# 28 CHANNELS LED DRIVER EVALUATION BOARD GUIDE

## DESCRIPTION

IS31FL3235/IS31FL3235A is comprised of 28 constant current channels each with independent PWM control, designed for driving LEDs, PWM frequency can be 3kHz or 22kHz (IS31FL3235A). The output current of each channel can be set at up to 38mA (Max.) by an external resistor and independently scaled by a factor of 1, 1/2, 1/3 and 1/4. The average LED current of each channel can be changed in 256 steps by changing the PWM duty cycle through an I2C interface.

## FEATURES

- 2.7V to 5.5V supply
- I2C interface, automatic address increment function
- Internal reset register
- Modulate LED brightness with 256 steps PWM
- Each channel can be controlled independently
- Each channel can be scaled independently by 1, 1/2, 1/3 and 1/4
- QFN-36 (4mm × 4mm) package

## QUICK START

*Figure 1: Photo of IS31FL3235/IS31FL3235A Evaluation Board*

## RECOMMENDED EQUIPMENT

- 5.0V, 1A 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 IS31FL3235/IS31FL3235A 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) If using external DC power supply connect the ground terminal of the power supply to the evaluation board's GND pin and the positive terminal to the VCC pin. The evaluation board can also be powered via the Micro USB connector.
2) Turn on the power supply or plug in the Micro-USB to the EVB and pay attention to the supply current. If the current exceeds 1A, please check for circuit fault.
3) Enter the desired mode of display by toggling the MODE button (K1).

## EVALUATION BOARD OPERATION

The evaluation board is controlled by LPC936 (8051 core).IS31FL3235/IS31FL3235A evaluation board demonstrates the white LEDs mode and RGB modes by switching between modes when the K1 button is pressed.

1) White LED Mode: White LEDs in three rows (27 LEDs in each row) are light as raining effect.
2) RGB Mode: Nine RGBs in the middle of the board will show color flowing effect.

***Note: IS31FL3235/IS31FL3235A solely controls the FxLED function on the evaluation board.***

## ORDERING INFORMATION

| Part No. | Temperature Range | Package |
|---|---|---|
| IS31FL3235-QFLS2-EB | -40°C to +85°C (Industrial) | QFN-36, Lead-free |
| IS31FL3235A-QFLS2-EB | | |

***Table1: Ordering Information***

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

## SOFTWARE SUPPORT

JP1 default setting is closed (jumper on). If it is open (no jumper), the on-board MCU will configure its own I2C/SDB/AD pins to High Impedance status so an external source can driver the I2C/SDB signals to control the IS31FL3235/ IS31FL3235A LED driver, the on-board MCU will also configure the U2 to open the VRGB and close the VLED. (Some early boards we provided still only open VLED)

The AD pin is pulled high via R5 setting the device address of IS31FL3235/ IS31FL3235A to 0x7E (0x3F for 7bit address format).

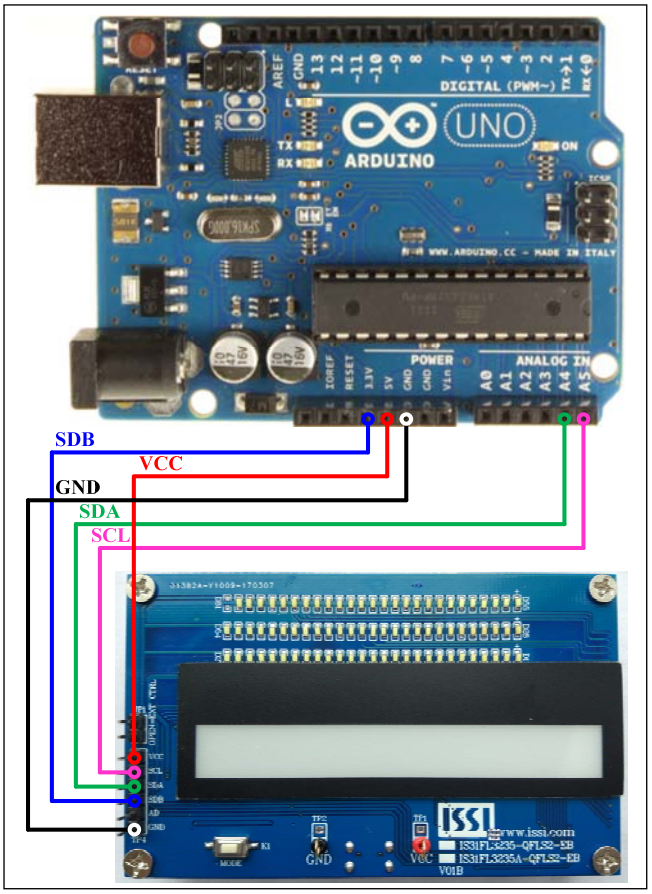


***Figure 2: Photo of Arduino UNO connected to Evaluation Board***

The steps listed below is 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. Also download the Wire.h library from 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 IS31FL3235/IS31FL3235A test firmware (sketch) from the ISSI website http://www.issi.com/US/product-analog-fxled-driversh tml.

1) Open JP1.
2) Connect the 5 pins from Arduino board to IS31FL3235/ IS31FL3235A EVB:
   a) Arduino 5V pin to IS31FL3235/ IS31FL3235A EVB VCC (TP4).
   b) Arduino GND to IS31FL3235/ IS31FL3235A EVB GND (TP4).
   c) Arduino SDA (A4) to IS31FL3235/ IS31FL3235A EVB SDA.
   d) Arduino SCL (A5) to IS31FL3235/ IS31FL3235A EVB SCL.
   e) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3235/ IS31FL3235A 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 LPC936 is disabled.
   (Some early board we provided is still controlling the white color LED)
5) In EVB code, the AD pin is pulled low via P0.1 of MCU, so the device address is 0x78. When JP1 is open, the AD pin will be pulled high via R5 and the default IS31FL3235 / IS31FL3235A device address becomes 0x7E (AD=VCC). The IS31FL3235 address can be changed by connecting the AD in TP4 as follows:
   a) AD=GND, device address=0x78.
   b) AD=SCL, device address=0x7A.
   c) AD=SDA, device address=0x7C.

***Please refer to the datasheet to get more information about IS31FL3235/IS31FL3235A.***

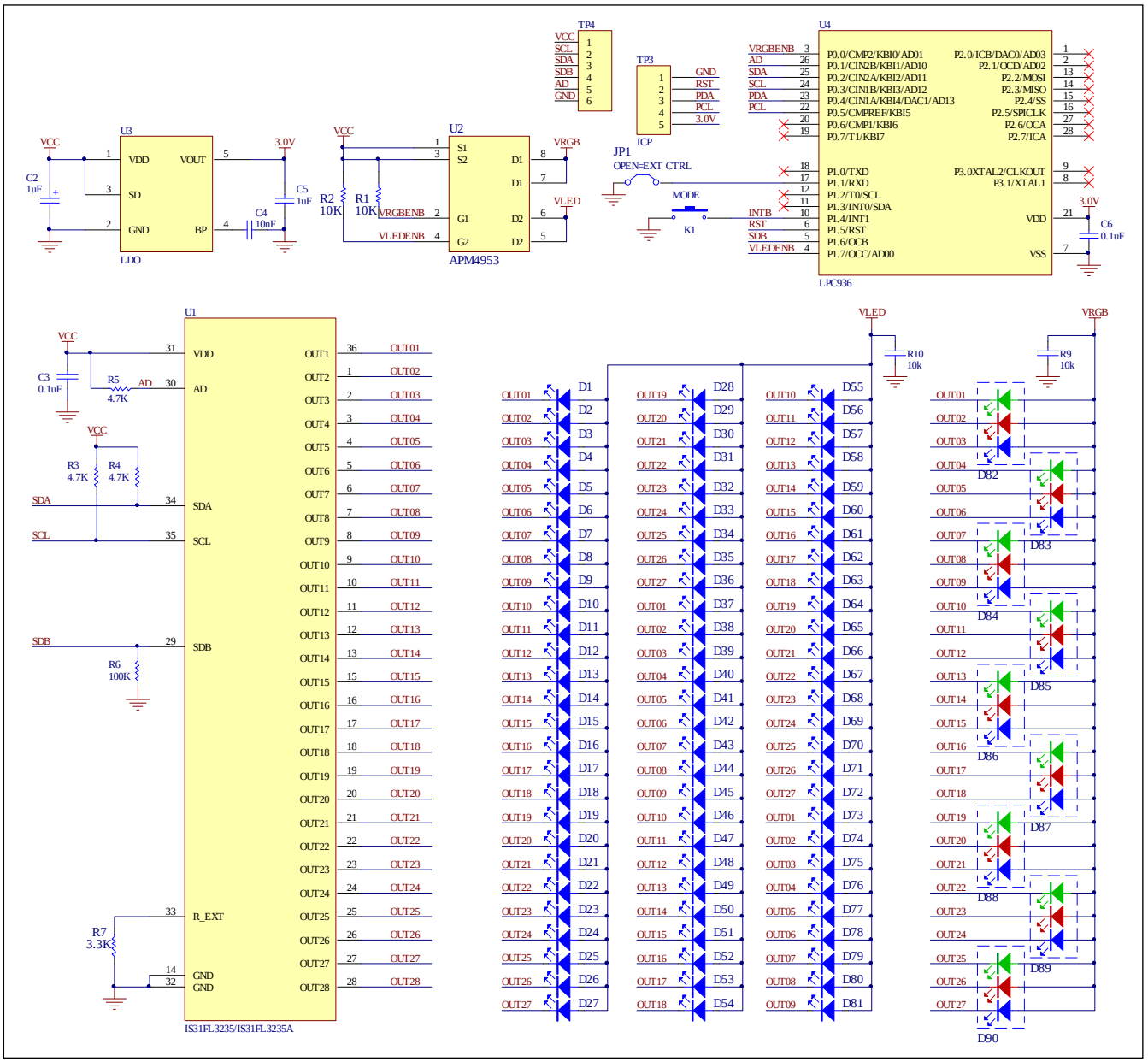


***Figure 3: IS31FL3235/IS31FL3235A Application Schematic***

## BILL OF MATERIALS

| Name | Symbol | Description | Qty | Supplier | Part No. |
|---|---|---|---|---|---|
| LED Driver | U1 | 28 CH FxLED Driver | 1 | ISSI | IS31FL3235/IS31FL3235A |
| PMOS | U2 | Dual PMOS | 1 | ANPEC | APM4953 |
| LDO | U3 | Low-dropout Regulator | 1 | SGMICRO | SGM2019 |
| MCU | U4 | Microcontroller | 1 | NXP | LPC936 |
| Diode | D1~D81 | Diode, LED White, SMD | 81 | Everlight | 19-217/BHC-ZL1M2RY/3T |
| Diode | D82~D90 | Diode, LED RGB, SMD | 9 | Everlight | 99-235/RGBC/TR8 |
| Diode | DS1,DS2 | Diode, SMD | 2 | DIODES | DFLS240 |
| Resistor | R1,R2, R9, R10 | RES,10k,1/16W,±5%,SMD R9 & R10 is for discharging the VCC when switch mode | 4 | Yageo | RC0603JR-0710KL |
| Resistor | R3,R4,R5 | RES,4.7k,1/16W,±5%,SMD | 3 | Yageo | RC0603JR-074K7L |
| Resistor | R6 | RES,100k,1/16W,±5%,SMD | 1 | Yageo | RC0603JR-07100KL |
| Resistor | R7 | RES,3.3k,1/16W,±5%,SMD | 1 | Yageo | RC0603JR-0713K3L |
| Resistor | R8 | NC | | | |
| Capacitor | C1 | CAP,10μF,16V,±20%,SMD | 1 | Yageo | CC0603KKX7R9BB106 |
| Capacitor | C2,C5 | CAP,1μF,16V,±20%,SMD | 2 | Yageo | CC0603KKX7R9BB105 |
| Capacitor | C3,C6 | CAP,0.1μF,16V,±20%,SMD | 2 | Yageo | CC0603KKX7R9BB104 |
| Capacitor | C4 | CAP,10nF,16V,±20%,SMD | 1 | Yageo | CC0603KKX7R9BB103 |
| Button | K1 | Button SMD | 1 | | |
| Connector | DC IN | Micro USB connector | 1 | | |

***Bill of Materials, refer to Figure 3 above.***

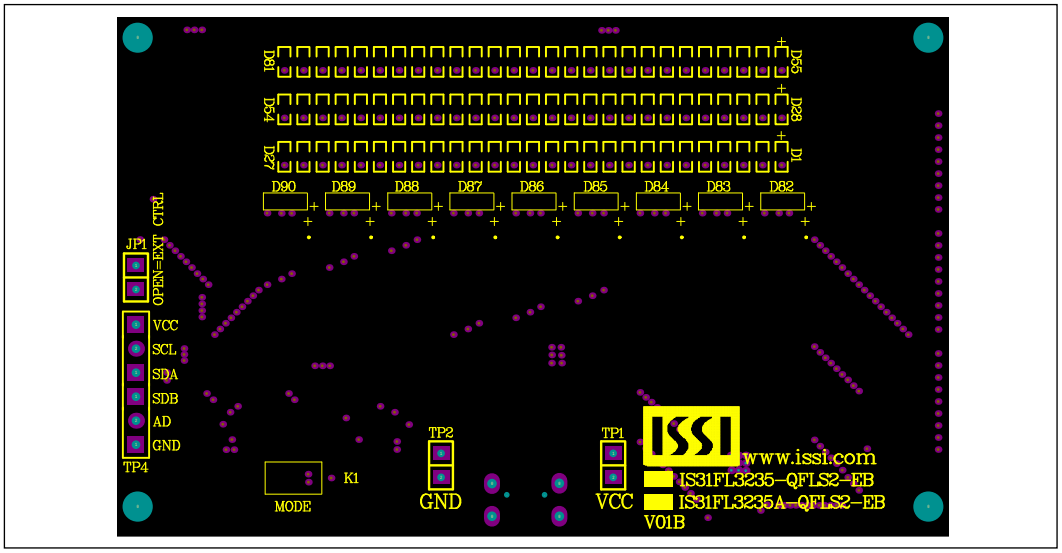


*Figure 4: Board Component Placement Guide - Top Layer*

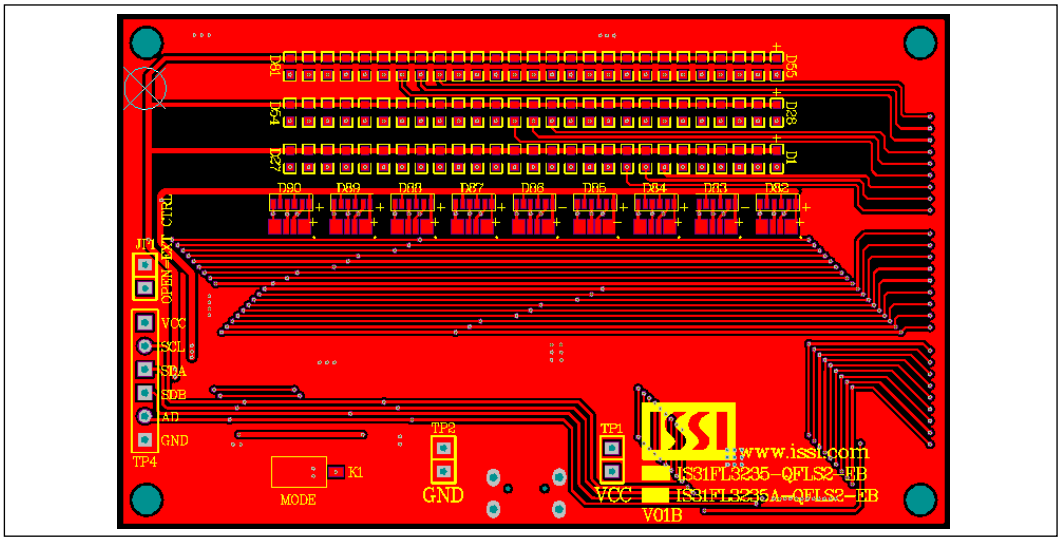


*Figure 5: Board PCB Layout - Top Layer*

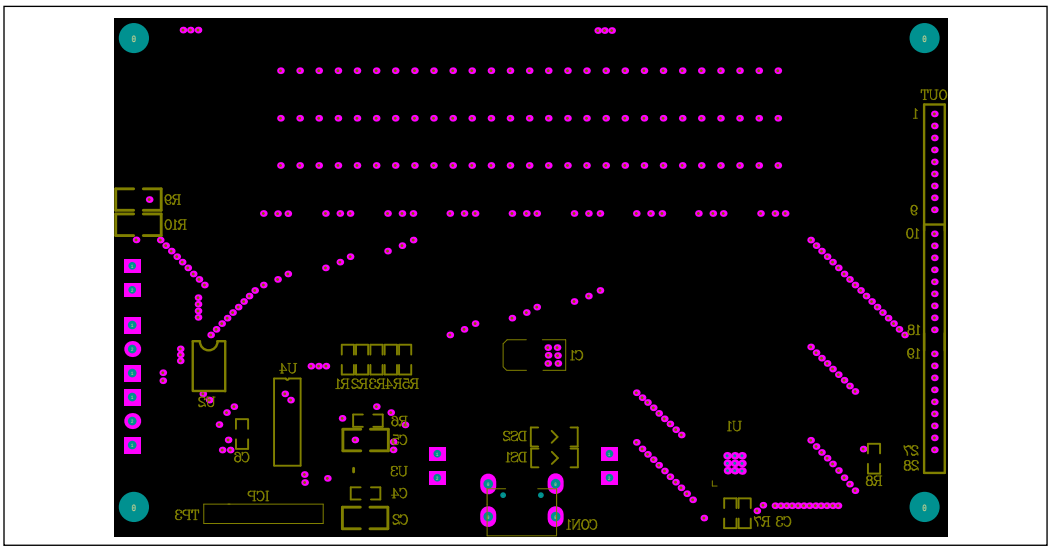

*Figure 6: Board Component Placement Guide - Bottom Layer*

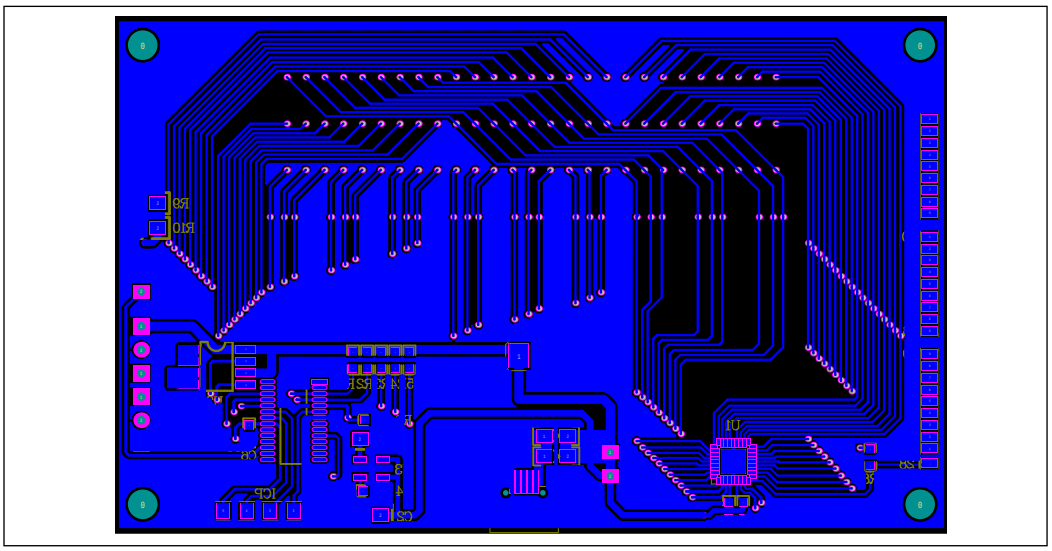

*Figure 7: Board PCB Layout - Bottom Layer*

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## REVISION HISTORY

| Revision | Detail Information | Data |
|---|---|---|
| R1.0 | Initial Release | 2012.11.18 |
| A | Translate Page to English | 2015.10.13 |
| B | 1. Update schematic and PCB.<br>2. Update bill of materials.<br>3. Add IS31FL3235A option<br>4. Add Arduino control guide<br>5. AD pin description: EVB code: AD=GND, Ext control: AD=VDD(Via R5) | 2017.05.04 |

## APPENDIX Ⅰ: IS31FL3235 / IS31FL3235A Arduino Test Code V01A

```
#include<Wire.h>
#include<avr/pgmspace.h>
#define Addr_VCC 0x7e//Some early boards we provided the AD pin is set to low, so if you couldn't make it work, try 0x78 as well

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() {
  // put your setup code here, to run once:
  Wire.begin();
  Wire.setClock(400000);//I2C 400kHz
  pinMode(4,OUTPUT);//SDB
  digitalWrite(4,HIGH);//SDB_HIGH
  Init_3235A();
}

void loop() {
  // put your main code here, to run repeatedly:
   IS31FL3235A_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_3235A(void)
{
  uint8_t i = 0;
  for(i=0x2A;i<=0x45;i++)
  {
    IS_IIC_WriteByte(Addr_VCC,i,0xff);//turn on all LED
```

```
  }

   for(i=0x05;i<=0x20;i++)
  {
    IS_IIC_WriteByte(Addr_VCC,i,0x00);//write all PWM set 0x00
  }

  IS_IIC_WriteByte(Addr_VCC,0x25,0x00);//updata
  IS_IIC_WriteByte(Addr_VCC,0x4B,0x01);//frequency setting 22KHz
  IS_IIC_WriteByte(Addr_VCC,0x00,0x01);//normal operation
}

void IS31FL3235A_mode1(void)//white LED
{
  uint8_t i = 0;
  int8_t j = 0;

  for(i=0x1D;i>=0x05;i-=3)//B LED running
  {
    IS_IIC_WriteByte(Addr_VCC,i,0xFF);//set   PWM
    IS_IIC_WriteByte(Addr_VCC,0x25,0x00);//updata
    delay(100);//100ms
  }
  for(i=0x06;i<=0x20;i+=3)//R LED running
  {
    IS_IIC_WriteByte(Addr_VCC,i,0xFF);//set   PWM
    IS_IIC_WriteByte(Addr_VCC,0x25,0x00);//updata
    delay(100);//100ms
  }
  for(i=0x1F;i>=0x05;i-=3)//G LED running
  {
    IS_IIC_WriteByte(Addr_VCC,i,0xFF);//set   PWM
    IS_IIC_WriteByte(Addr_VCC,0x25,0x00);//updata
    delay(100);//100ms
  }
   for (j=63;j>=0;j--)//all LED breath falling
  {
      for(i=0x05;i<0x20;i++)
    {
      IS_IIC_WriteByte(Addr_VCC,i,pgm_read_byte_near(&PWM_Gama64[j]));//set all PWM
    }
    IS_IIC_WriteByte(Addr_VCC,0x25,0x00);//updata
    delay(20);//20ms
  }
  delay(500); //keep on 0.5s
}
```

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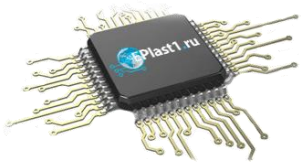


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