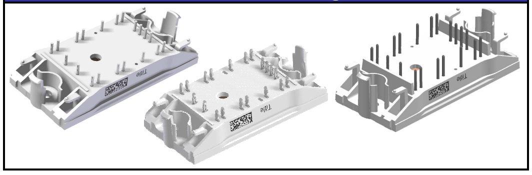
*flow*MNPC 0 — 1200 V/40 A

Features

- neutral point clamped inverter
- reactive power capability
- clip-in pcb mounting
- low inductance layout

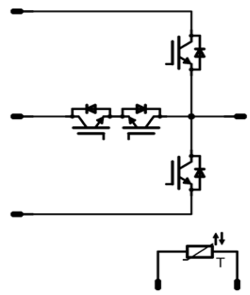
***flow* 0 housing**



Target Applications

- solar inverter
- UPS

Schematic



Types

- 10-FZ12NMA040SH-M267F
- 10-PZ12NMA040SH-M267FY
- 10-F012NMA040SH-M267F09

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Half Bridge IGBT					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	41 53	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_jmax		120	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	107 162	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j\leq150°C$ $V_{GE}=15V$		10 800	µs V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 1200V $T_{vj\ max}$= 150°C		80	A
Maximum Junction Temperature	T_jmax			175	°C
Neutral Point FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	21 41	A
Surge forward current	I_{FSM}	t_p=8,3ms , sin 180°	$T_c=25°C$	300	A
I2t-value	I^2t	t_p=8,3ms , sin 180°	$T_c=25°C$	370	A^2s
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		60	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	$T_h=80°C$ $T_c=80°C$	48 73	W
Maximum Junction Temperature	T_jmax			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Neutral Point IGBT					
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	31 39	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		90	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	57 86	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
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 600V $T_{vj\ max}$= 150°C		60	A
Maximum Junction Temperature	$T_j$max			175	°C
Half Bridge FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C T_c=80°C	13 17	A
Surge forward current	I_{FSM}	t_p=10ms , sin 180°	T_j=150°C	65	A
I2t-value	I^2t			21	A^2s
Repetitive peak forward current	I_{FRM}	tp limited by Tj max		45	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	31 47	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	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Half Bridge IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0015	Tj=25°C Tj=150°C	5,2	5,6	6,4	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		40	Tj=25°C Tj=150°C	1,7	1,96 2,29	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	350	28	Tj=25°C Tj=150°C		70 72		ns
Rise time	t_r					Tj=25°C Tj=150°C		13 15		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		166 217		
Fall time	t_f					Tj=25°C Tj=150°C		45 79		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,31 0,52		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,67 1,16		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		2300		pF
Output capacitance	C_{oss}							160		
Reverse transfer capacitance	C_{rss}							135		
Gate charge	Q_{Gate}		±15	960	40	Tj=25°C		203		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,89		K/W
Neutral Point FWD										
Diode forward voltage	V_F				30	Tj=25°C Tj=150°C		2,28 1,74	2,71	V
Reverse leakage current	I_r			600		Tj=25°C Tj=150°C			100	µA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	350	28	Tj=25°C Tj=150°C		32 41		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		18 40		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0,32 0,92		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		8818 3866		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0,03 0,12		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,98		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	Value Min	Value Typ	Value Max	Unit
Neutral Point IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,002	Tj=25°C Tj=150°C	5,0	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		30	Tj=25°C Tj=150°C	1,1	1,52 1,70	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,0016	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	350	28	Tj=25°C Tj=150°C		105 105		ns
Rise time	t_r					Tj=25°C Tj=150°C		11 16		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		164 187		
Fall time	t_f					Tj=25°C Tj=150°C		74 91		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,49 0,66		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,76 0,98		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1630		pF
Output capacitance	C_{oss}							108		
Reverse transfer capacitance	C_{rss}							50		
Gate charge	Q_{Gate}		±15	480	30	Tj=25°C		165		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,68		K/W
Half Bridge FWD										
Diode forward voltage	V_F				15	Tj=25°C Tj=125°C		2,28 2,39	2,71	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			60	µA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	350	28	Tj=25°C Tj=125°C		41 44		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		44 110		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		1,47 2,73		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		5094 3534		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,35 0,71		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,27		K/W
Thermistor										
Rated resistance	R					Tj=25°C		22000		Ω
Deviation of R100	ΔR/R	R100=1486Ω				Tj=100°C	-5		5	%
Power dissipation	P					Tj=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	

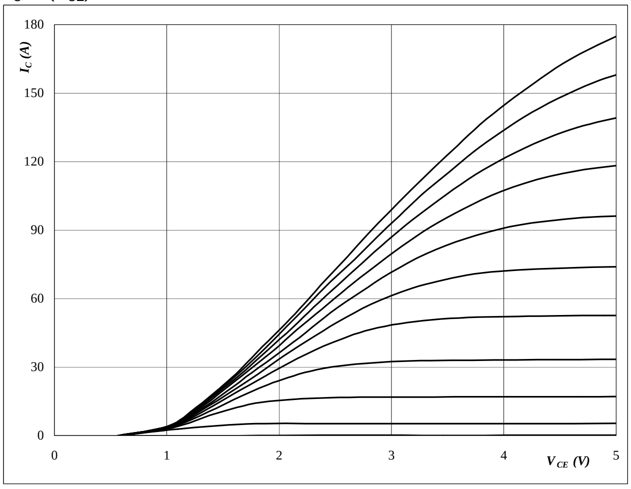
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



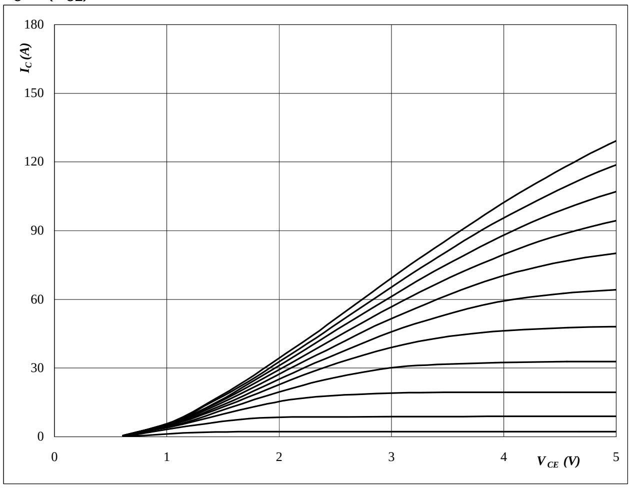
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



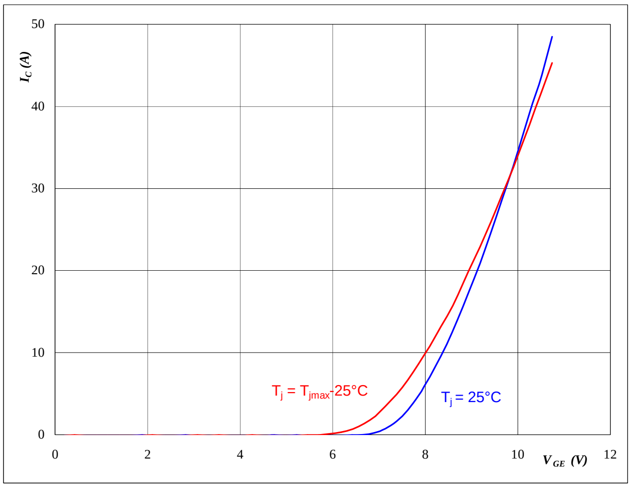
At

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

$I_C = f(V_{GE})$



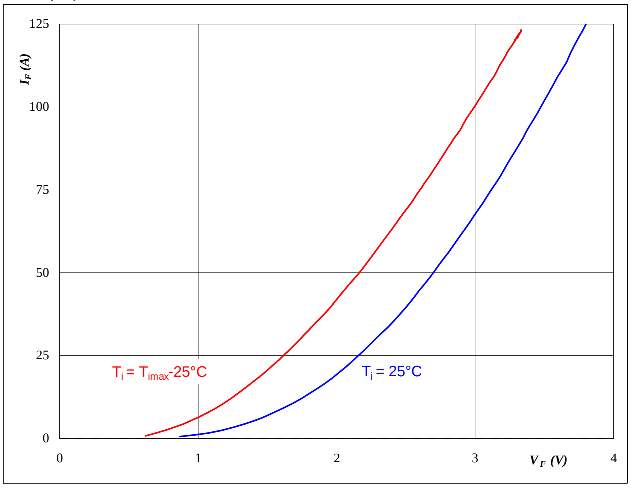
At

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

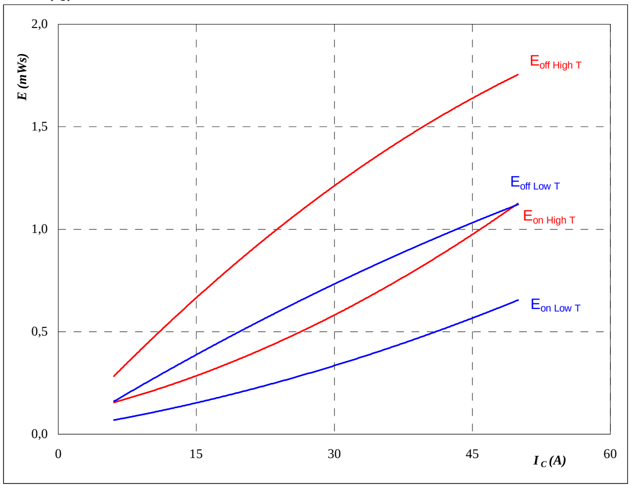
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 5	IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



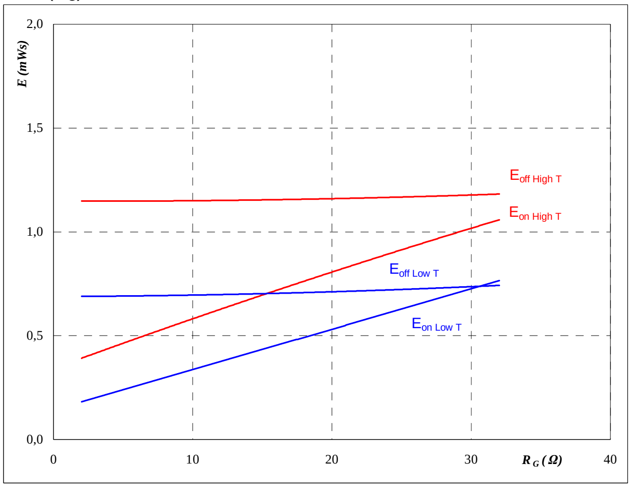
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 6	IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



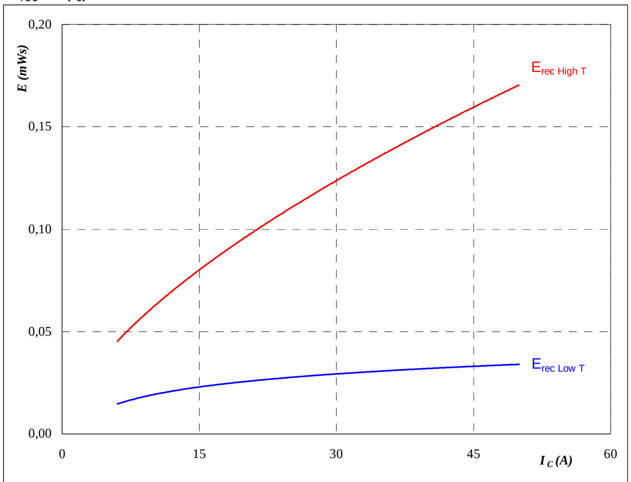
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	28	A

Figure 7	FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



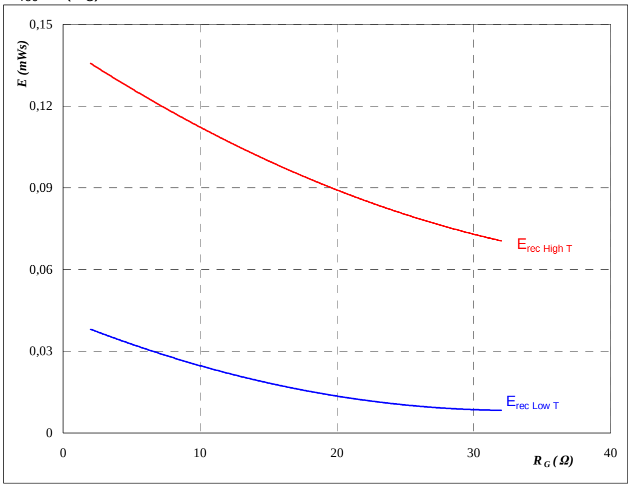
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	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 =	28	A

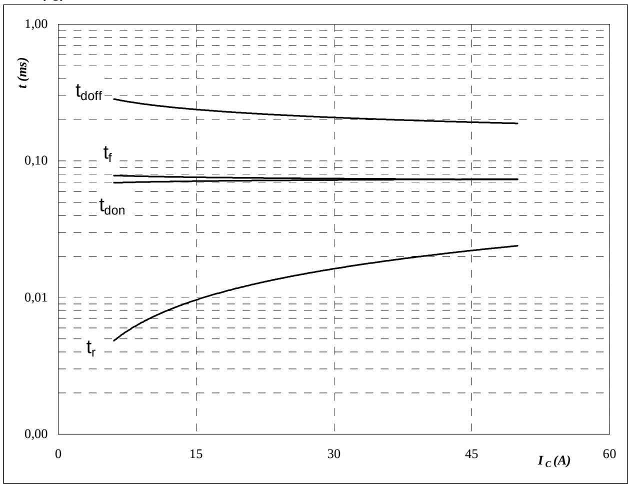
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



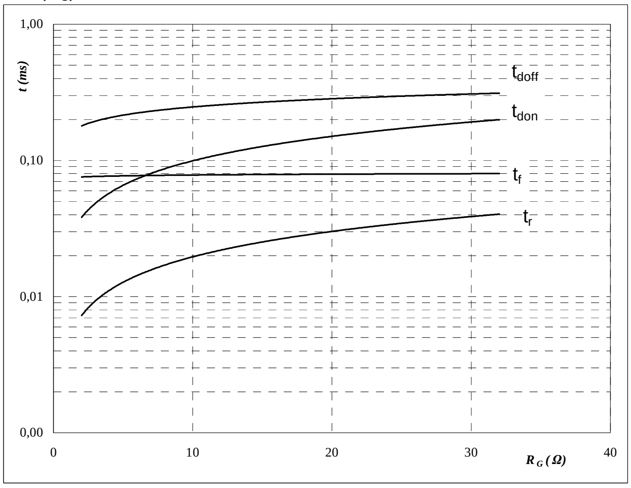
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



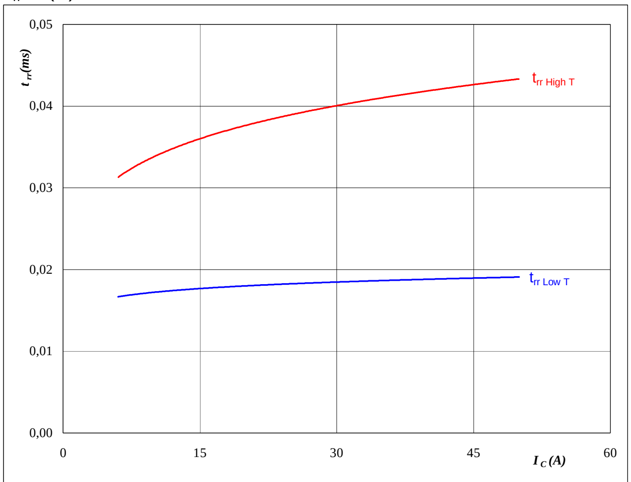
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	28	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



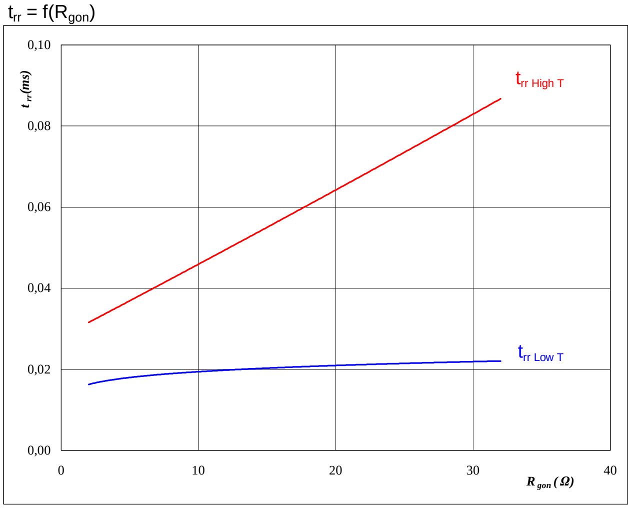
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	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 =	28	A
V_{GE} =	±15	V

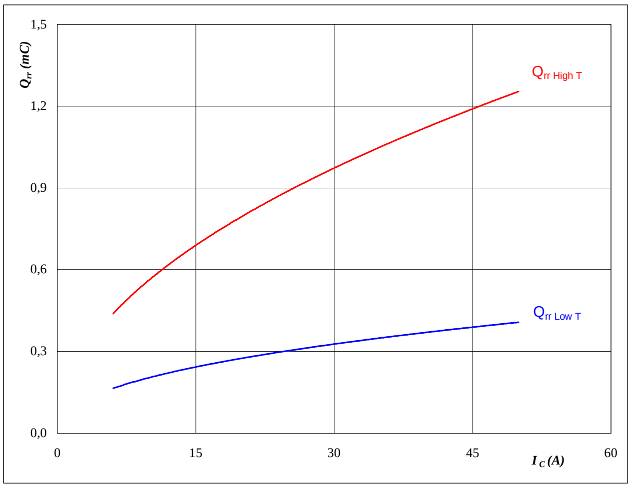
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



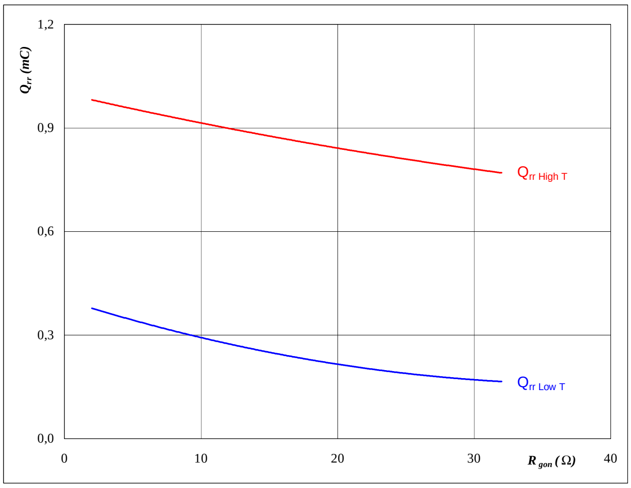
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 14 FWD

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

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



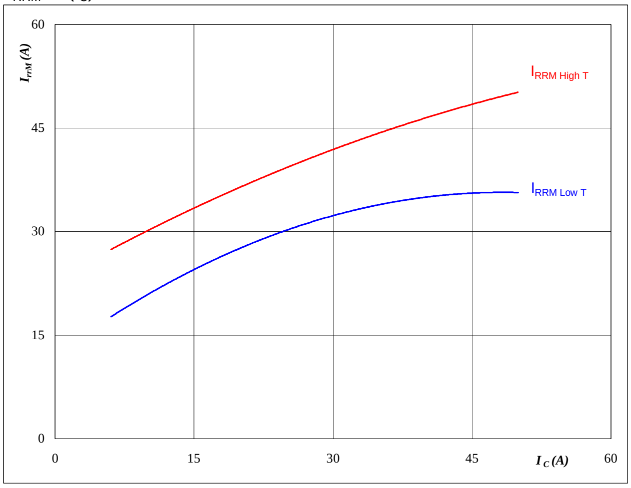
At

T_j =	25/125	°C
V_R =	350	V
I_F =	28	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



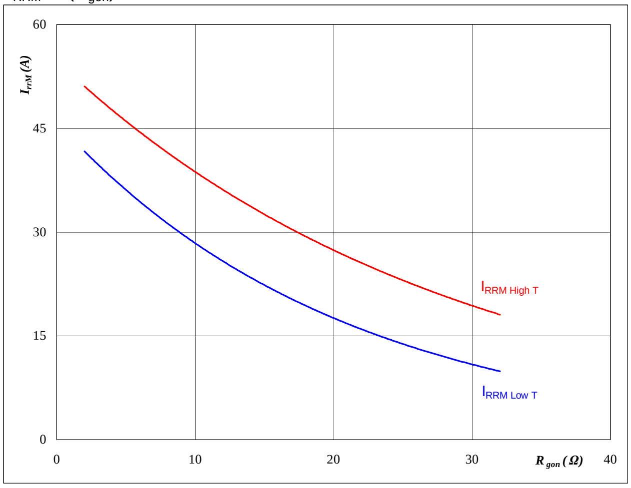
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	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 =	28	A
V_{GE} =	±15	V

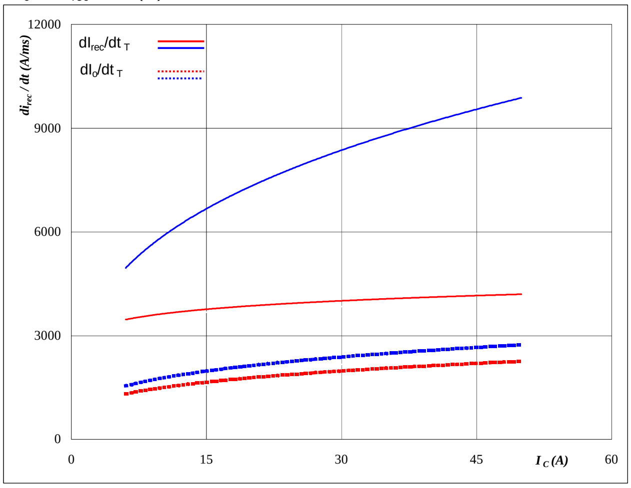
Half Bridge

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

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



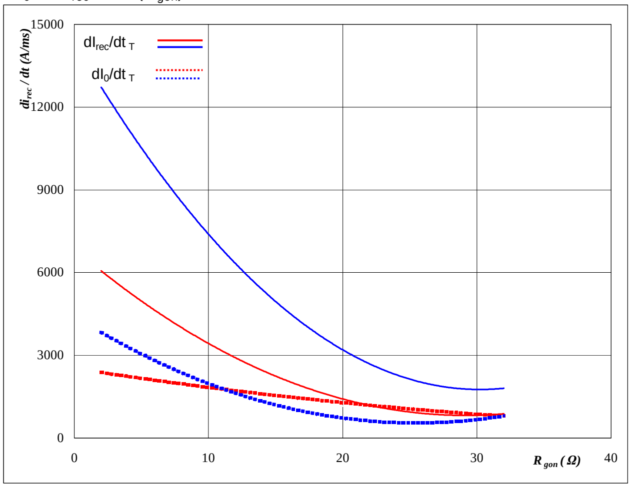
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 18 FWD

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

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



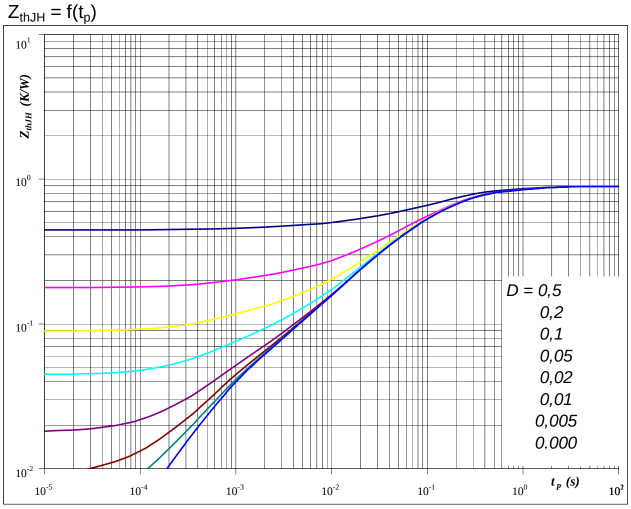
At

T_j =	25/125	°C
V_R =	350	V
I_F =	28	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} =	0,89	K/W

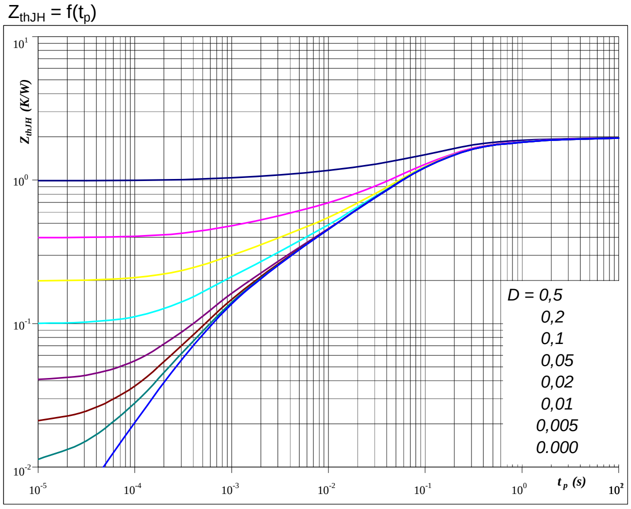
IGBT thermal model values

R (C/W)	Tau (s)
0,09	1,1E+00
0,17	2,9E-01
0,47	9,1E-02
0,12	1,4E-02
0,04	9,2E-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} =	1,98	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,07	5,6E+00
0,17	1,2E+00
0,52	2,2E-01
0,75	7,6E-02
0,25	1,5E-02
0,13	2,8E-03

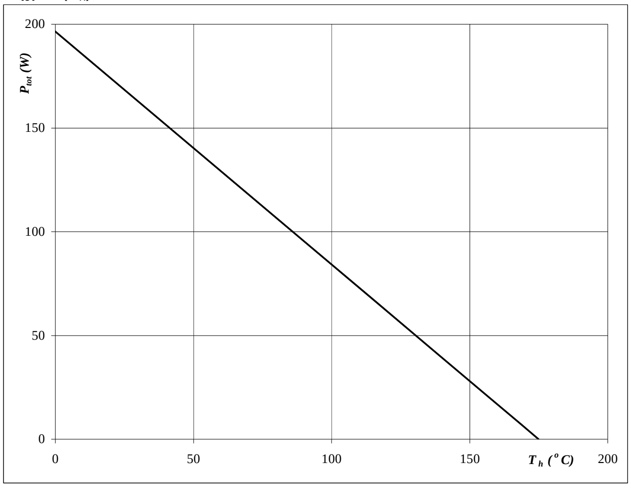
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



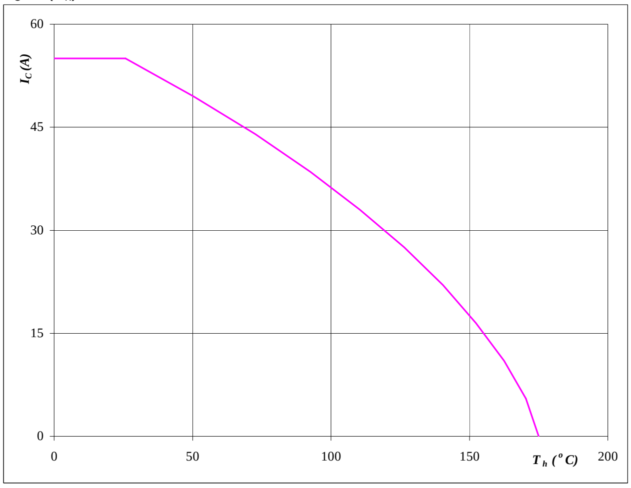
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

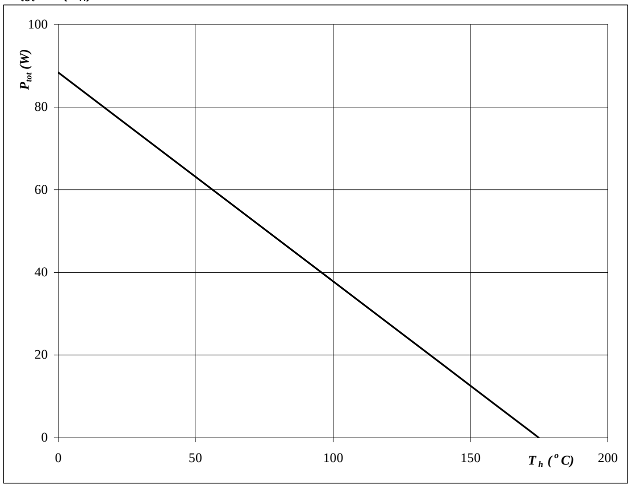
T_j = 175 °C

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



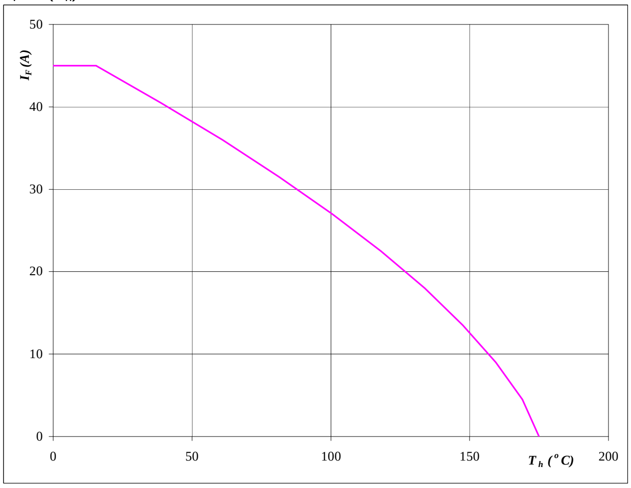
At

T_j = 175 °C

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 175 °C

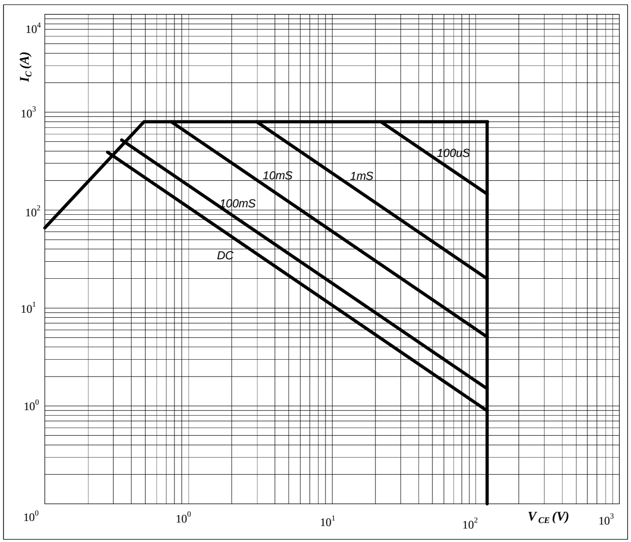
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



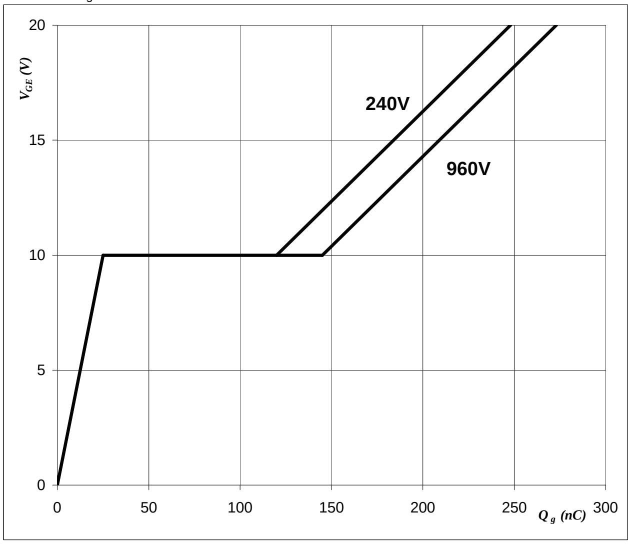
At

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

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



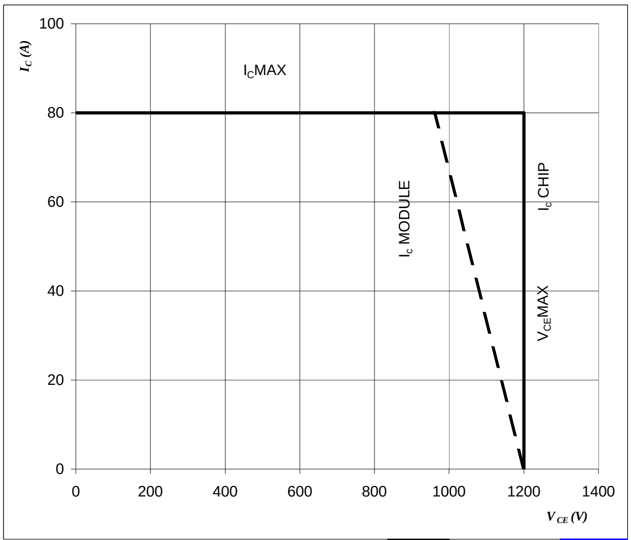
At

I_C =	40	A

Figure 27 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

DC link $_{minus}$=DC link $_{plus}$

Switching mode : 3 level switching

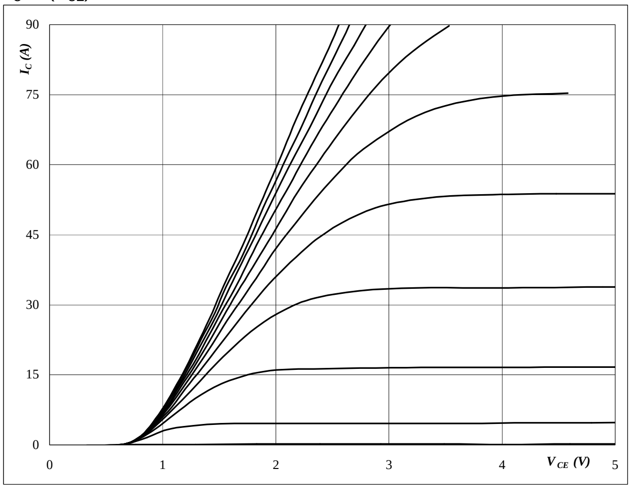
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



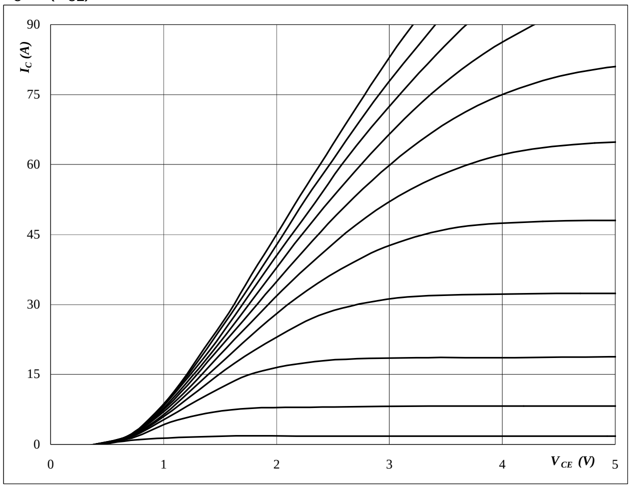
At

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

$I_C = f(V_{CE})$



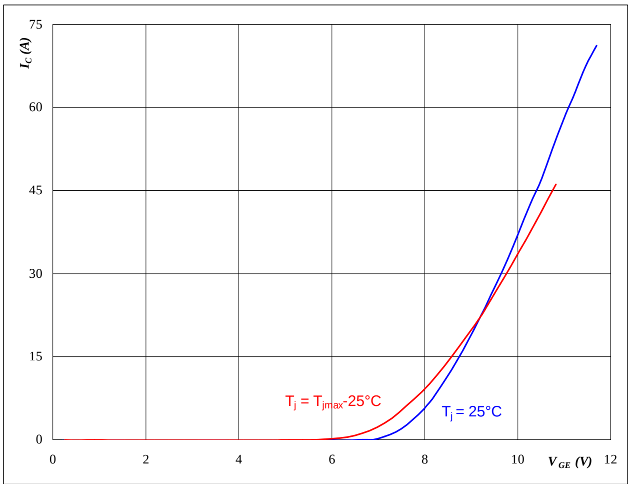
At

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

$I_C = f(V_{GE})$



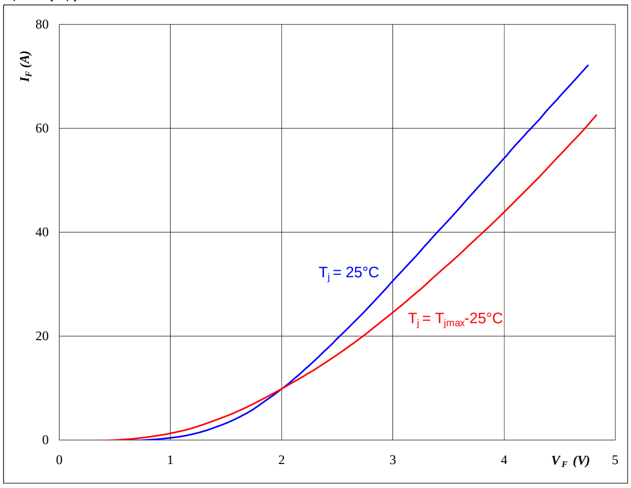
At

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

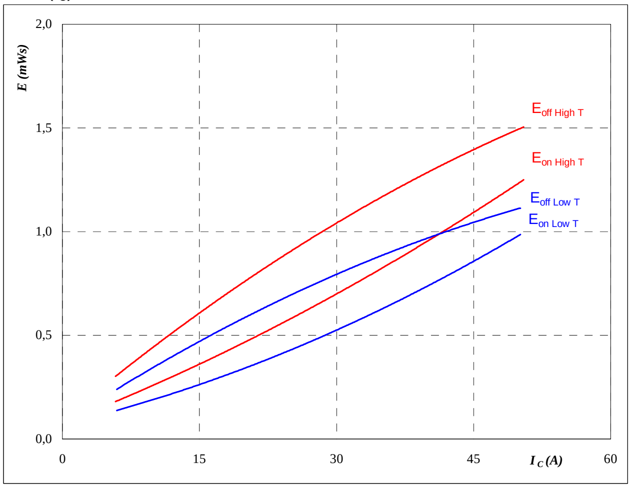
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



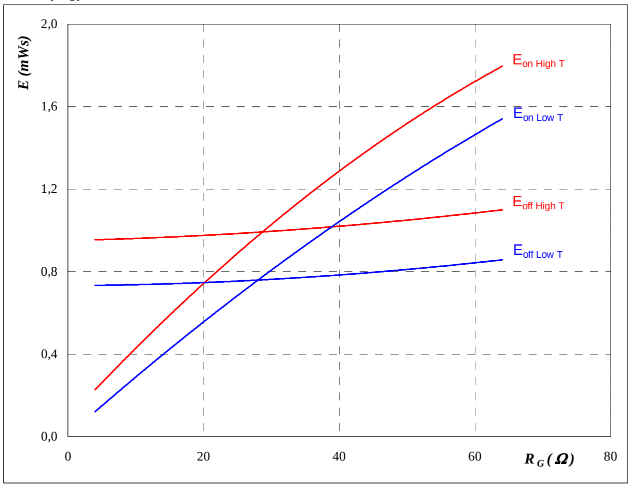
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



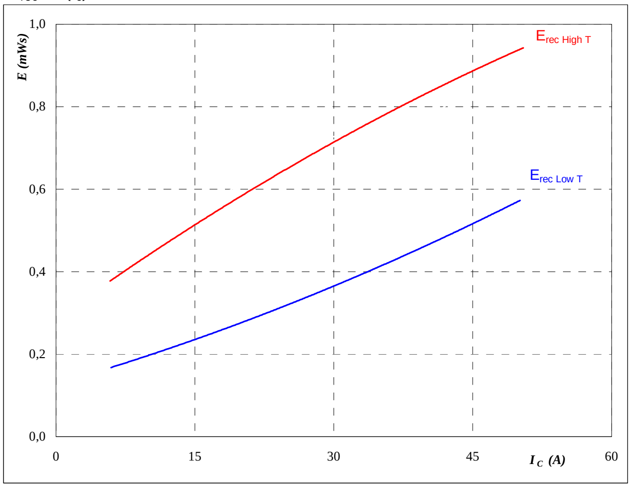
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	28	A

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

E_{rec} = f(I_c)



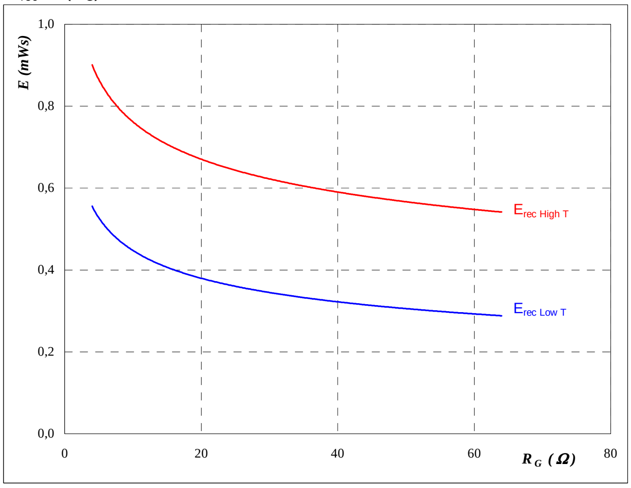
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	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 =	28	A

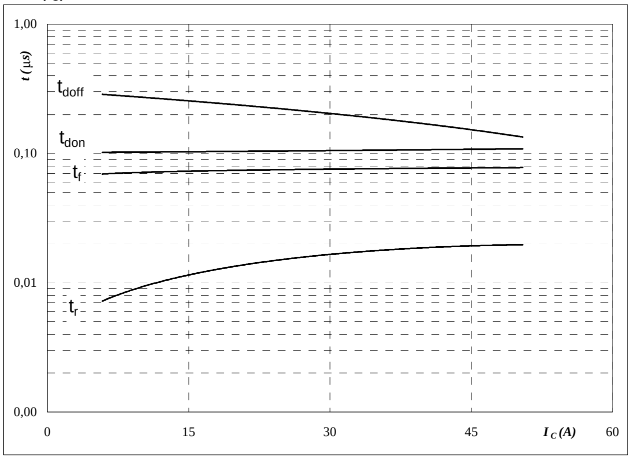
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



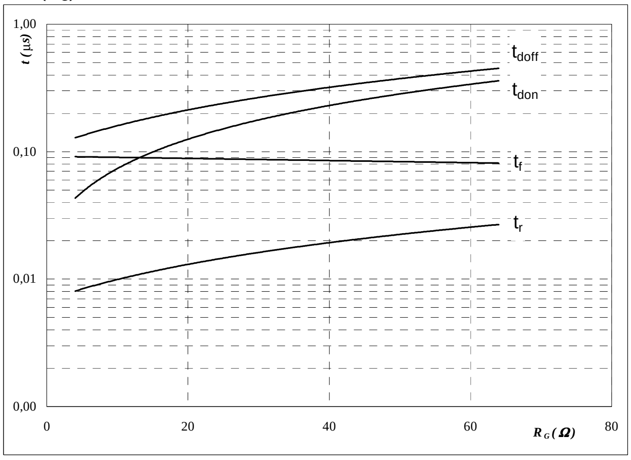
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



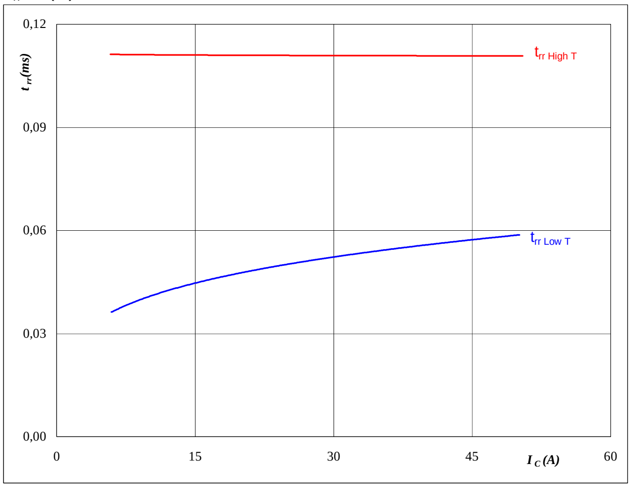
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	28	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



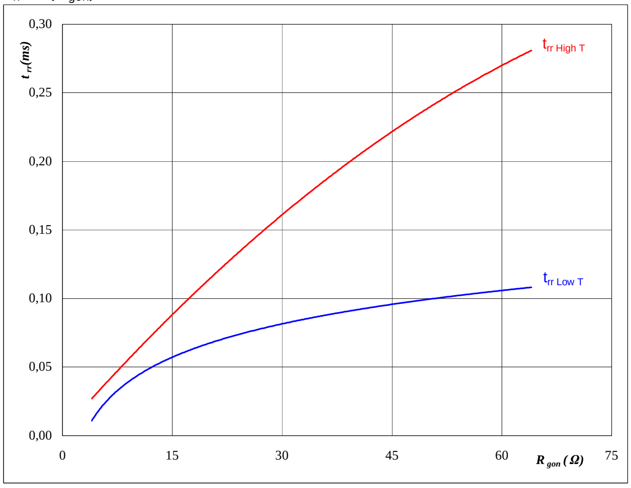
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	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 =	28	A
V_{GE} =	±15	V

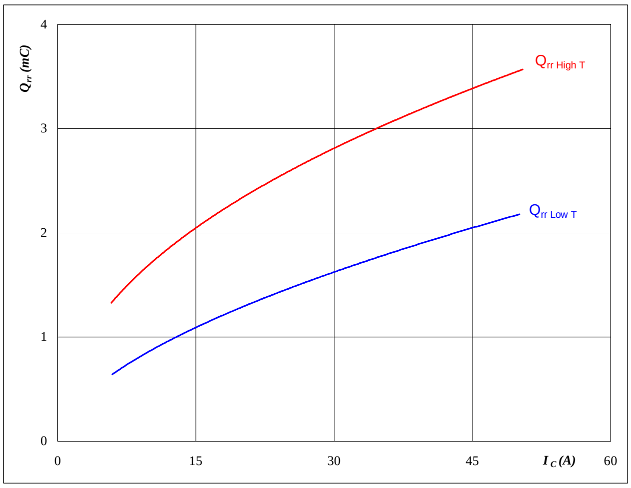
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 13	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



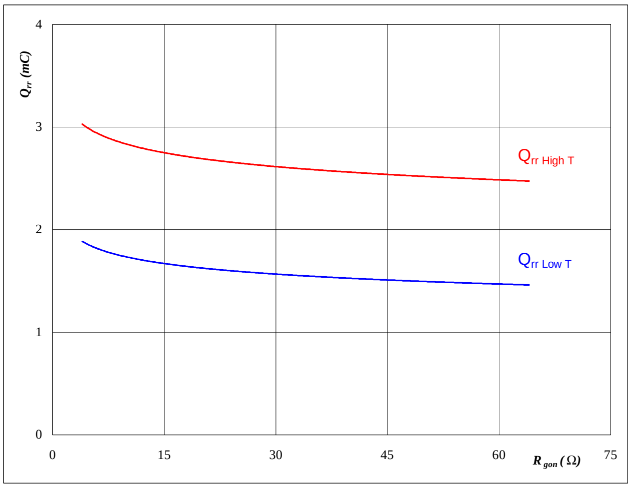
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 14	FWD

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

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



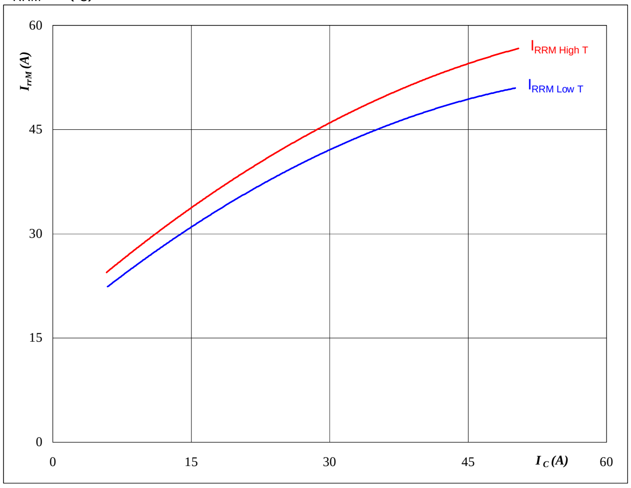
At

T_j =	25/125	°C
V_R =	350	V
I_F =	28	A
V_{GE} =	±15	V

Figure 15	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



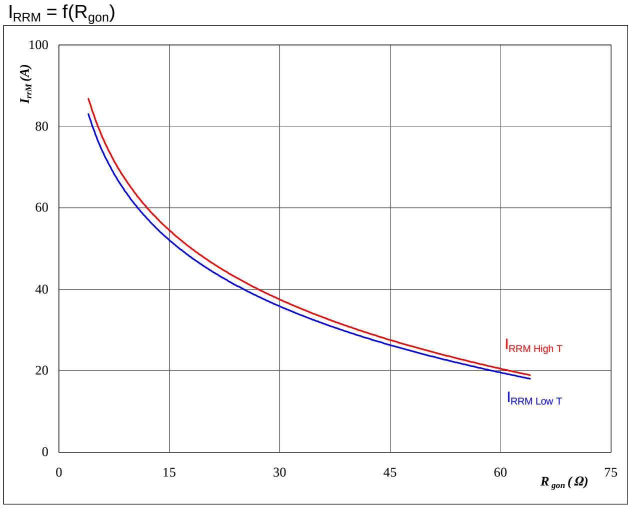
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	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 =	28	A
V_{GE} =	±15	V

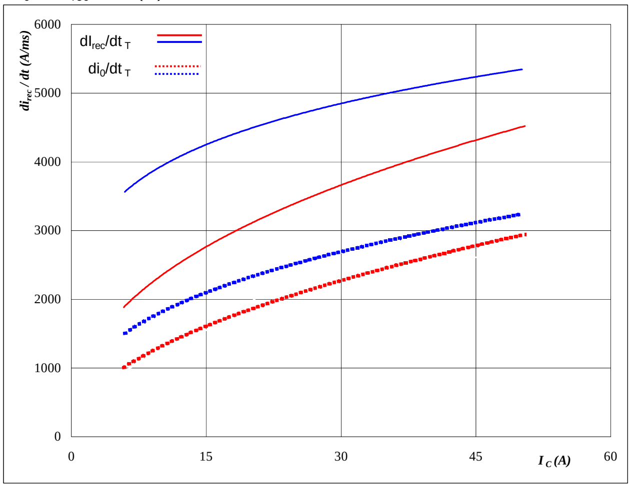
Neutral point

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

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



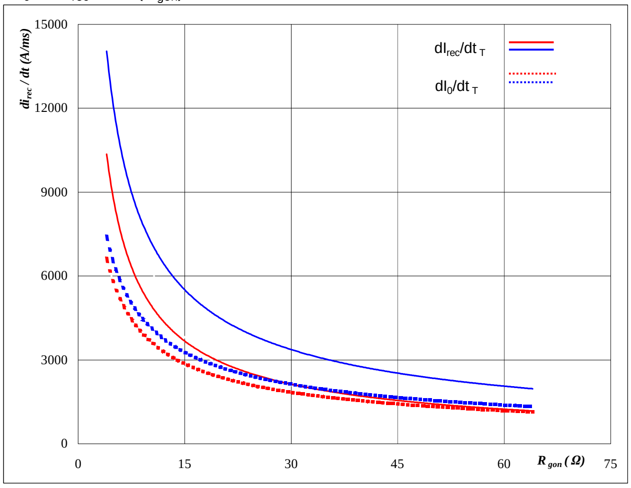
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 18 FWD

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

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



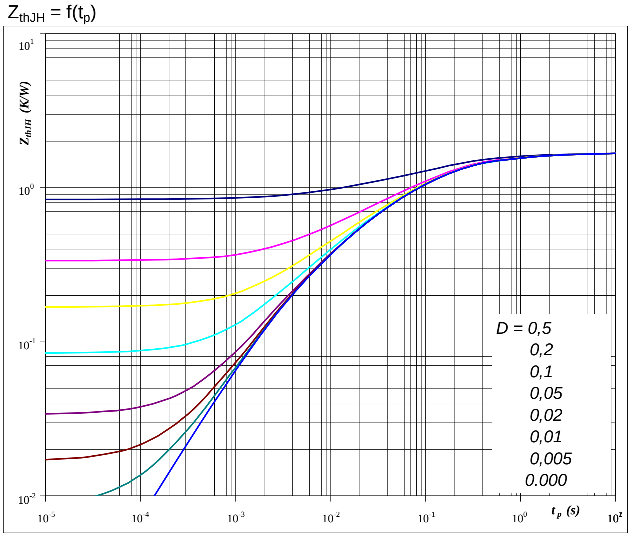
At

T_j =	25/125	°C
V_R =	350	V
I_F =	28	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} =	1,68	K/W

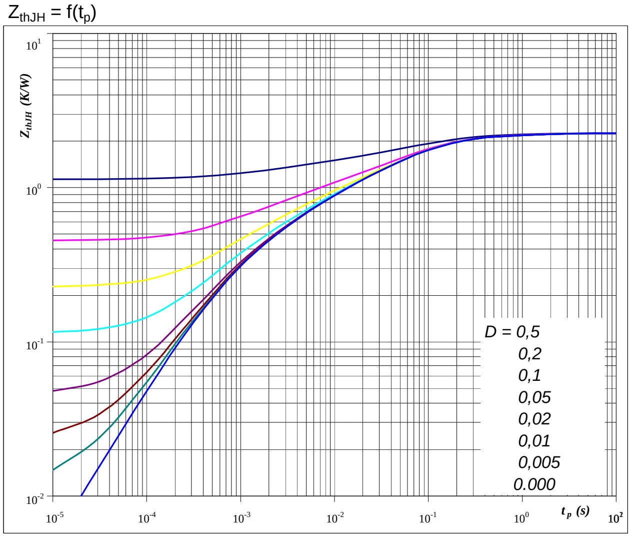
IGBT thermal model values

R (C/W)	Tau (s)
0,07	4,8E+00
0,17	1,0E+00
0,47	1,9E-01
0,56	6,8E-02
0,32	1,2E-02
0,09	2,5E-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} =	2,27	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,04	9,1E+00
0,13	9,0E-01
0,53	1,5E-01
0,66	5,1E-02
0,42	1,1E-02
0,29	2,5E-03
0,19	5,8E-04

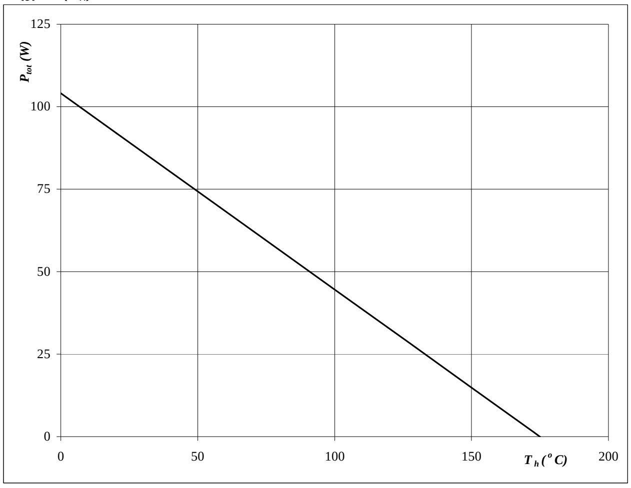
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



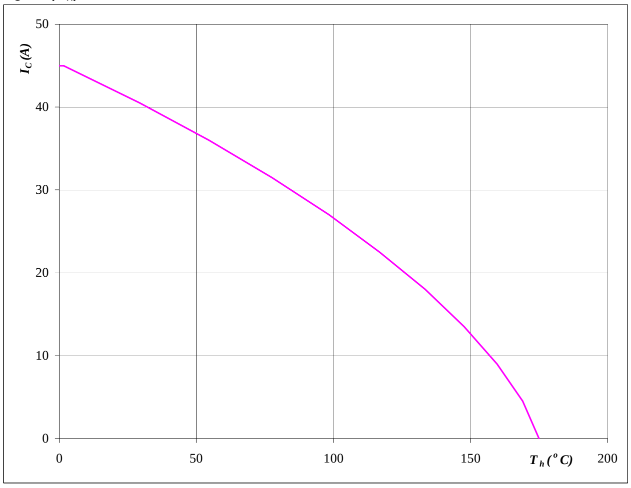
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

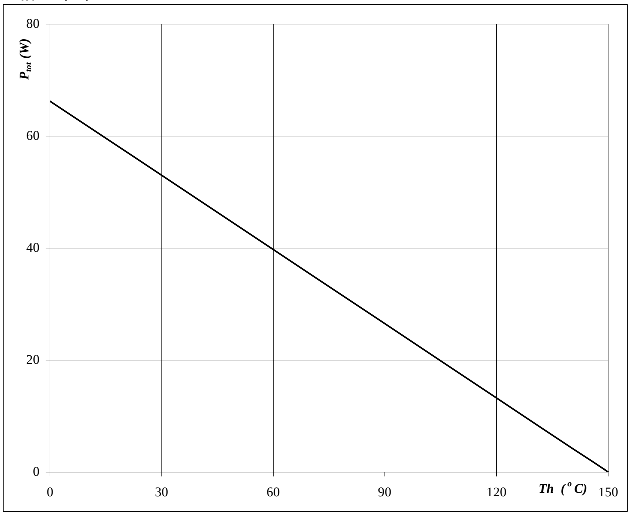
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



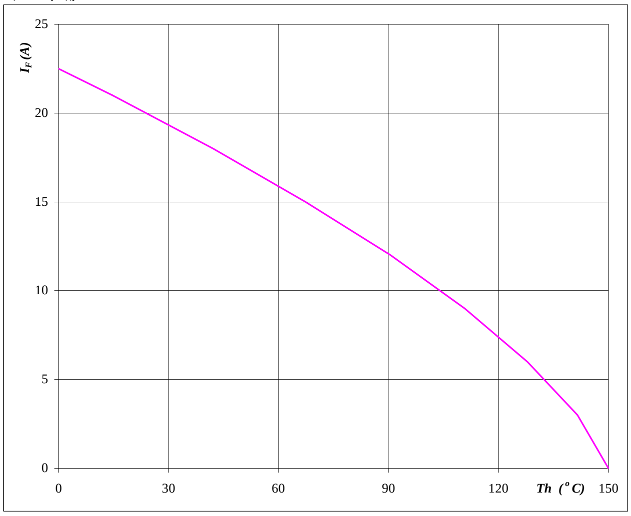
At

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

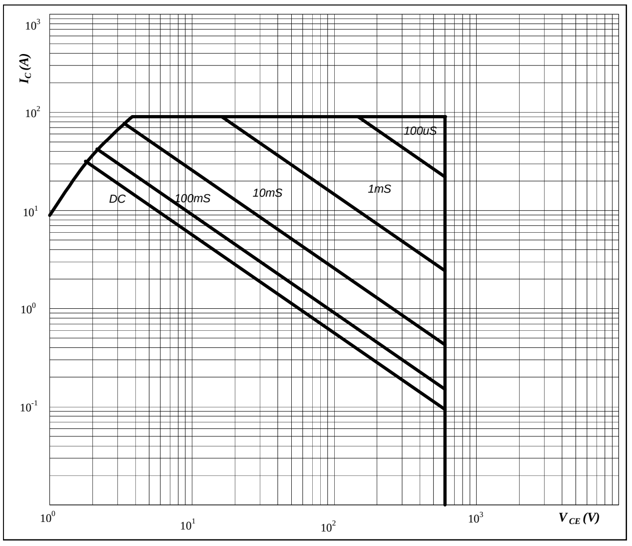
Neutral point

Neutral Point IGBT and Half Bridge FWD

Figure 25	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



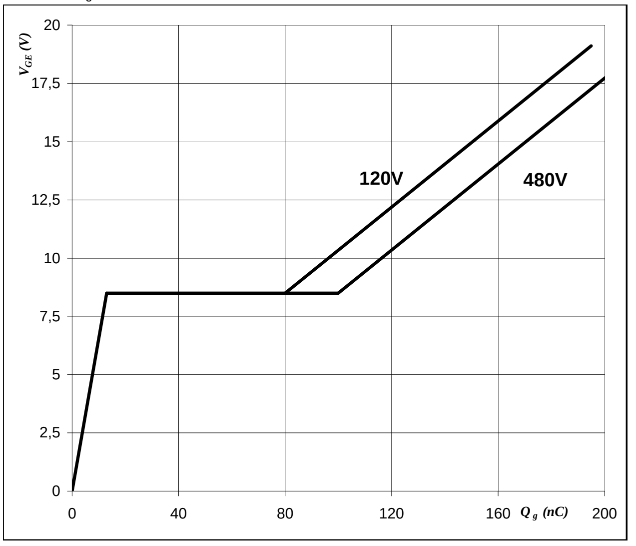
At

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

Figure 26	IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



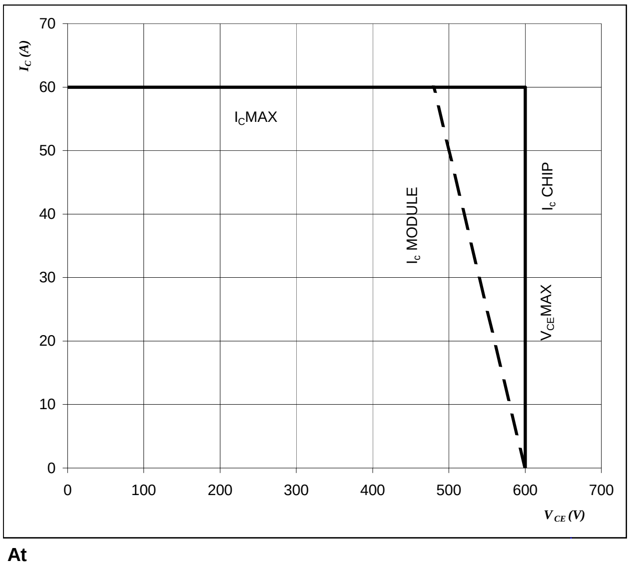
At

I_C =	30	A

Figure 27	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	T_{jmax}-25	ºC

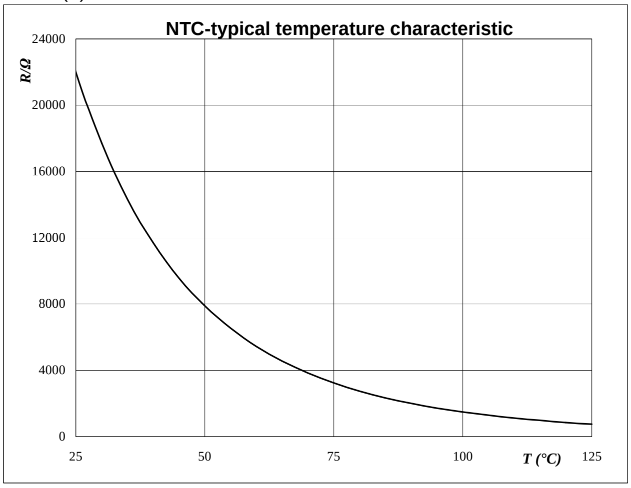
DC link $_{minus}$=DC link $_{plus}$

Switching mode : 3 level switching

Thermistor

Figure 1 Thermistor

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



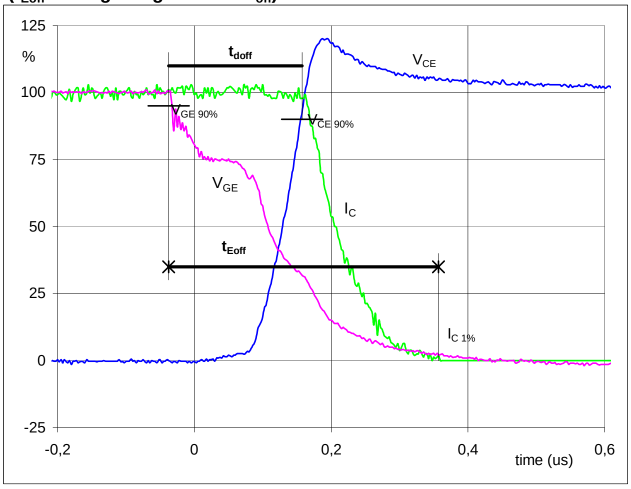
Switching Definitions Neutral point IGBT

General conditions

T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 Neutral point IGBT

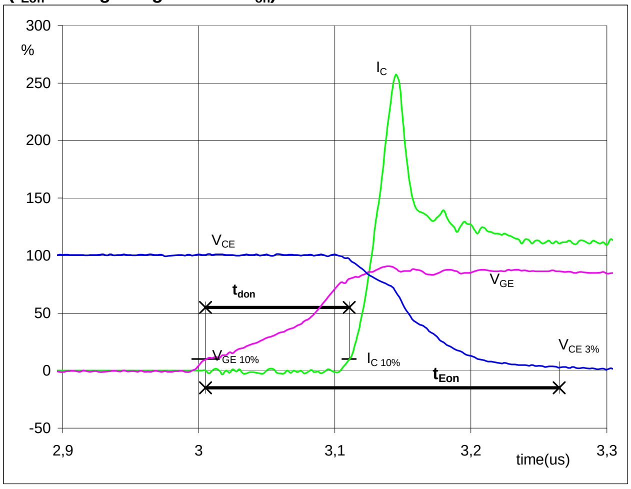
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
t_{doff} =	0,19	µs
t_{Eoff} =	0,39	µs

Figure 2 Neutral point IGBT

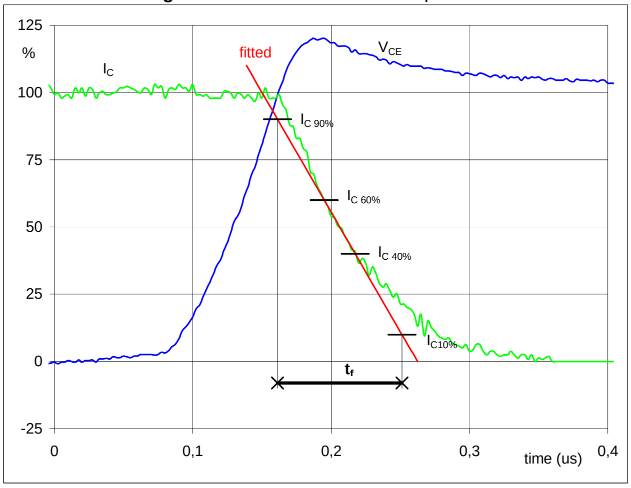
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
t_{don} =	0,11	µs
t_{Eon} =	0,26	µs

Figure 3 Neutral point IGBT

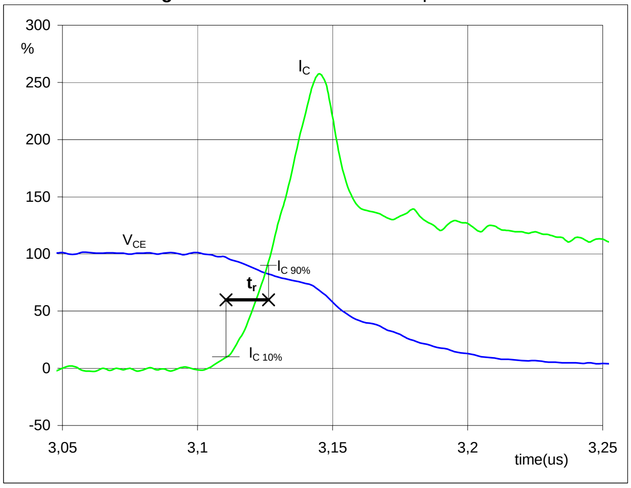
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	28	A
t_f =	0,09	µs

Figure 4 Neutral point IGBT

Turn-on Switching Waveforms & definition of t_r

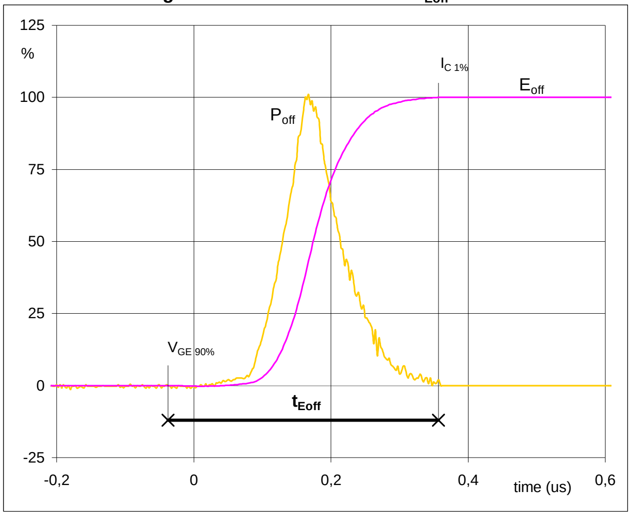


V_C (100%) =	350	V
I_C (100%) =	28	A
t_r =	0,02	µs

Switching Definitions Neutral point IGBT

Figure 5 — Neutral point IGBT

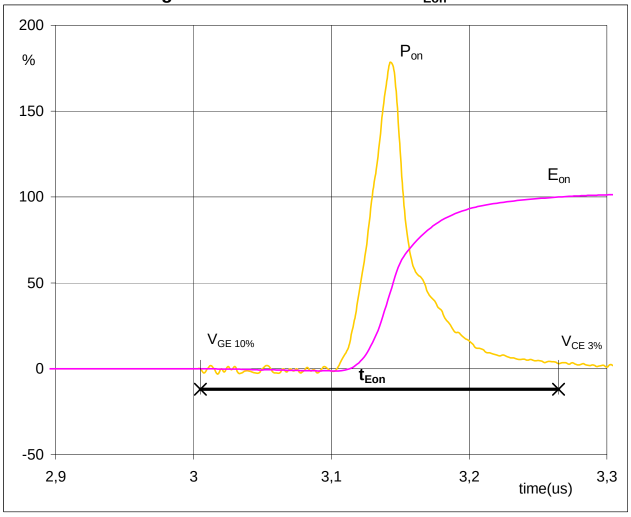
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	9,70	kW
E_{off} (100%) =	0,98	mJ
t_{Eoff} =	0,39	μs

Figure 6 — Neutral point IGBT

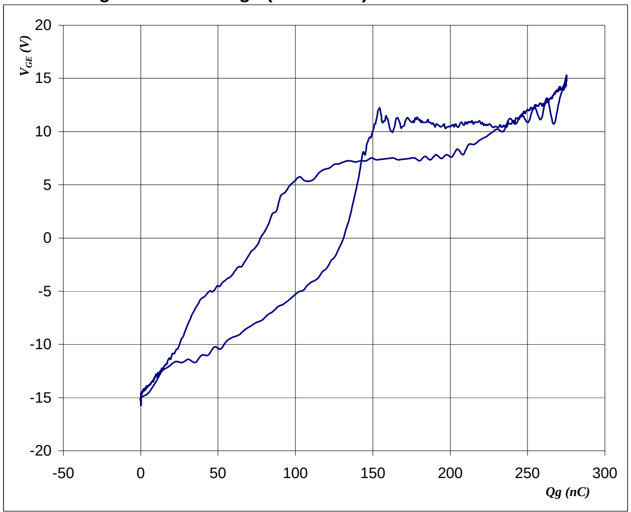
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	9,70	kW
E_{on} (100%) =	0,66	mJ
t_{Eon} =	0,26	μs

Figure 7 — Neutral point IGBT

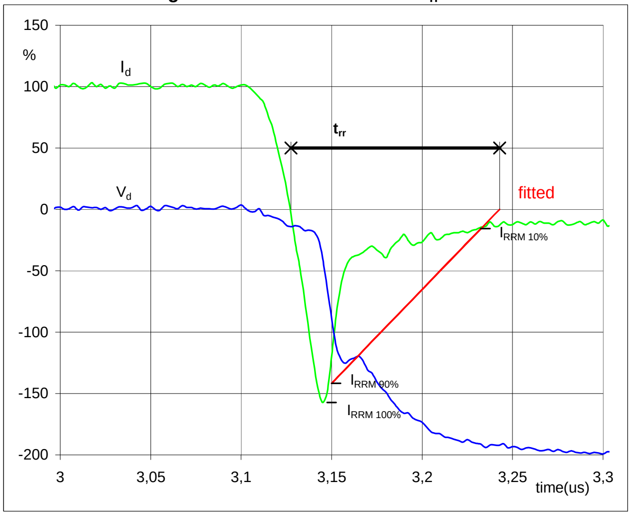
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
Q_g =	277	nC

Figure 8 — Neutral point FWD

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

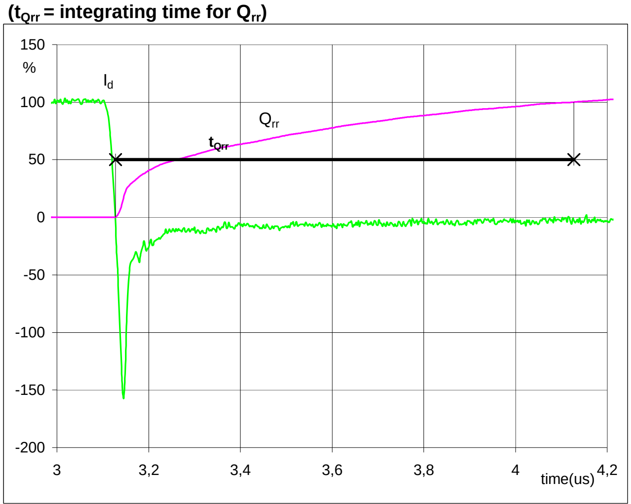


V_d (100%) =	350	V
I_d (100%) =	28	A
I_{RRM} (100%) =	-44	A
t_{rr} =	0,11	μs

Switching Definitions Neutral point IGBT

Figure 9 Neutral point IGBT

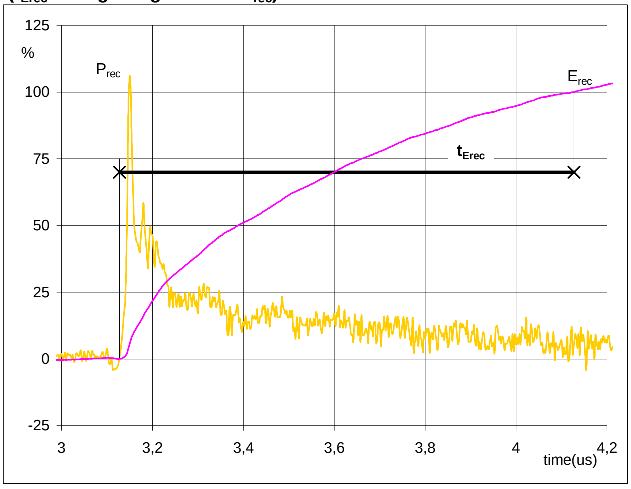
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	28	A
Q_{rr} (100%) =	2,73	μC
t_{Qrr} =	1,00	μs

Figure 10 Neutral point FWD

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

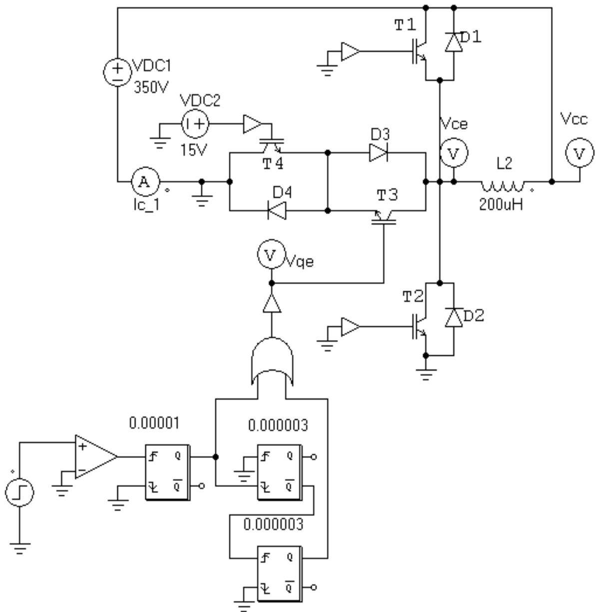


P_{rec} (100%) =	9,70	kW
E_{rec} (100%) =	0,71	mJ
t_{Erec} =	1,00	μs

Measurement circuits

Figure 11

BOOST stage switching measurement circuit



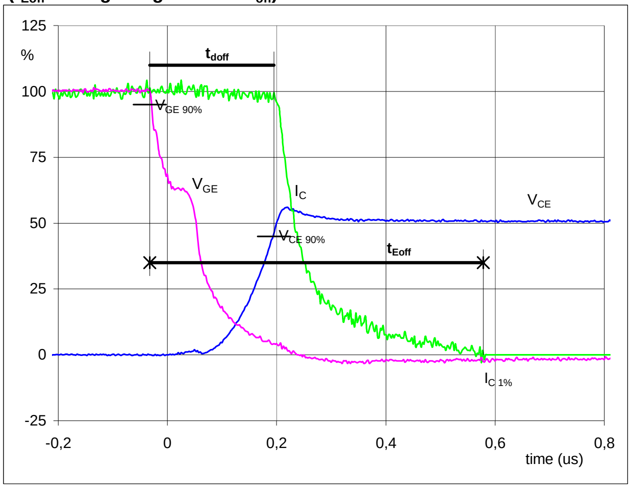
Switching Definitions Half Bridge IGBT

General conditions

T_j	=	125 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 Half Bridge IGBT

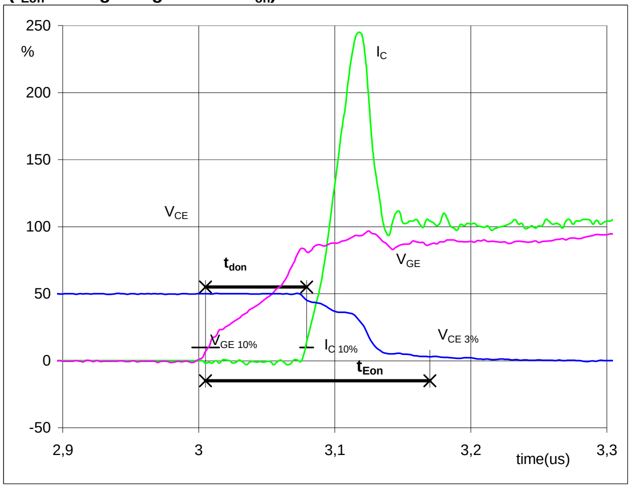
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	28	A
t_{doff} =	0,22	μs
t_{Eoff} =	0,61	μs

Figure 2 Half Bridge IGBT

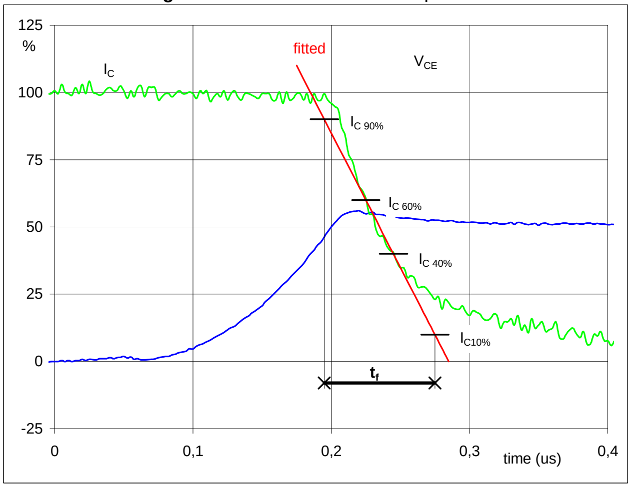
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	700	V
I_C (100%) =	28	A
t_{don} =	0,07	μs
t_{Eon} =	0,16	μs

Figure 3 Half Bridge IGBT

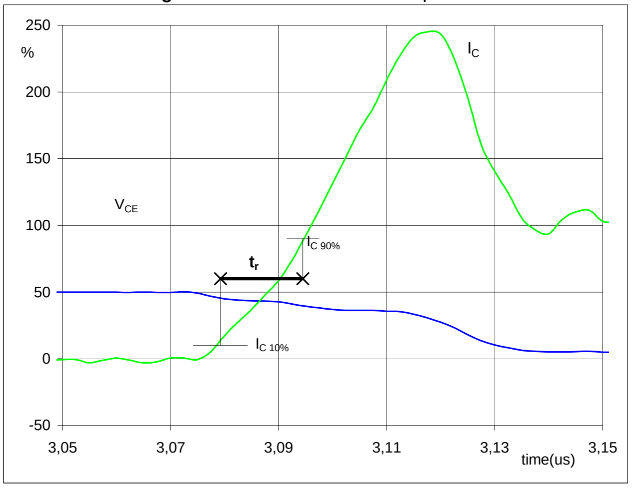
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	700	V
I_C (100%) =	28	A
t_f =	0,08	μs

Figure 4 Half Bridge IGBT

Turn-on Switching Waveforms & definition of t_r

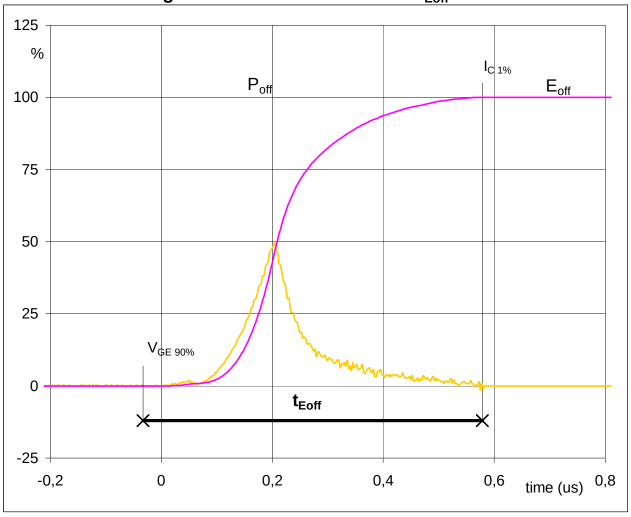


V_C (100%) =	700	V
I_C (100%) =	28	A
t_r =	0,02	μs

Switching Definitions Half Bridge IGBT

Figure 5 Half Bridge IGBT

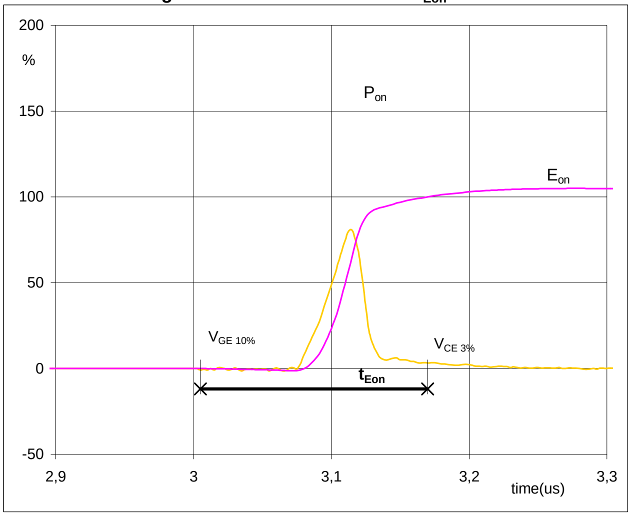
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	19,50	kW
E_{off} (100%) =	1,16	mJ
t_{Eoff} =	0,61	μs

Figure 6 Half Bridge IGBT

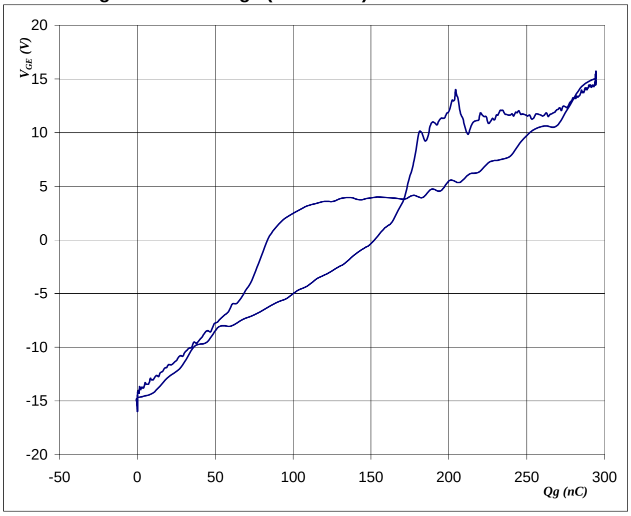
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	19,50	kW
E_{on} (100%) =	0,52	mJ
t_{Eon} =	0,16	μs

Figure 7 Half Bridge IGBT

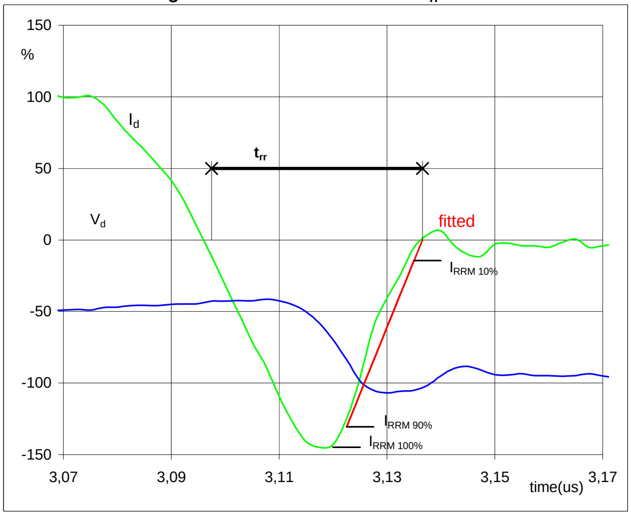
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	700	V
I_C (100%) =	28	A
Q_g =	299,41	nC

Figure 8 Half Bridge FWD

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

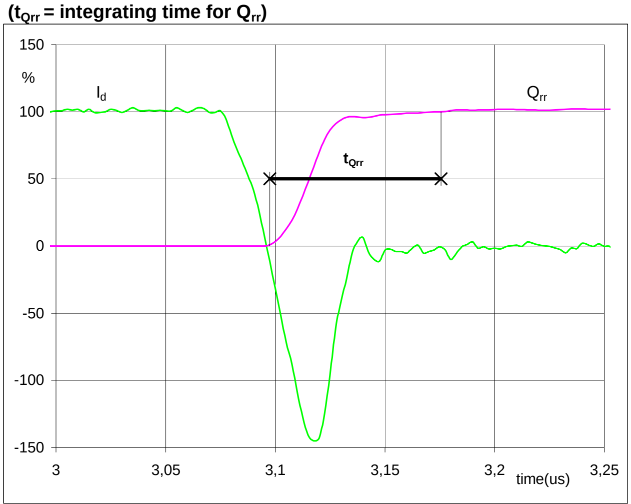


V_d (100%) =	700	V
I_d (100%) =	28	A
I_{RRM} (100%) =	-41	A
t_{rr} =	0,04	μs

Switching Definitions Half Bridge IGBT

Figure 9 Half Bridge IGBT

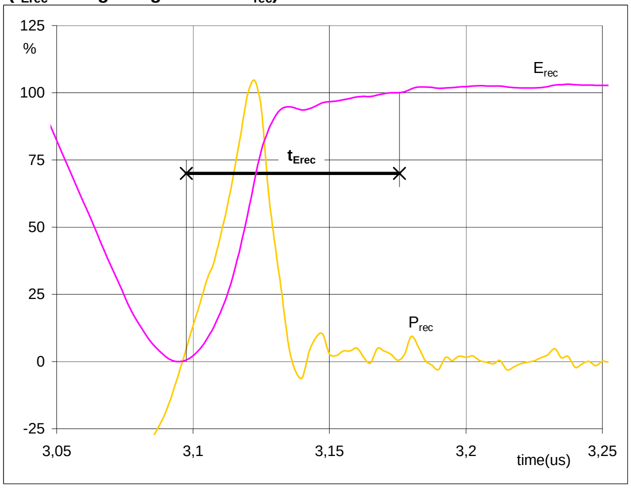
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	28	A
Q_{rr} (100%) =	0,92	µC
t_{Qrr} =	0,08	µs

Figure 10 Half Bridge FWD

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

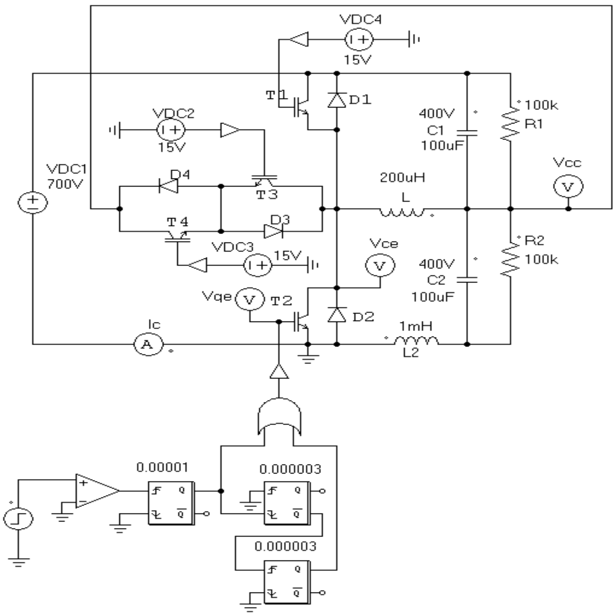


P_{rec} (100%) =	19,50	kW
E_{rec} (100%) =	0,12	mJ
t_{Erec} =	0,08	µs

Measurement circuits

Figure 11

BUCK stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

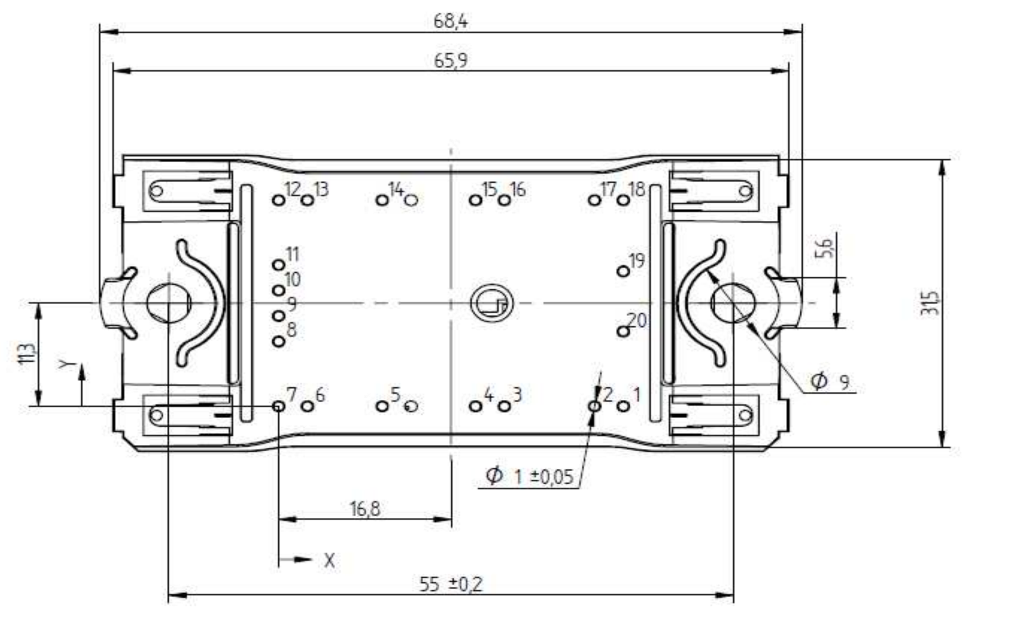
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
w/o thermal paste 12mm housing solder pin	10-FZ12NMA040SH-M267F	M267F	M267F
w/o thermal paste 12mm housing Press-fit pin	10-PZ12NMA040SH-M267FY	M267FY	M267FY
w/o thermal paste 17mm housing solder pin	10-F012NMA040SH-M267F09	M267F09	M267F09

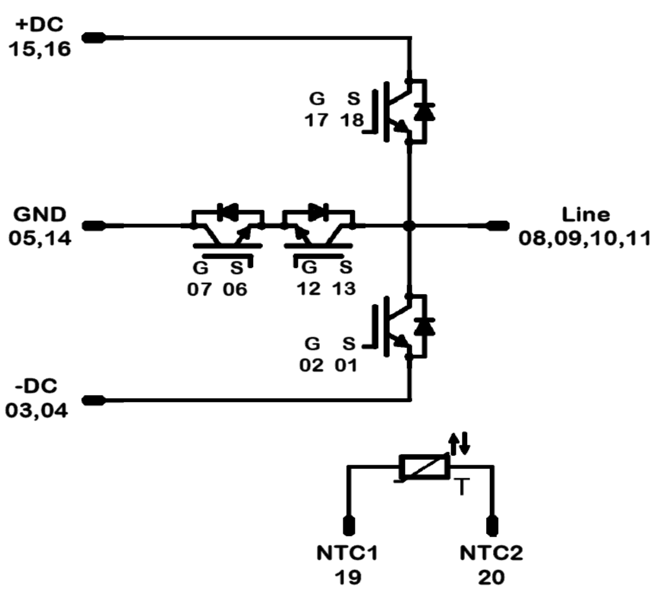
Outline

Pin table

Pin	X	Y
1	33,6	0
2	30,8	0
3	22	0
4	19,2	0
5	10,1	0
6	2,8	0
7	0	0
8	0	7,1
9	0	9,9
10	0	12,7
11	0	15,5
12	0	22,6
13	2,8	22,6
14	10,1	22,6
15	19,2	22,6
16	22	22,6
17	30,8	22,6
18	33,6	22,6
19	33,6	14,8
20	33,6	8,2



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.