International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-2 Issue-4, April 2013

TEST-JIG Card for Signal Conditioning Using DSPIC Microcontroller

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Abstract— In this paper we have presented an automated multichannel Data Acquisition System, which is used to provide a high resolution system and provides data regarding temperature, pressure, RPM and RTD calculation of system used for diesel engine. Test-Jig Card is used for this purpose. Test-Jig Card includes a microcontroller instead of a computer which work on very small voltage can even work on battery. It is very useful for all the application which is risky for humans to measure. It maintains high resolution and accurate measurement within the system. The DsPIC30F3013 microcontroller uses RS-485 communication protocol to dialog with other devices and other peripheral for remote application. The measurement for remote application is stored in controller or communicated to the communication protocol. The data is digitized with the help of RS485 communication protocol which is interfaced to microcontroller. The microcontroller takes the data verifies it, stores it, processes and displays it on LCD (Liquid Crystal Display). Here the user need not go to the place always at different time intervals. He does not always require a computer with him; this small system does a lot of job.

Index Terms—DSPIC30F3013, Pressure, RPM, RTD, RS-485.

I. INTRODUCTION

The database collection always requires a computer connection for the record which is not always feasible. If any problem arises we need a computer for detection. Every quantity needs to be measured separately which is time consuming. Fault detection requires a lot of time. In this paper we have discussed an automated multichannel Data Acquisition System, which is used to provide a high resolution system and provides data regarding temperature, pressure, RPM and RTD calculation of system used for diesel engine. It maintains high resolution and accurate measurement within the system. The microcontroller uses communication protocol to dialog with other devices and other peripheral for remote application.

The measurement for remote application is stored in controller or communicated to the communication protocol. The data is digitized with the help of RS485 communication protocol which is interfaced to microcontroller. The microcontroller takes the data verifies it, stores it, processes and displays it on LCD (Liquid Crystal Display).

II. STRUCTURE OF HARDWARE SYSTEM

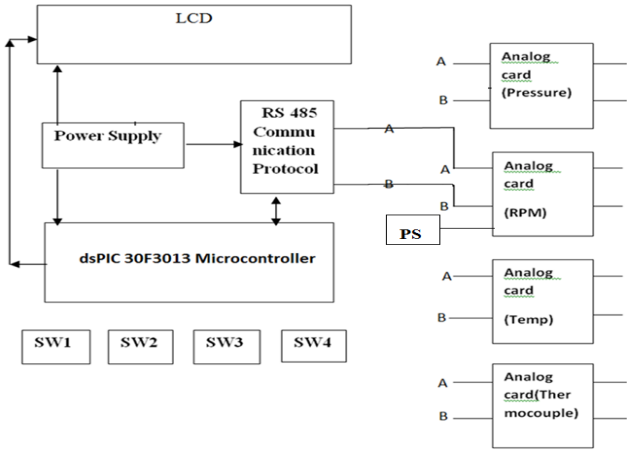

Figure 1: Block Diagram of Overall System

As shown in above diagram the sensor output will be given to the signal conditioner. Again the output of the signal conditioner is given to the PIC-microcontroller where PIC-microcontroller will convert hexadecimal data to BCD & BCD to ASCII. After converting the data to the ASCII format, it will be displayed on the LCD. The data transfer between PC & PIC-microcontroller will be done through the RS-485. For this purpose +5V power supply is given to the PIC-microcontroller. We are selecting dsPIC30F3013. The advantages are, it has 28 pins, 24K programmable memory, timer 3 i/p channels and in-built ADC so it has been selected. Pin diagram is as shown below.

DsPIC30F3013 pin diagram:

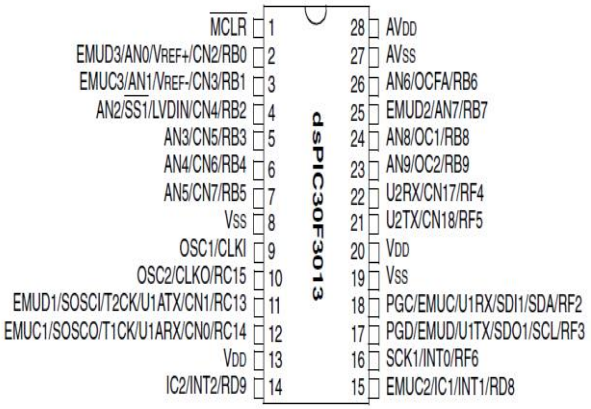

Figure 2: DSPIC30F3013

Specifications:
High performance modified RISC CPU.
Up to 24K bytes of on chip flash program
Up to 2K bytes of on chip data RAM.
12 bit analog to digital converter

Manuscript published on 30 April 2013.
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A. POWER SUPPLY DESIGN:

When working with electronics, you always need one basic thing: Power. In every electronic circuit power supply is required. The proper working of each and every component, the exact amount of voltage and current to be supplied to it. If the power exceeds its limit, it can be fatal. Fig 3.4.1 is the circuit diagram of power supply which gives output of 5V, which is required for microcontroller.

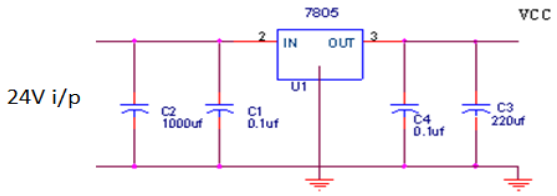

Figure 3: +05 V Regulated Power Supply

The +5 volt power supply is based on the commercial 7805 voltage regulator IC. This IC contains all the circuitry needed to accept any input voltage from 0 to 5 volts and produce a steady +5 volt output, accurate to within 5% (0.25 volt). It also contains current-limiting circuitry and thermal overload protection, so that the IC won't be damaged in case of excessive load current; it will reduce its output voltage instead. The advantage of a bridge rectifier is that you don't need a center tap on the secondary of the transformer. A further but significant advantage is that the ripple frequency at the output is twice the line frequency (i.e. 50Hz) and makes filtering somewhat easier.

The use of capacitor c1, c2, c3 and c4 is to make signal ripple free. The two capacitor used before the regulator is to make AC signal ripple free and then later which we are using is for safety, if incase there is a ripple left after regulating, then c3 and c4 will remove the ripple.

B. DISPLAY UNIT

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. The control lines of LCD comprises of RS, R/W and E.

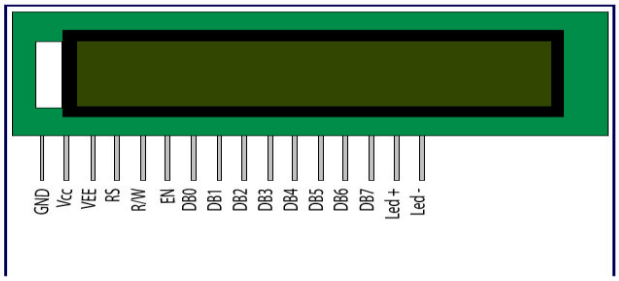

Figure 4: 16x2 LCD display

III. DESIGN IMPLEMENTATION

A. MPLAB:

MPLAB ICD2 is connected to the target PIC micro MCU with the modular interface cable. There are 2 steps to using MPLAB ICD2 as a debugger. The first requires that an application be programmed into the target PIC micro MCU. The Second uses the internal in-circuit debug hardware of the flash PIC micro MCU to run and test the application program. For programming no clock is needed on the target PIC micro MCU but power must be supplied.

MPLAB ICD2 must be connected to a PC. It must be powered by an external power supply or the PC via the USB cable, and must be communicating with MPLAB software via USB cable. The target PIC micro MCU must have power and a functional, running oscillator otherwise it will not debug.

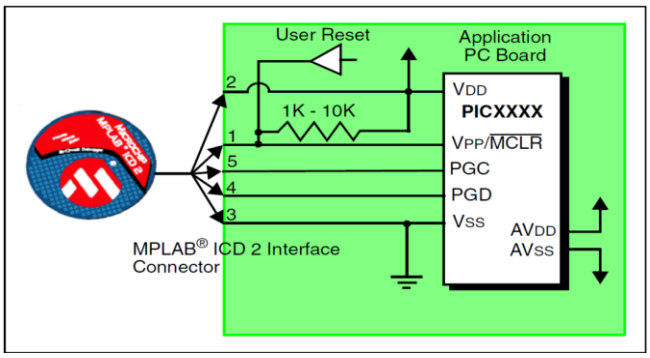

Figure 5: MPLAB ICD2 Interface Connector

B. EAGLE:

Eagle stands for Easily Applicable Graphical Layout Editor. Eagle is PCB design software to design an electronic schematic and layout of a printed circuit board (PCB).

Eagle is a PCB design software package consisting of a schematics editor, a PCB editor and an auto router module. The software comes with an extensive library of components, but a library editor is also available to design new parts or modify existing ones. Eagle is made by Cad Soft.

The user interface in Eagle is somewhat special when compared to other drawing utilities. The copy-tool can be used to easily clone a component. If you select copy and click on a component, a copy of the component will be attached to the mouse cursor, and can be placed in the schematic.

Circuit diagram is designed in Eagle as shown below

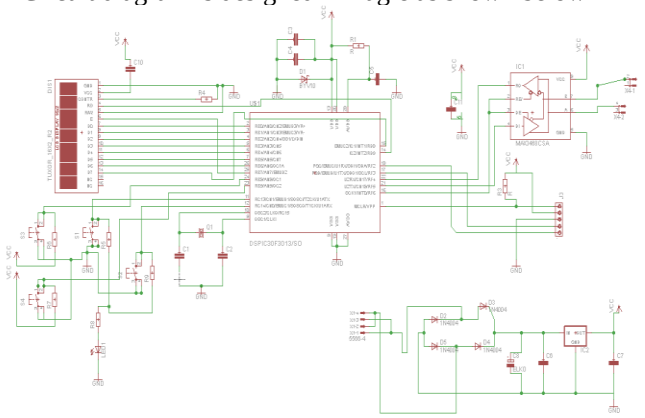

Figure 6: Circuit Diagram in Eagle

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Figure 7: Main Controller

C. *TEST-JIG:*

The Test Jig is used to measure the physical quantities in any object, machine or equipment. Here in the circuit a microcontroller (dsPIC30F3013), communication protocol (RS 485), LCD (16*2), switches, power supply (5v), icd2 programmer used. First the design of power supply is done that gives an output of 5 volts which is required to operate the microcontroller. LCD is used to display the data collected. The communication protocol works combined with the microcontroller which is the most important part of the Test Jig. The physical quantities are measured by the card and converted into digital there itself and are given to RS 485. The use of RS 485 is to just communicate the data with the microcontroller and the microcontroller compares the data and displays the readings on the LCD. The data can be collected from many places at a time and given to RS 485 but it takes only one reading at time. The controller compares the address of the received data with stored corresponding address and then communicates. Since more than one quantity is measured a provision is needed to take reading of quantities separately so switches are added on the kit. Key displays the reading, status of the card (module) and the sensor. Programmer is used to feed up appropriate program into the microcontroller which helps the Test Jig to function properly.

IV. ANALOG CARD

These are cards which are used for collecting data from the site. They collect the physical quantities and then send them to the microcontroller via RS 485 which is a communication protocol. RS 485 is used for serial communication which is point to point. The physical quantities are then converted into digital quantities which display the measurement. The card includes sensors which sense the physical quantities and then the controller displays the reading on the LCD. These cards provide an ease for an employee to take the reading on one place instead of being on the site always. The cards also provide a facility of checking whether we get all the readings in proper way, any fault can be detected easily. The main use of the card is to display these physical quantities into electrical form.

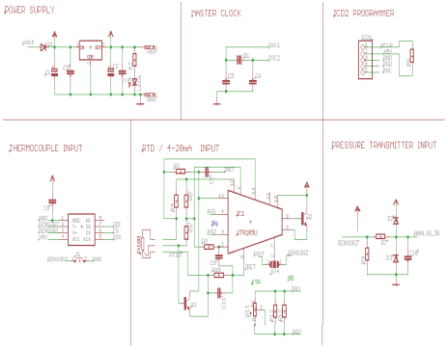

Figure 8: Analog Cards Circuit Diagram

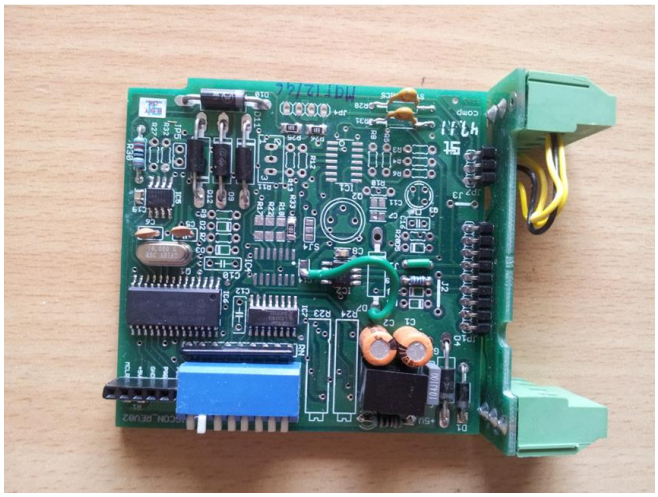

Figure 9: Analog Cards Design

We have designed four different sensor modules such as Temperature, Pressure, RPM, and RTD. Sensor Module is being design in such way that can interface with multiple sensors. Similarly for example RTD, RPM, Pressure. Output of this Sensor is given to RS-485 A and B line.

FINAL SETUP:

Figure 10: Final Setup of TEST-JIG

V. RESULTS

Pressure:

Input to the pressure card is through a resistance pot of 5K. We have set the pot on 2K value The 250 ohm resistance is in shunt in the card. The output varies accordingly from 4 to 20

Thermocouple:

The input to the thermocouple is in mille volts in 0 to 20 mV and the output is received in range of 0 to 600^0C. But practically we short the two inputs of the card to receive the room temperature; this is due to the internal sensor in the card.

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All the values are digitized by the card itself and are serially communicated to the controller through RS 485 communication protocol. The controller processes over the received value and displays it over the LCD display. Final result is displayed on the display.

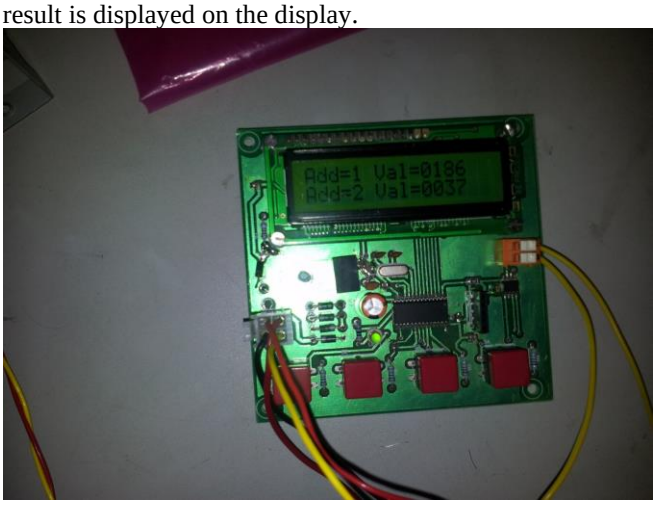

Fig 11: Results of Pressure and Thermocouple Analog Card

RTD:

The input to the RTD is a 3wire RTD sensor the resistance pot is varied from 100 to 200 ohms and the corresponding change in temperature in noted in the range 0 to 150^0 C on the LCD display.

RPM:

The input to the card is frequency through a function generator of 5V amplitude which is a square wave, it gives a simulated output of 2 to 5 volts and corresponding reading from 0 to 2000 rpm is displayed on the LCD display.

All the values are digitized by the card itself and is serially communicated to the controller through RS 485. The controller processes over the received value and displays it over the LCD.

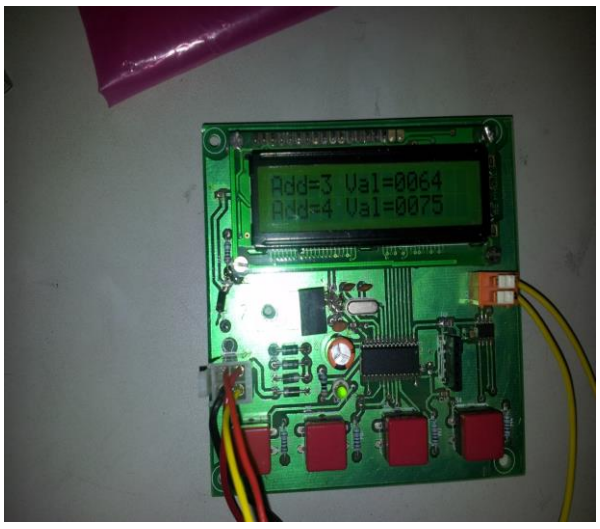

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Fig 12: Results of RPM and RTD Analog Card

VI. CONCLUSION

In this paper, the system is implemented to monitor industrial parameters like temperature, speed, pressure etc. with the help of the different sensors. Test Jig is used for receiving the data from site. So the different physical parameters can be monitored and collected by sitting at one place. System is highly portable. RS-485 provides full duplex communication, higher throughput, simple hardware interfacing and typically requires lower power.

The system designed in this paper can be operated by staff with little training hence proving its user friendliness and cost effectiveness. The fault in any machine running can be detected and cleared before any severe damage System reduces need of human beings which is the big advantage.

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