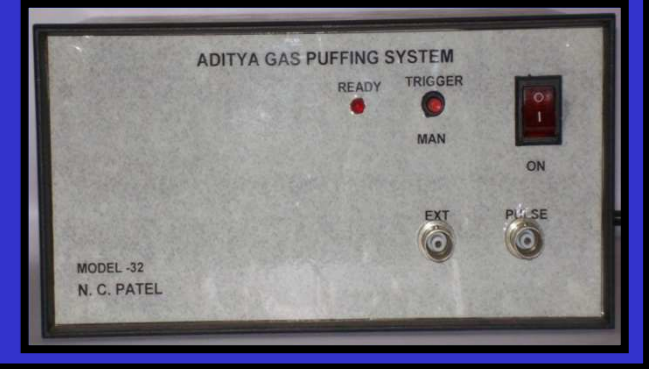


Development of Programmable Pulse Generator for ADITYA Gas Puffing System

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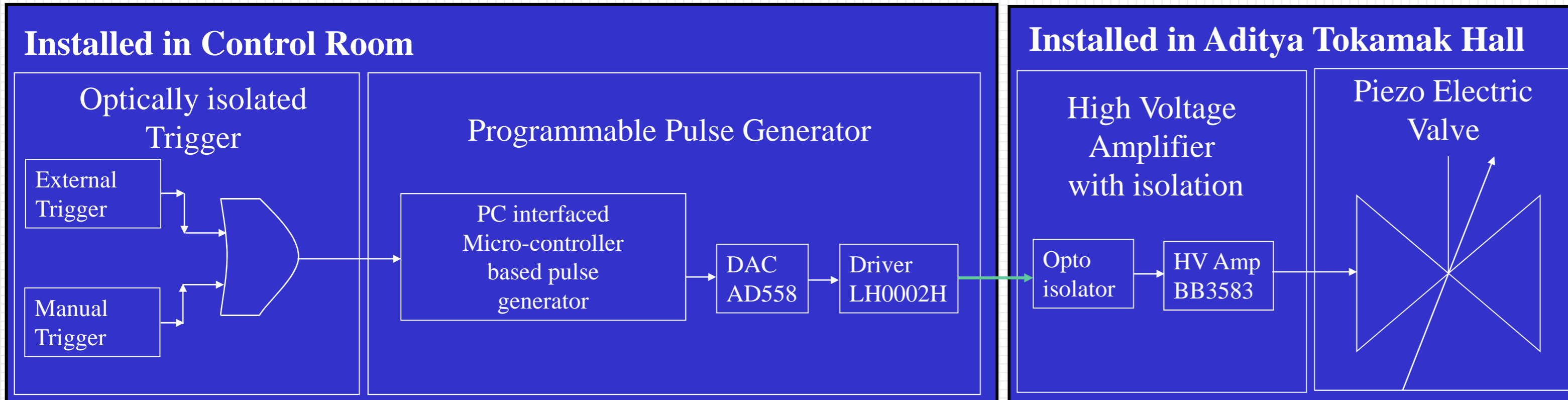


Abstract

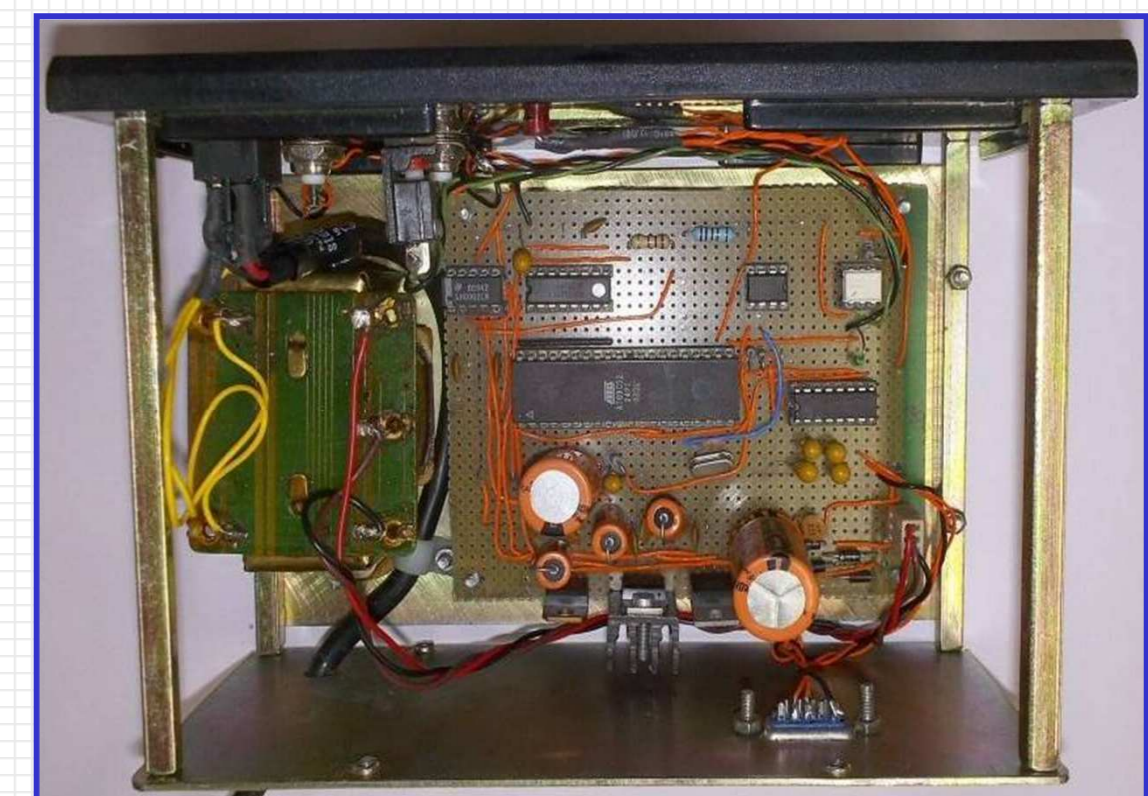
In the Aditya Tokamak, one of primary requirement for plasma generation is to feed the required quantity of the fuel gas prior to plasma shot, using the Gas Feed System. The Gas Feed System consists of Piezoelectric gas leak valve and Gas reservoir. The Hydrogen gas is pre filled approximately 300 ms prior to loop voltage for 4msec to 7msec. Additional gas is puffed during the shot for required plasma parameters and to increase plasma density using the same system. The Piezoelectric gas leak valve is fed with pulses of different width, amplitude and delay with respect to loop voltage trigger to control the Gas feed.

Parameters like quantity, time and delay for puffing the gas in vessel is controlled by control pulse parameter like amplitude, width and delay from loop voltage respectively. In house developed micro-controller based stand alone programmable pulse generator is used to generate such pulse. This developed system has user friendly GUI for programming through serial interface.

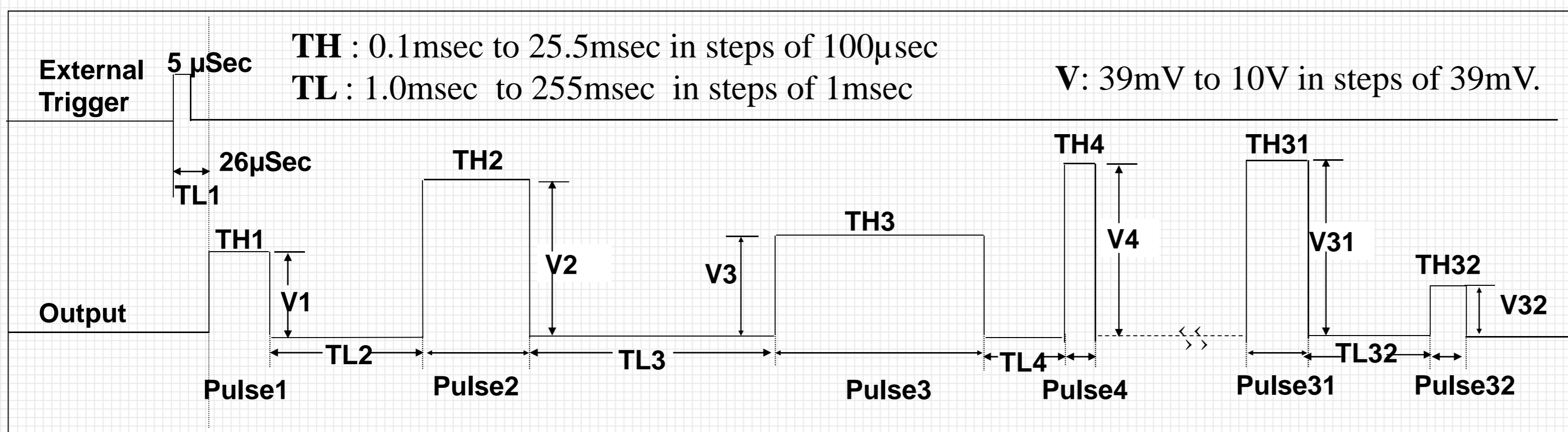
This programmable pulse generator is successfully tested and installed for gas puffing operation during ADITYA Tokamak discharges. The paper will discuss the design of the developed programmable pulse generator and the experimental results acquired with this pulse generator.



System Block Diagram



System Assembly Diagram



System Timing Diagram

MODEL MV 112 VALVE SPECIFICATIONS

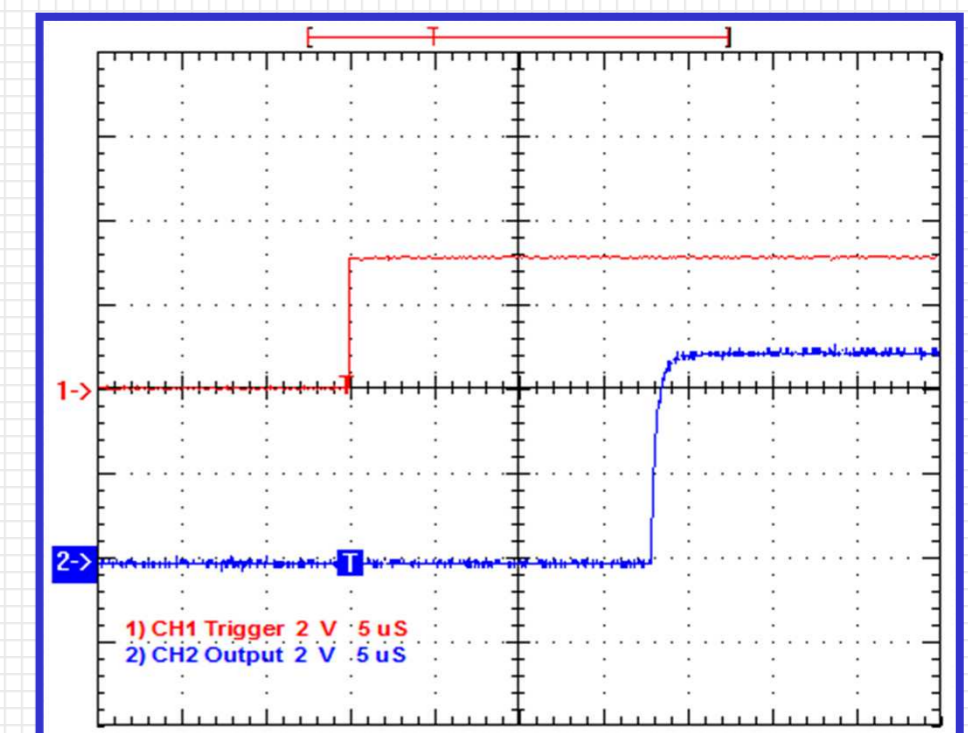
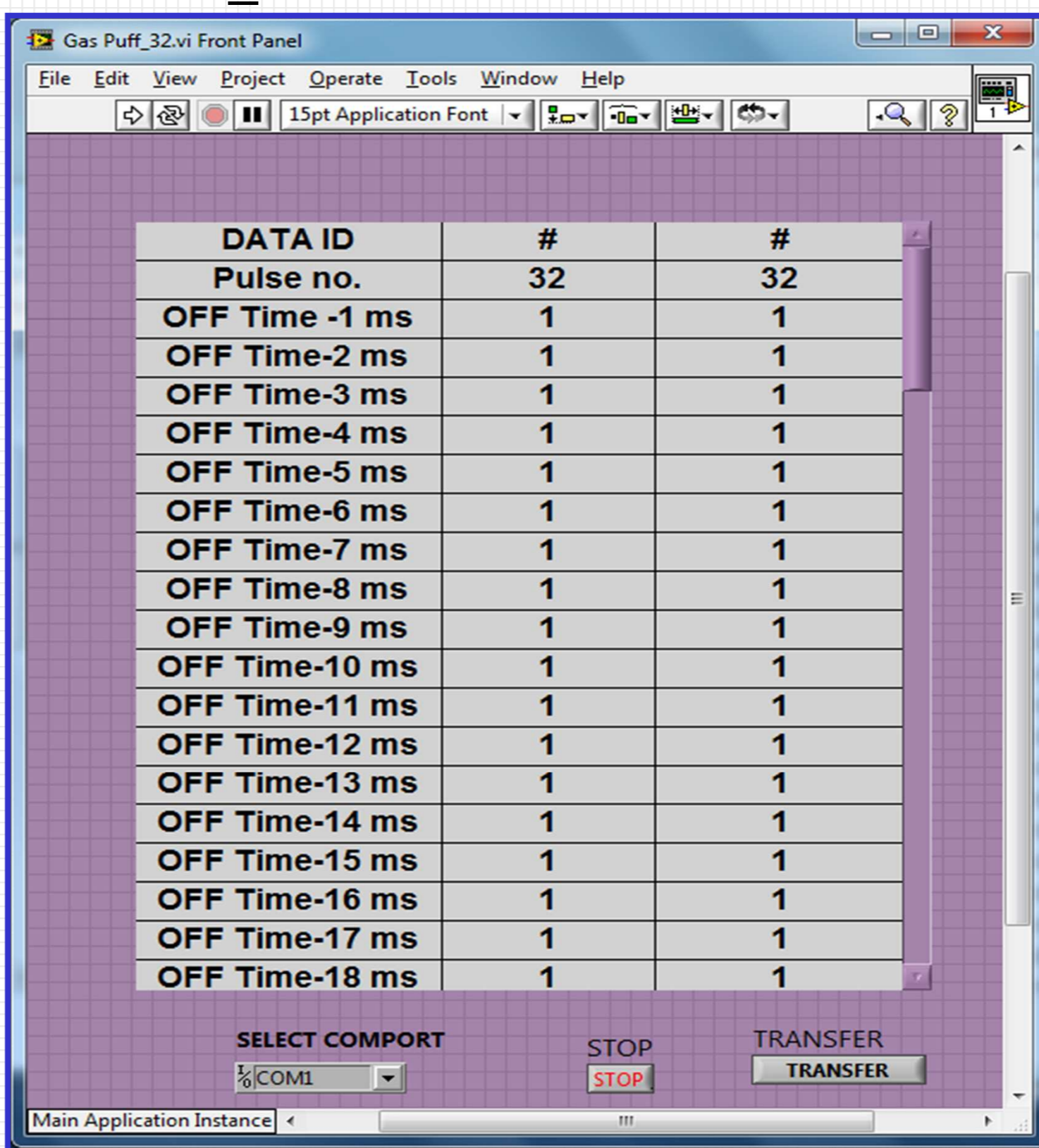
Electrical: Max Ope Vol 150V@10µA

- Throughput: > 1 torr-liter/sec. At 1 ATM pressure differential,100VDC input valve
- Valve Response Time: from full open to close < 2ms.
- Valve Natural Frequency: > 2000 Hz.

Valve Specification

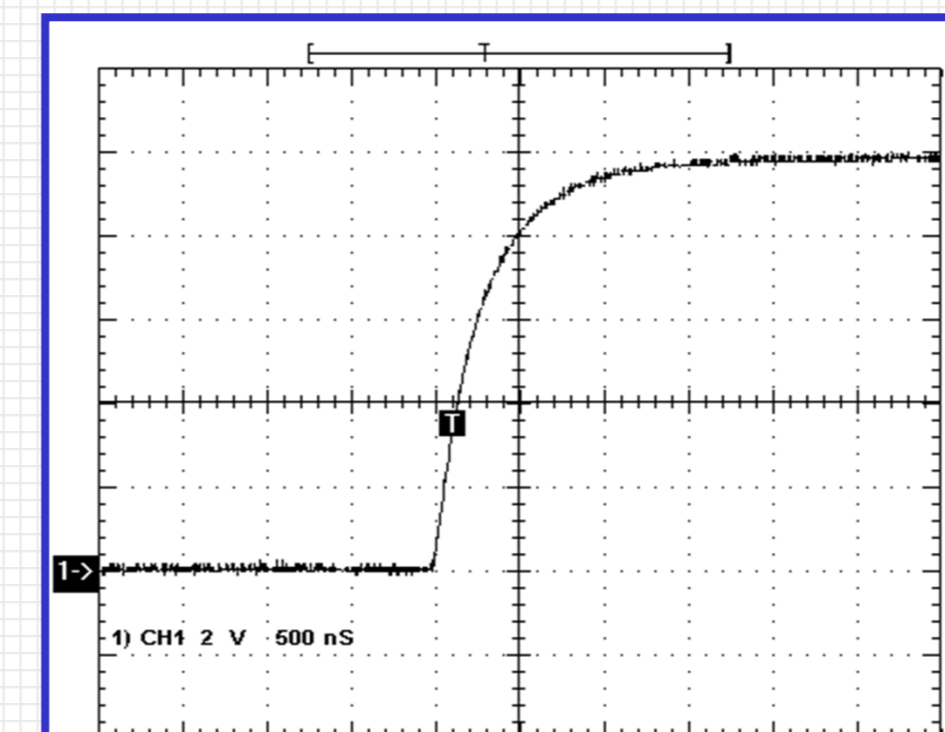
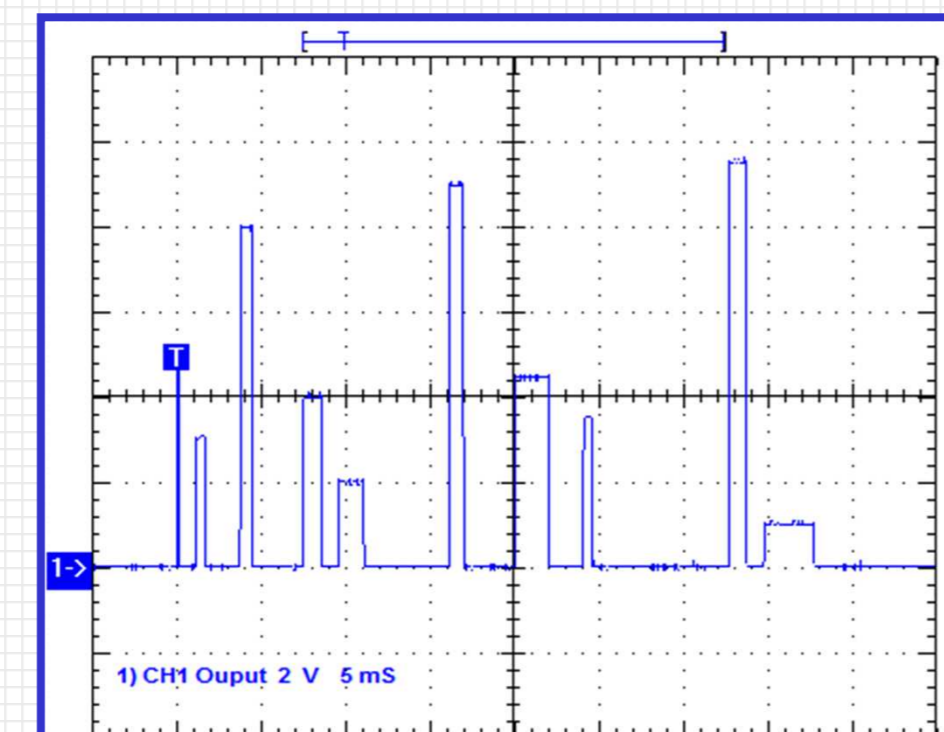
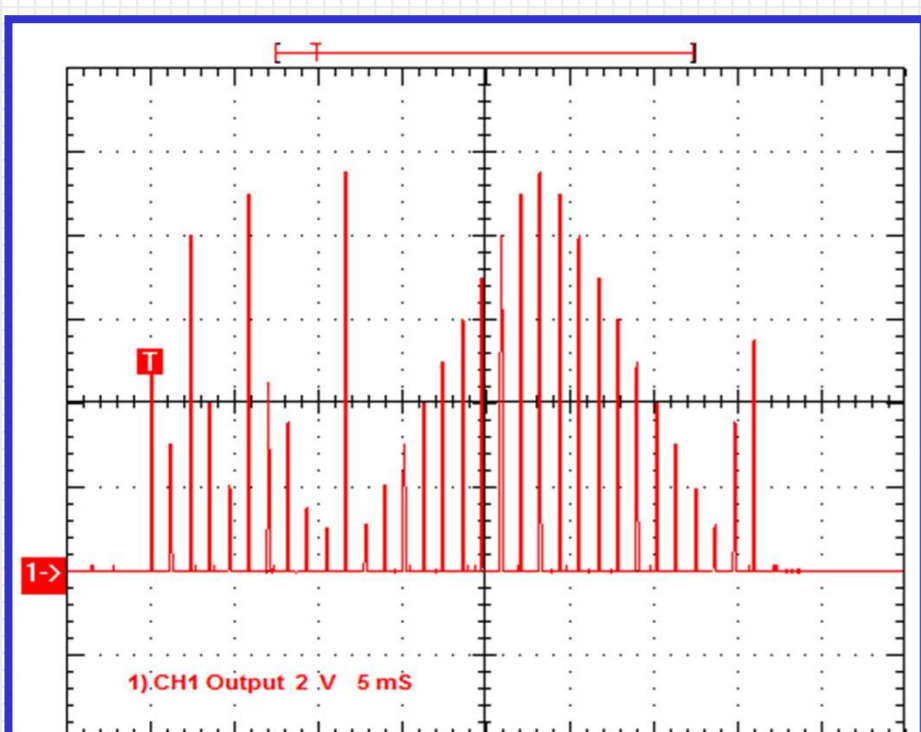
System Data file Gas Puff_32.vi

DATA ID	#	#	A	B	C	A	B	C	
1	DATA ID	#	35	ON Time -1 ms	0.1	1.67	Volt Pulse - 1	5	128
2	Pulse no.	32	36	ON Time -2 ms	0.1	1.68	Volt Pulse - 2	3	77
3	OFF Time -1 ms	1	37	ON Time -3 ms	0.1	1.69	Volt Pulse - 3	8	205
4	OFF Time -2 ms	1	38	ON Time -4 ms	0.1	1.70	Volt Pulse - 4	4	103
5	OFF Time -3 ms	1	39	ON Time -5 ms	0.1	1.71	Volt Pulse - 5	2	51
6	OFF Time -4 ms	1	40	ON Time -6 ms	0.1	1.72	Volt Pulse - 6	9	231
7	OFF Time -5 ms	1	41	ON Time -7 ms	0.1	1.74	Volt Pulse - 7	4.5	115
8	OFF Time -6 ms	1	42	ON Time -8 ms	0.1	1.74	Volt Pulse - 8	3.5	90
9	OFF Time -7 ms	1	43	ON Time -9 ms	0.1	1.75	Volt Pulse - 9	1.5	38
10	OFF Time -8 ms	1	44	ON Time -10 ms	0.1	1.76	Volt Pulse - 10	1	26
11	OFF Time -9 ms	1	45	ON Time -11 ms	0.1	1.77	Volt Pulse - 11	9.5	244
12	OFF Time -10 ms	1	46	ON Time -12 ms	0.1	1.78	Volt Pulse - 12	1	26
13	OFF Time -11 ms	1	47	ON Time -13 ms	0.1	1.79	Volt Pulse - 13	2	51
14	OFF Time -12 ms	1	48	ON Time -14 ms	0.1	1.80	Volt Pulse - 14	3	77
15	OFF Time -13 ms	1	49	ON Time -15 ms	0.1	1.81	Volt Pulse - 15	4	103
16	OFF Time -14 ms	1	50	ON Time -16 ms	0.1	1.82	Volt Pulse - 16	5	128
17	OFF Time -15 ms	1	51	ON Time -17 ms	0.1	1.83	Volt Pulse - 17	6	154
18	OFF Time -16 ms	1	52	ON Time -18 ms	0.1	1.84	Volt Pulse - 18	7	179
19	OFF Time -17 ms	1	53	ON Time -19 ms	0.1	1.85	Volt Pulse - 19	8	205
20	OFF Time -18 ms	1	54	ON Time -20 ms	0.1	1.86	Volt Pulse - 20	9	231
21	OFF Time -19 ms	1	55	ON Time -21 ms	0.1	1.87	Volt Pulse - 21	9.5	244
22	OFF Time -20 ms	1	56	ON Time -22 ms	0.1	1.88	Volt Pulse - 22	9	231
23	OFF Time -21 ms	1	57	ON Time -23 ms	0.1	1.89	Volt Pulse - 23	8	205
24	OFF Time -22 ms	1	58	ON Time -24 ms	0.1	1.90	Volt Pulse - 24	7	179
25	OFF Time -23 ms	1	59	ON Time -25 ms	0.1	1.91	Volt Pulse - 25	6	154
26	OFF Time -24 ms	1	60	ON Time -26 ms	0.1	1.92	Volt Pulse - 26	5	128
27	OFF Time -25 ms	1	61	ON Time -27 ms	0.1	1.93	Volt Pulse - 27	4	103
28	OFF Time -26 ms	1	62	ON Time -28 ms	0.1	1.94	Volt Pulse - 28	3	77
29	OFF Time -27 ms	1	63	ON Time -29 ms	0.1	1.95	Volt Pulse - 29	2	51
30	OFF Time -28 ms	1	64	ON Time -30 ms	0.1	1.96	Volt Pulse - 30	1	26
31	OFF Time -29 ms	1	65	ON Time -31 ms	0.1	1.97	Volt Pulse - 31	3.5	90
32	OFF Time -30 ms	1	66	ON Time -32 ms	0.1	1.98	Volt Pulse - 32	5.5	141
33	OFF Time -31 ms	1							
34	OFF Time -32 ms	1							

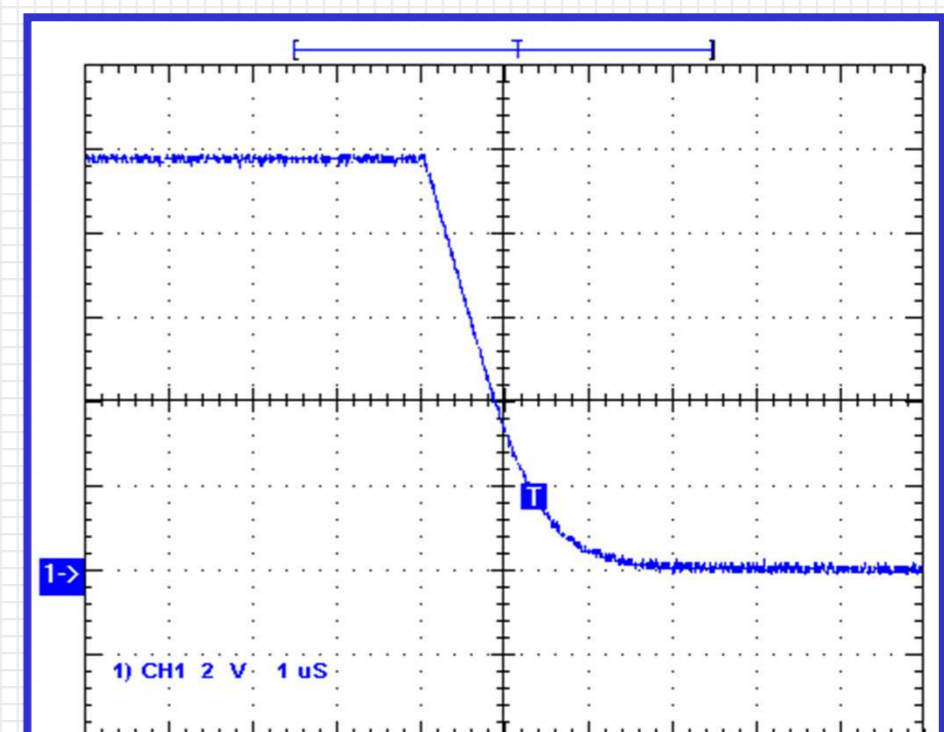


Graph for Delay Between Trigger and First pulse

Conclusion:
 The stand alone system is tested with Actual Experiment and it is working satisfactorily.



Graph for Rise Time



Graph for Fall Time

Graph for 32 pulses

Graph for 10 pulses