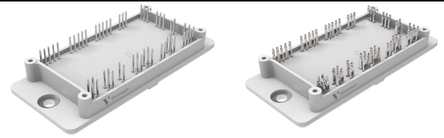
flowPIM 2	1200 V / 35 A

Features

- Three-phase rectifier, BRC, Inverter, NTC
- Very Compact housing, easy to route
- IGBT4/ EmCon4 technology for low saturation losses and improved EMC behavior

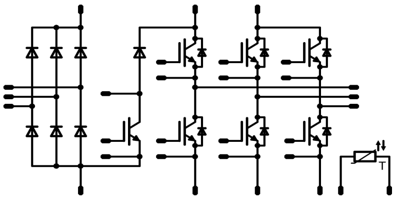
flow2 17mm housing



Target Applications

- Motor Drives
- Power Generation

Schematic



Types

- V23990-P767-A-PM
- V23990-P767-AY-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward current	I_{FAV}	DC current	T_s = 80 °C	80	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms		700	A
I^2t-value	I^2t			2450	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	100	W
Maximum Junction Temperature	T_{jmax}			150	°C
Inverter Switch					
Collector-emitter breakdown voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	42	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		105	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	125	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
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	50	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		75	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	100	W
Maximum Junction Temperature	T_{jmax}			175	°C
Brake Switch					
Collector-emitter breakdown voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		75	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	112	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
Brake Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	15	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Brake Inverse Diode	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	50	W
Maximum Junction Temperature	T_{jmax}			175	°C
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	25	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		50	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	75	W
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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 Test Voltage*	t_p = 2 s	4000	V
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min 12,7	mm
Clearance		with Press-fit pins / with Solder pins		11,96 / 12,03	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	
Input Rectifier Diode										
Forward voltage	V_F				50	25 125		1,1 1,05	1,7	V
Threshold voltage (for power loss calc. only)	V_{to}					25 125		0,89 0,77		V
Slope resistance (for power loss calc. only)	r_t					25 125		0,004 0,006		Ω
Reverse current	I_r			1500		25 125			0,05 1,1	mA
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						0,70		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25 150,00	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 150		1,87 2,28	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,015	mA
Gate-emitter leakage current	I_{GES}		20	0		25			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 16 Ω R_{gon} = 16 Ω	±15	600	35	25 150		108 109		ns
Rise time	t_r					25 150		18 24		
Turn-off delay time	$t_{d(off)}$					25 150		220 286		
Fall time	t_f					25 150		73 112		
Turn-on energy loss	E_{on}					25 150		2,07 3,22		mWs
Turn-off energy loss	E_{off}					25 150		1,78 2,93		
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	960	35	25		200		nC
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						0,76		K/W
Inverter Diode										
Diode forward voltage	V_F				35	25 150		1,75 1,70	2,2	V
Peak reverse recovery current	I_{RRM}	R_{gon} = 16 Ω	±15	600	35	25 150		45,6 51,5		A
Reverse recovery time	t_{rr}					25 150		256 380		ns
Reverse recovered charge	Q_{rr}					25 150		3,54 7,16		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		1714 313		A/µs
Reverse recovered energy	E_{rec}					25 150		1,36 2,93		mWs
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						0,95		K/W

Characteristic Values

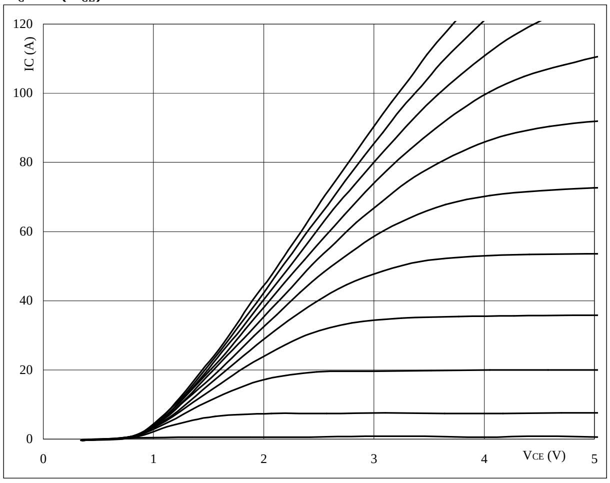
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00085	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		25	25 150		1,87 2,32	2,2	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		25			0,25	mA
Gate-emitter leakage current	I_{GES}		20	0		25			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 32 Ω R_{gon} = 32 Ω	±15	600	25	25 150		149 150		ns
Rise time	t_r					25 150		23 28		
Turn-off delay time	$t_{d(off)}$					25 150		227 300		
Fall time	t_f					25 150		73,2 108		
Turn-on energy loss	E_{on}					25 150		1,9 2,84		mWs
Turn-off energy loss	E_{off}					25 150		1,25 2,1		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		1393		pF
Output capacitance	C_{oss}							110		
Reverse transfer capacitance	C_{rss}							82		
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						0,85		K/W
Brake Inverse Diode										
Diode forward voltage	V_F				10	25 150	1,1	1,69 1,63	2,1	V
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						1,92		K/W
Brake Diode										
Diode forward voltage	V_F				25	25 150		1,93 1,91	2,2	V
Reverse leakage current	I_r			600		25			10	µA
Peak reverse recovery current	I_{RRM}	R_{gon}=32Ω	±15	600	25	25 150		21,57 24,85		A
Reverse recovery time	t_{rr}					25 150		318 510		ns
Reverse recovered charge	Q_{rr}					25 150		2,41 4,97		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		382 76		A/µs
Reverse recovery energy	E_{rec}					25 150		2,41 4,97		mWs
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						1,26		K/W
Thermistor										
Rated resistance	R_{25}					25	20,9	22	23,1	kΩ
Deviation of R_{100}	$D_{R/R}$	R_{100}=1486 Ω				100		2,9		%
Power dissipation	P					25		210		mW
Power dissipation constant	$B_{(25/100)}$	Tol. ±3%				25		2		K
B-value	B(25/50)	Tol. ±3%				Tj=25°C		4000		K
B-value	B(25/100)	Tol. ±3%				Tj=25°C		4000		K
Vincotech NTC Reference									B	

Output Inverter

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

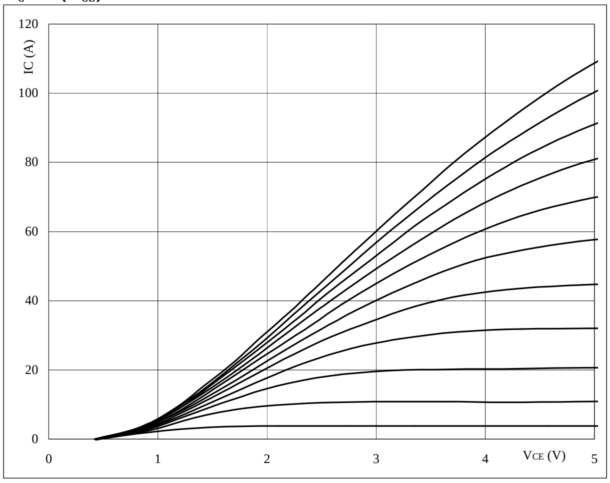
T_j = 25 °C

VGE 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

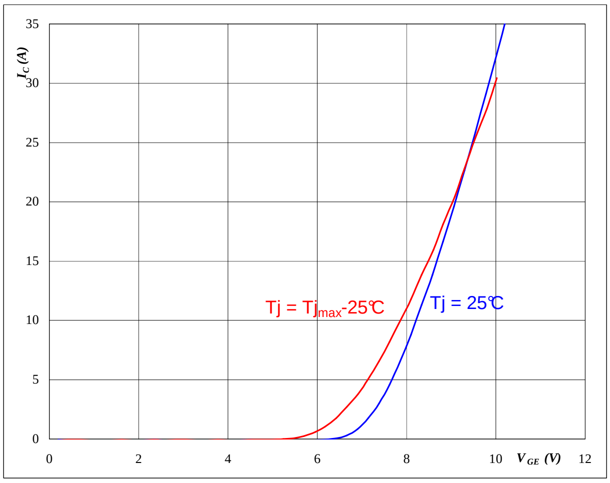
T_j = 150 °C

VGE from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_c = f(V_{GE})$



At

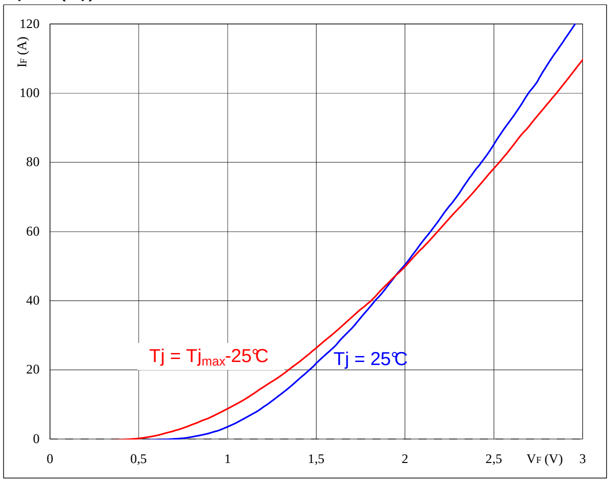
t_p = 250 µs

V_{CE} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

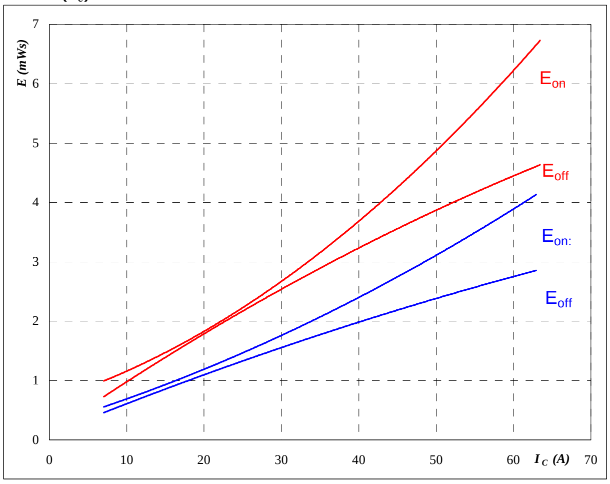
t_p = 250 µs

Output Inverter

figure 5.	IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_c)$



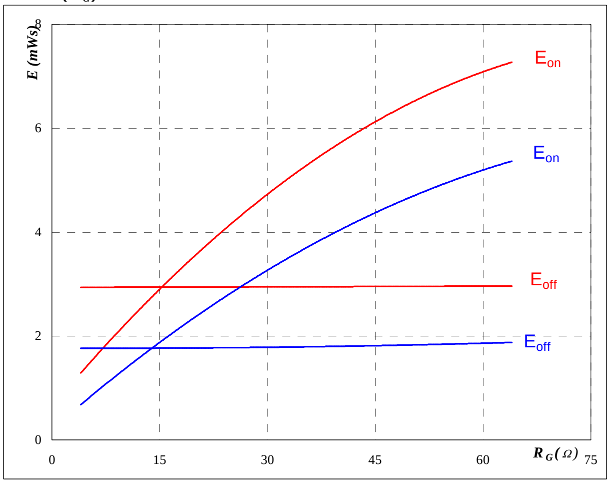
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 6.	IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



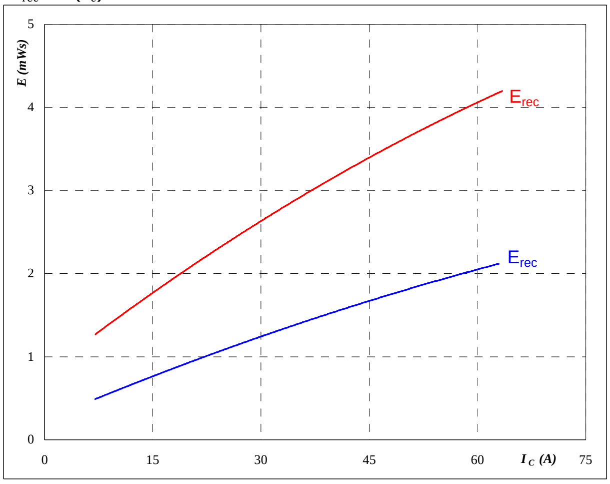
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	36	A

figure 7.	IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



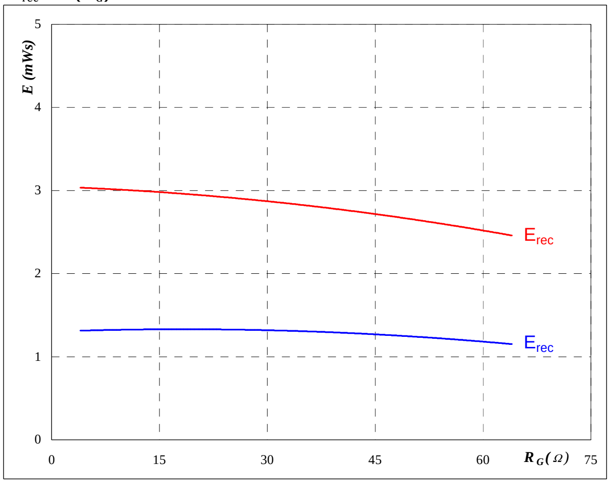
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 8.	IGBT

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

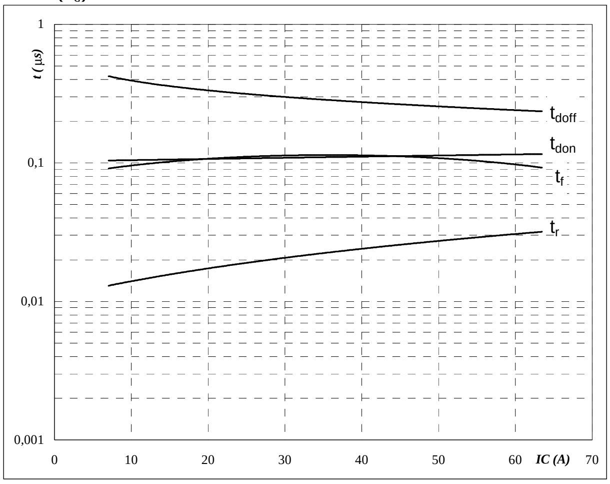
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	36	A

Output Inverter

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



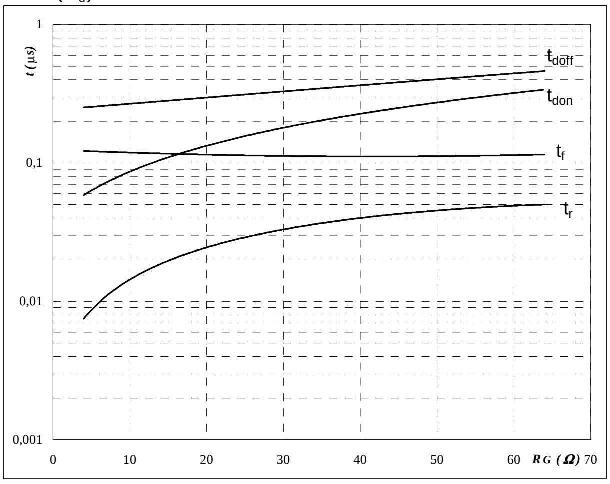
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



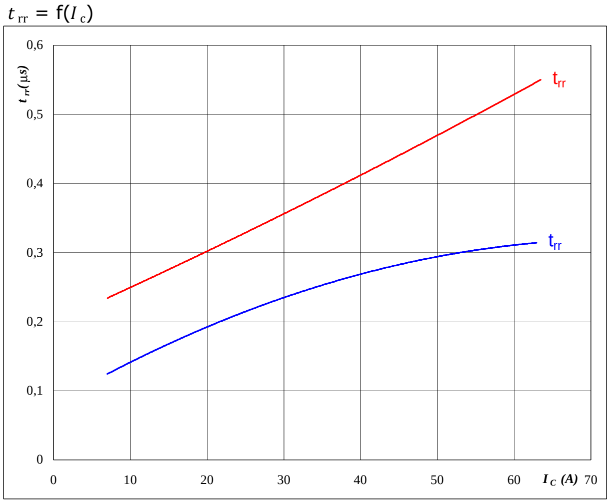
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	36	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



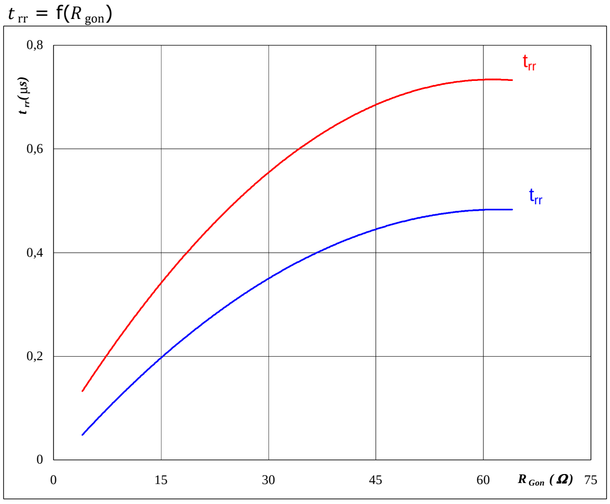
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 12. **FWD**

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

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



At

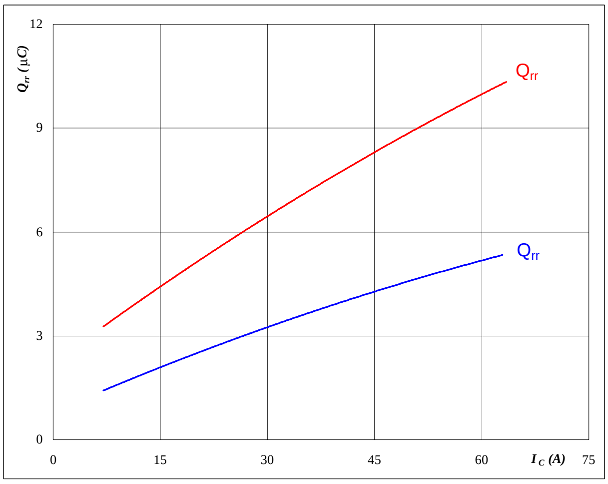
T_j =	25/150	°C
V_R =	600	V
I_F =	36	A
V_{GE} =	±15	V

Output Inverter

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_c)$



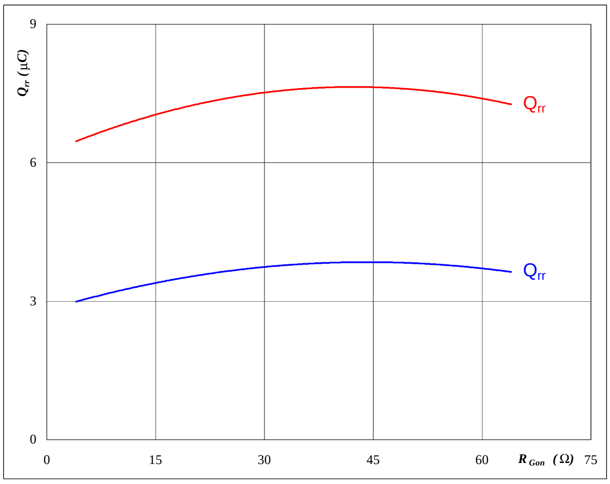
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 14. **FWD**

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

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



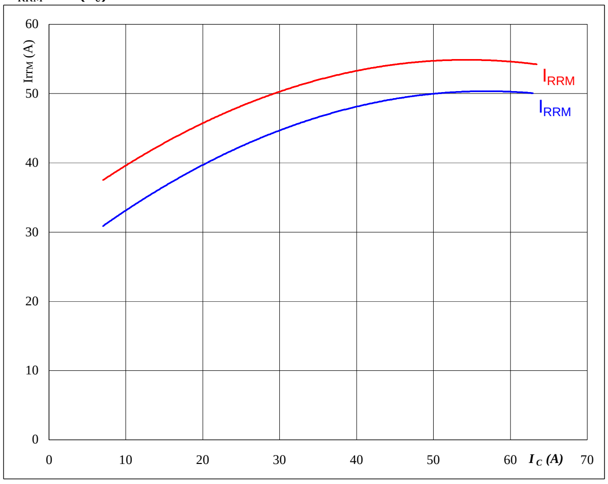
At

T_j =	25/150	°C
V_R =	600	V
I_F =	36	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_c)$



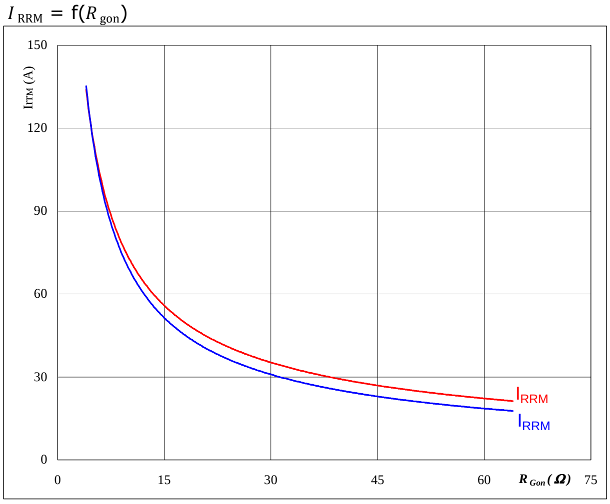
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 16. **FWD**

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

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



At

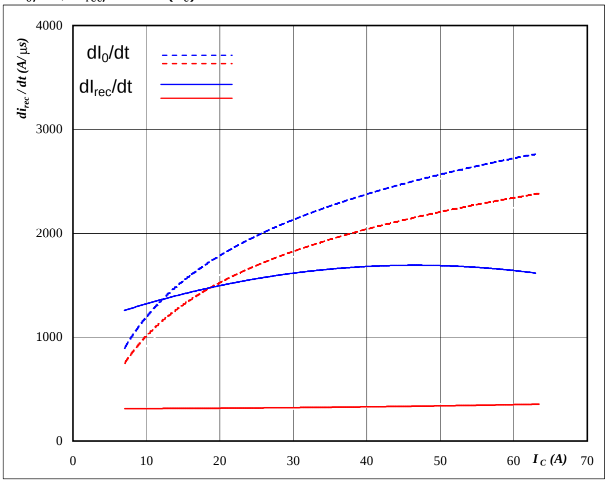
T_j =	25/150	°C
V_R =	600	V
I_F =	36	A
V_{GE} =	±15	V

Output Inverter

figure 17. **FWD**

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

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



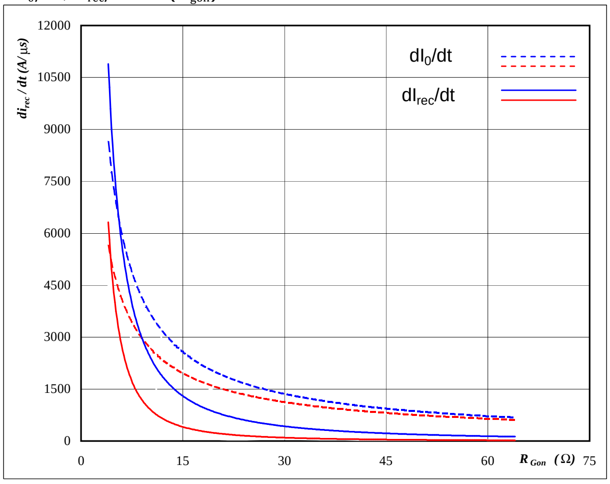
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 18. **FWD**

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

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



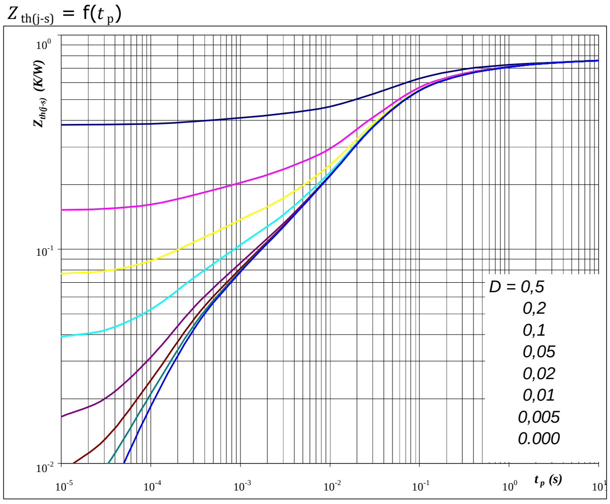
At

T_j =	25/150	°C
V_R =	600	V
I_F =	36	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

$R_{th(j\text{-}s)}$ = 0,759 K/W

Single device heated

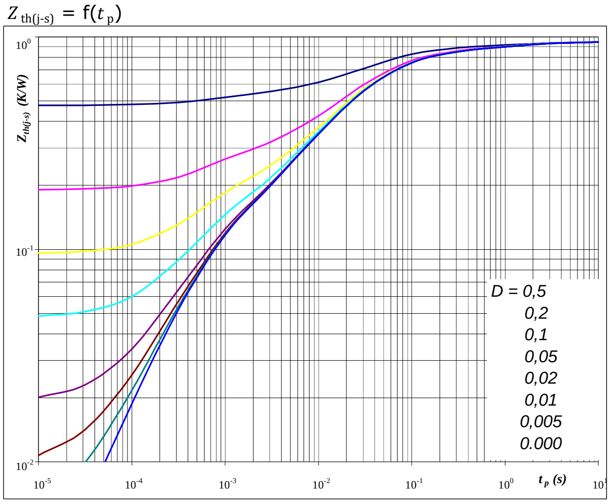
IGBT thermal model values

R (K/W)	Tau (s)
7,21E-02	2,25E+00
1,25E-01	2,93E-01
3,17E-01	5,53E-02
1,61E-01	1,48E-02
4,68E-02	1,31E-03
3,72E-02	2,25E-04

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

$R_{th(j\text{-}s)}$ = 0,95 K/W

Single device heated

FWD thermal model values

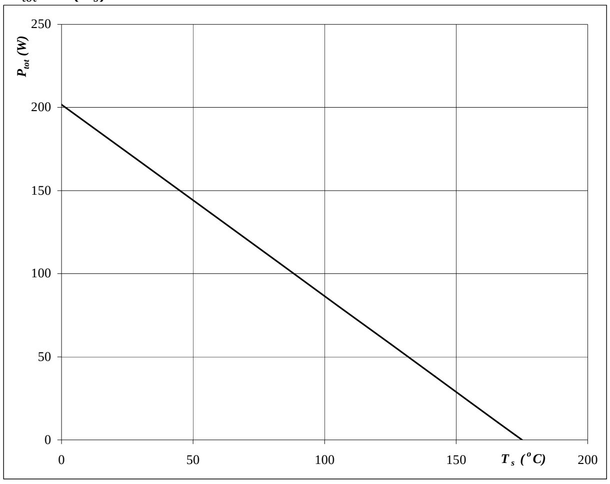
R (K/W)	Tau (s)
1,89E-02	9,45E+00
7,61E-02	1,26E+00
1,79E-01	1,49E-01
4,17E-01	3,08E-02
1,59E-01	7,12E-03
1,01E-01	6,22E-04

Output Inverter

figure 21.	IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



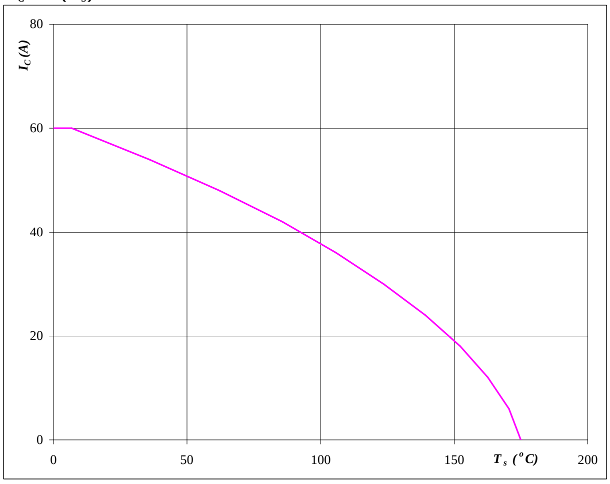
At

T_j = 175 °C

figure 22.	IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

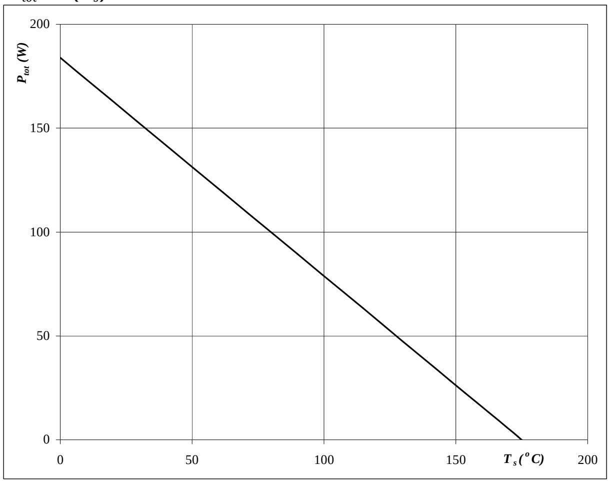
T_j = 175 °C

V_{GE} = 15 V

figure 23.	FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



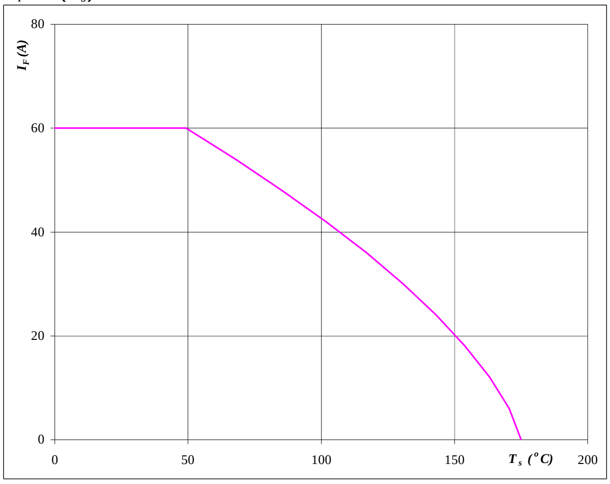
At

T_j = 175 °C

figure 24.	FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

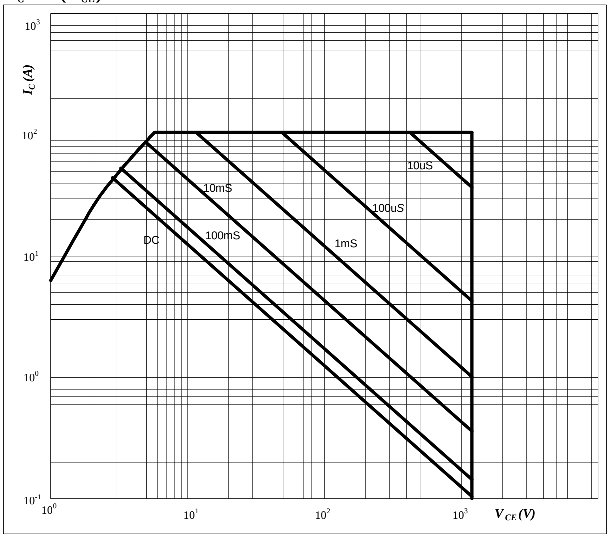
T_j = 175 °C

Output Inverter

figure 25. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



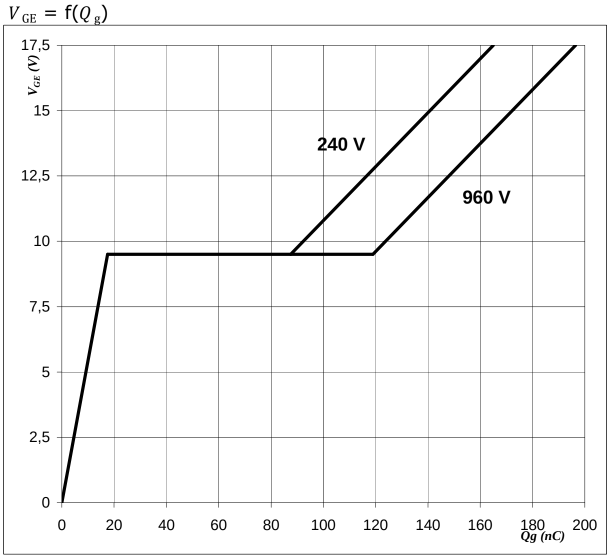
At

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

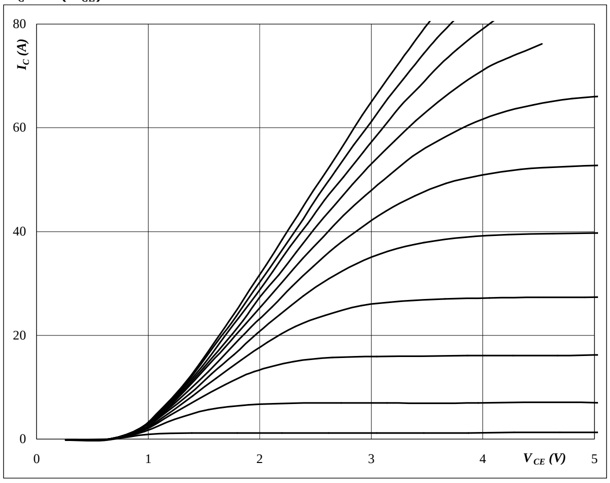
I_C =	36	A

Brake

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 μs

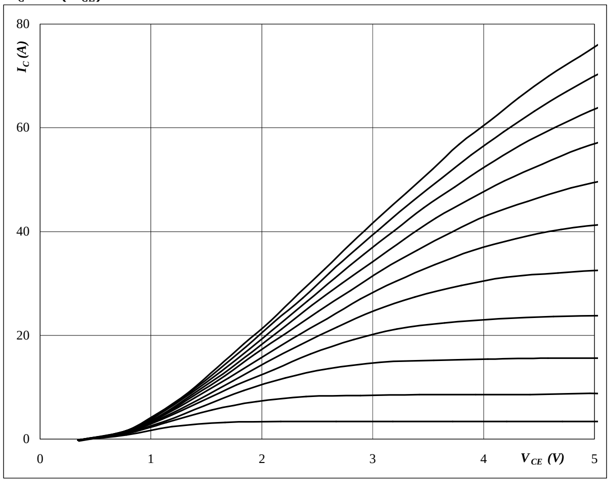
T_j = 25 °C

VGE 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

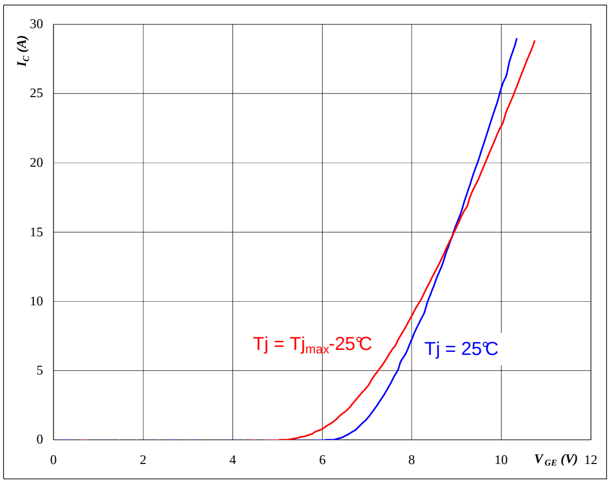
T_j = 151 °C

VGE from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



At

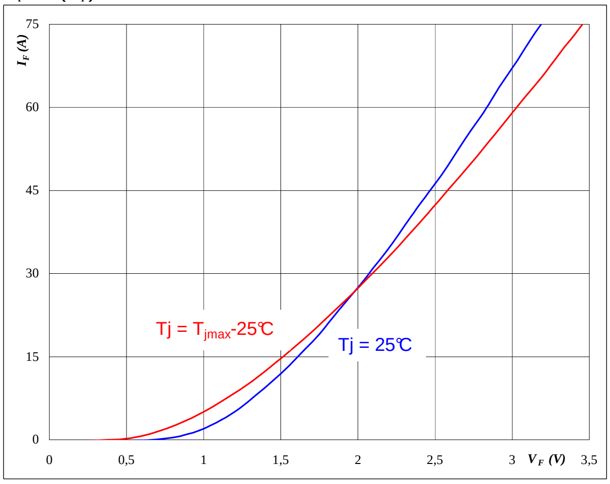
t_p = 250 μs

V_{CE} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

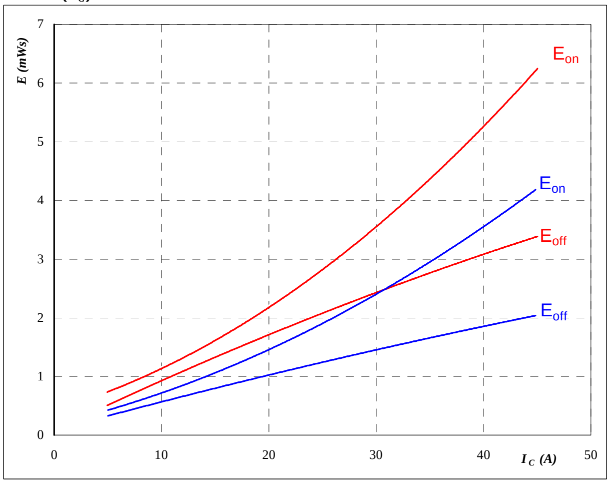
t_p = 250 μs

Brake

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

T_j = 25/150 °C

V_{CE} = 600 V

V_{GE} = ±15 V

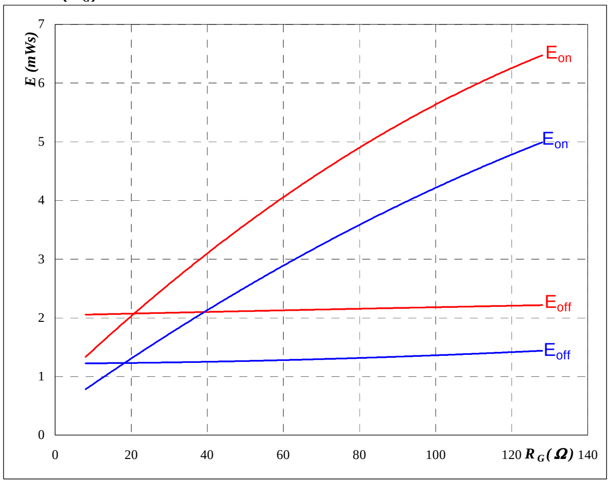
R_{gon} = 32 Ω

R_{goff} = 32 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 = 25/150 °C

V_{CE} = 600 V

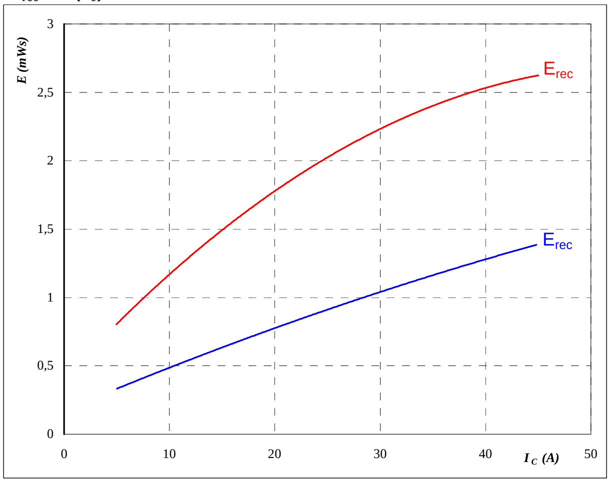
V_{GE} = ±15 V

I_C = 25 A

figure 7. **IGBT**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



With an inductive load at

T_j = 25/150 °C

V_{CE} = 600 V

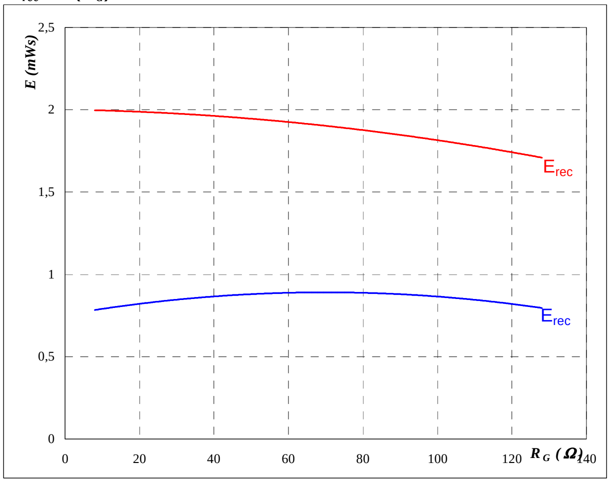
V_{GE} = ±15 V

R_{gon} = 32 Ω

figure 8. **IGBT**

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

T_j = 25/150 °C

V_{CE} = 600 V

V_{GE} = ±15 V

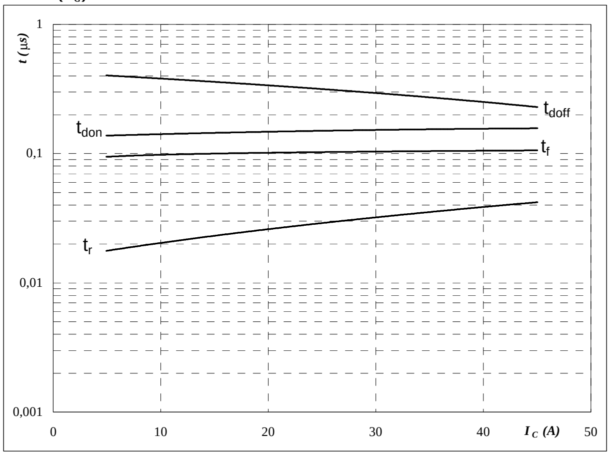
I_C = 25 A

Brake

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



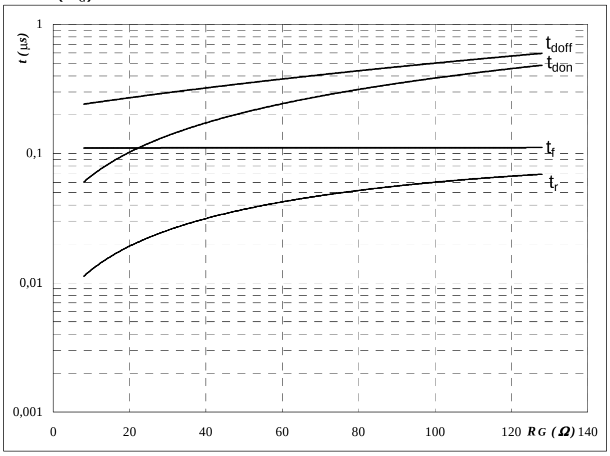
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32,015	Ω
R_{goff} =	32,015	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



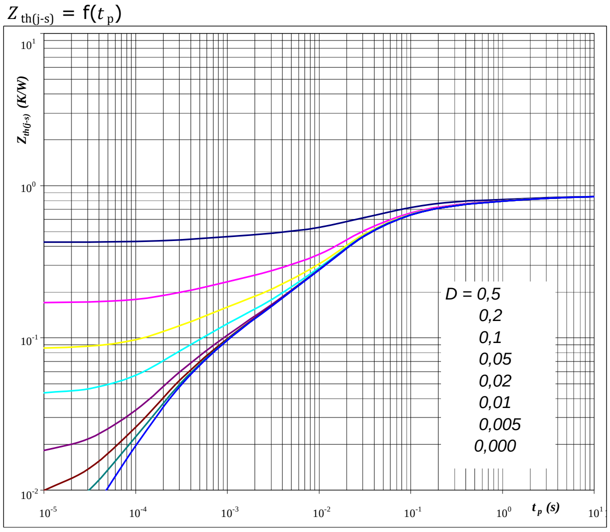
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

figure 11. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



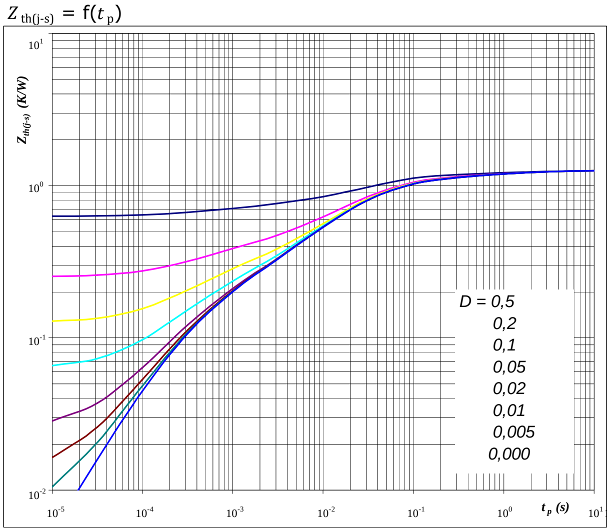
At

D =	t_p / T	
$R_{th(j-s)}$ =	0,85	K/W

figure 12. **IGBT**

FWD transient thermal impedance as a function of pulse width

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



At

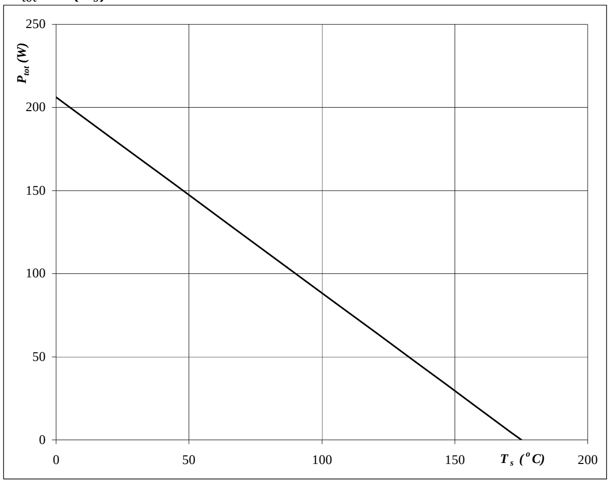
D =	t_p / T	
$R_{th(j-s)}$ =	1,26	K/W

Brake

figure 13. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



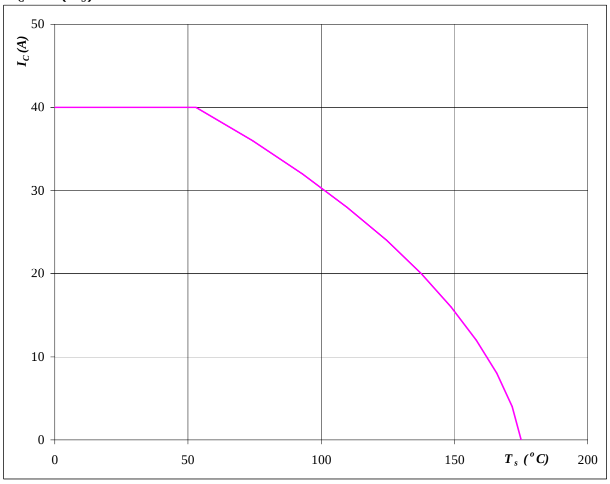
At

T_j = 175 ºC

figure 14. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

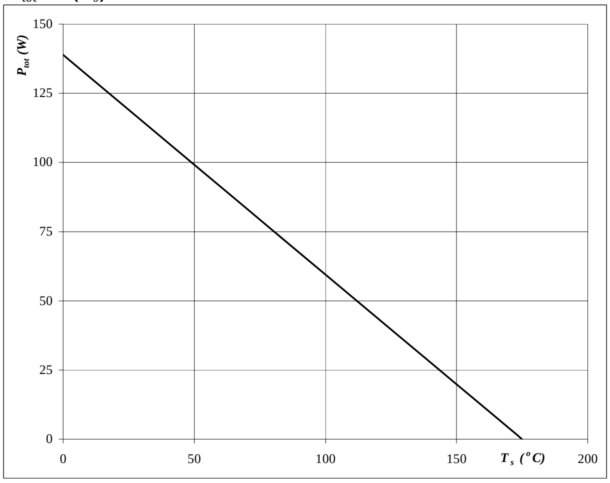
T_j = 175 ºC

V_{GE} = 15 V

figure 15. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



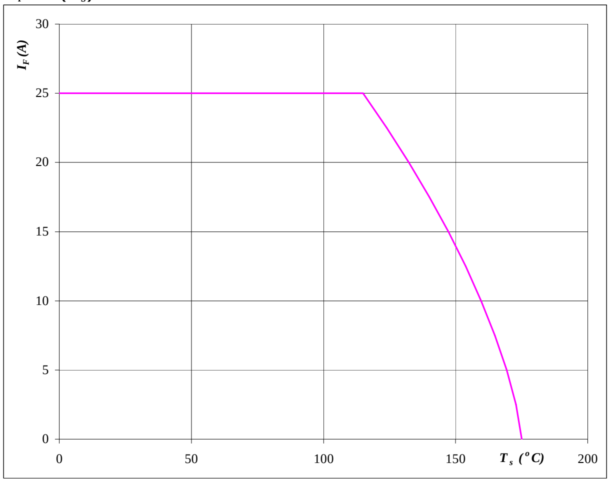
At

T_j = 175 ºC

figure 16. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

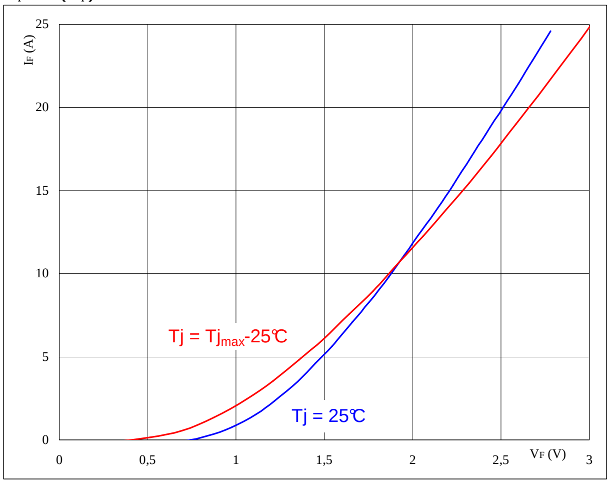
T_j = 175 ºC

Brake Inverse Diode

figure 1. **Brake inverse diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



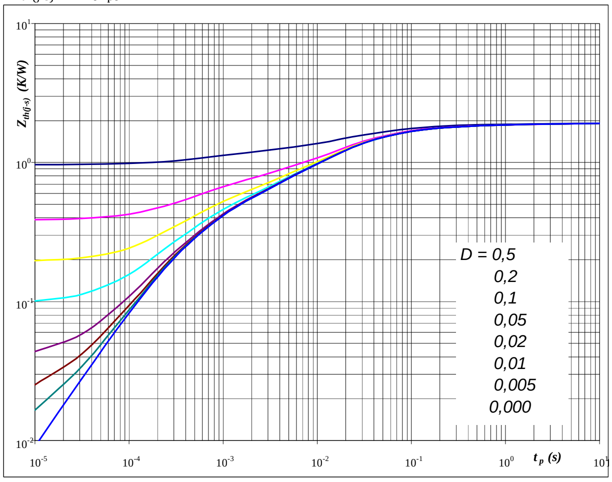
At

t_p = 250 µs

figure 2. **Brake inverse diode**

Diode transient thermal impedance as a function of pulse width

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



At

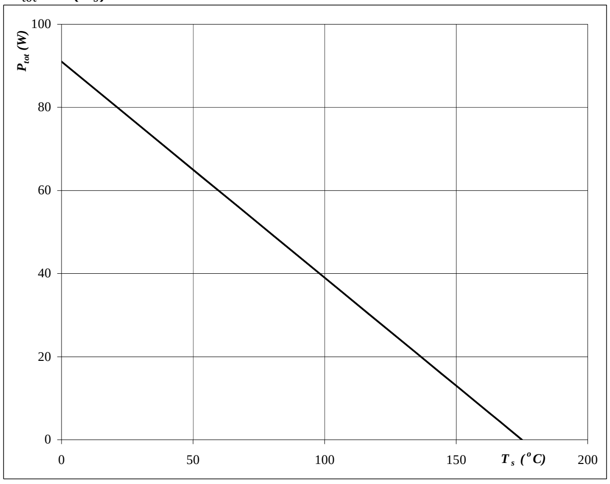
D = t_p / T

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

figure 3. **Brake inverse diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



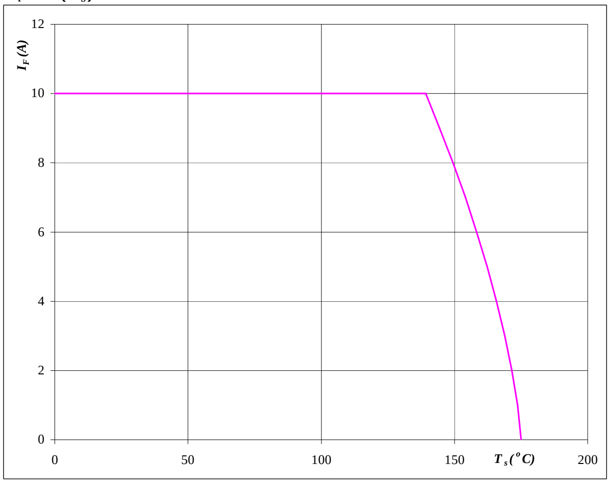
At

T_j = 175 ºC

figure 4. **Brake inverse diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

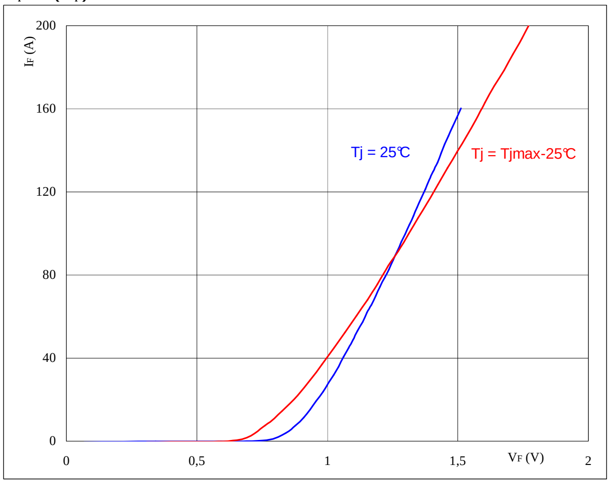
T_j = 175 ºC

Input Rectifier Bridge

figure 1. **Rectifier Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



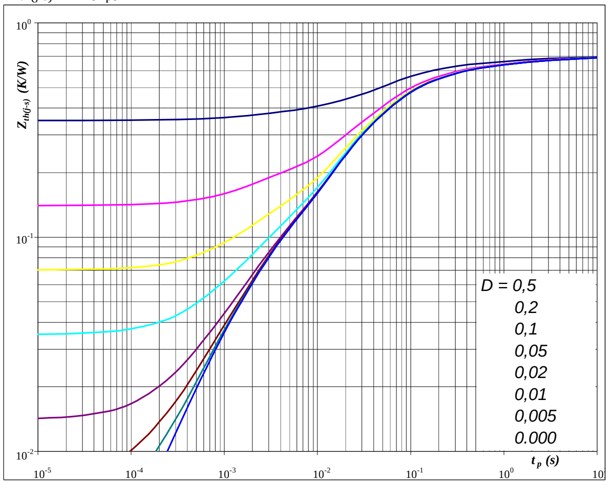
At

t_p = 250 µs

figure 2. **Rectifier Diode**

Diode transient thermal impedance as a function of pulse width

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



At

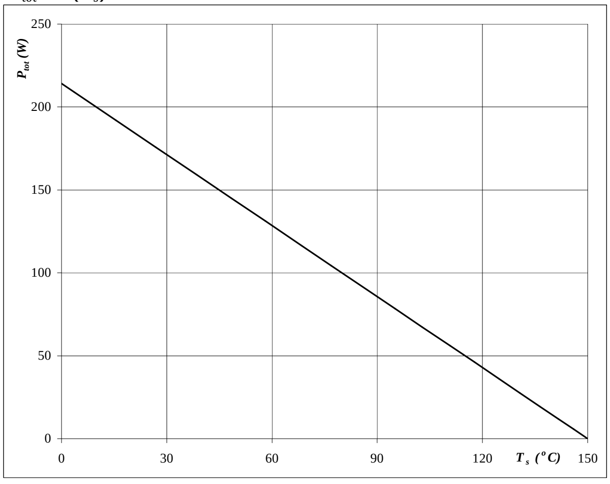
$D = t_p / T$

$R_{th(j-s)}$ = 0,70 K/W

figure 3. **Rectifier Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



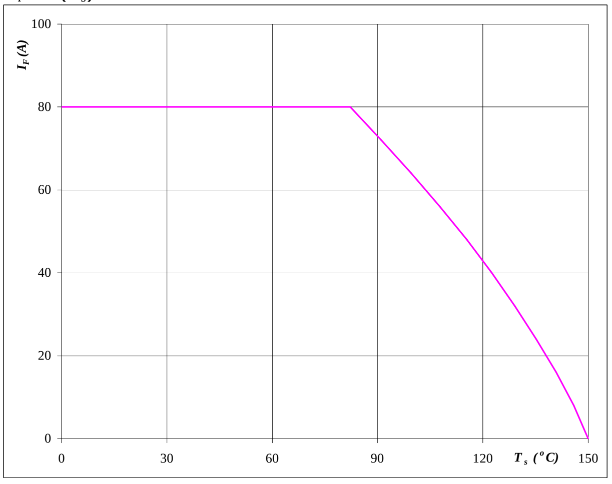
At

T_j = 150 ºC

figure 4. **Rectifier Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



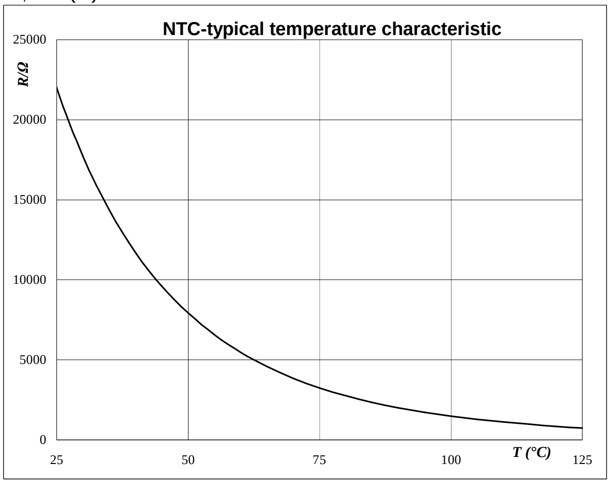
At

T_j = 150 ºC

Thermistor

figure 1.	Thermistor

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



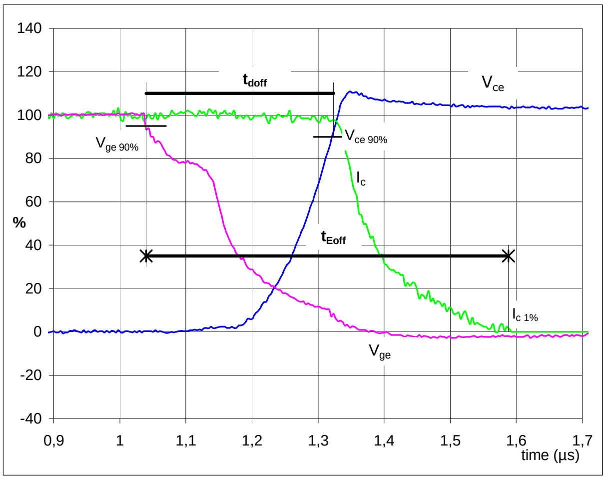
Switching Definitions Output Inverter

General conditions

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

figure 1. **IGBT**

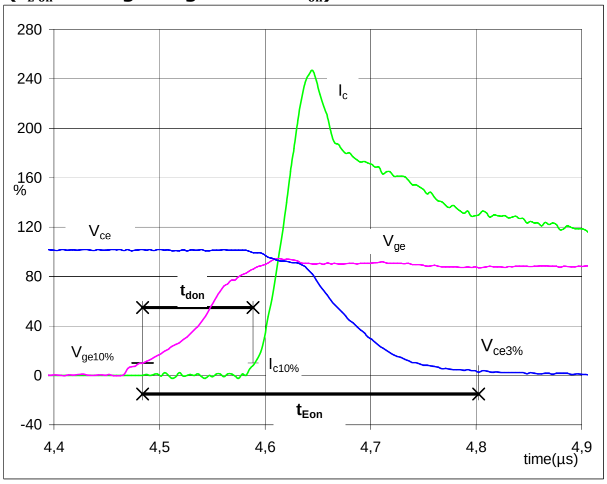
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0,28	µs
$t_{E\,off}$ =	0,55	µs

figure 2. **IGBT**

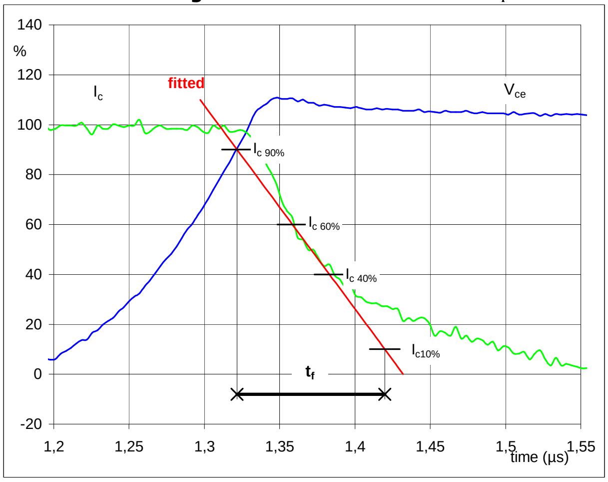
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0,11	µs
$t_{E\,on}$ =	0,3185	µs

figure 3. **IGBT**

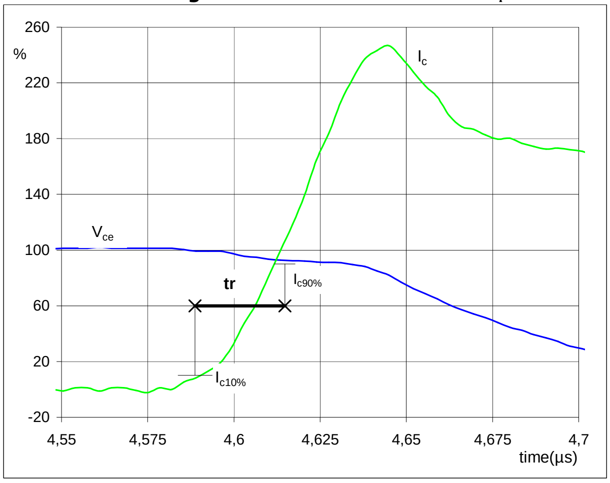
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0,11	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

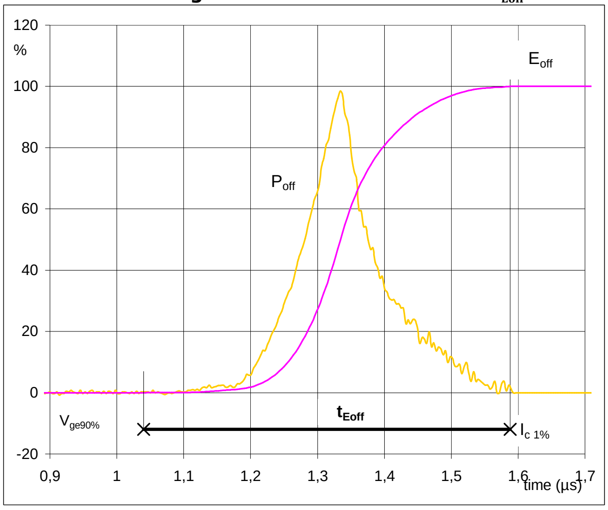


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,023	µs

Switching Definitions Output Inverter

figure 5. **IGBT**

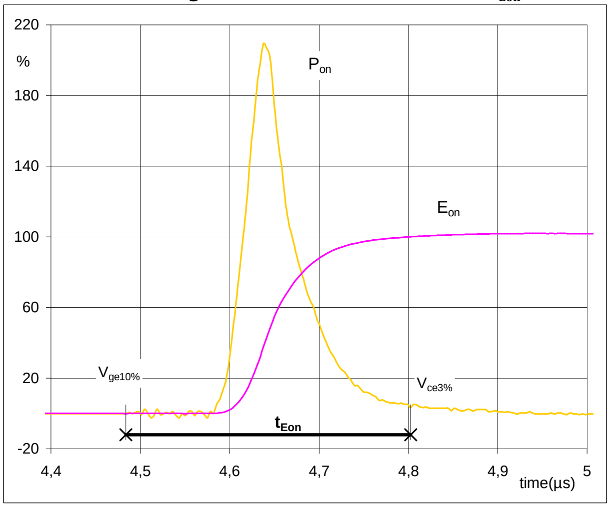
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	21,0	kW
E_{off} (100%) =	2,70	mJ
$t_{E\ off}$ =	0,55	µs

figure 6. **IGBT**

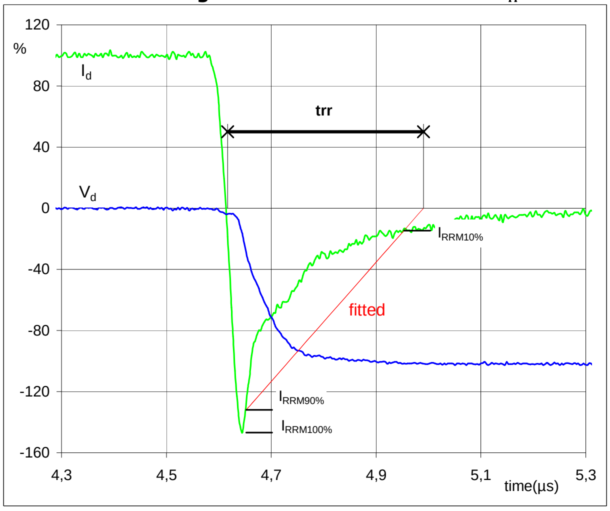
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	21,0	kW
E_{on} (100%) =	2,95	mJ
$t_{E\ on}$ =	0,3185	µs

figure 7. **FWD**

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

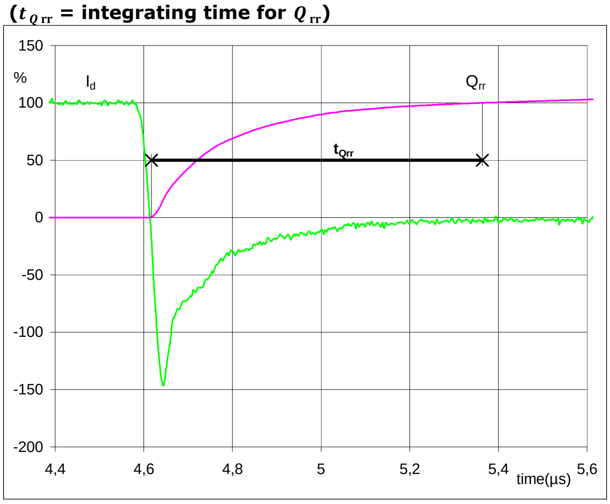


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-51	A
t_{rr} =	0,351	µs

Switching Definitions Output Inverter

figure 8. **FWD**

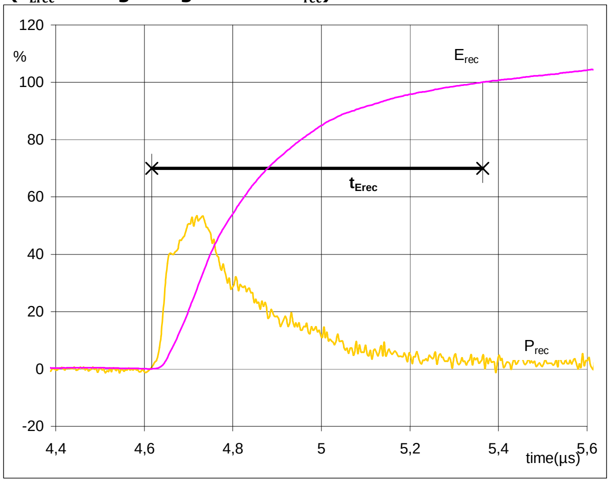
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	6,5	µC
t_{Qint} =	0,75	µs

figure 9. **FWD**

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



P_{rec} (100%) =	21,0	kW
E_{rec} (100%) =	2,64	mJ
$t_{E\,rec}$ =	0,75	µs

Ordering Code and Marking - Outline - Pinout

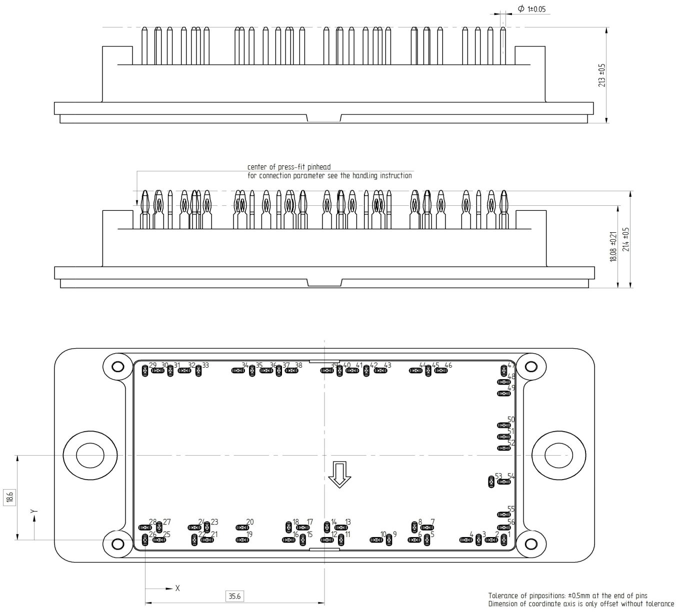
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste with solder pins	V23990-P767-A-PM	P767-A	P767-A
with thermal paste with solder pins	V23990-P767-A-/3/-PM	P767-A-/3/	P767-A-/3/
without thermal paste with Press-fit pins	V23990-P767-AY-PM	P767-AY	P767-AY
with thermal paste with Press-fitr pins	V23990-P767-AY-/3/-PM	P767-AY-/3/	P767-AY-/3/

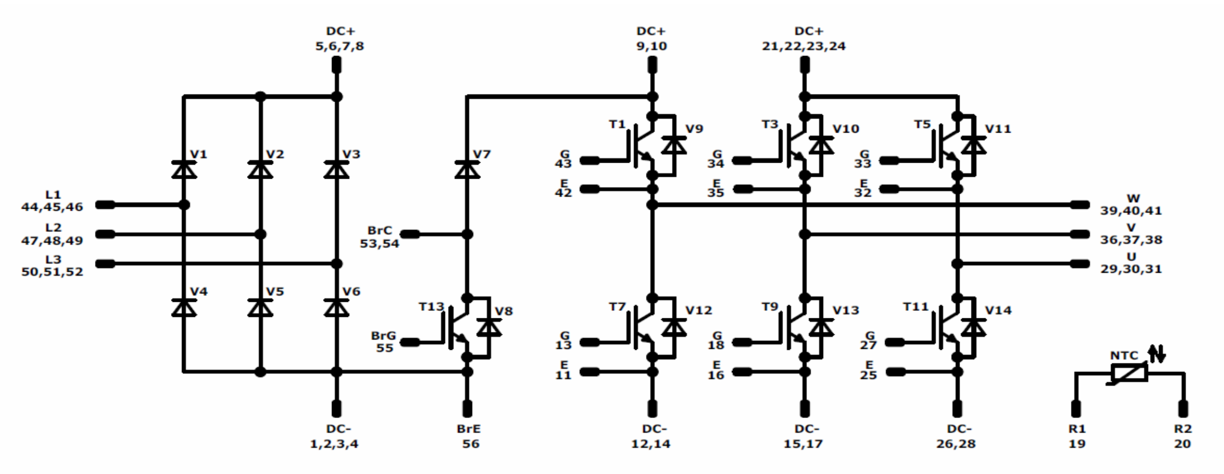
Text	Name	Date code	UL & Vinco	Lot	Serial
	NN-NNNNNNNNNNNNNN-TTTTTTTVV	WWYY	UL Vinco	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code	
	TTTTTTTVV	LLLLL	SSSS	WWYY	

Outline

Pin table [mm]				Pin table [mm]			
Pin	Func	X	Y	Pin	Func	X	Y
1	DC-	71,2	0	29	U	0	37,2
2	DC-	68,7	0	30	U	2,5	37,2
3	DC-	66,2	0	31	U	5	37,2
4	DC-	63,7	0	32	E	7,8	37,2
5	DC+	56	0	33	G	10,6	37,2
6	DC+	53,5	0	34	G	18,45	37,2
7	DC+	56	2,8	35	E	21,25	37,2
8	DC+	53,5	2,8	36	V	24,05	37,2
9	DC+	48,4	0	37	V	26,55	37,2
10	DC+	45,9	0	38	V	29,05	37,2
11	E	38,9	0	39	W	36,1	37,2
12	DC-	36,1	0	40	W	38,6	37,2
13	G	38,9	2,8	41	W	41,1	37,2
14	DC-	36,1	2,8	42	E	43,9	37,2
15	DC-	31,3	0	43	G	46,7	37,2
16	E	28,5	0	44	L1	53,7	37,2
17	DC-	31,3	2,8	45	L1	56,2	37,2
18	G	28,5	2,8	46	L1	58,7	37,2
19	R2	19,3	0	47	L2	71,2	37,2
20	R1	19,3	2,8	48	L2	71,2	34,7
21	DC+	12,3	0	49	L2	71,2	32,2
22	DC+	9,8	0	50	L3	71,2	25,2
23	DC+	12,3	2,8	51	L3	71,2	22,7
24	DC+	9,8	2,8	52	L3	71,2	20,2
25	E	2,8	0	53	BrC	71,2	12,8
26	DC-	0	0	54	BrC	68,7	12,8
27	G	2,8	2,8	55	BrG	71,2	5,6
28	DC-	0	2,8	56	BrE	71,2	2,8



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T3,T5,T7,T9,T11	IGBT	1200 V	35 A	Inverter Switch	
V9-V14	FWD	1200 V	35 A	Inverter Diode	
V1-V6	Rectifier	1600 V	50 A	Rectifier Diode	
T13	IGBT	1200 V	25 A	Brake Switch	
V7	FWD	1200 V	25 A	Brake Diode	
V8	FWD	1200 V	10 A	Brake Inverse Diode	
NTC	Thermistor			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
V23990-P767-Ax-D7-14	11 Jan. 2019	flow2 frame modification	1,23