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	400	A
t_f =	0,07	μs

Figure 4 Half Bridge IGBT

Turn-on Switching Waveforms & definition of t_r

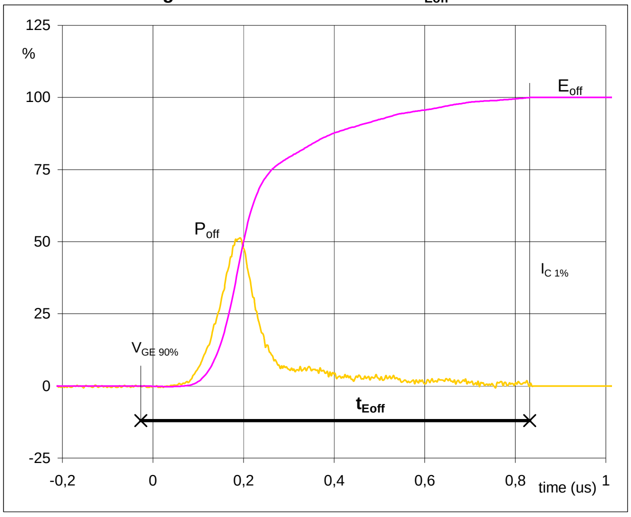


V_C (100%) =	700	V
I_C (100%) =	400	A
t_r =	0,02	μs

Switching Definitions Half Bridge

Figure 5 Half Bridge IGBT

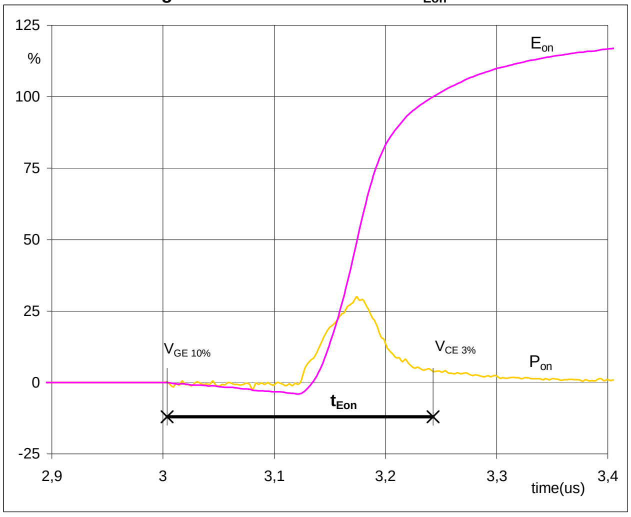
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	280	kW
E_{off} (100%) =	17,66	mJ
t_{Eoff} =	0,86	μs

Figure 6 Half Bridge IGBT

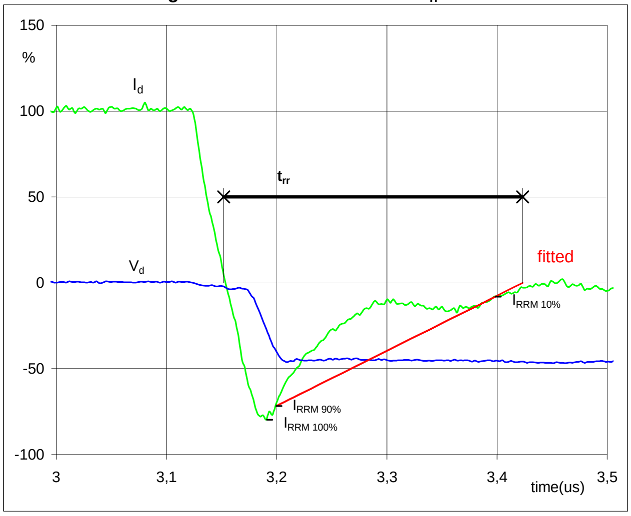
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	280	kW
E_{on} (100%) =	5,40	mJ
t_{Eon} =	0,24	μs

Figure 7 Half Bridge IGBT

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

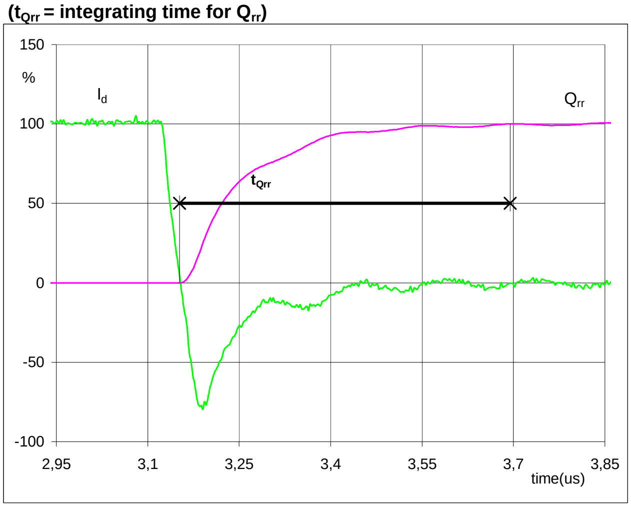


V_d (100%) =	700	V
I_d (100%) =	400	A
I_{RRM} (100%) =	-320	A
t_{rr} =	0,27	μs

Switching Definitions Half Bridge

Figure 8 Neutral Point FWD

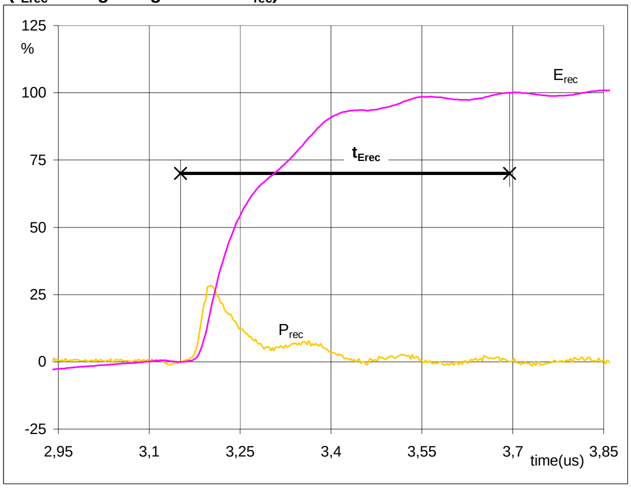
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	400	A
Q_{rr} (100%) =	30,81	μC
t_{Qrr} =	0,54	μs

Figure 9 Neutral Point FWD

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

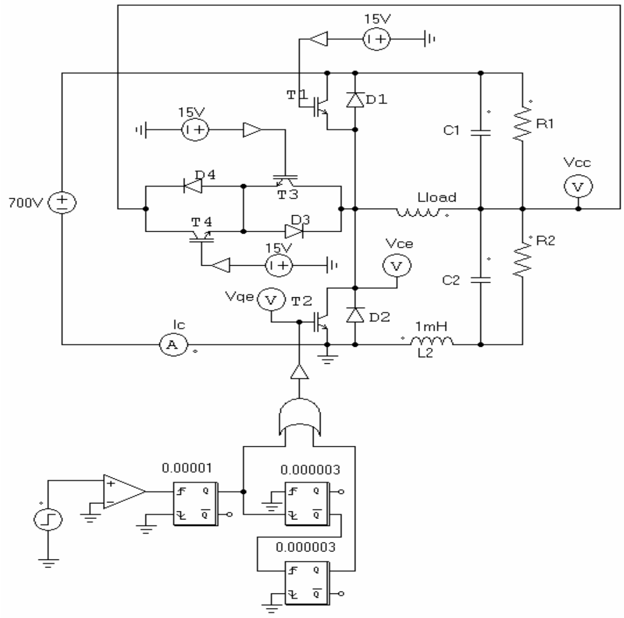


P_{rec} (100%) =	280	kW
E_{rec} (100%) =	7,81	mJ
t_{Erec} =	0,54	μs

Measurement circuits

Figure 10

Half Bridge stage switching measurement circuit



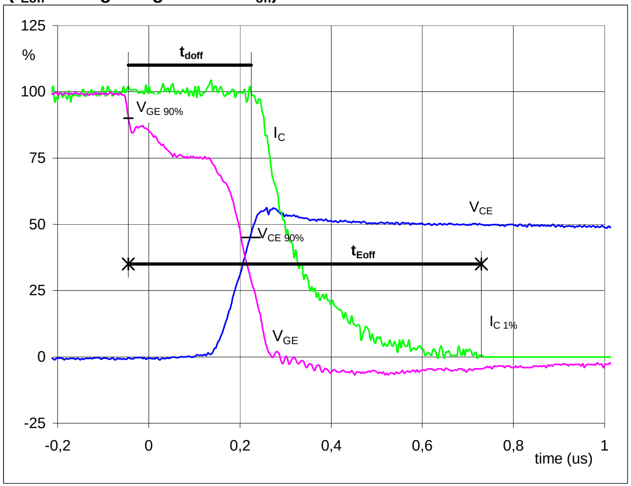
Switching Definitions Neutral Point

General conditions

T_j	=	125 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

Figure 1 Neutral Point IGBT

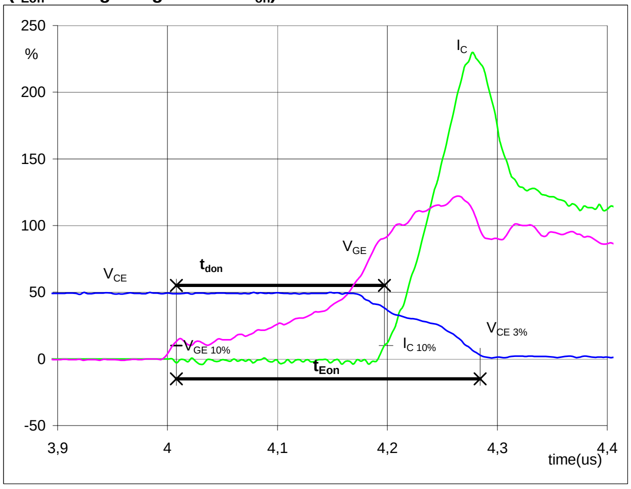
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	300	A
t_{doff} =	0,26	μs
t_{Eoff} =	0,77	μs

Figure 2 Neutral Point IGBT

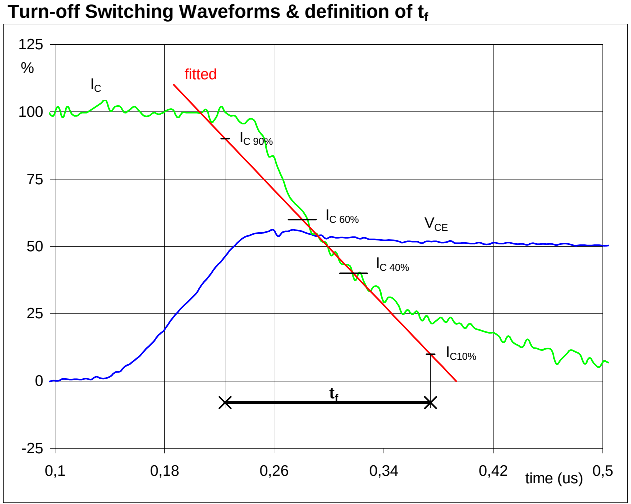
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	300	A
t_{don} =	0,19	μs
t_{Eon} =	0,28	μs

Figure 3 Neutral Point IGBT

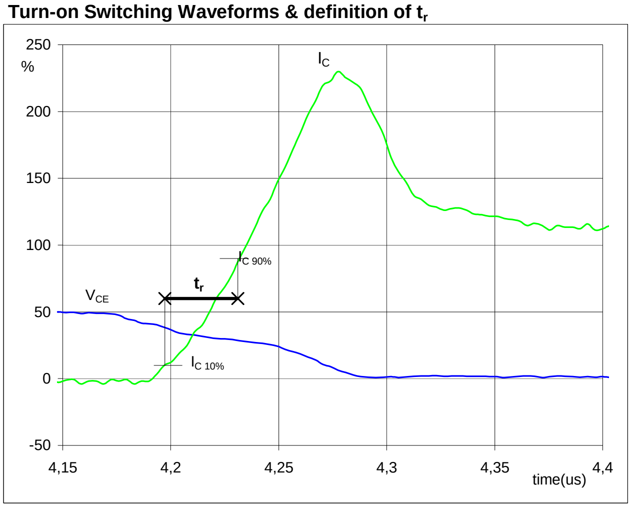
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	300	A
t_f =	0,12	μs

Figure 4 Neutral Point IGBT

Turn-on Switching Waveforms & definition of t_r

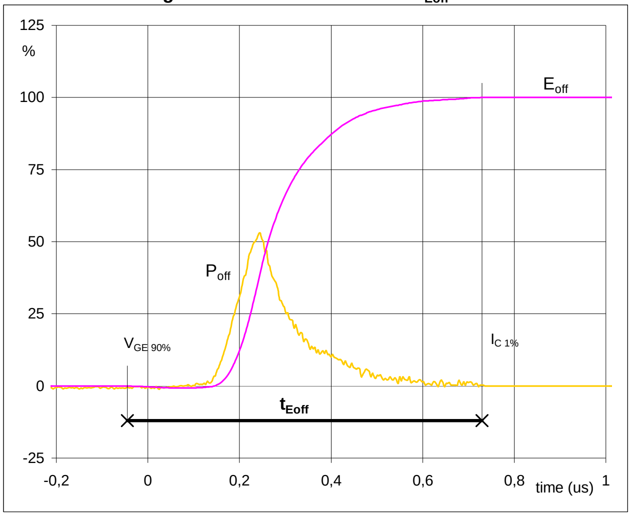


V_C (100%) =	700	V
I_C (100%) =	300	A
t_r =	0,03	μs

Switching Definitions Neutral Point

Figure 5 Neutral Point IGBT

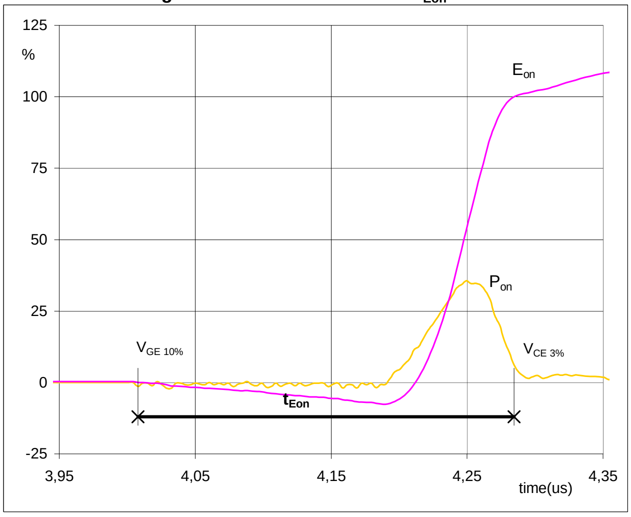
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	210	kW
E_{off} (100%) =	14,03	mJ
t_{Eoff} =	0,77	μs

Figure 6 Neutral Point IGBT

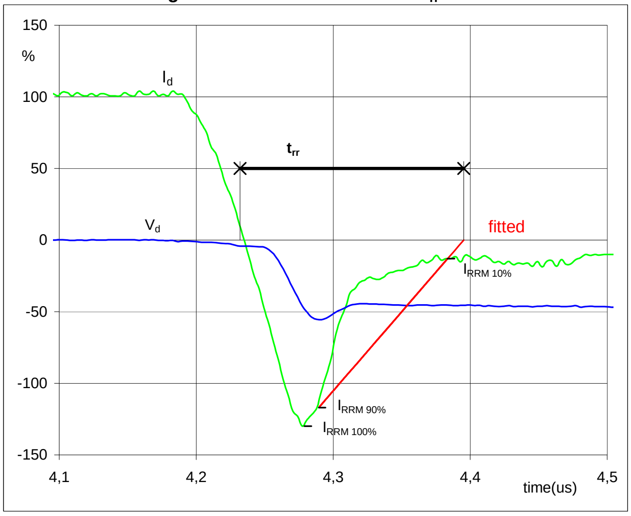
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	210	kW
E_{on} (100%) =	6,19	mJ
t_{Eon} =	0,28	μs

Figure 7 Neutral Point IGBT

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

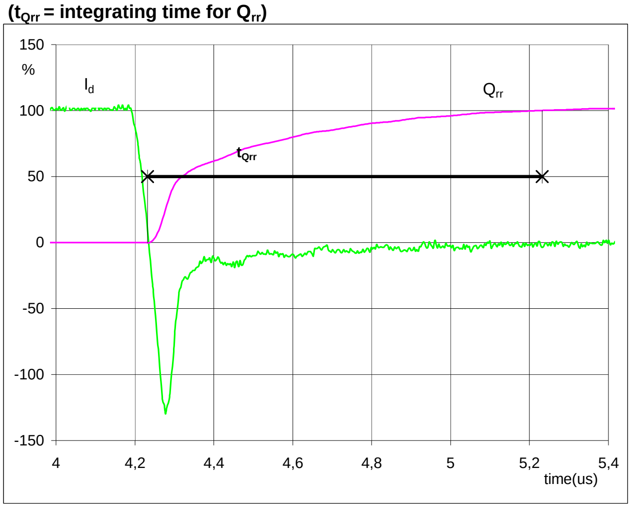


V_d (100%) =	700	V
I_d (100%) =	300	A
I_{RRM} (100%) =	-385	A
t_{rr} =	0,15	μs

Switching Definitions Neutral Point

Figure 8 Half Bridge FWD

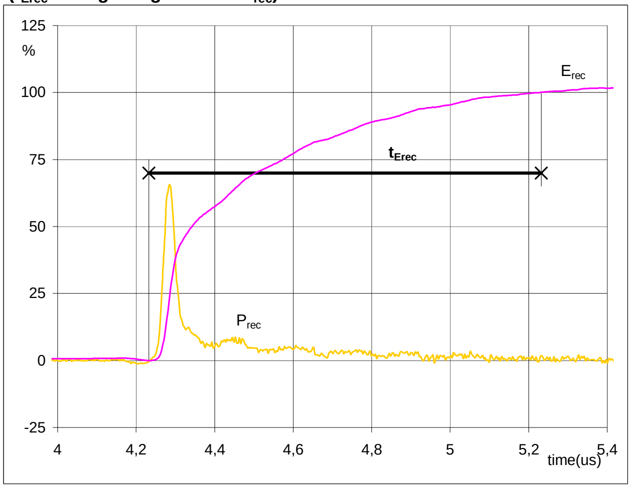
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	300	A
Q_{rr} (100%) =	38,18	μC
t_{Qrr} =	1,00	μs

Figure 9 Half Bridge FWD

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

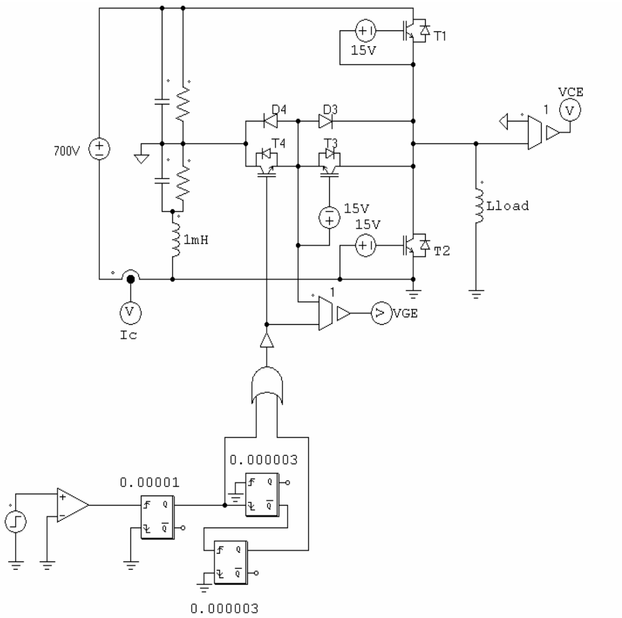


P_{rec} (100%) =	210	kW
E_{rec} (100%) =	9,72	mJ
t_{Erec} =	1,00	μs

Measurement circuits

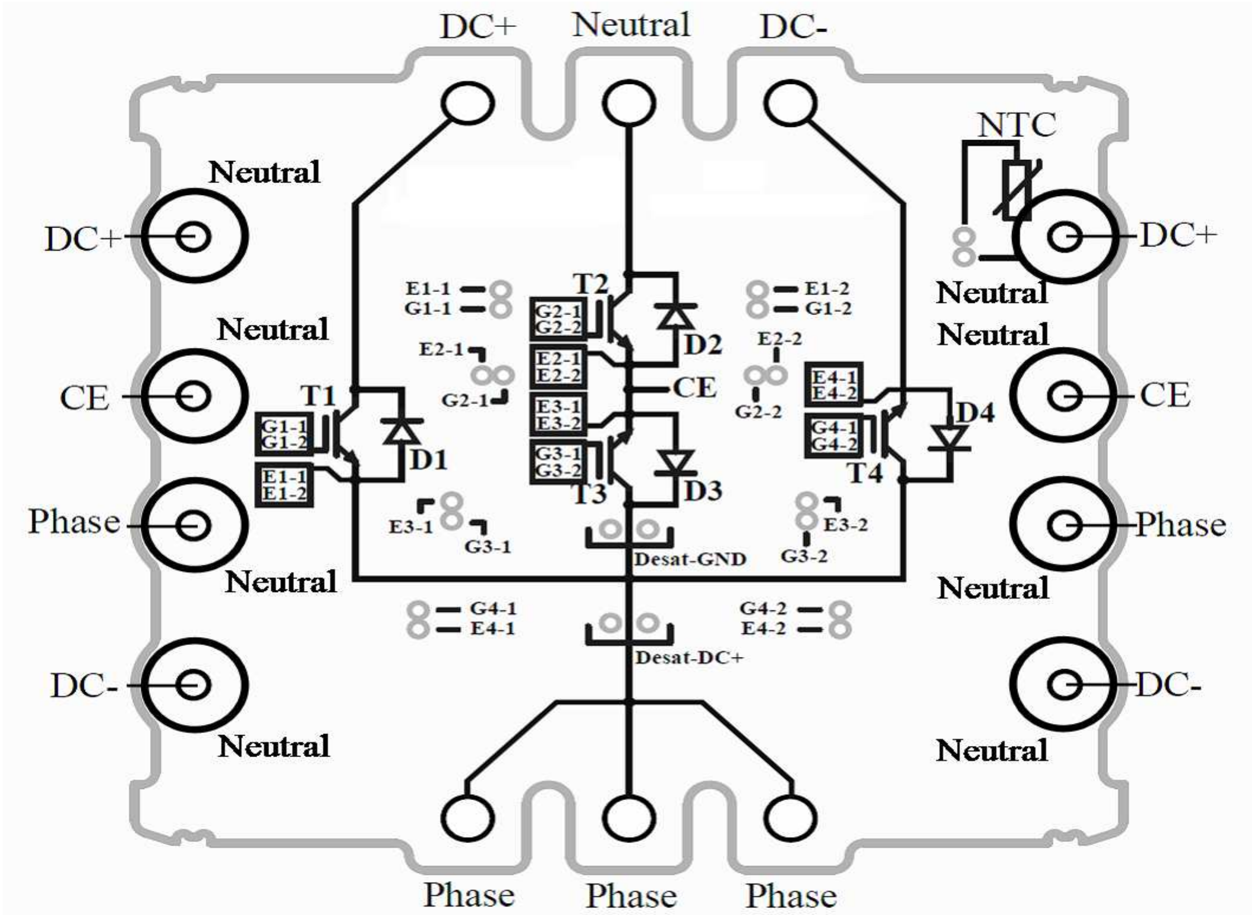
Figure 10

Neutral Point stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

Pinout



Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without PCM	70-W212NMA400NB02-M209P62	M209P62	M209P62
with PCM	70-W212NMA400NB02-M209P62-/3/	M209P62	M209P62-/3/

Outline

Driver pins

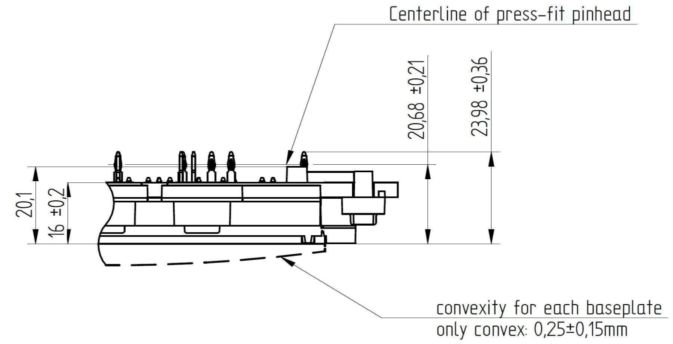
Pin	X1	Y1	Function	Group
1.1	4,5	78,65	G1-1	T1
1.2	4,5	81,55	E1-1	T1
1.3	39,5	78,65	G1-2	T1
1.4	39,5	81,55	E1-2	T1
1.5	1,95	68,4	E2-1	T2
1.6	4,85	68,4	G2-1	T2
1.7	39,15	68,4	G2-2	T2
1.8	42,05	68,4	E2-2	T2
1.9	-2,2	46	G3-1	T3
1.10	-2,2	48,9	E3-1	T3
1.11	46,2	46	G3-2	T3
1.12	46,2	48,9	E3-2	T3
1.13	-6,75	29,2	E4-1	T4
1.14	-6,75	32,1	G4-1	T4
1.15	50,75	29,2	E4-2	T4
1.16	50,75	32,1	G4-2	T4
1.17	19,45	30,15	Desat-DC+	
1.18	24,55	30,15	Desat-DC+	
1.19	19,45	44,65	Desat-GND	
1.20	24,55	44,65	Desat-GND	
1.21	67,65	86,7	NTC	
1.22	67,65	89,8	NTC	

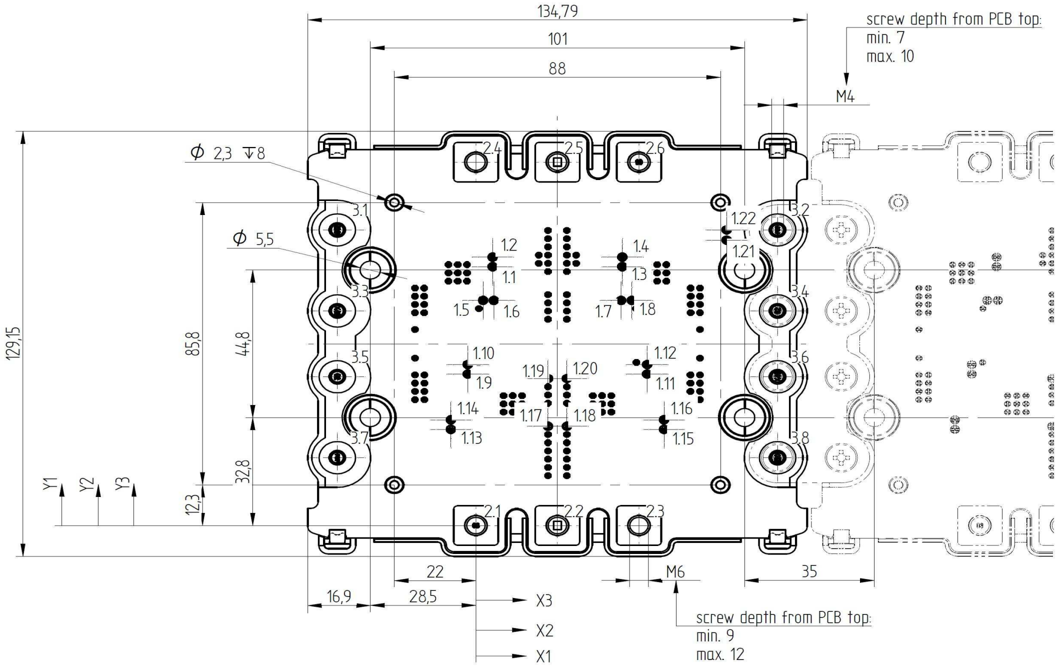
Low current connections

screw	X3	Y3	Function
3.1	-37,4	89,8	DC+
3.2	81,4	89,8	DC+
3.3	-37,4	65,2	CE
3.4	81,4	65,2	CE
3.5	-37,4	45,2	Phase
3.6	81,4	45,2	Phase
3.7	-37,4	20,6	DC-
3.8	81,4	20,6	DC-

Power connections

screw	X2	Y2	Function
2.1	0	0	Phase
2.2	22	0	Phase
2.3	44	0	Phase
2.4	0	110,4	DC+
2.5	22	110,4	Neutral
2.6	44	110,4	DC-





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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.