

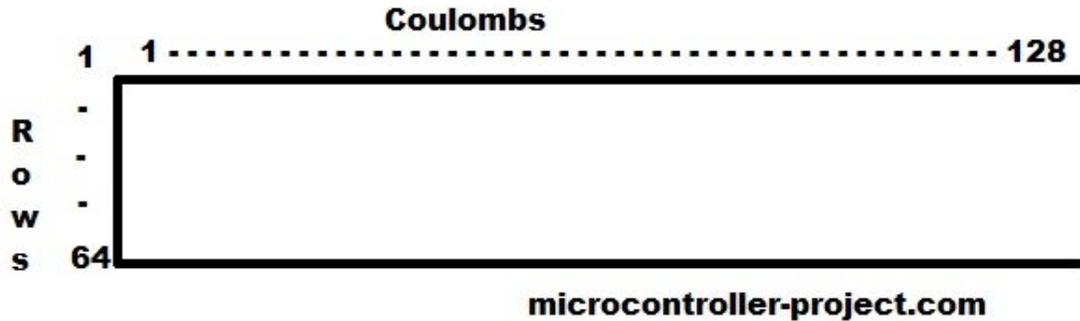
GRAPHICAL LCD

In this tutorial I am going to teach you 128x64 graphical lcd working and about its pin out. There are lot of graphical lcds available in the market. Each perform exactly the same function with some variations. Some are small in size and some bigger. Some are black and white and some multicoloured. Some perform few numbers of operations and some can perform many functions. For example the lcds you see on your mobile phone is different from the one in your car.

DIFFERENCE BETWEEN ORDINARY AND GRAPHICAL LCD

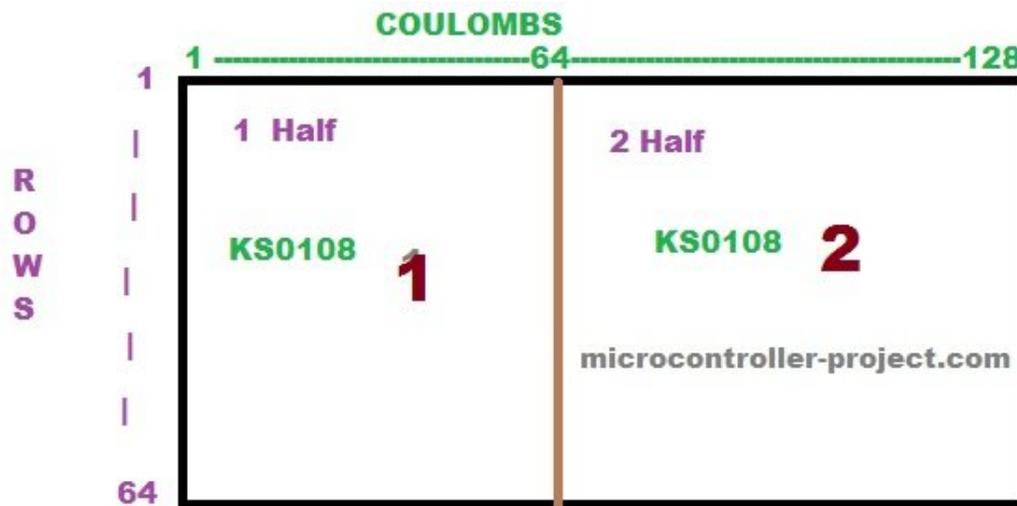
Graphical lcds are different from the ordinary lcds, like 16x1 16x2 16x4 20x1 20x2 etc. They (ordinary) can print only characters or custom made characters. They have a fixed size for displaying a character normally 5x7 or 5x8 matrix. Where as in graphical lcd we have $128 \times 64 = 8192$ dots or $8192 / 8 = 1024$ pixels. We can design a character in a size which we need. More over we can make a picture on a graphical lcd as well.

Normally the graphical lcd which is easily available in the market and is best to start in the field of graphical lcds is 128x64. It has 128 coulombs and 64 rows. You can display your data in 128x64 matrix.

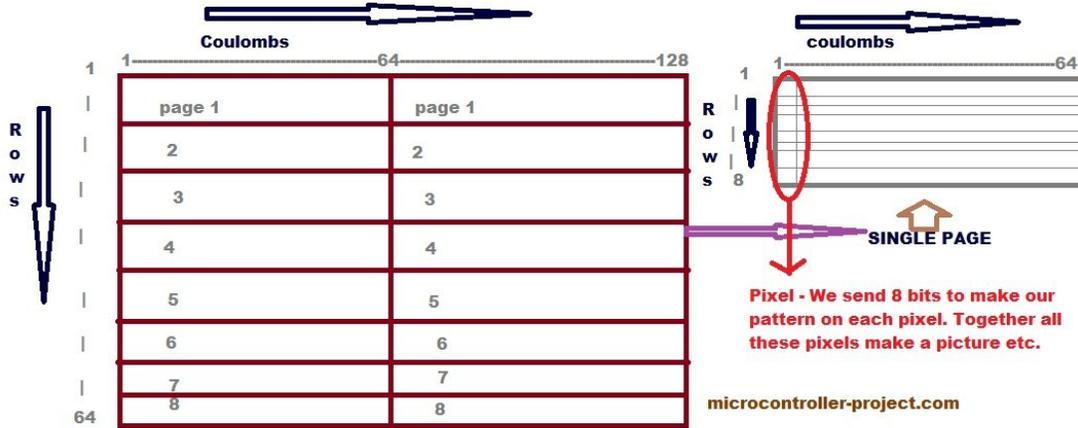


Graphical Lcd is controlled by two KS0108 controllers. A single KS0108 controller is capable of controlling 40 characters or $5 \times 8 = 40$ $40 \times 16 = 640$ $640 \times 2 = 1280$ dots. So for controlling a graphical Lcd we need two KS0108 controllers.

The Lcd is further divided into two equal parts 64×64 64 coulombs and rows. The first half from 1 to 64 coulombs is controlled by the first KS0108 controller. The second KS0108 controls the second half from 64 to 128 coulombs.



Each half is further divided in to 8 pages of equal sizes. Each page size is Rows/8 $64/8=8$ rows $8*64$, 8 rows and 64 coulombs. Each page contains $8*64=512$ dots or $512/8=64$ pixels.



Each page contains 64 pixels. You can create your desired output on these pixels. Each pixel lits when it is 0 and becomes off when it is 1. Each pixel contains 8 dots. Each dot is associated with D0 to D7.

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Graphical lcd pin out.

Pin No.	Symbol	Level	Description
1	VDD	5.0V	Supply voltage for logic and LCD (+)
2	VSS	0V	Ground
3	V0	-	Operating voltage for LCD (variable)
4~11	DB0~DB7	H/L	Data bit 0~7
12	CS2	L	Chip select signal for IC2
13	CS1	L	Chip select signal for IC1
14	/RES	L	Reset signal
15	R/W	H/L	H: read (MUP< — module),L: write (MPU —>module)
16	D/I	H/L	H: data, L: instruction code
17	E	H, H→L	Chip enable signal
18	VEE	-	Operating voltage for LCD (variable)
19	A	5.0V	Backlight power supply
20	K	0V	Backlight power supply

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The pins are same as other lcds. Only two new pins are introduced with the graphical lcd. These are CS1 and CS2. CS1 is chip select 1 it selects the first half or first KS0108 controller of lcd. CS2 is chip select 2 it selects the second half or second KS0108 controller of lcd. Both CS1 and CS2 are active low. By active low I mean for selecting a first or second half made its associated pin (CS1 , CS2)0. All the other pins E (enable) R/W (read/write) RS or D/I (register select) works in the same way like for normal lcds.

Like other lcds we also first have to initialize graphical lcd. By initializing I mean in which format we want to use our lcd. Like which half I want to use. Which page of which half I want to use. What is my x-address? What is my y-address?

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Read Display Data	1	1	Read data								Reads data (DB[7:0]) from display data RAM to the data bus.
Write Display Data	1	0	Write data								Writes data (DB[7:0]) into display data RAM. After writing instruction, Y address is incremented by 1 automatically
Status Read	0	1	Busy	0	ON/OFF	Re-set	0	0	0	0	Reads the internal status BUSY 0: Ready 1: In operation ON/OFF 0: Display ON 1: Display OFF RESET 0: Normal 1: Reset
Set Address (Y address)	0	0	0	1	Y address (0~63)						Sets the Y address in the Y address counter
Set Display Start Line	0	0	1	1	Display start line (0~63)						Indicates the display data RAM displayed at the top of the screen.
Set Address (X address)	0	0	1	0	1	1	1	Page (0~7)			Sets the X address at the X address register.
Display On/off	0	0	0	0	1	1	1	1	1	0/1	Controls the display ON or OFF. The internal status and the DDRAM data is not affected. 0: OFF, 1: ON

Display On/Off

The display data appears when D is 1 and disappears when D is 0. Though the data is not on the screen with D=0, it remains in the display data RAM. Therefore, you can make it appear by changing D=0 into D=1.

Set Address (Y Address)

Y-address is the pixel address. An address is set by instruction and increased by 1 automatically by read or write operations of display data.

Set Page (X Address)

X-address is the page address. X address of the display data RAM is set in the X address register.

Writing or reading to or from MPU (microcontroller) is executed in the specified page until the next page is set.

Write Display Data

Writes data (D0~D7) into the display data RAM. After writing instruction, Y address is increased by 1 automatically.

Read Display Data

Reads data (D0~D7) from the display data RAM. After reading instruction, Y address is increased by 1 automatically.

Display Start Line (Z Address)

Z address (AC0~AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen.