flowPIM 1 3rd gen — 1200V / 35A

Features

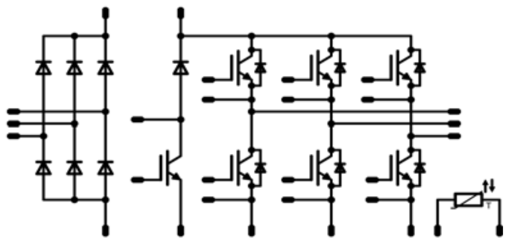
- 3~ rectifier, BRC, Inverter, NTC
- Very compact housing, easy to route
- IGBT4 / EmCon4 technology for low saturation losses and improved EMC behaviour
- High performance with AlN substrate

flowPIM1 housing

Target Applications

- Motor Drives
- Power Generation

Schematic



Types

- V23990-P580-A46-PM

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current per diode	I_{FAV}	DC current	T_h=80°C	50	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=45°C	320	A
I^2t-value	I^2t			510	A^2s
Power dissipation per diode	P_{tot}	$T_j=T_j$max	T_h=80°C	82	W
Maximum junction temperature	$T_j$max			150	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C	49	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		105	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C	152	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	μs V
Maximum junction temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	50	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		70	A
Power dissipation per diode	P_{tot}	T_j=$T_j$max	T_h=80°C	121	W
Maximum junction temperature	$T_j$max			175	°C
Brc Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C	40	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		75	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C	133	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	μs V
Maximum junction temperature	$T_j$max			175	°C
Brc Diode					
Peak repetitive reverse voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	20	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		20	A
Power dissipation per diode	P_{tot}	T_j=$T_j$max	T_h=80°C	59	W
Maximum junction temperature	$T_j$max			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12.7	mm
Clearance				min 12.7	mm

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				50	Tj=25°C Tj=125°C	0.8	1.29 1.24	1.6	V
Threshold voltage (for power loss calc. only)	V_{to}				50	Tj=25°C Tj=125°C		0.93 0.82		V
Slope resistance (for power loss calc. only)	r_t				50	Tj=25°C Tj=125°C		0.007 0.009		Ω
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0.02 2	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.85		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0.0012	Tj=25°C Tj=150°C	5	5.8	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		35	Tj=25°C Tj=150°C	1.6	1.95 2.39	2.3	V
Collector-emitter cut-off current incl. diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0.01	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			200	nA
Integrated gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=16Ω Rgon=16Ω	±15	600	35	Tj=25°C Tj=150°C		92 91.6		ns
Rise time	t_r					Tj=25°C Tj=150°C		18 23.4		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		213 274		
Fall time	t_f					Tj=25°C Tj=150°C		75.3 105		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1.62 2.49		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1.81 2.82		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1950		pF
Output capacitance	C_{oss}							155		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_{Gate}	Vcc=960V	±15		35	Tj=25°C		270		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.62		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Inverter Diode										
Diode forward voltage	V_F				35	Tj=25°C Tj=150°C	1	1.83 1.8	2.2	V
Peak reverse recovery current	I_{RRM}	Rgoff=16Ω	±15	600	35	Tj=25°C Tj=150°C		68.9 78.7		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		150 277		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		3.93 7.47		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		4100 2080		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		1.69 3.31		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.78		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Brc Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0.00085	Tj=25°C Tj=150°C	5	5.8	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		25	Tj=25°C Tj=150°C	1.6	1.86 2.31	2.2	V
Collector-emitter cut-off incl. diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0.005	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			200	nA
Integrated gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=32Ω Rgoff=32Ω	±15	600	25	Tj=25°C Tj=150°C		127 129		ns
Rise time	t_r					Tj=25°C Tj=150°C		36 41.8		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		232 276		
Fall time	t_f					Tj=25°C Tj=150°C		73.7 112		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		1.81 2.42		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1.37 2.19		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1430		pF
Output capacitance	C_{oss}							115		
Reverse transfer capacitance	C_{rss}							85		
Gate charge	Q_{Gate}	Vcc=960V	±15		25	Tj=25°C		200		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.71		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Brc Diode										
Diode forward voltage	V_F				10	Tj=25°C Tj=150°C	1.3	1.85 1.76	2.2	V
Reverse leakage current	I_r		±15	600	10	Tj=25°C Tj=150°C			5	μA
Peak reverse recovery current	I_{RRM}	Rgon=32Ω	±15	600	10	Tj=25°C Tj=150°C		10.2 12.3		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		396 624		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		1.55 3.03		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		36 32		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		0.63 1.30		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						1.62		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Thermistor										
Rated resistance	R					Tj=25°C Tj=125°C	20.9	22 0.75	23.1	kΩ
Operating current	I					Tj=25°C			0.3	mA
Power dissipation	P					Tj=25°C		200		mW
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3950		K

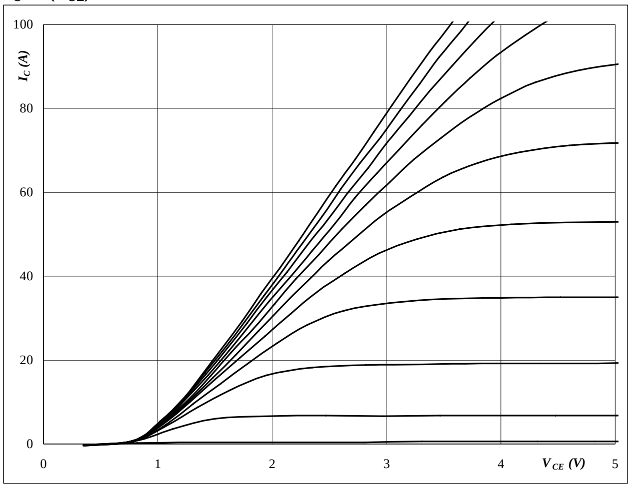
V23990-P580-A46-PM
preliminary datasheet

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



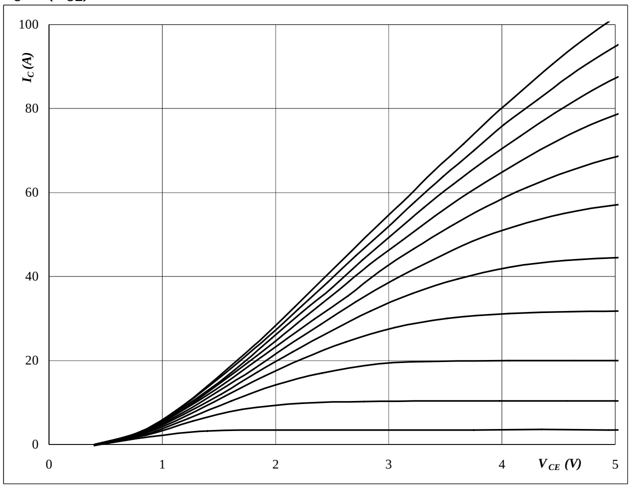
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



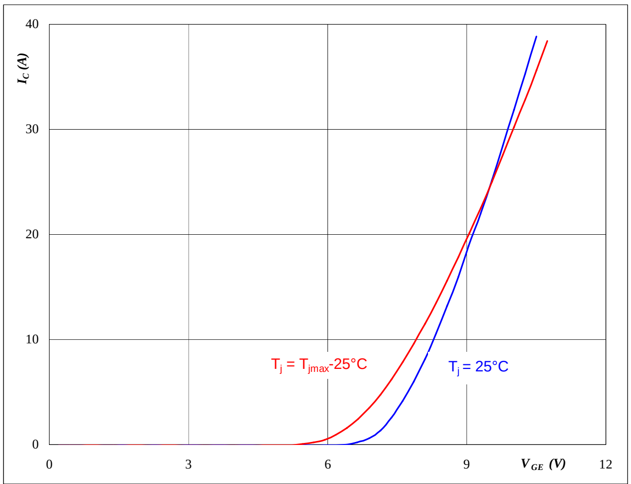
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



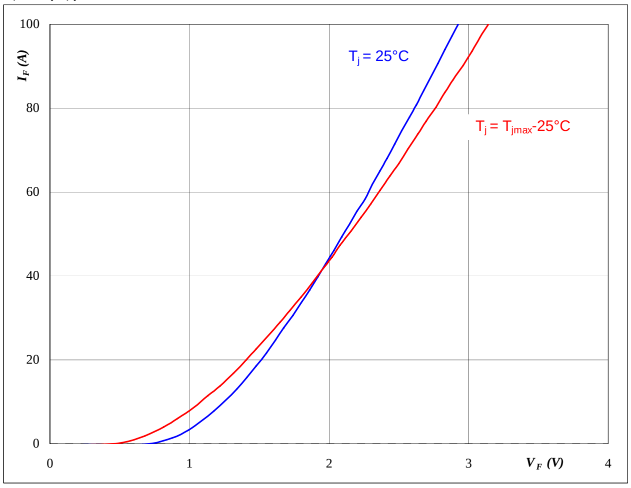
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

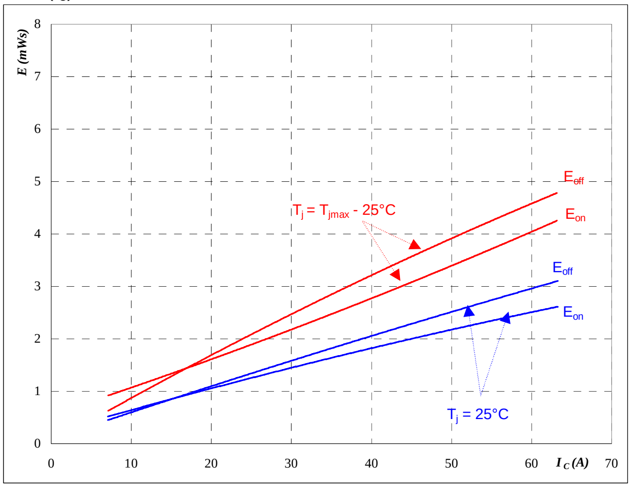
t_p =	250	μs

Output Inverter

Figure 5	Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



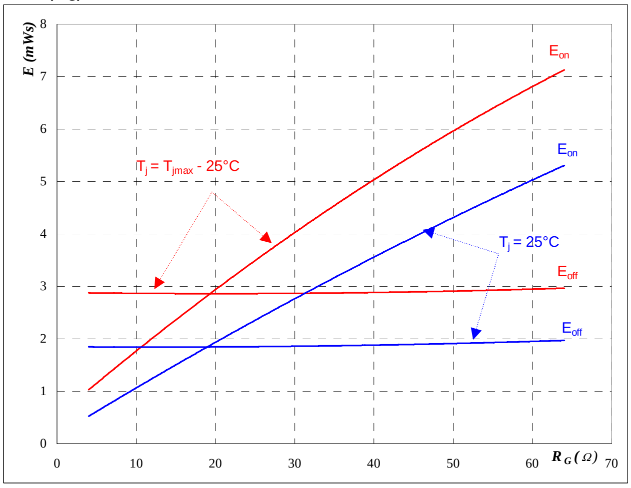
With an inductive load at

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

Figure 6	Output inverter IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



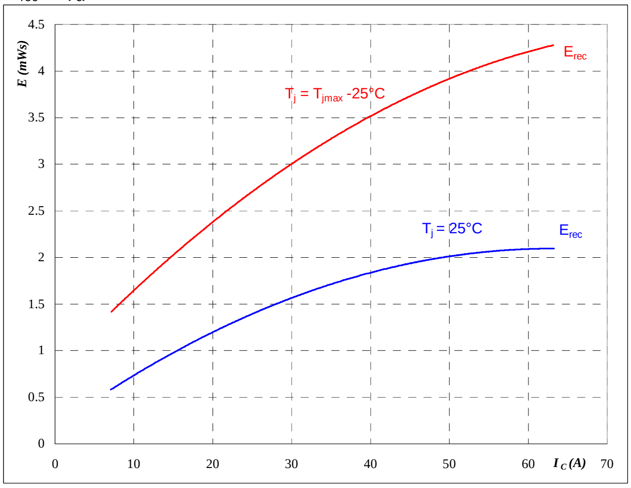
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 7	Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



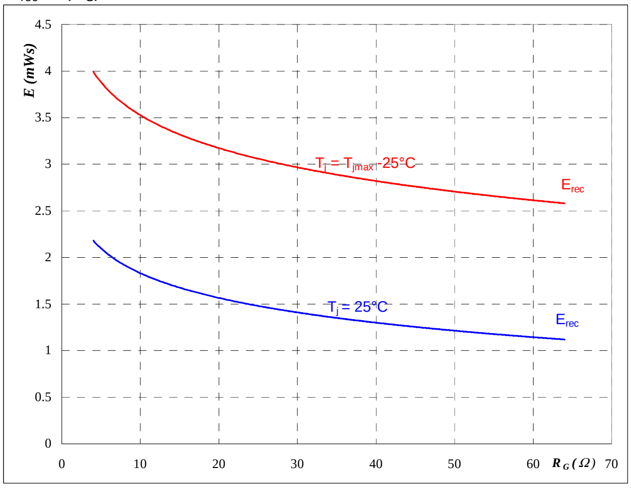
With an inductive load at

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

Figure 8	Output inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

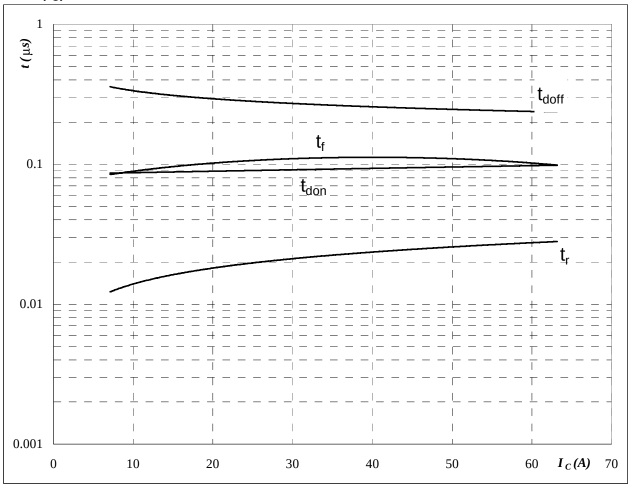
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Output Inverter

Figure 9	Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



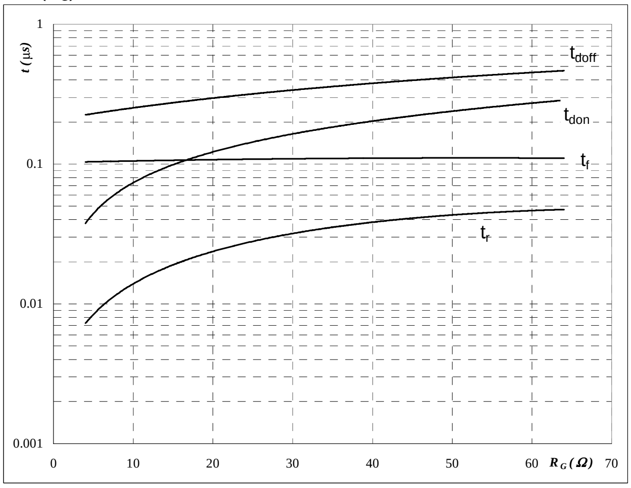
With an inductive load at

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

Figure 10	Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



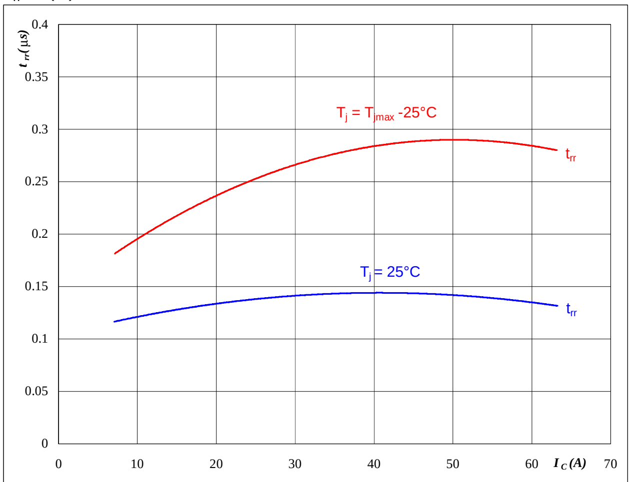
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 11	Output inverter FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



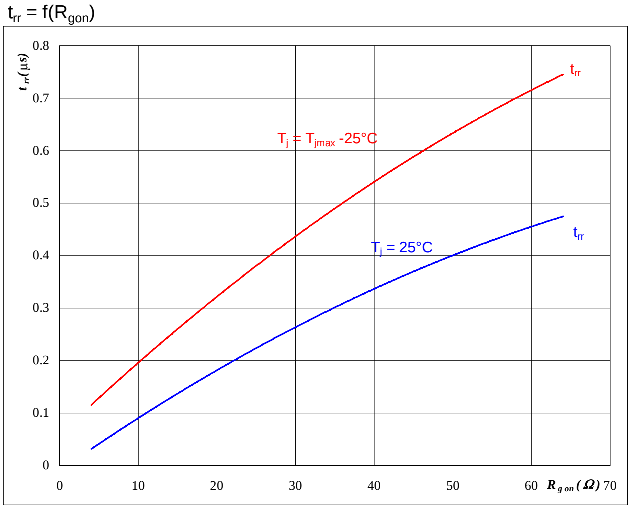
At

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

Figure 12	Output inverter FRED

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

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



At

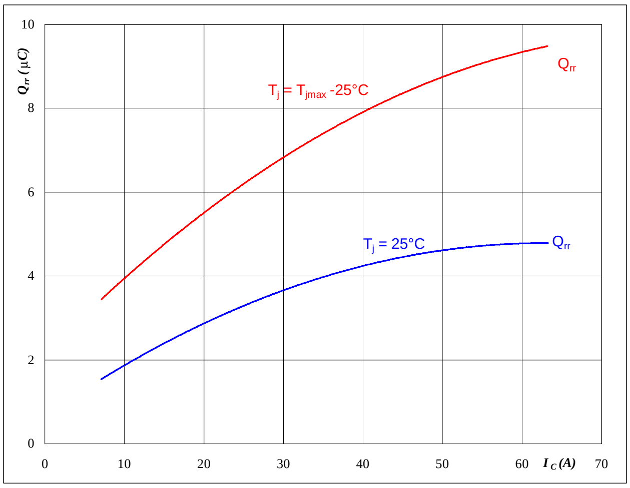
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



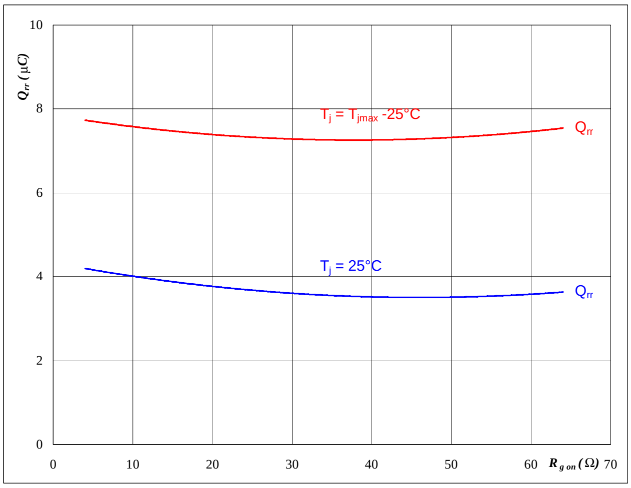
At

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

Figure 14 Output inverter FRED

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

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



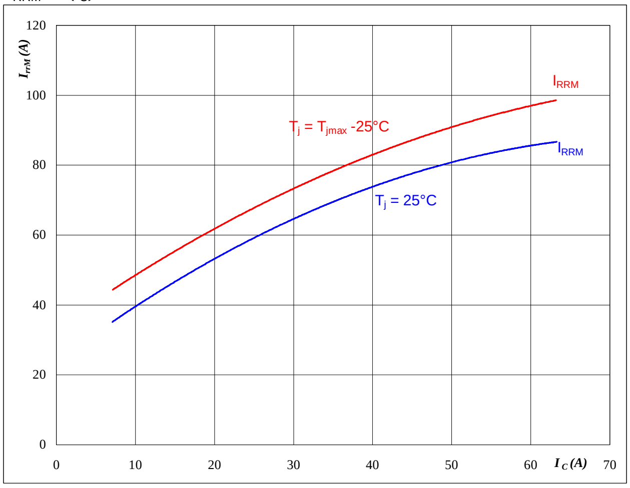
At

T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



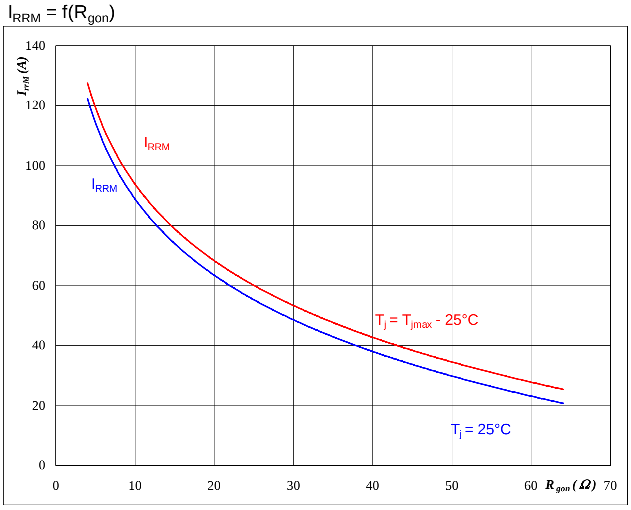
At

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

Figure 16 Output inverter FRED

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

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



At

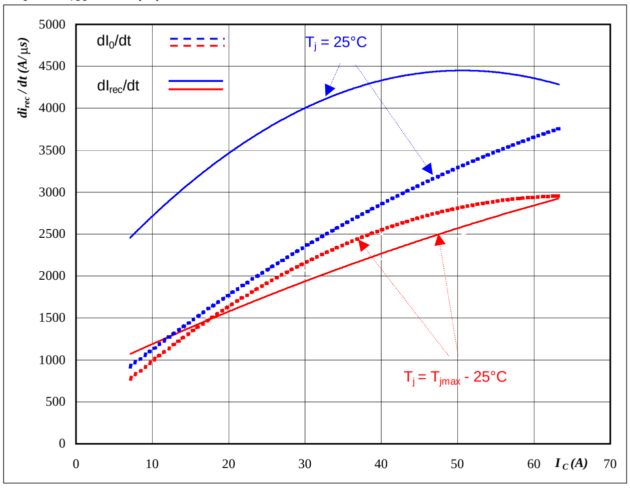
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

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

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



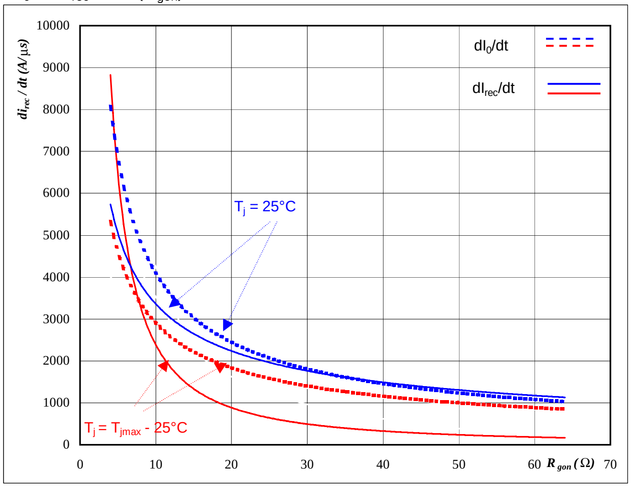
At

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

Figure 18 Output inverter FRED

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

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



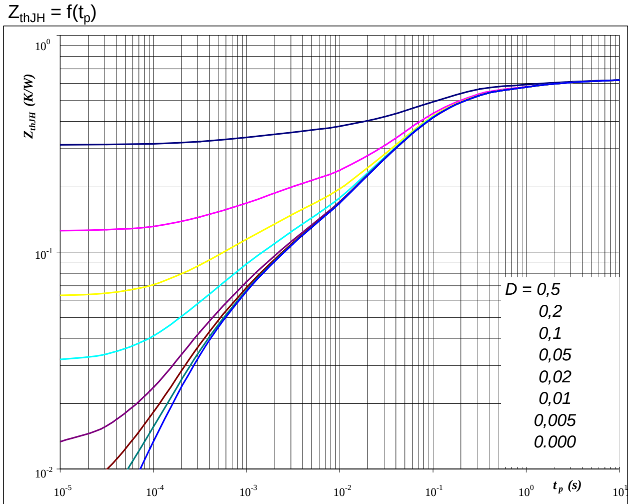
At

T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0.62	K/W

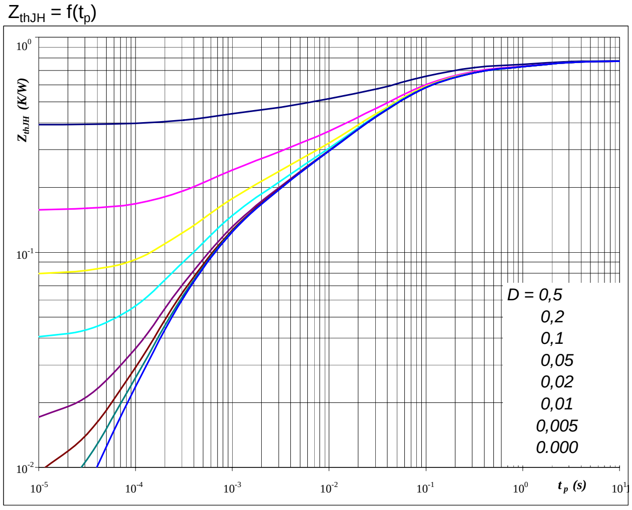
IGBT thermal model values

R (C/W)	Tau (s)
0.04	3.6E+00
0.09	5.8E-01
0.31	8.1E-02
0.09	1.7E-02
0.06	1.6E-03
0.03	2.8E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0.78	K/W

FRED thermal model values

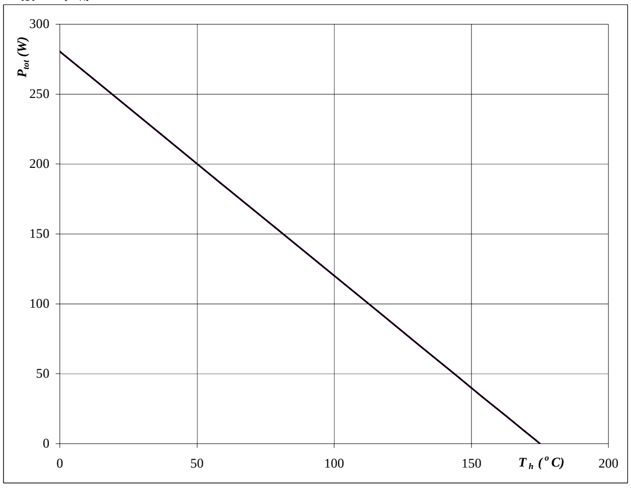
R (C/W)	Tau (s)
0.02	9.7E+00
0.09	9.8E-01
0.24	1.0E-01
0.22	2.5E-02
0.11	2.9E-03
0.09	4.1E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



At

T_j = 175 °C

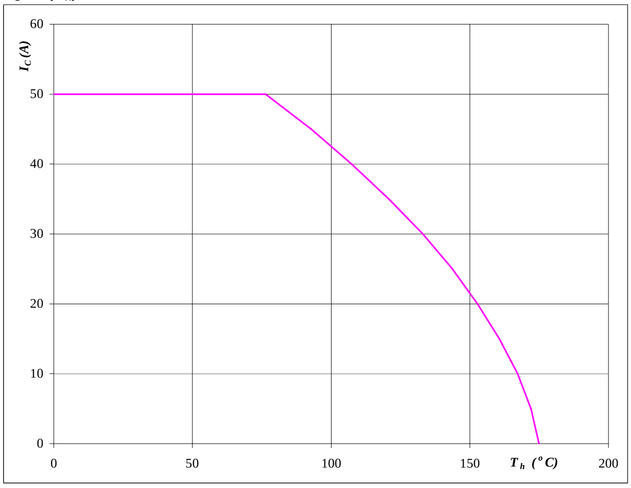
single heating

overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

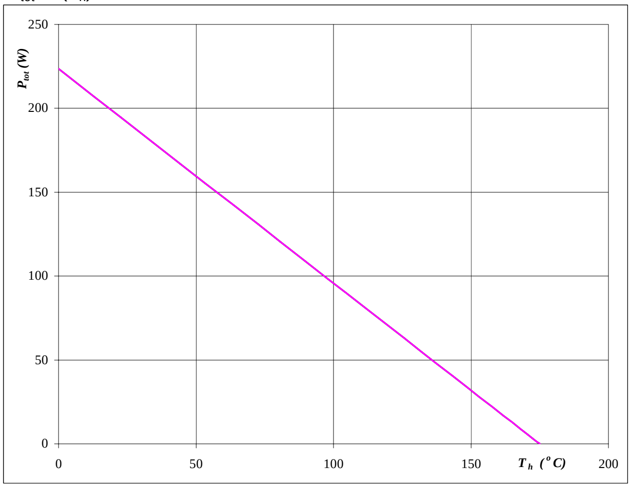
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



At

T_j = 175 °C

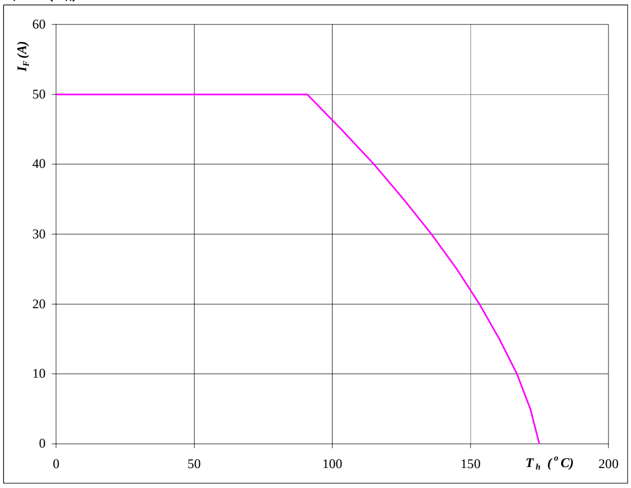
single heating

overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

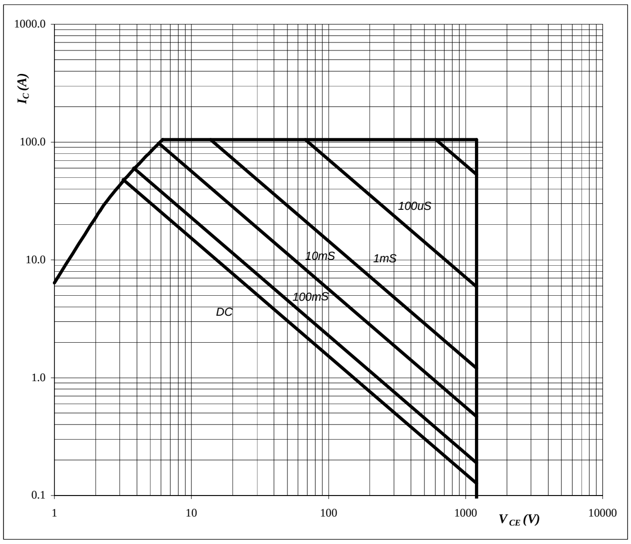
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



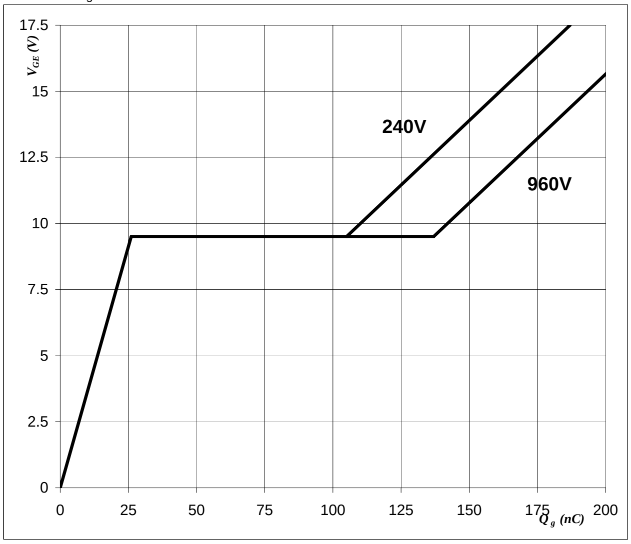
At

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

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

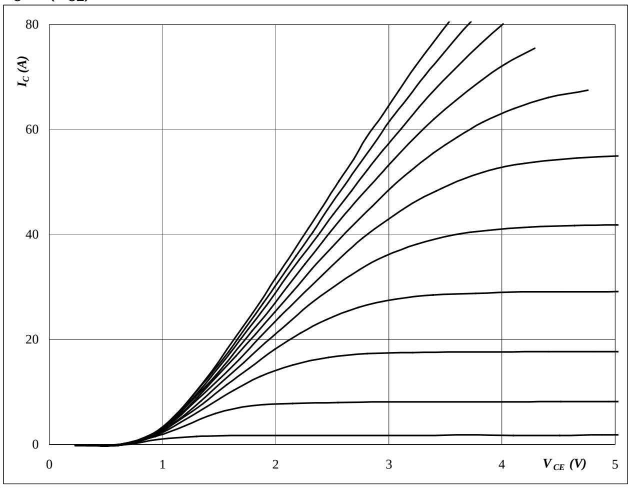
I_C =	35	A

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



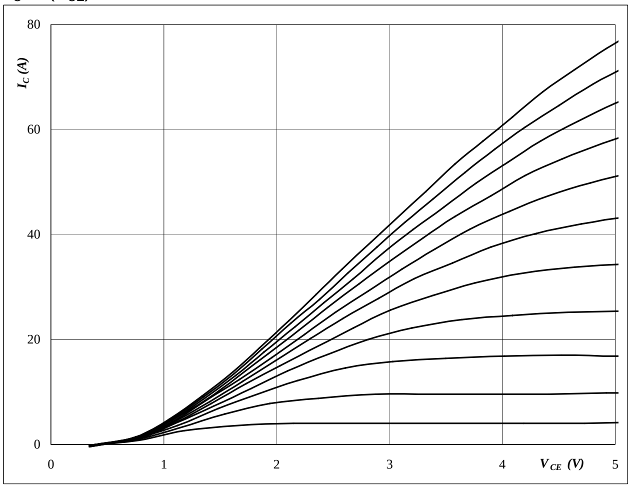
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



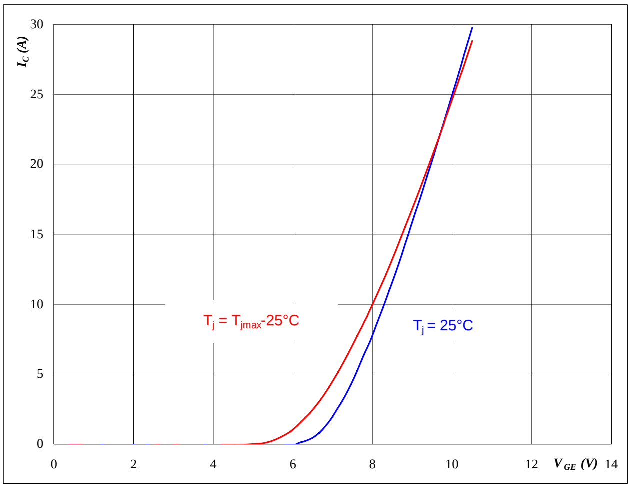
At

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



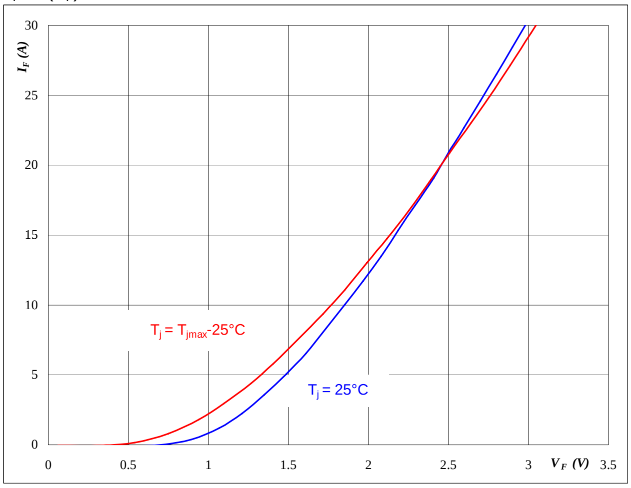
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Brake FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

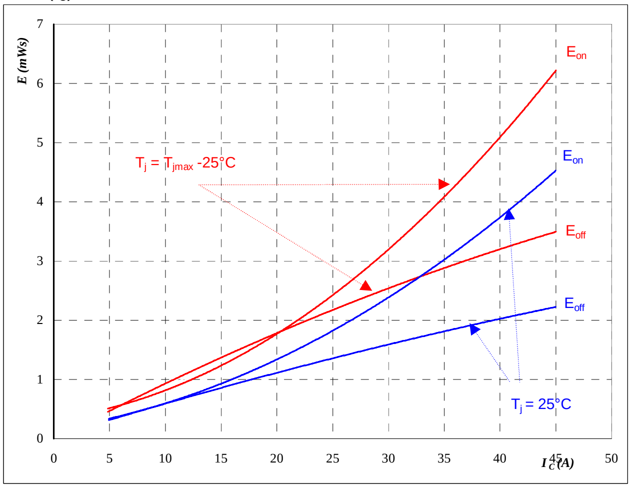
t_p =	250	μs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



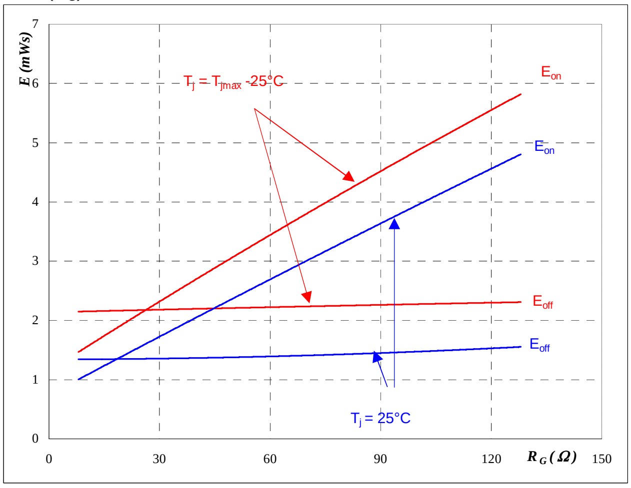
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



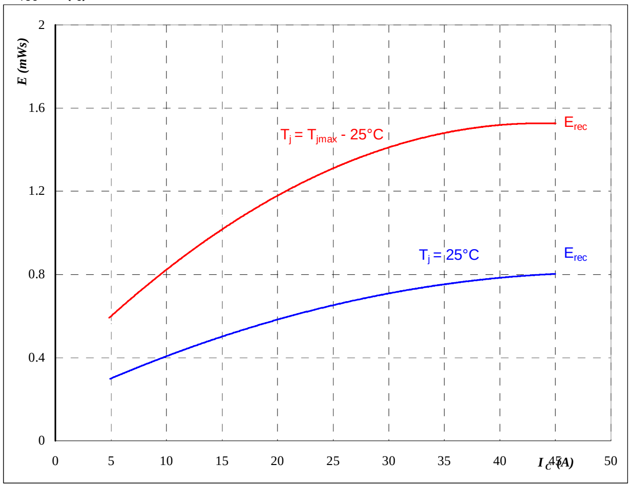
With an inductive load at

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

Figure 7 Brake IGBT

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



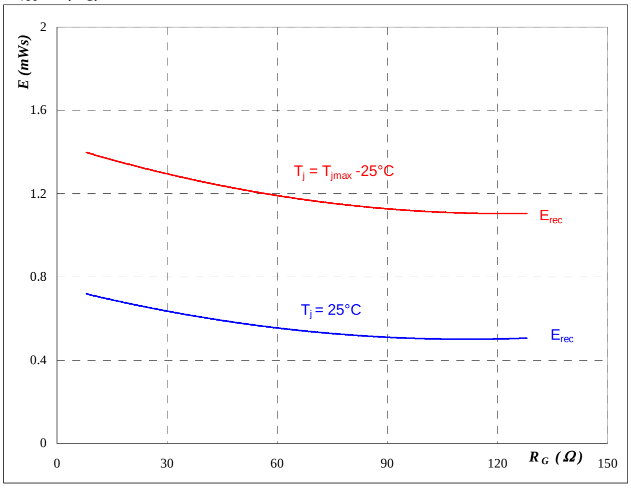
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 8 Brake IGBT

Typical reverse recovery energy loss as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

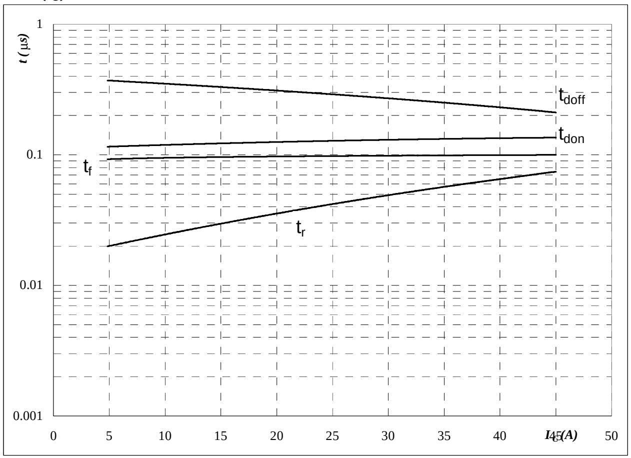
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



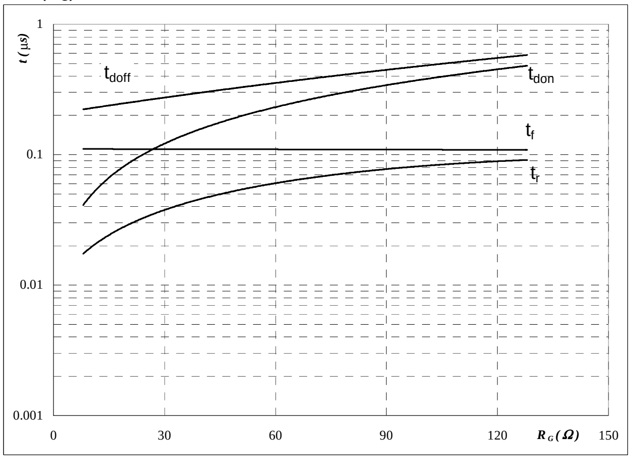
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



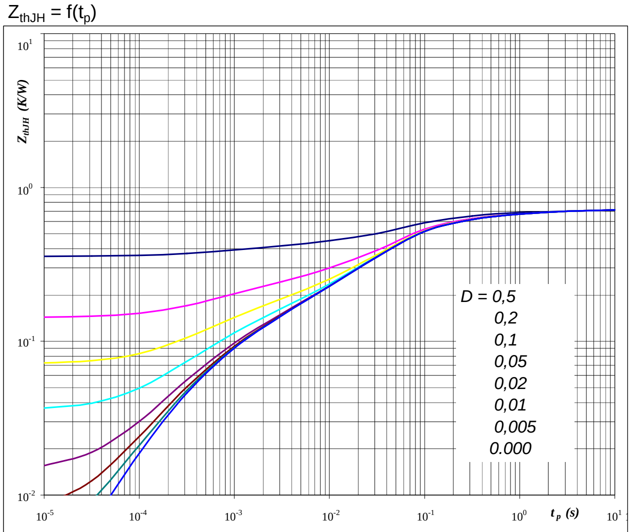
With an inductive load at

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

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



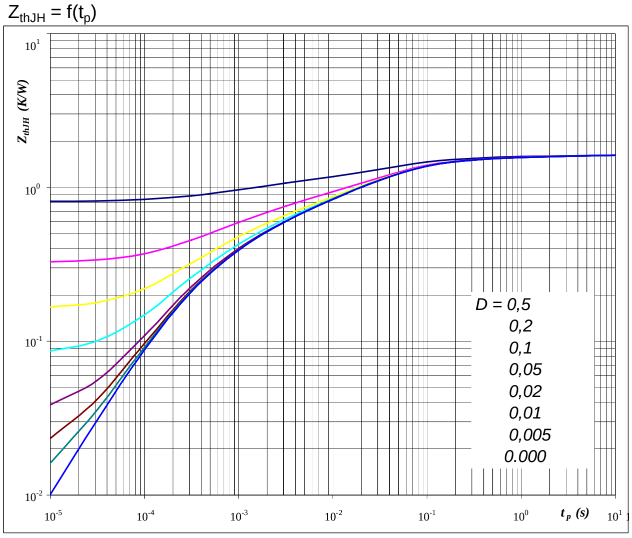
At

D =	tp / T	
R_{thJH} =	0.71	K/W

Figure 12 Brake FRED

FRED transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



At

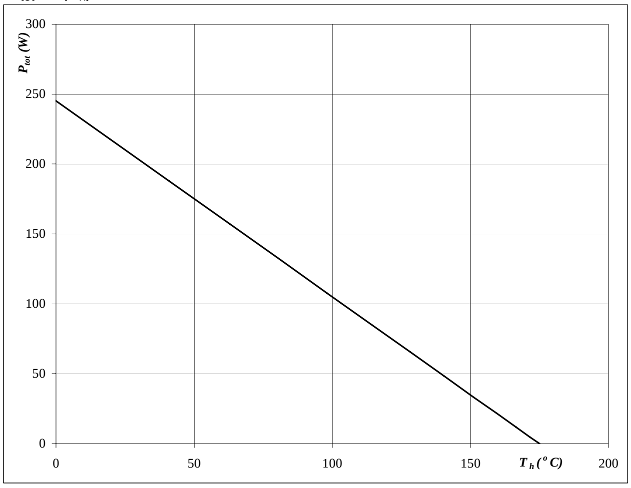
D =	tp / T	
R_{thJH} =	1.62	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



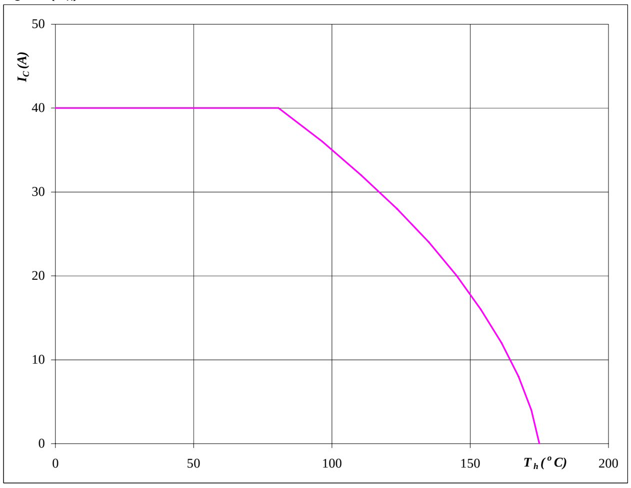
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

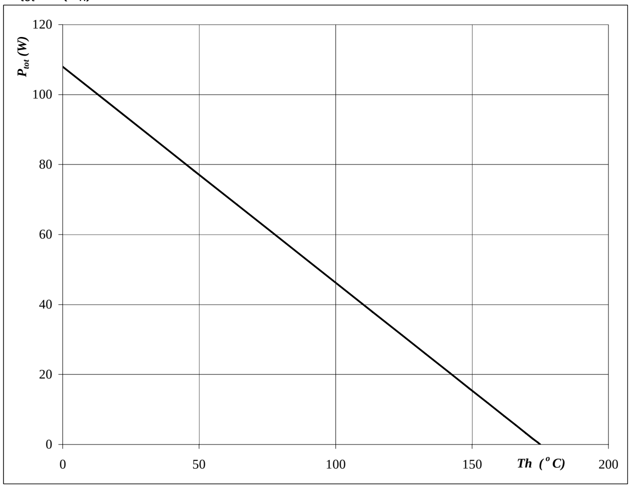
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



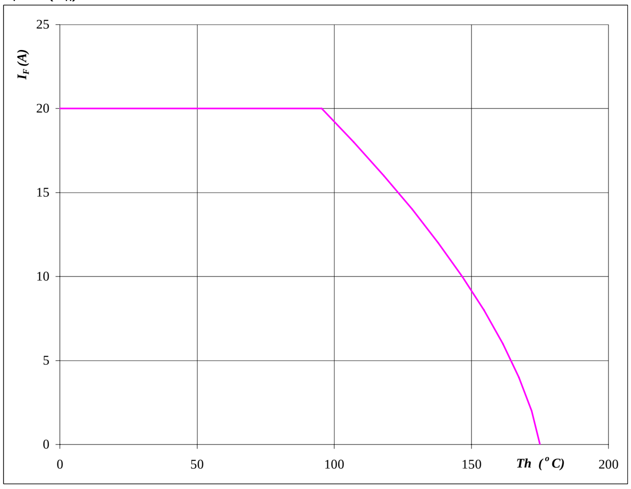
At

T_j = 175 ºC

Figure 16 Brake FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

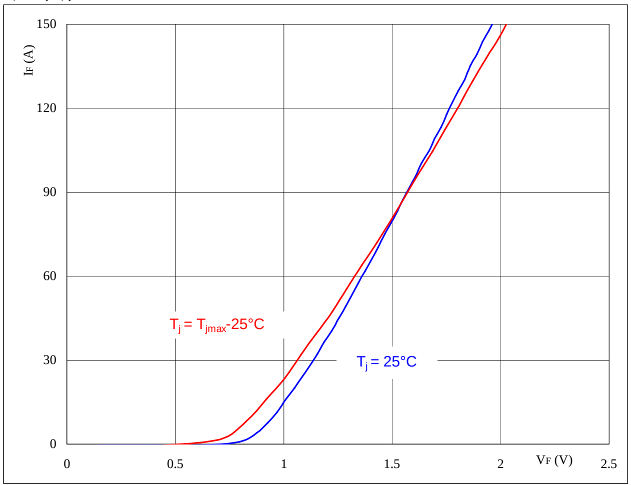
T_j = 175 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



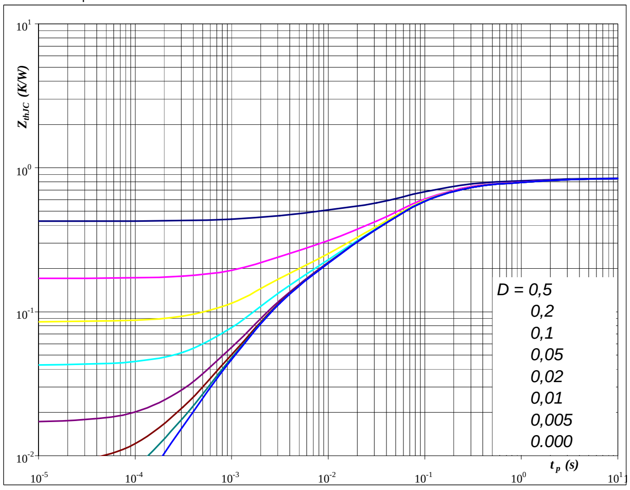
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

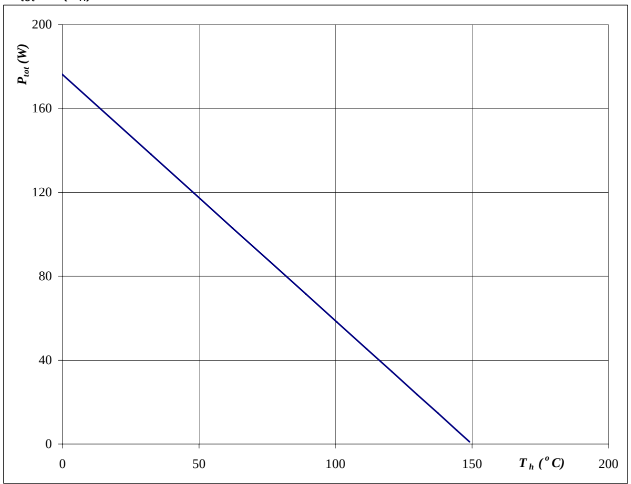
D = t_p / T

R_{thJH} = 0.851 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



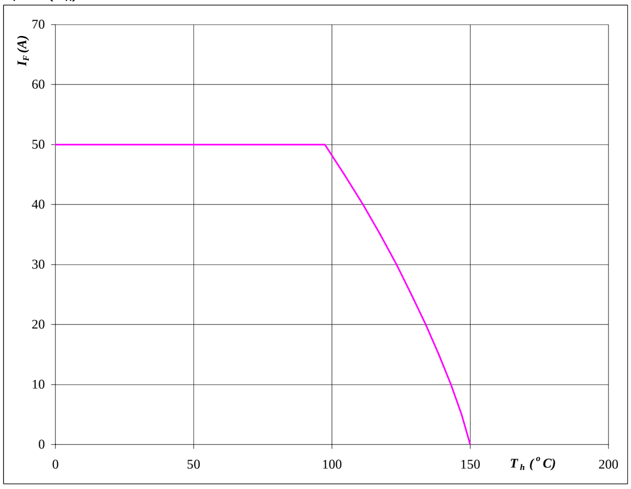
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



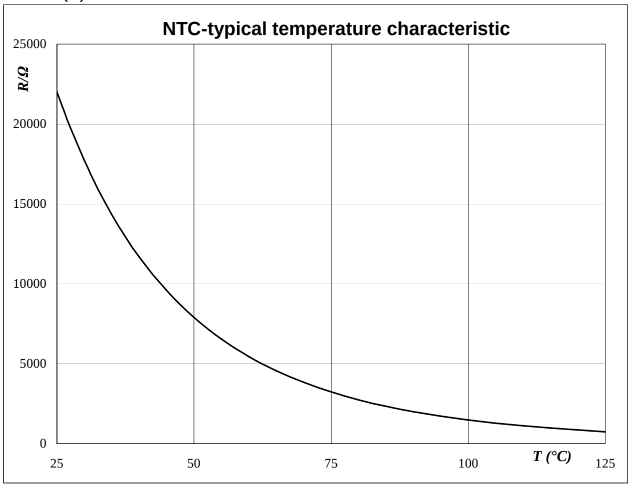
At

T_j = 150 ºC

Thermistor

Figure 1 Thermistor

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



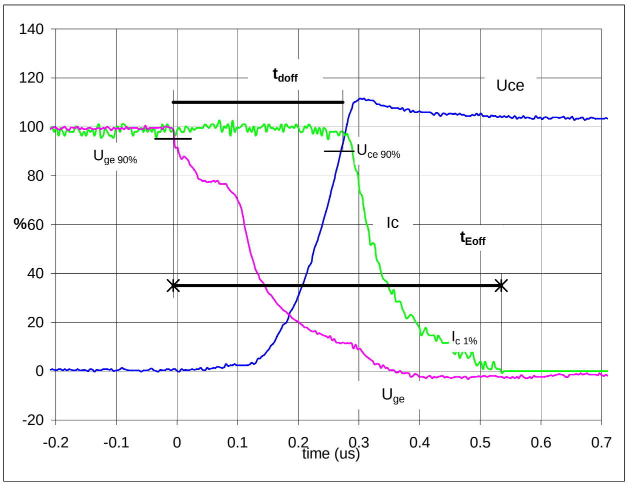
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 Output inverter IGBT

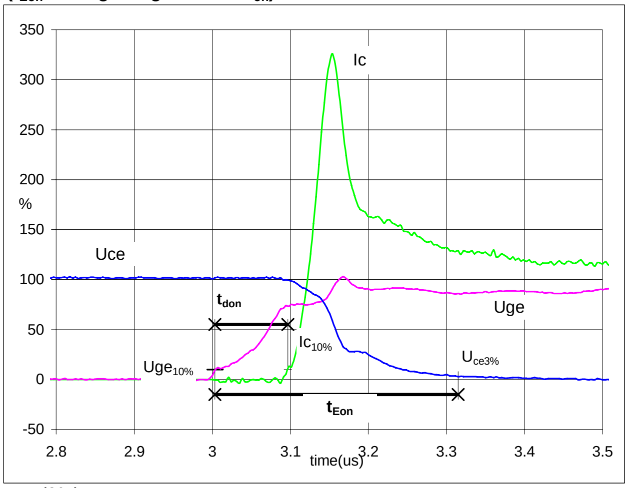
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0.27	µs
t_{Eoff} =	0.54	µs

Figure 2 Output inverter IGBT

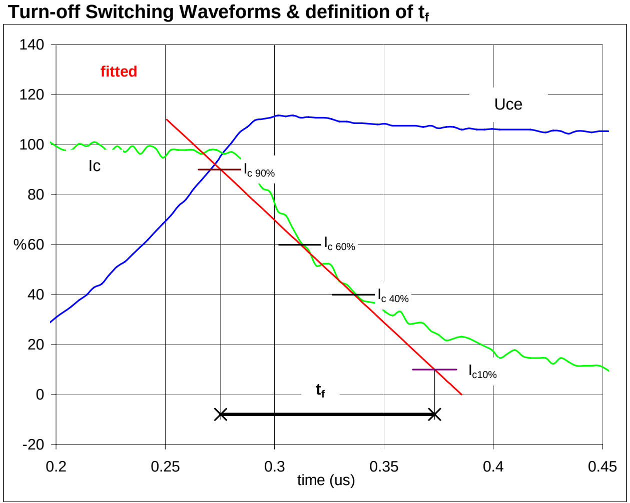
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0.09	µs
t_{Eon} =	0.31	µs

Figure 3 Output inverter IGBT

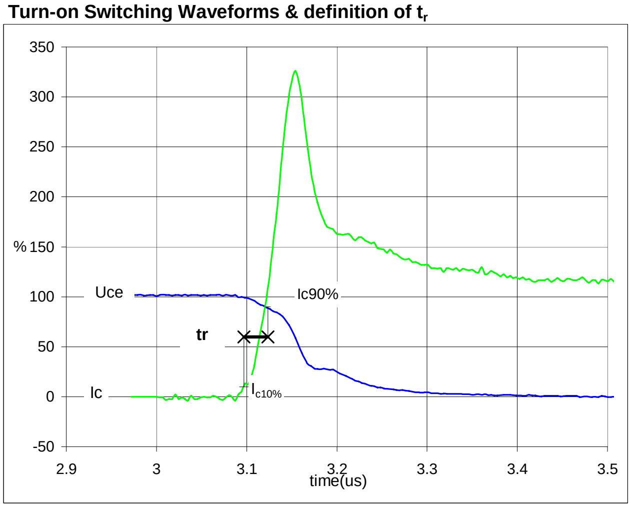
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0.11	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

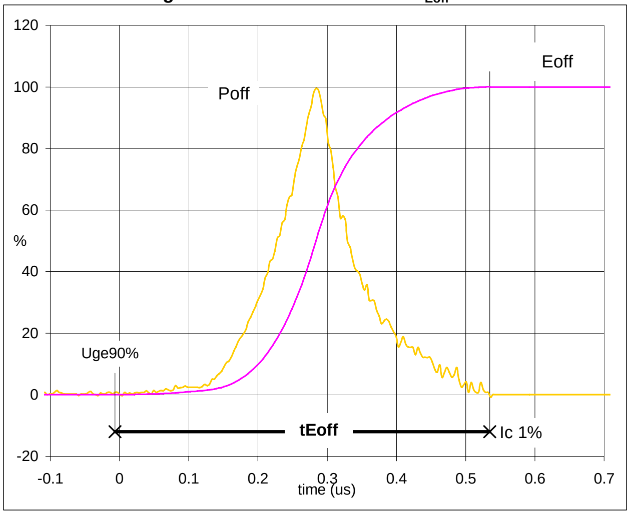


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0.02	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

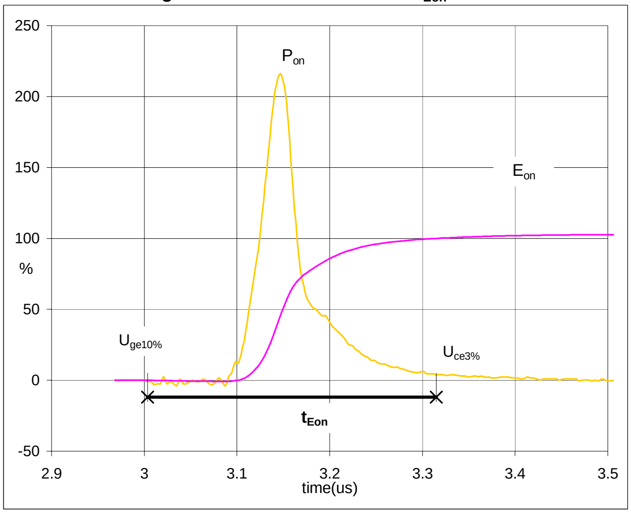
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	21.01	kW
E_{off} (100%) =	2.82	mJ
t_{Eoff} =	0.54	µs

Figure 6 Output inverter IGBT

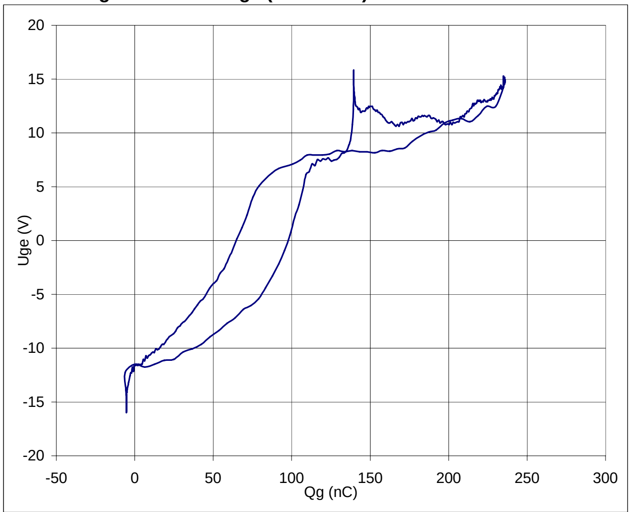
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	21.01	kW
E_{on} (100%) =	2.49	mJ
t_{Eon} =	0.31	µs

Figure 7 Output inverter FRED

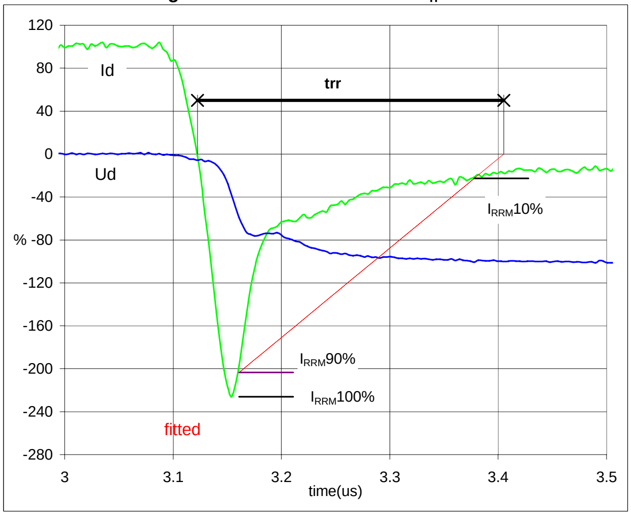
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_{C} (100%) =	600	V
I_{C} (100%) =	35	A
Q_{g} =	1239.53	nC

Figure 8 Output inverter IGBT

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

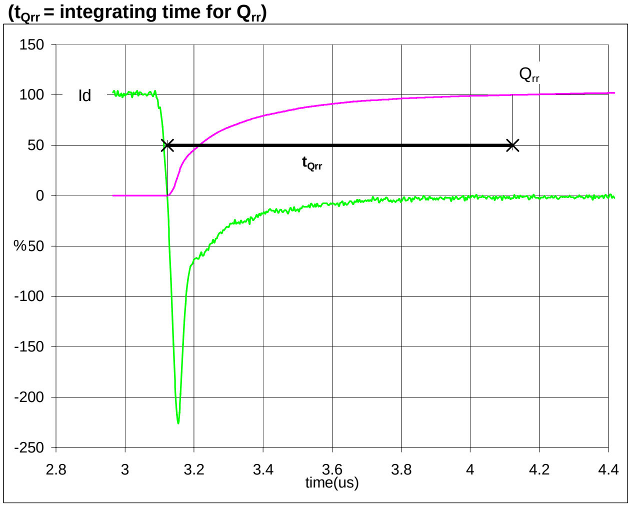


V_{d} (100%) =	600	V
I_{d} (100%) =	35	A
I_{RRM} (100%) =	-79	A
t_{rr} =	0.28	µs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

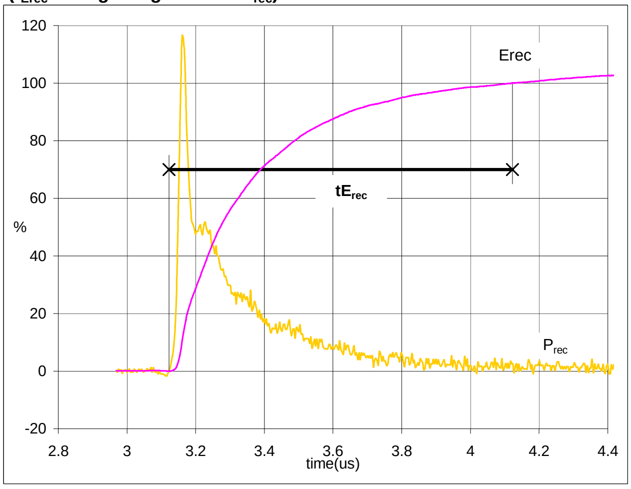
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	7.47	μC
t_{Qrr} =	1.00	μs

Figure 10 Output inverter FRED

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



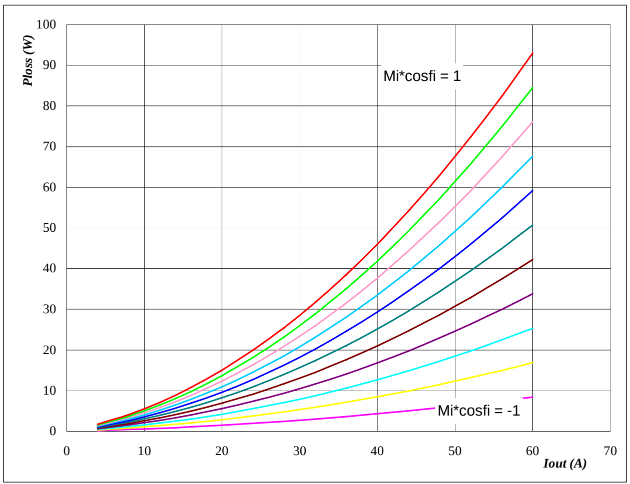
P_{rec} (100%) =	21.01	kW
E_{rec} (100%) =	3.31	mJ
t_{Erec} =	1.00	μs

General conditions

3phase SPWM		
V_{GEon}	=	15 V
V_{GEoff}	=	-15 V
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 IGBT

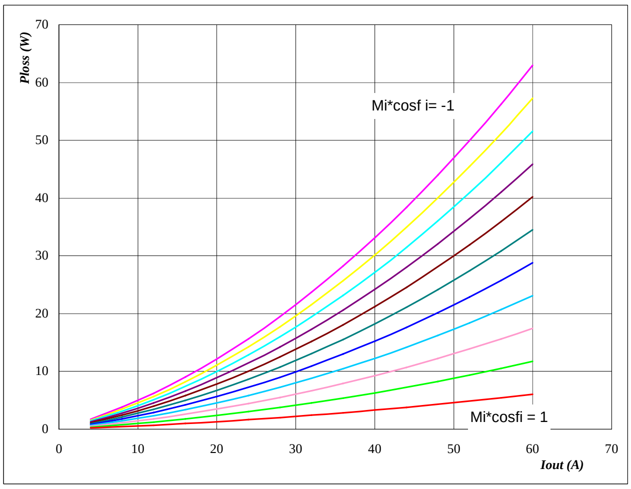
Typical average static loss as a function of output current
$P_{loss} = f(I_{out})$



At
T_j = 150 °C
Mi*cosφ from -1 to 1 in steps of 0.2

Figure 2 FRED

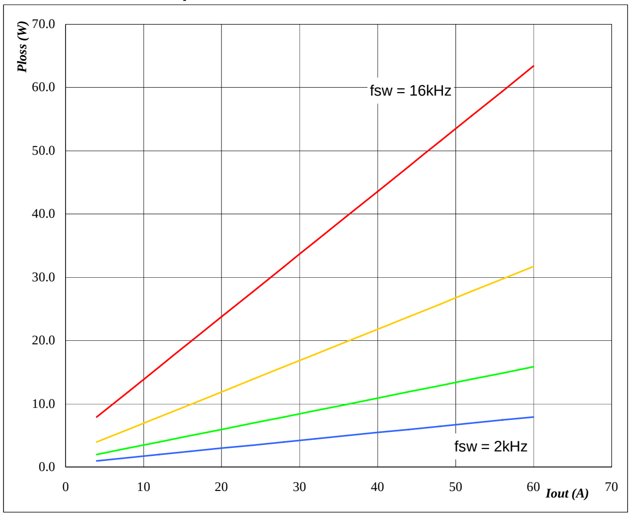
Typical average static loss as a function of output current
$P_{loss} = f(I_{out})$



At
T_j = 150 °C
Mi*cosφ from -1 to 1 in steps of 0.2

Figure 3 IGBT

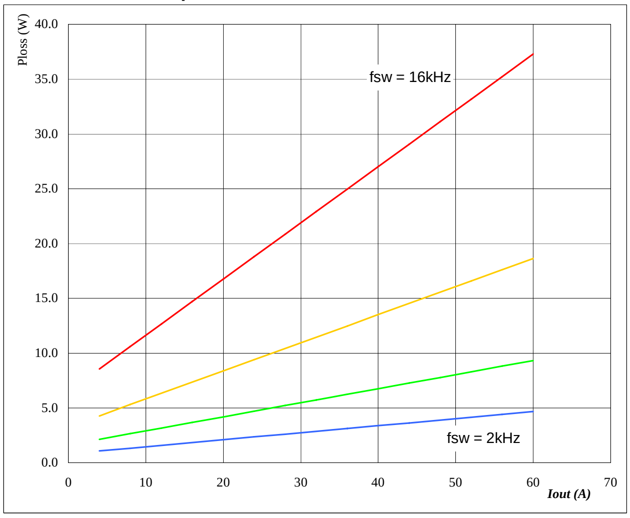
Typical average switching loss as a function of output current $P_{loss} = f(I_{out})$



At
T_j = 150 °C
DC link = 600 V
f_{sw} from 2 kHz to 16 kHz in steps of factor 2

Figure 4 FRED

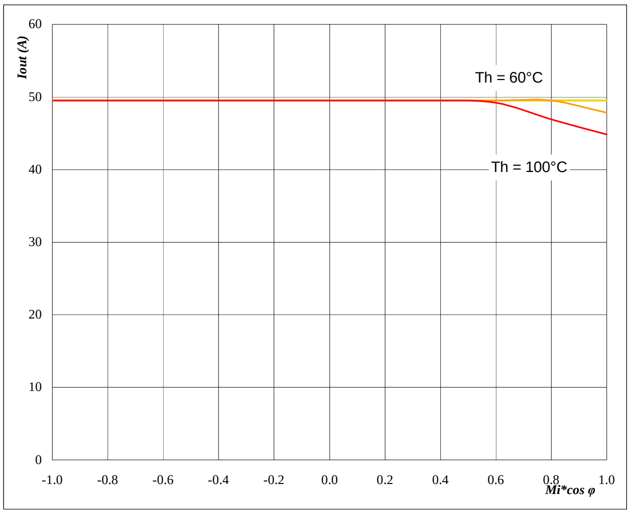
Typical average switching loss as a function of output current $P_{loss} = f(I_{out})$



At
T_j = 150 °C
DC link = 600 V
f_{sw} from 2 kHz to 16 kHz in steps of factor 2

Figure 5 Phase

Typical available 50Hz output current as a function Mi*cosφ $I_{out} = f(Mi*\cos\varphi)$

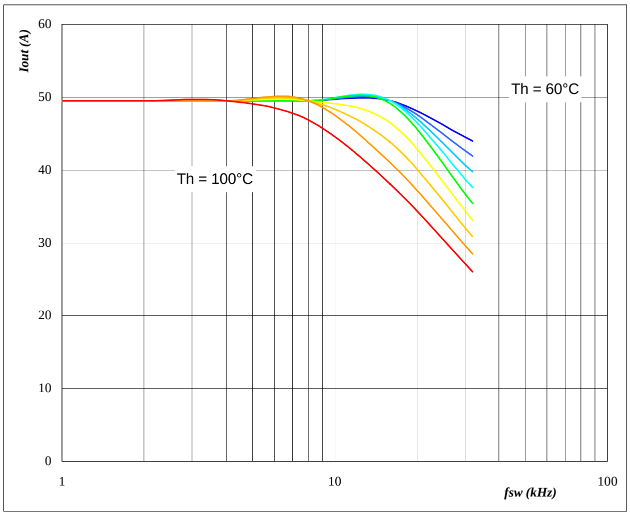


At

T_j =	150	°C
DC link =	600	V
f_{sw} =	8	kHz
T_h from	60 °C to 100 °C in steps of 5 °C	

Figure 6 Phase

Typical available 50Hz output current as a function of switching frequency $I_{out} = f(f_{sw})$

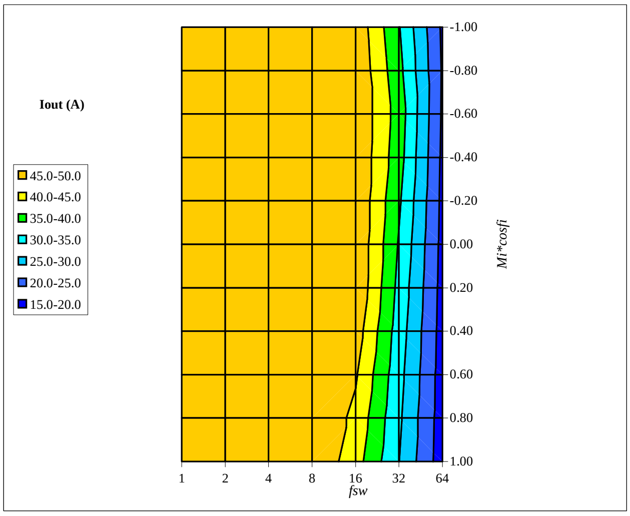


At

T_j =	150	°C
DC link =	600	V
Mi*cos φ =	0.8	
T_h from	60 °C to 100 °C in steps of 5 °C	

Figure 7 Phase

Typical available 50Hz output current as a function of Mi*cos φ and switching frequency $I_{out} = f(f_{sw}, Mi*\cos\varphi)$

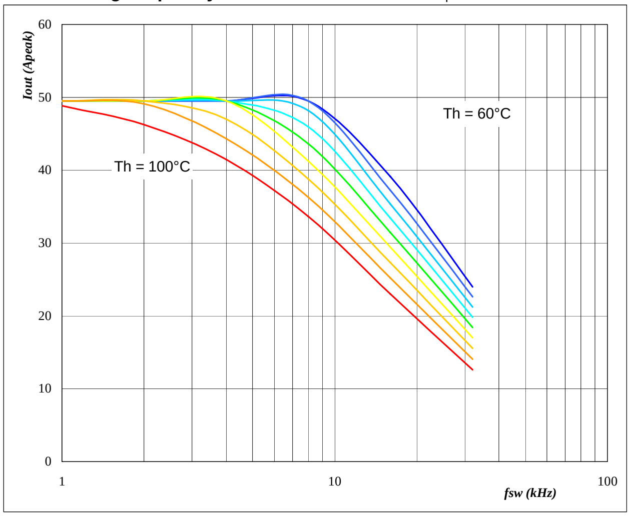


At

T_j =	150	°C
DC link =	600	V
T_h =	90	°C

Figure 8 Phase

Typical available 0Hz output current as a function of switching frequency $I_{outpeak} = f(f_{sw})$

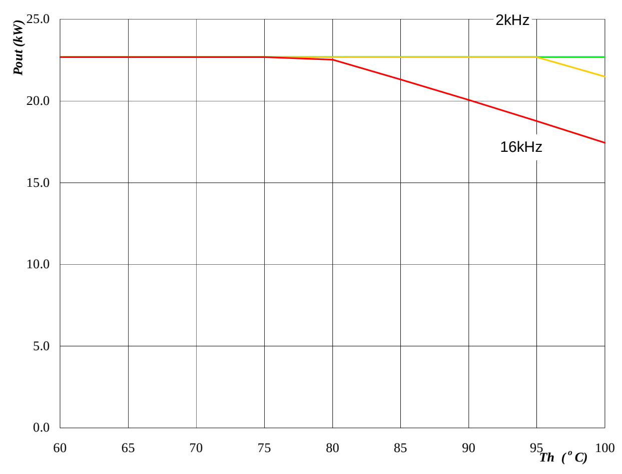


At

T_j =	150	°C
DC link =	600	V
T_h from	60 °C to 100 °C in steps of 5 °C	
Mi =	0	

Figure 9 Inverter

Typical available peak output power as a function of heatsink temperature $P_{out}=f(T_h)$

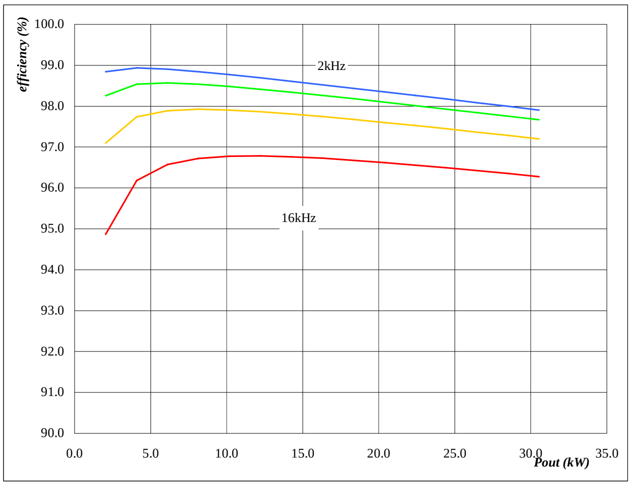


At

T_j = 150 °C
DC link = 600 V
Mi = 1
cos φ= 0.80
f_{sw} from 2 kHz to 16 kHz in steps of factor 2

Figure 10 Inverter

Typical efficiency as a function of output power
efficiency=f(P_{out})

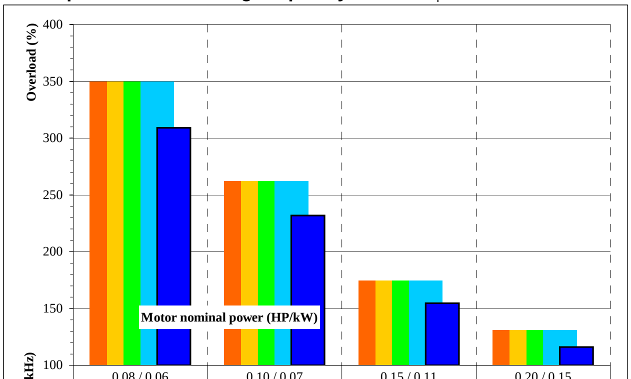


At

T_j = 150 °C
DC link = 600 V
Mi = 1
cos φ= 0.80
f_{sw} from 2 kHz to 16 kHz in steps of factor 2

Figure 11 Inverter

Typical available overload factor as a function of motor power and switching frequency $P_{peak} / P_{nom}=f(P_{nom},f_{sw})$



Switching frequency (kHz)	0,08 / 0,06	0,10 / 0,07	0,15 / 0,11	0,20 / 0,15
1	349	262	175	131
2	349	262	175	131
4	349	262	175	131
8	349	262	175	131
16	309	232	155	116

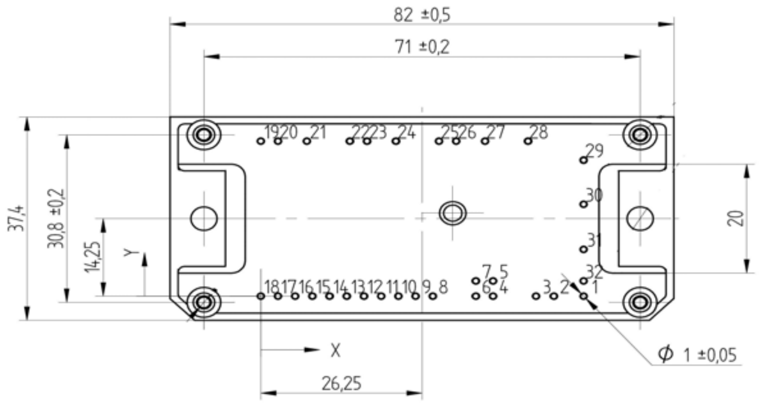
At

T_j = 150 °C
DC link = 600 V
Mi = 1
cos φ= 0.8
f_{sw} from 1 kHz to 16kHz in steps of factor 2
T_h = 90 °C
Motor eff = 0.85

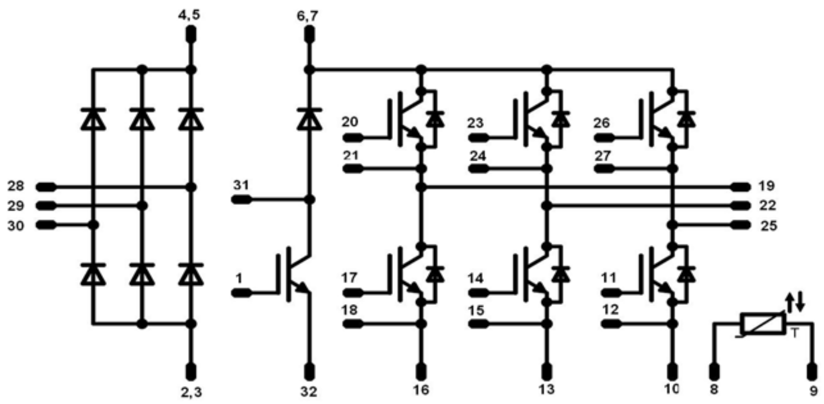
Package Outline and Pinout

Outline

Pin	X	Y
1	52,55	0
2	47,7	0
3	44,8	0
4	37,8	0
5	37,8	2,8
6	35	0
7	35	2,8
8	28	0
9	25,2	0
10	22,4	0
11	19,6	0
12	16,8	0
13	14	0
14	11,2	0
15	8,4	0
16	5,6	0
17	2,8	0
18	0	0
19	0	28,5
20	2,8	28,5
21	7,5	28,5
22	14,5	28,5
23	17,3	28,5
24	22	28,5
25	29	28,5
26	31,8	28,5
27	36,5	28,5
28	43,5	28,5
29	52,55	25
30	52,55	16,9
31	52,55	8,6
32	52,55	2,8



Pinout



PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.