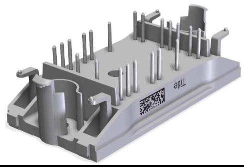
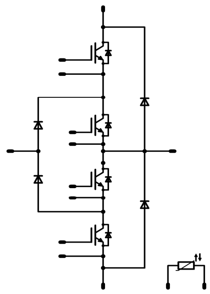
flow **NPC 0** **650 V / 50 A**

Features
- Neutral point clamped inverter
- Reactive power capability
- Low inductance layout
- Improved LVRT capability

flow 0 17mm housing


Target Applications
- Solar inverter
- UPS

Schematic


Types
- 10-F007NRA050SG-P966F09

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Buck Sw. Protection Diode				
Repetitive peak reverse voltage	V_{RRM}		650	V
Forward current	I_{FAV}	DC current; T_s = 80 °C	18	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$; T_s = 80 °C	33	W
Maximum Junction Temperature	T_{jmax}		175	°C
Buck Switch				
Collector-emitter break down voltage	V_{CES}		650	V
DC collector current	I_C	$T_j = T_{jmax}$; T_s = 80 °C	51	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Turn off safe operating area		$T_j \leq$ 150 °C $V_{CE} <= V_{CES}$	100	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$; T_s = 80 °C	119	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V	5 400	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	27	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		70	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	57	W
Maximum Junction Temperature	T_{jmax}			175	°C
Boost Switch					
Collector-emitter break down voltage	V_{CES}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	41	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		105	A
Turn off safe operating area		T_j ≤ 150 °C $V_{CE} <= V_{CES}$		70	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	101	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
Boost Sw. Protection Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_c=25°C		1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	16	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	36	W
Maximum Junction Temperature	T_{jmax}			150	°C
Boost Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	24	A
Surge forward current	I_{FSM}	10ms sin 180°	T_j=150°C	100	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	61	W
Maximum Junction Temperature	T_{jmax}			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t = 2 s	DC Test Voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI				

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 Sw. Protection Diode										
Forward voltage	V_F				10	25 125	1,3	1,67 1,54	2	V
Reverse current	I_r			650		25			0,14	µA
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,87		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,89		
Buck Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0008	25	4,2	5,1	5,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125	1,4	1,90 2,17	2,5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	650		25			5	µA
Gate-emitter leakage current	I_{GES}		20	0		25			150	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	350	35	25 125		67 67		ns
Rise time	t_r					25 125		7 9		
Turn-off delay time	$t_{d(off)}$					25 125		106 129		
Fall time	t_f					25 125		7 16		
Turn-on energy loss	E_{on}					25 125		0,15 0,18		mWs
Turn-off energy loss	E_{off}					25 125		0,24 0,46		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		3100		pF
Output capacitance	C_{oss}							tbd.		
Reverse transfer capacitance	C_{rss}							90		
Gate charge	Q_G		±15	480	50	25		315		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,80		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,53		
Buck Diode										
Diode forward voltage	V_F				16	25 125	1	1,38 1,49	1,7	V
Reverse leakage current	I_r			600		25			320	µA
Peak reverse recovery current	I_{RRM}	R_{gon} = 4 Ω	±15	350	35	25 125		22 20		A
Reverse recovery time	t_{rr}					25 125		9 9		ns
Reverse recovered charge	Q_{rr}					25 125		0,08 0,17		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		8029 7036		A/µs
Reverse recovered energy	E_{rec}					25 125		0,01 0,03		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,68		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,10		

Characteristic Values

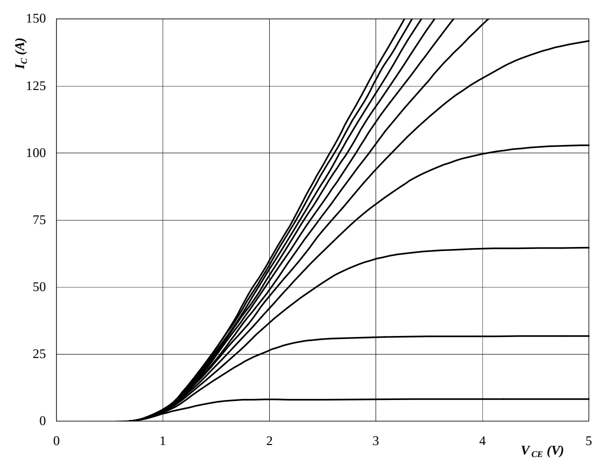
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Boost Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125	1,6	2,06 2,14	2,3	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		25			0,005	mA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	350	35	25 125		44 45		ns
Rise time	t_r					25 125		5 8		
Turn-off delay time	$t_{d(off)}$					25 125		148 192		
Fall time	t_f					25 125		71 110		
Turn-on energy loss	E_{on}					25 125		0,37 0,63		mWs
Turn-off energy loss	E_{off}					25 125		1,25 1,93		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		1950		pF
Output capacitance	C_{oss}							155		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_G		15	480	35	25		tbd.		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,94		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,62		
Boost Sw. Protection Diode										
Diode forward voltage	V_F				7	25 125	1,60	2,01 1,66	2,60	V
Reverse current	I_r			1200		25			250	μA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,92		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,27		
Boost Diode										
Diode forward voltage	V_F				25	25 125	2	2,30 2,40	2,9	V
Reverse leakage current	I_r			1200		25			60	μA
Peak reverse recovery current	I_{RRM}	R_{gon} = 4 Ω	±15	350	35	25 125		65 67		A
Reverse recovery time	t_{rr}					25 125		43 122		ns
Reverse recovered charge	Q_{rr}					25 125		2,24 4,25		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		5361 3861		A/μs
Reverse recovery energy	E_{rec}					25 125		0,59 1,18		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,56		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,03		
Thermistor										
Rated resistance	R					25		21511		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-4,5		+4,5	%
Power dissipation	P					25		210		mW
Power dissipation constant						25		3,5		mW/K
B-value	$B_{(25/50)}$					25		3884		K
B-value	$B_{(25/100)}$	Tol. ±1%				25		3964		K
Vincotech NTC Reference									E	

Buck

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



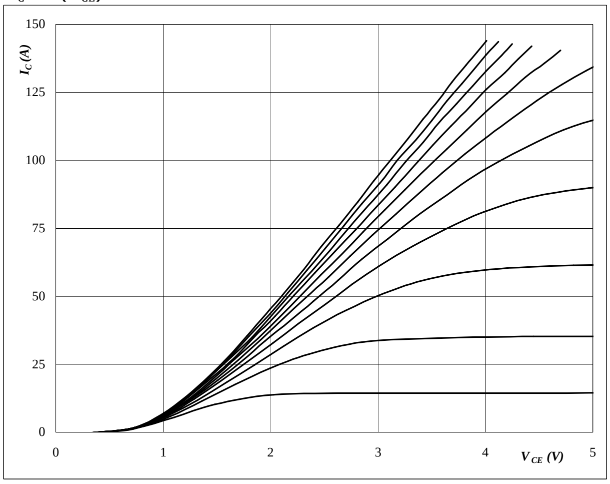
At

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

$I_C = f(V_{CE})$



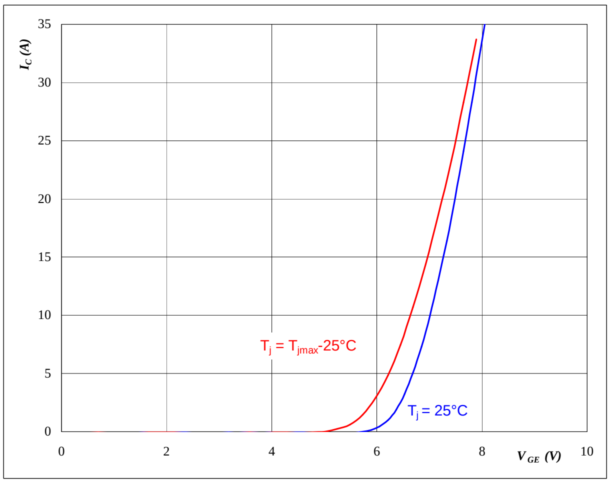
At

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

$I_C = f(V_{GE})$



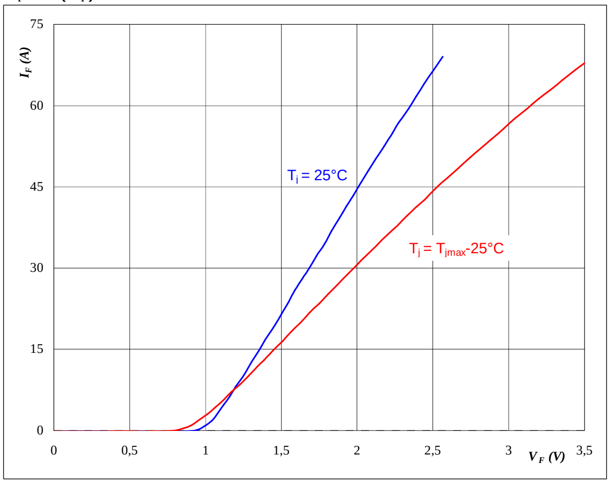
At

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

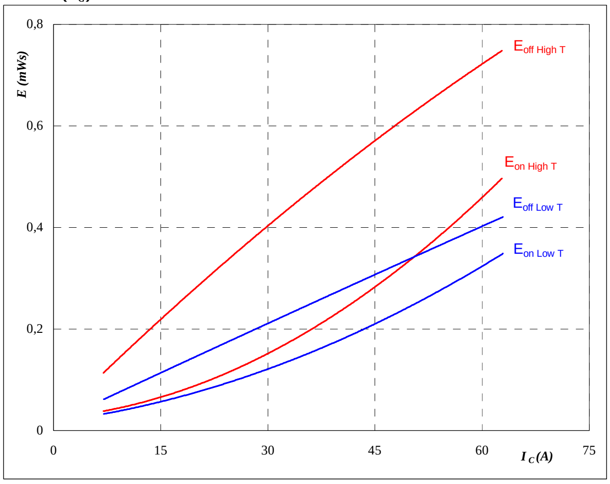
t_p =	250	µs

Buck

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



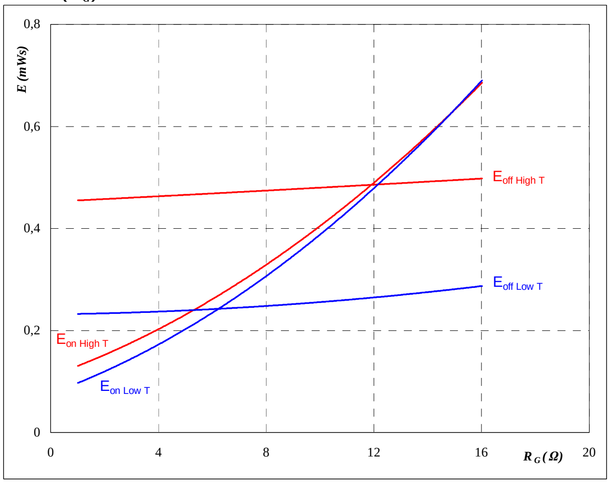
With an inductive load at

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

$E = f(R_G)$



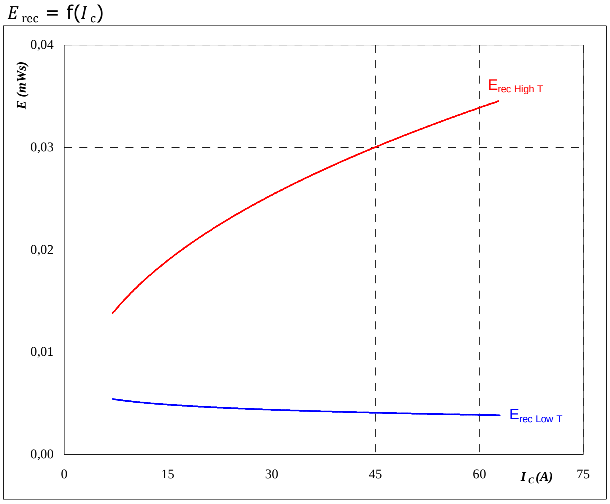
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

figure 7. **FWD**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



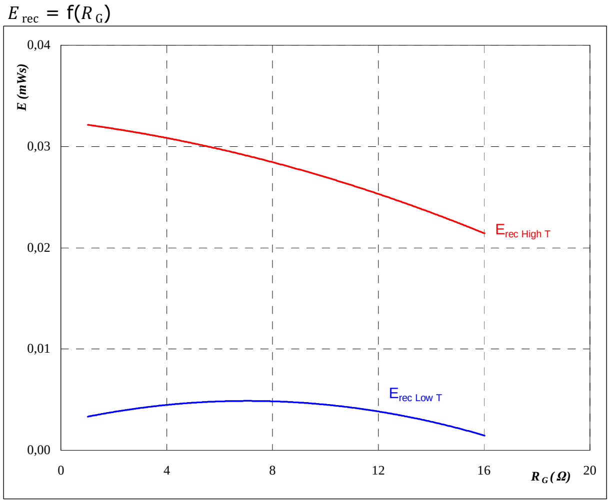
With an inductive load at

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

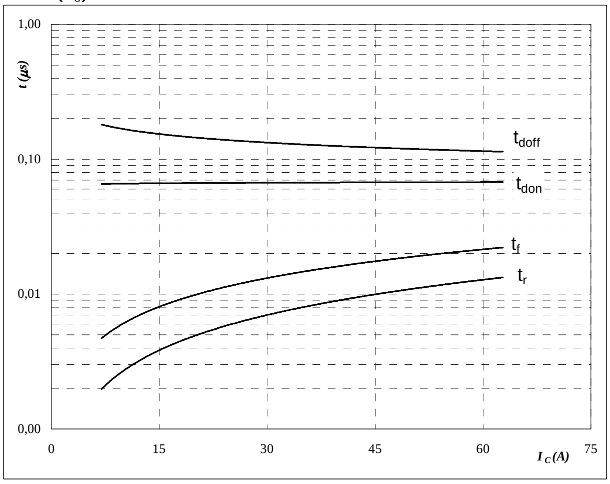
T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

Buck

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



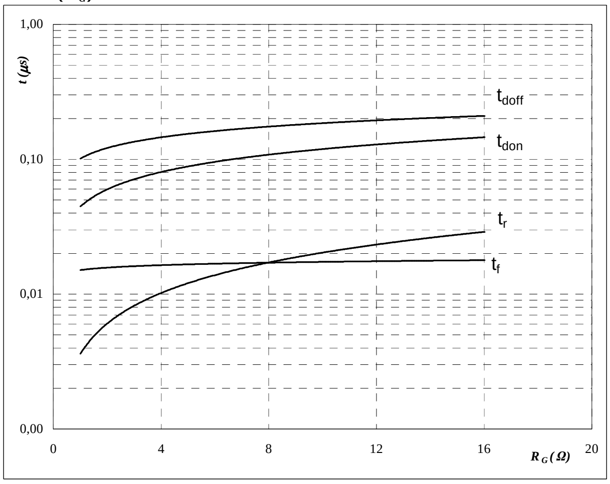
With an inductive load at

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

$t = f(R_G)$



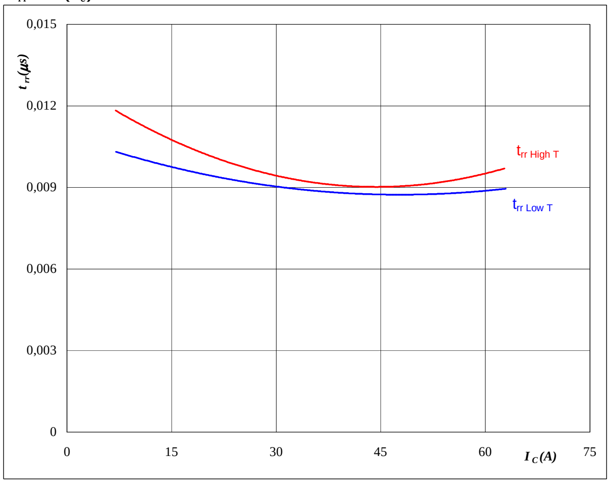
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



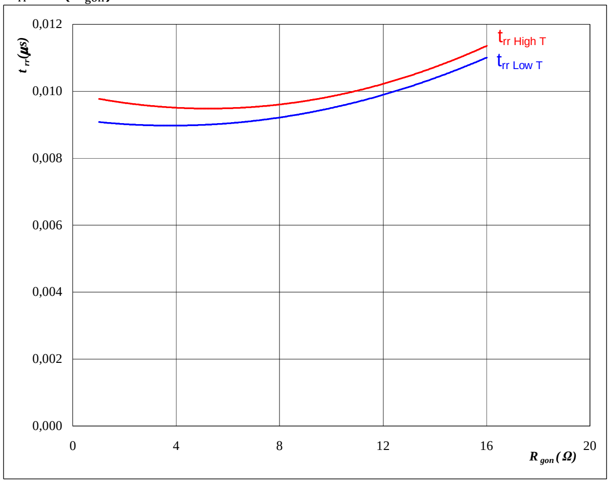
At

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

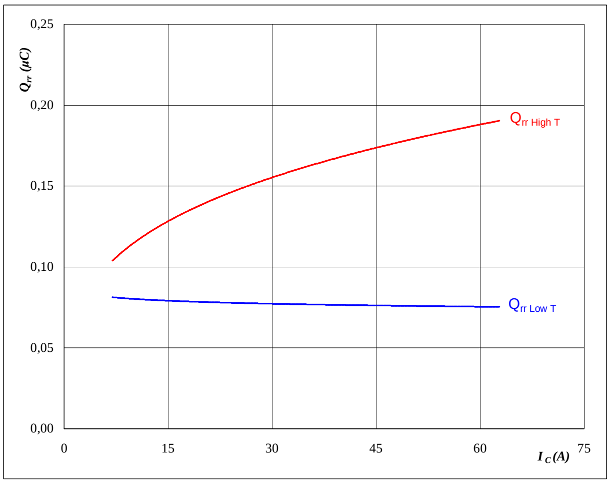
T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

Buck

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



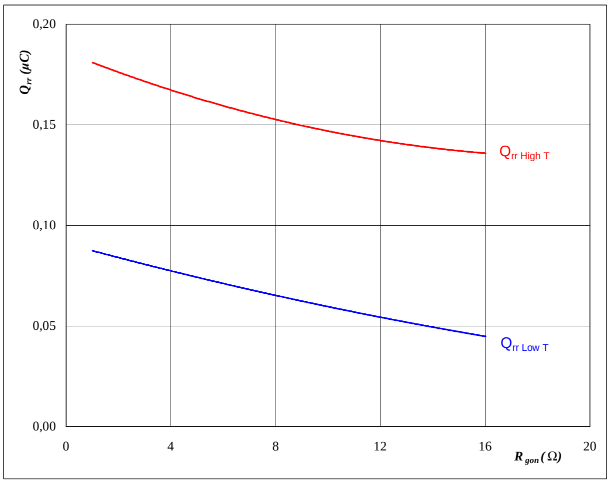
At

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

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



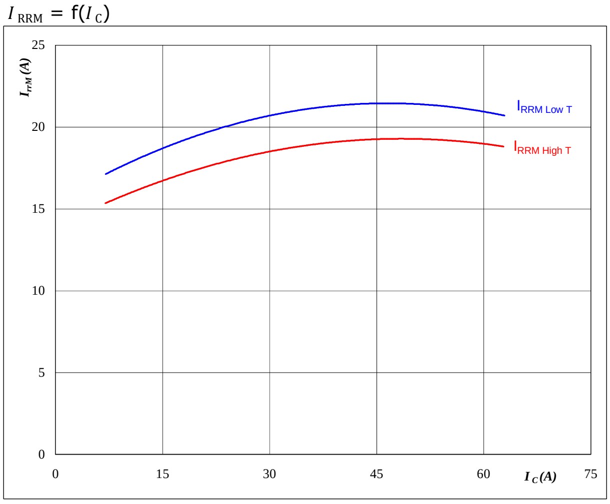
At

T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



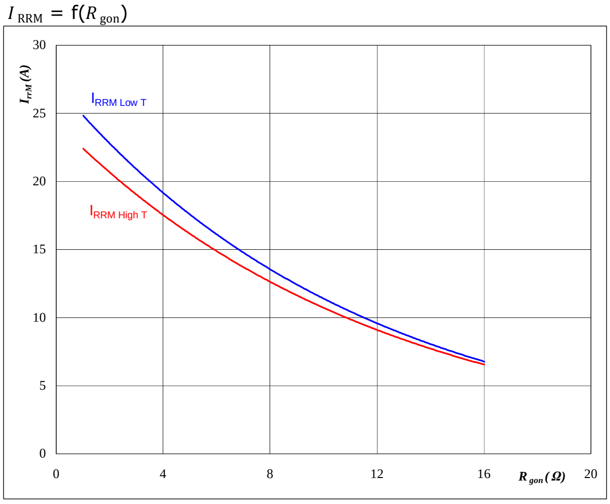
At

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

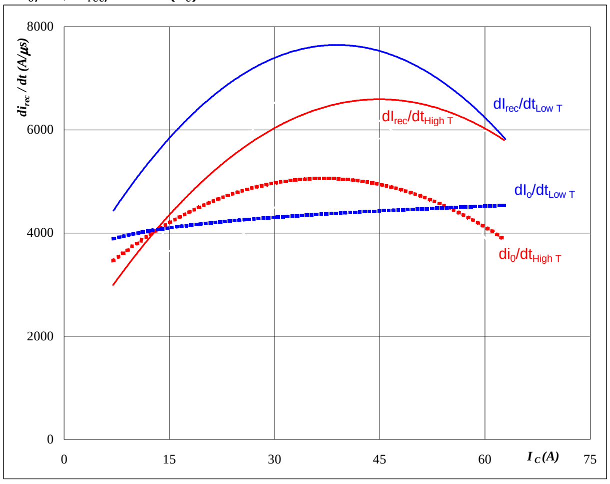
T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

Buck

figure 17. **FWD**

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

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



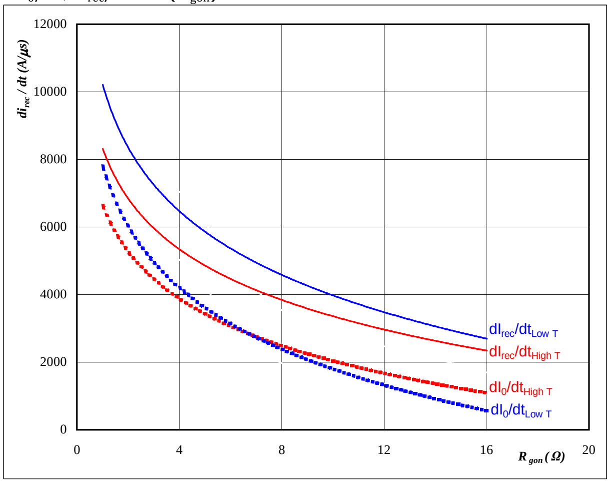
At

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

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



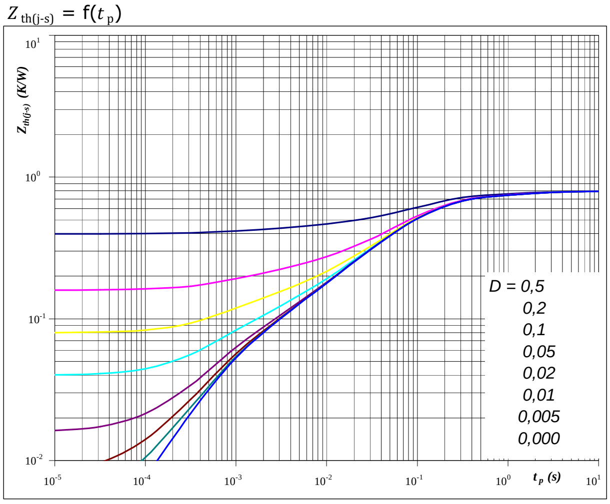
At

T_j =	25/125	°C
V_R =	350	V
I_F =	35	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	
$R_{th(j-s)}$ =	0,80	K/W

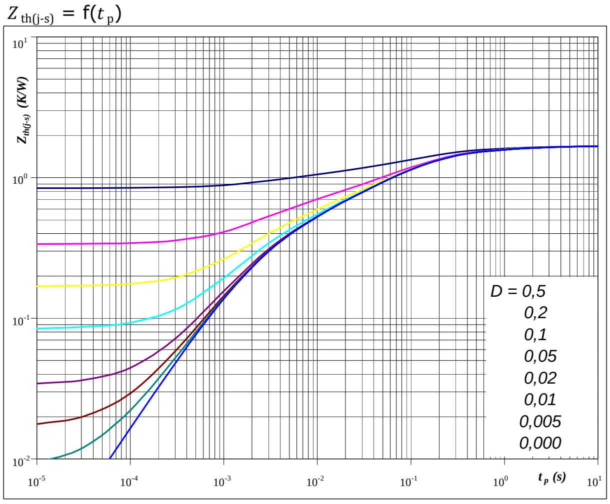
IGBT thermal model values

R (K/W)	Tau (s)
6,19E-02	2,26E+00
1,10E-01	4,08E-01
4,12E-01	9,23E-02
1,04E-01	2,31E-02
5,73E-02	5,67E-03
4,98E-02	8,49E-04

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	
$R_{th(j-s)}$ =	1,68	K/W

FWD thermal model values

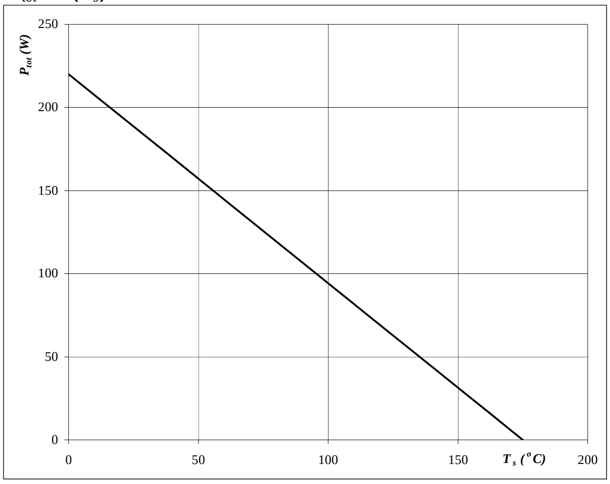
R (K/W)	Tau (s)
5,88E-02	4,81E+00
1,68E-01	8,53E-01
6,16E-01	1,45E-01
3,72E-01	3,88E-02
2,69E-01	7,13E-03
1,97E-01	1,68E-03

Buck

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



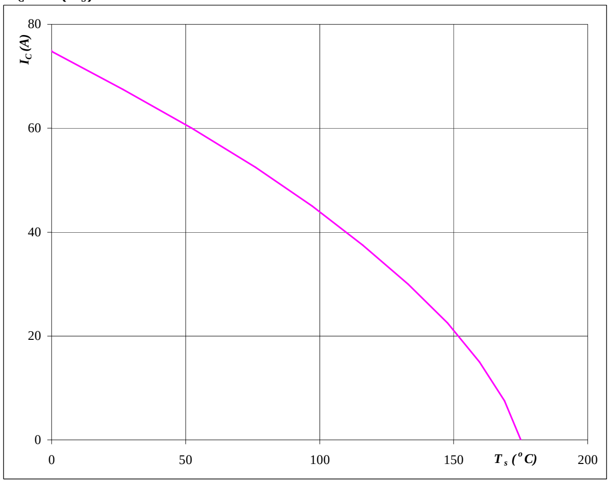
At

T_j = 175 °C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

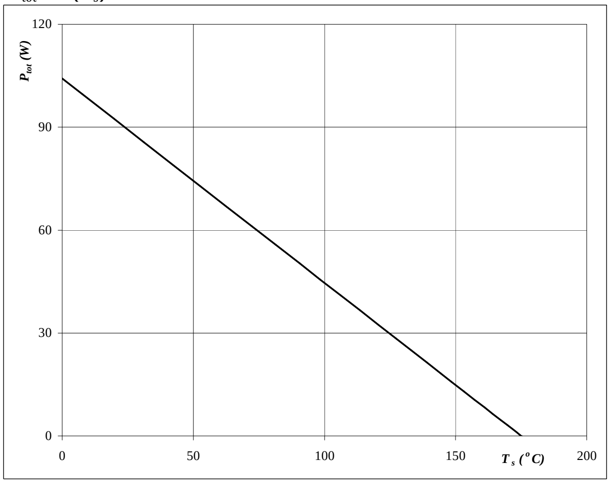
T_j = 175 °C

V_{GE} = 15 V

figure 23.. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



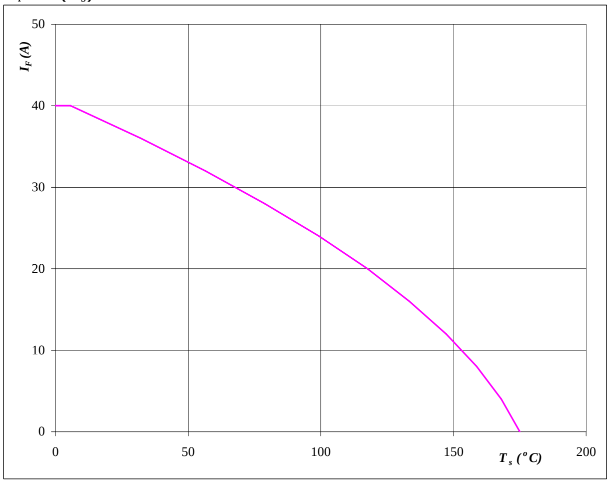
At

T_j = 175 °C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

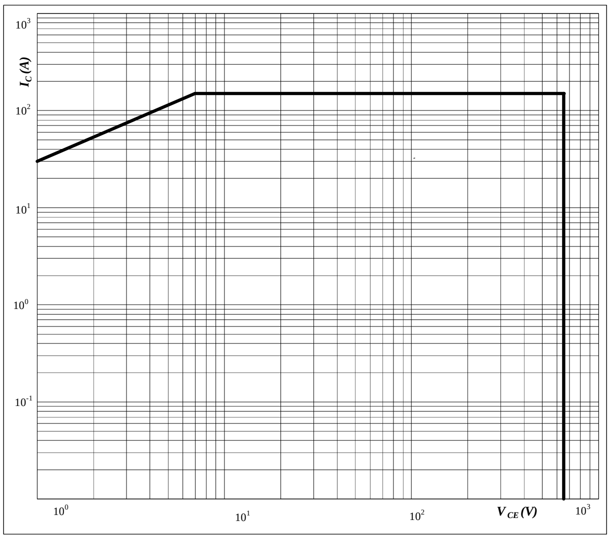
T_j = 175 °C

Buck

figure 25.	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



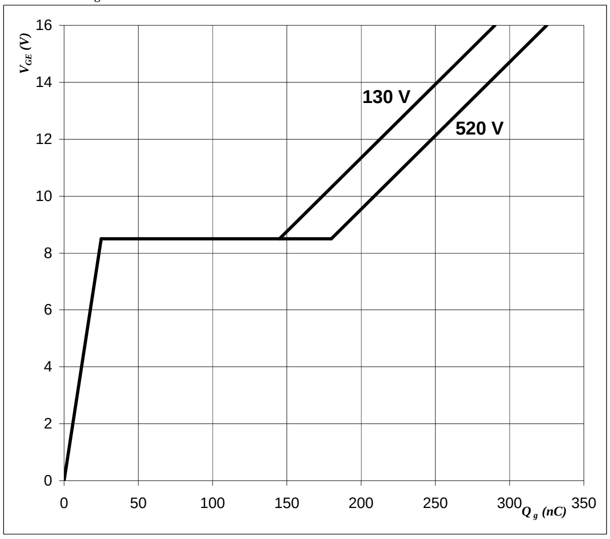
At

$T_j \leq$ T_{jmax}

figure 26.	IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

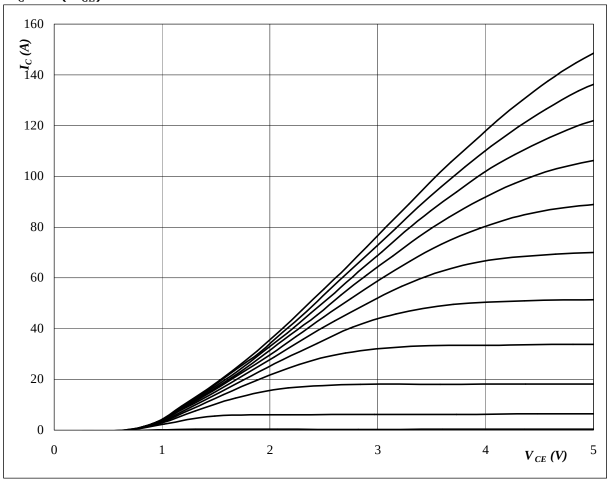
I_C = 50 A

Boost

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



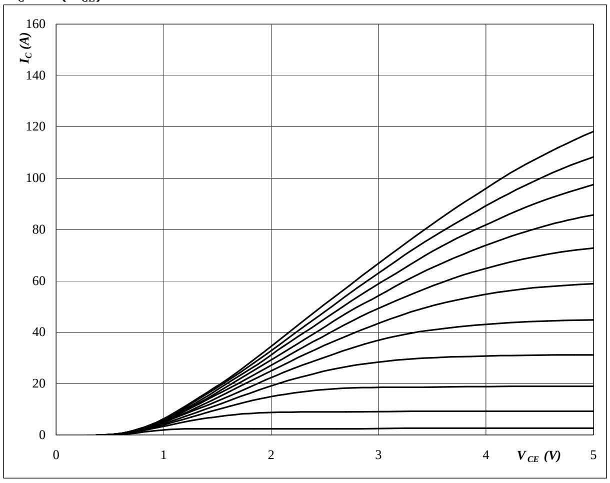
At

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

$I_C = f(V_{CE})$



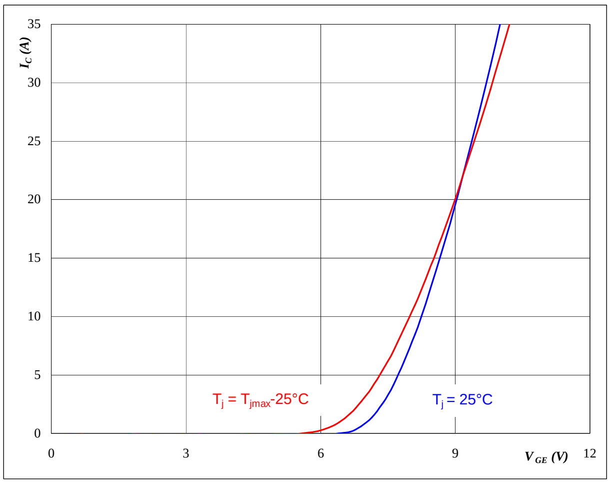
At

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

$I_C = f(V_{GE})$



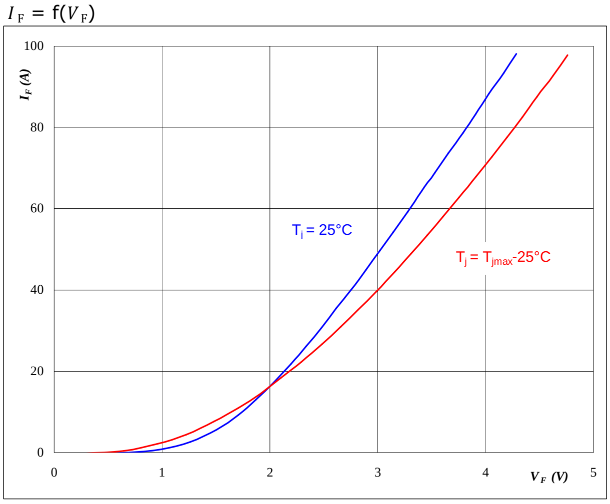
At

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

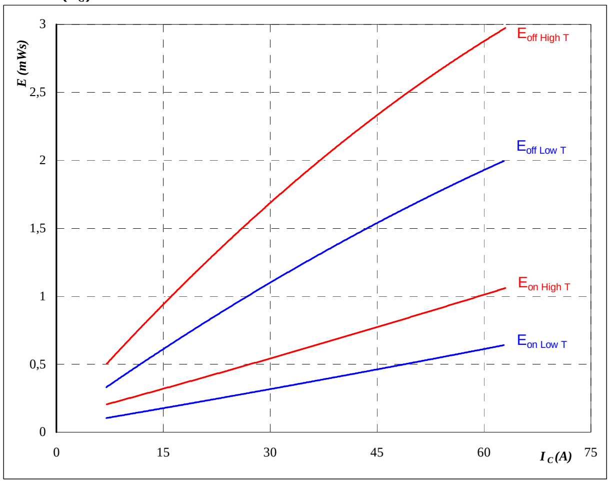
t_p =	250	µs

Boost

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



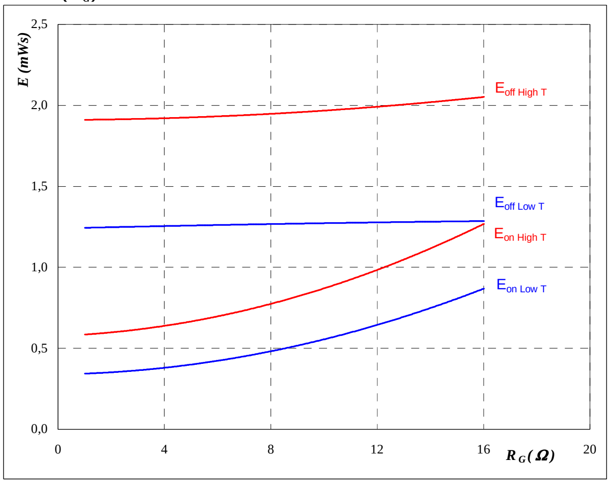
With an inductive load at

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

$E = f(R_G)$



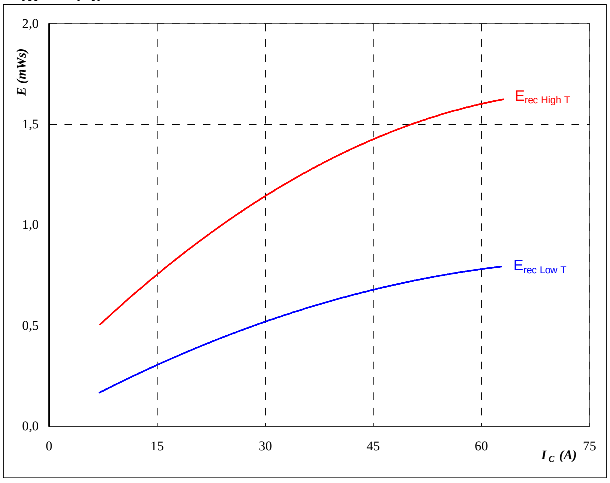
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

figure 7. **FWD**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



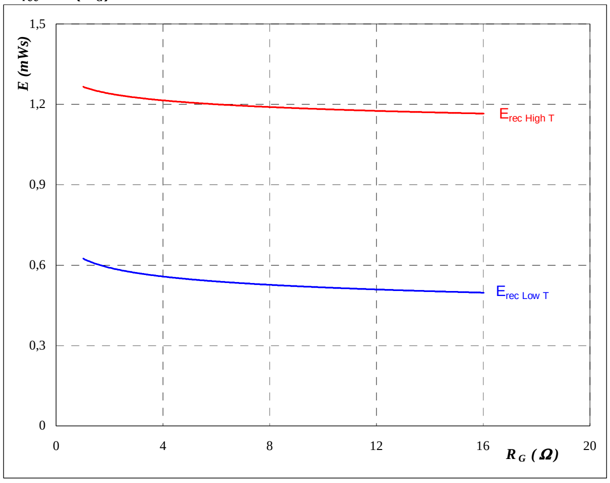
With an inductive load at

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

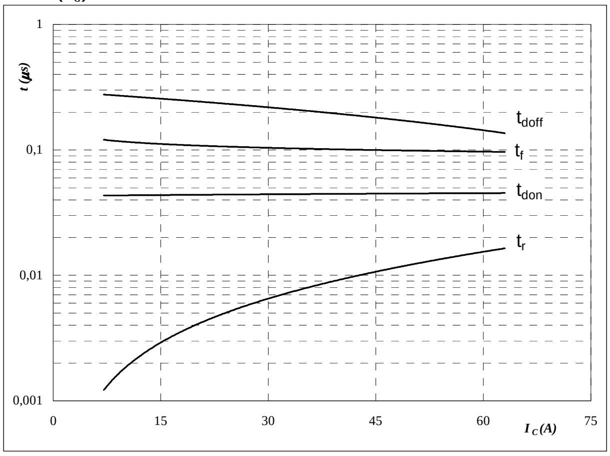
T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

Boost

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



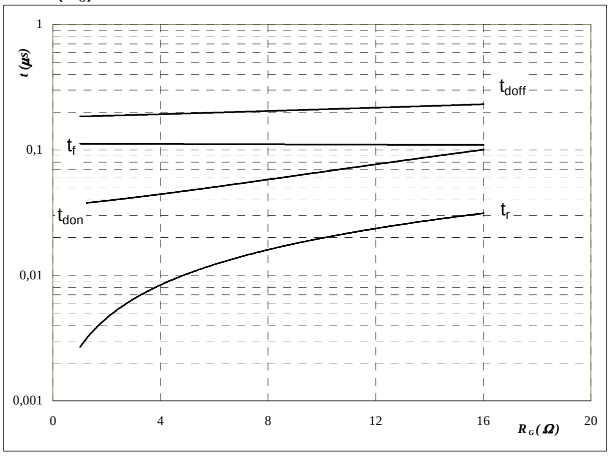
With an inductive load at

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

$t = f(R_G)$



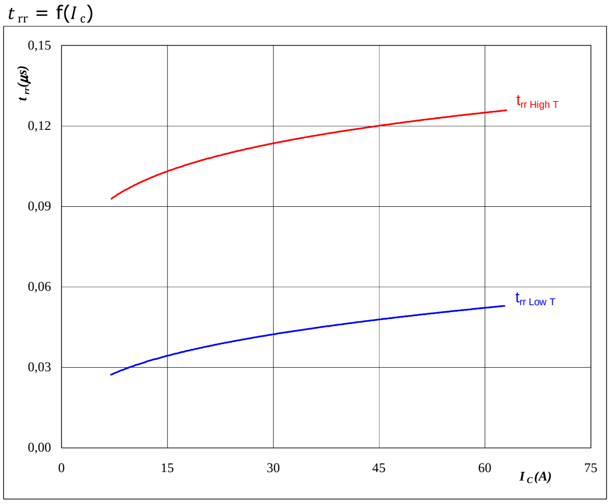
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	35	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



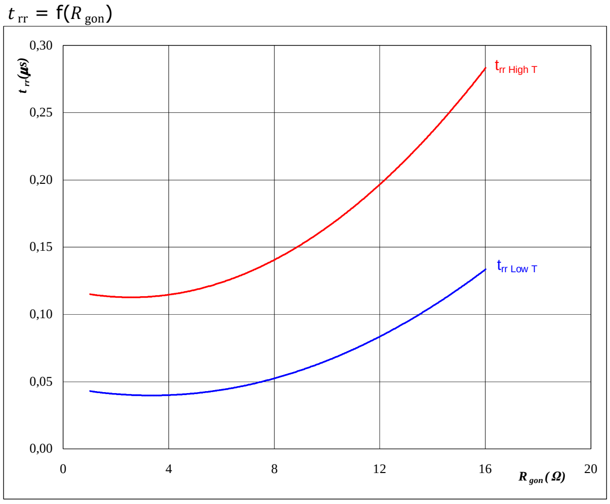
At

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

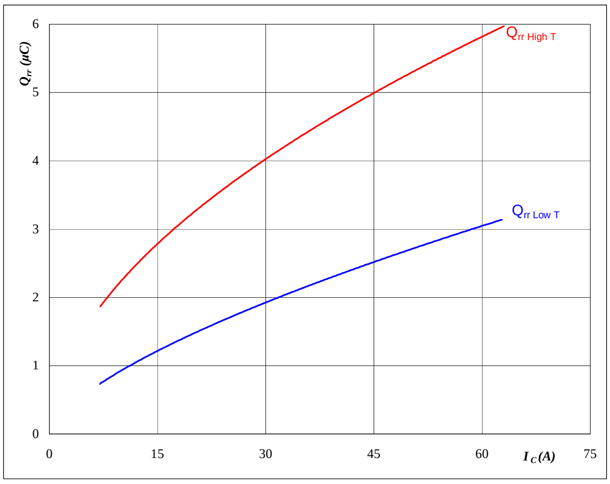
T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

Boost

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



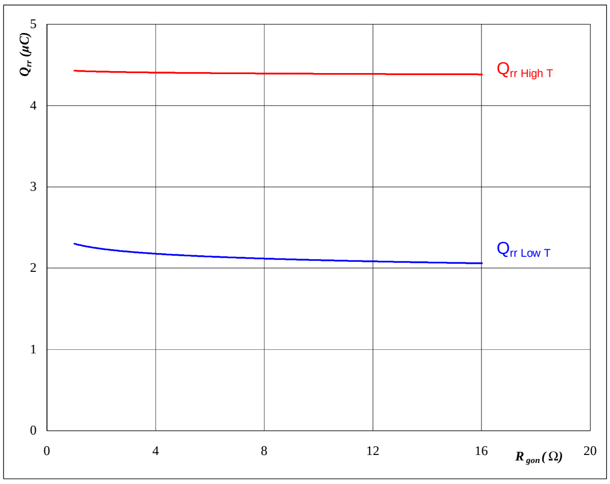
At

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

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



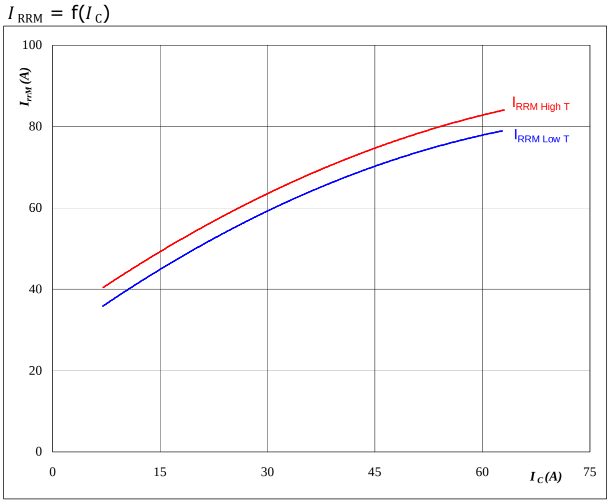
At

T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



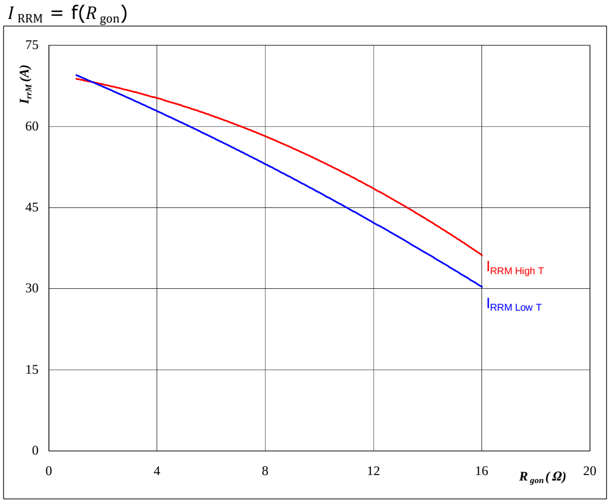
At

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

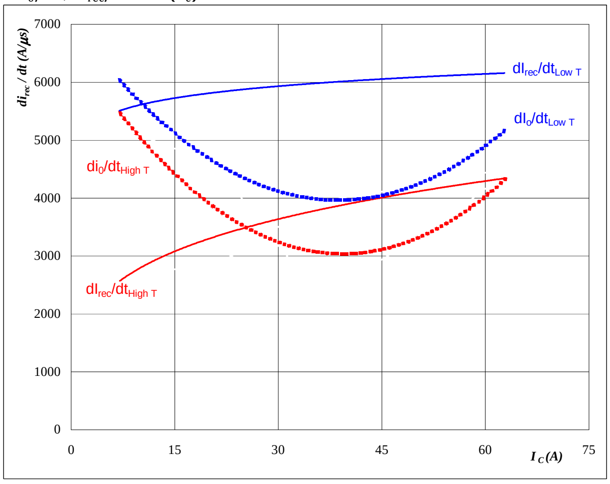
T_j =	25/125	°C
V_R =	350	V
I_F =	35	A
V_{GE} =	±15	V

Boost

figure 17. **FWD**

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

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



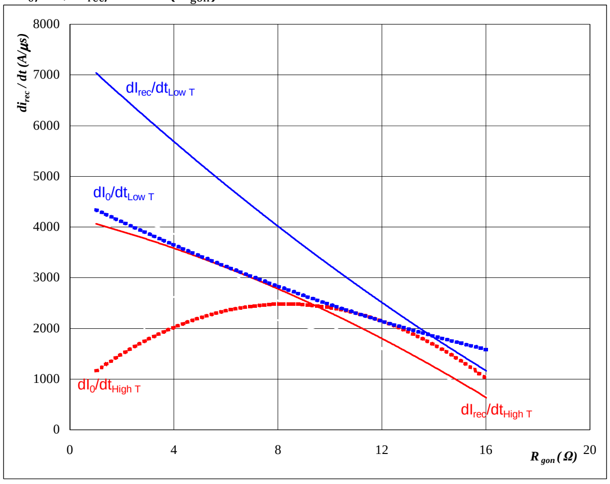
At

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

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



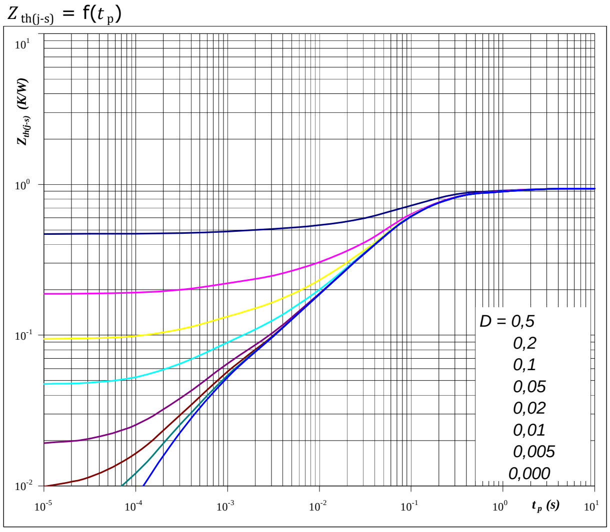
At

T_j =	25/125	°C
V_R =	350	V
I_F =	35	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	
$R_{th(j-s)}$ =	0,94	K/W

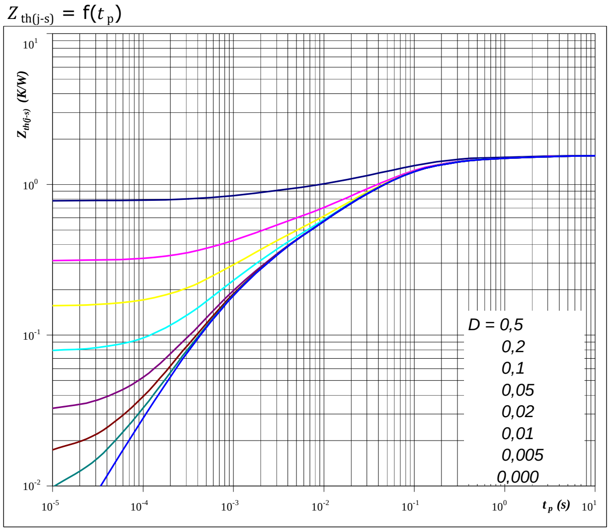
IGBT thermal model values

R (K/W)	Tau (s)
1,15E-01	9,47E-01
4,15E-01	1,24E-01
2,99E-01	4,81E-02
7,22E-02	5,86E-03
3,82E-02	5,62E-04

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	
$R_{th(j-s)}$ =	1,56	K/W

FWD thermal model values

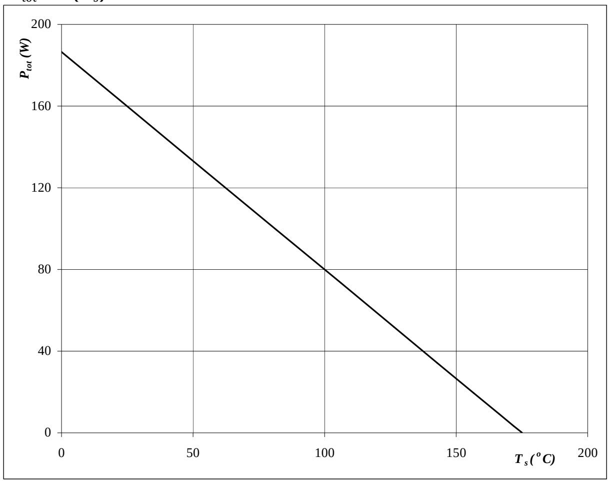
R (K/W)	Tau (s)
4,65E-02	4,86E+00
1,06E-01	8,11E-01
4,71E-01	1,09E-01
4,83E-01	3,07E-02
2,34E-01	7,03E-03
1,81E-01	1,25E-03

Boost

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



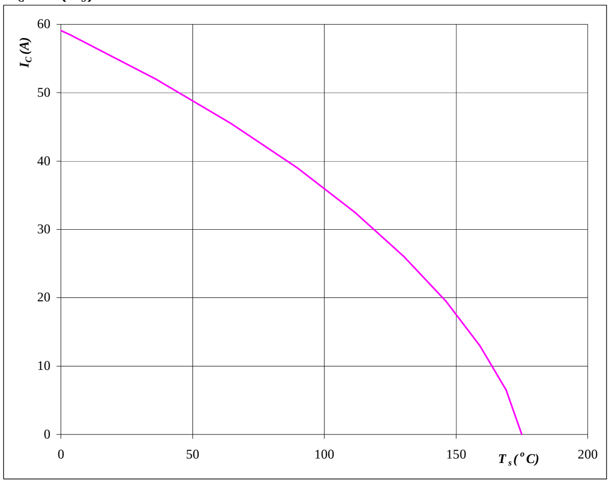
At

T_j = 175 ºC

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

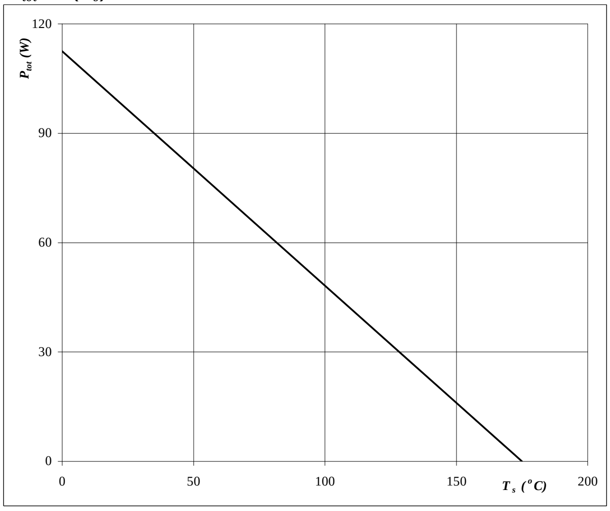
T_j = 175 ºC

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



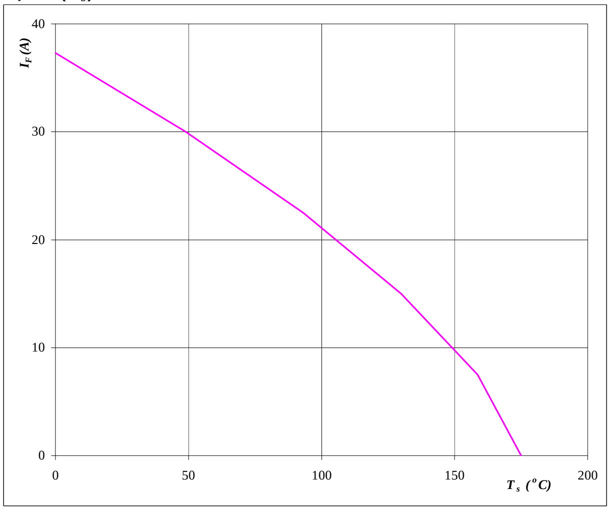
At

T_j = 175 ºC

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

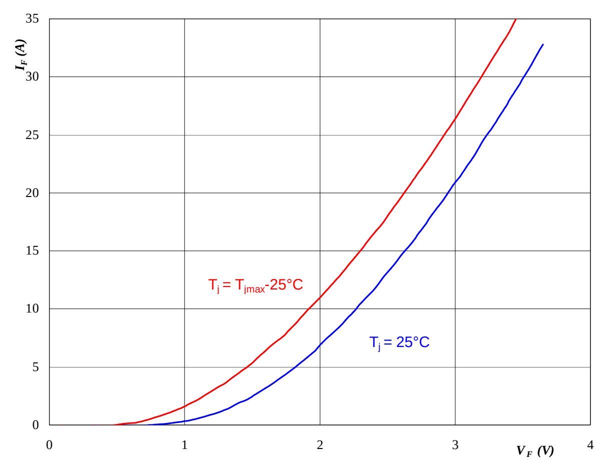
T_j = 175 ºC

Boost Sw. Protection Diode

figure 25. **Boost Sw. Protection Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



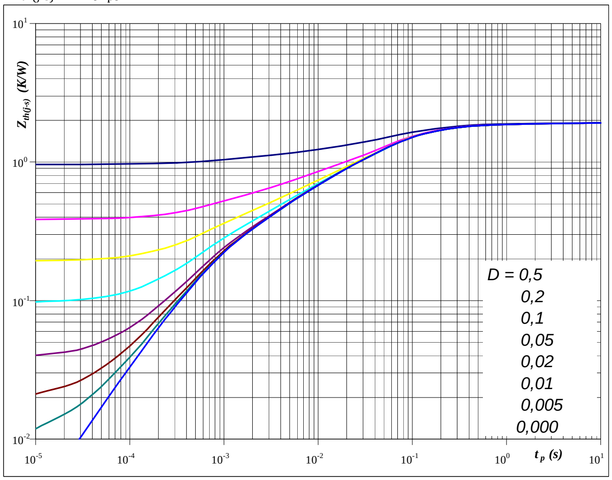
At

t_p = 250 µs

figure 26. **Boost Sw. Protection Diode**

Diode transient thermal impedance as a function of pulse width

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



At

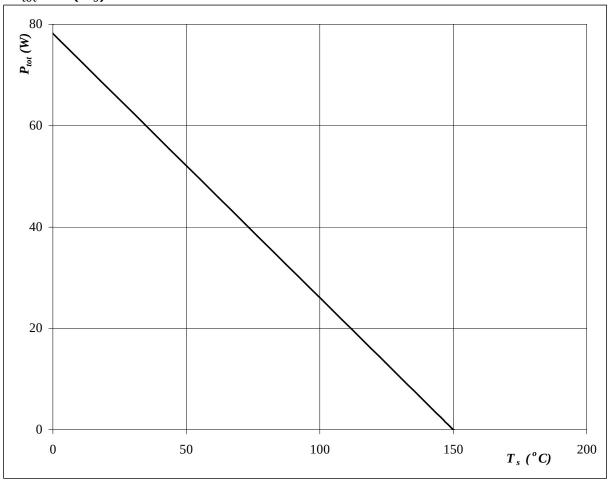
$D = t_p / T$

$R_{th(j-s)}$ = 1,92 K/W

figure 27. **Boost Sw. Protection Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



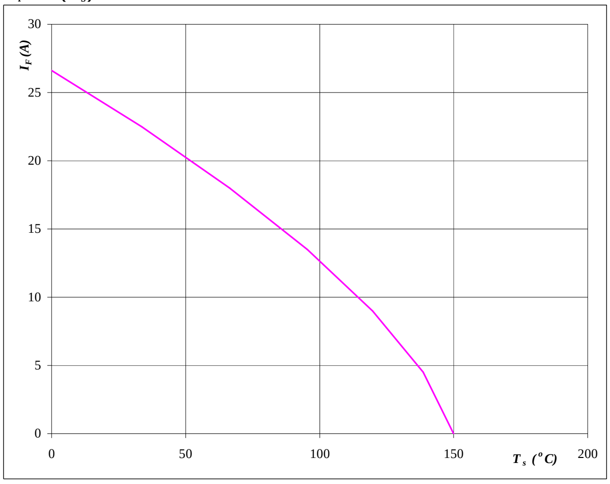
At

T_j = 150 ºC

figure 28. **Boost Sw. Protection Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

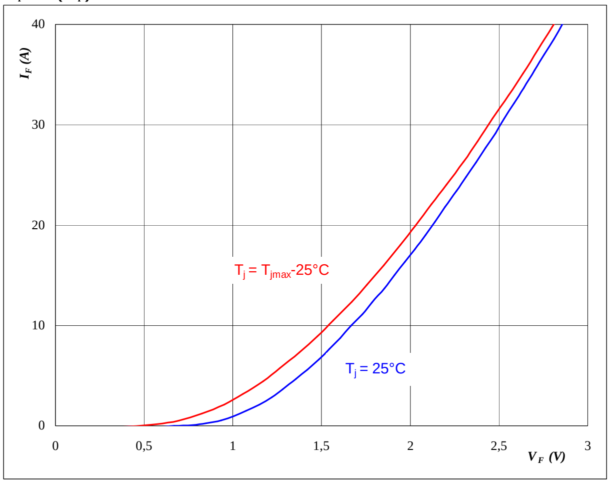
T_j = 150 ºC

Buck Sw. Protection Diode

figure 1. **Buck Sw. Protection Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



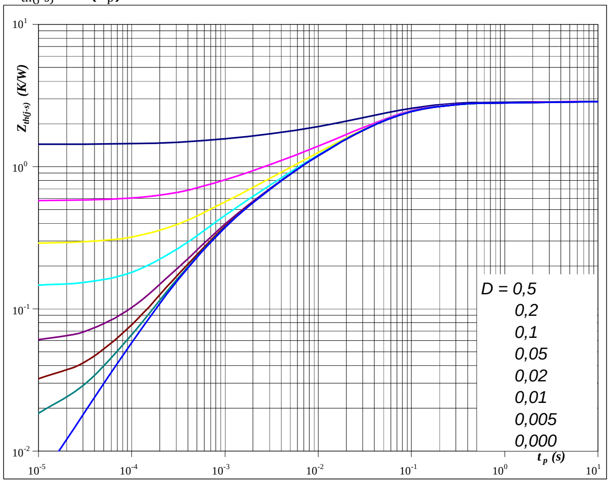
At

t_p = 250 µs

figure 2. **Buck Sw. Protection Diode**

Diode transient thermal impedance as a function of pulse width

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



At

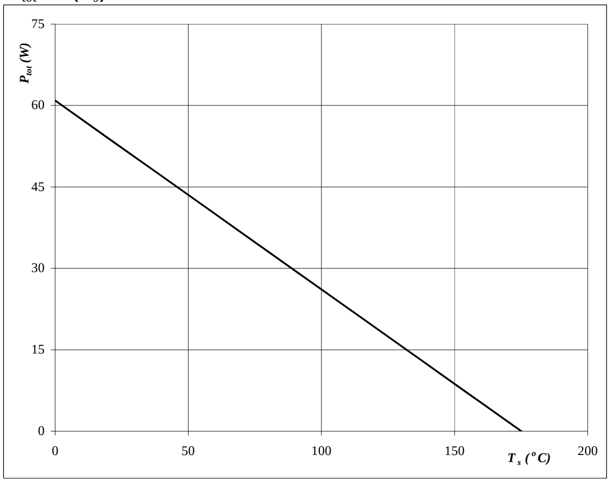
D = t_p / T

$R_{th(j-s)}$ = 2,87 K/W

figure 3. **Buck Sw. Protection Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



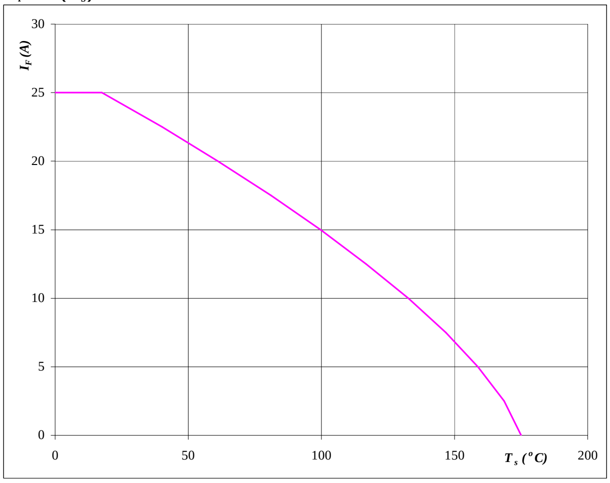
At

T_j = 175 ºC

figure 4. **Buck Sw. Protection Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



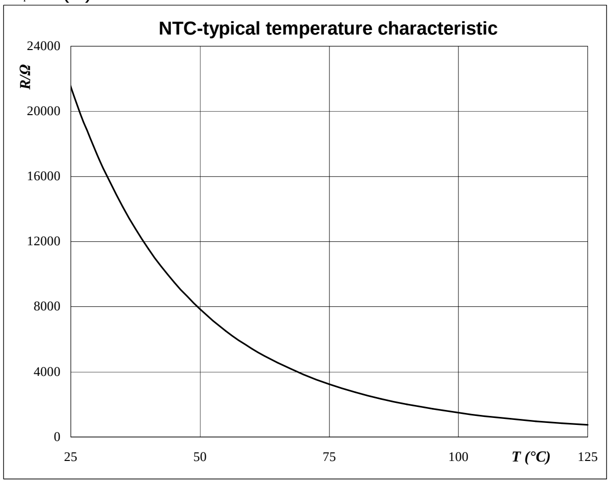
At

T_j = 175 ºC

Thermistor

figure 1.	Thermistor

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



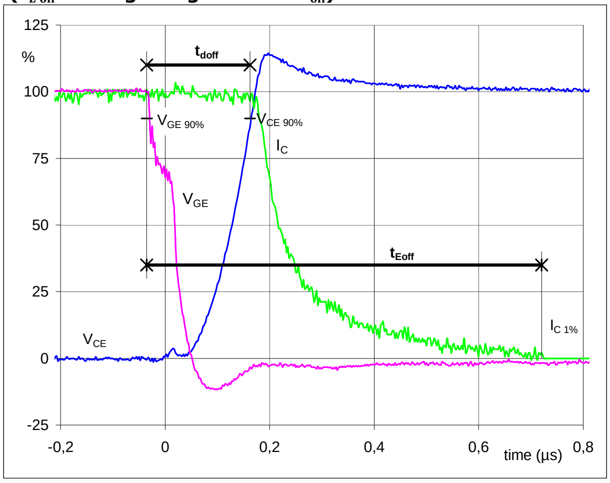
Switching Definitions BOOST

General conditions

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

figure 1. **BOOST IGBT**

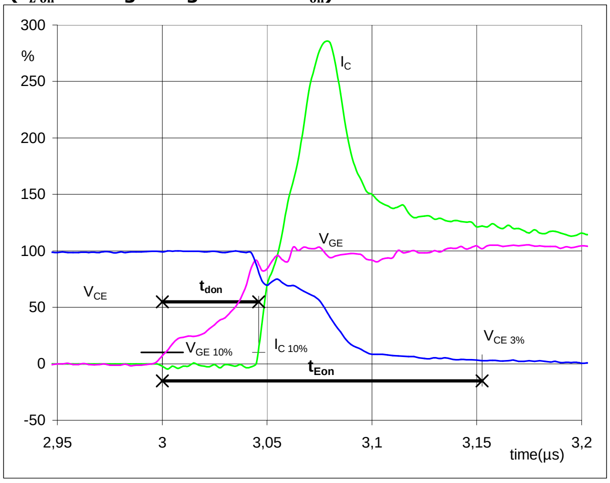
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	35	A
t_{doff} =	0,19	µs
$t_{E\,off}$ =	0,76	µs

figure 2. **BOOST IGBT**

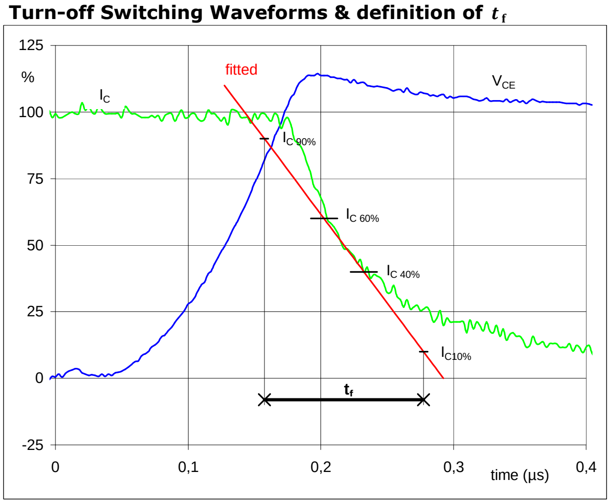
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	35	A
t_{don} =	0,05	µs
$t_{E\,on}$ =	0,15	µs

figure 3. **BOOST IGBT**

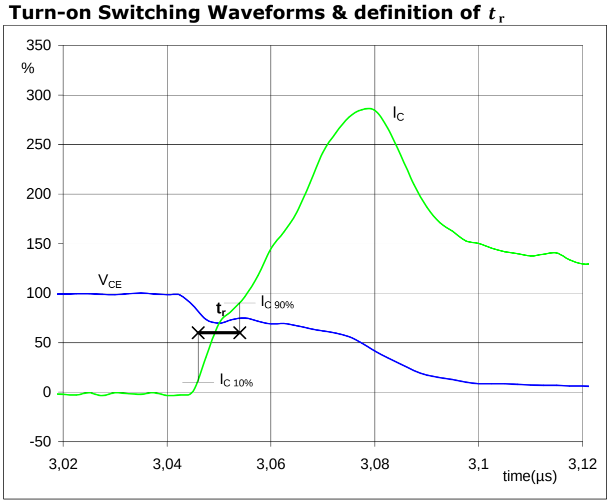
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	35	A
t_f =	0,11	µs

figure 4. **BOOST IGBT**

Turn-on Switching Waveforms & definition of t_r

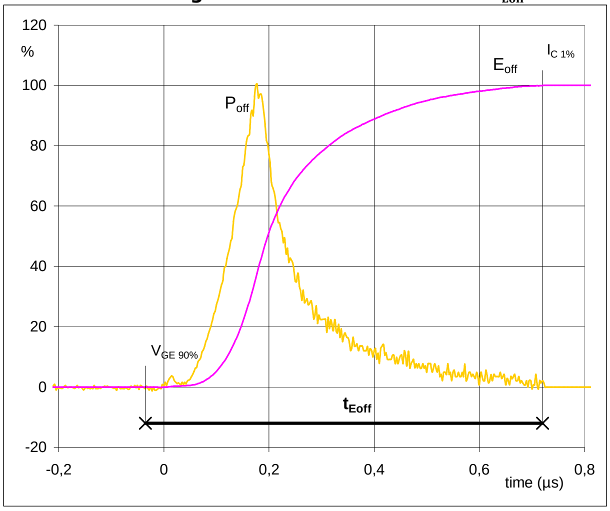


V_C (100%) =	350	V
I_C (100%) =	35	A
t_r =	0,01	µs

Switching Definitions BOOST

figure 5. **BOOST IGBT**

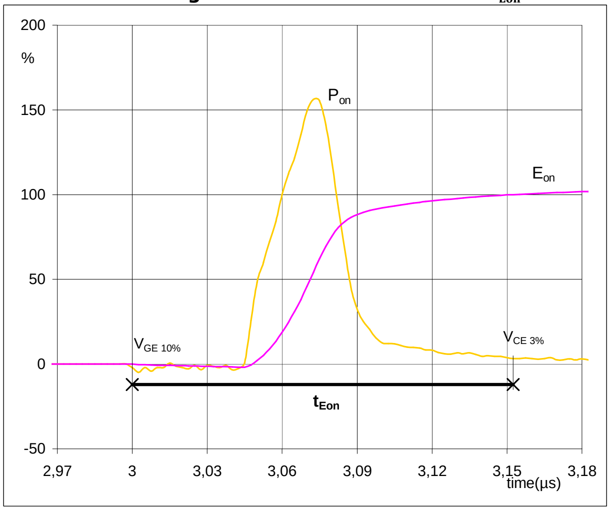
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	12,36	kW
E_{off} (100%) =	1,93	mJ
$t_{E\,off}$ =	0,76	µs

figure 6. **BOOST IGBT**

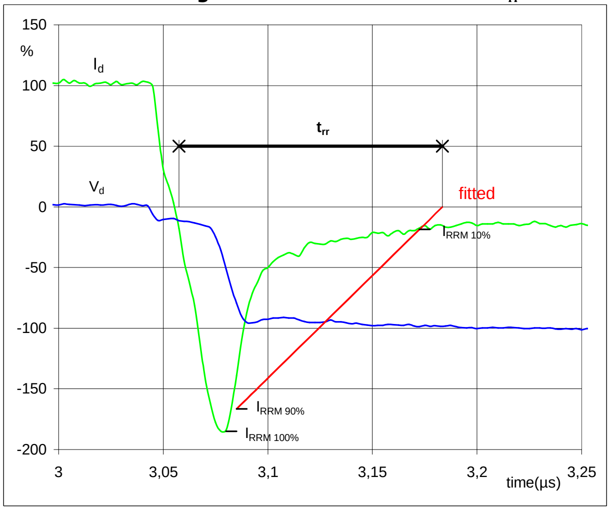
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	12,36	kW
E_{on} (100%) =	0,63	mJ
$t_{E\,on}$ =	0,15	µs

figure 7. **BOOST FWD**

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

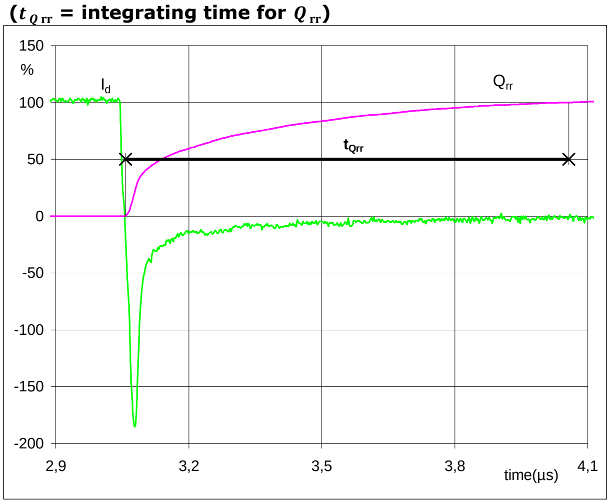


V_d (100%) =	350	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-67	A
t_{rr} =	0,12	µs

Switching Definitions BOOST

figure 8. **BOOST IGBT**

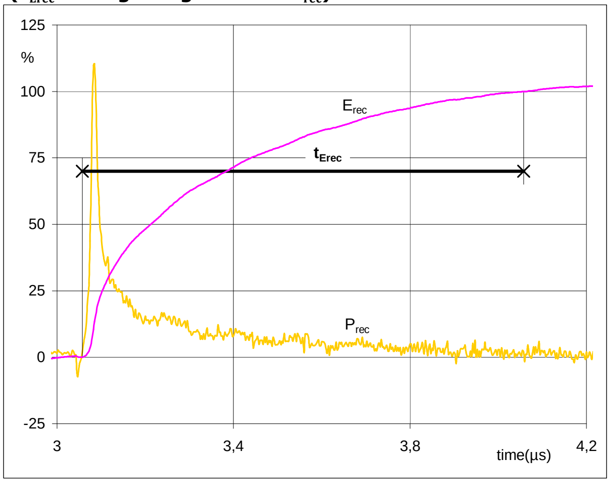
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q rr}$ = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	4,25	µC
$t_{Q rr}$ =	1,00	µs

figure 9. **BOOST IGBT**

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



P_{rec} (100%) =	12,36	kW
E_{rec} (100%) =	1,18	mJ
$t_{E rec}$ =	1,00	µs

Measurement circuits

figure 10.

BUCK stage switching measurement circuit

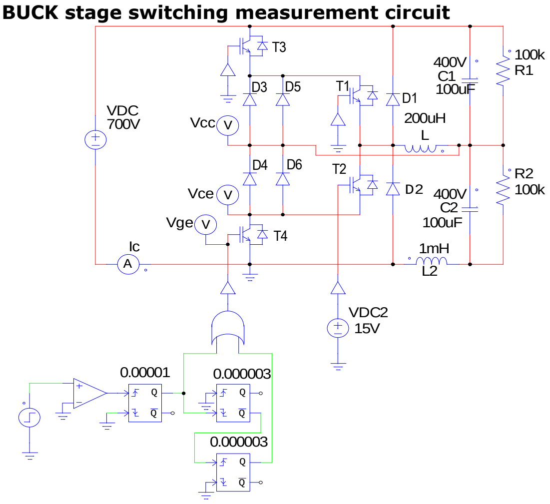
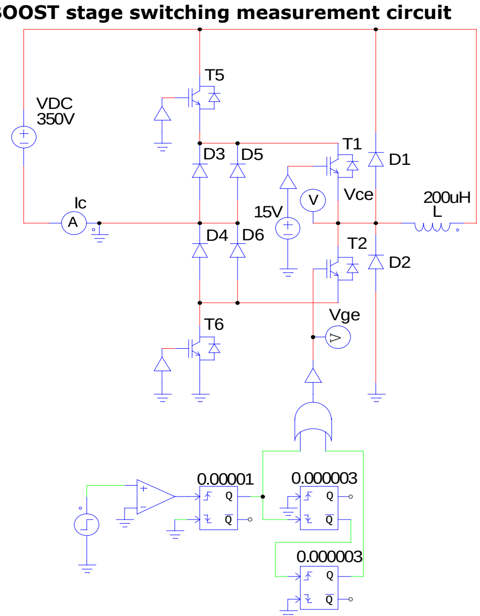


figure 11.

BOOST stage switching measurement circuit



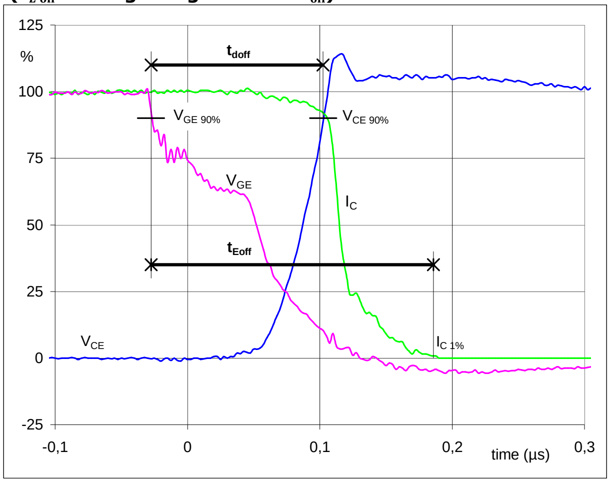
Switching Definitions BUCK

General conditions

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

figure 1. **BUCK IGBT**

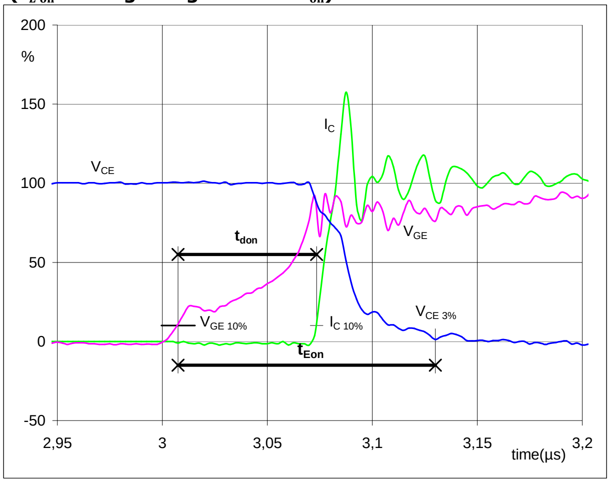
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	35	A
t_{doff} =	0,13	µs
$t_{E\,off}$ =	0,21	µs

figure 2. **BUCK IGBT**

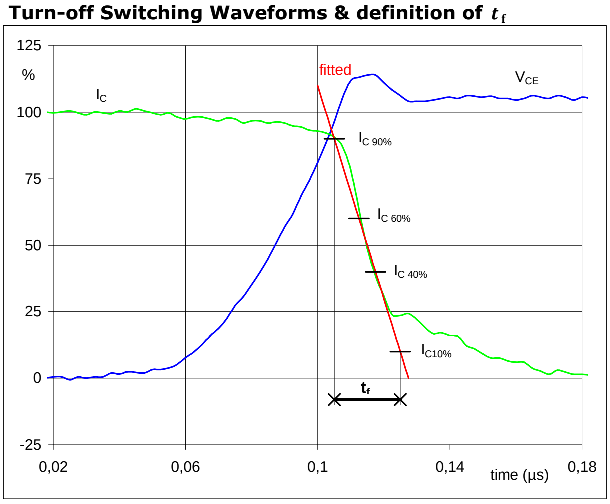
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	35	A
t_{don} =	0,07	µs
$t_{E\,on}$ =	0,12	µs

figure 3. **BUCK IGBT**

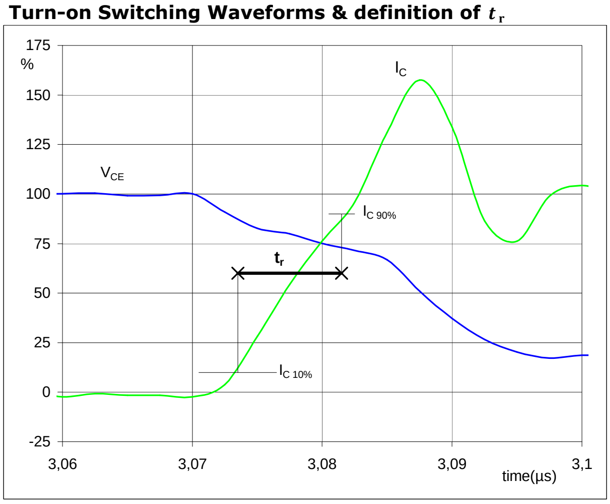
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	35	A
t_f =	0,02	µs

figure 4. **BUCK IGBT**

Turn-on Switching Waveforms & definition of t_r

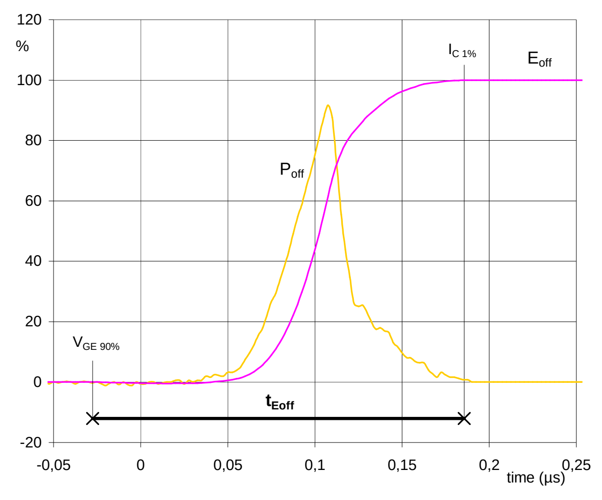


V_C (100%) =	350	V
I_C (100%) =	35	A
t_r =	0,01	µs

Switching Definitions BUCK

figure 5. **BUCK IGBT**

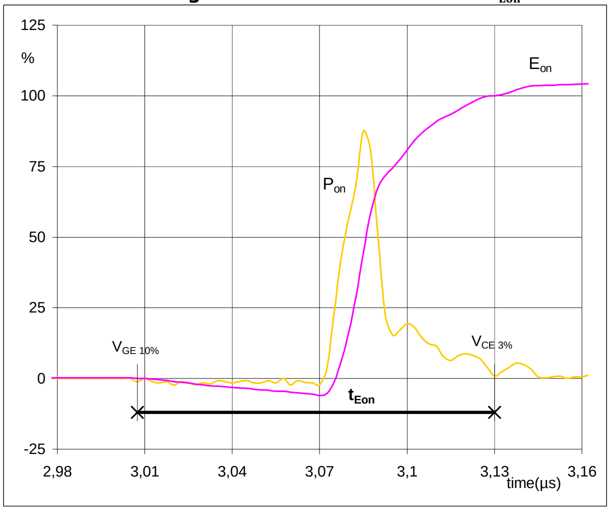
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	12,32	kW
E_{off} (100%) =	0,46	mJ
$t_{E\,off}$ =	0,21	µs

figure 6. **BUCK IGBT**

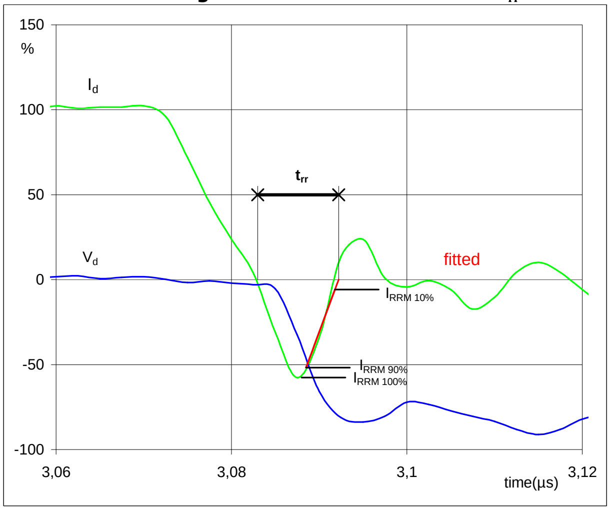
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	12,32	kW
E_{on} (100%) =	0,18	mJ
$t_{E\,on}$ =	0,12	µs

figure 7. **BUCK FWD**

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

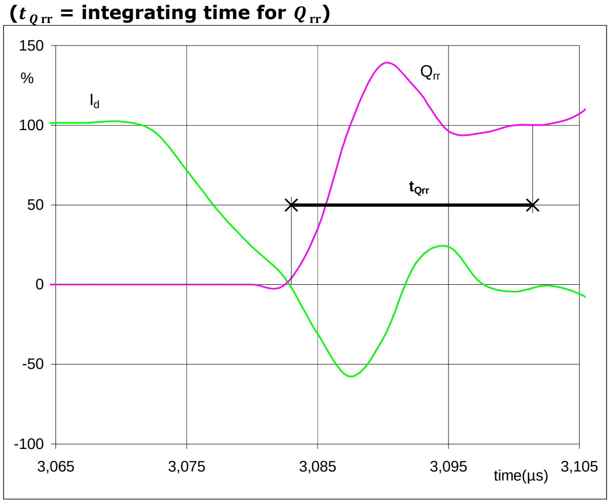


V_d (100%) =	350	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-20	A
t_{rr} =	0,01	µs

Switching Definitions BUCK

figure 8. **BUCK IGBT**

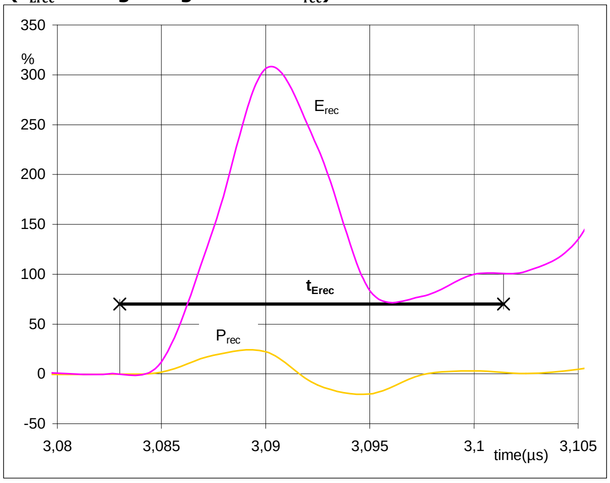
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	0,17	µC
$t_{Q\,rr}$ =	0,02	µs

figure 9. **BUCK IGBT**

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



P_{rec} (100%) =	12,32	kW
E_{rec} (100%) =	0,03	mJ
$t_{E\,rec}$ =	0,02	µs

Measurement circuits

figure 10.

BUCK stage switching measurement circuit

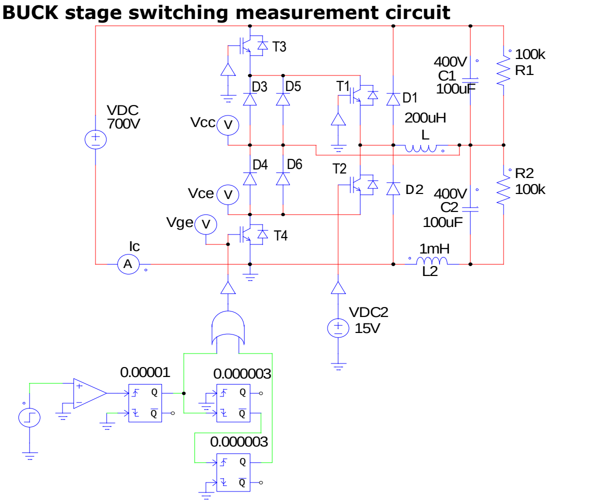
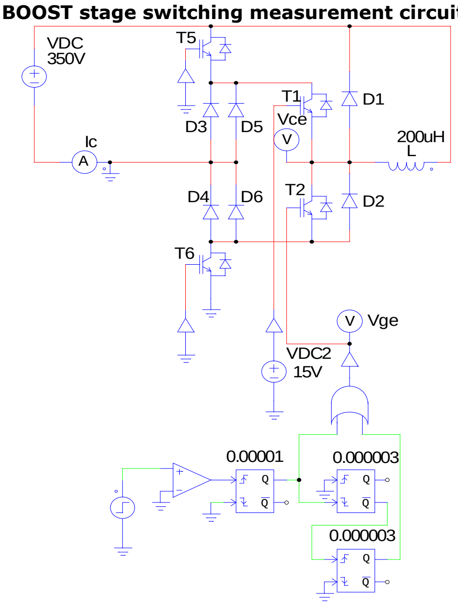


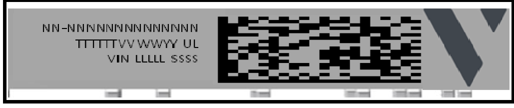
figure 11.

BOOST stage switching measurement circuit



Ordering Code & Marking

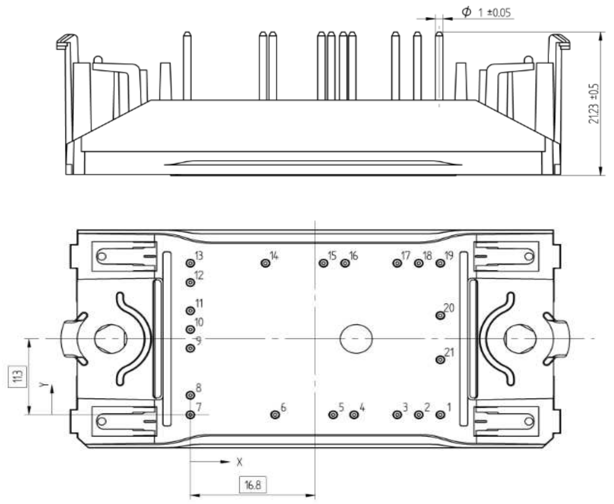
Version	Ordering Code
without thermal paste with solder pins 17mm housing	10-F007NRA050SG-P966F09



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

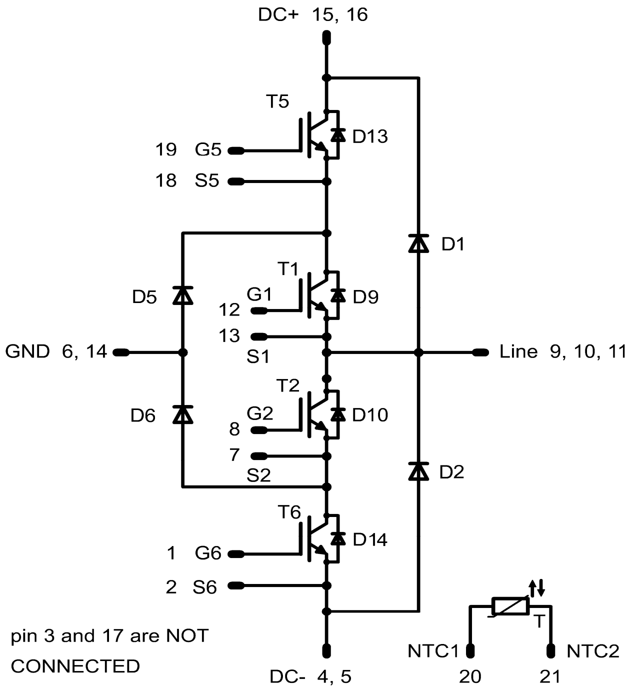
Outline

Pin table			
Pin	X	Y	Function
1	33,6	0	G6
2	30,7	0	S6
3	27,8	0	NC
4	22	0	DC-
5	19,2	0	DC-
6	11,4	0	GND
7	0	0	S2
8	0	2,9	G2
9	0	9,9	Line
10	0	12,7	Line
11	0	15,5	Line
12	0	19,7	G1
13	0	22,6	S1
14	10,1	22,6	GND
15	17,9	22,6	DC+
16	20,8	22,6	DC+
17	27,8	22,6	NC
18	30,7	22,6	S5
19	33,6	22,6	G5
20	33,6	14,8	NTC1
21	33,6	8,2	NTC2



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
T5, T6	IGBT	650 V	50 A	Buck Switch	
D5, D6	FWD	600 V	16 A	Buck Diode	
D13, D14	FWD	650 V	10 A	Buck Sw. Protection Diode	
T1, T2	IGBT	1200 V	35 A	Boost IGBT	
D1, D2	FWD	1200 V	25 A	Boost Diode	
D9, D10	FWD	1200 V	7 A	Boost Sw. Protection Diode	
T	Thermistor			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**135**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 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
10-F007NRA050SG-P966F09-D2-14	20 Jun. 2016	New brand, PCM Rth values	all