CONTROL OF WINDING MACHINE USING EMBEDDED MICRO CONTROLLER

PROJECT REPORT

2001 - 2002

SUBMITTED BY

DHANYA. K.S.

HEMA. V.

NITHIN. B.

SANDEEP ANAND. M.

GUIDED BY

Mrs. RANI THOTTUNGAL, *M.A.,M.E.,MISTE.*
SENIOR LECTURER

IN PARTIAL FULFILLMENT OF THE REQUIREMENT

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ELECTRICAL & ELECTRONICS ENGINEERING

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ELECTRICAL & ELECTRONICS ENGINEERING

Kumaraguru College of Technology

Coimbatore - 641 006.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Kumaraguru College of Technology

COIMBATORE - 641006.

CERTIFICATE

This is to certify that the project entitled

CONTROLLING A WINDING MACHINE USING AN EMBEDDED MICRO-CONTROLLER

has been submitted by

1. DHANYA K.S.,	**98EEE15**
2. HEMA V.,	**98EEE18**
3. NITHIN B.,	**98EEE34**
4. SANDEEP ANAND M.,	**98EEE41**

In partial fulfillment of the requirements for the award of degree of Bachelor of Engineering in Electrical and Electronics Engineering branch of the Bharathiar University, Coimbatore – 641006 during the academic year 2001 – 2002.

V. DURAISAMY, M.E., M.I.S.T.E.,
Assistant Professor of Elec. Engg.
Kumaraguru College of Tech.
COIMBATORE - 641 006.
Professor and Head

....
Guide

Certified that the candidates mentioned above were examined in project work viva-voce held on ....

....
Internal Examiner

....
External Examiner

GST No. 6200417
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Date : 13.,03.,2002

CERTIFICATE

This is to certiy that the following Final BE (EEE) students of Kumaraguru College of Technology, Coimbatore have carried out a Project Work in our organization, and completed successfully.

1. Ms.Dhanya. K.S
2. Ms.Hema. V.
3. Mr.Nithin. B.
4. Mr.Sandeep Anand.M.

Title of the Project : Controlling of the winding machine using Embedded Micro-Controller

Period of Project : July 2001-March 2002

During this period, their attendance and conduct were found to be good. We wish them the very best for their bright future.

FOR BEST ENGINEERS PUMPS PVT.LTD.,

(K.NATESAN),
GENERAL MANAGER - PROJECTS.

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

We are highly grateful to our Project Guide Mrs.Rani Thottungal, M.A., M.E., M.I.S.T.E., Senior Lecturer in Electrical and Electronics Engineering Department for her unparallel support, guidance and zeal offered in completing this project successfully.

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We sincerely thank Mr.K.Natesan, M.E., Project Manager, Best Engineers and Pumps Pvt.Ltd, Coimbatore and Mr.R.Karthikeyan, B.Sc (CT)., Proprietor, Saitron Electronics, for sponsoring this project, and guiding us to make this project a complete success.

We are also extremely grateful to the staff members of Electrical and Electronics Engineering Department and our friends for their timely help during the project.

DEDICATED TO OUR BELOVED
PARENTS AND FRIENDS

SYNOPSIS

SYNOPSIS

'Controlling a winding machine using an embedded micro controller' is application oriented project that has been developed to control the number of windings to be wound around the bobbin using a micro controller.

The proximity sensor is fixed on the shaft of the winding machine .It sends a signal to the embedded micro controller after each turn is made. The count of number of turns made is maintained and simultaneously displayed. When the required number of turns is reached, the micro controller sends a pulse to the control circuit. The relay in the control circuit closes immediately and cuts off the power supply to the brake motor and it also enables the braking process, thus stopping the winding process at the required number of turns.

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CONTENTS

CHAPTER I

CHAPTER I

1.1 Introduction

The rapid development of the "Embedded technology" has given us the right impetus to develop an automated system for a winding machine. This reflects in the usage of a micro controller, which is efficient in controlling the operation of the machine. The winding machine was previously controlled by a PC based system that has its own limitations.

The micro controller based system uses an application-specific embedded PIC16f84, which is a low power consuming and high-speed technology device. This system senses the signals from the sensor and sends a pulse to the brake motor, thus stopping the winding process at the exact number of turns required.

The project is aimed at developing a micro controller based system capable of windings the required number of turns around the bobbin that is given as the input.

1.2 Need for control:

The control of the winding machine involves the process of stopping the machine when the required number of turns is wound .In the absence of the control circuit, the machine will continue winding thereby making extra turns. This results in the copper loss due to which the cost increases. By the inclusion of our circuit, a lot of copper can be saved, thereby decreasing the total winding cost and also an efficient winding operation is assured .The laborers need to give the input which is the required number of turns and they don't have to worry about switching off the motor when the required turns are wound. This is taken care by our control circuit.

CHAPTER II

CHAPTER 2

WORKING OF THE EMBEDDED SYSTEM

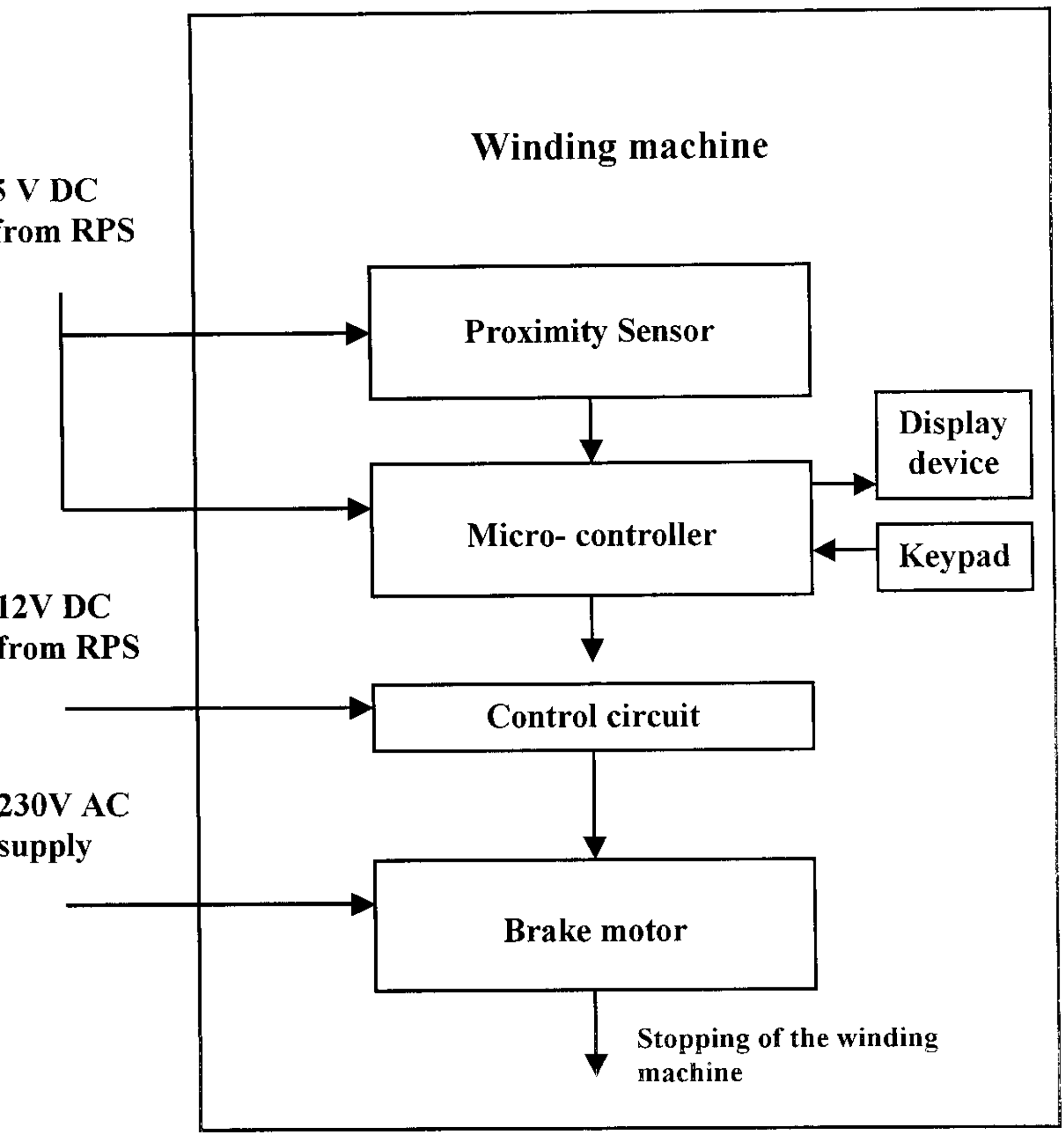
2.1 Principle of operation:

The circuit described here is a simple Micro-controller based system to provide the required control at the least capital investment. The salient feature of this project is that it has a reduced complexity and also provides a very economical approach for the winding operation.

The manually operated winding machine does not wind the exact number of turns around the bobbin. This results in additional copper turns being wound around the bobbin. For example, if the total number of bobbins is 50 and two extra turns are wound per bobbin then a total of 100 turns of copper are wasted per day. This amounts to a very large wastage when calculated in the long run. Thus, a hand-wound bobbin does not offer an economical approach.

In our approach, a sensor senses each rotation of the shaft of the winding machine and passes an electrical pulse the micro-controller. The micro-controller decrements its counter value for each pulse received. On reaching a value of zero in the counter, the micro-controller sends a pulse to the control circuit. Operation of the relays in the control circuit causes the brake motor to stop immediately, thus stopping the winding machine.

Main Block Diagram



2.2 Basic Block Diagram:

The basic block diagram of the micro-controller based system is shown in the figure 2.1. It consists of a proximity sensor, which produces a negative pulse on completion of one rotation of the shaft of the winding machine. This pulse is given as an input to the interrupt pin of the micro-controller.

The number of turns to be wound around the bobbin is obtained as input through the two-incrementing switches. This value is stored in a counter register. Reception of a pulse from the sensor decrements this stored value by one. The software takes care of the process of decrementing the counter and simultaneously displaying it.

Completion of the winding process is achieved when the micro-controller sends a pulse to the relay-operated control circuit. The input, the decrementing and the display processes are controlled by both software and hardware while the stopping of the brake motor is entirely controlled through the hardware circuit.

2.3 Circuit Description:

Input Section:

The input section consists of the proximity sensor and the regulated power supply.

The proximity sensor is used. A bearing fixed on the shaft of the winding machine reduces the sensing distance between the sensor and the shaft. This creates a fluctuation in the field of the transducer, thus triggering the in-built NPN transistor and producing a negative-going pulse as an output. The sensor receives a constant input voltage of 5V from the regulated power supply section.

The regulated power supply section consists of a step-down transformer, which produces an output voltage of 12V-unregulated AC at the secondary when the input is 220V AC at the primary. A bridge rectifier rectifies this output to produce a DC voltage. A regulated voltage of 5V DC is obtained after the use of a regulator IC 7805.

This regulated output is used for driving both the micro-controller and the proximity sensor.

Micro-Controller Section:

This section consists of a PIC16F84, a product of the Microchip Technology Inc., USA. The Programmable Interface Controller (PIC) is an 8-bit controller and it uses CMOS Flash technology. Devices with Flash program memory allow the same device to be used for both prototyping and production. In-circuit reprogrammability allows the code to be updated without the device being removed from the end-application.

Some of the key features of the micro-controller include low power consumption, high-speed technology with a wide operating voltage range of 2.0-6.0V DC. The high performance RISC CPU features include 35 single-word instructions with all instructions single-cycled, except for program branches which are two-cycled.

Display device and keypad section:

The display device section consists of two seven-segment display sections, which are operated, in the common anode mode. This produces a display of the number of turns obtained as input, and also the decrementing value in the counter of the micro controller. It receives its input from IC 74LS47, which converts a BCD input into a hexa-decimal output.

The keypad section consists of three switches – 2 incrementing switches and one start switch. The incrementing switches are used to increment the values in the units and tens digit of the input number of turns. The start key is pressed after giving the number of turns so as to start the motor and the winding process.

Control circuit section:

The control circuit section consists of relays and contactors, which operate on the receipt of a pulse from the micro-controller so as to stop the operation of the brake motor. A 12V DC input voltage is obtained from the main supply through a bridge rectifier, which is given to an opto-isolator.

The opto-isolator helps in electrically isolating the control section from the micro-controller section, but electrically coupling to it. The opto-isolator receives the pulse from the 12^{th} pin of the micro-controller when the counter register reaches a value of zero.

The output pulse of the opto-isolator is fed to the amplification stage, which includes two transistors. The amplified output is fed as an input to the relay section. The relay operates the contactors and provides a DC supply to the brake motor after cutting off the AC supply to the motor, thus stopping the motor at the required number of turns.

Brake motor section:

The brake motor operates with a supply of 230V AC from the mains. The motor used is 230V AC, 1440-rpm motor fixed with Emco brakes. Operation of the contactors in the control circuit allows for the rectification of the input supply, and thus, a DC supply is provided to the Emco brake of the brake motor. Thus, instantaneous stopping of the brake motor is achieved at the required number of turns.

CHAPTER III

CHAPTER III

3.1 Power Supply to the circuits:

The power supply circuit consists of two parts namely,

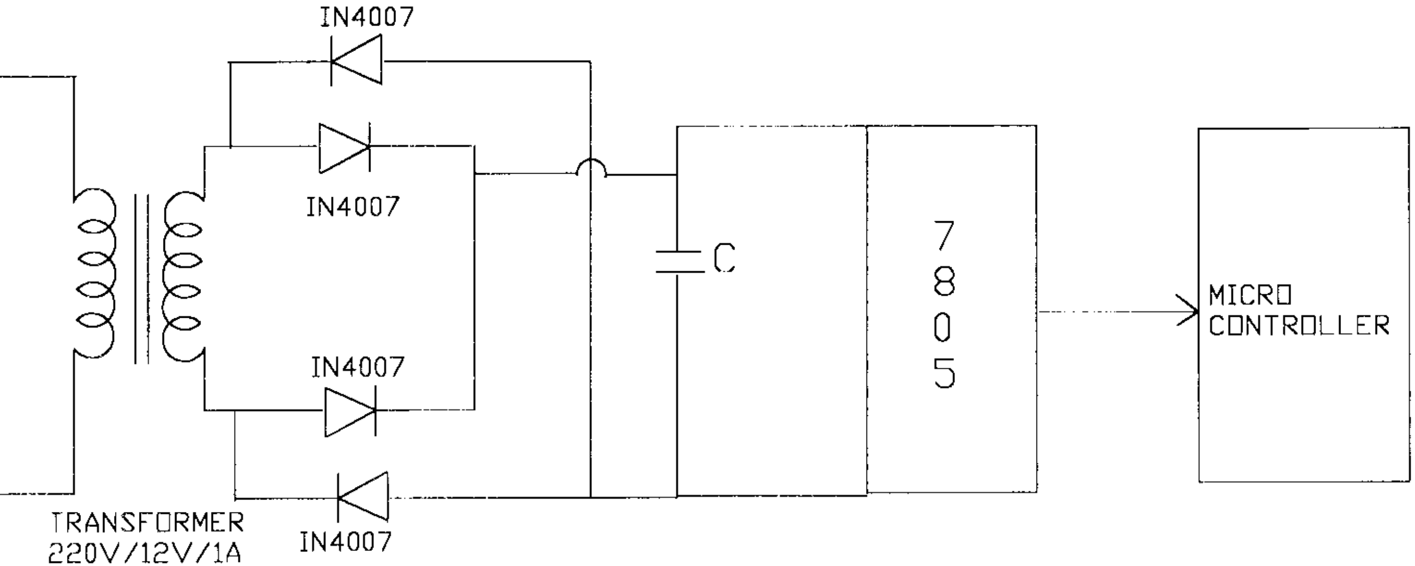
- The supply to the Micro Controller.
- The supply to the Opto-isolator circuit.

The supply to the Micro Controller is 5V DC supply. This is obtained through a step down Transformer (230V/12V). A bridge rectifier consisting of 4 IN4007 diodes, which rectifies the AC input to DC output. The use of a 1000 micro farad/25V capacitor eliminates the ripples in the output. The output from the capacitor is fed to a regulator L7805CV so that a regulated output of 5V DC is obtained.

This regulated output is used to drive both the micro controller and the proximity sensor.

A separate supply is given to the Opto-isolator. Two BC546 transistors provide the amplification stage. The amplified output is used to activate the relay circuit, which is connected to the Brake motor through a contactor.

SUPPLY TO THE MICROCONTROLLER

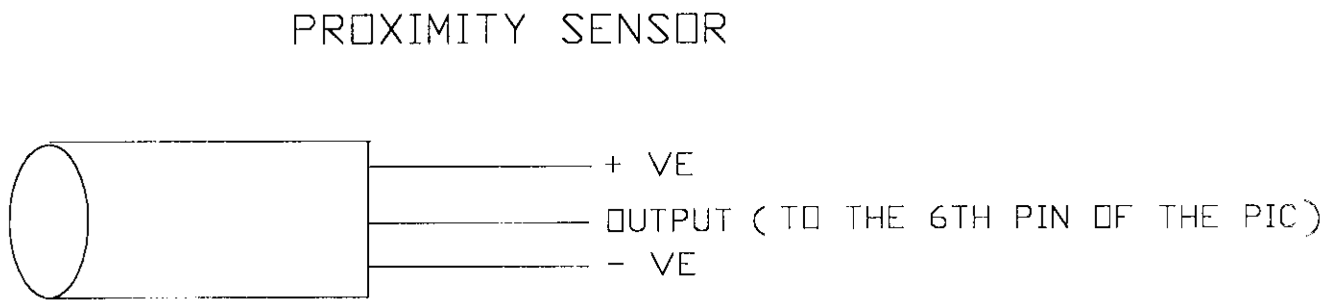


1. C=1000MFD/40V

3.2 Proximity sensor:

The proximity sensor is a transducer, which converts a mechanical input into an electrical output. The sensor is placed at a sensing distance of 8mm from the shaft of the winding machine. A bearing fixed on the shaft of the winding machine reduces the sensing distance between the sensor and the shaft when one winding is completed. This creates a fluctuation in the field of the transducer, thus triggering the in-built NPN transistor. This produces a positive going square pulse as an output, which is given to the opto-isolator as an input.

The sensor requires a voltage of 5-30 V DC and a current of 300mA.The diameter of the sensing portion is 18mm.In this circuit, the sensor receives a constant voltage input of 5V from the regulated power supply.


PROXIMITY SENSOR
+ VE
OUTPUT (TO THE 6TH PIN OF THE PIC)
- VE

CHAPTER IV

CHAPTER 4

4.1 Microcontroller details:

The PIC16F8X is a group of low-cost, high-performance, CMOS, fully static, 8-bit micro controllers. All PIC micro controllers employ an advanced RISC architecture. PIC16F8X devices have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources. The separate instruction and data buses of the Harvard architecture allow a 14-bit wide instruction word with a separate 8-bit wide data bus. The two-stage instruction pipeline allows all instructions to execute in a single cycle, except for program branches (which require two cycles).

A total of 35 instructions (reduced instruction set) are available. Additionally, a large register set is used to achieve a very high performance level. PIC16F8X micro controllers typically achieve 2:1 code compression and up to a 4:1 speed improvement (at 20 MHz) over other 8-bit micro controllers in their class. The PIC16F8X has up to 68 bytes of RAM, 64 bytes of Data EEPROM memory, and 13 I/O pins. A timer/ counter is also available.

The PIC16F8X family has special features to reduce external components, thus reducing cost, enhancing system reliability and reducing

power consumption. There are four oscillator options, of which the single pin RC oscillator provides a low-cost solution, the LP oscillator minimizes power consumption, XT is a standard crystal, and the HS is for High Speed crystals. The SLEEP (power-down) mode offers power saving.
The user can wake the chip from sleep through several external and internal interrupts and resets.

A highly reliable Watchdog Timer with its own on-chip RC oscillator provides protection against software lockup. The devices with Flash program memory allow the same device package to be used for prototyping and production. In-circuit reprogrammability allows the code to be updated without the device being removed from the end application. This is useful in the development of many applications where the device may not be easily accessible, but the prototypes may require code updates. This is also useful for remote applications where the code may need to be updated (such as rate information). A simplified block diagram of the PIC16F8X is shown in Figure 3-1.

The PIC16F8X fits perfectly in applications ranging from high speed automotive and appliance motor control to low-power remote sensors, electronic locks, security devices and smart cards. The Flash/EEPROM technology makes customization of application programs (transmitter codes, motor speeds, receiver frequencies, security codes, etc.) extremely fast and convenient. The small footprint packages make this microcontroller series perfect for all applications with space limitations. Low-cost, low-power, high performance, ease-of-use and I/O flexibility make the PIC16F8X very versatile even in areas where no microcontroller use has been considered before (e.g., timer functions; serial communication; capture, compare and PWM functions; and co-processor applications). The serial in-system programming feature (via two pins) offers flexibility of customizing the product after complete assembly and testing. This feature can be used to serialize a product, store calibration data, or program the device with the current firmware before shipping.

Serialized Quick-Turnaround-Production (SQTP) Device:

PIC16F84 offers the unique programming service where a few user-defined locations in each device are programmed with different serial numbers. The serial numbers may be random, pseudo-random or sequential. Serial programming allows each device to have a unique number, which can serve as an entry- code, password or ID number.

Architectural Overview:

The high performance of the PIC16F84 can be attributed to a number of architectural features commonly found in RISC microprocessors. To begin with, the PIC16F84 uses Harvard architecture. This architecture has the program and data accessed from separate memories. So the device has a program memory bus and a data memory bus. This improves bandwidth over traditional von Neumann architecture where program and data are fetched from the same memory (accesses over the same bus).

Separating program and data memory further allows instructions to be sized differently than the 8-bit wide data word. PIC16F84 opcodes are 14-bits wide, enabling single word instructions. The full 14-bit wide program memory bus fetches a 14-bit instruction in a single cycle. Consequently, all instructions execute in a single cycle except for program branches.

The PIC16F84 can directly or indirectly address its register files or data memory. All special function registers including the program counter, are mapped in the data memory. An orthogonal (symmetrical) instruction set makes it possible to carry out any operation on any register using any addressing mode. This symmetrical nature and lack of 'special optimal situations' make programming with the PIC16F84 simple yet efficient. In addition, the learning curve is reduced significantly.

PIC16F84 devices contain an 8-bit ALU and working register. The ALU is a general-purpose arithmetic unit. It performs arithmetic and Boolean functions between data in the working register and any register file. The ALU is 8-bits wide and capable of addition, subtraction, shift and logical operations. Unless otherwise mentioned, arithmetic operations are two's complement in nature. In two-operand instructions, typically one operand is the working register (W register), and the other operand is a file register or an immediate constant.

In single operand instructions, the operand is either the W-register or a file register. The W register is an 8-bit working register used for ALU operations. It is not an addressable register. Depending on the instruction executed, the ALU may affect the values of the Carry (C), Digit Carry (DC), and Zero (Z) bits in the STATUS register. The C and DC bits operate as borrow and digit-borrow out bit, respectively, in subtraction.

A simplified block diagram for the PIC16F8X is shown in Appendix B1 its corresponding pin description is shown in Appendix B2.

Clocking Scheme/Instruction Cycle:

The clock input (from OSC1) is internally divided by four to generate four non-overlapping quadrature-clocks namely Q1, Q2, Q3 and Q4. Internally, the program counter (PC) is incremented every Q1, the instruction is fetched from the program memory and latched into the instruction register in Q4. The instruction is decoded and executed during the following Q1 through Q4. The clocks and instruction execution flow is shown in Appendix B3

Instruction Flow/Pipelining:

An "Instruction Cycle" consists of four Q cycles (Q1, Q2, Q3 and Q4). The instruction fetch and execute are pipelined such that fetch takes one instruction cycle while decode and execute takes another instruction cycle. However, due to the pipelining, each instruction effectively executes in one cycle. If an instruction causes the program counter to change (e.g., GOTO) then two cycles are required to complete the instruction. From the Appendix B4, it can be understood that a fetch cycle begins with the Program Counter (PC) incrementing in Q1. In the execution cycle, the fetched instruction is latched into the "Instruction Register" in cycle Q1. This instruction is then decoded and executed during the Q2, Q3, and Q4 cycles. Data memory is read during Q2 (operand read) and written during Q4 (destination write).

Memory Organization:

There are two memory blocks in the PIC16F84. These are the program memory and the data memory. Each block has its own bus, so that access to each block can occur during the same oscillator cycle. The data memory can further be broken down into the general purpose RAM and the Special Function Registers (SFRs). The operations of the SFRs that control the "core" are described here. The SFRs used to control the peripheral modules are described in the section discussing each individual peripheral module. The data memory area also contains the data EEPROM memory. This memory is not directly mapped into the data memory, but is indirectly mapped. That is, an indirect address pointer specifies the address of the data EEPROM memory to read/write. The 64 bytes of data EEPROM memory have the address range 0h- 3Fh.

- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)

• Interrupts

• Watchdog Timer (WDT)

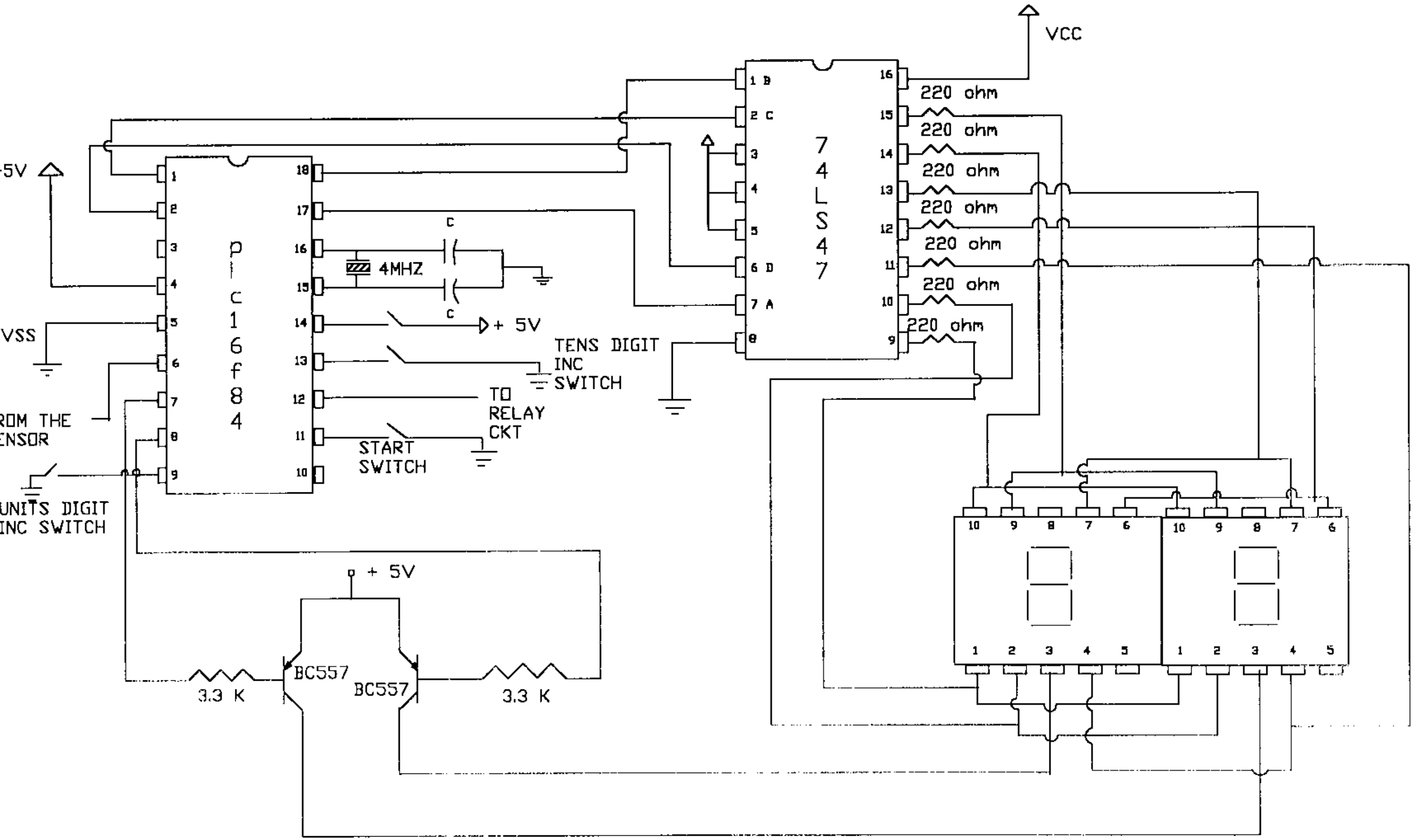
• SLEEP

• Code protection

• ID locations

• In-circuit serial programming

The PIC16F8X has a Watchdog Timer, which can be shut off only through configuration bits. It runs off its own RC oscillator for added reliability. There are two timers that offer necessary delays on power-up. One is the Oscillator Start-up Timer (OST), intended to keep the chip in reset until the crystal oscillator is stable. The other is the Power-up Timer (PWRT), which provides a fixed delay of 72 ms (nominal) on power- up only. This design keeps the device in reset while the power supply stabilizes. With these two timers on- chip, most applications need no external reset circuitry. SLEEP mode offers a very low current power-down mode. The user can wake-up from SLEEP through external reset, Watchdog Timer time-out or through an interrupt. Several oscillator options are provided to allow the part to fit the application. The RC oscillator option saves system



1. C= 0.1 micro Farad

cost while the LP crystal option saves power. A set of configuration bits is used to select the various options.

4.2 Algorithm:

STEP 0: Start.

STEP 1: Define the address of all Registers.

STEP 2: Initialize Units and Tens Digit to Zero and display.

STEP 3: Read the input, scan and display them.

STEP 4: Check if the START button is pressed.

STEP 5: If so, check the input from the sensor.

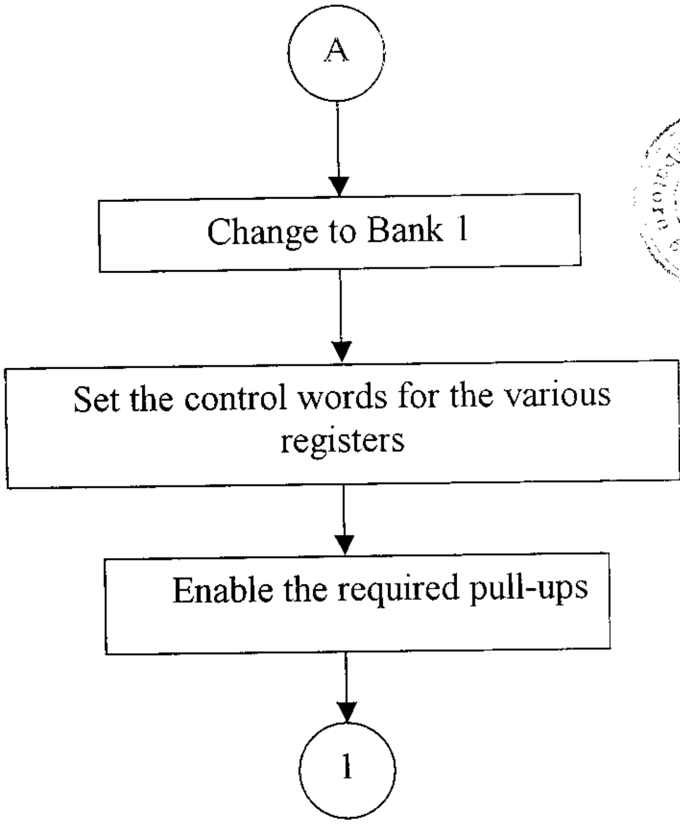
STEP 6: If there is input from the sensor, decrement Units digit by One.

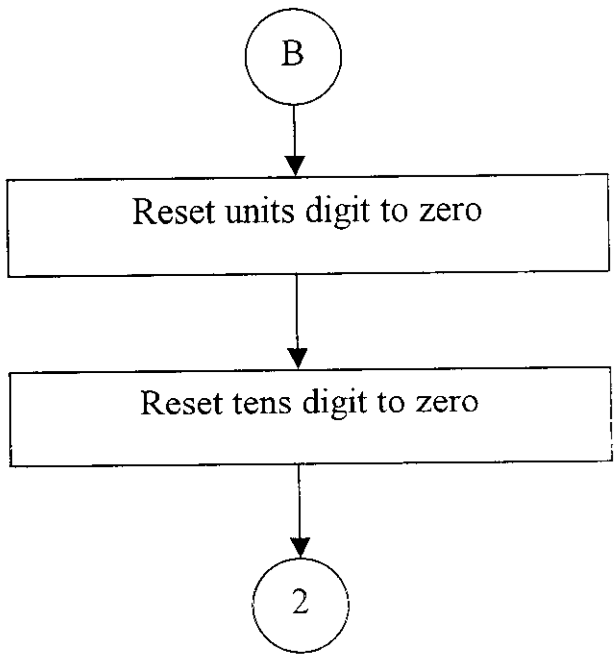
STEP 7: If units' digit is Zero, and tens' digit is not Zero, then decrement tens' by one and make units' digit nine.

STEP 8: Start decrementing it for each input from the sensor till both tens' and units' digit becomes Zero.

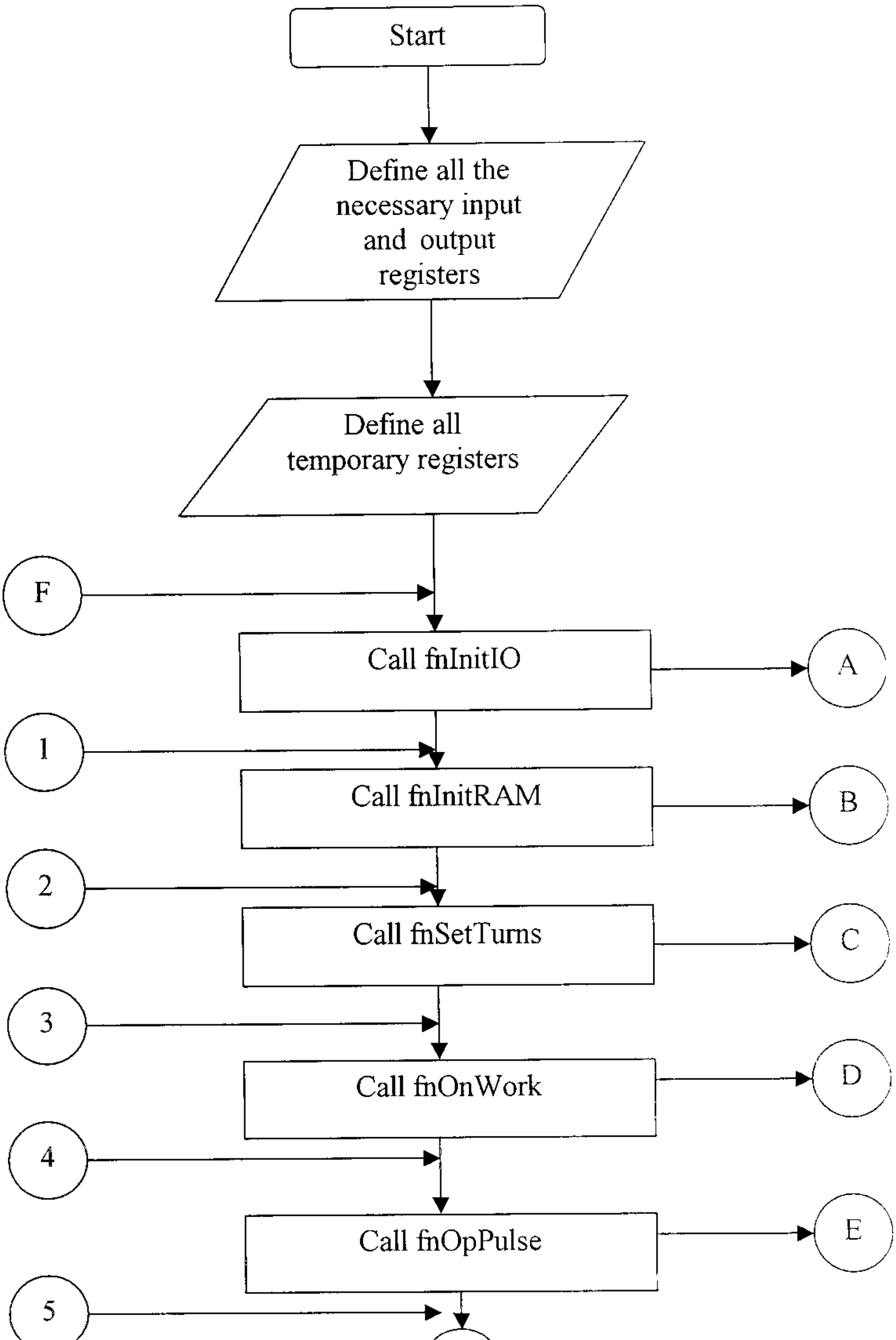
STEP 9: Check if both units' digit and tens' digit is Zero. If so, send the pulse to the relay to cut off the supply.

STEP 10: Stop the program.


A
Change to Bank 1
Set the control words for the various registers
Enable the required pull-ups
1


B
Reset units digit to zero
Reset tens digit to zero
2

4.3 Flowchart:



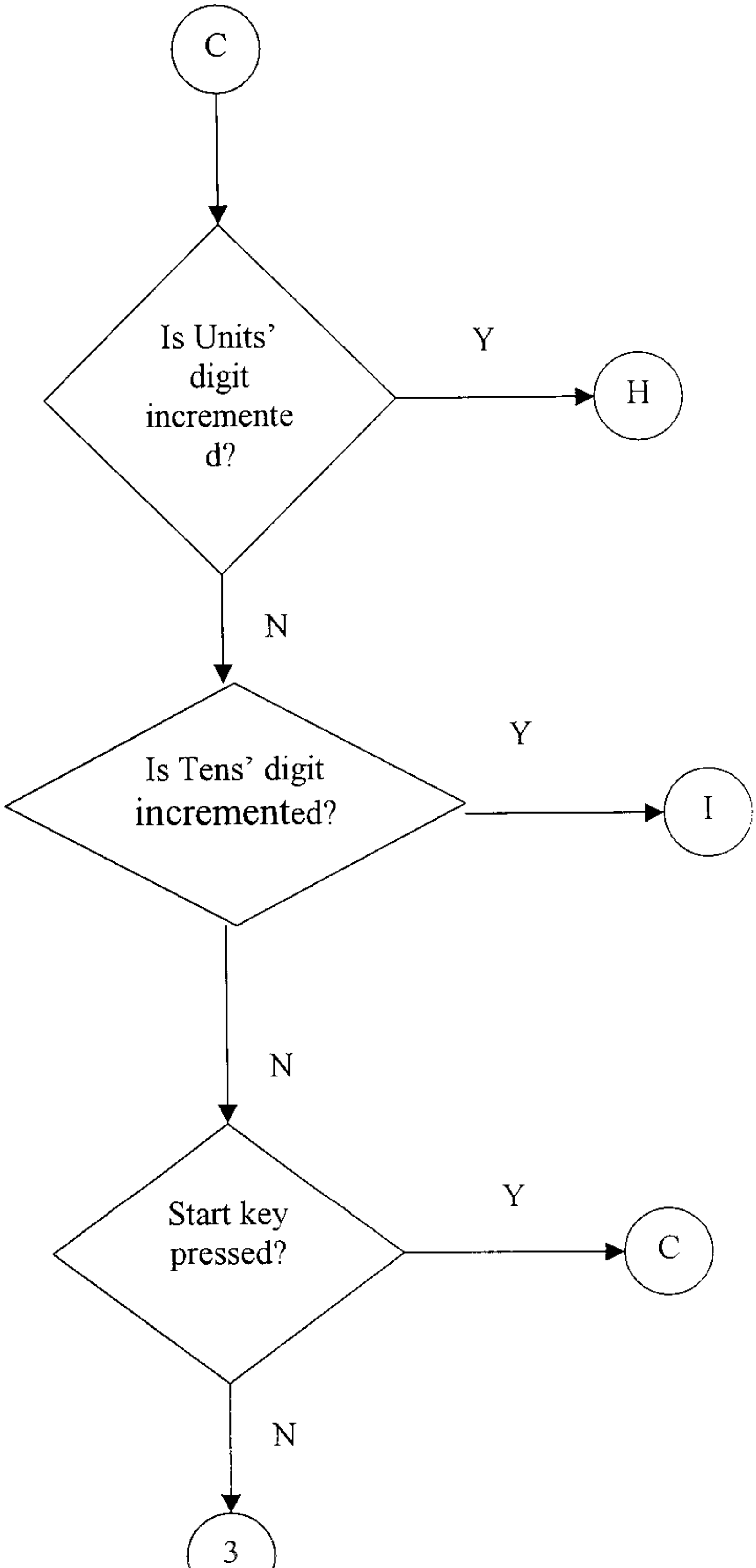
Watchdog Timer (WDT):

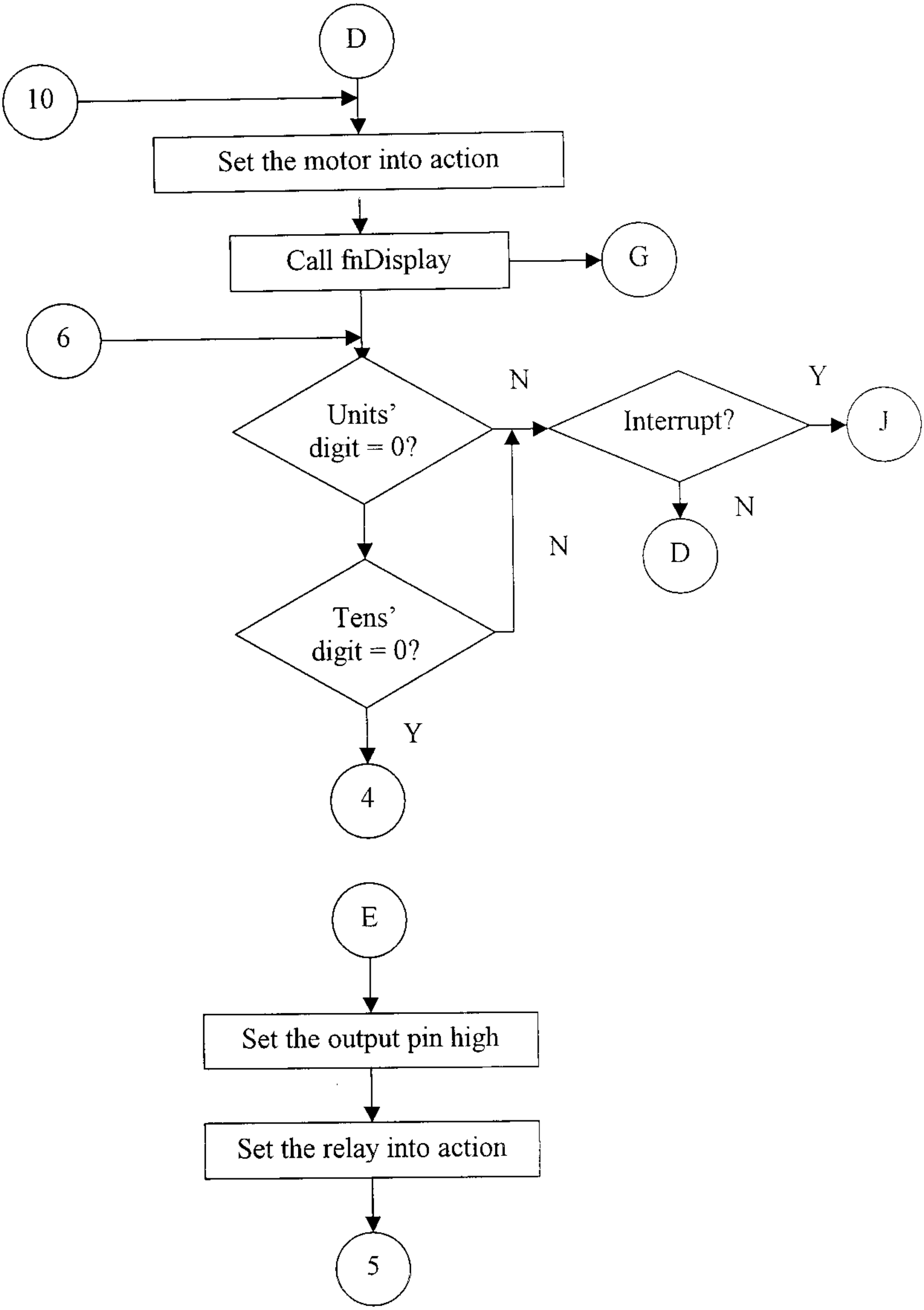
The Watchdog Timer is a free running on-chip RC oscillator that does not require any external components. This RC oscillator is separate from the RC oscillator of the OSC1/CLKIN pin. That means that the WDT will run even if the clock on the OSC1/CLKIN and OSC2/CLKOUT pins of the device has been stopped, for example, by execution of a SLEEP instruction. During normal operation a WDT time- out generates a device RESET. If the device is in SLEEP mode, a WDT Wake-up causes the device to wake-up and continue with normal operation. Programming the configuration bit WDTE as '0' can permanently disable the WDT.

Special Features of the CPU:

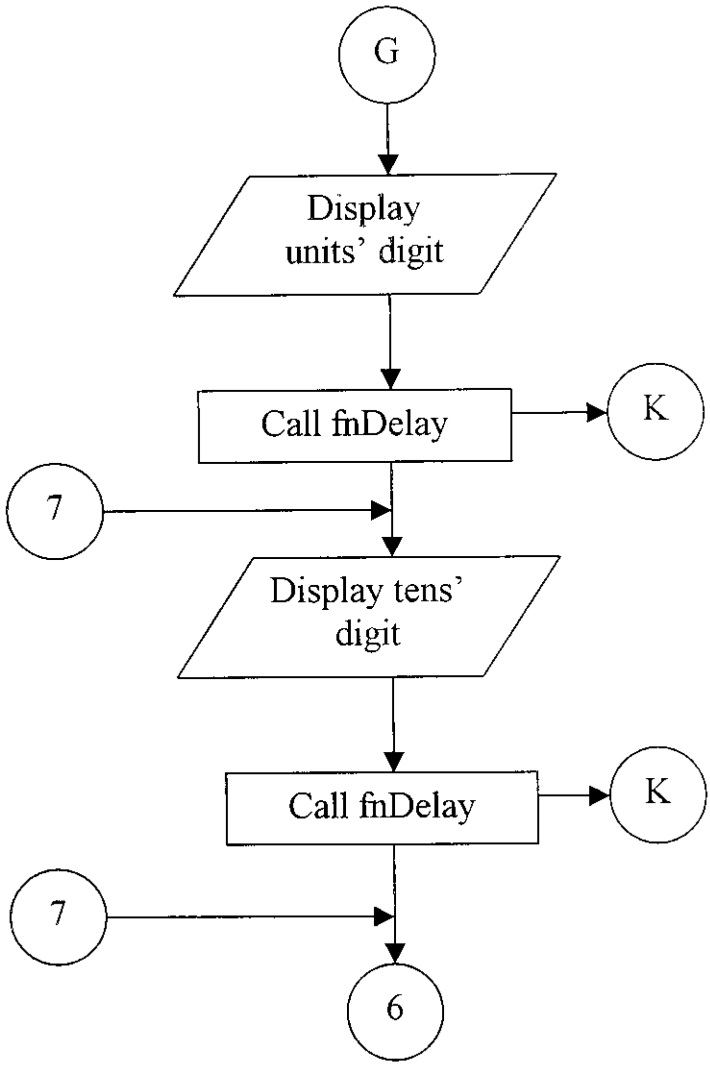
What sets a microcontroller apart from other processors are special circuits to deal with the needs of real time applications. The PIC16F8X has a host of such features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving operating modes and offer code protection. These features are:

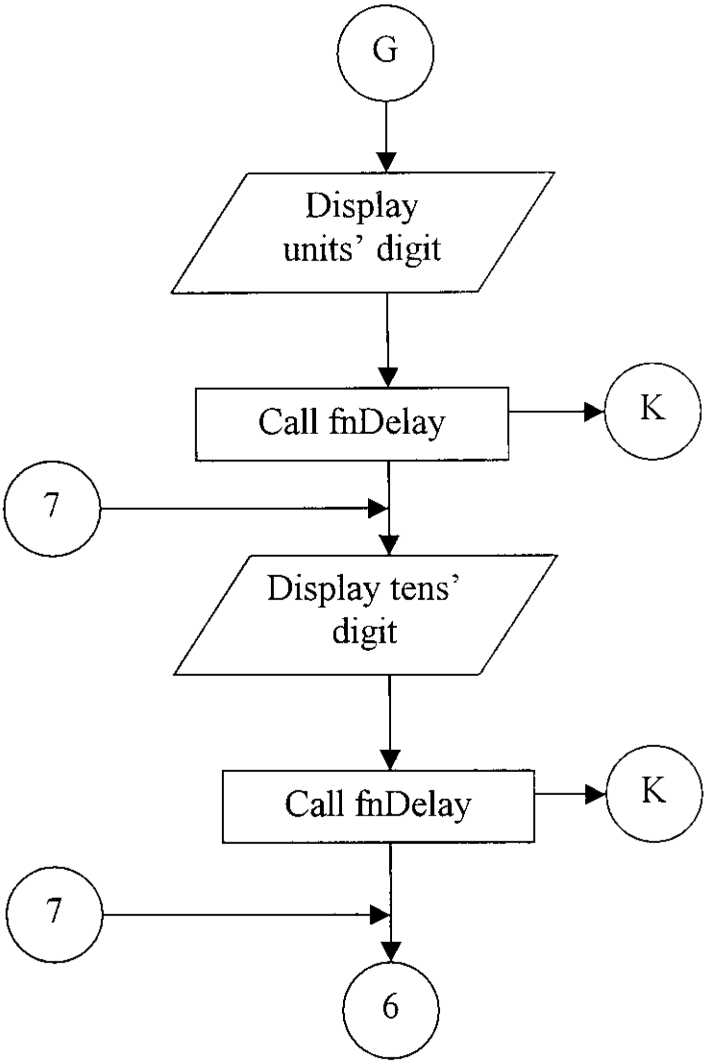
- OSC Selection
- Reset
    - Power-on Reset (POR)

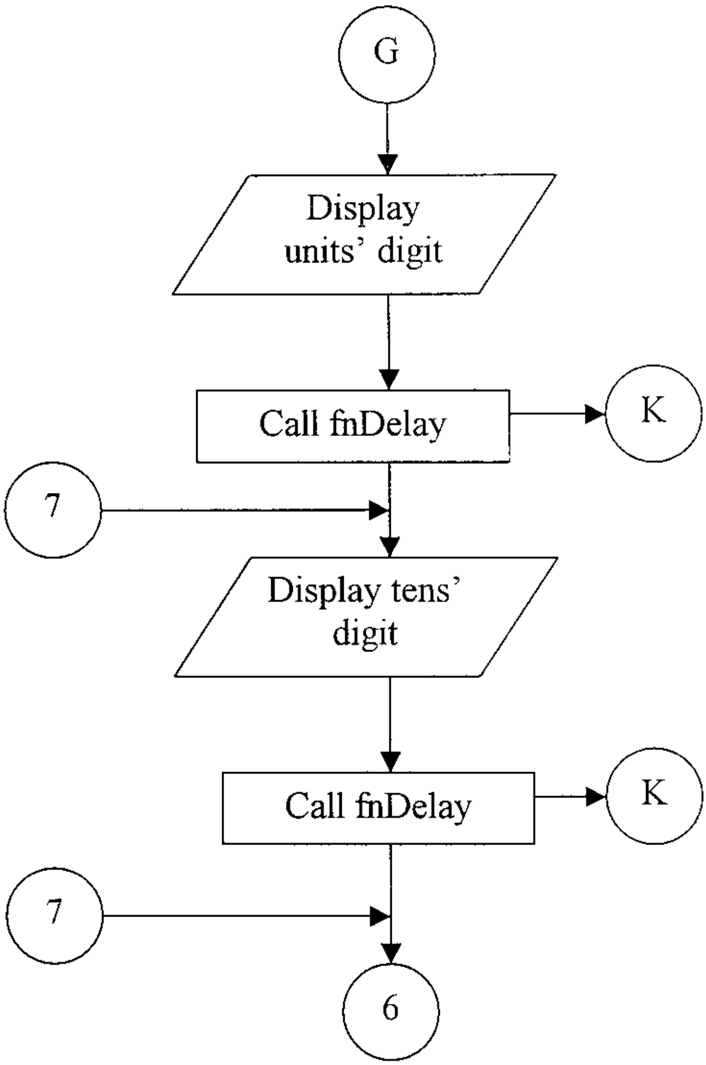

C
Is Units' digit incremente d?
Y
H
N
Is Tens' digit incremented?
Y
I
N
Start key pressed?
Y
C
N
3



D
10
Set the motor into action
Call fnDisplay
G
6
Units' digit = 0?
N
Interrupt?
Y
J
N
D
N
Tens' digit = 0?
Y
4
E
Set the output pin high
Set the relay into action
5


G
Display units' digit
Call fnDelay
K
7
Display tens' digit
Call fnDelay
K
7
6


G
Display units' digit
Call fnDelay
K
7
Display tens' digit
Call fnDelay
K
7
6


G
Display units' digit
Call fnDelay
K
7
Display tens' digit
Call fnDelay
K
7
6

CHAPTER V

CHAPTER V

CONTROL CIRCUIT SECTION

Introduction:

The hardware section mainly consists of relay and contactors, which operate on receipt of a pulse from micro controller, so as to stop the brake motor. A 12V DC input supply is obtained from the main supply through a bridge rectifier and given to the MCT2E opto-isolator. This receives the pulse from the 12^{th} pin of the controller, and the pulse is passed on to the relay after amplification.

5.1 Opto-isolator:

The opto-isolator helps in electrically isolating the control section from the micro controller section, but optically coupling to it. The opto-isolator receives a pulse from the controller, when the counter content reaches zero.

This device consists of an emitter, which is optically coupled to a photo-detector through an insulating medium. This arrangement permits the passage of information from one circuit, which contains the emitter, to the other circuit containing the detector.

Because this information is passed optically across an insulating gap, the transfer is one-way; that is, the detector cannot affect the input circuit. This is important because a low voltage circuit utilizing a micro controller drives the emitter, while the output circuit is a part of an AC load circuit. The optical isolation prevents interaction or even damage to the output circuit to be caused by the relatively hostile output circuit.

The MCT2E is a general-purpose 6-pin DIP. Pins 1 and 2 are generally connected to the emitter, while pins 4, 5 and 6 are connected to the detector. Between emitter and detector is an isolating medium, which incorporates the desired characteristics of high dielectric breakdown, infrared transmissivity, environmental properties, manufacturability and cost. The geometric designs widely used include the opposed isolator package and coplanar isolator package whose geometric designs are shown in the figure.

The output pulse of the optoisolator is fed to the amplification stage which includes two 548 transistors. The amplified output is fed as an input to the relay section. The triggering circuit for the relay is shown in the figure 5.3.

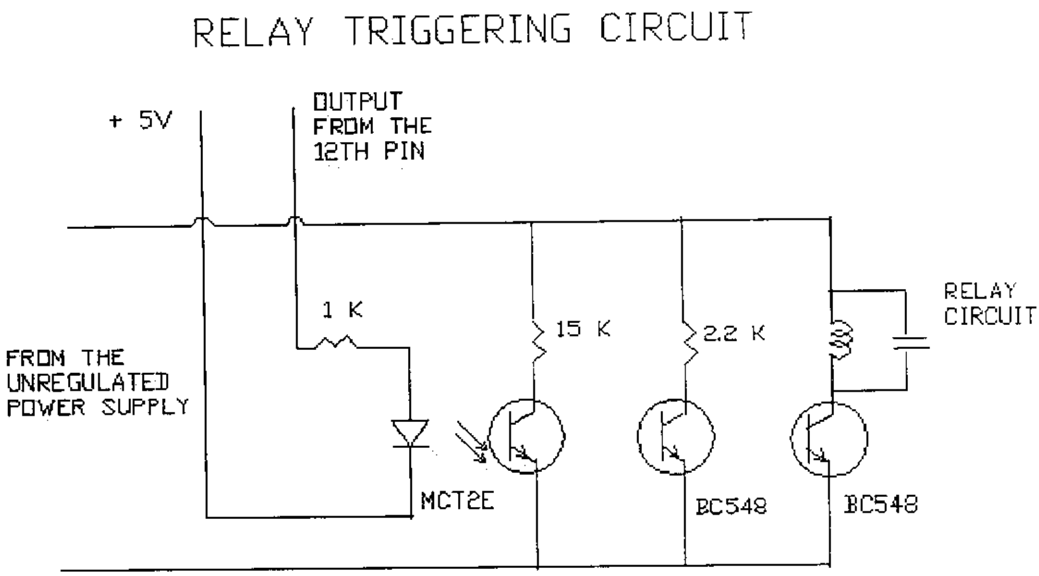


Figure 5.1

5.2 Relay section:

A relay is a simple **electromechanical switch** made up of an electromagnet and a set of contacts. Relays are found hidden in all sorts of devices. A relay, quite simply, is a small machine consisting of an electromagnet (coil), a switch, and a spring. The spring holds the switch in one position, until a current is passed through the coil. The coil generates a magnetic field, which moves the switch. A very small amount of current can be used to activate a relay, and the switch can be made to handle a lot of current.

Relays are amazingly simple devices. There are four parts in every relay:

- Electromagnet
- Armature that can be attracted by the electromagnet
- Spring
- Set of electrical contacts

A relay consists of two separate and completely independent circuits. The first is at the bottom and drives the electromagnet. A switch acts as the controlling power to the electromagnet. When the switch is on, the electromagnet is on, and it attracts the armature. The armature acts as a switch in the second circuit. When the electromagnet is energized, the armature completes the second circuit and the light is on. When the electromagnet is not energized, the spring pulls the armature away and the circuit is not complete.

The following parameters are to be carefully considered when choosing a relay for a particular application:

- The voltage and current that is needed to activate the armature
- The maximum voltage and current that can run through the armature and the armature contacts
- The number of armatures
- The number of contacts for the armature (generally one or two -- the relay shown here has two, one of which is unused)
- Whether the contact (if only one contact is provided) is **n**ormally **o**pen (**NO**) or **n**ormally **c**losed (**NC**)

Working of the relay:

A relay can be considered as an electromagnetic switch. A voltage is applied to the coil and a magnetic field is generated. This magnetic field sucks the contacts of the relay in, causing them to make a connection. These contacts can be considered to be a switch. They allow current to flow between 2 points thereby closing the circuit.

When the switch is open no current can flow through the coil of the relay. As soon as the switch is closed, however, current runs through the coil causing a magnetic field to build up. This magnetic field causes the contacts of the relay to close.

5.3 Contactor Operation:

The mechanical properties of the contactor have been briefly discussed. The contactor is a 4-pole device. The duty of this contactor is AC3, which is normally used for induction motor operation. The contactor that is currently used is of NORMALLY CLOSED type. The principle employed here is to get a high output signal from a low input signal from the relay, in our case it is around 220V, 5A. A standard current of 2A is sufficient for the operation of the contactor. The output that is got from the contactor is around 16A, 415V. The contactor uses a Double breaking mechanism. This mechanism divides the excess current between the two switches in each pole of the contactor, thus providing the DI/DT protection. Intricate knurling is provided on the surface of the contacts to prevent them from welding together.

When the input current from the relay comes into the contactor, the coils inside them get magnetized. This magnetizes the air gap. After a certain limit the force becomes so large that the other part of the coil is attracted towards it. This breaks the circuit connection.

Initially the contactor is in the CLOSED position. During this time the brake motor is in operation. When the input is given from the relay to the contactor, it operates and opens. This cut-off the supply for the brake motor and the supply is simultaneously given to the DC braking system. The contactor helps in isolating the power circuit and the control circuit. This is very important because the control circuit (in our case the Micro-controller) is a sensitive device. We have used contactor instead of a TRIAC since a TRIAC is not mechanically rugged as the contactor.

The operation of relay and contactor circuit is shown in the figure 5.3.

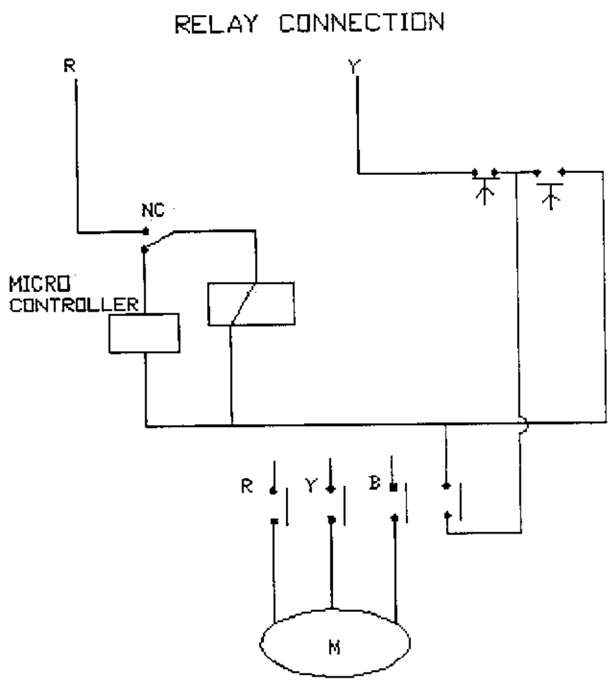


Figure 5.3

5.4 Brake motor:

In order to satisfy our need for efficient braking we go for a special type of motor with Emco brake, which stops instantly when a signal is received. The motor is a 3-phase, 2HP, 1440-rpm motor. The size of the motor is 10.The motor has a separate DC braking system, which needs a voltage of 190V. The AC signal is given to the brake motor as the input. This AC supply is rectified and given to the amplifier circuit. This output is used for the Electromagnetic braking. Initially the supply flows through the normally closed contactor. When the required number of turns is wound, the signal from the controller cuts the supply through the contactor stopping the motor instantly. The advantage of this motor when compared to the other motors is that, the motor stops instantly within 5 radians. This reduces the copper loss and also there is no extra winding. The conventional motor does not stop due to inertia and it takes some time to stop.

CHAPTER VI

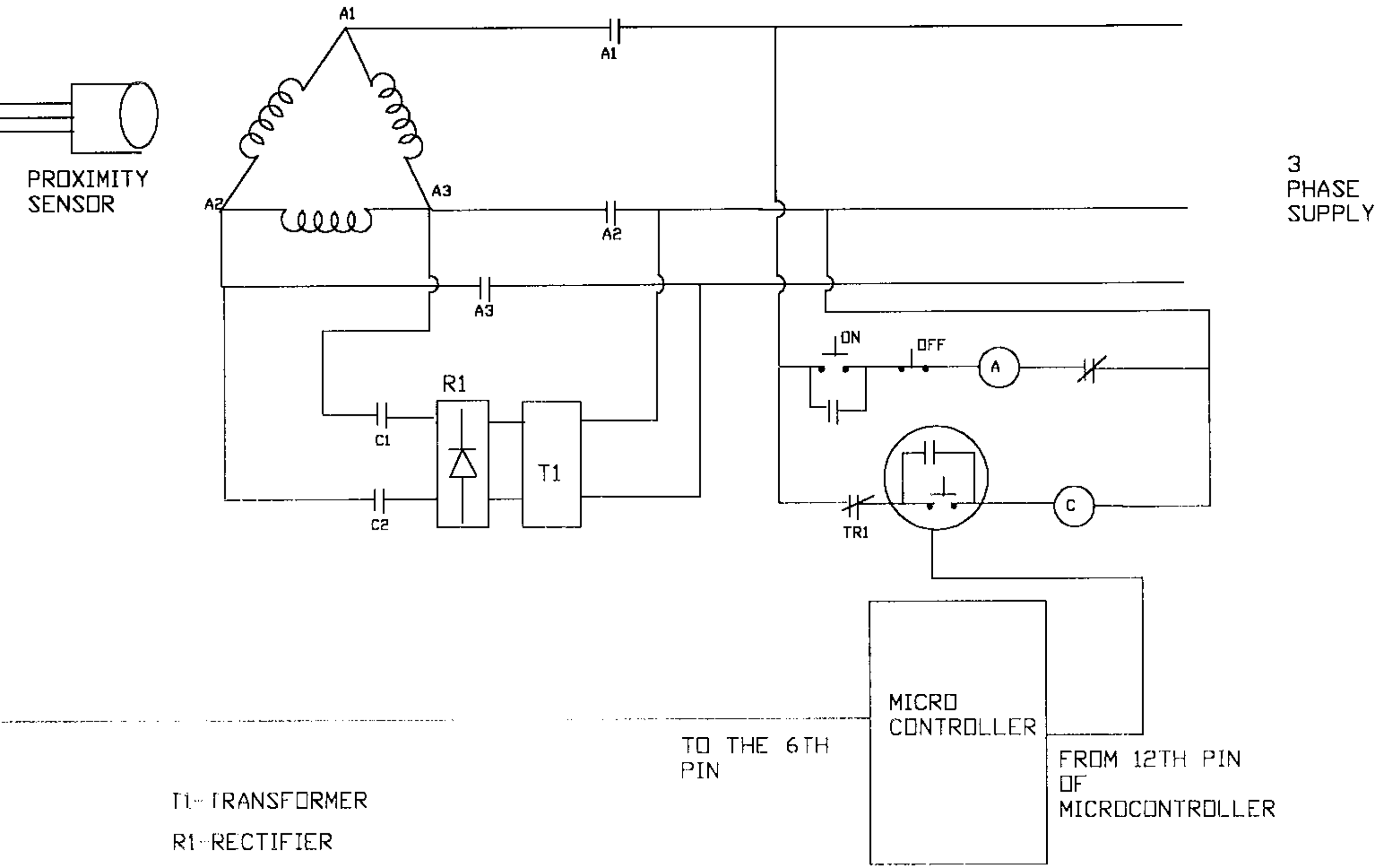
CHAPTER VI

6.1 Testings and Results:

The project is aimed to be implemented successfully in Best Engineers and Pumps Pvt.Ltd. The area where this is used is in the winding of transformers and other Electrical equipments. We would like to present the various components implemented in this project in a nutshell.

- PIC16f84 -Micro controller
- IC 74LS47 -BCD to Seven-segment display converter
- IC 7085 -Regulator
- Seven segment display -Common Anode type
- Contactor - BCH, 16A, 415V
- Brake Motor -2HP, 3 Phase, Emco brake.

The program has been developed using the PIC Micro Controller and the hardware circuit has been designed to complement the program. This project has been tested in the industry and we have been successful in satisfying the requirements of the industry.



T1 – TRANSFORMER

R1 – RECTIFIER

6.2 Conclusion:

The use of embedded systems has eliminated all the problems in the existing method and has been advantageous in many ways.

Some of the problems in the existing methods were

1) Improper termination of the supply to the machine

2) Winding excess turns

3) Copper loss

All these are overcome by the automation done through micro controller programming. This involves the proper termination of the machine at the required number of turns. Thus the winding excess turns and hence the wastage of copper is avoided. Turns to be wound are given as input and it is retained till the processor is off. In addition to this a battery is provided as back up which helps in retaining the last wound turns value in memory. This makes it more user- friendly.

6.3 Scope for Developments:

Our method of automation can further be developed to perform the following:

- Speed control can be performed.

REFERENCES

- Weight of copper can be checked with a preset value.
- Non-destructive testing can be done and also frequency can be adjusted to control the speed properly.

To conclude with, automation of winding machine is done in the most adequate and accurate way using embedded systems. This makes the winding operation much efficient and cost effective in application. We, as novices have taken our sincere efforts to make this project a successful one.

REFERENCES

1. Carl Berquist, **"Guide to PIC Micro Controllers"**, BPB Publications.

2. Albert Paul Malvino, Donald P.Leech, **"Digital Principles and Applications"**, Tata McGraw-Hill publishing Company Limited, 1993.

3. Ramesh S.Gaonkar, **"Microprocessor Architecture, Programming and Applications with 8085/8080a"**, new Age International, Publishers, 1995.

4. William H.Gothmann, **"Digital Electronics"**, Printice Hall of India Pvt.Ltd., 1987.

5. **"Micro Chip guide"**, Micro chip Inc.

6. **"Micro chip users manual"**, Micro Chip Inc.

APPENDIX-A

PROGRAM FOR THE PIC16F84

```
        list p=16f84

#define         PORTA           0x05
#define         PORTB           0x06
#define         STATUS          0x03
#define         INTCON          0x0b


#define         pUnit_inc       PORTB,3
#define         pTens_inc       PORTB,7
#define         pStart          PORTB,5
#define         pOut            PORTB,6


#define         pUnitDisplay            PORTB,1
#define         pTensDisplay            PORTB,2


#define                 F       .1
#define                 W       .0
#define                 Z       .2

;---------------Cblock-----------------

        cblock 0x10
varUnitDigit
varTensDigit
varTempCount
        endc

;-------------------------------------

                org 0x00
Main:

        Call            fnInitIO
```

```
ReMain:

        call        fnInitRam
        call        fnSetTurns
        call        fnOnWork
        call        fnOPPulse
        goto        ReMain

;---------------------------------------

fnSetTurns:

        call        fnDisplay
        btfsc       pUnit_inc               ;update unit
        call        fnUpdate_unit

        btfsc       pTens_inc               ;update tens
        call        fnUpdate_tens

        btfss       pStart
        goto        fnSetTurns

        return

;---------------------------------------------------

fnUpdate_unit:

        btfsc       pUnit_inc
        goto        $-1

        movlw       .9
        xorwf       varUnitDigit,W
        btfss       STATUS,Z
        goto        labMakeZero
        incf        varUnitDigit,F
        return
```

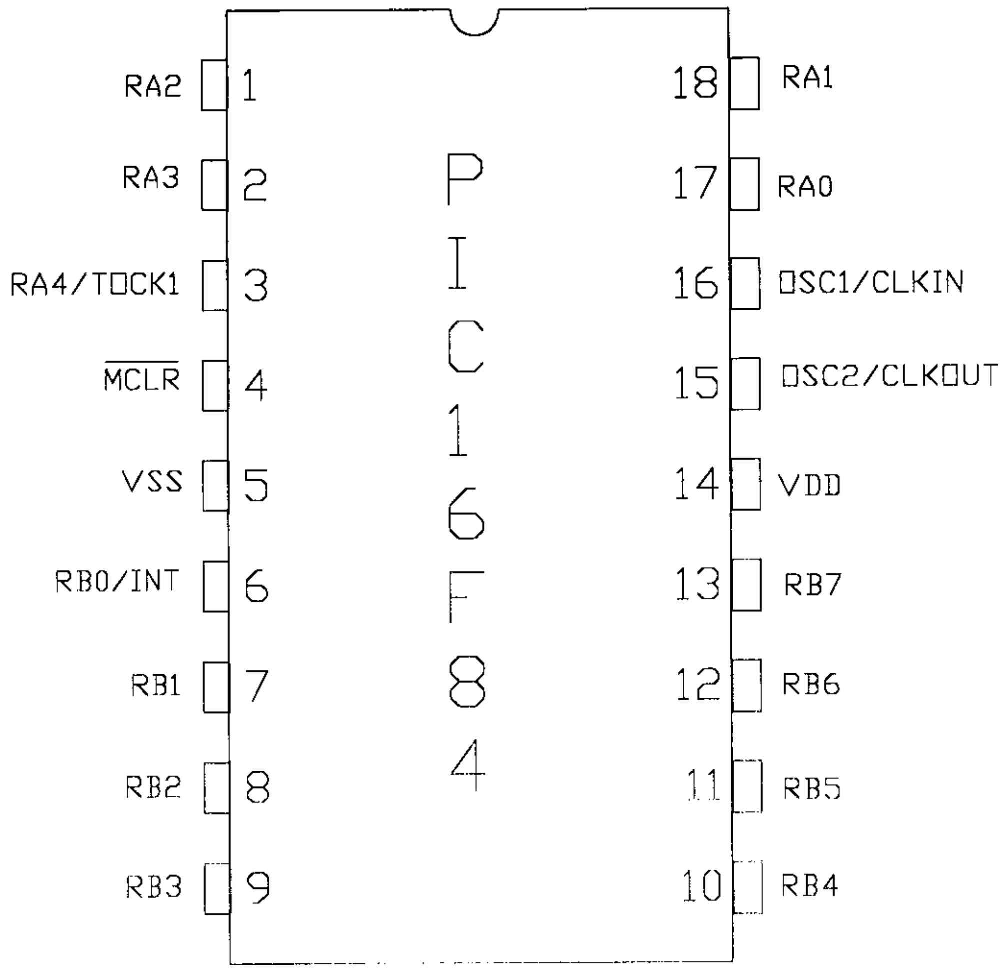
```
labMakeZero:

        clrf        varUnitDigit
        return

;----------------fnUpdate_tens---------------------------

fnUpdate_tens:

        btfsc       pTens_inc
        goto        $-1

        movlw       .9
        xorwf       varTensDigit,W
        btfsc       STATUS,Z
        goto        labMakeZeroten
        incf        varTensDigit,F
        return

labMakeZeroten:

        clrf        varTensDigit
        return

;-------------------------------------------------------

fnOnWork:

        bcf         pOut
        call        fnDisplay

        movf        varUnitDigit,F
        btfss       STATUS,Z
        goto        $+5
        movf        varTensDigit,F
        btfss       STATUS,Z
        goto        $+2
        return
```

```
        btfss       PORTB,0
        call        fnISR

        goto        fnOnWork

;-------------------------------------------------

fnISR:

        call        fnDelay
        call        fnDelay

        btfss       PORTB,0
        goto        $-1

        movf        varUnitDigit,F
        btfss       STATUS,Z
        goto        $+5
        decf        varTensDigit,F
        movlw       .9
        movwf       varUnitDigit
        return

        decf   varUnitDigit,F
        return

;-----------------------------------------

fnDelay:

        movlw       .40
        movwf       varTempCount
        decfsz      varTempCount,f
        goto   $-1
        nop
        nop

        return

;---------------------------------------
```

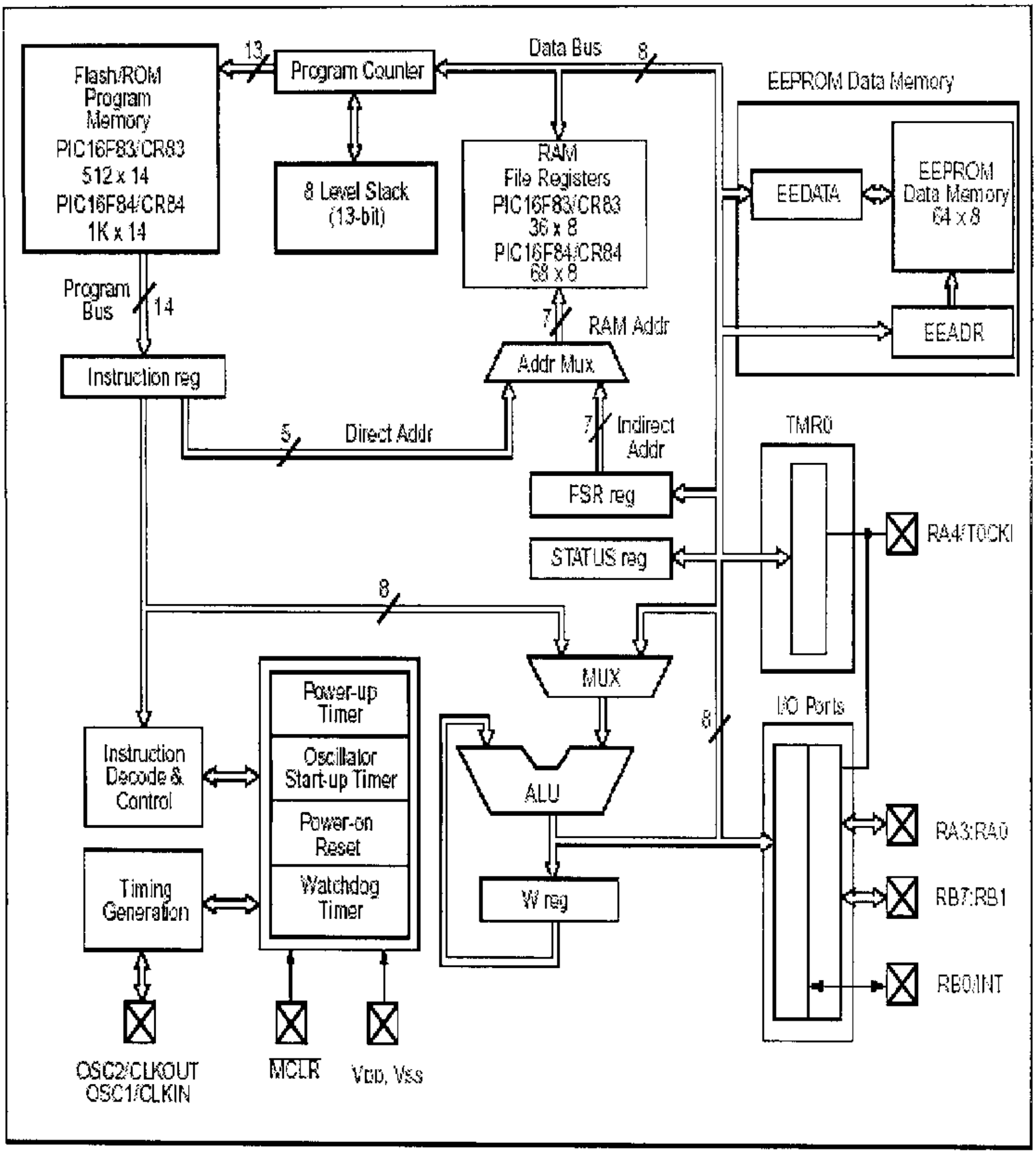
```
fnDisplay:

        movf        varUnitDigit,W
        movwf       PORTA
        bcf   pUnitDisplay
        call  fnDelay
        bsf   pUnitDisplay


        movf        varTensDigit,W
        movwf       PORTA
        bcf         pTensDisplay
        call        fnDelay
        bsf         pTensDisplay
        return


;------------fnInitRam--------------------

fnInitRam:

        clrf  varUnitDigit ;reset unit digit & tens digit to 0
        clrf  varTensDigit

        return

;------------fnInitIO---------------------

fnInitIO:

        bsf   STATUS,5                      ;change to bank 1
        clrf  PORTA
        movlw       0xb9                    ;CNTRL word for TRISB
        movwf       PORTB
        bcf   0x01,7                        ;Pull ups enabled in OPTION
        bsf   STATUS,5                      ;change to bank 0

        return
```

```
;-----------------------------------------------------
fnOPPulse:
        bsf     pOut                            ;put OP high
        return
;-----------------------------------------------------
        end
```

APPENDIX-B


PIC16F84
RA2 1
RA3 2
RA4/TOCK1 3
MCLR 4
VSS 5
RB0/INT 6
RB1 7
RB2 8
RB3 9
18 RA1
17 RA0
16 OSC1/CLKIN
15 OSC2/CLKOUT
14 VDD
13 RB7
12 RB6
11 RB5
10 RB4

1. BLOCK DIAGRAM – PIC16F84

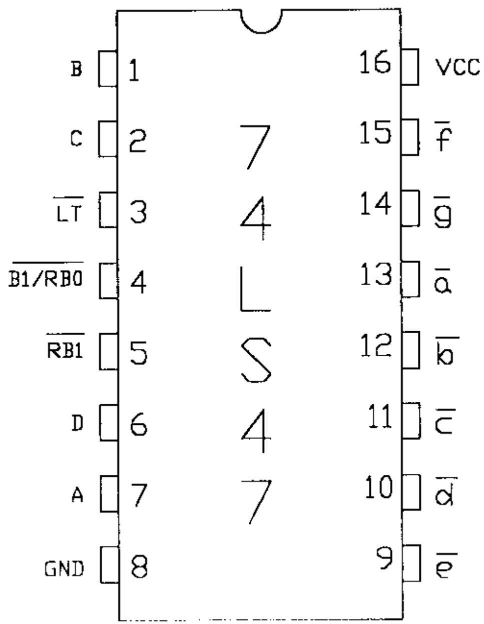


2. PIC16F84 PIN-OUT DESCRIPTION

Pin Name	DIP No.	SOIC No.	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	16	16	I	ST/CMOS (3)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	15	15	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
$\overline{MCLR}$	4	4	I/P	ST	Master clear (reset) input/programming voltage input. This pin is an active low reset to the device.
					PORTA is a bi-directional I/O port.
RA0	17	17	I/O	TTL	
RA1	18	18	I/O	TTL	
RA2	1	1	I/O	TTL	
RA3	2	2	I/O	TTL	
RA4/T0CKI	3	3	I/O	ST	Can also be selected to be the clock input to the TMR0 timer/counter. Output is open drain type.
					PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	6	6	I/O	TTL/ST (1)	RB0/INT can also be selected as an external interrupt pin.
RB1	7	7	I/O	TTL	
RB2	8	8	I/O	TTL	
RB3	9	9	I/O	TTL	
RB4	10	10	I/O	TTL	Interrupt on change pin.
RB5	11	11	I/O	TTL	Interrupt on change pin.
RB6	12	12	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming clock.
RB7	13	13	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming data.
V_{SS}	5	5	P	—	Ground reference for logic and I/O pins.
V_{DD}	14	14	P	—	Positive supply for logic and I/O pins.

Legend: I= input O = output I/O = Input/Output P = power
— = Not used TTL = TTL input ST = Schmitt Trigger input

Note 1: This buffer is a Schmitt Trigger input when configured as the external interrupt.
2: This buffer is a Schmitt Trigger input when used in serial programming mode.
3: This buffer is a Schmitt Trigger input when configured in RC oscillator mode and a CMOS input otherwise.


7
4
L
S
4
7
B 1
C 2
LT 3
B1/RB0 4
RB1 5
D 6
A 7
GND 8
16 VCC
15 f
14 g
13 a
12 b
11 c
10 d
9 e

PIN-OUT OF COMMON ANODE SEVEN-SEGEMENT DISPLAY