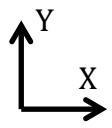# Red/Green LED Matrix – SPI Communication Reference

Display Layout

The display contains 128 pixels – 8 rows of 16. Pixels are addressed as shown below:

0,7	1,7	…											…	14,7	15,7
0,6	1,6	…											…	14,6	15,6
⋮	⋮													⋮	⋮
⋮	⋮													⋮	⋮
0,1	1,1	…											…	14,1	15,1
0,0	1,0	2,0	…										…	14,0	15,0

Y ↑
X →

Colour Values

Each pixel has both a red LED and a green LED which can each be set to a range of intensities allowing a range of green/red/yellow/orange colours to be produced. All colour values are 8 bits, with the upper four bits being the intensity of the green LED at that pixel and the lower four bits being the intensity of the red LED at that pixel:

G3	G2	G1	G0	R3	R2	R1	R0

Green LED intensity   Red LED intensity

Intensities range from 0 (LED off) to 0xF (LED on 100% of the time).

SPI Commands

The first byte in each command is the "command byte" which indicates the type of operation to be performed. The number of data bytes that will follow the command byte depend on the operation and will range from 0 to 128.

Update All Pixels

Send data for the whole screen (128 pixels). Pixel colour is sent from left to right (increasing X) for each row (increasing Y). In other words, pixel data is sent in sequence for (X,Y) addresses (0,0),(1,0), … ,(15,0),(0,1),(1,1), … , (14,7),(15,7).

Byte Number	Contents
1	0x00 (command byte)
2-129	Colour value for each pixel – as described above.

Update One Pixel

Send data for a specific pixel.

Byte Number	Contents
1	0x01 (command byte)
2	Pixel address (binary): 0YYYXXXX Most significant bit is ignored. The next 3 bits are the row number (Y). The least significant 4 bits are the column number (X).
3	Colour value for pixel - as described above.

Update Row
Send data for a whole row (16 pixels).

Byte Number	Contents
1	0x02 (command byte)
2	Row number (binary): 00000YYY The five most significant bits are ignored. The three least significant bits are the row number (Y).
3-18	Colour value for each pixel (left to right, X=0 to X=15) – as described above.

Update Column
Send data for a whole column (8 pixels).

Byte Number	Contents
1	0x03 (command byte)
2	Column number (binary): 0000XXXX The four most significant bits are ignored. The four least significant bits are the column number (X).
3-10	Colour value for each pixel (bottom to top, Y=0 to Y=7) – as described above.

Shift Display
Shift the display by one pixel in a given direction and clear the edge row/column.

Byte Number	Contents
1	0x04 (command byte)
2	Direction byte: 0000UDLR The four most significant bits are ignored. If the U bit is set, then the display will be moved up by one pixel and the bottom row will be cleared. If the D bit is set (and the U bit is not set), then the display will be moved down by one pixel and the top row will be cleared. If the L bit is set, then the display will be moved left by one pixel and the right edge column will be cleared. If the R bit is set (and the L bit is not set) then the display will be moved right by one pixel and the left edge column will be cleared. (It is possible to move diagonally by setting one of U/D and one of L/R.)

Clear Screen
Turn each pixel off.

Byte Number	Contents
1	0x0F (command byte)

Show test pattern
Shows a test pattern of colours with red pixel intensity increasing from left to right (increasing X) and green pixel intensity increasing from top to bottom (increasing Y).

Byte Number	Contents
1	0x10 (command byte)

Demo mode
Shows the reset state – a scrolling colour pattern with the matrix version number shown.

Byte Number	Contents
1	0x11 (command byte)

Clock Speed

The LED display matrix will accept and process all SPI commands at an SPI clock speed of 62.5kHz (i.e. 8MHz / 128). If data is sent continuously at a rate faster than this, then there is a chance the LED matrix SPI buffer will overflow. Short bursts of data can be sent at a faster rate (up to a 2MHz clock speed) provided the buffer (200 bytes) does not overflow.

Errors

The LED matrix will display "Err" if a communication error occurs. The colour of the text gives an indication of the cause:

Error message colour	Cause
Red	SPI Data Buffer overflow. Data was sent faster than the matrix could handle it and the buffer (200 bytes) overflowed.
Green	Timeout. A multi-byte command was incomplete. The timeout error occurs 250ms after the last byte was received.
Yellow	Invalid command. The first (command) byte was not one of the valid values specified above.
Orange	SPI Write collision flag set on LED matrix. Should never occur.