Development of Data Acquisition to Read out Sensirion SHT85 Temperature and Humidity Sensors for the RICH Detector

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In the single shot DAQ mode (SSDM) being developed for the readout of the SHT85 sensors [1], which will use the sbRIO-9627 CompactRIO readout controller [2], the FPGA is programmed to acquire a single pair of 16-bit temperature and 16-bit humidity data from the implemented sensors in the RICH detector in a cyclical fashion, i.e. a round robin process. This note presents the work done on SSDM, for which a LabVIEW library of sub-VI functions [3] based on the I²C data transaction sequence [4] specific to SHT85s has been developed.

In SSDM, data transactions are made with a LabVIEW library of sub-VI functions based on the I²C transaction sequence, Fig. 1. Each numbered block (1–97) represents a clock pulse and an associated data bit. In lines #1–#5, grey blocks indicate data sent from the sensor to the controller, clear blocks (not grey) indicate command/data sent from the controller to the sensor. Data sent to the controller are followed by a cyclic redundancy check (CRC) checksum, calculated from the data by the sensor.

Condition	Hex. code	
Repeatability	MSB	LSB
High	0x24	00
Medium		0B
Low		16
e.g. 0x2400: high repeatability measurement.		

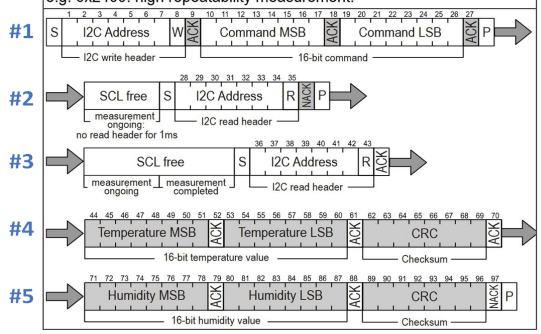

FIG. 1. SSDM transaction sequence. **P**, **S**, **R**, **W**, **ACK**, and **NACK** stand for sto**P**, **S**tart, **R**ead, **W**rite, **ACK**nowledged, and **N**ot-**AC**-**K**nowledged, respectively.

SSDM was tested with the development test station [1]. Figure 2 shows the SSDM transaction sequence captured by an Agilent 16902A Logic Analysis System.

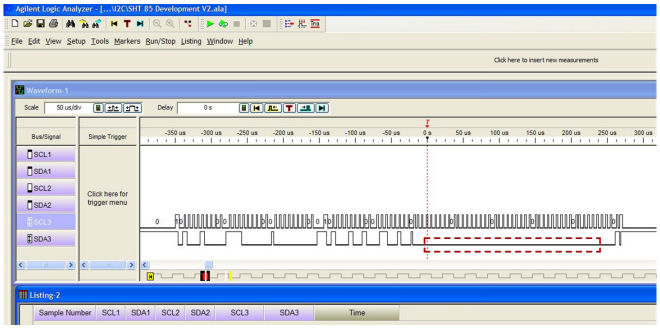

FIG. 2. Logic analysis system capture of the SHT85 single shot acquisition mode transaction error.

In Fig.2, SCL3 is the clock signal sent from the controller to sensor #3; SDA3 is the bi-directional data signal between the controller and sensor #3. During the time interval indicated by the red box, neither temperature nor humidity data from the sensor was received by the controller. To debug the absence of data, a comprehensive LabVIEW data acquisition test program was developed. The control and readback front panel for the test program is shown in Fig. 3.

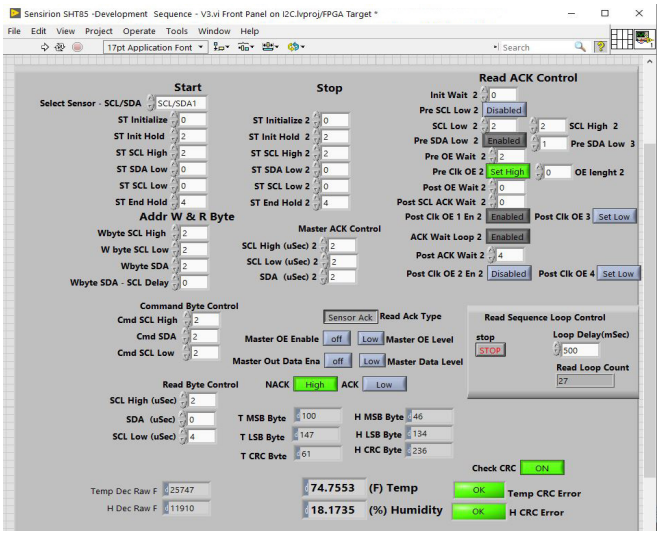

FIG. 3. SHT85 data acquisition test program LabVIEW front panel.

It was determined that data was missing because of the read header ACK signal, which per Sensirion documentation must be sent by the controller, line #3 Fig. 4, when in fact the ACK signal *must be sent by the sensor*. Once the ACK read header issue was corrected, SSDM worked properly, Fig. 5.

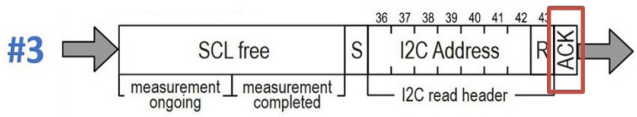

FIG. 4. Red box shows Sensirion ACK read header documentation error.

In conclusion, SSDM, has been developed, tested, and debugged and could be used for the readout of the SHT85 sensors in the RICH detector.

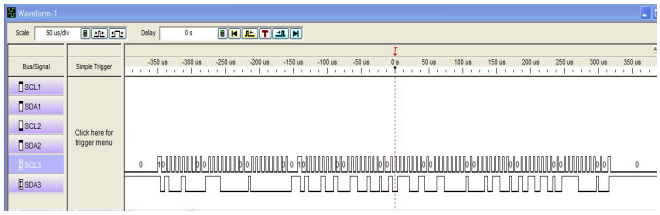

FIG. 5. Logic analysis system showing good data after correction of code.

[1] P. Bonneau, et al. *Proposed Integrated Temperature and Humidity Digital Sensor for the RICH Detector*, DSG Note 2019-12, 2019.

[2] P. Bonneau, et al. *Proposed Controller for the Readout of the Temperature and Humidity Digital Sensors Sensirion SHT85 Envisioned for the RICH Detector*, DSG Note 2019-27, 2019.

[3] P. Bonneau, et al. *Developing a Readout System for the Sensirion SHT85 Sensors*, DSG Note 2019-28, 2019.

[4] Sensirion Datasheet SHT85 / D1 Version 1.0, November 2018, https://www.sensirion.com/fileadmin/user_upload/customers/sensirion/Dokumente/0_Datasheets/Humidity/Sensirion_Humidity_Sensors_SHT85_Datasheet.pdf.