In House Development of Arbitary Square Wave Generator Using Microcontroller
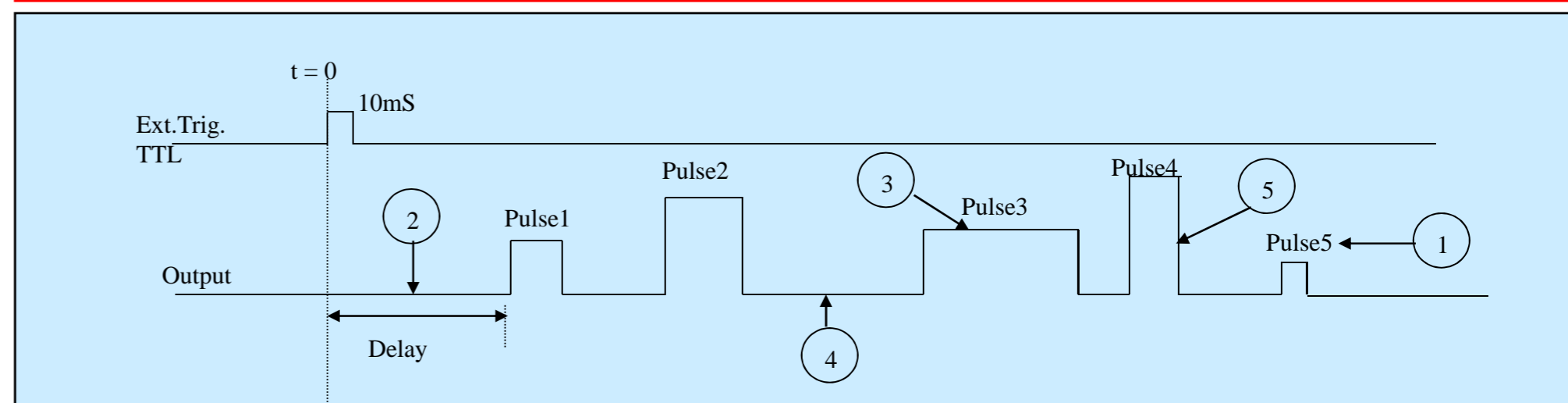
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Abstract

In the Aditya Tokamak, one of primary requirement for plasma generation is to feed the required quantity of the fuel gas. A piezoelectric valve is routinely used for feeding the fuel gas in Tokamak. Either continuous voltage or pulses of different width, amplitude and delay are applied to the Piezoelectric leak valve. This type of valve is also used to puff the gas during plasma discharges to control plasma density and other parameters. For puffing gas at various time during plasma discharge, a voltage pulses of different amplitude and widths are applied to piezoelectric valve to get desired Plasma parameter. This voltage pulses are normally given through pulse generator. To replace this costly programmable pulse generator, a Programmable Square wave Generator is designed and developed in house, which may replace costly pulse generator and oscilloscope. The heart of circuit is microcontroller interface with user interactive LCD and keyboard. It has two mode of operation. In the first mode, the desired train of pulses can be set. User can set a burst of one to five pulses, with desired individual pulse amplitude, ON time (pulse width) and OFF time (delay) using user-friendly keyboard and LCD. User can also set delay after getting trigger pulse. In second mode, the circuit is ready for trigger, which can be triggered, either manually or with any TTL pulse from external circuit. This circuit also provides optical isolation at the input side, which is essential in Aditya Tokamak electronics. One setting of pulse, which is commonly used for Aditya Tokamak operation, is kept as default setting. This paper presents the design and operation of the in-house developed programmable pulse generator. This programmable generator is successfully operated in ADITYA Tokamak for pre-filling and gas puffing experiments. A few test result and experimental results with the operation of this generator are presented in this paper.
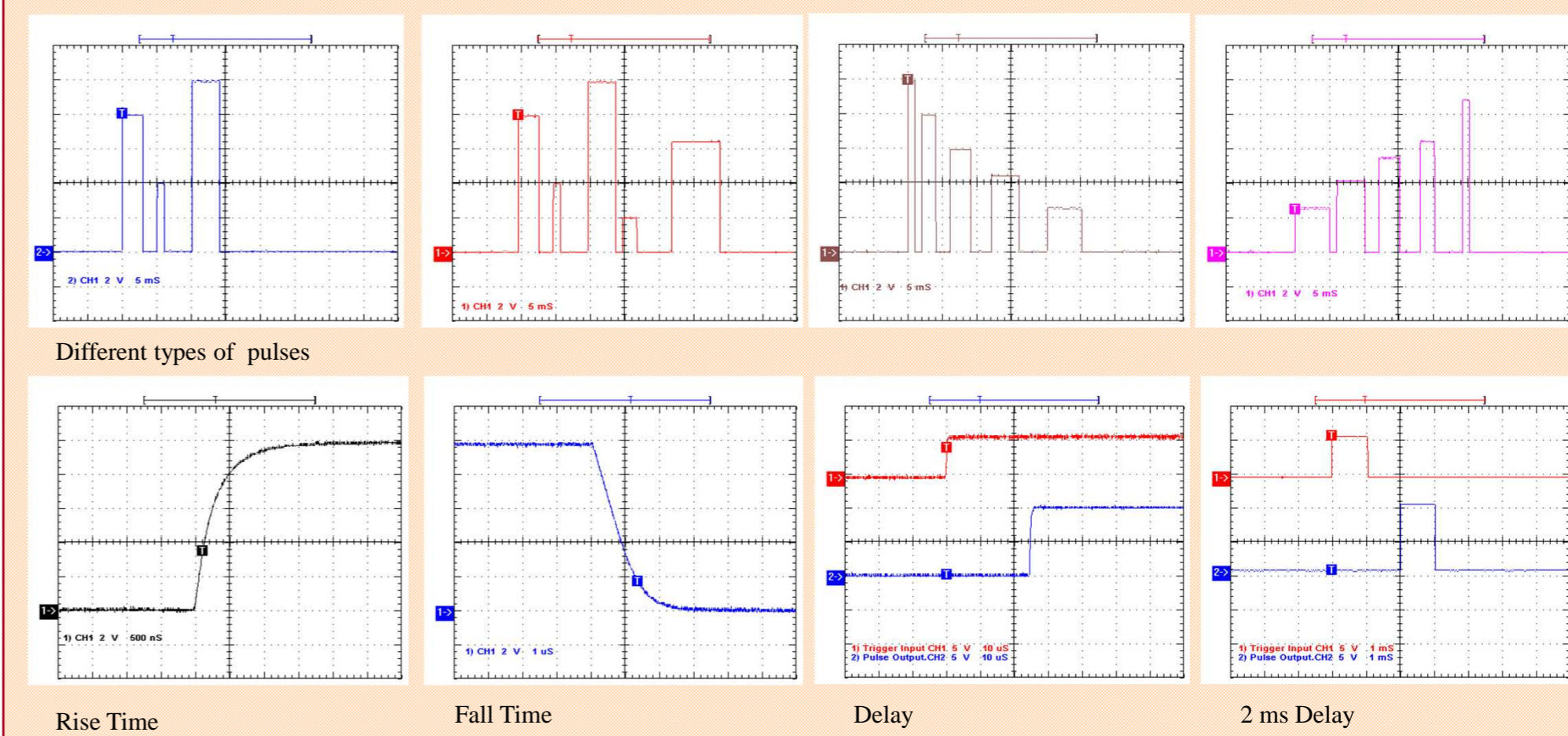
Experimental Block diagram

In House Developed Arbitrary Square Wave Generator   Piezoelectric Leak Valve

MODEL MV 112 VALVE SPECIFICATIONS

Electrical: Maximum voltage to valve 100 VDC@10μA

•**Throughput:** > 1 torr-liter/sec. At 1 ATM pressure differential,100VDC input valve

•**Valve Response Time:** Maximum time from full open to close < 2ms.

•**Valve Natural Frequency:** > 2000 Hz.

•**Leakage:**   <1X 10 –10 std ATM cc/sec a 1ATM helium on inlet and exhausting to vacuum @ 25°C.

•**Operating and storage temperature:** +10° to + 60° C.

•**Gases Controlled:** All dry, non-corrosive gasses

Block Diagram Programmable Pulse Generator
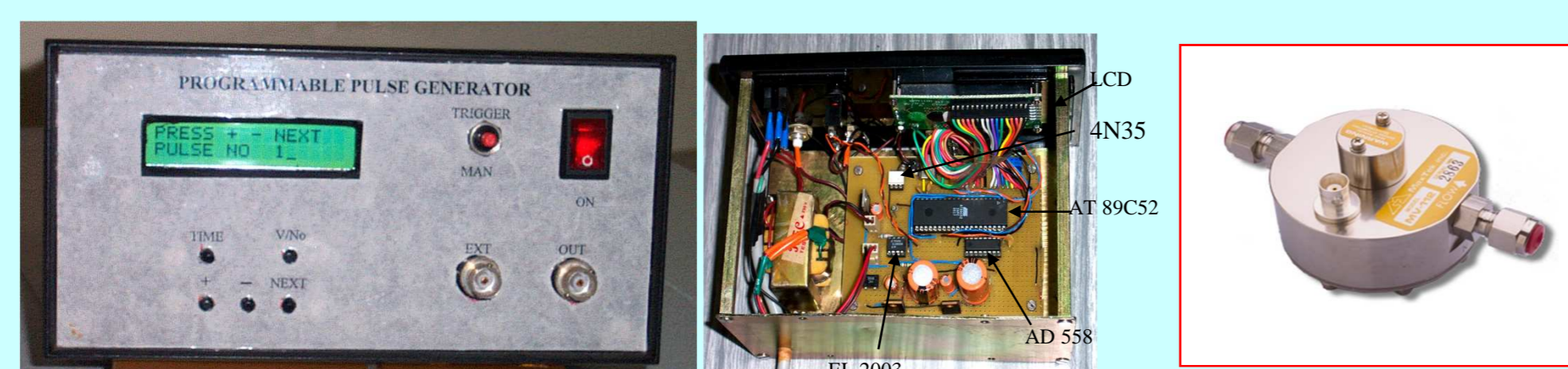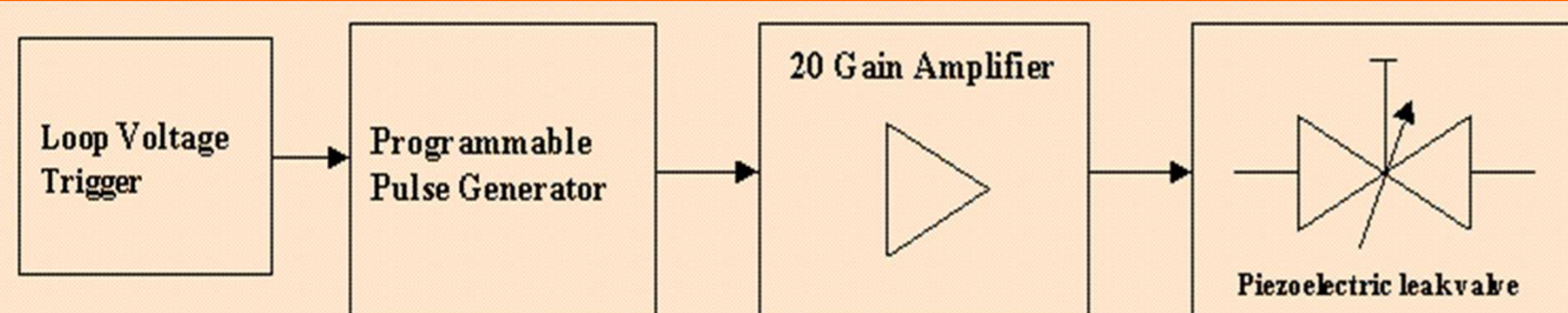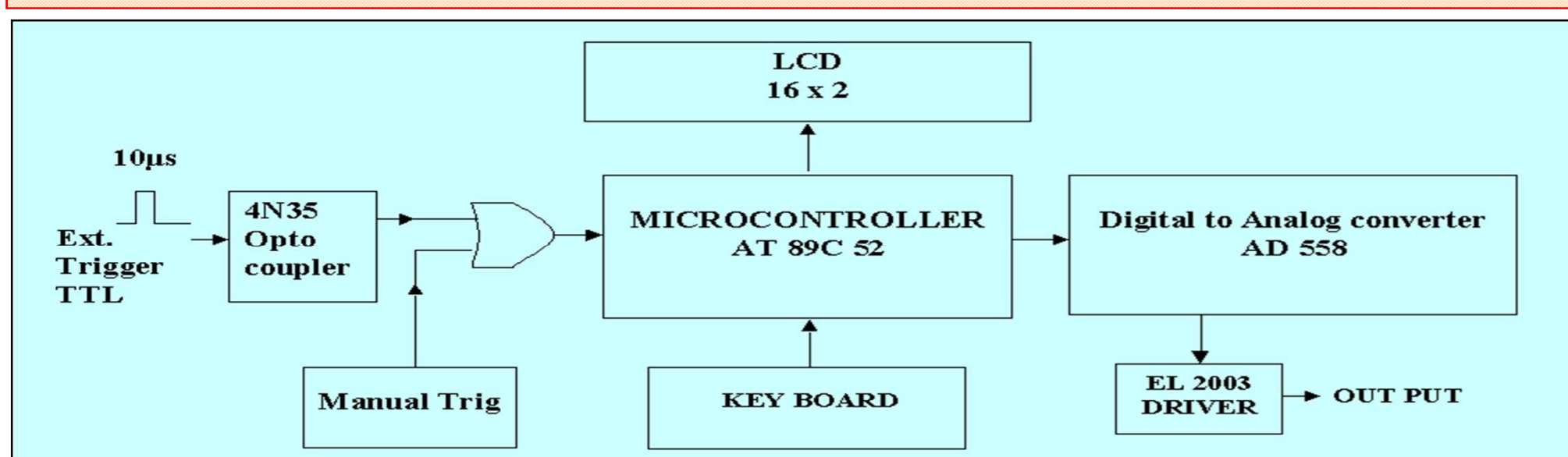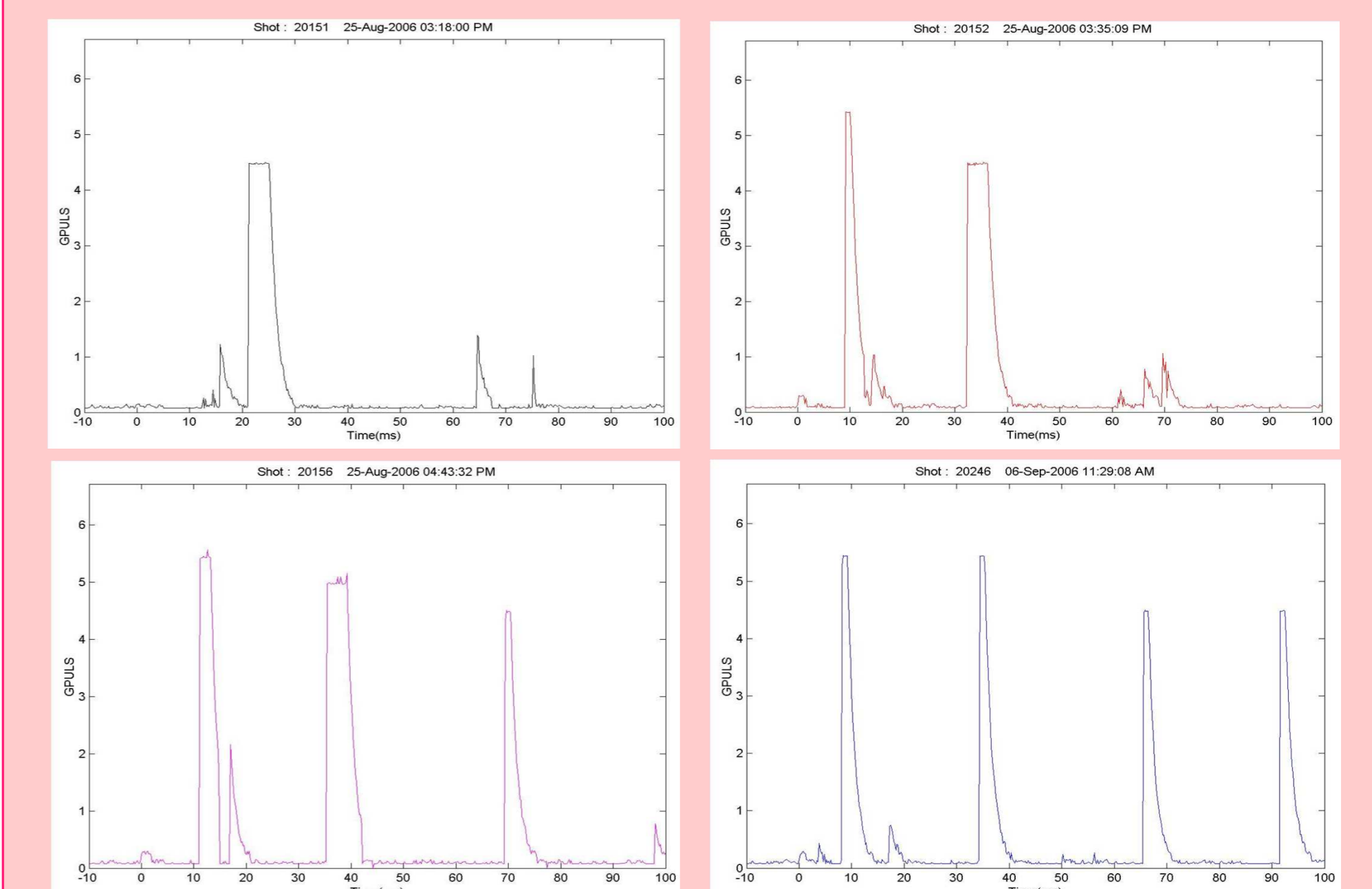

Timing Diagram

Feature

1. Number of pulses can be programmed within range of 1 to 5.

2. Delay can be programmed in the range of 0 to 255 ms. rate of 1ms.

3. On time of each pulse can be programmed individually 1 to 255 ms. rate of 1ms.

4. Delay between each pulses can be programmed individually 1 to 255 ms. rate of 1ms

5. Amplitude of each pulse can be programmed separately from 0 volts to 10 volts in steps of 39 mV per bit.

6. Users friendly

7. LCD display

8. Manual or Ext. Trigger TTL (optically isolated); BNC

9. Out put; BNC (as defined by user)

10. Inbuilt power supply

Results

Different types of pulses

Rise Time   Fall Time   Delay   2 ms Delay

Recorded Data During Aditya Shots

Conclusion

In house developed programmable pulse generator using microcontroller is successfully installed in gas puffing system in Aditya Tokamak. .