

## 6-CHANNEL LIGHT EFFECT LED DRIVER

### DESCRIPTION

IS31FL3196A is a 6-channel light effect LED driver which features two-dimensional auto breathing mode and an audio modulated display mode. It has One Shot Programming Mode and PWM Control Mode for RGB lighting effects. The maximum output current can be adjusted in 8 levels (5mA~40mA).

### FEATURES

- Supply voltage range from 2.7V to 5.5V
- Two groups RGB, single color LED breathing system-free pre-established pattern
- 6 independently controlled automatic and semiautomatic breathing system-free pre-established pattern
- 6 independently controlled outputs of 256 PWM steps
- 8 levels programmable output current
- Audio mode with AGC function
- Cascade for the synchronization of chips
- QFN-20 (3mm × 3mm) package

### QUICK START



Figure 1: Photo of IS31FL3196A Evaluation Board

### RECOMMENDED EQUIPMENT

- 5.0V, 2A power supply

### ABSOLUTE MAXIMUM RATINGS

- $\leq 5.5V$  power supply

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

### PROCEDURE

The IS31FL3196A 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 connect by board MCU (default short).
- 2) Connect the 5VDC power to the connector (TP1&TP2) (Skip this step if use Micro-USB as power input).
- 3) 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.

### EVALUATION BOARD OPERATION

The IS31FL3196A evaluation board has five display modes. Press K1 to switch configurations.

- 1) 6 lamps breathe at the same time
- 2) The RGB monochromatic breathes
- 3) RGB audio mode
- 4) 6 lamps breathe one by one
- 5) 6 lamps audio mode

**Note:** IS31FL3196A solely controls the FxLED function on the evaluation board.

### ORDERING INFORMATION

| Part No.             | Temperature Range          | Package           |
|----------------------|----------------------------|-------------------|
| IS31FL3196A-QFLS2-EB | -40°C ~ +85°C (Industrial) | QFN-20, Lead-free |

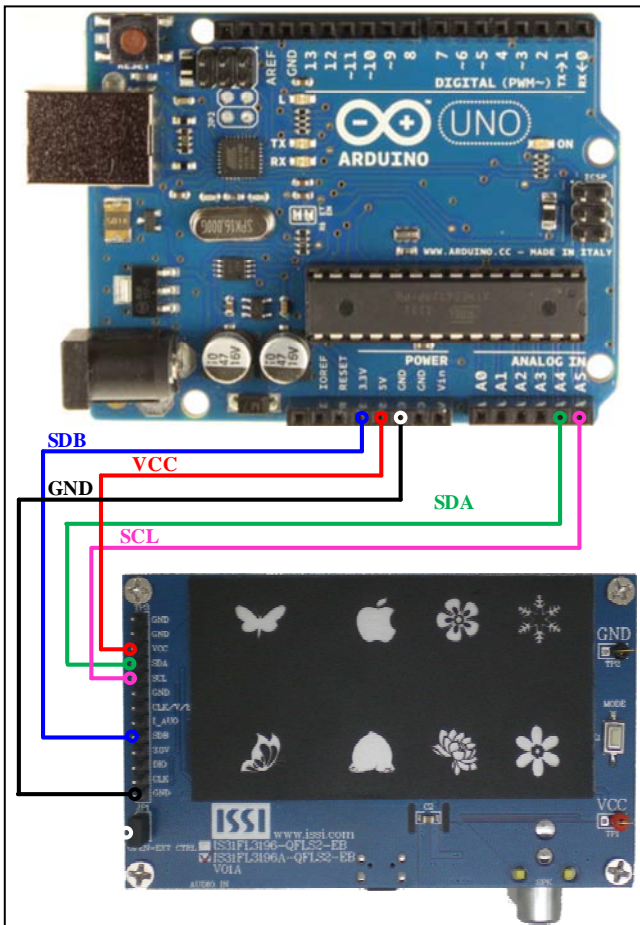
Table 1: Ordering Information

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

## 6-CHANNEL LIGHT EFFECT LED DRIVER

### SOFTWARE CONTROL

J1 default setting is closed (short). If it is set to open, the MCU's SDB, SCL, SDA and CLK pin will be high impedance (open-drain) and external control is allowed.



**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 IS31FL3196A test firmware (sketch) from the ISSI website <http://www.issi.com/US/product-analog-fxled-drivershtml>.

- 1) Open JP1.
- 2) Connect the 5 pins from Arduino board to IS31FL3196A EVB:
  - a) Arduino 5V pin to IS31FL3196A EVB VCC.
  - b) Arduino GND to IS31FL3196A EVB GND.
  - c) Arduino SDA (A4) to IS31FL3196A EVB SDA.
  - d) Arduino SCL (A5) to IS31FL3196A EVB SCL.
  - e) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3196A EVB SDB, if Arduino use 5.0V MCU VCC, connect 5.0V to EVB SDB.  
(Arduino UNO is 5.0V, so SDB=5.0V)
- 3) Use the test code in appendix I or download the test firmware (sketch) from the ISSI website, a .txt file and copy the code to Arduino IDE, compile and upload to Arduino.
- 4) Run the Arduino code and the initial mode will change the RGB LED brightness every second. Note: the white color LEDs cannot be controlled when the onboard STM32F103C8T6 is disabled. (Some early board we provided is still controlling the white color LED, if want to switch between single color LED and RGB, remove the U4 and connect the VCC to the LED+)

**Please refer to the datasheet to get more information about IS31FL3196A.**

# 6-CHANNEL LIGHT EFFECT LED DRIVER

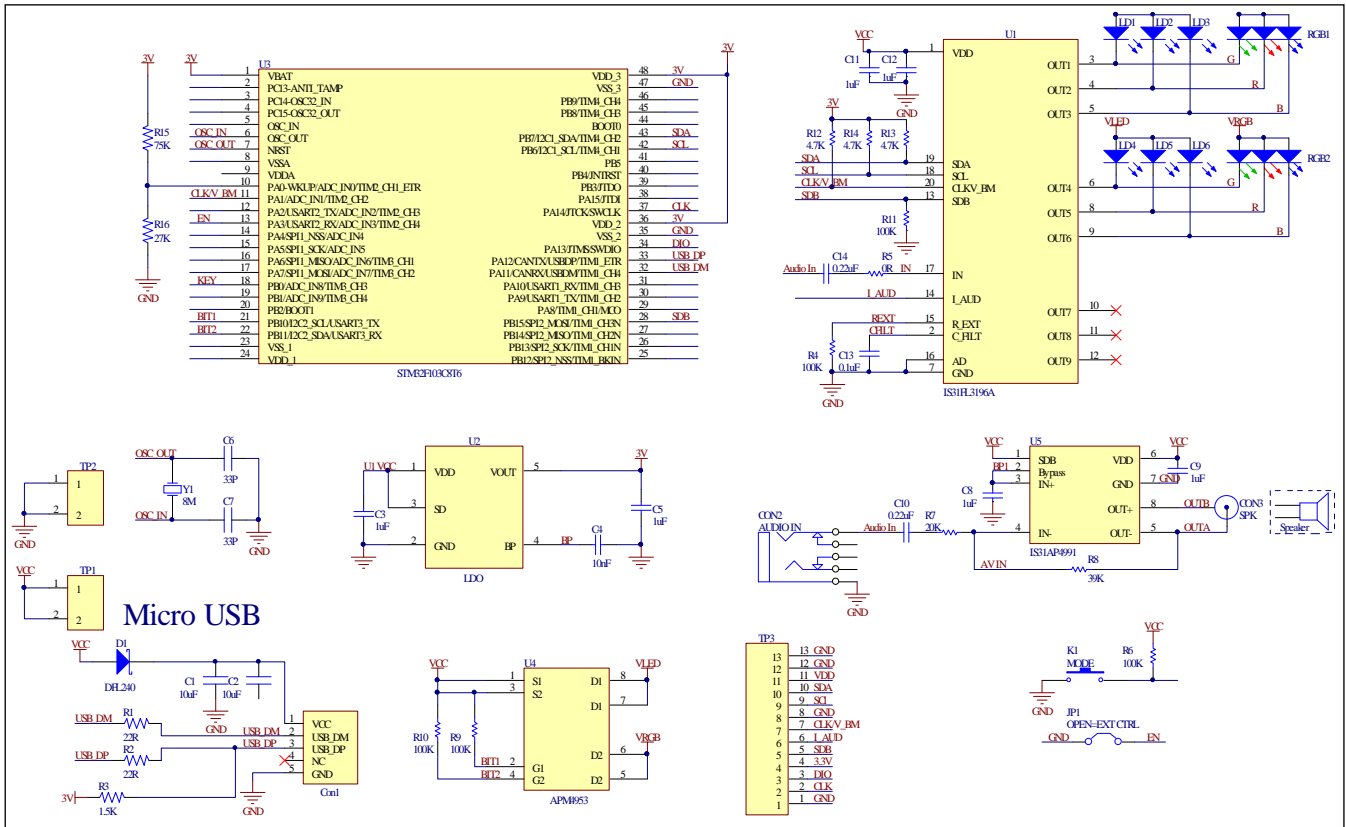


Figure 3: IS31FL3196A Application Schematic

## 6-CHANNEL LIGHT EFFECT LED DRIVER

### BILL OF MATERIALS

| Name       | Symbol               | Description             | Qty | Supplier  | Part No.             |
|------------|----------------------|-------------------------|-----|-----------|----------------------|
| LED Driver | U1                   | Matrix LED Driver       | 1   | ISSI      | IS31FL3196A          |
| LDO        | U2                   | 3.0V LDO                | 1   | SGMICRO   | SGM2019-3.0YN5G      |
| MCU        | U3                   | Microcontroller         | 1   | STM       | STM32F103C8T6        |
| PMOS       | U4                   | PMOS                    | 1   | ANPEC     | APM4953              |
| AMP        | U5                   | Audio power amplifier   | 1   | ISSI      | IS31AP4991           |
| LED        | LD1~LD6              | Blue LED,SMD            | 6   | Everlight | 9-217/BHC-ZL1M2RY/3T |
| LED        | RGB1,RGB2            | RGB LED,SMD             | 2   | Everlight | 99-235/RGBC/TR8      |
| Diode      | D1                   | Diode,SMD               | 1   | Diodes In | DFLS240              |
| Crystal    | Y1                   | Crystal,8MHz            | 1   | HLX       | HC-49S               |
| Resistor   | R1,R2                | RES,22R,1/16W,±5%,SMD   | 2   | Yageo     | RC0603JR-0722RL      |
| Resistor   | R3                   | RES,1.5k,1/16W,±5%,SMD  | 1   | Yageo     | RC0603JR-071K5L      |
| Resistor   | R4,R6,R9,<br>R10,R11 | RES,100k,1/16W,±5%,SMD  | 5   | Yageo     | RC0603JR-07100KL     |
| Resistor   | R5                   | RES,0R,1/16W,±5%,SMD    | 1   | Yageo     | RC0603JR-07000KL     |
| Resistor   | R7                   | RES,20k,1/16W,±5%,SMD   | 1   | Yageo     | RC0603JR-0720KL      |
| Resistor   | R8                   | RES,39k,1/16W,±5%,SMD   | 1   | Yageo     | RC0603JR-0739KL      |
| Resistor   | R12,R13,R14          | RES,4.7k,1/16W,±5%,SMD  | 3   | Yageo     | RC0603JR-0704K7L     |
| Resistor   | R15                  | RES,75k,1/16W,±5%,SMD   | 1   | Yageo     | RC0603JR-0775KL      |
| Resistor   | R16                  | RES,27k,1/16W,±5%,SMD   | 1   | Yageo     | RC0603JR-0727KL      |
| Capacitor  | C1,C2                | CAP,10µF,16V,±20%,SMD   | 2   | Yageo     | CC0603KKX7R9BB106    |
| Capacitor  | C3,C5,C8,<br>C9,C11  | CAP,1µF,16V,±20%,SMD    | 6   | Yageo     | CC0603KKX7R9BB105    |
| Capacitor  | C4                   | CAP,10nF,16V,±20%,SMD   | 1   | Yageo     | CC0603KKX7R9BB103    |
| Capacitor  | C6,C7                | CAP,33pF,16V,±20%,SMD   | 2   | Yageo     | CC0603KKX7R9BB330    |
| Capacitor  | C10,C14              | CAP,0.22µF,16V,±20%,SMD | 2   | Yageo     | CC0603KKX7R9BB224    |
| Capacitor  | C12,C13              | CAP,0.1µF,16V,±20%,SMD  | 2   | Yageo     | CC0603KKX7R9BB104    |
| Button     | K1                   | Button SMD              | 1   |           |                      |

Bill of Materials, refer to Figure 3 above.

**6-CHANNEL LIGHT EFFECT LED DRIVER**

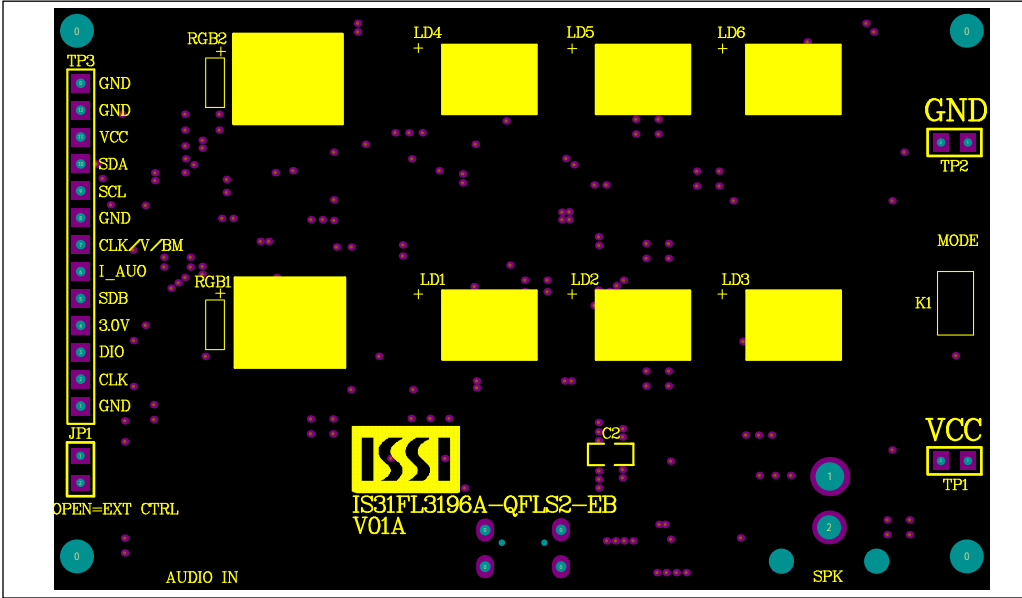


Figure 4: Board Component Placement Guide - Top Layer

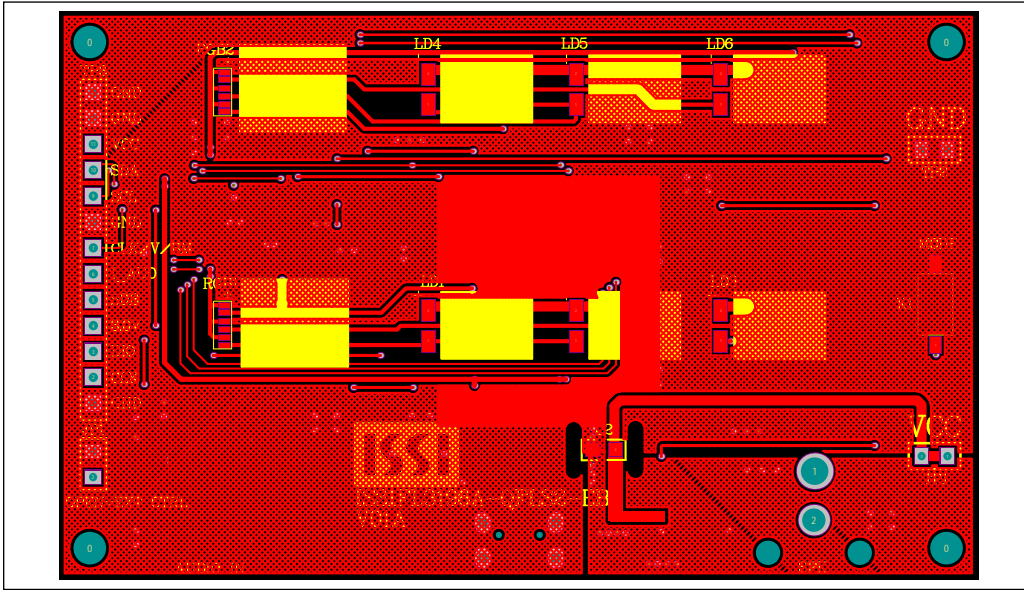
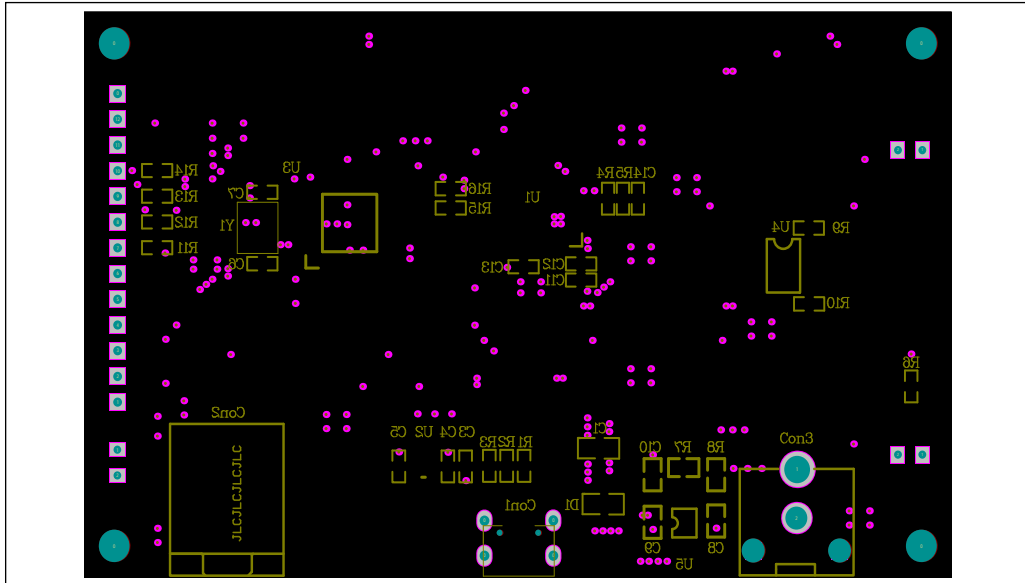
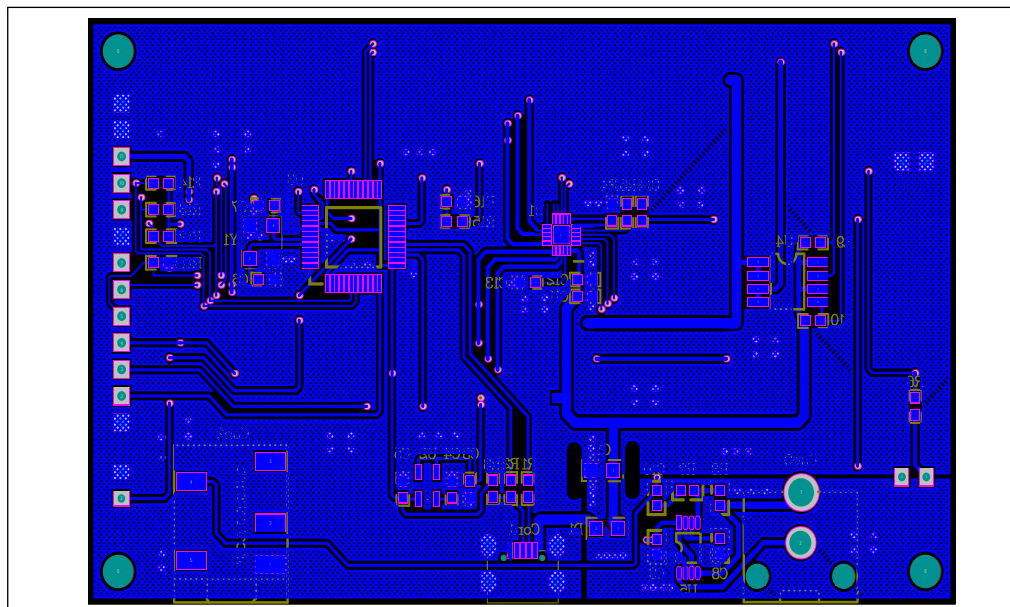


Figure 5: Board PCB Layout - Top Layer



**Figure 6: Board Component Placement Guide - Bottom Layer**



**Figure 7: Board PCB Layout - Bottom Layer**

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### REVISION HISTORY

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| Revision | Detail Information            | Data       |
|----------|-------------------------------|------------|
| B        | Initial release               | 2017.02.23 |
| C        | Remove IS31FL3196 description | 2017.08.22 |

### APPENDIX I : IS31FL3196A Arduino Test Code V01A

```

#include<Wire.h>
#include<avr/pgmspace.h>
#define Addr_GND  0xC8//7 bit format is 0x64
#define Addr_VCC  0xCE//7 bit format is 0x67
#define Addr_SCL  0xCA//7 bit format is 0x65
#define Addr_SDA  0xCC//7 bit format is 0x66

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
};

void setup() {
  // put your setup code here, to run once:
  Wire.begin();
  Wire.setClock(400000);//I2C 400kHz
  // pinMode(4,OUTPUT);//SDB
  // digitalWrite(4,HIGH);//SDB_HIGH
  IS31FL3196A_mode2();
}

void loop()
{
  // put your main code here, to run repeatedly:
  //IS31FL3196A_mode1();//PWM mode, if enable this mode, need to disable IS31FL3196A_mode2
}

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

void Init_FL3196A(void)
{
  IS_IIC_WriteByte(Addr_GND,0x00,0x01);//normal operation
  IS_IIC_WriteByte(Addr_GND,0x01,0x77);//on/off
  IS_IIC_WriteByte(Addr_GND,0x03,0x00);
  IS_IIC_WriteByte(Addr_GND,0x04,0x00);
  for(i=0x07;i<0x0F;i++){IS_IIC_WriteByte(Addr_GND, i, 0x00);}//PWM data
  IS_IIC_WriteByte(Addr_GND, 0x10, 0x00);//update
}

void Rgb_Pwm_Control_FL3196(uint8_t datx,uint8_t datR,uint8_t datG,uint8_t datB)//datx RGBx
{
  switch(datx)
  {
    case 1:IS_IIC_WriteByte(Addr_GND, 0x07, datG);//set out1 pwm  G
            IS_IIC_WriteByte(Addr_GND, 0x08, datR);//set out2 pwm  R
            IS_IIC_WriteByte(Addr_GND, 0x09, datB);//set out3 pwm  B
            break;
    case 2:IS_IIC_WriteByte(Addr_GND, 0x0A, datG);//set out4 pwm  G
            IS_IIC_WriteByte(Addr_GND, 0x0B, datR);//set out5 pwm  R
            IS_IIC_WriteByte(Addr_GND, 0x0C, datB);//set out6 pwm  B
            break;
    default:break;
  }
  IS_IIC_WriteByte(Addr_GND, 0x10, 0x00);//update PWM registers
}

```



## 6-CHANNEL LIGHT EFFECT LED DRIVER

```

void IS31FL3196A_mode1(void)//need to run in loop
{
  Init_FL3196A();
  for (j=0;j<64;j++)//all LED ramping up
  {
    Rgb_Pwm_Control_FL3196(1, PWM_Gamma64[j],PWM_Gamma64[j],PWM_Gamma64[j]);
    Rgb_Pwm_Control_FL3196(2, PWM_Gamma64[j],PWM_Gamma64[j],PWM_Gamma64[j]);
    delay(10);//10ms
  }
  delay(1000); //keep on 1s
  for (j=63;j>=0;j--)//all LED ramping down
  {
    Rgb_Pwm_Control_FL3196(1, PWM_Gamma64[j],PWM_Gamma64[j],PWM_Gamma64[j]);
    Rgb_Pwm_Control_FL3196(2, PWM_Gamma64[j],PWM_Gamma64[j],PWM_Gamma64[j]);
    delay(10);//10ms
  }
  delay(1000); //keep off 1s
}
void IS31FL3196A_mode2(void)//One shot mode, only in setup
{
  IS_IIC_WriteByte(Addr_GND,0x00,0x01);//normal operation
  IS_IIC_WriteByte(Addr_GND,0x01,0x77);//on/off
  IS_IIC_WriteByte(Addr_GND,0x04,0x00);

  IS_IIC_WriteByte(Addr_GND,0x07,0xff);//PWM
  IS_IIC_WriteByte(Addr_GND,0x08,0xff);
  IS_IIC_WriteByte(Addr_GND,0x09,0xff);
  IS_IIC_WriteByte(Addr_GND,0x0a,0xff);
  IS_IIC_WriteByte(Addr_GND,0x0b,0xff);
  IS_IIC_WriteByte(Addr_GND,0x0c,0xff);
  IS_IIC_WriteByte(Addr_GND,0x10,0x00);//update PWM registers

  IS_IIC_WriteByte(Addr_GND,0x11,0x00);//T0
  IS_IIC_WriteByte(Addr_GND,0x12,0x01);
  IS_IIC_WriteByte(Addr_GND,0x13,0x02);
  IS_IIC_WriteByte(Addr_GND,0x14,0x05);
  IS_IIC_WriteByte(Addr_GND,0x15,0x04);
  IS_IIC_WriteByte(Addr_GND,0x16,0x03);

  IS_IIC_WriteByte(Addr_GND,0x1a,0xa0);//T1~T3
  IS_IIC_WriteByte(Addr_GND,0x1b,0xa0);

  IS_IIC_WriteByte(Addr_GND,0x1d,0x07);//T4
  IS_IIC_WriteByte(Addr_GND,0x1e,0x07);
  IS_IIC_WriteByte(Addr_GND,0x1f,0x07);
  IS_IIC_WriteByte(Addr_GND,0x20,0x07);
  IS_IIC_WriteByte(Addr_GND,0x21,0x07);
  IS_IIC_WriteByte(Addr_GND,0x22,0x07);

  IS_IIC_WriteByte(Addr_GND,0x26,0x00);
  IS_IIC_WriteByte(Addr_GND,0x03,0x70);//One shot mode
}

```



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