flowSOL RI **600V/30A**

Features

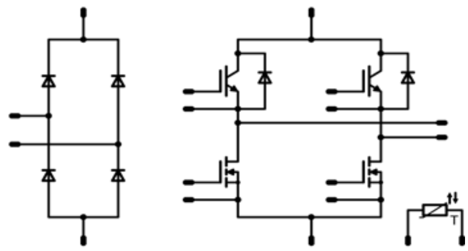
- High efficiency
- Ultra fast rectification and switching frequency
- Low inductive design
- Tandem to FZ06BIA083FI

flow0 housing

Target Applications

- Transformer-based solar inverters

Schematic



Types

- FZ06RIA045FH

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Fast Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			600	V
Forward average current	I_{FAV}	sine,d=0.5 T_j=$T_j$max	T_h=80°C T_c=80°C	27 36	A
Repetitive peak forward current	I_{FSM}	t_p=10ms	Tj=25°C	60	A
I2t-value	I^2t			90	A^2s
Power dissipation per diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	42 64	W
Maximum Junction Temperature	$T_j$max			175	°C
Buck Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	12 16	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	T_c=100°C	35	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	29 44	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, 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°C T_c=80°C	30 37	A
Pulsed drain current	I_{Dpulse}	t_p limited by $T_j$max	Tc=25°C	230	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	94 142	W
Gate-source peak voltage	Vgs			±20	V
Maximum Junction Temperature	$T_j$max			150	°C
Boost IGBT					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C T_c=80°C	39 40	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		150	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	79 120	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	$T_j$max			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					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	
Fast Rectifier Diode										
Forward voltage	V_F				30	Tj=25°C Tj=150°C	1	1,66 1,62	2,05	V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=150°C		1,11 0,96		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=150°C		18 22		mΩ
Reverse current	I_r			600		Tj=25°C Tj=150°C			0,02	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,25		K/W
Buck Diode										
Diode forward voltage	V_F				8	Tj=25°C Tj=125°C	1	1,52 1,64	2	V
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	10	400	15	Tj=25°C Tj=125°C		14 12		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		8 9		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,054 0,052		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		4078 3373		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,0075 0,0069		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,28		K/W
Buck MOSFET										
Static drain to source ON resistance	$R_{ds(on)}$		10		44	Tj=25°C Tj=125°C		45 89		mΩ
Gate threshold voltage	$V_{(GS)th}$				0,003	Tj=25°C Tj=125°C	2,1	3	3,9	V
Gate to Source Leakage Current	I_{gss}		20	0		Tj=25°C Tj=125°C			200	nA
Zero Gate Voltage Drain Current	I_{dss}		0	600		Tj=25°C Tj=125°C			25000	nA
Turn On Delay Time	$t_{d(ON)}$	Rgoff=4 Ω Rgon=4 Ω	10	400	15	Tj=25°C Tj=125°C		31 30		ns
Rise Time	t_r					Tj=25°C Tj=125°C		5 6		
Turn off delay time	$t_{d(OFF)}$					Tj=25°C Tj=125°C		147 158		
Fall time	t_f					Tj=25°C Tj=125°C		14 10		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,063 0,067		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,021 0,028		
Total gate charge	Q_g		10	400	44	Tj=25°C		150	190	nC
Gate to source charge	Q_{gs}							34		
Gate to drain charge	Q_{gd}							51		
Input capacitance	C_{iss}	f=1MHz	0	100		Tj=25°C		6800		pF
Output capacitance	C_{oss}							320		
Reverse transfer capacitance	C_{rss}							45		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,75		K/W

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
Boost IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0008	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=125°C	1	1,59 1,83	2,1	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,2	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_{Gate}		15	480	50	Tj=25°C		310		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,20		K/W

Note: For the **Boost IGBT** only LF switching allowed

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
Thermistor										
Rated resistance*	R_{25}					Tj=25°C	17,5	22	29,0	kΩ
	R_{100}	Tol. ±5%						1486		Ω
Power dissipation	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		4000		K

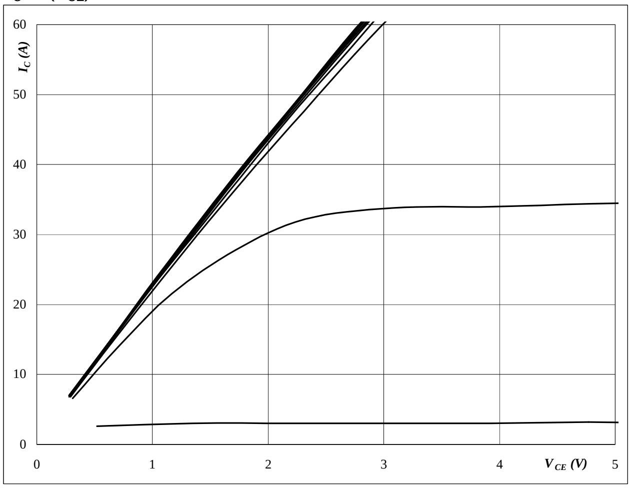
* see details on **Thermistor** charts on **Figure 2.**

Buck

Figure 1 MOSFET

Typical output characteristics

$I_C = f(V_{CE})$



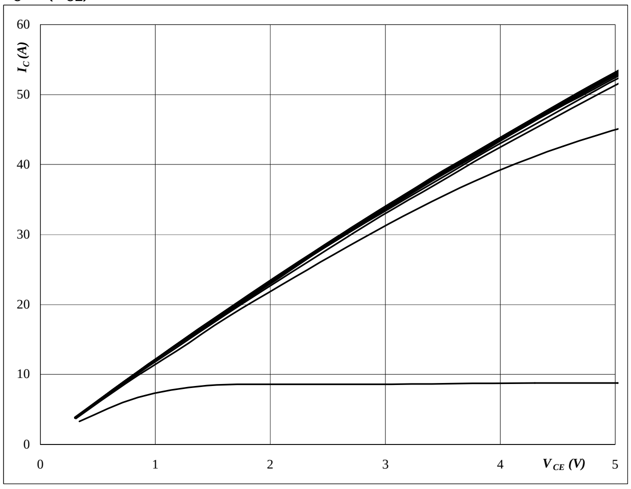
At

t_p =	250	µs
T_j =	25	°C
V_{GE} from	4 V to 14 V in steps of 1 V	

Figure 2 MOSFET

Typical output characteristics

$I_C = f(V_{CE})$



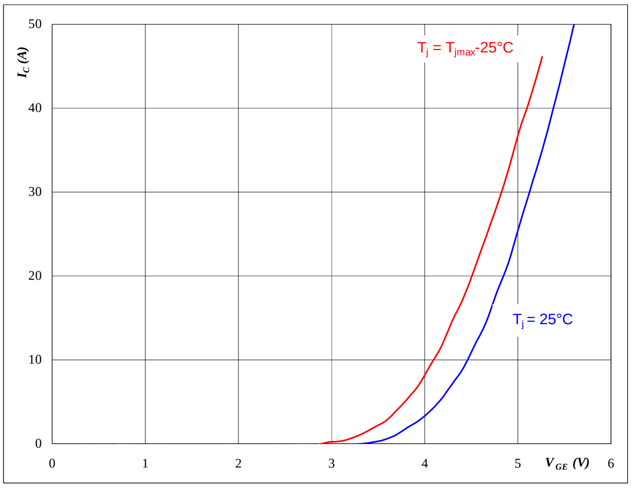
At

t_p =	250	µs
T_j =	125	°C
V_{GE} from	4 V to 14 V in steps of 1 V	

Figure 3 MOSFET

Typical transfer characteristics

$I_C = f(V_{GE})$



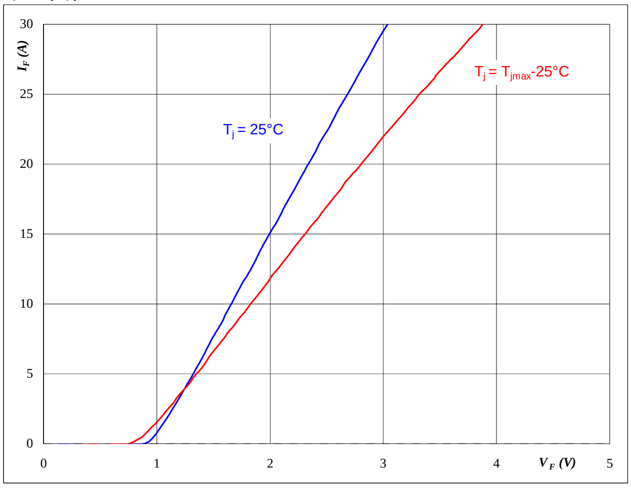
At

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

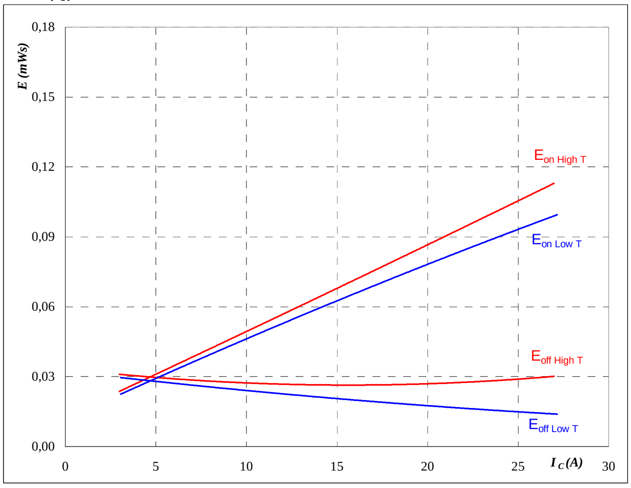
t_p =	250	µs

Buck

Figure 5 MOSFET

Typical switching energy losses
as a function of collector current

E = f(I_C)



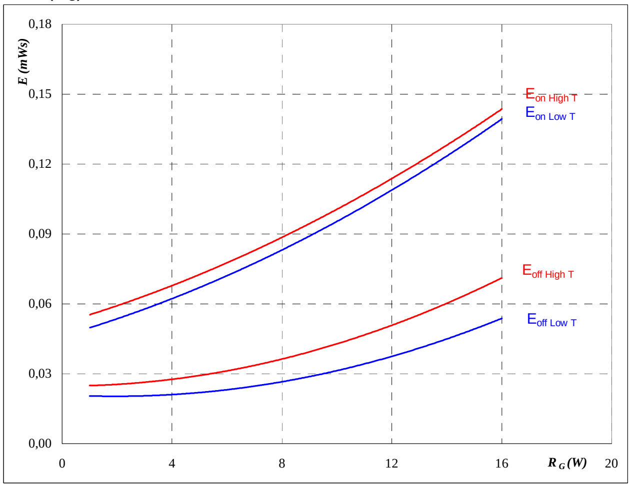
With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 MOSFET

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



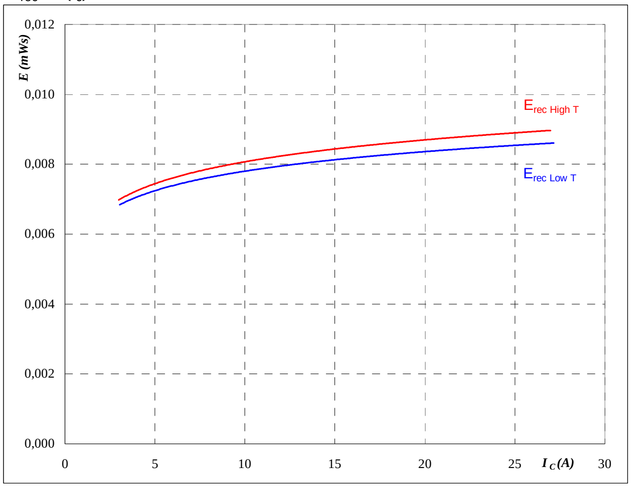
With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
I_C =	15	A

Figure 7 FRED

Typical reverse recovery energy loss
as a function of collector current

E_{rec} = f(I_c)



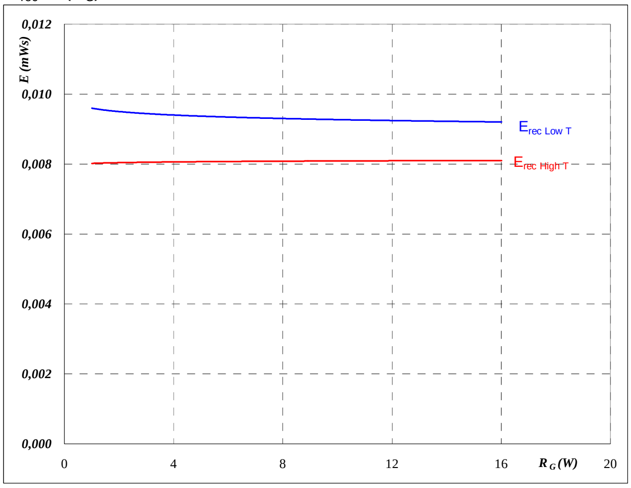
With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	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

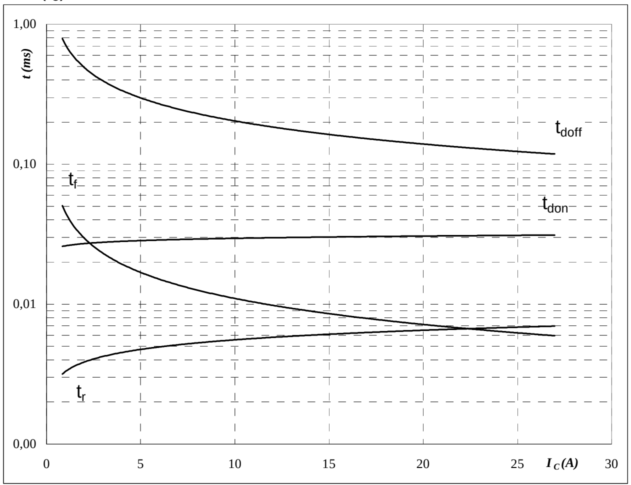
T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
I_C =	15	A

Buck

Figure 9 MOSFET

Typical switching times as a function of collector current

$t = f(I_C)$



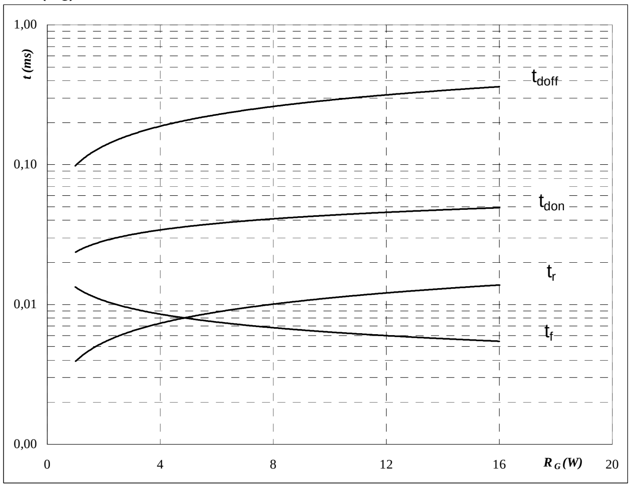
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 MOSFET

Typical switching times as a function of gate resistor

$t = f(R_G)$



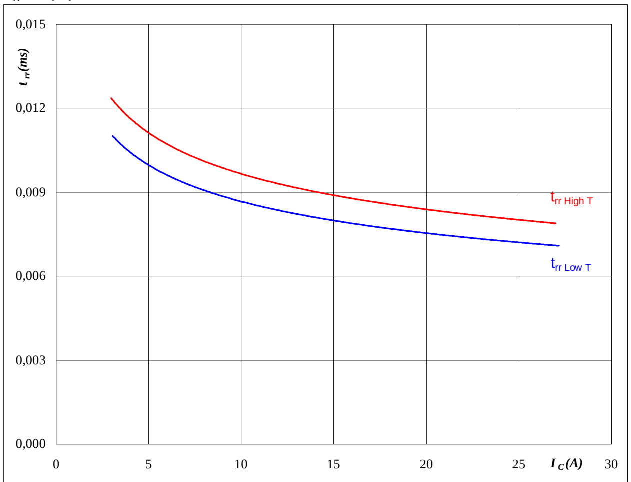
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	10	V
I_C =	15	A

Figure 11 FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



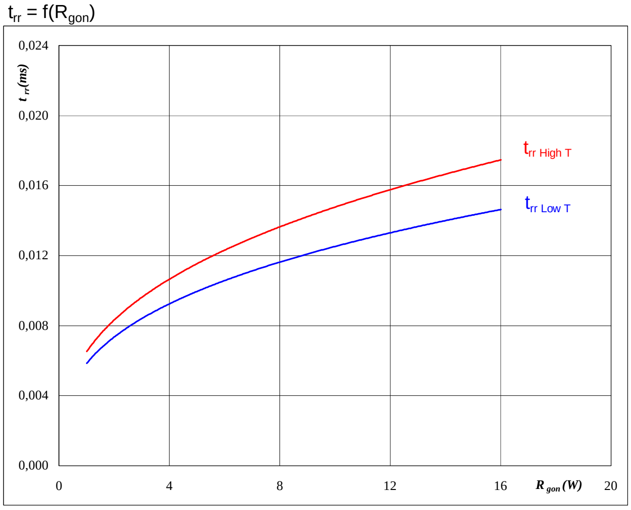
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	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

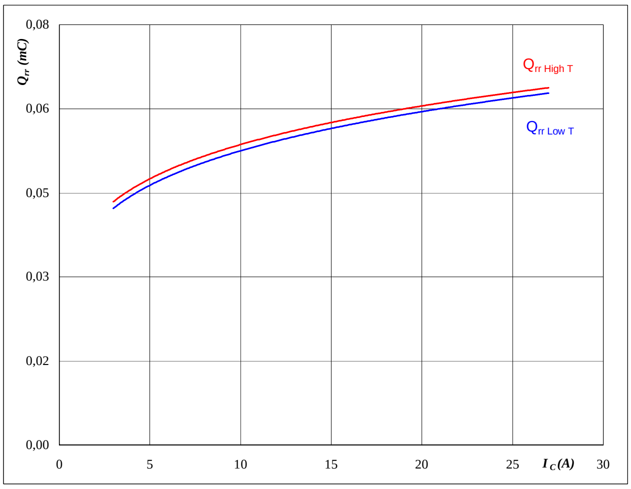
T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GE} =	10	V

Buck

Figure 13 FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



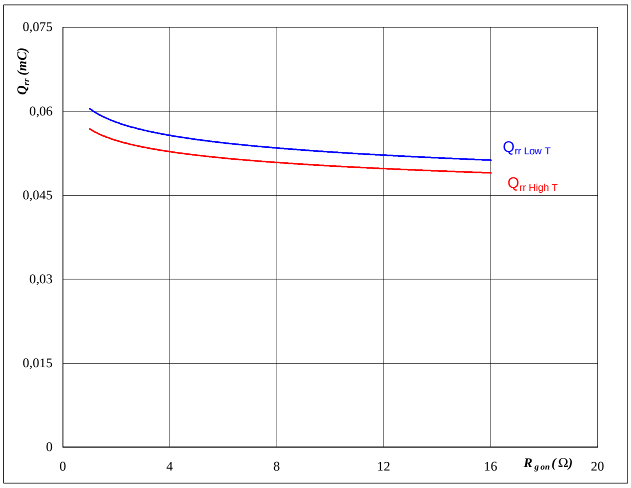
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω

Figure 14 FRED

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

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



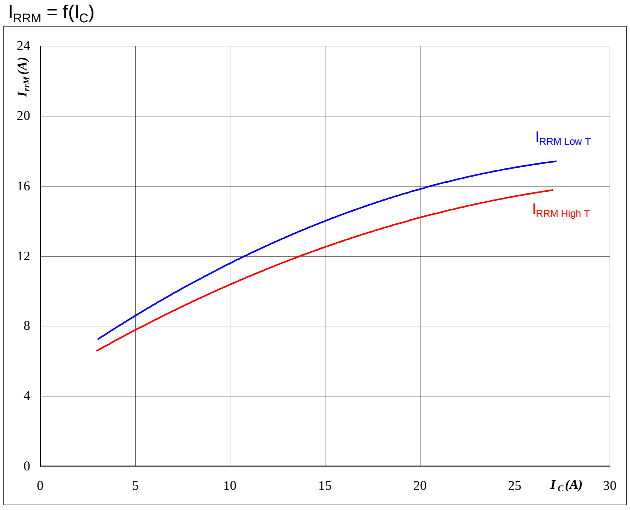
At

T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GE} =	10	V

Figure 15 FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



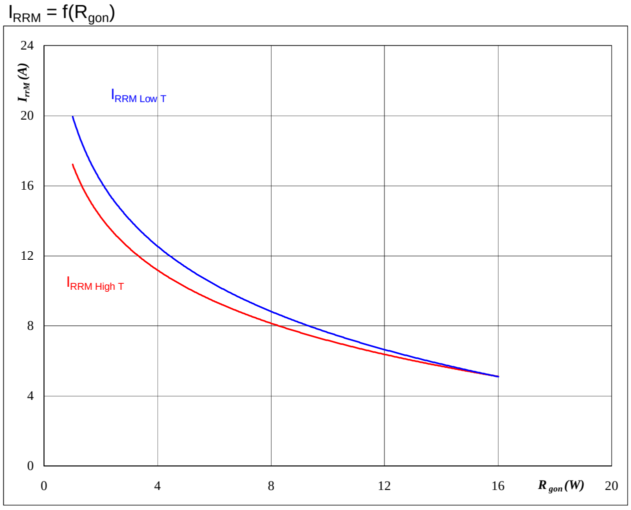
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	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

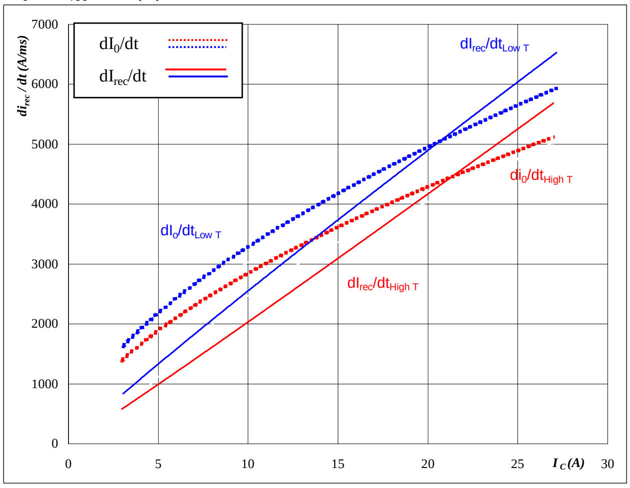
T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GE} =	10	V

Buck

Figure 17 FRED

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

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



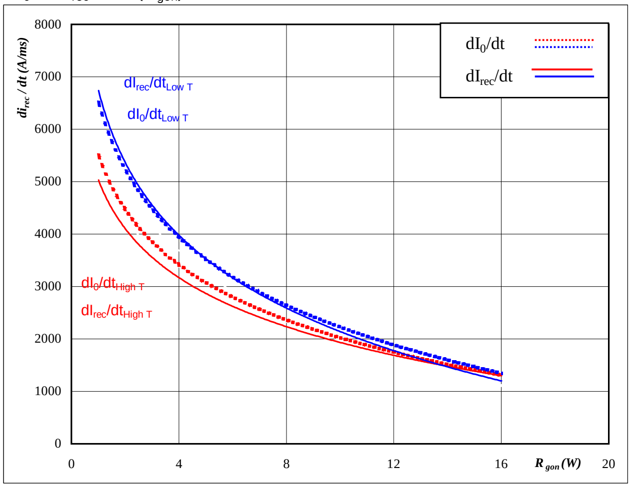
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	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

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



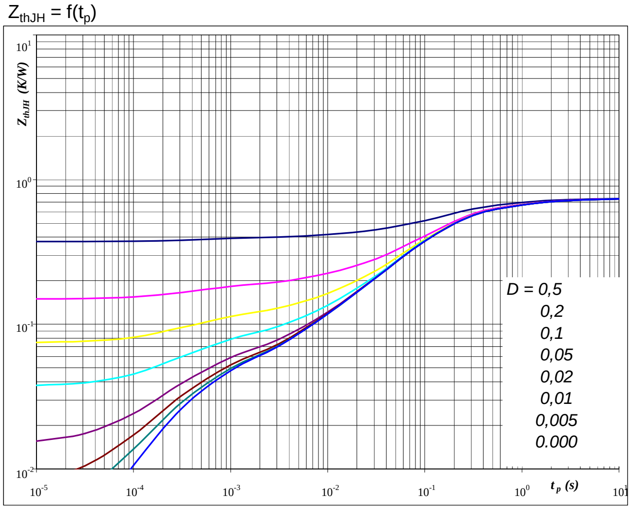
At

T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GE} =	10	V

Figure 19 MOSFET

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,75	K/W

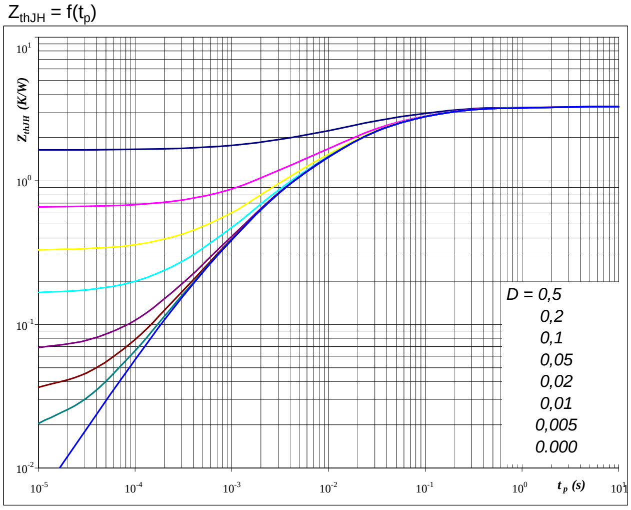
IGBT thermal model values

R (C/W)	Tau (s)
0,03	9,3E+00
0,12	1,2E+00
0,41	1,6E-01
0,11	3,8E-02
0,03	5,2E-03
0,04	3,7E-04

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} =	3,28	K/W

FRED thermal model values

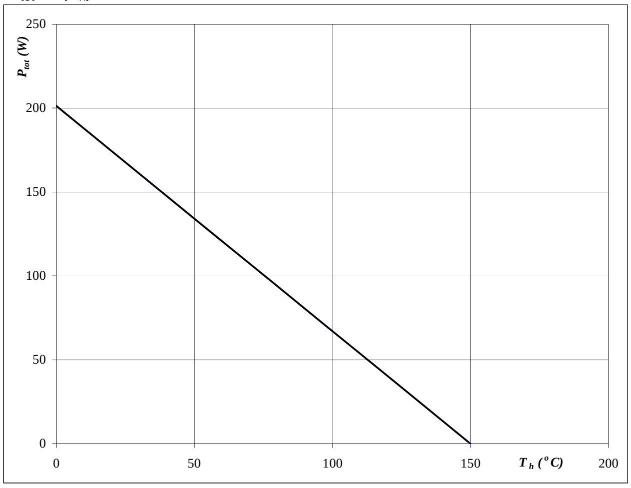
R (C/W)	Tau (s)
0,17	9,7E-01
1,04	8,5E-02
1,34	1,6E-02
0,65	2,5E-03
0,08	3,2E-04

Buck

Figure 21 MOSFET

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



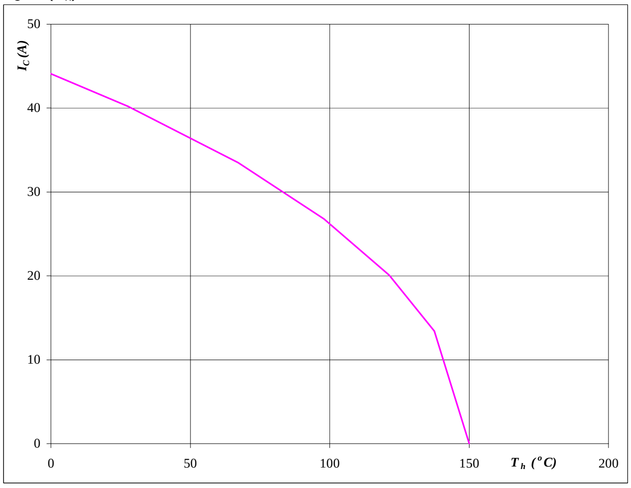
At

T_j = 150 °C

Figure 22 MOSFET

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

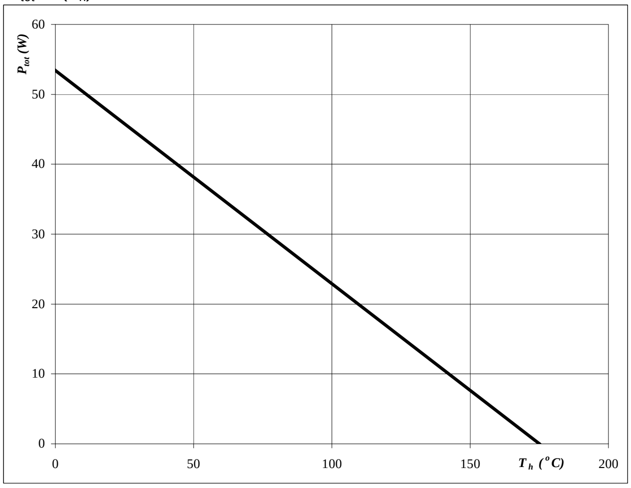
T_j = 150 °C

V_{GE} = 15 V

Figure 23 FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



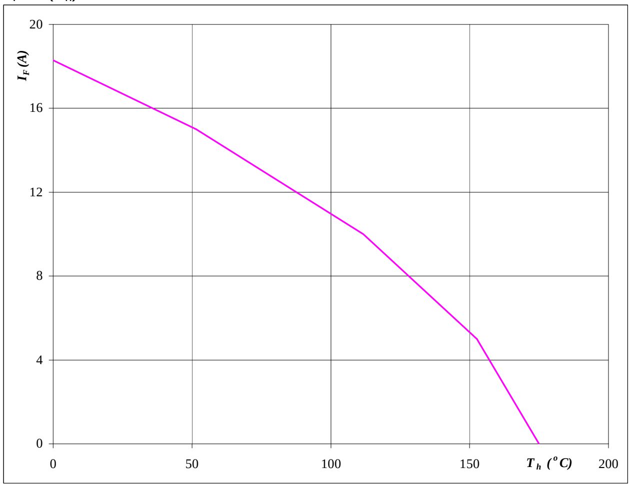
At

T_j = 175 °C

Figure 24 FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

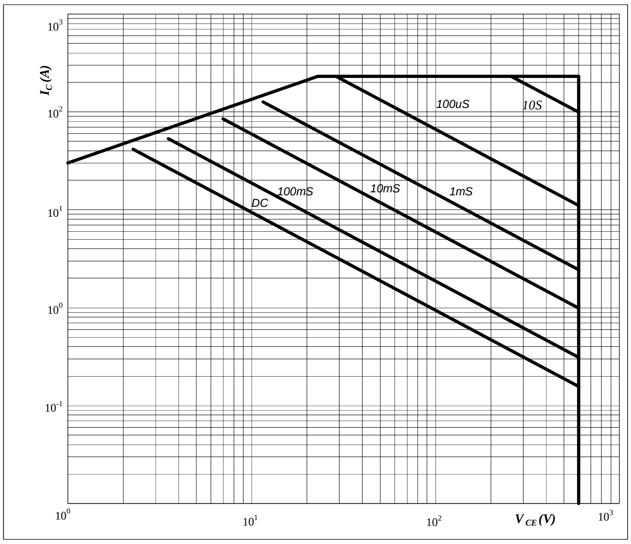
T_j = 175 °C

Buck

Figure 25 MOSFET

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



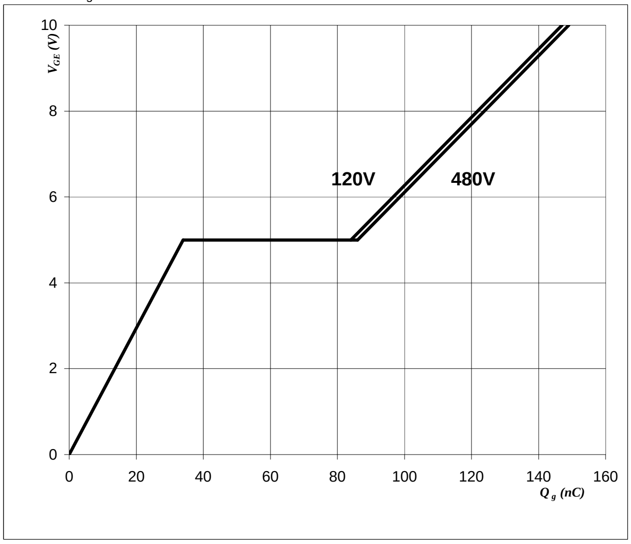
At

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

Figure 26 MOSFET

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

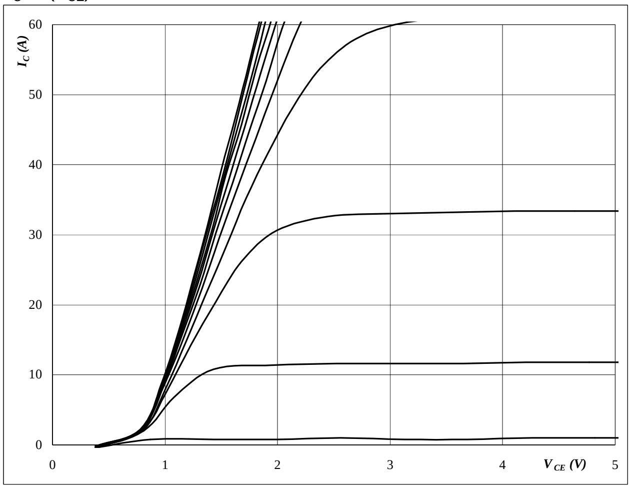
I_C =	44	A

Boost

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



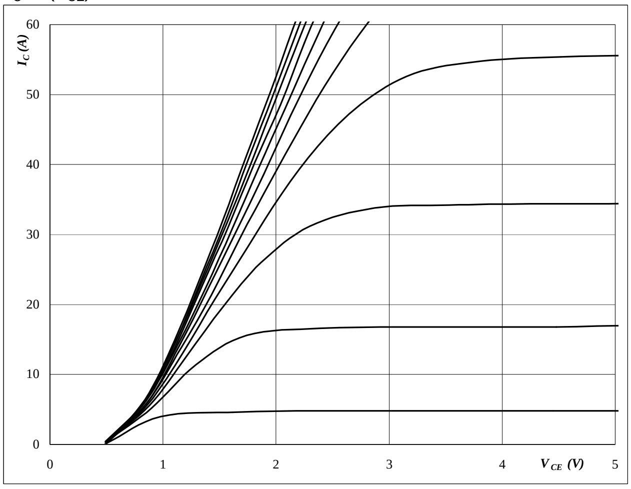
At

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

$I_C = f(V_{CE})$



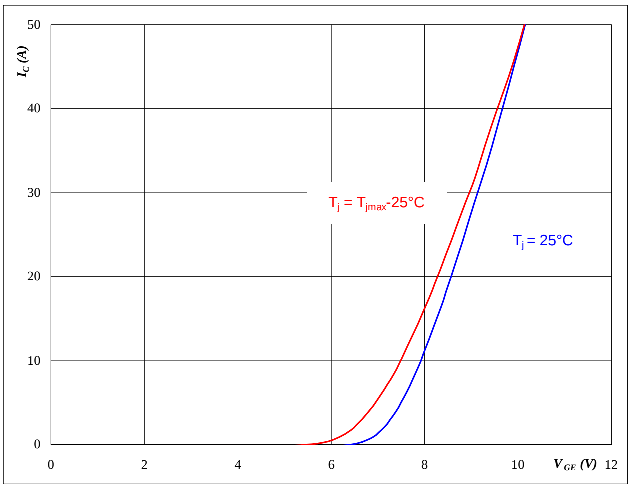
At

t_p =	250	μs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

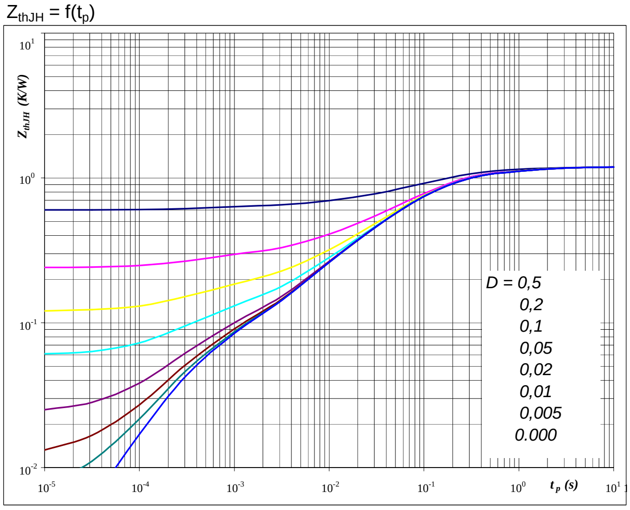
t_p =	250	μs
V_{CE} =	10	V

Figure 4 IGBT

IGBT transient thermal impedance

as a function of pulse width

$Z_{thJH} = f(t_p)$



At

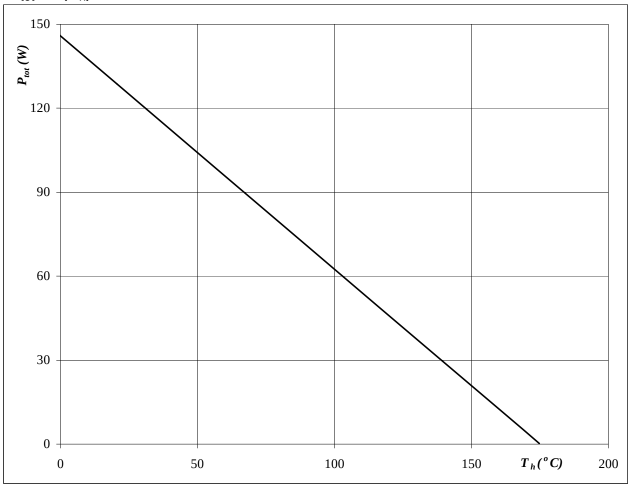
D =	tp / T	
R_{thJH} =	1,20	K/W

Boost

Figure 5 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



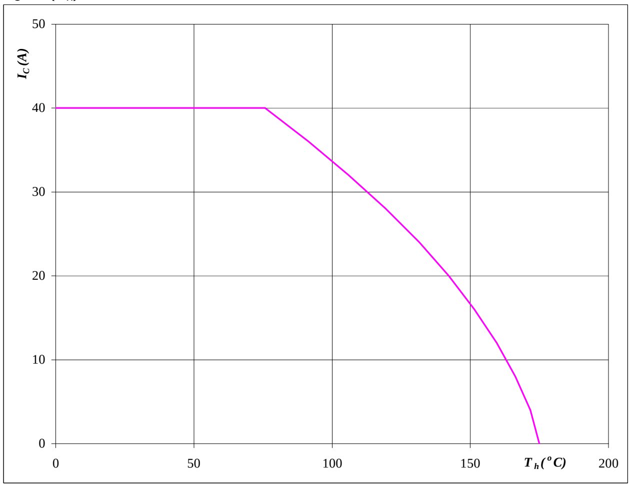
At

T_j = 175 ºC

Figure 6 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

T_j = 175 ºC

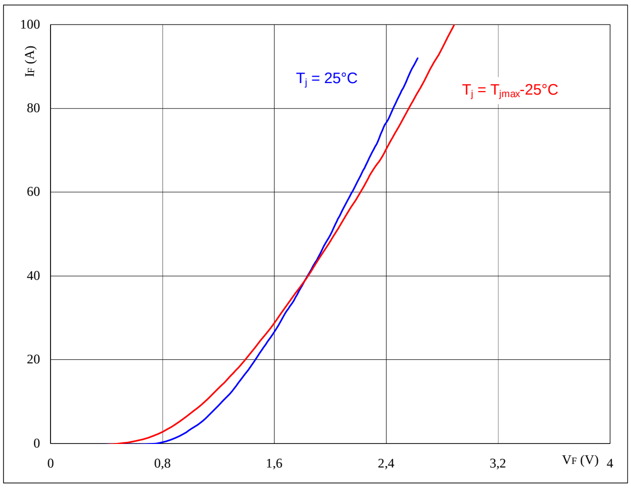
V_{GE} = 15 V

Fast Rectifier

Figure 1 Rectifier

Typical rectifier forward current as a function of forward voltage

$I_F = f(V_F)$



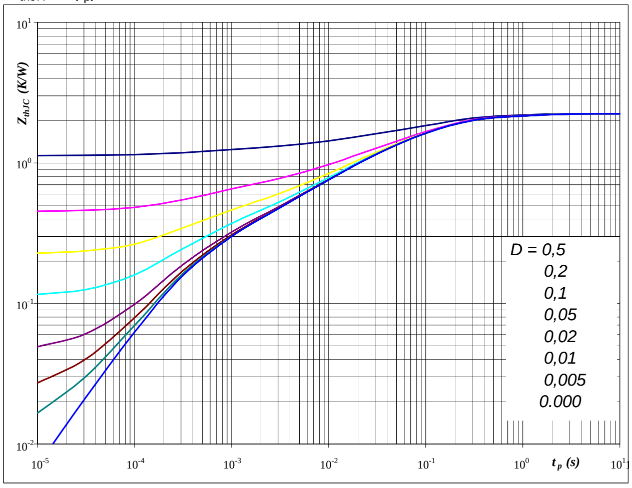
At

t_p = 250 µs

Figure 2 Rectifier

Rectifier transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

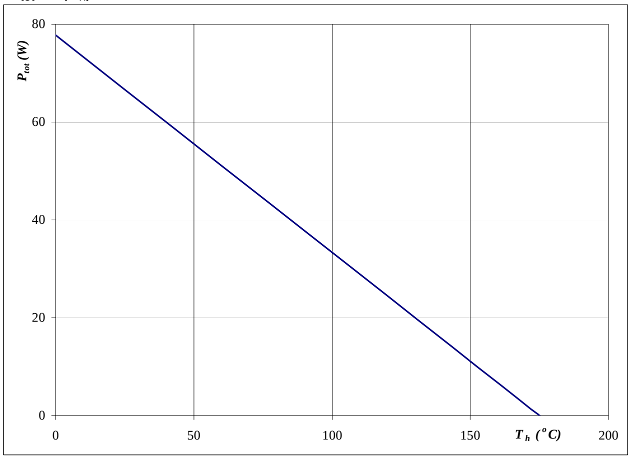
D = t_p / T

R_{thJH} = 2,25 K/W

Figure 3 Rectifier

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



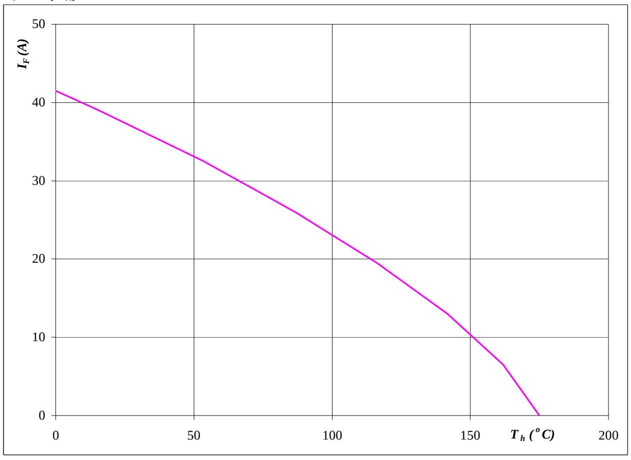
At

T_j = 175 ºC

Figure 4 Rectifier

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

$R_T = f(T)$

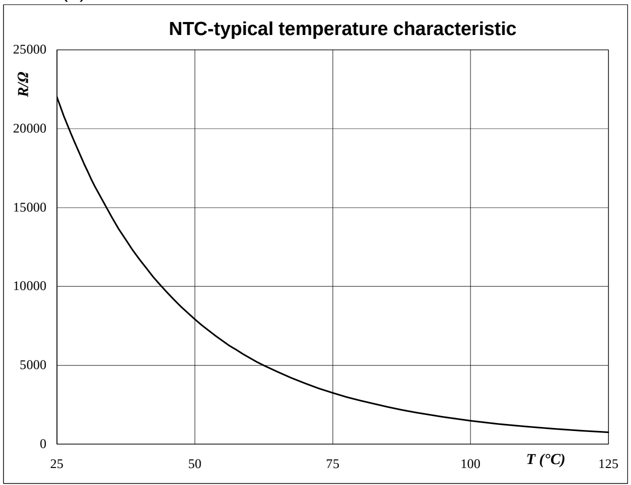


Figure 2 Thermistor

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_{nom} [Ω]	R_{min} [Ω]	R_{max} [Ω]	△R/R [±%]
-55	2089434,5	1506495,4	2672373,6	27,9
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

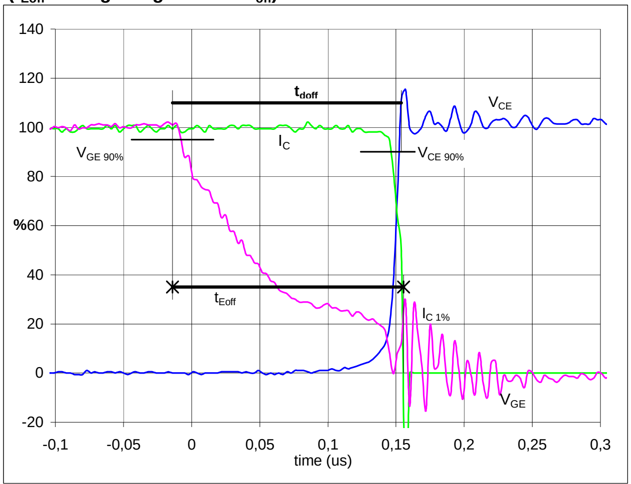
Switching Definitions BUCK MOSFET

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Output inverter IGBT

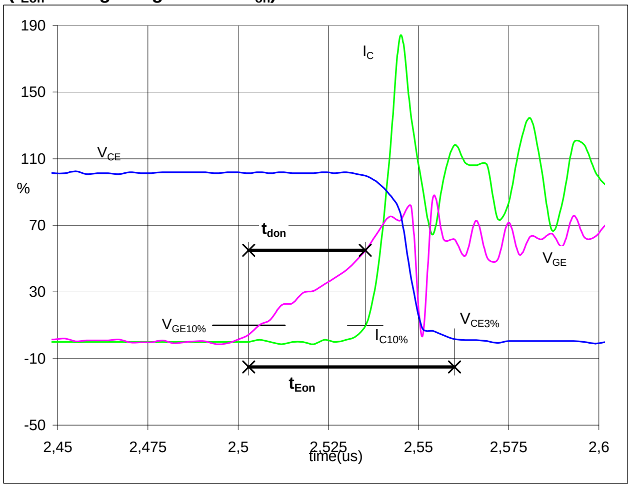
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
t_{doff} =	0,16	µs
t_{Eoff} =	0,17	µs

Figure 2 Output inverter IGBT

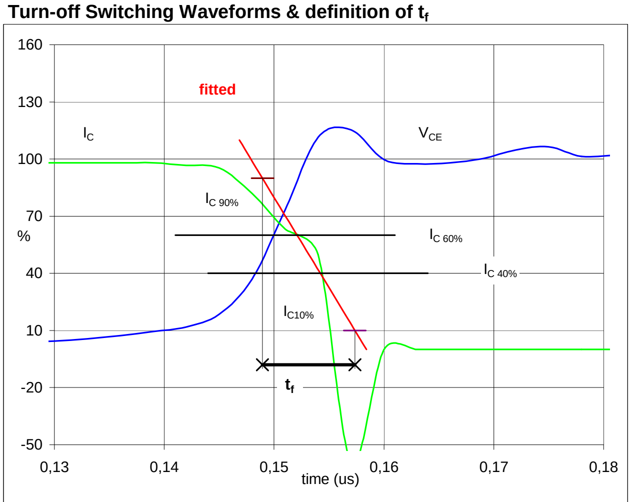
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
t_{don} =	0,03	µs
t_{Eon} =	0,06	µs

Figure 3 Output inverter IGBT

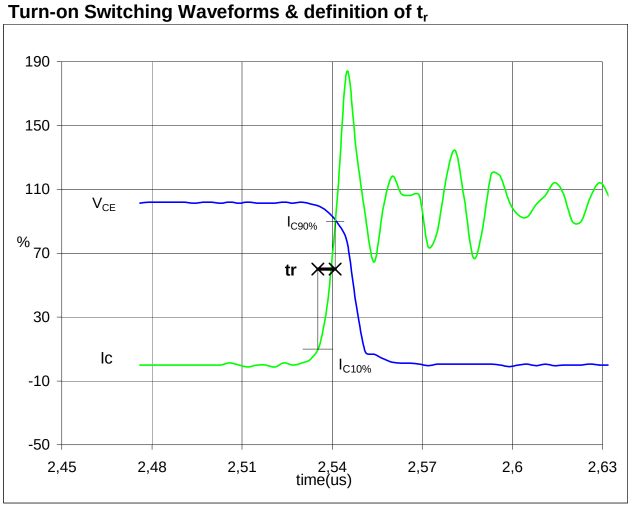
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	15	A
t_f =	0,01	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

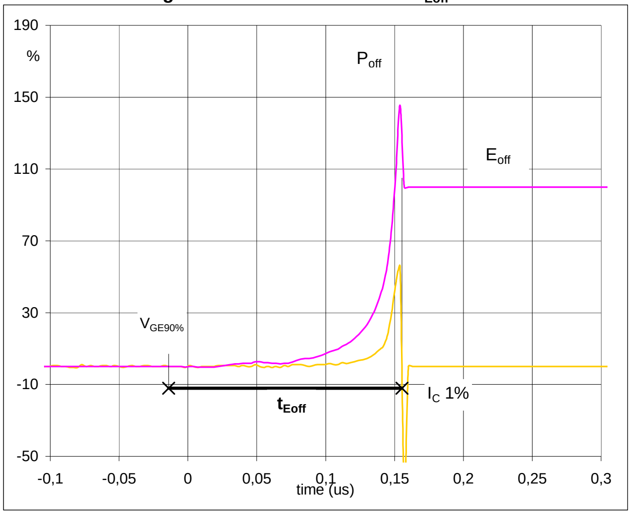


V_C (100%) =	400	V
I_C (100%) =	15	A
t_r =	0,01	µs

Switching Definitions BUCK MOSFET

Figure 5 Output inverter IGBT

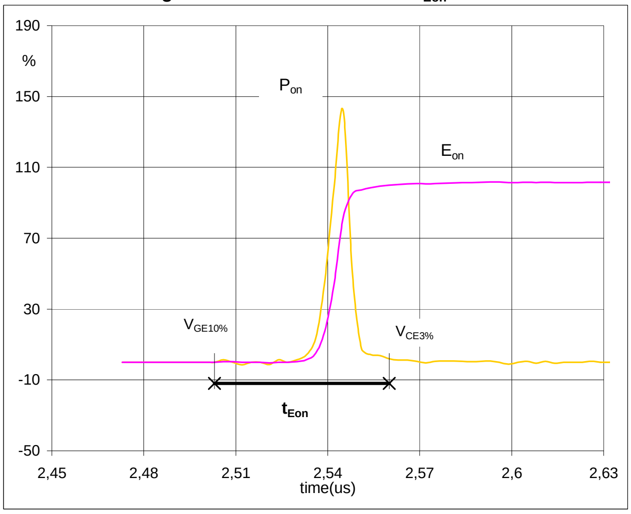
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	6,01	kW
E_{off} (100%) =	0,02	mJ
t_{Eoff} =	0,17	μs

Figure 6 Output inverter IGBT

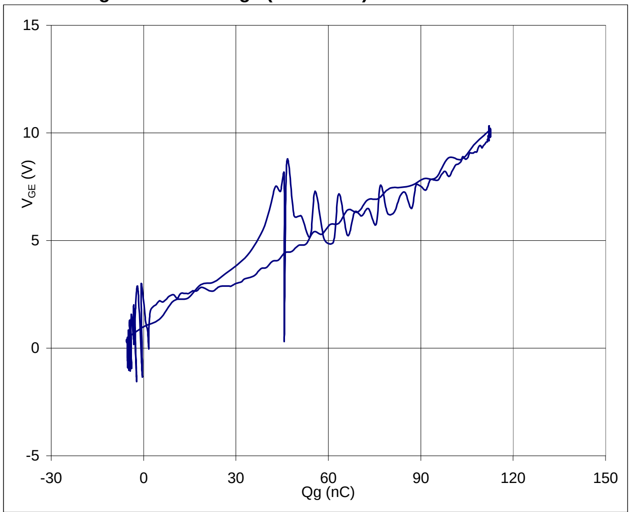
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	6,01	kW
E_{on} (100%) =	0,07	mJ
t_{Eon} =	0,06	μs

Figure 7 Output inverter FRED

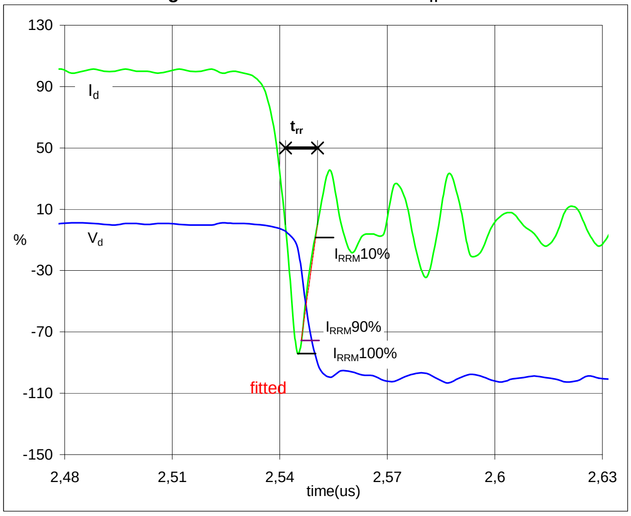
Gate voltage vs Gate charge (measured)



V_{GEoff} =	0	V
V_{GEon} =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
Q_g =	112,54	nC

Figure 8 Output inverter IGBT

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

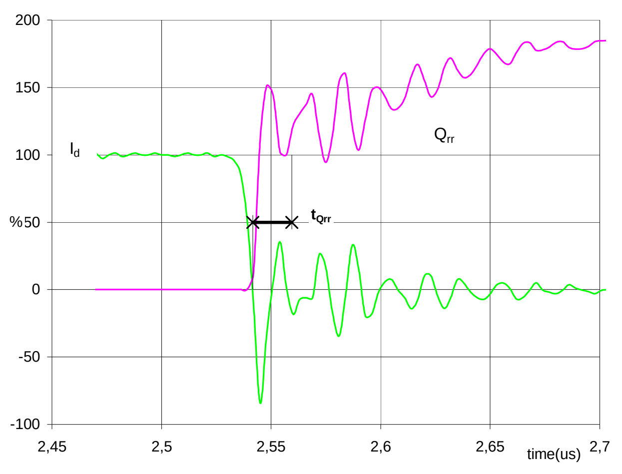


V_d (100%) =	400	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-6	A
t_{rr} =	0,01	μs

Switching Definitions BUCK MOSFET

Figure 9 Output inverter FRED

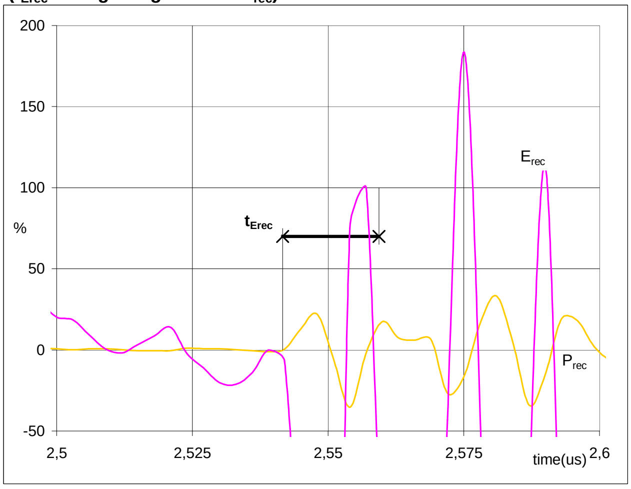
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	0,03	μC
t_{Qrr} =	0,02	μs

Figure 10 Output inverter FRED

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

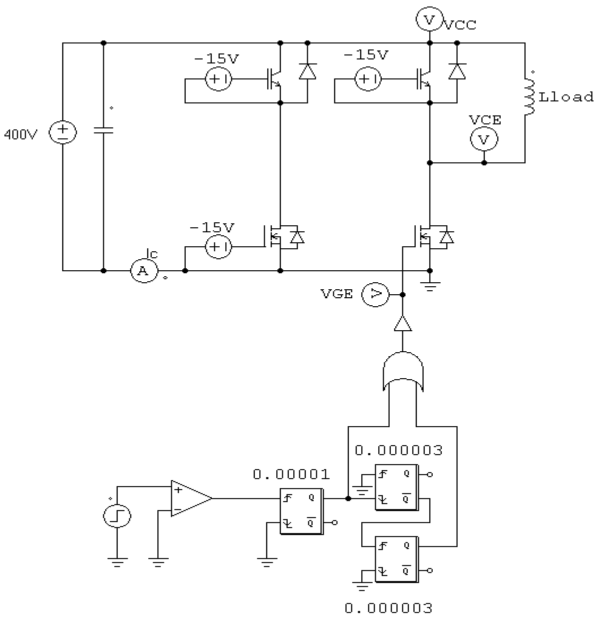


P_{rec} (100%) =	6,01	kW
E_{rec} (100%) =	0,01	mJ
t_{Erec} =	0,02	μs

Measurement circuits

Figure 11

BUCK stage switching measurement circuit



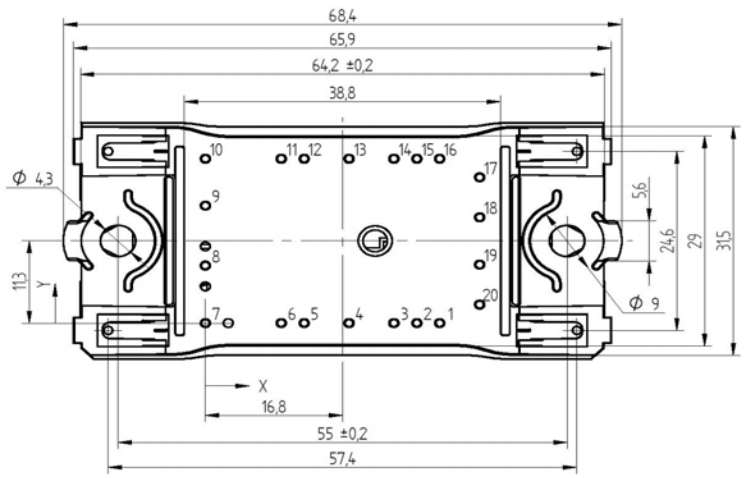
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

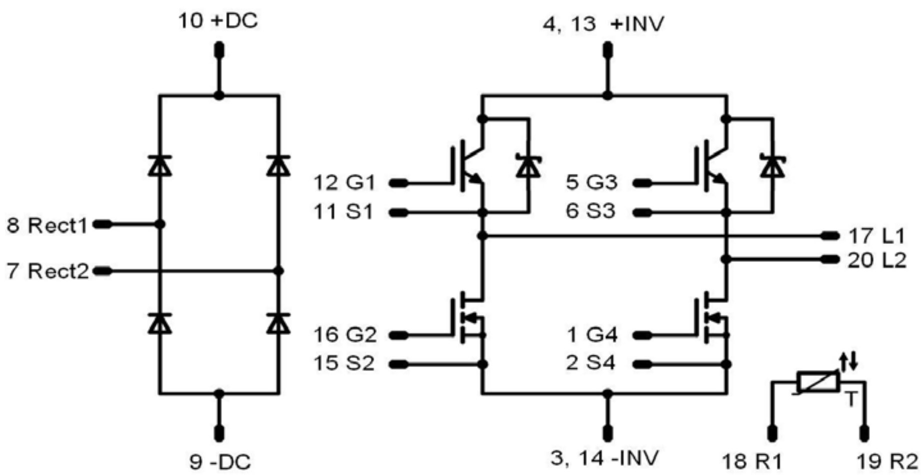
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FZ06RIA045FH-P906D	P906D	P906D

Outline

Pin table		
Pin	X	Y
1	28,7	0
2	25,9	0
3	23,1	0
4	17,6	0
5	12,1	0
6	9,3	0
7	0	0
8	0	7,9
9	0	16,15
10	0	22,6
11	9,3	22,6
12	12,1	22,6
13	17,6	22,6
14	23,1	22,6
15	25,9	22,6
16	28,7	22,6
17	33,6	20,05
18	33,6	14,55
19	33,6	8,05
20	33,6	2,55



Pinout



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Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
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