Scientific Journal of Impact Factor (SJIF): 4.14

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 3, Issue 12, December -2016

New Approach In Energy Meter Testing

[1]Nitin S. Patil , [2]Dr. K. D. Thakur

[1]*PG Scholar , Government College of Engineering, Amravati 444604 M.S*
[2]*Ass. Prof., Government College of Engineering, Amravati 444604 M.S*

Abstract:- *Energy Meters installed in the consumers premises need to be tested since if more units are calculated with less amount of power consumed, the user in loss. At the same time, if fewer units are calculated with more amount of power consumed, the electricity boards are at loss. This results in an increasing demand on the means to test the energy meters correctly with adequate frequency and ease to ensure the correctness of the measurement of the meter. Field-testing of meters will therefore increasingly become necessary. Up till now, meters were tested and calibrated by injecting power from a fairly stabilized stationary source into the device under test with a reference meter connected in the circuit. The accuracy of the test was determined by the accuracy of reference meter, which is referable to the national standard, and not by the power source.*

Keywords: *Energy Meters, Instantaneous power, Error display unit (EDU), Meter under test (MUT), Sensors, Transducers.*

I. Introduction

Energy meters used at consumer's premises by different electricity authorities are highly sophisticated digital analog and Electronic meters[1] with wide range of peripheral functions. To cope with this technology meter manufacturers have to import the testing and calibration panels at extra ordinary high cost. Due to privatization and globalization now there is additional pressure to reduce the prices of the meters and testing panel and provide enhanced functionality. This paper presents a new approach to develop portable test module by which Electricity Utility Officer [2] can verify accuracy of the energy meter before installation and in field (customers residence) and satisfy all queries raised by customer.

Power consumed by load = power indicated by instruments - power loss in voltmeter.

Thus the power indicated by the instruments is equal to the power consumed by the load plus the power consumed by the instruments nearest to the load terminals. In order to obtain the true power, corrections must be applied for power loss in instruments.

For a permanently wired installation, when power measurements are required, it is a distinct advantage to install a wattmeter in place of voltmeter and ammeter. Wattmeter gives direct indication or power and there is no need so multiplying two readings as in the case when voltmeter and ammeter are used. The labor involved[3] is reduced and the accuracy is also increased.

Power in AC circuits

In the case of alternating currents, the instantaneous power varies continuously as the currents and voltage go through a cycle. However, we are not interested in the instantaneous power (except where transient conditions are being required but in its average value over a cycle).

The fact that the power factor is involved in the expression for power means that a wattmeter must be used for power measurement of power in AC circuits instead of merely an ammeter a voltmeter[4], since the later method takes no account of the power factor.

II. COMPARISION BETWEEN ELECTROMECHANICAL Vs ELECTRONIC METER

	FEATURE	ELECROMECHANICAL METERS	ELECTRONIC METERS
1	Reliability	Less Reliable	High reliable due to usage of hybrid microcircuits
2	Accuracy	Deteriorates due to wear and tear of moving parts	Solid state circuit ensures high accuracy over entire life period
3	Linearity	Poor at lower ranges	1%accuracy over entire range
4	Tampering of meter	Possible by load supply reversal, earthed with phase neutral reversal	Impossible, Tamper Proof, meter detects tampering and corrects automatically
5	Tampering of counter	Possible by reverse rotation	Not possible as it is sealed and unidirectional
6	Calibration	Frequently required after transportation at site	Factory set calibration No calibration required at site, pre-scaled meters.
7	Effect of voltage and temperature fluctuation	Affects accuracy of the meter	No affect on accuracy
8	Effect of magnetic field	Affects the meter reading	No affect on meter reading
9	Indication	Moving red mark on the disk indicates	Clear LED indication for meter running pulse frequency varies with load variation.
10	Single phase meter Load and supply reversed	Meter does not register energy / deregisters	Reverse current tampering in each phase
11	Phase neutral wires interchanged and load earthed	Meter does not register energy	Meter registers full energy
12	Input / Output phase and load phase shorted through a thick shunt wire	Meter registers ½ energy	Meter registers full energy

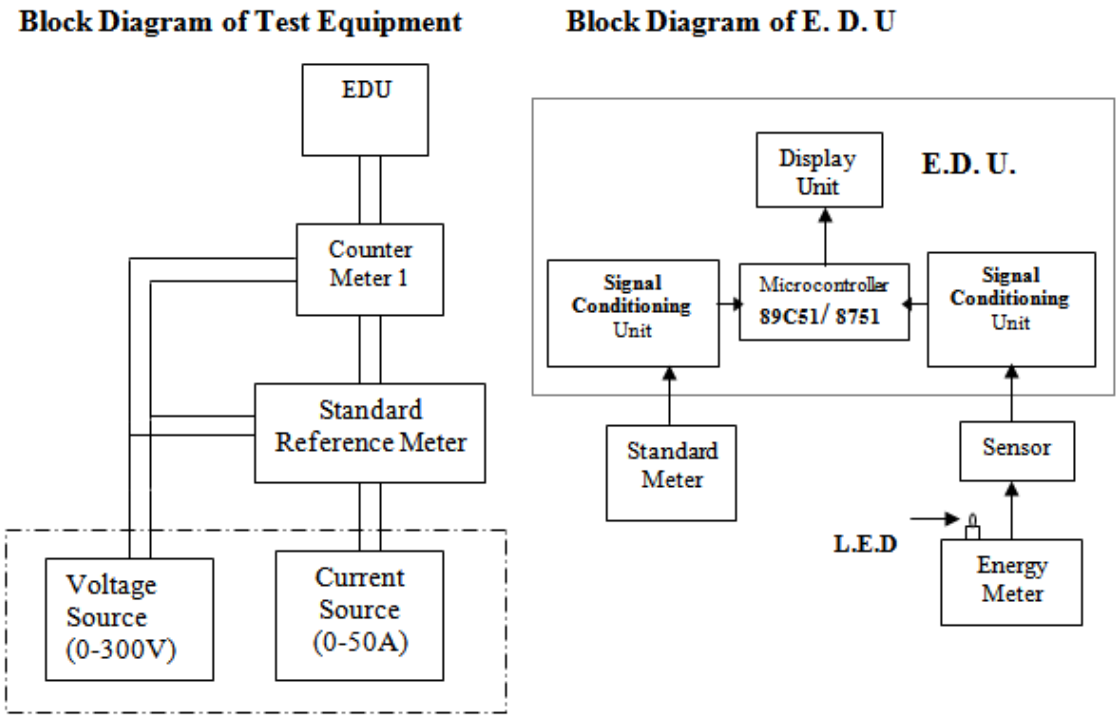

Fig 1. Explanation of the block diagram Test Equipment and EDU

The block diagram shown is consists of the heart of the system (i.e.) the microcontroller (89C51/8751), the signal conditioning unit, sensor, display unit & the computer.

The individual blocks can be described as follows:

- **Microcontroller 89C51:** The microcontroller is the heart of the system. It is basically used to count the no. of pulses in between the two (or 5) pulses of the meter under test.
- **Meter under Test:** This is the main meter, which is to be checked for whether it gives correct no. of units of the energy consumed. If not, it has to be corrected and thus calibrated.
- **Standard Meter:** This is the standard meter used to check no. of units given by the meter under test. It is a continuous pulse-generating meter according to the standard specifications.
- **Sensor:** A sensor is a light-sensitive device, which accepts optical pulses from the LED on the meter under test & converts it into electrical pulses and provides it to the signal-conditioning unit.
- **Signal Conditioning Unit:** This unit is used to make the input of the meter compatible with that of the microcontroller.
- **Display unit:** This unit is used to display the error calculated by using a seven-segment display. This is very intelligent device. It performs functions of computer in this module. It calculates the error by accepting the count from the EDU and calculating error according to a standard formula based on standard specifications.

III. Operating Principle

The basic operation of the system can be explained with the help of the following points:

- Power is fed to all the meters under test and the standard meter simultaneously; (i.e.) voltages are fed in parallel and current is fed in series to the meters under test and directly to the standard meter.
- The LED in the Meter under Test starts blinking according to the power consumed or units calculated.
- The sensor, which is an opto-electronic transducer, converts these optical pulses into electrical pulses and gives the same to the microcontroller (89C51) in the EDU.
- The second input to the microcontroller are the pulses from the standard meter whose rate of generating pulses is very much higher than that of the meter under test as mentioned earlier.
- In between two pulses (or any number as per requirement) of the MUT (Meter under Test), the microcontroller counts the number of pulses from the standard meter. The number can be decided according to the requirement by using software.
- This count of pulses is given by the microcontroller to the error display unit for error calculation and % error is calculated as.

$$\% \text{ Error} = \frac{\text{Constant} - \text{Count}}{\text{Constant}} \quad \text{X } 100$$

where,

Count = no. of pulses of standard meter in between 5 pulses of the meter under test.

Constant = a value calculated depending upon the constants of the standard meter & the meter under test.

If the error is within limit or range, a PASS LED glows on the front panel of the display unit; otherwise a FAIL LED glows, again decided by using software.

IV. Conclusion

Today energy meters are being used extensively in testing and trouble shooting of various industrial projects, which require continuous monitoring of energy consumed by the project being tested. This model will be beneficial in the field, as the industry will need the meters tested & that too without error. If there is any small error, it would lead to disastrous results & hence to avoid this, Error Display Unit for Energy Meter Test Bench can detect the error in the meters & also display it. Modern technology makes it possible to construct test systems, which are sufficiently accurate to test energy meters. Due to the test systems being under software control the meter can be tested in different test modes.

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