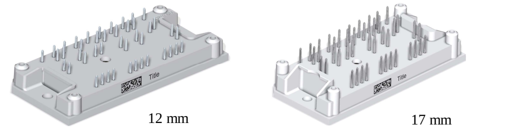
10-FY12M3A040SH-M749F08
10-F112M3A040SH-M749F09

flow3xMNPC 1 | **1200V/40A**

Features

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

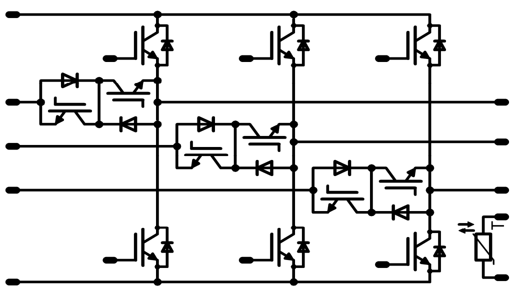
flow1 housing



Target Applications

- solar inverter
- UPS

Schematic



Types

- 10-FY12M3A040SH-M749F08
- 10-F112M3A040SH-M749F09

Maximum Ratings

T_j=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℃	31 41	A
Pulsed 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℃	75 114	W
Turn off safe operating area	I_C	T_j≤150℃ V_{CE}<=V_{CES}		120	A
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 800	μs V
Gate-emitter peak voltage	V_{GE}			±20	A
Maximum Junction Temperature	$T_j$max			175	℃
Neutral Point FWD					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	18 26	A
Surge forward current	I_{FSM}	t_p limited by $T_j$max		300	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	30 45	W
Maximum Junction Temperature	$T_j$max			150	℃

Maximum Ratings

Tj=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℃	23 29	A
Pulsed 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℃	37 56	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V	6 360	µs V
Turn off safe operating area (RBSOA)	I_{cmax}	$V_{CE\ max}$ = 600V $T_{vj\ max}$= 150℃	90	A
Maximum Junction Temperature	$T_j max$		175	℃
Half Bridge FWD				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j=T_j max$ T_h=80℃ T_c=80℃	12 14	A
Surge forward current	I_{FSM}	10 ms, sin 180° T_j = 150 ℃	65	A
Power dissipation per Diode	P_{tot}	$T_j=T_j max$ T_h=80℃ T_c=80℃	28 43	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°C Tj=125°C	5,2	5,8	6,4	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		40	Tj=25°C Tj=125°C	1,7	1,96 2,29	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,005	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	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	350	28	Tj=25°C Tj=125°C		70 72		ns
Rise time	t_r					Tj=25°C Tj=125°C		13 15		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		166 217		
Fall time	t_f					Tj=25°C Tj=125°C		45 79		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,31 0,52		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,67 1,16		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		2300		pF
Output capacitance	C_{oss}							150		
Reverse transfer capacitance	C_{rss}							135		
Gate charge	Q_{Gate}		±15	960	40	Tj=25°C		185		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,27		K/W
Neutral Point FWD										
Diode forward voltage	V_F				30	Tj=25°C Tj=125°C		2,28 1,74	2,5	V
Reverse leakage current	I_r			600		Tj=25°C Tj=125°C			100 500	µA
Peak reverse recovery current	I_{RRM}	Rgoff=8 Ω	±15	350	28	Tj=25°C Tj=125°C		32 41		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		18 40		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,32 0,92		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		8818 3866		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,03 0,12		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,34		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	$V_{GE(th)}$	$V_{CE}=V_{GE}$				Tj=25℃ Tj=125℃	5	5,80	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$				0,002	Tj=25℃ Tj=125℃	1,1	1,52 1,70	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		15		30	Tj=25℃ Tj=125℃			0,0016	mA
Gate-emitter leakage current	I_{GES}		0	600					300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω Rgon=16 Ω	±15	350	28	Tj=25℃ Tj=125℃		105 105		ns
Rise time	t_r					Tj=25℃ Tj=125℃		11 16		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		164 187		
Fall time	t_f					Tj=25℃ Tj=125℃		74 91		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		0,49 0,66		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		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℃		167		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,56		K/W
Half Bridge FWD										
Diode forward voltage	V_F				15	Tj=25℃ Tj=125℃		2,28 2,39	2,71	V
Reverse leakage current	I_r			1200		Tj=25℃ Tj=125℃			60	µA
Peak reverse recovery current	I_{RRM}	Rgoff=16 Ω	±15	350	28	Tj=25℃ Tj=125℃		41 44		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		44 110		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		1,47 2,73		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		5094 3534		A/µs
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		0,35 0,71		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,36		K/W
Thermistor										
Rated resistance	R					Tj=25℃		21511		Ω
Deviation of R25	ΔR/R	R100=1486 Ω				Tc=100℃	-4,5		+4,5	%
Power dissipation	P					Tj=25℃		210		mW
Power dissipation constant						Tj=25℃		3,5		mW/K
B-value	$B_{(25/50)}$					Tj=25℃		3884		K
B-value	$B_{(25/100)}$					Tj=25℃		3964		K
Vincotech NTC Reference						Tj=25℃			F	

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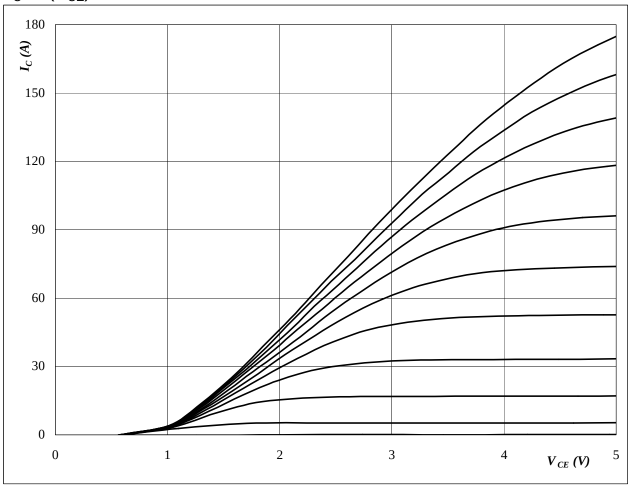
Half Bridge IGBT and **Neutral Point FWD**

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



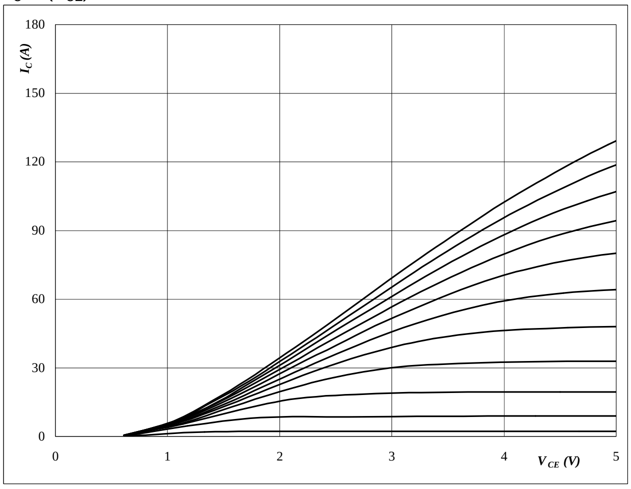
At

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

$I_C = f(V_{CE})$



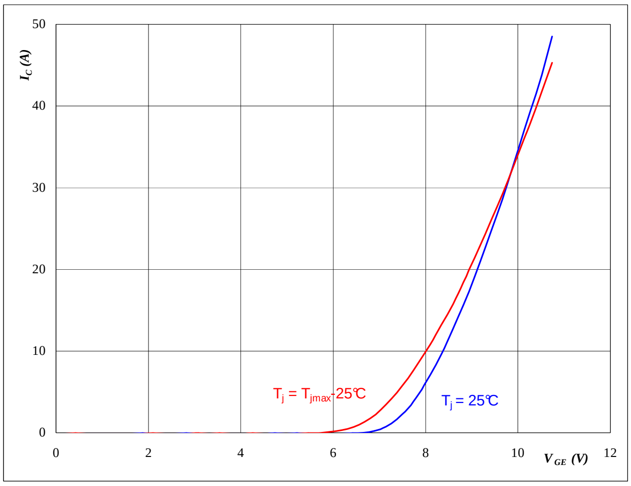
At

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

$I_C = f(V_{GE})$



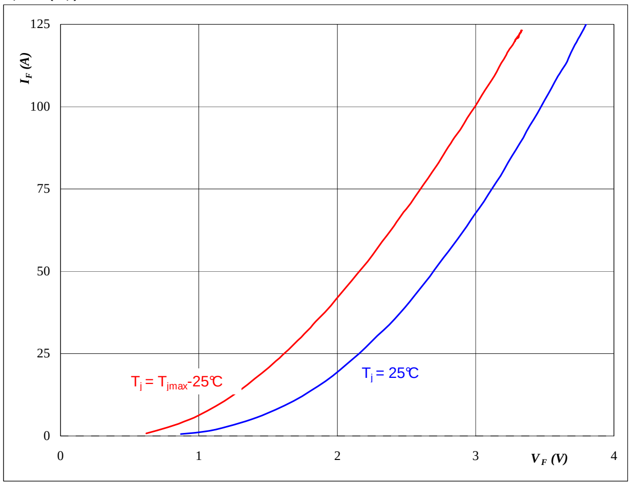
At

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

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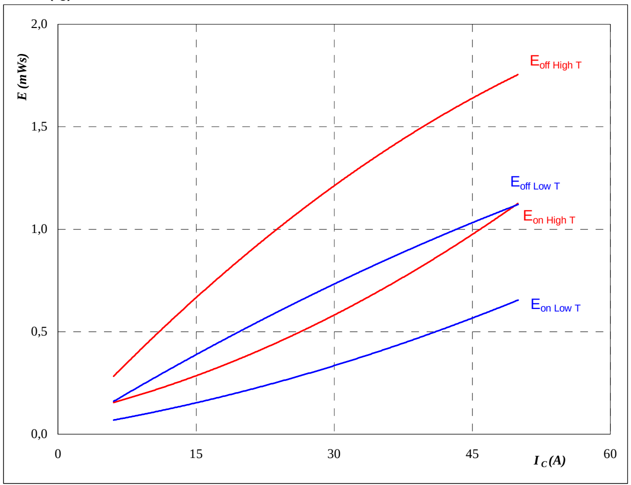
Half Bridge IGBT and Neutral Point FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



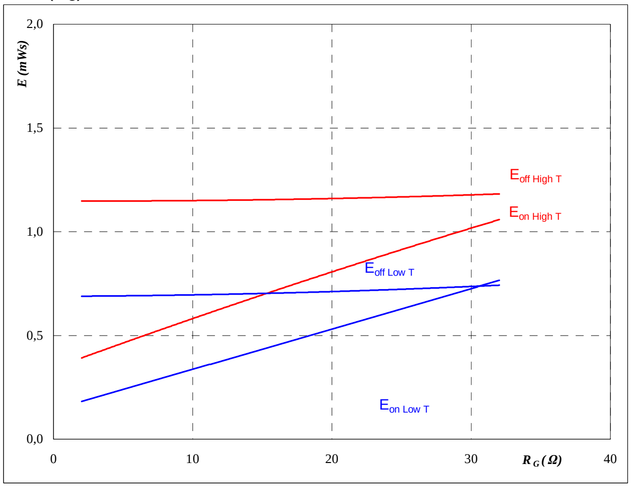
With an inductive load at

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

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



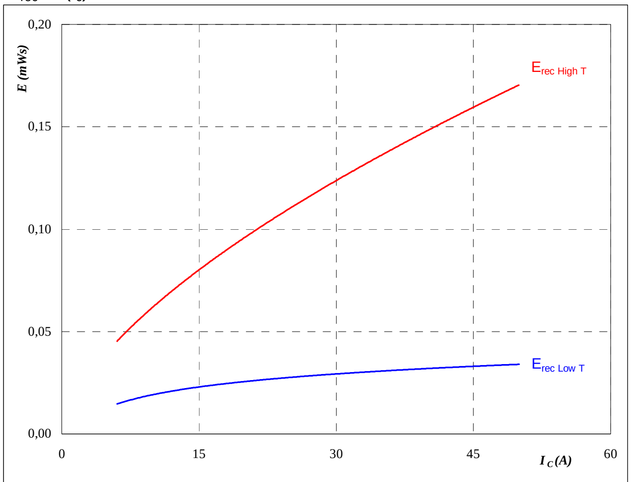
With an inductive load at

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

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

E_{rec} = f(I_c)



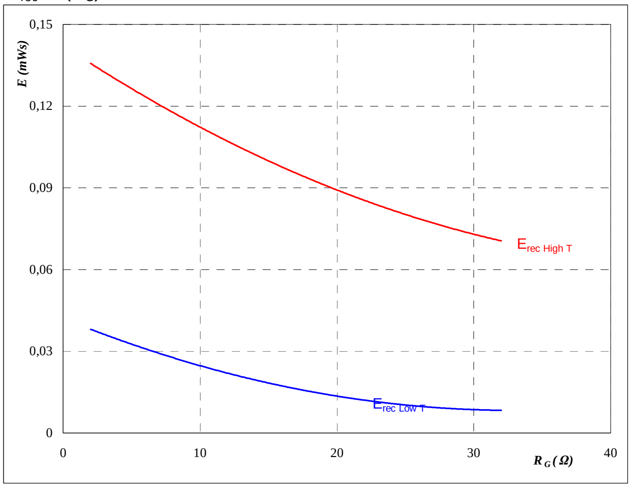
With an inductive load at

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

Figure 8 FWD

Typical reverse recovery energy loss
as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

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

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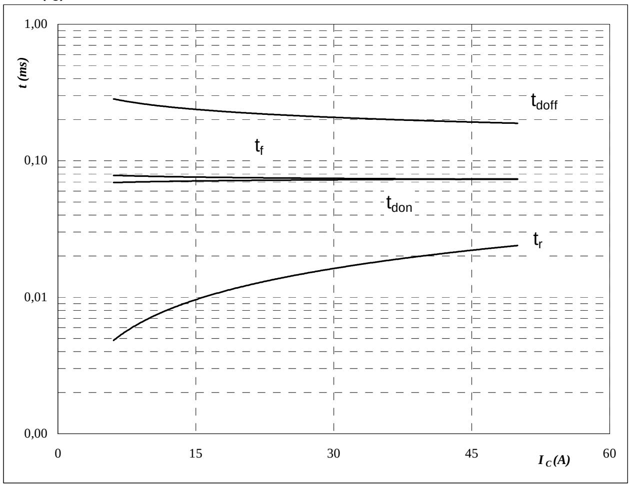
Half Bridge IGBT and Neutral Point FWD

Figure 9 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



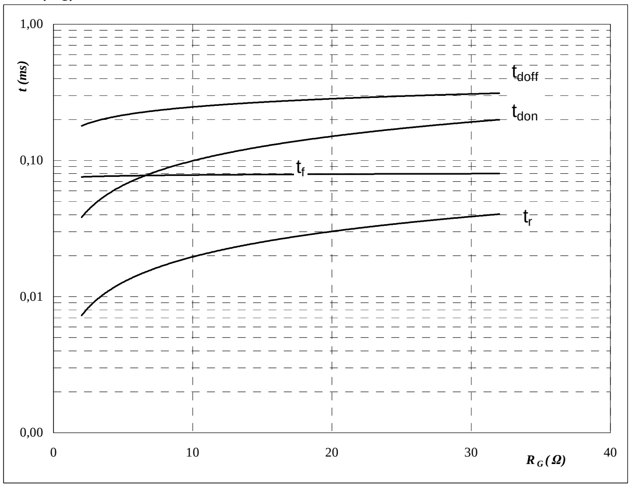
With an inductive load at

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

$t = f(R_G)$



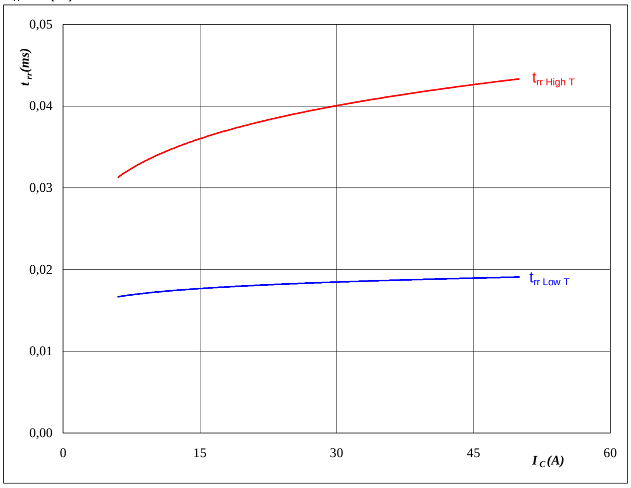
With an inductive load at

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

$t_{rr} = f(Ic)$



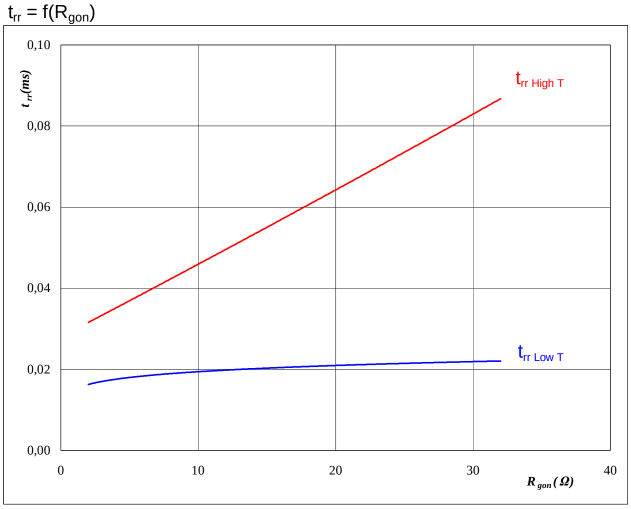
At

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

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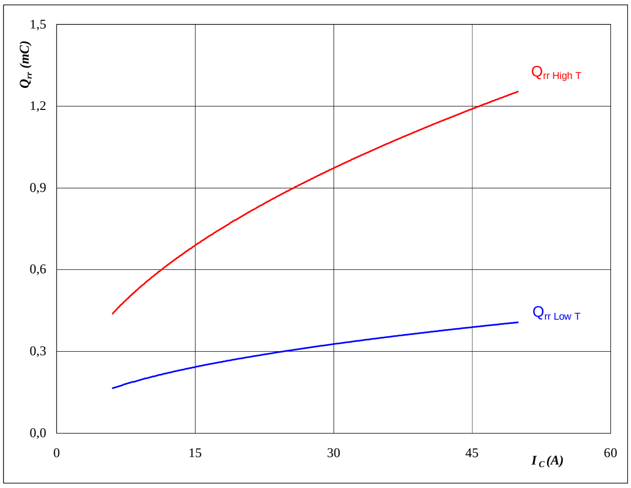
Half Bridge IGBT and Neutral Point FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



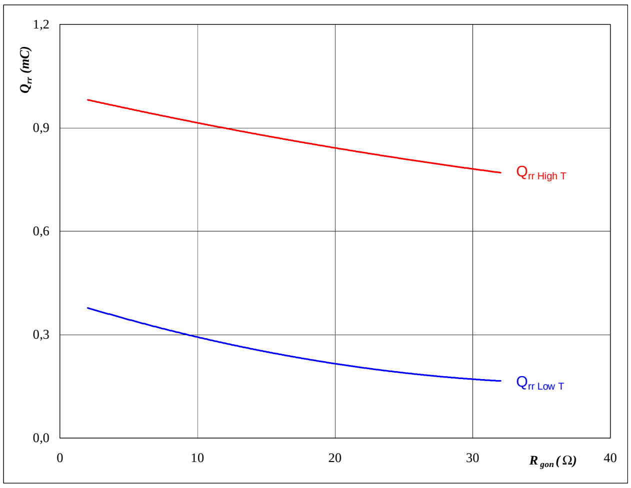
At

T_j =	25/125	℃
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

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



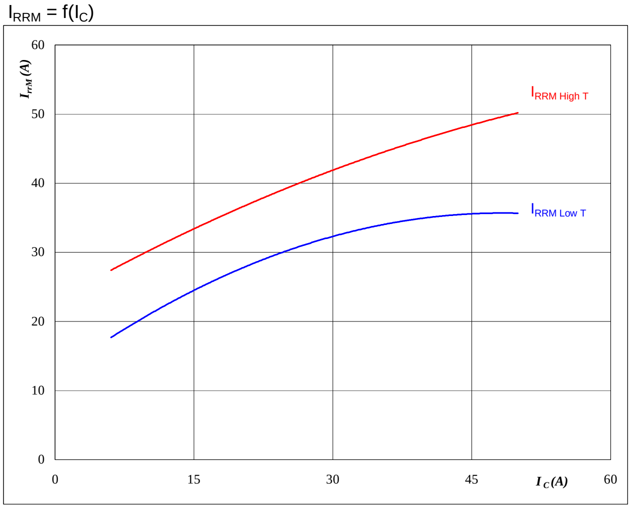
At

T_j =	25/125	℃
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

$I_{RRM} = f(I_C)$



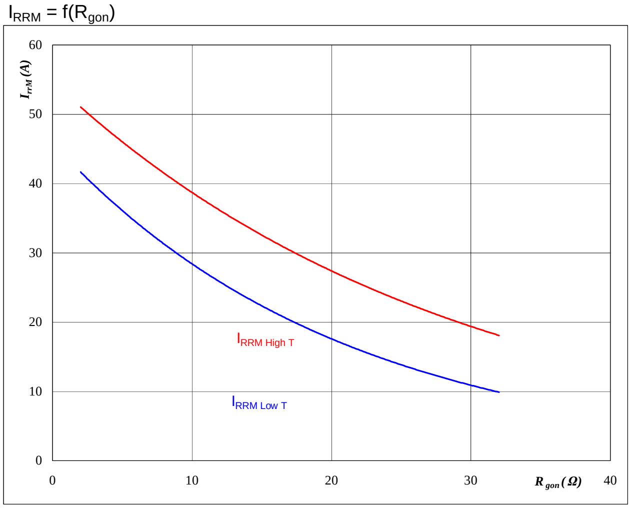
At

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

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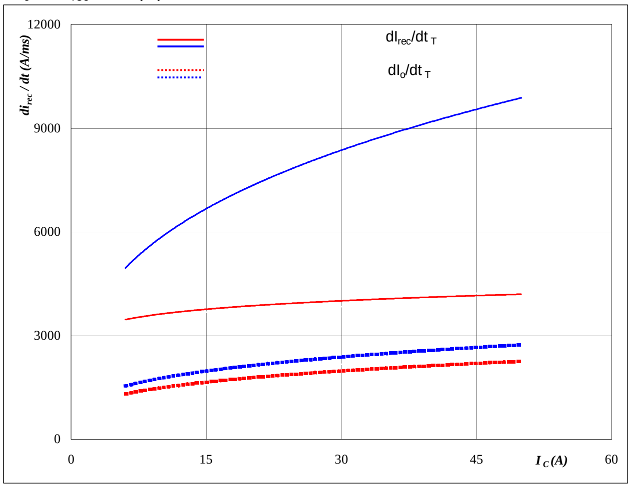
Half Bridge IGBT and Neutral Point FWD

Figure 17 FWD

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

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



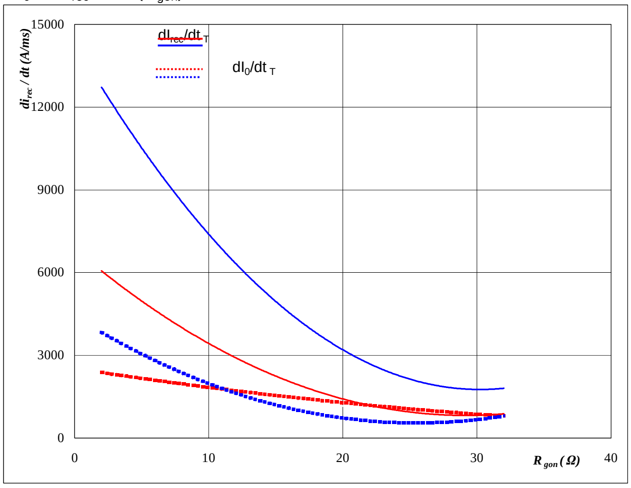
At

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

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



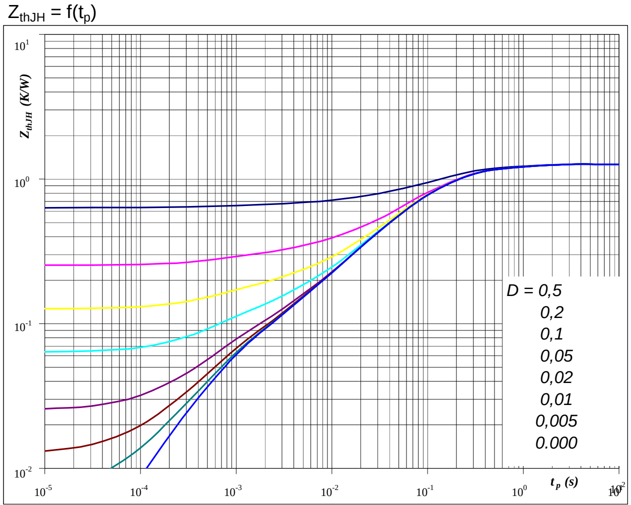
At

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} =	1,27	K/W

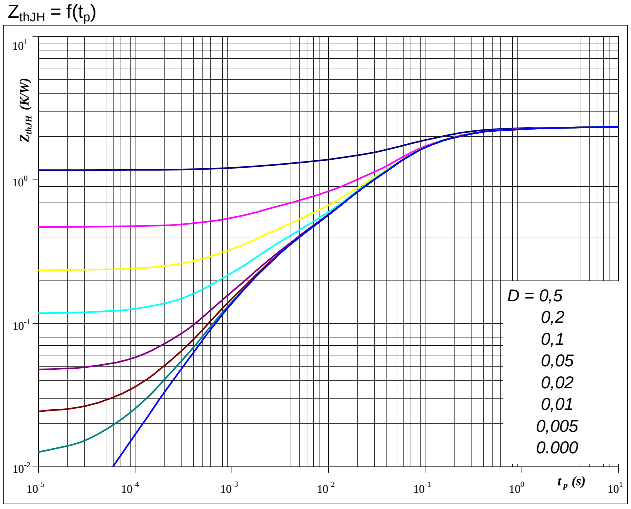
IGBT thermal model values

R (C/W)	Tau (s)
0,18	8,2E-01
0,64	1,3E-01
0,30	4,8E-02
0,10	9,3E-03
0,06	8,0E-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} =	2,34	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,11	2,4E+00
0,36	3,0E-01
1,41	6,5E-02
0,28	1,1E-02
0,19	1,6E-03

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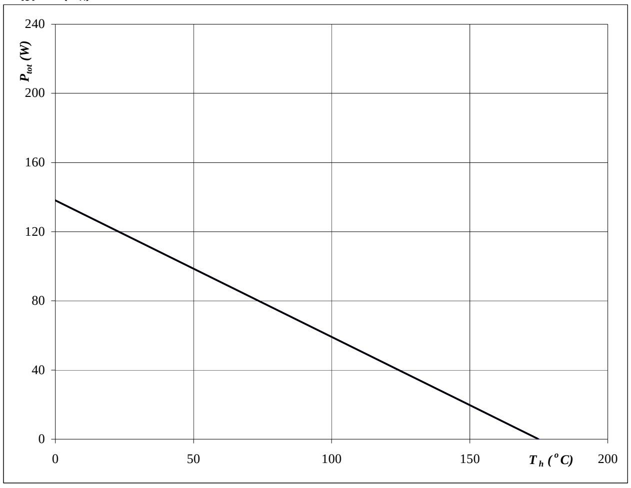
Half Bridge IGBT and Neutral Point FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



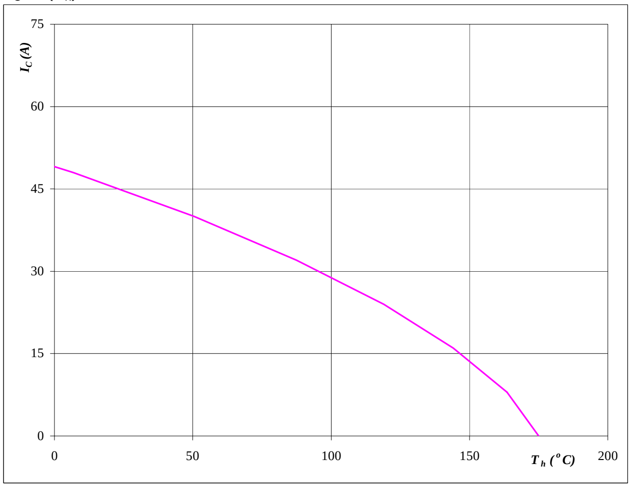
At

T_j = 175 ℃

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

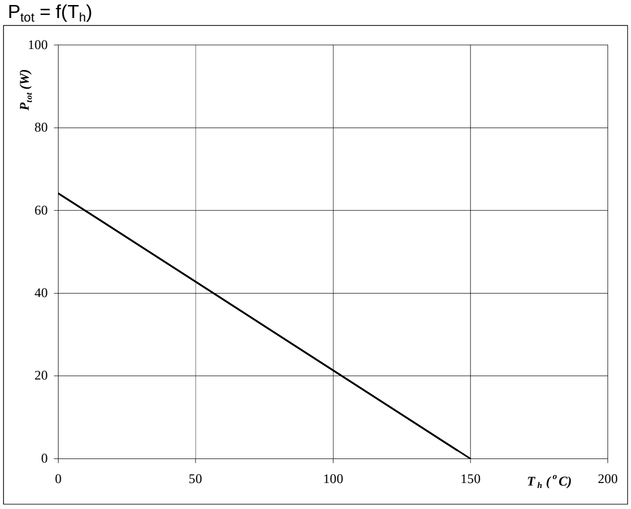
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



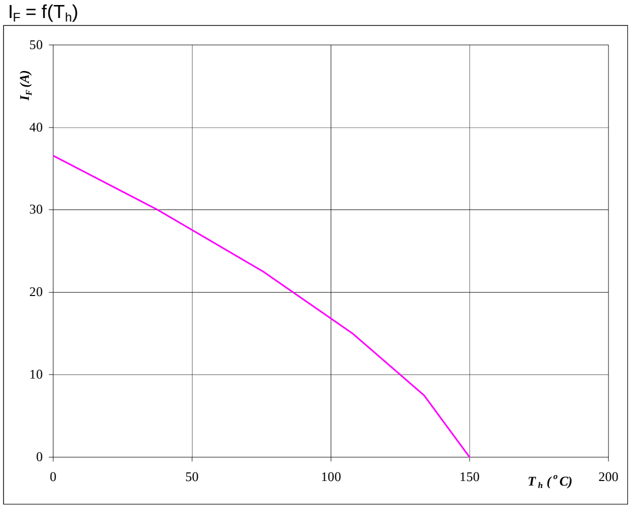
At

T_j = 150 ℃

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 ℃

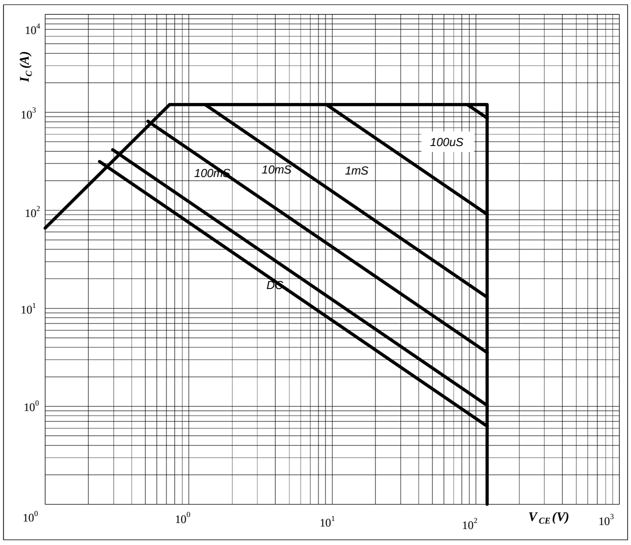
Buck

Half Bridge IGBT and Neutral Point FWD

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



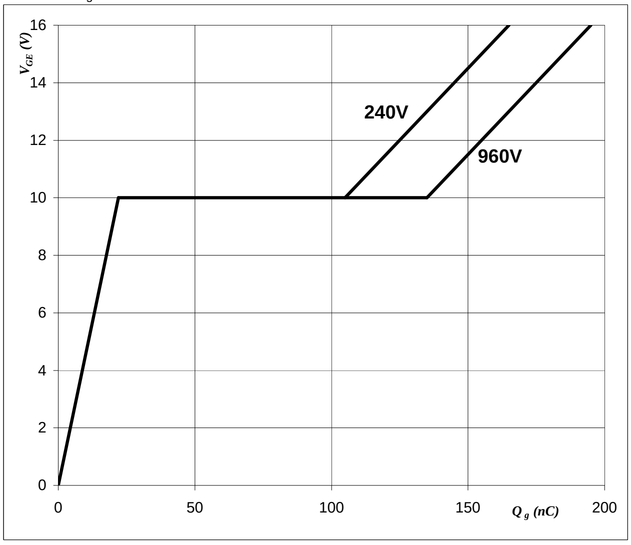
At

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

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



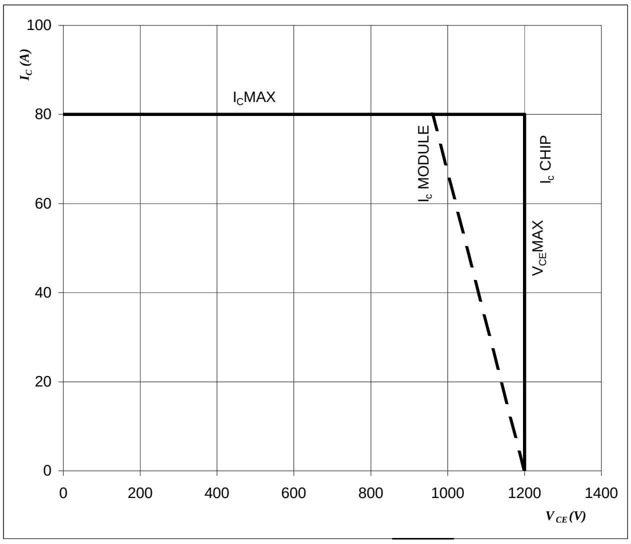
At

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

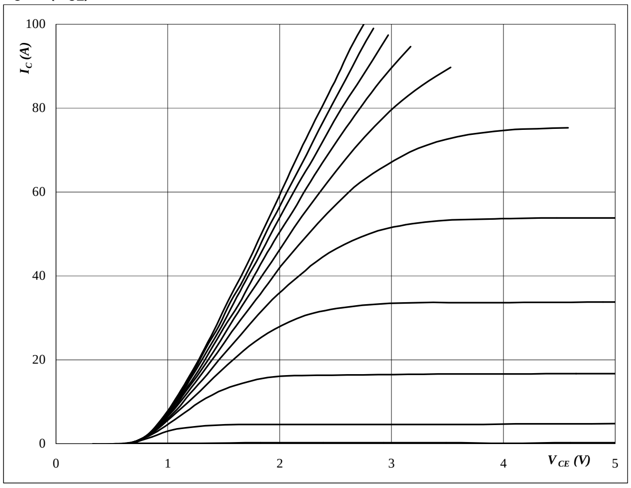
Boost

Neutral Point IGBT and Half Bridge FWD

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



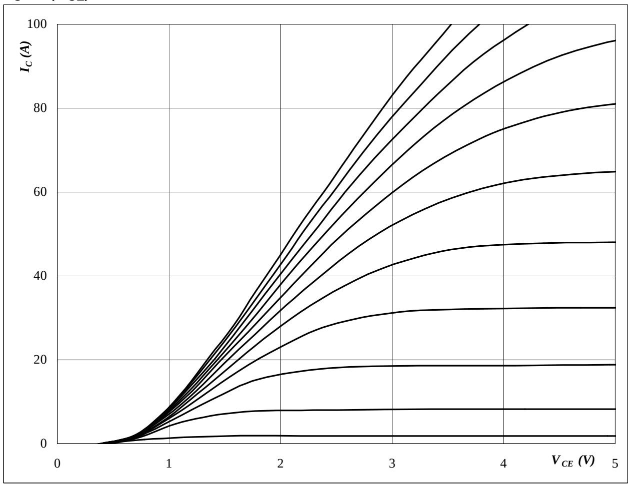
At

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

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



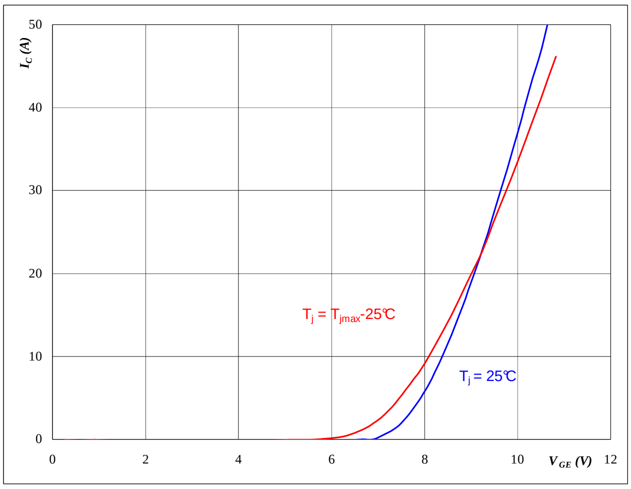
At

t_p =	250	μs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



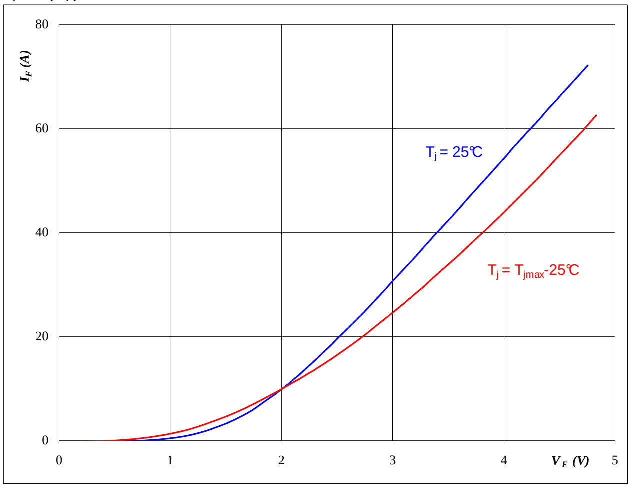
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	μs

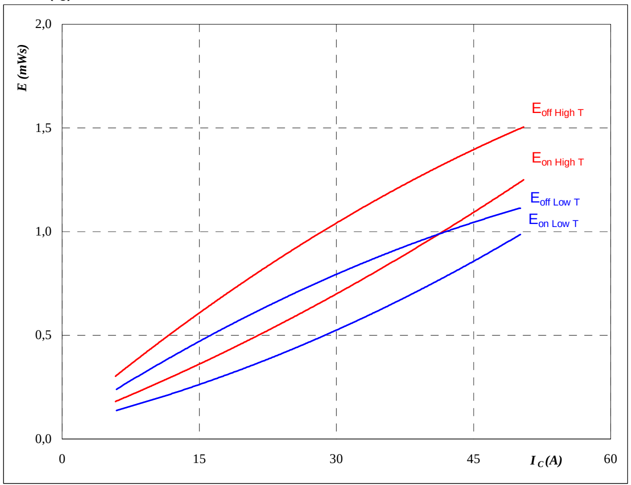
Boost

Neutral Point IGBT and Half Bridge FWD

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

E = f(I_C)



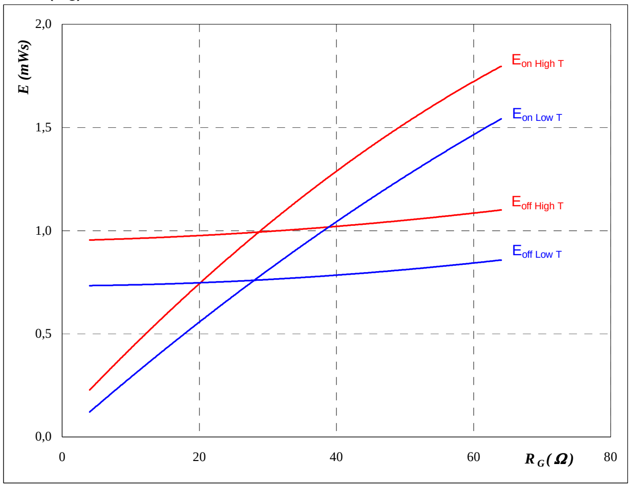
With an inductive load at

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

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

E = f(R_G)



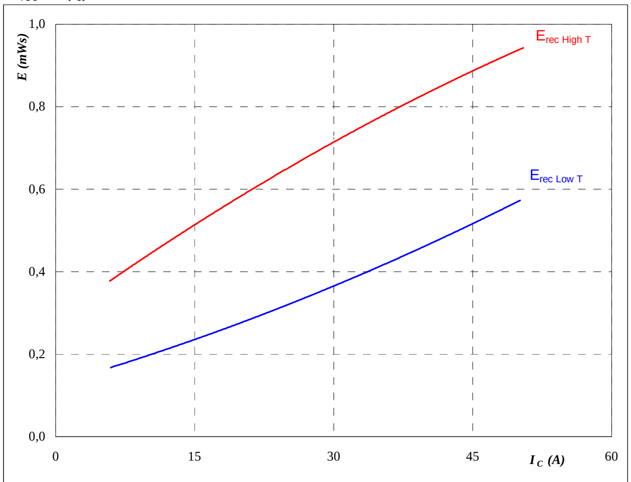
With an inductive load at

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

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

E_{rec} = f(I_c)



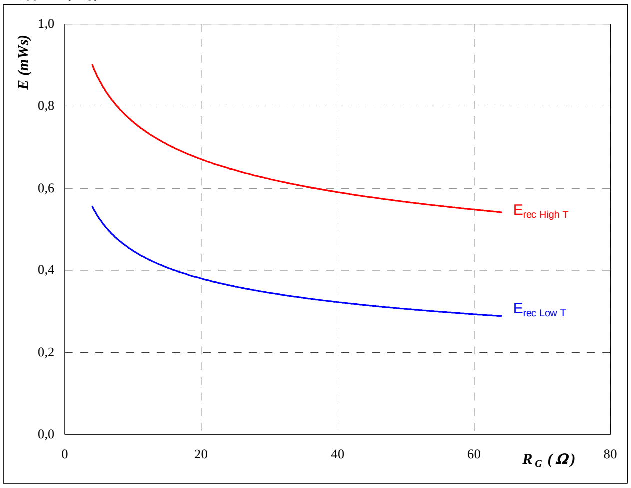
With an inductive load at

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

Figure 8 FWD

Typical reverse recovery energy loss
as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

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

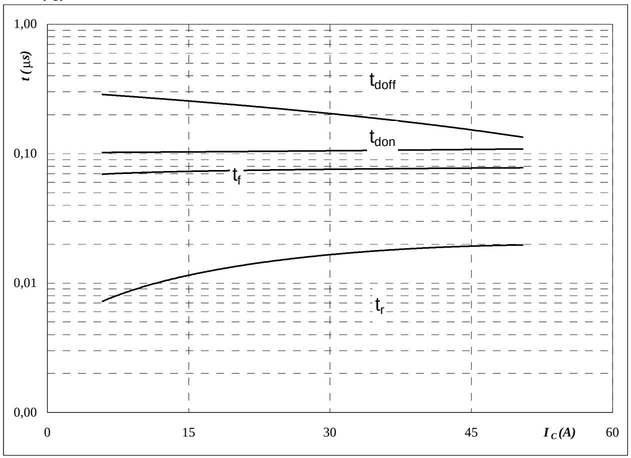
Boost

Neutral Point IGBT and Half Bridge FWD

Figure 9 IGBT

Typical switching times as a function of collector current

t = f(I_C)



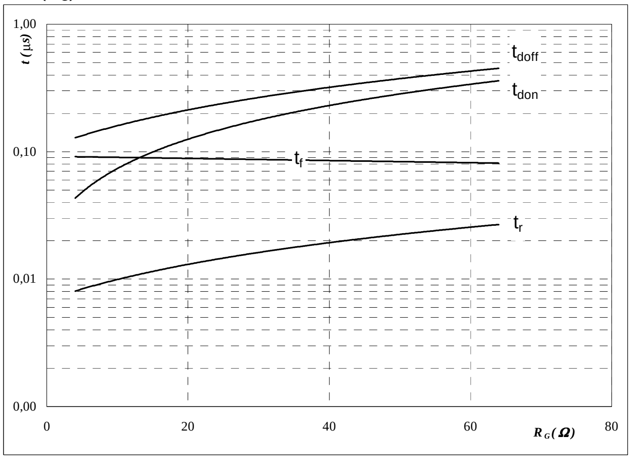
With an inductive load at

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

Figure 10 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



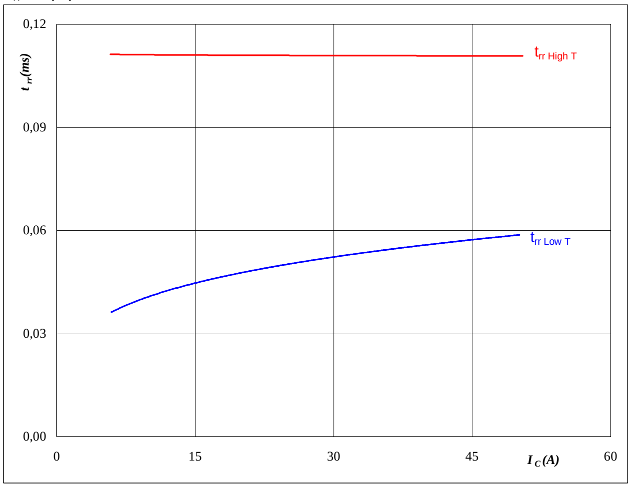
With an inductive load at

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

Figure 11 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



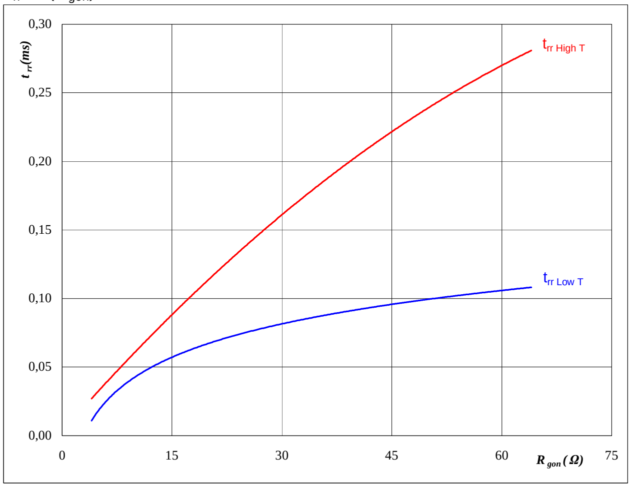
At

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

Figure 12 FWD

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

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



At

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

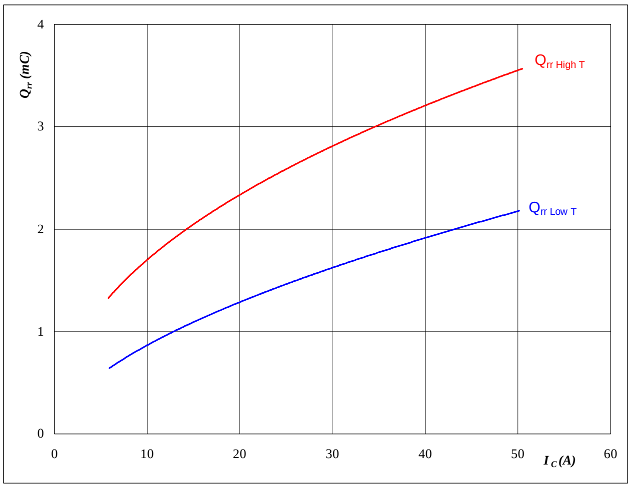
Boost

Neutral Point IGBT and Half Bridge FWD

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



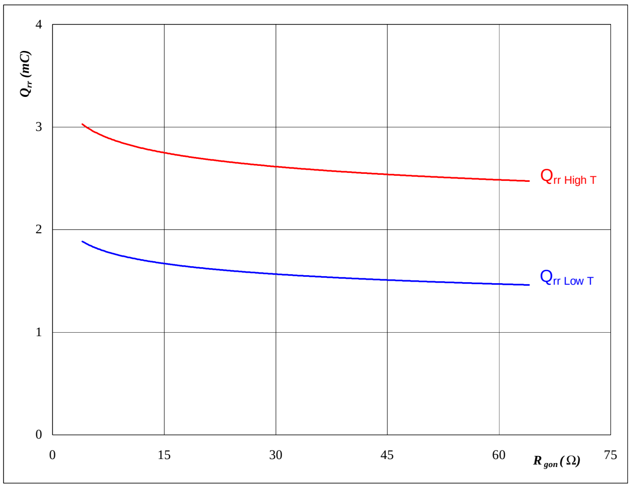
At

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

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



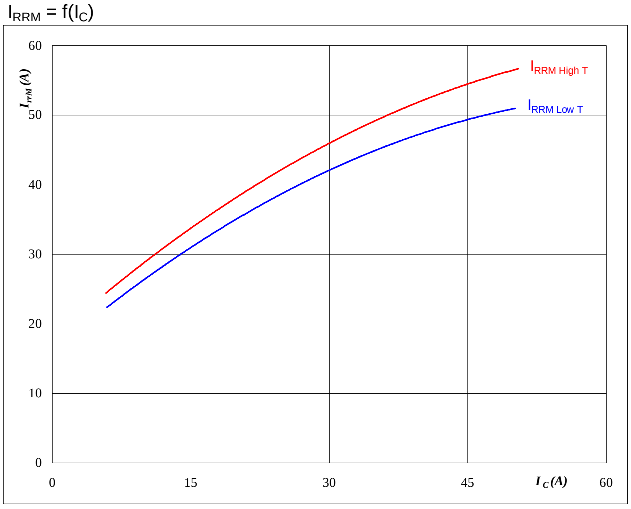
At

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

$I_{RRM} = f(I_C)$



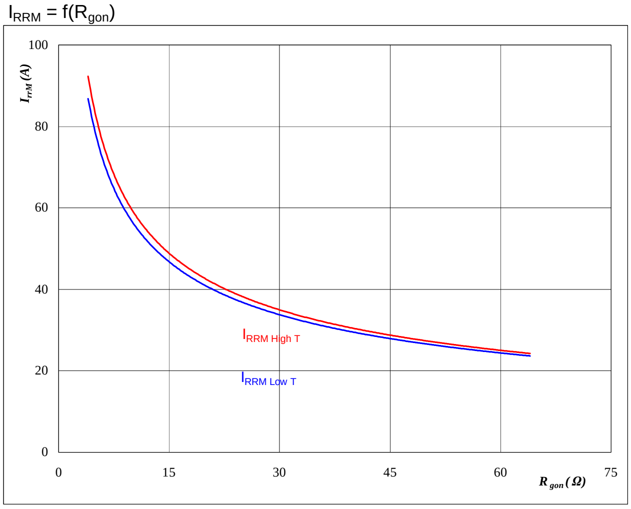
At

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

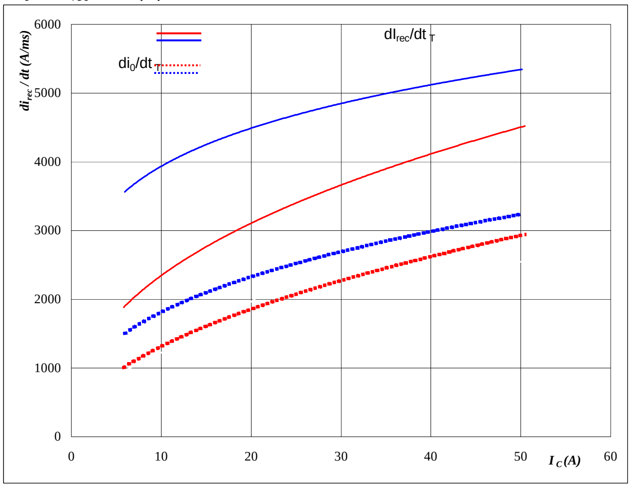
Boost

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

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



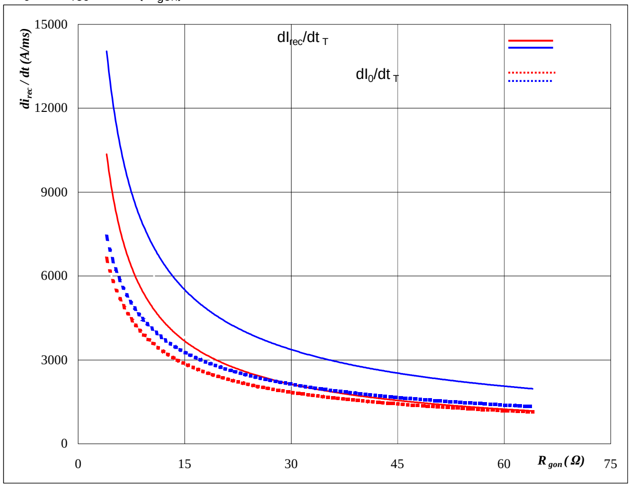
At

T_j =	25/125	℃
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

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



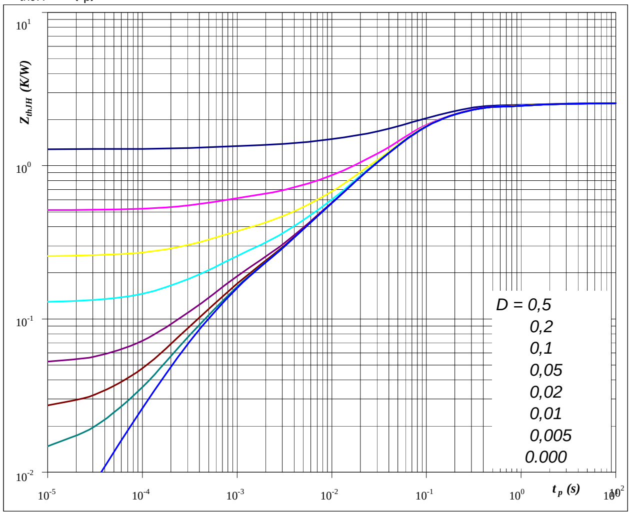
At

T_j =	25/125	℃
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} =	2,56	K/W

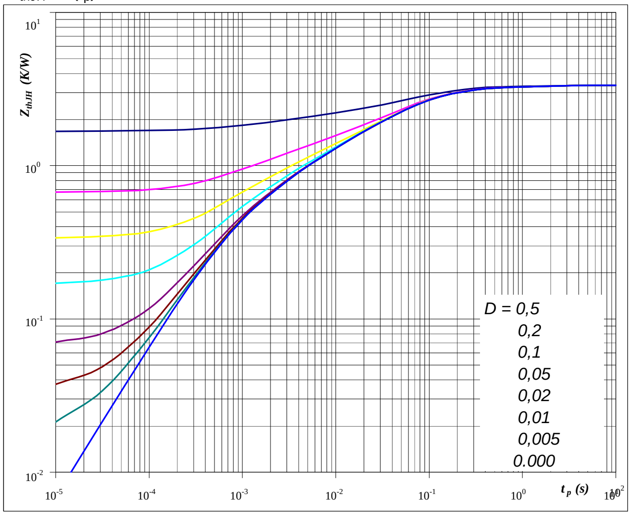
IGBT thermal model values

R (C/W)	Tau (s)
0,10	3,0E+00
0,25	4,8E-01
1,64	7,9E-02
0,32	1,9E-02
0,15	4,2E-03
0,11	5,1E-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} =	3,36	K/W

FWD thermal model values

R (C/W)	Tau (s)
0,11	2,6E+00
0,25	3,8E-01
1,48	7,2E-02
0,67	1,8E-02
0,50	3,4E-03
0,34	7,0E-04

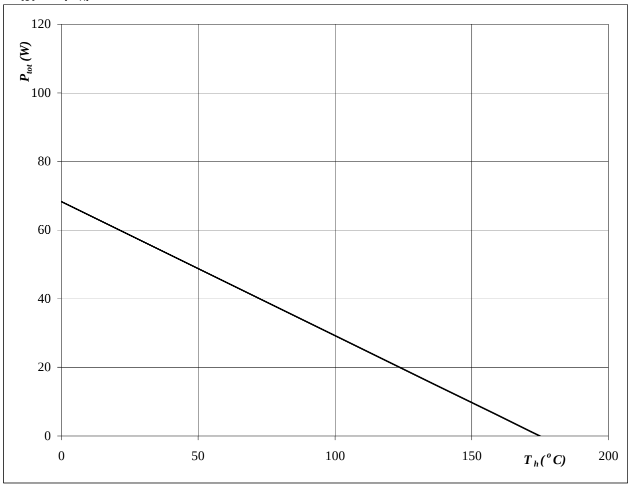
Boost

Neutral Point IGBT and Half Bridge FWD

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



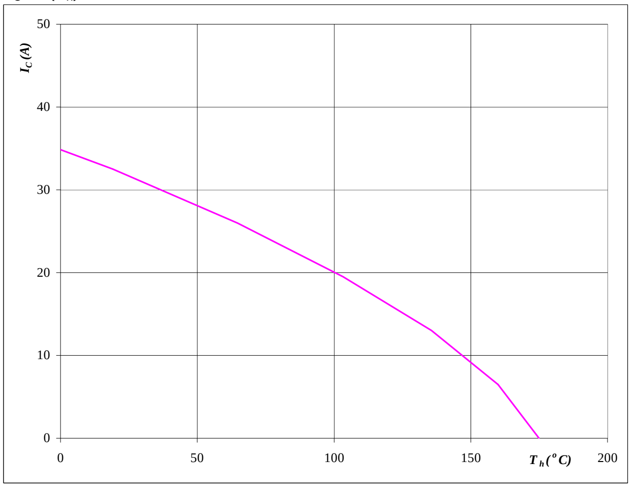
At

T_j = 175 ºC

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

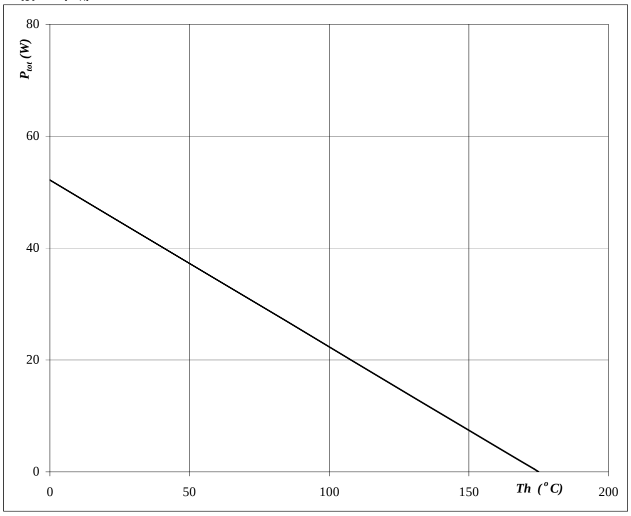
T_j = 175 ºC

V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



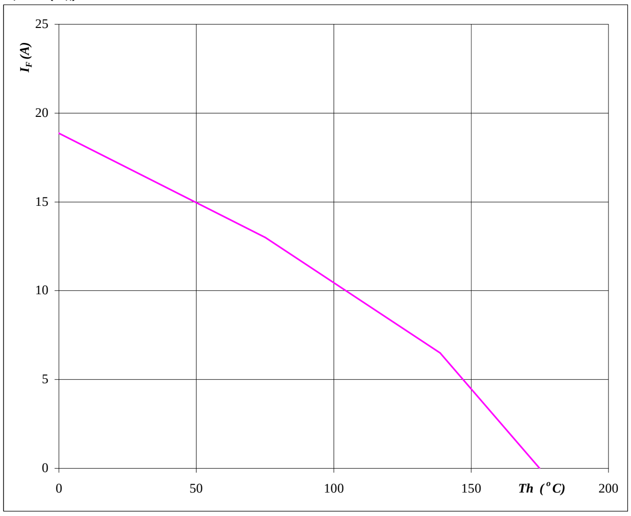
At

T_j = 175 ºC

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



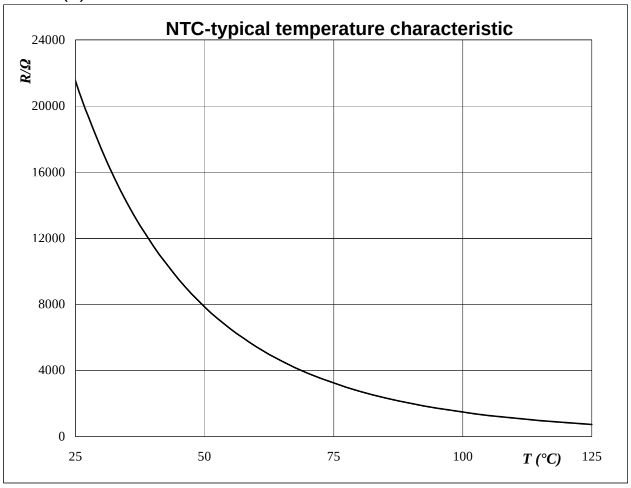
At

T_j = 175 ºC

Thermistor

Figure 1	Thermistor

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



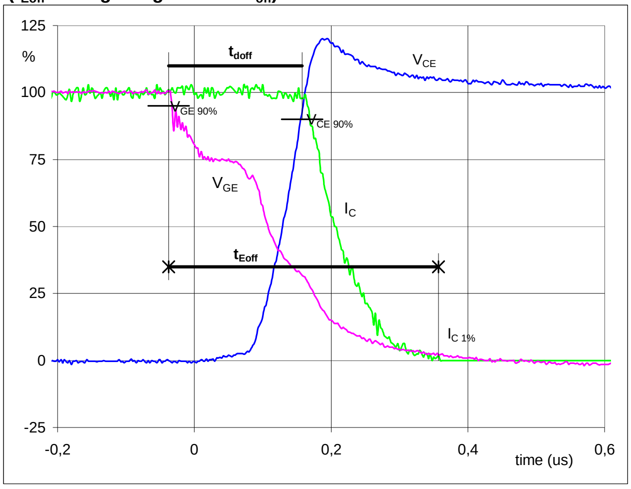
Switching Definitions Neutral Point

General conditions

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

Figure 1 Boost IGBT

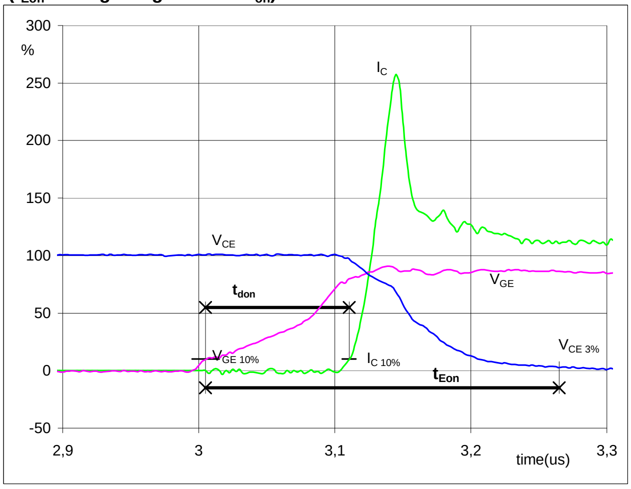
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



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 Boost IGBT

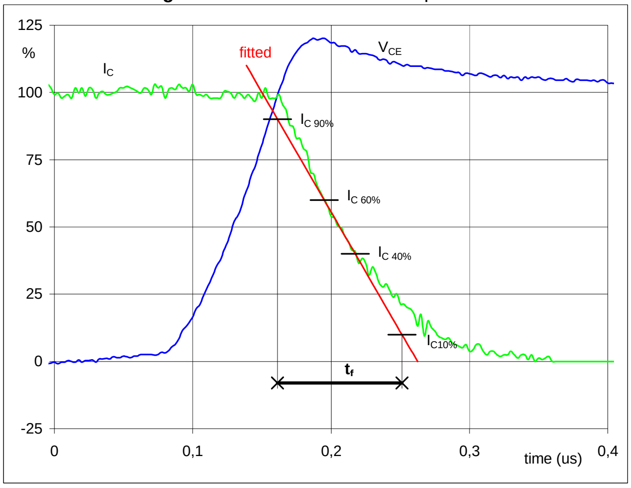
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



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 Boost IGBT

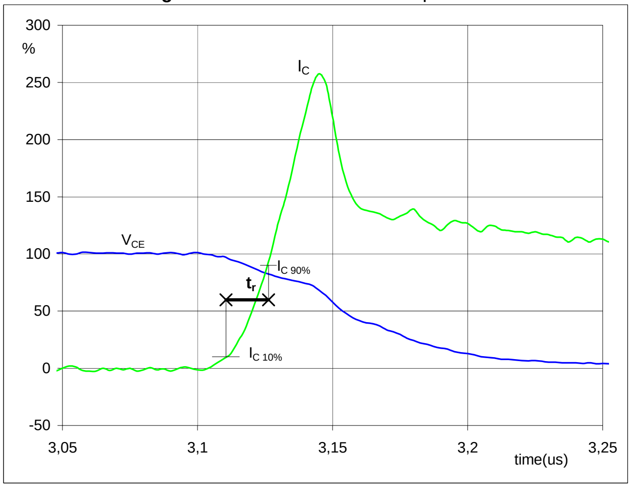
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 Boost IGBT

Turn-on Switching Waveforms & definition of t_r

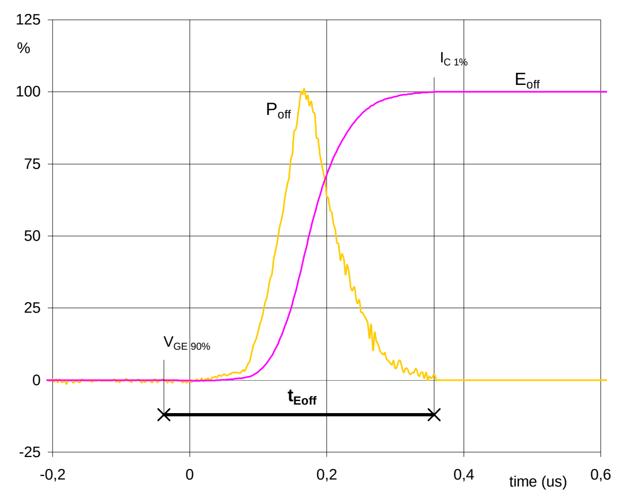


V_C (100%) =	350	V
I_C (100%) =	28	A
t_r =	0,02	µs

Switching Definitions Neutral Point

Figure 5 Boost IGBT

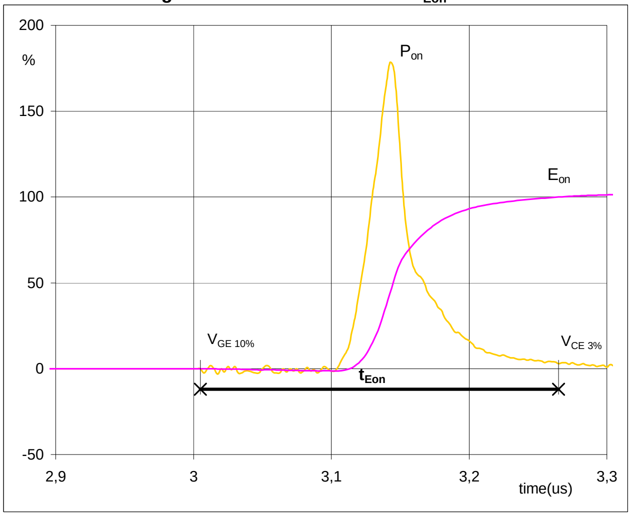
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 Boost IGBT

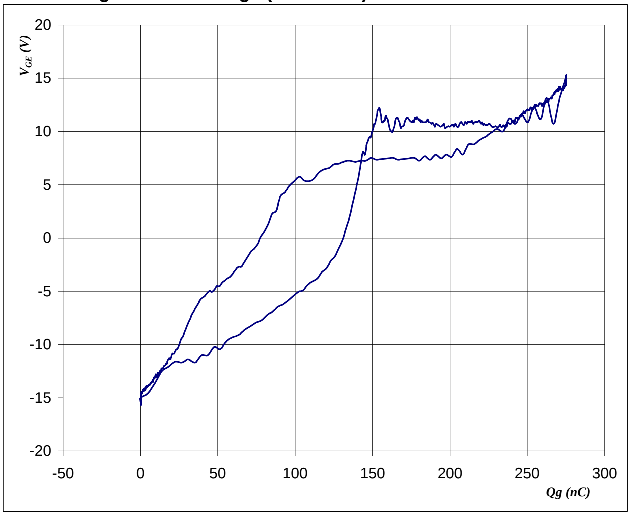
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Boost IGBT

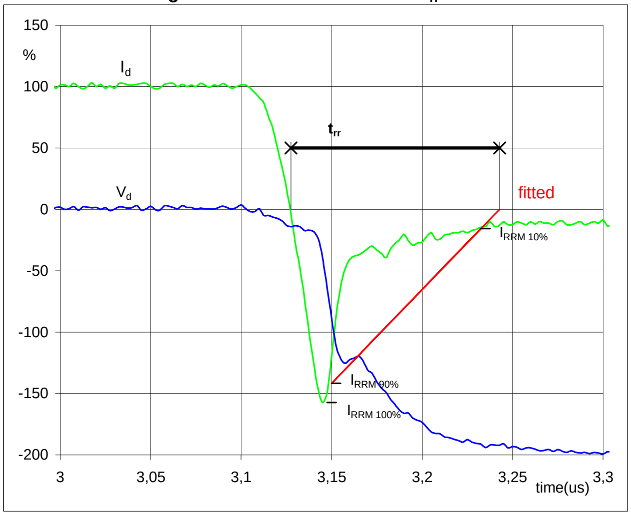
Gate voltage vs Gate charge (measured)



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

Figure 8 Buck FWD

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

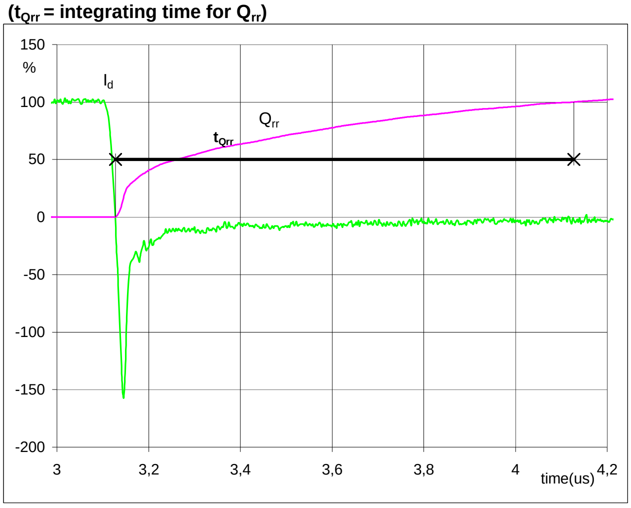


V_d (100%) =	350	V
I_d (100%) =	28	A
I_{RRM} (100%) =	-44	A
t_{rr} =	0,11	μs

Switching Definitions Neutral Point

Figure 9 Boost IGBT

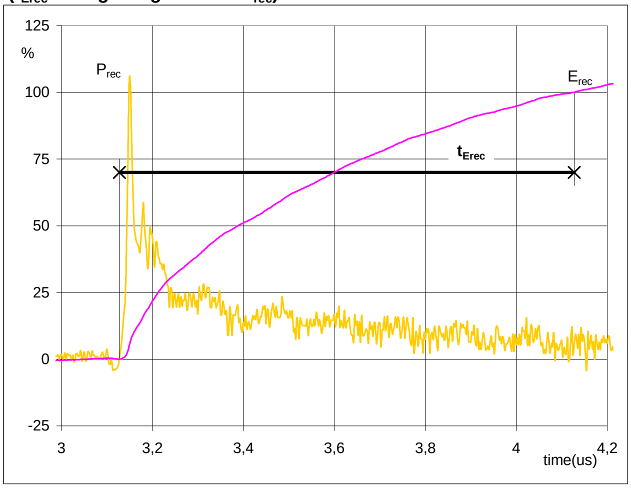
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

Figure 10 Buck FWD

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

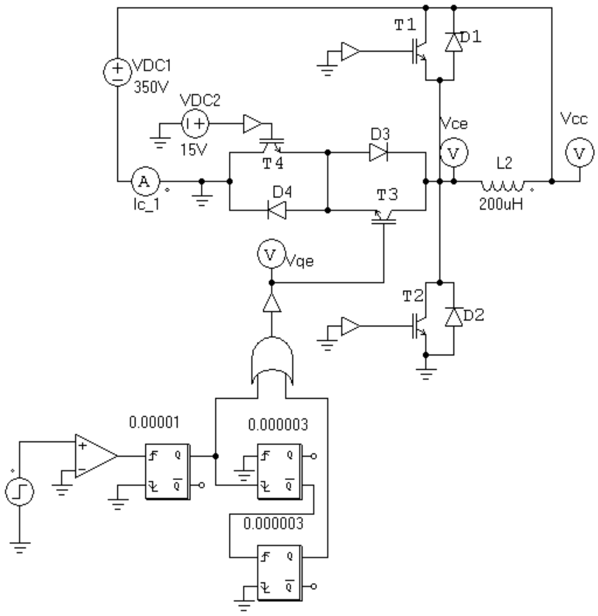


P_{rec} (100%) =	9,70	kW
E_{rec} (100%) =	0,71	mJ
t_{Erec} =	1,00	μs

Measurement circuits

Figure 11

Neutral Point stage switching measurement circuit



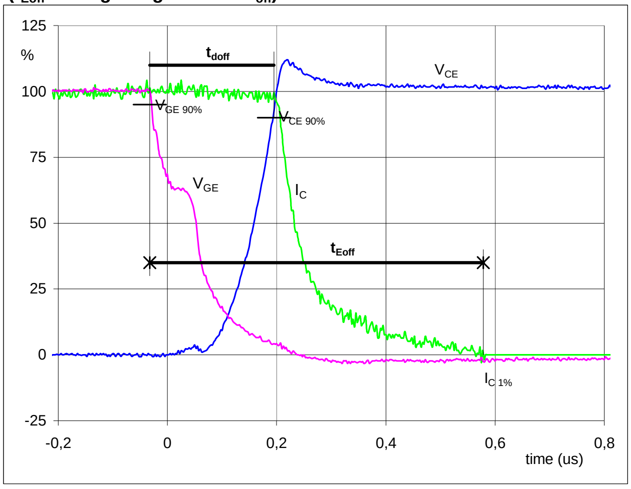
Switching Definitions Half Bridge

General conditions

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

Figure 1 Buck IGBT

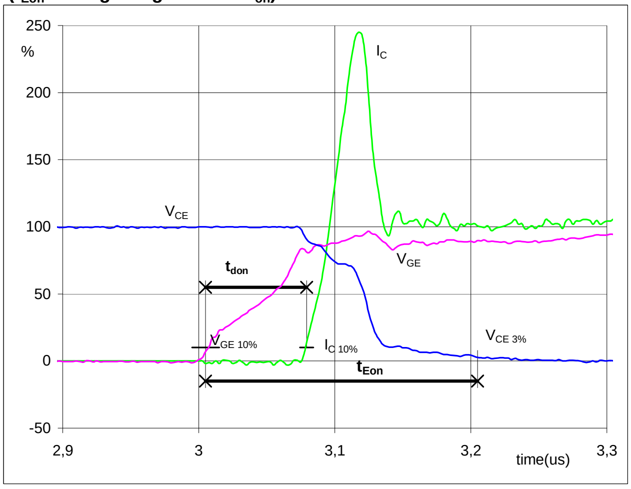
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
t_{doff} =	0,22	µs
t_{Eoff} =	0,61	µs

Figure 2 Buck IGBT

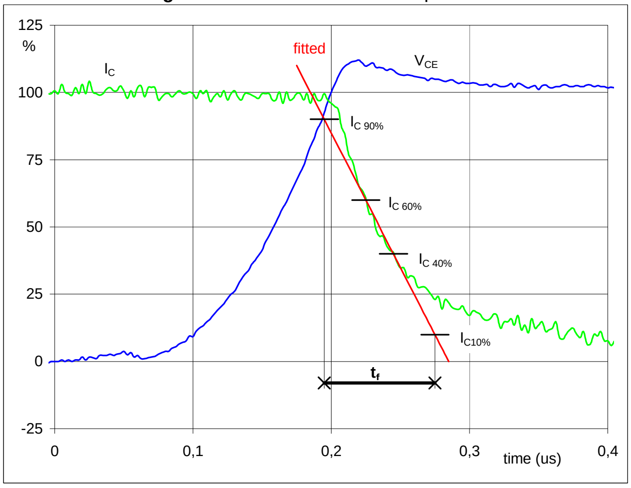
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
t_{don} =	0,07	µs
t_{Eon} =	0,20	µs

Figure 3 Buck IGBT

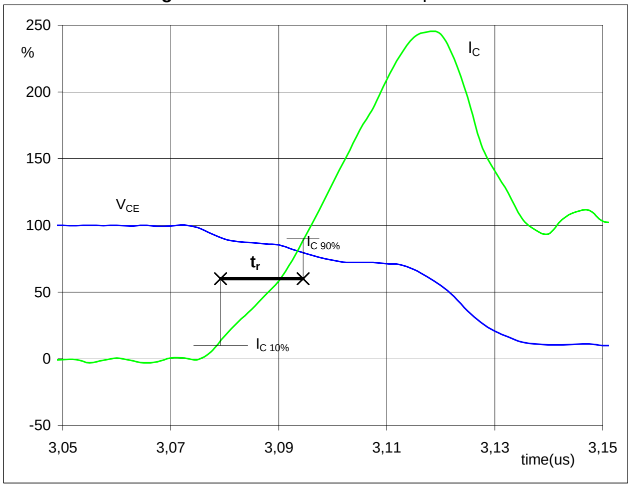
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	28	A
t_f =	0,08	µs

Figure 4 Buck IGBT

Turn-on Switching Waveforms & definition of t_r

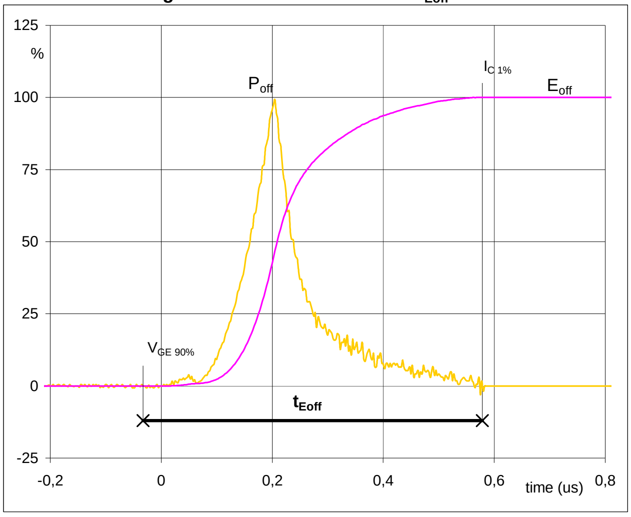


V_C (100%) =	350	V
I_C (100%) =	28	A
t_r =	0,02	µs

Switching Definitions Half Bridge

Figure 5 Buck IGBT

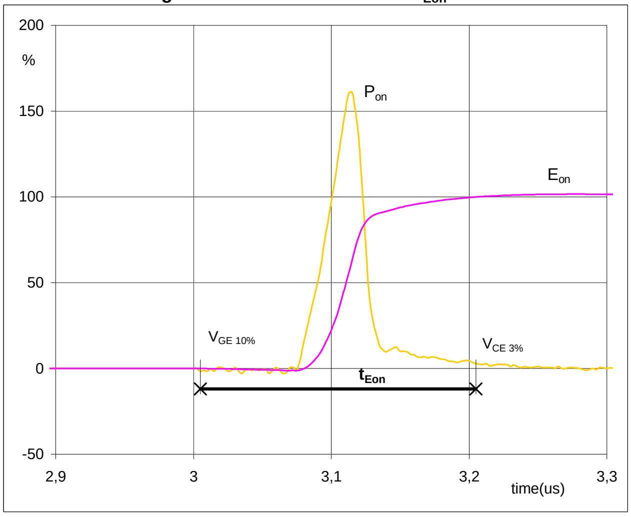
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	9,75	kW
E_{off} (100%) =	1,16	mJ
t_{Eoff} =	0,61	μs

Figure 6 Buck IGBT

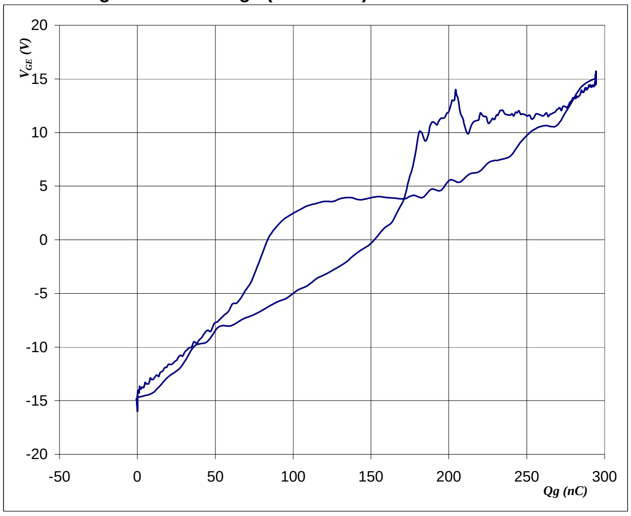
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	9,75	kW
E_{on} (100%) =	0,52	mJ
t_{Eon} =	0,20	μs

Figure 7 Buck IGBT

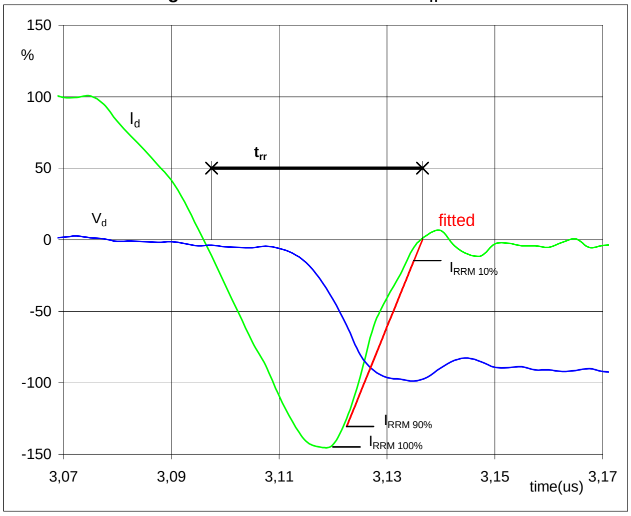
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	350	V
I_C (100%) =	28	A
Q_g =	299,41	nC

Figure 8 Boost FWD

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

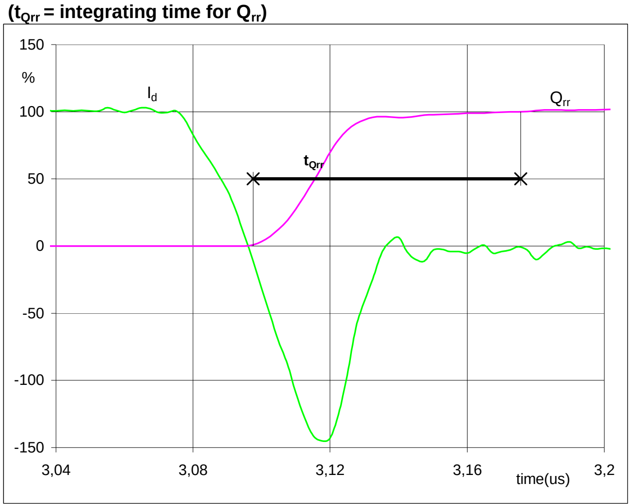


V_d (100%) =	350	V
I_d (100%) =	28	A
I_{RRM} (100%) =	-41	A
t_{rr} =	0,04	μs

Switching Definitions Half Bridge

Figure 9 Buck IGBT

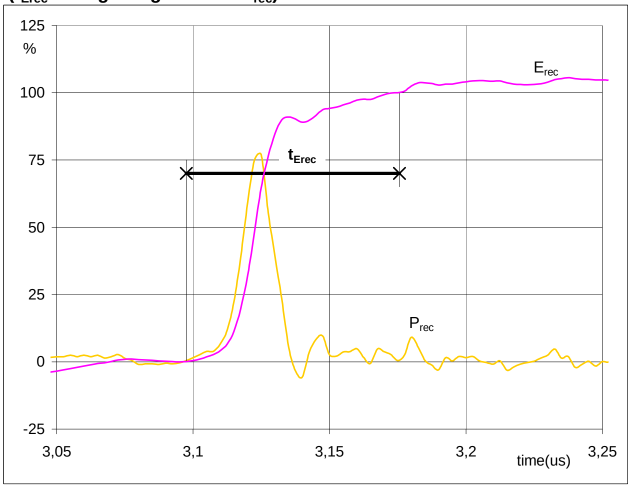
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

Figure 10 Boost FWD

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

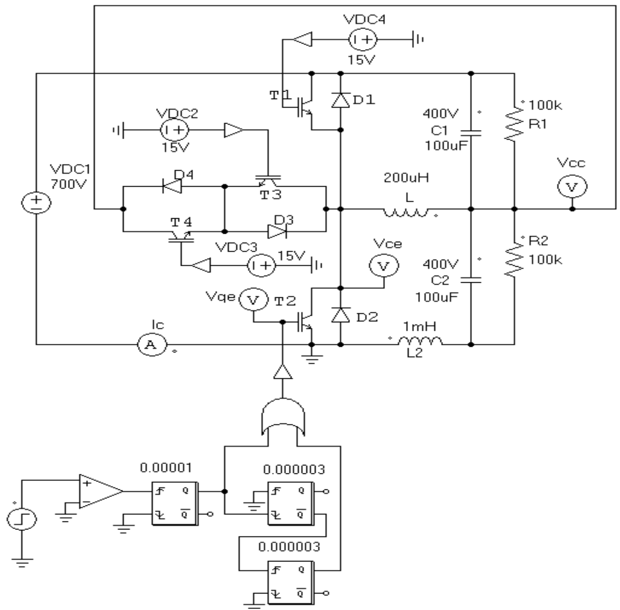


P_{rec} (100%) =	9,75	kW
E_{rec} (100%) =	0,12	mJ
t_{Erec} =	0,08	μs

Measurement circuits

Figure 11

Half Bridge stage switching measurement circuit



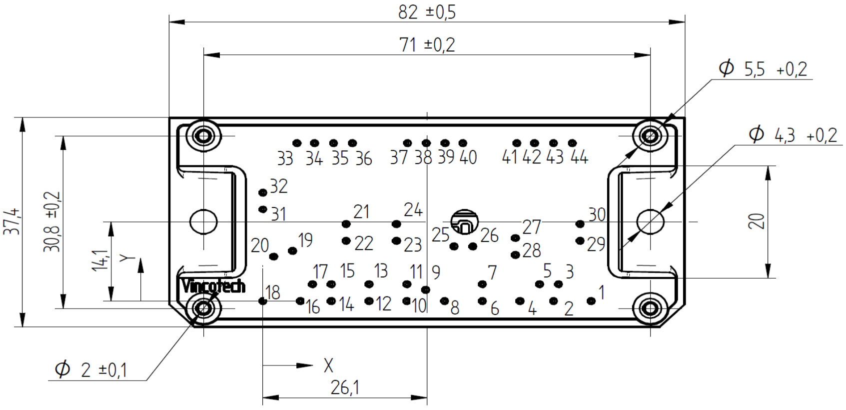
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

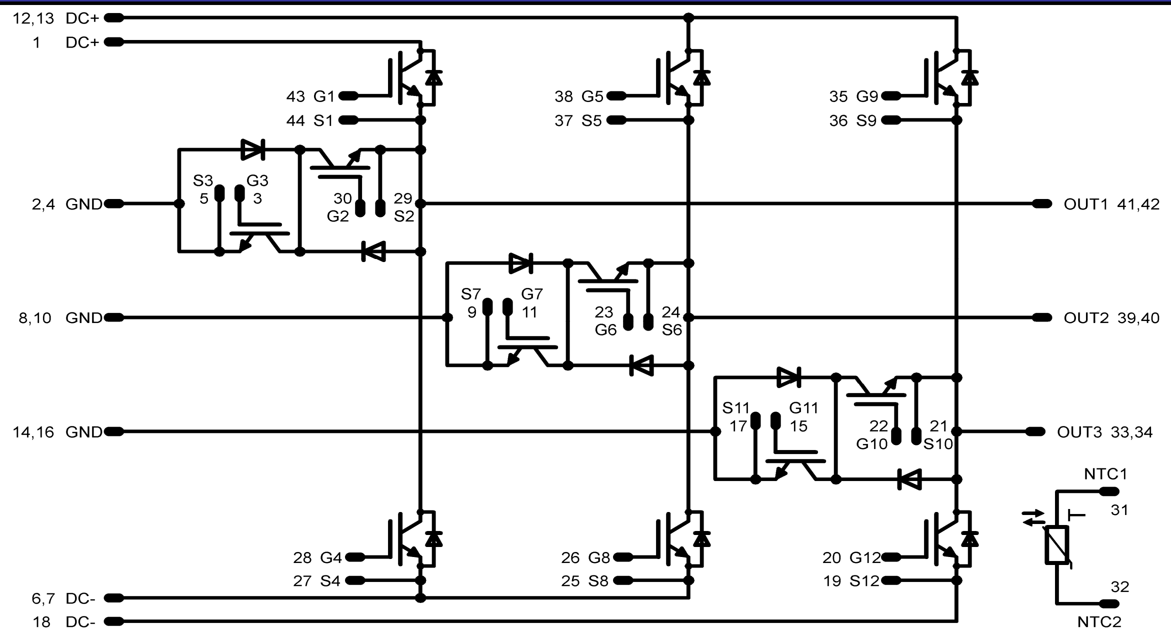
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FY12M3A040SH-M749F08	M749F08	M749F08
without thermal paste 17mm housing	10-F112M3A040SH-M749F09	M749F09	M749F09

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.