Status Overview

The code of the turbine is written as a state machine. The states you will find here. In order to debug and analyse there are so called error trigger. These trigger save changes of the status as well as reasons why the turbine has braked.

Turbine Status

Overview

Status	Definition
0x200: MPP_waiting	The turbine is waiting to start spinning. If there are no errors detectetd and the turbine speed is over 400 rpm it switches to MPP. The PWM is 0% under 300rpm and then 50%.
0x300: MPP	The turbine measures the speed and adjust the torque in order to reach the MPP. If the speed is over 750rpm it switches to 0x400
0x404: speed limitation	The turbine keeps the speed at 750rpm
0x401: emergency	The turbine reached a temperature above 95°C or torque was above 6Nm for 2min. Reference value for speed control is 500 rpm. If torque is low enough for 2 min and temperature is below 75°C it switches to 0x402.
0x402: emergency out	The turbine temperature is below 75°C and the rotation limit is changed to 600rpm. If the torque does not get to high, it changes back to 0x400 or 0x300
0x500: shortcircuit brake	The turbine tries to brake the turbine down to a rotation speed of 150 rpm. If it is reached the generator will be shortcircuit. After that or if the speed is not reached the turbine changes to 0x600
0x600: Brake	The brake is initialized and immediatlely switches to 0x601
0x601: Brake	The turbine is braked.
0x700: Emergency Brake	The turbine braked because of a parameter set by the software of Willers
0x800: Debug	A mode where parameters can be changed while driving
0x901: Partial Load	The turbine measured a voltage above 210 V. The speed limit will be set to the speed it had while switching to this state. It will reduce the speed in order to reduce power, until the voltage is stable below 210 V. It then changes to 0x902
0x902: Partial Load End	It will increase the speed limit until it either switches to 0x300 or 0x400

Error Trigger Overview

The trigger are saved in a 16 bit register. The last trigger is always written in the last nibble. If a new trigger gets triggered the old one will be bitshifted to the left and therefore the register shows the hiostory.

Example:

turbine starts: Errortrigge = 0x0007

Turbine changes from stop to 0x200: Errotrigger = 0x0070

Voltage is higher then 210: Errortrigger = 0x0706

The voltage rises to the limit: Errortriger = 0x7061

The turbine stoped and went back to normal mode 0x0610

Number	Definition
0x0	Turbine left the stop mode 0x600 to 0x200
0x1	The voltage was higher then the voltage limit 280V. The turbine changes to 0x600
0x2	The speed was higher then the speed limit 1200rpm. The turbine changes it status to 0x600
0x3	The generator temperatur was higher then the limit 100°C. The turbine changes it status to 0x600
0x4	The IGBT temperatur was higher then the limit 110°C. The turbine changes it status to 0x600
0x5	The turbine switched to 0x400
0x6	The turbine switched to 0x900 because of a voltage higher then 210V
0x7	The Pi sent the signal to stop/ or the turbine was reseted
0x8	The turbine braked because the chopper was on too long 20s
0x9	The turbine switched to 0x401 bercause the temperatur was higher then 95°C
0xA	The turbine stopped because there was a voltage over 150V without a speed ==> probably a problem with the hallsensors
0xB	The turbine turned off the IGBTs because the voltage was too high 300V
0xC	The turbine turned off the IGBTs because the temperature was too high 105°C
0xD	The turbine went into status 0x700
0xE	Changed from 0x700 to 0x600
0xF	Turbine startet after a reset

Brake Status

The register called IREG_GENERATOR_ERROR shows if the brake has a failure and the possibitlities for that are shown in the table bellow.

Register	Name	Function

0x0800	BRAKE_ERROR	Error in brake detected
0x0400	BRAKE_WIRE_ERROR	Broken wire from the mechanical brake. The brake can not be opened
0x0008	BRAKE_MOSFET_ERROR	The mosfet for controling the brake is bruned through. Brake is open all the time.
0x0004	SHUTDOWN_ERROR	See 0x700 Emergency stop