A.9: Development of fluxgate multiplexer module for HTS control system

Horizontal test stand (HTS) facility at RRCAT is used for testing and characterization of dressed superconducting radio frequency (SCRF) cavities. Magnetic sensors called 'fluxgate' are placed on the vessel enclosing the cavity to record magnetic field at various points. The readout unit called 'magnetometer' can interface to only one sensor at a time and is available in limited numbers. In order to interface multiple sensors using only one magnetometer, a C6-channel fluxgate multiplexer module has been designed, developed and deployed.

To use multiple sensors in the system, following limitations were being faced:

- There are a limited number of magnetometers and cost of the meter is quite high.
- Output of meter is analog voltage and data acquisition station is far from the sensors.
- The meter does not have any communication port.

To overcome these limitations, fluxgate multiplexer module has been designed and developed having following features:

- It helps in interfacing 6-sensors with one magnetometer.
- It uses precision bipolar analog switch ICs for channel switching.
- It uses differential input 16-bit ADC module for reading analog output from the meter.
- It sends combined data to control room over Ethernet network using UDP packets.
- It can operate both in Local and Remote modes with respect to channel switching.

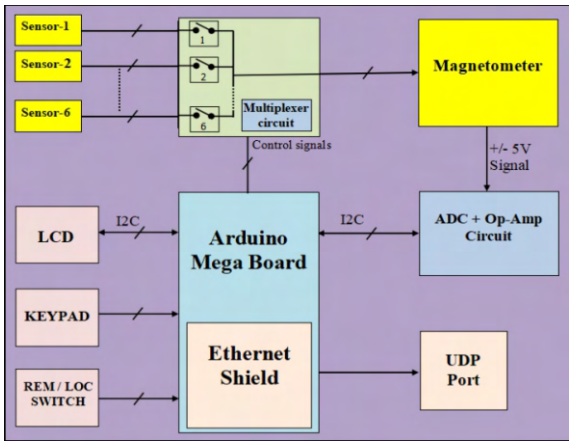

Fig. A.9.1: Scheme of the multiplexer module.

Figure A.9.1 shows the design scheme of the multiplexer module. Bi-directional, bi-polar and low on-resistance switch ICs with 4 change-over switch-contacts have been used to interface multiple sensors with the meter.

Arduino Mega controller has been used and interfaced with peripherals like ADC, LCD display, keypad and Ethernet shield. Op-amp based circuit has been implemented to convert bi-polar analog signal from magnetometer to unipolar differential signal for 16-bit ADC module. Arduino board has been programmed to operate analog switch ICs for channel selection, read ADC output and send combined data of all channels on its Ethernet port using UDP packets. It can operate in local and remote modes with respect to channel switching. In local mode, it takes channel number as input from keypad and shows its magnetic field on LCD display. In remote mode, it scans all the channels periodically.

A test setup as shown in Figure A.9.2 was developed and tested. A permanent magnet was used to compare values of magnetic field read by the magnetometer, when the sensor is connected directly and when it is connected through multiplexer channels one by one.

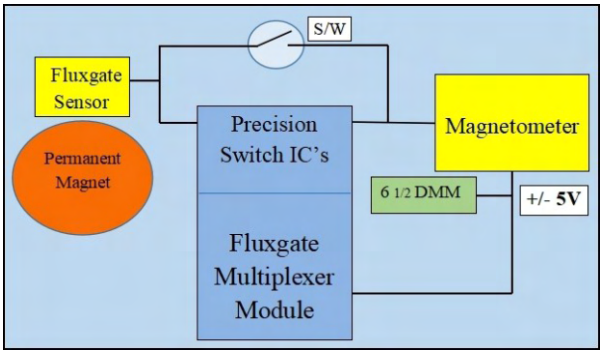

Fig. A.9.2: Scheme of test setup.

The module has been successfully tested and deployed in the HTS control system (Figure A.9.3). The data sent by the module is displayed on GUI control room. The module is being used regularly during the testing of SCRF cavities.

Fig. A.9.3: Fluxgate multiplexer module.

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