EFFECTIVE BUILDING ENERGY MANAGEMENT SYSTEM

By

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FINAL REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
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(Electrical & Electronics Engineering)

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CERTIFICATION OF APPROVAL

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Solihah Binti Mohd Salahuddin

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Last but not least, I would like to thank my parents and family, for having faith in me, and also for the words of inspiration that kept me going.

ABSTRACT

The energy management is crucial in the present time, as proper energy utilization will improve industry competitiveness and ensure a more sustainable energy in future. The focus of this project is on building's energy management system where the main purpose is to use of energy efficiently and reduce energy consumption. There are several factors which contribute to the energy consumption of buildings in Malaysia but the major factors are lighting as well as cooling. In 9th Malaysian plan, the aim is to ensure that efficient utilization of energy resources and minimization of wastage; and the focus will be on energy efficiency initiatives, particularly in the industrial, transport and commercial sectors as well as in government buildings. Software to estimate cooling load has been produced and in many ways will help a lot in identifying the energy use for a particular area. A prototype of an area which is well equipped and system for energy efficiency and saving is produced. The system is used for controlling the energy consumption of lighting and cooling. For lighting system, the use of occupancy sensor for controlling the on and off of the lights will definitely reduce the energy wastage. Besides, using the energy efficient equipment such as energy saver bulb can definitely lower the power consumption. As for cooling system, the temperature surrounding is monitored by the temperature sensor and the microcontroller will control the temperature of the air-conditioning system depends on the room temperature at that time. In addition, the occupancy sensor will send signal to the controller either to on or off depending on the present of people in the particular room. A small feature is added into the system where the blind used is automated using the photo sensor to control the amount of lights getting into the room.

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LIST OF ABBREVIATIONS

EE	Energy Efficiency
BEMS	Building Energy Management System
PTM	Pusat Tenaga Malaysia
FYP	Final Year Project
UTP	Universiti Teknologi PETRONAS
BAS	Building Automation System
MEP	Mechanical, Electrical and Plumbing
PCB	Printed Circuit Board
PIC	Programmable Integrated Circuit
LDR	Light Dependent Resistor
GUI	Graphical User Interface

CHAPTER 1
INTRODUCTION

This section will give an overview of this project entitled 'Effective Building Energy Management System' which consists of the background of study, problem statement, and also objective and the scope of study.

1.1 Background of study

Energy efficiency has not been practiced widely around Malaysia but the government has encouraged and exposed the benefits of applying it. Therefore, the use of appliances and equipments which contribute to the energy saving and energy efficiency is essential. This is in order to prevent a lot of energy wastage and saving them. Energy becomes more and more vital and plays an important role in people's life and daily activities nowadays. In Malaysia, the consumption of energy per year is divided into types of buildings and most of the energy are utilized for lightings and air-conditioning system. The types of buildings categorized are the residential, hotels, shopping complexes and also offices. Most of the electricity energy is being used by the shopping complexes and also offices.

The level of awareness among industries and building owners of saving energy in their premises need to be increased. Businesses should be made to realize that energy management is as important as managing their financial and human resources. Proper maintenance in buildings can also make a difference in terms of energy savings with little or no investment at all.

Therefore, this project will hopefully contribute to a better energy wise to these buildings in future particularly for offices and shopping complexes. Basically, the project will be focusing on how to reduce the energy consumption of cooling and lightings in a particular building.

1.2 Problem Statement

The purpose of this project is to come out with the best approach to manage the energy consumption and energy use of an office building. It means that, the energy consumption for cooling especially must be reduced as well as the heat and energy transfer in the building. The aim of this project is to produce a solution for saving the energy consumption and the amount of energy being used as well as contribution to energy efficiency.

1.2.1 Problem Identification

Building Energy Management System (BEMS) is designed due to the waste and misuse of energy. Energy especially electricity can be save and utilize wisely in future. Besides that, the amount of energy use can be cut-off and contributes to low expenditure. Less electricity consumption can actually protects the environment and avoid greenhouse effect. Electricity is generated using fuel oil where the gas emissions will pollute the air and emits carbon monoxide therefore less usage of electricity will lessen the gas emissions.

1.2.2 Significant of the Project

The energy utilized nowadays is in a large amount which definitely will cost a lot of money. The government has actually encouraged the citizens to use the electricity efficiently and there are a lot of ways to apply them. Therefore, this project will certainly help the country in such a way and expected to be economically feasible in future.

1.3 Objective and Scope of Study

In every project accomplishments, there will always be some objectives to endeavor and achieved so that in the end, the project can be completed successfully during the time frame given.

The objectives of this project are:

- To reduce the energy consumption of an office building
- To come out with an effective BEMS
- To integrate the software and hardware using serial port interface

The scope of study for this project is implementing energy efficiency in UTP office building where BEMS for UTP office building will be developed.

CHAPTER 2
LITERATURE REVIEW/THEORY

In this section, the literature reviews will support all the facts and information regarding this project. Besides that, some theory related to the topic will be pointed out in order to provide a better understanding of this project.

2.1 Energy Efficiency Concept

Energy efficiency is very important nowadays in order to save energy consumption as well as saving money and helps to protect the environment by reducing the amount of electricity that needs to be generated. Besides that, energy efficiency also reduces economic costs and environmental impacts as well as using less energy or electricity to perform the same function or job even better [2].

2.2 Energy Efficiency in Office Buildings

EE in office buildings means use less energy for heating, cooling and lighting. It also means buying energy-saving appliances and equipment for use in the building. [3] In Malaysia, cooling and lighting systems typically use the most energy in a building. The addition of efficient controls, such as programmable thermostat or timer can significantly reduce the energy use of this system. For commercial buildings, maximizing the use of Building Energy Management System (BEMS) can provide the best approach to energy-efficient cooling and lightings.

For this particular project, the focus is on office buildings, which use a very large amount of energy especially in cooling and lightings. The model building is the UTP's office buildings well-equipped with lightings and cooling systems.

2.3 Cooling System in Office Buildings

Basically, there are two types of cooling system in office buildings, a central cooling system or split unit. The central cooling system usually uses the air handling unit where chilled water is used to cool the air supply to a particular area. As for split unit, the cooling system operates individually where the air from outside is cooled using compressor and the evaporator.

2.4 Building Envelope and Material

The building materials or building envelope are one of the factors which contribute to the gain and loss of heat. The materials, including roofs, walls, windows and floors. The lower the u-value of the material, least heat absorption occurs. Comparing between the glass and brick wall, brick definitely will have least heat absorption as it contains very tiny wholes filled with air as insulation. The U-value of double glass is lower than single glass due to the air insulation between the two glasses.

2.5 Reducing Cooling Power Consumption

Most of energy in buildings are consumed for cooling purposes. In Malaysia, the optimization of energy consumption is still in progress where in the Ninth Malaysian plan the aim is to ensure that efficient utilization of energy resources and minimization of wastage [4]. In cooling system, windows have a significant role in connecting the indoor environment of buildings to the outdoor. Buildings with a large amount of glazing have higher electrical demand. Therefore, a good window design and best orientation should be analyzed and later be implemented.

Besides that, factors such as sensor-based demand controlled ventilation, use of renewable energy resources for driving cooling control systems, setting the comfort temperature to its higher value, optimal thermal design buildings, reducing lighting usage in daytime and also using day-lighting, will give an impact to the whole cooling system.

2.6 Lighting Controller in Building Energy Management System

Not many building control systems nowadays integrate the main innovations in the BEMS. In particular, the continuous adaptation of the system to the environment and building characteristics is a very promising feature that is rarely studied; only few studies have been done on adaptive controllers in buildings and nearly never implemented. In addition, a predictive approach in the control algorithms is quite necessary to obtain really efficient control systems. [5]

2.7 Building Automation Systems

Building automation system (BAS) begins with plans and specifications produced by mechanical, electrical and plumbing (MEP) design engineer. The MEP plans include equipment and process schematic which specify the locations of control elements and sensors for the mechanical system. It is an overall process and specifications of control strategy for heating, ventilation and air-conditioning system. A database configuration then created for the control system, which establishes communication, network and device parameters as well as input/output (I/O) configuration parameters. [6]

An automatic control system can be created either for controlling cooling or lightings. Instead of networking, a stand alone control system can be used and implemented for existing system. The usage of parallel port or serial port interfacing is also relevant.

2.8 Control in BEMS using Simulation

Some significant advances of the application of new building control techniques have been made. The concept of predictive control, which uses a model in addition to measured data in order to estimate the optimum control strategy to be implemented, could assist in the more efficient operation of BEMS. This should result in lower energy consumption and more comfortable buildings.

Simulation programs replacing the two areas are for the HVAC system where the first one called emulators; use a computer program to simulate their response to BEMS commands. Also used for control product development, tuning of control equipment and imitating fault situations to test on how the BEMS can cope. The second one is evaluators where it is used to test the efficacy of possible control strategies which are evaluated in terms of comfort acceptability and energy efficiency. [7]

2.9 The Cooling Load and Calculations

The air inside a building will gain heat from a number of sources. In order to maintain the temperature and humidity of the air at a comfortable level, this heat must be removed. The amount of heat that must be removed is called the cooling load. [11]

Cooling load through roof and walls use the following equations:

$$\mathbf{Q = U \times A \times CLTD_c} \qquad \text{Eq.2.1}$$

Where

Q = Cooling load for roof or wall, BTU/hr

U = Overall heat transfer coefficient for roof or wall, BTU/hr-ft^2-F

A = Area of the roof or wall, ft^2

$CLTD_c$ = corrected cooling load temperature difference, F

Cooling load for windows use the following equations:

$$\mathbf{Q = SHGF \times A \times SC \times CLF} \qquad \text{Eq.2.2}$$

Where

Q = Cooling load for window, BTU/hr

SHGF = maximum solar gain heat factor

A = Area of the glass, ft^2

SC = Shading Coefficient

CLF = Cooling Load Factor

All the values for calculating the formula are based on the Air-conditioning Principles and Energy Approach handbook. [11]

CHAPTER 3
METHODOLOGY/PROJECT WORK

All steps and procedures to be taken in carrying out this project will be clarified step by step. This methodology section will briefly show the path for accomplishing this project from the beginning until end.

3.1 Procedure Identification

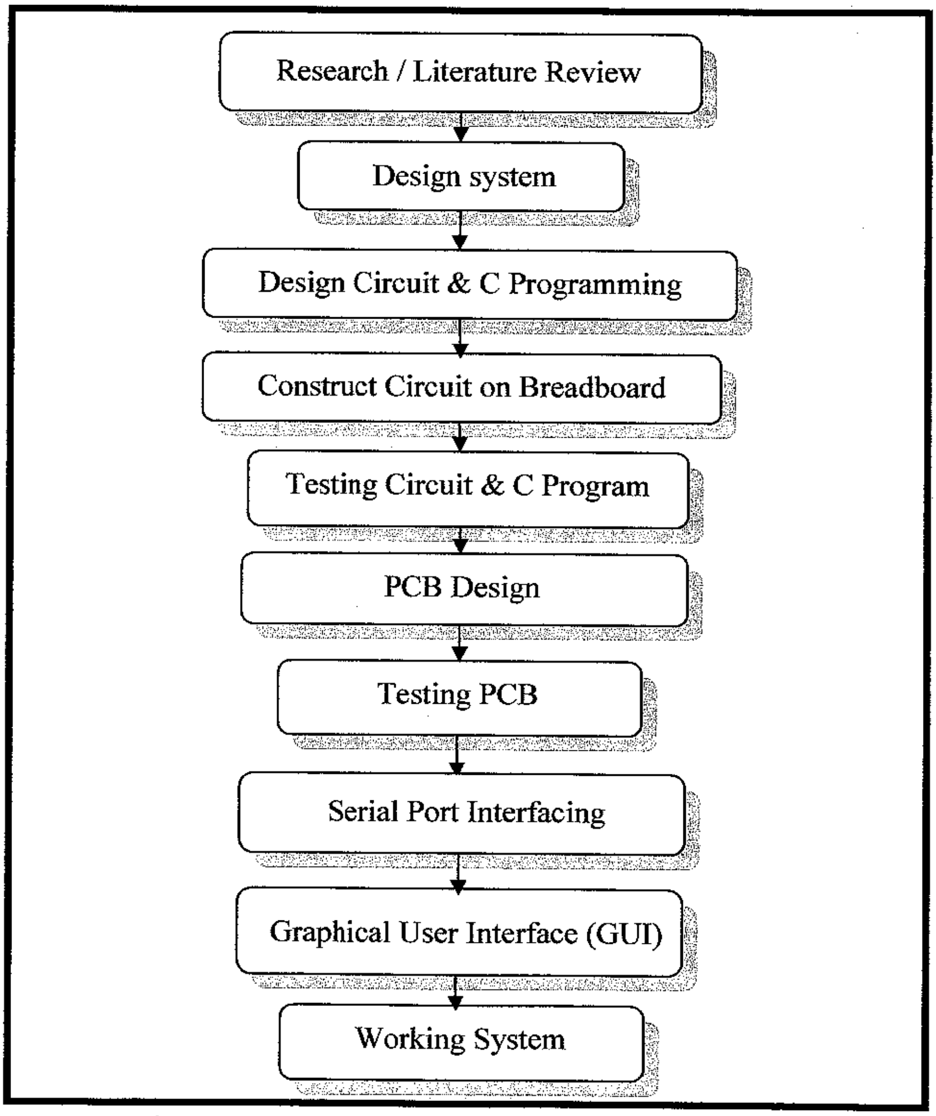

Figure 3.1 Process Flow of Methodology

3.2 Design System

During the initial stage of this project, some research and literature review is being done to get to know more about BEMS. After that, the designing stage begins where the main objective of this project is to reduce the energy consumption of cooling and also lighting. As for lighting, the idea of using an occupancy sensor to control the on and off the lights depending on the present of people is used. A small feature of using automated-blind is added to the system to reduce more energy on lighting and cooling usage. As for cooling, the temperature of the air-conditioner can be control by using also the occupancy sensor to on and off it and the temperature sensor for monitoring the room temperature.

3.3 Circuit Design & Construction

There will be two main circuits in this project which are the circuit for lighting system and also the temperature control circuit. As for the lighting system, an independent circuit which utilizes an occupancy sensor will be produced but due to the limitation of the project, the Light Dependent Resistor (LDR) will be used to replace the occupancy sensor. The same circuit will be used representing the automated blind for reducing heat transfer and energy consumption. The circuit used is the Light/Dark activated Relay circuit for both lighting and auto-blind. As for the air-conditioner control circuit, the microcontroller will be used to control the sensors. The circuit is being constructed and tested on the breadboard first before proceed with the PCB design process.

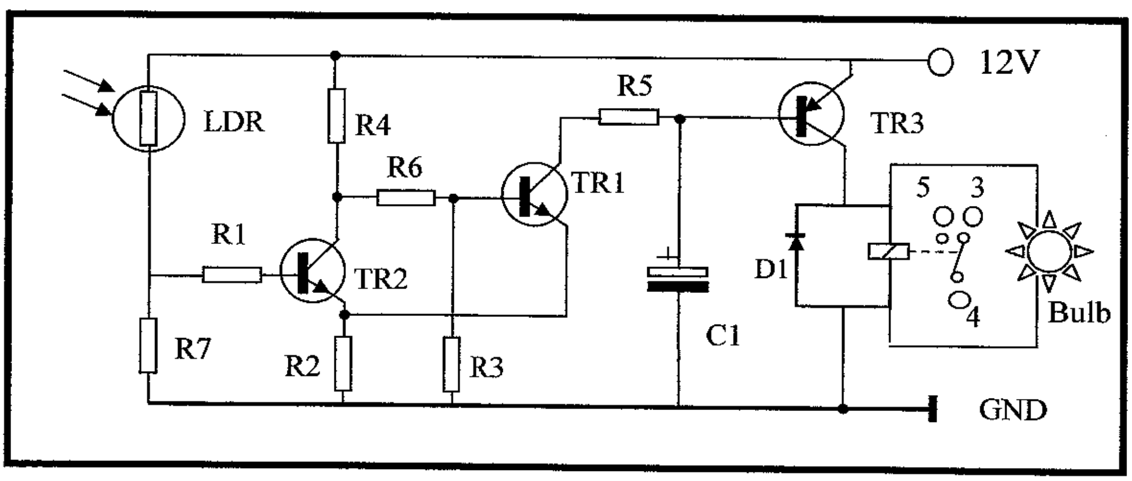

Figure 3.2 Light/Dark activated relay circuit [12]

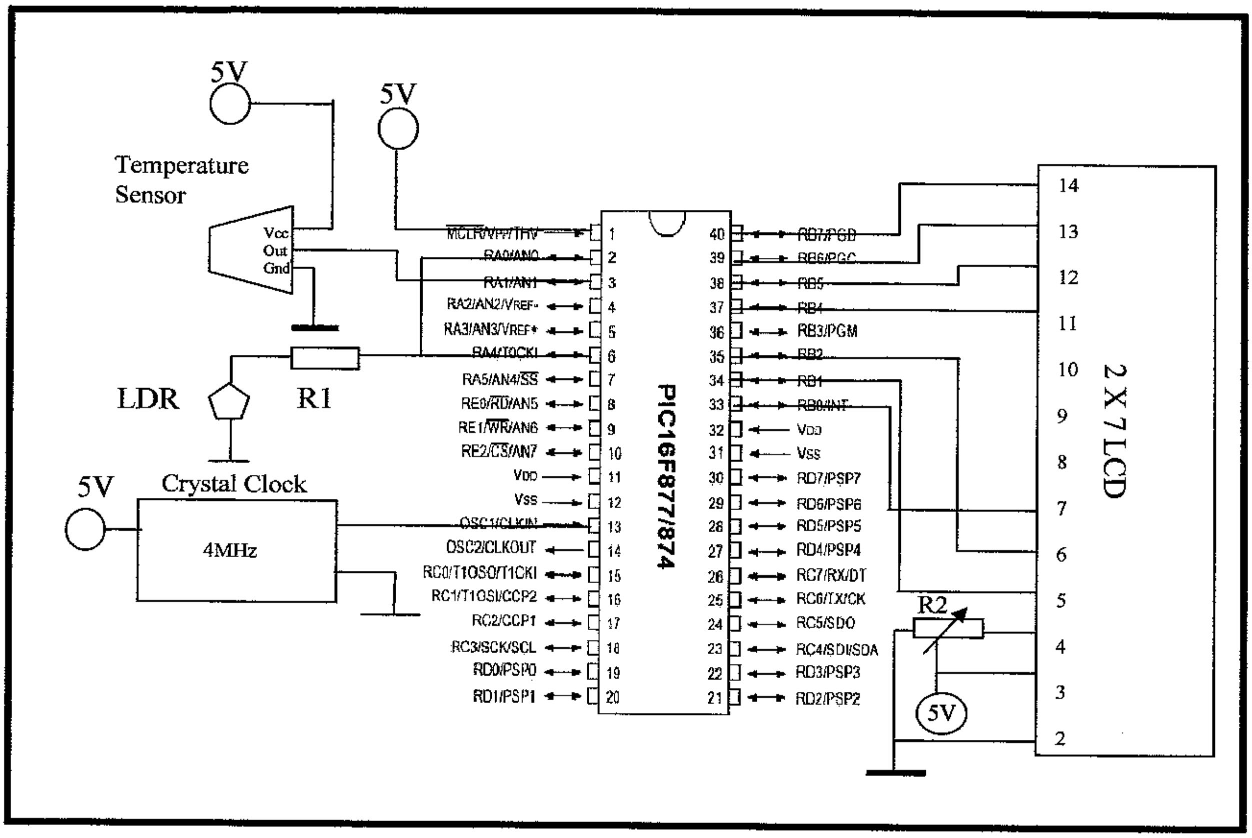

Figure 3.3 Microcontroller circuit

3.4 C Programming

The C program for controlling the sensors was created using the basic programming of microcontrollers. The ADC program and also LCD display program are being modified to suit the system of the temperature sensor circuit. There will be two sensors involved in this particular circuit. The LDR will represent the occupancy sensor for sensing people present or other wise. As for the temperature sensor, it will monitor the room temperature and ensure that it maintains at comfort level. In addition, there is also a function for RS 232 which is the serial port where it will be interface with the Graphical User Interface (GUI). Refer to Appendix E for PIC coding.

3.5 PIC for microcontroller circuit

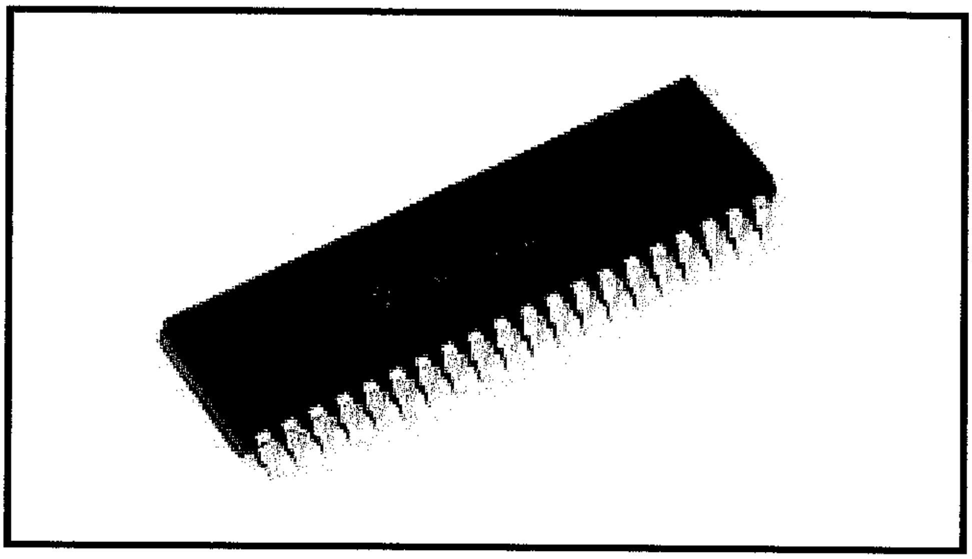

Figure 3.4 PIC 16F877A

The PIC is programmed to read analog input from sensors which will be converted into digital data and processed in the PIC. Then the data will be converted back into analog output which produced 0-5V, depending on the assigned output.

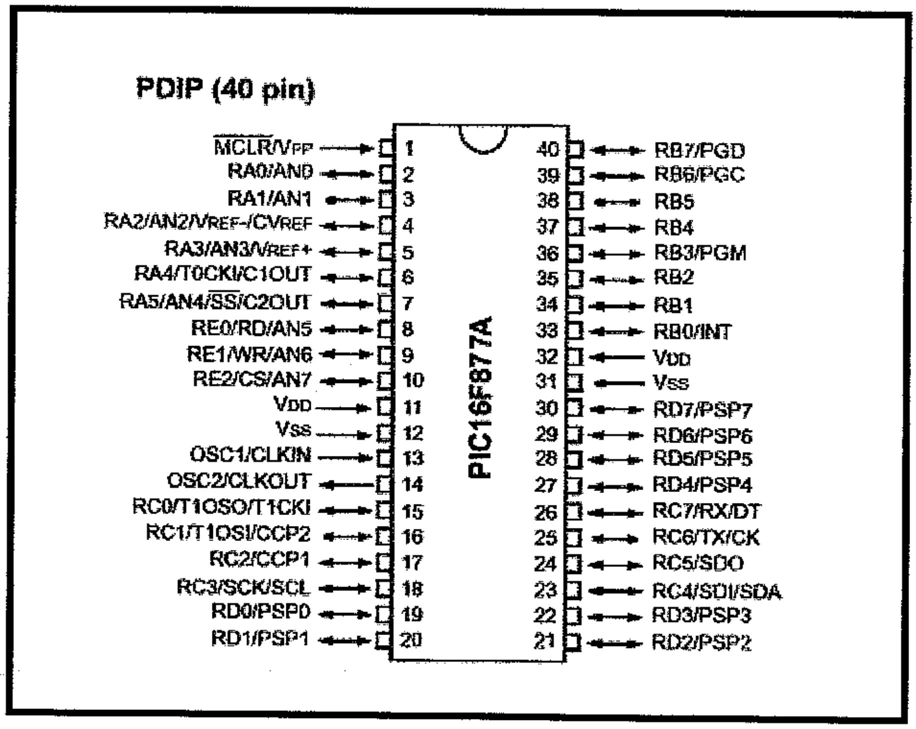

Figure 3.5 Input and Output Pin for PIC 16F877A

Table 3.1 Pin assignment for PIC 16F877A

Pin Name	Pin no.	Assignation
Vss	12,31	Ground reference for logic I/O pins
V_{DD}	11,32	Positive supply for logic I/O pins
OSC1	13	Oscillator Clock Input
$\overline{MCLR}$	1	Master Clear Reset input or programming voltage input
A0	2	Sensor 1- LDR
A1	3	Sensor 2 – LM 35
E0,E1,E2	8,9,10	LED Indicator for output
B0-B2	33,34,35	LCD Display
B4-B7	37,38,39,40	LCD Display
C6,C7	26,25	Data Receive and Transmit

The information on output and input of the pins are obtained from the datasheet (Refer to Appendix B – PIC 16F877A datasheet)

3.6 PCB Design

The PCB is design using the eagle 4.16 software where the schematics have to be drawn. Then the board will be automatically created. The sizing and shapes for the route and via must meet the requirement where the information was obtained from the PCB lab technician. Instead of using chemical etching method, drilling method was used to come out with the board due to machine faulty. The *.brd* file will be process into Gerber file before it can be produced into PCB.

3.7 PC communication Port Interface

During the earlier stage of the project, the parallel port, DB 25 is to be used to interface the circuit with the PC but after some research done, it seems that using serial port is easier to interface. The serial port, RS 232 is used so that the information from PIC can be transmitted, translated and recognized by the visual basic programming. Each pin of the serial port will be assigned whether to transmit or received data.

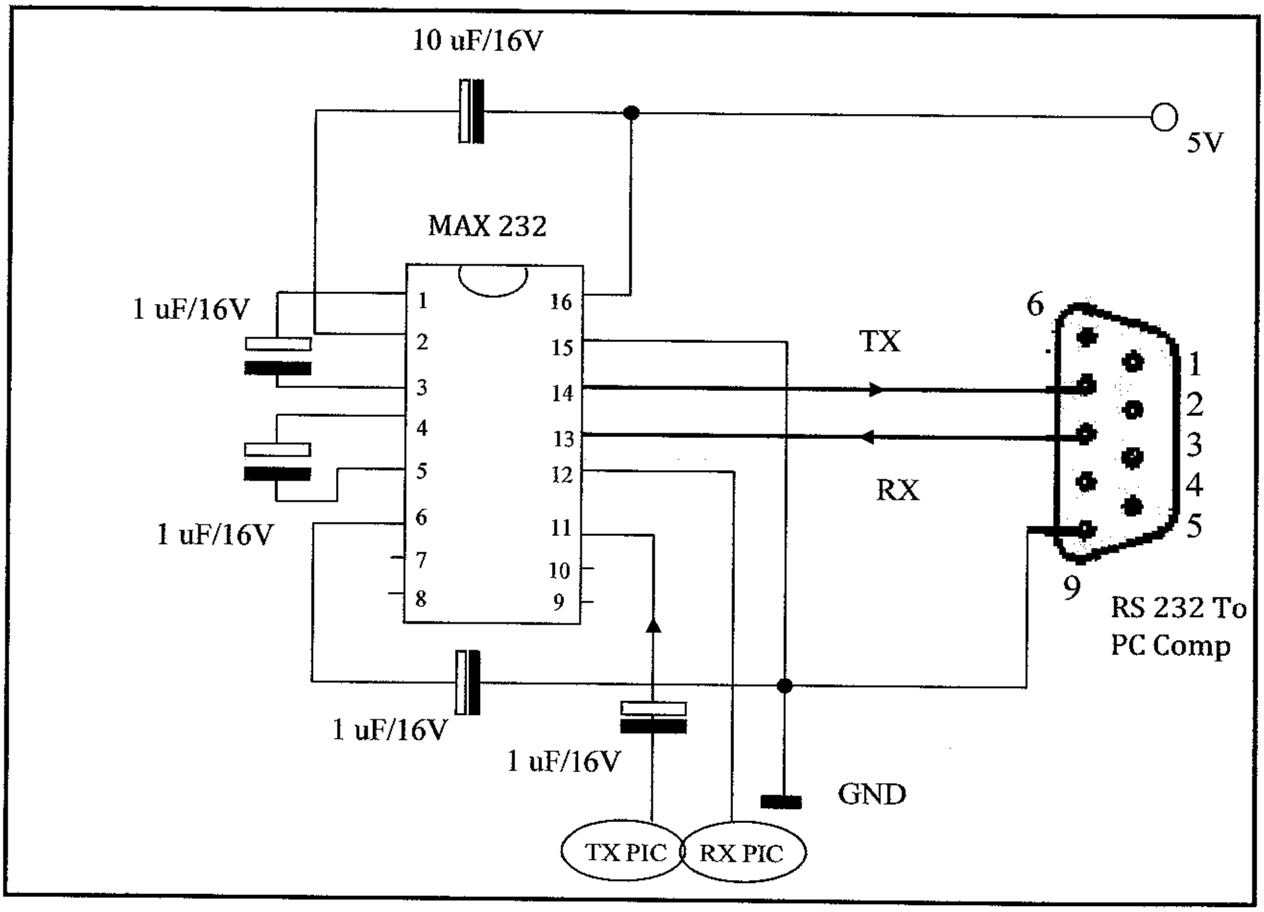

Figure 3.6 MAX 232 Interface Circuit

A female connector, DB 9 will be used to connect the interface circuit with the PC.

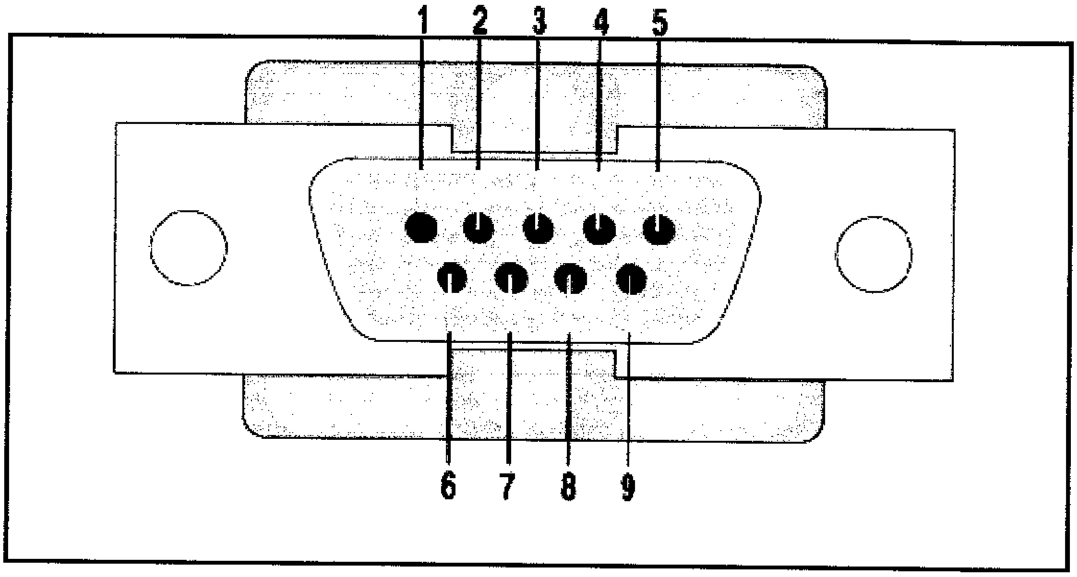

Figure 3.7 RS 232

Table 3.2 Pin assignment for RS 232

Pin	Signal	Pin	Signal
1	Data Carrier Detect	6	Data Set Ready
2	Received Data	7	Request to Send
3	Transmitted Data	8	Clear to Send
4	Data Terminal Ready	9	Ring Indicator
5	Signal Ground		

3.8 Graphical User Interface (GUI)

The Graphical User Interface will be created using visual basic 6. The GUI will receive data from serial port (COMM Port) inform of ASCII code and run the system according to the code receive.

CHAPTER 4
RESULTS AND DISCUSSION

This project covers the energy saving and energy efficiency system. The end results are discussed in this session where the steps to determined the complete project is explained below.

4.1 Energy Consumption by Building Type in Malaysia

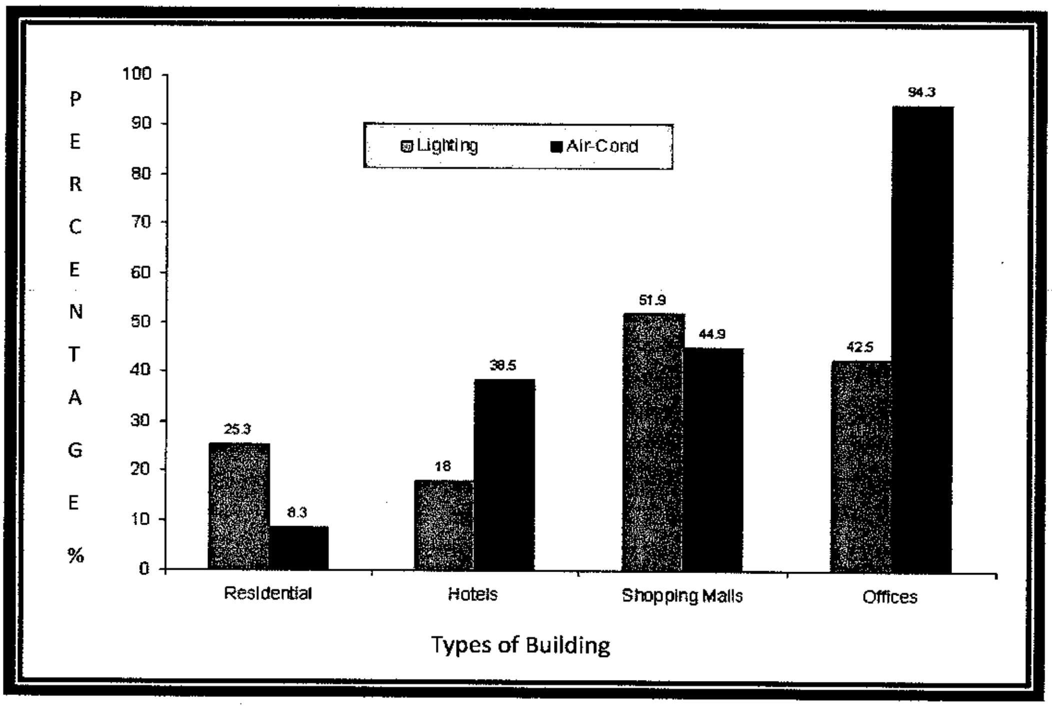

Figure 4.1 Energy Consumption by Building Type in Malaysia [8]

The energy consumption in Malaysia is divided into types of building where the graph shown in Figure 4.1 is the comparison between the energy used for lightings and also air-conditioning. It is obvious that offices consumed the most energy especially in air-conditioning and slightly lower for lightings compare to shopping malls.

4.2 Analysis on Power Consumption of an Air-conditioner

The Air-conditioner Split Unit is a 1 Horsepower type and the power consumption is being analysed referring to the cases below.

Table 4.1 Air-conditioning Usage (Case 1)

No.	**Equipment**	**Speed**			**Temperature Setting**	**rpm**		**Constant if ON**	**Estimated Power**
		1	2	3		Low	High		
1	Blower	✓							
2	Compressor					✓			
3	External Fan				16°C		✓		
4	Circulation Fan							✓	
5	Other parts								Low

For case 1, the energy consumption is estimated to be **0.746 kW.**
The total energy usage of 8 hours a day is 0.746 kW x 8 = **5.97 kWh**
Based on the Tenaga Nasional Berhad tariff, the cost is **23.4 sen/kWh**
(Refer to Appendix A)
Total Monthly cost: 23.4 sen/kwh x 5.97 kWh x 26 days = **RM 36.32**
Total Annual Cost: RM36.32 x 12 months = **RM 435.86**

Table 4.2 Air-conditioning Usage (Case 2)

No.	**Equipment**	**Speed**			**Temperature Setting**	**rpm**		**Constant if ON**	**Estimated Power**
		1	2	3		Low	High		
1	Blower	✓							
2	Compressor					✓			
3	External Fan				24°C		✓		
4	Circulation Fan							✓	
5	Other parts								Low

For case 2, all settings are maintained the same except that the temperature is increased from 16°C to 24°C. The energy consumption is estimated to be lower than case 1. Therefore the total energy consumption will also be lower. When the temperature is higher, the blower will work less and consumed less energy to produce cooled air.

Referring to the tables [Table 4.1 and 4.2], the cost of the air-conditioner power consumption can be reduced by controlling the air-conditioner temperature. By varying the temperature depending on the comfort level at a particular time can give an impact to cost of the electricity bills.

4.3 Cooling Load Calculator Software

The cooling load graphical user interface GUI named **EMSys** is used during designing stage where energy consumption can be estimated.

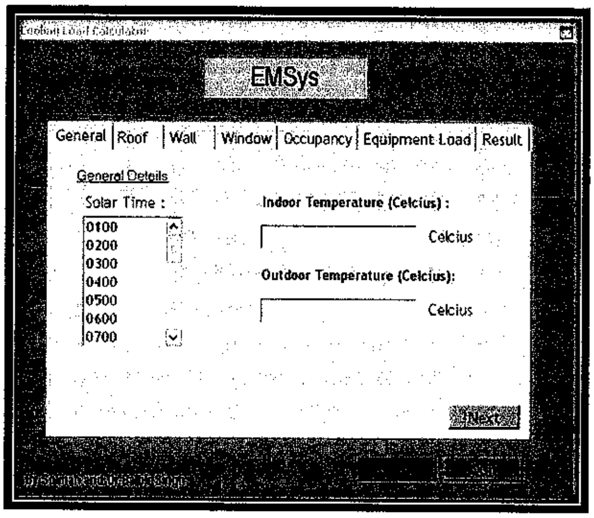

Figure 4.3 General details of cooling load calculation

The first tab for this GUI is the general description where users must select the appropriate solar time and also key-in the outdoor and indoor temperature. An error message will pop-up if all the choices and blanks are not completed.

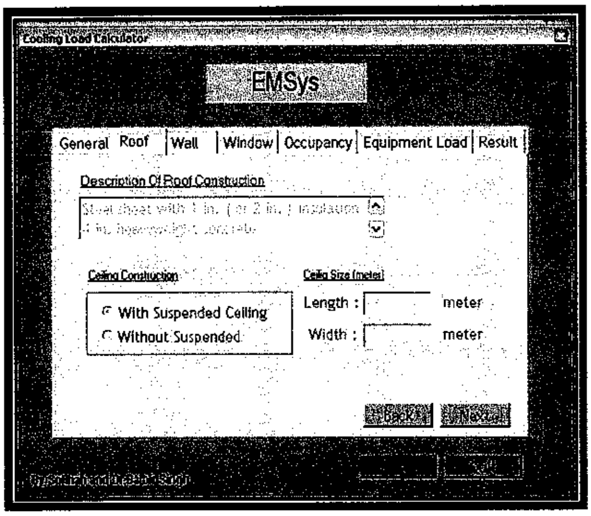

Figure 4.4 Roof descriptions for cooling load calculation

The next tab is the roof description where the details about the roof and ceiling construction to be selected and the size of the ceiling is key-in into the provided box. After that, then only the user can proceed to the next tab. The same thing happens if the details for roof tab are not completed; error message will pop-up

The equation used for calculating cooling load for roof can be referred to the equation below.

$$Q = U \times A \times CLTD_c$$

Where

Q = Cooling load for roof, BTU/hr

U = Overall heat transfer coefficient for roof, BTU/hr-ft^2-F

A = Area of the roof, ft^2

$CLTD_c$ = corrected cooling load temperature difference, F

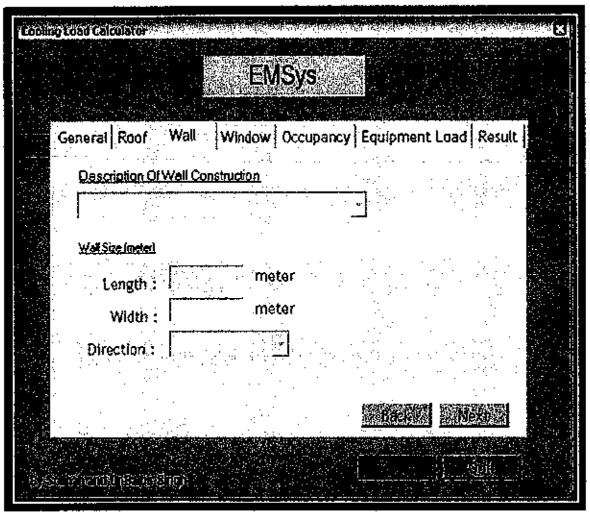

Figure 4.5 Wall descriptions for cooling load calculation

As for the wall tab, users have to choose the wall construction and also the orientation of the wall. Other than that, the size of the wall must be entered in order to proceed to next tab.

The equation used for calculating cooling load for wall can be referred to the equation below.

$$\mathbf{Q = U \times A \times CLTD_c}$$

Where

Q = Cooling load for wall, BTU/hr

U = Overall heat transfer coefficient for wall, BTU/hr-ft^2-F

A = Area of the wall, ft^2

$CLTD_c$ = corrected cooling load temperature difference, F

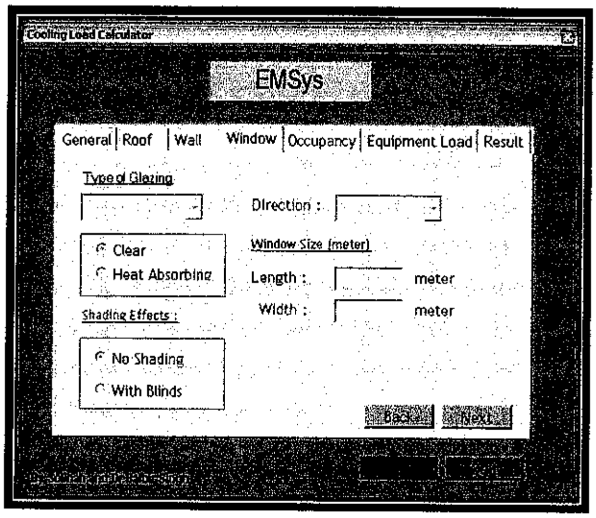

Figure 4.6 Window descriptions for cooling load calculation

For the window tab, users can select the type of glazing and specify whether there is a shading effect or not by selecting the radio-button under shading effects. Besides that, the direction/orientation of the window is also important as well as specifying the size of the window.

The equation used for calculating cooling load for window can be referred to the equation below.

$$\mathbf{Q = SHGF \times A \times SC \times CLF}$$

Where

Q = Cooling load for window, BTU/hr

SHGF = maximum solar gain heat factor

A = Area of the glass, ft^2

SC = Shading Coefficient

CLF = Cooling Load Factor

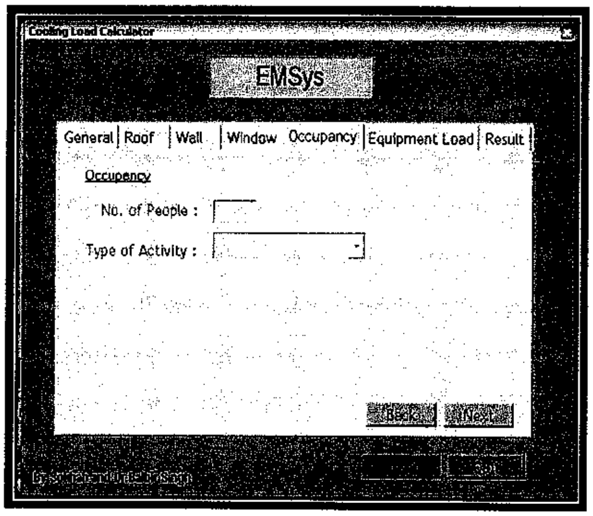

Figure 4.7 Occupancy details for cooling load calculation

The number of people occupying the room must be specified and the type of activity being done can be selected from the dropdown list.

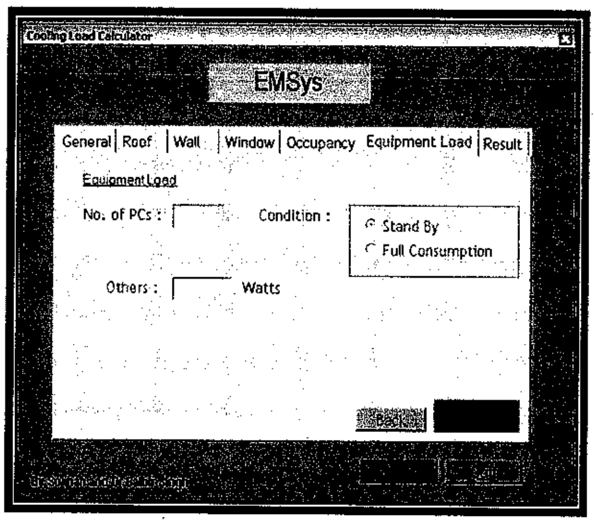

Figure 4.8 Equipment Load details for cooling load calculation

After specifying the number of people present, the number of personal computers used must be denoted and the condition of the computers must be selected either they are in stand by mode or full consumption mode. Other electrical appliances being used in the particular area must be stated in the box provided. Then the **calculate** button is pressed.

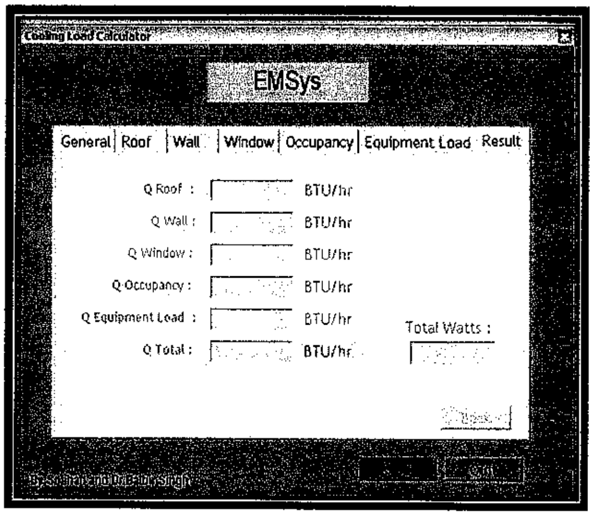

Figure 4.9 Results of cooling load calculations

After all the fields have been filled in and the button **Calculate** has been pressed, **EMSys** will calculate the total power consumed referring to the details and information specified by users. The button **Reset** and **Quit** can be used anytime the software runs. If the **Reset** button is pressed, the whole information specified before will be removed and the General tab will appear. As for button **Quit**, the whole system will be terminated once it is pressed.

This software can predict and estimates the energy consumption of an area specify by users. The options listed in the software are mostly common in Malaysia.

Table 4.3 Information selected using the ***EMSys***

Details	**Information selected**
Roof	Steel Sheet with 1 in. insulation, with suspended ceiling, size – 10m x 7m
Wall	4 in. face brick, size - 15m x 7m
Window	single glass, clear, without blinds, size-8m x 4m
Occupancy	No. of people- 2, light office work
Equipment	no. of PC-2, full consumption, others: 20 watts

Table 4.4 Power Consumption of Different Orientation

East/West Direction				North/South Direction			
Solar Time	Indoor Temp.	Outdoor Temp.	Total Watts	Solar Time	Indoor Temp.	Outdoor Temp.	Total Watts
0800	22	24	3614.56	0800	22	24	1528.11
0900	22	26	4692.56	0900	22	26	2158.45
1000	22	28	5876.144	1000	22	28	2987.91
1100	22	29	6962.09	1100	22	29	3911.61
1200	22	30	7596.14	1200	22	30	4552.91
1300	22	31	10710.73	1300	22	31	4667.44
1400	22	29	15795.733	1400	22	29	5064.67
1500	22	29	19629.08	1500	22	29	4588.58
1600	22	27	21843.75	1600	22	27	4570.66
1700	22	28	21082.17	1700	22	28	4012.99

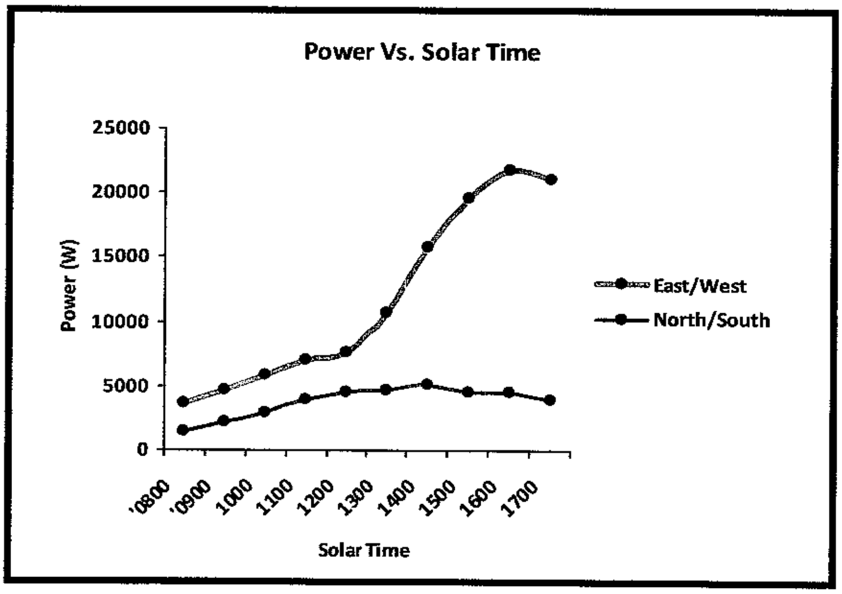

Figure 4.10 Graph Power vs. Solar Time

It can be seen from Figure 4.10, the east/west orientation consumed a lot of power compared to the one with north/south orientation. This proved that orientation of the building is very important in order to reduce energy consumption. The direction of walls and windows has to be designed facing north or south instead of west or east. Based on this result, the software can be used in designing and planning stage.

4.4 Lighting Circuit/Automated-blind circuit

The schematic of the circuit is obtained from the internet where it is the schematic of a light switch. It is being implemented for the stand-alone lighting system where the LDR will indicate as the occupancy sensor to sense the present of people in the room. The same thing is being applied for automated-blind where the LDR indicate as the photo sensor where when there is bright light, the blind will shut off indicate by the light bulb. The circuit has been tested and results in working circuit as shown in Figure 4.11.

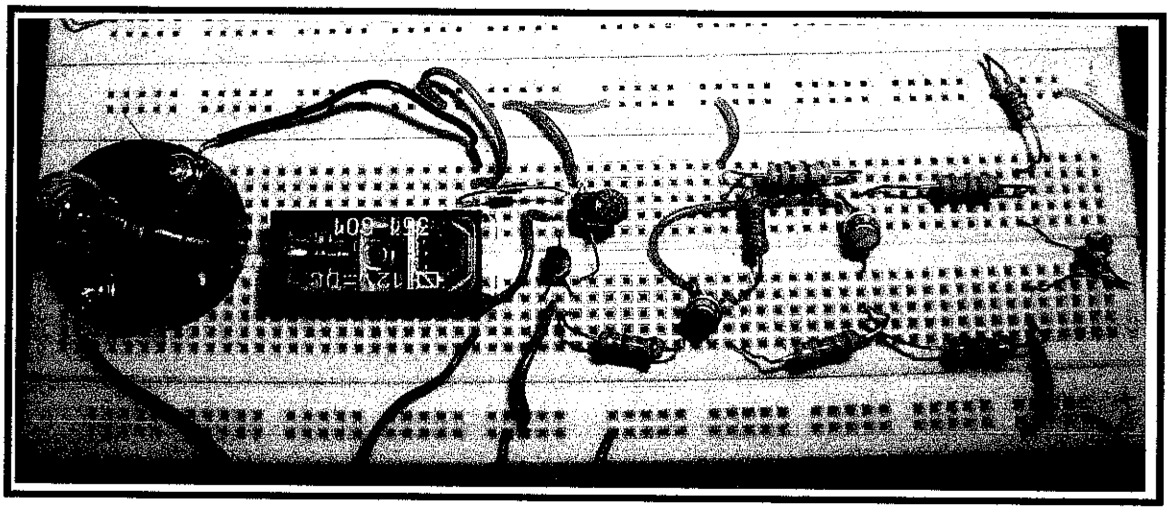

Figure 4.11 Lighting/Auto-Blind Circuit

The lighting and auto-blind circuit, basically using the same circuit. Due to the limitations of the project, instead of using the real sensor such as occupancy and photo sensor, they are being replaced by the Light Dependent Resistor. The LDR can represent the same function to be implemented in the prototyping part. Figure 4.12 shows the flow of operation for lighting system whereas Figure 4.13 shows the operation of automated-blind.

Lighting System

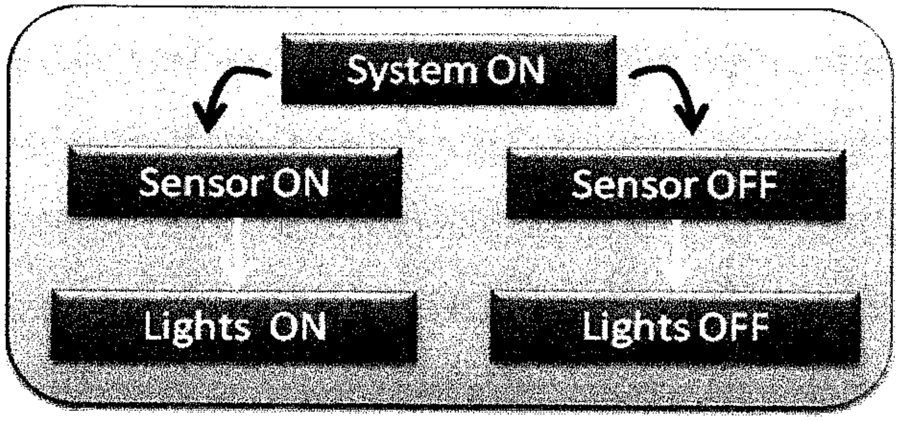

Figure 4.12 Flow of Operation for Lighting System

Automated-Blind

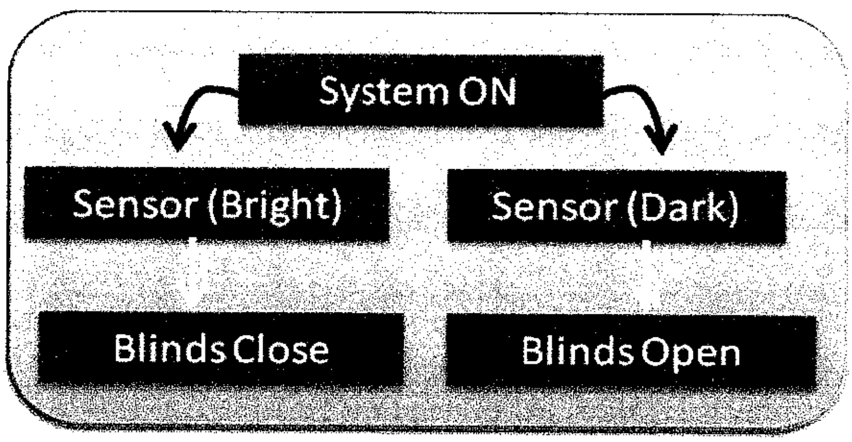

Figure 4.13 Flow of Operation for Automated-Blind

4.5 Microcontroller Circuit

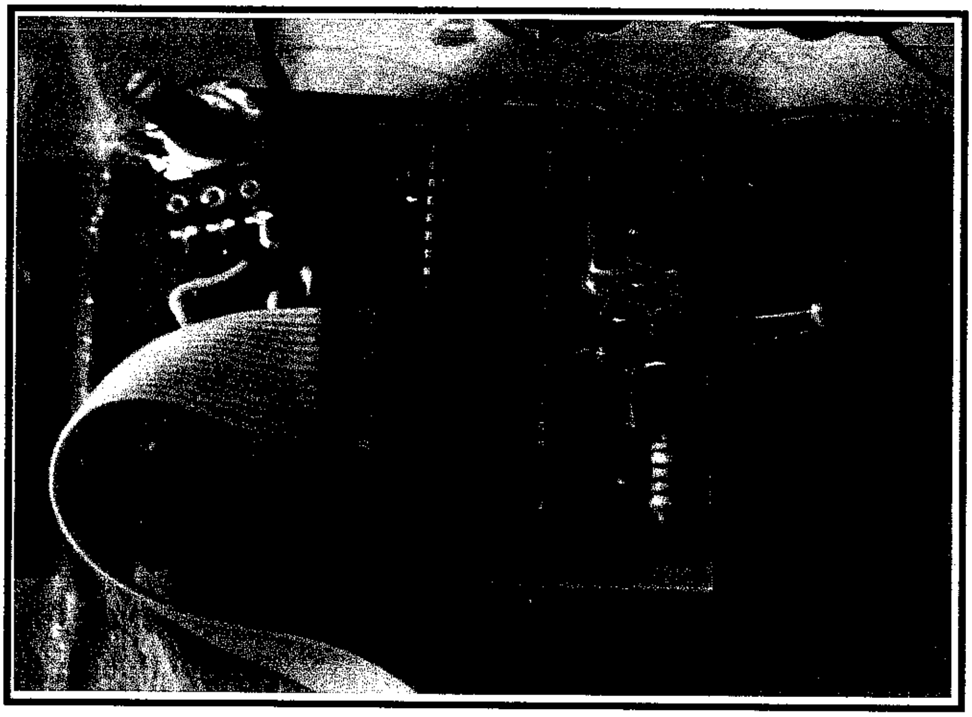

Figure 4.14 Microcontroller Circuit on PCB

For this microcontroller circuit [Figure 4.14], the PIC 16F877A is being used. The basic circuit was modified to fit in two sensors which is the temperature sensor (LM35) and also the LDR indicating occupancy sensor. LCD Display is added to the circuit to display the current temperature reading.

The LM 35 is being used for temperature monitoring but for the occupancy sensor, it will be represent by the LDR. Since there is certain limitations, the program for controlling the temperature; it is decided that there are only two conditions where if the temperature less than 24°C and temperature more than 24°C then only the circuit will trigger. The default value of room temperature is set to 24°C; comfortable temperature for human being. When the room temperature is higher than 24°C, the air-conditioner control system will reduce to 22°C and if the temperature is below 24°C the system will increase the temperature to 26 °C. The RS232 port is use for interfacing the controller circuit with the GUI.

4.6 PCB Design

After the circuit has been tested on breadboard, the PCB is designed using Eagle 4.16 software. PCB for both circuit were designed; the schematics and the boards are as shown in figure below.

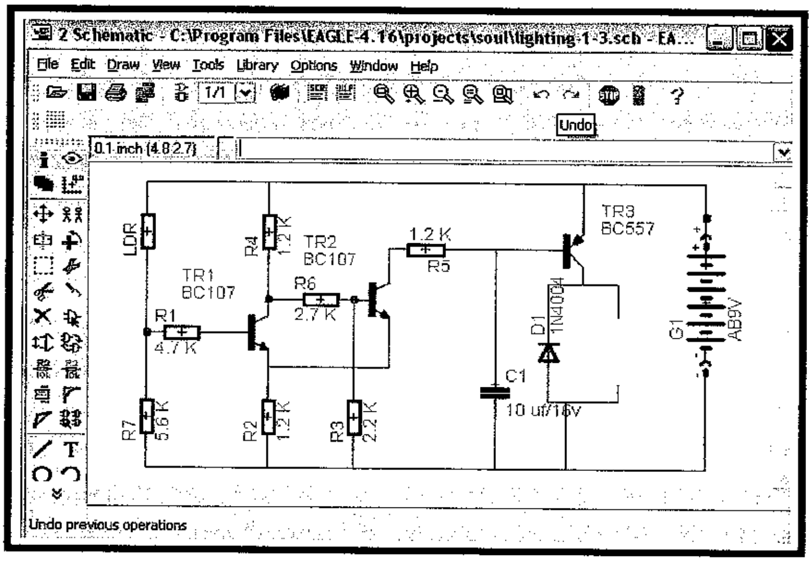

Figure 4.15 Lighting circuit

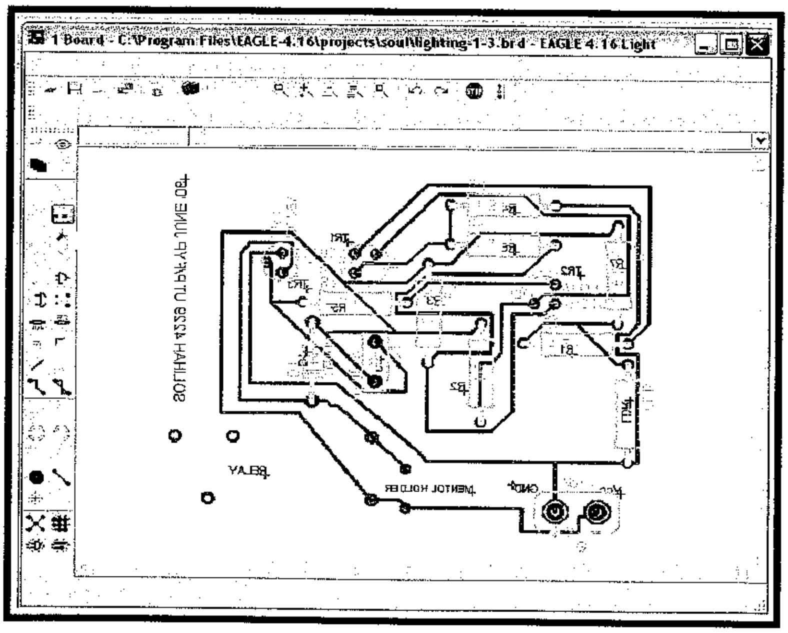

Figure 4.16 Lighting Board

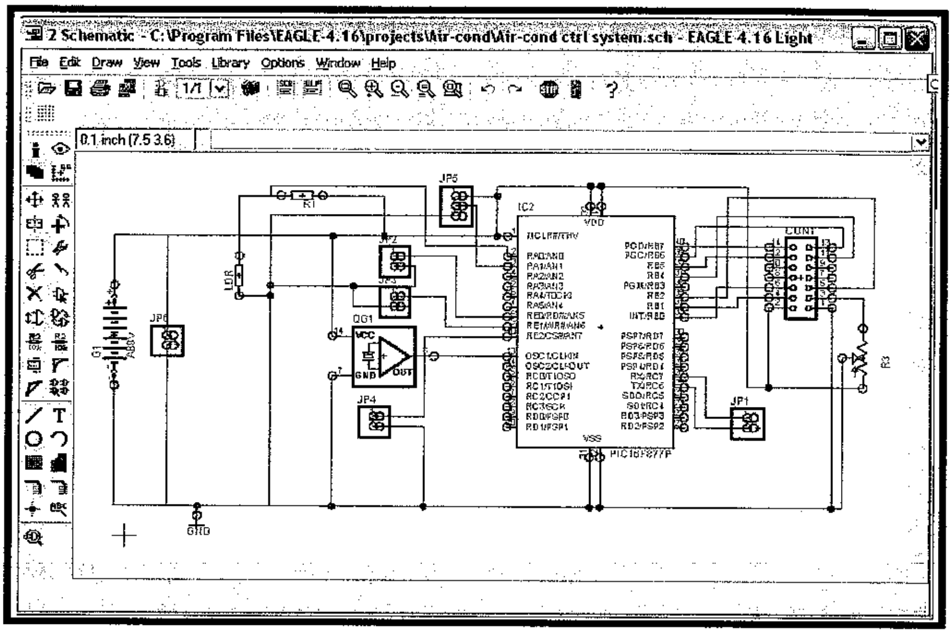

Figure 4.17 Microcontroller Schematic

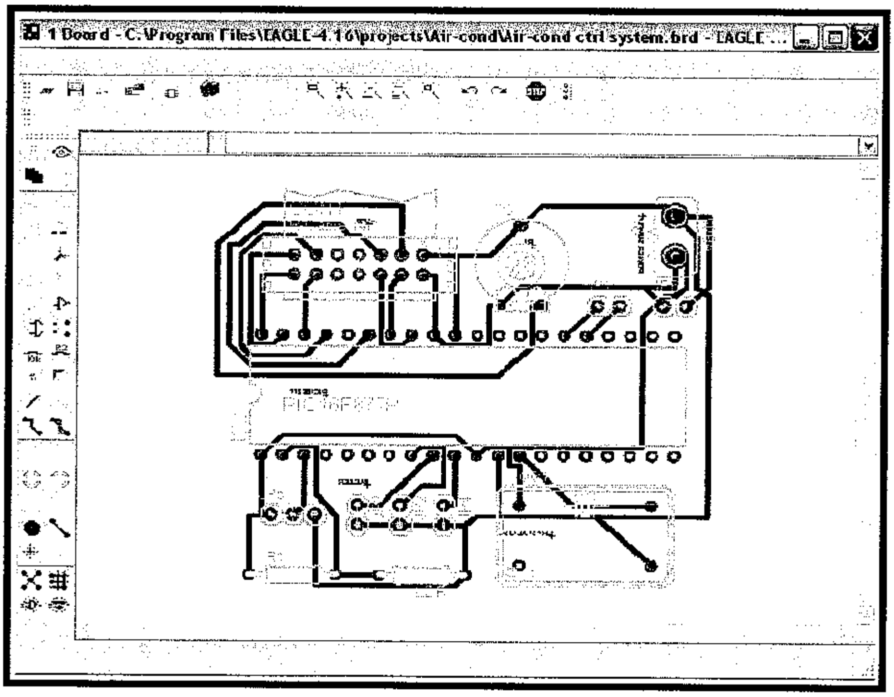

Figure 4.18 Microcontroller Board

4.7 PC Communication Port Interface

The microcontroller circuit will transmit signals to the interface circuit where an IC, MAX 232 will change the receive signal into readable PC signal line which is 12V and -12V. From the MAX 232, data will be transmitted inform of ASCII character which can be analyzed using the HyperTerminal software. The ASCII data transmitted to the PC will be recognized by Visual Basic program (GUI). The serial port RS 232 (COMM Port) is used to transmit data from MAX 232 which convert digital signals from PIC into computer serial port signal data. The circuit for interfacing is shown in figure below.

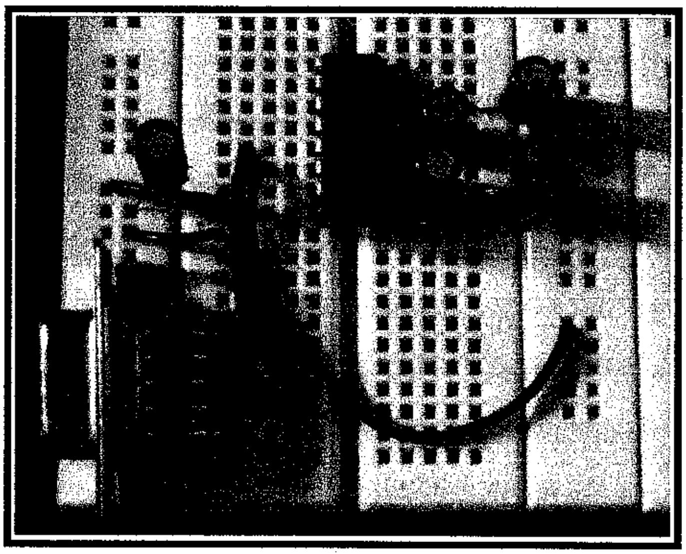

Figure 4.19 MAX 232 interface Circuit

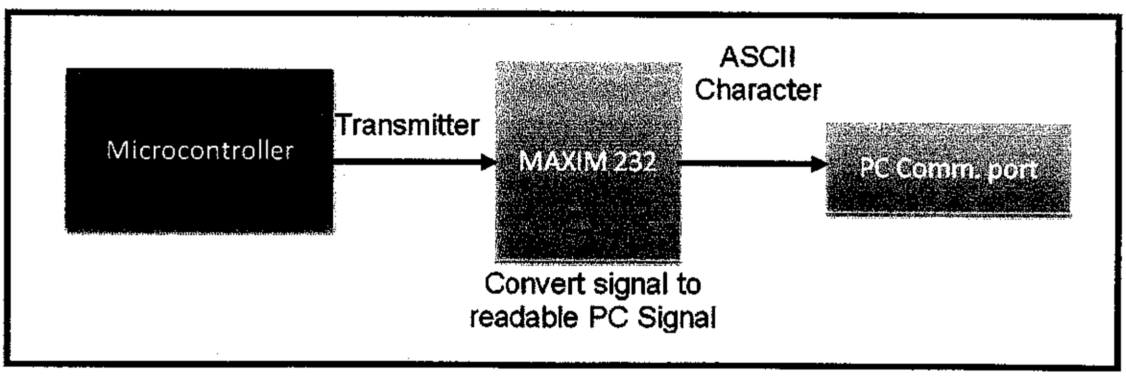

Figure 4.20 Flow of Operation using MAXIM 232

4.8 Graphical User Interface (GUI)

The GUI is an interface for users and the system provides with information of the temperature readings. The GUI receives data from the serial port (COMM Port) from the PC communication interface circuit.

The GUI will display default temperature for the air-conditioner and also the current temperature depending on the reading of the room temperature. It also displays the system on, off or in a standby mode depending on the occupancy of the particular room. The GUI is equipped with the emergency stop button so that user can stop the system manually if anything went wrong during the process.

The GUI is produced using the Visual Basic 6.0 programming which is reliable and very user friendly.

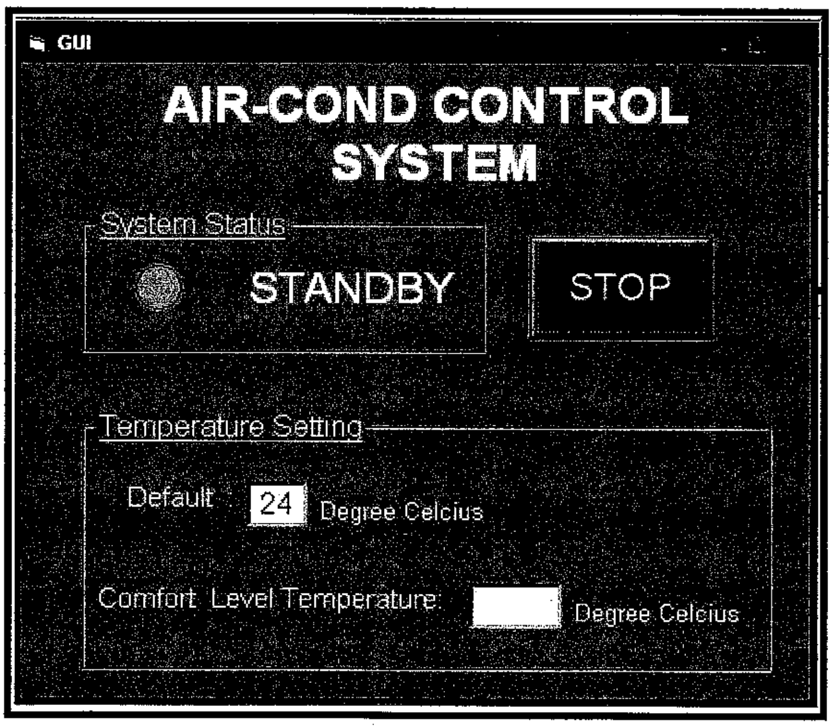

Figure 4.21 Graphical User Interface

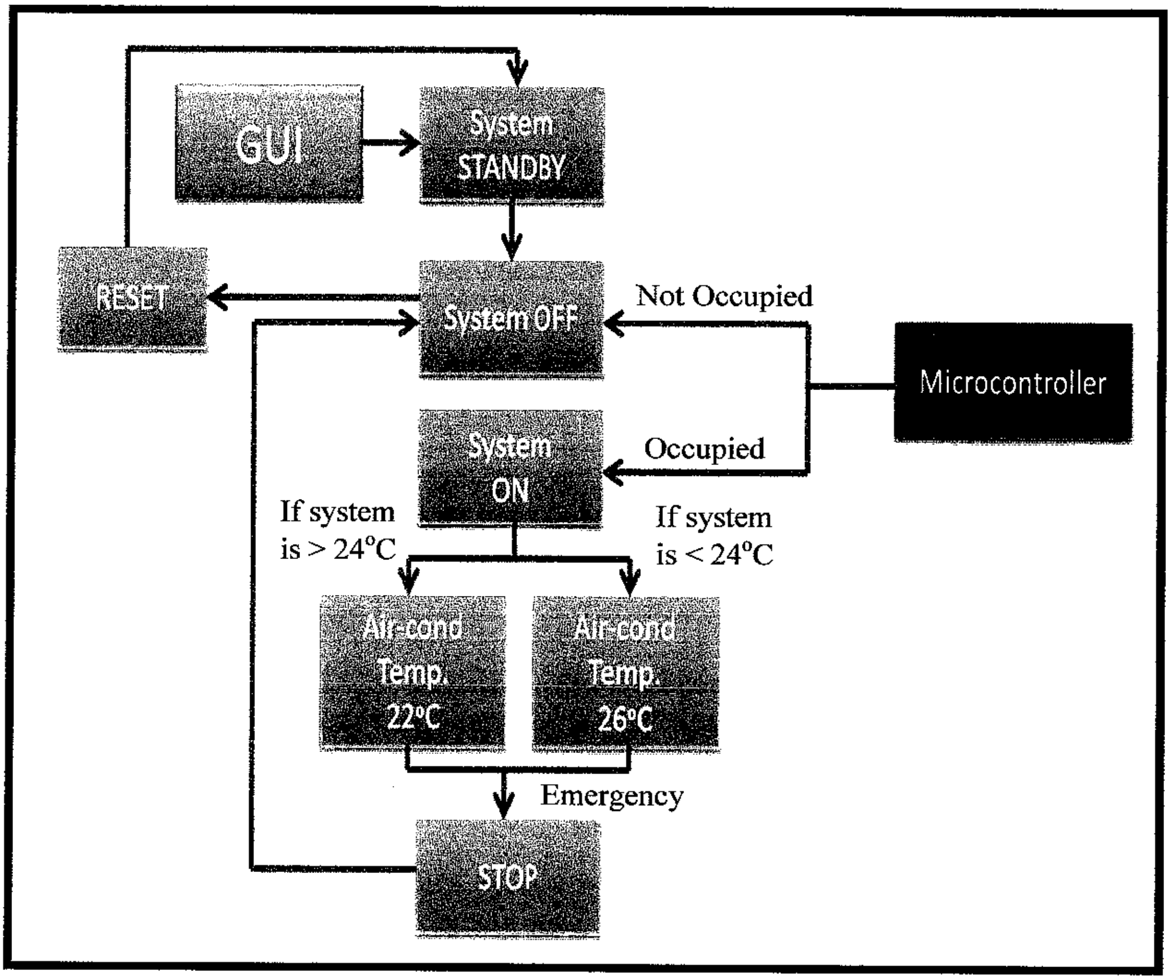

Figure 4.22 Flow of Operation for Air-conditioning System

Referring to Figure 4.22, it shows the flow operation for the air-conditioning system where the signals will be received from the microcontroller and read by the GUI.

4.9 The Prototype

The system is represented by a prototype where the circuits were placed into a room representing by a box made out of Perspex. The PCB is assembled and connected to the PC communication interface circuit and being placed in the box. [Figure 4.23]
The circuit board, PCB, interface circuit and display are all gathered and assembled into one system.

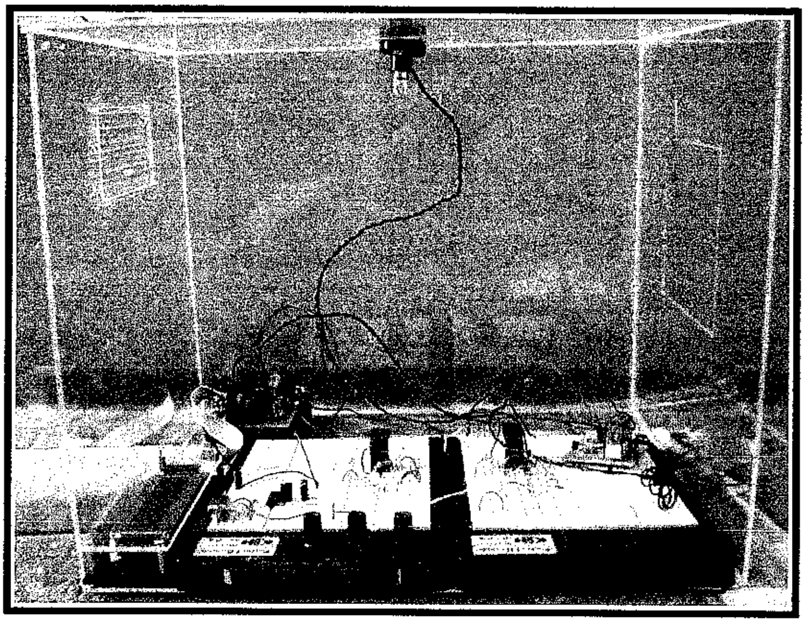

Figure 4.23 Prototype

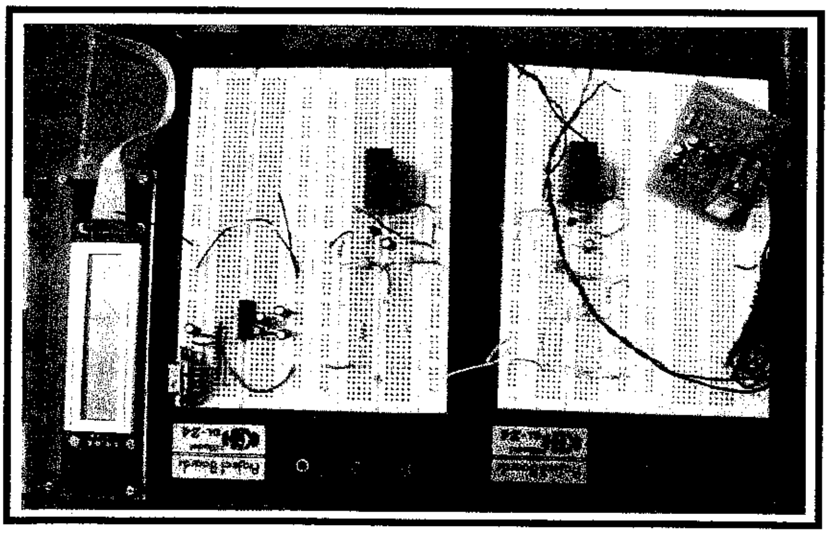

Figure 4.24 Zoom in Prototype

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This project has finally completed, where a system for reducing energy consumption for lightings and cooling have been produced. The objectives of this project have been achieved. Software for estimating cooling load has been developed. The Lightings can be control by using the occupancy sensor besides using energy efficient bulb which can produce 40 watts of power with only 8 watts of power consumption.

As for cooling, the temperature can be control depending on the room temperature to maintain the comfortable temperature at all times and also it will be automatically off when there is no one around the room.

BEMS is crucial in order to cut down the cost and reduce the energy usage of a building. Besides, using energy efficient and energy saving appliances will also contribute to reducing energy consumption.

5.2 Recommendation

For future recommendations, few improvements can be made to produce better solution for building energy management system.

- Varying air-conditioning temperature

  More conditions for varying temperature of air-conditioning system should be added in order to use energy efficiently depending on the outdoor temperature and the indoor temperature.

- Integrate Lighting and cooling system into one system

  Integrate the independent lighting circuit with the air-conditioning control system. The same occupancy sensor can be used to control on and off of the system.

- Solar radiation data collector

  Install the solar radiation data collector on-site to monitor the amount of radiation received by the building daily.

- Orientation

  The orientation of the building has to be taken into consideration as it will influence the power consumption of that particular building.

- BEMS for each building

  Each building must have BEMS in order to use energy efficiently and reduce the energy consumptions.

- Building Integrated Photovoltaic (BIPV)

  Use alternative energy (solar) as a source of power instead of electricity to reduce power consumption and electricity bills. BIPV should be implemented integrating with the building energy management system.

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APPENDICES

APPENDIX A

TABLE

Peninsular Malaysia

Commercial Tariffs	Unit	Rates (RM/sen)
Tariff B - Low Voltage Commercial Tariff		
For all kWh	sen/kWh	32.30
The minimum monthly charge is RM7.20		
Tariff C1 - Medium Voltage General Commerical Tariff		
For each kilowatt of maximum demand per month	RM/kW	19.50
For all kWh	sen/kWh	23.40
The minimum monthly charge is RM600.00		
Tariff C2 - Medium Voltage Peak/Off-Peak Commercial Tariff		
For each kilowatt of maximum demand per month during the peak period	RM/kW	29.00
For all kWh during the peak period	sen/kWh	23.40
For all kWh during the off-peak period	sen/kWh	14.40
The minimum monthly charge is RM600.00		

APPENDIX B

PIC 16F877 DATASHEET

MICROCHIP

PIC16F87X

28/40-pin 8-Bit CMOS FLASH Microcontrollers

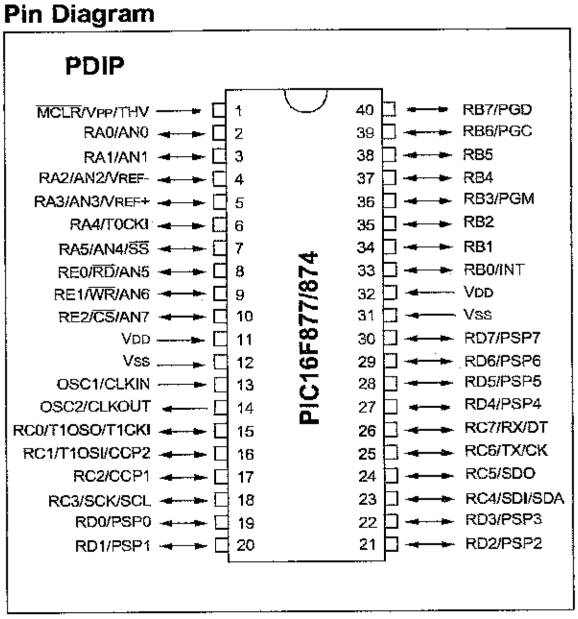
Devices Included in this Data Sheet:

- PIC16F873
- PIC16F874
- PIC16F876
- PIC16F877

Microcontroller Core Features:

- High-performance RISC CPU
- Only 35 single word instructions to learn
- 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
- Pinout compatible to the PIC16C73B/74B/76/77
- 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 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

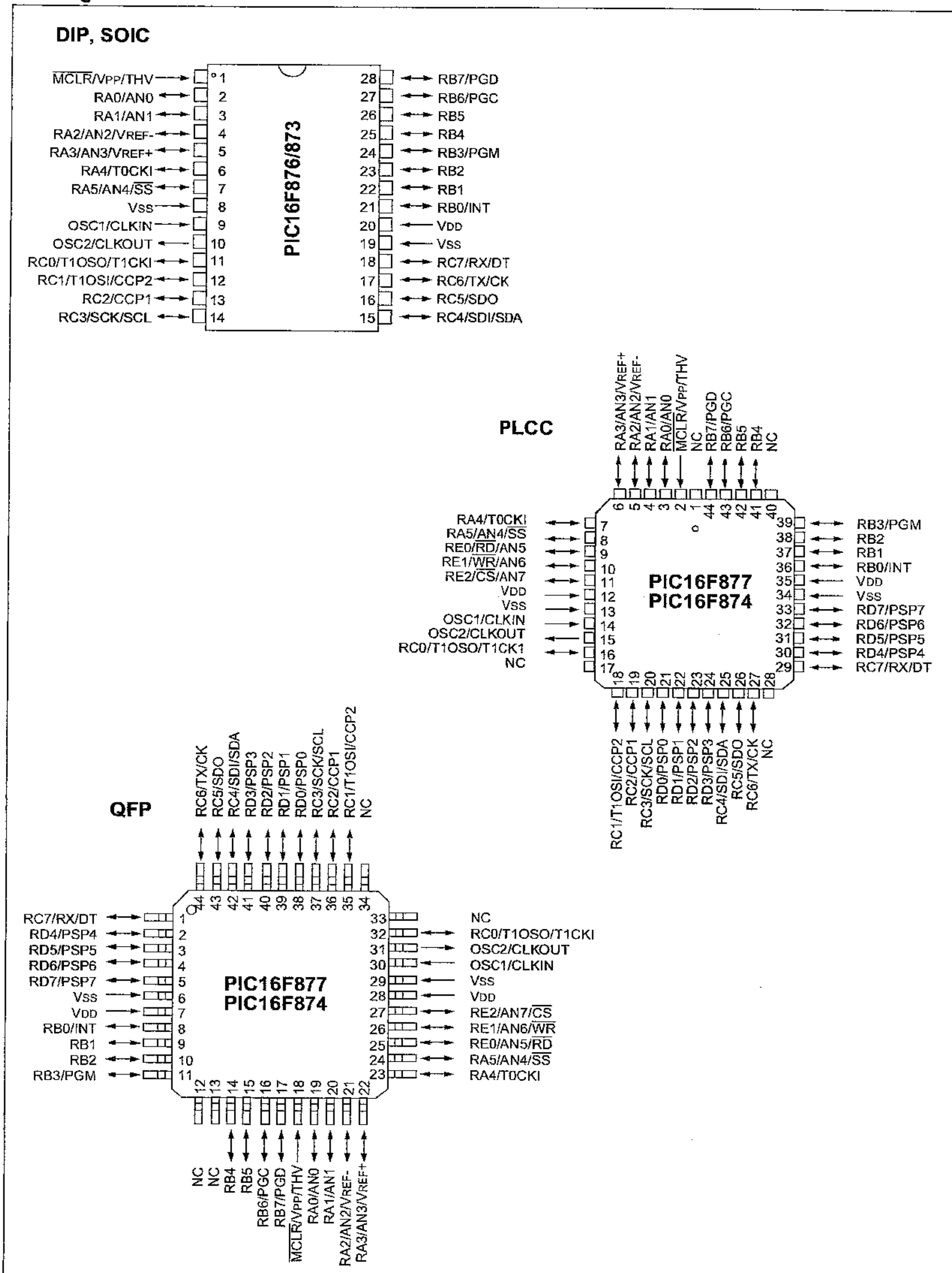
Pin Diagram



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)
- Brown-out detection circuitry for Brown-out Reset (BOR)

Pin Diagrams



Key Features PICmicro™ Mid-Range Reference Manual (DS33023)	PIC16F873	PIC16F874	PIC16F876	PIC16F877
Operating Frequency	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz
Resets (and Delays)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	4K	4K	8K	8K
Data Memory (bytes)	192	192	368	368
EEPROM Data Memory	128	128	256	256
Interrupts	13	14	13	14
I/O Ports	Ports A,B,C	Ports A,B,C,D,E	Ports A,B,C	Ports A,B,C,D,E
Timers	3	3	3	3
Capture/Compare/PWM modules	2	2	2	2
Serial Communications	MSSP, USART	MSSP, USART	MSSP, USART	MSSP, USART
Parallel Communications	—	PSP	—	PSP
10-bit Analog-to-Digital Module	5 input channels	8 input channels	5 input channels	8 input channels
Instruction Set	35 Instructions	35 Instructions	35 Instructions	35 Instructions

TABLE 1-2: PIC16F874 AND PIC16F877 PINOUT DESCRIPTION

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	13	14	30	I	ST/CMOS(4)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	15	31	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLK-OUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
$\overline{\text{MCLR}}$/VPP/THV	1	2	18	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
						PORTA is a bi-directional I/O port.
RA0/AN0	2	3	19	I/O	TTL	RA0 can also be analog input0
RA1/AN1	3	4	20	I/O	TTL	RA1 can also be analog input1
RA2/AN2/VREF-	4	5	21	I/O	TTL	RA2 can also be analog input2 or negative analog reference voltage
RA3/AN3/VREF+	5	6	22	I/O	TTL	RA3 can also be analog input3 or positive analog reference voltage
RA4/T0CKI	6	7	23	I/O	ST	RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.
RA5/$\overline{\text{SS}}$/AN4	7	8	24	I/O	TTL	RA5 can also be analog input4 or the slave select for the synchronous serial port.
						PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	33	36	8	I/O	TTL/ST(1)	RB0 can also be the external interrupt pin.
RB1	34	37	9	I/O	TTL	
RB2	35	38	10	I/O	TTL	
RB3/PGM	36	39	11	I/O	TTL	RB3 can also be the low voltage programming input
RB4	37	41	14	I/O	TTL	Interrupt on change pin.
RB5	38	42	15	I/O	TTL	Interrupt on change pin.
RB6/PGC	39	43	16	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.
RB7/PGD	40	44	17	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.
						PORTC is a bi-directional I/O port.
RC0/T1OSO/T1CKI	15	16	32	I/O	ST	RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1/T1OSI/CCP2	16	18	35	I/O	ST	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
RC2/CCP1	17	19	36	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/PWM1 output.
RC3/SCK/SCL	18	20	37	I/O	ST	RC3 can also be the synchronous serial clock input/output for both SPI and I^2C modes.
RC4/SDI/SDA	23	25	42	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I^2C mode).
RC5/SDO	24	26	43	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC6/TX/CK	25	27	44	I/O	ST	RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.
RC7/RX/DT	26	29	1	I/O	ST	RC7 can also be the USART Asynchronous Receive or Synchronous Data.

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 an 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 as general purpose I/O and a TTL input when used in the Parallel Slave Port mode (for interfacing to a microprocessor bus).
4: This buffer is a Schmitt Trigger input when configured in RC oscillator mode and a CMOS input otherwise.

TABLE 1-2: PIC16F874 AND PIC16F877 PINOUT DESCRIPTION (CONTINUED)

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
						PORTD is a bi-directional I/O port or parallel slave port when interfacing to a microprocessor bus.
RD0/PSP0	19	21	38	I/O	ST/TTL(3)	
RD1/PSP1	20	22	39	I/O	ST/TTL(3)	
RD2/PSP2	21	23	40	I/O	ST/TTL(3)	
RD3/PSP3	22	24	41	I/O	ST/TTL(3)	
RD4/PSP4	27	30	2	I/O	ST/TTL(3)	
RD5/PSP5	28	31	3	I/O	ST/TTL(3)	
RD6/PSP6	29	32	4	I/O	ST/TTL(3)	
RD7/PSP7	30	33	5	I/O	ST/TTL(3)	
						PORTE is a bi-directional I/O port.
RE0/$\overline{RD}$/AN5	8	9	25	I/O	ST/TTL(3)	RE0 can also be read control for the parallel slave port, or analog input5.
RE1/$\overline{WR}$/AN6	9	10	26	I/O	ST/TTL(3)	RE1 can also be write control for the parallel slave port, or analog input6.
RE2/$\overline{CS}$/AN7	10	11	27	I/O	ST/TTL(3)	RE2 can also be select control for the parallel slave port, or analog input7.
VSS	12,31	13,34	6,29	P	—	Ground reference for logic and I/O pins.
VDD	11,32	12,35	7,28	P	—	Positive supply for logic and I/O pins.
NC	—	1,17,28, 40	12,13, 33,34		—	These pins are not internally connected. These pins should be left unconnected.

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 an 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 as general purpose I/O and a TTL input when used in the Parallel Slave Port mode (for interfacing to a microprocessor bus).
4: This buffer is a Schmitt Trigger input when configured in RC oscillator mode and a CMOS input otherwise.

APPENDIX C

MAX232 DATASHEET

19-4323; Rev 11; 2/03

MAXIM

+5V-Powered, Multichannel RS-232 Drivers/Receivers

General Description

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available.

These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than 5μW. The MAX225, MAX233, MAX235, and MAX245/MAX246/MAX247 use no external components and are recommended for applications where printed circuit board space is critical.

Applications

Portable Computers

Low-Power Modems

Interface Translation

Battery-Powered RS-232 Systems

Multidrop RS-232 Networks

Features

Superior to Bipolar

- ♦ Operate from Single +5V Power Supply (+5V and +12V—MAX231/MAX239)
- ♦ Low-Power Receive Mode in Shutdown (MAX223/MAX242)
- ♦ Meet All EIA/TIA-232E and V.28 Specifications
- ♦ Multiple Drivers and Receivers
- ♦ 3-State Driver and Receiver Outputs
- ♦ Open-Line Detection (MAX243)

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX220CPE	0°C to +70°C	16 Plastic DIP
MAX220CSE	0°C to +70°C	16 Narrow SO
MAX220CWE	0°C to +70°C	16 Wide SO
MAX220C/D	0°C to +70°C	Dice*
MAX220EPE	-40°C to +85°C	16 Plastic DIP
MAX220ESE	-40°C to +85°C	16 Narrow SO
MAX220EWE	-40°C to +85°C	16 Wide SO
MAX220EJE	-40°C to +85°C	16 CERDIP
MAX220MJE	-55°C to +125°C	16 CERDIP

Ordering Information continued at end of data sheet.

**Contact factory for dice specifications.*

Selection Table

Part Number	Power Supply (V)	No. of RS-232 Drivers/Rx	No. of Ext. Caps	Nominal Cap. Value (μF)	SHDN & Three-State	Rx Active in SHDN	Data Rate (kbps)	Features
MAX220	+5	2/2	4	0.1	No	—	120	Ultra-low-power, industry-standard pinout
MAX222	+5	2/2	4	0.1	Yes	—	200	Low-power shutdown
MAX223 (MAX213)	+5	4/5	4	1.0 (0.1)	Yes	✔	120	MAX241 and receivers active in shutdown
MAX225	+5	5/5	0	—	Yes	✔	120	Available in SO
MAX230 (MAX200)	+5	5/0	4	1.0 (0.1)	Yes	—	120	5 drivers with shutdown
MAX231 (MAX201)	+5 and +7.5 to +13.2	2/2	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; same functions as MAX232
MAX232 (MAX202)	+5	2/2	4	1.0 (0.1)	No	—	120 (64)	Industry standard
MAX232A	+5	2/2	4	0.1	No	—	200	Higher slew rate, small caps
MAX233 (MAX203)	+5	2/2	0	—	No	—	120	No external caps
MAX233A	+5	2/2	0	—	No	—	200	No external caps, high slew rate
MAX234 (MAX204)	+5	4/0	4	1.0 (0.1)	No	—	120	Replaces 1488
MAX235 (MAX205)	+5	5/5	0	—	Yes	—	120	No external caps
MAX236 (MAX206)	+5	4/3	4	1.0 (0.1)	Yes	—	120	Shutdown, three state
MAX237 (MAX207)	+5	5/3	4	1.0 (0.1)	No	—	120	Complements IBM PC serial port
MAX238 (MAX208)	+5	4/4	4	1.0 (0.1)	No	—	120	Replaces 1488 and 1489
MAX239 (MAX209)	+5 and +7.5 to +13.2	3/5	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; single-package solution for IBM PC serial port
MAX240	+5	5/5	4	1.0	Yes	—	120	DIP or flatpack package
MAX241 (MAX211)	+5	4/5	4	1.0 (0.1)	Yes	—	120	Complete IBM PC serial port
MAX242	+5	2/2	4	0.1	Yes	✔	200	Separate shutdown and enable
MAX243	+5	2/2	4	0.1	No	—	200	Open-line detection simplifies cabling
MAX244	+5	8/10	4	1.0	No	—	120	High slew rate
MAX245	+5	8/10	0	—	Yes	✔	120	High slew rate, int. caps, two shutdown modes
MAX246	+5	8/10	0	—	Yes	✔	120	High slew rate, int. caps, three shutdown modes
MAX247	+5	8/9	0	—	Yes	✔	120	High slew rate, int. caps, nine operating modes
MAX248	+5	8/8	4	1.0	Yes	✔	120	High slew rate, selective half-chip enables
MAX249	+5	6/10	4	1.0	Yes	✔	120	Available in quad flatpack package

+5V-Powered, Multichannel RS-232 Drivers/Receivers

ABSOLUTE MAXIMUM RATINGS—MAX220/222/232A/233A/242/243

Supply Voltage (V_{CC}) ....-0.3V to +6V
Input Voltages
T_{IN}..-0.3V to (V_{CC} - 0.3V)
R_{IN} (Except MAX220) ....±30V
R_{IN} (MAX220)..±25V
T_{OUT} (Except MAX220) (Note 1) ....±15V
T_{OUT} (MAX220)...±13.2V
Output Voltages
T_{OUT}...±15V
R_{OUT}..-0.3V to (V_{CC} + 0.3V)
Driver/Receiver Output Short Circuited to GND.........Continuous
Continuous Power Dissipation (T_A = +70°C)
16-Pin Plastic DIP (derate 10.53mW/°C above +70°C)....842mW
18-Pin Plastic DIP (derate 11.11mW/°C above +70°C)....889mW
20-Pin Plastic DIP (derate 8.00mW/°C above +70°C) ..440mW
16-Pin Narrow SO (derate 8.70mW/°C above +70°C) ...696mW
16-Pin Wide SO (derate 9.52mW/°C above +70°C)......762mW
18-Pin Wide SO (derate 9.52mW/°C above +70°C)......762mW
20-Pin Wide SO (derate 10.00mW/°C above +70°C)....800mW
20-Pin SSOP (derate 8.00mW/°C above +70°C) 640mW
16-Pin CERDIP (derate 10.00mW/°C above +70°C).....800mW
18-Pin CERDIP (derate 10.53mW/°C above +70°C).....842mW
Operating Temperature Ranges
MAX2_ _AC_ _, MAX2_ _C_ _.............................0°C to +70°C
MAX2_ _AE_ _, MAX2_ _E_ _ ....-40°C to +85°C
MAX2_ _AM_ _, MAX2_ _M_ _.......................-55°C to +125°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10s) ....+300°C

Note 1: Input voltage measured with T_{OUT} in high-impedance state, $\overline{SHDN}$ or V_{CC} = 0V.
Note 2: For the MAX220, V+ and V- can have a maximum magnitude of 7V, but their absolute difference cannot exceed 13V.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243

(V_{CC} = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RS-232 TRANSMITTERS						
Output Voltage Swing	All transmitter outputs loaded with 3kΩ to GND		±5	±8		V
Input Logic Threshold Low				1.4	0.8	V
Input Logic Threshold High	All devices except MAX220		2	1.4		V
	MAX220: V_{CC} = 5.0V		2.4			
Logic Pull-Up/Input Current	All except MAX220, normal operation			5	40	µA
	$\overline{SHDN}$ = 0V, MAX222/242, shutdown, MAX220			±0.01	±1	
Output Leakage Current	V_{CC} = 5.5V, $\overline{SHDN}$ = 0V, V_{OUT} = ±15V, MAX222/242			±0.01	±10	µA
	V_{CC} = $\overline{SHDN}$ = 0V, V_{OUT} = ±15V			±0.01	±10	
Data Rate				200	116	kbps
Transmitter Output Resistance	V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V		300	10M		Ω
Output Short-Circuit Current	V_{OUT} = 0V		±7	±22		mA
RS-232 RECEIVERS						
RS-232 Input Voltage Operating Range					±30	V
RS-232 Input Threshold Low	V_{CC} = 5V	All except MAX243 $R2_{IN}$	0.8	1.3		V
		MAX243 $R2_{IN}$ (Note 2)	-3			
RS-232 Input Threshold High	V_{CC} = 5V	All except MAX243 $R2_{IN}$		1.8	2.4	V
		MAX243 $R2_{IN}$ (Note 2)		-0.5	-0.1	
RS-232 Input Hysteresis	All except MAX243, V_{CC} = 5V, no hysteresis in shdn.		0.2	0.5	1	V
	MAX243			1		
RS-232 Input Resistance			3	5	7	kΩ
TTL/CMOS Output Voltage Low	I_{OUT} = 3.2mA			0.2	0.4	V
TTL/CMOS Output Voltage High	I_{OUT} = -1.0mA		3.5	V_{CC} - 0.2		V
TTL/CMOS Output Short-Circuit Current	Sourcing V_{OUT} = GND		-2	-10		mA
	Shrinking V_{OUT} = V_{CC}		10	30		

ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243 (continued)

(V_{CC} = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
TTL/CMOS Output Leakage Current	$\overline{SHDN}$ = V_{CC} or $\overline{EN}$ = V_{CC} ($\overline{SHDN}$ = 0V for MAX222), 0V ≤ V_{OUT} ≤ V_{CC}			±0.05	±10	µA
$\overline{EN}$ Input Threshold Low	MAX242			1.4	0.8	V
$\overline{EN}$ Input Threshold High	MAX242		2.0	1.4		V
Operating Supply Voltage			4.5		5.5	V
V_{CC} Supply Current ($\overline{SHDN}$ = V_{CC}), Figures 5, 6, 11, 19	No load	MAX220		0.5	2	mA
		MAX222/232A/233A/242/243		4	10	
	3kΩ load both inputs	MAX220		12		
		MAX222/232A/233A/242/243		15		
Shutdown Supply Current	MAX222/242	T_A = +25°C		0.1	10	µA
		T_A = 0°C to +70°C		2	50	
		T_A = -40°C to +85°C		2	50	
		T_A = -55°C to +125°C		35	100	
$\overline{SHDN}$ Input Leakage Current	MAX222/242				±1	µA
$\overline{SHDN}$ Threshold Low	MAX222/242			1.4	0.8	V
$\overline{SHDN}$ Threshold High	MAX222/242		2.0	1.4		V
Transition Slew Rate	C_L = 50pF to 2500pF, R_L = 3kΩ to 7kΩ, V_{CC} = 5V, T_A = +25°C, measured from +3V to -3V or -3V to +3V	MAX222/232A/233A/242/243	6	12	30	V/µs
		MAX220	1.5	3	30	
Transmitter Propagation Delay TLL to RS-232 (Normal Operation), Figure 1	t_{PHLT}	MAX222/232A/233A/242/243		1.3	3.5	µs
		MAX220		4	10	
	t_{PLHT}	MAX222/232A/233A/242/243		1.5	3.5	
		MAX220		5	10	
Receiver Propagation Delay RS-232 to TLL (Normal Operation), Figure 2	t_{PHLR}	MAX222/232A/233A/242/243		0.5	1	µs
		MAX220		0.6	3	
	t_{PLHR}	MAX222/232A/233A/242/243		0.6	1	
		MAX220		0.8	3	
Receiver Propagation Delay RS-232 to TLL (Shutdown), Figure 2	t_{PHLS}	MAX242		0.5	10	µs
	t_{PLHS}	MAX242		2.5	10	
Receiver-Output Enable Time, Figure 3	t_{ER}	MAX242		125	500	ns
Receiver-Output Disable Time, Figure 3	t_{DR}	MAX242		160	500	ns
Transmitter-Output Enable Time ($\overline{SHDN}$ Goes High), Figure 4	t_{ET}	MAX222/242, 0.1µF caps (includes charge-pump start-up)		250		µs
Transmitter-Output Disable Time ($\overline{SHDN}$ Goes Low), Figure 4	t_{DT}	MAX222/242, 0.1µF caps		600		ns
Transmitter + to - Propagation Delay Difference (Normal Operation)	t_{PHLT} - t_{PLHT}	MAX222/232A/233A/242/243		300		ns
		MAX220		2000		
Receiver + to - Propagation Delay Difference (Normal Operation)	t_{PHLR} - t_{PLHR}	MAX222/232A/233A/242/243		100		ns
		MAX220		225		

Note 3: MAX243 $R2_{OUT}$ is guaranteed to be low when $R2_{IN}$ is ≥ 0V or is floating.

APPENDIX D

LM35 DATASHEET

National Semiconductor

November 2000

LM35
Precision Centigrade Temperature Sensors

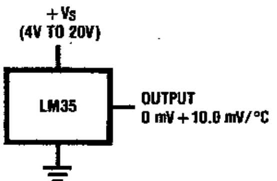
General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features

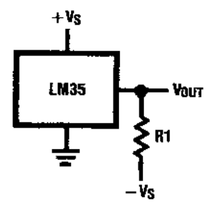
- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±¼°C typical
- Low impedance output, 0.1 Ω for 1 mA load

Typical Applications



DS005516-3

FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)



DS005516-4

Choose $R_1 = -V_S/50\ \mu A$

V_{OUT}=+1,500 mV at +150°C

= +250 mV at +25°C

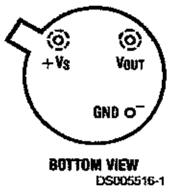
= −550 mV at −55°C

FIGURE 2. Full-Range Centigrade Temperature Sensor

 DS005516

Connection Diagrams

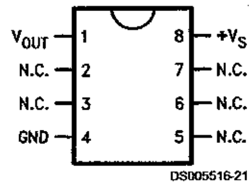
TO-46
Metal Can Package*



*Case is connected to negative pin (GND)

Order Number LM35H, LM35AH, LM35CH, LM35CAH or LM35DH
See NS Package Number H03H

SO-8
Small Outline Molded Package



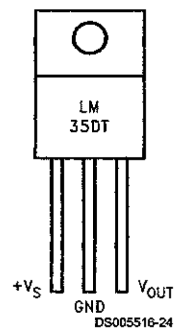
N.C. = No Connection

Top View
Order Number LM35DM
See NS Package Number M08A

TO-92
Plastic Package

Order Number LM35CZ, LM35CAZ or LM35DZ
See NS Package Number Z03A

TO-220
Plastic Package*



*Tab is connected to the negative pin (GND).
Note: The LM35DT pinout is different than the discontinued LM35DP.

Order Number LM35DT
See NS Package Number TA03F

Absolute Maximum Ratings (Note 10)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage	+35V to −0.2V
Output Voltage	+6V to −1.0V
Output Current	10 mA
Storage Temp.;	
TO-46 Package,	−60°C to +180°C
TO-92 Package,	−60°C to +150°C
SO-8 Package,	−65°C to +150°C
TO-220 Package,	−65°C to +150°C
Lead Temp.:	
TO-46 Package, (Soldering, 10 seconds)	300°C
TO-92 and TO-220 Package, (Soldering, 10 seconds)	260°C
SO Package (Note 12)	
Vapor Phase (60 seconds)	215°C
Infrared (15 seconds)	220°C
ESD Susceptibility (Note 11)	2500V

Specified Operating Temperature Range: T_{MIN} to T_{MAX} (Note 2)

LM35, LM35A	−55°C to +150°C
LM35C, LM35CA	−40°C to +110°C
LM35D	0°C to +100°C

Electrical Characteristics

(Notes 1, 6)

Parameter	Conditions	LM35A Typical	LM35A Tested Limit (Note 4)	LM35A Design Limit (Note 5)	LM35CA Typical	LM35CA Tested Limit (Note 4)	LM35CA Design Limit (Note 5)	Units (Max.)
Accuracy	T_A=+25°C	±0.2	±0.5		±0.2	±0.5		°C
(Note 7)	T_A=−10°C	±0.3			±0.3		±1.0	°C
	$T_A=T_{MAX}$	±0.4	±1.0		±0.4	±1.0		°C
	$T_A=T_{MIN}$	±0.4	±1.0		±0.4		±1.5	°C
Nonlinearity (Note 8)	$T_{MIN} \leq T_A \leq T_{MAX}$	**±0.18**		**±0.35**	**±0.15**		**±0.3**	°C
Sensor Gain (Average Slope)	$T_{MIN} \leq T_A \leq T_{MAX}$	**+10.0**	**+9.9, +10.1**		**+10.0**		**+9.9, +10.1**	mV/°C
Load Regulation	T_A=+25°C	±0.4	±1.0		±0.4	±1.0		mV/mA
(Note 3) $0 \leq I_L \leq 1$ mA	$T_{MIN} \leq T_A \leq T_{MAX}$	**±0.5**		**±3.0**	**±0.5**		**±3.0**	mV/mA
Line Regulation	T_A=+25°C	±0.01	±0.05		±0.01	±0.05		mV/V
(Note 3)	$4V \leq V_S \leq 30V$	**±0.02**		**±0.1**	**±0.02**		**±0.1**	mV/V
Quiescent Current	V_S=+5V, +25°C	56	67		56	67		μA
(Note 9)	V_S=+5V	**105**		**131**	**91**		**114**	μA
	V_S=+30V, +25°C	56.2	68		56.2	68		μA
	V_S=+30V	**105.5**		**133**	**91.5**		**116**	μA
Change of Quiescent Current	$4V \leq V_S \leq 30V$, +25°C	0.2	1.0		0.2	1.0		μA
(Note 3)	$4V \leq V_S \leq 30V$	**0.5**		**2.0**	**0.5**		**2.0**	μA
Temperature Coefficient of Quiescent Current		**+0.39**		**+0.5**	**+0.39**		**+0.5**	μA/°C
Minimum Temperature for Rated Accuracy	In circuit of *Figure 1*, I_L=0	+1.5		+2.0	+1.5		+2.0	°C
Long Term Stability	$T_J=T_{MAX}$, for 1000 hours	±0.08			±0.08			°C

APPENDIX E

PIC CODING

PIC Coding

```
#include <16F877A.h>
#device ADC=8
#fuses XT, NOWDT, NOPROTECT, NOPUT,
NOBROWNOUT, NOLVP
#use delay (clock=4000000)
#include <LCD.C>
#include <string.h>
#use rs232(baud=1200, xmit=PIN_C6,
rcv=PIN_C7)


float adcValue1;
float voltage1;
float temperature;
float adcValue2;
float voltage2;



void main( )
{
setup_adc_ports(ALL_ANALOG);
setup_adc(ADC_CLOCK_INTERNAL);



while (1)
{
set_adc_channel(0);
delay_us(30);
adcValue1=read_adc();
delay_us(30);
voltage1= 5.000*adcValue1/255.000;

set_adc_channel(1);
delay_us(30);
adcValue2=read_adc();
voltage2= 5.000*adcValue2/255.000;

temperature=voltage2/0.01;


lcd_init();
lcd_putc('\f');
lcd_gotoxy(1,1);
lcd_putc("Room Temperature:");

lcd_gotoxy(1,2);
printf(lcd_putc, "%f", temperature);
lcd_gotoxy(9,2);
lcd_putc(" deg C ");


if(adcValue1>102)

{
output_high(pin_E0);
putchar(65);

if(adcValue2>12.75)

{
output_high(pin_E1);
putchar(67);
}

else if(adcValue2<12.24)

{
output_high(pin_E2);
putchar(68);
}

}

else
{
output_low(pin_E0);
putchar(66);

}
delay_ms(2000);

}

}
```

APPENDIX F

VISUAL BASIC CODING (EMSYS)

```
Public Class Form1
Inherits System.Windows.Forms.Form

#Region " Windows Form Designer generated code "

Public Sub New()
MyBase.New()

'This call is required by the Windows Form Designer.
InitializeComponent()

'Add any initialization after the InitializeComponent() call

End Sub

'Form overrides dispose to clean up the component list.
Protected Overloads Overrides Sub Dispose(ByVal disposing As
Boolean)
If disposing Then
If Not (components Is Nothing) Then
components.Dispose()
End If
End If
MyBase.Dispose(disposing)
End Sub

'Required by the Windows Form Designer
Private components As System.ComponentModel.IContainer

'NOTE: The following procedure is required by the Windows
Form Designer
'It can be modified using the Windows Form Designer.
'Do not modify it using the code editor.
Friend WithEvents tctrContent As
System.Windows.Forms.TabControl
Friend WithEvents tpgGeneral As
System.Windows.Forms.TabPage
Friend WithEvents tpgRoof As System.Windows.Forms.TabPage
Friend WithEvents tpgwall As System.Windows.Forms.TabPage
Friend WithEvents tpgwindow As
System.Windows.Forms.TabPage
Friend WithEvents prgOccupancy As
System.Windows.Forms.TabPage
Friend WithEvents tpgEquip As
System.Windows.Forms.TabPage
Friend WithEvents tpgresult As System.Windows.Forms.TabPage
Friend WithEvents btnQuit As System.Windows.Forms.Button
Friend WithEvents btnreset As System.Windows.Forms.Button
Friend WithEvents lstSolarTime As
System.Windows.Forms.ListBox
Friend WithEvents Label1 As System.Windows.Forms.Label
Friend WithEvents txtIndoor As
System.Windows.Forms.TextBox
Friend WithEvents txtOutdoor As
System.Windows.Forms.TextBox
Friend WithEvents Label2 As System.Windows.Forms.Label
Friend WithEvents Label3 As System.Windows.Forms.Label
Friend WithEvents lstRoofCons As
System.Windows.Forms.ListBox
Friend WithEvents Label4 As System.Windows.Forms.Label
Friend WithEvents Label5 As System.Windows.Forms.Label
Friend WithEvents GroupBox1 As
System.Windows.Forms.GroupBox
Friend WithEvents Label6 As System.Windows.Forms.Label
Friend WithEvents Label7 As System.Windows.Forms.Label
Friend WithEvents Label8 As System.Windows.Forms.Label
Friend WithEvents Label9 As System.Windows.Forms.Label
Friend WithEvents Label10 As System.Windows.Forms.Label
Friend WithEvents txtRLength As
System.Windows.Forms.TextBox
Friend WithEvents txtRWidth As
System.Windows.Forms.TextBox
Friend WithEvents Label11 As System.Windows.Forms.Label
Friend WithEvents cboWallCons As
System.Windows.Forms.ComboBox
Friend WithEvents Label12 As System.Windows.Forms.Label
Friend WithEvents txtWlength As
System.Windows.Forms.TextBox
Friend WithEvents txtWWidth As
System.Windows.Forms.TextBox
Friend WithEvents Label13 As System.Windows.Forms.Label
Friend WithEvents Label14 As System.Windows.Forms.Label
Friend WithEvents Label15 As System.Windows.Forms.Label
Friend WithEvents Label16 As System.Windows.Forms.Label
Friend WithEvents cboWDirection As
System.Windows.Forms.ComboBox
Friend WithEvents Label17 As System.Windows.Forms.Label
Friend WithEvents Label18 As System.Windows.Forms.Label
Friend WithEvents Label19 As System.Windows.Forms.Label
Friend WithEvents cboWinType As
System.Windows.Forms.ComboBox
Friend WithEvents GroupBox2 As
System.Windows.Forms.GroupBox
Friend WithEvents rboClear As
System.Windows.Forms.RadioButton
Friend WithEvents rboSC As
System.Windows.Forms.RadioButton
Friend WithEvents rboNoSC As
System.Windows.Forms.RadioButton
Friend WithEvents rboHeatAbs As
System.Windows.Forms.RadioButton
Friend WithEvents Label20 As System.Windows.Forms.Label
Friend WithEvents GroupBox3 As
System.Windows.Forms.GroupBox
Friend WithEvents rboNoShade As
System.Windows.Forms.RadioButton
Friend WithEvents rboBlinds As
System.Windows.Forms.RadioButton
Friend WithEvents Label21 As System.Windows.Forms.Label
Friend WithEvents cboWinDirection As
System.Windows.Forms.ComboBox
Friend WithEvents Label22 As System.Windows.Forms.Label
Friend WithEvents Label23 As System.Windows.Forms.Label
Friend WithEvents Label24 As System.Windows.Forms.Label
Friend WithEvents Label25 As System.Windows.Forms.Label
Friend WithEvents Label26 As System.Windows.Forms.Label
Friend WithEvents Label27 As System.Windows.Forms.Label
Friend WithEvents Label28 As System.Windows.Forms.Label
Friend WithEvents txtWinWidth As
System.Windows.Forms.TextBox
Friend WithEvents txtWinLength As
System.Windows.Forms.TextBox
Friend WithEvents Label29 As System.Windows.Forms.Label
Friend WithEvents Label30 As System.Windows.Forms.Label
Friend WithEvents Label31 As System.Windows.Forms.Label
Friend WithEvents txtNoPeople As
System.Windows.Forms.TextBox
Friend WithEvents cboTypeAct As
System.Windows.Forms.ComboBox
Friend WithEvents Label32 As System.Windows.Forms.Label
Friend WithEvents Label33 As System.Windows.Forms.Label
Friend WithEvents txtComp As System.Windows.Forms.TextBox
Friend WithEvents Label34 As System.Windows.Forms.Label
Friend WithEvents GroupBox4 As
System.Windows.Forms.GroupBox
Friend WithEvents rboStandby As
System.Windows.Forms.RadioButton
Friend WithEvents rbofullcomp As
System.Windows.Forms.RadioButton
Friend WithEvents Label35 As System.Windows.Forms.Label
```

```
Friend WithEvents Label36 As System.Windows.Forms.Label
Friend WithEvents txtOthers As
System.Windows.Forms.TextBox
Friend WithEvents Label37 As System.Windows.Forms.Label
Friend WithEvents Label38 As System.Windows.Forms.Label
Friend WithEvents Label39 As System.Windows.Forms.Label
Friend WithEvents Label40 As System.Windows.Forms.Label
Friend WithEvents Label41 As System.Windows.Forms.Label
Friend WithEvents Label42 As System.Windows.Forms.Label
Friend WithEvents Label43 As System.Windows.Forms.Label
Friend WithEvents Label44 As System.Windows.Forms.Label
Friend WithEvents Label45 As System.Windows.Forms.Label
Friend WithEvents Label46 As System.Windows.Forms.Label
Friend WithEvents Label48 As System.Windows.Forms.Label
Friend WithEvents Label49 As System.Windows.Forms.Label
Friend WithEvents btnNext1 As System.Windows.Forms.Button
Friend WithEvents btnBack2 As System.Windows.Forms.Button
Friend WithEvents btnNext2 As System.Windows.Forms.Button
Friend WithEvents btnBack3 As System.Windows.Forms.Button
Friend WithEvents btnNext3 As System.Windows.Forms.Button
Friend WithEvents btnBack4 As System.Windows.Forms.Button
Friend WithEvents btnNext4 As System.Windows.Forms.Button
Friend WithEvents btnBack5 As System.Windows.Forms.Button
Friend WithEvents btnNext5 As System.Windows.Forms.Button
Friend WithEvents btnBack6 As System.Windows.Forms.Button
Friend WithEvents btnCalculate As
System.Windows.Forms.Button
Friend WithEvents btnBack7 As System.Windows.Forms.Button
Friend WithEvents txtQwall As System.Windows.Forms.TextBox
Friend WithEvents txtQRoof As
System.Windows.Forms.TextBox
Friend WithEvents txtQwindow As
System.Windows.Forms.TextBox
Friend WithEvents txtQoccupancy As
System.Windows.Forms.TextBox
Friend WithEvents txtQequip As
System.Windows.Forms.TextBox
Friend WithEvents txtQtotal As System.Windows.Forms.TextBox
Friend WithEvents txtQKW As System.Windows.Forms.TextBox
Friend WithEvents Label50 As System.Windows.Forms.Label
Friend WithEvents Label47 As System.Windows.Forms.Label
Friend WithEvents Label51 As System.Windows.Forms.Label
<System.Diagnostics.DebuggerStepThrough()> Private Sub
InitializeComponent()
Me.tctrContent = New System.Windows.Forms.TabControl
Me.tpgGeneral = New System.Windows.Forms.TabPage
Me.Label23 = New System.Windows.Forms.Label
Me.Label22 = New System.Windows.Forms.Label
Me.Label19 = New System.Windows.Forms.Label
Me.btnNext1 = New System.Windows.Forms.Button
Me.Label3 = New System.Windows.Forms.Label
Me.Label2 = New System.Windows.Forms.Label
Me.txtOutdoor = New System.Windows.Forms.TextBox
Me.txtIndoor = New System.Windows.Forms.TextBox
Me.Label1 = New System.Windows.Forms.Label
Me.lstSolarTime = New System.Windows.Forms.ListBox
Me.tpgRoof = New System.Windows.Forms.TabPage
Me.Label10 = New System.Windows.Forms.Label
Me.Label9 = New System.Windows.Forms.Label
Me.Label8 = New System.Windows.Forms.Label
Me.Label7 = New System.Windows.Forms.Label
Me.txtRWidth = New System.Windows.Forms.TextBox
Me.txtRLength = New System.Windows.Forms.TextBox
Me.Label6 = New System.Windows.Forms.Label
Me.Label5 = New System.Windows.Forms.Label
Me.btnBack2 = New System.Windows.Forms.Button
Me.btnNext2 = New System.Windows.Forms.Button
Me.Label4 = New System.Windows.Forms.Label
Me.lstRoofCons = New System.Windows.Forms.ListBox
Me.GroupBox1 = New System.Windows.Forms.GroupBox
Me.rboNoSC = New System.Windows.Forms.RadioButton
Me.rboSC = New System.Windows.Forms.RadioButton
Me.tpgwall = New System.Windows.Forms.TabPage
Me.Label17 = New System.Windows.Forms.Label
Me.cboWDirection = New System.Windows.Forms.ComboBox
Me.Label16 = New System.Windows.Forms.Label
Me.Label15 = New System.Windows.Forms.Label
Me.Label14 = New System.Windows.Forms.Label
Me.Label13 = New System.Windows.Forms.Label
Me.txtWWidth = New System.Windows.Forms.TextBox
Me.txtWlength = New System.Windows.Forms.TextBox
Me.Label12 = New System.Windows.Forms.Label
Me.cboWallCons = New System.Windows.Forms.ComboBox
Me.Label11 = New System.Windows.Forms.Label
Me.btnBack3 = New System.Windows.Forms.Button
Me.btnNext3 = New System.Windows.Forms.Button
Me.tpgwindow = New System.Windows.Forms.TabPage
Me.Label25 = New System.Windows.Forms.Label
Me.Label26 = New System.Windows.Forms.Label
Me.Label27 = New System.Windows.Forms.Label
Me.Label28 = New System.Windows.Forms.Label
Me.txtWinWidth = New System.Windows.Forms.TextBox
Me.txtWinLength = New System.Windows.Forms.TextBox
Me.Label24 = New System.Windows.Forms.Label
Me.Label21 = New System.Windows.Forms.Label
Me.cboWinDirection = New System.Windows.Forms.ComboBox
Me.GroupBox3 = New System.Windows.Forms.GroupBox
Me.rboBlinds = New System.Windows.Forms.RadioButton
Me.rboNoShade = New System.Windows.Forms.RadioButton
Me.Label20 = New System.Windows.Forms.Label
Me.cboWinType = New System.Windows.Forms.ComboBox
Me.Label18 = New System.Windows.Forms.Label
Me.btnBack4 = New System.Windows.Forms.Button
Me.btnNext4 = New System.Windows.Forms.Button
Me.GroupBox2 = New System.Windows.Forms.GroupBox
Me.rboHeatAbs = New System.Windows.Forms.RadioButton
Me.rboClear = New System.Windows.Forms.RadioButton
Me.prgOccupancy = New System.Windows.Forms.TabPage
Me.cboTypeAct = New System.Windows.Forms.ComboBox
Me.txtNoPeople = New System.Windows.Forms.TextBox
Me.Label31 = New System.Windows.Forms.Label
Me.Label30 = New System.Windows.Forms.Label
Me.Label29 = New System.Windows.Forms.Label
Me.btnBack5 = New System.Windows.Forms.Button
Me.btnNext5 = New System.Windows.Forms.Button
Me.tpgEquip = New System.Windows.Forms.TabPage
Me.Label36 = New System.Windows.Forms.Label
Me.txtOthers = New System.Windows.Forms.TextBox
Me.Label35 = New System.Windows.Forms.Label
Me.GroupBox4 = New System.Windows.Forms.GroupBox
Me.rbofullcomp = New System.Windows.Forms.RadioButton
Me.rboStandby = New System.Windows.Forms.RadioButton
Me.Label34 = New System.Windows.Forms.Label
Me.txtComp = New System.Windows.Forms.TextBox
Me.Label33 = New System.Windows.Forms.Label
Me.Label32 = New System.Windows.Forms.Label
Me.btnBack6 = New System.Windows.Forms.Button
Me.btnCalculate = New System.Windows.Forms.Button
Me.tpgresult = New System.Windows.Forms.TabPage
Me.Label47 = New System.Windows.Forms.Label
Me.Label49 = New System.Windows.Forms.Label
Me.txtQKW = New System.Windows.Forms.TextBox
Me.Label48 = New System.Windows.Forms.Label
Me.Label46 = New System.Windows.Forms.Label
Me.Label45 = New System.Windows.Forms.Label
Me.Label44 = New System.Windows.Forms.Label
Me.Label43 = New System.Windows.Forms.Label
Me.Label42 = New System.Windows.Forms.Label
Me.Label40 = New System.Windows.Forms.Label
Me.Label39 = New System.Windows.Forms.Label
```

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Me.Label38 = New System.Windows.Forms.Label
Me.Label37 = New System.Windows.Forms.Label
Me.txtQtotal = New System.Windows.Forms.TextBox
Me.txtQequip = New System.Windows.Forms.TextBox
Me.txtQoccupancy = New System.Windows.Forms.TextBox
Me.txtQwindow = New System.Windows.Forms.TextBox
Me.txtQRoof = New System.Windows.Forms.TextBox
Me.txtQwall = New System.Windows.Forms.TextBox
Me.btnBack7 = New System.Windows.Forms.Button
Me.Label41 = New System.Windows.Forms.Label
Me.btnQuit = New System.Windows.Forms.Button
Me.btnreset = New System.Windows.Forms.Button
Me.Label50 = New System.Windows.Forms.Label
Me.Label51 = New System.Windows.Forms.Label
Me.tctrContent.SuspendLayout()
Me.tpgGeneral.SuspendLayout()
Me.tpgRoof.SuspendLayout()
Me.GroupBox1.SuspendLayout()
Me.tpgwall.SuspendLayout()
Me.tpgwindow.SuspendLayout()
Me.GroupBox3.SuspendLayout()
Me.GroupBox2.SuspendLayout()
Me.prgOccupancy.SuspendLayout()
Me.tpgEquip.SuspendLayout()
Me.GroupBox4.SuspendLayout()
Me.tpgresult.SuspendLayout()
Me.SuspendLayout()
'
'tctrContent
'
Me.tctrContent.Controls.Add(Me.tpgGeneral)
Me.tctrContent.Controls.Add(Me.tpgRoof)
Me.tctrContent.Controls.Add(Me.tpgwall)
Me.tctrContent.Controls.Add(Me.tpgwindow)
Me.tctrContent.Controls.Add(Me.prgOccupancy)
Me.tctrContent.Controls.Add(Me.tpgEquip)
Me.tctrContent.Controls.Add(Me.tpgresult)
Me.tctrContent.Location = New System.Drawing.Point(32, 80)
Me.tctrContent.Name = "tctrContent"
Me.tctrContent.SelectedIndex = 0
Me.tctrContent.Size = New System.Drawing.Size(496, 312)
Me.tctrContent.TabIndex = 0
'
'tpgGeneral
'
Me.tpgGeneral.BackColor =
System.Drawing.Color.LavenderBlush
Me.tpgGeneral.Controls.Add(Me.Label23)
Me.tpgGeneral.Controls.Add(Me.Label22)
Me.tpgGeneral.Controls.Add(Me.Label19)
Me.tpgGeneral.Controls.Add(Me.btnNext1)
Me.tpgGeneral.Controls.Add(Me.Label3)
Me.tpgGeneral.Controls.Add(Me.Label2)
Me.tpgGeneral.Controls.Add(Me.txtOutdoor)
Me.tpgGeneral.Controls.Add(Me.txtIndoor)
Me.tpgGeneral.Controls.Add(Me.Label1)
Me.tpgGeneral.Controls.Add(Me.lstSolarTime)
Me.tpgGeneral.Location = New System.Drawing.Point(4, 29)
Me.tpgGeneral.Name = "tpgGeneral"
Me.tpgGeneral.Size = New System.Drawing.Size(488, 279)
Me.tpgGeneral.TabIndex = 0
Me.tpgGeneral.Text = "General"
'
'Label23
'
Me.Label23.Location = New System.Drawing.Point(384, 144)
Me.Label23.Name = "Label23"
Me.Label23.Size = New System.Drawing.Size(56, 24)
Me.Label23.TabIndex = 10
Me.Label23.Text = "Celcius"
'
'Label22
'
Me.Label22.Location = New System.Drawing.Point(384, 72)
Me.Label22.Name = "Label22"
Me.Label22.Size = New System.Drawing.Size(56, 24)
Me.Label22.TabIndex = 9
Me.Label22.Text = "Celcius"
'
'Label19
'
Me.Label19.Font = New System.Drawing.Font("Microsoft Sans
Serif", 9.75!, System.Drawing.FontStyle.Underline,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label19.Location = New System.Drawing.Point(24, 16)
Me.Label19.Name = "Label19"
Me.Label19.Size = New System.Drawing.Size(104, 16)
Me.Label19.TabIndex = 8
Me.Label19.Text = "General Details "
'
'btnNext1
'
Me.btnNext1.BackColor = System.Drawing.Color.SandyBrown
Me.btnNext1.Location = New System.Drawing.Point(408, 248)
Me.btnNext1.Name = "btnNext1"
Me.btnNext1.Size = New System.Drawing.Size(72, 24)
Me.btnNext1.TabIndex = 6
Me.btnNext1.Text = "Next"
'
'Label3
'
Me.Label3.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Bold,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label3.Location = New System.Drawing.Point(216, 112)
Me.Label3.Name = "Label3"
Me.Label3.Size = New System.Drawing.Size(232, 24)
Me.Label3.TabIndex = 5
Me.Label3.Text = "Outdoor Temperature (Celcius):"
'
'Label2
'
Me.Label2.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Bold,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label2.Location = New System.Drawing.Point(216, 40)
Me.Label2.Name = "Label2"
Me.Label2.Size = New System.Drawing.Size(224, 24)
Me.Label2.TabIndex = 4
Me.Label2.Text = "Indoor Temperature (Celcius) :"
'
'txtOutdoor
'
Me.txtOutdoor.Location = New System.Drawing.Point(216, 144)
Me.txtOutdoor.Name = "txtOutdoor"
Me.txtOutdoor.Size = New System.Drawing.Size(160, 25)
Me.txtOutdoor.TabIndex = 3
Me.txtOutdoor.Text = ""
'
'txtIndoor
'
Me.txtIndoor.Location = New System.Drawing.Point(216, 72)
Me.txtIndoor.Name = "txtIndoor"
Me.txtIndoor.Size = New System.Drawing.Size(160, 25)
Me.txtIndoor.TabIndex = 2
Me.txtIndoor.Text = ""
'
'Label1
'
Me.Label1.Location = New System.Drawing.Point(32, 40)
```

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Me.Label1.Name = "Label1"
Me.Label1.Size = New System.Drawing.Size(104, 24)
Me.Label1.TabIndex = 1
Me.Label1.Text = "Solar Time :"
'
'lstSolarTime
'
Me.lstSolarTime.Font = New System.Drawing.Font("Trebuchet MS", 9.75!, System.Drawing.FontStyle.Bold, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.lstSolarTime.ItemHeight = 18
Me.lstSolarTime.Items.AddRange(New Object() {"0100", "0200", "0300", "0400", "0500", "0600", "0700", "0800", "0900", "1000", "1100", "1200", "1300", "1400", "1500", "1600", "1700", "1800", "1900", "2000", "2100", "2200", "2300", "2400"})
Me.lstSolarTime.Location = New System.Drawing.Point(32, 64)
Me.lstSolarTime.Name = "lstSolarTime"
Me.lstSolarTime.Size = New System.Drawing.Size(104, 130)
Me.lstSolarTime.TabIndex = 0
'
'tpgRoof
'
Me.tpgRoof.BackColor = System.Drawing.Color.LavenderBlush
Me.tpgRoof.Controls.Add(Me.Label10)
Me.tpgRoof.Controls.Add(Me.Label9)
Me.tpgRoof.Controls.Add(Me.Label8)
Me.tpgRoof.Controls.Add(Me.Label7)
Me.tpgRoof.Controls.Add(Me.txtRWidth)
Me.tpgRoof.Controls.Add(Me.txtRLength)
Me.tpgRoof.Controls.Add(Me.Label6)
Me.tpgRoof.Controls.Add(Me.Label5)
Me.tpgRoof.Controls.Add(Me.btnBack2)
Me.tpgRoof.Controls.Add(Me.btnNext2)
Me.tpgRoof.Controls.Add(Me.Label4)
Me.tpgRoof.Controls.Add(Me.lstRoofCons)
Me.tpgRoof.Controls.Add(Me.GroupBox1)
Me.tpgRoof.Location = New System.Drawing.Point(4, 22)
Me.tpgRoof.Name = "tpgRoof"
Me.tpgRoof.Size = New System.Drawing.Size(488, 286)
Me.tpgRoof.TabIndex = 1
Me.tpgRoof.Text = "Roof"
'
'Label10
'
Me.Label10.Location = New System.Drawing.Point(400, 168)
Me.Label10.Name = "Label10"
Me.Label10.Size = New System.Drawing.Size(64, 24)
Me.Label10.TabIndex = 18
Me.Label10.Text = "meter"
'
'Label9
'
Me.Label9.Location = New System.Drawing.Point(400, 136)
Me.Label9.Name = "Label9"
Me.Label9.Size = New System.Drawing.Size(56, 24)
Me.Label9.TabIndex = 17
Me.Label9.Text = "meter"
'
'Label8
'
Me.Label8.Location = New System.Drawing.Point(256, 168)
Me.Label8.Name = "Label8"
Me.Label8.Size = New System.Drawing.Size(64, 24)
Me.Label8.TabIndex = 16
Me.Label8.Text = " Width :"
'
'Label7
'
Me.Label7.Location = New System.Drawing.Point(256, 136)
Me.Label7.Name = "Label7"
Me.Label7.Size = New System.Drawing.Size(64, 24)
Me.Label7.TabIndex = 15
Me.Label7.Text = "Length :"
'
'txtRWidth
'
Me.txtRWidth.Location = New System.Drawing.Point(320, 168)
Me.txtRWidth.Name = "txtRWidth"
Me.txtRWidth.Size = New System.Drawing.Size(72, 25)
Me.txtRWidth.TabIndex = 14
Me.txtRWidth.Text = ""
'
'txtRLength
'
Me.txtRLength.Location = New System.Drawing.Point(320, 136)
Me.txtRLength.Name = "txtRLength"
Me.txtRLength.Size = New System.Drawing.Size(72, 25)
Me.txtRLength.TabIndex = 13
Me.txtRLength.Text = ""
'
'Label6
'
Me.Label6.Font = New System.Drawing.Font("Microsoft Sans Serif", 8.25!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label6.Location = New System.Drawing.Point(256, 112)
Me.Label6.Name = "Label6"
Me.Label6.Size = New System.Drawing.Size(104, 16)
Me.Label6.TabIndex = 12
Me.Label6.Text = "Ceilig Size (meter)"
'
'Label5
'
Me.Label5.Font = New System.Drawing.Font("Microsoft Sans Serif", 8.25!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label5.Location = New System.Drawing.Point(32, 112)
Me.Label5.Name = "Label5"
Me.Label5.Size = New System.Drawing.Size(192, 16)
Me.Label5.TabIndex = 10
Me.Label5.Text = "Ceiling Construction"
'
'btnBack2
'
Me.btnBack2.BackColor = System.Drawing.Color.SandyBrown
Me.btnBack2.Location = New System.Drawing.Point(320, 248)
Me.btnBack2.Name = "btnBack2"
Me.btnBack2.Size = New System.Drawing.Size(72, 24)
Me.btnBack2.TabIndex = 9
Me.btnBack2.Text = "Back"
'
'btnNext2
'
Me.btnNext2.BackColor = System.Drawing.Color.SandyBrown
Me.btnNext2.Location = New System.Drawing.Point(400, 248)
Me.btnNext2.Name = "btnNext2"
Me.btnNext2.Size = New System.Drawing.Size(72, 24)
Me.btnNext2.TabIndex = 8
Me.btnNext2.Text = "Next"
'
'Label4
'
Me.Label4.Font = New System.Drawing.Font("Microsoft Sans Serif", 9.75!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label4.Location = New System.Drawing.Point(24, 16)
Me.Label4.Name = "Label4"
Me.Label4.Size = New System.Drawing.Size(216, 16)
Me.Label4.TabIndex = 1
Me.Label4.Text = "Description Of Roof Construction"
```

```
'
'lstRoofCons
'
Me.lstRoofCons.ItemHeight = 20
Me.lstRoofCons.Items.AddRange(New Object() {"Steel sheet
with 1 in. ( or 2 in. ) insulation", "4 in. heavyweight concrete",
"Roof terrace system", "6 in. heavyweight concrete with 1 in. ( or
2 in. ) insulation"})
Me.lstRoofCons.Location = New System.Drawing.Point(24, 40)
Me.lstRoofCons.Name = "lstRoofCons"
Me.lstRoofCons.Size = New System.Drawing.Size(320, 44)
Me.lstRoofCons.TabIndex = 0
'
'GroupBox1
'
Me.GroupBox1.Controls.Add(Me.rboNoSC)
Me.GroupBox1.Controls.Add(Me.rboSC)
Me.GroupBox1.Location = New System.Drawing.Point(32, 128)
Me.GroupBox1.Name = "GroupBox1"
Me.GroupBox1.Size = New System.Drawing.Size(216, 72)
Me.GroupBox1.TabIndex = 11
Me.GroupBox1.TabStop = False
'
'rboNoSC
'
Me.rboNoSC.Location = New System.Drawing.Point(16, 40)
Me.rboNoSC.Name = "rboNoSC"
Me.rboNoSC.Size = New System.Drawing.Size(160, 24)
Me.rboNoSC.TabIndex = 1
Me.rboNoSC.Text = "Without Suspended Ceiling"
'
'rboSC
'
Me.rboSC.Checked = True
Me.rboSC.Location = New System.Drawing.Point(16, 16)
Me.rboSC.Name = "rboSC"
Me.rboSC.Size = New System.Drawing.Size(192, 24)
Me.rboSC.TabIndex = 0
Me.rboSC.TabStop = True
Me.rboSC.Text = "With Suspended Ceiling"
'
'tpgwall
'
Me.tpgwall.BackColor = System.Drawing.Color.LavenderBlush
Me.tpgwall.Controls.Add(Me.Label17)
Me.tpgwall.Controls.Add(Me.cboWDirection)
Me.tpgwall.Controls.Add(Me.Label16)
Me.tpgwall.Controls.Add(Me.Label15)
Me.tpgwall.Controls.Add(Me.Label14)
Me.tpgwall.Controls.Add(Me.Label13)
Me.tpgwall.Controls.Add(Me.txtWWidth)
Me.tpgwall.Controls.Add(Me.txtWlength)
Me.tpgwall.Controls.Add(Me.Label12)
Me.tpgwall.Controls.Add(Me.cboWallCons)
Me.tpgwall.Controls.Add(Me.Label11)
Me.tpgwall.Controls.Add(Me.btnBack3)
Me.tpgwall.Controls.Add(Me.btnNext3)
Me.tpgwall.Location = New System.Drawing.Point(4, 22)
Me.tpgwall.Name = "tpgwall"
Me.tpgwall.Size = New System.Drawing.Size(488, 286)
Me.tpgwall.TabIndex = 2
Me.tpgwall.Text = "Wall"
'
'Label17
'
Me.Label17.Location = New System.Drawing.Point(32, 184)
Me.Label17.Name = "Label17"
Me.Label17.Size = New System.Drawing.Size(80, 16)
Me.Label17.TabIndex = 22
Me.Label17.Text = "Direction :"
'
'cboWDirection
'
Me.cboWDirection.Items.AddRange(New Object() {"North",
"North East", "East", "South East", "South", "South West",
"West", "North West"})
Me.cboWDirection.Location = New System.Drawing.Point(120,
176)
Me.cboWDirection.Name = "cboWDirection"
Me.cboWDirection.Size = New System.Drawing.Size(128, 28)
Me.cboWDirection.TabIndex = 21
'
'Label16
'
Me.Label16.Location = New System.Drawing.Point(208, 144)
Me.Label16.Name = "Label16"
Me.Label16.Size = New System.Drawing.Size(48, 24)
Me.Label16.TabIndex = 20
Me.Label16.Text = "meter"
'
'Label15
'
Me.Label15.Location = New System.Drawing.Point(208, 112)
Me.Label15.Name = "Label15"
Me.Label15.Size = New System.Drawing.Size(48, 24)
Me.Label15.TabIndex = 19
Me.Label15.Text = "meter"
'
'Label14
'
Me.Label14.Location = New System.Drawing.Point(56, 152)
Me.Label14.Name = "Label14"
Me.Label14.Size = New System.Drawing.Size(64, 16)
Me.Label14.TabIndex = 18
Me.Label14.Text = "Width :"
'
'Label13
'
Me.Label13.Location = New System.Drawing.Point(48, 120)
Me.Label13.Name = "Label13"
Me.Label13.Size = New System.Drawing.Size(64, 24)
Me.Label13.TabIndex = 17
Me.Label13.Text = "Length :"
'
'txtWWidth
'
Me.txtWWidth.Location = New System.Drawing.Point(120, 144)
Me.txtWWidth.Name = "txtWWidth"
Me.txtWWidth.Size = New System.Drawing.Size(80, 25)
Me.txtWWidth.TabIndex = 16
Me.txtWWidth.Text = ""
'
'txtWlength
'
Me.txtWlength.Location = New System.Drawing.Point(120, 112)
Me.txtWlength.Name = "txtWlength"
Me.txtWlength.Size = New System.Drawing.Size(80, 25)
Me.txtWlength.TabIndex = 15
Me.txtWlength.Text = ""
'
'Label12
'
Me.Label12.Font = New System.Drawing.Font("Microsoft Sans
Serif", 8.25!, System.Drawing.FontStyle.Underline,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label12.Location = New System.Drawing.Point(24, 88)
Me.Label12.Name = "Label12"
Me.Label12.Size = New System.Drawing.Size(176, 16)
Me.Label12.TabIndex = 14
Me.Label12.Text = "Wall Size (meter)"
```

```
'
'cboWallCons
'
Me.cboWallCons.Items.AddRange(New Object() {"4 in. face brick + ( light or heavyweight concrete block )", "Heavyweight concrete wall + ( finish )"})
Me.cboWallCons.Location = New System.Drawing.Point(24, 40)
Me.cboWallCons.Name = "cboWallCons"
Me.cboWallCons.Size = New System.Drawing.Size(304, 28)
Me.cboWallCons.TabIndex = 13
'
'Label11
'
Me.Label11.Font = New System.Drawing.Font("Microsoft Sans Serif", 9.75!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label11.Location = New System.Drawing.Point(24, 16)
Me.Label11.Name = "Label11"
Me.Label11.Size = New System.Drawing.Size(200, 16)
Me.Label11.TabIndex = 12
Me.Label11.Text = "Description Of Wall Construction"
'
'btnBack3
'
Me.btnBack3.BackColor = System.Drawing.Color.SandyBrown
Me.btnBack3.Location = New System.Drawing.Point(320, 248)
Me.btnBack3.Name = "btnBack3"
Me.btnBack3.Size = New System.Drawing.Size(72, 24)
Me.btnBack3.TabIndex = 11
Me.btnBack3.Text = "Back"
'
'btnNext3
'
Me.btnNext3.BackColor = System.Drawing.Color.SandyBrown
Me.btnNext3.Location = New System.Drawing.Point(400, 248)
Me.btnNext3.Name = "btnNext3"
Me.btnNext3.Size = New System.Drawing.Size(72, 24)
Me.btnNext3.TabIndex = 10
Me.btnNext3.Text = "Next"
'
'tpgwindow
'
Me.tpgwindow.BackColor = System.Drawing.Color.LavenderBlush
Me.tpgwindow.Controls.Add(Me.Label25)
Me.tpgwindow.Controls.Add(Me.Label26)
Me.tpgwindow.Controls.Add(Me.Label27)
Me.tpgwindow.Controls.Add(Me.Label28)
Me.tpgwindow.Controls.Add(Me.txtWinWidth)
Me.tpgwindow.Controls.Add(Me.txtWinLength)
Me.tpgwindow.Controls.Add(Me.Label24)
Me.tpgwindow.Controls.Add(Me.Label21)
Me.tpgwindow.Controls.Add(Me.cboWinDirection)
Me.tpgwindow.Controls.Add(Me.GroupBox3)
Me.tpgwindow.Controls.Add(Me.Label20)
Me.tpgwindow.Controls.Add(Me.cboWinType)
Me.tpgwindow.Controls.Add(Me.Label18)
Me.tpgwindow.Controls.Add(Me.btnBack4)
Me.tpgwindow.Controls.Add(Me.btnNext4)
Me.tpgwindow.Controls.Add(Me.GroupBox2)
Me.tpgwindow.Location = New System.Drawing.Point(4, 22)
Me.tpgwindow.Name = "tpgwindow"
Me.tpgwindow.Size = New System.Drawing.Size(488, 286)
Me.tpgwindow.TabIndex = 3
Me.tpgwindow.Text = "Window"
'
'Label25
'
Me.Label25.Location = New System.Drawing.Point(368, 144)
Me.Label25.Name = "Label25"
Me.Label25.Size = New System.Drawing.Size(48, 24)
Me.Label25.TabIndex = 31
Me.Label25.Text = "meter"
'
'Label26
'
Me.Label26.Location = New System.Drawing.Point(368, 112)
Me.Label26.Name = "Label26"
Me.Label26.Size = New System.Drawing.Size(48, 24)
Me.Label26.TabIndex = 30
Me.Label26.Text = "meter"
'
'Label27
'
Me.Label27.Location = New System.Drawing.Point(208, 144)
Me.Label27.Name = "Label27"
Me.Label27.Size = New System.Drawing.Size(64, 24)
Me.Label27.TabIndex = 29
Me.Label27.Text = "Width :"
'
'Label28
'
Me.Label28.Location = New System.Drawing.Point(200, 112)
Me.Label28.Name = "Label28"
Me.Label28.Size = New System.Drawing.Size(64, 24)
Me.Label28.TabIndex = 28
Me.Label28.Text = "Length :"
'
'txtWinWidth
'
Me.txtWinWidth.Location = New System.Drawing.Point(288, 144)
Me.txtWinWidth.Name = "txtWinWidth"
Me.txtWinWidth.Size = New System.Drawing.Size(72, 25)
Me.txtWinWidth.TabIndex = 27
Me.txtWinWidth.Text = ""
'
'txtWinLength
'
Me.txtWinLength.Location = New System.Drawing.Point(288, 112)
Me.txtWinLength.Name = "txtWinLength"
Me.txtWinLength.Size = New System.Drawing.Size(72, 25)
Me.txtWinLength.TabIndex = 26
Me.txtWinLength.Text = ""
'
'Label24
'
Me.Label24.Font = New System.Drawing.Font("Trebuchet MS", 9.75!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label24.Location = New System.Drawing.Point(200, 80)
Me.Label24.Name = "Label24"
Me.Label24.Size = New System.Drawing.Size(144, 24)
Me.Label24.TabIndex = 25
Me.Label24.Text = "Window Size (meter)"
'
'Label21
'
Me.Label21.Location = New System.Drawing.Point(200, 40)
Me.Label21.Name = "Label21"
Me.Label21.Size = New System.Drawing.Size(80, 24)
Me.Label21.TabIndex = 24
Me.Label21.Text = "Direction :"
'
'cboWinDirection
'
Me.cboWinDirection.Items.AddRange(New Object() {"North", "North East", "East", "South East", "South", "South West", "West", "North West"})
```

```
Me.cboWinDirection.Location = New
System.Drawing.Point(288, 40)
Me.cboWinDirection.Name = "cboWinDirection"
Me.cboWinDirection.Size = New System.Drawing.Size(112, 28)
Me.cboWinDirection.TabIndex = 23
'
'GroupBox3
'
Me.GroupBox3.Controls.Add(Me.rboBlinds)
Me.GroupBox3.Controls.Add(Me.rboNoShade)
Me.GroupBox3.Location = New System.Drawing.Point(24, 176)
Me.GroupBox3.Name = "GroupBox3"
Me.GroupBox3.Size = New System.Drawing.Size(152, 80)
Me.GroupBox3.TabIndex = 16
Me.GroupBox3.TabStop = False
'
'rboBlinds
'
Me.rboBlinds.Location = New System.Drawing.Point(16, 48)
Me.rboBlinds.Name = "rboBlinds"
Me.rboBlinds.TabIndex = 1
Me.rboBlinds.Text = "With Blinds"
'
'rboNoShade
'
Me.rboNoShade.Checked = True
Me.rboNoShade.Location = New System.Drawing.Point(16, 16)
Me.rboNoShade.Name = "rboNoShade"
Me.rboNoShade.Size = New System.Drawing.Size(120, 24)
Me.rboNoShade.TabIndex = 0
Me.rboNoShade.TabStop = True
Me.rboNoShade.Text = "No Shading"
'
'Label20
'
Me.Label20.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Underline,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label20.Location = New System.Drawing.Point(24, 152)
Me.Label20.Name = "Label20"
Me.Label20.Size = New System.Drawing.Size(120, 24)
Me.Label20.TabIndex = 15
Me.Label20.Text = "Shading Effects :"
'
'cboWinType
'
Me.cboWinType.Items.AddRange(New Object() {"Single Glass",
"Double Glass"})
Me.cboWinType.Location = New System.Drawing.Point(24, 40)
Me.cboWinType.Name = "cboWinType"
Me.cboWinType.Size = New System.Drawing.Size(128, 28)
Me.cboWinType.TabIndex = 13
'
'Label18
'
Me.Label18.Font = New System.Drawing.Font("Microsoft Sans
Serif", 9.75!, System.Drawing.FontStyle.Underline,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label18.Location = New System.Drawing.Point(24, 16)
Me.Label18.Name = "Label18"
Me.Label18.Size = New System.Drawing.Size(104, 16)
Me.Label18.TabIndex = 12
Me.Label18.Text = "Type of Glazing :"
'
'btnBack4
'
Me.btnBack4.BackColor = System.Drawing.Color.SandyBrown
Me.btnBack4.Location = New System.Drawing.Point(320, 248)
Me.btnBack4.Name = "btnBack4"
Me.btnBack4.Size = New System.Drawing.Size(72, 24)
Me.btnBack4.TabIndex = 11
Me.btnBack4.Text = "Back"
'
'btnNext4
'
Me.btnNext4.BackColor = System.Drawing.Color.SandyBrown
Me.btnNext4.Location = New System.Drawing.Point(400, 248)
Me.btnNext4.Name = "btnNext4"
Me.btnNext4.Size = New System.Drawing.Size(72, 24)
Me.btnNext4.TabIndex = 10
Me.btnNext4.Text = "Next"
'
'GroupBox2
'
Me.GroupBox2.Controls.Add(Me.rboHeatAbs)
Me.GroupBox2.Controls.Add(Me.rboClear)
Me.GroupBox2.Location = New System.Drawing.Point(24, 72)
Me.GroupBox2.Name = "GroupBox2"
Me.GroupBox2.Size = New System.Drawing.Size(152, 72)
Me.GroupBox2.TabIndex = 14
Me.GroupBox2.TabStop = False
'
'rboHeatAbs
'
Me.rboHeatAbs.Location = New System.Drawing.Point(16, 40)
Me.rboHeatAbs.Name = "rboHeatAbs"
Me.rboHeatAbs.Size = New System.Drawing.Size(128, 16)
Me.rboHeatAbs.TabIndex = 1
Me.rboHeatAbs.Text = "Heat Absorbing"
'
'rboClear
'
Me.rboClear.Checked = True
Me.rboClear.Location = New System.Drawing.Point(16, 16)
Me.rboClear.Name = "rboClear"
Me.rboClear.Size = New System.Drawing.Size(96, 16)
Me.rboClear.TabIndex = 0
Me.rboClear.TabStop = True
Me.rboClear.Text = "Clear"
'
'prgOccupancy
'
Me.prgOccupancy.BackColor =
System.Drawing.Color.LavenderBlush
Me.prgOccupancy.Controls.Add(Me.cboTypeAct)
Me.prgOccupancy.Controls.Add(Me.txtNoPeople)
Me.prgOccupancy.Controls.Add(Me.Label31)
Me.prgOccupancy.Controls.Add(Me.Label30)
Me.prgOccupancy.Controls.Add(Me.Label29)
Me.prgOccupancy.Controls.Add(Me.btnBack5)
Me.prgOccupancy.Controls.Add(Me.btnNext5)
Me.prgOccupancy.Location = New System.Drawing.Point(4, 22)
Me.prgOccupancy.Name = "prgOccupancy"
Me.prgOccupancy.Size = New System.Drawing.Size(488, 286)
Me.prgOccupancy.TabIndex = 4
Me.prgOccupancy.Text = "Occupancy"
'
'cboTypeAct
'
Me.cboTypeAct.Items.AddRange(New Object() {"Very light
office work", "Moderately active office work"})
Me.cboTypeAct.Location = New System.Drawing.Point(160, 80)
Me.cboTypeAct.Name = "cboTypeAct"
Me.cboTypeAct.Size = New System.Drawing.Size(160, 28)
Me.cboTypeAct.TabIndex = 16
'
'txtNoPeople
'
Me.txtNoPeople.Location = New System.Drawing.Point(160, 48)
Me.txtNoPeople.Name = "txtNoPeople"
```

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Me.txtNoPeople.Size = New System.Drawing.Size(48, 25)
Me.txtNoPeople.TabIndex = 15
Me.txtNoPeople.Text = ""
'
'Label31
'
Me.Label31.Font = New System.Drawing.Font("Trebuchet MS", 11.25!, System.Drawing.FontStyle.Regular, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label31.Location = New System.Drawing.Point(24, 88)
Me.Label31.Name = "Label31"
Me.Label31.Size = New System.Drawing.Size(152, 24)
Me.Label31.TabIndex = 14
Me.Label31.Text = "Type of Activity :"
'
'Label30
'
Me.Label30.Font = New System.Drawing.Font("Trebuchet MS", 11.25!, System.Drawing.FontStyle.Regular, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label30.Location = New System.Drawing.Point(40, 48)
Me.Label30.Name = "Label30"
Me.Label30.Size = New System.Drawing.Size(128, 24)
Me.Label30.TabIndex = 13
Me.Label30.Text = "No. of People :"
'
'Label29
'
Me.Label29.Font = New System.Drawing.Font("Microsoft Sans Serif", 9.75!, System.Drawing.FontStyle.Underline, System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label29.Location = New System.Drawing.Point(24, 16)
Me.Label29.Name = "Label29"
Me.Label29.Size = New System.Drawing.Size(80, 16)
Me.Label29.TabIndex = 12
Me.Label29.Text = "Occupancy"
'
'btnBack5
'
Me.btnBack5.BackColor = System.Drawing.Color.SandyBrown
Me.btnBack5.Location = New System.Drawing.Point(320, 248)
Me.btnBack5.Name = "btnBack5"
Me.btnBack5.Size = New System.Drawing.Size(72, 24)
Me.btnBack5.TabIndex = 11
Me.btnBack5.Text = "Back"
'
'btnNext5
'
Me.btnNext5.BackColor = System.Drawing.Color.SandyBrown
Me.btnNext5.Location = New System.Drawing.Point(400, 248)
Me.btnNext5.Name = "btnNext5"
Me.btnNext5.Size = New System.Drawing.Size(72, 24)
Me.btnNext5.TabIndex = 10
Me.btnNext5.Text = "Next"
'
'tpgEquip
'
Me.tpgEquip.BackColor = System.Drawing.Color.LavenderBlush
Me.tpgEquip.Controls.Add(Me.Label36)
Me.tpgEquip.Controls.Add(Me.txtOthers)
Me.tpgEquip.Controls.Add(Me.Label35)
Me.tpgEquip.Controls.Add(Me.GroupBox4)
Me.tpgEquip.Controls.Add(Me.Label34)
Me.tpgEquip.Controls.Add(Me.txtComp)
Me.tpgEquip.Controls.Add(Me.Label33)
Me.tpgEquip.Controls.Add(Me.Label32)
Me.tpgEquip.Controls.Add(Me.btnBack6)
Me.tpgEquip.Controls.Add(Me.btnCalculate)
Me.tpgEquip.Location = New System.Drawing.Point(4, 22)
Me.tpgEquip.Name = "tpgEquip"
Me.tpgEquip.Size = New System.Drawing.Size(488, 286)
Me.tpgEquip.TabIndex = 5
Me.tpgEquip.Text = "Equipment Load"
'
'Label36
'
Me.Label36.Location = New System.Drawing.Point(192, 120)
Me.Label36.Name = "Label36"
Me.Label36.Size = New System.Drawing.Size(48, 32)
Me.Label36.TabIndex = 19
Me.Label36.Text = "Watts"
'
'txtOthers
'
Me.txtOthers.Location = New System.Drawing.Point(120, 120)
Me.txtOthers.Name = "txtOthers"
Me.txtOthers.Size = New System.Drawing.Size(64, 25)
Me.txtOthers.TabIndex = 18
Me.txtOthers.Text = ""
'
'Label35
'
Me.Label35.Location = New System.Drawing.Point(48, 120)
Me.Label35.Name = "Label35"
Me.Label35.Size = New System.Drawing.Size(64, 24)
Me.Label35.TabIndex = 17
Me.Label35.Text = "Others :"
'
'GroupBox4
'
Me.GroupBox4.Controls.Add(Me.rbofullcomp)
Me.GroupBox4.Controls.Add(Me.rboStandby)
Me.GroupBox4.Location = New System.Drawing.Point(304, 40)
Me.GroupBox4.Name = "GroupBox4"
Me.GroupBox4.Size = New System.Drawing.Size(176, 80)
Me.GroupBox4.TabIndex = 16
Me.GroupBox4.TabStop = False
'
'rbofullcomp
'
Me.rbofullcomp.Location = New System.Drawing.Point(16, 40)
Me.rbofullcomp.Name = "rbofullcomp"
Me.rbofullcomp.Size = New System.Drawing.Size(152, 24)
Me.rbofullcomp.TabIndex = 1
Me.rbofullcomp.Text = "Full Consumption"
'
'rboStandby
'
Me.rboStandby.Checked = True
Me.rboStandby.Location = New System.Drawing.Point(16, 16)
Me.rboStandby.Name = "rboStandby"
Me.rboStandby.Size = New System.Drawing.Size(112, 24)
Me.rboStandby.TabIndex = 0
Me.rboStandby.TabStop = True
Me.rboStandby.Text = "Stand By"
'
'Label34
'
Me.Label34.Location = New System.Drawing.Point(208, 48)
Me.Label34.Name = "Label34"
Me.Label34.Size = New System.Drawing.Size(96, 32)
Me.Label34.TabIndex = 15
Me.Label34.Text = "Condition :"
'
'txtComp
'
Me.txtComp.Location = New System.Drawing.Point(120, 48)
Me.txtComp.Name = "txtComp"
Me.txtComp.Size = New System.Drawing.Size(56, 25)
Me.txtComp.TabIndex = 14
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Me.txtComp.Text = ""
'
'Label33
'
Me.Label33.Font = New System.Drawing.Font("Microsoft Sans
Serif", 9.75!, System.Drawing.FontStyle.Underline,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label33.Location = New System.Drawing.Point(24, 16)
Me.Label33.Name = "Label33"
Me.Label33.Size = New System.Drawing.Size(112, 16)
Me.Label33.TabIndex = 13
Me.Label33.Text = "Equipment Load"
'
'Label32
'
Me.Label32.Location = New System.Drawing.Point(24, 48)
Me.Label32.Name = "Label32"
Me.Label32.Size = New System.Drawing.Size(88, 16)
Me.Label32.TabIndex = 12
Me.Label32.Text = "No. of PCs :"
'
'btnBack6
'
Me.btnBack6.BackColor = System.Drawing.Color.SandyBrown
Me.btnBack6.Location = New System.Drawing.Point(312, 248)
Me.btnBack6.Name = "btnBack6"
Me.btnBack6.Size = New System.Drawing.Size(72, 24)
Me.btnBack6.TabIndex = 11
Me.btnBack6.Text = "Back"
'
'btnCalculate
'
Me.btnCalculate.BackColor = System.Drawing.Color.DarkRed
Me.btnCalculate.Font = New System.Drawing.Font("Trebuchet
MS", 12.0!, System.Drawing.FontStyle.Bold,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.btnCalculate.ForeColor =
System.Drawing.SystemColors.ControlLightLight
Me.btnCalculate.Location = New System.Drawing.Point(392,
240)
Me.btnCalculate.Name = "btnCalculate"
Me.btnCalculate.Size = New System.Drawing.Size(88, 32)
Me.btnCalculate.TabIndex = 10
Me.btnCalculate.Text = "Calculate"
'
'tpgresult
'
Me.tpgresult.BackColor = System.Drawing.SystemColors.Menu
Me.tpgresult.Controls.Add(Me.Label47)
Me.tpgresult.Controls.Add(Me.Label49)
Me.tpgresult.Controls.Add(Me.txtQKW)
Me.tpgresult.Controls.Add(Me.Label48)
Me.tpgresult.Controls.Add(Me.Label46)
Me.tpgresult.Controls.Add(Me.Label45)
Me.tpgresult.Controls.Add(Me.Label44)
Me.tpgresult.Controls.Add(Me.Label43)
Me.tpgresult.Controls.Add(Me.Label42)
Me.tpgresult.Controls.Add(Me.Label40)
Me.tpgresult.Controls.Add(Me.Label39)
Me.tpgresult.Controls.Add(Me.Label38)
Me.tpgresult.Controls.Add(Me.Label37)
Me.tpgresult.Controls.Add(Me.txtQtotal)
Me.tpgresult.Controls.Add(Me.txtQequip)
Me.tpgresult.Controls.Add(Me.txtQoccupancy)
Me.tpgresult.Controls.Add(Me.txtQwindow)
Me.tpgresult.Controls.Add(Me.txtQRoof)
Me.tpgresult.Controls.Add(Me.txtQwall)
Me.tpgresult.Controls.Add(Me.btnBack7)
Me.tpgresult.Controls.Add(Me.Label41)
Me.tpgresult.Location = New System.Drawing.Point(4, 29)
Me.tpgresult.Name = "tpgresult"
Me.tpgresult.Size = New System.Drawing.Size(488, 279)
Me.tpgresult.TabIndex = 6
Me.tpgresult.Text = "Result"
'
'Label47
'
Me.Label47.Location = New System.Drawing.Point(256, 152)
Me.Label47.Name = "Label47"
Me.Label47.Size = New System.Drawing.Size(64, 16)
Me.Label47.TabIndex = 32
Me.Label47.Text = "BTU/hr"
'
'Label49
'
Me.Label49.Location = New System.Drawing.Point(360, 160)
Me.Label49.Name = "Label49"
Me.Label49.Size = New System.Drawing.Size(104, 16)
Me.Label49.TabIndex = 31
Me.Label49.Text = "Total Watts :"
'
'txtQKW
'
Me.txtQKW.Location = New System.Drawing.Point(368, 184)
Me.txtQKW.Name = "txtQKW"
Me.txtQKW.Size = New System.Drawing.Size(88, 25)
Me.txtQKW.TabIndex = 30
Me.txtQKW.Text = ""
'
'Label48
'
Me.Label48.BackColor = System.Drawing.Color.White
Me.Label48.Location = New System.Drawing.Point(256, 184)
Me.Label48.Name = "Label48"
Me.Label48.Size = New System.Drawing.Size(64, 16)
Me.Label48.TabIndex = 29
Me.Label48.Text = "BTU/hr"
'
'Label46
'
Me.Label46.Location = New System.Drawing.Point(256, 120)
Me.Label46.Name = "Label46"
Me.Label46.Size = New System.Drawing.Size(64, 16)
Me.Label46.TabIndex = 27
Me.Label46.Text = "BTU/hr"
'
'Label45
'
Me.Label45.Location = New System.Drawing.Point(256, 88)
Me.Label45.Name = "Label45"
Me.Label45.Size = New System.Drawing.Size(72, 16)
Me.Label45.TabIndex = 26
Me.Label45.Text = "BTU/hr"
'
'Label44
'
Me.Label44.Location = New System.Drawing.Point(256, 56)
Me.Label44.Name = "Label44"
Me.Label44.Size = New System.Drawing.Size(64, 24)
Me.Label44.TabIndex = 25
Me.Label44.Text = "BTU/hr"
'
'Label43
'
Me.Label43.Location = New System.Drawing.Point(256, 24)
Me.Label43.Name = "Label43"
Me.Label43.Size = New System.Drawing.Size(64, 24)
Me.Label43.TabIndex = 24
Me.Label43.Text = "BTU/hr"
'
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'Label42
'
Me.Label42.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label42.Location = New System.Drawing.Point(88, 184)
Me.Label42.Name = "Label42"
Me.Label42.Size = New System.Drawing.Size(64, 16)
Me.Label42.TabIndex = 23
Me.Label42.Text = "Q Total :"
'
'Label40
'
Me.Label40.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label40.Location = New System.Drawing.Point(56, 120)
Me.Label40.Name = "Label40"
Me.Label40.Size = New System.Drawing.Size(96, 16)
Me.Label40.TabIndex = 21
Me.Label40.Text = "Q Occupancy :"
'
'Label39
'
Me.Label39.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label39.Location = New System.Drawing.Point(72, 88)
Me.Label39.Name = "Label39"
Me.Label39.Size = New System.Drawing.Size(80, 16)
Me.Label39.TabIndex = 20
Me.Label39.Text = "Q Window :"
'
'Label38
'
Me.Label38.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label38.Location = New System.Drawing.Point(96, 56)
Me.Label38.Name = "Label38"
Me.Label38.Size = New System.Drawing.Size(64, 16)
Me.Label38.TabIndex = 19
Me.Label38.Text = "Q Wall :"
'
'Label37
'
Me.Label37.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label37.Location = New System.Drawing.Point(88, 24)
Me.Label37.Name = "Label37"
Me.Label37.Size = New System.Drawing.Size(64, 16)
Me.Label37.TabIndex = 18
Me.Label37.Text = "Q Roof :"
'
'txtQtotal
'
Me.txtQtotal.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQtotal.Location = New System.Drawing.Point(160, 184)
Me.txtQtotal.Name = "txtQtotal"
Me.txtQtotal.Size = New System.Drawing.Size(88, 23)
Me.txtQtotal.TabIndex = 17
Me.txtQtotal.Text = ""
'
'txtQequip
'
Me.txtQequip.Font = New System.Drawing.Font("Trebuchet
MS", 9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQequip.Location = New System.Drawing.Point(160, 152)
Me.txtQequip.Name = "txtQequip"
Me.txtQequip.Size = New System.Drawing.Size(88, 23)
Me.txtQequip.TabIndex = 16
Me.txtQequip.Text = ""
'
'txtQoccupancy
'
Me.txtQoccupancy.Font = New System.Drawing.Font("Trebuchet
MS", 9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQoccupancy.Location = New System.Drawing.Point(160,
120)
Me.txtQoccupancy.Name = "txtQoccupancy"
Me.txtQoccupancy.Size = New System.Drawing.Size(88, 23)
Me.txtQoccupancy.TabIndex = 15
Me.txtQoccupancy.Text = ""
'
'txtQwindow
'
Me.txtQwindow.Font = New System.Drawing.Font("Trebuchet
MS", 9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQwindow.Location = New System.Drawing.Point(160, 88)
Me.txtQwindow.Name = "txtQwindow"
Me.txtQwindow.Size = New System.Drawing.Size(88, 23)
Me.txtQwindow.TabIndex = 14
Me.txtQwindow.Text = ""
'
'txtQRoof
'
Me.txtQRoof.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQRoof.Location = New System.Drawing.Point(160, 24)
Me.txtQRoof.Name = "txtQRoof"
Me.txtQRoof.Size = New System.Drawing.Size(88, 23)
Me.txtQRoof.TabIndex = 13
Me.txtQRoof.Text = ""
'
'txtQwall
'
Me.txtQwall.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.txtQwall.Location = New System.Drawing.Point(160, 56)
Me.txtQwall.Name = "txtQwall"
Me.txtQwall.Size = New System.Drawing.Size(88, 23)
Me.txtQwall.TabIndex = 12
Me.txtQwall.Text = ""
'
'btnBack7
'
Me.btnBack7.BackColor =
System.Drawing.SystemColors.Control
Me.btnBack7.Location = New System.Drawing.Point(400, 248)
Me.btnBack7.Name = "btnBack7"
Me.btnBack7.Size = New System.Drawing.Size(72, 24)
Me.btnBack7.TabIndex = 11
Me.btnBack7.Text = "Back"
'
'Label41
'
Me.Label41.Font = New System.Drawing.Font("Trebuchet MS",
9.75!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label41.Location = New System.Drawing.Point(24, 152)
```

```
Me.Label41.Name = "Label41"
Me.Label41.Size = New System.Drawing.Size(128, 16)
Me.Label41.TabIndex = 22
Me.Label41.Text = "Q Equipment Load  :"
'
'btnQuit
'
Me.btnQuit.BackColor = System.Drawing.Color.Salmon
Me.btnQuit.Location = New System.Drawing.Point(440, 408)
Me.btnQuit.Name = "btnQuit"
Me.btnQuit.Size = New System.Drawing.Size(80, 24)
Me.btnQuit.TabIndex = 1
Me.btnQuit.Text = "Quit"
'
'btnreset
'
Me.btnreset.BackColor = System.Drawing.Color.Tomato
Me.btnreset.Location = New System.Drawing.Point(352, 408)
Me.btnreset.Name = "btnreset"
Me.btnreset.Size = New System.Drawing.Size(80, 24)
Me.btnreset.TabIndex = 2
Me.btnreset.Text = "Reset"
'
'Label50
'
Me.Label50.BackColor = System.Drawing.Color.Thistle
Me.Label50.BorderStyle =
System.Windows.Forms.BorderStyle.Fixed3D
Me.Label50.Font = New System.Drawing.Font("Arial Narrow",
20.25!, System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label50.ForeColor = System.Drawing.SystemColors.InfoText
Me.Label50.Location = New System.Drawing.Point(192, 16)
Me.Label50.Name = "Label50"
Me.Label50.Size = New System.Drawing.Size(168, 40)
Me.Label50.TabIndex = 3
Me.Label50.Text = "EMSys"
Me.Label50.TextAlign =
System.Drawing.ContentAlignment.MiddleCenter
'
'Label51
'
Me.Label51.Font = New System.Drawing.Font("Arial Narrow",
9.75!, System.Drawing.FontStyle.Bold,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.Label51.Location = New System.Drawing.Point(8, 424)
Me.Label51.Name = "Label51"
Me.Label51.Size = New System.Drawing.Size(192, 24)
Me.Label51.TabIndex = 4
Me.Label51.Text = "By Solihah and Dr.Balbir Singh"
'
'Form1
'
Me.AutoScaleBaseSize = New System.Drawing.Size(7, 18)
Me.BackColor = System.Drawing.Color.Plum
Me.ClientSize = New System.Drawing.Size(570, 448)
Me.Controls.Add(Me.Label51)
Me.Controls.Add(Me.Label50)
Me.Controls.Add(Me.btnreset)
Me.Controls.Add(Me.btnQuit)
Me.Controls.Add(Me.tctrContent)
Me.Font = New System.Drawing.Font("Trebuchet MS", 11.25!,
System.Drawing.FontStyle.Regular,
System.Drawing.GraphicsUnit.Point, CType(0, Byte))
Me.FormBorderStyle =
System.Windows.Forms.FormBorderStyle.FixedToolWindow
Me.Name = "Form1"
Me.Text = " Cooling Load Calculator"
Me.tctrContent.ResumeLayout(False)
Me.tpgGeneral.ResumeLayout(False)
```

```
Me.tpgRoof.ResumeLayout(False)
Me.GroupBox1.ResumeLayout(False)
Me.tpgwall.ResumeLayout(False)
Me.tpgwindow.ResumeLayout(False)
Me.GroupBox3.ResumeLayout(False)
Me.GroupBox2.ResumeLayout(False)
Me.prgOccupancy.ResumeLayout(False)
Me.tpgEquip.ResumeLayout(False)
Me.GroupBox4.ResumeLayout(False)
Me.tpgresult.ResumeLayout(False)
Me.ResumeLayout(False)

End Sub

#End Region

'---------------------Database connection---------------------

Public cnnData As New OleDb.OleDbConnection()
Public Con As String = Application.StartupPath

'----------------------Variable Declaration---------------------

Dim Tfaren As Double 'Temp Diff.
Dim Stime As Double 'Solar Time
Dim RCLTD, RUvalue, Qroof As Double 'Roof Attribute
Dim WallGE, WallUvalue, Qwall As Double 'Wall Attribute
Dim SHGF, CLF, SC, QWin As Double 'Window Attribute
Dim LS, QOccupancy As Double 'Occupancy Attribute
Dim QEquip As Double 'Equipment load Attribute

'---------------------Variable Program Logic Flow-----------------
----

Public skiptabs As Boolean

'------------------------Error Message Control--------------------

Private Sub MsgErrorEmpty()
MsgBox("Please fill in all fields before proceed.",
MsgBoxStyle.Exclamation, "Invalid Data Processing")
End Sub

Private Sub MsgErrorNotcompatible()
MsgBox("Please fill in the correct Data Type.",
MsgBoxStyle.Exclamation, "Error Data Processing")
End Sub

'-----------------------Button Next procedure------------------

Private Sub btnNext1_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnNext1.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(1).Enabled = True
tctrContent.SelectedIndex = 1
End Sub

Private Sub btnNext2_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnNext2.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(2).Enabled = True
tctrContent.SelectedIndex = 2
End Sub
```

```
Private Sub btnNext3_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnNext3.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(3).Enabled = True
tctrContent.SelectedIndex = 3
End Sub

Private Sub btnNext4_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnNext4.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(4).Enabled = True
tctrContent.SelectedIndex = 4
End Sub

Private Sub btnNext5_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnNext5.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(5).Enabled = True
tctrContent.SelectedIndex = 5
End Sub

Private Sub btnCalculate_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnCalculate.Click
errorCheckingTabs()
If skiptabs = False Then
Exit Sub
End If
tctrContent.TabPages(6).Enabled = True

'-----------------------Calculation Part----------------------
tabGeneralCalculation()
tabroofcalculation()
tabwallcalculation()
tabwincalculation()
tabOccupancycalculation()
tabEquipcalculation()

'-----------------------Result Display-------------------------
tctrContent.TabPages(6).Enabled = True
txtQRoof.Text = Format(Qroof, "0.000")
txtQwall.Text = Format(Qwall, "0.000")
txtQwindow.Text = Format(QWin, "0.000")
txtQoccupancy.Text = Format(QOccupancy, "0.000")
txtQequip.Text = Format(QEquip, "0.000")

txtQtotal.Text = Format(Qroof + Qwall + QWin + QOccupancy +
QEquip, "0.000")
txtQKW.Text = Format(Val(txtQtotal.Text) * (0.293), "0.000")
tctrContent.SelectedIndex = 6

End Sub


'-----------Button Back Procedure-----------'

Private Sub btnBack2_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack2.Click
tctrContent.SelectedIndex = 0
End Sub

Private Sub btnBack3_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack3.Click
tctrContent.SelectedIndex = 1
End Sub

Private Sub btnBack4_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack4.Click
tctrContent.SelectedIndex = 2
End Sub

Private Sub btnBack5_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack5.Click
tctrContent.SelectedIndex = 3
End Sub

Private Sub btnBack6_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack6.Click
tctrContent.SelectedIndex = 4
End Sub

Private Sub btnBack7_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnBack7.Click
tctrContent.SelectedIndex = 5
End Sub

------------------Main Form Control----------------
Private Sub btnQuit_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnQuit.Click
Me.Close()
End Sub

Private Sub Form1_Load(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles MyBase.Load

---------------Tabstrips Control ---------------
tctrContent.TabPages(0).Enabled = True
tctrContent.TabPages(1).Enabled = False
tctrContent.TabPages(2).Enabled = False
tctrContent.TabPages(3).Enabled = False
tctrContent.TabPages(4).Enabled = False
tctrContent.TabPages(5).Enabled = False
tctrContent.TabPages(6).Enabled = False

'-----------Connection String Declaration--------
cnnData.ConnectionString =
"Provider=Microsoft.Jet.OLEDB.4.0;" & _
"Data Source=" & Con & "\data.mdb;"
End Sub


Private Sub errorCheckingTabs()
skiptabs = True
If tctrContent.SelectedIndex = 0 Then
If txtIndoor.Text = "" Or txtOutdoor.Text = "" Or
lstSolarTime.SelectedIndex = -1 Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtIndoor.Text) = False Or
IsNumeric(txtOutdoor.Text) = False Then
MsgErrorNotcompatible()
skiptabs = False
End If
ElseIf tctrContent.SelectedIndex = 1 Then
If lstRoofCons.SelectedIndex = -1 Or txtRWidth.Text = "" Or
txtRLength.Text = "" Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtRLength.Text) = False Or
IsNumeric(txtRWidth.Text) = False Then
MsgErrorNotcompatible()
```

```
skiptabs = False
End If
ElseIf tctrContent.SelectedIndex = 2 Then
If cboWallCons.SelectedIndex = -1 Or
cboWDirection.SelectedIndex = -1 Or txtWlength.Text = "" Or
txtWWidth.Text = "" Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtWlength.Text) = False Or
IsNumeric(txtWWidth.TabIndex) = False Then
MsgErrorNotcompatible()
skiptabs = False
End If
ElseIf tctrContent.SelectedIndex = 3 Then
If cboWinType.SelectedIndex = -1 Or
cboWinDirection.SelectedIndex = -1 Or txtWinLength.Text = ""
Or txtWinWidth.Text = "" Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtWinLength.Text) = False Or
IsNumeric(txtWinWidth.Text) = False Then
MsgErrorNotcompatible()
skiptabs = False
End If
ElseIf tctrContent.SelectedIndex = 4 Then
If cboTypeAct.SelectedIndex = -1 Or txtNoPeople.Text = "" Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtNoPeople.Text) = False Then
MsgErrorNotcompatible()
skiptabs = False
End If
ElseIf tctrContent.SelectedIndex = 5 Then
If txtComp.Text = "" Or txtOthers.Text = "" Then
MsgErrorEmpty()
skiptabs = False
ElseIf IsNumeric(txtComp.Text) = False Or
IsNumeric(txtOthers.Text) = False Then
MsgErrorNotcompatible()
skiptabs = False
End If
End If
End Sub

Private Sub tabGeneralCalculation()
Tfaren = 9 / 5 * (Val(txtOutdoor.Text) - Val(txtIndoor.Text))
Stime = lstSolarTime.SelectedIndex + 1
End Sub

Private Sub tabroofcalculation()
Dim dsroof As New DataSet()
Dim odaRoof As New OleDb.OleDbDataAdapter()
Dim RselectSQl As String

If rboSC.Checked = True Then
RselectSQl = "SELECT [Roof No], [" & Stime & "], [Uvalue]
FROM RoofWSus"
odaRoof.SelectCommand = New
OleDb.OleDbCommand(RselectSQl, cnnData)
dsroof.Tables.Add("RoofWSus")
odaRoof.FillSchema(dsroof, SchemaType.Mapped, "RoofWSus")
odaRoof.Fill(dsroof, "RoofWSus")

RCLTD =
dsroof.Tables("RoofWSus").Rows(lstRoofCons.SelectedIndex).It
emArray(1)
RUvalue =
dsroof.Tables("RoofWSus").Rows(lstRoofCons.SelectedIndex).It
emArray(2)
ElseIf rboNoSC.Checked = True Then
```

```
RselectSQl = "SELECT [Roof No], [" & Stime & "], [Uvalue]
FROM RoofWOSus"
odaRoof.SelectCommand = New
OleDb.OleDbCommand(RselectSQl, cnnData)
dsroof.Tables.Add("RoofWOSus")
odaRoof.FillSchema(dsroof, SchemaType.Mapped,
"RoofWOSus")
odaRoof.Fill(dsroof, "RoofWOSus")

RCLTD =
dsroof.Tables("RoofWOSus").Rows(lstRoofCons.SelectedIndex).
ItemArray(1)
RUvalue =
dsroof.Tables("RoofWOSus").Rows(lstRoofCons.SelectedIndex).
ItemArray(2)
MsgBox(RCLTD & " , " & RUvalue)
End If

Qroof = RUvalue * (Val(txtRLength.Text) * Val(txtRWidth.Text)
* 10.7584) * (RCLTD - Tfaren)

End Sub

Private Sub tabwallcalculation()
Dim odaWall As New OleDb.OleDbDataAdapter()
Dim dswall As New DataSet()
Dim wallSelectSql As String
Dim Walldirection As Integer

Walldirection = cboWDirection.SelectedIndex

If cboWallCons.SelectedIndex = 0 Then
WallUvalue = 0.319
ElseIf cboWallCons.SelectedIndex = 1 Then
WallUvalue = 0.585
End If

wallSelectSql = "SELECT direction, [" & Stime & "] FROM
WallGE"
odaWall.SelectCommand = New
OleDb.OleDbCommand(wallSelectSql, cnnData)
dswall.Tables.Add("WallGE")
odaWall.FillSchema(dswall, SchemaType.Mapped, "WallGE")
odaWall.Fill(dswall, "WallGE")

WallGE =
dswall.Tables("WallGE").Rows(Walldirection).ItemArray(1)
Qwall = WallUvalue * (Val(txtWlength.Text) *
Val(txtWWidth.Text) * 10.7584) * (WallGE - Tfaren)
End Sub

Private Sub tabwincalculation()
Dim odawindow As New OleDb.OleDbDataAdapter()
Dim dswindow As New DataSet()
Dim WinSelectSQl As String

If cboWinDirection.SelectedIndex = 0 Then
SHGF = 47
ElseIf cboWinDirection.SelectedIndex = 1 Or
cboWinDirection.SelectedIndex = 7 Then
SHGF = 184
ElseIf cboWinDirection.SelectedIndex = 2 Or
cboWinDirection.SelectedIndex = 6 Then
SHGF = 217
ElseIf cboWinDirection.SelectedIndex = 3 Or
cboWinDirection.SelectedIndex = 5 Then
SHGF = 124
ElseIf cboWinDirection.SelectedIndex = 4 Then
SHGF = 42
End If
```

```
If rboClear.Checked = True Then
If rboNoShade.Checked = True Then
If cboWinType.SelectedIndex = 0 Then
SC = 0.94
ElseIf cboWinType.SelectedIndex = 1 Then
SC = 0.81
End If
ElseIf rboBlinds.Checked = True Then
If cboWinType.SelectedIndex = 0 Then
SC = 0.74
ElseIf cboWinType.SelectedIndex = 1 Then
SC = 0.62
End If
End If
ElseIf rboHeatAbs.Checked = True Then
If rboNoShade.Checked = True Then
If cboWinType.SelectedIndex = 0 Then
SC = 0.69
ElseIf cboWinType.SelectedIndex = 1 Then
SC = 0.55
End If
ElseIf rboBlinds.Checked = True Then
If cboWinType.SelectedIndex = 0 Then
SC = 0.57
ElseIf cboWinType.SelectedIndex = 1 Then
SC = 0.39
End If
End If
End If

WinSelectSQl = "SELECT Direction, [" & Stime & "] FROM
CLF"
odawindow.SelectCommand = New
OleDb.OleDbCommand(WinSelectSQl, cnnData)
dswindow.Tables.Add("CLF")
odawindow.FillSchema(dswindow, SchemaType.Mapped,
"CLF")
odawindow.Fill(dswindow, "CLF")

CLF =
dswindow.Tables("CLF").Rows(cboWinDirection.SelectedIndex)
.ItemArray(1)
QWin = SHGF * SC * CLF * (Val(txtWinLength.Text) *
Val(txtWinWidth.Text) * 10.7584)

End Sub

Private Sub tabOccupancycalculation()
If cboTypeAct.SelectedIndex = 0 Then
LS = 410
ElseIf cboTypeAct.SelectedIndex = 1 Then
LS = 450
End If
QOccupancy = LS * Val(txtNoPeople.Text)
End Sub

Private Sub tabEquipcalculation()
Dim PCwat As Double

If rboStandby.Checked = True Then
PCwat = Val(txtComp.Text) * 15
ElseIf rbofullcomp.Checked = True Then
PCwat = Val(txtComp.Text) * 75
End If

QEquip = (PCwat + Val(txtOthers.Text)) / 0.293
End Sub

Private Sub btnreset_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnreset.Click
txtIndoor.Text = ""
txtOutdoor.Text = ""
lstSolarTime.SelectedIndex = -1
lstRoofCons.SelectedIndex = -1
txtRWidth.Text = ""
txtRLength.Text = ""
cboWallCons.SelectedIndex = -1
cboWDirection.SelectedIndex = -1
txtWlength.Text = ""
txtWWidth.Text = ""
cboWinType.SelectedIndex = -1
cboWinDirection.SelectedIndex = -1
txtWinLength.Text = ""
txtWinWidth.Text = ""
cboTypeAct.SelectedIndex = -1
txtNoPeople.Text = ""
txtComp.Text = ""
txtOthers.Text = ""

tctrContent.TabPages(6).Enabled = True
txtQRoof.Text = ""
txtQwall.Text = ""
txtQwindow.Text = ""
txtQoccupancy.Text = ""
txtQequip.Text = ""
txtQtotal.Text = ""
txtQKW.Text = ""

tctrContent.TabPages(0).Enabled = True
tctrContent.TabPages(1).Enabled = False
tctrContent.TabPages(2).Enabled = False
tctrContent.TabPages(3).Enabled = False
tctrContent.TabPages(4).Enabled = False
tctrContent.TabPages(5).Enabled = False
tctrContent.TabPages(6).Enabled = False
tctrContent.SelectedIndex = 0
End Sub

Private Sub txtQRoof_TextChanged(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
txtQRoof.TextChanged

End Sub

Private Sub tpgresult_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles tpgresult.Click

End Sub

Private Sub txtIndoor_TextChanged(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
txtIndoor.TextChanged

End Sub
End Class
```

APPENDIX G

VISUAL BASIC CODING (AIR-COND CONTROL)

```
VERSION 5.00
Object = "{648A5603-2C6E-101B-82B6-000000000014}#1.1#0";
"MSCOMM32.OCX"
Begin VB.Form Form1
Caption      = "Form1"
ClientHeight = 5280
ClientLeft   = 60
ClientTop    = 450
ClientWidth  = 6315
LinkTopic    = "Form1"
ScaleHeight  = 5280
ScaleWidth   = 6315
StartUpPosition = 3 'Windows Default
Begin VB.Timer Timer1
Left         = 5880
Top          = 0
End
Begin VB.Frame Frame2
Caption      = "Temperature"
BeginProperty Font
Name         = "Arial"
Size         = 12
Charset      = 0
Weight       = 400
Underline    = -1 'True
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 2175
Left         = 720
TabIndex     = 4
Top          = 2880
Width        = 5535
Begin VB.TextBox Text1
Alignment    = 2 'Center
BeginProperty Font
Name         = "MS Sans Serif"
Size         = 12
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 375
Left         = 1320
TabIndex     = 6
Text         = "24"
Top          = 600
Width        = 495
End
Begin VB.TextBox temp
Height       = 375
Left         = 3120
Locked       = -1 'True
TabIndex     = 5
Top          = 1440
Width        = 735
End
Begin VB.Label Label2
Caption      = "Degree Celcius"
BeginProperty Font
Name         = "Arial"
Size         = 9.75
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 255
Left         = 4080
TabIndex     = 10
Top          = 1560
Width        = 1335
End
Begin VB.Label Label5
Caption      = "Default :"
BeginProperty Font
Name         = "Arial"
Size         = 12
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 375
Left         = 360
TabIndex     = 9
Top          = 600
Width        = 975
End
Begin VB.Label Label6
Caption      = "Degree Celcius"
BeginProperty Font
Name         = "Arial"
Size         = 9.75
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 255
Left         = 1920
TabIndex     = 8
Top          = 720
Width        = 1335
End
Begin VB.Label Label7
Caption      = "Current Temperature :"
BeginProperty Font
Name         = "Arial"
Size         = 12
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
EndProperty
Height       = 615
Left         = 240
TabIndex     = 7
Top          = 1440
Width        = 2535
End
End
Begin VB.CommandButton button_stop
BackColor    = &H000000FF&
Caption      = "STOP"
Enabled      = 0 'False
BeginProperty Font
Name         = "Arial"
Size         = 15.75
Charset      = 0
Weight       = 400
Underline    = 0 'False
Italic       = 0 'False
Strikethrough = 0 'False
```

```
EndProperty
Height       =  855
Left         =  4080
MaskColor    =  &H00E0E0E0&
Style        =  1 'Graphical
TabIndex     =  3
Top          =  1440
Width        =  1455
End
Begin VB.Frame Frame1
Caption      =  "System Status"
BeginProperty Font
Name         =  "Arial"
Size         =  12
Charset      =  0
Weight       =  400
Underline    =  -1 'True
Italic       =  0 'False
Strikethrough  =  0 'False
EndProperty
Height       =  1215
Left         =  480
TabIndex     =  0
Top          =  1200
Width        =  3255
Begin VB.Label system_status_label
Alignment    =  2 'Center
Caption      =  "STANDBY"
BeginProperty Font
Name         =  "Arial"
Size         =  18
Charset      =  0
Weight       =  400
Underline    =  0 'False
Italic       =  0 'False
Strikethrough  =  0 'False
EndProperty
Height       =  495
Left         =  1320
TabIndex     =  2
Top          =  480
Width        =  1695
End
Begin VB.Shape system_status
BackColor    =  &H0000C0C0&
BackStyle    =  1 'Opaque
BorderColor  =  &H00000000&
Height       =  375
Left         =  360
Shape        =  3 'Circle
Top          =  480
Width        =  495
End
End
Begin MSCommLib.MSComm comm
Left         =  0
Top          =  0
_ExtentX     =  1005
_ExtentY     =  1005
_Version     =  393216
DTREnable    =  -1 'True
End
Begin VB.Label Label1
Alignment    =  2 'Center
Caption      =  "AIR-COND CONTROL SYSTEM"
BeginProperty Font
Name         =  "Arial"
Size         =  20.25
Charset      =  0
Weight       =  700
Underline    =  0 'False
Italic       =  0 'False
Strikethrough  =  0 'False
EndProperty
Height       =  975
Left         =  720
TabIndex     =  1
Top          =  120
Width        =  5175
End
End
Attribute VB_Name = "Form1"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Dim system As Integer
Dim stopind As Integer
Dim counter As Integer


Private Sub button_stop_Click()
If stopind = 0 Then

temp.Locked = False
temp.Text = ""
temp.Locked = True

stopind = 1
ElseIf stopind = 1 Then

temp.Locked = False
temp.Text = ""
temp.Locked = True

Timer1.Enabled = True
Timer1.Interval = 2000
GoTo tamat

End If

If (system > 0) Then
system = 0
system_status.BackColor = &HFF&
system_status_label.Caption = "OFF"
button_stop.BackColor = &HC000&
button_stop.Caption = "RESET"
GoTo tamat
End If
If (system < 1) Then
system = 1
system_status.BackColor = &HC000&
system_status_label.Caption = "ON"
button_stop.BackColor = &HFF&
button_stop.Caption = "STOP"
GoTo tamat
End If

tamat:

End Sub

Private Sub Form_Load()

'we set variables for comm port here... DO NOT CHANGE if you
dont know
comm.InputMode = 0 'take ascii as input
comm.CommPort = 1
comm.Settings = "1200,N,8,1"
comm.PortOpen = True 'open port
```

```
comm.InputLen = 1 'limitation for input
comm.RThreshold = 1
'end of setting com port
stopind = 0
'we set all default variables here
system = 1
'system_status.BackColor = &HC000&
'system_status_label.Caption = "ON"

'end of set variables



End Sub


Private Sub Comm_OnComm()

'1st transmitter

If stopind = 0 Then

Select Case comm.Input
Case "A"    'system on
system = 1
system_status.BackColor = &HC000&
system_status_label.Caption = "ON"
button_stop.Enabled = True


Case "B"    'system off
system = 0
system_status.BackColor = &HFF&
system_status_label.Caption = "OFF"
temp.Locked = False
temp.Text = ""
temp.Locked = True

Case "C"    'adcValue2>12.75
temp.Locked = False
temp.Text = 22
temp.Locked = True
Case "D"    'adcValue<12.24
temp.Locked = False
temp.Text = 26
temp.Locked = True

End Select
End If
End Sub

Private Sub Timer1_Timer()

'counter = counter + 1

system_status.BackColor = &HC0C0&
system_status_label.Caption = "STANDBY"
button_stop.BackColor = &HFF&
button_stop.Caption = "STOP"


'If counter = 2 Then
Timer1.Enabled = False
counter = 0

'End If

stopind = 0

End Sub
```