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Measurement of Power Frequency Deviation using 8085 Micro Processor

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Abstract: ***Measurement of power frequency deviation is important for the design of power system equipments. An electric power system is required to operate at a constant frequency but because of randomly varying power demands the system line frequency tends to deviate from its nominal value. This paper has suggested a monitoring scheme using a 90 ^{0} phase shifter. The shifted and normal frequency signals are combined through EX-OR gate. Deviation of power frequency from nominal value gives a difference in the pulse counts of two successive pulses occur which will be proportional to amount of deviated frequency. This method provides high resolution .Also it is simple and cheaper as compare to other methods. The scheme is implemented using 8085 micro processor and program in assembly language has been developed.***

Keywords: comparator, Deviation, Phase shifter, register

I. INTRODUCTION

A synchronous electric power system is required to operate at a constant frequency, but because of randomly varying power demands and disturbances, the system line frequency tends to deviate from its nominal value[3] .To maintain the line frequency within specified limits, various control schemes are employed, such as load frequency control, frequency sensitive relays and other. The line frequency and its deviation are very important parameter for measuring accurately and monitoring continuously in an electric power system, for analyzing irregularities in its operation and for improving its operating security. [4]

Measurement of power system freq deviation is also required in designing the automatic load shedding systems as well as in monitoring the system frequency .The continuous monitoring of system freq is also required for automatic generation control. Therefore accurate and quick measurement of freq deviation is very important in an interconnected power system.

There are various methods for accurately measure the frequency deviation have been reported in literature which are based on leakage effects in magnitudes in a fourier transform calculation, level crossing, up-down counter etc. [1]-[2].

1. Frequency Deviation Measurement Scheme

A) Hardware Design

A simple scheme is suggested which is shown by a block diagram of fig.1

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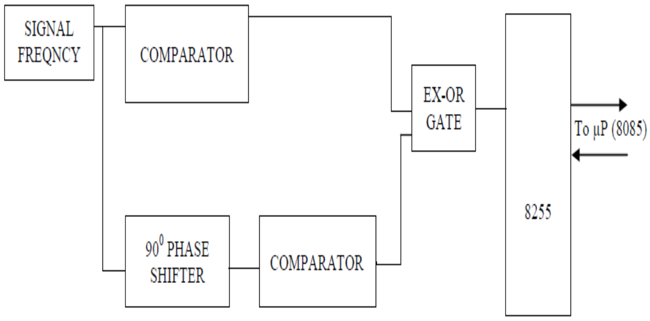

Fig 1: Block Diagram for Measurement of Frequency Deviation

The circuit is fabricated in lab. in which opamp as phase shifter and comparator are used. The comparator converts the sinusoidal signal into a rectangular wave having two binary levels ,high and low.The positive part of the sin wave is converted into low level and negative part into high level . The sinusoidal signal whose normal freq is known and whose deviation from the normal value is desired to be measured is transformed to a low voltage signal using a signal generator. This signal is then passed through a comparator to convert it into a train of pulses which are then applied to one of the inputs of EX-OR gate.

The sinusoidal signal is also applied to a phase shifting circuit made up from an OPAMP 741. The phase shifting circuit introduces a phase shift of 90^0. The output of this phase shifter has a constant magnitude but its phase angle can be controlled. Since the desired signal frequency is known , the values of R and C can be adjusted to get $\varphi = \pi/2$ (i.e. $\omega RC = 1$). This 90^0 phase shifted signal is also passed through another comparator to convert it into another train of pulses .These train of pulses are then applied to an Ex-OR gate . The output of Ex-OR gate is another train of pulses. The output of Ex-OR is interfaced through Intel 8255 with an 8085 microprocessor.

For 90^0 phase shift, two successive pulses of train C will be of equal width. However , the phase shift is more than 90^0 , the first pulse will have more width than the second successive pulse. Similarly. if the phase shift is less than 90^0 ,second pulse will have more width. Thus the change in width of two successive pulses indicates the amount of phase shift which is proportional to the frequency deviation from its nominal value. It has been found that for small variation in frequency , the relationship between phase shift and frequency deviation is linear, as depicted in relation between frequency and pulse count, in fig2.

B) Software Description

In previous discussion, system's hardware design were considered .This part concentrates on the system's software design to operate the hardware in order to perform the required objective. The software develop in this chapter will control the overall operation of the system, i.e., detection of zero crossing ,measurement of counts, calculation of frequency deviation and its display.

As dicussed earlier in this scheme, the frequency deviation is available in the form of the change in pulse width in two successive pulses of a train of pulses on the output of Ex-OR. This change in time period of two successive pulses is measured through 8085 microprocessor.

This program inputs the state of pulse and checks for the starting point of the positive pulse and negative pulse. In program HL pair is used to count the number of times the loop is executed during the time , state of pulse is high or non zero. This count is proportional to the time period stored at memory location 2300-2301. The content of HL pair is then exchanged withregister pair DE.

The HL register pair is again used for the time period of next pulse .This time period is stored at memory location 2302-2303. The contents of DE are transferred to BC register pair. The difference between two times is obtained by using instruction DSUB which subtract the content of BC register pair with the content of HL pair and the result resides inHL pair and is stored in memory location 2304. Jump instruction is used to measure the frequency deviation continuously.

<u>Program for Measuring Frequency Deviation</u>

Memory Address	**Op Code**		**Mnemonics Operands**	**Comments**
2000	3E, 90		MVI A, 90	Get Control word in accumulator
2002	D3, 03		OUT 03	Initialize ports
2004	DB, 00	L_1	IN 00	
2006	47		MOV B, A	
2007	DB, 00		IN 00	
2009	B8		CMP B	Check for zero instant of positive pulse
200A	CA, 04, 20		JZ L1	
200D	DA, 04, 20		JC L1	
2010	21, 00, 00		LXI H, 0000	Start counting
2013	23	L_2	INX H	
2014	DB, 00		IN 00	
2016	E6, 01		ANI 01	
2018	C2, 13, 20		JNZ L2	
201B	22, 00, 23		SHLD 2300	Store count
201E	EB		XCHG	
201F	DB, 00	L_3	IN 00	
2021	47		MOV B, A	
2022	DB, 00		IN 00	
2025	B8		CMP B	
2028	CA, IF, 20		JZ L_3	
202B	D2, IOF, 20		JNC L_3	
202B	21, 00, 00		LXI H, 0000	Start counting the negative pulse
202E	23	L_4	INX H	
202F	DB, 00		IN 00	
2031	E6, 01		ANI 01	
2033	CA, 2E, 20		JZ L_4	
2036	22, 02, 23		SHLD 2302	Store the count for negative pulse
2039	4B		MOV C, E	
203A	42		MOV B, D	
203B	08		DSUB	Subtract the two counts
203C	22, 04, 23		SHLD 2304	Store the difference
203F	C3, 04, 20		JMP L1	

II. RESULTS

A program in assembly language for 8085 microprocessor has been developed. The result shows good linearity between pulse count and frequency deviation for frequency range of 45-55 Hz.

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Table 1: Relationship between Frequency and Pulse Count

S. No.	Frequency in Hz	Pulse count in KHz
1	47	3.1
2	48	2.0
3	49	1.0
4	50	0.0
5	51	0.9
6	52	1.8
7	53	1.9

III. CONCLUSION

A relatively simple method has been implemented for the measurement of line frequency deviation from the nominal value of 50 Hz .The method has been implemented using opamps and a microprocessor system that provide highly suitable and fast line data processing. The phase shifted and the normal power frequency signals are fed to Ex- OR gate, the output of the gate gives pulse train with unequal widths which are then counted and displayed in the form of deviation .The instrument offers a resolution of 0.01 Hz. This method has also the advantage of being simpler and less expensive as compared to other methods.

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