Fachhochschule Jena
University of Applied Sciences Jena

Microcontroller technology

Topic 5: ASURO

Burkart Voss

Images are partly taken from:
- Asuros documentation

Overview

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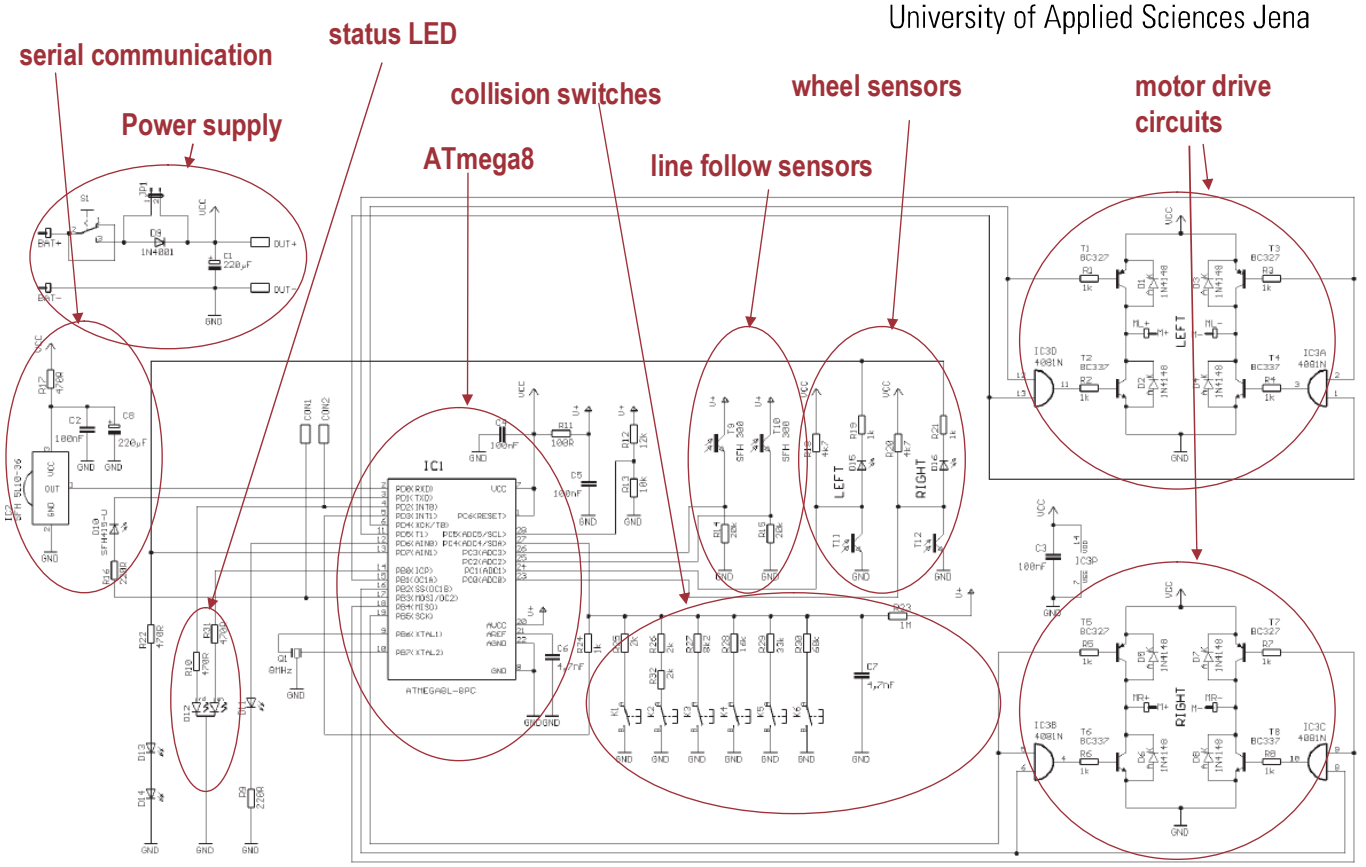

Motor bridge

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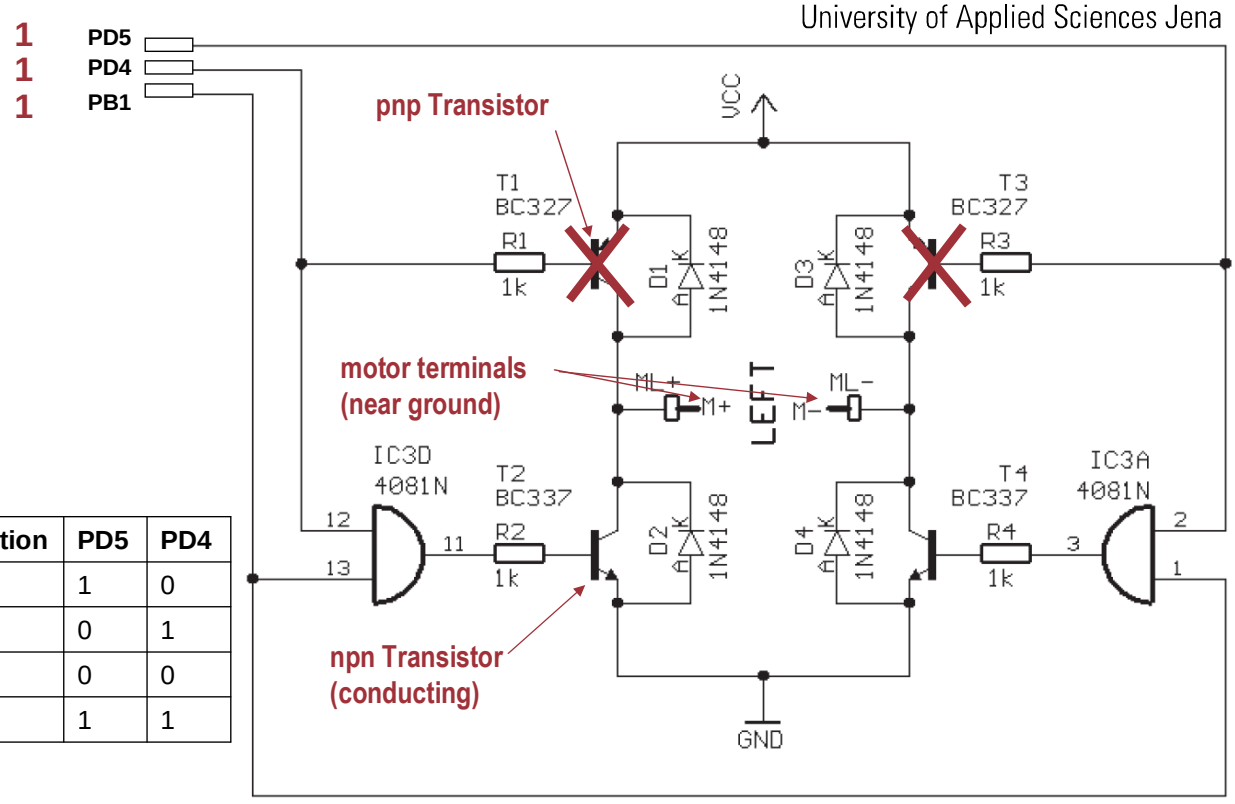

function	PD5	PD4
	1	0
	0	1
	0	0
idle	1	1

Motor bridge

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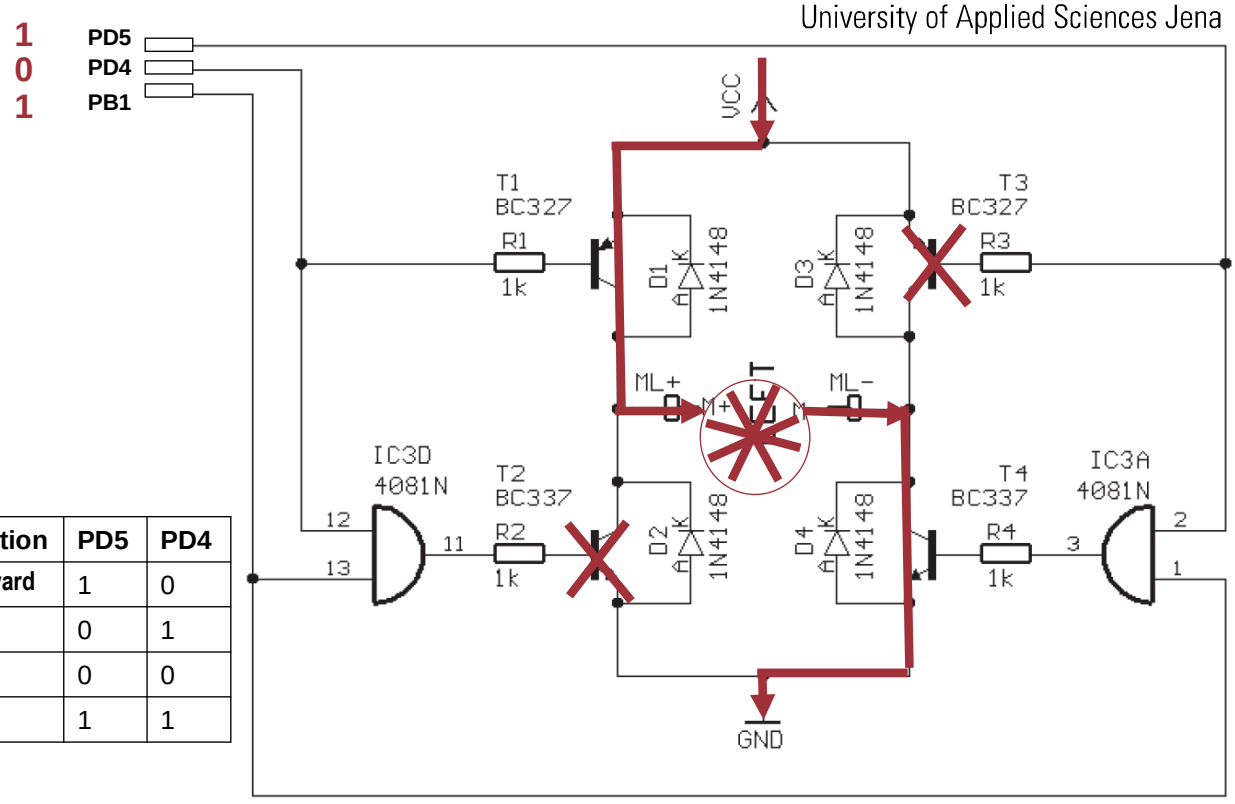

function	PD5	PD4
forward	1	0
	0	1
	0	0
idle	1	1

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Motor bridge

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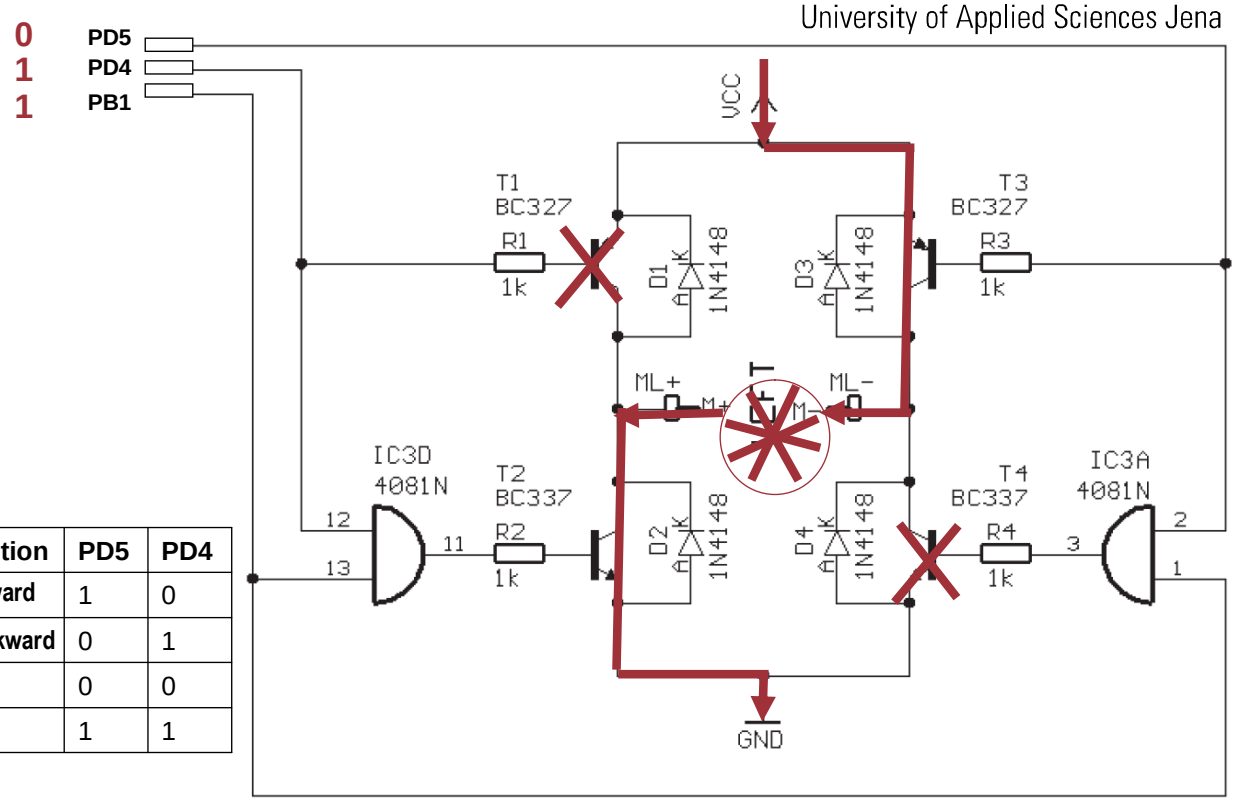

function	PD5	PD4
forward	1	0
backward	0	1
	0	0
idle	1	1

Motor bridge

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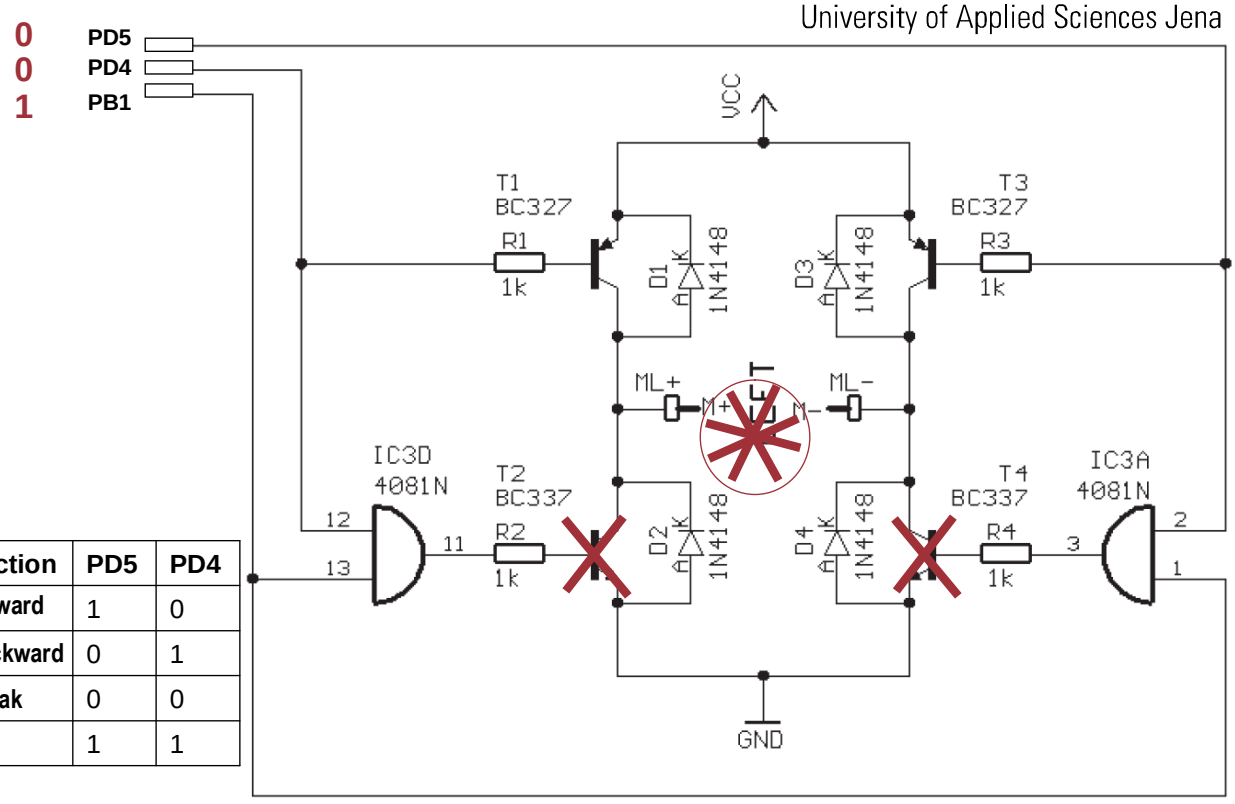
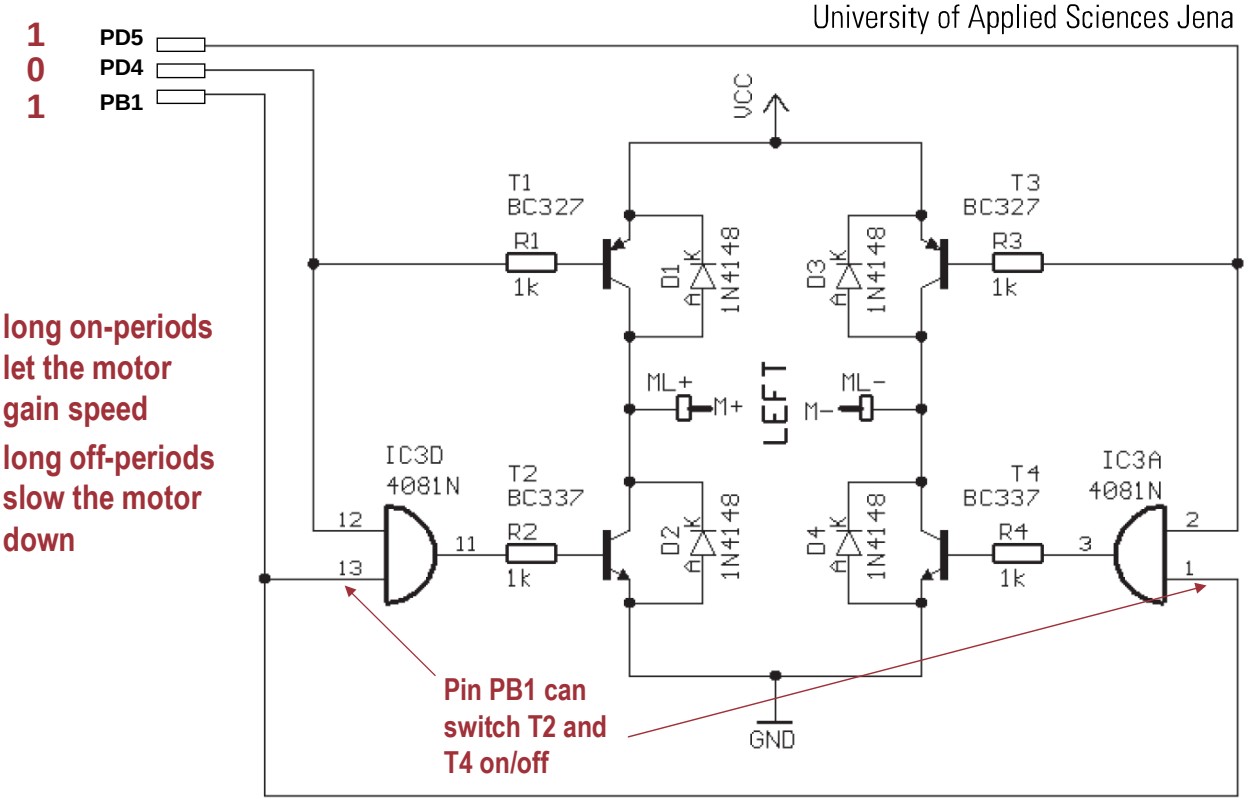


function	PD5	PD4
forward	1	0
backward	0	1
break	0	0
idle	1	1

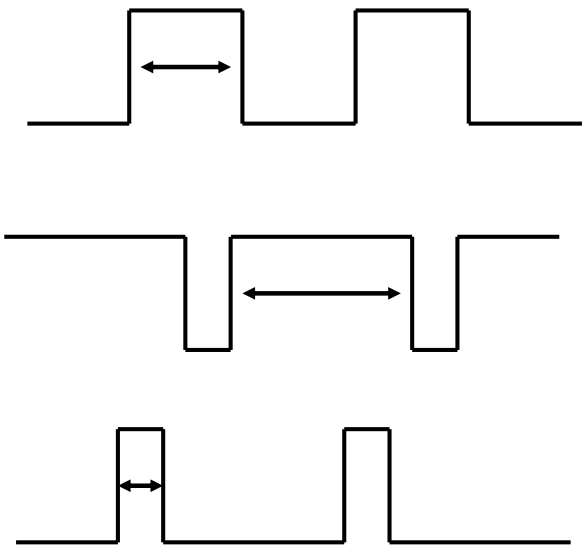
Setting the speed



- long on-periods let the motor gain speed
- long off-periods slow the motor down

Pulse width modulation (PWM)

- The time the signal is high is a measure of the average speed of the motor.
- If the cycle frequency is larger than the LR time constant of the motor, the motor basically sees a DC current.
- Rule-of-thumb: 50% duty cycle equivalent to 50% of input power.
- The AVR has a timer with PWM output stages that are used here.



Line follow circuit

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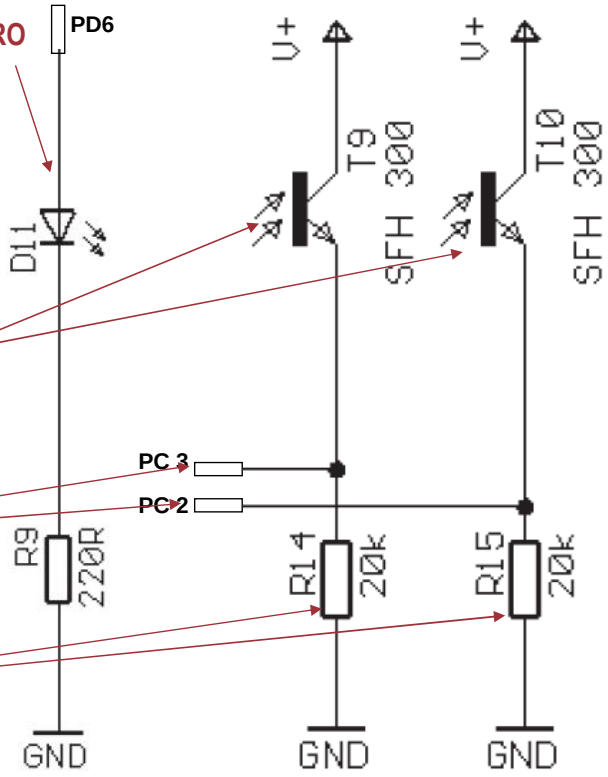
With D11 (switched on with PD6) the area in front of ASURO is illuminated.

Detect the reflected light
→ generate a current flow proportional to the detected light.

inputs into the AD/C of the AVR.

Current generates a voltage drop over R14 and R15



Wheel sensors and back LEDs

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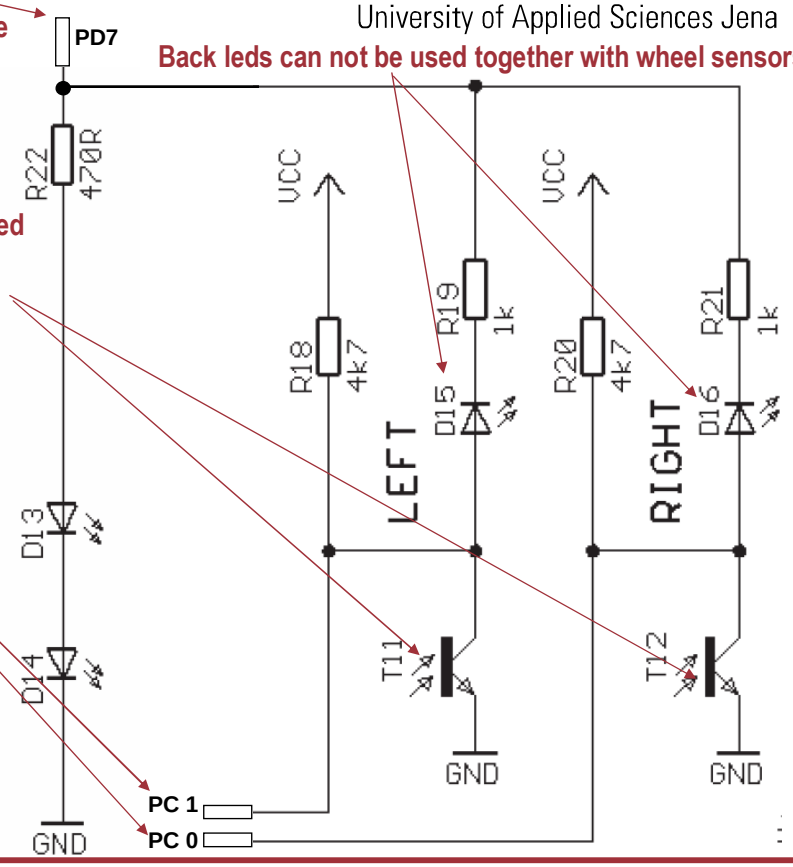
PD7 high
→ IR diodes D13 and D14 are active
→ D15 and D16 are reverse biased.

Back leds can not be used together with wheel sensors.

T11 and T12 are illuminated by reflected light of D13 and D14
→ voltage drop over R18 and R20.

inputs into the AD/C of the AVR.



Collision switches

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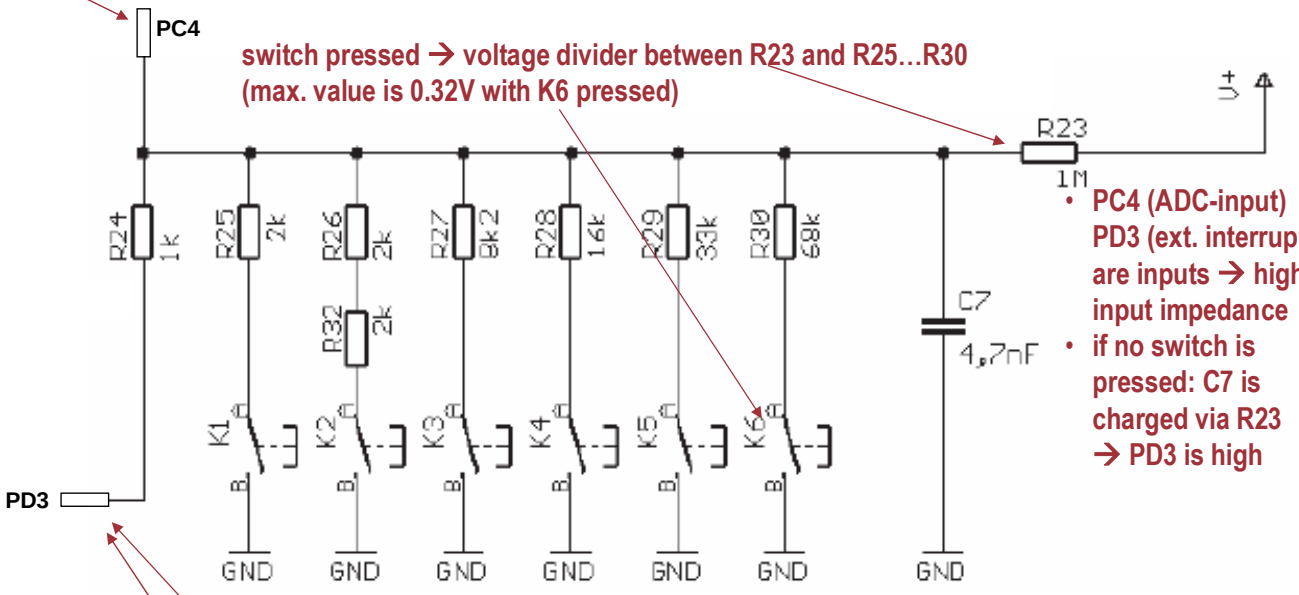
Voltage at PC4 (between 98.5% and 50.5% of supply voltage) is measure of which switch is pressed and can be converted with ADC.



- PC4 (ADC-input) PD3 (ext. interrupt) are inputs → high input impedance
- if no switch is pressed: C7 is charged via R23 → PD3 is high

0.32V or lower is sensed as 0 (can be polled or trigger an interrupt)

if low level is detected, PD3 is configured as „output high“ building a voltage divider R24 with R25…R30.

Which switch was pressed?

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- There is a voltage divider build by R_{24} and the respective resistors activated by the switches:

$$\frac{U_a}{U_e} = \frac{R_2}{(R_{24} + R_2)}$$

Resistors and with that the conductance are graded in steps of the power of two.

- R_2 represents the interconnection of the resistors by the switches:

$$R_2 = \frac{R_{24}}{\left(\frac{U_e}{U_a} - 1\right)}$$

- The 10 bit ADC creates a value A relative to the measurement voltage and the reference voltage which is equal to the Voltage U_e:

$$A = \frac{U_a}{U_e} \cdot 1024$$

- Result:

$$\text{Value} = \frac{\left(\frac{1024}{A} - 1\right)}{R_{24}} \cdot R_{\max}$$

Normalise with Rmax
→ smallest pressed conductance results in 1
→ largest pressed conductance results in 32

IR Communication

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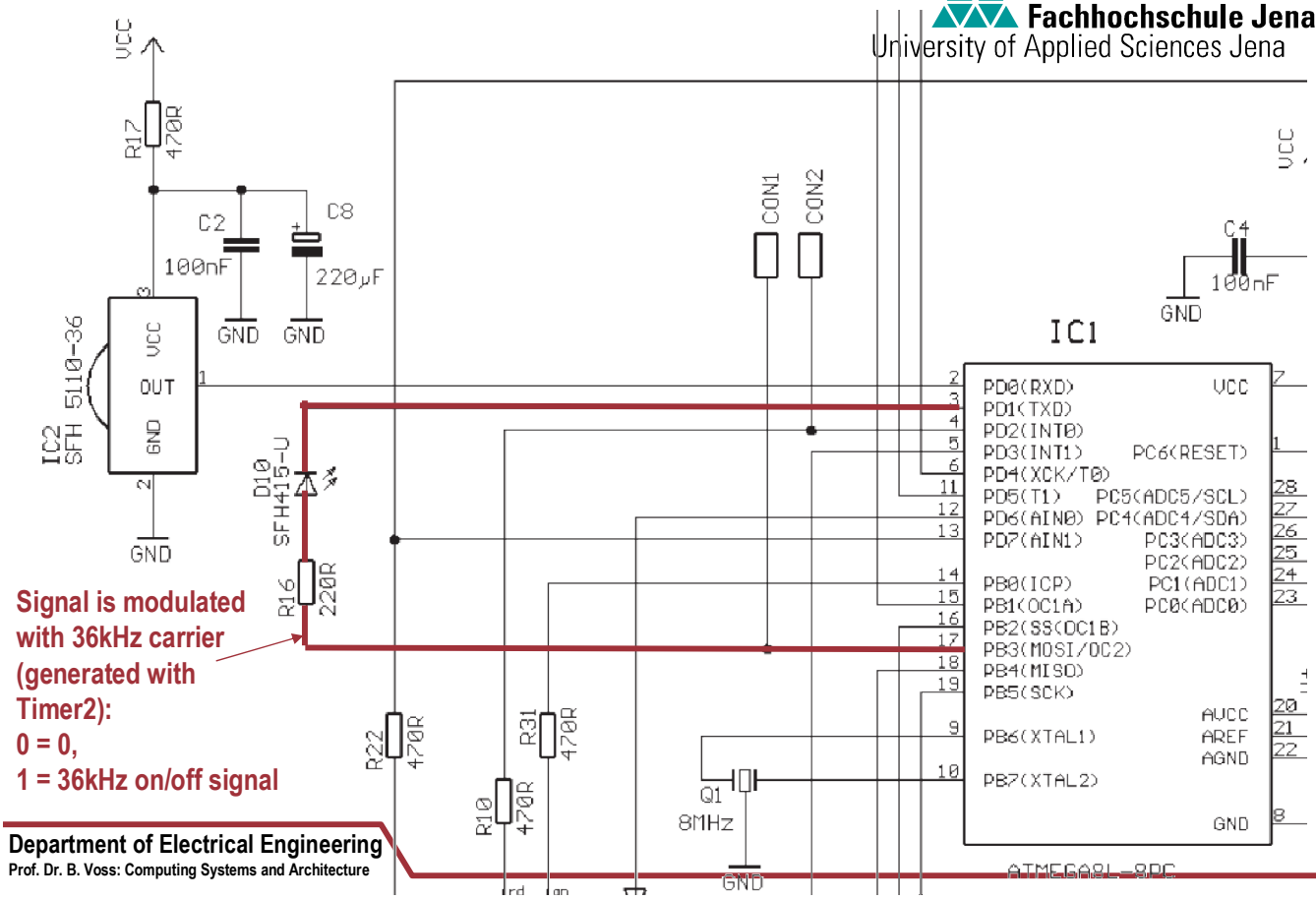

Signal is modulated with 36kHz carrier (generated with Timer2):
0 = 0,
1 = 36kHz on/off signal

IR communciation

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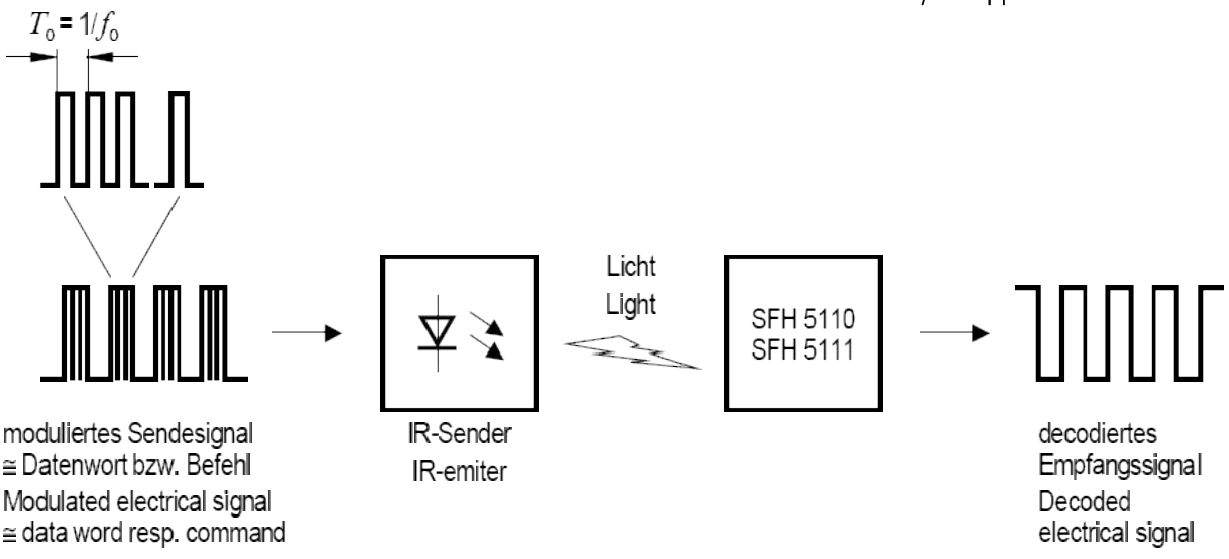

image taken from „IR Remote Control Receiver“
By Thomas Richter and Karl Leahy, June 1999

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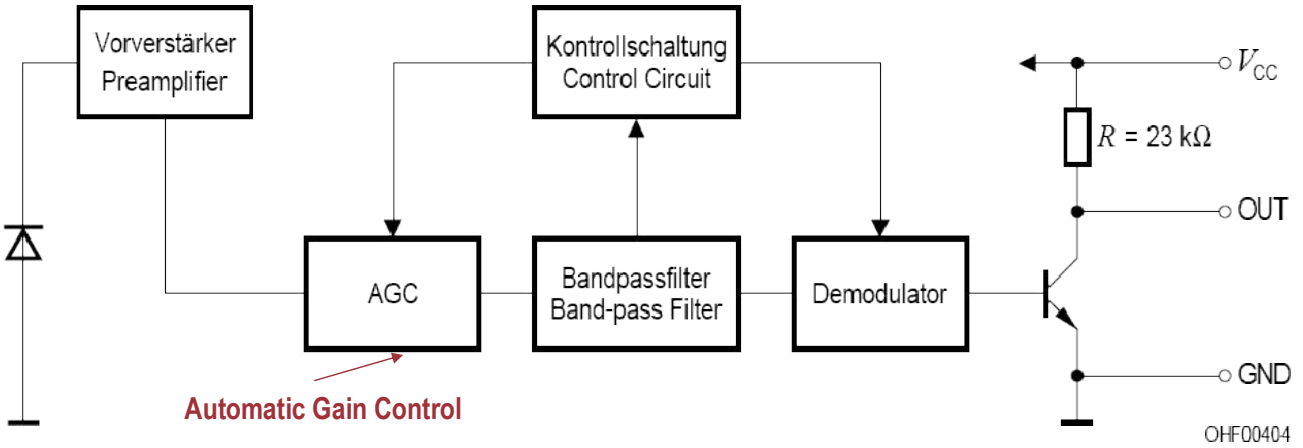

image taken from „IR Remote Control Receiver“
By Thomas Richter and Karl Leahy, June 1999

Port assignment

Port	Pin	I/O	function	comment
PB0	14	Output	Status LED green	
PB1	15	OC1A	PWM for left Motor	
PB2	16	OC1B	PWM for right Motor	
PB3	17	OC2	36kHz Modulation IR LED	Sleep Timer
PB4	18	Output	forward/backward right Motor	
PB5	19	Output	forward/backward right Motor	
PB6	9	XTAL1	8 Mhz crystal	
PB7	7	XTAL2	8 Mhz crystal	
PC0	23	ADC0/Output	Odometry left /back LED left	not simultaneously
PC1	24	ADC1/Output	Odometry right/ Back LED right	not simultaneously
PC2	25	ADC2	photo transistor down left	
PC3	26	ADC3	photo transistor down right	
PC4	27	ADC4	read out of switches	
PC5	28	ADC5	battery control	
PC6	1	Reset	---	
PD0	2	RXD	UART receive	
PD1	3	TXD	UART send	
PD2	4	Output	Status LED red	
PD3	5	INT1	Interrupt for switch	
PD4	6	Output	forward/backward left Motor	
PD5	11	Output	forward/backward left Motor	
PD6	12	Output	Front LED down	
PD7	13	Output/Input	Switching Odometrie/Back LED	