A SINGLE PHASE AC DIGITAL MULTIROLE SMART METER

[1]Dr.Netravati U.M, [2]Prof K Raghavendra Prasad, [3]Sonia D, [4]Pooja G

[1]Professor, [2]Asst.Professor, [3,4]Students,

[1]Dept. of Electrical and Electronics Engineering,

[1]R Y M Engineering college, Ballari, India

Abstract: This paper presents design and construction of AC modern meter. The meter is designed to overcome the error occur due to manual readings and minimize the space consumption of the unit. The meter is portable and adaptable as it can measure voltage, current, frequency, power, energy, power factor in a unit. AC modern meter have several advantages that includes measurement of residential electrical consumption, factory electrical consumption, laboratory measurement of voltage, current, power, energy, power factor and frequency. Individual meters are required to estimate electrical parameters, but the AC modern meter is abundant to measure voltage, current, power, energy, power factor, frequency and to display them simultaneously on an LCD. The designed AC modern meter computes the electrical parameter using an Arduino-UNO and PZEM-004T and display the numerical value on a digital programmed screen simultaneously. AC modern meter gives the accurate and efficient reading for electrical equipment and is also used for safety purpose while is in electrical circuit development and in testing lab. Multi-meter can measure voltage, current, frequency, but it cannot display all of these simultaneously, but whereas the AC modern meter is of great benefit in measuring and monitoring the voltage, current, power, energy, power factor and frequency.

Index Terms: Arduino-UNO, PZEM-004T, transformer, rectifier, current transformer, display unit.

I. INTRODUCTION

. Every management system is trying to make an automatic, portable, accurate and reliable system for measurement. A smart meter is an electronic measuring instrument that combines several measurement functions in one unit. The combination of the Arduino and LCD provide the meter reading system with some automatic functions that are predefined. The proposed smart meter system can incorporate with an embedded microcontroller and PZEM-004T AC Contemporary Meter. PZEM-004T has the ability to measure electrical parameters such as voltage, current, active power, energy, power factor and frequency. The measured parameters directly communicate with TTL serial interface with Arduino nano board and display on 16*2 LCD. The meter is able to provide all required measurements of voltage, current, power, power factor, energy and frequency.

Some of the major use cases of smart meter are as follows:

To find out the unknown values of the electrical quantities and for comparison with the standard values. To note down the error in the measuring value in the circuit or system. Smart meter is essential for displaying numerical values of electrical quantities.

Smart meter gives the accurate and efficient reading for electrical equipment. Smart meter is also used for the safety purpose while in electrical circuit development and in lab testing.

II. BLOCK DIAGRAM

Smart meter consists of transformer, rectifier, arduino, PZEM-004T, display unit (LCD). Connections of these equipments are as shown in the block diagram of Fig.1.
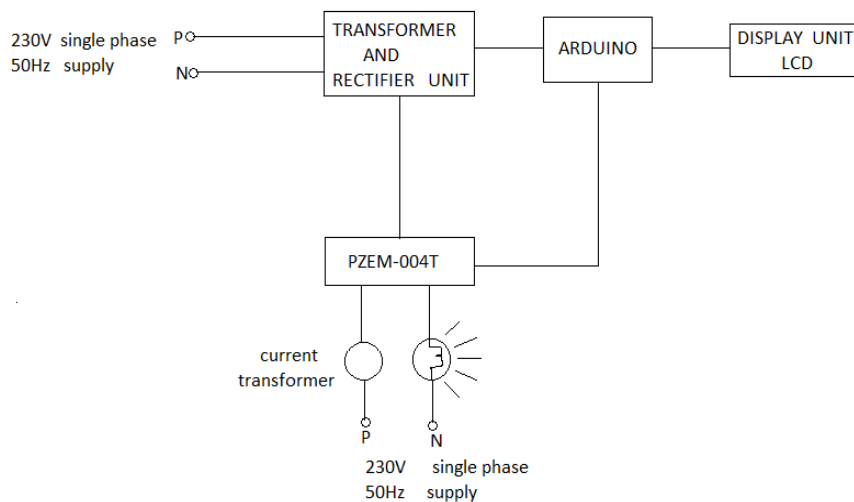
fig.1: block diagram of single phase ac multirole smart meter

Smart meter makes use of ARDUINO-UNO as microcontroller to read the input from PZEM-004T and display a voltage, current, power, power factor, energy and frequency on the 16*2 LCD.

2.1 Arduino-Uno:

The Arduino Uno is an access time microcontroller boards based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is provided with sets of digital and analog inputs/output (I/O) pins that may be connected to different extension boards and other circuits.

Board has 14 digital I/O pins, 6 analog I/O pins, and is drafted with the Arduino IDE, via a type B USB cable. It can be charged by the USB cable or by an exterior 9-volt battery, though it accepts voltages between 7 and 20volts. The hardware testimonial plan is issued with inventive multitude sorting share-alike 2.5 permits and is accessible on the Arduino network. Presentation and manufacture folder for a few varieties of the hardware are as well accessible.

The name "Uno" refer "one" in Italian and was selected to spot the beginning liberate of Arduino software. The Uno is the earliest in a sequence of USB-type Arduino panels; it and type 1.0 of the Arduino IDE was the recommended sort of Arduino, which has now developed up-to-the-minute let out.

ATmega328 on the panel approach pre-organised with a Boot maneger that permits transferring new key to it without the use o an exterior hardware organizer. The Uno liaise with the use of primary STK500 protocol, it varies from all previous panels in that it will not use the FTDI USB-to-serial driver bit. Alternatively, it makes use of the ATmega16U2 organized as a USB-to-serial converter.

2.2 PZEM 004T:

PZEM-004T is the best for the purpose of the DIY project, where we need to measure the voltage, current and power using Arduino/ESP8266/Raspberry Pi like open source platform. Usually in every electrical projects, engineer directly grapple with measurements with few basic requirements like

- High piezoelectric segregation.
- Parameter array.
- Undeviating transmission with computer.
- Data accession and depository with successive viewing or monitoring to the computer.

The manual proportion of the PZEM-004T board is 3.1×7.4 cm, The pzem-004t module is bundled with 33 mm diameter current transformer coil.

The assembly of the PZEM-004T module is the SD3004 chip from the SDIC Microelectronics. Besides, the board having the EEPROM from Atmel(now microchip) 24C02C which is a 2K bit Serial Electrically Erasable PROM with a voltage range of 4.5V to 5.5V. Table 1 gives the operating parameters and their ranges of the PZEM.

table 1. operating parameters and ranges of pzem

Working voltage	80 ~ 260VAC
Current	0 – 100 A
Rated power	22kW
Operating frequency	45-65Hz
Measurement accuracy	1.0 grade

Function:

1. Electrical parameter measurement function such as voltage, current, connected load, and total consumption.

2. The power button clear function.

3. Power-down depository function (accruing power down before saving).

4. The serial communication function (assigns TTL serial interface, through various terminals communicate with the adapter plate, read, and set the parameter).

III. Operation

When the current flows in the load, Current is sensed by current transformer and this current is read by PZEM-004T which sends signal to the arduino. Transformer and rectifier unit is connected to arduino.PZEM-004T is used for measuring AC voltage, current, power, power factor, energy and frequency of single phase power supply power circuit. The PZEM-004T works on 5V DC power supply and wiring diagram is as shown in Fig.2.
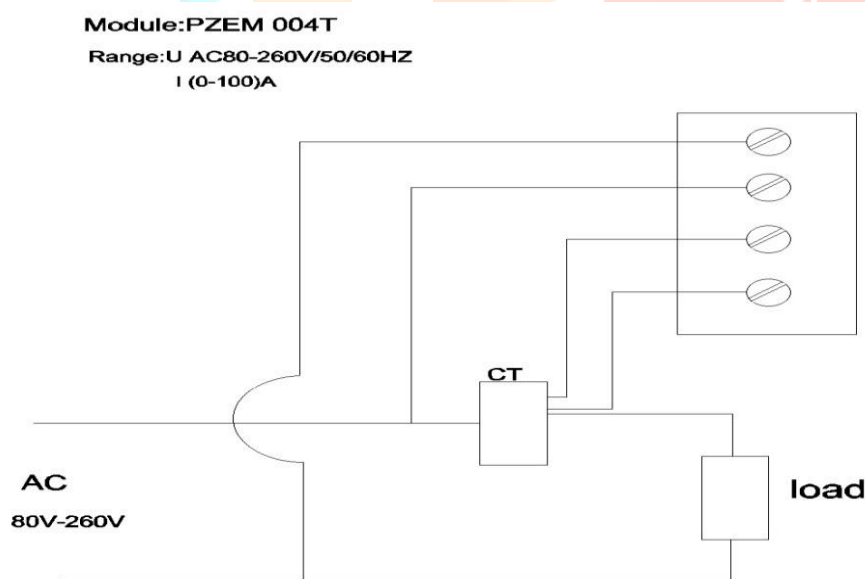

fig (2): wiring diagram

It is interfaced with Arduino nano or Uno to read and display the parameters and current transformer is connected to that to read current and on power side maximum operating current is 100A. Smart meter rated voltage is 220V, output voltage is 220V and power range is 22000W. We have a transformer and a rectifier circuit to power Arduino Uno or nano. AC single phase multirole smart meter has 80W, 260V AC at 45 to 65Hz frequency and PZEM-004T.

When Arduino gets signal from PZEM-004T, it displays output on LCD unit. When load circuit is switched on, depending upon the load current starts flowing in the load circuit. The current flowing in the load circuit is sensed by the current transformer and the current is read by the power side circuit of PZEM-004T.The PZEM-004T in turn sends a command to Arduino to display the current flowing through the load circuit. Similarly, voltage is read by PZEM-004T and commands Arduino to display. Based on the current flowing and voltage across the load the power factor of the load circuit, power and energy are displayed. And the power factor and frequency of the supply are displayed by the Arduino.

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