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Project work testing the asynchronous ZanderLink protocol

introduction

For the close coupling of the ZX series controller (Zander, Aachen), protocols are used that implement continuous data exchange. This corresponds to a modified provider-subscriber model, whereby no messages have to be subscribed to: the data exchange configured at compile time runs automatically.

This is achieved particularly efficiently via synchronous transmission, in which the clock and data run on separate lines. The main disadvantages are noticeable due to the double connection and the clock skew (offset between the sent and received clock).

For communications that are less fast but over longer distances, an asynchronous protocol is usually used, in which the transmitter and receiver have the same frequency set (max. deviation approx. 2-5%), but the receiver is informed by the start bit (usually a transition from '1' is synchronized to '0' at the start of the transmission.

In the present definition and implementation of ZanderLink_as, the reception is sampled at 20 times the frequency (oversampling) and thus the phase position of the start bit is determined with sufficient precision. So far, the basic functionality has been proven with frequencies of 2, 10, 20 and 50 kbit/s with a cable length of approx. 10 cm. Extensive tests will now be carried out to determine the range, error rate and, if necessary, undetected errors.

Two general types of errors are currently being discovered: CRC and format errors. A CRC error is caused by bit errors (even several) and is discovered by comparing the sent and recalculated checksum. The CRC7 is used at ZanderLink_as with the generator polynomial 0x09 ($x^7 + x^3 + 1$), which corresponds to the Hamming code (127,120) (a code that provides a Hamming distance of 3 for a maximum of 120 bits.

Format errors consist of deviations from the prescribed format (2 start bits, either “00” or (at the last byte) “01”, 1 stop bit). You may experience a resulting false start quickly end in error bursts during the next communication. As a countermeasure, a waiting time for resynchronization is introduced and marked with the signal resync_req, which can be used for error counting. CRC and format errors can certainly occur together.

Despite these measures, it is entirely possible that errors remain undetected. This can be proven in the present experimental setup by knowing the partner's transmission and comparing the received value with the expected value.

Task in the project

The experimental setup is shown in Figure 1: A controller (ZX09A) communicates with itself, for which two independent instances of the function block run. Since both instances are in the same controller, the results can of course be compared. The existing application implements communication with corresponding error counters.

The following tasks should be carried out:

- Check the primary test: Is it capable of detecting errors? This test of the Tests can be done using error injection, for example.

- Making cable connections for various length tests, thereby carrying out
  Long-term tests to determine error rates
- Development of tests to determine undetected errors including checking them
  Testing
- ….
- Documentation of the various test procedures and discussion of the results

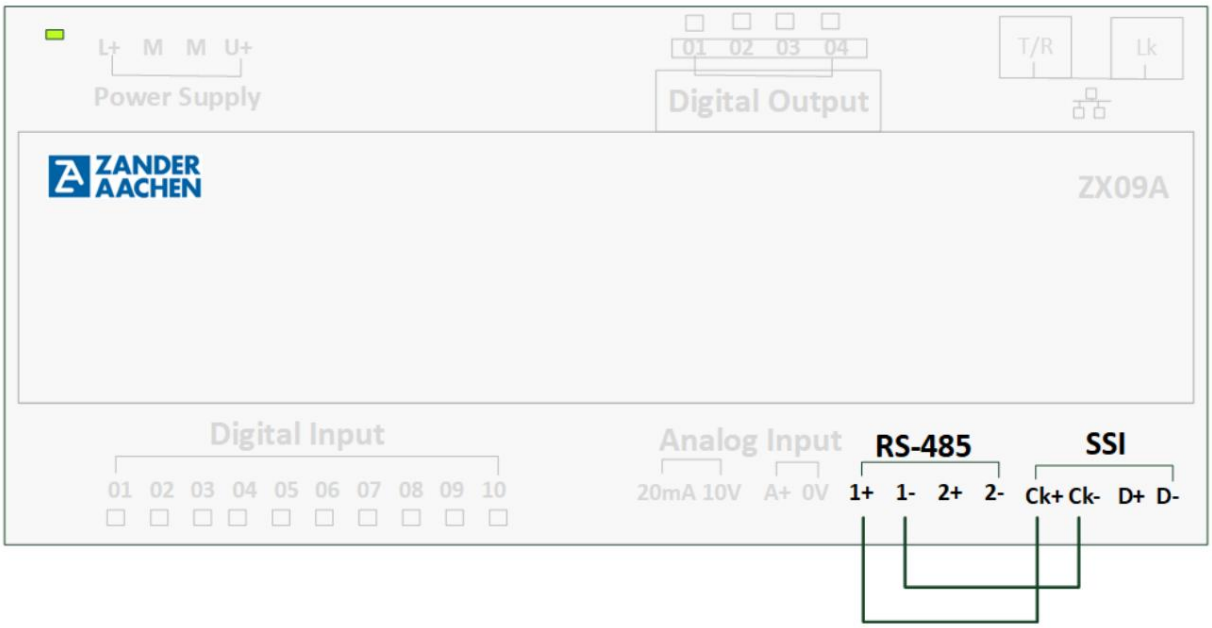

Figure 1 Experimental setup to determine the performance and error rate of ZanderLink_as

Funds handed over:

- 1 ZX09A controller including power supply
- Development software Ex_Press 5 V5.20 student version
- Various Ethernet cables (30 cm to 10 m length, CAT 5, 6 or 7)
- Coupling plug for coupling Ethernet cables