DC Motor Control 2.0

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Inhaltsverzeichnis

1 Overview

A brief overview of contained IP-core is given in figure 1.

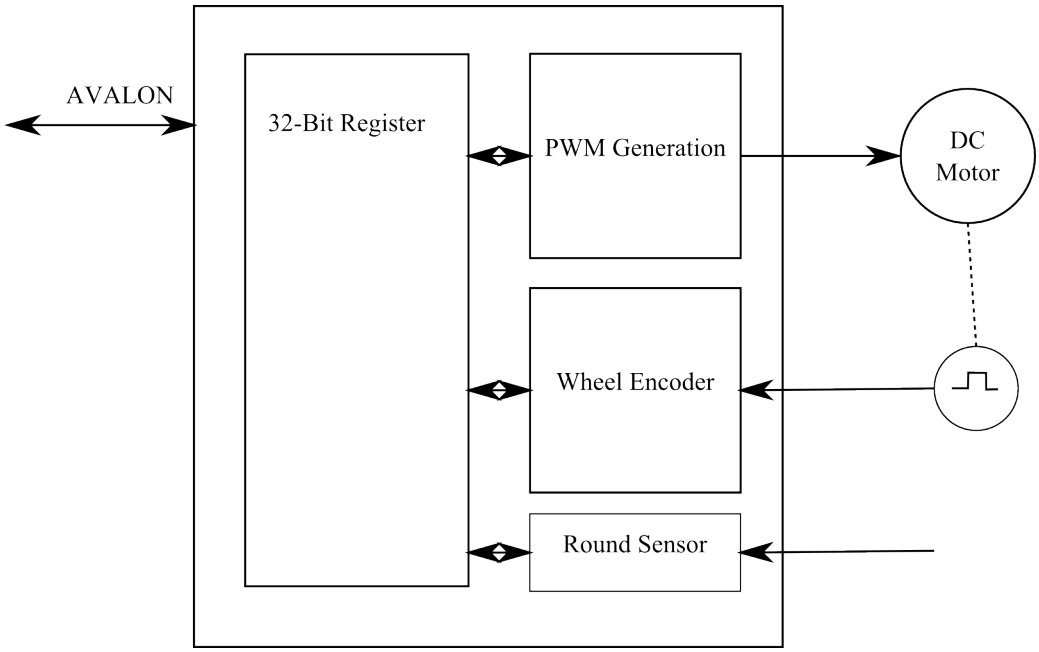

Abbildung 1: block diagram of motor control IP Core

1.1 Design units

The IP core is divided in several sub units. Design units can be found under svn repository

Unit	Files
top level (QSYS)	/Motor_control/Motor_Control.vhd
Testbench	/Motor_control/tbMotor_Control.vhd
Round Sensor	/Motor_control/RoundSensor/RoundSensor-e.vhd
Round Sensor	/Motor_control/RoundSensor/RoundSensor-Rtl-a.vhd
Testbench	/Motor_control/RoundSensor/tbRoundSensor.vhd
Wheel Encoder	/Motor_control/WheelEncoderTimer/WheelEncoderTimer-e.vhd
Wheel Encoder	/Motor_control/WheelEncoderTimer/WheelEncoderTimer-Rtl-a.vhd
Testbench	/Motor_control/WheelEncoderTimer/tbWheelEncoderTimer.vhd
PWMGen, StrobeGen, ..	/src

1.2 External parts

smart power fet, optical reflex wheel sensor, optical reflex round sensor

2 QSYS Integration

2.1 QSYS Interface and Parameters

Memory mapped slave interface is used.

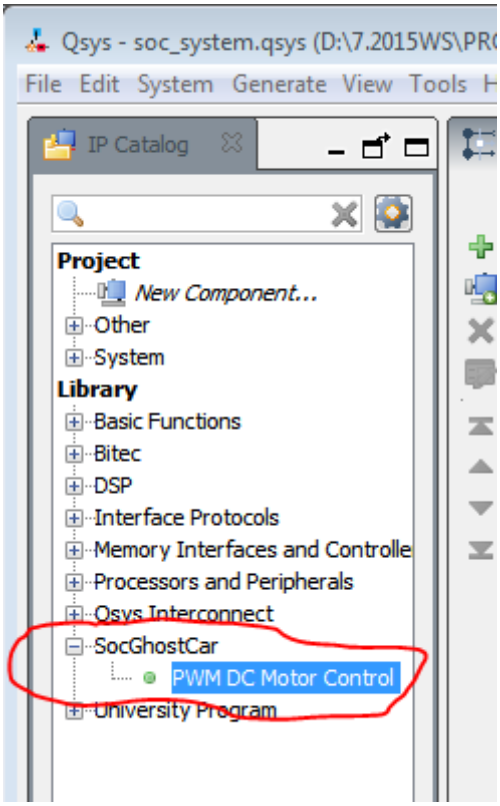

Abbildung 2: Library SocGhostCar

Parameter	Target	Description
gQSYS_ClkFreqeuncy_Hz	IP core	system clock frequency in hertz
gQSYS_MotorFrequency_Hz	MotorControl	motor switching frequency in hertz
gQSYS_TimerResolution_us	WheelEncoder	LSB of speed sensor impulse period value
gQSYS_TimeOut_us	WheelEncoder	within this time window the signal state must be stable
gQSYS_ValidSamples	WheelEncoder	valid Samples from speed sensor to guarantee stable edge detection

For details see functional description below.

2.2 Register Mapping

The data width of all used registers are 32bit

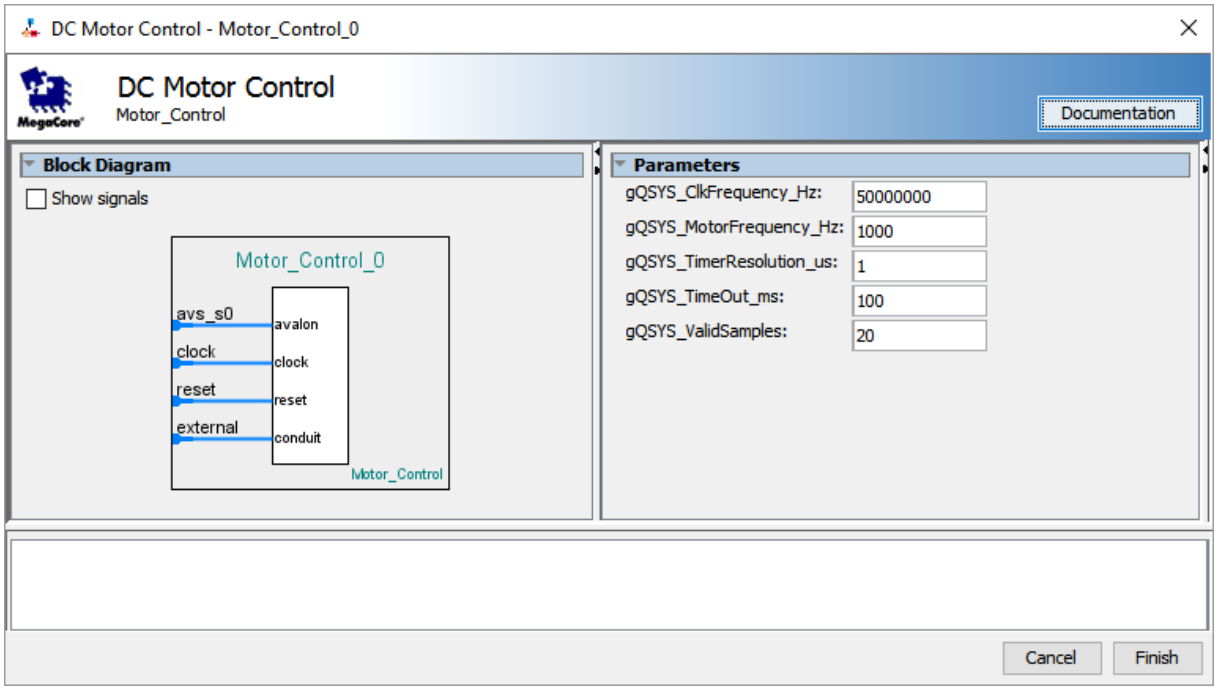

Abbildung 3: IP Interface parameters

Address	Register	R/W	Description
+0	Control	R/W	Bit 0: Enable PWM Bit 1: Run otherwise Brake Bit 2: Reset new round detected signal
+1	Status	R	Bit 0: new round detected (Reset see Control, Bit 2) Bit 1: new round detected toggle
+2	PWM	R/W	10Bit Resolution Duty Cycle
+3	Speed	R	Impulse periode of speed sensor in us
+4	Distance	R/W	Impulse counter, Write to address to set value
+5	Error	R	Error counter of speed sensor unit

3 Wheel Sensor module

3.1 WheelSensor

Window method has been cancelled due to bad resolution and emc.

3.2 WheelSensorTimer

Frequency measurement: measures the elapsed time between two identical edges of sensor signal. Measured time in us is populated to register. Time out is defined to have finite sampling time period. Signal parameters are shown in figure 4.

3.2.1 Speed

HINT: If Register holds 0x0000 it will indicate zero speed.

$$v = \frac{1}{Register[3]} \cdot \frac{d \cdot \pi \cdot 10^6}{i} = [\frac{m}{s}]$$

$d = 0,028m$, $i = 16$

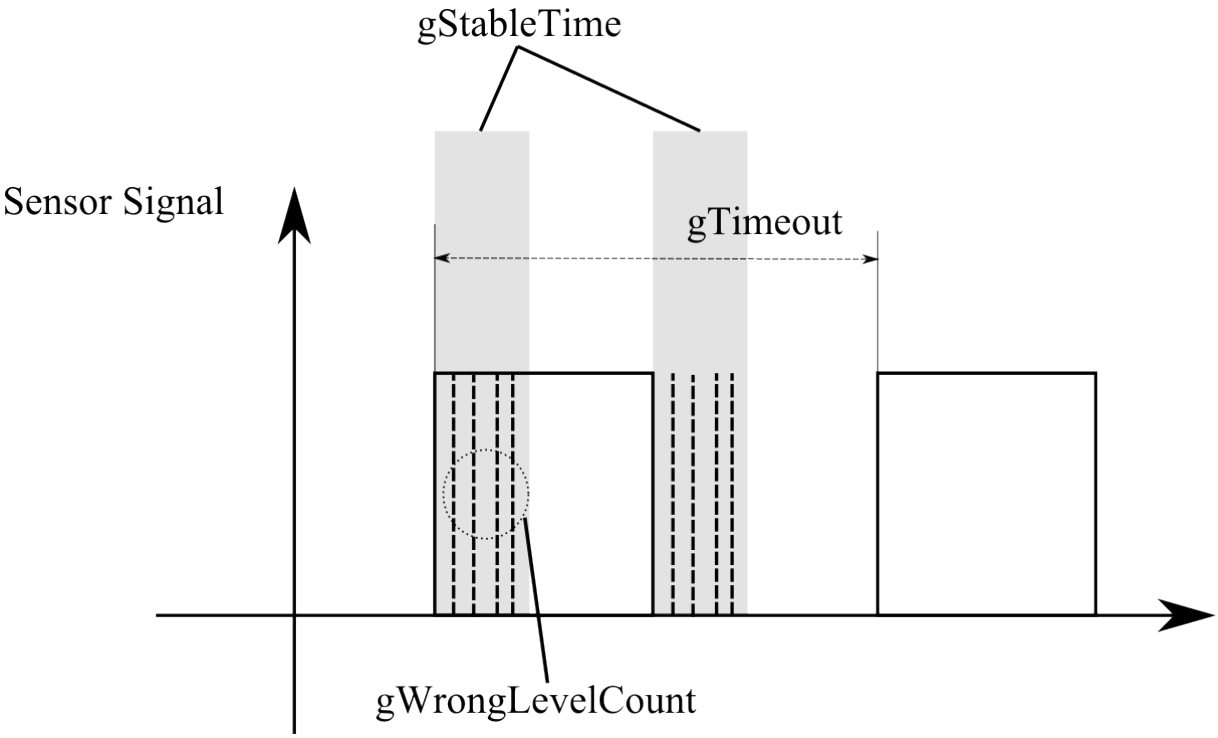

Abbildung 4: Signal parameters

3.2.2 Distance

$$x = Register[4] \cdot \frac{d \cdot \pi}{i} = [\frac{m}{s}]$$

$d = 0,028m$, $i = 16$

4 Round Sensor

Sampling time 10us (default). Valid Samples 10. 2 Kind of signals: Reset by user and toggled see 6. After detection of falling edge and rising edge at round sensor signal bit 0 and bit 1 in status register (+1) will be modified. Bit 0 will be set by sensor signal and reset by setting Bit 2 in control register (+0).

5 Motor Control (PWM)

10-Bit PWM Control

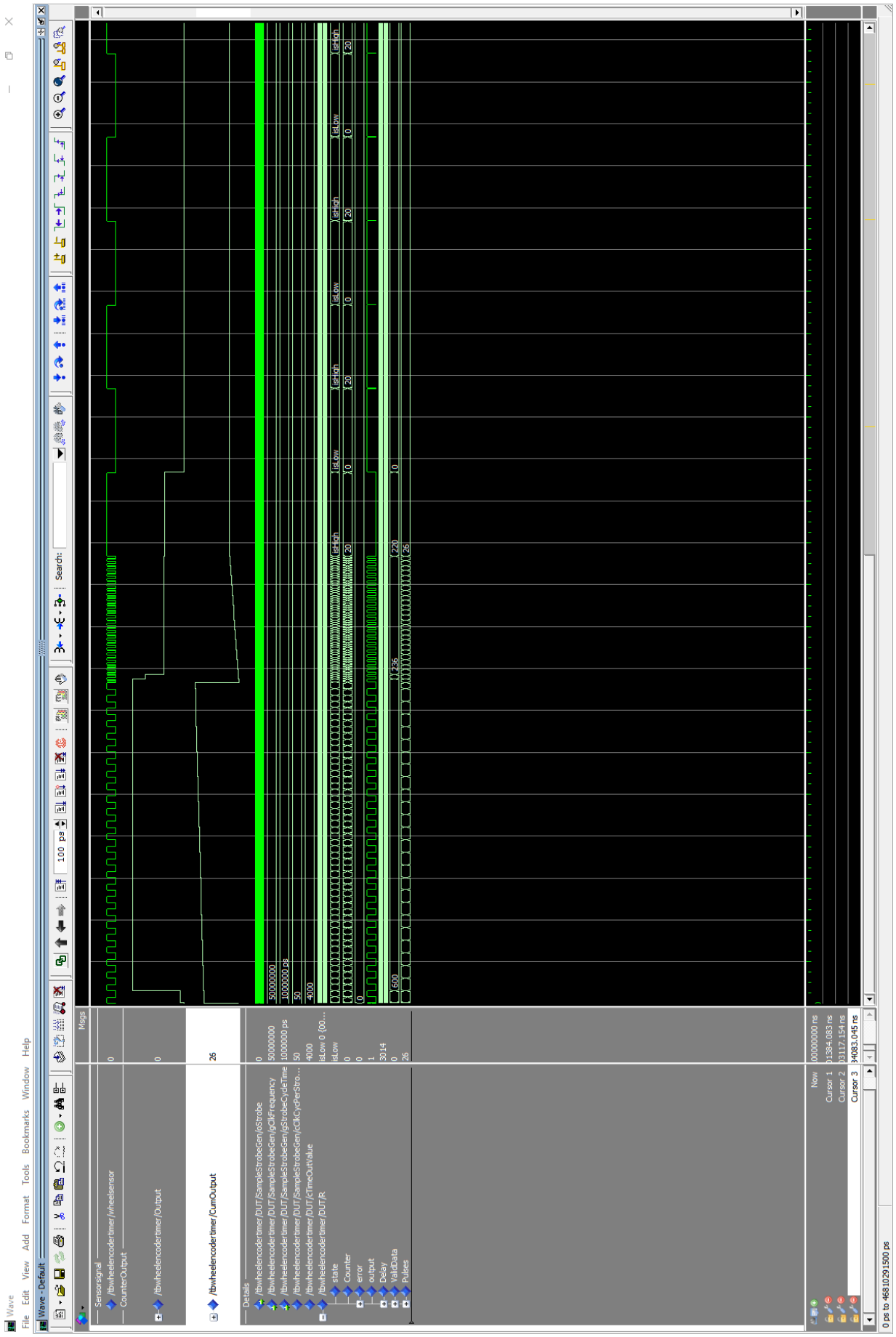

Abbildung 5: wheel encoder unit waveform from simulation

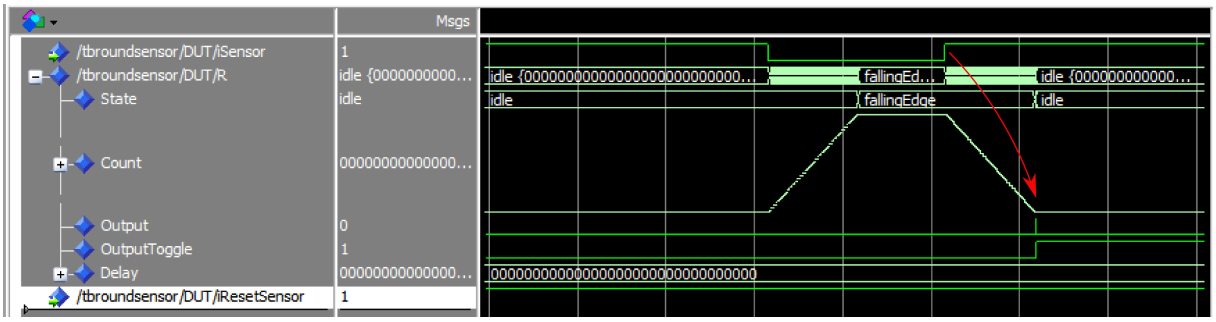

Abbildung 6: Round Sensor waveform from simulation

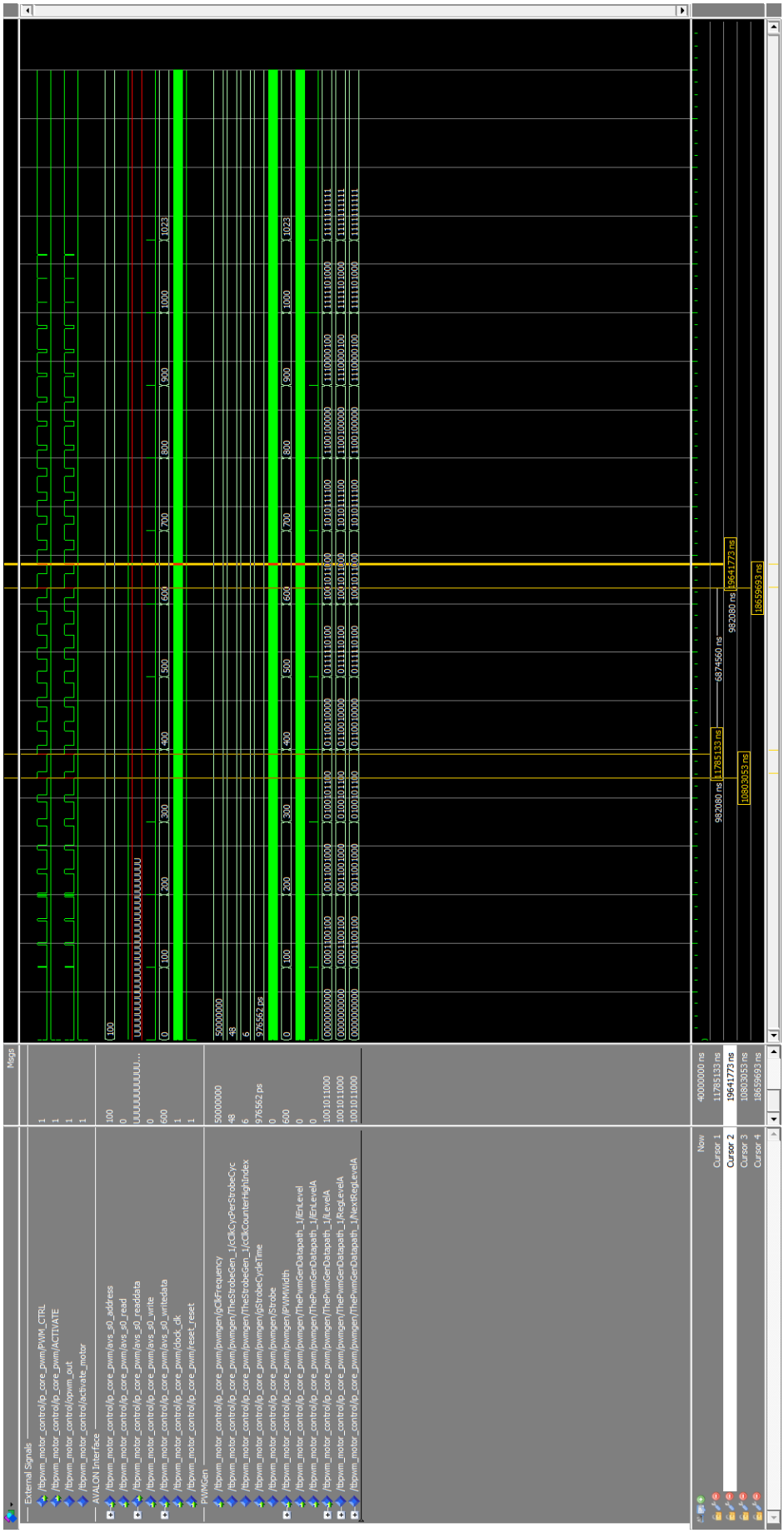

Abbildung 7: PWM Generation unit waveform from simulation