

flowSOL 0 BI
600V/35A
Features

- High efficiency
- Ultra fast switching frequency
- Low inductive design
- SiC in boost

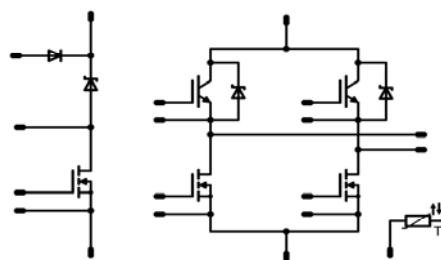
Target Applications

- Transformerless solar inverters

Types

- FZ06BIA045FH01

flow0 housing

Schematic


Maximum Ratings

 $T_j = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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Bypass FWD

Repetitive peak reverse voltage	V_{RRM}		600	V
Forward current per FWD	I_{FAV}	DC current $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	36 49	A
Surge forward current	I_{FSM}	$t_p = 10\text{ms}$ $T_j = 25^\circ\text{C}$	370	A
I^2t -value	I^2t		360	A^2s
Power dissipation per FWD	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	42 63	W
Maximum Junction Temperature	T_{jmax}		150	$^\circ\text{C}$

Input Boost MOSFET

Drain to source breakdown voltage	V_{DS}		600	V
DC drain current	I_D	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	30 37	A
Pulsed drain current	I_{Dpulse}	t_p limited by T_{jmax}	230	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	92 139	W
Gate-source peak voltage	V_{GS}		± 20	V
Maximum Junction Temperature	T_{jmax}		150	$^\circ\text{C}$

Maximum Ratings

 $T_j=25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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Input Boost FWD

Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25^{\circ}\text{C}$	600	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	20 24	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	70	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	41 62	W
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Buck FWD

Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25^{\circ}\text{C}$	600	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	22 29	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax} $T_c=100^{\circ}\text{C}$	15	A
Power dissipation per FWD	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	34 52	W
Maximum Junction Temperature	T_{jmax}		150	$^{\circ}\text{C}$

Buck MOSFET

Drain to source breakdown voltage	V_{DS}		600	V
DC drain current	I_D	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	30 37	A
Pulsed drain current	I_{Dpulse}	t_p limited by T_{jmax} $T_c=25^{\circ}\text{C}$	230	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	94 142	W
Gate-source peak voltage	V_{GS}		± 20	V
Maximum Junction Temperature	T_{jmax}		150	$^{\circ}\text{C}$

Boost IGBT

Collector-emitter break down voltage	V_{CE}		600	V
DC collector current	I_C	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	40 40	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by T_{jmax}	150	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	86 131	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^{\circ}\text{C}$ $V_{GE}=15\text{V}$	6 360	μs V
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Maximum Ratings

$T_j=25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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Thermal Properties

Storage temperature	T_{stg}		-40...+125	$^{\circ}\text{C}$
Operation temperature under switching condition	T_{op}		-40...+($T_{j\text{max}}$ - 25)	$^{\circ}\text{C}$

Insulation Properties

Insulation voltage	V_{is}	$t=2\text{s}$ 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	
Bypass FWD										
Forward voltage	V_{FWD}	solar inverter			15	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	0,7	1,01 0,93	1,3	V
Threshold voltage (for power loss calc. only)	V_{th}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,86 0,75		V
Slope resistance (for power loss calc. only)	r_t					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,1 0,1		Ω
Reverse current	I_r			1200		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			0,05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						1,68		K/W
Input Boost MOSFET										
Static drain to source ON resistance	$R_{DS(on)}$		10		44	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,04 0,09		Ω
Gate threshold voltage	$V_{(GS)th}$	VGS=VDS			0,003	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	2,1	3	3,9	V
Gate to Source Leakage Current	I_{gss}		20	0		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			200	nA
Zero Gate Voltage Drain Current	I_{dss}		0	600		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			25000	nA
Turn On Delay Time	$t_{d(ON)}$	Rgoff=4 Ω Rgon=4 Ω	10	400	15	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		28 27		ns
Rise Time	t_r					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		5 6		
Turn off delay time	$t_{d(OFF)}$					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		154 167		
Fall time	t_f					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		10 9		
Turn-on energy loss per pulse	E_{on}	Rgon=4 Ω	10	400	44	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,063 0,072		mWs
Turn-off energy loss per pulse	E_{off}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,025 0,025		
Total gate charge	Q_g	Rgon=4 Ω	10	400	44	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		150	190	nC
Gate to source charge	Q_{gs}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		34		
Gate to drain charge	Q_{gd}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		51		
Input capacitance	C_{iss}	f=1MHz	0	100		$T_j=25^{\circ}C$		6800		pF
Output capacitance	C_{oss}							320		
Reverse transfer capacitance	C_{rss}							48		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						0,76		K/W
Input Boost FWD										
Forward voltage	V_F				8	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	1	1,54 1,71	1,8	V
Reverse leakage current	I_{rm}		10	400	15	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$			400	μA
Peak recovery current	I_{RRM}	Rgon=4 Ω	10	400	15	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		16,63 14,68		A
Reverse recovery time	t_{rr}					$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		9,3 10,4		ns
Reverse recovery charge	Q_{rr}					$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		0,058 0,064		μC
Reverse recovered energy	E_{rec}					$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		0,005 0,006		mWs
Peak rate of fall of recovery current	$di(rec)_{max}/dt$					$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		4244 2752		A/ μs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						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	
Buck FWD										
FWD forward voltage	V_F				15	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	1,5	2,04 1,50	2,7	V
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	10	400	15	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		42 58		A
Reverse recovery time	t_{rr}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		12,2 19,4		ns
Reverse recovered charge	Q_{rr}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,26 0,65		μC
Peak rate of fall of recovery current	$di(rec)_{max}/dt$					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		14190 13169		A/ μs
Reverse recovered energy	E_{rec}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,036 0,108		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1$ W/mK						2,04		K/W
Buck MOSFET										
Static drain to source ON resistance	$R_{ds(on)}$		10		44	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		45 90		m Ω
Gate threshold voltage	$V_{(GS)th}$			$V_{DS}=V_{GS}$	0,003	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	2,1	3	3,9	V
Gate to Source Leakage Current	I_{gss}		20	0		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			200	nA
Zero Gate Voltage Drain Current	I_{dss}		0	600		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			25000	nA
Turn On Delay Time	$t_{d(ON)}$	Rgoff=4 Ω Rgon=4 Ω	10	400	15	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		31 30		ns
Rise Time	t_r					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		5,6 6,2		
Turn off delay time	$t_{d(OFF)}$					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		158 170		
Fall time	t_f					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		45,4 11,5		
Turn-on energy loss per pulse	E_{on}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,132 0,229		mWs
Turn-off energy loss per pulse	E_{off}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		0,026 0,026		
Total gate charge	Q_g		10	400	44	$T_j=25^{\circ}C$		150	190	nC
Gate to source charge	Q_{gs}							34		
Gate to drain charge	Q_{gd}							51		
Input capacitance	C_{iss}	f=1MHz	0	100		$T_j=25^{\circ}C$		6800		pF
Output capacitance	C_{oss}							320		
Reverse transfer capacitance	C_{rss}							48		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1$ W/mK						0,75		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	

Boost IGBT

Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0008	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$		1,18 1,21		V
Collector-emitter cut-off incl FWD	I_{CES}		0	600		$T_j=25^{\circ}C$ $T_j=150^{\circ}C$			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		$T_j=25^{\circ}C$ $T_j=150^{\circ}C$			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Input capacitance	C_{ies}	f=1MHz	0	25		$T_j=25^{\circ}C$		3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_{Gate}		15	480	50	$T_j=25^{\circ}C$		310		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						1,10		K/W

Note: For the **Boost IGBT** only LF switching allowed

Thermistor

Rated resistance*	R_{25}					$T_j=25^{\circ}C$	17,5	22	29,0	k Ω
	R_{100}	Tol. $\pm 5\%$						1486		Ω
Power dissipation	P					$T_j=25^{\circ}C$		210		mW
B-value	$B_{(25/100)}$	Tol. $\pm 3\%$				$T_j=25^{\circ}C$		4000		K

* see details on **Thermistor** charts on **Figure 2**.

Buck

Figure 1 MOSFET

Typical output characteristics

$$I_C = f(V_{CE})$$

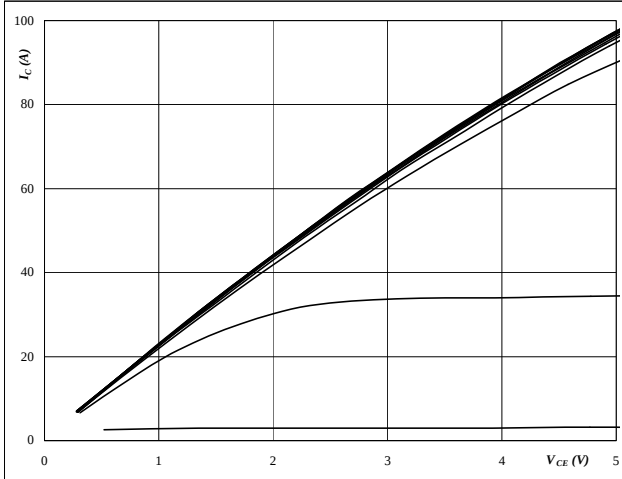

At
 $t_p = 250 \mu s$
 $T_J = 25 ^\circ C$
 V_{GE} from 4 V to 14 V in steps of 1 V

Figure 2 MOSFET

Typical output characteristics

$$I_C = f(V_{CE})$$

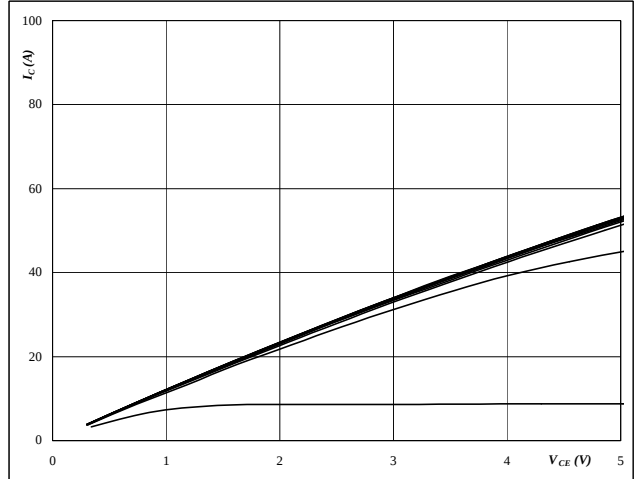
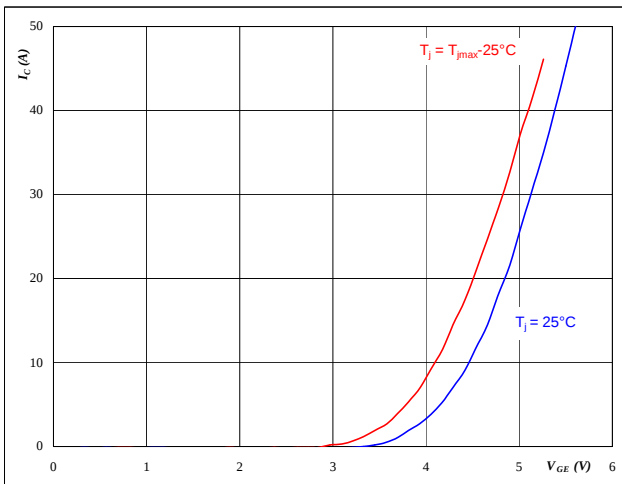

At
 $t_p = 250 \mu s$
 $T_J = 125 ^\circ C$
 V_{GE} from 4 V to 14 V in steps of 1 V

Figure 3 MOSFET

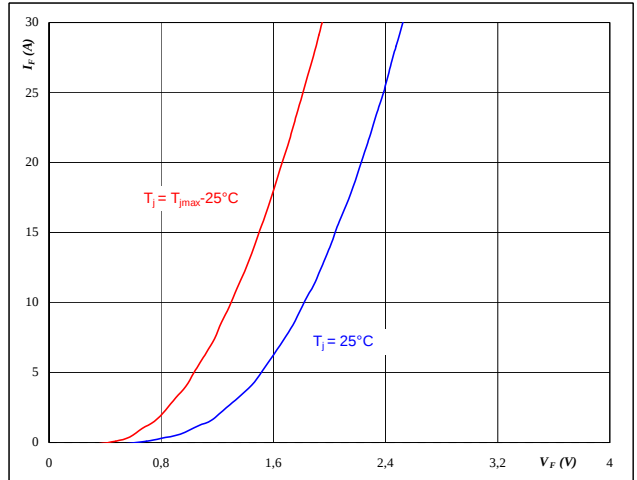
Typical transfer characteristics

$$I_C = f(V_{GE})$$


At
 $t_p = 250 \mu s$
 $V_{CE} = 10 V$
Figure 4 FRED

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

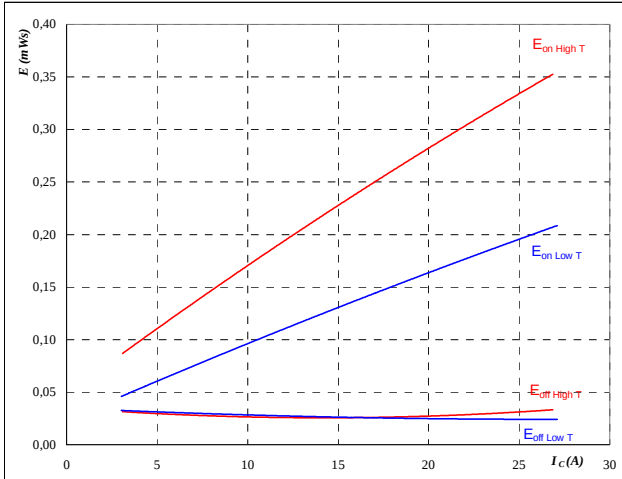

At
 $t_p = 250 \mu s$

Buck

Figure 5 MOSFET

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



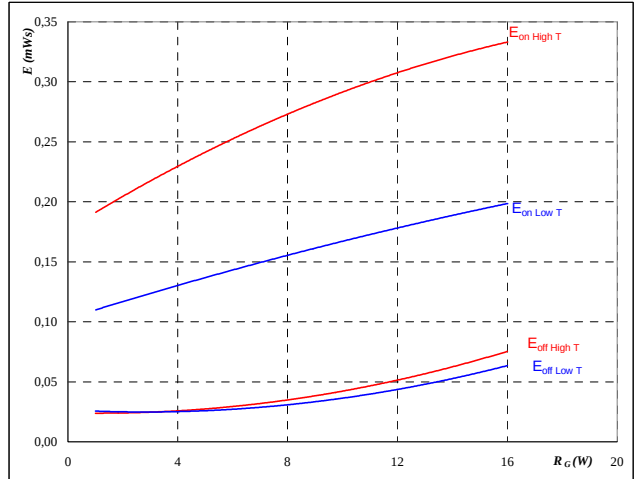
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

Figure 6 MOSFET

Typical switching energy losses
as a function of gate resistor

$$E = f(R_G)$$



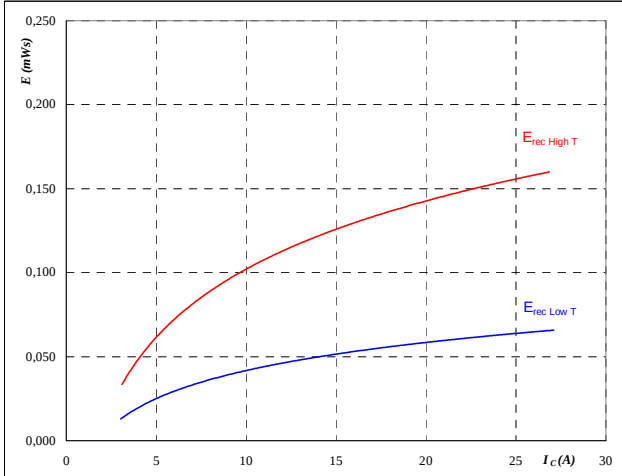
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $I_C = 15$ A

Figure 7 FRED

Typical reverse recovery energy loss
as a function of collector current

$$E_{rec} = f(I_C)$$



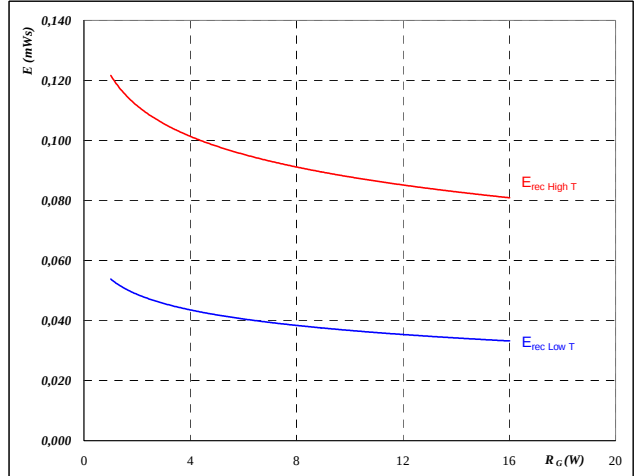
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $R_{gon} = 4$ Ω

Figure 8 FRED

Typical reverse recovery energy loss
as a function of gate resistor

$$E_{rec} = f(R_G)$$



With an inductive load at

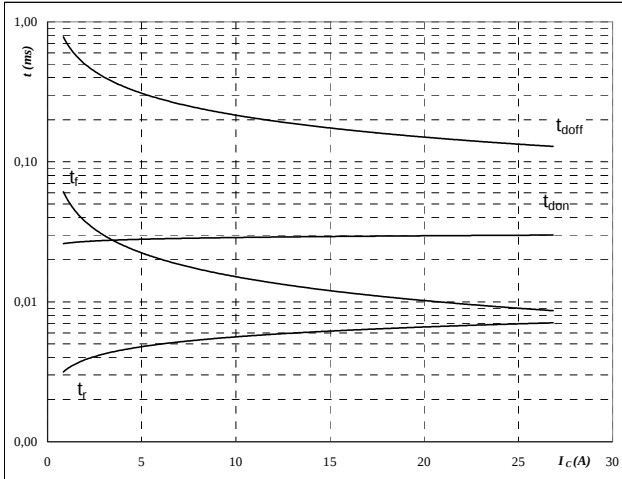
$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $I_C = 15$ A

Buck

Figure 9 MOSFET

Typical switching times as a function of collector current

$$t = f(I_C)$$



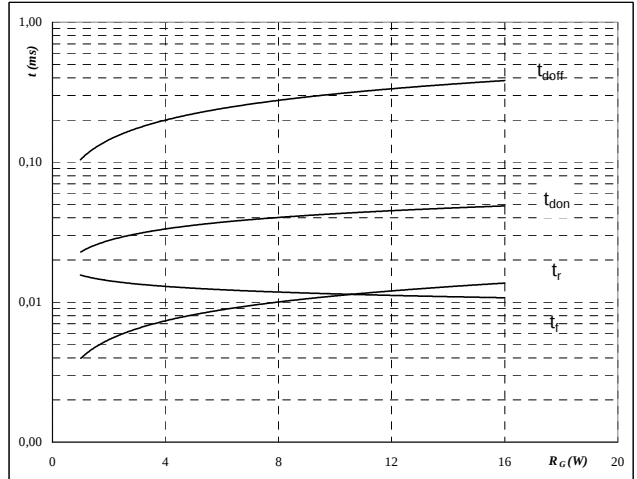
With an inductive load at

$T_J =$	125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω
$R_{goff} =$	4	Ω

Figure 10 MOSFET

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



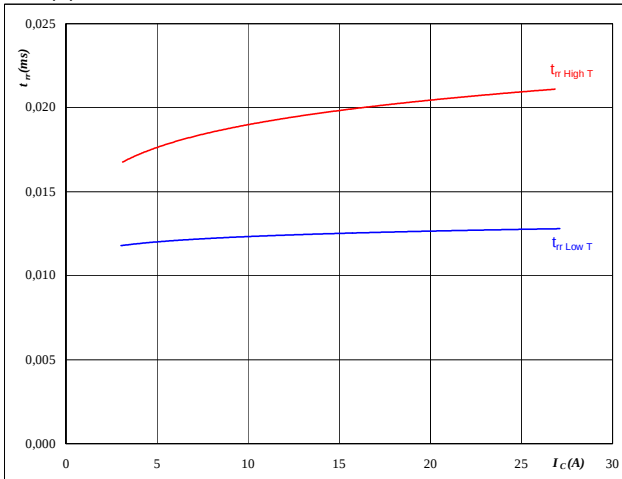
With an inductive load at

$T_J =$	125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$I_C =$	15	A

Figure 11 FRED

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



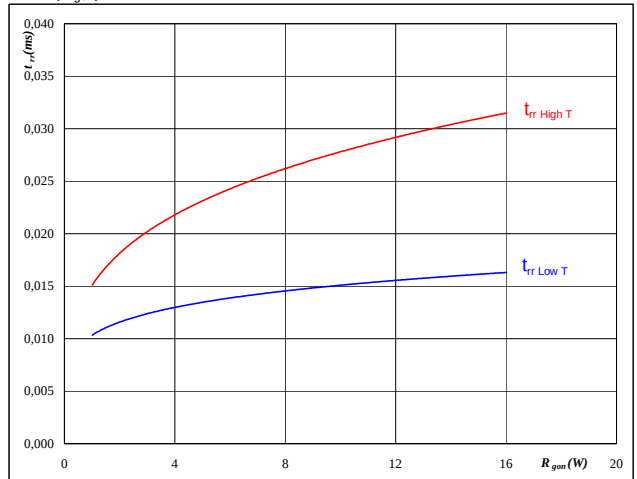
At

$T_J =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 12 FRED

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
$I_F =$	15	A
$V_{GE} =$	10	V

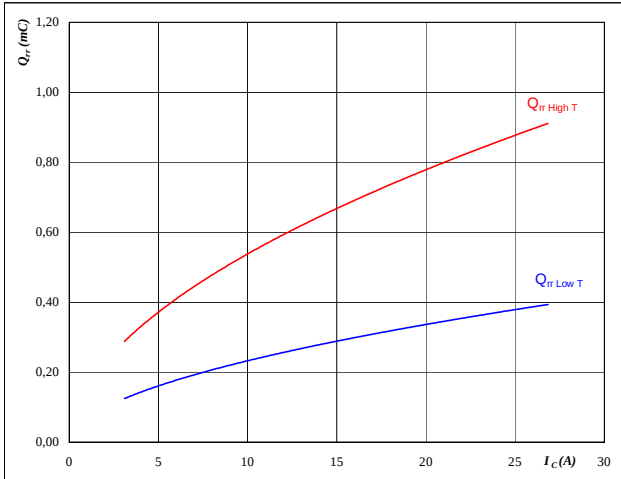
Buck

Figure 13

FRED

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_C)$$



At

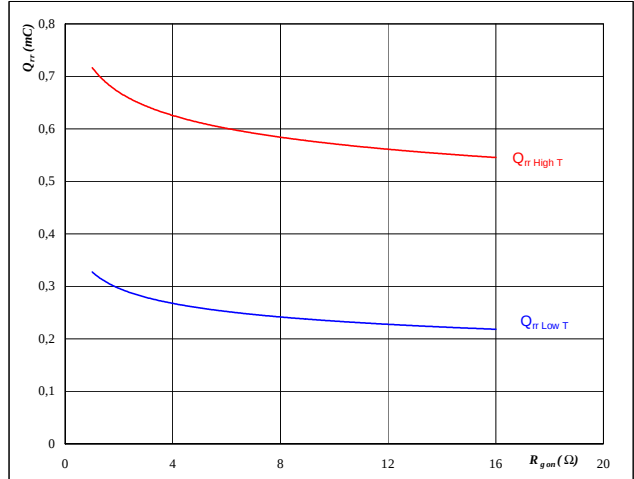
$T_j =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 14

FRED

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

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



At

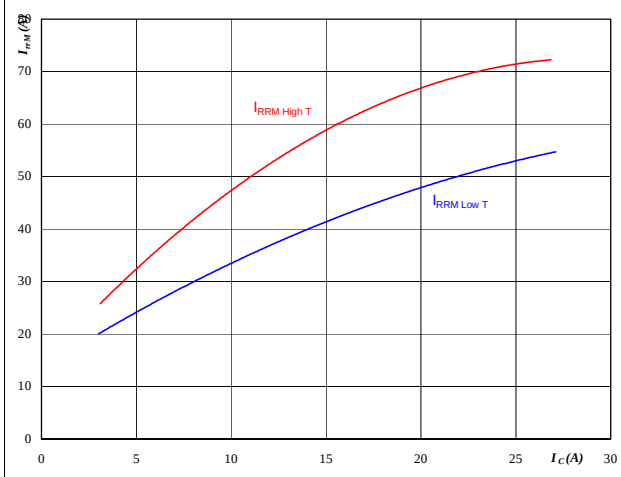
$T_j =$	25/125	°C
$V_R =$	400	V
$I_F =$	15	A
$V_{GE} =$	10	V

Figure 15

FRED

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_C)$$



At

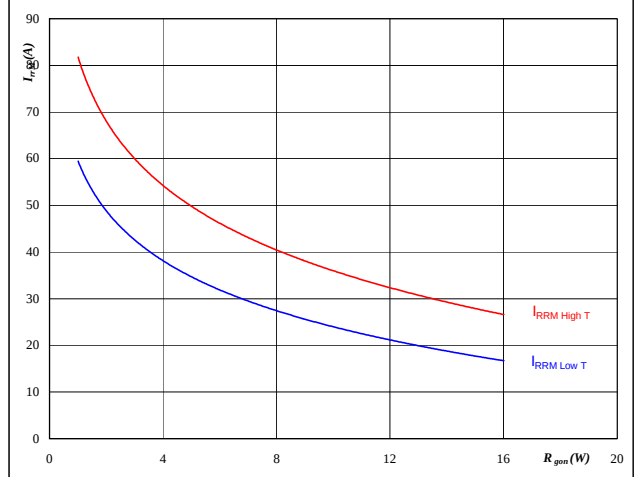
$T_j =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 16

FRED

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

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



At

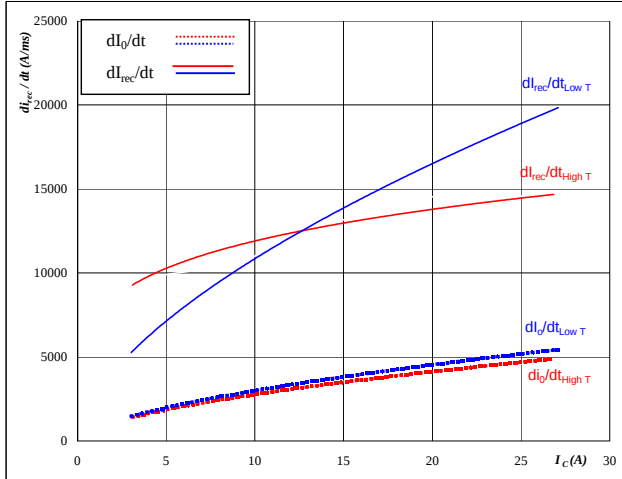
$T_j =$	25/125	°C
$V_R =$	400	V
$I_F =$	15	A
$V_{GE} =$	10	V

Buck

Figure 17
FRED

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

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



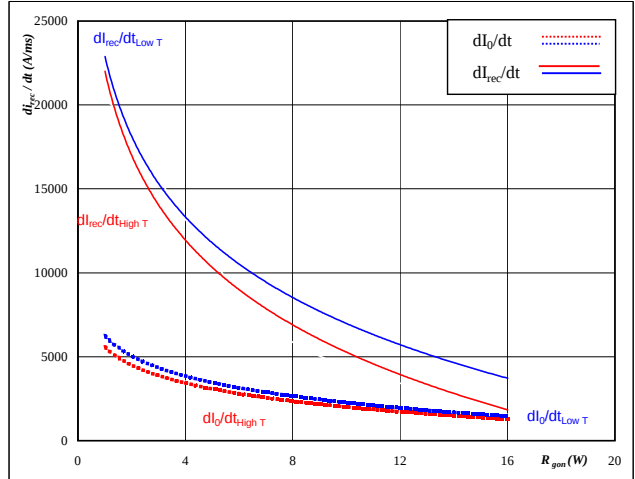
At

$T_j =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 18
FRED

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

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



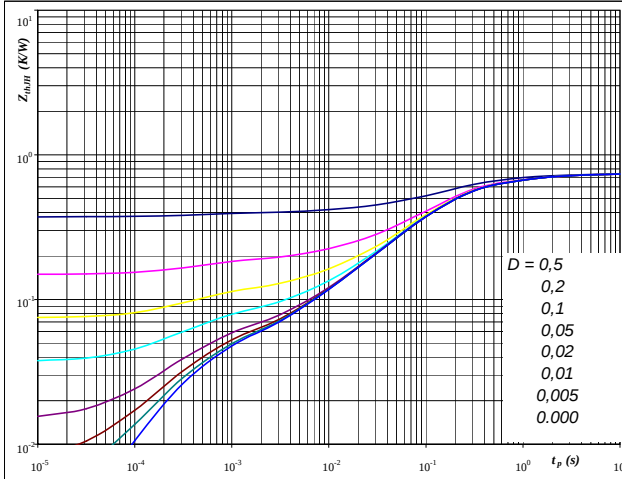
At

$T_j =$	25/125	°C
$V_R =$	400	V
$I_F =$	15	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	
$R_{thJH} =$	0,75	K/W

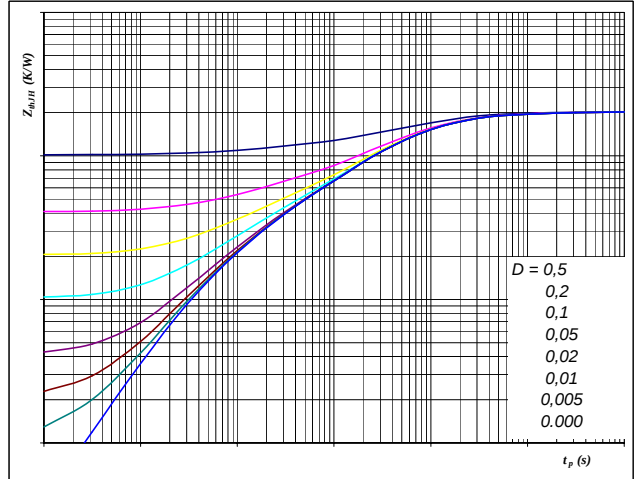
IGBT thermal model values

R (C/W)	Tau (s)
0,03	9,3E+00
0,12	1,2E+00
0,41	1,6E-01
0,11	3,8E-02
0,03	5,2E-03
0,04	3,7E-04

Figure 20
FRED

FRED transient thermal impedance
as a function of pulse width

$$Z_{thJH} = f(t_p)$$



At

$D =$	t_p / T	
$R_{thJH} =$	2,04	K/W

FRED thermal model values

R (C/W)	Tau (s)
0,06	5,6E+00
0,25	5,0E-01
0,90	7,8E-02
0,53	1,5E-02
0,23	1,8E-03
0,07	3,3E-04

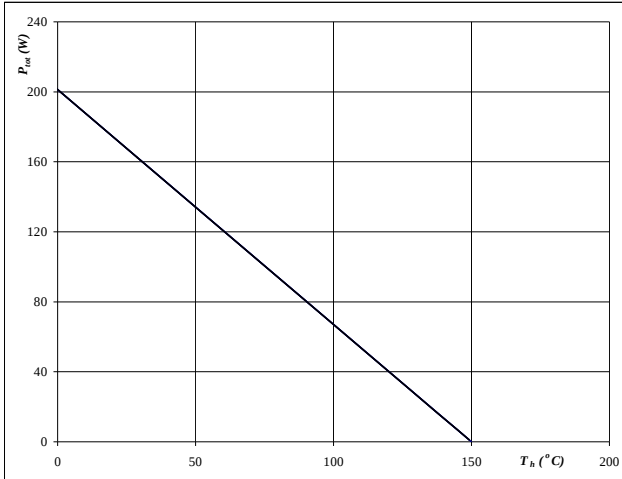
Buck

Figure 21

MOSFET

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$



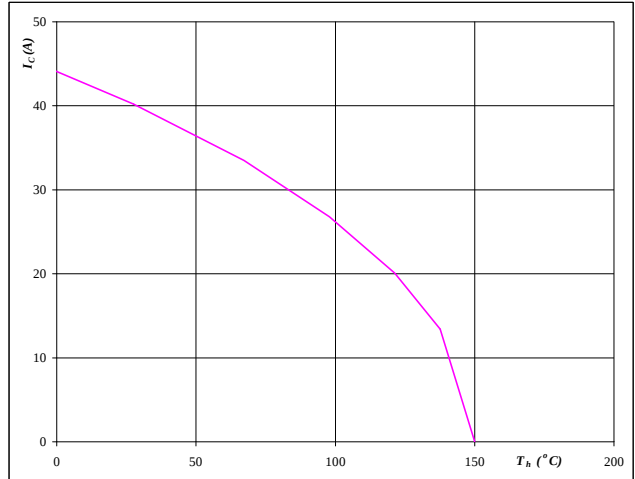
At
 $T_j = 150$ °C

Figure 22

MOSFET

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$



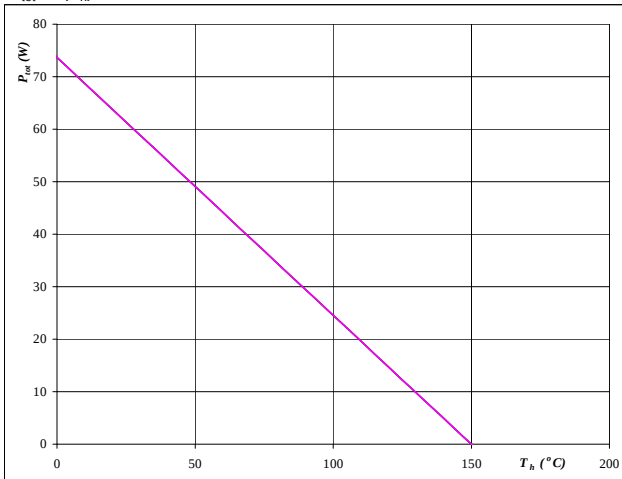
At
 $T_j = 150$ °C
 $V_{GE} = 15$ V

Figure 23

FRED

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$



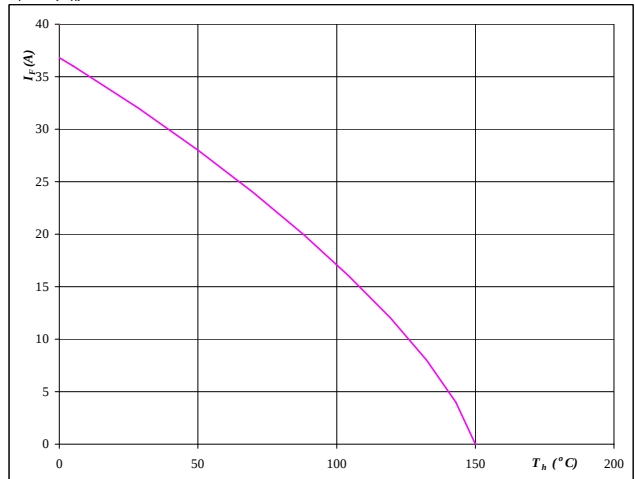
At
 $T_j = 150$ °C

Figure 24

FRED

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



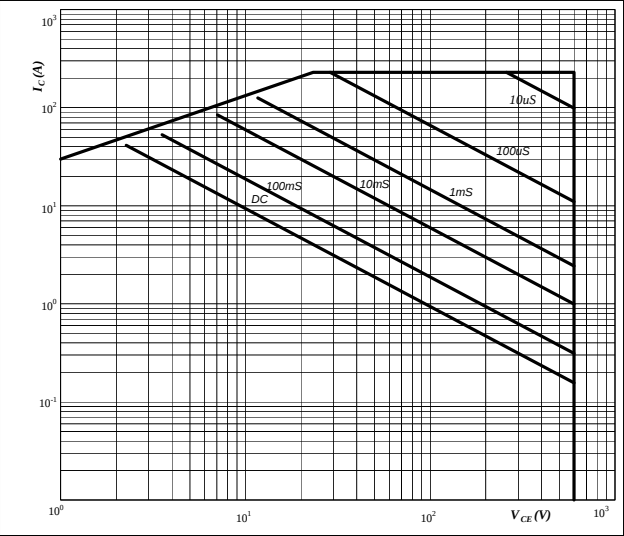
At
 $T_j = 150$ °C

Buck

Figure 25 MOSFET

Safe operating area as a function
of collector-emitter voltage

$I_C = f(V_{CE})$

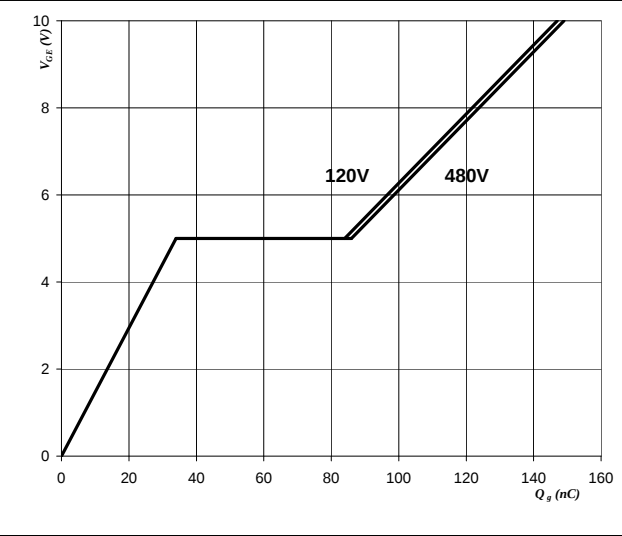


At
D = single pulse
Th = 80 °C
V_{GE} = 15 V
T_j = T_{jmax} °C

Figure 26 MOSFET

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At
I_C = 15 A

Boost

Figure 1 IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

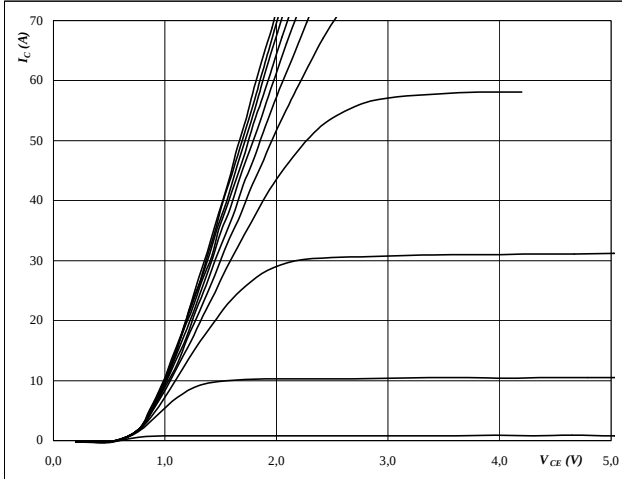

At
 $t_p = 250 \mu s$
 $T_J = 25 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

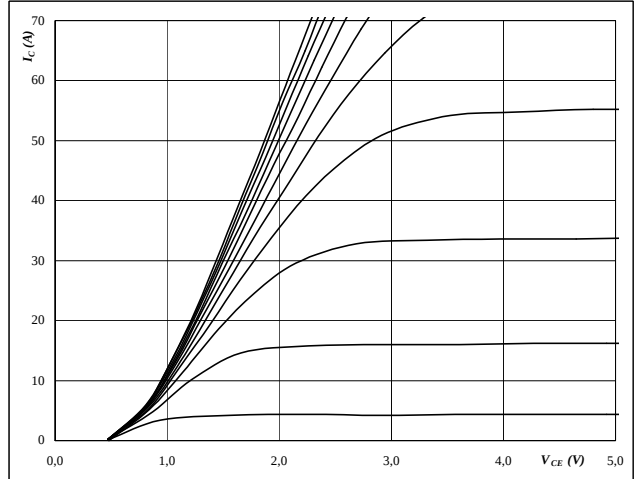
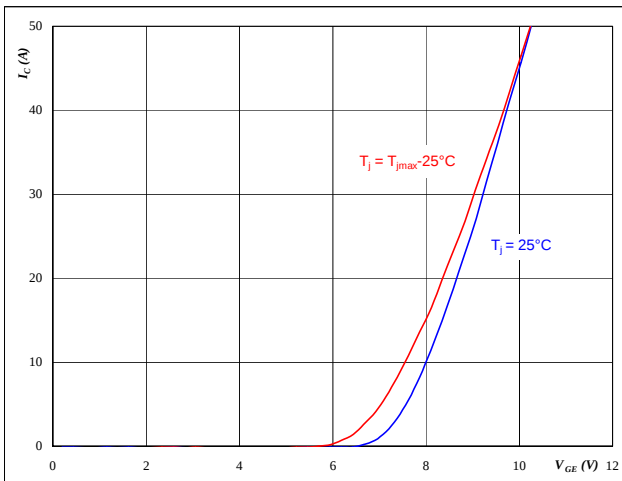

At
 $t_p = 250 \mu s$
 $T_J = 125 ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 IGBT

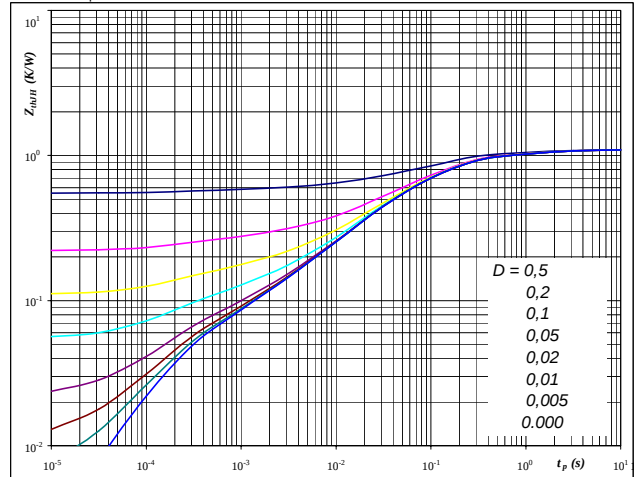
Typical transfer characteristics

$$I_C = f(V_{GE})$$


At
 $t_p = 250 \mu s$
 $V_{CE} = 10 V$
Figure 4 IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(t_p)$$

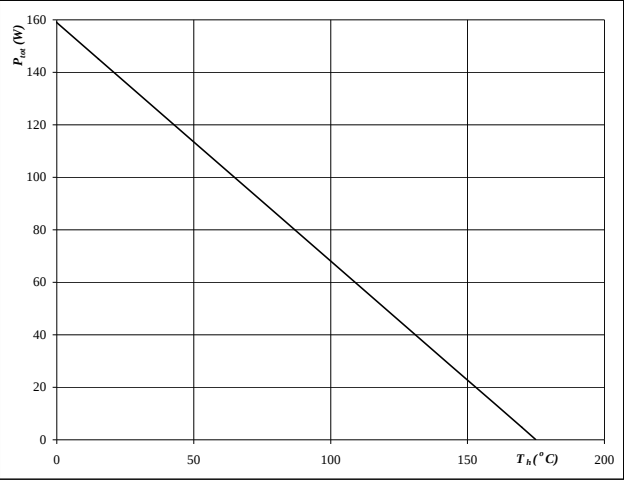

At
 $D = t_p / T$
 $R_{thJH} = 1,10 K/W$

Boost

Figure 5 IGBT

Power dissipation as a
function of heatsink temperature

$P_{tot} = f(T_h)$

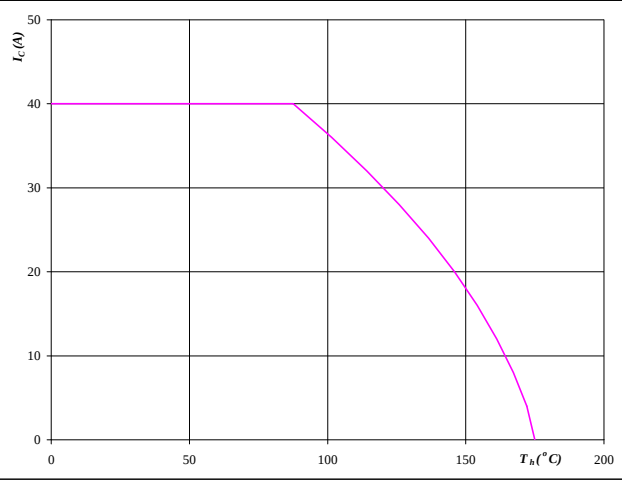


At
 $T_j = 175^{\circ}C$

Figure 6 IGBT

Collector current as a
function of heatsink temperature

$I_C = f(T_h)$



At
 $T_j = 175^{\circ}C$
 $V_{GE} = 15 V$

INPUT BOOST

Figure 1 BOOST MOSFET

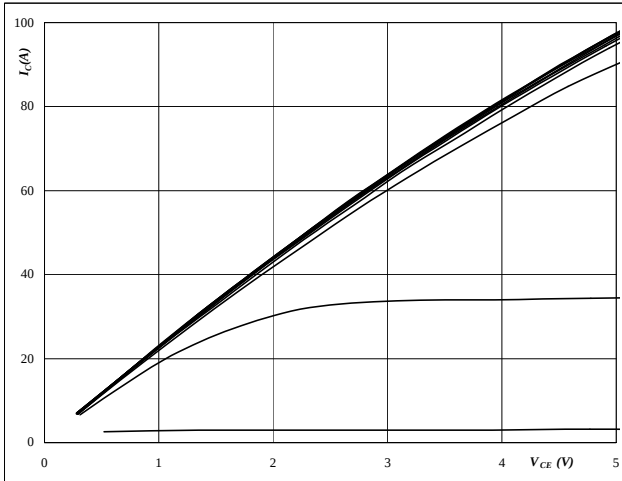
Typical output characteristics
 $I_D = f(V_{DS})$

At
 $t_p = 250 \mu s$
 $T_j = 25 ^\circ C$
 V_{GS} from 4 V to 14 V in steps of 1 V

Figure 2 BOOST FRED

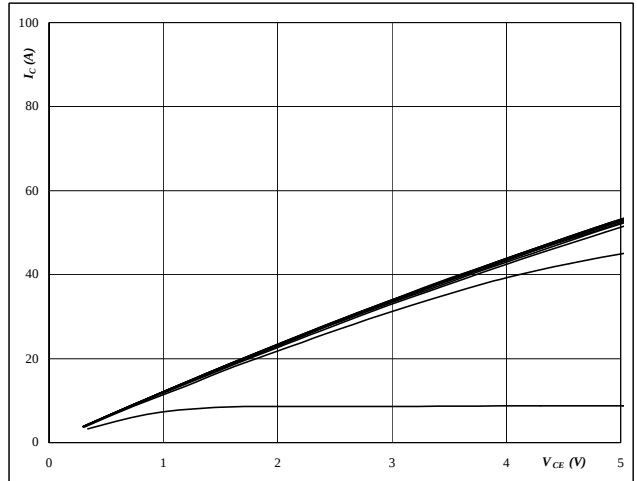
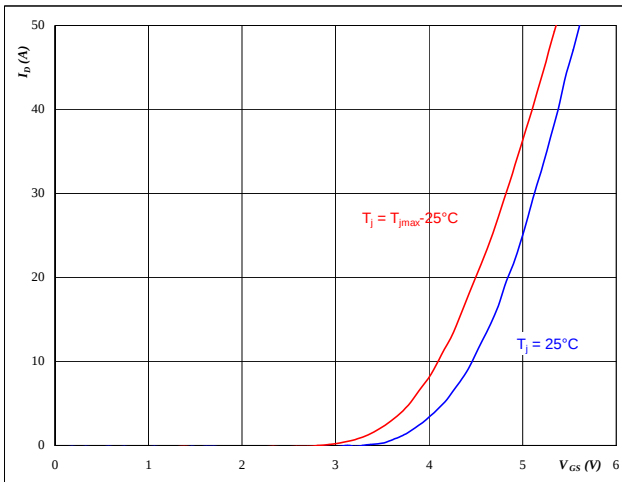
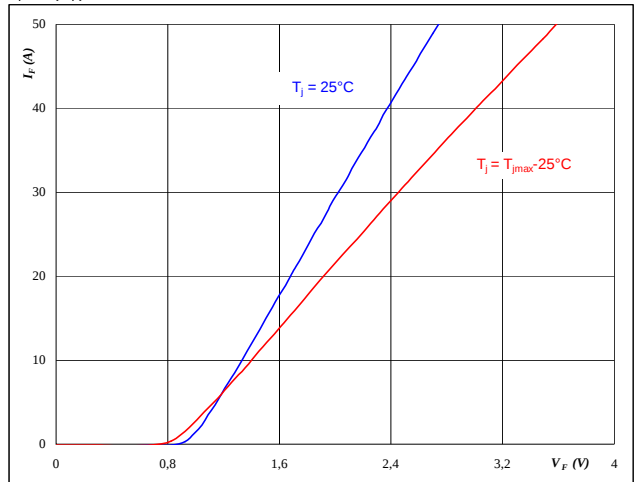
Typical output characteristics
 $I_D = f(V_{DS})$

At
 $t_p = 250 \mu s$
 $T_j = 126 ^\circ C$
 V_{GS} from 4 V to 14 V in steps of 1 V

Figure 3 BOOST MOSFET

Typical transfer characteristics
 $I_D = f(V_{DS})$

At
 $t_p = 250 \mu s$
 $V_{DS} = 10 V$
Figure 4 BOOST FRED

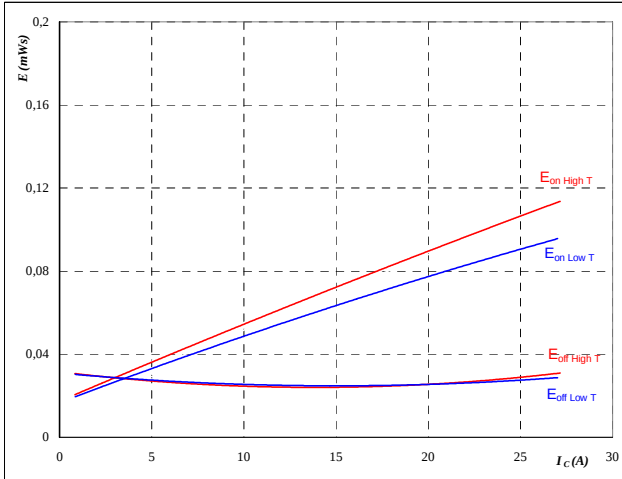
Typical diode forward current as a function of forward voltage
 $I_F = f(V_F)$

At
 $t_p = 250 \mu s$

INPUT BOOST

Figure 5 BOOST MOSFET

Typical switching energy losses
as a function of collector current

$$E = f(I_D)$$



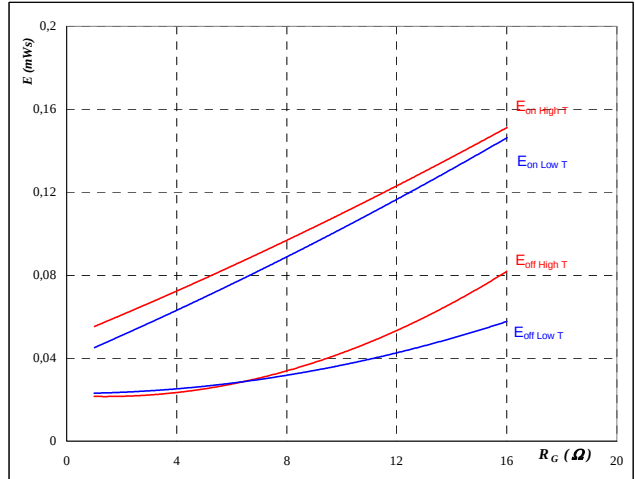
With an inductive load at

$T_J = 25/125$ °C
 $V_{DS} = 400$ V
 $V_{GS} = 10$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

Figure 6 BOOST MOSFET

Typical switching energy losses
as a function of gate resistor

$$E = f(R_G)$$



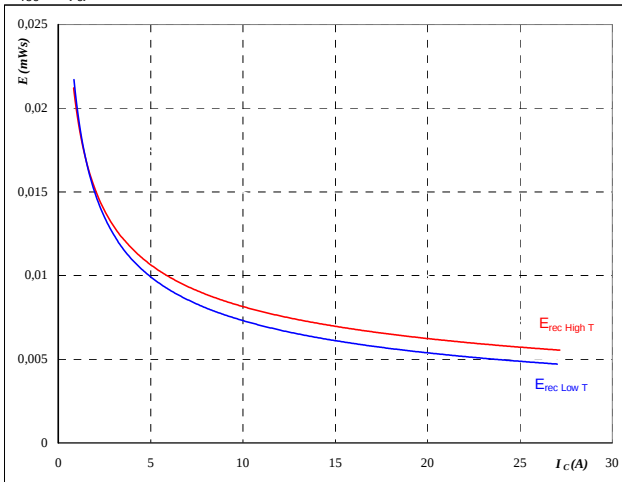
With an inductive load at

$T_J = 25/125$ °C
 $V_{DS} = 400$ V
 $V_{GS} = 10$ V
 $I_D = 15$ A

Figure 7 BOOST MOSFET

Typical reverse recovery energy loss
as a function of collector (drain) current

$$E_{rec} = f(I_C)$$



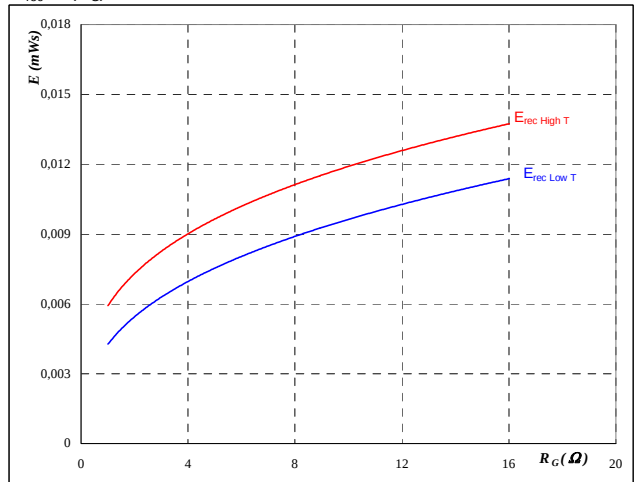
With an inductive load at

$T_J = 25/125$ °C
 $V_{DS} = 400$ V
 $V_{GS} = 10$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

Figure 8 BOOST MOSFET

Typical reverse recovery energy loss
as a function of gate resistor

$$E_{rec} = f(R_G)$$



With an inductive load at

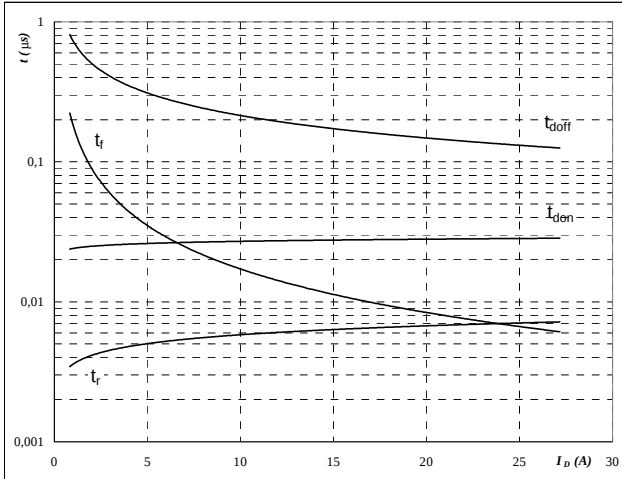
$T_J = 25/125$ °C
 $V_{DS} = 400$ V
 $V_{GS} = 10$ V
 $I_D = 15$ A

INPUT BOOST

Figure 9 BOOST MOSFET

Typical switching times as a function of collector current

$$t = f(I_C)$$



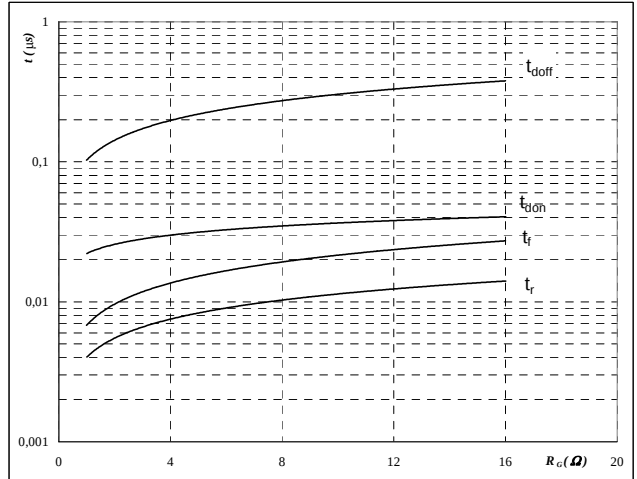
With an inductive load at

$T_J =$	125	°C
$V_{DS} =$	400	V
$V_{GS} =$	10	V
$R_{gon} =$	4	Ω
$R_{goff} =$	4	Ω

Figure 10 BOOST MOSFET

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



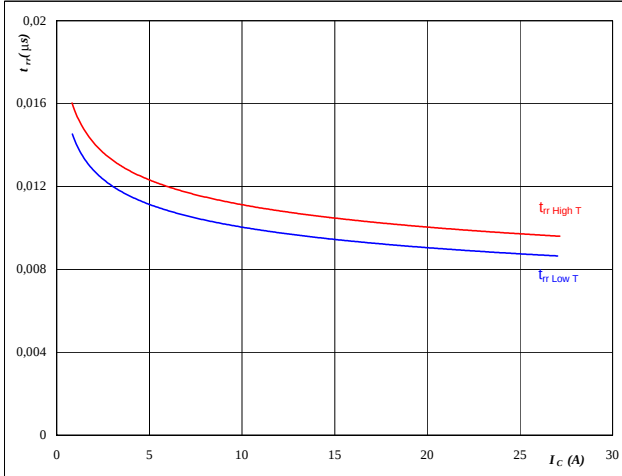
With an inductive load at

$T_J =$	125	°C
$V_{DS} =$	400	V
$V_{GS} =$	10	V
$I_C =$	15	A

Figure 11 BOOST FRED

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



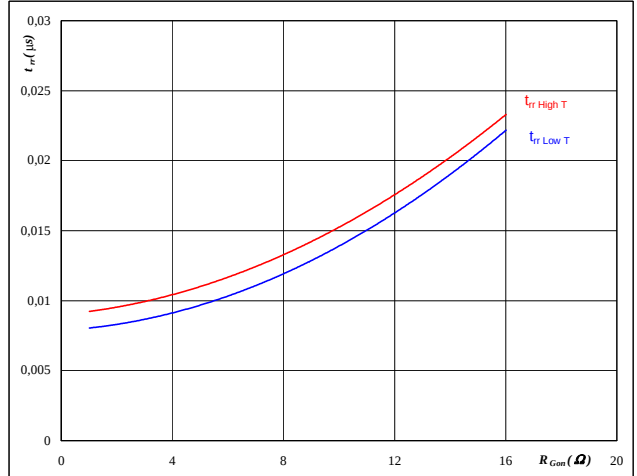
At

$T_J =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 12 BOOST FRED

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
$I_F =$	15	A
$V_{GS} =$	10	V

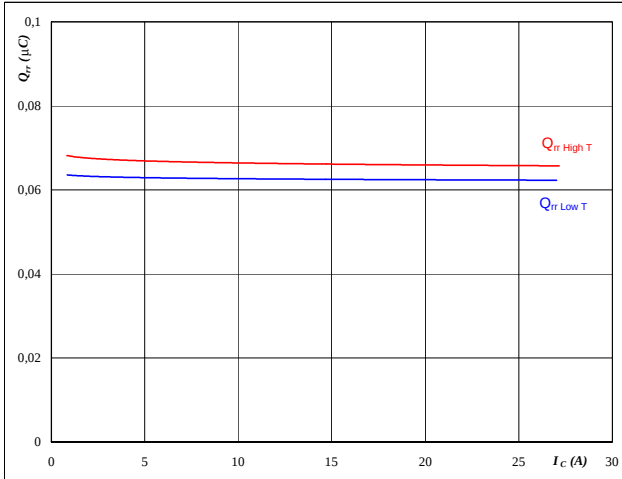
INPUT BOOST

Figure 13

BOOST FRED

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_C)$$



At

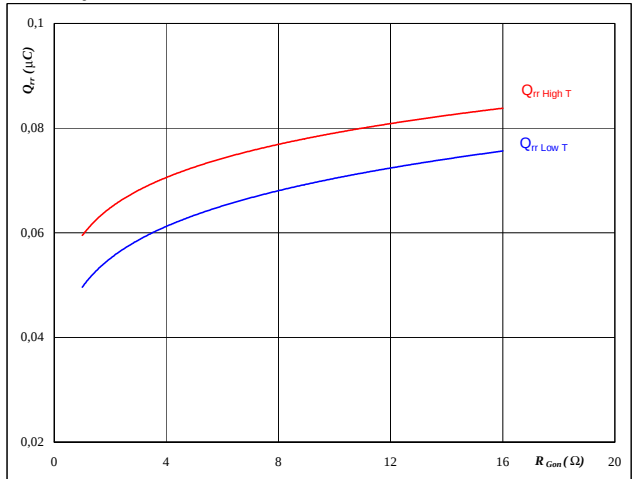
$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $R_{gon} = 4$ Ω

Figure 14

BOOST FRED

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

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



At

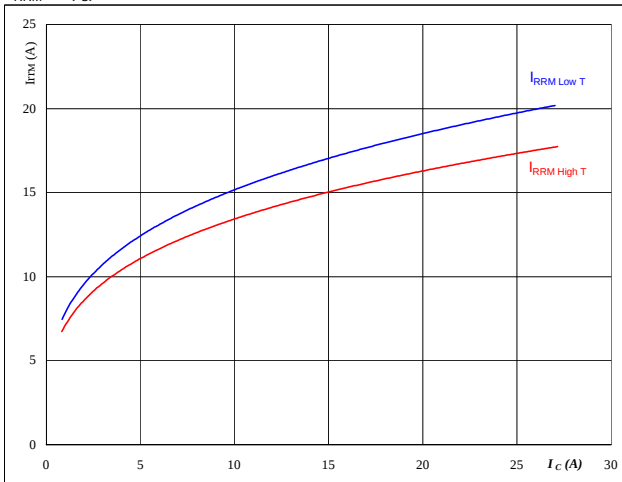
$T_J = 25/125$ °C
 $V_R = 400$ V
 $I_F = 15$ A
 $V_{GS} = 10$ V

Figure 15

BOOST FRED

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_C)$$



At

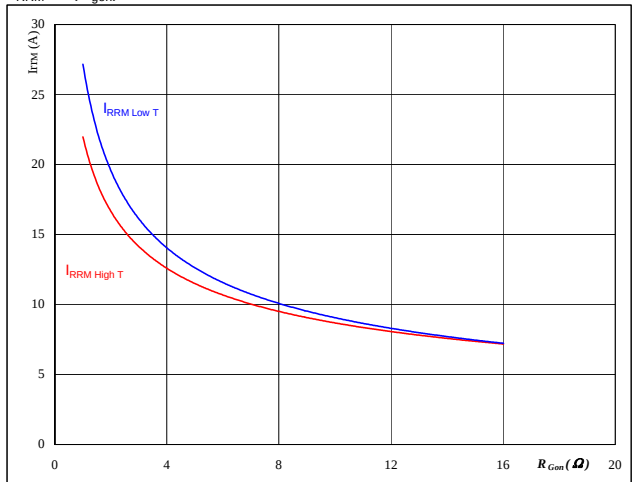
$T_J = 25/125$ °C
 $V_{CE} = 400$ V
 $V_{GE} = 10$ V
 $R_{gon} = 4$ Ω

Figure 16

BOOST FRED

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

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



At

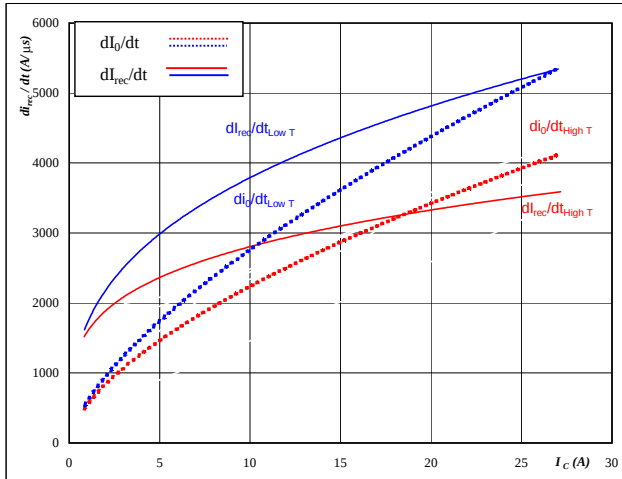
$T_J = 25/125$ °C
 $V_R = 400$ V
 $I_F = 15$ A
 $V_{GS} = 10$ V

INPUT BOOST

Figure 17 BOOST FRED

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

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



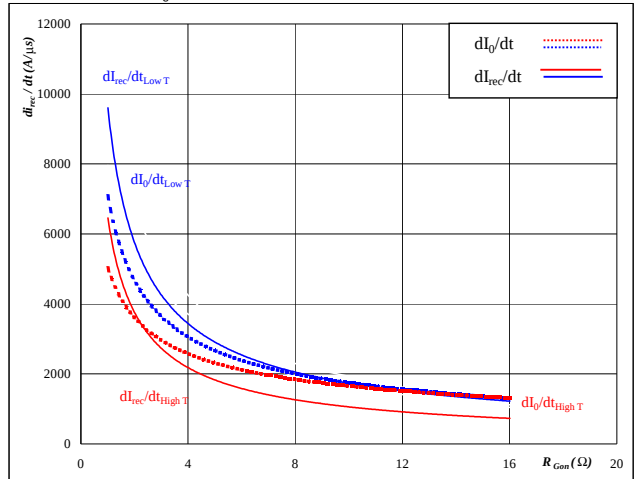
At

$T_J =$	25/125	°C
$V_{CE} =$	400	V
$V_{GE} =$	10	V
$R_{gon} =$	4	Ω

Figure 18 BOOST FRED

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

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



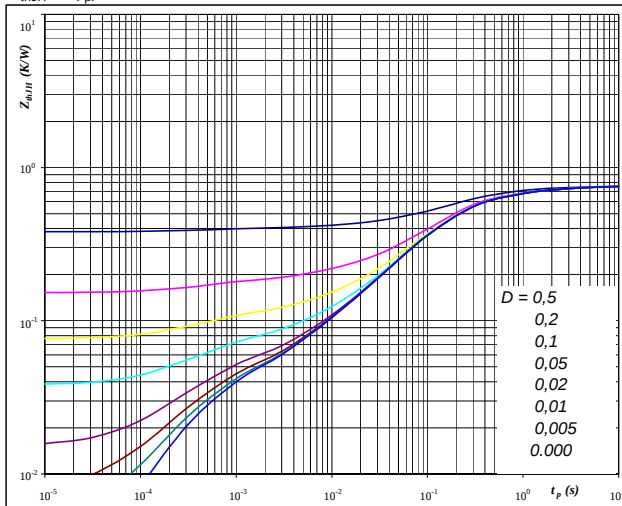
At

$T_J =$	25/125	°C
$V_R =$	400	V
$I_F =$	15	A
$V_{GS} =$	10	V

Figure 19 BOOST MOSFET

IGBT/MOSFET transient thermal impedance
as a function of pulse width

$$Z_{thJH} = f(t_p)$$



At

$D =$	t_p / T	
$R_{thJH} =$	0,76	K/W

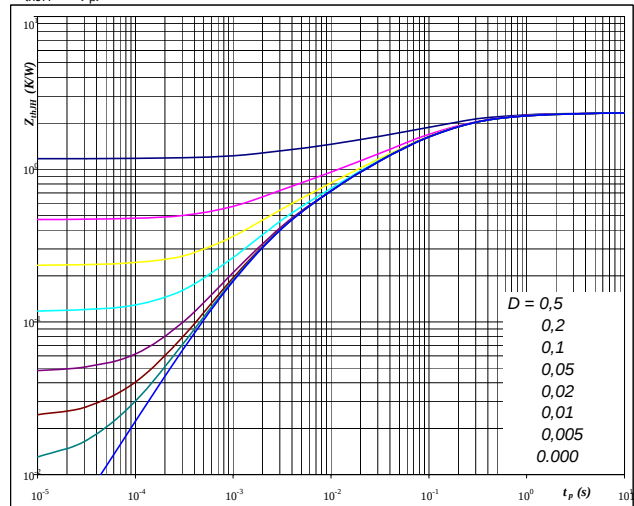
IGBT thermal model values

R (C/W)	Tau (s)
0,03247	9,971
0,1223	1,22
0,4264	0,1797
0,1173	0,04698
0,03103	0,005891
0,03298	0,0004038

Figure 20 BOOST FRED

FRED 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

FRED thermal model values

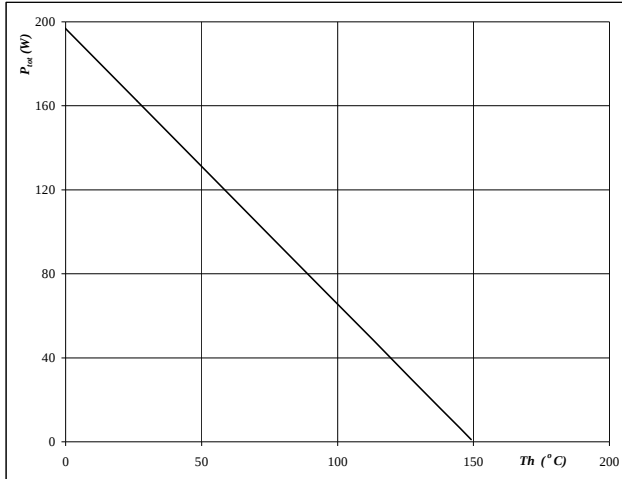
R (C/W)	Tau (s)
0,1024	2,885
0,495	0,3437
0,9886	0,07039
0,4865	0,01004
0,2673	0,001614

INPUT BOOST

Figure 21 BOOST MOSFET

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$

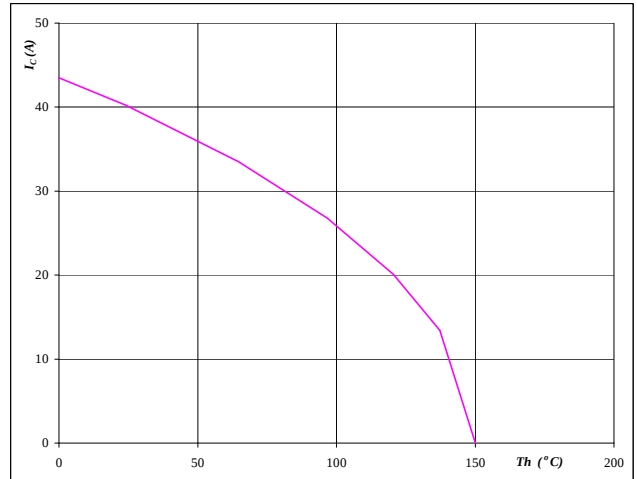


At
 $T_j = 150$ °C

Figure 22 BOOST MOSFET

Collector/Drain current as a function of heatsink temperature

$$I_C = f(T_h)$$

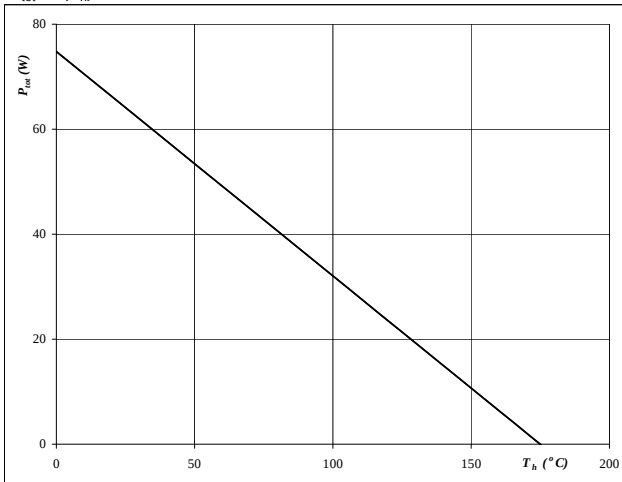


At
 $T_j = 150$ °C
 $V_{GS} = 10$ V

Figure 23 BOOST FRED

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$

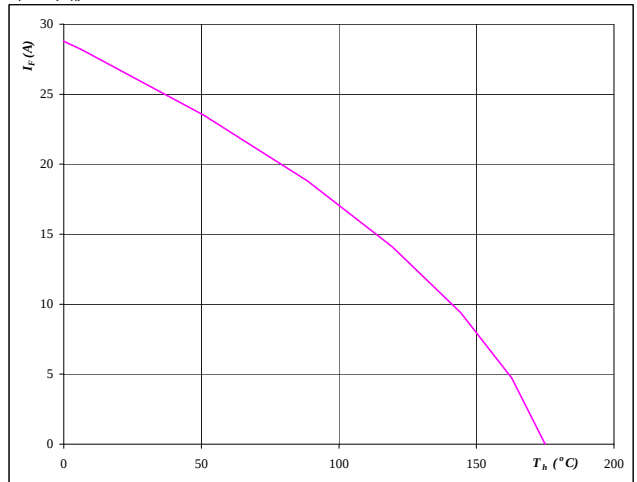


At
 $T_j = 175$ °C

Figure 24 BOOST FRED

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



At
 $T_j = 175$ °C

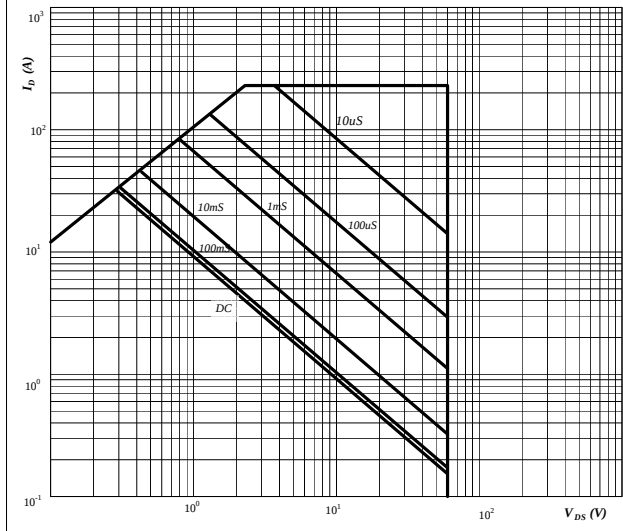
INPUT BOOST

Figure 25

BOOST MOSFET

Safe operating area as a function
of drain-source voltage

$$I_D = f(V_{DS})$$


At

D = single pulse

$T_h = 80$ °C

$V_{GS} = 10$ V

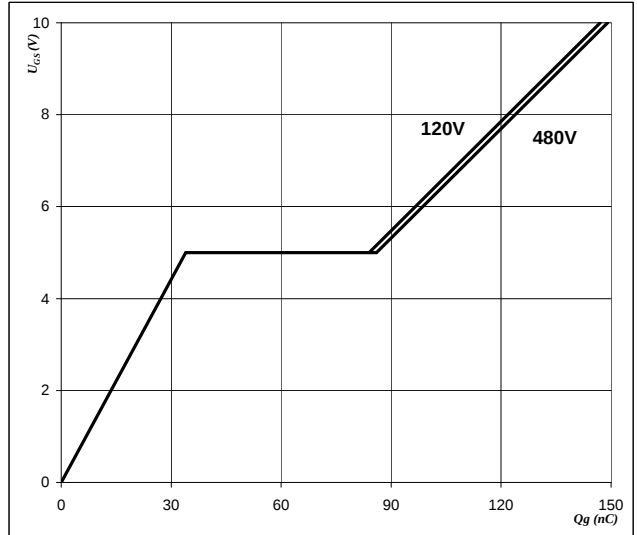
$T_j = T_{jmax}$ °C

Figure 26

BOOST MOSFET

Gate voltage vs Gate charge

$$V_{GS} = f(Q_g)$$


At

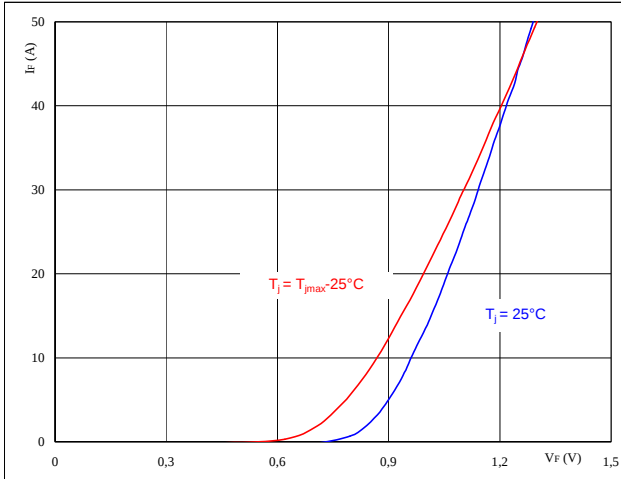
$I_D = 15$ A

Bypass Diode

Figure 1 Bypass diode

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

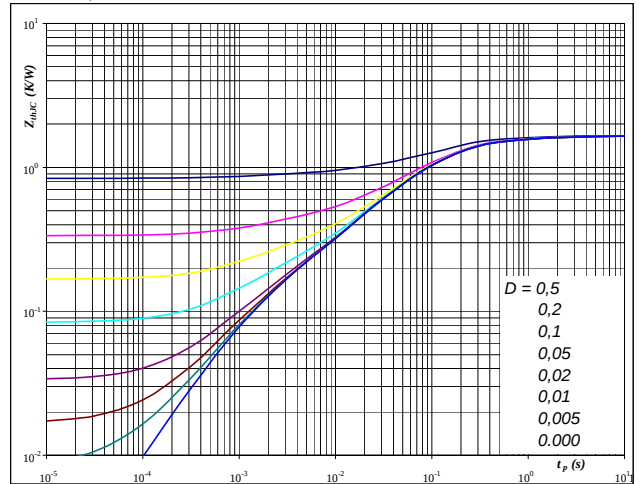


At
 $t_p = 250 \mu s$

Figure 2 Bypass diode

Diode transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(t_p)$$

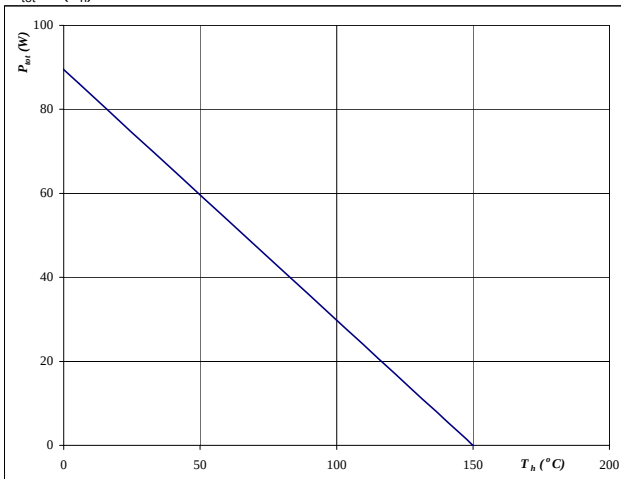


At
 $D = t_p / T$
 $R_{thJH} = 1,677 \text{ K/W}$

Figure 3 Bypass diode

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_h)$$

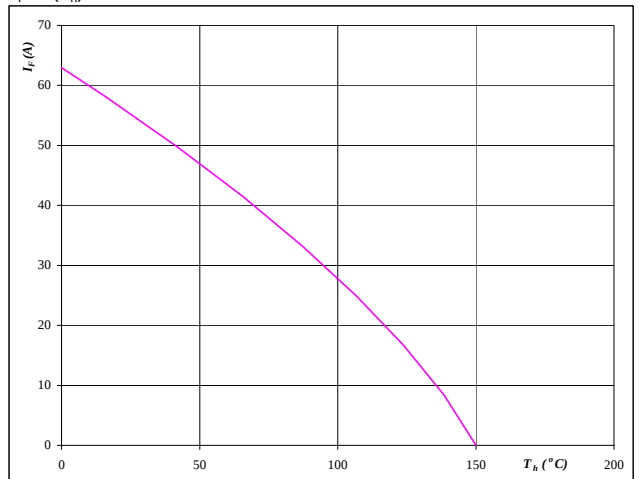


At
 $T_j = 150 \text{ °C}$

Figure 4 Bypass diode

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



At
 $T_j = 150 \text{ °C}$

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$

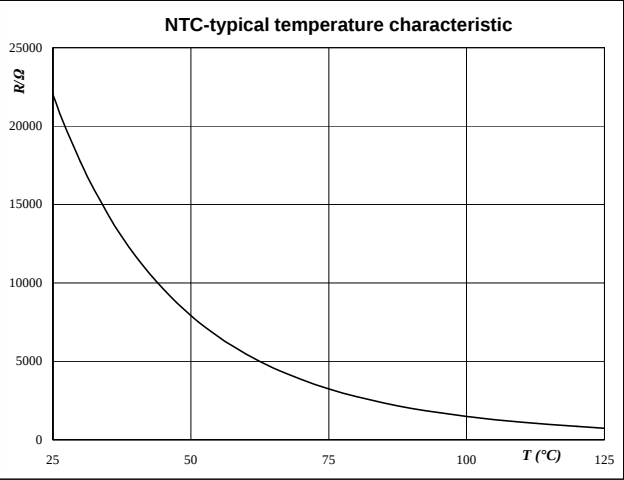


Figure 2 Thermistor

Typical NTC resistance values

$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \left(\frac{1}{T} - \frac{1}{T_{25}} \right) \right)} \quad [\Omega]$$

T [°C]	R _{nom} [Ω]	R _{min} [Ω]	R _{max} [Ω]	ΔR/R [±%]
-55	2089434,5	1506495,4	2672373,6	27,9
0	71804,2	59724,4	83884	16,8
10	43780,4	37094,4	50466,5	15,3
20	27484,6	23684,6	31284,7	13,8
25	22000	19109,3	24890,7	13,1
30	17723,3	15512,2	19934,4	12,5
60	5467,9	4980,6	5955,1	8,9
70	3848,6	3546	4151,1	7,9
80	2757,7	2568,2	2947,1	6,9
90	2008,9	1889,7	2128,2	5,9
100	1486,1	1411,8	1560,4	5
150	400,2	364,8	435,7	8,8

Switching Definitions BUCK MOSFET

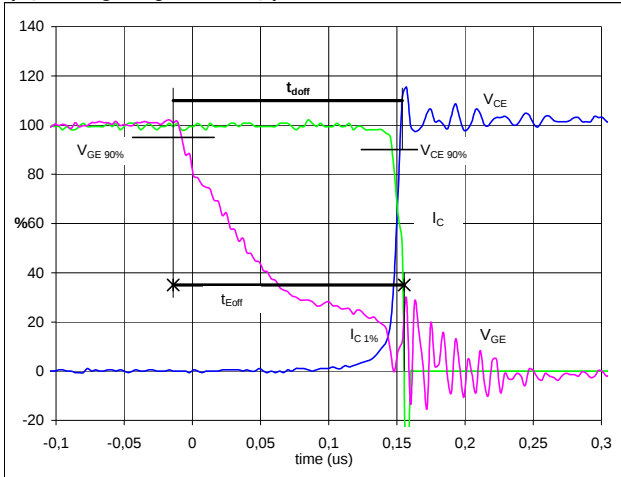
General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Output inverter IGBT

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

(t_{Eoff} = integrating time for E_{off})

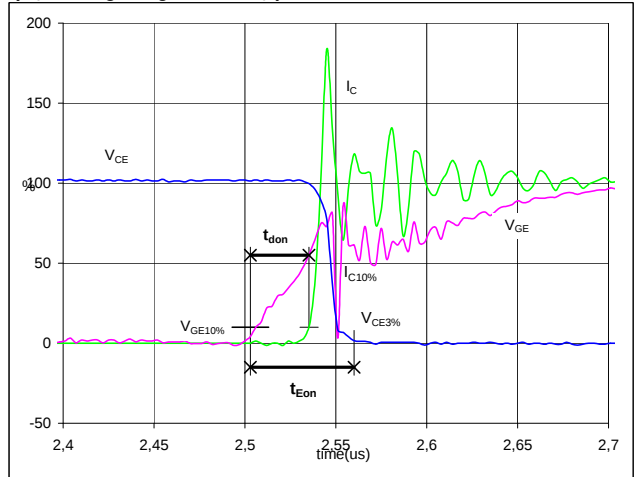


$V_{GE} (0\%) =$	0	V
$V_{GE} (100\%) =$	10	V
$V_C (100\%) =$	400	V
$I_C (100\%) =$	15	A
$t_{doff} =$	0,16	μs
$t_{Eoff} =$	0,17	μs

Figure 2 Output inverter IGBT

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

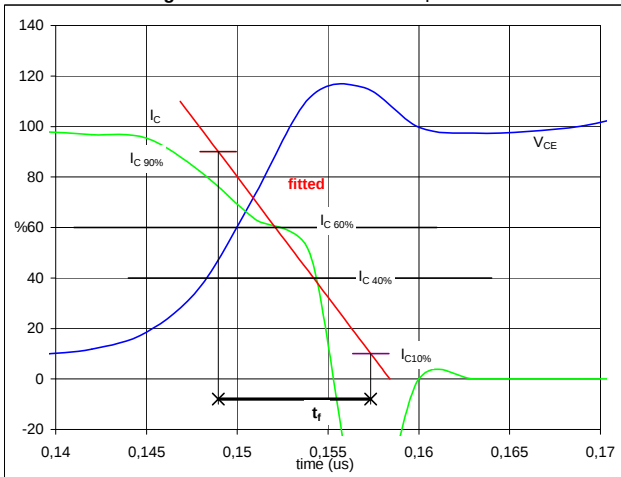
(t_{Eon} = integrating time for E_{on})



$V_{GE} (0\%) =$	0	V
$V_{GE} (100\%) =$	10	V
$V_C (100\%) =$	400	V
$I_C (100\%) =$	15	A
$t_{don} =$	0,03	μs
$t_{Eon} =$	0,06	μs

Figure 3 Output inverter IGBT

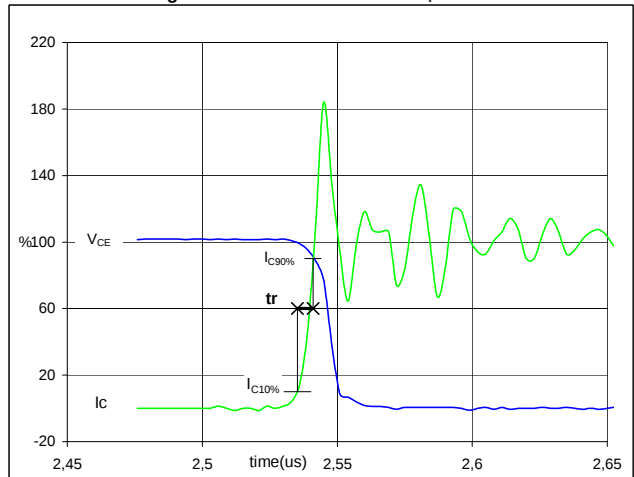
Turn-off Switching Waveforms & definition of t_f



$V_C (100\%) =$	400	V
$I_C (100\%) =$	15	A
$t_f =$	0,01	μs

Figure 4 Output inverter IGBT

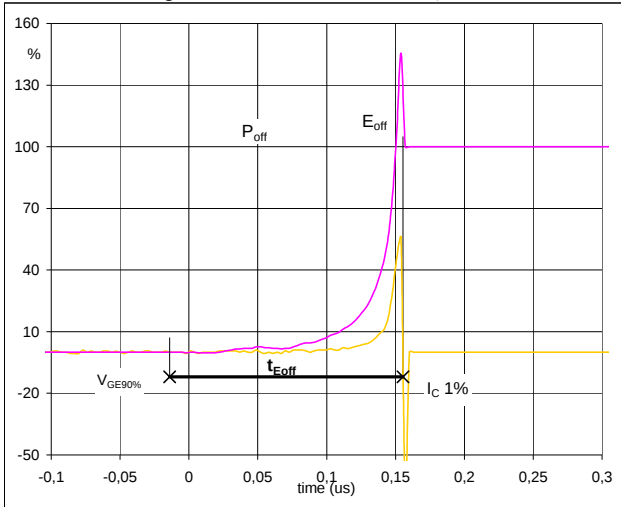
Turn-on Switching Waveforms & definition of t_r



$V_C (100\%) =$	400	V
$I_C (100\%) =$	15	A
$t_r =$	0,01	μs

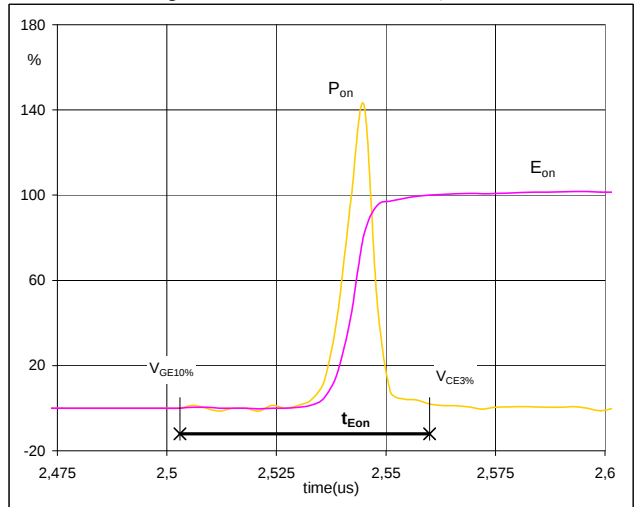
Switching Definitions BUCK MOSFET

Figure 5 Output inverter IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



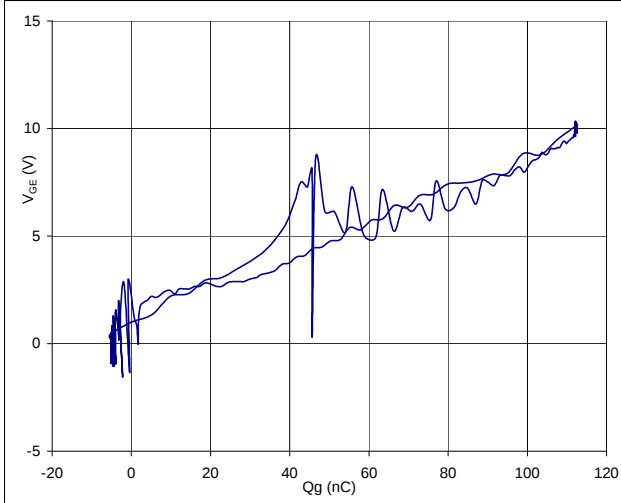
$P_{off} (100\%) = 6,01$ kW
 $E_{off} (100\%) = 0,02$ mJ
 $t_{Eoff} = 0,17$ μ s

Figure 6 Output inverter IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



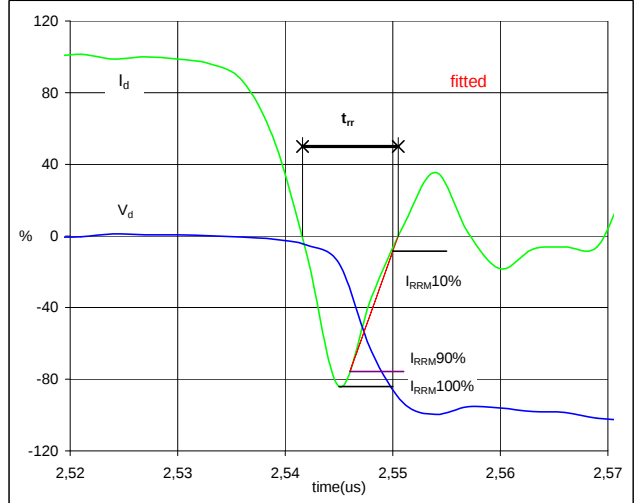
$P_{on} (100\%) = 6,01$ kW
 $E_{on} (100\%) = 0,07$ mJ
 $t_{Eon} = 0,06$ μ s

Figure 7 Output inverter FRED
Gate voltage vs Gate charge (measured)



$V_{GEoff} = 0$ V
 $V_{GEon} = 10$ V
 $V_C (100\%) = 400$ V
 $I_C (100\%) = 15$ A
 $Q_g = 112,54$ nC

Figure 8 Output inverter IGBT
Turn-off Switching Waveforms & definition of t_{rr}

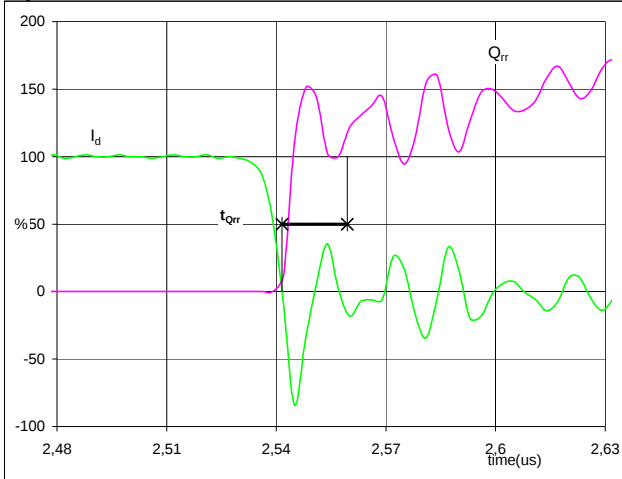


$V_d (100\%) = 400$ V
 $I_d (100\%) = 15$ A
 $I_{RRM} (100\%) = -6$ A
 $t_{rr} = 0,01$ μ s

Switching Definitions BUCK MOSFET

Figure 9 Output inverter FRED

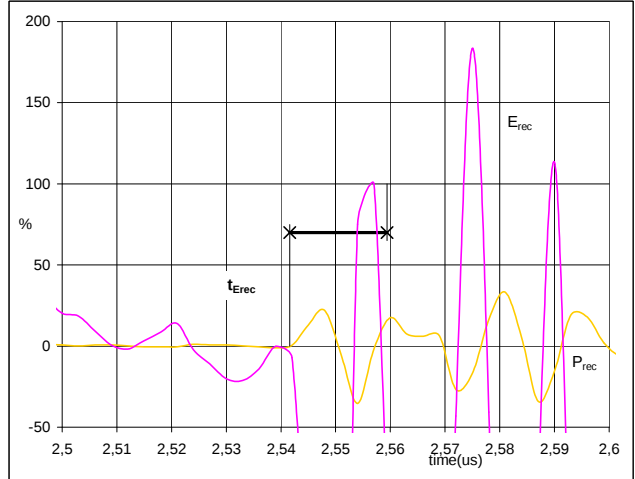
Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) = 15 A
 Q_{rr} (100%) = 0,03 μ C
 t_{Qrr} = 0,02 μ s

Figure 10 Output inverter FRED

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

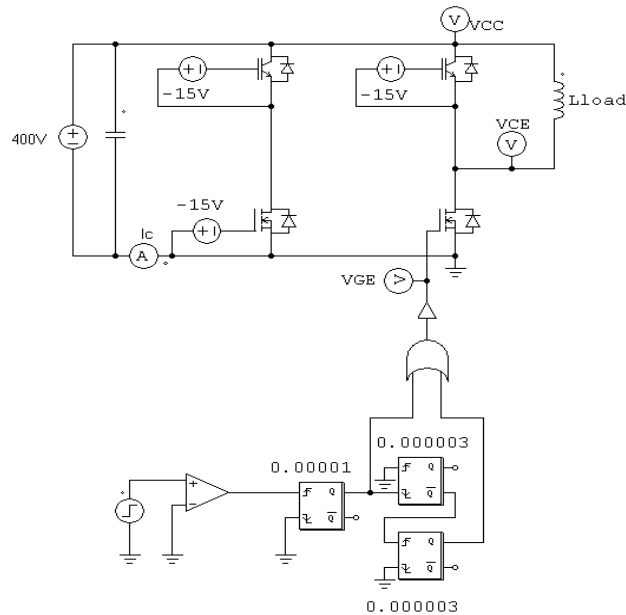


P_{rec} (100%) = 6,01 kW
 E_{rec} (100%) = 0,01 mJ
 t_{Erec} = 0,02 μ s

Measurement circuits

Figure 11

BUCK stage switching measurement circuit



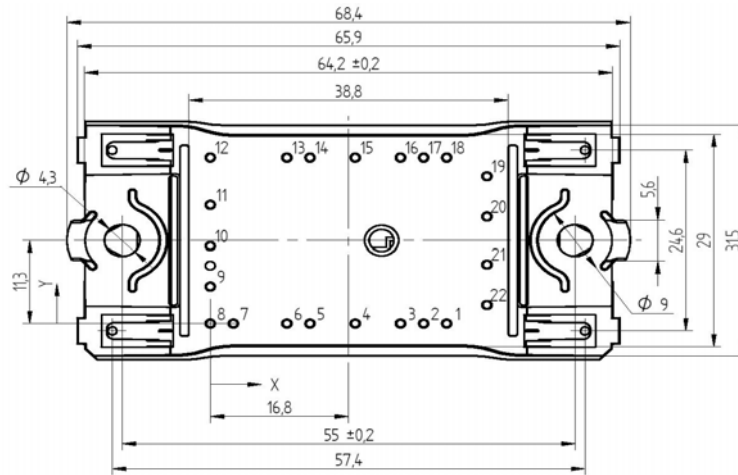
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

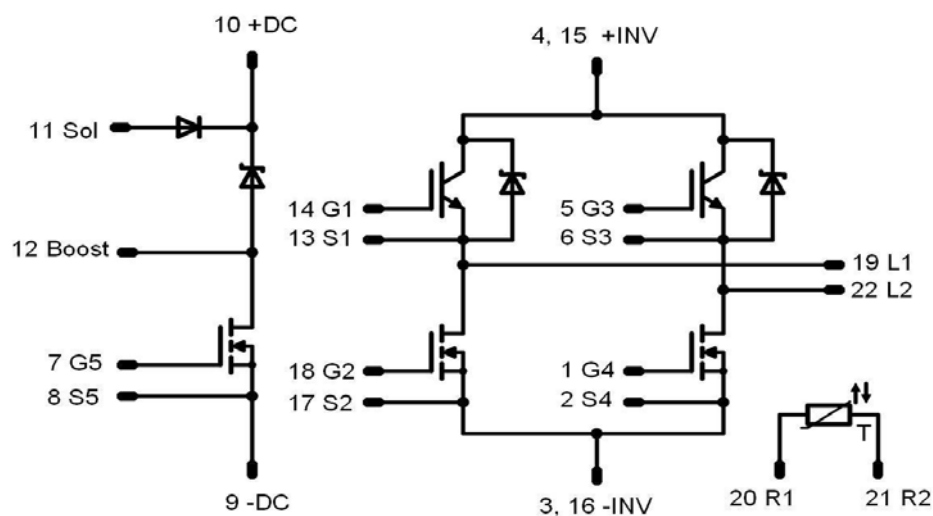
	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FZ06BIA045FH01-P897E10	P897E10	P897E10

Outline

Pin table		
Pin	X	Y
1	28,7	0
2	25,9	0
3	23,1	0
4	17,6	0
5	12,1	0
6	9,3	0
7	2,8	0
8	0	0
9	0	5,05
10	0	10,55
11	0	16,15
12	0	22,6
13	9,3	22,6
14	12,1	22,6
15	17,6	22,6
16	23,1	22,6
17	25,9	22,6
18	28,7	22,6
19	33,6	20,05
20	33,6	14,55
21	33,6	8,05
22	33,6	2,55



Pinout



PRODUCT STATUS DEFINITIONS

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.
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