eldoLED

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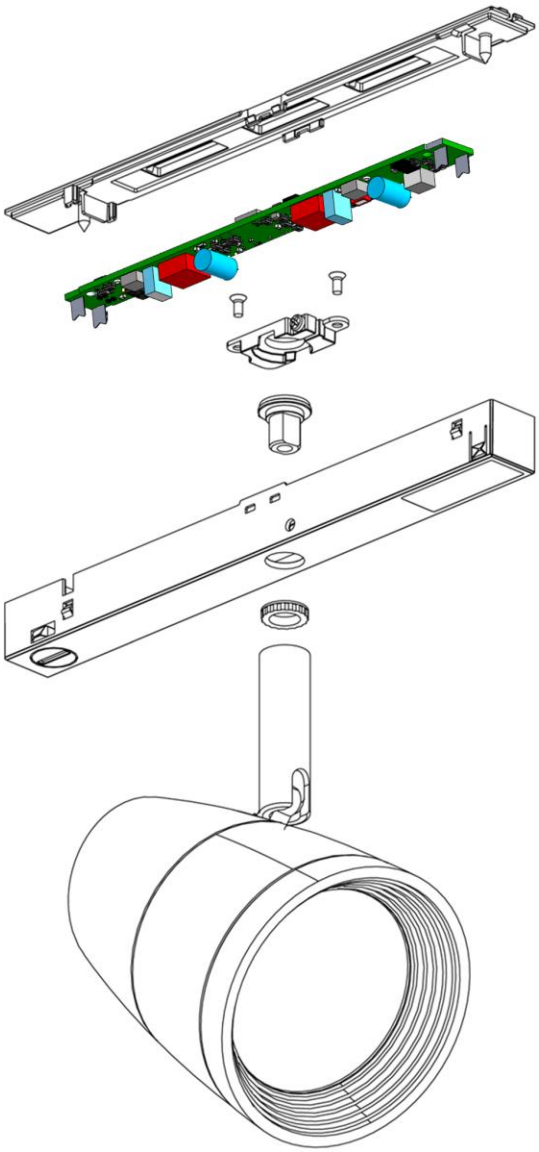

32W/P LED Driver for 48V track applications

(compatible with the Stucchi MULTISYSTEM single spot track adapter)

December 29, 2020

AcuityBrands.

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1. Introduction

Thank you for your interest in the eldoLED 32W/P LED driver family. This design guide addresses common design features, configurations, and performance considerations when designing a track luminaire around any one of the LED driver configurations in this family. This design guide applies to these configurations in the 32W/P LED driver family:

PRODUCT	LED OUTPUTS	CONTROL HANDLES	MINIMUM DIMMING	CONTROL	LIGHTSHAPE SUPPORT
ECOdrive 32P-D1Z0D	1	1	1%	DALI-2 DT6	-
SOLOdrive 32P-D1Z0D	1	1	0.1%	DALI-2 DT6	-
SOLOdrive 32P-D2Z0D	2	1	0.1%	DALI-2 DT6	Dim-to-Warm
DUALdrive 32P-D2Z0D	2	2	0.1%	DALI-2 DT6	Tunable White
DUALdrive 32P-D2Z0C	2	2	0.1%	DALI-2 DT8(Tc)	Tunable White

2. Product Overview

Rapid improvements in LED performance have enabled further miniaturization of track and downlights. Stucchi, with its MULTISYSTEM track lighting solution, now offers a broad set of components to enable a variety of track-based lighting applications. To meet the ever-tighter form factor constraints, these tracks rely on small DC-2-DC LED drivers that are powered by a separate (remote) power supply unit via a constant voltage bus.

The 32W/P LED driver family is mechanically and electrically compatible with the Stucchi MULTISYSTEM single spot track adapter series 9519-166 (polarized and non-polarized; magnetic and mechanical). Despite their diminutive size, the 32W/P LED drivers deliver the Quality of Light (e.g. smooth and deep dimming, no objectionable flicker) for which eldoLED LED drivers are known and which is demanded by the specification-grade installations in which these tracks will be used. Figure 1 shows an exploded 3D mechanical rendition of an eldoLED 32W/P LED driver inside a fully assembled track head that is built around the Stucchi MULTISYSTEM track adapter.

The eldoLED 32W/P LED driver is an open-frame LED driver, i.e. it does not include any protective housing, see Figure 2. Therefore, proper precautions must be taken when handling these LED drivers to avoid damaging the components and/or the solder connections, either through physical force or via electrostatic discharge events.

The 32W/P LED driver is fully programmable across a wide operating window and supports a load up to 32W. Depending on the configuration, the 32W/P LED driver either has one or two constant current LED outputs. The dual-output 32W/P LED driver configurations include LightShape in support of Dim-to-Warm and Tunable White applications. The 32W/P LED driver is designed to be powered by a 48VDC constant voltage bus and can be controlled via DALI.

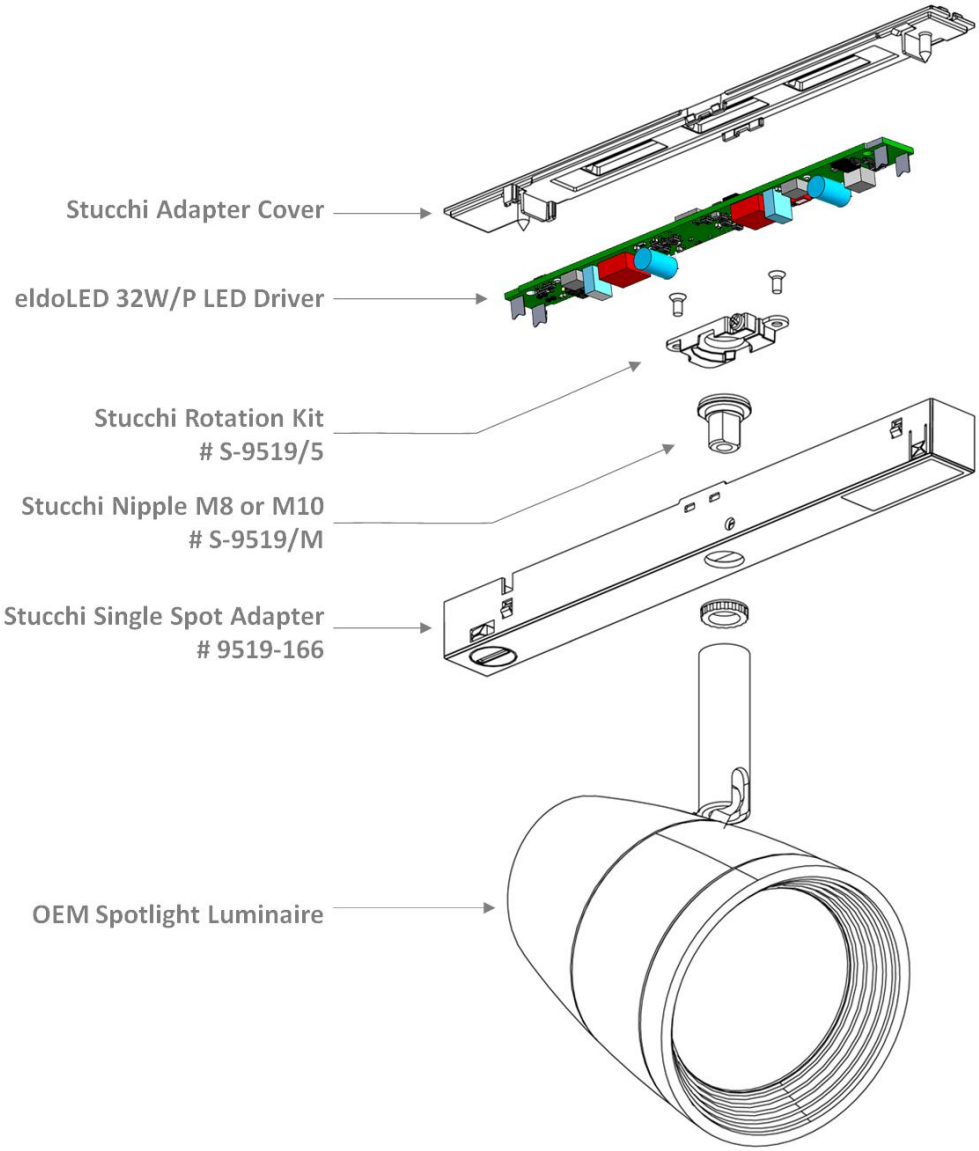


Figure 1: The 32W/P LED driver (in color) is an open-frame LED constant current LED driver that is designed for use in the Stucchi MULTISYSTEM track adapter. To facilitate assembly, the 32W/P LED driver includes special connector blades that mate with the IDC connectors in the Stucchi track adapter for DC bus power and DALI communication.

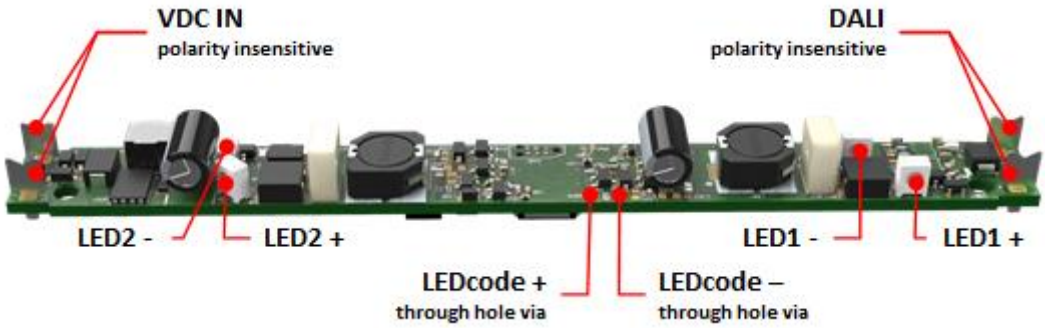


Figure 2: Mechanical rendering of the dual-channel 32W/P LED driver, with each input / output connection labelled. The single-channel 32W/P LED driver configuration is similar but with all components associated with LED output 2 depopulated.

3. Electrical

Input Power

The 32W/P LED driver is designed to be powered by a constant voltage power supply unit (PSU). To ensure reliable operation, the DC input voltage to the 32W/P LED driver shall be maintained within 48VDC ± 2VDC. Table 1 lists several constant voltage PSUs that have been successfully used to power one or more 32W/P LED drivers on a single bus.

The 32W/P LED driver is insensitive to the polarity of the constant voltage bus and DALI bus to which it is connected. Consequently, the 32W/P LED driver can be used with both the polarized as well as the non-polarized Stucchi track adapter configurations. The Stucchi MULTISYSTEM track adapter also offers two different mechanisms (mechanical and magnetic) to secure the fully assembled track adapter into a track profile. The 32W/P LED driver is compatible with both.

Table 1: Constant voltage PSUs that have been successfully used to power one or more 32W/P LED drivers.

MANUFACTURER	PRODUCT	MAXIMUM POWER [W]
Meanwell	HEP-150-48A	150
	CLG-150-48A	150
	HDR-150-48	150
Puls Dimension	QS10.481	240
ERP	VLM100W-48	100

The 32W/P drivers have been designed and validated to meet the EMC specifications listed in the product datasheet. It is the customer's responsibility to validate that the complete track solution (light engine, drivers, power supply, and control gear) meet all the relevant EMC specifications at a system level.

Output Characteristics

The 32W/P LED driver is designed to power LED light engines only. It is not recommended to use a 32W/P LED driver to power other electronic loads or circuitry; this may cause unpredictable behavior and/or damage to the 32W/P LED driver.

Depending on its configuration, the 32W/P LED driver contains either one or two constant current LED outputs, each capable of generating up to 1050mA; the cumulative drive current for a two-channel configuration cannot exceed 1200mA. Multiple LED light engines can be connected in series or in parallel if the total LED load (in terms of cumulative forward voltage and output current) does not fall outside the operating window for each LED output, as specified in the product datasheet. Any series/parallel connection of LED loads shall be designed considering the variations in forward voltage and/or current over the full operating range of the luminaire.

There are also certain LED load configurations that are not supported by the 32W/P LED driver. In particular:

- Common-anode or common-cathode configurations are not acceptable for the dual-channel SOLOdrive and DUALdrive 32W/P LED drivers, i.e. Tunable White LED modules that have only three wires are not supported.
- The LED outputs of a dual-channel 32W/P LED driver cannot be connected in series to power an LED load with a forward voltage > 40V.
- The LED outputs of a dual-channel 32W/P LED driver cannot be connected in parallel to deliver a drive current that exceeds the maximum drive current that can be delivered by a single LED output.

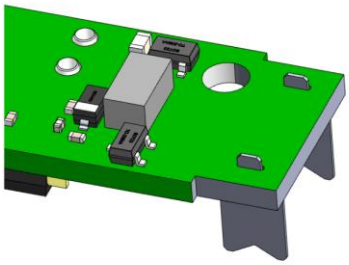
Cross connecting multiple LED outputs of a 32W/P LED driver, such as in the configurations listed above, may result in permanent damage to the LED driver itself and/or the LED light engine(s).

Electrical Connections

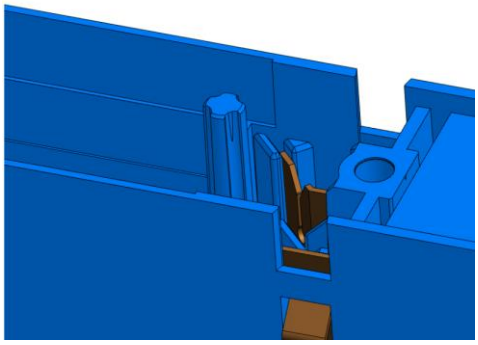
To facilitate assembly, the 32W/P LED driver includes a pair of connector blades on each end of the PCB, see Figure 2. These blades are designed to make electrical contact with the IDC connectors in the Stucchi track adapter, see Figure 3. The IDC connectors in the track adaptor connect to the 48VDC power bus and the DALI control lines in a 4-conductor Stucchi track profile.

Each LED output has two white AVX IDC connectors (AVX part number: 009176001601906), which support 20AWG solid or stranded copper wires.

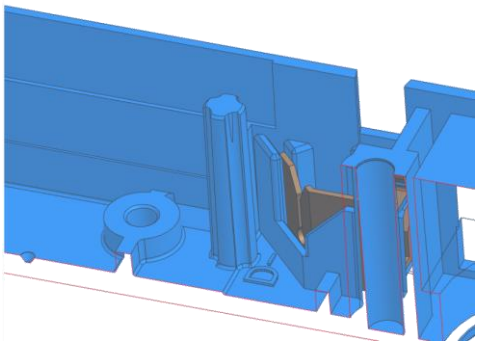
LEDcode contact pads, with 3.5mm spacing, are placed on both sides of the driver, to facilitate programming of the driver prior to and/or after assembly into the Stucchi track adapter. Programming without DC power is supported with FluxTool, TOOLbox pro, and TOOLbox adapter, see Figure 9.



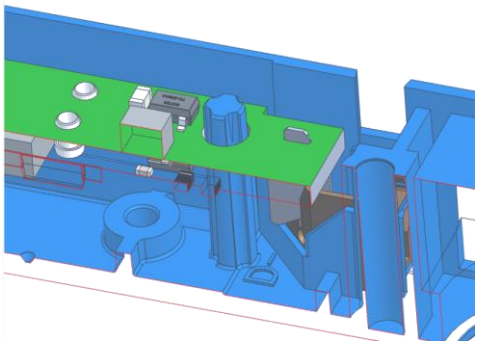
The 32W/P LED driver includes a pair of connector blades on the end of the PCB



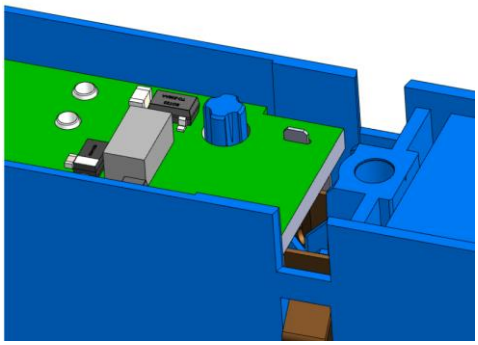
Detail of the IDC connectors in the track adapter, which contact the VDC and DALI conductors in the track profile.



This cross-section of the Stucchi track adapter details a single IDC connector as well as a small mechanical guidance pin to enforce the correct orientation of the 32W/P LED driver during assembly.



During assembly, each blade connector mates with its IDC counterpart in the Stucchi track adopter, as shown. The 32W/P LED driver includes a small hole in the PCB to accommodate the mechanical guidance pin in the track adapter.



Fully assembled 32W/P LED driver in the track adapter prior to closing the lid.

Figure 3: The 32W/P LED driver is designed to be mechanically and electrically compatible with the Stucchi track adapter.

4. Mechanical Assembly

ESD protection measures prior to assembly

The eldoLED 32W/P LED driver is an open-frame LED driver, i.e. it does not include any protective housing, see Figure 2. Therefore, proper precautions must be taken when handling these LED drivers to avoid damaging the components and/or the solder connections, either through physical force or via electrostatic discharge (ESD) events. The likelihood of ESD events can be reduced by adopting common ESD protection methods that are used in the assembly of LED lamps and/or luminaires, such as ankle / wrist straps, ESD safe shoes, conductive work mats or flooring.

LED output wiring

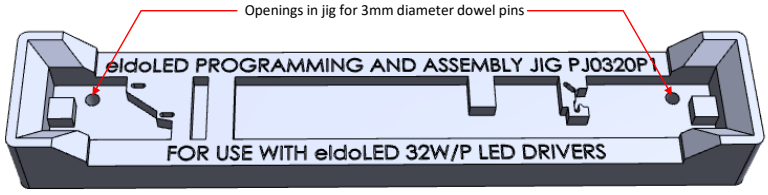
The 32W/P LED driver has 2x AVX IDC type board level connectors (AVX part number: 009176001601906) for each LED output, see Figure 2. These are intended for wiring the LED load(s) to the 32W/P LED driver in an OEM factory; these are not suitable for field installation. Each LED load must have a dedicated (+) and (-) connection to the 32W/P LED driver.

Assembly of the LED wires into the AVX connectors of the 32W/P LED driver is best done with these tools:

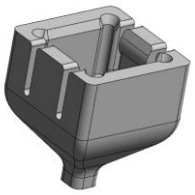
- An arbor press;
- A small plastic attachment piece that fits over the ram of the arbor press (see Figure 4) to ensure only the AVX connectors are touched during assembly of the LED wires; good results have been achieved with an attachment piece that fits over a 1 x 1 inch ram and tapers to a head size of 8.6 x 8.6mm.
- A dedicated jig (eldoLED part number: PJ0320P1) that mechanically fixates and supports the 32W/P LED driver (see Figure 4) during assembly to prevent flexing of the PCB, which, in turn, could result in broken solder joints.

The 3D mechanical files for the ram attachment piece and the jig will be made available for download on the eldoLED website. These can then be printed with a 3D printer.

To facilitate alignment of the PCB onto the jig, the jig has two small holes that can accommodate stainless steel dowel pins (3mm diameter; 12mm long) that mate with the circular openings in the 32W/P driver PCB. Alternatively, customers can purchase the jig directly from eldoLED.



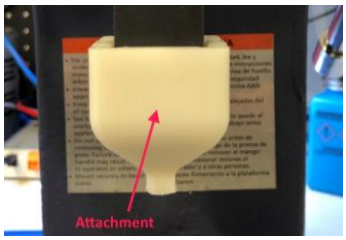
3D rendering of programming and assembly jig for 32W/P drivers



Arbor press ram attachment piece

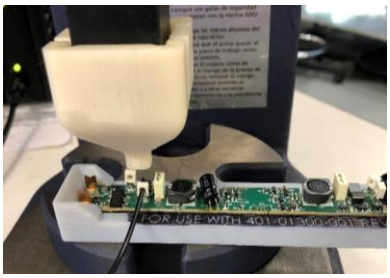
Figure 4: To minimize the likelihood of any damage to the driver PCB and/or its components during assembly, it is best to place the 32W/P driver into a jig (left) and to use an attachment piece that fits over the arbor press ram (right).

Follow these assembly instructions to secure a wire mechanically and electrically into the AVX IDC connector:

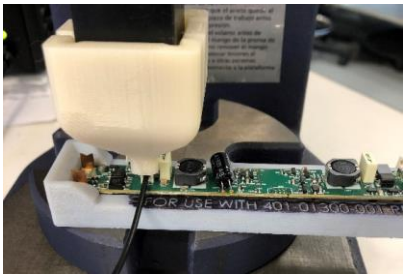


1. Secure the custom attachment piece onto the ram of the arbor press.

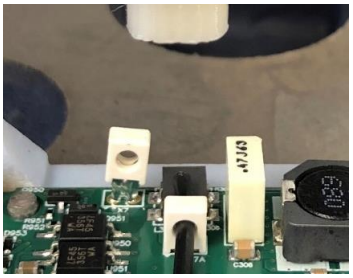
2. Align the guiding holes in the 32W/P PCBA with the metal dowel pins in the assembly jig. Place the PCBA onto the jig.



3. Place the jig onto the arbor press plate. Insert a 20AWG solid or stranded copper wire into the AVX connector and carefully align the arbor press attachment piece with the connector cap.



4. Use the lever arm to lower the arbor press attachment piece onto the connector cap. Be careful not to contact any nearby components on the 32W/P driver. Slowly apply pressure to the connector cap until the wire is seated into the AVX IDC connector.

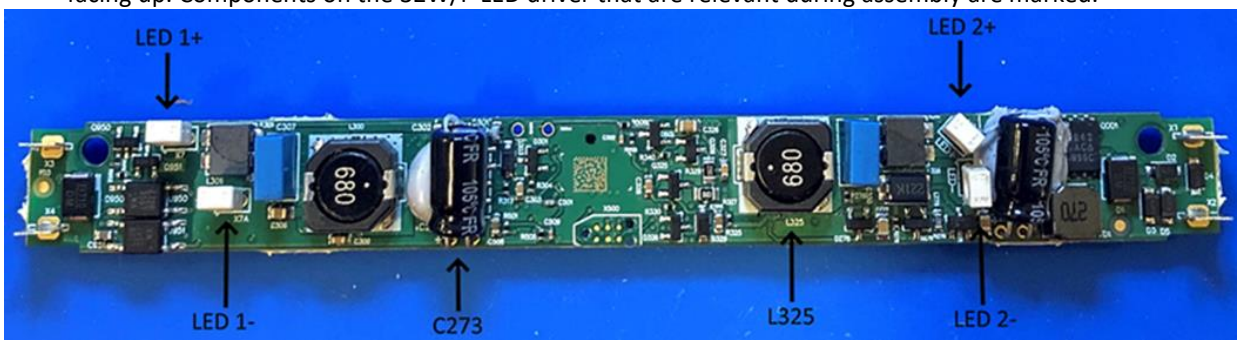


5. Inspect the connection.

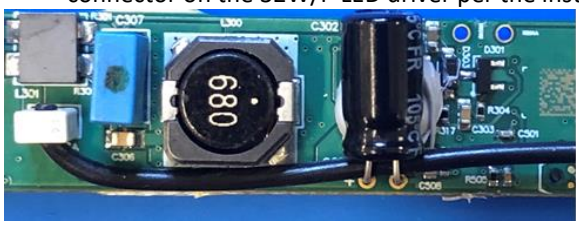
Assembly of the 32W/P LED driver into the Stucchi track adapter

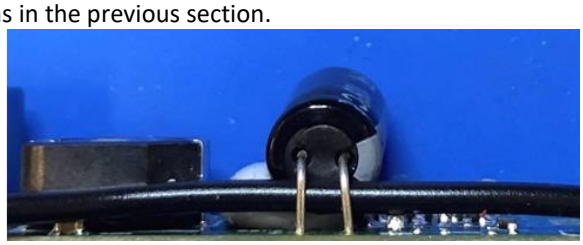
Follow these instructions to assemble the 32W/P LED driver into the Stucchi track adapter:

1. Place the 32W/P LED driver on a soft surface, such as a gel pad, with the IDC connectors for the LED outputs facing up. Components on the 32W/P LED driver that are relevant during assembly are marked.



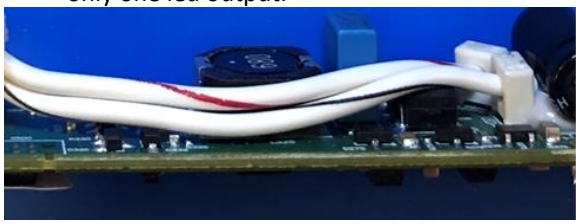
2. Route the (black) LED 1- wire through the leads of capacitor C273 and connect to the LED 1 – AVX IDC connector on the 32W/P LED driver per the instructions in the previous section.



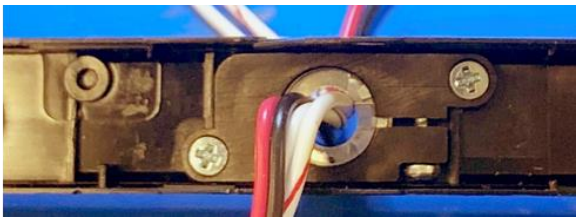


3. Route the (red) LED 1+ wire over the top of the leads of capacitor C273 and connect to the LED 1 + AVX IDC connector on the 32W/P LED driver per the instructions in the previous section.

4. Route the LED 2 + and LED 2 – wires around inductor L325 and connect to the LED 2 AVX IDC connectors on the 32W/P LED driver per the instructions in the previous section. Skip this step if the 32W/P LED driver has only one led output.

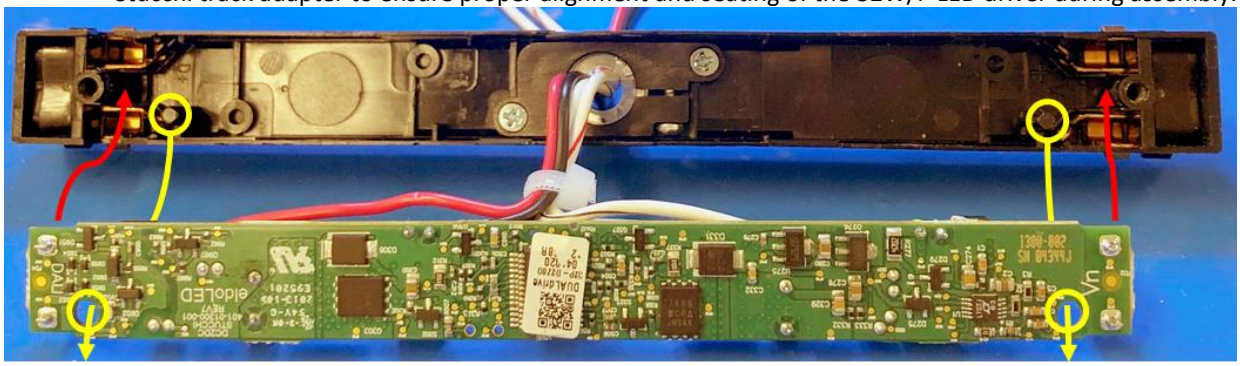


5. Install any Stucchi track adapter accessories, such as the rotation kit or nipple, into the track adapter.
6. Bundle the wires of LED1 and LED2 together with a zip tie prior to routing the cable bundle through the spot opening in the Stucchi track adapter.



7. Assemble the 32W/P LED driver into the Stucchi track adapter:
    a. align the guide pins in the housing with the holes in the driver PCB (yellow arrows).
    b. gently press both ends of the 32W/P LED driver simultaneously into the track adapter to engage the blade connectors on the 32W/P LED driver with the IDC connectors in the track adapter (red arrows).

    See Figure 3 how the 32W/P LED driver is designed to leverage the guide pins and IDC connectors in the Stucchi track adapter to ensure proper alignment and seating of the 32W/P LED driver during assembly.



8. 32W/P LED driver assembled in the Stucchi track adapter, prior to closing the lid.

9. Assemble the remainder of the track adapter per the Stucchi instructions.

5. Thermals

Thermal Performance

32W/P LED drivers are designed to operate reliably if the critical component Tc temperature (Tc max) of the driver does not exceed the maximum allowable temperature as specified in the product datasheet. So, any luminaire design must be properly tested to ensure that the 32W/P LED driver Tc point stays below its maximum value under all operating conditions.

The projected 32W/P LED driver lifetime is a strong function of both the ambient room temperature and the LED load that is connected. The graph in Figure 5 shows the typical relationship between the forward voltage of the LED load (at different load levels) and the ambient air temperature assuming a target driver lifetime of 50k hours. This assumes that the 32W/P LED driver is mounted in the single-spot Stucchi track adapter (9519-166 series), which, in turn, is mounted in a Stucchi track

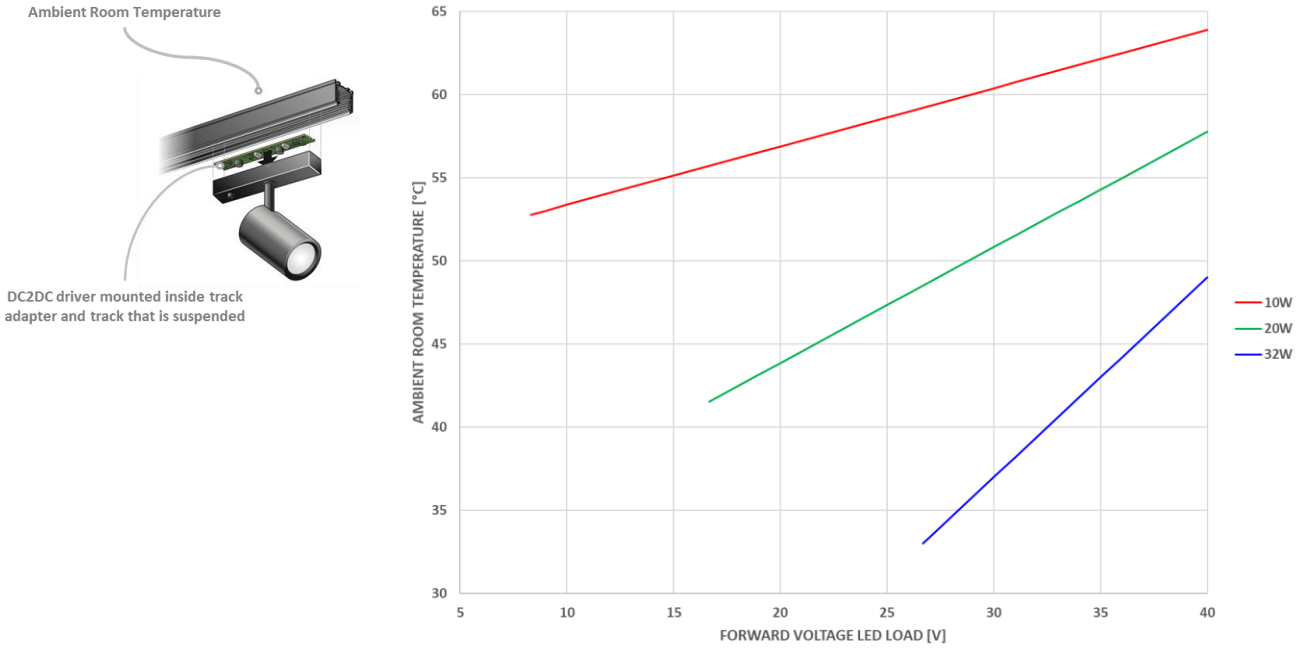


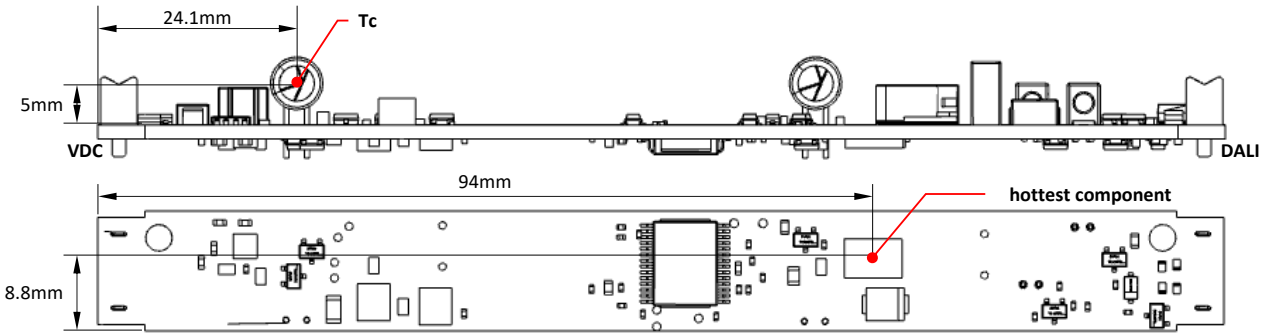
Figure 5: This graph shows the typical relationship between the forward voltage of the LED load (at different load levels) and the ambient room temperature, assuming a target 32W/P LED driver lifetime of 50k hours.

profile that is suspended in ambient air. Actual results may vary slightly. So, customers should always perform their own measurements to validate that the LED driver does not exceed the maximum allowable Tc temperatures as specified in the product datasheet.

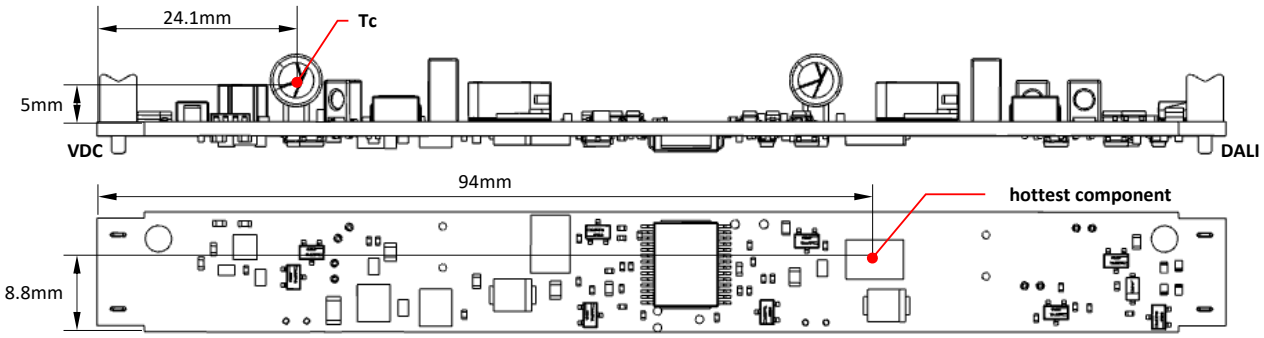
Thermal Measurements

From a driver reliability perspective, the critical component to monitor is the top of the electrolytic capacitor near the VDC input, see Figure 6. To ensure a lifetime of at least 50k hours, the temperature of this capacitor shall not exceed the value specified in the product datasheet. While this electrolytic capacitor is the most critical component from a driver reliability

perspective, it is typically not the hottest component on the 32W/P LED driver. Certification Bodies may ask to monitor the hottest component on the 32W/P LED driver. The component that typically runs hottest on the 32W/P LED driver is a MOSFET on the bottom of the 32W/P LED driver. This component is also identified in Figure 6.



Single-channel 32W/P LED driver configuration



Dual-channel 32W/P LED driver configuration

Figure 6: Location of the Tc measurement point for the single-channel (top) and dual-channel (bottom) 32W/P LED driver configurations. This temperature shall not exceed the maximum allowable temperature in the product datasheet. The component on the 32W/P LED driver that typically runs hottest does not coincide with the Tc location; it is located on the bottom of the 32W/P LED driver and is annotated separately in the drawings above.

6. Control

Each 32W/P LED driver can be controlled via DALI and has been validated by DiiA to meet the DALI-2 standard [*]. The DALI control interface on the 32W/P LED driver is designed to withstand any voltage < 60VDC in case of accidental miswiring.

Per the product documentation, the Stucchi MULTISYSTEM track pattern is designed to be Class III – SELV, i.e. the supply voltage shall be less than 60VDC and the supply current cannot exceed 15A. Furthermore, any component that is connected

[*] DiiA certification for DUALdrive 32P-D2Z0C is still pending.

to the Stucchi MULTISYSTEM track pattern shall be Class III. Even though the potential on a DALI voltage bus is well below 60VDC, a DALI cable is not considered SELV. To allow connection between a (non) isolated DALI bus and the MULTISYSTEM track pattern, an opto-isolated DALI repeater may be required, see Figure 7.

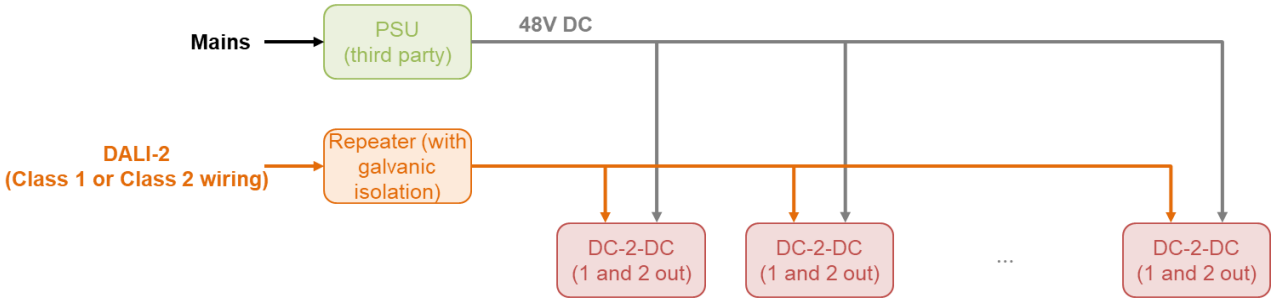


Figure 7: The Stucchi MULTISYSTEM track pattern is designed to be Class III – SELV, but a typical DALI control bus is not guaranteed to be SELV. An opto-isolated DALI repeater may be placed between the DALI network and the DALI control bus in the MULTISYSTEM track pattern to make the incoming DALI signal suitable compatible with the MULTISYSTEM track pattern.

7. Programming

The 32W/P LED driver is fully programmable via LEDcode and FluxTool, eldoLED's dedicated software application for programming of LED drivers. Unlike other eldoLED LED drivers, the 32W/P LED driver does not have dedicated LEDcode push-in connectors. Instead, the 32W/P LED driver includes LEDcode contact pads, which can be accessed from both sides of the PCB, see Figure 2, to enable programming of the 32W/P LED driver prior to and/or after assembly into the Stucchi track adapter, see Figure 8. Programming is done with FluxTool, TOOLbox pro, and the optional TOOLbox adapter. The benefit of programming with TOOLbox adapter is that the 32W/P LED driver does not need to be powered, see Figure 9.

The order number configurator in the product datasheet of the 32W/P LED driver captures the most common driver settings and configurations. These settings are all accessible via FluxTool as well. Please contact your eldoLED Sales representative if you further customization of the 32W/P LED driver is desired.

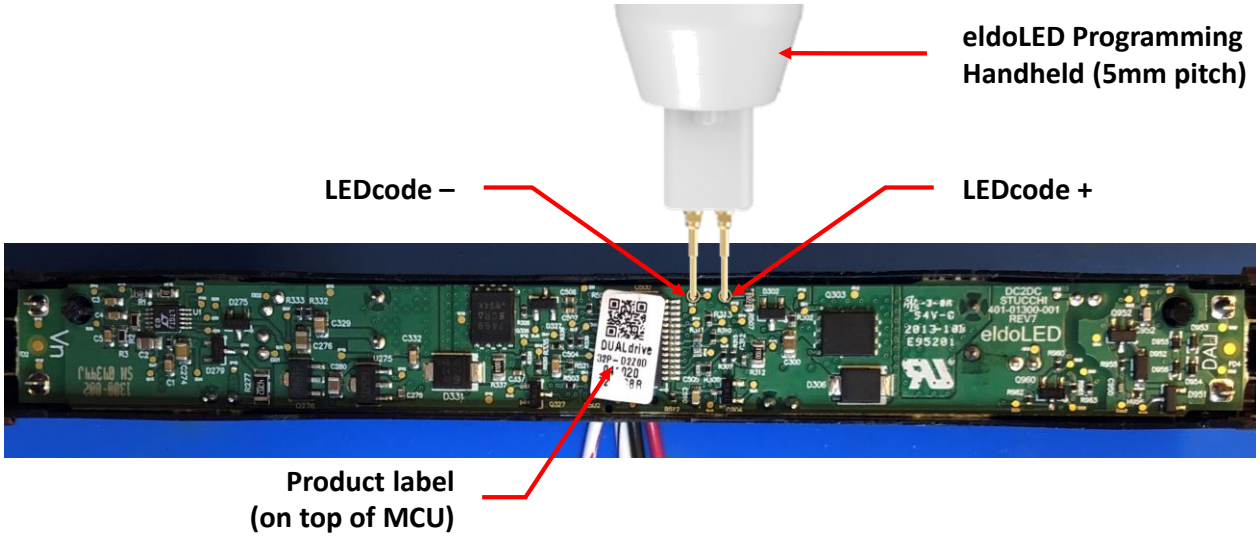


Figure 8: The 32W/P LED connector includes LEDcode programming pads that can be accessed even when the 32W/P LED driver has already been assembled into the Stucchi track adapter.

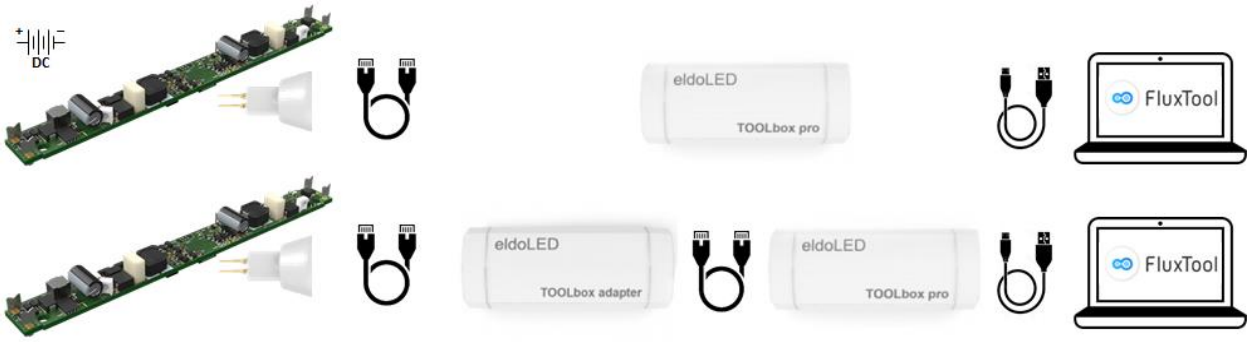


Figure 9: The 32W/P LED driver is fully programmable via FluxTool. If the 32W/P LED driver is already powered by a DC PSU, only TOOLbox pro is required (top). If the 32W/P LED driver is not powered, programming can be done with TOOLbox pro in combination with TOOLbox adapter (bottom).

8. Driver Protections

The 32W/P LED driver has several protection mechanisms to comply with standards and to prevent damage to the LED driver during operation. These protection mechanisms include:

Thermal protection – When the internal LED driver temperature exceeds a factory preset limit, the output current on all LED outputs is gracefully scaled back until the LED driver temperature drops below this limit. If the internal

LED driver temperature continues to increase, despite a decrease in output current, the LED driver eventually shuts down when a second temperature threshold is reached. Once the temperature drops below the threshold, the driver will restart.

Open protection – All LED outputs are turned off whenever the LED driver detects an open circuit on any one of the LED outputs. The LED driver will automatically attempt a restart every 400ms after an open circuit is detected.

Short protection – All LED outputs are turned off whenever the LED driver detects a short circuit on any one of the LED outputs. The LED driver will automatically attempt a restart every 400ms after a short-circuit is detected.

Overload protection – The driver monitors the cumulative load across all LED outputs. Whenever this cumulative load exceeds the maximum output power rating of the LED driver, the output current on all LED outputs is gracefully scaled down until the cumulative load drops below the maximum output power rating of the LED driver.

Reverse polarity – The LED driver does not yield any current if the polarity of the load on an LED output is reversed. This situation will not damage the LED driver but may damage the LED load due to the reverse voltage across the LEDs.

Hot plugging – In general, it is best to turn off power to the Stucchi track solution prior to changing its configuration to avoid damaging any of the electronic components that are connected to the track solution. However, the 32W/P LED driver does include protection against hot-plugging, i.e. the 32W/P LED driver can be plugged into or removed from a fully powered Stucchi track pattern without risking any damage to the 32W/P LED driver.

Input Polarity - The 32W/P LED driver is insensitive to the polarity of the constant voltage bus to which it is connected. Consequently, the 32W/P LED driver can be used in both the polarized as well as the non-polarized Stucchi track adapter versions.

The thermal, open, short, and overload protection mechanisms typically kick in if one or more of these limits are violated:

- The current of any LED output exceeds 1050mA
- The cumulative current for both LED outputs exceeds 1200mA (dual-channel configurations only)
- The LED load on any LED output exceeds 40V
- The total output power of the LED driver exceeds 32W
- The internal LED driver temperature exceeds a factory preset limit

Only the first limit is pro-actively enforced during programming of a 32W/P LED driver in FluxTool, i.e. the nominal current for any one LED output cannot be programmed above 1050mA. The other limits cannot be enforced when programming a 32W/P LED driver since these are dependent on factors that are beyond eldoLED's control, including:

- the operating conditions in the final application
- the LED load(s) that is(are) connected
- whether LightShape is enabled or not

It is the responsibility of the luminaire design engineer to ensure none of the limits above are violated in the targeted application, including worst-case operating conditions such as cold start-up.

9. Best Practices

To reduce the likelihood of issues in the field, it is best to communicate clearly how a DALI track luminaire is configured to the specifier, control system designer, installer, and commissioning party. The following information is best included in the luminaire specification sheet and/or installation sheet:

- Type of luminaire (e.g. general white, Dim-to-Warm, or Tunable White)
- Color temperature (for general white) or supported CCT range for Dim-to-Warm or Tunable White configurations
- DALI Device Type: DT6 or DT8(Tc)
- State of the LED driver, e.g. uncommissioned with no short address
- Default DALI group
- Default dimming curve of the driver
- Wiring diagram

Furthermore, it is often beneficial to clearly specify that commissioning shall be performed onsite by a qualified integrator and that DALI wiring to the track system shall be installed by qualified personnel in compliance with all relevant electrical standards as well as the DALI standard.

10. Troubleshooting

A handheld DALI programming and bus sniffing device is indispensable for testing, validation, and troubleshooting of a DALI luminaire. The process of troubleshooting a DALI LED driver is like that used when troubleshooting a complete DALI system:

1. Isolate the LED driver/fixture from the network
2. Validate the function of the LED driver/fixture
3. Validate the DALI network

To validate the LED driver is functioning correctly, follow these steps:

1. Isolate the track head in question from the track. Power the LED driver with nothing connected to the DALI inputs and verify that the track head lights up.
2. Validate the correct settings are programmed into the LED driver using the TOOLbox pro interface and FluxTool software.
    a. Verify that the software recognizes the LED driver. If the software cannot communicate with the LED driver, it may indicate a damaged LED driver.
    b. Verify the dimming curve, output current(s), and minimum dimming level are set to the proper values
    c. If LightShape is enabled in the LED driver for Dim-to-Warm or Tunable White operation, verify that the LED driver has the proper LightShape settings. Since LightShape settings cannot be directly read from the LED driver, it may be necessary to reprogram the LED driver with the correct LightShape profile.
3. Connect a portable DALI device to the DALI input of the LED driver.
    a. Perform a system extension to identify and verify communication with the LED driver. If communication via DALI cannot be established, it may indicate a damaged LED driver.
    b. Verify the short address, group, and scene settings of the LED driver.
    c. If (a) and (b) are successful, exercise the LED driver by sending DALI commands to change the intensity and/or CCT as appropriate.
4. If the track head communicates with the FluxTool software and the DALI tool, but does not illuminate, the LED load may be damaged:
    a. Isolate the driver LED load from the LED driver.
    b. Test the LED load to verify that it operates properly.

c. If the LED load operates correctly, reconnect the LED load to the LED driver and verify the following:
    i. Correct polarity
    ii. No cross-connected/shared outputs
    iii. Forward voltage below 40V
5. If the LED driver is still not responding, replace the LED driver with another unit and retest.
6. If these steps do not identify the issue, consult your eldoLED Sales representative for further support.

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