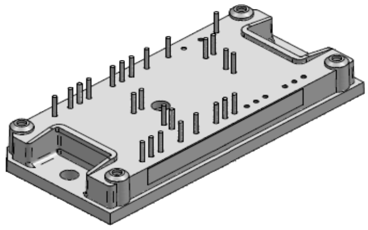
flowSOL 1 RI — 650V/80mΩ

Features

- Low inductive 12mm flow1 package
- Rectifier Bridge:
  - Ultra fast rectifier bridge
- Inverter:
  - Pseudo H-bridge topology
  - Trench IGBT + fast FWD
  - MOSFET 650V/80mOhm CFD + ultrafast FWD
- Integrated DC-capacitors
- Temperature sensor

flow1 12mm housing

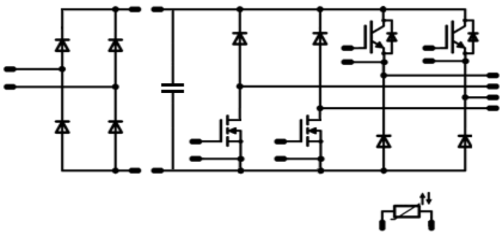


Target Applications

- Solar Inverter:

Secondary of high efficient transformer-based solar inverter with unipolar or bipolar modulation

Schematic



Types

10-FY06RIA080MF-M537D68

Fast Rectifier Diode (D1 , D2 , D3 , D4)

Repetitive peak reverse voltage	V_{RRM}			600	V
Forward average current	I_{FAV}	sine,d=0.5 T_j=$T_j$max	T_h=80°C T_c=80°C	42 56	A
Surge forward current	I_{FSM}	t_p=1 ms	Tj=25°C	100	A
I2t-value	I^2t	tp=10ms	Tj=125°C	330	A^2s
Power dissipation per Thyristor	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	59 90	W
Maximum Junction Temperature	$T_j$max			175	°C

Low Side MOSFET (T1 , T2)

Drain to source breakdown voltage	V_{DS}			650	V
DC drain current	I_D	T_j=$T_j$max	T_h=80°C T_c=80°C	20 23	A
Pulsed drain current	I_{Dpulse}	t_p limited by $T_j$max	Tc=25°C	137	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	77 116	W
Gate-source peak voltage	Vgs			±30	V
Maximum Junction Temperature	$T_j$max			150	°C

High Side IGBT (T3 , T4)

Collector-emitter break down voltage	V_{CE}	T_j=25°C		600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	38 44	A
Repetitive peak collector current	$I_{c\ pulse}$	t_p limited by $T_j$max		150	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	88 134	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

Low Side FWD (D5 , D6)

Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	26 35	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		30	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	45 68	W
Maximum Junction Temperature	$T_j$max			150	°C

High Side Inverse Diode (D9 , D10)

Peak Repetitive Reverse Voltage	V_{RRM}	T_c=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	19 26	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		20	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	37 57	W
Maximum Junction Temperature	$T_j$max			175	°C

High Side FWD (D7 , D8)

Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	24 32	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		40	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	40 61	W
Maximum Junction Temperature	$T_j$max			175	°C

DC link Capacitor (C1)

Max.DC voltage	V_{MAX}	Tc=25°C	500	V

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	Vdc
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	
Fast Rectifier Diode (D1 , D2 , D3 , D4)										
Forward voltage	V_F				50	Tj=25°C Tj=150°C	1,2	1,58 1,55	1,9	V
Threshold voltage (for power loss calc. only)	V_{to}				50	Tj=25°C Tj=150°C		1,08 0,92		V
Slope resistance (for power loss calc. only)	r_t				50	Tj=25°C Tj=150°C		0,01 0,01		mΩ
Reverse current	I_r			600		Tj=25°C Tj=150°C			0,027	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,60		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,06		
Low Side MOSFET (T1 , T2)										
Static drain to source ON resistance	$R_{ds(on)}$					Tj=25°C Tj=125°C		90 190		mΩ
Gate threshold voltage	$V_{(GS)th}$	V_{DS}=V_{GS}			0,00176	Tj=25°C Tj=125°C	3,5	4	4,5	V
Gate to Source Leakage Current	I_{gss}		20	0		Tj=25°C Tj=125°C			100	nA
Zero Gate Voltage Drain Current	I_{dss}		0	650		Tj=25°C Tj=125°C			1000	nA
Turn On Delay Time	$t_{d(ON)}$	Rgoff=8 Ω Rgon=8 Ω	±10	400	20	Tj=25°C Tj=125°C		32 33		ns
Rise Time	t_r					Tj=25°C Tj=125°C		7,8 8,8		
Turn off delay time	$t_{d(OFF)}$					Tj=25°C Tj=125°C		195 206		
Fall time	t_f					Tj=25°C Tj=125°C		3,5 4,4		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,21 0,41		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,08 0,07		
Total gate charge	Q_g		0/10	480	26	Tj=25°C		170		nC
Gate to source charge	Q_{gs}							25		
Gate to drain charge	Q_{gd}							120		
Input capacitance	C_{iss}	f=1MHz	0	100		Tj=25°C		5030		pF
Output capacitance	C_{oss}							215		
Reverse transfer capacitance	C_{rss}							tbd		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,91		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,60		

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
High Side IGBT (T3 , T4)										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$			0,004	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C	1,05	1,43 1,57	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,0026	mA
Gate-emitter leakage current	I_{GES}		30	0		Tj=25°C Tj=150°C			600	nA
Integrated Gate resistor	R_{gint}					Tj=25°C Tj=150°C		none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	400	20	Tj=25°C Tj=150°C		84 86		ns
Rise time	t_r					Tj=25°C Tj=150°C		10 11		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		194 237		ns
Fall time	t_f					Tj=25°C Tj=150°C		97 80		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,36 0,48		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,74 1,00		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3140		pF
Output capacitance	C_{oss}							200		pF
Reverse transfer capacitance	C_{rss}							93		pF
Gate charge	Q_{Gate}		15	480	50	Tj=25°C		310		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,08		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,71		
High Side FWD (D7 , D8)										
Diode forward voltage	V_F				20	Tj=25°C Tj=125°C	1,26	1,70 1,58	1,95	V
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	400	20	Tj=25°C Tj=125°C		25 30		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		134 195		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,88 1,72		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		5040 1874		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,24 0,50		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,37		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,56		
High Side Inverse Diode (D9 , D10)										
Diode forward voltage	V_F				20	Tj=25°C Tj=125°C	1,25	1,68 1,54	1,95	V
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,54		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,68		

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	
Low Side FWD (D5 , D6)										
Diode forward voltage	V_F				30	Tj=25°C Tj=150°C		2,23 1,97	2,6	V
Reverse leakage current	I_r			600		Tj=25°C Tj=150°C			100	μA
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	10	400	20	Tj=25°C Tj=150°C		23 34		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		15 33		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0,21 0,68		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		6876 1756		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		0,02 0,07		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,55		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,02		
DC link Capacitor (C1)										
C value	C							120		nF
Thermistor										
Rated resistance	R					Tj=25°C		22000		Ω
Deviation of R25	ΔR/R	R100=1486 Ω				Tc=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						Tj=25°C			B	

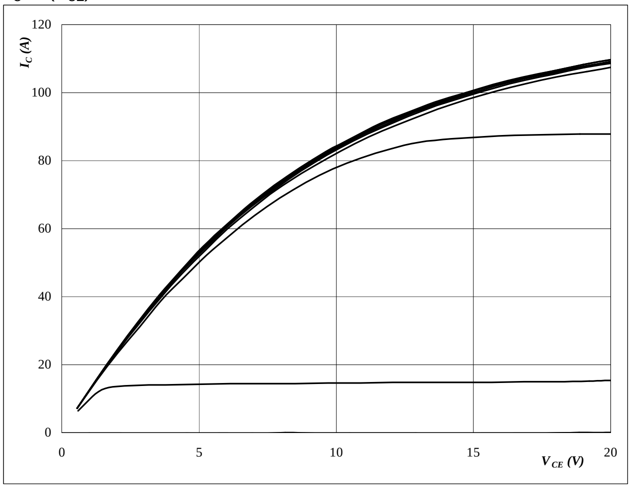
Low Side

Low Side MOSFET and High Side FWD

Figure 1	MOSFET

Typical output characteristics

$I_C = f(V_{CE})$



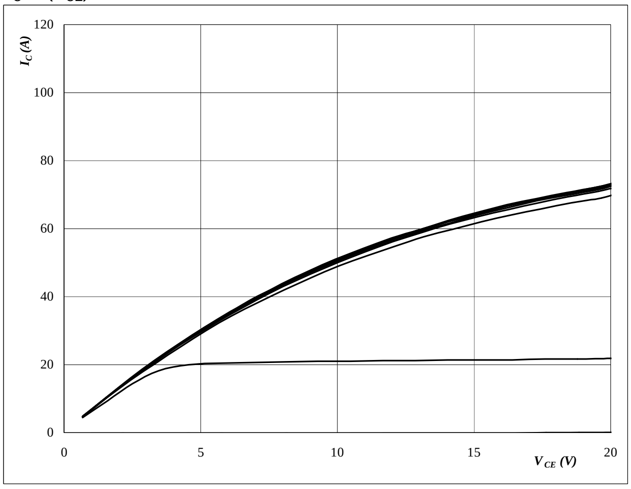
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	0 V to 20 V in steps of 2 V	

Figure 2	MOSFET

Typical output characteristics

$I_C = f(V_{CE})$



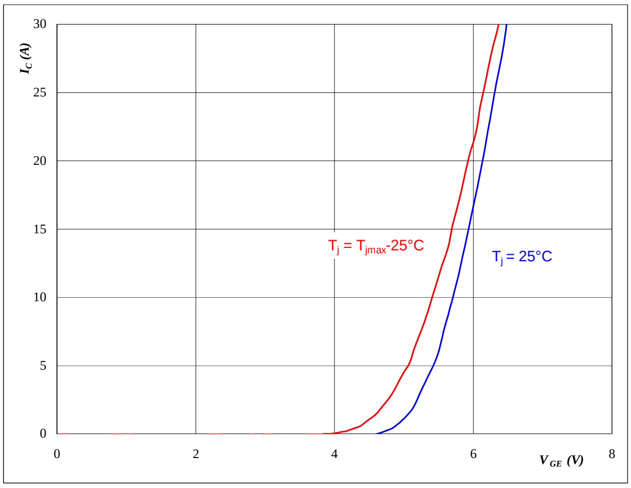
At

t_p =	250	μs
T_j =	125	°C
V_{GE} from	0 V to 20 V in steps of 2 V	

Figure 3	MOSFET

Typical transfer characteristics

$I_C = f(V_{GE})$



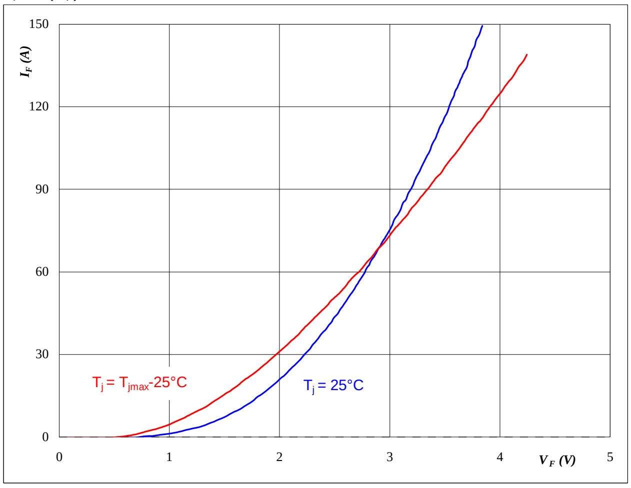
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4	FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

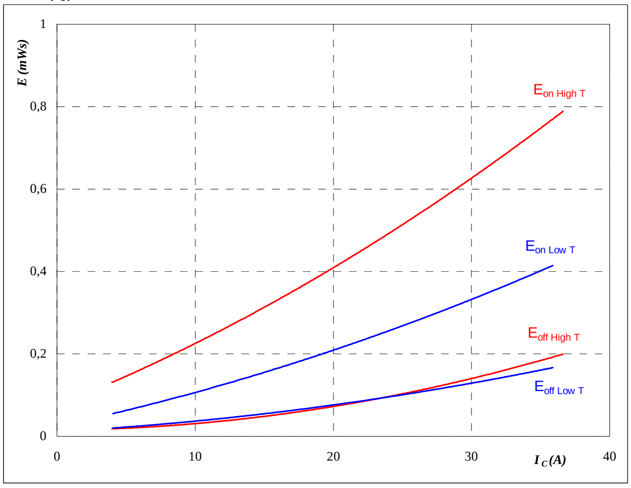
t_p =	250	μs

Low Side

Low Side MOSFET and High Side FWD

Figure 5	MOSFET

Typical switching energy losses
as a function of collector current
$E = f(I_C)$

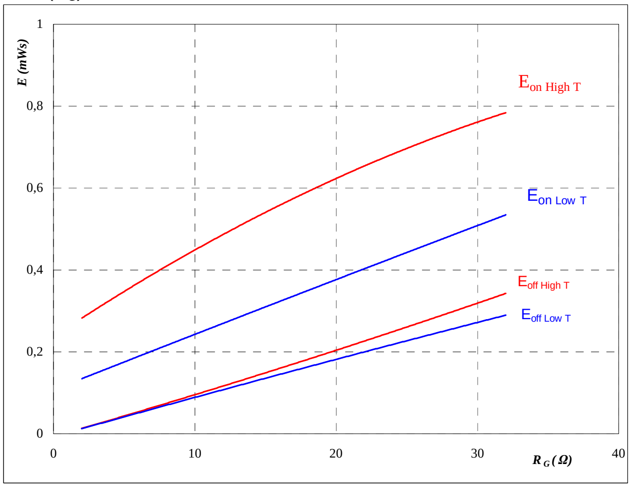


With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω
R_{goff} =	8,0	Ω

Figure 6	MOSFET

Typical switching energy losses
as a function of gate resistor
$E = f(R_G)$

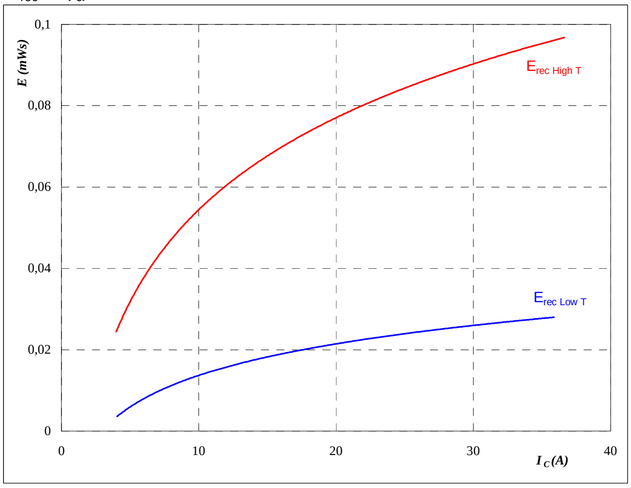


With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
I_C =	20	A

Figure 7	FWD

Typical reverse recovery energy loss
as a function of collector current
$E_{rec} = f(I_c)$

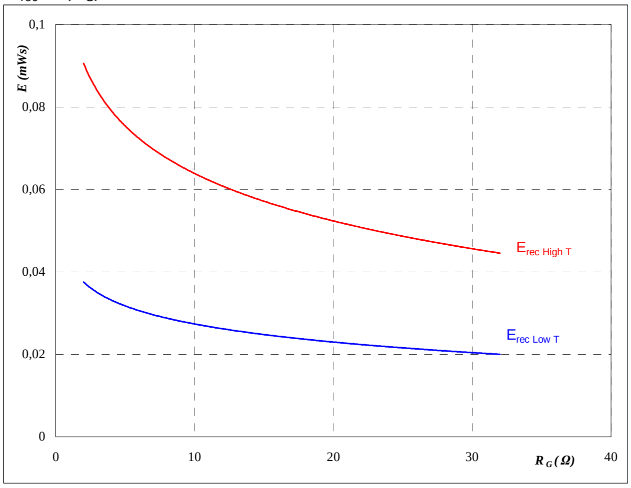


With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	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} =	400	V
V_{GE} =	10	V
I_C =	20	A

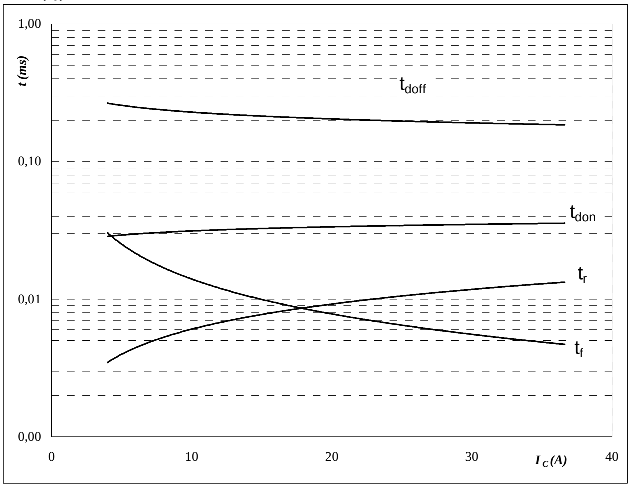
Low Side

Low Side MOSFET and High Side FWD

Figure 9 MOSFET

Typical switching times as a function of collector current

$t = f(I_C)$



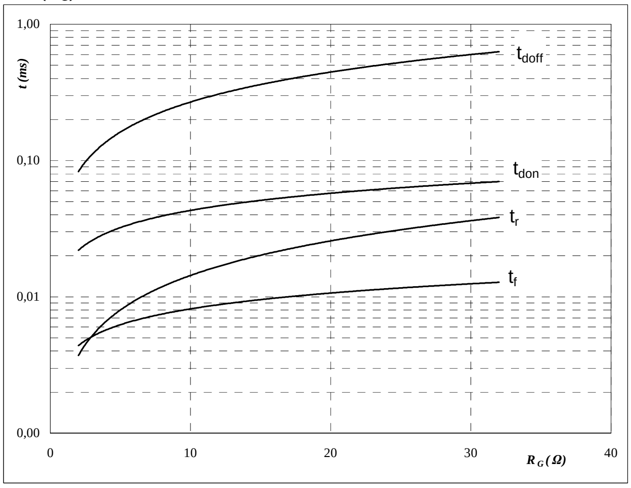
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω
R_{goff} =	8,0	Ω

Figure 10 MOSFET

Typical switching times as a function of gate resistor

$t = f(R_G)$



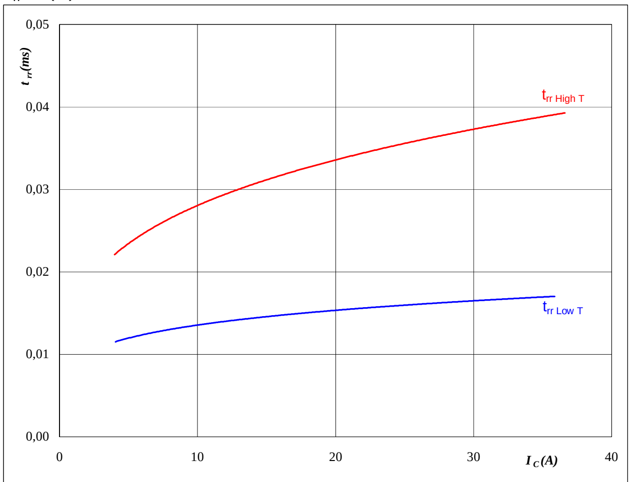
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	10	V
I_C =	20	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(Ic)$



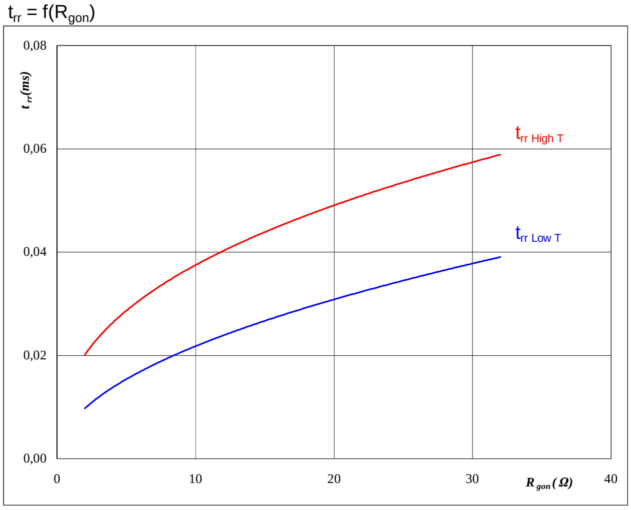
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω

Figure 12 FWD

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

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



At

T_j =	25/125	°C
V_R =	400	V
I_F =	20	A
V_{GE} =	10	V

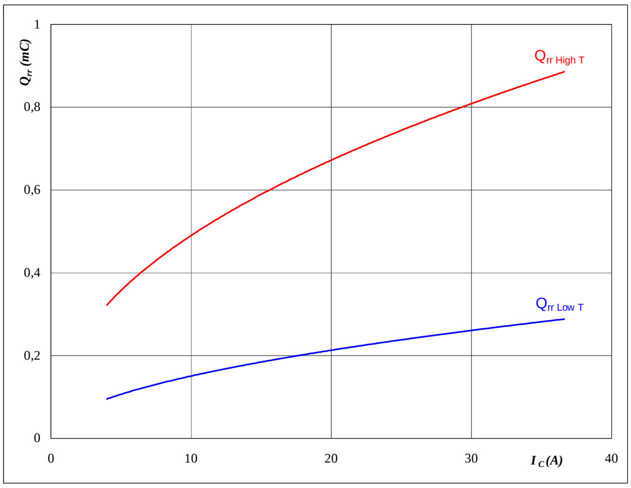
Low Side

Low Side MOSFET and High Side FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



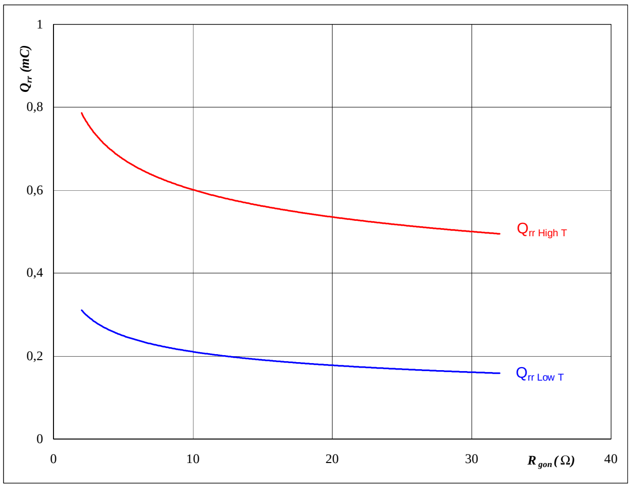
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω

Figure 14 FWD

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

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



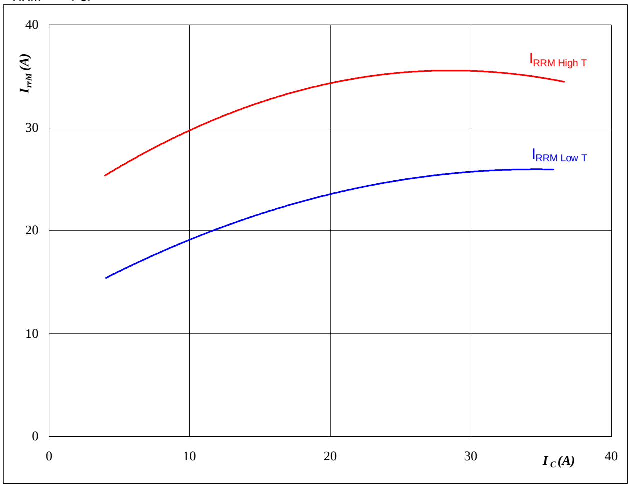
At

T_j =	25/125	°C
V_R =	400	V
I_F =	20	A
V_{GE} =	10	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



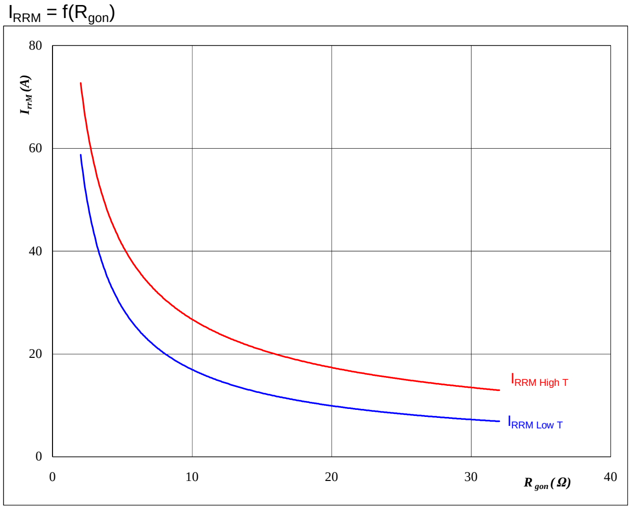
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω

Figure 16 FWD

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

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



At

T_j =	25/125	°C
V_R =	400	V
I_F =	20	A
V_{GE} =	10	V

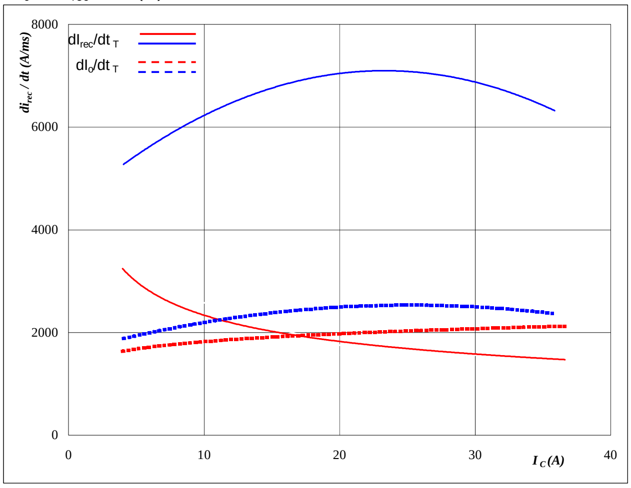
Low Side

Low Side MOSFET and High Side FWD

Figure 17 FWD

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

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



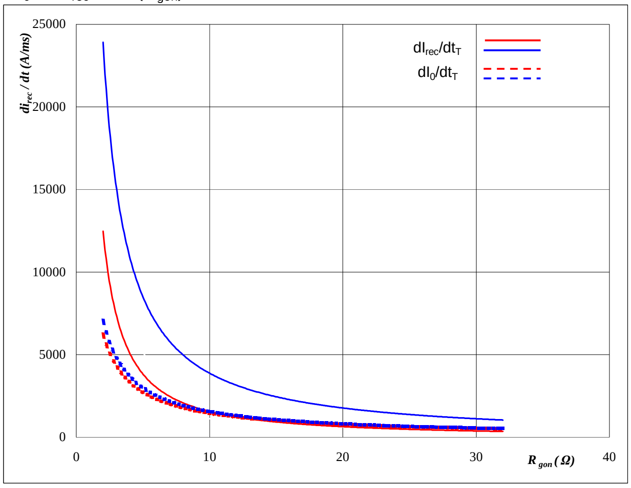
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,0	Ω

Figure 18 FWD

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

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



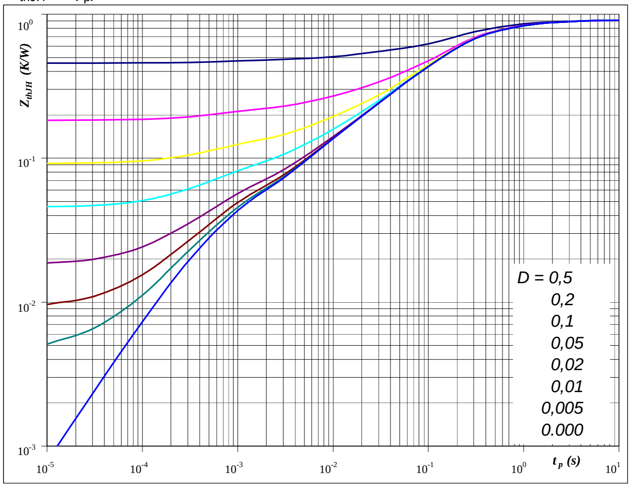
At

T_j =	25/125	°C
V_R =	400	V
I_F =	20	A
V_{GE} =	10	V

Figure 19 MOSFET

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,91	K/W

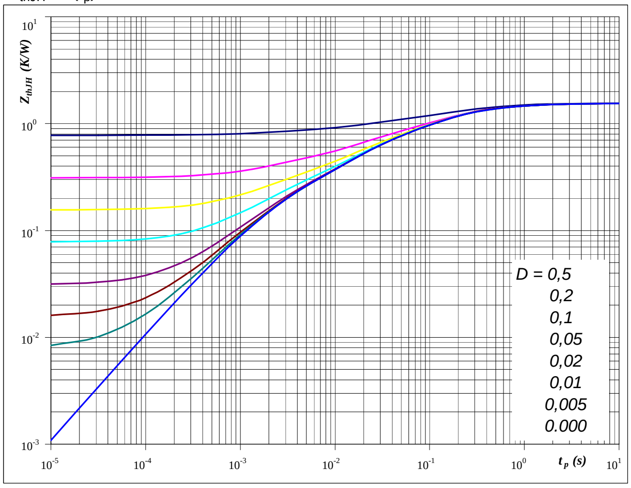
IGBT thermal model values

R (C/W)	Tau (s)
0,02	7,4E+00
0,10	1,4E+00
0,28	3,1E-01
0,37	1,2E-01
0,10	1,0E-02
0,04	5,5E-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} =	1,55	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,04	6,1E+00
0,12	1,1E+00
0,48	2,3E-01
0,46	7,5E-02
0,32	1,4E-02
0,13	1,7E-03

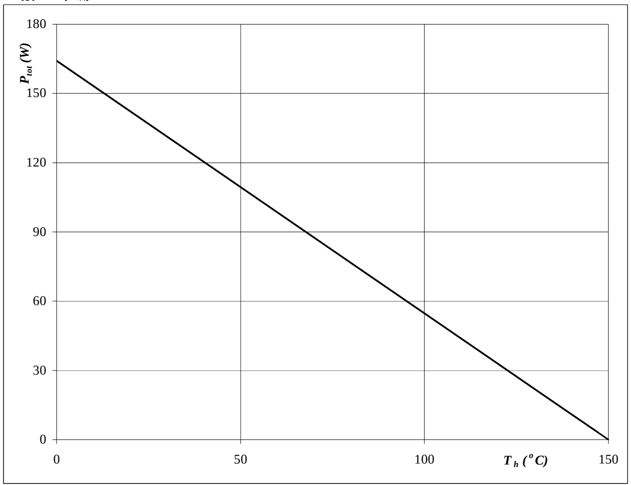
Low Side

Low Side MOSFET and High Side FWD

Figure 21 MOSFET

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



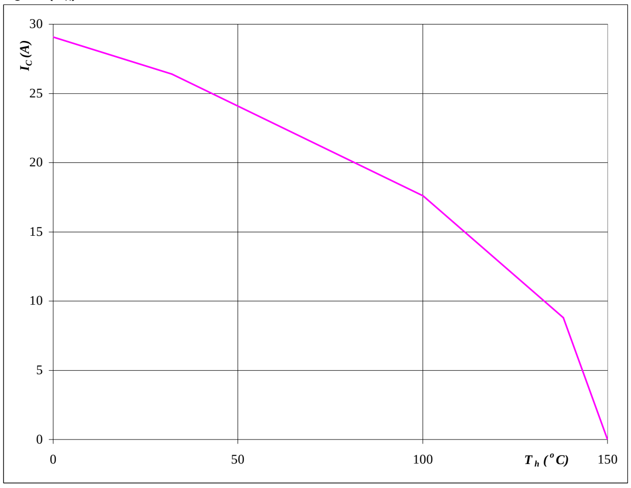
At

T_j = 150 °C

Figure 22 MOSFET

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

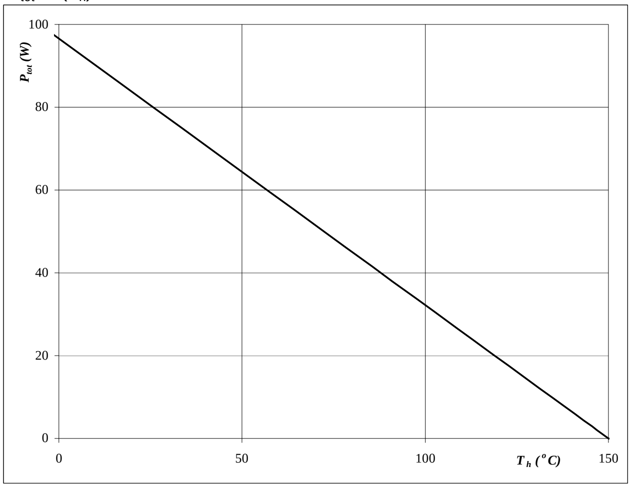
T_j = 150 °C

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



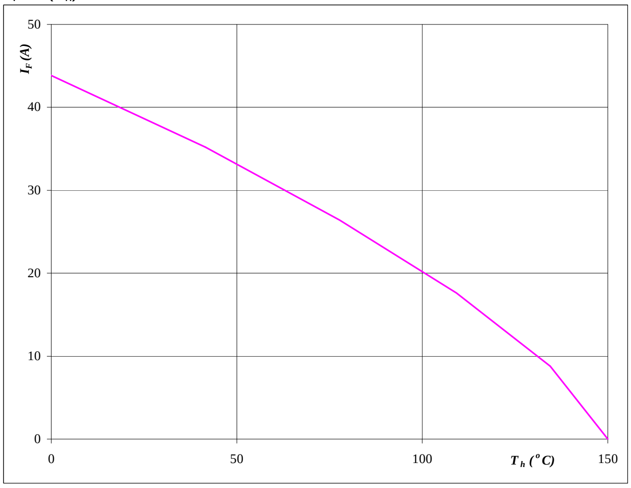
At

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

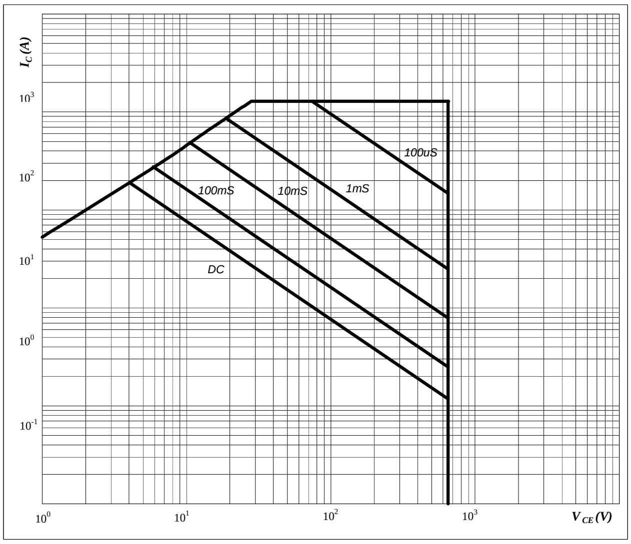
Low Side

Low Side MOSFET and High Side FWD

Figure 25	MOSFET

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



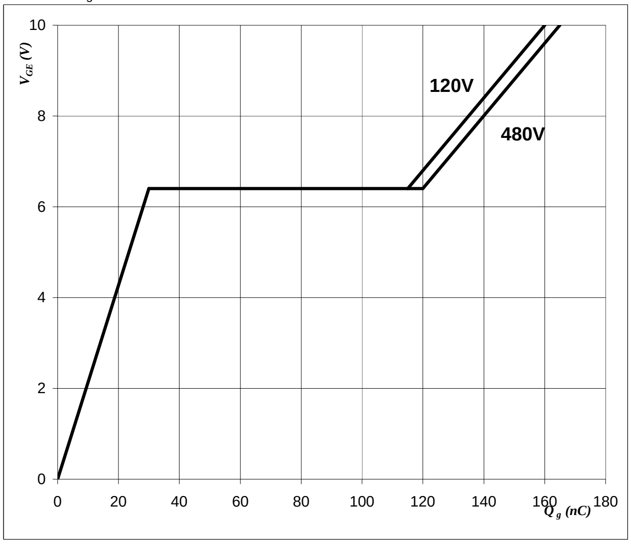
At

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

Figure 26	MOSFET

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



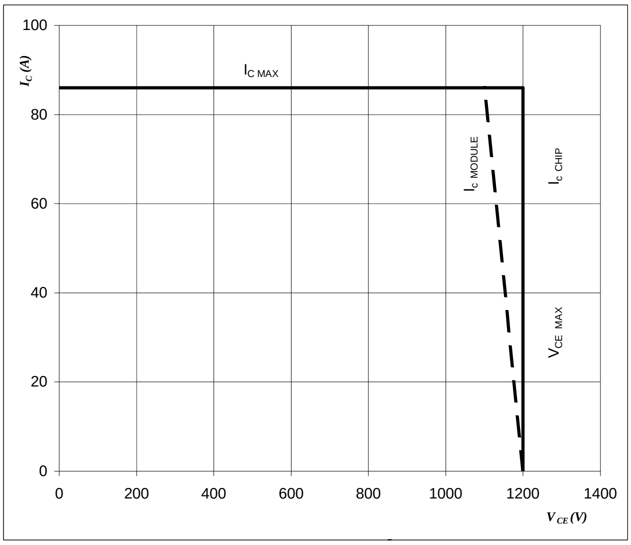
At

I_C =	43	A

Figure 27	MOSFET

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

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

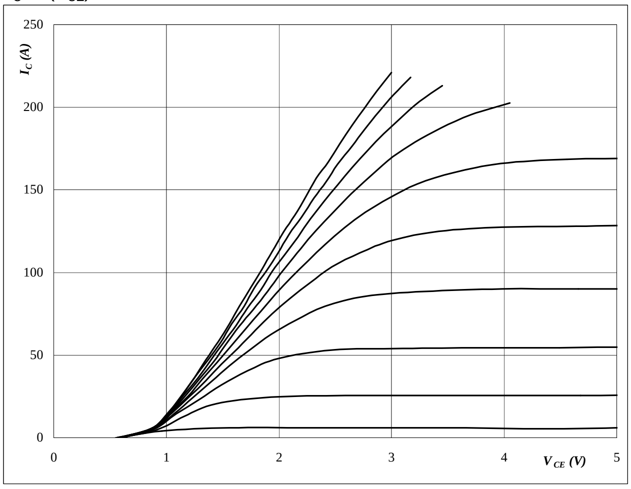
High Side

High Side IGBT and Low Side FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

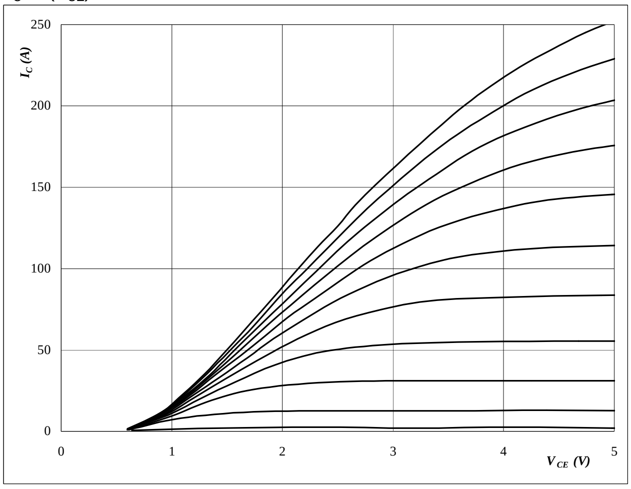
T_j = 25 °C

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

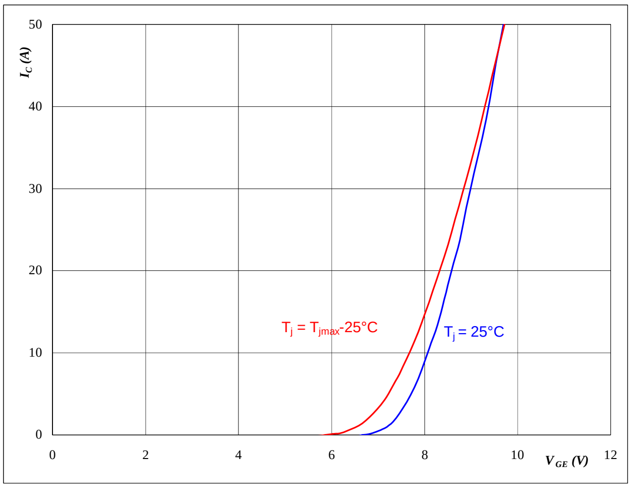
T_j = 125 °C

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

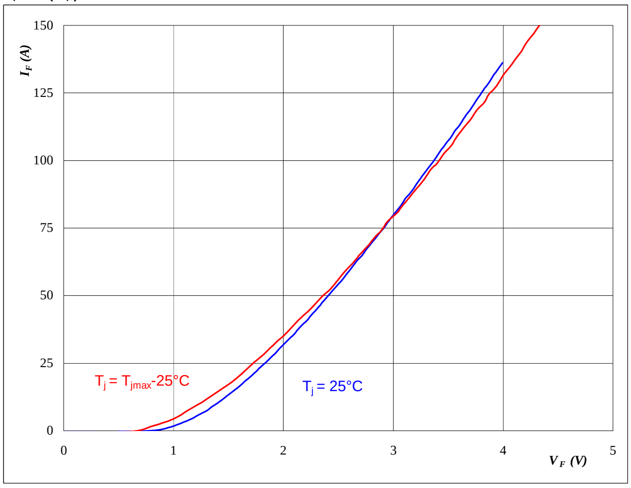
t_p = 250 µs

V_{CE} = 10 V

Figure 4 FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p = 250 µs

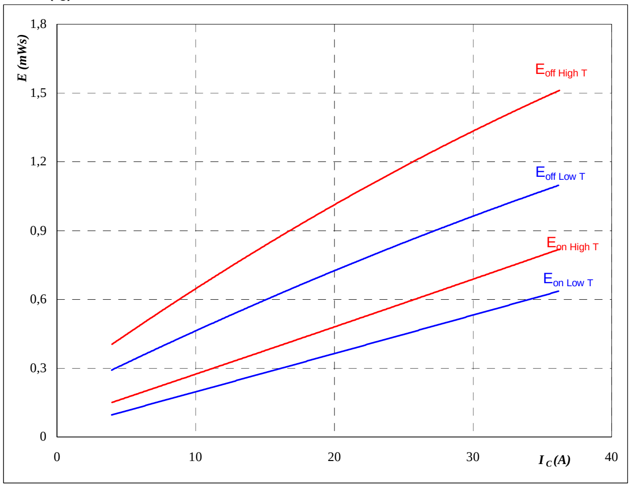
High Side

High Side IGBT and Low Side FWD

Figure 5 IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



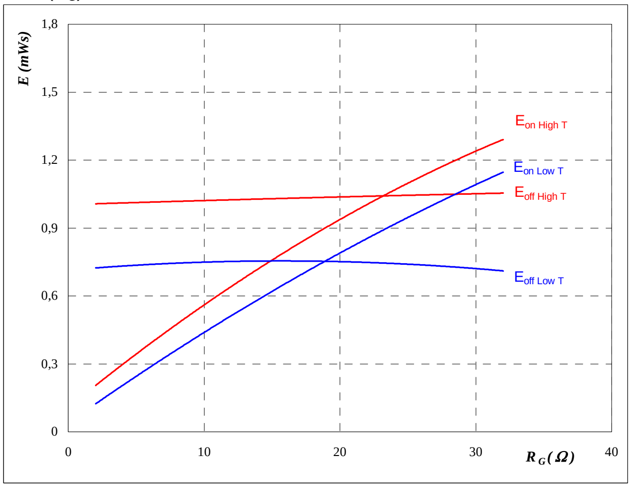
With an inductive load at

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω
R_{goff} =	8,0	Ω

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



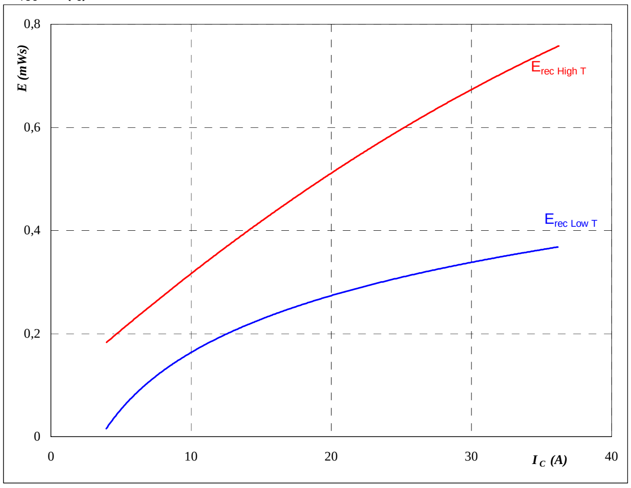
With an inductive load at

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
I_C =	20	A

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



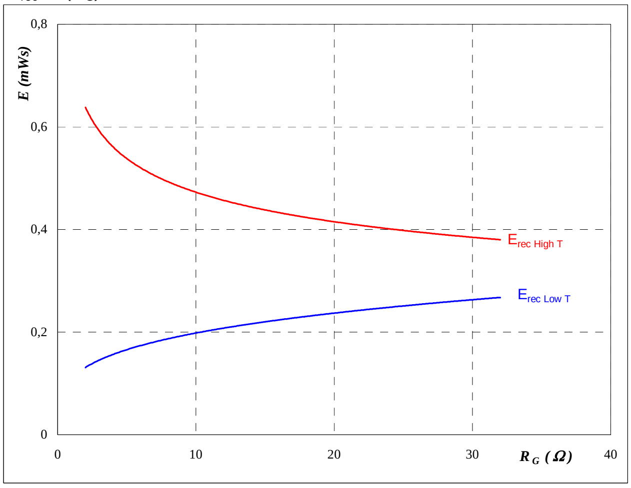
With an inductive load at

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	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} =	200	V
V_{GE} =	±15	V
I_C =	20	A

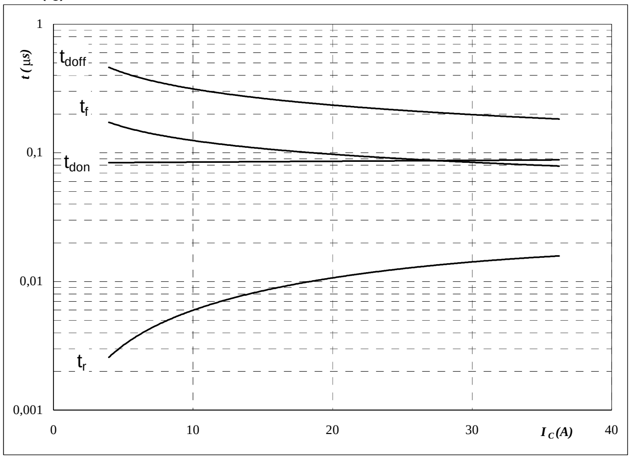
High Side

High Side IGBT and Low Side FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



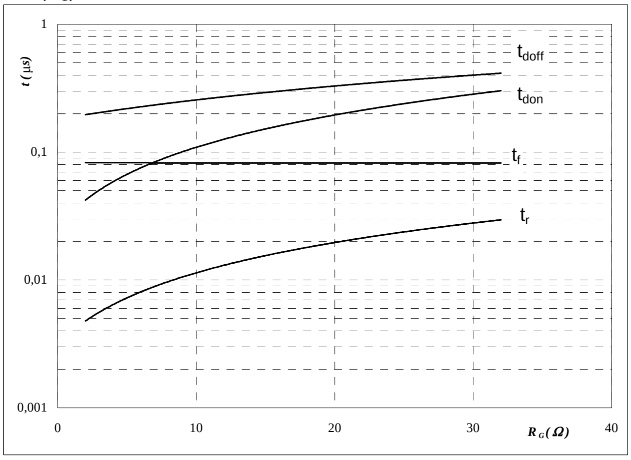
With an inductive load at

T_j =	125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω
R_{goff} =	8,0	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



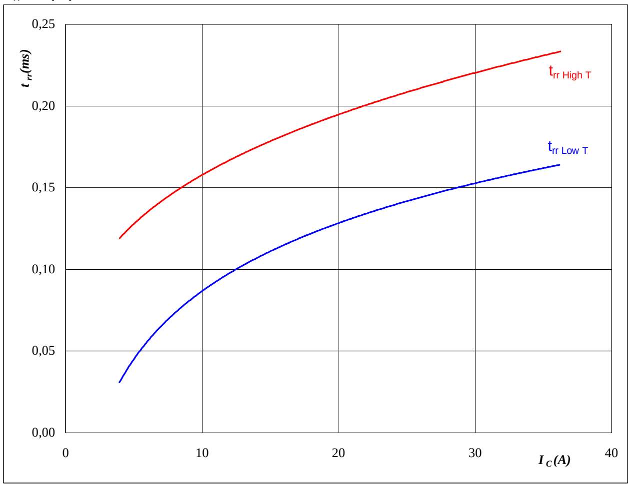
With an inductive load at

T_j =	125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
I_C =	20	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



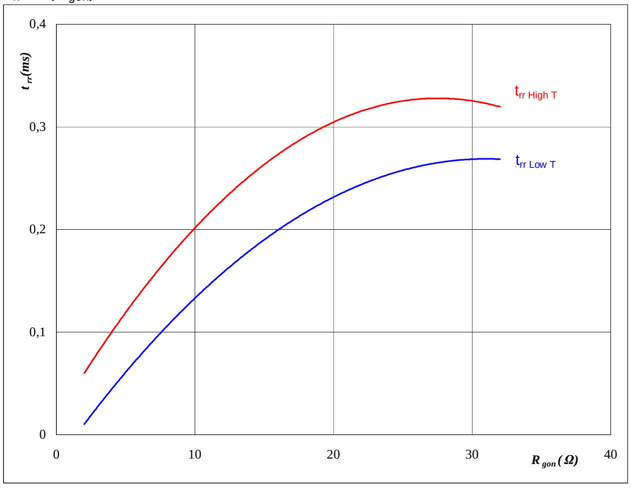
At

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω

Figure 12 FWD

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

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



At

T_j =	25/125	°C
V_R =	200	V
I_F =	20	A
V_{GE} =	±15	V

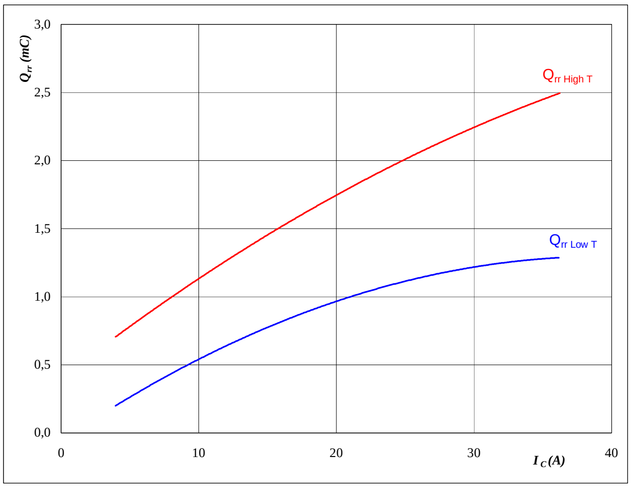
High Side

High Side IGBT and Low Side FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



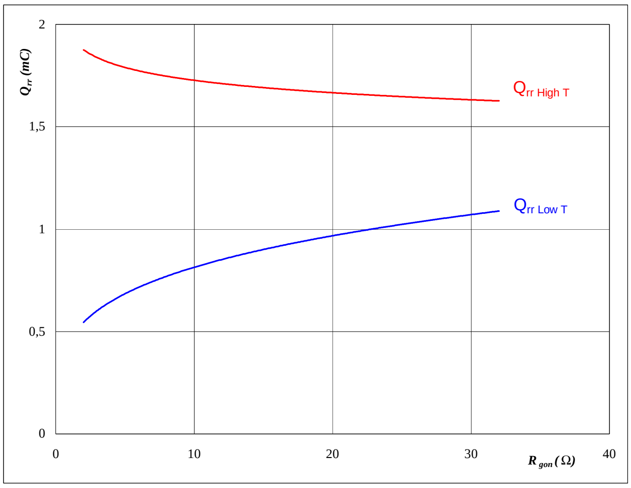
At

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω

Figure 14 FWD

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

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



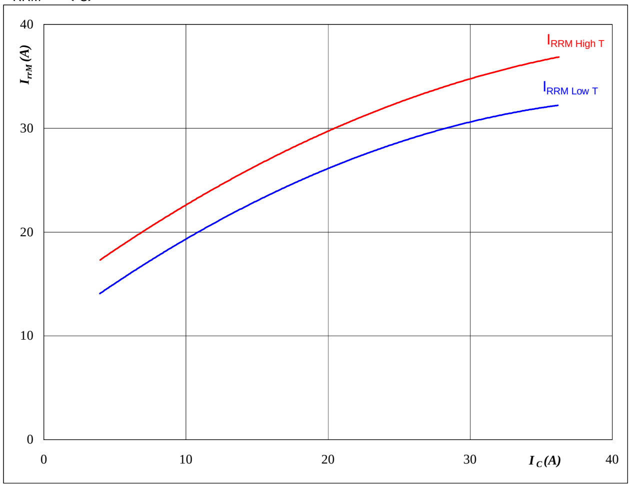
At

T_j =	25/125	°C
V_R =	200	V
I_F =	20	A
V_{GE} =	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



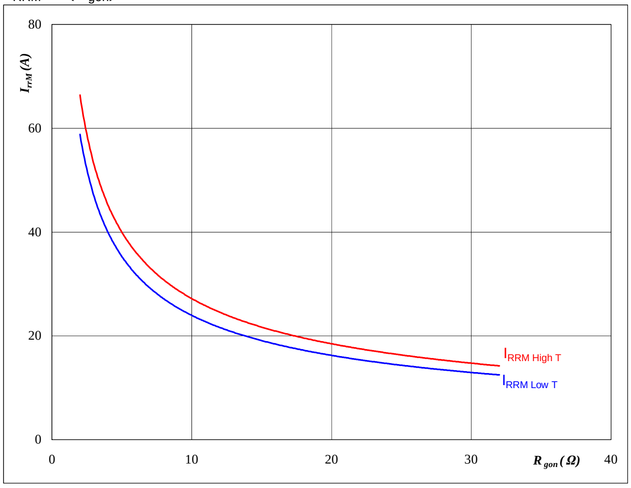
At

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω

Figure 16 FWD

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

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



At

T_j =	25/125	°C
V_R =	200	V
I_F =	20	A
V_{GE} =	±15	V

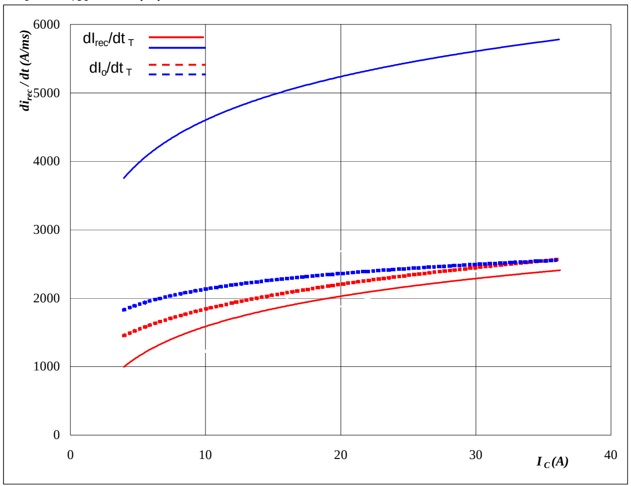
High Side

High Side IGBT and Low Side FWD

Figure 17 — FWD

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

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



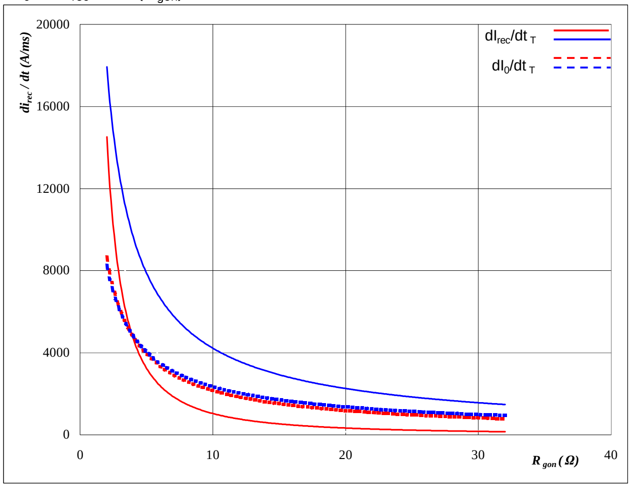
At

T_j =	25/125	°C
V_{CE} =	200	V
V_{GE} =	±15	V
R_{gon} =	8,0	Ω

Figure 18 — FWD

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

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



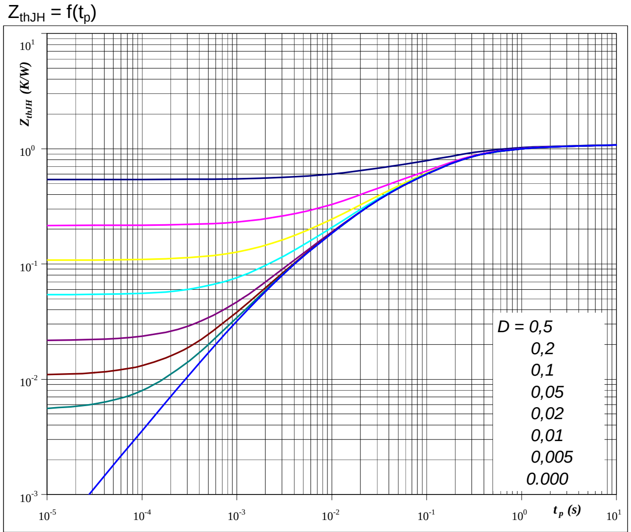
At

T_j =	25/125	°C
V_R =	200	V
I_F =	20	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} =	1,08	K/W

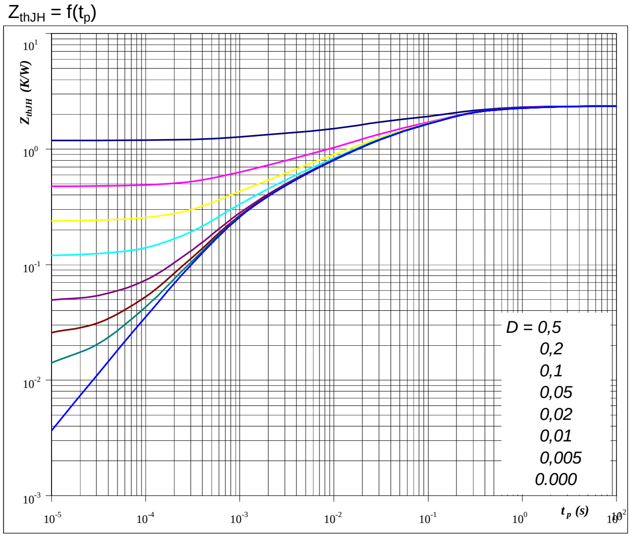
IGBT thermal model values

R (C/W)	Tau (s)
0,05	3,76
0,09	1,04
0,32	0,25
0,38	0,09
0,20	0,01

Figure 20 — FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	tp / T	
R_{thJH} =	2,37	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,05	8,95
0,14	1,10
0,69	0,20
0,57	0,06
0,62	0,01

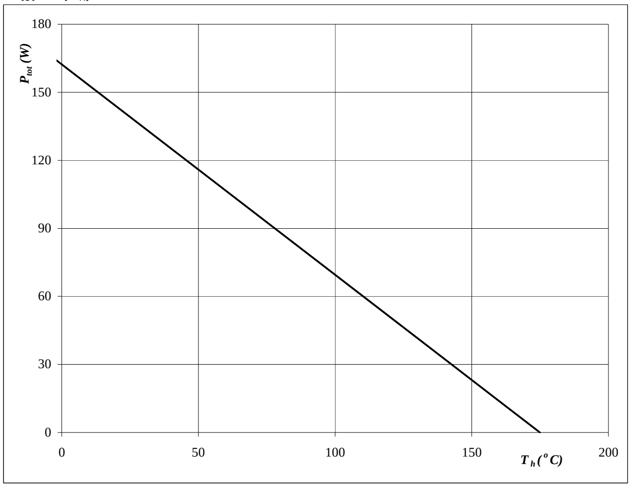
High Side

High Side IGBT and Low Side FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



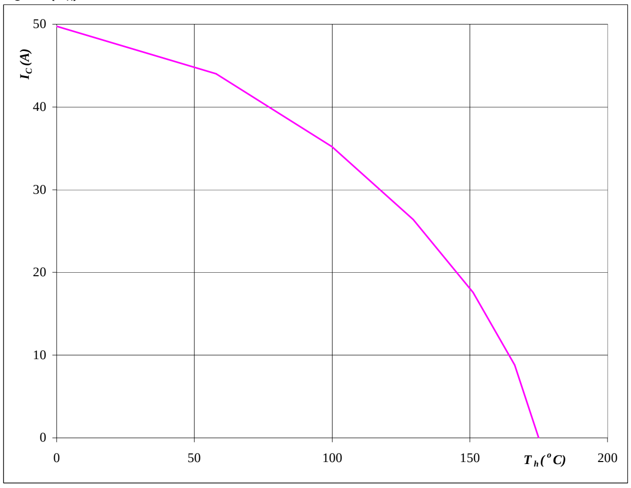
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

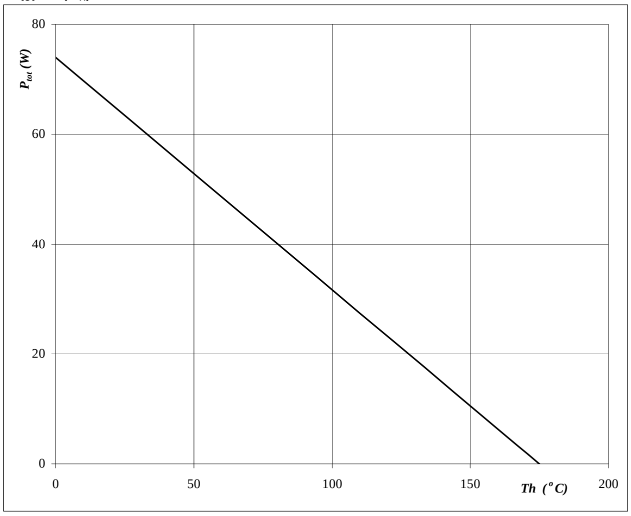
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



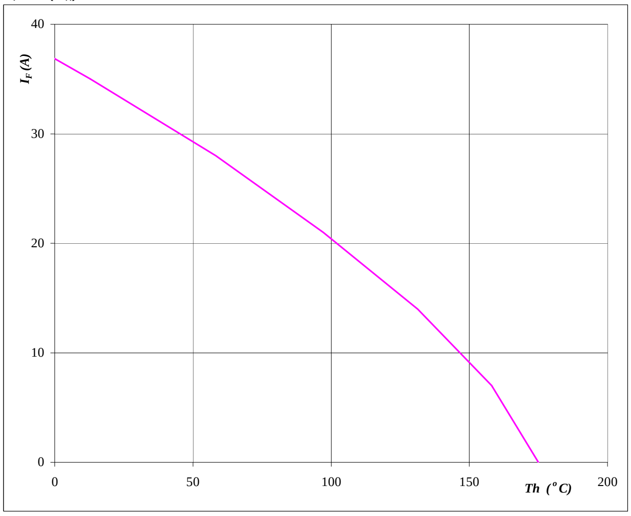
At

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

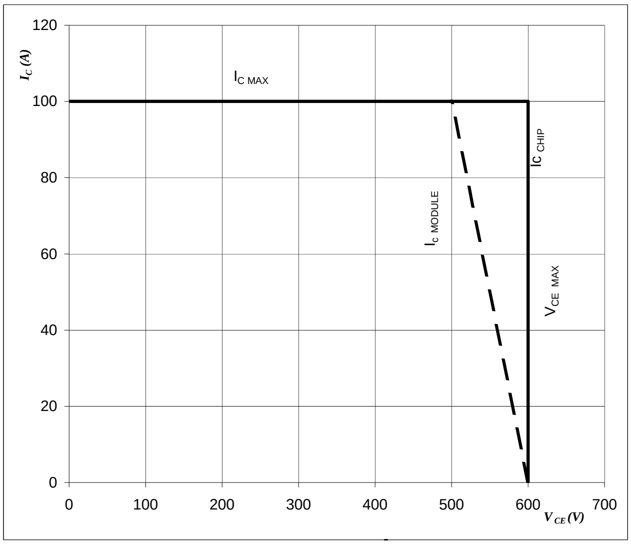
High Side

High Side IGBT

Figure 25	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

$U_{ccminus}$=U_{ccplus}

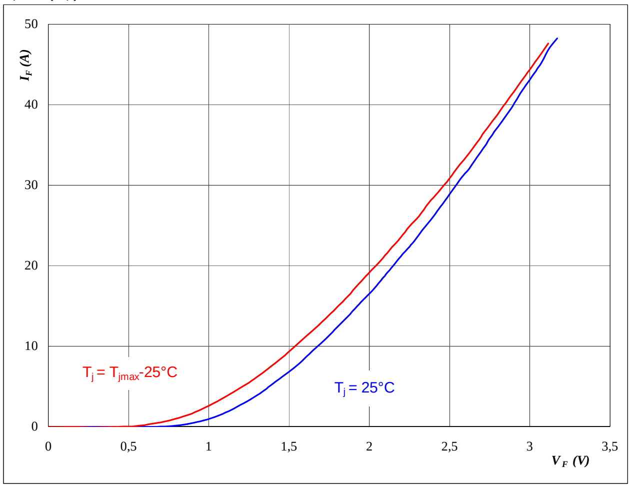
Switching mode : 3 level switching

High Side Inverse Diode

Figure 25 High Side Inverse Diode

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



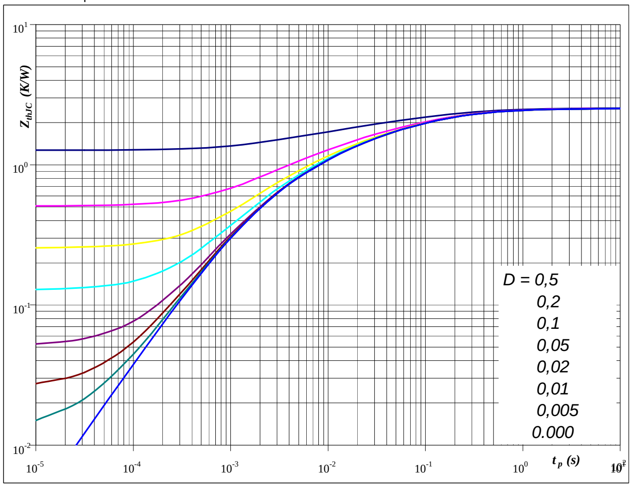
At

t_p =	250	μs

Figure 26 High Side Inverse Diode

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



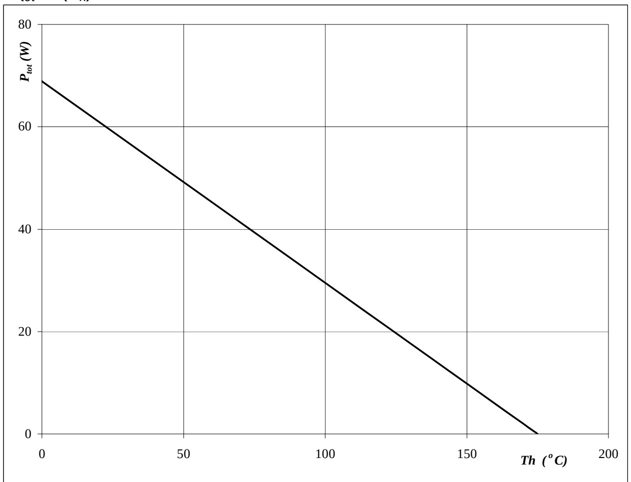
At

D =	tp / T	
R_{thJH} =	2,54	K/W

Figure 27 High Side Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



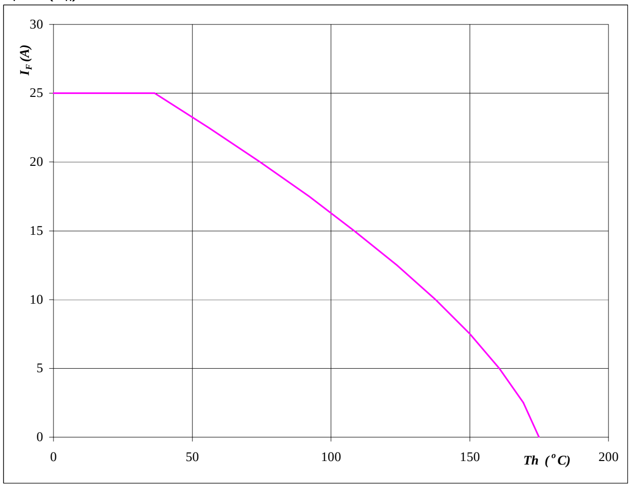
At

T_j =	175	ºC

Figure 28 High Side Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

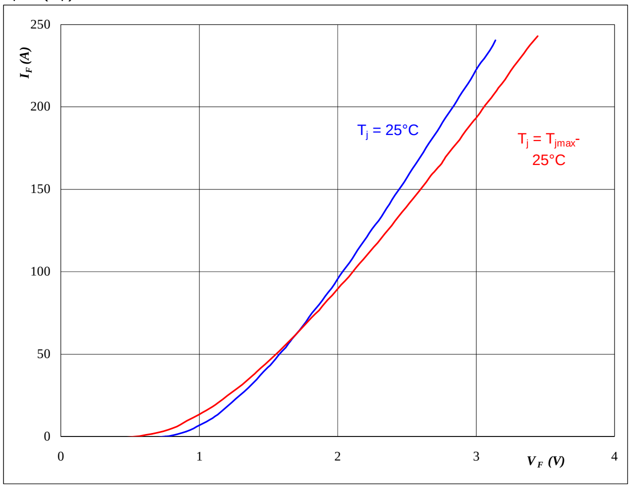
T_j =	175	ºC

Fast Rectifier FWD

Figure 1 Fast Rectifier FWD

Typical thyristor forward current as a function of forward voltage

$I_F = f(V_F)$



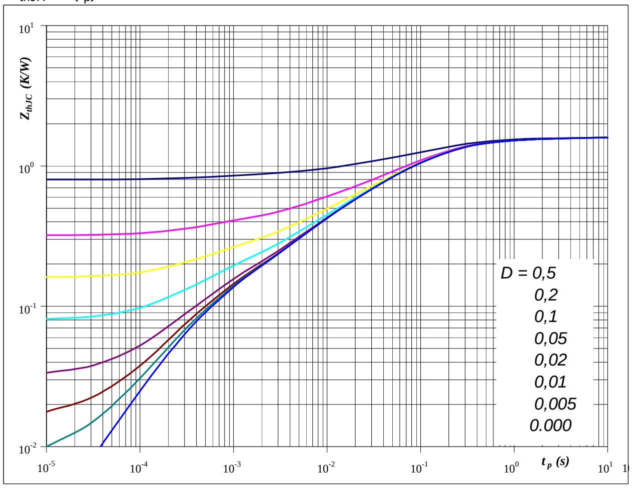
At

t_p =	250	µs

Figure 2 Fast Rectifier FWD

Thyristor transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



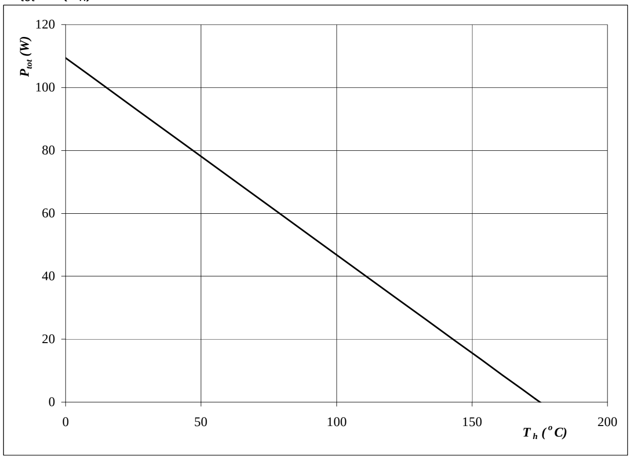
At

D =	t_p / T	
R_{thJH} =	1,60	K/W

Figure 3 Fast Rectifier FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



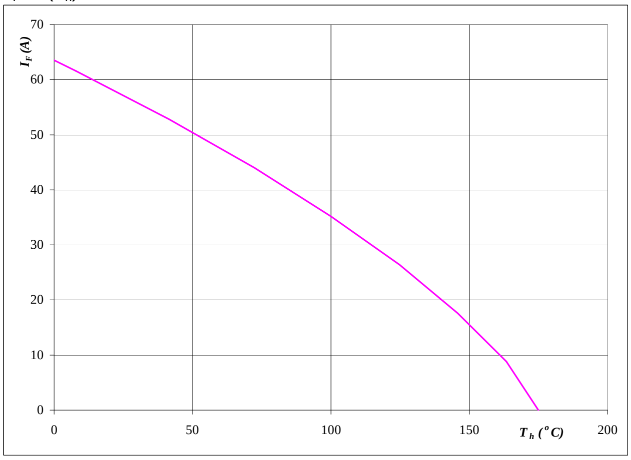
At

T_j =	175	ºC

Figure 4 Fast Rectifier FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



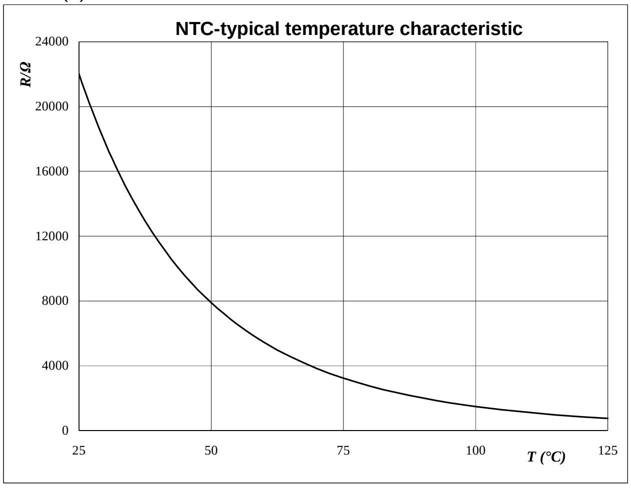
At

T_j =	175	ºC

Thermistor

Figure 1	Thermistor

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



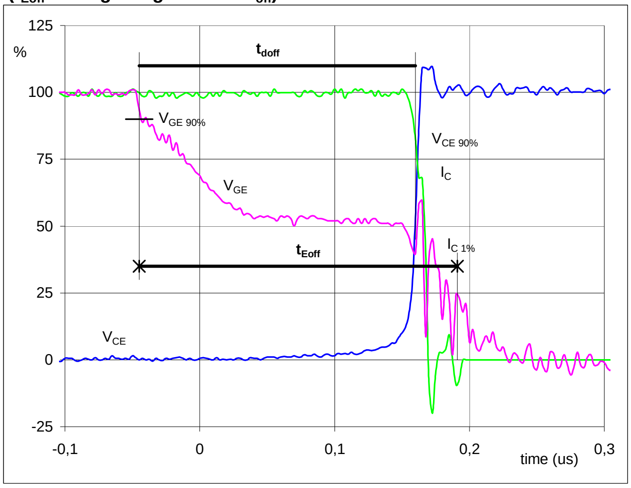
Switching Definitions Low Side MOSFET

General conditions

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

Figure 1 Low Side MOSFET

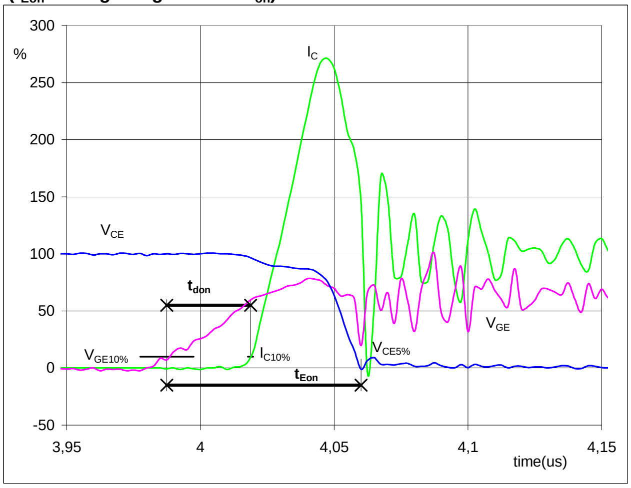
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	20	A
t_{doff} =	0,21	μs
t_{Eoff} =	0,24	μs

Figure 2 Low Side MOSFET

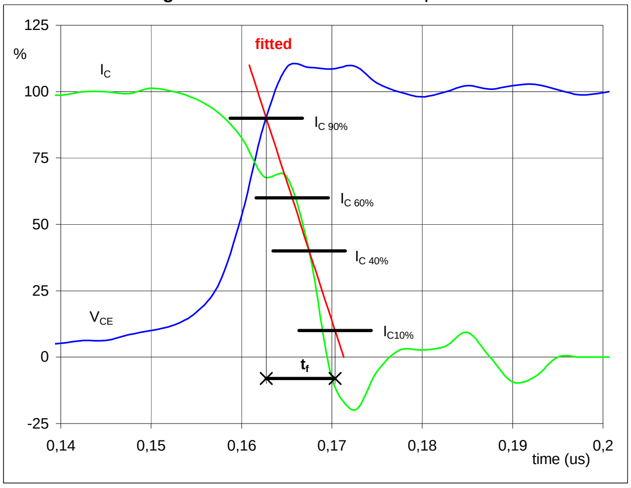
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	20	A
t_{don} =	0,03	μs
t_{Eon} =	0,07	μs

Figure 3 Low Side MOSFET

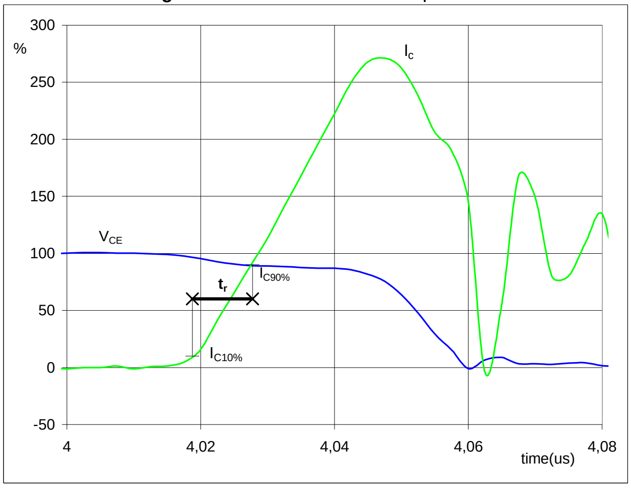
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	20	A
t_f =	0,00	μs

Figure 4 Low Side MOSFET

Turn-on Switching Waveforms & definition of t_r

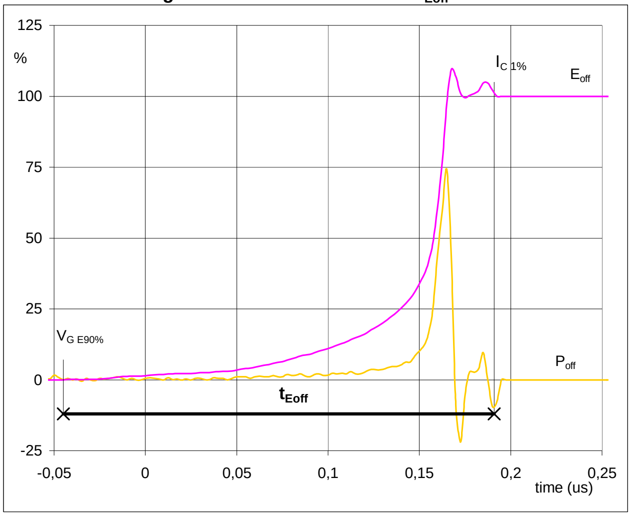


V_C (100%) =	400	V
I_C (100%) =	20	A
t_r =	0,01	μs

Switching Definitions Low Side MOSFET

Figure 5 Low Side MOSFET

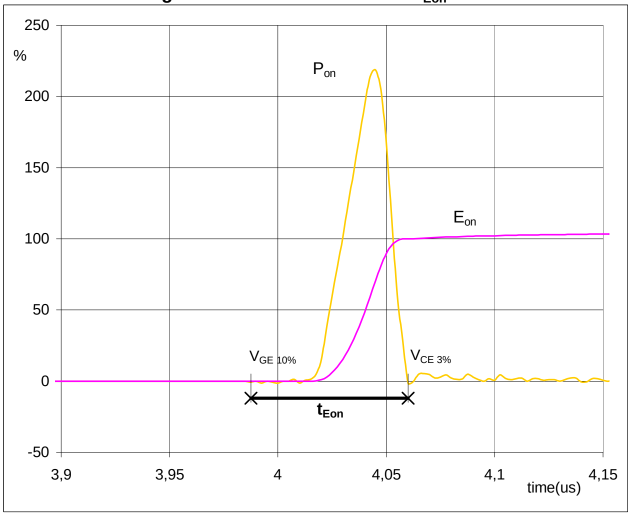
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	7,99	kW
E_{off} (100%) =	0,07	mJ
t_{Eoff} =	0,24	μs

Figure 6 Low Side MOSFET

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



P_{on} (100%) =	7,99	kW
E_{on} (100%) =	0,41	mJ
t_{Eon} =	0,07	μs

Figure 7 Low Side MOSFET

Gate voltage vs Gate charge (measured)

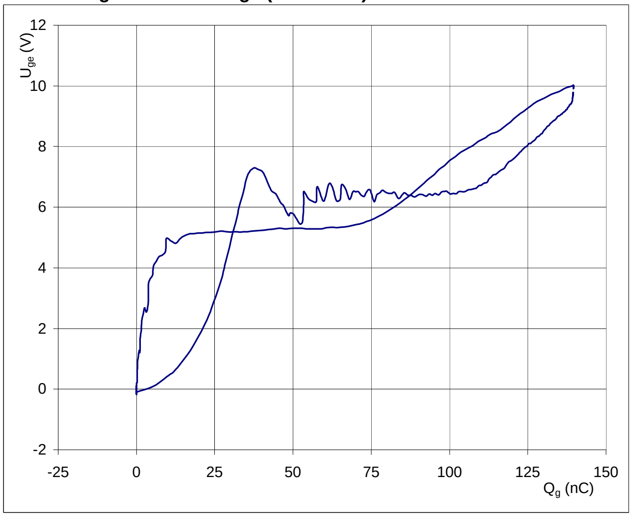
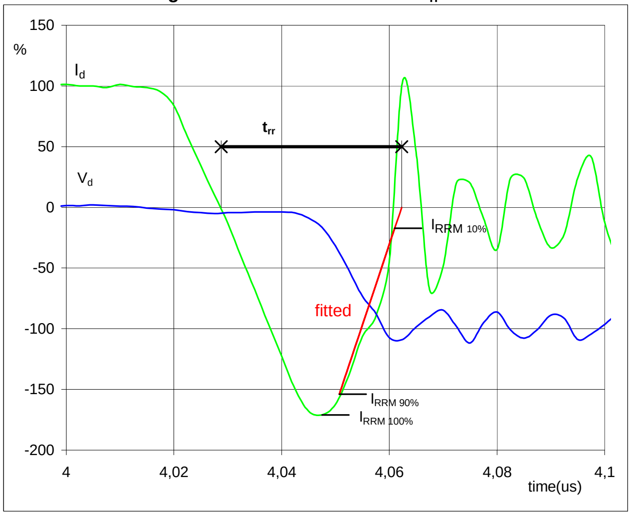


Figure 8 Low Side FWD

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

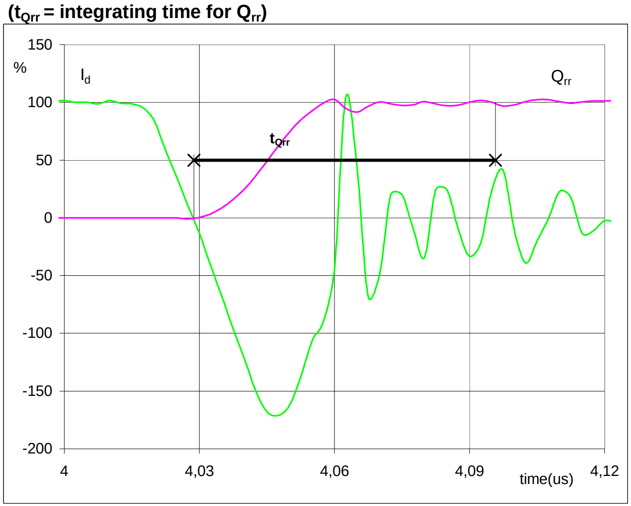


V_d (100%) =	400	V
I_d (100%) =	20	A
I_{RRM} (100%) =	-34	A
t_{rr} =	0,03	μs

Switching Definitions Low Side MOSFET

Figure 9 Low Side FWD

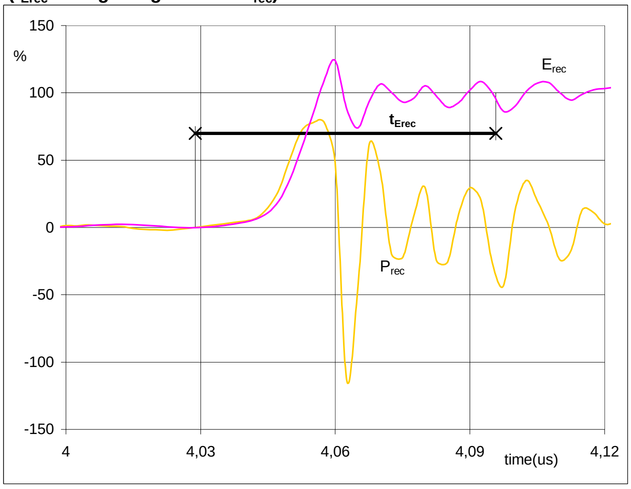
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	20	A
Q_{rr} (100%) =	0,68	µC
t_{Qrr} =	0,07	µs

Figure 10 Low Side FWD

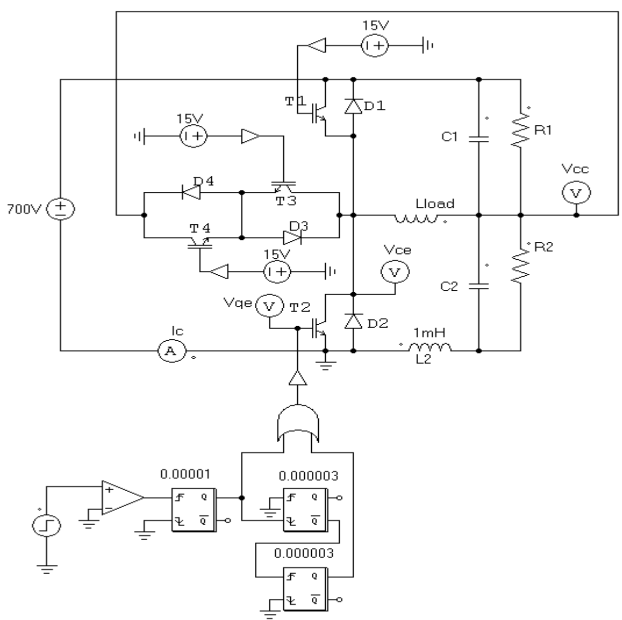
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	7,99	kW
E_{rec} (100%) =	0,08	mJ
t_{Erec} =	0,07	µs

Low Side MOSFET switching measurement circuit

Figure 11



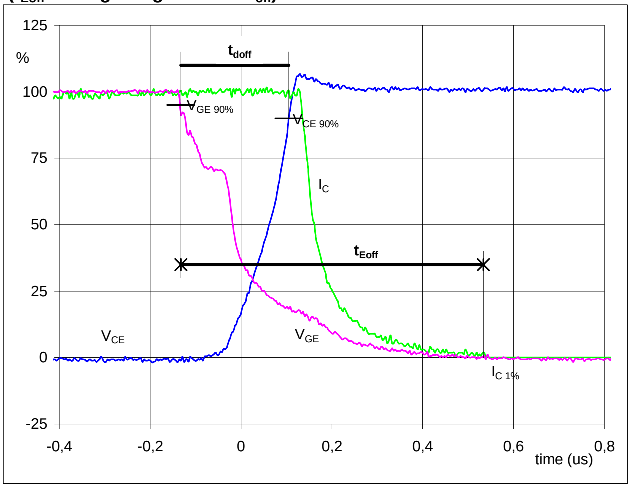
Switching Definitions High Side IGBT

General conditions

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

Figure 1 High Side IGBT

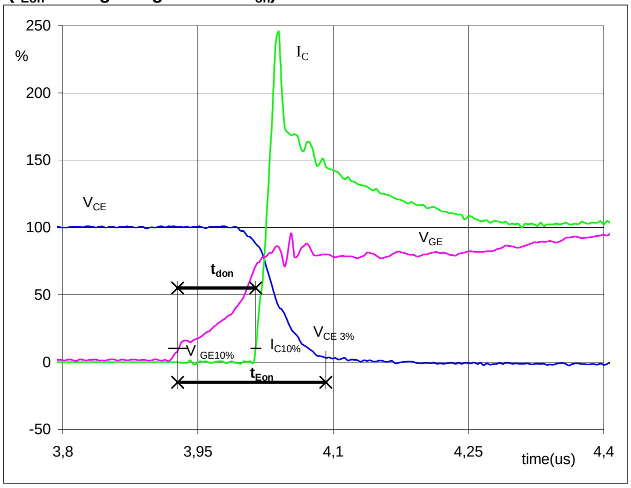
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	20	A
t_{doff} =	0,10	µs
t_{Eoff} =	0,17	µs

Figure 2 High Side IGBT

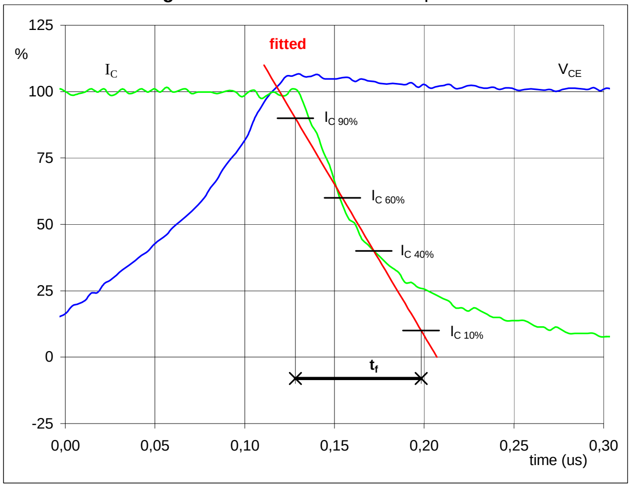
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	20	A
t_{don} =	0,09	µs
t_{Eon} =	0,12	µs

Figure 3 High Side IGBT

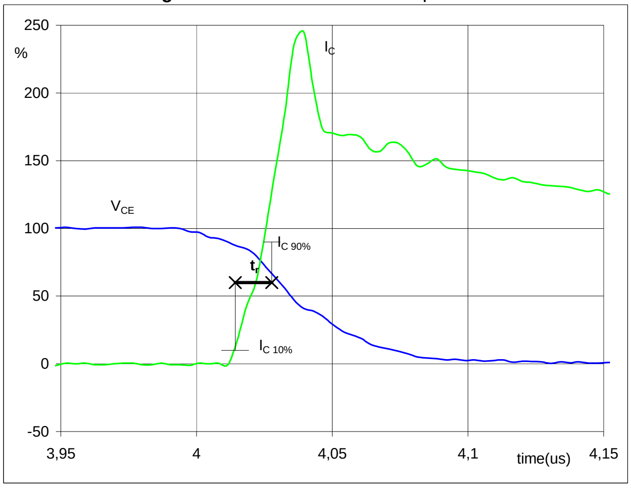
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	20	A
t_f =	0,080	µs

Figure 4 High Side IGBT

Turn-on Switching Waveforms & definition of t_r

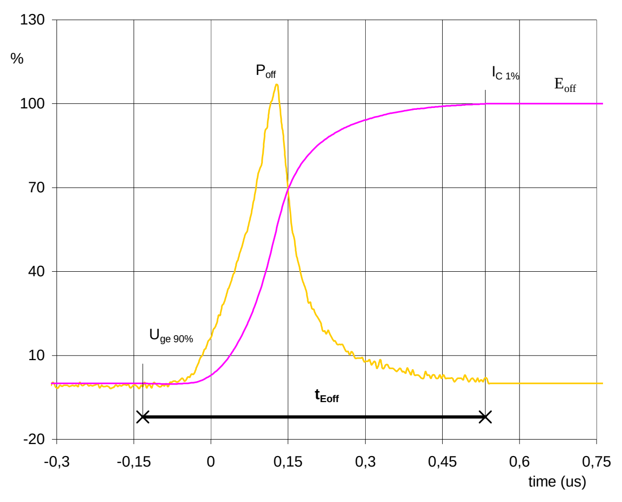


V_C (100%) =	400	V
I_C (100%) =	20	A
t_r =	0,011	µs

Switching Definitions High Side IGBT

Figure 5 High Side IGBT

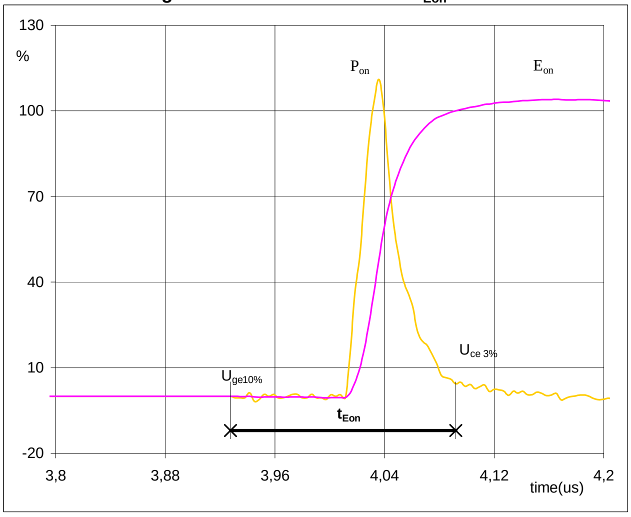
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	7,96	kW
E_{off} (100%) =	1,48	mJ
t_{Eoff} =	0,17	µs

Figure 6 High Side IGBT

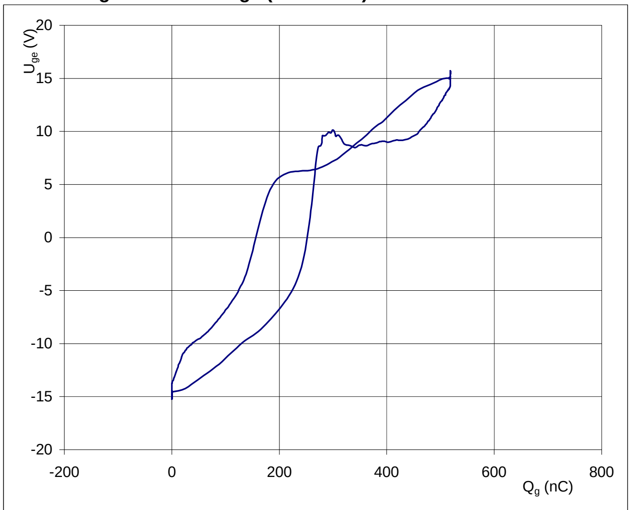
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	7,9608	kW
E_{on} (100%) =	0,38	mJ
t_{Eon} =	0,12	µs

Figure 7 High Side IGBT

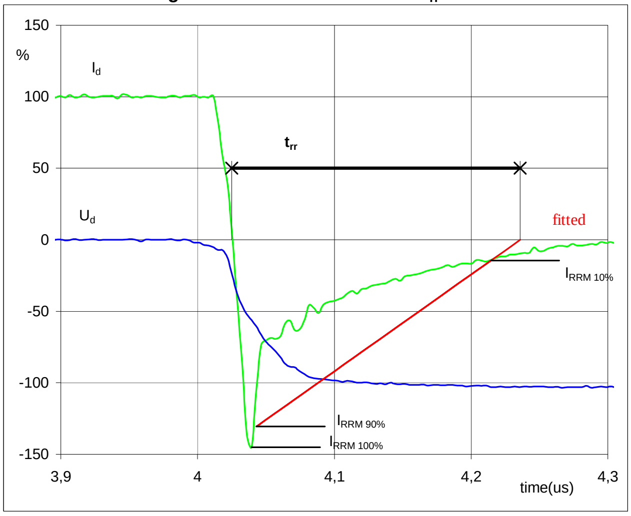
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	400	V
I_C (100%) =	20	A
Q_g =	3441,54	nC

Figure 8 Low Side FWD

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

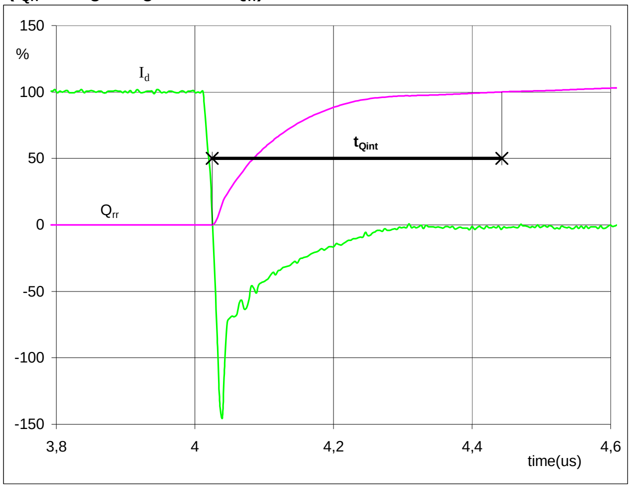


V_d (100%) =	400	V
I_d (100%) =	20	A
I_{RRM} (100%) =	-29	A
t_{rr} =	0,04	µs

Switching Definitions High Side IGBT

Figure 9 Low Side FWD

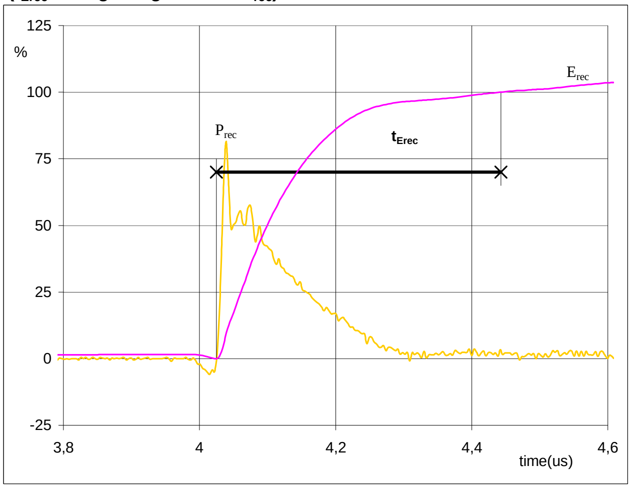
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	20	A
Q_{rr} (100%) =	1,54	μC
t_{Qint} =	0,09	μs

Figure 10 Low Side FWD

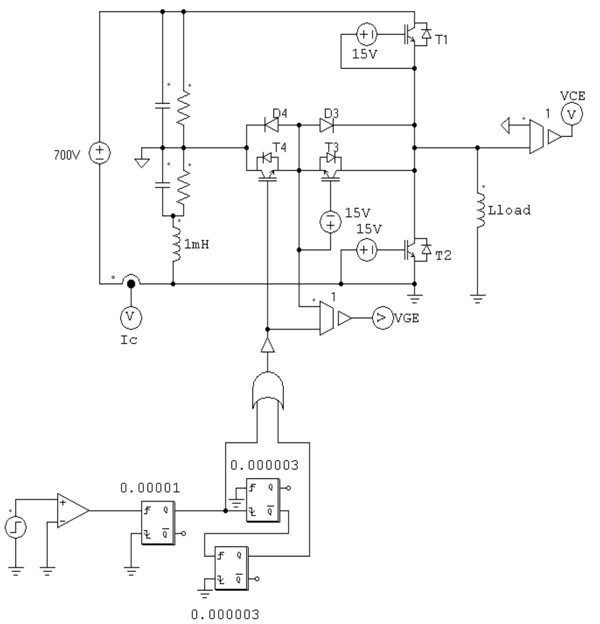
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	7,96	kW
E_{rec} (100%) =	0,18	mJ
t_{Erec} =	0,09	μs

High Side IGBT switching measurement circuit

Figure 11



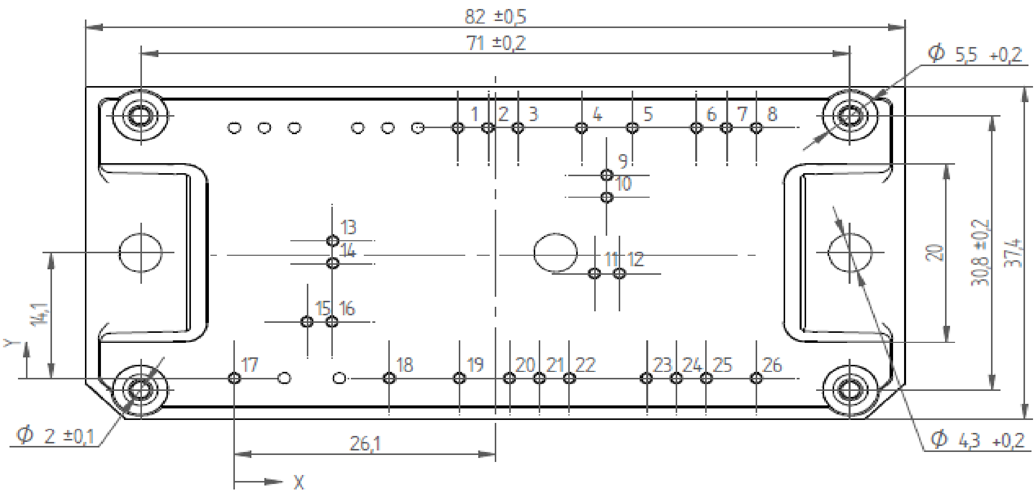
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FY06RIA080MF-M537D68	M537D68	M537D68

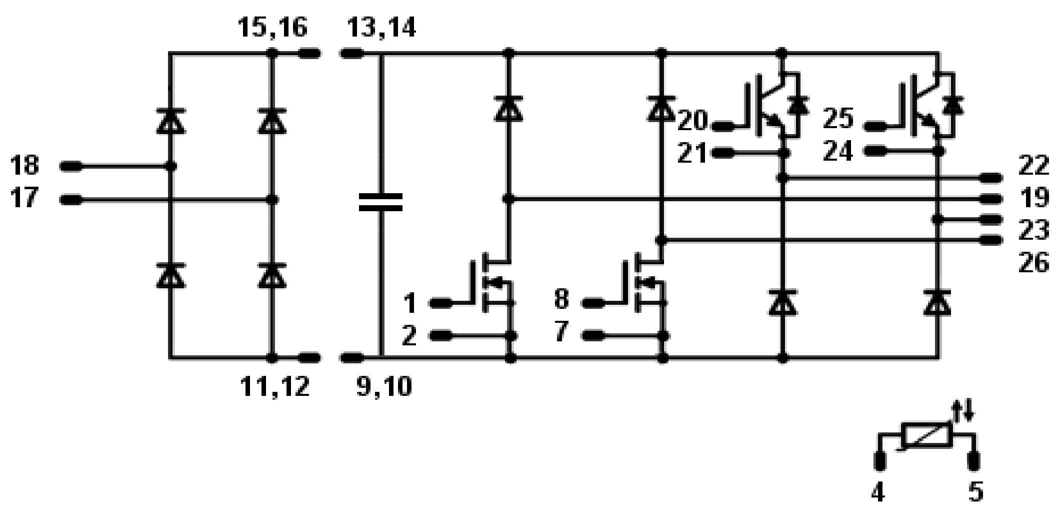
Outline

Pin table		
Pin	X	Y
1	22,35	28,2
2	25,35	28,2
3	28,35	28,2
4	34,7	28,2
5	39,8	28,2
6	46,2	28,2
7	49,2	28,2
8	52,2	28,2
9	37,25	22,85
10	37,25	20,35
11	36	11,8
12	38,5	11,8
13	9,85	15,45
14	9,85	12,95
15	7,25	6,35
16	9,75	6,35
17	0	0
18	15,5	0
19	22,5	0
20	27,5	0
21	30,5	0
22	33,5	0
23	41,2	0
24	44,2	0
25	47,2	0
26	52,2	0



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance
PCB cutouts and holes see in handling instructions document

Pinout



Pins 3 and 6 are not connected.

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Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
Final	Full Production	This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.

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