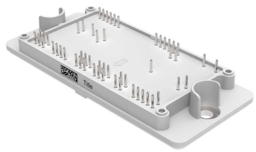
flow **2 MNPC** **1200 V / 160 A**

Features

- mixed voltage NPC topology
- reactive power capability
- low inductance layout
- Split output
- Common collector neutral connection

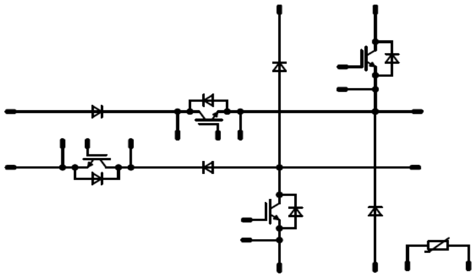
flow 2 13mm housing



Target Applications

- solar inverter
- UPS
- Active frontend

Schematic



Types

- 30-FT12NMA160SH-M669F08

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Buck Inverse Diode					
Repetitive peak reverse voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	7	A
Maximum repetitive forward current	I_{FRM}	t_p = 10 ms		14	A
I^2t-value	I^2t	$T_j = T_{jmax}$		40	A^2s
Power dissipation	P_{tot}		T_s = 80 °C	40	W
Maximum Junction Temperature	T_{jmax}			150	°C
Buck Switch					
Collector-emitter breakdown voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	157	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		480	A
Turn off safe operating area		V_{CE}max = 1200V, T_{vj} ≤ 150°C		320	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	398	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		10 800	μs V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Buck Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	96	A
Non-repetitive Peak Surge Current	I_{FSM}	t_p limited by T_{jmax}		1200	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	110	W
Maximum Junction Temperature	T_{jmax}			150	°C
Boost Switch					
Collector-emitter breakdown voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	91	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		300	A
Turn off safe operating area		V_{CE} ≤ 600V, T_j ≤ 175°C		300	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	174	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		6 360	µs V
Maximum Junction Temperature	T_{jmax}			175	°C
Boost Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	38	A
Maximum repetitive forward current	I_{FRM}	t_p limited by T_{jmax}		60	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	65	W
Maximum Junction Temperature	T_{jmax}			175	°C
Boost Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	50	A
Nonrepetitive peak surge current	I_{FRM}	t_p limited by T_{jmax} (Halfwave 1 Phase 60Hz)		650	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	94	W
Maximum Junction Temperature	T_{jmax}			150	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC voltage*	t_p = 2 s	4000	V
		AC voltage	t_p = 1 min	2500	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			>200	

* 100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Buck Inverse Diode										
Forward voltage	V_F				7	25 125	1	1,97 1,65	3,4	V
Threshold voltage (for power loss calc. only)	V_{to}				7	25 125		1,33 1,01		V
Slope resistance (for power loss calc. only)	r_t				7	25 125		91 91		mΩ
Reverse current	I_r			1200		25			0,25	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,77		K/W
Buck Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,006	25	5,2	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		160	25 125	2	2,02 2,37	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		25			480	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					25 125		133 135		ns
Rise time	t_r					25 125		20 23		ns
Turn-off delay time	$t_{d(off)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	350	100	25 125		225 276		ns
Fall time	t_f					25 125		38 64		ns
Turn-on energy loss	E_{on}					25 125		1,80 3,18		mWs
Turn-off energy loss	E_{off}					25 125		2,52 4,03		mWs
Input capacitance	C_{ies}							9200		pF
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		920		pF
Reverse transfer capacitance	C_{rss}							540		pF
Gate charge	Q_G		15	960	160			740		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,24		K/W

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Buck Diode										
Diode forward voltage	V_F				120	25 125		1,47 1,29	1,7	V
Peak reverse recovery current	I_{RRM}					25 125		127 151		A
Reverse recovery time	t_{rr}					25 125		40 81		ns
Reverse recovered charge	Q_{rr}	R_{gon} = 4 Ω	±15	350	100	25 125		3,02 7,13		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		12386 3767		A/μs
Reverse recovered energy	E_{rec}					25 125		0,31 1,01		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,64		K/W
Boost Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0016	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		100	25 125	1,05	1,58 1,8	1,85	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		25			0,0052	mA
Gate-emitter leakage current	I_{GES}		20	0		25			1200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					25 125		103 103		
Rise time	t_r					25 125		17 19		
Turn-off delay time	$t_{d(off)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	350	100	25 125		158 179		ns
Fall time	t_f					25 125		44 64		
Turn-on energy loss	E_{on}					25 125		1,06 1,52		μWs
Turn-off energy loss	E_{off}					25 125		2,48 3,32		
Input capacitance	C_{ies}							6280		
Output capacitance	C_{oss}	f = 1 MHz	0	25				400		pF
Reverse transfer capacitance	C_{rss}					25		186		
Gate charge	Q_G		15	480	100			620		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,54		K/W
Boost Inverse Diode										
Diode forward voltage	V_F				30	25 125	1,00	1,64 1,55	1,95	V
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,45		K/W

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Boost Diode										
Diode forward voltage	V_F				60	25 125	1,50	2,47 2,11	3,30	V
Reverse leakage current	I_r			1200		25			200	µA
Peak reverse recovery current	I_{RRM}	R_{gon} = 4 Ω	±15	350	100	25 125		107 142		A
Reverse recovery time	t_{rr}					25 125		51 69		ns
Reverse recovered charge	Q_{rr}					25 125		6 13		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		5985 2890		A/µs
Reverse recovery energy	E_{rec}					25 125		1,71 3,61		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						0,74		K/W
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-5		+5	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3998		K
Vincotech NTC Reference									B	

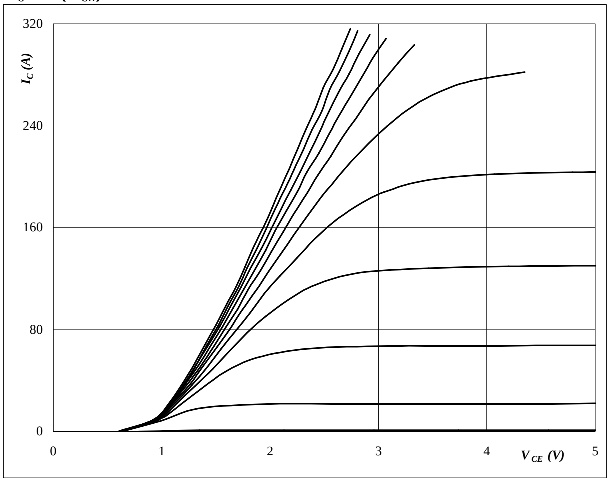
Buck Switch

Buck IGBT and Buck FWD

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

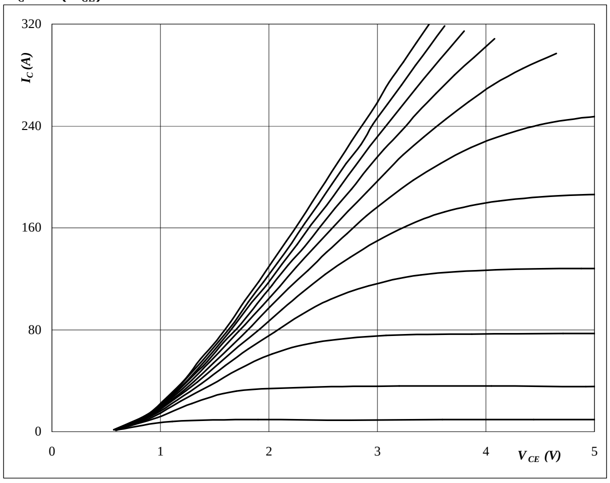
T_j = 25 °C

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

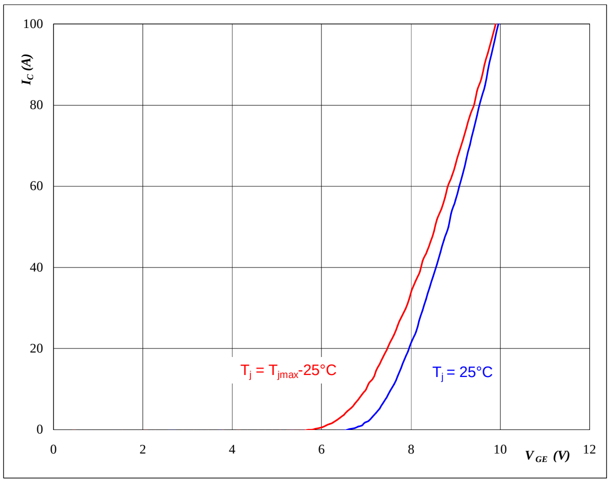
T_j = 125 °C

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

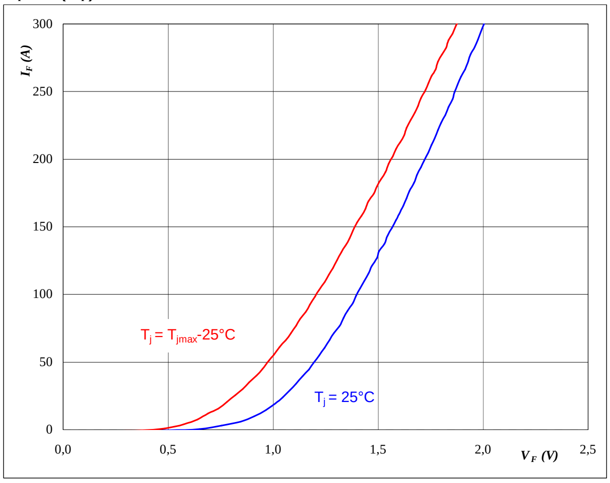
V_{CE} = 10 V

T_j = 25/150 °C

figure 4. **FWD**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p = 250 µs

T_j = 25/150 °C

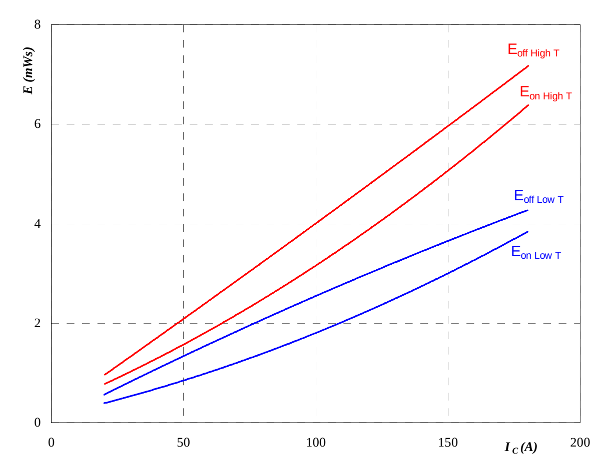
Buck Switch

Buck IGBT and Buck FWD

figure 5. **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



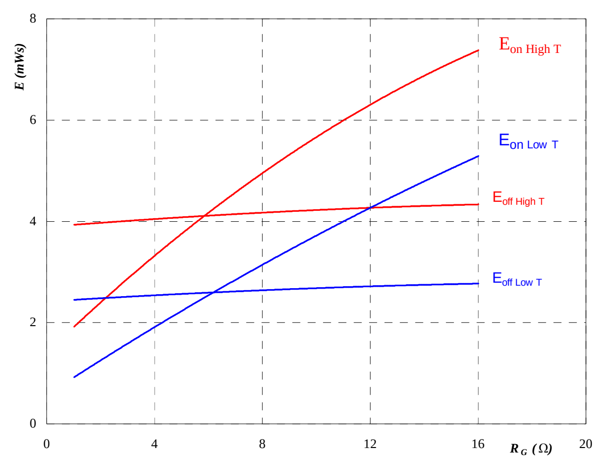
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 6. **IGBT**

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



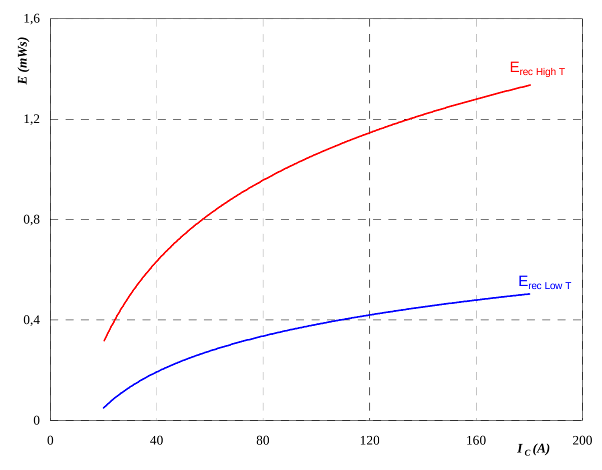
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

figure 7. **FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



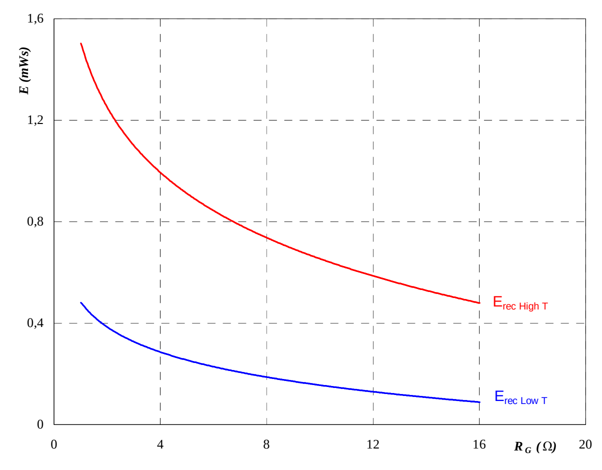
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	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 =	100	A

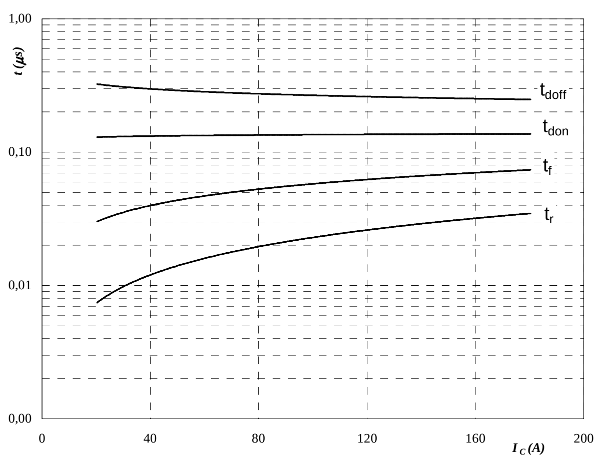
Buck Switch

Buck IGBT and Buck FWD

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



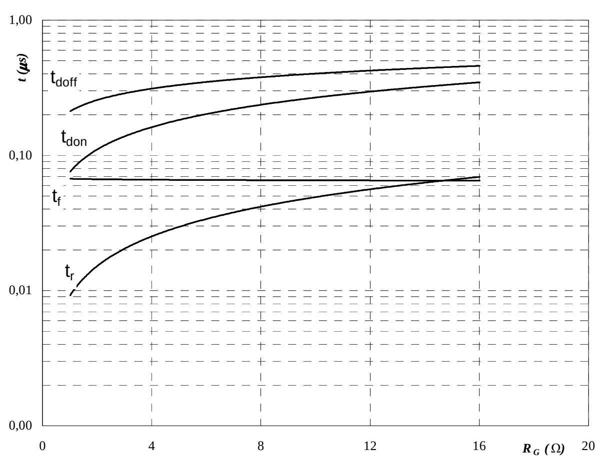
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



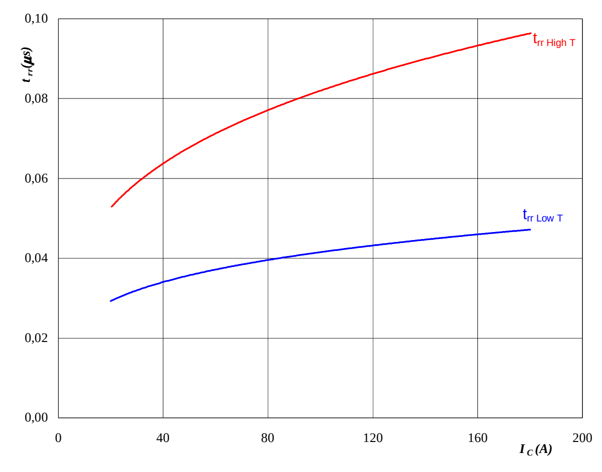
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



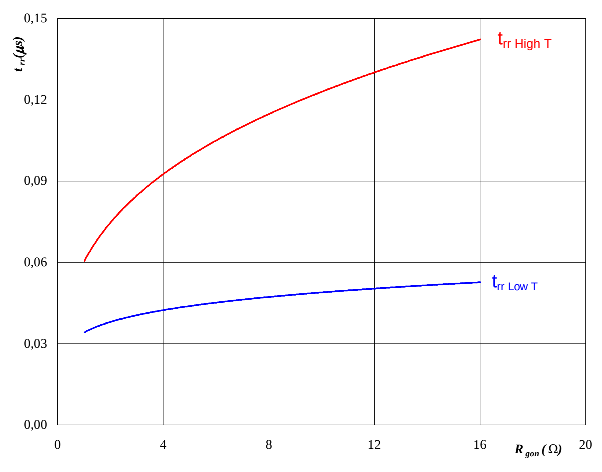
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	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 =	100	A
V_{GE} =	±15	V

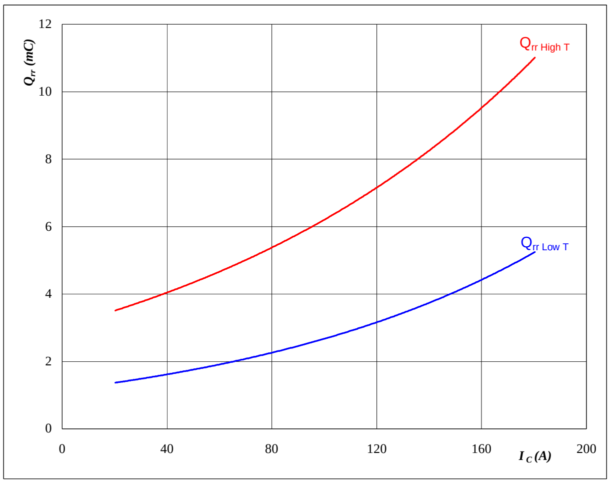
Buck Switch

Buck IGBT and Buck FWD

figure 13.	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



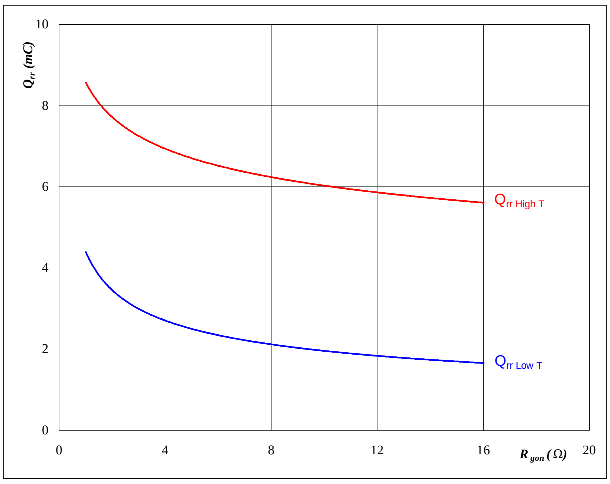
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 14.	FWD

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

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



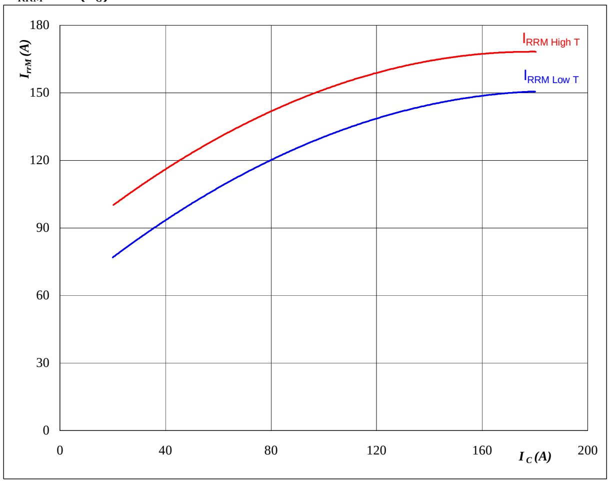
At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

figure 15.	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



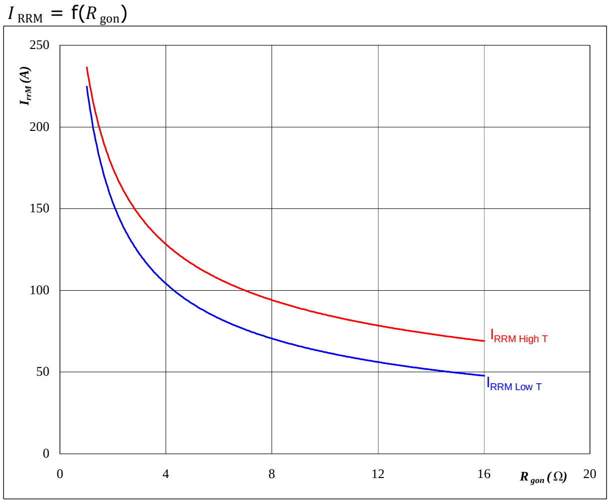
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 16.	FWD

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

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



At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

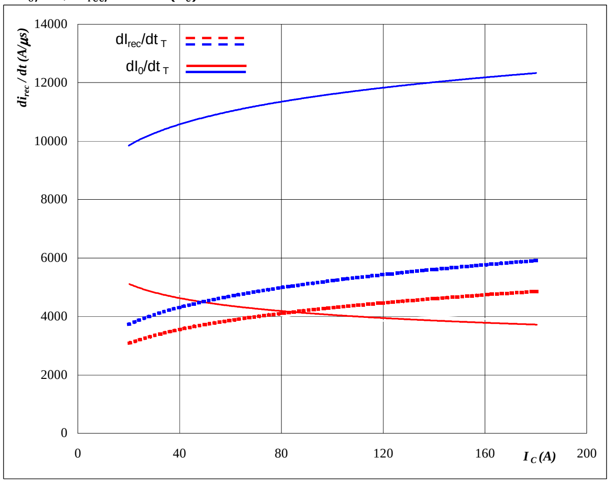
Buck Switch

Buck IGBT and Buck FWD

figure 17. **FWD**

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

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



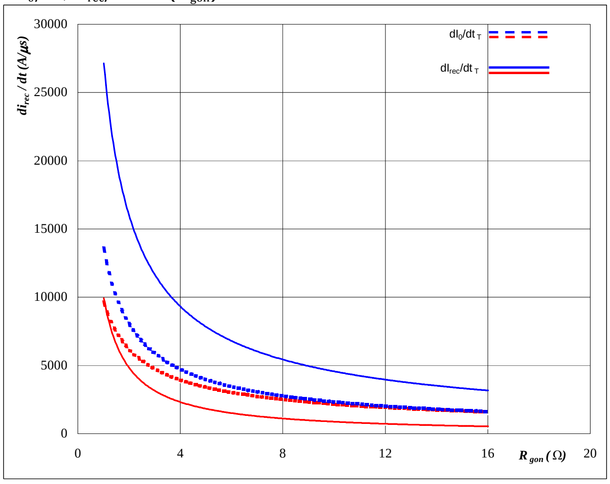
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 18. **FWD**

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

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



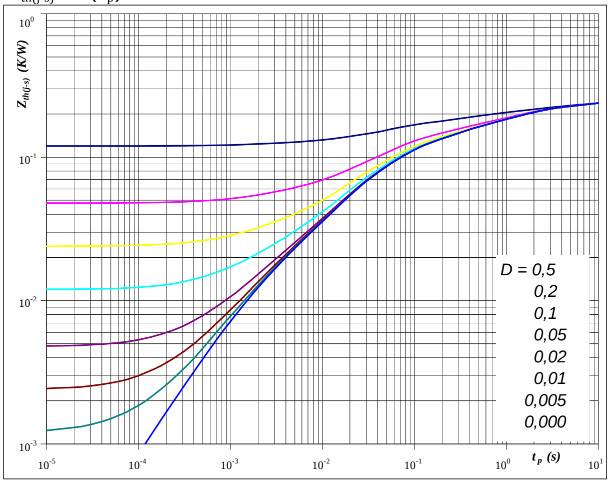
At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

figure 19. **IGBT**

IGBT transient thermal impedance as a function of pulse width

$Z_{th(j\text{-}s)} = f(t_p)$



At

D =	t_p / T		350
$R_{th(j\text{-}s)}$ =	0,24	K/W	

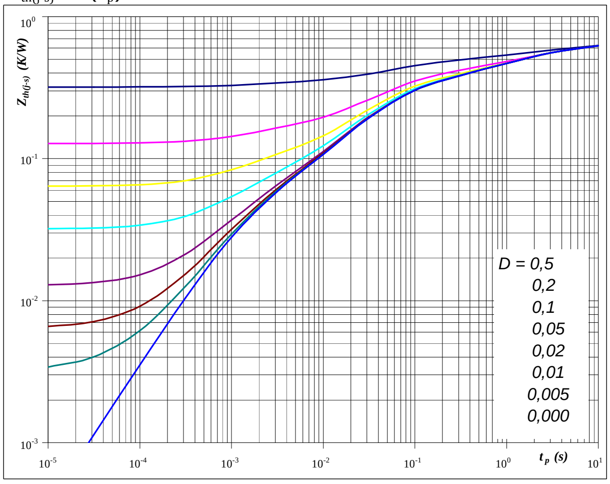
IGBT thermal model values

R (K/W)	Tau (s)
8,15E-02	2,26E+00
5,67E-02	2,93E-01
7,19E-02	4,58E-02
2,05E-02	1,26E-02
7,97E-03	1,53E-03

figure 20. **FWD**

FWD transient thermal impedance as a function of pulse width

$Z_{th(j\text{-}s)} = f(t_p)$



At

D =	t_p / T	
$R_{th(j\text{-}s)}$ =	0,64	K/W

FWD thermal model values

R (K/W)	Tau (s)
1,73E-01	3,90E+00
1,15E-01	8,45E-01
8,15E-02	1,79E-01
1,95E-01	4,20E-02
3,86E-02	9,89E-03
3,49E-02	1,28E-03

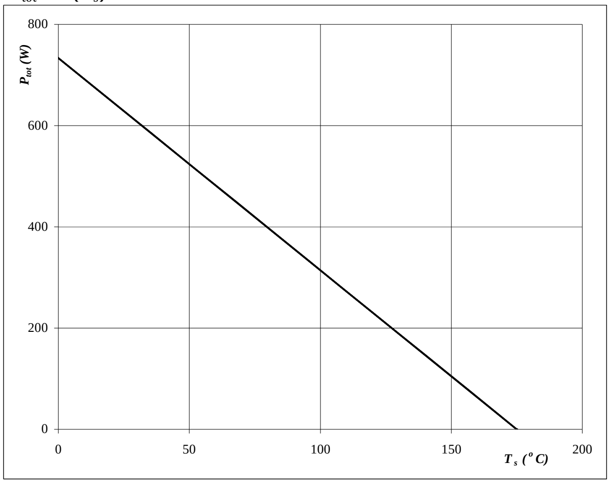
Buck Switch

Buck IGBT and Buck FWD

figure 21.	**IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



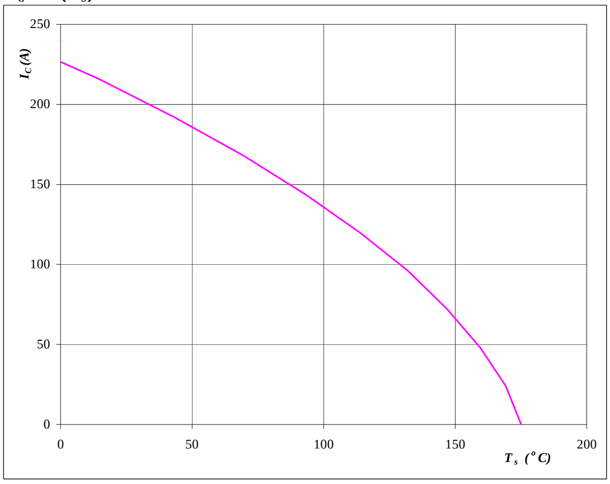
At

T_j = 175 °C

figure 22.	**IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

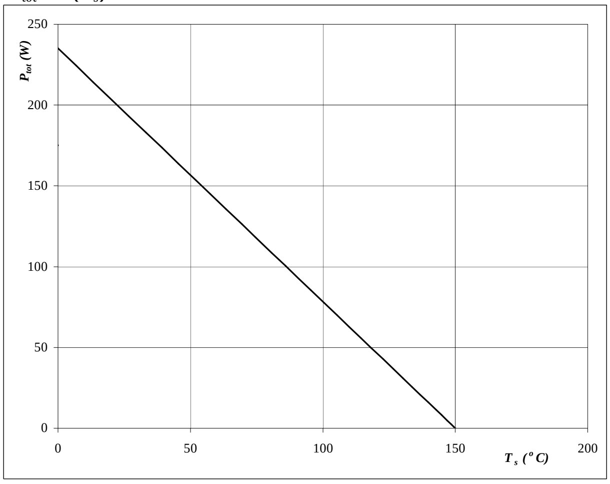
T_j = 175 °C

V_{GE} = 15 V

figure 23.	**FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



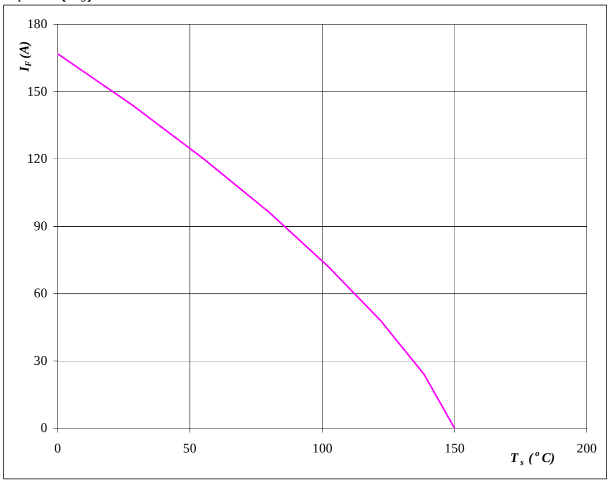
At

T_j = 150 °C

figure 24.	**FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

T_j = 150 °C

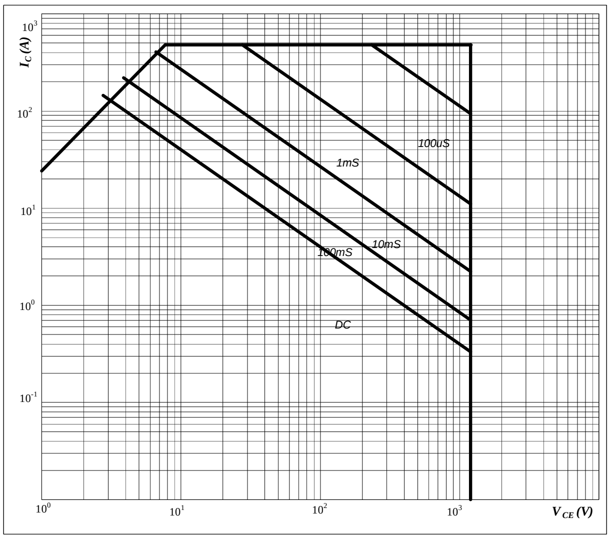
Buck Switch

Buck IGBT and Buck FWD

figure 25. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



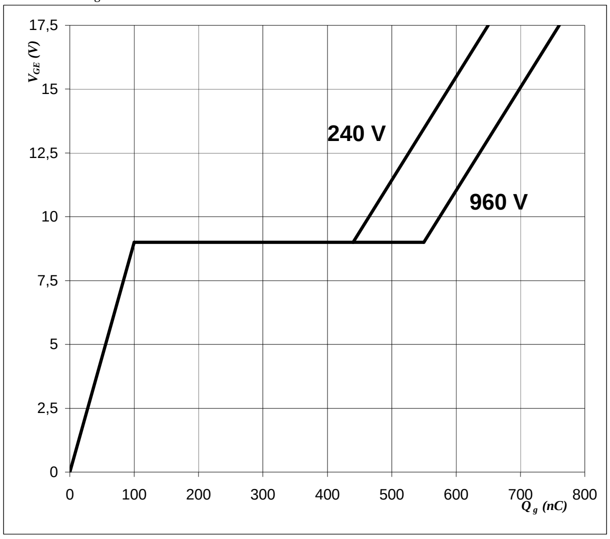
At

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

figure 26. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



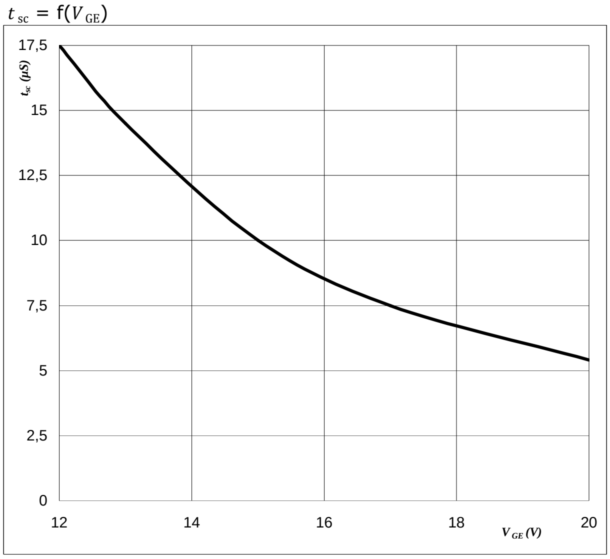
At

I_D =	160	A
T_j=	25	ºC

figure 27. **IGBT**

Short circuit withstand time as a function of gate-emitter voltage

$t_{sc} = f(V_{GE})$



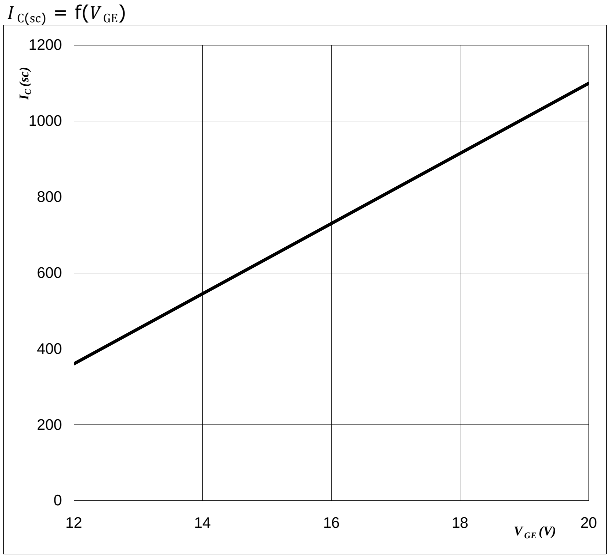
At

V_{CE} =	1200	V
T_j ≤	175	ºC

figure 28. **IGBT**

Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(sc)} = f(V_{GE})$



At

V_{CE} ≤	1200	V
T_j =	175	ºC

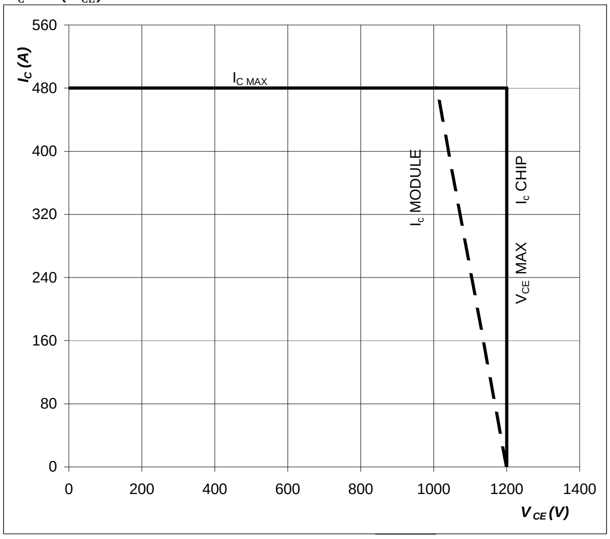
Buck Switch

Buck IGBT and Buck FWD

figure 29.	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

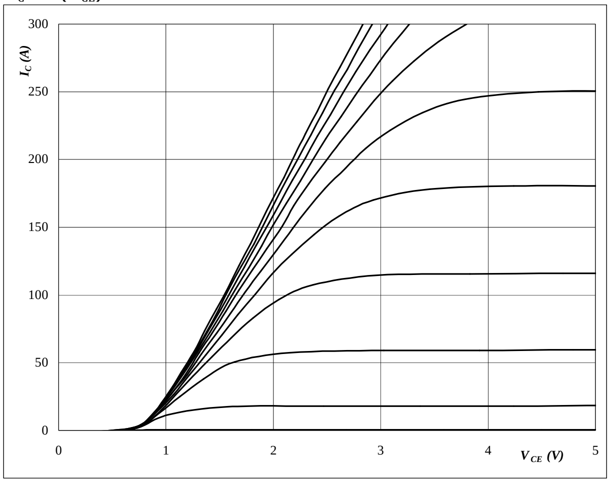
Boost Switch

Boost IGBT and Boost FWD

figure 1.	**IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



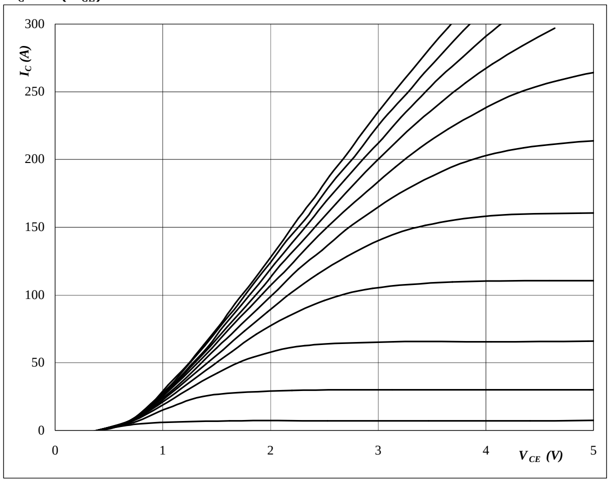
At

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

$I_C = f(V_{CE})$



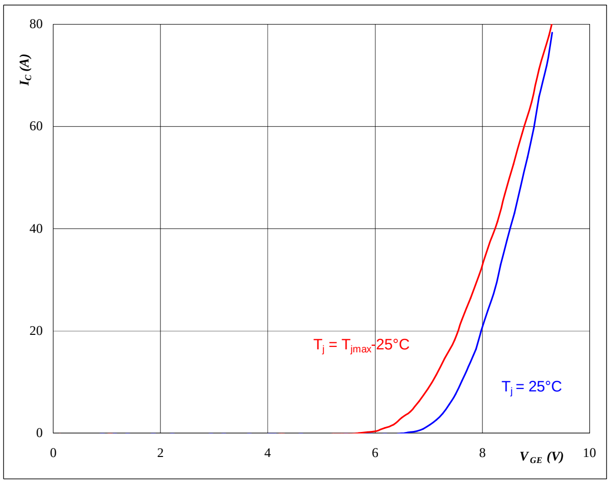
At

t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3.	**IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



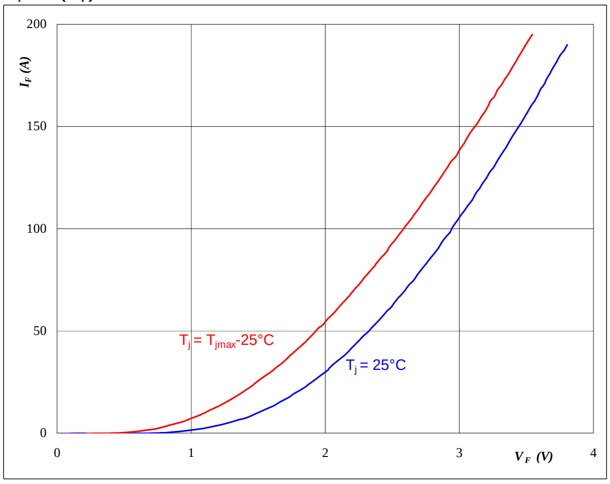
At

t_p =	250	µs
V_{CE} =	10	V
T_j =	25/150	°C

figure 4.	**FWD**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

t_p =	250	µs
T_j =	25/150	°C

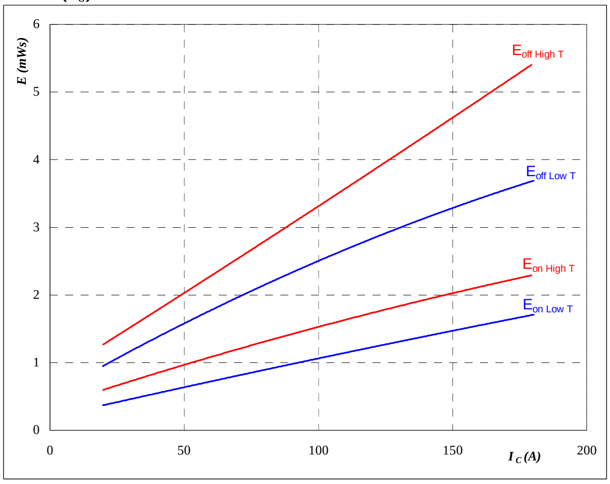
Boost Switch

Boost IGBT and Boost FWD

figure 5.	**IGBT**

Typical switching energy losses
as a function of collector current

$E = \mathrm{f}(I_C)$



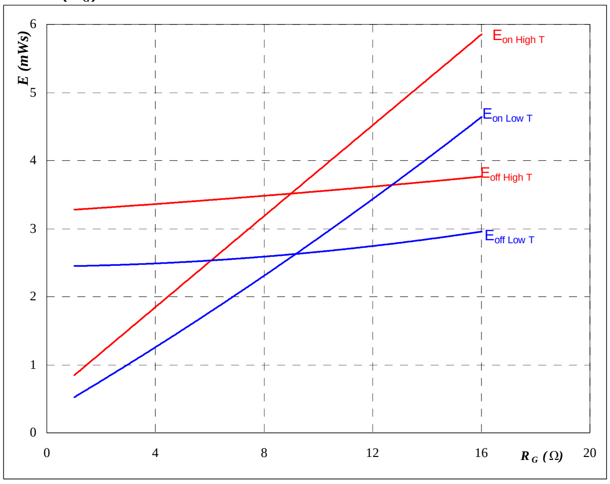
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 6.	**IGBT**

Typical switching energy losses
as a function of gate resistor

$E = \mathrm{f}(R_G)$



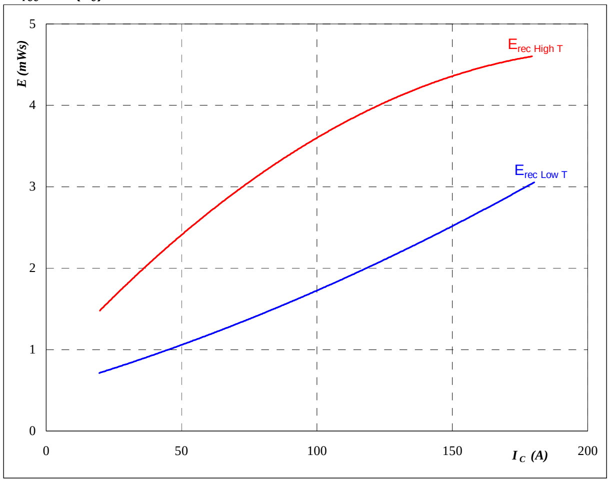
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

figure 7.	**FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = \mathrm{f}(I_c)$



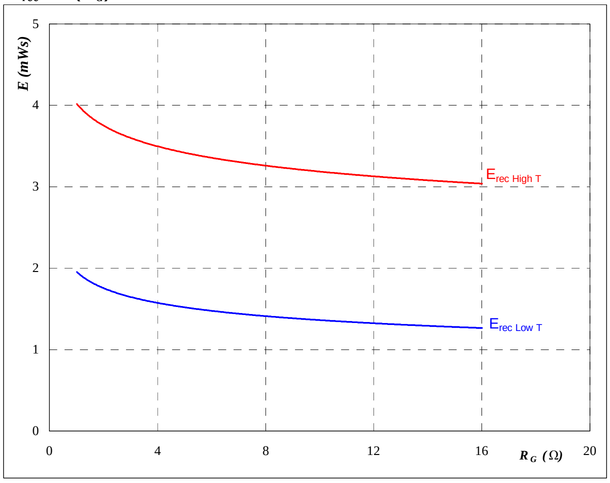
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 8.	**FWD**

Typical reverse recovery energy loss
as a function of gate resistor

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



With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

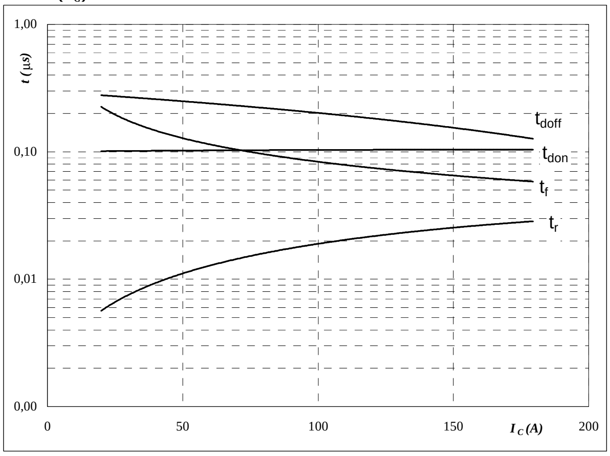
Boost Switch

Boost IGBT and Boost FWD

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$ **350**



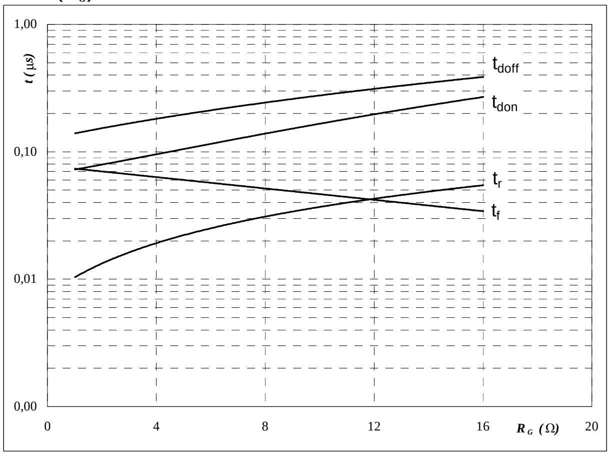
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



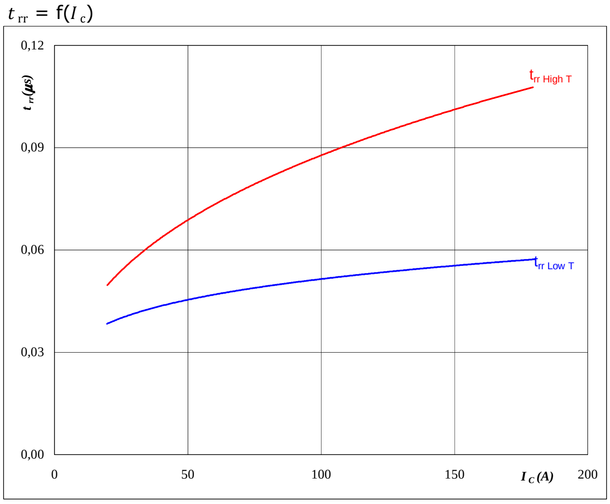
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



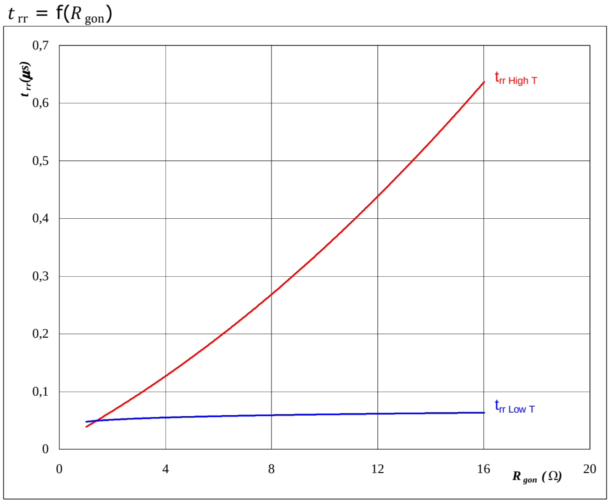
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4,0	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 =	350	V
I_F =	100	A
V_{GE} =	±15	V

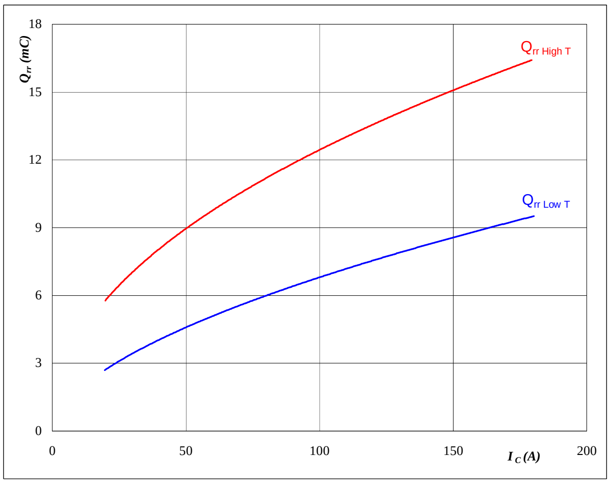
Boost Switch

Boost IGBT and Boost FWD

figure 13.	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



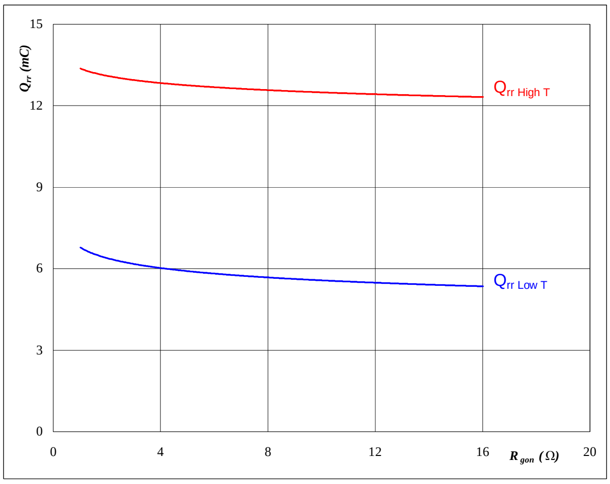
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 14.	FWD

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

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



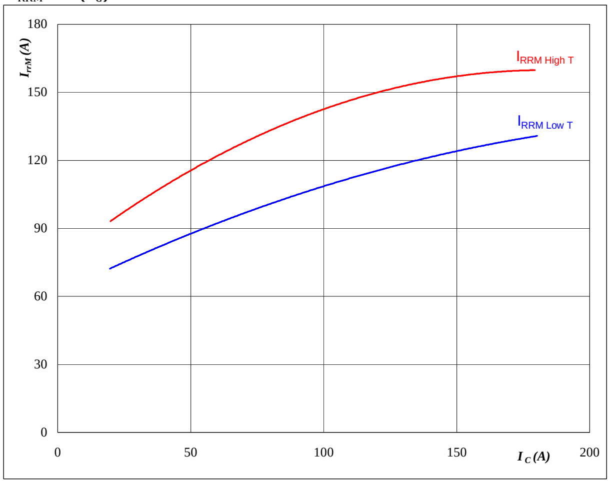
At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

figure 15.	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



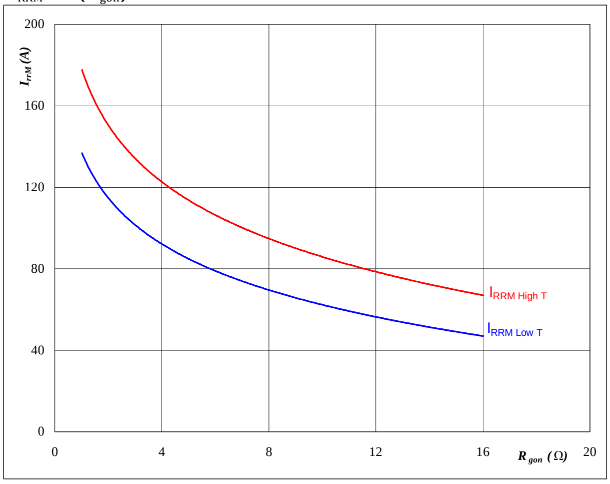
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 16.	FWD

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

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



At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

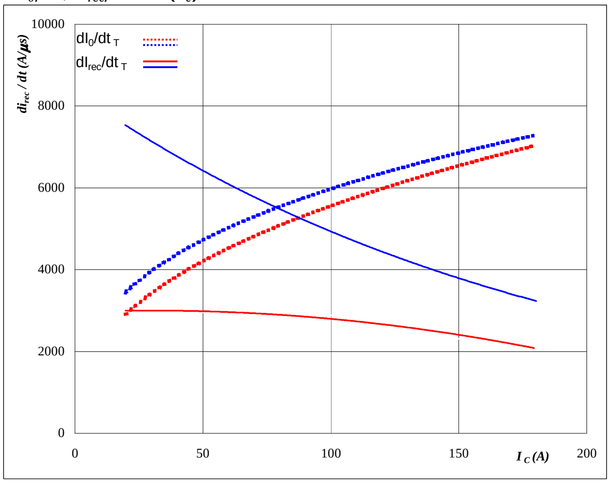
Boost Switch

Boost IGBT and Boost FWD

figure 17.	FWD

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

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



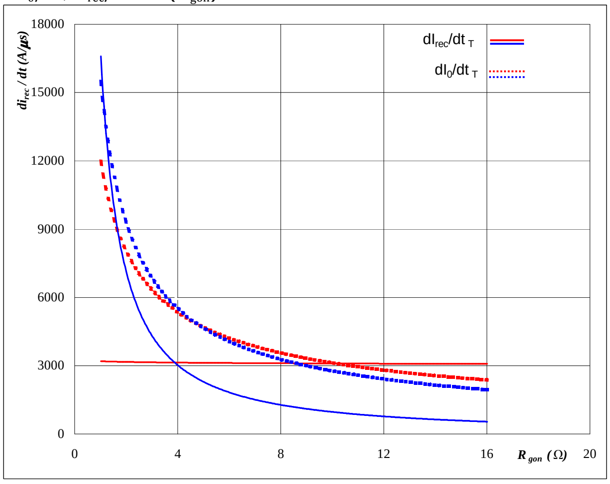
At

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

figure 18.	FWD

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

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



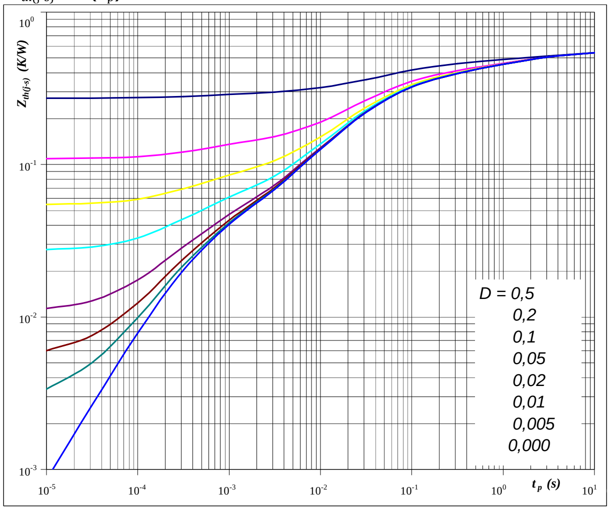
At

T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

figure 19.	IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



At

D =	t_p / T	
$R_{th(j-s)}$ =	0,54	K/W

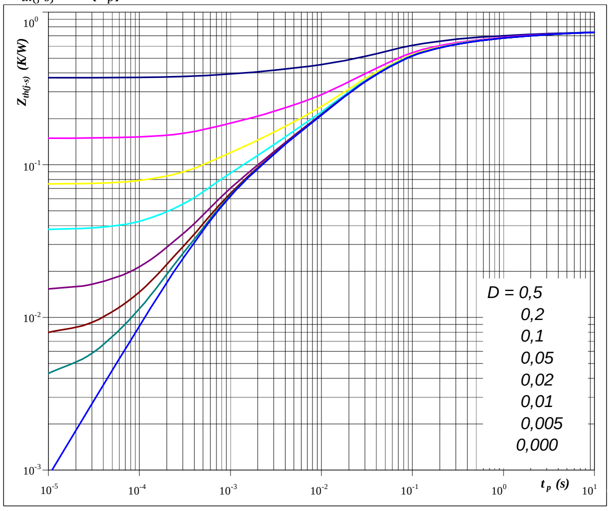
IGBT thermal model values

R (K/W)	Tau (s)
1,12E-01	2,87E+00
8,79E-02	4,59E-01
1,16E-01	9,51E-02
1,70E-01	2,49E-02
3,03E-02	4,36E-03

figure 20.	FWD

FWD transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



At

D =	t_p / T	
$R_{th(j-s)}$ =	0,74	K/W

FWD thermal model values

R (K/W)	Tau (s)
6,78E-02	3,67E+00
1,00E-01	5,41E-01
1,97E-01	9,81E-02
2,56E-01	2,84E-02
6,83E-02	4,90E-03

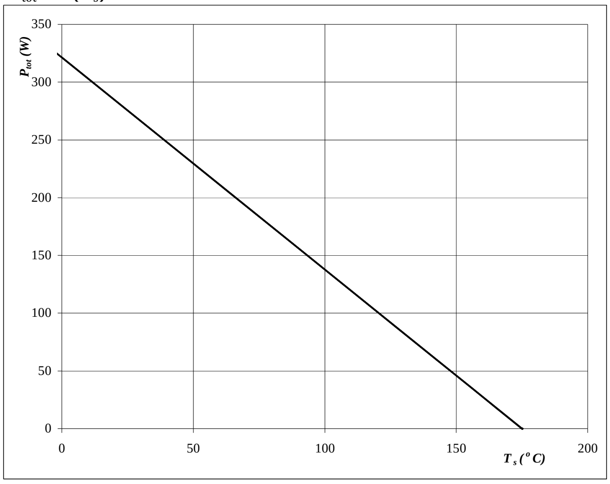
Boost Switch

Boost IGBT and Boost FWD

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



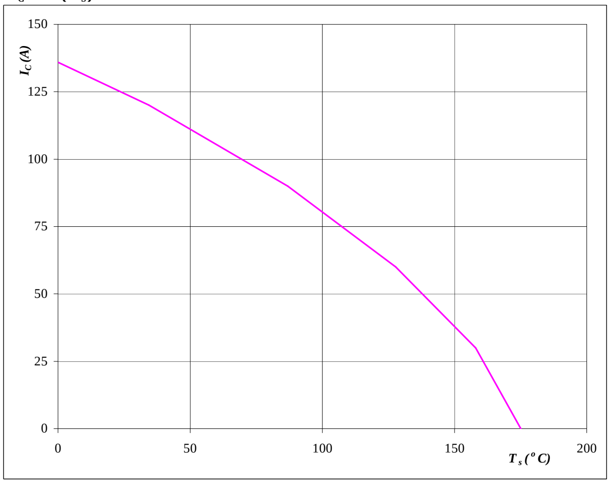
At

T_j = 175 ºC

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

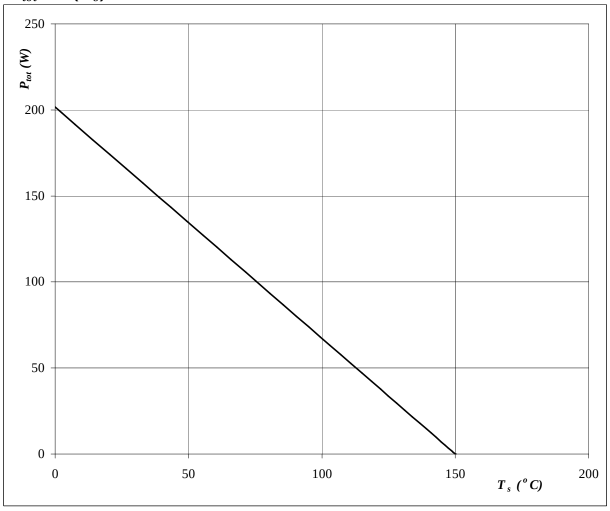
T_j = 175 ºC

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



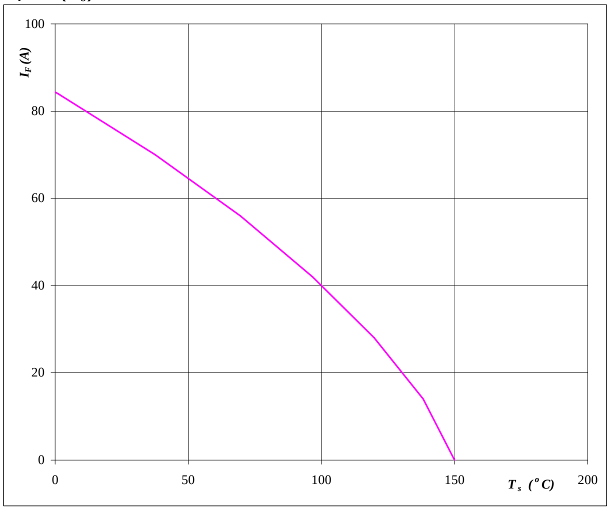
At

T_j = 150 ºC

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

T_j = 150 ºC

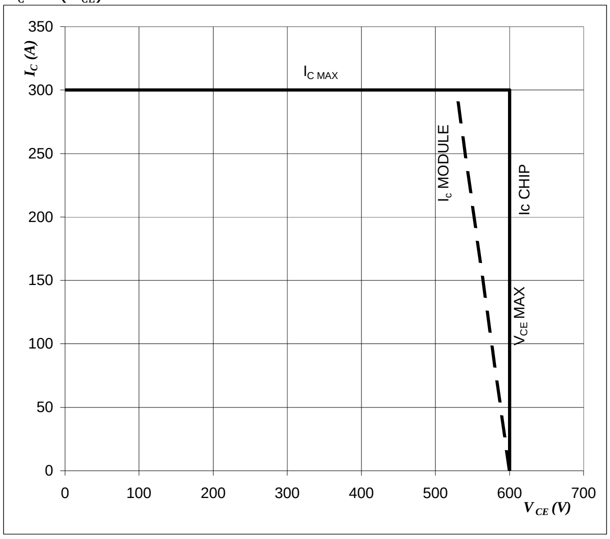
Boost Switch

Boost IGBT

figure 25. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j = T_{jmax}-25 ºC

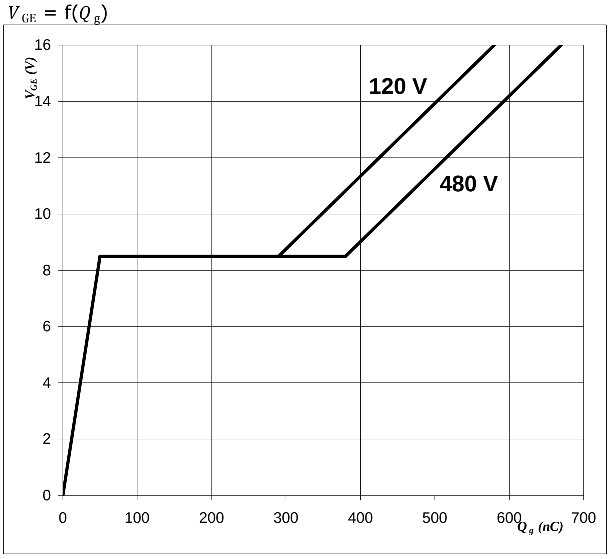
$U_{ccminus}$=U_{ccplus}

Switching mode : 3 level switching

figure 26. **IGBT**

Gate voltage vs Gate charge

V_{GE} = f(Q_g)



At

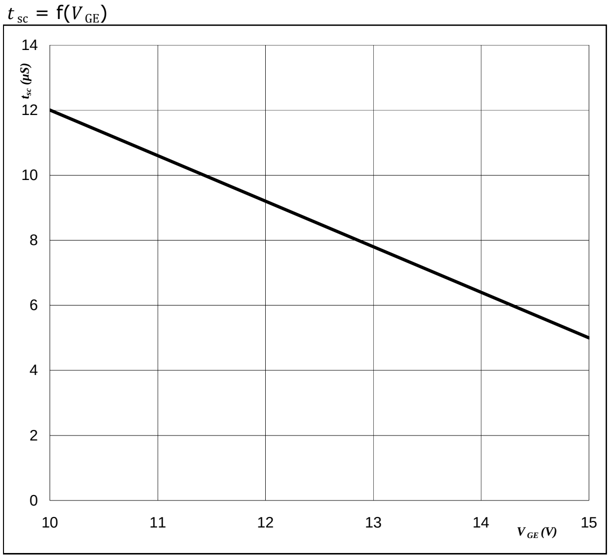
I_D = 100 A

T_j= 25 ºC

figure 27. **IGBT**

Short circuit withstand time as a function of gate-emitter voltage

t_{sc} = f(V_{GE})



At

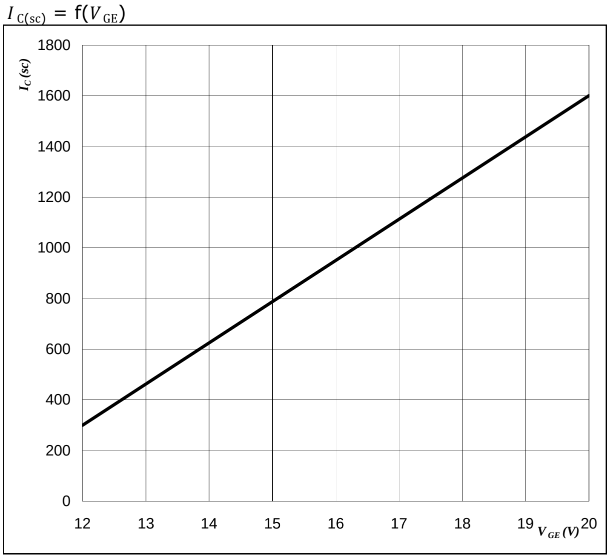
V_{CE} = 600 V

T_j ≤ 150 ºC

figure 28. **IGBT**

Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(sc)}$ = f(V_{GE})



At

V_{CE} ≤ 400 V

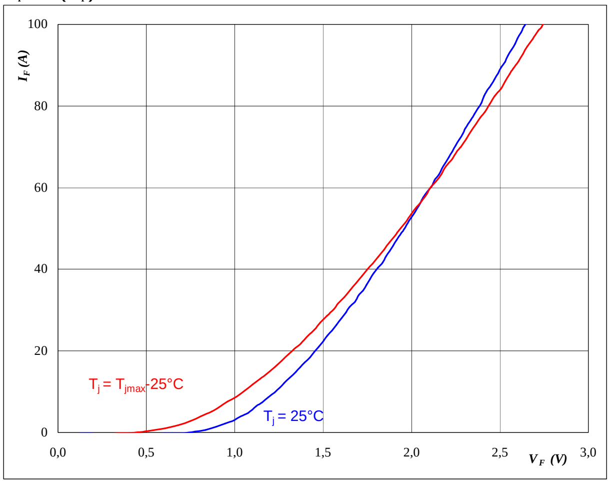
T_j = 125 ºC

Boost Inverse Diode

figure 25. **Boost Inverse Diode**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



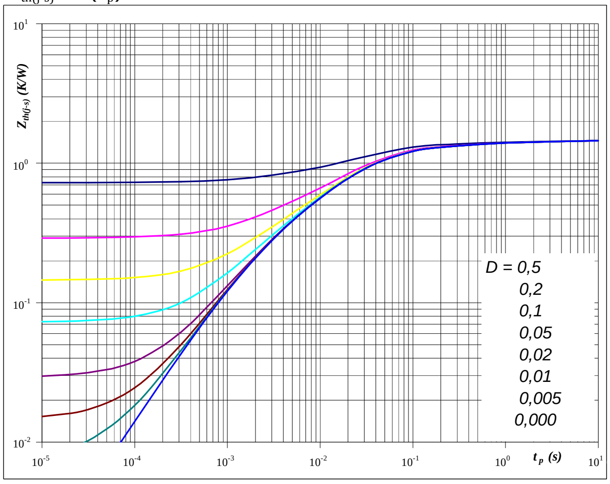
At

t_p = 250 µs

figure 26. **Boost Inverse Diode**

FWD transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



At

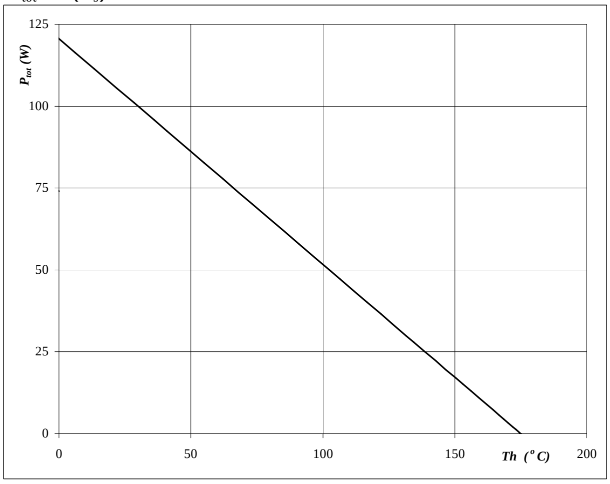
$D = t_p / T$

$R_{th(j-s)}$ = 1,45 K/W

figure 27. **Boost Inverse Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



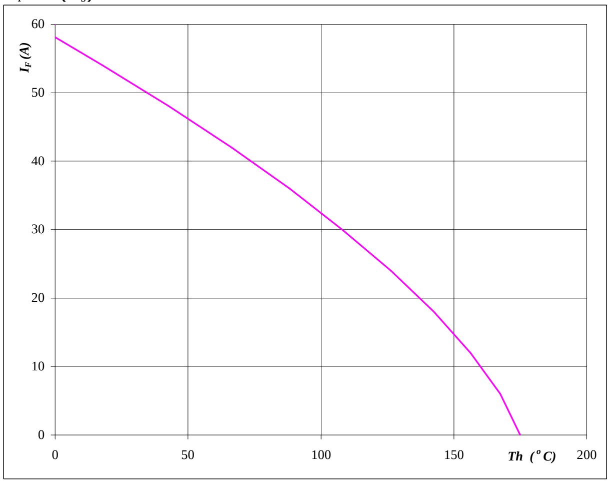
At

T_j = 175 ºC

figure 28. **Boost Inverse Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

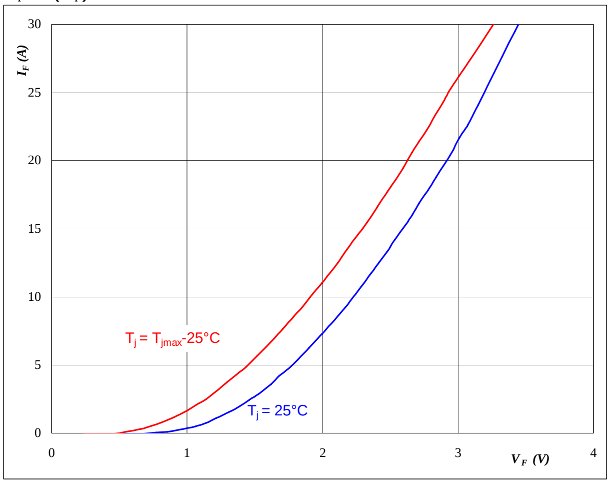
T_j = 175 ºC

Buck Inverse Diode

figure 1.	Buck Inverse Diode

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



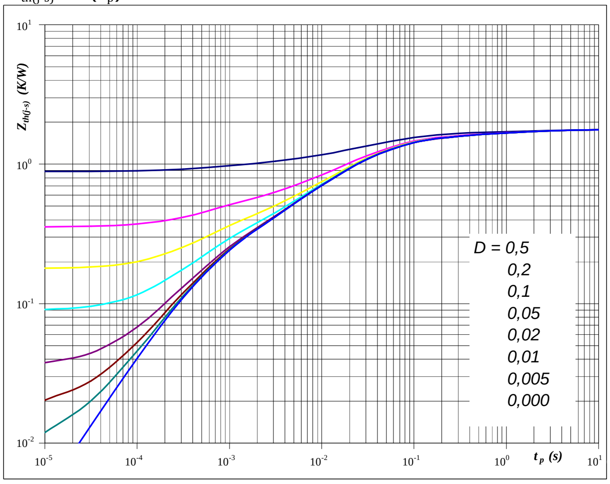
At

t_p = 250 µs

figure 2.	Buck Inverse Diode

FWD transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



At

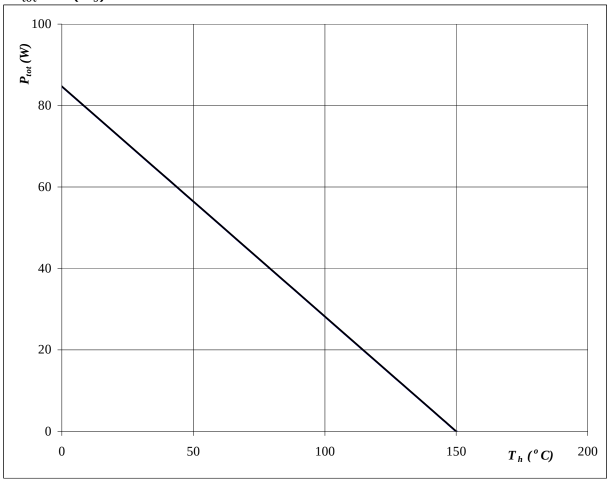
$D = t_p / T$

$R_{th(j-s)}$ = 1,77 K/W

figure 3.	Buck Inverse Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



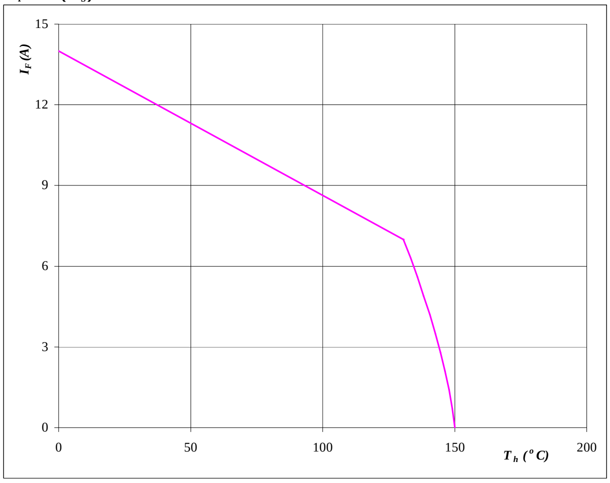
At

T_j = 150 ºC

figure 4.	Buck Inverse Diode

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



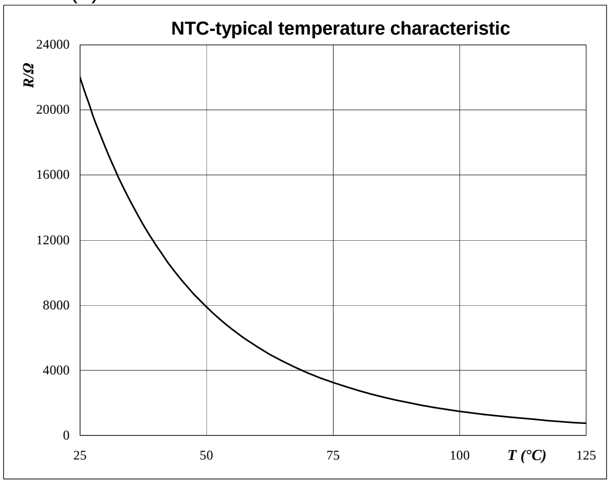
At

T_j = 150 ºC

Thermistor

figure 1.	Thermistor

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



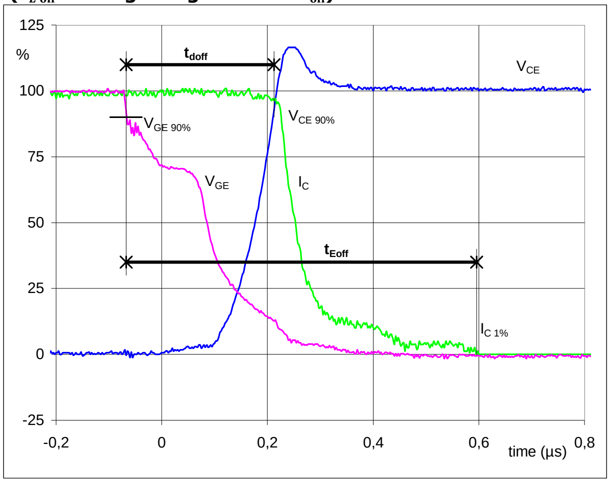
Switching Definitions Buck

General conditions

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

figure 1. **Buck IGBT**

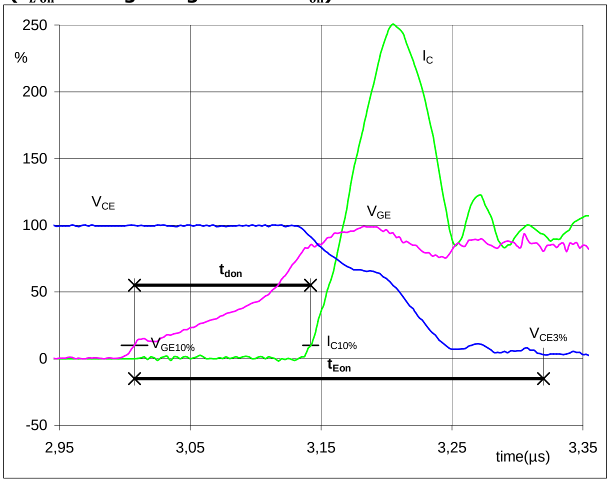
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	100	A
t_{doff} =	0,28	µs
$t_{E\,off}$ =	0,66	µs

figure 2. **Buck IGBT**

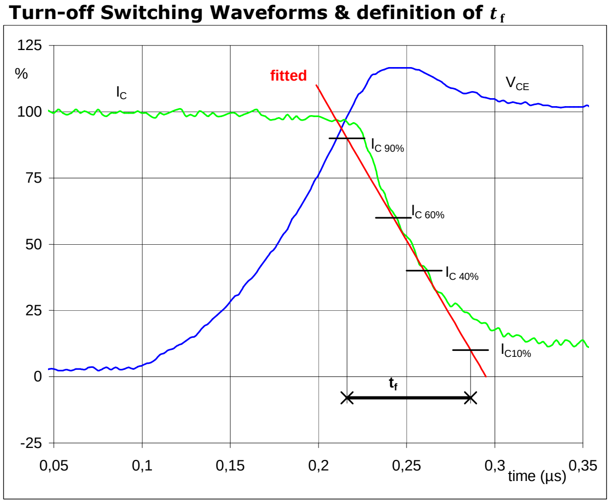
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	100	A
t_{don} =	0,14	µs
$t_{E\,on}$ =	0,31	µs

figure 3. **Buck IGBT**

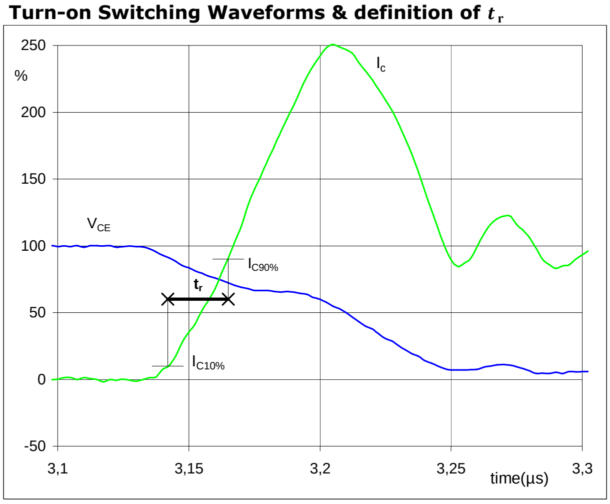
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	100	A
t_f =	0,06	µs

figure 4. **Buck IGBT**

Turn-on Switching Waveforms & definition of t_r

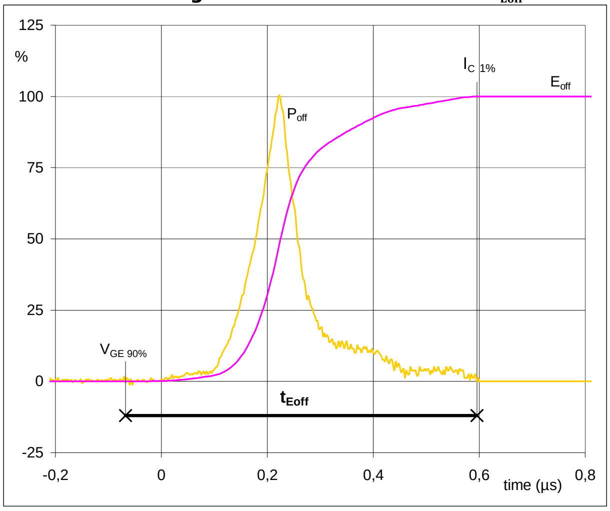


V_C (100%) =	350	V
I_C (100%) =	100	A
t_r =	0,02	µs

Switching Definitions Buck

figure 5. **Buck IGBT**

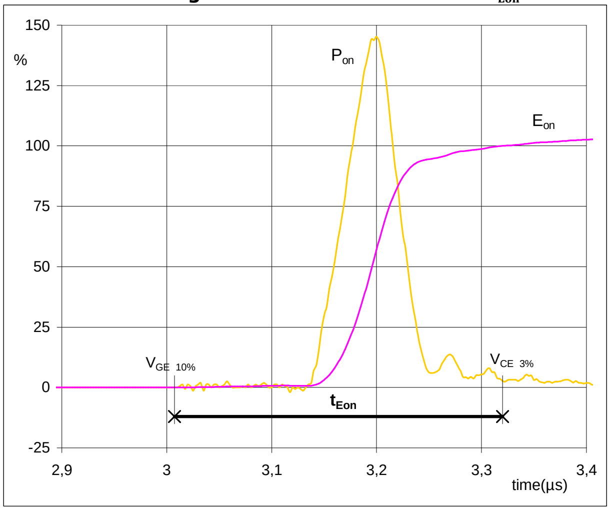
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	35,11	kW
E_{off} (100%) =	4,03	mJ
$t_{E\,off}$ =	0,66	µs

figure 6. **Buck IGBT**

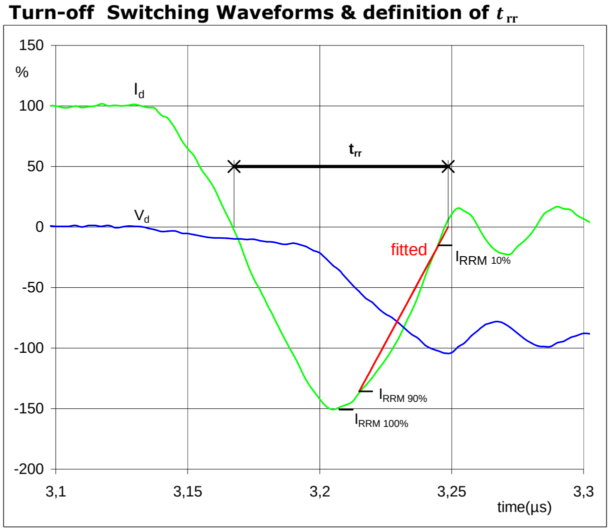
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	35,11	kW
E_{on} (100%) =	3,18	mJ
$t_{E\,on}$ =	0,31	µs

figure 7. **Boost FWD**

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

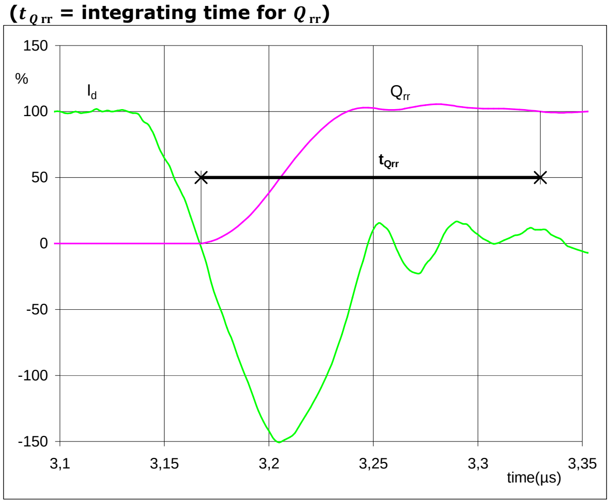


V_d (100%) =	350	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-151	A
t_{rr} =	0,08	µs

Switching Definitions Buck

figure 8. **Boost FWD**

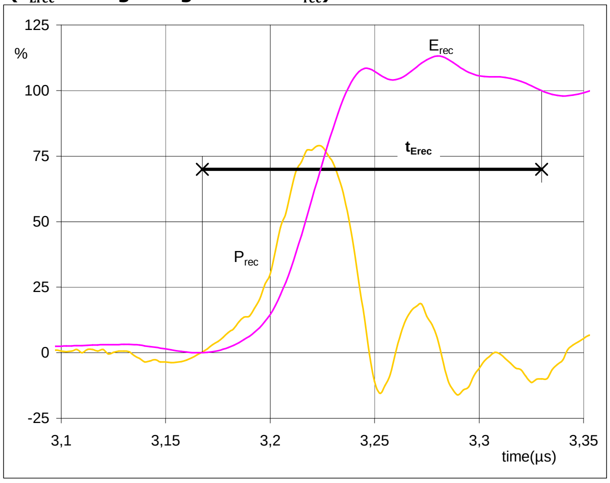
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	7,13	µC
t_{Qrr} =	0,16	µs

figure 9. **Boost FWD**

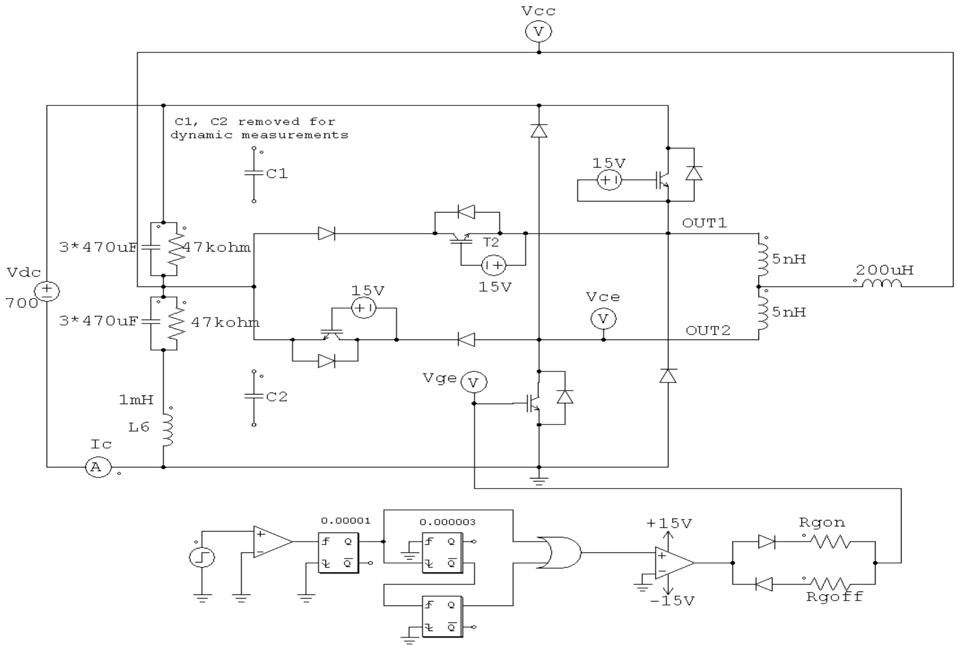
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	35,11	kW
E_{rec} (100%) =	1,01	mJ
t_{Erec} =	0,16	µs

Buck switching measurement circuit

figure 10.



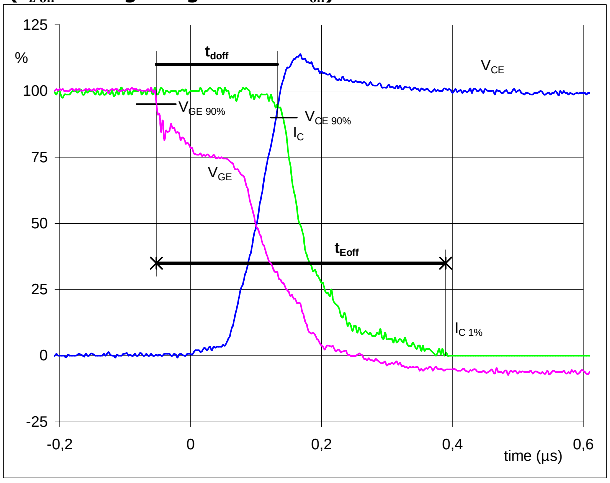
Switching Definitions Boost

General conditions

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

figure 1. **Boost IGBT**

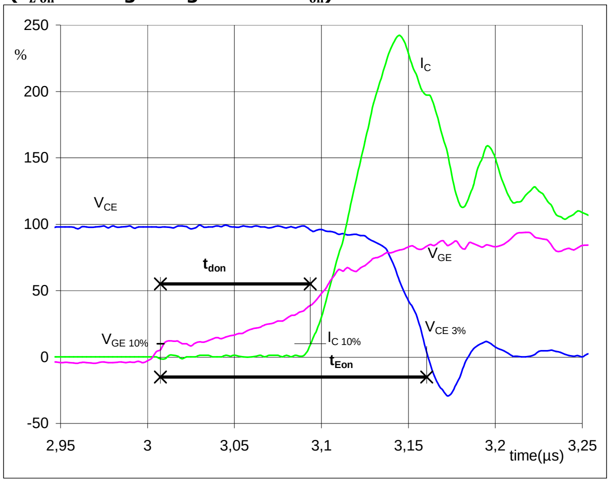
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	100	A
t_{doff} =	0,18	µs
$t_{E\,off}$ =	0,44	µs

figure 2. **Boost IGBT**

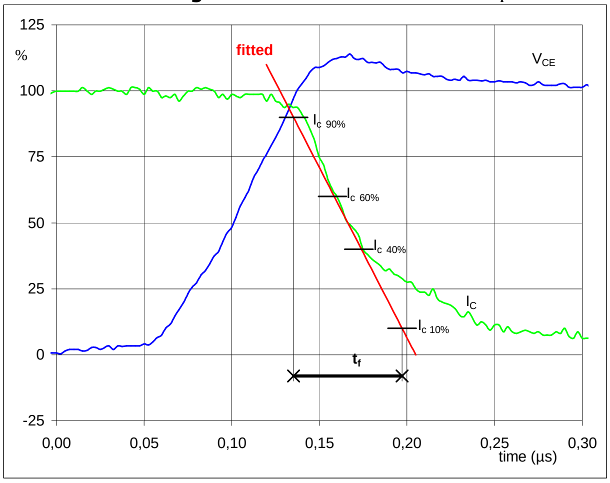
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	100	A
t_{don} =	0,10	µs
$t_{E\,on}$ =	0,15	µs

figure 3. **Boost IGBT**

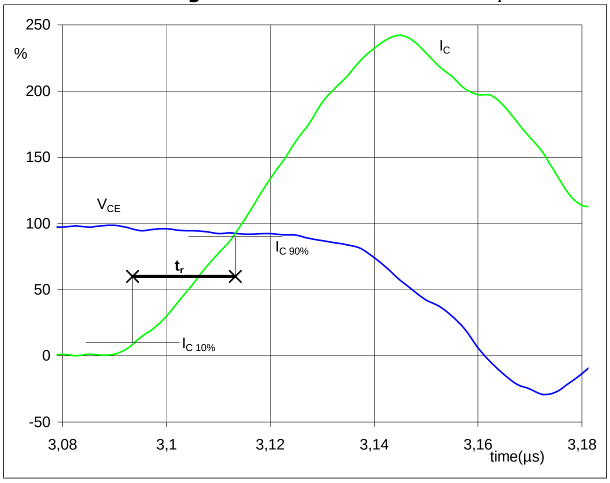
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	100	A
t_f =	0,064	µs

figure 4. **Boost IGBT**

Turn-on Switching Waveforms & definition of t_r

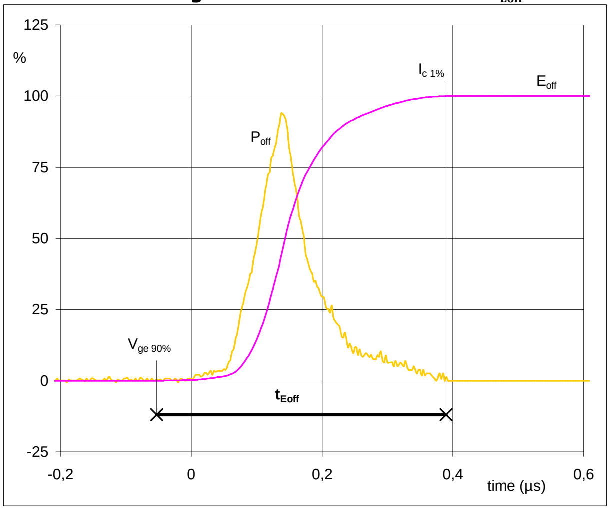


V_C (100%) =	350	V
I_C (100%) =	100	A
t_r =	0,019	µs

Switching Definitions Boost

figure 5.	**Boost IGBT**

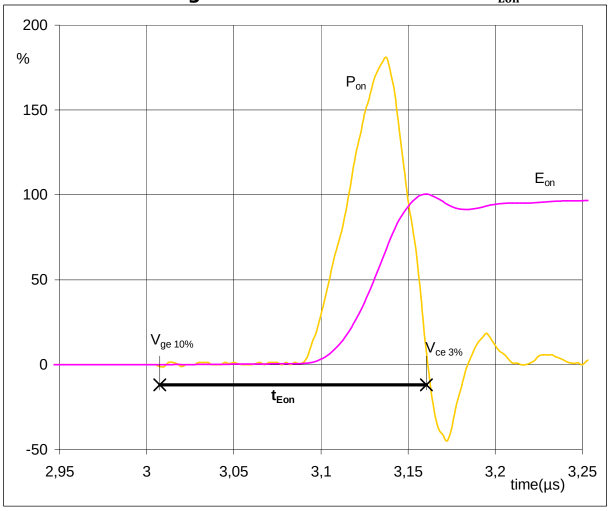
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	34,96	kW
E_{off} (100%) =	3,32	mJ
$t_{E\ off}$ =	0,44	µs

figure 6.	**Boost IGBT**

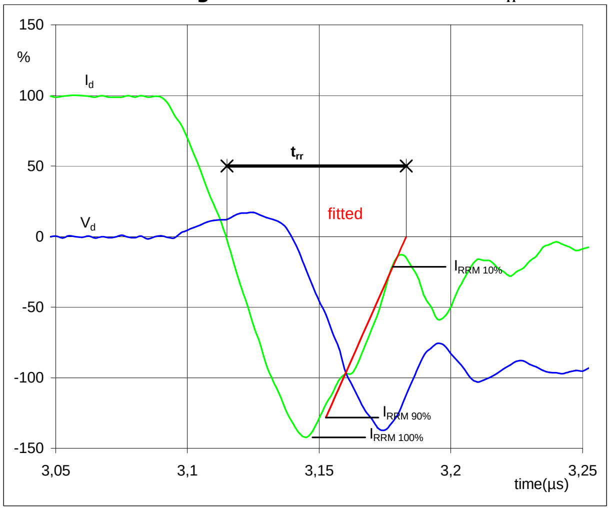
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	34,964	kW
E_{on} (100%) =	1,52	mJ
$t_{E\ on}$ =	0,18	µs

figure 7.	**Buck FWD**

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

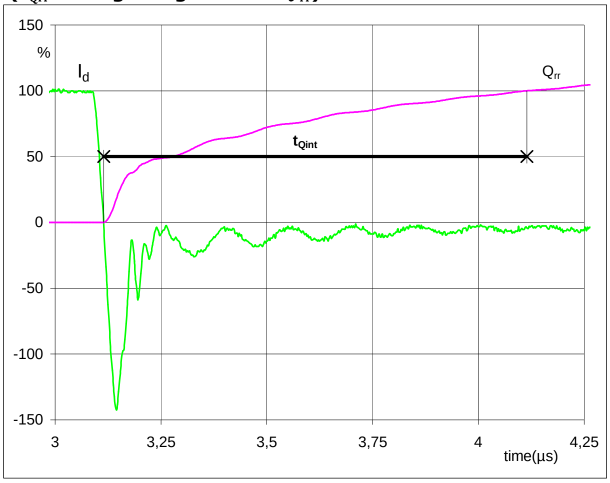


V_d (100%) =	350	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-142	A
t_{rr} =	0,07	µs

Switching Definitions Boost

figure 8. **Buck FWD**

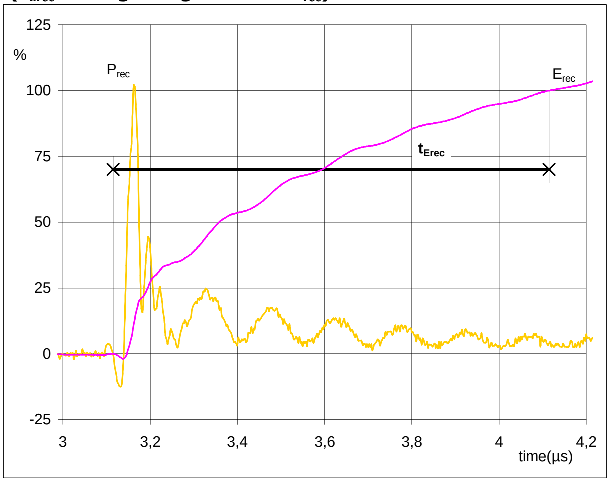
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	12,71	µC
t_{Qint} =	1,00	µs

figure 9. **Buck FWD**

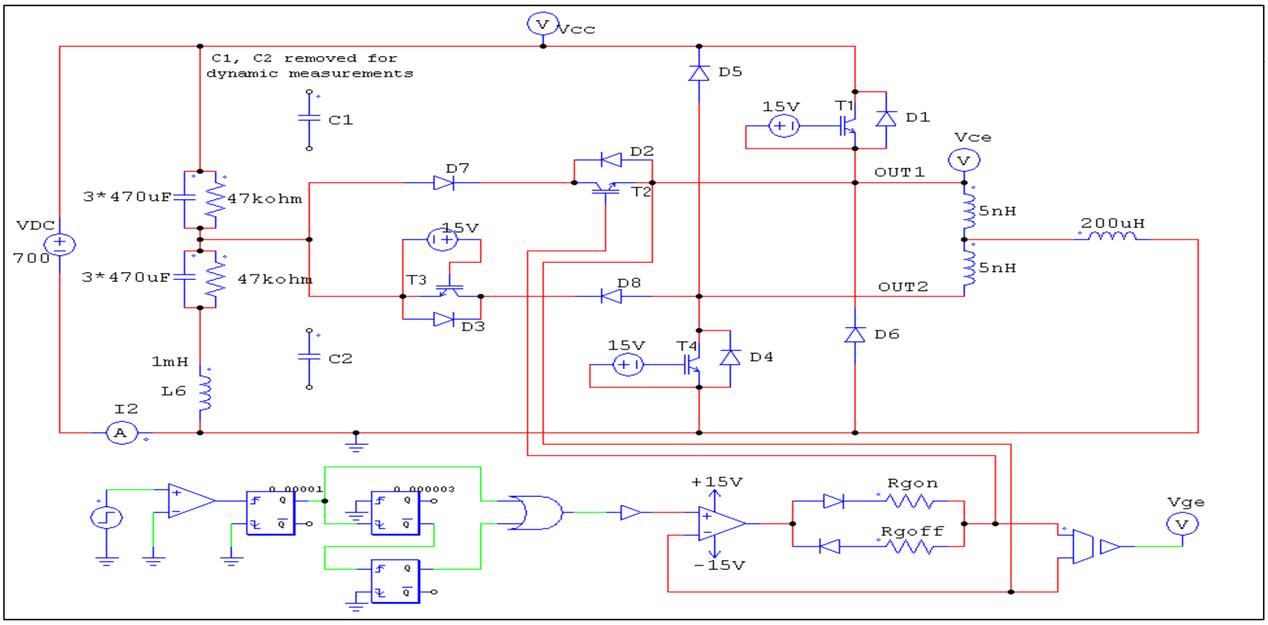
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	69,93	kW
E_{rec} (100%) =	3,61	mJ
t_{Erec} =	1,00	µs

Boost switching measurement circuit

figure 10.



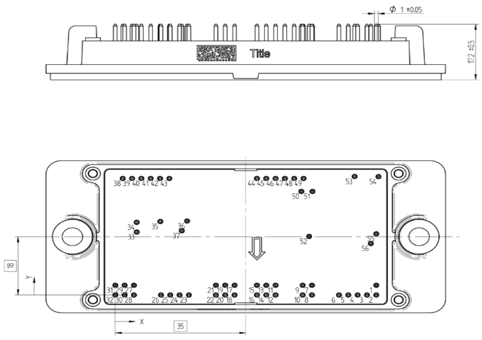
Ordering Code & Marking

Version	Ordering Code
without thermal paste 13mm housing	30-FT12NMA160SH-M669F08

	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTTVV	LLLLL	SSSS	All		

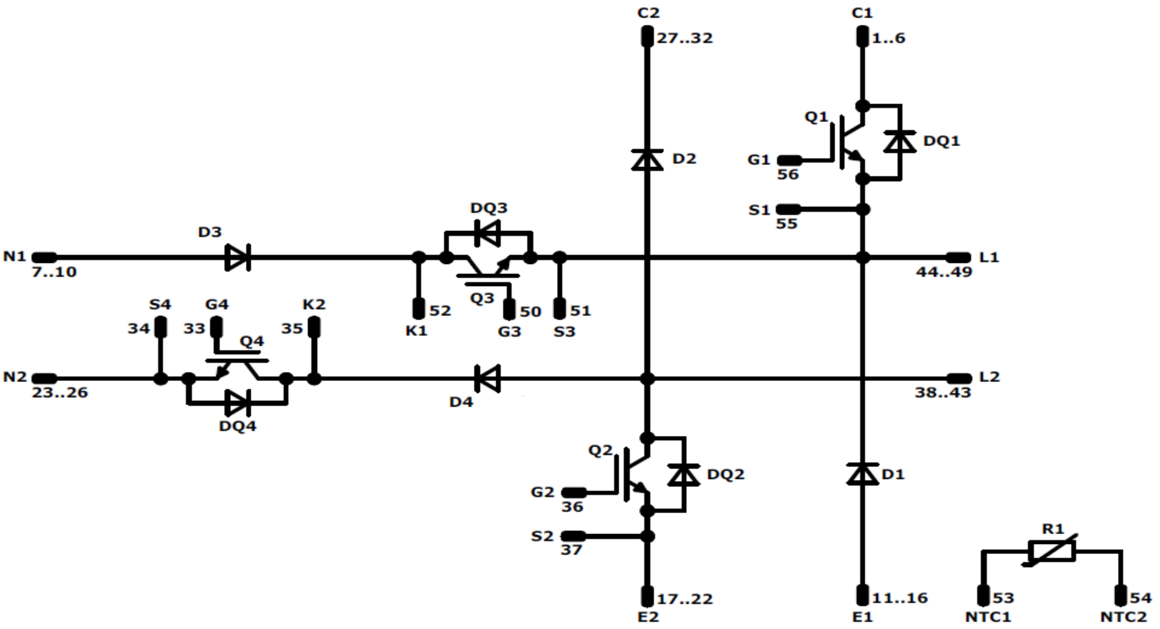
Outline

Pin table [mm]				Pin table [mm]			
Pin	X	Y	Function	Pin	X	Y	Function
1	70	3	C1	29	2,5	3	C2
2	70	0	C1	30	2,5	0	C2
3	67,5	0	C1	31	0	3	C2
4	65	0	C1	32	0	0	C2
5	62,5	0	C1	33	5,75	19,45	G4
6	60	0	C1	34	5,75	22,45	S4
7	52,75	3	N1	35	12,1	22,7	K2
8	52,75	0	N1	36	19,25	22,85	G2
9	50,25	3	N1	37	17,85	19,85	S2
10	50,25	0	N1	38	2	36	L2
11	43	3	E1	39	4,5	36	L2
12	43	0	E1	40	7	36	L2
13	40,5	3	E1	41	9,5	36	L2
14	40,5	0	E1	42	12	36	L2
15	38	3	E1	43	14,5	36	L2
16	38	0	E1	44	38	36	L1
17	32	3	E2	45	40,5	36	L1
18	32	0	E2	46	43	36	L1
19	29,5	3	E2	47	45,5	36	L1
20	29,5	0	E2	48	48	36	L1
21	27	3	E2	49	50,5	36	L1
22	27	0	E2	50	49,9	32	G3
23	19,75	0	N2	51	52,9	32	S3
24	17,25	0	N2	52	52	18,1	K1
25	14,75	0	N2	53	64,2	36,6	NTC
26	12,25	0	N2	54	70,6	36,55	NTC
27	5	3	C2	55	70	18,9	S1
28	5	0	C2	56	68,55	15,9	G1



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
Q1,Q2	IGBT	1200 V	160 A	Buck Switch	
DQ1,DQ2	FWD	1200 V	7 A	Buck Inverse Diode	
D3,D4	FWD	600 V	120 A	Buck Diode	
Q3,Q4	IGBT	600 V	120 A	Boost Switch	
D1,D2	FWD	1200 V	60 A	Boost Diode	
DQ3,DQ4	FWD	600 V	50 A	Boost Inverse Diode	
R1	NTC			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	36	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 2 packages see vincotech.com website.

Package data
Package data for *flow* 2 packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
30-FT12NMA160SH-M669F08-D5-14	27 Jun. 2017	Corrected Isolation Properties	All