FNU FIJI NATIONAL UNIVERSITY

Final Examination

College	Engineering, Science & Technollogy
School	Electrical & Electronics Engineering
Programme	Bachelor of Engineering (Electrical & Renewable) [Year 3]
Semester	II
Year	2016
Unit Code	EEE766
Unit Title	Microcontroller Based System Design
Date of Examination	TBA
Time	TBA
Venue	TBA
Duration	3 Hours *(extra 10 mins allowed to read the paper)*
Maximum Marks	100

Instructions

1. There are three (3) questions in total with parts and subparts. Attempt all questions in the answer booklet.
2. Write your answers legibly in the answer booklet.
3. Write your student identification number on each page used.

Question 1 (*20 Marks*)

The following are short answer questions.

(a) What are microcontrollers and where are they used? (2)

(b) What is the function of a CPU in a microcontroller? (2)

(c) Explain the purpose of the accumulator or working (W) register? (1)

(d) What is an interrupt? (2)

(e) Explain the main difference between the three subgroups of 8-bit PIC microcontroller family and give an example of each. (6)

(f) With the aid of a bock diagram compare the Harvard architecture and the von-Neumann architecture. Which architecture is used in 8 bit PIC microcontroller family? (5)

(g) The 8 bit PIC processors are referred to as reduced instruction set computers (RISCs). What is the main idea behind RISC? (2)

Question 2 (*40 Marks*)

The following questions are related to your projects completed as part of the course.

(a) With the aid of a block diagram discuss the overall functionality and features of your microcontroller based project. (8)

(b) List the input devices or components of your project. (2)

(c) List the output devices or components of your project. (2)

(d) You have used the PIC16F877 microcontroller in your project. Give justifications for this choice in your project. (Note: Do not give availability as a justification) (2)

(e) Draw a schematic showing how you have interfaced an input device or component in your project and write a segment of the embedded C code showing how to read the input device. (Note: Clearly show the microcontroller pins you have used and write the `main()` program only) (8)

(f) Draw a schematic showing how you have interfaced an output device or component in your project and write a segment of the embedded C code showing how you controlled the output device. (Note: Clearly show the microcontroller pins you have used and write the `main()` program only) (8)

(g) Draw a high level flowchart of the complete embedded software that you have developed for your project. (10)

Question 3 (*40 Marks*)

The following are design questions.

(a) You are required to design a microcontroller based wash selector for a washing machine whereby the user will press a push button to select a washing mode. There are three led's on the washing machine to indicate the modes 'wash','rinse' and 'dry'. The push button can be pressed continuously to cycle between the three modes.

i. Draw and label a PIC16F877 microcontroller based schematic diagram showing the pin connections clearly. (8)

ii. Write a complete C program to fulfill the objective of the circuit. (Assume that you are using CCS®C compiler) (10)

iii. Which subgroup of 8-bit PIC microcontrolller would you recommend for this design project. Give justifications. (2)

(b) Design a microcontroller based system to read and display the temperature in degrees Celcius. You are given an analog temperature sensor LM35 which outputs analog voltage signal representing temperature. The voltage/temperature coefficient is 10 mV/degrees Celcius. Thus, an output voltage of 100 mV represents 10 degrees Celcius. You are required to display the temperature on a 16×2 LCD alphanumeric display.

i. Draw and label a PIC16F877 microcontroller based schematic diagram showing the pin connections clearly. (8)

ii. Write a complete C program to fulfill the objective of the circuit. (Assume that you are using CCS®C compiler) (10)

iii. Which subgroup of 8-bit PIC microcontrolller would you recommend for this design project. Give justifications. (2)

The End
Happy Holidays!

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

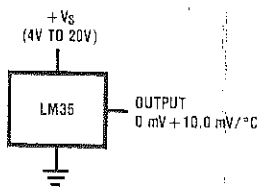
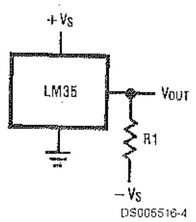
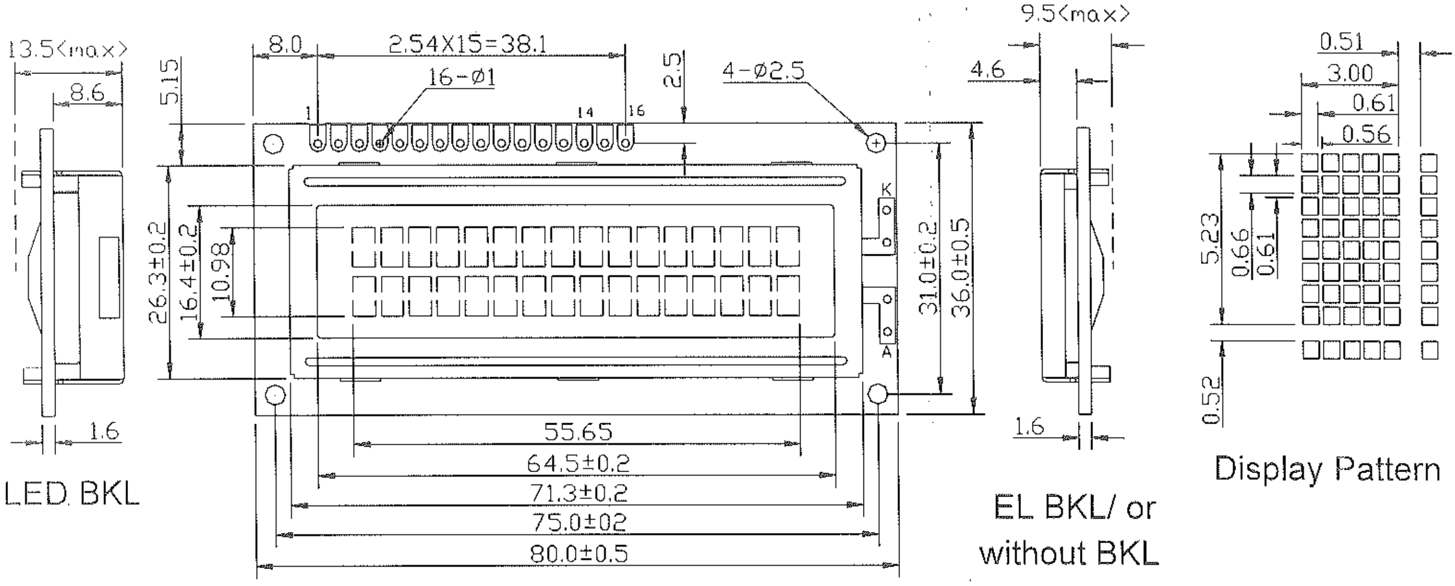


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)



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



LED BKL

EL BKL/ or without BKL

Display Pattern

Feature

1. 5X8 dots with cursor
2. Built-in controller (KS0066U or Equivalent)
3. +5V power supply(Also available for +3.0V)
4. 1/16 duty
5. BKL to be driven by pin1,pin2,or pin15,pin16,or A,K
6. N.V.optional

PIN NO	Symbol	Fuction
1	VSS	GND
2	VDD	+5V
3	V0	Contrast adjustment
4	RS	H/L Register select signal
5	R/W	H/L Read/Write signal
6	E	H/L Enable signal
7	DB0	H/L Data bus line
8	DB1	H/L Data bus line
9	DB2	H/L Data bus line
10	DB3	H/L Data bus line
11	DB4	H/L Data bus line
12	DB5	H/L Data bus line
13	DB6	H/L Data bus line
14	DB7	H/L Data bus line
15	A	+4.2V for LED
16	K	Power supply for BKL(0V)

Mechanical Data

Item	Standard	Unit
Module dimension	80.0x36.0	mm
Viewing area	64.5x16.4	mm
Dot size	0.56x0.61	mm
Character size	3.00x5.23	mm

Absolute Maximum Rating

Item	Symbol	Standard			Unit
		Min	Typ	Max	
Power supply	VDD-VSS	-0.3	--------	5.5	V
Input voltage	VI	-0.3	--------	VDD	

Electronical characteristics

Item	Symbol	Condition	Standard			Unit
			Min	Typ	Max	
Input voltage	VDD	+5V	4.7	5.0	5.5	V
		+3.3V	2.7	3.0	5.3	V
Supply current	IDD	VDD=5V	------	1.5	4	mA
Recommended LCD riling voltage for normal temp version module	VDD-V0	-20°C	------	------	------	V
		0 °C	4.7	5.0	5.5	
		25°C	4.3	4.5	4.7	
		50°C	4.1	4.3	4.5	
		70°C	------	------	------	
LED forward voltage	VF	25°C	------	4.2	4.6	V
LED forward current	IF	25°C	------	120	160	mA
EL power supply current	IEL	VEL=110V AC 400Hz	-----	------	------	mA

Display character address code:

Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DDRAM address	00	01	02	---	---	---	---	---								0FH
DDRAM address	40	41	42	---	---	---	---	---								4FH