
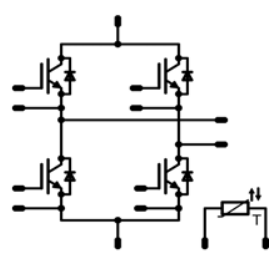


<i>fastPACK 0 H 2nd gen</i>	<b>600V / 50A</b>
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px; background-color: #ffcc00; text-align: center;"><b>Features</b></div> <ul style="list-style-type: none"> <li>Low inductive design</li> <li>Clip-in PCB mounting</li> </ul> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px; background-color: #ffcc00; text-align: center;"><b>Target Applications</b></div> <ul style="list-style-type: none"> <li>Distributed Power Generation</li> <li>Welding</li> </ul> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px; background-color: #ffcc00; text-align: center;"><b>Types</b></div> <ul style="list-style-type: none"> <li>V23990-P623-F24</li> </ul>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px; background-color: #ffcc00; text-align: center;"><b>flow0 housing</b></div> <div style="text-align: center;">  </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px; background-color: #ffcc00; text-align: center;"><b>Schematic</b></div> <div style="text-align: center;">  <p>P623-F24</p> </div>

### Maximum Ratings

Parameter	Symbol	Condition	Value	Unit
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#### Transistor H-bridge (IGBT)

Collector-emitter break down voltage	$V_{CE}$		600	V	
DC collector current	$I_C$	$T_j = T_{j,max}$	$T_n = 80^\circ C$	43	A
			$T_c = 80^\circ C$	50	
Repetitive peak collector current	$I_{cpuls}$	tp limited by $T_{j,max}$	150	A	
Power dissipation per IGBT	$P_{tot}$	$T_j = T_{j,max}$	$T_n = 80^\circ C$	79	W
			$T_c = 80^\circ C$	120	
Gate-emitter peak voltage	$V_{GE}$		$\pm 20$	V	
SC withstand time*	$t_{SC}$	$T_j = 125^\circ C$ $V_{GE} = 15V$ $V_{CC} = 360V$	6	$\mu s$	
Maximum junction temperature	$T_{j,max}$		175	$^\circ C$	

\* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

#### Diode H-bridge

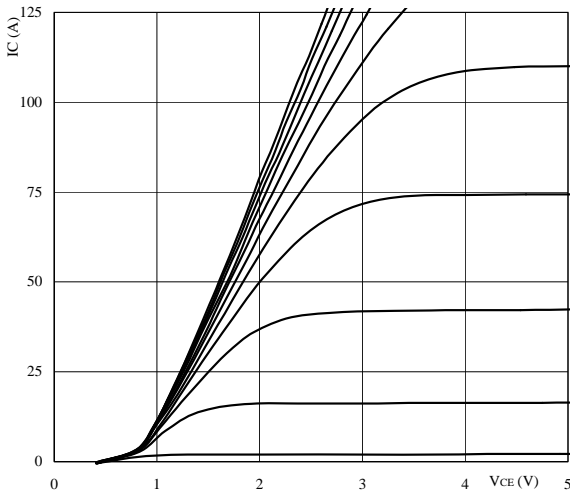
DC forward current	$I_F$	$T_j = T_{j,max}$	$T_n = 80^\circ C$	41	A
			$T_c = 80^\circ C$	50	
Repetitive peak forward current	$I_{FRM}$	tp limited by $T_{j,max}$	150	A	
Power dissipation per Diode	$P_{tot}$	$T_j = T_{j,max}$	$T_n = 80^\circ C$	64	W
			$T_c = 80^\circ C$	97	
Maximum junction temperature	$T_{j,max}$		175	$^\circ C$	

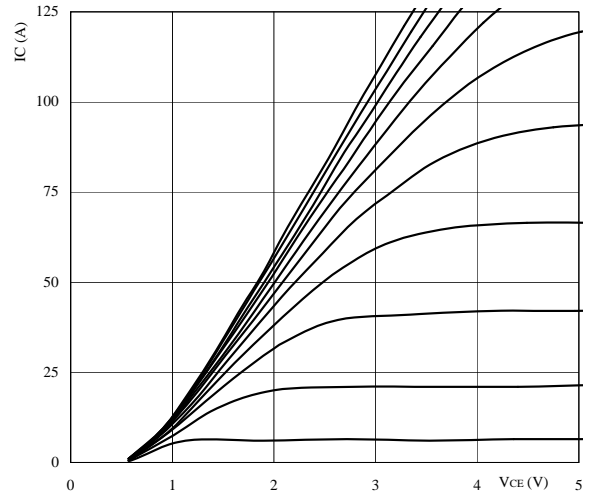
### Maximum Ratings

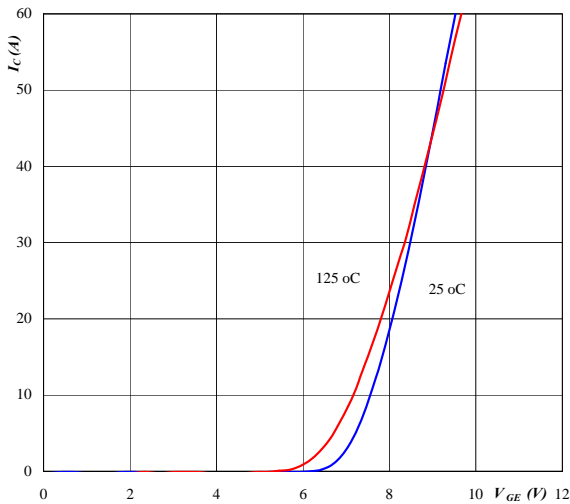
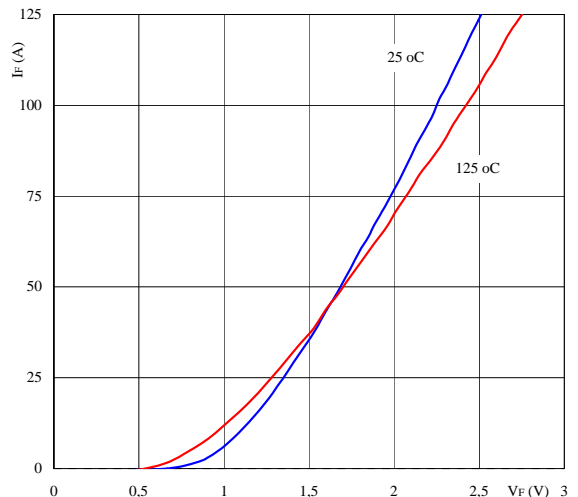
Parameter	Symbol	Condition	Value	Unit
<b>Thermal properties</b>				
Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature	$T_{op}$		-40...+125	°C
<b>Insulation properties</b>				
Insulation voltage	$V_{is}$	$t=1min$	4000	Vdc
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm

**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 $I_o(A)$	$T(C^\circ)$	Min	Typ	Max		
<b>Transistor H-bridge (IGBT)</b>										
Gate emitter threshold voltage	$V_{GE(th)}$	VGE=VCE			0,0008	Tj=25°C Tj=125°C	4	5,8	7	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=125°C		1,64 1,9	2,35	V
Collector-emitter cut-off	$I_{CES}$		0	600		Tj=25°C Tj=125°C			0,35	mA
Gate-emitter leakage current	$I_{GES}$		20	0		Tj=25°C Tj=125°C			650	nA
Integrated Gate resistor	$R_{gint}$					Tj=25°C Tj=125°C		-		Ohm
Turn-on delay time	$t_{d(on)}$					Tj=25°C Tj=125°C		100		ns
Rise time	$t_r$					Tj=25°C Tj=125°C		15		ns
Turn-off delay time	$t_{d(off)}$	Rgoff=8 Ω Rgon=8 Ω	±15	300	50	Tj=25°C Tj=125°C		174		ns
Fall time	$t_f$					Tj=25°C Tj=125°C		96		ns
Turn-on energy loss per pulse	$E_{on}$					Tj=25°C Tj=125°C		0,5		mWs
Turn-off energy loss per pulse	$E_{off}$					Tj=25°C Tj=125°C		1,37		mWs
Input capacitance	$C_{ies}$					Tj=25°C Tj=125°C		3,14		nF
Output capacitance	$C_{oss}$	f=1MHz	0	25		Tj=25°C Tj=125°C		0,2		nF
Reverse transfer capacitance	$C_{rss}$					Tj=25°C Tj=125°C		0,09		nF
Gate charge	$Q_{Gate}$	Rgon=8 Ω Rgoff=8 Ω	±15	300	50	Tj=25°C Tj=125°C		518		nC
Thermal resistance chip to heatsink per chip	$R_{thJH}$	Thermal grease thickness≤50um						1,2		K/W
Thermal resistance chip to case per chip	$R_{thJC}$	λ = 0,61 W/mK								K/W
<b>Diode H-bridge</b>										
Diode forward voltage	$V_F$				50	Tj=25°C Tj=125°C		1,68 1,7	2,3	V
Peak reverse recovery current	$I_{RM}$					Tj=25°C Tj=125°C		89		A
Reverse recovery time	$t_{rr}$	Rgon=8 Ω di0/dt=4429 A/us	-15	300	50	Tj=25°C Tj=125°C		133		ns
Reverse recovery charge	$Q_{rr}$					Tj=25°C Tj=125°C		3,85		μC
Thermal resistance chip to heatsink per chip	$R_{thJH}$	Thermal grease thickness≤50um						1,48		K/W
Thermal resistance chip to case per chip	$R_{thJC}$	λ = 0,61 W/mK								K/W
<b>NTC Thermistor</b>										
Rated resistance	$R_{25}$					Tj=25°C	20,9	22	23,1	kOhm
Deviation of R100	$D_{R/R}$	R100=1503Ω				Tc=100°C		2,9		%/K
Power dissipation given Epcos-Type	$P$					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3980		K

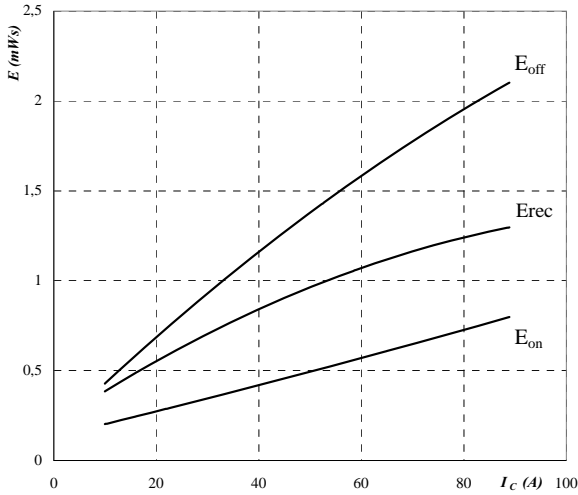
**Output inverter**
**Figure 1. Typical output characteristics**  
*Output inverter IGBT*  
 $I_c = f(V_{CE})$ 

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

**Figure 2. Typical output characteristics**  
*Output inverter IGBT*  
 $I_c = f(V_{CE})$ 

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

**Figure 3. Typical transfer characteristics**  
*Output inverter IGBT*  
 $I_c = f(V_{GE})$ 

 parameter:  $t_p = 250 \mu s$   $V_{CE} = 10 \text{ V}$ 
**Figure 4. Typical diode forward current as a function of forward voltage**  
*Output inverter FRED*  $I_F = f(V_F)$ 

 parameter:  $t_p = 250 \mu s$

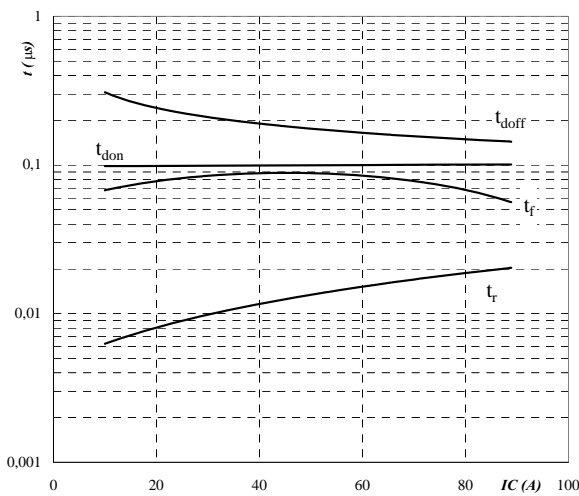
**Output inverter**

**Figure 5. Typical switching energy losses as a function of collector current**  
 Output inverter IGBT  
 $E = f(I_C)$



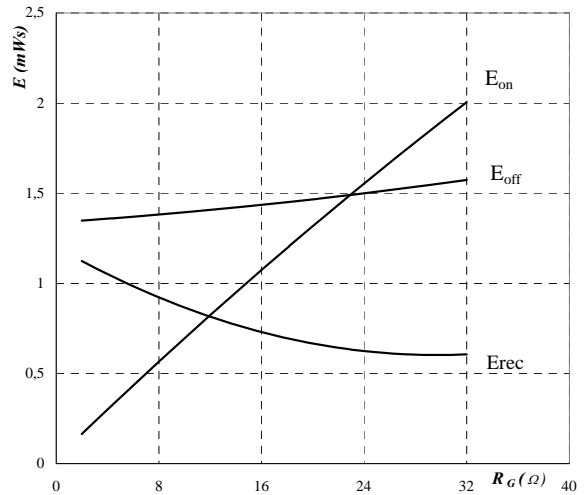
inductive load, Tj = 125 °C  
 VCE = 300 V  
 VGE = ±15 V  
 Rgon = 8 Ω  
 Rgoff = 8 Ω

**Figure 7. Typical switching times as a function of collector current**  
 Output inverter IGBT  
 $t = f(I_C)$



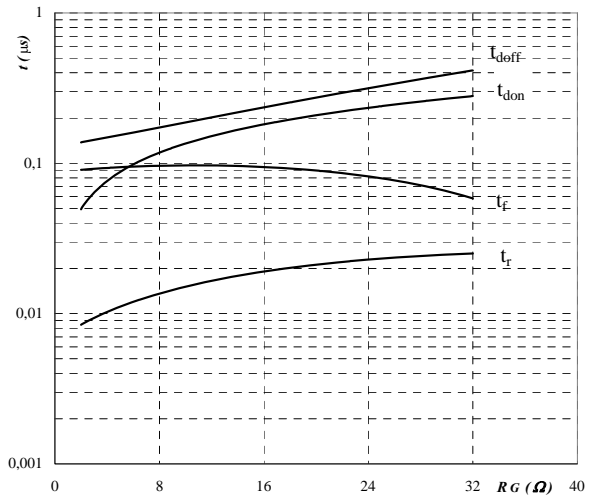
inductive load, Tj = 125 °C  
 VCE = 300 V  
 VGE = ±15 V  
 Rgon = 8 Ω  
 Rgoff = 8 Ω

**Figure 6. Typical switching energy losses as a function of gate resistor**  
 Output inverter IGBT  
 $E = f(R_G)$



inductive load, Tj = 125 °C  
 VCE = 300 V  
 VGE = ±15 V  
 Ic = 50 A

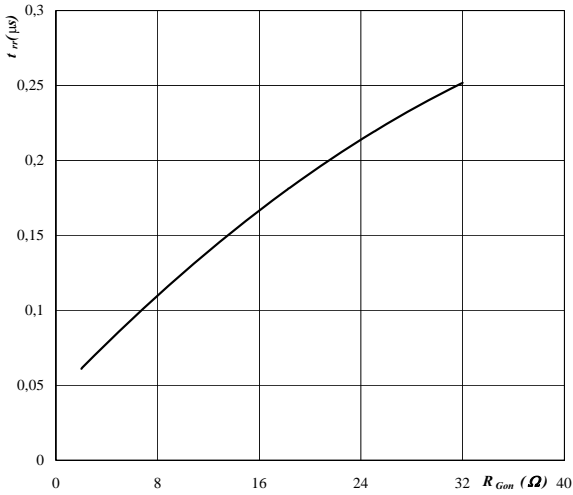
**Figure 8. Typical switching times as a function of gate resistor**  
 Output inverter IGBT  
 $t = f(R_G)$



inductive load, Tj = 125 °C  
 VCE = 300 V  
 VGE = ±15 V  
 Ic = 50 A

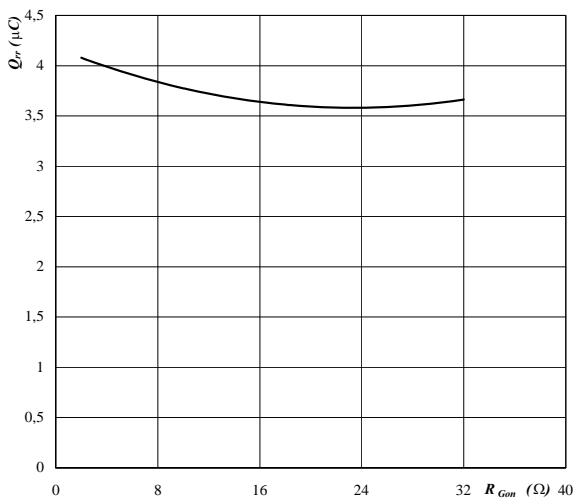
**Output inverter**

**Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor**  
*Output inverter FRED diode*  
 $t_{rr} = f(R_{gon})$



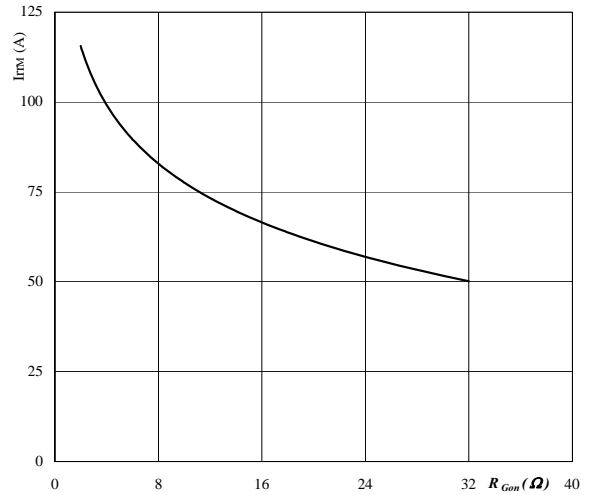
$T_j = 125\text{ }^\circ\text{C}$   
 $V_R = 300\text{ V}$   
 $I_F = 50\text{ A}$   
 $V_{GE} = \pm 15\text{ V}$

**Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor**  
*Output inverter FRED diode*  
 $Q_{rr} = f(R_{gon})$



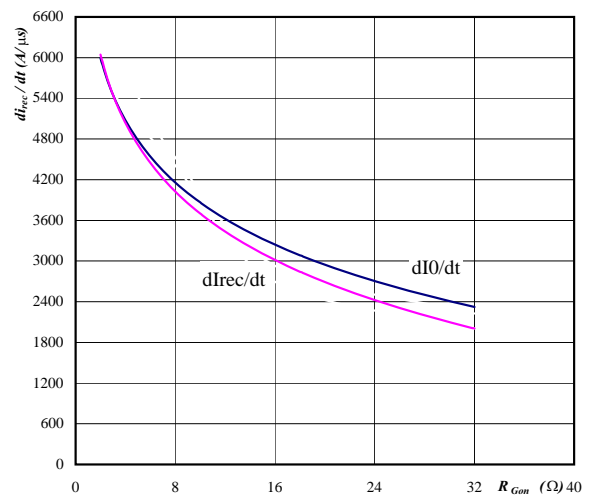
$T_j = 125\text{ }^\circ\text{C}$   
 $V_R = 300\text{ V}$   
 $I_F = 50\text{ A}$   
 $V_{GE} = \pm 15\text{ V}$

**Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor**  
*Output inverter FRED diode*  
 $I_{RRM} = f(R_{gon})$

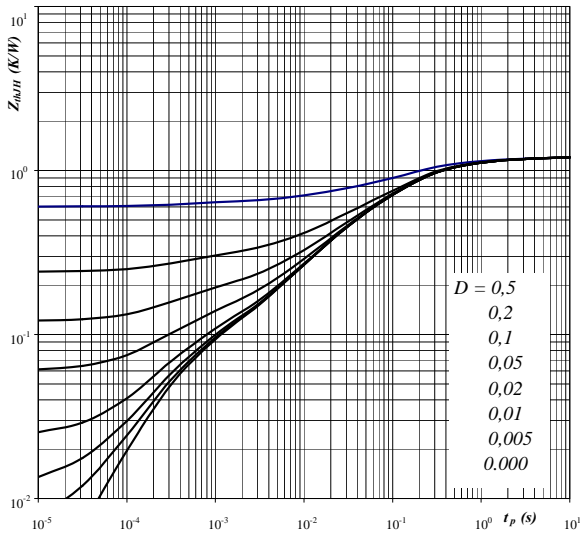


$T_j = 125\text{ }^\circ\text{C}$   
 $V_R = 300\text{ V}$   
 $I_F = 50\text{ A}$   
 $V_{GE} = \pm 15\text{ V}$

**Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**  
*Output inverter FRED diode*  
 $dI_{f0}/dt, dI_{rec}/dt = f(R_{gon})$

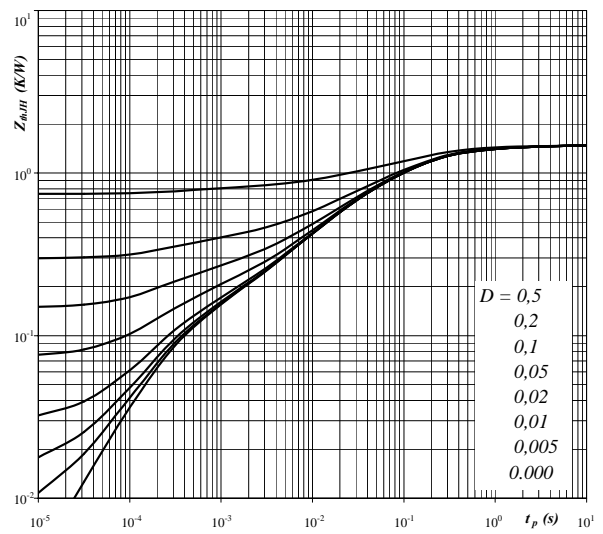


$T_j = 125\text{ }^\circ\text{C}$   
 $V_R = 300\text{ V}$   
 $I_F = 50\text{ A}$   
 $V_{GE} = \pm 15\text{ V}$

**Output inverter**
**Figure 13. IGBT transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$ 

 Parameter:  $D = t_p / T$        $R_{thJH} = 1,20 \text{ K/W}$ 

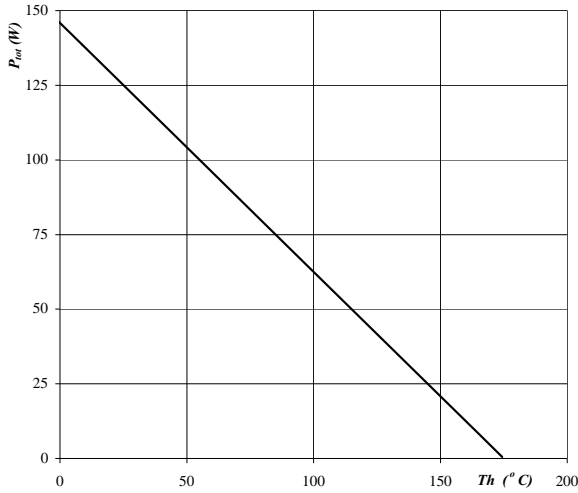
## IGBT thermal model values

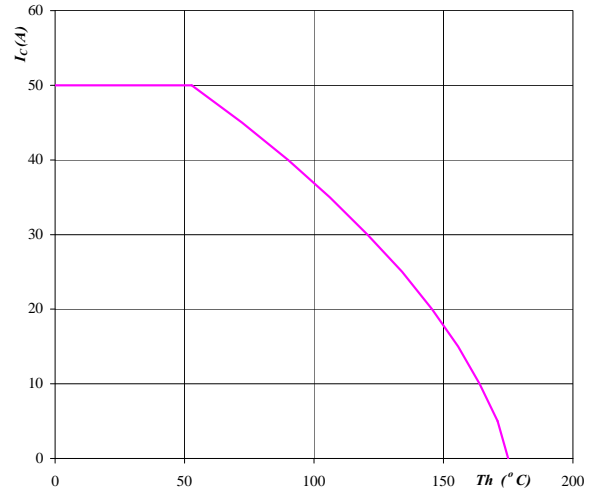
R (C/W)	Tau (s)
0,07	3,9E+00
0,21	5,8E-01
0,54	1,3E-01
0,25	2,1E-02
0,07	3,5E-03
0,06	3,5E-04
0,00	0,0E+00
0,00	0,0E+00
0,00	0,0E+00
0,00	0,0E+00

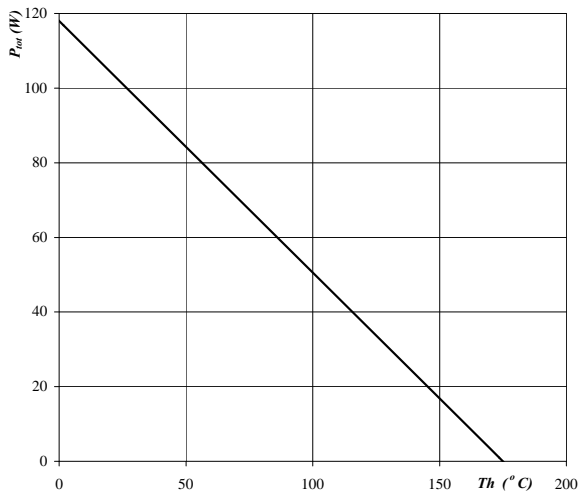
**Figure 14. FRED transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$ 

 Parameter:  $D = t_p / T$        $R_{thJH} = 1,48 \text{ K/W}$ 

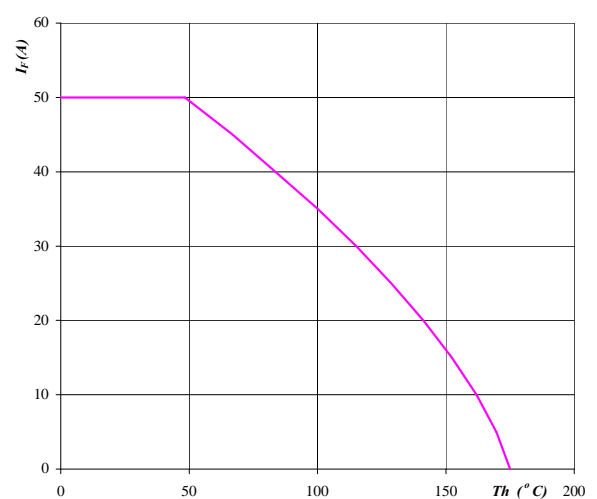
## FRED thermal model values

R (C/W)	Tau (s)
0,08	2,9E+00
0,26	3,7E-01
0,62	8,7E-02
0,33	1,5E-02
0,09	2,5E-03
0,10	2,8E-04
0,00	0,0E+00
0,00	0,0E+00
0,00	0,0E+00
0,00	0,0E+00

**Output inverter**
**Figure 15. Power dissipation as a function of heatsink temperature**
*Output inverter IGBT*  
 $P_{tot} = f(T_h)$ 

 parameter: T<sub>j</sub> = 175 °C

**Figure 16. Collector current as a function of heatsink temperature**
*Output inverter IGBT*  
 $I_c = f(T_h)$ 

 parameter: T<sub>j</sub> = 175 °C  
 V<sub>GE</sub> = 15 V

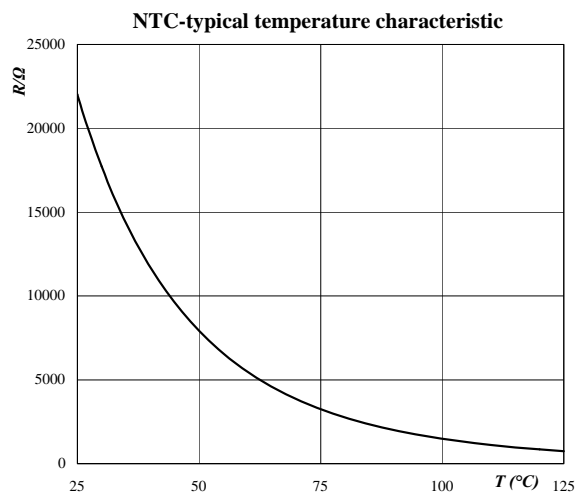
**Figure 17. Power dissipation as a function of heatsink temperature**
*Output inverter FRED*  
 $P_{tot} = f(T_h)$ 

 parameter: T<sub>j</sub> = 175 °C

**Figure 18. Forward current as a function of heatsink temperature**
*Output inverter FRED*  
 $I_F = f(T_h)$ 

 parameter: T<sub>j</sub> = 175 °C

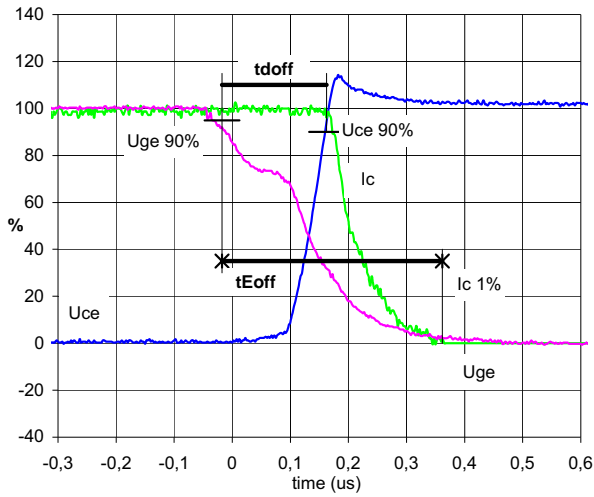


**Thermistor****Figure 1. Typical NTC characteristic  
as a function of temperature**

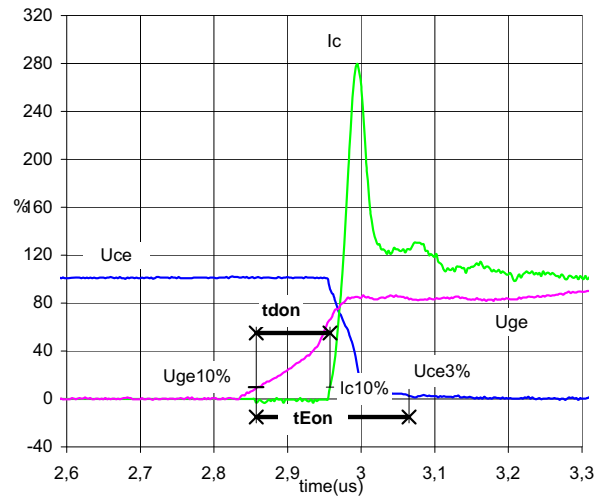
$$R_T = f(T)$$



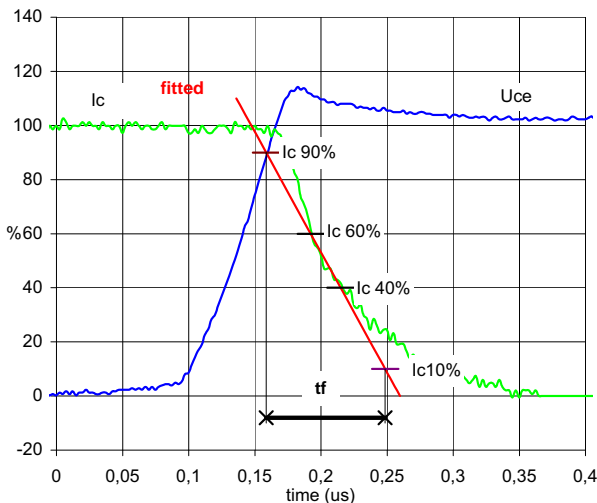
**Switching definitions**

 General conditions:  $T_j = 125\text{ }^\circ\text{C}$ 
 $R_{gon} = 8\ \Omega$        $R_{goff} = 8\ \Omega$ 
**Figure 1. Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$**   
 ( $t_{Eoff}$  = integrating time for  $E_{off}$ )  
 Output inverter IGBT


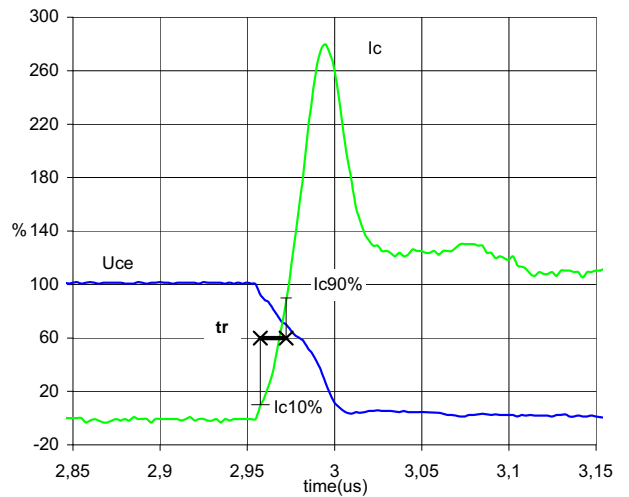
$U_{ge}(0\%) = -15\text{ V}$   
 $U_{ge}(100\%) = 15\text{ V}$   
 $U_c(100\%) = 300\text{ V}$   
 $I_c(100\%) = 50\text{ A}$   
 $t_{doff} = 0,17\ \mu\text{s}$   
 $t_{Eoff} = 0,38\ \mu\text{s}$

**Figure 2. Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$**   
 ( $t_{Eon}$  = integrating time for  $E_{on}$ )  
 Output inverter IGBT


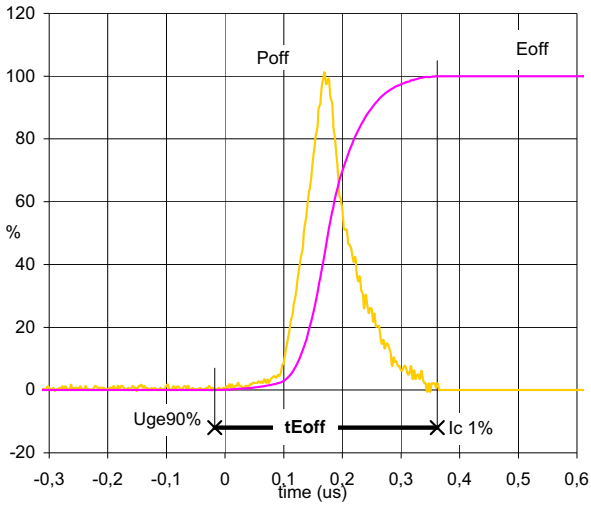
$U_{ge}(0\%) = -15\text{ V}$   
 $U_{ge}(100\%) = 15\text{ V}$   
 $U_c(100\%) = 300\text{ V}$   
 $I_c(100\%) = 50\text{ A}$   
 $t_{don} = 0,10\ \mu\text{s}$   
 $t_{Eon} = 0,21\ \mu\text{s}$

**Figure 3. Turn-off Switching Waveforms & definition of  $t_f$**   
 Output inverter IGBT


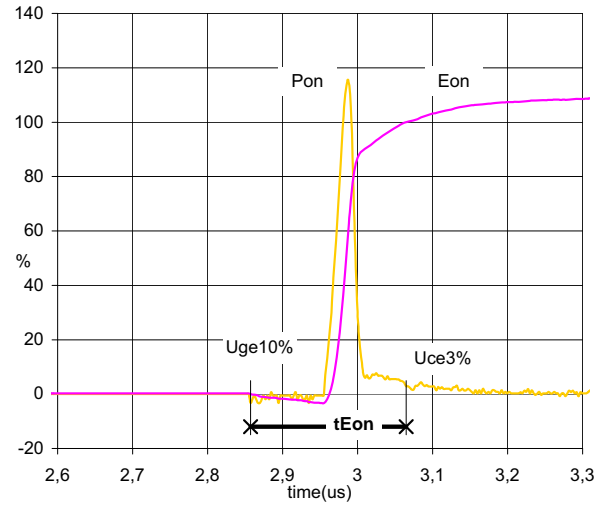
$U_c(100\%) = 300\text{ V}$   
 $I_c(100\%) = 50\text{ A}$   
 $t_f = 0,096\ \mu\text{s}$

**Figure 4. Turn-on Switching Waveforms & definition of  $t_r$**   
 Output inverter IGBT


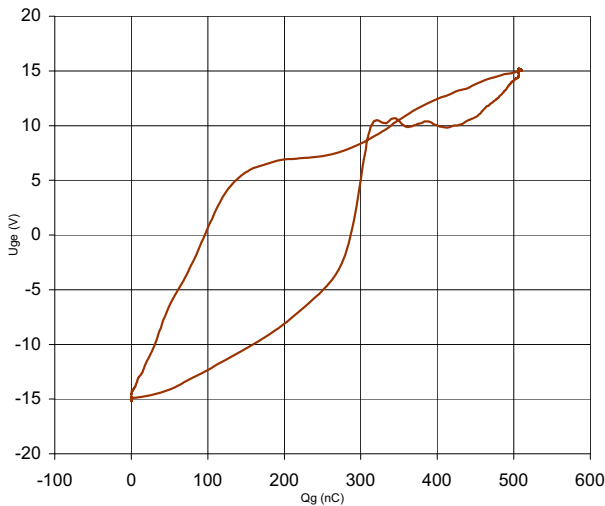
$U_c(100\%) = 300\text{ V}$   
 $I_c(100\%) = 50\text{ A}$   
 $t_r = 0,015\ \mu\text{s}$

**Switching definitions**
**Figure 5. Turn-off Switching Waveforms & definition of  $t_{Eoff}$**   
*Output inverter IGBT*


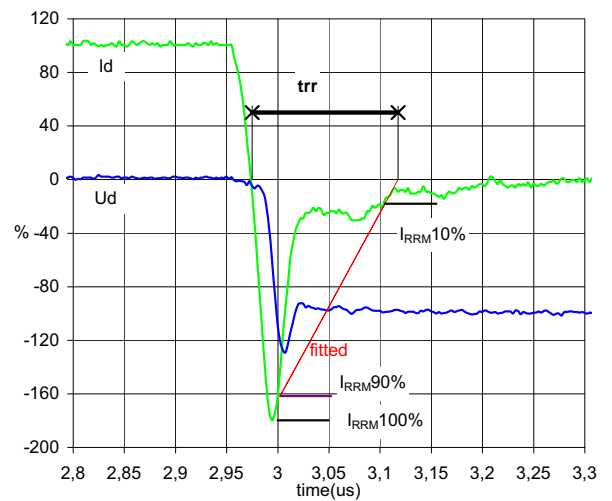
$P_{off}(100\%) = 14,89 \text{ kW}$   
 $E_{off}(100\%) = 1,38 \text{ mJ}$   
 $t_{Eoff} = 0,38 \text{ us}$

**Figure 6. Turn-on Switching Waveforms & definition of  $t_{Eon}$**   
*Output inverter IGBT*


$P_{on}(100\%) = 14,9 \text{ kW}$   
 $E_{on}(100\%) = 0,50 \text{ mJ}$   
 $t_{Eon} = 0,21 \text{ us}$

**Figure 7. Gate voltage vs Gate charge**  
*Output inverter IGBT*


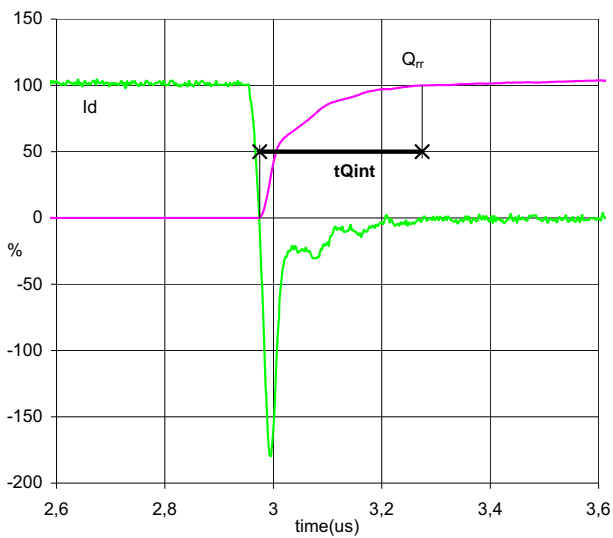
$U_{geoff} = -15 \text{ V}$   
 $U_{geon} = 15 \text{ V}$   
 $U_{c}(100\%) = 300 \text{ V}$   
 $I_{c}(100\%) = 50 \text{ A}$   
 $Q_g = 509,8 \text{ nC}$

**Figure 8. Turn-off Switching Waveforms & definition of  $t_{rr}$**   
*Output inverter FRED*


$U_d(100\%) = 300 \text{ V}$   
 $I_d(100\%) = 50 \text{ A}$   
 $I_{RRM}(100\%) = 89 \text{ A}$   
 $t_{rr} = 0,13 \text{ us}$

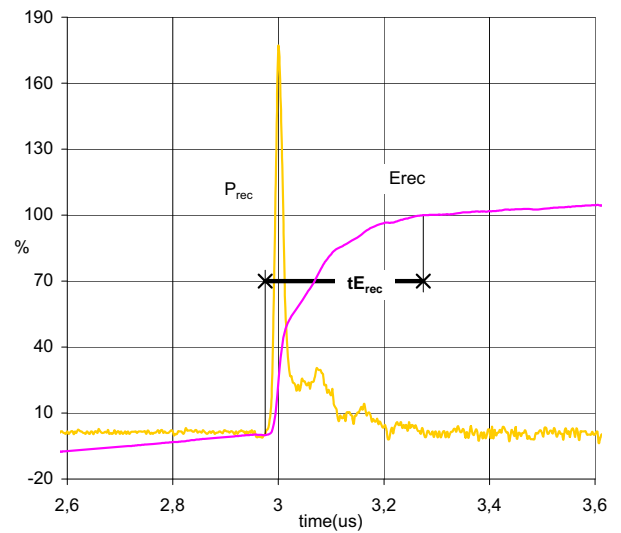
**Switching definitions**

**Figure 9. Turn-on Switching Waveforms & definition of  $t_{Qrr}$**   
 ( $t_{Qrr}$ = integrating time for  $Q_{rr}$ )  
*Output inverter FRED*

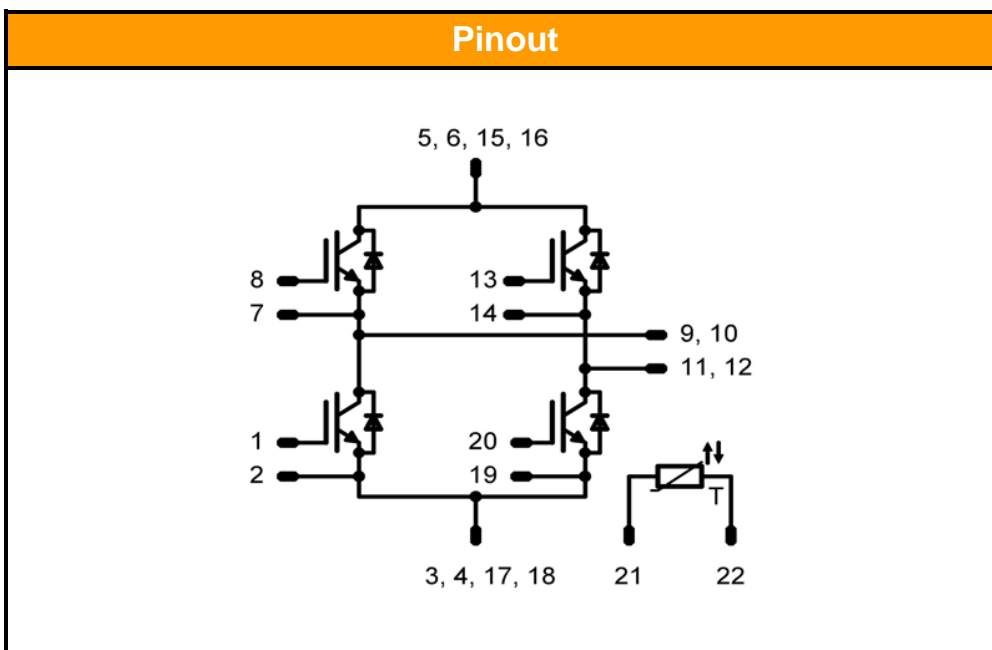
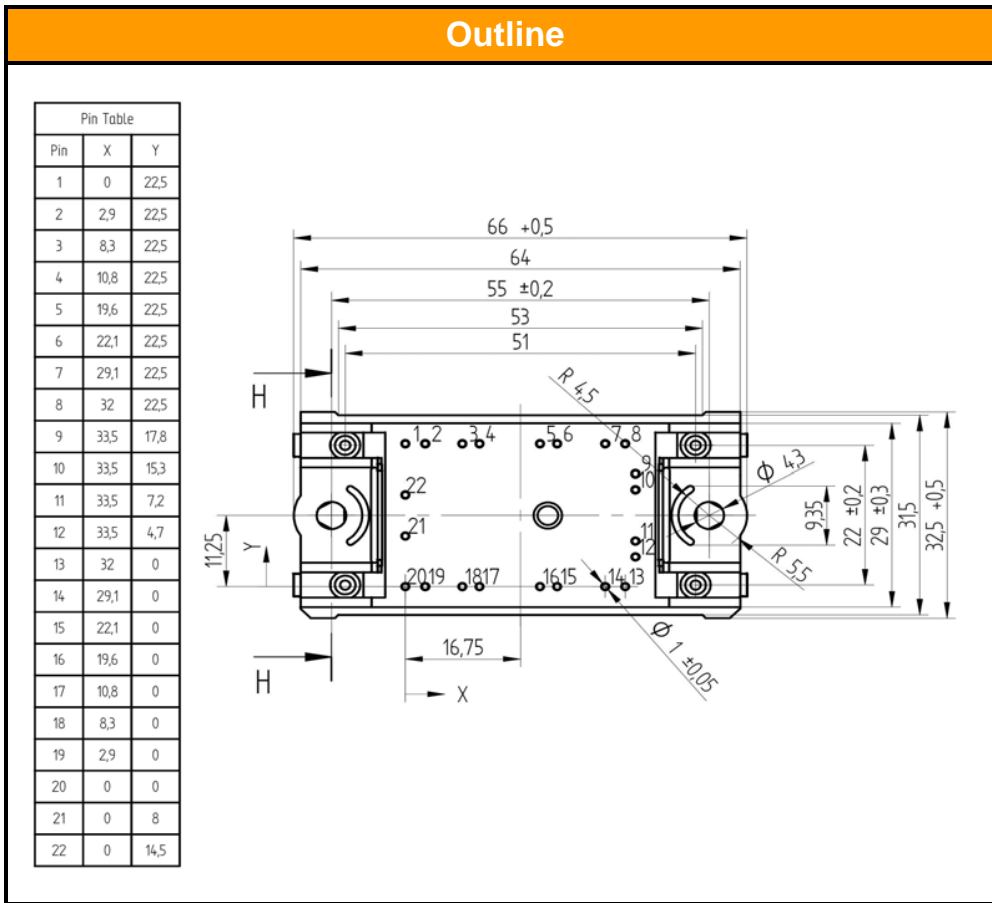


$I_d(100\%) = 50 \text{ A}$   
 $Q_{rr}(100\%) = 3,85 \text{ uC}$   
 $t_{Qint} = 0,30 \text{ us}$

**Figure 10. Turn-on Switching Waveforms & definition of  $t_{Erec}$**   
 ( $t_{Erec}$ = integrating time for  $E_{rec}$ )  
*Output inverter FRED*



$P_{rec}(100\%) = 14,9 \text{ kW}$   
 $E_{rec}(100\%) = 0,94 \text{ mJ}$   
 $t_{Erec} = 0,30 \text{ us}$

**Package Outline and 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.
Final	Full Production	This datasheet contains final specifications. 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.

**DISCLAIMER**

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