METHODS AND APPARATUS FOR PROVIDING DC POWER FOR LOW VOLTAGE LIGHTING

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Abstract

A DC power supply for lighting includes low voltage driver electronics for any suitable load such as lighting along with a supervisory controller that communicates to the driver electronics via any suitable digital communication protocol. Each driver's output ports include a 3rd wire that communicates to the low voltage load fixture for the purpose of auto-negotiating the appropriate power level without first having to energize the fixture.

7 Claims, 3 Drawing Sheets
DC Power Supply

supervisory controller 15

12 PRE

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LED Driver

136BD 136A 3 - conductor - 33 cable

28 - 300

Load

EEPROM 38

Serve

Fig. 1
Fig. 2
DC Power Supply

Fig. 3
METHODS AND APPARATUS FOR PROVIDING DC POWER FOR LOW VOLTAGE LIGHTING


FIELD OF THE INVENTIONS

The inventions described below relate to the field of low voltage lighting.

BACKGROUND OF THE INVENTIONS

Current negotiated power standards lack a requirement for a standby power level to be available such that the load device can turn on active electronics and respond via a full communication stack.

SUMMARY

The devices and methods described below provide for a DC power supply for loads such as lighting. The DC power supply includes low voltage lighting driver electronics along with a supervisory controller that communicates to the driver electronics via any suitable digital communication protocol. The output of each low voltage lighting port includes a third wire that communicates to the low voltage lighting fixture for the purpose of auto-negotiating the appropriate power level without first having to energize the fixture.

The DC power supply housing includes light emitting diode (LED) driver electronics along with a supervisory controller that communicates the driver electronics via digital method such as the digital addressable lighting interface (DALI). LED constant current or constant voltage style signals are then originated to LED fixture assemblies that contain no drivers of their own; only LED arrays manufactured by others using any suitable means.

Through the use either of a backplane circuit board or wiring harnesses each driver's output includes a 3rd wire that communicates to the LED fixture for the purpose of auto-negotiating the appropriate power level without first having to energize the fixture. This allows fixture brands and types to be mixed and even moved from port to port without the risk of damage to the fixture or requiring expertise by the installer to understand how to balance (i.e. bias) LED array power levels for optimal output.

Optionally, driver manufacturer's would be allowed to license the methodology such that their driver could perform the auto-negotiation on its own. Second, the housing could optionally implement a method where LED drivers' form factors are modified by the manufacturer to include additional input pins either in the form of discrete connectors or card-edge connector format such that inclusion in a particular slot sets the bus address for communicating to the master controller in the housing. An example being if the LED drivers in each slot were DALI slaves, slot 1 would take bus address 1, slot 2 bus address 2, etc. such that the master controller could address each slot individually without requiring a technician to intervene by supplying individual bus addresses as is required to individually address DALI drivers or ballasts mounted directly in fixtures. An additional benefit is now that each slot could be purpose chosen based on price, performance, brand, or other factors even allowing the installing contractor, facility maintenance professional, or specifier to call out different capabilities for each output channel without impacting their choice in fixture form factor, aesthetics, CRI, or other similar factors. The LED fixtures, in effect, become as interchangeable as incandescent lamps.

The devices and methods described below:
1. Remove cost from LED fixtures;
2. Remove UL certification cycle from LED fixtures;
3. Removes LED driver control performance specification from fixture manufacturer;
4. Prevents damage to LED fixtures when swapping out driver technologies;
5. Allows mix and match or field comparison of driver performance with a given fixture;
6. Reduces LED drivers to a single standard form factor;
7. Reduces the number of global controller addresses and/or radio for per fixture control schemes from 1:fixture to 1:housing-diversity (likely models are 4 slot, 8 slot, 16 slot, 32 slot) thus reducing commissioning and re-commissioning times;
8. Reduces UL certification “pairing” cycles for drivers from 1:fixture (potentially 10,000’s) to 1:housing-diversity (likely models are 4 slot, 8 slot, 16 slot, 32 slot);
9. Added efficiency through the ability to bulk-power a housing through a single large AC/DC conversion or DC/DC conversion;
10. Added safety through allowing DC class 2 wiring to fixtures;
11. Added safety through having LED driver assemblies of whatever form factor in a cavity/barrier scheme that isolates high voltage connections from service personnel more effectively than a fixture housing;
12. Long term serviceability improvement by allowing potentially EOL or expensive drivers to be easily field replaced without fear of damaging the fixture.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a low voltage lighting power housing.
FIG. 2 is an illustration of the details of the wired terminal connections of the low voltage lighting power housing of FIG. 1.
FIG. 3 is a block diagram of an alternate low voltage lighting power housing.

DETAILED DESCRIPTION OF THE INVENTIONS

DC power supply 10 illustrated in FIG. 1 includes one or more LED drivers, such as DC or LED drivers 11, 12, 13 and 14 along with a supervisory controller 15 that communicates with the LED drivers via any suitable method such as digital communications, for example using DALI. Supervisory controller 15 is capable of receiving wired or wireless communication from wired load controllers 16 and wireless load controllers 18 communicating control accessories such as motion detectors, switch stations, ambient light sensors, occupancy sensors and other load controllers. For example wireless load controller 20 exchanges wireless communication signals 21 via antenna 22. Similarly, wired load controllers 16 exchange control signals 24 with supervisory controller 15.

Any suitable line voltage energy 30 is shared within power supply 10 to provide energy for supervisory controller 15 and LED drivers 13-15. The LED drivers are opti-
The document describes a system for power supply units designed to charge one or more batteries where the voltage and current needs can be known and included on the 1Wire EEPROM for the charger output to read before engaging. For example, a 6V cell for exit sign needs 7.2V @ 400 mA to charge whereas a 24V cell for light fixture needs 29V @ 500 mA to charge, but the same channel could support both for charging purposes by first reading back the charging input required. Other related charging system applications include appliance devices such as cordless/cell phone, handheld power tools, etc.

The devices and methods described may also include wired low power commercial ceiling accessory devices which could also auto-negotiate for their required accessory voltage safely by including the EEPROM and 3rd wire connector. Examples include HVAC devices such as VAV controllers, I/O controllers, controllable shade motors, electro-chronic glass controller, or controllable skylight dampers.

The devices and methods as described may also include wired-for-power but wireless-for-communication devices of any kind where communication via an unsecured connection such as USB or via an expensive per port tech like PoE is not optimal with examples including wall mounted touch screen controllers, thermostats, and digital RF communicating light switches.

The devices and methods as described may also include the power supply as discussed above supporting a connector, wiring harness, or socket enabling the in-field addition of a programmed EEPROM with the power negotiation parameters for a device type that did not include the chip from the factory or vendor that chose not to factory-include the capability.

The low voltage lighting system uses power auto-negotiation technology circuit such as Maxim-IC Dallas 1-wire or similar. The low voltage lighting driver housing uses standard commercial-off-the-shelf (COTS) LED drivers that are factory or in-field wired to the output ports and the master controller.

An alternate power supply is illustrated in FIG. 3. Power supply 50 incorporates backplane 51 and an industrial design method and form factor such that insertion of a low voltage lighting driver such as driver 52 into the backplane, or the socket of the backplane such as socket 51A, sets a communication bus address such that master controller 53 can automatically address driver 52.

For example, if the LED drivers in slots 51A, 51B, 51C and 51D were DALI slaves, slot 51A would take bus address 1, slot 51 bus address 2, etc. such that master controller 53 could address each slot individually without requiring a technician to intervene by supplying individual bus addresses as is required to individually address DALI drivers or ballasts mounted directly in fixtures. An additional benefit is now that each load and driver could be purpose chosen based on price, performance, brand, or other factors even allowing the installing contractor, facility maintenance professional, or specifier to call out different capabilities for each output channel without impacting their choice in fixture form factor, aesthetics, CRI, or other similar factors.

Alternatively, the addresses of slots in the backplane such as slots 51A, 51B, 51C and 51D may have their binary addressing set for each slot by means of pins pulled high or low via dip switches or other discrete components on the backplane, such as dip switches 54A, 54B, 54C and 54D for the purpose of automatically addressing the DALI communication to each slot automatically so that LED drivers can be easily mixed, matched, and moved to different slots.
without affecting the ability of the master controller to address each slot individually.

Master or supervisory controllers such as controllers 15 and 53 have a global network connection, lighting control algorithm, DALI master, DALI slave, I2C/SPI, and UART/Serial connections for connection to LED drivers or a backplane.

While the preferred embodiments of the devices and methods have been described in reference to the environment in which they were developed, they are merely illustrative of the principles of the inventions. The elements of the various embodiments may be incorporated into each of the other species to obtain the benefits of those elements in combination with such other species, and the various beneficial features may be employed in embodiments alone or in combination with each other. Other embodiments and configurations may be devised without departing from the spirit of the inventions and the scope of the appended claims.

We claim:

1. A system for providing DC power to a driverless load comprising:
   a power supply comprising:
   a supervisory controller operably connected to line power;
   a DC driver having an output with at least three conductors, the DC driver operably connected to line power and the supervisory controller;
   wherein the DC driver is operably connected to the driverless load to conduct energy and communication between the power supply to the driverless load; and
   an integrated circuit for single wire communication embedded in the driverless load.

2. The system of claim 1 wherein the supervisory controller communicates with the DC driver using a digital addressable lighting interface protocol.

3. The system of claim 1 wherein the DC driver provides energy to the load using constant voltage pulse width modulation topology.

4. The system of claim 1 wherein the DC driver provides energy to the load using constant current topology.

5. The system of claim 1 further comprising:
   one or more load controllers operably connected to the supervisory controller for applying or removing energy to the load.

6. The system of claim 1 wherein the driverless load is batteries.

7. The system of claim 1 wherein the driverless load is lights.

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