Microcontroller & Embedded Systems-Module-3-2

ESTD : 2001
An Institute with a Difference

Dr. Girijamma H A
Professor
Department of Computer Science and Engineering
RNS Institute of Technology
Bangalore -560098
Email: girijakasal@gmail.com
Contact: 9480031494

Module-3-2-Contents

ESTD : 2001
An Institute with a Difference

2. The Typical Embedded System

3.2.1Core of an Embedded System

3.2.2 Memory

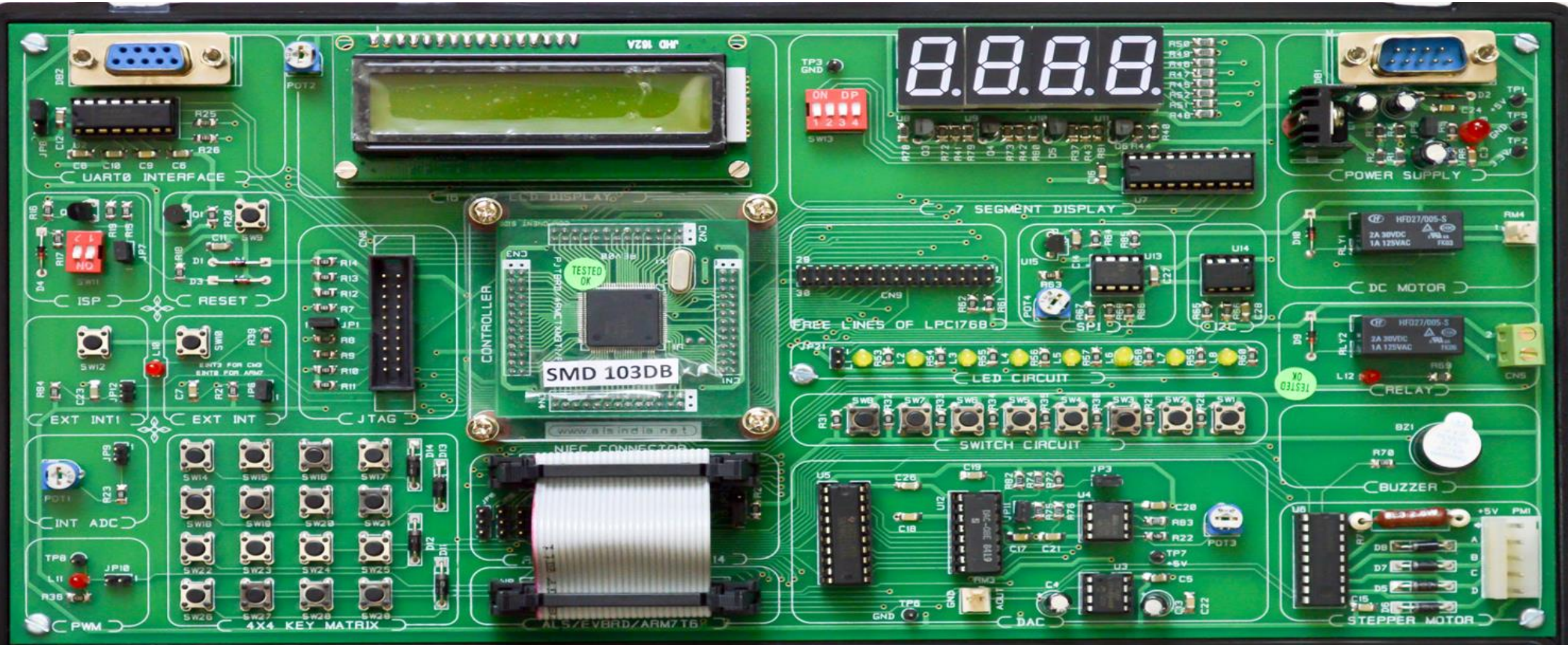
3.2.3 Sensors and Actuators

3.2.4 Communication Interface

3.2.5 Embedded firmware

3.2.6 Other system components.

Text book 2: Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education, Private Limited, 2nd Edition.
Chapter 1(Sections 1.2 to 1.6) ,Chapter 2(Sections 2.1 to 2.6)



ARM7 LPC2148 EVALUATION BOARD

ALS-SDA-ARM7-06

ADVANCED ELECTRONIC SYSTEMS
#143, 9th Main Road, 3rd Phase, Peenya Industrial Area,
Bangalore - 560 058, Karnataka, INDIA.
Phone : 91-80-41625285 / 41539484
E-mail : sales@alsindia.net URL : www.alsindia.net

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor

- Stepper motor is an electro mechanical device which generates discrete displacement (motion) in response to dc electrical signals
- It differs from the normal dc motor in its operation.
- The dc motor produces continuous rotation on applying dc voltage whereas a stepper motor produces discrete rotation in response to the dc voltage applied to it.
- It is a brushless DC motor that divides a full rotation into no of equal steps.
- Stepper motors are widely used in industrial embedded applications, consumer electronic products and robotics control systems

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor

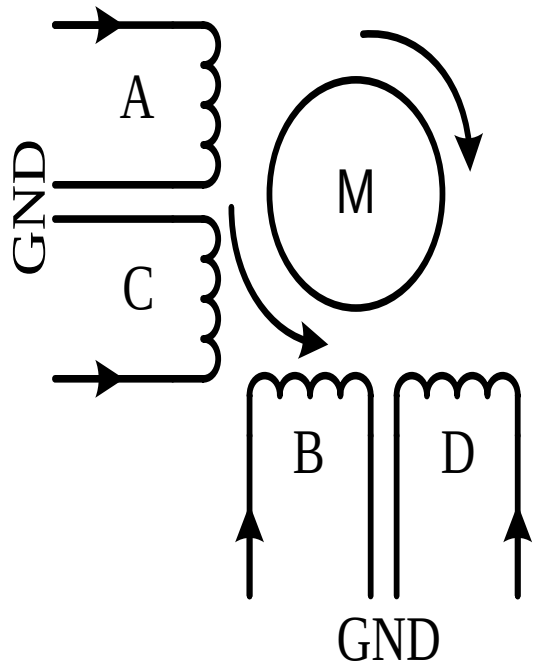
- The paper feed mechanism of a printer/fax makes use of stepper motors for its functioning.
- Based on the coil winding arrangements, a two phase stepper motor is classified into
  1. Unipolar
  2. Bipolar

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor - Unipolar

- A unipolar stepper motor contains two windings per phase.
- The direction of rotation (clockwise or anticlockwise) of a stepper motor is controlled by changing the direction of current flow.
- Current in one direction flows through one coil and in the opposite direction flows through the other coil.
- It is easy to shift the direction of rotation by just switching the terminals to which the coils are connected



Sensors and Actuators

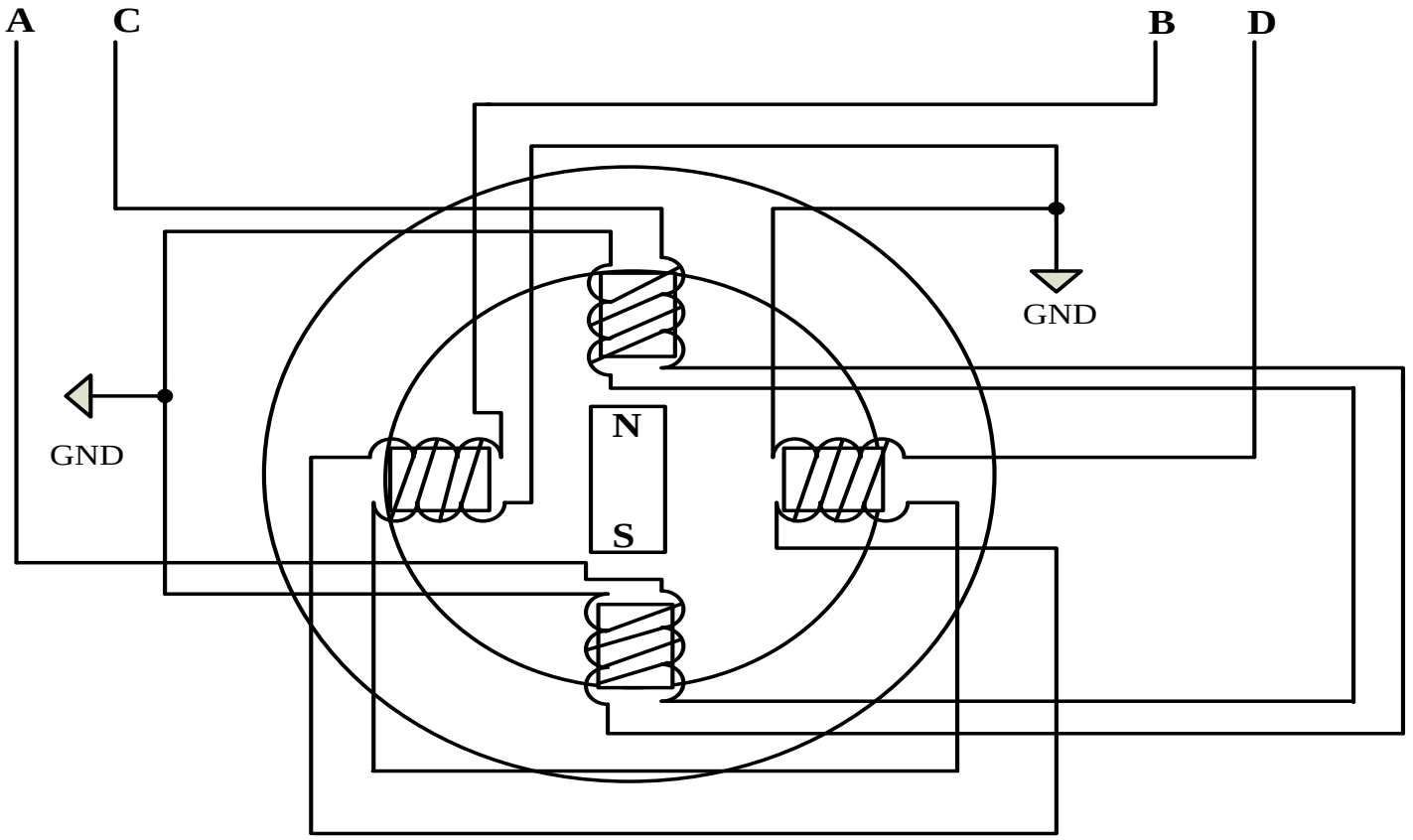
ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor - Bipolar

- A bipolar stepper motor contains single winding per phase.
- For reversing the motor rotation the current flow through the windings is reversed dynamically.
- It requires complex circuitry for current flow reversal

Sensors and Actuators

I/O Subsystem: Stepper Motor – 2 Phase Stepper Motor: Stator Windings



Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor – 2 Phase Unipolar Stepper Motor: Stator Windings

Full Step:

In the full step mode both the phases are energized simultaneously. The coils A, B, C and D are energized in the order

Step	Coil A	Coil B	Coil C	Coil D
1	H	H	L	L
2	L	H	H	L
3	L	L	H	H
4	H	L	L	H

Only one winding of a phase is energized at a time

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor – 2 Phase Unipolar Stepper Motor: Stator Windings

Wave Step: Only one phase is energized at a time and each coils of the phase are energized alternatively. The coils A, B, C and D are energized in the order

Step	Coil A	Coil B	Coil C	Coil D
1	H	L	L	L
2	L	H	L	L
3	L	L	H	L
4	L	L	L	H

Only one winding of a phase is energized at a time

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor – 2 Phase Unipolar Stepper Motor: Stator Windings

Half Step: Half step uses the combination of wave and full step. It has the highest torque and stability. The coils A, B, C and D are energized in the order

Step	Coil A	Coil B	Coil C	Coil D
1	H	L	L	L
2	H	H	L	L
3	L	H	L	L
4	L	H	H	L
5	L	L	H	L
6	L	L	H	H
7	L	L	L	H
8	H	L	L	H

The rotation of the stepper motor can be reversed by reversing the order in which the coil is energized

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

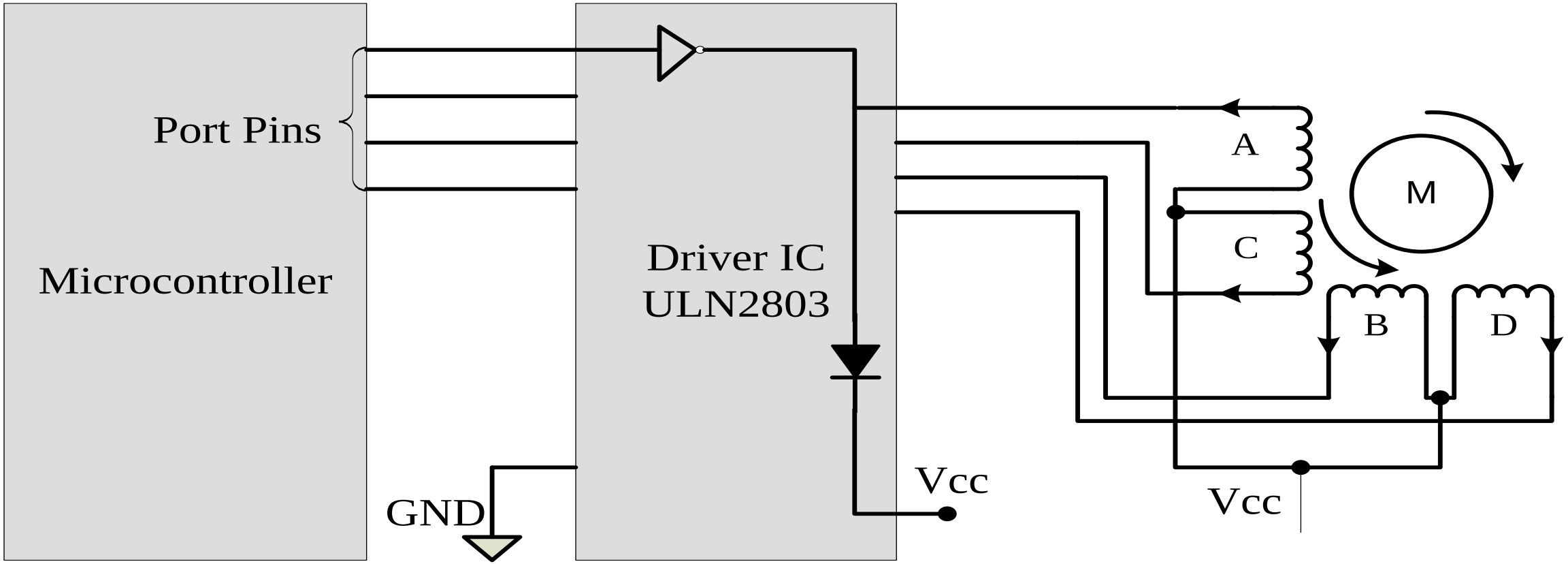
I/O Subsystem: Stepper Motor – 2 Phase Unipolar Stepper Motor: Interfacing

- Depending on the current and voltage requirements, special driving circuits are required to interface the stepper motor with microcontroller/processors.
- Stepper motor driving ICs like ULN2803 or simple transistor based driving circuit can be used for interfacing stepper motors with processor/controller

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Stepper Motor – 2 Phase Unipolar Stepper Motor: Interfacing

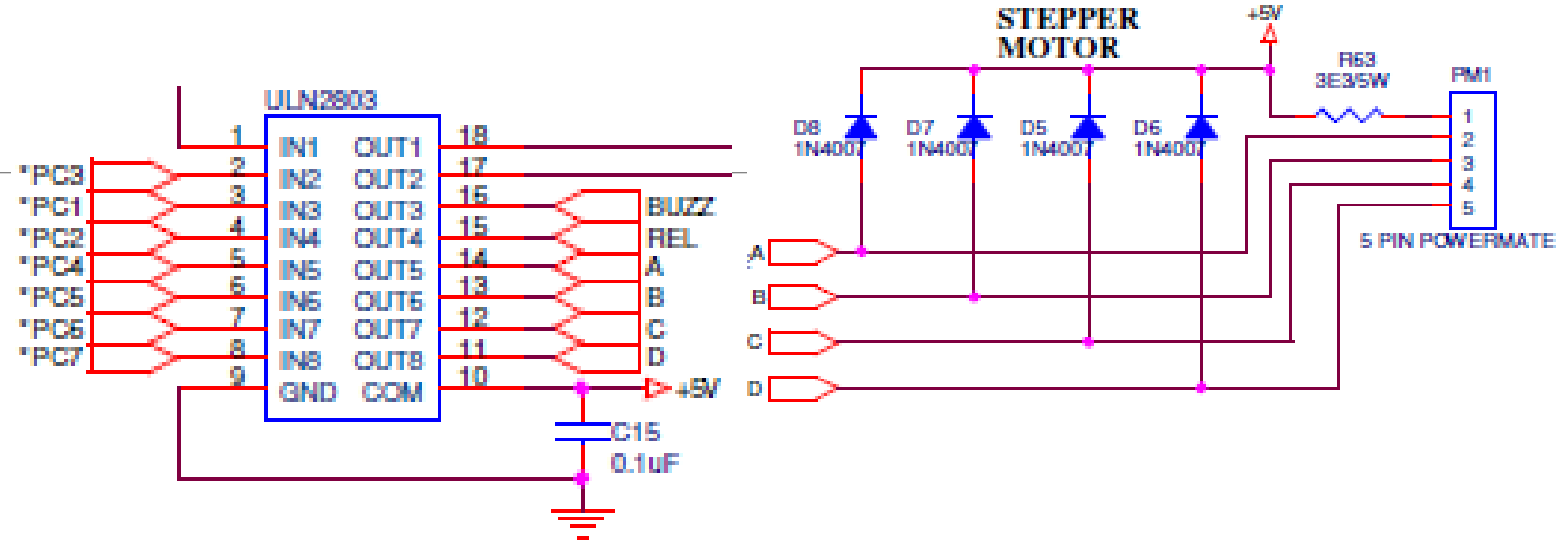


P0.12->PC4

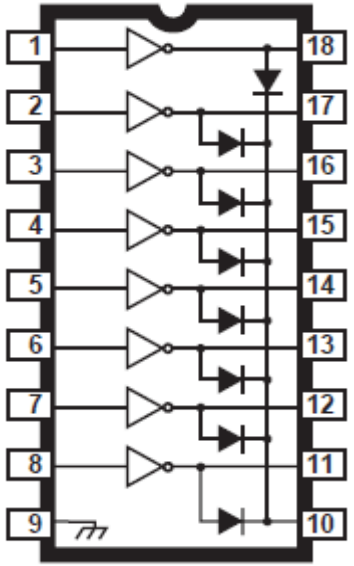
P0.13->PC5

P0.14->PC6

P0.15->PC7



P0.15	P0.14	P0.13	P0.12
0	0	0	1
0	0	1	0
0	1	0	0
1	0	0	0



D	C	B	A
1	1	1	0
1	1	0	1
1	0	1	1
0	1	1	1

https://www.youtube.com/watch?v=TWMai3oirnM

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Keyboard

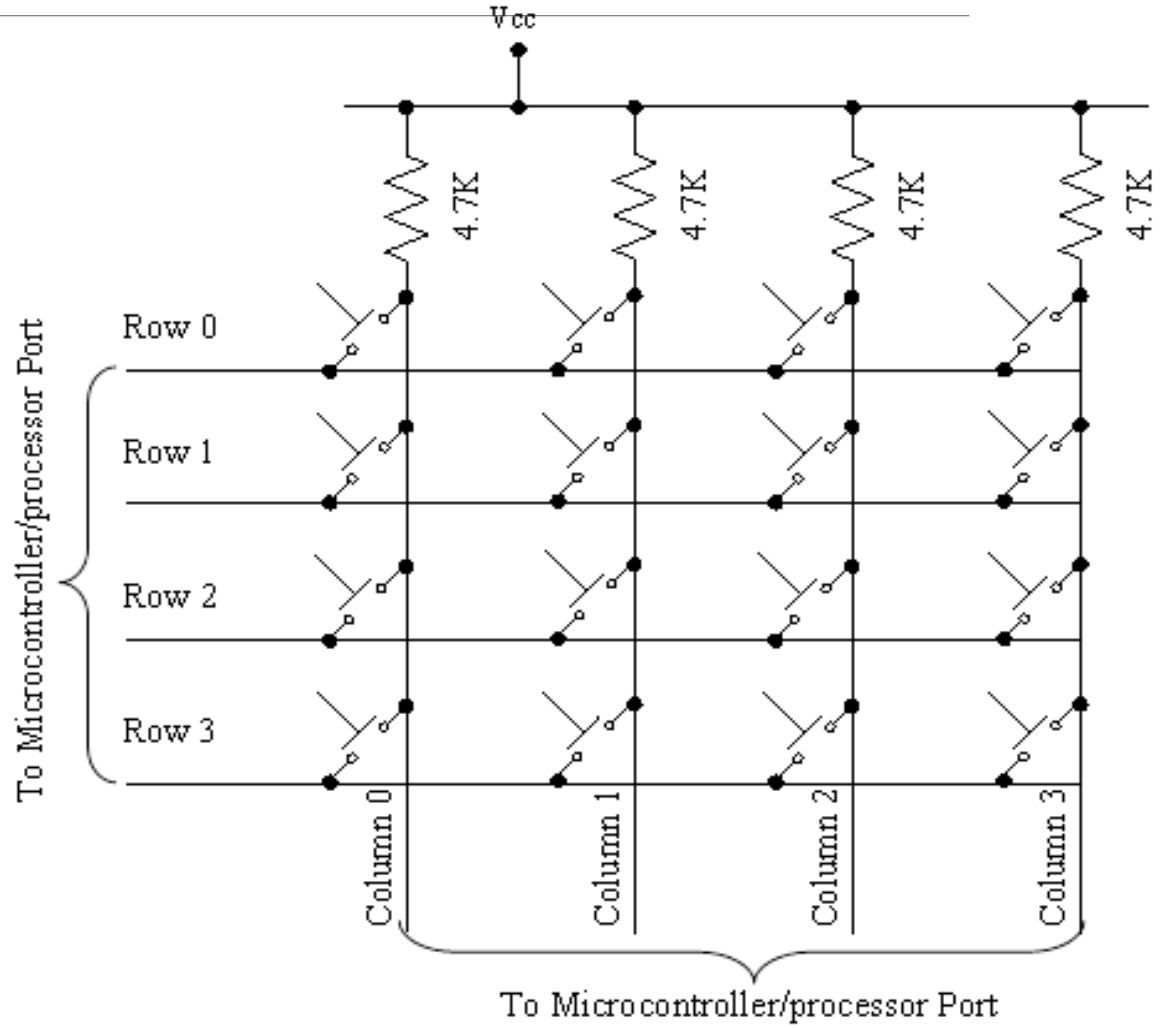
- Keyboard is an input device for user interfacing.
- If the number of keys required is very limited, push button switches can be used and they can be directly interfaced to the port pins for reading.
- Matrix keyboard is an optimum solution for handling large number of key requirements.
- Matrix keyboard greatly reduces the number of interface connections.

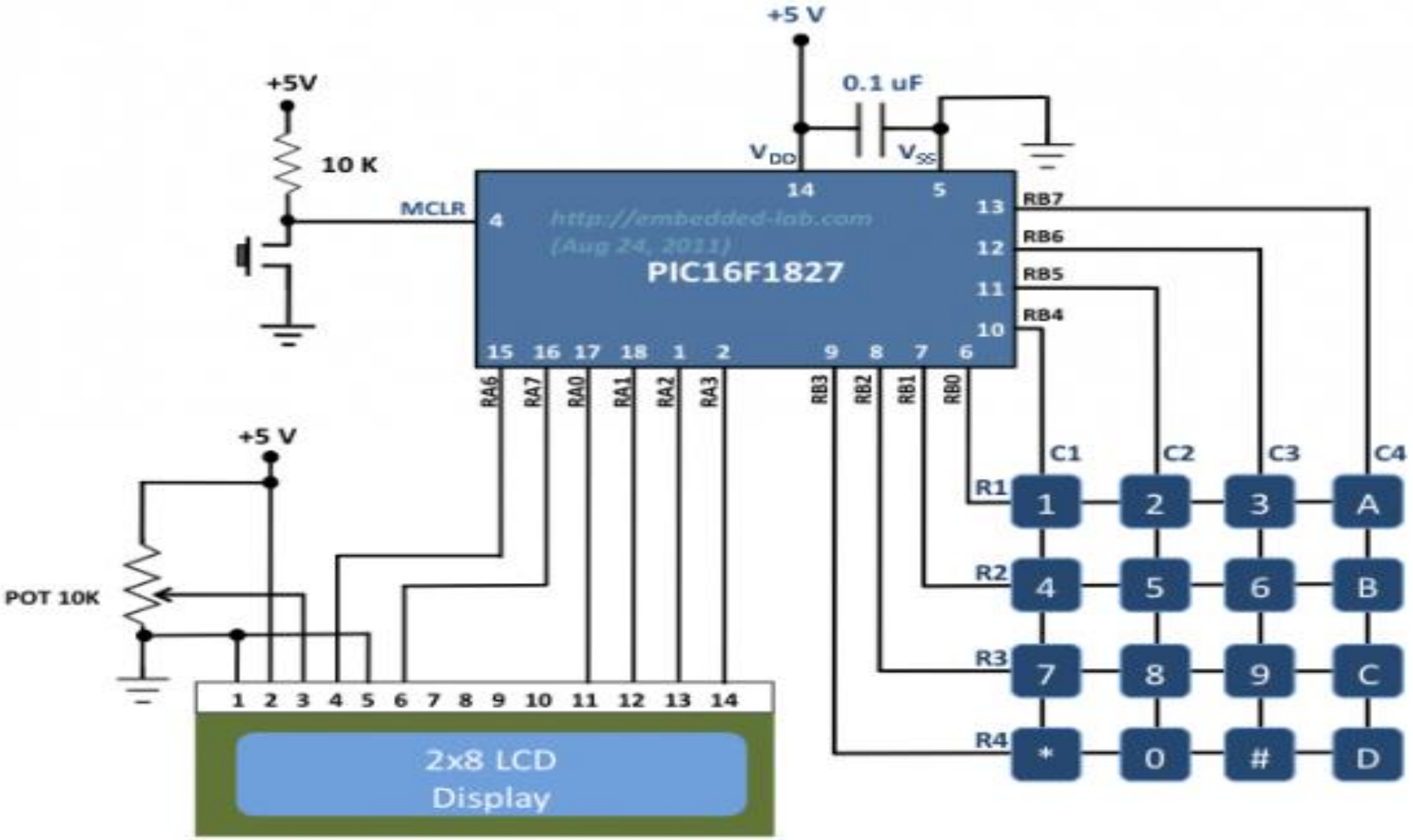
Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Keyboard

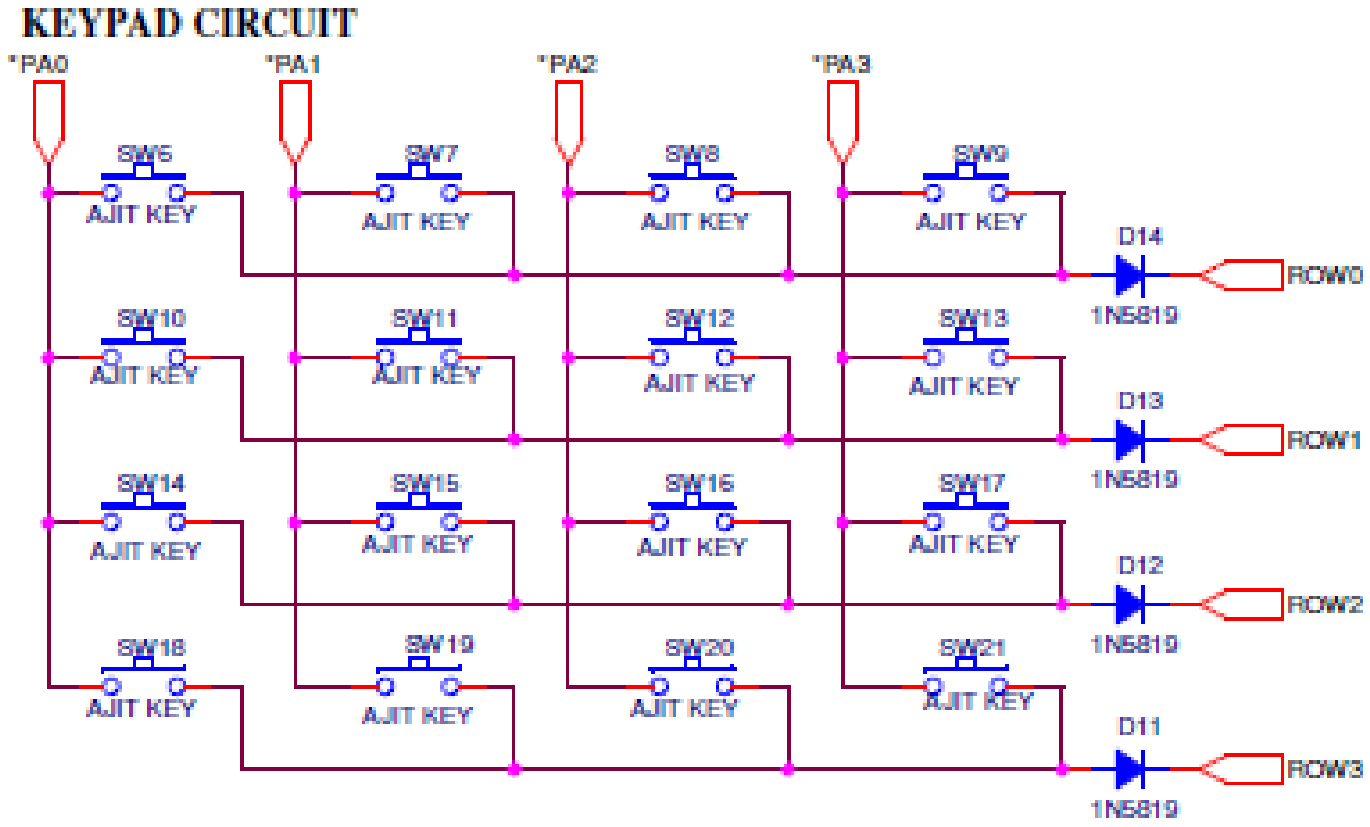
- Matrix keyboard connects the keys in a row column fashion.
- For example, for interfacing 16 keys, in the direct interfacing technique 16 port pins are required, where as in the matrix keyboard only 4 columns and 4 rows are required for interfacing 16 keys
- The 16 keys are arranged in a 4*4 matrix.




+5 V
0.1 uF
+5V
10 K
MCLR
VDD
VSS
14
5
4
http://embedded-lab.com
(Aug 24, 2011)
PIC16F1827
13
12
11
10
RB7
RB6
RB5
RB4
15 16 17 18 1 2 9 8 7 6
RA6 RA7 RA0 RA1 RA2 RA3 RB3 RB2 RB1 RB0
+5 V
C1 C2 C3 C4
R1 1 2 3 A
R2 4 5 6 B
R3 7 8 9 C
R4 * 0 # D
POT 10K
1 2 3 4 5 6 7 8 9 10 11 12 13 14
2x8 LCD
Display

P1.16 to P1.19->PA0 to PA3

P1.20 to P1.23->ROW0 to ROW3



- The switches SW1 to SW16 are organized as 4 rows X 4 columns matrix. One end of all the switches is configured as columns. The other end of the matrix configured as rows.
- A row line will be always an output from the controller. Column lines are inputs.
- A low level sent from the row will appear at column end if the switch is pressed.

Sensors and Actuators

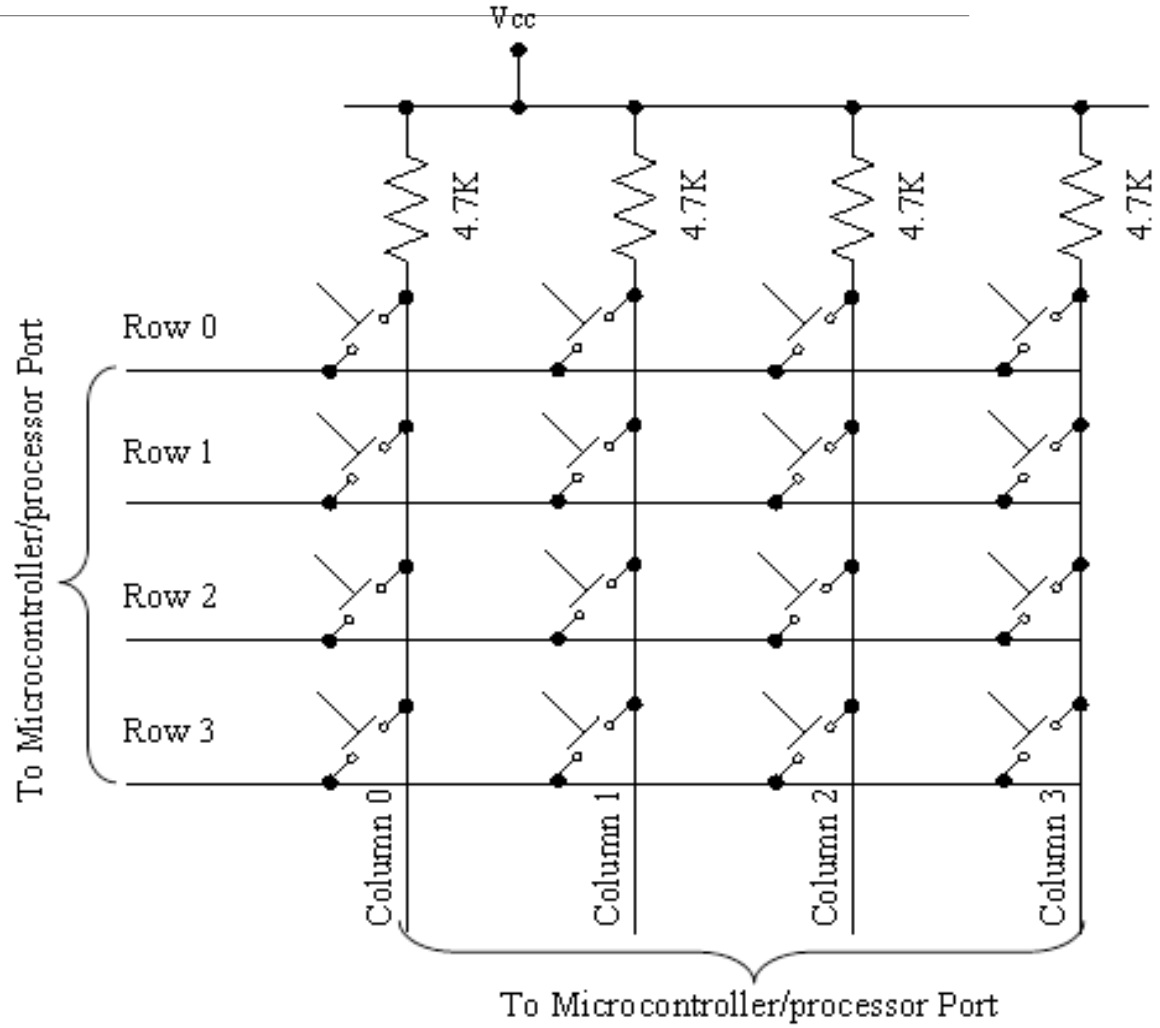
```
unsigned long int scan_code[16]=
 {0x00EE0000,0x00ED0000,0x00EB0000,0x00E70000,

0x00DE0000,0x00DD0000,0x00DB0000,0x00D70000,

0x00BE0000,0x00BD0000,0x00BB0000,0x00B70000,

0x007E0000,0x007D0000,0x007B0000,0x00770000};


unsigned char ASCII_CODE[16]= {'0','1','2','3',
                               '4','5','6','7',
                               '8','9','A','B',
                               'C','D','E','F'};
```



file:///C:/Users/sirik/Downloads/1586146816199.pdf

Sensors and Actuators

ESTD : 2001
An Institute with a Difference

I/O Subsystem: Push button switch

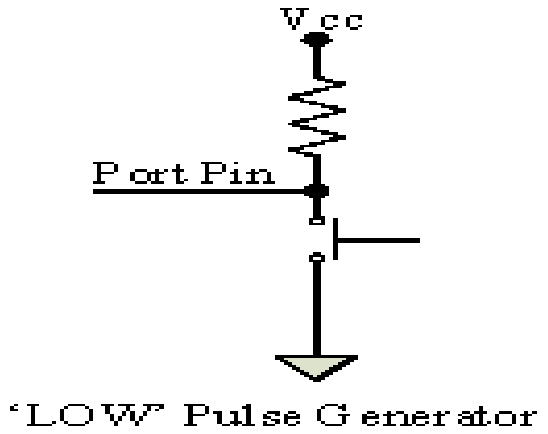
- It is an input device. Push button switch comes in two configurations, namely ‘Push to Make’ and ‘Push to Break’.
- **In the ‘Push to Make’ configuration**, the switch is normally in the open state and it makes a circuit contact when it is pushed or pressed.
- **In the ‘Push to Break’ configuration**, the switch is normally in the closed state and it breaks the circuit contact when it is pushed or pressed.

Sensors and Actuators

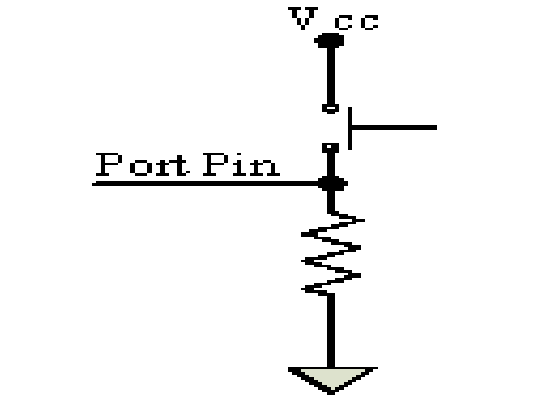
ESTD : 2001
An Institute with a Difference

I/O Subsystem: Push button switch

- In the embedded application push button is generally used as reset and start switch.
- The Push button is normally connected to the port pin of the host processor/controller.
- Depending on the way in which the push button interfaced to the controller, it can generate either a "HIGH" pulse or a "LOW" pulse.



'LOW' Pulse Generator



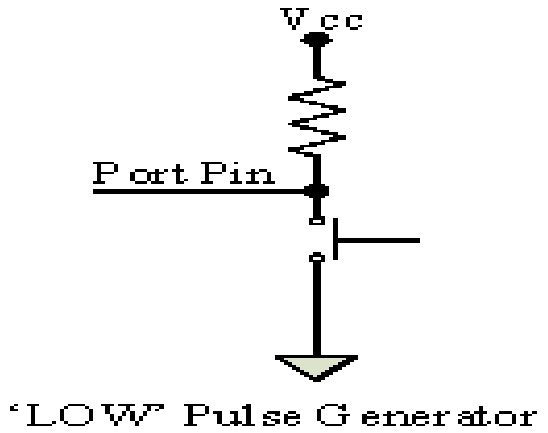
'HIGH' Pulse Generator

Sensors and Actuators

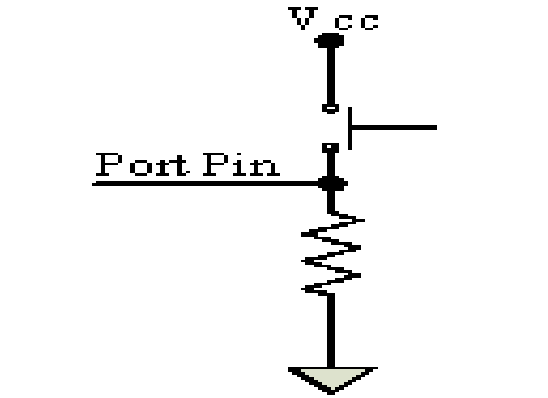
ESTD : 2001
An Institute with a Difference

I/O Subsystem: Push button switch

- In the embedded application push button is generally used as reset and start switch.
- The Push button is normally connected to the port pin of the host processor/controller.
- Depending on the way in which the push button interfaced to the controller, it can generate either a "HIGH" pulse or a "LOW" pulse.



'LOW' Pulse Generator



'HIGH' Pulse Generator

Thank You