IS31FL3731 AUDIO MODULATED MATRIX LED DRIVER EVALUATION BOARD GUIDE

DESCRIPTION

The IS31FL3731 is a compact LED driver for 144 single LEDs. The device can be programmed via an I2C compatible interface. The IS31FL3731 offers two blocks each driving 72 LEDs with 1/9 cycle rate. The required lines to drive all 144 LEDs are reduced to 18 by using the cross-plexing feature optimizing space on the PCB. Additionally each of the 144 LEDs can be dimmed individually with 8-bit allowing 256 steps of linear dimming.

To reduce CPU usage up to 8 frames can be stored with individual time delays between frames to play small animations automatically. LED frames can be modulated with audio signal.

FEATURES

- Supply voltage range from 2.7V to 5.5V
- 8 frames memory for animations
- Picture mode and animation mode
- Auto intensity breathing during the switching of different frames
- LED frames displayed can be modulated with audio signal intensity
- LED light intensity can be modulated with audio signal intensity
- QFN-28 (4mm × 4mm) and SSOP-28 package

QUICK START

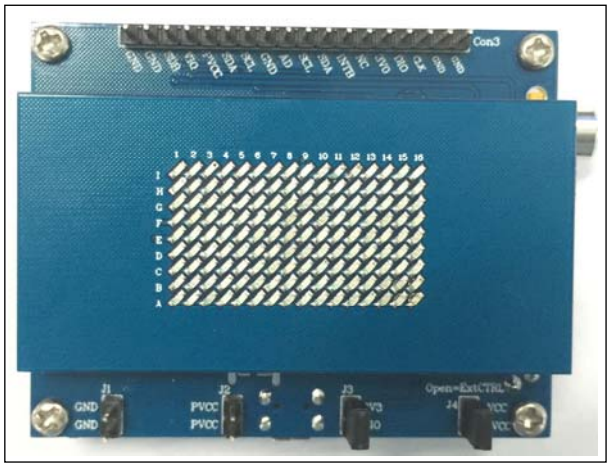

Figure 1: Photo of IS31FL3731 Evaluation Board

(***Note: Old version EVB please refer to Appendix I***)

RECOMMENDED EQUIPMENT

- 5.0V, 2A power supply
- Audio source(i.e. MP3 player, Notebook PC, etc)
- 8Ω speaker

ABSOLUTE MAXIMUM RATINGS

- ≤ 5.5V power supply

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

PROCEDURE

The IS31FL3731 evaluation board is fully assembled and tested. Follow the steps listed below to verify board operation. If don't want to check the audio function, skip 1) 2) 7) 8), but the audio modes you will see only a few LEDs turned on.

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

1) Connect an 8Ω speaker to the "SPK" connector.
2) Connect the audio source to the "AUDIO IN" connector.
3) Short J3 to connect 3VO and VIO.
4) Short J4 to connect PVCC and U1VCC.
5) Connect the 5VDC power to the connector (J1&J2).
6) Turn on the power supply/Plug in the Micro USB and pay attention to the supply current. If the current exceeds 1A, please check for circuit fault.
7) Turn on the audio signal.
8) Modulation of the audio signal utilized to obtain better sound output performance

ORDERING INFORMATION

Part No.	Temperature Range	Package
IS31FL3731-QFLS2-EB	-40°C to +85°C (Industrial)	QFN-28, Lead-free

Table 1: Ordering Information

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

EVALUATION BOARD OPERATION

The IS31FL3731 evaluation board has three animation display modes. Press K1 to switch configurations.

1) Firework animation
2) Lighting animation
3) Power-on animation
4) All on with full brightness
   Below modes maybe omitted in some early EVB we make:
5) Water drop animation
6) Static graphics breathe dimming effect
7) Triangular music bar effect: more triangular music bars are displayed with stronger music.
8) Equalizer bar effect: EQ bars move up and down with music.
9) Multiple graphics display: different graphics change with music rhythm.

Note: IS31FL3731 solely controls the FxLED function on the evaluation board.

EXTERNAL SOFTWARE CONTROL

J4 default setting is closed (short). If it is set to open, the U1 (LDO) will stop working and all the 3V, including the supply of MCU will be cut off, all the MCU's IO will be high impedance (open-drain) and external control is allowed.

The IS31FL3731 can set its I2C bus interface logic threshold based on the voltage on the VIO pin. An external VIO voltage in the range of $1.8V \le V_{IO} \le V_{CC}$ can be applied after removing (open) the J4 jumper.

The board comes with J4 default setting closed (short). If it is set to open, the user can connect an external VIO voltage supply, the external VIO voltage is recommended to equal to ex-IIC's high logic.

Follow the steps listed below for external control.

1) Open J4 to disconnect the power of U1, disable the 3V0 (3.0V).
2) Open J3 to disconnect the VIO to 3V0, and connect an external MCU VCC to VIO.
3) Pull-up the SDB to VIO.
4) Connect the 5VDC power to the connector (J1&J2).
5) Turn on the power supply/Plug in the Micro USB
   Pay attention to the supply current. If the current exceeds 1A, please check for circuit fault.
6) Start external IIC control.

Caution: If J4 is closed (shorted), user can't connect the user's MCU VCC to VIO directly, otherwise the user's MCU (maybe 1.8V) will connect to evaluation bard's VIO (3.0V) and maybe damaged.

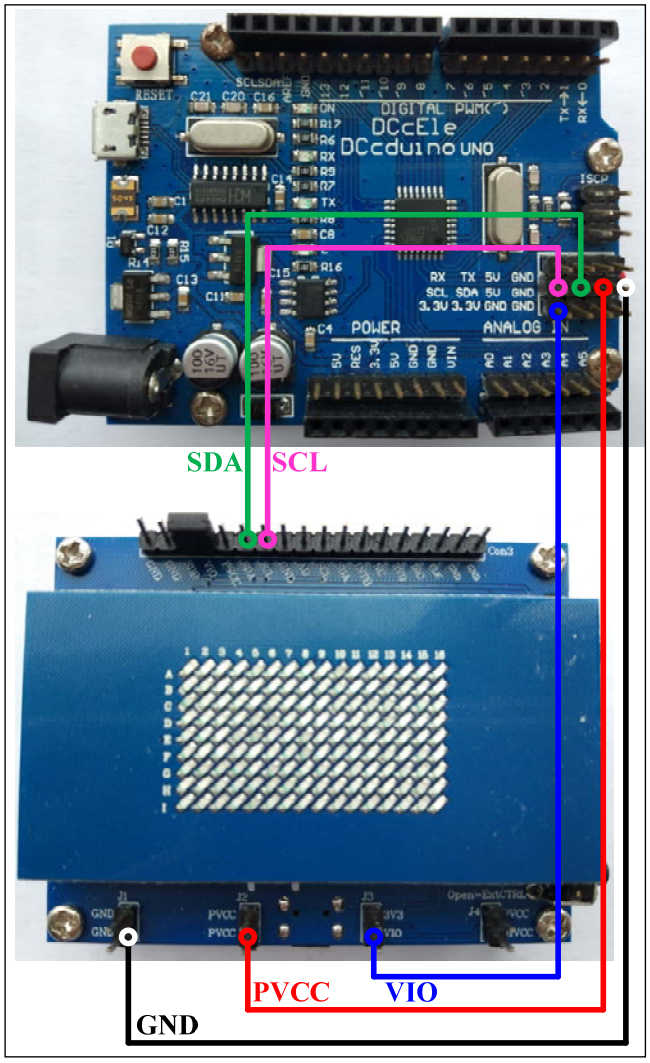

Figure 2: Photo of Arduino connect to Evaluation Board

Follow the steps listed below for external Arduino 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. Then download the latest IS31FL3731 test firmware (sketch) from the Lumissil website http://www.lumissil.com/products/led-driver/fxled.

1) Open J4 and J3.
2) Pull-up or short the SDB of Con3 to VIO (Use the jumper cap from J3 or J4).
3) Connect the 5 pins from Arduino board to IS31FL3731 EVB:
   a) Arduino VCC5V to IS31FL3731 EVB PVCC (Con3 or J2).
   b) Arduino GND to IS31FL3731 EVB GND (Con3 or J1).
   c) Arduino SDA to IS31FL3731 EVB SDA.
   d) Arduino SCL to IS31FL3731 EVB SCL.
   e) If Arduino use 3.3V MCU VCC, connect

3.3V to IS31FL3731 EVB VIO, if Arduino use 5.0V MCU VCC, connect 5.0V to EVB VIO.

(Arduino UNO is 3.3V, so VIO=3.3V)

4) Use the test code in appendix II or Download the test firmware (sketch) form Lumissil website, a .txt file and copy the code to Arduino IDE and download to Arduino.
5) Run the Arduino code and initial mode all the EVB LED keep ramping up and down.
6) Default 31FL3731 device address is 0xE8 (AD=LOW), if user want to change the device address, use the AD in Con3
   a) AD=VIO or PVCC, device address=0xEE.
   b) AD=SCL, device address=0xEA.
   c) AD=SDA, device address=0xEC.

Please refer to the datasheet to get more information about IS31FL3731.

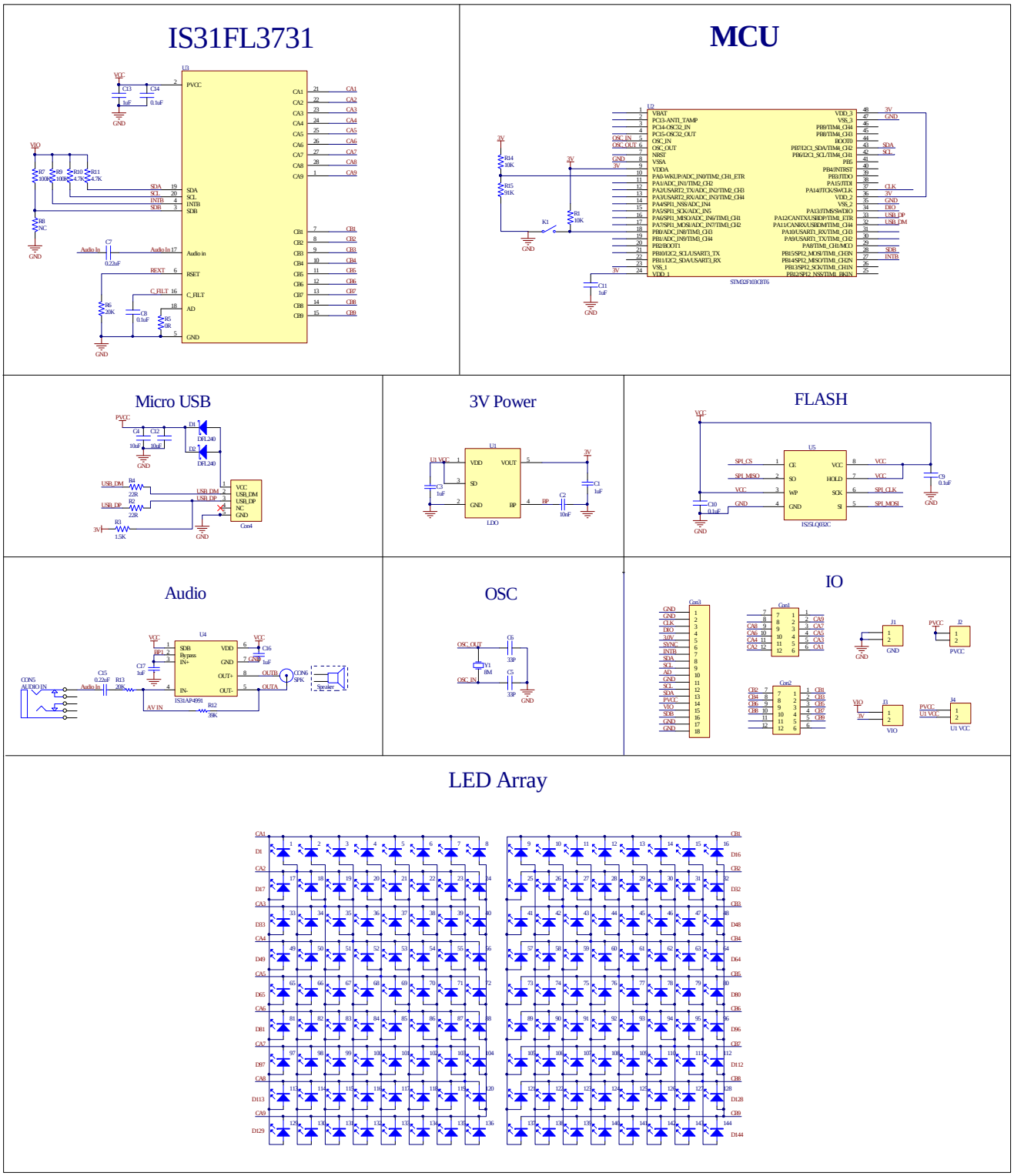

Figure 3: IS31FL3731 Application Schematic

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
LDO	U1	Reduced voltage	1	SGMICRO	
MCU	U2	Microcontroller	1	STM	STM32F103C8T6
LED Driver	U3	Matrix LED Driver	1	Lumissil	IS31FL3731
AMP	U4	Audio Amplifier	1	Lumissil	IS31AP4991
Diode	LD1~LD144	Blue LED, SMD	144	Everlight	9-217/BHC-ZL1M2RY/3T
Diode	D1,D2	Diode, SMD	2	DIODES	DFLS240
Crystal	Y1	Crystal, 8MHz	1	JB	HC-49S
Resistor	R7,R9	RES,100k,1/16W,±5%,SMD	2	Yageo	RC0603JR-07100KL
Resistor	R2,R4	RES,22R,1/16W,±5%,SMD	2	Yageo	RC0603JR-0722RL
Resistor	R3	RES,1.5k,1/16W,±5%,SMD	1	Yageo	RC0603JR-071K5L
Resistor	R6,R13	RES,20k,1/16W,±5%,SMD	1	Yageo	RC0603JR-0720KL
Resistor	R12	RES,39k,1/16W,±5%,SMD	1	Yageo	RC0603JR-0720KL
Resistor	R10,R11	RES,4.7k,1/16W,±5%,SMD	2	Yageo	RC0603JR-0701KL
Resistor	R1,R14	RES,10k,1/16W,±5%,SMD	1	Yageo	RC0603JR-0710KL
Resistor	R15	RES,91k,1/16W,±5%,SMD	1	Yageo	RC0603JR-0791KL
Resistor	R5	RES,0R,1/16W,±5%,SMD	1	Yageo	RC0603JR-0791KL
Resistor	R8	NC	1		
Capacitor	C1,C3,C11 C13,C16,C17	CAP,1μF,16V,±20%,SMD	6	Yageo	CC0603KKX7R9BB105
Capacitor	C2	CAP,10pF,16V,±20%,SMD	1	Yageo	CC0603KKX7R9BB100
Capacitor	C4,12	CAP,10μF,16V,±20%,SMD	2	Yageo	CC0603KKX7R9BB106
Capacitor	C5,C6	CAP,33pF,16V,±20%,SMD	2	Yageo	CC0603KKX7R9BB330
Capacitor	C7,C15	CAP,0.22μF,16V,±20%,SMD	2	Yageo	CC0603KKX7R9BB330
Capacitor	C8,C9,C10,C14	CAP,0.1μF,16V,±20%,SMD	4	Yageo	CC0603KKX7R9BB104
Button	K1	Button SMD	1		

Bill of Materials, refer to Figure 3 above.

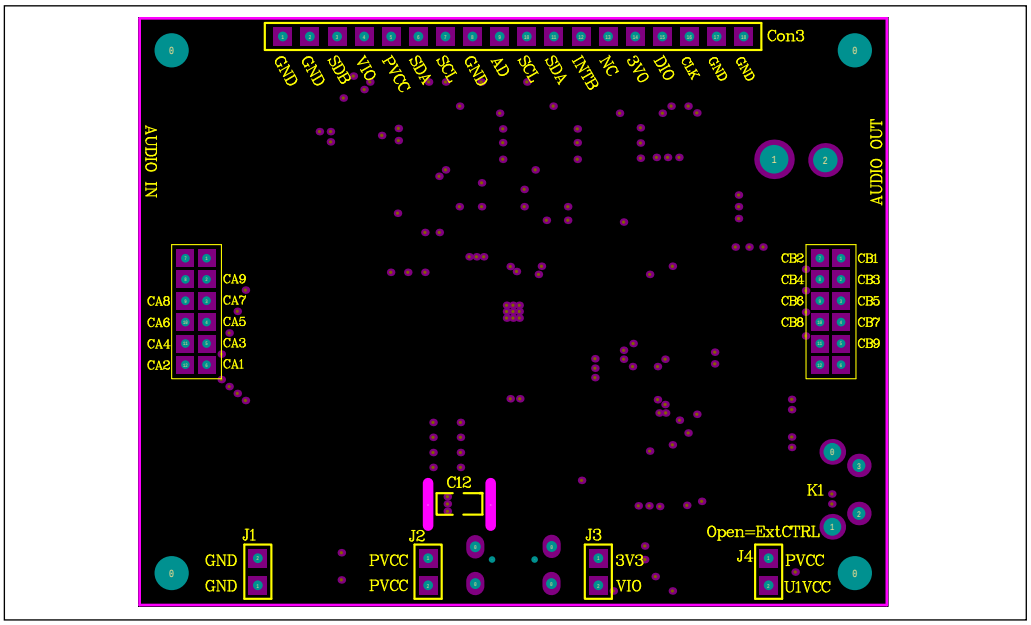

Figure 4: Board Component Placement Guide - Top Layer

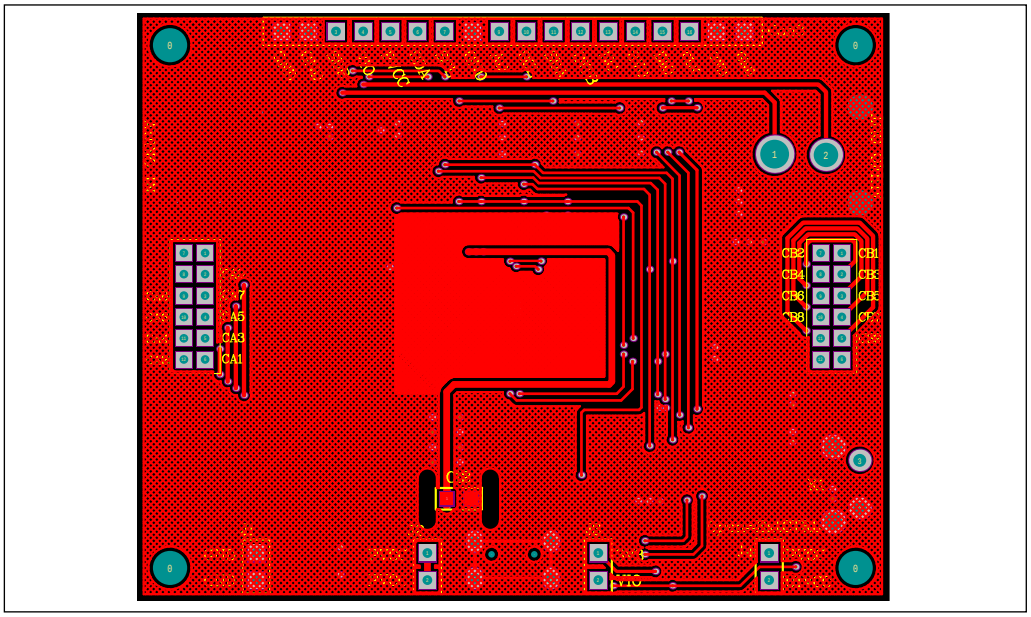

Figure 5: Board PCB Layout - Top Layer

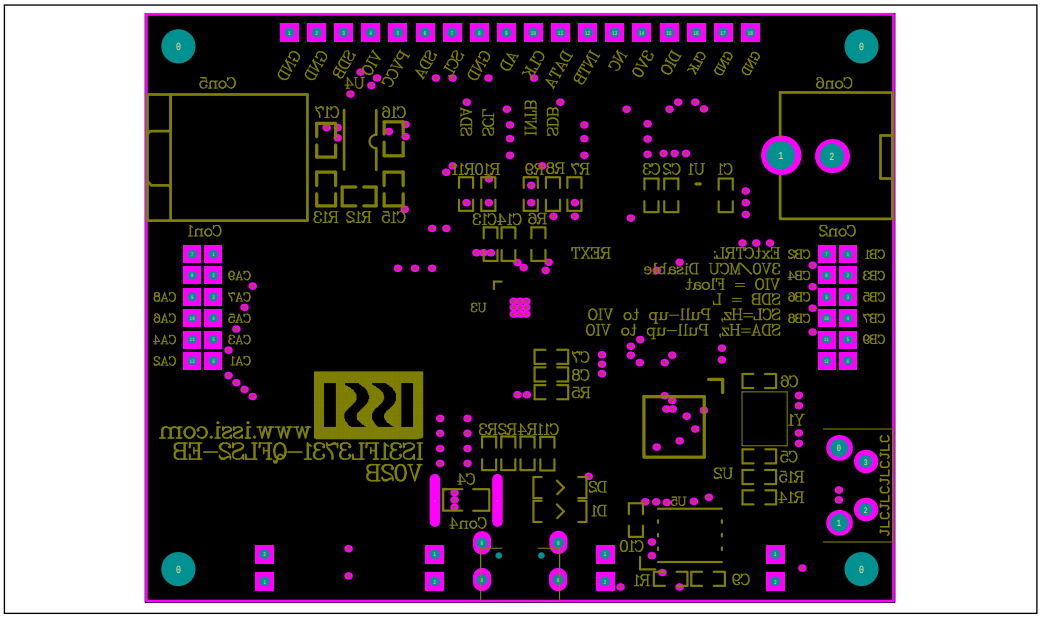

Figure 6: Board Component Placement Guide - Bottom Layer

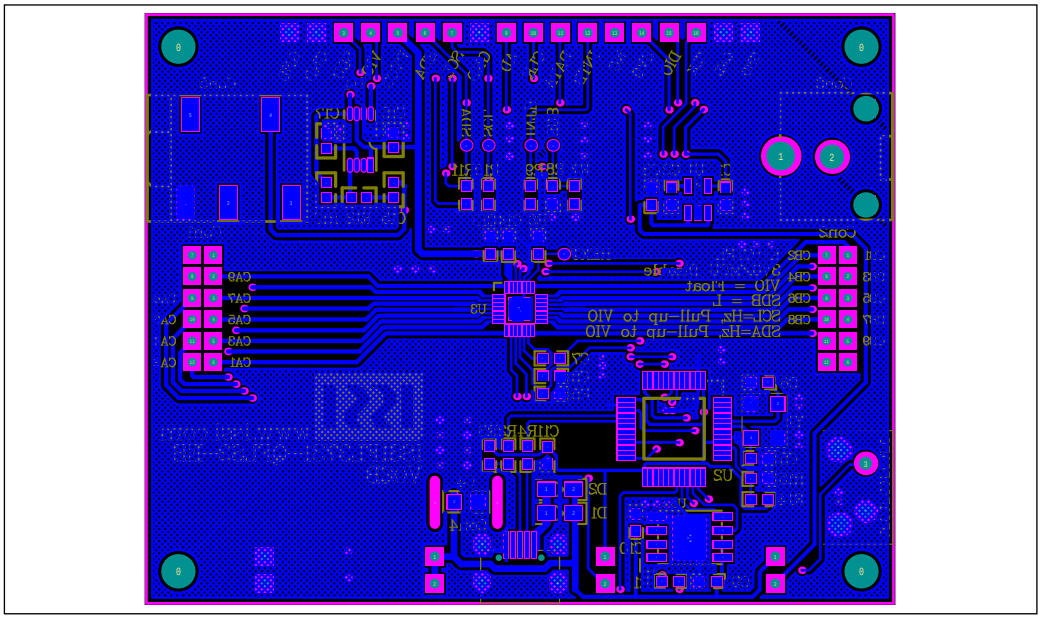

Figure 7: Board PCB Layout - Bottom Layer

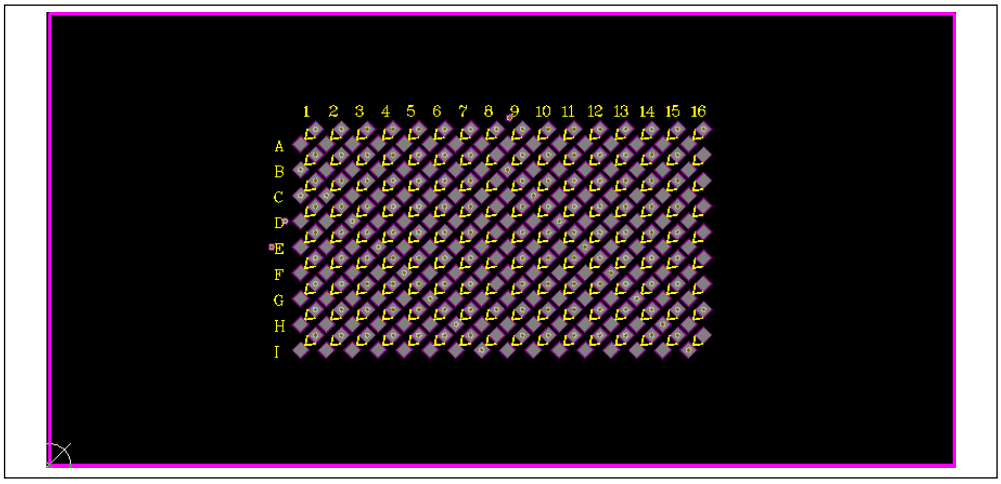

Figure 8: LED Board Component Placement Guide - Top Layer

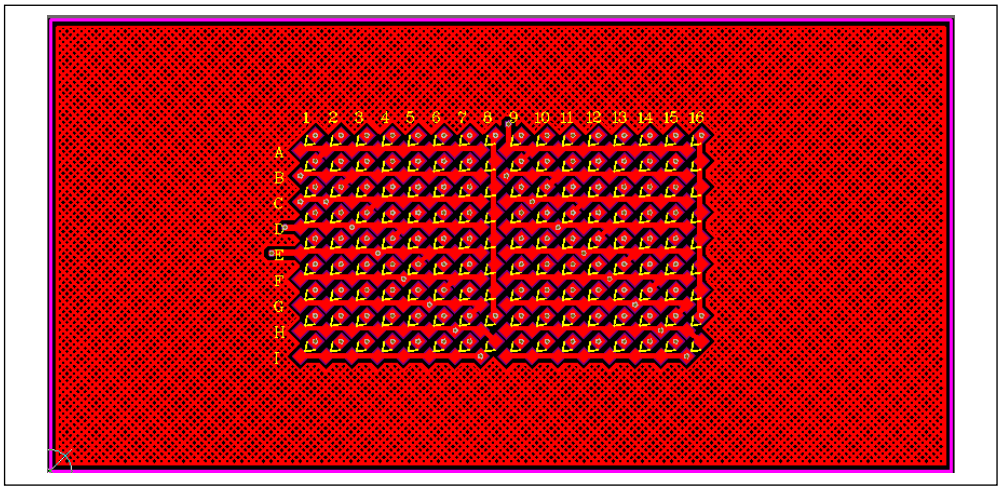

Figure 9: LED Board PCB Layout - Top Layer

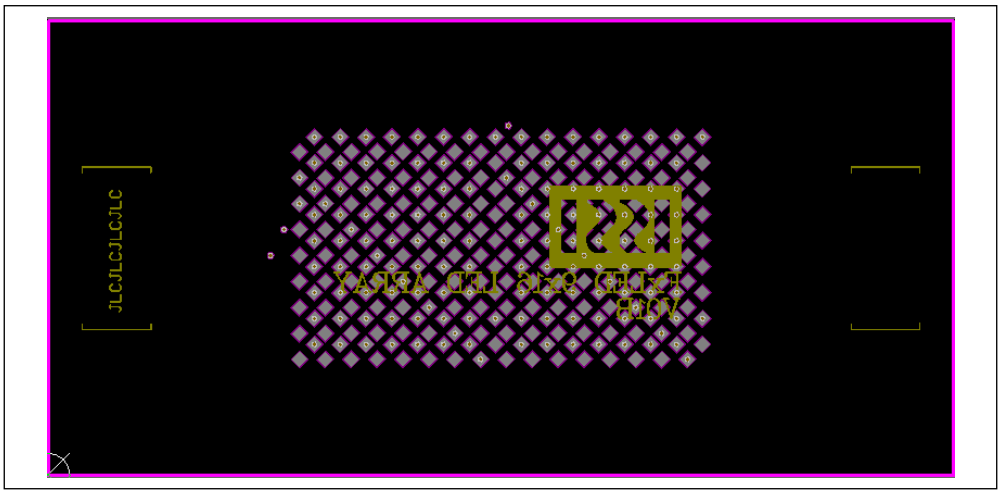

Figure 10: LED Board Component Placement Guide - Bottom Layer

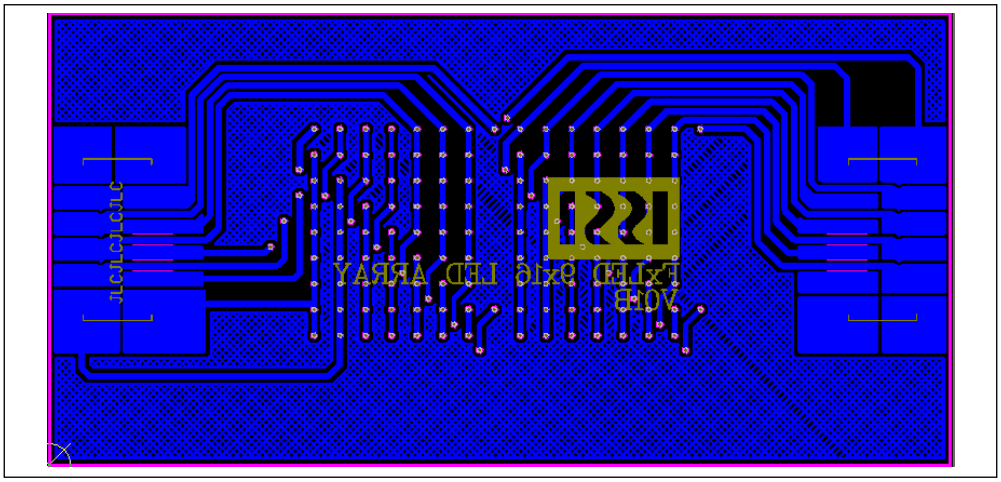

Figure 11: LED Board PCB Layout - Bottom Layer

REVISION HISTORY

Revision	Detail Information	Date
R1.0	Initial release	2012.07.12
A	1. New EVB version, Update to STM32 MCU 2. Add Arduino control guide section	2017.04.20

APPENDIX Ⅰ: R1.0 GUIDE

QUICK START

Figure 12: Photo of IS31FL3731 Evaluation Board

PROCEDURE

The IS31FL3731 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) Connect an 8Ω speaker to the “SPK” connector.
2) Connect the audio source to the “AUDIO IN” connector.
3) Connect the DC power to the connector (DC IN).
4) Turn on the power supply and pay attention to the supply current. If the current exceeds 1A, please check for circuit fault.
5) Turn on the audio signal.
6) Modulation of the audio signal utilized to obtain better sound output performance.

EVALUATION BOARD OPERATION

The IS31FL3731 evaluation board has eight display modes. Press MODE button to switch configurations.

1) Firework animation
2) Lighting animation
3) Power-on animation
4) Water drop animation
5) Static graphics breathe dimming effect
6) Triangular music bar effect: more triangular music bars are displayed with stronger music.
7) Equalizer bar effect: EQ bars move up and down with music.
8) Multiple graphics display: different graphics change with music rhythm.

Note: IS31FL3731 solely controls the FxLED function on the evaluation board.

SOFTWARE CONTROL

JP1 default setting is close circuit. If it is set to open, the on-board MCU will stop control the IIC bus and SDB pin. The I2C/SDB pins are set to High Impedance. External I2C/SDB (SDB default is pulled L, H for normal working) signals can be connected to TP3 to control the IS31FL3731 LED driver.

Please refer to the datasheet to get more information about IS31FL3731.

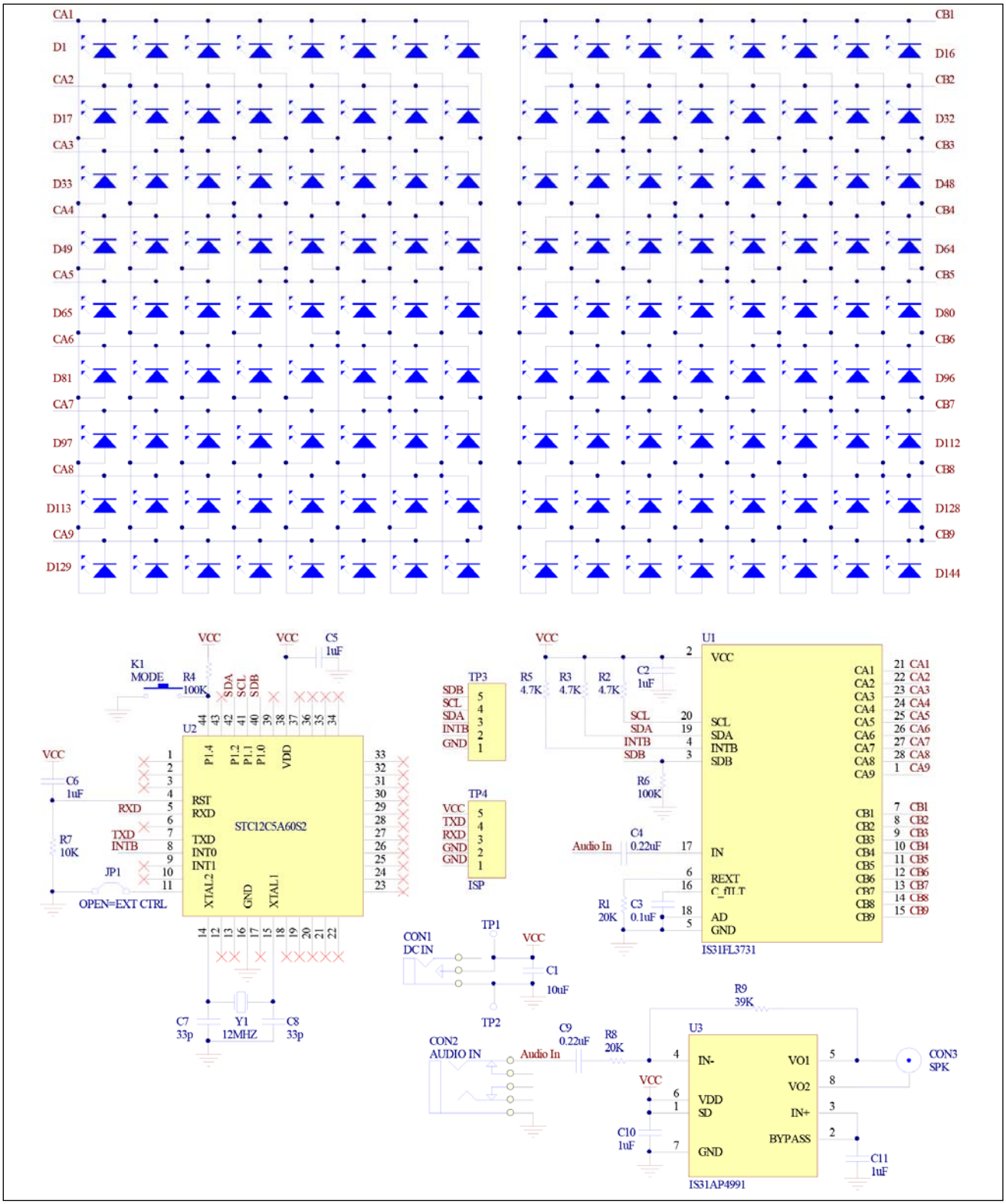

Figure 13: IS31FL3731 Application Schematic

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
LED Driver	U1	Matrix LED Driver	1	Lumissil	IS31FL3731
MCU	U2	Microcontroller	1	NXP	STC12C5A60S2
Audio Amplifier	U3	Class- AB Audio Amplifier	1	Lumissil	IS31AP4991
Diode	D1~D144	Diode, LED Blue, SMD	144	Everlight	9-217/BHC-ZL1M2RY/3T
Crystal	Y1	Crystals,12MHz,HC-49S	1		
Resistor	R1,R8	RES,20k,1/16W,±5%,SMD	2		
Resistor	R2,R3,R5,	RES,4.7k,1/16W,±5%,SMD	3		
Resistor	R4,R6	RES,100k,1/16W,±5%,SMD	2		
Resistor	R7	RES,10k,1/16W,±5%,SMD	1		
Resistor	R9	RES,39k,1/16W,±5%,SMD	1		
Capacitor	C1	CAP,10μF,16V,±20%,SMD	2		
Capacitor	C2,C5,C6, C10,C11	CAP,1μF,16V,±20%,SMD	5		
Capacitor	C3,	CAP,0.1μF,16V,±20%,SMD	1		
Capacitor	C4,C9	CAP,0.22μF,16V,±20%,SMD	2		
Button	K1	Button SMD	1		

Bill of Materials, refer to Figure 13 above.

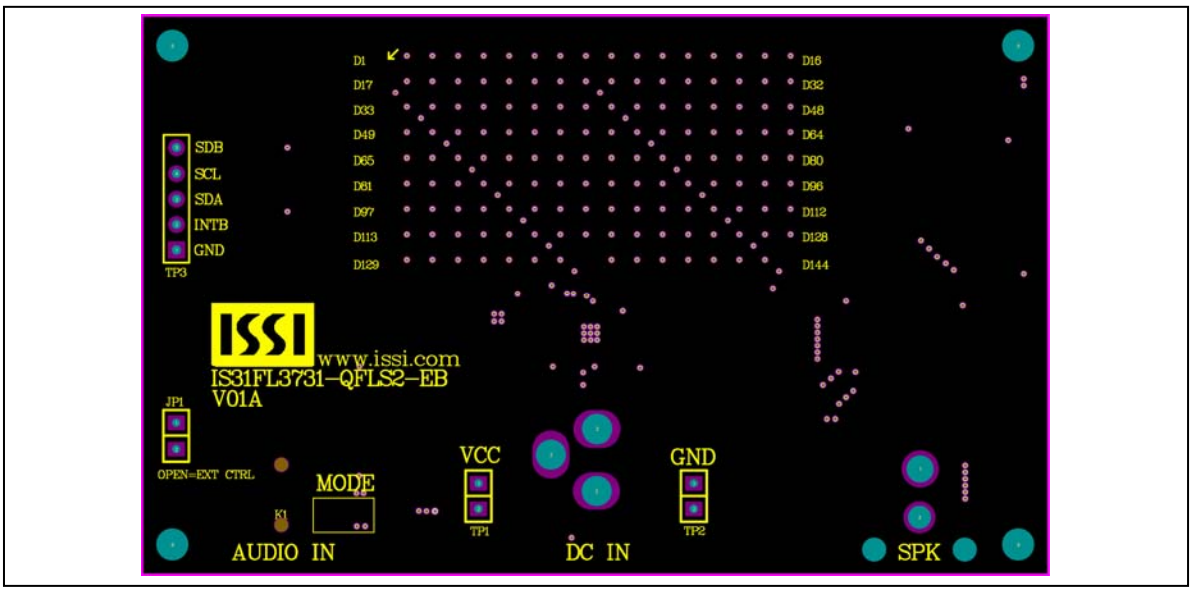

Figure 14: Board Component Placement Guide -Top Layer

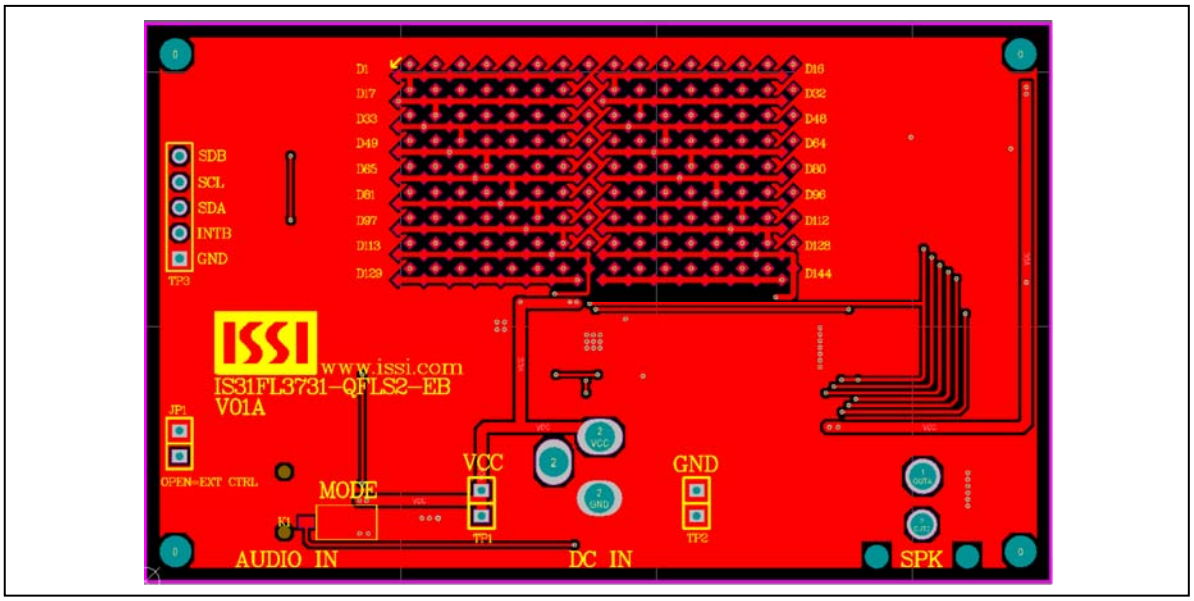

Figure 15: Board PCB Layout- Top Layer

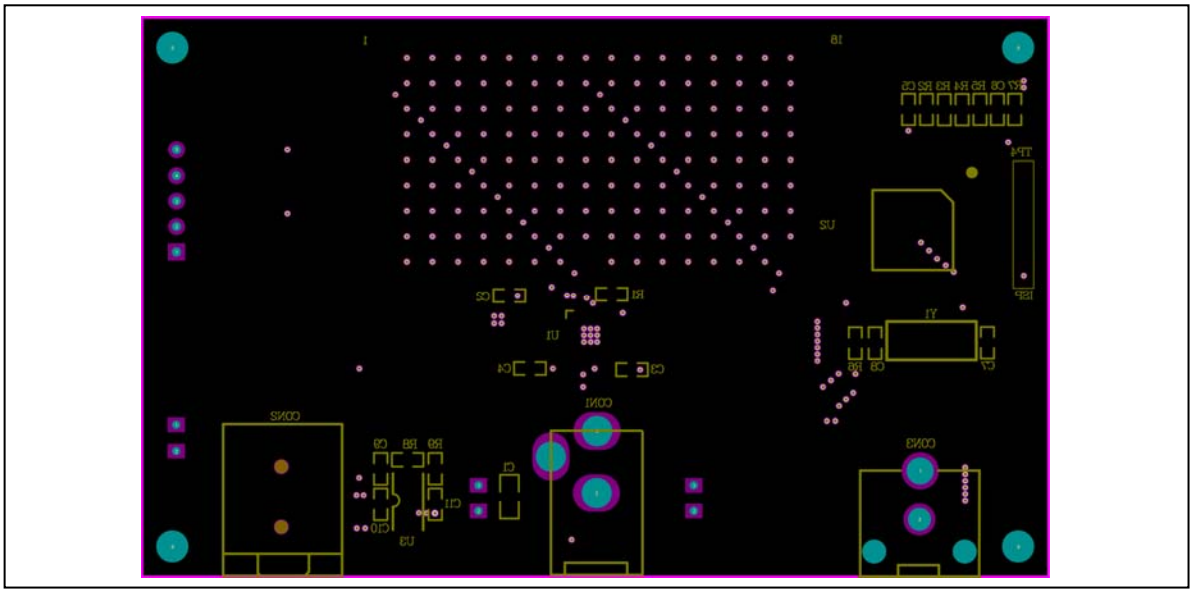

Figure 16: Board Component Placement Guide -Bottom Layer

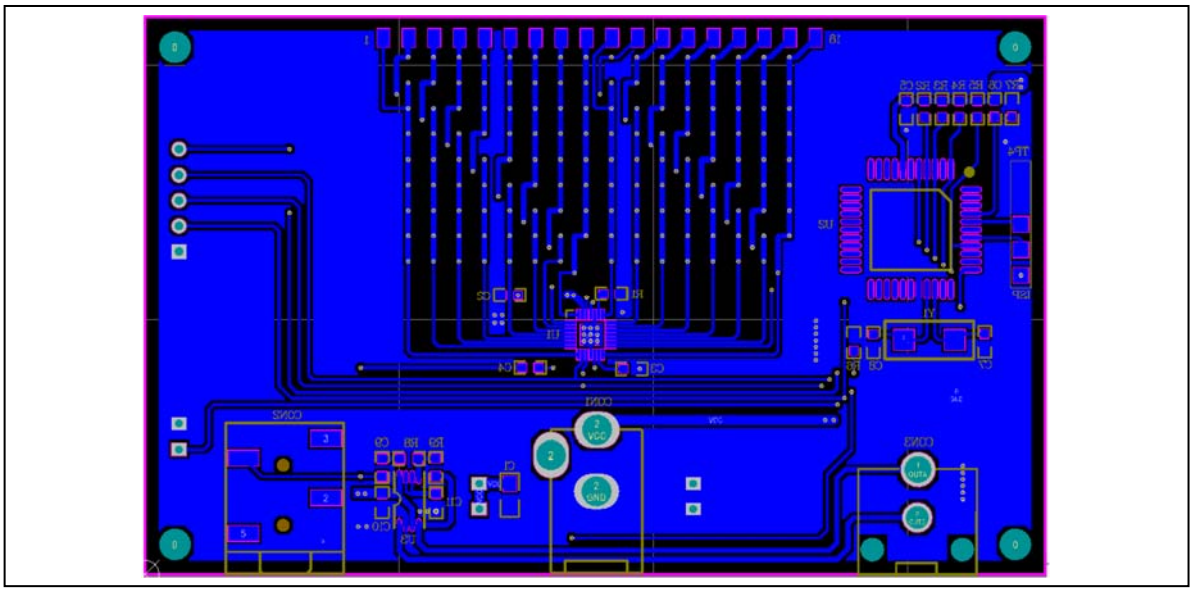

Figure 17: Board PCB Layout-Bottom Layer

APPENDIX II: IS31FL3731 ARDUINO TEST CODE V01A

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

#define Addr_GND 0xE8
#define Addr_SCL 0xEA
#define Addr_SDA 0xEC
#define Addr_VCC 0xEE

uint8_t i,j;

const PROGMEM byte PWM_Gama64[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() {
  Wire.begin();
  Wire.setClock(400000);//I2C 400kHz
  Init_3731();
}

void loop() {
    IS31FL3731_Test_mode1();//breath mode
}

void IS_IIC_WriteByte(uint8_t Dev_Add,uint8_t Reg_Add,uint8_t Reg_Dat)
{
  Wire.beginTransmission(Dev_Add/2); // transmit to device IS31FL373x
  Wire.write(Reg_Add); // sends regaddress
  Wire.write(Reg_Dat); // sends regaddress
  Wire.endTransmission(); // stop transmitting
}

void Init_3731(void)
{
  IS_IIC_WriteByte(Addr_GND,0xFD,0x0B);//write function register
  IS_IIC_WriteByte(Addr_GND,0x0A,0x00);//enter software shutdown mode
```

```
  IS_IIC_WriteByte(Addr_GND,0xFD,0x00);//write first frame
  for(i=0;i<0x12;i++)
  {
    IS_IIC_WriteByte(Addr_GND,i,0xff);//turn on all LED
  }//Need to turn off the position where LED is not mounted
  for(i=0x24;i<0xB4;i++)
  {
    IS_IIC_WriteByte(Addr_GND,i,0x00);//write all PWM set 0x00
  }//init all the PWM data to 0
  IS_IIC_WriteByte(Addr_GND,0xFD,0x0B);//write function register
  IS_IIC_WriteByte(Addr_GND,0x00,0x00);//picture mode
  IS_IIC_WriteByte(Addr_GND,0x01,0x00);//select first frame
  IS_IIC_WriteByte(Addr_GND,0x0A,0x01);//normal operation
}

void IS31FL3731_Test_mode1(void)//
{
  IS_IIC_WriteByte(Addr_GND,0xFD,0x00);//write first frame
  for (j=0;j<64;j++)//all LED ramping up
  {
    for(i=0x24;i<0xB4;i++)
    {
      IS_IIC_WriteByte(Addr_GND,i,pgm_read_byte_near(&PWM_Gama64[j]));//set all PWM
    }
    delay(20);//20ms
  }
  delay(1000); //keep on 1s

  for (j=63;j>=0;j--)//all LED ramping down
  {
    for(i=0x24;i<0xB4;i++)
    {
      IS_IIC_WriteByte(Addr_GND,i,pgm_read_byte_near(&PWM_Gama64[j]));//set all PWM
    }
    delay(20);//20ms
  }
  delay(500); //keep off 0.5s
}
```

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