Vincotech

VINcoMNPC X4 — 1200 V / 600 A

Features

- Mixed-voltage NPC
- Low inductive
- High power screw interface
- Integrated DC-snubber capacitors

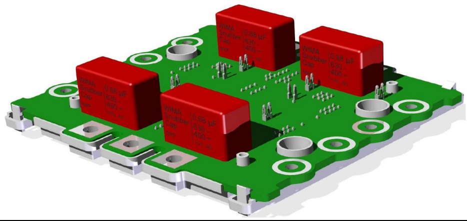
Target Applications

- Solar inverter
- UPS
- High speed motor drive

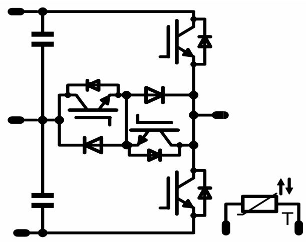
Types

- 70-W212NMA600SC-M200P

VINco X4 housing



Schematic



Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Buck Switch (T1 , T4)					
Collector-emitter breakdown voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	498 637	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		1800	A
Power dissipation	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	1188 1799	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j\leq150°C$ $V_{GE}=15V$		10 800	µs V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 1200V $T_{vj\ max}$= 150°C		1200	A
Maximum Junction Temperature	$T_j$max			175	°C
Buck Diode (D2 , D3)					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$		600	V
DC forward current	I_F	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	288 384	A
Surge forward current	I_{FSM}	t_p = 10 ms, sine halfwave	T_{vj} < 150°C	1250	A
I2t-value	I^2t	t_p = 10 ms, sine halfwave	T_{vj} < 150°C	7800	A^2s
Repetitive peak forward current	I_{FRM}	t_P = 1 ms	T_{vj} < 150°C	1200	A
Power dissipation per FWD	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	365 554	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Boost Switch (T2 , T3)					
Collector-emitter breakdown voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	388 510	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		1800	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	594 900	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	$T_j$max			175	°C
Boost Diode (D1 , D4)					
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 T_c=80°C	355 470	A
Surge forward current	I_{FSM}	t_p=10ms , sin 180°	T_j=150°C	3600	A
I2t-value	I^2t			16200	A^2s
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		1800	A
Power dissipation per FWD	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	633 960	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
DC link Capacitor				
Max.DC voltage	V_{MAX}		630	V
Operation Temperature	T_{OP}		-40…+105	°C
RMS Current	I_{RMS}		10	A
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}	for power part	-40…+(Tjmax - 25)	°C
Isolation Properties				
Isolation voltage	V_{is}	t=2s DC voltage	4000	V
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm
Comparative tracking index	CTI		>200	

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Buck Switch (T1 , T4)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,024	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		600	Tj=25°C Tj=125°C	1	2,16 2,42	2,4	V
Collector-emitter cut-off current incl.	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,6	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			3000	nA
Integrated Gate resistor	R_{gint}							1,25		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25°C Tj=125°C		296 310		
Rise time	t_r					Tj=25°C Tj=125°C		57 64		ns
Turn-off delay time	$t_{d(off)}$	Rgoff=1 Ω Rgon=1 Ω	±15	350	600	Tj=25°C Tj=125°C		350 410		
Fall time	t_f					Tj=25°C Tj=125°C		62 83		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		12 17		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		20 31		
Input capacitance	C_{ies}							37200		
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		2320		pF
Reverse transfer capacitance	C_{rss}							2040		
Gate charge	Q_{Gate}		±15	600	600	Tj=25°C		4800		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,08		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,06		
Buck Diode (D2 , D3)										
FWD forward voltage	V_F				600	Tj=25°C Tj=125°C	1,2	1,67 1,65	2,3	V
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=125°C		339 399		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		132 257		ns
Reverse recovered charge	Q_{rr}	Rgon=1 Ω	±15	350	600	Tj=25°C Tj=125°C		23 44		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		4888 3314		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		5 9		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,26		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,17		
Boost Switch (T2 , T3)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0096	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		600	Tj=25°C Tj=125°C	1	1,57 1,80	2,3	V
Collector-emitter cut-off incl.	I_{CES}		0	600		Tj=25°C Tj=125°C			0,1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			3000	nA
Integrated Gate resistor	R_{gint}							0,5		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25°C Tj=125°C		244 250		
Rise time	t_r					Tj=25°C Tj=125°C		49 53		ns
Turn-off delay time	$t_{d(off)}$	Rgoff=1 Ω Rgon=1 Ω	±15	350	600	Tj=25°C Tj=125°C		306 325		
Fall time	t_f					Tj=25°C Tj=125°C		48 67		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		8 13		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		15 22		
Input capacitance	C_{ies}							36960		
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		2304		pF
Reverse transfer capacitance	C_{rss}							1096		
Gate charge	Q_{Gate}		±15	300	600	Tj=25°C		6400		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,16		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,11		

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
Boost Diode (D1 , D4)										
FWD forward voltage	V_F				600	Tj=25°C Tj=125°C	1	2,23 2,31	3	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			720	µA
Peak reverse recovery current	I_{RRM}	Rgon=1 Ω	±15	350	600	Tj=25°C Tj=125°C		422 568		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		76 290		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		20 61		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		14692 12189		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		4 14		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,15		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,10		
DC link Capacitor										
Capacitance	C							1360		nF
Tolerance							-10		+10	%
Dissipation factor						T_j=20ºC			0,0004	mΩ
Climatic category								40/105/56		
Thermistor										
Rated resistance	R					Tj=25°C		22000		Ω
Deviation of R_{100}	ΔR/R	R100=1484 Ω				Tj=100°C	-5		+5	%
Power dissipation	P					Tj=25°C		5		mW
Power dissipation constant						Tj=25°C		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1%				Tj=25°C		3962		K
B-value	$B_{(25/100)}$	Tol. ±1%				Tj=25°C		4000		K
Vincotech NTC Reference						Tj=25°C			I	
Module Properties										
Module inductance (from chips to PCB)	L_{sCE}							5		nH
Module inductance (from PCB to PCB using Intercon board)	L_{sCE}							3		nH
Resistance of Intercon boards (from PCB to PCB using Intercon board)	$Rcc_{1+EE'}$	Tc=25°C, per switch						1,5		mΩ
Mounting torque	M	Screw M4 - mounting according to valid application note VINcoX-*-HI					2		2,2	Nm
Mounting torque	M	Screw M5 - mounting according to valid application note VINcoX-*-HI					4		6	Nm
Terminal connection torque	M	Screw M6 - mounting according to valid application note VINcoX-*-HI					2,5		5	Nm
Weight	G								710	g

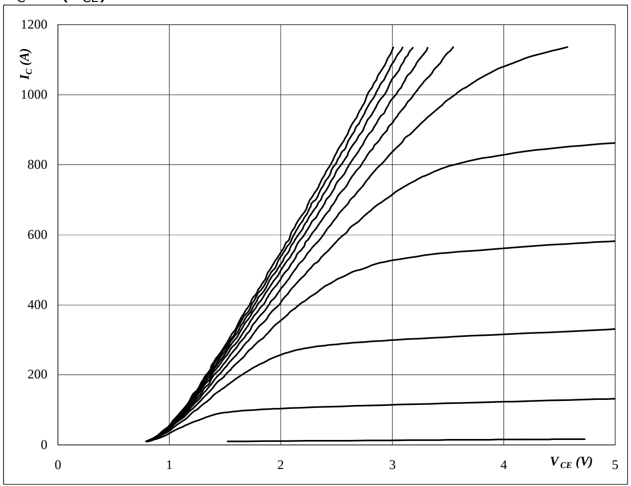
Buck

Half bridge IGBT and Neutral point FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



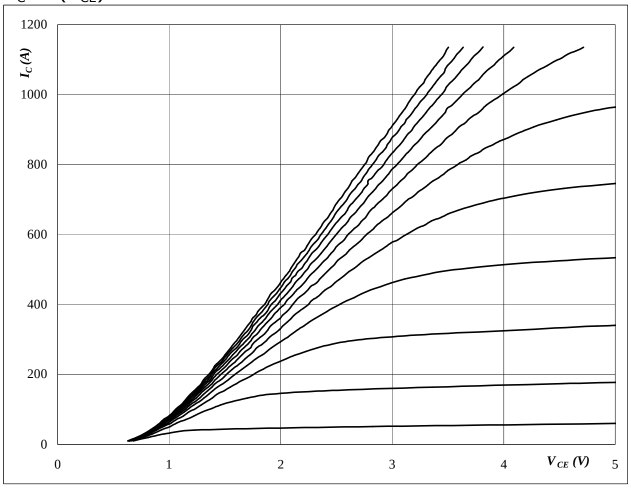
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



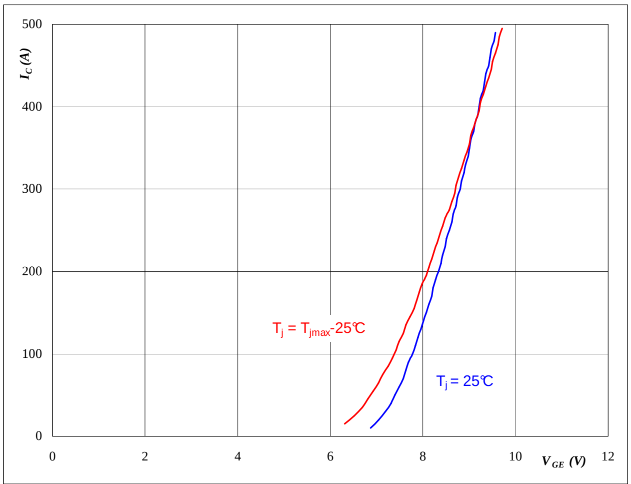
At

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



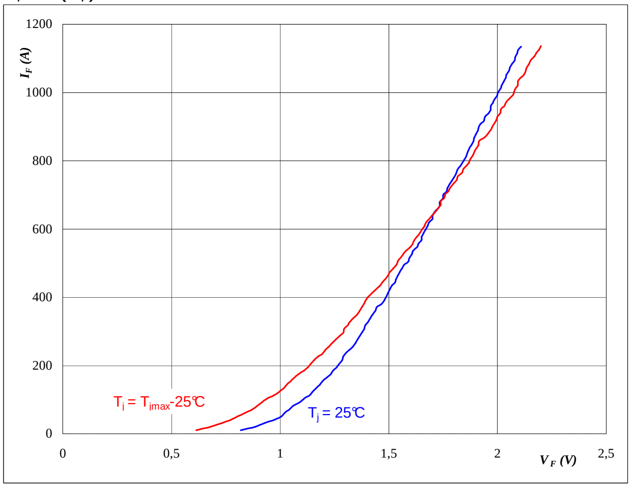
At

t_p =	350	µs
V_{CE} =	10	V

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	350	µs

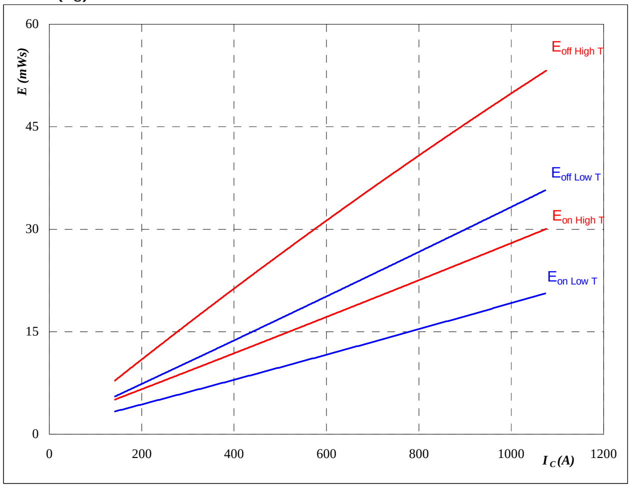
Buck

Half bridge IGBT and Neutral point FWD

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



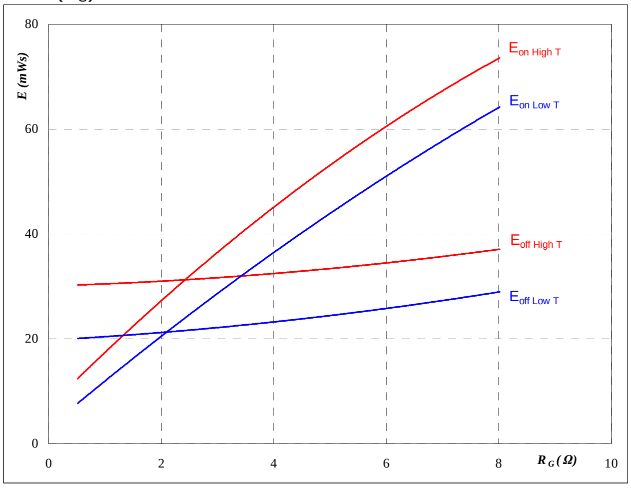
With an inductive load at

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

$E = f(R_G)$



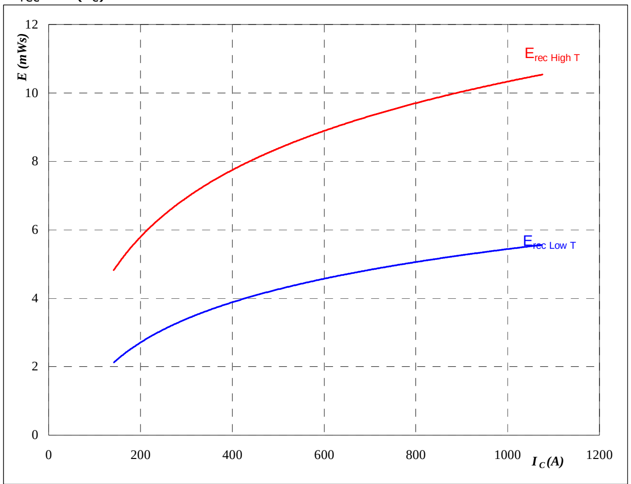
With an inductive load at

T_j = 25/125 °C
V_{CE} = 350 V
V_{GE} = ±15 V
I_C = 596 A

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



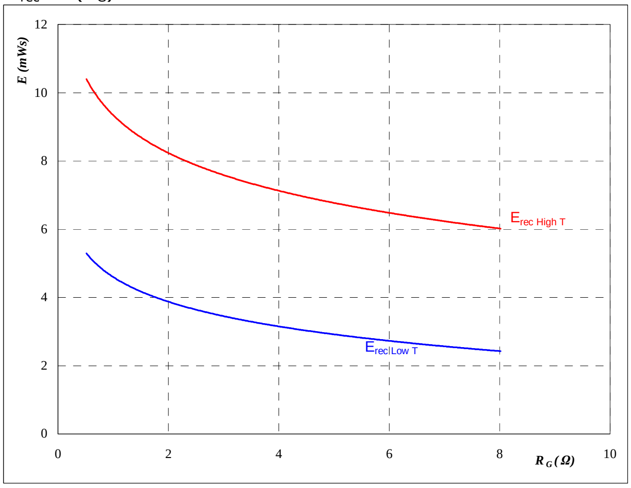
With an inductive load at

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 = 596 A

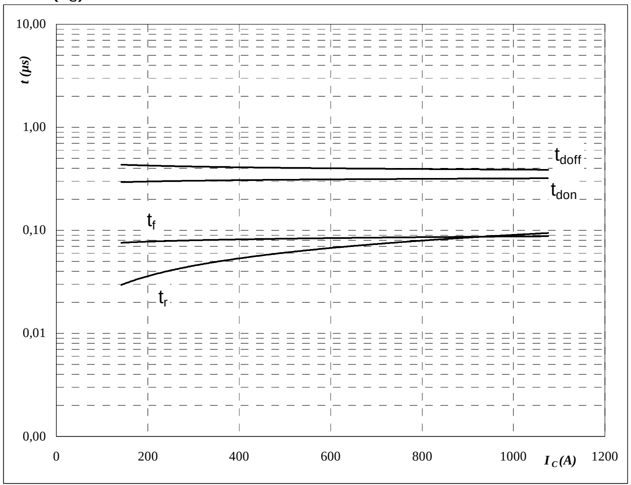
Buck

Half bridge IGBT and Neutral point FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



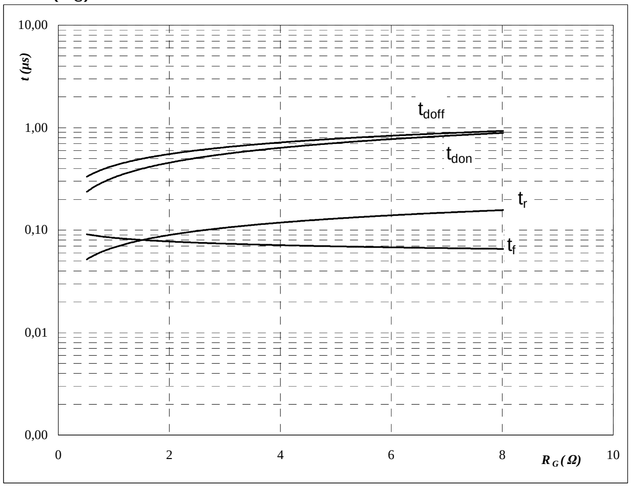
With an inductive load at

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)



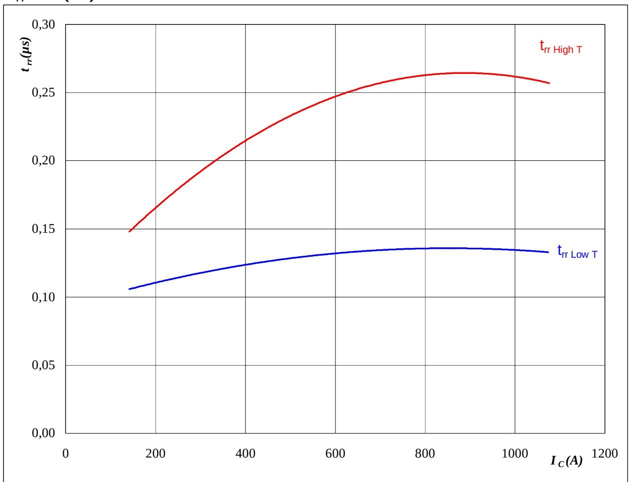
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	596	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



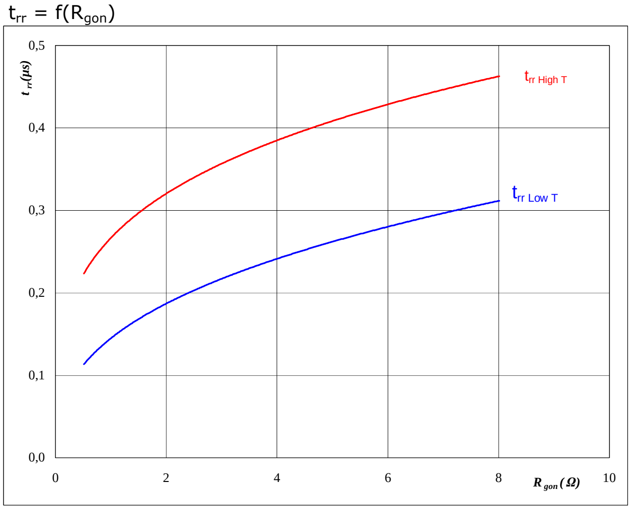
At

T_j =	25/125	°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	°C
V_R =	350	V
I_F =	596	A
V_{GE} =	±15	V

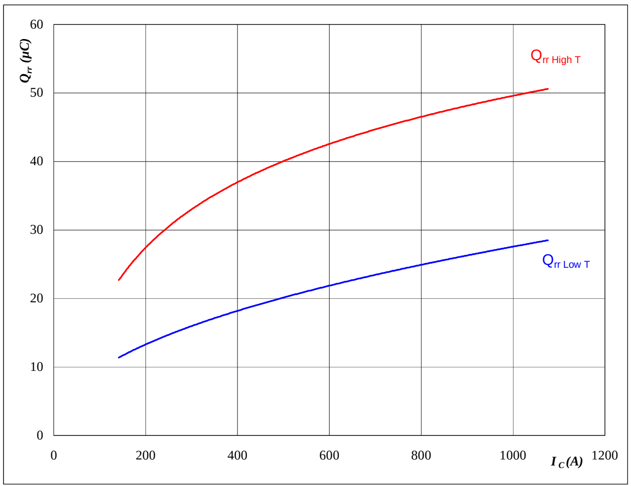
Buck

Half bridge IGBT and Neutral point FWD

Figure 13	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



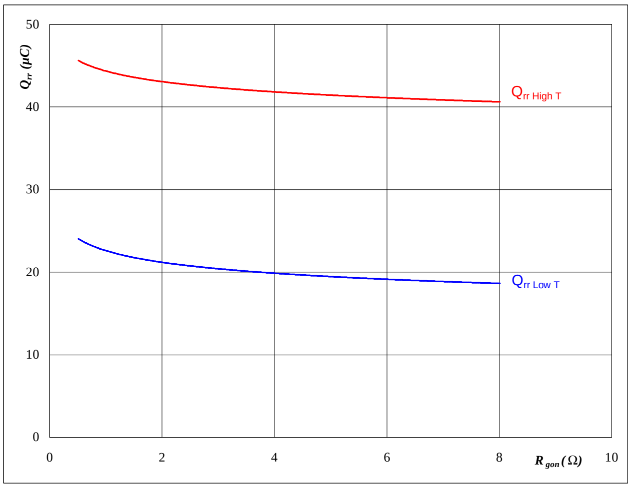
At

T_j =	25/125	°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

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



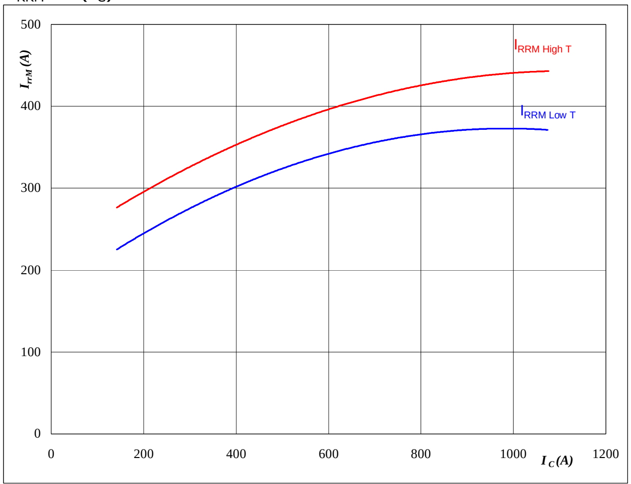
At

T_j =	25/125	°C
V_R =	350	V
I_F =	596	A
V_{GE} =	±15	V

Figure 15	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



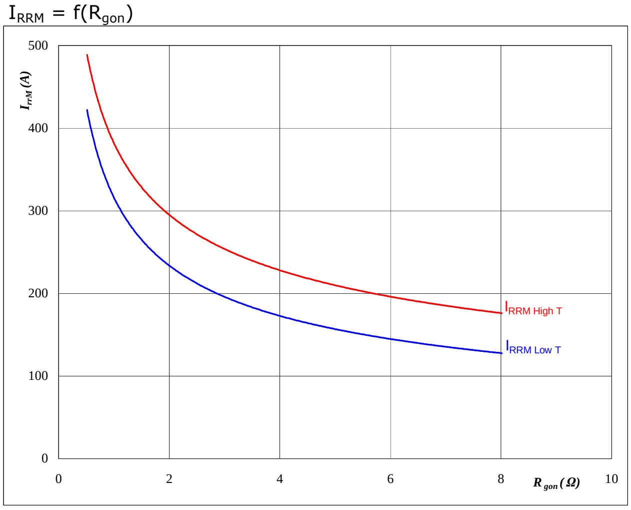
At

T_j =	25/125	°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	°C
V_R =	350	V
I_F =	596	A
V_{GE} =	±15	V

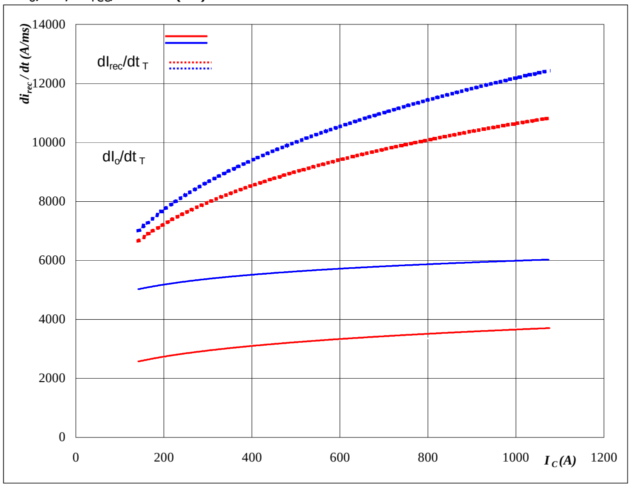
Buck

Half bridge IGBT and Neutral point FWD

Figure 17 FWD

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

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



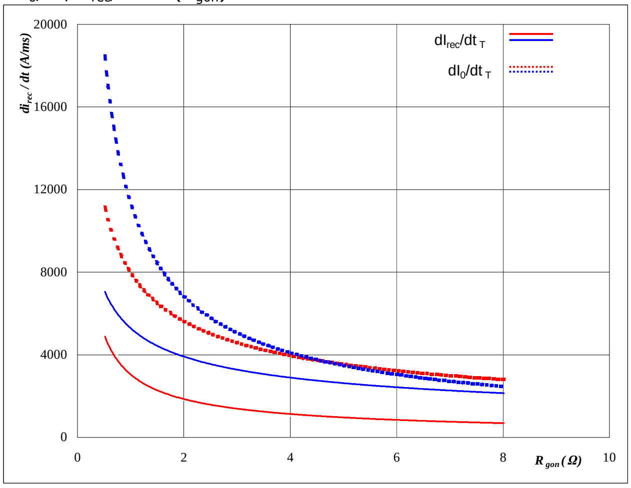
At

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

Figure 18 FWD

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

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



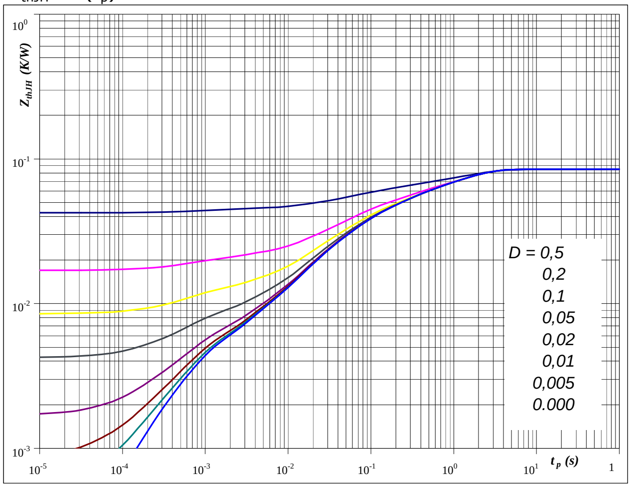
At

T_j =	25/125	°C
V_R =	350	V
I_F =	596	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} =	0,08	K/W

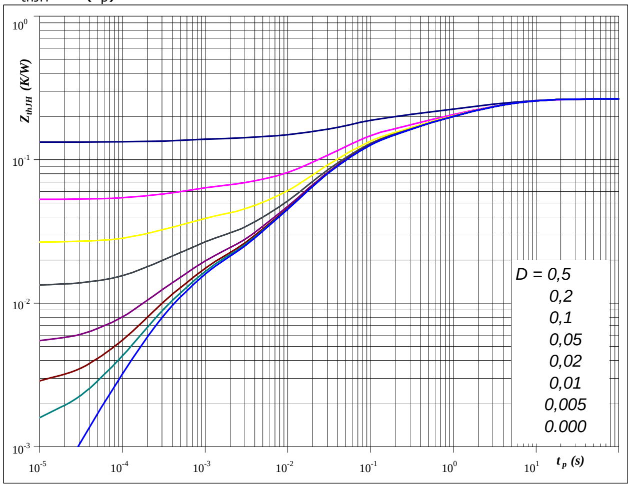
IGBT thermal model values

R (C/W)	Tau (s)
3,54E-02	1,20E+00
2,06E-02	1,85E-01
2,16E-02	3,61E-02
2,86E-03	8,04E-03
4,30E-03	6,80E-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} =	0,26	K/W

FWD thermal model values

R (C/W)	Tau (s)
4,86E-02	5,38E+00
5,69E-02	1,12E+00
4,08E-02	2,59E-01
7,52E-02	4,95E-02
2,43E-02	1,67E-02
6,46E-03	3,42E-03
1,22E-02	3,99E-04

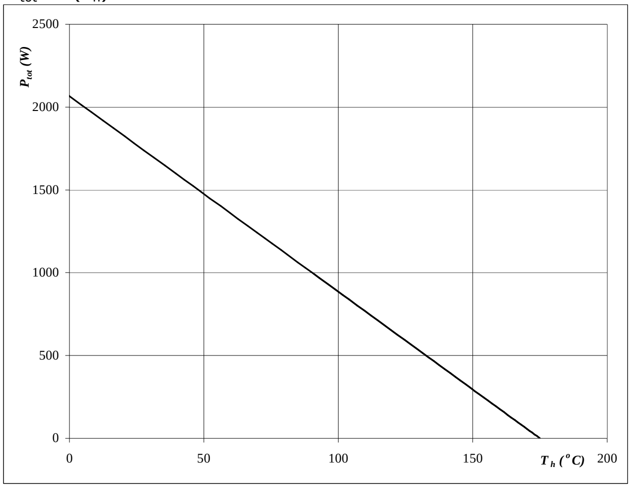
Buck

Half bridge IGBT and Neutral point FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



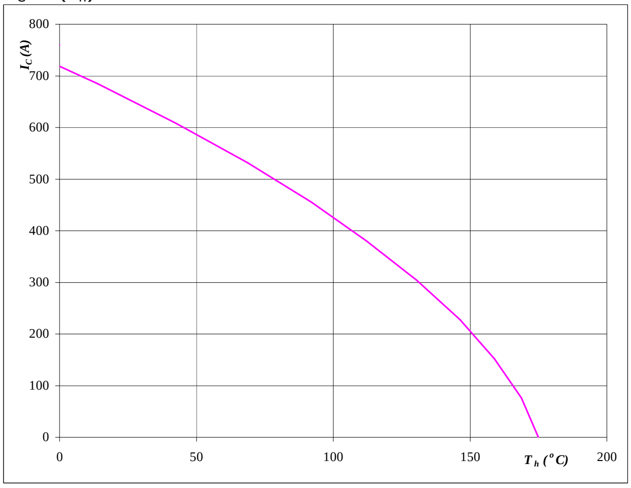
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

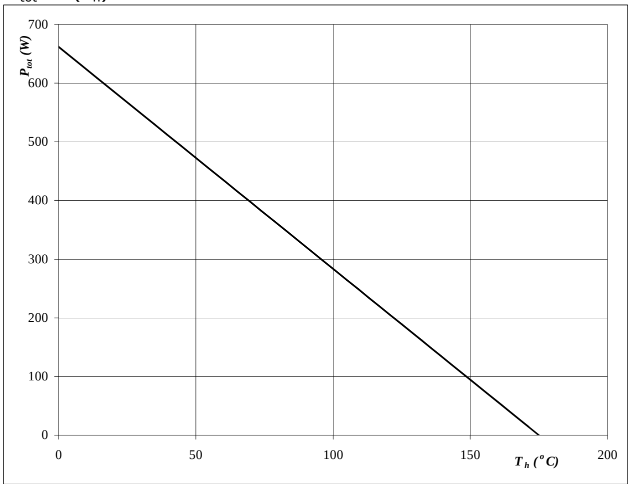
T_j = 175 °C

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



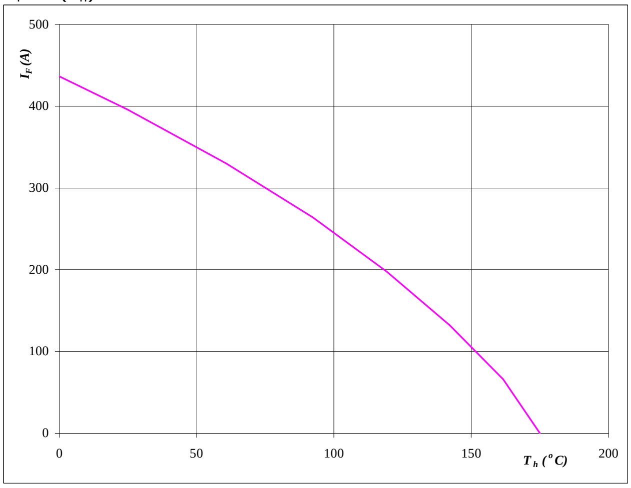
At

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

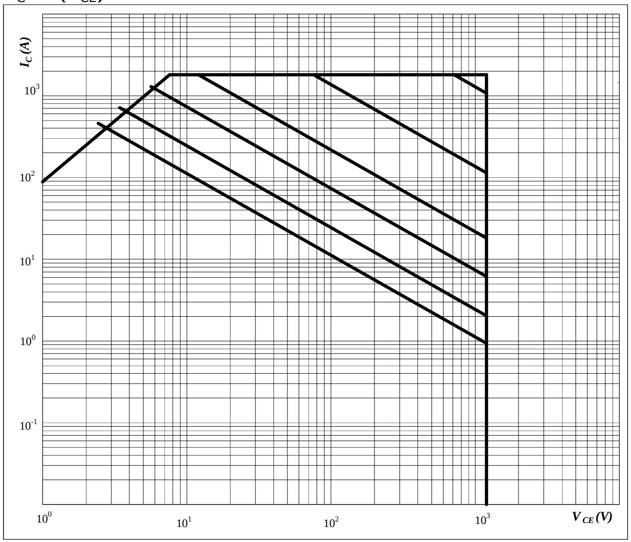
Buck

Half bridge IGBT and Neutral point FWD

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



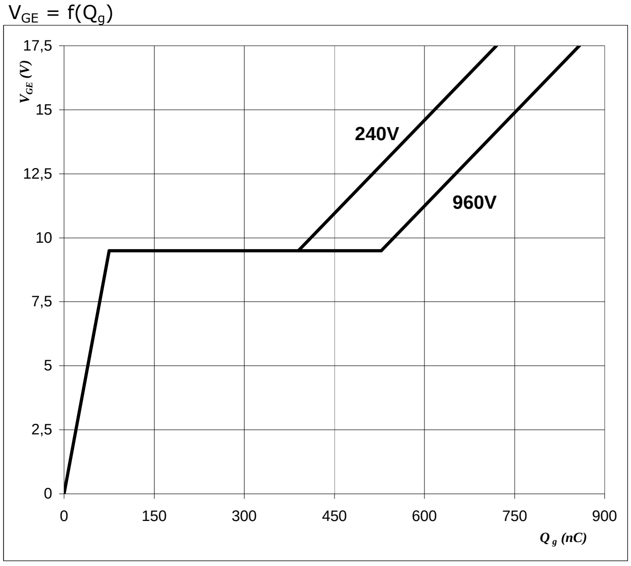
At

D =	single pulse	
Th =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



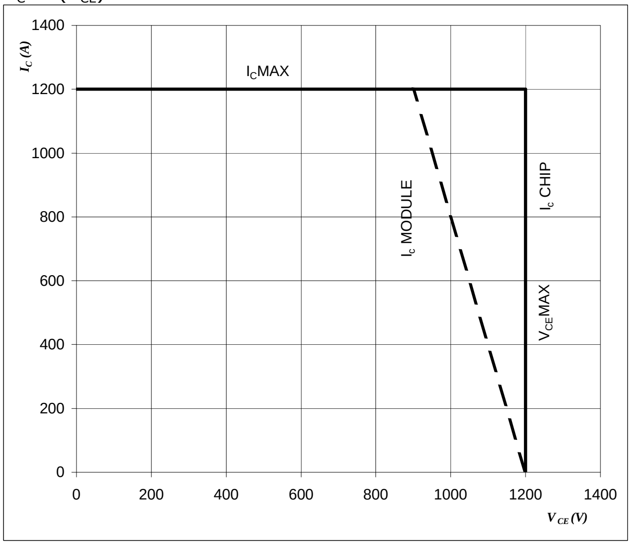
At

I_C =	600	A

Figure 27 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	T_{jmax}-25	ºC
$U_{ccminus}$=U_{ccplus}		
Switching mode :	3 level switching	

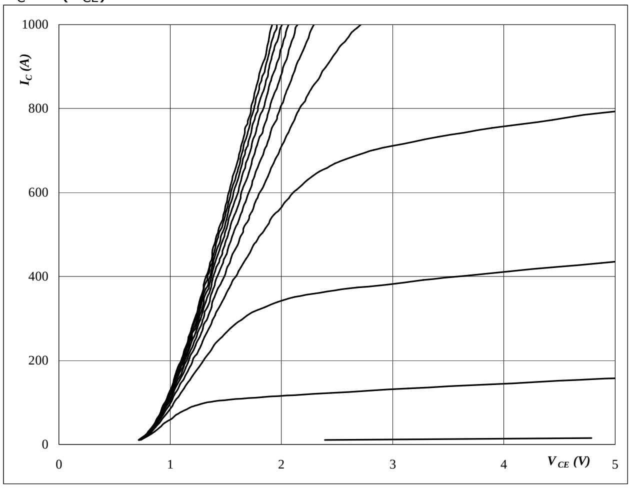
Boost

Neutral point IGBT and Half bridge FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 350 µs

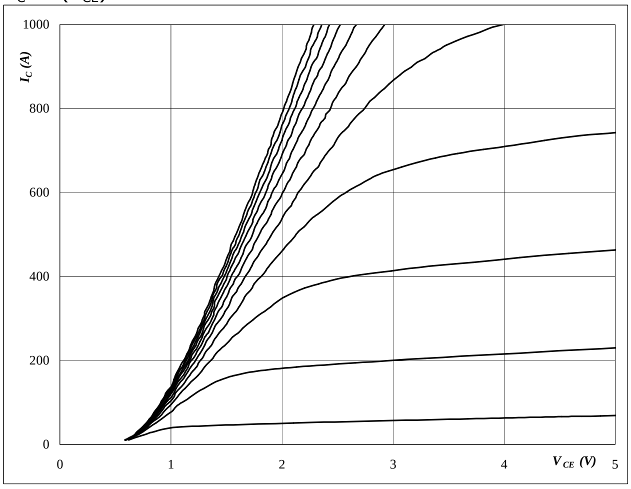
T_j = 25 °C

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

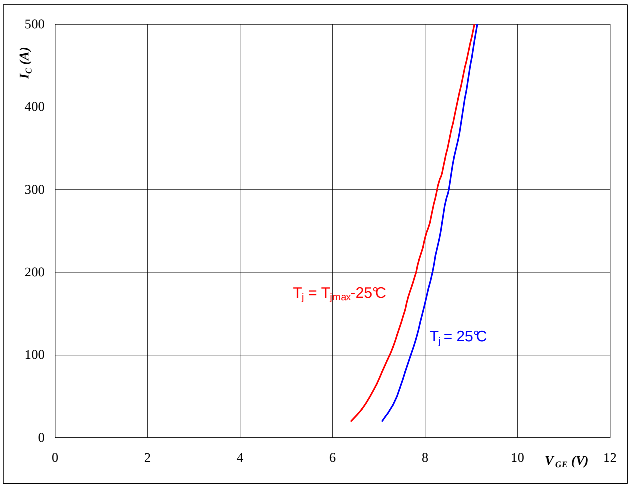
T_j = 125 °C

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

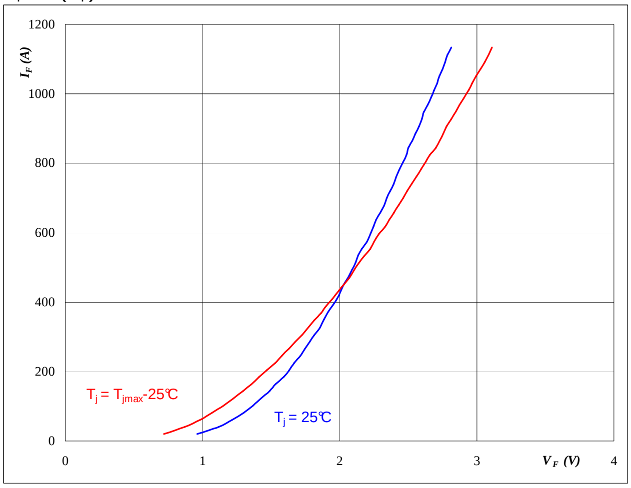
t_p = 350 µs

V_{CE} = 0 V

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p = 350 µs

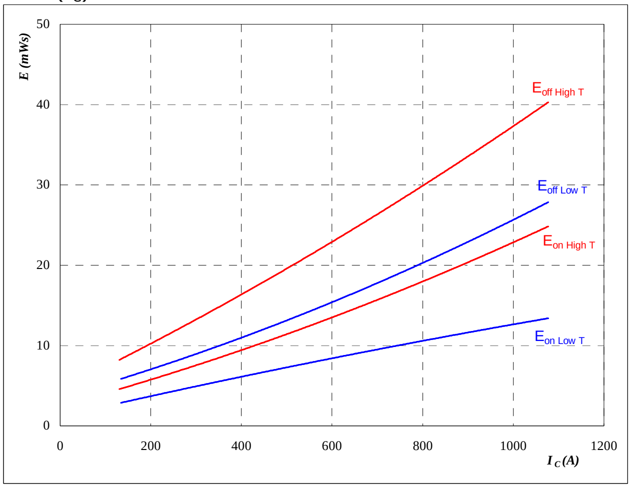
Boost

Neutral point IGBT and Half bridge FWD

Figure 5	IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



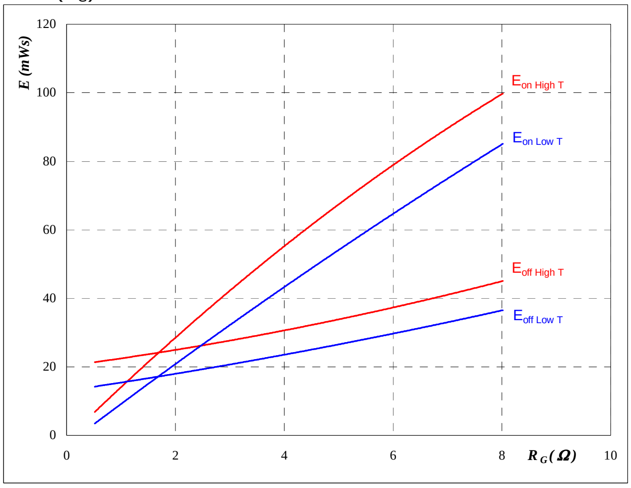
With an inductive load at

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

$E = f(R_G)$



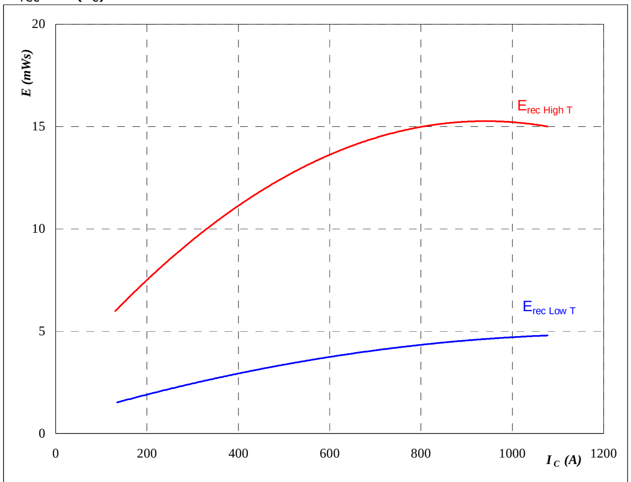
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	600	A

Figure 7	FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



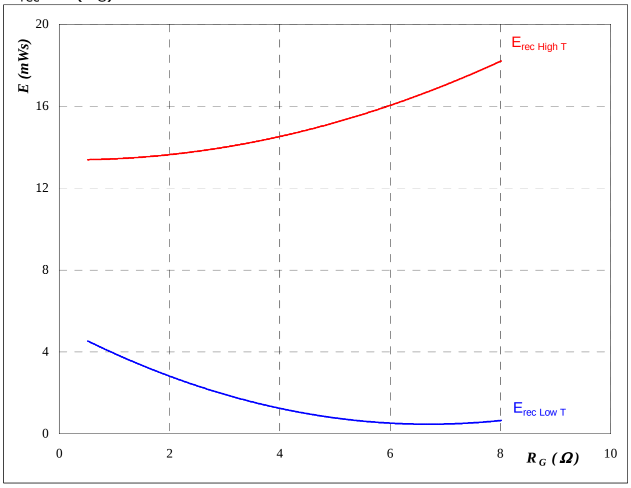
With an inductive load at

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 =	600	A

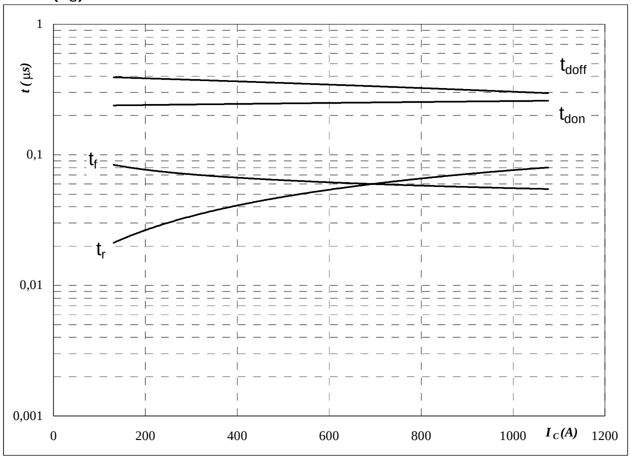
Boost

Neutral point IGBT and Half bridge FWD

Figure 9	IGBT

Typical switching times as a function of collector current

t = f(I_C)



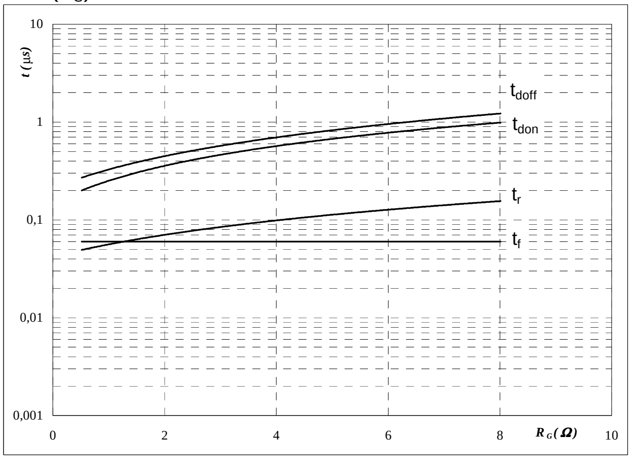
With an inductive load at

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)



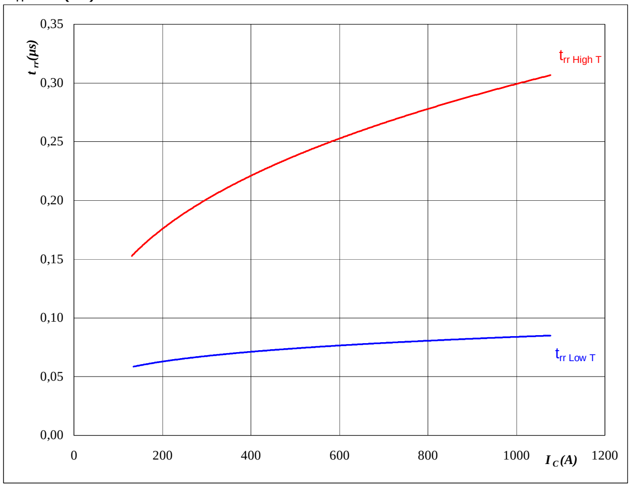
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	600	A

Figure 11	FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



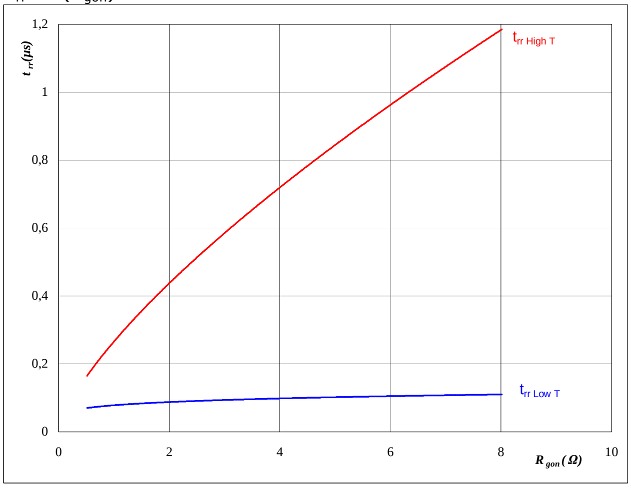
At

T_j =	25/125	°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	°C
V_R =	350	V
I_F =	600	A
V_{GE} =	±15	V

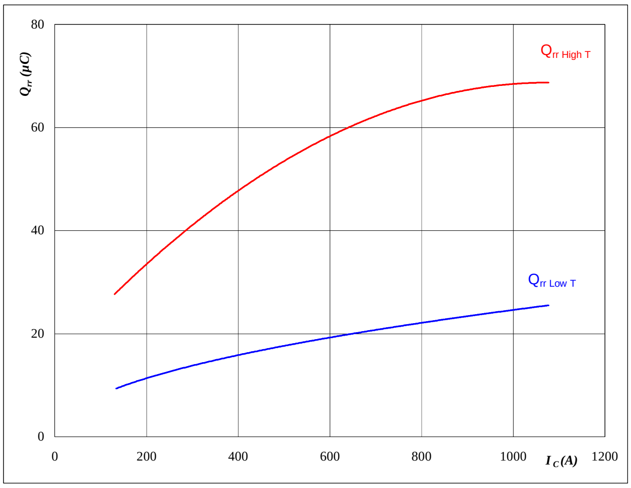
Boost

Neutral point IGBT and Half bridge FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



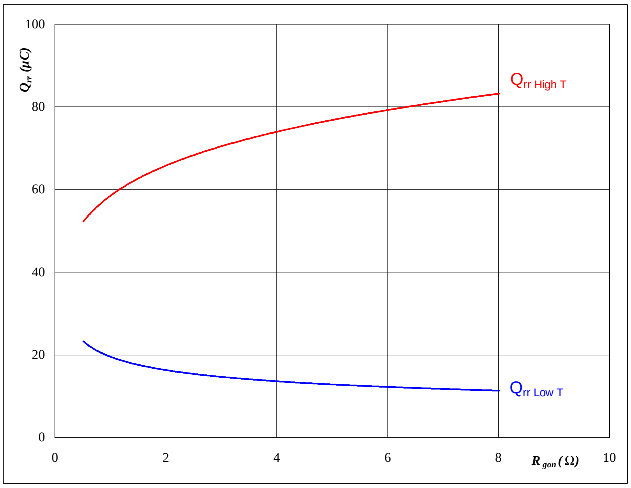
At

T_j =	25/125	°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

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



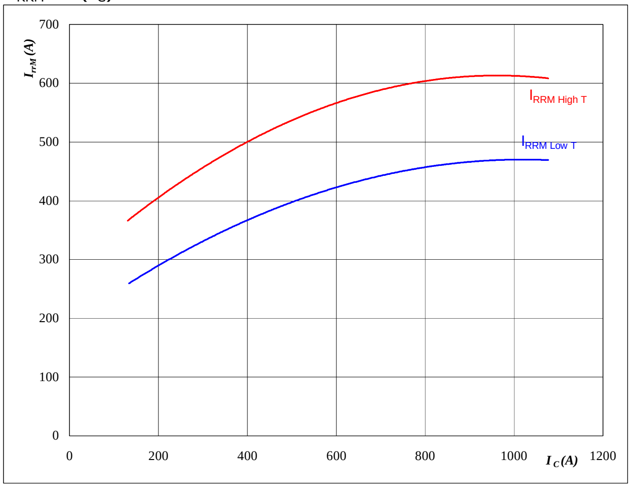
At

T_j =	25/125	°C
V_R =	350	V
I_F =	600	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



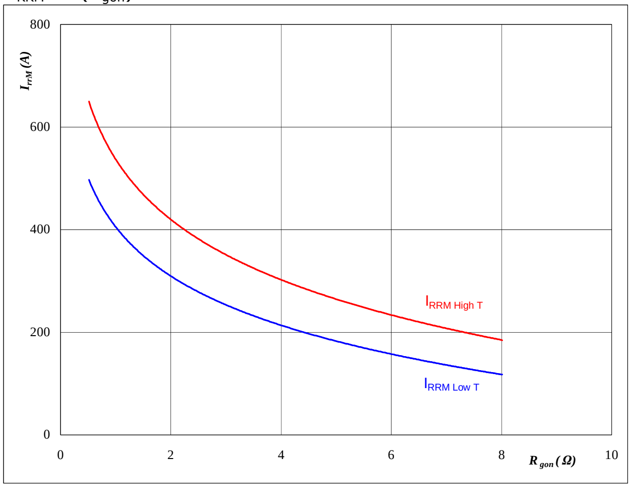
At

T_j =	25/125	°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	°C
V_R =	350	V
I_F =	600	A
V_{GE} =	±15	V

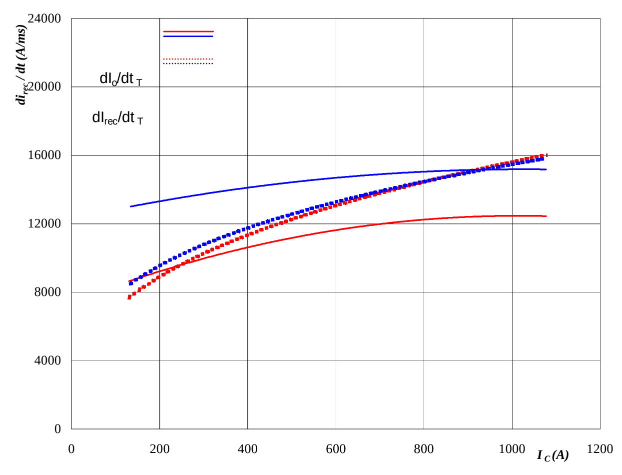
Boost

Neutral point IGBT and Half bridge FWD

Figure 17 FWD

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

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



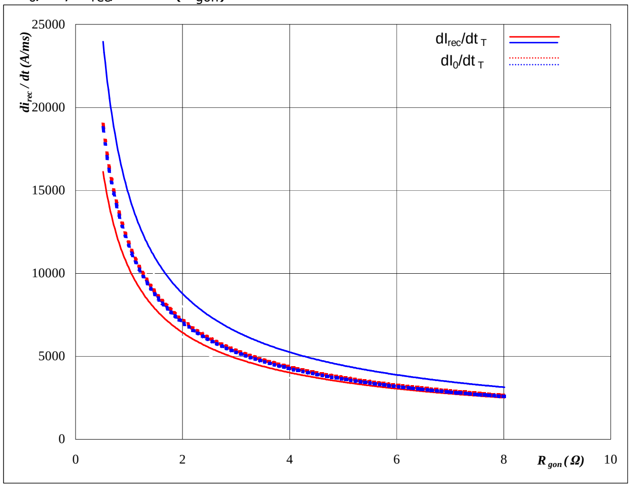
At

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

Figure 18 FWD

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

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



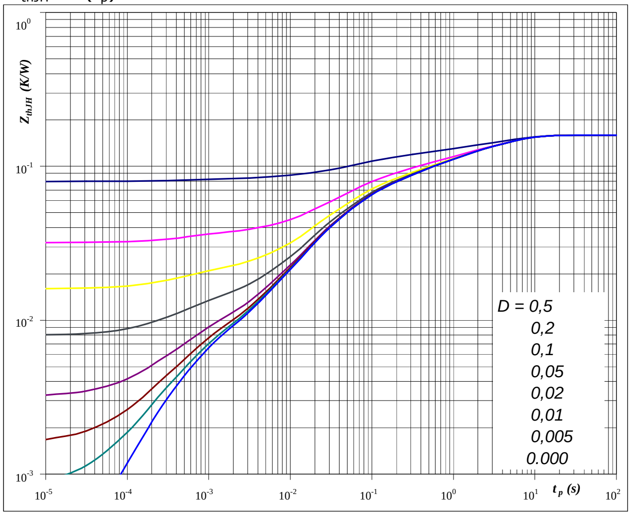
At

T_j =	25/125	°C
V_R =	350	V
I_F =	600	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} =	0,16	K/W

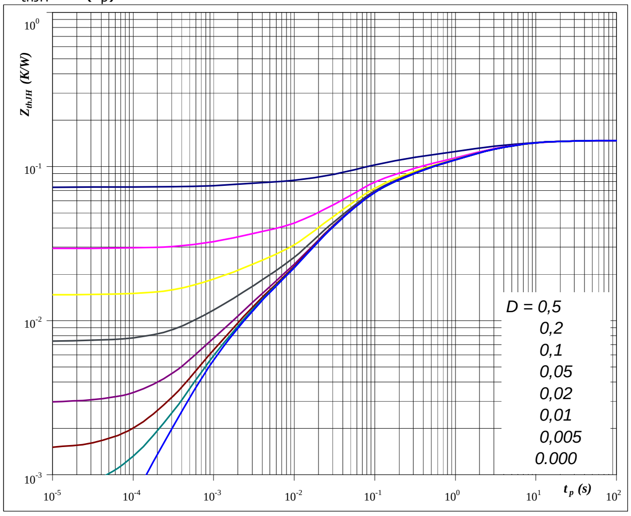
IGBT thermal model values

R (K/W)	Tau (s)
4,60E-02	4,40E+00
2,82E-02	1,10E+00
2,81E-02	2,36E-01
3,54E-02	5,04E-02
1,47E-02	1,71E-02
2,19E-03	2,97E-03
4,85E-03	4,64E-04

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

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

FWD thermal model values

R (K/W)	Tau (s)
2,30E-02	6,05E+00
3,53E-02	1,29E+00
2,90E-02	2,22E-01
4,43E-02	4,71E-02
8,50E-03	1,13E-02
6,93E-03	1,30E-03

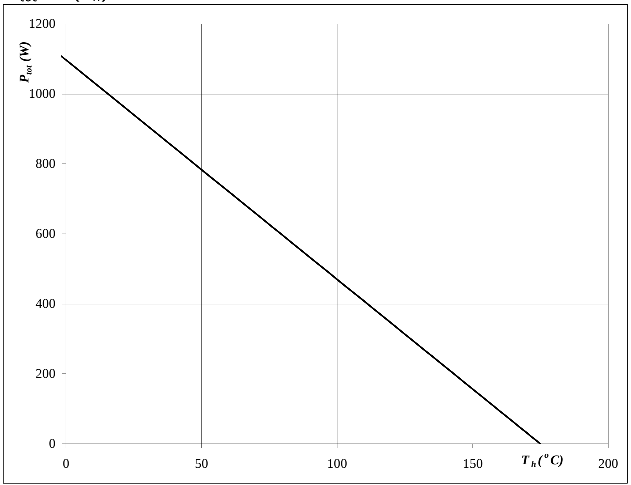
Boost

Neutral point IGBT and Half bridge FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

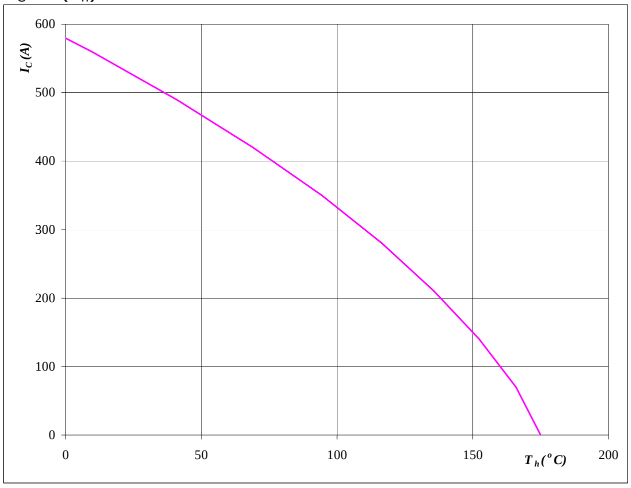


At
T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

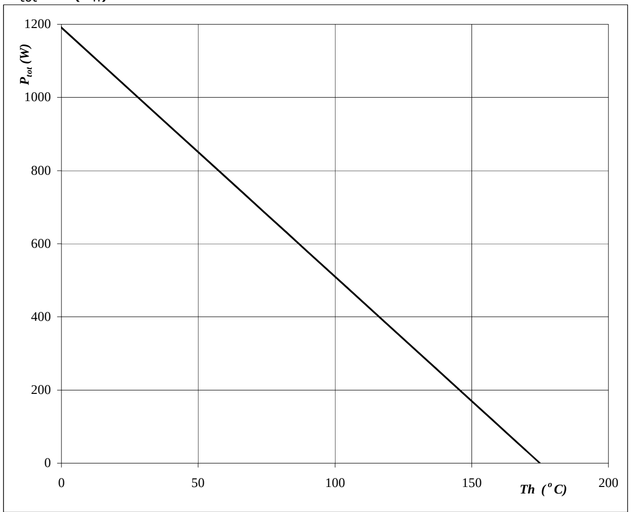


At
T_j = 175 ºC
V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

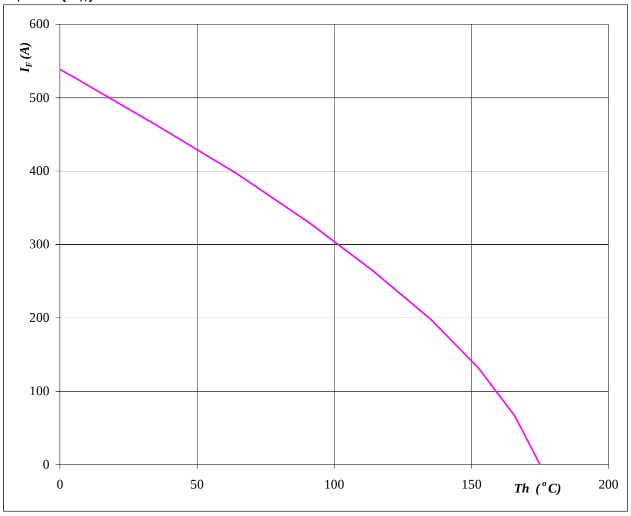


At
T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At
T_j = 175 ºC

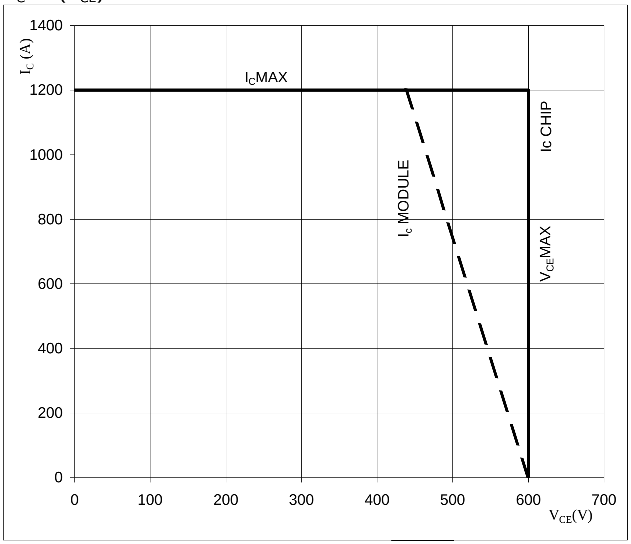
Boost

Neutral point IGBT

Figure 25 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 °C

$U_{ccminus}$=U_{ccplus}

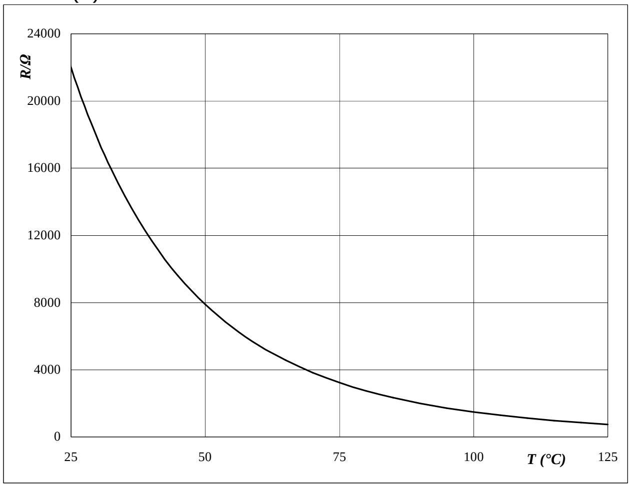
Switching mode : 3 level switching

Thermistor

Figure 26	Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



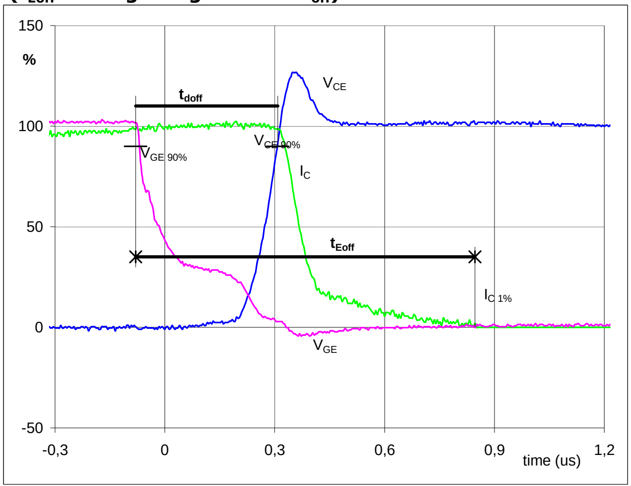
Switching Definitions Half bridge IGBT

General conditions

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

Figure 1 Half bridge IGBT

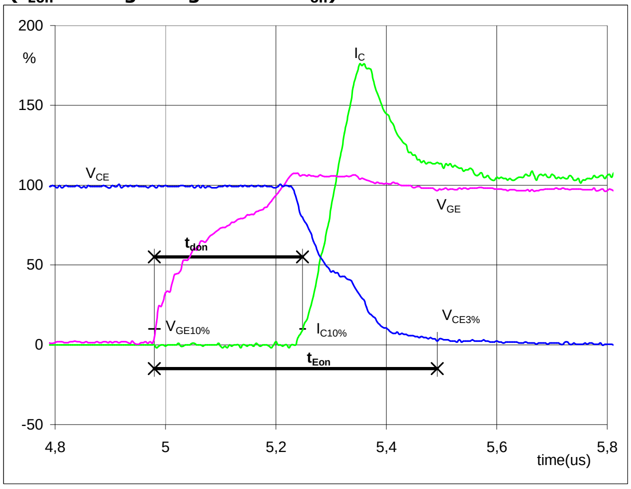
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	591	A
t_{doff} =	0,37	μs
t_{Eoff} =	0,93	μs

Figure 2 Half bridge IGBT

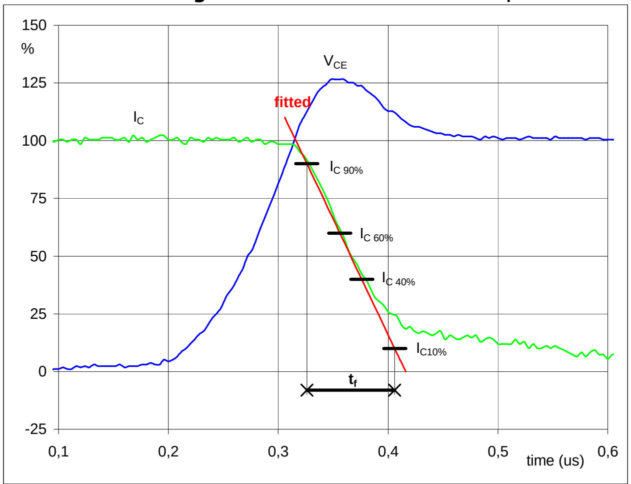
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	591	A
t_{don} =	0,26	μs
t_{Eon} =	0,51	μs

Figure 3 Half bridge IGBT

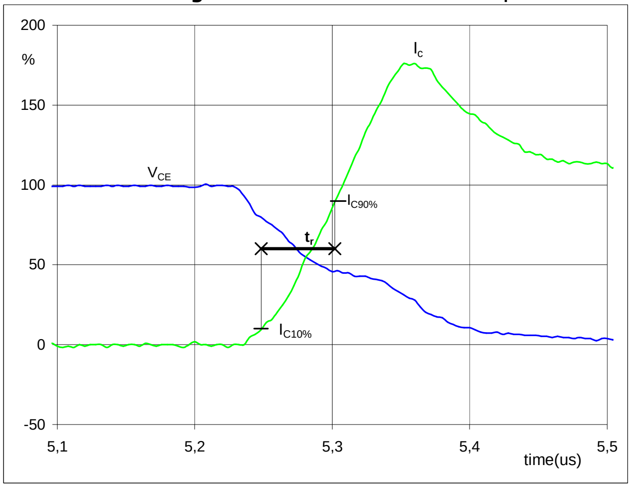
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	591	A
t_f =	0,08	μs

Figure 4 Half bridge IGBT

Turn-on Switching Waveforms & definition of t_r

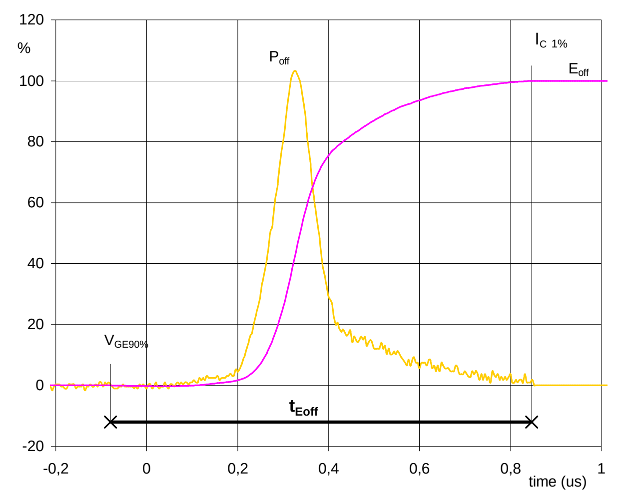


V_C (100%) =	350	V
I_C (100%) =	591	A
t_r =	0,06	μs

Switching Definitions half bridge IGBT

Figure 5	Half bridge IGBT

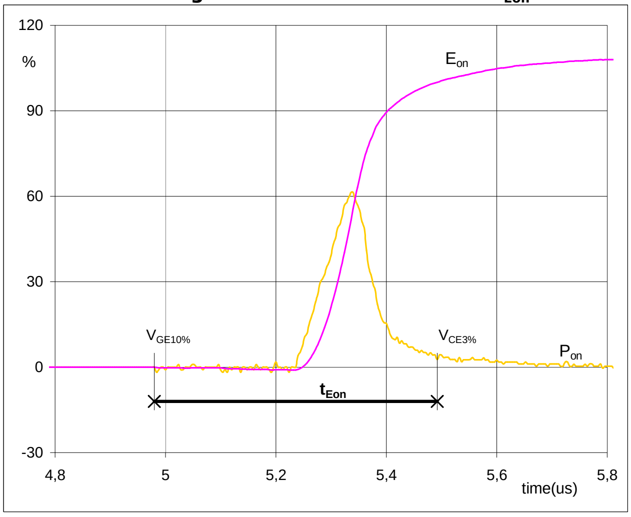
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	206,68	kW
E_{off} (100%) =	30,27	mJ
t_{Eoff} =	0,93	μs

Figure 6	Half bridge IGBT

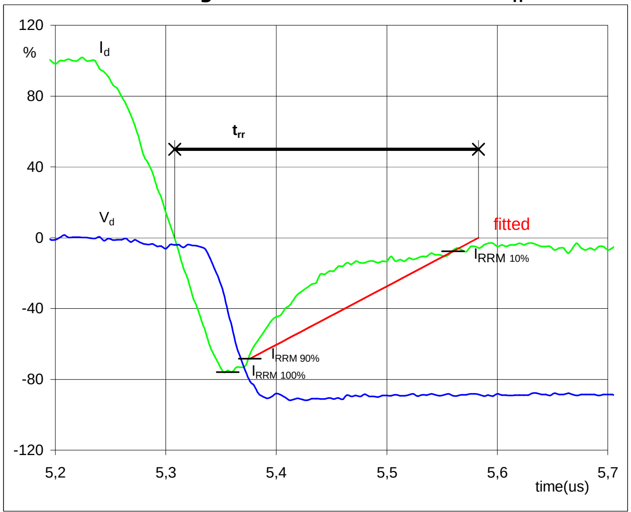
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	206,68	kW
E_{on} (100%) =	12,81	mJ
t_{Eon} =	0,51	μs

Figure 7	Neutral point FWD

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

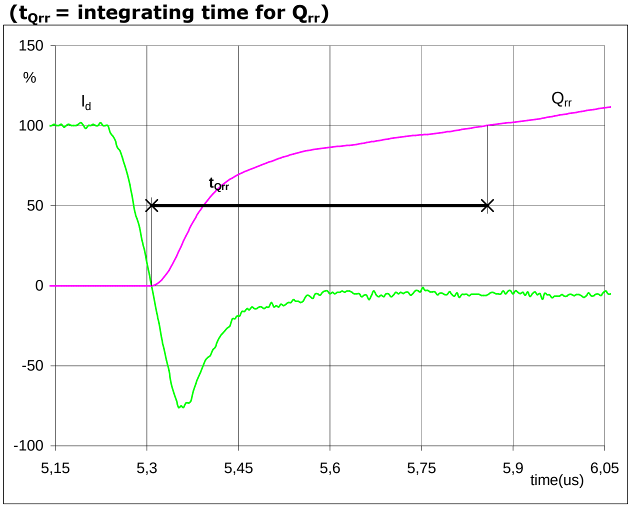


V_d (100%) =	350	V
I_d (100%) =	591	A
I_{RRM} (100%) =	-457	A
t_{rr} =	0,25	μs

Switching Definitions half bridge IGBT

Figure 8	Neutral point FWD

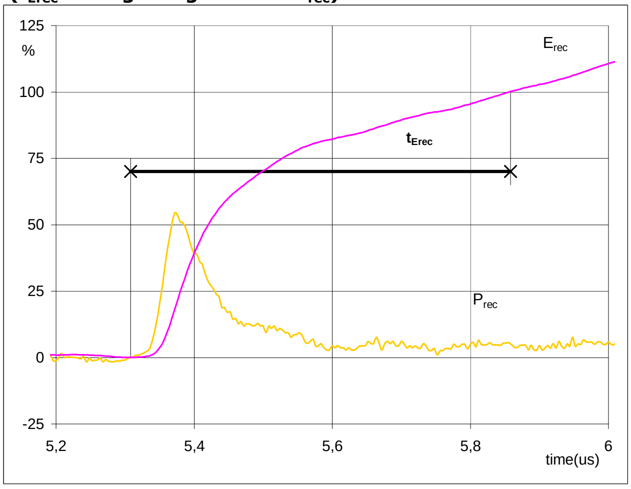
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	591	A
Q_{rr} (100%) =	47,04	μC
t_{Qrr} =	0,55	μs

Figure 9	Neutral point FWD

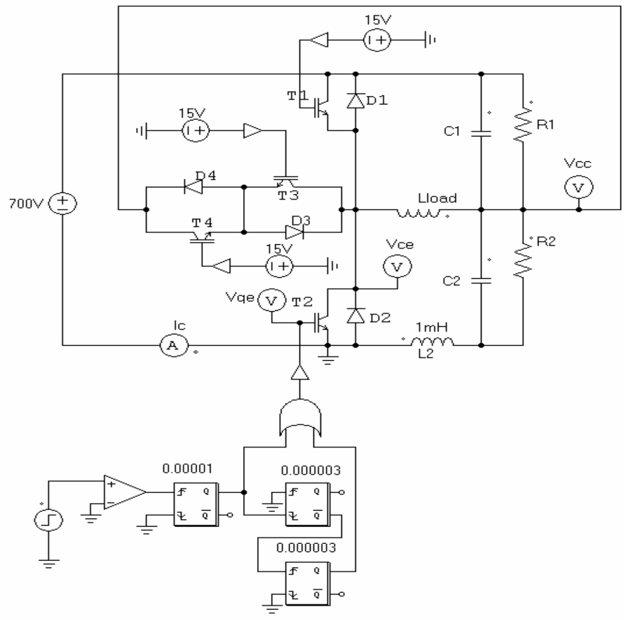
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	206,68	kW
E_{rec} (100%) =	10,70	mJ
t_{Erec} =	0,55	μs

half bridge IGBT switching measurement circuit

Figure 10



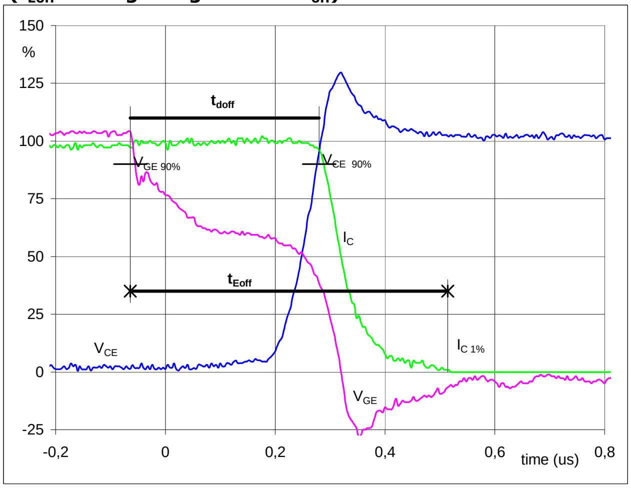
Switching Definitions neutral point IGBT

General conditions

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

Figure 1 Neutral point IGBT

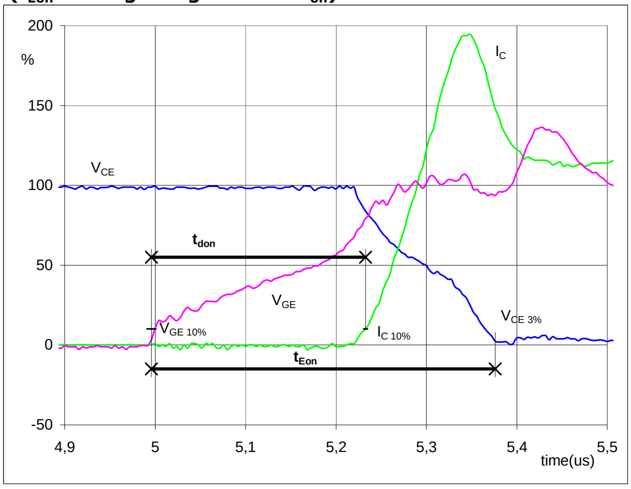
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	592	A
t_{doff} =	0,23	μs
t_{Eoff} =	0,58	μs

Figure 2 Neutral point IGBT

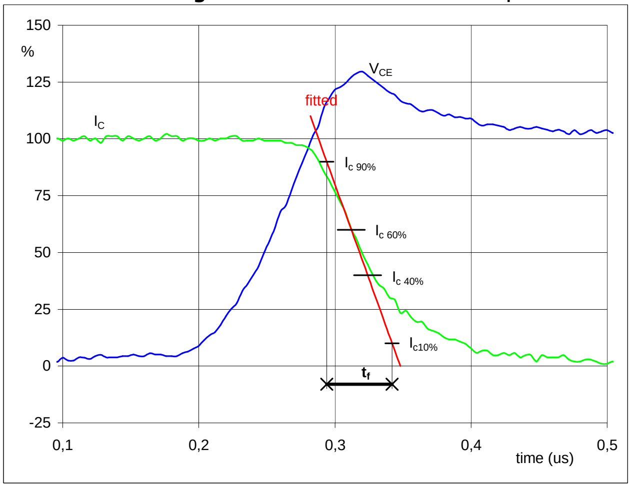
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	592	A
t_{don} =	0,25	μs
t_{Eon} =	0,38	μs

Figure 3 Neutral point IGBT

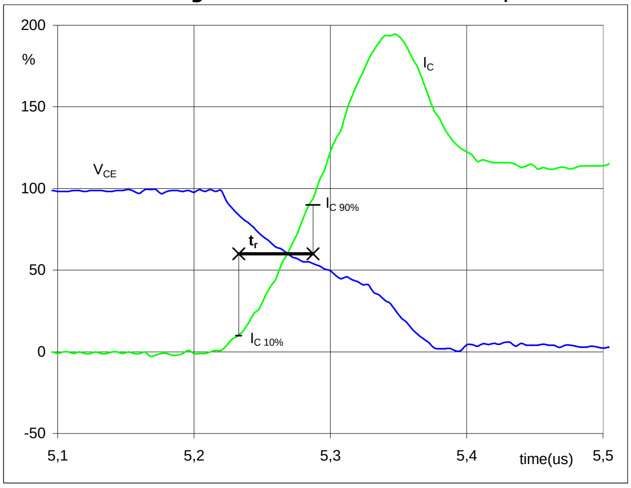
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	592	A
t_f =	0,067	μs

Figure 4 Neutral point IGBT

Turn-on Switching Waveforms & definition of t_r

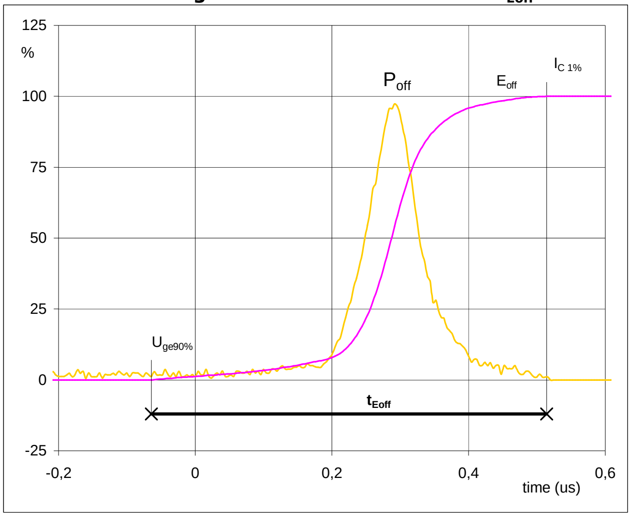


V_C (100%) =	350	V
I_C (100%) =	592	A
t_r =	0,053	μs

Switching Definitions neutral point IGBT

Figure 5 Neutral point IGBT

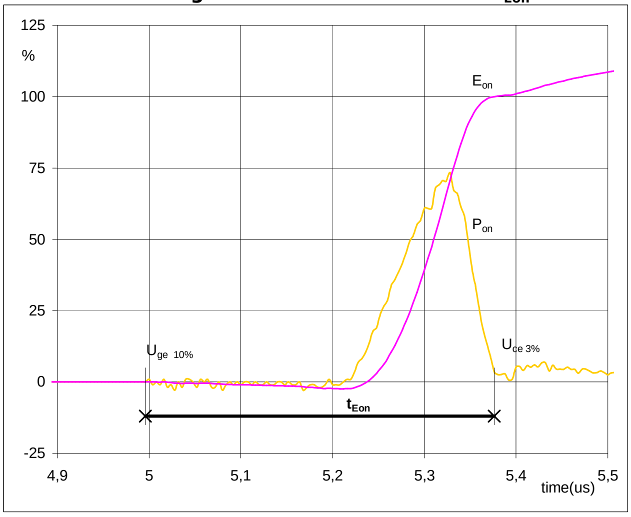
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	207,31	kW
E_{off} (100%) =	22,22	mJ
t_{Eoff} =	0,58	μs

Figure 6 Neutral point IGBT

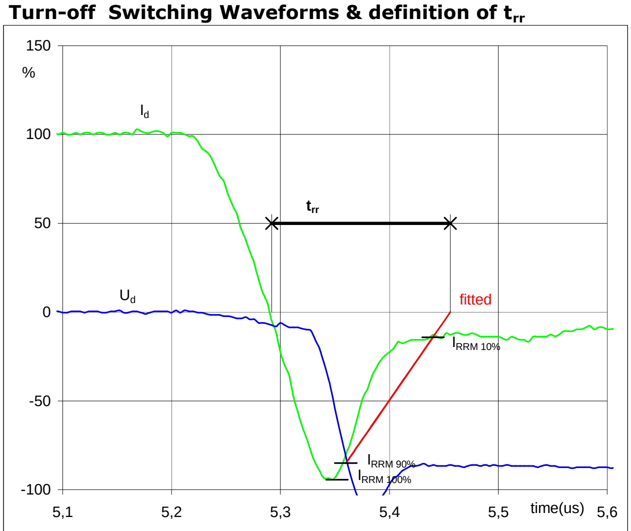
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	207,3054	kW
E_{on} (100%) =	13,39	mJ
t_{Eon} =	0,38	μs

Figure 7 Half bridge FWD

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

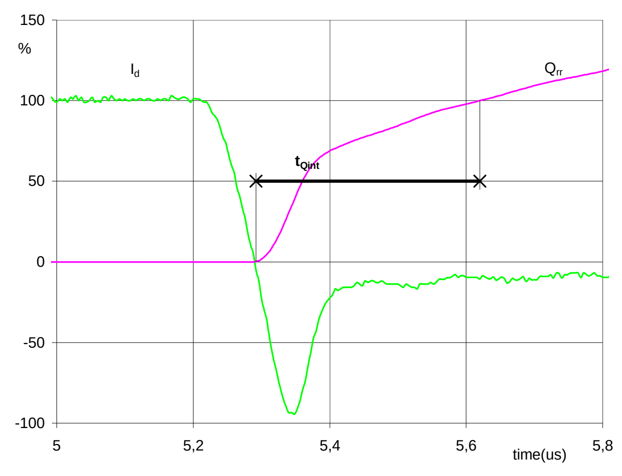


V_d (100%) =	350	V
I_d (100%) =	592	A
I_{RRM} (100%) =	-568	A
t_{rr} =	0,29	μs

Switching Definitions neutral point IGBT

Figure 8	Half bridge FWD

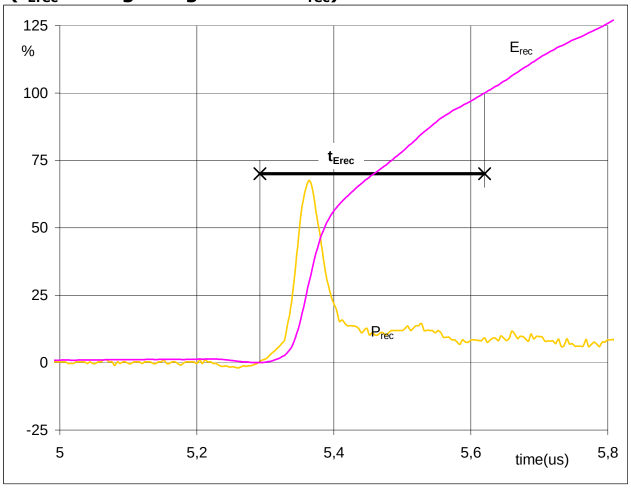
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	592	A
Q_{rr} (100%) =	60,53	µC
t_{Qint} =	0,33	µs

Figure 9	Half bridge FWD

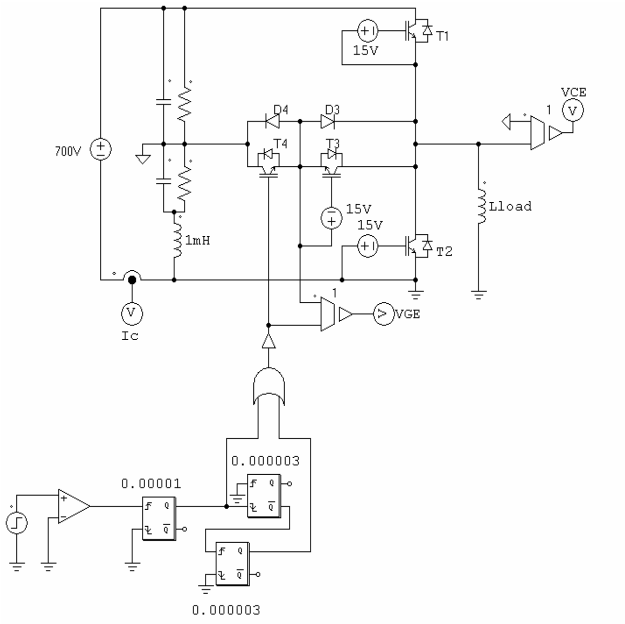
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	207,31	kW
E_{rec} (100%) =	14,30	mJ
t_{Erec} =	0,33	µs

neutral point IGBT switching measurement circuit

Figure 10



Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without PCM	70-W212NMA600SC-M200P	M200P	M200P
with PCM	70-W212NMA600SC-M200P-/3/	M200P	M200P-/3/

Outline

Driver pins

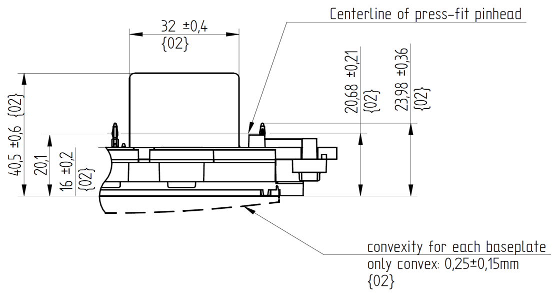
Pin	X1	Y1	Function	Group
1.1	4,5	78,7	G1-1	T1
1.2	4,5	81,6	E1-1	T1
1.3	39,5	78,7	G1-2	T1
1.4	39,5	81,6	E1-2	T1
1.5	1,95	68,4	E2-1	T2
1.6	4,85	68,4	G2-1	T2
1.7	39,2	68,4	G2-2	T2
1.8	42,1	68,4	E2-2	T2
1.9	-2,2	46	G3-1	T3
1.10	-2,2	48,9	E3-1	T3
1.11	46,2	46	G3-2	T3
1.12	46,2	48,9	E3-2	T3
1.13	-6,75	29,2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

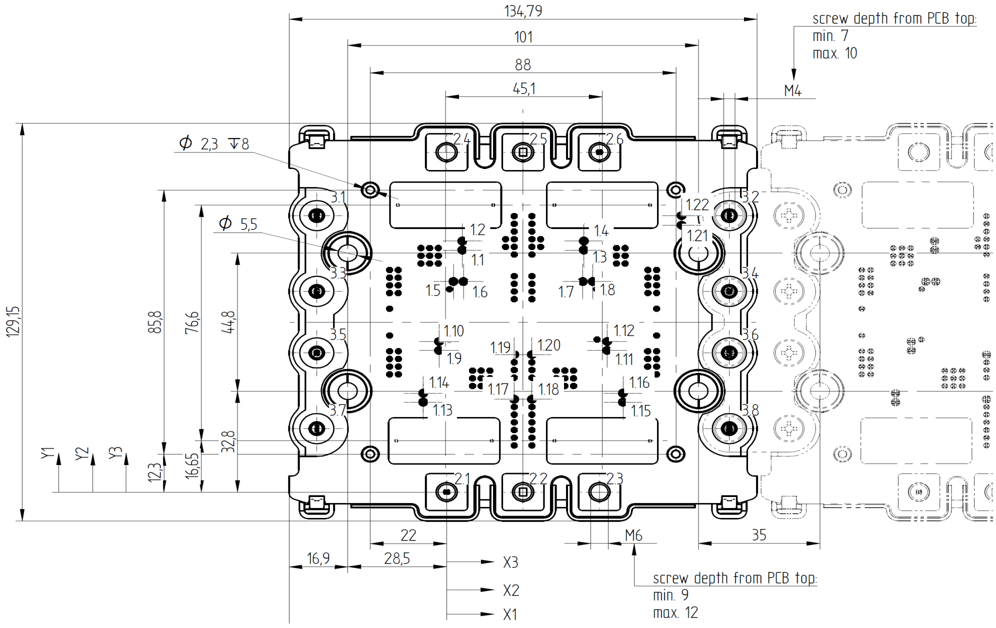
Low current connections

M4 screw	X3	Y3	Function
3.1	-37	89,8	DC+
3.2	81,4	89,8	DC+
3.3	-37	65,2	CE
3.4	81,4	65,2	CE
3.5	-37	45,2	Phase
3.6	81,4	45,2	Phase
3.7	-37	20,6	DC-
3.8	81,4	20,6	DC-

Power connections

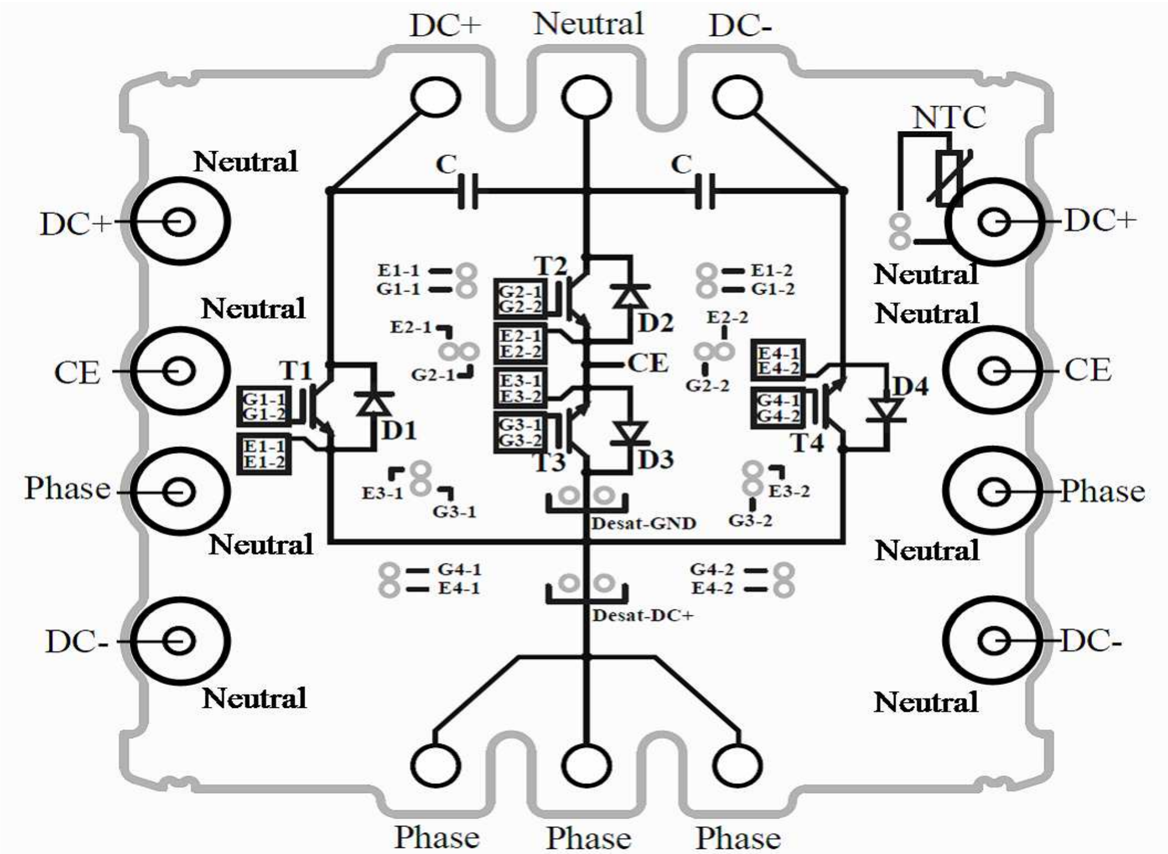
M6 screw	X2	Y2	Function
2.1	0	0	Phase
2.2	22	0	Phase
2.3	44	0	Phase
2.4	0	110,4	DC+
2.5	22	110,4	Neutral
2.6	44	110,4	DC-





Ordering Code and Marking - Outline - Pinout

Pinout



NOTE: Driver pins for parallel devices are not connected inside the module!
Gx-1 to Gx-2 and Ex-1 to Ex2 shall be connected on customer PCB!
Where x = 1 to 4

Identification

ID	Component	Voltage	Current	Function	Comment
T1, T4	IGBT	1200 V	600 A	Buck Switch	
T2, T3	IGBT	600 V	600 A	Boost Switch	
D2, D3	FWD	600 V	600 A	Buck Diode	
D1, D4	FWD	1200 V	600 A	Boost Diode	
C	Capacitor	630 V		DC Link Capacitor	
NTC	NTC			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**Variable***	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for VINco X4 packages see vincotech.com website.

Package data
Package data for VINco X4 packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

*10 without PCM
6 with PCM

Document No.:	Date:	Modification:	Pages
70-W212NMA600SC-M200P-D9-14	02 Aug. 2018	Boost dynamic characteristics corrected, NTC changed	4,5,13,14,15,16, 17,18,19