Chapter 9

LCD (Liquid Crystal Display)

ขนาด 16x2 with AVR

เนื้อหา

LCD 16x2 Pinout

LCD 16x2 โหมด 4 บิต

การเชื่อมต่อ LCD ขนาด 16x2 กับ เอวีอาร์ ATmega328P โหมด 4 บิต

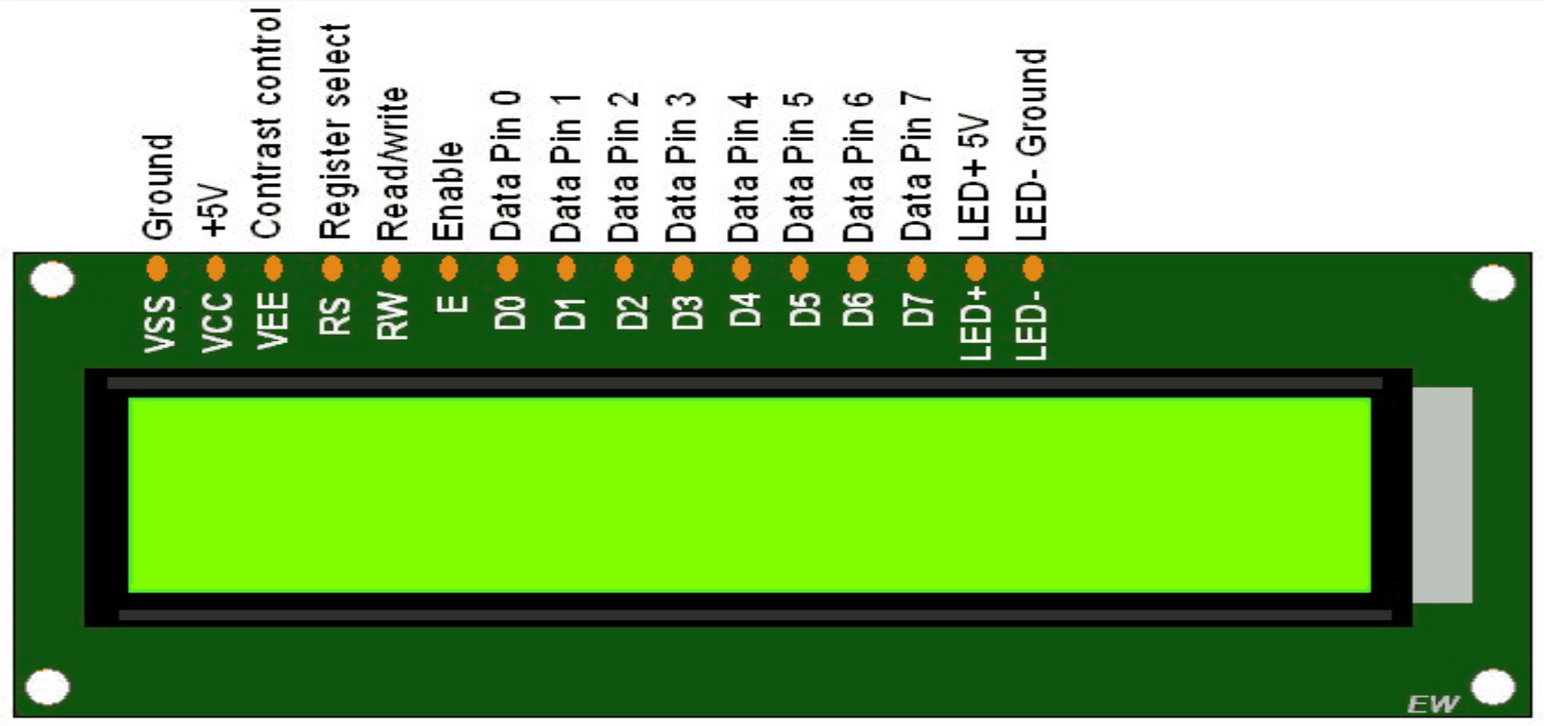
คำสั่งที่เกี่ยวข้องกับการโปรแกรม LCD

Library <LiquidCrystal.h>

Advantages of LCD

- Becoming cheaper
- Display: numbers, characters, and graphics
- Built-in refreshing controller
- Easy to program (displaying ASCII codes)
- Consume less power
- Generate and display custom characters

LCD 16x2 Pinout



- LCD 16x2 is a 16 pin device which has 8 data pins (D0-D7) and 3 control pins (RS, RW, EN). The remaining 5 pins are for supply and backlight for the LCD. (Either 4-bit mode or 8-bit mode)

ขาสัญญาณที่เกี่ยวข้อง

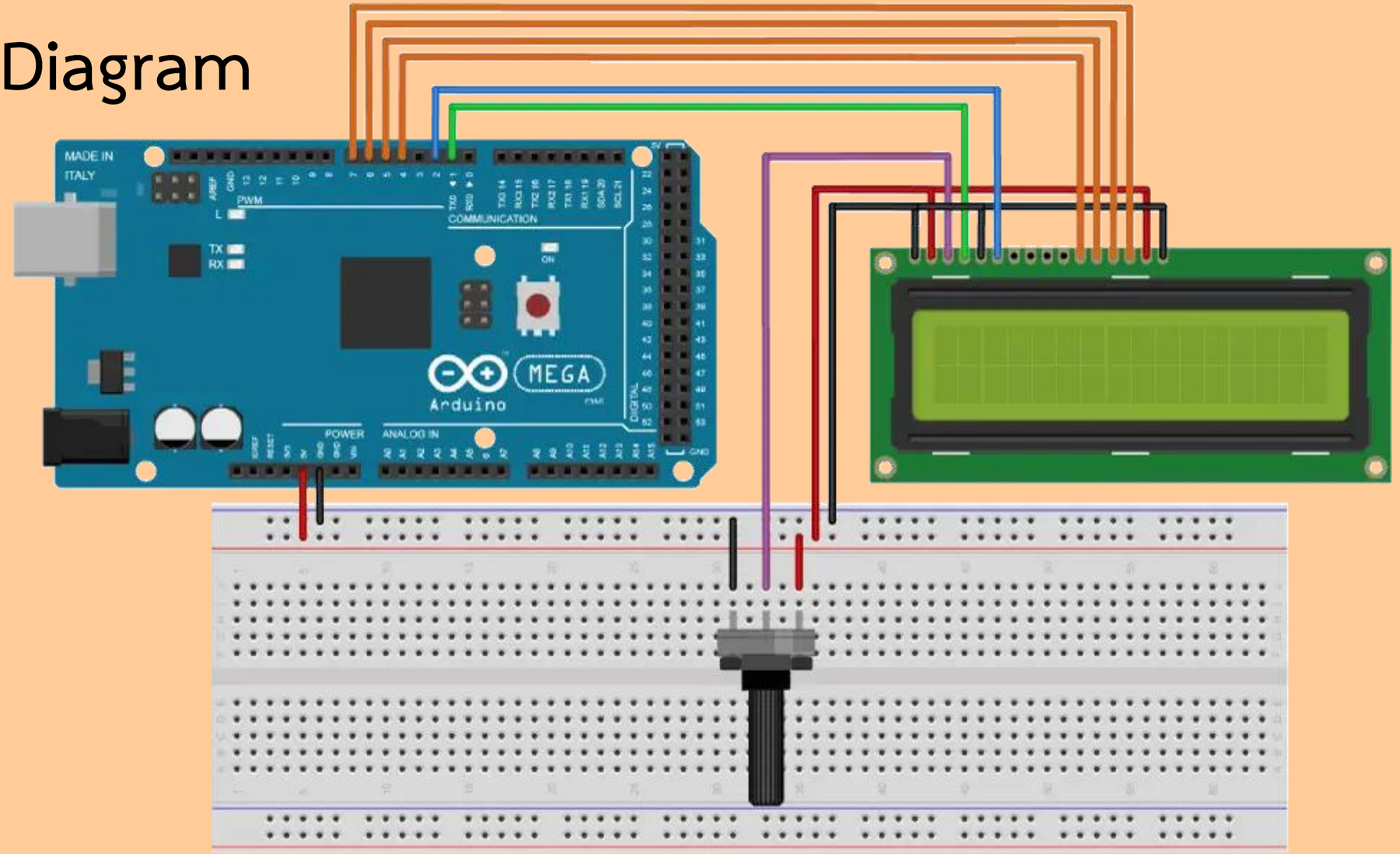
- Power Supply: VCC (+5V) & VSS (GND)
- Control:
  - VEE: Contrast Control
  - RS: Register Select
  - RW: Read/Write
  - E: Enable
- Data: D0-D7

Register Select Pin

- RS is used for:
- Sending Command:
  - If RS pin is set on low state, then we are sending commands, such as: set the cursor to a specific location, clear the display, turn off the display and so on.
- Sending Data :
  - If RS pin is set on High state,then we are sending data or characters to the LCD.

How to Connect Arduino to LCD

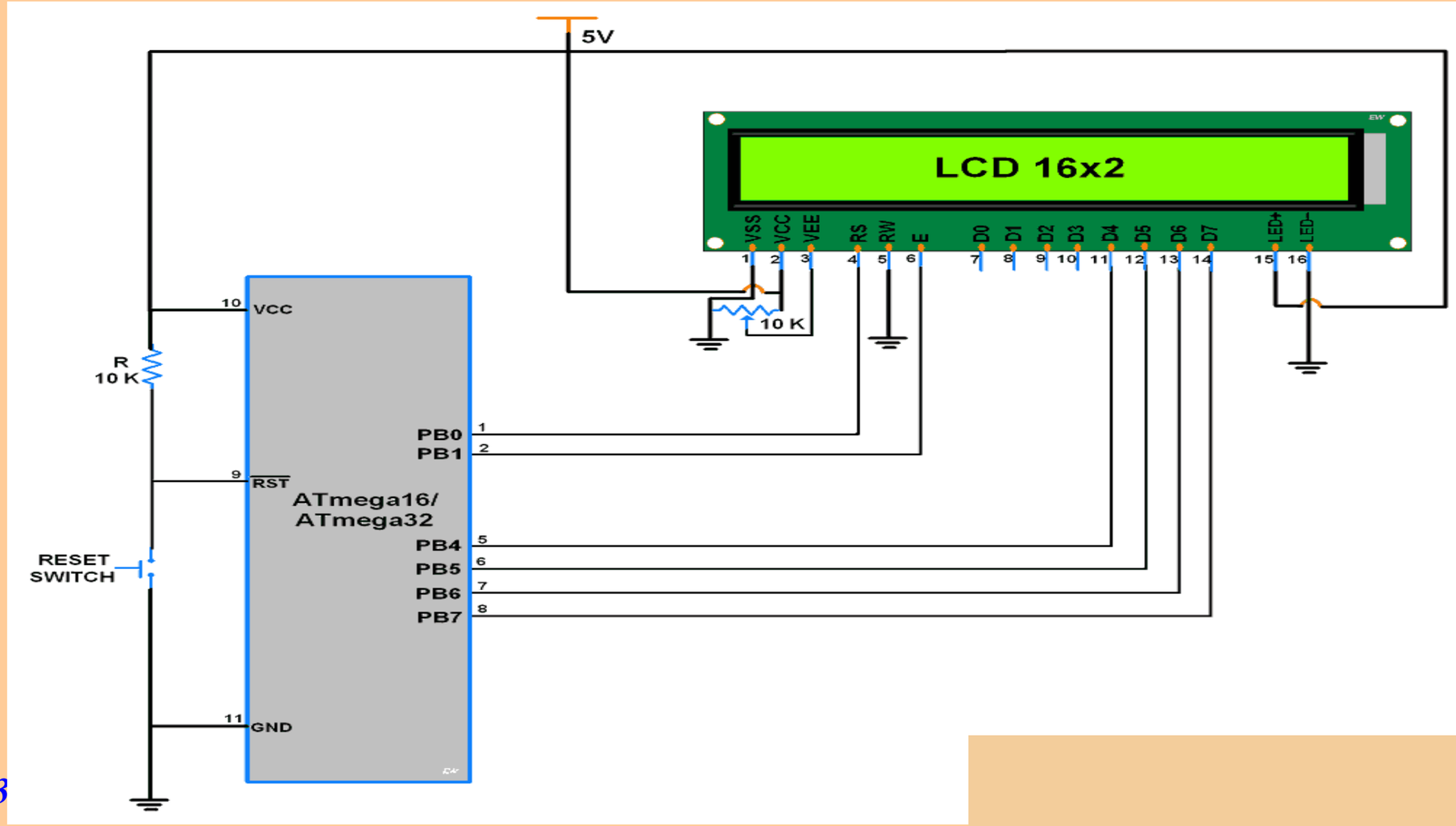
- Wiring Diagram



LCD 16x2 โหมด 4 บิต

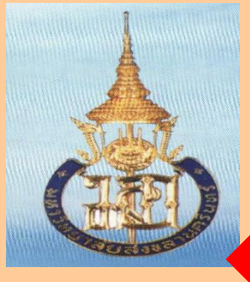
- Data/command is sent in a 4-bit (nibble) format
  - 1st send a higher 4-bit
  - and then send a lower 4-bit
- 4 data (D4 - D7) pins are connected to the μC
- RS, RW, E connected to other GPIO Pins

การเชื่อมต่อ LCD ขนาด 16x2 กับ เอวีอาร์ ATmega328P โหมด 4 บิต



คำสั่งที่เกี่ยวข้องกับการโปรแกรม LCD

Hex Code	Command to LCD Instruction Register	Hex Code	Command to LCD Instruction Register
0F	LCD ON, cursor ON	C0	Force cursor to beginning of second line
01	Clear display screen	38	2 lines and 5×7 matrix
02	Return home	83	Cursor line 1 position 3
04	Decrement cursor (shift cursor to left)	3C	Activate second line
06	Increment cursor (shift cursor to right)	08	Display OFF, cursor OFF
05	Shift display right	C1	Jump to second line, position 1
07	Shift display left	OC	Display ON, cursor OFF
0E	Display ON, cursor blinking	C1	Jump to second line, position 1
80	Force cursor to beginning of first line	C2	Jump to second line, position 2



Library <LiquidCrystal.h>

- LiquidCrystal()
- begin()
- clear()
- home()
- setCursor()
- write()
- print()
- cursor()
- noCursor()
- blink()
- noBlink()
- display()
- noDisplay()
- scrollDisplayLeft()
- scrollDisplayRight()
- autoscroll()
- noAutoscroll()

ตัวอย่างโปรแกรมที่ใช้ LiquidCrystal.h

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);  // RS,E,D4,D5,D6,D7
void setup() {
  lcd.begin(16,2); // 16 chars on 2 lines
}
void loop() {
 lcd.print("PSU CoE# 34"); // Prints "PSU CoE# 34" on the LCD
 delay(3000);
 lcd.setCursor(2,1); // Sets the location
 lcd.print("LCD Example");
 delay(3000);
 lcd.clear(); // Clears the display
 lcd.blink(); //Displays the blinking LCD cursor
 delay(4000);
 lcd.setCursor(7,1);
 delay(3000);
 lcd.noBlink(); // Turns off the blinking LCD cursor
 lcd.cursor(); // Displays an underscore (line)
 delay(4000);
 lcd.noCursor(); // Hides the LCD cursor
 lcd.clear(); // Clears the LCD screen
}
```

จบบทที่ 9