24 CHANNELS LED DRIVER EVALUATION BOARD GUIDE

DESCRIPTION

IS31FL3224 is an LED driver with 24 high voltage (16V) constant current channels. Each channel can be pulse width modulated (PWM) with 7-bit/8-bit precision for smooth LED brightness control. The maximum output current of each channel is designed to be 40mA, which can be adjusted by three 7-bit/8-bit global control registers group (one group for R for CS 3×n, one group for G for channels 3×n+1, and one group for B for channels 3×n+2, n=0~7, for example: one group for R is CS0, CS3, CS6 … CS21. one group for G is CS1, CS4, CS7 … CS22 and one group for B is CS2, CS5, CS8 … CS23). Proprietary algorithms are used in IS31FL3224 to minimize power bus noise caused by passive components on the power bus such as MLCC decoupling capacitor. All registers can be programmed via HSB (high speed series bus, up to 10MHz), DSB (Manchester encoded, daisy chained serial bus, up to 2MHz), SPI (12MHz) bus or I2C (1MHz) interface.

FEATURES

- V$_{CC}$= 3.0V to 5.5V
- Support 24 constant current channels, tolerate up to 18V, nominal operation voltage up to 16V
- Constant-current output range: 40mA
- Current output range (open drain (OD) mode): 100mA × 24 channels
- Interface (MODE pins)
- DSB (Daisy Chained Serial Bus, 2MHz)
- HSB (High Speed Series Bus: 10MHz)
- SPI (12MHz)
- I2C (1MHz)
- For DSB and HSB
- Built-in PWM generator: 7-bit/ch
- 7-bit × 3 global current adjustment
- For SPI and I2C
- Built-in PWM generator: 8-bit/ch
- 8-bit × 3 global current adjustment
- Power noise reduction method
- 4-groups delay to minimize the power ripple (See application information section for more detail)
- Power Noise Reduction (PNR): Left, Right, Middle
- Spread spectrum
- Programmable detection of open/short, detected LED and store detected LED information in registers for ease of manufacturing/debugging
- Over temperature (thermal shutdown) protection
- Over current protection
- Under voltage protection
- Software shutdown mode
- Operating temperature: -40°C to 125°C
- QFN-40 (5mm×5mm) package
- RoHS & Halogen-Free Compliance
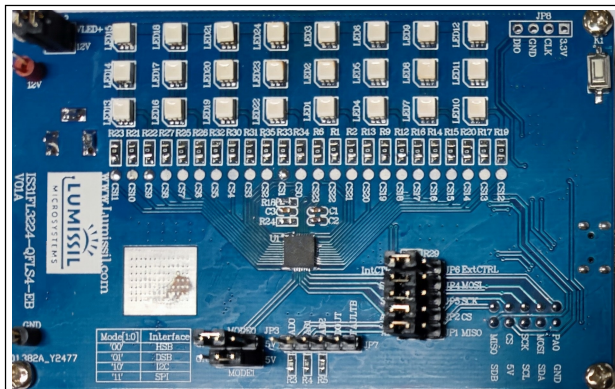- TSCA Compliance

QUICK START

Figure 1: Photo of IS31FL3224 Evaluation Board

RECOMMENDED EQUIPMENT

- 12V, ≥1.5A power supply

ABSOLUTE MAXIMUM RATINGS

- VIN+, ≤16V power supply

Caution: EVB is designed for 12V application, higher than 12V will cause extra-heat on the IC and if VIN (CON2) is higher than 16V, the IS32FL3224 will be too hot and enter thermal shutdown mode, if VIN (CON2) exceeds the conditions listed above, the board may be damaged.

ORDERING INFORMATION

Part No.	Temperature Range	Package
IS31FL3224-QFLS4-EB	-40°C to +125°C	QFN-40, 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.*

PROCEDURE

The IS31FL3224 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 the ground terminal of the power supply to the GND and the positive terminal to the 12V or connect the DC power to the connector (CON2).
2) JP6 set to 'IntCTRL' (Internal Control) to enable the control of board MCU (default status).
3) I2C MODE (default mode):
    JP3 MODE1 set to 5V, MODE0 set to GND.
    JP4 set to SDA.
    JP5 set to SCL.
    JP2 set to AD0.
    JP1 set to AD1.
    SPI MODE:
    JP3 MODE1 set to 5V, MODE0 set to 5V.
    JP4 set to MOSI.
    JP5 set to SCK.
    JP2 set to CS.
    JP1 set to MISO.
    DSB MODE:
    JP3 MODE1 set to GND, MODE0 set to 5V.
    JP4 set to MOSI.
    JP2 set to AD0.
    JP1 set to AD1.
    HSB MODE:
    JP3 MODE1 set to GND, MODE0 set to GND.
    JP4 set to MOSI.
    JP5 set to SCK.
    JP2 set to AD0.
    JP1 set to AD1.
4) Turn on the power supply and pay attention to the supply current. If the current exceeds 1.5A, please check for circuit fault.
5) Enter the desired mode of display by toggling the MODE button.

EVALUATION BOARD OPERATION

The IS31FL3224 evaluation board has four display modes. Press K1 to switch configurations:

Note: See Appendix for each mode's detail.

1) (Default mode) Waterfall #1.

2) Breath.

3) White.

*Note: IS31FL3224 solely controls the FxLED function on the evaluation board.*

SOFTWARE SUPPORT

JP6 default setting is 'IntCTRL' (Internal Control). If it is set to 'ExtCTRL' (External Control), the on-board MCU will stop working. The SPI/I2C pins and SDB pin are set to High Impedance. External I2C and SDB signals can be connected to TP1 to control the IS31FL3224 LED driver.

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. 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 IS31FL3224 test firmware (sketch) from the Lumissil website http://www.lumissil.com/products/led-driver/fxled.
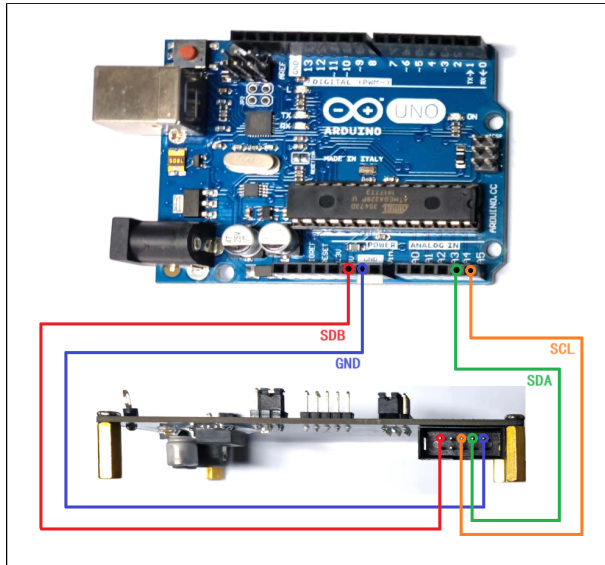
Figure 2: Photo of Arduino UNO connected to Evaluation Board

1) JP6 set to 'ExtCTRL' (External Control).
2) MODE1 Short the 5V, MODE0 Short the GND.
3) JP4 set to SDA.

4) JP5 set to SCL.
5) JP2 set to AD0.
6) JP1 set to AD1.
7) Connect the 4 pins from Arduino board to IS31FL3224 EVB:
   a) Arduino GND to IS31FL3224 EVB GND.
   b) Arduino SDA (A4) to IS31FL3224 EVB SDA.
   c) Arduino SCL (A5) to IS31FL3224 EVB SCL.
   d) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3224 EVB SDB, if Arduino use 5.0V MCU VCC, connect 5.0V to EVB SDB. (Arduino UNO's VCC (VOH) is 5.0V, so SDB=5.0V).
8) 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.
9) Run the Arduino code and the initial mode will change the RGB LED colors.

Please refer to the datasheet to get more information about IS31FL3224.
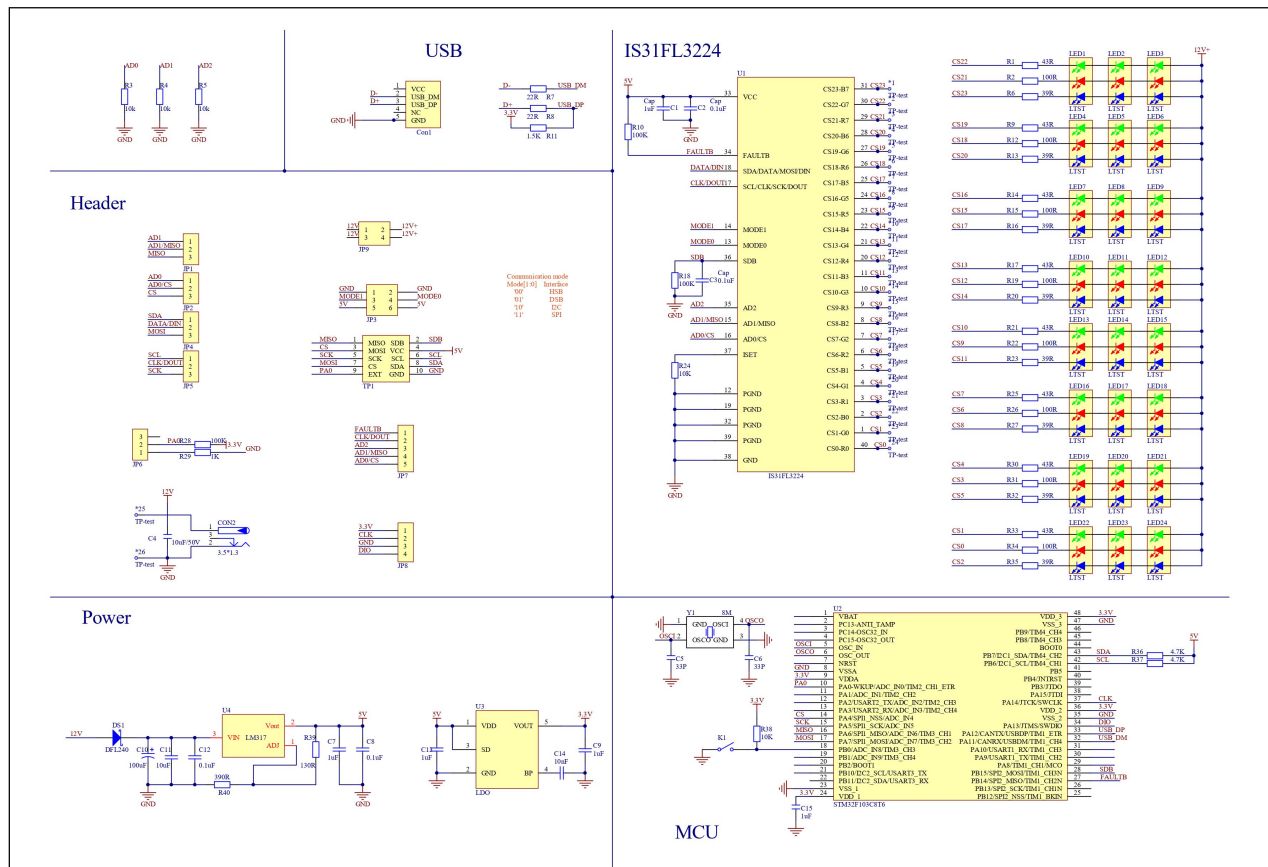
Figure 3: IS31FL3224 Application Schematic

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
LED Driver	U1	24CH FxLED Driver	1	Lumissil	IS31FL3224
MCU	U2	Microcontroller	1	STM	STM32F103C8T6
LDO	U3	Low-dropout Regulator	1	SGMICRO	SGM2019-3.3V
LDO	U4	Low-dropout Regulator	1	ONSEMI	LM317
LED	LED1~LED24	RGB LED	18	LITEON	LTST-G683GEBW-P2
Diode	DS1	Diode, SMD	1	DIODES	DFLS240
Resistor	R3, R4, R5, R38	RES,10K,1/10W,±5%,SMD	4	Yageo	RC0603JR-0710KL
Resistor	R1, R9, R14, R17, R21, R25, R30, R33	RES,43R,1/8W,±5%,SMD	8	Yageo	RC0805JR-0743RL
Resistor	R7, R8	RES,22R,1/10W,±5%,SMD	2	Yageo	RC0603JR-0722RL
Resistor	R6, R13, R16, R20, R23, R27, R32, R35	RES,39R,1/8W,±5%,SMD	8	Yageo	RC0805JR-0739RL
Resistor	R2, R12, R15, R19, R22, R26, R31, R34	RES,100R,1/8W,±5%,SMD	8	Yageo	RC0805JR-07100RL
Resistor	R40	RES,390R,1/10W,±5%,SMD	1	Yageo	RC0603JR-07390RL
Resistor	R10,R18,R28	RES,100K,1/10W,±5%,SMD	3	Yageo	RC0603JR-07100KL
Resistor	R36, R37	RES,4.7K,1/10W,±5%,SMD	2	Yageo	RC0603JR-074K7L
Resistor	R11	RES,1.5K,1/10W,±5%,SMD	1	Yageo	RC0603JR-071K5L
Resistor	R24	RES,10K,1/10W,±5%,SMD	1	Yageo	RC0603JR-0710KL
Resistor	R39	RES,130R,1/10W,±5%,SMD	1	Yageo	RC0603JR-07130RL
Resistor	R29	RES,1K,1/10W,±5%,SMD	1	Yageo	RC0603JR-071KL
Capacitor	C14	CAP,10nF,16V,±20%,SMD	1	Yageo	CC0603KRX7R7BB103
Capacitor	C1, C2, C3, C8	CAP,100nF,16V,±20%,SMD	4	Yageo	CC0603MRX7R7BB104
Capacitor	C10	CAP,100µF,35V,±20%,SMD	1	Lelon	VEU101M1VTR-0810
Capacitor	C11, C4	CAP,10µF, 50V,±10%,SMD	2	Yageo	CC1206KKX5R9BB106
Capacitor	C12	CAP,100nF,25V,±10%,SMD	1	Yageo	AC1206KRX7R8BB104
Capacitor	C7	CAP,1µF,16V,±10%,SMD	1	Yageo	AC0805KFX7R7BB105
Capacitor	C5, C6	CAP,33pF,25V,±10%,SMD	2	Yageo	CQ0603JRNPO9BN330
Capacitor	C9, C13, C15	CAP,1µF,16V,±10%,SMD	3	Yageo	CC0603KRX7R7BB105
Crystal	Y1	Crystal, 8MHz,SMD	1	JB	HC-49S
Button	K1	Button, SMD	1		

Bill of Materials, refer to Figure 3 above.
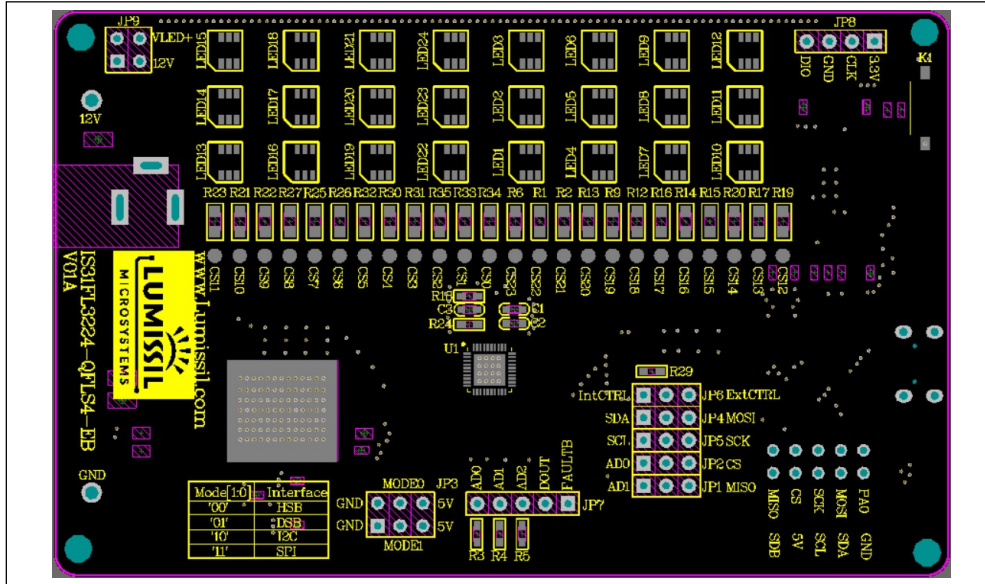
Figure 4: Board Component Placement Guide - Top Layer
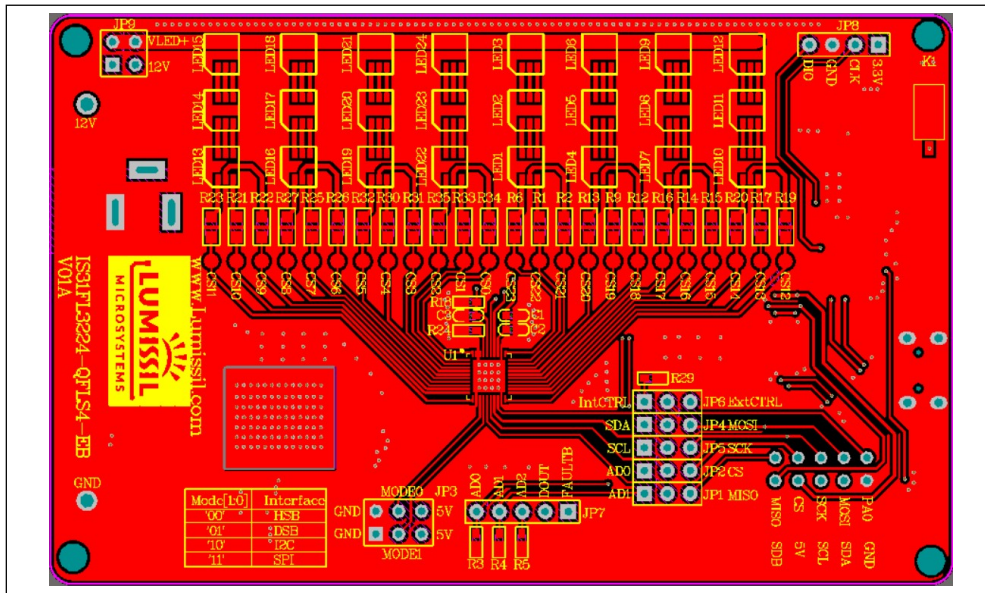
Figure 5: Board PCB Layout - Top Layer
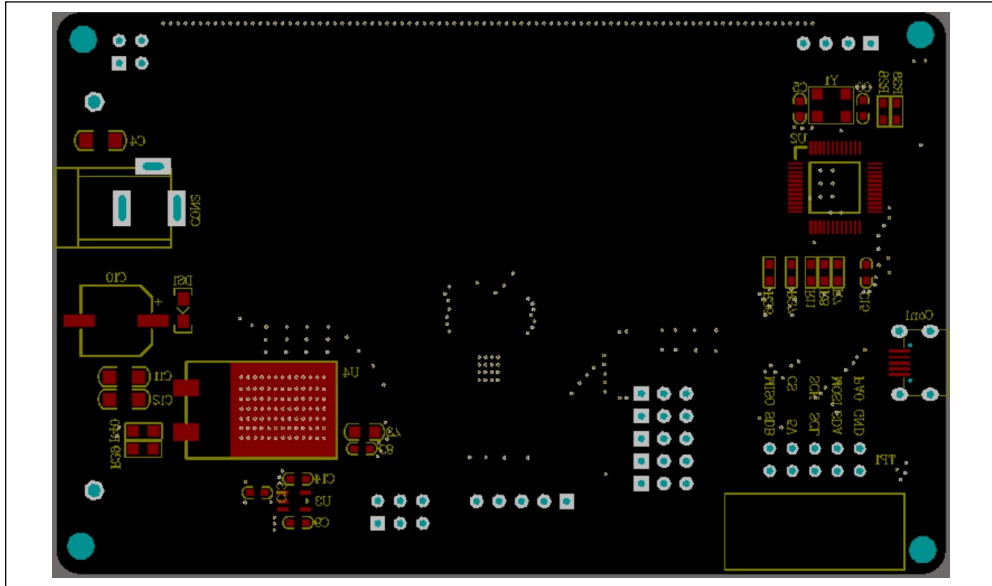
Figure 6: Board Component Placement Guide - Bottom Layer
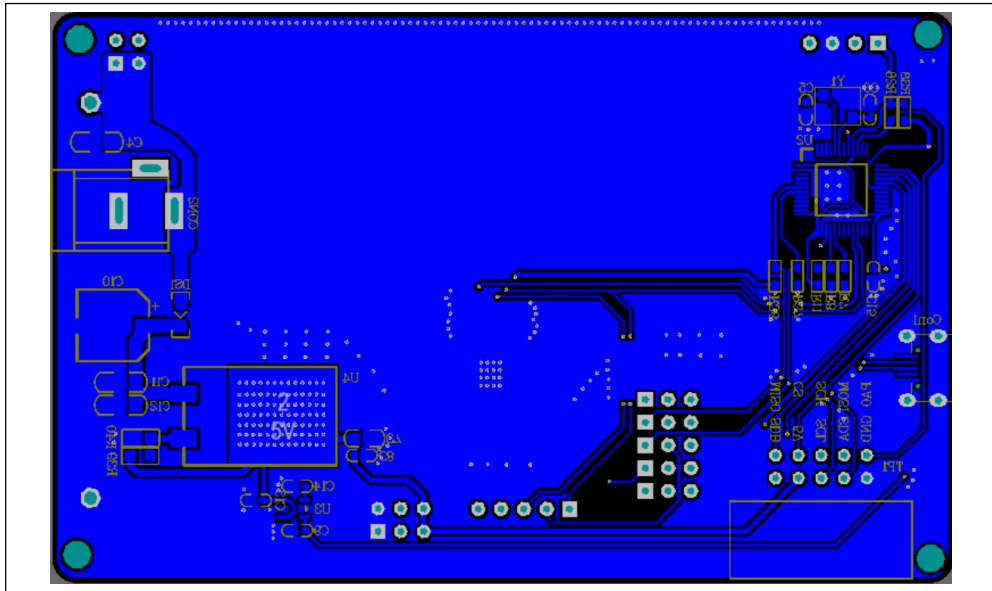
Figure 7: Board PCB Layout - Bottom Layer

REVISION HISTORY

Revision	Detail Information	Data
A	Initial Release	2024.01.03

APPENDIX Ⅰ: IS31FL3224 Arduino Test Code IIC V01A

```
#include<Wire.h>
#include<avr/pgmspace.h>
#define Addr_GND_GND_GND 0x80 //IC Address

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:


  // initialize IIC:
  Wire.begin();
  Wire.setClock(400000); //I2C 400kHz
  Init3224();
}
void loop() {
  // put your main code here, to run repeatedly:
  IS31FL3224_MODE1();
}
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 IS_IIC_WriteBuffer(uint8_t pBuffer, int length, uint8_t Dev_Add,uint8_t Reg_Add) //writing an LED register (Automatic address increment)
{
  Wire.beginTransmission(Dev_Add/2); // send in the address and value via IIC:
  Wire.write(Reg_Add); // sends regaddress
  while(length--)
  {
  Wire.write(pBuffer);
  }
  Wire.endTransmission(); // stop transmitting
}
void Init3224(void)
{
  int i,j;
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x8E,0xC6); //unlock function register
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x90,0x02); //normal operation and set PWM frequency 32kHz

  IS_IIC_WriteByte(Addr_GND_GND_GND,0x92,0xFF);//GCCR
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x94,0xFF);//GCCG
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x96,0xFF);//GCCB

  IS_IIC_WriteByte(Addr_GND_GND_GND,0x98,0x00);//disable SSP function.
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x9A,0x90);//Enable phase delay
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x9C,0x00);//Disable thermal roll off and disable open short
  IS_IIC_WriteByte(Addr_GND_GND_GND,0x8E,0x00);//lock function register
  delay(50);
}
void IS31FL3224_MODE1(void)
{
  int i,j;
  while(1)
  {
     for(j=0;j<64;j++)// LED Breath Up
       {
         for (i=0x02;i<=0x30;i+=2)
         {
             IS_IIC_WriteByte(Addr_GND_GND_GND,i,PWM_Gamma64[j]); //PWM Data
         }
```

```
            IS_IIC_WriteByte(Addr_GND_GND_GND,0x32,0x00);    //Update
            delay(10);
        }
    for(j=63;j>=0;j--)// LED Breath Down
    {
            for (i=0x02;i<=0x30;i+=2)
            {
                IS_IIC_WriteByte(Addr_GND_GND_GND,i,PWM_Gamma64[j]); //PWM Data
            }
            IS_IIC_WriteByte(Addr_GND_GND_GND,0x32,0x00);    //Update
            delay(10);
    }
  }
}
```