Simple lighting control with a single pair of wires

Now you can control hundreds of individual lights with a single pair of wires. The LCI bus allows full lighting control with just two wires. Not two wires per light going back to a central control box, but two wires total, daisy chained from light to light to light. The LCI bus allows for long chains of thousands of lights, individually controlled, with just two wires. The LCI Bus is a simple, light control network.

Basic lighting

In normal lighting installations, individual light control is not a design requirement. Basic on / off functionality of a set of lights is sufficient and only requires a simple switch at the power source.

When individual control of lights is desired, the wiring can quickly become very complex, with individual power wires running to each light. In a situation where there are hundreds or thousands of lights, individual control is almost impossible due to the complexity of the control wiring.

What is needed is a simple and inexpensive method of commanding and controlling individual lights without complex wiring. If intelligence were added to each light, then we could arrange them in a simple network, to drastically reduce the wiring.

Introducing the LCI Bus

The LCI Bus is a very simple lighting network, that allows individual lighting control, and simple two wire daisy-chained control connections. The LCI Bus only requires two control signals, that connect from one light to the next. There is no maximum to the number of lights that can exist on an LCI Bus, therefore you can have a string of thousands of lights, each individually controlled, with a total of only two control wires for the entire string.

The LCI Node™ Chip

The heart of the LCI Bus is an intelligent microchip located at each light node, the LCI Node chip. The engineering team at Unagi Net has created this very inexpensive intelligent control chip for each light, which connects directly to the LCI Bus. The chip communicates over the LCI Bus, using the LCI-2 bus protocol. The chip also directly drives LEDs or can be part of a high wattage drive circuit for incandescent lights.

Since each light requires one chip, the LCI Node chip must be physically small and very inexpensive. Figure 1 shows a typical LCI Node chip next to a grain of rice, for size comparison. Notice that the LCI Node chip is the same size as the LED it is driving.

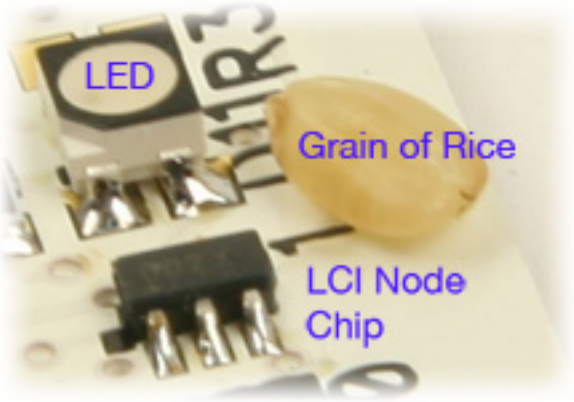


Figure 1 - The LCI Node Chip. Grain of rice for size comparison.

The LCI Node chips are daisy-chained from adjacent chips. This allows for simple serial network wiring. Figure 2 shows how the LCI Node chips are wired up to form the LCI Bus. Notice that there are only two control wires going from one light to the next. No other wires are required for the LCI Bus.

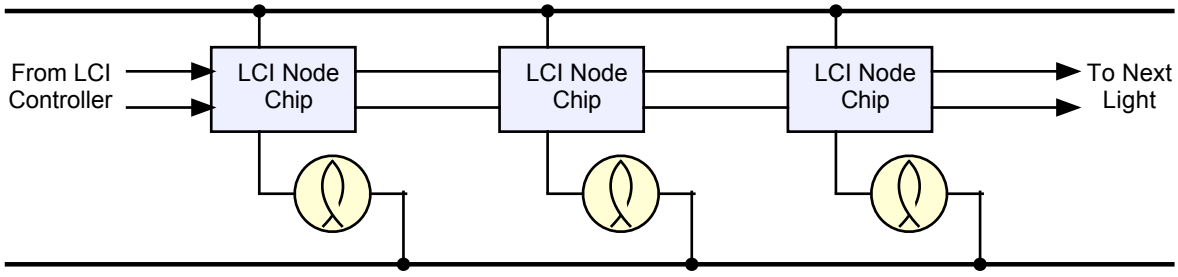


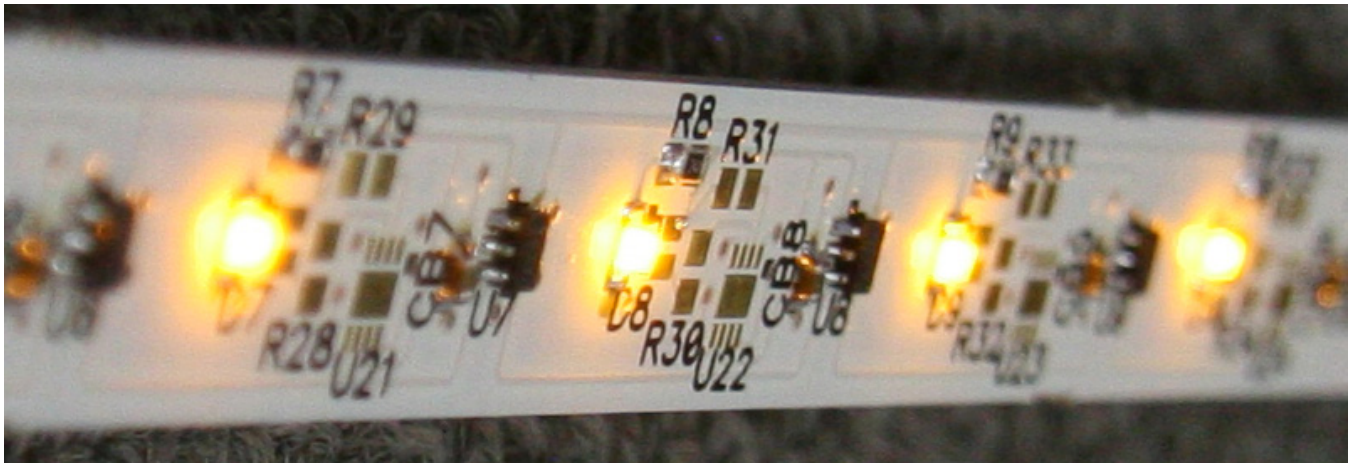
Figure 2 - The LCI Node Chip Typical Wiring

The LCI Bus Technical Description

The LCI bus is an asynchronous, daisy chained, digital data bus that allows command and control of individual lights without a individual control wire per light. The LCI bus consists of only two (2) control wires per light, with those wires being daisy-chained from an adjacent light. Because separate control wires are not required for each individual light, extremely long strings (1000's) of lights can be controlled with a single wire pair.

Each LCI bus contains a Master Controller that programs one entire string of LCI bus lights. This Master Controller exists at one end of the light string and sends out commands to the first light on the LCI bus, with the commands propagating down the string to the very last light on the bus. There is no maximum length for an LCI bus, and no maximum number of lights per bus. All lights on the bus are controlled by this single Master Controller.

Each light has a LCI Node Chip that receives LCI bus commands, drives and controls the light, and then sends additional LCI commands to the next LCI Node Chip. Each chip controls one light, either directly in the case of LEDs, or indirectly via optoisolators or solid state relays, for high wattage light applications.



Close up of individual LEDs and their associated LCI Node Chips.

There is NO maximum to the number of lights that can be controlled by a LCI bus. The only parameter that will be affected is the time it takes to configure all of the lights. The LCI-2 bus protocol is designed to update 25,000 lights in one second, which is quick enough for almost any application.

The LCI-2 Bus can operate at a faster update rate by reducing the number of lights on the bus. The update rate is linear with respect to the number of lights. In other words, for the LCI-2 Bus, you can have 25,000 lights updated ever second, or 1000 lights updated 25 times a second, or 100 lights updated 250 times a second.

Individual Brightness Control

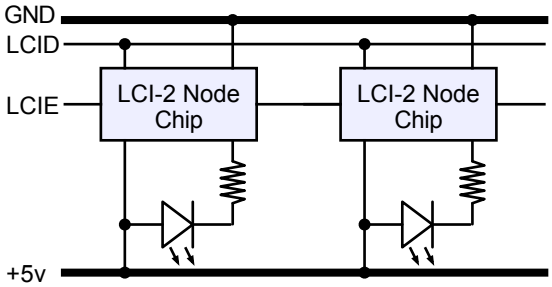
The LCI bus protocol allows each light to have individual brightness or color levels, regardless of the number of lights on the bus. In other words, with the LCI bus, each light in the chain of a 10,000 lights, can have different brightness settings, individually controlled, with one LCI bus Master Controller.

Strips of LEDs on the LCI-2 Bus, showing different brightness levels per LED

The LCI bus operates with several different protocols, LCI-2, LCI-8, and LCI-8c. The LCI-2 protocol contains four (4) light brightness levels, which are off, dim, medium, & bright. The LCI-8 protocol contains 256 brightness levels. The LCI-8c protocol contains 256 different color levels.

LCI Bus Signals

The LCI Bus consists of two signals, LCID and LCIE. LCID is the main LCI Bus Data. LCIE is the node Enable signal. The node chip operates on 5 volts, with 5 volt CMOS signaling on the LCI Bus.

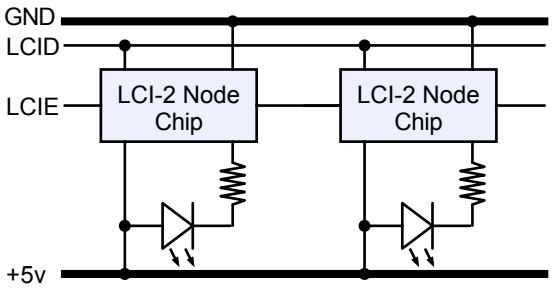


The LCID and LCIE signals originate at the LCI Bus Master Controller. This controller sends out a serial stream of commands on the LCI Bus, which is then picked up by all the individual Node chips. This allows a controller to completely control one entire LCI Bus full of lights.

The update rate of an LCI Bus is entirely set by the number of lights on the bus. The more lights, the slower the update rate. The LCI-2 Bus can update 1000 lights 25 times a second. Or it can update 10,000 lights 2.5 times a second. Since most installations do not require update rates anywhere near these values, the LCI-2 Bus is more than adequate for tens of thousands of lights on one bus.

LCI Node Chip Connections

The LCI Node Chip has direct LED drive, which can sink 25mA. An external series resistor should be used when direct driving LEDs. LED brightness is performed with pulse width modulation of the LED drive output.



Typical LCI-2-N200 Node Chip Connections - Direct LED Drive

The LCI Node Chip can also drive opto-isolators and other high wattage drive circuits, which allows for the installation of strings of incandescent lamps.

Available LCI Node Chips

The LCI Node Chips are available in small surface-mount packages, for minimal board real estate usage. There are different LCI Node Chips for the different LCI Bus Protocols.

LCI-2 Bus Protocol Node Chips

The LCI-2-N200 chip is housed in a small SOT-23 6-pin package. It is available Q1 2012.

LCI-8 Bus Protocol Node Chips

The LCI-8-N617 chip is housed in a tiny MSOP 8-pin package. It is available Q2 2012.

LCI-8c Bus Protocol Node Chips

The LCI-8C-N617 chip is housed in tiny MSOP 8-pin packages. It is available Q2 2012.

LCI Demonstration Kit - LCI2DK150

To demonstrate the LCI bus capabilities, there is an LCI demonstration kit that includes a basic LCI Master Controller, plus five (5) 12” long LED strips, for a total of 60 LEDs (1 LED per inch). The demo kit includes all the parts and boards needed for a quick setup and demo of the LCI bus.

The LCI Demo Master Controller lets you move a user selectable LED pattern through all 60 LEDs with a DC control voltage or through an adjustable on-board potentiometer.

The LCI-2 Demo LED strips are 12” long, end-stackable boards, with LEDs located at every inch. The control signals and power are passed from one board to the next, so that the entire stacked 60” length performs as a single LCI Bus network. This enables the Master Controller to control every LED on the entire length of the strips.

The LCI2DK150 LCI Demonstration Kit is available directly from Unagi Net, or through one of our distributors.