MiniSKiiP® 1 PIM — 1200V / 8A

Features

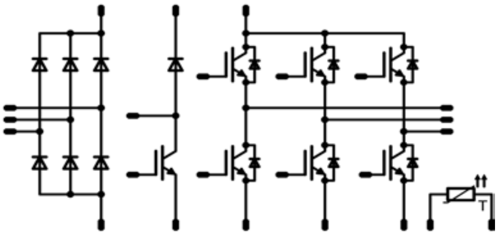
- Solderless interconnection
- Trench Fieldstop IGBT4 technology

MiniSKiiP® 1 housing

Target Applications

- Industrial Motor Drives

Schematic



Types

- V23990-K209-A40-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
DC forward current	I_{FAV}	$T_j=T_j max$	T_h=80°C	27	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	220	A
I^2t-value	I^2t			240	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_j max$	T_h=80°C	41	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	13	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j max$		24	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j max$	T_h=80°C	47	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

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Repetitive peak reverse voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	11	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		24	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C	31	W
Maximum Junction Temperature	$T_j$max			175	°C
Brake Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C	13	A
Repetitive peak collector current	I_{Cpuls}	t_p limited by $T_j$max		24	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C	44	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
Brake Diode					
Repetitive peak reverse voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C	12	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		24	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C	33	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				15	Tj=25°C Tj=125°C	1	1.07 0.98	1.75	V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0.85 0.73		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		0.027 0.031		Ω
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0.1 1.1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ=0.61W/mK						1.71		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0.0003	Tj=25°C Tj=150°C	5	5.8	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		8	Tj=25°C Tj=150°C	1.6	2.01 2.38	2.5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0.06	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			180	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=64Ω Rgon=64Ω	±15	600	8	Tj=25°C Tj=150°C		115 126		ns
Rise time	t_r					Tj=25°C Tj=150°C		33 39		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		225 290		
Fall time	t_f					Tj=25°C Tj=150°C		89 130		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0.56 0.88		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0.48 0.77		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		490		pF
Output capacitance	C_{oss}							50		
Reverse transfer capacitance	C_{rss}							30		
Gate charge	Q_{Gate}	Vcc=960V	15		8	Tj=25°C		53		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ=0.61W/mK						2.01		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Inverter Diode										
Diode forward voltage	V_F				8	Tj=25°C Tj=150°C	1.5	2.37 2.28	2.9	V
Peak reverse recovery current	I_{RRM}	Rgoff=64Ω	±15	600	8	Tj=25°C Tj=150°C		4.49 6.2		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		362 574		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0.61 1.47		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		31 22		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0.24 0.62		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50µm λ=0.61W/mK						3.1		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		

Characteristic Values

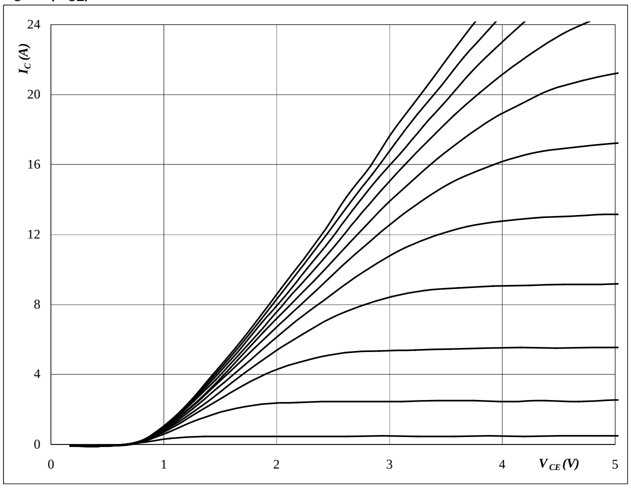
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Brake Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0.0003	Tj=25°C Tj=150°C	5	5.8	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		8	Tj=25°C Tj=150°C	1.6	2.01 2.38	2.5	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0.06	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			180	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=64Ω Rgoff=64Ω	±15	600	8	Tj=25°C Tj=150°C		114 116		ns
Rise time	t_r					Tj=25°C Tj=150°C		32 38		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		221 279		
Fall time	t_f					Tj=25°C Tj=150°C		93 134		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0.52 0.84		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0.49 0.78		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		490		pF
Output capacitance	C_{oss}							50		
Reverse transfer capacitance	C_{rss}							30		
Gate charge	Q_{Gate}	Vcc=960V	15		8	Tj=25°C		53		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50μm λ=0.61W/mK						2.14		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Brake Diode										
Diode forward voltage	V_F				8	Tj=25°C Tj=150°C	1.5	2.47 2.3	2.9	V
Reverse leakage current	I_r		±15	600	8	Tj=25°C Tj=150°C			60 700	μA
Peak reverse recovery current	I_{RRM}	Rgon=64Ω	±15	600	8	Tj=25°C Tj=150°C		4.46 6.38		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		315 570		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0.56 1.44		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		31 25		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		0.23 0.61		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50μm λ=0.61W/mK						2.86		K/W
Thermal resistance chip to case per chip	R_{thJC}							N/A		
Thermistor										
Rated resistance	R					Tj=25°C Tj=150°C	0.97	1 2.23	1.03	kΩ
Temperature coefficient	a					Tj=25°C		0.76		%/K
Recommended measuring current	I					Tj=25°C		1	3	mA

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



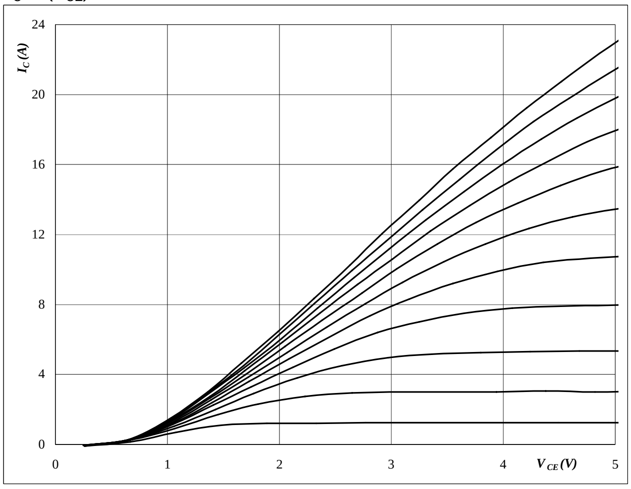
At

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

$I_C = f(V_{CE})$



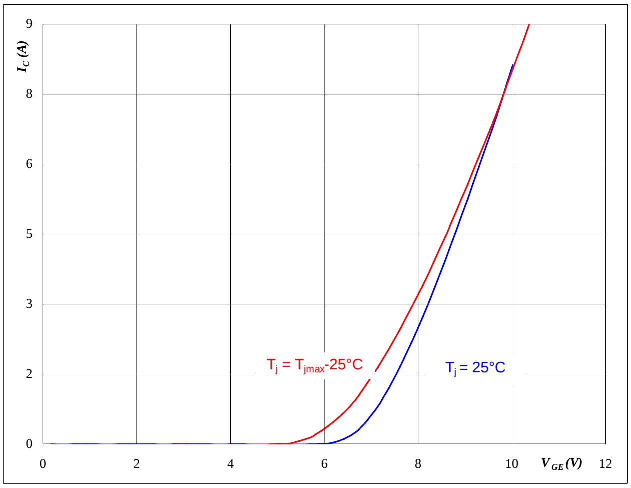
At

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

$I_C = f(V_{GE})$



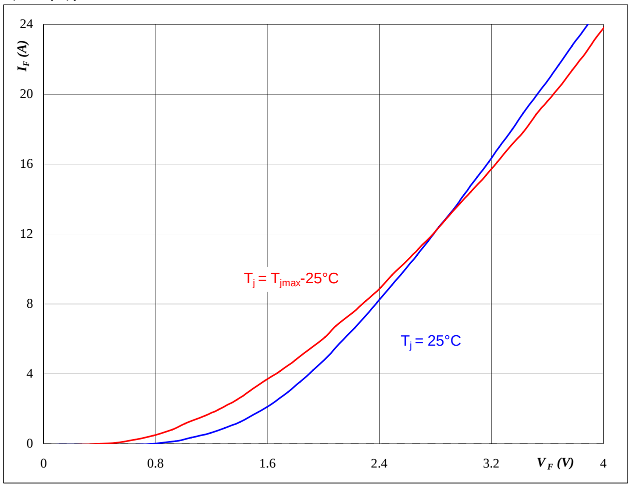
At

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

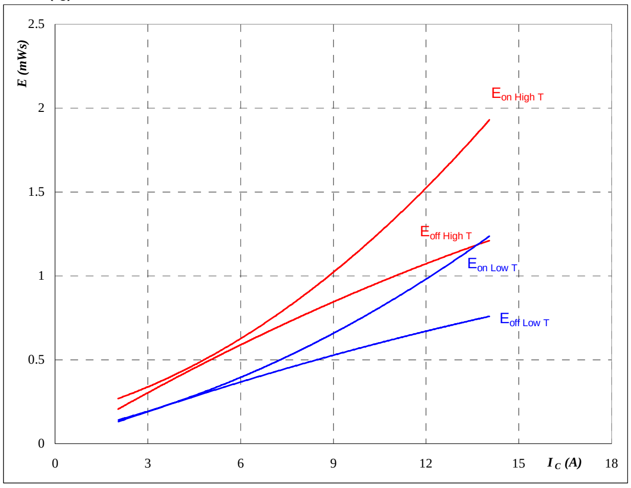
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



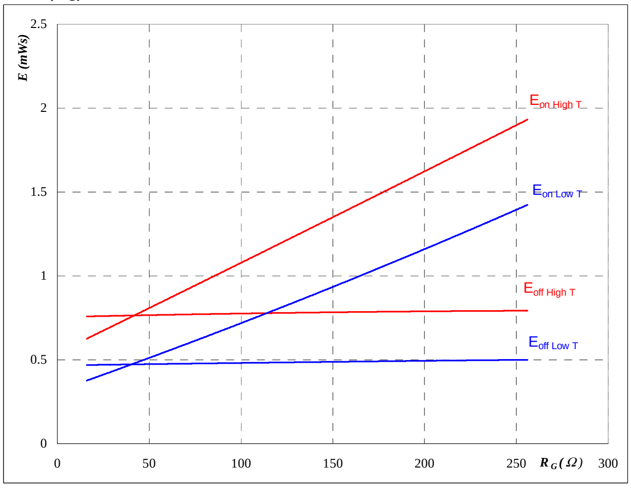
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



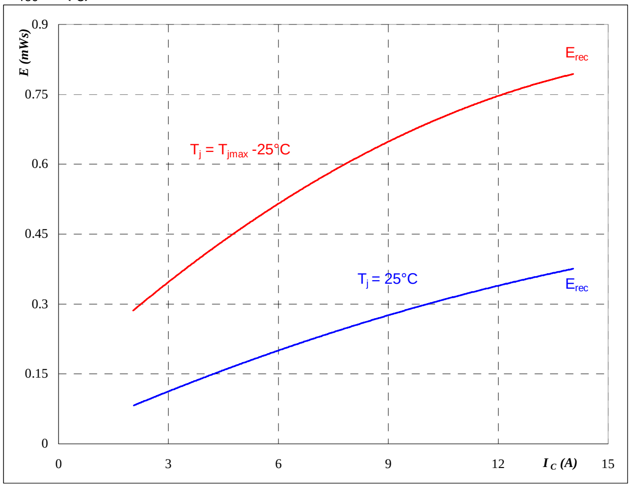
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



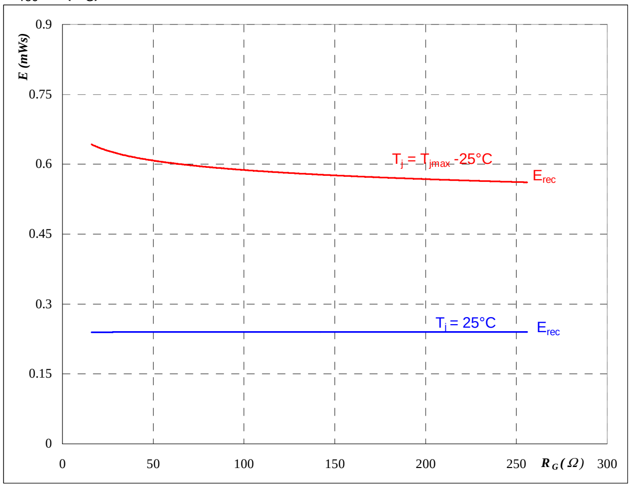
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

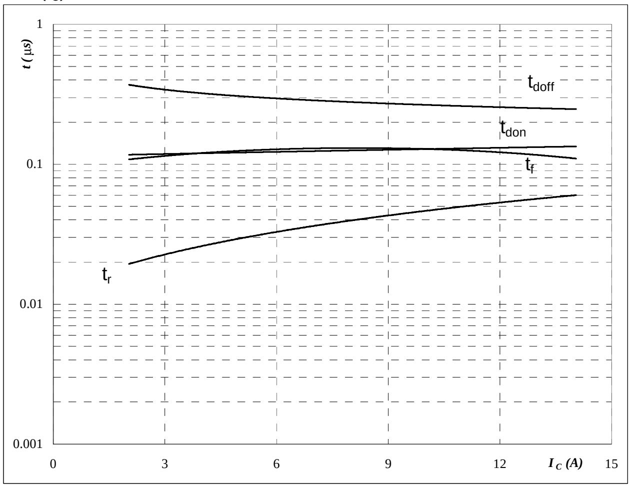
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



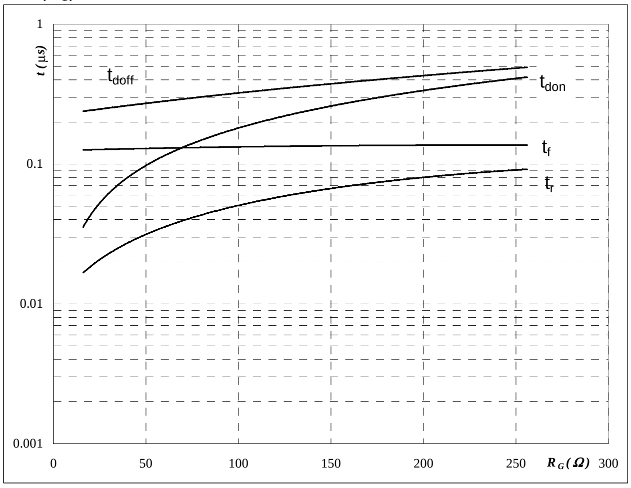
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



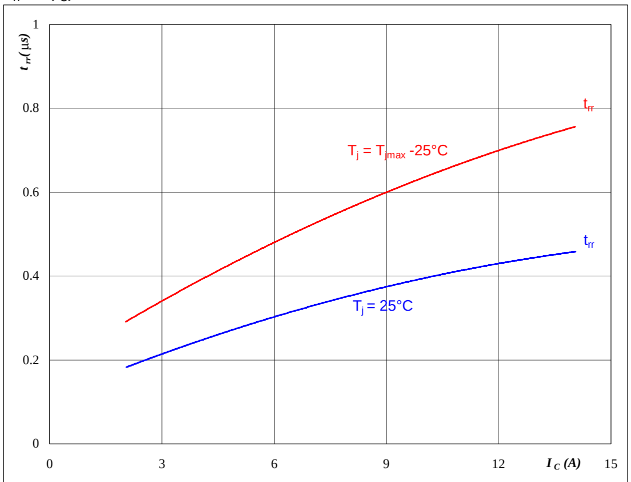
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



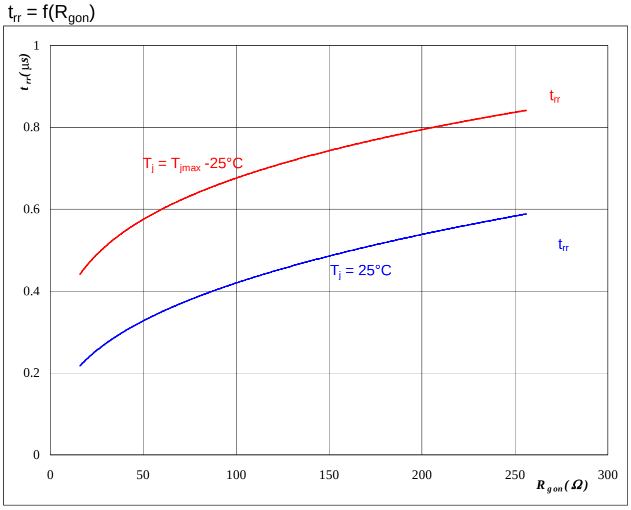
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

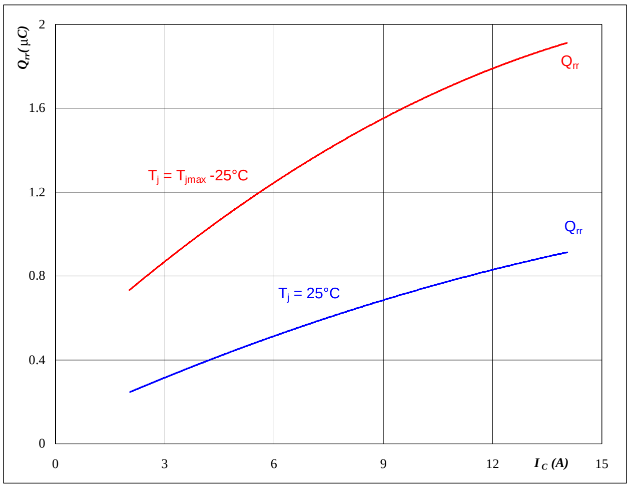
T_j =	25/150	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



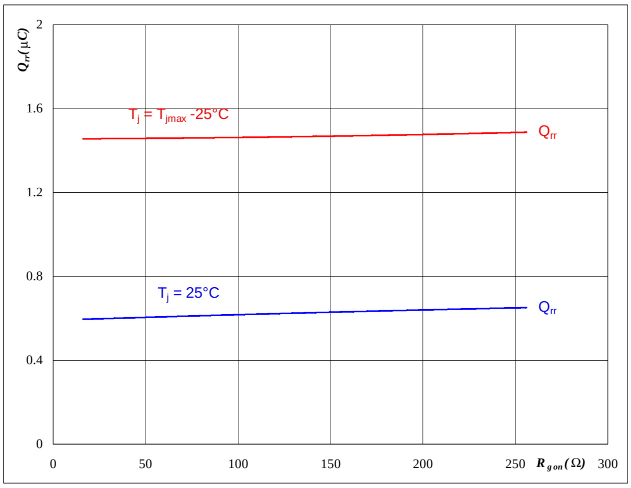
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

Figure 14 Output inverter FRED

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

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



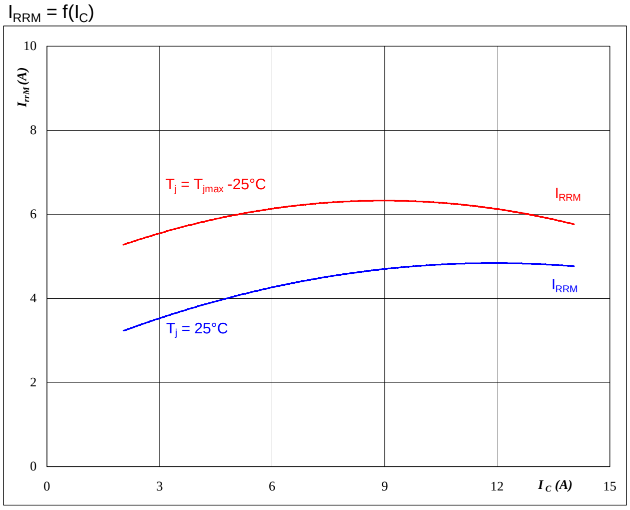
At

T_j =	25/150	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



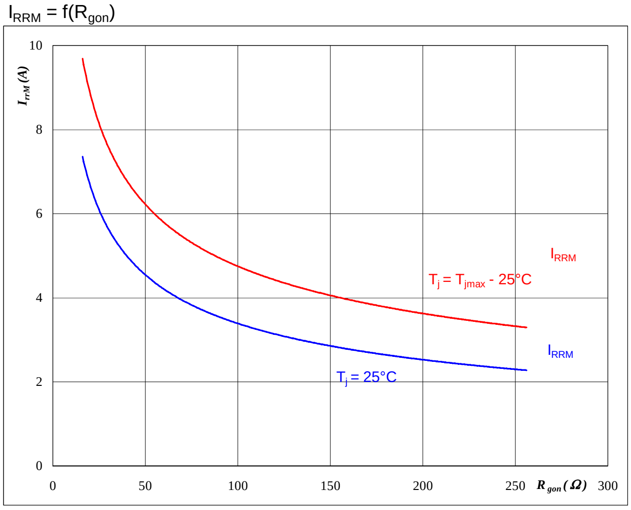
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

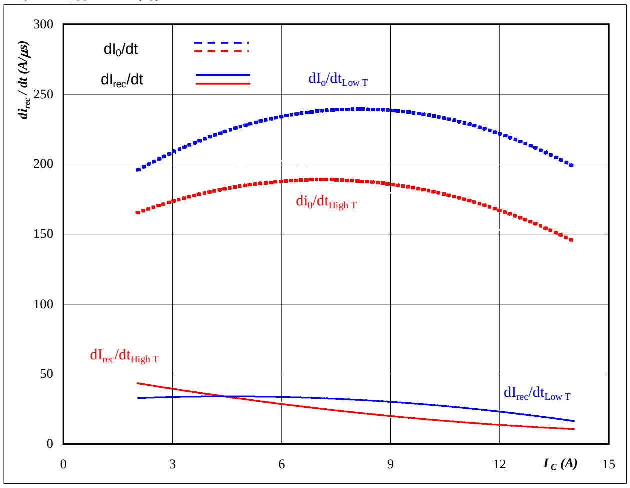
T_j =	25/150	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

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

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



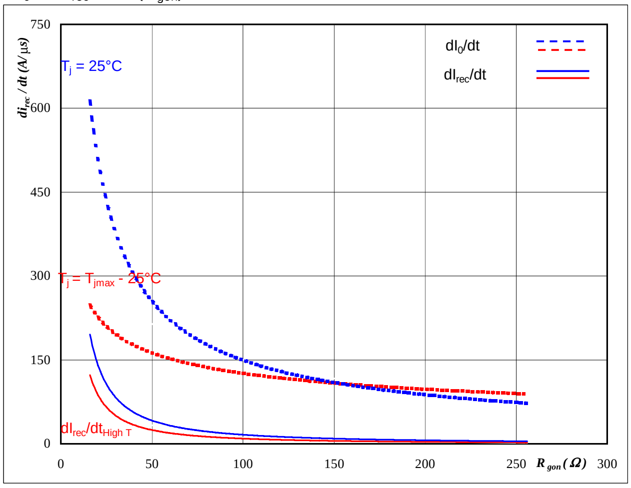
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

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



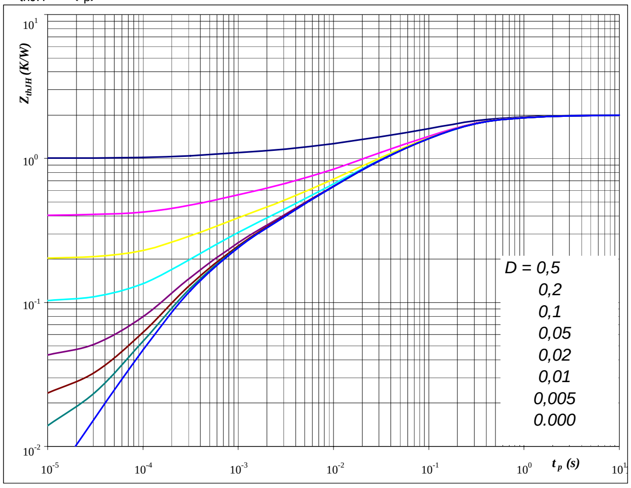
At

T_j =	25/150	°C
V_R =	600	V
I_F =	8	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} =	2.01	K/W

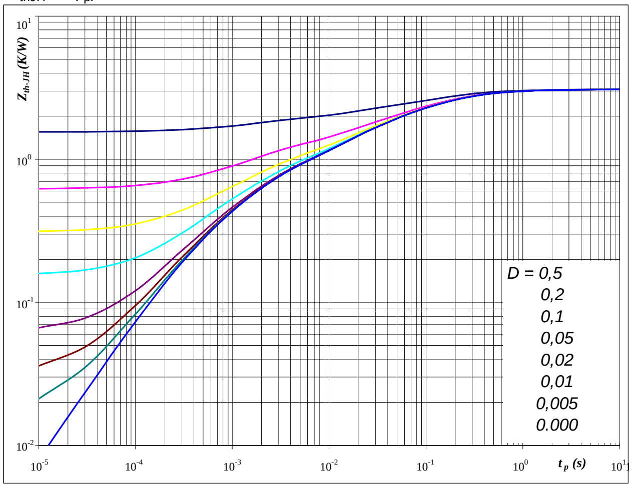
IGBT thermal model values

R (C/W)	Tau (s)
0.05	7.7E+00
0.29	5.4E-01
0.84	1.1E-01
0.47	1.7E-02
0.21	2.6E-03
0.15	3.6E-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} =	3.10	K/W

FRED thermal model values

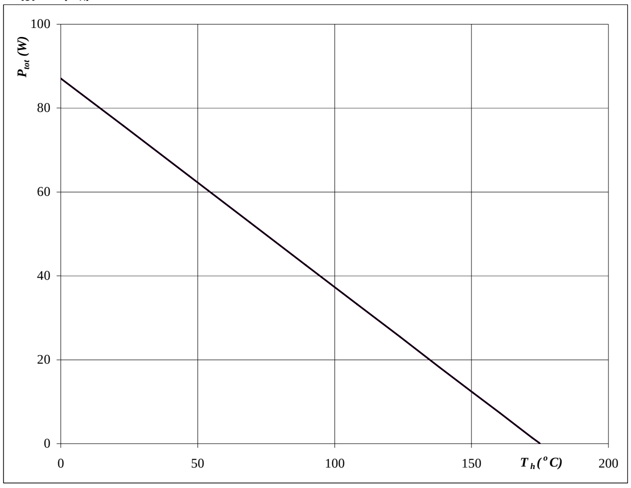
R (C/W)	Tau (s)
0.08	9.0E+00
0.49	4.4E-01
1.25	7.9E-02
0.67	1.2E-02
0.50	1.4E-03
0.11	2.9E-04

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

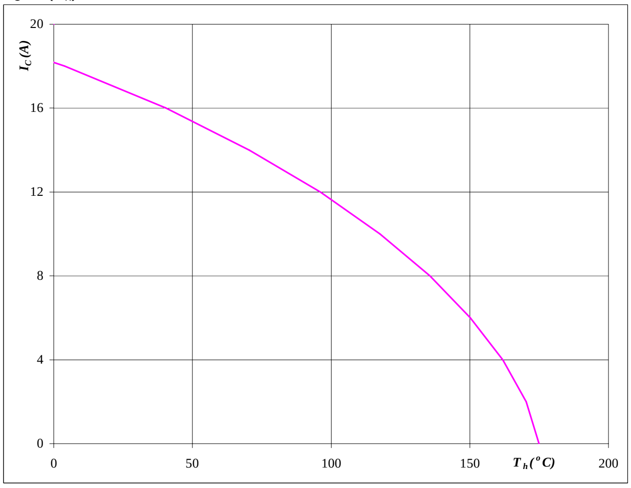
single heating

overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

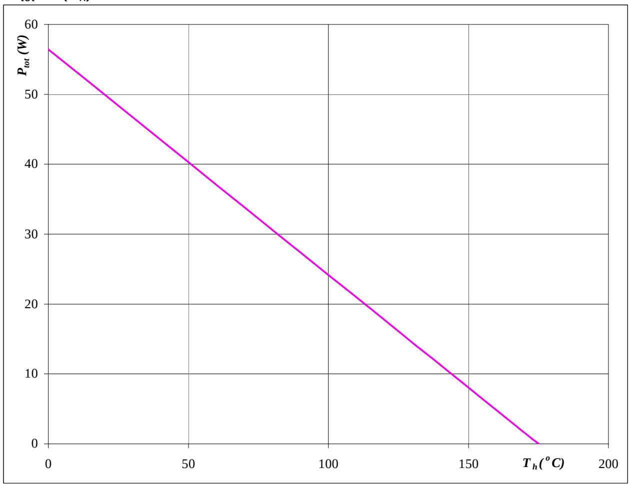
T_j = 175 °C

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

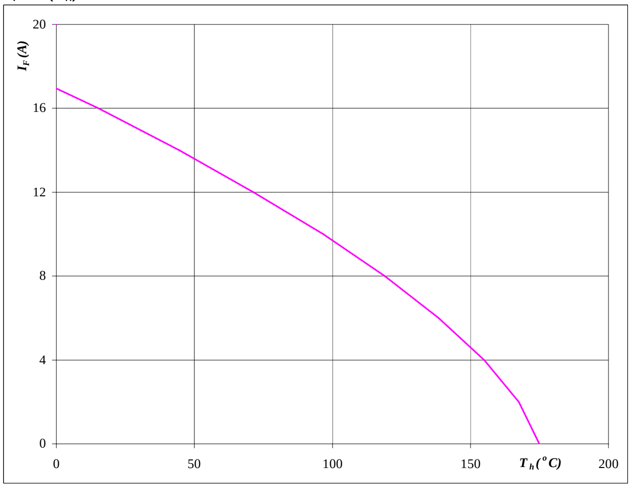
single heating

overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

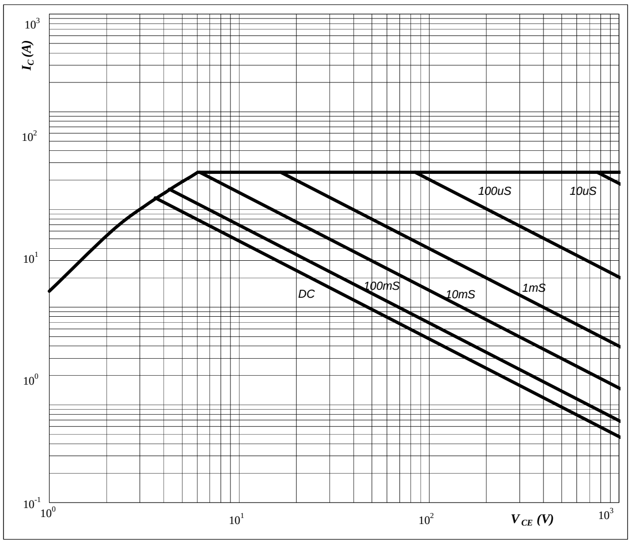
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



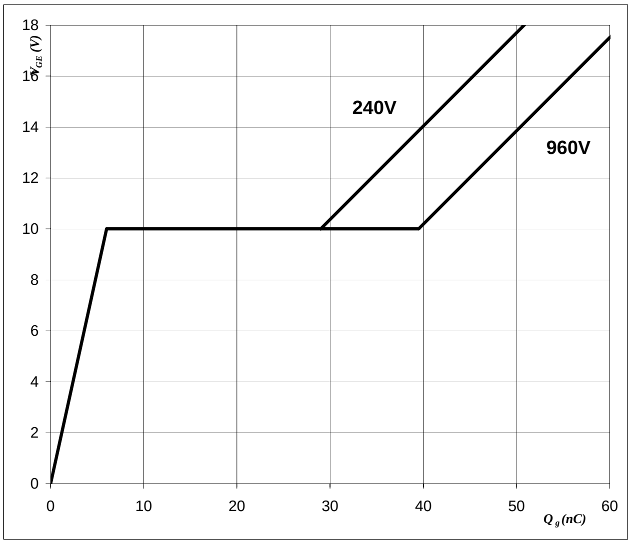
At

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

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_{GE})$



At

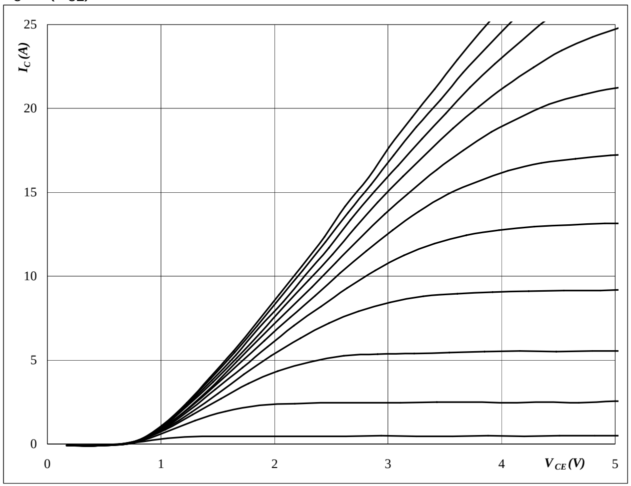
I_C =	8	A

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

$t_p =$ 250 µs

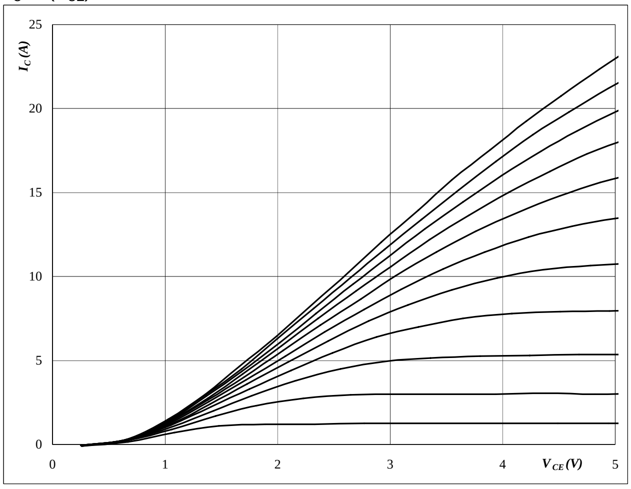
$T_j =$ 25 °C

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

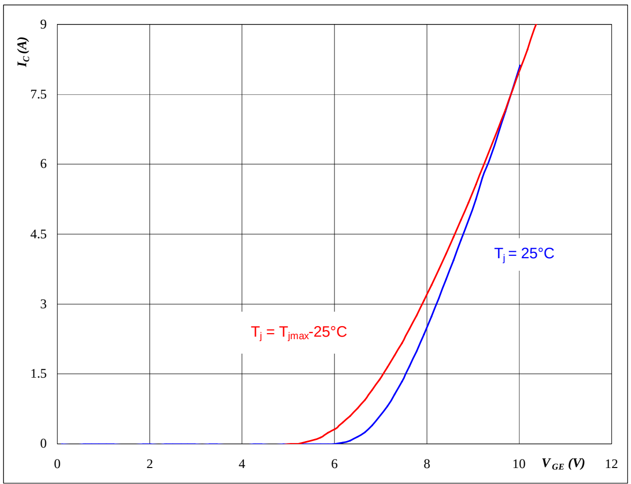
$T_j =$ 150 °C

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

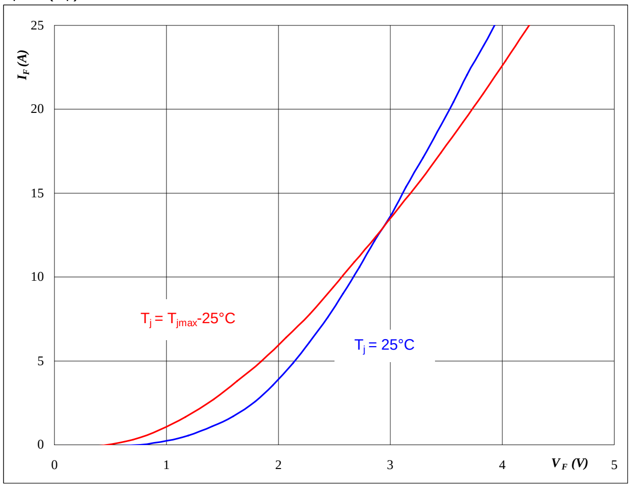
$t_p =$ 250 µs

$V_{CE} =$ 10 V

Figure 4 Brake FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

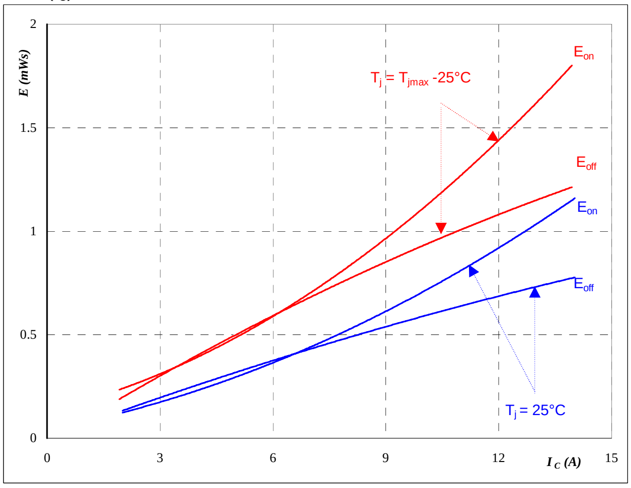
$t_p =$ 250 µs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



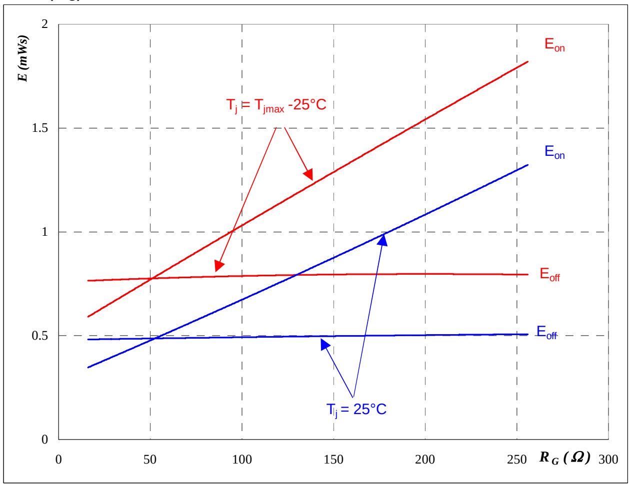
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



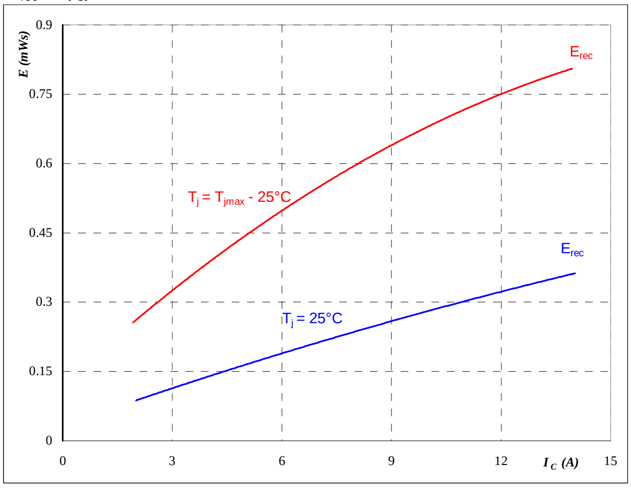
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 7 Brake IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



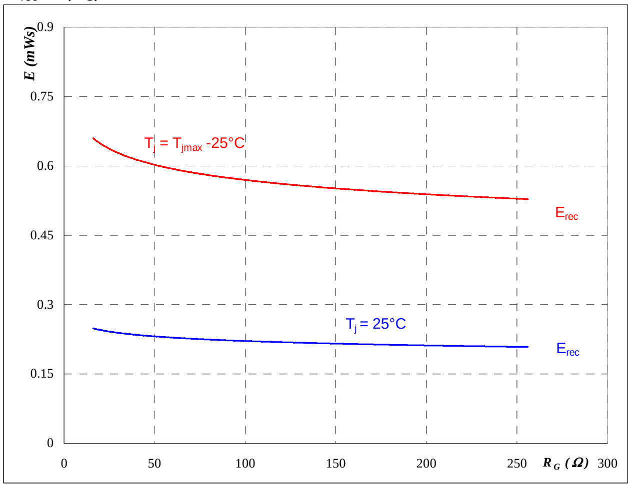
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

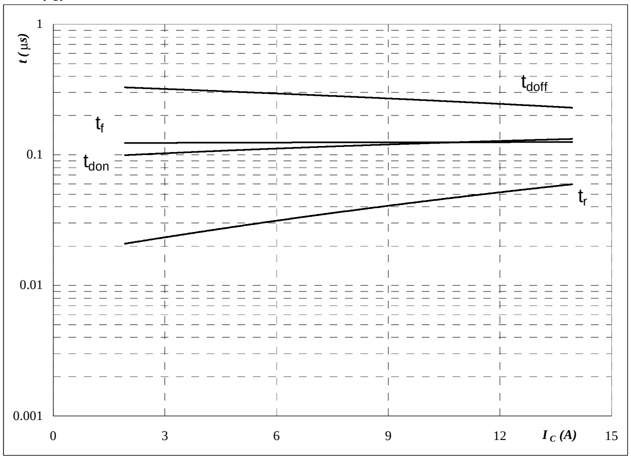
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Brake

Figure 9 Brake IGBT

Typical switching times as a function of collector current

t = f(I_C)



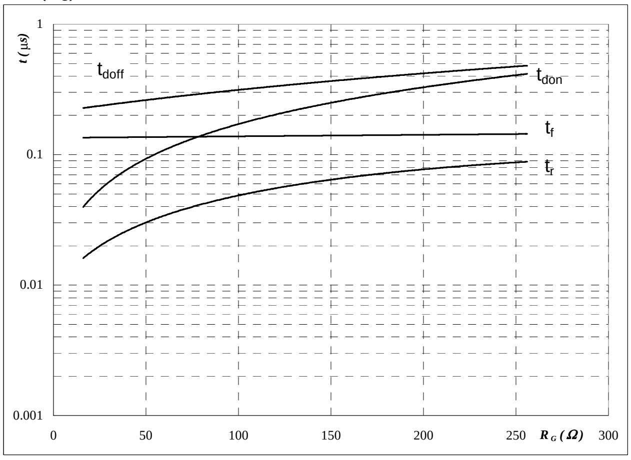
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 10 Brake IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



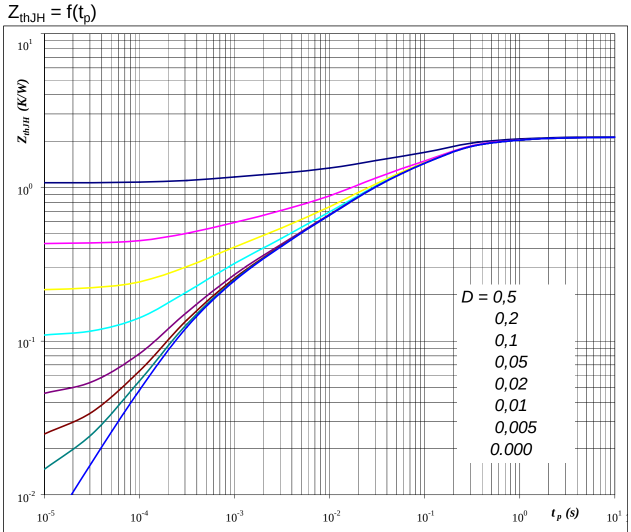
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



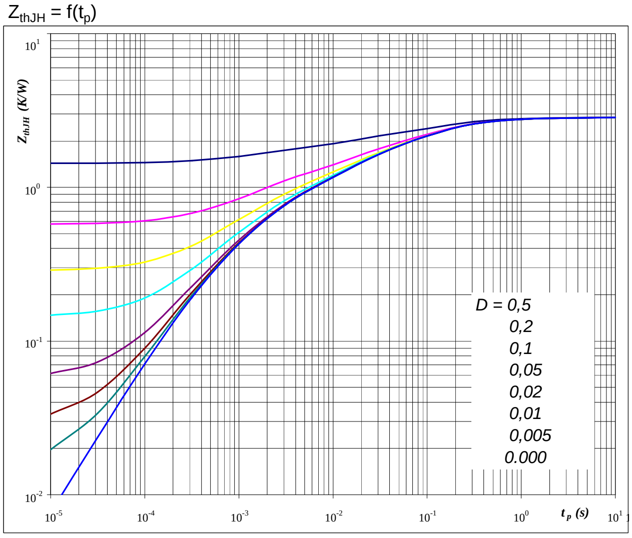
At

D =	tp / T	
R_{thJH} =	2.14	K/W

Figure 12 Brake FRED

FRED transient thermal impedance as a function of pulse width

Z_{thJH} = f(t_p)



At

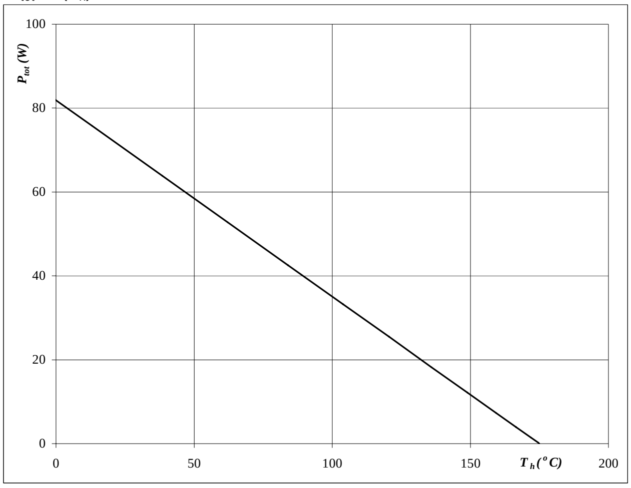
D =	tp / T	
R_{thJH} =	2.86	K/W

Brake

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



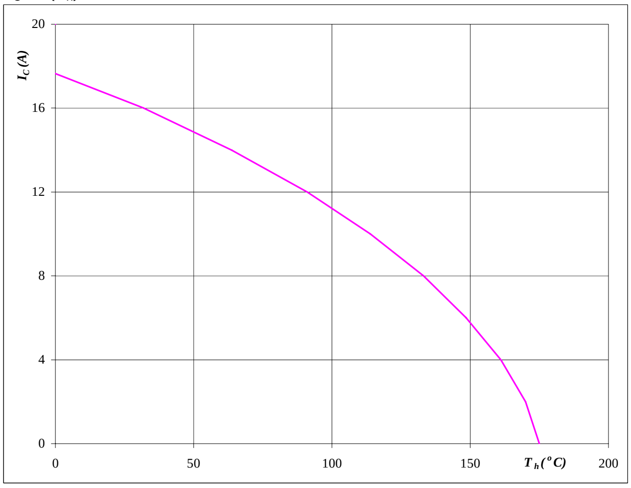
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

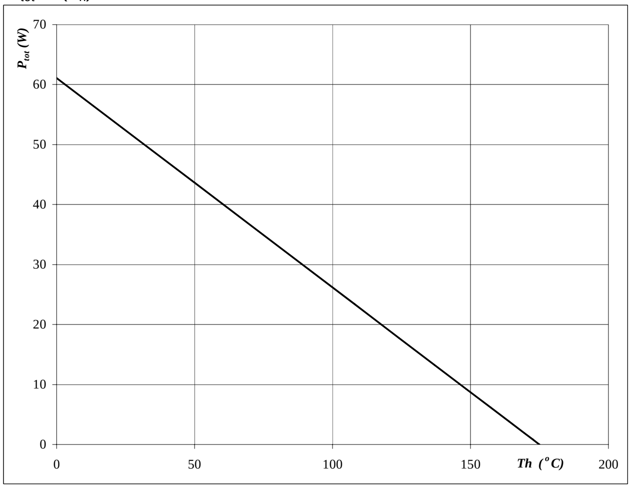
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



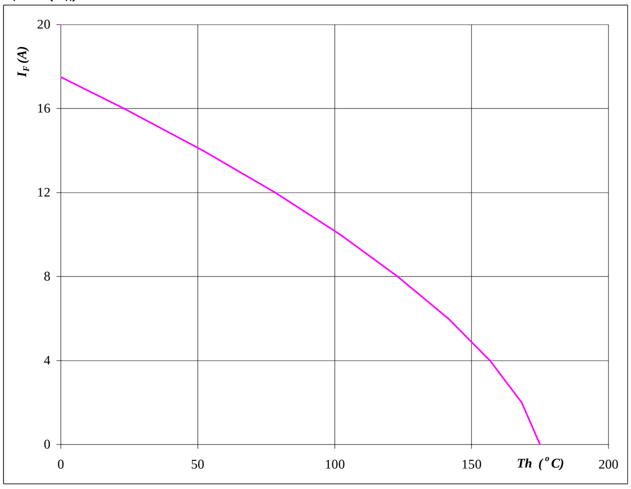
At

T_j = 175 ºC

Figure 16 Brake FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

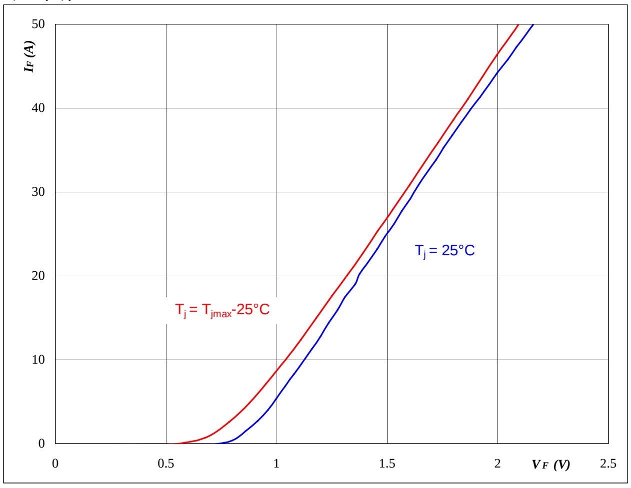
T_j = 175 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



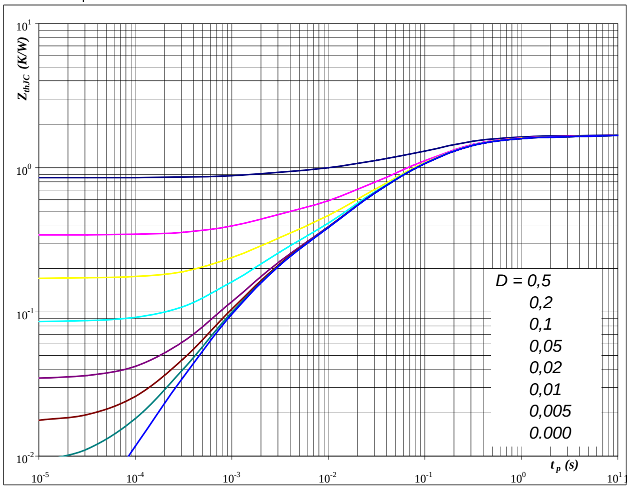
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

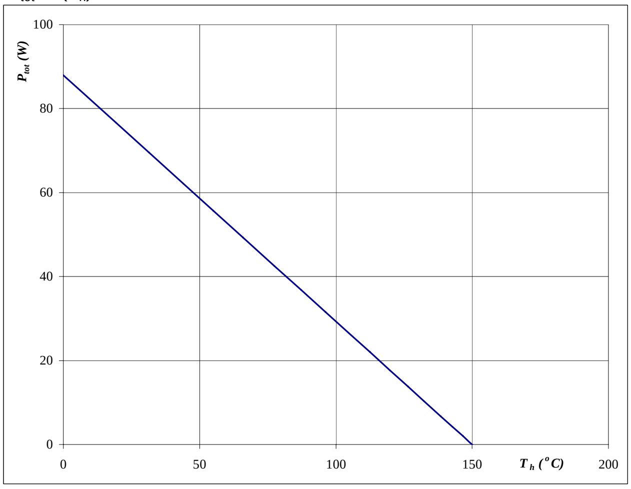
D = t_p / T

R_{thJH} = 1.706 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



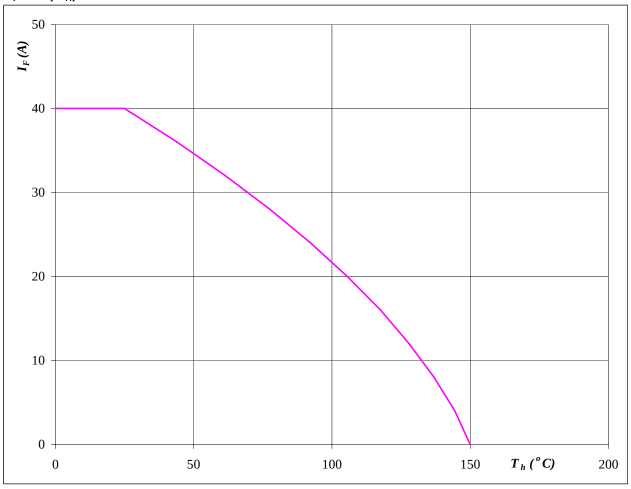
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



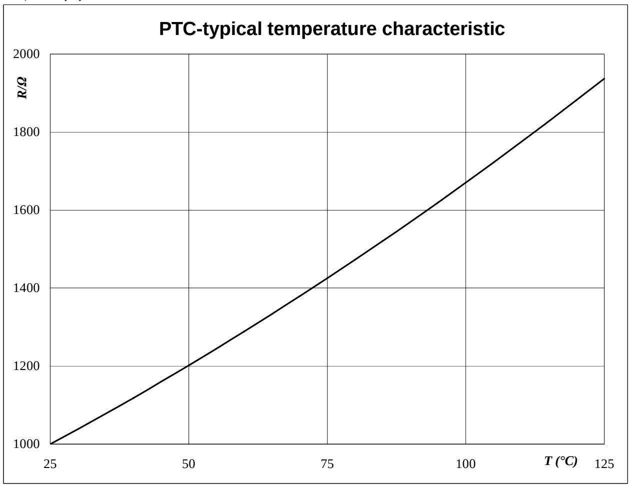
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



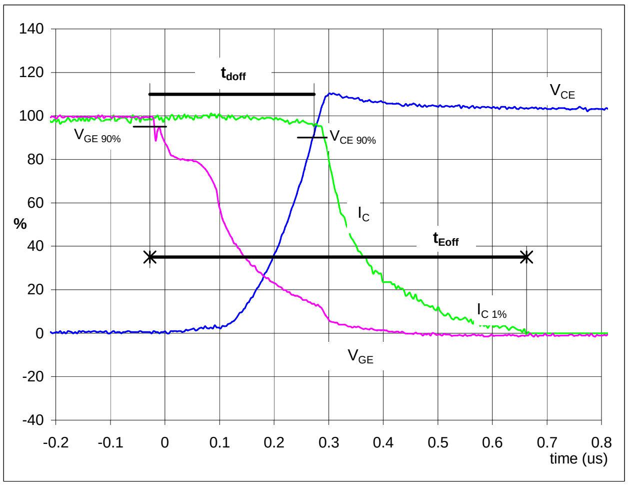
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	64 Ω
R_{goff}	=	64 Ω

Figure 1 Output inverter IGBT

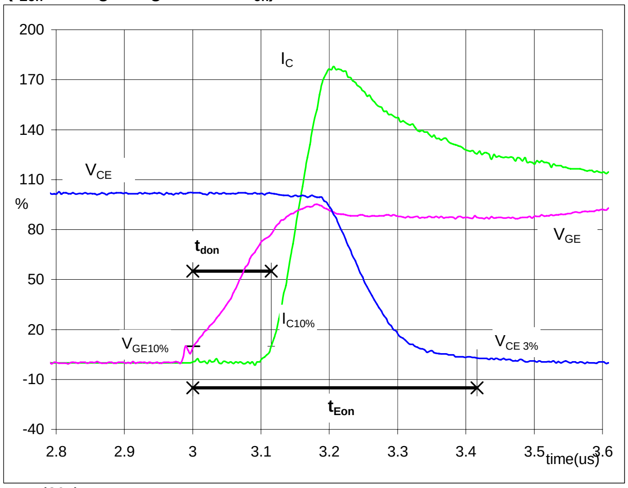
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{doff} =	0.29	μs
t_{Eoff} =	0.69	μs

Figure 2 Output inverter IGBT

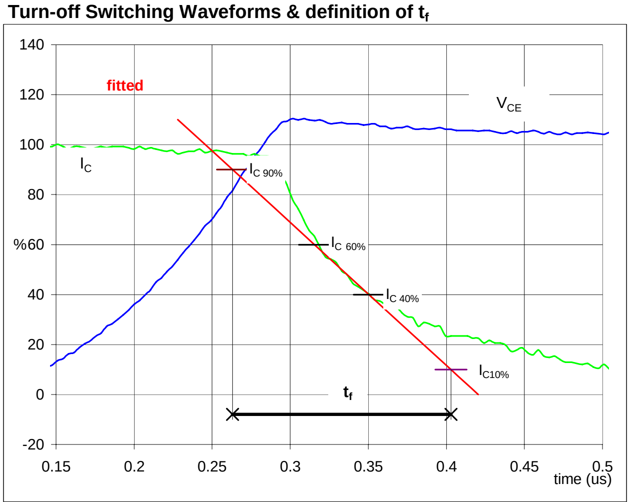
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{don} =	0.13	μs
t_{Eon} =	0.42	μs

Figure 3 Output inverter IGBT

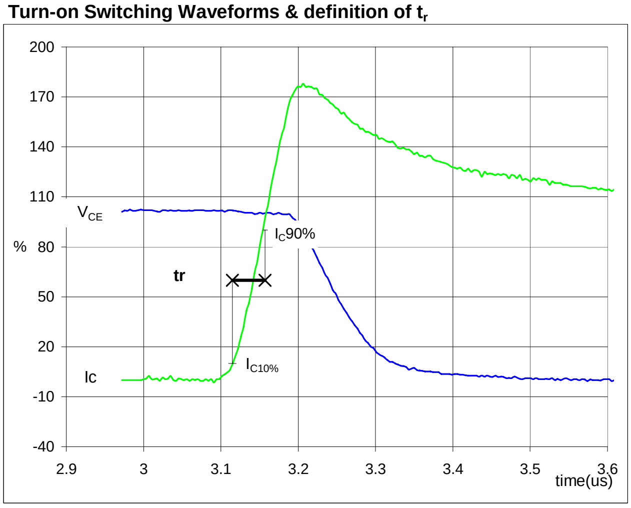
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	8	A
t_f =	0.13	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

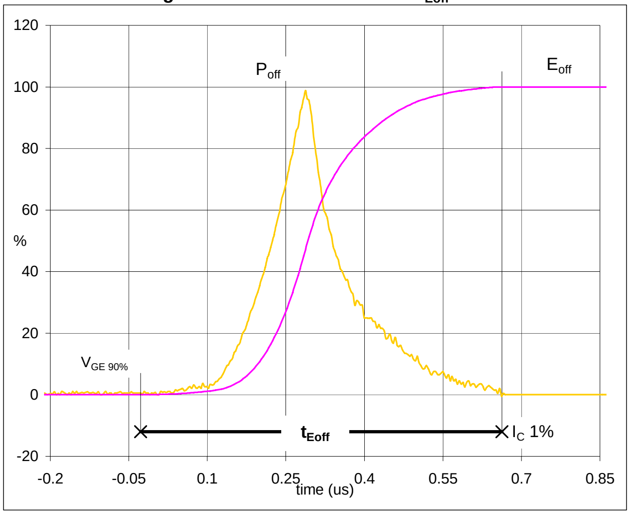


V_C (100%) =	600	V
I_C (100%) =	8	A
t_r =	0.04	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

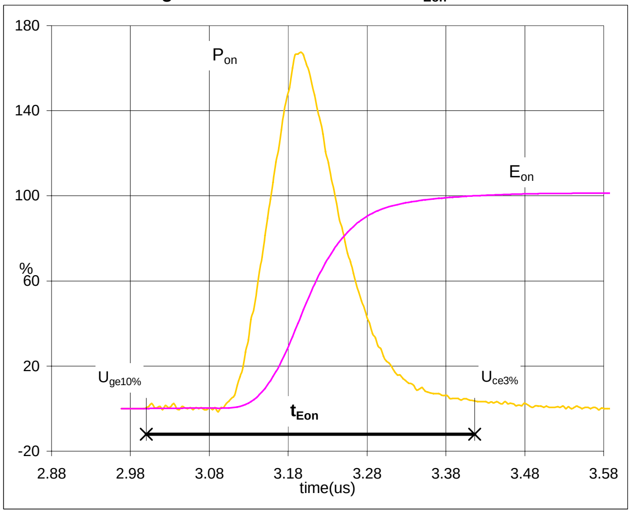
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	4.81	kW
E_{off} (100%) =	0.77	mJ
t_{Eoff} =	0.69	μs

Figure 6 Output inverter IGBT

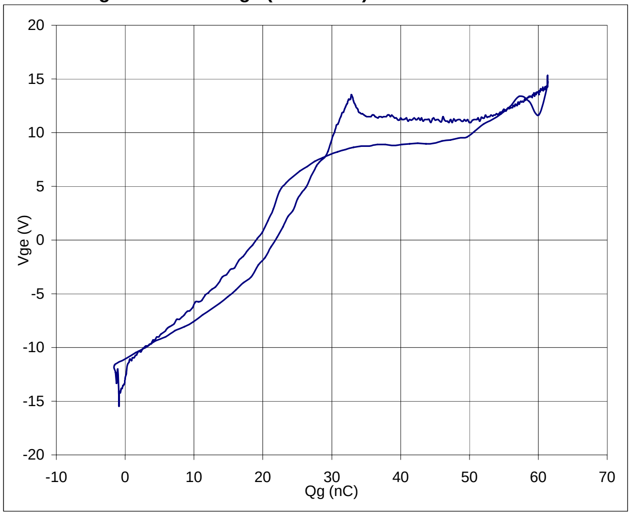
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	4.81	kW
E_{on} (100%) =	0.88	mJ
t_{Eon} =	0.42	μs

Figure 7 Output inverter FRED

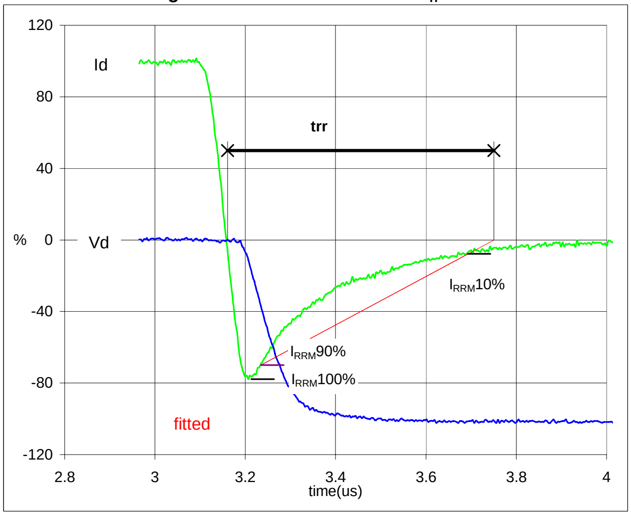
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
Q_g =	187.85	nC

Figure 8 Output inverter IGBT

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

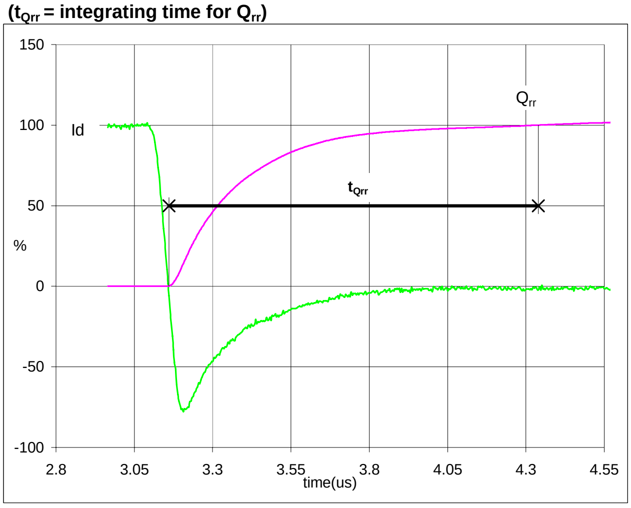


V_d (100%) =	600	V
I_d (100%) =	8	A
I_{RRM} (100%) =	-6	A
t_{rr} =	0.57	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

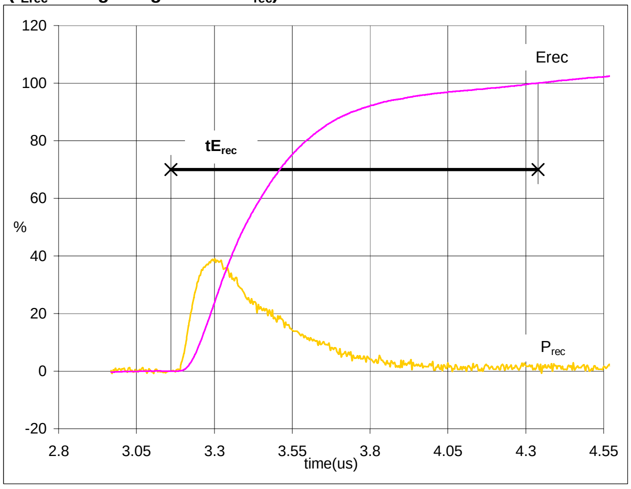
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	8	A
Q_{rr} (100%) =	1.47	μC
t_{Qrr} =	1.18	μs

Figure 10 Output inverter FRED

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



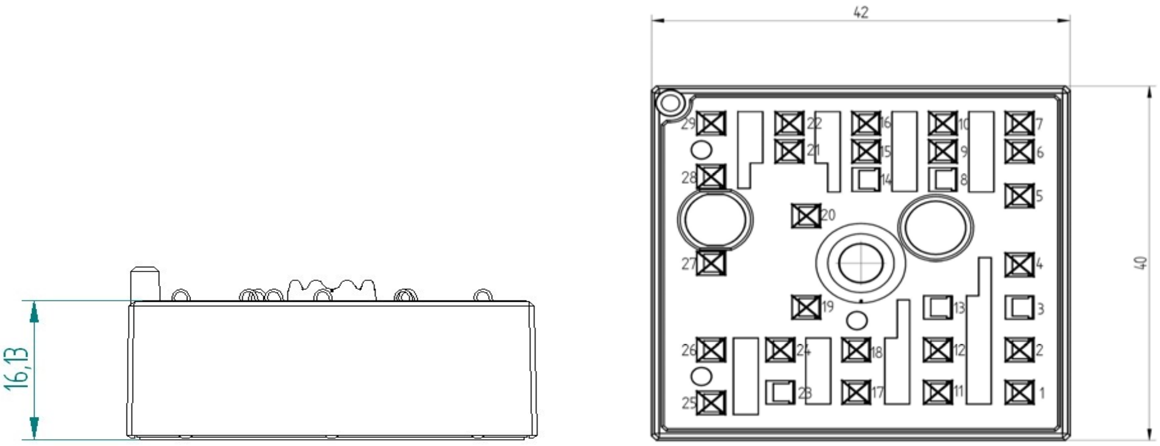
P_{rec} (100%) =	4.81	kW
E_{rec} (100%) =	0.62	mJ
t_{Erec} =	1.18	μs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

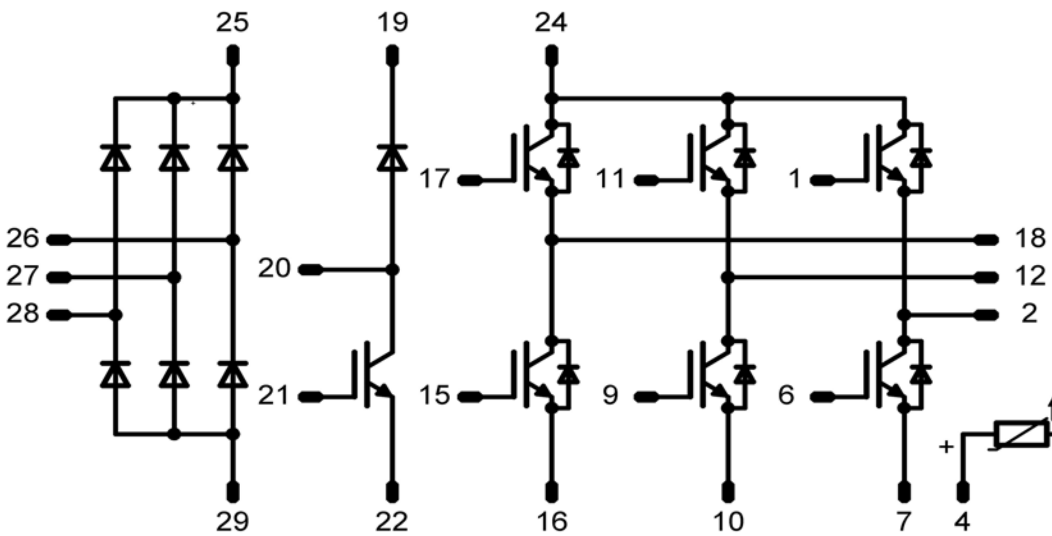
Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K12-T-PM)	V23990-K209-A40-/0A/-PM	K209A40	K209A40-/0A/
with std lid (black V23990-K12-T-PM) and P12	V23990-K209-A40-/1A/-PM	K209A40	K209A40-/1A/
with thin lid (white V23990-K13-T-PM)	V23990-K209-A40-/0B/-PM	K209A40	K209A40-/0B/
with thin lid (white V23990-K13-T-PM) and P12	V23990-K209-A40-/1B/-PM	K209A40	K209A40-/1B/

Outline



X = assembled pin position

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.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
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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.