flowMNPC 1 | **1200V/160A**

Features

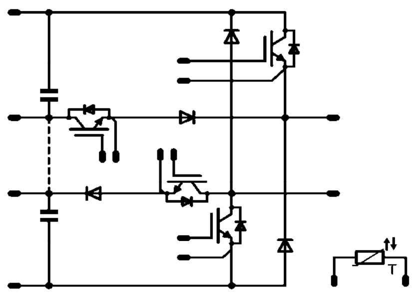
- mixed voltage NPC topology
- reactive power capability
- low inductance layout
- Split output
- enhanced LVRT capability

flow1 12mm housing

Target Applications

- solar inverter
- UPS
- Active frontend

Schematic



Types

- 10-FY12NMA160SH01-M820F18
- 10-PY12NMA160SH01-M820F18Y

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Halfbridge IGBT Inverse Diode					
Repetitive peak reverse voltage	V_{RRM}			1200	V
Forward current per diode	I_{FAV}	DC current	T_h=80℃ T_c=80℃	14 19	A
Repetitive peak forward current	I_{FSM}	t_p=10ms	T_j=25℃	14	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	31 47	W
Maximum Junction Temperature	$T_j$max			150	℃
Halfbridge IGBT					
Collector-emitter break down voltage	V_{CES}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	117 151	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		480	A
Turn off safe operating area		T_j≤150℃ V_{CE}<=V_{CES}		480	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	260 394	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 800	µs V
Maximum Junction Temperature	$T_j$max			175	℃

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
NP Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25℃		700	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	53 72	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	63 96	W
Maximum Junction Temperature	$T_j$max			150	℃
NP IGBT					
Collector-emitter break down voltage	V_{CES}			650	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	76 101	A
Pulsed collector current	I_{Cpuls}	t_p limited by $T_j$max		450	A
Turn off safe operating area		T_j≤150℃ V_{CE}<=V_{CES}		450	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	96 145	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		6 360	µs V
Maximum Junction Temperature	$T_j$max			175	℃
NP Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	15 21	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		30	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	28 42	W
Maximum Junction Temperature	$T_j$max			175	℃
Halfbridge Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	31 46	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		140	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	61 92	W
Maximum Junction Temperature	$T_j$max			150	℃

Maximum Ratings

Tj=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
DC link Capacitor				
Max.DC voltage	V_{MAX}	Tc=25℃	630	V
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	℃
Operation temperature under switching condition	T_{op}		-40…+(Tjmax - 25)	℃
Insulation Properties				
Insulation voltage	V_{is}	t=2s DC voltage	4000	V
Creepage distance			min 12,7	mm
Clearance			min 8,06	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
Halfbridge IGBT Inverse Diode										
Forward voltage	V_F				7	Tj=25℃ Tj=125℃		1,97 1,65	2,7	V
Reverse current	I_r			1200		Tj=25℃ Tj=125℃			0,25	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,24		K/W
Halfbridge IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,006	Tj=25℃ Tj=125℃	5	5,80	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		160	Tj=25℃ Tj=125℃	1	2,02 2,37	2,70	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25℃ Tj=125℃			0,25	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			480	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	±15	350	100	Tj=25℃ Tj=125℃		127 129		ns
Rise time	t_r					Tj=25℃ Tj=125℃		26 30		ns
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		219 274		ns
Fall time	t_f					Tj=25℃ Tj=125℃		45 59		ns
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		1,52 2,60		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		2,69 4,19		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		9200		pF
Output capacitance	C_{oss}							600		pF
Reverse transfer capacitance	C_{rss}							540		pF
Gate charge	Q_{Gate}		±15	960	160	Tj=25℃		740		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,37		K/W
NP Diode										
Diode forward voltage	V_F				150	Tj=25℃ Tj=125℃	1	2,00 1,88	2,6	V
Reverse leakage current	I_r			700		Tj=25℃ Tj=125℃			50	µA
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	350	100	Tj=25℃ Tj=125℃		86 113		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		57 109		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		2,93 7,16		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		3683 1519		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=125℃		0,53 1,38		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,11		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
NP IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,008	Tj=25℃ Tj=125℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	Tj=25℃ Tj=125℃	1,05	1,48 1,62	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	650		Tj=25℃ Tj=125℃			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			700	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	±15	700	100	Tj=25℃ Tj=125℃		170 171		ns
Rise time	t_r					Tj=25℃ Tj=125℃		29 31		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		235 265		
Fall time	t_f					Tj=25℃ Tj=125℃		54 71		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		1,29 1,70		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		2,88 3,95		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		9240		pF
Output capacitance	C_{oss}							276		
Reverse transfer capacitance	C_{rss}							274		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,99		K/W
NP Inverse Diode										
Diode forward voltage	V_F				15	Tj=25℃ Tj=125℃	1,23	1,89 1,79	2,20	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,43		K/W
Halfbridge Diode										
Diode forward voltage	V_F				150	Tj=25℃ Tj=125℃		2,46 2,07	3,5	V
Reverse leakage current	I_r			1200		Tj=25℃ Tj=125℃			200	µA
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	700	100	Tj=25℃ Tj=125℃		83 116		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		113 136		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		6,17 12,86		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		2952 3586		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		1,66 3,63		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,15		K/W
DC link Capacitor										
C value	C						80	100	120	nF
Thermistor										
Rated resistance	R					T=25℃		21511		Ω
Deviation of R25	ΔR/R	R100=1486 Ω				T=100℃	-4,5		+4,5	%
Power dissipation	P					T=25℃		210		mW
Power dissipation constant						T=25℃		3,5		mW/K
B-value	B(25/50)					T=25℃		3884		K
B-value	B(25/100)					T=25℃		3964		K
Vincotech NTC Reference									F	

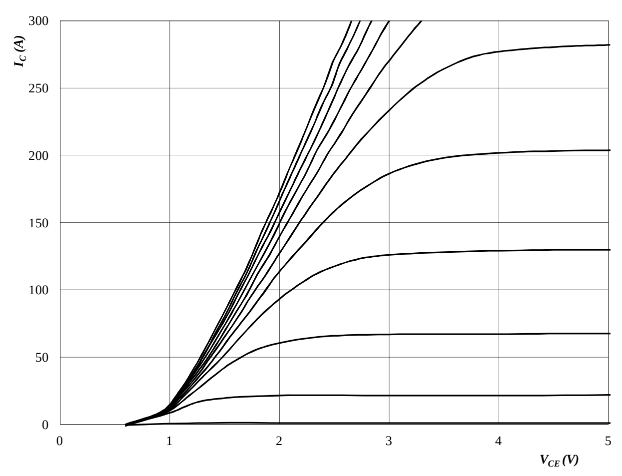
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



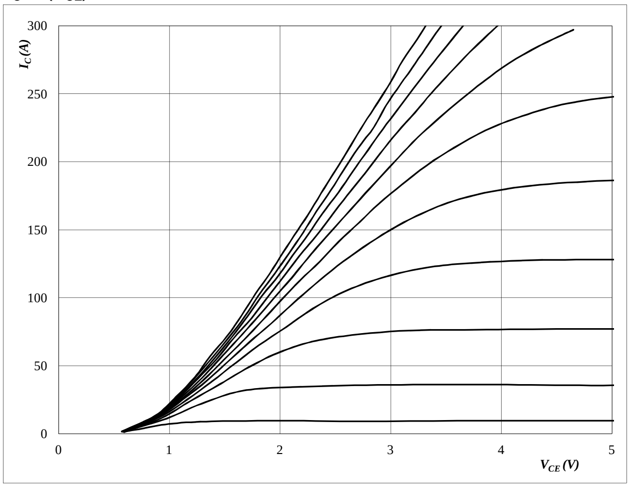
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



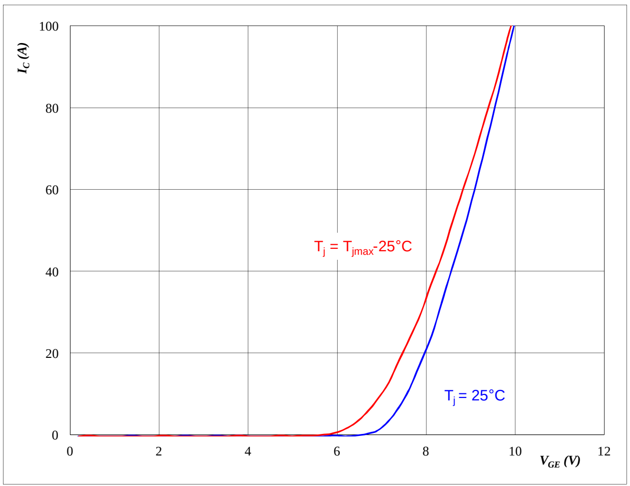
At

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



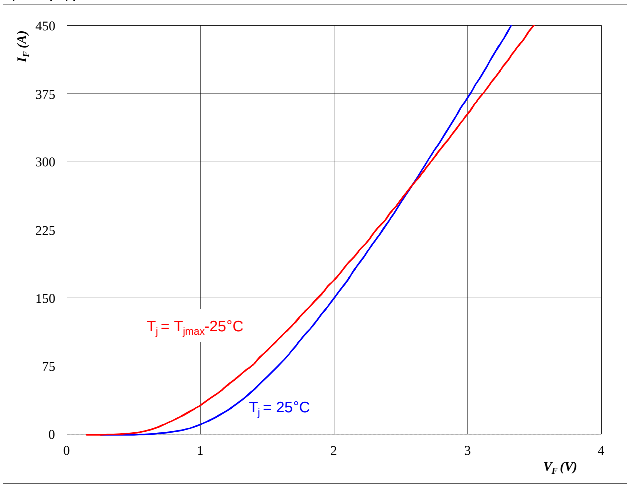
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	μs

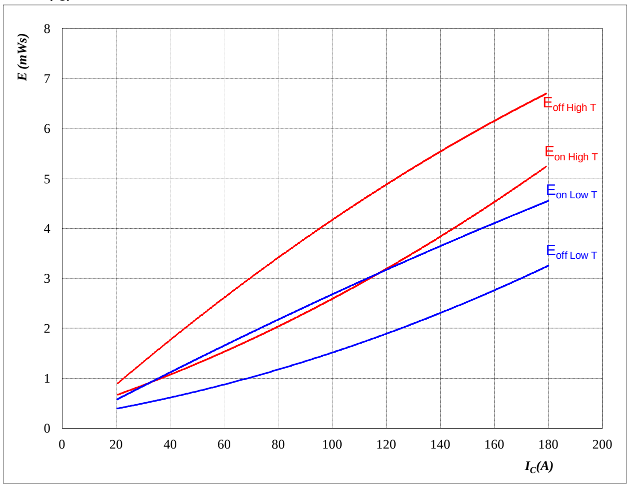
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



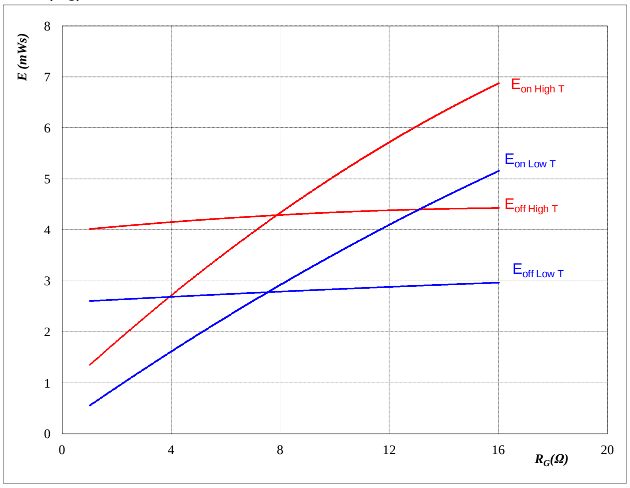
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



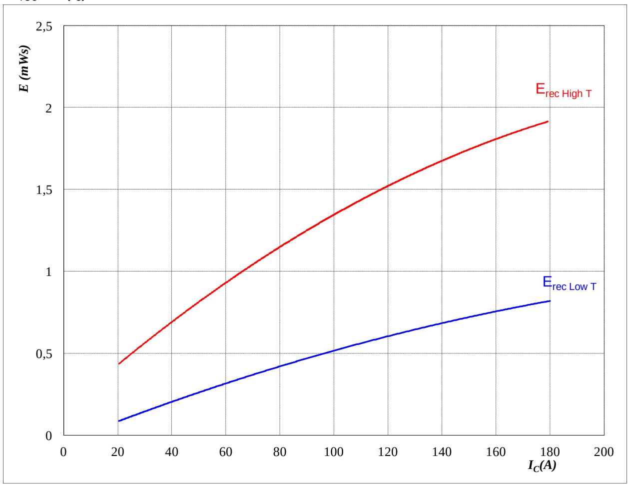
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



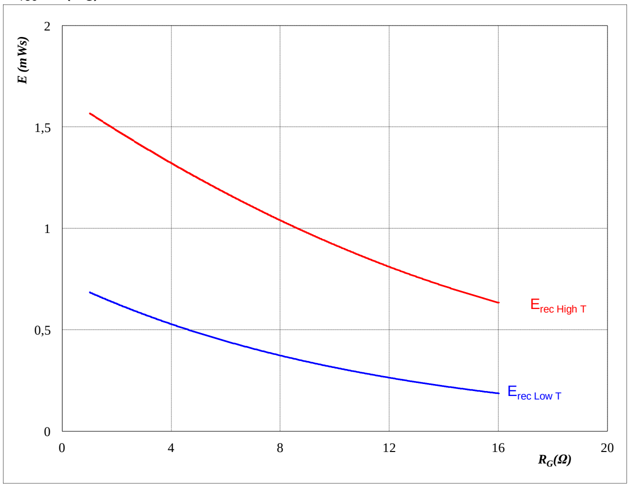
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 8 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_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

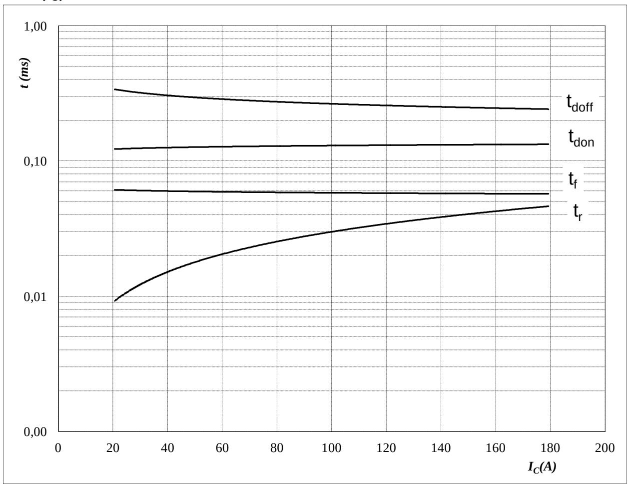
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



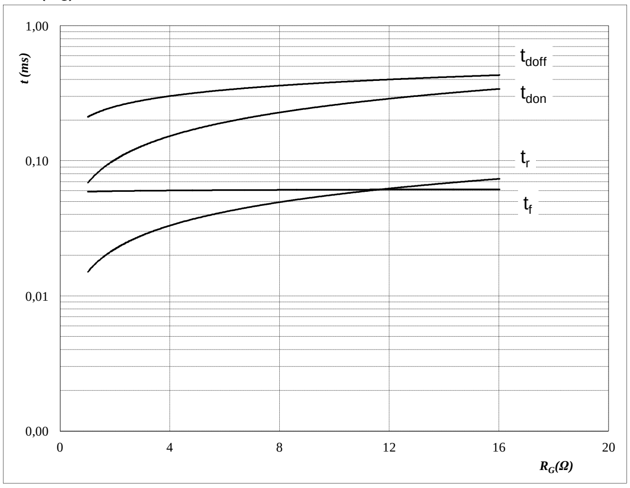
With an inductive load at

T_j =	125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



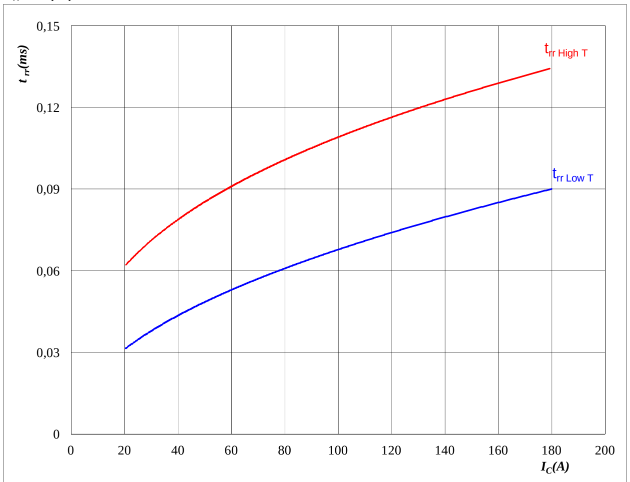
With an inductive load at

T_j =	125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



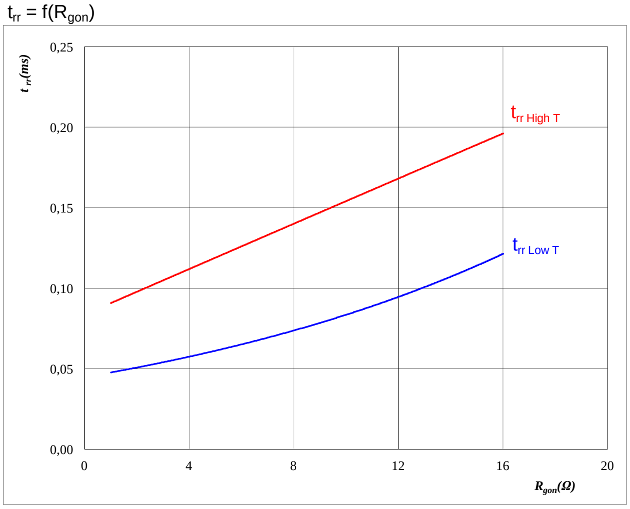
At

T_j =	25/125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 12 FWD

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

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



At

T_j =	25/125	℃
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

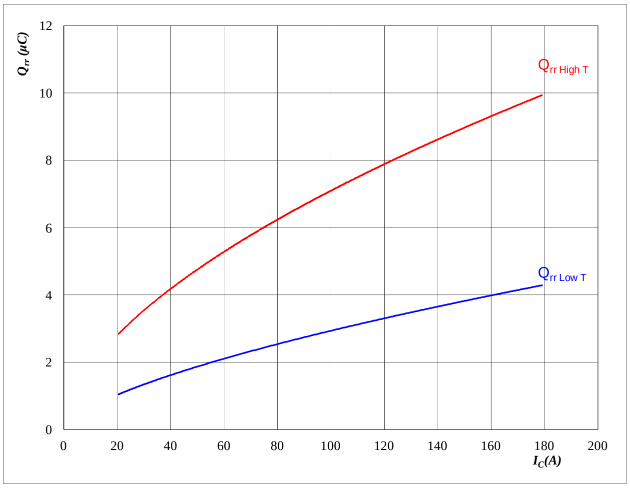
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



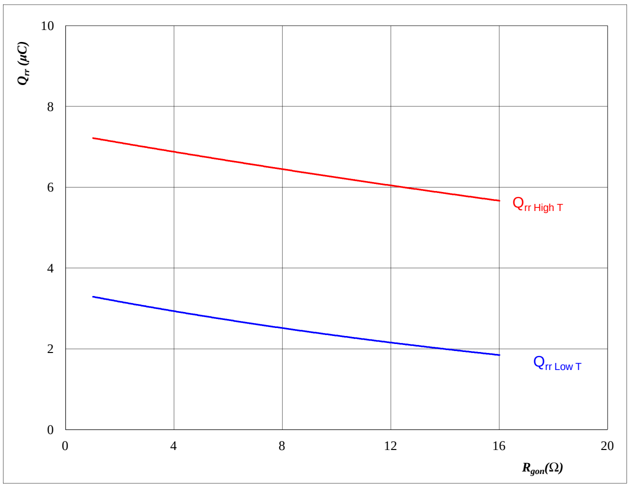
At

T_j =	25/125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 14 FWD

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

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



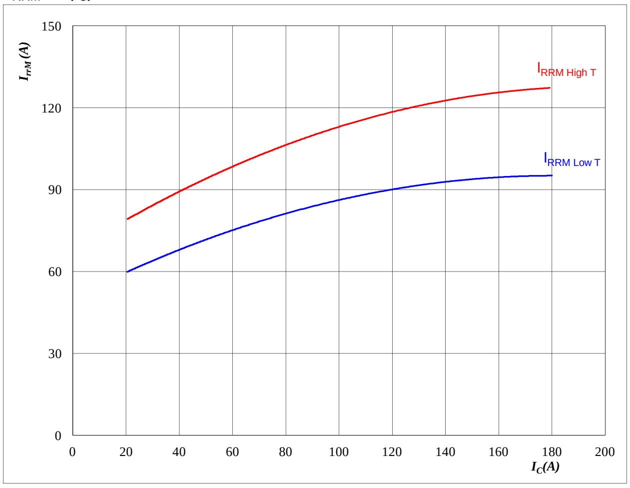
At

T_j =	25/125	℃
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



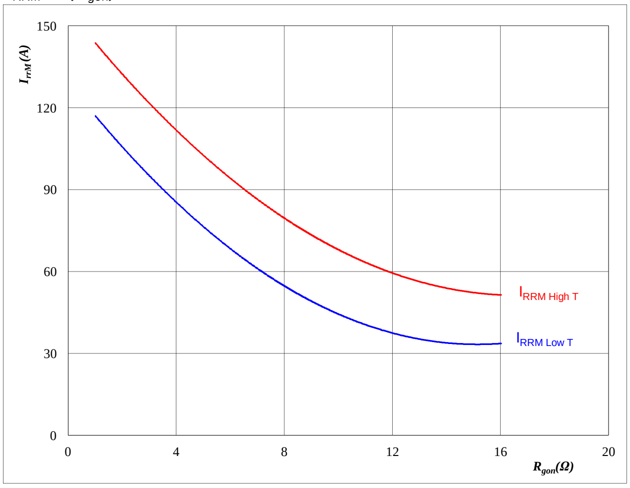
At

T_j =	25/125	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 16 FWD

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

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



At

T_j =	25/125	℃
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

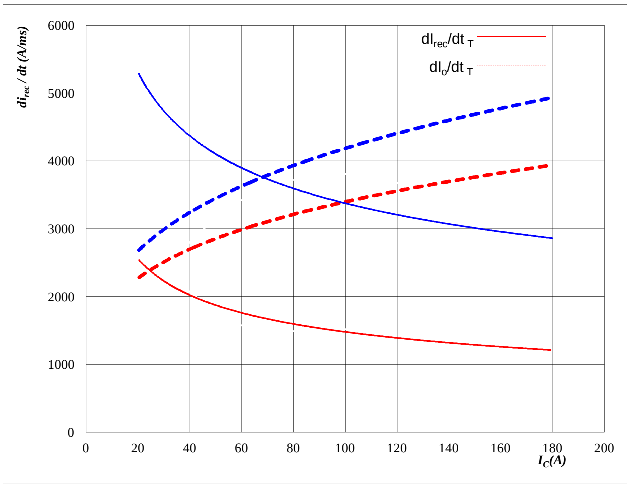
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 17 FWD

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

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



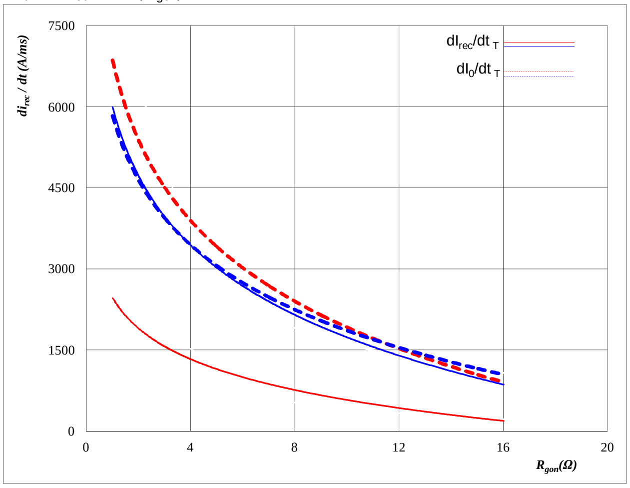
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 18 FWD

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

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



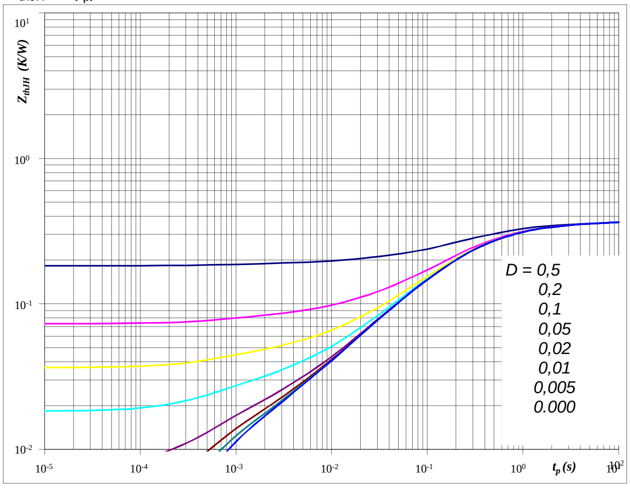
At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Figure 19 IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,37	K/W

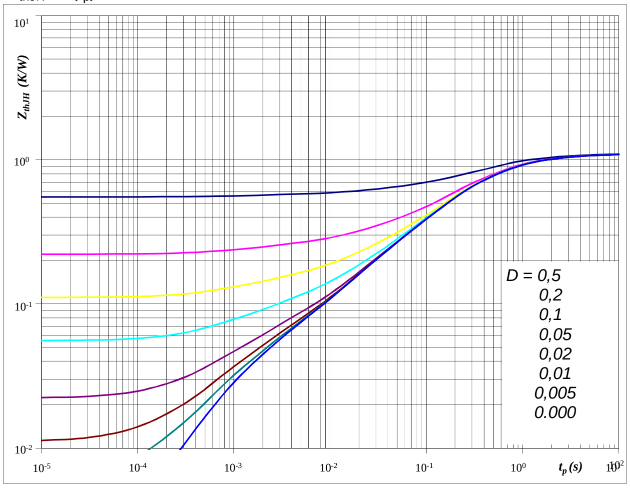
IGBT thermal model values

R (C/W)	Tau (s)
0,06	2,4E+00
0,15	4,0E-01
0,12	1,0E-01
0,03	1,3E-02
0,01	8,4E-04

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1,11	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,07	6,8E+00
0,25	1,2E+00
0,57	2,8E-01
0,12	6,0E-02
0,06	1,3E-02
0,03	1,1E-03

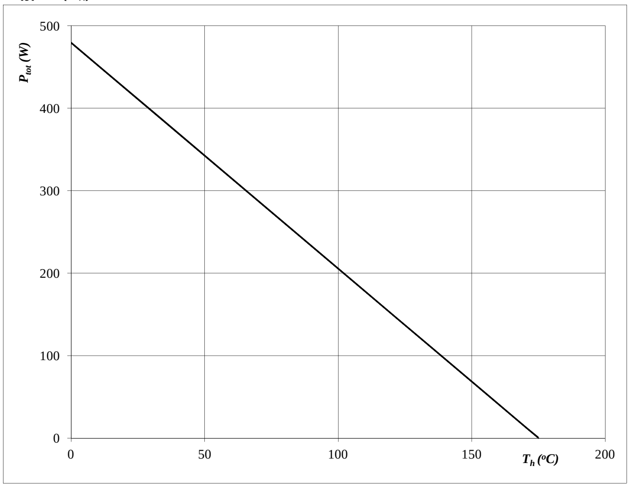
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



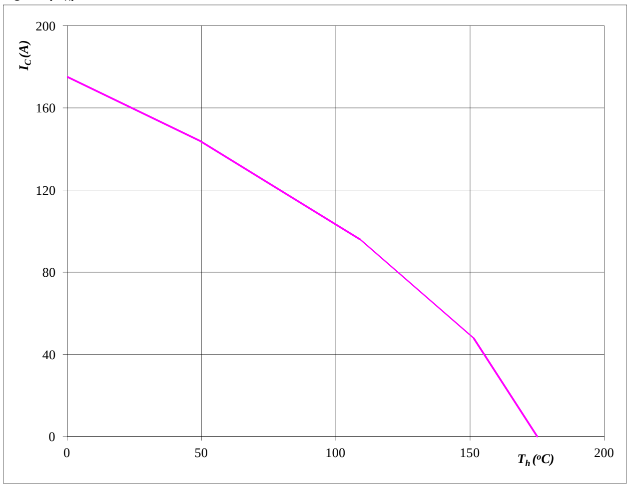
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

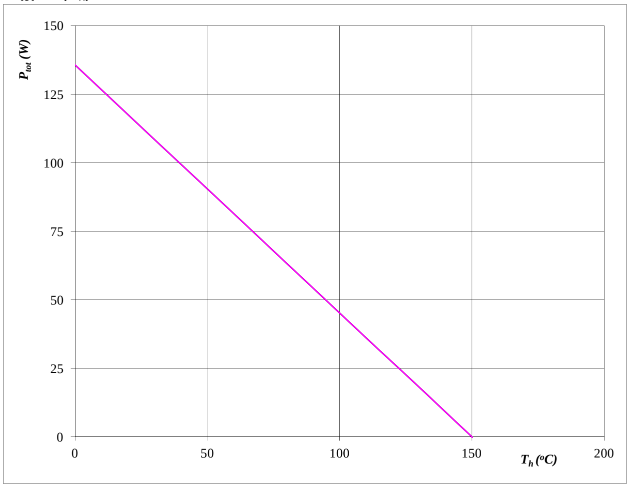
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



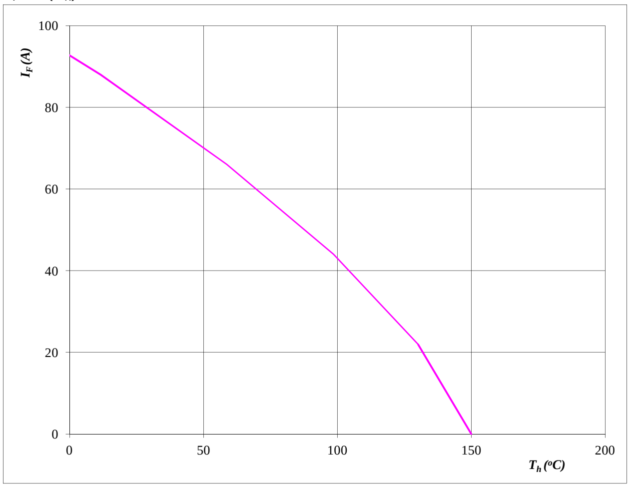
At

T_j = 150 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 ℃

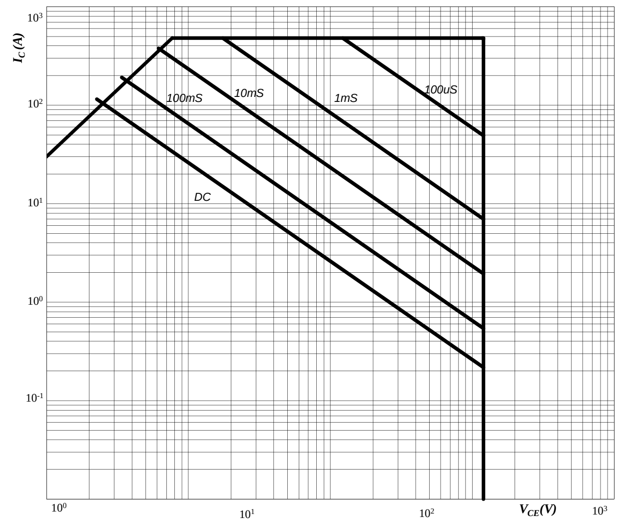
Half Bridge

Half Bridge IGBT and Neutral Point FWD

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



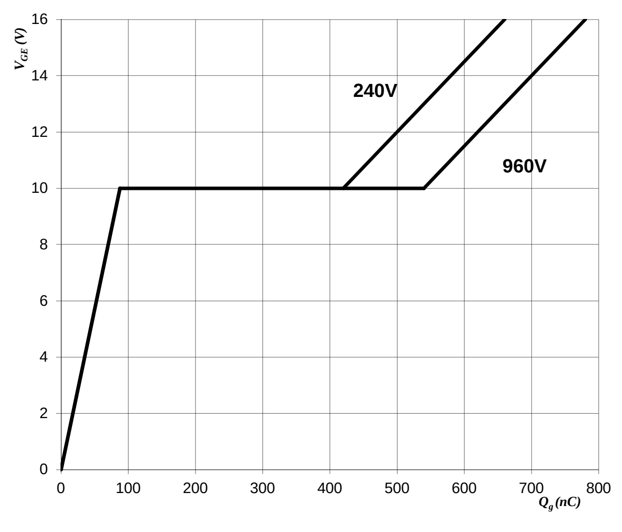
At

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

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

I_C =	160	A

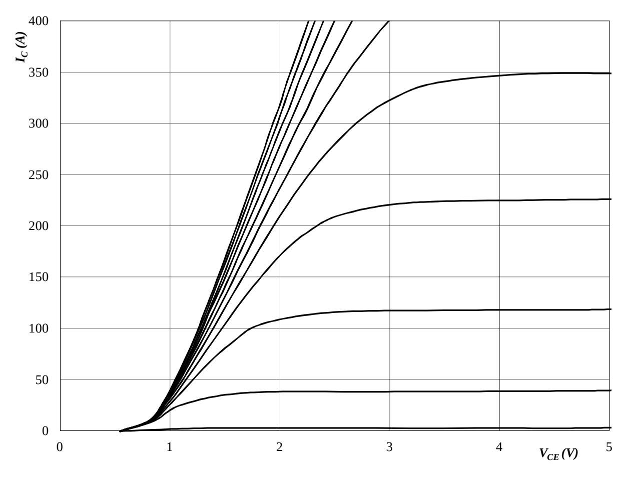
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



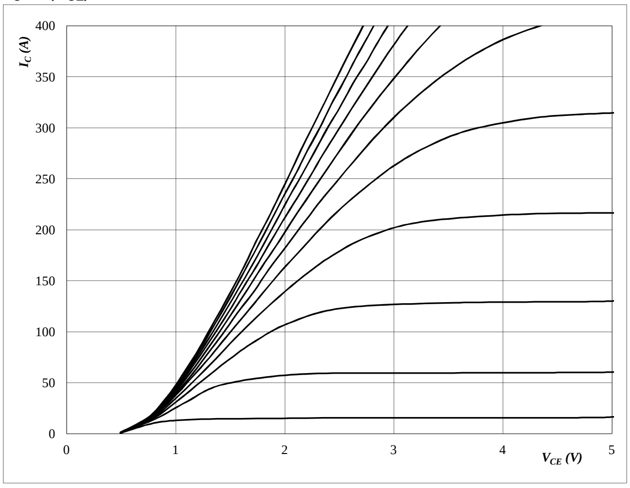
At

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

$I_C = f(V_{CE})$



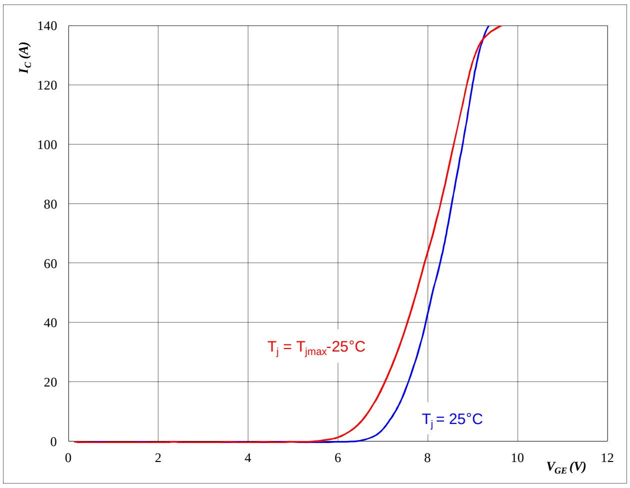
At

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

$I_C = f(V_{GE})$



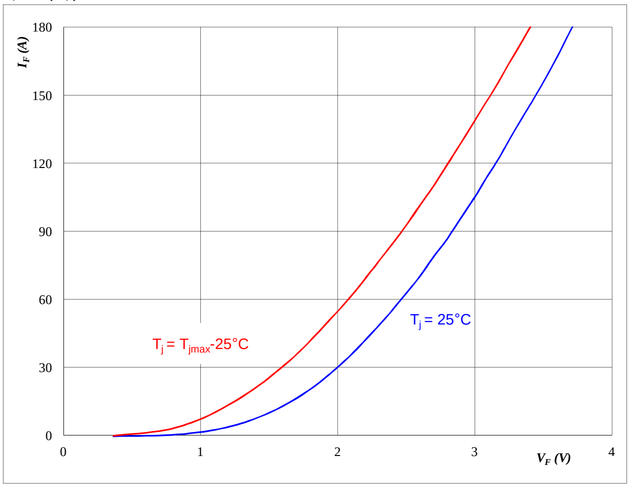
At

t_p =	250	µs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	µs

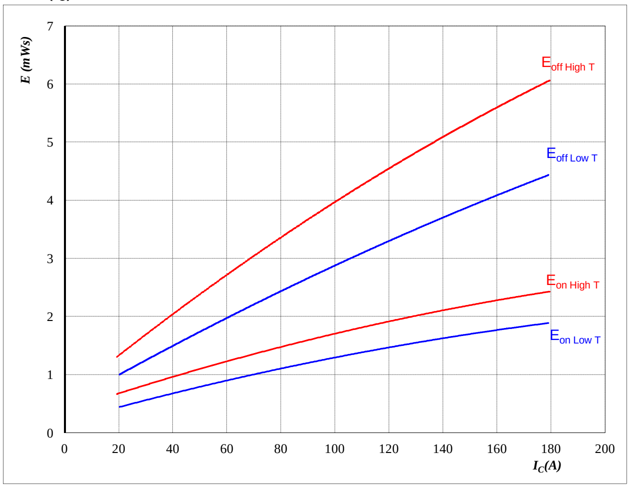
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



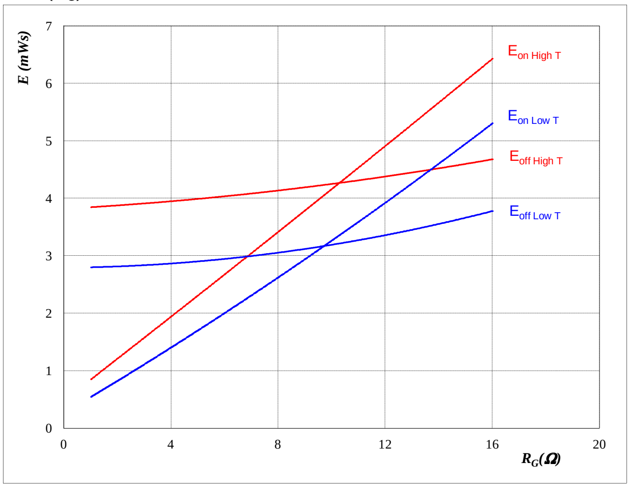
With an inductive load at

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



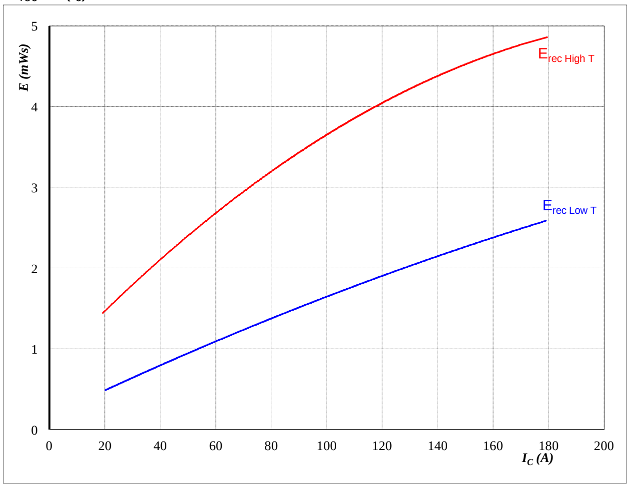
With an inductive load at

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	99	A

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



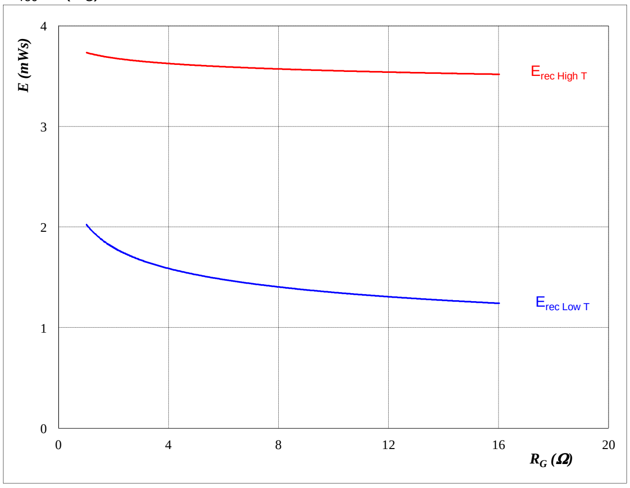
With an inductive load at

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 8 FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	99	A

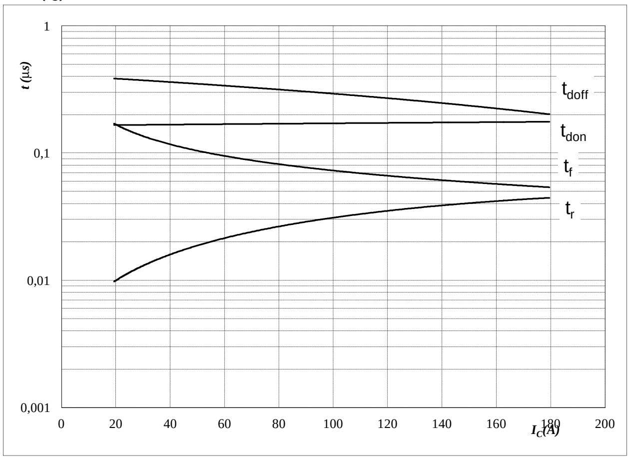
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 9 — IGBT

Typical switching times as a function of collector current

t = f(I_C)



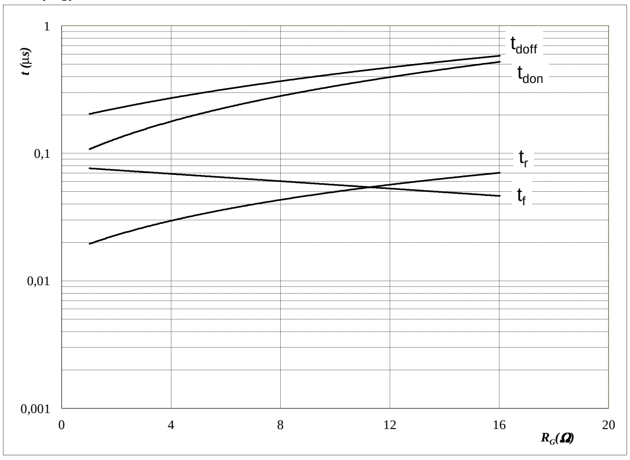
With an inductive load at

T_j =	126	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 — IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



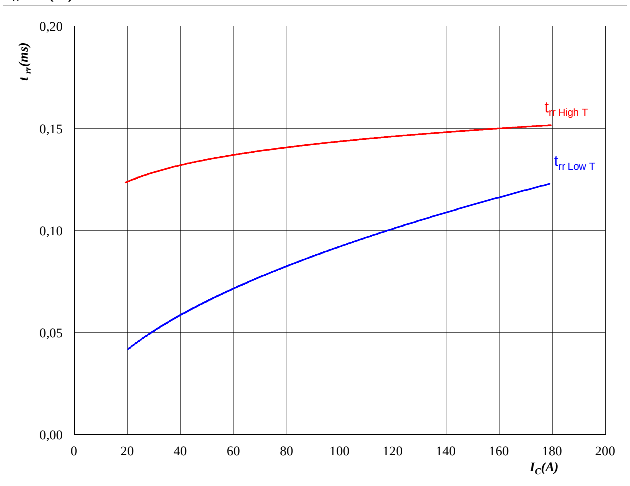
With an inductive load at

T_j =	126	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

Figure 11 — FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



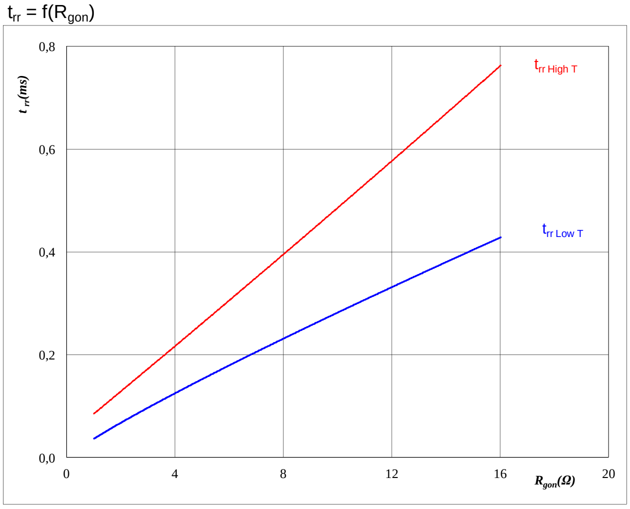
At

T_j =	25/126	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 12 — FWD

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

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



At

T_j =	25/126	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

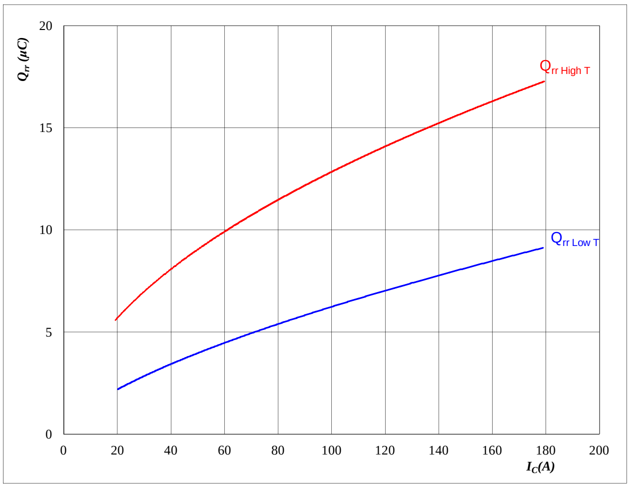
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



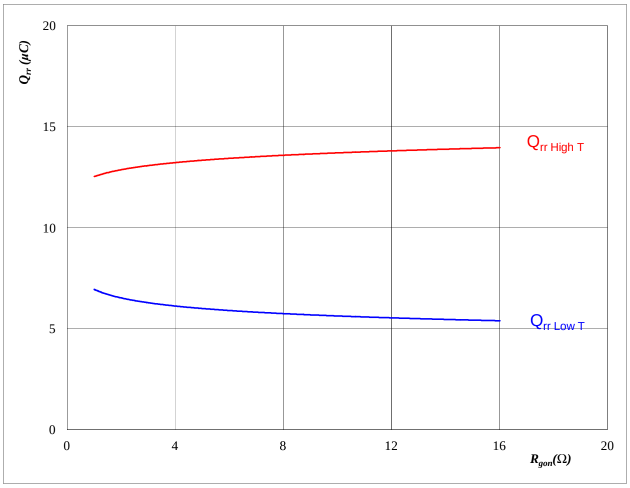
At

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 14 FWD

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

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



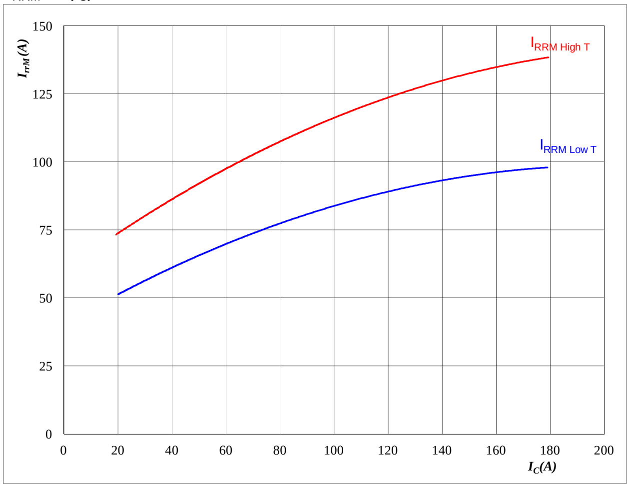
At

T_j =	25/126	℃
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



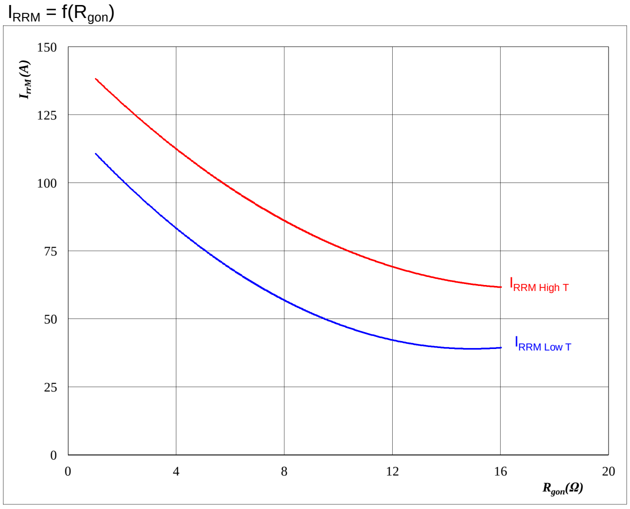
At

T_j =	25/126	℃
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 16 FWD

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

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



At

T_j =	25/126	℃
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

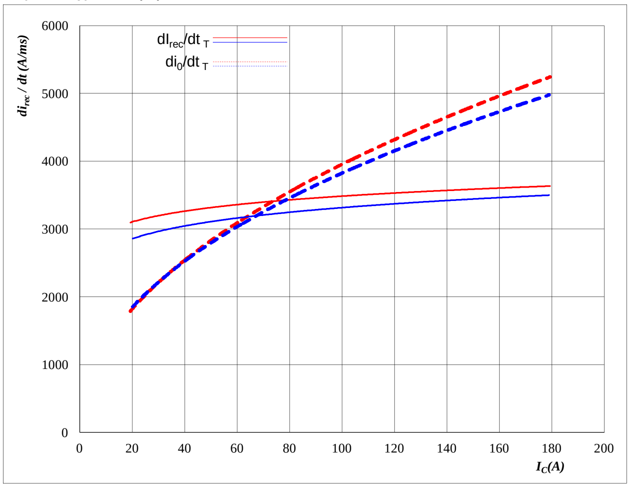
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 17 FWD

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

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



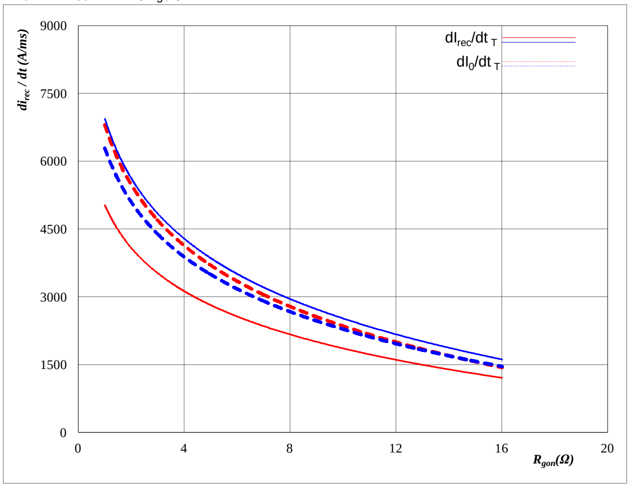
At

T_j =	25/126	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 18 FWD

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

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



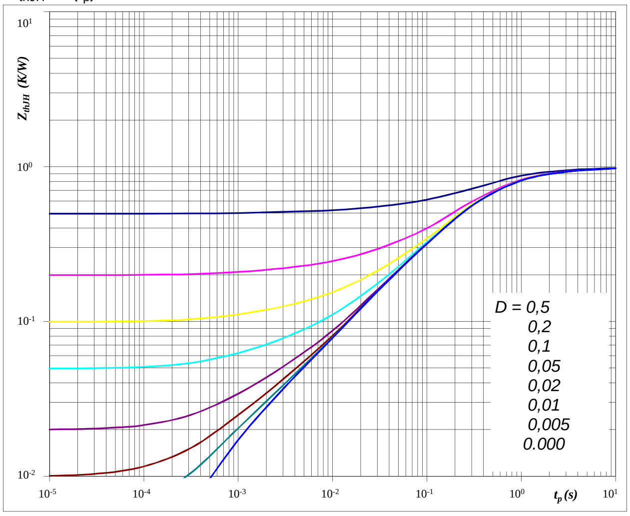
At

T_j =	25/126	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Figure 19 IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	0,99	K/W

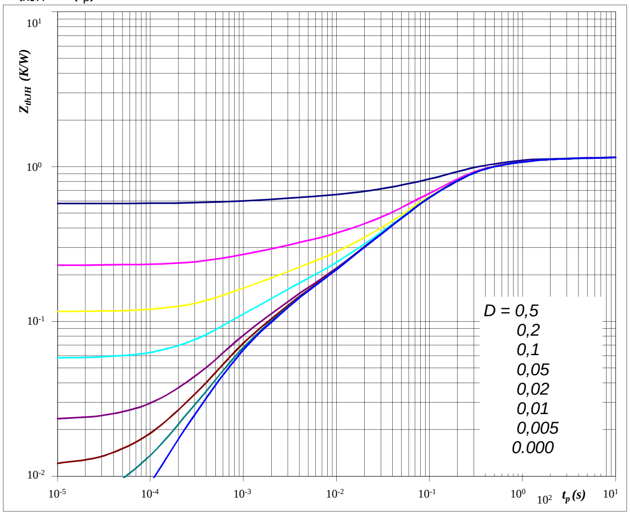
IGBT thermal model values

R (C/W)	Tau (s)
0,08	6,3E+00
0,24	1,1E+00
0,52	2,8E-01
0,09	6,6E-02
0,05	1,3E-02
0,02	1,2E-03

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	1,15	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,05	4,9E+00
0,13	8,2E-01
0,59	1,8E-01
0,22	4,7E-02
0,10	7,8E-03
0,07	9,8E-04

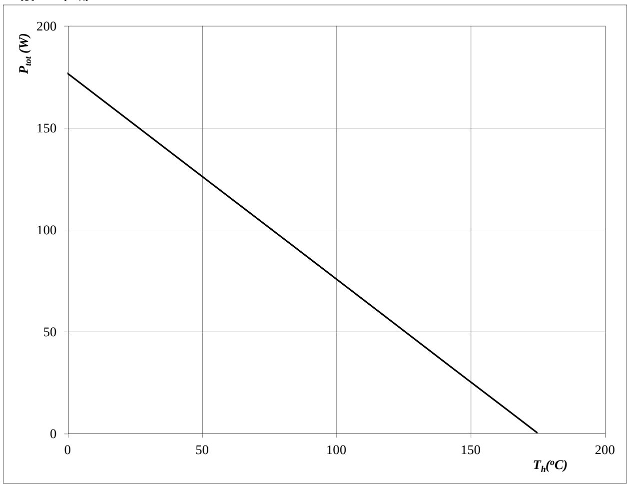
Neutral Point

Neutral Point IGBT and Half Bridge FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



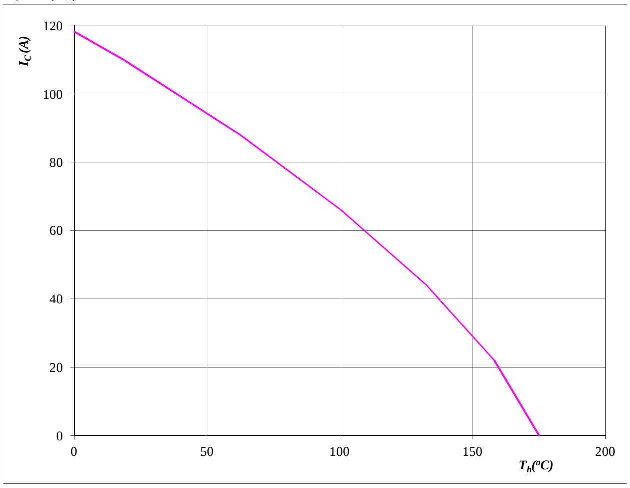
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

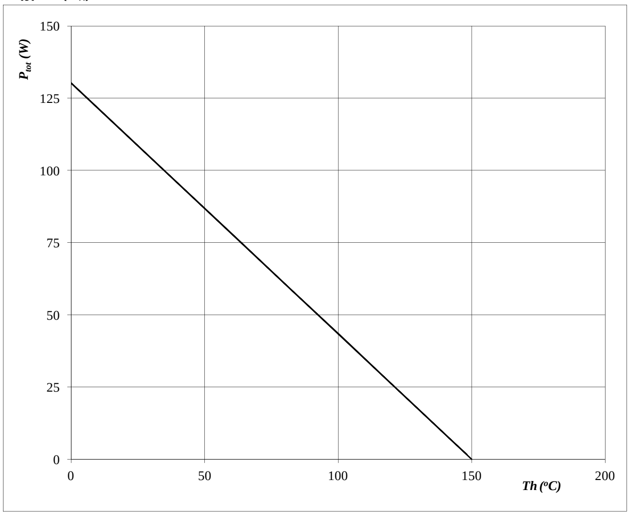
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



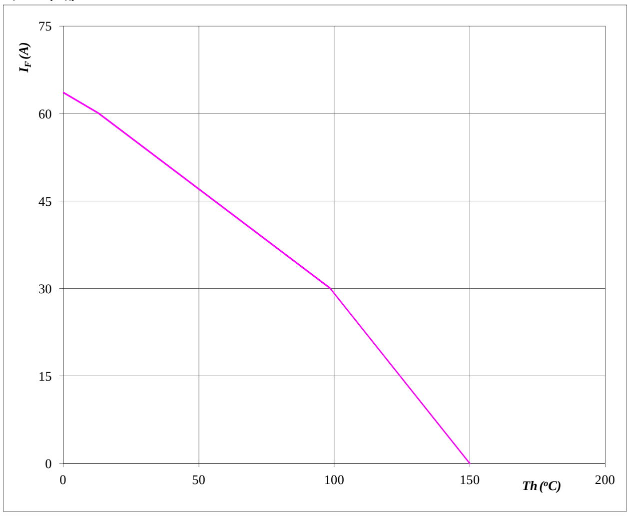
At

T_j = 150 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

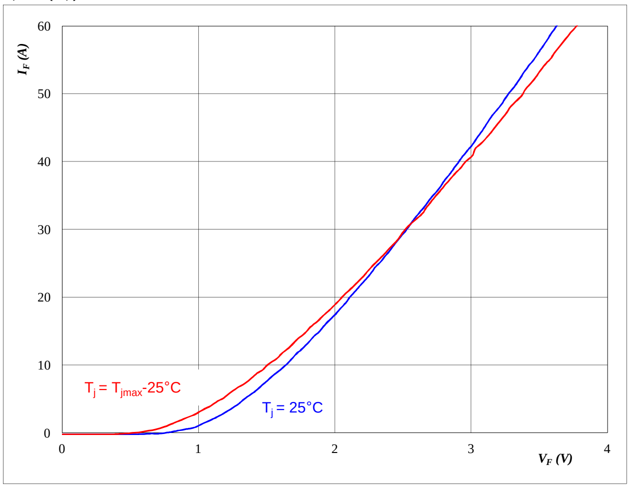
T_j = 150 ºC

NP IGBT Inverse Diode

Figure 25 NP IGBT Inverse Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



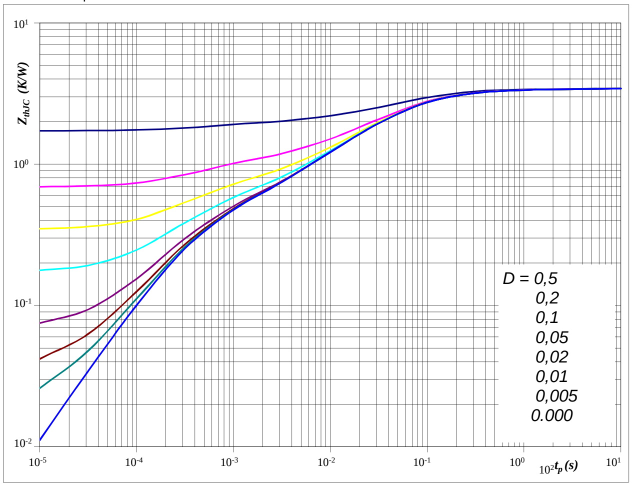
At

t_p =	250	µs

Figure 26 NP IGBT Inverse Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



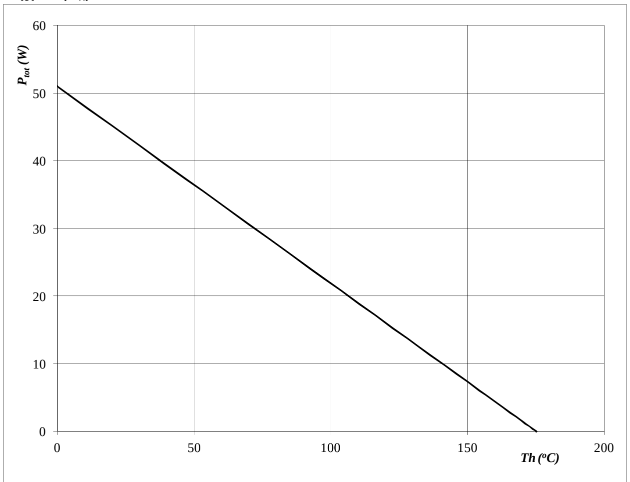
At

D =	tp / T	
R_{thJH} =	3,43	K/W

Figure 27 NP IGBT Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



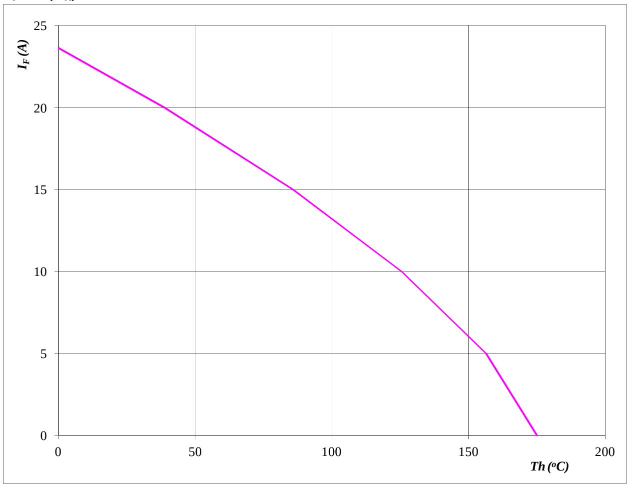
At

T_j =	175	ºC

Figure 28 NP IGBT Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

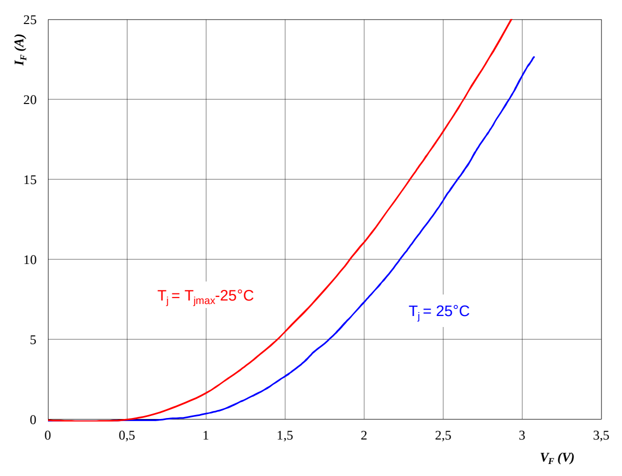
T_j =	175	ºC

Half Bridge Inverse Diode

Figure 1	Half Bridge Inverse Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



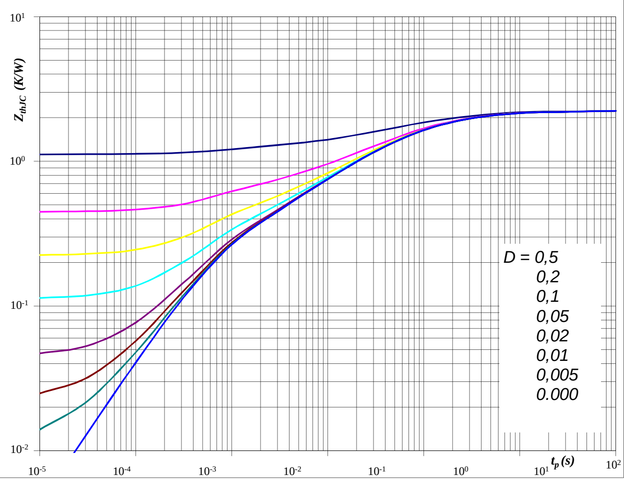
At

t_p = 250 µs

Figure 2	Half Bridge Inverse Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

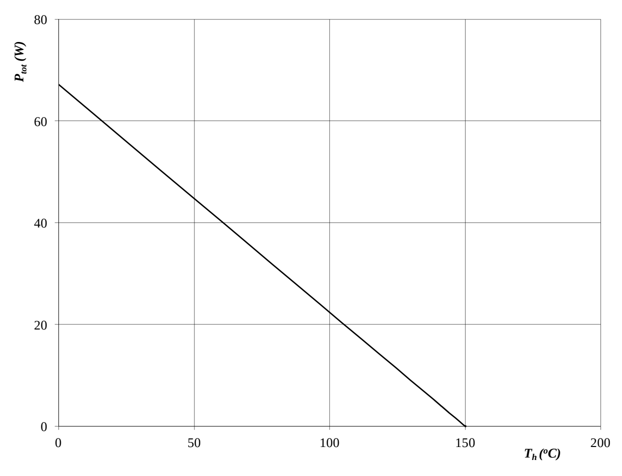
D = t_p / T

R_{thJH} = 2,24 K/W

Figure 3	Half Bridge Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



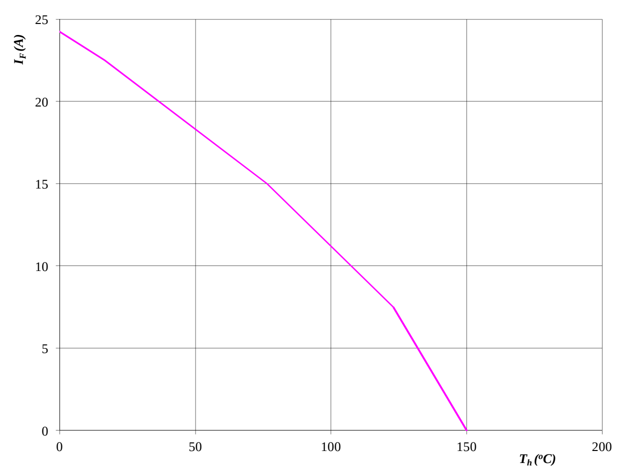
At

T_j = 150 ºC

Figure 4	Half Bridge Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



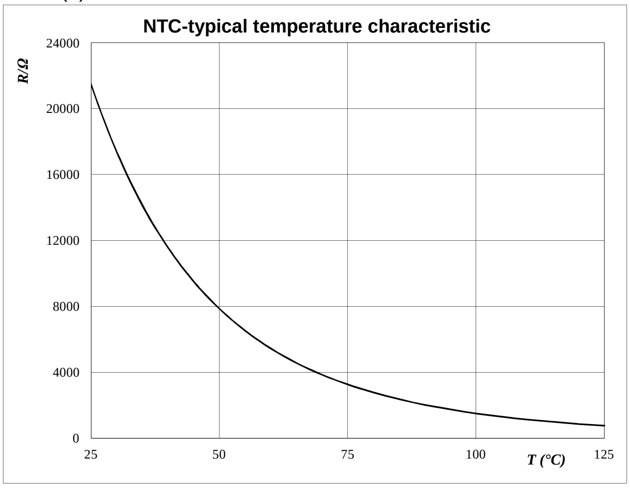
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



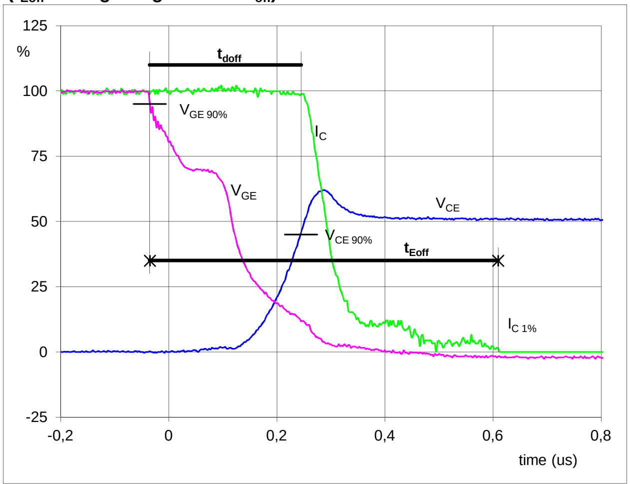
Switching Definitions Half Bridge

General conditions

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

Figure 1 Half Bridge IGBT

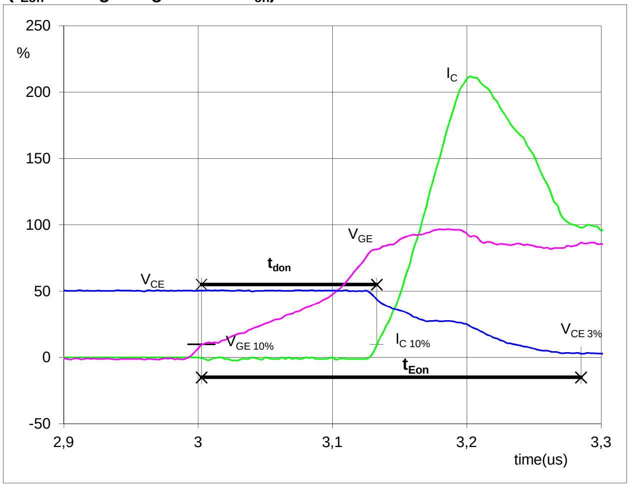
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{doff} =	0,27	µs
t_{Eoff} =	0,64	µs

Figure 2 Half Bridge IGBT

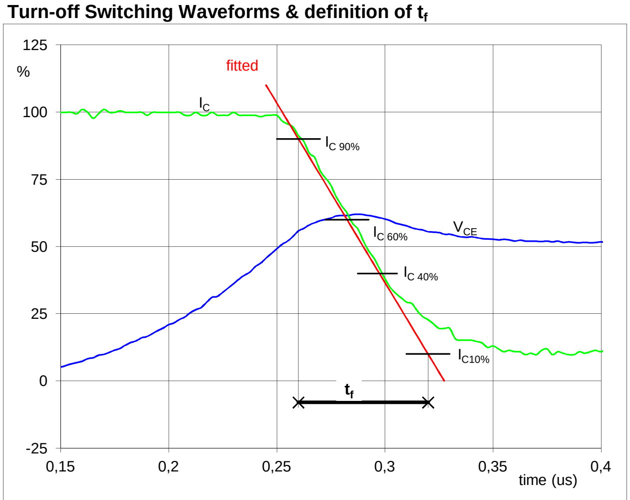
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{don} =	0,13	µs
t_{Eon} =	0,28	µs

Figure 3 Half Bridge IGBT

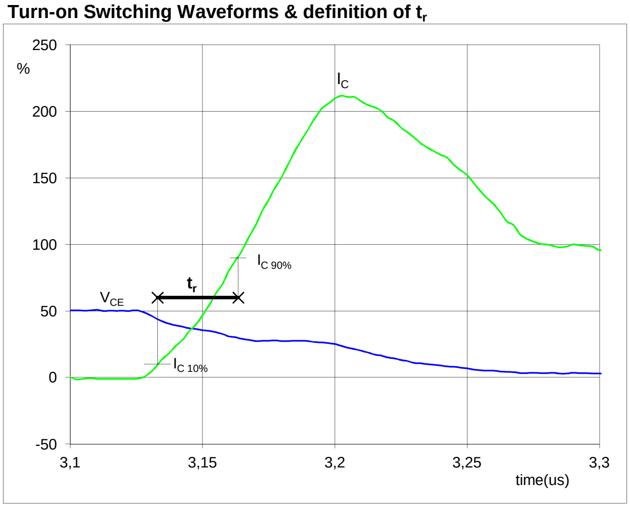
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	100	A
t_f =	0,06	µs

Figure 4 Half Bridge IGBT

Turn-on Switching Waveforms & definition of t_r

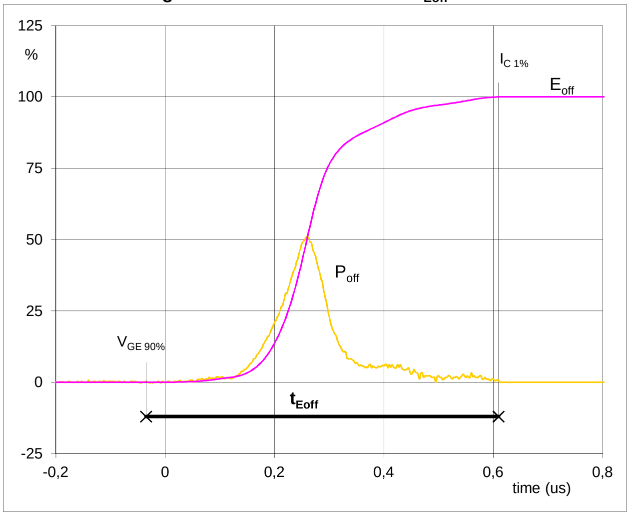


V_C (100%) =	700	V
I_C (100%) =	100	A
t_r =	0,03	µs

Switching Definitions Half Bridge

Figure 5 Half Bridge IGBT

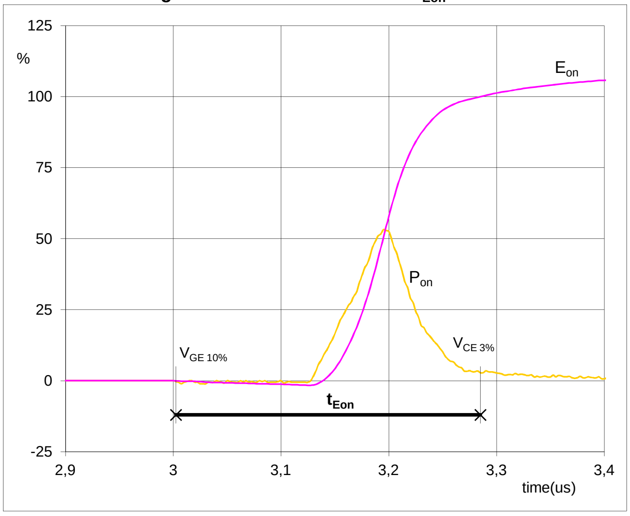
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	70,11	kW
E_{off} (100%) =	4,19	mJ
t_{Eoff} =	0,64	µs

Figure 6 Half Bridge IGBT

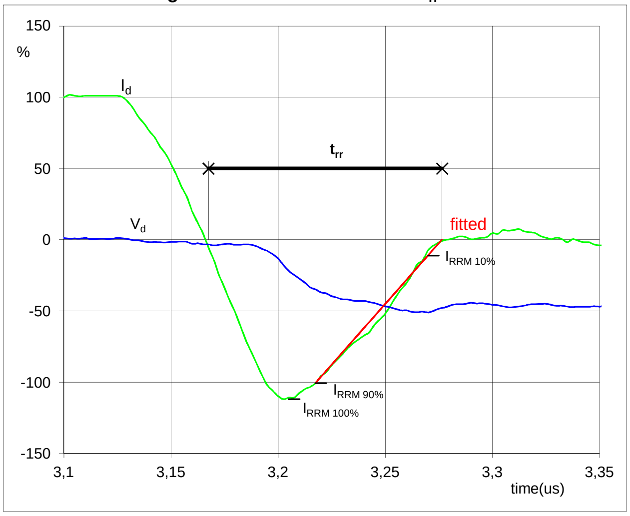
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	70,11	kW
E_{on} (100%) =	2,60	mJ
t_{Eon} =	0,28	µs

Figure 7 Half Bridge FWD

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

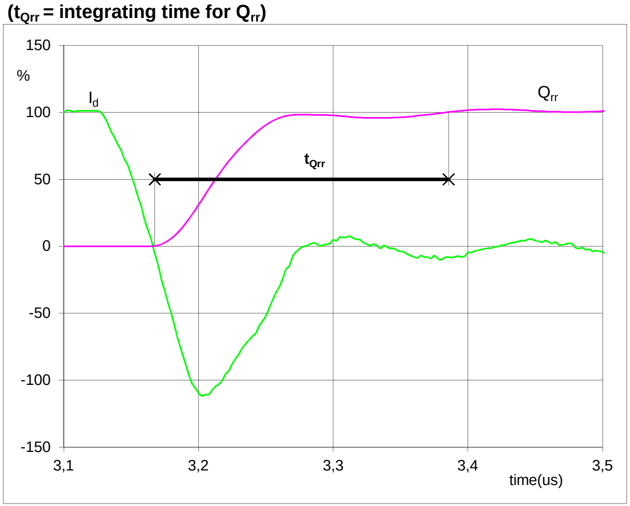


V_d (100%) =	700	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-113	A
t_{rr} =	0,11	µs

Switching Definitions Half Bridge

Figure 8 0

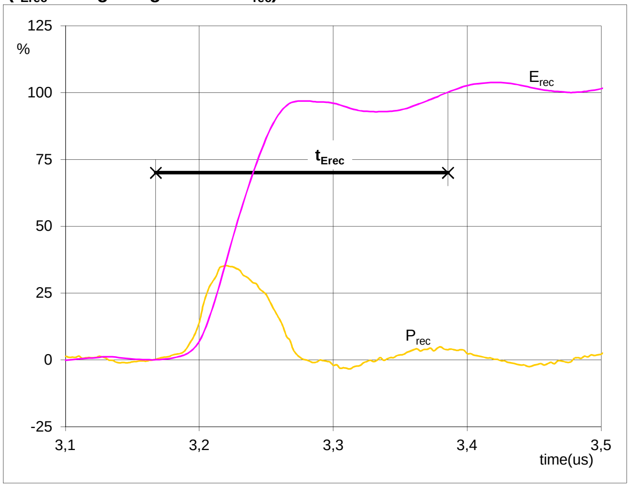
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	7,16	μC
t_{Qrr} =	0,22	μs

Figure 9 0

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

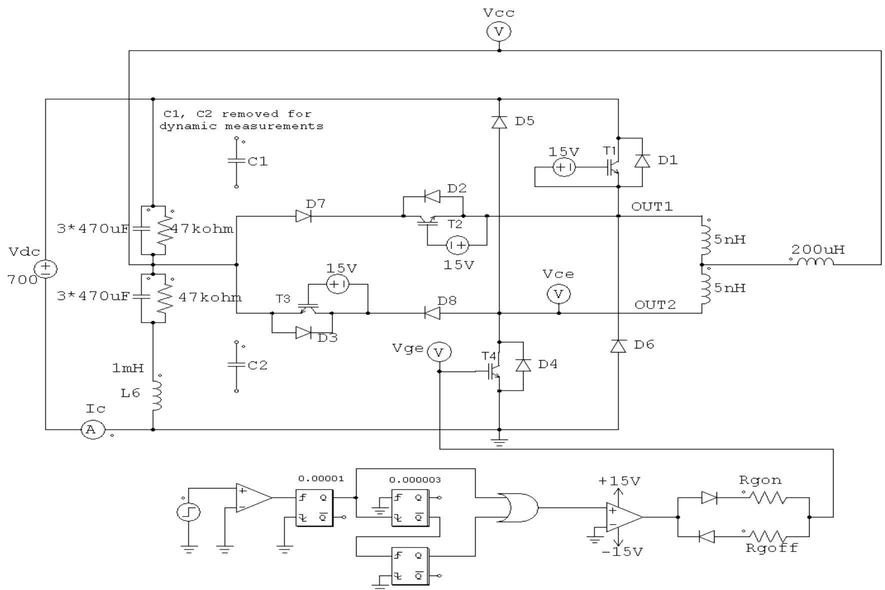


P_{rec} (100%) =	70,11	kW
E_{rec} (100%) =	1,38	mJ
t_{Erec} =	0,22	μs

Measurement circuits

Figure 11

BUCK stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

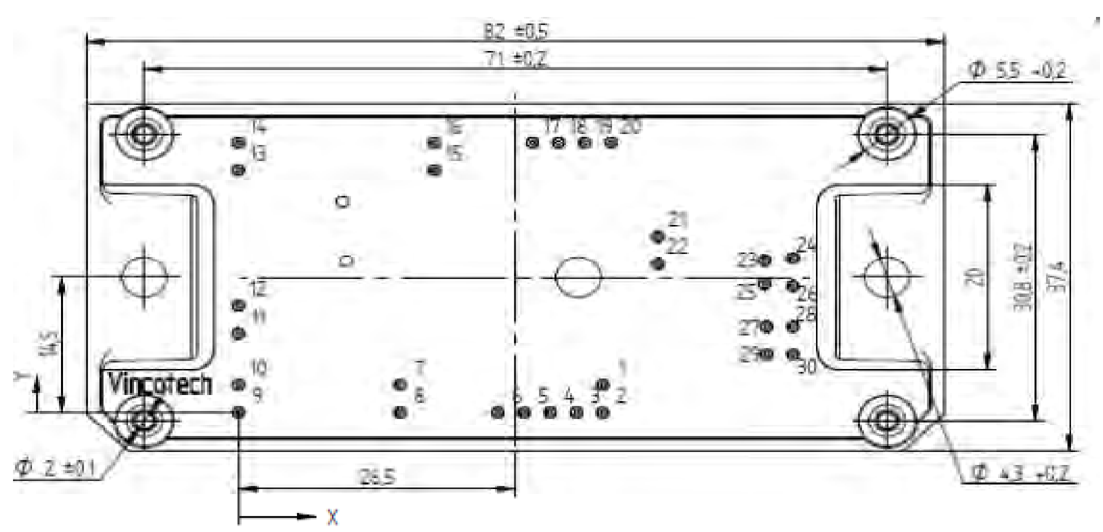
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FY12NMA160SH01-M820F18	M820F	M820-F
without thermal paste 12mm housing with PressFiT	10-PY12NMA160SH01-M820F18Y	M820FY	M820-FY

Outline

Pin table

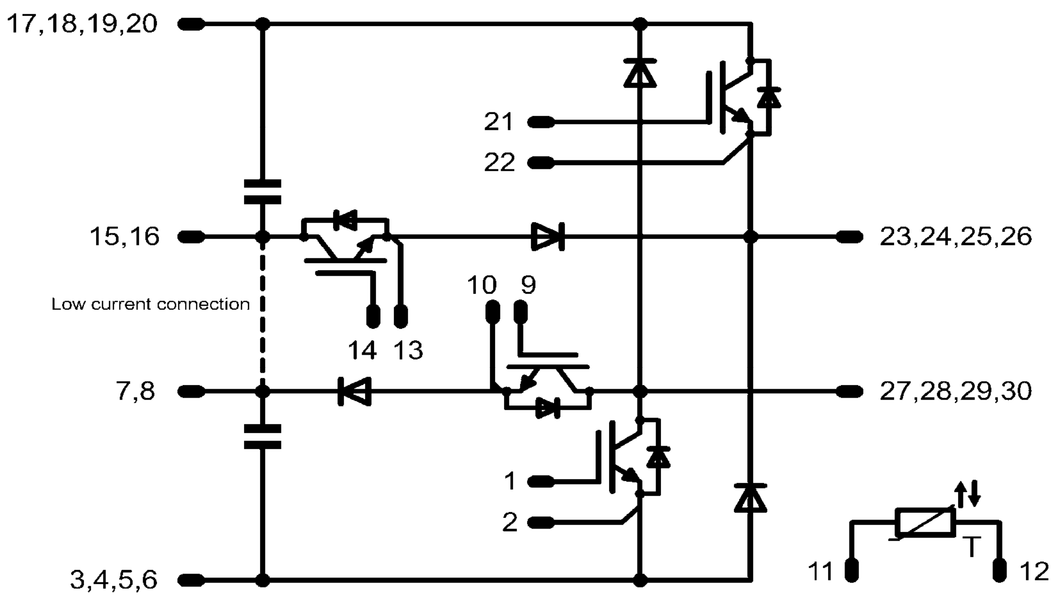
Pin	X	Y
1	34,8	2,95
2	34,8	0
3	32,3	0
4	29,8	0
5	27,3	0
6	24,8	0
7	15,45	2,95
8	15,45	0
9	0	0
10	0	2,95
11	0	8,45
12	0	11,45
13	0	26,05
14	0	29
15	18,7	26,05
16	18,7	29
17	28,1	29
18	30,6	29
19	33,1	29
20	35,6	29
21	40,1	18,9
22	40,1	15,95
23	50,3	16,3
24	53	16,55
25	50,3	13,8
26	53	13,55
27	50,5	9,2
28	53	9,2



Pin table

Pin	X	Y
29	50,5	6,2
30	53	6,2

Pinout



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