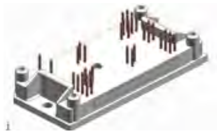
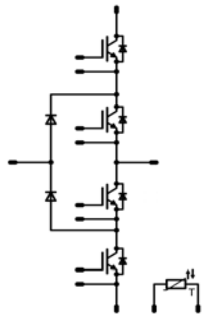
flowNPC 1 — 600V/150A

Features
- Neutral-point-Clamped inverter
- Compact flow1 housing
- Low Inductance Layout

flow1 housing


Target Applications
- UPS
- Motor Drive
- Solar inverters

Schematic


Types
- 10-F106NIA150SA-M136F

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Buck IGBT					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	109 144	A
Pulsed collector current	I_{Cpulse}	t_p limited by T_jmax		450	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	166 251	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
Maximum Junction Temperature	T_jmax			175	°C
Turn off safe operating area		$T_j≤150°C$ $V_{CE}<=V_{CES}$		300	A
Buck Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$		600	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	62 82	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax	$T_c=100°C$	450	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	74 112	W
Maximum Junction Temperature	T_jmax			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Boost IGBT					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	100 134	A
Pulsed collector current	I_{Cpuls}	t_p limited by T_jmax		450	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	151 228	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
Maximum Junction Temperature	T_jmax			175	°C
Turn off safe operating area		$T_j≤150°C$ $V_{CE}<=V_{CES}$		300	A
Boost Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_c=25°C$		600	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	91 121	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		300	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	123 187	W
Maximum Junction Temperature	T_jmax			175	°C
Boost Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$		600	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	98 129	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		300	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	135 205	W
Maximum Junction Temperature	T_jmax			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

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
Buck IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0024	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	Tj=25°C Tj=150°C	1,05	1,57 1,73	1,85	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			60	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			1,4	µA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=4 Ω Rgoff=4 Ω	±15	350	150	Tj=25°C Tj=150°C		161 162		ns
Rise time	t_r					Tj=25°C Tj=150°C		24 28		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		221 249		
Fall time	t_f					Tj=25°C Tj=150°C		82 114		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1,01 1,75		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		4,10 5,92		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		9240		pF
Output capacitance	C_{oss}							576		
Reverse transfer capacitance	C_{rss}							274		
Gate charge	Q_{Gate}		15	480	150	Tj=25°C		940		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,81 W/mK						0,574		K/W
Buck Diode										
Diode forward voltage	V_F				150	Tj=25°C Tj=150°C	1,2	1,69 1,75	1,9	V
Peak reverse recovery current	I_{RRM}	Rgoff=4 Ω	±15	350	150	Tj=25°C Tj=150°C		150 178		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		119 148		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		8,6 13,7		µC
Peak rate of fall of recovery current	di(rec)max/dt					Tj=25°C Tj=150°C		4704 3013		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		2,30 3,63		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,81 W/mK						1,288		K/W

Note: All characteristic values are related to gates of paralell IGBTs connected together

Characteristic Values

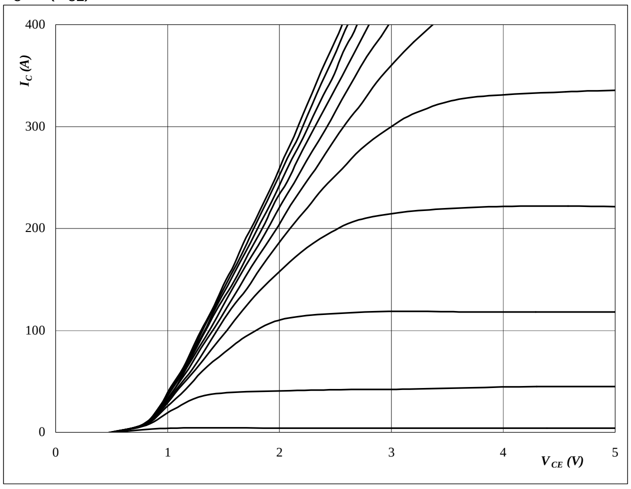
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Boost IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0024	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	Tj=25°C Tj=150°C	1,05	1,57 1,73	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=150°C			60	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			1,4	µA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	±15	350	150	Tj=25°C Tj=150°C		160 159		ns
Rise time	t_r					Tj=25°C Tj=150°C		27 30		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		224 248		ns
Fall time	t_f					Tj=25°C Tj=150°C		75 99		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1,08 1,68		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		4,35 5,94		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		9240		pF
Output capacitance	C_{oss}							576		pF
Reverse transfer capacitance	C_{rss}							274		pF
Gate charge	Q_{Gate}		15	480	150	Tj=25°C		940		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,81 W/mK						0,630		K/W
Boost Inverse Diode										
Diode forward voltage	V_F				150	Tj=25°C Tj=125°C	1,2	1,68 1,68	1,9	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,81 W/mK						0,771		K/W
Boost Diode										
Diode forward voltage	V_F				150	Tj=25°C Tj=150°C	1,2	1,68 1,68	1,9	V
Reverse leakage current	I_r			600		Tj=25°C Tj=150°C			60	µA
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	350	150	Tj=25°C Tj=150°C		131 166		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		121 151		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		7,6 14,4		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		3810 1668		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		2,20 4,14		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,81 W/mK						0,701		K/W
Thermistor										
Rated resistance	R					T=25°C		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100°C	-5		5	%
Power dissipation	P					T=25°C		200		mW
Power dissipation constant						T=25°C		2		mW/K
B-value	B(25/50)	Tol. ±3%				T=25°C		3950		K
B-value	B(25/100)	Tol. ±3%				T=25°C		3996		K
Vincotech NTC Reference									B	

Buck

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



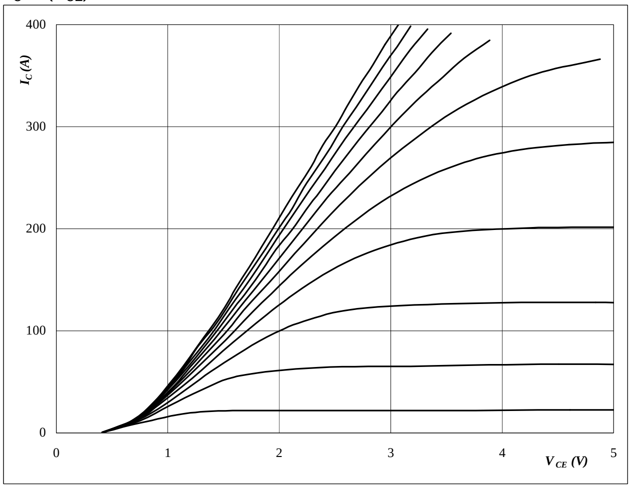
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



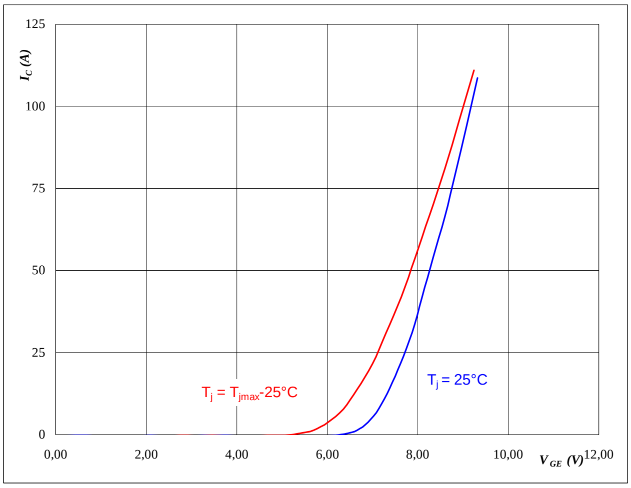
At

t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



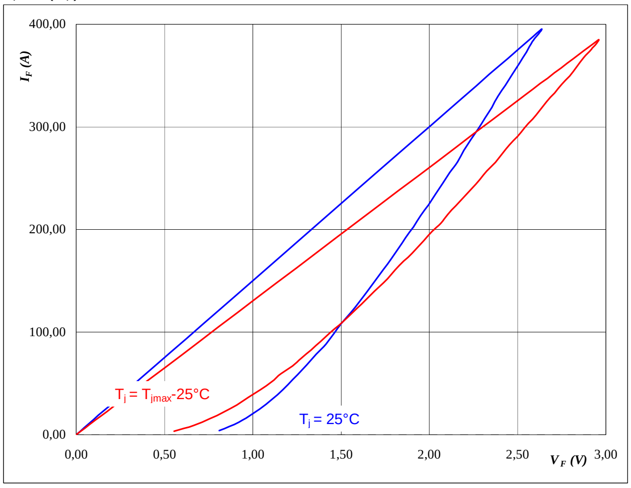
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

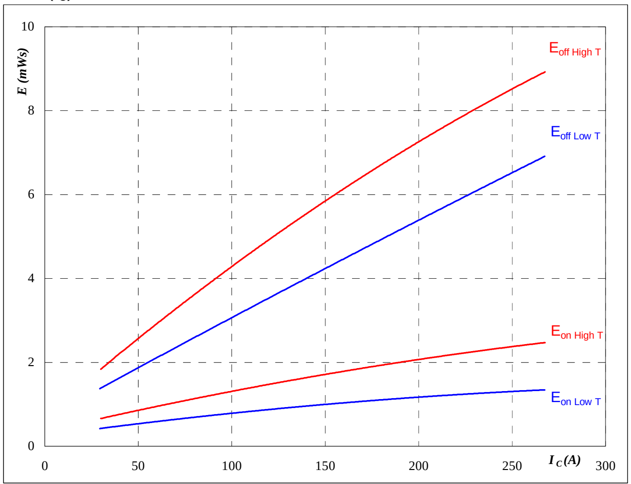
t_p =	250	μs

Buck

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



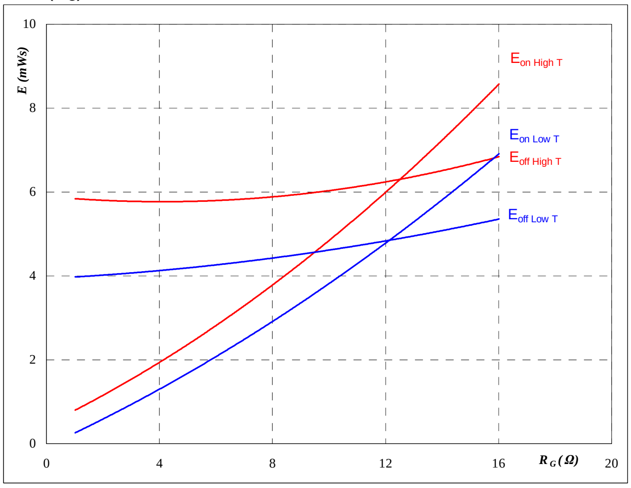
With an inductive load at

T_j =	25/150	°C
V_{CE} =	175	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

$E = f(R_G)$



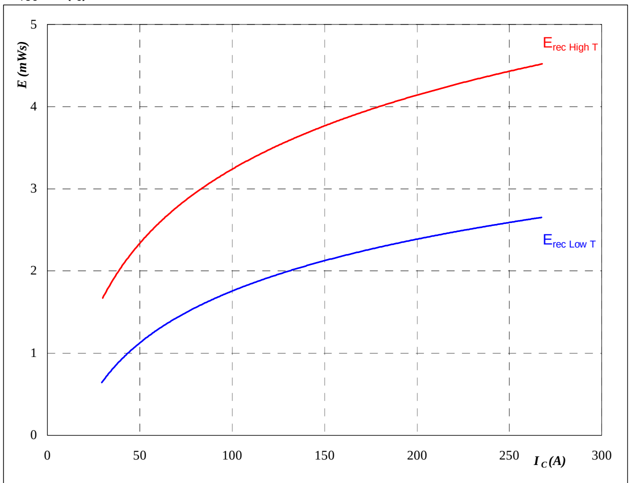
With an inductive load at

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
I_C =	150	A

Figure 7 FRED

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



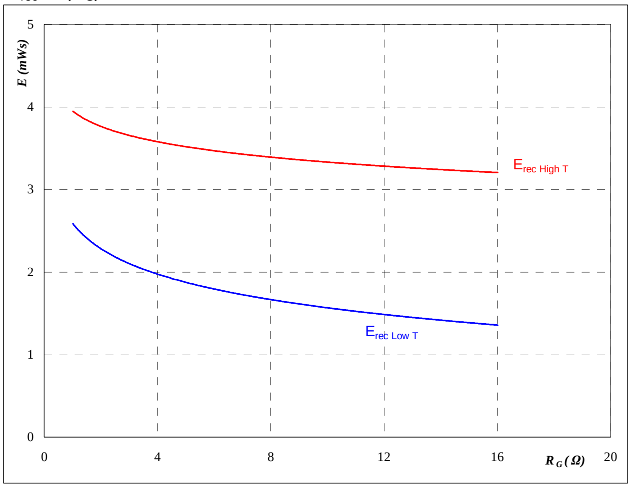
With an inductive load at

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 8 FRED

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

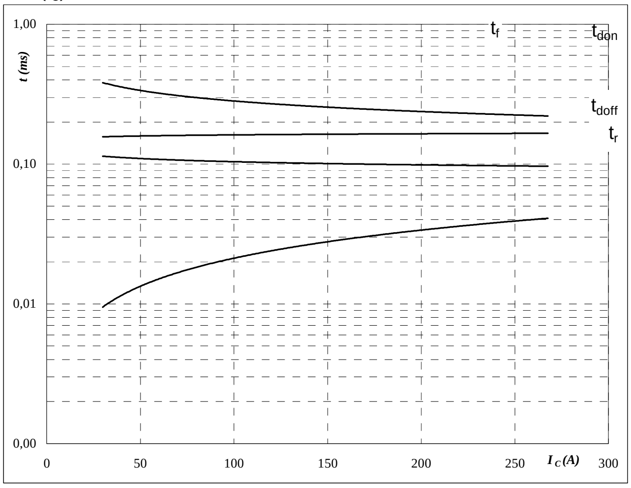
T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
I_C =	150	A

Buck

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



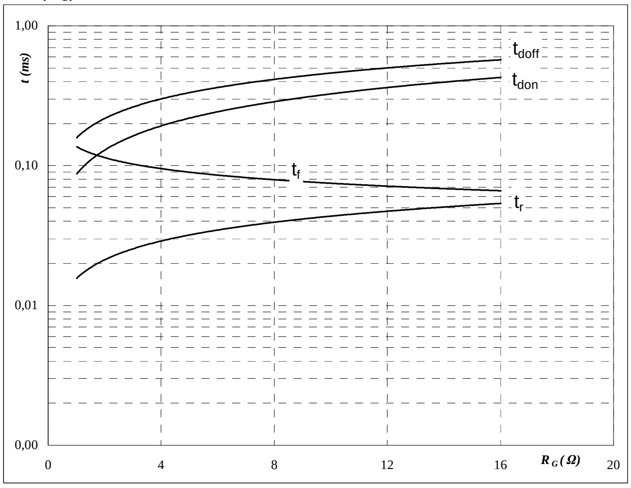
With an inductive load at

T_j =	150	°C
V_{CE} =	175	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

$t = f(R_G)$



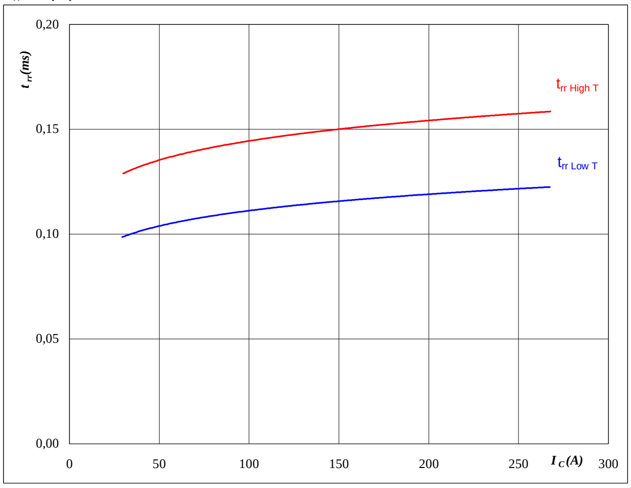
With an inductive load at

T_j =	150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
I_C =	150	A

Figure 11 FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



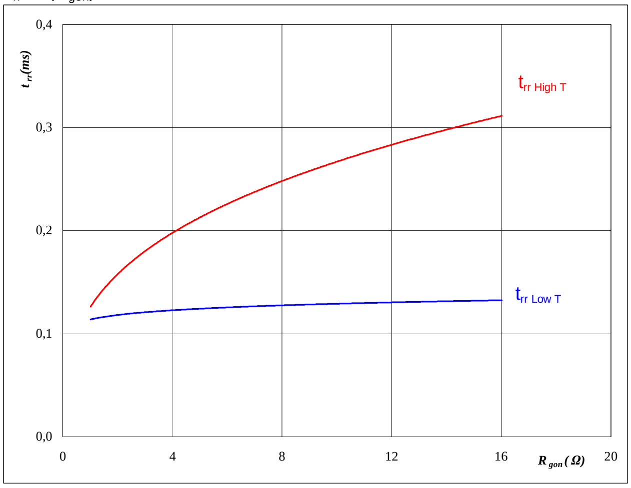
At

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 12 FRED

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

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



At

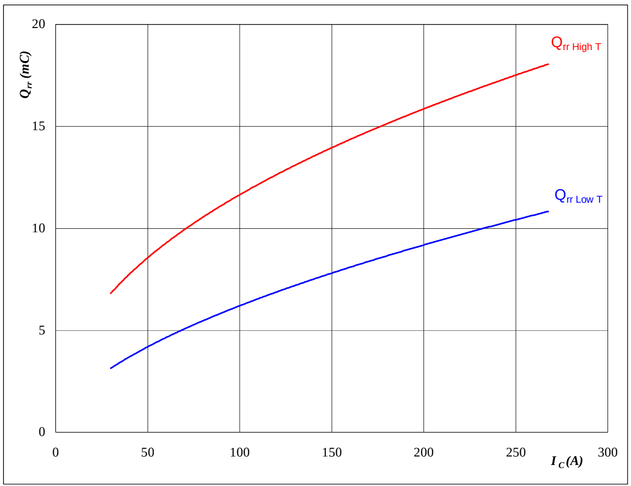
T_j =	25/150	°C
V_R =	175	V
I_F =	150	A
V_{GE} =	±15	V

Buck

Figure 13 FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



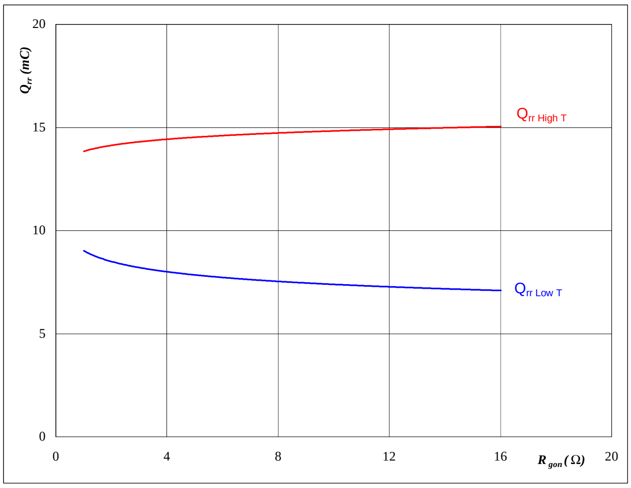
At

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 14 FRED

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

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



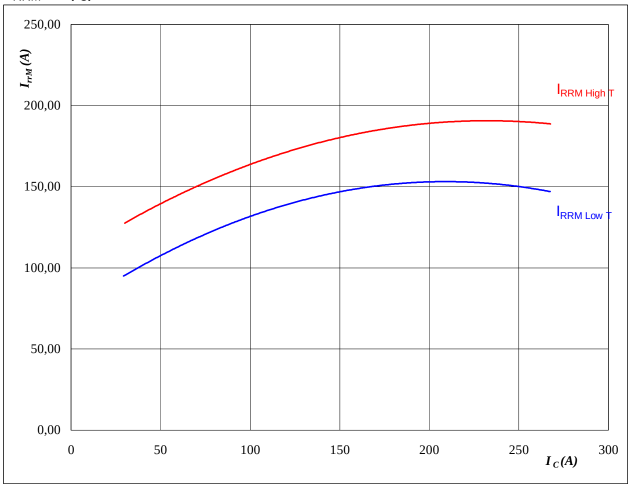
At

T_j =	25/150	°C
V_R =	175	V
I_F =	150	A
V_{GE} =	±15	V

Figure 15 FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



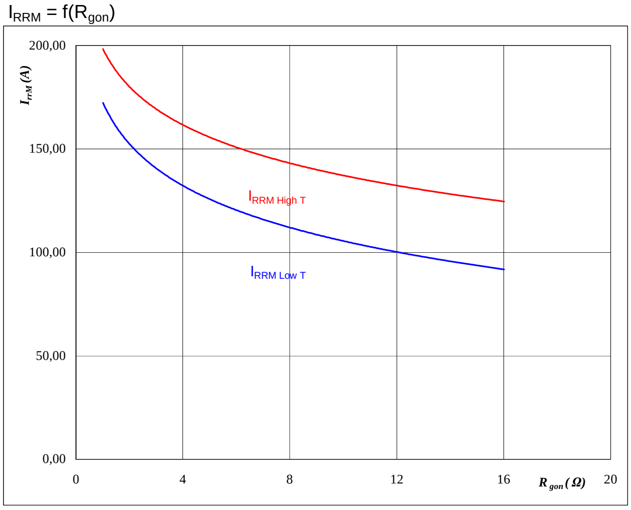
At

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 16 FRED

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

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



At

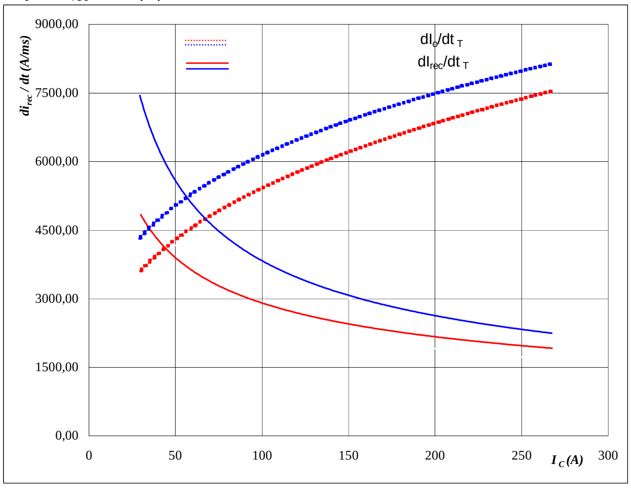
T_j =	25/150	°C
V_R =	175	V
I_F =	150	A
V_{GE} =	±15	V

Buck

Figure 17 FRED

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

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



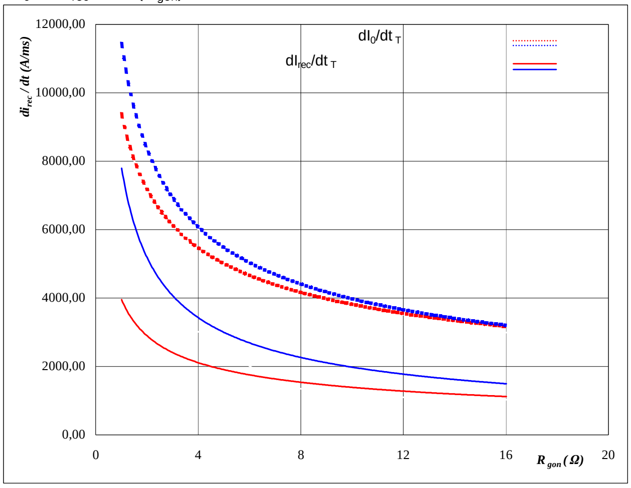
At

T_j =	25/150	°C
V_{CE} =	175	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 18 FRED

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

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



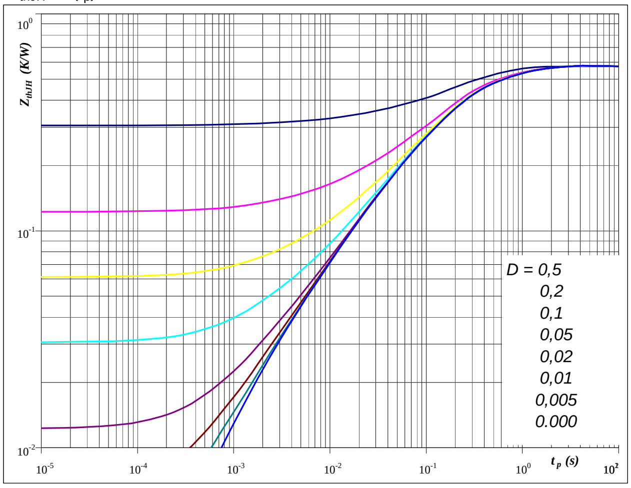
At

T_j =	25/150	°C
V_R =	175	V
I_F =	150	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} =	0,574	K/W

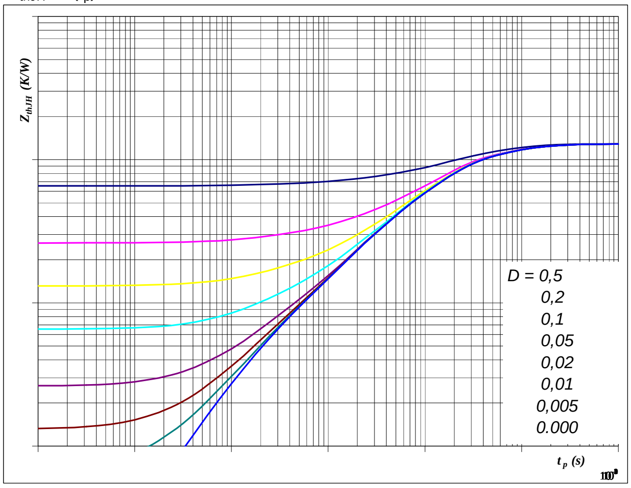
IGBT thermal model values

R (C/W)	Tau (s)
0,05	4,5E+00
0,10	1,0E+00
0,26	2,0E-01
0,10	6,1E-02
0,05	1,3E-02
0,01	1,8E-03

Figure 20 FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1,288	K/W

FRED thermal model values

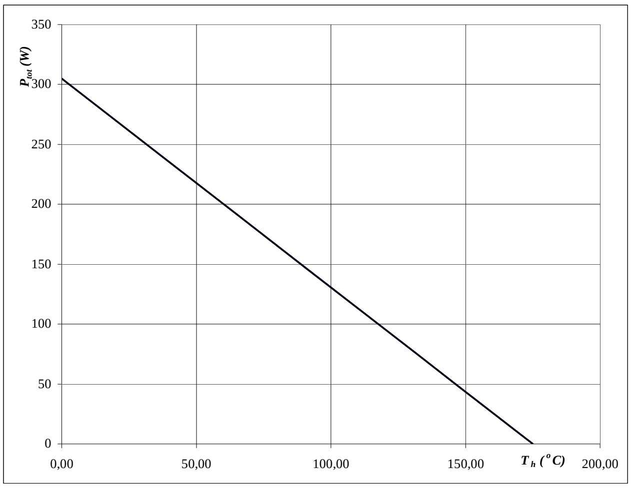
R (C/W)	Tau (s)
0,07	4,9E+00
0,20	1,0E+00
0,60	2,3E-01
0,28	8,0E-02
0,12	1,6E-02
0,03	1,8E-03

Buck

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



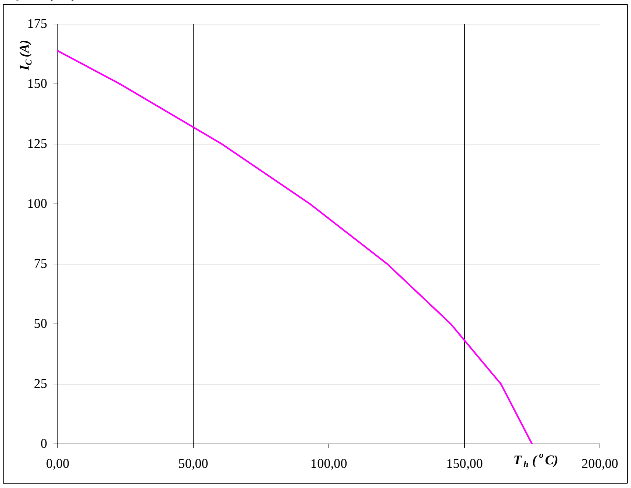
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

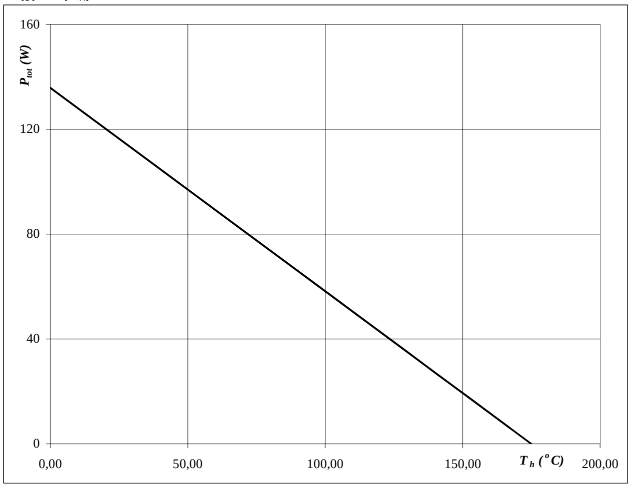
T_j = 175 °C

V_{GE} = 15 V

Figure 23 FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



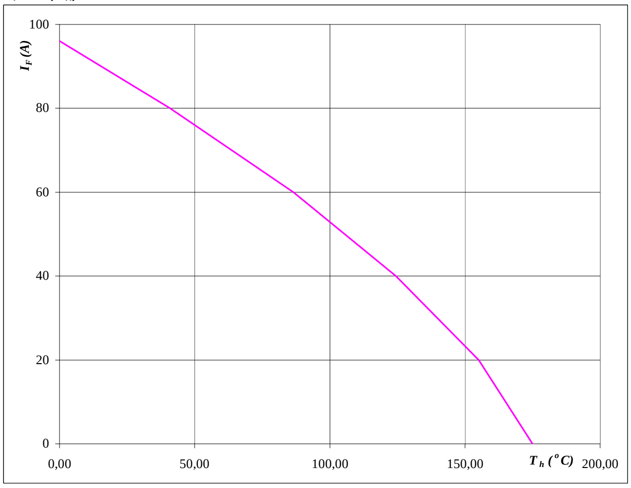
At

T_j = 175 °C

Figure 24 FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

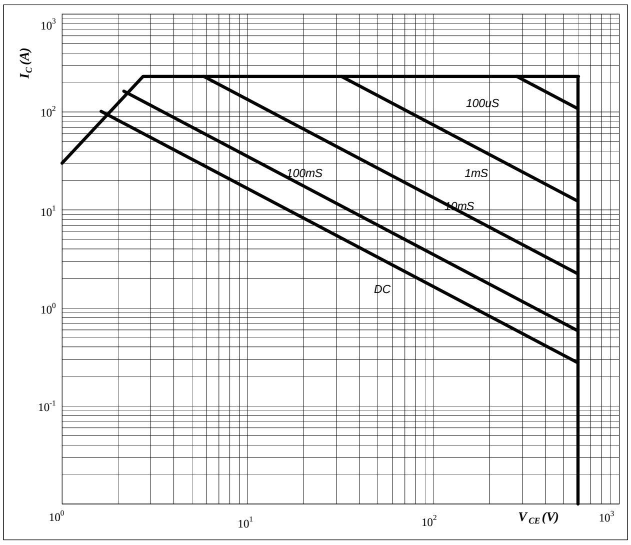
T_j = 175 °C

Buck

Figure 25	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



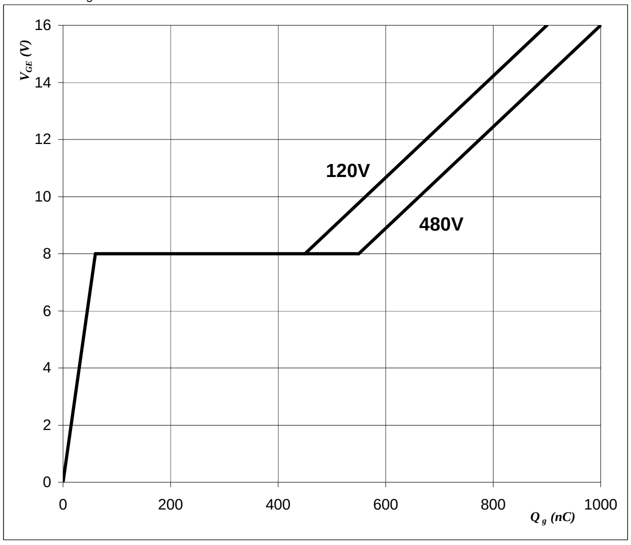
At

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

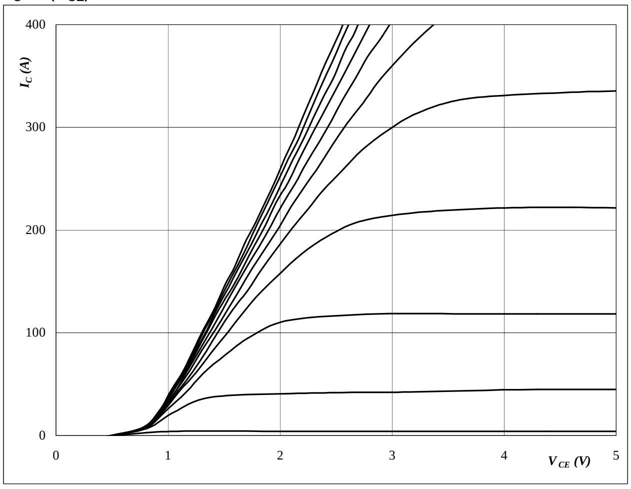
I_C =	150	A

Boost

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

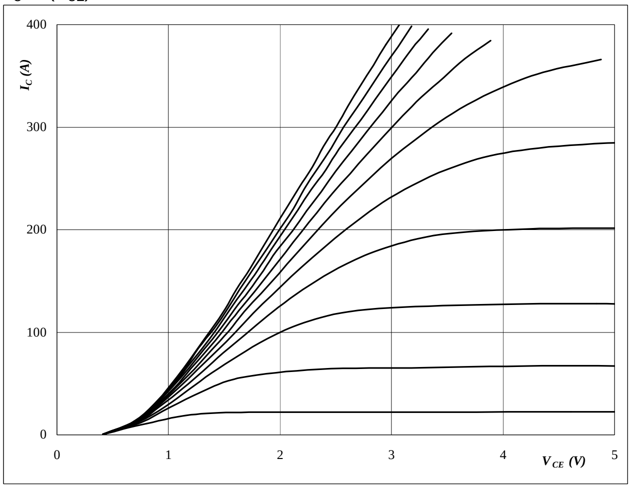
T_j = 25 °C

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 = 250 µs

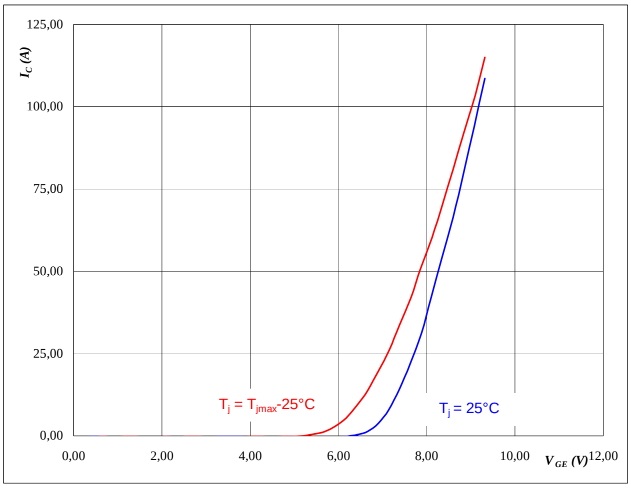
T_j = 150 °C

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

t_p = 250 µs

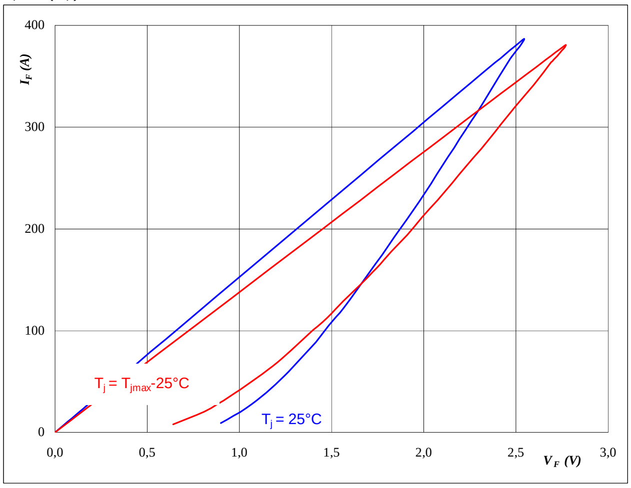
V_{CE} = 10 V

Figure 4 FRED

Typical diode forward current as

a function of forward voltage

$I_F = f(V_F)$



At

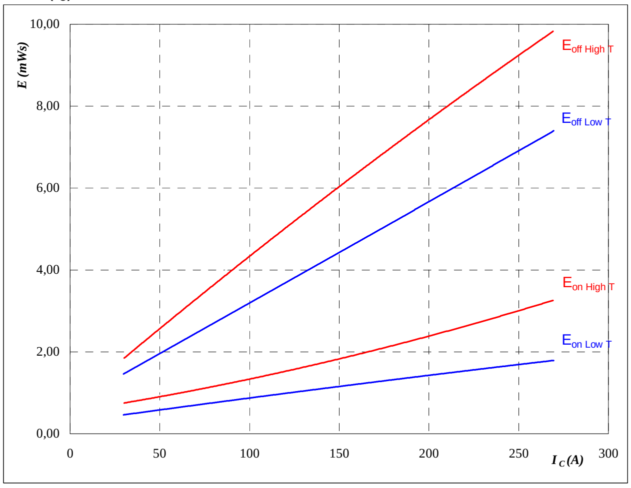
t_p = 250 µs

Boost

Figure 5 IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



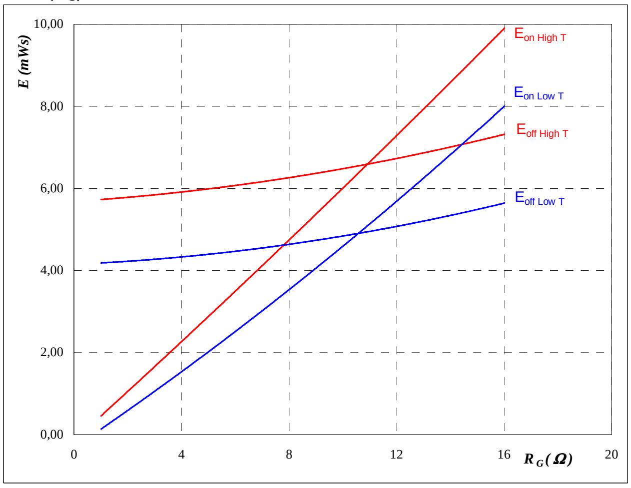
With an inductive load at

T_j =	25/150	°C
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)



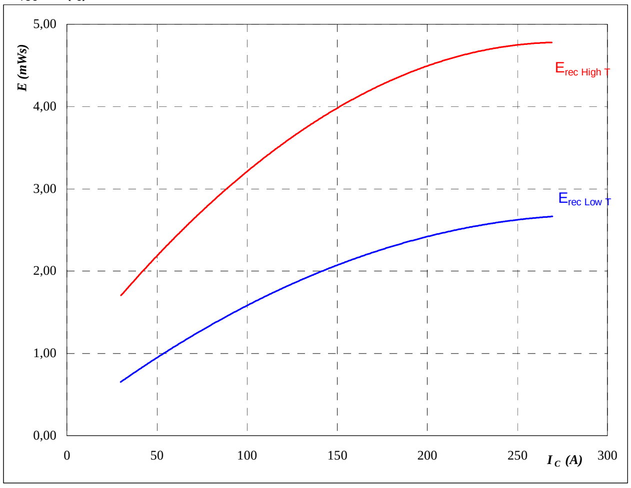
With an inductive load at

T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	149	A

Figure 7 IGBT

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



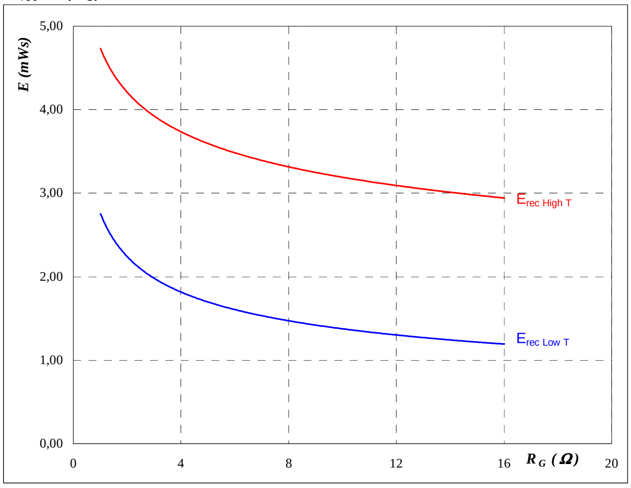
With an inductive load at

T_j =	25/150	°C
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

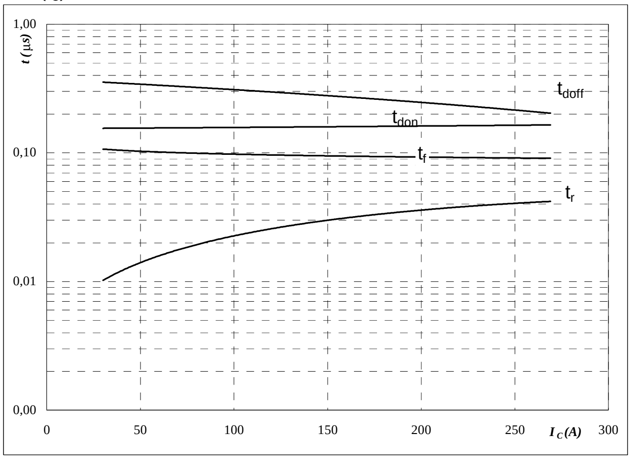
T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	149	A

Boost

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



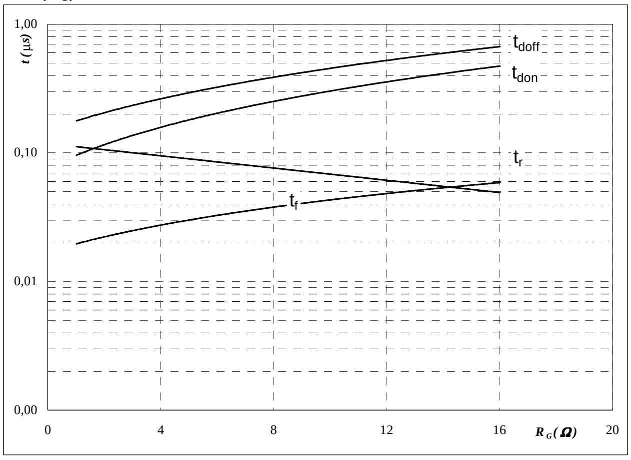
With an inductive load at

T_j =	150	°C
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)



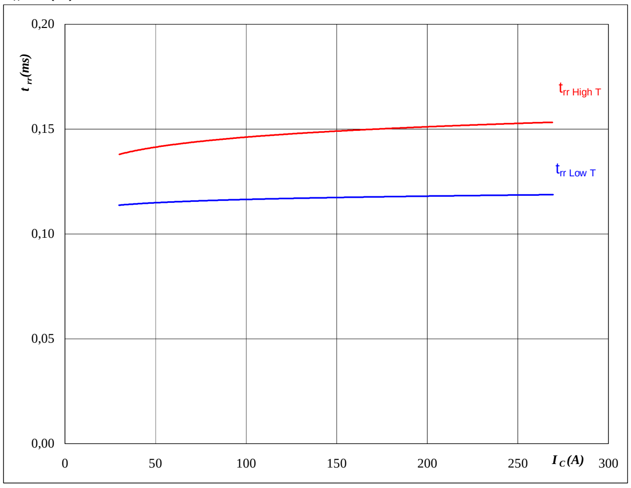
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	149	A

Figure 11 FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



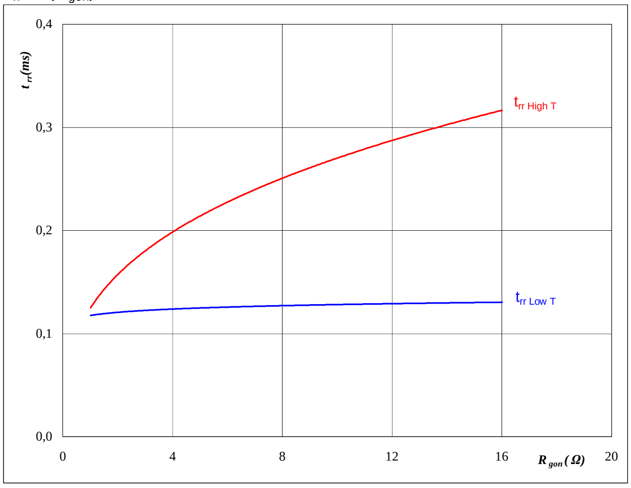
At

T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 12 FRED

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

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



At

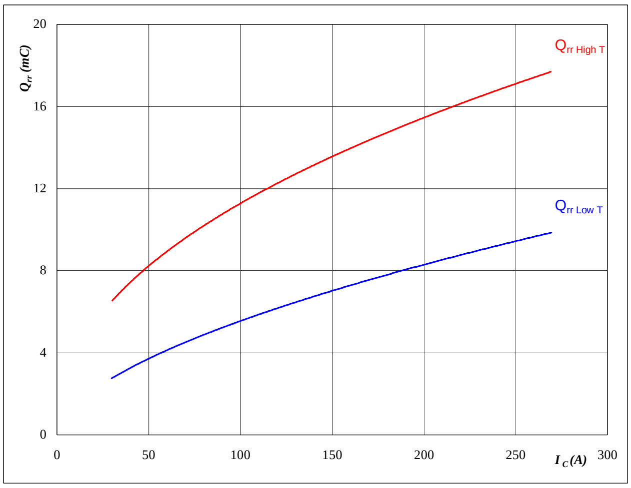
T_j =	25/150	°C
V_R =	350	V
I_F =	149	A
V_{GE} =	±15	V

Boost

Figure 13 FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



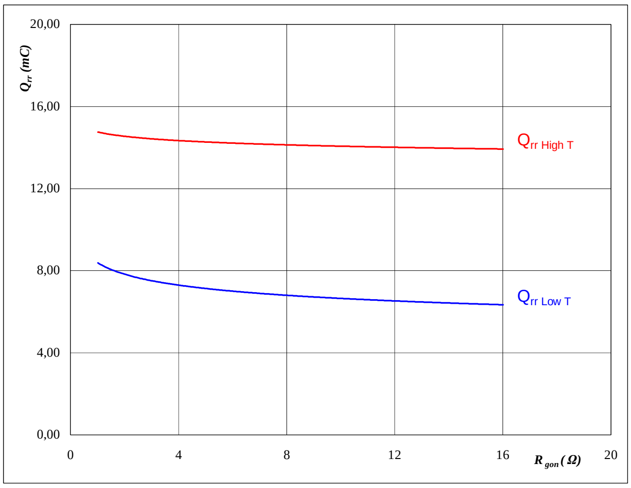
At

T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 14 FRED

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

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



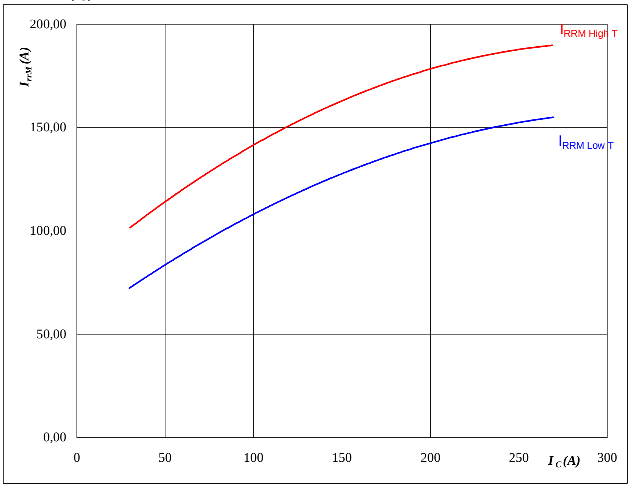
At

T_j =	25/150	°C
V_R =	350	V
I_F =	149	A
V_{GE} =	±15	V

Figure 15 FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



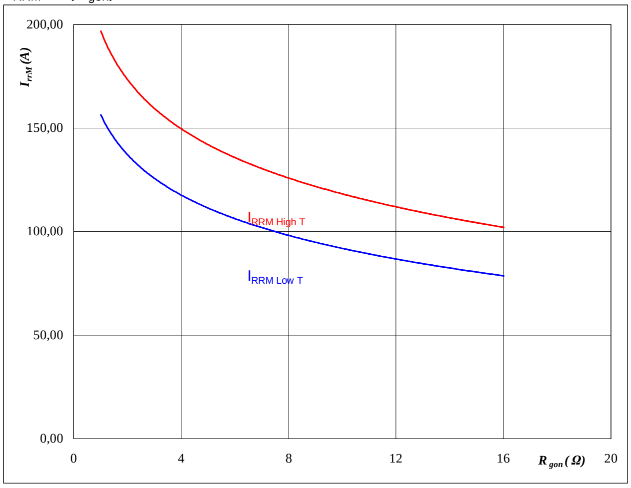
At

T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 16 FRED

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

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



At

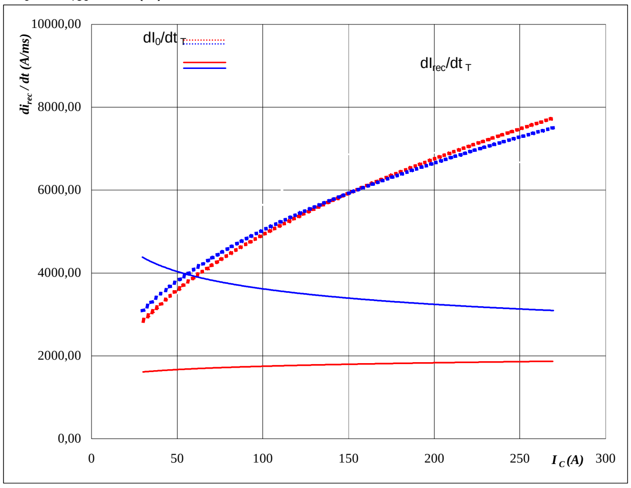
T_j =	25/150	°C
V_R =	350	V
I_F =	149	A
V_{GE} =	±15	V

Boost

Figure 17 FRED

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

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



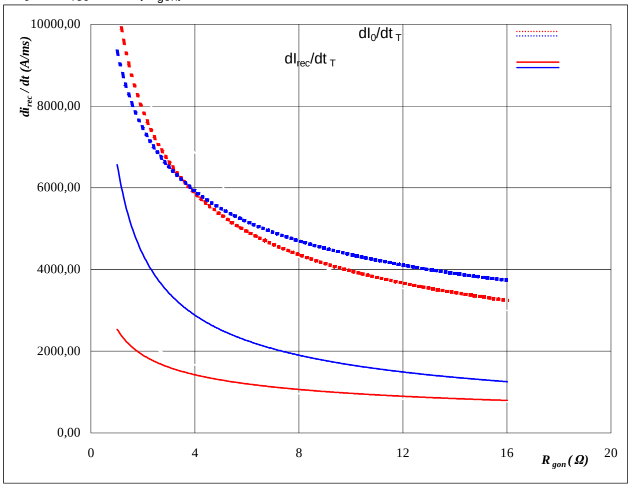
At

T_j =	25/150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 18 FRED

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

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



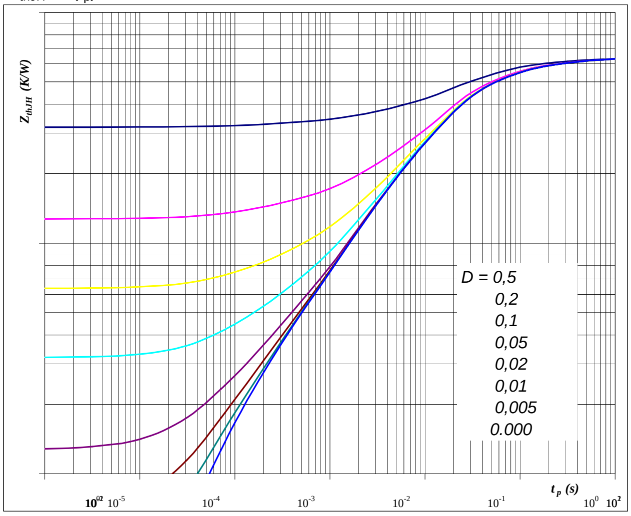
At

T_j =	25/150	°C
V_R =	350	V
I_F =	149	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} =	0,630	K/W

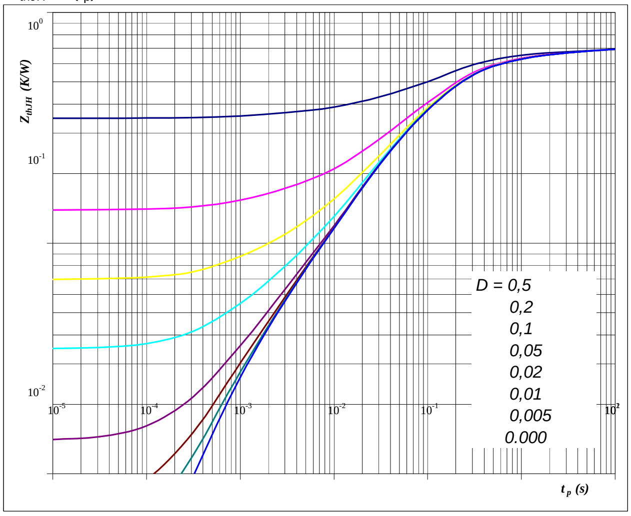
IGBT thermal model values

R (C/W)	Tau (s)
0,06	4,3E+00
0,10	1,1E+00
0,31	2,2E-01
0,10	6,2E-02
0,05	1,2E-02
0,02	1,3E-03

Figure 20 FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	0,701	K/W

FRED thermal model values

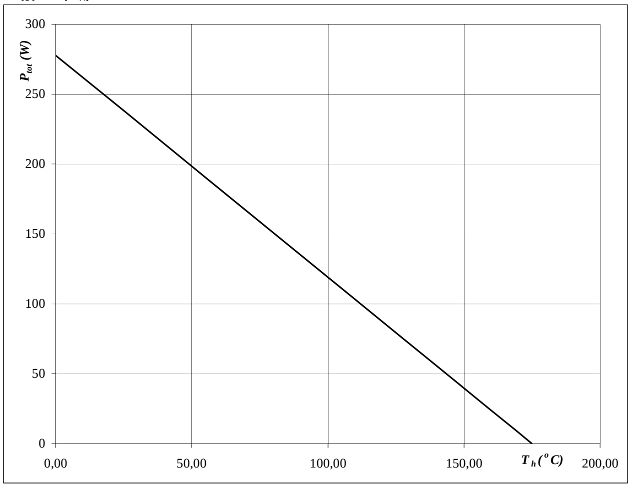
R (C/W)	Tau (s)
0,07	3,3E+00
0,17	4,3E-01
0,34	9,8E-02
0,10	1,4E-02
0,03	1,2E-03

Boost

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



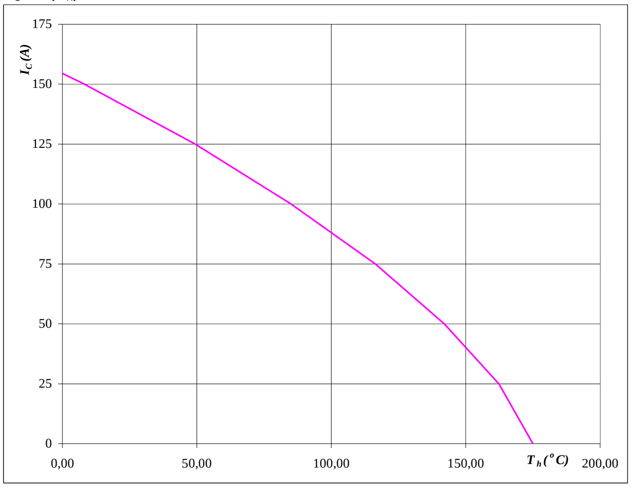
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

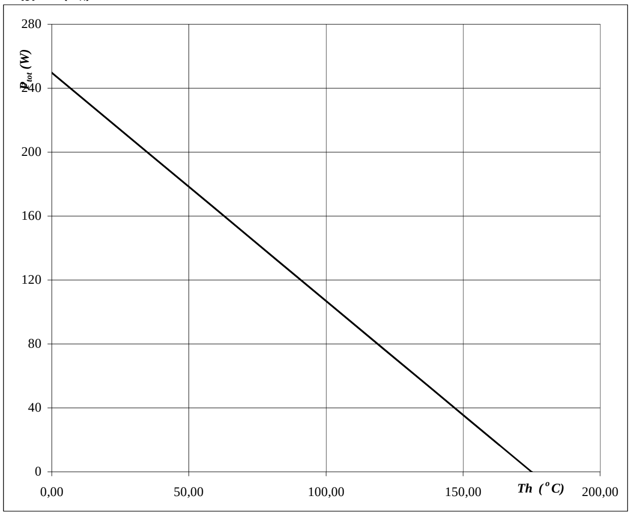
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



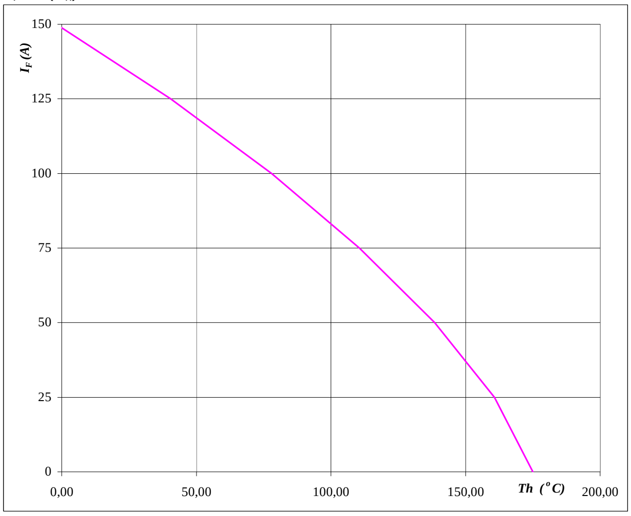
At

T_j = 175 ºC

Figure 24 FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

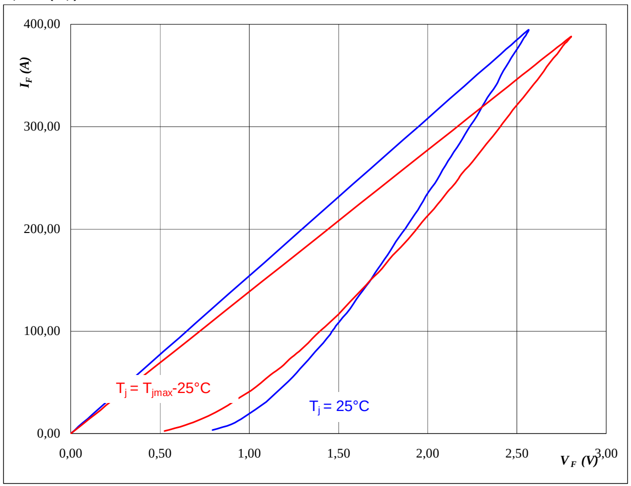
T_j = 175 ºC

Boost

Figure 25 Boost Inverse Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



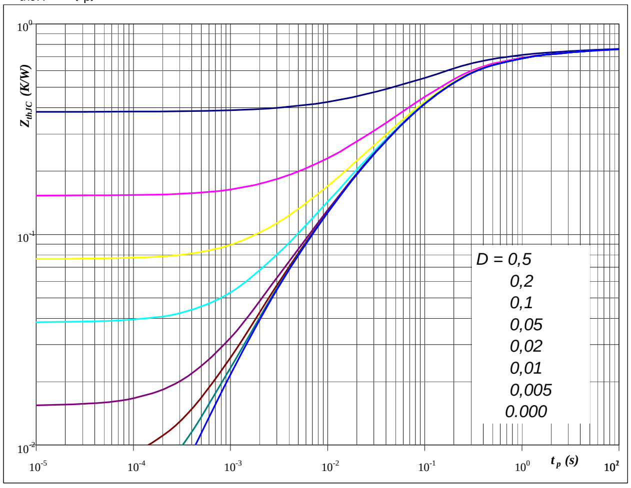
At

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

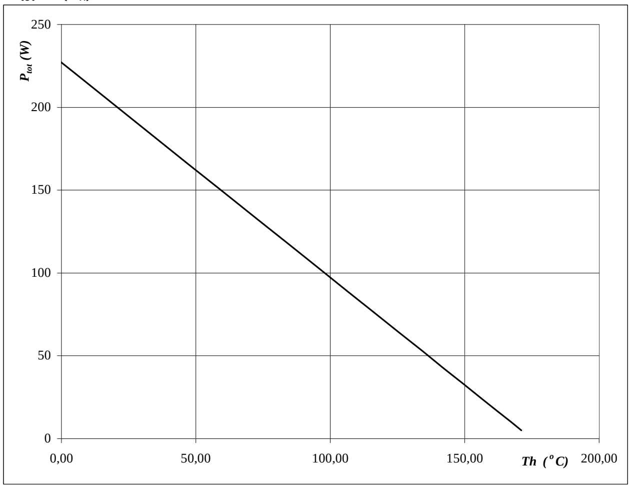
D = tp / T

R_{thJH} = 0,771 K/W

Figure 27 Boost Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



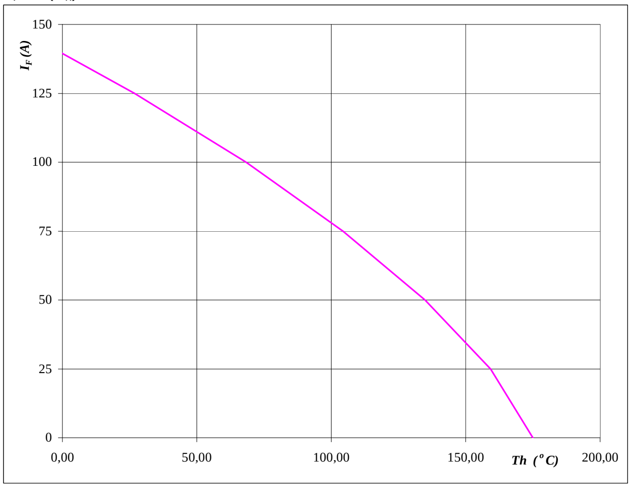
At

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)

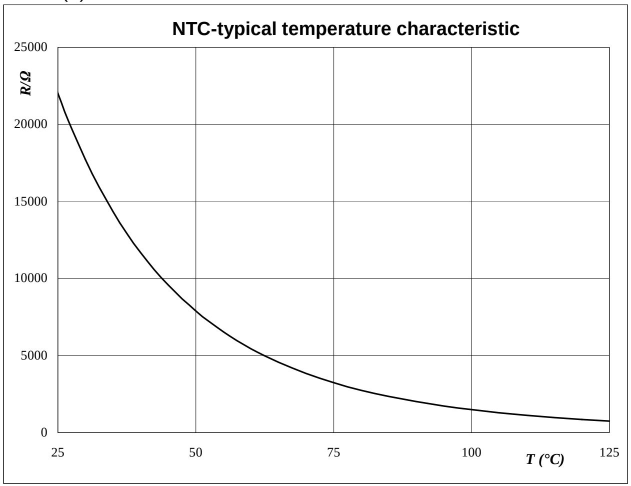


Figure 2 Thermistor

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 [Ω]	T [°C]	R [Ω]
-55	3006477	30	17635
-50	1993973	40	11574
-45	1346473	50	7796
-40	924676	55	6457
-35	645112	60	5378
-30	456784	65	4503
-25	327965	70	3791
-20	238577	75	3207
-15	175705	80	2726
-10	130914	85	2327
-5	98618	90	1996
0	75063	95	1718
5	57698	100	1486
10	44764	105	1289
15	35037	110	1123
20	27654	115	982
25	22000	120	861
30	17635	125	758

Switching Definitions BUCK IGBT

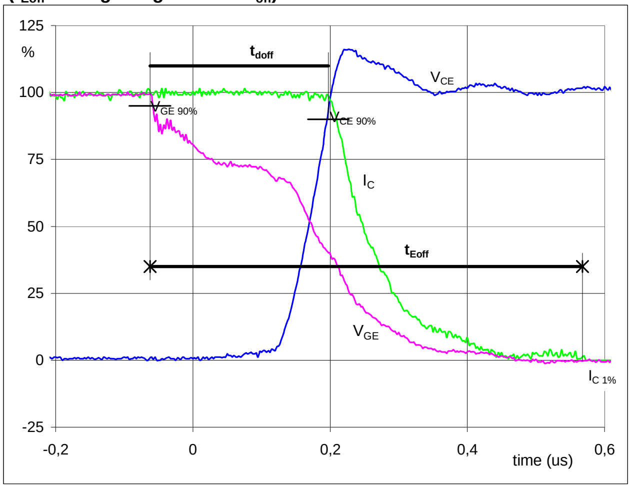
General conditions

T_j	=	150 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 10-F106NIA150SA-M136F Output inverter IGBT

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

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

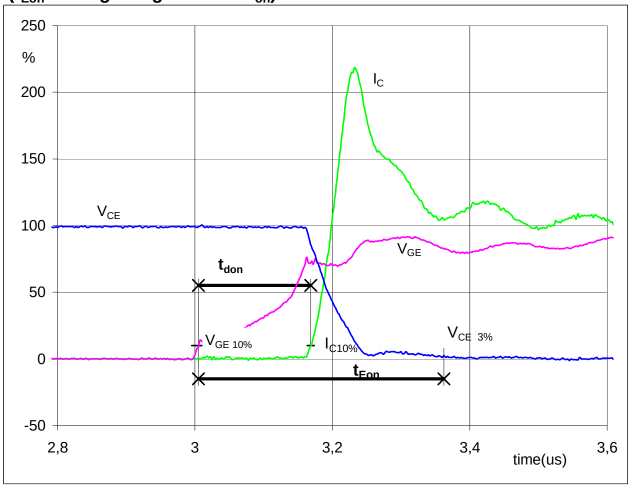


V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
t_{doff} =	0,25	µs
t_{Eoff} =	0,63	µs

Figure 2 Output inverter IGBT

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

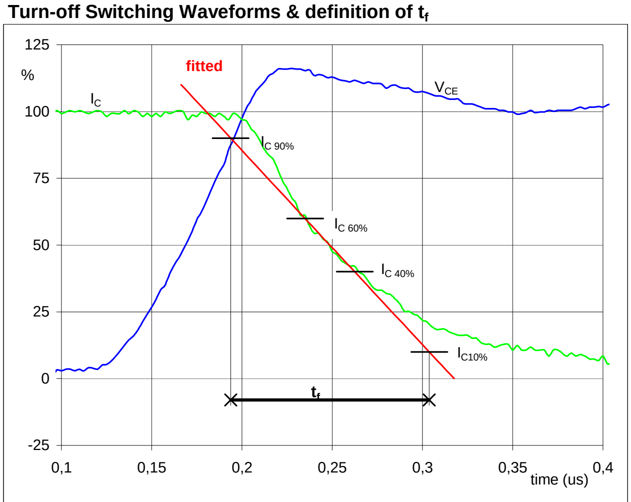
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
t_{don} =	0,16	µs
t_{Eon} =	0,36	µs

Figure 3 Output inverter IGBT

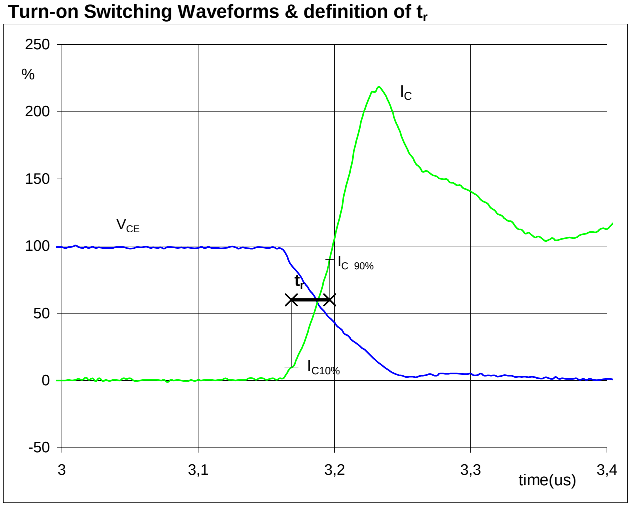
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	150	A
t_f =	0,11	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

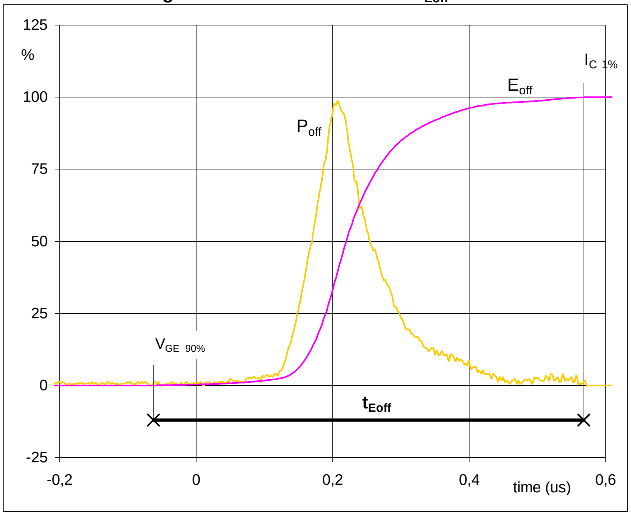


V_C (100%) =	350	V
I_C (100%) =	150	A
t_r =	0,03	µs

Switching Definitions BUCK IGBT

Figure 5 Output inverter IGBT

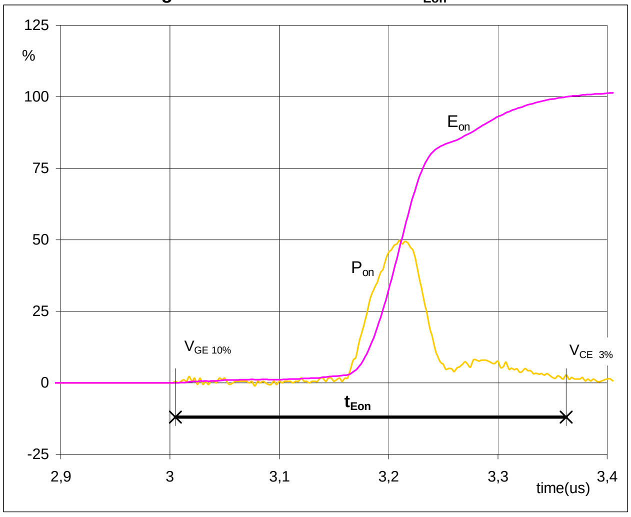
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	52,44	kW
E_{off} (100%) =	5,92	mJ
t_{Eoff} =	0,63	μs

Figure 6 Output inverter IGBT

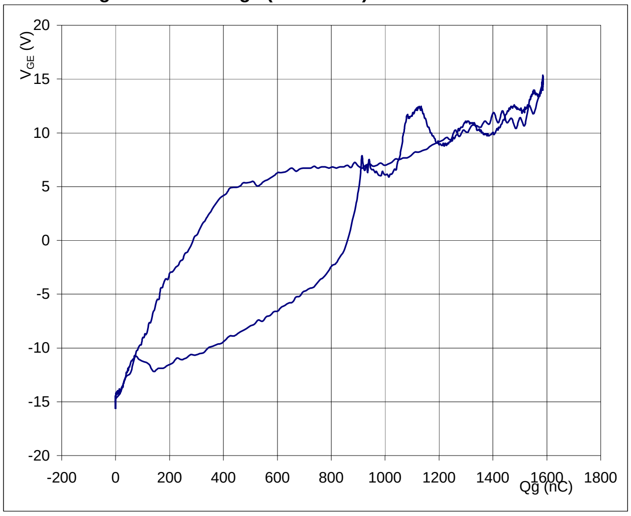
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	52,44	kW
E_{on} (100%) =	1,75	mJ
t_{Eon} =	0,36	μs

Figure 7 Output inverter FRED

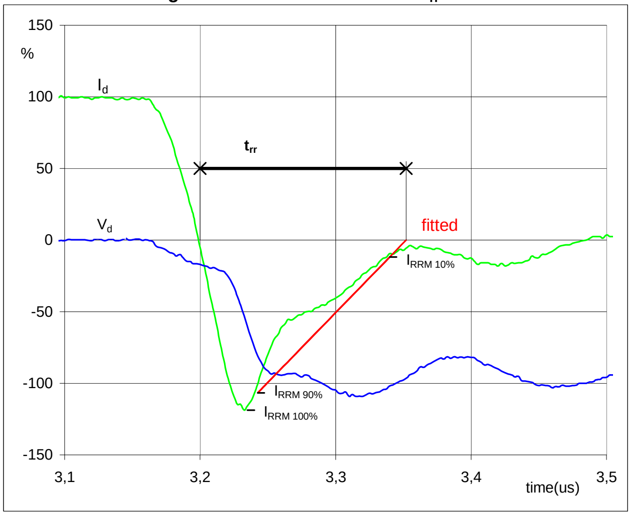
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
Q_g =	1585,43	nC

Figure 8 Output inverter IGBT

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

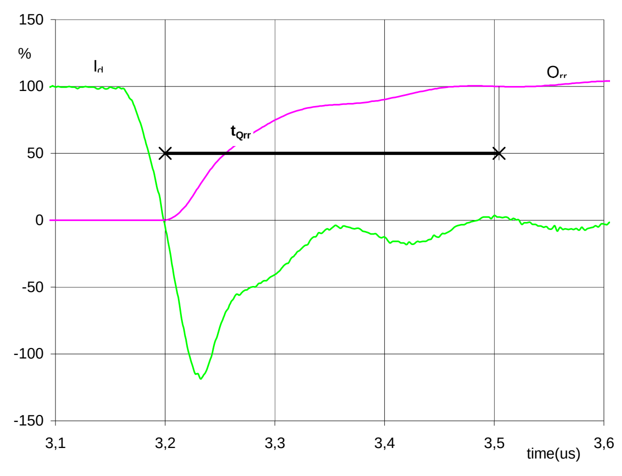


V_d (100%) =	350	V
I_d (100%) =	150	A
I_{RRM} (100%) =	-178	A
t_{rr} =	0,15	μs

Switching Definitions BUCK IGBT

Figure 9 Output inverter FRED

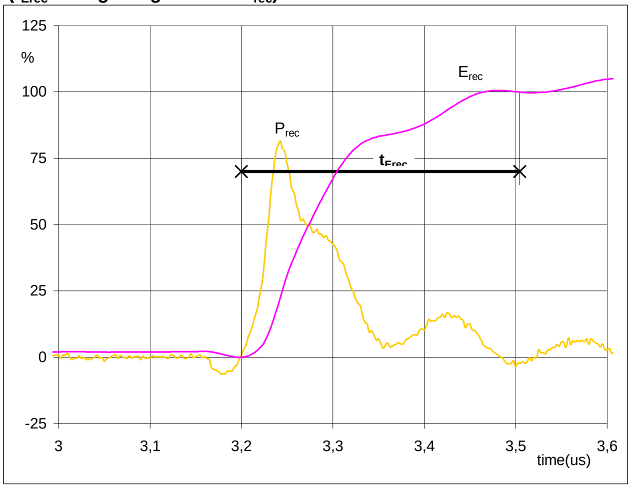
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	150	A
Q_{rr} (100%) =	13,73	µC
t_{Qrr} =	0,30	µs

Figure 10 Output inverter FRED

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

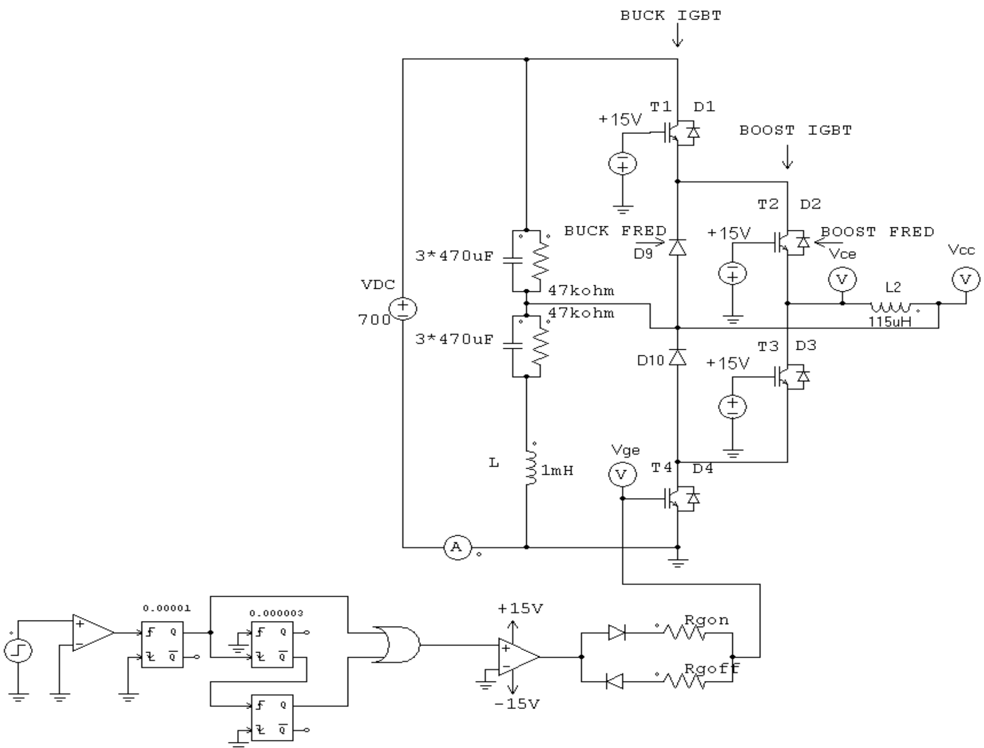


P_{rec} (100%) =	52,44	kW
E_{rec} (100%) =	3,63	mJ
t_{Erec} =	0,30	µs

Measurement circuit

Figure 11

BUCK stage switching measurement circuit



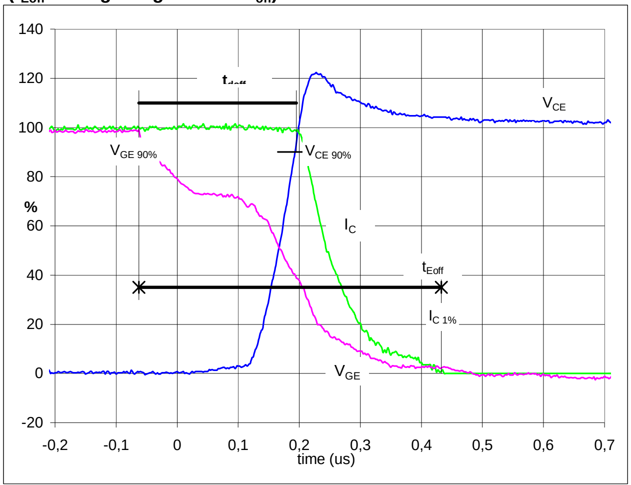
Switching Definitions BOOST IGBT

General conditions

T_j	=	150 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 10-F106NIA150SA-M136F Output inverter IGBT

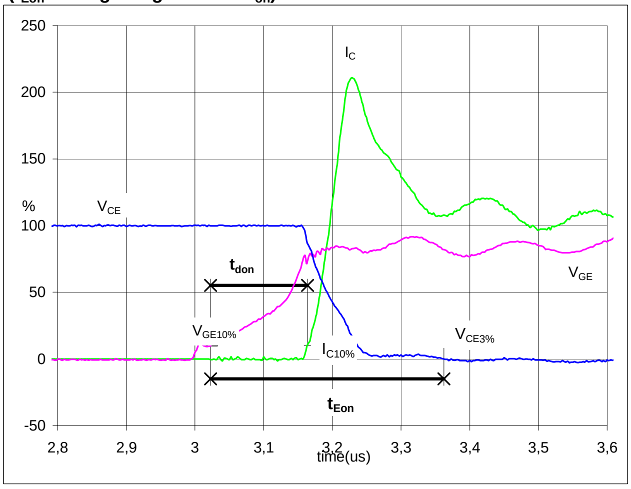
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
t_{doff} =	0,25	µs
t_{Eoff} =	0,49	µs

Figure 2 Output inverter IGBT

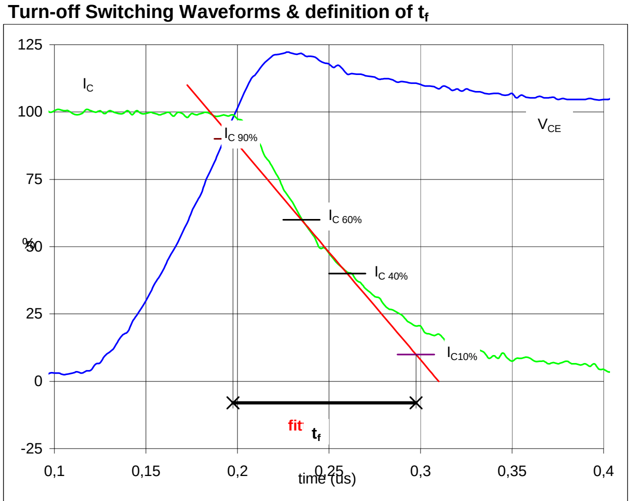
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
t_{don} =	0,16	µs
t_{Eon} =	0,34	µs

Figure 3 Output inverter IGBT

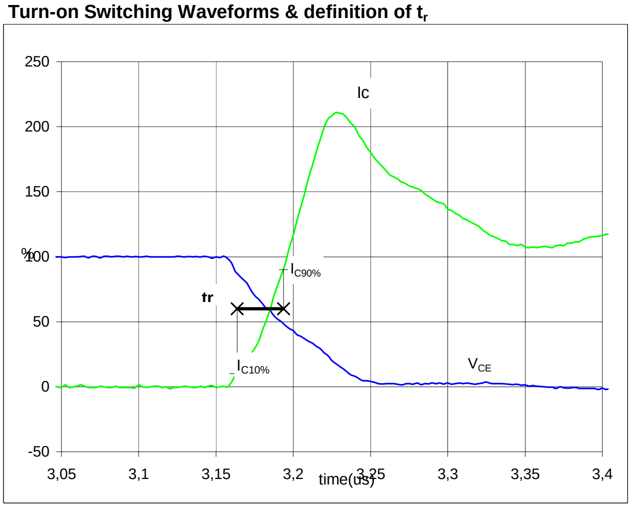
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	150	A
t_f =	0,10	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

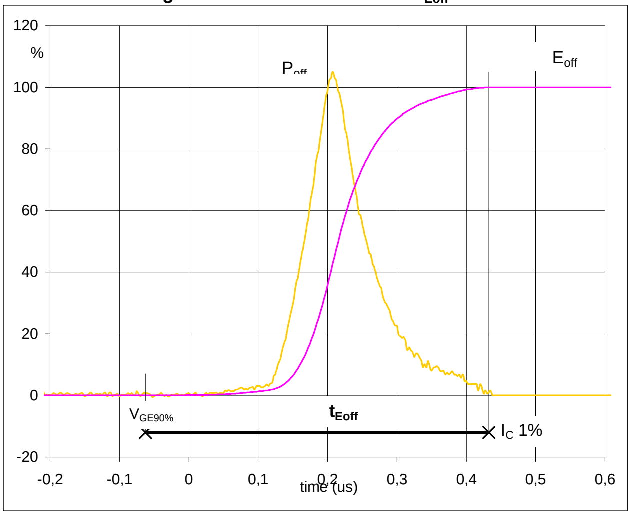


V_C (100%) =	350	V
I_C (100%) =	150	A
t_r =	0,03	µs

Switching Definitions BOOST IGBT

Figure 5 Output inverter IGBT

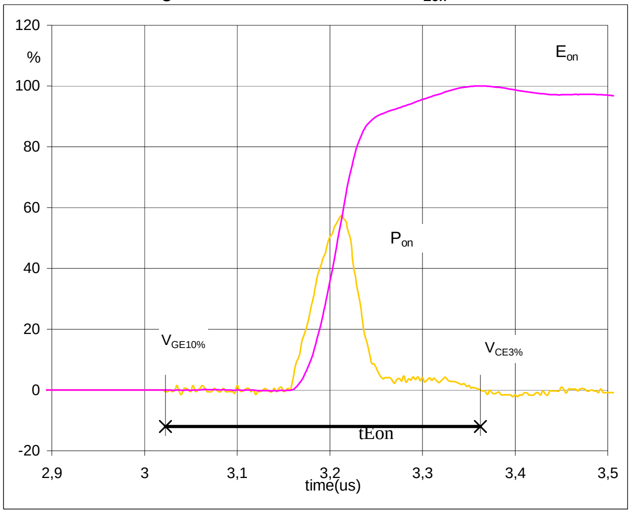
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	52,38	kW
E_{off} (100%) =	5,94	mJ
t_{Eoff} =	0,49	μs

Figure 6 Output inverter IGBT

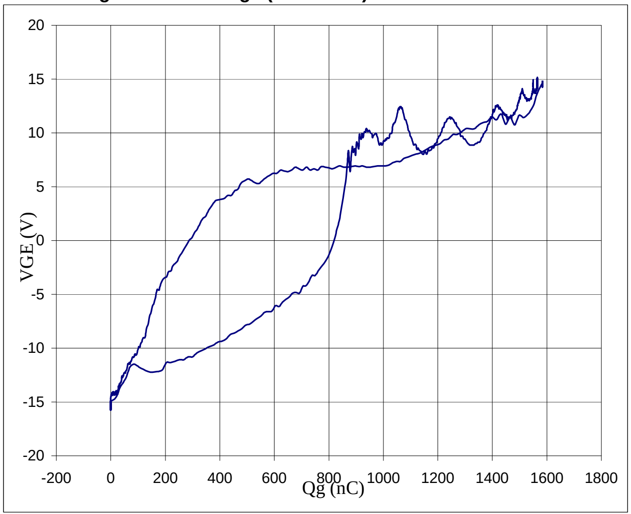
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	52,38	kW
E_{on} (100%) =	1,68	mJ
t_{Eon} =	0,34	μs

Figure 7 Output inverter FRED

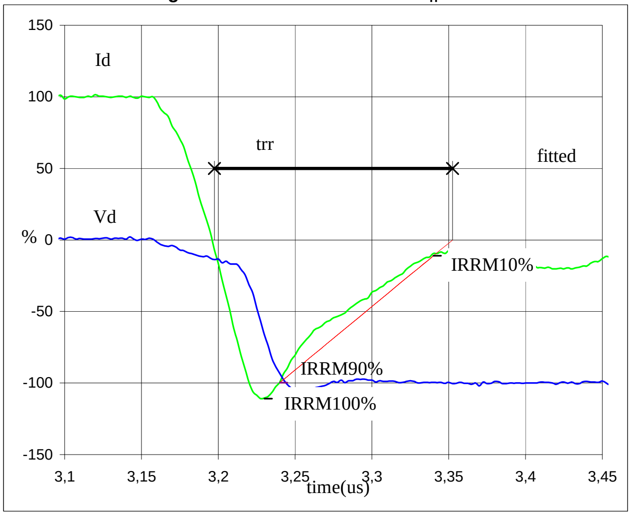
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	150	A
Q_g =	1583,47	nC

Figure 8 Output inverter IGBT

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

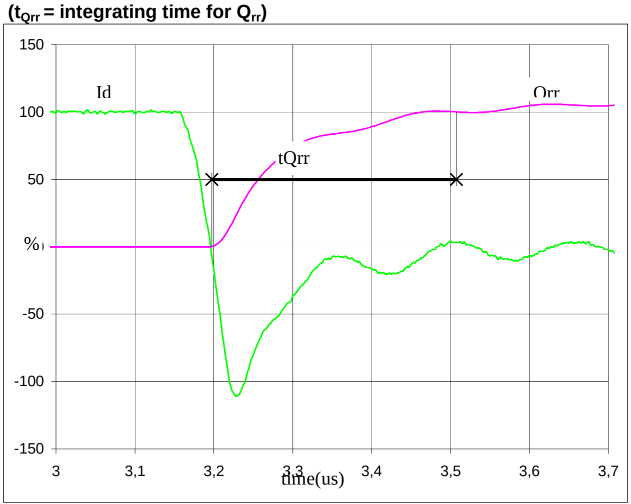


V_d (100%) =	350	V
I_d (100%) =	150	A
I_{RRM} (100%) =	-166	A
t_{rr} =	0,15	μs

Switching Definitions BOOST IGBT

Figure 9	Output inverter FRED

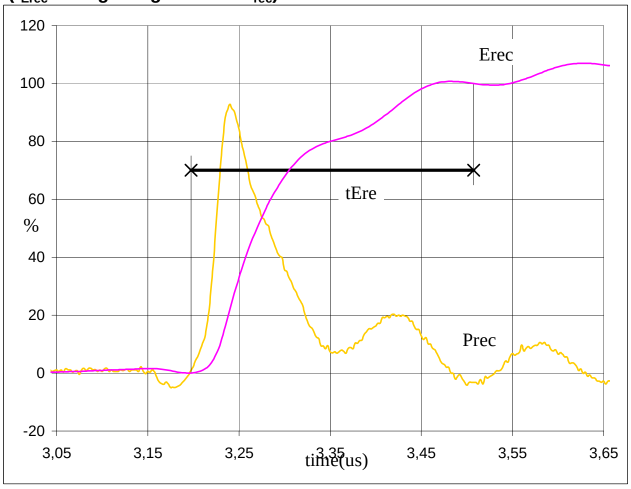
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	150	A
Q_{rr} (100%) =	14,35	μC
t_{Qrr} =	0,31	μs

Figure 10	Output inverter FRED

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

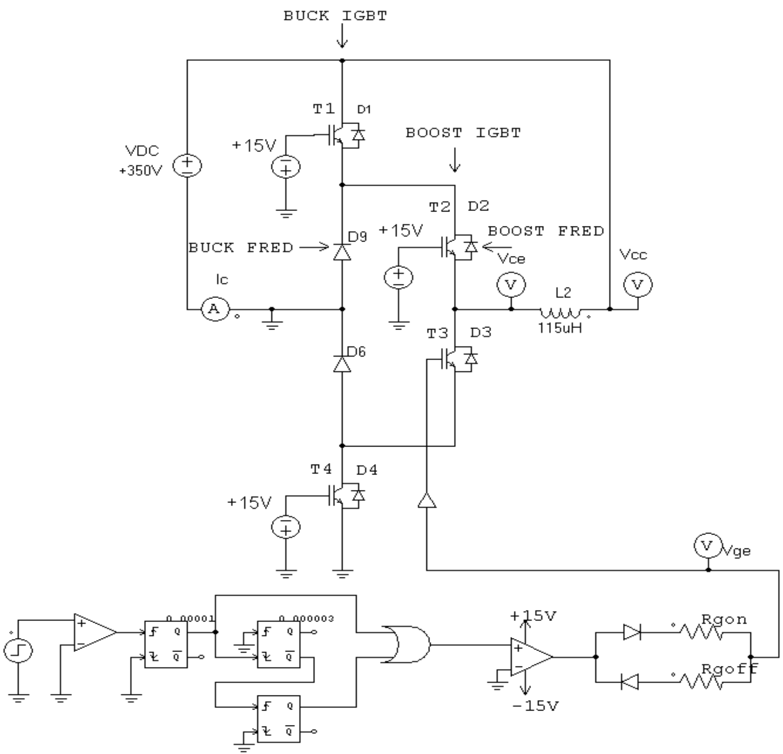


P_{rec} (100%) =	52,38	kW
E_{rec} (100%) =	4,14	mJ
t_{Erec} =	0,31	μs

Measurement circuit

Figure 11

BOOST stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

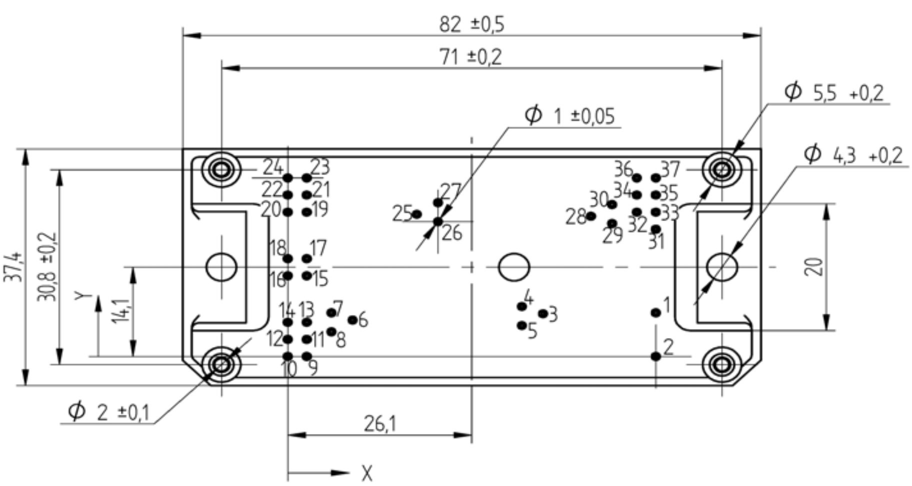
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-F106NIA150SA-M136F	M136F	M136F

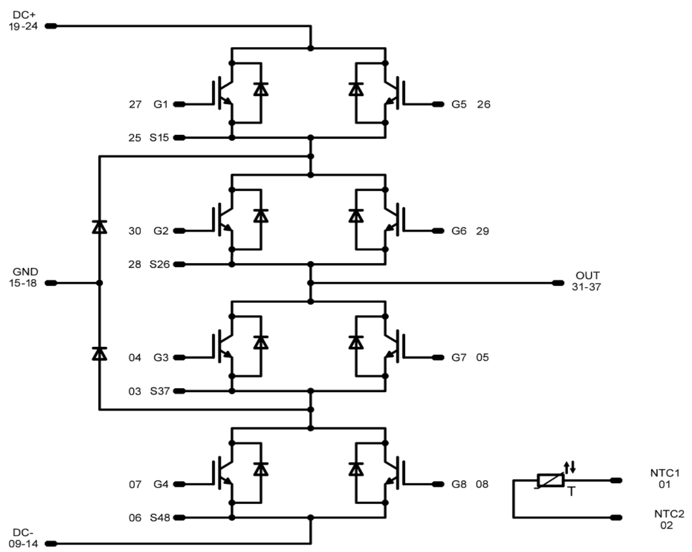
Outline

Pin table		
Pin	X	Y
1	52,2	6,9
2	52,2	0
3	36,2	6,75
4	33,2	7,9
5	33,2	4,9
6	9,2	5,75
7	6,2	6,9
8	6,2	3,9
9	2,7	0
10	0	0
11	2,7	2,7
12	0	2,7
13	2,7	5,4
14	0	5,4
15	2,7	12,75
16	0	12,75
17	2,7	15,45
18	0	15,45
19	2,7	22,8

Pin table		
Pin	X	Y
20	0	22,8
21	2,7	25,5
22	0	25,5
23	2,7	28,2
24	0	28,2
25	18,3	22,45
26	21,3	21,3
27	21,3	24,3
28	43	22,15
29	46	21
30	46	24
31	52,2	20,1
32	49,5	22,8
33	52,2	22,8
34	49,5	25,5
35	52,2	25,5
36	49,5	28,2
37	52,2	28,2



Pinout



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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.