ZigBee Based Earthquake Sensing System

Project Report submitted in partial fulfilment of the requirement for the degree of

Bachelor of Technology.

in

Electronics and Communication Engineering

under the Supervision of

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to

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Certificate

This is to certify that project report entitled **"ZigBee based earthquake sensing system"**, submitted by **"Deepak Garg(091044),Surabhi Sharma (091091),Ankush kumar (091105)"** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: 13 May 2013
Supervisor's Name : Mr. Bhasker Gupta
Designation: Senior Lecturer (Dept. of ECE)

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Abstract

The natural disasters that cause destruction to the environment should be known well before the reoccurrence so that the damage could be minimized. So we will design a project which will cover problem of earthquake and should help the environment in many ways. In this Project we design a system that will help in the detection of earthquake which can thus prevent the damage. For Earthquake monitoring we will use a accelerometer sensor which will detect the vibrations in the environment.

Along with all this the data is being logged into the PC using a Software Matlab which will store all the information in the data base. We use a Max-232 IC send or receive data from MCU to PC or vice versa. We use this circuit to convert the logics from Rs-232 to TTL. Also the data will be send or received through to the PC using a wireless ZigBee Transceiver Module.

CHAPTER 1

INTRODUCTION

In this Project we design a system that will help in the detection of earthquake which can thus prevent the damage. For Earthquake monitoring we will use a accelerometer sensor which will detect the vibrations in the environment.

1.1 Definition of sensor

A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument. A sensor is a device which receives and responds to a signal when touched. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. Sensors that measure very small changes must have very high sensitivities. Sensors also have an impact on what they measure. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro-sensors using MEMS technology. In most cases, a micro-sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches. In such cases, we are using accelerometer sensor that will sense the variations produced in the earth surface. Firstly, we will mount this accelerometer sensor on the earth surface and then it will measure the variations in terms of voltage. Accelerometer sensor can measure static (earth gravity) or dynamic acceleration in all three axes. Accelerometer sensor measures level of acceleration where it is mounted this enable us to measure acceleration/deceleration of object like car or robot, or tilt of a platform with respected to earth axis, or vibration produced by machines. Sensor provides 0G output which detect linear free fall. Sensitivity can be adjusted in two ranges. Acceleration is a vector force which has direction and measured in meters per Second Square. Earth produces gravitational acceleration on all objects on earth. By measuring the three axis acceleration one can measure the level of tilt of any platform.

The block diagram of the proposed sensing system to sense the earthquake variations is shown below.

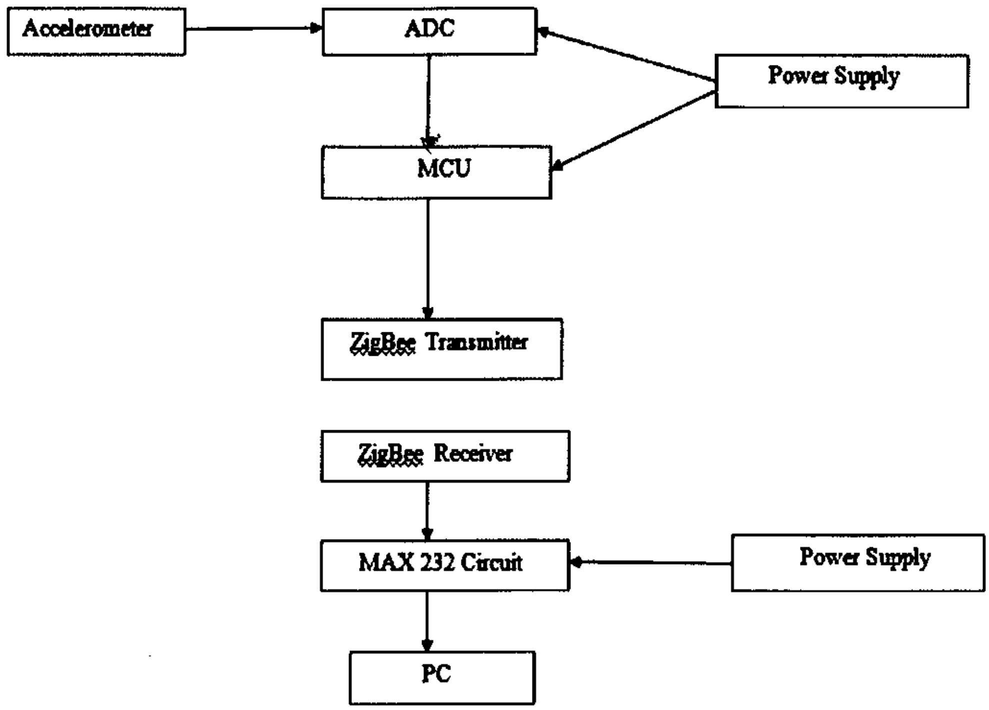


Fig1: Block diagram of the sensing system

The analog voltage that is being measured by the accelerometer is converted to digital voltage with the help of ADC (analog to digital convertor).then this voltage is fed to MCU from where it is given to LCD to display. Also to transmit this voltage over long range, we need to use ZigBee (IEEE 802.15.4) which is a wireless technology. It has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device.

1.2 ZigBee

ZigBee is a low-cost, low-power standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries.

ZigBee protocols are intended for embedded applications requiring low data rates and low power consumption. The resulting network will use very small amounts of power — individual devices must have a battery life of at least two years to pass ZigBee certification

It is better in comparison to Wi-Fi and Bluetooth. It is shown with the help of this below table.

	ZigBee	Wi-Fi	Bluetooth
Range	10-100 meters	50-100 meters	10-100 meters
Networking Topology	Ad-hoc,peer to peer,star or mesh	Point to hub	Ad-hoc,very small networks
Operating Frequency	868 MHZ(IN EUROPE),900-928(NA),2.4 GHz(Worldwide)	2.4 and 5 GHz	2.4 GHz
Complexity	Low	High	High
Power Consumptio n	Very Low	High	Medium
Security	128 AES plus application layer security		64 and 128 bit encryption
Typical Application s	Industrial control and monitoring, sensor networks, building automation, home control and automation,toys,games	Wireless LAN connectivity,broadband,Internet Access	Wireless connectivity between devices such as phones,PDA,laptops,headsets

Table1: Comparison between ZigBee, Wi-Fi and Bluetooth

CHAPTER 2

Components Specifications

2.1 Regulated Power Supply

Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function. Each of the blocks has its own function as described below

1. Transformer- steps down high voltage AC mains to low voltage AC.

2. Rectifier - converts AC to DC, but the DC output is varying.

3. Smoothing - smoothes the DC from varying greatly to a small ripple.

4. Regulator - eliminates ripple by setting DC output to a fixed voltage.

2.1.1. Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. The two types of transformers

1. Step up transformer increases voltage.

2. Step down transformer decreases voltage.

Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (220V in INDIA) to a safer lower voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up. The ratio of the number of turns on each coil, called the turn ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

Turns Ratio = Vp/Vs =Np/Ns

And Power Out = Power In

Where

Vp = primary (input) voltage

Np = number of turns on primary coil

Ns = number of turns on secondary coil

Vs = secondary (output) voltage

2.1.2. Bridge Rectifier

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all AC wave (both positive and negative sections). 1.4V is used up in the bridge rectifier because each diode uses 0.7V when conducting and there are always two diodes conducting, as shown in the diagram below. Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand (this must be at least three times the supply of rms voltage so the rectifier can withstand the peak voltages). In this alternate pairs of diodes conduct, changing over the connections so the alternating directions of AC are converted to the unidirectional DC.

Fig 2:_OUTPUT - Full-wave Varying DC

2.1.3 Smoothing

Smoothing is performed by a large value electrolytic capacitor connected across the C (capacitor) supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

Fig 3: Smoothing

Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4 × RMS value). For example 6V RMS AC is rectified to full wave DC of about 4.6V RMS (1.4V is lost in the bridge rectifier), with smoothing this increases to almost the peak value giving 1.4 × 4.6 = 6.4V smooth DC. Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small ripple voltage. For many circuits a ripple which is 10% of the supply voltage is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give fewer ripples. The capacitor value must be doubled when smoothing half-wave DC.

Smoothing capacitor for 10% ripple, $C = 5 \times Io$

Where

C = smoothing capacitance in farads (F)

Io = output current from the supply in amps (A)

Vs = supply voltage in volts (V), this is the peak value of the unsmoothed DC

2.1.4. Regulator

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most

Regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection'). Many of the fixed voltage regulator ICs has 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. They include a hole for attaching a heat sink if necessary.

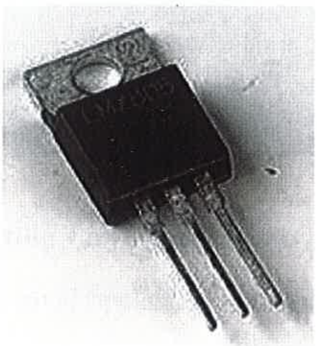


Fig 4: Regulator LM7805

2.1.5. Working of Power Supply

Transformer

Fig 5: Transformer converting high voltage into low voltage

The low voltage AC output is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor.

Transformer + Rectifier

Fig 6: Rectifier converting ac voltage into varying dc

The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor.

Transformer + Rectifier + Smoothing

Fig 7: Filter converting varying dc to smooth dc

The smooth DC output has a small ripple. It is suitable for most electronic circuits.

Transformer + Rectifier + Smoothing + Regulator

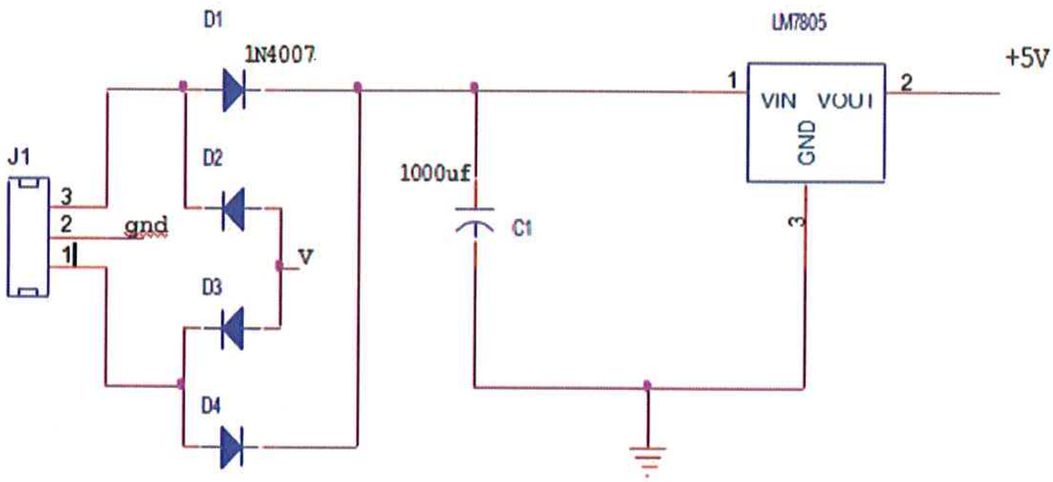


Fig 8: Complete Circuit of Power Supply

The regulated DC output is very smooth with no ripple. It is suitable for electronic circuits.

2.2 MICROCONTROLLER 8051 FAMILY

2.2.1. Microcontrollers for Embedded Systems

In the literature discussing microprocessors, we often see a term embedded system. Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs one task only: namely, get data and print it. Contrasting this with a IBM PC which can be used for a number of applications such as word processor, print server, network server, video game player, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it. In an embedded system, there is only one application software that is burned into ROM. A PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller to perform the task of finding the mouse position and sending it to the PC.

Although microcontrollers are the preferred choice for many embedded systems, there are times that a microcontroller is inadequate for the task. For his reason, in many years the manufacturers for general-purpose microprocessors have targeted their microprocessor for the high end of the embedded market.

2.2.2. A brief history of 8051 Family

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (8-bit) all on a single chip. The 8051 is an 8-bit processor, meaning the CPU can work on only 8- bit pieces to be processed by the CPU. The 8051 has a total of four I/O ports, each 8- bit wide. Although 8051 can have a maximum of 64K bytes of on-chip ROM, many manufacturers put only 4K bytes on the chip. The 8051 became widely popular after Intel allowed other manufacturers to make any flavour of the 8051 they please with the condition that they remain code compatible with the 8051. This has led to many versions of the 8051 with different speeds and amount of on-chip ROM marketed by more than half a dozen manufacturers. It is important to know that although there are different flavours of the 8051, they are all compatible with the original 8051 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer. The major 8051 manufacturers are Intel, Atmel, Dallas Semiconductors, Philips Corporation, Infineon.

2.2.3. 8051 microcontroller

The 8051 is the original member of the 8051 family. Intel refers to it as MCS-51.

2.2.4. Other members of the 8051 family

There are two other members in the 8051 family of microcontrollers. They are the 8052 and the 8031.

2.2.5. Hardware features

1. 40 pin IC
2. 4 Kbytes of Flash
3. 128 Bytes of RAM
4. 32 I/O lines
5. Two16-Bit Timer/Counters
6. Two-Level Interrupt architecture
7. Full Duplex Serial Port
8. On Chip Oscillator and Clock Circuitry

2.2.6. Software features

1. Bit Manipulations
2. Single Instruction Manipulation
3. Separate Program And Data memory
4. 4 Bank Of Temporary Registers
5. Direct, Indirect, Register and Relative Addressing.

2.2.7. Comparison of 8051 Family Members

Feature	8051	8052	8031
ROM(on Chip)	4K	8K	0K
RAM(bytes)	128	256	128
Timers	2	3	2
I/O pins	32	32	32
Serial Port	1	1	1
Interrupt Sources	6	8	6

Table2: Comparison of 8051 family members

2.2.8. Pin Description

The 89C51 have a total of 40 pins that are dedicated for various functions such as i/O, RD, WR, address and interrupts. Out of 40 pins, a total of 32 pins are set aside for the four ports P0, P1, P2, and p3, where each port takes 8 pins. The rest of the pins are designated as V_{cc}, GND, XTAL1, XTAL, RST, EA, and PSEN. All these pins except PSEN and ALE are used by all members of the 8051 and 8031 families. In other words, they must be connected in order for the system to work, regardless of whether the microcontroller is of the 8051 or the 8031 family.

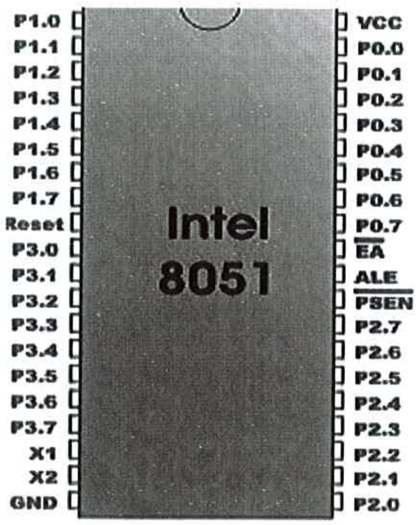


Fig 9: Pin diagram of microcontroller 8051

2.2.8.1 Vcc

Pin 40 provides supply voltage to the chip. The voltage source is +5V.

2.2.8.2 GND

Pin 20 is the ground

2.2.8.3 Oscillator Characteristics

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure. Either a quartz crystal or ceramic resonator may be used.To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven.

It must be noted that there are various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to the XTAL. For example, a 12 MHz chip must be connected to a crystal with 12 MHz frequency or less. Likewise, a 20 MHz microcontroller requires a crystal frequency of not more than 20 MHZ. When the 8051 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using oscilloscope.

2.2.8.4 RST

Pin 9 is the reset pin. It is an input and is active high (normally low). Upon plying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power -on reset. Activating a power-on reset will cause all values in the registers to be lost. Notice that the value of Program Counter is 0000 upon reset, forcing the CPU to fetch the first code from ROM memory location 0000. This means that we must place the first line of source code in ROM location 0000 that is where the CPU wakes up and expects to find the first instruction. In order to RESET input to be effective, it must have a minimum duration of 2 machine cycles. In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.

2.2.8.5 EA

All the 8051 family members come with on-chip ROM to store programs. In such cases, the EA pin is connected to the V_{cc}. For family members such as 8031 and 8032 in which there is no on-chip ROM, code is stored on an external ROM and is fetched by the 8031/32. Therefore for the 8031 the EA pin must be connected to ground to indicate that the code is stored externally. EA, which stands for "external access," is pin number 31 in the DIP packages. It is input pin and must be connected to either V_{cc} or GND. In other words, it cannot be left unconnected.

2.2.8.6 PSEN

This is an output pin. PSEN stands for "program store enable." It is the read strobe to external program memory. When the microcontroller is executing from external memory, PSEN is activated twice each machine cycle.

2.2.8.7 ALE

ALE (Address latch enable) is an output pin and is active high. When connecting a microcontroller to external memory, port 0 provides both address and data. In other words the microcontroller multiplexes address and data through port 0 to save pins. The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of the 74LS373 chip.

2.2.9 I/O port pins and their functions

The four ports P0, P1, P2, and P3 each use 8 pins, making them 8-bit ports. All the ports upon RESET are configured as output, ready to be used as output ports. To use any of these as input port, it must be programmed.

2.2.9.1 Port 0

Port 0 occupies a total of 8 pins (pins 32 to 39). It can be used for input or output. To use the pins of port 0 as both input and output ports, each pin must be connected externally to a 10K-ohm pull-up resistor. This is due to fact that port 0 is an open drain, unlike P1, P2 and P3. With external pull-up resistors connected upon reset, port 0 is configured as output port. In order to make port 0 an input port, the port must be programmed by writing 1 to all the bits of it. Port 0 is also designated as AD0-AD7, allowing it to be used for both data and address. When connecting a microcontroller to an external memory, port 0 provides both address and data. The microcontroller multiplexes address and data through port 0 to save pins. ALE indicates if P0 has address or data. When ALE=0, it provides data D0-D7, but when ALE=1 it has address A0-A7. Therefore, ALE is used for de-multiplexing address and data with the help of latch 74LS373.

2.2.9.2 Port 1

Port 1 occupies a total of 8 pins (pins 1 to 8). It can be used as input or output. In contrast to port 0, this port does not require pull-up resistors since it has already pull-up resistors internally. Upon reset, port 1 is configures as an output port. Similar to port 0, port 1 can be used as an input port by writing 1 to all its bits.

2.2.9.3 Port 2

Port 2 occupies a total of 8 pins (pins 21 to 28). It can be used as input or output. Just like P1, port 2 does not need any pull-up resistors since it has pull-up resistors internally. Upon reset port 2 is configured as output port. To make port 2 as input port, it must be programmed as such by writing 1s to it.

2.2.9.4 Port 3

Port 3 occupies a total of 8 pins (pins 10 to 17). It can be used as input or output. P3 does not need any pull-up resistors, the same as P1 and P2 did not. Although port 3 is configured as output port upon reset, this is not the way it is most commonly used. Port 3 has an additional function of providing some extremely important signals such as interrupts. Some of the alternate functions of P3 are listed below:

P3.0 RXD (Serial input)
P3.1 TXD (Serial output)
P3.2 INT0 (External interrupt 0)
P3.3 INT1 (External interrupt 1)
P3.4 T0 (Timer 0 external input)
P3.5 T1 (Timer 1 external input)
P3.6 WR (External memory write strobe)
P3.7 RD (External memory read strobe)

2.3 LIQUID CRYSTAL DISPLAY

Liquid crystal displays (LCD) are widely used in recent years as compares to LEDs. This is due to the declining prices of LCD, the ability to display numbers, characters and graphics, incorporation of a refreshing controller into the LCD, their by relieving the CPU of the task of refreshing the LCD and also the ease of programming for characters and graphics. HD 44780 based LCDs are most commonly used. The LCD, which is used as a display in the system, is LMB162A. The main features of this LCD are: 16 X 2 display, intelligent LCD, used for alphanumeric characters & based on ASCII codes. This LCD contains 16 pins, in which 8 pins are used as 8-bit data I/O, which are extended ASCII. Three pins are used as control lines these are Read/Write pin, Enable pin and Register select pin. Two pins are used for Backlight and LCD voltage, another two pins are for Backlight & LCD ground and one pin is used for contrast change.

2.3.1. LCD pin description

The LCD discuss in this section has the most common connector used for the Hitachi 44780 based LCD is 14 pins in a row and modes of operation and how to program and interface with microcontroller is describes in this section. The voltage V_{CC} and V_{SS} provided by +5V and ground respectively while V_{EE} is used for controlling LCD contrast. Variable voltage between Ground and V_{cc} is used to specify the contrast (or "darkness") of the characters on the LCD screen.

2.3.1.1 RS (register select)

There are two important registers inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, then allowing to user to send a command such as clear display, cursor at home etc.. If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

2.3.1.2 R/W (read/write)

The R/W (read/write) input allowing the user to write information from it. R/W=1, when it read and R/W=0, when it writing.

2.3.1.3 EN (enable) .

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high power, a high-to-low pulse must be applied to this pin in order to for the LCD to latch in the data presented at the data pins.

2.3.1.4 D0-D7 (data lines)

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD's internal registers. To displays the letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS =1. There are also command codes that can be sent to clear the display or force the cursor to the home position or blink the cursor

We also use RS =0 to check the busy flag bit to see if the LCD is ready to receive the information. The busy flag is D7 and can be read when R/W =1 and RS =0, as follows: if R/W =1 and RS =0, when D7 =1(busy flag =1), the LCD is busy taking care of internal operations and will not accept any information. When D7 =0, the LCD is ready to receive new information.

2.3.2 Interfacing of micro-controller with LCD display

In most applications, the "R/W" line is grounded. This simplifies the application because when data is read back, the microcontroller I/O pins have to be alternated between input and output modes. In this case, "R/W" to ground and just wait the maximum amount of time for each instruction and also the application software is simpler, it also frees up a microcontroller pin for other uses. Different LCD execute instructions at different rates and to avoid problems later on (such as if the LCD is changed to a slower unit). Before sending commands or data to the LCD module, the Module must be initialized. Once the initialization is complete, the LCD can be written to with data or instructions as required. Each character to display is written like the control bytes, except that the "RS" line is set. During initialization, by setting the "S/C" bit during the "Move Cursor/Shift Display" command, after each character is sent to the LCD, the cursor built into the LCD will increment to the next position (either right or left). Normally, the "S/C" bit is set (equal to "1")

Pin	Symbol	I/O	Description
1	Vss	-	Ground
2	Vcc	-	+5V Power supply
3	Vee	-	Power supply to control contrast
4	RS	I	RS=0 to select Command register, RS=1 to select Data register
5	R/W	I	R/W=0 for Write, R/W=1 for Read.
6	E	I/O	Enable
7	DB0	I/O	The 8 bit data bus
8	DB1	I/O	The 8 bit data bus
9	DB2	I/O	The 8 bit data bus
10	DB3	I/O	The 8 bit data bus
11	DB4	I/O	The 8 bit data bus
12	DB5	I/O	The 8 bit data bus
13	DB6	I/O	The 8 bit data bus
14	DB7	I/O	The 8 bit data bus

Table 3: Pin description of LCD Display

2.4 Analog to Digital Converter (ADC 0808)

The process of conversion of analog signal to digital signal is referred to as analog to digital conversion. The system used for realizing this conversion is referred to as an analog-to-digital converter (A/D converter or ADC). The A/D conversion is a quantizing process whereby analog signal is represented by equivalent binary states. A/D converter can be classified into two groups based on conversion technique.

1. One technique involves comparing a given analog signal with the internally generated equivalent signal. This group includes Successive approximation Register, counter and flash type converters. It is used for data loggers and instrumentation

2. The second technique involves changing an analog signal into time or frequency and comparing these new parameters to known values. This group includes Integrator and Voltage to Frequency Converters. It is used in digital meters, panel meters and monitoring system.

2.4.1 Successive Approximation A/D converter

This is the most popular method of analog to digital conversion. It has an excellent compromise between accuracy and speed. An unknown voltage V_{in} is compared with a fraction of reference voltage, V_r. For n-bit digital output comparison is made many times with different fractions of V_r and the value of a particular bit is set to 1, if V_{in} is greater than the set fraction of Vr. It includes three major elements:

1. The D/A converter
2. The Successive Approximation Register
3. The comparator.

2.4.2 Signal conversion

The output signal from the humidity and temperature sensors is in analog form and the data can be fed to the microcontroller only in digital form so an analog to digital converter is to be used. The 8-bit A/D converter ADC 0809 uses successive approximation as the conversion technique. The ADC0809 data acquisition has a component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8- Channel multiplexed and microprocessor compatible control logic. The converter features a high impedance chopper stabilized comparator, a 25R voltage divider with analog switch tree and a successive approximation register. The 8 -Channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full -scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexed address inputs and latched TTL TRI-STATE outputs. Incorporating the most desirable aspects of several A/D conversion Techniques has optimized the design of the ADC0809. The ADC0808, ADC0809 offers high-speed .High accuracy, minimal temperature dependence, excellent long-term accuracy And repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications.

2.4.3 Key specifications of ADC0808

1. Easy interface to all microprocessors and microcontrollers.
2. Resolution: 8 Bits.
3. Operates ratio metrically or with 5 VDC or analog span.
4. No zero or full scale adjusts required.
5. 8-channel multiplexer with address logic
6. Total Unadjusted Error = ½ LSB.

7. Single supply 5 VDC
8. Low Power 15m W, conversion time 100ns

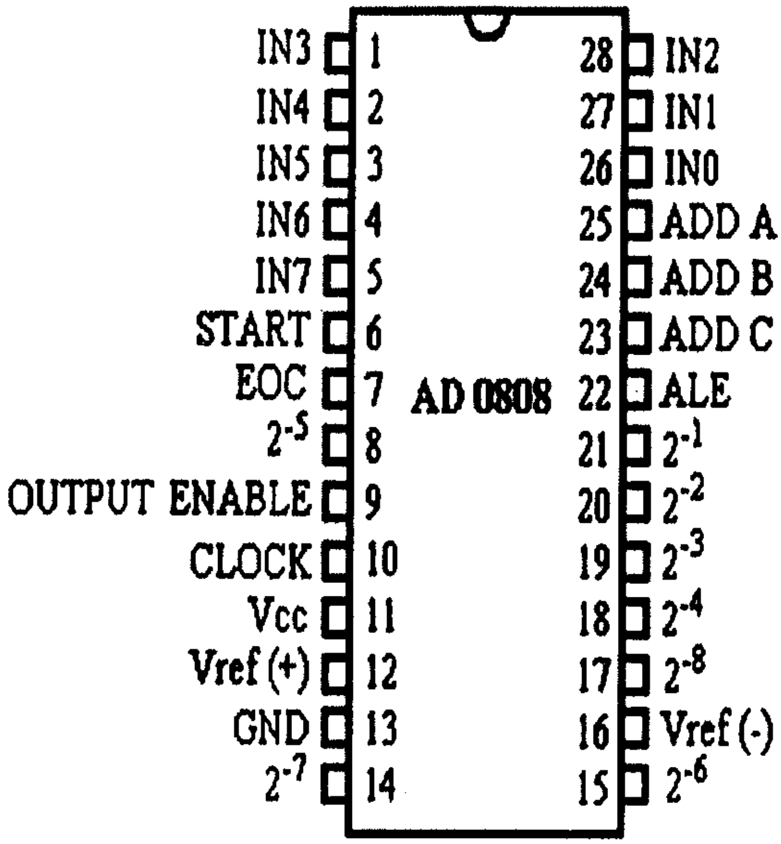


Fig 10: Pin Diagram of ADC Convertor

2.4.4 Pin Description

The 8-channel multiplexer can be controlled by a microcontroller through a 3-bit address decoder with address load to select any one of eight single-ended analog switches connected directly to the comparator. Channel 0 of the multiplexer has been selected permanently by grounding the address pins of multiplexer in the electronics hardware i.e. Pin no. 23, Pin no. 24 and Pin no. 25. The comparison and the converting methods used eliminate the possibility of missing codes, non-monotonicity, and the need for zero or full-scale adjustment. Also featured are latched 3-state outputs from the SAR and latched inputs to the multiplexer address decoder. The single 5V supply and low power requirements make the ADC 0808 especially useful for a wide variety of applications. Ratio metric conversion is made possible by access to the reference voltage input terminals. The ADC 0809 are characterized for operation from - 40 ^{0}C to 85 ^{0}C. The ADC 0809/0808 contains a network with 256-300□ **resistors in series. Analog switch taps are made at the** junction of each resistor and at each end of the network. In operation, are ference of 5V is applied across the network of 256 resistors. An analog input V_{IN} is first compared to the centre point of the ladder via the appropriate switch. If V_{IN} is larger than V_{REF} / 2, the internal logic changes the switch points and now compares V_{IN} and ¾ V_{REF}.

This process, known as successive approximation, continues until the best match of V_{IN} and V_{REF} is made. N defines a specific tap of the resistor network. When the conversion is complete, the logic loads a binary word corresponding to this tap into the output latch and an end of conversion(EOC) logic level appears. The output latch holds this data valid until a new conversion is completed and new data is loaded into the latches.

The data transfer occurs in about 100ns so that valid data is present virtually all the time in the latches. The data outputs are activated when the output enable is high, and in TRI-STATE when output enable is low. The enable delay time is approximately 100ns.each conversion requires 40 clock periods. The device may be operated in the free running mode by connecting the start conversion line to the end of conversion line. However, to ensure start-up under all possible conditions, an external start conversion pulse is required during power up conditions.

The EOC line (pin 7) will be in the low state for a maximum of 40 clock periods to indicate "busy". A START pulse that occurs while the A/D is BUSY will reset the SAR and start a new conversion with the EOC signal remaining in the low state until the end of this new conversion. When the conversion is complete, the EOC line will go to the high Voltage State. An additional 4-clock period must be allowed to elapse after EOC goes high, before a new conversion cycle is requested. Start conversion pulses that occurs during this last 4 clock period interval may be ignored. This is a problem only for high conversion rates and keeping the number of conversions per second less than f_{CLOCK}/44 automatically guarantees proper operation. The transfer of new digital data to the output is initiated when EOC goes to the high Voltage State. The reference applied across the 256 networks determines the analog input range. A reference voltage of 5V is applied to the pin number 12 of the ADC 0808. Since the conversion completes with in 256 steps. By using V_{REF} = 5V, each step have voltage of 20mv as 5 / 256 = 20mv.The pin numbers 1, 2, 3, 4, 5, 26, 27, 28 of the ADC 0808 describes the 8 multiplexer channels. Any channel can be selected by using three address bits ADDA (pin 25), ADDB (pin 24), ADDC (pin 23). In the hardware channel (INO) pin number 26 is selected permanently by grounding ADDA, ADDB, ADDC.

The 8-bit digital output we are getting at the pin numbers 21, 20, 19, 18, 8,15, 14, 17 of ADC 0808 are connected to port 2 of the 8051 microcontroller. Pin10 of ADC 0809 is for CLK input. Since ADC 0808 have clock between 50 KHz to 800 KHz. A reference of 5V is provided at pin12 of ADC 0809. Pin number 16 is grounded. Pin 22 (ALE) and pin 6(Start) are connected to port 3 pin P3.2 of the microcontroller.

2.5 ACCELEROMETER

Accelerometer sensor can measure static (earth gravity) or dynamic acceleration in all three axes. Application of the sensor in various fields and many applications can be developed using this sensor. Accelerometer sensor measures level of acceleration where it is mounted this enable us to measure acceleration/deceleration of object like car or robot, or tilt of a platform with respected to earth axis, or vibration produced by machines. Sensor provides 0G output which detect linear free fall. Sensitivity can be adjusted in two ranges. Acceleration is a vector force which has direction and measured in meters per Second Square. Earth produces gravitational acceleration on all objects on earth. By monitoring the three axis acceleration one can measure the level of tilt of any platform.

2.5.1 Features

1. Simple to use
2. Analog output for each axis
3. +5V operation @1mA current
4. High Sensitivity (800mV/g @ 1.5g)
5. Selectable Sensitivity (+- 1.5g, +- 6g)
6. 0g detect for free fall detection
7. Robust design, high shock survivability
8. Low Cost

2.5.2 Applications

1. 3D Gaming: Tilt and Motion Sensing, Event Recorder
2. HDD MP3 Player: Freefall Detection
3. Laptop PC: Freefall Detection, Anti-Theft
4. Cell Phone: Image Stability, Text Scroll, Motion Dialling, E-Compass
5. Pedometer: Motion Sensing / PDA: Text Scroll
6. Navigation and Dead Reckoning: E-Compass Tilt Compensation
7. Robotics: Motion Sensing

2.5.3 Interfacing to Microcontroller Unit:

Just need to give supply (+5v and Gnd) to the sensor and it starts. And then gives analog signals from pin X, Y and Z corresponds to its orientation with respect to Earth.

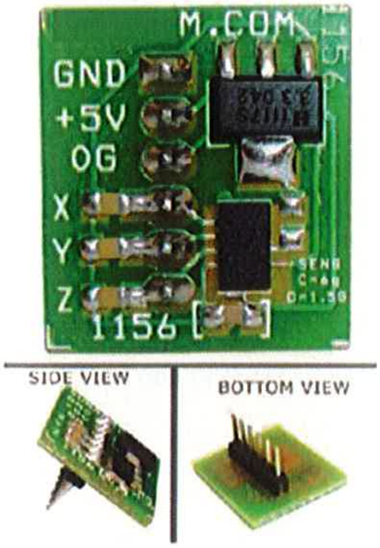


Fig 11: Accelerometer Sensor

2.6 MAX232

2.6.1 TTL to RS232 Line-Driver Module (MAX232)

Some devices like PC, GSM Modem, and GPS Modem works on RS232 voltage standards which are not compatible with MCU's TTL voltage standards. So MAX232 has to be used to make their communication compatible to each other.

2.6.2 RS232 Voltage Standards:

The RS-232 standard defines the voltage levels that correspond to logical one and logical zero levels for the data transmission and the control signal lines. Valid signals are plus or minus 3 to 15 volts; the ±3 V range near zero volts is not a valid RS-232 level. The standard specifies a maximum open-circuit voltage of 25 volts: signal levels of ±5 V, ±10 V, ±12 V, and ±15 V are all commonly seen depending on the power supplies available within a device. RS-232 drivers and receivers must be able to withstand indefinite short circuit to ground or to any voltage level up to ±25 volts.

For data transmission lines (TxD , RxD and their secondary channel equivalents) logic one is defined as a negative voltage, the signal condition is called marking, and has the functional significance. Logic zero is positive and the signal condition is termed spacing. Control signals are logically inverted with respect to what one sees on the data transmission lines. When one of these signals is active, the voltage on the line will be between +3 to+15 volts. The inactive state for these signals is the opposite voltage condition, between −3 and −15 volts. Examples of control lines include request to send (RTS), clear to send (CTS), data terminal ready (DTR), and data set ready (DSR).

Because the voltage levels are higher than logic levels typically used by integrated circuits, special intervening driver circuits are required to translate logic levels. These also protect the device's internal circuitry from short. Circuits or transients that may appear on the RS-232 interface, and provide sufficient current to comply with the slew rate requirements for data transmission.

2.6.3 Max232

This chip is used when interfacing micro controller with PC to check the Baud rate and changes the voltage level because micro controller is TTL compatible whereas PC is CMOS compatible. The MAX 232 IC contains the necessary drivers {two} and receivers {two}, to adapt the RS- 232 signal voltage levels to TTL logic. It became popular, because it just needs one voltage {+5V} and generates the necessary RS-232 voltage levels {approx -10V AND +10V} internally. This greatly simplified the design of circuitry. And this made the IC so popular.MAX232 is just a driver/receiver. It does not generate the necessary RS-232 sequence of marks and spaces with the right timing, it does not decode RS-232 signal, it does not provide a serial /parallel conversion. All it does is to convert signal voltage levels.

2.6.4 General Description

The MAX220-MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available. These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than 5μW.

2.6.5 Applications

1. Portable Computers
2. Low-Power modems
3. Interface Translation
4. Battery-Powered RS-232 Systems
5. Multi-drop RS-232 Networks

2.6.6 Features

1. Superior to bipolar
2. Low-power receive mode in shutdown
3. Meet all EIA/TIA-232E and v.28 specifications.
4. 3-state driver and receiver output.

The MAX220-MAX249 contain four sections: dual charge-pump DC-DC voltage converters, RS-232 drivers, RS-232 receivers, and receiver and transmitter enable control inputs.MAX245-MAX247, where these pins are not available. V+ and V- are not regulated, so the output voltage drops with increasing load current. Do not load V+ and V- to a point that violates the minimum ±5V EIA/TIA-232E driver output voltage when sourcing current from V+ and V- to external circuitry. When using the shutdown feature in the MAX222, MAX225, MAX230, MAX235, MAX236, MAX240, MAX241, and MAX24 -MAX249, avoid using V+ and V to power external circuitry. When these parts are shut down, V- falls to 0V, and V+ falls to +5V. For applications where a +10V external supply is applied to the V+ pin (instead of using the internal charge pump to generate +10V), the C1 capacitor must not be installed and the SHDN pin must be tied to VCC. This is because V+ is internally connected to VCC in shutdown mode.

2.6.7 RS-232 Drivers

The typical driver output voltage swing is ±8V when loaded with a nominal 5kΩ RS-232 receiver and VCC = +5V. Output swing is guaranteed to meet the EIA/TIA-232E and V.28 specification, which calls for ±5V minimum driver output levels under worst-case conditions. These include a minimum 3kΩ load, VCC = +4.5V, and maximum operating temperature. Unloaded driver output voltage ranges from (V+ -1.3V) to (V-+0.5V). Input thresholds are both TTL and CMOS compatible. The inputs of unused drivers can be left unconnected since 400kΩ input pull-up resistors to VCC are built in (except for the MAX220). The pull-up resistors force the outputs of unused drivers low because all drivers invert. The internal input pull-up resistors typically source 12μA, except in shutdown mode where the pull-ups are disabled. Driver outputs turn off and enter a high-impedance state— where leakage current is typically microamperes (maximum 25μA)—when in shutdown mode, or when in three-state mode, device power is removed.

Outputs can be driven to ±15V. The power supply current typically drops to 8μA in shutdown mode.

The MAX220 does not have pull-up resistors to force the outputs of the unused drivers low. Connect unused inputs to GND or VCC. The MAX239 has a receiver free-state control line, and the MAX223,MAX225,MAX235, MAX236, MAX240, and MAX241 have both a receiver three-state control line and a low-power shutdown control. The receiver TTL/CMOS outputs are in a high-impedance, three-state mode whenever the three-state enable line is high(for theMAX225/MAX235/MAX236/MAX239-MAX241), and are also high-impedance whenever the shutdown control line is high. When in low-power shutdown mode, the driver outputs are turned off and their leakage current is less than 1μA with the driver output pulled to ground. The driver output leakage remains less than 1μA, even if the transmitter output is back driven between 0V and (VCC + 6V). Below -0.5V, the transmitter is diode clamped to ground with 1kΩ series impedance. The transmitter is also zener clamped to approximately VCC + 6V, with a series impedance of 1kΩ. The driver output slew rate is limited to less than 30V/μs as required by the EIA/TIA-232E and V.28 specifications. Typical slew rates are 24V/μs unloaded and 10V/μs loaded with 3Ω and 2500pF.

2.6.8. RS-232 Receivers

EIA/TIA-232E and V.28 specifications define a voltage level greater than3V as logic 0, so all receivers invert. Input thresholds are set at 0.8V and 2.4V, so receivers respond to TTL level inputs as well as EIA/TIA-232E and V.28 levels. The receiver inputs withstand an input over voltage up to ±25V and provide input terminating resistors with nominal 5kΩ values. The receivers implement Type 1 interpretation of the fault conditions of V.28 and EIA/TIA-232E. The receiver input hysteresis is typically 0.5V with a guaranteed minimum of 0.2V. This produces clear output transitions with slow-moving input signals, even with moderate amounts of noise and ringing. The receiver propagation delay is typically 600ns and is independent of input swing direction.

2.7 RF Transmitter Receiver

Radio frequency (**RF**) is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals.

2.7.1. Special Properties of RF Current

Electric currents that oscillate at radio frequencies have special properties not shared by direct current or alternating current of lower frequencies. The energy in an RF current can radiate off a conductor into space as electromagnetic waves (radio waves); this is the basis of radio technology. RF current does not penetrate deeply into electrical conductors but flows along their surfaces; this is known as the skin effect. For this reason, when the human body comes in contact with high power RF currents it can cause superficial but serious burns called RF burns. RF current can easily ionize air, creating a conductive path through it. This property is exploited by "high frequency" units used in electric arc welding, which use currents at higher frequencies than power distribution uses. Another property is the ability to appear to flow through paths that contain insulating material, like the dielectric insulator of a capacitor. When conducted by an ordinary electric cable, RF current has a tendency to reflect from discontinuities in the cable such as connectors and travel back down the cable toward the source, causing a condition called standing waves, so RF current must be carried by specialized types of cable called transmission line.

2.7.2 Radio Communication

In order to receive radio signals an antenna must be used. However, since the antenna will pick up thousands of radio signals at a time, a radio tuner is necessary to tune in to a particular frequency (or frequency range). This is typically done via a resonator – in its simplest form, a circuit with a capacitor and an inductor forming a tuned circuit. The resonator amplifies oscillations within a particular frequency band, while reducing oscillations at other frequencies outside the band.

2.7.2.1 RF Transmitter

In electronics and telecommunications a **transmitter** or **radio transmitter** is an electronic device which, with the aid of an antenna, produces radio waves. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves. In addition to their use in broadcasting, transmitters are necessary component parts of many electronic devices that communicate by radio, such as cell phones, wireless computer networks, Bluetooth enabled devices, garage door openers, two-way radios in aircraft, ships, and spacecraft, radar sets, and navigational beacons. The term transmitter is usually limited to equipment that generates radio waves for communication purposes; or radiolocation, such as radar and navigational transmitters. Generators of radio waves for heating or industrial purposes, such as microwave ovens or diathermy equipment, are not usually called transmitters even though they often have similar circuits.

The term is popularly used more specifically to refer to a broadcast transmitter, a transmitter used in broadcasting, as in FM radio transmitter or television transmitter. This usage usually includes the transmitter proper, the antenna, and often the building it is housed in.

An unrelated use of the term is in industrial process control, where a "transmitter" is a telemetry device which converts measurements from a sensor into a signal, and sends it, usually via wires, to be received by some display or control device located a distance away.

2.7.2.2 Radio Receiver

A **tuned radio frequency receiver** (TRF receiver) is a radio receiver that is usually composed of several tuned radio frequency amplifiers followed by circuits to detect and amplify the audio signal. Prevalent in the early 20th century, it can be difficult to operate because each stage must be individually tuned to the station's frequency. It was replaced by the Super-heterodyne receiver invented by Edwin Armstrong.

2.7.2.3 Transceiver

A **transceiver** is a device comprising both a transmitter and a receiver which are combined and share common circuitry or a single housing. When no circuitry is common between transmit and receive functions, the device is a transmitter-receiver. The term originated in the early 1920s. Technically, transceivers must combine a significant amount of the transmitter and receiver handling circuitry. Similar devices include transponders, transverses, and repeaters.

In radio terminology, a transceiver means a unit which contains both a receiver and a transmitter. From the beginning days of radio the receiver and transmitter were separate units and remained so until around 1920. Amateur radio or "ham" radio operators can build their own equipment and it is now easier to design and build a simple unit containing both of the functions: transmitting and receiving. Almost every modern amateur radio equipment is now a transceiver but there is an active market for pure radio receivers, mainly for shortwave listening (SWL) operators. An example of a transceiver would be a walkie-talkie, or a CB radio.

2.7.2.4 ST1197 – Serial Interface IC for RF Transceiver based on CC1100/CC2500

ST1197 Serial Interface IC supports any RF based modules/transceiver which is based on Texas Instrument's Chip on ICs like CC1100 (433 Mhz) and CC2500 (2.4 GHZ). It provides a simple UART interface for transmission and reception of serial data at 9600 bps. It can be used for applications that need two way wireless data transmission. The communication protocol is self controlled and completely transparent to user interface. The IC can be embedded to your current design so that wireless communication can be set up easily.

2.7.3 Features

1. Automatic switching between TX and RX mode with LED indication.
2. Adjustable baud rate setting of 9600, 4800, 38400 and 19200
3. Channel can be set to operating multiple pairs in same area
4. FSK technology, half duplex mode, robust interference.
5. Protocol translation is self controlled, easy to use.
6. High sensitivity, long transmission range.
7. Standard UART interface, TTL (3-5V) logic level.
8. Very reliable, small size, easier mounting.
9. No tuning required, PLL based self tuned.
10. Error checking (CRC) to prevent corrupted data output at receiver

2.7.4 Application

1. Robotics
2. Sensor Networks
3. Wireless metering & Weather stations
4. Remote control/measurement system
5. Access control & Identity discrimination
6. Data collection, IT home appliance, Smart house products, Security Systems

2.7.5 Baud Rate Setting

BAUD1 and BAUD2 pins will be default HIGH if left unconnected. The pin status is read only during power up. Any changes to these pin during operation will have no effect.

BAUD1	BAUD2	Mode
HIGH	HIGH	9600 bps
LOW	HIGH	4800 bps
HIGH	LOW	38400 bps
LOW	LOW	19200 bps

Table 4: baud rate

2.7.6 Frequency Channel Setting

FREQ1 and FREQ2 pins will be default HIGH if left unconnected. The pin status is read only during power up. Any changes to these pin during operating will have no effect. Setting Frequency Channel can be used to have multiple sets operating at same time but without interfering with each other. The pair having same Channel setting will be able to communicate with each other. Frequency channel has to be set when unit is OFF, as the switches are read only during power up. Modifying during power up will have no effect on operation of module.

FREQ1	FREQ2	Mode
HIGH	HIGH	Channel #1
LOW	HIGH	Channel #2
HIGH	LOW	Channel #3
LOW	LOW	Channel #4

Table 5: Frequency Comparison

2.7.7 Working

This IC works in half-duplex mode. Means it can either transmit or receive but not both at same time. After each transmission, IC will be switched to receiver mode automatically. The LED for TX and RX indicates whether IC is currently receiving or transmitting data. The data sent is checked for CRC error if any. If chip is transmitting and any data is input to transmit, it will be kept in buffer for next transmission cycle. It has internal 64 bytes of buffer for incoming data.

When you power on the unit, the TX LED will briefly blink indicating that initialization is complete and it has detected Chip on based transceiver. If LED remains continuous on then the problem could be related to connection between IC and RF Module or RF module is faulty.

The RX LED is put directly on TX OUT pin to indicate that data is received and being output. All chip on ICs, CC1100 and CC2500 operating on 3V so the ST1197 also has to be operating on3V due to communication required at this level.

If you are interested in knowing RF related working details you can search for CC1100 and CC2500 in google. This will lead you to taxes instrument site with details of the ICs and lots of application notes.

Interfacing with RF Trans-receiver – 2.4 GHz, CC2500 based

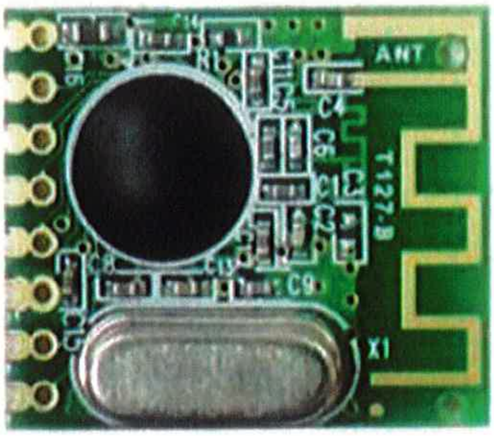


Fig12: RF Trans-receiver - 2.4 GHz – 30 meters Range Model 3478,

2.7.8 Antenna Onboard

In a typical system, this trans-receiver will be used together with a microcontroller. It provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake on radio. It can be used in 2400-2483.5 MHz ISM/SRD band systems. (eg. RKE-two way Remote Keyless Entry, wireless alarm and security systems, AMR-automatic Meter Reading, Consumer Electronics. Industrial monitoring and control, Wireless Game Controllers, Wireless Audio/Keyboard/Mouse)

2.7.8.1 Features

1. Low power consumption.
2. Integrated bit synchronizer.
3. Integrated IF and data filters.
4. High sensitivity (type -104dBm)
5. Programmable output power -20dBm~1dBm
6. Operation temperature range : -40~+85 deg C
7. Operation voltage: 1.8~3.6 Volts.
8. Available frequency at : 2.4~2.483 GHz
9. Digital RSSI

2.7.8.2 Applications

1. 2.4 GHz ISM/SRD band systems
2. Consumer Electronics
3. Industrial monitoring and control
4. Wireless alarm and security systems
5. Home and building automation
6. AMR – Automatic Meter Reading
7. RKE – Two-way Remote Keyless Entry
8. Wireless Game Controllers/Audio/Keyboard/Mouse

RF Module and ST1197 are working below at 3V level so a 3V regulator is required as shown below. The UART interface can be interfaced with either 3V or 5V logic level circuits since it has a 1K resistor (R8) in series to RXD

CHAPTER 3

MATLAB Code

Matlab is a programming environment as well as a high level, interpreted, dynamically typed language, supporting functional, object oriented, and event driven paradigms. It is well suited for numerical computation, particularly computations involving matrix operations and linear algebra. Matlab has excellent support for data visualization and its concise and expressive syntax, as well as the plethora of predefined functions, results in powerful environment excellent for rapid prototyping with minimal overhead. Yet, Matlab is not just a scripting language for quick and dirty calculations. Recent versions have seen a dramatic increase for the support of large scale highly structured code to rival C++, Java and the like. If you want the best of both worlds, Matlab's integrated java support lets you create and manipulate instances of java classes right in your Matlab programs. You can also call out to code written in C, C++, Perl, Fortran, or execute dos or unix system commands. Furthermore, Matlab code can be exported for use in Java, C, C++, and .Net programs, or as a standalone application, mitigating its primary disadvantage that it is not free.

As an interpreted language, some operations are slower than in a compiled language, particularly those involving loops. This too has improved in recent versions. In many cases, however, loops can be vectorized resulting in very quick code that invokes low level, highly optimized, compiled functions from the Matlab library. When the most computationally expensive parts of your program can be written this way, the speed of Matlab code rivals that of compiled languages.

Finally, with the addition of various toolkits, e.g. for Statistics, Bioinformatics, Optimization, or Image Processing, to name just a few, the Matlab environment can be extended for more specialized requirements.

3.1 CODE:

```
% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @main_final_OpeningFcn, ...
                   'gui_OutputFcn',  @main_final_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
   gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
   [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
   gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT
% --- Executes just before main_final is made visible.
function main_final_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to main_final (see VARARGIN)

% Choose default command line output for main_final
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes main_final wait for user response (see UIRESUME)
```

```
% uiwait(handles.figure1);

% --- Outputs from this function are returned to the command line.
function varargout = main_final_OutputFcn(hObject, eventdata, handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;


% --- Executes on button press in start.
function start_Callback(hObject, eventdata, handles)
% hObject    handle to start (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global s flag x1 y1
s = serial('COM1','BaudRate',9600,'DataBits',8 ,'Parity','none');
fopen(s);
flag=1;
flag1=1;
r=[];
t=[];
z=0;
i=1;
while(flag==1)

    out=fread(s,3) ;
    out=double(out);

     x=out(2);
```

```
y=out(3);

    if(x>=x1)
     t(i)=(x-x1)  ;

    else
     t(i)=(x1-x) ;
    end
  if(t(i)>4)
     set(handles.result,'string','Alert')
      set(handles.result2,'string','   ')
 else
     set(handles.result2,'string','Normal')
  end
  % z=(x1-x)-(y1-y);
   x=num2str(x);
    y=num2str(y);
   plot(t,':r*','Linewidth',2),ylim([-5 10])
hold on
pause(.5)

      z=num2str(t(i));
  set(handles.scale,'string',z)
   set(handles.x,'string',x)
    set(handles.y,'string',y)
    pause(.2)
    i=i+1;
end
  delete(s)
clear s

% --- Executes on button press in stop.
```

```
function stop_Callback(hObject, eventdata, handles)
% hObject    handle to stop (see GCBO)

% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global  flag
flag=0;
% --- Executes on button press in close.
function close_Callback(hObject, eventdata, handles)
% hObject    handle to close (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
clc
clear all
close all

% --- Executes on button press in ref.
function ref_Callback(hObject, eventdata, handles)
% hObject    handle to ref (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global x1 y1
s = serial('COM1','BaudRate',9600,'DataBits',8 ,'Parity','none');
fopen(s);
 out=fread(s,3) ;
 out=double(out);
   x1=out(2);
      y1=out(3);
       % x1=num2str(x1);
        % y1=num2str(y1);
          set(handles.x1,'string',num2str(x1))
     set(handles.y1,'string',num2str(y1))
      delete(s)
clear s
```

CHAPTER 4

EXPERIMENTAL RESULTS

Power Supply-Ac mains power supply of 220 V is stepped down to 10V by a transformer,the Bridge rectifier then converts it to Dc supply with ripples.A smoothing circuit consisting of 1000uF capacitor reduces it to very small ripples,it is then passed through a 7805 regulator to give a 5V DC to MCU.

Accelerometer:

The top and side view of the dynamic acceleration produced by the accelerometer.

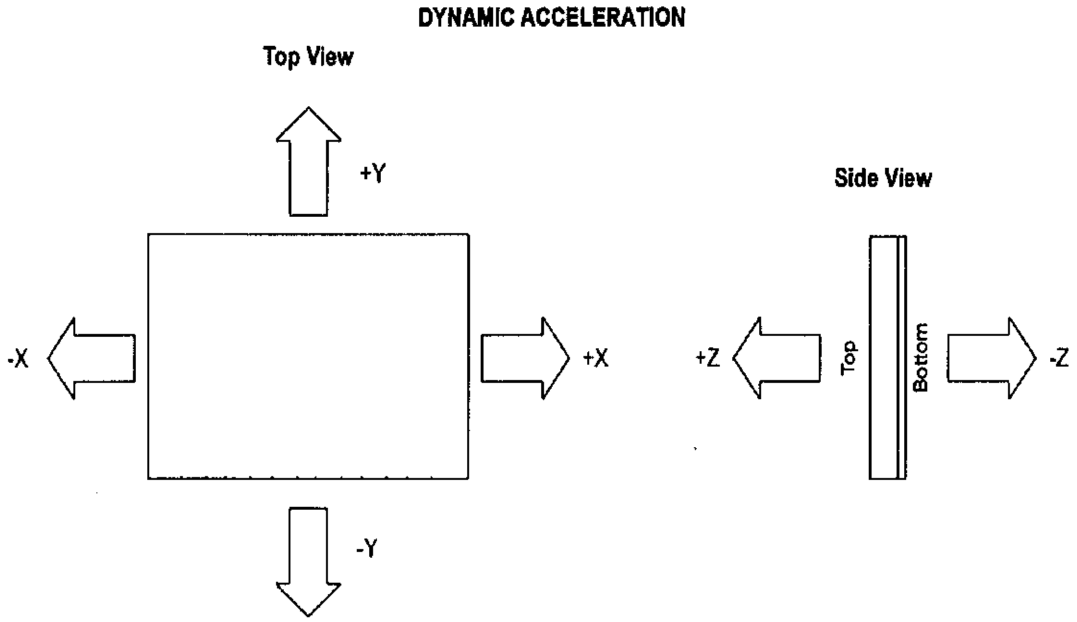
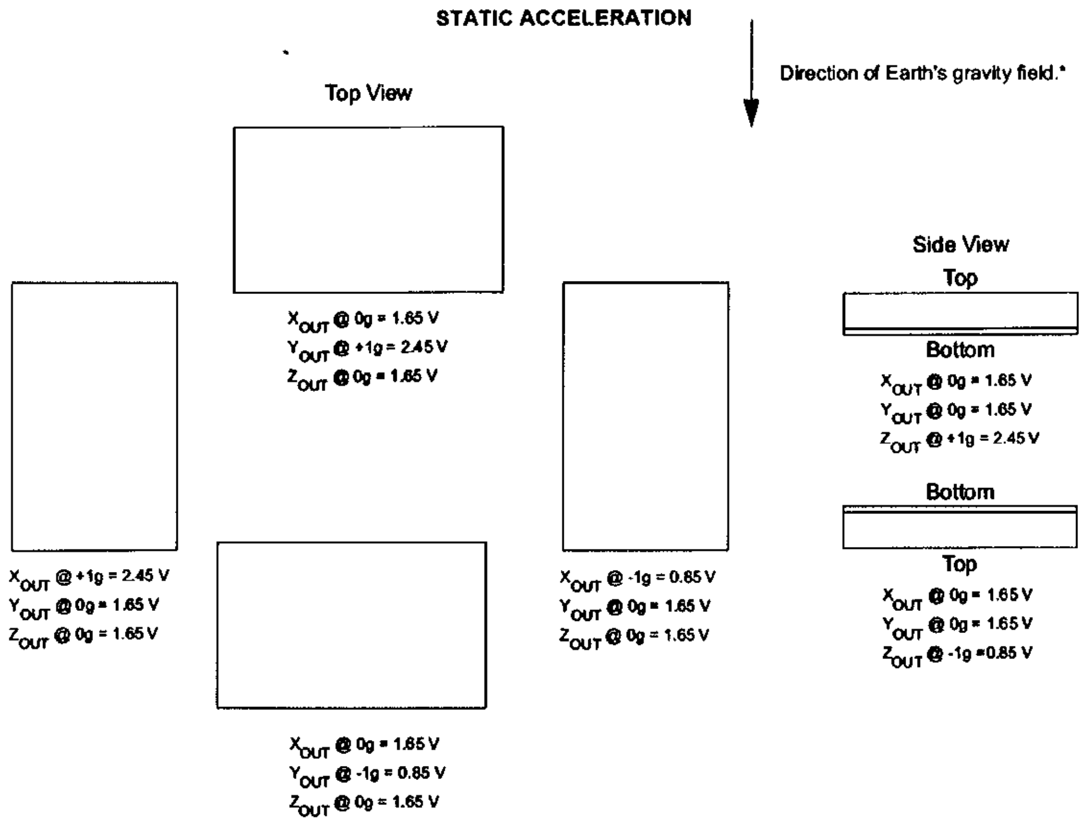


Fig 13: Top and side view of dynamic acceleration



* When positioned as shown, the Earth's gravity will result in a positive 1g output.

1.When accelerometer is still:

Ac power supply-220V

Dc power supply-5V

Threshold of accelerometer-800mV

X- axis= 103
Y- axis=103

Fig 14:LCD displaying voltage values when accelerometer is still

2.Motion 1 of accelerometer:

X-axis=051

Y-axis=075

Fig15 :LCD Display when in accelerometer in motion 1

3.Motion 2 of accelerometer:

X-axis=079

Y-axis=079

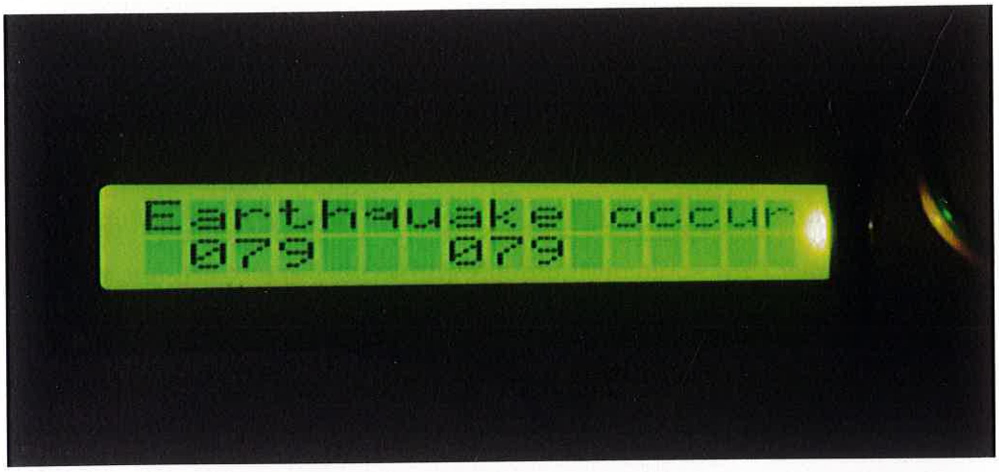


Fig 16: LCD Display when accelerometer in motion2

CHAPTER 5

CONCLUSION

Hence, we succeeded in making zigBee based earthquake sensing system prototype on a small scale. Thereby, bring forth the idea of sensing earth tremors in hard-to-reach areas where its hard to reach by wires and also brought forth the ZigBee technology use in this, which is not only cheaper than Bluetooth, its low power consumer and has a long battery life. ZigBee technology uses wire mesh topology unlike star topology in Bluetooth and hence, we proved that it's the best wireless technology when it comes to low data rate transmission. Future work-Our prototype can be employed on a large scale in various hard-to-reach areas with better, more sensitive accelerometers. Because of its low cost and power consumption, it can be deployed at large and hence, coverage would be more. In this ever growing world, where resources are becoming scarce, at present, this was our attempt to make our world a safer place.

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