

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

## DESCRIPTION

The IS31FL3743B is a general purpose 18xn (n=1~11) LED Matrix programmed via 12MHz SPI interface. Each LED can be dimmed individually with 8-bit PWM data and 8-bit DC scaling data which allowing 256 steps of linear PWM dimming and 256 steps of DC current adjustable level.

Additionally each LED open state can be detected, IS31FL3743B store the open information in Open-Registers. The Open Registers allowing MCU to read out via SPI, inform MCU whether there are LEDs open or short LEDs.

## FEATURES

- Supply voltage range: 2.7V to 5.5V
- 18 current sinks (Maximum)
- Support 18xn (n=1~11) LED matrix configurations
- Individual 256 PWM control steps
- Individual 256 DC current steps
- Global 256 DC current steps
- SDB rising edge reset SPI module
- 24kHz PWM frequency
- 12MHz SPI interface
- State lookup registers
- Individual open and short error detect function
- 180 degree phase delay operation to reduce power noise
- De-Ghost
- Cascade for synchronization of chips
- UQFN-40 (5mmx5mm) package

## QUICK START



Figure 1: Photo of IS31FL3743B Evaluation Board

## RECOMMENDED EQUIPMENT

- 5.0V, 2A power supply

## ABSOLUTE MAXIMUM RATINGS

- ≤ 5.5V power supply

**Caution:** Do not exceed the conditions listed above, otherwise the board will be damaged.

## PROCEDURE

The IS31FL3743B evaluation board is fully assembled and tested. Follow the steps listed below to verify board operation.

**Caution:** Do not turn on the power supply until all connections are completed.

- 1) Short JP1 to enable the control of board MCU (default status).
- 2) Connect the 5VDC power to VCC/GND of CON4, or plug in the USB power input to micro-USB.
- 3) Turn on the power supply, pay attention to the supply current. If the current exceeds 1A, please check for circuit fault.

## EVALUATION BOARD OPERATION

The IS31FL3743B evaluation board has five display modes. Press K1 to switch configurations:

**Note:** See Appendix for each mode's detail.

- 1) (Default mode) Rainbow #1.
- 2) Rainbow #2.
- 3) Purple breath.
- 4) Change colors.
- 5) White.

**Note:** IS31FL3743B solely controls the FxLED function on the evaluation board.

## ORDERING INFORMATION

| Part No.             | Temperature Range           | Package            |
|----------------------|-----------------------------|--------------------|
| IS31FL3743B-QULS4-EB | -40°C to +125°C, Industrial | UQFN-40, Lead-free |

Table 1: Ordering Information

For pricing, delivery, and ordering information, please contacts Lumissil's analog marketing team at [analog@Lumissil.com](mailto:analog@Lumissil.com) or (408) 969-6600.

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

## SOFTWARE SUPPORT

JP1 default setting is close circuit. If it is set to open, the on-board MCU will stop working. The SPI pins and SDB pin are set to High Impedance. External SPI and SDB signals can be connected to TP4 to control the IS31FL3743B LED driver.

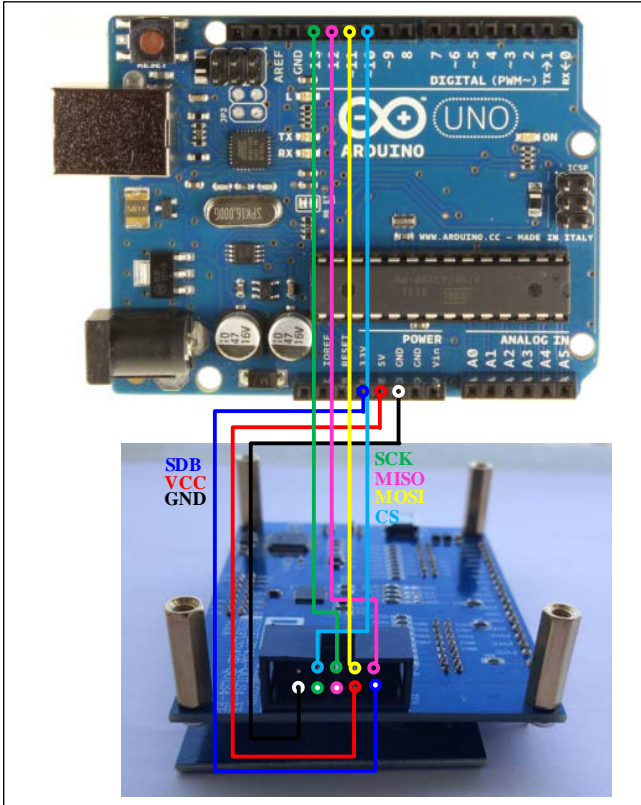


Figure 2: Photo of Arduino UNO connected to Evaluation Board

The steps listed below are an example using the Arduino for external control.

The Arduino hardware consists of an Atmel microcontroller with a bootloader allowing quick firmware updates. First download the latest Arduino Integrated Development Environment IDE (1.6.12 or greater) from [www.arduino.cc/en/Main/Software](http://www.arduino.cc/en/Main/Software). Also download the Wire.h library from [www.arduino.cc/en/reference/wire](http://www.arduino.cc/en/reference/wire) and verify that pgmspace.h is in the directory ...program Files(x86)/Arduino/hardware/tools/avr/avr/include/avr/. Then download the latest IS31FL3743B test firmware (sketch) from the Lumissil website <http://www.lumissil.com/products/led-driver/fxled>.

- 1) Check if the interface selection resistors are replaced to 4.7kΩ resistors on MISO/ CS/ SCK/ MOSI position. If these resistors is 0R, ext-control will fail due to Arduino is 5V power rail while IS31FL3743B is 3V power rail.
- 2) Open JP1.
- 3) Connect the 7 pins from Arduino board to IS31FL3743B EVB:
  - a) Arduino 5V pin to IS31FL3743B EVB VCC.
  - b) Arduino GND to IS31FL3743B EVB GND.
  - c) Arduino 3.3V pin to IS31FL3743B EVB SDB.
  - d) Arduino SCK (13) to IS31FL3743B EVB SCK.
  - e) Arduino MISO (12) to IS31FL3743B EVB MISO.
  - f) Arduino MOSI (11) to IS31FL3743B EVB MOSI.
  - g) Arduino SS (10) to IS31FL3743B EVB CS.
  - h) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3743B EVB SDB, if Arduino use 5.0V MCU VCC, connect 5.0V to EVB SDB.  
(Arduino UNO is 5.0V, so SDB=5.0V)
- 4) Use the test code in appendix I or download the test firmware (sketch) from the Lumissil website, a .txt file and copy the code to Arduino IDE, compile and upload to Arduino.
- 5) Run the Arduino code and the initial mode will change the RGB LED colors.

**Please refer to the datasheet to get more information about IS31FL3743B.**

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

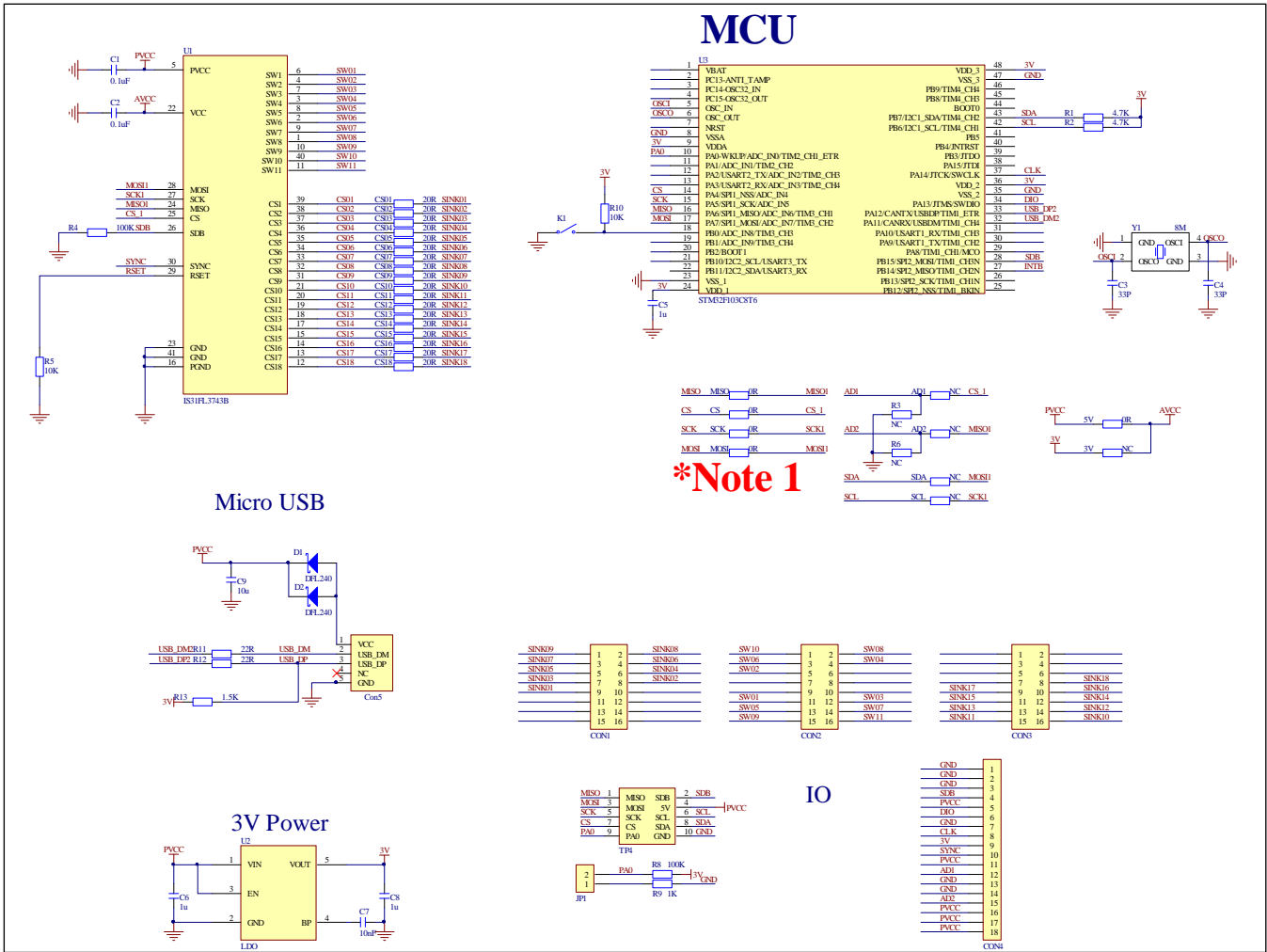


Figure 3: IS31FL3743B Application Schematic

Note 1: IS31FL3743B use SPI interface and MISO, CS, SCK, MOSI position need to short by 0R resistors. In order to use the Arduino for external control, MISO, CS, SCK, MOSI positions are changed by 4.7k resistors.

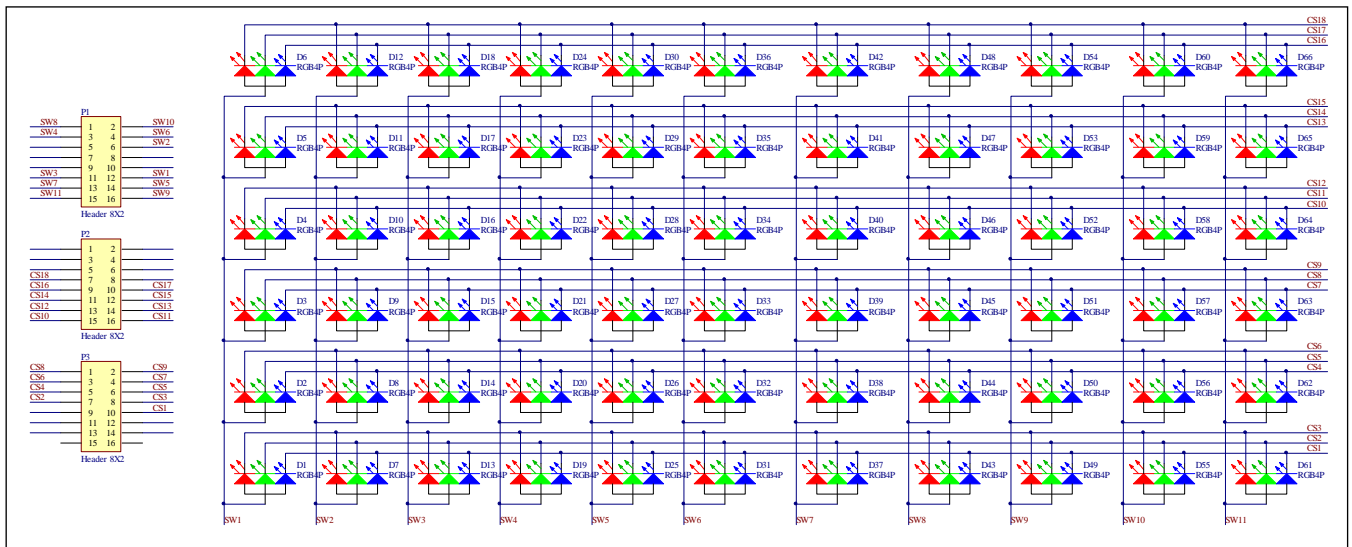


Figure 4: FxLED 6x11 ARRAY Application Schematic

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

## BILL OF MATERIALS

### IS31FL3743B

| Name       | Symbol  | Description                        | Qty | Supplier | Part No.          |
|------------|---|------------------------------------|-----|----------|-------------------|
| LED Driver | U1  | Matrix LED Driver                  | 1   | Lumissil | IS31FL3743B       |
| LDO        | U2  | Reduced voltage                    | 1   | SGMICRO  | SGM2019-3.3V      |
| MCU        | U3  | Microcontroller                    | 1   | STM      | STM32F103C8T6     |
| Diode      | D1,D2   | Diode, SMD                         | 2   | DIODES   | DFLS240           |
| Crystal    | Y1  | Crystal, 8MHz                      | 1   | JB       | HC-49S            |
| Resistor   | R1,R2   | RES,4.7k,1/10W,±5%,SMD             | 2   | Yageo    | RC0603JR-074K7L   |
| Resistor   | R4,R8   | RES,100k,1/10W,±5%,SMD             | 2   | Yageo    | RC0603JR-07100KL  |
| Resistor   | R5,R10  | RES,10k,1/10W,±5%,SMD              | 2   | Yageo    | RC0603JR-0710KL   |
| Resistor   | R9  | RES,1k,1/10W,±5%,SMD               | 1   | Yageo    | RC0603JR-071KL    |
| Resistor   | R11,R12   | RES,22R,1/10W,±5%,SMD              | 2   | Yageo    | RC0603JR-0722RL   |
| Resistor   | R13   | RES,1.5k,1/10W,±5%,SMD             | 1   | Yageo    | RC0603JR-071K5L   |
| Resistor   | MISO,CS,SCK,<br>MOSI,3V   | RES,4.7k,1/10W,±5%,SMD<br>(Note 2) | 2   | Yageo    | RC0603JR-074K7L   |
| Resistor   | CS01,CS02,C<br>S04,CS05,CS0<br>7,CS08,CS10,<br>CS11,CS13,CS<br>14,CS16,CS17 | RES,20R,1/10W,±5%,SMD              | 12  | Yageo    | RC0603JR-0720RL   |
| Resistor   | CS03,CS06,C<br>S09,CS12,CS1<br>5,CS18                                       | RES,20R,1/10W,±5%,SMD<br>(Note 3)  | 6   | Yageo    | RC0603JR-0720RL   |
| Capacitor  | C1,C2   | CAP,100nF,16V,±20%,SMD             | 2   | Yageo    | CC0603MRX7R7BB104 |
| Capacitor  | C3,C4   | CAP,33pF,50V,±5%,SMD               | 2   | Yageo    | CQ0603JRNPO9BN330 |
| Capacitor  | C5,C6,C8  | CAP,1µF,16V,±10%,SMD               | 3   | Yageo    | CC0603KRX7R7BB105 |
| Capacitor  | C7  | CAP,10nF,16V,±10%,SMD              | 1   | Yageo    | CC0603KRX7R7BB103 |
| Capacitor  | C9  | CAP,10µF,16V,±20%,SMD              | 1   | Yageo    | CC0603MRX5R7BB106 |
| Button     | K1  | Button SMD                         | 1   |          |                   |

Bill of Materials, refer to Figure 3 above.

### FxLED 6x11 ARRAY

| Name  | Symbol | Description  | Qty | Supplier  | Part No.             |
|-------|--------|--------------|-----|-----------|----------------------|
| Diode | D1~D66 | RGB LED, SMD | 66  | Everlight | 9-237/R6GHBHC-A01/2T |

Bill of Materials, refer to Figure 4 above.

**Note 2:** IS31FL3743B use SPI interface and MISO, CS, SCK, MOSI position need to short by 0R resistors. In order to use the Arduino for external control, MISO, CS, SCK, MOSI positions are changed by 4.7kΩ resistors.

**Note 3:** The value of these resistors on the evaluation board is 20Ω. For  $PV_{CC}=5V$  and red LED application, prefer 51Ω for these resistors as shown in datasheet Figure 1.

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

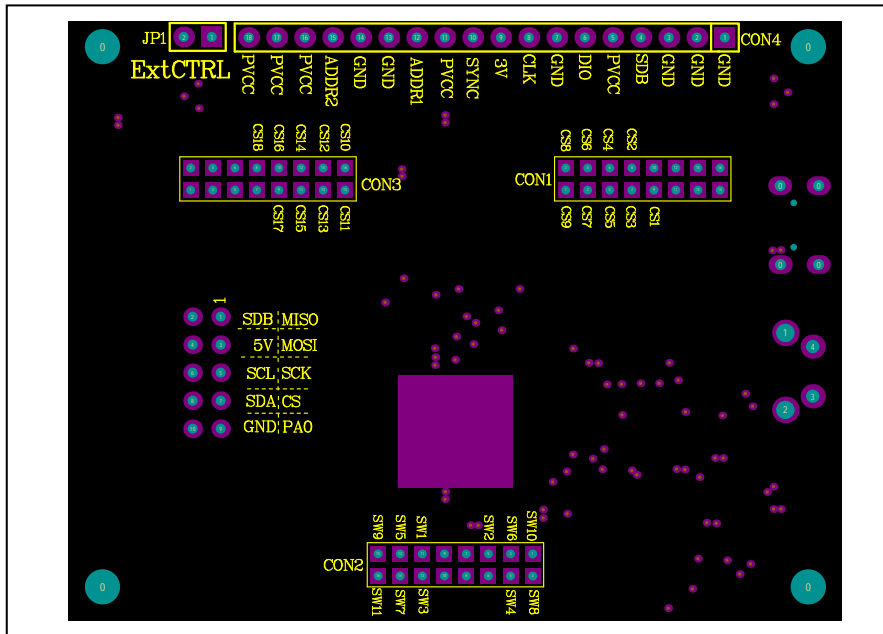


Figure 5: Board Component Placement Guide - Top Layer

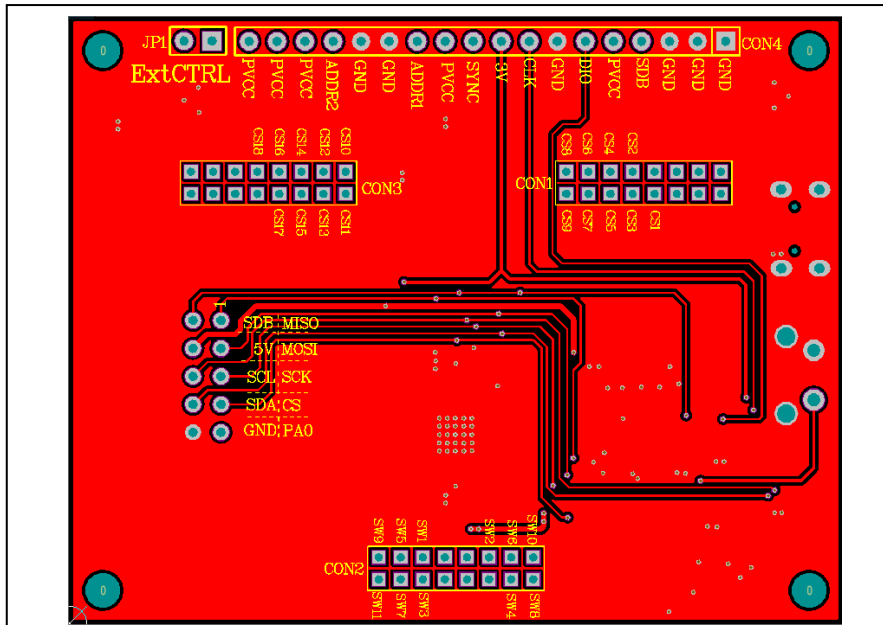


Figure 6: Board PCB Layout - Top Layer

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

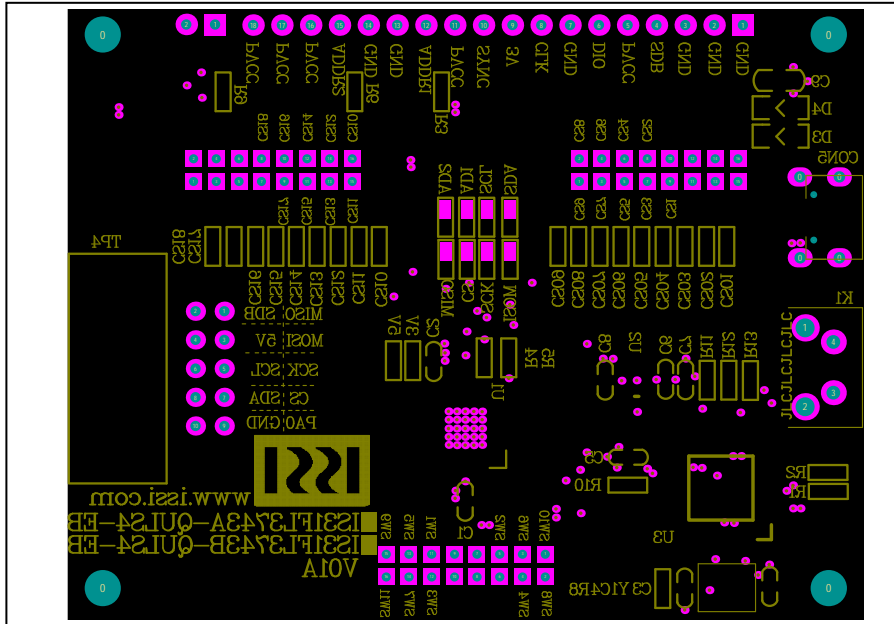


Figure 7: Board Component Placement Guide - Bottom Layer

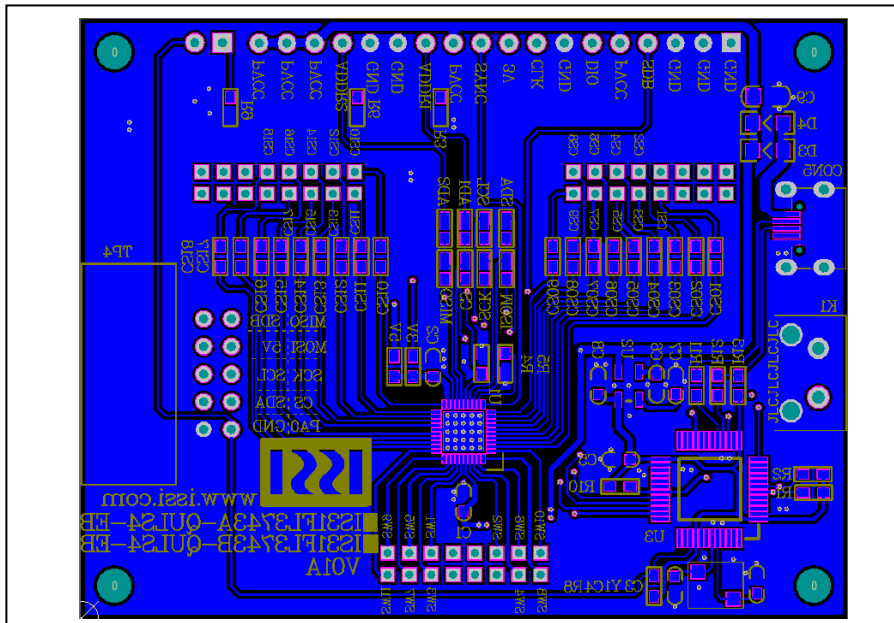
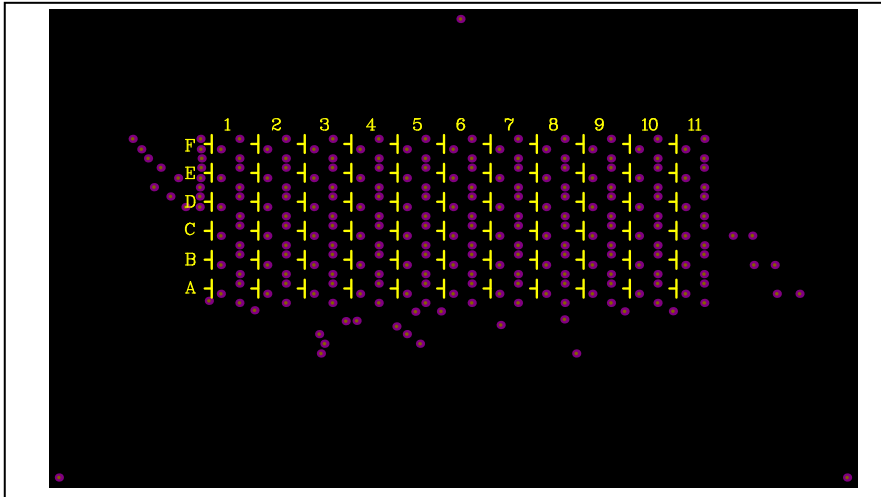
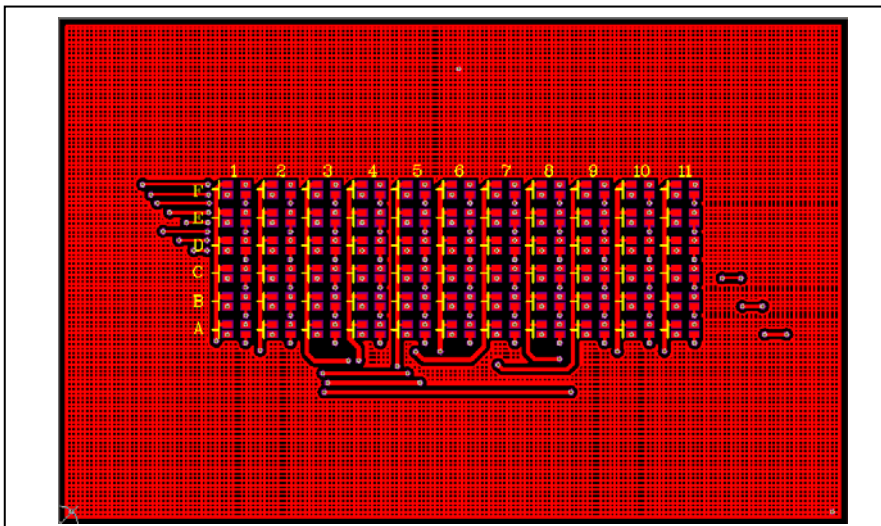


Figure 8: Board PCB Layout - Bottom Layer

**18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI**



*Figure 9: Board Component Placement Guide - Top Layer*



*Figure 10: Board PCB Layout - Top Layer*

# 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

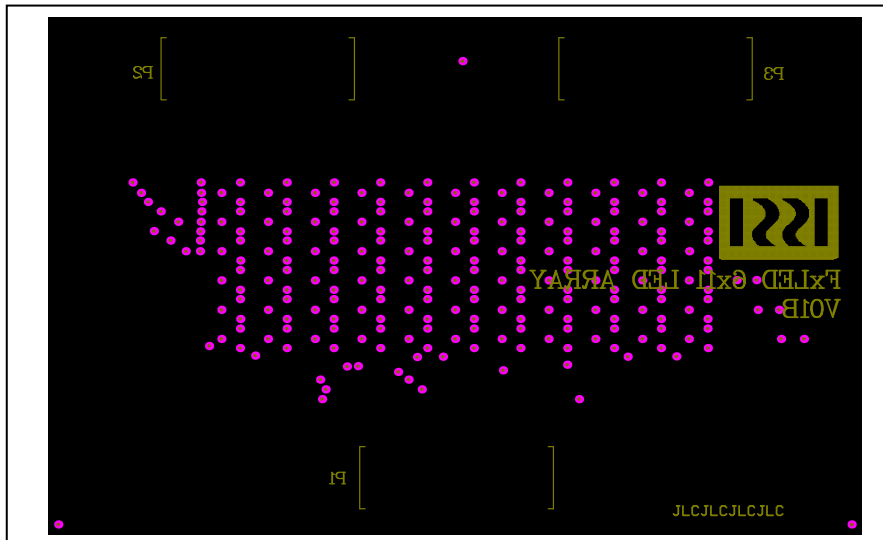


Figure 11: Board Component Placement Guide - Top Layer

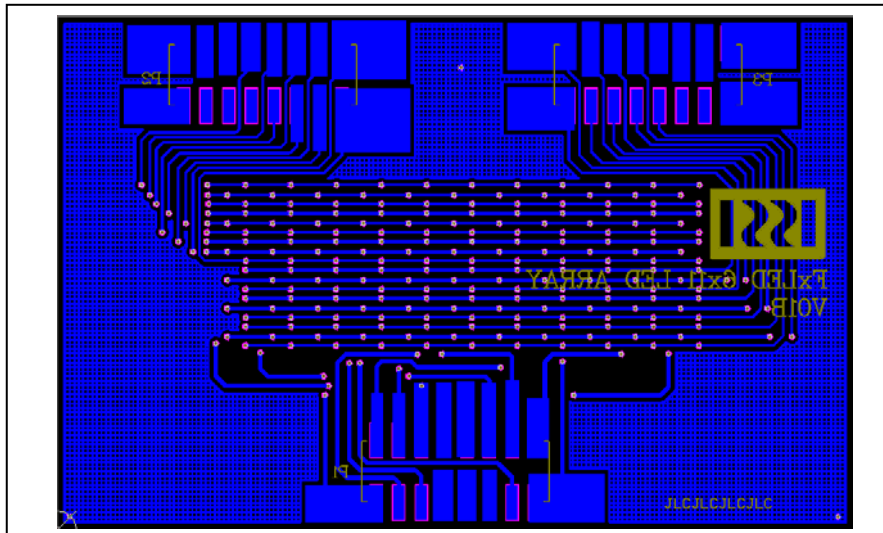


Figure 12: Board PCB Layout - Top Layer

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**18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI**

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**REVISION HISTORY**

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| Revision | Detail Information | Date       |
|----------|--------------------|------------|
| A        | Initial release    | 2018.08.14 |

## APPENDIX I : IS31FL3743B Arduino Test Code V01A

```
#include<SPI.h>
#include<avr/pgmspace.h>

#define Addr_Write_Page0 0x50
#define Addr_Write_Page1 0x51
#define Addr_Write_Page2 0x52
const int slaveSelectPin = 10;

byte PWM_Gamma64[64]=
{
  0x00,0x01,0x02,0x03,0x04,0x05,0x06,0x07,
  0x08,0x09,0x0b,0x0d,0x0f,0x11,0x13,0x16,
  0x1a,0x1c,0x1d,0x1f,0x22,0x25,0x28,0x2e,
  0x34,0x38,0x3c,0x40,0x44,0x48,0x4b,0x4f,
  0x55,0x5a,0x5f,0x64,0x69,0x6d,0x72,0x77,
  0x7d,0x80,0x88,0x8d,0x94,0x9a,0xa0,0xa7,
  0xac,0xb0,0xb9,0xbf,0xc6,0xcb,0xcf,0xd6,
  0xe1,0xe9,0xed,0xf1,0xf6,0xfa,0xfe,0xff
};

void setup()
{
  // put your setup code here, to run once:
  // set the slaveSelectPin as an output:
  pinMode (slaveSelectPin, OUTPUT);
  // initialize SPI:
  SPI.begin();
  SPI.beginTransaction(SPISettings(20000000, MSBFIRST, SPI_MODE0));
  //SPI.setClockDivider(SPI_CLOCK_DIV4);
  SPI.setDataMode(3);
}

void loop() {
  // put your main code here, to run repeatedly:
  mainloop();
}

void SPI_WriteByte(uint8_t Dev_Add,uint8_t Reg_Add,uint8_t Reg_Dat) //writing an LED register
{
  digitalWrite(slaveSelectPin, LOW); // take the SS pin low to select the chip:
  SPI.transfer(Dev_Add); // send in the address and value via SPI:
  SPI.transfer(Reg_Add);
  SPI.transfer(Reg_Dat);
  digitalWrite(slaveSelectPin, HIGH); // take the SS pin high to de-select the chip:
}

uint8_t SPI_ReadByte(uint8_t address)
{
  digitalWrite(slaveSelectPin,LOW);
  SPI.transfer(0x05);
  SPI.transfer(address);
  uint8_t result = SPI.transfer(0x00);
  digitalWrite(slaveSelectPin, HIGH);
  return result;
}

void Init3743B(void)
{
  int i,j;
  for(i=0;i<0xC7;i++)
  {
    SPI_WriteByte(Addr_Write_Page0,i,0);//PWM
  }

  for(i=1;i<0xC7;i++)
  {
    SPI_WriteByte(Addr_Write_Page1,i,0xff);//scaling
  }

  SPI_WriteByte(Addr_Write_Page2,0x02,0x70);
  SPI_WriteByte(Addr_Write_Page2,0x01,0xFF);//GCC
  SPI_WriteByte(Addr_Write_Page2,0x00,0x01);//
}

```

## 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

```

void mainloop(void)//
{
  int i,j;
  Init3743B();
  // digitalWrite(0, LOW); // turn the ARDUINO BOARD LED on (HIGH is the voltage level)
  while(1)
  {
    for(j=0;j<64;j++)//BLUE
    {
      for(i=1;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=63;j>=0;j--)
    {
      for(i=1;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);
    for(j=0;j<64;j++)//GREEN
    {
      for(i=2;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=63;j>=0;j--)
    {
      for(i=2;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=0;j<64;j++)//RED
    {
      for(i=3;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=63;j>=0;j--)
    {
      for(i=3;i<0xC7;i=i+3)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=0;j<64;j++)//WHITE
    {
      for(i=1;i<0xC7;i++)
      {
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]);//PWM}
      }
    }
    delay(500);

    for(j=63;j>=0;j--)
    {
      for(i=1;i<0xC7;i++)
      {

```

## 18x11 DOTS MATRIX LED DRIVER WITH 12MHZ SPI

---

```
        SPI_WriteByte(Addr_Write_Page0,i,PWM_Gamma64[j]); //PWM}
    }
}
delay(500);
}
```