

# 16x2 LCD Display Module

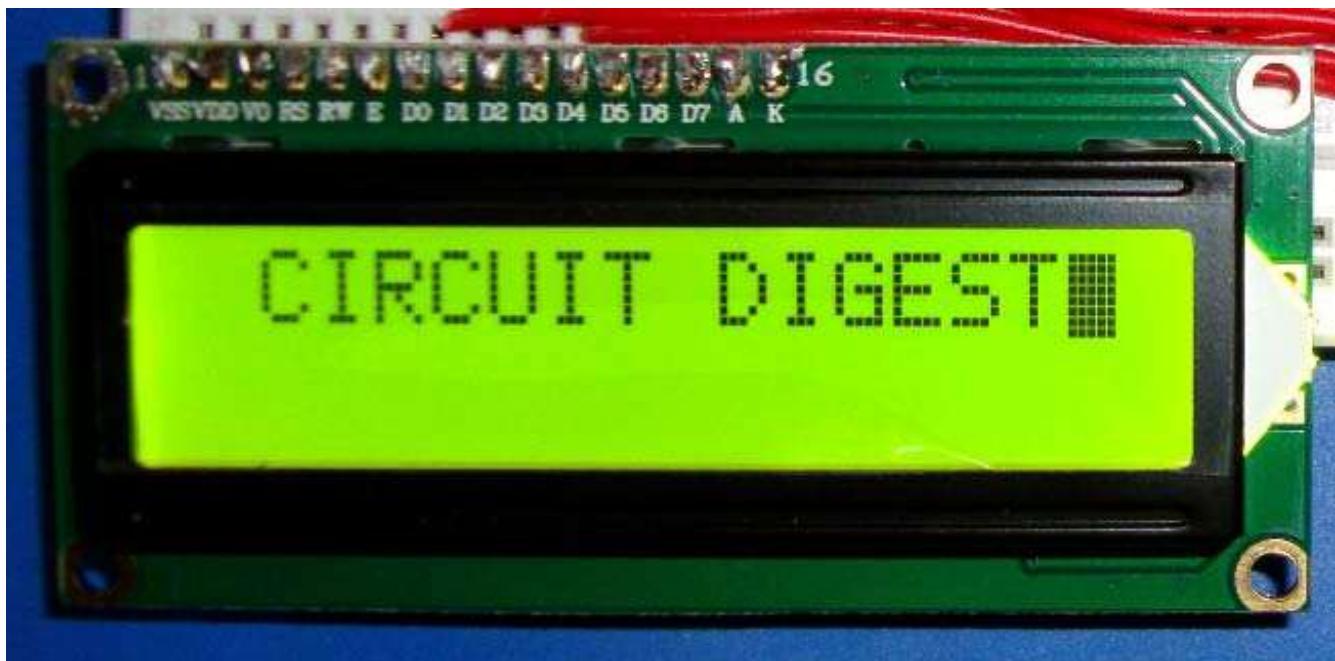
Published October 24, 2015

9



Aswinth Raj (/users/aswinth-raj)

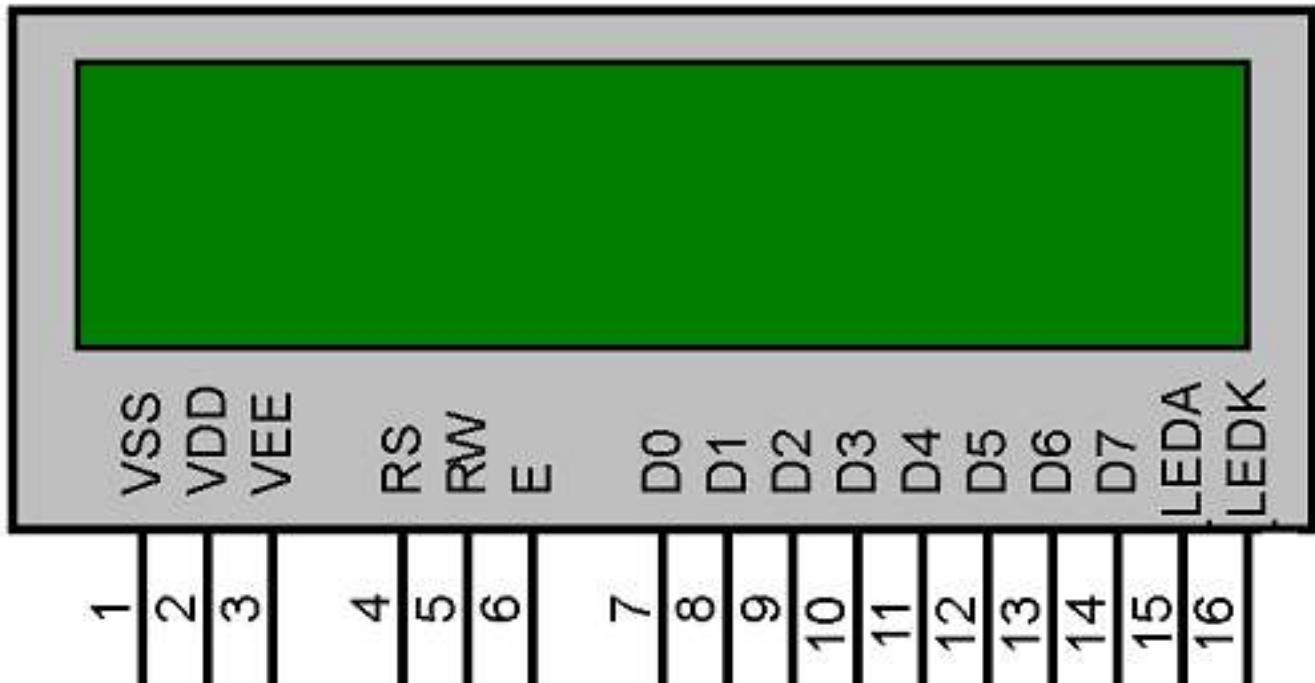
Author



16x2 LCD Display Module with HD44780 Controller

**16x2 LCD** is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16\*2 LCD, hence we are using it here.

All the above mentioned LCD display will have 16 Pins and the programming approach is also the same and hence the choice is left to you. Below is the **Pinout and Pin Description of 16x2 LCD Module:**

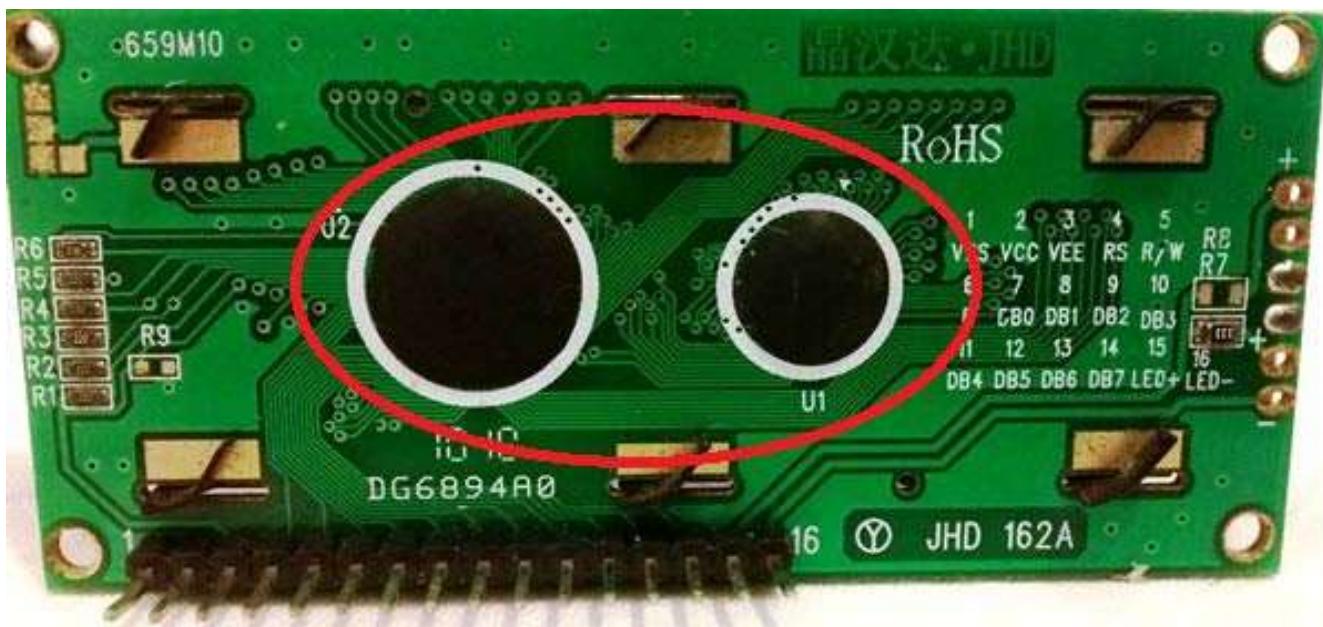


Sr. No	Pin No.	Pin Name	Pin Type	Pin Description	Pin Connection
1	Pin 1	Ground	Source Pin	This is a ground pin of LCD	Connected to the ground of the MCU/ Power source
2	Pin 2	VCC	Source Pin	This is the supply voltage pin of LCD	Connected to the supply pin of Power source
3	Pin 3	V0/VEE	Control Pin	Adjusts the contrast of the LCD.	Connected to a variable POT that can source 0-5V

4	Pin 4	Register Select	Control Pin	Toggles between Command/Data Register	Connected to a MCU pin and gets either 0 or 1. 0 -> Command Mode 1-> Data Mode
5	Pin 5	Read/Write	Control Pin	Toggles the LCD between Read/Write Operation	Connected to a MCU pin and gets either 0 or 1. 0 -> Write Operation 1-> Read Operation
6	Pin 6	Enable	Control Pin	Must be held high to perform Read/Write Operation	Connected to MCU and always held high.
7	Pin 7-14	Data Bits (0-7)	Data/Command Pin	Pins used to send Command or data to the LCD.	<u>In 4-Wire Mode</u>  Only 4 pins (0-3) is connected to MCU  <u>In 8-Wire Mode</u>  All 8 pins(0-7) are connected to MCU
8	Pin 15	LED Positive	LED Pin	Normal LED like operation to illuminate the LCD	Connected to +5V

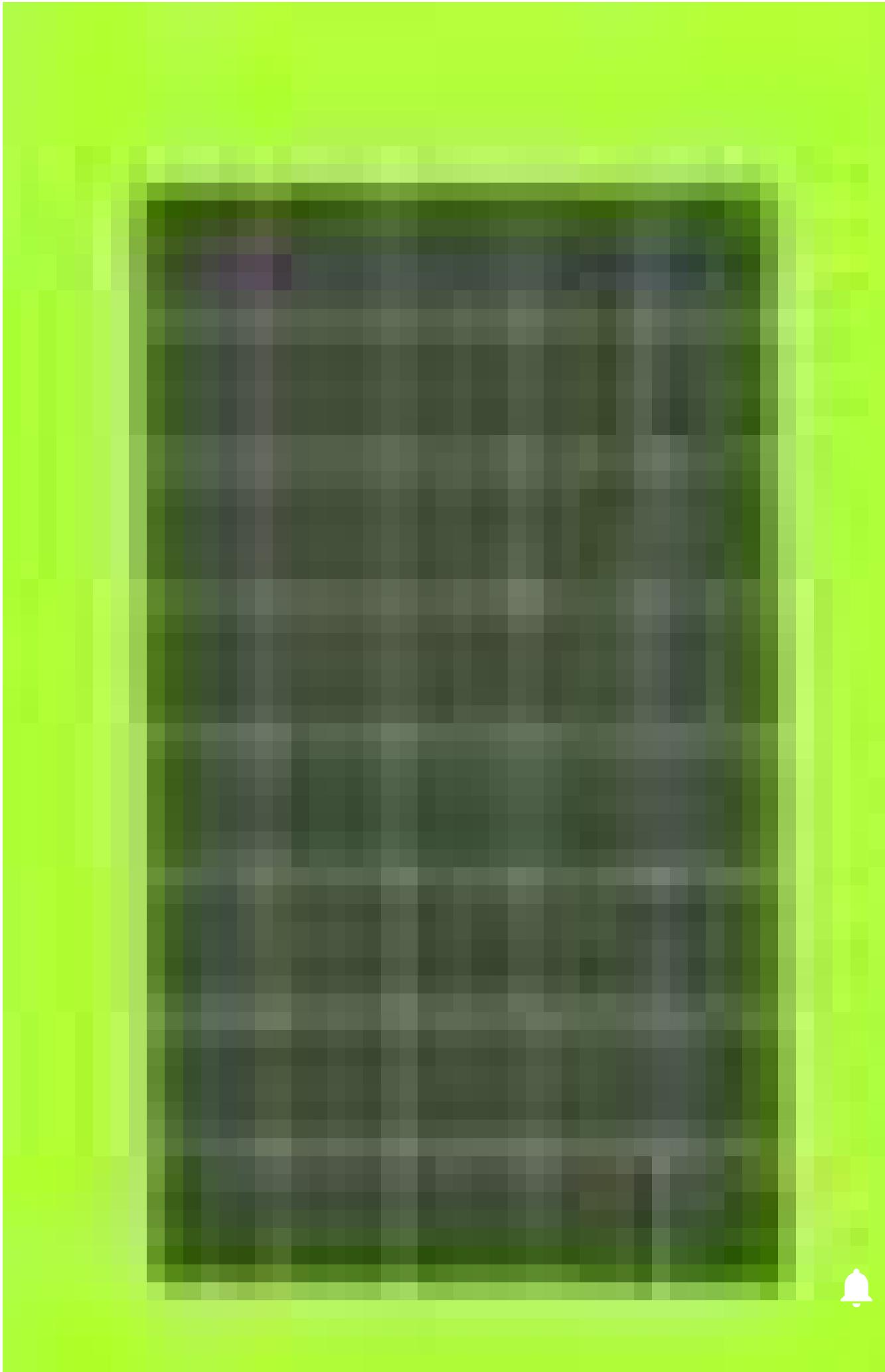
9	Pin 16	LED Negative	LED Pin	Normal operation to illuminate the LCD connected with GND.	Connected to ground
---	--------	--------------	---------	--	---------------------

It is okay if you do not understand the function of all the pins, I will be explaining in detail below. Now, let us turn back our LCD:



*Okay, what is this two black circle like things on the back of our LCD?*

These black circles consist of an interface IC and its associated components to help us use this LCD with the MCU. Because our LCD is a 16\*2 Dot matrix LCD and so it will have ( $16 \times 2 = 32$ ) 32 characters in total and each character will be made of 5\*8 Pixel Dots. A Single character with all its Pixels enabled is shown in the below picture.



So Now, we know that each character has ( $5 \times 8 = 40$ ) 40 Pixels and for 32 Characters we will have ( $32 \times 40$ ) 1280 Pixels. Further, the LCD should also be instructed about the Position of the Pixels.

It will be a hectic task to handle everything with the help of MCU, hence an **Interface IC like HD44780** is used, which is mounted on LCD Module itself. The function of this IC is to get the **Commands and Data** from the MCU and process them to display meaningful information onto our LCD Screen.

Let's discuss the different type of mode and options available in our LCD that has to be controlled by our Control Pins.

#### **4-bit and 8-bit Mode of LCD:**

The LCD can work in two different modes, namely the 4-bit mode and the 8-bit mode. In **4 bit mode** we send the data nibble by nibble, first upper nibble and then lower nibble. For those of you who don't know what a nibble is: a nibble is a group of four bits, so the lower four bits (D0-D3) of a byte form the lower nibble while the upper four bits (D4-D7) of a byte form the higher nibble. This enables us to send 8 bit data.

Whereas **in 8 bit mode** we can send the 8-bit data directly in one stroke since we use all the 8 data lines.

Now you must have guessed it, Yes 8-bit mode is faster and flawless than 4-bit mode. But the major drawback is that it needs 8 data lines connected to the microcontroller. This will make us run out of I/O pins on our MCU, so 4-bit mode is widely used. No control pins are used to set these modes. It's just the way of programming that change.

#### **Read and Write Mode of LCD:**

As said, the LCD itself consists of an Interface IC. The MCU can either read or write to this interface IC. Most of the times we will be just writing to the IC, since reading will make it more complex and such scenarios are very rare. Information like position of cursor, status completion interrupts etc. can be read if required, but it is out of the scope of this tutorial.

The Interface IC present in most of the LCD is **HD44780U**, in order to program our LCD we should learn the complete datasheet of the IC. The [datasheet is given here](#) (<http://circuitdigest.com/sites/default/files/HD44780U.pdf>).

#### **LCD Commands:**

There are some preset commands instructions in LCD, which we need to send to LCD through some microcontroller. Some important command instructions are given below:

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

C1	Jump to second line, position 1
C2	Jump to second line, position 2

Check our LCD interfacing Articles with different Microcontrollers:

- [LCD Interfacing with 8051 Microcontroller](http://circuitdigest.com/microcontroller-projects/lcd-interfacing-with-8051-microcontroller-89s52) (<http://circuitdigest.com/microcontroller-projects/lcd-interfacing-with-8051-microcontroller-89s52>)
- [Interfacing LCD with ATmega32 Microcontroller](http://circuitdigest.com/microcontroller-projects/lcd-interfacing-with-atmega32-avr) (<http://circuitdigest.com/microcontroller-projects/lcd-interfacing-with-atmega32-avr>)
- [LCD Interfacing with PIC Microcontroller](http://circuitdigest.com/microcontroller-projects/16x2-lcd-interfacing-with-pic-microcontroller) (<http://circuitdigest.com/microcontroller-projects/16x2-lcd-interfacing-with-pic-microcontroller>)
- [Interfacing 16x2 LCD with Arduino](http://circuitdigest.com/microcontroller-projects/arduino-lcd-interfacing-tutorial) (<http://circuitdigest.com/microcontroller-projects/arduino-lcd-interfacing-tutorial>)
- [16x2 LCD Interfacing with Raspberry Pi using Python](http://circuitdigest.com/microcontroller-projects/raspberry-pi-lcd-display-tutorial) (<http://circuitdigest.com/microcontroller-projects/raspberry-pi-lcd-display-tutorial>)

## Tags

---

16x2 LCD (/Tags/16x2-Lcd)      Display (/Tags/Display)

Submitted by aparna on Mon, 07/10/2017 - 21:45

Permalink (/comment/16008#comment-16008)

### output of arduino uno r3 (/comment/16008#comment-16008)

In my project i have to connect a relay to digital pins of the arduino uno board. But I couldn't control the relay since the output is 2.18v. Could you please guide me what should i do.

Submitted by Aswinth Raj (/users/aswinth-raj) on Tue, 07/11/2017 - 09:16

Permalink (/comment/16018#comment-16018)

### Use a transistor (/comment/16018#comment-16018)

Hi aparna,

You should not drive the Relay directly from an Arduino I/O pin. If your Relay is a 5V relay you can use the circuit shown in the link below

[https://circuitdigest.com/fullimage?i=circuitdiagram\\_mic/Visitor-Counter-Circuit1.gif](https://circuitdigest.com/fullimage?i=circuitdiagram_mic/Visitor-Counter-Circuit1.gif)

([https://circuitdigest.com/fullimage?i=circuitdiagram\\_mic/Visitor-Counter-Circuit1.gif](https://circuitdigest.com/fullimage?i=circuitdiagram_mic/Visitor-Counter-Circuit1.gif)) (Check the relay driving part alone)

As shown in the circuit if you use a transistor like BC547 and current limiting resistor, you should be able to toggle the relay without any problem.

The reason is that when you trigger a relay directly from Arduino, the current provided by the I/O pin will not be enough and hence there will be a voltage drop (In your case 2.7) on your Arduino pin.

Hence we use the I/O pin to trigger the transistor, which closes the connection between a constant +5V and the relay.

Submitted by Sundar on Tue, 01/16/2018 - 19:40

Permalink ([/comment/22206#comment-22206](#))

## **Solution ([/comment/22206#comment-22206](#))**

Please use the transistor with relay

Submitted by Yuvraj Rathod on Tue, 01/23/2018 - 14:19

Permalink ([/comment/22430#comment-22430](#))

## **datasheet of LCD Display ([/comment/22430#comment-22430](#))**

datasheet of LCD Display

Submitted by Aswinth Raj ([/users/aswinth-raj](#)) on Wed, 01/24/2018 - 19:11

Permalink ([/comment/22515#comment-22515](#))

## **Here is the datasheet ([/comment/22515#comment-22515](#))**

Here is the datasheet

[https://components101.com/sites/default/files/component\\_datasheet/16x2%20LCD%20Datasheet.pdf](https://components101.com/sites/default/files/component_datasheet/16x2%20LCD%20Datasheet.pdf)

([https://components101.com/sites/default/files/component\\_datasheet/16x2%20LCD%20Datasheet.pdf](https://components101.com/sites/default/files/component_datasheet/16x2%20LCD%20Datasheet.pdf))

Submitted by Shaheed Hussain on Tue, 01/30/2018 - 12:56

Permalink ([/comment/22706#comment-22706](#))

## **16X2 character LCD Display unit for replacement of potter panel ([/comment/22706#comment-22706](#))**

Need advise on availability and compatibility . Required 12 unit.

Submitted by Hassan ([/users/hassan-0](#)) on Wed, 06/06/2018 - 23:01

Permalink ([/comment/26938#comment-26938](#))

## **wrong matrix ([/comment/26938#comment-26938](#))**

the hex command 38 is used for making 5x8 dot martix not for 5x7

Submitted by BODI069 (/users/bodi069) on Sun, 01/27/2019 - 17:10

Permalink (/comment/29627#comment-29627)

## How to find out what LCD I have ... (/comment/29627#comment-29627)

Hi

Tank you for your interesting and usefull articel. Question: Is it possible to find out a pinout from an older, used LCD display? I have different, old displays I got out of still working but sorted out electronic gears like server nodes, video recorders , ... , you name it .... Of course, I would like to use them and I asked myself, if it is possible, to find out how the pinout for that devcices is.

Submitted by Aswinth Raj (/users/aswinth-raj) on Wed, 01/30/2019 - 15:46

Permalink (/comment/29644#comment-29644)

## Yes it is possible!! to which (/comment/29644#comment-29644)

Yes it is possible!! to which motor u r trying? providing pics will help

Log in (/user/login?destination=/article/16x2-lcd-display-module-pinout-datasheet%23comment-form) or register (/user/register?destination=/article/16x2-lcd-display-module-pinout-datasheet%23comment-form) to post comments



1555F Series IP68 Wall Mounted Enclosures for Harsh Environments  
(<https://bit.ly/3Z0Rkf8>)

1555F Series enclosures have several innovative features that provide excellent functionality

(<https://bit.ly/3Z0Rkf8>)



**LM-23B Series Enclosed Power Supplies (<https://bit.ly/3ZiLpBV>)**  
15-600W LM Series are High-EMC-performance AC/DC power supplies, with 85-305VAC wide input range

(<https://bit.ly/3ZiLpBV>)

---



**JMR03 Series 3.5 W Medical DC/DC Converters (<https://bit.ly/3KCduA7>)**  
The 4:1 input JMR03 provides 2 x MOPP for BF and CF rated applications with 2µA leakage current.

(<https://bit.ly/3KCduA7>)

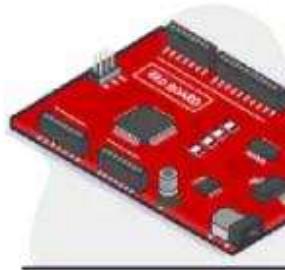
---



**MKP Series Class X2 EMI/RFI Suppression Capacitors (<https://bit.ly/40b3xil>)**  
This makes it easier to implement noise suppression with an optimal footprint and low BOM cost.

(<https://bit.ly/40b3xil>)

---



**Digi-Key products, tools, and resources for innovation (<https://bit.ly/3ZmNmNy>)**  
Digi-Key enables your ideas with products, tools, and resources to fuel your innovation.

(<https://bit.ly/3ZmNmNy>)

---



**Front-End Modules for IoT and Smart Energy (<https://bit.ly/3Y4awrx>)**  
Skyworks' Front-End Modules for IoT and Smart Energy featuring SKY85716-11

(<https://bit.ly/3Y4awrx>)

---



SSM10N954L 12 V Common Drain N-channel MOSFET for Battery

Protection (<https://bit.ly/3DpRK65>)

Toshiba's 12 V low on-resistance common-drain MOSFETs help battery-driven devices

(<https://bit.ly/3DpRK65>)



WR-FAST Fast Connection Solutions (<https://bit.ly/3YWYkcS>)

Würth Elektronik's THT male header is offered in two blade designs for a wide range of applications

(<https://bit.ly/3YWYkcS>)



## Join 100K+ Subscribers

Your email is safe with us, we don't spam.

Type your email address

Subscribe

Be a part of our ever growing community.



Semicon Media is a unique collection of online media, focused purely on the Electronics Community across the globe. With a perfectly blended team of Engineers and Journalists, we demystify electronics and its related technologies by providing high value content to our readers.



 (<https://www.facebook.com/circuitdigest/>)  (<https://twitter.com/CircuitDigest>) 



(<https://twitter.com/CircuitDigest>)



(<https://www.youtube.com/channel/UCy3CUAIYgZdAOG9k3IPdLmw>) 



(<https://www.linkedin.com/company/circuit-digest/>)

## COMPANY

[Privacy Policy \(/privacy-policy\)](#)    [Cookie Policy \(/cookie-policy\)](#)    [Terms of Use \(/terms-of-use\)](#)  
[Contact Us \(/contact\)](#)    [Advertise \(/advertise\)](#)

## PROJECT

- 555 Timer Circuits (/555-timer-circuits)
- Op-amp Circuits (/op-amp-circuits)
- Audio Circuits (/audio-circuits)
- Power Supply Circuits (/smps-power-supply-circuits)
- Arduino Projects (/arduino-projects)
- Raspberry Pi Projects (/simple-raspberry-pi-projects-for-beginners)
- MSP430 Projects (/msp430-projects)
- STM32 Projects (/stm32-projects-and-tutorials)
- ESP8266 Projects (/esp8266-projects)
- PIC Projects (/pic-microcontroller-projects)
- AVR Projects (/avr-microcontroller-projects)
- 8051 Projects (/8051-microcontroller-projects)
- ESP32 Projects (/esp32-projects)
- IoT Projects (/internet-of-things-iot-projects)
- PCB Projects (/diy-pcb-projects)
- Arduino ESP8266 Projects (/arduino-esp8266-projects)
- All Microcontroller Projects (/microcontroller-projects)

## OUR NETWORK



(<https://circuitdigest.com>)



(<https://components101.com>)



(<https://iotdesignpro.com>)

Copyright © 2022 Circuit Digest (/). All rights reserved.