flowMNPC 0 **1200V/40A**

Features

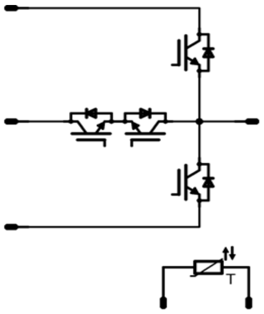
- neutral point clamped inverter
- reactive power capability
- clip-in pcb mounting
- low inductance layout

flow0 12mm housing

Target Applications

- solar inverter
- UPS

Schematic



Types

- 10-FZ12NMA040SH-M267F
- 10-PZ12NMA040SH-M267FY

Maximum Ratings

Tj=25℃, 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	$T_j=T_j$max T_h=80℃ T_c=80℃	39 51	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max	120	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max T_h=80℃ T_c=80℃	107 162	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
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 1200V $T_{vj\ max}$= 150℃	80	A
Maximum Junction Temperature	$T_j$max		175	℃
Neutral Point FWD				
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25℃	600	V
DC forward current	I_F	$T_j=T_j$max T_h=80℃ T_c=80℃	21 31	A
Surge forward current	I_{FSM}	t_p=8,3ms , sin 180° T_c=25℃	300	A
I2t-value	I^2t		370	A^2s
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	60	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max T_h=80℃ T_c=80℃	35 54	W
Maximum Junction Temperature	$T_j$max		175	℃

Maximum Ratings

$T_j=25$℃, 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 $T_h=80$℃ $T_c=80$℃	31 38	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 $T_h=80$℃ $T_c=80$℃	57 86	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j\leq150$℃ $V_{GE}=15$V	6 360	μs V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 600V $T_{vj\ max}$= 150℃	60	A
Maximum Junction Temperature	$T_j$max		175	℃
Half Bridge FWD				
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25$℃	1200	V
DC forward current	I_F	$T_j=T_j$max $T_h=80$℃ $T_c=80$℃	13 18	A
Surge forward current	I_{FSM}	t_p=10ms , sin 180° $T_j=150$℃	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 $T_h=80$℃ $T_c=80$℃	42 64	W
Maximum Junction Temperature	$T_j$max		175	℃
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 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℃ Tj=150℃	5,2	5,6	6,4	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		40	Tj=25℃ Tj=150℃	1,7	1,96 2,29	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25℃ Tj=150℃			0,005	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			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℃ Tj=150℃		70 72		ns
Rise time	t_r					Tj=25℃ Tj=150℃		13 15		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		166 217		
Fall time	t_f					Tj=25℃ Tj=150℃		45 79		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		0,31 0,52		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		0,67 1,16		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		2300		pF
Output capacitance	C_{oss}							160		
Reverse transfer capacitance	C_{rss}							135		
Gate charge	Q_{Gate}		±15	960	40	Tj=25℃		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℃ Tj=150℃		2,28 1,74	2,71	V
Reverse leakage current	I_r			600		Tj=25℃ Tj=150℃			100	µA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	350	28	Tj=25℃ Tj=150℃		32 41		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		18 40		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		0,32 0,92		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		8818 3866		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=150℃		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					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	
Neutral Point IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,002	Tj=25℃ Tj=150℃	5,0	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		30	Tj=25℃ Tj=150℃	1,1	1,52 1,70	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25℃ Tj=150℃			0,0016	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			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℃ Tj=150℃		105 105		ns
Rise time	t_r					Tj=25℃ Tj=150℃		11 16		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		164 187		
Fall time	t_f					Tj=25℃ Tj=150℃		74 91		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		0,49 0,66		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		0,76 0,98		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		1630		pF
Output capacitance	C_{oss}							108		
Reverse transfer capacitance	C_{rss}							50		
Gate charge	Q_{Gate}		±15	480	30	Tj=25℃		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℃ Tj=150℃		2,28 2,39	2,71	V
Reverse leakage current	I_r			1200		Tj=25℃ Tj=150℃			60	µA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	350	28	Tj=25℃ Tj=150℃		41 44		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		44 110		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		1,47 2,73		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		5094 3534		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=150℃		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℃		22000		Ω
Deviation of R100	ΔR/R	R100=1486Ω				Tj=100℃	-5		5	%
Power dissipation	P					Tj=25℃		200		mW
Power dissipation constant						Tj=25℃		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25℃		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25℃		3996		K
Vincotech NTC Reference									B	

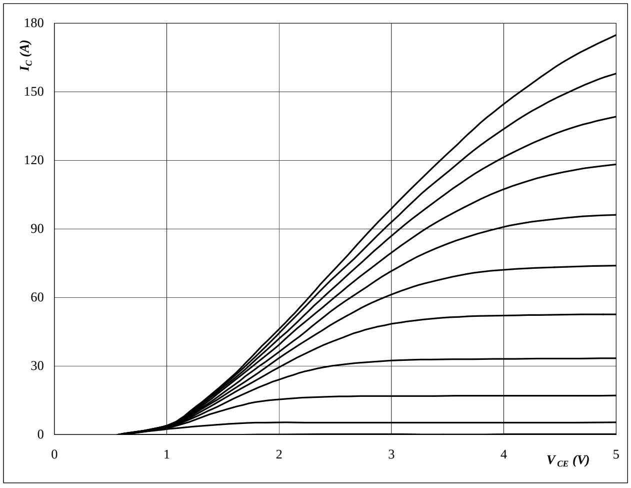
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

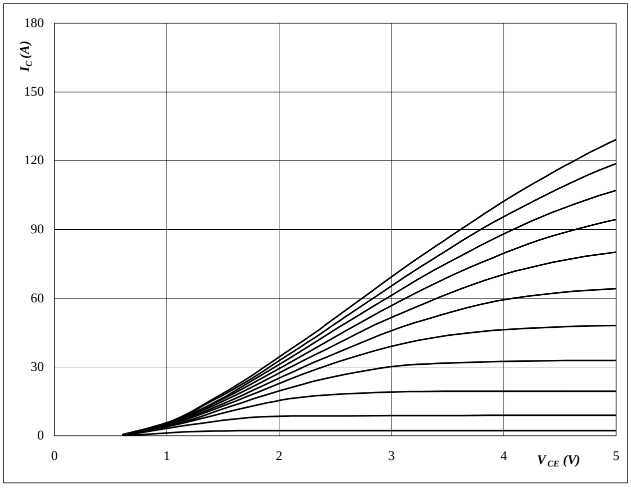
T_j = 25 ℃

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

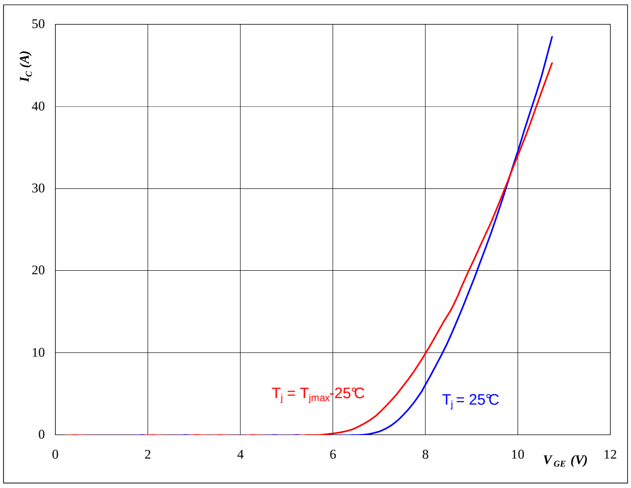
T_j = 125 ℃

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

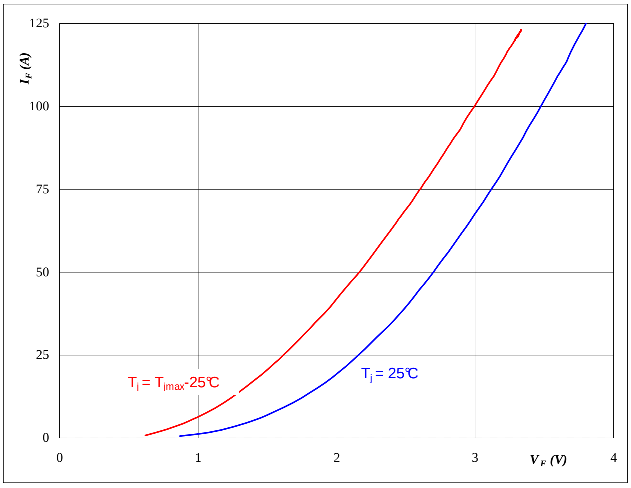
t_p = 250 µs

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

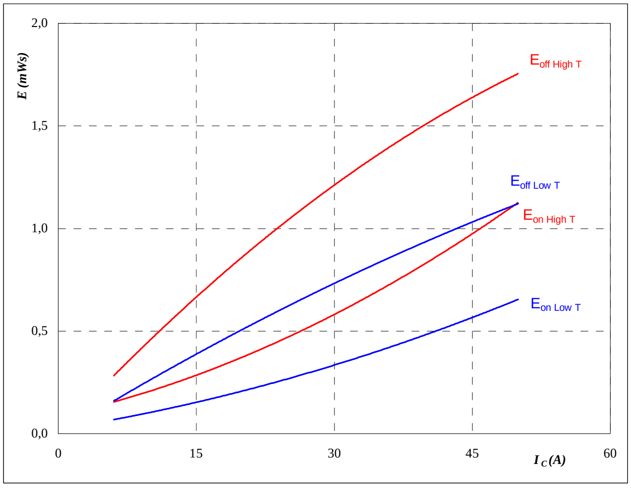
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



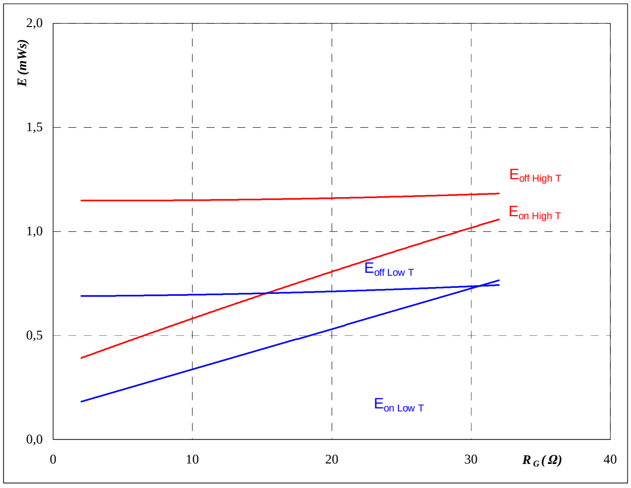
With an inductive load at

T_j =	25/125	℃
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)



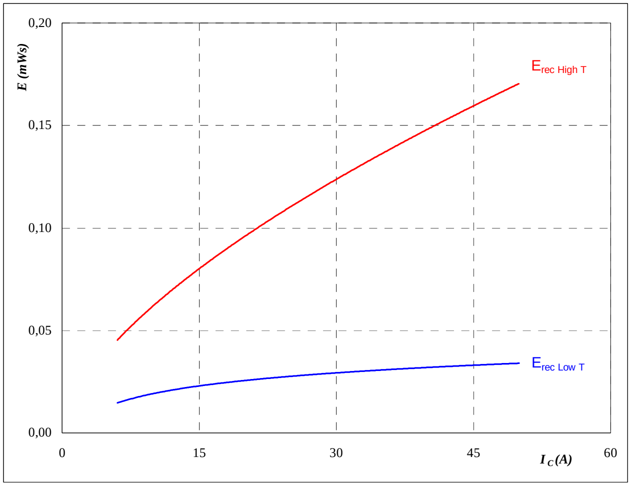
With an inductive load at

T_j =	25/125	℃
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)



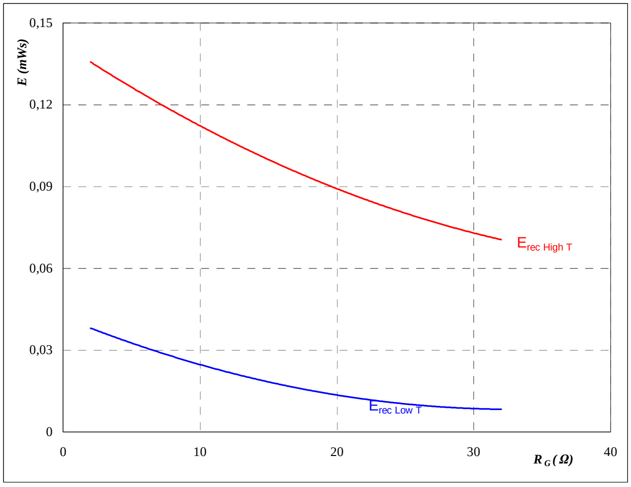
With an inductive load at

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

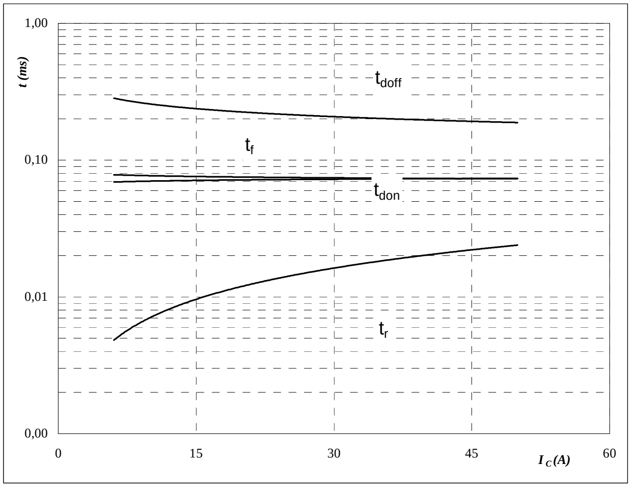
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



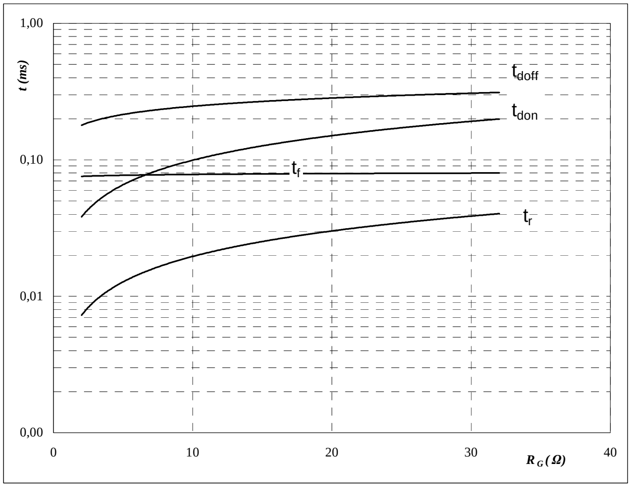
With an inductive load at

T_j = 125 ℃
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)



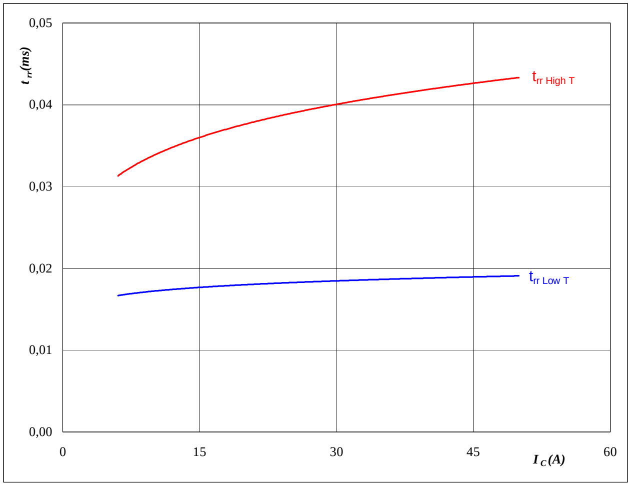
With an inductive load at

T_j = 125 ℃
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)



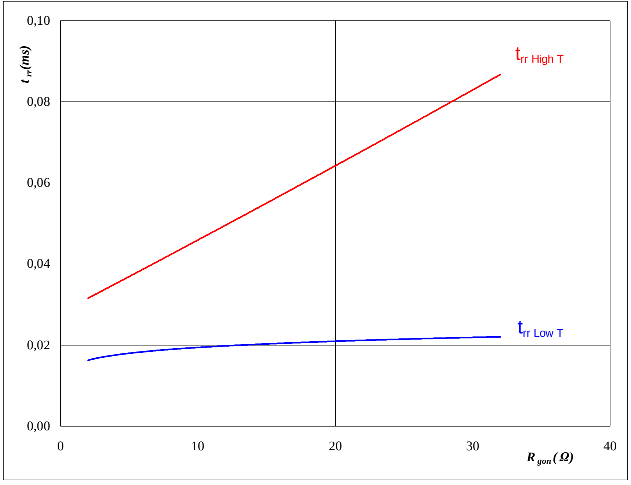
At

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

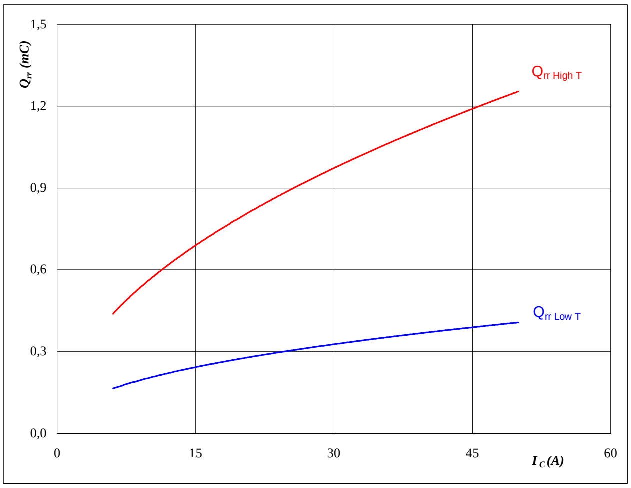
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



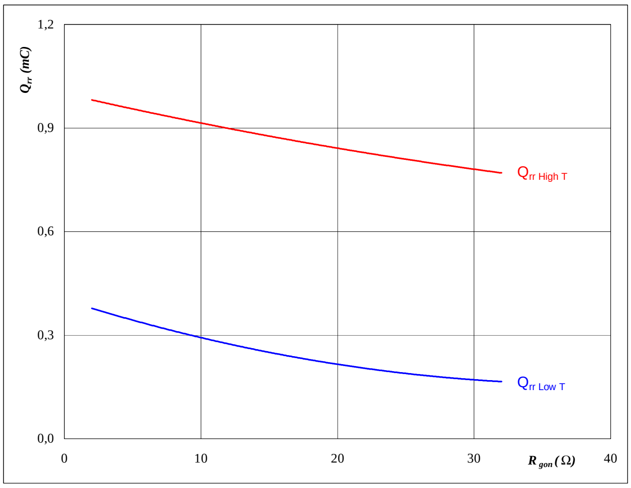
At

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

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



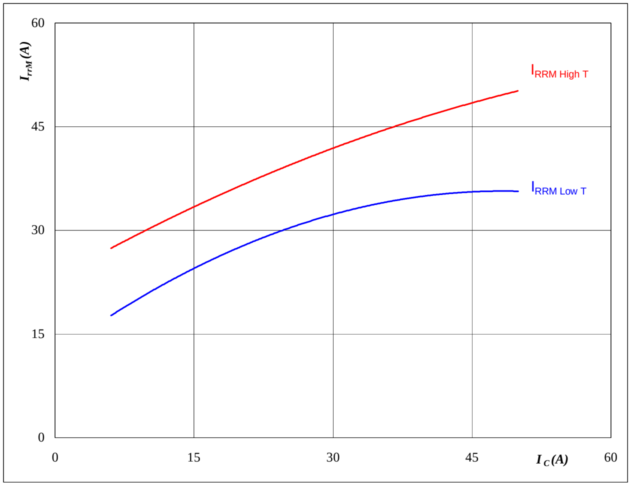
At

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

$I_{RRM} = f(I_C)$



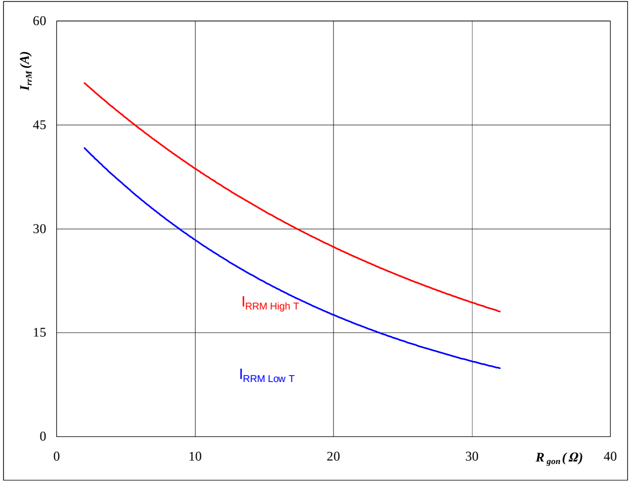
At

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

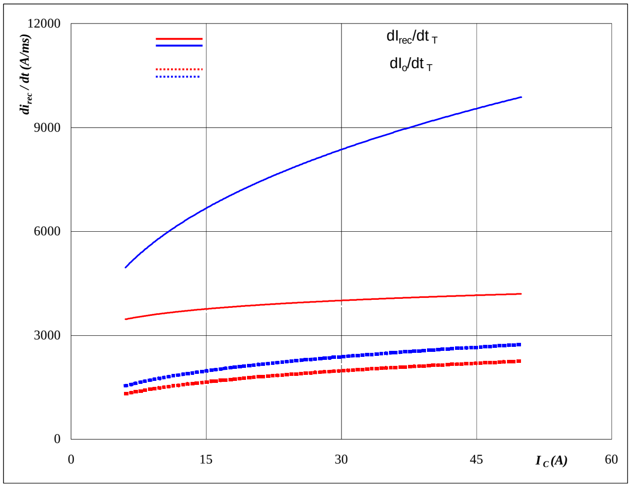
Half Bridge

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

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



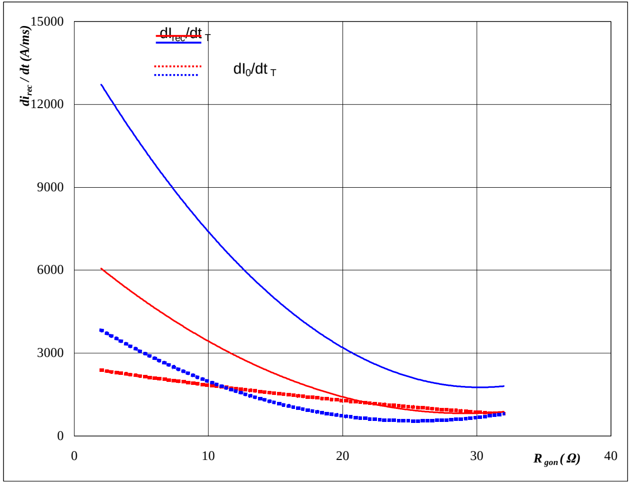
At

T_j =	25/125	℃
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

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



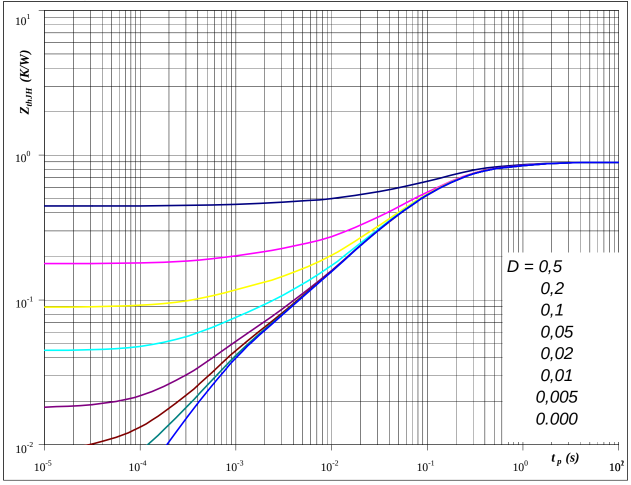
At

T_j =	25/125	℃
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

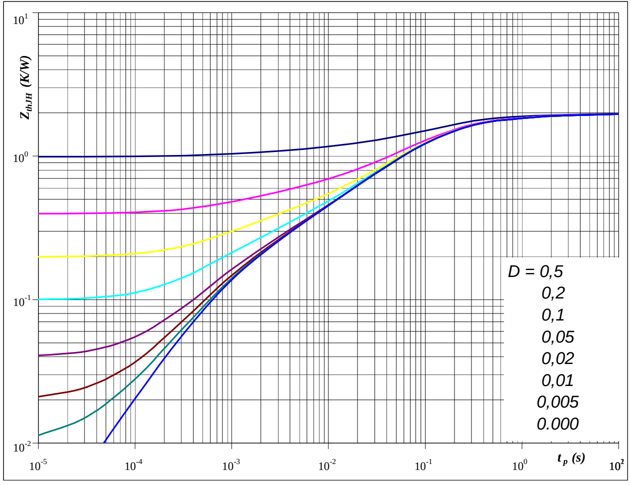
IGBT thermal model values

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

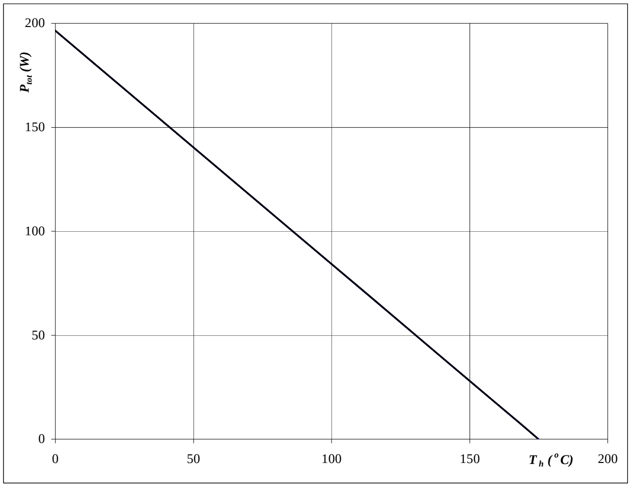
Half Bridge

Half Bridge IGBT and **Neutral Point FWD**

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



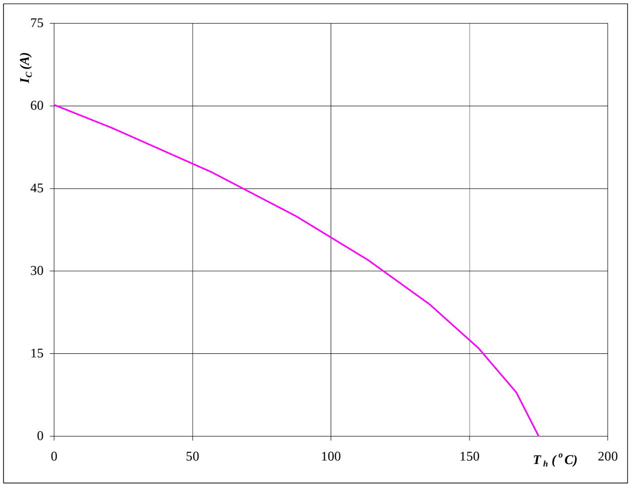
At

$T_j =$ 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

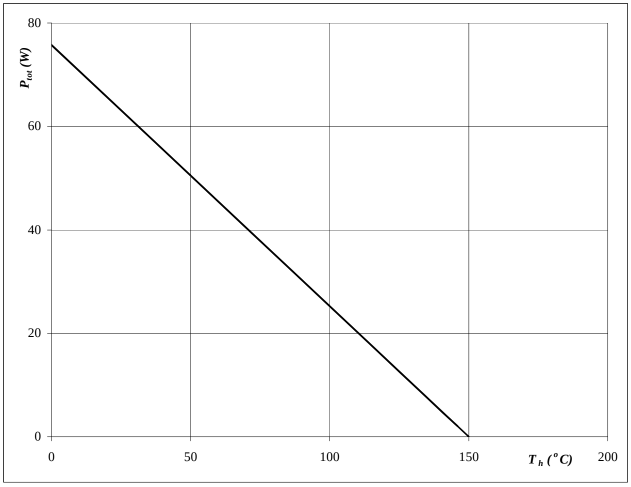
$T_j =$ 175 ℃

$V_{GE} =$ 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



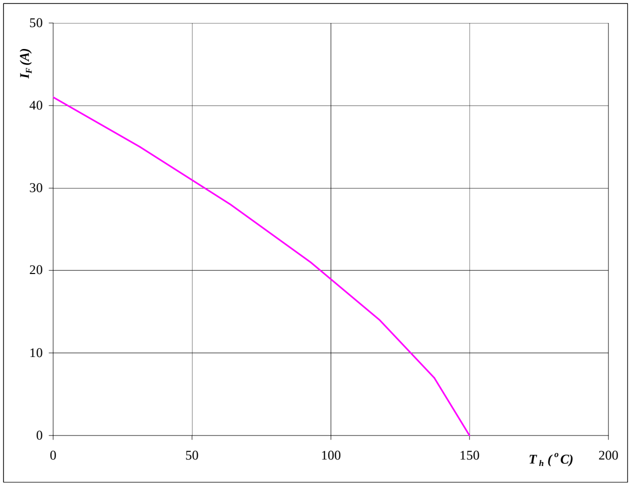
At

$T_j =$ 150 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

$T_j =$ 150 ℃

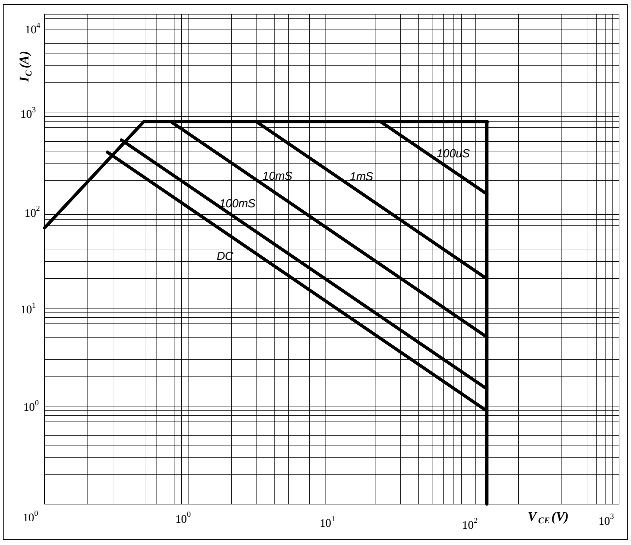
Half Bridge

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

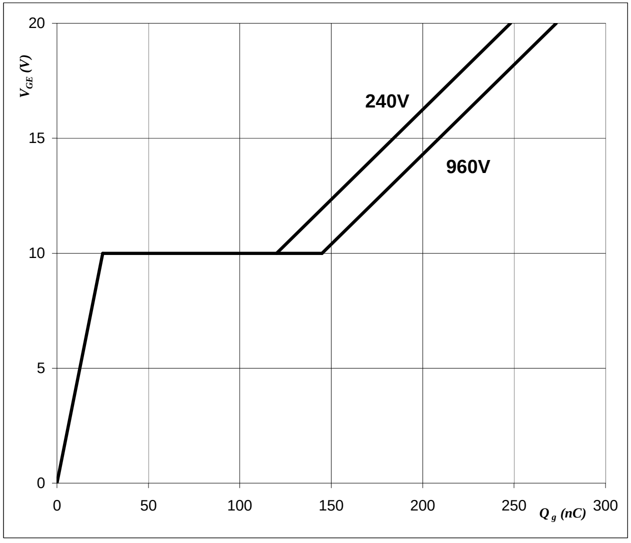
V_{GE} = ±15 V

T_j = T_{jmax} ºC

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



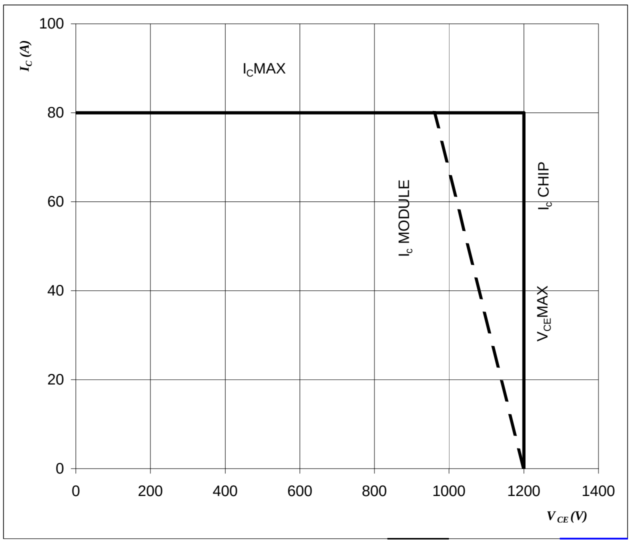
At

I_C = 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

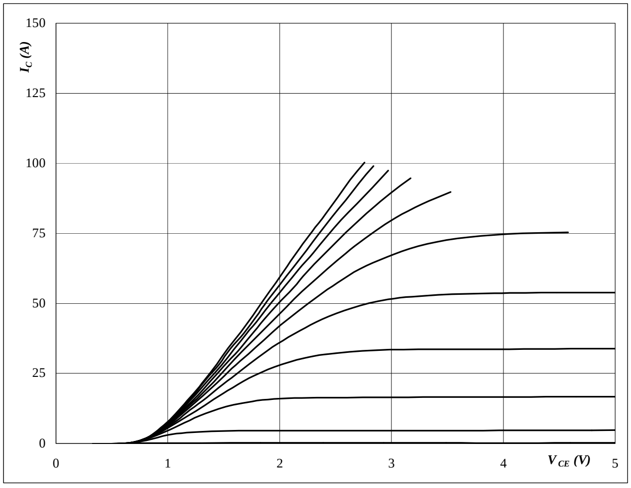
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



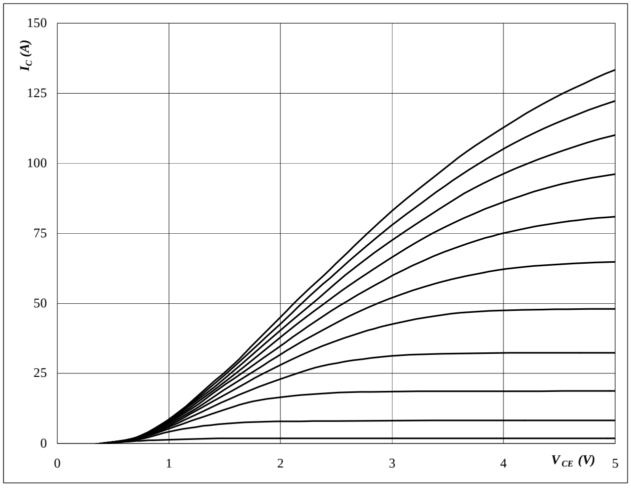
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



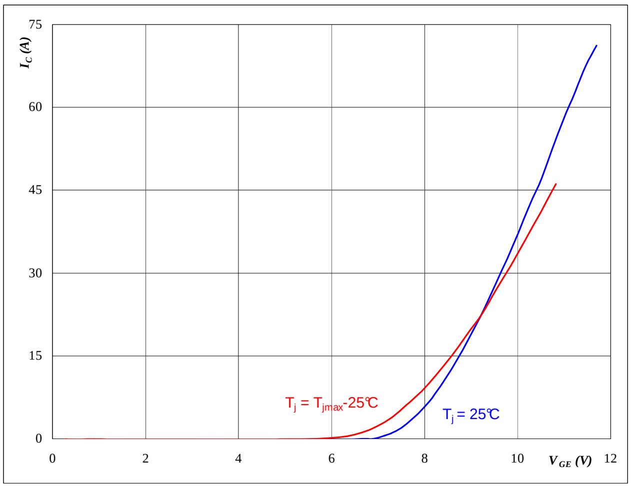
At

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

$I_C = f(V_{GE})$



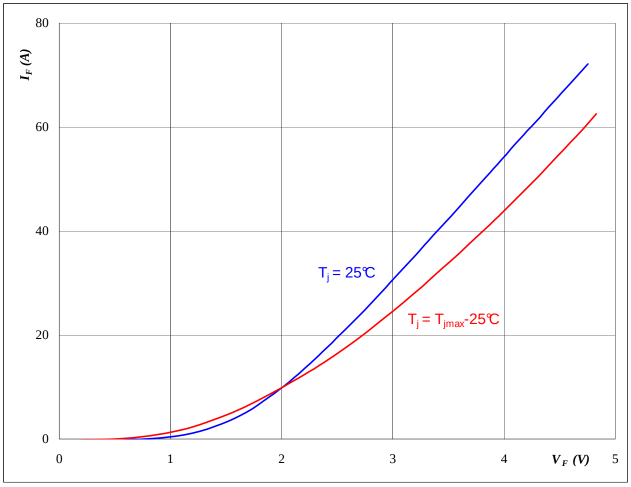
At

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

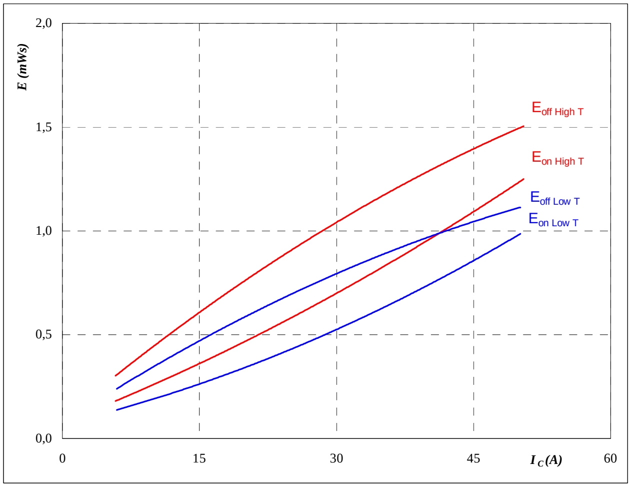
t_p =	250	µs

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)

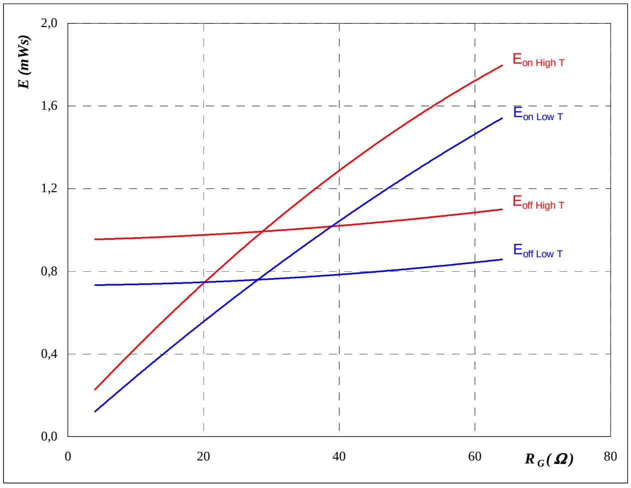


With an inductive load at

T_j = 25/125 ℃
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)

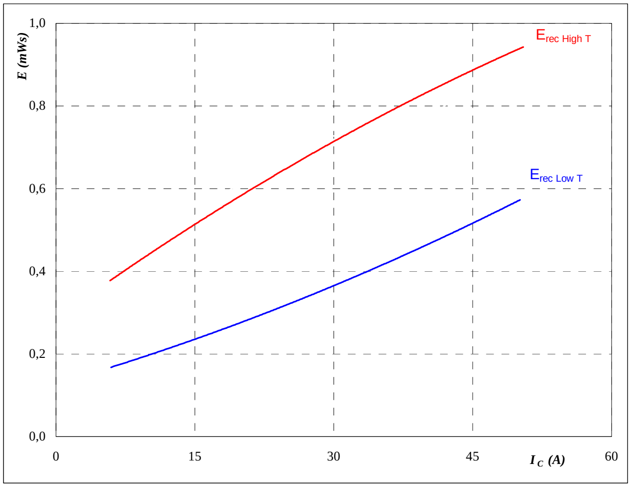


With an inductive load at

T_j = 25/125 ℃
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)

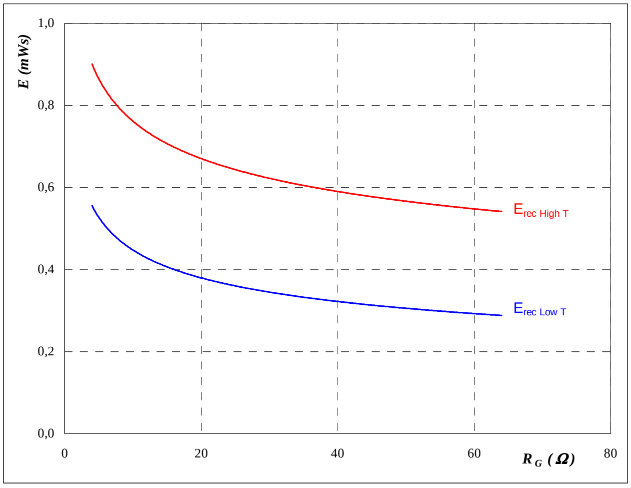


With an inductive load at

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

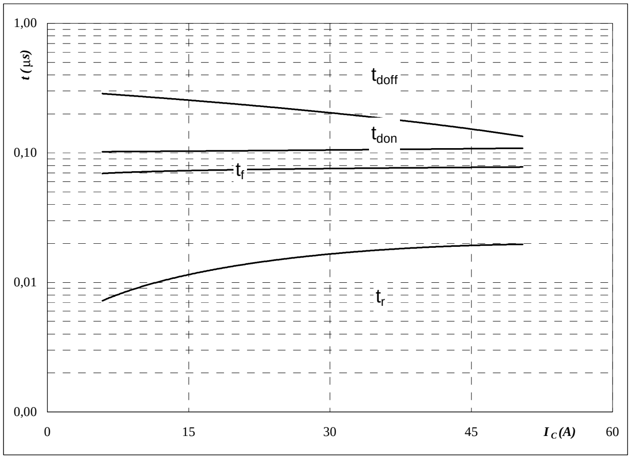
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



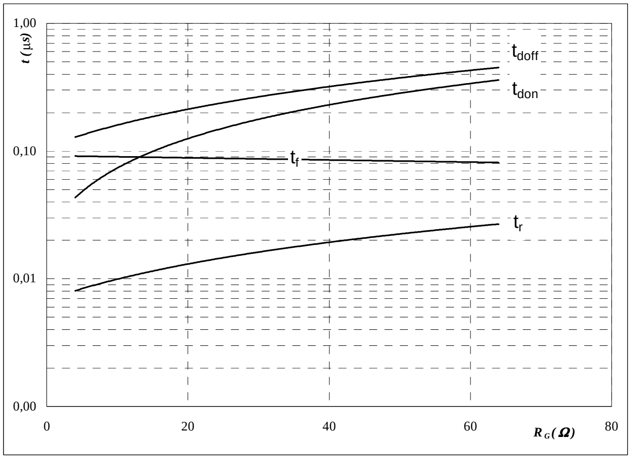
With an inductive load at

T_j = 125 ℃
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)



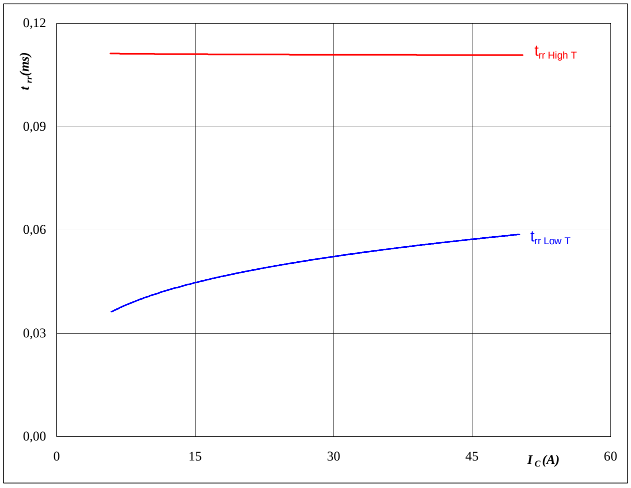
With an inductive load at

T_j = 125 ℃
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)



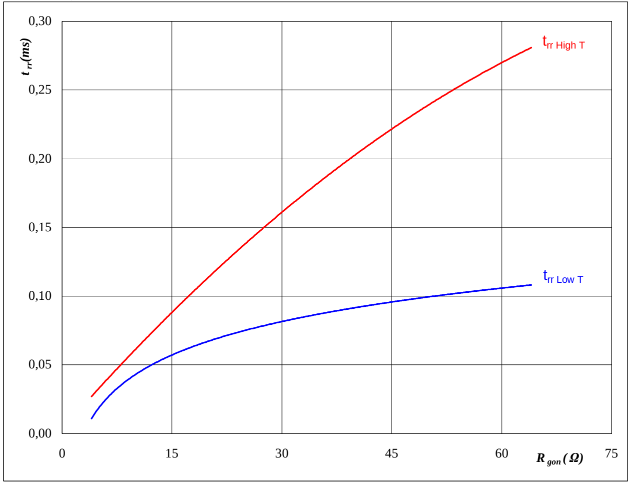
At

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

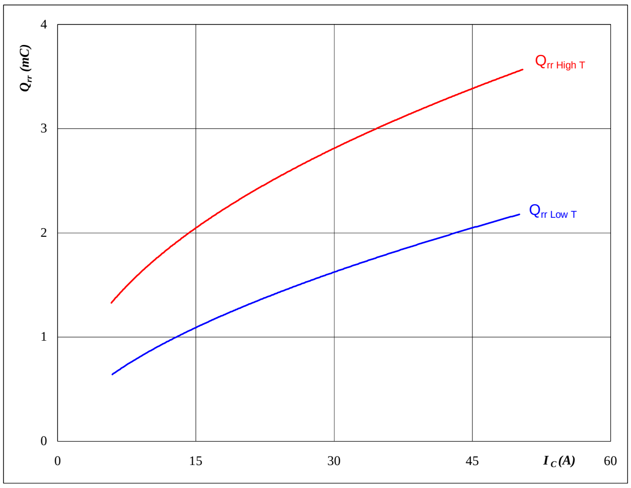
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



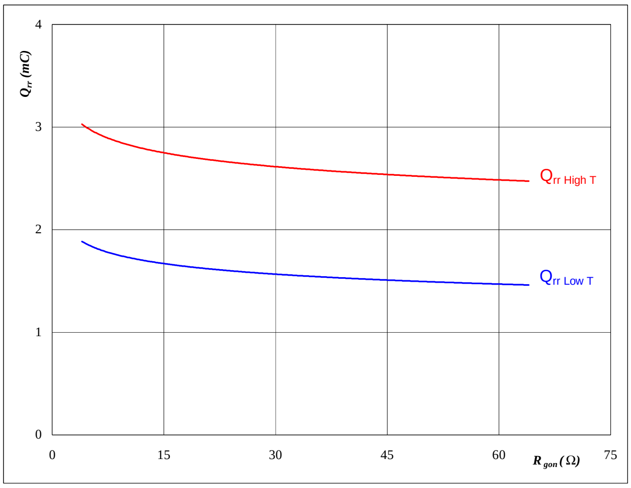
At

T_j =	25/125	℃
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

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



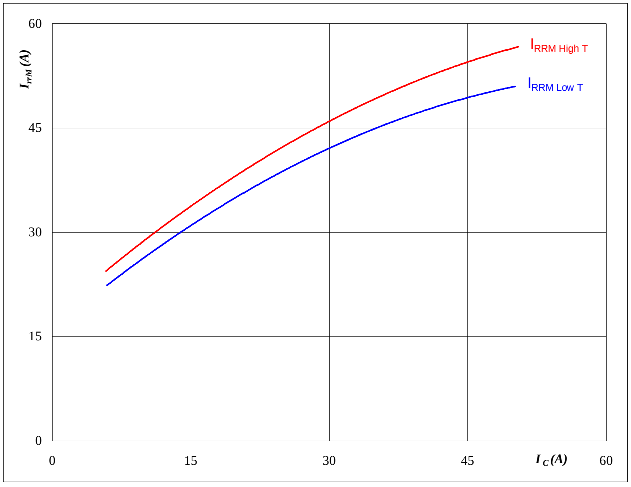
At

T_j =	25/125	℃
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

$I_{RRM} = f(I_C)$



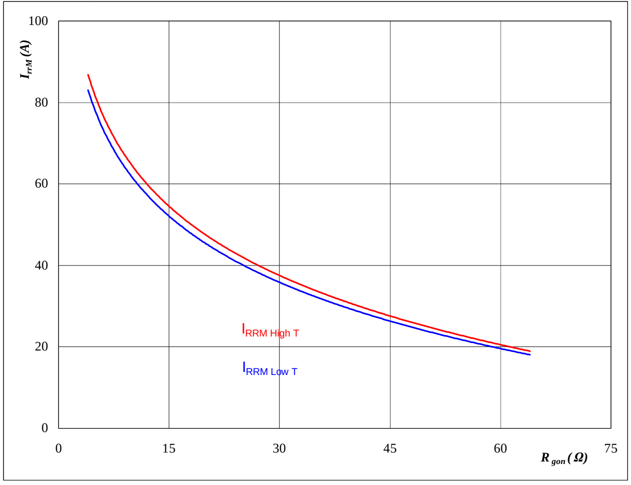
At

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

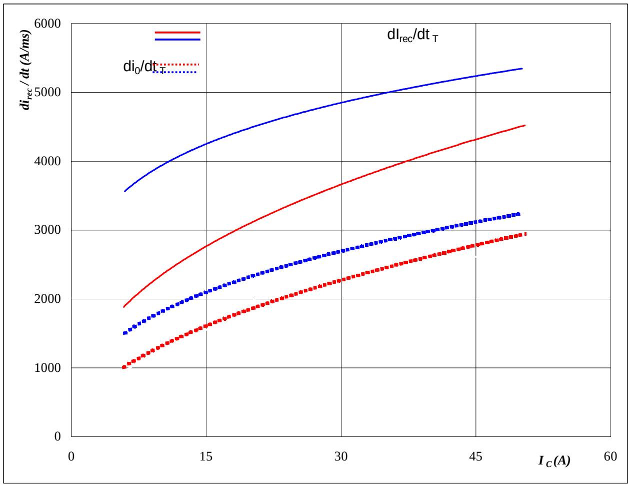
Neutral point

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

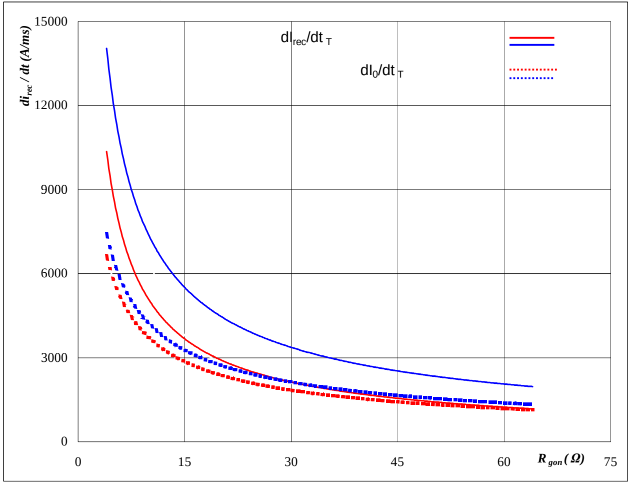
V_{GE} = ±15 V

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

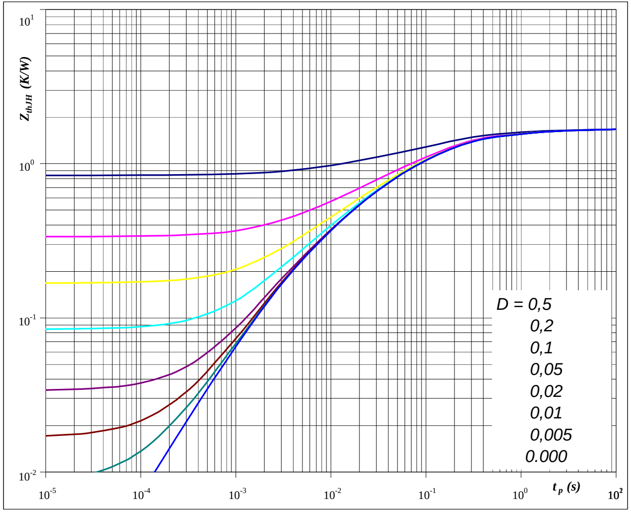
I_F = 28 A

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

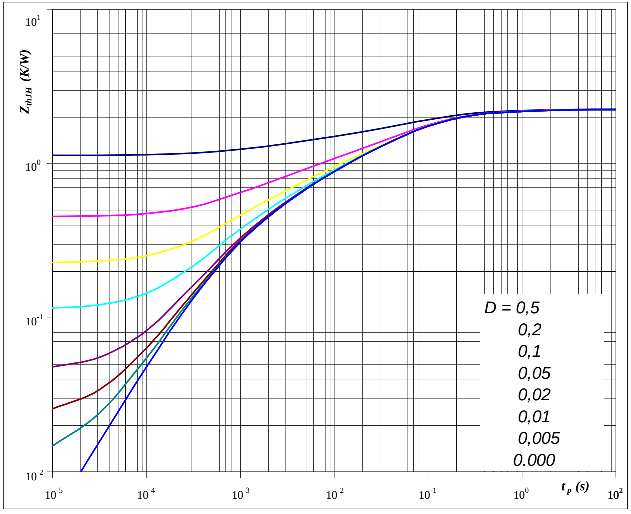
IGBT thermal model values

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

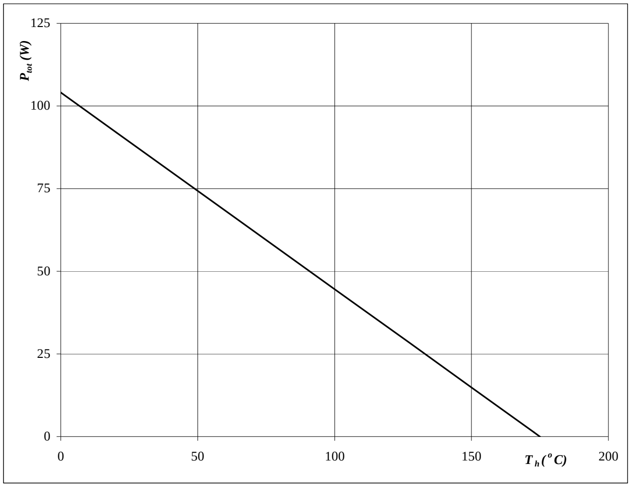
Neutral point

Neutral Point IGBT and **Half Bridge FWD**

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



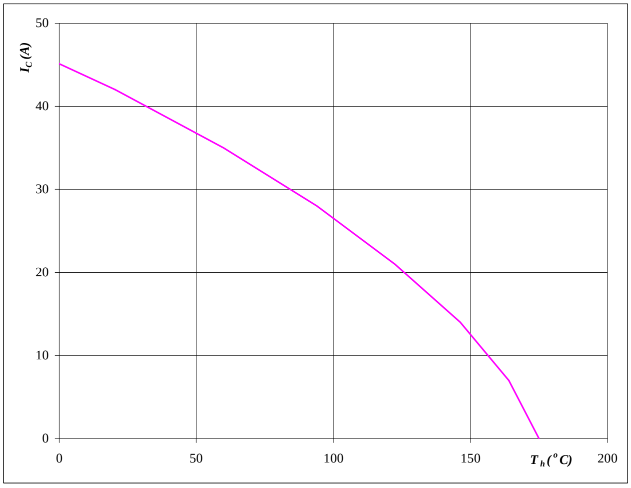
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

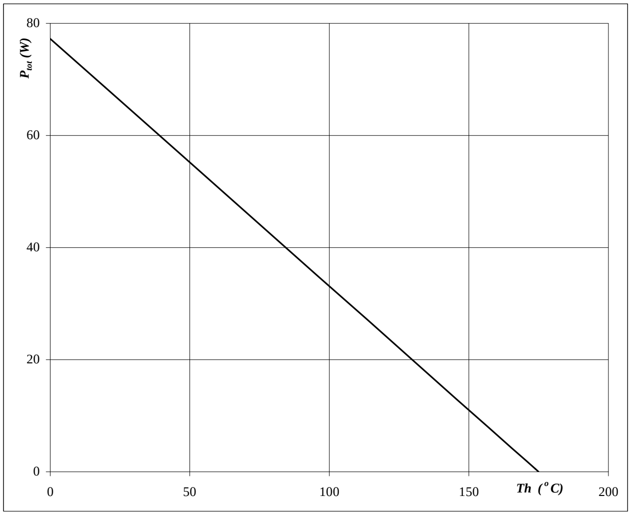
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



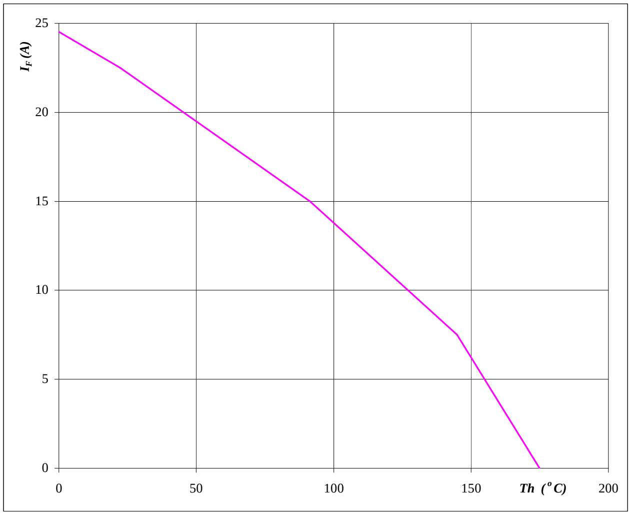
At

T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 175 ºC

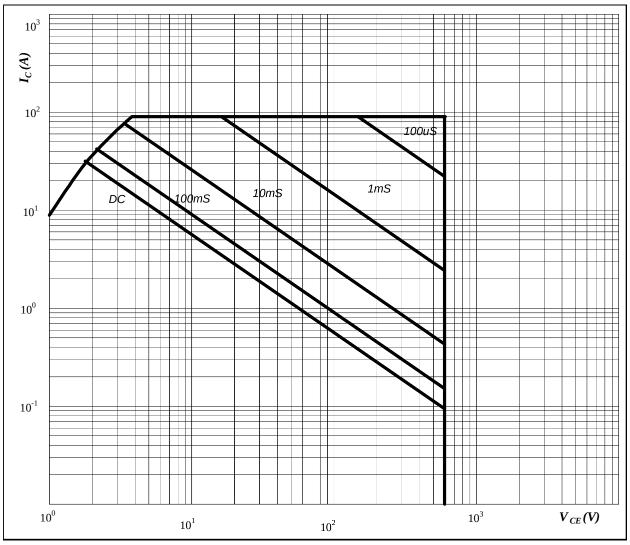
Neutral point

Neutral Point IGBT and Half Bridge FWD

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



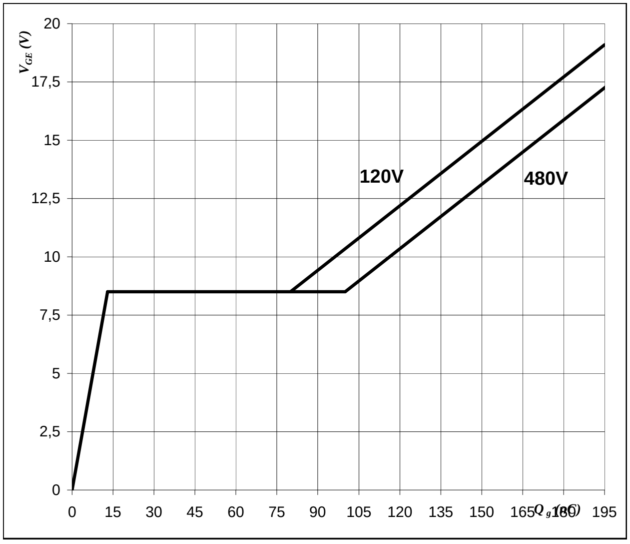
At

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

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



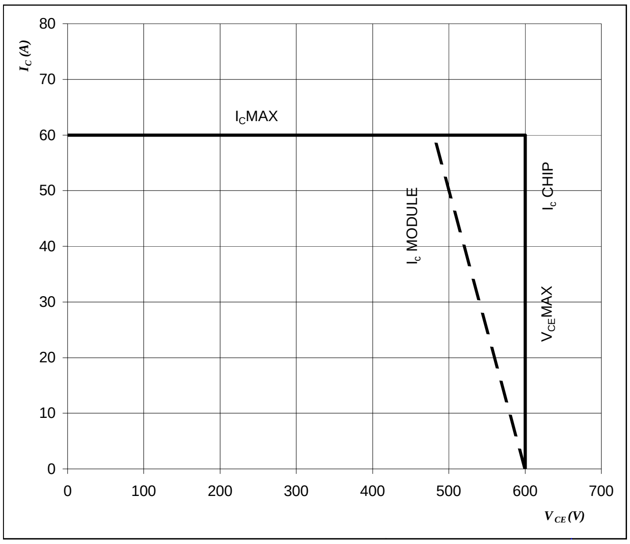
At

I_C =	30	A

Figure 27 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

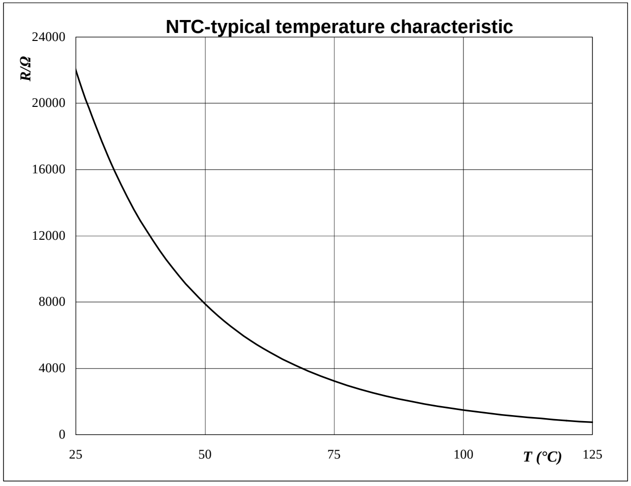
DC link $_{minus}$=DC link $_{plus}$

Switching mode : 3 level switching

Thermistor

Figure 1 Thermistor

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



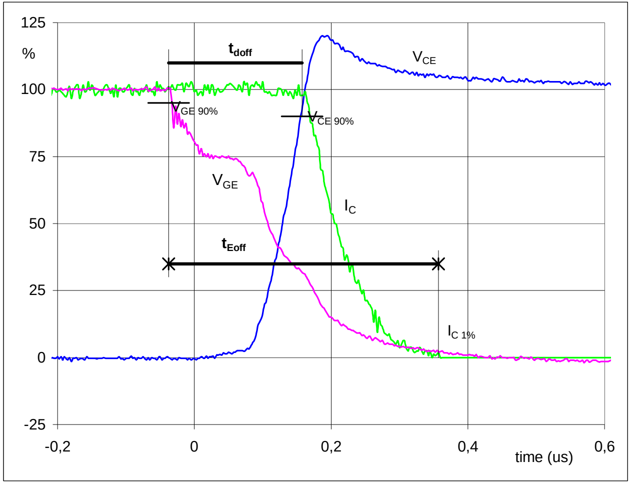
Switching Definitions Neutral point IGBT

General conditions

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

Figure 1 Neutral point IGBT

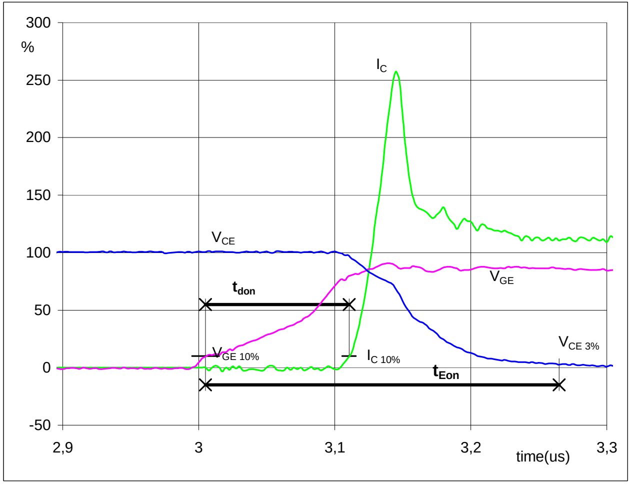
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



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

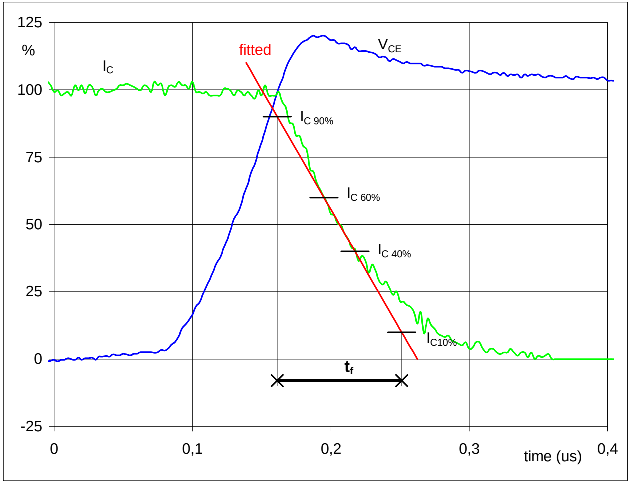
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



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

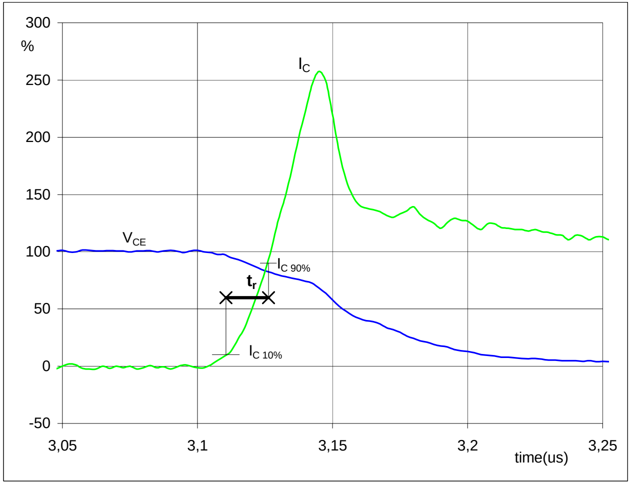
Turn-off Switching Waveforms & definition of t_f



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

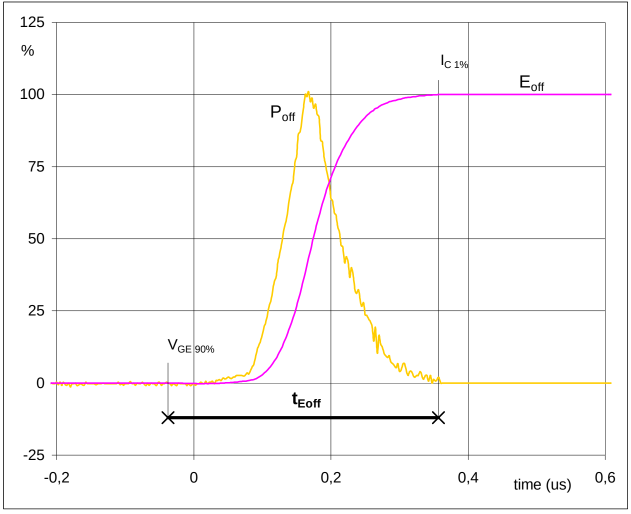


V_C (100%) =	350	V
I_C (100%) =	28	A
t_r =	0,02	μs

Switching Definitions Neutral point IGBT

Figure 5 Neutral point IGBT

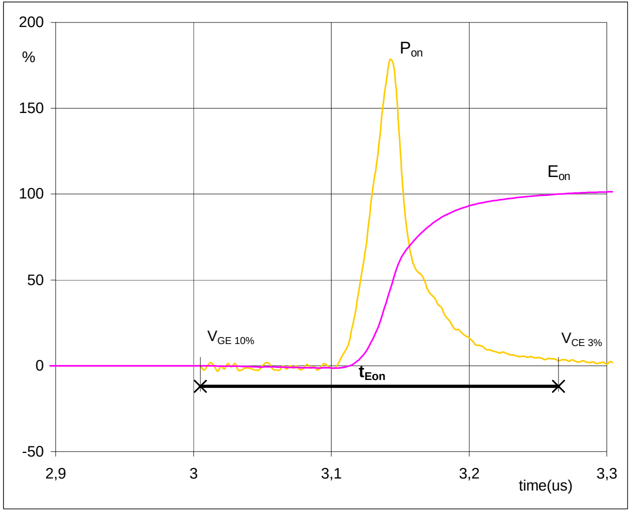
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 Neutral point IGBT

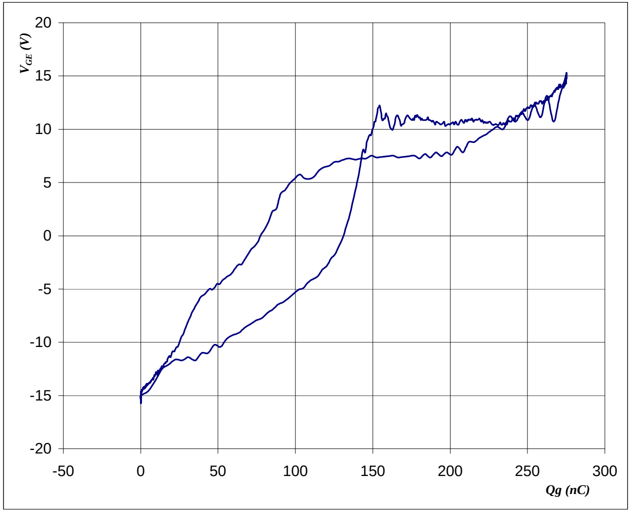
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Neutral point IGBT

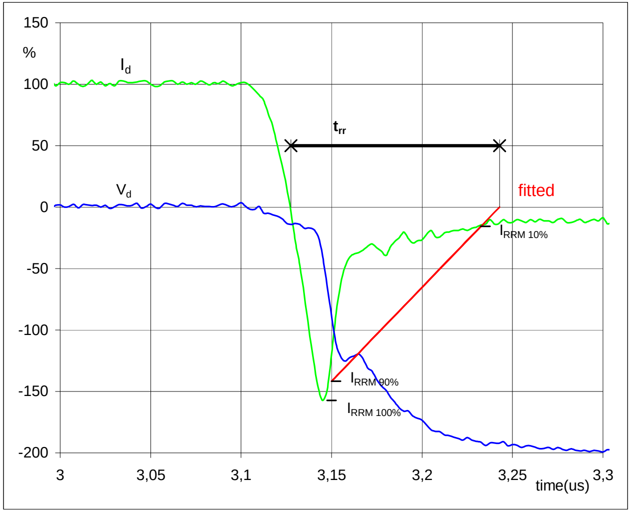
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
Q_g =	277,42	nC

Figure 8 Neutral point FWD

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

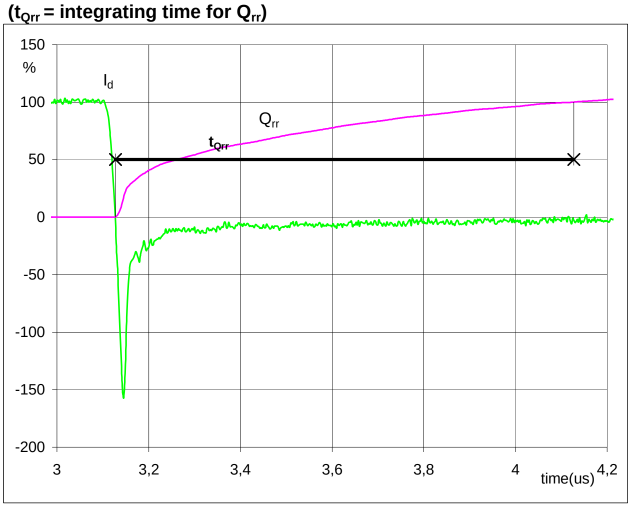


V_d (100%) =	350	V
I_d (100%) =	28	A
I_{RRM} (100%) =	-44	A
t_{rr} =	0,11	µs

Switching Definitions Neutral point IGBT

Figure 9 Neutral point IGBT

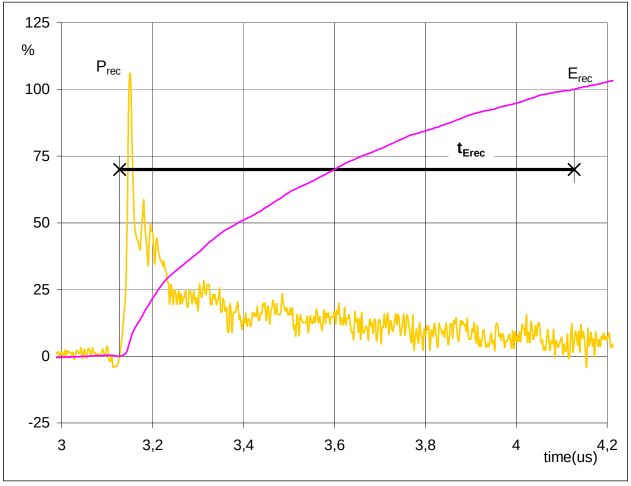
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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})

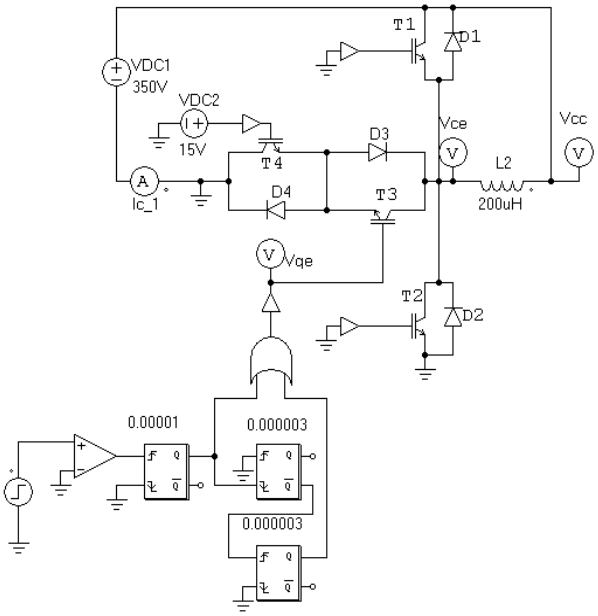


P_{rec} (100%) = 9,70 kW
E_{rec} (100%) = 0,71 mJ
t_{Erec} = 1,00 µs

Measurement circuits

Figure 11

BOOST stage switching measurement circuit



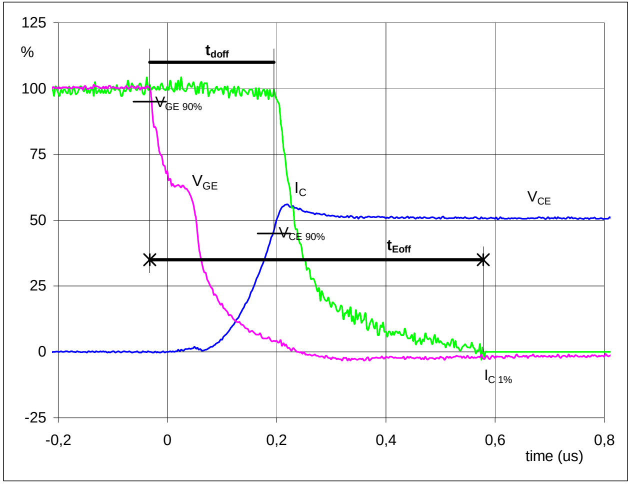
Switching Definitions Half Bridge IGBT

General conditions

T_j = 125 ℃
R_{gon} = 8 Ω
R_{goff} = 8 Ω

Figure 1 Half Bridge IGBT

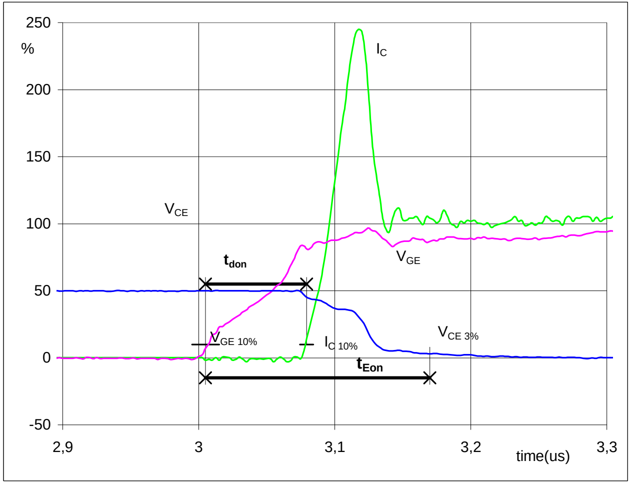
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



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

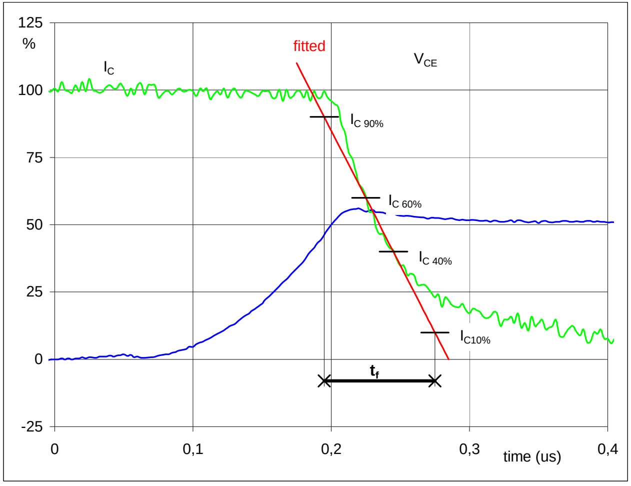
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



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

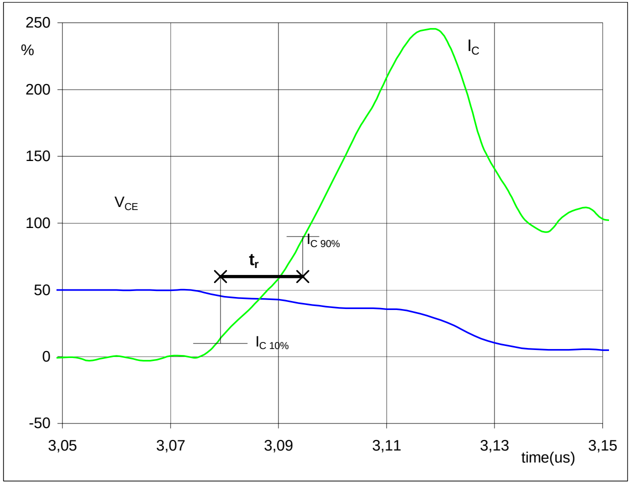
Turn-off Switching Waveforms & definition of t_f



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

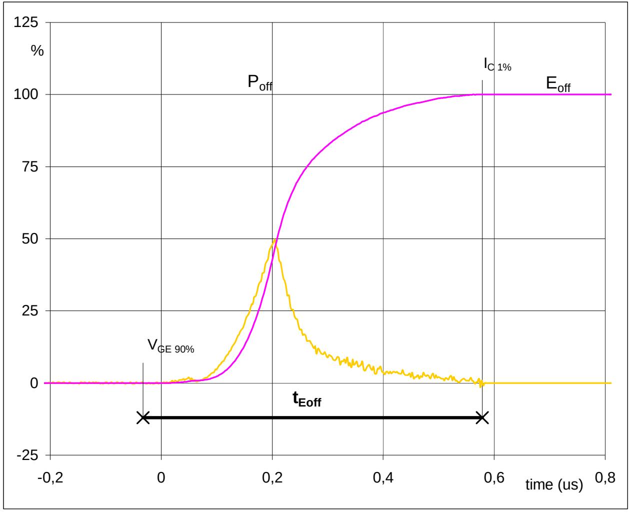


V_C (100%) = 700 V
I_C (100%) = 28 A
t_r = 0,02 μs

Switching Definitions Half Bridge IGBT

Figure 5 Half Bridge IGBT

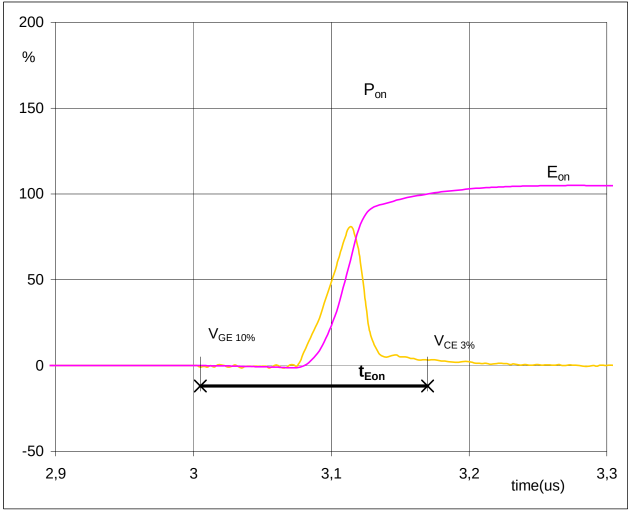
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 Half Bridge IGBT

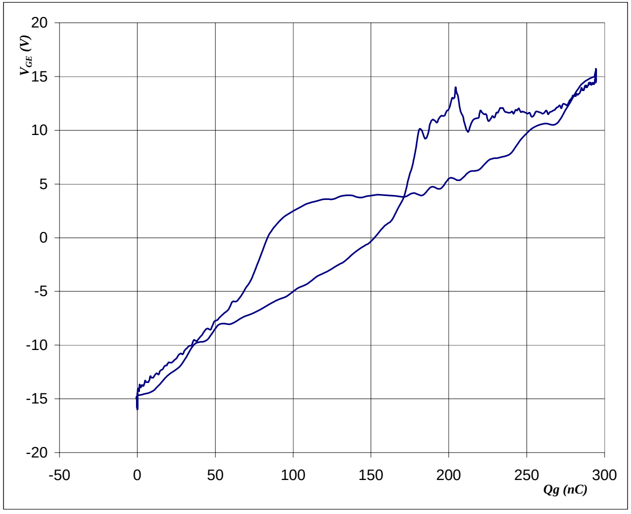
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Half Bridge IGBT

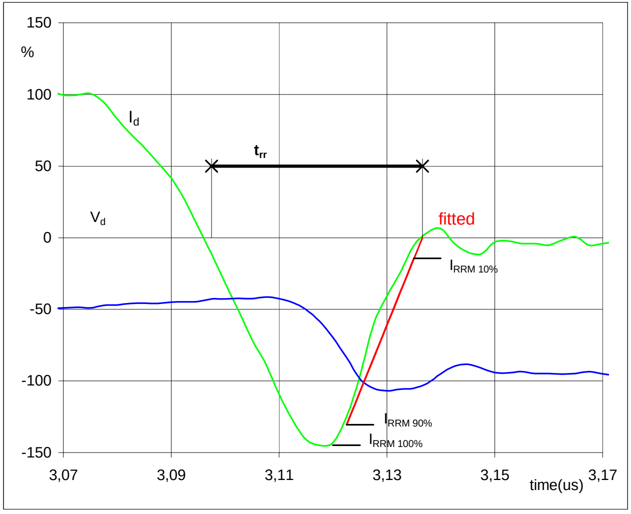
Gate voltage vs Gate charge (measured)



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}

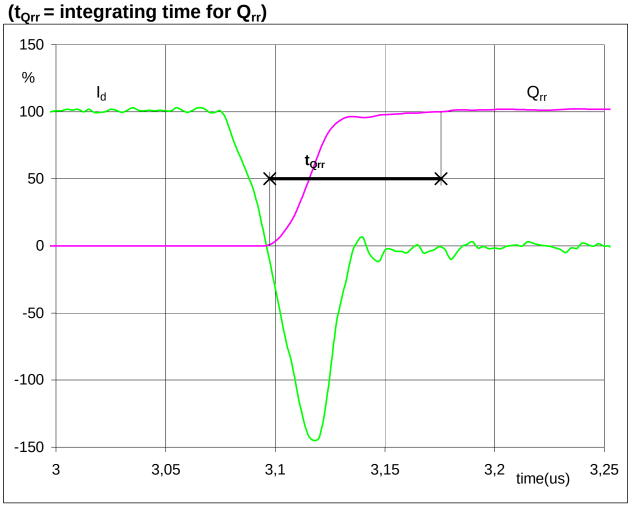


V_d (100%) = 700 V
I_d (100%) = 28 A
I_{RRM} (100%) = -41 A
t_{rr} = 0,04 μs

Switching Definitions Half Bridge IGBT

Figure 9 Half Bridge IGBT

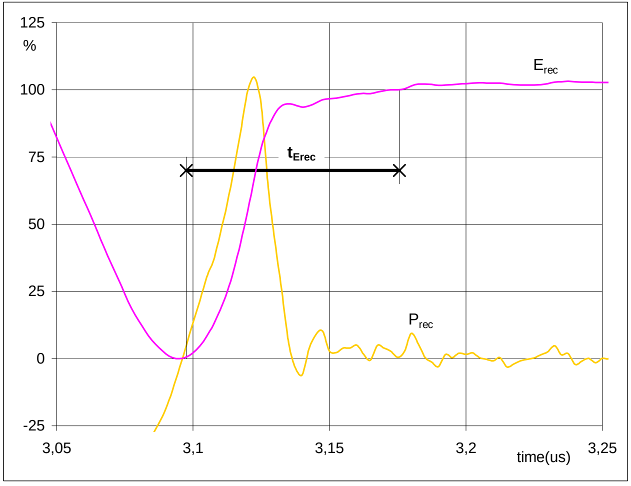
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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})

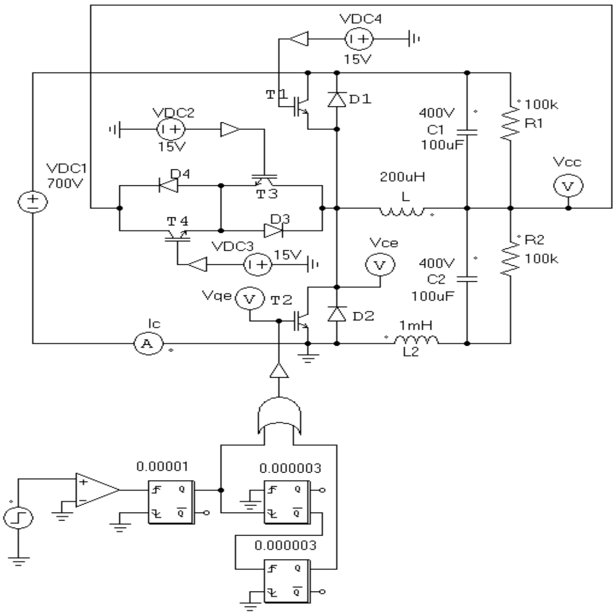


P_{rec} (100%) =	19,50	kW
E_{rec} (100%) =	0,12	mJ
t_{Erec} =	0,08	μs

Measurement circuits

Figure 11

BUCK stage switching measurement circuit



Ordering Code and Marking - Outline - Pinout

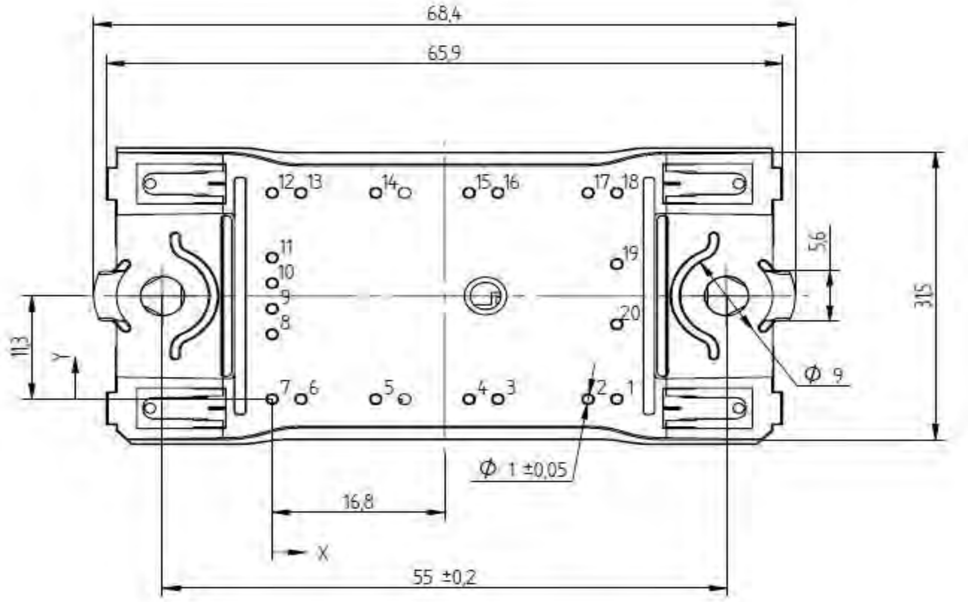
Ordering Code & Marking

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

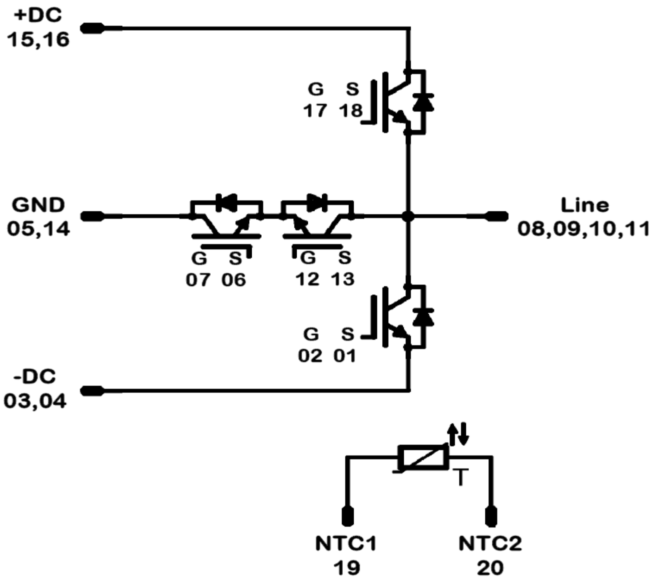
Outline

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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