MICROCONTROLLER BASED LIFT CONTROL SYSTEM

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ABSTRACT

Lift or elevator is transport devices that are used to move goods or peoples vertically. In this project, the Motorola MC68CH11 A1 microcontroller based lift control system is constructed to simulate as an actual lift in the real life. This project dissertation documents the findings and results of a research on a microcontroller based lift control system. It provides useful information to those who wish to carry out a lift control system research or project.

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LIST OF ABBREVIATION

MCU	-	Microcontroller Unit
MicroC	-	Microcontroller
MicroP	-	Microprocessor
CPU	-	Central Processing Unit
ROM	-	Read-Only Memory
RAM	-	Random Access Memory
ADC	-	Analog-to-Digital Converter
HCMOS	-	High-Density Complementary Metal-Oxide Semiconductor
CMOS	-	Complementary Metal-Oxide Semiconductor
EEPROM	-	Electrically Erasable Programmable ROM
CCR	-	Condition Code Register
I/O	-	Input output
SFR	-	Special Function Register
SCI	-	Serial Communications Interface
SPI	-	Serial Peripheral Interface
CLK	-	Clock
LCD	-	Liquid Crystal Display
PWM	-	Pulse Width Modulation
IC	-	Integrated Chip
DC	-	Direct Current
IR	-	Infra-red
PC	-	Personal Computer
NRZ	-	non-return-to zero
LED	-	Light Emitting Diodes

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CHAPTER I

INTRODUCTION

1.1 Introduction

Lift or *elevator*, is a transport device that is very common to us nowadays. We use it everyday to move goods or peoples vertically in a high building such as shopping center, working office, hotel and many more. It is a very useful device that moves people to the desired floor in the shortest time.

This project dissertation documents the findings and results of a research on a microcontroller based lift control system. It provides information, which is useful to those who wish to carry out a lift control system research or project.

In this project, Motorola 68HC11 A1 microcontroller is used as the primary controller. Besides, it is consist of various inputs and outputs circuits together with a lift model. The MC68HC11 A1 microcontroller is used to coordinate the functions of various hardware circuitries. Service request circuit or keypad and sensors are used as input. Stepper motor driver circuit, DC motor circuit, seven-segment display, buzzers and various types of LED (light emitting diodes) displays are used as output.

The lift model was constructed to simulate an actual lift in the real life. It can be counted as the output hardware of the system. The software for the system was designed according to the real lift traffic management algorithm. The combination of the hardware and software perform the simulate function of a basic lift system.

1.2 Objective of Study and Scope

In this project, lift control system is going to be produce by using microcontroller. Thus, the main objectives for this project is to design and construct a microcontroller based lift control system.

There are some scopes which needed to achieve the objective for this project:

a) To design a lift control system by using microcontroller MC68HC11 A1.

b) To design the program (software) for the overall system according to the real lift traffic management algorithm

c) To integrate the hardware and software in order to simulate the functions of a basic lift system.

d) To build a lift model to simulate the actual system.

CHAPTER II

LITERATURE REVIEW

2.1 Elevator

An *elevator* is a transport device used to move goods or people vertically. In British English and other Commonwealth English, elevators are known more commonly as lifts, although the word elevator is familiar from American movies and television shows.

(Wikipedia, 2 August 2005)

2.1.1 History of Elevator

Elevators began as simple rope or chain hoists. An elevator is essentially a platform that is either pulled or pushed up by a mechanical means. A modern day elevator consists of a cab (also called a "cage" or "car") mounted on a platform within an enclosed space called a shaft or more correctly a hoist way. In the past elevator drive mechanisms were powered by steam and water hydraulic pistons.

(Wikipedia, 2 August 2005)

During the middle ages, the elevator operated by animal and human power or by water-driven mechanisms. The elevator as we know it today was first developed during the 1800s and relied on steam or hydraulic plungers for lifting capability. In the latter application, the cab was affixed to a hollow plunger that lowered into an underground cylinder. Liquid, most commonly water, was injected into the cylinder to create pressure and make the plunger elevate the cab, which would simply lower by gravity as the water was removed. Valves governing the water flow were manipulated by passengers using ropes running through the cab, a system later enhanced with the incorporation of lever controls and pilot valves to regulate cab speed. The granddaddy of today's traction elevators first appeared during the 19th century in the United Kingdom, a lift using a rope running through a pulley and a counterweight tracking along the shaft wall.

(Elevator Info, 1992)

In the 1800s, with the advent of electricity, the electric motor was integrated into elevator technology by German inventor Werner von Siemens. With the motor mounted at the bottom of the cab, this design employed a gearing scheme to climb shaft walls fitted with racks. By 1903, this design had evolved into the gearless traction electric elevator, allowing hundred-plus story buildings to become possible and forever changing the urban landscape. Multi-speed motors replaced the original single-speed models to help with landing-leveling and smoother overall operation. Electromagnet technology replaced manual rope-driven switching and braking. Besides, Push-button controls and various complex signal systems modernized the elevator even further. Safety improvements have been continual, including a notable development by Charles Otis.

(Charles Otis, 1996)

Today, there are intricate governors and switching schemes to carefully control cab speeds in any situation. Buttons have been giving way to keypads. Virtually all commercial elevators operate automatically and the computer age has brought the microchip-based capability to operate vast banks of elevators with precise scheduling, maximized efficiency and extreme safety. Elevators have become a medium of architectural expression as compelling as the buildings, in which they are installed, and new technologies and designs regularly allow the human spirit.

(Elevator Info, 1992)

2.2 Microcontroller

2.2.1 Microprocessor, Microcomputer and Microcontroller

Microprocessor is a CPU (Central Processing Unit) that is compacted into a single chip semiconductor device [1]. It is a general-purpose device, suitable to perform many kinds of applications. When the microprocessor is combined with input or output and memory devices, it is called microcomputer [1]. The choice of these devices that are combined depends on the specific application. For example, most personal computers contain a keyboard and monitor as standard input and output devices.

The major difference of a microcontroller compared to a microprocessor and microcomputer is that microcontroller consists of central processing unit (CPU), memory devices (ROM and RAM), input and output ports and timer embedded into a single chip [2]. They also have many on-chip facilities such as serial port, counters, analog to digital converter and interrupt control so that they can be interfaced with hardware and control functions of many kinds of application. It is ideal for many applications in which cost and space are critical.

Microcontroller has a wide range of applications in many control-oriented activities. For example, they are used as engine controllers in automobiles and as exposure and focus controllers in cameras as well as they are used in a lift control system. The difference between microprocessor and microcontroller is shown in Figure 2.1.

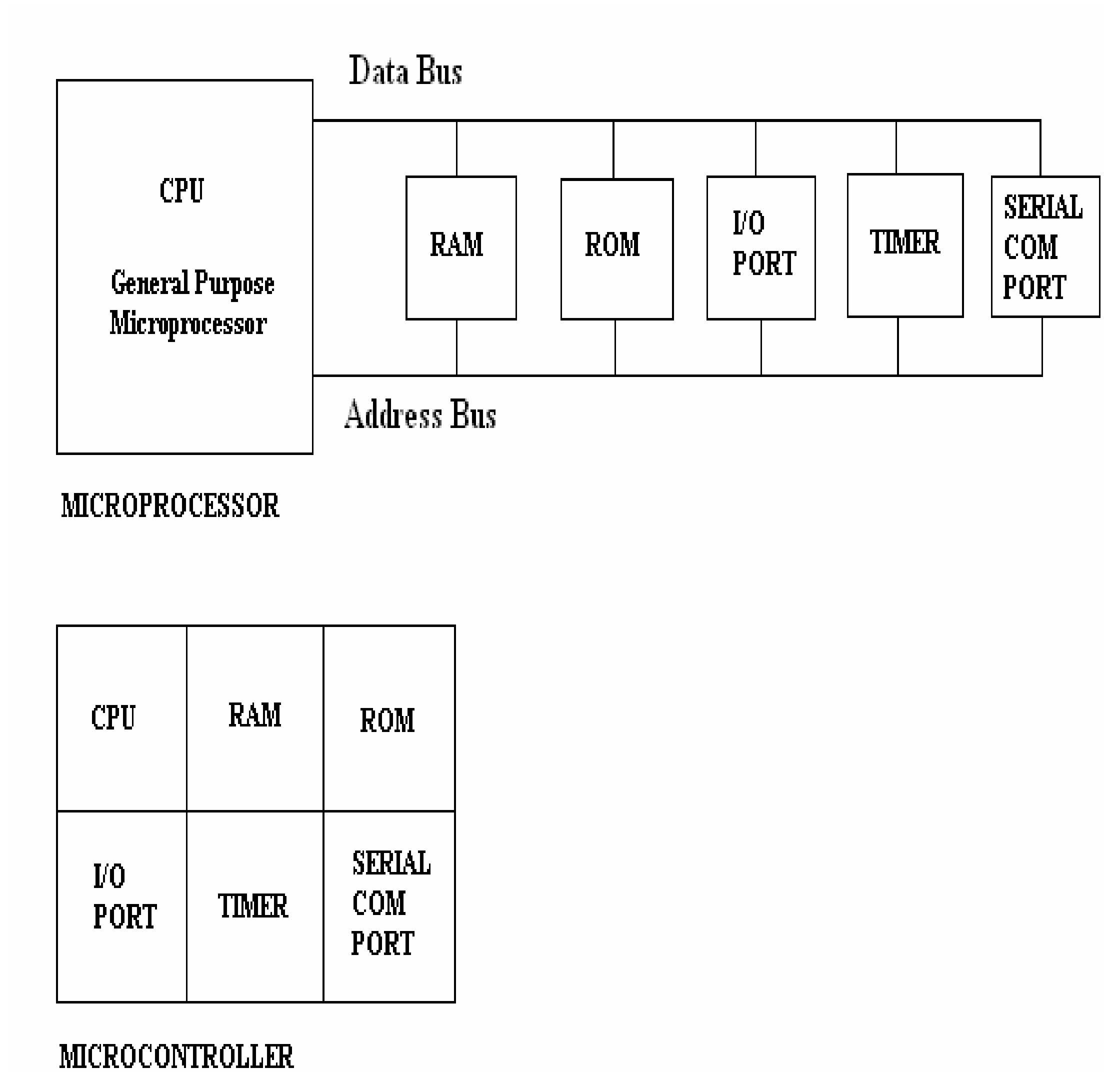

Figure 2.1: The Difference between Microprocessor and Microcontroller

2.3 Motorola 68HC11 Family Overview

Microcontroller is a high performance single chip controller with simple assembly language, input and output together with peripheral capacities, which would increase the range of applicability and reduce total of system cost [3]. Motorola introduced 6800 as its first processor. It is followed by 6808, 6802 and 6803 with added features [2]. In 1985, Motorola developed the high performance 68HC11 with added features such as analog to digital converter (ADC) and output compare. Then, in 1991, Motorola introduced 68HC16 which is upward compatible to 68HC11 [2]. It uses the High-Density Complementary Metal-Oxide Semiconductor (HCMOS) technology to produce faster and small controller with less power consumption and high tolerance for noisy signal [2]. In this project, 68HC11 A1 is use as the controller for the system.

Features included in Motorola 68HC11 A1 microcontroller are:

1. Power-saving stops and waits modes
2. Low voltage devices available (3.15 – 5.5Vdc)
3. 8 bit analog to digital converter (ADC)
4. 16 bit timer system
5. 256 bytes of on-chip RAM
6. 512 bytes EEPROM

Some comparisons feature and comments of the family member for MC68HC11 is shown in table 2.1

Table 2.1: Comparison features of MC68HC11 Family Members

Part Number	EPROM	ROM	EEPROM	RAM	CONFIG[2]	Comments
MC68HC11A8	—	—	512	256	$0F	Family Built Around This Device
MC68HC11A1	—	—	512	256	$0D	'A8 with ROM Disabled
MC68HC11A0	—	—	—	256	$0C	'A8 with ROM and EEPROM Disabled
MC68HC811A8	—	—	8K + 512	256	$0F	EEPROM Emulator for 'A8
MC68HC11E9	—	12K	512	512	$0F	Four Input Capture/Bigger RAM 12K ROM
MC68HC11E1	—	—	512	512	$0D	'E9 with ROM Disabled
MC68HC11E0	—	—	—	512	$0C	'E9 with ROM and EEPROM Disabled
MC68HC811E2	—	—	2K[1]	256	$FF[3]	No ROM Part for Expanded Systems
MC68HC711E9	12K	—	512	512	$0F	One-Time Programmable Version of 'E9
MC68HC11D3	—	4K	—	192	N/A	Low-Cost 40-Pin Version
MC68HC711D9	4K	—	—	192	N/A	One-Time Programmable Version of 'D3
MC68HC11F1	—	—	512[1]	1K	$FF[3]	High-Performance Non-Multiplexed 6B-Pin
MC68HC11K4	—	24K	640	768	$FF	> 1 Mbyte memory space, PWM, C_S, 84-Pin
MC68HC711K4	24K	—	640	768	$FF	One-Time Programmable Version of 'K4
MC68HC11L6	—	16K	512	512	$0F	Like 'E9 with more ROM and more I/O, 64/68
MC68HC711L6	16K	—	512	512	$0F	One-Time Programmable Version of 'L4

2.4 Architecture of Microcontroller 68HC11

The M68HC11 is optimized for low power consumption and high-performance operation used to achieve a normalize bus speed of 2 MHz [4]. The 68HC11 chip includes many features that often must be implemented with external hardware to the microprocessor itself. Some the features include:

1. Serial line input and output
2. Analog to digital converter
3. Programmable timers
4. Counters

The construction of MC68HC11 A1 is same as MC68HC11. The simplified block diagram of the standard 68HC11 is shown in Figure 2.2.

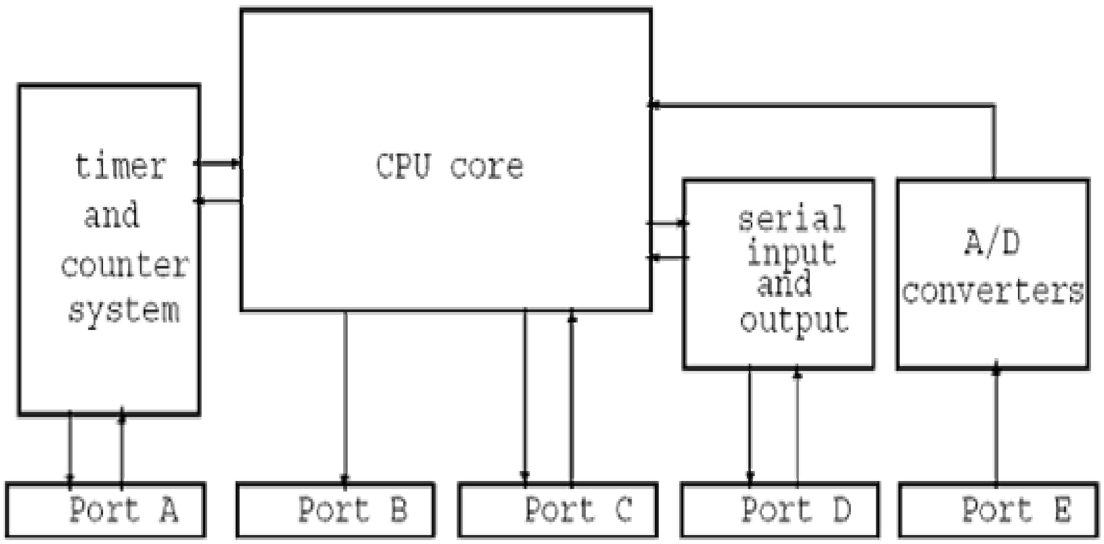

Figure 2.2: Simplified System Block Diagram of 68HC11

Figure 2.3 is a functional block diagram of the MC68HC11 Microcontroller Unit (MCU). This diagram shows the major sub-systems and how they relate to the pins of the microcontroller unit (MCU).

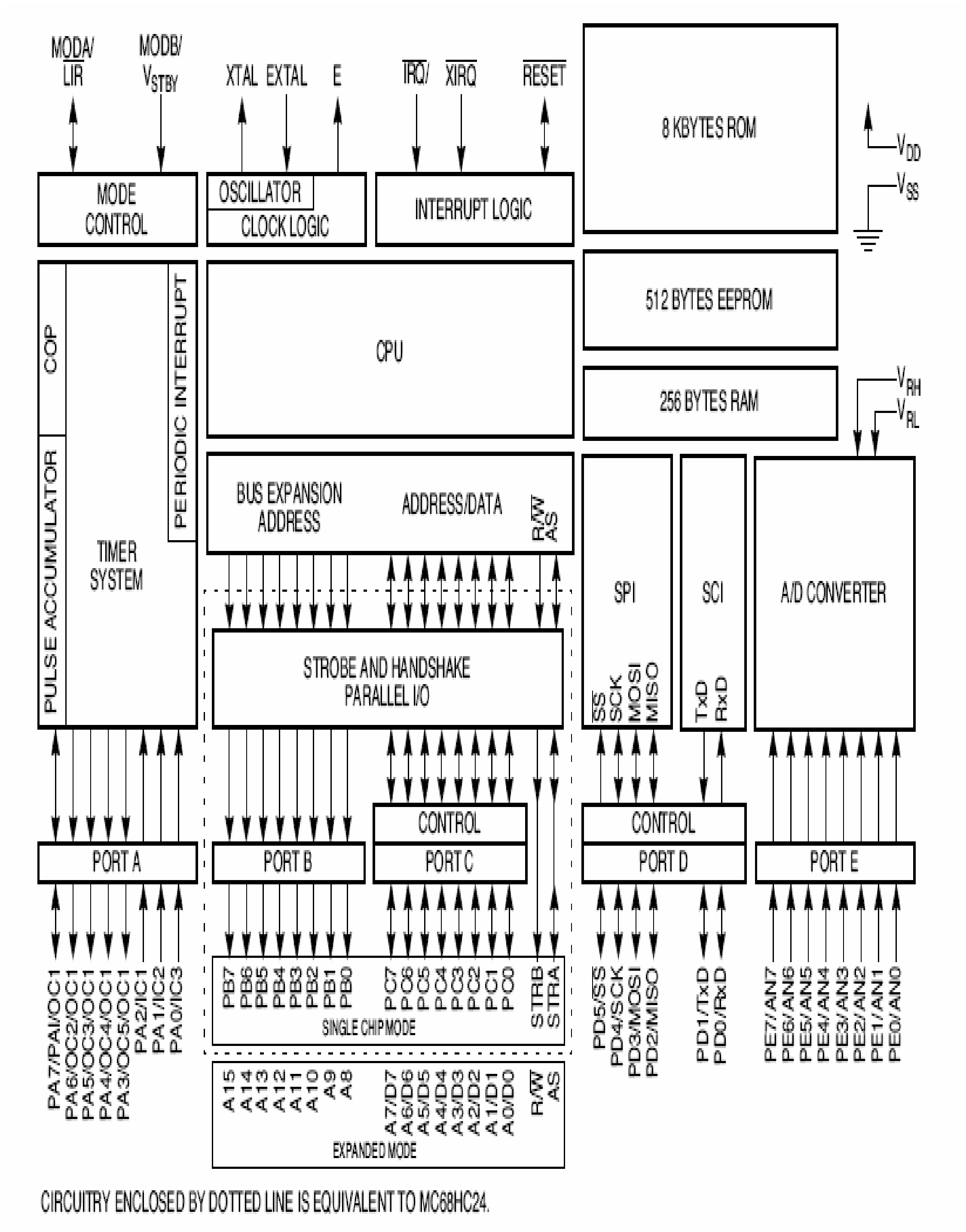

Figure 2.3: Functional block Diagram of M68HC11

2.5 Pin Configuration and Its Function

The pin assignment of the MH68HC11 A1 is shown in the figure 2.4. It consists of 48 pin and each pin has its own function.

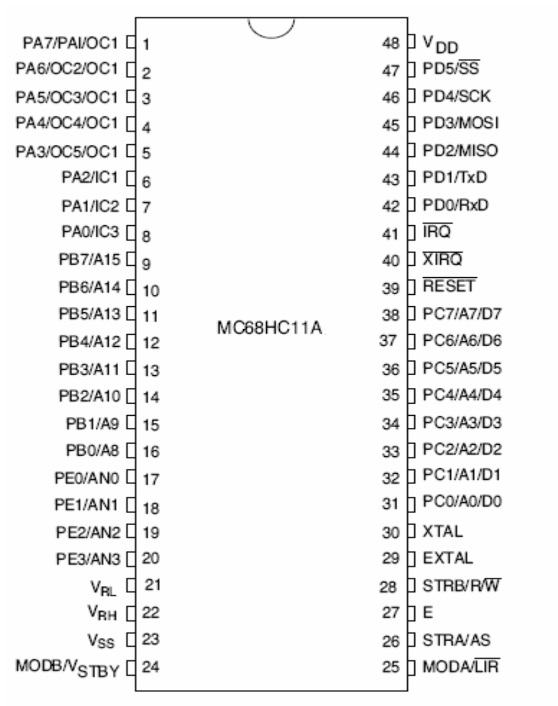

Figure 2.4: Pin Assignment for 48-pin SDIP

2.5.1 V_{DD} and V_{SS}

Power is supplied to the Microcontroller Unit (MCU) through V_{DD} and V_{SS}. V_{DD} is the power supply, and V_{SS} is ground. The Microcontroller Unit (MCU) operates from a single 5-volt (nominal) power supply. Low-voltage devices in the A series operate at 3.0–5.5 volts [5].

2.5.2 RESET

A bidirectional control signal, RESET acts as the input to initialize the MCU and therefore to a known startup state. It is active low, by applying low pulse to this pin; the microcontroller will reset and terminates all activities. This is often referred as power reset [4].

2.5.3 Crystal Driver and External Clock Input (XTAL and EXTAL)

These two pins provide the interface for either a crystal or a Complementary Metal-Oxide Semiconductor (CMOS) - compatible clock to control the internal clock generator circuitry. The frequency applied to these pins is four times higher than the desired E-clock rate. The XTAL pin must be left un-terminated when an external CMOS-compatible clock input is connected to the EXTAL pin. The XTAL output is normally intended to drive only a crystal [5]. The crystal use here is 8MHz. the connection is shown in figure below:

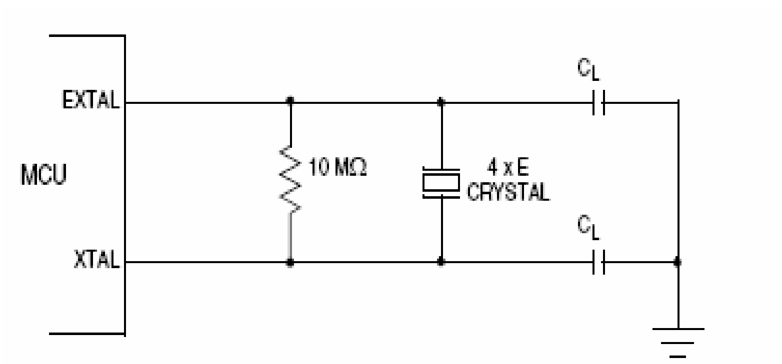

Figure 2.5: Connection of the Crystal to the MCU

2.5.4 E-Clock Output (E)

E is the output connection for the internally generated E clock. The signal from E is used as a timing reference [5]. The frequency of the E-clock output is one fourth that of the input frequency at the XTAL and EXTAL pins. When E-clock output is low, an internal process is taking place. When it is high, data is being accessed. All clocks, including the E clock, are halted when the MCU is in stop mode [5].

2.5.5 Interrupt Request (IRQ)

The IRQ input provides a means of applying asynchronous interrupt requests to the MCU. Either negative edge-sensitive triggering or level-sensitive triggering is program selectable (OPTION register). IRQ is always configured to level-sensitive triggering at reset [4].

2.5.6 Non-Maskable Interrupt (XIRQ/VPPE)

The XIRQ input provides a means of requesting a non-maskable interrupt after reset initialization. During reset, the X bit in the condition code register (CCR) is set and any interrupt is masked until MCU software enables it [6].

2.5.7 MODA and MODB

There are four operating modes: Single-chip mode, expanded mode, test mode and bootstrap mode [5]. These modes can be obtained by set the MODE A and MODE B as shown in Table 2.2.