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Wireless Power Meter Using Data Acquisition

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Abstract:

Our aim of the project is to provide a wireless meter reading device for implementing the data acquisition or for observing the power theft occurring in the present power distribution system. The project also can be used as the monitoring section of the power parameters in case of fault occurrences in parameters like voltage, current and frequency. The transmitter section contains a VT and CT for measuring load voltage, current and frequency. The parameters are converted into digital data using ADC 0809 and then forwarded to the micro controller. The micro controller transmits the data using 433MHz zigbee transmitter and the data is received using 433MHz receiver and then provided to amplifier for current amplification and the provided to micro controller for displaying and comparison of values for permissible limits.

Keywords: Data Acquisition, 433mhz, Zigbee Transmitter, micro controller, MAX23C

I INTRODUCTION

With the electric industry undergoing change, increased attention is being focused on power supply reliability and power quality. Power providers and users alike are concerned about reliable power, whether the focus is on interruptions and disturbances or extended outages. One of the most critical elements in ensuring reliability is monitoring power system performance. Monitoring can provide information about power flow and demand and help identify the cause of power system disturbances. It can even help identify problem conditions on a power system before they cause interruptions or disturbances.

The implementation of this project is to monitor the power consumed by a model organization such a household consumers from a centrally located point. Monitoring the power means calculating the power consumed exactly by the user at a given time. The power consumed by the user is measured and communicated to the controlling substation whenever needed by the person at the substation. The communication can be of two types

1. Wired communication like using the existing transmission lines and sending the data by modulating with high frequency carrier signal or using the existing telephone lines.
2. Wireless communication based on the available technologies like IR communication, Bluetooth technology or GSM technology. Among these two communications, the one used in our project is wired communication which suits best for long distance communication.

II SYSTEM ARCHITECTURE

The block diagram consists of Load, current transformer, voltage transformer, 89C52 microcontroller, ADC 0809, and a differential relay. The household load to be supplied is connected in series to the AC supply mains through a switch which is operated by the action of a relay. Current transformer is used to measure the current required for the user and the voltage transformer is used to measure the voltage of operation for the user. The measured values are given to the ADC to convert the analog values to the digital values. These values are stored in microcontroller registers and the information is transmitted to the pc when ever there is a request for the data from the remote controlling station. Oscillator is provided for the ADC and microcontroller for the clock signal and the reference voltage is given for the each of the IC used.

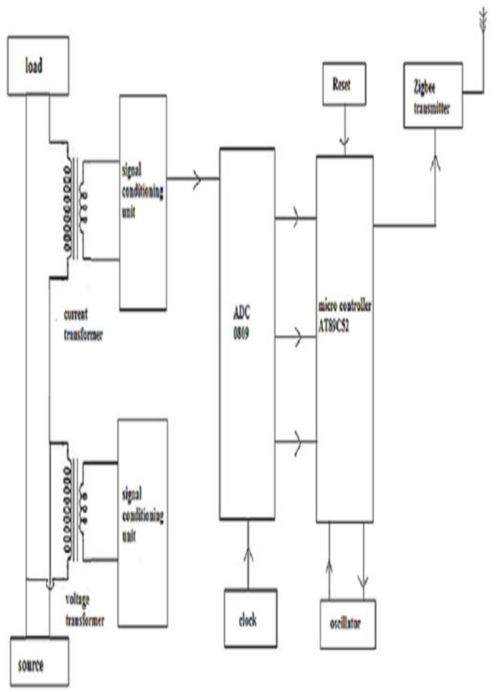


Fig 1:Transmitter block diagram

This supplier side is the basic for the operation of the project; the entire consumer side is controlled in accordance with the program written on this supplier side. The supplier side (substation) is located remotely at some distance away from the user and the signal is sent to the consumer side for data or to control the supply of power to the user. The request for information and the power data is received from the user side via RS232. Microcontroller is interfaced to the personal computer serial port through MAX23C to drive between RS232 and TTL levels.

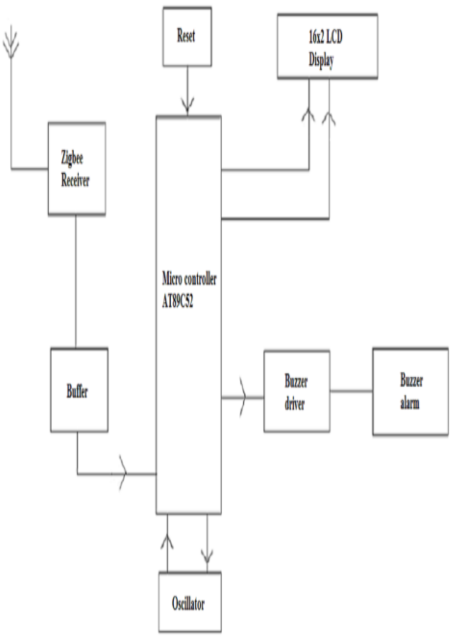


Fig 2 :Receiver block diagram

A. Micro Controller (AT89C52)

The AT89C52 is 80C51 microcontrollers with 128kB Flash and 1024 bytes of data RAM.A key feature of the AT89C52 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The AT89C52 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

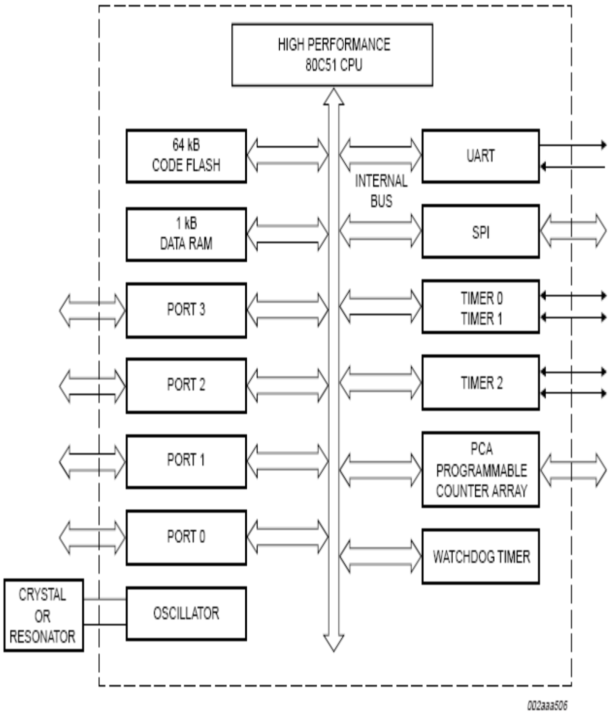


Fig 3 AT89C52 MICRO CONTROLLER

B. FUNCTIONAL DESCRIPTION

Power-On reset code execution

Following reset, the AT89C52 will either enter the Soft ICE mode (if previously enabled via ISP command) or attempt to auto baud to the ISP boot loader. If this auto baud is not successful within about 400 ms, the device will begin execution of the user code.

C. IN-SYSTEM PROGRAMMING (ISP)

In-System Programming is performed without removing the microcontroller from the system. The In-System Programming facility consists of a series of internal hardware resources coupled with internal firmware to facilitate remote programming of the AT89C52 through the serial port. This firmware is provided by Atmel and embedded within each AT89C52 device. The Atmel In-System Programming facility has made in-circuit programming in an embedded application possible with a minimum of additional expense in components and circuit board area. The ISP function uses five pins (VDD, VSS, TxD, RxD, and RST). Only a small connector needs to be available to interface your application to an external circuit in order to use this feature.

Input/output (I/O) ports 32 of the pins are arranged as four 8-bit I/O ports P0–P3. Twenty-four of these pins are dual purpose with each capable of operating as a control line or part of the data/address bus in addition to the I/O functions. Details are as follows:

Port 0: This is a dual-purpose port occupying pins 32 to 39 of the device. The port is an open-drain bidirectional I/O port with Schmitt trigger inputs. Pins that have 1s written to them float and can be used as high-impedance inputs. The port may be used with external memory to provide a multiplexed address and data bus. In this application internal pull-ups are used when emitting 1s. The port also outputs the code bytes during EPROM programming. External pull-ups are necessary during program verification.

Port 1: This is a dedicated I/O port occupying pins 1 to 8 of the device. The pins are connected via internal pull-ups and Schmitt trigger input. Pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs; as inputs, pins that are externally pulled low will source current via the internal pull-ups. The port also receives the low-order address byte during program memory verification. Pins P1.0 and P1.1 could also function as external inputs for the third timer/counter i.e.:

(P1.0) T2 Timer/counter 2 external count input/clockout

(P1.1) T2EX Timer/counter 2 reload/capture/direction control

Port 2: This is a dual-purpose port occupying pins 21 to 28 of the device. The specification is similar to that of port 1. The port may be used to provide the high-order byte of the address bus for external program memory or external data memory that uses 16-bit addresses. When accessing external data memory that uses 8-bit addresses, the port emits the contents of the P2 register. Some port 2 pins receive the high-order address bits during EPROM programming.

Port 3: This is a dual-purpose port occupying pins 10 to 17 of the device. The specification is similar to that of port 1. These pins, in addition to the I/O role, serve the special features of the 80C51 family B.

III SCHEMATIC DIAGRAM

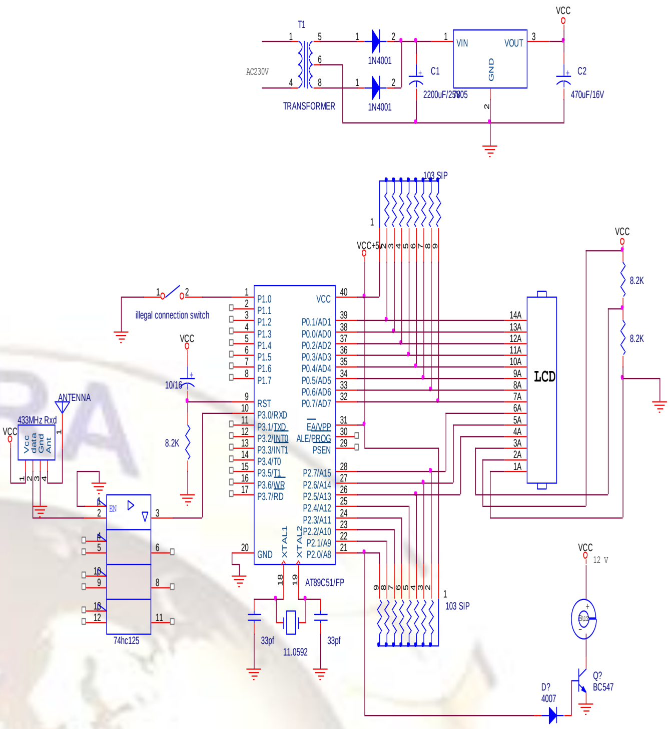


Fig 4 Transmitter Schematic diagram

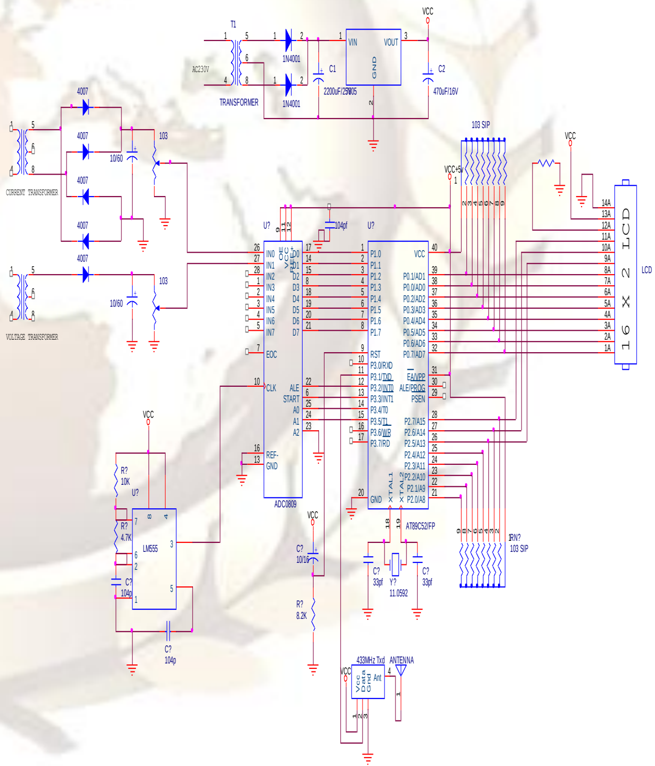


Fig 5 Receiver Schematic diagram

The above figure shows the circuit diagram for the consumer side. A relay operated switch is connected in series with the load. The switch is used to switch on and off the power. By the relay is initially in on state and whenever the voltage across its terminals changes the relay senses the voltage and trips which in turns closes the switch. The relay is connected to the port of the microcontroller through a transistor and zener diode to drive the relay. The current transformer primary is connected to the load in series to the mains and the secondary is connected across the variable resistance to change the measured value to the close actual value. The potential transformer primary is connected in parallel to the load to measure the applied voltage and the secondary is connected to the variable resistance to adjust the measured value to the close accurate value. The outputs of this are given to the ADC analog input pins. A 555 timer is connected in astable multivibrator mode and is given as clock signal to the ADC. The digital outputs are given as inputs to the microcontroller port.

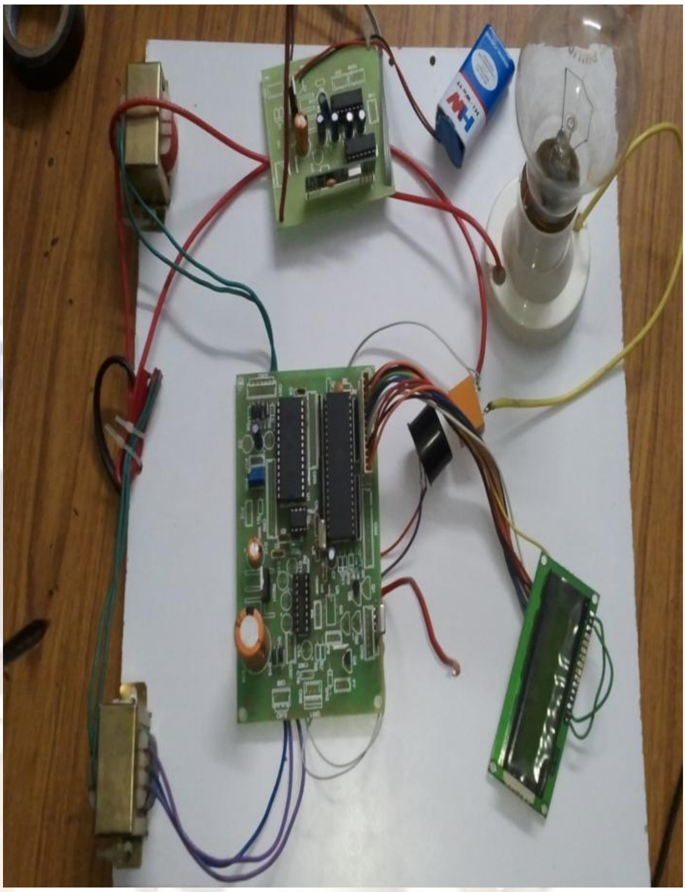
The control pins of the ADC are given from the microcontroller port to select the input to be received. The voltage and current measured are received in accordance to the inputs given to the status pins A, B, C by the controller. The ADC starts the conversion at the end of the pulse Start and sends data at the end of the pulse EOC these are also connected to the port of the microcontroller. The microcontroller is provided with a quartz crystal to provide the clock signal, the clock frequency is changed by the capacitors connected to the crystal the operating frequency in this circuit is 11.0592MHz.

A series combination of the resistor and capacitor is taken and the capacitor voltage is given as the reset logic to the 9th pin of the microcontroller. The 10th pin of the microcontroller is the RXD pin is connected to the receiver data pin of RS232. The data from the RXD is stored internally for further processing. The 11th pin of the microcontroller is the TXD pin is connected to the RS232 which transmits the data from the microcontroller. The microcontroller baud rate is set in accordance to the frequency of the 555 timer to ensure consistency of data. Thus data is transmitted from the microcontroller at a preset frequency and the request for data is received by the microcontroller connected to the port and the further processing is done as per the code written to calculate the power by taking the correction factors in to consideration.

The computer is programmed so as to send requests for data and receive data via the serial port. The work at TTL voltage levels and the computer works at RS232C voltage levels. So to bridge this voltage variation MAX 232C is used which is driver cum receiver.

The driver is connected to the IR transmitter and the receiver is connected to the IR receiver. The data from data pin of IR receiver is given to the computer and displayed on the screen. IR transmitter is connected to the computer and the program is written to send the data via the serial port to the IR transmitter to send data at a given baud rate. The oscillator is connected to the transmitter to match the transmission with the baud rate. The oscillator used is 555 timer using astable multivibrator.

IV KIT DIAGRAM



V CONCLUSION

The ability to remotely monitor and/or control power at the rack level can provide a huge return on investment by providing savings in both man hours and downtime. Remote monitoring capabilities eliminate the need for manual power audits as well as provide immediate alerts to potential problems. Remote control allows for quick response and recovery of stalled hardware either down the hall or across the country. This ability can save not only travel costs but minimize costly downtime.

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