

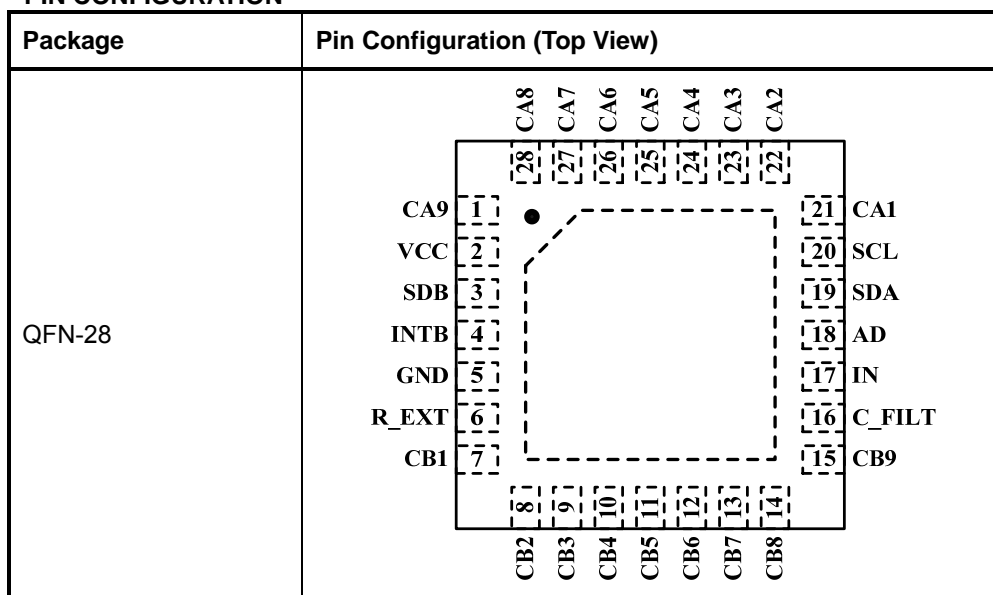
**APPLICATION NOTE**

**GENERAL DESCRIPTION**

The IS31FL3731 is a compact LED driver for 144 single LEDs. The device can be programmed via an I2C compatible interface. The IS31FL3731 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.

**PIN CONFIGURATION**



# IS31FL3731 AUDIO MODULATED MATRIX LED DRIVER



## TYPICAL APPLICATION CIRCUIT

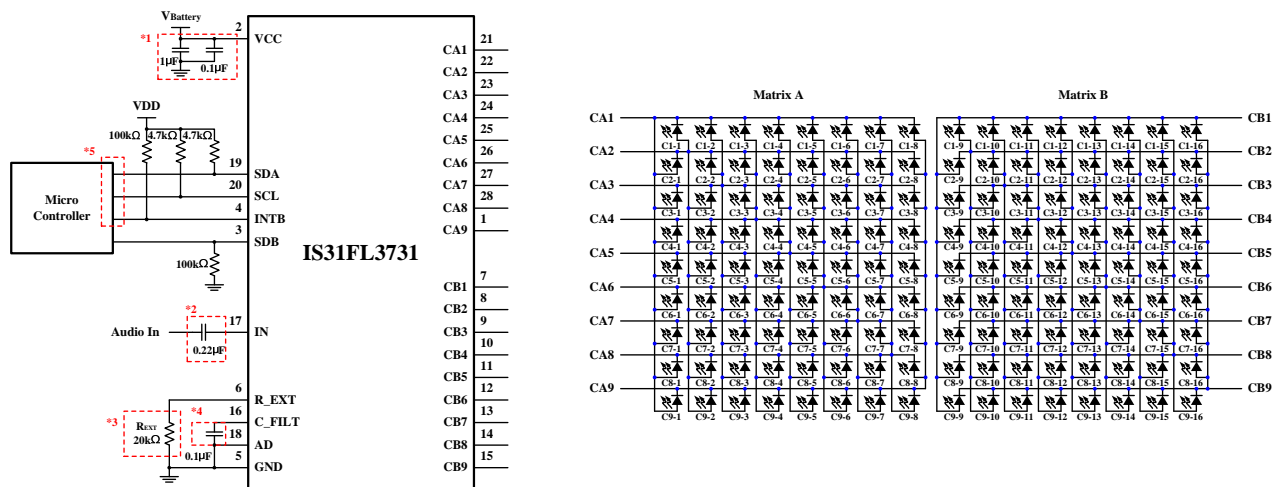


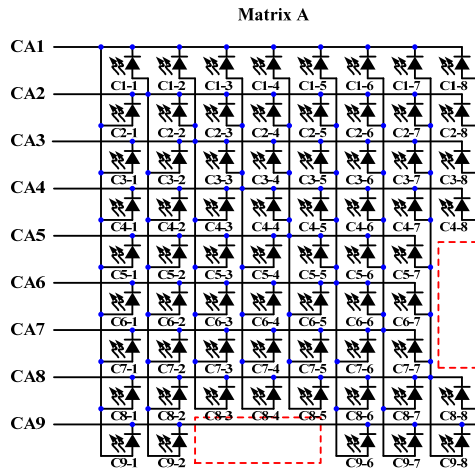
Figure 1 Typical Application Circuit

- \*1: The filter capacitor which connects to VCC pin should be placed close to the IC as possible to decrease the ripple from supply voltage.
- \*2: The audio input capacitor (0.22µF) should be placed as close as possible to the IC.
- \*3: The recommended minimum value of R<sub>EXT</sub> is 18kΩ, or it may cause a large current. R<sub>EXT</sub> should be placed as close as possible to the IC.
- \*4: The audio filter capacitor (0.1µF) should be placed as close as possible to the IC.
- \*5: The voltage which pulling I2C and INTB pins up should be above 1.4V. 1.8V and 2.8V are allowed.
- \*6: The IC should be placed far away from the mobile antenna in order to prevent the EMI.
- \*7: The traces connect from the IC to LED should be short and thick.

**FAQ**

1、 Q: IS31FL3731 can support 8×9×2 LEDs. How should the circuit be if not all of the LEDs are used?

A: Each LED can be disconnected as what customers want (Figure 2). But the corresponding LED Control Register (8 Pages) should be shut down if the LED is disconnected.



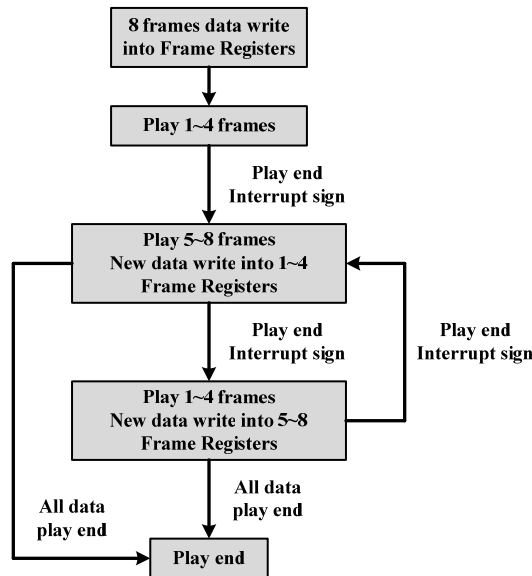
**Figure 2** C9-1 to C9-8 and C1-8 to C9-8 are disconnected

2、 Q: What's the function of internal SRAM for IS31FL3731?

A: IS31FL3731 drive 144 LEDs and each LED can be dimmed in 256 steps which requiring great data to write into microcontroller. It will consume lots of system resource if there is no SRAM. SRAM can store pre-programmed animation and color-effect lighting and free-up the microcontroller to do other system functions resulting in increased performance and battery life.

3、 Q: The IC can store 8 frames data at best. How does it achieve if more frames animation display?

A: Each 4 frames writing in Frame Registers is recommended if there are more frames to play (Figure 3). First, store 8 frames data and play 4 frames in front. Then play last 4 frames and writing new data in the Frame Registers (1~4) at the same time. Play the new 4 frames (1~4) and write new data in the Frame Registers (5~8).



**Figure 3** More frame data writing in

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4、 Q: What's the definition of Page and how to use it?

A: There are nine Pages in IS31FL3731 and corresponding registers in each Page (Figure 4). The Frame Registers are stored in Page One to Page Eight and Function Register is stored in Page Nine. Register address in each Page is from 00h. Page One to Page Eight have the same register format.

The Command Register should be configured first after writing in the slave address to choose the available register (Frame Registers and Function Registers). Then write data in the choosing register. The Command Register should be configured again if registers in other Page requiring setting.

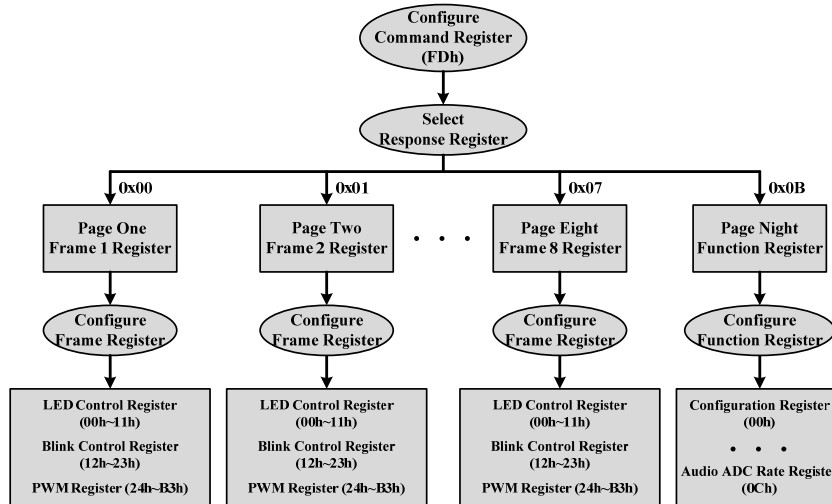


Figure 4 Register Control

5、 Q: How the I2C goes on for IS31FL3731? Is the I2C interface standard?

A: The I2C goes on below:

Start—Slave Address—Page Address—Page Data—Stop;Start—Slave Address —Register Address—Register Data—Stop

The I2C interface is standard.

6、 Q: Can the registers be read and how to read data from registers?

A: All of registers in IS31FL3731 can be read. But Frame Registers can only be read in software shutdown mode as SDB pin is high. The Function Register can be read in software shutdown mode or operating mode.

To read the device data, the bus master must first send the IS31FL3731 address with the R/W bit set to “0”, followed by the Command Register address, FDh, then send command data which determines which response register is accessed. After a restart, the bus master must send the IS31FL3731 address with the R/W bit set to “0” again, followed by the register address which determines which register is accessed. Then restart I2C, the bus master should send the IS31FL3731 address with the R/W bit set to “1”. Data from the register defined by the command byte is then sent from the IS31FL3731 to the master (Figure 6). The IC supports address auto increment.

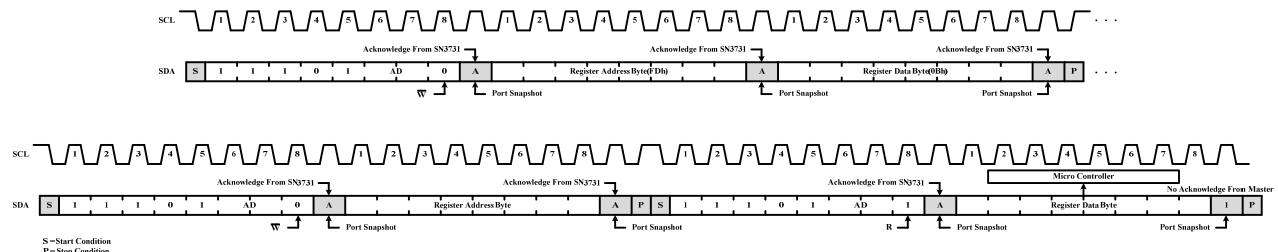


Figure 6 Reading from IS31FL3731

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7、Q: What's the "Reserve" meaning for 04h Register?

A: 04h Register is reserve without function. Writing any date into it will be ok by address auto increment. 04 register also can be read. But the data which read from 04h will be random and not the same as what write in.

8、Q: Could SDB pin be used in 1.8V by GPIO port?

A: 1.8V voltage could be used to control SDB pin. Any voltage above 1.4V will be recognized high level. Low level from GPIO port is recommended to control SDB pin when power on.

9、Q: Could IS31FL3731 drive RGB?

A: Yes, the IS31FL3731 can drive 32 common cathode / common anode RGBs at best (Figure 7 and 8). The location of red LED must follow the below circuit and the black location could connect single LED except red one, or the IC can't work normally.

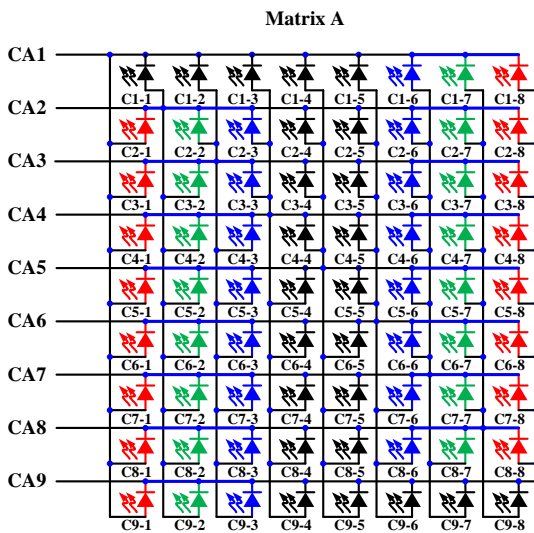


Figure 7 Common Cathode RGB Connection (Matrix A)

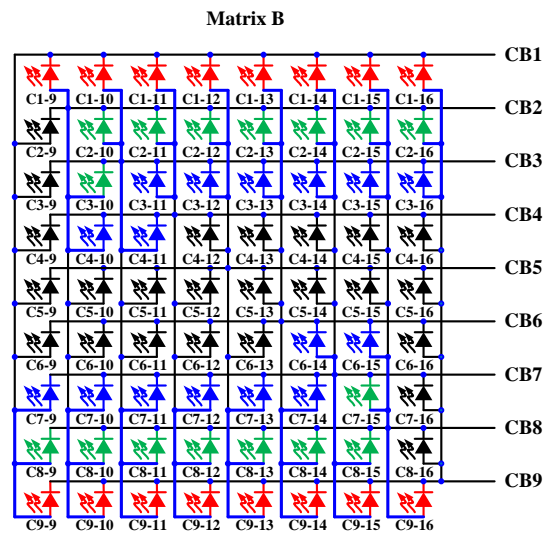


Figure 8 Common Anode RGB Connection (Matrix B)

10、Q: Could IS31FL3731 display follow audio signal? What's the different between Audio Modulate and Audio Frame Play?

A: IS31FL3731 has two audio play modes. The intensity of LEDs is adjusted by the input signal in Audio Modulate Mode. The input signal is higher the intensity of display is stronger. There will be no display when no audio signal. It stores data of 8 frames and the 8 frames playing follow the input signal in Audio Frame Play Mode. It plays the first frame when the value is the smallest and plays the eighth frame when the value is the biggest.

11、Q: What's the blink function and how to achieve?

A: The blink function can make each LED on and off switching by configured time. By setting the BE bit of the Display Option Register (05h) to "1", blink function enable. If the BE bit is set to "1", each LED can be controlled by the Blink Control Registers (12h~23h in Page One to Page Eight). The Display Option Register (05h) is used to set the blink period time, BPT, and the duty cycle is 50%.

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**AUDIO MODULATED MATRIX LED DRIVER**

12、 Q: When the breath function will be available? Does it affect the breath function when switch pictures quickly in Picture Mode?

A: The breath function will be available in Picture Mode and Auto Frame Play Mode. And it should be shut down in Audio Modulate Mode.

When writing into switching command during FOT and ET in Picture Mode, it will display the last picture while fade in. When writing during FIT, the command is inefficacy (Figure 9).

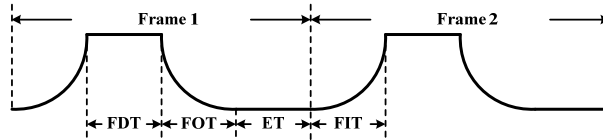


Figure 9 Breathing function

13、 Q: How does the IS31FL3731 scan and how low is the whole scan cycle?

A: The required signals to drive all 144 LEDs have been reduced to 18 by using a multiplexing feature. The scan time for each channel is 115µs (Typ.) and interval time is 20µs (Typ.) (Figure 10). Matrix A and B can scan together and the whole scan cycle is  $(115+20) \times 9 = 1215\mu\text{s}$ .

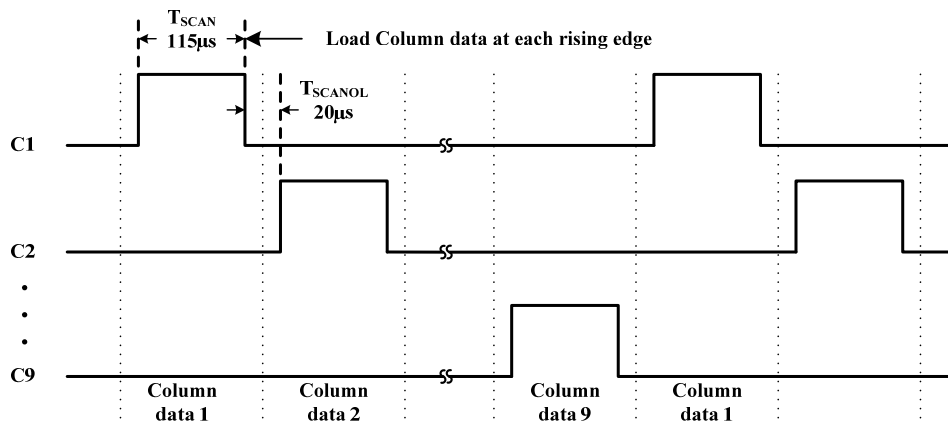


Figure 10 Scanning timing