flow BOOST 0 — 1200V/40A

Features

- Ultra fast switching frequency
- Low Inductance Layout
- 1200V IGBT and 1200V SiC diode
- Antiparallel IGBT protection diode with high current

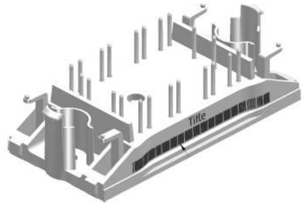
Target Applications

- solar inverter

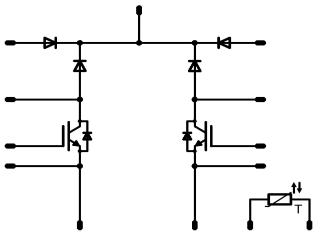
Types

- V23990-P629-L99-PM

flow 0 17mm housing



Schematic



Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
D7,D8					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward average current	I_{FAV}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	45 45	A
Surge forward current	I_{FSM}	$t_p=10ms$	$T_j=150°C$	200	A
I2t-value	I^2t			200	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	68 102	W
Maximum Junction Temperature	$T_j$max			150	°C
T1,T2					
Collector-emitter break down voltage	V_{CES}			1200	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	55 55	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		160	A
Turn off safe operating area		$T_j\leq150°C$ $V_{CE}<=V_{CES}$		160	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	202 306	W
Gate-emitter peak voltage	V_{GE}			25	V
Short circuit ratings	t_{SC} V_{CC}	$T_j\leq150°C$ $V_{GE}=15V$		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
D1,D2,D3,D4,D5,D6 *					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
Forward average current	I_{FAV}	$T_j=T_j max$	$T_h=80°C$ $T_c=80°C$	54 55	A
Surge forward current	I_{FSM}	$t_p=10ms$	$T_j=25°C$	213	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j max$		141	A
Power dissipation per Diode	P_{tot}	$T_j=T_j max$	$T_h=80°C$ $T_c=80°C$	154 234	W
Maximum Junction Temperature	$T_j max$			175	°C

* The values was measured on 3 diodes in paralell

Parameter	Symbol	Condition		Value	Unit
D9,D10					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_c=25°C$		1200	V
Forward average current	I_{FAV}	$T_j=T_j max$	$T_h=80°C$ $T_c=80°C$	12 15	A
Surge non repetitive forward current	I_{FSM}	tp=10ms half sine wave		28	A
Power dissipation per Diode	P_{tot}	$T_j=T_j max$	$T_h=80°C$ $T_c=80°C$	33 49	W
Maximum Junction Temperature	$T_j max$			150	°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		t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

Characteristic Values

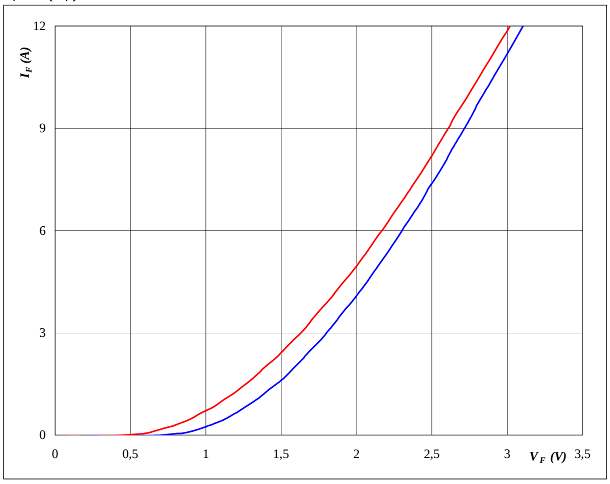
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
D7,D8										
Forward voltage	V_F				25	Tj=25°C Tj=125°C	0,8	1,13 1,09	1,9	V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0,93 0,80		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		0,008 0,011		Ω
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						1,04		K/W
T1,T2										
Gate emitter threshold voltage	$V_{GE(th)}$		15		0,00025	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	2,74 3,01	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		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	15	700	40	Tj=25°C Tj=125°C		23,2 22,6		ns
Rise time	t_r					Tj=25°C Tj=125°C		10 11,2		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		186,4 215,8		
Fall time	t_f					Tj=25°C Tj=125°C		11,1 32,3		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,542 0,630		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,850 1,679		
Input capacitance	C_{ies}	f=1MHz		30		Tj=25°C		3200		pF
Output capacitance	C_{oss}							370		
Reverse transfer capacitance	C_{rss}							125		
Gate charge	Q_{Gate}	f=1MHz		30		Tj=25°C		220	330	nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,35		K/W
D1,D2,D3,D4,D5,D6 *										
Forward voltage	V_F				30	Tj=25°C Tj=125°C	1	1,49 1,77	1,9	V
Reverse leakage current	I_{rm}			700		Tj=25°C Tj=125°C			750	µA
Peak recovery current	I_{RRM}	Rgon=4 Ω	15	700	40	Tj=25°C Tj=125°C		29,24 28,42		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		11,7 12,5		ns
Reverse recovery charge	Q_{rr}					Tj=25°C Tj=125°C		0,187 0,19		µC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		0,026 0,028		mWs
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		7553 7097		A/µs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,62		K/W
D9,D10										
Diode forward voltage	V_F				4	Tj=25°C Tj=125°C		1,98 1,82		V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						2,15		K/W
Thermistor										
Rated resistance	R					T=25°C		21511		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100°C	-4,5		+4,5	%
Power dissipation	P					T=25°C		210		mW
Power dissipation constant						T=25°C		3,5		mW/K
B-value	B(25/50)					T=25°C		3884		K
B-value	B(25/100)					T=25°C		3964		K
Vincotech NTC Reference									F	

D9,D10

Figure 25 D9,D10

Typical diode forward current as
a function of forward voltage

$I_F = f(V_F)$



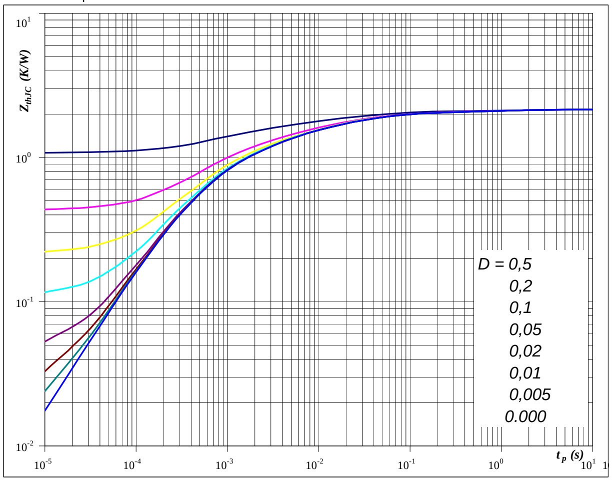
At

t_p =	250	μs	T_j =	25/125	°C

Figure 26 D9,D10

Diode transient thermal impedance
as a function of pulse width

$Z_{thJH} = f(t_p)$



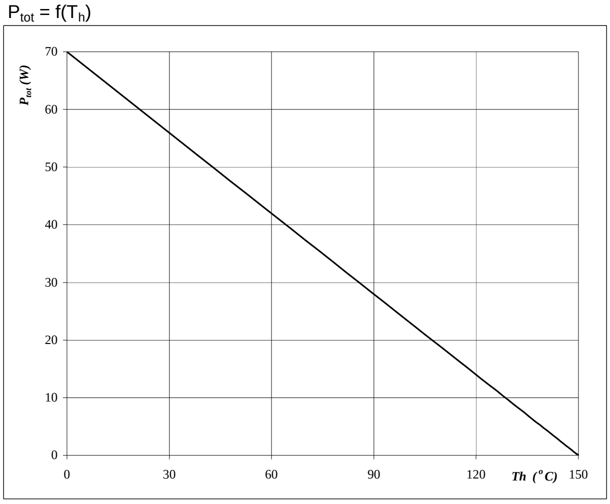
At

D =	tp / T	
R_{thJH} =	2,15	K/W

Figure 27 D9,D10

Power dissipation as a
function of heatsink temperature

$P_{tot} = f(T_h)$



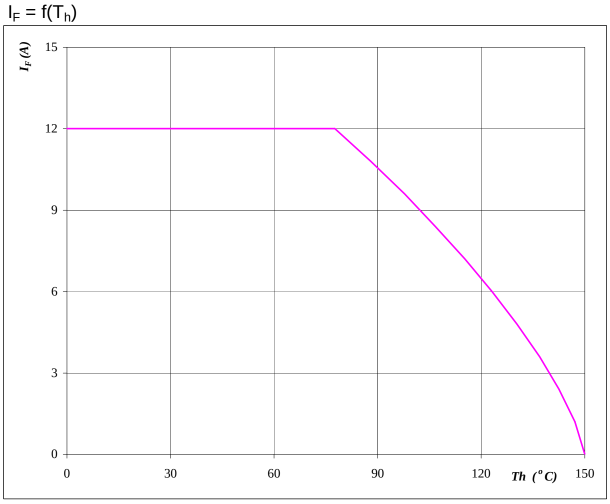
At

T_j = 150 ºC

Figure 28 D9,D10

Forward current as a
function of heatsink temperature

$I_F = f(T_h)$



At

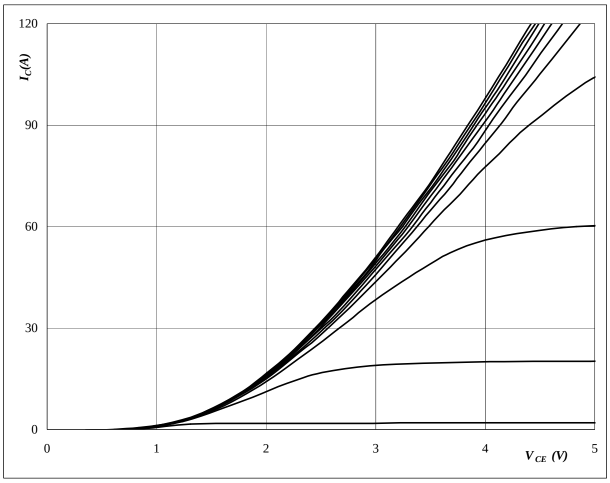
T_j = 150 ºC

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 1 T1,T2

Typical output characteristics

$I_D = f(V_{DS})$



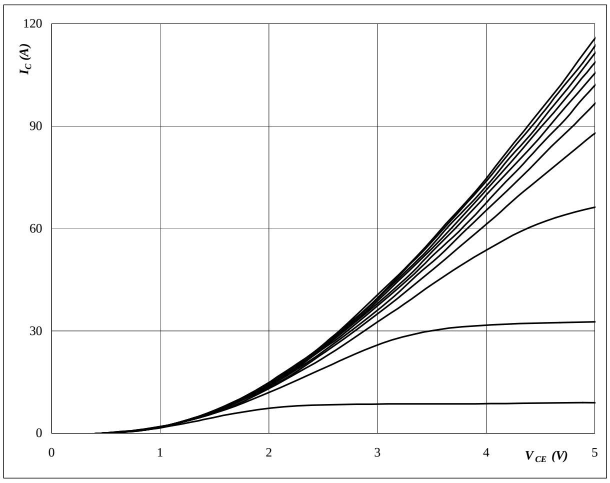
At

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

Figure 2 T1,T2

Typical output characteristics

$I_D = f(V_{DS})$



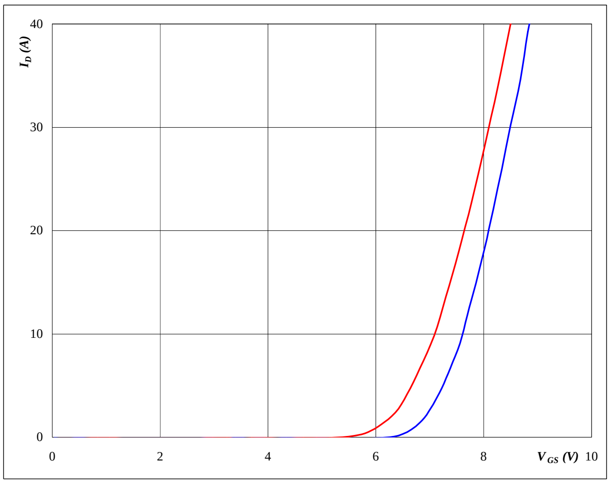
At

t_p =	250	µs
T_j =	126	°C
V_{GS} from	7 V to 17 V in steps of 1 V	

Figure 3 T1,T2

Typical transfer characteristics

$I_D = f(V_{GS})$



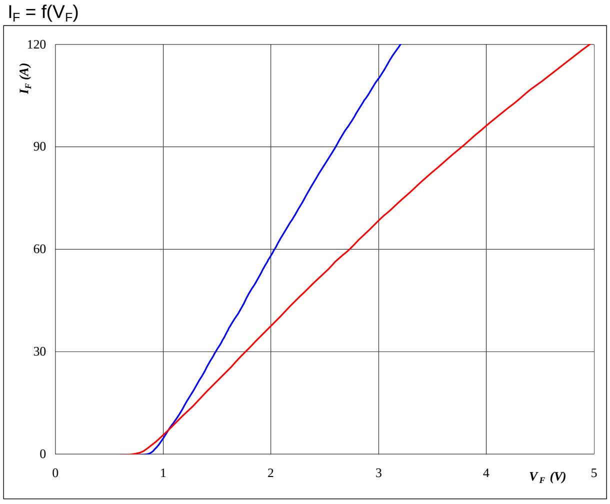
At

t_p =	100	µs	T_j =	25/125	°C
V_{DS} =	10	V			

Figure 4 D1,D2,D3,D4,D5,D6

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

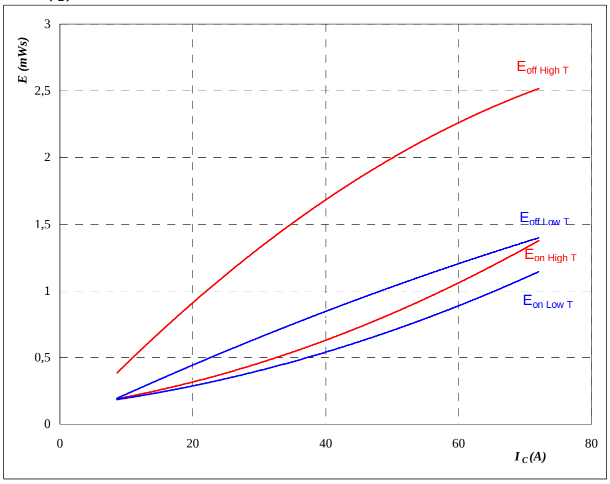
t_p =	250	µs	T_j =	25/125	°C

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 5 T1,T2

Typical switching energy losses
as a function of collector current

$E = f(I_D)$



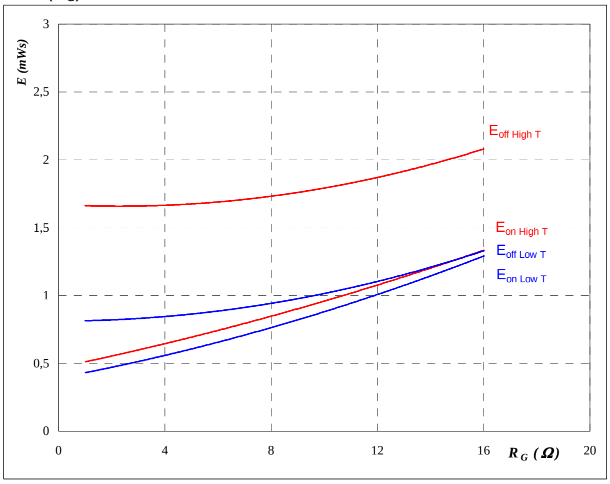
With an inductive load at

T_j =	25/125	°C
V_{DS} =	700	V
V_{GS} =	15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 T1,T2

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



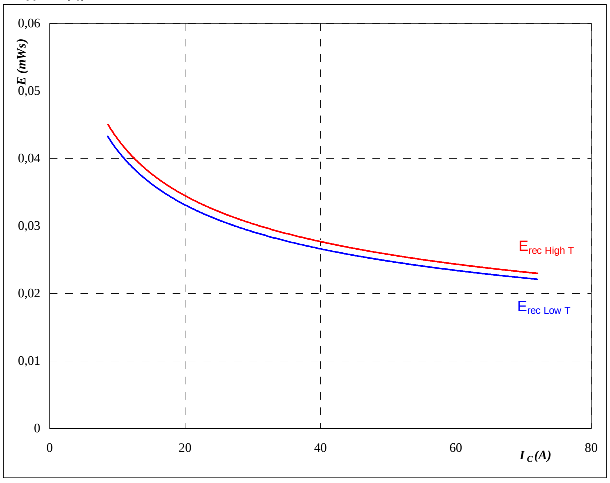
With an inductive load at

T_j =	25/125	°C
V_{DS} =	700	V
V_{GS} =	15	V
I_D =	40	A

Figure 7 D1,D2,D3,D4,D5,D6

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

$E_{rec} = f(I_c)$



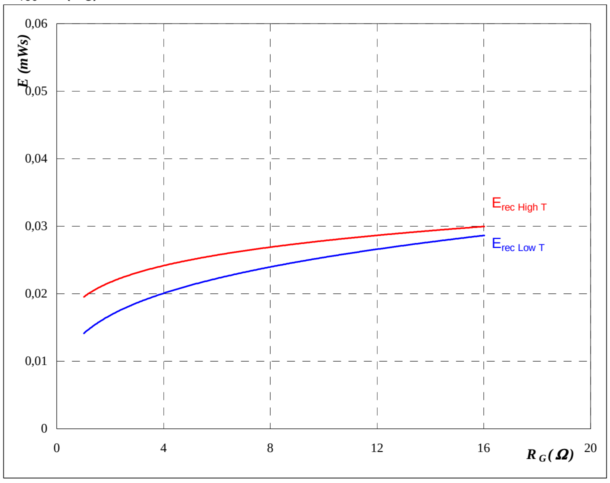
With an inductive load at

T_j =	25/125	°C
V_{DS} =	700	V
V_{GS} =	15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 8 D1,D2,D3,D4,D5,D6

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

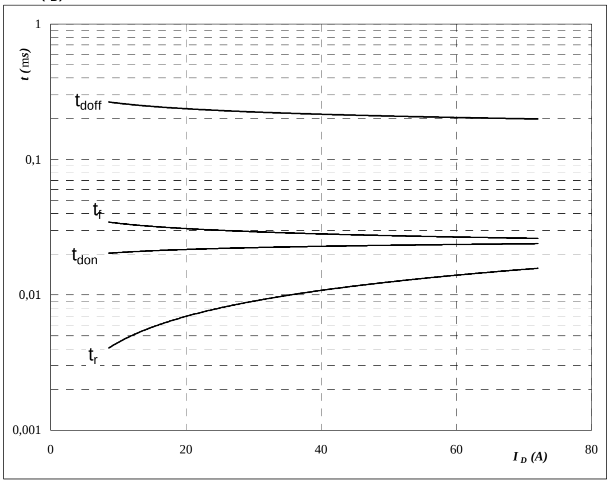
T_j =	25/125	°C
V_{DS} =	700	V
V_{GS} =	15	V
I_D =	40	A

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 9 T1,T2

Typical switching times as a function of collector current

$t = f(I_D)$



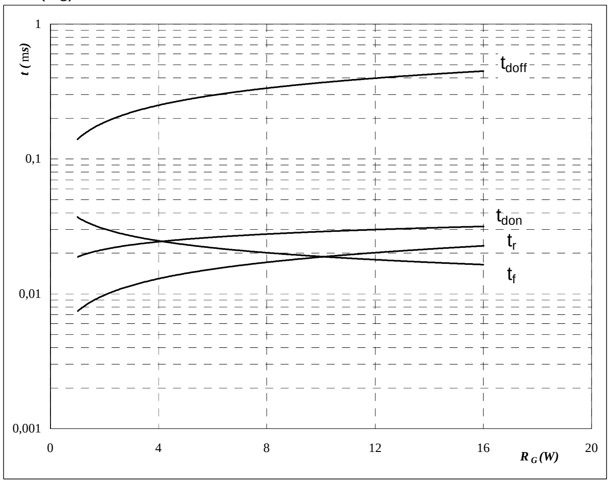
With an inductive load at

T_j =	125	°C
V_{DS} =	700	V
V_{GS} =	15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 T1,T2

Typical switching times as a function of gate resistor

$t = f(R_G)$



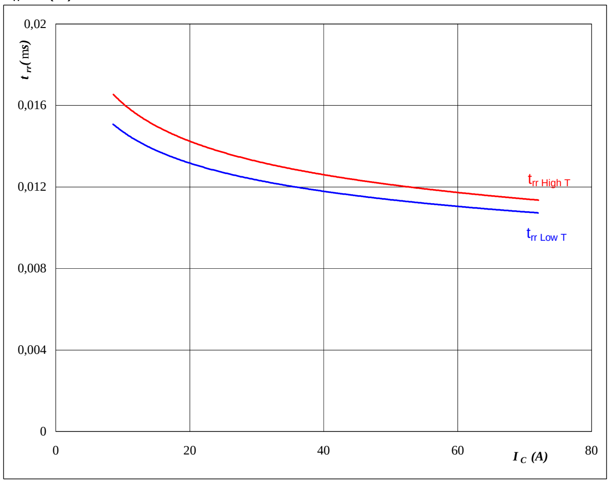
With an inductive load at

T_j =	125	°C
V_{DS} =	700	V
V_{GS} =	15	V
I_C =	40	A

Figure 11 D1,D2,D3,D4,D5,D6

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



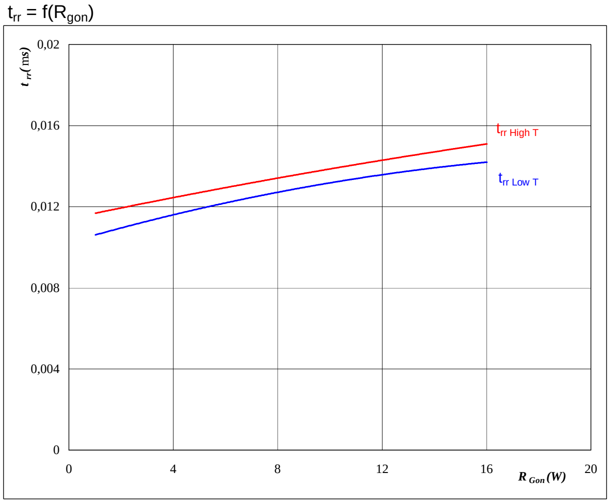
At

T_j =	25/125	°C
V_{CE} =	700	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 12 D1,D2,D3,D4,D5,D6

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

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



At

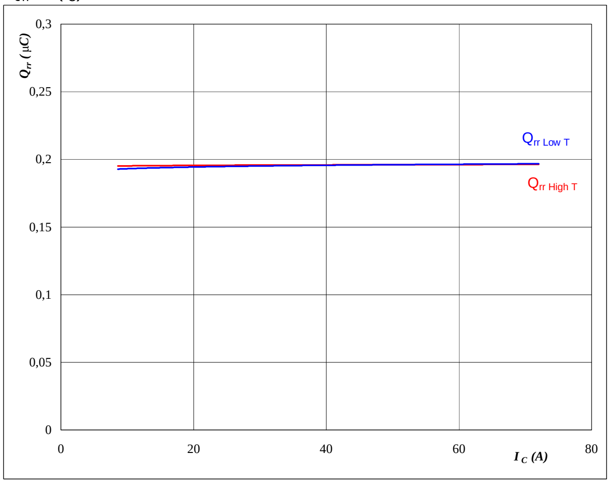
T_j =	25/125	°C
V_R =	700	V
I_F =	40	A
V_{GS} =	15	V

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 13 D1,D2,D3,D4,D5,D6

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



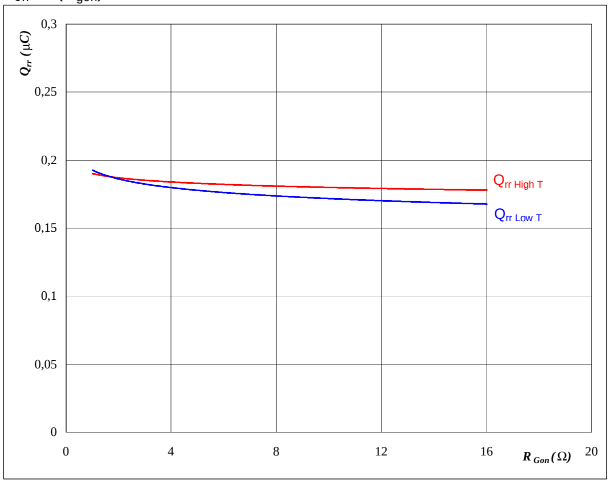
At

T_j =	25/125	°C
V_{CE} =	700	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 14 D1,D2,D3,D4,D5,D6

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

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



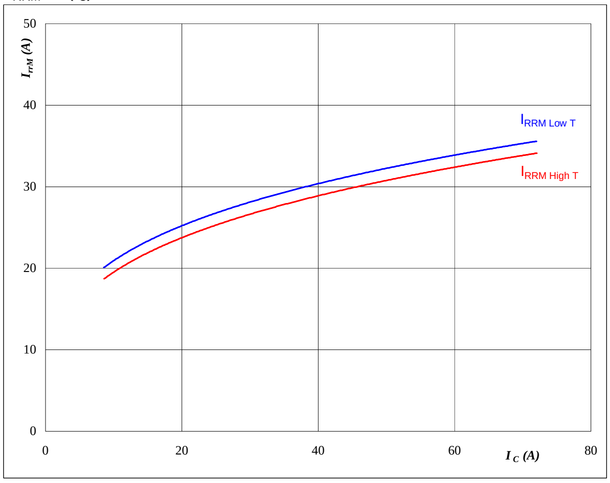
At

Tj =	25/125	°C
V_R =	700	V
I_F =	40	A
V_{GS} =	15	V

Figure 15 D1,D2,D3,D4,D5,D6

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



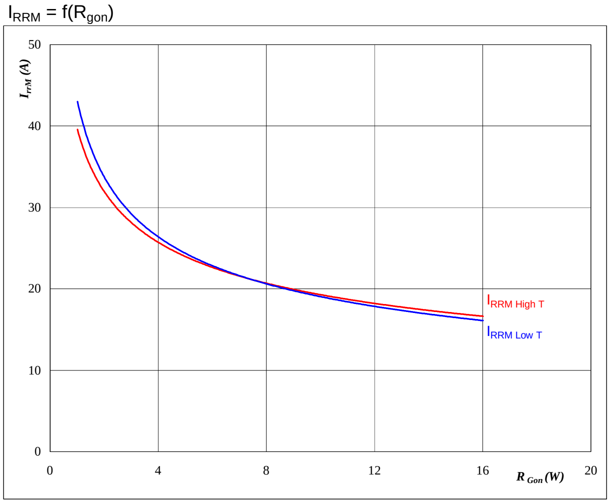
At

T_j =	25/125	°C
V_{CE} =	700	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 16 D1,D2,D3,D4,D5,D6

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

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



At

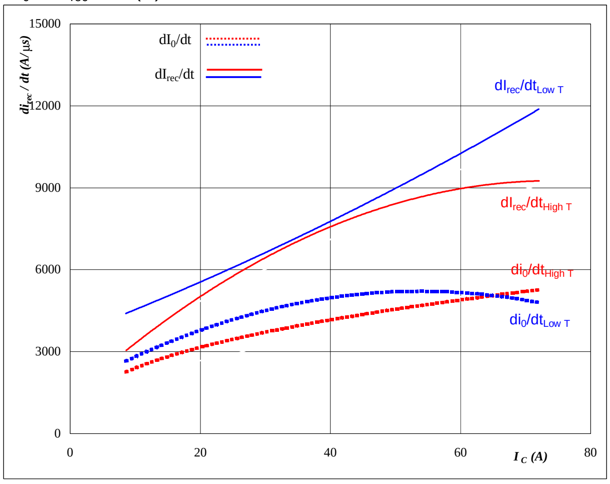
T_j =	25/125	°C
V_R =	700	V
I_F =	40	A
V_{GS} =	15	V

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 17 D1,D2,D3,D4,D5,D6

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

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



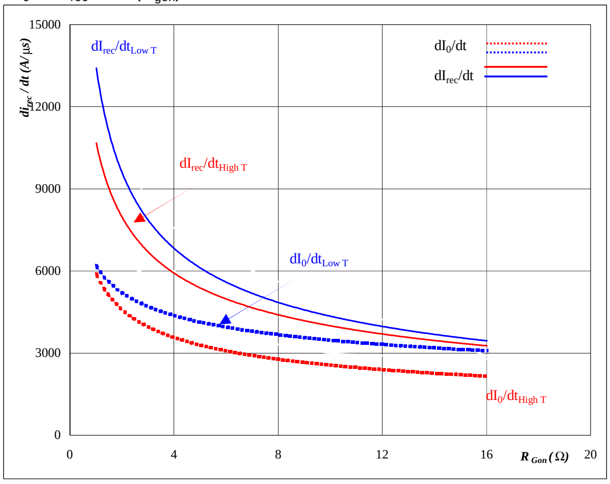
At

T_j =	25/125	°C
V_{CE} =	700	V
V_{GE} =	15	V
R_{gon} =	4	Ω

Figure 18 D1,D2,D3,D4,D5,D6

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

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



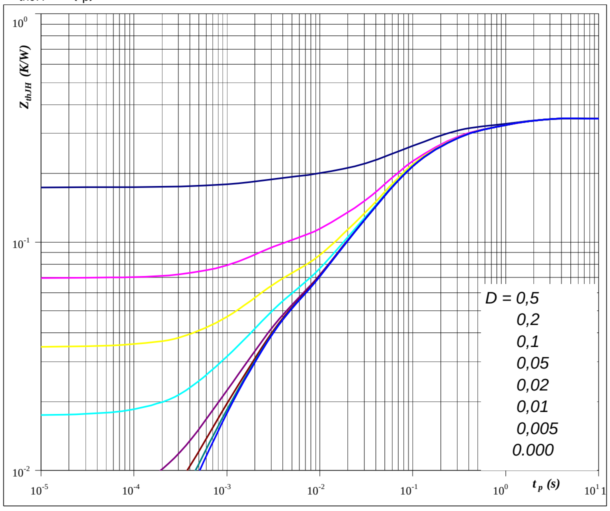
At

Tj =	25/125	°C
VR =	700	V
IF =	40	A
VGS =	15	V

Figure 19 T1,T2

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,35	K/W

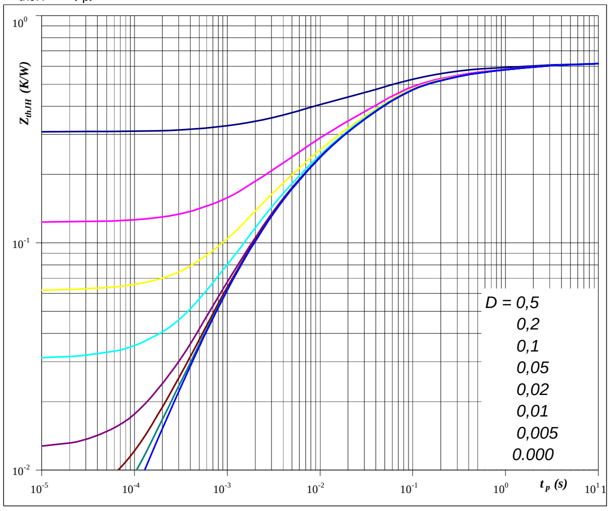
IGBT thermal model values

R (C/W)	Tau (s)
0,080	0,780
0,161	0,100
0,072	0,030
0,035	0,002

Figure 20 D1,D2,D3,D4,D5,D6

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,62	K/W

FWD thermal model values

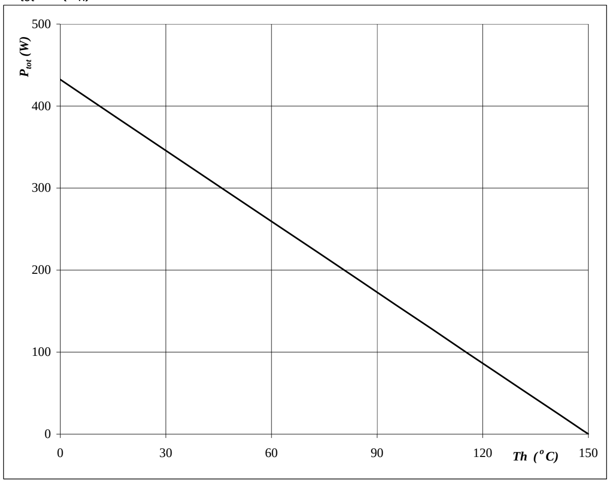
R (C/W)	Tau (s)
0,042	2,693
0,072	0,483
0,218	0,064
0,128	0,017
0,125	0,004

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 21 T1,T2

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



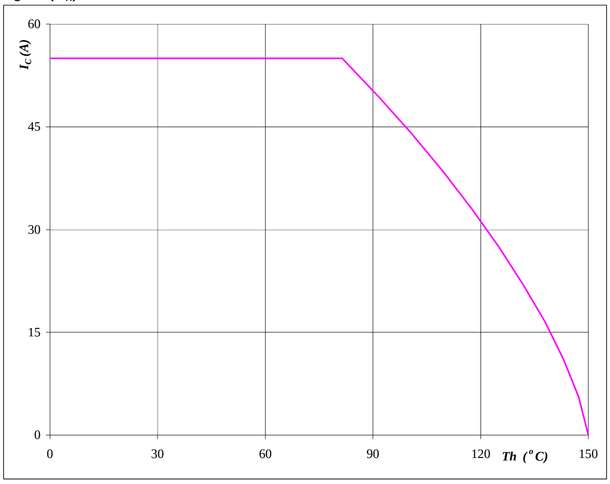
At

T_j = 150 ºC

Figure 22 T1,T2

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_h)$



At

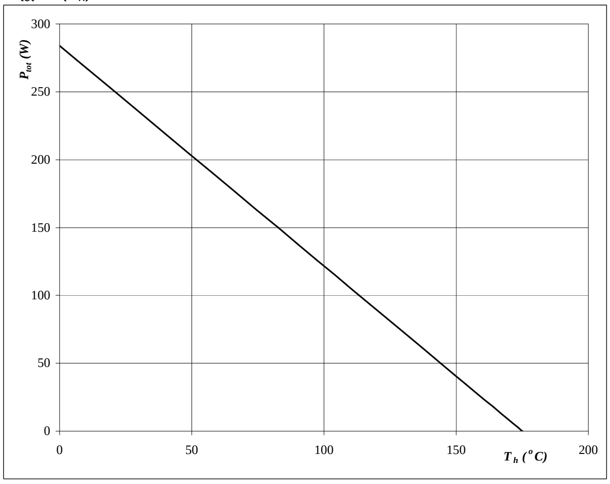
T_j = 150 ºC

V_{GS} = 15 V

Figure 23 D1,D2,D3,D4,D5,D6

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



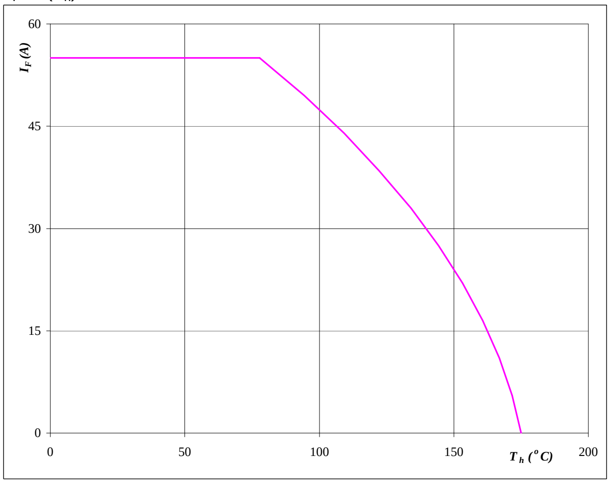
At

T_j = 175 ºC

Figure 24 D1,D2,D3,D4,D5,D6

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

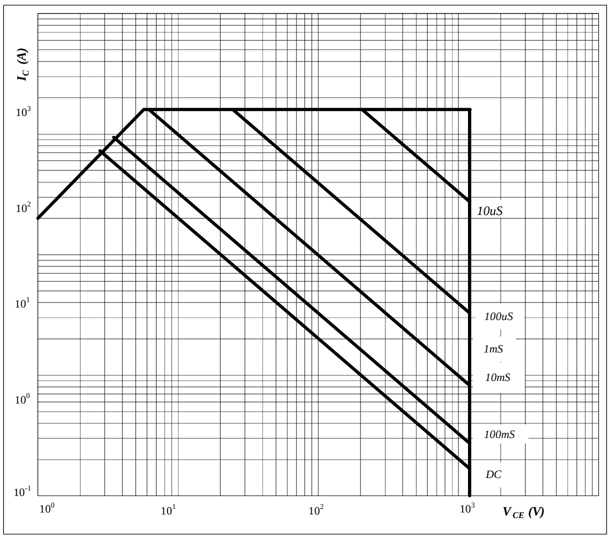
T_j = 175 ºC

T1/(D1,D2,D3) , T2/(D4,D5,D6)

Figure 25 T1,T2

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$



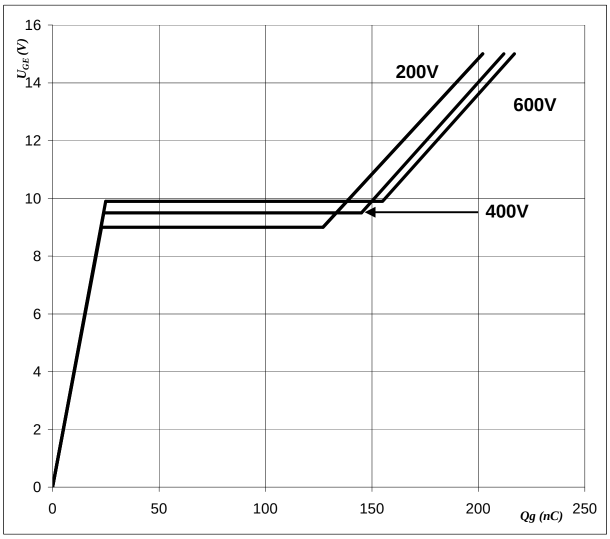
At

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

Figure 26 T1,T2

Gate voltage vs Gate charge

$V_{GS} = f(Qg)$



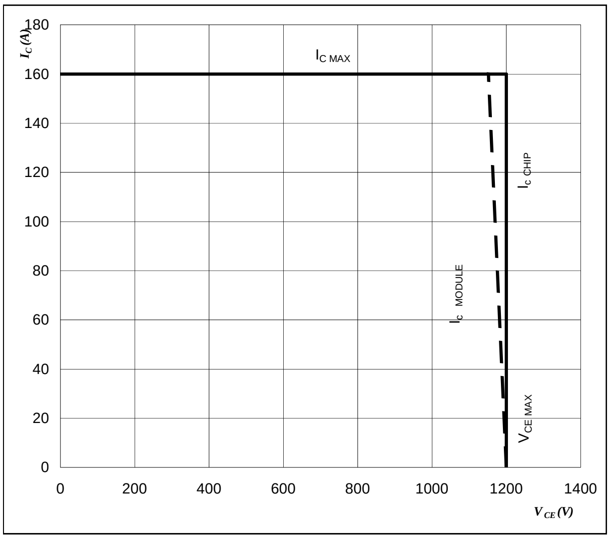
At

I_C =	40	A

Figure 29 T1,T2

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

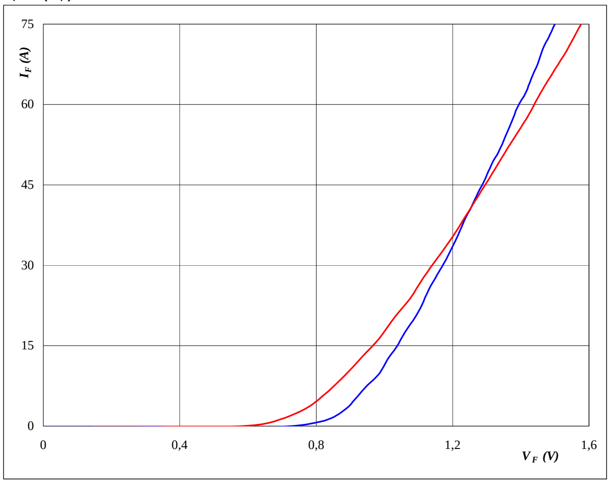
T_{vj} =	150	ºC

D7,D8

Figure 1 D7,D8

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



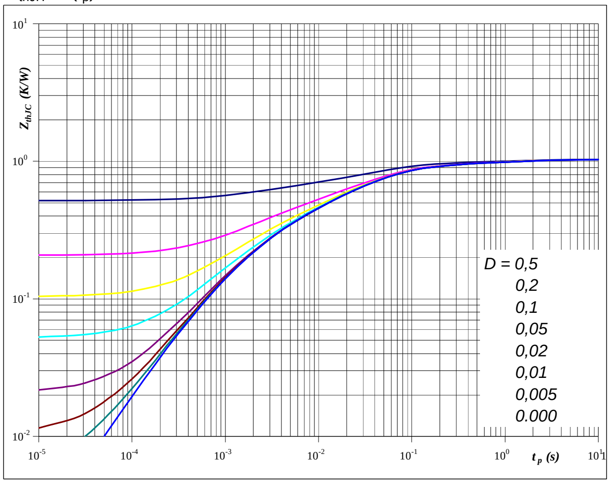
At

T_j =	25/125	°C
t_p =	250	µs

Figure 2 D7,D8

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



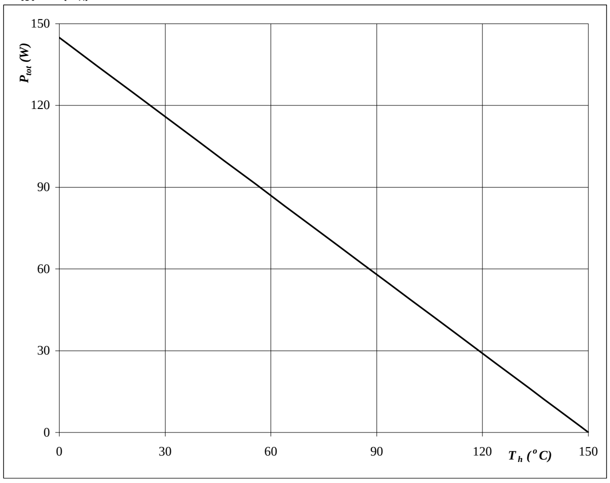
At

D =	t_p / T	
R_{thJH} =	1,04	K/W

Figure 3 D7,D8

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



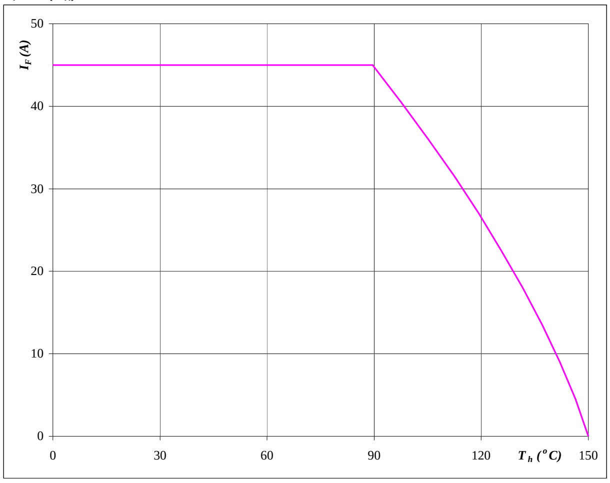
At

T_j =	150	ºC

Figure 4 D7,D8

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

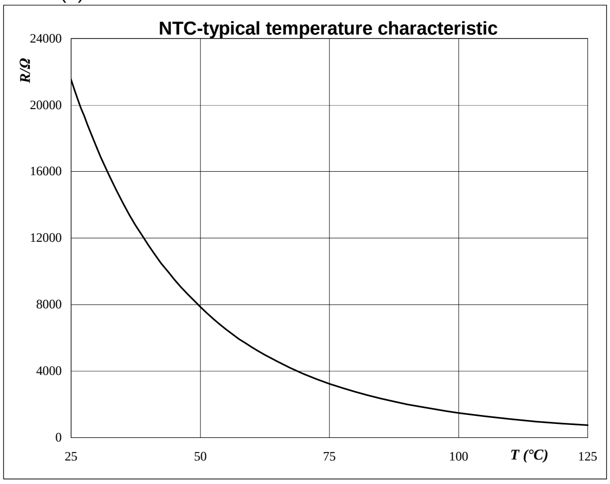
T_j =	150	ºC

Thermistor

Figure 1	Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



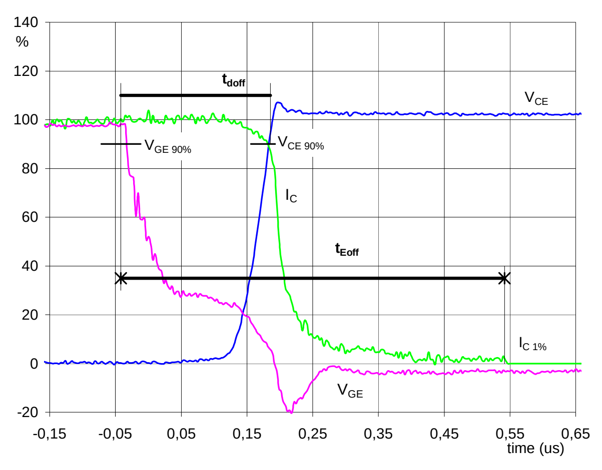
Switching Definitions Boost

General conditions

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

Figure 1 IGBT

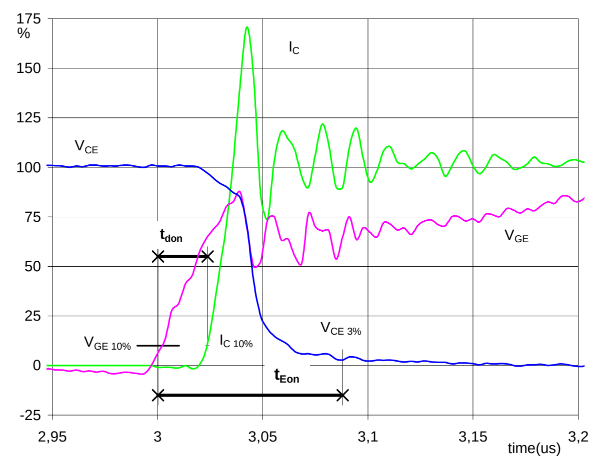
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	40	A
t_{doff} =	0,216	µs
t_{Eoff} =	0,583	µs

Figure 2 IGBT

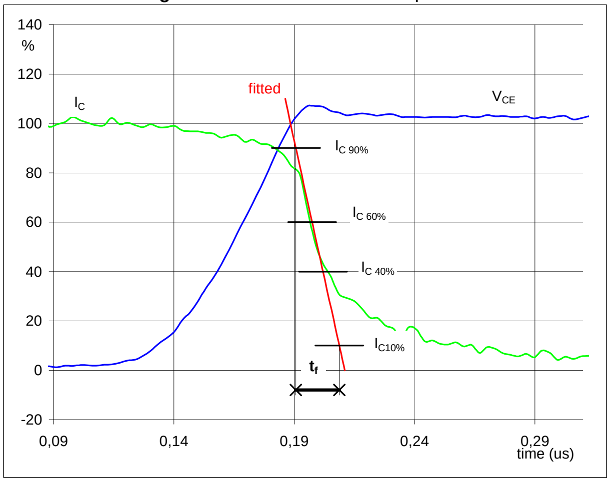
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	40	A
t_{don} =	0,023	µs
t_{Eon} =	0,088	µs

Figure 3 IGBT

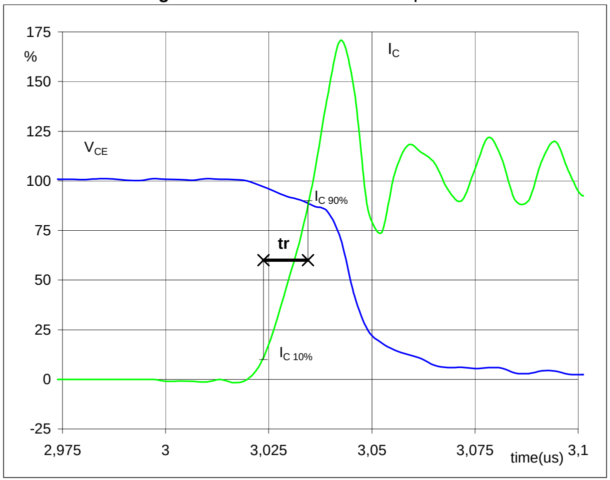
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	40	A
t_f =	0,032	µs

Figure 4 IGBT

Turn-on Switching Waveforms & definition of t_r

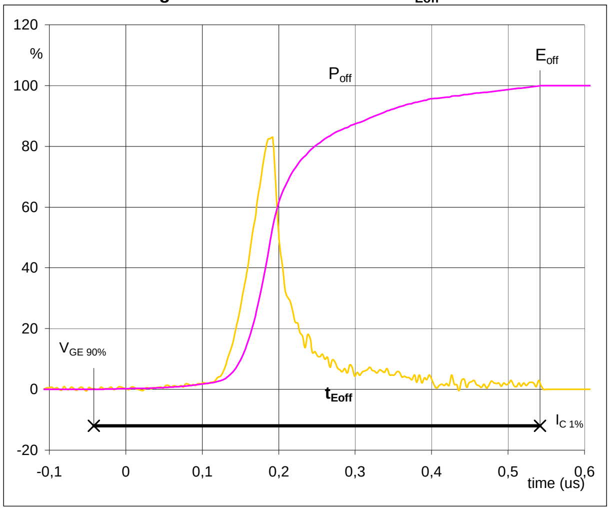


V_C (100%) =	700	V
I_C (100%) =	40	A
t_r =	0,011	µs

Switching Definitions Boost

Figure 5 IGBT

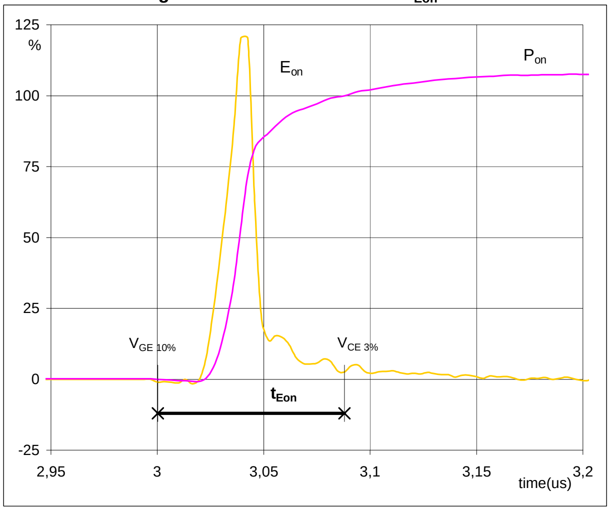
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	27,92	kW
E_{off} (100%) =	1,68	mJ
t_{Eoff} =	0,583	μs

Figure 6 IGBT

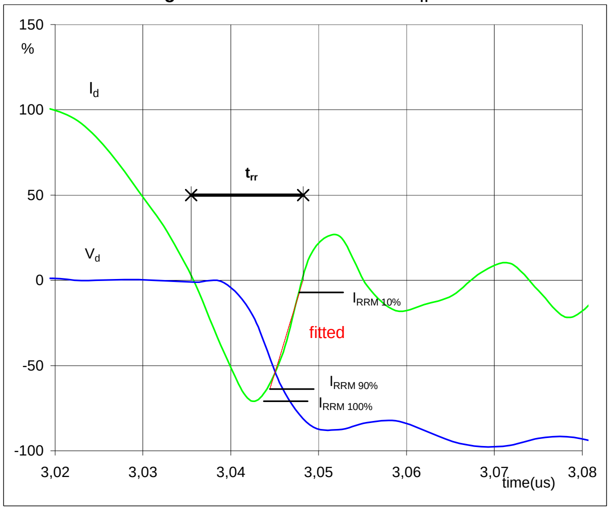
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	27,92	kW
E_{on} (100%) =	0,63	mJ
t_{Eon} =	0,0877	μs

Figure 7 IGBT

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

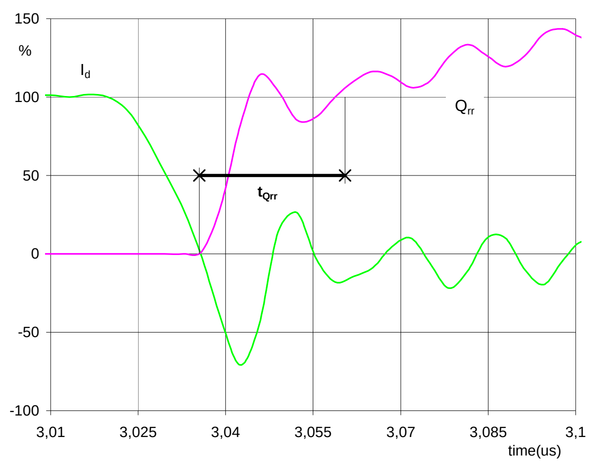


V_d (100%) =	700	V
I_d (100%) =	40	A
I_{RRM} (100%) =	-28	A
t_{rr} =	0,013	μs

Switching Definitions Boost

Figure 8 FWD

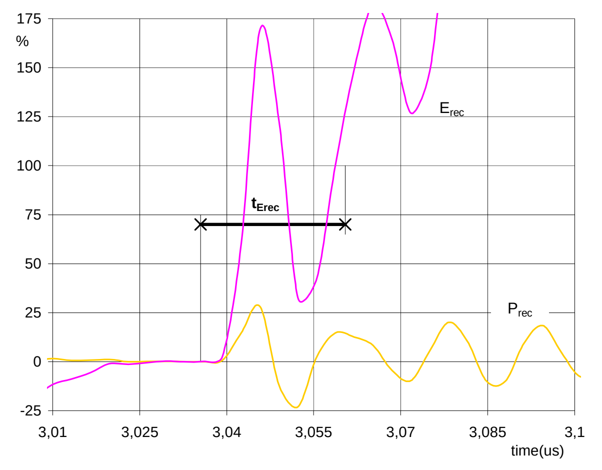
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	40	A
Q_{rr} (100%) =	0,19	µC
t_{Qrr} =	0,02	µs

Figure 9 FWD

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



P_{rec} (100%) =	27,92	kW
E_{rec} (100%) =	0,03	mJ
t_{Erec} =	0,02	µs

Ordering Code and Marking - Outline - Pinout

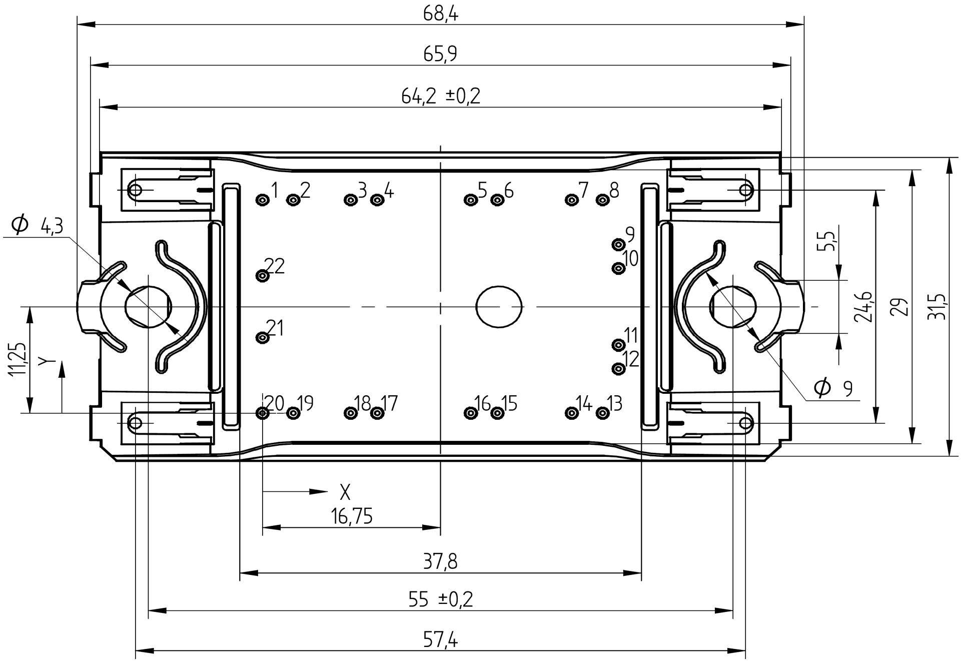
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 17mm housing	V23990-P629-L99-PM	P629-L99	P629-L99

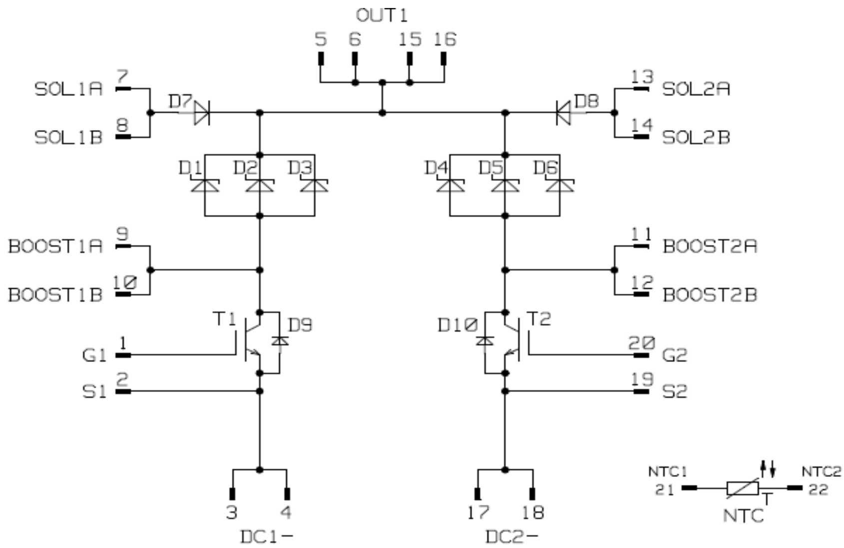
Outline

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



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