Testing of the SHT35 Sensor Printed Circuit Boards for Hall B's RICH II

Tyler Lemon, Peter Bonneau, Marc McMullen, and Brian Eng; Mary Ann Antonioli, Aaron Brown, Pablo Campero, George Jacobs, Mindy Leffel, and Amrit Yegneswaran
Physics Division, Thomas Jefferson National Accelerator Facility, Newport News, VA 23606
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This note discusses the first article testing performed to check whether the SHT35 sensor printed circuit boards (PCBs) [1, 2] developed for the Hall B RICH II detector work as designed.

The Hall B RICH II hardware interlock system [3, 4, 5] will measure the detector's internal humidity and temperature using Sensirion SHT35 sensors. Twenty-four PCBs (12 for the nitrogen volume and 12 for the electronics volume), with two sensors per board, will be mounted inside the detector. Ten PCBs, Fig.1, were first article tested.

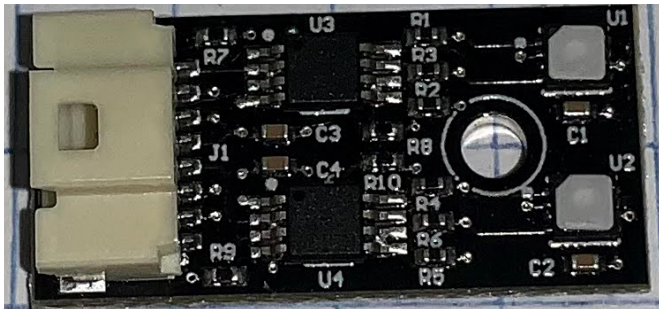

FIG. 1. Fabricated and populated SHT35 sensor PCB.

The test setup, Fig. 2, consisted of Schottky diodes, buffer drivers, pull-up resistors, RJ-45 bulkhead feedthroughs, and ~150 feet of individually-shielded twisted-pair cable (100-ft cable coupled to a ~50-ft cable using feedthrough).

Each PCB was checked to see whether it correctly measures temperature and humidity, using the FPGA command engine on the sbRIO and to ensure that all functions of the SHT35 sensors can be used. Table II lists the SHT35 sensor functions tested.

In conclusion, all ten PCBs passed first article testing.

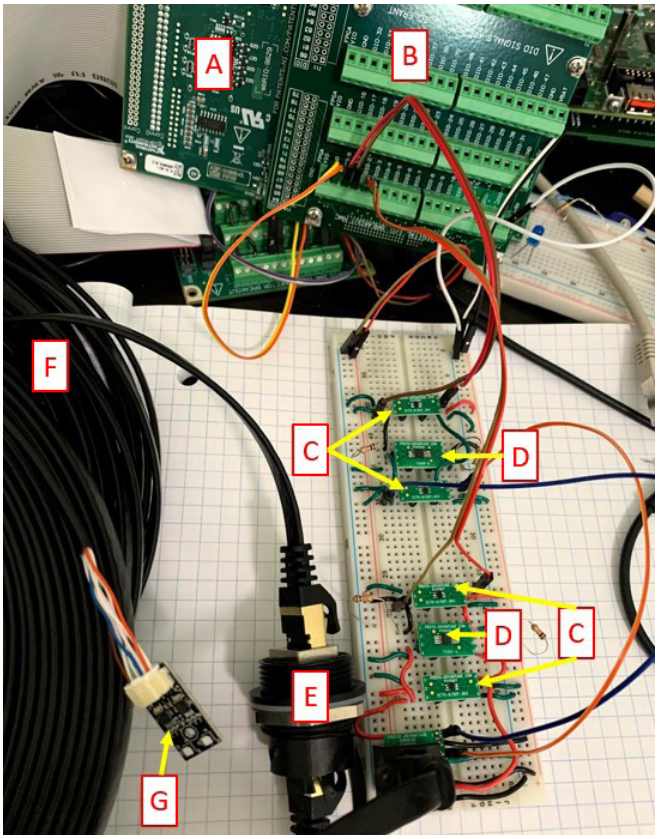

FIG. 2. Setup used to test SHT35 sensor boards. (A) sbRIO, (B) RMC breakout board, (C) Schotkky diodes on both the input and output of each buffer driver, (D) PCA9600 buffer drivers, (E) RJ-45 bulkhead feedthrough, (F) ~150-ft cable, and (G) sensor under test.

Command	Explanation
Read temperature and humidity	sends two command bytes to sensor; reads six data bytes from sensor: temperature measurement (two bytes), sensor's temperature CRC checksum (one byte), humidity measurement (two bytes), and sensor's humidity CRC checksum (one byte)
Read sensor status register	sends two command bytes to sensor; reads three data bytes from sensor: status register (two bytes) and the status CRC checksum (one byte)
Clear sensor status register	sends two command bytes to sensor to clear sensor's status register
Enable sensor's on-board heater	sends two command bytes to sensor to enable sensor's on-board heater, causing temperature to increase by ~3°C
Disable sensor's on-board heater	sends two command bytes to sensor to disable sensor's on-board heater
Reset sensor	sends two command bytes to sensor to reset sensor, returning all settings of sensor to default state

TABLE II. Functions of the SHT35 sensor that were tested during PCB tests.

[1] Peter Bonneau, et al., *Proposed Temperature and Humidity Digital Sensors for Interlock System of Detector Hardware*, DSG Note 2020-28, 2020.
[2] Marc McMullen, et al., *Sensirion SHT-35 Sensor Board Design for Hall B's RICH II Detector*, DSG Note 2021-14, 2021.
[3] Peter Bonneau, et al., *Development of Data Acquisition to Read out Sensirion SHT85 Temperature and Humidity Sensors for the RICH Detector*, DSG Note 2019-31, 2019.
[4] Peter Bonneau, et al., *FPGA Command Engine Development for the RICH Hardware Interlock System*, DSG Note 2020-02, 2020.
[5] Peter Bonneau, et al., *Data Acquisition System for the Sensirion Humidity and Temperature Sensors*, DSG Note 2020-10, 2020.