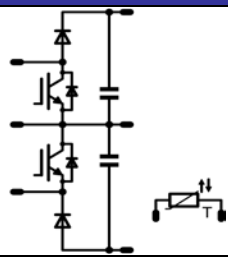
flowBOOST 4w **600V/600A**

Features
- Symmetrical Booster
- Integrated DC-capacitor
- Low DC Inductance (<5nH)
- Transient Interface for optional regeneration of switching losses
- Temperature Sensor

FlowSCREW 4w

Target Applications
- UPS (3 Phase PFC)
- Solar inverter (Booster)

Schematic



Types
- 70-W206NBA600SA-M788L

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Boost IGBT					
Collector-emitter break down voltage	V_{CES}			600	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	515 600	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		1800	A
Turn off safe operating area		$T_j≤150°C$ $V_{CE}<=V_{CES}$		1800	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	792 1199	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
Input Boost Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
Forward average current	I_{FAV}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	40 81	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		40	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	113 160	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Boost FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
Forward average current	I_{FAV}	$T_j=T_jmax$	T_h=80°C T_c=80°C	334 432	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	1760	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		1800	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	501 759	W
Maximum Junction Temperature	T_jmax			175	°C

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C

Parameter	Symbol	Condition		Value	Unit
Insulation Properties					
Insulation voltage		t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

Characteristic Values

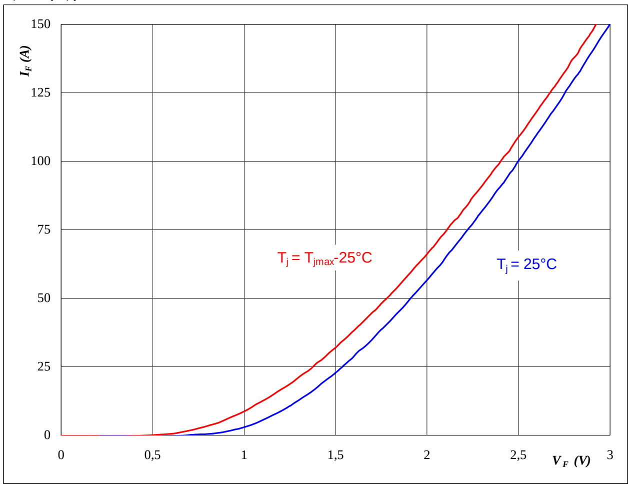
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
Input Boost IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0096	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		600	Tj=25°C Tj=125°C	1	1,43 1,58	2,1	V
Collector-emitter cut-off	I_{CES}		0	600		Tj=25°C Tj=125°C			0,03	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			2400	nA
Integrated Gate resistor	R_{gint}							0,5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=1 Ω Rgon=1 Ω	±15/-8	400	492	Tj=25°C Tj=125°C		202 209		ns
Rise time	t_r					Tj=25°C Tj=125°C		46 46		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		485 519		
Fall time	t_f					Tj=25°C Tj=125°C		30 44		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		6,91 7,52		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		19,34 22,64		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		36960		pF
Output capacitance	C_{oss}							2304		
Reverse transfer capacitance	C_{rss}							1096		
Gate charge	Q_{Gate}		±15	480	600	Tj=25°C		3760		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,12		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,08		
Input Boost Inverse Diode										
Diode forward voltage	V_F				20	Tj=25°C Tj=125°C	1	1,45 1,28	2,1	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,84		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,56		
Input Boost FWD										
Forward voltage	V_F				600	Tj=25°C Tj=125°C	1	1,74 1,91	2,1	V
Reverse leakage current	I_{rm}		±15/-8	400	492	Tj=25°C Tj=125°C			960	µA
Peak recovery current	I_{RRM}	Rgon=1 Ω	±15/-8	400	492	Tj=25°C Tj=125°C		315 462		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		174 175		ns
Reverse recovery charge	Q_{rr}					Tj=25°C Tj=125°C		19,38 34,94		µC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		6,29 11,35		mWs
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		5361 4811		A/µs
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,19		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,13		
Thermistor										
Rated resistance	R					T=25°C		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100°C	-12		+14	%
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	

Boost Inverse Diode

Figure 25 Boost Inverse Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



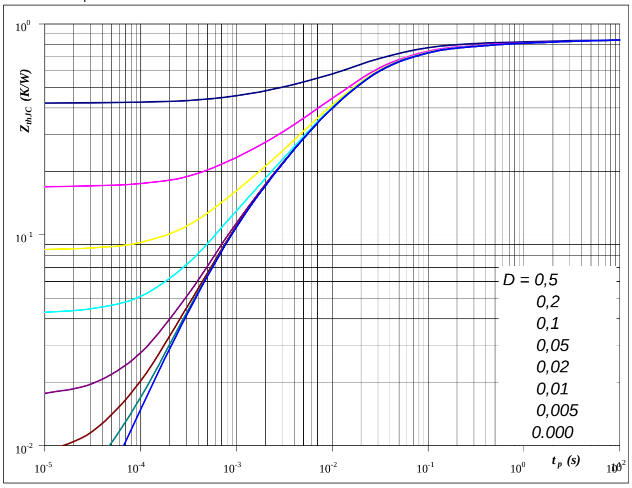
At

t_p =	250	μs

Figure 26 Boost Inverse Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



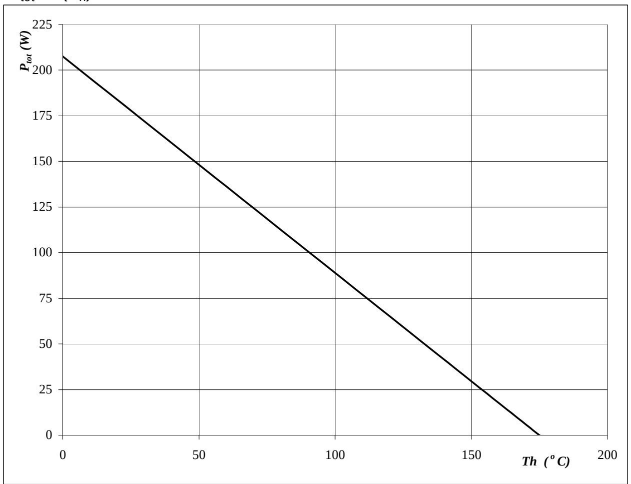
At

D =	tp / T	
R_{thJH} =	0,84	K/W

Figure 27 Boost Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



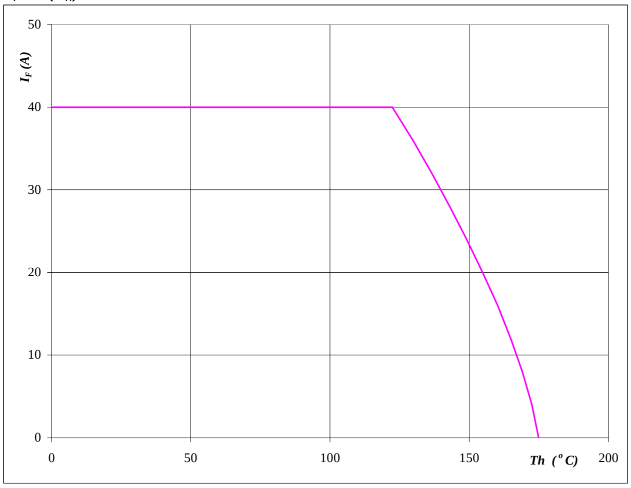
At

T_j =	175	ºC

Figure 28 Boost Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

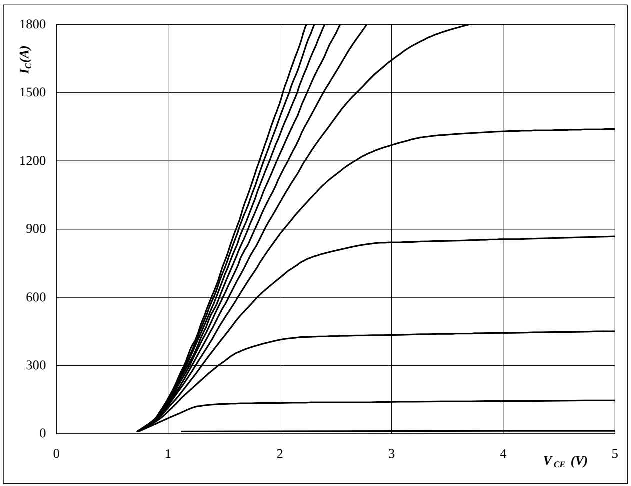
T_j =	175	ºC

INPUT BOOST

Figure 1	BOOST IGBT

Typical output characteristics

$I_D = f(V_{DS})$



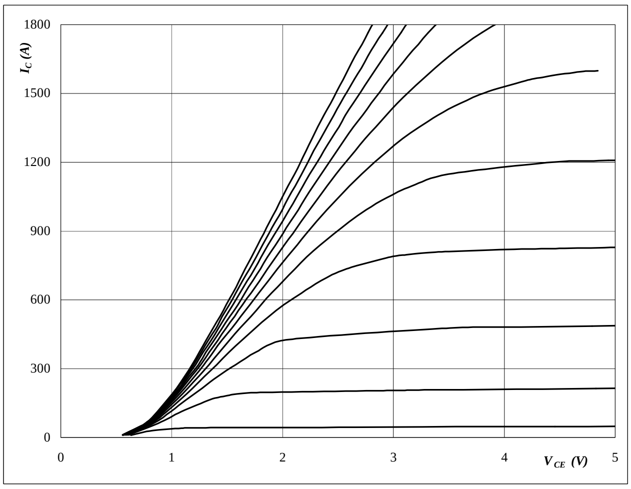
At

t_p =	350	µs
T_j =	25	°C
V_{GS} from	7 V to 17 V in steps of 1 V	

Figure 2	BOOST IGBT

Typical output characteristics

$I_D = f(V_{DS})$



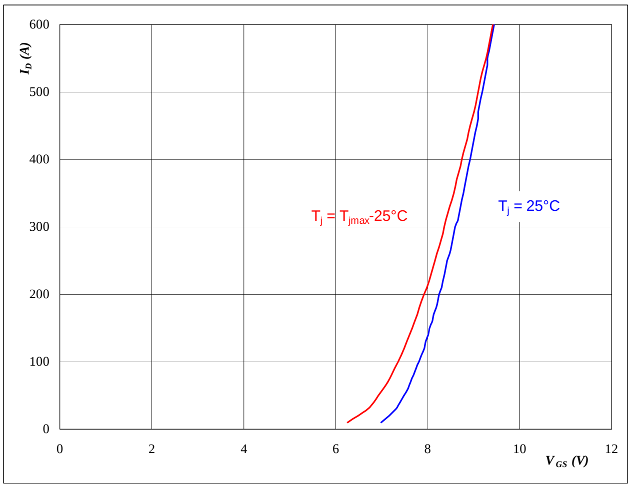
At

t_p =	350	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

$I_D = f(V_{GS})$



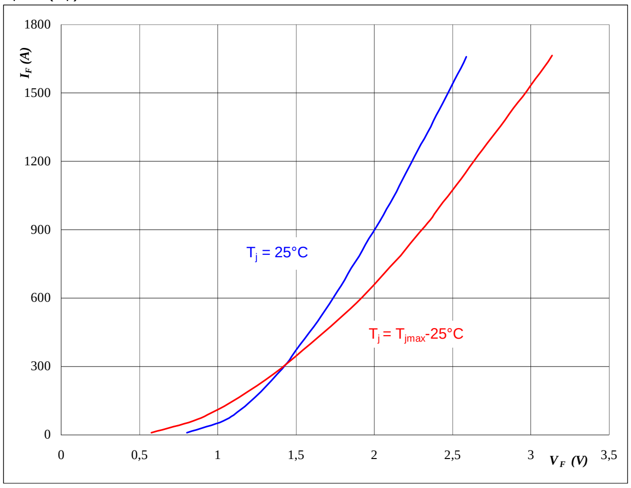
At

t_p =	350	µs
V_{DS} =	10	V

Figure 4	BOOST FWD

Typical diode forward current as
a function of forward voltage

$I_F = f(V_F)$



At

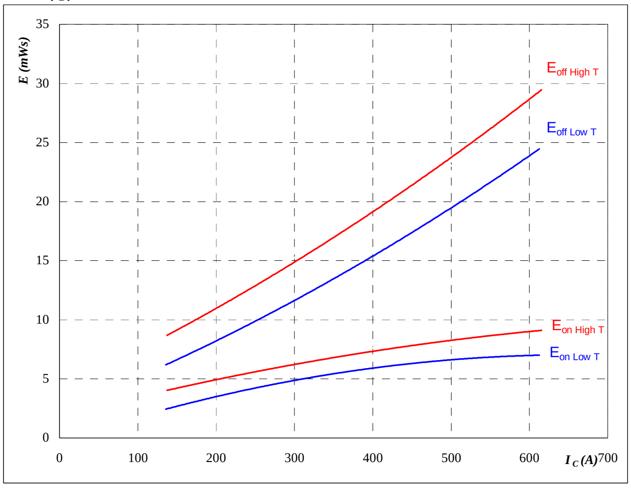
t_p =	350	µs

INPUT BOOST

Figure 5 BOOST IGBT

Typical switching energy losses
as a function of collector current

E = f(I_D)



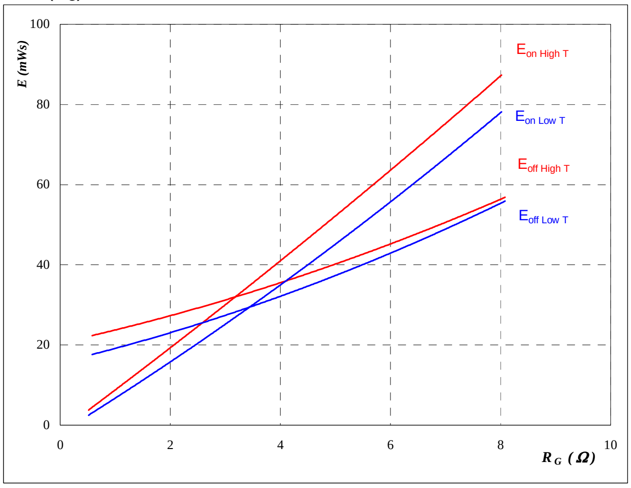
With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
R_{gon} =	1	Ω
R_{goff} =	1,08	Ω

Figure 6 BOOST IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



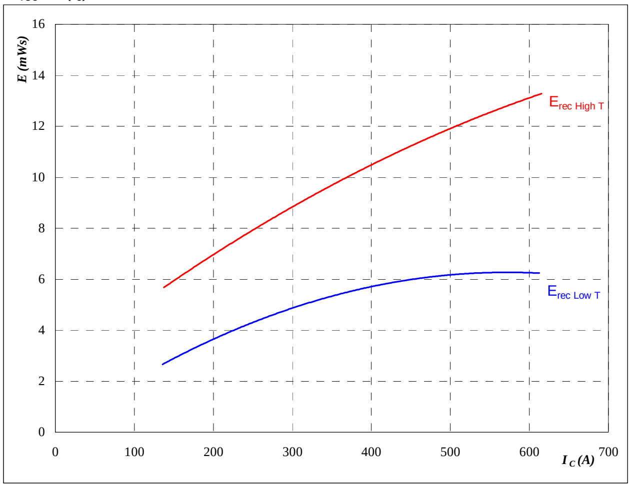
With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
I_D =	492	A

Figure 7 BOOST FWD

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

E_{rec} = f(I_c)



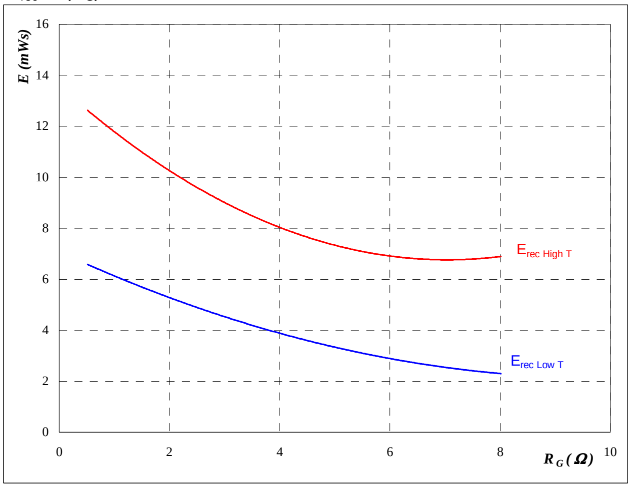
With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
R_{gon} =	1	Ω
R_{goff} =	1,08	Ω

Figure 8 BOOST FWD

Typical reverse recovery energy loss
as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

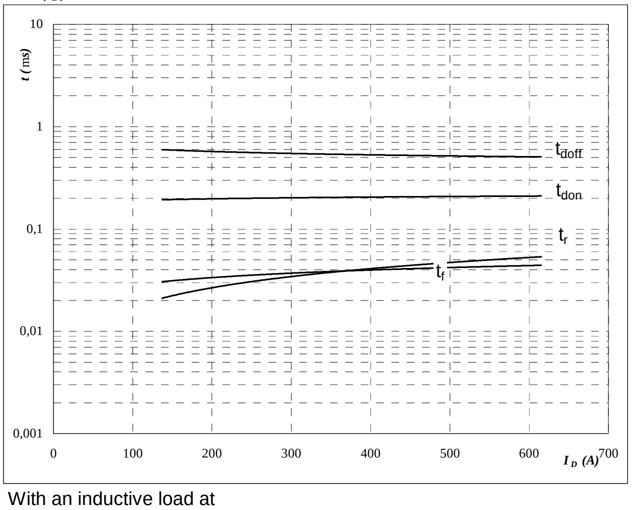
T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
I_D =	492	A

INPUT BOOST

Figure 9 BOOST IGBT

Typical switching times as a function of collector current

$t = f(I_D)$



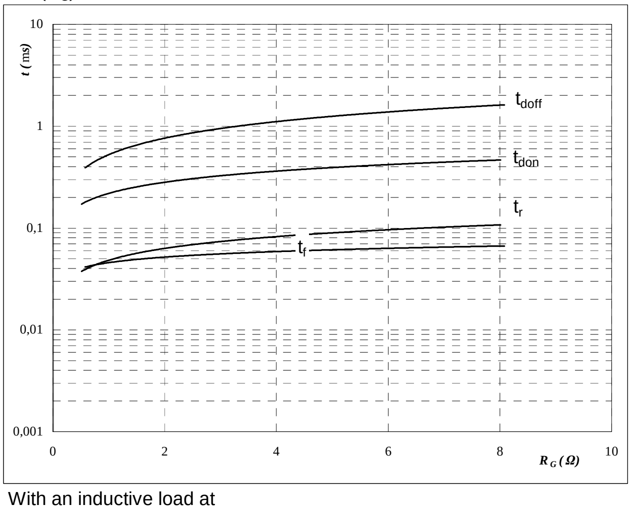
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
R_{gon} =	1	Ω
R_{goff} =	1,08	Ω

Figure 10 BOOST IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



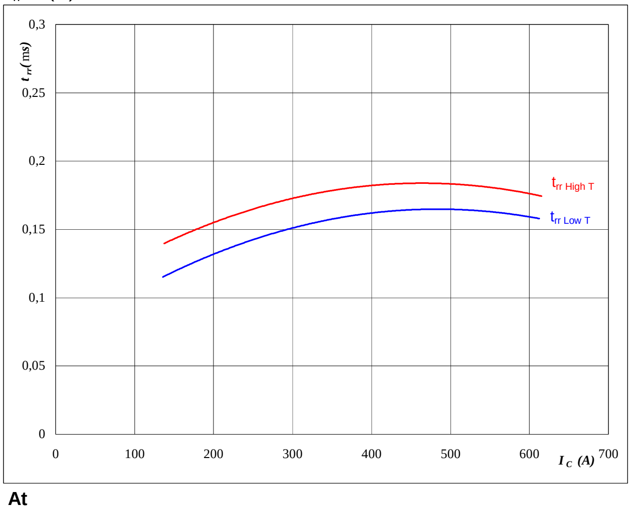
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	+15/-8	V
I_C =	492	A

Figure 11 BOOST FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



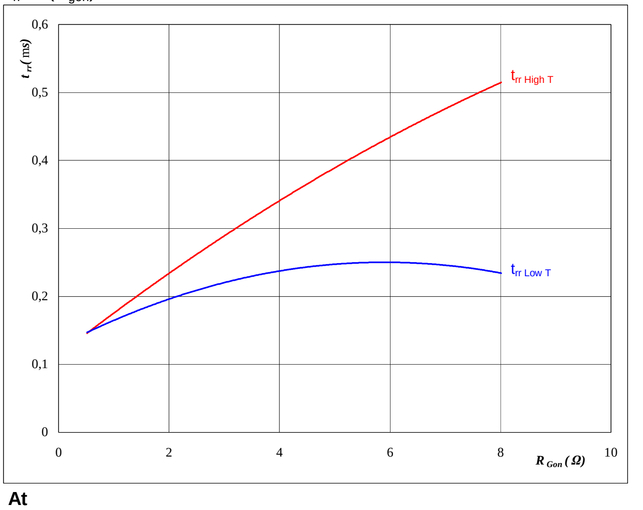
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	+15/-8	V
R_{gon} =	1	Ω

Figure 12 BOOST FWD

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

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



At

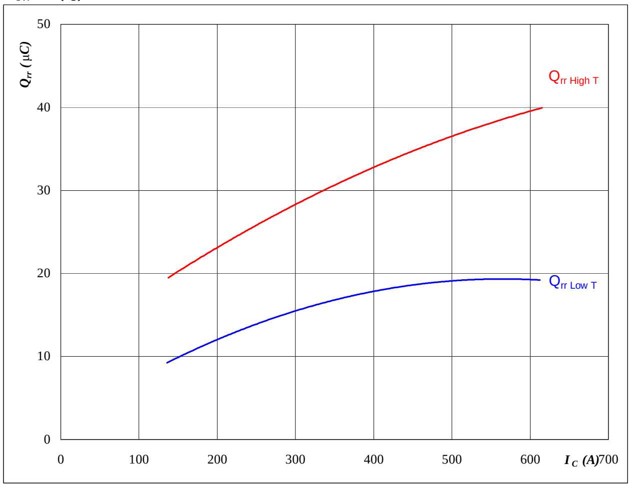
T_j =	25/125	°C
V_R =	400	V
I_F =	492	A
V_{GS} =	+15/-8	V

INPUT BOOST

Figure 13 BOOST FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



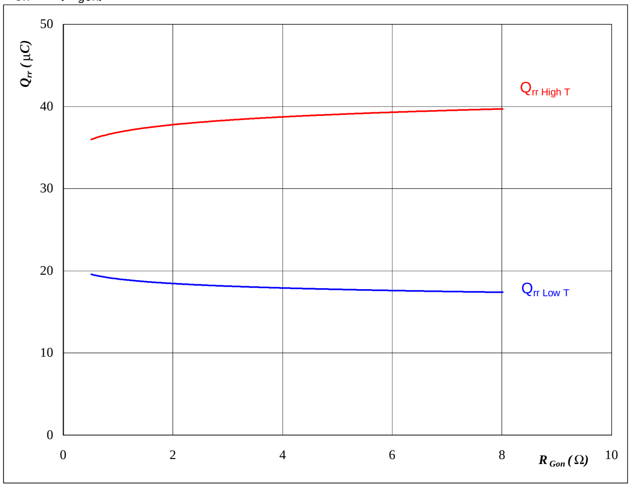
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	+15/-8	V
R_{gon} =	1	Ω

Figure 14 BOOST FWD

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

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



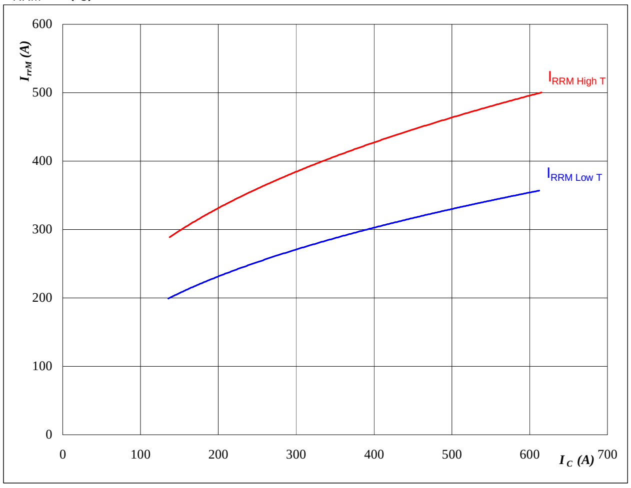
At

Tj =	25/125	°C
V_R =	400	V
I_F =	492	A
V_{GS} =	+15/-8	V

Figure 15 BOOST FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



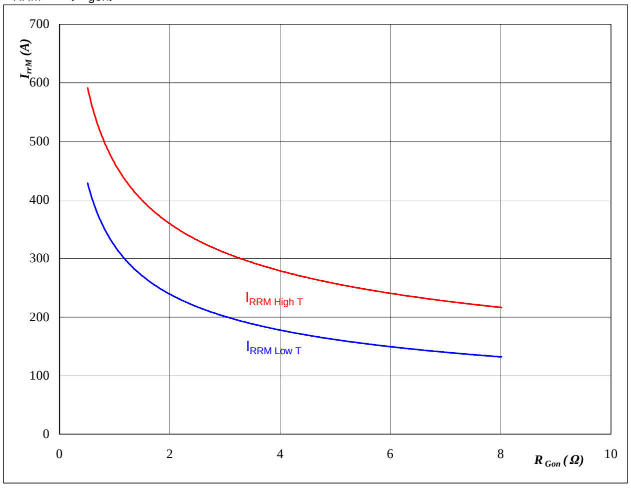
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	+15/-8	V
R_{gon} =	1	Ω

Figure 16 BOOST FWD

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

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



At

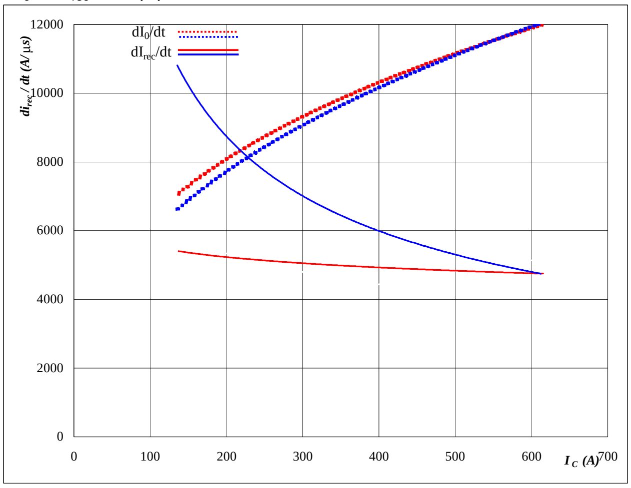
T_j =	25/125	°C
V_R =	400	V
I_F =	492	A
V_{GS} =	+15/-8	V

INPUT BOOST

Figure 17 BOOST FWD

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

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



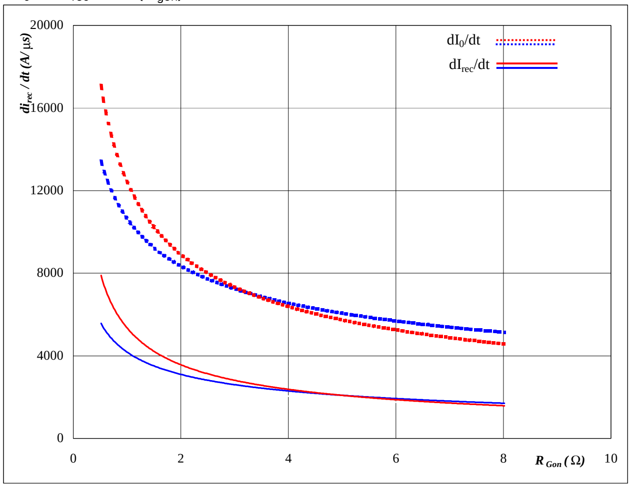
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	+15/-8	V
R_{gon} =	1	Ω

Figure 18 BOOST FWD

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

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



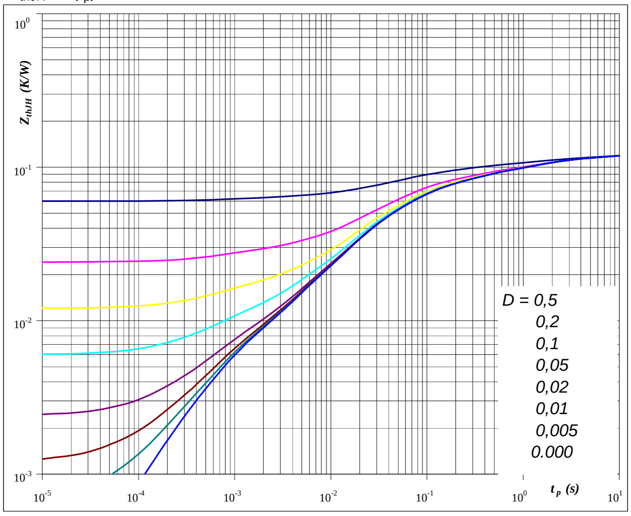
At

Tj =	25/125	°C
VR =	400	V
IF =	492	A
VGS =	+15/-8	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} =	0,12	K/W

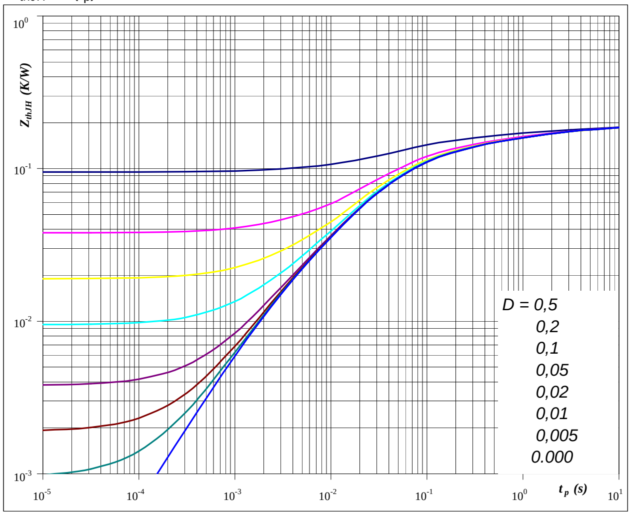
IGBT thermal model values

R (C/W)	Tau (s)
1,96E-02	3,49E+00
2,10E-02	8,16E-01
2,82E-02	1,43E-01
4,04E-02	3,10E-02
6,08E-03	6,85E-03
4,80E-03	7,10E-04

Figure 20 BOOST FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,19	K/W

FWD thermal model values

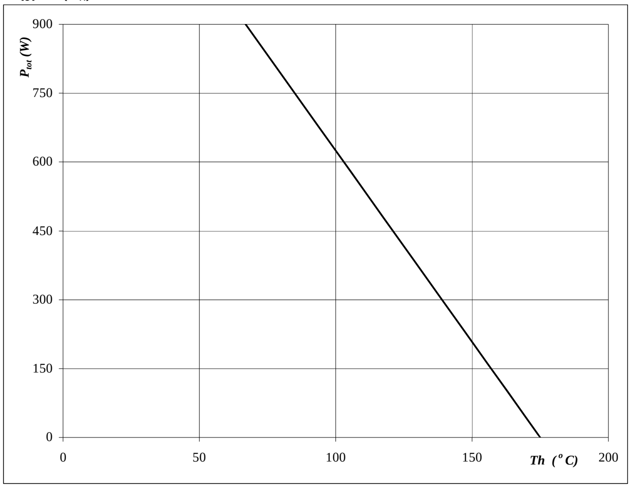
R (C/W)	Tau (s)
2,29E-02	5,42E+00
2,65E-02	1,12E+00
4,14E-02	2,09E-01
6,70E-02	4,40E-02
2,51E-02	1,39E-02
6,68E-03	2,22E-03

INPUT BOOST

Figure 21 BOOST IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



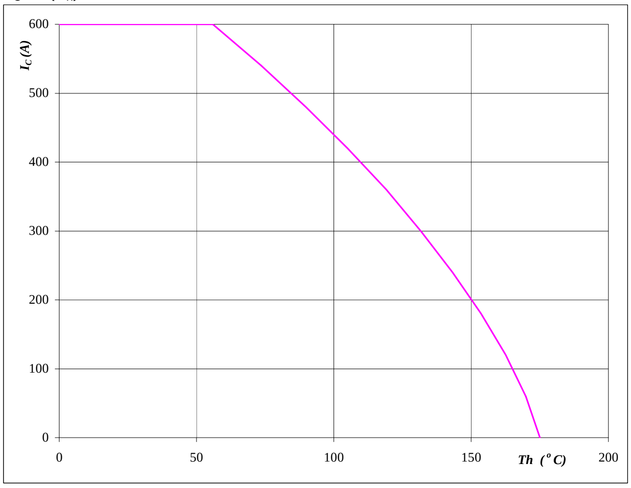
At

T_j = 175 ºC

Figure 22 BOOST IGBT

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_h)$



At

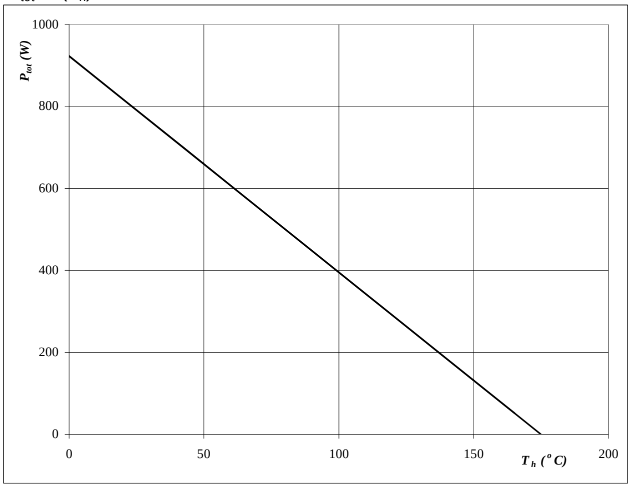
T_j = 175 ºC

V_{GS} = 15 V

Figure 23 BOOST FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



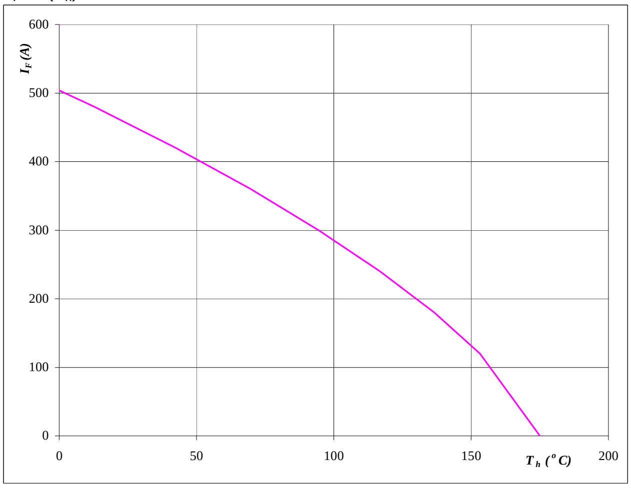
At

T_j = 175 ºC

Figure 24 BOOST FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

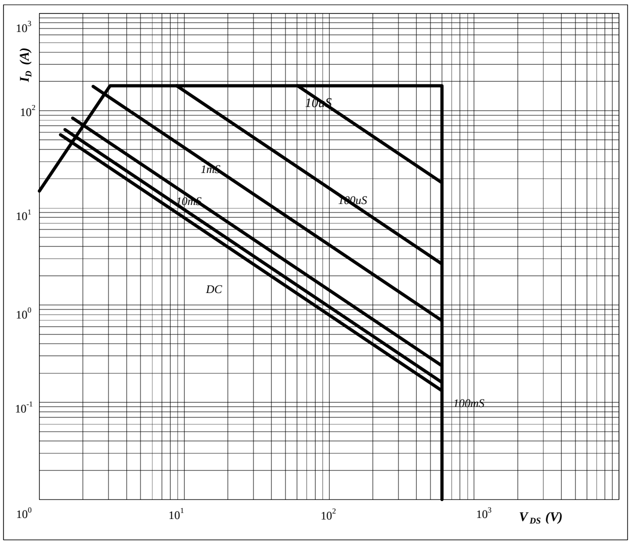
T_j = 175 ºC

INPUT BOOST

Figure 25 BOOST IGBT

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$



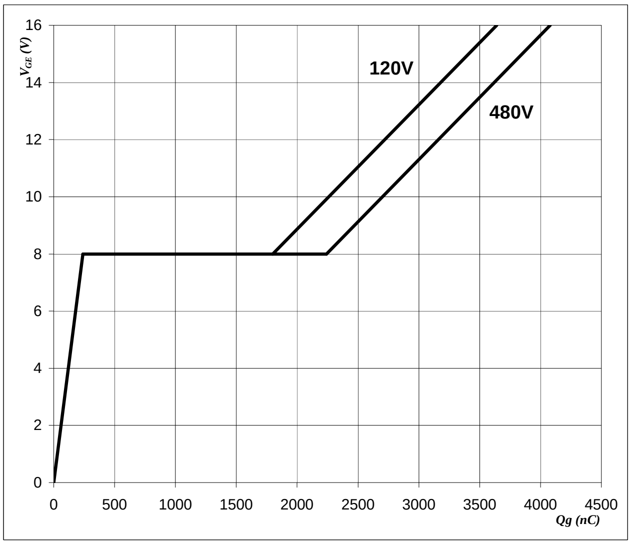
At

D =	single pulse	
T_h =	80	ºC
V_{GS} =	+15/-8	V
T_j =	T_{jmax}	ºC

Figure 26 BOOST IGBT

Gate voltage vs Gate charge

$V_{GS} = f(Qg)$



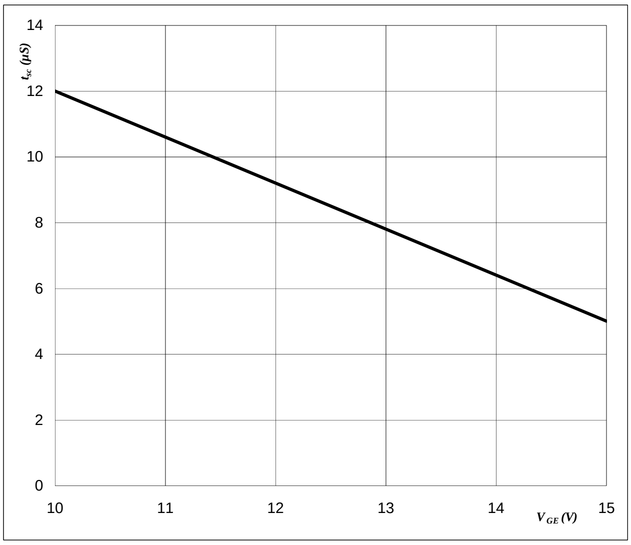
At

I_C =	600	A

Figure 27 Output inverter IGBT

Short circuit withstand time as a function of gate-emitter voltage

$t_{sc} = f(V_{GE})$



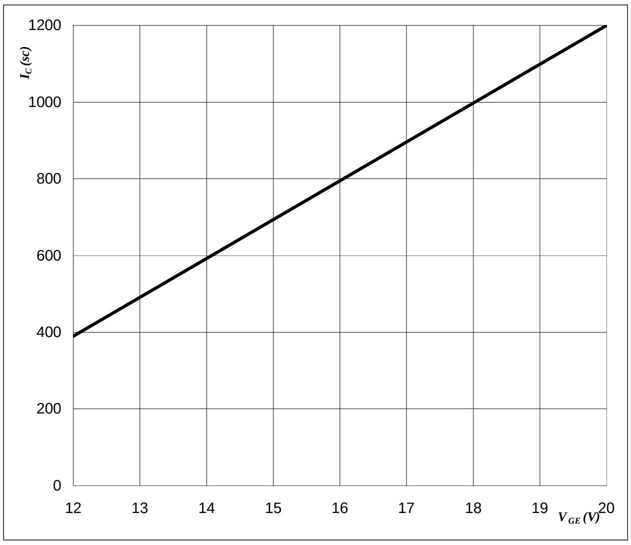
At

V_{CE} =	400	V
T_j ≤	150	ºC

Figure 28 Output inverter IGBT

Typical short circuit collector current as a function of gate-emitter voltage

$V_{GE} = f(Q_{GE})$



At

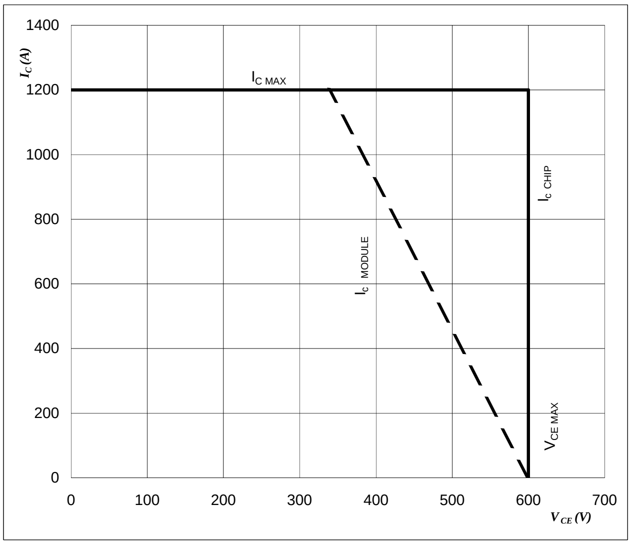
V_{CE} ≤	600	V
T_j =	150	ºC

INPUT BOOST

Figure 29 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

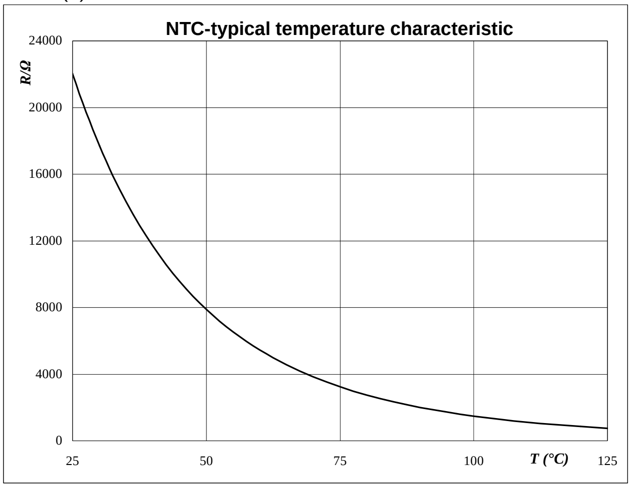
T_j =	T_{jmax}-25	ºC	R_{gon} =	1	Ω
$U_{ccminus}$=U_{ccplus}			R_{goff} =	1	Ω
Switching mode :		3 level switching			

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



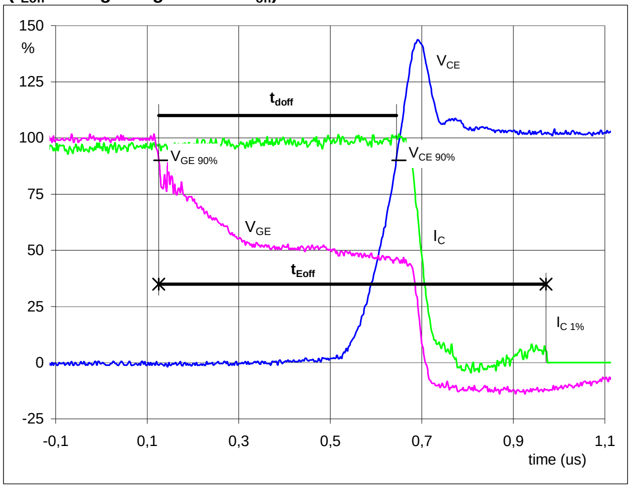
Switching Definitions Boost IGBT

General conditions

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

Figure 1 Output inverter IGBT

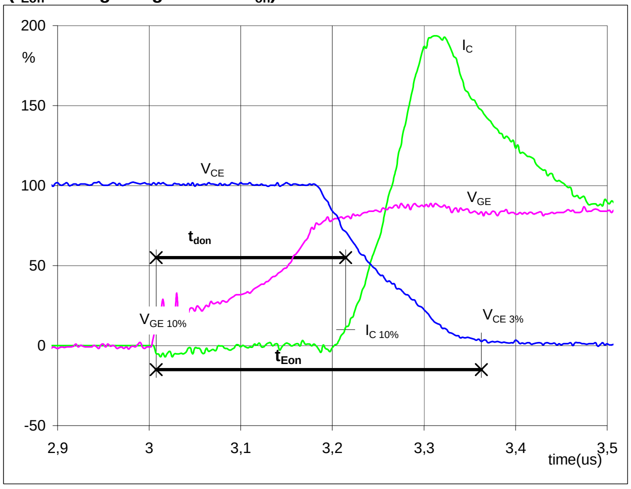
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	23	V
V_C (100%) =	400	V
I_C (100%) =	492	A
t_{doff} =	0,52	µs
t_{Eoff} =	0,85	µs

Figure 2 Output inverter IGBT

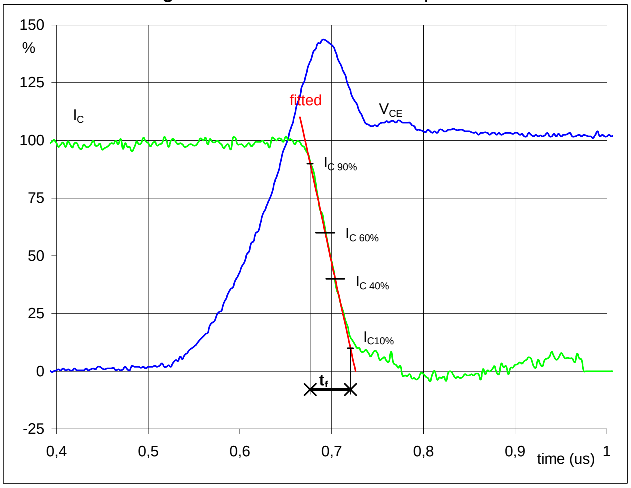
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	23	V
V_C (100%) =	400	V
I_C (100%) =	492	A
t_{don} =	0,21	µs
t_{Eon} =	0,35	µs

Figure 3 Output inverter IGBT

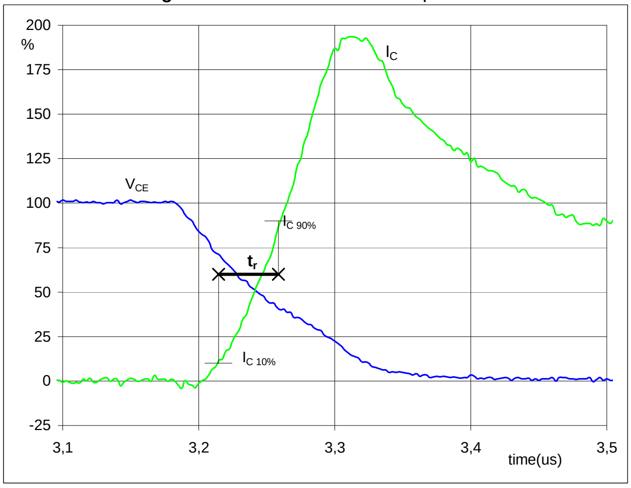
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	492	A
t_f =	0,04	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

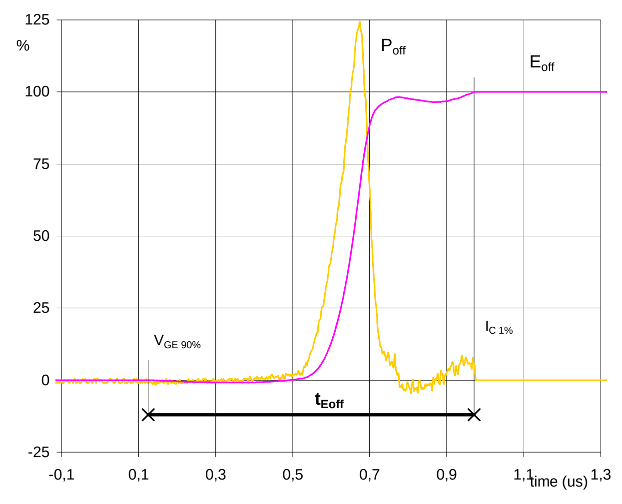


V_C (100%) =	400	V
I_C (100%) =	492	A
t_r =	0,05	µs

Switching Definitions Boost IGBT

Figure 5 Output inverter IGBT

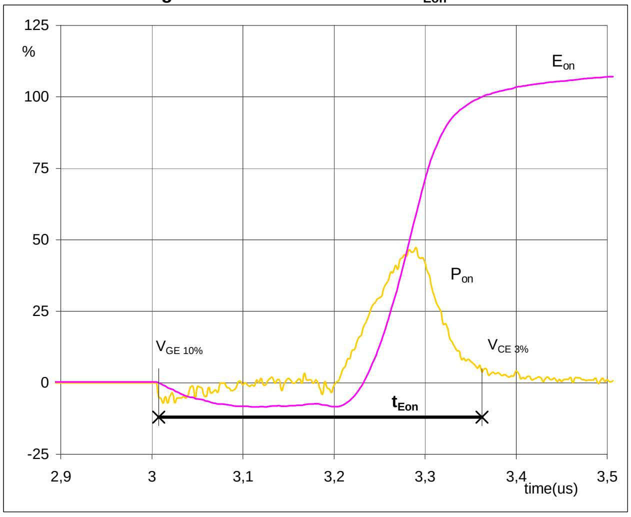
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	196,80	kW
E_{off} (100%) =	22,64	mJ
t_{Eoff} =	0,85	µs

Figure 6 Output inverter IGBT

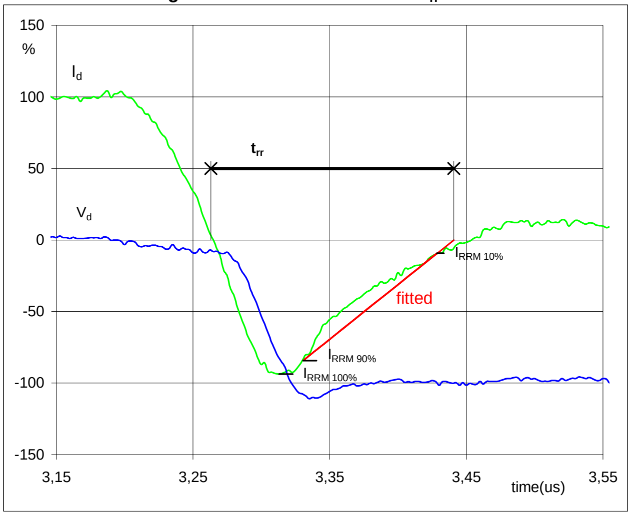
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	196,80	kW
E_{on} (100%) =	7,52	mJ
t_{Eon} =	0,35	µs

Figure 7 Output inverter IGBT

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

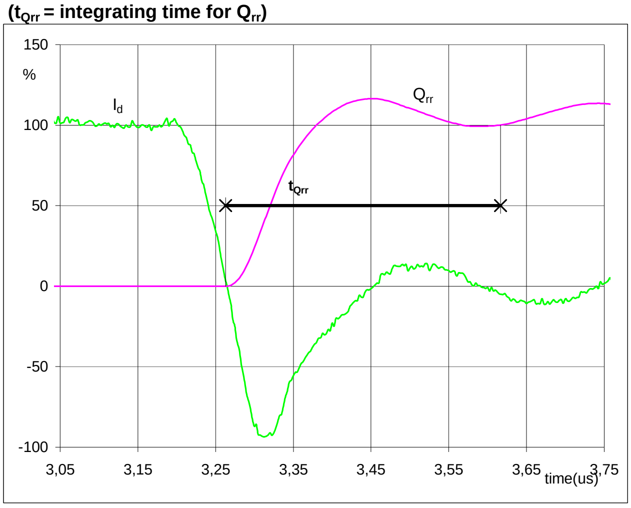


V_d (100%) =	400	V
I_d (100%) =	492	A
I_{RRM} (100%) =	-462	A
t_{rr} =	0,18	µs

Switching Definitions Boost IGBT

Figure 8 Output inverter FRED

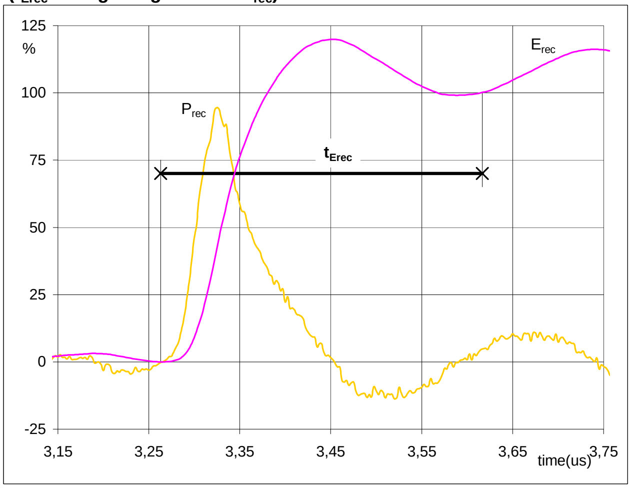
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	492	A
Q_{rr} (100%) =	34,94	µC
t_{Qrr} =	0,35	µs

Figure 9 Output inverter FRED

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



P_{rec} (100%) =	196,80	kW
E_{rec} (100%) =	11,35	mJ
t_{Erec} =	0,35	µs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

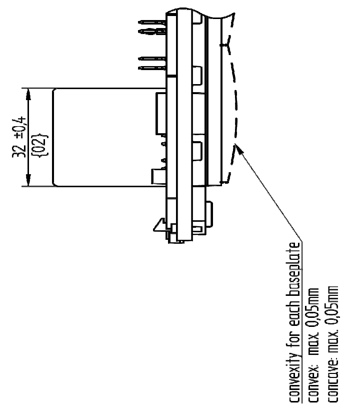
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	70-W206NBA600SA-M788L	M788L	M788L

Outline

Driver pins				
Pin	X1	Y1	Function	Group
1.1	-11,75	59,65	T2C1	T2
1.2	30,25	59,65	T2C2	T2
1.3	1	62,65	G21	G2
1.4	43	62,65	G22	G2
1.5	1	59,65	E21	E2
1.6	43	59,65	E22	E2
1.7	-14,45	50,75	T3C1	T3
1.8	27,55	50,75	T3C2	T3
1.9	1	47,75	G31	G3
1.10	43	47,75	G32	G3
1.11	1	50,75	E31	E3
1.12	43	50,75	E32	E3
1.13	67,65	86,7	Th1	NTC
1.14	67,65	89,8	Th2	NTC

Power connections			
M6 screw	X2	Y2	Function
2.1	0	0	IN-
2.2	44	0	IN+
2.3	0	110,4	DC-
2.4	22	110,4	GND
2.5	44	110,4	DC+

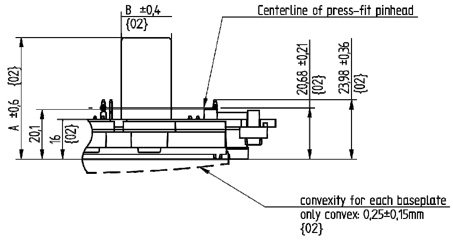
Low current connections			
M4 screw	X3	Y3	Function
3.1	-37,4	89,8	DC+
3.2	81,4	89,8	DC+
3.3	-37,4	65,2	IN+
3.4	81,4	65,2	IN+
3.5	-37,4	45,2	IN-
3.6	81,4	45,2	IN-
3.7	-37,4	20,6	DC-
3.8	81,4	20,6	DC-

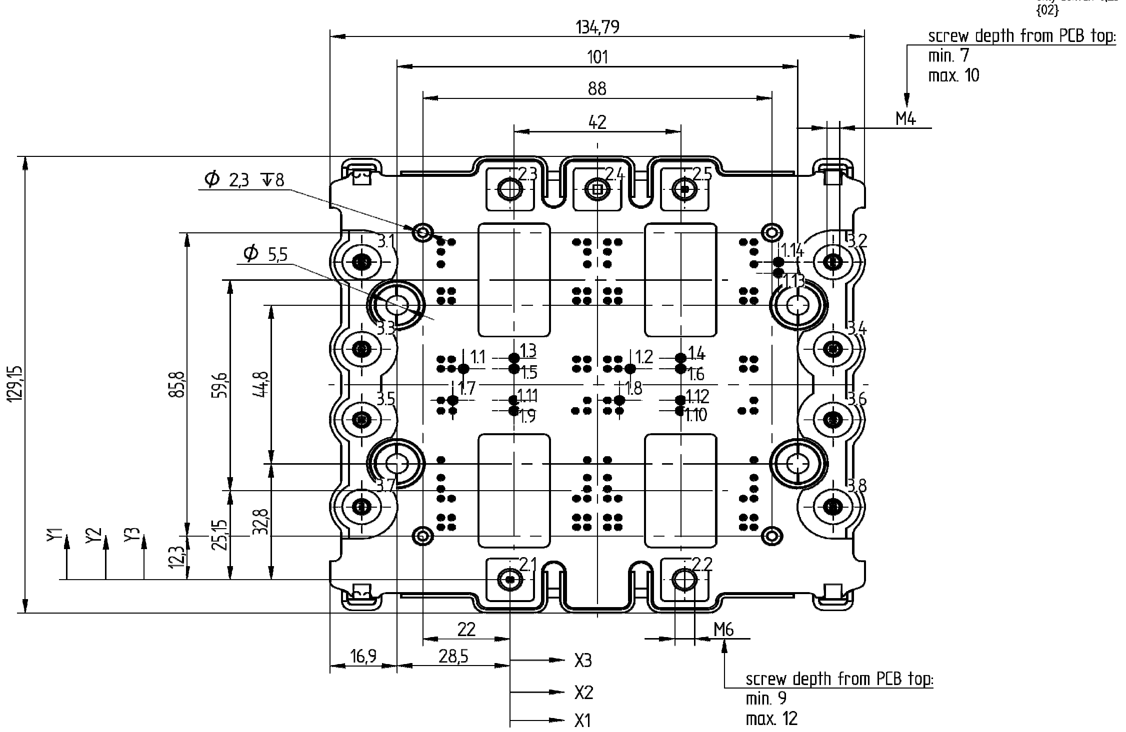


Tolerance of pinpositions: ±0,3mm at the end of pins
PCB holes and connection parameters of pins see in
the handling instruction document

{02}

Module type	dim. A	dim. B
M786L	40,5	15
M788L	49	18

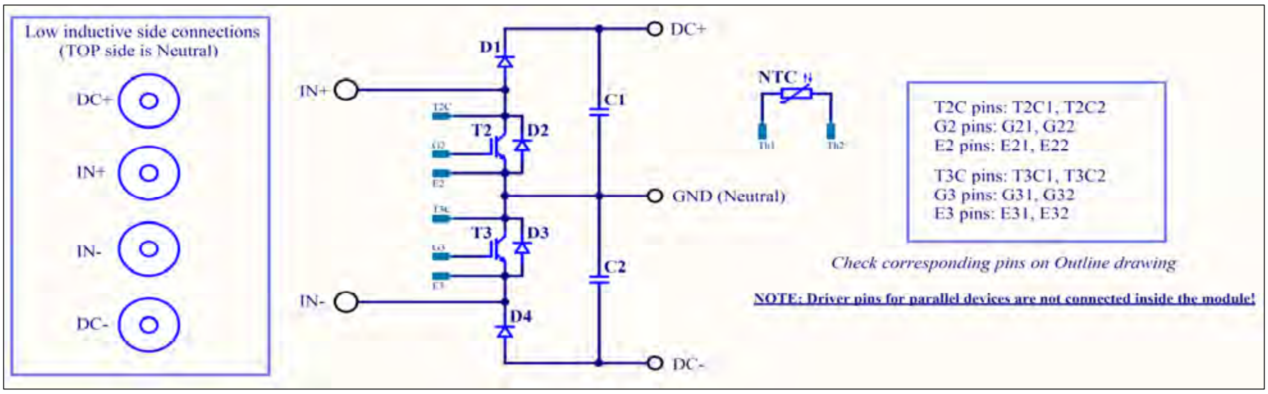




Ordering Code and Marking - Outline - Pinout

Pinout

70-W206NBA600SA-M788L



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