

Exercise 7: Digital Sensors

Overview

In the last exercise, you have evaluated the DCF77 time signal. For reasons of simplicity, we used sampling to decode the signal. In this lab course exercise, we will analyze a different type of signal with a different digital communication protocol. The protocol we are interested in is called ZACwire™ and our “communication partner” is a TSic™ 306 temperature sensor. Figure 1 shows an example oscilloscope plot on the signal in question.

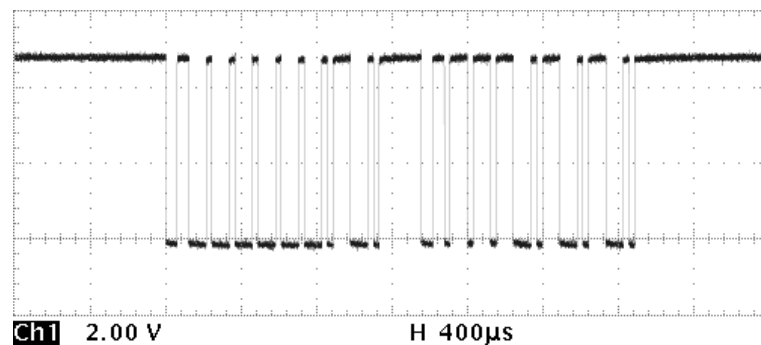


Figure 1: ZACwire™ signal plot

ZACwire™ Signal Structure

The following files on the lab course file server and on the website are needed for this lab course:

- ZACWire.pdf specifies the ZACwire™ protocol.
- TSic-Datasheet.pdf is the technical documentation of the TSic™ sensor family.

Scan through the documents and answer the following questions.

Exercise 7.1

- What is the ZACwire™ signal being used for?
- What is the advantage of sensors with digital communication in contrast to analog value acquisition? Think of the following aspects:
 - Sensor calibration
 - Sensor networks with a large amount of sensors
 - Long cables between sensor and microcontroller

Can you imagine what is the downside of this approach?

- How often does the TSic™ 306 sensor transmit its temperature value? What is the resolution in °C of the sensor? What is the resolution of the value transferred in a ZACwire™ packet (in bits)? What is the possible range of values (in digital values) and their interpretation (in °C)?
- Derive a concrete formula to calculate the temperature value T in °C from the digital value d transmitted by TSic™306. There should be no additional variables besides T and d .

- e) What recommendation does the ZACwire™ specification give on attaching the sensor to a microcontroller? Explain both possible scenarios and their advantages/disadvantages:
- “Always on” scenario as explained in section 1.4
 - “Power up on request” scenario as presented in section 1.4.2

Microcontroller-based Analysis of the ZACwire™ Signal

Exercise 7.2

- a) Attach the TSic 306 sensor to the microcontroller according to figure 5-2 on page 9 of the TSic data sheet. Use the “power up on request” configuration as suggested in section 4.1.2 of the ZACwire™ specification and be sure to use an external interrupt pin for the signal pin. We neglect the RC filter circuit that is suggested in the ZACwire™ specification.
- b) Write a program that analyzes the ZACwire™ signal and displays the current temperature value in the debug console. Be sure to follow the guidelines given in the specification, namely sampling T_{strobe} and verifying that the parity is correct.