UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	MICROCONTROLLER APPLICATION
COURSE CODE	:	BER 4223
PROGRAMME	:	BEE
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

THIS PAPER CONSISTS OF **SEVEN** (7) PAGES

Q1 A differential wheel mobile robot is controlled by Pinguino PIC18F4550 with 48MHz internal clock as given in Figure Q1. This robot is driven by two 12VDC motors for left and right side.

(a) Design the interface circuit for controlling both motors by Pinguino controller through two motor drivers (MD10C).

(6 marks)

(b) The speed of motor can be varied by using a few methods.
   i. Choose the suitable method.
   ii. Construct the code statement for configuring this method.

(4 marks)

(c) Write a subroutine to handle the motor speed and change direction for both motors.

(10 marks)

Q2 The robot in question **Q1** is powered by 11.2VDC Li-Po battery.

(a) Design the interface circuit for monitoring the voltage of battery.

(5 marks)

(b) Write a subroutine of *void Battery_Status(void)* that will handle the following tasks:
   [1] Read voltage
   [2] Display "GOOD" status if voltage more than 10.5V or otherwise display "WEAK" onto 16x2 Alphanumeric LCD.

(15 marks)

Q3 The movement of robot in question **Q1** depends on a flame sensor UVTRON. This sensor has been installed at a driving circuit board C3704. This board is attached on a remote control (RC) servomotor in order to make a location scanning. The servomotor will be controlled to three positions at 0°, 90°, and 180°. If flame is detected at position 0°, the robot will turn left; if at 90°, robot will move forward; and if at 180°, the robot will turn right.

(a) Design the interface circuit between the flame driving board and Pinguino controller.

(3 marks)

(b) Write a related configuration code for flame sensor and RC servomotor in *void setup(void)* subroutine.

(2 marks)

(c) Write a code to control robot movement according the flame detection in *void flame_following(void)* subroutine.

(15 marks)

Q4   A digital temperature sensor (TC72 or TC74) needs to be connected to Pinguino controller and the temperature reading will be used to stop the robot movement.

   (a)   Design the interface circuit between this sensor and Pinguino controller

(2 marks)

   (b)   Select the suitable SCL/SCK clock speed and configuration needed for this interfacing.

(4 marks)

   (c)   Write a related subroutine to read temperature and save in one variable.

(14 marks)

Q5   A DF Bluetooth module is the easiest wireless connection that used for communicating with android phone. This module uses common serial (UART) interface with a default setting (115200bps). This module does not need initialization code where it works as normal as wired serial interface. A program in android phone has four buttons that is used to control the robot in question **Q1** for forward, backward, left, and right direction.

   (a)   Design the interface circuit between this module and Pinguino controller.

(3 marks)

   (b)   Write a subroutine to manually handle and control the robot according the input command from android phone through DF Bluetooth module:
   - If command received "moveF" then robot moves forward.
   - If command received "moveB" then robot moves backward.
   - If command received "moveL" then robot turns left.
   - If command received "moveR" then robot turns right.

(17 marks)

FINAL EXAMINATION

SEMESTER/SESSION : SEMESTER II / 2011/2012
COURSE : MICROCONTROLLER APPLICATION
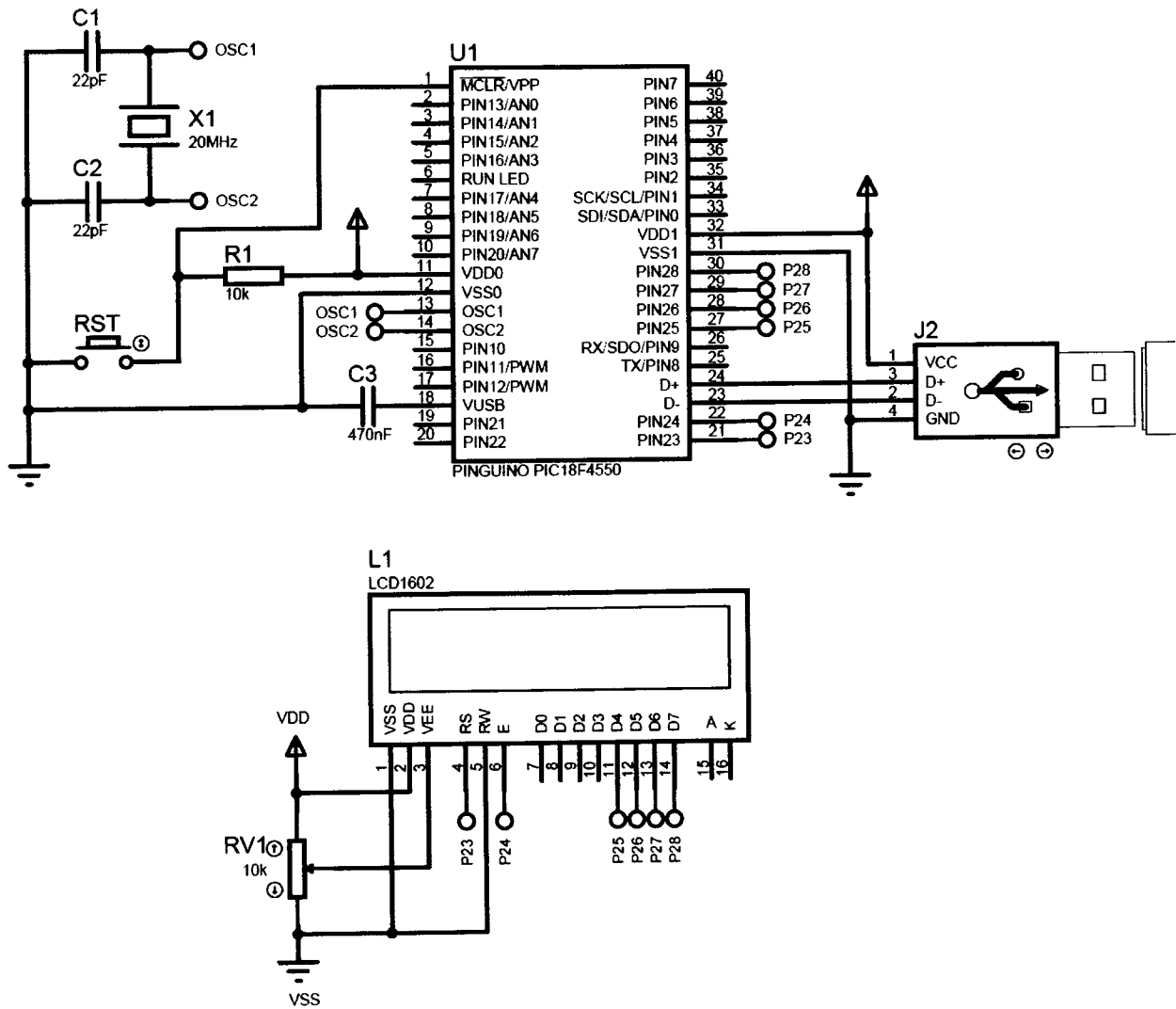
PROGRAMME : BEE
COURSE CODE : BER4223

FIGURE Q1

References
# MD10C – Motor Driver
(Important data from datasheet)

3. PRODUCT SPECIFICATION AND LIMITATIONS

Absolute Maximum Rating

No	Parameters	Min	Typical	Max	Unit
1	Power Input Voltage (Motor Supply Voltage)	3	-	25	V
2	I_{MAX} (Maximum Continuous Motor Current)	-	-	10	A
3	I_{PEAK} – (Peak Motor Current) *	-	-	15	A
4	V_{IN} (Board Supply Voltage)	11	12	14	V
5	V_{IOH} (Logic Input – High Level)	3	-	5.5	V
6	V_{IOL} (Logic Input – Low Level)	0	0	0.5	V
7	Maximum PWM Frequency	-	-	10	KHz

Must not exceed 10 seconds.

5. BOARD LAYOUT
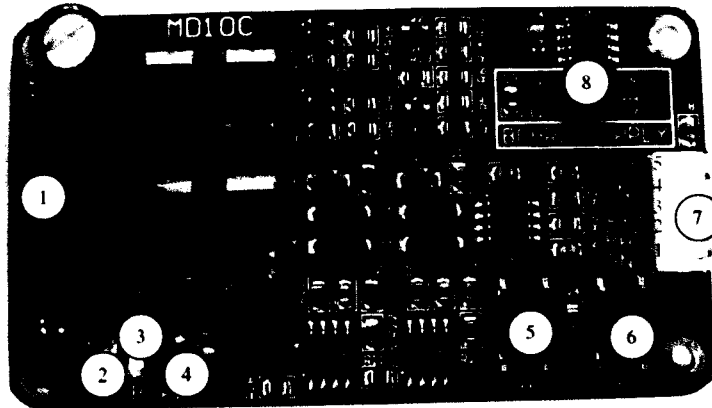
1. Terminal Block – Connect to motor and power source.

Pin No.	Pin Name	Description
1	POWER +	Positive supply.
2	POWER -	Negative supply.
3	Motor Output A	Connect to motor terminal A.
4	Motor Output B	Connect to motor terminal B.

7. Input

Pin No.	Pin Name	Description
1	GND	Logic ground.
2	PWM	PWM input for speed control.
3	DIR	Direction control.
4	NC	Not connected. This pin is not used.
5	VIN*	Board power supply.

This can be left unconnected if the board is powered by motor power input.

The truth table for the control logic is as follow:

Pin 2 (PWM)	Pin 3 (DIR)	Output A	Output B
Low	X (Don't Care)	Low	Low
High	Low	High	Low
High	High	Low	High

References
C3704 and UVTRON – Flame Sensor
(Important data from datasheet)

UV TRON
(SOLD SEPARATELY)
ANODE   CATHODE

OUTPUT SIGNAL
WAVEFORM

Q   5V
             GND

Q̄   5V
             GND
             10 ms
             (Note 4)

A ○   ← +350Vdc   ○ K

+5Vdc

POWER SUPPLY
+ ○ — CONSTANT * VOLTAGE CIRCUIT — HIGH VOLTAGE DC-DC CONVERTER — SIGNAL PROCESSING CIRCUIT 3 5 7 9 — ○ Q (1)

○ Q̄ (2)

OPEN COLLECTOR OUTPUT (3)

Tr : 50 -100mA

─ ○ GND

* Not included in C3704-02.

JUMPER LEAD FOR SETTING
BACKGROUND CANCEL LEVEL

Figure 3: Method of Connection

JUMPER LEAD FOR SETTING
BACKGROUND CANCEL LEVEL
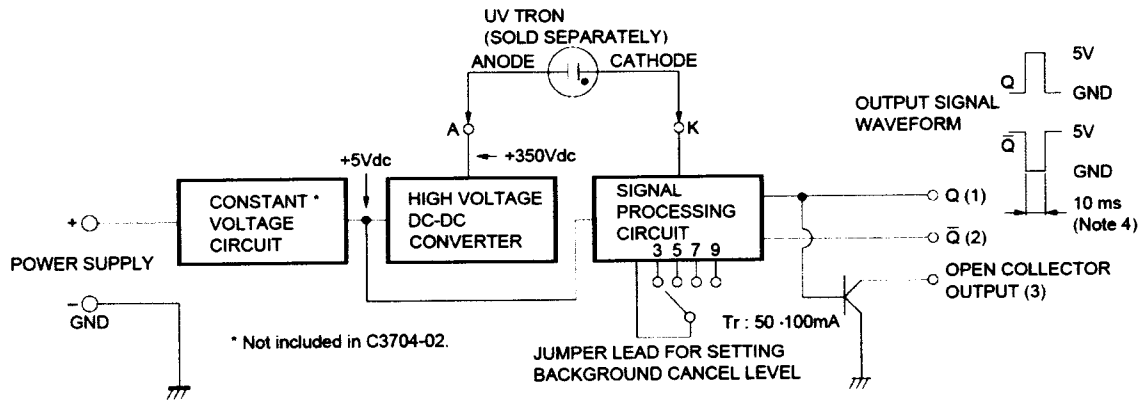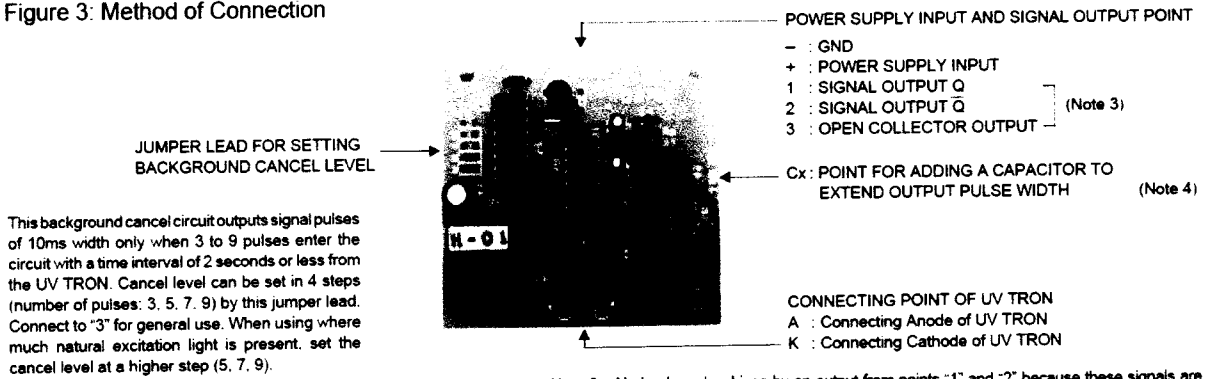
This background cancel circuit outputs signal pulses of 10ms width only when 3 to 9 pulses enter the circuit with a time interval of 2 seconds or less from the UV TRON. Cancel level can be set in 4 steps (number of pulses: 3, 5, 7, 9) by this jumper lead. Connect to "3" for general use. When using where much natural excitation light is present, set the cancel level at a higher step (5, 7, 9).

POWER SUPPLY INPUT AND SIGNAL OUTPUT POINT
─ : GND
+ : POWER SUPPLY INPUT
1 : SIGNAL OUTPUT Q
2 : SIGNAL OUTPUT Q̄   (Note 3)
3 : OPEN COLLECTOR OUTPUT

Cx : POINT FOR ADDING A CAPACITOR TO
EXTEND OUTPUT PULSE WIDTH   (Note 4)

CONNECTING POINT OF UV TRON
A : Connecting Anode of UV TRON
K : Connecting Cathode of UV TRON

Note 3: No load can be driven by an output from points "1" and "2" because these signals are output from the only C-MOS IC directly. When a load such as a buzzer and a relay is connected to this circuit, it should be connected to the point open collector output. The transistor ratings of the open collector is 50V, 100mA. Be careful not to exceed the ratings.

Note 4: The output pulse width is set to 10ms at shipping. If the pulse width needs to be extended, add a capacitor to this point. (When using an electrolytic condenser, make sure the polarity is correct.)
e.g. CX = 1 µF: Pulse Width = 1s, CX=10 µF : Pulse Width ≈ 10s

VERTICAL VIEWING
o (Left fig.)

UV EMISSION POINT

HORIZONTAL VIEWING
● (Left fig.)
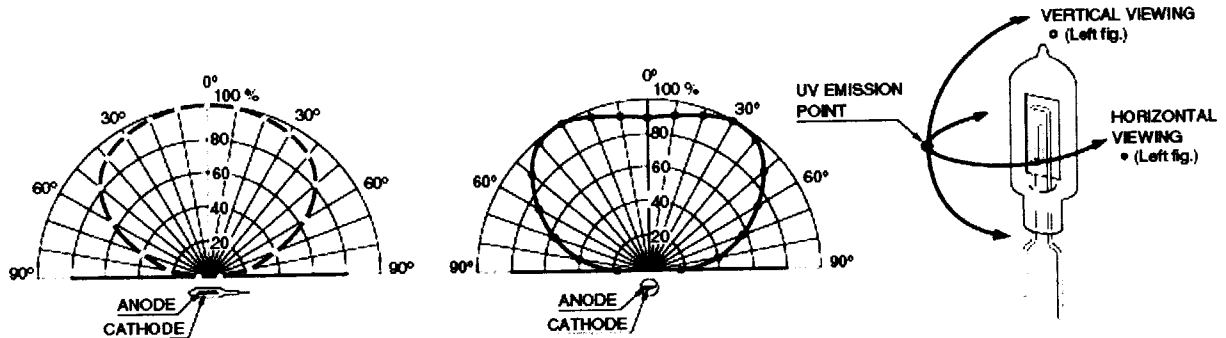
References
TC72 and TC74 – Temperature Sensor
(Please refer to the full datasheet provided)