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A Division of ISSI

New Low Power Matrix LED Drivers for Battery Applications

As companies integrate more features with LED status into their battery-operated products; long battery life has become an important design factor. Many IoT devices and wearables use primary batteries which are not rechargeable. For such products, improving the battery life by minimizing power consumption is a key differentiator and an important selling feature. Therefore, to ensure efficient and long battery life, circuits must support ultra-low power consumption, Figure 1.

FIGURE 1 - SMALL FOOTPRINT AND ULTRA-LOW POWER

To address this low power market segment, Lumissil recently introduced four LED matrix drivers incorporating ultra-low power consumption and other advanced features. The new IS31FL3751/2/6 and IS31FL3242 drivers require less than 500µA (or 0.5mA) of operating current, 0.5uA (or 0.0005mA) of shutdown current, and support 12-bit PWM with dot correction; all in a small IC footprint. See the Press Release.

LEADERSHIP

As a leader in LED driver technology, Lumissil maintains its lead by introducing innovations that provide our customers with feature rich IC solutions to address their competitive needs. This new family of matrix LED drivers were designed to address the critical challenges of low power consumption and minimal board space demanded by today's battery powered devices. Besides the 12-bit PWM and dot correction for rich color palettes, they also incorporate spread spectrum with 180-degree phase delay of the outputs to minimize electrical-magnetic interference (EMI). In addition, the family solves the 'ghosting' artifact challenges present in LED arrays.

De-ghost technology is an important feature designed into Lumissil matrix drivers. A pixel 'ghost' is any weird pixel artifact or glitch that appears randomly in an LED array as shown in Figure 2. This 'ghost' is a result of stray capacitance in the matrix wiring that discharges through an LED which normally should be OFF but instead becomes dimly ON due to stray capacitor discharge. Lumissil's de-ghost technology periodically discharges any stray capacitance from the matrix to avoid this 'ghost' effect.

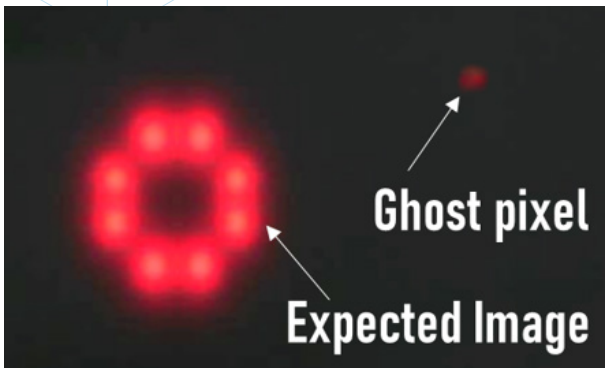

FIGURE 2 - GHOST PIXEL

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FIGURE 3 - FAMILY OF ULTRA-LOW POWER MATRIX DRIVERS

Device Number	Matrix Size	Operating Current (typ)	PWM	Dot Correction	De-Ghost	Spread Spectrum	180 Degree Shift	Package Size
IS31FL3751	72 (9x8)	550µA	8/12-bit	4-bit	Yes	Yes	Yes	QFN-20 (4mm×4mm)
IS31FL3242	12 (12x1)	500µA	8/12-bit	8-bit	Yes	Yes	Yes	QFN-20 (3mm×3mm)
IS31FL3752	24 (12x2)	500µA	8/12-bit	8-bit	Yes	Yes	Yes	QFN-20 (3mm×3mm)
IS31FL3756	36 (12x3)	500µA	8/12-bit	8-bit	Yes	Yes	Yes	QFN-20 (3mm×3mm)

The IS31FL375x family of matrix LED drivers consist of four devices housed in small 20-pin QFN packages. They enable each LED in the array with its own corresponding control and fault status register to provide individual LED color and dimming effects, de-ghosting and fault reporting for enhanced system performance, health, and reliability. Since LEDs can fail to turn ON due to an LED open or short condition the IS31FL375x family can detect a failed LED within the array and make this information available to the system.

SELLING POINTS

Ultra-Low Power Consumption

The IS31FL375x family of matrix drivers were designed to operate with extremely low current consumption; both static and dynamic. Static current comes from leakage current when the LED driver is in “shutdown” mode and all functions are disabled. Dynamic or “quiescent” current results from the normal operating current required when all functions are enabled.

When calculating total system current consumption, note the Lumissil drivers will consume only a minimal current while most of the current will go to the LEDs. For example, the IS31FL375x will consume a maximum of 1mA quiescent current but depending on the desired brightness level, each LED can consume more than 1mA.

Package Compatibility

The family of devices are available in the same standardized 20 pin QFN type package to simplify part migration as the desired LED count changes. However, there are some differences which must be considered. First the IS31FL3756 package does not support a pin for address selection, it has a fixed address of 44h while the IS31FL3742/52 and IS31FL3751 have an AD pin for address selection. The peak LED current is software configured for the IS31FL3742/52/56 while a current set resistor is used in the IS31FL3756. Note the package pinout is the same for IS31FL3742/52 but the IS31FL3756 has a pinout shifted by one. The IS31FL3751 has a larger (4x4mm) package with a totally different pinout.

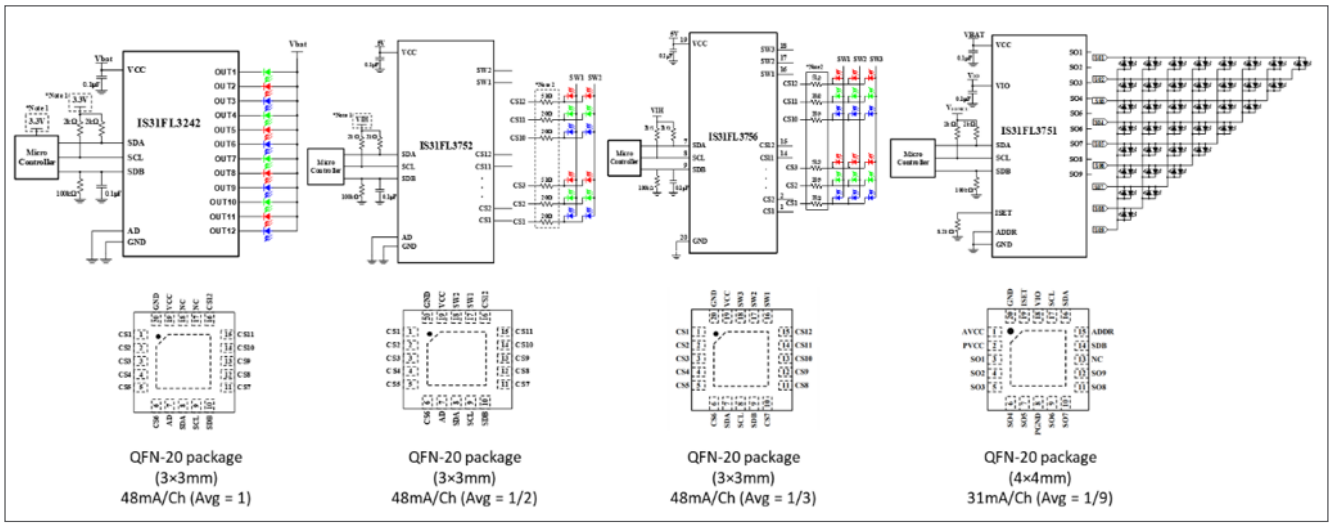

FIGURE 4 - PACKAGE PINOUTS

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MULTIPLEX VS CHARLIEPLEX

Ultra-Low Power Consumption

A matrix LED array is the preferred method for reducing the number of I/O lines when driving more than 36 LEDs. An added benefit is the matrix driver package will have smaller dimensions because less I/O pins are required. The IS31FL375x family implements one of two matrix techniques; multiplex or charlieplex (crossplex) with each having their advantages.

Multiplex

A matrix driver will implement a row and column scanning technique so that only one row is powered while the columns are individually controlled for PWM, current adjust, etc. This 3x12 matrix example (Figure 5) requires only 15 I/O pins to support 36 LEDs. Both the IS31FL756 (3x12) and IS31FL3752 (2x12) devices implement multiplex scanning.

The disadvantage of any matrix driver is the LEDs do not appear as bright as expected given the applied peak LED current. This is due to the scan timing, as shown in Figure 5. In this 3x12 example there are 3 row switches and each row is ON for only 1/3 of the time. Therefore the 12 LEDs enabled by a row switch will be ON for only 1/3 of the time, for the remaining 2/3 of the scan cycle they are OFF. This results in an "Average Current" that is only 1/3 of the peak current which causes the "appearance" of only 1/3 of the expected LED brightness.

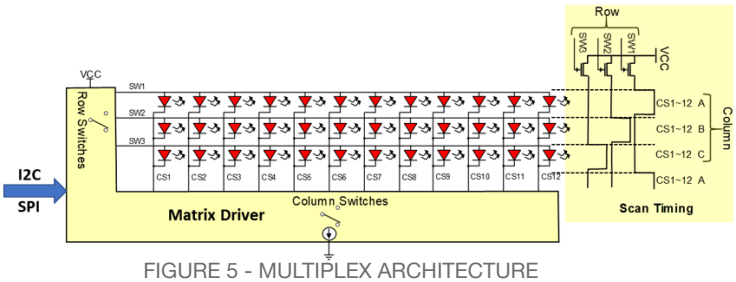

FIGURE 5 - MULTIPLEX ARCHITECTURE

Charlieplex

The Charlieplex scanning architecture implements bipolar I/O lines so that each pin can source or sink a current. In this architecture, one I/O pin provides the LED power while the other remaining pins are reconfigured for sinking current. The scan cycle consists of each I/O pin taking a turn in being the source while the remaining I/Os sink the current.

The advantage of a Charlieplex is only 9 I/O pins are required to support 72 LEDs while the multiplex version would require a minimum of 17 (9x8) I/O pins. The disadvantage with Charlieplexing is the LEDs are periodically subjected to reverse voltage bias for a short period of time during the scan timing, Figure 6. Also, as with the multiplex architecture, the average current/brightness will be a fraction of the expected level. The IS31FL3751 implements Charlieplex scanning and therefore the average brightness is 1/9.

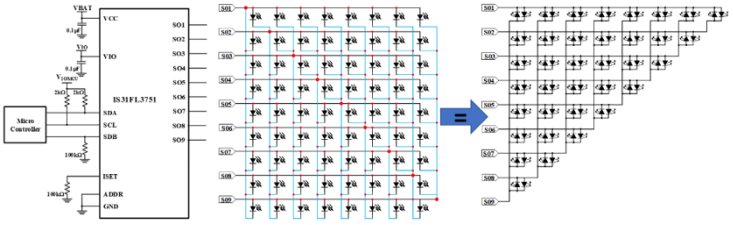

FIGURE 6 - CHARLIEPLEX ARCHITECTURE

CONCLUSION

These latest matrix drivers represent Lumissil's commitment to continuously innovate and enhance the LED driver product line. As a leader in LED driver technology, Lumissil has raised the performance bar by adding noise reduction, 12-bit color, dot correction and low power consumption in small 20-pin QFN packages. These drivers pack a lot of performance features in small footprint compatible packages.

IC samples and evaluation boards are available now, Figure 7. Documents such as datasheet, eval board guide, etc can be downloaded from the Lumissil website.

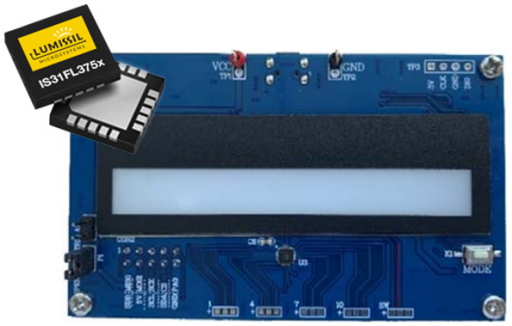

FIGURE 7 - IC AND EVAL BOARD SAMPLES

CONTACT:

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