flow BOOST 0 — 1200V/40A

Features

- High efficiency dual boost
- Ultra fast switching frequency
- Low Inductance Layout
- 1200V IGBT and 1200V SiC diode
- PressFiT option

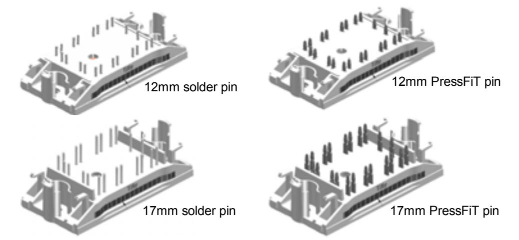
Target Applications

- solar inverter

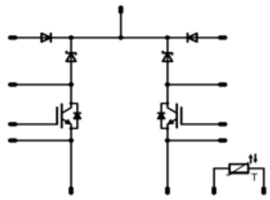
Types

- V23990-P629-F62-PM
- V23990-P629-F629-PM
- V23990-P629-F628Y-PM
- V23990-P629-F629Y-PM

flow0 12mm and 17mm housing



Schematic



Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Bypass diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	DC current	T_h=80°C T_c=80°C	34 47	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	220	A
I2t-value	I^2t			240	A^2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	41 62	W
Maximum Junction Temperature	$T_j$max			150	°C
Boost IGBT					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	35 48	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		120	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	108 164	W
Gate-emitter peak voltage	V_{GE}			±25	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 600	μs V
Maximum Junction Temperature	$T_j$max			150	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Boost IGBT Protection Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	7 9	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		6	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	24 37	W
Maximum Junction Temperature	$T_j$max			150	°C
Boost FRED					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	24 28	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		90	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	90 136	W
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	
Bypass diode										
Forward voltage	solar inverte				25	Tj=25°C Tj=125°C	0.8	1.13 1.09	1.9	V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0.93 0.8		V
Slope resistance (for power loss calc. only)	r_t				25	Tj=25°C Tj=125°C		0.0081 0.0112		Ω
Reverse current	I_r			1600		Tj=25°C Tj=145°C			0.05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						1.71		K/W
Thermal resistance chip to case per chip	R_{thJC}							1		
Boost IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$		VCE=VGE		0.025	Tj=25°C Tj=125°C	3.5	5.5	7.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		40	Tj=25°C Tj=125°C	1	2.6 2.9	3.5	V
Collector-emitter cut-off	I_{CES}		0	1200		Tj=25°C Tj=125°C			1	mA
Gate-emitter leakage current	I_{GES}		25			Tj=25°C Tj=125°C			300	nA
Integrated Gate resistor	R_{gint}							none none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	±15	600	40	Tj=25°C Tj=125°C		25 25		ns
Rise time	t_r					Tj=25°C Tj=125°C		13 35		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		172 202		
Fall time	t_f					Tj=25°C Tj=125°C		13 35		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0.41 0.513		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0.846 1.661		
Input capacitance	C_{ies}	f=1MHz	0	30		Tj=25°C		3200		pF
Output capacitance	C_{oss}							370		
Reverse transfer capacitance	C_{rss}							125		
Gate charge	Q_{Gate}		15	600	40	Tj=25°C		25		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.65		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.43		
Boost IGBT Protection Diode										
Diode forward voltage	V_F				3	Tj=25°C Tj=125°C	0.7	1.8 1.63	2.4	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						2.87		K/W
Thermal resistance chip to case per chip	R_{thJC}							1.89		
Boost FRED										
Forward voltage	V_F				40	Tj=25°C Tj=150°C	1	2.74 3.01	1.9	V
Reverse leakage current	I_{rm}		±15	600	40	Tj=25°C Tj=175°C			600	μA
Peak recovery current	I_{RRM}	Rgon=4 Ω	±15	600	40	Tj=25°C Tj=150°C		23.95 22.64		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		8.6 9.4		ns
Reverse recovery charge	Q_{rr}					Tj=25°C Tj=150°C		0.1 0.1115		μC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		0.004 0.011		mWs
Peak rate of fall of recovery current	di(rec)max/dt					Tj=25°C Tj=150°C		10933 7266		A/μs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						1.60		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.70		

Characteristic Values

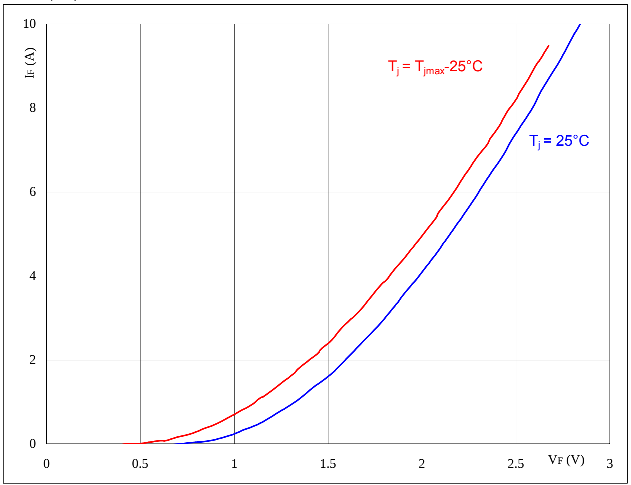
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Thermistor										
Rated resistance	R					T=25°C		22		kΩ
Deviation of R25	ΔR/R	R25=22KΩ				T=25°C	-3%		+3%	%/K
Power dissipation	P					T=25°C			200	%/K
Power dissipation constant						Tj=25°C		2		mW
B-value	B(25/50)	Tol. ±3%				Tj=25°C		3950		K
B-value	B(25/100)	Tol. ±3%				Tj=25°C		3998		K
Vincotech NTC Reference										K

Boost IGBT Protection Diode

Figure 1 Boost IGBT Protection Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



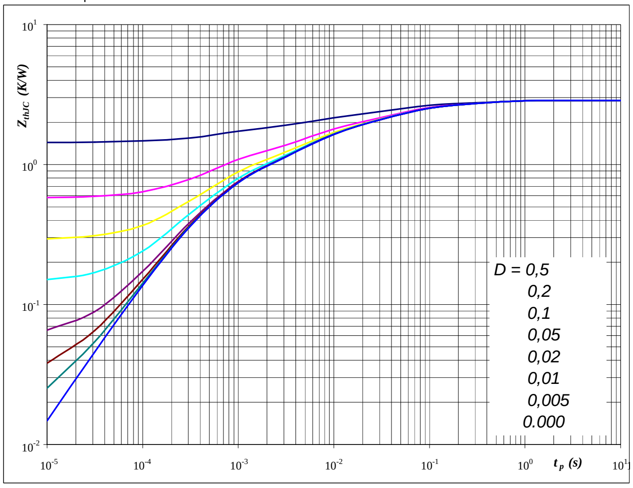
At

t_p = 250 µs

Figure 2 Boost IGBT Protection Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

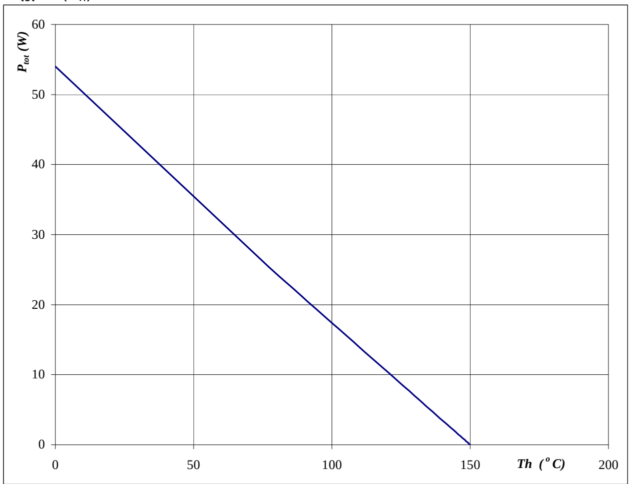
D = tp / T

R_{thJH} = 2.87 K/W

Figure 3 Boost IGBT Protection Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



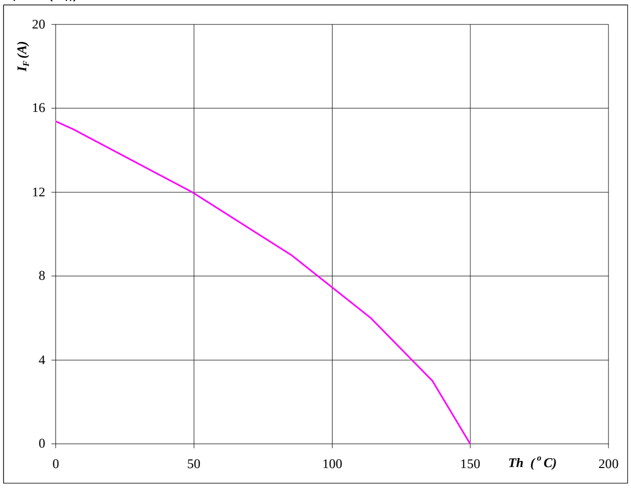
At

T_j = 150 ºC

Figure 4 Boost IGBT Protection Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

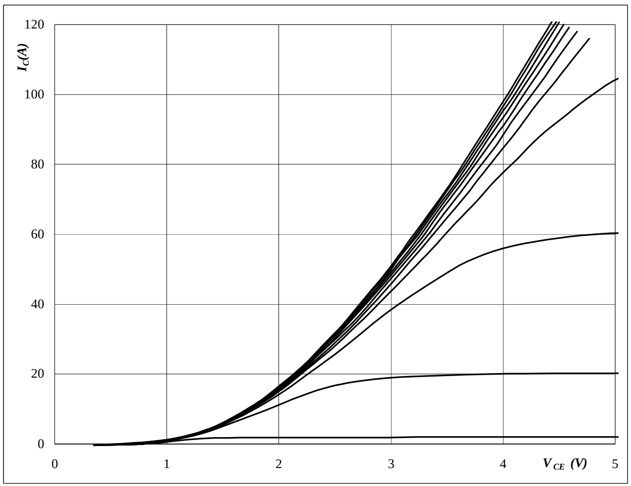
T_j = 150 ºC

INPUT BOOST

Figure 3 BOOST IGBT

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

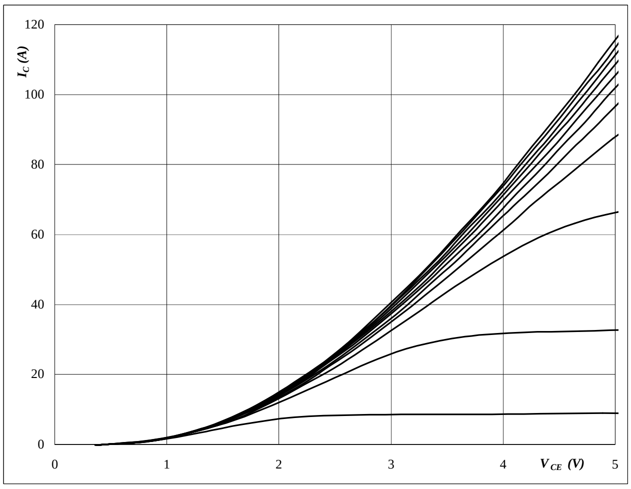
T_j = 25 °C

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

Figure 4 BOOST FRED

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

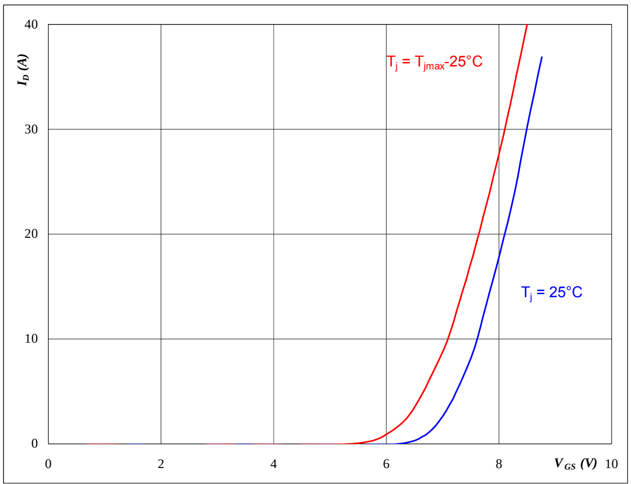
T_j = 125 °C

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

Figure 3 BOOST IGBT

Typical transfer characteristics

$I_D = f(V_{DS})$



At

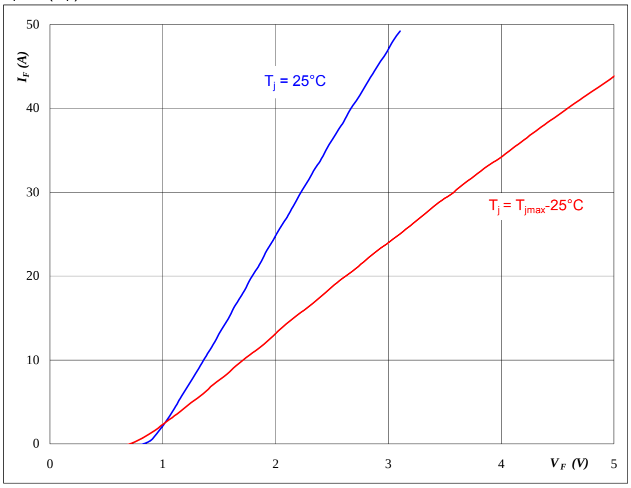
t_p = 250 µs

V_{DS} = 10 V

Figure 4 BOOST FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

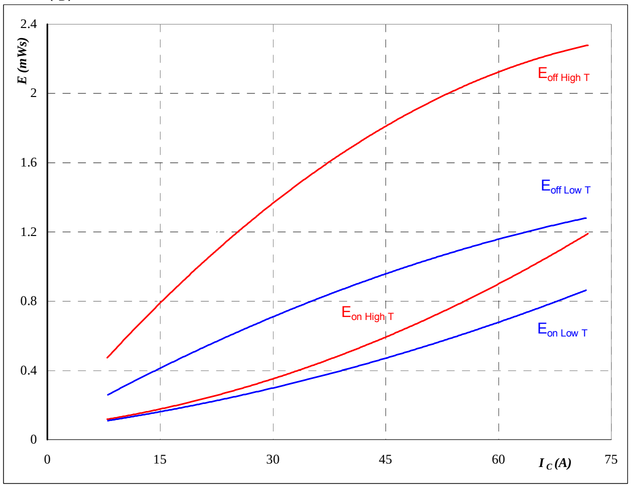
t_p = 250 µs

INPUT BOOST

Figure 5 BOOST IGBT

Typical switching energy losses as a function of collector current

$E = f(I_D)$



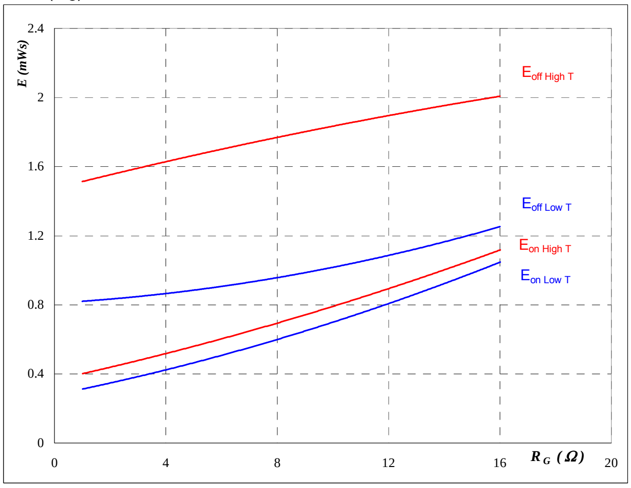
With an inductive load at

T_j =	25/125	°C
V_{DS} =	600	V
V_{GS} =	15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 BOOST IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



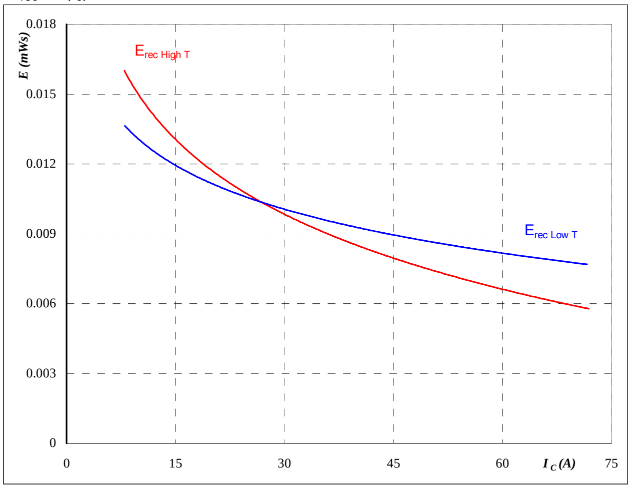
With an inductive load at

T_j =	25/125	°C
V_{DS} =	600	V
V_{GS} =	15	V
I_D =	40	A

Figure 7 BOOST IGBT

Typical reverse recovery energy loss as a function of collector (drain) current

$E_{rec} = f(I_c)$



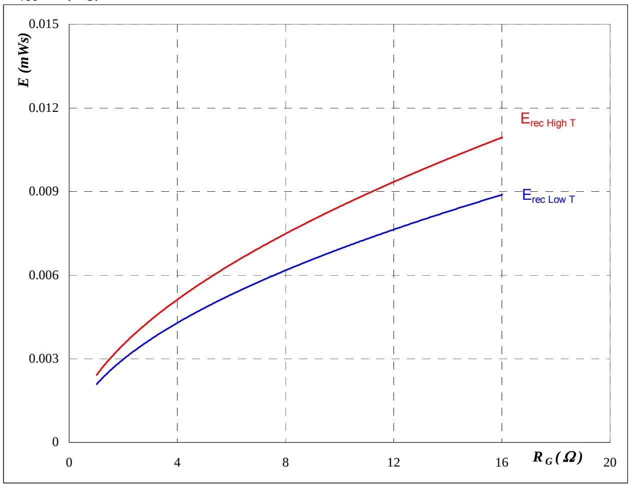
With an inductive load at

T_j =	25/125	°C
V_{DS} =	600	V
V_{GS} =	15	V
R_{gon} =	4	Ω

Figure 8 BOOST IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

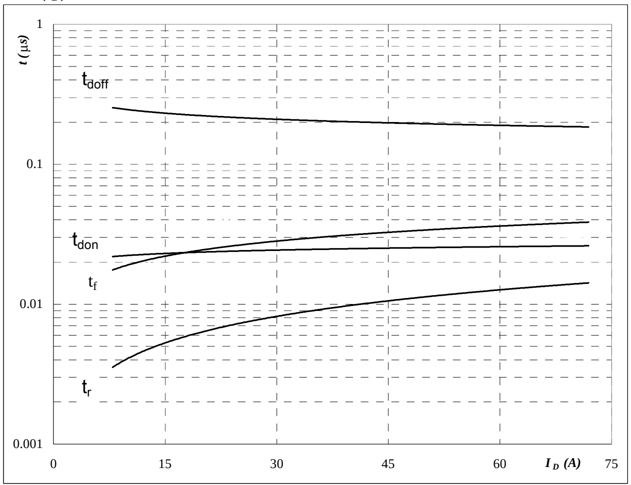
T_j =	25/125	°C
V_{DS} =	600	V
V_{GS} =	15	V
I_D =	40	A

INPUT BOOST

Figure 9 BOOST IGBT

Typical switching times as a function of collector current

t = f(I_D)



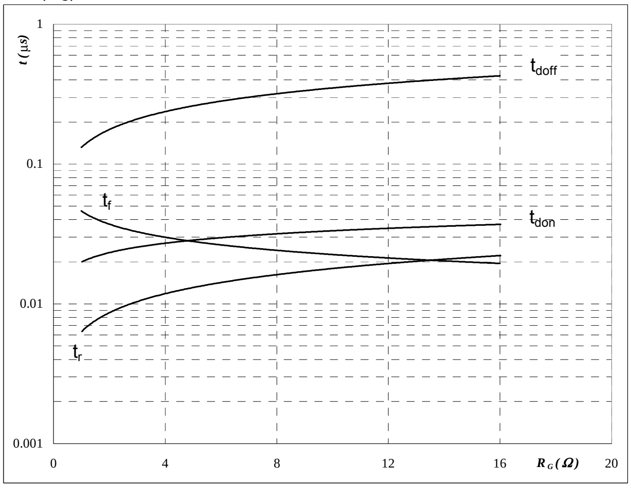
With an inductive load at

T_j =	125	°C
V_{DS} =	600	V
V_{GS} =	15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 BOOST IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



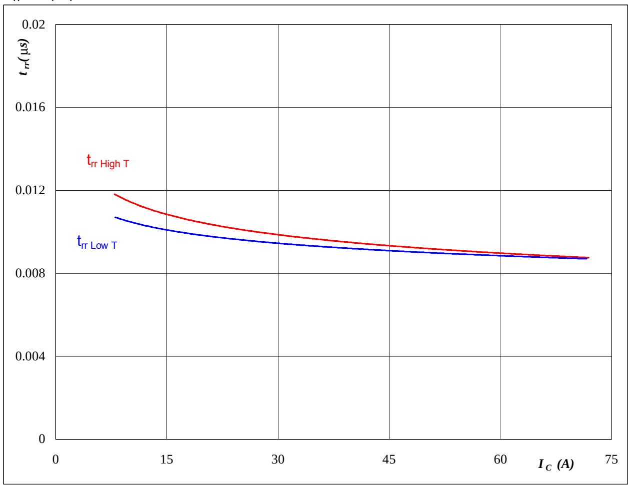
With an inductive load at

T_j =	125	°C
V_{DS} =	600	V
V_{GS} =	15	V
I_C =	40	A

Figure 11 BOOST FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



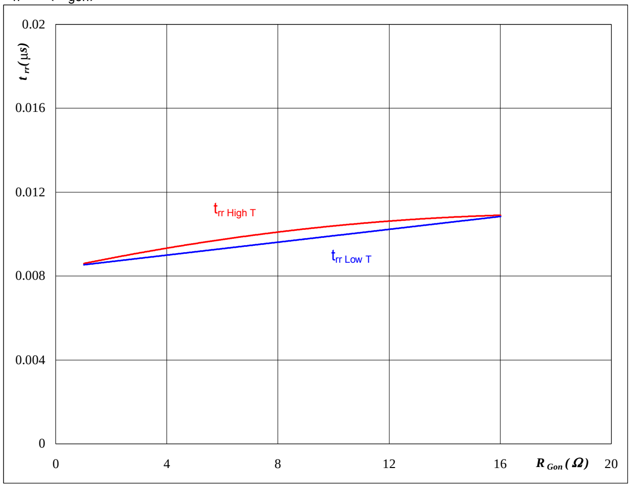
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 12 BOOST FRED

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

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



At

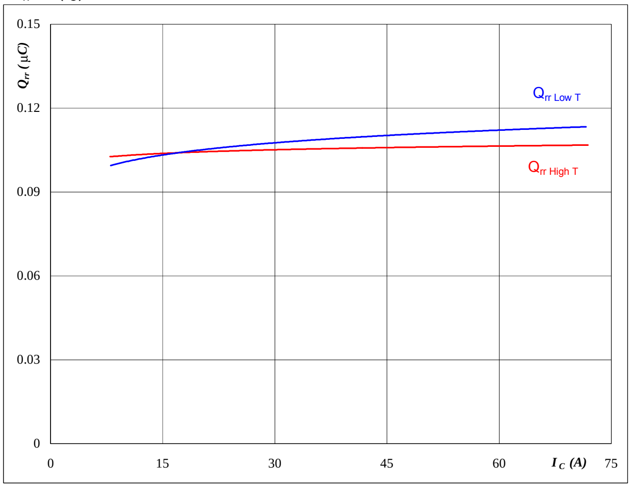
T_j =	25/125	°C
V_R =	600	V
I_F =	40	A
V_{GS} =	15	V

INPUT BOOST

Figure 13 BOOST FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



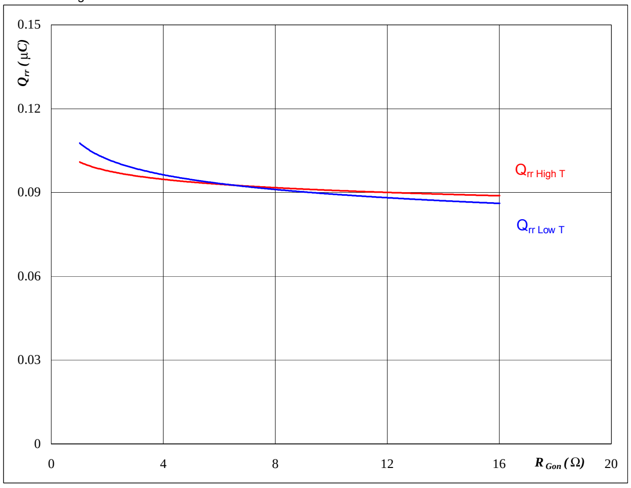
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 14 BOOST FRED

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

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



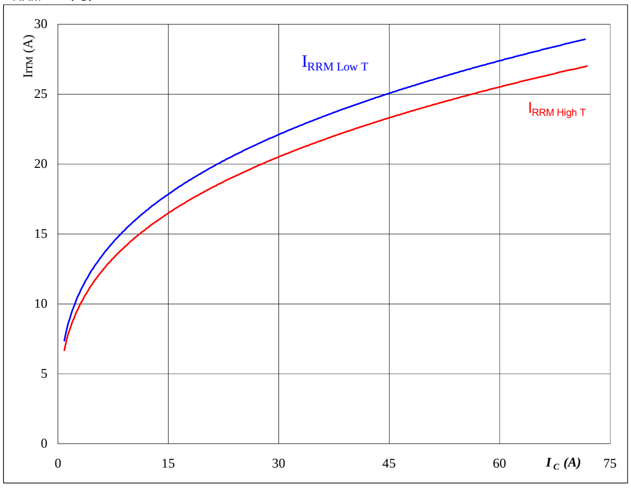
At

Tj =	25/125	°C
VR =	600	V
IF =	40	A
VGS =	15	V

Figure 15 BOOST FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



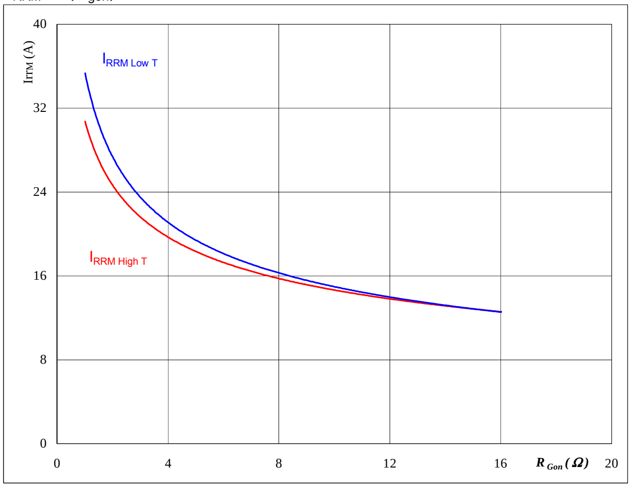
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 16 BOOST FRED

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

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



At

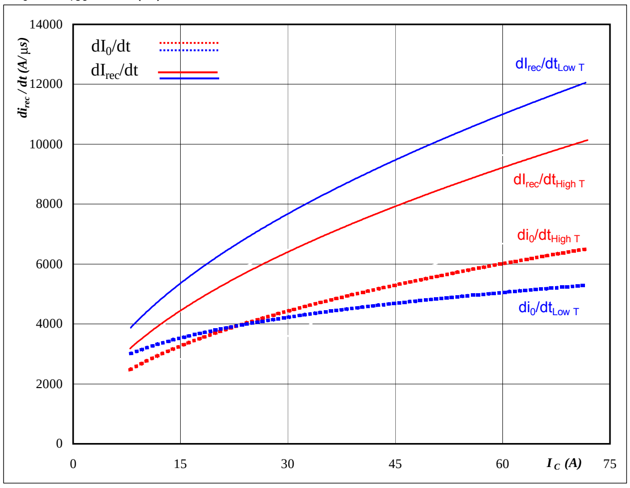
T_j =	25/125	°C
V_R =	600	V
I_F =	40	A
V_{GS} =	15	V

INPUT BOOST

Figure 17 BOOST FRED

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

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



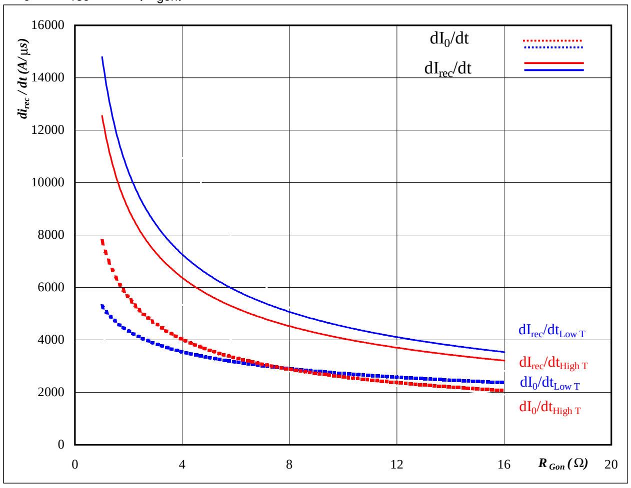
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 18 BOOST FRED

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

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



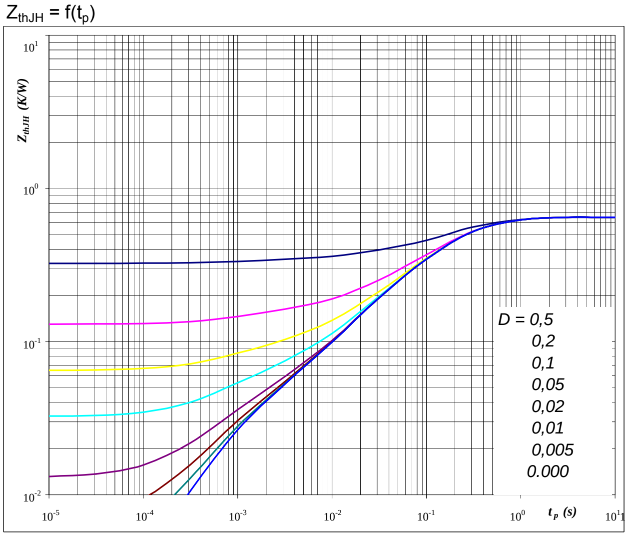
At

Tj =	25/125	°C
VR =	600	V
IF =	40	A
VGS =	15	V

Figure 19 BOOST IGBT

IGBT/MOSFET transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0.65	K/W

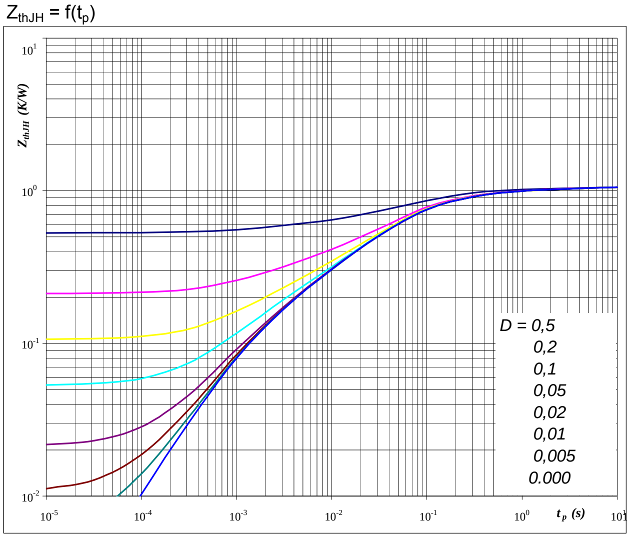
IGBT thermal model values

R (C/W)	Tau (s)
0.1982	0.4954
0.3469	0.1114
0.07537	0.01455
0.02798	0.0009603
0.02697	0.004091
0.03879	0.0003081

Figure 20 BOOST FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1.06	K/W

FRED thermal model values

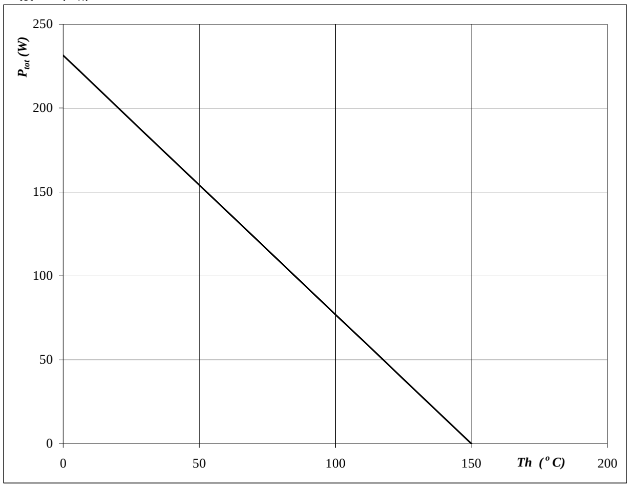
R (C/W)	Tau (s)
0.06292	3.888
0.1803	0.398
0.5248	0.0619
0.2026	0.009365
0.08858	0.001177

INPUT BOOST

Figure 21 BOOST IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



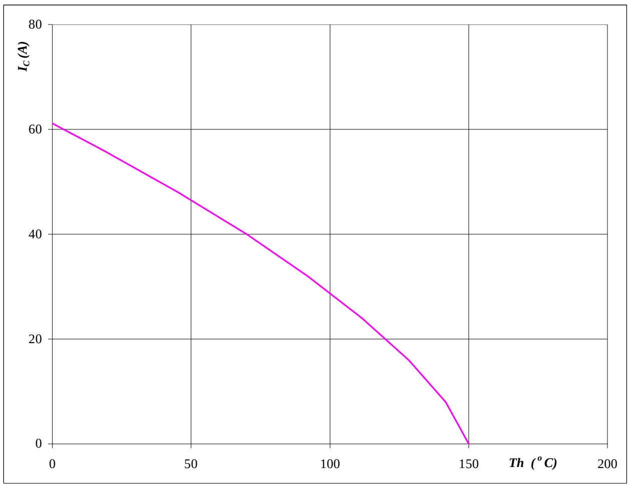
At

T_j = 150 ºC

Figure 22 BOOST IGBT

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_h)$



At

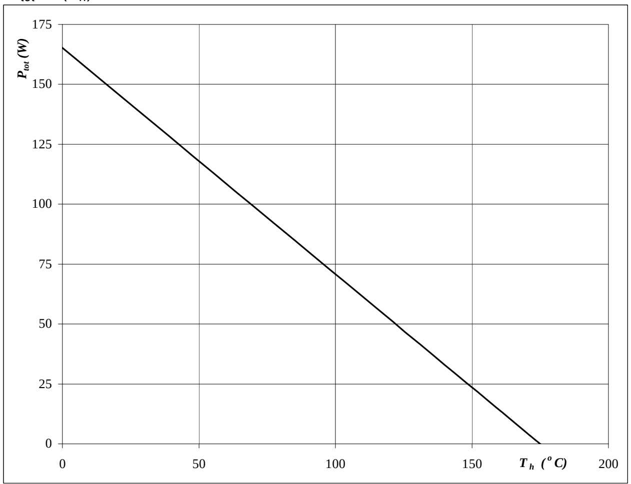
T_j = 150 ºC

V_{GS} = 15 V

Figure 23 BOOST FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



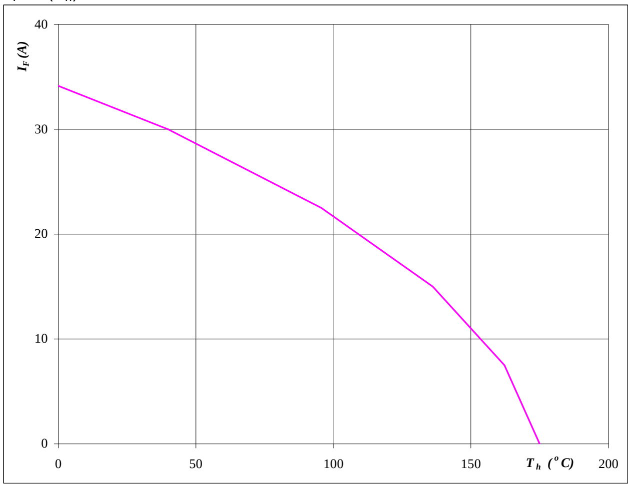
At

T_j = 175 ºC

Figure 24 BOOST FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

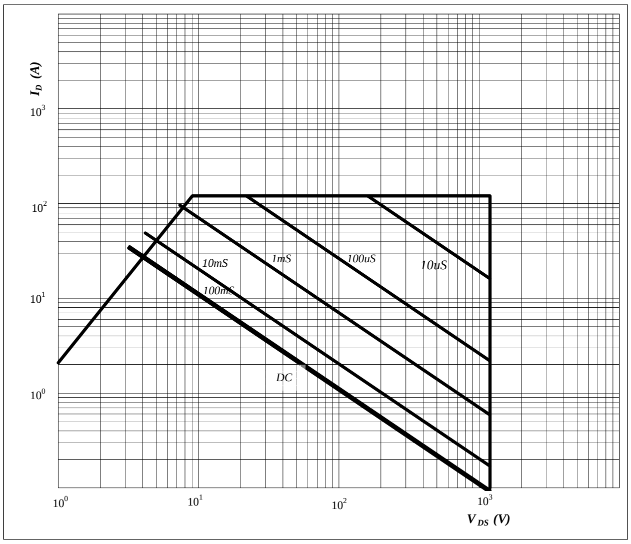
T_j = 175 ºC

INPUT BOOST

Figure 25 BOOST IGBT

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$



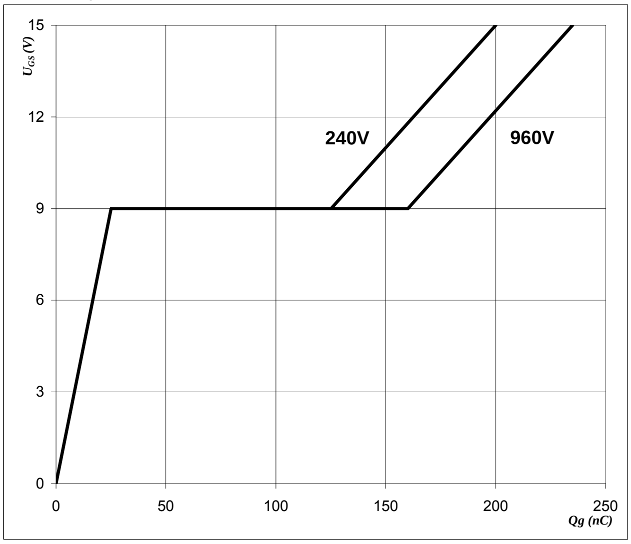
At

D =	single pulse	
T_h =	80	ºC
V_{GS} =	15	V
T_j =	T_{jmax}	ºC

Figure 26 BOOST IGBT

Gate voltage vs Gate charge

$V_{GS} = f(Qg)$



At

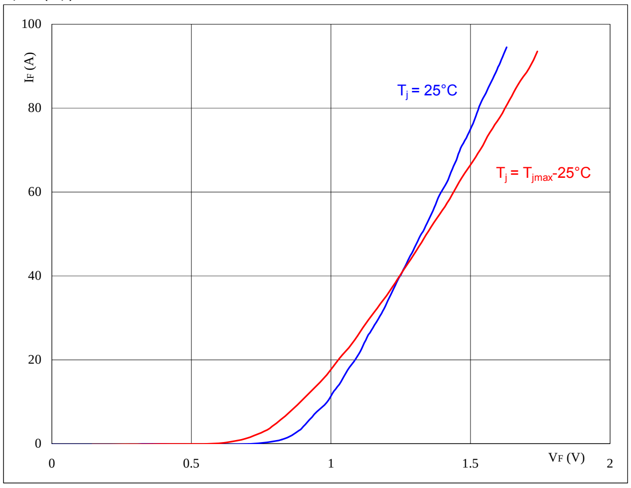
I_D =	40	A

Bypass Diode

Figure 1 Bypass diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



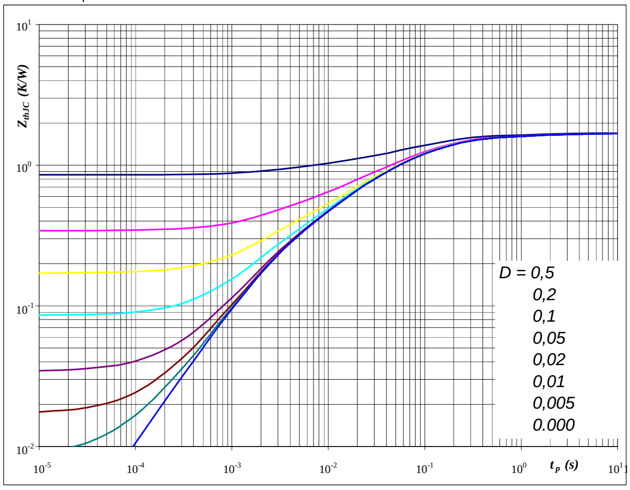
At

t_p = 250 µs

Figure 2 Bypass diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

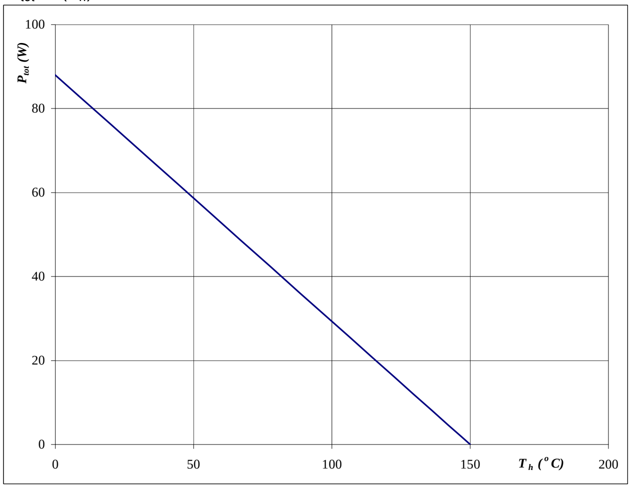
D = t_p / T

R_{thJH} = 1.705 K/W

Figure 3 Bypass diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



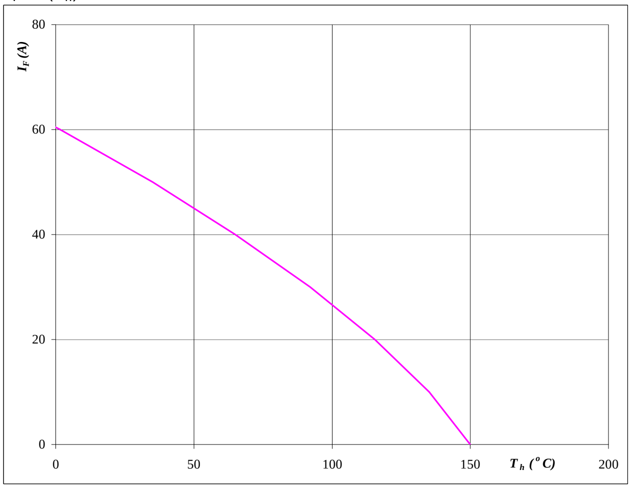
At

T_j = 150 ºC

Figure 4 Bypass diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



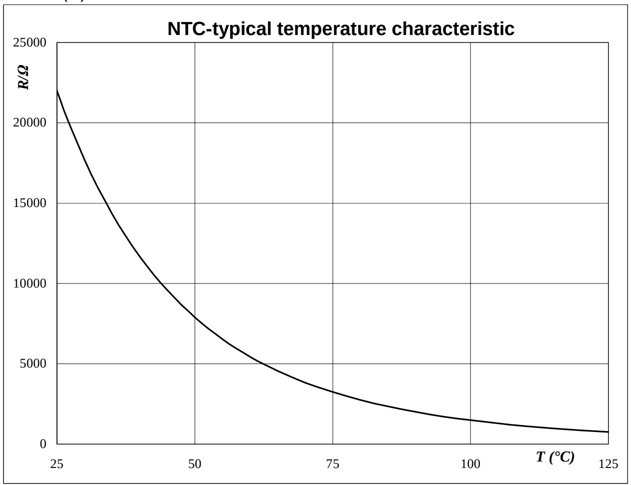
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$



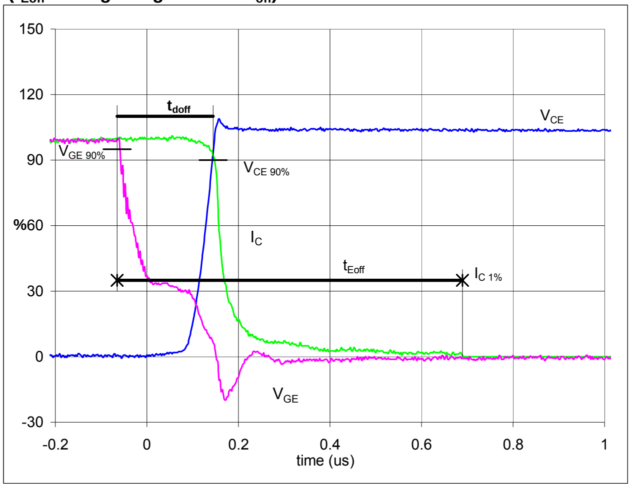
Switching Definitions BUCK MOSFET

General conditions

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

Figure 1 Output inverter IGBT

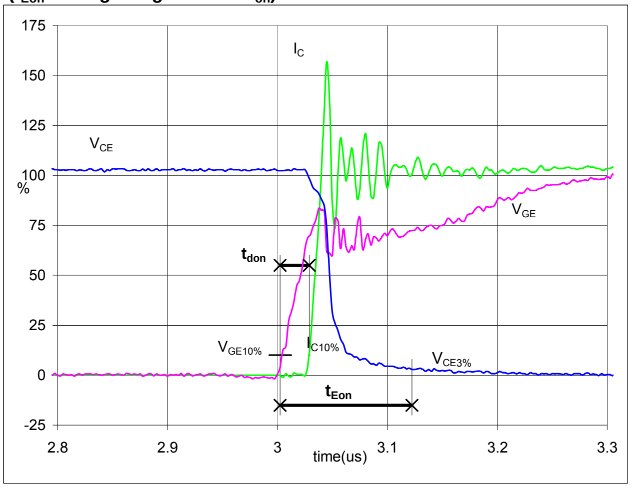
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	40	A
t_{doff} =	0.20	µs
t_{Eoff} =	0.75	µs

Figure 2 Output inverter IGBT

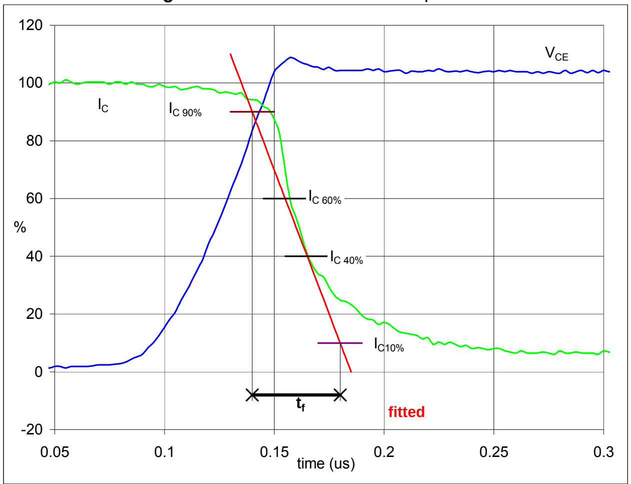
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	40	A
t_{don} =	0.03	µs
t_{Eon} =	0.12	µs

Figure 3 Output inverter IGBT

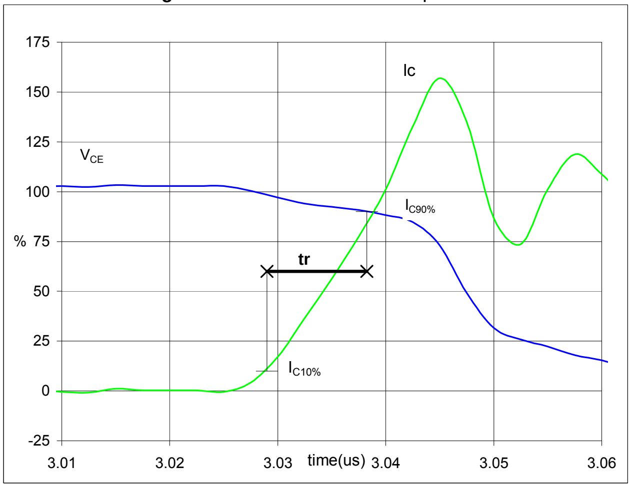
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	40	A
t_f =	0.04	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

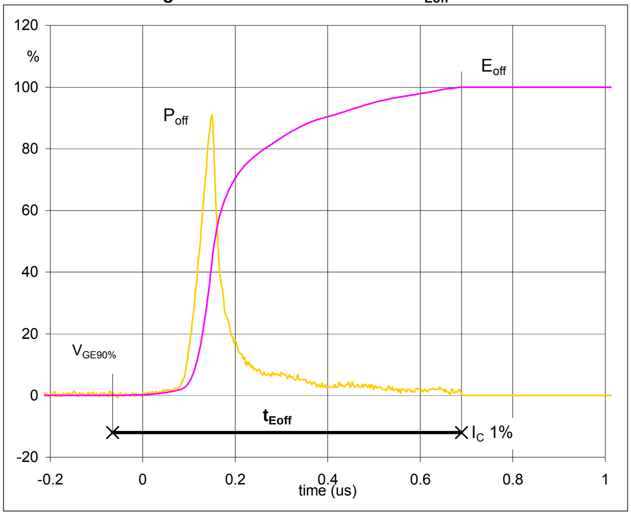


V_C (100%) =	600	V
I_C (100%) =	40	A
t_r =	0.01	µs

Switching Definitions BUCK MOSFET

Figure 5 Output inverter IGBT

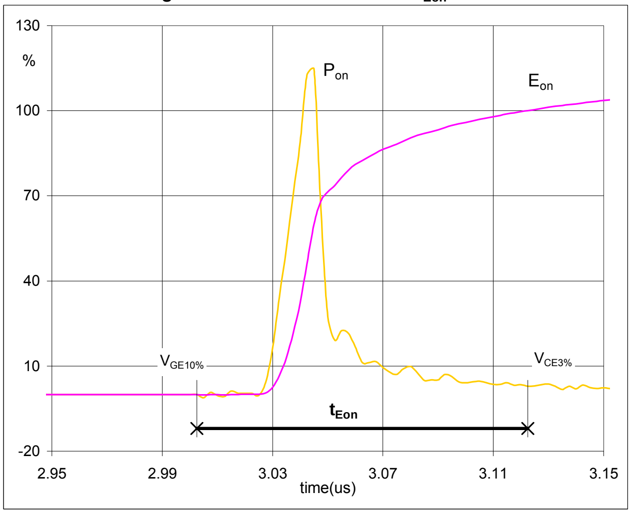
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	24.06	kW
E_{off} (100%) =	1.66	mJ
t_{Eoff} =	0.75	μs

Figure 6 Output inverter IGBT

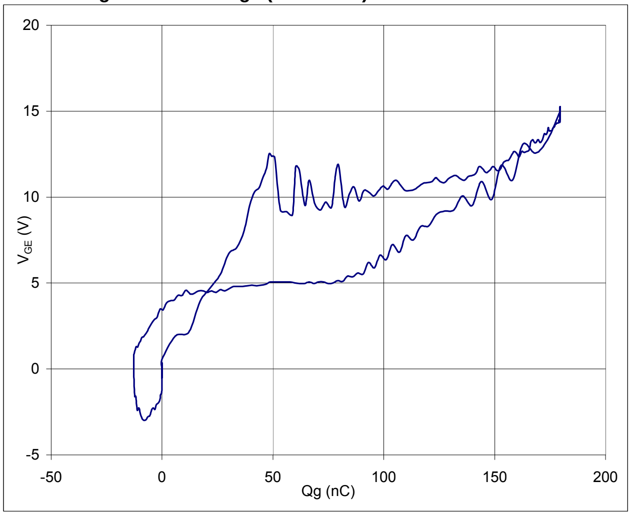
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	24.06	kW
E_{on} (100%) =	0.51	mJ
t_{Eon} =	0.12	μs

Figure 7 Output inverter FRED

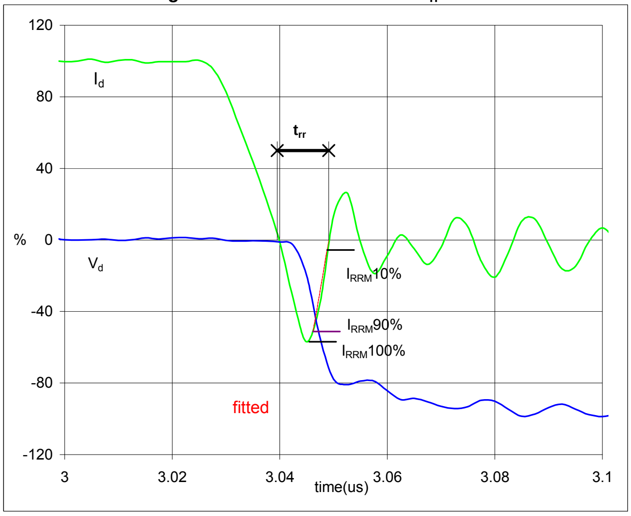
Gate voltage vs Gate charge (measured)



V_{GEoff} =	0	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	40	A
Q_g =	179.55	nC

Figure 8 Output inverter IGBT

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

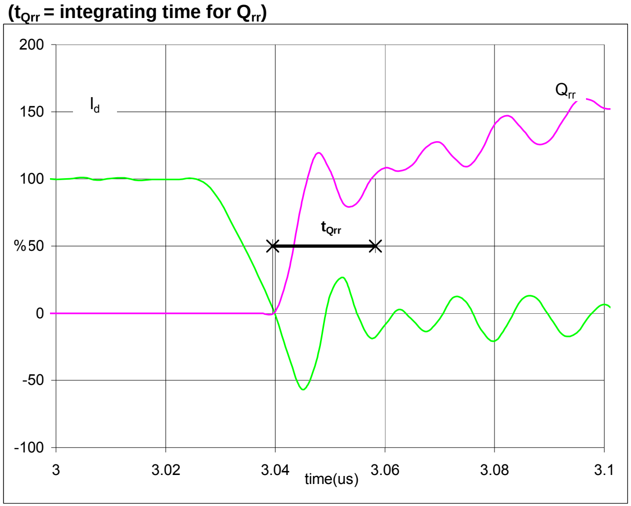


V_d (100%) =	600	V
I_d (100%) =	40	A
I_{RRM} (100%) =	-23	A
t_{rr} =	0.01	μs

Switching Definitions BUCK IGBT

Figure 9 Output inverter FRED

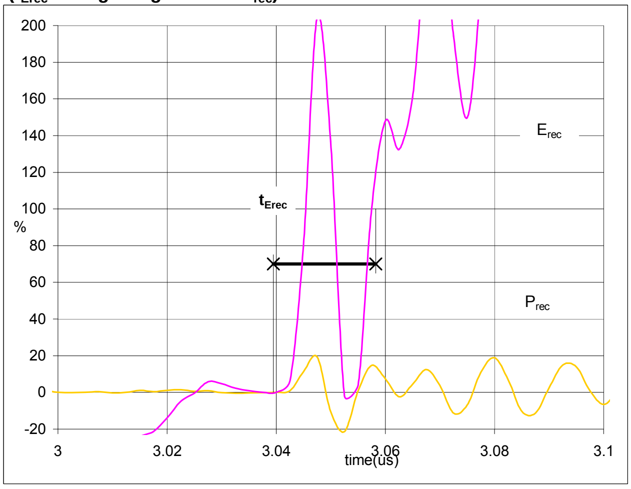
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	40	A
Q_{rr} (100%) =	0.11	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%) =	24.06	kW
E_{rec} (100%) =	0.01	mJ
t_{Erec} =	0.02	µs

Measurement circuits

Figure 11

BUCK stage switching measurement circuit

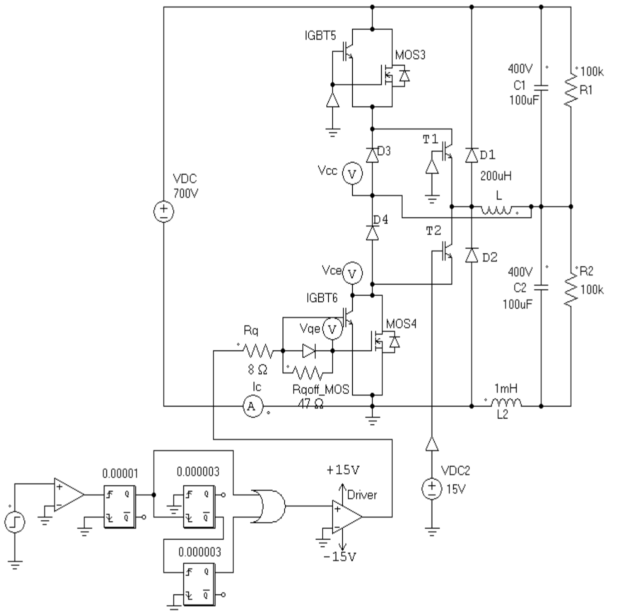
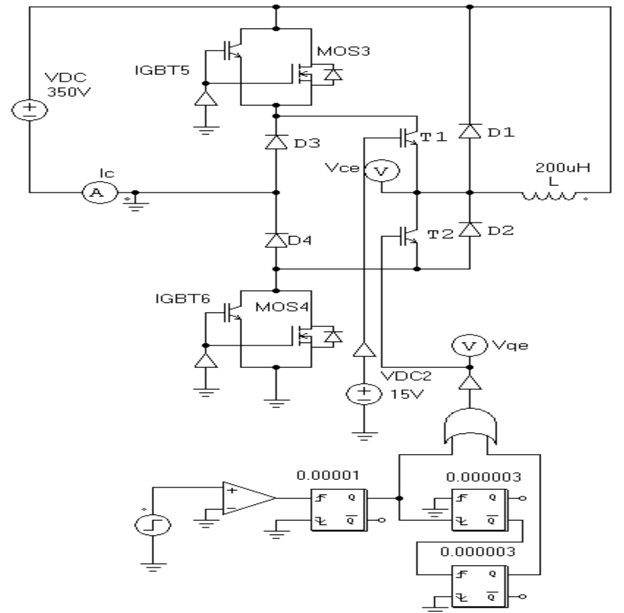


Figure 12

BOOST stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

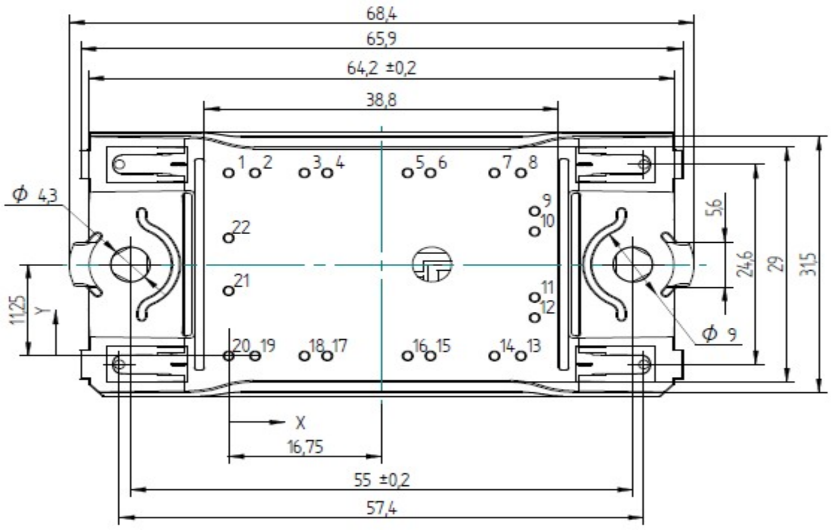
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	V23990-P629-F62-PM	P629-F62	P629-F62
without thermal paste 17mm housing	V23990-P629-F629-PM	P629-F629	P629-F62
without thermal paste 12mm housing with PressFiT	V23990-P629-F628Y-PM	P629-F628Y	P629-F628Y
without thermal paste 17mm housing with PressFiT	V23990-P629-F629Y-PM	P629-F629Y	P629-F629Y

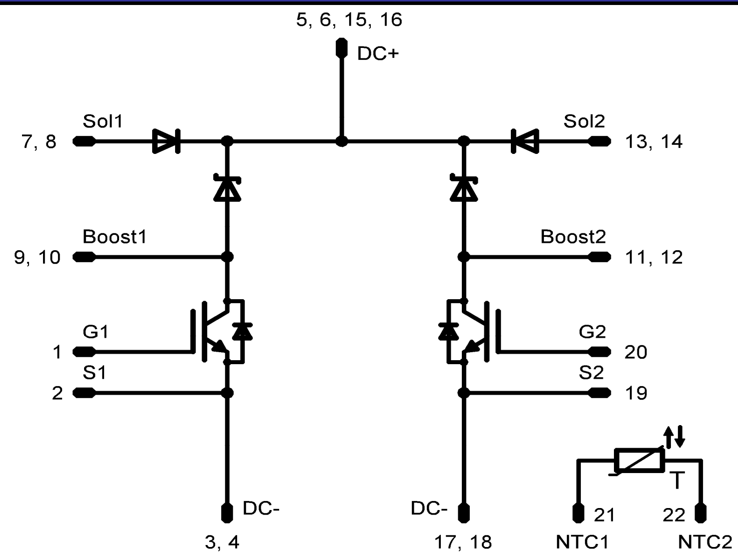
Outline

Pin table

Pin	X	Y
1	0	22,5
2	2,9	22,5
3	8,3	22,5
4	10,8	22,5
5	19,6	22,5
6	22,1	22,5
7	29,1	22,5
8	32	22,5
9	33,5	17,8
10	33,5	15,3
11	33,5	7,2
12	33,5	4,7
13	32	0
14	29,1	0
15	22,1	0
16	19,6	0
17	10,8	0
18	8,3	0
19	2,9	0
20	0	0
21	0	8
22	0	14,5



Pinout



PRODUCT STATUS DEFINITIONS

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.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
Final	Full Production	This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.