CONVERGING SYSTEMS

TechNotes

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Converging Systems Dimming Technology

Background.
Dimming of LED elements is a complex task. Traditional methods have generated flicker, fall-offs at lower levels, inconsistent results between "similar" fixtures and in some cases burned out LED lamps (when remote power is driving multiple connected units and one or more units fail or burn out). Converging Systems has developed two distinct technologies for the proper dimming of various 3rd party LED lamps. These products (controllers) are described within this document.

Controller Types. Converging Systems manufactures two distinct controller families—***CV/constant voltage controllers*** (ILC-100m/ILC-300/ILC-400) and ***CC/constant current controllers*** (ILC-450 family). The CV controllers are primarily designed for constant voltage LED devices such as our own Flexible Linear Lighting Array/FLLA linear devices. The CC controllers are designed for constant current LED devices which typically are manufacturer/configured as LED recessed or surface mounted fixtures. Occasionally with the proper system design, Converging Systems' CV controllers can be deployed with CC-monochrome LED fixtures as long as the OEM, specifier or installer is (i) willing to follow the requirements set forth herein and is (ii) willing to accept any and all risks that might otherwise occur.

System Design for Constant Voltage Controllers driving CC monochrome lamps.

When a potentially compatible monochrome CC LED fixture (or multiple sets of monochrome LED fixtures connected in parallel) are connected to a (single) CV controller, it is important to understand appropriate system design parameters.

- A constant current LED (bulb) has a current rating established and documented by its manufacturer. Except in some circumstances, LEDs will typically run at its rated current. These circumstances might occur when (i) the ambient temperature surrounding the LED is higher than expected or rated levels, or (ii) the fixture design with integrated heat sink does not offer the proper heat dissipation causing the LED element to consume more than its rated current (i.e. a 250 ma LED element drawing 300 ma or higher when it is running at a higher than recommended temperature). When an LED begins to operate at higher current, the voltage drop across its anode/cathode will increase and if the provided power supply is not equipped with circuitry to voltage regulate its output (using through a potentiometer-front end to an electronic circuit), higher than rated/acceptable voltages will be seen at the LED itself which may/will damage the LED element. Accordingly, a specified power supply which can regulate voltage output is critical here. Converging Systems recommends the Meanwell HLG-100h-xxA model here (where xx refers to its base voltage level, hereinafter the "A" model.
- With remote power configurations where multiple CC (monochrome) LEDS are connected in parallel to the CV controller, should one or more connected LEDs fail, burn out or become disconnected, a generic power supply which only constant current output may react by supplying higher voltages instantly upon the occurrence of the disturbance and thus burn out one or more remaining LED connected to the circuit. Similarly, the above Meanwell power supply with adjustable voltage limiting circuit should be used here to prevent this eventuality.

In order to determine how many monochrome LEDs can be connected to a single CV controller, follow these instructions:

- All LEDs should have the same current draw (i.e. all 9 watts/250ma or all 11 watts/300ma or some other constant value). To determine the maximum number that can be connected in parallel, add the current draw from all connected LEDS together and verify that the current draw is less than or equal to the derated value of the target power supply. Derating is typically 90% of the voltage and current of the power supply (i.e. a 100-watt 4.13 amp 24vDC power supply should never be run at more than 92 watts/ 3.8 amps). Set the maximum current output of the power supply to this value (by using an amp meter in series with the load and adjust the ***current potentiometer*** until the current is <= the calculated current of all connected devices.

  Example: If 10 LEDS running at 250ma are connected together, the total current draw with all lamps operating will be .250amps x 10 = 2.5 amps. In such case the output of the power supply should be set to 2.5 amps which will be the maximum amount of amperage that the power supply could supply with all loads operating.

- All LEDs should have the same maximum DC voltage specification and a power supply with that rating must be selected (i.e. 36vDC LEDS require a 36vDC power supply, 24vDC LEDs require a 24vDC power supply). All LEDS must be at minimum 12vDC devices and at maximum 36vDC devices). Set the maximum **voltage** output of the power supply to this value (by using an volt meter in series with the load and adjust the ***voltage potentiometer*** until the **voltage** is <= the voltage of any one device (with all devices being equal here in their voltage limits).

  Example: If 10 LEDS all with a maximum voltage of 36vDC are connected together in parallel, the voltage draw of all will still be 36vDC. In such case the output of the power supply should be set to 36vdc (under load) which will be the maximum voltage that the power supply will supply with all loads operating.

IMPORTANT NOTE

The key to the above vis-à-vis traditional remote power operations of monochrome LEDs with standard constant current (only) ballasts or drivers, is that if one or more LEDs are taken out of the system, with a traditional power supply a disruption to the load on the system will cause the voltage provided by the power supply to increase which will burn or damage remaining bulbs/lamps in the system. With a dual voltage/current limiting power supply, the voltage will not be permitted to swing when there is a disruption to the load. Although this design is not foolproof, it is far superior to a non-dual voltage/current limiting power supply.

All LEDs may behave differently. The OEM or installer or specifier should as the responsible party verify the behavior of the monochrome LEDS by wiring them as specified above with the specified power supply (referenced above the "**A**" model) and confirm that (i) the units operate within their rated limits given the environment of the installation and (ii) that the LED in the circuit can withstand any disruption to the system when one or more devices fails, becomes unplugged, burns out or any other eventuality occurs. Converging Systems can only recommend that our design is empirical and that actual testing on the target LED should be performed and that Converging Systems cannot be held responsible for any failures in the field whether to our own products or those products manufactured by third parties or for resulting property damage, loss or any

other unexpected outcomes. It shall be the responsibility of the OEM, installer or specifier to take all proper precautions and follow suitable testing to evaluate any possible risks.

Alternative Approach-Utilize Constant Current Controllers with Constant Current Monochrome LED devices

Converging Systems has developed the ILC-450 Constant Current controller to eliminate any potential that certain eventualities might manifest themselves in the field such as

- errors in the field by not setting potentiometers correctly, or
- failures of the power supplies to perform as documented, or
- failure of the installer to install the proper **A** type power supply, or
- failure of the target LED to perform as anticipated
- failure to maintain proper temperatures for the driven LEDs
- attempting to drive multiple color LED constant current devices whatsoever.

The ILC-450 is by design a current limiting device which obviates the possibility of most of the failures of the above from occurring. But that also implies that (i) our design with the shunts is engineered into the device (to avoid the failure of one lamp from impacting the entire circuit since the wiring for the ILC-450 is in series), and that (ii) all devices are properly wired as per our documentation, and that (iii) products are installed as per all local and national electrical codes. We would recommend that in all cases where constant current color devices as well as constant current monochrome devices are to be installed and properly dimmed, that the ILC-450 is selected.