DESCRIPTION

The IS31FL3732A is a compact LED driver for 144 single LEDs. The device can be programmed via an I2C compatible interface. The IS31FL3732A 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: 2.7V to 5.5V
- 1MHz I2C-compatible interface
- 144 LEDs in dot matrix
- Individual blink control
- Individual PWM control 256 steps
- Individual on/off control
- Global current control 256 steps
- Cascade for synchronization of chips
- 8 frames memory for animations
- QFN-40 (5mm×5mm) package

QUICK START

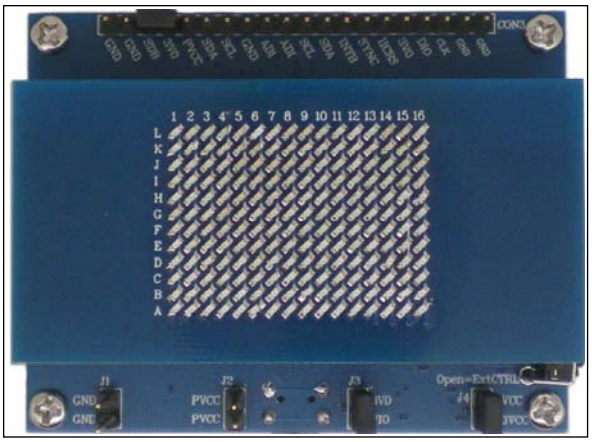

Figure 1: Photo of IS31FL3732A Evaluation Board

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 IS31FL3732A 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) Short J3 to connect 3V0 and VIO (default connected).
4) Short J4 to connect PVCC and U1VCC (default connected.
5) Connect the 5VDC power to the connector (J1&J2), if use Micro USB as power supply, skip this step.
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
IS31FL3732A-QFLS2-EB	-40°C to +85°C (Industrial)	QFN-40, Lead-free

Table 1: Ordering Information

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

EVALUATION BOARD OPERATION

The IS31FL3732A 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: IS31FL3732A 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 IS31FL3732A 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-I2C'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), if use Micro USB as power supply, skip this step.
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 I2C 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.

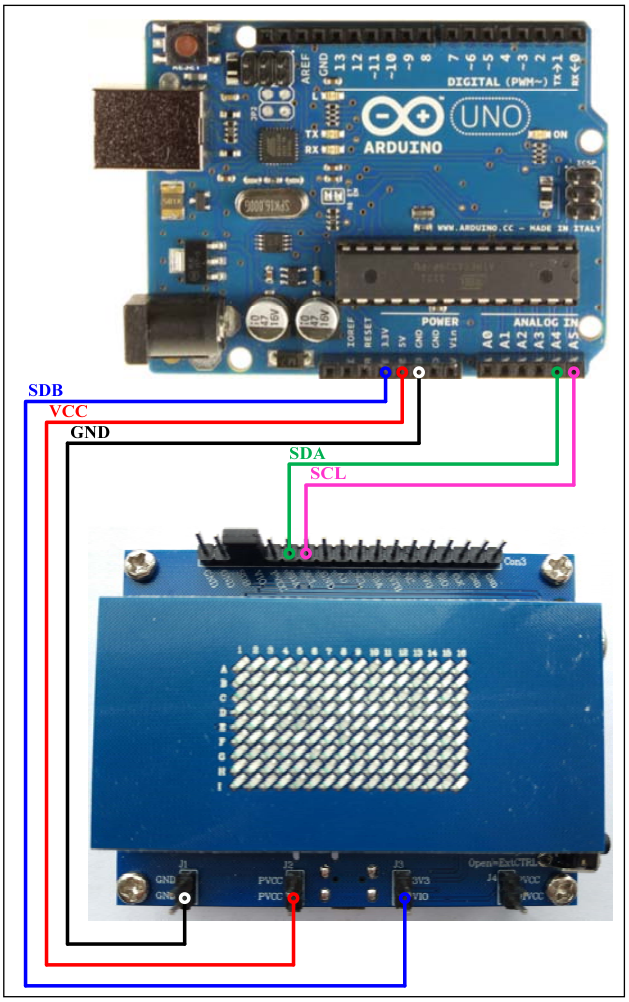

Figure 2: Photo of Arduino connect to Evaluation Board

Follow the example 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 IS31FL3732A test firmware (sketch) from the ISSI website http://www.issi.com/US/product-analog-fxled-driver.shtml.

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 IS31FL3732A EVB:
   a) Arduino VCC5V to IS31FL3732A EVB PVCC (Con3 or J2).
   b) Arduino GND to IS31FL3732A EVB GND (Con3 or J1).
   c) Arduino SDA to IS31FL3732A EVB SDA.
   d) Arduino SCL to IS31FL3732A EVB SCL.
   e) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3732A 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 I or Download the test firmware (sketch) form ISSI 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 IS31FL3732A device address is 0xA0 (AD=LOW), if user want to change the device address, use the AD in Con3
   a) AD=VIO or PVCC, device address=0xA6 (7bit format is 0x53).
   b) AD=SCL, device address=0xA2 (7bit format is 0x51).
   c) AD=SDA, device address=0xA4 (7bit format is 0x52).

Please refer to the datasheet to get more information about IS31FL3732A.

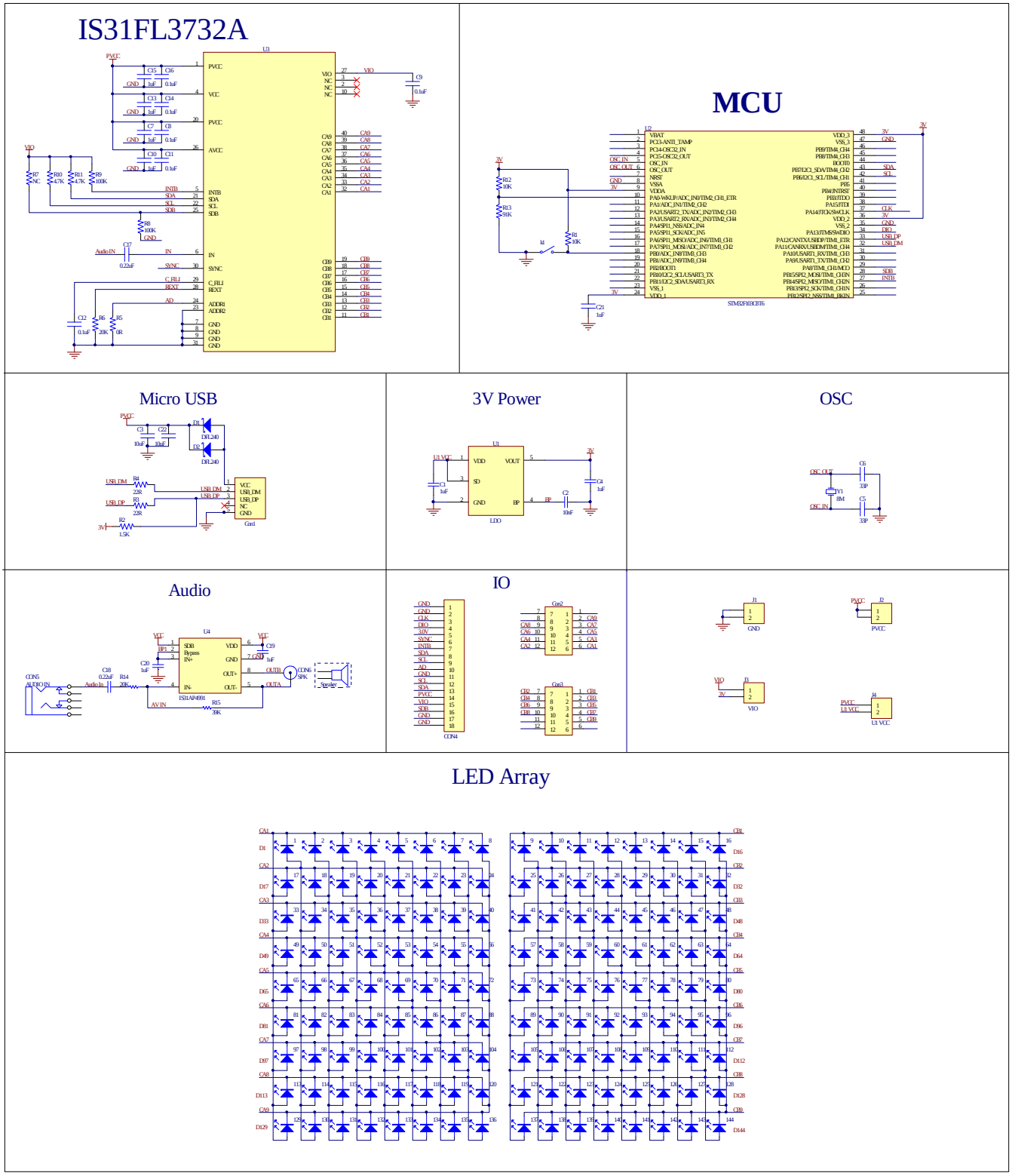

Figure 3: IS31FL3732A Application Schematic

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
LDO	U1	Reduced voltage	1		SGM2019-3V
MCU	U2	Microcontroller	1	STM	STM32F103C8T6
LED Driver	U3	Matrix LED Driver	1	ISSI	IS31FL3732A
Audio Driver	U4	Audio amplifier	1	ISSI	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	R8,R9	RES,100k,1/16W,±5%,SMD	2	Yageo	RC0603JR-07100KL
Resistor	R3,R4	RES,22R,1/16W,±5%,SMD	2	Yageo	RC0603JR-0722RL
Resistor	R2	RES,1.5k,1/16W,±5%,SMD	1	Yageo	RC0603JR-071K5L
Resistor	R6,R14	RES,20k,1/16W,±5%,SMD	2	Yageo	RC0603JR-0720KL
Resistor	R15	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,R12	RES,10k,1/16W,±5%,SMD	2	Yageo	RC0603JR-0710KL
Resistor	R13	RES,91k,1/16W,±5%,SMD	1	Yageo	RC0603JR-0791KL
Resistor	R5	RES,0R,1/16W,±5%,SMD	1	Yageo	RC0603JR-0791KL
Resistor	R7	NC	1		
Capacitor	C1,C4,C7,C10, C13,C15,C19, C20,C21	CAP,1μF,16V,±20%,SMD	9	Yageo	CC0603KKX7R9BB105
Capacitor	C2	CAP,10pF,16V,±20%,SMD	1	Yageo	CC0603KKX7R9BB100
Capacitor	C3,12	CAP,10μF,16V, ±20%,SMD	2	Yageo	CC0603KKX7R9BB106
Capacitor	C5,C6	CAP,33pF,16V,±20%,SMD	2	Yageo	CC0603KKX7R9BB330
Capacitor	C17,C18	CAP,0.22μF,16V,±20%,SMD	2	Yageo	CC0603KKX7R9BB330
Capacitor	C8,C9,C11, C12,C14,C16	CAP,0.1μF,16V,±20%,SMD	6	Yageo	CC0603KKX7R9BB104
Button	K1	Button SMD	1		

Bill of Materials, refer to Figure 3 above.

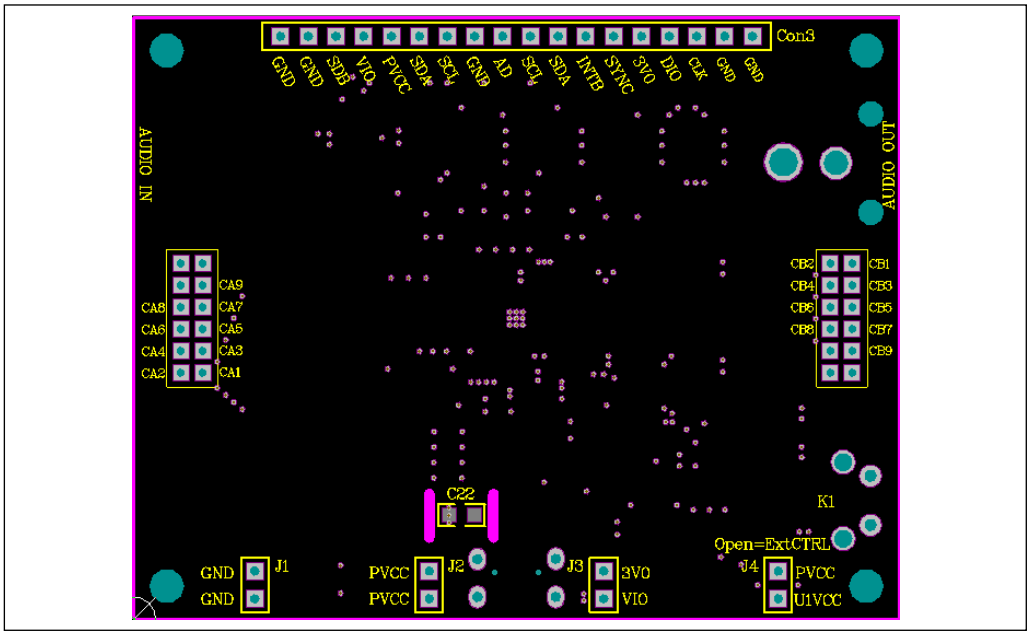

Figure 4: Board Component Placement Guide - Top Layer

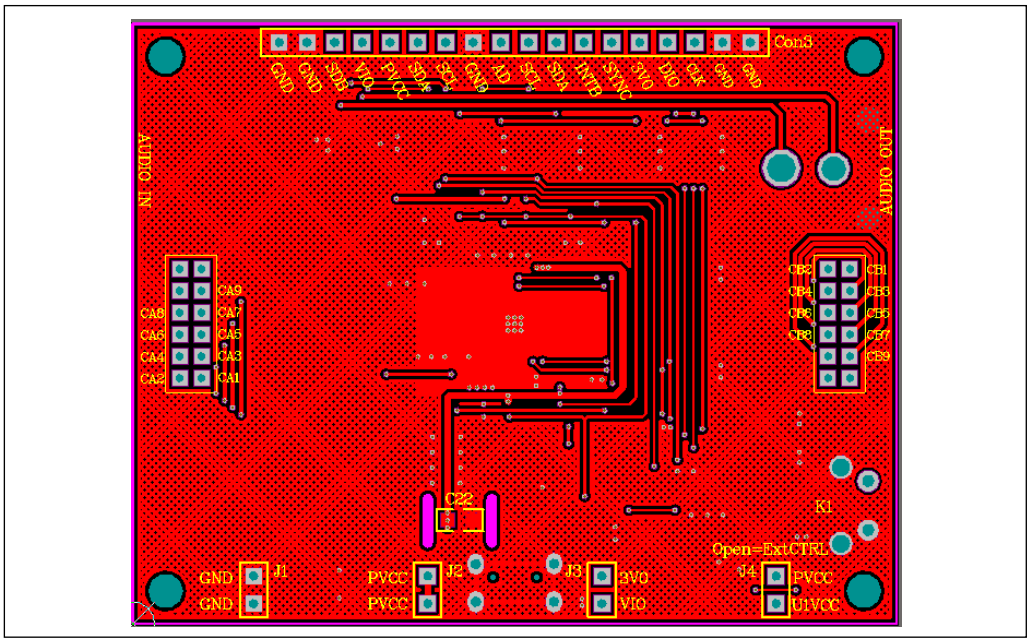

Figure 5: Board PCB Layout - Top Layer

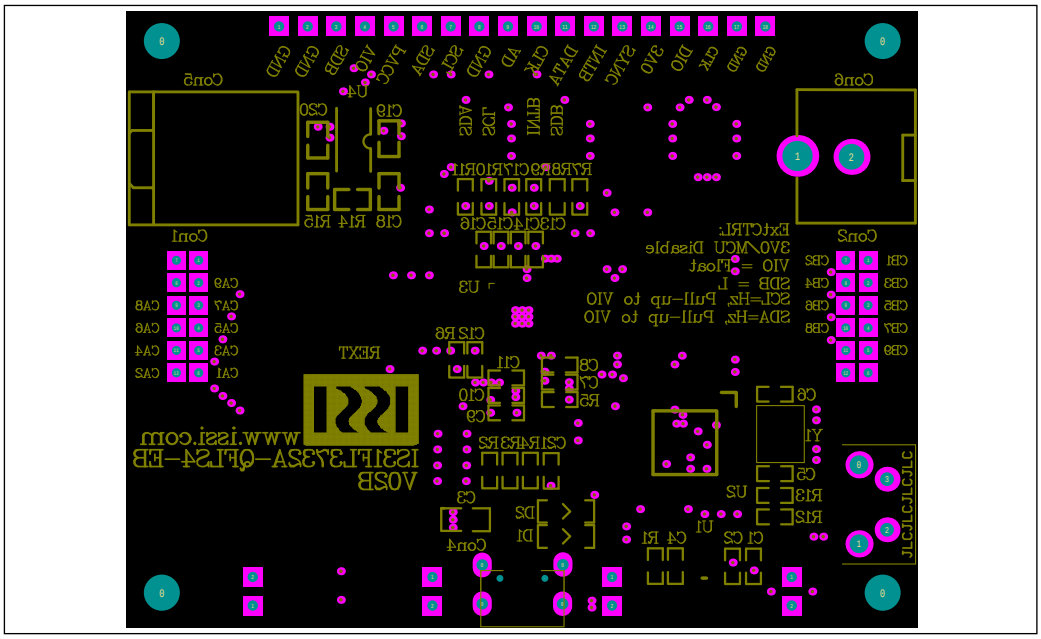

Figure 6: Board Component Placement Guide - Bottom Layer

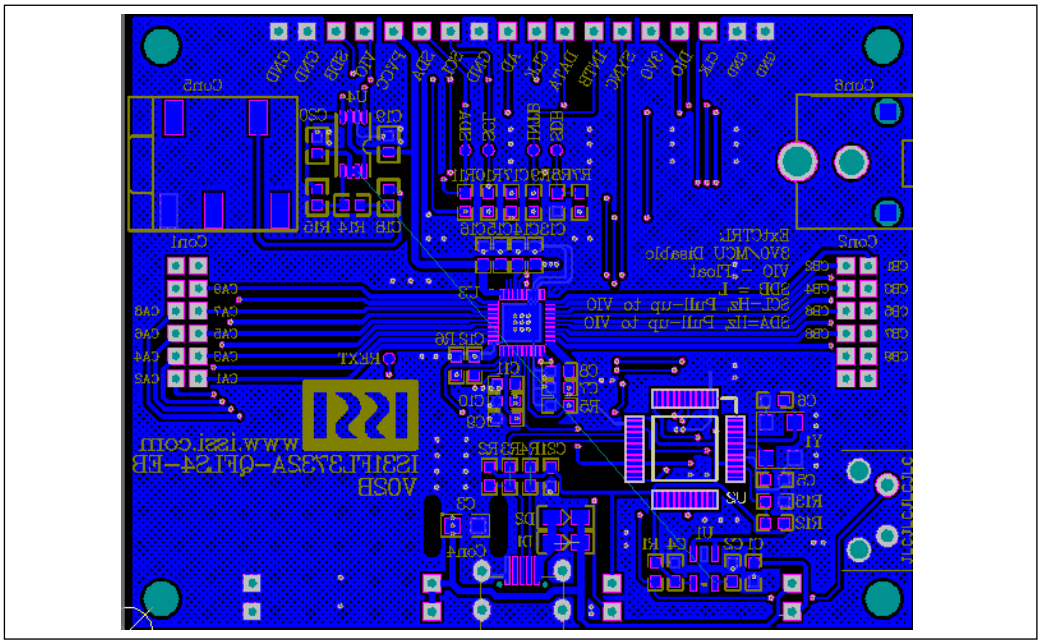

Figure 7: Board PCB Layout - Bottom Layer

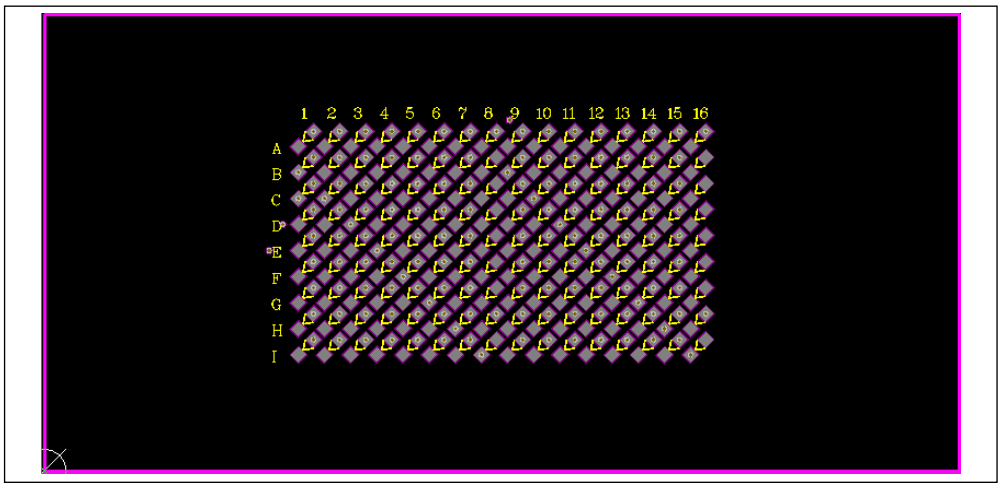

Figure 8: LED Board Component Placement Guide - Top Layer

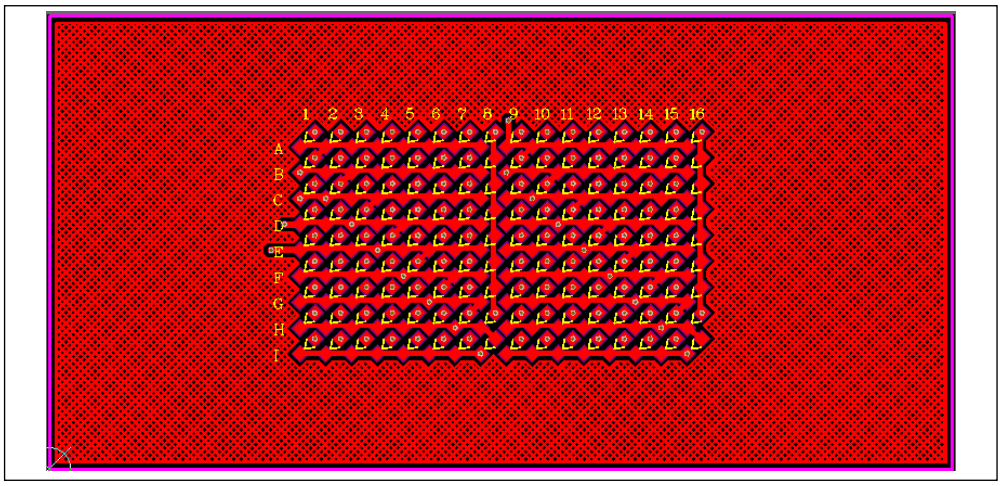

Figure 9: LED Board PCB Layout - Top Layer

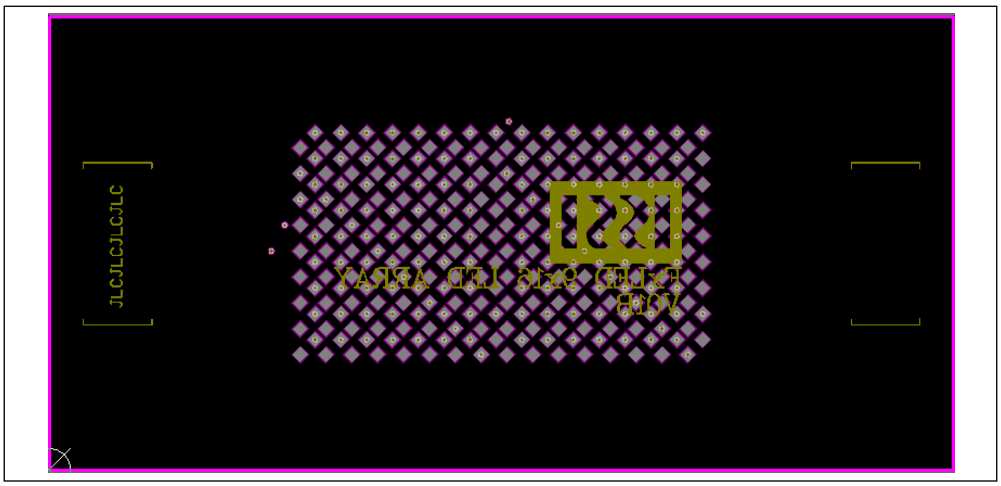

Figure 10: LED Board Component Placement Guide - Bottom Layer

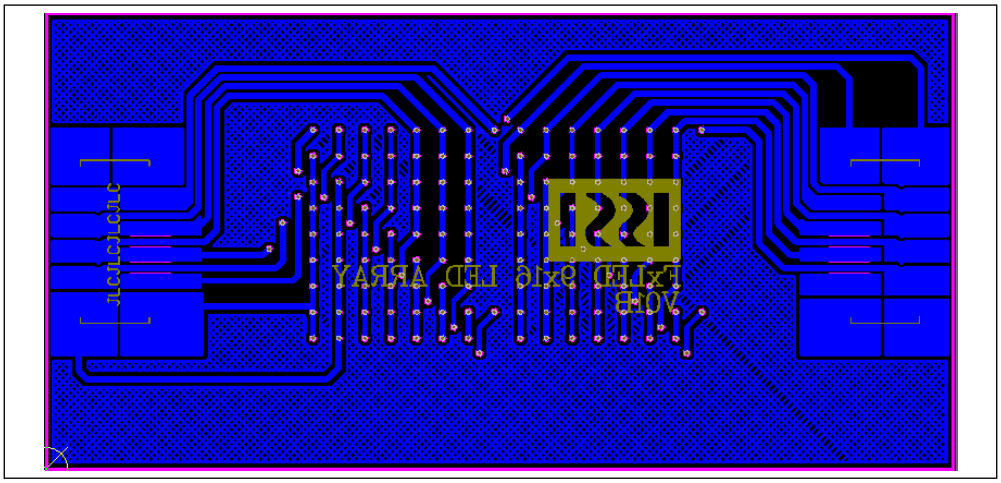

Figure 11: LED Board PCB Layout - Bottom Layer

REVISION HISTORY

Revision	Detail Information	Date
A	Initial release	2015.04.22
B	1. Change the MCU to STM32F103C8T6. 2. Update schematic and PCB. 3. Update bill of materials. 4. Add 31FL3732A option. 5. Add Arduino control guide section.	2017.06.27
C	Remove IS31FL3732 description	2017.08.22

APPENDIX Ⅰ: IS31FL3732A ARDUINO TEST CODE V01A

```
#include<Wire.h>
#include<avr/pgmspace.h>
#define Addr_GND_GND 0xA0//8 bit format, if 7 bit only, use 0x50
#define Addr_GND_SCL 0xA2//8 bit format, if 7 bit only, use 0x51
#define Addr_GND_SDA 0xA4//8 bit format, if 7 bit only, use 0x52
#define Addr_GND_VCC 0xA6//8 bit format, if 7 bit only, use 0x54
int i,j;
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
};
byte PWM144_DAT[144]=
{
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
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  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
  0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,   0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
};
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 IS_IIC_WriteBuf(byte Dev_Add,byte Reg_Add,byte *Reg_DatPoint,int n)
{
  int k=1;
  Wire.beginTransmission(Dev_Add/2); // transmit to device IS31FL373x
  Wire.write(Reg_Add); // sends regaddress
  for(k=1;k<=n;k++)
```

```
  {
    Wire.write(*Reg_DatPoint); // sends regaddress
    Reg_DatPoint++;
  }
  Wire.endTransmission(); // stop transmitting
}
void Init_FL3732A(void)
{
  IS_IIC_WriteByte(Addr_GND_GND,0xFD,0x0B);//write function register
  IS_IIC_WriteByte(Addr_GND_GND,0x0A,0x00);//enter software shutdown mode
  IS_IIC_WriteByte(Addr_GND_GND,0xFD,0x00);//write first frame
  for(i=0;i<0x12;i++){IS_IIC_WriteByte(Addr_GND_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_GND,i,0x10);}//write all PWM set 0x00//init all the PWM data to 0
  IS_IIC_WriteByte(Addr_GND_GND,0xFD,0x0B);//write function register
  IS_IIC_WriteByte(Addr_GND_GND,0x00,0x00);//picture mode
  IS_IIC_WriteByte(Addr_GND_GND,0x01,0x00);//select first frame
  IS_IIC_WriteByte(Addr_GND_GND,0x04,0xff);//global current=255
  IS_IIC_WriteByte(Addr_GND_GND,0x06,0x00);//shutdown audio mode
  IS_IIC_WriteByte(Addr_GND_GND,0x0A,0x01);//normal operation
}
void IS31FL3732A_Test_mode1(void)//
{
  byte s=0;
  IS_IIC_WriteByte(Addr_GND_GND,0xFD,0x00);//write first frame
  for (j=0;j<64;j++)//all LED ramping up
  {
    for(s=0;s<144;s++)PWM144_DAT[s]=PWM_Gamma64[j];
    for(s=0;s<144;s=s+16)IS_IIC_WriteBuf(Addr_GND_GND,0x24+s,PWM144_DAT+s,16);
    //for(i=0;i<144;i++){IS_IIC_WriteByte(Addr_GND_GND,0x24+i,PWM_Gamma64[j]);}//set all PWM
    delay(10);//10ms
  }
  delay(1000); //keep on 1s
  for (j=63;j>=0;j--)//all LED ramping down
  {
    for(s=0;s<144;s++)PWM144_DAT[s]=PWM_Gamma64[j];
    for(s=0;s<144;s=s+16)IS_IIC_WriteBuf(Addr_GND_GND,0x24+s,PWM144_DAT+s,16);
    //for(i=0;i<144;i++){IS_IIC_WriteByte(Addr_GND_GND,0x24+i,PWM_Gamma64[j]);}//set all PWM
    delay(1);//10ms
  }
  delay(1000); //keep off 1s
}

void setup()
{
  Wire.begin();
  Wire.setClock(400000);//I2C 400kHz
```

```
    //in Genuino Micro, if >800 the IIC waveform will be not normal
    Init_FL3732A();
}
void loop()
{
    Wire.begin();
    Serial.begin(9600);
    Serial.println("Test code of FL3732&FL3732A");
    IS31FL3732A_Test_mode1();//breath mode
}
```