Microcontroller Based Smart Calibration Meter

[1] P. D. More, [2] Vaibhav Chougule, [3] Shubham Powar, [4] Vikas Jadhav, [5] Suhas Redekar, [6] Akshay Patil
[1][2][3][4][5][6] Department of Electrical Engineering, Sanjay Ghodawat Institute, Atigre

Abstract: -- The proposed system is based on the concept of calibration which includes calibration of ac voltmeter, ac ammeter, wattmeter, energy meter. The working of this system can be divided into three sections such as controller section, metering section and the display section. In order to maintain the precision of a device, we need to do the calibration. Thus to minimize the factors that cause the faulty reading is the fundamental aspect of our instrumentation design. So by calibrating the meter after a specific interval of time, we can secure the acceptable range of that instrument.

We know that the process of calibration is done only at an industrial level. But in small-scale industries and in the educational level we use un-calibrated devices which causes an inaccurate reading. The most inherent part of our measuring system is that we have to use the different meters to calibrate respective quantities, Because of that the size and cost of meter increases. So in order to overcome these all demerits we have designed a system which helps to calibrate the voltage, current, power and active energy using a standard meter with high precision. And the most important part of our meter is that we can use it at small scale level also to increase the accuracy of the instrument.

Keywords: Calibration, Error, voltage, current, power, energy, microcontroller.

1. INTRODUCTION

Contravention of the rapid development in large number of electricity sectors in India. Electrical energy is the main source and mainstay of every industry. Electricity has limited resource in India since its proper use and measurement is very important.[1]The proposed system contains the methodology to build smart calibration meter which is suitable for calibration of different meters in single unit.[2] The paper mainly deals with calculating error in meters and display on LCD which is the combination of hardware and software for implementing desired features.[3]The goal of creating accurate measurement of voltmeter, ammeter, energy meter, by optimization of time and cost. It consist of Resistive load by using the bulbs of rating is 200 watts.[4] For measurement of current from ac supply current transformers are used to linearly step down the current passing through the sensor to lower level compatible with measurement instrument. Similarly for measurement of supply ac voltage Potential transformer are used to step down the voltage.[5]

The atmega328p microcontroller is used for controlling and programming. It receive and send the information to many device and software program (C) is used.[6] In the circuit we require 5Vdc supply.[7]Observing the reading on the display and fill in the software in the computer.

II. SYSTEM MODEL

A. 1. BLOCK DIAGRAM-

Single phase ac supply is given to the PT and CT which gives reduced output voltage 12 V ac and current 1A respectively to the PT circuit and CT circuit (Burden circuit) of ADE7758. Through the same supply is given to the microcontroller kit through PT, DB107 Rectifier, Voltage regulator LM7805 respectively. If meter under test is an Ammeter is connected in series and Voltmeter is connected across the resistive load. Energy is calculated by connecting load of 500 watt for two hours.
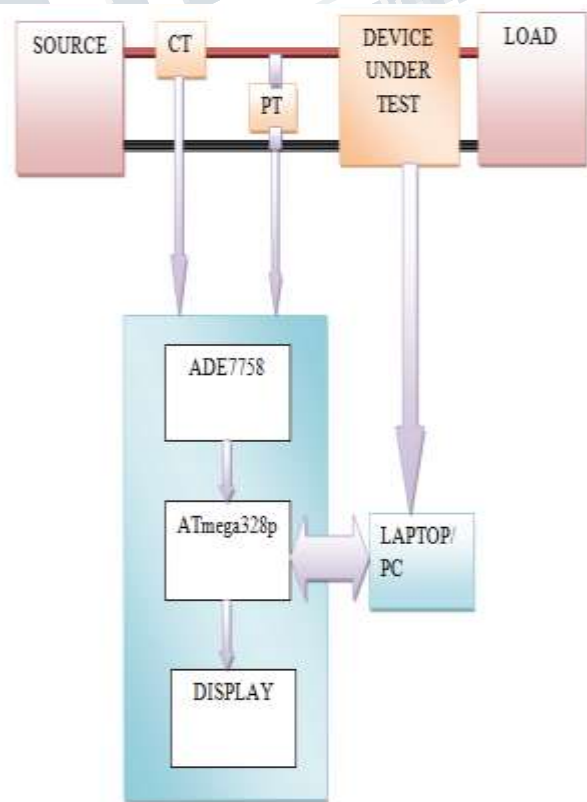

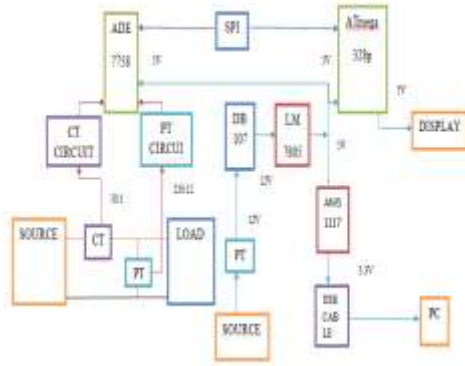*Fig.1 Proposal System Block Diagram*

A. 2. PARTS OF SYSTEM-

Fig.2 Parts of the system

1. CT and PT, 2. DB107, 3. ADE7758, 4. ATMEGA328P
5. LM7805, 6. LM1117,7. LCD,8. USB CABLE, 9. RESISTIVE LOAD
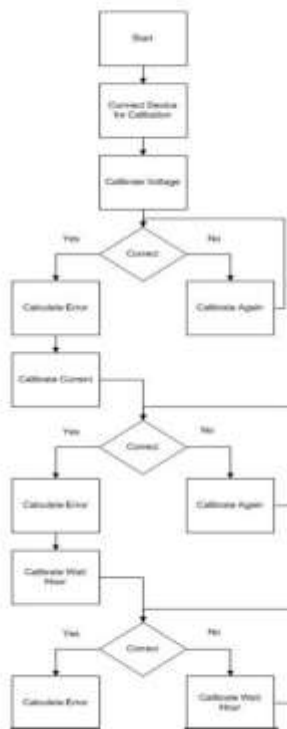
B. FLOWCHART-

Fig.3 Flowchart

III. HARDWARE-

A. CURRENT TRANSFORMER-
Current Transformers are simple transformers which steps down the current. Toroidal type CT is used for sensing current from single phase ac supply. We have put the Burden resister in parallel with the secondary of CT.

B. POTENTIAL TRANSFORMER-
Potential Transformer is used to step down the ac Voltage from difference in Voltmeter circuit and Ammeter circuit is only Burden resistor is connected across CT.

C. DB 107 RECTIFIER-
It is used to converting 12VAC into 12VDC.
Features-
1. Low forward voltage drop, high current capability.
2. Voltage range 50V to 1000V.
3. Current range 1A.
4. Single phase half wave.

Fig.3 DB107 Bridge Rectifier

D. ADE 7758-
The ADE7758 is a high accuracy 3-phase electrical energy measurement IC with serial interface. It is suitable to measure active, reactive, apparent energy in three phase configurations. As well as it measures RMS voltage and RMS current it provides system calibration features for each phase.

Features-
1. Single 5V supply, low power
2. Digital power, phase, RMS offset calibration, and sampled waveform data
3. Less than 0.1% active energy error.

E. ATMEGA328P MICROCONTROLLER-

In proposed system Microcontroller ATMEGA 328P has performed the important role like brain of the circuit. In proposed system, Microcontroller has been performing various important features like measuring, recording, displaying and taking action in abnormal cases like over voltage, under voltage, and over current protection.

Features-

1. ATMEGA 328P microcontroller is a single chip microcontroller created by Atmel in the mega AVR family.
2. 8bit AVR RISC based microcontroller combines 32KB ISP flash memory with read while write capabilities,
3. 1KB EEPROM,
4. 2KB SRAM,
5. 23 general purpose I/O lines,
6. 32 general purpose working resisters,
7. Three flexible timer/counters with compare modes,
8. Internal and external interrupts,
9. Programmable USTART,
10. a byte oriented 2 wire serial interface,
11. SPI serial port,
12. 6 channel 10 bit A/D converter
13. Programmable watchdog timer with internal oscillator,
14. Five software selectable modes,
15. Device operates between 1.8 to 5.5 volts
16. The device achieves through put approaching 1MIPS per MHz

F. VOLTAGE REGULATOR- LM7805-

It is used to getting stable output voltage. It is three terminal positive configuration regulators.

Features-

1. Output current up to 1.5A.
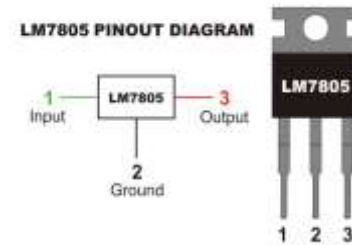2. High power dissipation capabilities.

Fig.4 Pin Diagram of LM7805

LM1117-
The LM1117 is used to getting stable output voltage.
Features-
1. Available in 1.8V, 2.5V, 3.3V, 5V and adjustable Versions.
2. Output current 80 mA.
3. Line regulation 0.2% (maximum), Load regulation 0.4% (maximum) Post regulator for switching DC-DC converter.
4. High efficiency linear regulators.

Fig.5 LM1117 Regulator

G. LCD-
The LCD is used in smart calibration meter to display the reading of voltage and current of standard meter on the display screen. The data stored in ADE7758 is interfaced with microcontroller 328P and after that data is displayed on the screen (RW logic "zero"). When enable pin is changes from high to low then the data will change from previous reading to the next reading. The time required for changing data is about 0.3 msec.
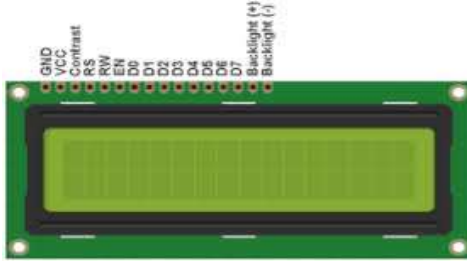
Fig.6 LCD

H. LAPTOP/COMPUTER-

As we observe the reading of reference meter and testing meter, then these readings are filled up in the software which is present in Laptop/ computer. Using this software we can calculate the error between reference meter and testing meter and display.

C. RESULT-

Voltmeter

Sr. No.	Reference Voltage (V)	Testing Meter Voltage(V)	Error (%)
1.	247	245	0.8

Ammeter

Sr. No.	Reference Current (A)	Testing Meter Current(A)	Error (%)
1.	4.1	4.3	-4.87

Energy Meter

Sr. No.	Reference Watt (W)	Testing Meter Watt(W)	Error (%)
1.	99.88	100	-0.12

D. CONCLUSION-

The single unit is able to calibrate multiple numbers of meters. The Cost and Size of proposed system is effective than the other system of calibration. It is easy to use.

E. REFERENCE

[1] Tajeen k Hundekari, Prof. G. P. Jain, Mr. Sagar R. Somani, "Microcontroller Based Prepaid Energy Meter To Control Electricity Theft" International journal of Innovative Research in Computer and Communication engineering, vol.4, Issue 11, November, 2016.

[2]Naveenkumar, Jagadeesh S K , "Smart Energy Meter" International Journal of Technical and Applications vol.4, Issue 3 (May-June, 2016), PP. 126-129 and Calibrating analog meters with the 5080A Multi -Product Calibrator Fluke datasheet.

[3] Irfan Quazi, Sachin Kumar Gupta, Rajendra Prasad, "Pre-Paid Energy Meter based on AVR Microcontroller" International Journal of Engineering Research, vol.1, Issue 4, pp.1879-1884.

[4] Srividyaadevi p., Pushalatha D.V., Sharma P.M., "Measurement of Power and Energy Using Arduino" Research Journal of Engineering Sciences, vol2 (10), 10-15, October (2013).

[5] National Instrument and Technology ni.com/smartgrid.

[6]Yusuf Abdullani Badamasi, Ardiuno,"Aurdino Uno" The working principle of Ardiuno,

[7] Mohammad Shah Alamgir, Sumit Dev, "Design and Implementation of an Automatic Voltage Regulator with a Great Precision and Proper Hysteresis" International Journal of Advanced Science and Technology, vol.75 (2015),pp.21-32.