***flow* PIM 1** — **1200 V / 15 A**

Features

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

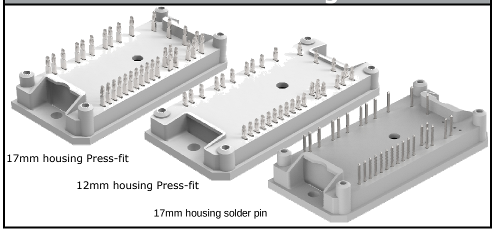
Target Applications

- Industrial drives
- Embedded drives

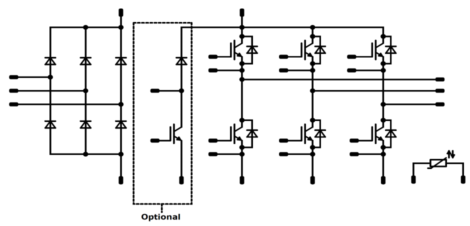
Types

- V23990-P588-A41-PM
- V23990-P588-A418-PM
- V23990-P588-A418Y-PM
- V23990-P588-C41-PM
- V23990-P588-C418-PM

flow 1 housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}		35	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms 50Hz half sine wave	280	A
I2t-value	I^2t		380	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	68	W
Maximum Junction Temperature	T_{jmax}		150	°C
Inverter Switch				
Collector-emitter breakdown voltage	V_{CE}		1200	V
DC collector current	I_C		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Turn off safe operating area		V_{CE} ≤ 1200V, $T_j ≤ T_{op}$ max,	30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	71	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	14	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	52	W
Maximum Junction Temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter breakdown voltage	V_{CE}		1200	V
DC collector current	I_C		8	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	24	A
Turn off safe operating area		V_{CE} ≤ 1200V, $T_j \le T_{op}$ max	16	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	61	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 Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F		10	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	20	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	46	W
Maximum Junction Temperature	T_{jmax}		175	°C
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation temperature under switching condition	T_{op}		-40…+(T_{jmax} - 25)	°C
Isolation Properties				
Isolation voltage	V_{is}	t = 2 s DC Test Voltage	4000	V
Creepage distance			min 12,7	mm
Clearance		12mm housing solder pins / press-fit pins	7,91 / 7,96	mm
		17mm housing	min 12,7	mm
Comparative tracking index	CTI		>200	

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Value Min	Value Typ	Value Max	Unit
Rectifier Diode										
Forward voltage	V_F				30	25 125	0,8	1,16 1,13	1,6	V
Threshold voltage (for power loss calc. only)	V_{to}				30	25 125		0,90 0,78		V
Slope resistance (for power loss calc. only)	r_t				30	25 125		8,00 11,00	20	mΩ
Reverse current	I_r			1600		25 150			2	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,03		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0005	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	0,8	1,84 2,25	2,25	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,005	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	15	25 125		85 85		ns
Rise time	t_r					25 125		17 22		ns
Turn-off delay time	$t_{d(off)}$					25 125		201 264		ns
Fall time	t_f					25 125		82 123		ns
Turn-on energy loss	E_{on}					25 125		0,817 1,255		mWs
Turn-off energy loss	E_{off}					25 125		0,878 1,358		mWs
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		900		pF
Output capacitance	C_{oss}							80		pF
Reverse transfer capacitance	C_{rss}							55		pF
Gate charge	Q_G		15			25		120		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,35		K/W
Inverter Diode										
Diode forward voltage	V_F				15	25 125	1,35	1,61 1,50	2,05	V
Peak reverse recovery current	I_{RRM}	R_{gon} = 32 Ω	0	600	15	25 125		25 26		A
Reverse recovery time	t_{rr}					25 125		153 313		ns
Reverse recovered charge	Q_{rr}					25 125		1,35 2,98		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		1700 776		A/μs
Reverse recovered energy	E_{rec}					25 125		0,518 1,259		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,83		K/W

Characteristic Values

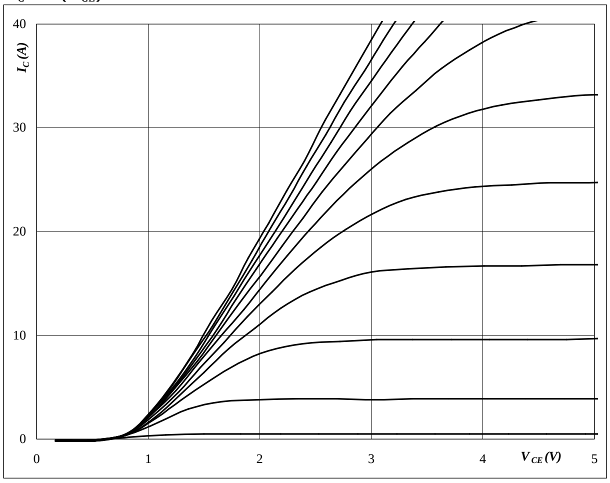
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Value Min	Typ	Max	Unit
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0005	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	1,3	1,82 2,23	2,15	V
Collector-emitter cut-off incl diode	I_{CES}		0			25			0,005	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	15	25 125		53 55		ns
Rise time	t_r					25 125		18 23		
Turn-off delay time	$t_{d(off)}$					25 125		169 231		
Fall time	t_f					25 125		82 119		
Turn-on energy loss	E_{on}					25 125		0,47 0,75		mWs
Turn-off energy loss	E_{off}					25 125		0,44 0,68		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		490		pF
Output capacitance	C_{oss}							50		
Reverse transfer capacitance	C_{rss}							30		
Gate charge	Q_G		15			25		50		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,57		K/W
Brake Diode										
Diode forward voltage	V_F				10	25 125	1,3	2,31 1,89	2,2	V
Reverse leakage current	I_r			1200		25			5	µA
Peak reverse recovery current	I_{RRM}	R_{gon} = 32 Ω R_{gon} = 32 Ω	15	600	15	25 125		8 10		A
Reverse recovery time	t_{rr}					25 125		273 415		ns
Reverse recovered charge	Q_{rr}					25 125		0,92 0,92		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		68 65		A/µs
Reverse recovery energy	E_{rec}					25 125		0,38 0,70		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,07		K/W
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$					25	-5		5	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$					25		3996		K
Vincotech NTC Reference									B	

Inverter Characteristics

Figure 1 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

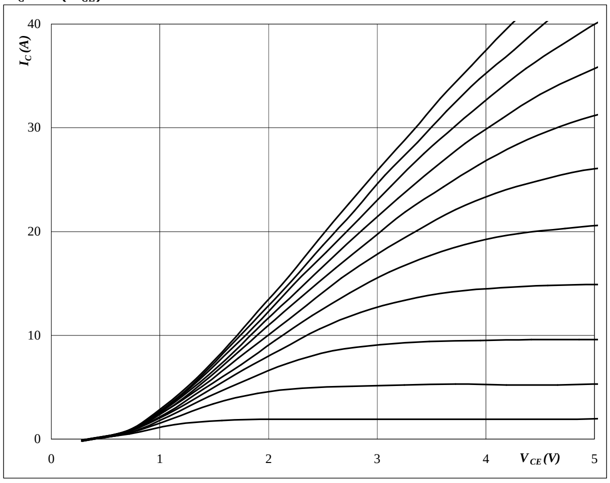
T_j = 25 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

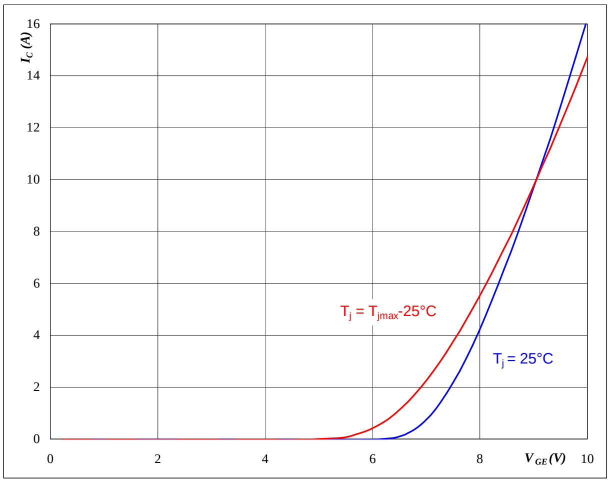
T_j = 150 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

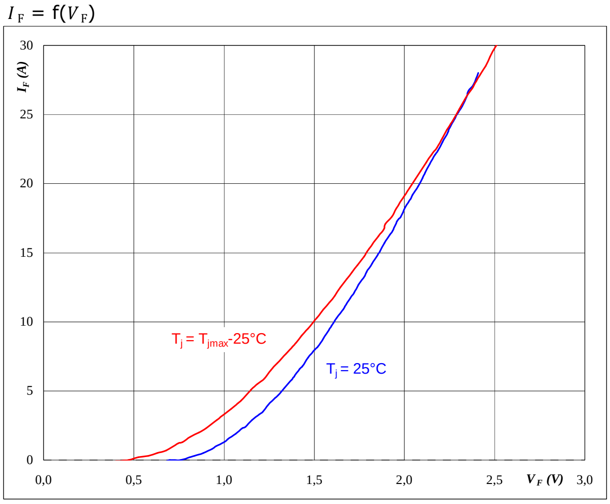
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

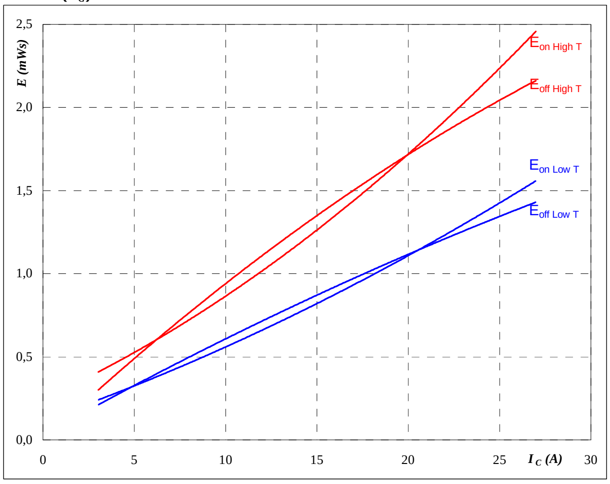
t_p = 250 µs

Inverter Characteristics

Figure 5 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

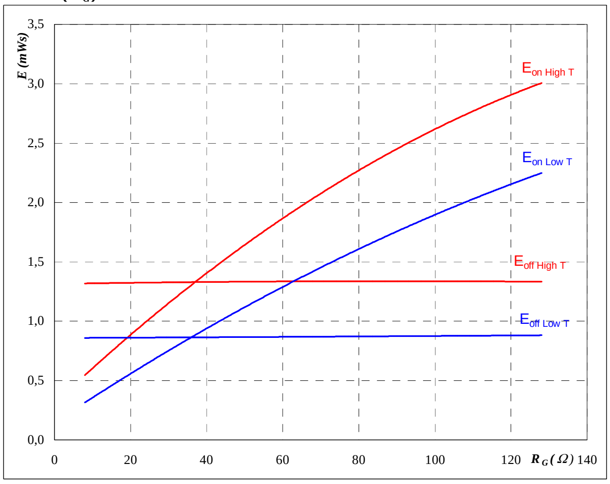
R_{gon} = 32 Ω

R_{goff} = 32 Ω

Figure 6 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

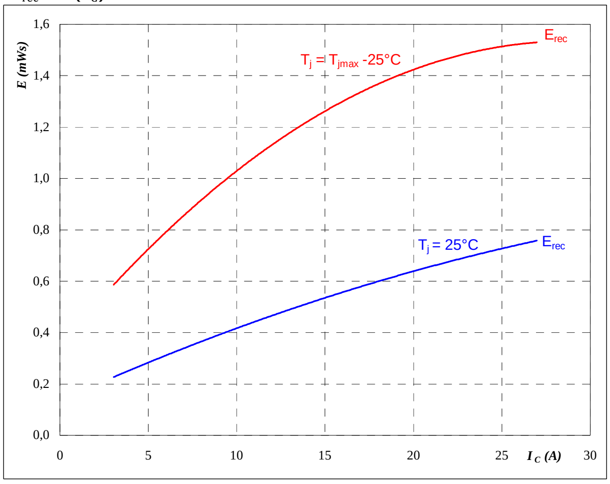
V_{GE} = ±15 V

I_C = 15 A

Figure 7 Inverter FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

T_j = 25/150 °C

V_{CE} = 600 V

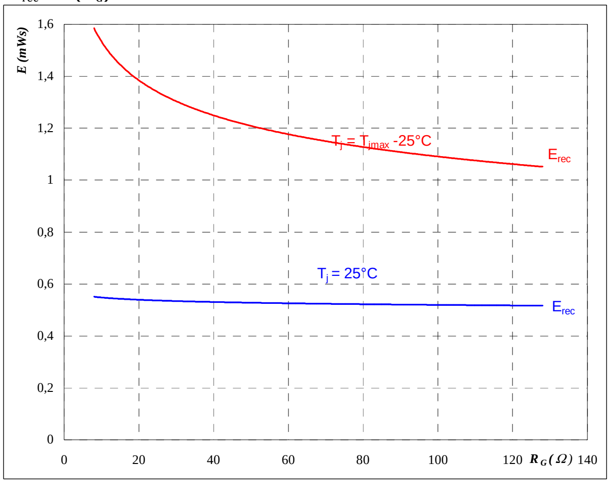
V_{GE} = ±15 V

R_{gon} = 32 Ω

Figure 8 Inverter FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

T_j = 25/150 °C

V_{CE} = 600 V

V_{GE} = ±15 V

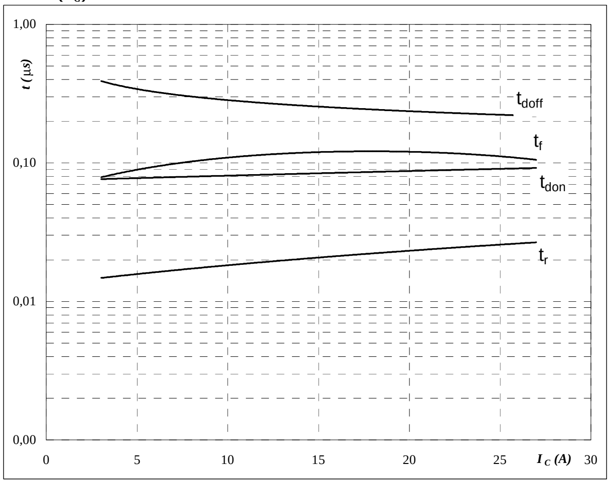
I_C = 15 A

Inverter Characteristics

Figure 9 Inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



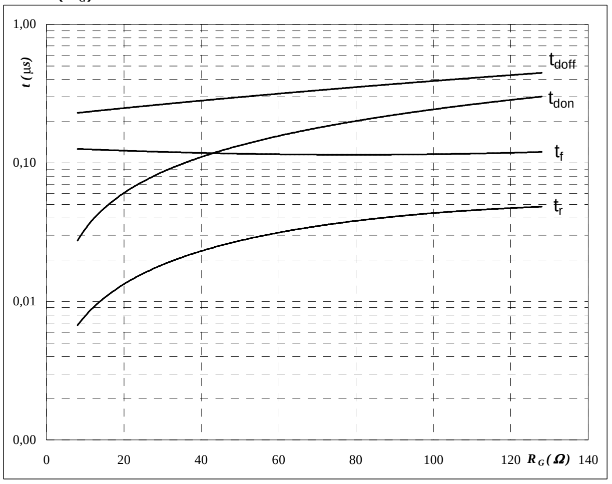
With an inductive load at

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

Figure 10 Inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



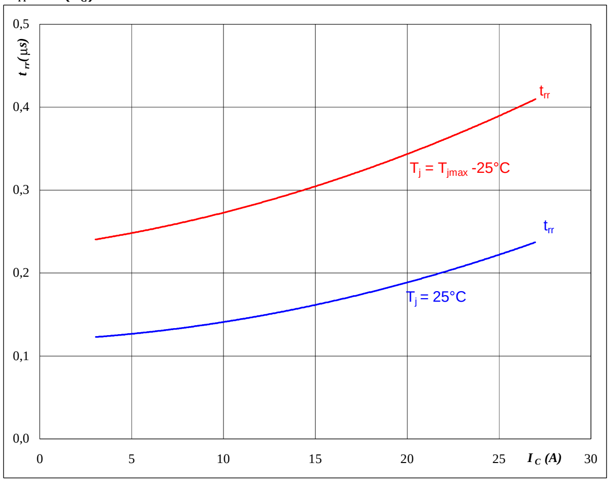
With an inductive load at

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

Figure 11 Inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



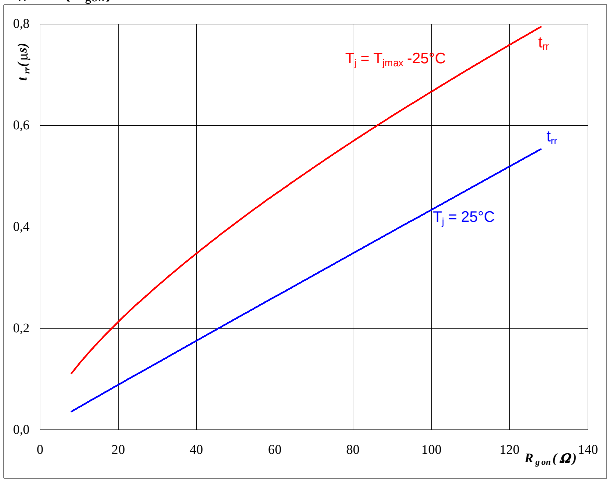
At

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

Figure 12 Inverter FWD

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

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



At

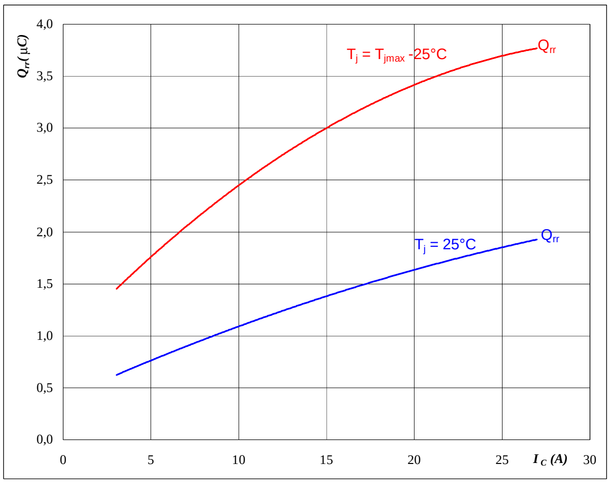
T_j =	25/150	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Inverter Characteristics

Figure 13 Inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



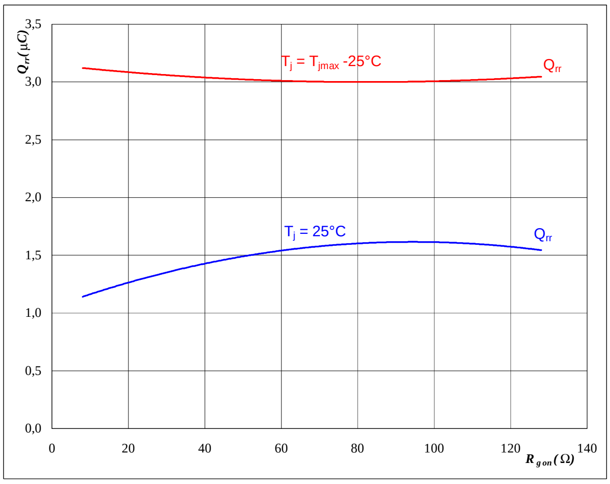
At

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

Figure 14 Inverter FWD

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

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



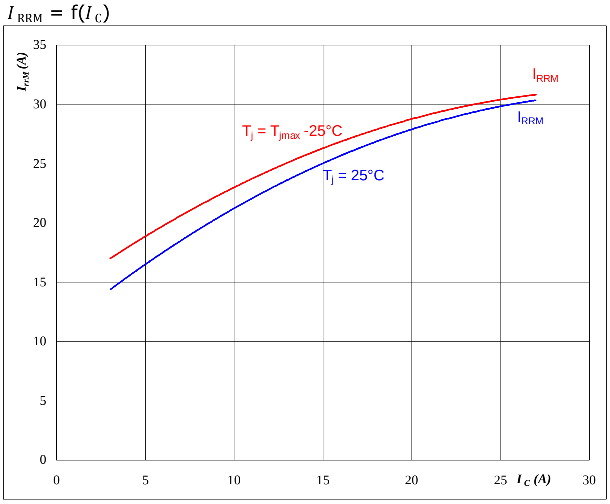
At

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

Figure 15 Inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



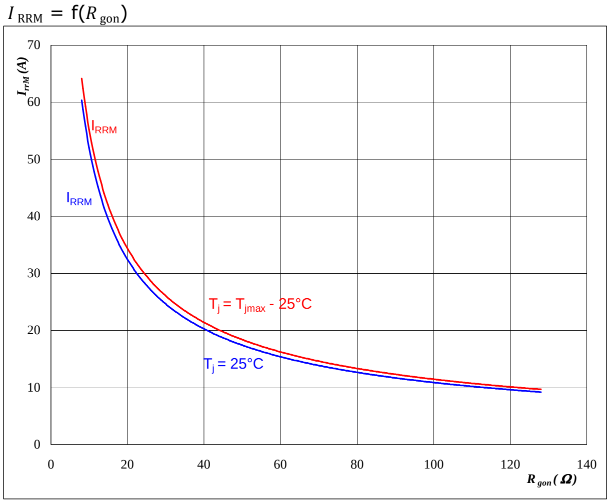
At

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

Figure 16 Inverter FWD

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

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



At

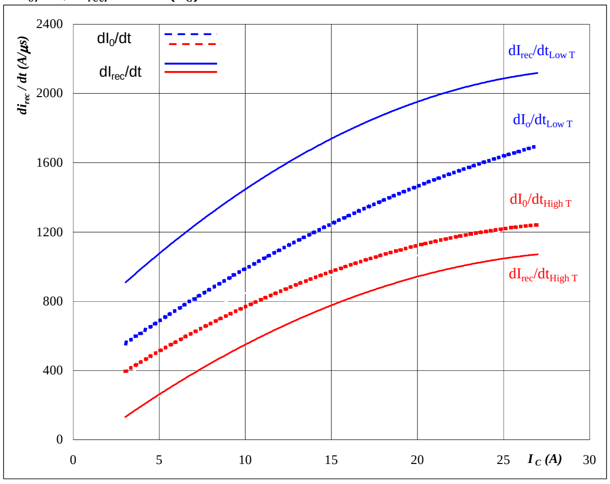
T_j =	25/150	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Inverter Characteristics

Figure 17	Inverter FWD

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

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



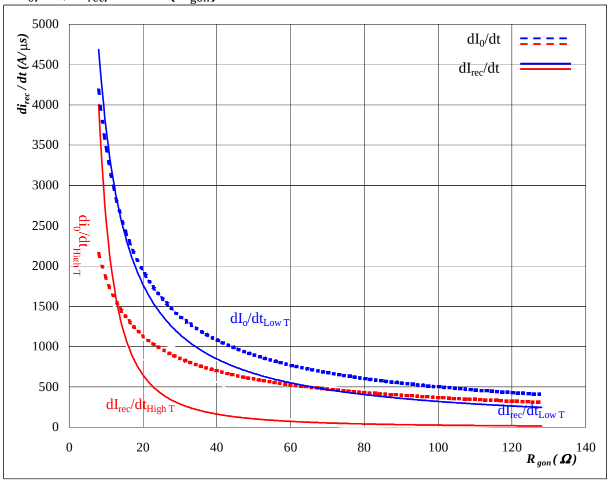
At

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

Figure 18	Inverter FWD

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

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



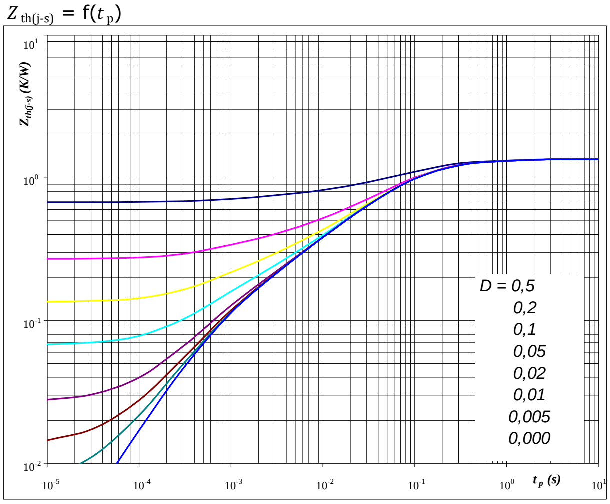
At

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

Figure 19	Inverter IGBT

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	1,35	K/W

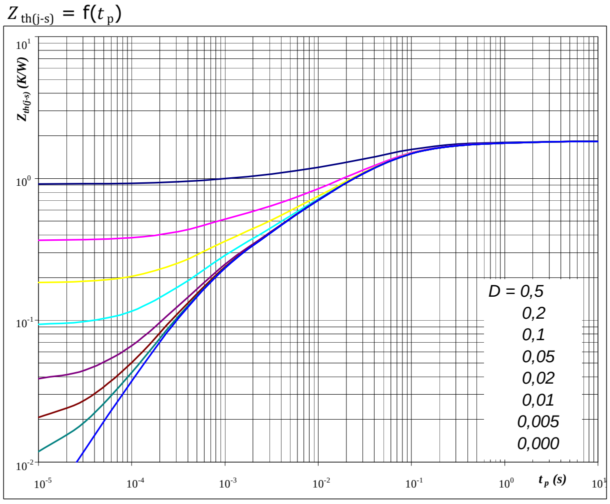
IGBT thermal model values

R (K/W)	Tau (s)
0,16	5,9E-01
0,63	9,4E-02
0,28	2,9E-02
0,16	6,7E-03
0,09	9,4E-04
0,02	3,8E-04

Figure 20	Inverter FWD

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	1,83	K/W

FWD thermal model values

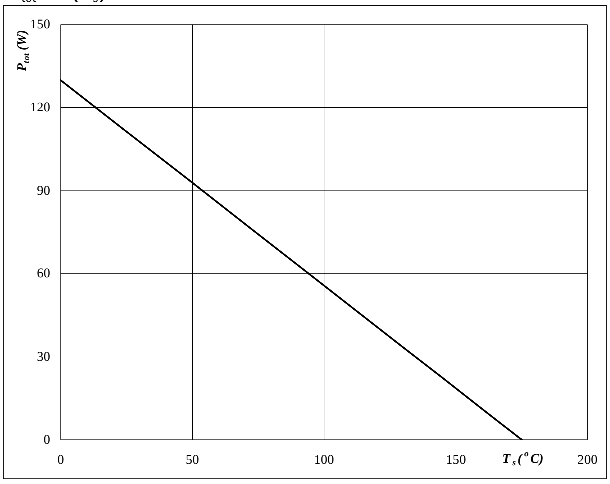
R (K/W)	Tau (s)
0,06	2,8E+00
0,14	3,9E-01
0,71	6,8E-02
0,50	2,0E-02
0,25	4,0E-03
0,18	5,9E-04

Inverter Characteristics

Figure 21 Inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



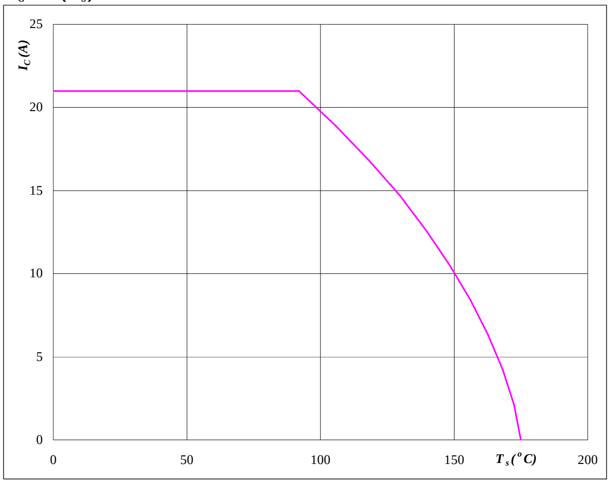
At

T_j = 175 °C

Figure 22 Inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

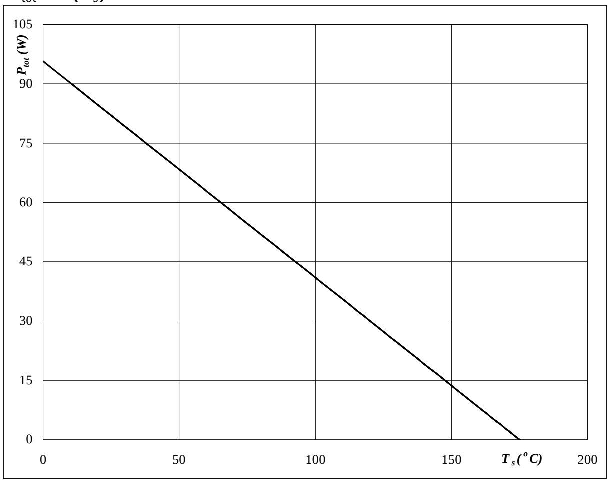
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



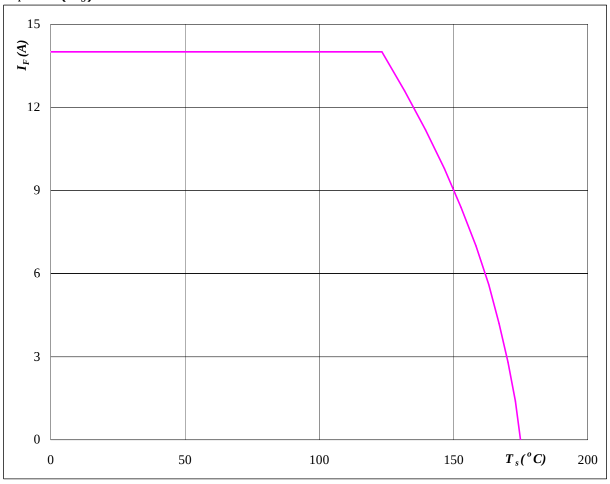
At

T_j = 175 °C

Figure 24 Inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

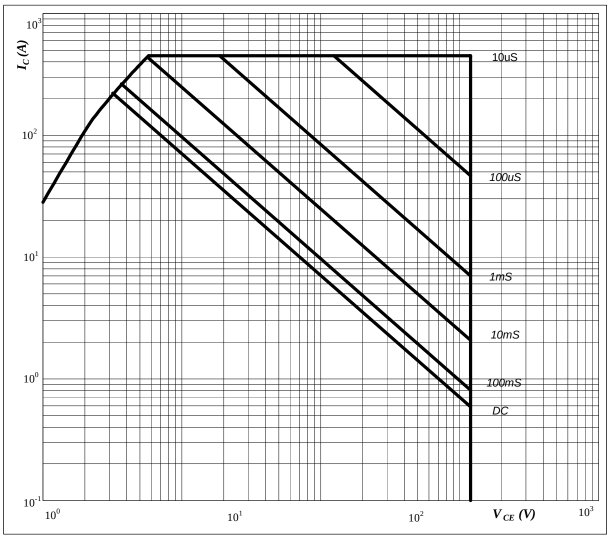
T_j = 175 °C

Inverter Characteristics

Figure 25 Inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



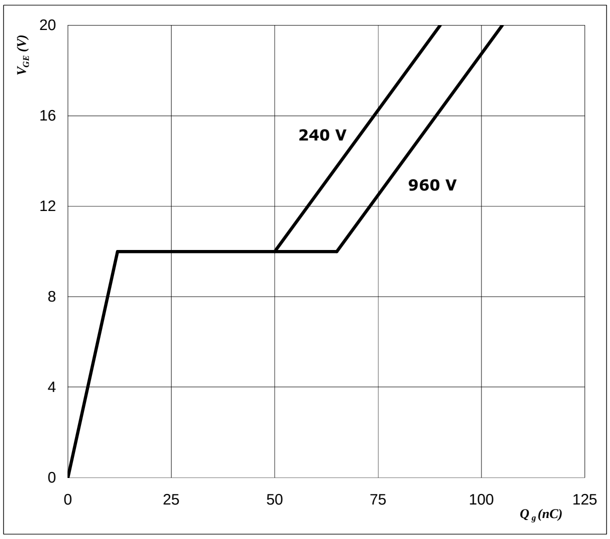
At

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

Figure 26 Inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_G)$



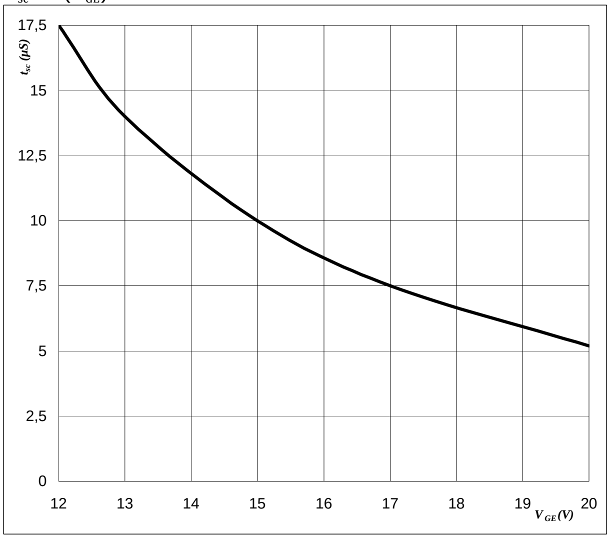
At

I_C =	15	A

Figure 27 Inverter IGBT

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

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



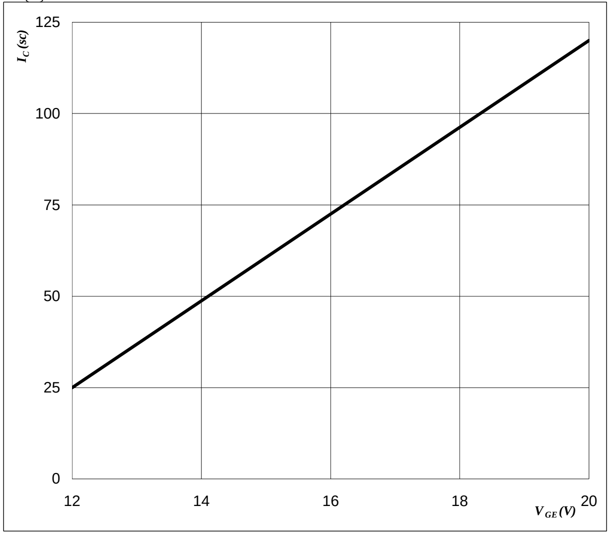
At

V_{CE} =	1200	V
T_j ≤	175	ºC

Figure 28 Inverter IGBT

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

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



At

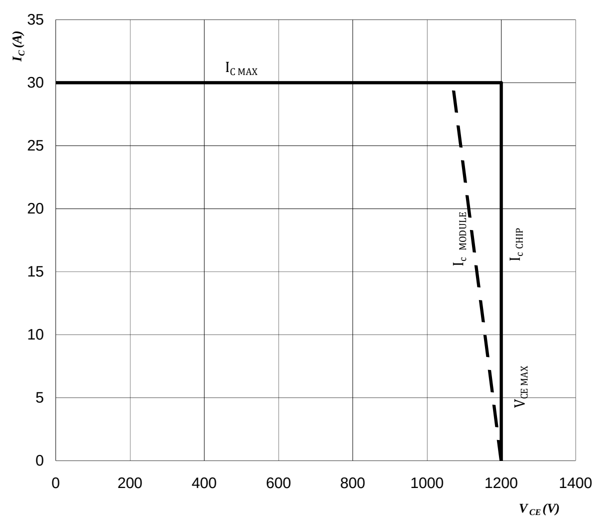
V_{CE} ≤	1200	V
T_j =	175	ºC

Inverter Characteristics

Figure 29	Inverter IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

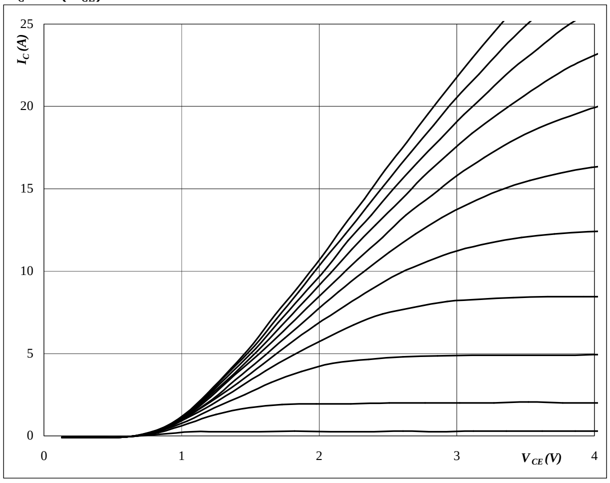
T_j = T_{jmax}-25 ºC

Brake Characteristics

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



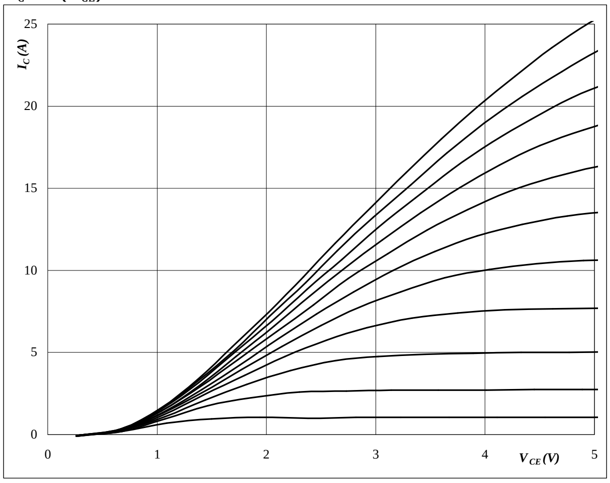
At

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

$I_C = f(V_{CE})$



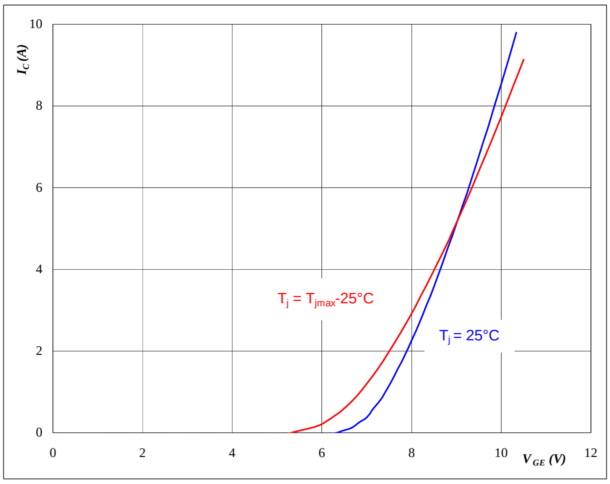
At

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

$I_C = f(V_{GE})$



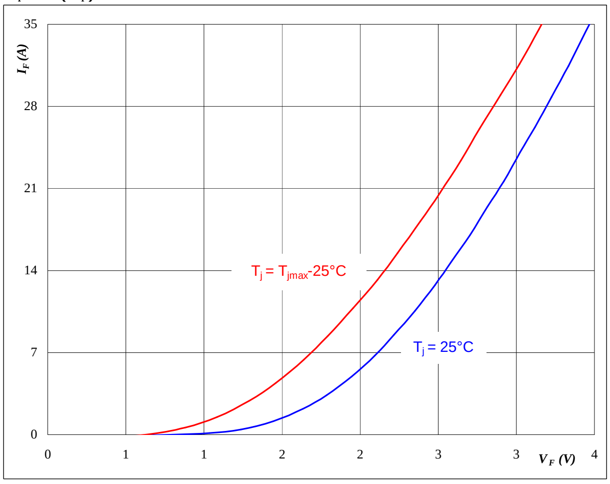
At

t_p =	250	µs
V_{CE} =	10	V

Figure 4 Brake FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

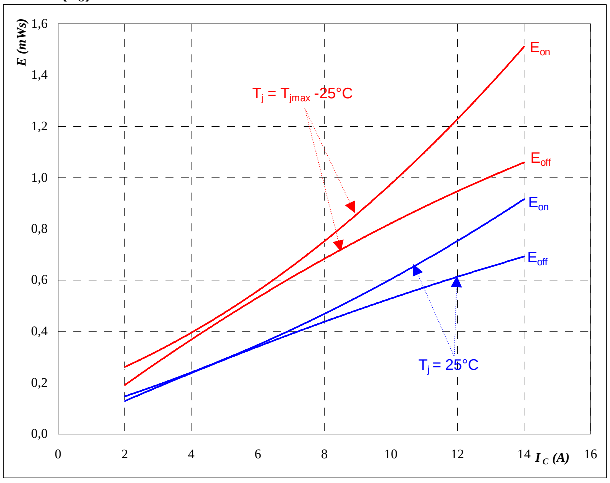
t_p =	250	µs

Brake Characteristics

Figure 5 Brake IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



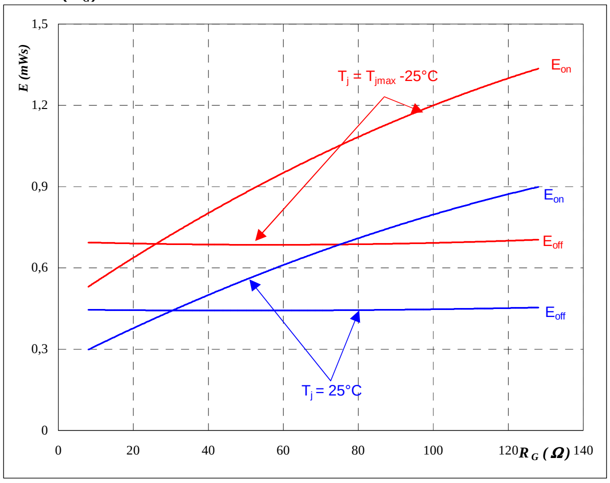
With an inductive load at

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

$E = f(R_G)$



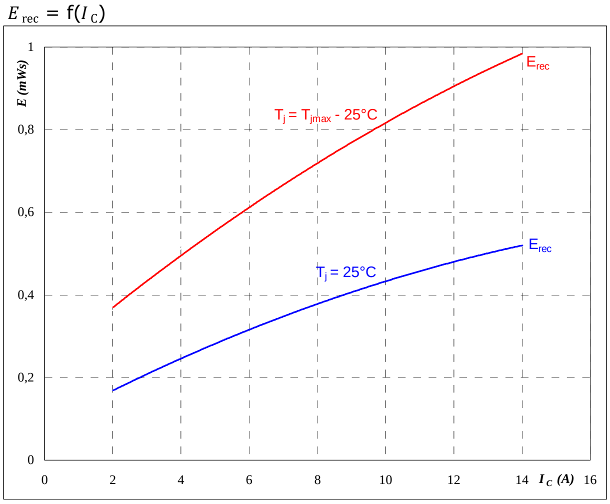
With an inductive load at

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

Figure 7 Brake FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



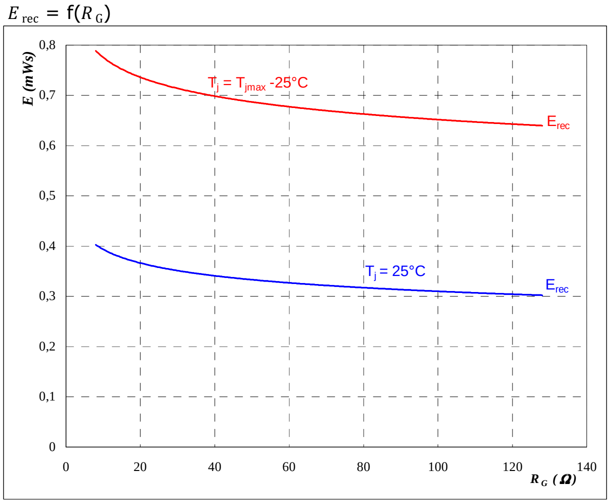
With an inductive load at

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

Figure 8 Brake FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

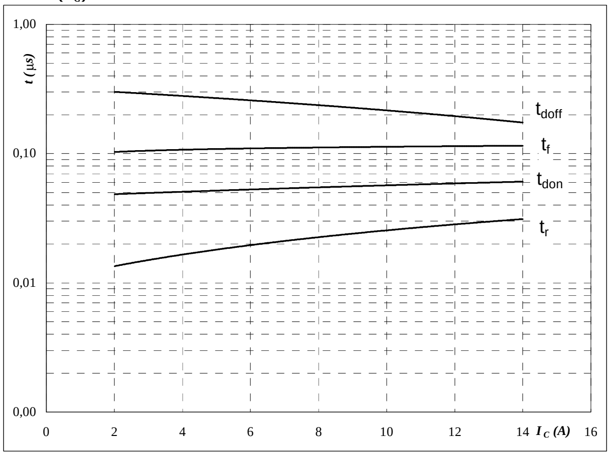
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Brake Characteristics

Figure 9 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



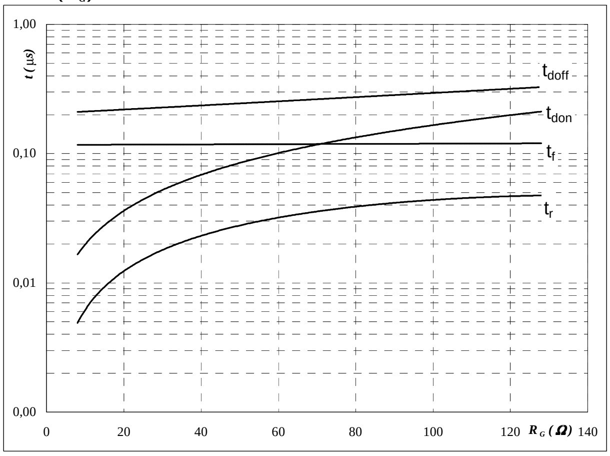
With an inductive load at

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

$t = f(R_G)$



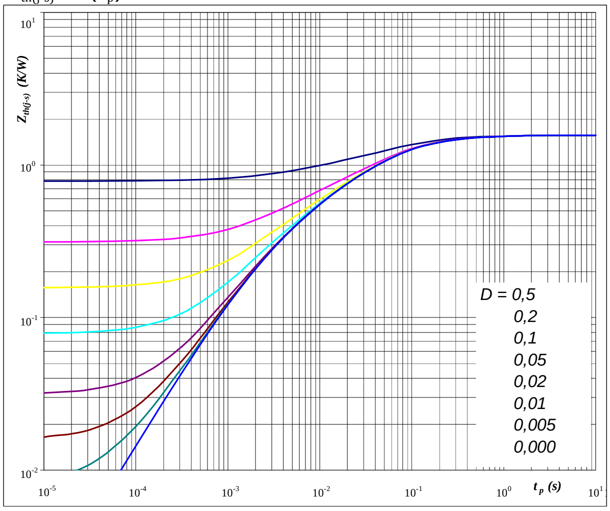
With an inductive load at

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

Figure 11 Brake IGBT

IGBT transient thermal impedance as a function of pulse width

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



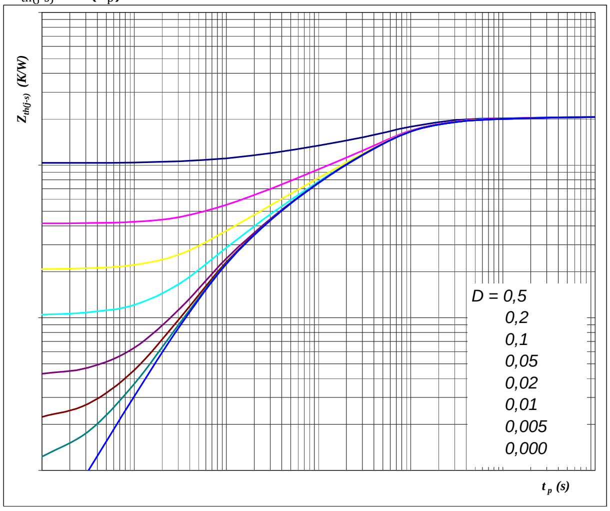
At $D = t_p / T$

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

Figure 12 Brake FWD

FWD transient thermal impedance as a function of pulse width

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



At $D = t_p / T$

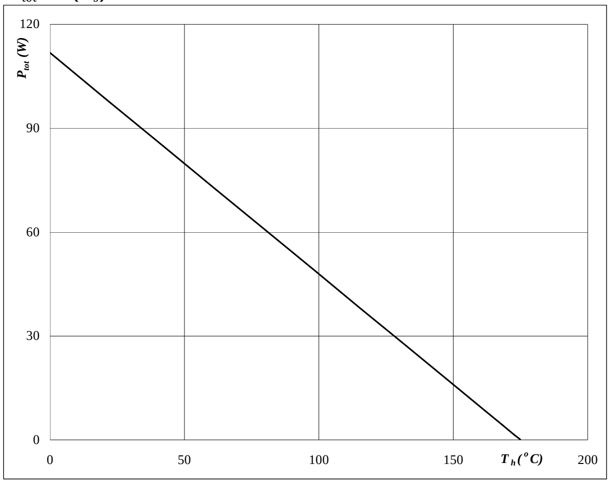
$R_{th(j-s)}$ = 2,07 K/W

Brake Characteristics

Figure 13 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



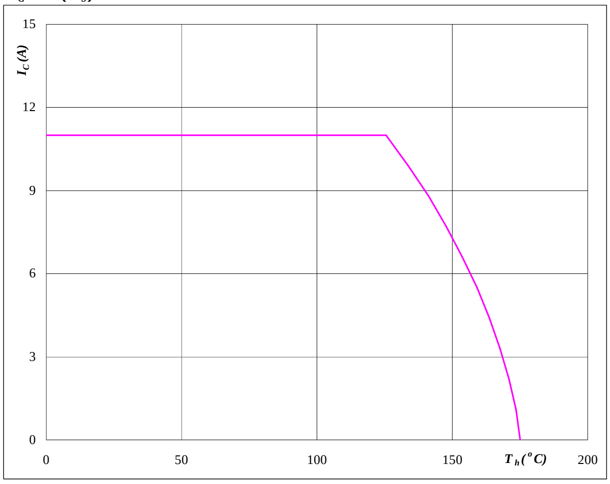
At

T_j = 175 ºC

Figure 14 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

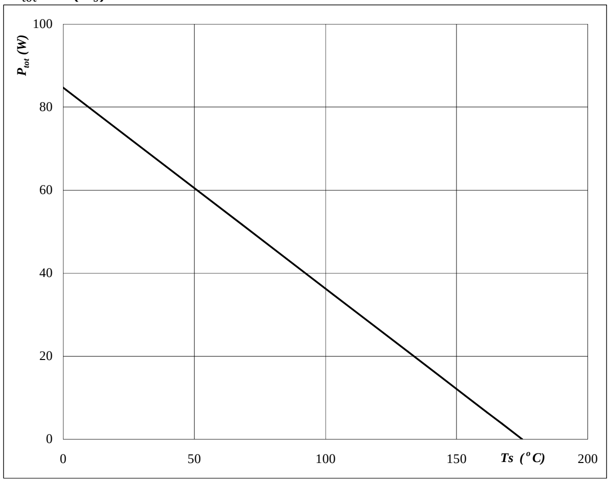
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 Brake FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



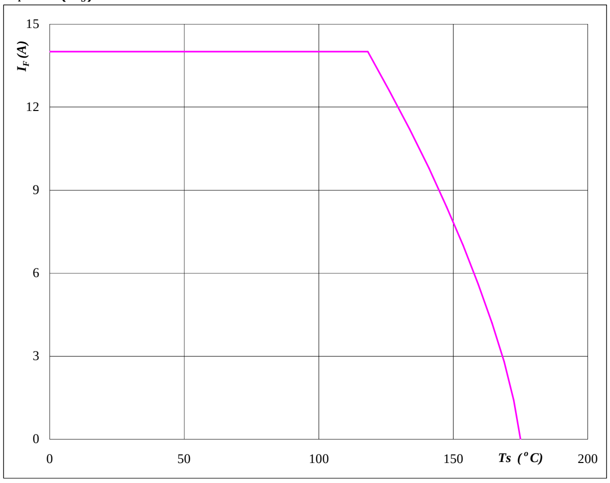
At

T_j = 175 ºC

Figure 16 Brake FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

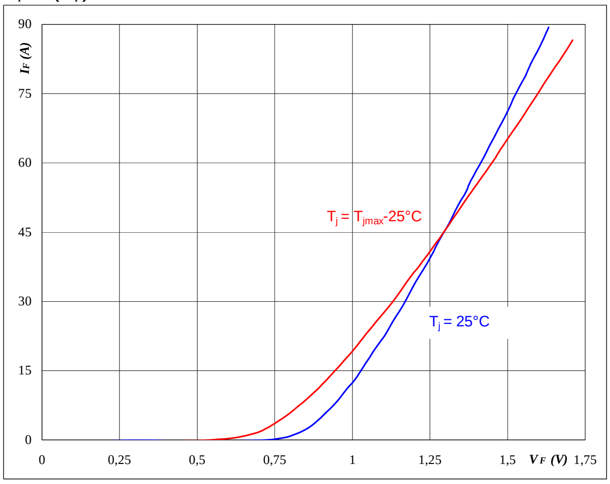
T_j = 175 ºC

Rectifier Diode

Figure 1 Rectifier Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



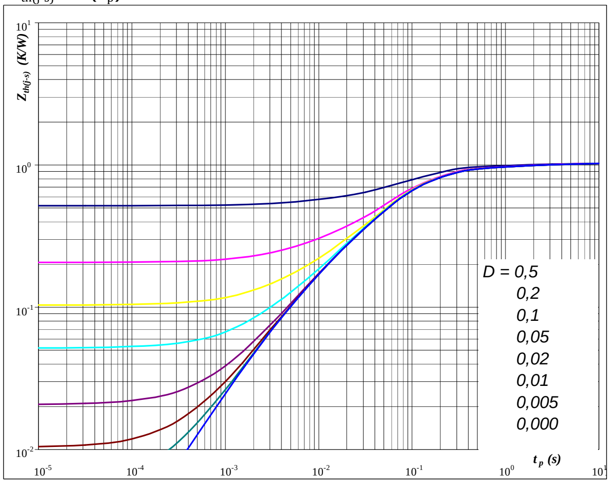
At

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

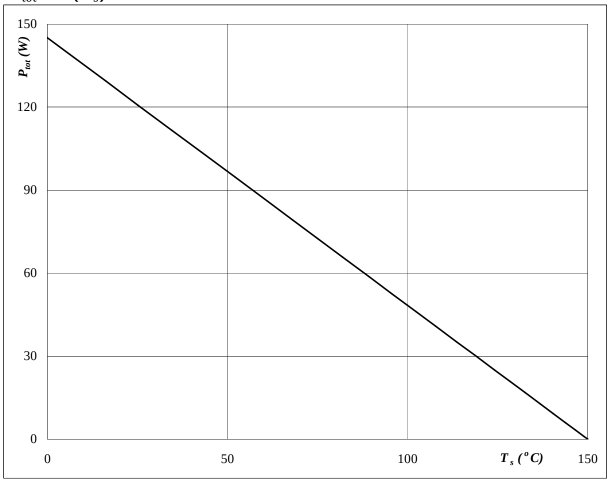
D = t_p / T

$R_{th(j-s)}$ = 1,03 K/W

Figure 3 Rectifier Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



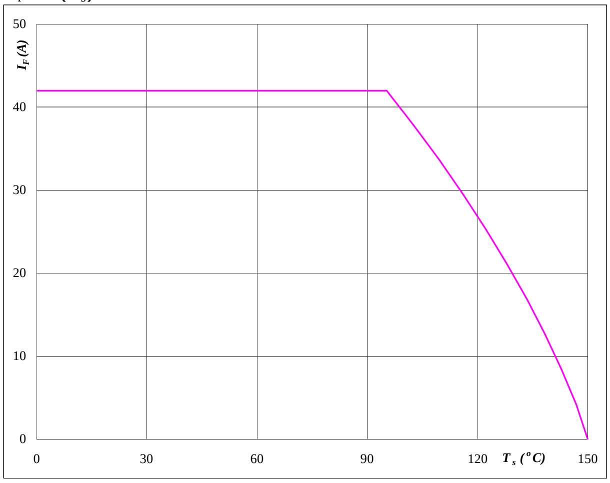
At

T_j = 150 ºC

Figure 4 Rectifier Diode

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

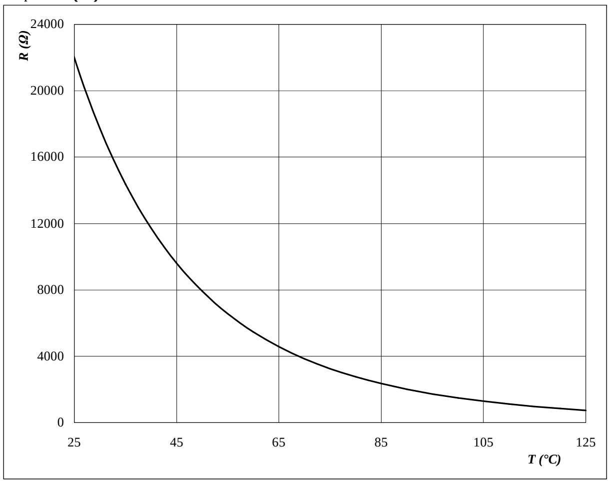
T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



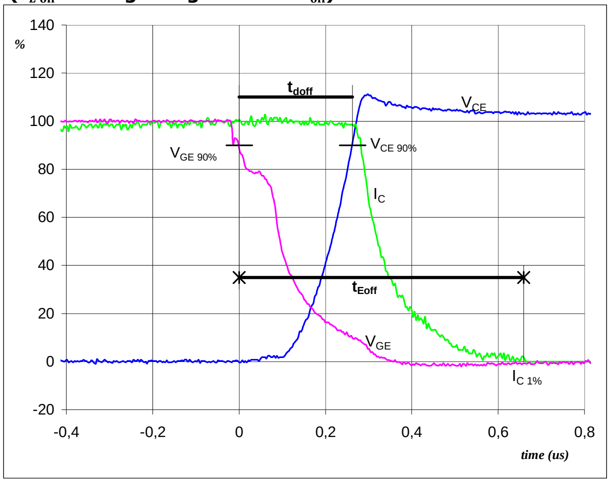
Switching Definitions Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

Figure 1 Inverter IGBT

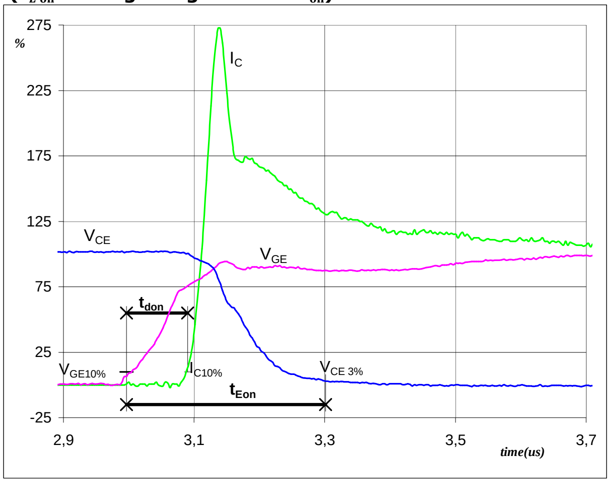
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{doff} =	0,26	μs
$t_{E\,off}$ =	0,66	μs

Figure 2 Inverter IGBT

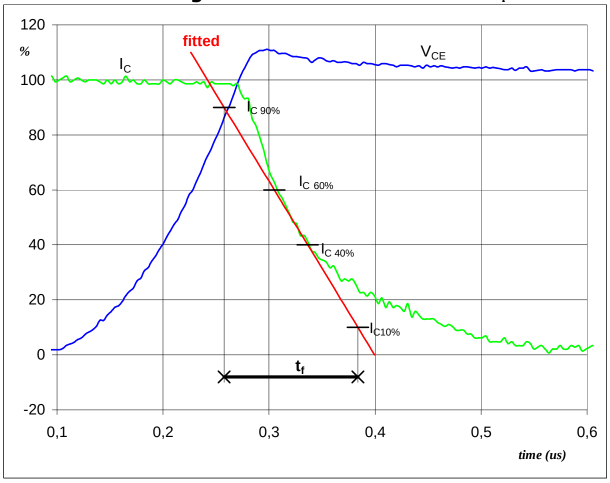
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{don} =	0,09	μs
$t_{E\,on}$ =	0,30	μs

Figure 3 Inverter IGBT

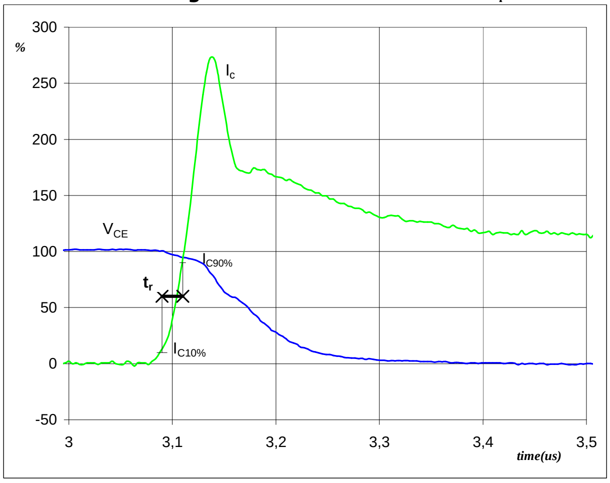
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	15	A
t_f =	0,12	μs

Figure 4 Inverter IGBT

Turn-on Switching Waveforms & definition of t_r

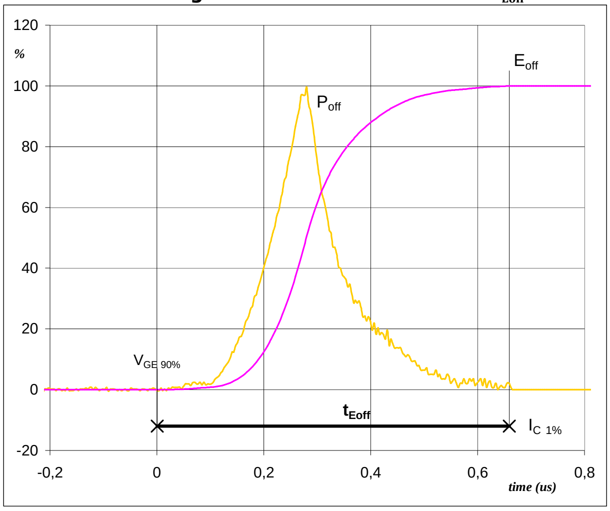


V_C (100%) =	600	V
I_C (100%) =	15	A
t_r =	0,02	μs

Switching Definitions Inverter

Figure 5 Inverter IGBT

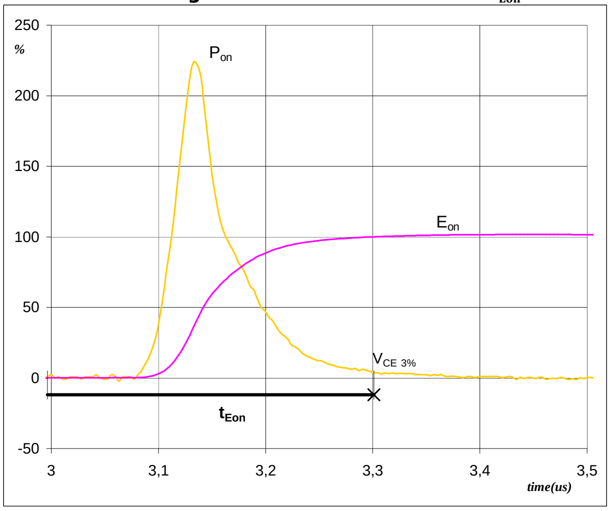
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	8,96	kW
E_{off} (100%) =	1,36	mJ
$t_{E\,off}$ =	0,66	µs

Figure 6 Inverter IGBT

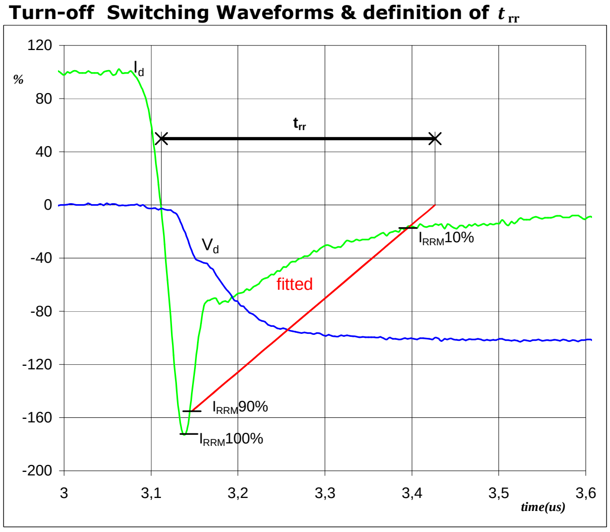
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	8,96	kW
E_{on} (100%) =	1,26	mJ
$t_{E\,on}$ =	0,30	µs

Figure 7 Inverter FWD

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

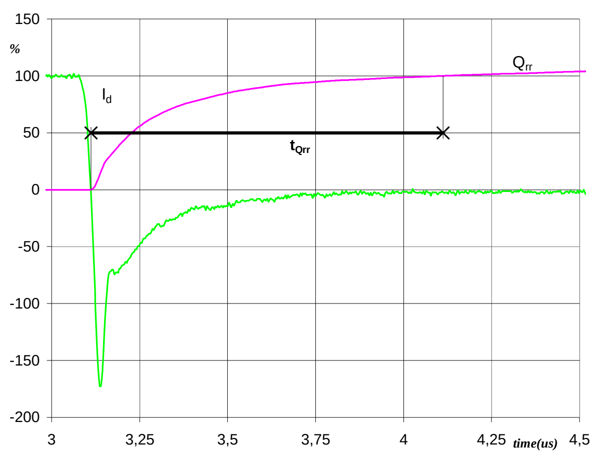


V_d (100%) =	600	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-26	A
t_{rr} =	0,31	µs

Switching Definitions Inverter

Figure 8 Inverter FWD

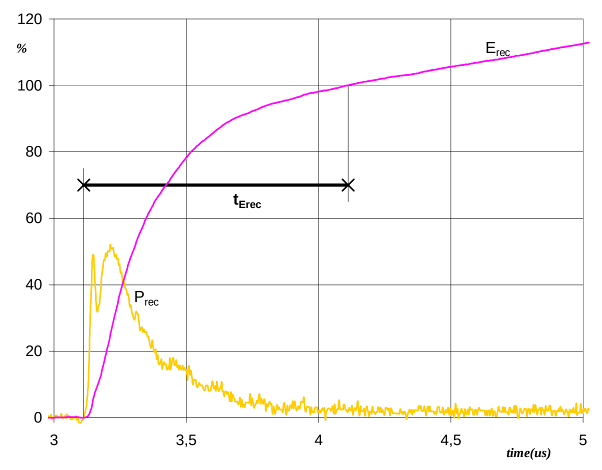
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	2,98	µC
$t_{Q\,rr}$ =	1,00	µs

Figure 9 Inverter FWD

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



P_{rec} (100%) =	8,96	kW
E_{rec} (100%) =	1,26	mJ
$t_{E\,rec}$ =	1,00	µs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

Version	Ordering Code
Without thermal paste 17mm housing	V23990-P588-A41-PM
With thermal paste 17mm housing	V23990-P588-A41-/3/-PM
Without thermal paste 12mm housing	V23990-P588-A418-PM
With thermal paste 12mm housing with pressfit pins	V23990-P588-A418Y-PM
Without thermal paste 12mm housing with pressfit pins	V23990-P588-A418Y-/3/-PM
With thermal paste 12mm housing	V23990-P588-A418-/3/-PM
Without thermal paste 17mm housing without brake	V23990-P588-C41-PM
Without thermal paste 12mm housing without brake	V23990-P588-C418-PM
With thermal paste 12mm housing without brake	V23990-P588-C418-/3/-PM

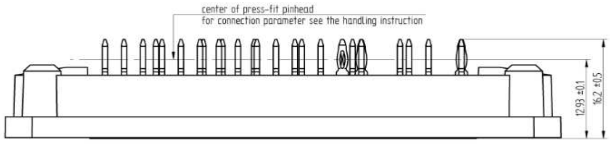
	VIN	Date code	Name&Ver	UL	Lot	Serial
Text	VIN	WWYY	NNNNNNVV	UL	LLLLL	SSSS
	Name&Ver	Lot number	Serial	Date code		
Datamatrix	NNNNNNVV	LLLLL	SSSS	WWYY		

Outline

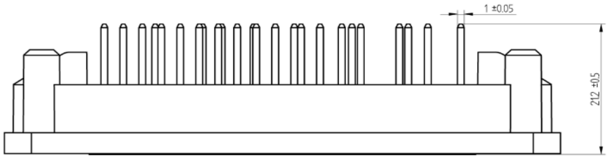
Pin table			
Pin	X	Y	Function
1	52,55	0	BrG
2	47,7	0	DC-
3	44,8	0	DC-
4	37,8	0	DC+
5	37,8	2,8	DC+
6	35	0	Inv+
7	35	2,8	Inv+
8	28	0	R1
9	25,2	0	R2
10	22,4	0	N6
11	19,6	0	G6
12	16,8	0	S6
13	14	0	N4
14	11,2	0	G4
15	8,4	0	S4
16	5,6	0	N2
17	2,8	0	G2
18	0	0	S2
19	0	28,5	U
20	2,8	28,5	G1
21	7,5	28,5	S1
22	14,5	28,5	V
23	17,3	28,5	G3
24	22	28,5	S3
25	29	28,5	W
26	31,8	28,5	G5
27	36,5	28,5	S5
28	43,5	28,5	L1
29	52,55	25	L2
30	52,55	16,9	L3
31	52,55	8,6	BrC
32	52,55	2,8	BrE

module	whitout pins
P589-C41	1, 31, 32
P589-C418	1, 31, 32

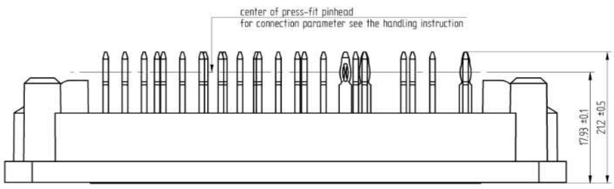
12mm housing, Press-fit

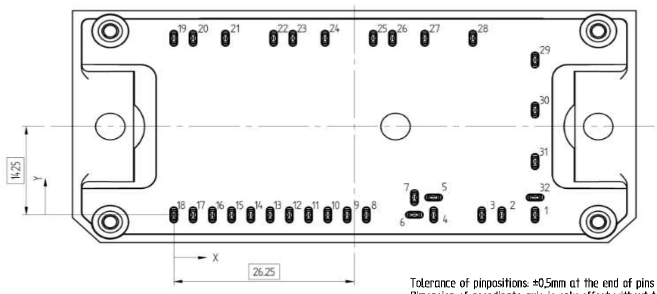


17mm housing, solder pin



17mm housing, Press-fit

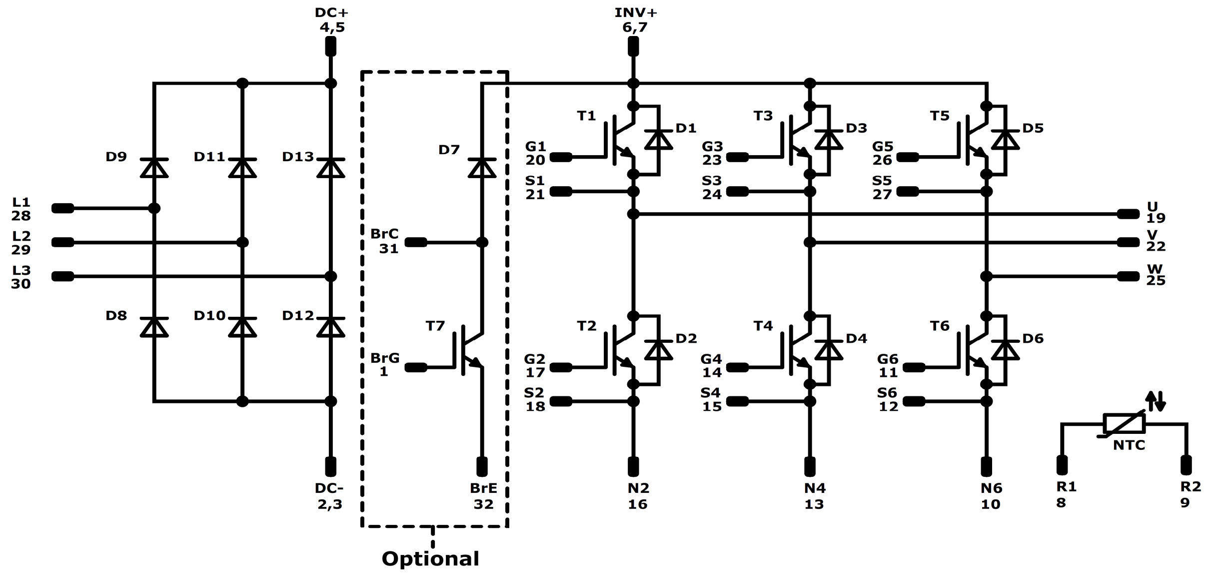




Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Ordering Code and Marking - Outline - Pinout

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	1200 V	15 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	1200 V	15 A	Inverter Diode	
T7	IGBT	1200 V	8 A	Brake Switch	
D7	FWD	1200 V	10 A	Brake Diode	
D8,D9,D10,D11,D12,D13	Rectifier	1600 V	35 A	Rectifier Diode	
NTC	NTC			Thermistor	

Packaging instruction						
Standard packaging quantity (SPQ)	**100**		>SPQ	Standard	<SPQ	Sample

Handling instruction
Package data for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 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-P588-x4x-D5-14	30 Nov. 2017	12 mm press-fit variants added	1 , 22