


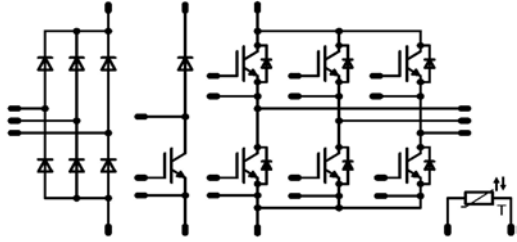
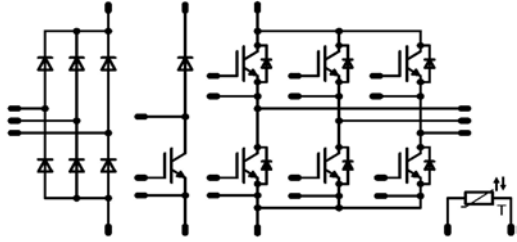
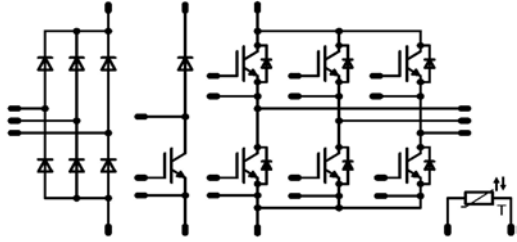


MiniSKiiP® 3 PIM	600V/75A				
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Maximum Ratings

$T_J=25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
D8,D9,D10,D11,D12,D13				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}	$T_J=T_{Jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	69 93	A
Surge forward current	I_{FSM}	$t_p=10\text{ms}$ $T_J=25^{\circ}\text{C}$	700	A
I ² t-value	I^2t		2450	A ² s
Power dissipation per Diode	P_{tot}	$T_J=T_{Jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	77 117	W
Maximum Junction Temperature	T_{Jmax}		150	°C
T1,T2,T3,T4,T5,T6,T7				
Collector-emitter break down voltage	V_{CE}		600	V
DC collector current	I_C	$T_J=T_{Jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	70 92	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{Jmax}	225	A
Turn off safe operating area		$V_{CE} \leq 1200\text{V}$, $T_J \leq T_{op max}$	225	A
Power dissipation per IGBT	P_{tot}	$T_J=T_{Jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	126 191	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_J \leq 150^{\circ}\text{C}$ $V_{GE}=15\text{V}$	6 360	µs V
Maximum Junction Temperature	T_{Jmax}		175	°C

Maximum Ratings

 $T_j=25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit	
D1,D2,D3,D4,D5,D6,D7					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25^{\circ}\text{C}$	600	V	
DC forward current	I_F	$T_j=T_{jmax}$	$T_h=80^{\circ}\text{C}$	55	A
			$T_c=80^{\circ}\text{C}$	72	
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	45	A	
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$	$T_h=80^{\circ}\text{C}$	79	W
			$T_c=80^{\circ}\text{C}$	120	
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$	

Thermal Properties

Storage temperature	T_{stg}		-40...+125	$^{\circ}\text{C}$
Operation temperature under switching condition	T_{op}		-40...+125	$^{\circ}\text{C}$

Insulation Properties

Insulation voltage	V_{is}	$t=2\text{s}$ 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 $V_{GS}[V]$	$V_f[V]$ or $V_{CE}[V]$ or $V_{DS}[V]$	$I_c[A]$ or $I_f[A]$ or $I_b[A]$	T_j	Min	Typ	Max		
D8,D9,D10,D11,D12,D13										
Forward voltage	V_F			35	$T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$	0,8	1,02 0,94	1,35		V
Threshold voltage (for power loss calc. only)	V_{to}			35	$T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$		0,88 0,75			V
Slope resistance (for power loss calc. only)	r_t			35	$T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$		4 6			m Ω
Reverse current	I_r		1500		$T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$			0,1 2		mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness \leq 50um $\lambda = 1$ W/mK					0,90			K/W

T1,T2,T3,T4,T5,T6,T7

Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$		0,0012	$T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	5	5,8	6,5		V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15	75	$T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$		1,54 1,75			V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	612	$T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$			0,1		mA
Gate-emitter leakage current	I_{GES}		± 25	0	$T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$			650		nA
Integrated Gate resistor	R_{gint}						4			Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff}=8 \Omega$ $R_{gon}=8 \Omega$	± 15	300	75	$T_j=25^\circ\text{C}$	217			ns
Rise time	t_r					$T_j=150^\circ\text{C}$	223			
Turn-off delay time	$t_{d(off)}$					$T_j=25^\circ\text{C}$	27			
Fall time	t_f					$T_j=150^\circ\text{C}$	30			
Turn-on energy loss per pulse	E_{on}					$T_j=25^\circ\text{C}$	266			
Turn-off energy loss per pulse	E_{off}					$T_j=150^\circ\text{C}$	290			
Input capacitance	C_{ies}	f=1MHz	0	25	$T_j=25^\circ\text{C}$		4700			pF
Output capacitance	C_{oss}						300			
Reverse transfer capacitance	C_{rss}						145			
Gate charge	Q_{Gate}		± 15		$T_j=25^\circ\text{C}$		470			nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness \leq 50um $\lambda = 1$ W/mK					0,75			K/W

D1,D2,D3,D4,D5,D6,D7

Diode forward voltage	V_F			75	$T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	1	1,54 1,6	2,6		V
Peak reverse recovery current	I_{RRM}	$R_{goff}=8 \Omega$		300	75	$T_j=25^\circ\text{C}$	63,45			A
Reverse recovery time	t_{rr}					$T_j=150^\circ\text{C}$	74,57			
Reverse recovered charge	Q_{rr}					$T_j=25^\circ\text{C}$	58,2			
Peak rate of fall of recovery current	$di(rec)_{max}/dt$					$T_j=150^\circ\text{C}$	262,4			
Reverse recovered energy	E_{rec}					$T_j=25^\circ\text{C}$	3,74			
						$T_j=150^\circ\text{C}$	6,47			
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness \leq 50um $\lambda = 1$ W/mK					1,2			K/W

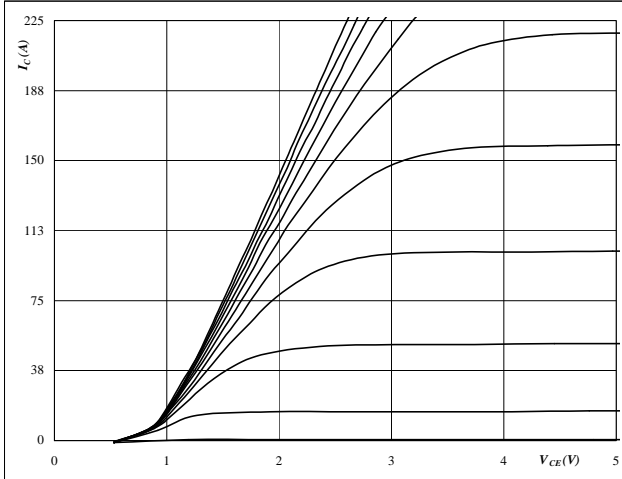
Thermistor

Rated resistance	R				$T=25^\circ\text{C}$		1000			Ω
Deviation of R100	$\Delta R/R$	R100=1670 Ω			$T=100^\circ\text{C}$	-3		3		%
R100	P				$T=100^\circ\text{C}$		1670,313			Ω
Power dissipation constant					$T=25^\circ\text{C}$					mW/K
A-value	B(25/50)	Tol. %			$T=25^\circ\text{C}$		$7,635 \cdot 10^{-3}$			1/K
B-value	B(25/100)	Tol. %			$T=25^\circ\text{C}$		$1,731 \cdot 10^{-5}$			1/K ²
Vincotech NTC Reference									E	

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 1 T1,T2,T3,T4,T5,T6,T7 IGBT

Typical output characteristics

$I_C = f(V_{CE})$

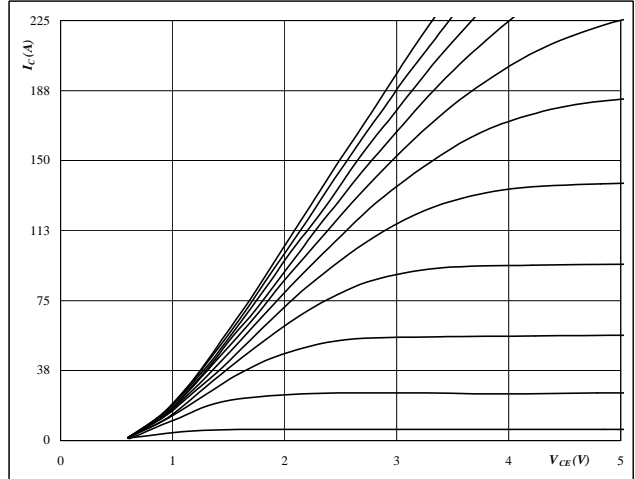


At
 $t_p = 250 \mu s$
 $T_j = 25 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 T1,T2,T3,T4,T5,T6,T7 IGBT

Typical output characteristics

$I_C = f(V_{CE})$

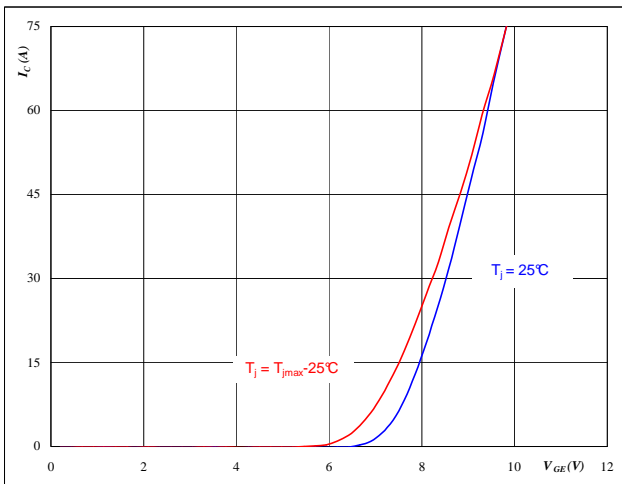


At
 $t_p = 250 \mu s$
 $T_j = 125 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 T1,T2,T3,T4,T5,T6,T7 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

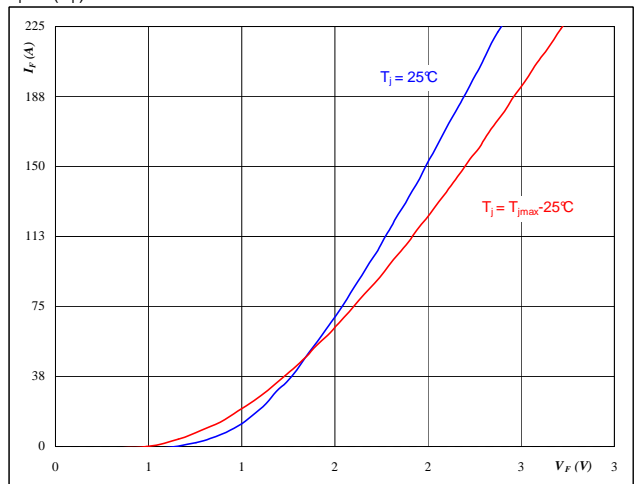


At
 $t_p = 250 \mu s$
 $V_{CE} = 10 V$

Figure 4 D1,D2,D3,D4,D5,D6,D7 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

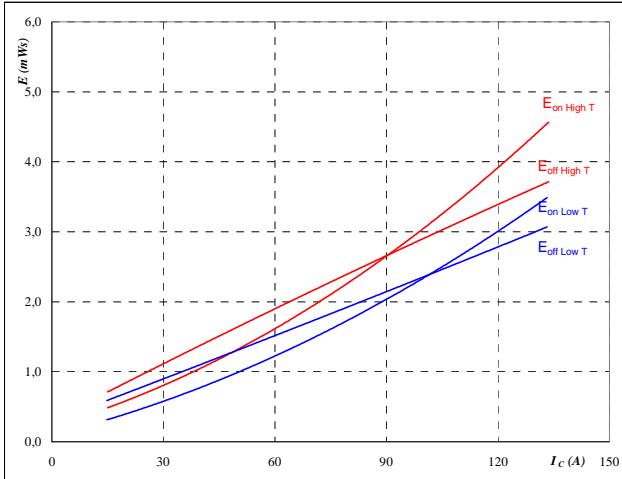


At
 $t_p = 250 \mu s$

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 5 T1,T2,T3,T4,T5,T6,T7 IGBT

**Typical switching energy losses
as a function of collector current**

$$E = f(I_C)$$



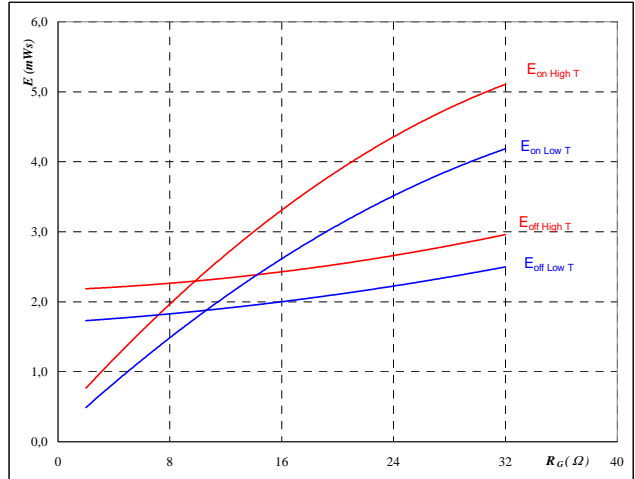
With an inductive load at

$T_J =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

Figure 6 T1,T2,T3,T4,T5,T6,T7 IGBT

**Typical switching energy losses
as a function of gate resistor**

$$E = f(R_G)$$



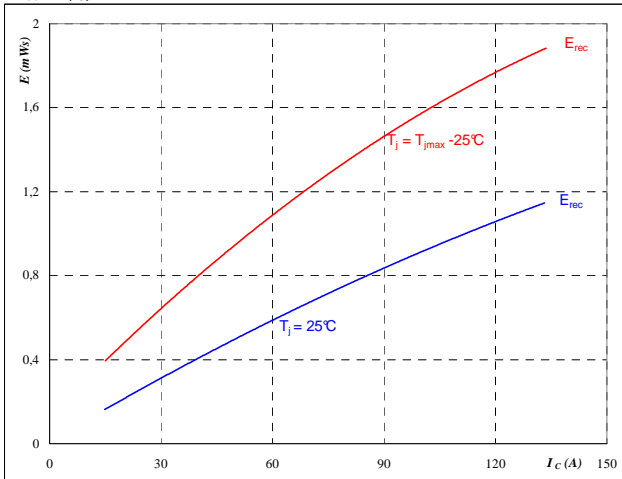
With an inductive load at

$T_J =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Figure 7 T1,T2,T3,T4,T5,T6,T7 IGBT

**Typical reverse recovery energy loss
as a function of collector current**

$$E_{rec} = f(I_C)$$



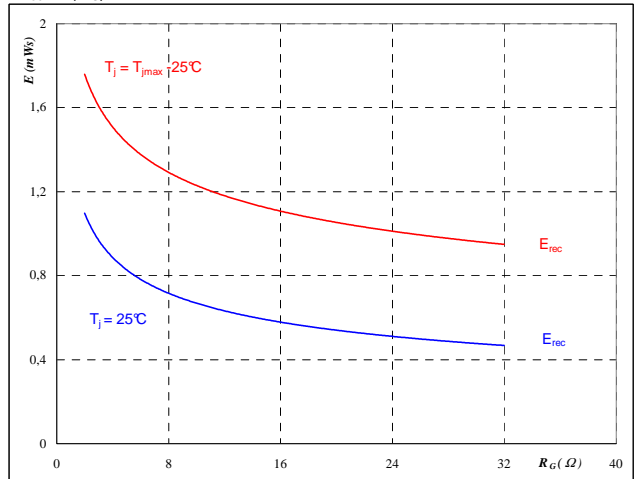
With an inductive load at

$T_J =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 8 T1,T2,T3,T4,T5,T6,T7 IGBT

**Typical reverse recovery energy loss
as a function of gate resistor**

$$E_{rec} = f(R_G)$$



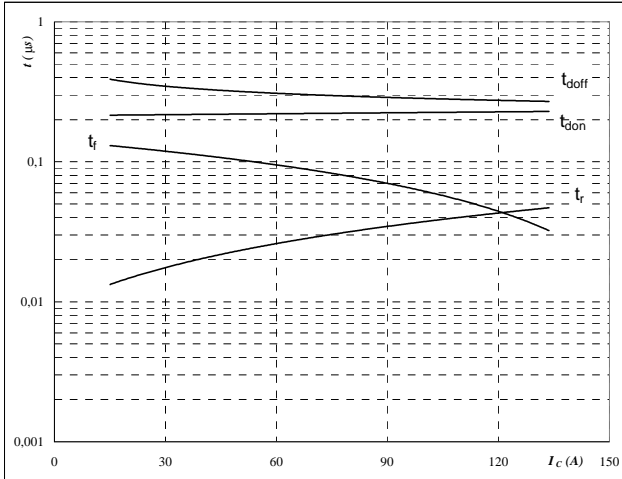
With an inductive load at

$T_J =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 9 T1,T2,T3,T4,T5,T6,T7 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



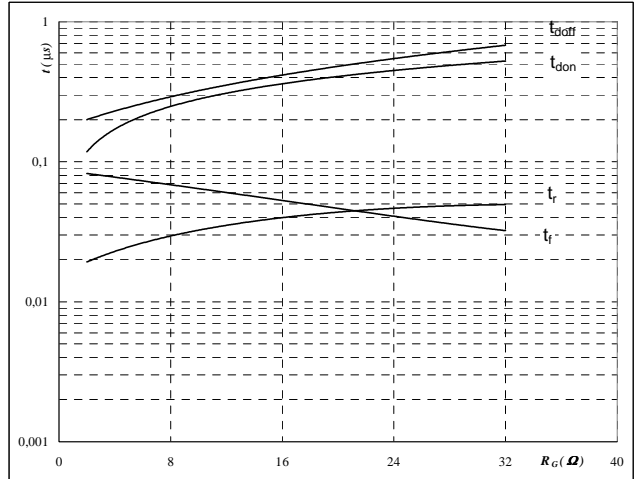
With an inductive load at

$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

Figure 10 T1,T2,T3,T4,T5,T6,T7 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



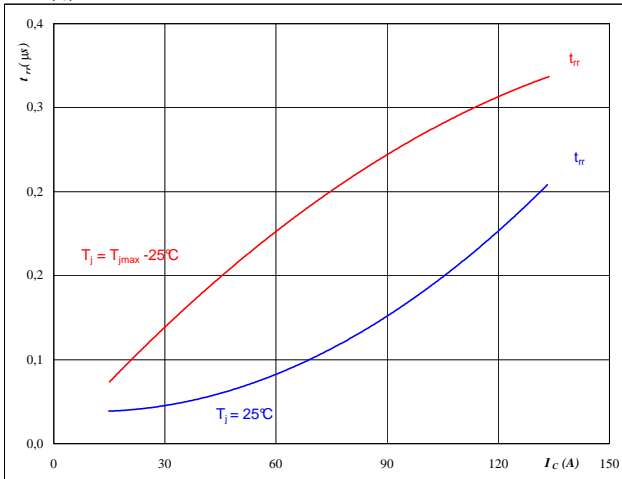
With an inductive load at

$T_j =$	125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Figure 11 D1,D2,D3,D4,D5,D6,D7 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

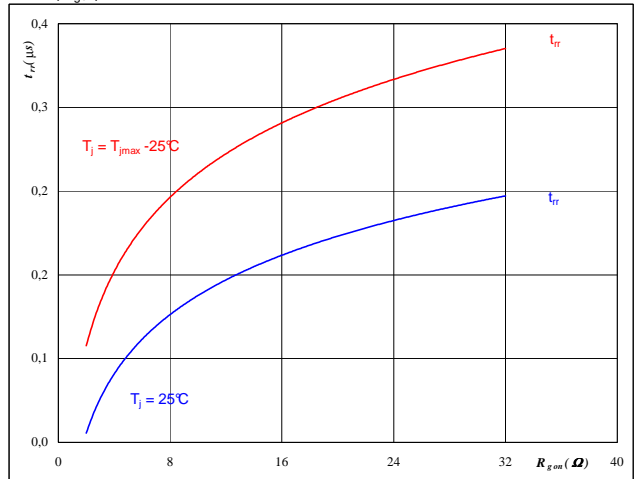

At

$T_j =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 12 D1,D2,D3,D4,D5,D6,D7 FWD

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

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

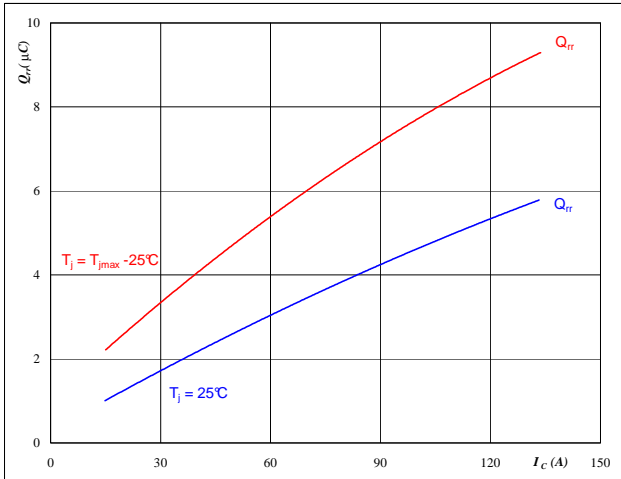

At

$T_j =$	25/125	°C
$V_R =$	300	V
$I_F =$	75	A
$V_{GE} =$	±15	V

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 13 D1,D2,D3,D4,D5,D6,D7 FWD

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_C)$$

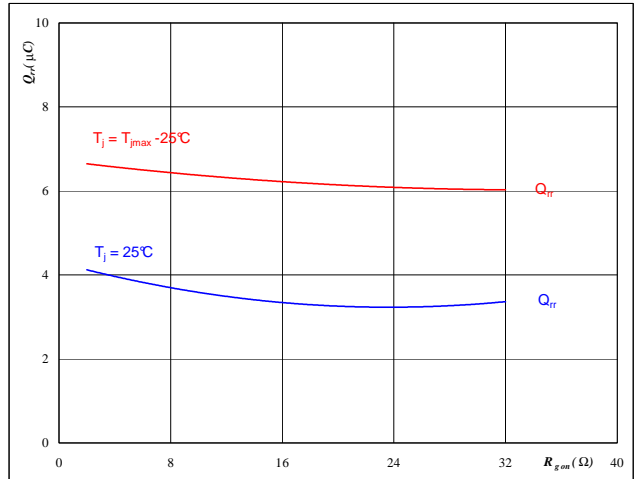

At

$T_j =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 14 D1,D2,D3,D4,D5,D6,D7 FWD

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

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

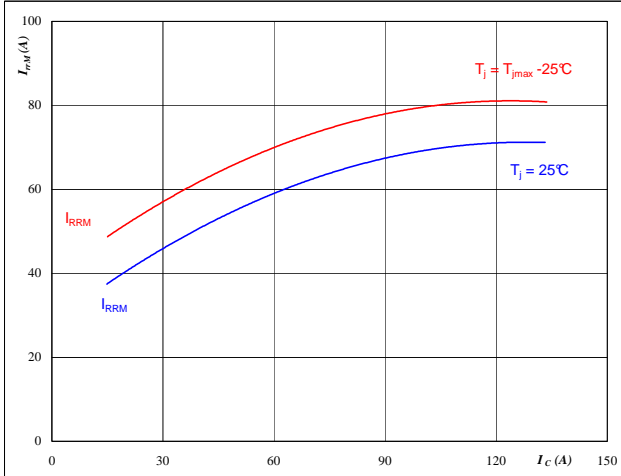

At

$T_j =$	25/125	°C
$V_R =$	300	V
$I_F =$	75	A
$V_{GE} =$	±15	V

Figure 15 D1,D2,D3,D4,D5,D6,D7 FWD

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_C)$$

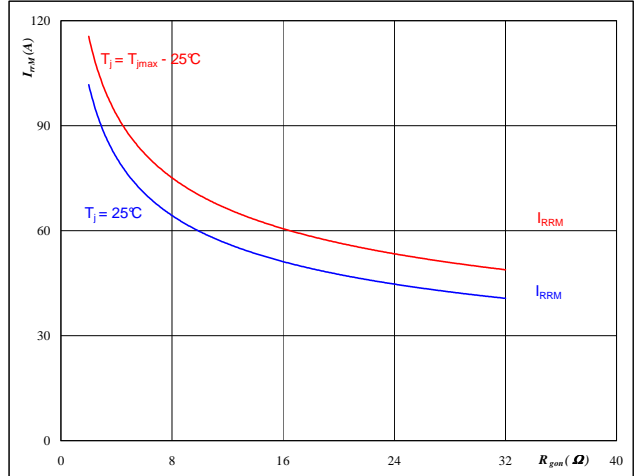

At

$T_j =$	25/125	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 16 D1,D2,D3,D4,D5,D6,D7 FWD

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

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


At

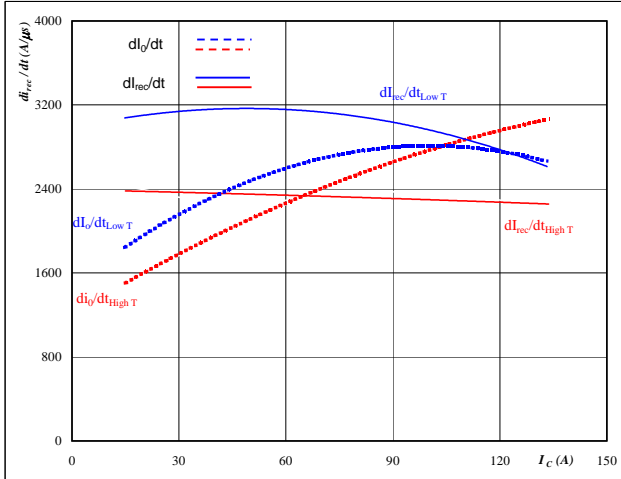
$T_j =$	25/125	°C
$V_R =$	300	V
$I_F =$	75	A
$V_{GE} =$	±15	V

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7

Figure 17 D1,D2,D3,D4,D5,D6,D7 FWD

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

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

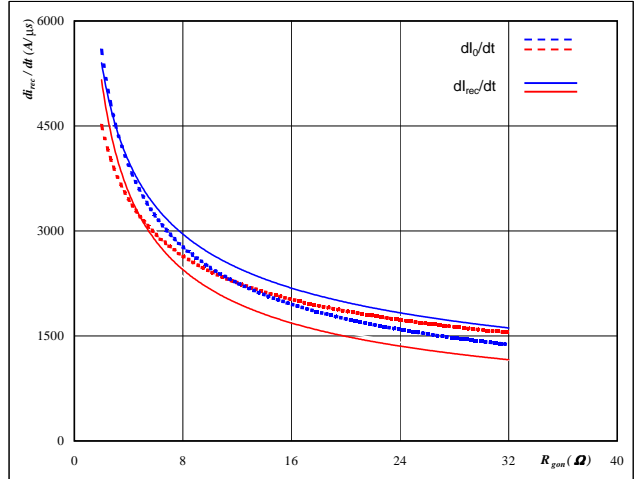


At
 $T_j = 25/125$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

Figure 18 D1,D2,D3,D4,D5,D6,D7 FWD

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

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

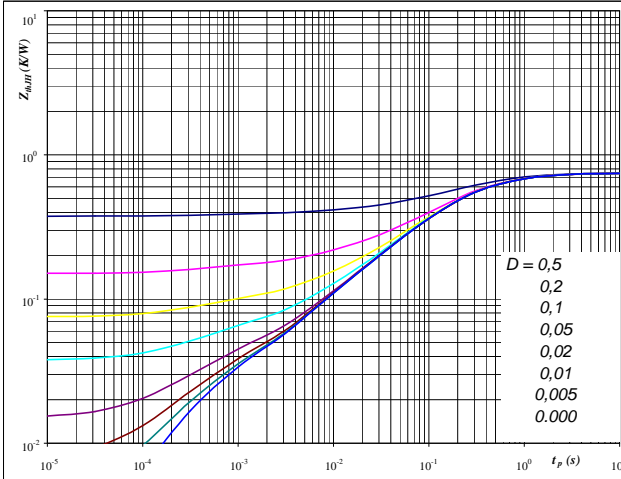


At
 $T_j = 25/125$ °C
 $V_R = 300$ V
 $I_F = 75$ A
 $V_{GE} = \pm 15$ V

Figure 19 T1,T2,T3,T4,T5,T6,T7 IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At
 $D = t_p / T$
 $R_{thJH} = 0,75$ K/W

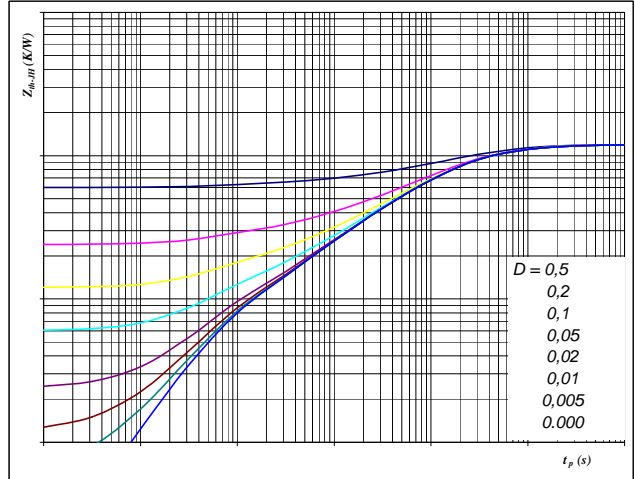
IGBT thermal model values

Thermal grease R (C/W)	Tau (s)
0,02	9,4E+00
0,12	1,1E+00
0,41	2,1E-01
0,14	4,0E-02
0,04	6,3E-03
0,02	4,0E-04

Figure 20 D1,D2,D3,D4,D5,D6,D7 FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At
 $D = t_p / T$
 $R_{thJH} = 1,20$ K/W

FWD thermal model values

Thermal grease R (C/W)	Tau (s)
0,02	9,9E+00
0,19	1,0E+00
0,54	1,8E-01
0,27	3,4E-02
0,11	6,0E-03
0,07	6,5E-04

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 21 T1,T2,T3,T4,T5,T6,T7 IGBT

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_h)$$

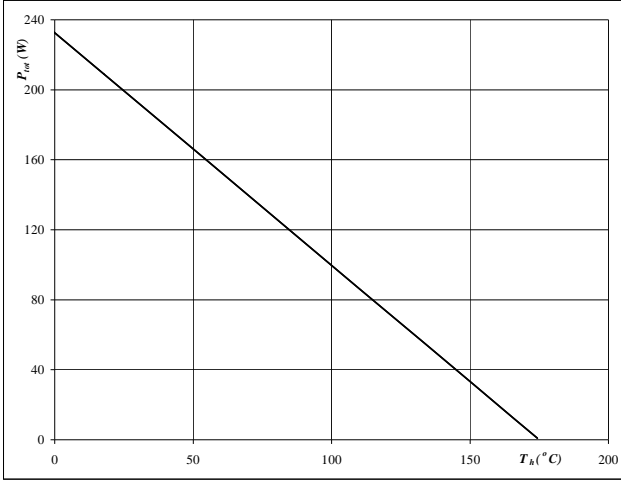

At
 $T_j = 175$ °C

Figure 22 T1,T2,T3,T4,T5,T6,T7 IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$

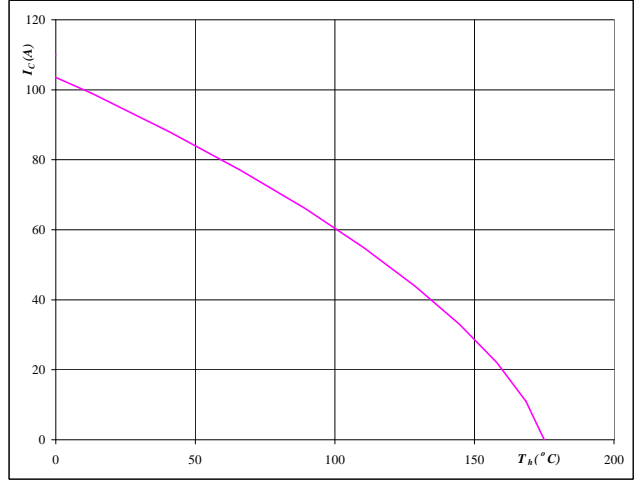

At
 $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 23 D1,D2,D3,D4,D5,D6,D7 FWD

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_h)$$

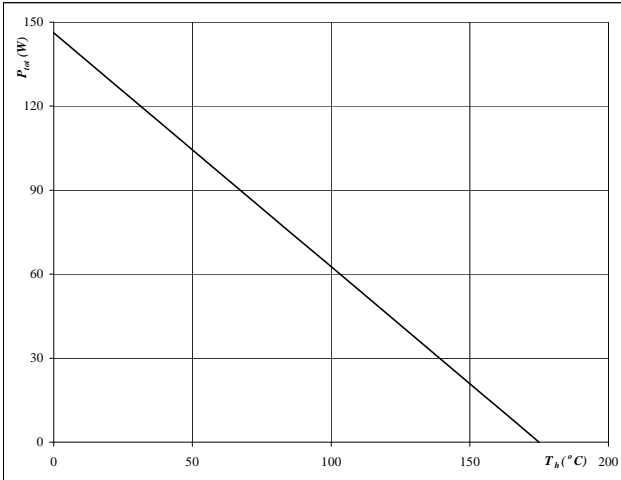
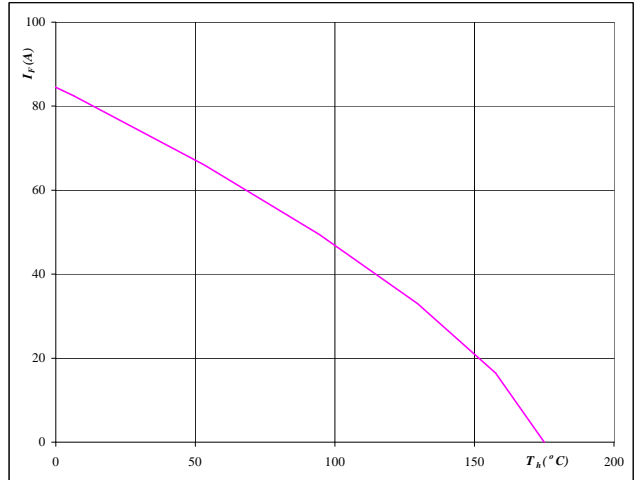

At
 $T_j = 175$ °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

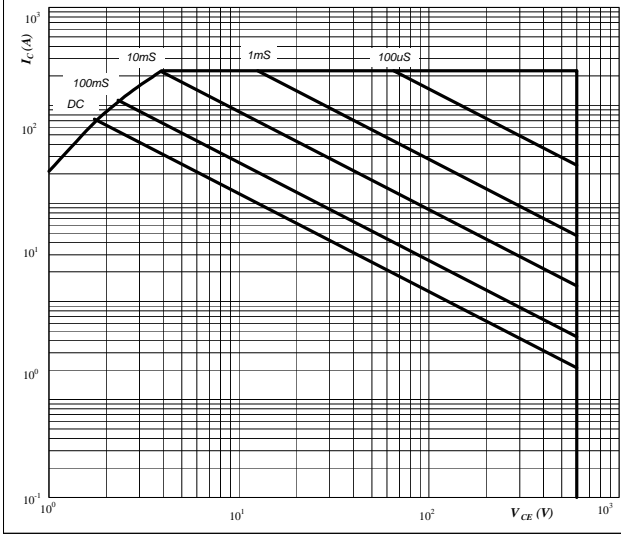
$$I_F = f(T_h)$$


At
 $T_j = 175$ °C

T1,T2,T3,T4,T5,T6,T7 / D1,D2,D3,D4,D5,D6,D7
Figure 25 T1,T2,T3,T4,T5,T6,T7 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

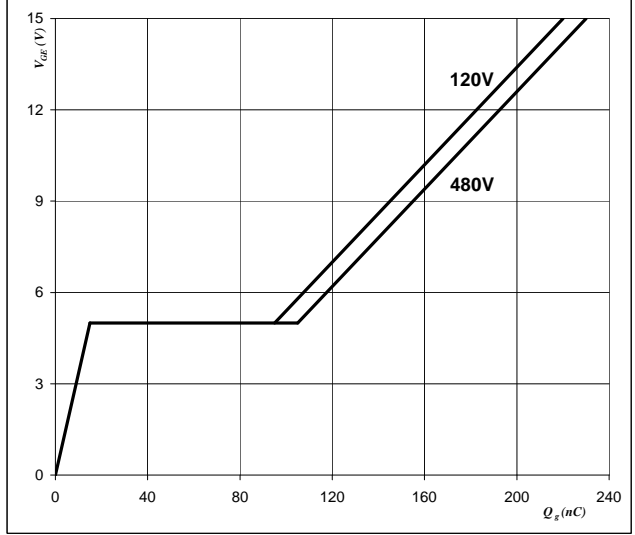


At
 D = single pulse
 T_h = 80 °C
 V_{GE} = ±15 V
 T_j = T_{jmax} °C

Figure 26 T1,T2,T3,T4,T5,T6,T7 IGBT

Gate voltage vs Gate charge

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

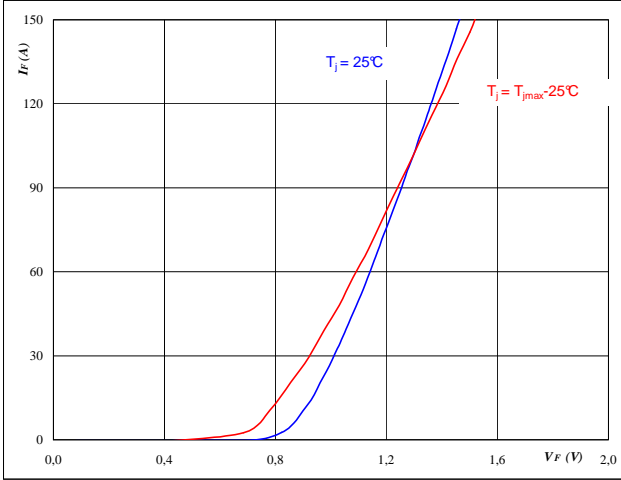


At
 I_C = 75 A

D8,D9,D10,D11,D12,D13
Figure 1 D8,D9,D10,D11,D12,D13 diode

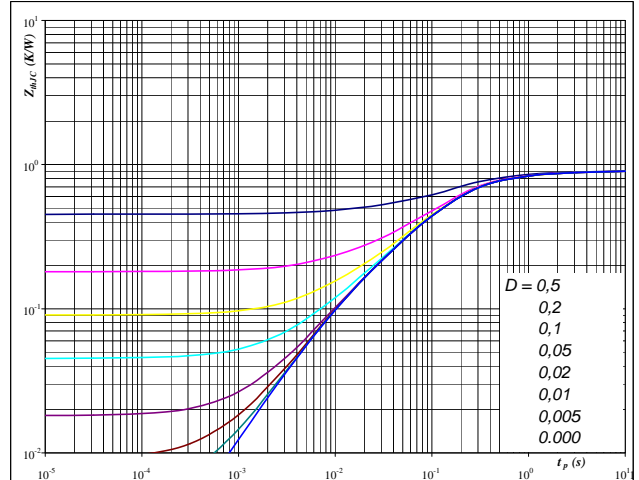
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$


At
 $t_p = 250 \mu s$
Figure 2 D8,D9,D10,D11,D12,D13 diode

Diode transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(t_p)$$


At
 $D = t_p / T$
 $R_{thJH} = 0,90 \text{ K/W}$
Figure 3 D8,D9,D10,D11,D12,D13 diode

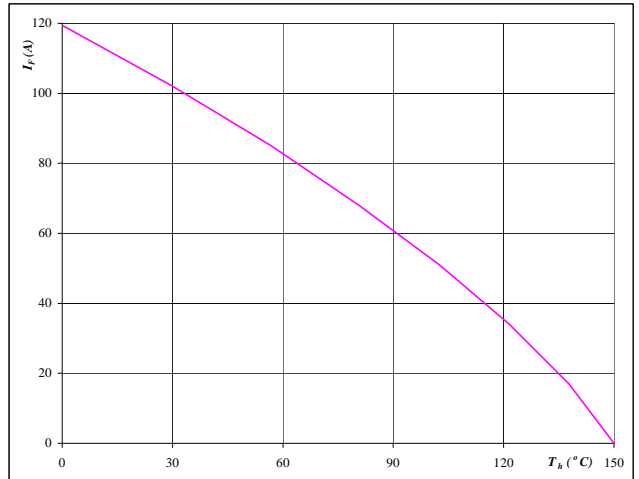
Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_h)$$


At
 $T_j = 150 \text{ °C}$
Figure 4 D8,D9,D10,D11,D12,D13 diode

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$

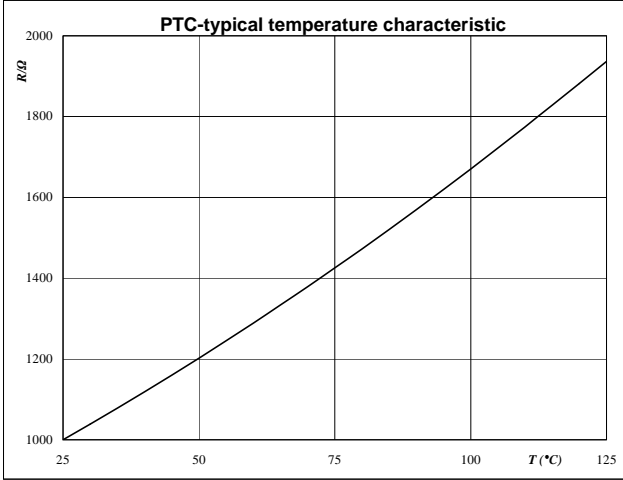

At
 $T_j = 150 \text{ °C}$

Thermistor

Figure 1 Thermistor

Typical PTC characteristic
as a function of temperature

$$R_T = f(T)$$

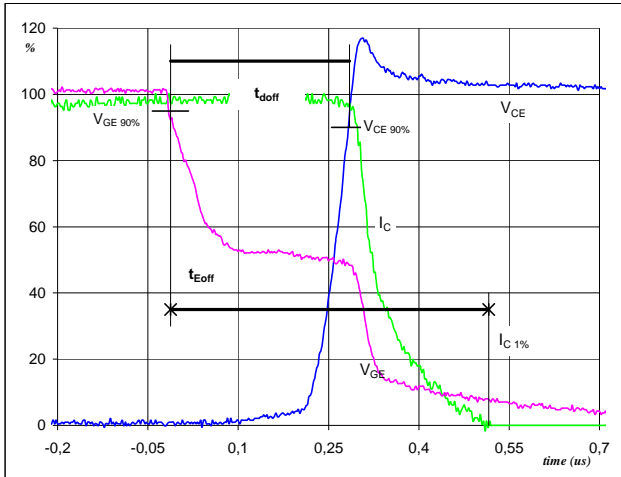


Switching Definitions Output Inverter

General conditions	
T_j	= 125 °C
R_{gon}	= 8 Ω
R_{goff}	= 8 Ω

Figure 1 Output inverter IGBT

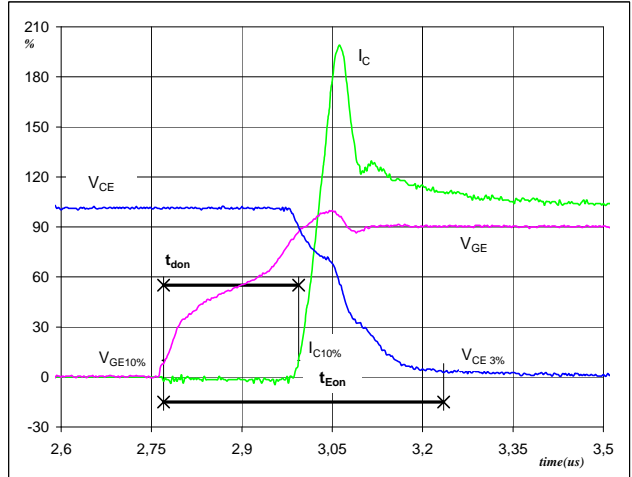
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_{doff} =$	0,29	μs
$t_{Eoff} =$	0,53	μs

Figure 2 Output inverter IGBT

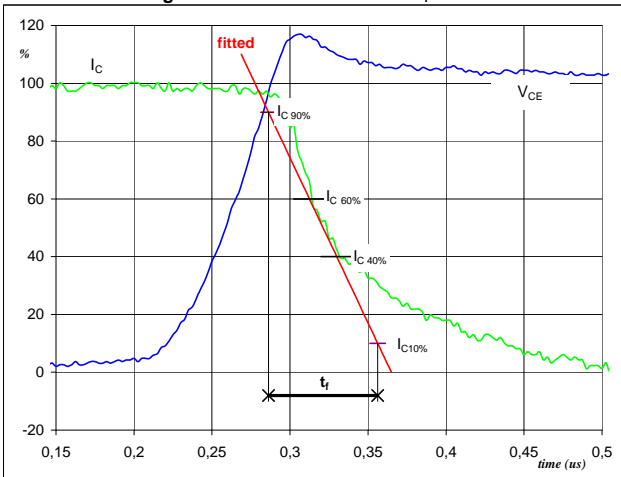
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_{don} =$	0,22	μs
$t_{Eon} =$	0,47	μs

Figure 3 Output inverter IGBT

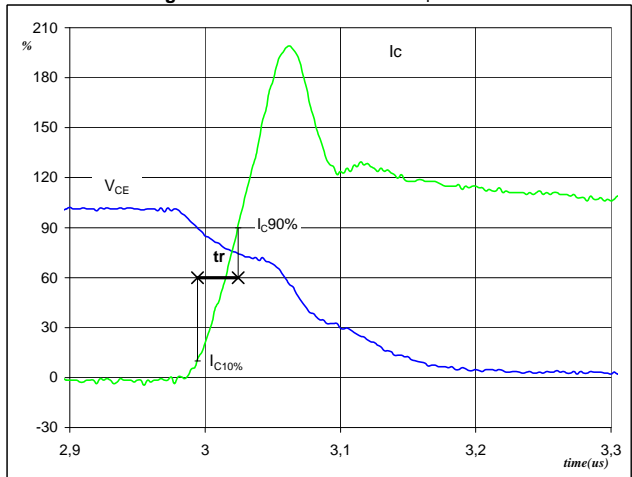
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_f =$	0,08	μs

Figure 4 Output inverter IGBT

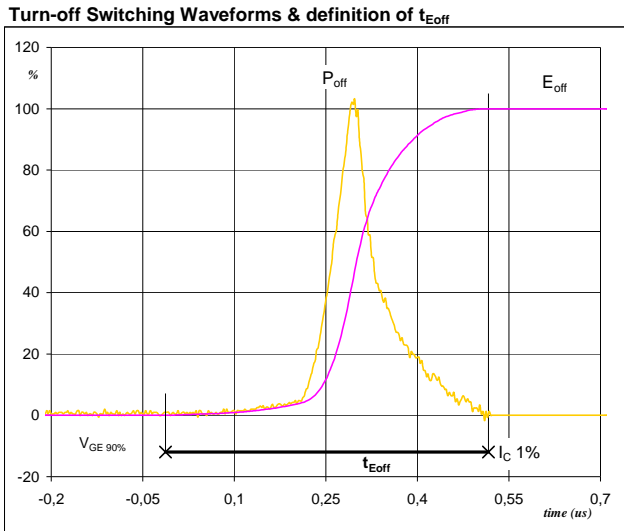
Turn-on Switching Waveforms & definition of t_r



$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_r =$	0,03	μs

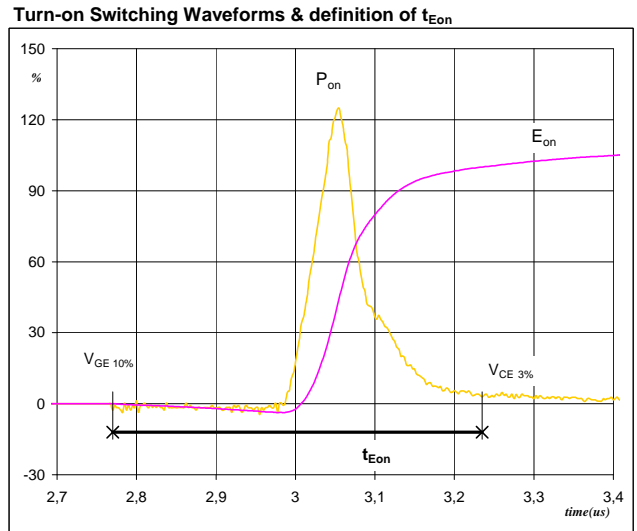
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT



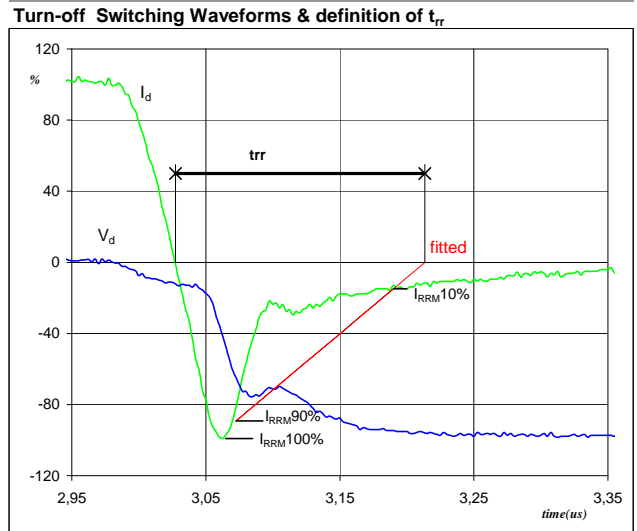
$P_{off} (100\%) = 22,50 \text{ kW}$
 $E_{off} (100\%) = 2,24 \text{ mJ}$
 $t_{Eoff} = 0,53 \text{ } \mu\text{s}$

Figure 6 Output inverter IGBT



$P_{on} (100\%) = 22,50 \text{ kW}$
 $E_{on} (100\%) = 2,07 \text{ mJ}$
 $t_{Eon} = 0,47 \text{ } \mu\text{s}$

Figure 7 Output inverter FWD

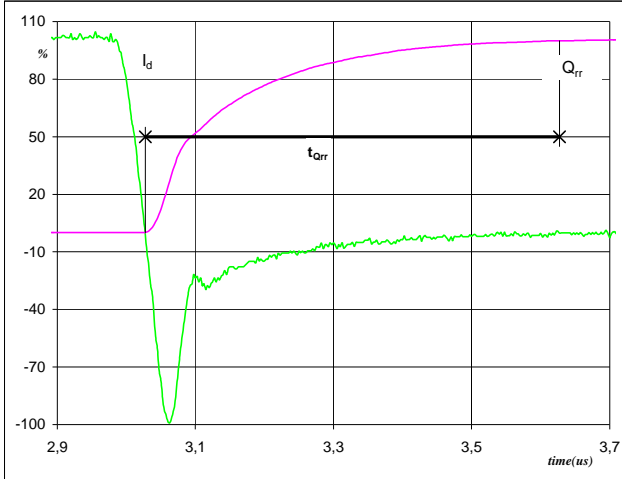


$V_d (100\%) = 300 \text{ V}$
 $I_d (100\%) = 75 \text{ A}$
 $I_{RRM} (100\%) = 75 \text{ A}$
 $t_{rr} = 0,26 \text{ } \mu\text{s}$

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

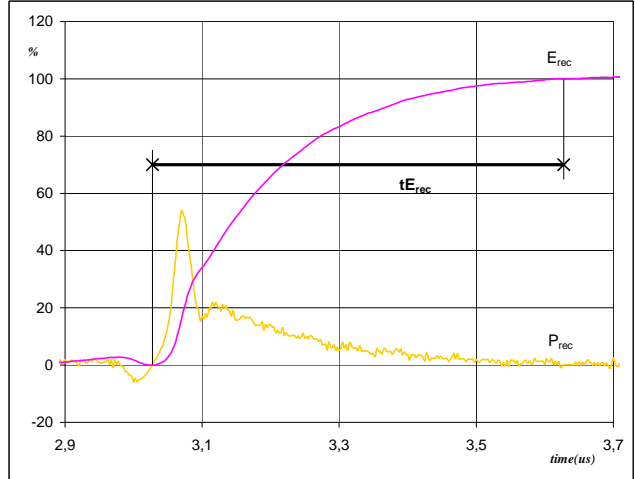
Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	75	A
Q_{rr} (100%) =	6,47	μC
t_{Qrr} =	0,60	μs

Figure 9 Output inverter FWD

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



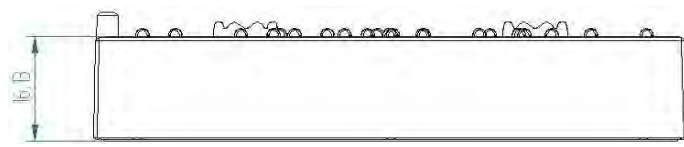
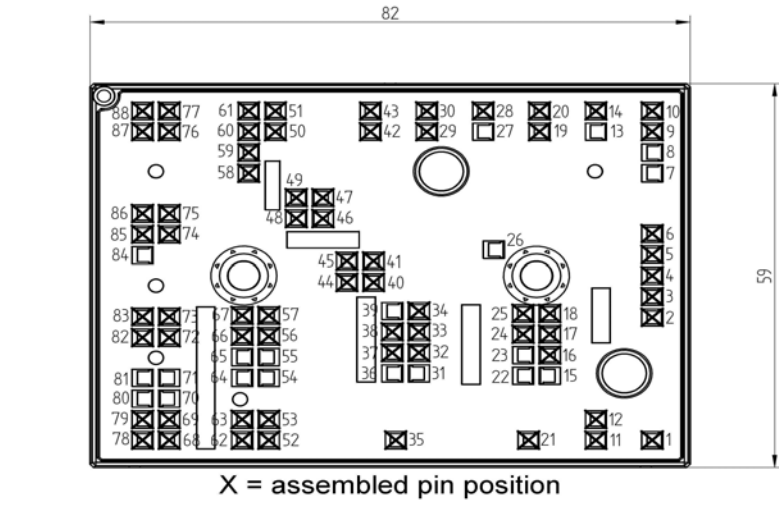
P_{rec} (100%) =	22,50	kW
E_{rec} (100%) =	1,33	mJ
t_{Erec} =	0,60	μs

Ordering Code and Marking - Outline - Pinout

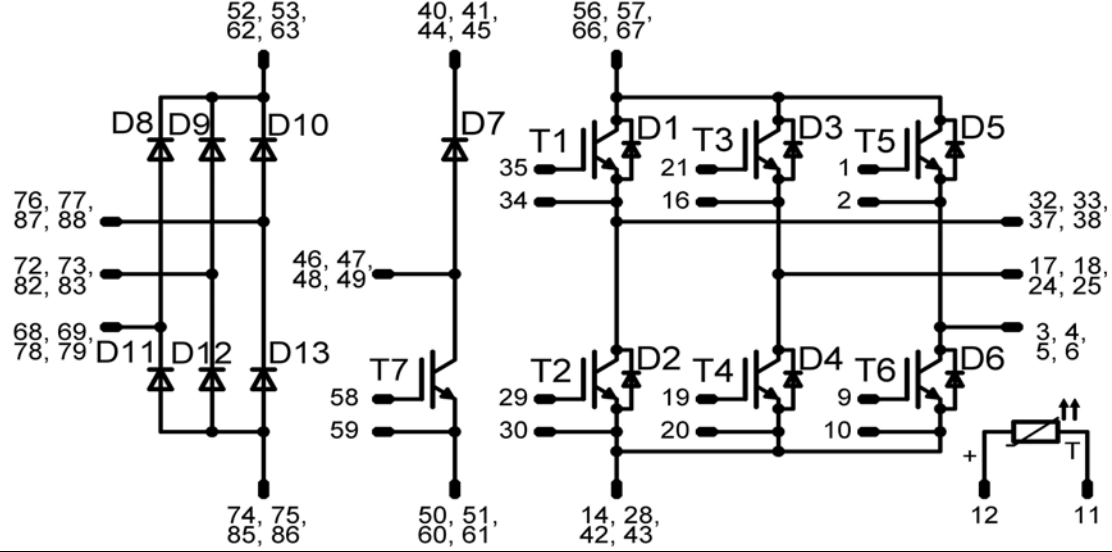
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V23990-K32-T-PM)	V23990-K242-A-/0A/-PM	K242A	K242A-/0A/
with std lid (black V23990-K32-T-PM) and P12	V23990-K242-A-/1A/-PM	K242A	K242A-/1A/
with thin lid (white V23990-K33-T-PM)	V23990-K242-A-/0B/-PM	K242A	K242A-/0B/
with thin lid (white V23990-K33-T-PM) and P12	V23990-K242-A-/1B/-PM	K242A	K242A-/1B/

Outline



Pinout



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