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Interfacingof Power Factor Transducer Using Modbus

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Abstract- There are many existing system to measure and calculate the power factor, but those transducer were calculate only one parameter. This device is used to measure and calculate Active, Apparent, Reactive Power, Phase angle and Power Factor of a single phase or three phase Ac system. Also in our proposed system Transducer can be configured with PC and programmed using MODBUS protocol. The values of parameters after measurement will be displayed on PC by GUI.

Keywords-Power Factor, Active Power, Reactive Power, Apparent Power, Modbus.

I. INTRODUCTION

The term Transducer is used for converting one form of energy into another form. There are many existing system to measure and calculate the power factor, but those transducer calculate only one parameter. This Power Factor transducer measures the input power and convert it into Active, Apparent and Reactive power.With the help of this transducer we can measure and display following parameters -:

1. PT Ratio.
2. CT Ratio.
3. Input Characteristics.
4. Output Characteristics

The basics on which it works are Line supply characteristics, Power Factor, Apparent Power, Active Power, Reactive Power, Voltage and Current

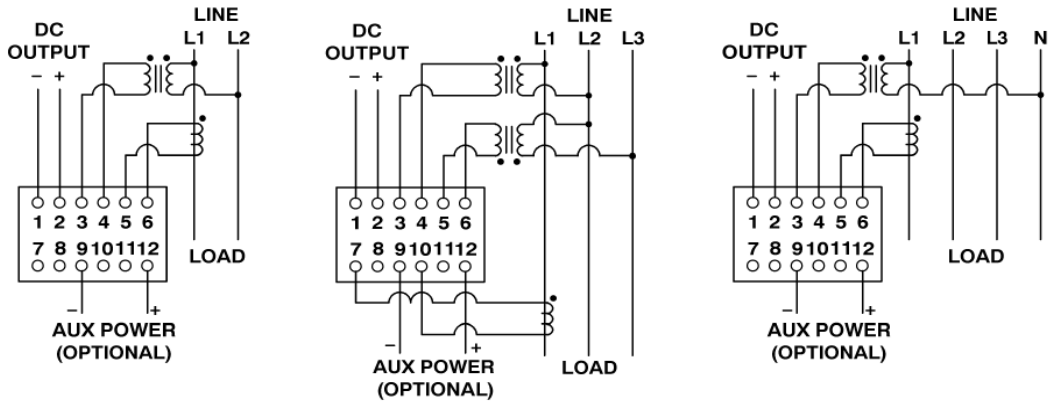
Line Supply Characteristics

This transducer is used to measure Power Factor of single phase and three phase AC system with Balanced or Unbalanced load into a proportional DC current or voltage [1]. Fig.1 shows the line supply connection of the power transducer, which shows the connections with CT and PT input.

II. POWER MEASURED

1. Active Power- Alternative words used for active power are Actual Power, True Power, Watt Full Power, Useful Power and Real Power. In DC circuit, power supply to the DC load is simply the product of voltage across the load and current flowing through it. i.e. ***P=VI***. Because in DC circuit there is no concept of phase angle between current and voltage. In other words there is no power

factor in DC circuit. But the situation in sinusoidal or AC circuits is more complex because of phase difference between current and voltage.



246971
248971
Single phase

246973
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3 phase 3 wire balanced load

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3 phase 4 wire balanced load

Figure 1. Line supply connections

Therefore average value of power is $P=VI\cos\theta$. Is in fact supplied to the load. In AC circuit, when circuit is pure resistive, then the same formula is used for power as used in DC as $P=VI$. AC Single phase and AC Three phase circuits Real power formulas:-

$P=VI$ (In DC circuits)

$P=VI\cos\theta$ (In single phase AC circuits

2. Reactive Power-It is also known as Useless Power, Watt less Power. The powers that continuously bounce back and forth between source and load, is known as reactive power.

Power merely absorbed and returned in load due to its reactive properties is referred to as reactive power. The unit of active or Real power is Watt, where $1W=1V*1A$.

Reactive power is represented that the energy is first stored and then released in the form of magnetic filed or electrostatic filed in case of Inductor and Capacitor respectively.

Reactive Power is given by $Q=VI\sin\theta$ which can be positive for inductive and negative for capacitive load. The unit of Reactive Power is volt-ampere reactive. i.e. VAR, where 1VAR=1V*1A. In more simple words, IN Inductor or Capacitor, How much magnetic or electric field made by 1V*1A is called the unit of Reactive Power.

Reactive Power formulas- $Q=VI\sin\theta$

3. Apparent power: The product of voltage and current, if and only if the phase angle difference between current and voltage are ignored. Total Power in an AC Circuit, both dissipated and absorbed or returned is referred to as apparent power. The combination of Reactive power and True power is called as apparent power.

In an AC circuit the product of the RMS voltage and RMS current is called apparent power. It is the product of voltage and current without phase angle. The unit of apparent power VA i.e.1VA=1V*1A

When the circuit is pure resistive then apparent power is equal to real or true power, but in inductive or capacitive circuit (when reactance exist) the apparent power is greater than real or true power. Apparent power formulas: S=VA.

III. POWER FACTOR

In electrical engineering, the Power Factor of an AC electrical power system is defined as the ratio of the real power flowing to the load, to the apparent power in the circuit, and is a dimensionless number in the closed interval of -1 to 1.[2] Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the current and voltage of the circuit. Due to energy stored in the load and returned to the source or due to non-linear load that distorts the wave shape of current flow from source. Device is considered as generator normally when load generator power flows back towards the device. [3]

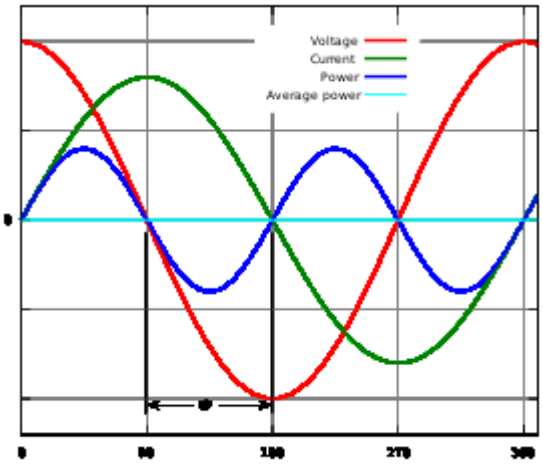

Figure2. Linear circuit characteristics

Instantaneous and average power calculated from AC voltage and current with a zero power factor. The blue line shows all the power is stored temporarily in the load during the first quarter cycle and returned to the grid during the second quarter cycle, so no real power is consumed. Power factor is denoted by *Fp* and Unit for power factor is given as Watt/voltamps. Formula for this is given as follows:-

Power Factor (Fp) = Total Active Power ÷ Apparent Power

IV. MEASUREING TECHNIQUES

1. Wattmeter- Electrical power can be measured with a wattmeter. Wattmeter consists of a one current coil connected in series with load, while the other potential coil is connected parallel with load. Depending on the strength of each magnetic field movement, the pointer gets affected. Due to this the true or active power is directly shown on a wattmeter. In three-phase systems, power can be measured using several methods. For temporary measurements, a single wattmeter can be used. While, for permanent measurements, a three phase wattmeter having two elements is used this indicates both balanced and unbalanced loads.

2. Zero Crossing Detectors- In this synchronizing unit will produce a pulse at each Zero-crossing of the supplied sine wave voltage. These output pulses will be applied to the microcontroller as a reference in order to achieve a required firing pulse to control the firing angle. The output pulses obtained from the zero crossing detectors will also be used to measure displacement angle between voltage and current.

V. NEW PROPOSED SCHEME

In many existing systems only one technique is used for display the measurements of the Power Factor Transducer by using LCD display only. But here we interface the device with PC using Modbus 485 and display the measurements on PC using GUI. GUI for this is designed with the help of Dot net visual studio. This is user friendly and shows the readings along with parameter's name.

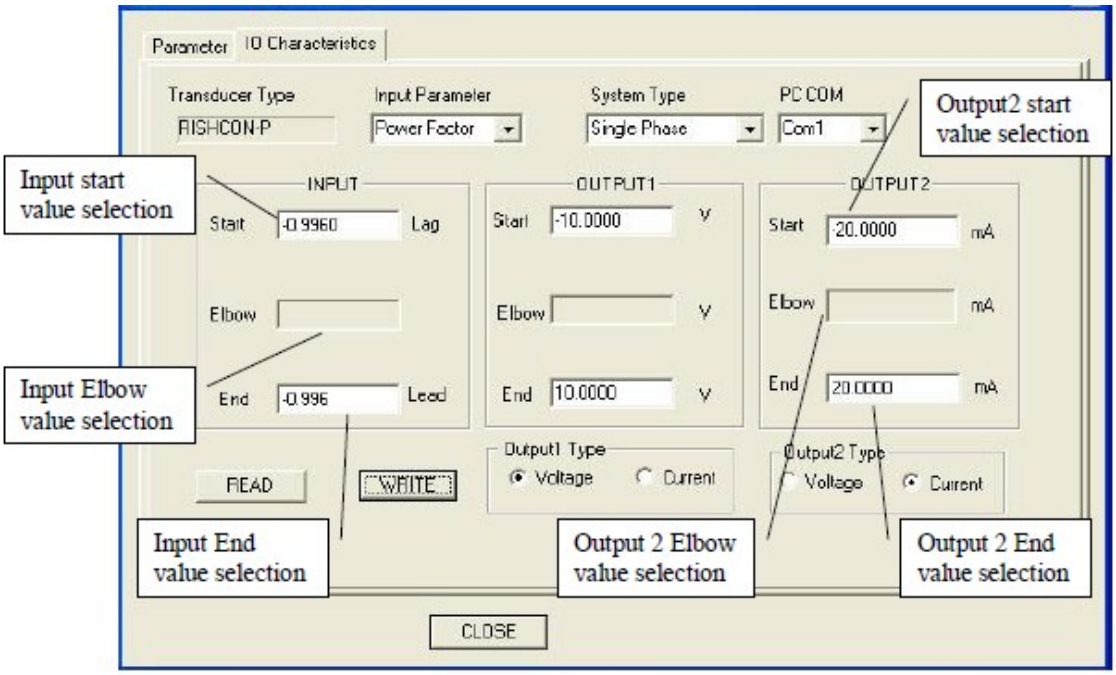

Figure3.

VI. CONCLUSION

There are many alternative for measurement and conversion of power factor individually. But the proposed system is a multiple power measuring system. As it is consist of GUI it becomes easy to handle and user friendly.

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