Preliminary Design of Data Exchange Module with USB and QSFP Interface for Test of Readout Electronics

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Motivation

The amount of data generated by modern large-scale scientific instruments is tremendously vast, and the efficiency of data retrieval is of utmost importance. The FT601 is a high-performance USB3.0 to FIFO bridge chip, which can be utilized in applications that require high data throughput, such as multi-channel FIFO ADC or DAC devices. This paper presents the design of a circuit board that enables the transmission of data from a QSFP interface to a PC via a Type-C interface, based on the FT601 and Xilinx Artix-XC7A35T FPGA. The design of the data transmission board and its performance test results are discussed in this paper.

Hardware Design

The main components of the board include the QSFP data receiver module, FPGA, FT601, and Type-C data transmitter module. The FPGA is XC7A35TCSG325-2I while the Type-C connector needs to use 24pin full-featured Type-C, and it needs to use the MUX chip to realize the function of the Type-C connector.

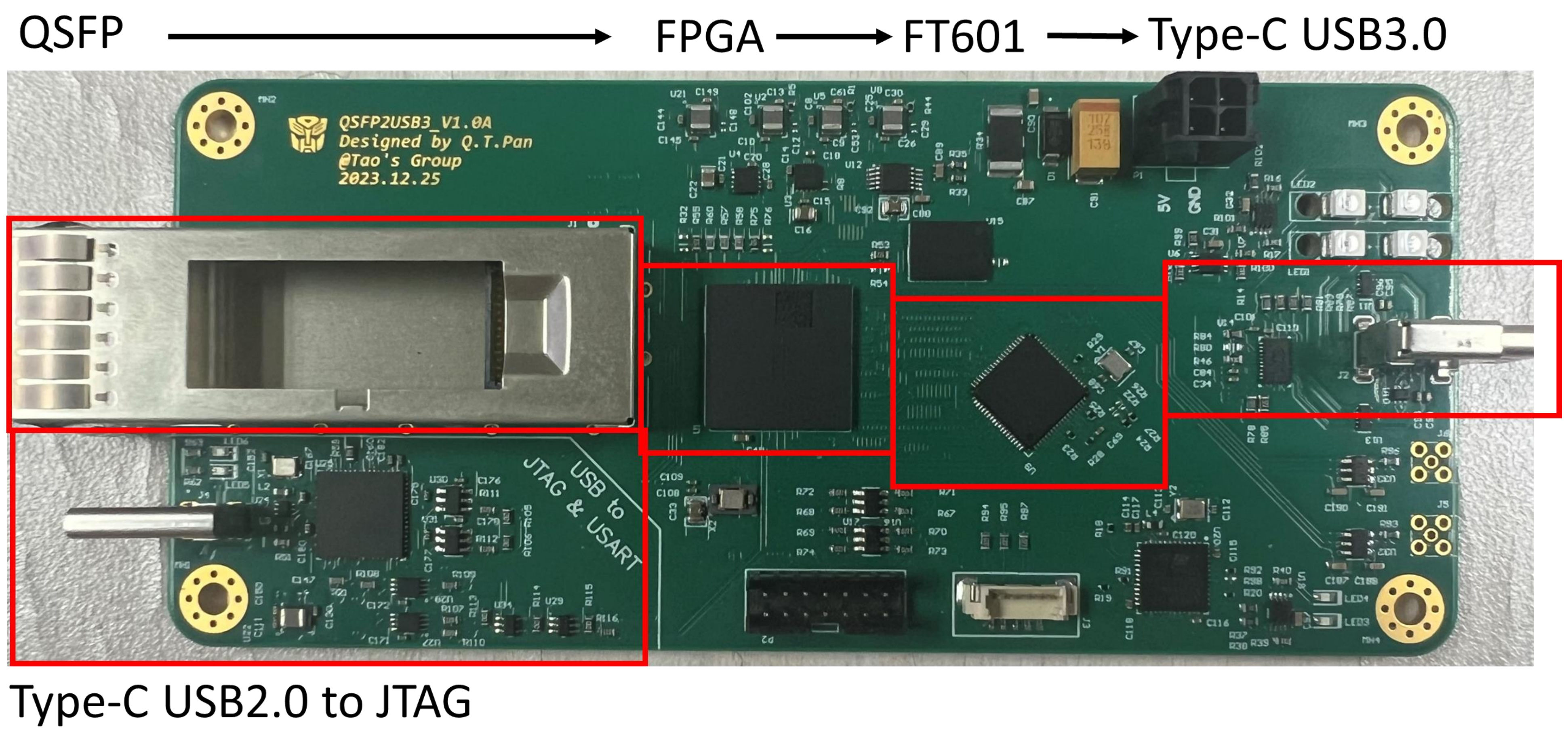

Fig.1. PCB photograph

Experiment

Data transfer was tested by using Aurora64B/66B's external self-loopback mode. The Data Generation Module generates continuously growing data, which is subsequently sent to the Optical Module via AURORA, looped back within the Optical Module, and then AURORA reads the data and sends it to the Data Transmission Module. The data is sent in the timing sequence required by the FT601 and then sent to the PC via Type-C using the USB3.0 protocol.

To read the data on the PC side the official FTDI driver and the FT60X header file are necessary.

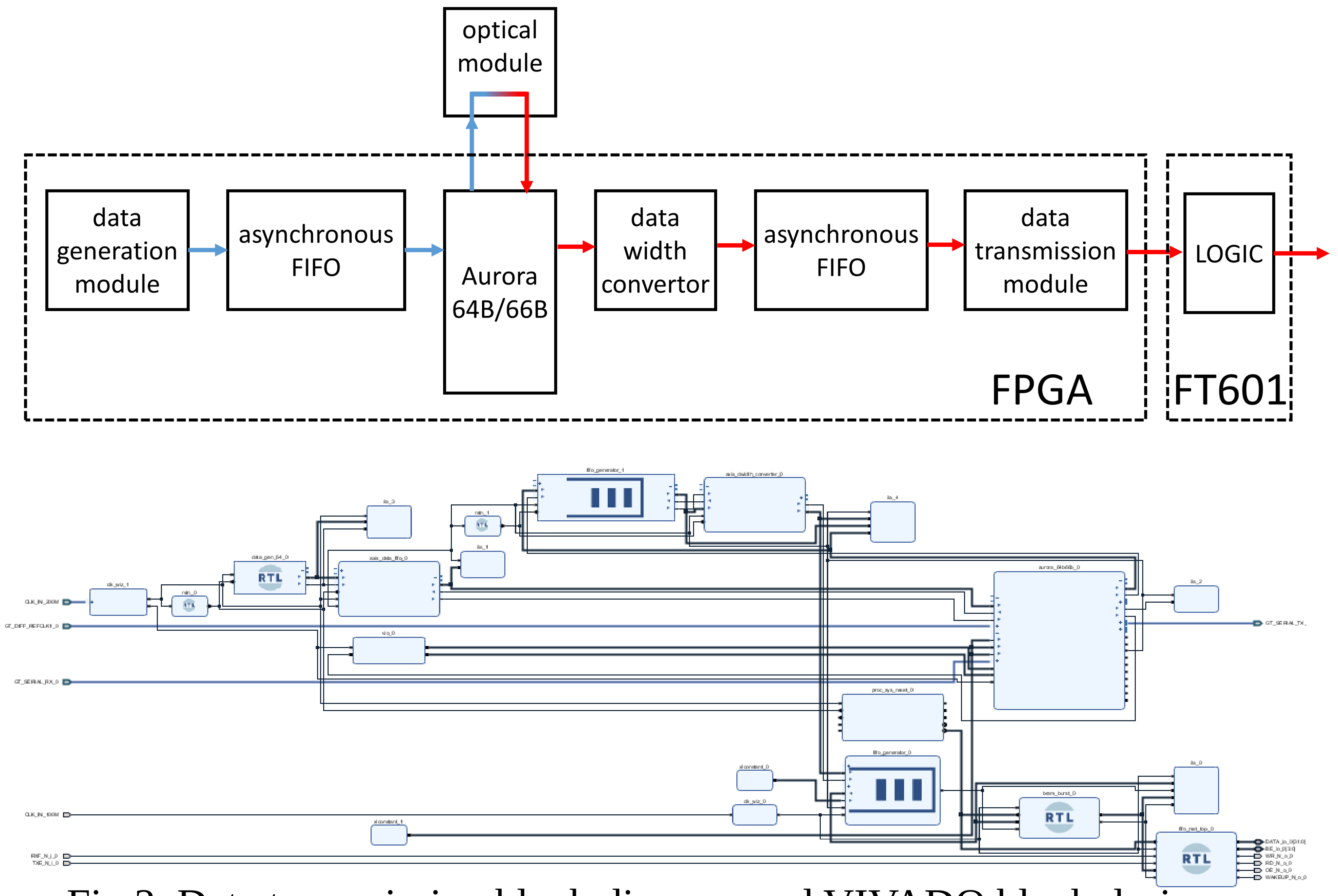

Fig.2. Data transmission block diagram and VIVADO block design

Result

PC reads the data and stores the data as a file in .bin format. In this study, MATLAB is used to read the data in the file in degrees and do the analysis.

The data read by matlab is shown on the right, and it is exactly the same as the preset values, with an error rate of 0% for all 100 transmission results.

The number of bytes transferred and stored can be rewritten by the driver. The size of a single .bin file in this experiment is about 8192kB, which can store 100 files in a few seconds. Faster storage can be achieved if larger files are stored.

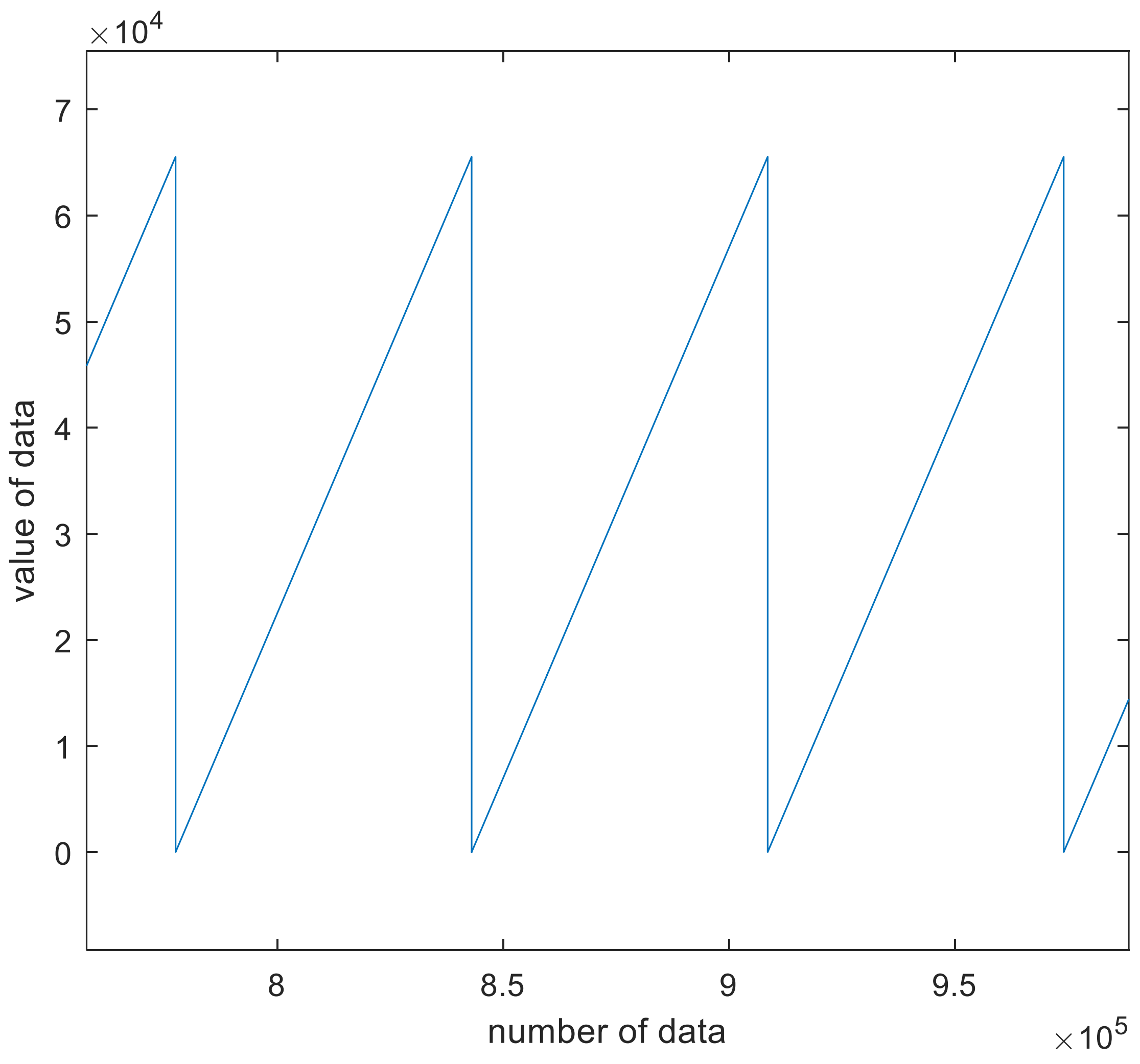

Fig.3. Data read from the PCB

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