# 16 CHANNELS LED DRIVER EVALUATION BOARD GUIDE

## DESCRIPTION

The IS31FL3216A is a fun light LED controller with an audio modulation mode. It can store data of 8 frames with internal RAM to play small animations automatically.

IS31FL3216A can sample the input signal to modulate the intensity of LEDs, or control 8 frames playing by internal ADC block.

The LED current of each channel can be set in 256 steps by adjusting the PWM duty cycle through an I2C interface. 8 channels can be used as GPIO ports.

## FEATURES

- 2.7V to 5.5V supply
- I2C interface, automatic address increment function
- Internal RAM
- Modulate LED brightness with 256 steps PWM
- PWM frequency up to 26kHz
- Each channel can be controlled independently
- Auto Frame Play Mode with 8 frames
- 8 frames memory for animations
- Audio Frame Mode with 8 frames
- 8 of 16 outputs not used as LED drivers can be used as GPIO ports
- 8 levels of maximum intensity control
- QFN-28 (4mm × 4mm) package

## QUICK START

*Figure 1: Photo of IS31FL3216A 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
- ≥ 8Ω speaker

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

## PROCEDURE

The IS31FL3216A 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) Connect an 8Ω speaker to the “SPK” connector.
3) Connect the audio source to the “AUDIO IN” connector.
4) Short J1 to close external control.
5) 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.
6) Turn on the audio signal.
7) Enter the desired mode of display by toggling the MODE button (K1).

## ORDERING INFORMATION

| Part No. | Temperature Range | Package |
|---|---|---|
| IS31FL3216A-QFLS3-EB | -40°C to +105°C (Industrial) | QFN-28, 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 evaluation board is controlled by LPC922. IS31FL3216A evaluation board has 9 modes:

1) Audio Mode: Blue LEDs light bar in board flashes to the sides with the strength of the music. The stronger the music, the closer the LED bar is to sides.
2) Audio Mode: Blue LEDs light bar in board flashes from left to right with the strength of the music. The stronger the music, the brighter the LED.
3) Audio Mode: Blue LEDs light bar in board flashes from right to left with the strength of the music. The stronger the music, the brighter the LED.
4) Audio Mode: RGBs light bar in board with music and weak flicker and switch colors. (The color changes to B-G-R).
5) Audio Mode (AGC OFF): RGBs light bar in board flashes from left to right with the strength of the music. Music the stronger the color bar the longer. Switch colors automatically every six to seven seconds.
6) Audio Mode (AGC ON, AGS 6dB): RGBs light bar in board flashes from left to right with the strength of the music. Music the stronger the color bar the longer. Switch colors automatically every six to seven seconds.
7) Auto frame play Mode: Blue LEDs light bar in board move form right to left with off-tail effect.
8) Auto frame play Mode: The blue LED light below the demo board moves from center to side.
9) Button Mode: OUT9~OUT16 use as input port, OUT~OUT drives 8 LEDs as output. The default 8 LEDs are all bright. Press the corresponding button on the left (OUT9~OUT16 corresponding pin grounding). Then the corresponding LED lights will go out.

***Note: IS31FL3216A solely controls the FxLED function on the evaluation board.***

## SOFTWARE SUPPORT

JP1 default setting is closed (jumper on). If it is open (when the EVB is powered on by 5V DC or micro-USB, no jumper JP1), 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 IS31FL3216A LED driver, the on-board MCU will also configure the U5 and U6 to open the VLED (Single color LED+) and close the VRGB.

The AD pin is pulled low setting the device address of IS31FL3216A to 0xE8 (0x74 for 7bit address format).

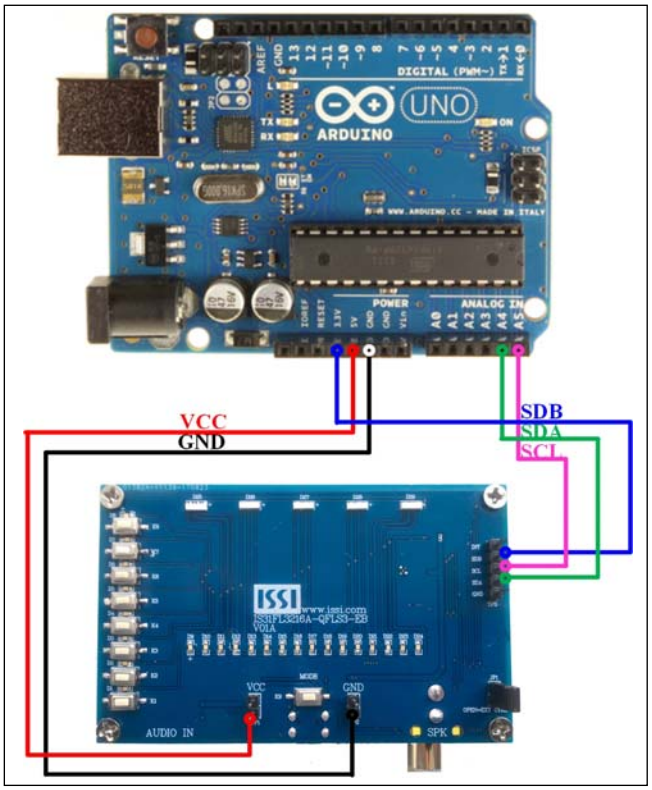


***Figure 2: Photo of Arduino UNO connected to Evaluation Board***

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. 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 IS31FL3216A 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 IS31FL3216A EVB:
   a) Arduino 5V pin to IS31FL3216A EVB VCC (TP3).
   b) Arduino GND to IS31FL3216A EVB GND (TP3).
   c) Arduino SDA (A4) to IS31FL3216A EVB SDA.
   d) Arduino SCL (A5) to IS31FL3216A EVB SCL.
   e) If Arduino use 3.3V MCU VCC, connect 3.3V to IS31FL3216A 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 single LED will always breathing.

***Please refer to the datasheet to get more information about IS31FL3216A.***

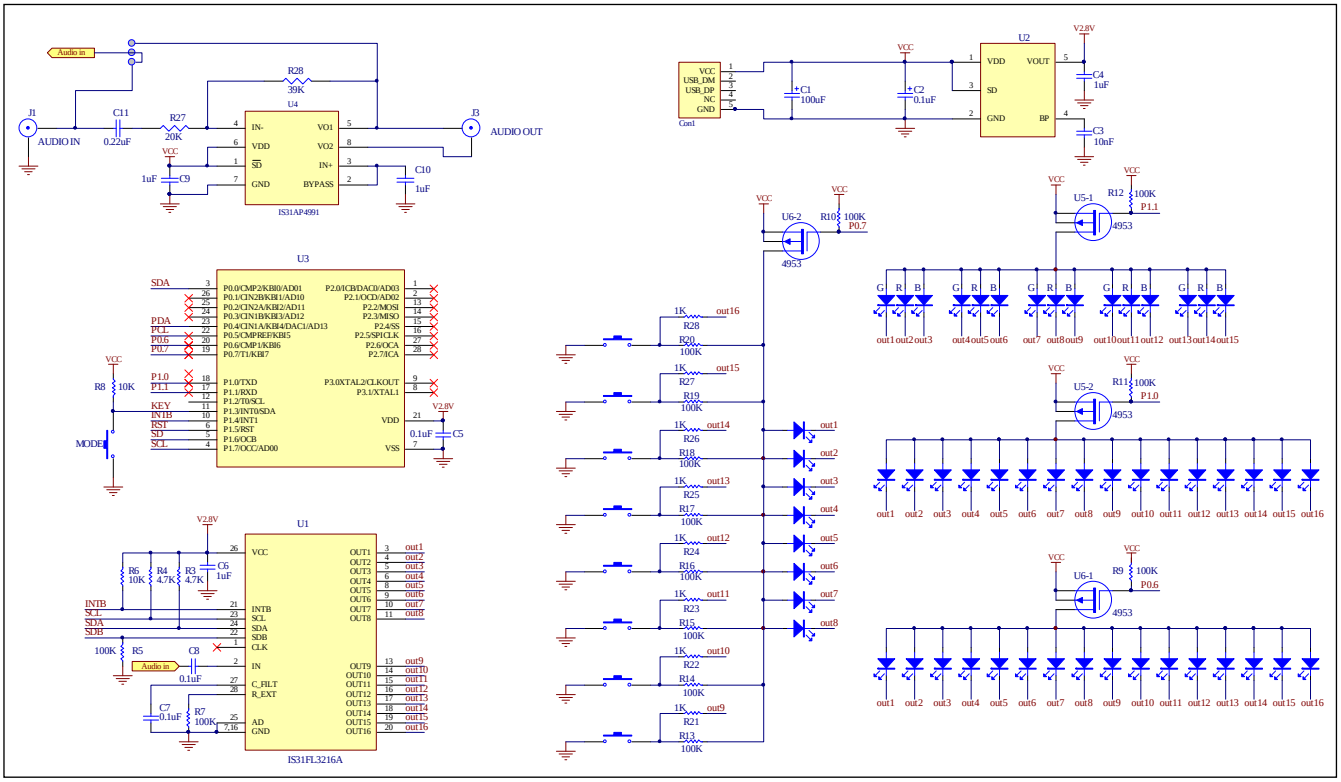


***Figure 3: IS31FL3216A Application Schematic***

## BILL OF MATERIALS

| Name | Symbol | Description | Qty | Supplier | Part No. |
|---|---|---|---|---|---|
| LED Driver | U1 | 16CH FxLED Driver | 1 | ISSI | IS31FL3216A |
| LDO | U2 | Low-dropout Regulator | 1 | PAM | PAM3101 |
| MCU | U3 | Microcontroller | 1 | NXP | LPC922 |
| Audio Amplifier | U4 | Class-AB Audio Amplifier | 1 | ISSI | IS31AP4991 |
| PMOS | U5,U6 | Dual PMOS | 2 | ANPEC | APM4953 |
| Diode | D1~D24 | Diode, LED Blue, SMD | 24 | Everlight | 19-217/BHC-ZL1M2RY/3T |
| Diode | D25~D29 | Diode, LED RGB, SMD | 5 | Everlight | 99-235/RGBC/TR8 |
| Resistor | R1 | RES,3.3k,1/16W,±5%,SMD | 1 | Yageo | RC0603JR-073K3KL |
| Resistor | R2,R3 | RES,4.7k,1/16W,±5%,SMD | 2 | Yageo | RC0603JR-074K7L |
| Resistor | R4~R11 | RES,100k,1/16W,±5%,SMD | 8 | Yageo | RC0603JR-07100KL |
| Resistor | R13,R15, R17,R18, R21,R23,R25 | RES,100k,1/16W,±5%,SMD | 7 | Yageo | RC0603JR-07100KL |
| Resistor | R12,R14, R16,R18,R20 R22,R24,R26 | RES,4.7k,1/16W,±5%,SMD | 8 | Yageo | RC0603JR-074K7L |
| Resistor | R27 | RES,20k,1/16W,±5%,SMD | 1 | Yageo | RC0603JR-0720KL |
| Resistor | R28 | RES,39k,1/16W,±5%,SMD | 1 | Yageo | RC0603JR-07100KL |
| Capacitor | C1 | CAP,100μF,16V,±20%,SMD | 1 | Yageo | CC0603KKX7R9BB107 |
| Capacitor | C2,C5,C7,C8 | CAP, 0.1μF,16V,±20%,SMD | 4 | Yageo | CC0603KKX7R9BB104 |
| Capacitor | C4,C6, C9,C10, | CAP,1μF,16V,±20%,SMD | 4 | Yageo | CC0603KKX7R9BB105 |
| Capacitor | C3 | CAP,10nF,16V,±20%,SMD | 1 | Yageo | CC0603KKX7R9BB103 |
| Capacitor | C11 | CAP, 0.22μF,16V,±20%,SMD | 1 | Yageo | CC0603KKX7R9BB224 |
| Button | K1~K9 | Button SMD | 9 | | |
| Connector | DC IN | Micro USB connector | 1 | | |

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

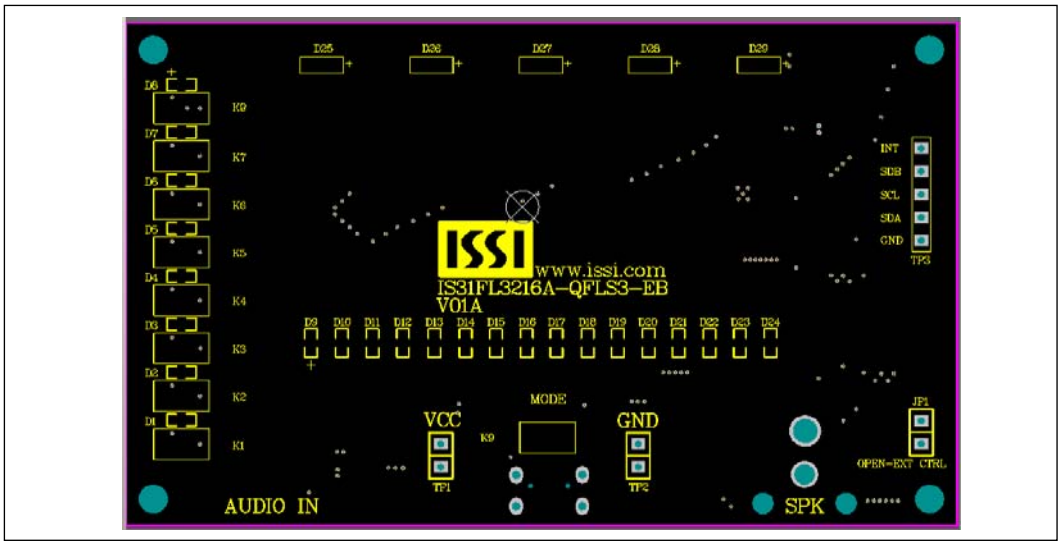


*Figure 4: Board Component Placement Guide - Top Layer*

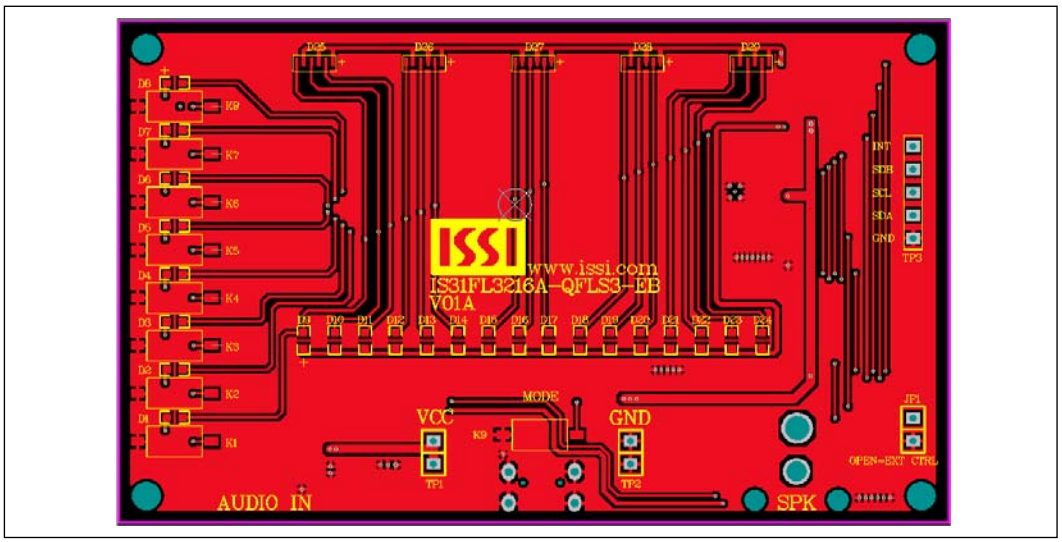


*Figure 5: Board PCB Layout - Top Layer*

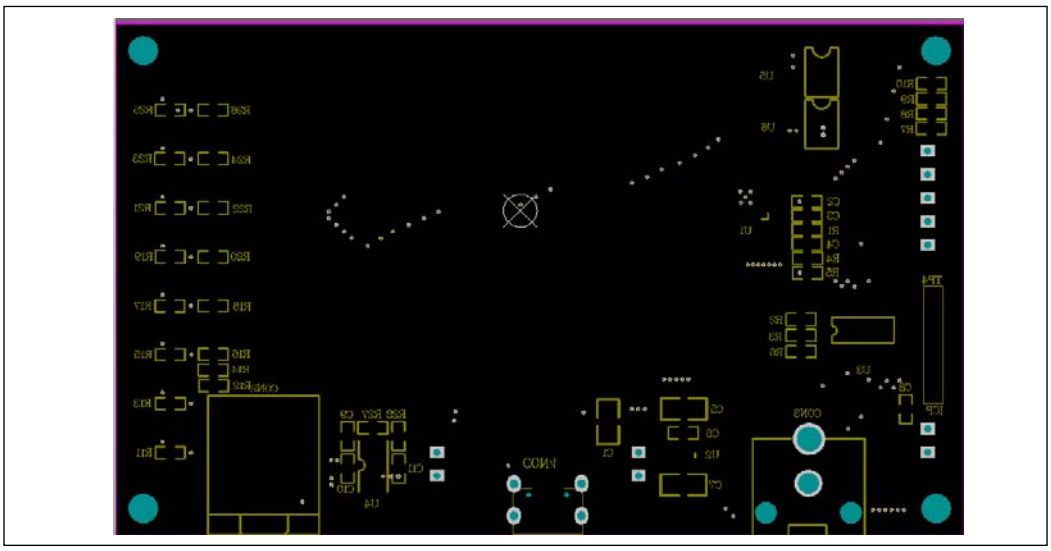

*Figure 6: Board Component Placement Guide - Bottom Layer*

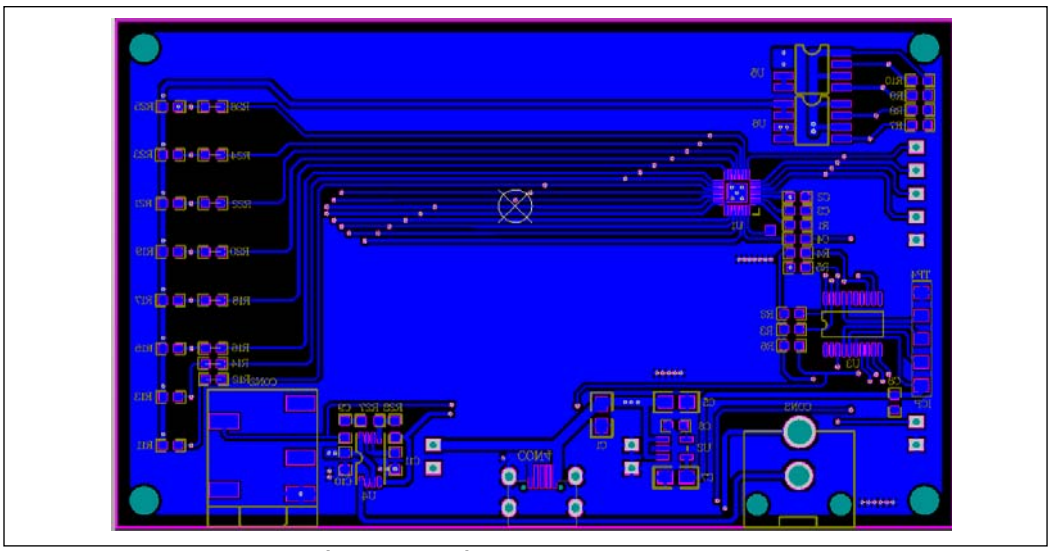

*Figure 7: Board PCB Layout - Bottom Layer*

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## REVISION HISTORY

| Revision | Detail Information | Data |
|---|---|---|
| A | Initial Release | 2017.09.18 |

## APPENDIX Ⅰ: IS31FL3216A Arduino Test Code V01A

```
#include<Wire.h>
#include<avr/pgmspace.h>
#define Addr_GND 0xE8
//7 bit format is 0x74(AD=L) or 0x77(AD=H)
const PROGMEM byte PWM_Gama64[128]=
{
   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,

   0xff,0xfe,0xfa,0xf6,0xf1,0xed,0xe9,0xe1,
   0xd6,0xcf,0xcb,0xc6,0xbf,0xb9,0xb0,0xac,
   0xa7,0xa0,0x9a,0x94,0x8d,0x88,0x80,0x7d,
   0x77,0x72,0x6d,0x69,0x64,0x5f,0x5a,0x55,
   0x4f,0x4b,0x48,0x44,0x40,0x3c,0x38,0x34,
   0x2e,0x28,0x25,0x22,0x1f,0x1d,0x1c,0x1a,
   0x16,0x13,0x11,0x0f,0x0d,0x0b,0x09,0x08,
   0x07,0x06,0x05,0x04,0x03,0x02,0x01,0x00
};

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_3216A();
}

void loop() {
   // put your main code here, to run repeatedly:
    IS31FL3216A_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_3216A(void)
{
  uint8_t i = 0;
  IS_IIC_WriteByte(Addr_GND,0x01,0xff);//turn on out9~16
  IS_IIC_WriteByte(Addr_GND,0x02,0xff);//turn on out1~8
   for(i=0x10;i<0x20;i++)
  {
    IS_IIC_WriteByte(Addr_GND,i,0x00);//write all PWM set 0x00
  }

  IS_IIC_WriteByte(Addr_GND,0xB0,0x00);//update
  IS_IIC_WriteByte(Addr_GND,0x00,0x00);//normal operation
}

void IS31FL3216A_mode1(void)//All LED Breath
{
  uint8_t i = 0;
  int8_t j = 0;
   for (j=0;j<127;j++)//all LED breath
  {
      for(i=0x10;i<0x20;i++)
    {
      IS_IIC_WriteByte(Addr_GND,i,pgm_read_byte_near(&PWM_Gama64[j]));//set all PWM
    }
    IS_IIC_WriteByte(Addr_GND,0xB0,0x00);//update
    delay(20);//20ms
  }
}
```

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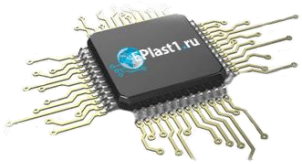


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