Vincotech

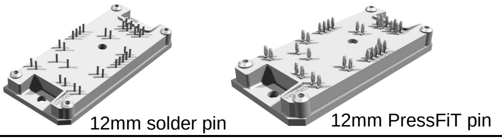
10-FY12NMA160SH-M420F
10-PY12NMA160SH-M420FY
datasheet

***flow* MNPC 1** — **1200 V / 160 A**

Features

- mixed voltage NPC topology
- reactive power capability
- low inductance layout
- Split output
- Common collector neutral connection

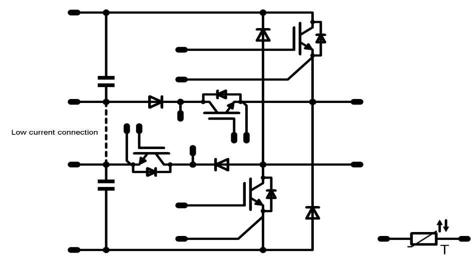
flow 1 12mm housing



Target Applications

- solar inverter
- UPS
- Active frontend

Schematic



Types

- 10-FY12NMA160SH-M420F
- 10-PY12NMA160SH-M420FY

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Halfbridge IGBT Inverse Diode (D1, D4)					
Repetitive peak reverse voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	14 19	A
Repetitive peak forward current	I_{FRM}	tp=10ms		14	A
Power dissipation per Diode	P_{tot}		$T_h=80°C$ $T_c=80°C$	31 47	W
Maximum Junction Temperature	T_{jmax}			150	°C
Halfbridge IGBT (T1, T4)					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	116 156	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		640	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	260 394	W
Gate-emitter peak voltage	V_{GE}			±20	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			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
NP Diode (D7, D8)					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C T_c=80°C	66 90	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		240	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	67 101	W
Maximum Junction Temperature	$T_j$max			150	°C
NP IGBT (T2, T3)					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C T_c=80°C	63 83	A
Repetitive peak collector current	I_{cpulse}	t_p limited by $T_j$max		300	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	94 142	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
NP Inverse Diode (D2, D3)					
Peak Repetitive Reverse Voltage	V_{RRM}	T_c=25°C		600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C T_c=80°C	13 18	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°C T_c=80°C	20 31	W
Maximum Junction Temperature	$T_j$max			150	°C
Halfbridge Diode (D5, D6)					
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	36 50	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		120	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	61 92	W
Maximum Junction Temperature	$T_j$max			150	°C
DC link Capacitor (C1, C2)					
Max.DC voltage	V_{MAX}		Tc=25°C	630	V

Maximum Ratings

Tj=25°C, unless otherwise specified

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
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

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	
Halfbridge IGBT Inverse Diode (D1, D4)										
Forward voltage	V_f				7	Tj=25°C Tj=125°C	1	1,97 1,65	2,7	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,24		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,48		
Halfbridge IGBT (T1, T4)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,004	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		160	Tj=25°C Tj=125°C	1	2,02 2,37	2,5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			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°C Tj=125°C		133 135		ns
Rise time	t_r					Tj=25°C Tj=125°C		20 23		
Turn-off delay time	$t_{d(OFF)}$					Tj=25°C Tj=125°C		225 276		
Fall time	t_f					Tj=25°C Tj=125°C		38 64		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		1,80 3,18		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		2,52 4,03		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		9320		pF
Output capacitance	C_{oss}							600		
Reverse transfer capacitance	C_{rss}							520		
Gate charge	Q_{Gate}		15	960	160	Tj=25°C		740		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,37		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,24		
*additional value stands for built-in capacitor										
NP Diode (D7, D8)										
Diode forward voltage	V_F				120	Tj=25°C Tj=125°C	1,4	1,47 1,29	2	V
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	350	100	Tj=25°C Tj=125°C		127 151		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		40 81		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		3,02 7,13		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		12386 3767		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,31 1,01		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,05		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,69		

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	
NP IGBT (T2, T3)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0016	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		100	Tj=25°C Tj=125°C	1,05	1,58 1,8	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,0052	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			1200	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°C Tj=125°C		103 103		ns
Rise time	t_r					Tj=25°C Tj=125°C		16,8 19,2		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		158 179		
Fall time	t_f					Tj=25°C Tj=125°C		44 64		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		1,06 1,52		µWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		2,48 3,32		
Input capacitance	C_{ies}	f=1MHz	15	480	100	Tj=25°C		6280		pF
Output capacitance	C_{oss}							400		
Reverse transfer capacitance	C_{rss}							186		
Gate charge	Q_{Gate}					Tj=25°C		620		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,01		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,67		
NP Inverse Diode (D2, D3)										
Diode forward voltage	V_F				15	Tj=25°C Tj=125°C	1,00	1,61 1,57	2,15	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,43		K/W
Coupled thermal resistance inverter transistor-diode	R_{thJC}							2,27		
Halfbridge Diode (D5, D6)										
Diode forward voltage	V_F				60	Tj=25°C Tj=125°C	1,50	2,47 2,11	3,40	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			200	µA
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	350	100	Tj=25°C Tj=125°C		107 142		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		51 69		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		6,24 12,71		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		5985 2890		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		1,71 3,61		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,15		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,76		
DC link Capacitor (C1, C2)										
C value	C	DC+ to Neutral and DC- to Neutral						100		nF
Thermistor										
Rated resistance	R					T=25°C		22000		Ω
Deviation of R25	ΔR/R	R100=1486 Ω				T=25°C	-5		+5	%
Power dissipation	P					T=25°C		200		mW
Power dissipation constant						Tj=25°C		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3996		K
Vincotech NTC Reference									B	
Module Properties										
Thermal resistance, case to heatsink	R_{thCH}	per module λPaste=1W/(m·K)/λgrease=1W/(m·K)						tbd.		K/W
Module stray inductance	L_{sCE}	V23990-P-M107-*-31						5		nH
Chip module lead resistance, terminals -chip	$Rcc_{'1+EE'}$	Tc=25°C, per switch						tbd.		mΩ
Mounting torque	M	Screw M4 - mounting according to valid application note Flow1-4TY-P-*-HI for PressFiT, V23990-P-M101-*-31 for SolderPin					2		2,2	Nm
Weight	G							42,28		g

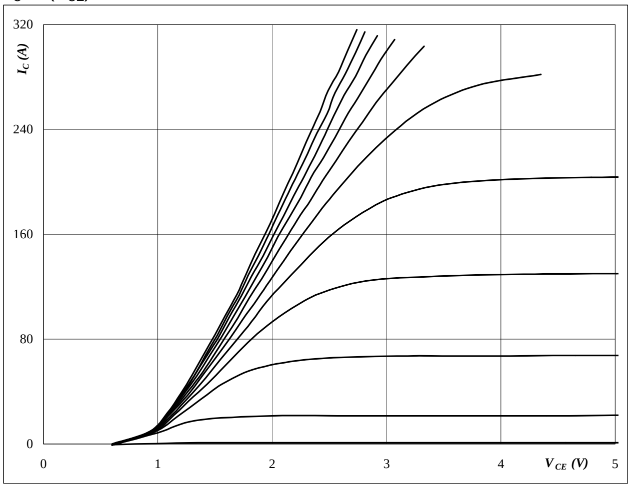
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



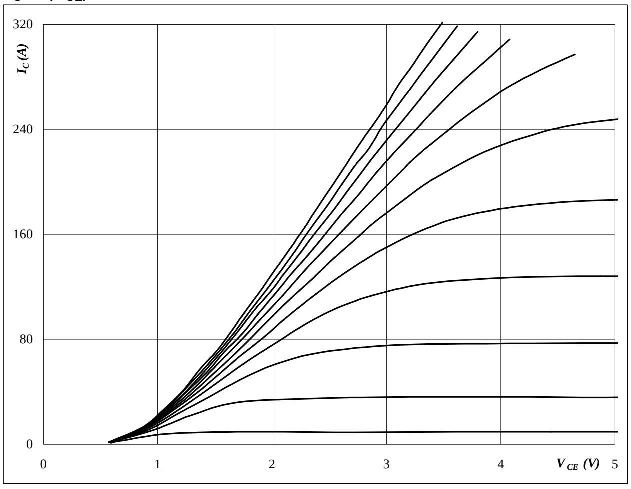
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



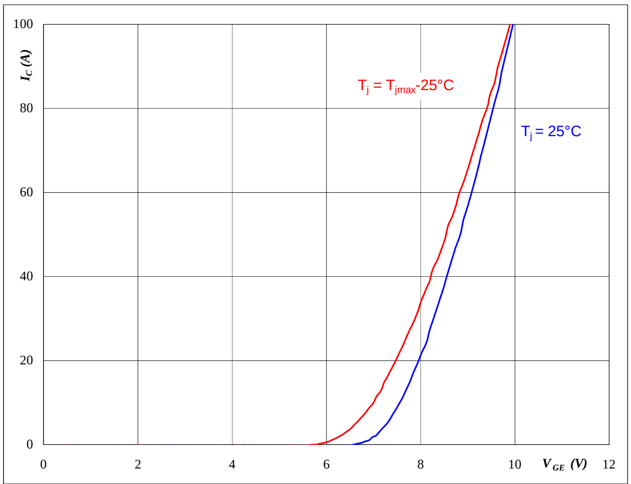
At

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

$I_C = f(V_{GE})$



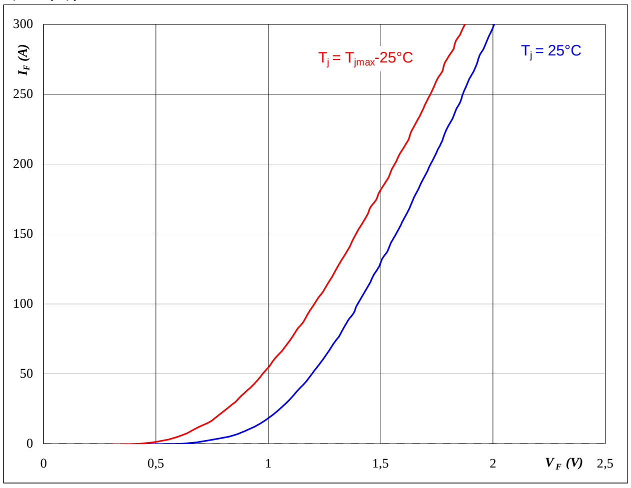
At

t_p =	250	μs
V_{CE} =	10	V
T_j =	25/150	°C

Figure 4 NP FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	μs
T_j =	25/150	°C

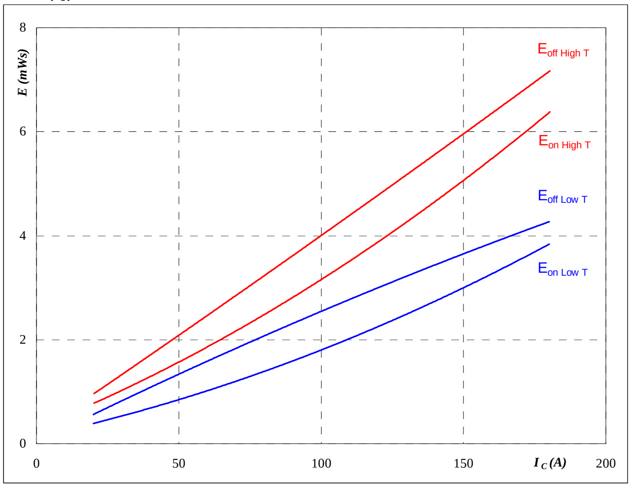
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



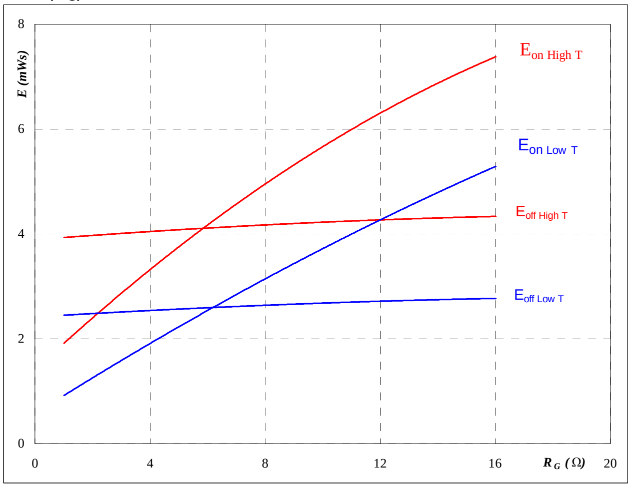
With an inductive load at

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

$E = f(R_G)$



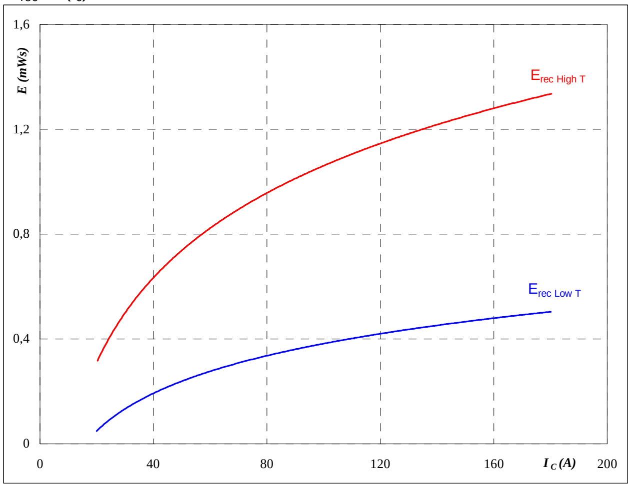
With an inductive load at

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

Figure 7 NP FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



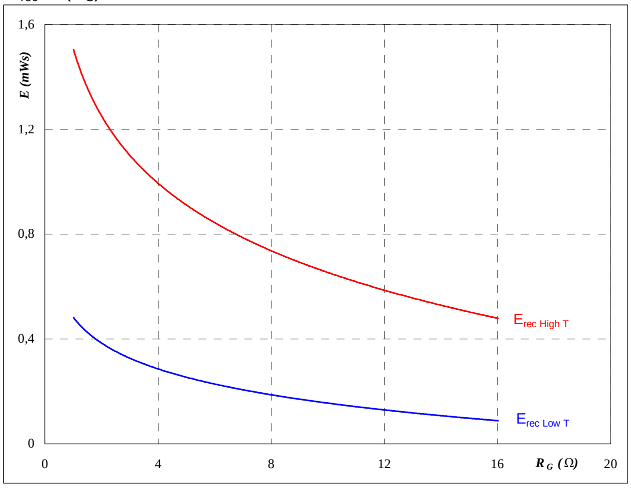
With an inductive load at

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

Figure 8 NP 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

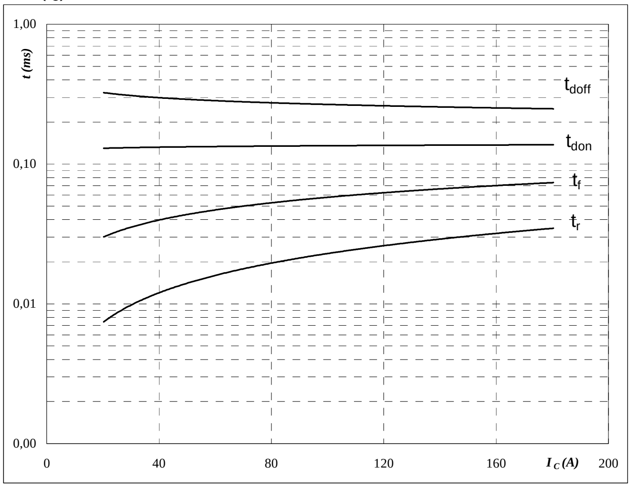
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



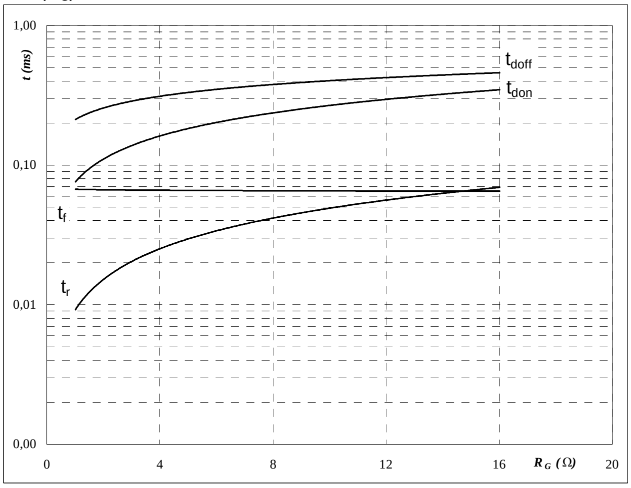
With an inductive load at

T_j =	125	°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)



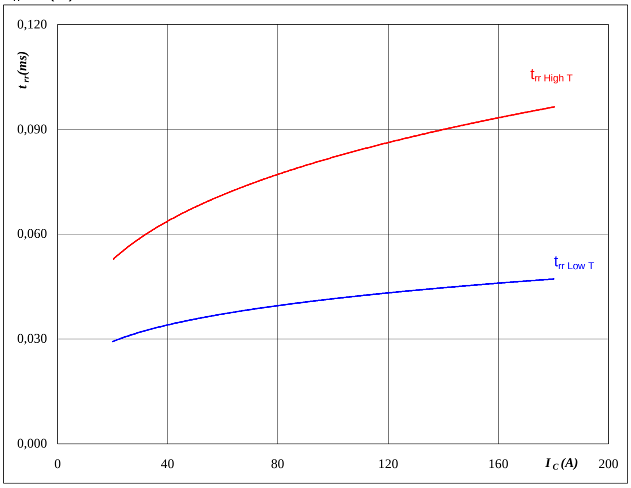
With an inductive load at

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

Figure 11 NP FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



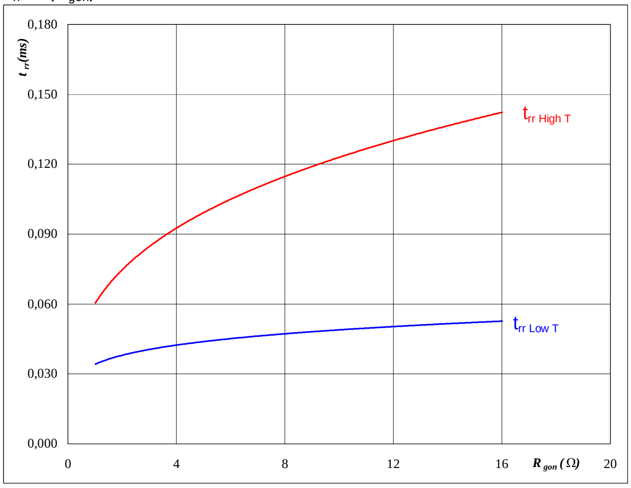
At

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

Figure 12 NP 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 =	350	V
I_F =	100	A
V_{GE} =	±15	V

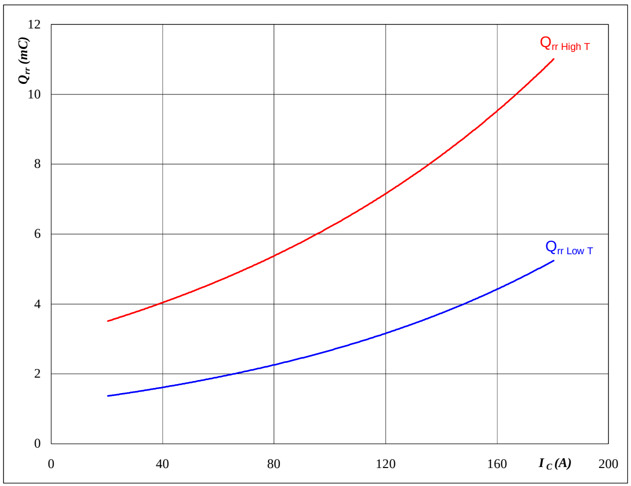
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 13 NP FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



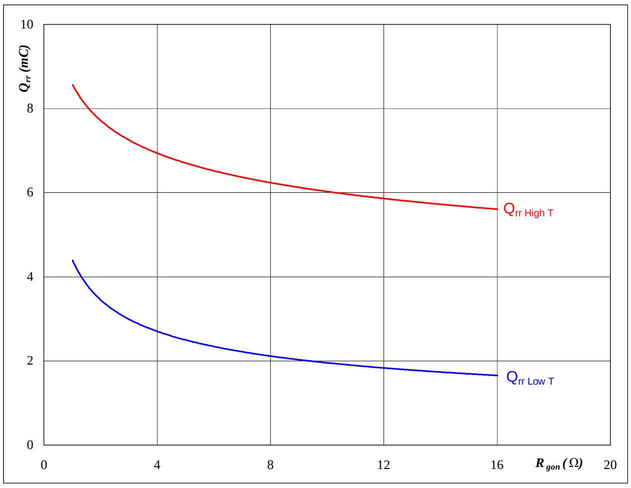
At

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

Figure 14 NP FWD

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

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



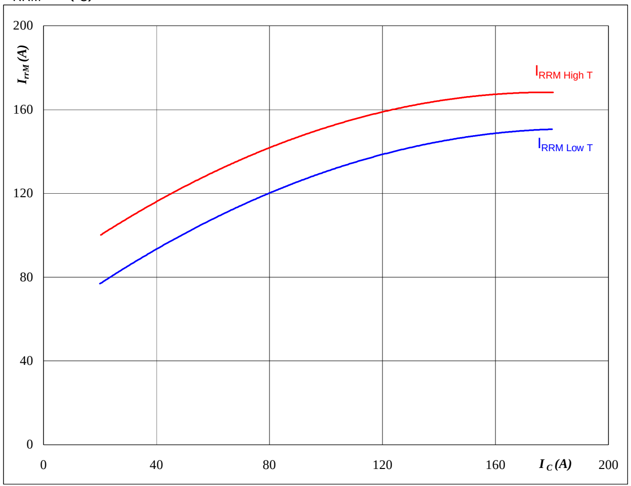
At

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

Figure 15 NP FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



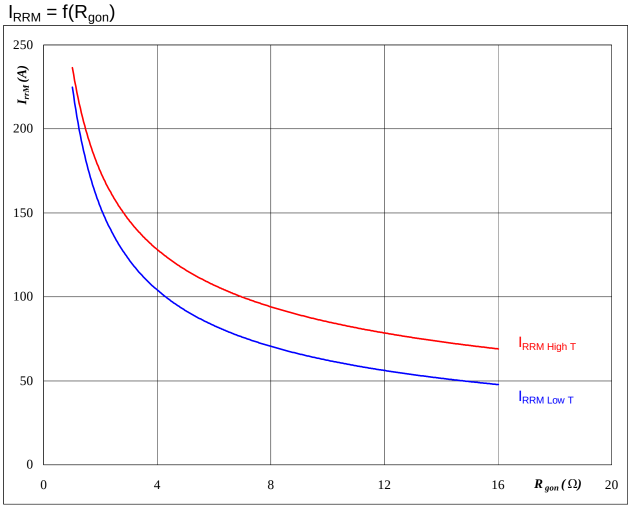
At

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

Figure 16 NP FWD

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

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



At

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

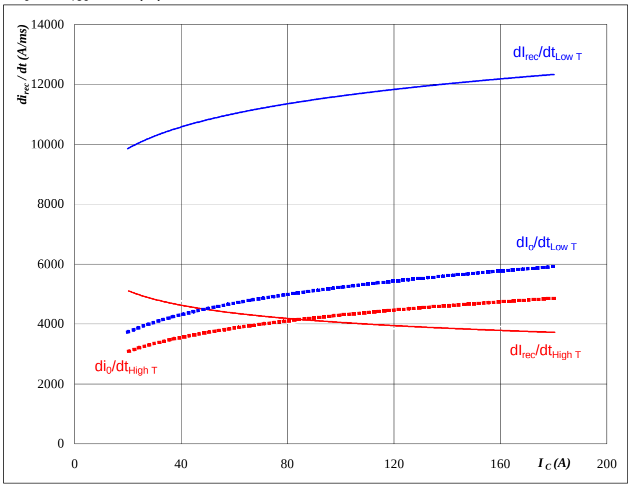
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 17 NP FWD

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

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



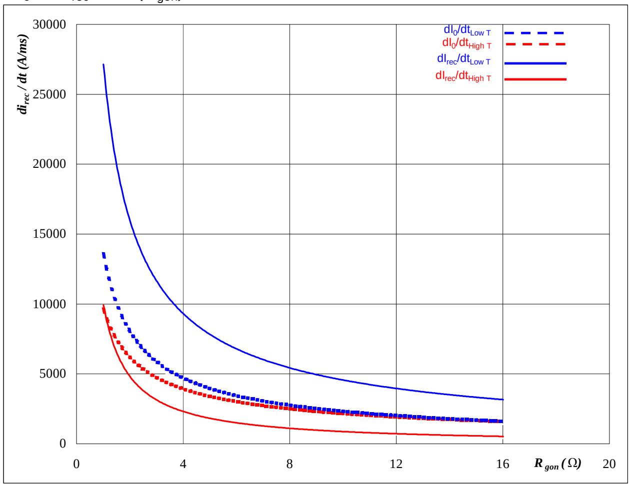
At

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

Figure 18 NP FWD

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

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



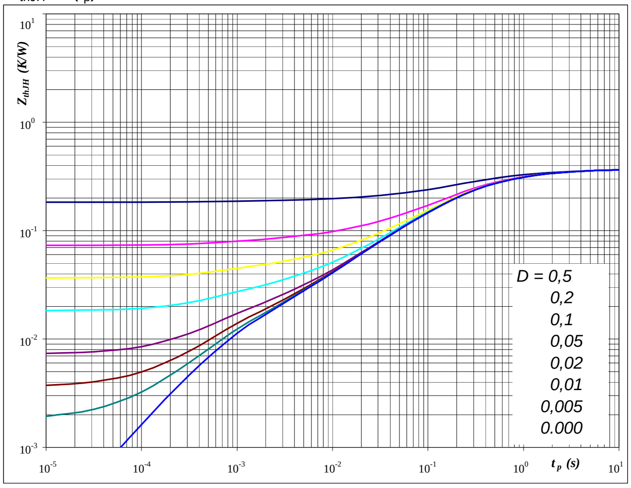
At

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

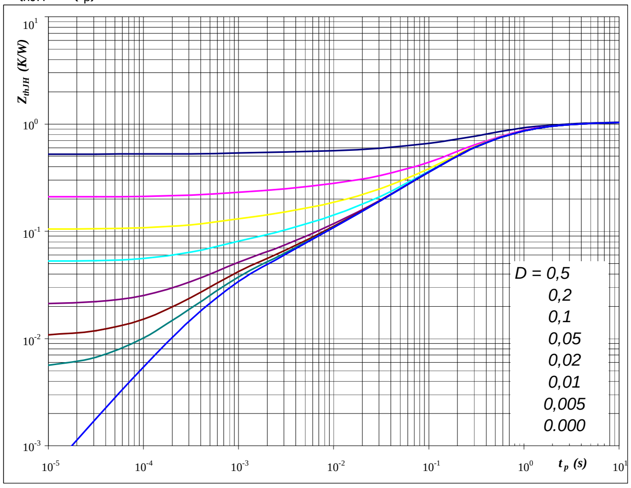
IGBT thermal model values

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 NP FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1,05	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,05	7,4E+00
0,27	1,3E+00
0,55	2,7E-01
0,11	4,0E-02
0,04	5,1E-03
0,03	6,0E-04

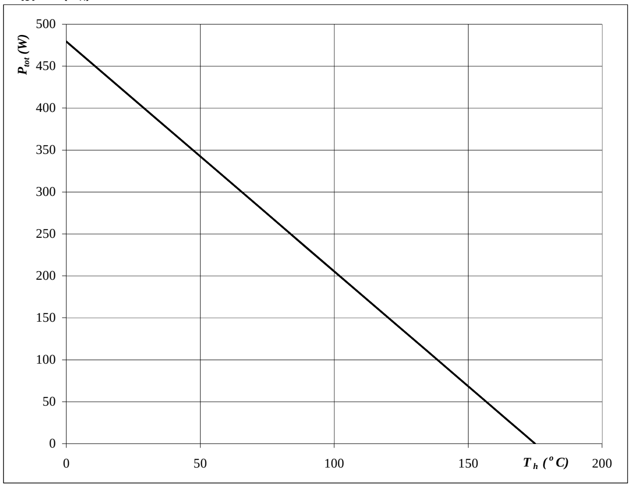
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



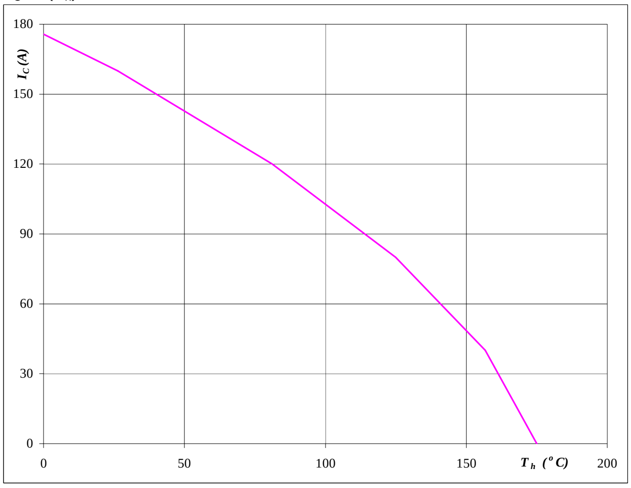
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

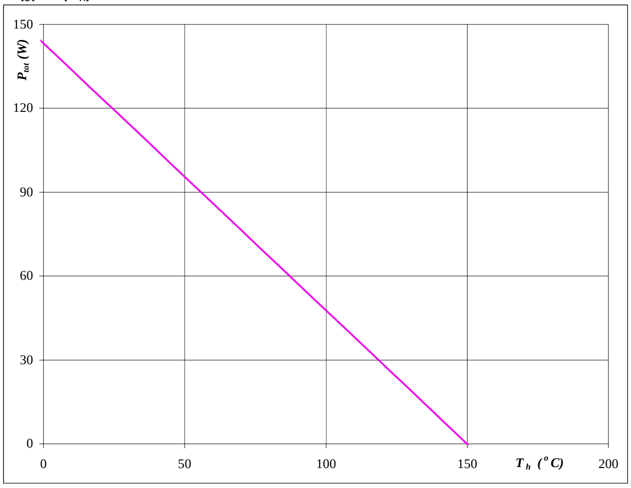
T_j = 175 °C

V_{GE} = 15 V

Figure 23 NP FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



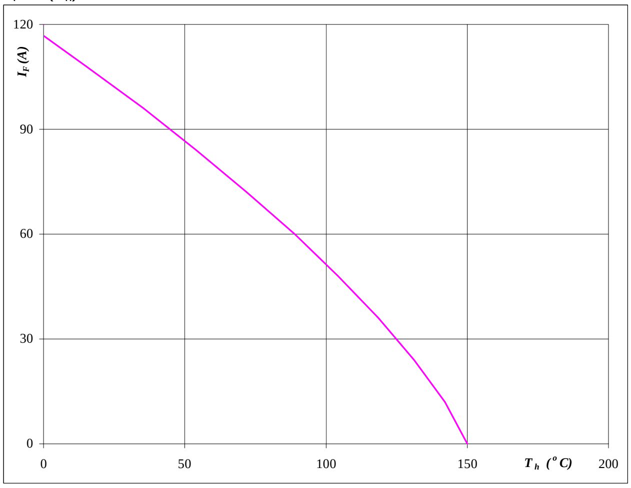
At

T_j = 150 °C

Figure 24 NP FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 °C

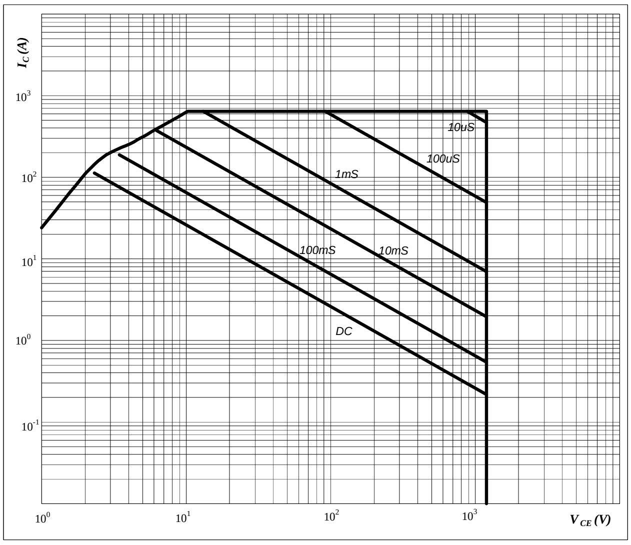
Half bridge (T1, T4 / D7, D8)

half bridge IGBT and Neutral Point FWD

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



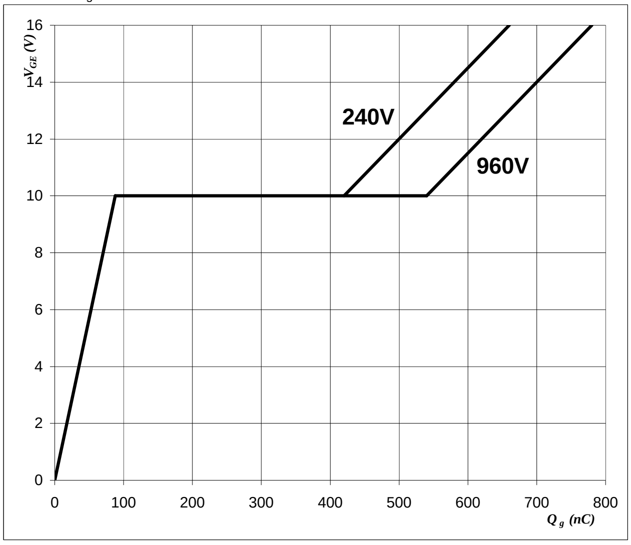
At

D =	single pulse	
Th =	80	ºC
V_{GE} =	0	V
T_j =	T_{jmax}	ºC

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



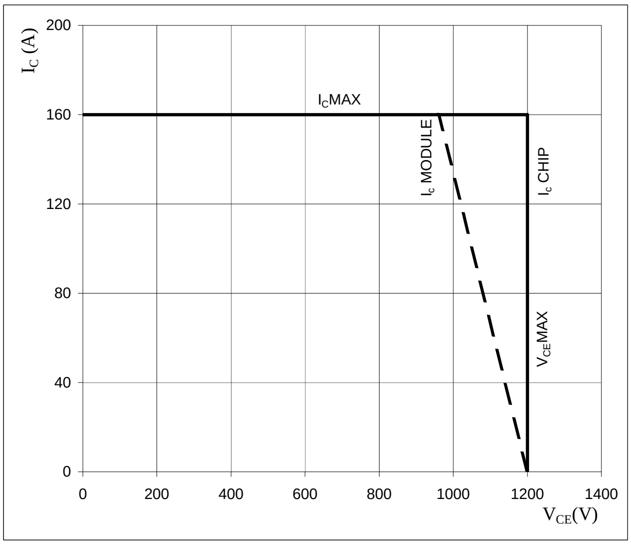
At

I_D =	20	A
V_{DS}=	600	V
T_j=	25	ºC

Figure 27 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	T_{jmax}-25	ºC
$U_{ccminus}$=U_{ccplus}		
Switching mode :	3 level switching	

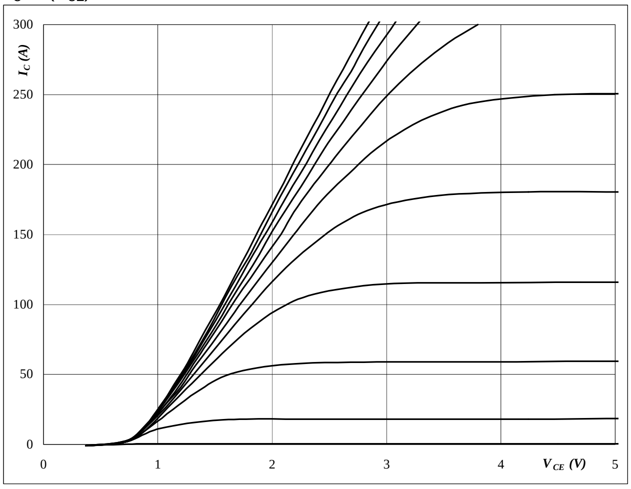
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT and half bridge FWD

Figure 1 NP IGBT

Typical output characteristics

$I_C = f(V_{CE})$



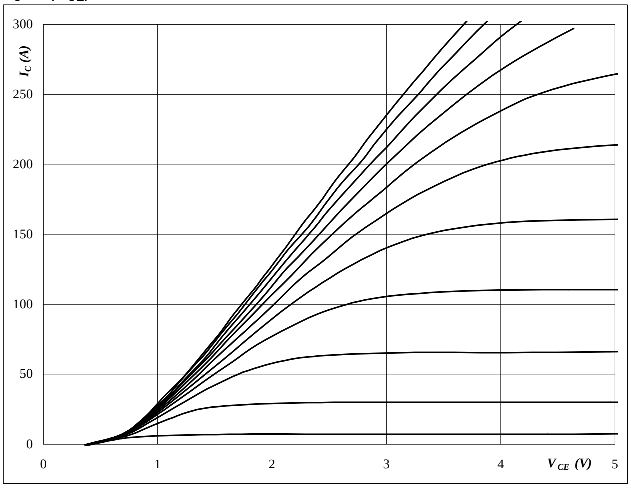
At

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

Figure 2 NP IGBT

Typical output characteristics

$I_C = f(V_{CE})$



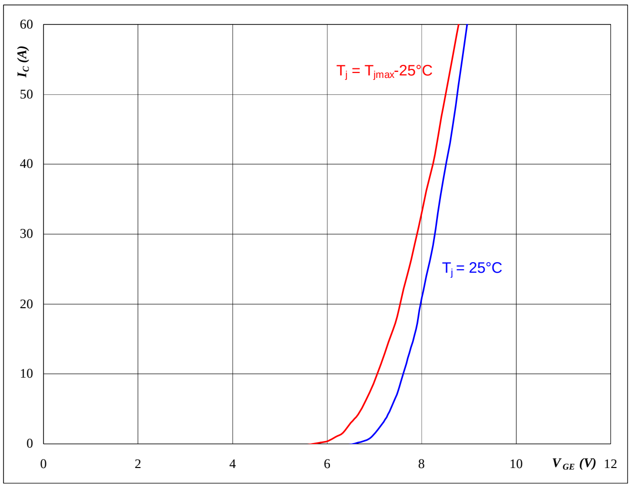
At

t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 NP IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



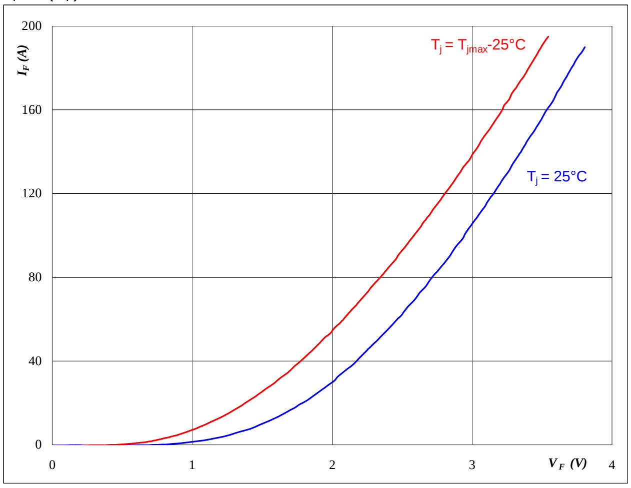
At

t_p =	250	μs
V_{CE} =	10	V
T_j =	25/150	°C

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	μs
T_j =	25/150	°C

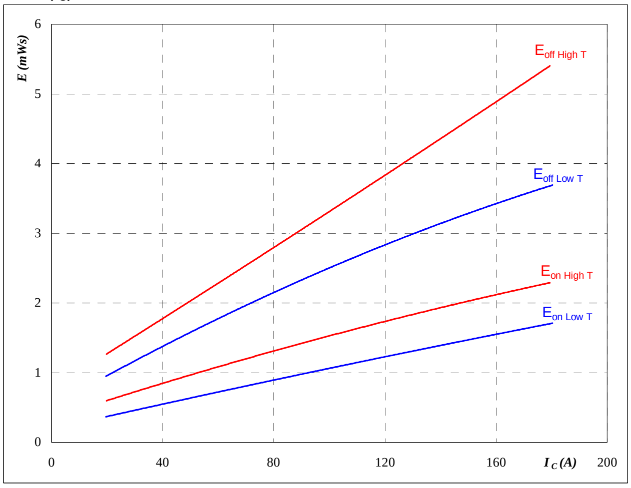
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT and half bridge FWD

Figure 5 NP IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



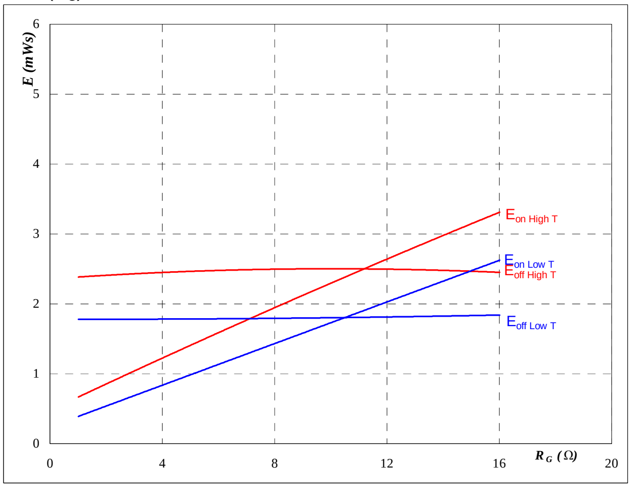
With an inductive load at

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

Figure 6 NP IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



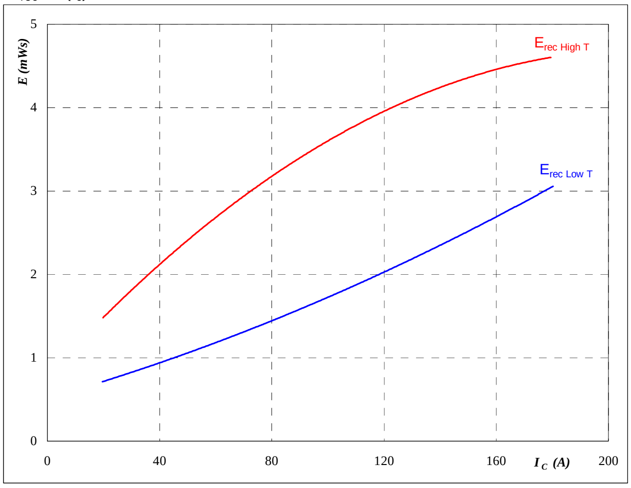
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	60	A

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



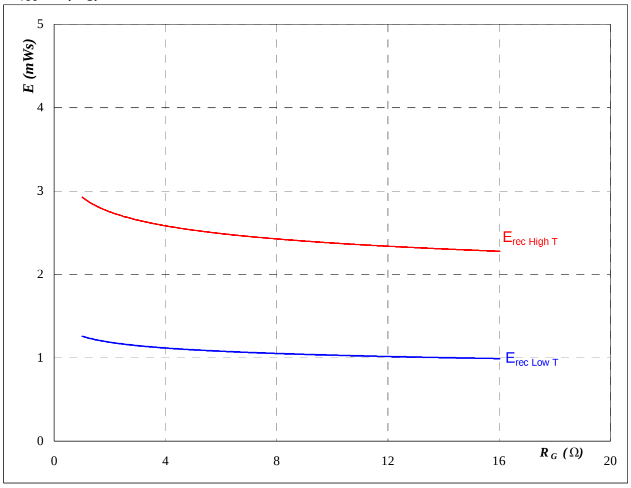
With an inductive load at

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 =	60	A

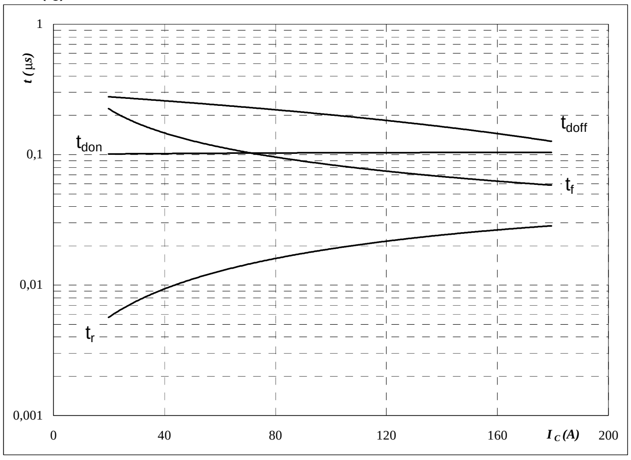
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT and half bridge FWD

Figure 9 NP IGBT

Typical switching times as a function of collector current

t = f(I_C)



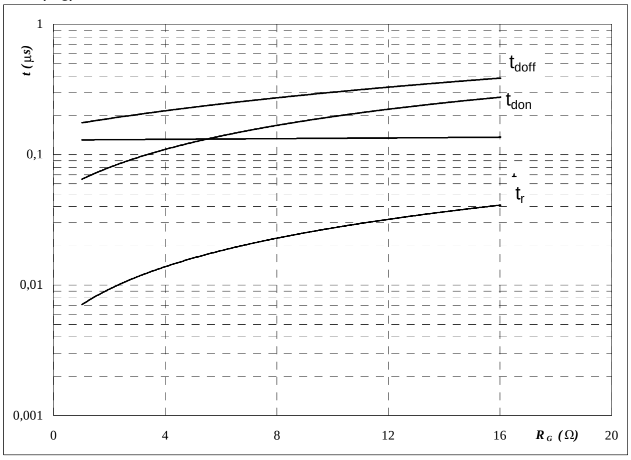
With an inductive load at

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

Figure 10 NP IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



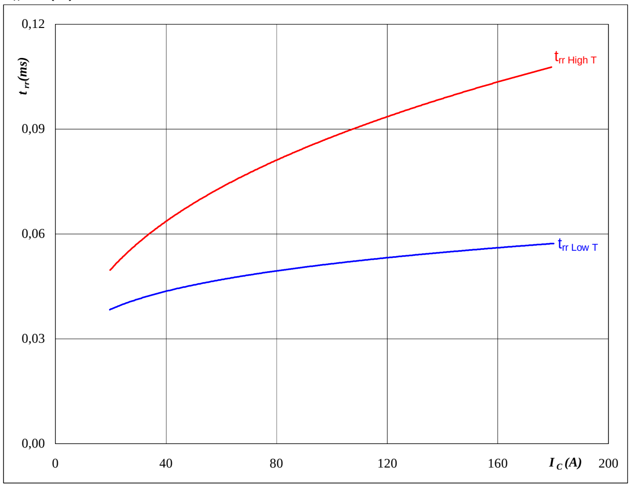
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	60	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



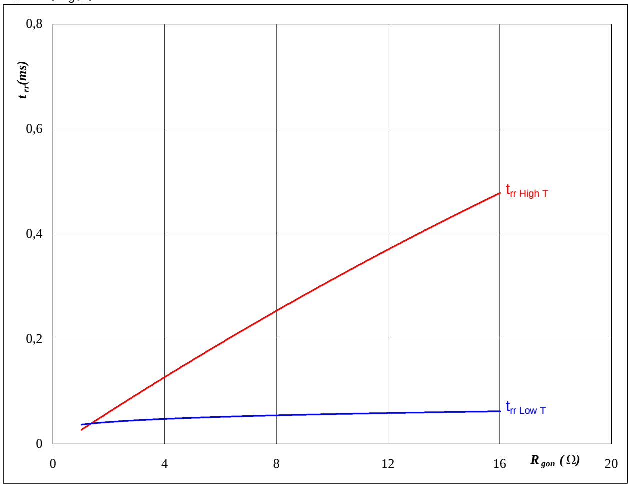
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4,0	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	°C
V_R =	350	V
I_F =	60	A
V_{GE} =	±15	V

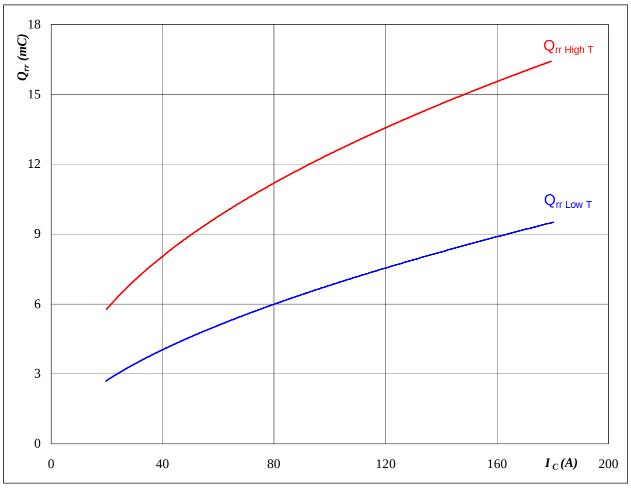
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT and half bridge FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



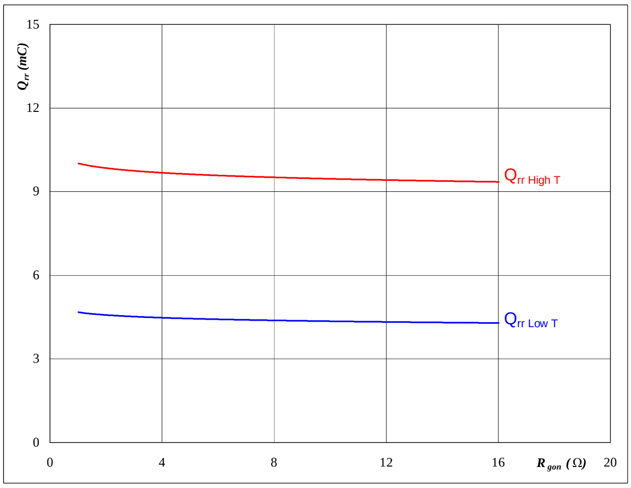
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4,0	Ω

Figure 14 FWD

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

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



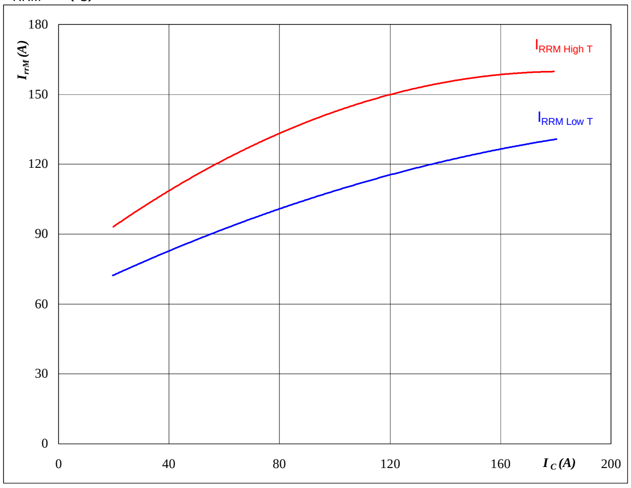
At

T_j =	25/125	°C
V_R =	350	V
I_F =	60	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



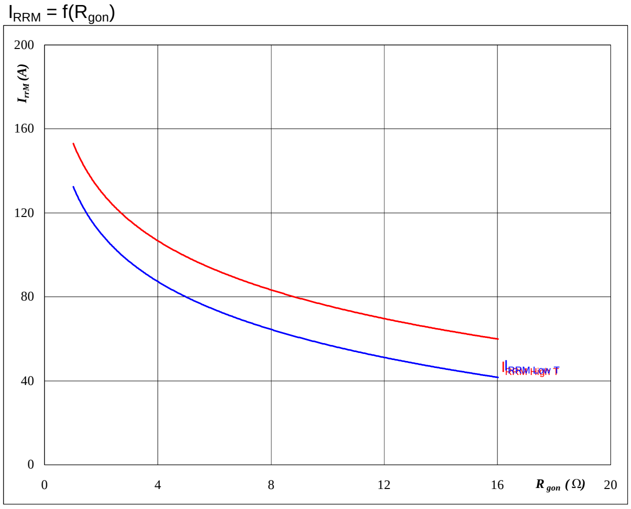
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4,0	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	°C
V_R =	350	V
I_F =	60	A
V_{GE} =	±15	V

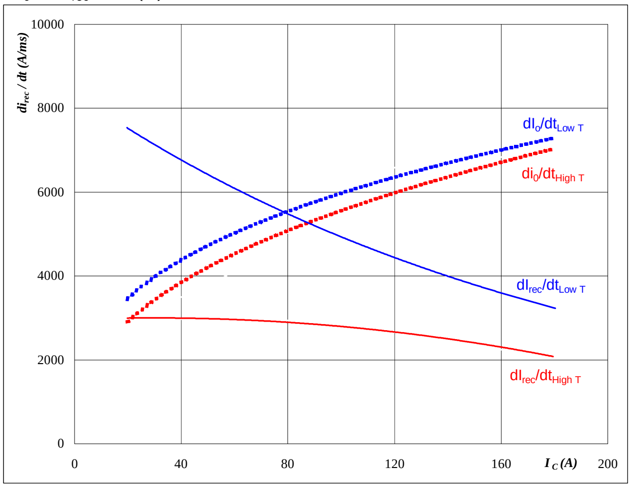
Neutral Point IGBT (T2, T3 / D5, D6)

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

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



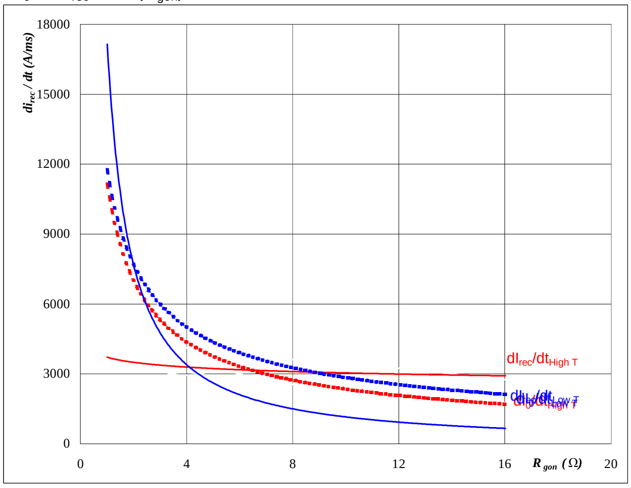
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4,0	Ω

Figure 18 FWD

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

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



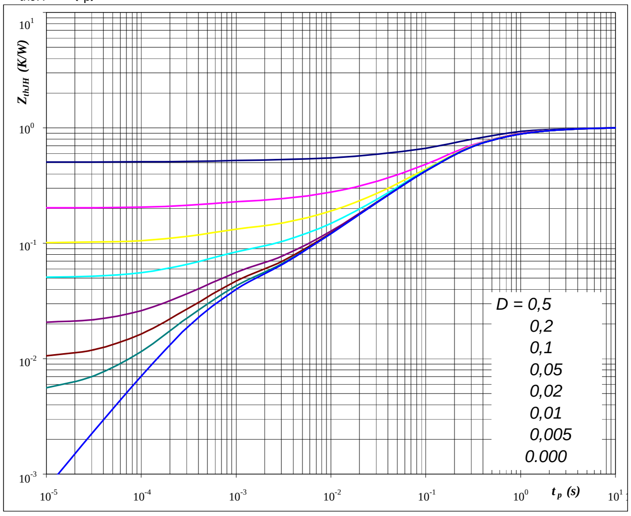
At

T_j =	25/125	°C
V_R =	350	V
I_F =	60	A
V_{GE} =	±15	V

Figure 19 NP IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	1,01	K/W

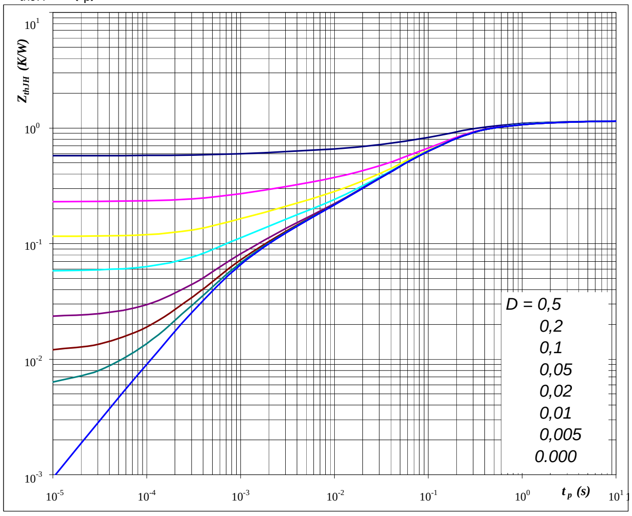
IGBT thermal model values

R (C/W)	Tau (s)
0,05	6,49
0,16	1,27
0,52	0,25
0,18	0,07
0,07	0,01

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	4,90
0,13	0,82
0,59	0,18
0,22	0,05
0,10	0,01

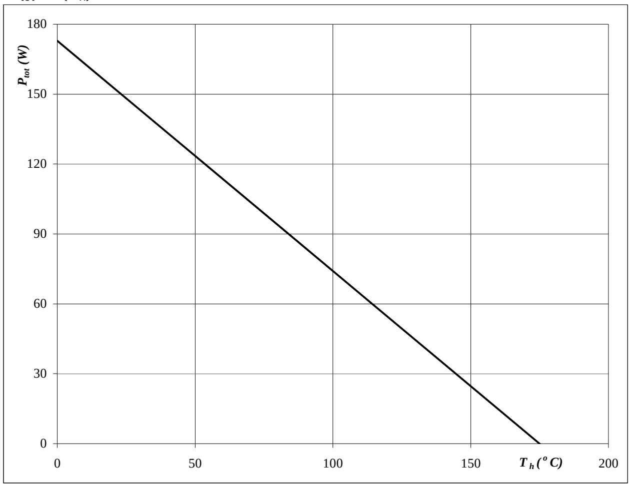
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT and half bridge FWD

Figure 21 NP IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



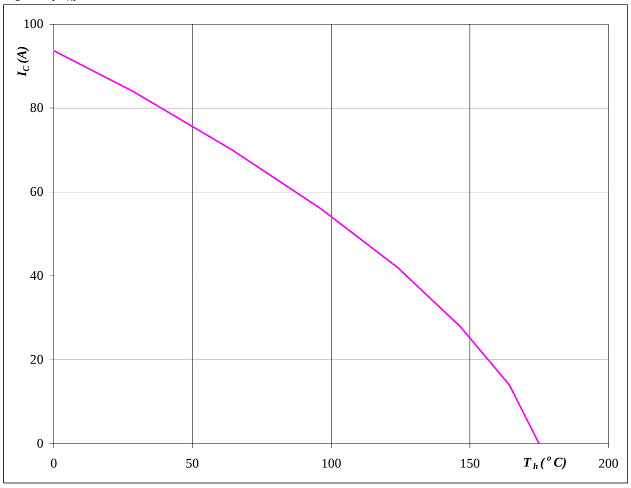
At

T_j = 175 ºC

Figure 22 NP IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

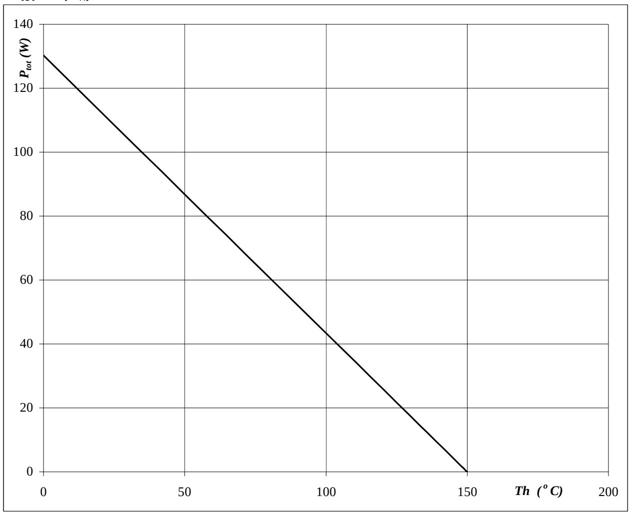
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



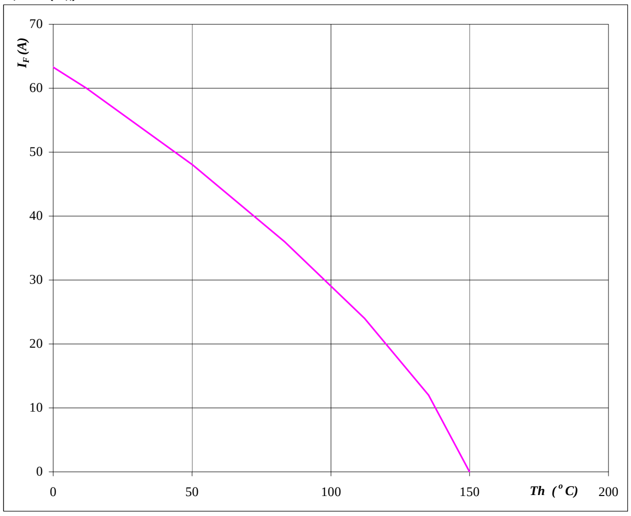
At

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

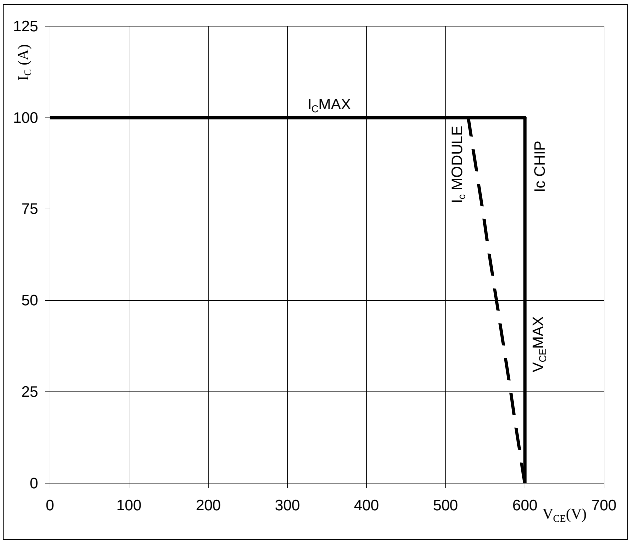
Neutral Point IGBT (T2, T3 / D5, D6)

neutral point IGBT

Figure 25	NP IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

$U_{ccminus}=U_{ccplus}$

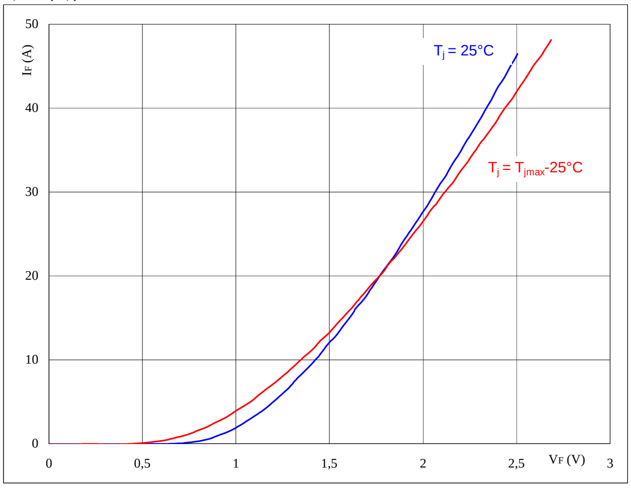
Switching mode : 3 level switching

NP IGBT Inverse Diode (D2, D3)

Figure 25 NP Inverse Diode

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



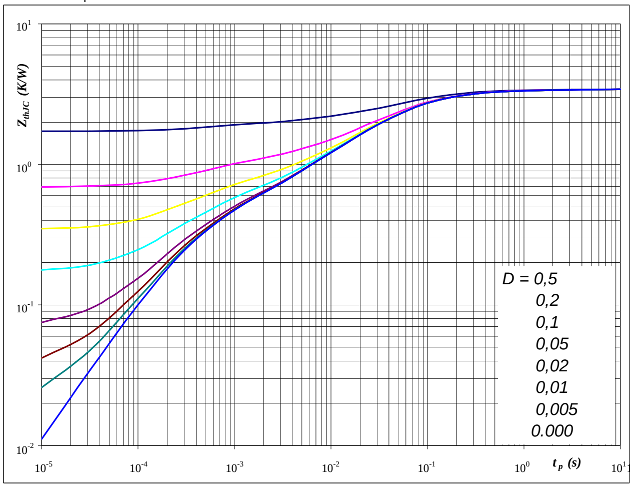
At

t_p =	250	μs

Figure 26 NP Inverse Diode

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



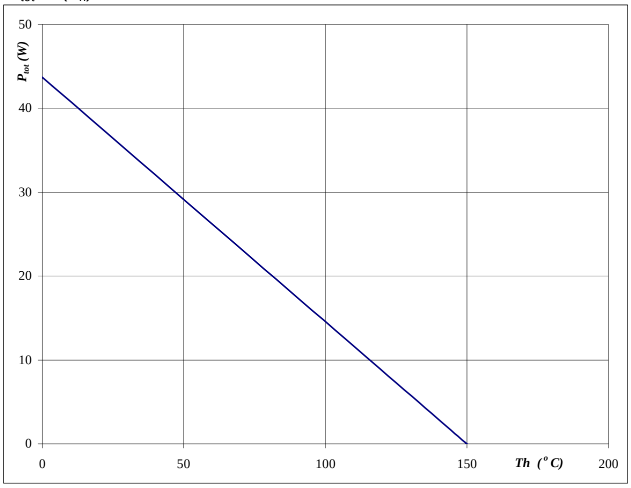
At

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

Figure 27 NP Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



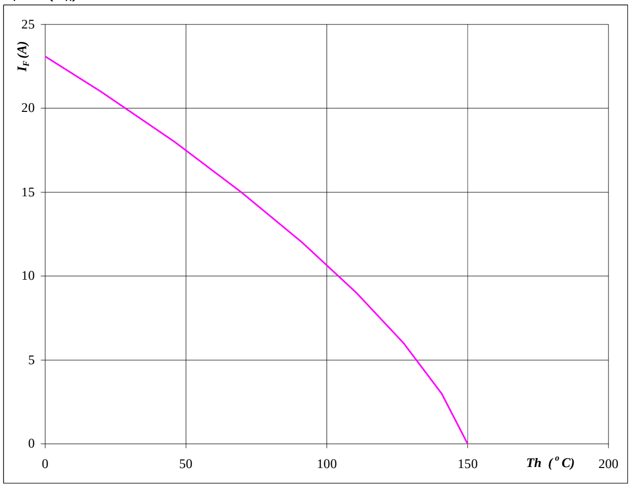
At

T_j =	150	ºC

Figure 28 NP Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

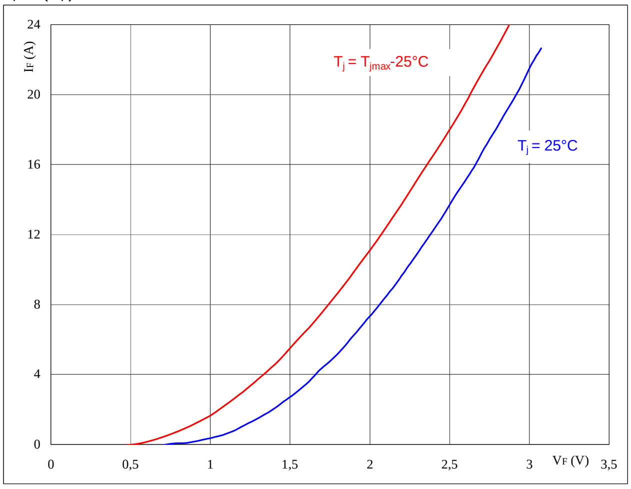
T_j =	150	ºC

Half bridge Inverse Diode (D1, D4)

Figure 1	Halfbridge IGBT Inverse Diode

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



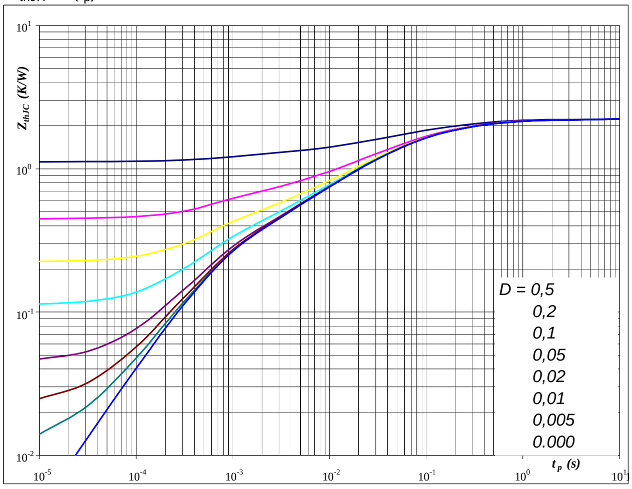
At

t_p = 250 µs

Figure 2	Halfbridge IGBT Inverse Diode

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

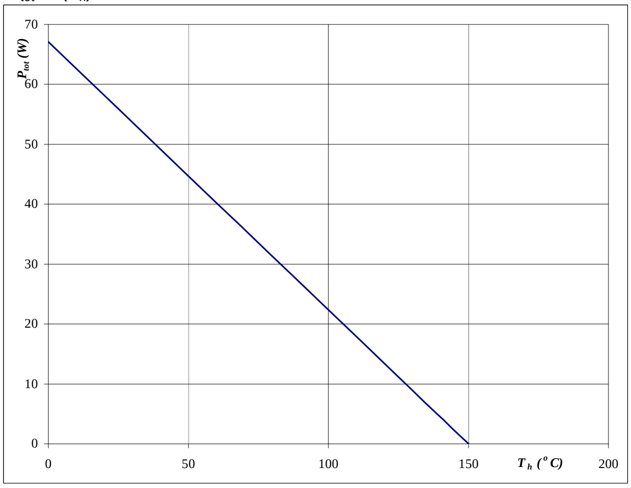
D = t_p / T

R_{thJH} = 2,235 K/W

Figure 3	Halfbridge IGBT Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



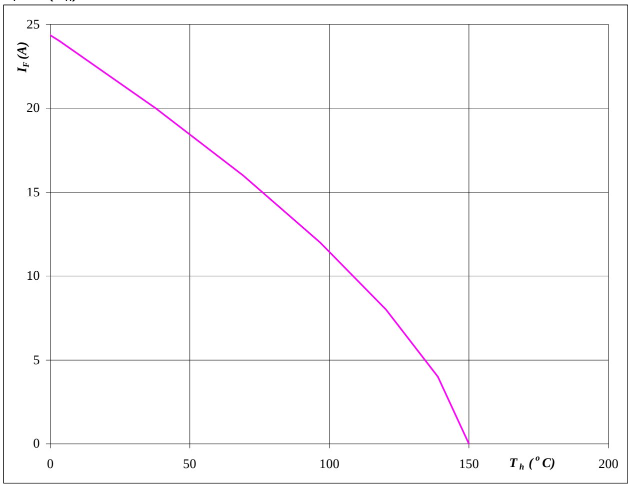
At

T_j = 150 ºC

Figure 4	Halfbridge IGBT Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



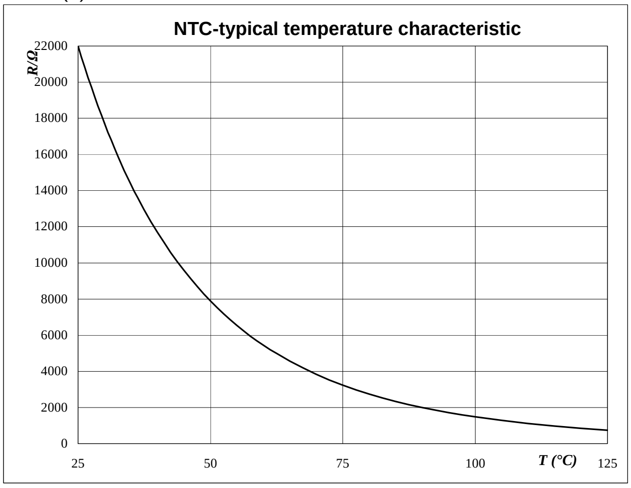
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



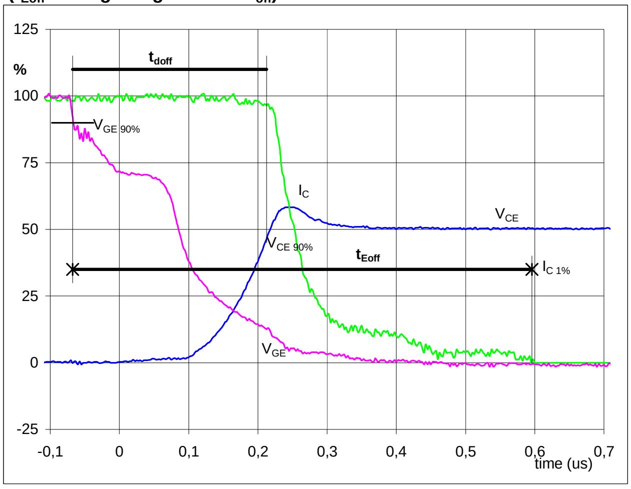
Switching Definitions half bridge (T1, T4 / D7, D8)

General conditions

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

Figure 1 half bridge IGBT

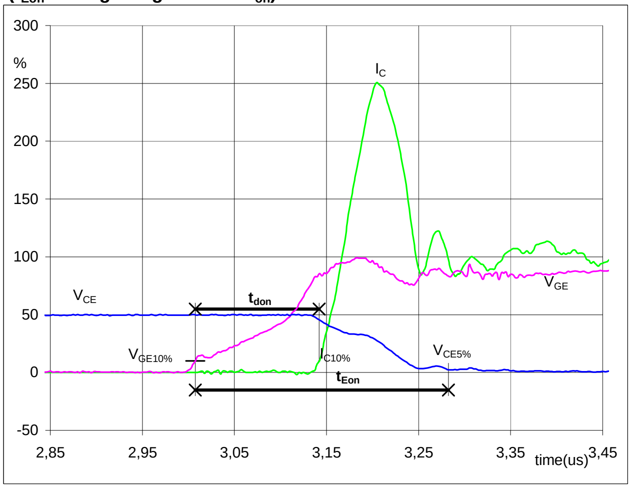
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{doff} =	0,28	µs
t_{Eoff} =	0,66	µs

Figure 2 half bridge IGBT

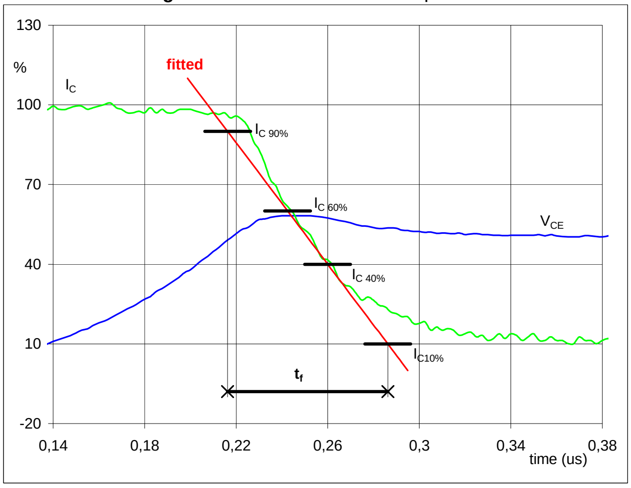
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{don} =	0,14	µs
t_{Eon} =	0,27	µs

Figure 3 half bridge IGBT

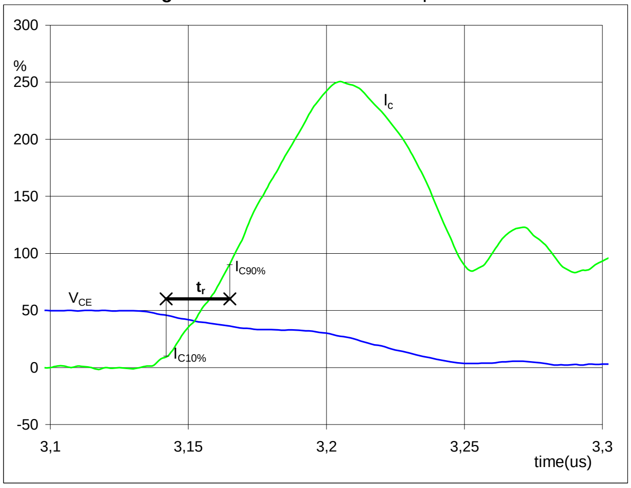
Turn-off Switching Waveforms & definition of t_f



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

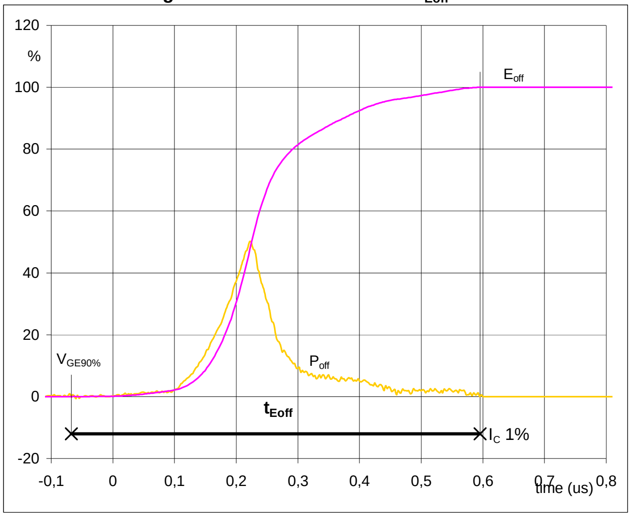


V_C (100%) =	700	V
I_C (100%) =	100	A
t_r =	0,02	µs

Switching Definitions half bridge (T1, T4 / D7, D8)

Figure 5 half bridge IGBT

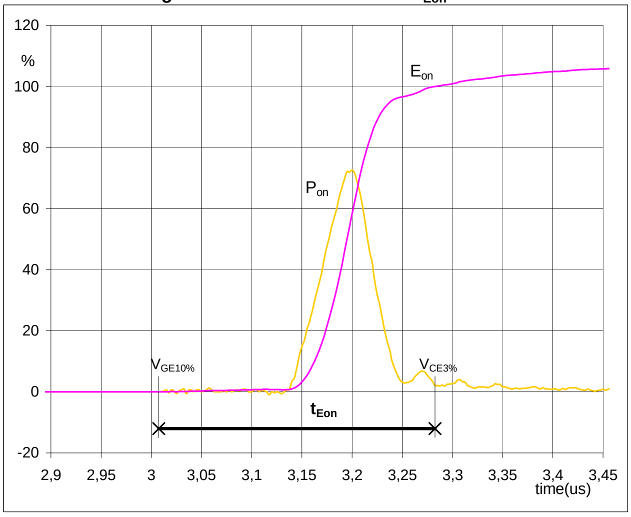
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	70,22	kW
E_{off} (100%) =	4,03	mJ
t_{Eoff} =	0,66	μs

Figure 6 half bridge IGBT

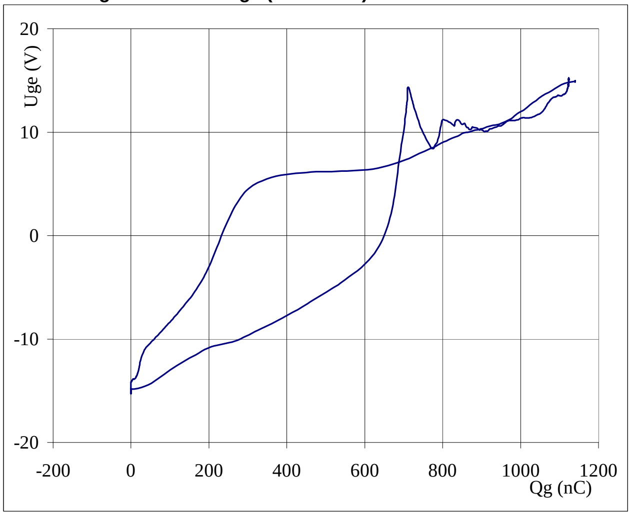
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	70,22	kW
E_{on} (100%) =	3,18	mJ
t_{Eon} =	0,27	μs

Figure 7 half bridge IGBT

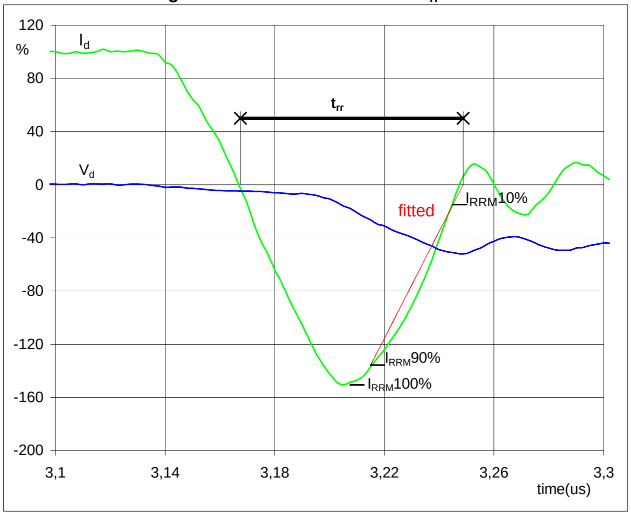
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
Q_g =	1140,19	nC

Figure 8 neutral point FWD

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

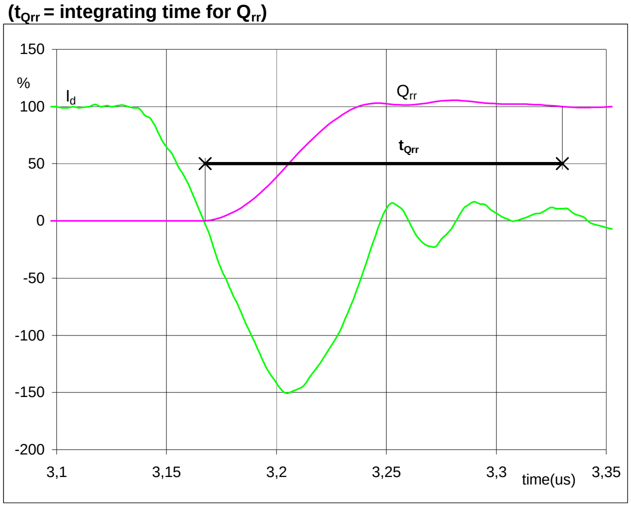


V_d (100%) =	700	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-151	A
t_{rr} =	0,08	μs

Switching Definitions half bridge (T1, T4 / D7, D8)

Figure 9 neutral point FWD

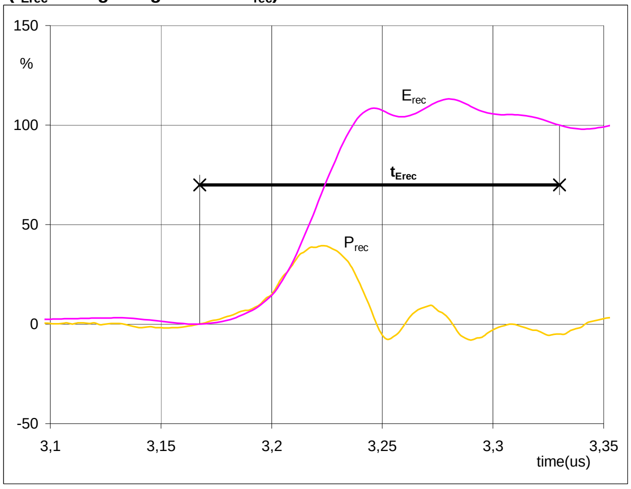
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	7,13	μC
t_{Qrr} =	0,16	μs

Figure 10 neutral point FWD

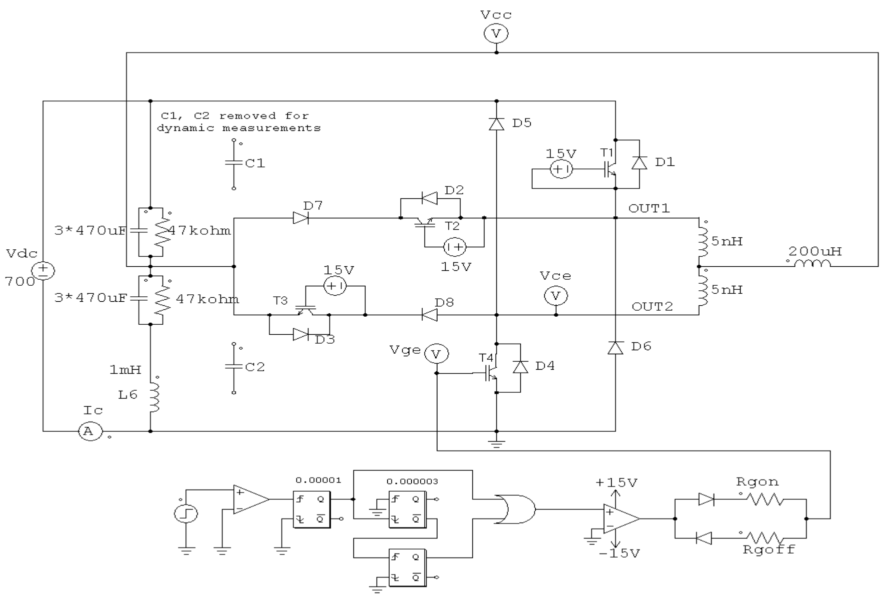
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	70,22	kW
E_{rec} (100%) =	1,01	mJ
t_{Erec} =	0,16	μs

half bridge switching measurement circuit (T1, T4 / D7, D8)

Figure 11 half bridge IGBT



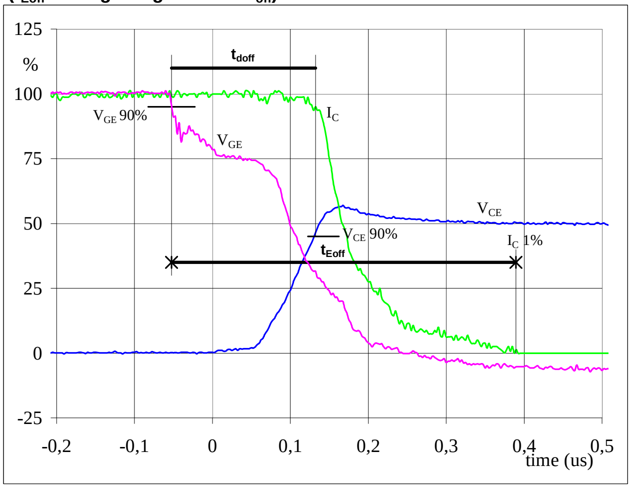
Switching Definitions neutral point IGBT (T2, T3 / D5, D6)

General conditions

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

Figure 1 neutral point IGBT

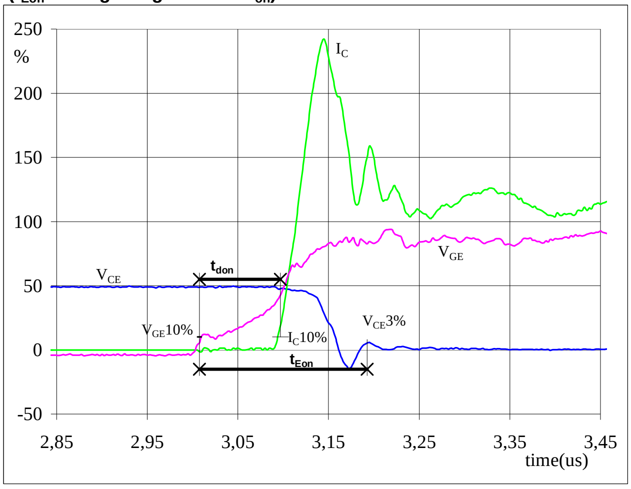
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{doff} =	0,18	µs
t_{Eoff} =	0,44	µs

Figure 2 neutral point IGBT

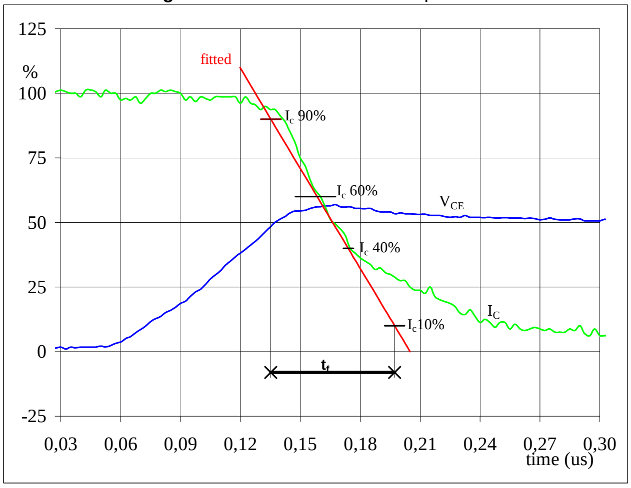
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
t_{don} =	0,10	µs
t_{Eon} =	0,18	µs

Figure 3 neutral point IGBT

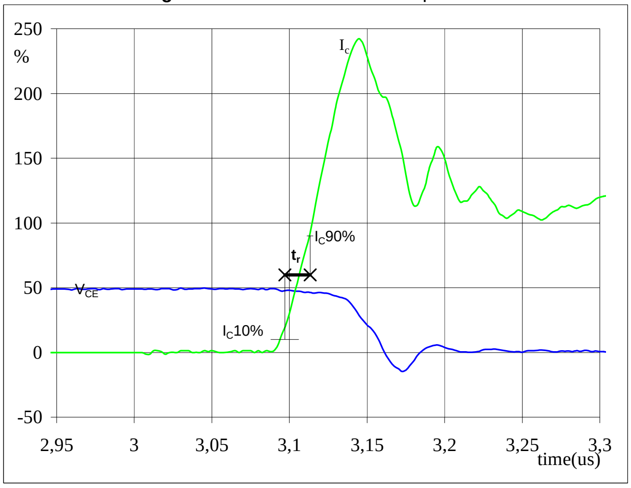
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	100	A
t_f =	0,064	µs

Figure 4 neutral point IGBT

Turn-on Switching Waveforms & definition of t_r

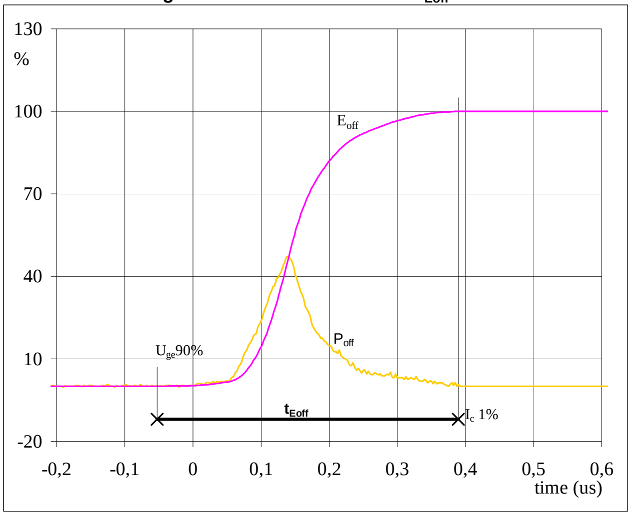


V_C (100%) =	700	V
I_C (100%) =	100	A
t_r =	0,019	µs

Switching Definitions neutral point IGBT (T2, T3 / D5, D6)

Figure 5 neutral point IGBT

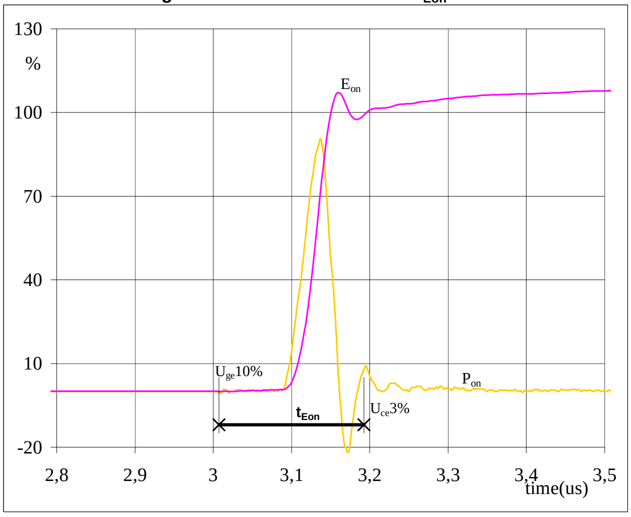
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	69,93	kW
E_{off} (100%) =	3,32	mJ
t_{Eoff} =	0,44	μs

Figure 6 neutral point IGBT

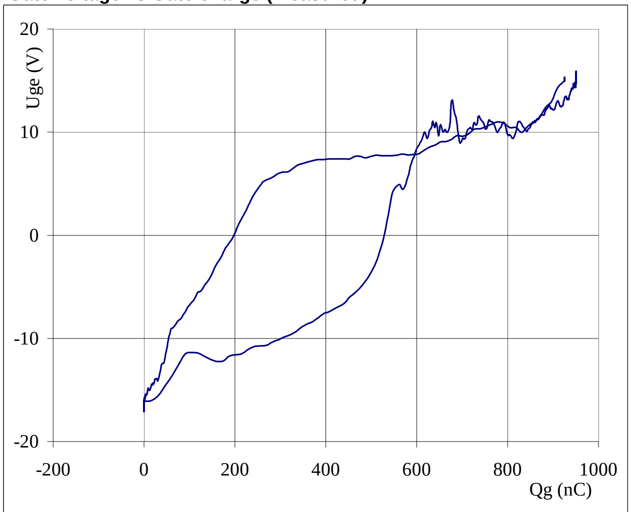
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	69,9279	kW
E_{on} (100%) =	1,52	mJ
t_{Eon} =	0,18	μs

Figure 7 neutral point IGBT

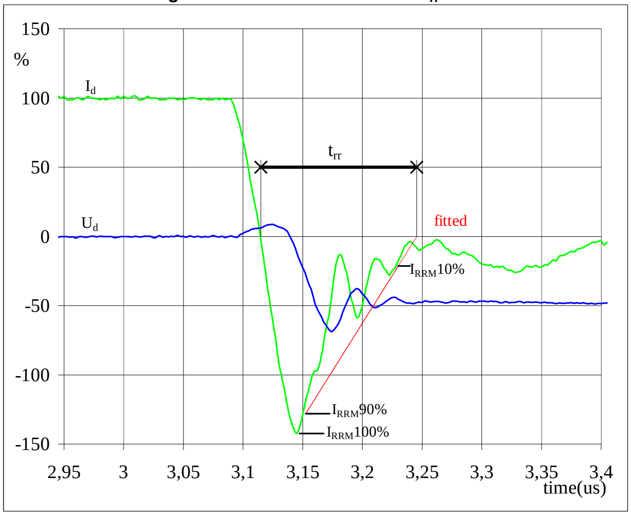
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	700	V
I_C (100%) =	100	A
Q_g =	950,59	nC

Figure 8 half bridge FWD

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

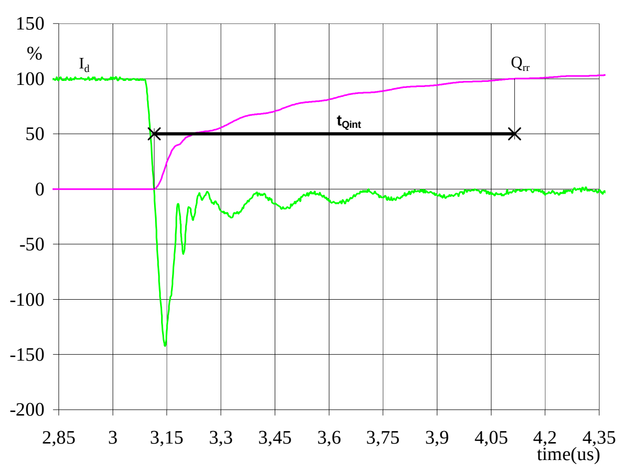


V_d (100%) =	700	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-142	A
t_{rr} =	0,07	μs

Switching Definitions neutral point IGBT (T2, T3 / D5, D6)

Figure 9 half bridge FWD

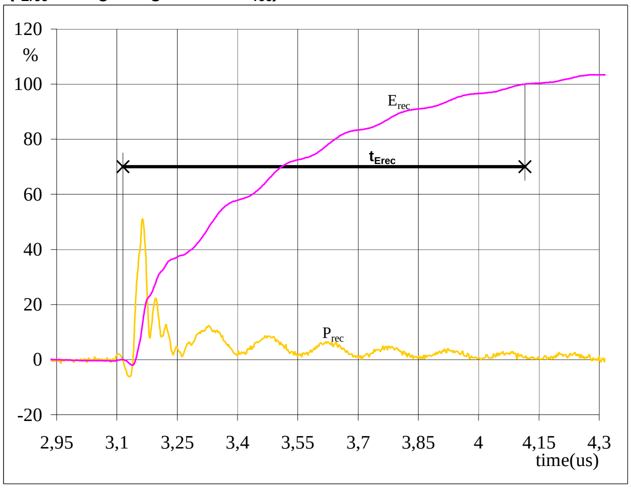
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	12,71	µC
t_{Qint} =	1,00	µs

Figure 10 half bridge FWD

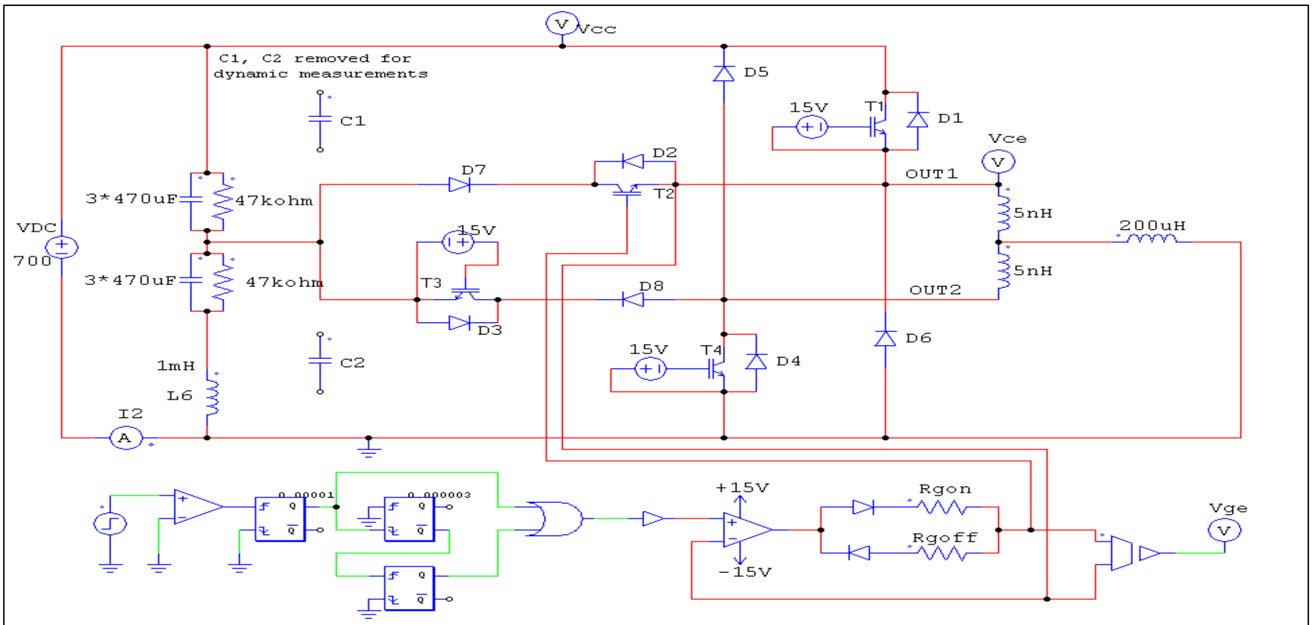
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	69,93	kW
E_{rec} (100%) =	3,61	mJ
t_{Erec} =	1,00	µs

neutral point IGBT switching measurement circuit (T2, T3 / D5, D6)

Figure 11 neutral point IGBT



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-FY12NMA160SH-M420F	M420F	M420F
without thermal paste 12mm housing with PressFiT	10-PY12NMA160SH-M420FY	M420FY	M420FY
with phase change thermal paste 12mm housing	10-FY12NMA160SH-M420F-/3/	M420F	M420F
with phase change thermal paste 12mm housing with PressFiT	10-PY12NMA160SH-M420FY-/3/	M420FY	M420FY

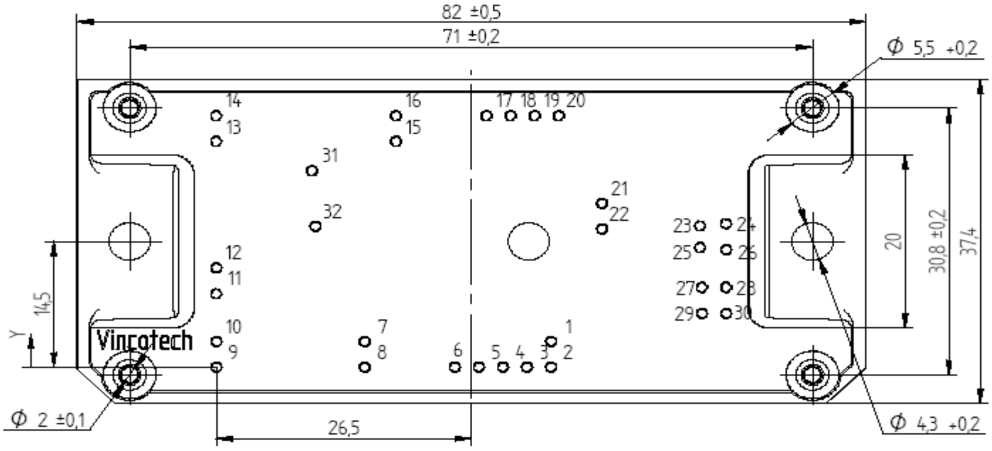
Outline

Pin table

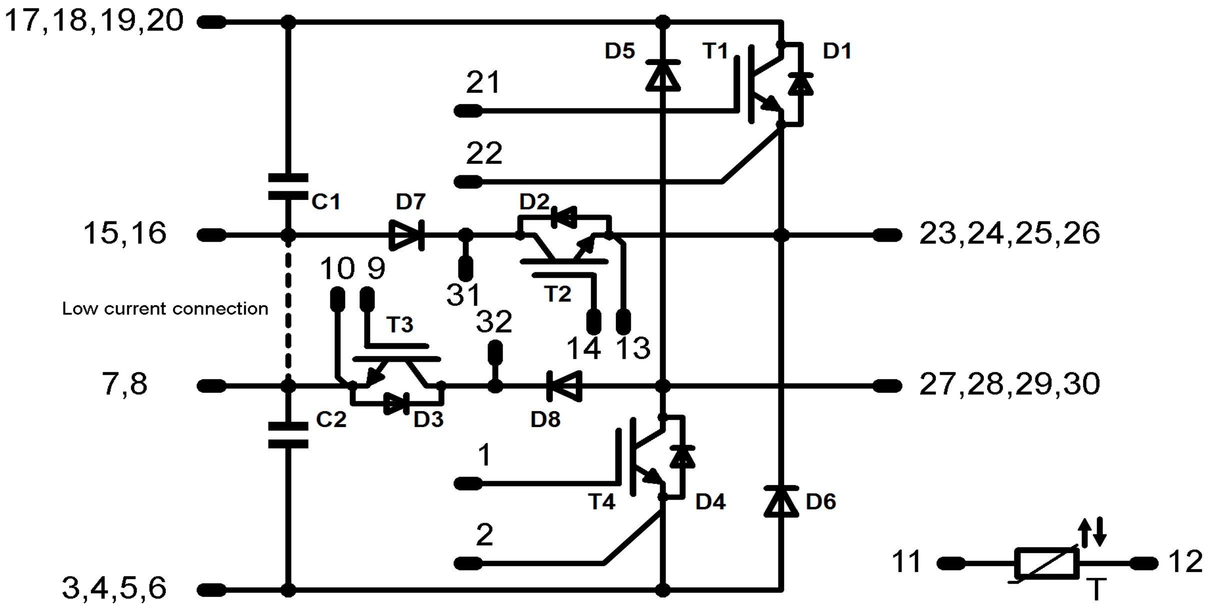
Pin	X	Y
1	34,8	2,95
2	34,8	0
3	32,3	0
4	29,8	0
5	27,3	0
6	24,8	0
7	15,45	2,95
8	15,45	0
9	0	0
10	0	2,95
11	0	8,45
12	0	11,45
13	0	26,05
14	0	29
15	18,7	26,05
16	18,7	29
17	28,1	29
18	30,6	29
19	33,1	29
20	35,6	29
21	40,1	18,9
22	40,1	15,95
23	50,3	16,3
24	53	16,55
25	50,3	13,8
26	53	13,55
27	50,5	9,2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

Pin table

Pin	X	Y
29	50,5	6,2
30	53	6,2
31	9,95	22,65
32	10,3	16,25



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.