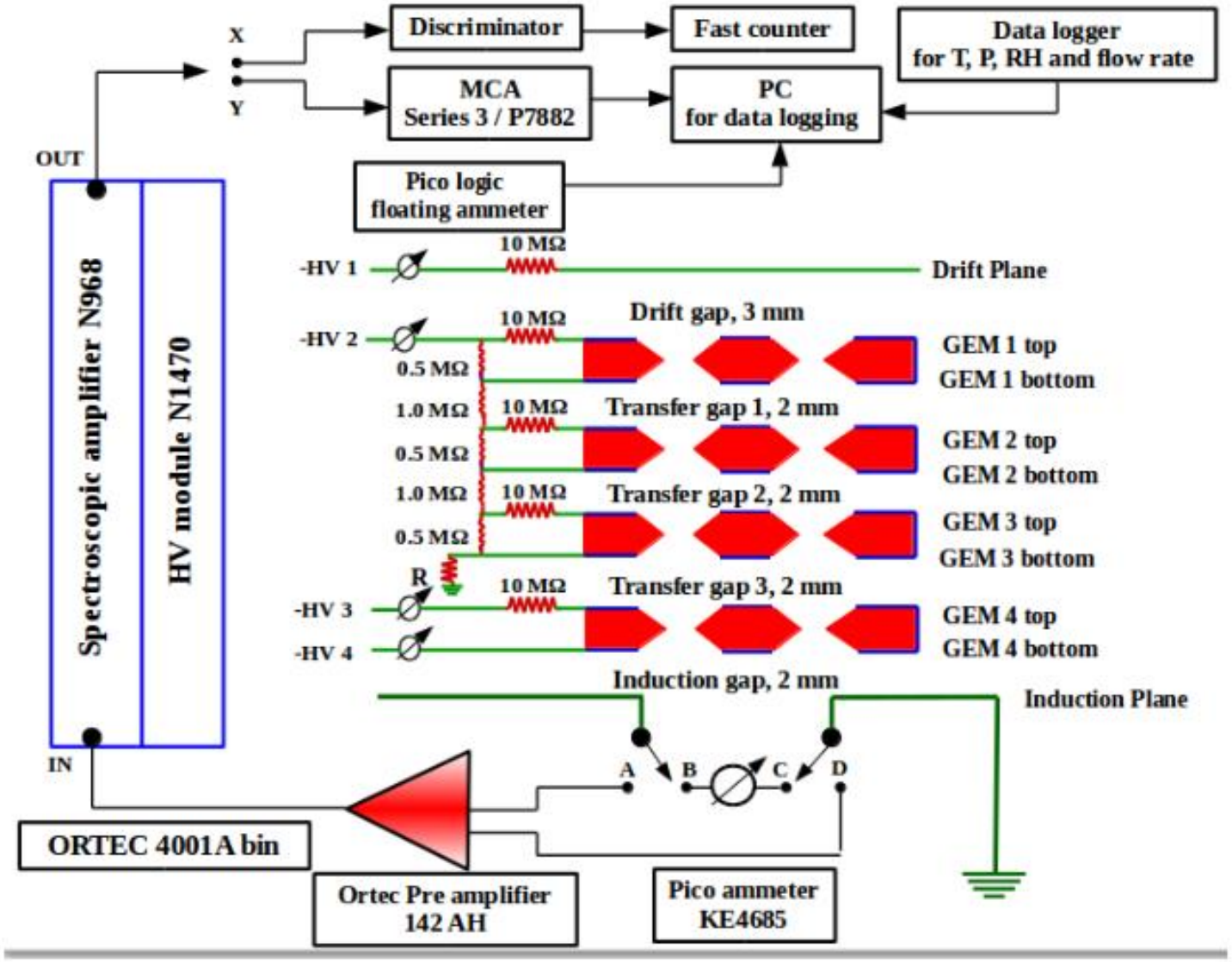
Automation Of GEM DAQ
ALICE STAR School

Vth ALICE-STAR India school on Quark-Gluon plasma
1st -12th November 2022, Institute of Physics (IOP), Bhubaneswar

HED Group
Institute of Physics, Bhubaneswar
Sanjib Sahu, Pradip Sahu, Sagarika Swain

Detector DAQ Setup



Motivation

In the GEM Detector Experimental /Gas Detector Setup requires to capture following parameters,

1. Atmospheric Temperature
2. Atmospheric Pressure
3. Humidity
4. Gas flow rate
5. Count Rate
6. Current measurement
7. Voltage Measurement

The Setup at IOP

- The GEM Detector setup at IOP has following facility

1. Atmospheric Temperature
2. Atmospheric Pressure
3. Humidity
4. Gas flow rate
5. Count Rate
6. Current measurement
7. Voltage Measurement

The Setup at IOP

- In the IOP, HED Lab we have planed a setup to measure and control different parameters from a single PC using LabVIEW program.

- The Instrument & software for Automation of the Experimental Setup.
    A. KE6485 PICOAMMETER for current measurement.
    B. MICROCONTROLLERS
    C. Lab VIEW platform

- The advance communication Technology like, Wireless, WiFi and Ethernet protocols are used.

Communication Mode

- The Wireless , Ethernet, WiFi and Serial Communication modes are used to avoid complicated wiring and cabling in the Experimental Setup
- The Instruments, which can be kept away from the Detector setup are connected using Ethernet protocol to access over the LAN.
- The instruments need to be kept very near to the Detector is connected using wireless link to the LAN / DAQ PC.

Gas Flow Instruments

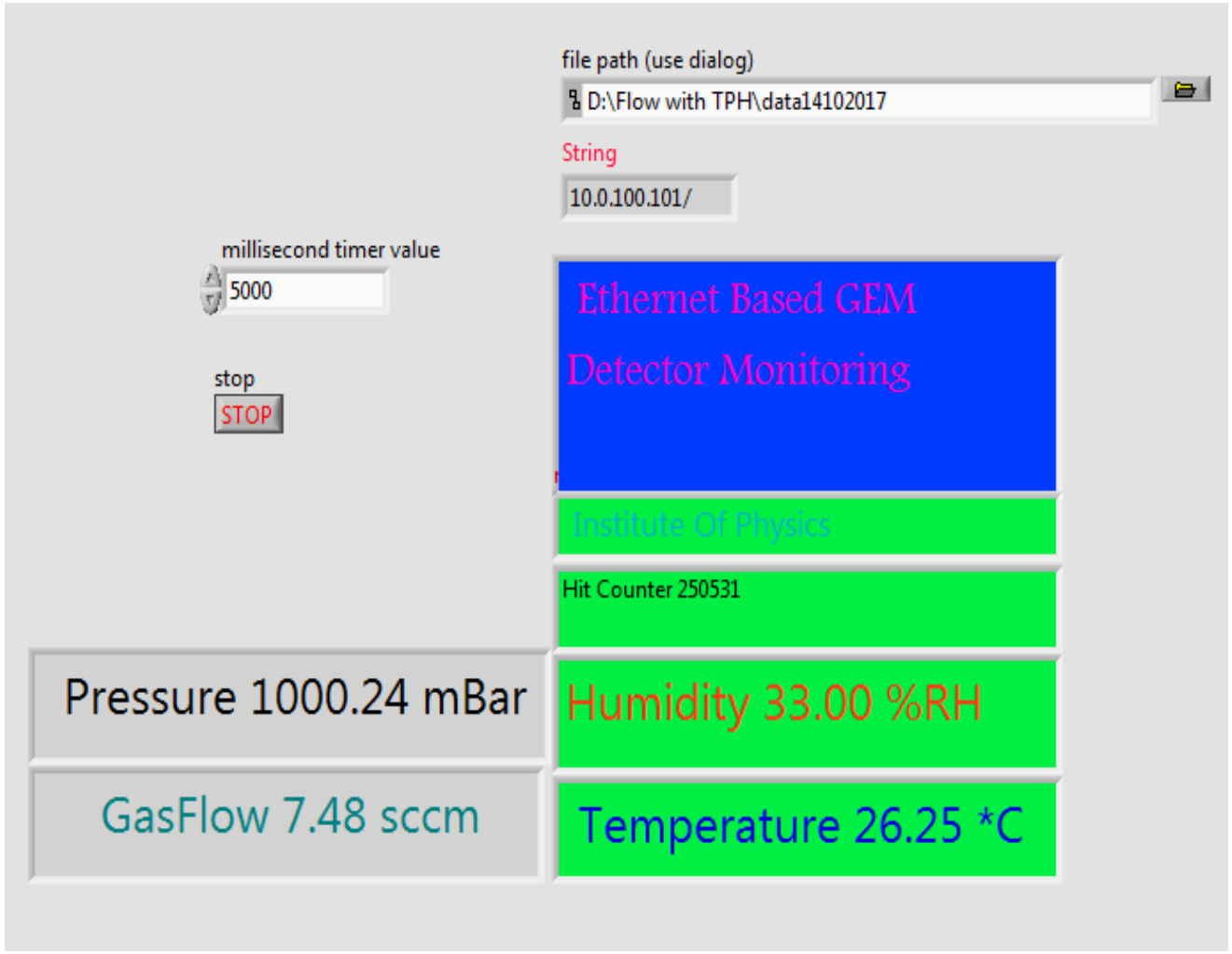
THE ATMOSPHERIC DATA LOGGER

This is a Ethernet based Instrument to store following data in a single file with time stamp.

- Atmospheric Temperature
- Atmospheric Pressure
- Humidity
- Gas flow rate($Ar+CO_2$)

- The Instrument is designed with Standard Sensors and interfaced to the PC using Ethernet/ LAN port.
- The Frontend GUI software is developed using LabVIEW platform .

Interface and Data



data14102017 - Notepad

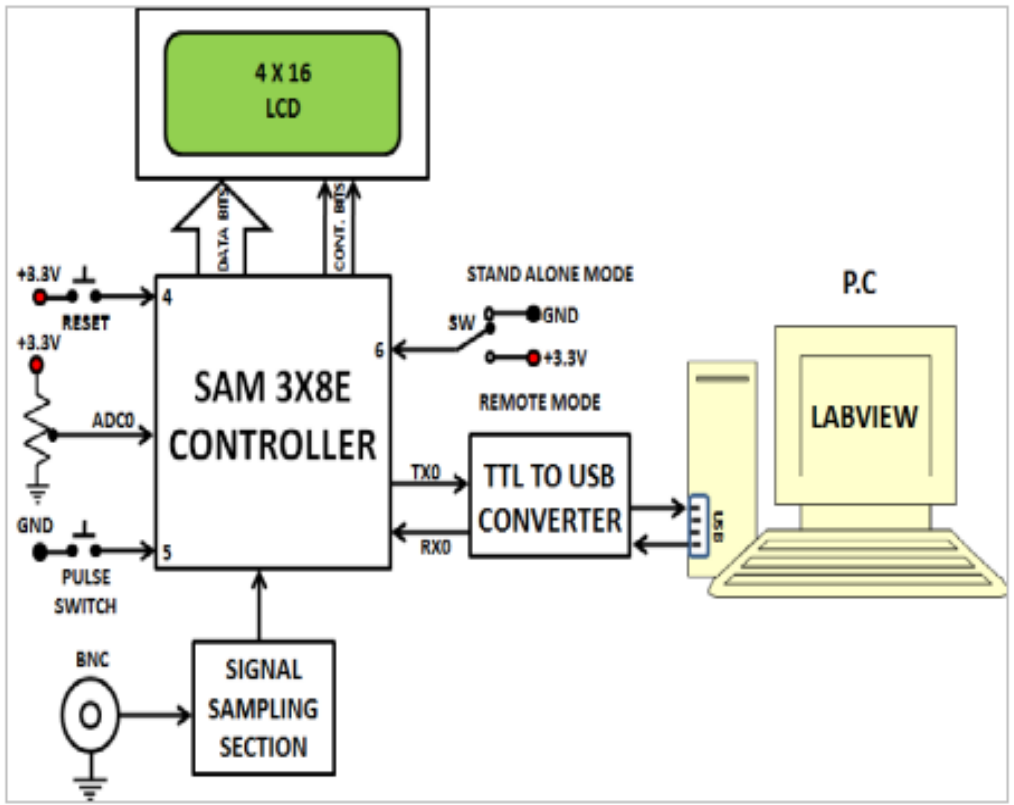
File Edit Format View Help

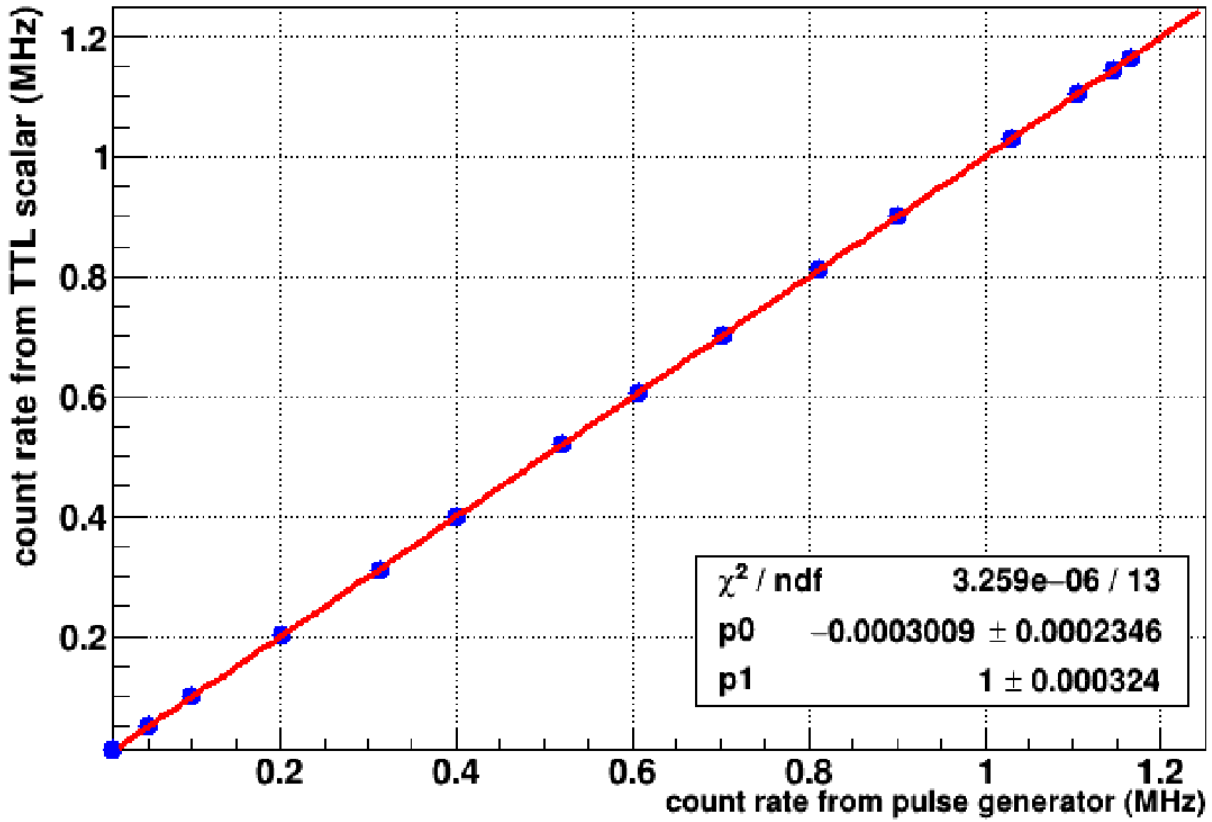
102220171544	3:44 PM	33.00	26.31	1000.16	7.48
102220171544	3:44 PM	33.00	26.25	1000.15	9.25
102220171544	3:44 PM	34.00	26.25	1000.15	7.48
102220171544	3:44 PM	33.00	26.25	1000.20	7.48
102220171544	3:44 PM	33.00	26.25	1000.12	4.22
102220171544	3:44 PM	34.00	26.25	1000.18	7.48
102220171545	3:45 PM	33.00	26.25	1000.17	7.48
102220171545	3:45 PM	33.00	26.25	1000.17	11.10
102220171545	3:45 PM	33.00	26.25	1000.16	7.48
102220171545	3:45 PM	33.00	26.25	1000.17	9.25
102220171545	3:45 PM	33.00	26.25	1000.12	7.48
102220171545	3:45 PM	33.00	26.25	1000.14	11.10
102220171545	3:45 PM	33.00	26.25	1000.18	11.10
102220171545	3:45 PM	33.00	26.31	1000.16	11.10
102220171545	3:45 PM	33.00	26.25	1000.14	7.48
102220171545	3:45 PM	33.00	26.25	1000.22	5.81
102220171545	3:45 PM	33.00	26.25	1000.17	7.48
102220171545	3:45 PM	33.00	26.25	1000.16	7.48
102220171546	3:46 PM	33.00	26.25	1000.20	7.48
102220171546	3:46 PM	33.00	26.31	1000.13	7.48
102220171546	3:46 PM	33.00	26.25	1000.16	9.25
102220171546	3:46 PM	34.00	26.25	1000.20	7.48
102220171546	3:46 PM	33.00	26.25	1000.19	7.48
102220171546	3:46 PM	33.00	26.25	1000.19	9.25
102220171546	3:46 PM	33.00	26.25	1000.18	7.48
102220171546	3:46 PM	33.00	26.25	1000.22	5.81
102220171546	3:46 PM	33.00	26.25	1000.22	0.00
102220171546	3:46 PM	33.00	26.25	1000.17	7.48
102220171546	3:46 PM	33.00	26.25	1000.10	7.48
102220171546	3:46 PM	33.00	26.25	1000.18	7.48
102220171547	3:47 PM	33.00	26.25	1000.23	9.25
102220171547	3:47 PM	33.00	26.25	1000.15	11.10
102220171547	3:47 PM	33.00	26.25	1000.13	7.48
102220171547	3:47 PM	33.00	26.25	1000.12	5.81
102220171547	3:47 PM	33.00	26.25	1000.16	5.81
102220171547	3:47 PM	33.00	26.25	1000.20	5.81
102220171547	3:47 PM	33.00	26.25	1000.20	5.81
102220171547	3:47 PM	33.00	26.31	1000.17	4.22
102220171547	3:47 PM	33.00	26.25	1000.17	9.25
102220171547	3:47 PM	33.00	26.25	1000.22	7.48
102220171547	3:47 PM	33.00	26.25	1000.24	11.10
102220171547	3:47 PM	33.00	26.25	1000.24	7.48
102220171548	3:48 PM	33.00	26.25	1000.26	7.48
102220171548	3:48 PM	33.00	26.25	1000.19	5.81

FAST TTL Counter

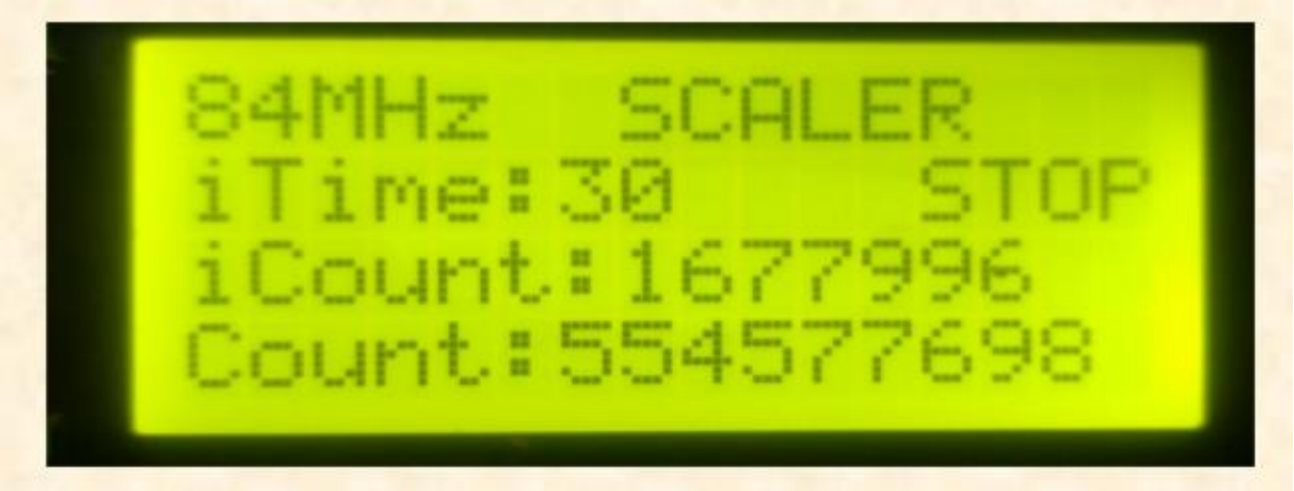
- 84MHz FAST Counter
- This instrument Measure the high frequency pulse from the detector
- The Data Can be logged in a file with an interval.
- This device is interfaced to the PC using LabVIEW platform

Fast Counter Design





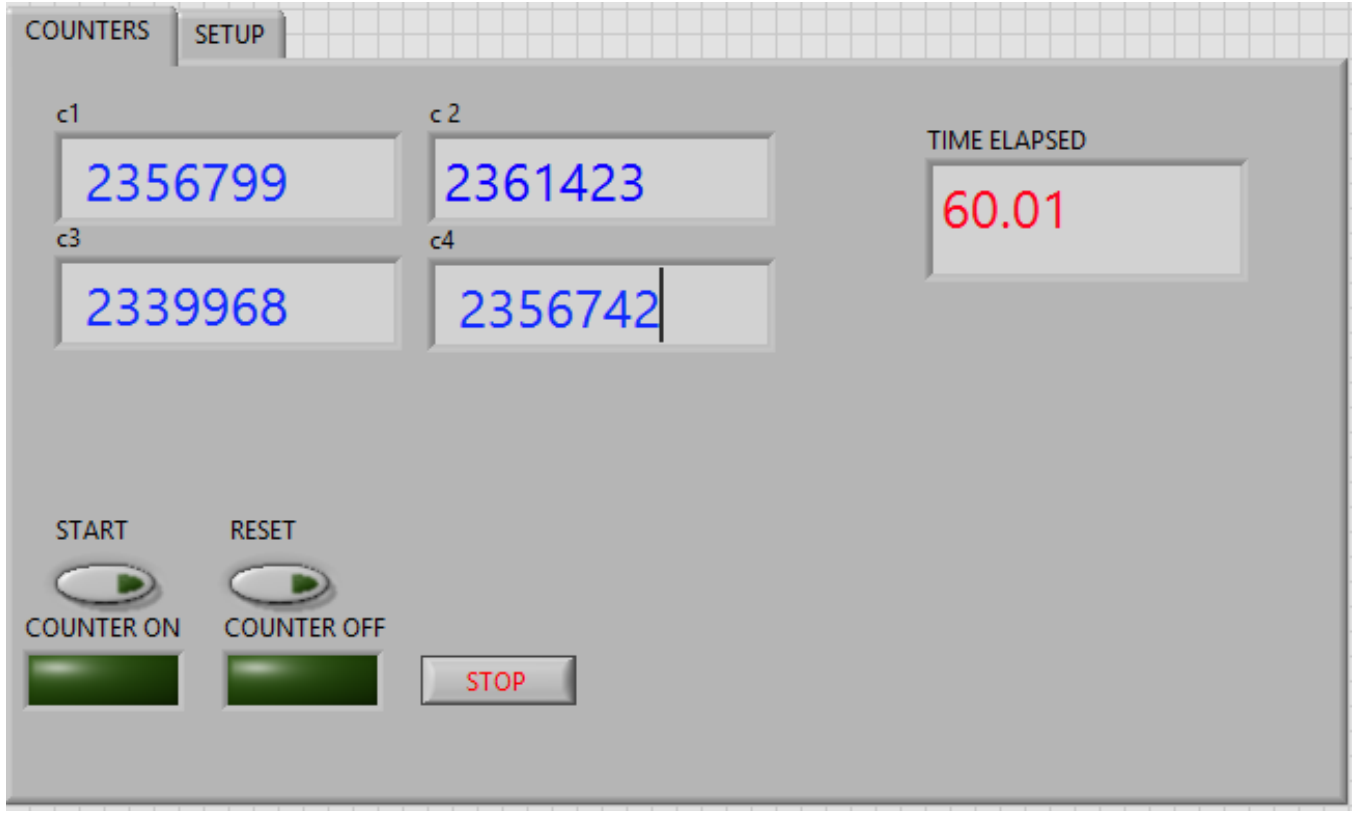
Fast Counter Local Display



- The Counter accepts TTL pulse in general Digital pulse
- It display instantaneous count per second also Total count for the duration
- A 16X4 LCD display unit is used for this purpose.

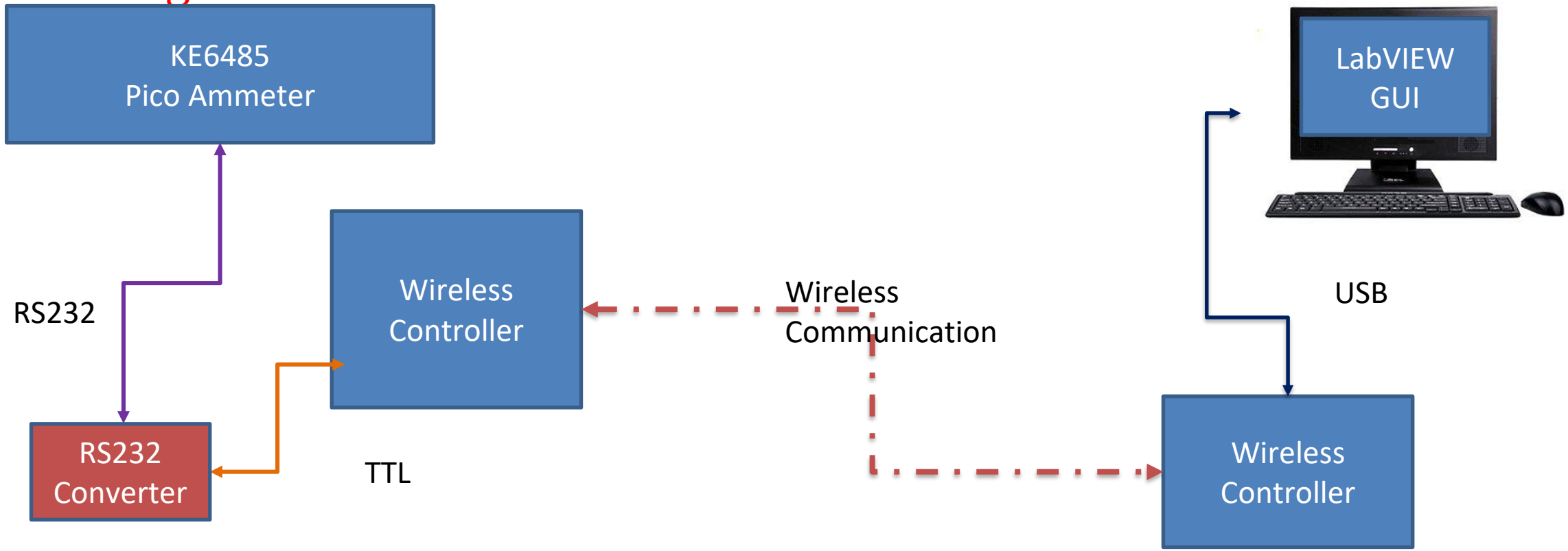
FAST Counter PC interface

- The fast counter is interfaced to PC using a USB port of the PC. The LabVIEW based program acquire the count and store in a file.
- Front Pannel



Pico Ammeter Interface (KE6485)

- The Pico Ammeter is placed near to the GEM detector, to avoid Cabling mesh we have used Wireless communication technique



Pico Ammeter Interface

A KE6485 Pico Ammeter is interfaced wirelessly to the PC using ATMEGA2560 Microcontrollers and SI4463 RF chip.

The RF chip has 1000m range and operate in 433.4MHz.

ATmega2560 is 8bit microcontroller , Set to communicate with 9600 b/s baud rate.

Open source Arduino IDE is used for programming the Controller.

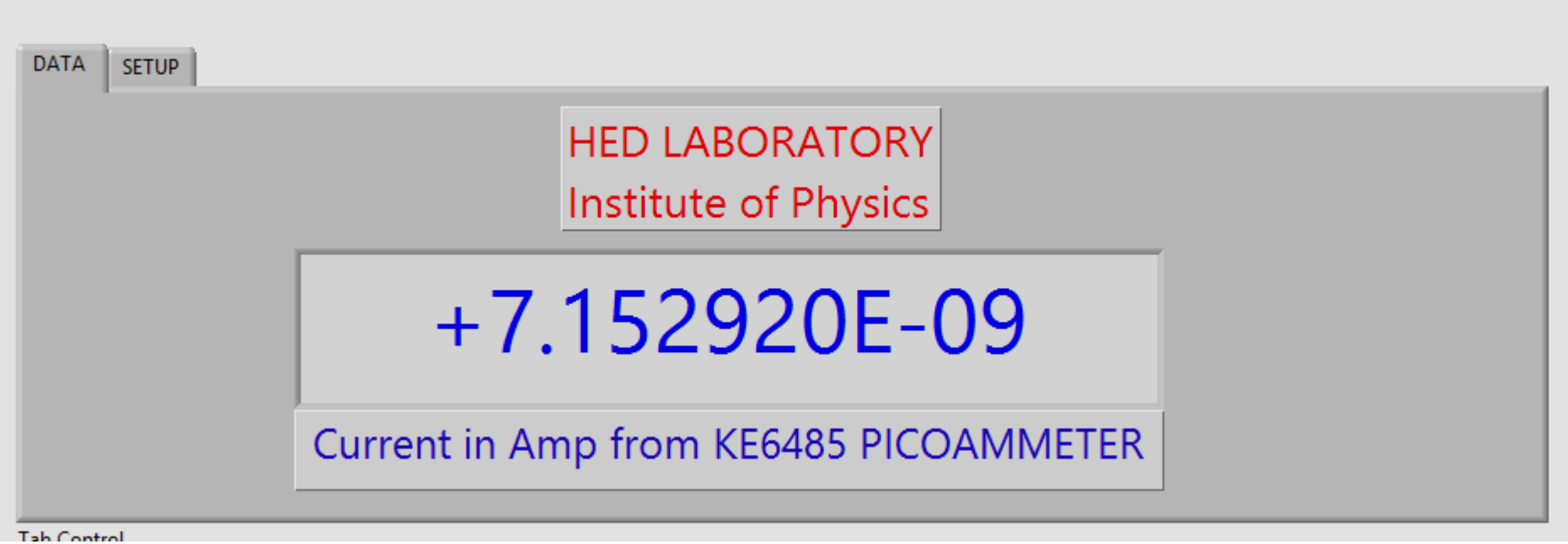
Design Principle

- The Kethily Pico Ammeter has one RS232 comport and other one is GPIB port
- We use RS232 Serial communication port for data and command communication
- The Instrument follows SCPI (Standard Command for Programming Instrument) command set
- The microcontrollers are being used at both ends to communicate the user commands from the GUI(Graphic User Interface) to the Instrument end using wireless media.

GUI Description-1

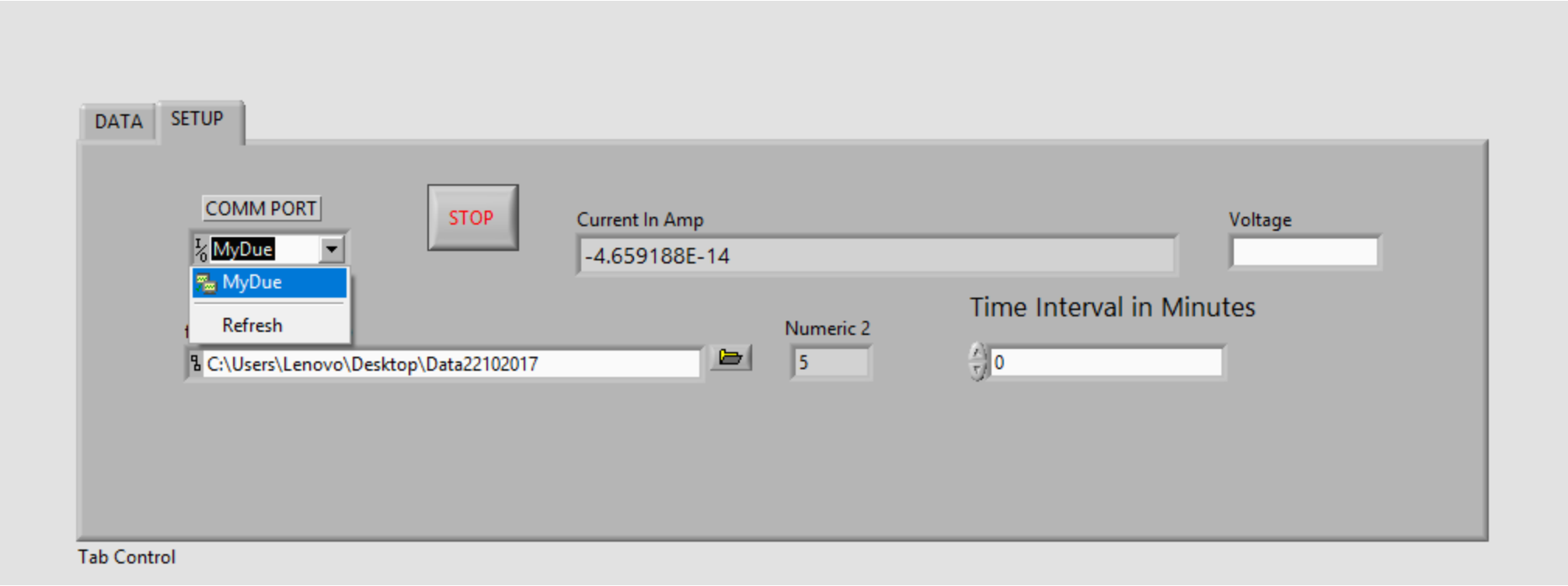
- Graphic User Interface(GUI)

FRONT Panel
DATA display Page



GUI Description-2

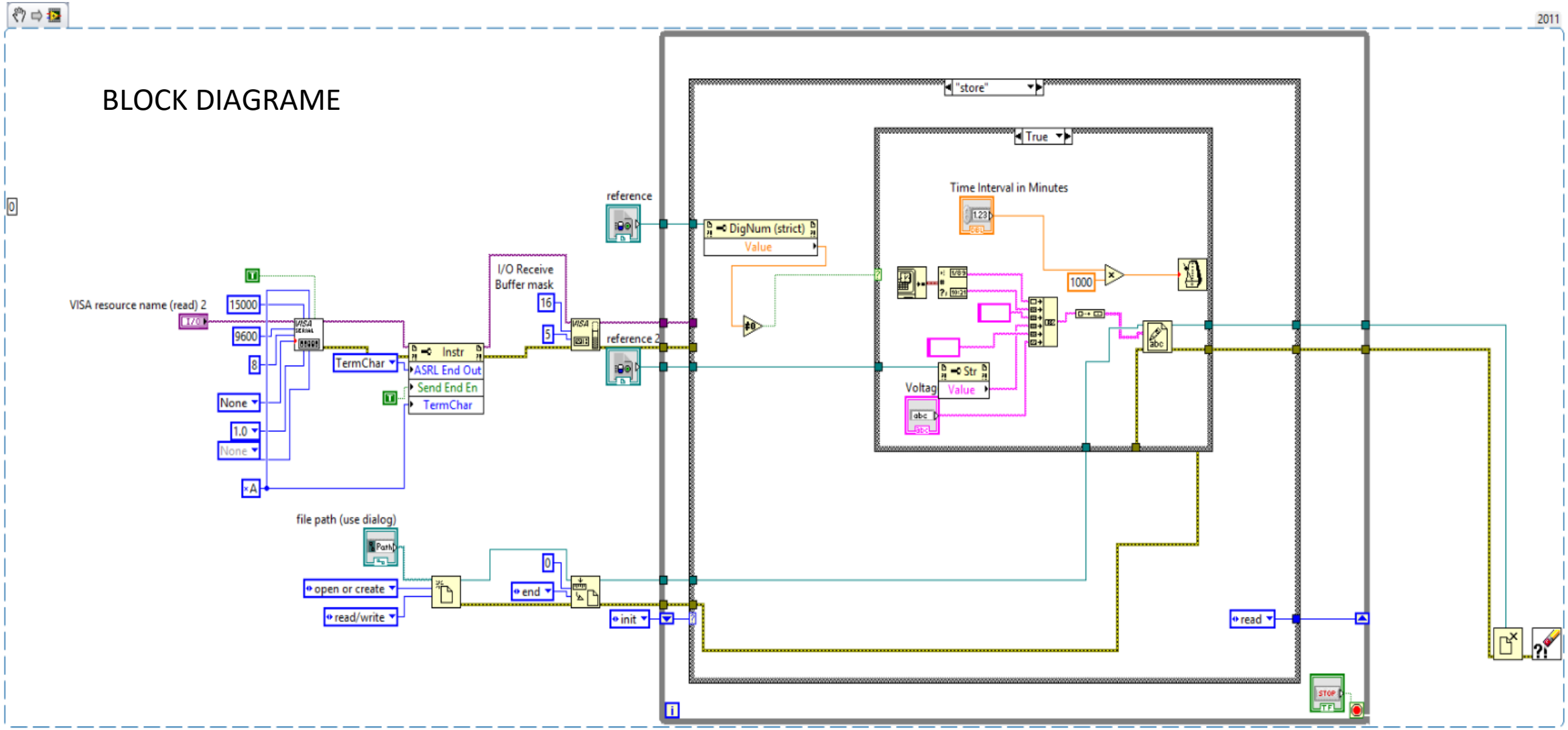
FRONT Panel
SETUP Page



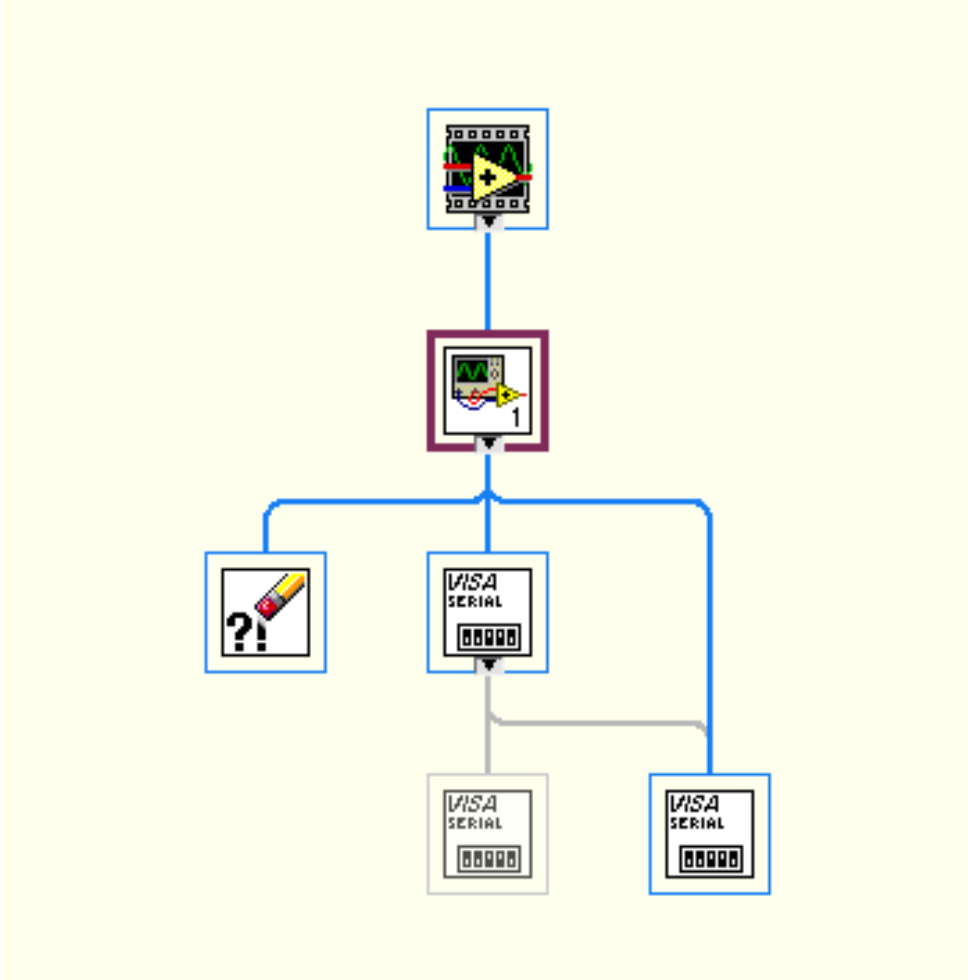
GUI Description-3

- Setup
- The Setup panel in the front panel takes the following input
    1. Time interval---This is the Time in seconds between the measurement . This is user programmable
    2. File path for creating a file to store the data
    3. Select The PC COM port to which the microcontroller is connected
    4. Manually feed the voltage(This will be the next work)

GUI Description-4



VI Architecture



Sample Data

- The Data Format: in Text
- The File stores the PC Time stamp, Current from Pico Ammeter and the Voltage set from CAEN N1470
- Presently the Voltage from N1470 is manually controlled and feed in the GUI window.

Data Format

Time	Current	voltage
22-10-201712:31	+7.607508E-09	3600
22-10-201712:31	+7.597197E-09	3600
22-10-201712:31	+7.599664E-09	3600
22-10-201712:31	+7.590010E-09	3600
22-10-201712:31	+7.597326E-09	3600
22-10-201712:31	+4.459587E-09	3600
22-10-201712:31	+4.446107E-09	3600
22-10-201712:31	+4.438764E-09	3600
22-10-201712:31	+4.433453E-09	3600
22-10-201712:31	+4.426771E-09	3600
22-10-201712:31	+4.415562E-09	3600
22-10-201712:31	+4.401839E-09	3600
22-10-201712:31	+4.398493E-09	3600
22-10-201712:31	+4.405984E-09	3600
22-10-201712:31	+2.465804E-09	3600
22-10-201712:31	+2.987024E-09	3600
22-10-201712:31	+2.998141E-09	3600
22-10-201712:31	+2.941055E-09	3600
22-10-201712:31	+2.466860E-09	3600
22-10-201712:31	+2.071932E-09	3600
22-10-201712:31	+2.939060E-09	3600
22-10-201712:31	+2.950118E-09	3600
22-10-201712:31	+2.774000E-09	3600
22-10-201712:31	+2.306408E-09	3600
22-10-201712:31	+2.218089E-09	3600
22-10-201712:31	+2.098019E-09	3600
22-10-201712:31	+2.006655E-09	3600
22-10-201712:31	+2.063153E-09	3600
22-10-201712:32	+2.967604E-10	3600
22-10-201712:32	+2.607280E-10	3600

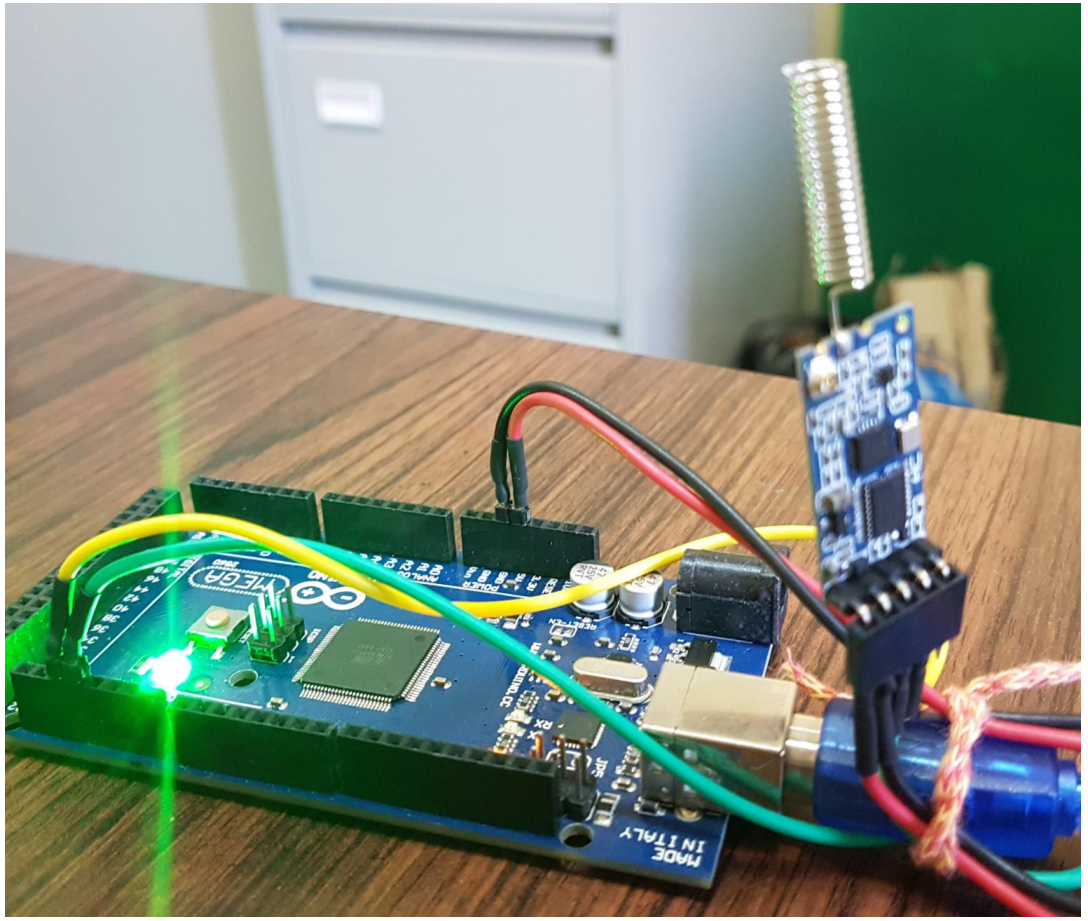
Principle

- When the program is started the LabVIEW program is designed with a structured state machine.
- The initialize state send RESET and Auto ZERO command to the microcontroller connected to PC The controller Transmit the same command using a 433MHz FSK transmitter.
- The other microcontroller receive the command and convert it into SCPI command and send to the KE6485 instrument
- The Instrument perform accordingly, if there is return Current data then the controller at the Instrument end send back the data to the PC using the wireless modules.

Mother Board at PC END

The Picture aside shows the Arduino MEGA 2560 R3 board with RF module connected to it. This setup is interfaced with the PC USB port for communication.

This mother board receives the SCPI command from the PC and transmit to the PicoAmmeter using 433MHz FSK communication

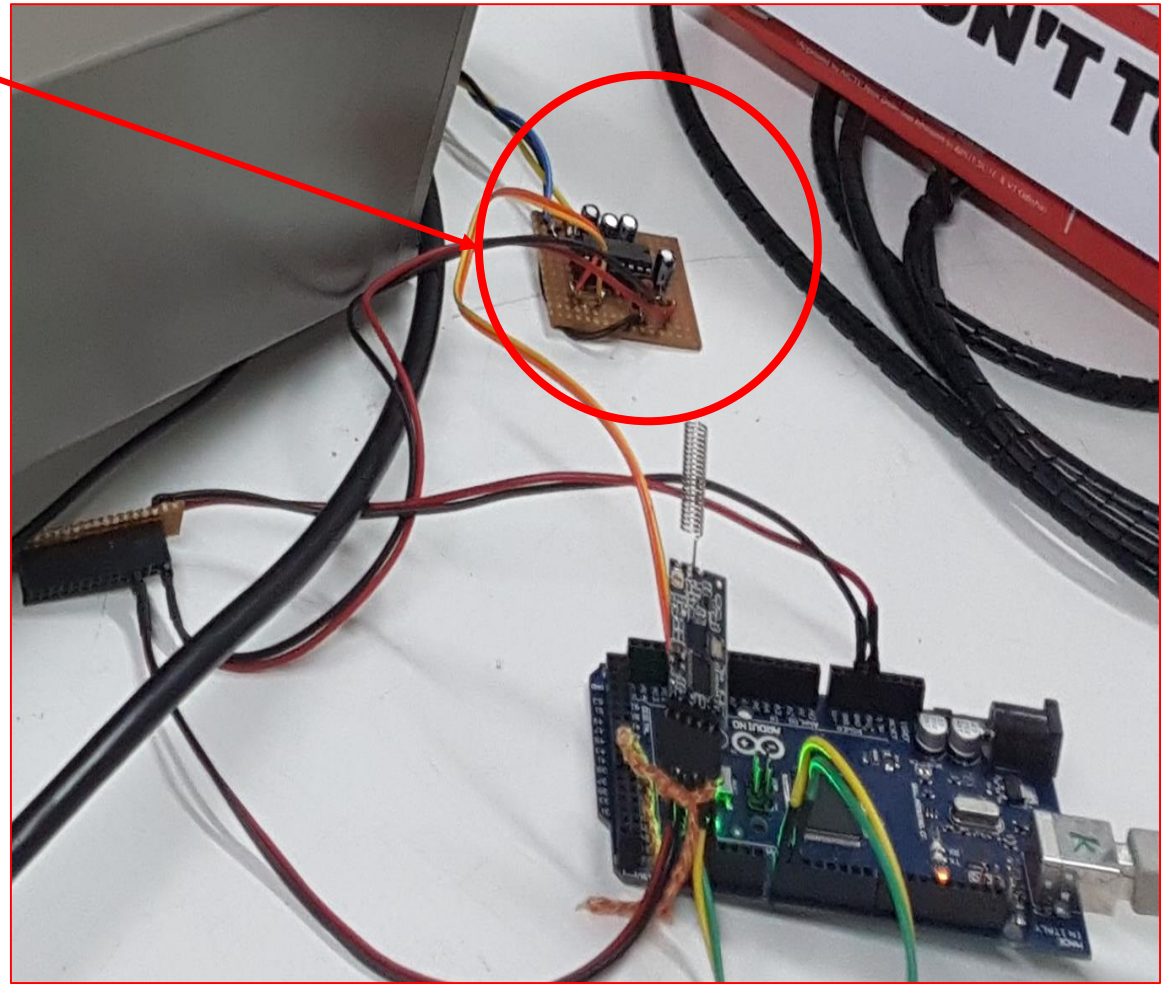


Mother Board at Instrument End

RS232 Converter Module

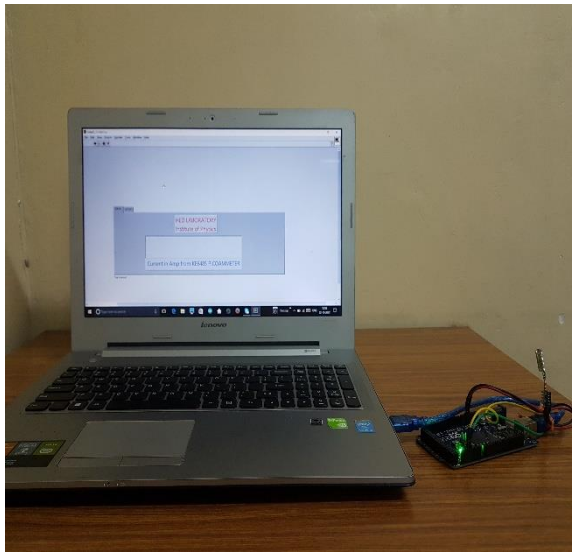
The Picture aside shows the Arduino MEGA 2560 R3 board with RF module connected to it. A RS232 to TTL convereter designed with MAX232 IC.

This mother board receives the SCPI command from the other Microcontroller and send the command to the Pico Ammeter through RS232 converter.

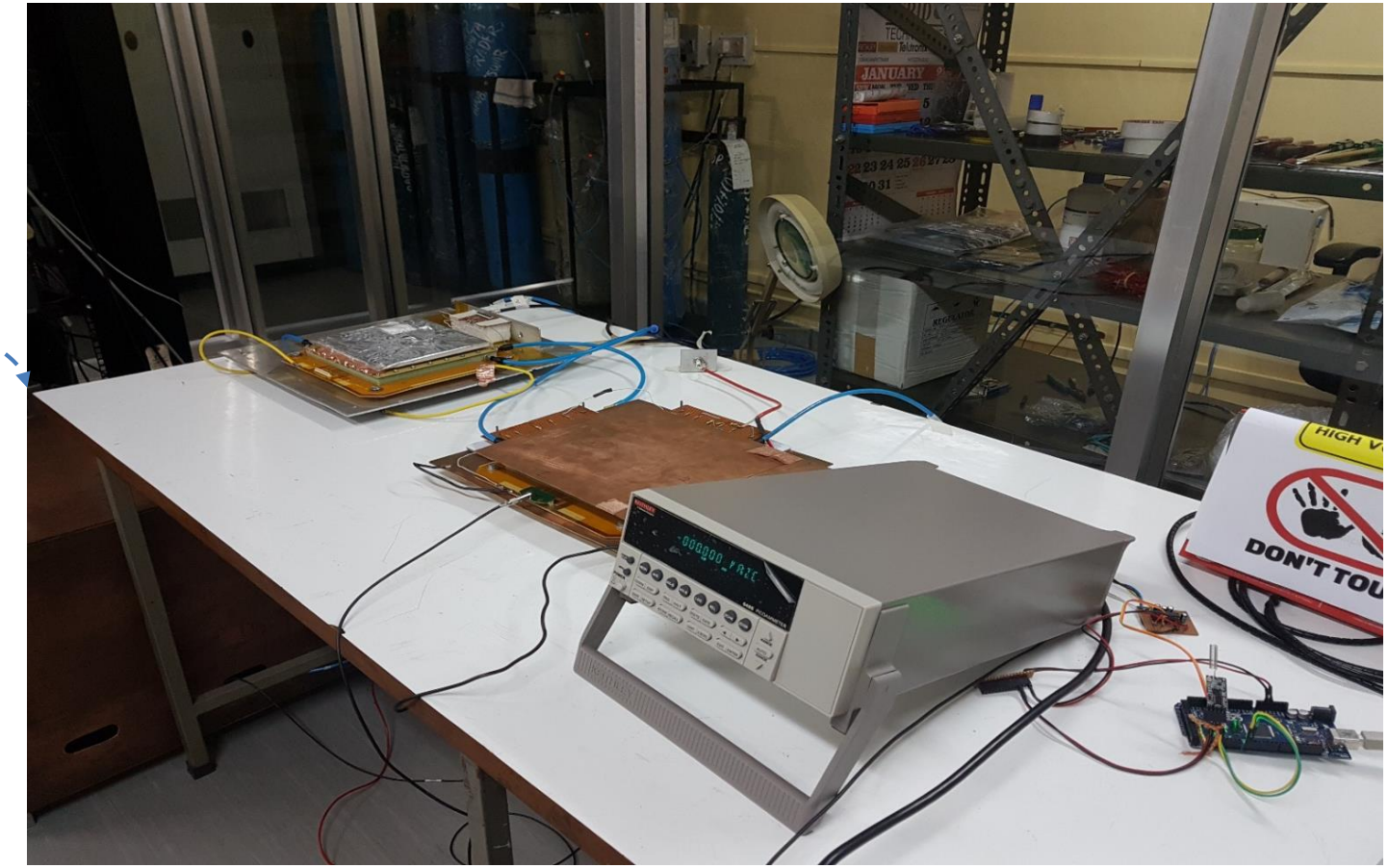


Experimental Setup picture at IOP

Wireless Communication



DAQ PC



Gem Detector with Pico Ammeter Setup

Thank You