flow NPC 0 600V/60A & 99mΩ PS*

Features

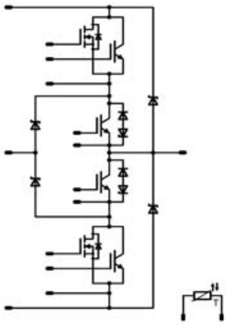
- *PS: 65A parallel switch (60A IGBT and 99mΩ MOSFET)
- neutral point clamped inverter
- reactive power capability
- low inductance layout

flow 0 12mm housing

Target Applications

- solar inverter
- UPS

Schematic



Types

10-PZ06NRA069FP03-P967F78Y
10-FZ06NRA069FP03-P967F78

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Buck IGBT				
Collector-emitter break down voltage	V_{CE}		650	V
DC collector current	I_C	$T_j=T_j$max $T_h=80$℃ $T_c=80$℃	59 60	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max	180	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max $T_h=80$℃ $T_c=80$℃	118 179	W
Gate-emitter peak voltage	V_{GE}		±20	V
Maximum Junction Temperature	$T_j$max		175	℃
Buck FWD				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F	$T_j=T_j$max $T_h=80$℃ $T_c=80$℃	28 30	A
Non Repetitive peak Surge current	I_{FSM}	t_p limited by $T_j$max 60Hz Single Half-Sine Wave	120	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max $T_h=80$℃ $T_c=80$℃	40 60	W
Maximum Junction Temperature	$T_j$max		150	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Buck MOSFET					
Drain to source breakdown voltage	V_{DS}			600	V
DC drain current	I_D	T_j=$T_j$max	T_h=80℃ T_c=80℃	16 19	A
Pulsed drain current	I_{Dpulse}	t_p limited by $T_j$max	Tc=25℃	112	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	60 91	W
Gate-source peak voltage	Vgs			±20	V
Maximum Junction Temperature	$T_j$max			150	℃
Boost IGBT					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	59 60	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		225	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	93 141	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		6 360	µs V
Maximum Junction Temperature	$T_j$max			175	℃
Boost Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	17 17	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	44 61	W
Maximum Junction Temperature	$T_j$max			175	℃
Boost FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	17 23	A
Repetitive peak Surge current	I_{FSM}	t_p limited by $T_j$max		36	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	33 50	W
Maximum Junction Temperature	$T_j$max			150	℃
DC link Capacitor					
Max.DC voltage	V_{MAX}		Tc=25℃	25	V

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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

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	
Buck IGBT *										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00025	Tj=25℃ Tj=125℃	3,5	4,5	6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		60	Tj=25℃ Tj=125℃		1,93 1,74	2,5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25℃ Tj=125℃			250	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			±400	nA
Integrated Gate resistor	R_{gint}							none		Ω
Input capacitance **	C_{ies}	f=1MHz	0	30		Tj=25℃		2,9+4,7		nF
Output capacitance	C_{oss}							270		pF
Reverse transfer capacitance	C_{rss}							85		
Gate charge **	Q_{Gate}		15	400	60	Tj=25℃		189+70		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,80		K/W

* see dinamic characteristic at **Buck MosFET**
**additional value stands for built-in capacitor

Buck FWD										
Diode forward voltage	V_F				30	Tj=25℃ Tj=125℃		2,15 1,61	2,6	V
Reverse leakage current	I_r			600		Tj=25℃ Tj=125℃			100	µA
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	350	30	Tj=25℃ Tj=125℃		76 87		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		12 20		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		0,51 1,10		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		20215 16847		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=125℃		0,12 0,19		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,77		K/W
Buck MOSFET										
Static drain to source ON resistance	$R_{ds(on)}$		10		18	Tj=25℃ Tj=125℃		106 214		mΩ
Gate threshold voltage	$V_{(GS)th}$			V_{DS}=V_{GS}	0,0012	Tj=25℃ Tj=125℃	2,4	3	3,6	V
Gate to Source Leakage Current	I_{gss}		20	0		Tj=25℃ Tj=125℃			100	nA
Zero Gate Voltage Drain Current	I_{dss}		0	600		Tj=25℃ Tj=125℃			5	µA
Turn On Delay Time	$t_{d(ON)}$	Rgon=4 Ω Rgoff=4 Ω	±15	350	30	Tj=25℃ Tj=125℃		37 38		ns
Rise Time	t_r					Tj=25℃ Tj=125℃		2 3		
Turn off delay time	$t_{d(OFF)}$					Tj=25℃ Tj=125℃		405 422		
Fall time	t_f					Tj=25℃ Tj=125℃		4 5		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		0,05 0,22		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		0,04 0,22		
Total gate charge	Q_g		10	480	18,1	Tj=25℃		119		nC
Gate to source charge	Q_{gs}							14		
Gate to drain charge	Q_{gd}							61		
Input capacitance	C_{iss}	f=1MHz	0	100		Tj=25℃		2660		pF
Output capacitance	C_{oss}							154		
Gate resistor	r_G							1,6		Ω
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,16		K/W

** see schematic of the Gate-complex at characteristic figures

Characteristic Values

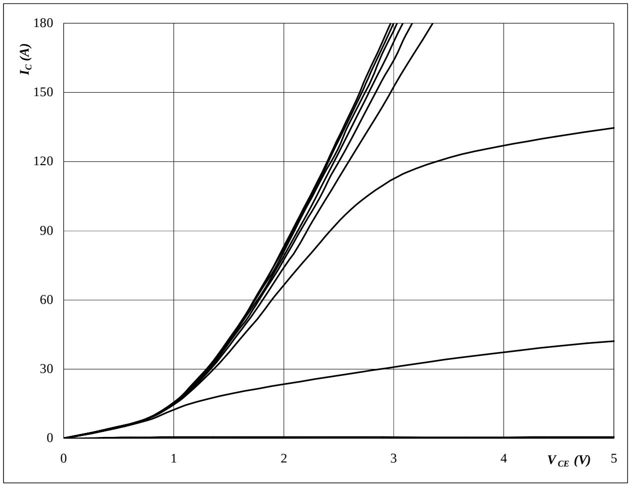
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Boost IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0012	Tj=25℃ Tj=125℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		75	Tj=25℃ Tj=125℃	1,05	1,11 1,12	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25℃ Tj=125℃			0,038	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			600	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=8 Ω Rgoff=8 Ω	±15	350	50	Tj=25℃ Tj=125℃		87 88		ns
Rise time	t_r					Tj=25℃ Tj=125℃		11 12		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		177 204		
Fall time	t_f					Tj=25℃ Tj=125℃		85 93		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		0,37 0,54		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		1,69 2,25		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		4620		pF
Output capacitance	C_{oss}							288		
Reverse transfer capacitance	C_{rss}							137		
Gate charge	Q_{Gate}		15	480	75	Tj=25℃		470		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,02		K/W
Boost Inverse Diode										
Diode forward voltage	V_F				10	Tj=25℃ Tj=125℃	1,25	1,88 1,22	1,95	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,17		K/W
Boost FWD										
Diode forward voltage	V_F				18	Tj=25℃ Tj=125℃	1,5	2,23 2,04	3,5	V
Reverse leakage current	I_r			1200		Tj=25℃ Tj=125℃			100	µA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	350	50	Tj=25℃ Tj=125℃		69 91		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		25,4 87,9		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		3,4 5,7		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		9632 6270		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		1,04 1,97		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,11		K/W
DC link Capacitor										
C value	C							4,7		nF
Thermistor										
Rated resistance	R					Tj=25℃		22000		Ω
Deviation of R100	ΔR/R	R_{100}= 1486Ω				Tc=100℃	-5		+5	%
Power dissipation	P					Tj=25℃		210		mW
Power dissipation constant						Tj=25℃		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25℃				K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25℃		4000		K
Vincotech NTC Reference									A	

Buck

Figure 1 MOSFET & IGBT

Typical output characteristics

$I_C = f(V_{CE})$



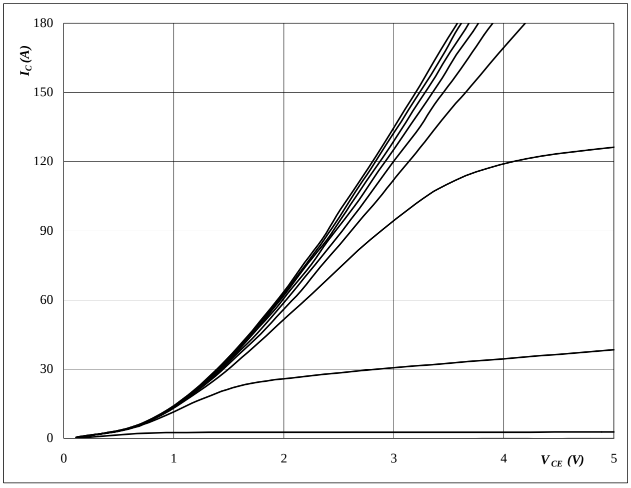
At

t_p =	250	µs
T_j =	25	℃
V_{GE} from	0 V to 20 V in steps of 2 V	

Figure 2 MOSFET & IGBT

Typical output characteristics

$I_C = f(V_{CE})$



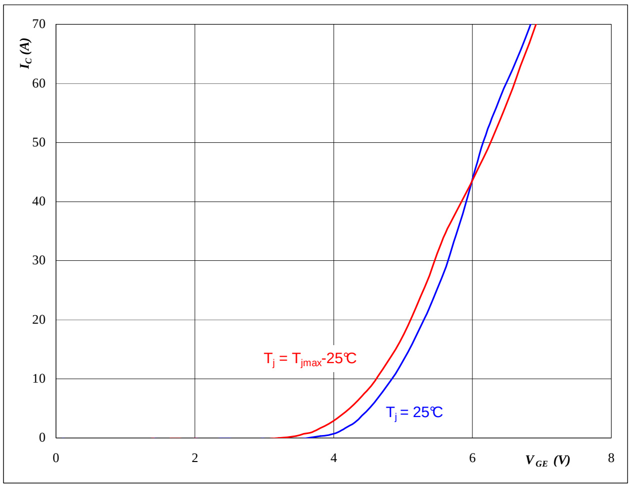
At

t_p =	250	µs
T_j =	125	℃
V_{GE} from	0 V to 20 V in steps of 2 V	

Figure 3 MOSFET & IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



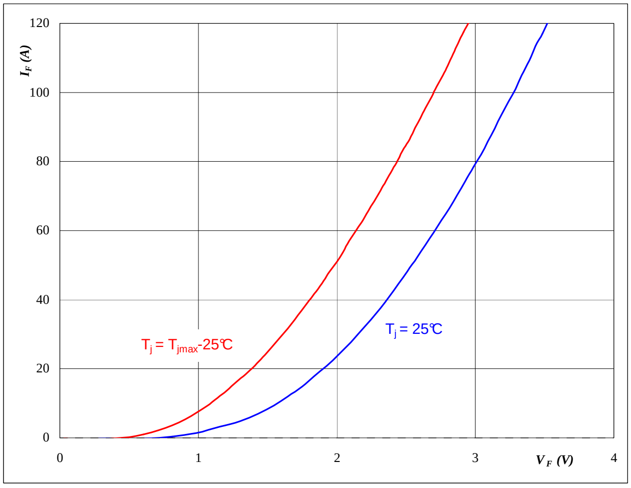
At

t_p =	250	µs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

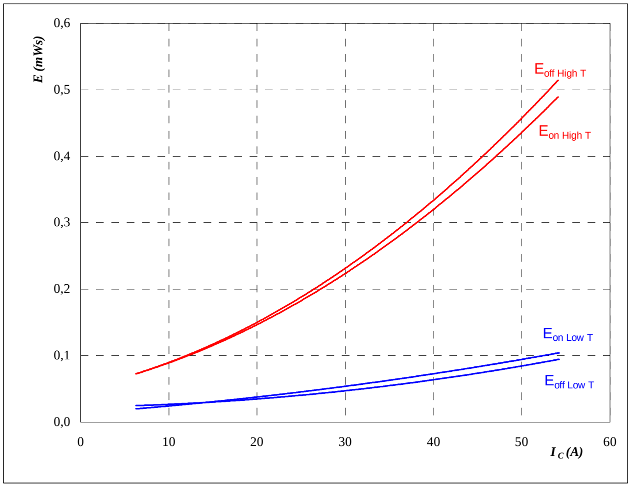
t_p =	250	µs

Buck

Figure 5 MOSFET & IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



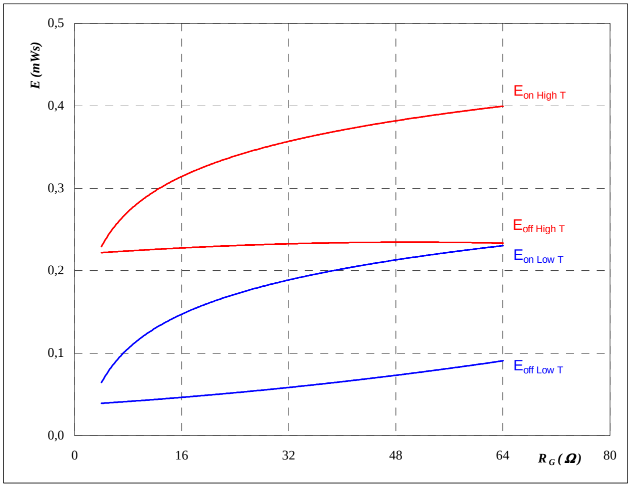
With an inductive load at

T_j =	25/125	℃	Gate on/off resistor of IGBT is fix 4Ω
V_{CE} =	350	V	MOSFET turn off delayed with 350 nS
V_{GE} =	±15	V	
R_{gon} =	4	Ω	
R_{goff} =	4	Ω	

Figure 6 MOSFET & IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



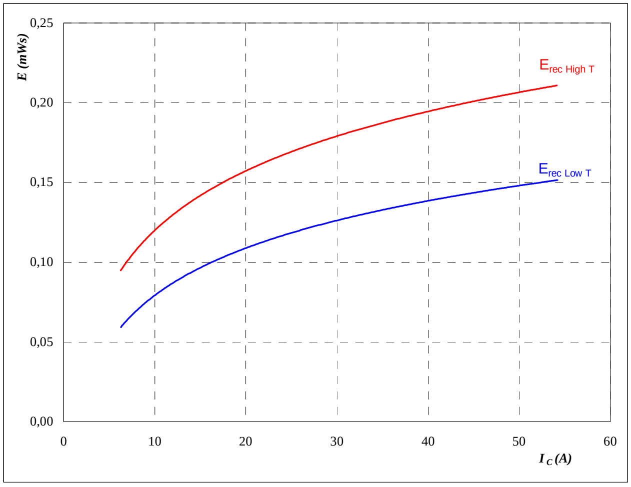
With an inductive load at

T_j =	25/125	℃	Gate on/off resistor of IGBT is fix 4Ω
V_{CE} =	350	V	MOSFET turn off delayed with 350 nS
V_{GE} =	±15	V	
I_C =	30	A	

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



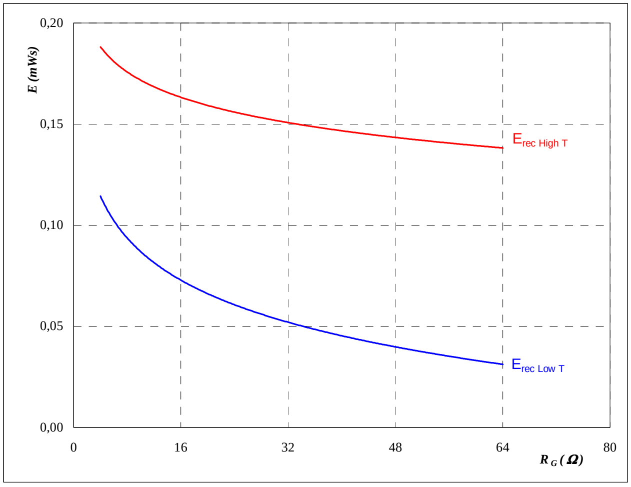
With an inductive load at

T_j =	25/125	℃	Gate on/off resistor of IGBT is fix 4Ω
V_{CE} =	350	V	MOSFET turn off delayed with 350 nS
V_{GE} =	±15	V	
R_{gon} =	4	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

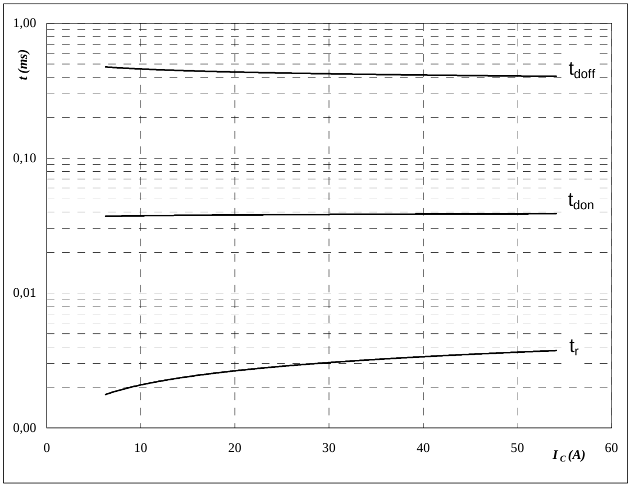
T_j =	25/125	℃	Gate on/off resistor of IGBT is fix 4Ω
V_{CE} =	350	V	MOSFET turn off delayed with 350 nS
V_{GE} =	±15	V	
I_C =	30	A	

Buck

Figure 9 MOSFET & 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} = 4 Ω

R_{goff} = 4 Ω

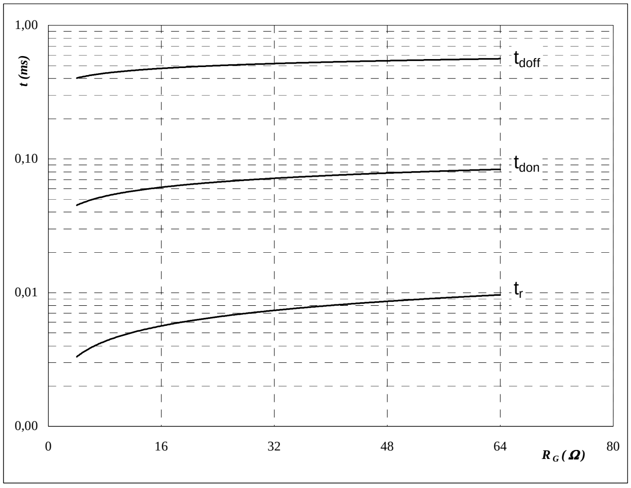
Gate on/off resistor of IGBT is fix 4Ω

MOSFET turn off delayed with 350 nS

Figure 10 MOSFET & 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 = 30 A

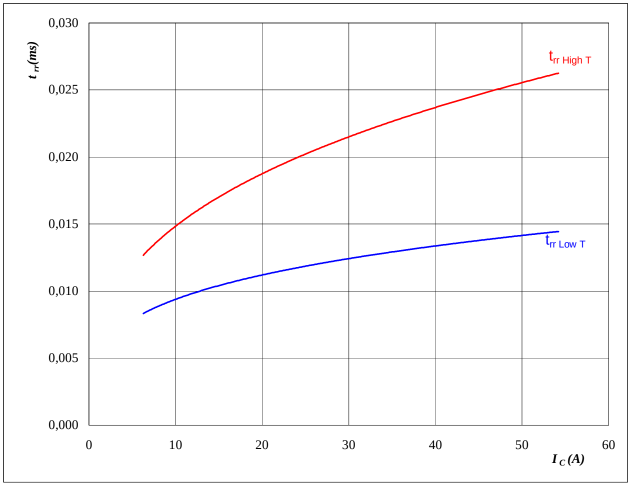
Gate on/off resistor of IGBT is fix 4Ω

MOSFET turn off delayed with 350 nS

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} = 4 Ω

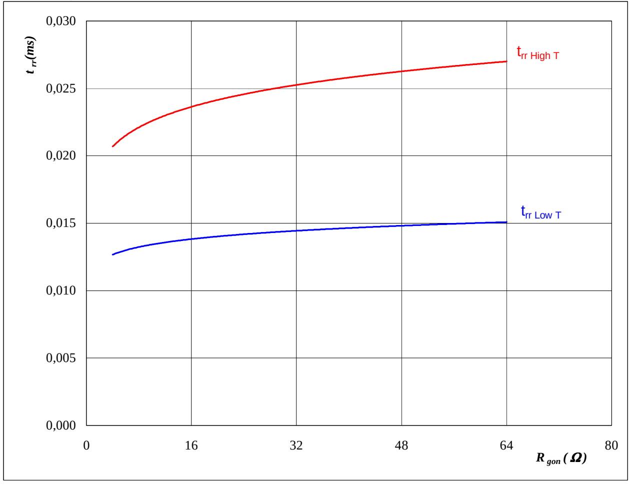
Gate on/off resistor of IGBT is fix 4Ω

MOSFET turn off delayed with 350 nS

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 = 30 A

V_{GE} = ±15 V

Gate on/off resistor of IGBT is fix 4Ω

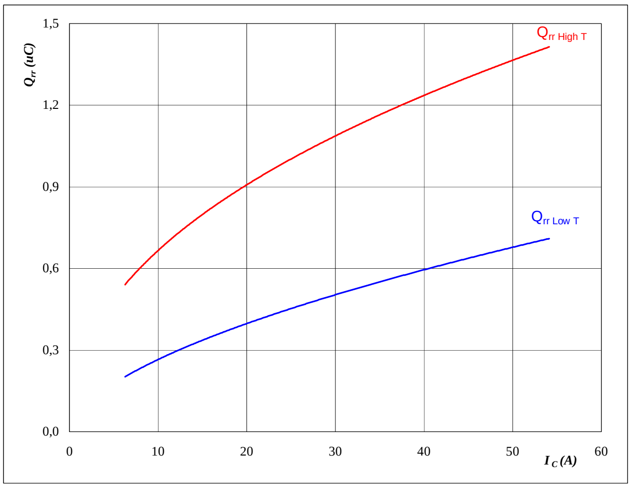
MOSFET turn off delayed with 350 nS

Buck

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



At

T_j = 25/125 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_{CE} = 350 V MOSFET turn off delayed with 350 nS

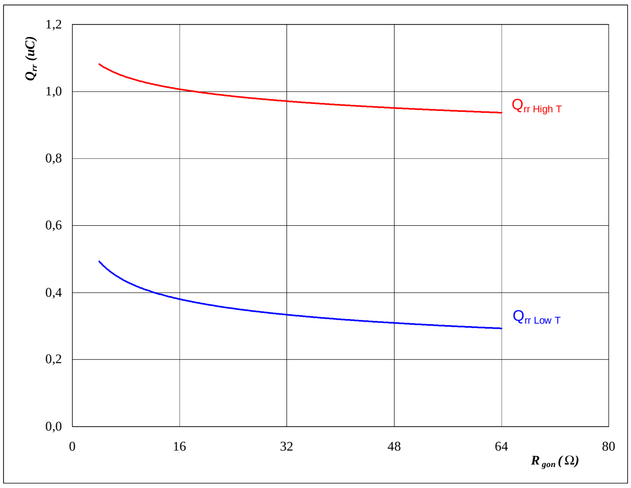
V_{GE} = ±15 V

R_{gon} = 4 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 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_R = 350 V MOSFET turn off delayed with 350 nS

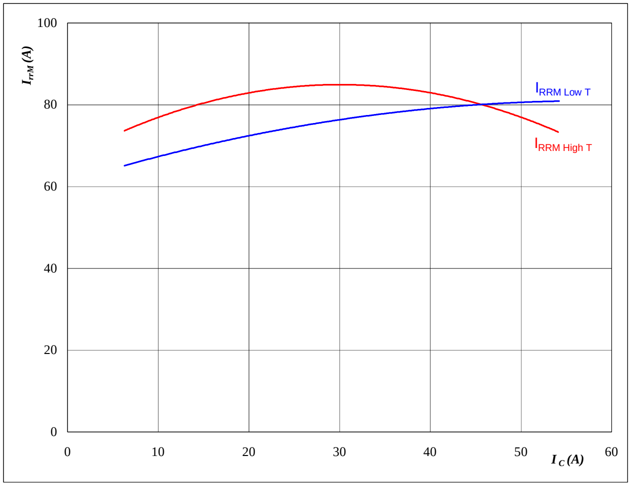
I_F = 30 A

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 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_{CE} = 350 V MOSFET turn off delayed with 350 nS

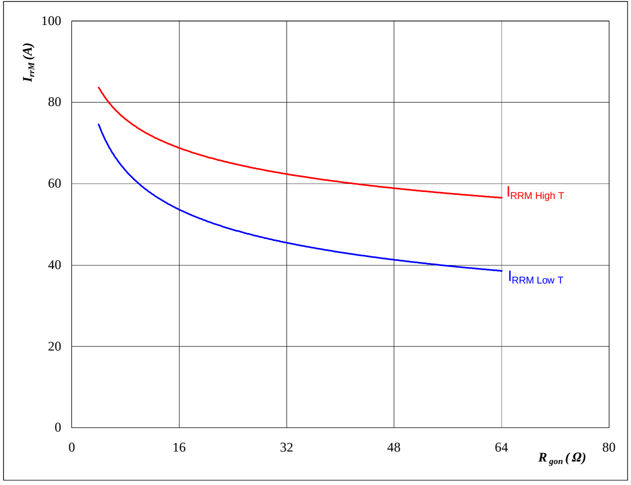
V_{GE} = ±15 V

R_{gon} = 4 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 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_R = 350 V MOSFET turn off delayed with 350 nS

I_F = 30 A

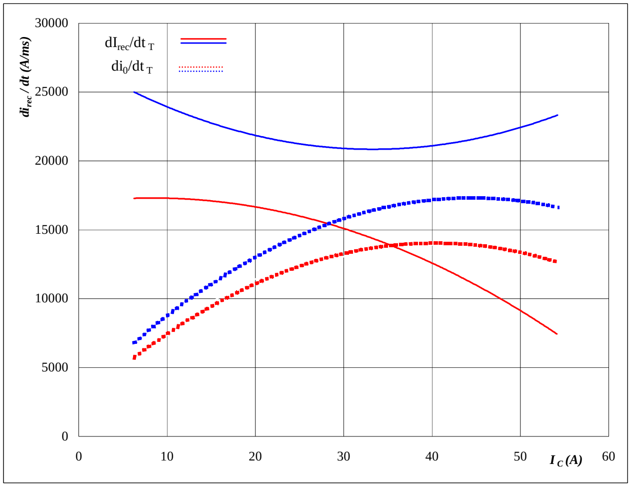
V_{GE} = ±15 V

Buck

Figure 17 FWD

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

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



At

T_j = 25/125 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_{CE} = 350 V MOSFET turn off delayed with 350 nS

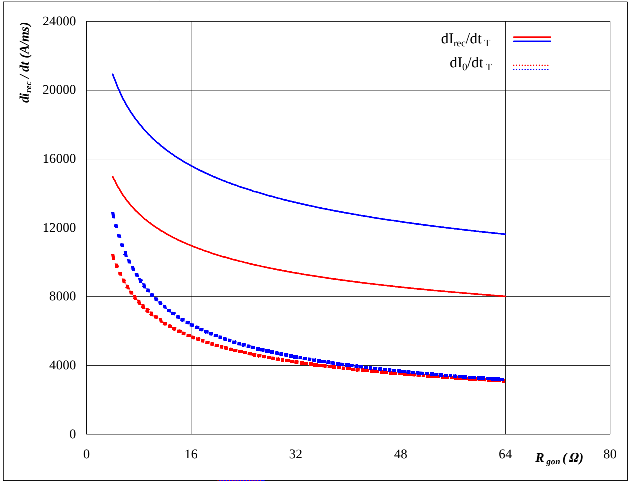
V_{GE} = ±15 V

R_{gon} = 4 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 ℃ Gate on/off resistor of IGBT is fix 4Ω

V_R = 350 V MOSFET turn off delayed with 350 nS

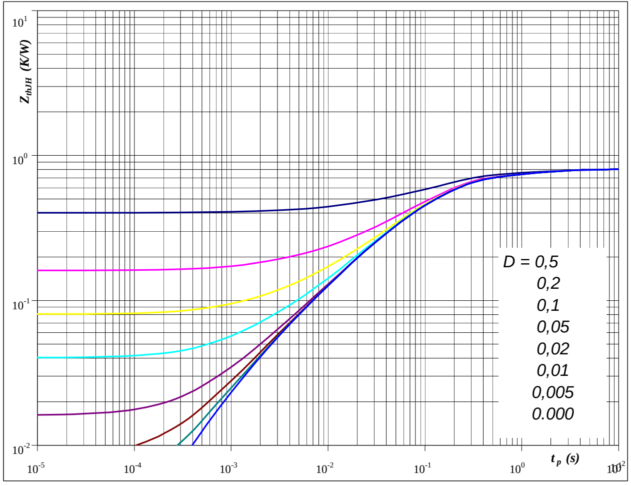
I_F = 30 A

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} = 0,80 K/W

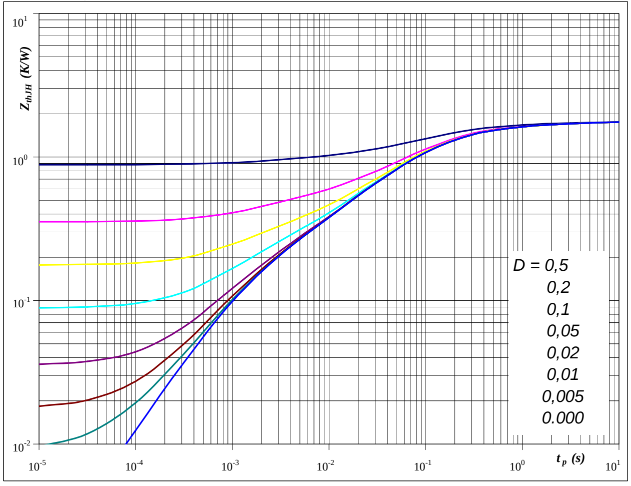
IGBT thermal model values

R (C/W)	Tau (s)
0,11	1,6E+00
0,39	1,6E-01
0,19	5,5E-02
0,08	1,2E-02
0,02	1,6E-03

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} = 1,77 K/W

FWD thermal model values

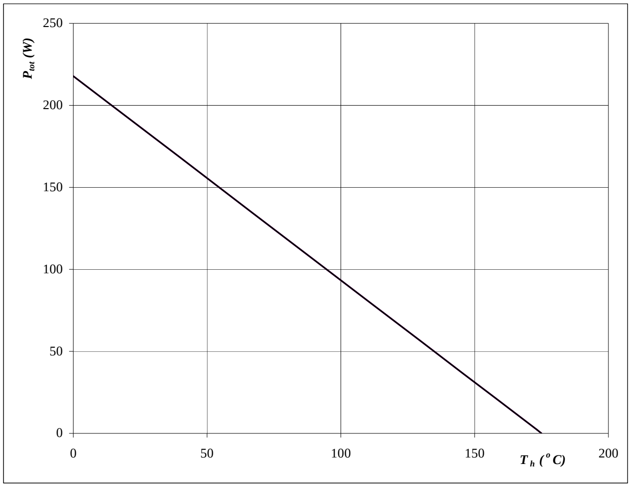
R (C/W)	Tau (s)
0,10	5,3E+00
0,23	8,1E-01
0,71	1,4E-01
0,45	4,0E-02
0,16	8,4E-03
0,12	1,3E-03

Buck

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



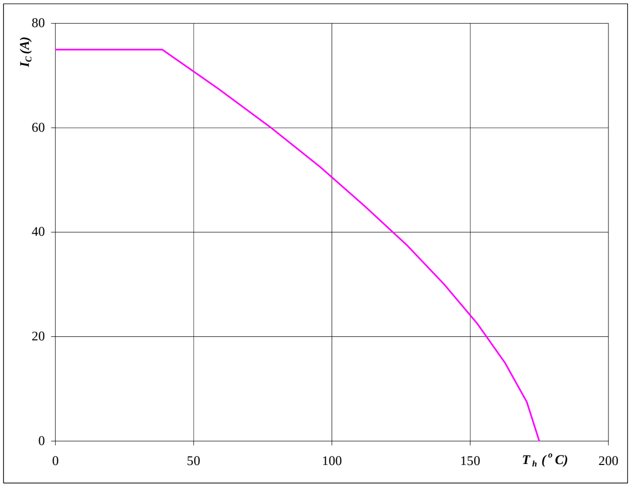
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

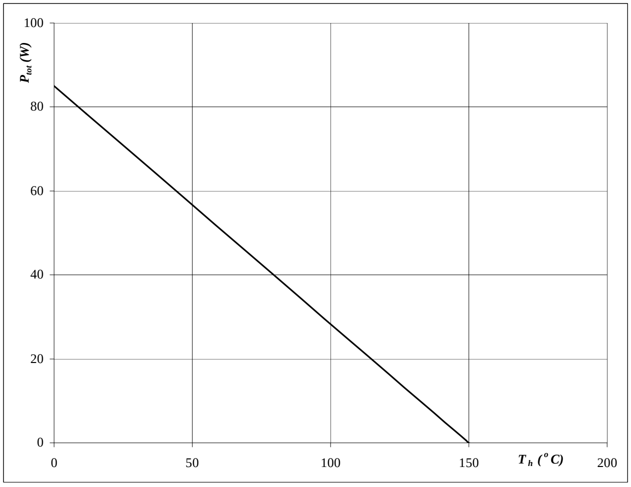
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



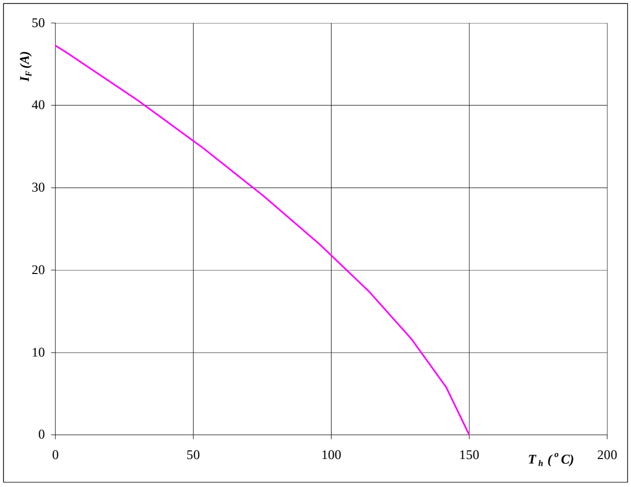
At

T_j = 150 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

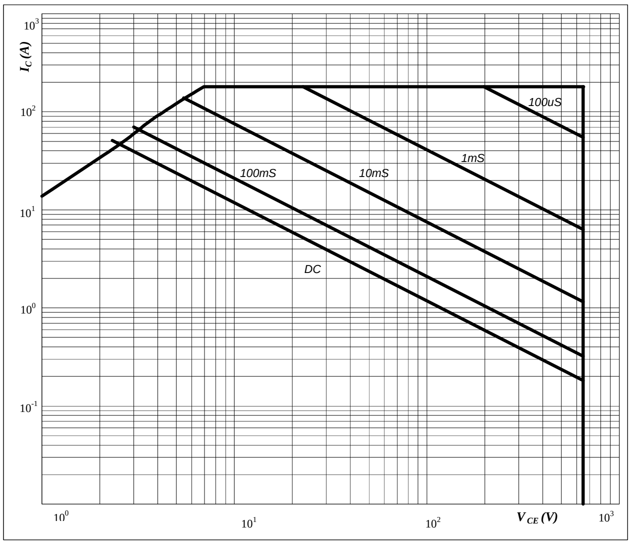
T_j = 150 ℃

Buck

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

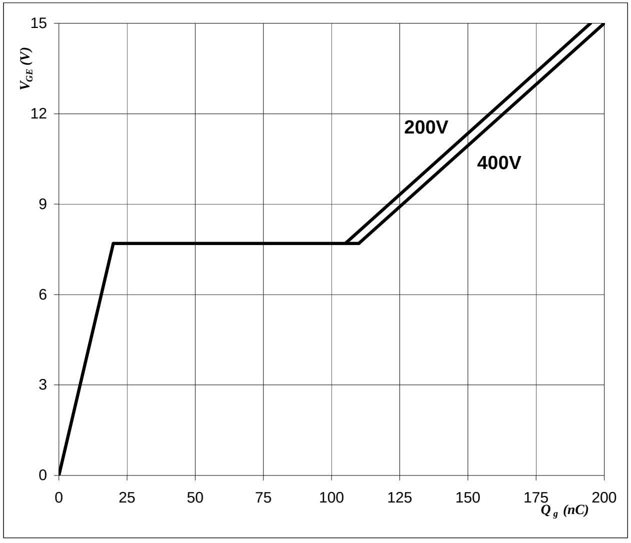
V_{GE} = ±15 V

T_j = T_{jmax} ºC

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

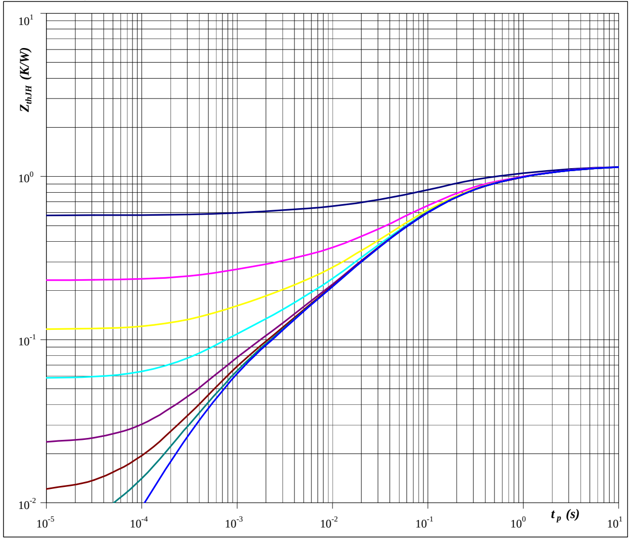
$I_{G(REF)}$=1mA, R_L=15Ω

Figure 27 MOSFET

MOSFET transient thermal impedance

as a function of pulse width

$Z_{thJH} = f(t_p)$



D = t_p / T

R_{thJH} = 1,16 K/W

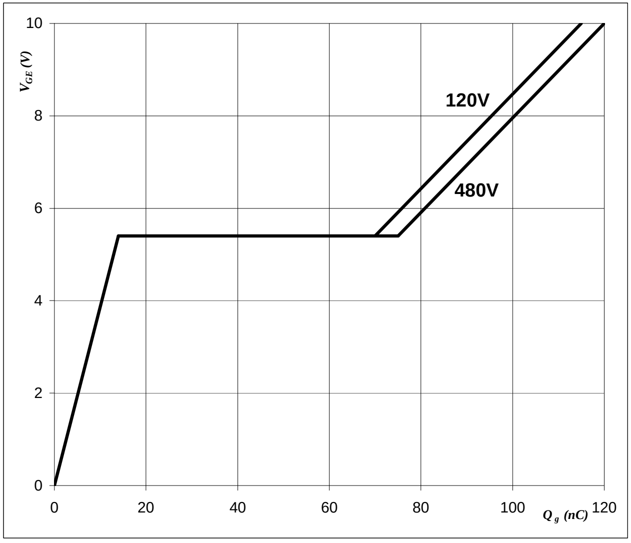
MOSFET thermal model values

R (C/W)	Tau (s)
0,11	4,7E+00
0,22	9,0E-01
0,39	1,7E-01
0,25	4,8E-02
0,10	1,3E-02
0,05	2,5E-03

Figure 28 MOSFET

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

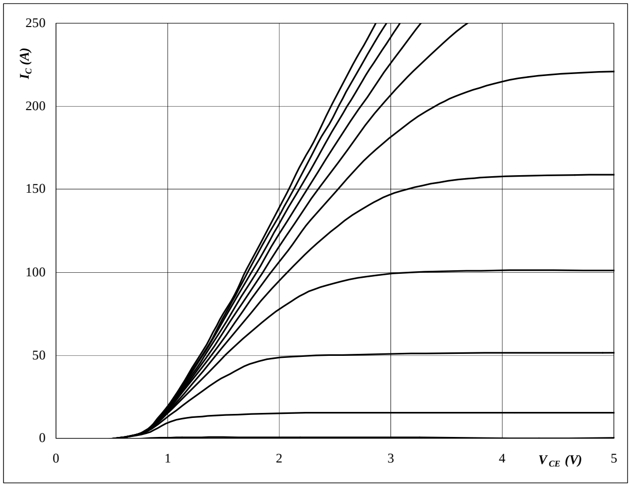
I_C = 18 A

Boost

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

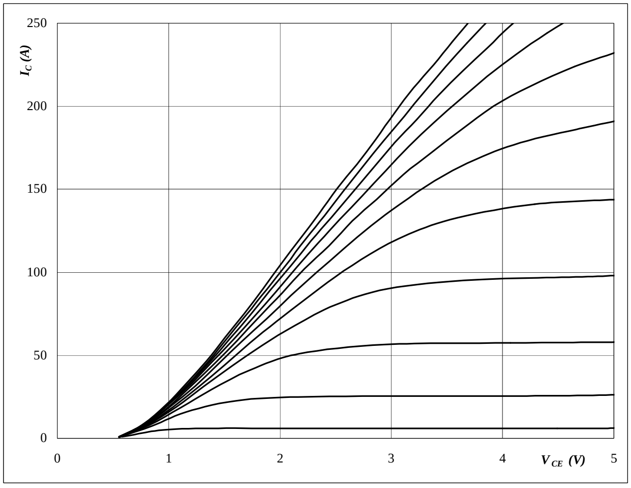
T_j = 25 ℃

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 = 250 µs

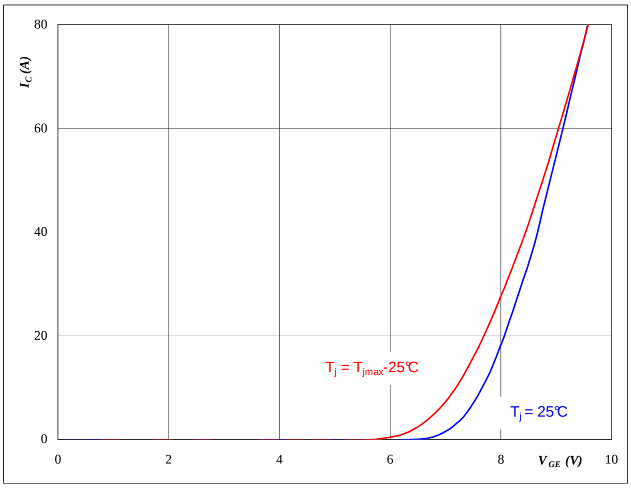
T_j = 125 ℃

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

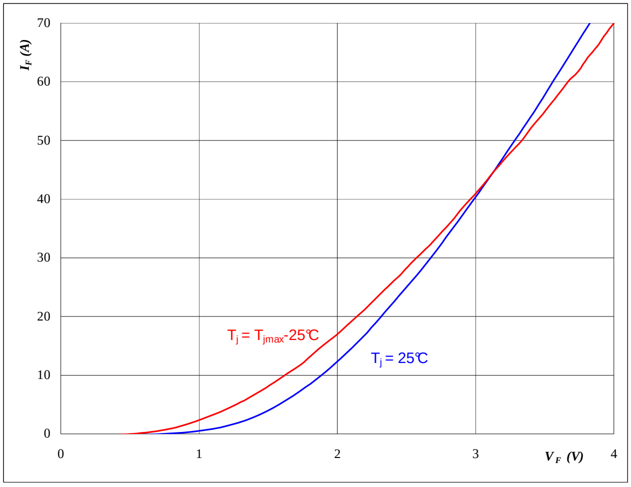
t_p = 250 µs

V_{CE} = 10 V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

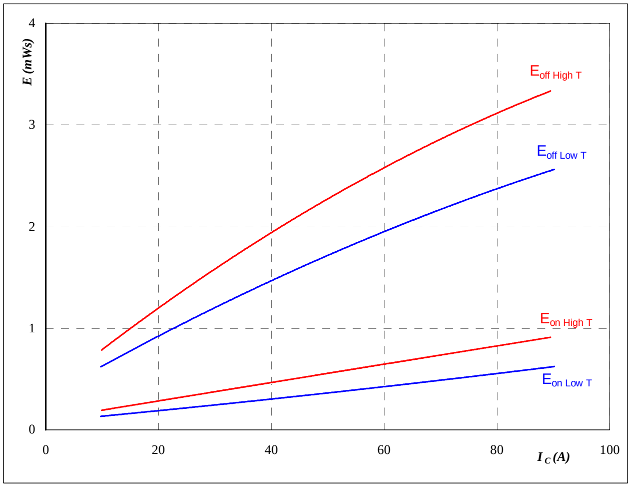
t_p = 250 µs

Boost

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



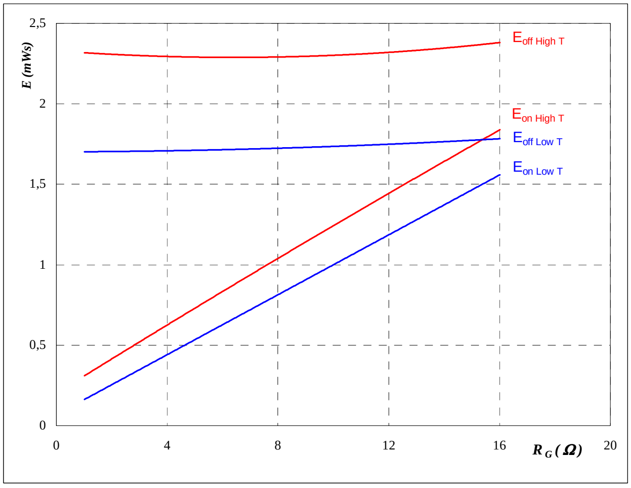
With an inductive load at

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω
R_{goff} = 4 Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



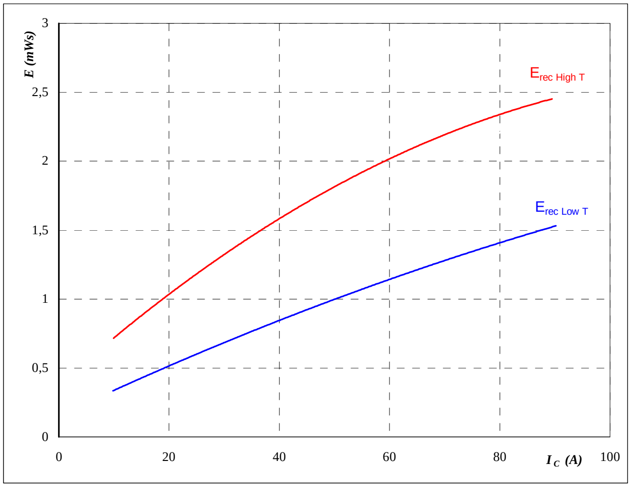
With an inductive load at

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
I_C = 51 A

Figure 7 IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



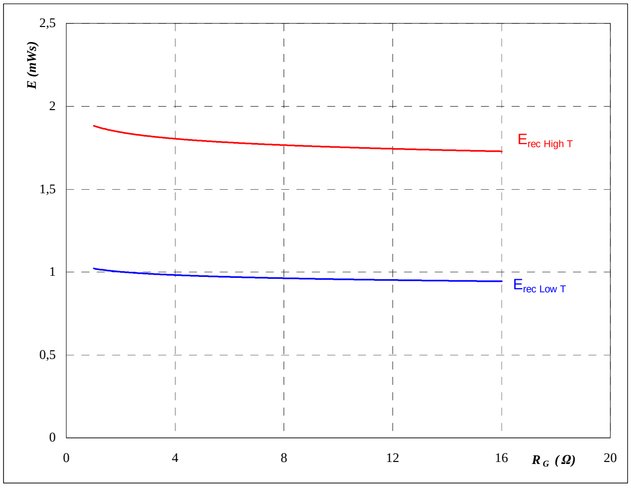
With an inductive load at

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω

Figure 8 IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

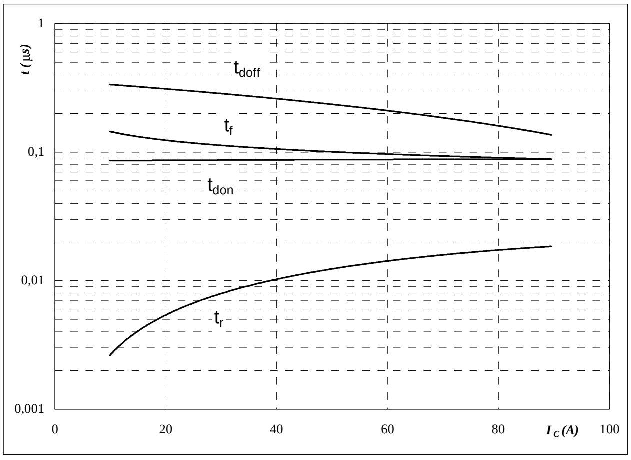
T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
I_C = 51 A

Boost

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



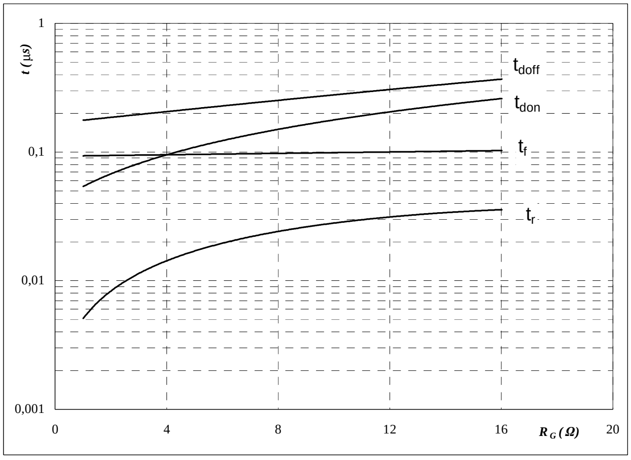
With an inductive load at

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω
R_{goff} = 4 Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



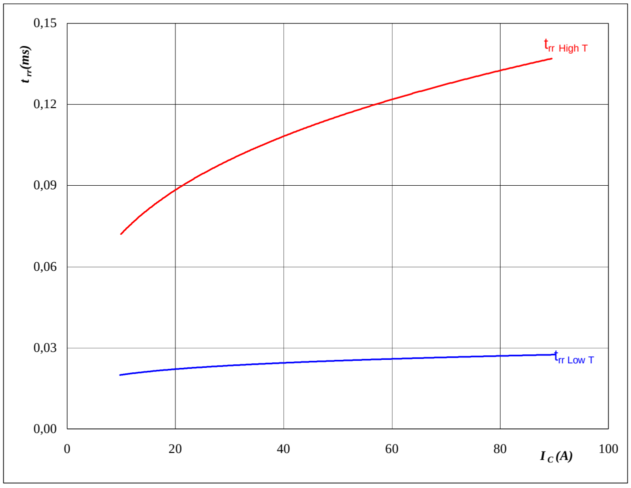
With an inductive load at

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
I_C = 51 A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



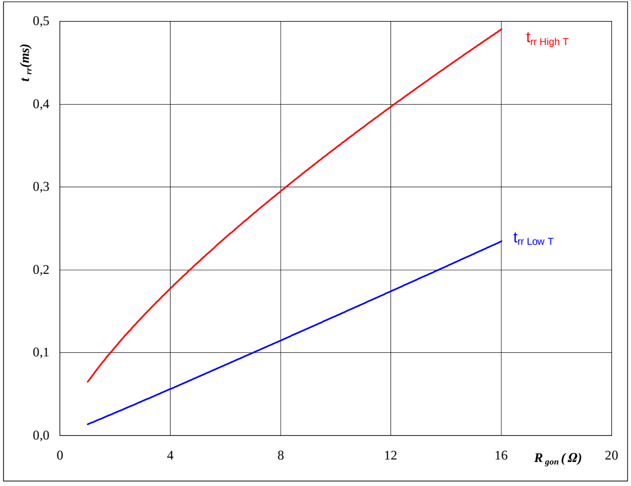
At

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω

Figure 12 FWD

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

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



At

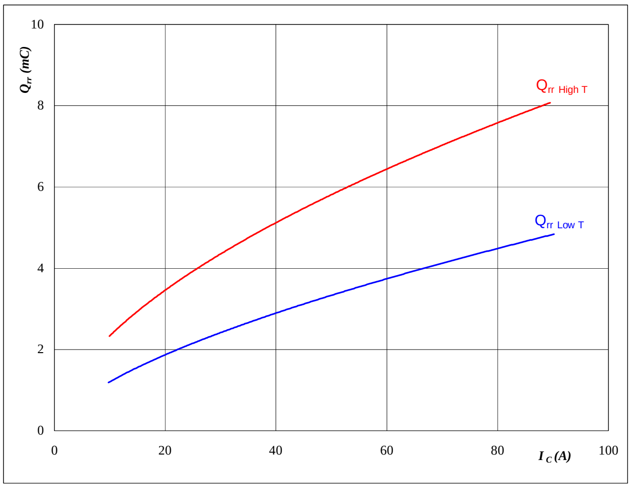
T_j = 25/125 ℃
V_R = 350 V
I_F = 51 A
V_{GE} = ±15 V

Boost

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



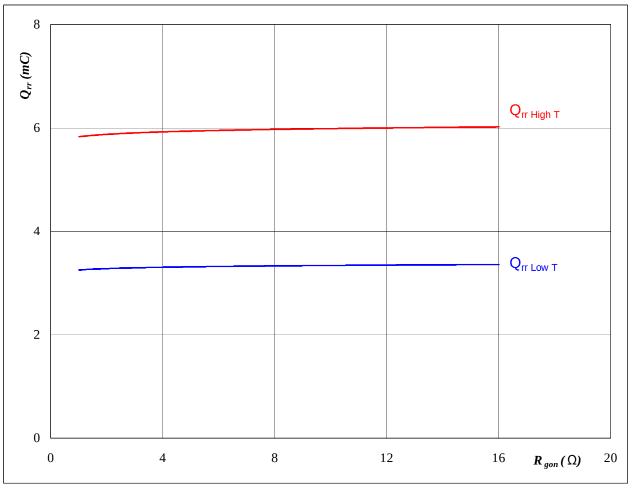
At

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω

Figure 14 FWD

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

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



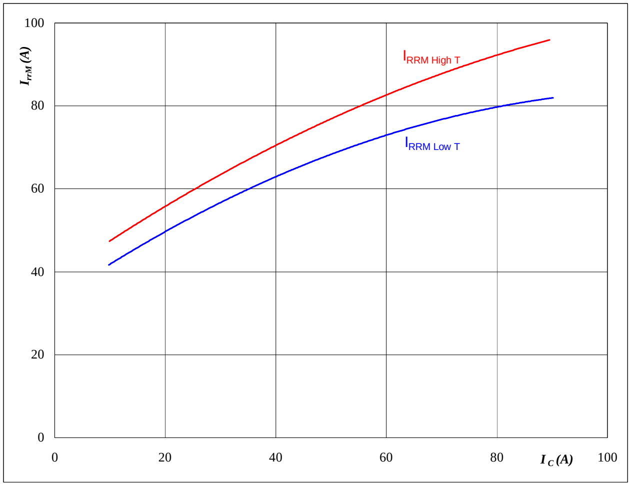
At

T_j = 25/125 ℃
V_R = 350 V
I_F = 51 A
V_{GE} = ±15 V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



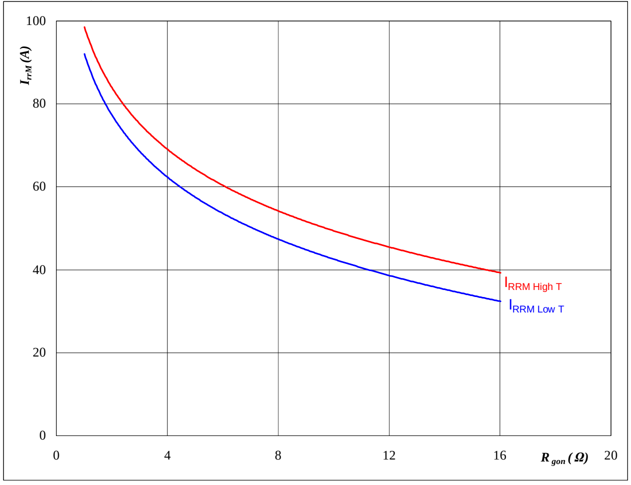
At

T_j = 25/125 ℃
V_{CE} = 350 V
V_{GE} = ±15 V
R_{gon} = 4 Ω

Figure 16 FWD

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

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



At

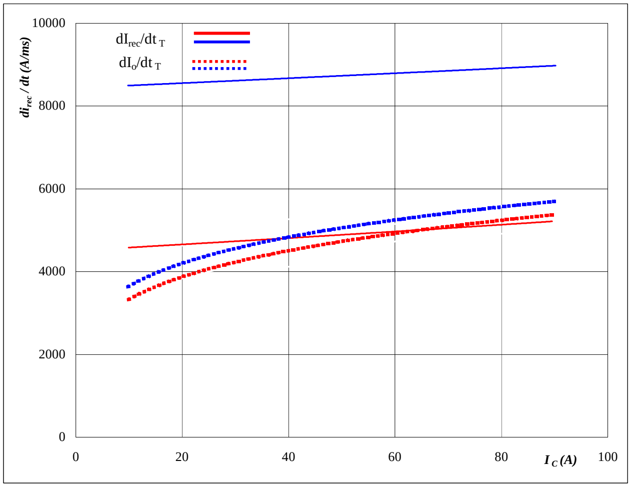
T_j = 25/125 ℃
V_R = 350 V
I_F = 51 A
V_{GE} = ±15 V

Boost

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

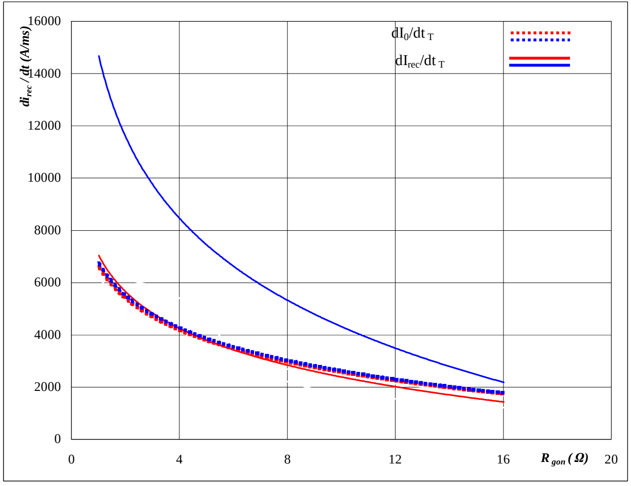
V_{GE} = ±15 V

R_{gon} = 4 Ω

Figure 18 FWD

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

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



At

T_j = 25/125 ℃

V_R = 350 V

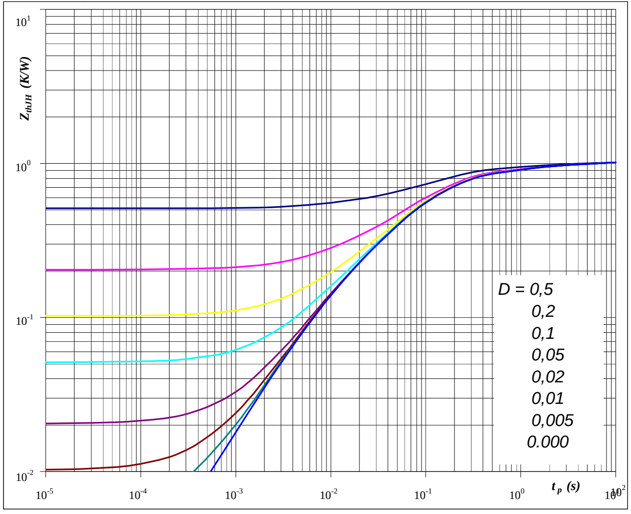
I_F = 51 A

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} = 1,02 K/W

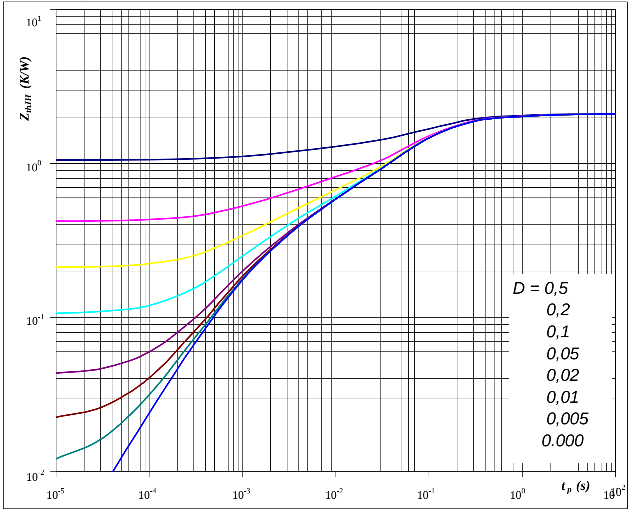
IGBT thermal model values

R (C/W)	Tau (s)
0,08	4,30
0,12	1,00
0,47	0,15
0,26	0,05
0,08	0,01

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D = tp / T

R_{thJH} = 2,11 K/W

FWD thermal model values

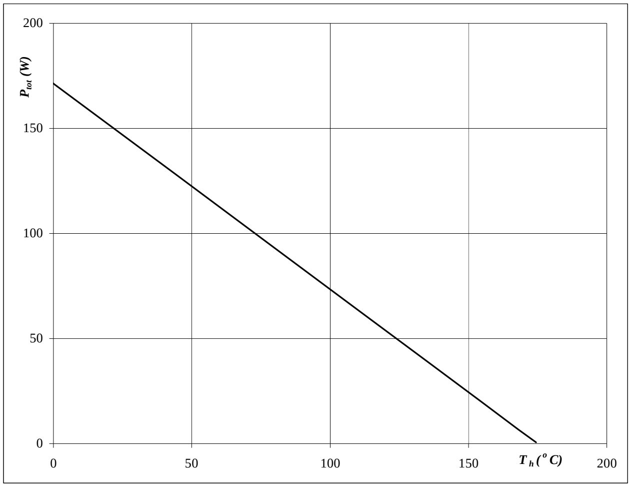
R (C/W)	Tau (s)
0,04	6,53
0,11	1,19
0,53	0,18
0,96	0,06
0,30	0,01
0,17	0,00

Boost

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



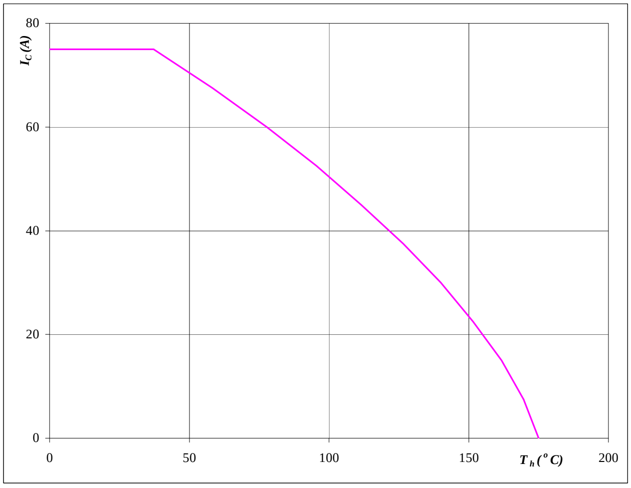
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

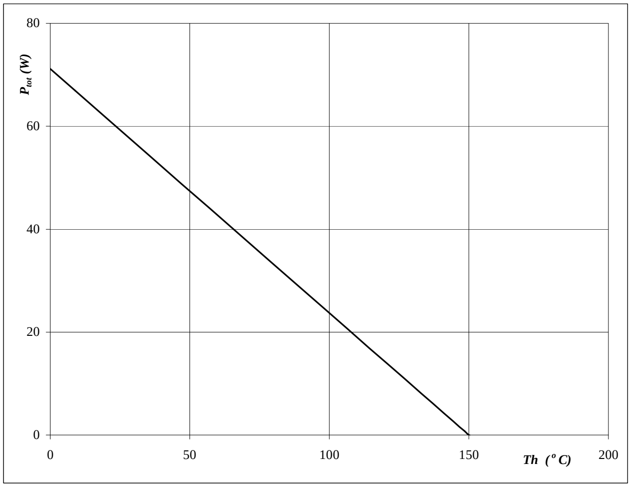
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



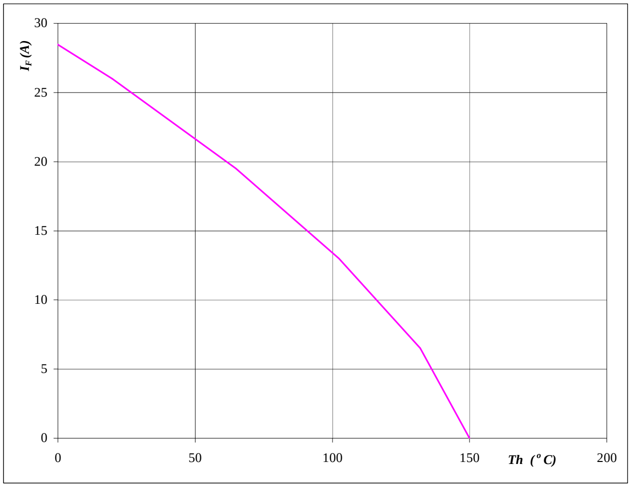
At

T_j = 150 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

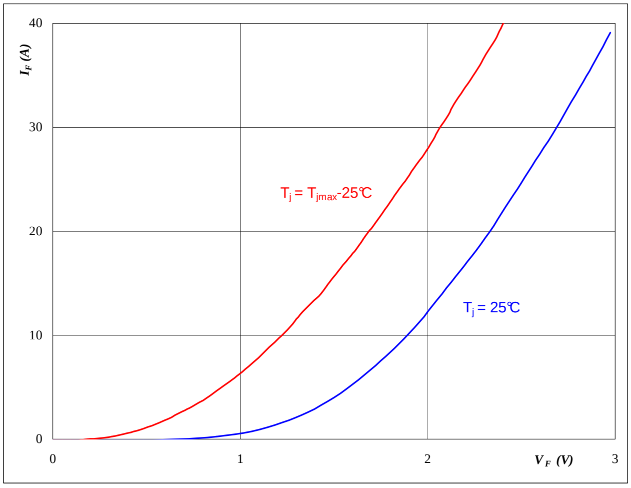
T_j = 150 ºC

Boost

Figure 25 Boost Inverse Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



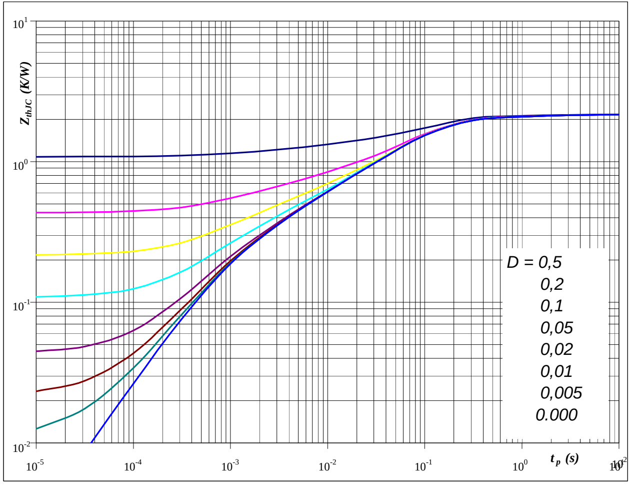
At

t_p = 250 μs

Figure 26 Boost Inverse Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

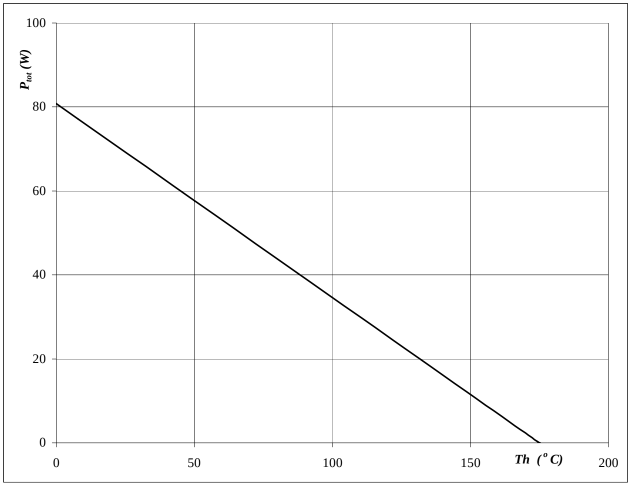
D = tp / T

R_{thJH} = 2,17 K/W

Figure 27 Boost Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



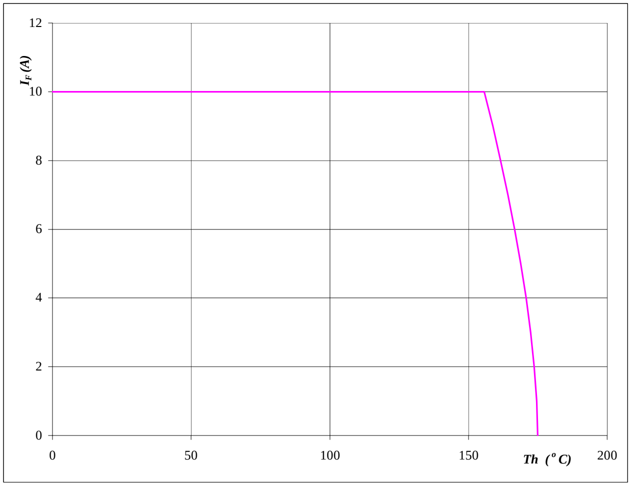
At

T_j = 175 ºC

Figure 28 Boost Inverse Diode

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
$R_T = f(T)$

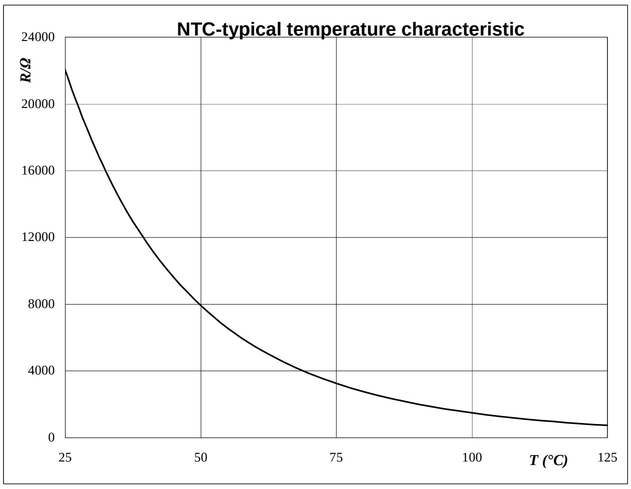
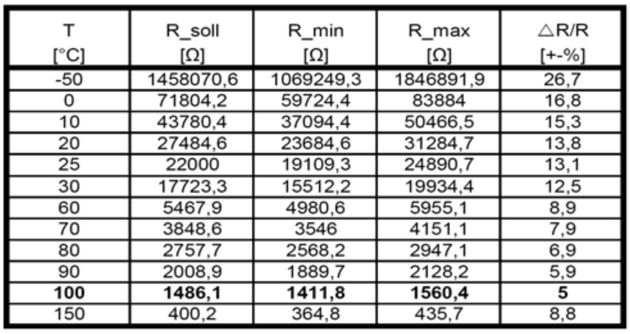


Figure 2 Thermistor

Typical NTC resistance values

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



T [°C]	R_soll [Ω]	R_min [Ω]	R_max [Ω]	△R/R [+-%]
-50	1458070,6	1069249,3	1846891,9	26,7
0	71804,2	59724,4	83884	16,8
10	43780,4	37094,4	50466,5	15,3
20	27484,6	23684,6	31284,7	13,8
25	22000	19109,3	24890,7	13,1
30	17723,3	15512,2	19934,4	12,5
60	5467,9	4980,6	5955,1	8,9
70	3848,6	3546	4151,1	7,9
80	2757,7	2568,2	2947,1	6,9
90	2008,9	1889,7	2128,2	5,9
100	**1486,1**	**1411,8**	**1560,4**	**5**
150	400,2	364,8	435,7	8,8

Switching Definitions BUCK MOSFET&IGBT

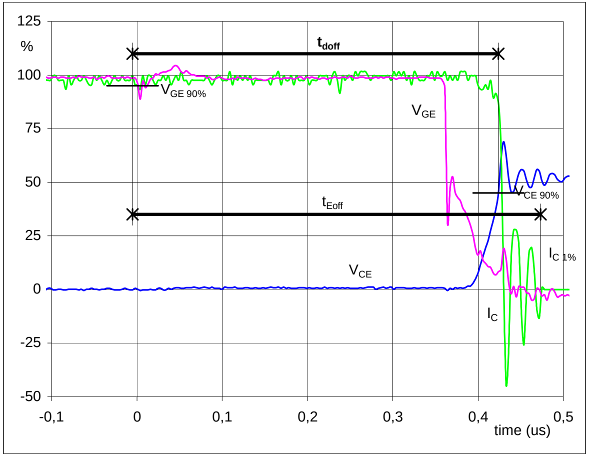
General conditions

		T_j	**=**	**125℃**	
$R_{gon\ IGBT}$	**=**	**4 Ω**	**$R_{gon\ MOSFET}$**	**=**	**4 Ω**
$R_{goff\ IGBT}$	**=**	**4 Ω**	**$R_{goff\ MOSFET}$**	**=**	**4 Ω**
			MOSFET turn off delayed time with 350 nS		

Figure 1 BUCK MOSFET

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

(t_{Eoff} = integrating time for E_{off})

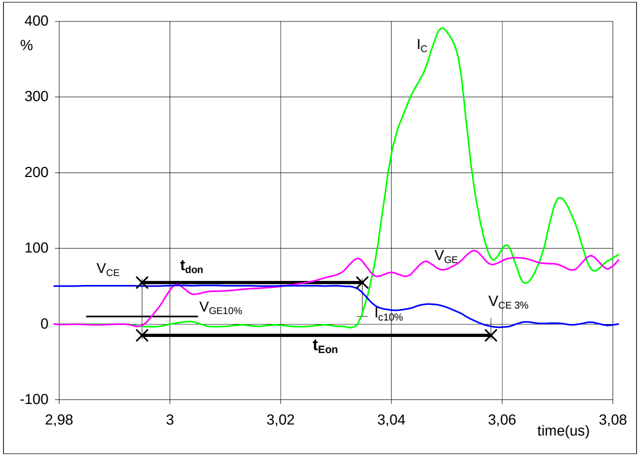


V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	30	A
t_{doff} =	0,42	μs
t_{Eoff} =	0,48	μs

Figure 2 BUCK MOSFET

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

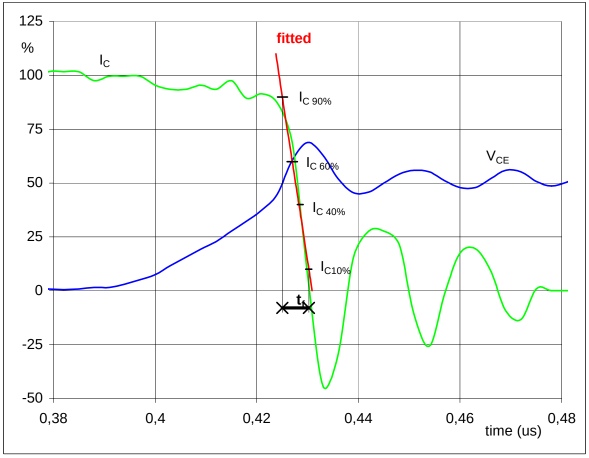
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	30	A
t_{don} =	0,04	μs
t_{Eon} =	0,06	μs

Figure 3 BUCK MOSFET

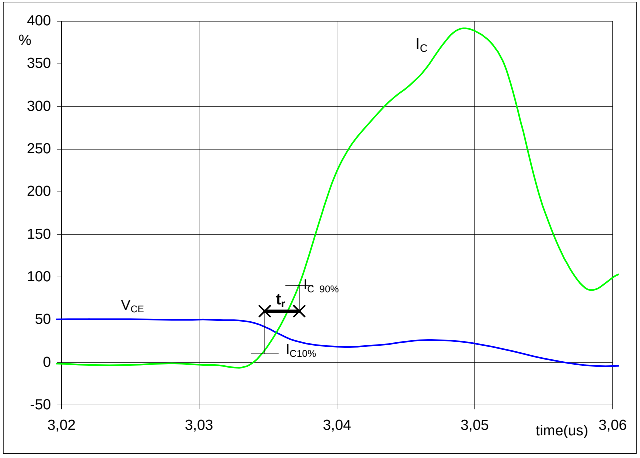
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	30	A
t_f =	0,005	μs

Figure 4 BUCK MOSFET

Turn-on Switching Waveforms & definition of t_r

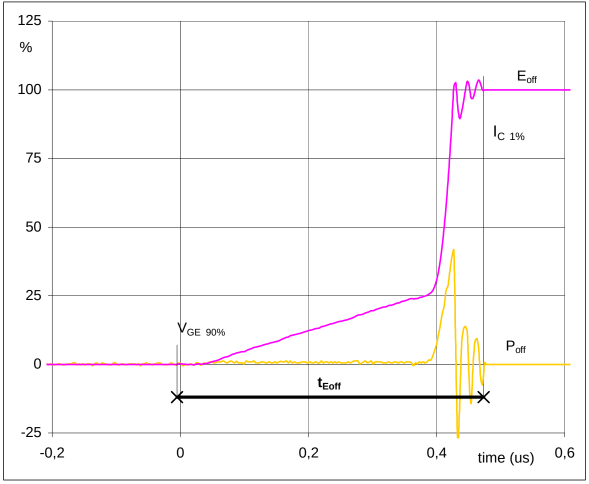


V_C (100%) =	700	V
I_C (100%) =	30	A
t_r =	0,00	μs

Switching Definitions BUCK MOSFET

Figure 5 BUCK MOSFET

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



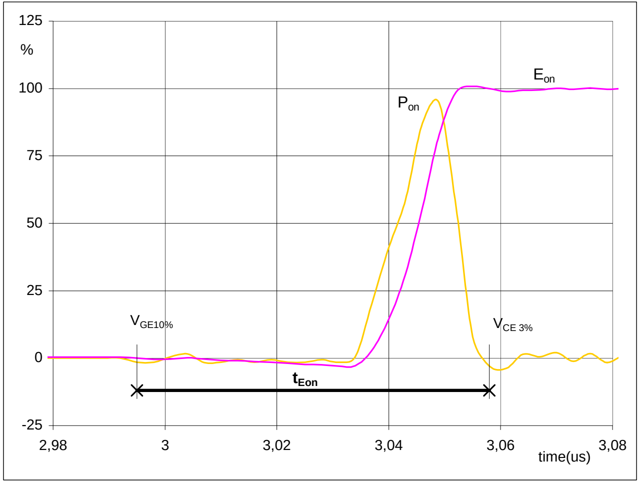
P_{off} (100%) = 21,13 kW

E_{off} (100%) = 0,22 mJ

t_{Eoff} = 0,48 μs

Figure 6 BUCK MOSFET

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



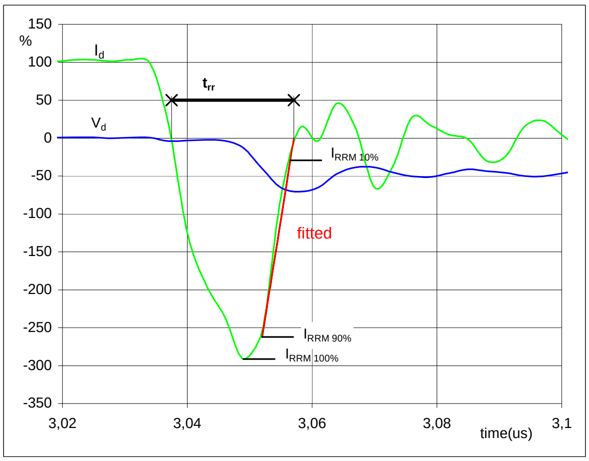
P_{on} (100%) = 21,13 kW

E_{on} (100%) = 0,22 mJ

t_{Eon} = 0,06 μs

Figure 7 BUCK MOSFET

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



V_d (100%) = 700 V

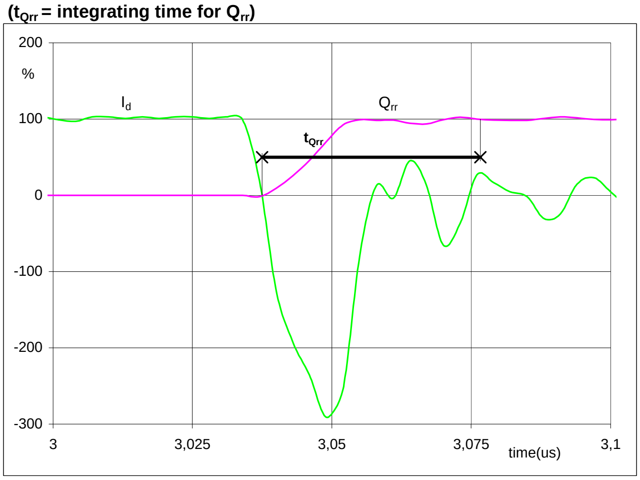
I_d (100%) = 30 A

I_{RRM} (100%) = -87 A

t_{rr} = 0,02 μs

Figure 8 BUCK FWD

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



I_d (100%) = 30 A

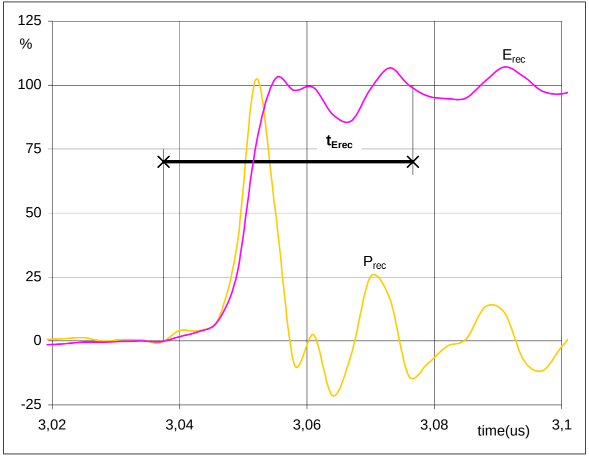
Q_{rr} (100%) = 1,10 μC

t_{Qrr} = 0,04 μs

Switching Definitions BUCK MOSFET

Figure 9 Output inverter FWD

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

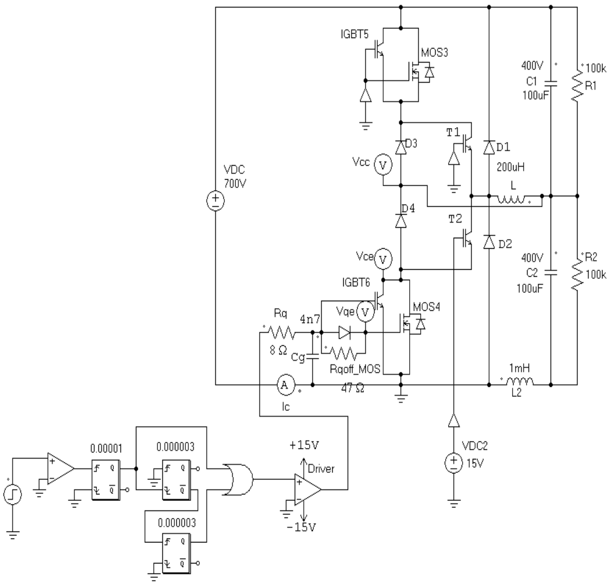


P_{rec} (100%) = 21,13 kW
E_{rec} (100%) = 0,19 mJ
t_{Erec} = 0,04 μs

Measurement circuits

Figure 11

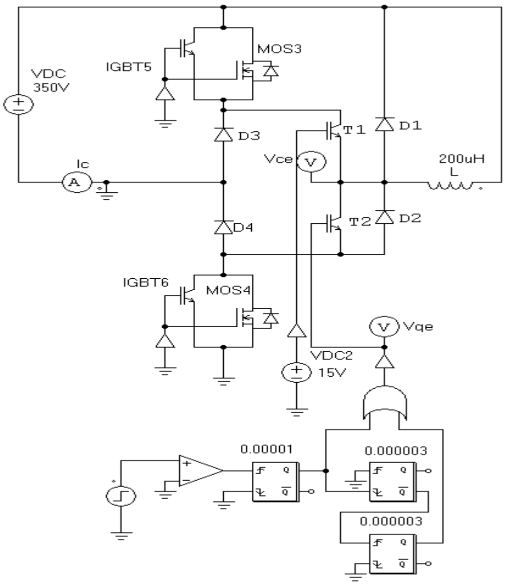
BUCK stage switching measurement circuit



Cg is included in the module

Figure 12

BOOST stage switching measurement circuit



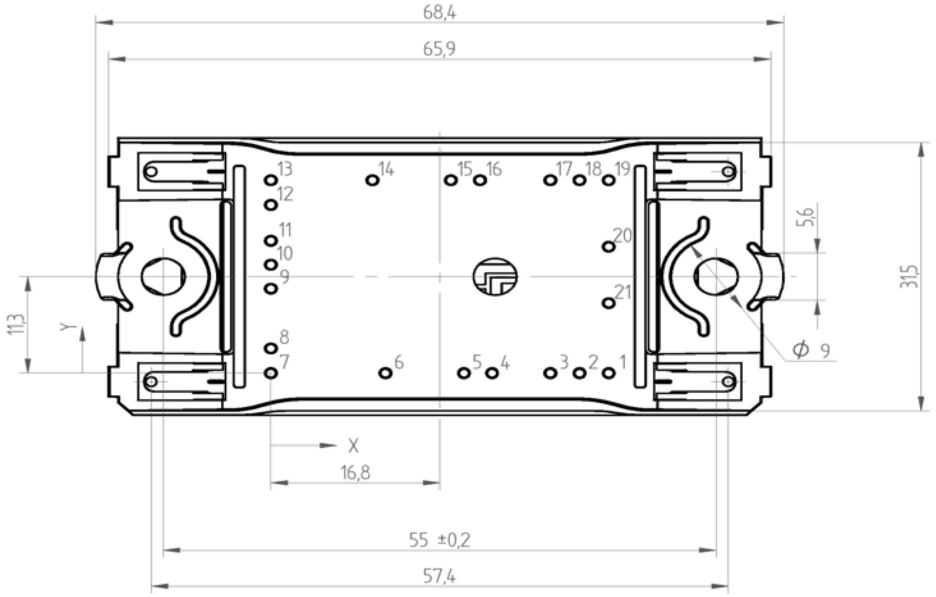
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

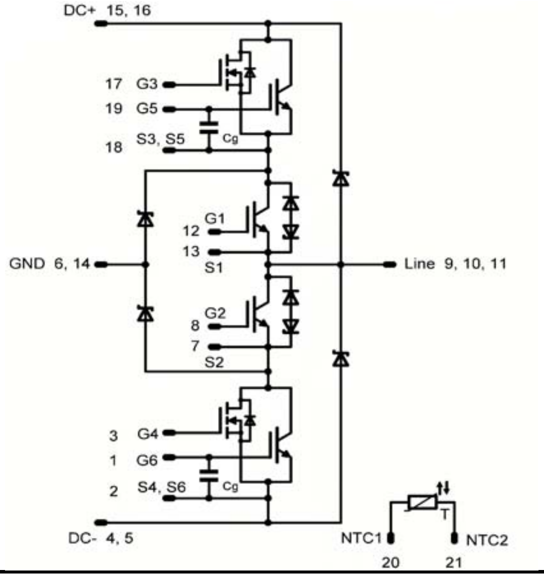
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing with PressFiT	10-PZ06NRA069FP03-P967F78Y	P967F78Y	P967F78Y
without thermal paste 12mm housing	10-FZ06NRA069FP03-P967F78	P967F78	P967F78

Outline

Pin	X	Y
1	33,6	0
2	30,7	0
3	27,8	0
4	22	0
5	19,2	0
6	11,4	0
7	0	0
8	0	2,9
9	0	9,9
10	0	12,7
11	0	15,5
12	0	19,7
13	0	22,6
14	10,1	22,6
15	17,9	22,6
16	20,8	22,6
17	27,8	22,6
18	30,7	22,6
19	33,6	22,6
20	33,6	14,8
21	33,6	8,2



Pinout



DISCLAIMER

The information given in this datasheet describes the type of component and does not represent assured characteristics. For tested values please contact Vincotech.Vincotech reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Vincotech does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights, nor the rights of others.

LIFE SUPPORT POLICY

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
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.