

# Detecting the distance to an object with an ultrasonic sensor

With the capture capability of Netzer a simple ultrasonic sensor like the HC-SR04 module can be used.

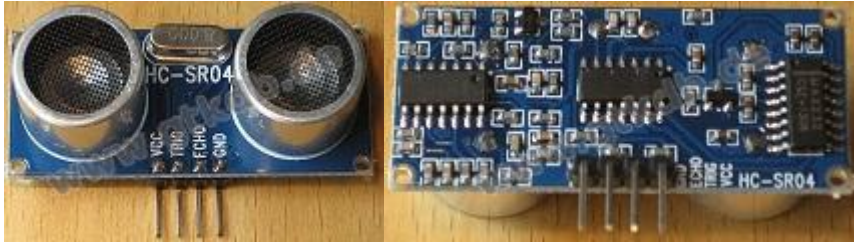


Fig. 1: Ultrasonic sensor HC-SR04

For that reason the sensor shall be connected like:

Sensor signal	Netzer signal	Further descriptions
VCC	-	Connect the sensor to +5V
GND	GND	Ground signal
TRIG (I)	I03	The trigger signal
ECHO (O)	I00, SPI_INT	The echo signal. Due to the Netzer pins are +5V tolerant, no voltage divider is needed!

## I03

I03 is used for generating the trigger signal. Datasheet of the sensor states that at least 10  $\mu$ s pulse must be generated to start the measurement.

### IO3 (ID d)

Digital input  
Alert events:

Digital output  
Startup value:  0  1

PWM output  
Frequency <sup>\*</sup>:  Hz  
Logic:  0  1  
Startup value:

Impulse output  
Logic:  0  1  
Startup value:

Input capture  
Capture:  On falling edges  On rising edges

Mode <sup>\*</sup>:   
Unit <sup>\*</sup>:  ns

\*Parameter for IO3 and SPI\_INT

Fig. 2: Configuration of IO3 for trigger

Due to the ultrasonic sensor has a resolution of about 0.3 cm it is sufficient to configure the resolution to 800 ns. The maximum values to measure (18 meters) are more than enough for the maximum of 3 meters the sensor will return.

At 800 ns the value 0x0D must be written to IO3 to get the 10  $\mu$ s impulse. The easiest way is to configure the impulse as startup value like shown in image above.

## IO0

IO0 is triggered by the rising edge of the sensor capture signal ECHO.

**IO0 (ID a)**

Digital input  
Alert events:

Digital output  
Startup value:  0  1

Edge trigger:   
Impulse timer:  Reset  
Edge filter:   
Edge counter:   
Edge counter value: 0  Reset

Fig. 3: IO0 configure for starting measurement

Important is to mark the “Impulse timer Reset” checkbox. Configured like this the rising edge of the ECHO signal will start the capture timer.

## SPI\_INT

SPI\_INT is connected to the ECHO pin, too.

## SPI\_INT (ID j)

Digital input  
Alert events:

Digital output  
Startup value:  0  1

PWM output  
Frequency \*:  Hz  
Logic:  0  1  
Startup value:

Impulse output  
Logic:  0  1  
Startup value:

Input capture  
Capture:  On falling edges  
 On rising edges

Mode \*:   
Unit \*:  ns

\* Parameter for IO3 and SPI\_INT

The falling edge of the ECHO signal will stop the capture timer and finally show the result on the GPIO webpage.

## Result

Depending on set time resolution the measured value must be multiplied with the appropriate unit.

If the result is  $0x1234$  at resolution  $800ns$  the measured pulse width is  $3.728 ms$ .

The velocity of sound in dry air is  $343 m/s$  (at  $20^{\circ}C$ ) or  $34.3 cm / ms$ .

$3.728 ms \times 34.3 cm / ms = 127.87 cm$  is the propagation the signal takes. Due to the echo two ways are measured so the result must be divided in halves:  $63.94 cm$

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