LUMISSIL Microsystems
A Division of ISSI

High Voltage LED Drivers for Automotive and Signage

Lumissil offers a diverse range of high voltage LED drivers that cover a wide selection of configuration options. From single LEDs to multiple individually addressable ones, these drivers can be utilized in multi-channel or matrix array setups. The LED drivers come with various bus interfaces, providing flexibility in selection. With this extensive selection of LED drivers, design teams can easily find the ideal driver to match their specific requirements, ensuring both differentiation and cost-efficiency in their designs

Large numbers of high-brightness LEDs (HB LEDs) are increasingly being used in a variety of configurations for automotive animation, digital signage, and display backlighting. While driving a single or even a few LEDs may seem straightforward, managing these larger arrays presents challenges concerning the overall LED interconnection topology, as well as the powering and control aspects of the entire LED array.

When dealing with multiple LEDs, whether it's tens, hundreds, or even thousands, designers must first decide on which driver topology is most appropriate for their applications. Each choice involves trade-offs in terms of driver options, cost, reliability, PCB layout and functionality. Selecting the proper LED driver upfront can help minimize downstream issues related to LED communication, PCB routing, as well as subsequent thermaland electromagnetic interference (EMI) considerations.

DRIVERS FOR LARGE LED CONFIGURATIONS

Lumissil has developed a range of LED drivers specifically designed for automotive and signage applications. For example, the IS3xFL3248 is a 48-channel serial shift LED driver featured in Lumissil's May 2023 newsletter article titled "IS31FL3248 Performance 48 Channel Serial-Shift LED Driver". These drivers are available in two versions: the industrial grade "IS31FL3248" and the automotive grade "IS32FL3248." Since then, Lumissil has continued to expand its lineup of LED drivers for controlling larger numbers of high voltage LED strings.

Although many of these drivers were primarily intended for the automotive sector, there are no limitations preventing their successful design into industrial applications. They come with various bus interfaces, driving architectures, and LED control quantities to meet diverse application requirements.

Below is an overview of the available topologies for selecting an LED driver.

BUS TYPE

To be able to communicate with a large array of pixel-controlled lighting requires an LED driver IC with a digital communication interface. Previously, the available bus options were limited to I2C or SPI, but these bus interfaces have limitations on communication distance and speed. Lumissil has added CAN, Serial-Shift Daisy-Chain and UART bus interfaces to a series of LED drivers supporting many high voltage LED strings.

CAN Bus: Communicating over long wire distances requires CAN bus (Controller Area Network bus), a serial communication protocol over a differential wire pair, CAN High (CANH) and CAN Low (CANL). This differential signaling approach ensures dependable and robust data communication that is immune to noise and interference, making it suitable for noisy and harsh environments found in automotive applications. CAN bus makes it possible to communicate over a wiring harness with far flung LED arrays on separate PCBs. However, to accomplish this, CAN bus requires specialized transceivers with termination

resistors on the bus to convert the differential signals to and from the logic levels used by microcontrollers and LED drivers. See Figure 1

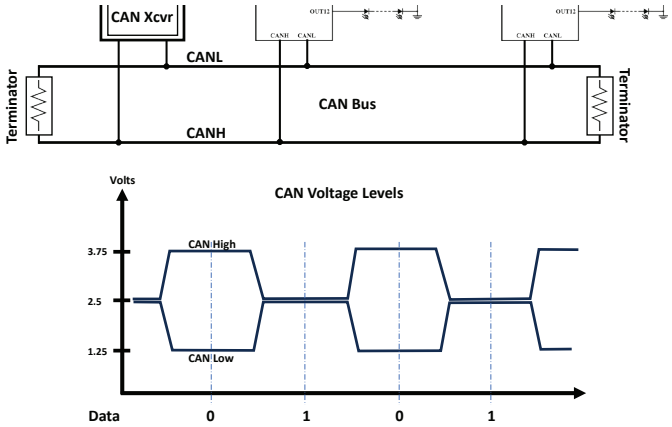

Figure 1 CAN Bus Connection and Signaling

Serial-Shift Daisy-Chain: Communicating with large LED arrays is simplified by inter-connecting multiple LED drivers in a sequential manner, such that data is passed from one driver to the next, creating a linear communication path. This approach is effective for LED arrays on the same PCB, but it is not suitable for long-distance communication. To implement this communication bus, an MCU is connected to the first LED driver in the chain using data, clock, and latch signal wires. The first driver receives the data and then forwards it to the next driver in the chain, and this pattern continues down the chain until all drivers have received the data. This approach simplifies the PCB routing and allows for scalability. However, there are limitations to consider, such as the LED update speed decreases with the number of drivers in the chain, the MCU needs to keep track of which driver in the chain requires an update, and the entire chain is impacted in the event of a driver failure. See Figure 2.

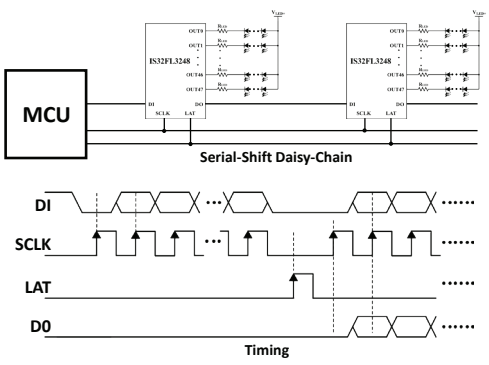

Figure 2 Serial-Shift Daisy-Chain Bus Connection and Signaling

UART (Universal Asynchronous Receiver Transmitter): A UART channel has two data communication lines, RX pin (receive data) and TX pin (transmit data). In the case of UART-capable LED drivers, the RX pin of the microcontroller (MCU) is connected to the TX pin of the LED drivers and the LED driver's RX pin is connected to the MCU's TX pin. Since there is no shared clock line, the communication between the MCU and LED driver is asynchronous. This two-wire asynchronous communication method has low overhead and allows for the inclusion of parity bits for CRC error detection and correction, enhancing the robustness of the communication bus. Despite the various advantages of UART, it has some limitations, such as its point-to-point nature and vulnerability to signal noise interference. See Figure 3.

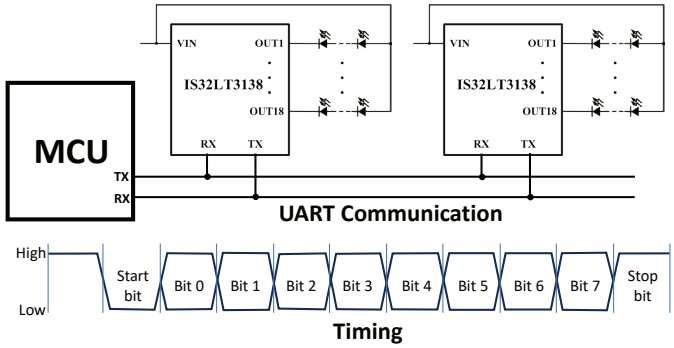

Figure 3. UART Communication Bus and Timing

I2C and SPI Bus Standards: I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface) are both popular serial communication protocols used in many LED drivers. Both protocols are well understood serial communication interfaces with low overhead, making them suitable choices for communication in resource-constrained systems. The choice between I2C and SPI depends on the specific application and the hardware capabilities of the LED drivers being used. See Figure 4.

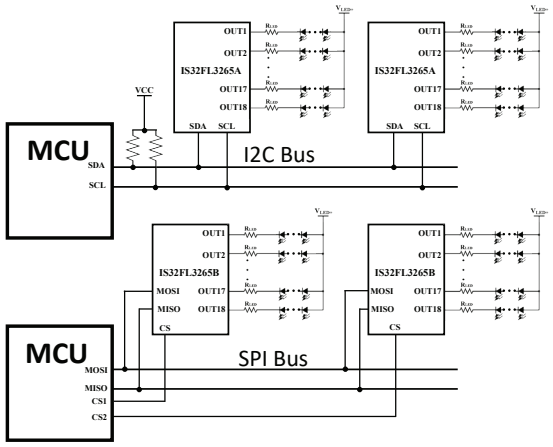

Figure 4. I2C and SPI Bus Interfaces

LED CONFIGURATION ARCHITECTURE

After selecting the bus interface type, the next step is to select the desired LED configuration: either multi-channel or matrix array. Each configuration offers its own unique set of advantages and disadvantages.

Multi-Channel Configuration: A multi-channel LED configuration requires an LED driver designed to independently control and drive multiple LED channels. Each LED channel can consist of one or more individual LEDs. In this configuration, the LED driver can adjust the brightness, color, or other parameters of each LED channel individually. This allows for precise control and customization of the light output from different groups of LEDs. Multi-channel LED drivers are commonly used, but they do have certain limitations. For instance, one limitation is the package size since each LED channel requires its own package pin, having many channels results in a larger package.

Matrix Configuration: A matrix LED driver is designed to control and drive LED arrays arranged in a matrix or grid format. It employs a scan timing design to control many LEDs in an array format, while using minimum number of package pins. It can individually control each LED in the array using row and column scanning techniques to activate specific LEDs at precise positions in the matrix. Matrix LED drivers allow for dynamic and flexible control of LED displays containing hundreds of LEDs. One limitation of matrix LED drivers is the perceived brightness of the LEDs is a function of the number of columns (PSWx). As the number of scanning columns increases, the perceived brightness of the LEDs decreases. See Figure 5.

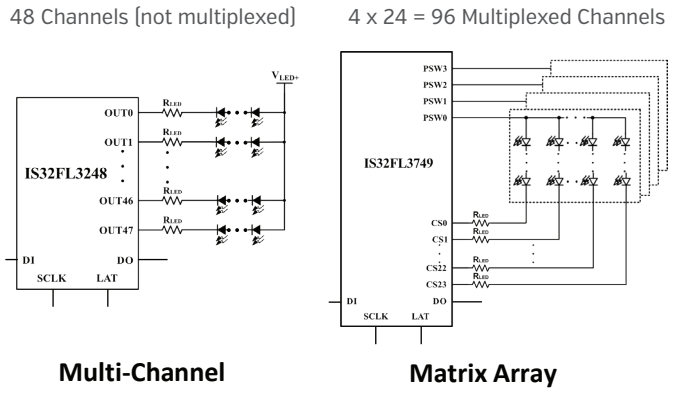

Figure 5. Multi-Channel and Matrix Array LED driver types

LED DRIVER OPTIONS

Lumissil has a wide selection of LED drivers that support high voltage LED strings. Supporting long LED string (> 1 LED per channel) requires the LED driver be capable of supporting high LED string voltages. For example a string of 4 white LEDs would require up to 14V. Below is a table displaying Lumissil's available high voltage string LED drivers, categorized by bus type and architecture.

Part Number	Bus Type	Architecture
IS32FL3265A	I2C	Multi-Channel
IS32FL3265B	SPI	Multi-Channel
IS32LT3131A	UART	Multi-Channel
IS32LT3131B	CAN	Multi-Channel
IS32LT3131C	SPI	Multi-Channel
IS32LT3138	UART	Multi-Channel
IS32FL3248	SPI / Serial Shift Daisy Chain	Multi-Channel
IS32FL3749	SPI / Serial Shift Daisy Chain	Matrix Array

These LED drivers can be used in diverse products, including industrial signage and automotive rear lamps. Below are some examples to illustrate their usage.