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A Fet Controlled Attenuator for Measurement of LVDT Output

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ABSTRACT

A simple electronic circuit for measurement of displacement using linear variable differential transformer (LVDT) has been reported. The circuit uses FET as variable resistance to form an attenuator which works in accordance with excitation, and secondary output is rectified either positive or negative depending upon core positions.

1. Introduction

The advantage of displacement measurement using LVDT over conventional micrometer is that of remote indication and easy readability. The characteristics and performance of LVDT has been described in literature by several researchers [1]-[4] but its practical circuits for measurement of LVDT output are not given much attention in literature [5]. Here a simple practical circuit is described which uses FET in controlled attenuator leading to a phase sensitive rectifier, finally realizing a measurement circuit for LVDT output.

2. Fet Controlled Attenuator

The field effect transistor (FET) can be used as a variable resistor. The circuit of FET controlled attenuator is shown in Fig.1. It's output is given by

$$\frac{V_o}{V_i} = \frac{R_2}{R_1 + R_2} \tag{1}$$

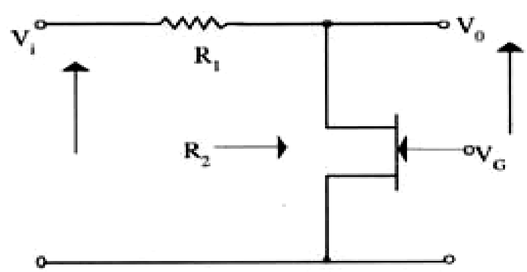

Fig.1 FET Controlled attenuator

Where R_1 is an ordinary resistance while R_2 is resistance offered by FET, which depends on the control voltage V_G. If $V_G \geq 0$, R_2 is minimum. When V = -5 Volt, R2 is much higher than the minimum value. Thus for $V_G = 0$ & $V_G = -5V$ it has two output levels. If V_G is replaced by a square wave of 0 and –5V then it acts as a switched attenuator. The output waveform for sinusoidal input and for control input V_G of same frequency for two positions (one in phase with input and other output of phase) is shown in fig.2. It is thus seen that a phase sensitive rectification is obtained by controlling V_G.

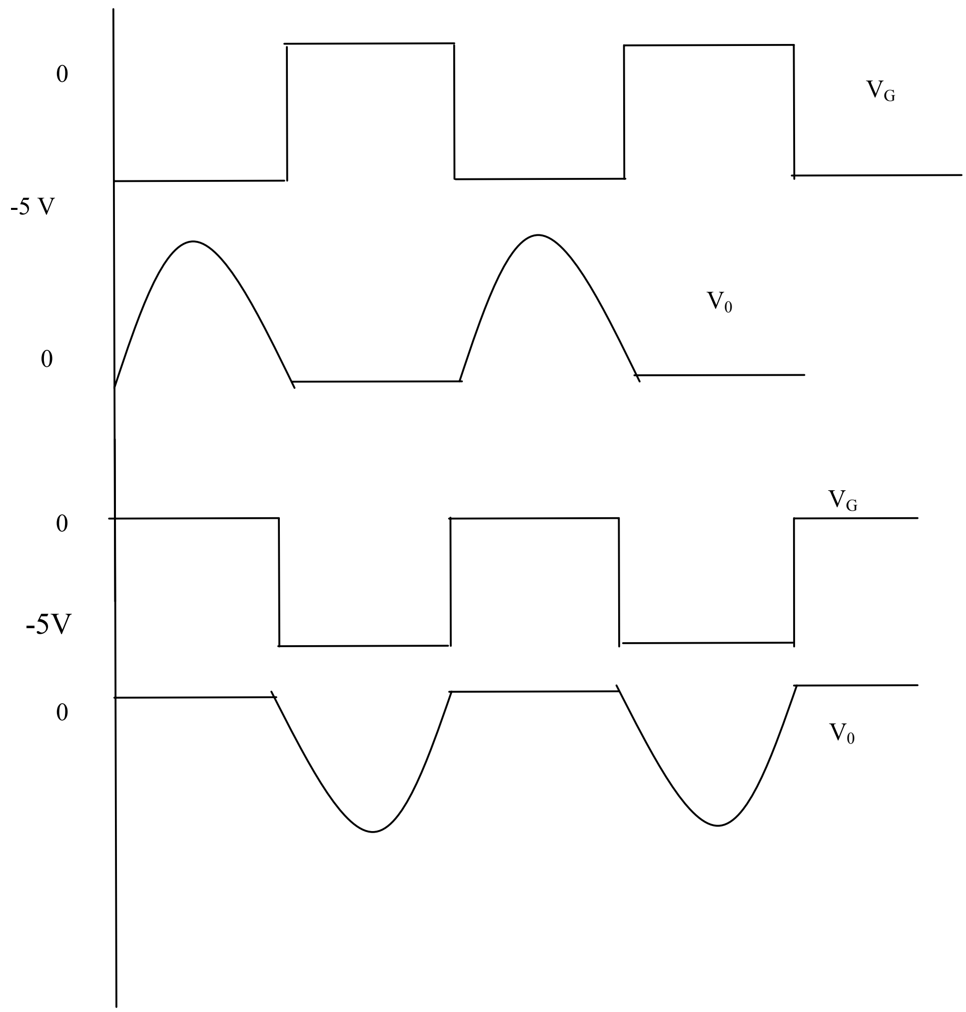

Fig.2 Attenuator output for square wave control signal

3. Electronic Circuit for Measurement of LVDT Output

The practical circuit for measurement of LVDT output is shown in fig3. The excitation ranging from 2KHz to 5KHz and 1V amplitude is given to primary winding of LVDT, which gives two outputs in two secondary windings. When these windings are connected in series opposition, a zero output is obtained when LVDT core is at the center. The positions of output with respect to excitation (input) are shown in fig.4 for three positions, i.e., core inside, core at the center and core outside the LVDT main body. The output of LVDT is given to attenuator and control signal is produced by input after converting it into square wave. The phase shifter is used for compensating the phase difference between input and output due to cable capacitances, winding capacitance etc. The output of ± 10 mm LVDT after filtering has been measured through a DPM and is shown in Table 1.

Table 1.

S. No.	Displacement (mm)	**Output Voltage (mv)** when the core is at one end	Output Voltage (mv) when the core is at other end
1	0	0	0
2	0.5	-0.5	0.5
3	1.0	-1.1	1.2
4	1.5	-1.7	1.8
5	2.0	-2.4	2.4
6	2.5	-3.0	3.0
7	3.0	-3.6	3.7
8	3.5	-4.3	4.3
9	4.0	-4.9	4.9
10	4.5	-5.6	5.5
11	5.0	-6.3	6.2

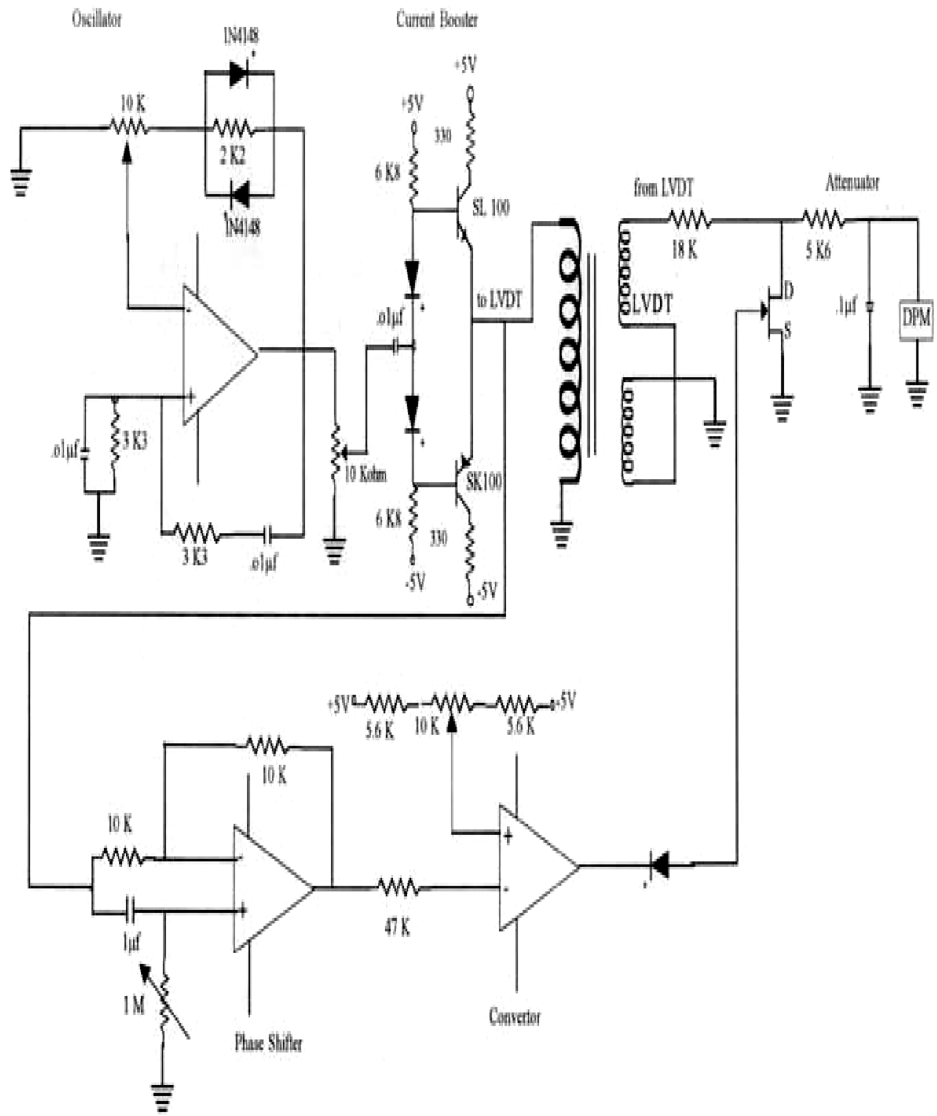

Fig. 3 Circuit diagram for LVDT output measurement

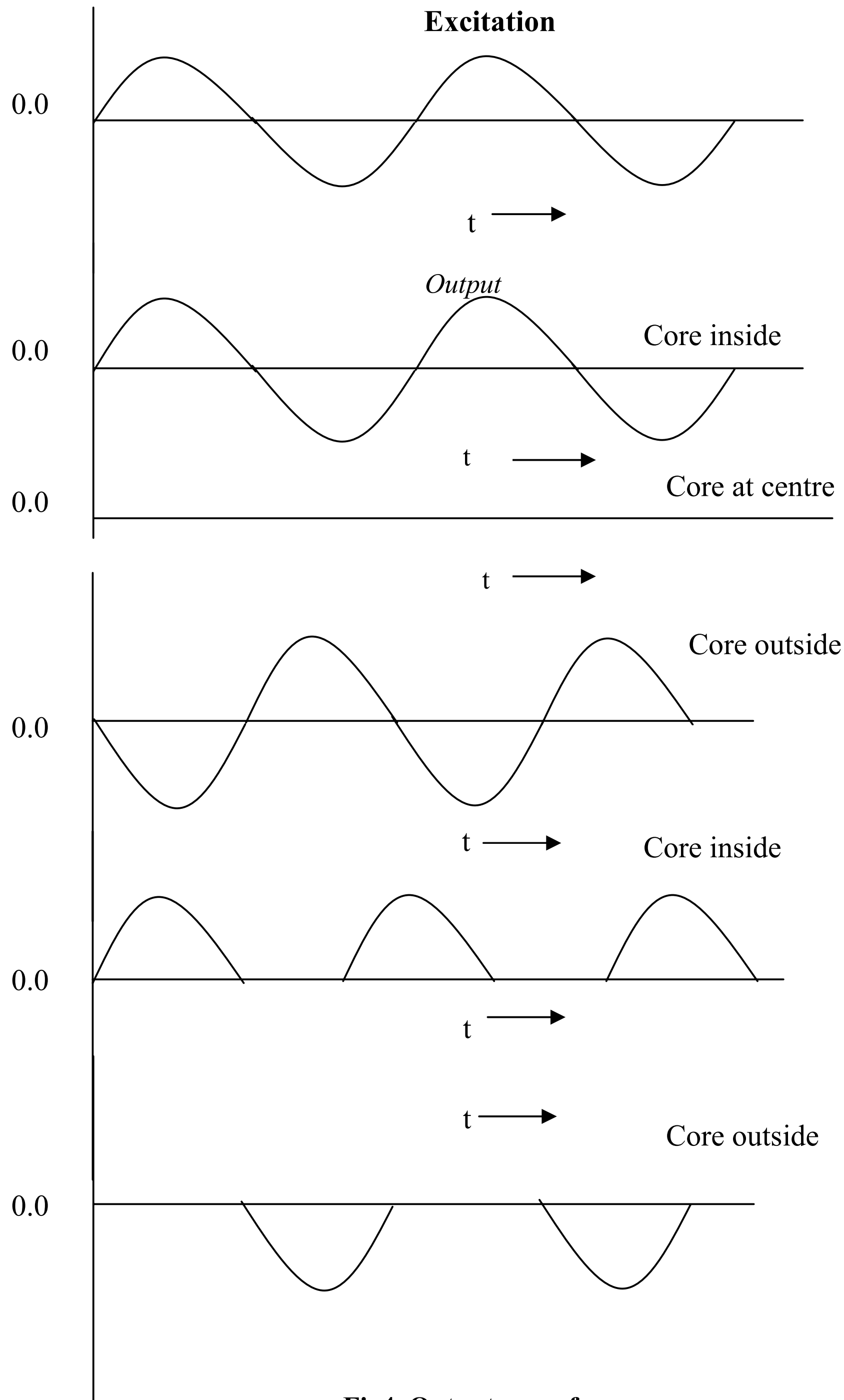

Fig4. Output wave forms

4. Conclusion

A simple circuit for measurement of LVDT output is reported. The experimental results show good linearity.

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