COIN BASED WATER DISPENSER SYSTEM

PROJECT REPORT

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Submitted by

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In partial fulfill of the requirements for the project work

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BONAFIDE CERTIFICATE

Certified that this thesis titled "COIN BASED WATER DISPENSER SYSTEM" is the bonafide work of SABARISH MANIKANDAN .A (18410238),JASPER JEBARAJ .P (18410188), MANOJ .S (18410208), SUDHARSHANAM .k (18410260), & NAVEEN KUMAR .S (18410220) who carried out the work under my supervision.

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Submitted for the board of examination held on ________________

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I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future.

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PREFACE

We are thankful to the Director of Technical education for introduction the project work in the curriculum for final semester Mechatronics engineering. This Project helps us in importing our practical knowledge and creating power which will be very in our future.

We have gained much till by doing this project .We have also gained the necessary self-confidence to start a small –small industry on our own this project works also us in building better co-ordinate among the team members.

ABSTRACT:

Here we put forward a fully automated coin based water dispenser system using microcontroller and sensor. The system is capable of fully automated water (coin-based) dispensing using motors and sensors. The system also senses if glass is placed at the counter to avoid water spoilage if there is no glass placed at the counter panel. The system uses IR sensors to detect presence of glass and then the sensors send a signal to the microcontroller. The microcontroller now processes the information sent by the sensors to determine if glass is present. The system also has a coin detector that is used to sense particular coins and send information to the microcontroller about valid coins. On detecting a valid coin, the system now sends a signal to the controller which checks if glass is present and then it starts the motor to pour water in glass using motor as long the glass is present. If glass is removed during a process, system stops the water supply until glass is encountered. Thus, we here put forward a smart water dispenser system with water saving feature.

TABLE OF CONTENTS

CHAPTER 1

1.1. INTRODUCTION:

Coin based water dispenser system works with the help of microcontroller and sensor. This system is capable of fully automated water or cola dispensing using motors and sensors. This system also senses, if glass is not present the dispensing system could not operate. It is useful for spoilage or leakage of water. For presence of glass, IR sensor is used and it sends a signal to microcontroller. This system is with coin detector which is used to sense valid coins and the information is sent to microcontroller. The motor’s work is to pour water in glass. If glass is removed during the process, system stops the water supply until it is encountered. So here we put forward a smarter water dispenser system for the water saving and to avoid leakage of water.

1.2. WORKING OF POWER SUPPLY:

The power supply section consists of a transformer, a bridge circuit, a filter and a regulator. The step down transformer is used to convert 230v ac to 12v ac.

The bridge circuit converts ac to dc. The filter is used to remove the ripples in the supply. The regulator makes the supply voltage constant.

1.3. TRANSFORMER:

Usually, DC voltages are required to operate various electronic equipment and these voltages are 5V, 9V or 12V. But these voltages cannot be obtained directly. Thus the AC input available at the mains supply i.e. 230V is to be brought down to the required voltage level. This is done by a transformer. Thus, a step down transformer is employed to decrease the voltage to a required level.

Fig. 1.1

Fig. 1.1 shows the picture of a transformer.

1.4. RECTIFIER:

The output from the transformer is fed to the rectifier. It converts AC into pulsating DC signals. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification.

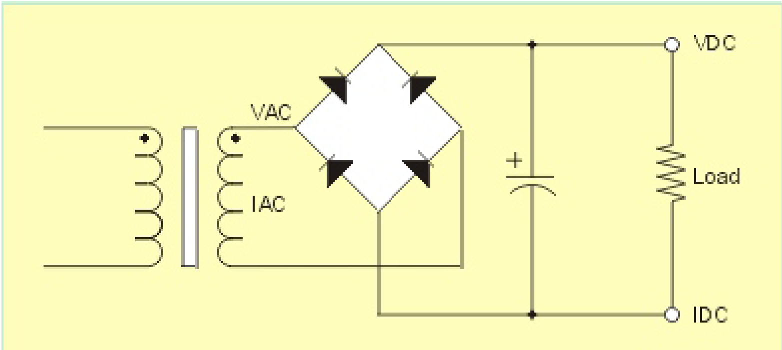


Fig 1.2

Fig. 1.2 shows the circuit diagram of a bridge rectifier.

The bridge rectifier is a circuit, which converts an AC voltage into DC voltage using both half cycles of the input AC voltage. The above given circuit has four diodes connected to form a bridge. The load resistance is connected between the other two ends of the bridge.

For the positive half cycle of the input AC voltage, diodes D1 and D3 conduct, whereas the diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L.

For the negative half cycle of the input AC voltage, diodes D2 and D4 conduct, whereas the diodes D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.

1.5. FILTER:

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and smoothens the DC output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, DC voltage received at this point changes. Therefore a regulator is applied at the output stage.

1.6. VOLTAGE REGULATOR:

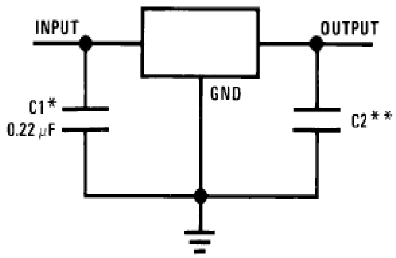


Fig. 1.3

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. Fig. 1.3 shows the circuit diagram of a voltage regulator.

The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3, D2PAK and DPAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. Fig. 1.4 shows the pin diagram of the IC7805 voltage regulator.

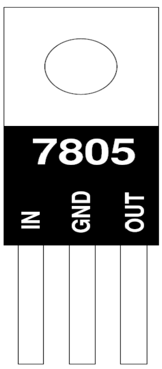


Fig 1.4

1.7. POWER SUPPLY:

A power supply provides a constant output regardless of voltage variations. “Fixed” three-terminal linear regulators are commonly available to generate fixed voltages of plus 3V, and plus or minus 5V, 9V, 12V or 15V when the load is less than about 7 amperes.

The “78xx” series (7805, 7812, etc.) regulate positive voltages while the “79xx” series (7905, 7912, etc.) regulate negative voltages. Often, the last two digits of the device number are the output voltage; e.g., a 7805 is a +5V regulator, while a 7915 is a -15V regulator. The 78xx series ICs can supply up to 1.5 Amperes depending on the model.

1.8. POWER SUPPLY - FEATURES:

1. Output Current up to 1A
2. Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24
3. Thermal Overload Protection
4. Short Circuit Protection
5. Output Transistor Safe Operating Area Protection

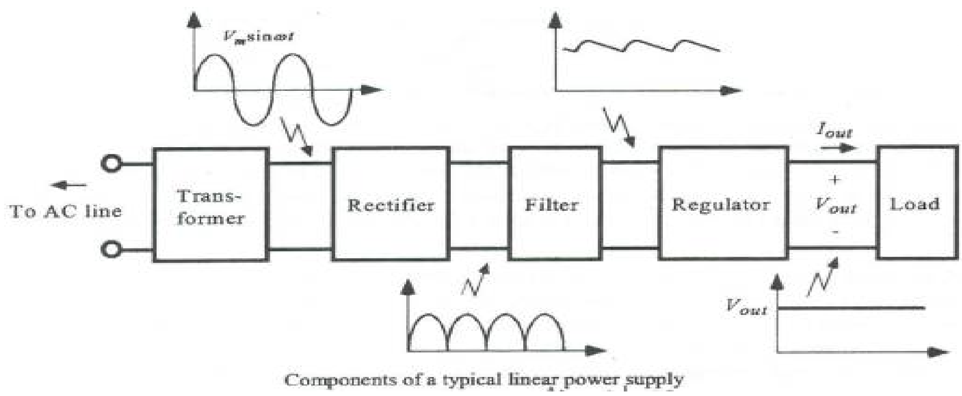


Fig. 1.5

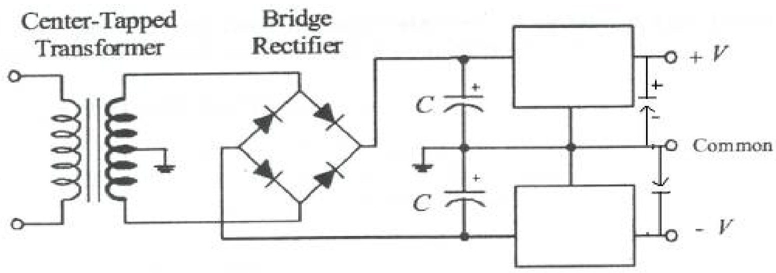


Fig. 1.6

Figures 1.5 and 1.6 show the power supply block diagram and circuit diagram, respectively.

1.9. SUMMARY OF CIRCUIT FEATURES:

Brief description of operation - Gives out well regulated +5V output, output current

capability of 100 mA

Circuit protection - Built-in overheating protection shuts down output

when regulator IC gets too hot

Circuit complexity - Very simple and easy to build

Circuit performance - Very stable +5V output voltage, reliable operation

Availability of components - Easy to get, uses only very common basic components

Design testing - Based on datasheet example circuit, I have used this

circuit succesfully as part of many electronics projects

Applications - Part of electronics devices, small laboratory power

supply

Power supply voltage - Unreglated DC 8-18V power supply

Power supply current - Needed output current + 5 mA

Component costs - Few dollars for the electronics components + the

input transformer cost

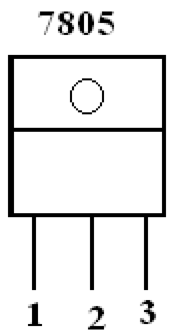


Fig. 1.7

Here, figure 1.7 shows the pin diagram of an IC 7805 voltage regulator.

1.9.1.PIN OUT OF THE 7805 REGULATOR IC.

1. Unregulated voltage in
2. Ground
3. Regulated voltage out

1.9.2. COMPONENT LIST

- 7805 regulator IC
- 1000 uF electrolytic capacitor, at least 25V voltage rating
- 10 uF electrolytic capacitor, at least 6V voltage rating
- 100 nF ceramic or polyester capacitor

CHAPTER 2

PIC MICROCONTROLLER

2.1. Introduction to Microcontrollers

Circumstances that we find ourselves in today in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits. These integrated circuits contained both processor and peripherals

2.2. Memory unit

Memory is part of the microcontroller whose function is to store data. For a certain input we get the contents of a certain addressed memory location and that's all. Two new concepts are brought to us: addressing and memory location. Memory consists of all memory locations, and addressing is nothing but selecting one of them. This means that we need to select the desired memory location on one hand, and on the other hand we need to wait for the contents of that location. Besides reading from a memory location, memory must also provide for writing onto it. This is done by supplying an additional line called control line. We will designate this line as R/W (read/write). Control line is used in the following way: if r/w=1, reading is done, and if opposite is true then writing is done on the memory location.

2.3. CENTRAL PROCESSING UNIT

Let us add 3 more memory locations to a specific block that will have a built in capability to multiply, divide, subtract, and move its contents from one memory location onto another. The part we just added in is called "central processing unit" (CPU). Its memory locations are called registers.

2.4. INPUT-OUTPUT UNIT

Those locations we've just added are called "ports". There are several types of ports: input, output or bidirectional ports. When working with ports, first of all it is necessary to choose which port we need to work with, and then to send data to, or take it from the port. When working with it the port acts like a memory location. Something is simply being written into or read from it, and it could be noticed on the pins of the microcontroller.

2.5. WATCHDOG

One more thing is requiring our attention is a flawless functioning of the microcontroller during its run-time. Here, figure 2.1 shows the block diagram of a watch dog timer.

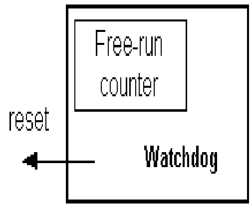


Fig. 2.1. Watch dog timer

2.6. MICROCONTROLLER WITH ITS BASIC ELEMENTS AND INTERNAL CONNECTIONS

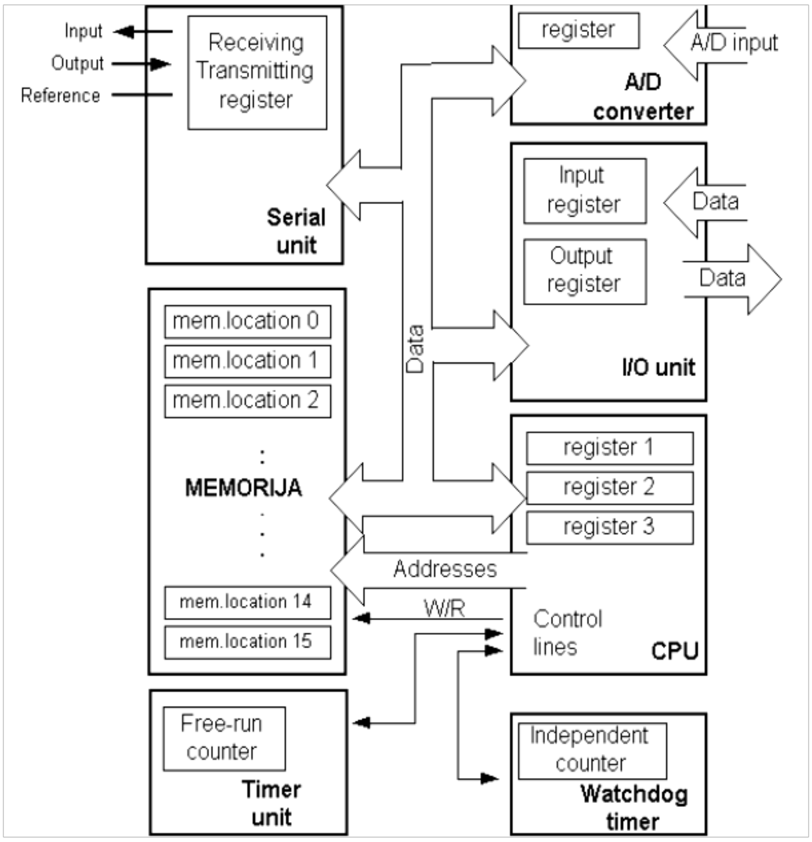


Fig. 2.2

Figure 2.2 shows us the block diagram of a micro controller with its basic elements and internal connections.

2.7. PIC Microcontroller (PIC16F87X) Microcontroller Core Features:

• High-performance RISC CPU
• Only 35 single word instructions

• All single cycle instructions except for program branches which are two cycle
• Operating speed: DC - 20 MHz clock input DC - 200 ns instruction cycle
• Up to 8K x 14 words of FLASH Program Memory,
Up to 368 x 8 bytes of Data Memory (RAM)
Up to 256 x 8 bytes of EEPROM data memory
• Interrupt capability (up to 14 sources)
• Eight level deep hardware stack
• Direct, indirect and relative addressing modes
• Power-on Reset (POR)
• Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
• Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
• Programmable code-protection
• Power saving SLEEP mode
• Selectable oscillator options
• Low-power, high-speed CMOS FLASH/EEPROM technology
• Fully static design
• In-Circuit Serial Programming (ICSP) via two pins
• Single 5V In-Circuit Serial Programming capability
• In-Circuit Debugging via two pins
• Processor read/write access to program memory
• Wide operating voltage range: 2.0V to 5.5V
• High Sink/Source Current: 25 mA
• Commercial and Industrial temperature ranges
• Low-power consumption:
- < 2 mA typical @ 5V, 4 MHz
- 20 mA typical @ 3V, 32 kHz
- < 1 mA typical standby current

2.8. PERIPHERAL FEATURES

• Timer0: 8-bit timer/counter with 8-bit prescaler
• Timer1: 16-bit timer/counter with prescaler, can be incremented during sleep via
external crystal/clock
• Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
• Two Capture, Compare, PWM modules
- Capture is 16-bit, max. resolution is 12.5 ns
- Compare is 16-bit, max. resolution is 200 ns
- PWM max. resolution is 10-bit
• 10-bit multi-channel Analog-to-Digital converter
• Synchronous Serial Port (SSP) with SPI (Master Mode) and I2C (Master/Slave)
• Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI)

with 9-bit address detection
• Parallel Slave Port (PSP) 8-bits wide, with external RD, WR and CS controls (40/44- pin only)

2.9. PIN LAYOUT OF PIC16F877A

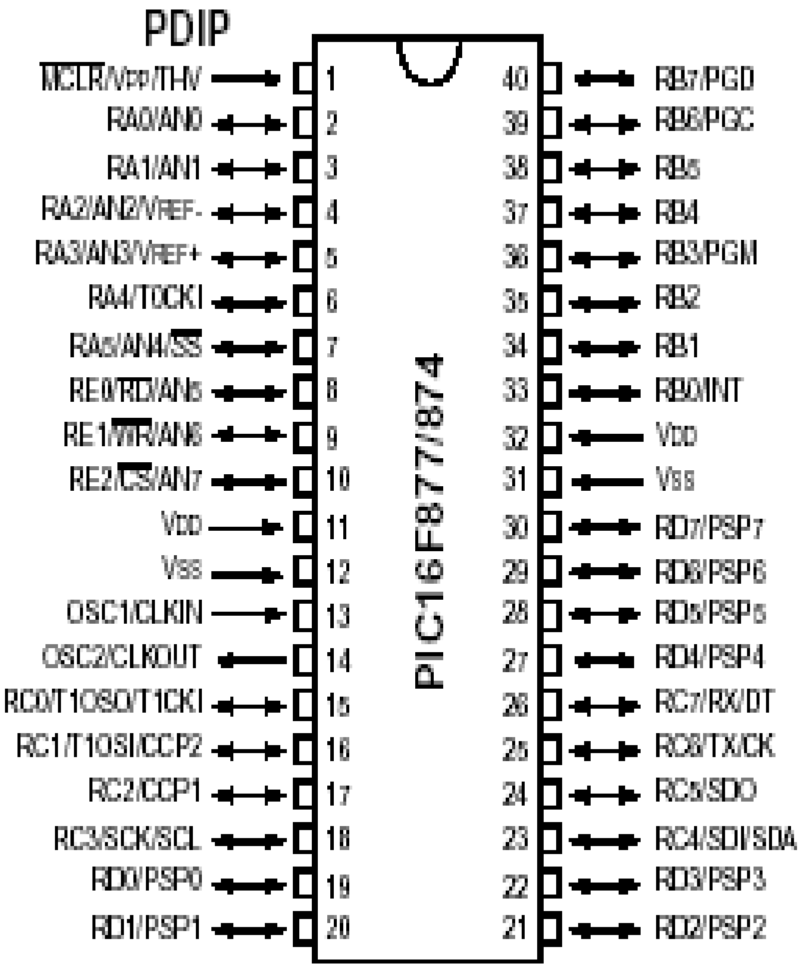
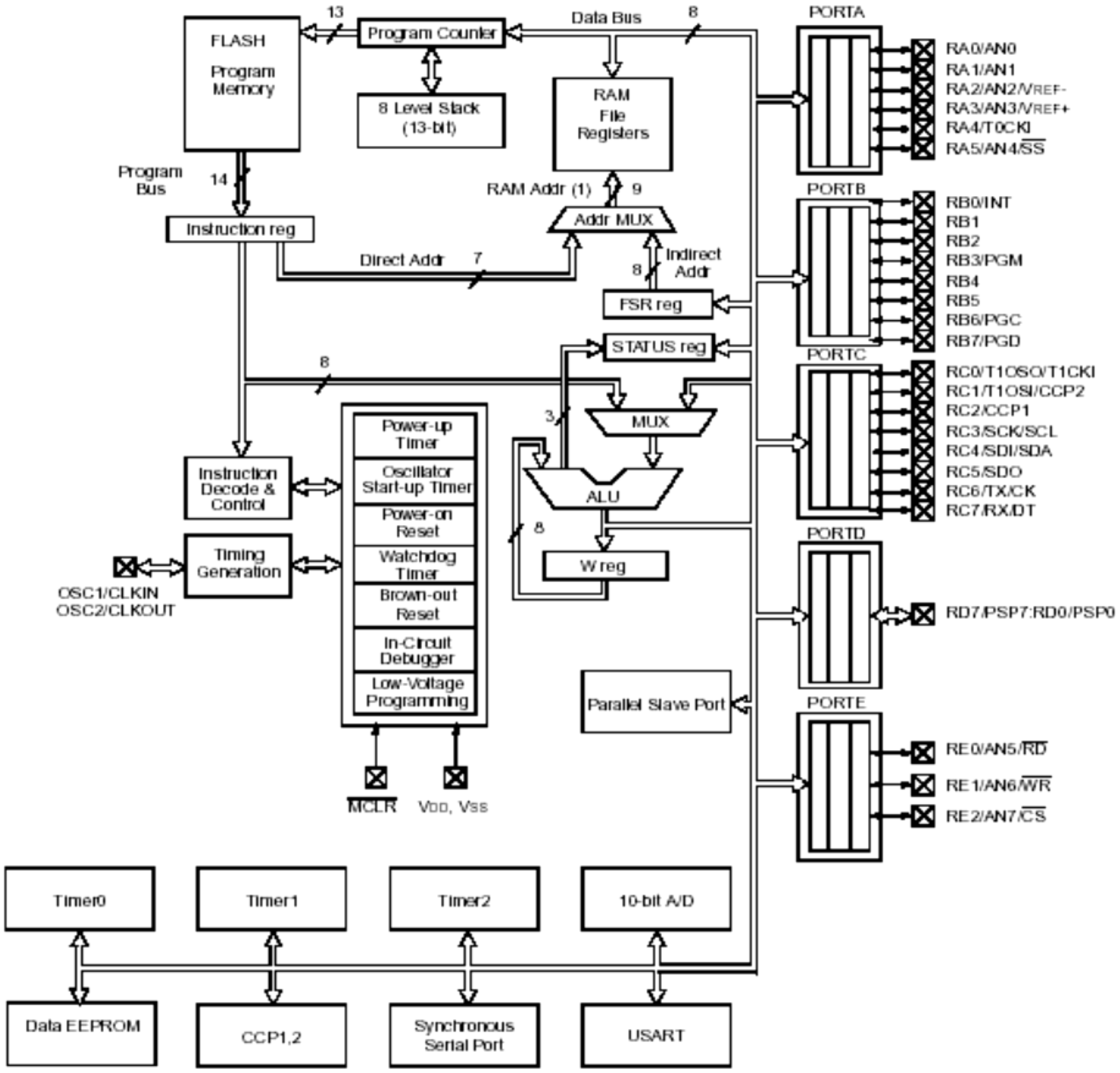


Fig. 2.3.

Here, figure 2.3. shows the pin layout diagram of PIC16F877A.

2.10. PIC 16F877A BLOCK DIAGRAM

Device	Program FLASH	Data Memory	Data EEPROM
PIC16F874	4K	192 Bytes	128 Bytes
PIC16F877	8K	368 Bytes	256 Bytes



Note 1: Higher order bits are from the STATUS register.

Fig. 2.4. Architecture of PIC16F877A

Here, the figure 2.4. clearly picturises the architecture of PIC16F877A

2.11. PROGRAM MEMORY ORGANIZATION

The PIC16F87X devices have a 13-bit program counter capable of addressing an 8K x 14 program memory space. The PIC16F877/876 devices have 8K x 14 words of FLASH program memory and the PIC16F873/874 devices have 4K x 14. Accessing a location above the physically implemented address will cause a wraparound. The reset vector is at 0000h and the interrupt vector is at 0004h. The below diagram, figure 2.5., shows us the block diagram of program memory and stack memory organization

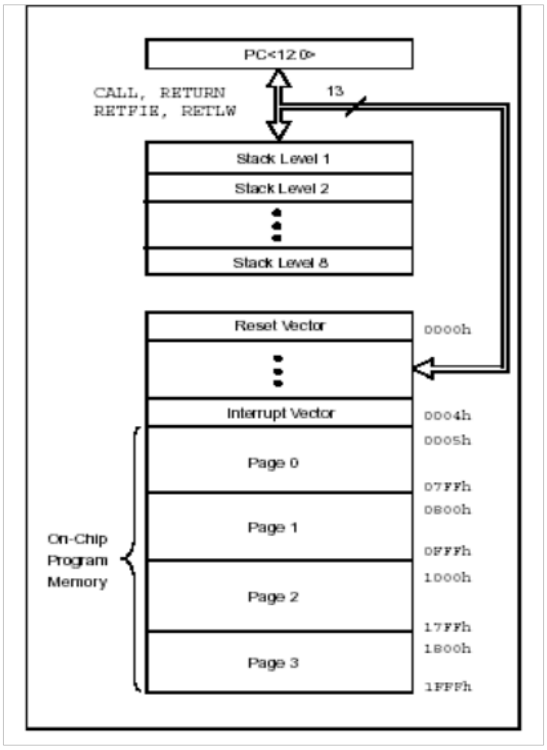


Fig. 2.5. Program memory and stack memory

2.12. DATA MEMORY ORGANIZATION

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the Special Function Registers. Bits RP1(STATUS<6>) and RP0 (STATUS<5>) are the bank select bits.

RP1:RP0	Bank
00	0
01	1
10	2
11	3

Table Register bank selection

Each bank extends up to 7Fh (128 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM.

2.13. GENERAL PURPOSE REGISTER FILE

The register file can be accessed either directly or indirectly through the File Select Register FSR.

2.14. SPECIAL FUNCTION REGISTERS

The Special Function Registers are registers used by the CPU and peripheral modules for controlling the desired operation of the device. These registers are implemented as static RAM. The Special Function Registers can be classified into two sets; core (CPU) and peripheral.

2.15. STATUS REGISTER

The STATUS register contains the arithmetic status of the ALU, the RESET status and the bank select bits for data memory. The STATUS register can be the destination for any instruction, as with any other register. If the STATUS register is the destination for an instruction that affects the Z, DC or C bits, then the write to these three bits is disabled. These bits are set or cleared according to the device logic. The TO and PD bits are not writable, therefore, the result of an instruction with the STATUS register as destination may be different than intended.

2.16. INTCON register

The INTCON Register is a readable and writable register, which contains various enable and flag bits for the TMR0 register overflow, RB Port change and External RB0/INT pin interrupts.

PIE1 register

The PIE1 register contains the individual enable bits for the peripheral interrupts.

PIR1 register

The PIR1 register contains the individual flag bits for the peripheral interrupts.

PIE2 register

The PIE2 register contains the individual enable bits for the CCP2 peripheral interrupt, the SSP bus collision interrupt, and the EEPROM write operation interrupt.

PIR2 register

The PIR2 register contains the flag bits for the CCP2 interrupt, the SSP bus collision interrupt and the EEPROM write operation interrupt.

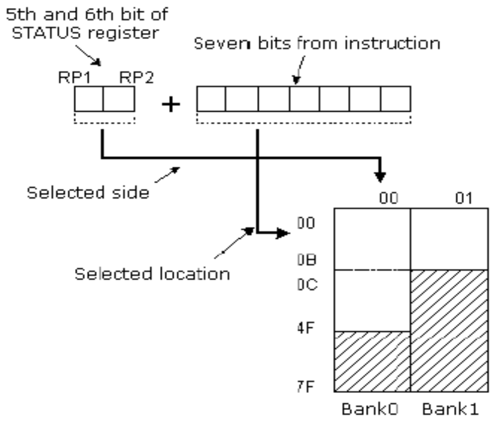
2.17. PCON register

The Power Control (PCON) Register contains flag bits to allow differentiation between a Power-on Reset (POR), a Brown-out Reset (BOR), a Watch-dog Reset (WDT) and an external MCLR Reset.

ADDRESSING MODES:

2.18. DIRECT ADDRESSING

Direct Addressing is done through a 9-bit address. This address is obtained by connecting 7th bit of direct address of an instruction with two bits (RP1, RP0) from STATUS register as is shown on the following picture. Any access to SFR registers can be an example of direct addressing.



Direct addressing

Figure 2.6

The figure 2.6 shows the block diagram of a direct addressing system/mode.

2.19. INDIRECT ADDRESSING

Indirect unlike direct addressing does not take an address from an instruction but makes it with the help of IRP bit of STATUS and FSR registers. Addressed location is accessed via INDF register which in fact holds the address indicated by a FSR. In other words, any instruction which uses INDF as its register in reality accesses data indicated by a FSR register. Let's say, for instance, that one general purpose register (GPR) at address 0Fh contains a value of 20. By writing a value of 0Fh in FSR register we will get a register indicator at address 0Fh, and by reading from INDF register, we will get a value of 20, which means that we have read from the first register its value without accessing it directly (but via FSR and INDF). It appears that this type of addressing does not have any advantages over direct addressing, but certain needs do exist during programming which can be solved smoothly only through indirect addressing.

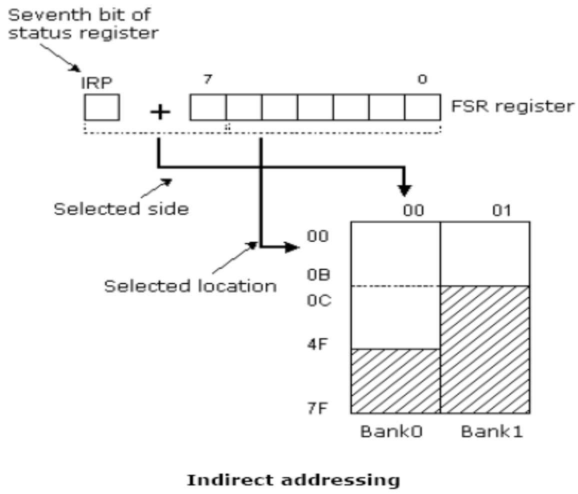


Fig. 2.7

The figure 2.7 shows the block diagram of an indirect addressing system/mode.

2.20. I/O Ports

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

2.21. DATA EEPROM AND FLASH PROGRAM MEMORY

The Data EEPROM and FLASH Program Memory are readable and writable during normal operation over the entire VDD range. The data memory is not directly mapped in the register file space. Instead it is indirectly addressed through the Special Function Registers (SFR). There are six SFRs used to read and write the program and data EEPROM memory.

These registers are: EECON1, EECON2, EEDATA, EEDATH, EEADR and

EEADRH. The EEPROM data memory allows byte read and writes. When interfacing to the data memory block, EEDATA holds the 8-bit data for read/write and EEADR holds the address of the EEPROM location being accessed. The registers EEDATH and EEADRH are not used for data EEPROM access. These devices have up to 256 bytes of data EEPROM with an address range from 0h to FFh.

2.22. TIMER0 MODULE

The Timer0 module timer/counter has the following features:
• 8-bit timer/counter
• Readable and writable
• 8-bit software programmable prescaler
• Internal or external clock select
• Interrupt on overflow from FFh to 00h
• Edge select for external clock

2.22.1. TIMER0 INTERRUPT

The TMR0 interrupt is generated when the TMR0 register overflows from FFh to 00h. This overflow sets bit T0IF (INTCON<2>). The interrupt can be masked by clearing bit T0IE (INTCON<5>). Bit T0IF must be cleared in software by the Timer0 module interrupt service routine before re-enabling this interrupt. The TMR0 interrupt cannot awaken the processor from SLEEP since the timer is shut off during SLEEP.

2.22.2. PRESCALER

A prescaler assignment for the Timer0 module means that there is no prescaler for the watchdog timer, and vice-versa. The PSA and PS2:PS0 bits (OPTION_REG<3:0>) determine the prescaler assignment and prescale ratio. When assigned to the Timer0 module, all instructions writing to the TMR0 register (e.g. CLRF 1, MOVWF 1, BSF 1,x....etc.) will clear the prescaler. When assigned to WDT, a CLRWDT instruction will clear the prescaler along with the Watchdog Timer. The prescaler is not readable or writable. The below diagram figure 2.8 shows us the block diagram of the TIMER0/WDT prescaler.

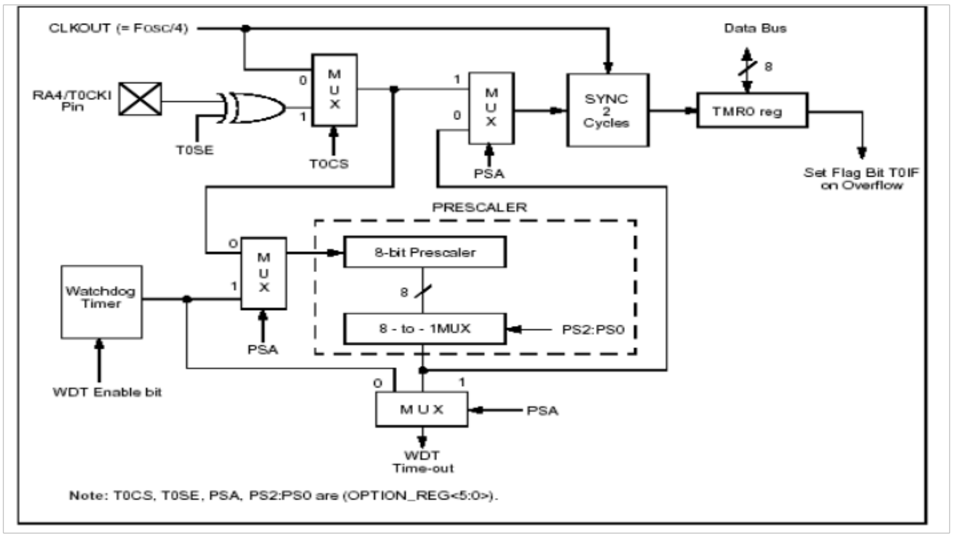


Fig. 2.8. Block diagram of the TIMER0/WDT Prescaler

2.23. TIMER1 MODULE

The Timer1 module is a 16-bit timer/counter consisting of two 8-bit registers (TMR1H and TMR1L), which are readable and writable. The TMR1 Register pair (TMR1H:TMR1L) increments from 0000h to FFFFh and rolls over to 0000h. The TMR1 Interrupt, if enabled, is generated on overflow, which is latched in interrupt flag bit TMR1IF (PIR1<0>). This interrupt can be enabled/disabled by setting/clearing TMR1 interrupt enable bit TMR1IE (PIE1<0>).Timer1 can operate in one of two modes 1) As a timer, 2) As a counter.

The operating mode is determined by the clock select bit, TMR1CS (T1CON<1>). In timer mode, Timer1 increments every instruction cycle. In counter mode, it increments on every rising edge of the external clock input. Timer1 can be enabled/disabled by setting/clearing control bit TMR1ON (T1CON<0>).

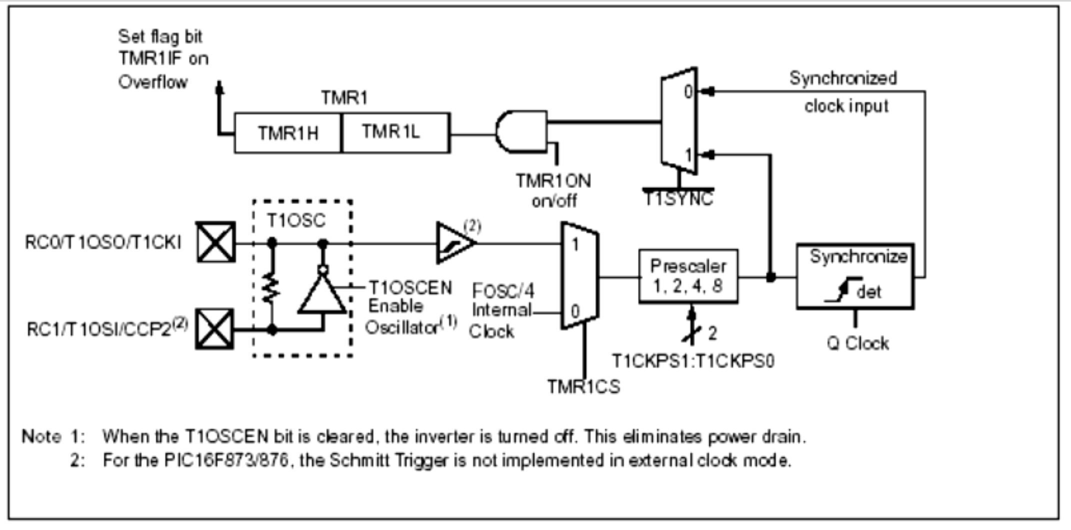


Fig. 2.9

The figure 2.9 shows us the Block diagram of TIMER1

2.24. TIMER2 MODULE

Timer2 is an 8-bit timer with a prescaler and a postscaler. It can be used as the PWM time base for the PWM mode of the CCP module(s). The TMR2 register is readable and writable and is cleared on any device Reset.

2.24.1. SPI Mode

The SPI mode allows 8 bits of data to be synchronously transmitted and received simultaneously. All four modes of SPI are supported. To accomplish communication, typically three pins are used:

• Serial Data Out (SDO)
• Serial Data In (SDI)
• Serial Clock (SCK)

Additionally, a fourth pin may be used when in a slave mode of operation: Slave Select (SS)

To enable the serial port, MSSP Enable bit, SSPEN (SSPCON<5>) must be set. To reset or reconfigure SPI mode, clear bit SSPEN, re-initialize the SSPCON registers, and then set bit SSPEN. Figure shows the block diagram of the MSSP module when in SPI mode. This configures the SDI, SDO, SCK and SS pins as serial port pins. For the pins to behave as the serial port function, some must have their data direction bits (in the TRIS register) appropriately programmed. That is:

• SDI is automatically controlled by the SPI module
• SDO must have TRISC<5> cleared
• SCK (Master mode) must have TRISC<3> cleared
• SCK (Slave mode) must have TRISC<3> set
• SS must have TRISA<5> set

2.25. MASTER MODE

The master can initiate the data transfer at any time because it controls the SCK. The master determines when the slave is to broadcast data by the software protocol. In master mode, the data is transmitted/received as soon as the SSPBUF register is written to. If the SPI module is only going to receive, the SDO output could be disabled (programmed as an input).

2.26. SLAVE MODE

In slave mode, the data is transmitted and received as the external clock pulses appear on SCK. When the last bit is latched, the interrupt flag bit SSPIF (PIR1<3>) is set. While in slave mode, the external clock is supplied by the external clock source on the SCK pin. This external clock must meet the minimum high and low times as specified in the electrical specifications. While in sleep mode, the slave can transmit/receive data. When a byte is received, the device will wake-up from sleep.

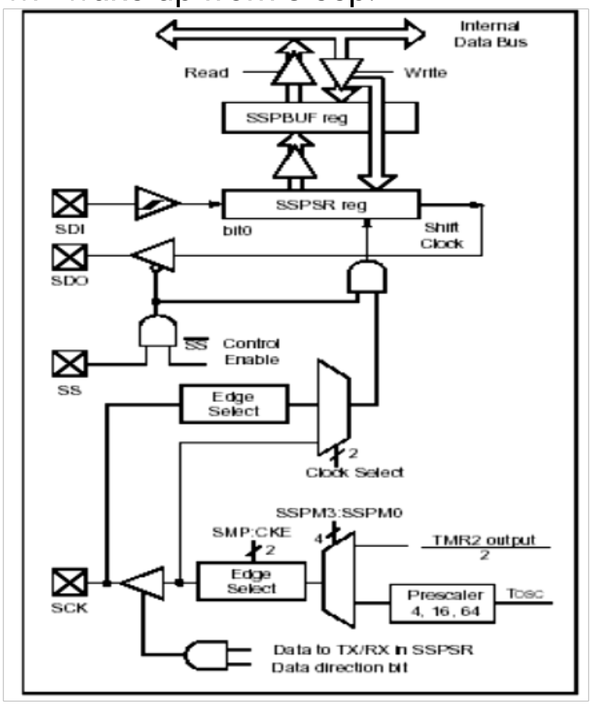


Fig. 2.10

The figure 2.10 shows us the MSSP Block diagram.

2.27. MSSP I2C OPERATION

The MSSP module in I2C mode fully implements all master and slave functions (including general call support) and provides interrupts-on-start and stop bits in hardware to determine a free bus (multi-master function). The MSSP module implements the standard mode specifications, as well as 7-bit and 10-bit addressing.

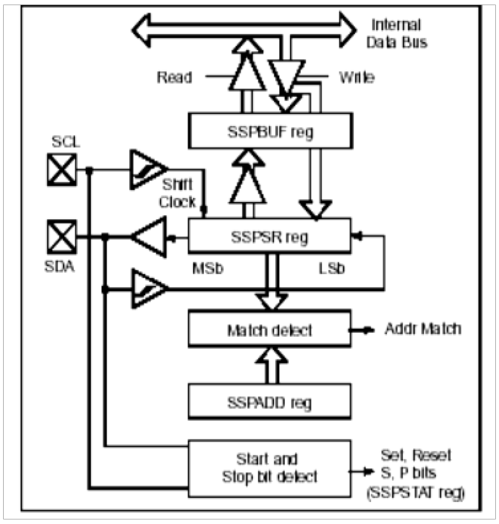


Fig. 2.11 - IIC Slave Mode Block Diagram

Figure 2.11 shows us the block diagram of slave mode operation.

Two pins are used for data transfer. These are the SCL pin, which is the clock, and the SDA pin, which is the data. The SDA and SCL pins are automatically configured when the I2C mode is enabled. The SSP module functions are enabled by setting SSP Enable bit SSPEN (SSPCON<5>). The SSPCON register allows control of the I2C operation. Four mode selection bits (SSPCON<3:0>) allow one of the following I2C modes to be selected:

- I2C Slave mode (7-bit address)
- I2C Slave mode (10-bit address)
- I2C Master mode, clock = OSC/4 (SSPADD +1)

2.27.1. MASTER MODE

Master mode of operation is supported by interrupt generation on the detection of the START and STOP conditions. The STOP (P) and START (S) bits are cleared from a reset or when the MSSP module is disabled. In master mode, the SCL and SDA lines are manipulated by the MSSP hardware. The following events will cause the SSP Interrupt Flag bit, SSPIF, to be set (SSP Interrupt if enabled):

• START condition
• STOP condition
• Data transfer byte transmitted/received
• Acknowledge transmit
• Repeated Start

2.28. ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The analog input charges a sample and hold capacitor. The output of the sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation.

The A/D conversion of the analog input signal results in a corresponding 10-bit digital number. The A/D converter has a unique feature of being able to operate while the device is in SLEEP mode. To operate in sleep, the A/D clock must be derived from the A/D's internal RC oscillator.

The A/D module has four registers. These registers are:
• A/D Result High Register (ADRESH)
• A/D Result Low Register (ADRESL)
• A/D Control Register0 (ADCON0)
• A/D Control Register1 (ADCON1)

The ADCON0 register, controls the operation of the A/D module. The ADCON1 register, configures the functions of the port pins. The port pins can be configured as analog inputs (RA3 can also be the voltage reference) or as digital I/O.

The following steps should be followed for doing an A/D conversion:
1. Configure the A/D module:
• Configure analog pins / voltage reference / and digital I/O (ADCON1)
• Select A/D input channel (ADCON0)
• Select A/D conversion clock (ADCON0)
• Turn on A/D module (ADCON0)
2. Configure A/D interrupt (if desired):
• Clear the ADIF bit
• Set the ADIE bit
• Set the GIE bit
3. Wait the required acquisition time.
4. Start conversion:
• Set the GO/DONE bit (ADCON0)
5. Wait for A/D conversion to complete, by either:
• Polling for the GO/DONE bit to be cleared
OR

• Waiting for the A/D interrupt
6. Read A/D Result register (ADRES), clear the ADIF bit, if required.
7. For next conversion, go to step 1 or step 2 as required. The A/D conversion time per bit is defined as TAD. A minimum wait of 2TAD is required before next acquisition starts.

Acquisition time is the time that the A/D module's holding capacitor is connected to the external voltage level. Then there is the conversion time of 10 TAD, which is started when the GO bit is set. The sum of these two times is the sampling time. There is a minimum acquisition time to ensure that the holding capacitor is charged to a level that will give the desired accuracy for the A/D conversion.

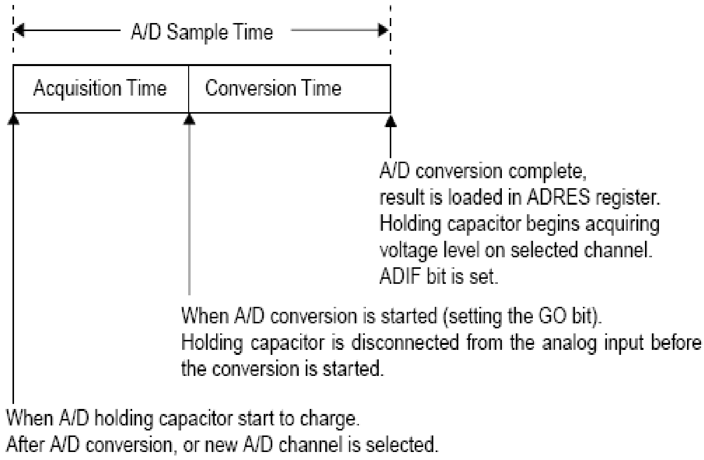


Fig. 2.12

The figure 2.12 shows us the time taken for A/D conversion

2.29. OSCILLATOR CONFIGURATIONS

The PIC16F87X can be operated in four different oscillator modes. The user can program two configuration bits (FOSC1 and FOSC0) to select one of these four modes:
• LP Low Power Crystal
• XT Crystal/Resonator
• HS High Speed Crystal/Resonator
• RC Resistor/Capacitor

2.30. RESET

The PIC16F87X differentiates between various kinds of reset:
• Power-on Reset (POR)
• MCLR reset during normal operation

• MCLR reset during SLEEP
• WDT Reset (during normal operation)
• WDT Wake-up (during SLEEP)
• Brown-out Reset (BOR)

These devices have a MCLR noise filter in the MCLR reset path. The filter will detect and ignore small pulses. It should be noted that a WDT Reset does not drive MCLR pin low.

2.31. INTERRUPTS

The PIC16F87X family has up to 14 sources of interrupt. The interrupt control register (INTCON) records individual interrupt requests in flag bits. It also has individual and global interrupt enable bits. A global interrupt enable bit, GIE (INTCON<7>) enables (if set) all un-masked interrupts or disables (if leared) all interrupts. When bit GIE is enabled, and an interrupt’s flag bit and mask bit are set, the interrupt will vector immediately. Individual interrupts can be disabled through their corresponding enable bits in various registers. Individual interrupt bits are set regardless of the status of the GIE bit. The GIE bit is cleared on reset. The “return from interrupt” instruction, RETFIE, exits the interrupt routine, as well as sets the GIE bit, which re-enables interrupts.

2.31.1. INT INTERRUPT

External interrupt on the RB0/INT pin is edge triggered, either rising, if bit INTEDG (OPTION_REG<6>) is set, or falling, if the INTEDG bit is clear. When a valid edge appears on the RB0/INT pin, flag bit INTF (INTCON<1>) is set. This interrupt can be disabled by clearing enable bit INTE (INTCON<4>). Flag bit INTF must be cleared in software in the interrupt service routine before re-enabling this interrupt. The INT interrupt can wake-up the processor from SLEEP, if bit INTE was set prior to going into SLEEP.

2.31.2. TMR0 INTERRUPT

An overflow (FFh ® 00h) in the TMR0 register will set flag bit T0IF (INTCON<2>). The interrupt can be enabled/disabled by setting/clearing enable bit T0IE (INTCON<5>).

2.31.3. PORTB INTCON CHANGE

An input change on PORTB<7:4> sets flag bit RBIF (INTCON<0>). The interrupt can be enabled/disabled by setting/clearing enable bit RBIE (INTCON<4>).

2.32. INSTRUCTION SET SUMMARY

The instruction set is highly orthogonal and is grouped into three basic categories:

- Byte-oriented operations
- Bit-oriented operations
- Literal and control operations

All instructions are executed within one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction. In this case, the execution takes two instruction cycles with the second cycle executed as a NOP. One instruction cycle consists of four oscillator periods. Thus, for an oscillator frequency of 4 MHz, the normal instruction execution time is 1 ms. If a conditional test is true or the program counter is changed as a result of an instruction, the instruction execution time is 2 ms. The figure 2.13 shows the general formats that the instructions can have.

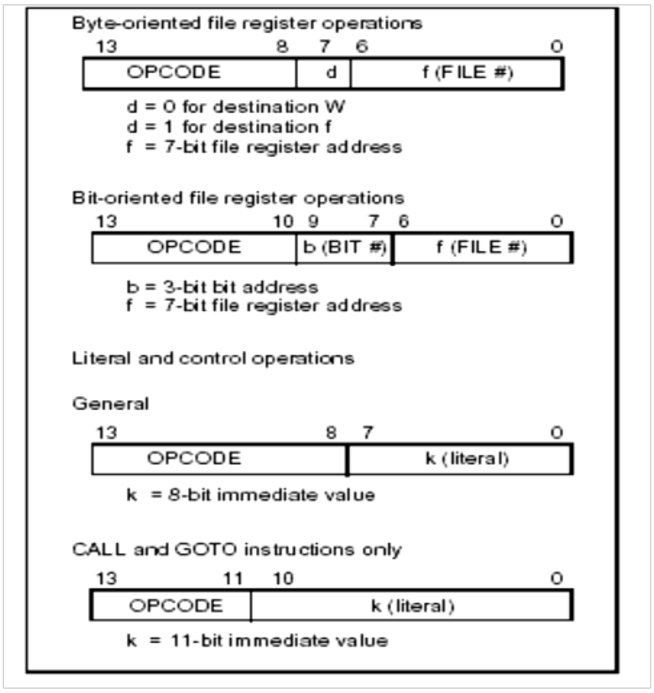
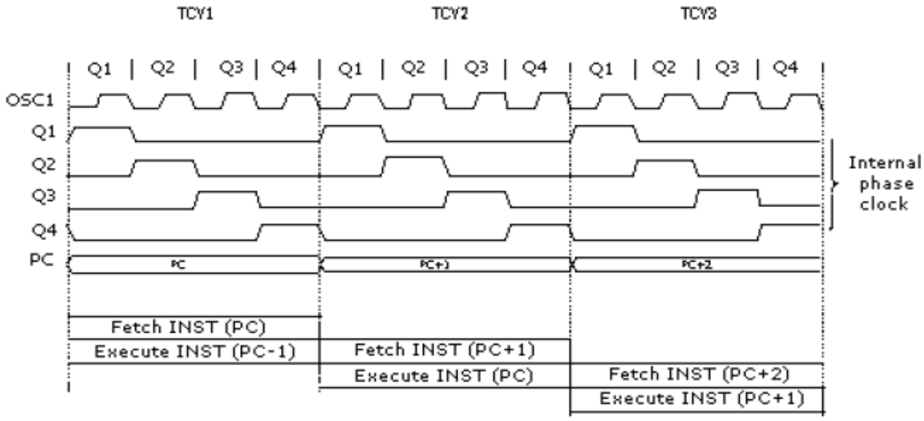


Fig. 2.13 - General instruction format

2.33. CLOCK / INSTRUCTION CYCLE :

Clock is microcontroller's main starter, and is obtained from an external memory component called an "oscillator". If we were to compare a microcontroller with a time clock, our "clock" would then be a ticking sound we hear from the time clock. In that case, oscillator could be compared to a spring that is wound so time clock can run. Also, force used to wind the time clock can be compared to an electrical supply. Clock from the oscillator enters a microcontroller via OSC1 pin where internal circuit of a microcontroller divides the clock into four even clocks Q1, Q2, Q3, and Q4 which do not overlap. These four clocks make up one instruction cycle (also called machine cycle) during which one instruction is executed.

Execution of instruction starts by calling an instruction that is next in line. Instruction is called from program memory on every Q1 and is written in instruction register on Q4. Decoding and execution of instruction are done between the next Q1 and Q4 cycles. On the following diagram we can see the relationship between instruction cycle and clock of the oscillator (OSC1) as well as that of internal clocks Q1-Q4. Program counter (PC) holds information about the address of the next instruction.



Clock/Instruction Cycle

Fig. 2.14

The figure 2.14 shows us the input-output waveform of the oscillator.

2.34. PIPELINING CONCEPT:

Instruction cycle consists of cycles Q1, Q2, Q3 and Q4.Cycles of calling and executing instructions are connected in such a way that in order to make a call, one instruction cycle is needed, and one more is needed for decoding and execution. However, due to pipelining, each instruction is effectively executed in one cycle. If instruction causes a change on program counter, and PC doesn't point to the following but to some other address (which can be the case with jumps or with calling subprograms), two cycles are needed for executing an instruction. This is so because instruction must be processed again, but this time from the right address. Cycle of calling begins with Q1 clock, by writing into instruction register (IR). Decoding and executing begins with Q2, Q3 and Q4 clocks.

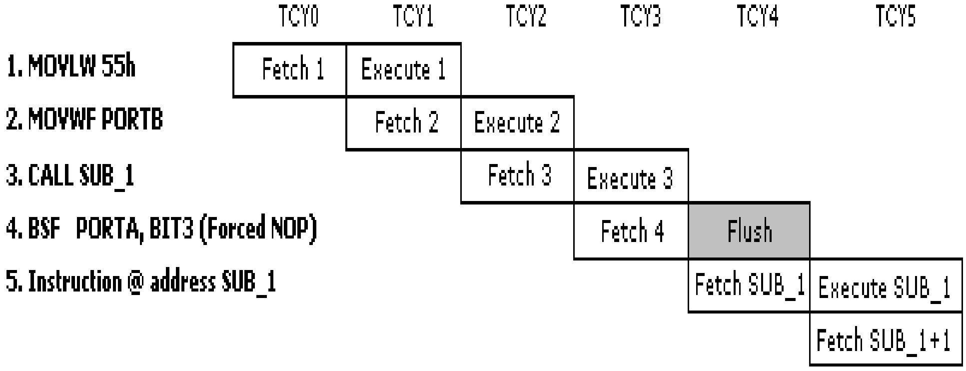


Fig. 2.15

The figure 2.15 shows us the brief details of the clock cycles.

2.35. INSTRUCTION PIPELINE FLOW

- TCY0 reads in instruction MOVLW 55h (it doesn't matter to us what instruction was then executed, which is why there is no rectangle pictured on the bottom).
- TCY1 executes instruction MOVLW 55h and reads in MOVWF PORTB.
- TCY2 executes MOVWF PORTB and reads in CALL SUB_1.
- TCY3 executes a call of a subprogram CALL SUB_1, and reads in instruction BSF PORTA, BIT3. As this instruction is not the one we need, or is not the first instruction of a subprogram SUB_1 whose execution is next in order, instruction must be read in again. This is a good example of an instruction needing more than one cycle.
- TCY4 instruction cycle is totally used up for reading in the first instruction from a subprogram at address SUB_1.
- TCY5 executes the first instruction from a subprogram SUB_1 and reads in the next one.

CHAPTER 3

3.1. LIQUID CRYSTAL DISPLAY (LCD)

A liquid crystal display (LCD) is an electro-optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power.

Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

3.2. PASSIVE-MATRIX AND ACTIVE-MATRIX ADDRESSED LCDS

LCDs with a small number of segments, such as those used in digital watches and pocket calculators, have individual electrical contacts for each segment. An external dedicated circuit supplies an electric charge to control each segment.

Small monochrome displays such as those found in personal organizers, or older laptop screens have a passive-matrix structure employing super-twisted nematic (STN) or double-layer STN (DSTN) technology—the latter of which addresses a color-shifting problem with the former—and color-STN (CSTN)—wherein color is added by using an internal filter. Each row or column of the display has a single electrical circuit. The pixels are addressed one at a time by row and column addresses. This type of display is called passive-matrix addressed.

INTERFACING AN LCD TO PIC MICROCONTROLLER.

3.3. LCD OPERATION:

In recent years the LCD is finding widespread use replacing LEDs (seven -segment LEDs or other multisegment LEDs). This is due to the following reasons:

- The declining prices of LCDs.
- The ability to display numbers, characters, and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
- Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU (or in some other way) to keep displaying the data.
- Ease of programming for characters and graphics.

3.4. LCD PIN DESCRIPTIONS:

The LCD discussed in this section has 14 pins. The function of each pin is given in the table below.

3.4.1. V_{CC}, VSS, AND V_{EE}:

While V_{CC} and V_{SS} provide +5V and ground, respectively, V_{EE} is used for controlling LCD contrast.

3.4.2. RS, REGISTER SELECT:

There are two very 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, allowing the 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.

3.4.3. R/W, READ/WRITE:

R/W input allows the user to write information to the LCD or read information from it. R/W=1 when reading; R/W=0 when writing.

3.4.4. E, 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-to-low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450ns wide.

3.4.5. D0-D7:

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 display 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.

Note: It is recommended to check the busy flag before writing any data to the LCD

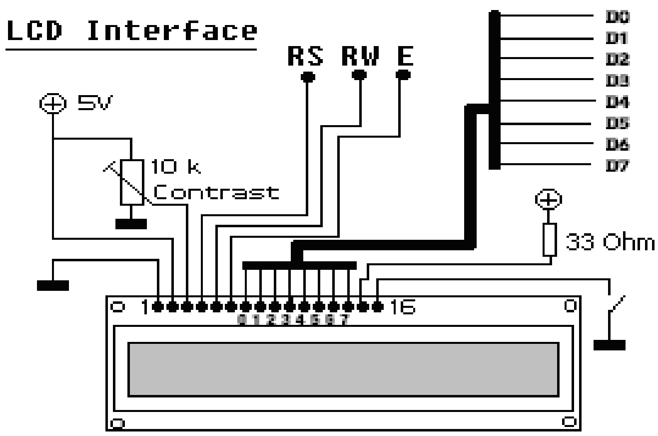


Fig. 3.1

The figure 3.1 shows us the block diagram of a LCD interface.

Code	Command to LCD Instruction Register (Hex)
1	Clear display screen
2	Return home
4	Decrement cursor (shift cursor to left)
6	Increment cursor (shift cursor to right)
5	Shift display right
7	Shift display left
8	Display off, cursor off
A	Display off, cursor on
C	Display on, cursor off
E	Display on, cursor blinking
F	Display off, cursor blinking
10	Shift cursor position to left
14	Shift cursor position to right
18	Shift the entire display to the left
1C	Shift the entire display to the right
80	Force cursor to beginning of 1st line
C0	Force cursor to beginning of 2nd line
38	2 lines and 5x7 matrix

Pin No	Name	Function	USE
1	Vss	Ground	
2	Vdd	+ve Supply	5v Volts Regulated DC
3	Vee	Contrast	This is used to set the contrast1
4	RS	Register Set	Register select signal 0:Instruction register (when writing) Busy flag & address counter (When reading) 1:Data

			register (when writing & reading)
5	R/W	Read / Write	Read/write select signal “0” for writing , “1” for reading
6	E	Enable	Operation (data read/write) enable signal
7	D0	Data Bit 0	
8	D1	Data Bit 1	
9	D2	Data Bit 2	
10	D3	Data Bit 3	
11	D4	Data Bit 4	
12	D5	Data Bit 5	
13	D6	Data Bit 6	
14	D7	Data Bit 7	
15	A	+4.2 for Back light	Positive supply for back light if available
16	K	Power supply Back light (0V)	

In some LCD's you might not find the 15 and 16 pin so don’t worry. Here is how you must wire them up.

3.5. Steps to Interface LCD with PIC Microcontroller

STEP 1: Identify:

Determine what you want LCD are available in many flavors which are specified as follows 16x1 , 16x2 , 20x2 in the format AxB where A is the number of columns (chatters) and B is the number of Rows (lines) An LCD might also be Back lit .

STEP 2: Connect: Most of the LCD's follow the standard Hitachi Pin out which is simply...

STEP 3: Interface:

Now connect pins RS ,RW ,E ,D0 - D7 to pins on the micro controller Lets suppose I connect Data bus on port A and the RS , RW , E on port B . (you can save pins by using LCD in Nibble Mode (4 data pins) and permanently grounding the RW line (always in write mode) . Now well see how to go from simple switching it on to graphics on the LCD.

3.6. LCD ADVANTAGES

1. Sharpness - Image is perfectly sharp at the native resolution of the panel.
2. Geometric Distortion - Zero geometric distortion at the native resolution of the panel.
3. Brightness - High peak intensity produces very bright images.
4. Screen Shape - Screens are perfectly flat.
5. Physical - Thin, with a small footprint. Consume little electricity and produce little heat.

CHAPTER 4

4.1. COIN SENSOR

Fig. 4.1

This coin acceptor will take up to 6 different kinds of coin! Whether you're building your own arcade cabinet or just charging admission to your house, this programmable coin acceptor makes it easy to monetize your next project. The figure 4.1 shows us the picture of an industrial coin sensor.

The sensors in this coin acceptor use the thickness, diameter and fall time of the coins to identify them and it's fully programmable so you're not limited to any particular type of currency. Simply use the buttons and 7-segment display on the side of the unit to select a coin profile, insert a bunch of coin samples (or the same one, over and over) then designate the value.

After you've programmed the coin profiles, simply read the serial output of the coin acceptor and it will tell you the value of each coin as they’re inserted. It reports these values as binary bytes and the baud rate is selectable on the unit.

This coin acceptor also has a coin reject, so your controller can tell the coin acceptor not to take any more coins, as well as a (very loud) alert beeper. All you need to get the coin acceptor working is a pocket full of change, a 12VDC supply and somewhere for the change to fall after it’s accepted.

4.2. FEATURES:

Ø Capable of accepting all worldwide Coins and Tokens

Ø Intelligent CPU software control and high accuracy

Ø Accept 1-3 Different kinds of coins at the same time

Ø Free to set up pulses' output

Ø Prevent not only electric shock but also electromagnetic interference

Ø Automatic self-test for problems

4.3. SPECIFICATION:

1. Coin Size: Diameter: 15mm-32mm

2. Thickness: 1.2mm-3.8mm

4.4. WORKING ENVIRONMENT:

1.Working Temperature: 0°C to 50°C

2.Storage Temperature: -30°C to55°C

3.Ambient Humidity: Up to 95% RH non-condensing

4.Working Voltage: Normal 12VDC

5.Working Current: Standby 65mA

6.Communication Interface:Standard parallel port -- 10Pin

7.Special serial port -- 5Pin Installation Position: On any plane, the angle can't be more than 2 degrees between coin acceptor and vertical

4.5. APPLICATIONS

- Wireless PC peripherals
- Coin kiosk
- car washing machine
- TV
- Massage chair
- Cloth dryer
- Cyber coffee
- Laundromat
- Laundry
- Computer
- Amusement machine
- Arcade machine

CHAPTER 5

5.1. CRYSTAL OSCILLATOR

Fig. 5.1

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters/receivers.

The figure 5.1 shows us the picture of a crystal oscillator.

5.2. THE DESIGN PRINCIPLES OF CRYSTAL OSCILLATORS

Crystal Oscillators are usually, fixed frequency oscillators where stability and accuracy are the primary considerations. For example it is almost impossible to design a stable and accurate LC oscillator for the upper HF and higher frequencies without resorting to some sort of crystal control. Hence the reason for crystal oscillators.

5.3. PRACTICAL EXAMPLE OF A CRYSTAL OSCILLATOR

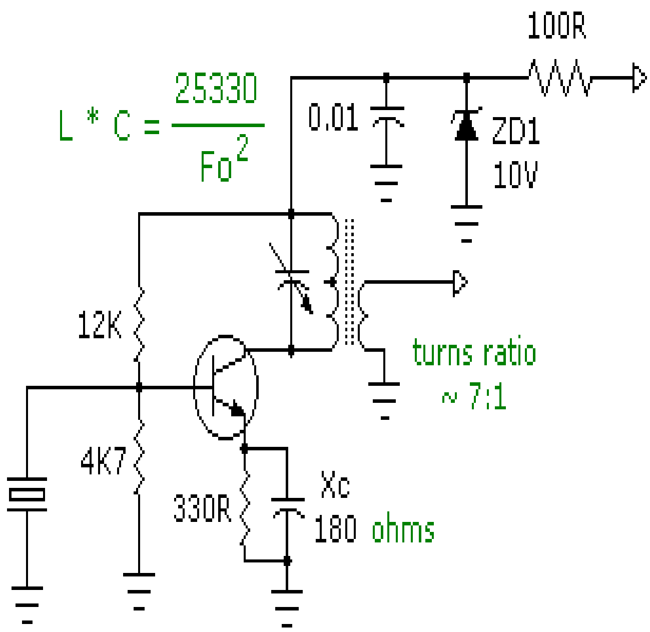


Fig. 5.2

This figure 5.2 is a typical example of the type of crystal oscillators which may be used for say converters. Some points of interest on crystal oscillators.

5.4. OSCILLATOR TYPES

The PIC16F87XA can be operated in four different oscillator modes. The user can program two configuration bits (FOSC1 and FOSC0) to select one of these four modes:

- LP Low-Power Crystal
- XT Crystal/Resonator
- HS High-Speed Crystal/Resonator
- RC Resistor/Capacitor

5.5. EXTERNAL CLOCK INPUT OPERATION (HS, XT OR LP OSC CONFIGURATION)

CERAMIC RESONATORS

Ranges Tested:			
Mode	Freq.	OSC1	OSC2
XT	455 kHz 2.0 MHz 4.0 MHz	68-100 pF 15-68 pF 15-68 pF	68-100 pF 15-68 pF 15-68 pF
HS	8.0 MHz 16.0 MHz	10-68 pF 10-22 pF	10-68 pF 10-22 pF
These values are for design guidance only. See notes following Table 14-2.			
Resonators Used:			
2.0 MHz	Murata Erie CSA2.00MG		± 0.5%
4.0 MHz	Murata Erie CSA4.00MG		± 0.5%
8.0 MHz	Murata Erie CSA8.00MT		± 0.5%
16.0 MHz	Murata Erie CSA16.00MX		± 0.5%
All resonators used did not have built-in capacitors.			

CAPACITOR SELECTION FOR CRYSTAL OSCILLATOR

Osc Type	Crystal Freq.	Cap. Range C1	Cap. Range C2
LP	32 kHz	33 pF	33 pF
	200 kHz	15 pF	15 pF
XT	200 kHz	47-68 pF	47-68 pF
	1 MHz	15 pF	15 pF
	4 MHz	15 pF	15 pF
HS	4 MHz	15 pF	15 pF
	8 MHz	15-33 pF	15-33 pF
	20 MHz	15-33 pF	15-33 pF
Crystals Used			
32 kHz	Epson C-001R32.768K-A		± 20 PPM
200 kHz	STD XTL 200.000KHz		± 20 PPM
1 MHz	ECS ECS-10-13-1		± 50 PPM
4 MHz	ECS ECS-40-20-1		± 50 PPM
8 MHz	EPSON CA-301 8.000M-C		± 30 PPM
20 MHz	EPSON CA-301 20.000M-C		± 30 PPM

5.6. RC OSCILLATOR

For timing insensitive applications, the “RC” device option offers additional cost savings. The RC oscillator frequency is a function of the supply voltage, the resistor (REXT) and capacitor (CEXT) values and the operating temperature. In addition to this, the oscillator frequency will vary from unit to unit due to normal process parameter variation. Furthermore, the difference in lead frame capacitance between package types will also affect the oscillation frequency, especially for low CEXT values. The user also needs to take into account variation due to tolerance of external R and C components used. Figure shows how the R/C combination is connected to the Microcontroller.

NOTES:

1: Higher capacitance increases the stability of oscillator but also increases the start-up time.

2: Since each resonator/crystal has its own characteristics, the user should consult the resonator/crystal manufacturer for appropriate values of external components.
3: *Rs* may be required in HS mode, as well as XT mode, to avoid overdriving crystals with low drive level specification.
4: When migrating from other microcontroller devices, oscillator performance should be verified.

CHAPTER 6

6.1. IR TRANSMITER AND RECIEVER

Infrared is an energy radiation with a frequency below our eyes sensitivity, so we cannot see it Even that we cannot "see" sound frequencies, we know that it exist, we can listen them. Even that we cannot see or hear infrared, we can feel it at our skin temperature sensors. When you approach your hand to fire or warm element, you will "feel" the heat, but you can't see it. You can see the fire because it emits other types of radiation, visible to your eyes, but it also emits lots of infrared that you can only feel in your skin.

A photodiode is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. Most photodiodes is similar to a light emitting diode. They will have two leads, or wires, coming from the bottom. The shorter end of the two is the cathode, while the longer end is the anode. See below for a schematic drawing of the anode and cathode side. Current will pass from the anode to the cathode, basically following the arrow.The best frequency for the job is between 30 and 60 kHz, the most used is around 36kHz.So, remote controls use the 36 kHz (or around) to transmit information. Infra Red light emitted by IR Diodes is pulsated at 36 thousand times per second, when transmitting logic level "1" and silence for "0".

The figure 6.1 shows us the diagram of a photo diode.

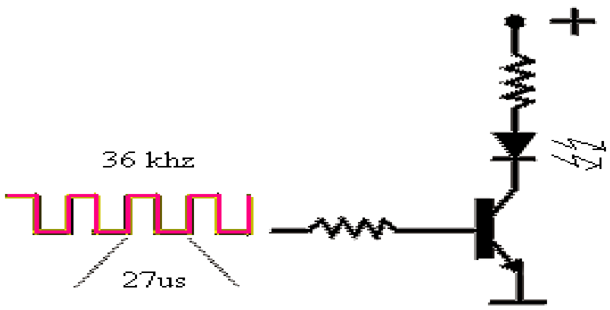


Fig. 6.1

6.2. PRINCIPLE OF OPERATION

A photodiode is a PN junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced.

As the name implies, the sensor is always ON, meaning that the IR led is constantly emitting light. This design of the circuit is suitable for **counting objects**, or **counting revolutions** of a rotating object, that may be of the order of 15,000 rpm or much more. However this design is more power consuming and is not optimized for high ranges. In this design, range can be from 1 to 10 cm, depending on the ambient light conditions.

- **The sender** is composed of an IR LED (D2) in series with a 470 Ohm resistor, yielding a forward current of 7.5mA.
- **The receiver** part is more complicated, the 2 resistors R5 and R6 form a voltage divider which provides 2.5V at the anode of the IR LED (here, this led will be used as a sensor). When IR light falls on the LED (D1), the voltage drop increases, the cathode's voltage of D1 may go as low as 1.4V or more, depending on the light intensity. The output will be High when IR light is detected, which is the purpose of the receiver.

Using infrared signals, controller is able to localize the position of devices. With the relevant upgrade, microcontroller also allows two-way data exchange between two devices. The transmitter and the receiver face each other. The transmitter and receiver have to be positioned so that they are opposite of and within sight of one another. There is a window for the optical signals at the front (IR receiver/transmitter, status LEDs).

6.3. APPLICATIONS

The primary function is to recognize IR signals which are emitted from an IR transmitter. The transmitter is usually mounted on a shearer and the receivers in the shields. The latter are connected to the controller.

6.4. INFRARED SENSOR

6.4.1. INTRODUCTION

The sensing element used in the PASCO CI-6628 Infrared Sensor is a thermopile. Thermopile detectors are voltage-generating devices that can be thought of as a miniature array of thermocouples. The thermopile is a high output, thin film, silicon based device which has 48 thermopile junctions. The active or ‘Hot’ junctions are blackened to efficiently absorb radiation. The reference or ‘Cold’ junctions are maintained at the ambient temperature of the detector The blackening material used on the ‘Hot’ junctions is capable of absorbing radiant energy from ultra violet to the far infrared. In order to limit the spectral sensitivity, optical filters and windows may be placed in front of the detector.

The absorption of radiation by the blackened area causes a rise in temperature in the ‘hot’ junctions as compared to the ‘cold’ junctions of the thermopile. This difference in temperature across the thermocouple junction causes the detector to generate a positive voltage. If the active or ‘hot’ junction were to cool to a temperature less than the reference or ‘cold’ junction the voltage output would be negative. The output of the thermopile detector is presented to a gain selectable amplifier. The GAIN switch located on the top of the sensor is used to adjust the output of the sensor to a level appropriate for the experiment being performed. Gain settings of 1X, 10X and 100X are provided. The gain settings on the sensor coupled with the user selectable gain of the PASCO Computer Interface allow a very broad range of measurements to be made with the Infrared Sensor.

6.5. OPERATION

6.5.1. FIGURE 1

1. Connecting the amplifier box to the interface box1. Connect the Infrared

Sensor unit to analogchannel A, B, or C of the Science Workshopcomputer interface box using the cable with theDIN connectors (Figure 1). Alternatively, the unitcan be plugged directly into the analog channeljack without using the cable.

6.5.2. FIGURE 2

Select the appropriate gain setting on the sensor box for the light levels to be measured (Figure 2). The correct gain setting is the one for which the intensity levels on the display vary appropriately for measuring the relative light intensity changes in your experiment.

The figures 6.2 & 6.3 shows us the diagrams of installation procedures done in an infra-red sensor experiment.

Fig. 6.2

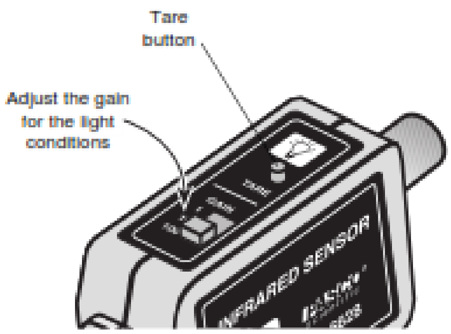


Figure 2
Setting the Gain On the Infrared Sensor

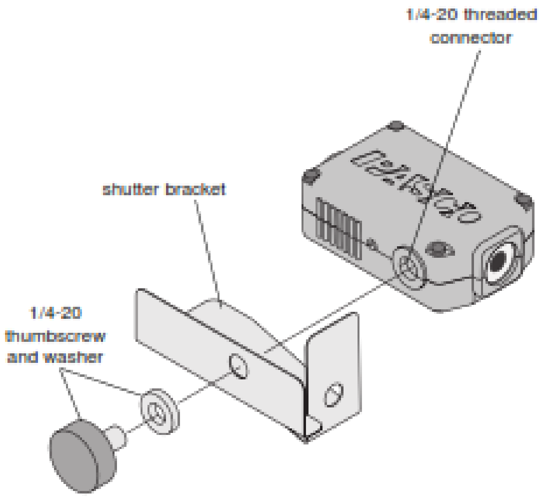


Figure 3
Installation of Shutter Bracket

Fig. 6.3

6.5.3. FIGURE 3

Installation of Shutter Bracket Using the Shutter Bracket Note the orientation of components as illustrated in Figure 3. Mount the shutter bracket to the Infrared
Sensor unit, with the included hardware, as shown. Do not over tighten thumbscrew.

6.6. WATER PUMP

Fig. 6.4

The figure 6.4 shows us the example of a water pump. This small, high volume, 12v fluid circulation pump is very well suited for circulating water through heat exchangers on water intercooled turbo applications. Magnetic drive motor with sealed pump chamber for long life even with continuous use (up to 5000 hrs.). High temperature capable (up to 212 degrees). Pump can also be used as replacement for Bosch 392 020 024, 027, 034, 039, 064 type pumps used in a variety of functions on various European cars. Fluid connections for 3/4" i.d. (19mm) or 5/8" (16mm) hose. Info: model CM30P7-1, flow rate is up to 7 GPM (5.2 for 16mm) at up to 5 psi. working pressure, Length 7.0", weight 1.2 lbs, current 12 volt 2.2 amp max, bracket included.

6.7. SPECIFICATIONS:

Pump Body: PPA thermoplastic Pump Impeller:

PPS thermoplastic Shaft: Stainless steel Motor:

12/24 V DC Enclosed (IP67) permanent magnet, ball bearing mounted designed for continuous operation Liquids:

water, fresh/salt, water glycol mix (max 60%) Liquid temp.: -40c to +100c

Connections: 16mm (5/8") or 20mm (3/4") push-on hose

6.8.SOFTWARE ANALYSIS

6.8.1. INTRODUCTION

Programming the PIC 16F684A processor using the MPLab Integrated Development Environment (IDE) v. 8.5. Programming the processor has the following steps:

• Create a Project in MPLab using the Project Wizard. Alternatively, you can create a new project using the New option or open an existing project.
• Create, add, delete, and edit source code, and in this case the language will be C.
• Compile the code using Build.
• Simulate and debug the program.
• Recompile the code using Rebuild.
• Set up the processor chip on a protoboard.
• Program the processor using Pickit 2.

6.9. HARDWARE SETUP

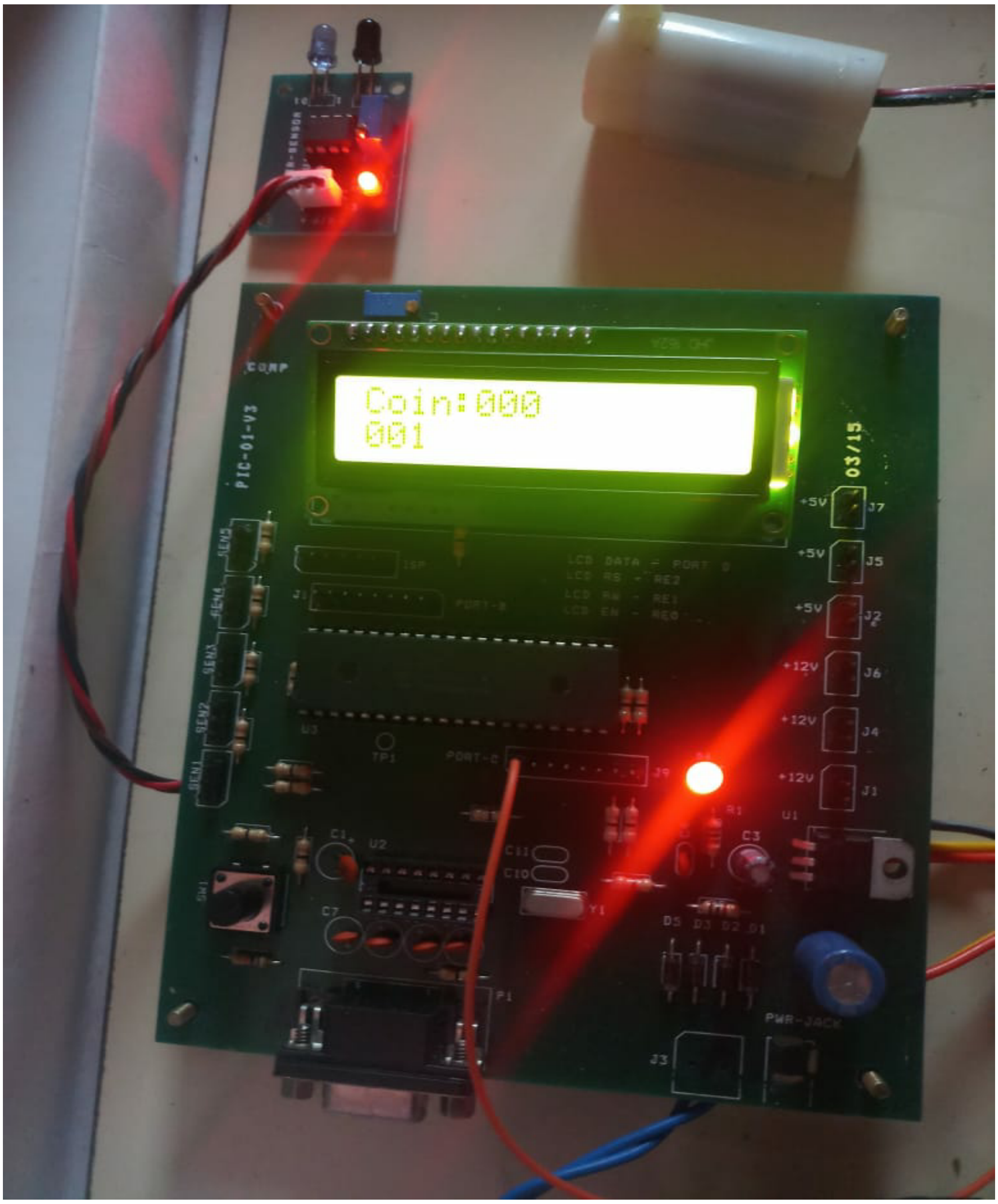


Fig. 6.5

The figure 6.5 shows us the real image of our project experimented in ON condtion.

This section explains how to connect up PIC 16F648A to the Pickit 2 via the protoboard. Connect the Pickit 2 to a protoboard using wires, which are slightly thicker than the ordinary wires we use for protoboards (ordinary wires are used to connect telephones but we need thicker wires for the connectors in Pickit 2). These wires should be in a small plastic bag (snack bag size) that comes with your Pickit 2. Each Pickit 2 should be in a plastic bag with a number, that corresponds to a lab bench. It also comes with a USB 2.0 connector.

CHAPTER 7

7.1. RESULT:

Finally we have finished our project with major parts comprising of Microcontroller, coin sensor, water pump and to name a few. As students of Mechatronics Engineering department, we have collaborated our knowledge in both mechanical & electrical engineering and applied it in our project.

We have broadened our knowledge by researching about Micro controllers and its programming methods through preparation for our project. We hope that in the oncoming future, these skills & knowledge might be helpful in our jobs.

7.2. CONCLUSION:

Our project *"Coin based water dispenser system"* is quite efficient in processing data which eases human-machine interaction and we are aiming to install our project in various public places along with Government approval for subsidies to support our project. We are open to the critics and reviews of students & staffs which will be helpful in modifying and improving our project.