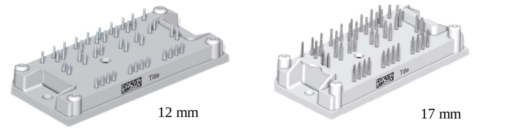
flow3xMNPC 1 — **1200V/25A**

Features

- 3 phase mixed voltage component topology
- neutral point clamped inverter
- reactive power capability
- low inductance layout

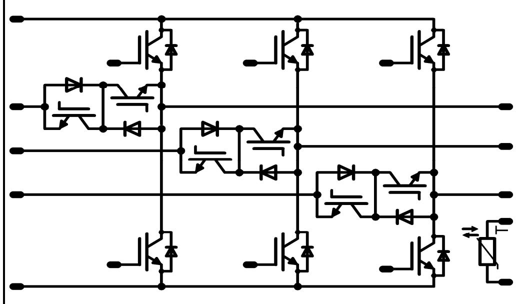
flow1 housing



Target Applications

- solar inverter
- UPS

Schematic



Types

- 10-FY12M3A025SH-M746F08
- 10-F112M3A025SH-M746F09

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Half Bridge IGBT (T1,T4,T5,T8,T9,T12)					
Collector-emitter break down voltage	V_{CES}			1200	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C T_c=80°C	23 30	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max		75	A
Turn off safe operating area		T_j≤150°C V_{CE}<=V_{CES}		75	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	58 88	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	µs V
Maximum Junction Temperature	$T_j$max			175	°C
Neutral P. FWD (D2,D3,D6,D7,D10,D11)					
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	17 23	A
Surge forward current	I_{FRM}	t_p limited by $T_j$max	T_c=100°C	150	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	28 43	W
Maximum Junction Temperature	$T_j$max			150	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Neutral P. IGBT (T2,T3,T6,T7,T10,T11)					
Collector-emitter break down voltage	V_{CES}			600	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	18 24	A
Pulsed collector current	I_{Cpuls}	t_p limited by $T_j$max		60	A
Turn off safe operating area		$T_j≤150°C$ $V_{CE}<=V_{CES}$		60	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	31 47	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

Parameter	Symbol	Condition		Value	Unit
Half Bridge FWD (D1,D4,D5,D8,D9,D12)					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	10 13	A
Surge forward current	I_{FRM}	t_p limited by $T_j$max		36	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	26 39	W
Maximum Junction Temperature	$T_j$max			175	°C

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

Parameter	Symbol	Condition		Value	Unit
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 (T1,T4,T5,T8,T9,T12)										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00085	Tj=25°C Tj=125°C	5,2	5,8	6,4	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		25	Tj=25°C Tj=125°C	1,7	2,11 2,42	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,0024	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25°C Tj=125°C		73 74		
Rise time	t_r					Tj=25°C Tj=125°C		15 18		ns
Turn-off delay time	$t_{d(off)}$	Rgoff=16 Ω Rgon=16 Ω	±15	350	15	Tj=25°C Tj=125°C		166 220		
Fall time	t_f					Tj=25°C Tj=125°C		21 116		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,17 0,30		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,37 0,63		
Input capacitance	C_{ies}							1430		
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		99		pF
Reverse transfer capacitance	C_{rss}							85		
Gate charge	Q_{Gate}		±15	960	25	Tj=25°C		155		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,64		K/W
Neutral P. FWD (D2,D3,D6,D7,D10,D11)										
Diode forward voltage	V_F				15	Tj=25°C Tj=125°C		2,47 1,73	2,6	V
Reverse leakage current	I_r			600		Tj=25°C Tj=150°C			10	µA
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=125°C		16 22		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		23 33		ns
Reverse recovered charge	Q_{rr}	Rgon=16 Ω	±15	350	15	Tj=25°C Tj=125°C		0,19 0,44		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		1860 1998		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,03 0,05		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,48		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 P. IGBT (T2,T3,T6,T7,T10,T11)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0012	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		20	Tj=25°C Tj=125°C	1,1	1,53 1,70	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,0011	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	350	15	Tj=25°C Tj=125°C		72 74		ns
Rise time	t_r					Tj=25°C Tj=125°C		14 16		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		131 157		
Fall time	t_f					Tj=25°C Tj=125°C		34 69		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,31 0,39		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,38 0,53		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1100		pF
Output capacitance	C_{oss}							71		
Reverse transfer capacitance	C_{rss}							32		
Gate charge	Q_{Gate}		15	480	20	Tj=25°C		120		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,09		K/W
Half Bridge FWD (D1,D4,D5,D8,D9,D12)										
Diode forward voltage	V_F				8	Tj=25°C Tj=125°C		2,18 2,30	2,65	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			60	µA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ω	±15	350	15	Tj=25°C Tj=125°C		21 24		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		29,9 34,7		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,7 1,5		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		1972 2214		A/µs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,14 0,38		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,65		K/W
Thermistor										
Rated resistance	R					T=25°C		21511		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100°C	-4,5		+4,5	%
Power dissipation	P					T=25°C		210		mW
Power dissipation constant						T=25°C		3,5		mW/K
B-value	B(25/50)					T=25°C		3884		K
B-value	B(25/100)					T=25°C		3964		K
Vincotech NTC Reference									F	

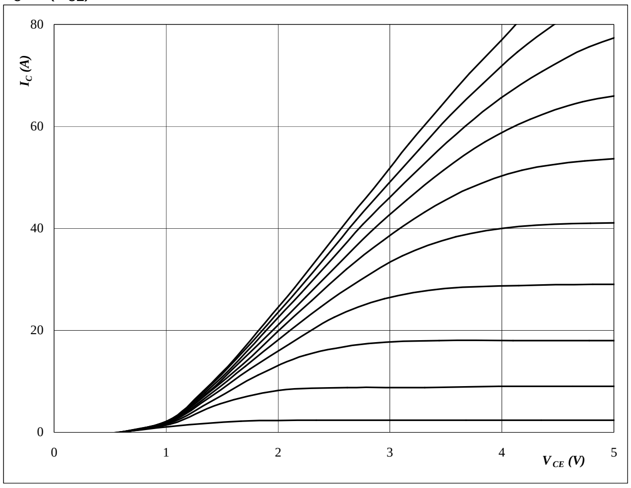
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



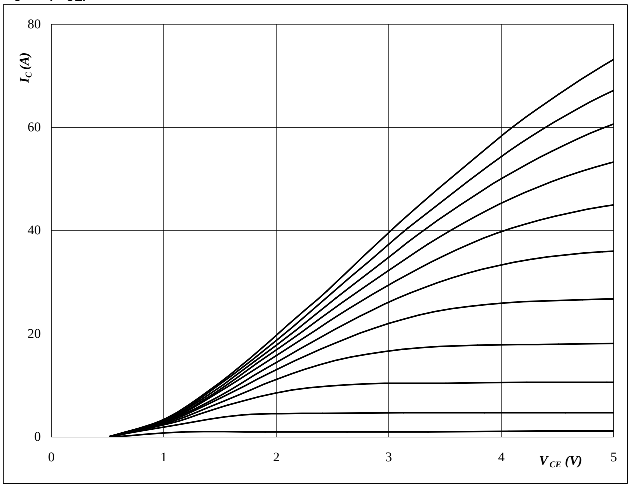
At

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

$I_C = f(V_{CE})$



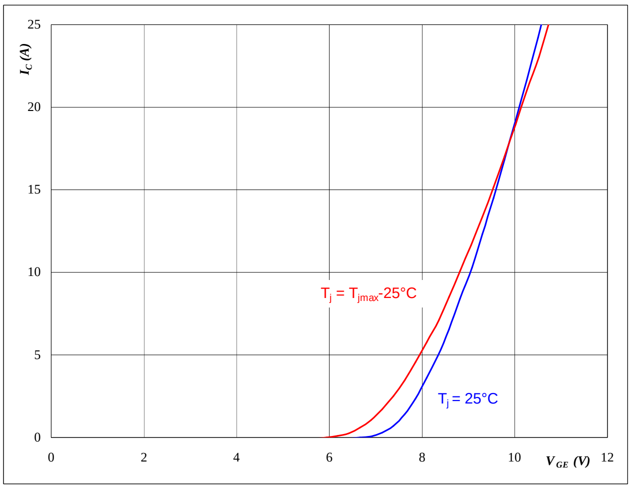
At

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

$I_C = f(V_{GE})$



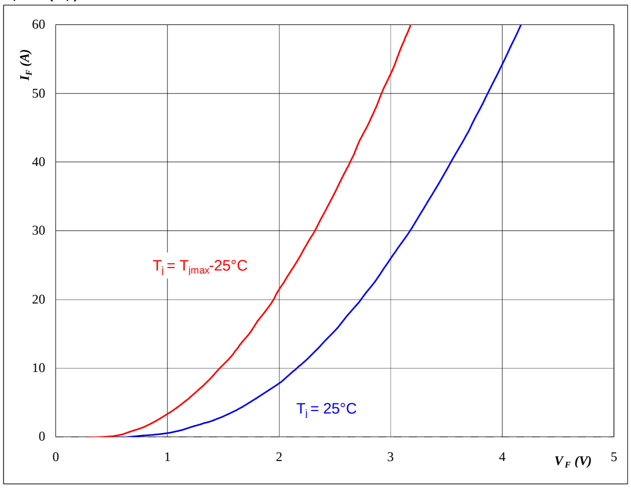
At

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

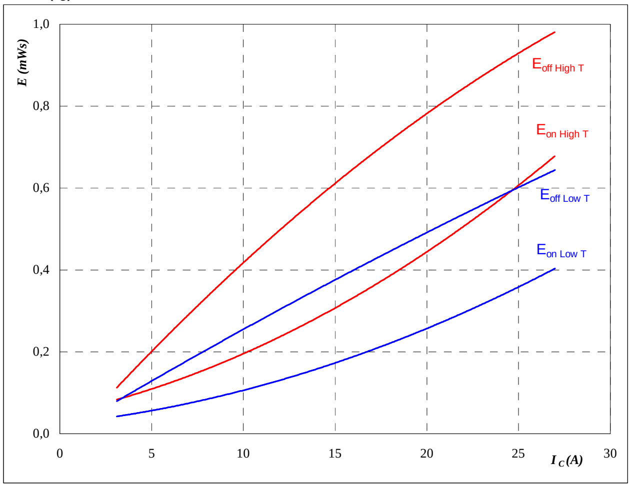
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



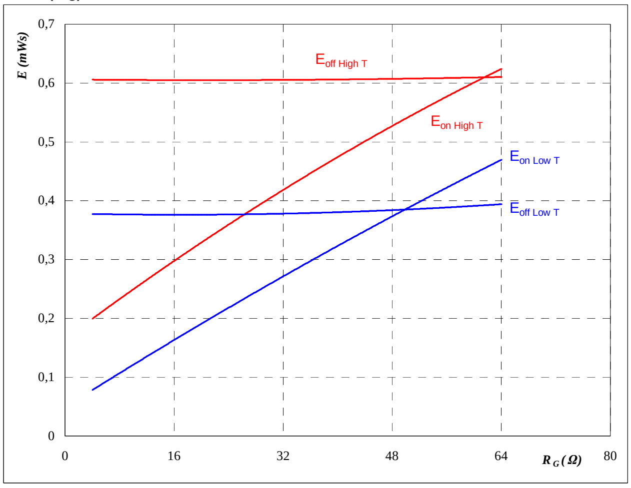
With an inductive load at

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

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



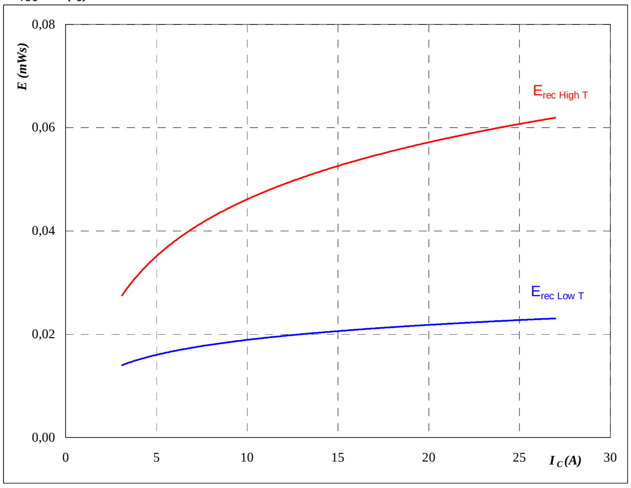
With an inductive load at

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

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

E_{rec} = f(I_c)



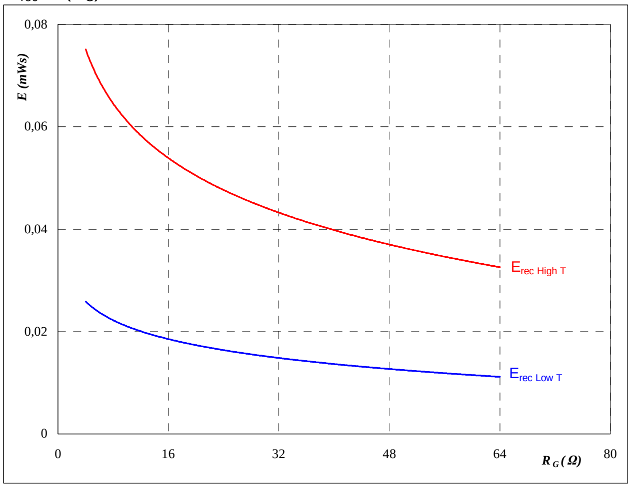
With an inductive load at

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 =	15	A

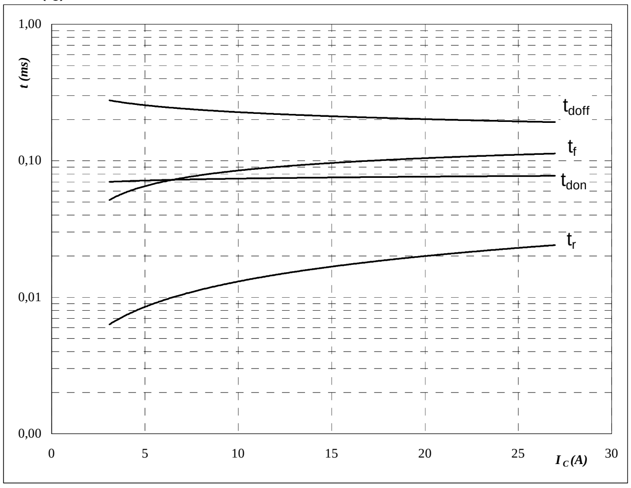
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



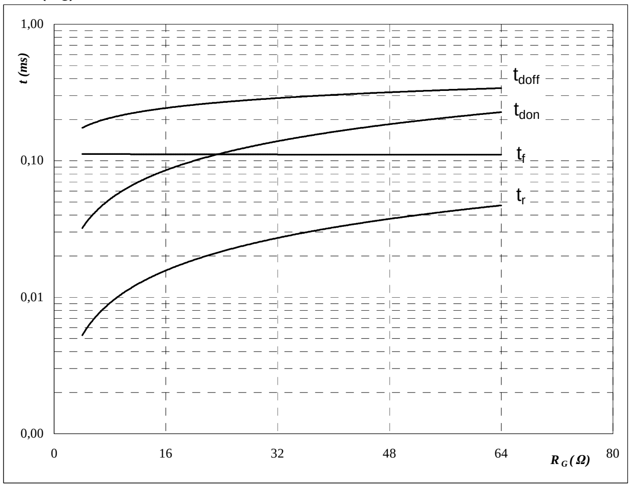
With an inductive load at

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

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



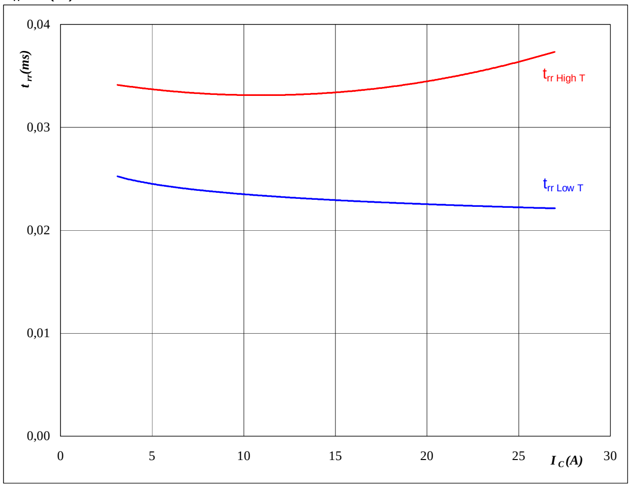
With an inductive load at

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

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



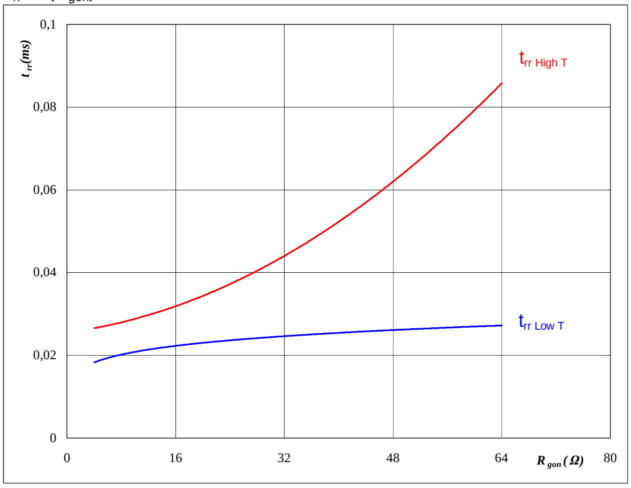
At

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 =	15	A
V_{GE} =	±15	V

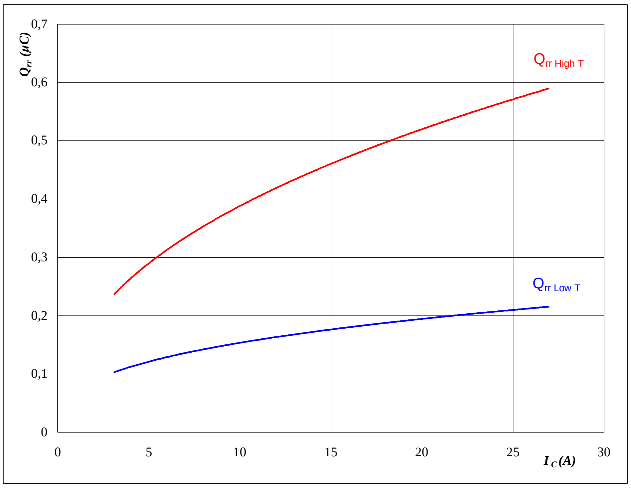
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



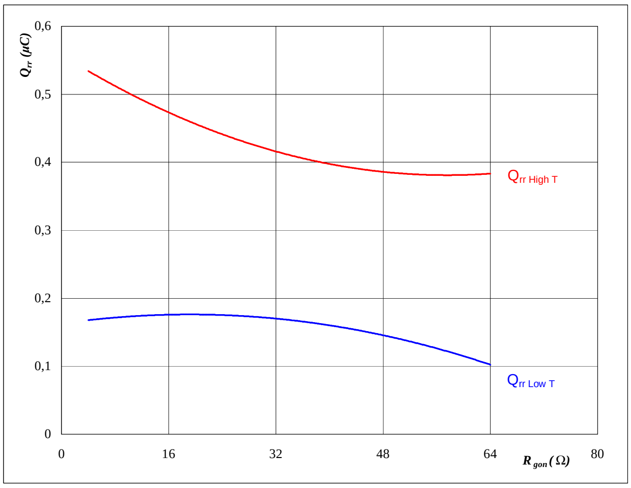
At

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

Figure 14 FWD

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

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



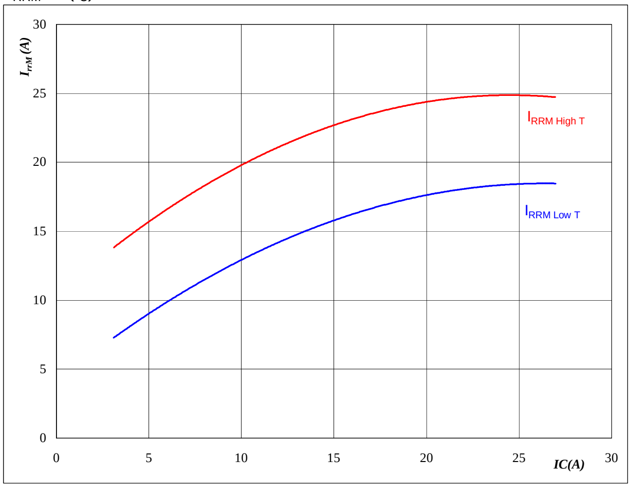
At

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

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



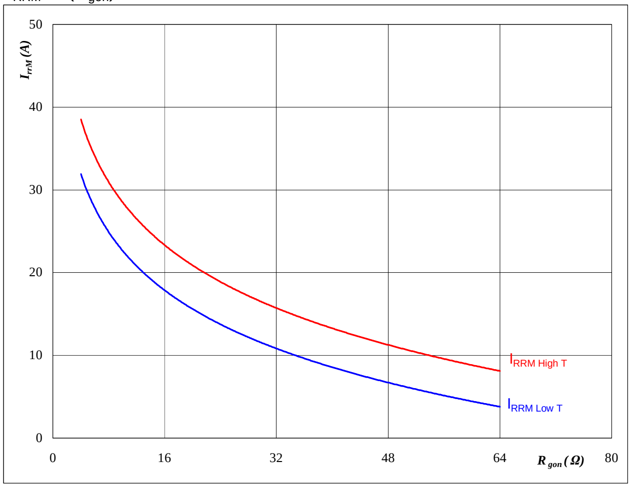
At

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 =	15	A
V_{GE} =	±15	V

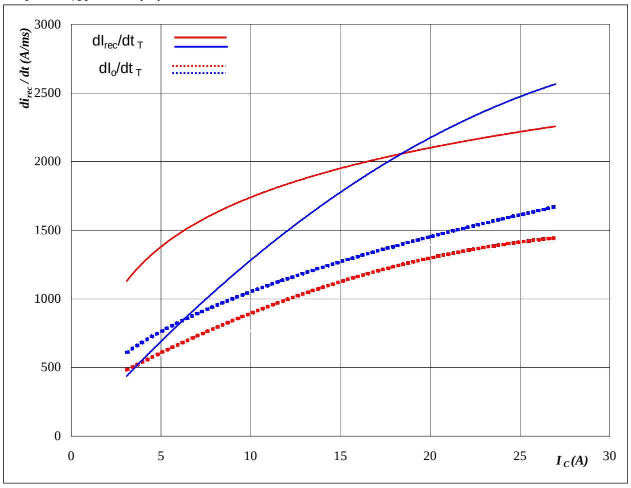
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 17 FWD

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

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



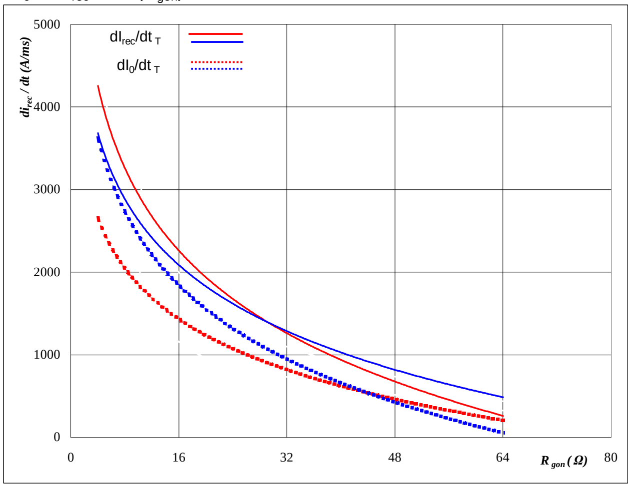
At

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

Figure 18 FWD

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

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



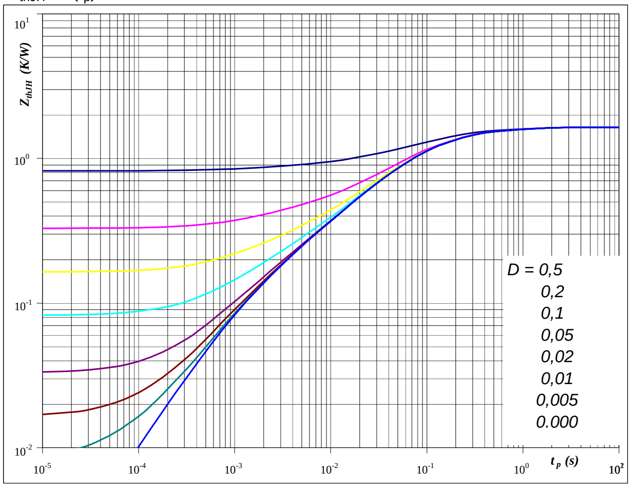
At

T_j =	25/125	°C
V_R =	350	V
I_F =	15	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} =	1,64	K/W

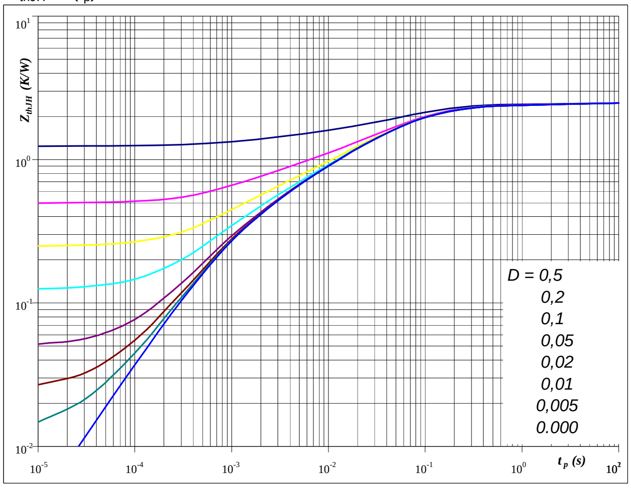
IGBT thermal model values

R (C/W)	Tau (s)
0,20	7,2E-01
0,61	1,3E-01
0,53	4,6E-02
0,21	9,8E-03
0,09	1,3E-03

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} =	2,48	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,08	4,1E+00
0,16	5,7E-01
1,07	7,9E-02
0,61	2,0E-02
0,31	4,7E-03
0,25	9,2E-04

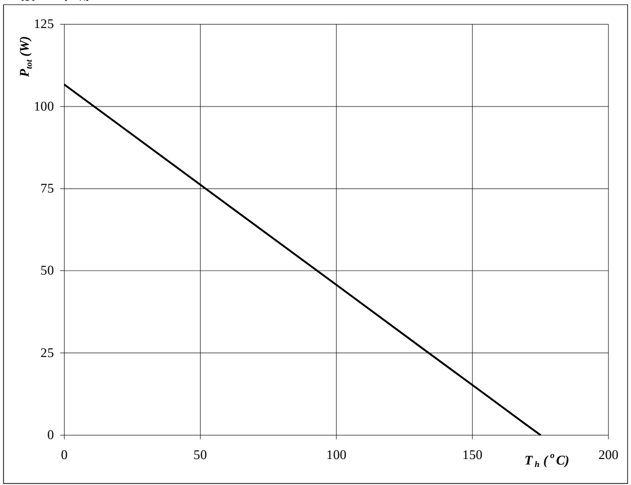
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



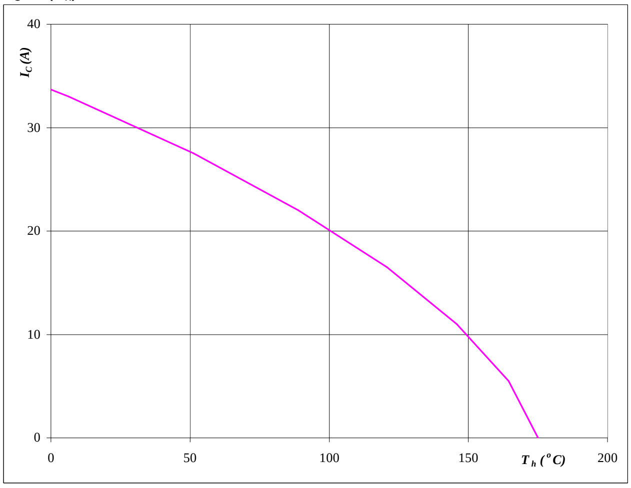
At

T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

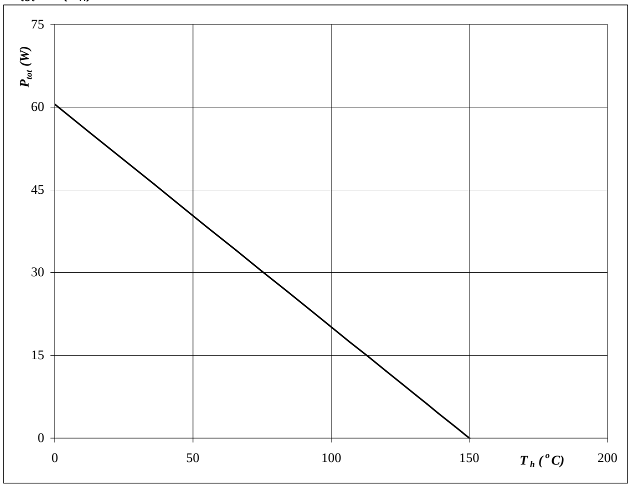
T_j = 175 °C

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



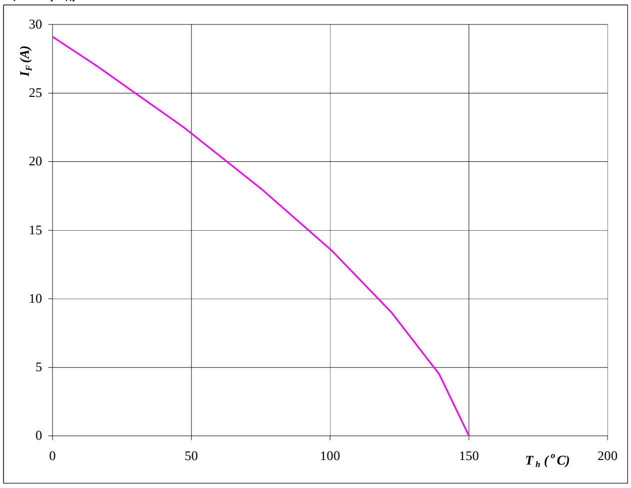
At

T_j = 150 °C

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 °C

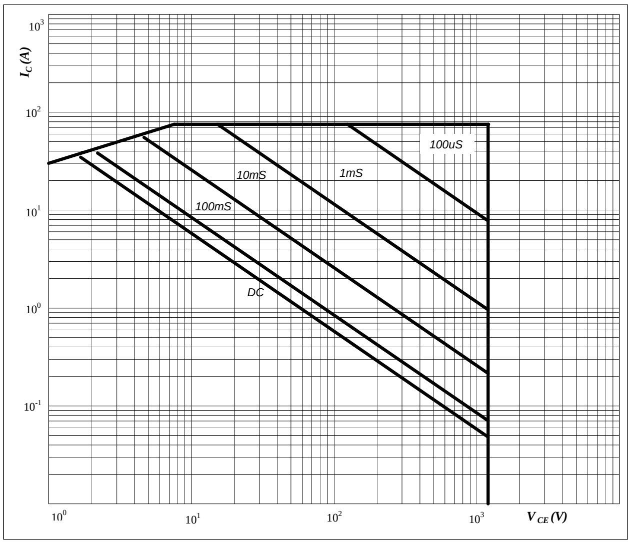
Half Bridge

Half Bridge IGBT & Neutral Point FWD

Figure 25	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



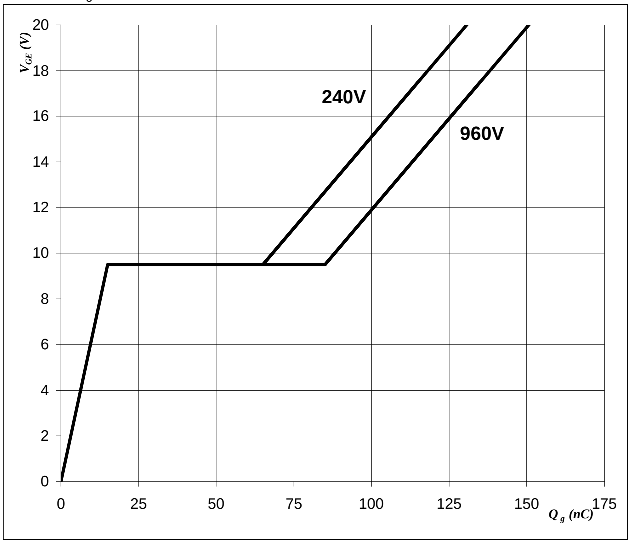
At

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 =	0	A

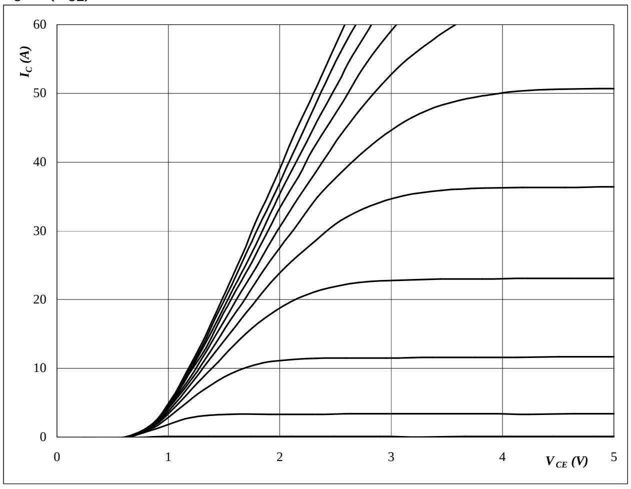
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



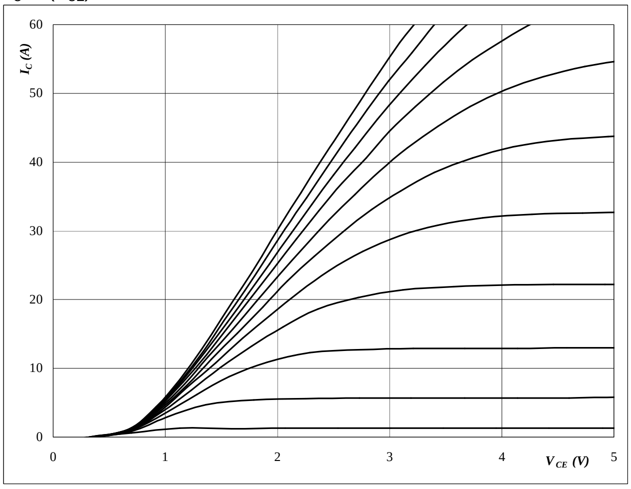
At

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

$I_C = f(V_{CE})$



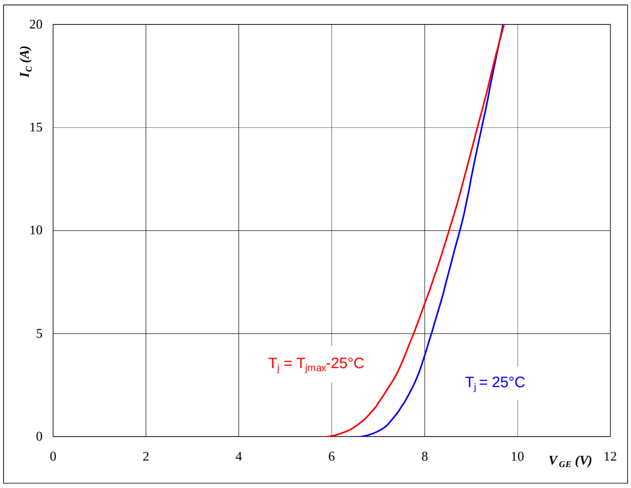
At

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

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



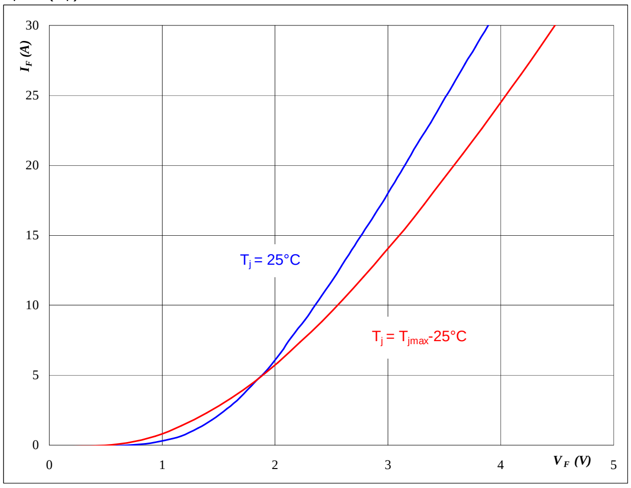
At

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

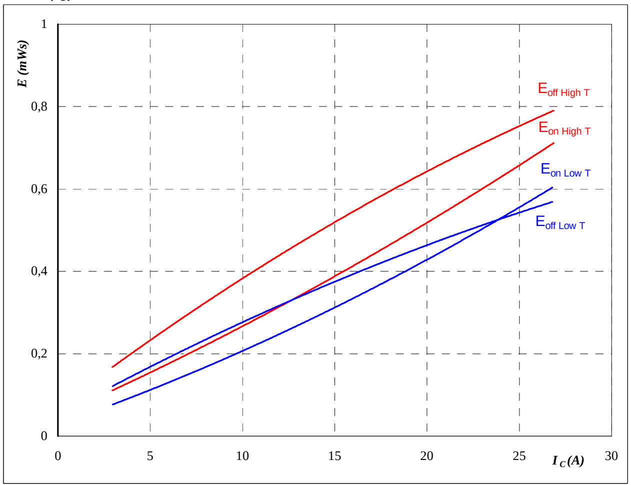
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



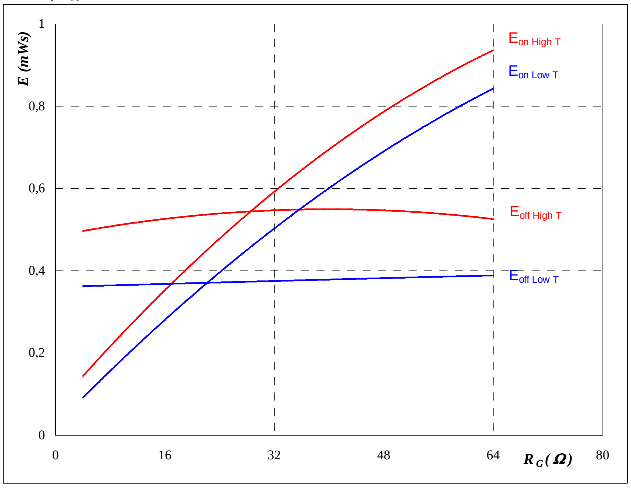
With an inductive load at

T_j =	25/126	°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

$E = f(R_G)$



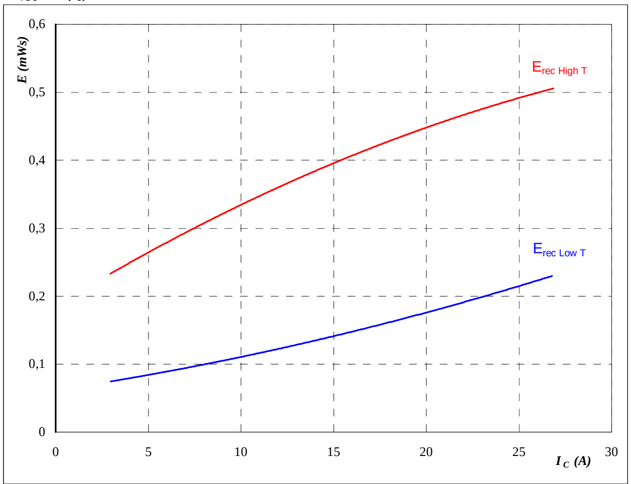
With an inductive load at

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

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



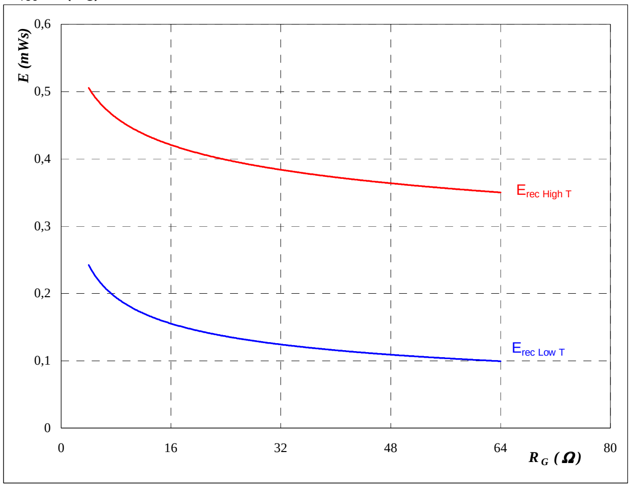
With an inductive load at

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

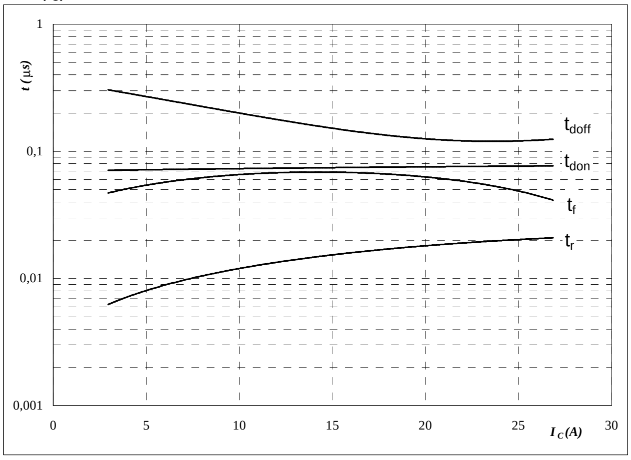
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



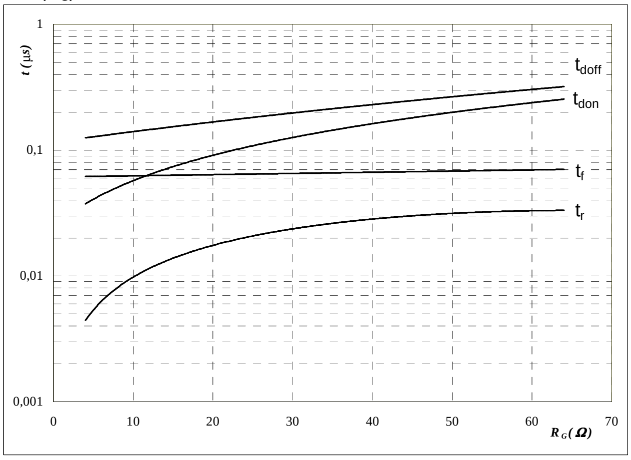
With an inductive load at

T_j =	126	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



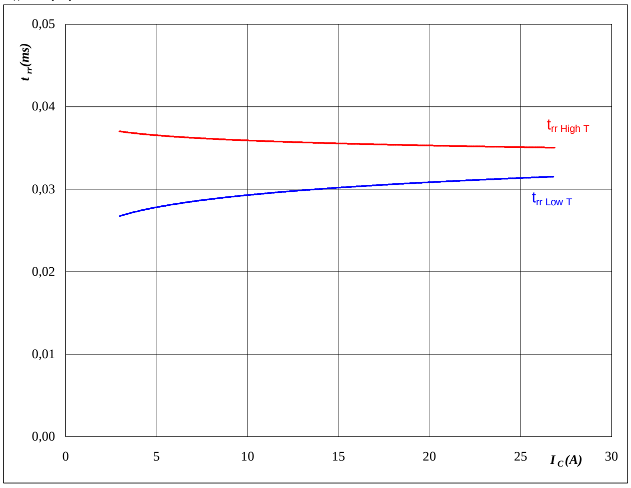
With an inductive load at

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

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



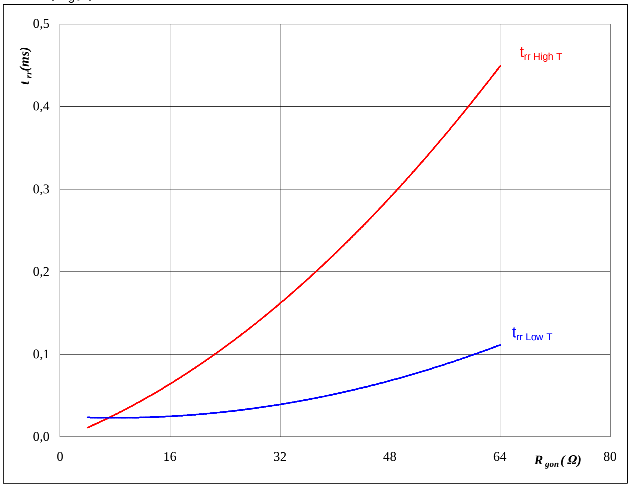
At

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

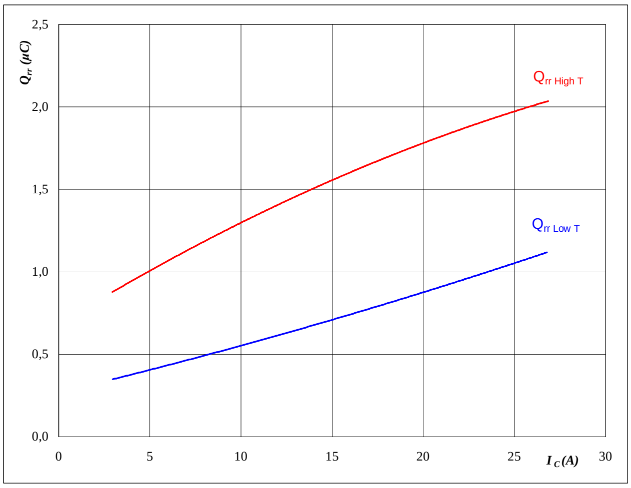
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



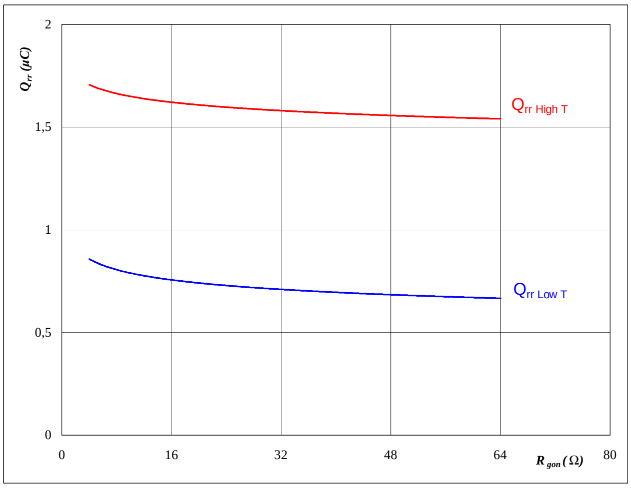
At

T_j =	25/126	°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

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



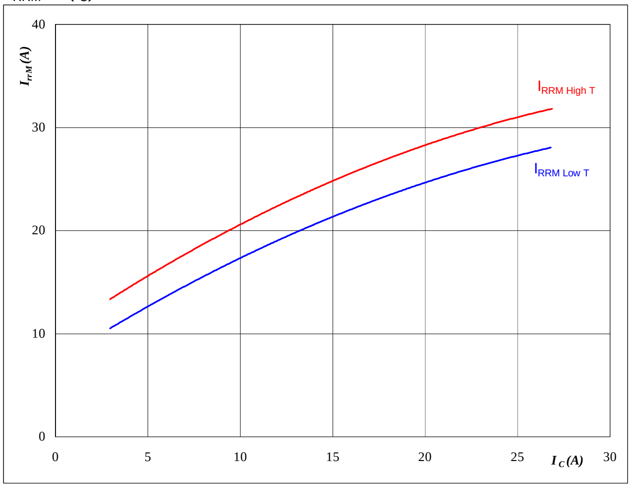
At

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

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



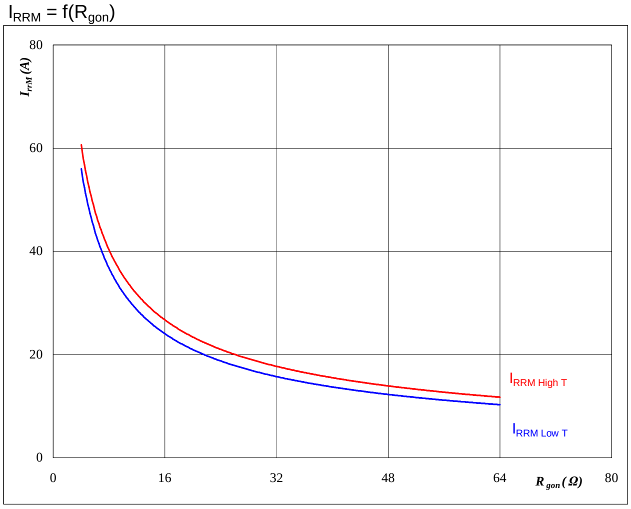
At

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

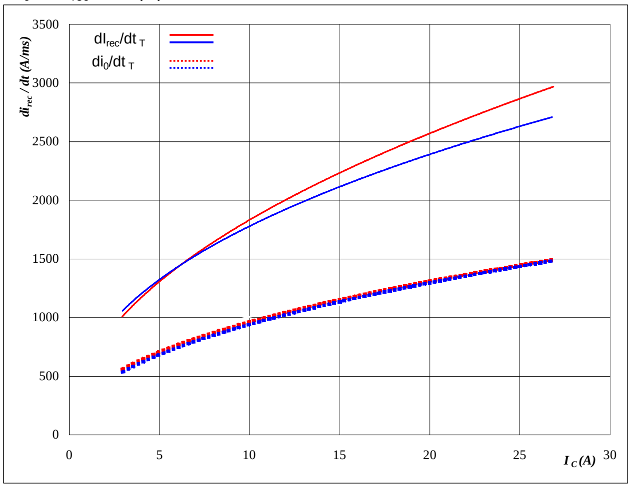
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 17 FWD

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

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



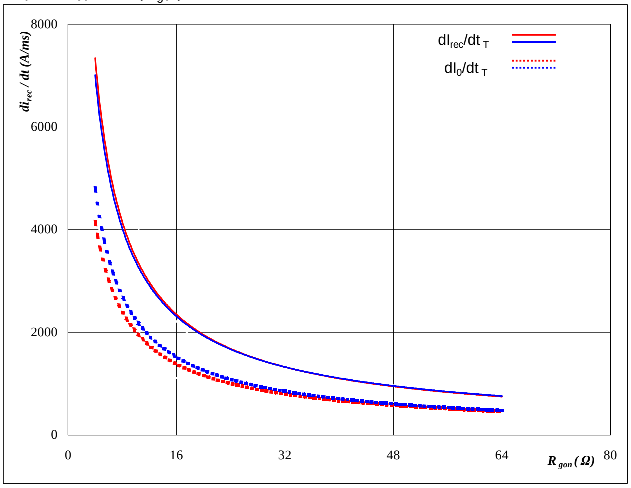
At

T_j =	25/126	°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

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



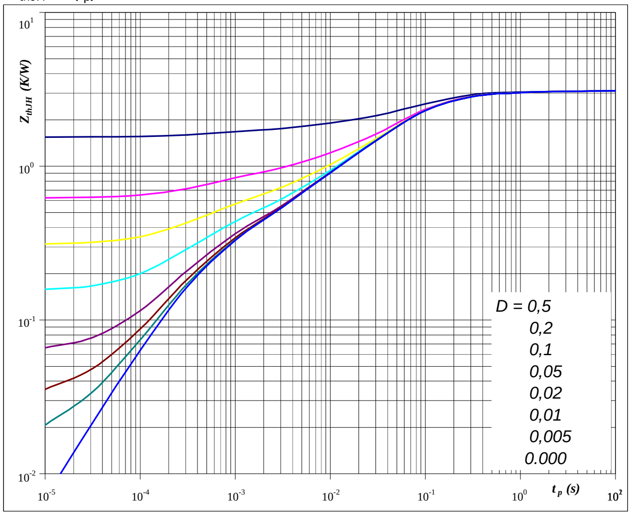
At

T_j =	25/126	°C
V_R =	350	V
I_F =	15	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} =	3,09	K/W

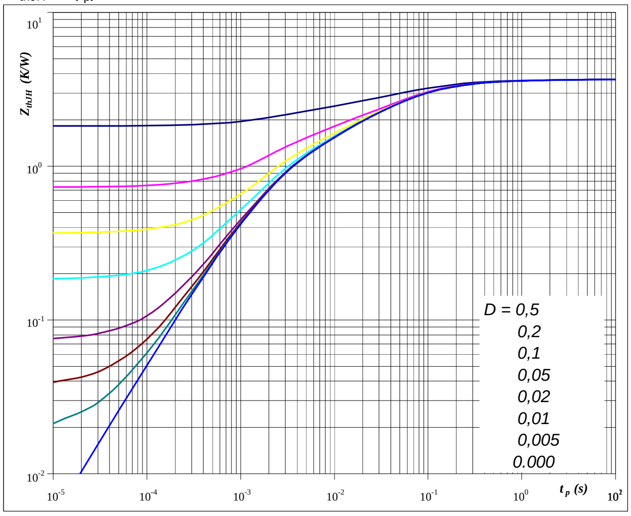
IGBT thermal model values

R (C/W)	Tau (s)
0,09	1,8E+00
0,37	2,7E-01
1,74	6,9E-02
0,36	1,4E-02
0,25	3,4E-03
0,24	4,1E-04

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	3,65	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,15	1,2E+00
0,58	1,7E-01
1,42	4,8E-02
0,77	9,0E-03
0,72	1,8E-03

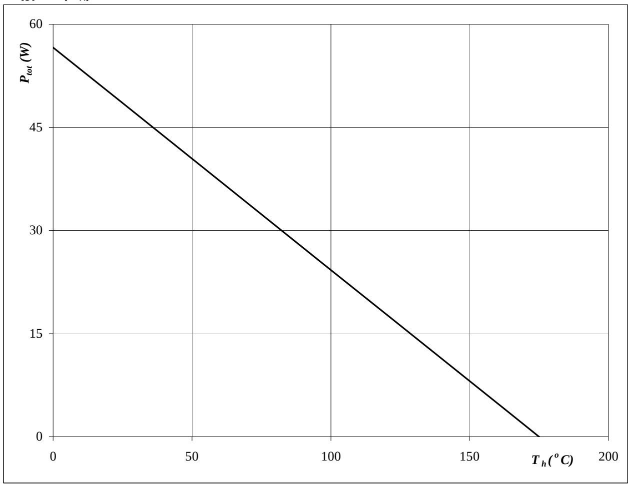
Neutral Point

Neutral Point IGBT & Half Bridge FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



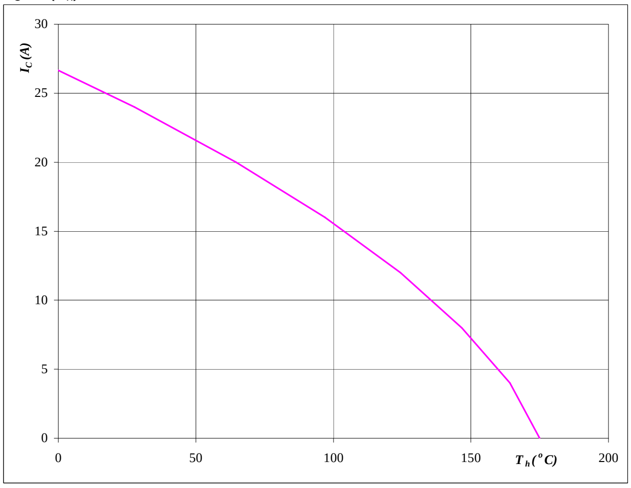
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

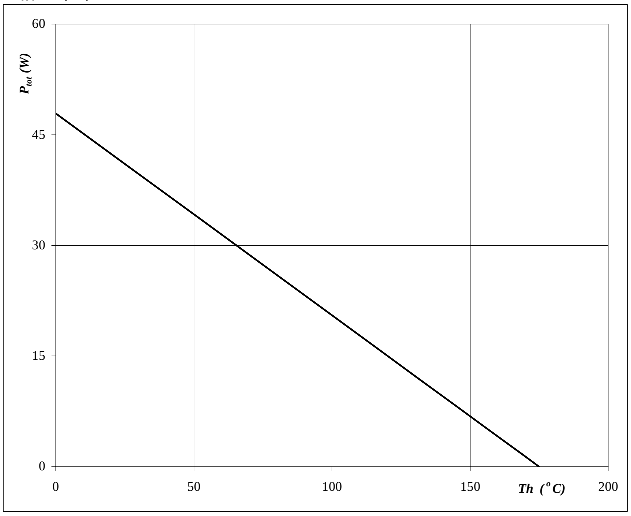
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



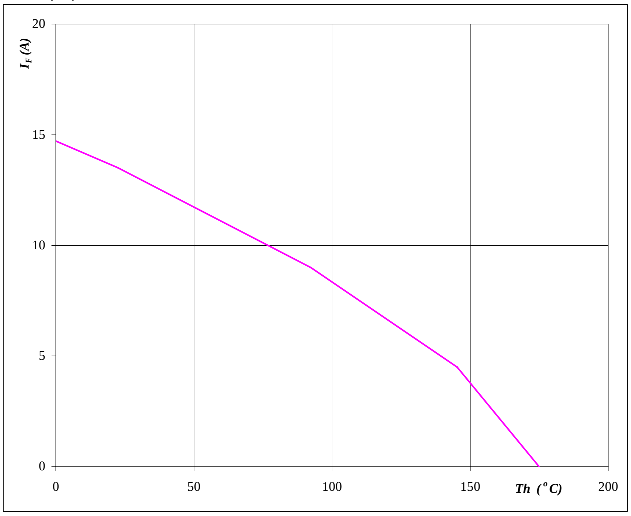
At

T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



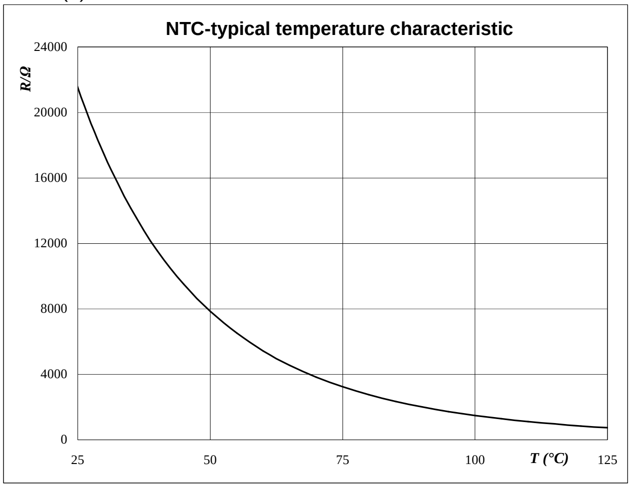
At

T_j = 175 ºC

Thermistor

Figure 1	Thermistor

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



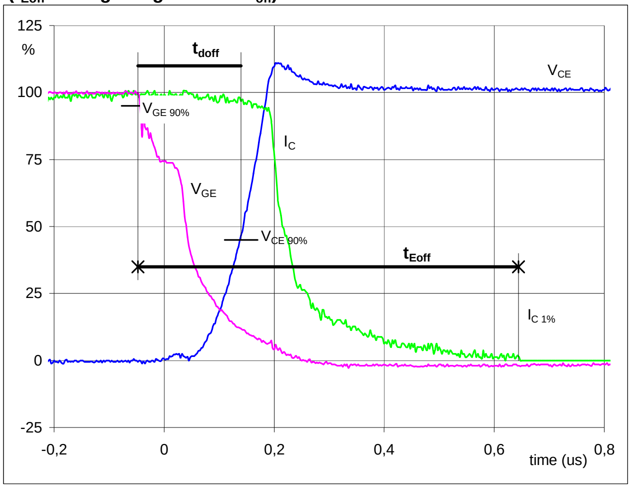
Switching Definitions Half Bridge

General conditions

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

Figure 1 Half Bridge IGBT

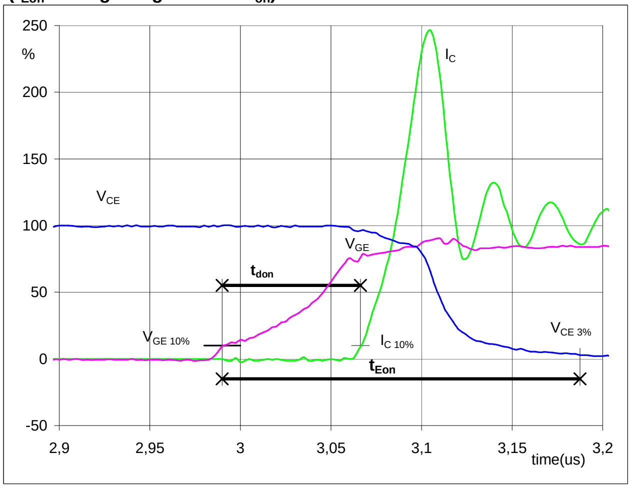
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
t_{doff} =	0,22	µs
t_{Eoff} =	0,69	µs

Figure 2 Half Bridge IGBT

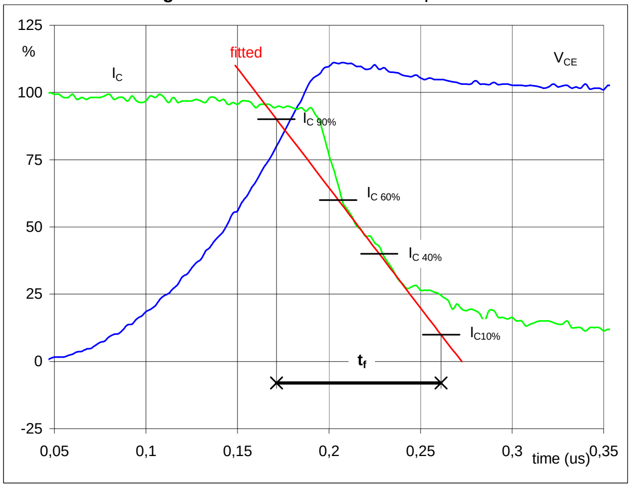
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
t_{don} =	0,07	µs
t_{Eon} =	0,20	µs

Figure 3 Half Bridge IGBT

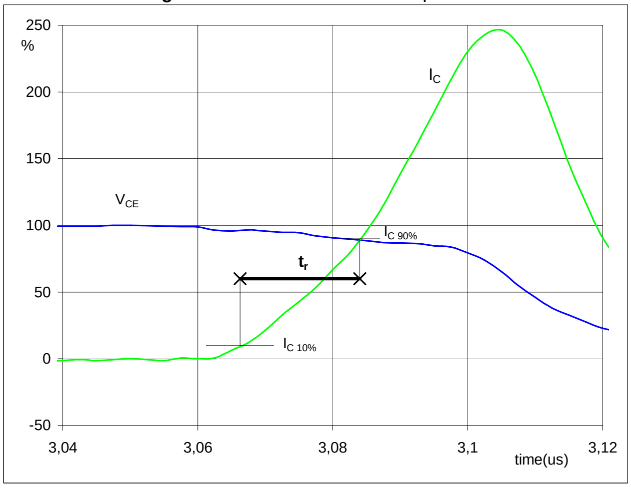
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	15	A
t_f =	0,12	µs

Figure 4 Half Bridge IGBT

Turn-on Switching Waveforms & definition of t_r

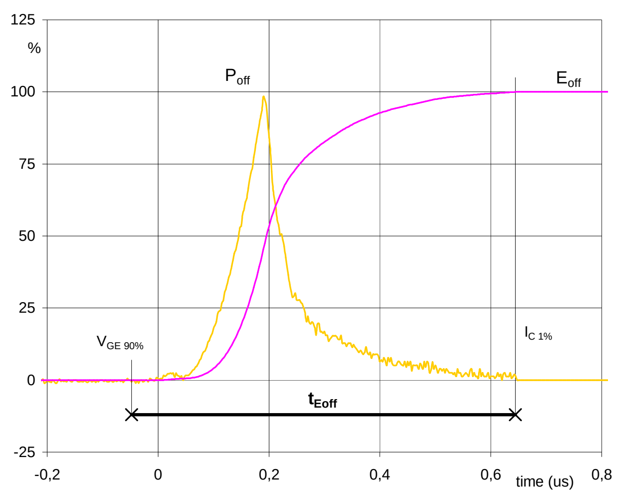


V_C (100%) =	350	V
I_C (100%) =	15	A
t_r =	0,02	µs

Switching Definitions Half Bridge

Figure 5 Half Bridge IGBT

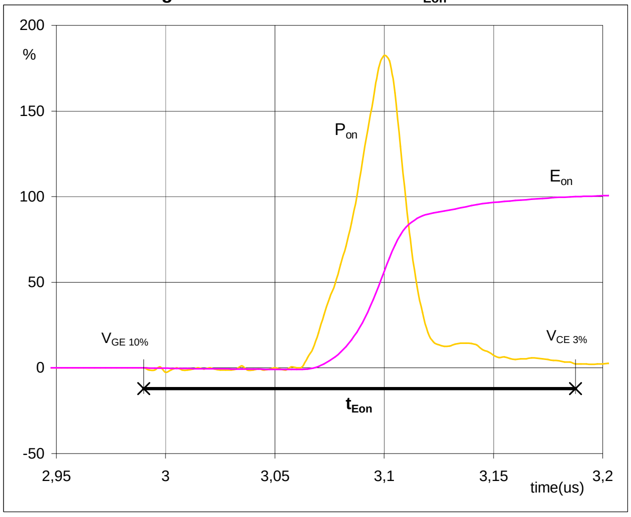
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	5,28	kW
E_{off} (100%) =	0,63	mJ
t_{Eoff} =	0,69	μs

Figure 6 Half Bridge IGBT

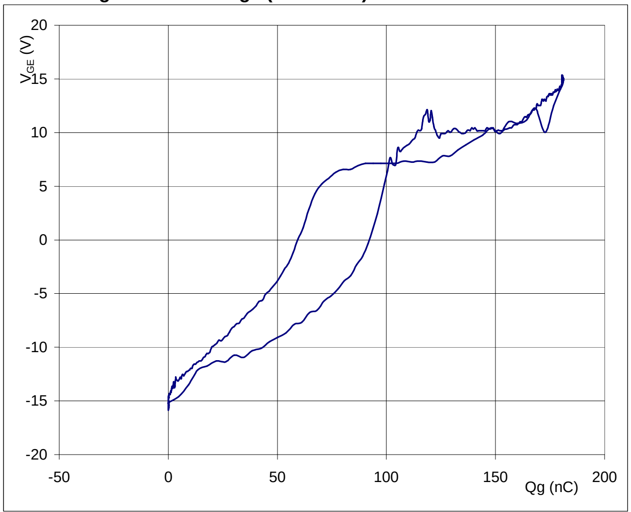
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	5,28	kW
E_{on} (100%) =	0,30	mJ
t_{Eon} =	0,20	μs

Figure 7 Half Bridge IGBT

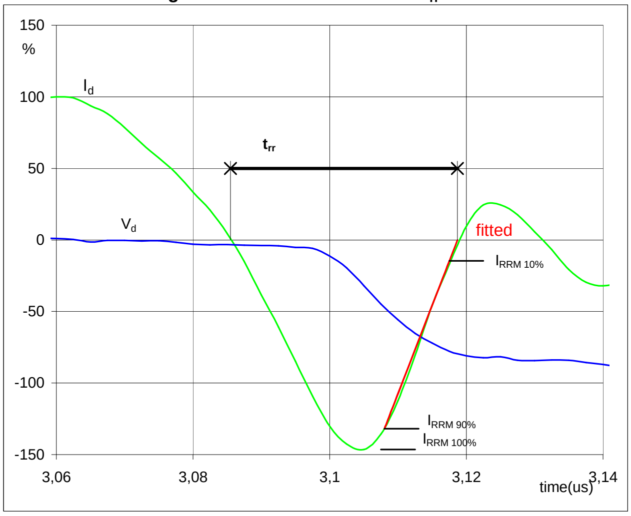
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
Q_g =	180,95	nC

Figure 8 Neutral Point FWD

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

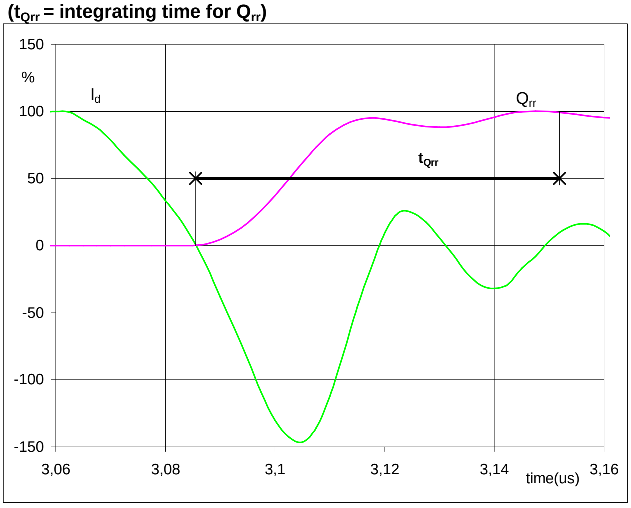


V_d (100%) =	350	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-22	A
t_{rr} =	0,03	μs

Switching Definitions Half Bridge

Figure 9 Half Bridge IGBT

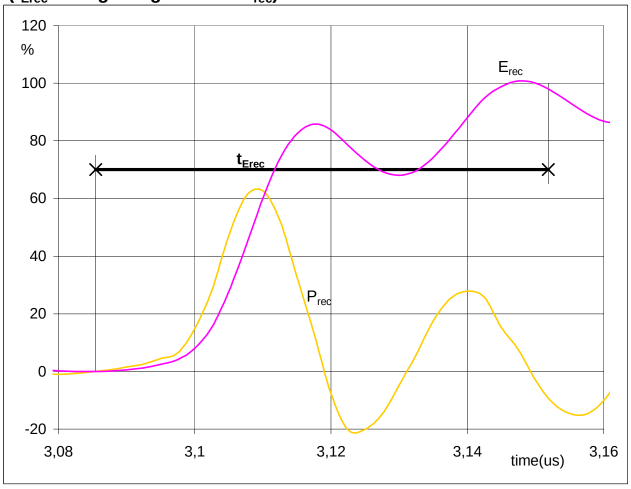
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	0,44	μC
t_{Qrr} =	0,07	μs

Figure 10 Half Bridge IGBT

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

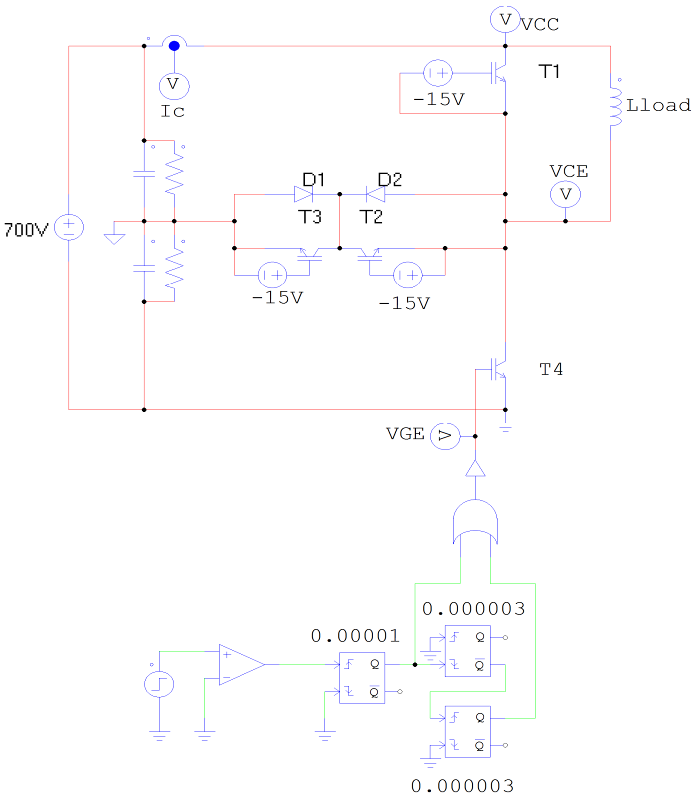


P_{rec} (100%) =	5,28	kW
E_{rec} (100%) =	0,05	mJ
t_{Erec} =	0,07	μs

Half Bridge switching measurement circuit

Figure 11

Half Bridge stage switching measurement circuit



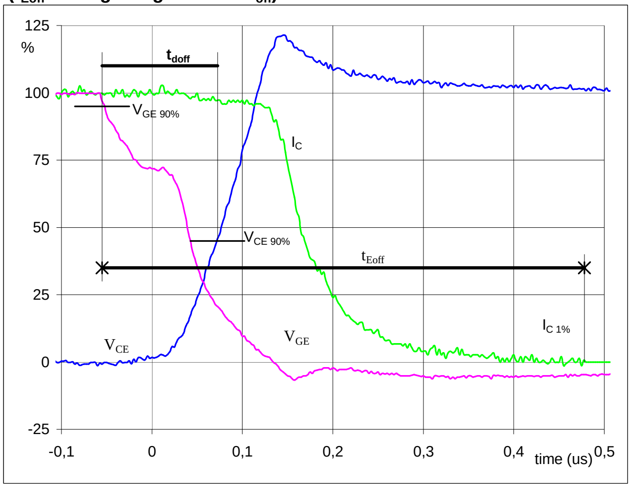
Switching Definitions Neutral Point

General conditions

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

Figure 1 Neutral Point IGBT

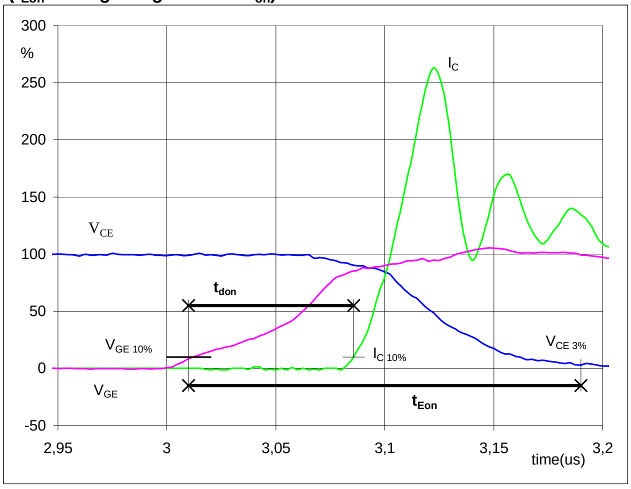
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
t_{doff} =	0,16	μs
t_{Eoff} =	0,53	μs

Figure 2 Neutral Point IGBT

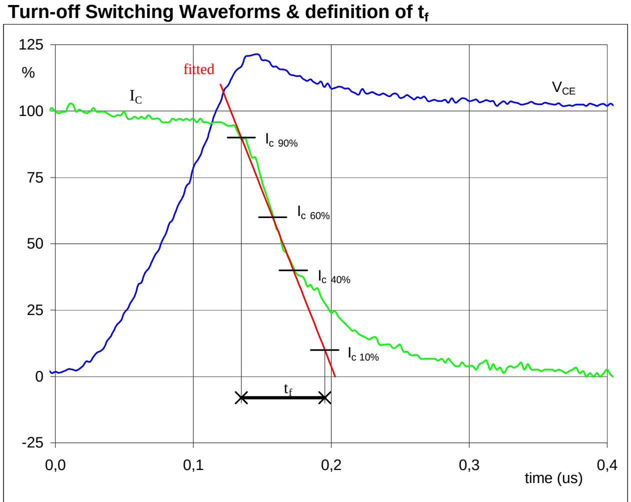
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
t_{don} =	0,07	μs
t_{Eon} =	0,18	μs

Figure 3 Neutral Point IGBT

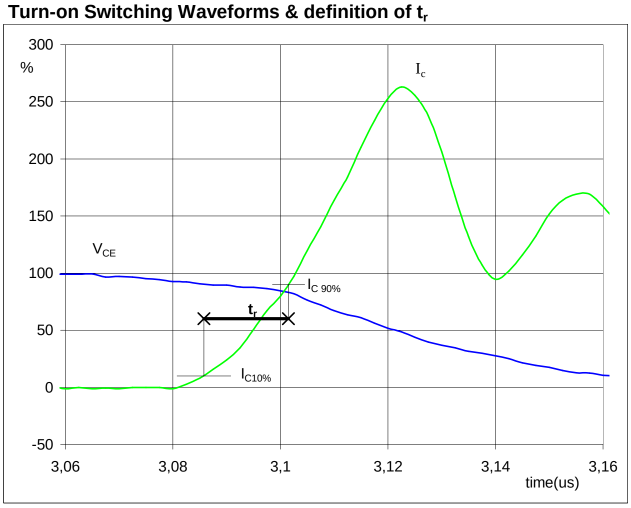
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	15	A
t_f =	0,069	μs

Figure 4 Neutral Point IGBT

Turn-on Switching Waveforms & definition of t_r

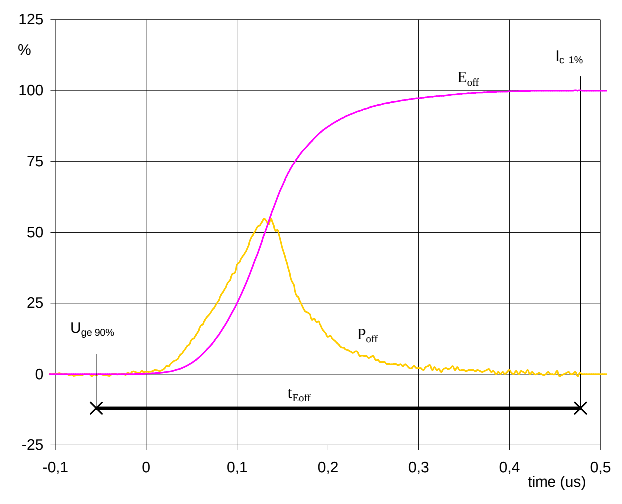


V_C (100%) =	350	V
I_C (100%) =	15	A
t_r =	0,016	μs

Switching Definitions Neutral Point

Figure 5 Neutral Point IGBT

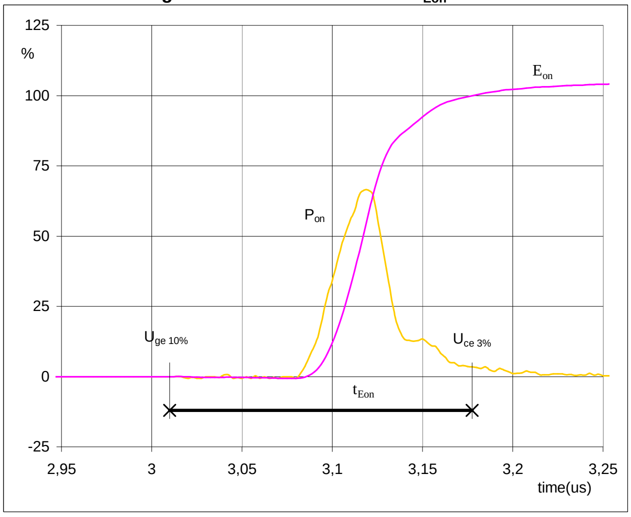
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	5,26	kW
E_{off} (100%) =	0,53	mJ
t_{Eoff} =	0,53	μs

Figure 6 Neutral Point IGBT

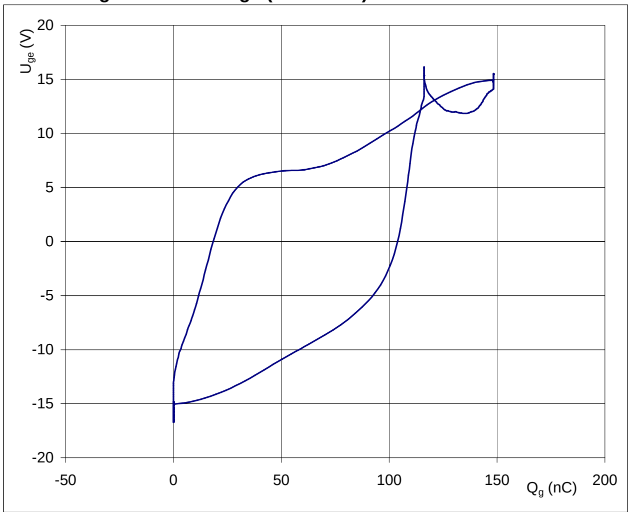
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	5,26	kW
E_{on} (100%) =	0,30	mJ
t_{Eon} =	0,18	μs

Figure 7 Neutral Point IGBT

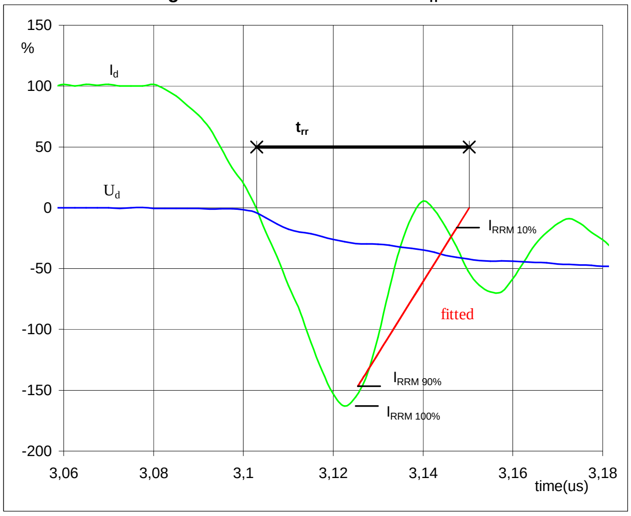
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	15	A
Q_g =	148	nC

Figure 8 Half Bridge FWD

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

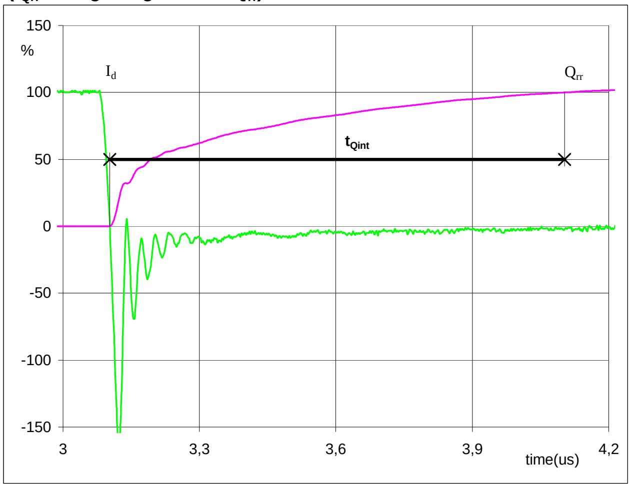


V_d (100%) =	350	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-24	A
t_{rr} =	0,04	μs

Switching Definitions Neutral Point

Figure 9 Half Bridge FWD

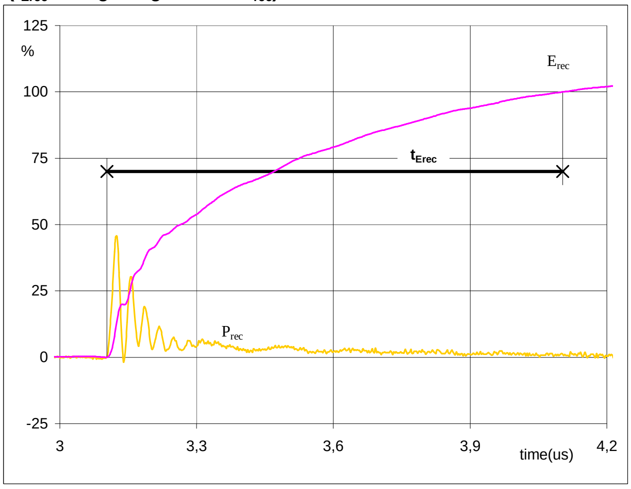
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	1,51	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})

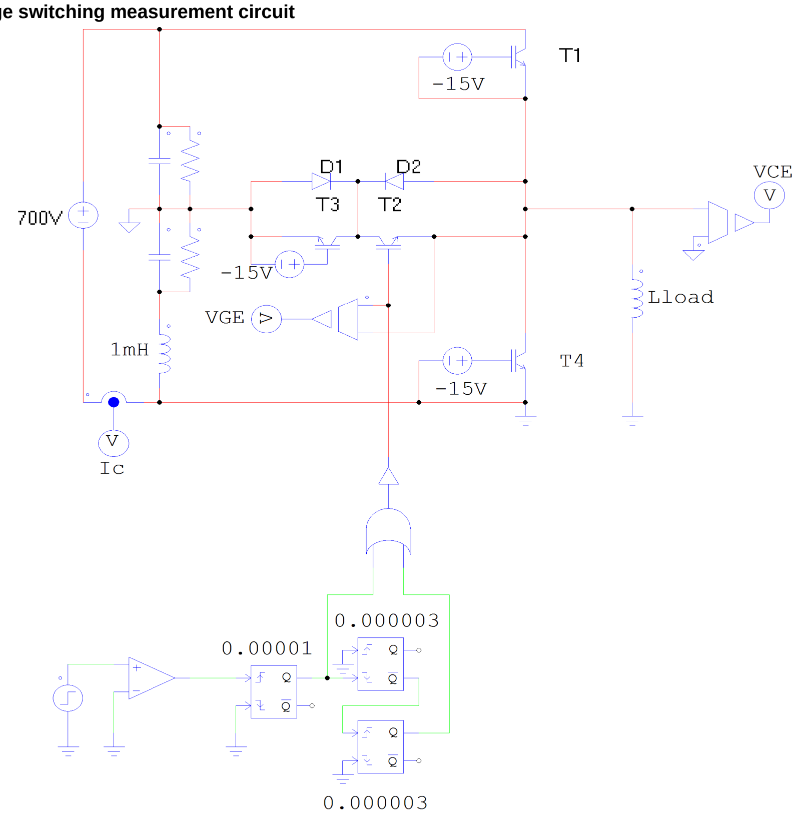


P_{rec} (100%) =	5,26	kW
E_{rec} (100%) =	0,38	mJ
t_{Erec} =	1,00	μs

Neutral Point switching measurement circuit

Figure 11

Neutral Point stage switching measurement circuit



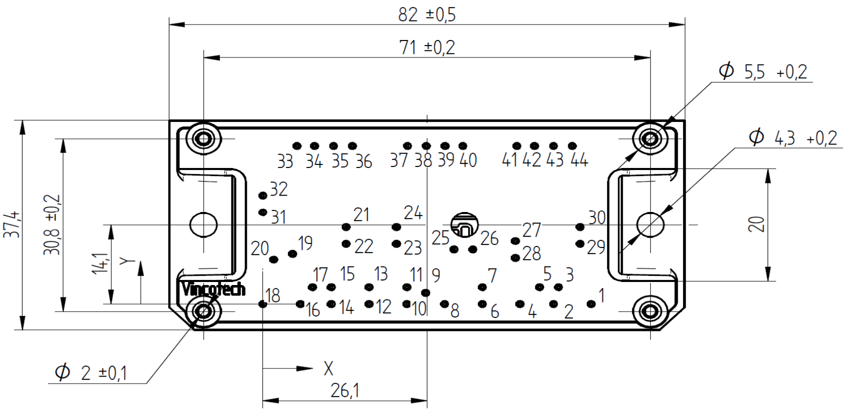
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

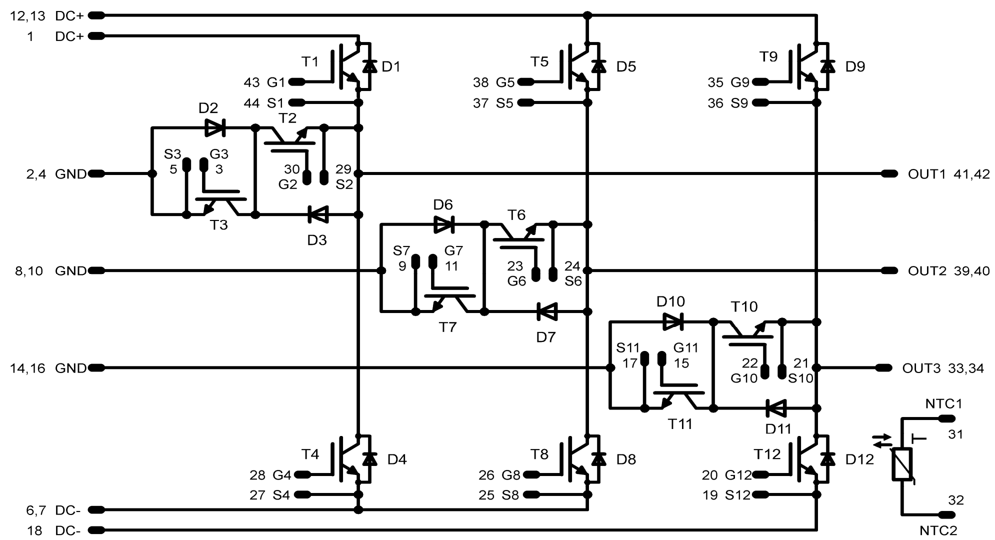
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FY12M3A025SH-M746F08	M746F08	M746F08
without thermal paste 17mm housing	10-F112M3A025SH-M746F09	M746F09	M746F09

Outline

Pin	X	Y	Pin	X	Y
1	52,2	0	23	21,25	10,7
2	46,2	0	24	21,25	13,7
3	47	3	25	30,4	9,7
4	40,9	0	26	33,4	9,7
5	44	3	27	40,15	11,2
6	34,9	0	28	40,15	8,2
7	34,9	3	29	50,45	10,7
8	28,9	0	30	50,45	13,7
9	25,9	2	31	0	16,35
10	22,9	0	32	0	19,35
11	22,9	3	33	5,45	28,2
12	16,9	0	34	8,25	28,2
13	16,9	3	35	11,25	28,2
14	10,9	0	36	14,25	28,2
15	10,9	3	37	23	28,2
16	6	0	38	26	28,2
17	7,9	3	39	29	28,2
18	0	0	40	31,8	28,2
19	4,75	8,9	41	40,4	28,2
20	1,75	7,9	42	43,2	28,2
21	13,25	13,7	43	46,2	28,2
22	13,25	10,7	44	49,2	28,2



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.