Development of a Fast Single-channel TTL scalar for detector signal Counting

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Introduction

At IOP High Energy Experimental Physics (HED) laboratory, various gas detectors such as Gas Electron Multiplier (GEM), Resistive Plate Chamber (RPC), Single Wire Proportional Chamber (SWPC) and scintillator detectors have been developed [1-5]. During the characterisation of these detectors signals are counted in general with source and without source. A rising edge triggered Single channel TTL (Transistor-Transistor Logic) scalar has been developed to record the number of pulses in a given interval of time. The Single channel counter can record 1 Hz to 84 MHz signal with updating the status in each second. The channel is capable of capturing maximum of 4,294,967,295 (2^{32}-1) number of signals pulse. The details of the design, fabrication and calibration of the scalar are presented as below.

Design principle

The Single channel edge triggered TTL scalar is designed here to count the pulses from the detector. The scalar has been designed to avoid multiple counting with larger pulse width. So, the edge trigger with fast response has been designed i.e. whenever the digital signal changes its state from 0 to 1(0 V-3.3V) then only the scalar counts. A rate of maximum 84 MHz, that is a pulse of width 12ns can be counted without any delay independently. As the entire system is designed with SAM3X8E, ARM Cotex-M3 processor operating with 84 MHz main clock. The block diagram is given in Fig 1

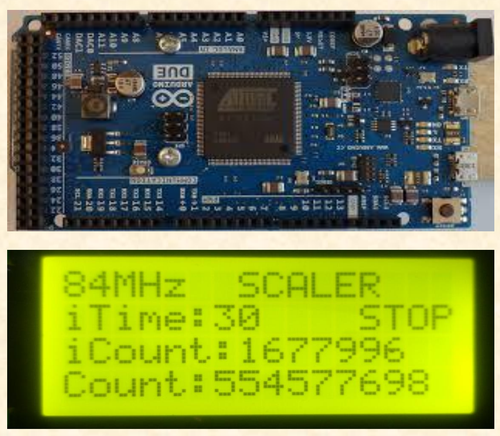

Fig 1: Motherboard with Front display

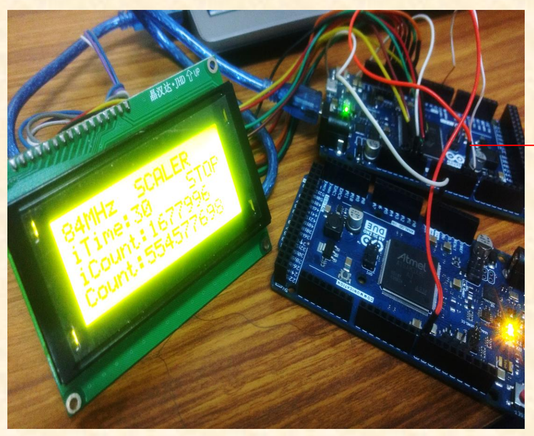

Fig 2: TTL scalar with display

TTL Scalar

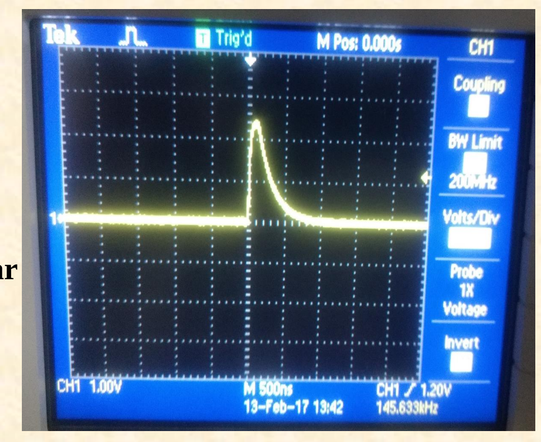

Fig 3: NIM signal from Pulse generator

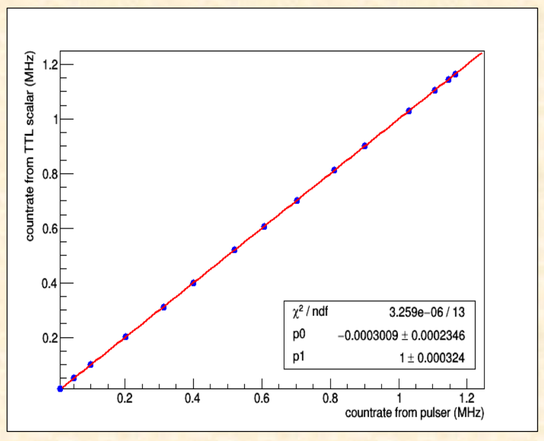

Fig 4: Calibration with NIM Pulse generator

The scalar can accept user command by external knob (potentiometer) for setting up of sampling time. After setting up of sampling time one pulse switch (KEY) is pressed to start the count. The elapsed time and the sampling set time in seconds are displayed on the LCD. One such display is shown in Fig 1. The time calculated in second accuracy, also the counter updates its 'count per second (iCount)' and its cumulative value for the span of time. There are two timers used in this design, one is set as timer for one second to refresh the display on every one second and other one is configured as counter to count the pulse input to the counter. As the system is designed with time counter, it works as a Real time process.

Summary

One Single channel TTL scalar has been fabricated. The scalar has the following characteristics.

(a) The scalar has Single channel,

(b) The scalar can accept TTL input,

(c) It can accept the maximum count rate of 84MHz,

(d) The maximum pre-set time can be 120 minutes,

(e) And Counts displayed once in every second.

The count rate of the TTL scalar is calibrated with a commercially available NIM pulse generator. The calibration curve is found to be a straight line with a calibration factor of 1.0.

References

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