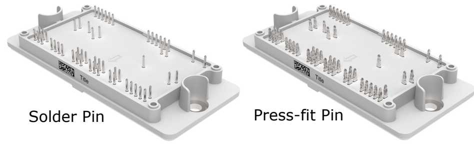
***flow* 2 MNPC** **1200 V / 160 A**

Features

- Mixed voltage NPC topology
- Reactive power capability
- Low inductance layout
- Split output
- Common collector neutral connection

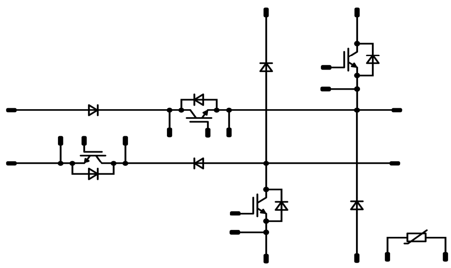
flow 2 13mm housing



Target Applications

- Solar inverter
- UPS
- Active frontend

Schematic



Types

- 30-FT12NMA160SH02-M669F28
- 30-PT12NMA160SH02-M669F28Y

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	17	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	156	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	480	A
Turn off safe operating area		V_{CEmax} = 1200 V, 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}			650	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	96	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	129	W
Maximum Junction Temperature	T_{jmax}			175	°C
Boost Switch					
Collector-emitter breakdown voltage	V_{CE}			650	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	94	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		300	A
Turn off safe operating area		V_{CE} ≤ 600 V, 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}			650	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	65	A
Nonrepetitive peak surge current	I_{FSM}	t_p = 8,3 ms Half sine wave 60 Hz		650	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	128	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
Isolation Properties					
Isolation voltage	V_{is}	DC Test 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	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,57		K/W
Buck Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,006	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		160	25 125	2	2,02 2,37	2,42	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		K
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 4\ \Omega$ $R_{gon} = 4\ \Omega$	±15	350	150	25 125		134 132		ns
Rise time	t_r					25 125		29 33		
Turn-off delay time	$t_{d(off)}$					25 125		199 247		
Fall time	t_f					25 125		36 54,8		
Turn-on energy loss	E_{on}					25 125		1,82 3,36		mWs
Turn-off energy loss	E_{off}					25 125		3,39 5,81		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		9320		pF
Output capacitance	C_{oss}							600		
Reverse transfer capacitance	C_{rss}							520		
Gate charge	Q_G		15	960	160			740		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,22		K/W
Buck Diode										
Diode forward voltage	V_F				100	25 125		2,28 1,67		V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 4\ \Omega$	±15	350	150	25 125		92 133		A
Reverse recovery time	t_{rr}					25 125		30 115		ns
Reverse recovered charge	Q_{rr}					25 125		1,65 6,41		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		12559 4726		A/μs
Reverse recovered energy	E_{rec}					25 125		0,23 1,25		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,73		K/W

Characteristic Values

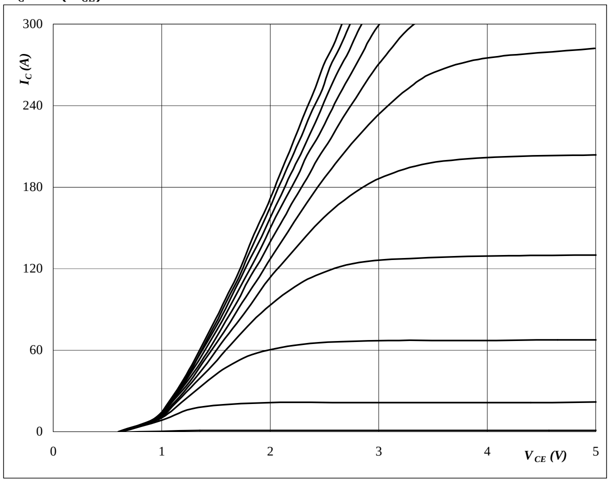
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Boost Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0016	25	5,1	5,8	6,4	V
Collector-emitter saturation voltage	V_{CEsat}		15		100	25 125	0,93	1,58 1,8	1,77	V
Collector-emitter cut-off incl diode	I_{CES}		0	650		25			0,0056	mA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Integrated Gate resistor	R_{gint}							none		K
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	350	100	25 125		103 103		ns
Rise time	t_r					25 125		17 19		ns
Turn-off delay time	$t_{d(off)}$					25 125		158 179		ns
Fall time	t_f					25 125		44 64		ns
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		µWs
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		6280		pF
Output capacitance	C_{oss}							400		pF
Reverse transfer capacitance	C_{rss}							186		pF
Gate charge	Q_G		15	480	100			620		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,48		K/W
Boost Inverse Diode										
Diode forward voltage	V_F				30	25 125	1,23	1,64 1,55	1,87	V
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,22		K/W
Boost Diode										
Diode forward voltage	V_F				60	25 150	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	25 150		107 142		A
Reverse recovery time	t_{rr}					25 150		51 69		ns
Reverse recovered charge	Q_{rr}					25 150		6 13		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		5985 2890		A/µs
Reverse recovery energy	E_{rec}					25 150		1,71 3,61		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,68		K/W
Thermistor										
Rated resistance	R					25		22000		K
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-12		+12	%
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 Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

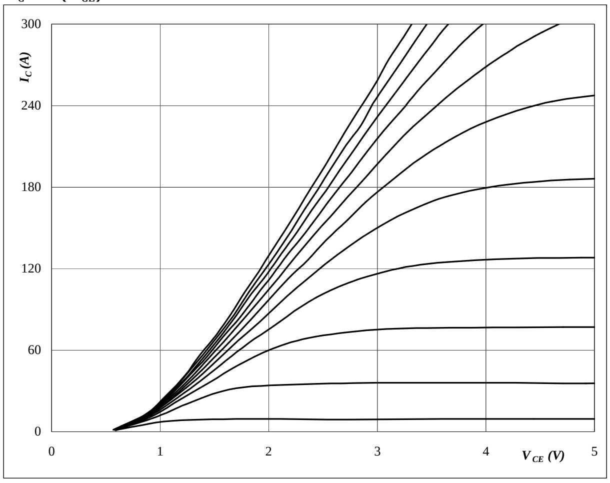
T_j = 25 °C

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

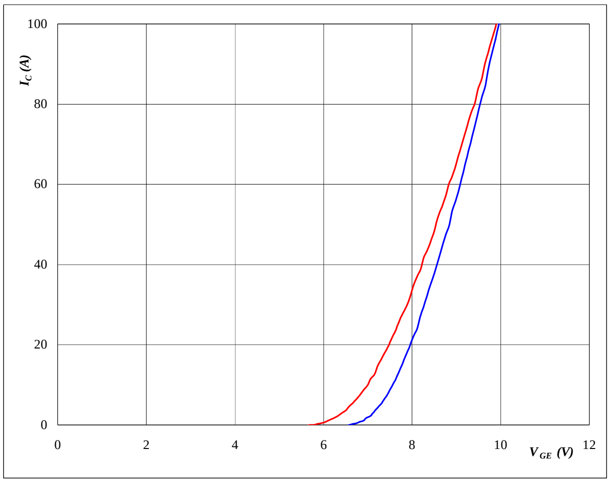
T_j = 125 °C

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_j = 25/125 °C

t_p = 250 µs

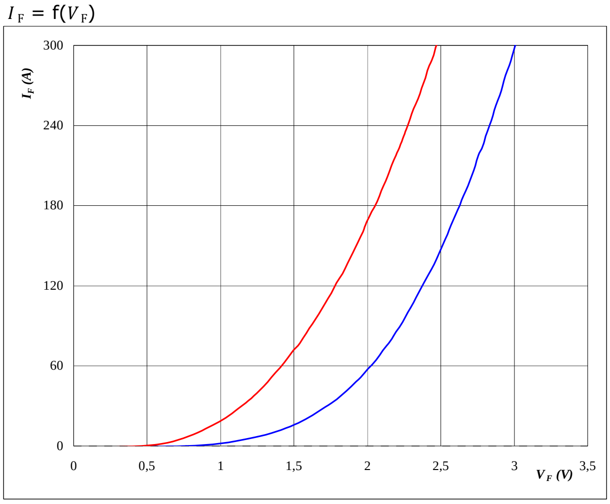
V_{CE} = 10 V

T_j = 25/125 °C

figure 4. **FWD**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

T_j = 25/125 °C

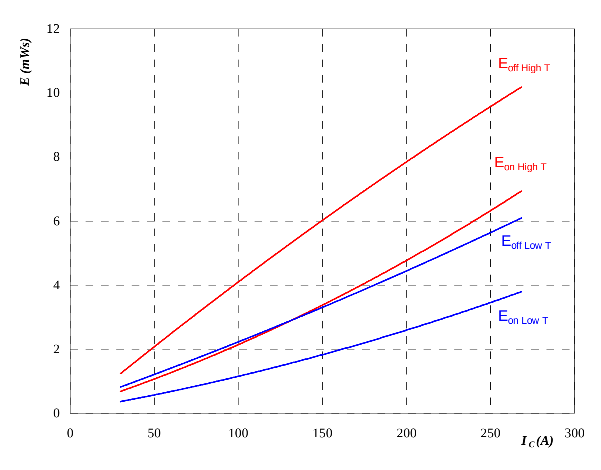
t_p = 250 µs

Buck Characteristics

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



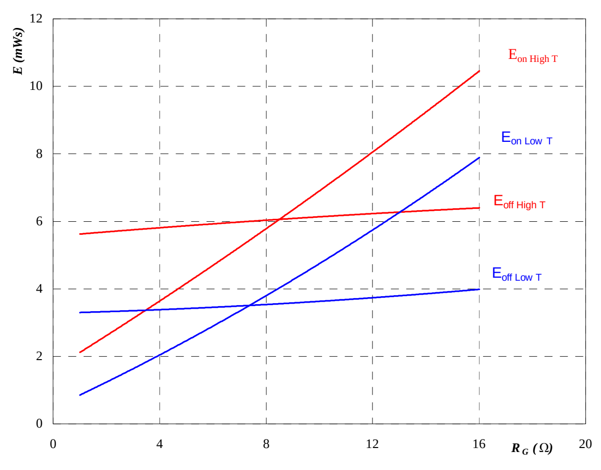
With an inductive load at

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

figure 6. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



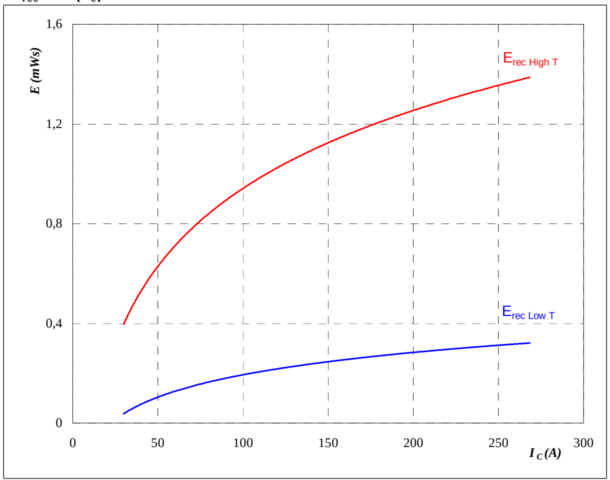
With an inductive load at

T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	150	A

figure 7. **FWD**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



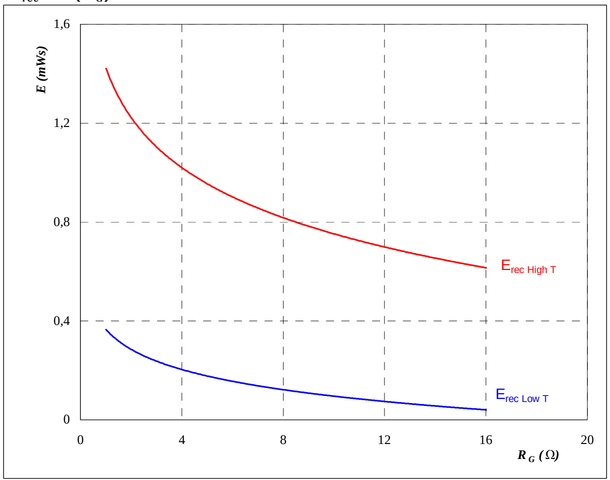
With an inductive load at

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

figure 8. **FWD**

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

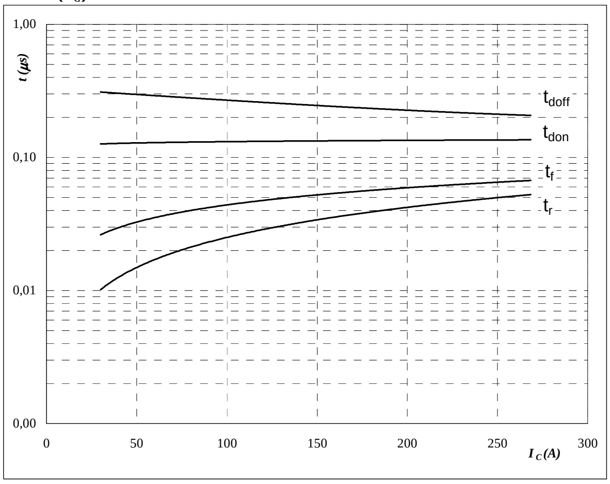
T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	150	A

Buck Characteristics

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



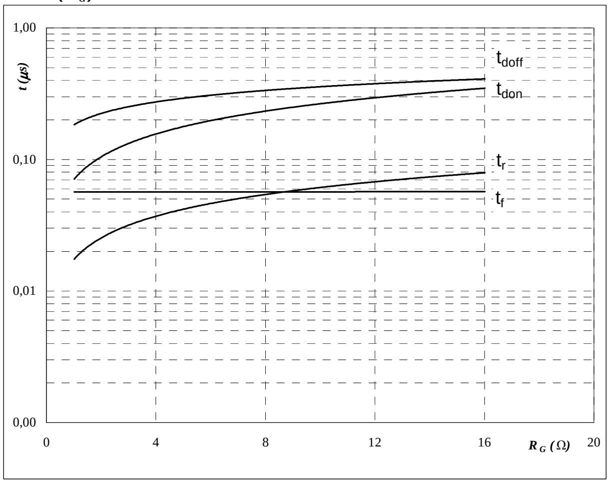
With an inductive load at

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

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



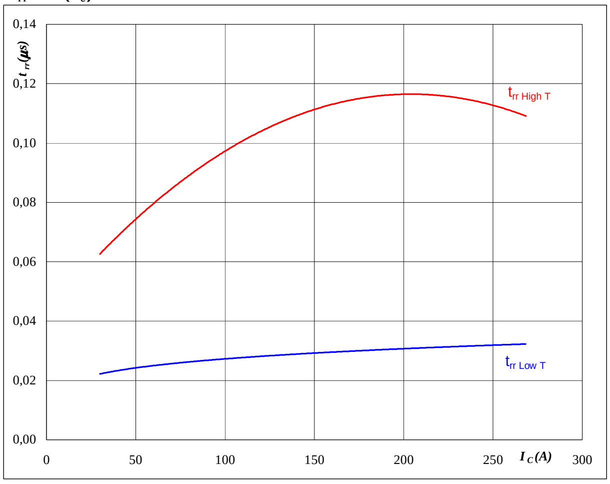
With an inductive load at

T_j =	125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	150	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



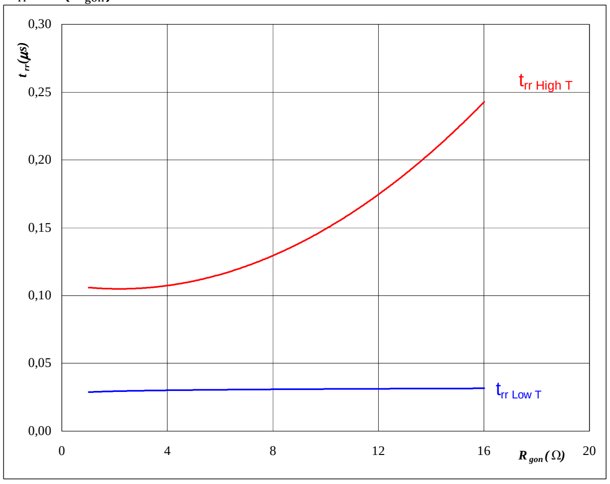
At

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

figure 12. **FWD**

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

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



At

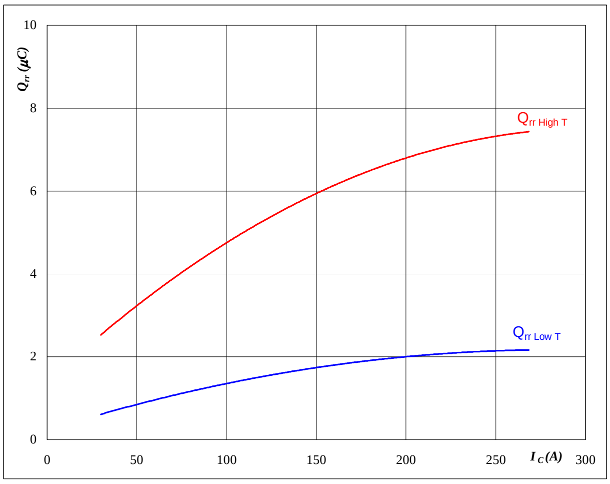
T_j =	25/125	°C
V_R =	350	V
I_F =	150	A
V_{GE} =	±15	V

Buck Characteristics

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



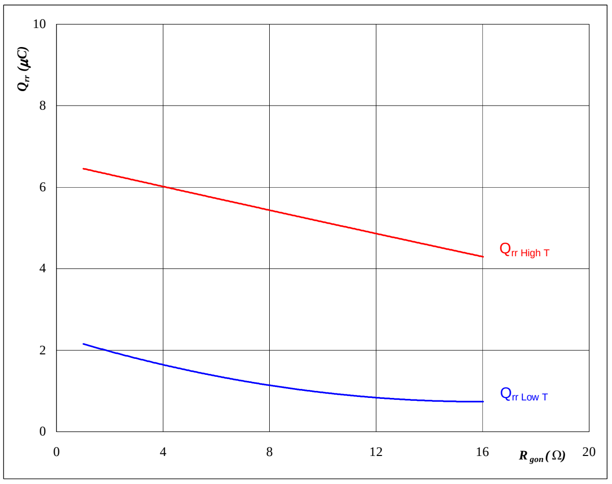
At

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

figure 14. **FWD**

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

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



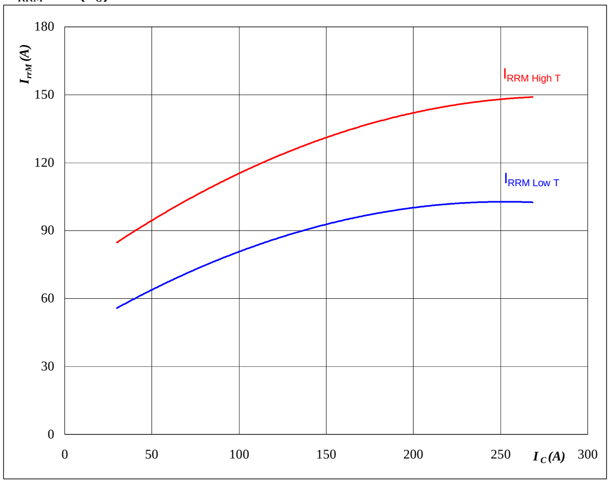
At

T_j =	25/125	°C
V_R =	350	V
I_F =	150	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



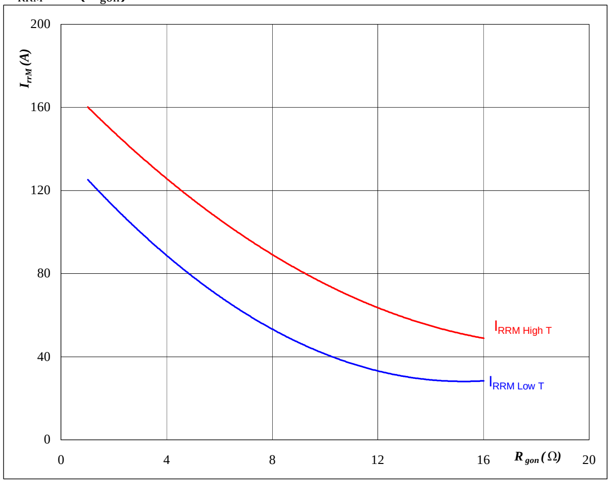
At

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

figure 16. **FWD**

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

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



At

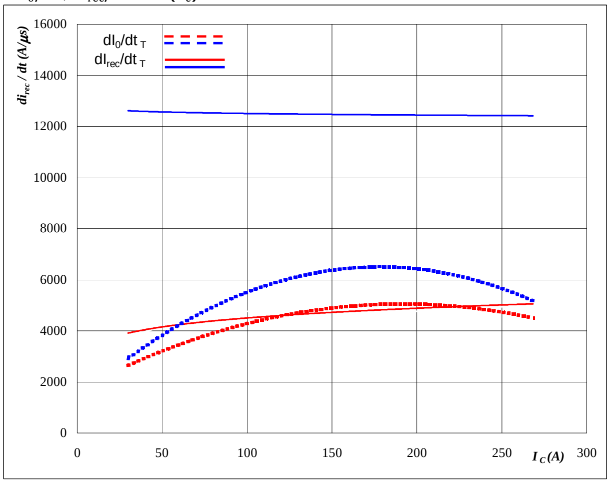
T_j =	25/125	°C
V_R =	350	V
I_F =	150	A
V_{GE} =	±15	V

Buck Characteristics

figure 17. **FWD**

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

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



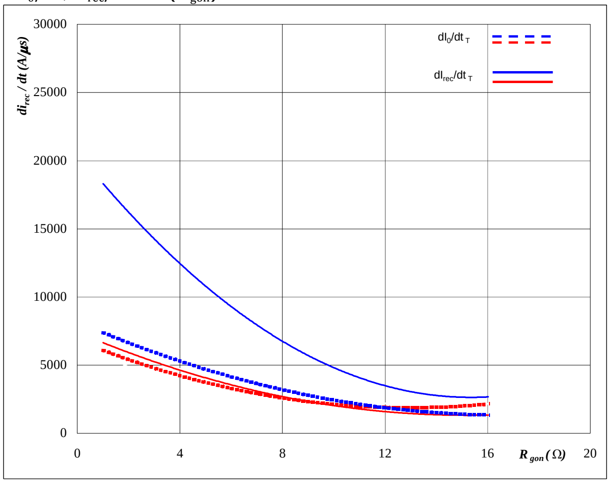
At

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

figure 18. **FWD**

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

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



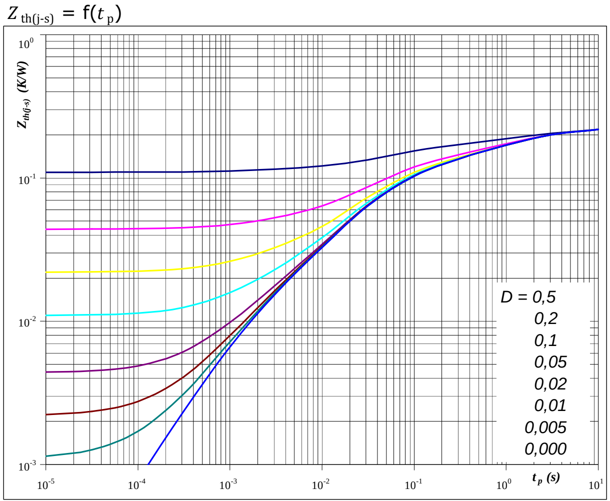
At

T_j =	25/125	°C
V_R =	350	V
I_F =	150	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	
$R_{th(j-s)}$ =	0,22	K/W

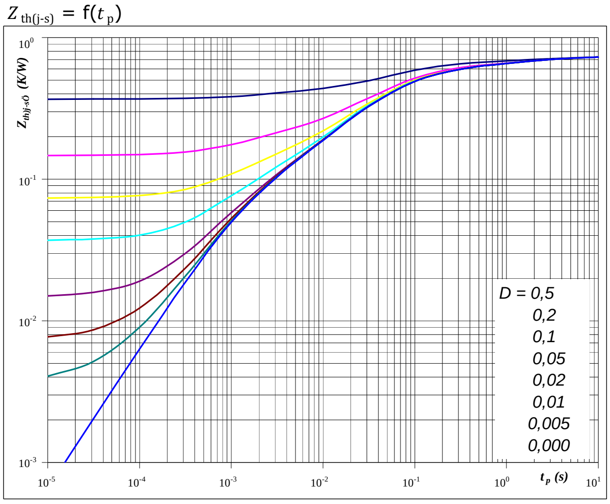
IGBT thermal model values

R (K/W)	Tau (s)
8,1E-02	2,3E+00
5,7E-02	2,9E-01
7,2E-02	4,6E-02
2,1E-02	1,3E-02
8,0E-03	1,5E-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	
$R_{th(j-s)}$ =	0,73	K/W

FWD thermal model values

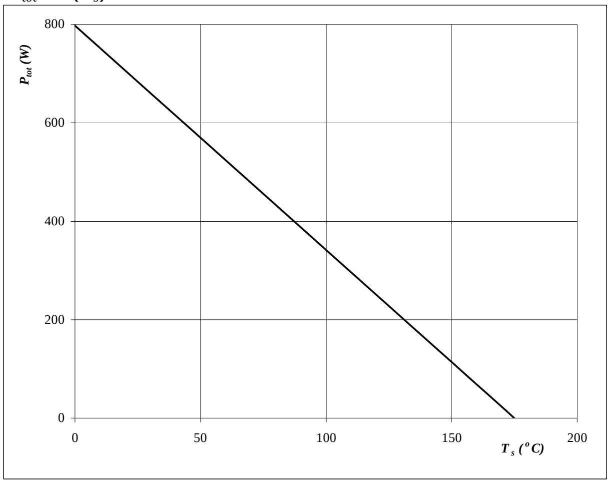
R (K/W)	Tau (s)
6,7E-02	4,1E+00
7,9E-02	9,3E-01
1,9E-01	1,4E-01
2,8E-01	3,5E-02
6,1E-02	6,8E-03
5,6E-02	1,2E-03

Buck Characteristics

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



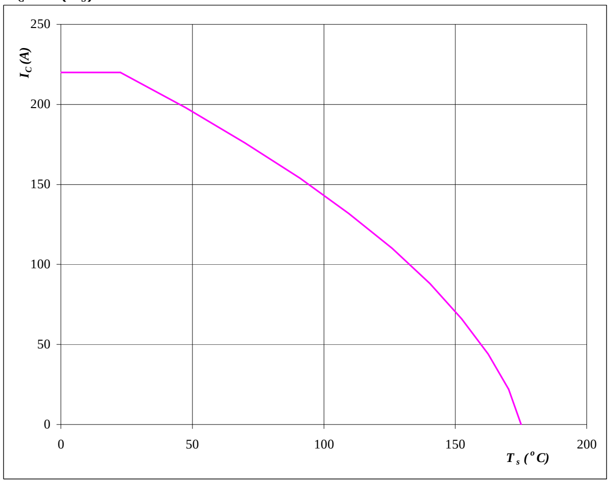
At

T_j = 175 °C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

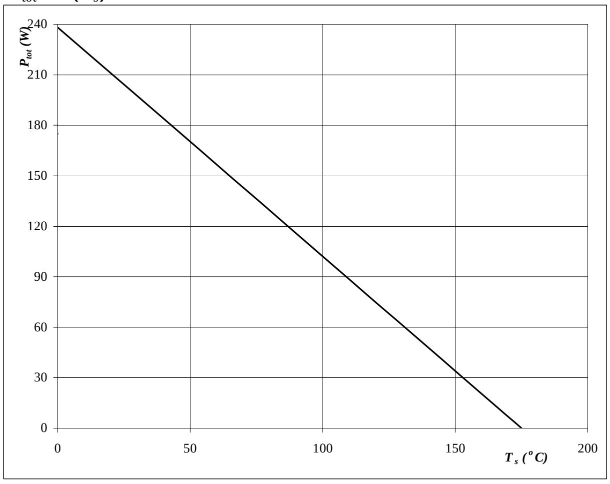
T_j = 175 °C

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



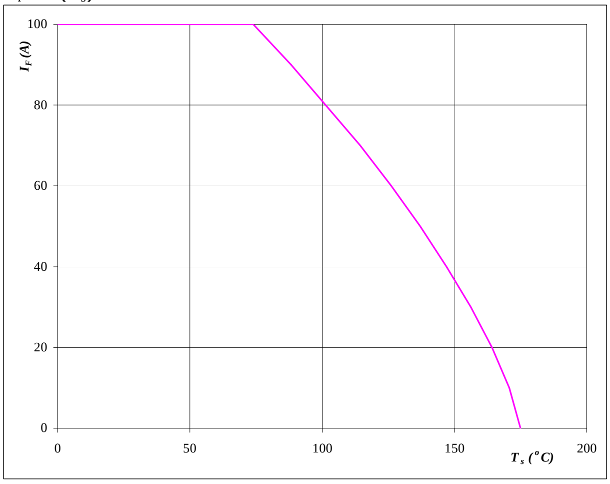
At

T_j = 175 °C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

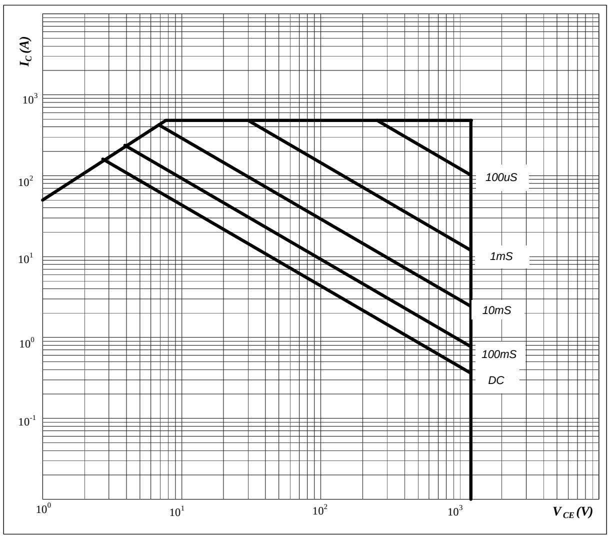
T_j = 175 °C

Buck Characteristics

figure 25.	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



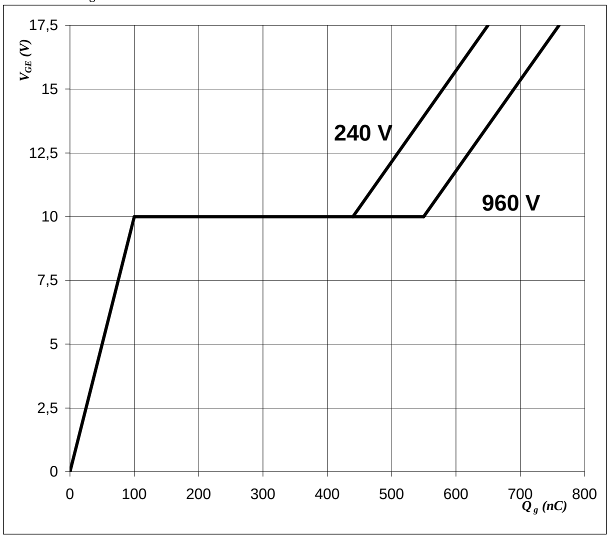
At

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

figure 26.	IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



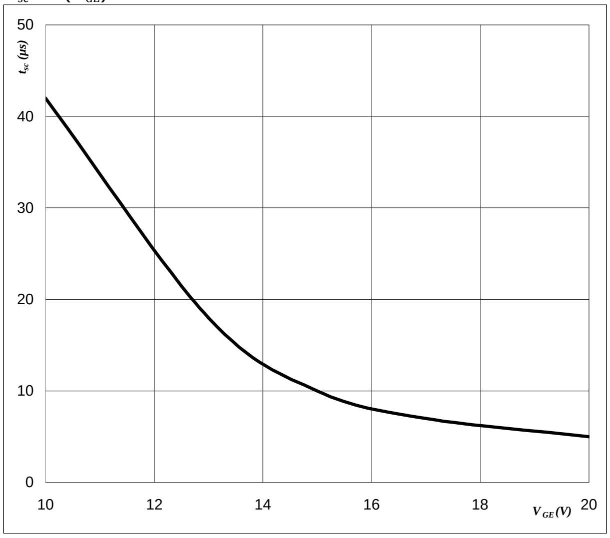
At

I_C =	160	A
T_j=	25	ºC

figure 27.	IGBT

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

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



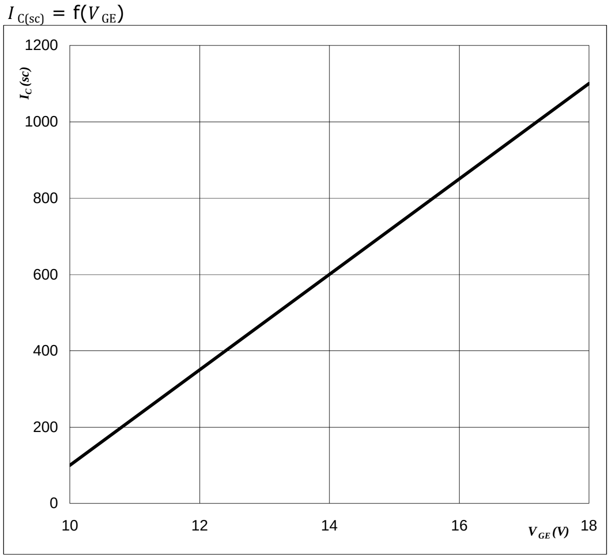
At

V_{CE} =	600	V
$T_j \leq$	175	ºC

figure 28.	IGBT

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

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



At

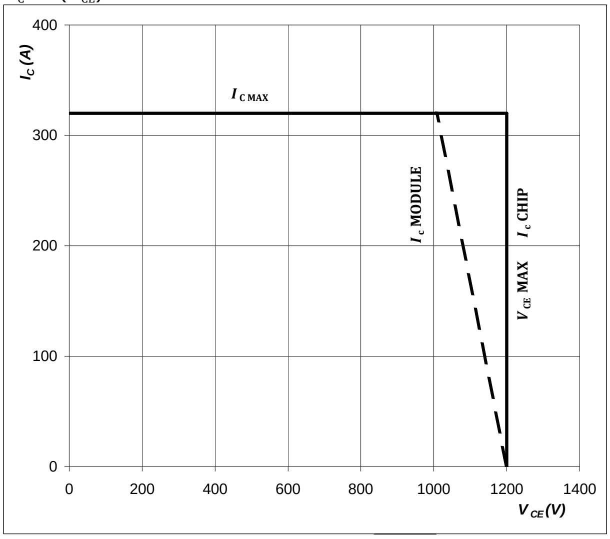
$V_{CE} \leq$	600	V
T_j =	175	ºC

Buck Characteristics

figure 29. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

$V_{ccminus} = V_{ccplus}$

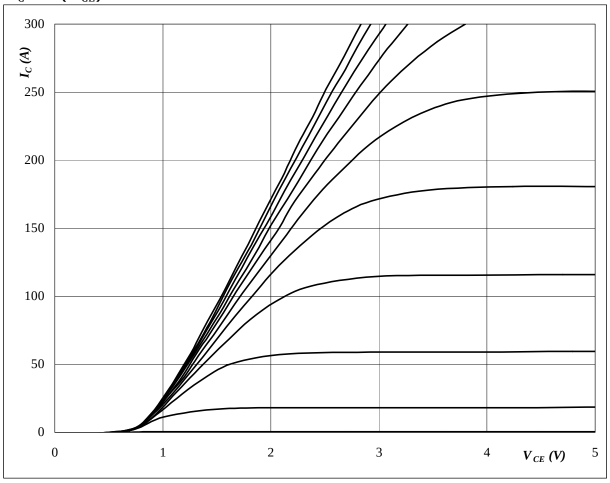
Switching mode : 3 level switching

Boost Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



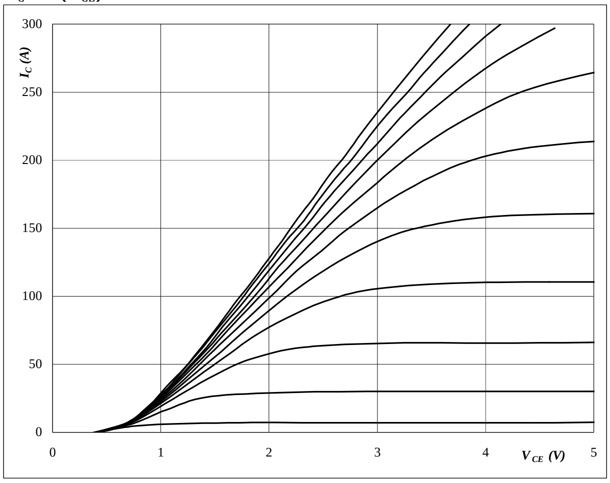
At

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

$I_C = f(V_{CE})$



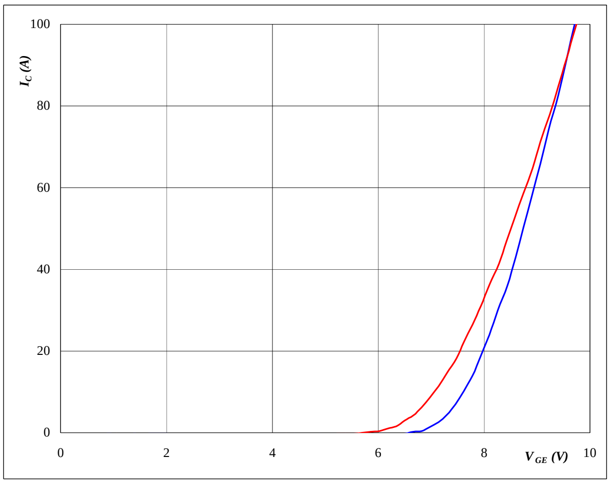
At

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

$I_C = f(V_{GE})$



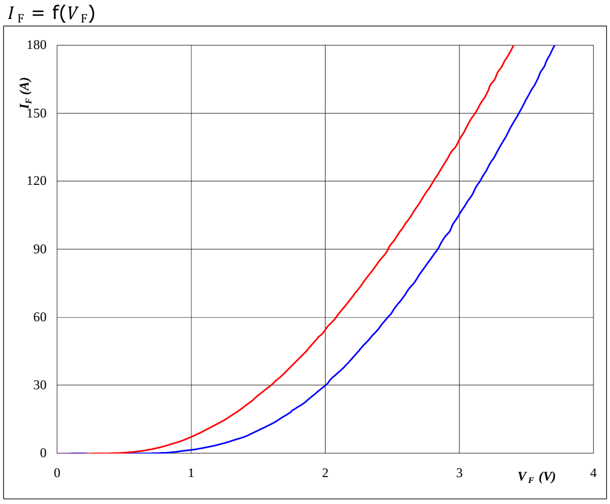
At

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

figure 4. **FWD**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

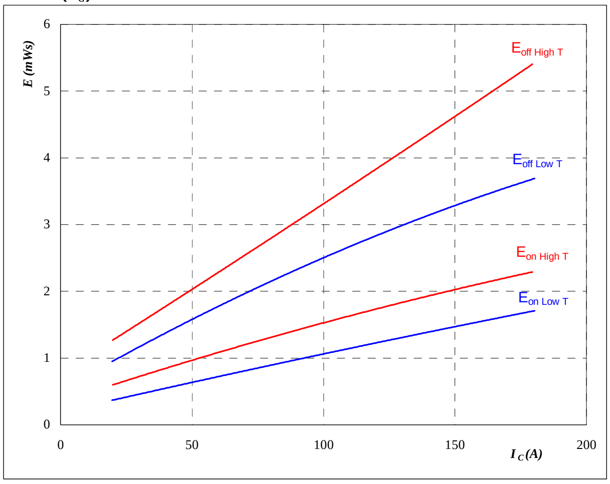
T_j =	25/150	°C
t_p =	250	µs

Boost Characteristics

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



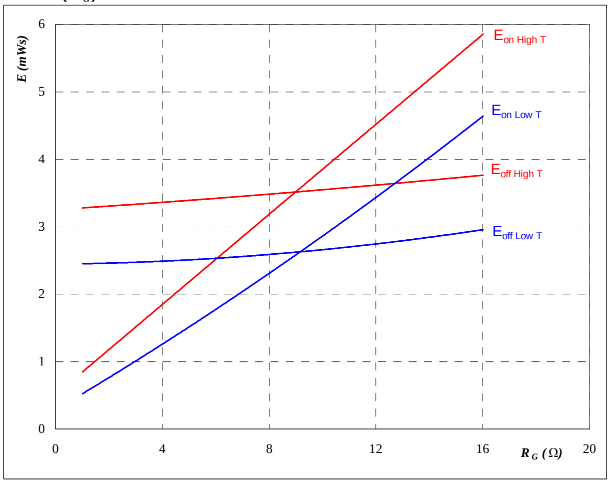
With an inductive load at

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

figure 6. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



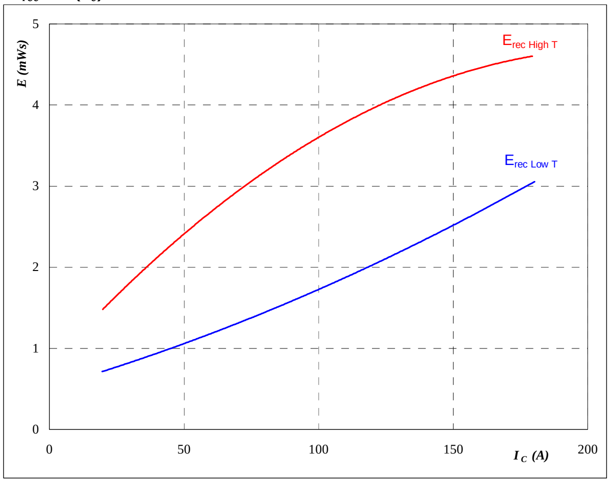
With an inductive load at

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

$E_{rec} = f(I_c)$



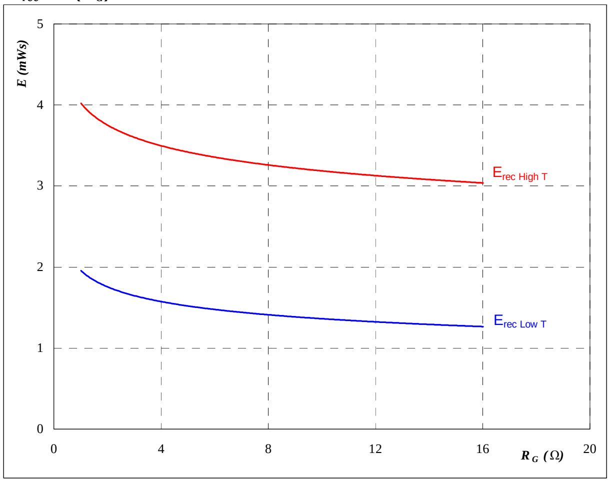
With an inductive load at

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

figure 8. **FWD**

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

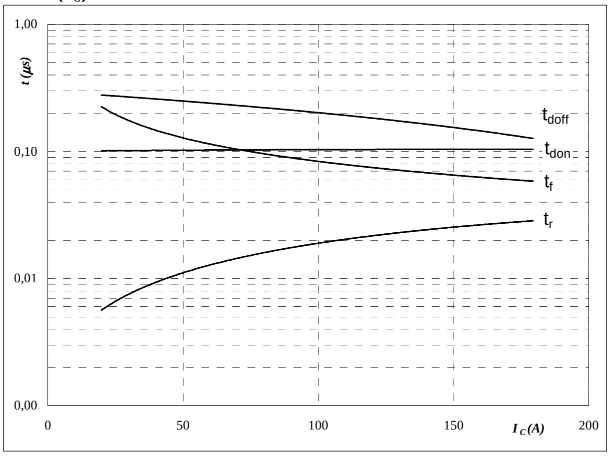
T_j =	25/125	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	100	A

Boost Characteristics

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



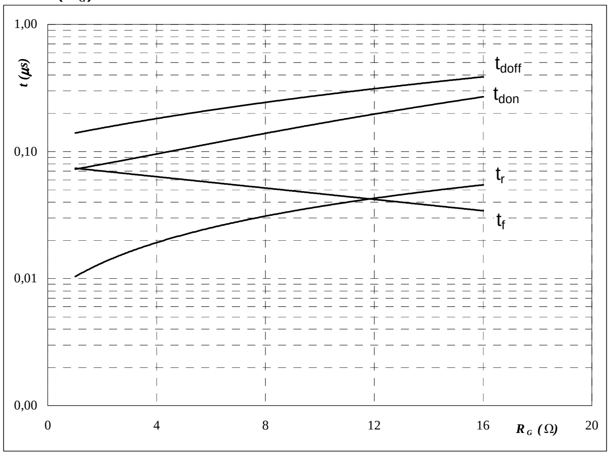
With an inductive load at

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

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



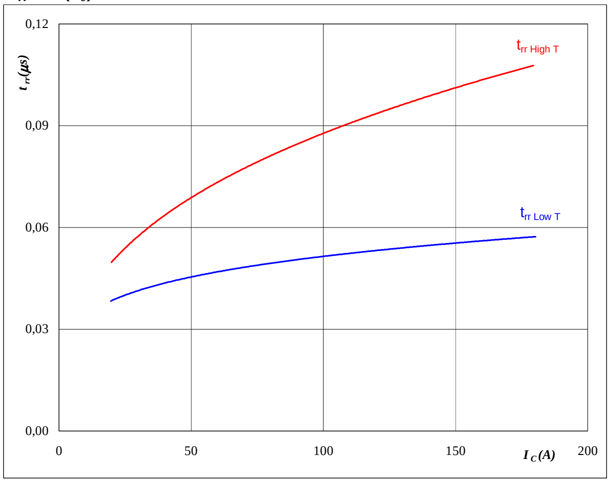
With an inductive load at

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

$t_{rr} = f(I_c)$



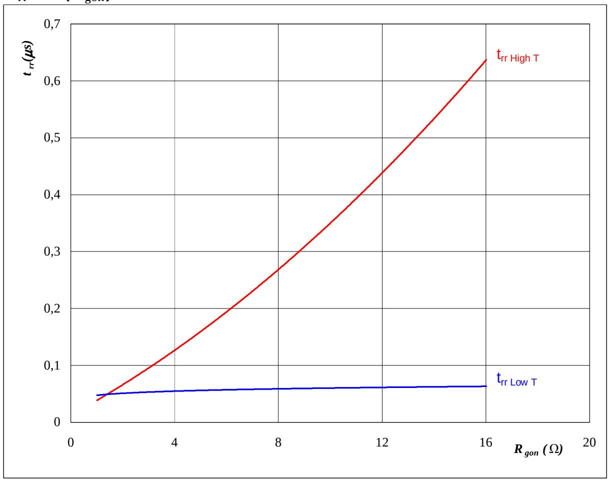
At

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

figure 12. **FWD**

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

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



At

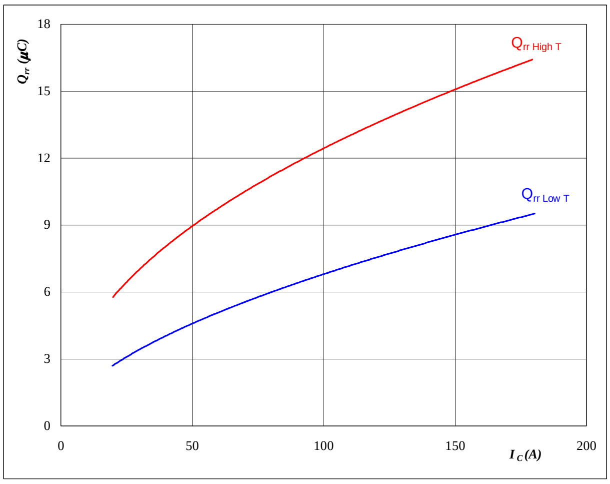
T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Boost Characteristics

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



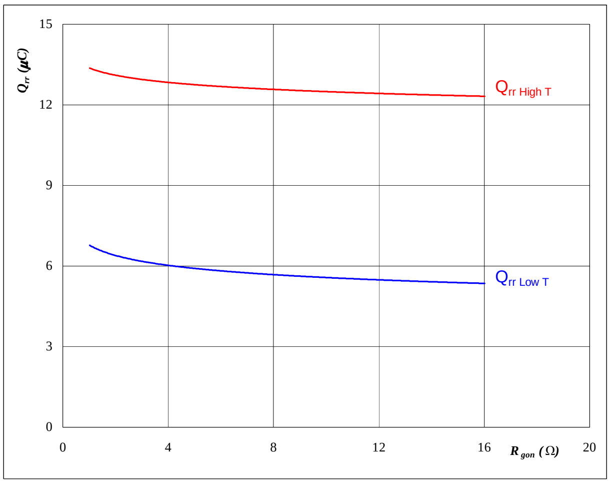
At

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

figure 14. **FWD**

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

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



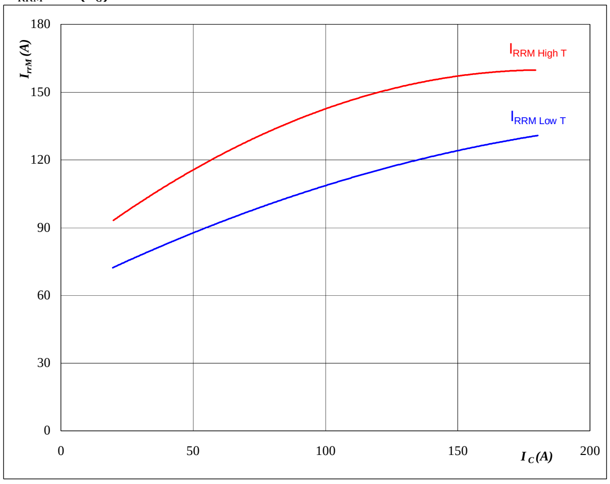
At

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

$I_{RRM} = f(I_C)$



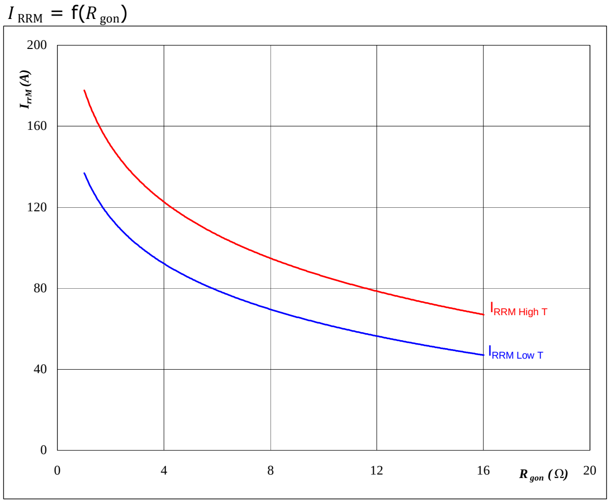
At

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

figure 16. **FWD**

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

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



At

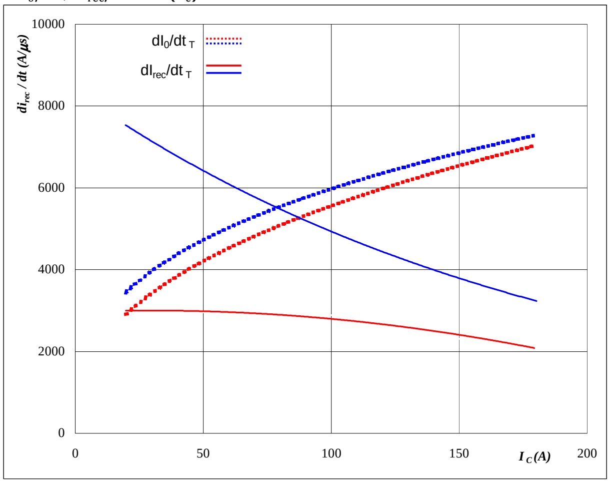
T_j =	25/125	°C
V_R =	350	V
I_F =	100	A
V_{GE} =	±15	V

Boost Characteristics

figure 17. **FWD**

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

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



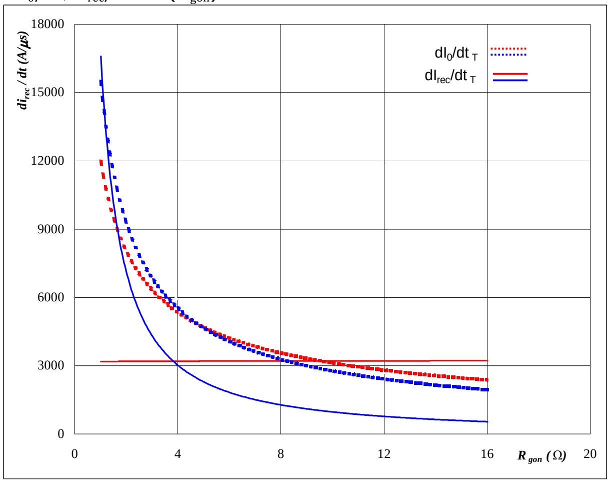
At

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

figure 18. **FWD**

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

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



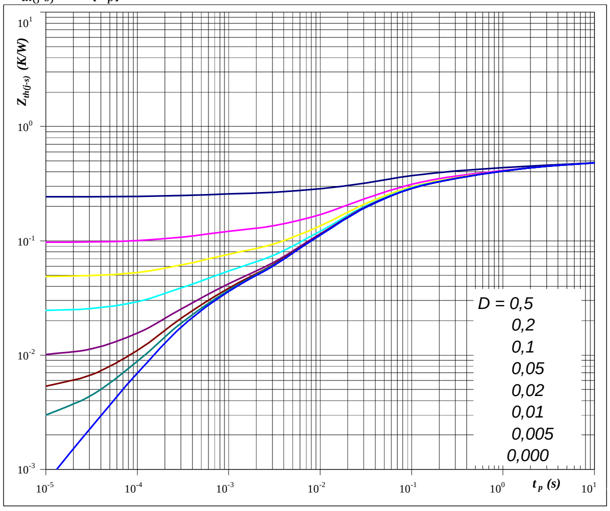
At

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	
$R_{th(j-s)}$ =	0,48	K/W

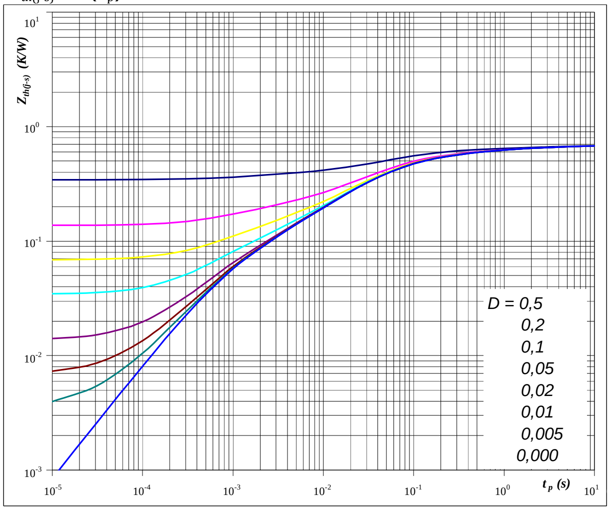
IGBT thermal model values

R (K/W)	Tau (s)
1,1E-01	2,9E+00
8,8E-02	4,6E-01
1,2E-01	9,5E-02
1,7E-01	2,5E-02
3,0E-02	4,4E-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	
$R_{th(j-s)}$ =	0,68	K/W

FWD thermal model values

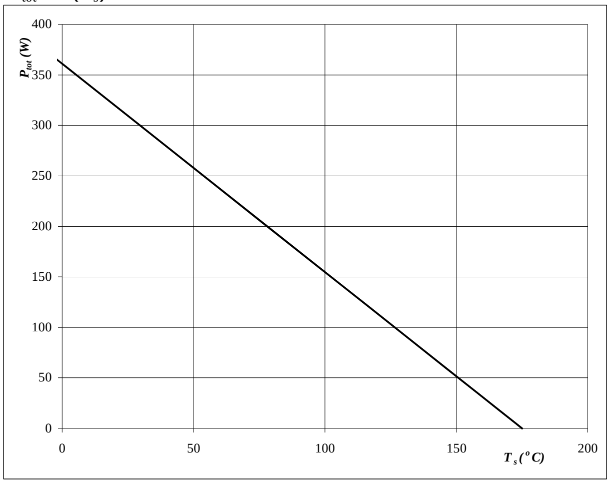
R (K/W)	Tau (s)
6,8E-02	3,7E+00
1,0E-01	5,4E-01
2,0E-01	9,8E-02
2,6E-01	2,8E-02
6,8E-02	4,9E-03

Boost Characteristics

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



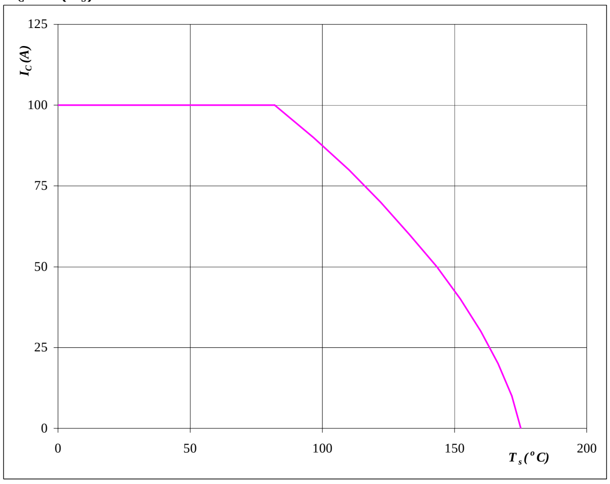
At

T_j = 175 ºC

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

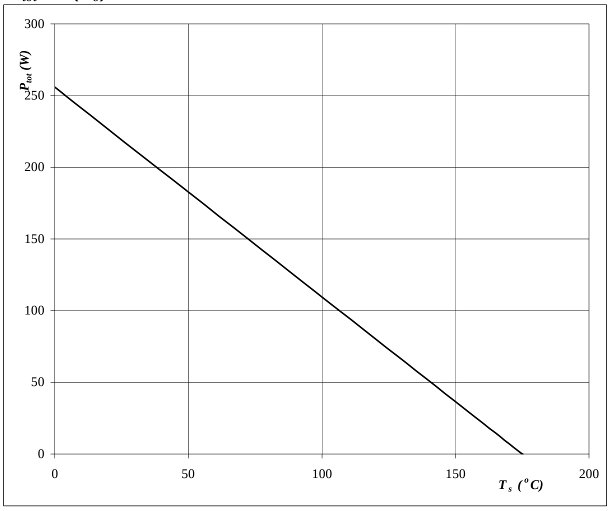
T_j = 175 ºC

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



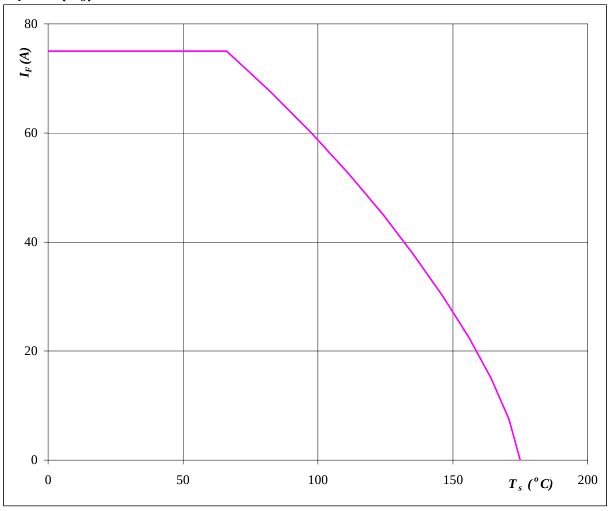
At

T_j = 175 ºC

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

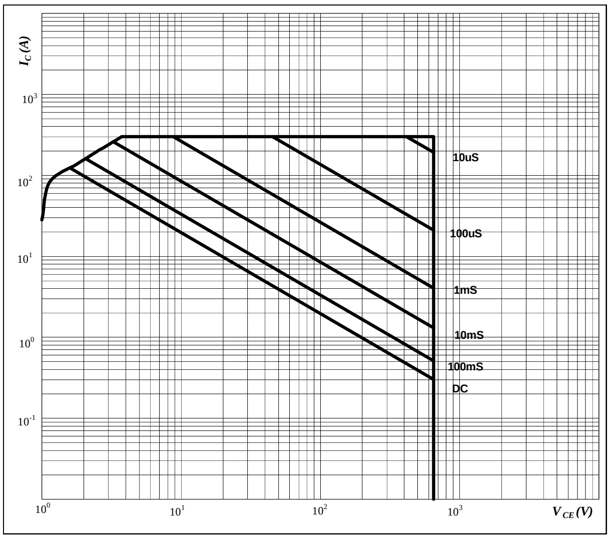
T_j = 175 ºC

Boost Characteristics

figure 25.	**IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



At

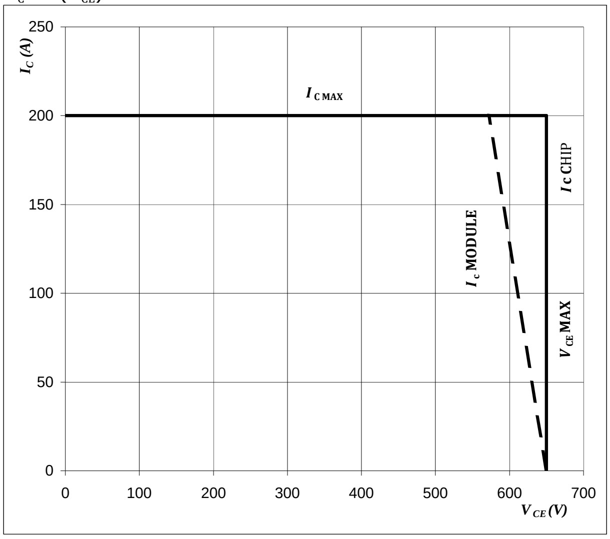
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Boost Characteristics

figure 25. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

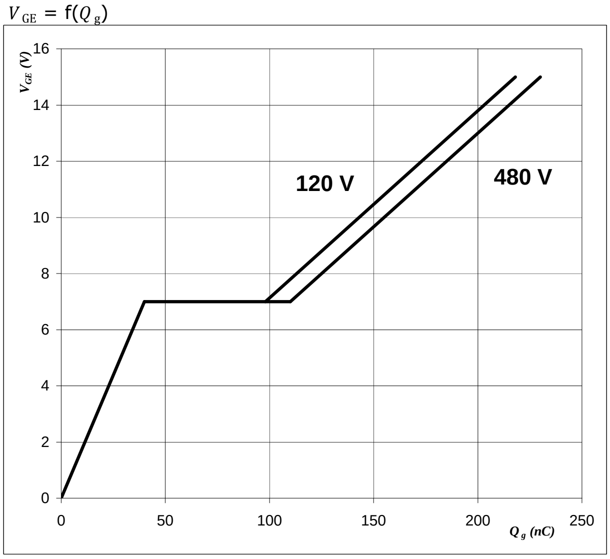
$V_{ccminus} = V_{ccplus}$

Switching mode : 3 level switching

figure 26. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



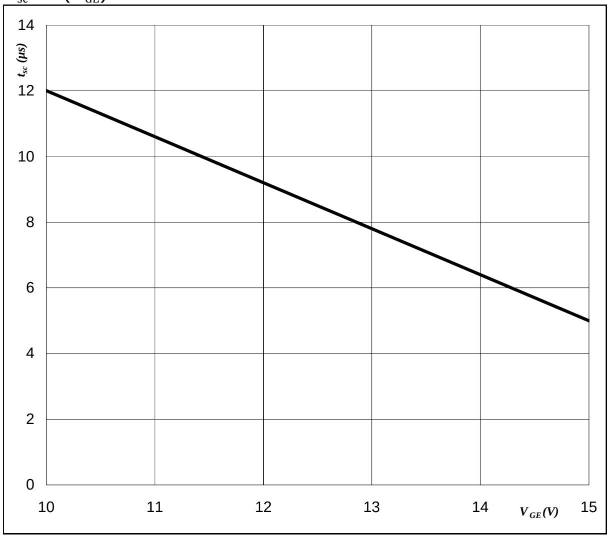
At

I_C =	100	A
T_j=	25	ºC

figure 27. **IGBT**

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

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



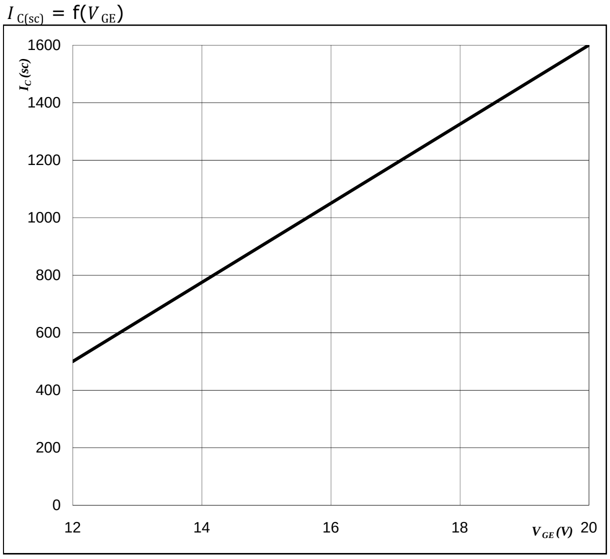
At

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

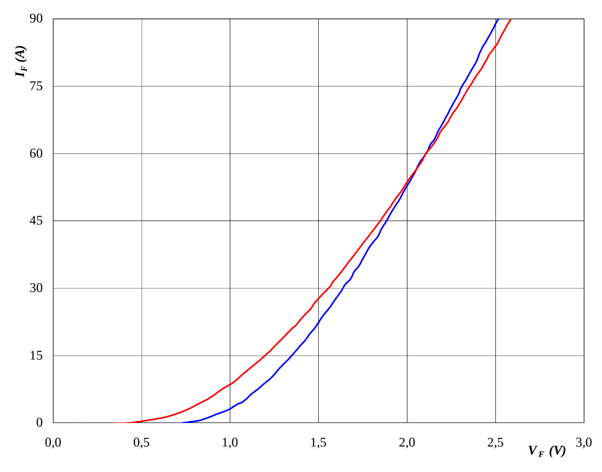
V_{CE} ≤	400	V
T_j =	125	ºC

Boost Inverse Diode

figure 25. **FWD**

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



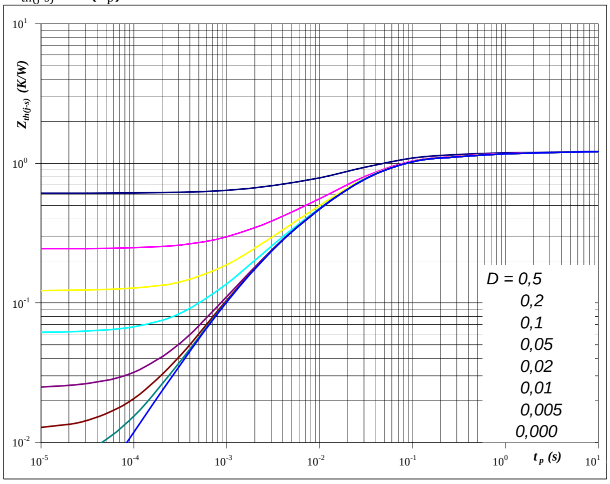
At

T_j =	25/150	°C
t_p =	250	µs

figure 26. **FWD**

FWD transient thermal impedance as a function of pulse width

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



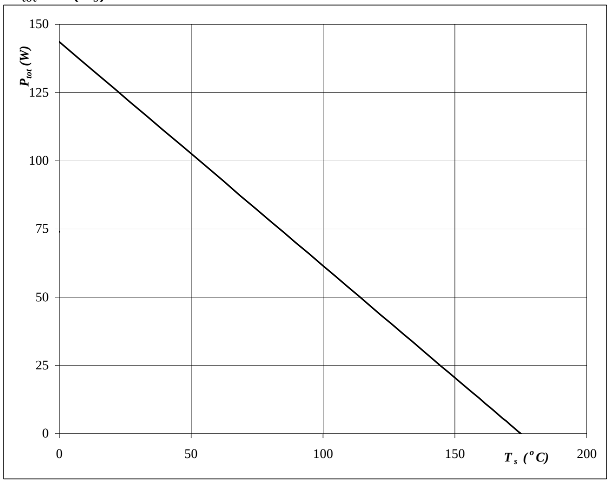
At

D =	t_p / T	
$R_{th(j-s)}$ =	1,22	K/W

figure 27. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



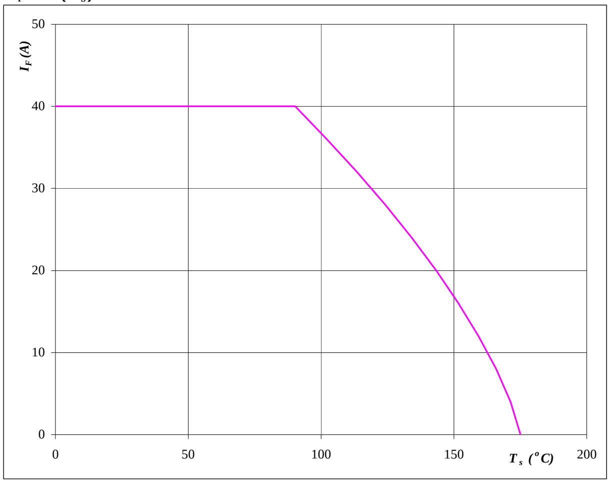
At

T_j =	175	ºC

figure 28. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

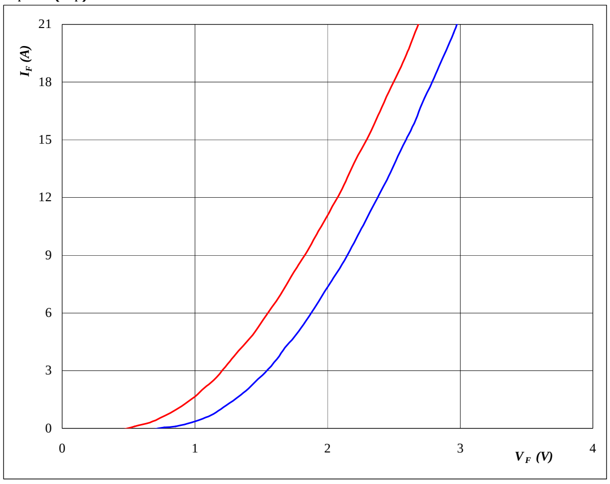
T_j =	175	ºC

Buck Inverse Diode

figure 1.	FWD

Typical FWD forward current as a function of forward voltage

$I_F = f(V_F)$



At

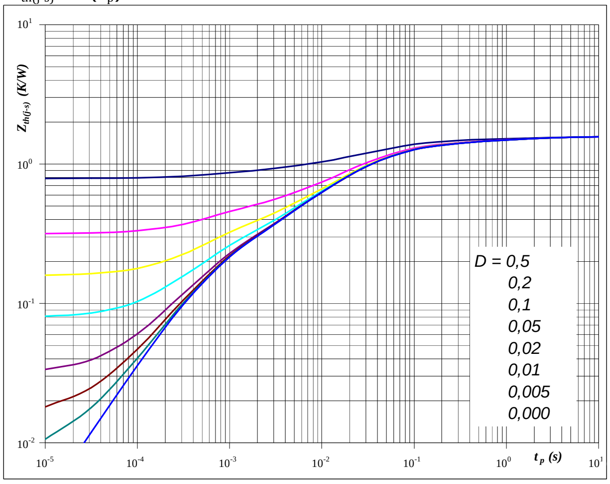
T_j = 25/125 °C

t_p = 250 µs

figure 2.	FWD

FWD transient thermal impedance as a function of pulse width

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



At

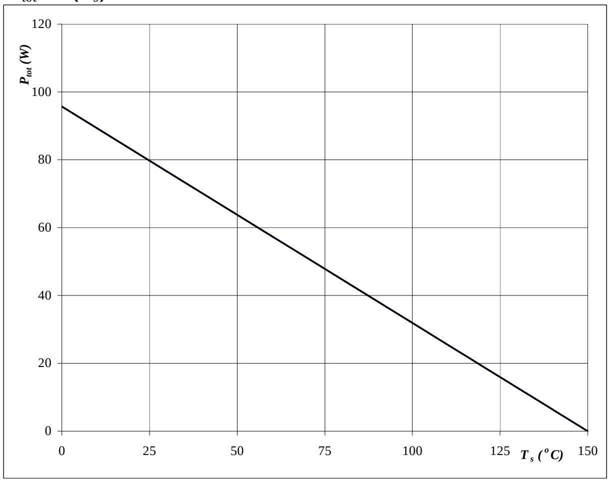
D = t_p / T

$R_{th(j-s)}$ = 1,57 K/W

figure 3.	FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



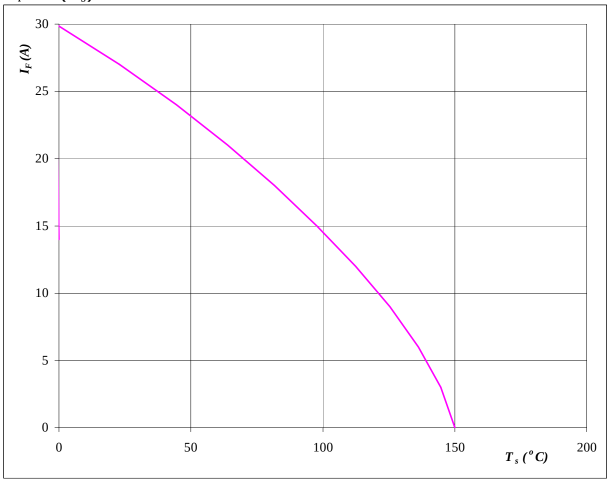
At

T_j = 150 ºC

figure 4.	FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

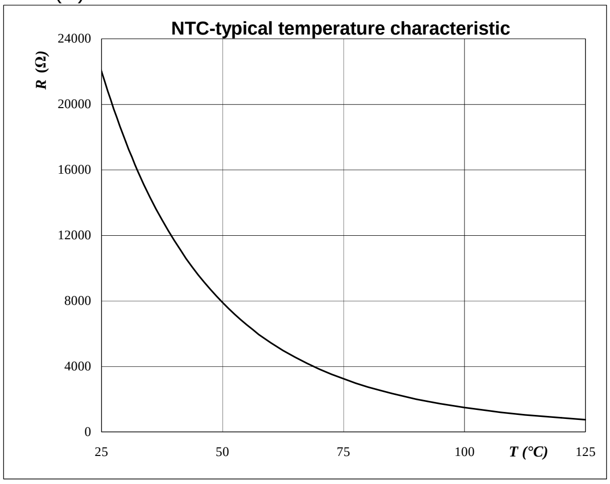
T_j = 150 ºC

Thermistor

figure 1.	Thermistor

Typical NTC characteristic
as a function of temperature

$R = \mathrm{f}(T)$



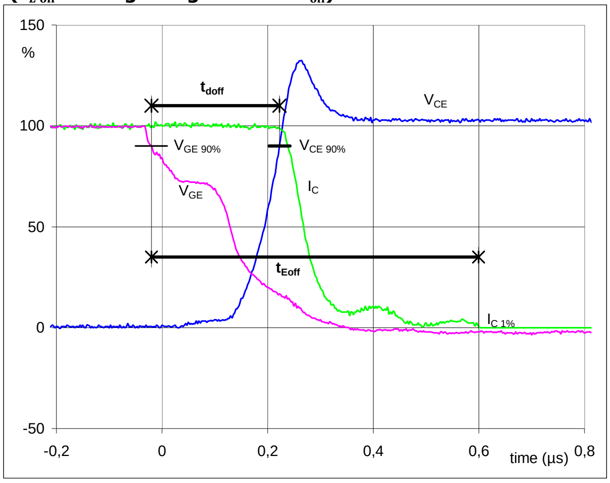
Buck Switching Characteristics

General conditions

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

figure 1. **IGBT**

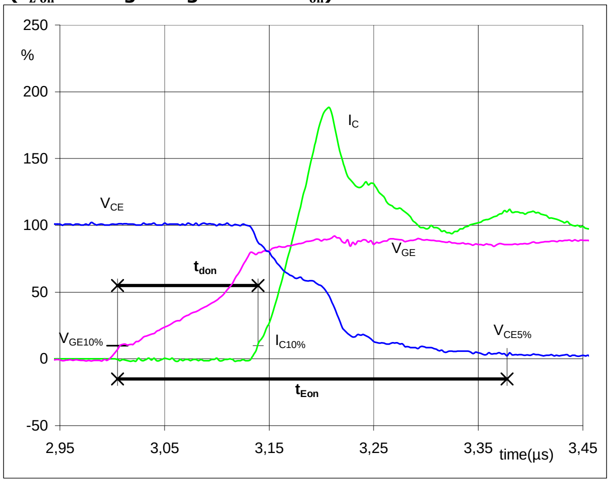
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	149	A
t_{doff} =	0,25	µs
$t_{E\,off}$ =	0,62	µs

figure 2. **IGBT**

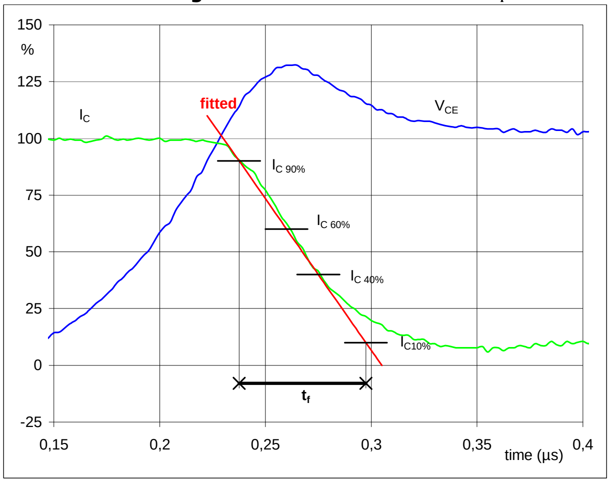
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	350	V
I_C (100%) =	149	A
t_{don} =	0,13	µs
$t_{E\,on}$ =	0,37	µs

figure 3. **IGBT**

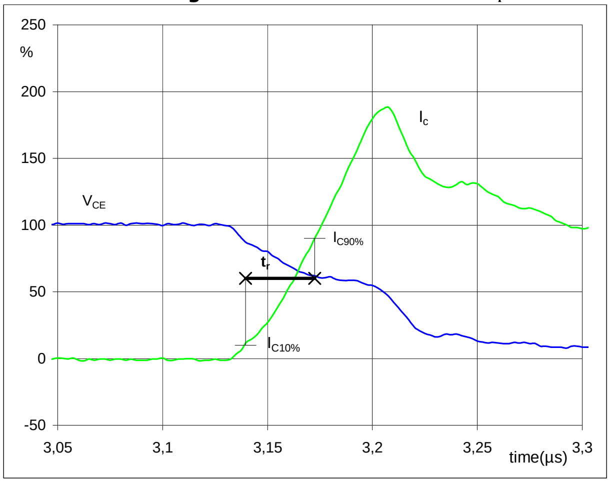
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	350	V
I_C (100%) =	149	A
t_f =	0,06	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

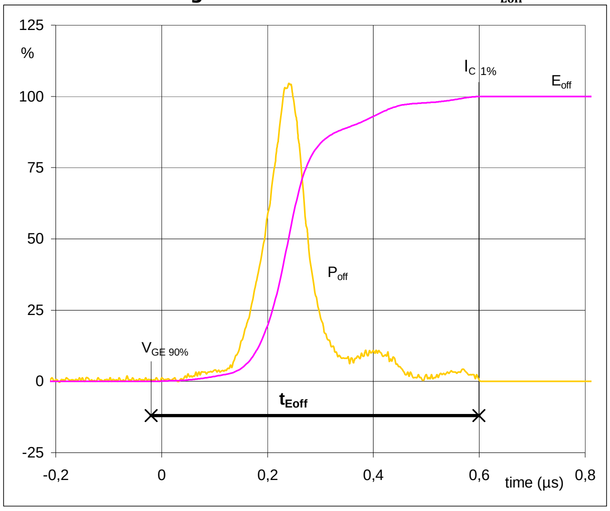


V_C (100%) =	350	V
I_C (100%) =	149	A
t_r =	0,03	µs

Buck Switching Characteristics

figure 5. **IGBT**

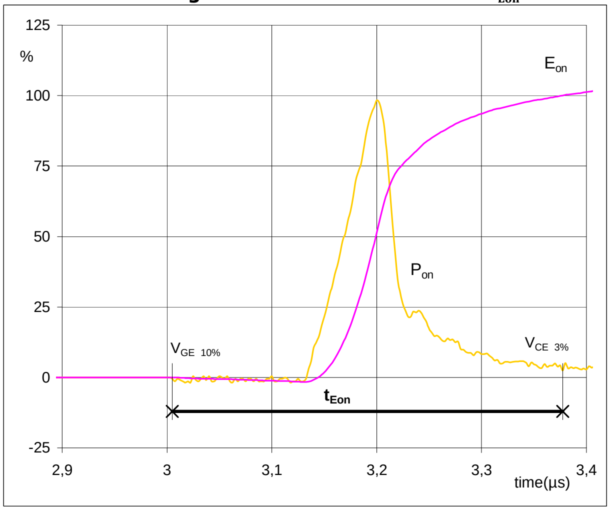
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	52,08	kW
E_{off} (100%) =	5,81	mJ
$t_{E\ off}$ =	0,62	µs

figure 6. **IGBT**

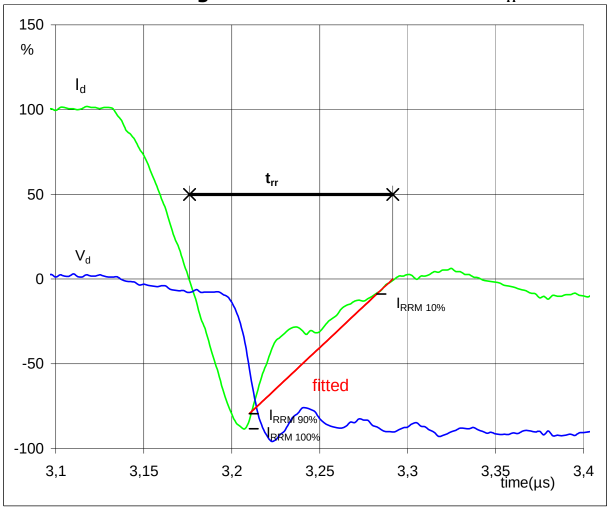
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	52,08	kW
E_{on} (100%) =	3,36	mJ
$t_{E\ on}$ =	0,37	µs

figure 7. **FWD**

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

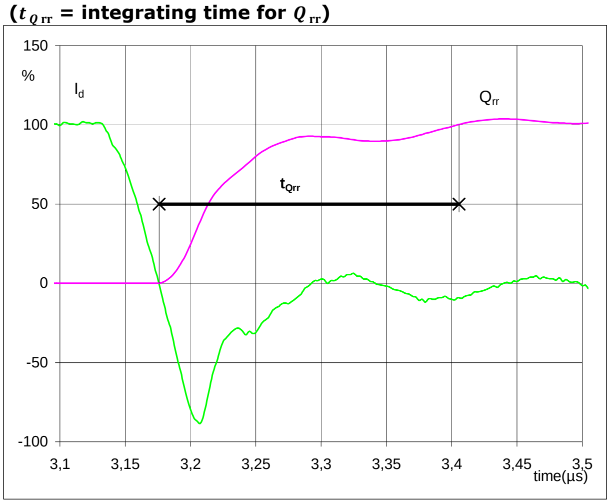


V_d (100%) =	350	V
I_d (100%) =	149	A
I_{RRM} (100%) =	-133	A
t_{rr} =	0,11	µs

Buck Switching Characteristics

figure 8. **FWD**

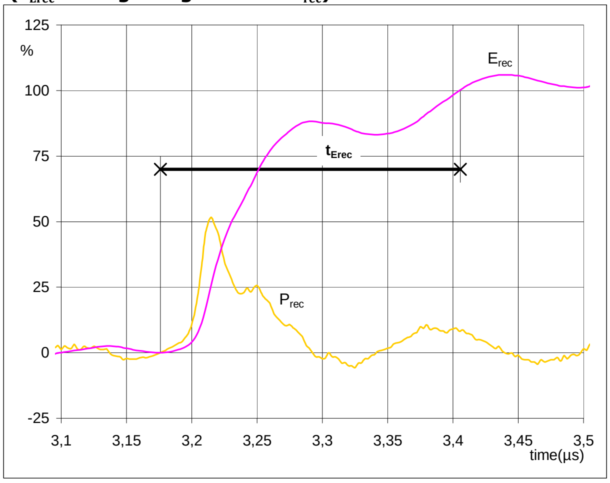
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	149	A
Q_{rr} (100%) =	6,41	µC
t_{Qrr} =	0,23	µs

figure 9. **FWD**

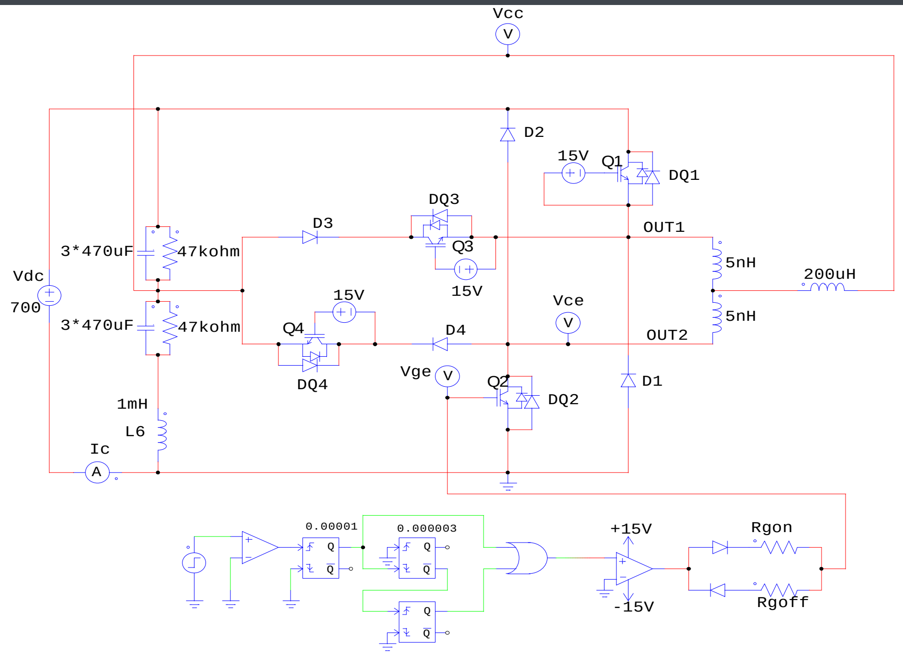
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	52,08	kW
E_{rec} (100%) =	1,25	mJ
t_{Erec} =	0,23	µs

Buck switching measurement circuit

figure 10. **IGBT**



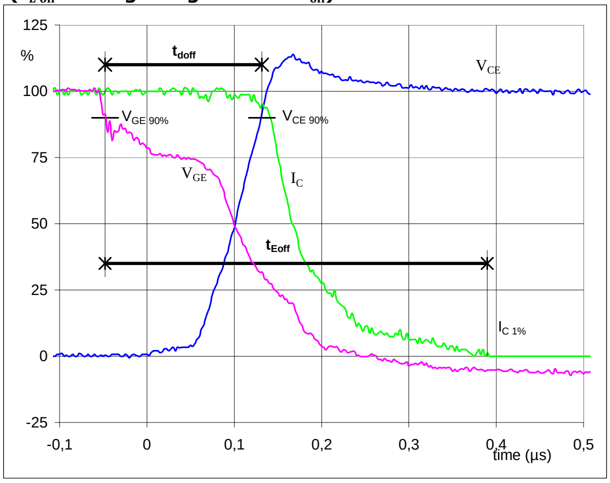
Boost Switching Characteristics

General conditions

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

figure 1. **IGBT**

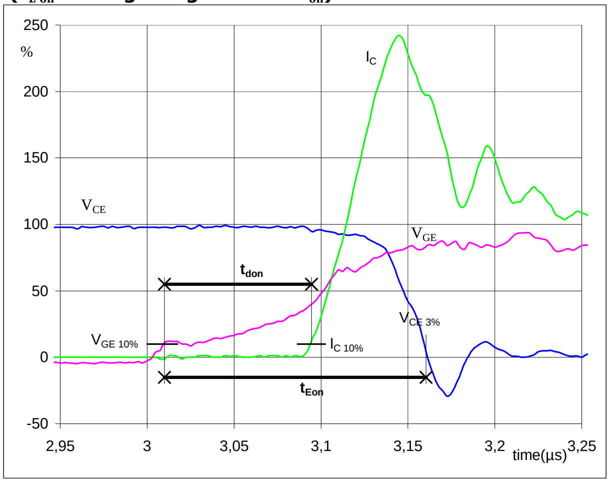
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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. **IGBT**

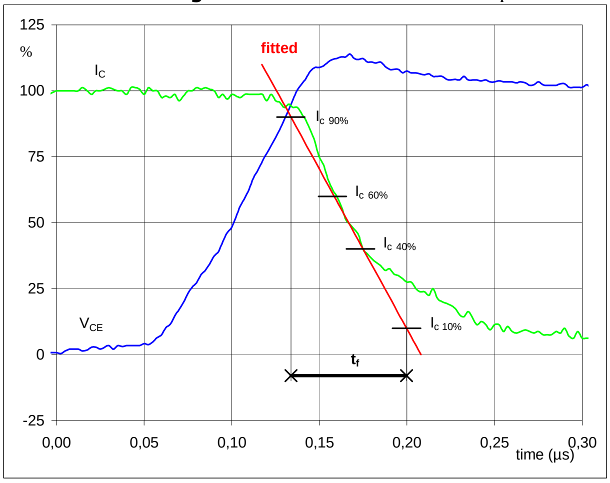
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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. **IGBT**

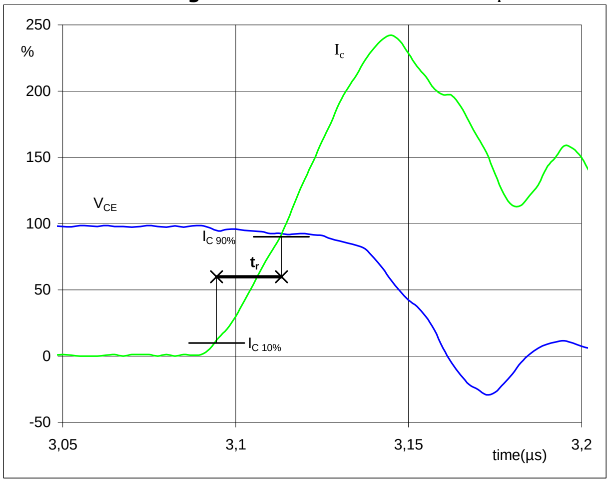
Turn-off Switching Waveforms & definition of t_f



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

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

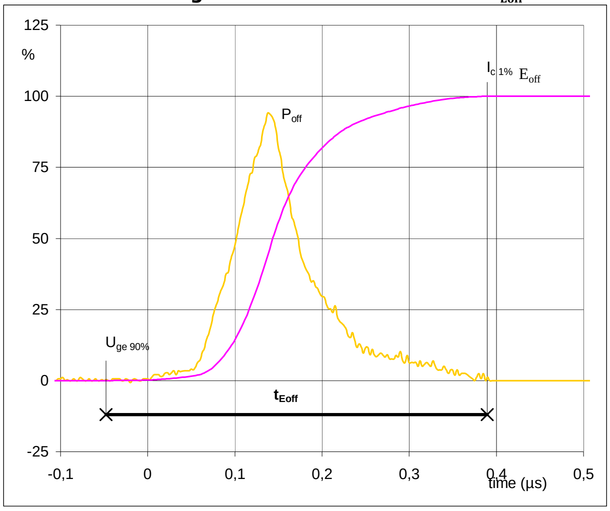


V_C (100%) =	350	V
I_C (100%) =	100	A
t_r =	0,019	µs

Boost Switching Characteristics

figure 5. **IGBT**

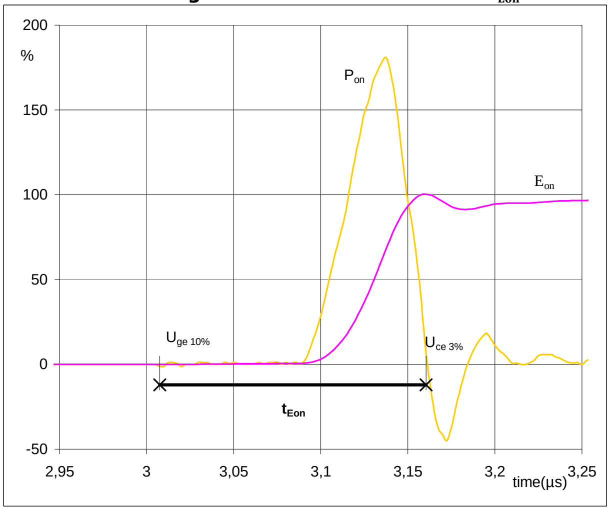
Turn-off Switching Waveforms & definition of t_{Eoff}



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

figure 6. **IGBT**

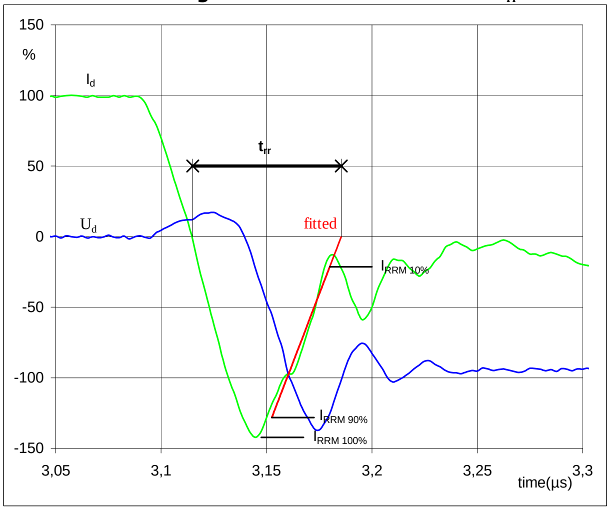
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	34,964	kW
E_{on} (100%) =	1,52	mJ
$t_{E\,on}$ =	0,15	µs

figure 7. **FWD**

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

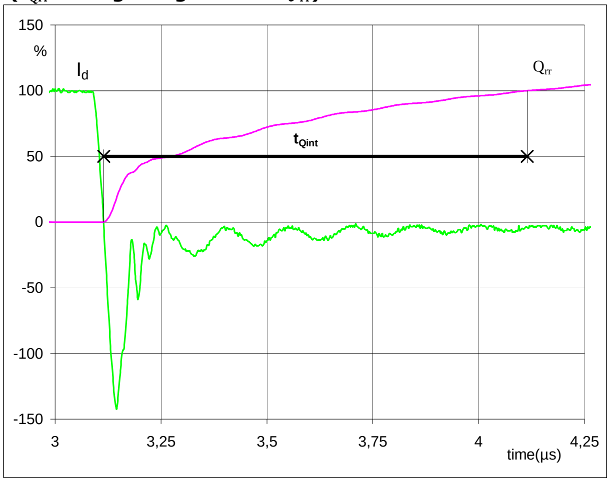


V_d (100%) =	350	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-142	A
t_{rr} =	0,07	µs

Boost Switching Characteristics

figure 8. **FWD**

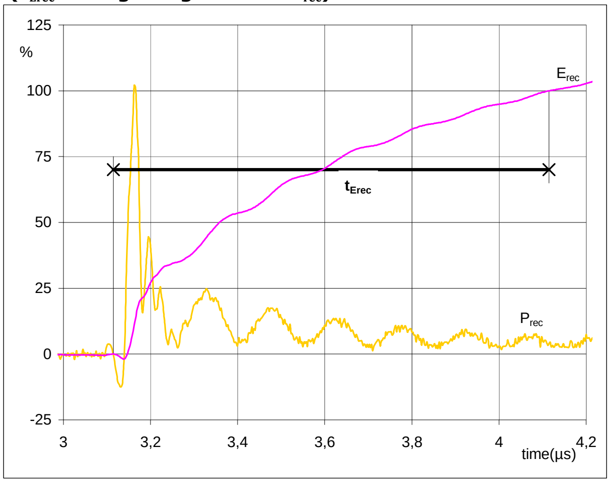
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



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

figure 9. **FWD**

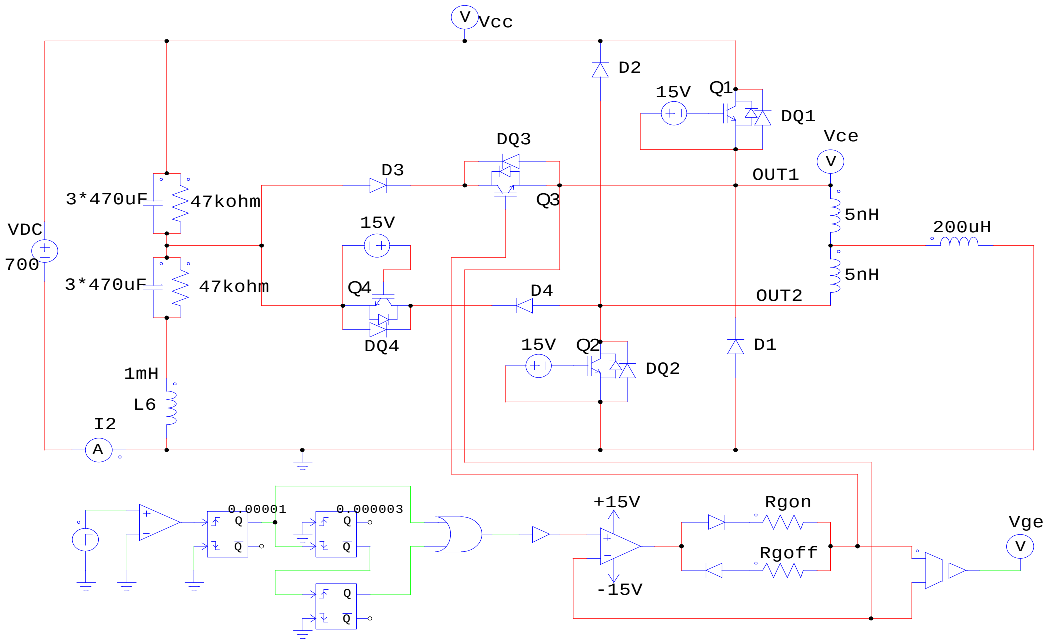
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	34,96	kW
E_{rec} (100%) =	3,61	mJ
$t_{E\,rec}$ =	1,00	µs

Boost switching measurement circuit

figure 10. **IGBT**



Ordering Code & Marking

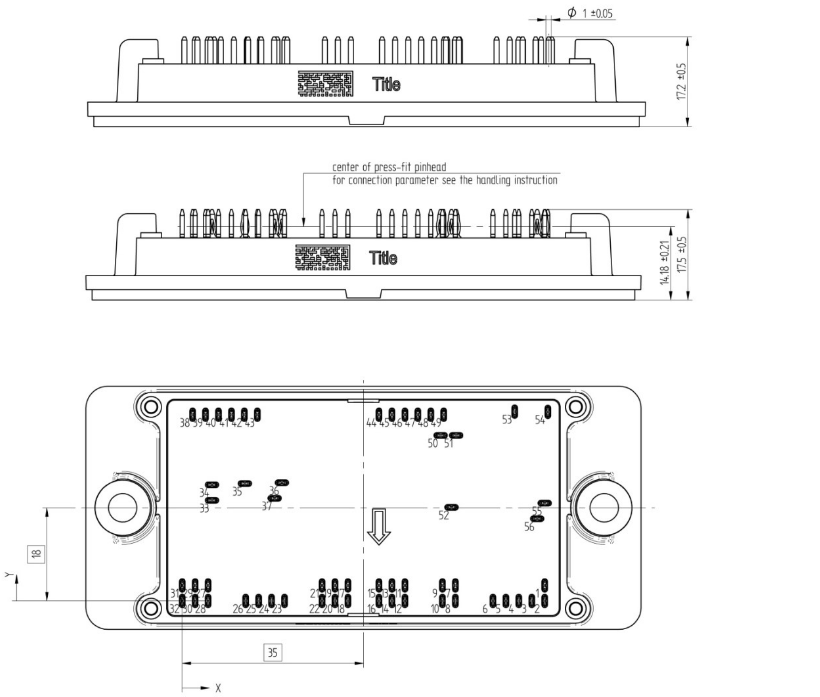
Version	Ordering Code
without thermal paste 13 mm housing with solder pins	30-FT12NMA160SH02-M669F28
with thermal paste 13 mm housing with solder pins	30-FT12NMA160SH02-M669F28-/3/
without thermal paste 13 mm housing with press-fit pins	30-PT12NMA160SH02-M669F28Y
with thermal paste 13 mm housing with press-fit pins	30-PT12NMA160SH02-M669F28Y-/3/

	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	WWYY		

Outline

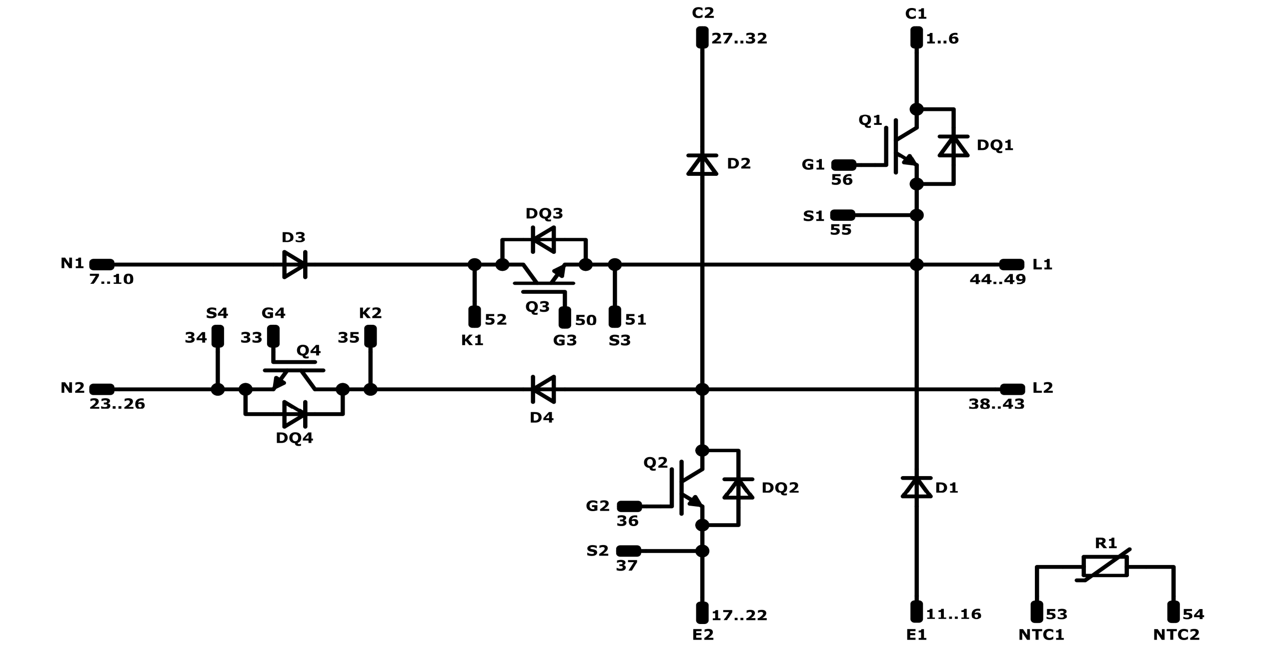
Pin	X	Y	Function
1	70	3	C1
2	70	0	C1
3	67,5	0	C1
4	65	0	C1
5	62,5	0	C1
6	60	0	C1
7	52,75	3	N1
8	52,75	0	N1
9	50,25	3	N1
10	50,25	0	N1
11	43	3	E1
12	43	0	E1
13	40,5	3	E1
14	40,5	0	E1
15	38	3	E1
16	38	0	E1
17	32	3	E2
18	32	0	E2
19	29,5	3	E2
20	29,5	0	E2
21	27	3	E2
22	27	0	E2
23	19,75	0	N2
24	17,25	0	N2
25	14,75	0	N2
26	12,25	0	N2
27	5	3	C2
28	5	0	C2
29	2,5	3	C2
30	2,5	0	C2
31	0	3	C2
32	0	0	C2
33	5,75	19,45	G4
34	5,75	22,45	S4
35	12,1	22,7	K2

Pin	X	Y	Function
52	52	18,1	K1
53	64,2	36,6	NTC1
54	70,6	36,55	NTC2
55	70	18,9	S1
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 Sw. Protection Diode	
D3, D4	FWD	650 V	100 A	Buck Diode	
Q3, Q4	IGBT	650 V	100 A	Boost Switch	
DQ3, DQ4	FWD	650 V	60 A	Boost Sw. Protection Diode	
D1, D2	FWD	1200 V	60 A	Boost 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-xT12NMA160SH02-M669F28x-D6-14	04 Jun. 2021	Ordering Code and Marking corrected	30