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LCDs MADE SIMPLE®
Ph. 480-503-4295 | NOPP@FocusLCD.com

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LCD Resources:

Color Depth (65k, 262k, 16.7M colors)

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Color depth is the number of colors that can be used for each pixel on the display. This can range from 8-bit color, 16-bit high color to 24-bit true color. The range of color is determined by how many bits of red, green and blue (RGB) each pixel is assigned to the frame buffer.

A pixel's color value is measured in bits-per-pixel or bpp. These colors are then color mapped from the signals in a variety of combinations. Memory, frame buffering, and bandwidth can be trade off's for higher color depth and should be considered when choosing color depth of the display. Below are some typical color depths and their characteristics.

Color Depth *(bpp total)*	**R,G,B *(bpp)***	**No. of Colors**	**Note**
8-bit	(3,3,2)	256	VGA
15/16-bit	(5,5,5) or (5,6,5)	32.7k or 65.5k	High color
18-bit	(6,6,6)	262k	
24-bit	(8,8,8)	16.7M	True Color

A 16-bit color depth know as "High color" can contain 5 red bpp, 6 green bpp, and 5 blue bpp. This is also referred to as RGB-565. Alternatively, the 16-bit color depth can assign RGB-555 with one unused bit. The RGB-565 color depth will result in a range of 65k different colors. $(2^5 + 2^6 + 2^5 = 2^{16} = 65.5k\ colors)$.

These 16-bit RGB values are typically transmitted as hexadecimal values ranging from black RGB (0,0,0) = 0x0000 (no color) to white RGB(1,1,1) = 0xFFFF (all colors) and everything in between. Below are definitions for a variety of 16-bit colors.

Color	**(R, G, B)**	**Frame Buffer Value**	**16-bit Output (Hex)**	**Range (Decimal)**	
White	(1, 1, 1)	7	0xFFFF	65,535	
Yellow	(1, 1, 0)	6	0xFFE0	65,504	
Magenta	(1, 0, 1)	5	0xF81F	63,519	
Red	(1, 0, 0)	4	0xF800	63,488	
Cyan	(0, 1, 1)	3	0x07FF	2047	
Green	(0, 1, 0)	2	0x07E0	2016	
Blue	(0, 0, 1)	1	0x001F	31	
Black	(0, 0, 0)	0	0x0000	0	

The RGB data is stored in the frame buffer which is memory allocated in RAM to periodically refresh the display. Higher color depth (higher bpp) means that more memory will need to be used to display the image. The frame buffer memory needed is the total number of bits or bytes for one frame. This is calculated as pixel area x number of bits/pixel.

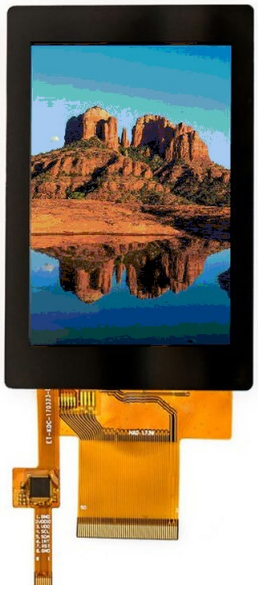
For example: a 240x320 resolution display using 16-bit color will require a minimum of

$$240\ p\ x\ 320\ p\ x\ 16\frac{bits}{p} = 1{,}228{,}800\ bits = 153.6\ kB$$

153.6 kB of memory allocated per frame. This can result in a large portion of memory being used depending on the size of the display and the color depth chosen.

The size of the frame buffer and how often it is refreshed is called the bandwidth. Typically displays will have a refresh rate of 60Hz, this results in a bandwidth of (153.6kB x 60Hz) 9.2 MB/second. Larger displays with higher color depth would need a controller capable of higher speeds and memory storage.

24-bit, RGB888, 16.7M colors



8-bit, RGB3322, 256 colors

The difference in picture quality between 6bpp (262k colors) and 8bpp (16.7M colors) is very minimal as it pertains to visible color range. Unless using the display for very high precision graphics it may be a good option to opt for a lower bpp ratio to conserve memory and optimize the speed of your device.