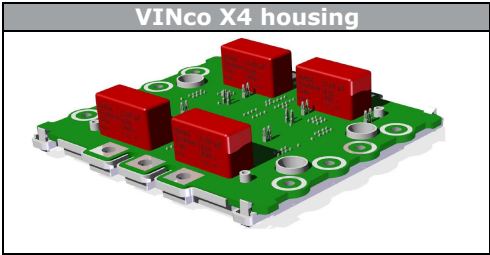
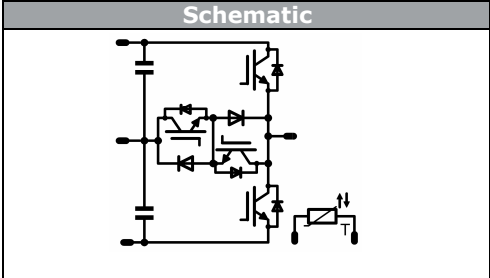




Vincotech

VINcoMNPC X4	1200 V / 300 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> Mixed-voltage NPC Low inductive High power screw interface Integrated DC-snubber capacitors <div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Target Applications</div> <ul style="list-style-type: none"> Solar inverter UPS High speed motor drive <div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Types</div> <ul style="list-style-type: none"> 70-W212NMA300SC-M208P 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">VINco X4 housing</div>  <div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Schematic</div> 

Maximum Ratings

$T_j = 25\text{ °C}$, 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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	270	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	900	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	646	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150\text{ °C}$ $V_{GE} = 15\text{ V}$	10 800	μs V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max} = 1200\text{V}$ $T_{vj\ max} = 150\text{°C}$	600	A
Maximum Junction Temperature	T_{jmax}		175	°C
Buck Diode (D2 , D3)				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	244	A
Surge forward current	I_{FSM}	$t_p = 10\text{ ms}$, sine halfwave	698	A
I^2t -value	I^2t	$T_{vj} < 150\text{°C}$	2440	A ² s
Repetitive peak forward current	I_{FRM}	$tP = 1\text{ ms}$ $T_{vj} < 150\text{°C}$	600	A
Power dissipation per FWD	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	357	W
Maximum Junction Temperature	T_{jmax}		175	°C

**Maximum Ratings** $T_j = 25\text{ °C}$, 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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	252	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	900	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	476	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC}	$T_j \leq 150\text{ °C}$	6	µs
	V_{CC}	$V_{GE} = 15\text{ V}$	360	V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max} = 1200\text{V}$ $T_{vj\ max} = 150\text{°C}$	600	A
Maximum Junction Temperature	T_{jmax}		175	°C

Boost Diode (D1 , D4)

Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	222	A
Surge forward current	I_{FSM}	$t_p = 10\text{ms}$, $\sin 180^\circ$ $T_j = 150\text{°C}$	1720	A
I ² t-value	I^2t		3700	A ² s
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	900	A
Power dissipation per FWD	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	476	W
Maximum Junction Temperature	T_{jmax}		175	°C

DC link Capacitor

Max.DC voltage	V_{MAX}	$T_c = 25\text{°C}$	630	V
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General Module Properties

Material of module baseplate			Cu	
Material of internal insulation			Al2O3	

Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{op}		-40...+($T_{jmax} - 25$)	°C

Isolation Properties

Isolation voltage	V_{isol}	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm
Comparative Tracking Index	CTI		>200	

*100% tested in production



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit							
		V_{GE} [V]	V_{GS} [V]	V_r [V]	V_{CE} [V]	V_{DS} [V]	I_C [A]	I_F [A]	I_D [A]		T_j [°C]	Min	Typ	Max			
Buck Switch (T1 , T4)																	
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$				0,012	25			5	5,8	6,5	V				
Collector-emitter saturation voltage	V_{CESat}		15			300	25 125			1,6	2,03 2,29	2,4	V				
Collector-emitter cut-off current incl.	I_{CES}		0	1200			25					0,6	mA				
Gate-emitter leakage current	I_{GES}		20	0			25					3000	nA				
Integrated Gate resistor	R_{gint}										2,5		Ω				
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 1 \Omega$ $R_{gon} = 1 \Omega$	± 15	350	300	25					201		ns				
Rise time	t_r					125				42					212		
Turn-off delay time	$t_{d(off)}$					25				50					260		
Fall time	t_f					125				82					318		
Turn-on energy loss	E_{on}					25				8					11		mWs
Turn-off energy loss	E_{off}					125				9					16		
Input capacitance	C_{ies}															17600	
Output capacitance	C_{oss}	$f = 1 \text{ MHz}$	0	25		25					1160						
Reverse transfer capacitance	C_{rss}										940						
Gate charge	Q_G		15	960	300	25					1400		nC				
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 0,8 \text{ W/mK}$ (P12)									0,15		K/W				
Buck Diode (D2 , D3)																	
FWD forward voltage	V_F					300	25 125			1,2	1,61 1,58	2,2	V				
Peak reverse recovery current	I_{RRM}	$R_{goff} = 1 \Omega$	± 15	350	300	25					180		A				
Reverse recovery time	t_{rr}					125				154					217		
Reverse recovered charge	Q_{rr}					25				274						μC	
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					125				14				25			
Reverse recovered energy	E_{rec}					25				2014				3		mWs	
Thermal resistance junction to sink	$R_{th(j-s)}$					125				1364				5			
						$\lambda_{paste} = 0,8 \text{ W/mK}$ (P12)									0,27		K/W
Boost Switch (T2 , T3)																	
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$				0,0048	25			5	5,8	6	V				
Collector-emitter saturation voltage	V_{CESat}		15			300	25 125			1	1,59 1,82	2,2	V				
Collector-emitter cut-off incl.	I_{CES}		0	600			25					0,1	mA				
Gate-emitter leakage current	I_{GES}		20	0			25					3000	nA				
Integrated Gate resistor	R_{gint}										1		Ω				
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 1 \Omega$ $R_{gon} = 1 \Omega$	± 15	350	300	25					179		ns				
Rise time	t_r					125				185							
Turn-off delay time	$t_{d(off)}$					25				29					231		
Fall time	t_f					125				34					258		
Turn-on energy loss	E_{on}					25				43					65		mWs
Turn-off energy loss	E_{off}					125				4					7		
Input capacitance	C_{ies}															18800	
Output capacitance	C_{oss}	$f = 1 \text{ MHz}$	0	25		25					1200						
Reverse transfer capacitance	C_{rss}										580						
Gate charge	Q_G		15	480	75	25					1860		nC				
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 0,8 \text{ W/mK}$ (P12)									0,20		K/W				



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit	
		V_{GE} [V]	V_{GS} [V]	V_r [V]	V_{CE} [V]	V_{DS} [V]	I_C [A]	I_F [A]	I_D [A]		T_j [°C]

Boost Diode (D1 , D4)

FWD forward voltage	V_F					300	25 125	1	2,28 2,40	2,9	V
Reverse leakage current	I_r			1200			25			480	µA
Peak reverse recovery current	I_{RRM}	$R_{gon} = 1 \Omega$	± 15	350	300		25		309		A
Reverse recovery time	t_{rr}						125		62 152		ns
Reverse recovered charge	Q_{rr}						25		18		µC
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$						125		14916 10204		A/µs
Reverse recovery energy	E_{rec}						25		4 9		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 0,8 \text{ W/mK}$ (P12)							0,20		K/W

DC link Capacitor

C value	C								2 * 0,68		µF
Stray inductance of on board capacitors	ESL								26/2		nH
Series resistance of on board capacitors	ESR								14/2		mΩ

Thermistor

Rated resistance	R						25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1486 \Omega$					100	-12		+14	%
Power dissipation	P						25		200		mW
Power dissipation constant							25		2		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 3\%$					25		3950		K
B-value	$B_{(25/100)}$	Tol. $\pm 3\%$					25		3996		K
Vincotech NTC Reference							25			B	

Module Properties

Module inductance (from chips to PCB)	L_{sCE}								5		nH
Module inductance (from PCB to PCB using Intercon)	L_{sCE}								3		nH
Resistance of Intercon boards (from PCB to PCB using)	R_{CC1+EE}	$T_c = 25^\circ\text{C}$, 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



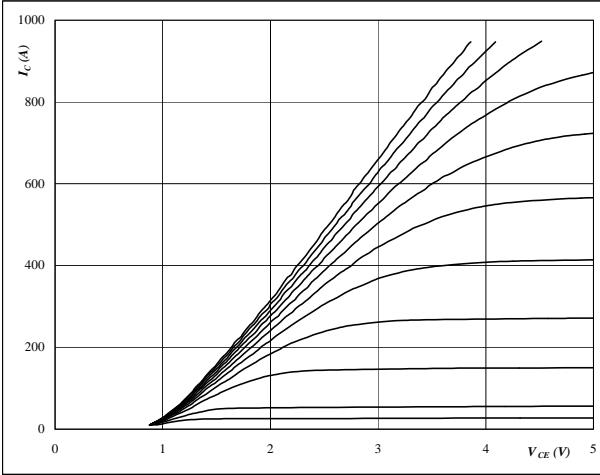
Buck

half bridge IGBT and neutral point FWD

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$



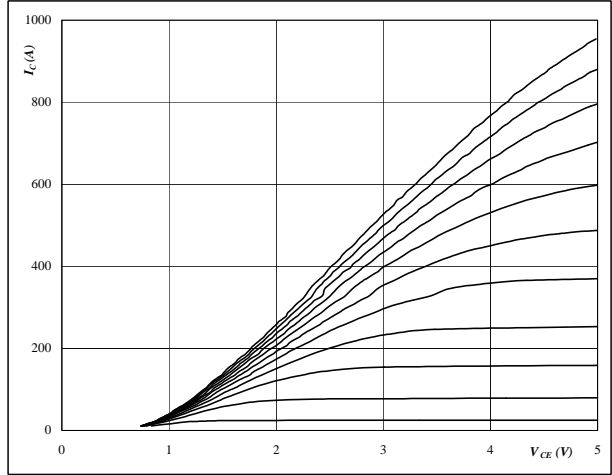
At

$t_p = 350 \mu s$
 $T_j = 25 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$



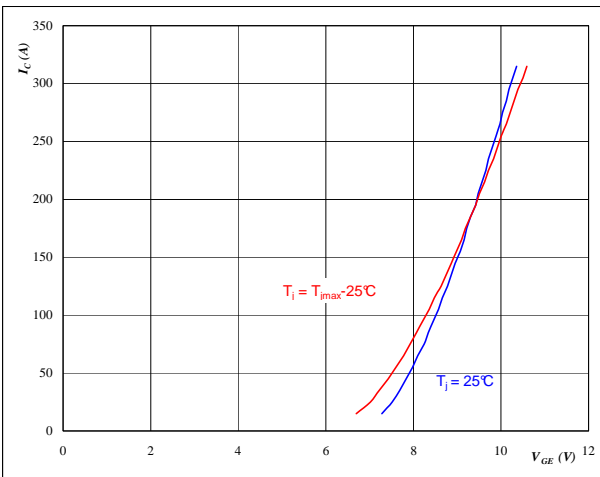
At

$t_p = 350 \mu s$
 $T_j = 125 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



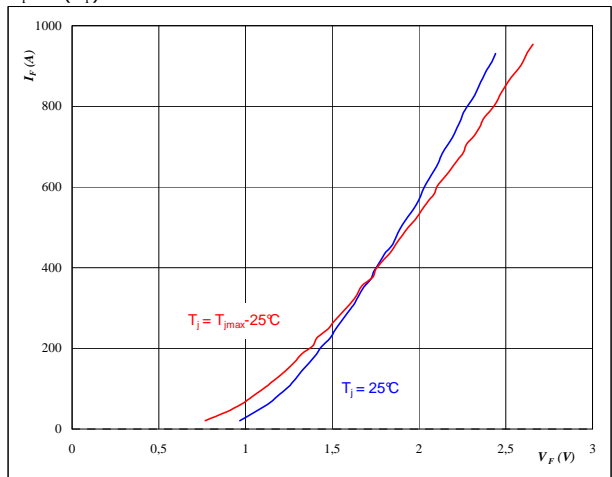
At

$t_p = 350 \mu s$
 $V_{CE} = 10 V$

figure 4. FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

$t_p = 350 \mu s$



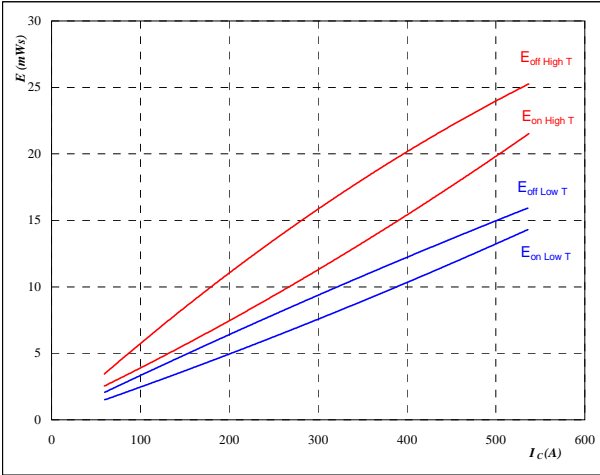
Buck

half bridge IGBT and neutral point FWD

figure 5. IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



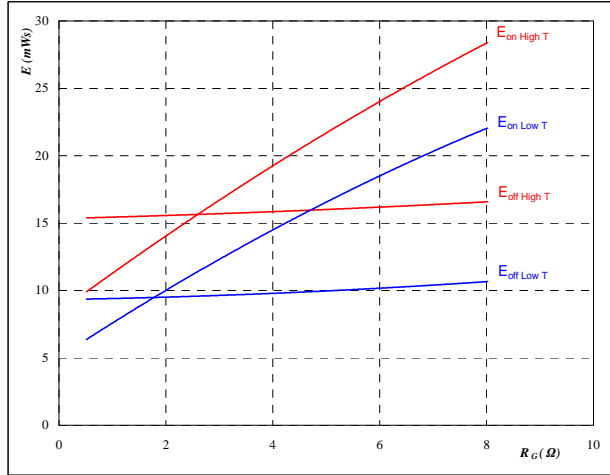
With an inductive load at

- $T_j = 25/125\ ^\circ\text{C}$
- $V_{CE} = 350\ \text{V}$
- $V_{GE} = \pm 15\ \text{V}$
- $R_{gon} = 1\ \Omega$
- $R_{goff} = 1\ \Omega$

figure 6. IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



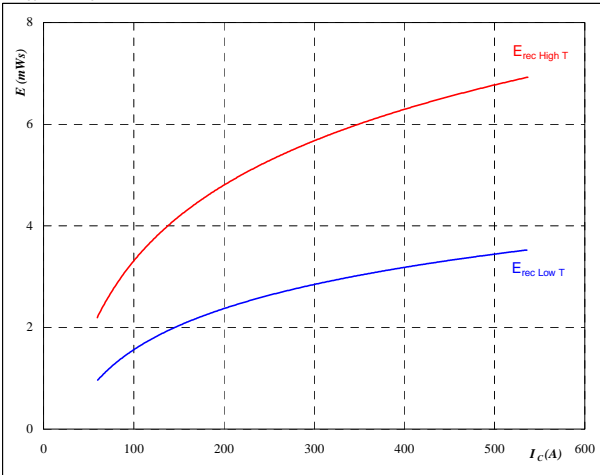
With an inductive load at

- $T_j = 25/125\ ^\circ\text{C}$
- $V_{CE} = 350\ \text{V}$
- $V_{GE} = \pm 15\ \text{V}$
- $I_C = 300\ \text{A}$

figure 7. FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



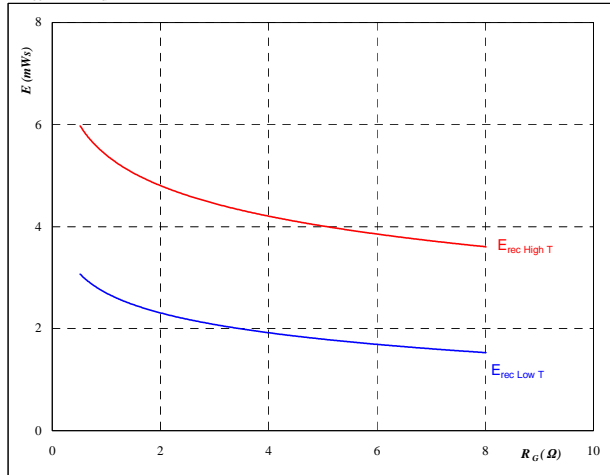
With an inductive load at

- $T_j = 25/125\ ^\circ\text{C}$
- $V_{CE} = 350\ \text{V}$
- $V_{GE} = \pm 15\ \text{V}$
- $R_{gon} = 1\ \Omega$

figure 8. FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

- $T_j = 25/125\ ^\circ\text{C}$
- $V_{CE} = 350\ \text{V}$
- $V_{GE} = \pm 15\ \text{V}$
- $I_C = 300\ \text{A}$



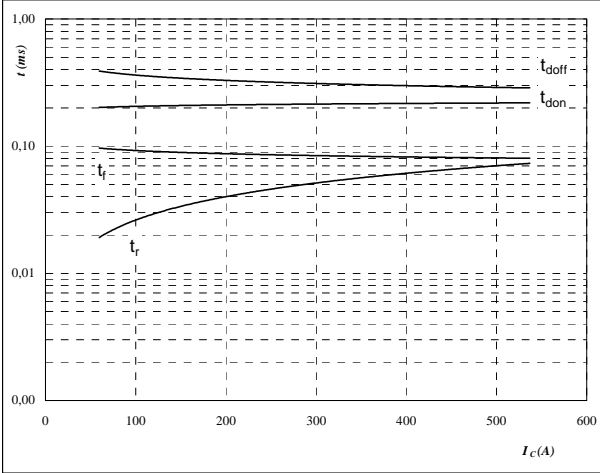
Buck

half bridge IGBT and neutral point FWD

figure 9. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



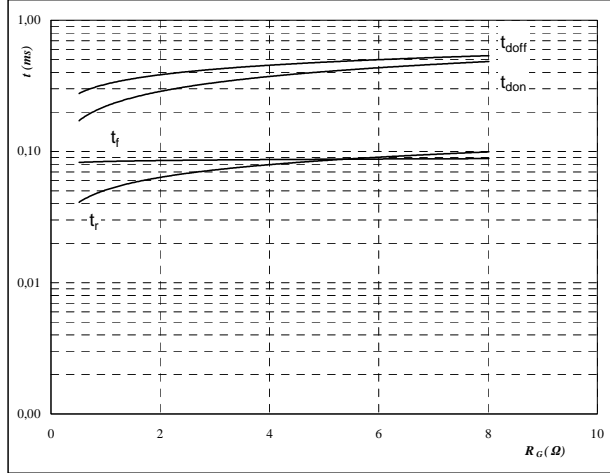
With an inductive load at

$T_j =$	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

$$t = f(R_G)$$



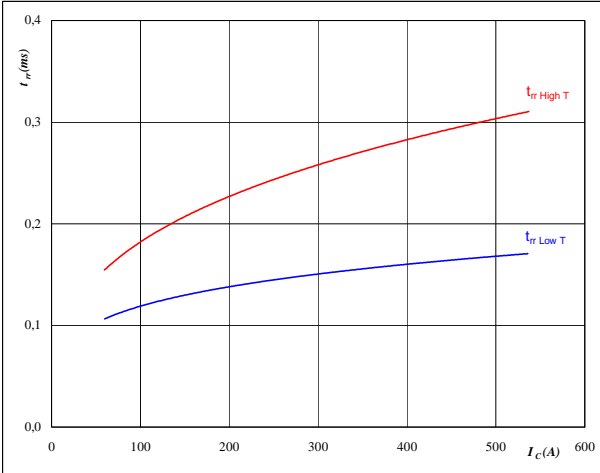
With an inductive load at

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

figure 11. FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



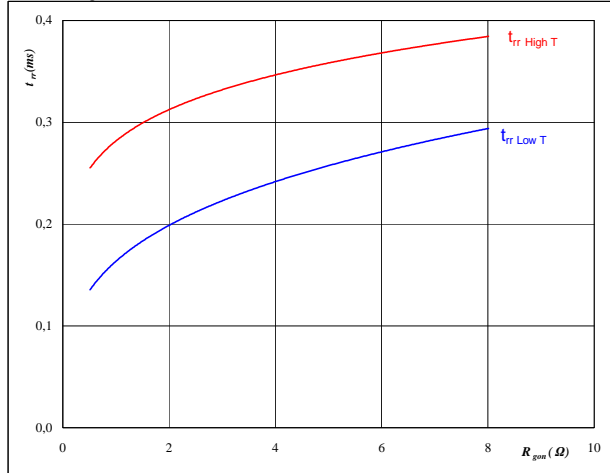
At

$T_j =$	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
$I_F =$	300	A
$V_{GE} =$	±15	V



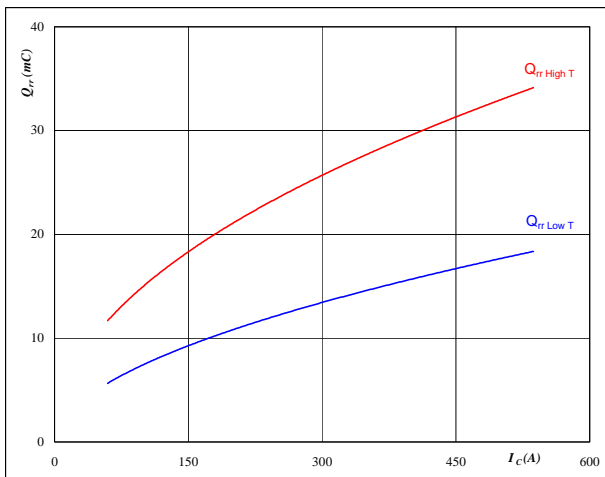
Buck

half bridge IGBT and neutral point FWD

figure 13. FWD

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_c)$$

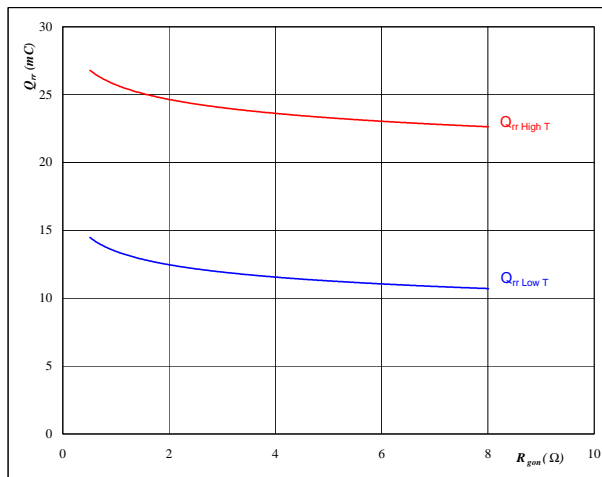


At
 $T_j = 25/125$ °C
 $V_{CE} = 350$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 1$ Ω

figure 14. FWD

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

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

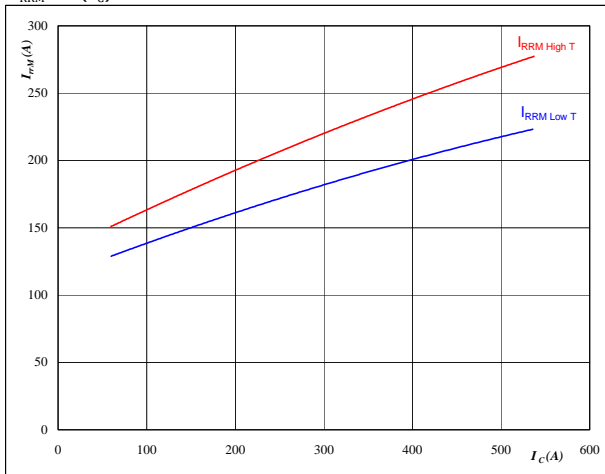


At
 $T_j = 25/125$ °C
 $V_R = 350$ V
 $I_F = 300$ A
 $V_{GE} = \pm 15$ V

figure 15. FWD

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_c)$$

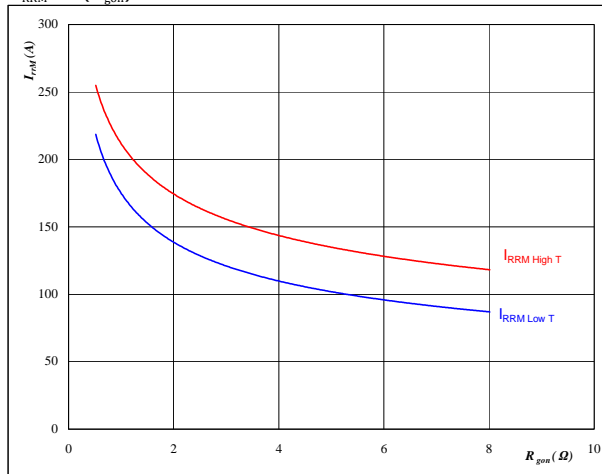


At
 $T_j = 25/125$ °C
 $V_{CE} = 350$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 1$ Ω

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
 $I_F = 300$ A
 $V_{GE} = \pm 15$ V



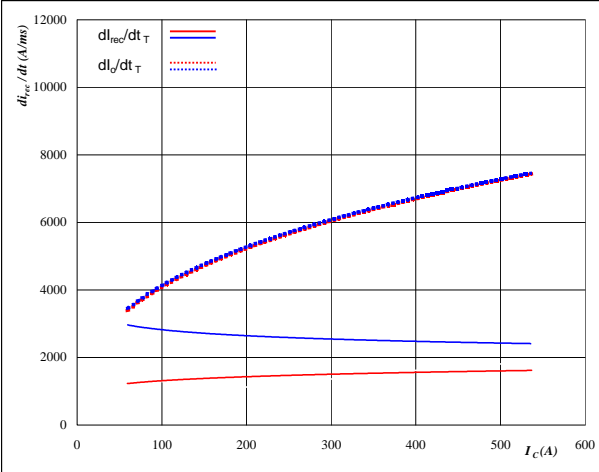
Buck

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

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

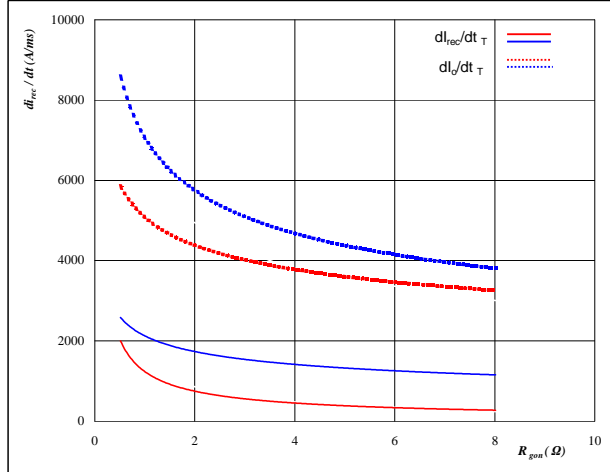


At
 $T_j = 25/125 \text{ } ^\circ\text{C}$
 $V_{CE} = 350 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 1 \text{ } \Omega$

figure 18. FWD

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

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

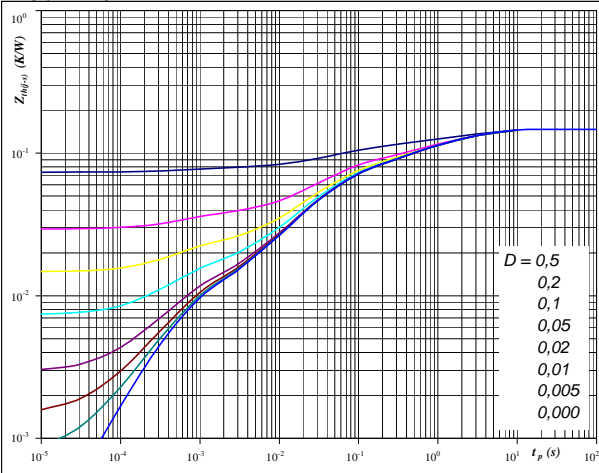


At
 $T_j = 25/125 \text{ } ^\circ\text{C}$
 $V_R = 350 \text{ V}$
 $I_F = 300 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

figure 19. IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{th(j-s)} = f(t_p)$$



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,15 \text{ K/W}$

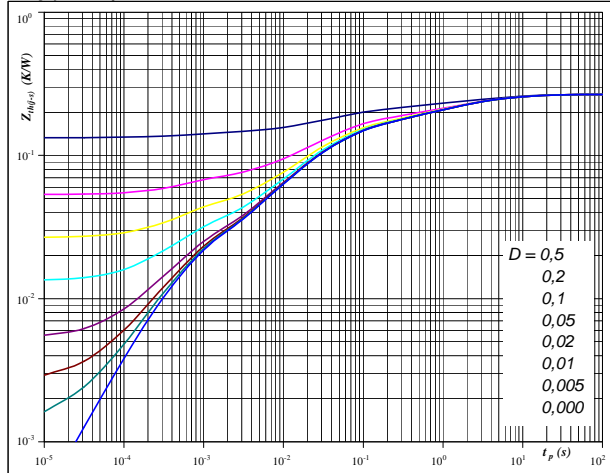
IGBT thermal model values

R (K/W)	Tau (s)
4,1E-02	3,0E+00
3,4E-02	4,9E-01
4,4E-02	5,7E-02
1,8E-02	1,4E-02
9,1E-03	5,7E-04

figure 20. FWD

FWD transient thermal impedance as a function of pulse width

$$Z_{th(j-s)} = f(t_p)$$



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,27 \text{ K/W}$

FWD thermal model values

R (K/W)	Tau (s)
2,5E-02	9,7E+00
5,8E-02	1,8E+00
4,0E-02	3,0E-01
8,5E-02	4,3E-02
3,8E-02	9,8E-03
1,9E-02	5,4E-04



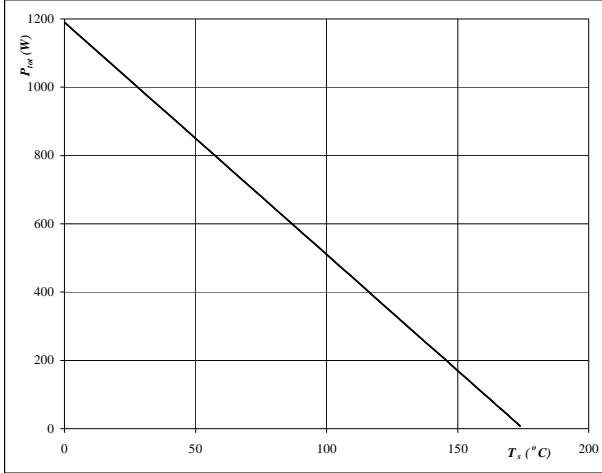
Buck

half bridge IGBT and neutral point FWD

figure 21. IGBT

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

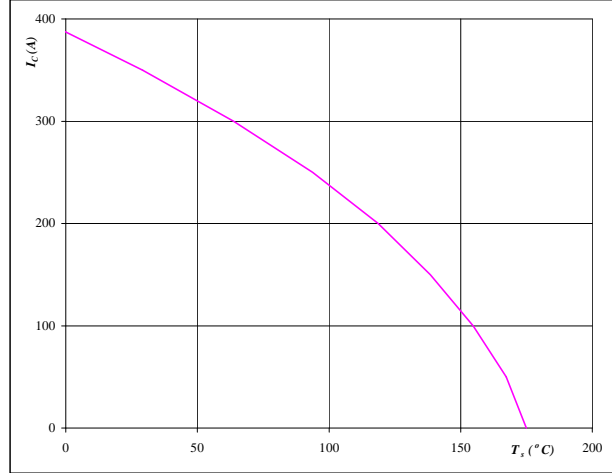


At
T_j = 175 °C

figure 22. IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_s)$$

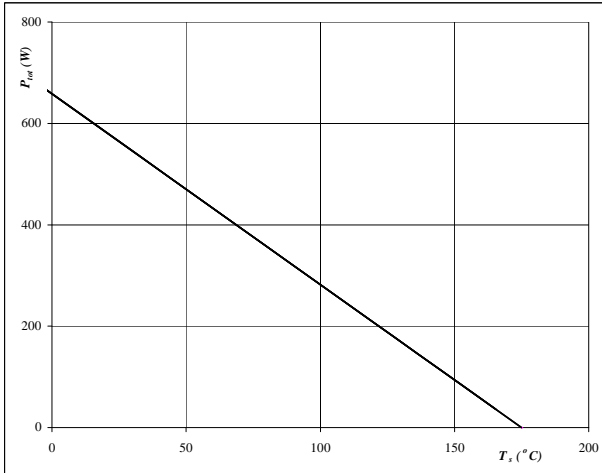


At
T_j = 175 °C
V_{GE} = 15 V

figure 23. FWD

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

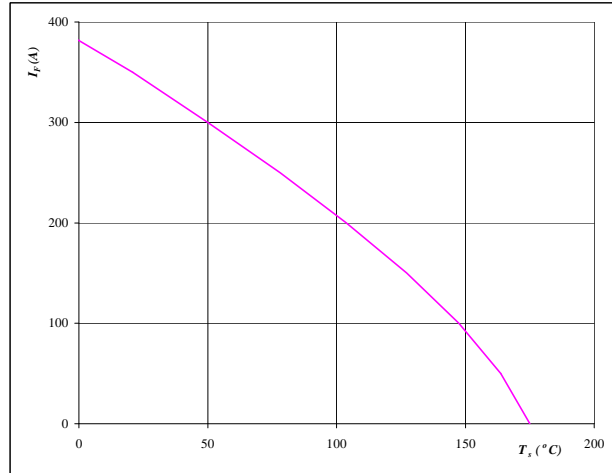


At
T_j = 175 °C

figure 24. FWD

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



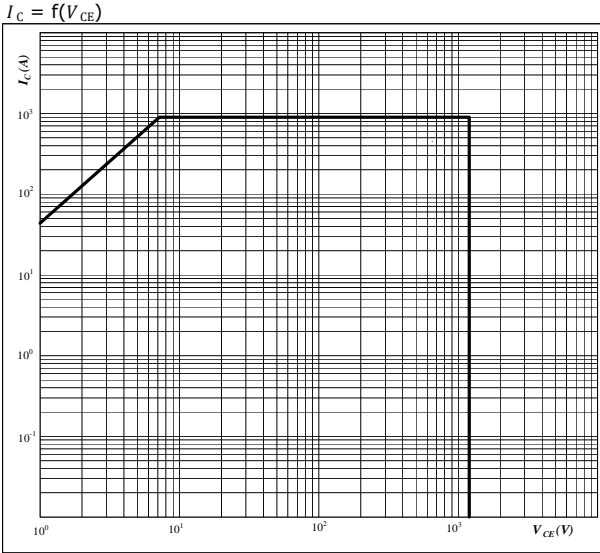
At
T_j = 175 °C



Buck

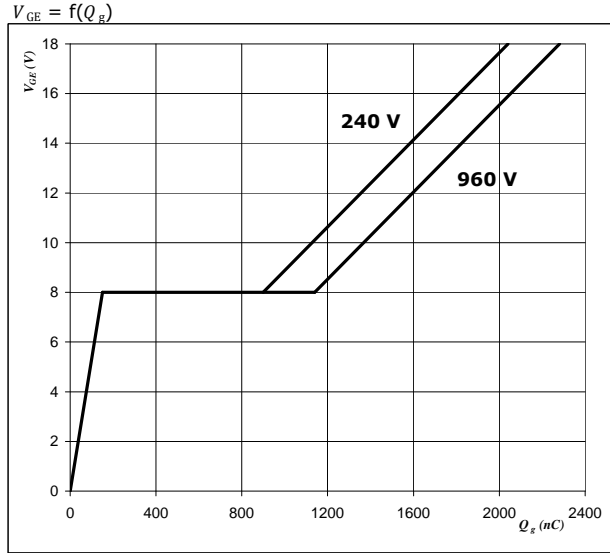
half bridge IGBT and neutral point FWD

figure 25. IGBT
Safe operating area as a function of collector-emitter voltage



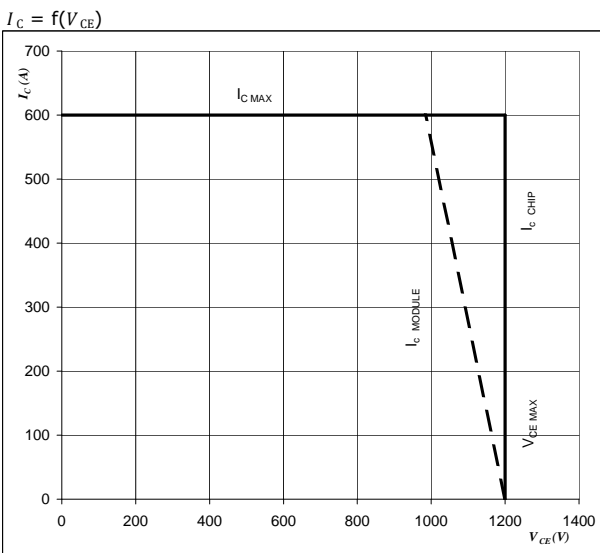
At
 $D =$ single pulse
 $T_s =$ 80 °C
 $V_{GE} =$ ±15 V
 $T_j = T_{jmax}$

figure 26. IGBT
Gate voltage vs Gate charge



At
 $I_C =$ 300 A

figure 27. IGBT
Reverse bias safe operating area



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



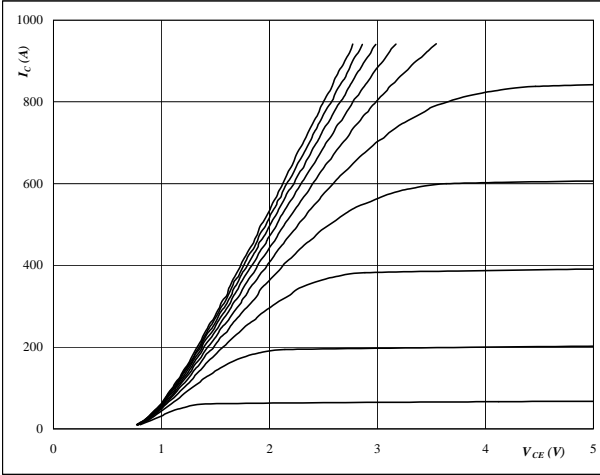
Boost

neutral point IGBT and half bridge FWD

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

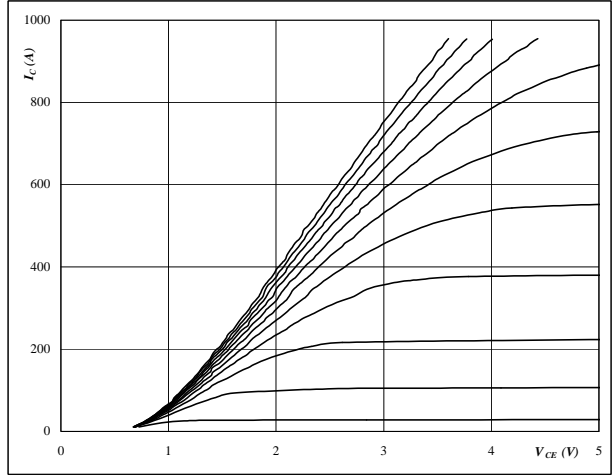


At
 $t_p = 350 \mu s$
 $T_j = 25 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

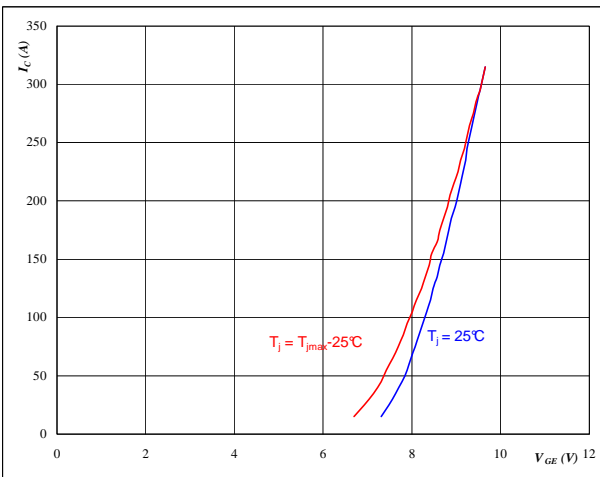


At
 $t_p = 350 \mu s$
 $T_j = 125 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

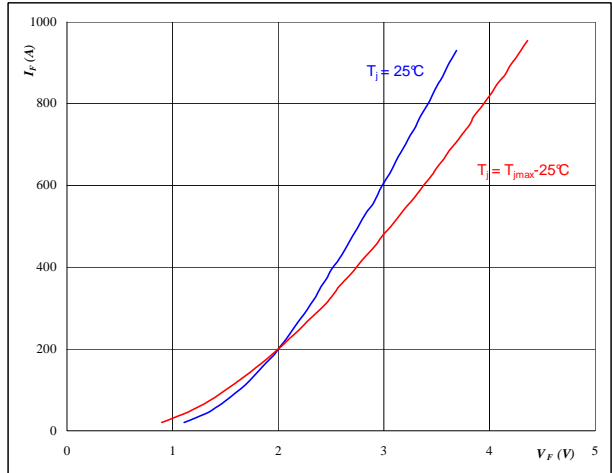


At
 $t_p = 350 \mu s$
 $V_{CE} = 10 V$

figure 4. FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At
 $t_p = 350 \mu s$



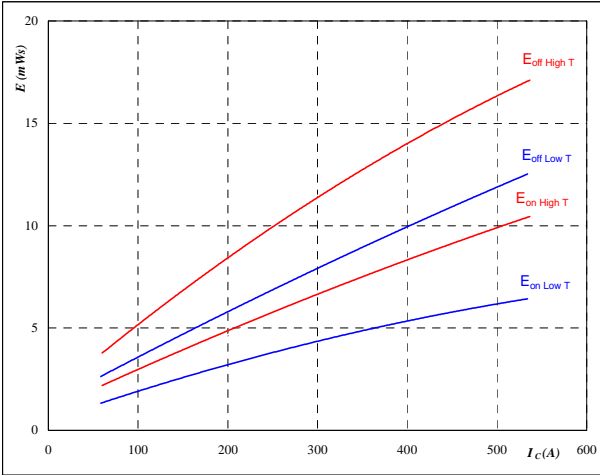
Boost

neutral point IGBT and half bridge FWD

figure 5. IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



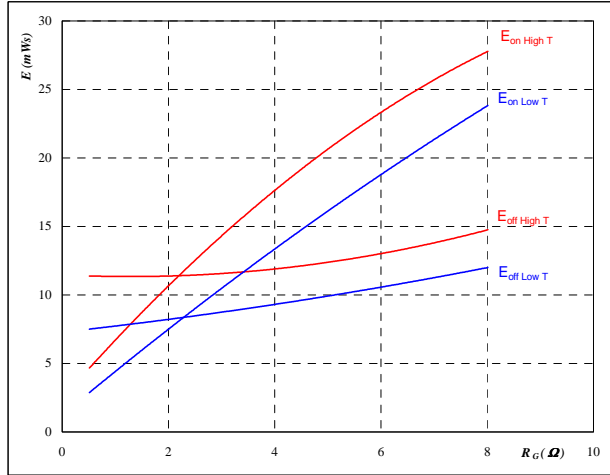
With an inductive load at

- $T_j = 25/125 \text{ } ^\circ\text{C}$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 1 \text{ } \Omega$
- $R_{goff} = 1 \text{ } \Omega$

figure 6. IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



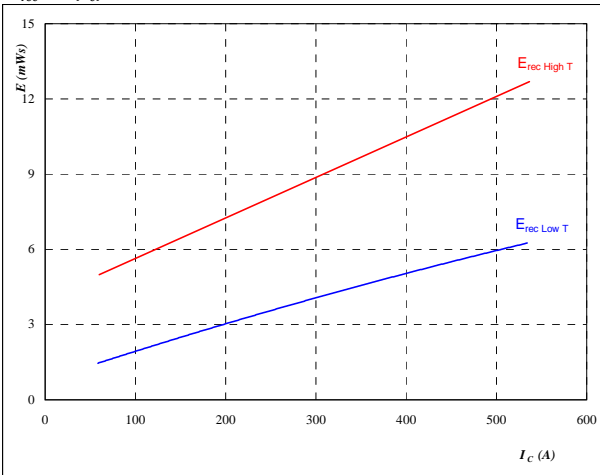
With an inductive load at

- $T_j = 25/125 \text{ } ^\circ\text{C}$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 300 \text{ A}$

figure 7. FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



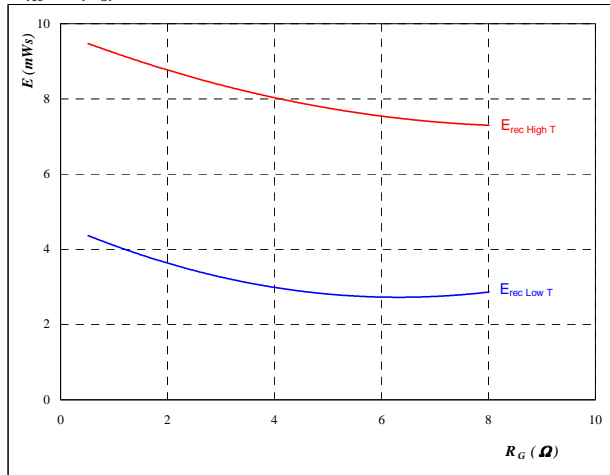
With an inductive load at

- $T_j = 25/125 \text{ } ^\circ\text{C}$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 1 \text{ } \Omega$

figure 8. FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

- $T_j = 25/125 \text{ } ^\circ\text{C}$
- $V_{CE} = 350 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 300 \text{ A}$



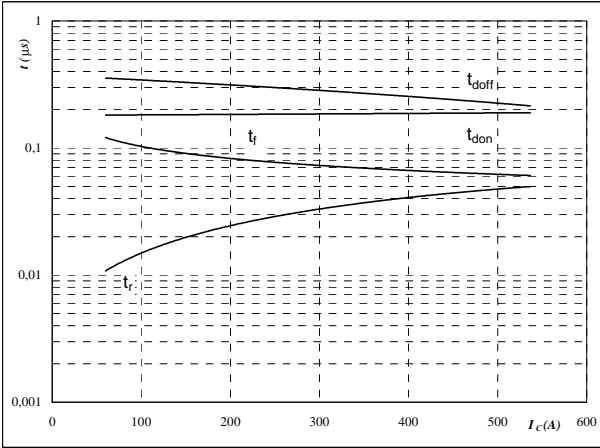
Boost

neutral point IGBT and half bridge FWD

figure 9. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



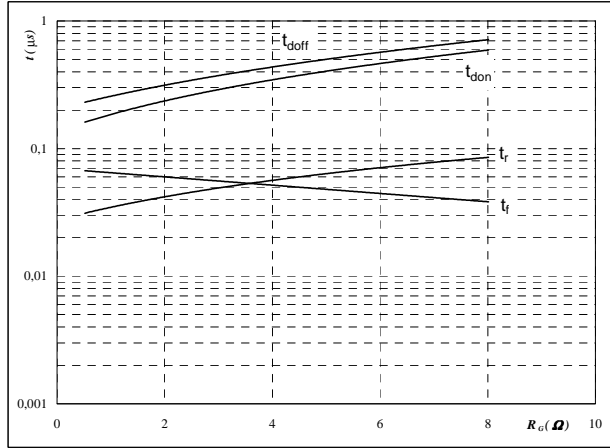
With an inductive load at

$T_j =$	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

$$t = f(R_G)$$



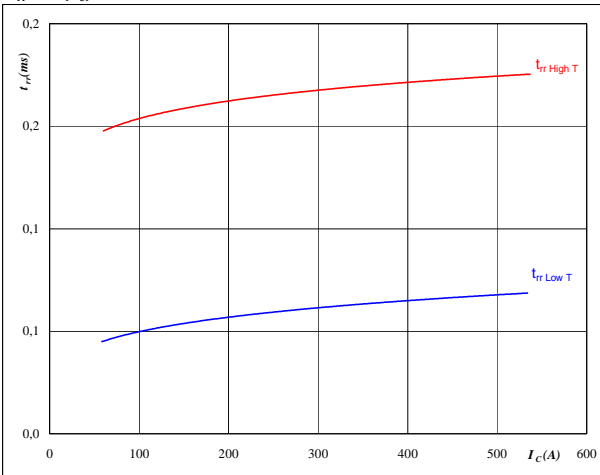
With an inductive load at

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

figure 11. FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



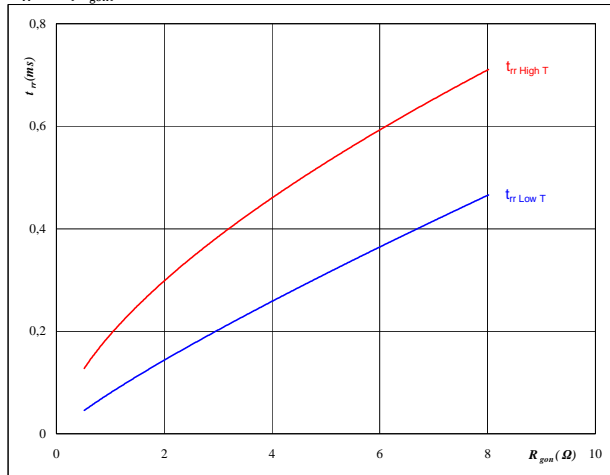
At

$T_j =$	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

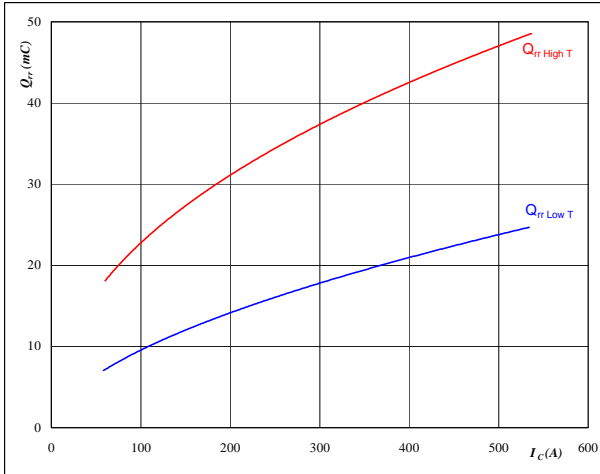
$T_j =$	25/125	°C
$V_R =$	350	V
$I_F =$	300	A
$V_{GE} =$	±15	V

**Boost**

neutral point IGBT and half bridge FWD

figure 13. FWD**Typical reverse recovery charge as a function of collector current**

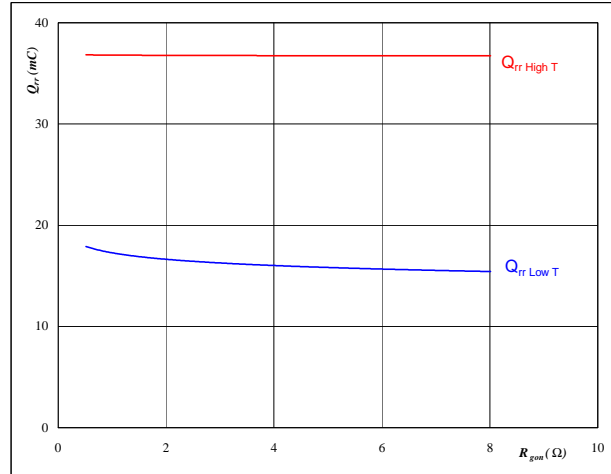
$$Q_{rr} = f(I_c)$$

**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**

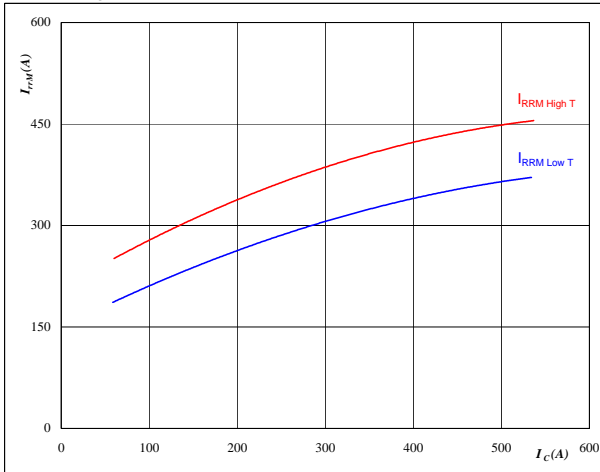
$$Q_{rr} = f(R_{gon})$$

**At**

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

figure 15. FWD**Typical reverse recovery current as a function of collector current**

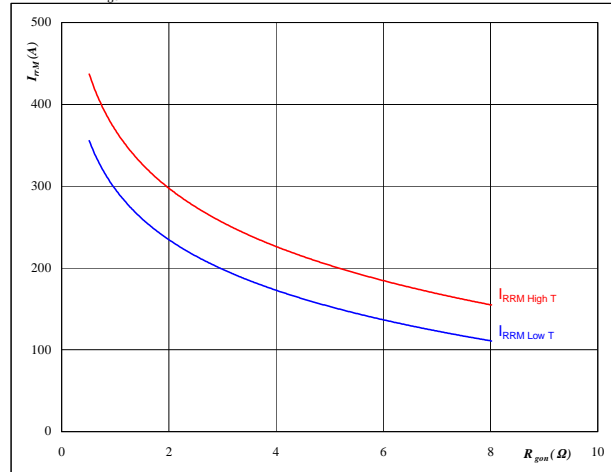
$$I_{RRM} = f(I_c)$$

**At**

$T_j =$	25/125	°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
$I_F =$	300	A
$V_{GE} =$	±15	V



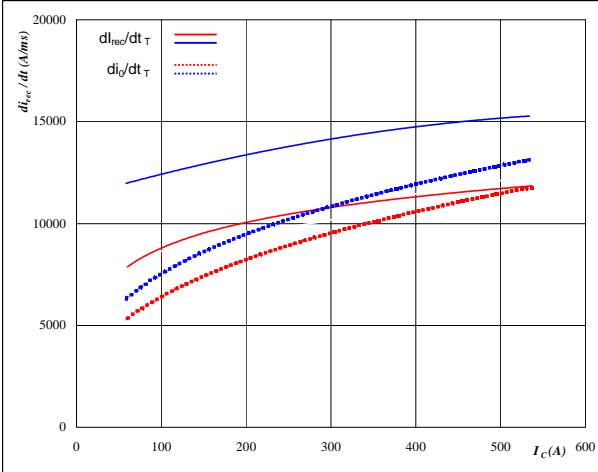
Boost

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

$$di_0/dt, di_{rec}/dt = f(I_c)$$

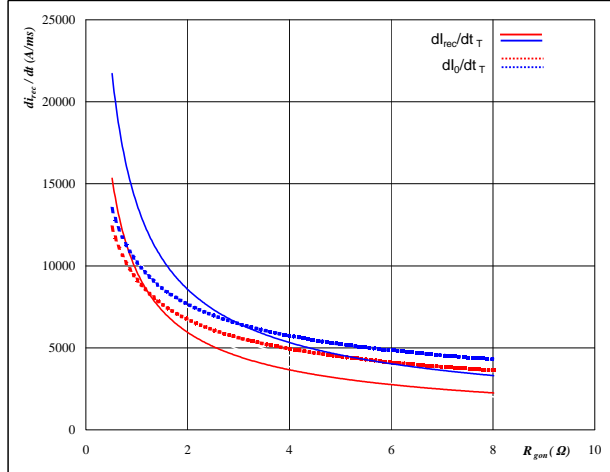


At
 $T_j = 25/125 \text{ } ^\circ\text{C}$
 $V_{CE} = 350 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 1 \text{ } \Omega$

figure 18. FWD

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

$$di_0/dt, di_{rec}/dt = f(R_{gon})$$

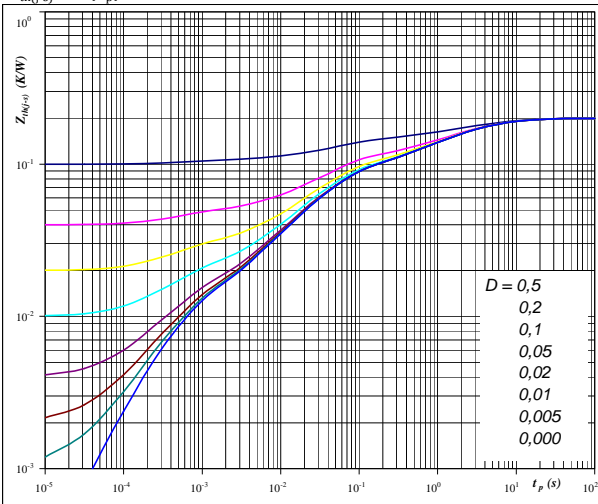


At
 $T_j = 25/125 \text{ } ^\circ\text{C}$
 $V_R = 350 \text{ V}$
 $I_F = 300 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

figure 19. IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{th(j-s)} = f(t_p)$$



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,20 \text{ K/W}$

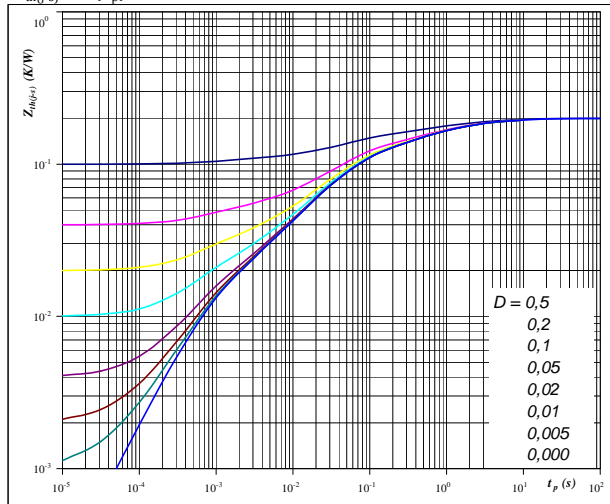
IGBT thermal model values

R (K/W)	Tau (s)
2,3E-02	9,7E+00
6,4E-02	1,9E+00
2,8E-02	3,6E-01
5,9E-02	4,3E-02
1,5E-02	8,0E-03
1,1E-02	4,7E-04

figure 20. FWD

FWD transient thermal impedance as a function of pulse width

$$Z_{th(j-s)} = f(t_p)$$



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,20 \text{ K/W}$

FWD thermal model values

R (K/W)	Tau (s)
1,2E-02	1,0E+01
4,0E-02	1,6E+00
4,5E-02	3,0E-01
6,9E-02	4,5E-02
2,0E-02	8,9E-03
1,3E-02	8,0E-04



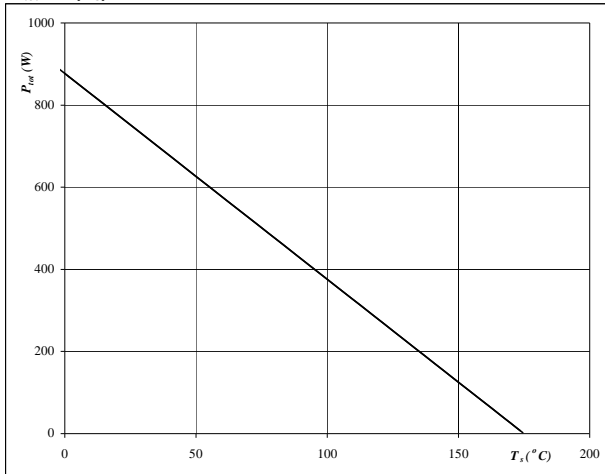
Boost

neutral point IGBT and half bridge FWD

figure 21. IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

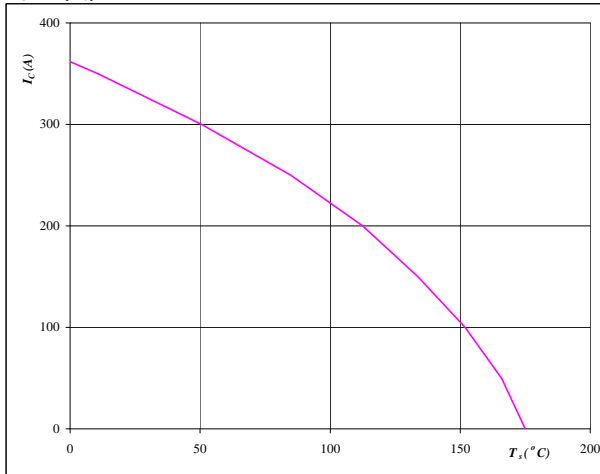


At
 $T_j = 175 \text{ } ^\circ\text{C}$

figure 22. IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$

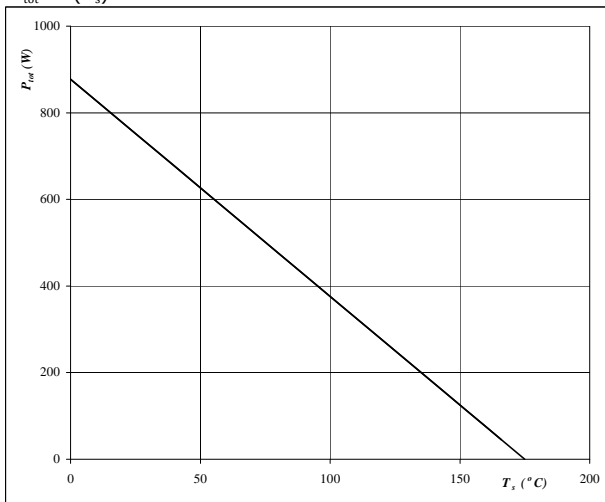


At
 $T_j = 175 \text{ } ^\circ\text{C}$
 $V_{GE} = 15 \text{ V}$

figure 23. FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

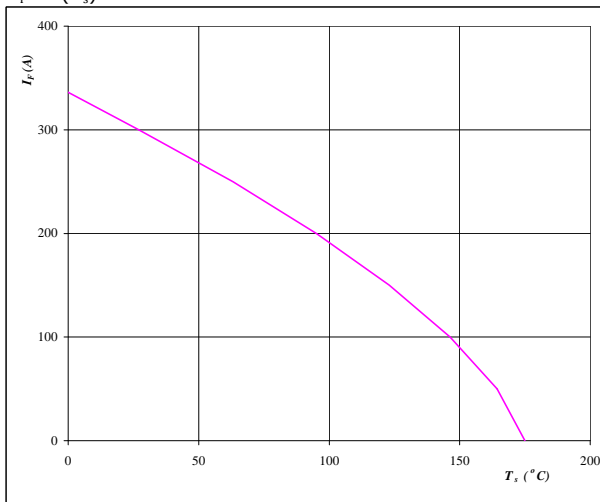


At
 $T_j = 175 \text{ } ^\circ\text{C}$

figure 24. FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$

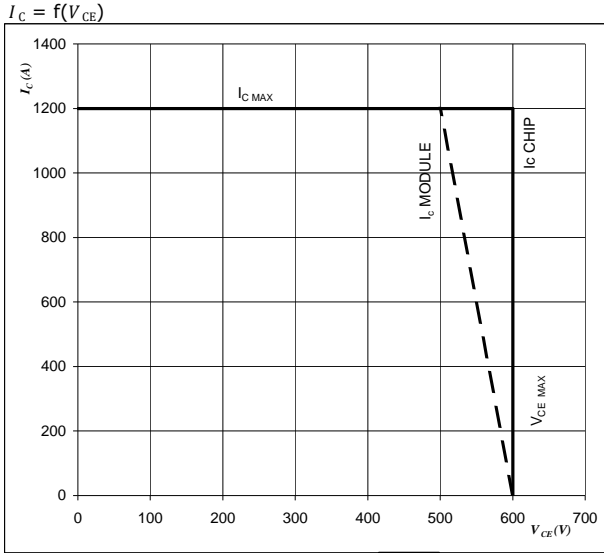


At
 $T_j = 175 \text{ } ^\circ\text{C}$



Boost neutral point IGBT

figure 25. IGBT
Reverse bias safe operating area



At

$T_j = T_{j\text{max}} - 25 \text{ } ^\circ\text{C}$

$U_{cc\text{minus}} = U_{cc\text{plus}}$

Switching mode : 3 level switching

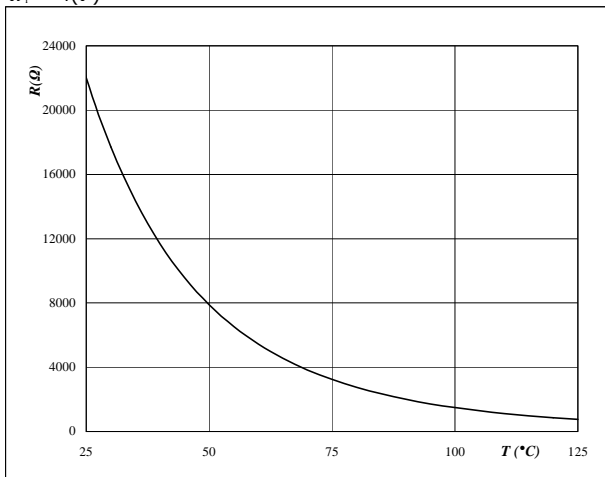


Thermistor

figure 1. Thermistor

**Typical NTC characteristic
as a function of temperature**

$$R_T = f(T)$$





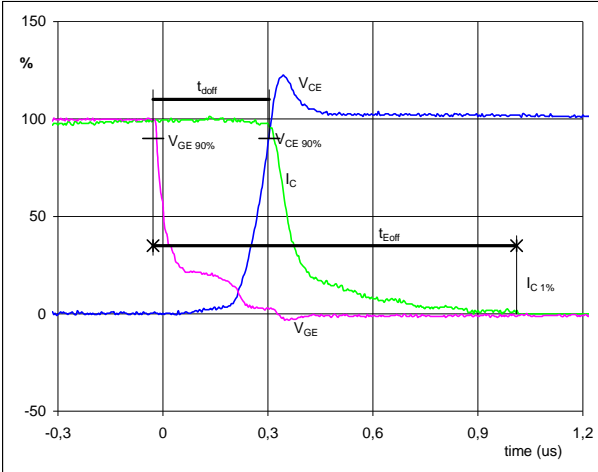
Switching Definitions Buck IGBT

General conditions

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

figure 1. IGBT

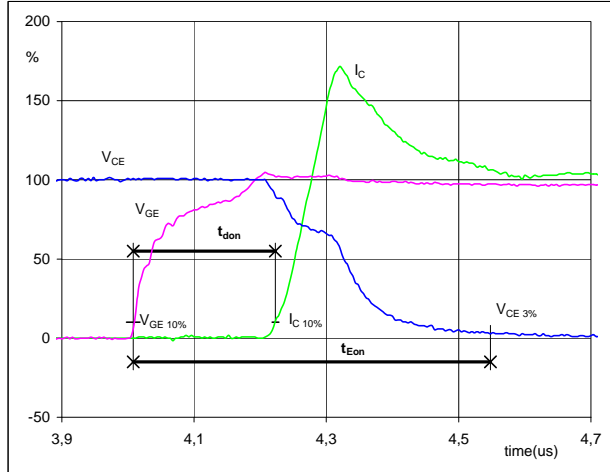
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	350	V
$I_C (100\%) =$	400	A
$t_{doff} =$	0,32	μ S
$t_{Eoff} =$	1,04	μ S

figure 2. IGBT

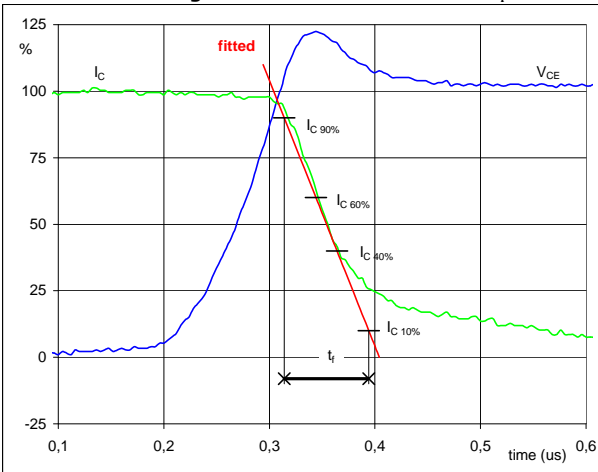
Turn-on Switching Waveforms & definition of t_{donr} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	350	V
$I_C (100\%) =$	400	A
$t_{don} =$	0,21	μ S
$t_{Eon} =$	0,54	μ S

figure 3. IGBT

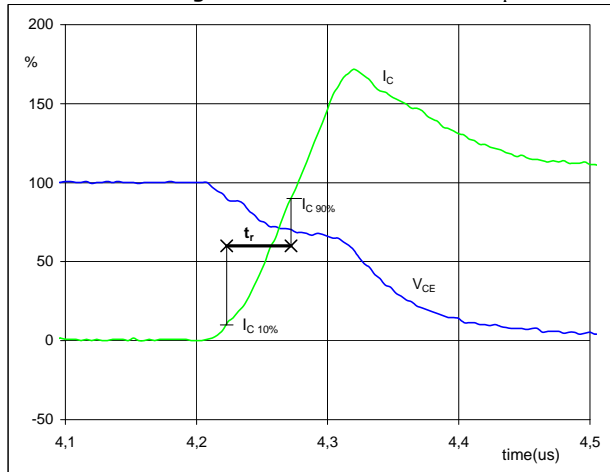
Turn-off Switching Waveforms & definition of t_f



$V_C (100\%) =$	350	V
$I_C (100\%) =$	400	A
$t_f =$	0,08	μ S

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

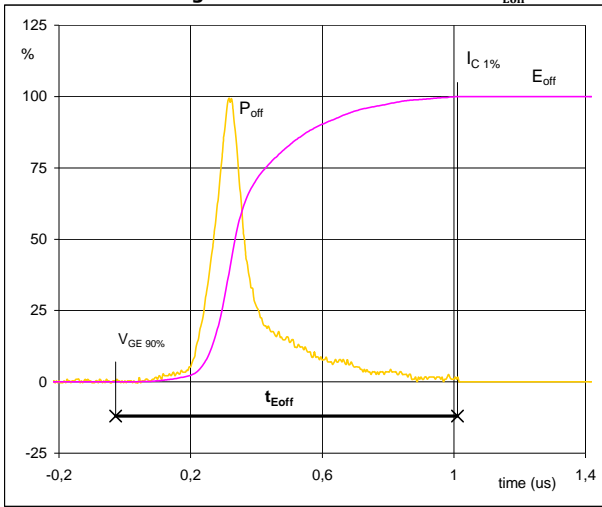


$V_C (100\%) =$	350	V
$I_C (100\%) =$	400	A
$t_r =$	0,05	μ S



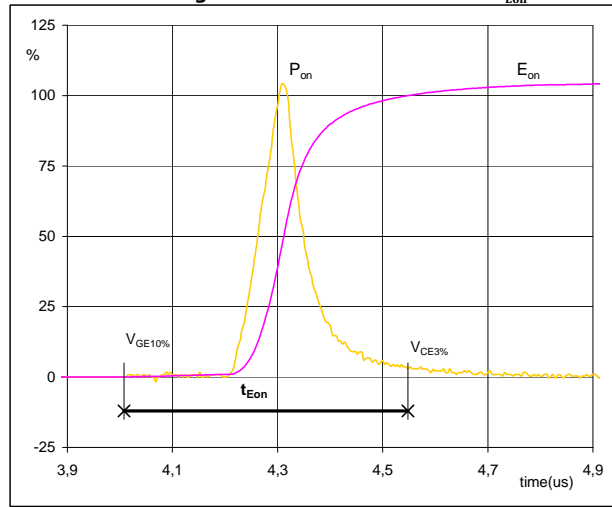
Switching Definitions Buck IGBT

figure 5. IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



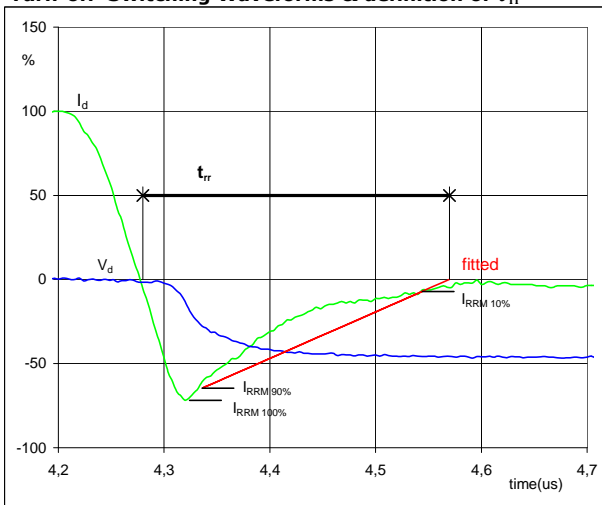
$P_{off} (100\%) = 140 \text{ kW}$
 $E_{off} (100\%) = 15,62 \text{ mJ}$
 $t_{Eoff} = 1,04 \text{ } \mu\text{s}$

figure 6. IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 140 \text{ kW}$
 $E_{on} (100\%) = 11,38 \text{ mJ}$
 $t_{Eon} = 0,54 \text{ } \mu\text{s}$

figure 7. FWD
Turn-off Switching Waveforms & definition of t_{tr}



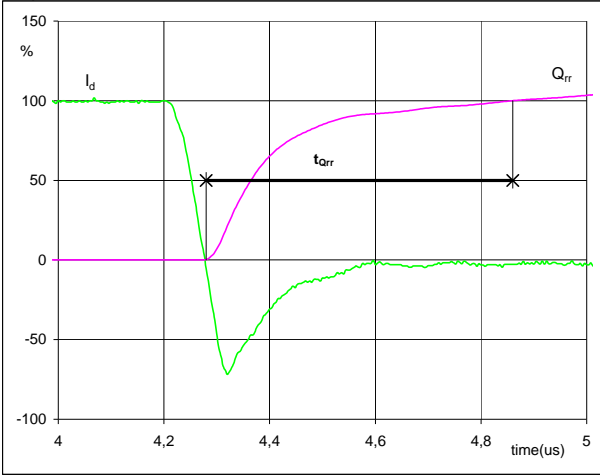
$V_d (100\%) = 350 \text{ V}$
 $I_d (100\%) = 400 \text{ A}$
 $I_{RRM} (100\%) = -217 \text{ A}$
 $t_{tr} = 0,27 \text{ } \mu\text{s}$



Switching Definitions Buck IGBT

figure 8. FWD

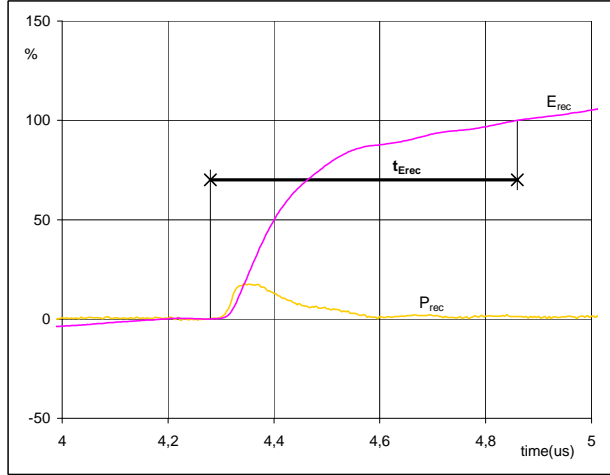
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	400	A
Q_{rr} (100%) =	25,32	μC
t_{Qrr} =	0,58	μs

figure 9. FWD

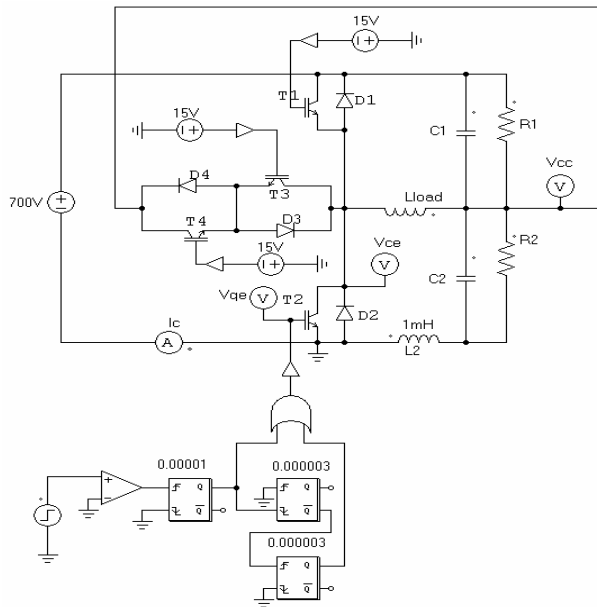
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	140	kW
E_{rec} (100%) =	5,33	mJ
t_{Erec} =	0,58	μs

Buck IGBT switching measurement circuit

figure 10.





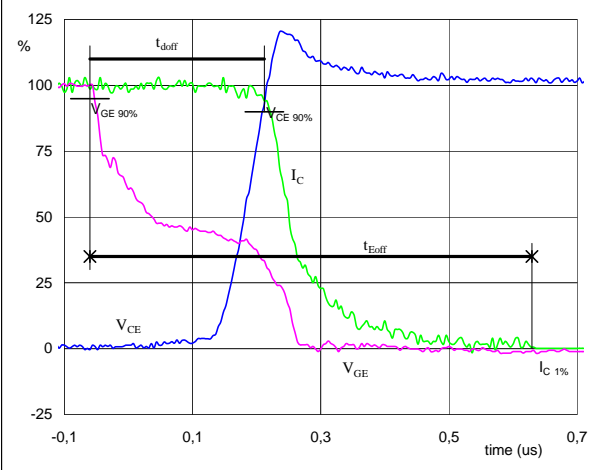
Switching Definitions Boost IGBT

General conditions

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

figure 1. IGBT

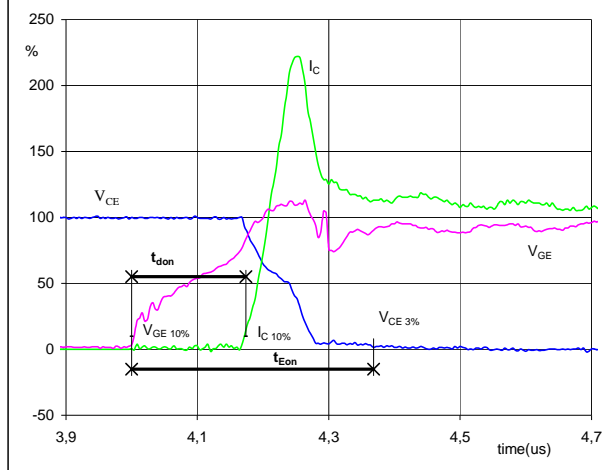
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	302	A
t_{doff} =	0,23	μ s
t_{Eoff} =	0,58	μ s

figure 2. IGBT

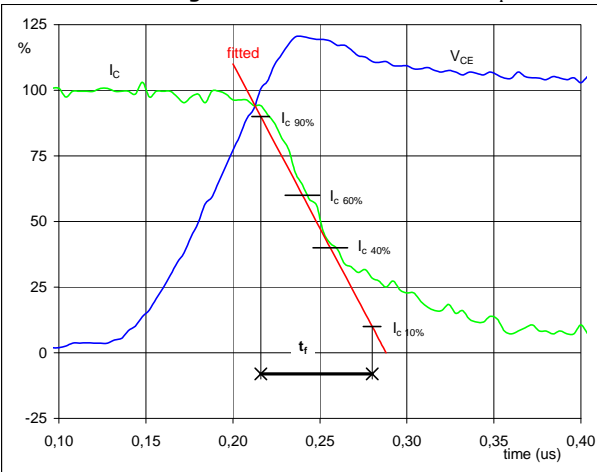
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	302	A
t_{don} =	0,19	μ s
t_{Eon} =	0,38	μ s

figure 3. IGBT

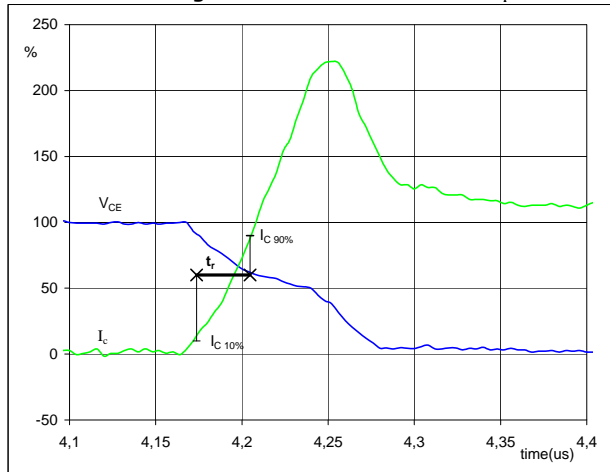
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	302	A
t_f =	0,065	μ s

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

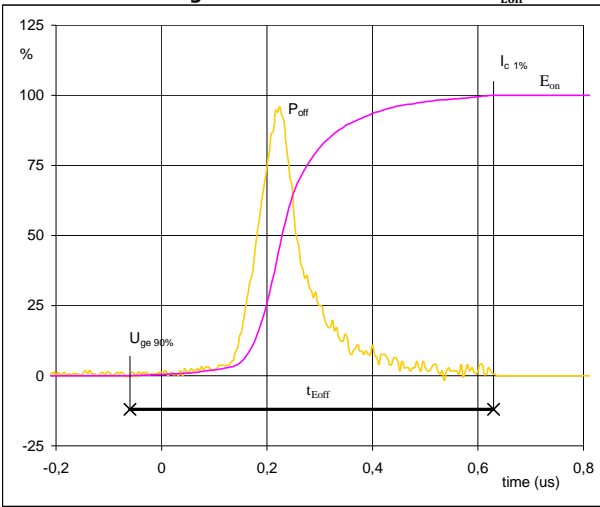


V_C (100%) =	350	V
I_C (100%) =	302	A
t_r =	0,034	μ s



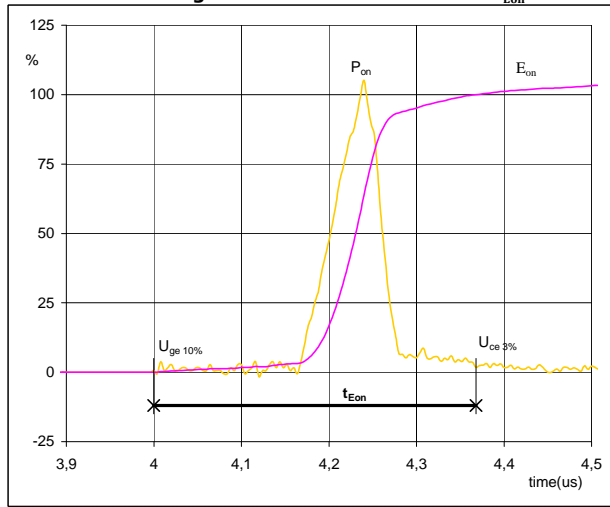
Switching Definitions Boost IGBT

figure 5. IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



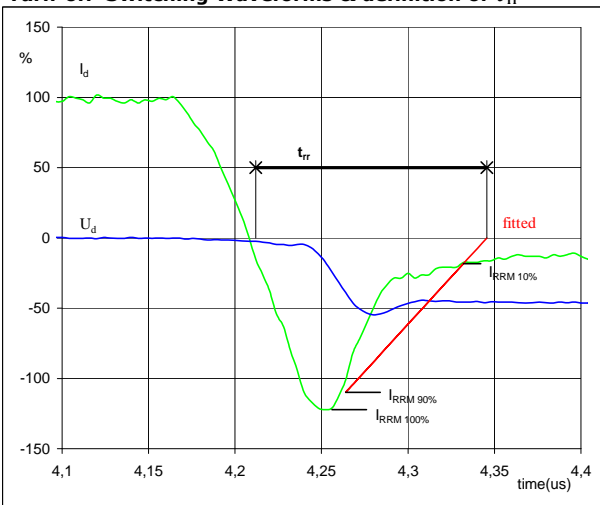
$P_{off} (100\%) = 106 \text{ kW}$
 $E_{off} (100\%) = 11,52 \text{ mJ}$
 $t_{Eoff} = 0,58 \text{ } \mu\text{s}$

figure 6. IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 106 \text{ kW}$
 $E_{on} (100\%) = 13,39 \text{ mJ}$
 $t_{Eon} = 0,38 \text{ } \mu\text{s}$

figure 7. FWD
Turn-off Switching Waveforms & definition of t_{rr}

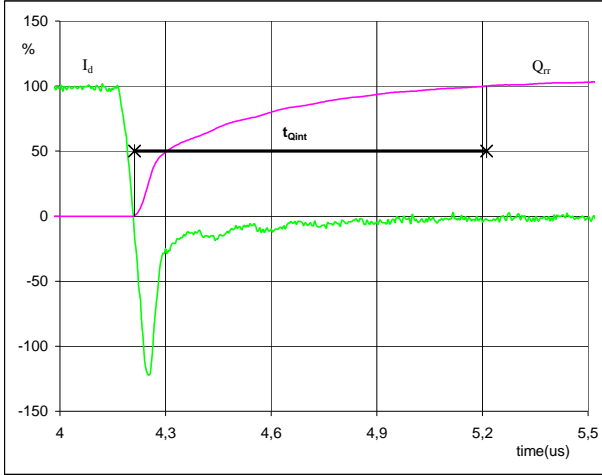


$V_d (100\%) = 350 \text{ V}$
 $I_d (100\%) = 302 \text{ A}$
 $I_{RRM} (100\%) = -384 \text{ A}$
 $t_{rr} = 0,15 \text{ } \mu\text{s}$



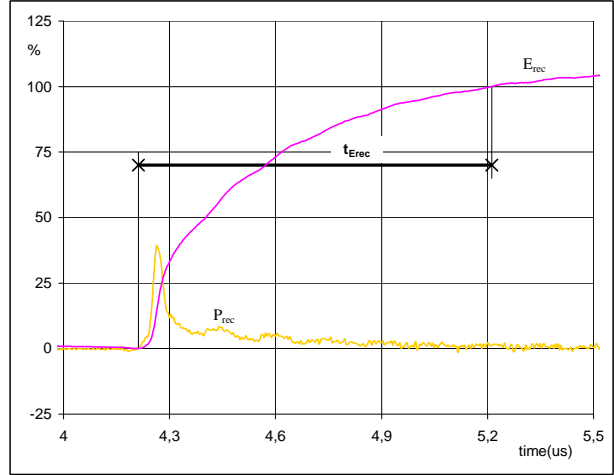
Switching Definitions Boost IGBT

figure 8. FWD
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	302	A
Q_{rr} (100%) =	35,60	μC
t_{Qint} =	0,33	μs

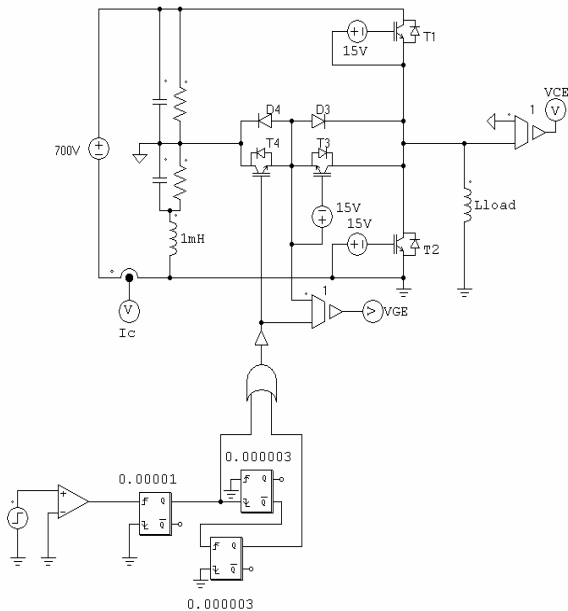
figure 9. FWD
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	106	kW
E_{rec} (100%) =	8,89	mJ
t_{Erec} =	0,33	μs


Boost IGBT switching measurement circuit

figure 10.





Ordering Code & Marking

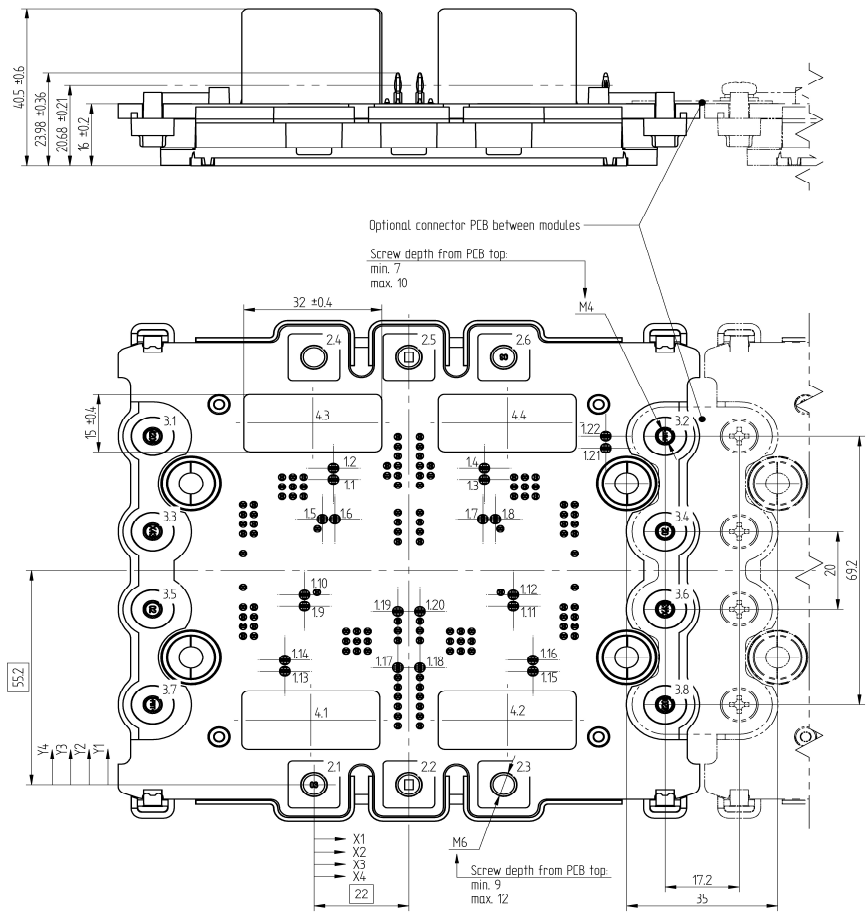
Version		Ordering Code					
without PCM		70-W612M3A300SC-M208P					
with PCM		70-W612M3A300SC-M208P-/3/					
Name  Vincotech	Date code	Text	Name	Date code	UL & VIN	Lot	Serial
	Lot		NN-NNNNNNNNNNNN-TTTTTTV	WWYY	UL VIN	LLLLL	SSSS
Serial UL		Datamatrix	Type&Ver	Lot number	Serial	Date code	
			TTTTTTTV	LLLLL	SSSS	WWYY	

Outline

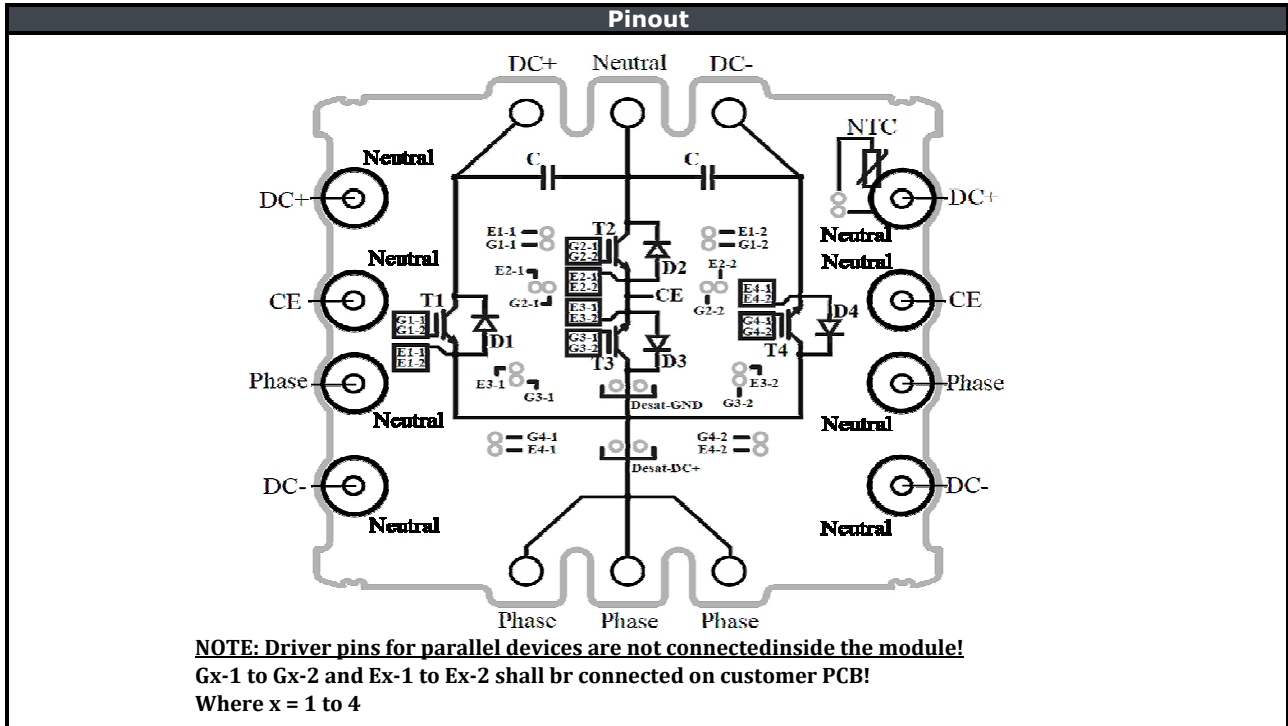
Driver pins				Capacitor positions		
Pin	X1	Y1	Function	Capacitor	X4	Y4
1.1	4,5	78,65	G1-1	4.1	-0,75	16,65
1.2	4,5	81,55	E1-1	4.2	44,8	16,65
1.3	39,5	78,65	G1-2	4.3	-0,3	93,25
1.4	39,5	81,55	E1-2	4.4	44,8	93,25
1.5	1,95	68,4	E2-1			
1.6	4,85	68,4	G2-1			
1.7	39,15	68,4	G2-2			
1.8	42,05	68,4	E2-2			
1.9	-2,2	46	G3-1			
1.10	-2,2	48,9	E3-1			
1.11	46,2	46	G3-2			
1.12	46,2	48,9	E3-2			
1.13	-6,75	29,2	E4-1			
1.14	-6,75	32,1	G4-1			
1.15	50,75	29,2	E4-2			
1.16	50,75	32,1	G4-2			
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			

Power interconnections			
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-

Low current connections			
M4 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-



Dimension of coordinate axis is only offset without tolerance




Identification					
ID	Component	Voltage	Current	Function	Comment
T1, T4	IGBT	1200 V	300 A	Buck Switch	
T2, T3	IGBT	600 V	300 A	Boost Switch	
D2, D3	FWD	600 V	300 A	Buck Diode	
D1, D4	FWD	1200 V	300 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-W612M3A300SC-M208P-D7-14	28 Sep. 2021	Correction in 'Maximum Ratings' and 'Characteristic Values' headline text	1, 2, 3, 4

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- 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.