OLED Integration – Enabling Technologies

January 31, 2018

Introduction

- Our focus is to develop OLED application enabling technologies to accelerate OLED adoption
- Initial product set being developed with support of NYSERDA
- Working in close collaboration with OLEDWorks and their OLED product characteristics
- Other technology products (needs) defined for future development

Market Research – Who Did We Talk To?

- Lighting Designers
- Commercial Property Developer
- Marine Fixture Manufacturer
- Architectural Lighting Fixture Manufacturer
- Film/Photography Location Lighting Manufacturer
- Hospitality Fixture Manufacturer
- Commercial Fixture Manufacturer
- Elevator Manufacturer
- Retail Display Manufacturer
- Museum Lighting Manufacturer
- Lighting Research Center
- Department of Energy
- OLED Panel Substrate Manufacturer (UDC)
- OLED Panel Manufacturer (OLEDWorks)

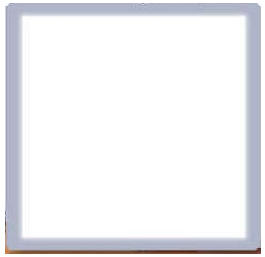
What did we learn?

- Low voltage (Class 2) Power Distribution scheme will work for most applications (thinner wiring, no conduits, minimal fixture structure, more flexibility)
- Need for small, thin, compact low voltage drivers to be mounted on or in close proximity to OLED panels
- Need for OLED “Module” containing OLED, Driver, Mounting Frame and connection feature (Plug and Play, easy for installers)
- Mounting frame: Light, thin, minimal border, easy to connect OLED to surface
- Panel-to-panel attachment
- Other accessories to mount on tracks (aim OLED panels)
- Accessories must complement “thin”, light-weight OLED characteristics
- Drivers must be dimmable (0-10V, DALI, DMX, Triac)
- Need high efficiency power system/driver
- Need robust electrical interconnects and wiring
- Be able to support multiple panels applications
- Also need for Single and Multi-channel Line voltage drivers
- No consensus on RF (WiFi, ZigBee, other) standards – use off-the-shelf RF controls for now

OLED Products Considered

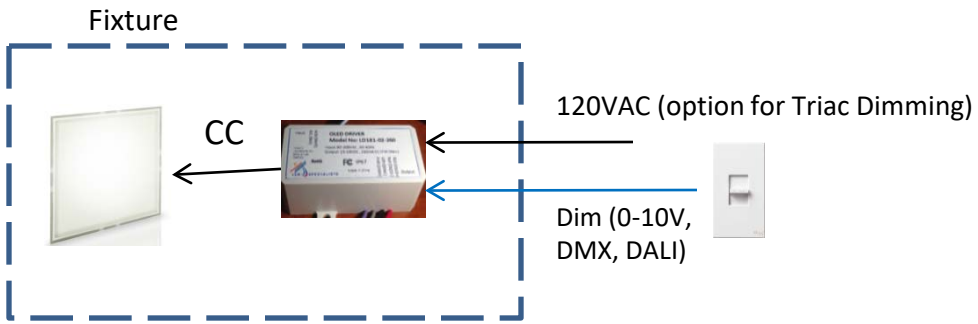
1. Amber Marker OLED Panel (OLEDWorks)

2. Brite 1 and Brite 2 OLED Panels (OLEDWorks)

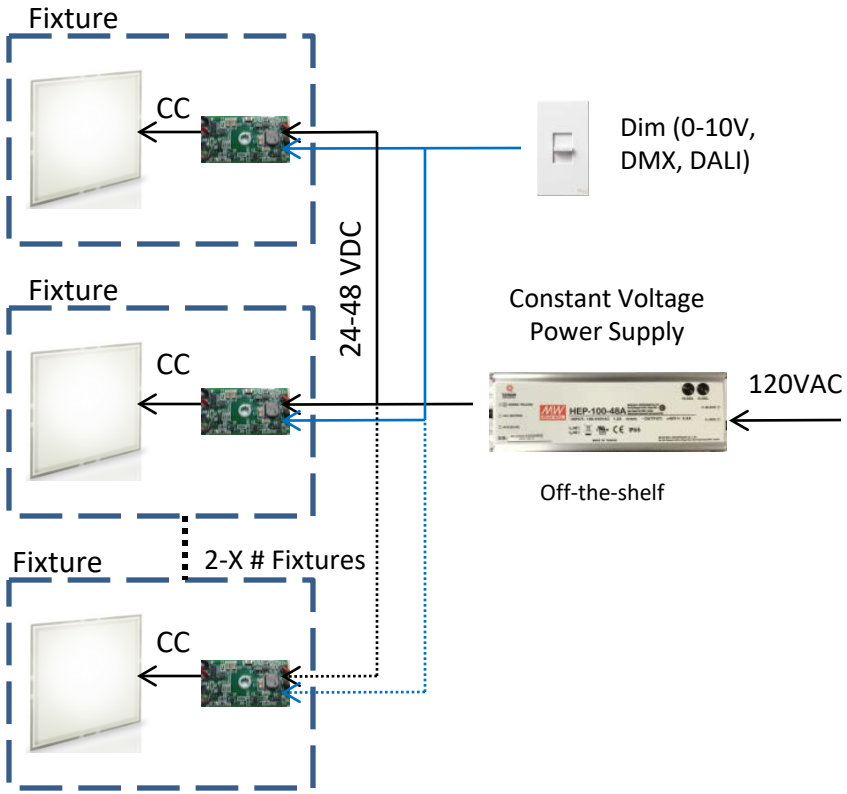


Considered Products Available Today

OLED Electrical System Configurations

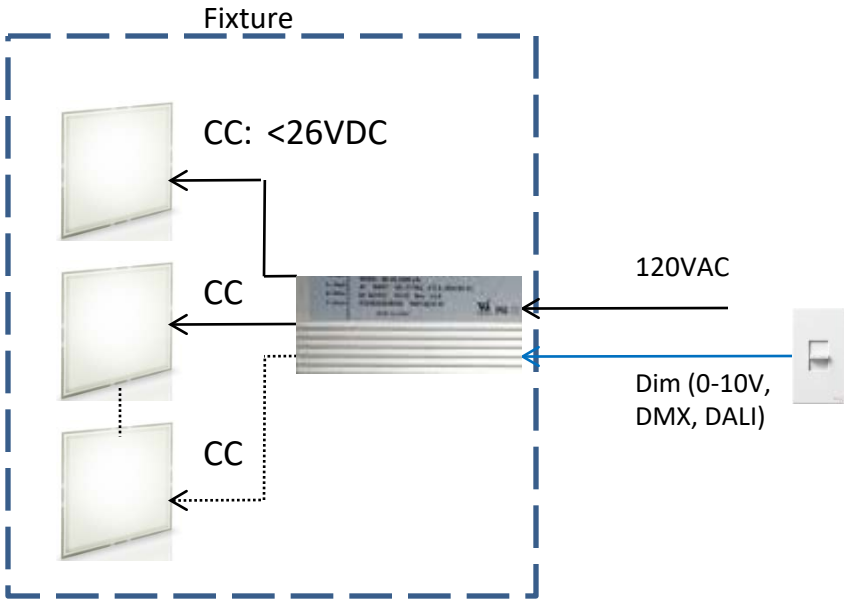


- Consumer Products
- Task Lighting

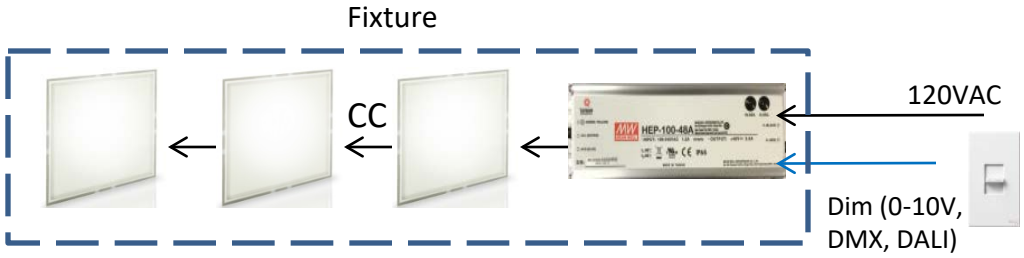


- Commercial or Residential Lighting
- Large number of OLEDs separately mounted
- Longer wire runs (Need to consider voltage drops)
- Class 2 Installation:
  - Voltage: <60v
  - Power: <100W
  - Current: <8A

OLED Electrical System Configurations (cont.)



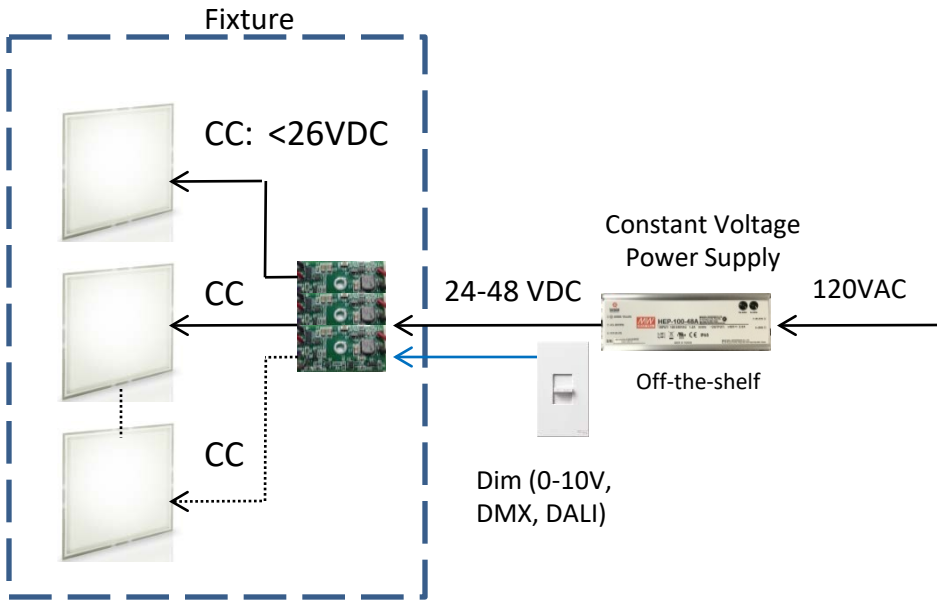
- Commercial or Residential Light Fixture with 2 or more OLEDs
- Multi-Channel CC Driver, close to OLEDs (e.g. in fixture, canopy or ceiling)
- Class 2 Fixture Design



<60VDC, Class 2, > 60VDC Class 1

- Commercial or Residential Light Fixture with 2 or more OLEDs
- Single Channel CC Driver, close to OLEDs (e.g. in fixture, canopy or ceiling)
- Forward Voltage <60VDC for Class 2
- Forward Voltge >60VDC for Class 1 Fixture Design (Safety, Grounding, etc.)
- OLED Short detection?

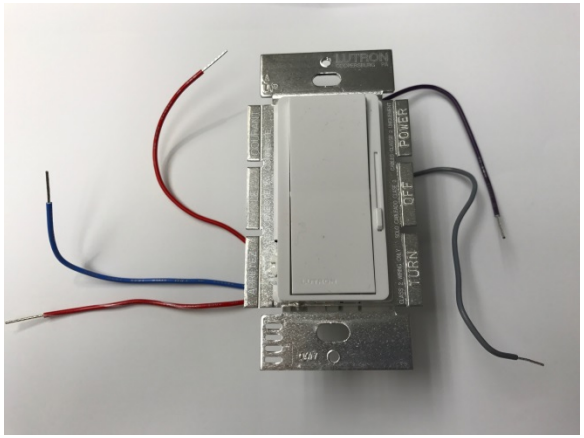
OLED Electrical System Configurations (cont.)



- Commercial or Residential Light Fixture with 2 or more OLEDs
- Low voltage Multi-Channel CC Driver, close to OLEDs (e.g. in fixture, canopy or ceiling)
- Class 2 Fixture Design

0-10V Dimming

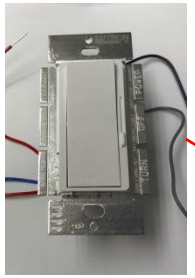
- Use 0-10V dimmer that complies with IEC 60929 (e.g. Lutron DVTV supports Class 2)
  - One dimmer can support up to 30mA of current
  - Number of OLED Modules on circuit depends on source current of driver



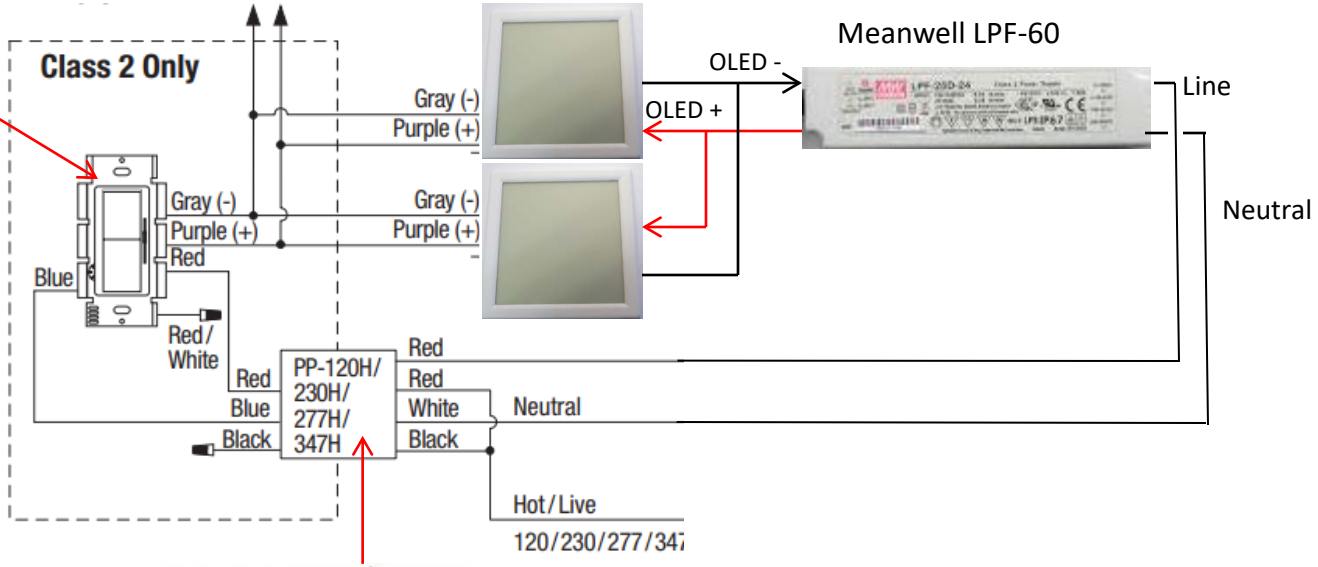
Lutron DVTV Dimmer and ON/OFF Control

Lutron PP-DV Power Pack for Switching Driver Power

Dimmer Wiring (Example)

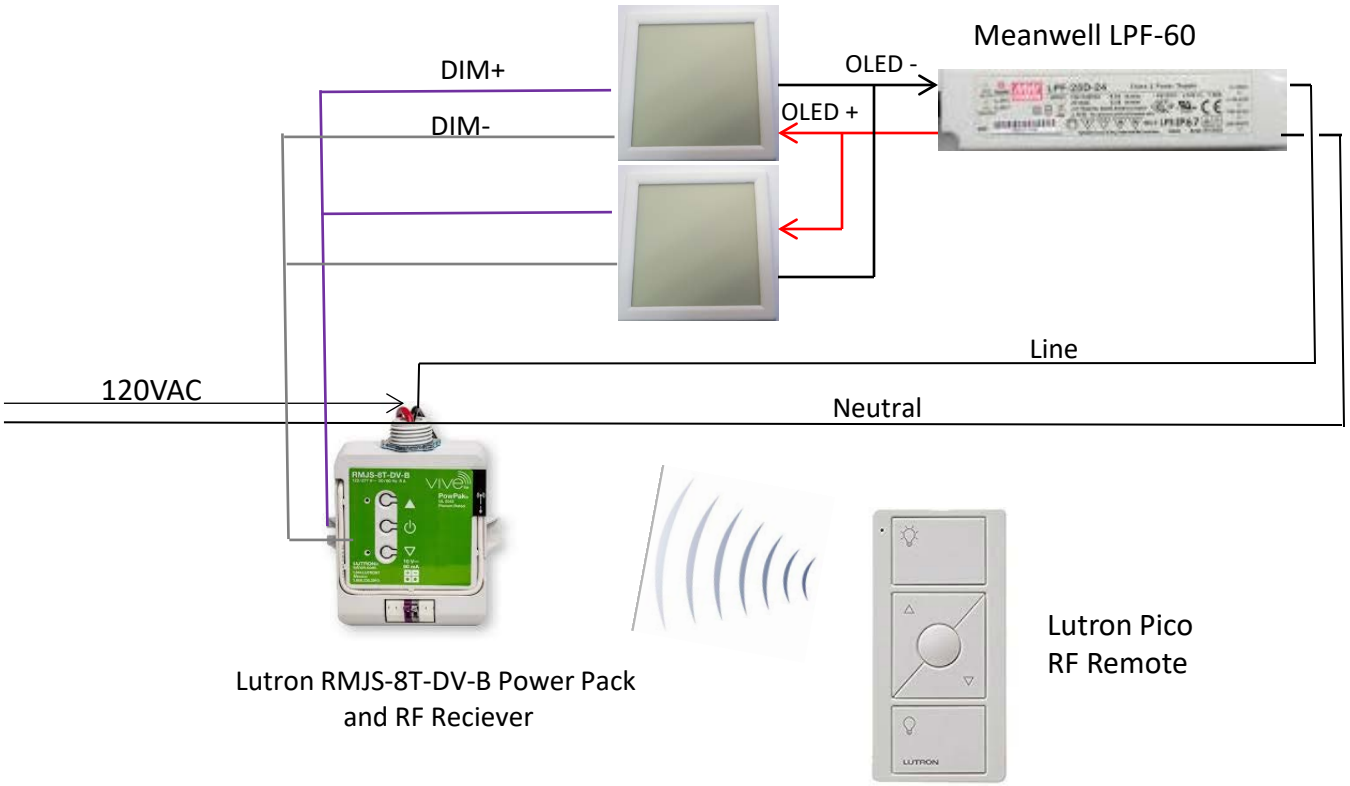


Lutron DVTV Dimmer
- Slide for Dim
- Paddle for On/Off



Lutron PP-DV Power Pack for Switching Driver Power

RF, 0-10V Dimming (Example)

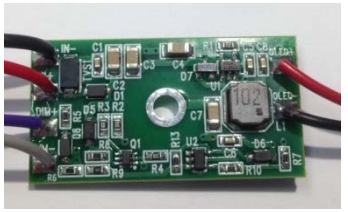


LD0196 Brite-Amber Driver

- Input Voltage: 10-24VDC
- Output Voltage: 5.8 - 21.6VDC (up to 3 panels in series)
- Output Current: 44mA constant current
- Power: 0.29W (nom), 0.33W (max)
- Efficiency: 92%
- 0-10V Dimming (IEC 60929): 10% - 100%
- Dimensions (PCBA): 1.5” x 0.80” x 0.134”
- Reverse Polarity Protection
- Short and Open Circuit Protection
- Spike and Transient Protection
- Operating Temperature: -20 to +50C
- Safety: UL/EN/CSA UL8750, IEC 61347 (CE)
- EMC: EN55022, EN61000-3-2, -3-3, -4-2, -4-3, -4-5, -4-6

In Production

OLED Panel Brite Amber Marker Light
LPA1015R1AML201



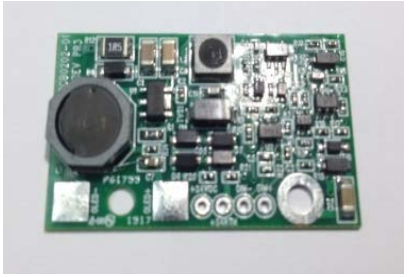
LD0196-01

LD0196-02

LD0202 Brite-Consumer Driver

- Input Voltage: 24-28VDC
- Output Voltage: 5.8 - 26VDC
- Output Current: 260mA or 368mA constant current
- Power (@260mA): 5.2W (nom), 6.8W (max)
- Efficiency: 92%
- 0-10V Dimming (IEC 60929): 5% - 100%
- Dimensions (PCBA): 1.5” x 0.9” x 0.15”
- OLED Short Circuit Protection
- Reverse Polarity Protection
- Open Circuit Protection
- Spike and Transient Protection
- Operating Temperature: -20 to +50C
- Safety: UL/EN/CSA UL8750, IEC 61347 (CE)
- EMC: EN55022, EN61000-3-2, -3-3, -4-2, -4-3, -4-5, -4-6

In Production



LD0202-01

LD0202-02

LD0181-03 OLED Line Voltage Driver

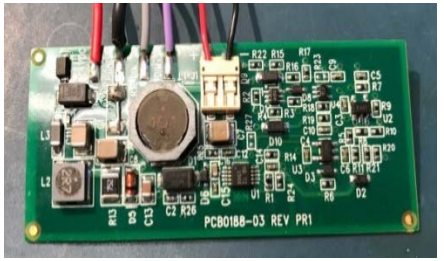
- Input Voltage: 90-305VAC, 50/60Hz Universal Input
- Output Voltage: 15-26VDC @ 260mA
- Power: 7W Max
- 0-10V dimming per IEC 60929 (4%-100%)
- OLED short circuit protection
- Operating Temperature: -40 to +75C
- Ingress Protection to IP67
- Complies with emissions requirements of EN 55022; FCC Part 15
- Complies with UL/CSA Product Safety requirements (UL8750 and UL1310 Class 2)

2.7”L x 1.3”W x. 1.0”H

In Production

LD0188 Brite-Commercial Driver

- Input Voltage: 24-50VDC
- Output Voltage: 18 - 26VDC
- Output Current: 260mA or 368mA constant current
- Power (@260mA): 5.2W (nom), 6.8W (max)
- Efficiency: 92%
- 0-10V Dimming (IEC 60929): 2% - 100%
- Dimensions (PCBA): 2.34” x 1.0” x 0.135”
- OLED Short Circuit Protection
- Reverse Polarity Protection
- Open Circuit Protection
- Spike and Transient Protection
- Operating Temperature: -20 to +50C
- Safety: UL/EN/CSA UL8750, IEC 61347 (CE)
- EMC: EN55022, EN61000-3-2, -3-3, -4-2, -4-3, -4-5, -4-6



LD0188-03

In Qualification Testing

OLED Mounting Accessory

- OLED panels have no inherent methods for mechanical mounting
- OLED panels have electrical interconnect schemes that require supplemental strain relief and connectors
- Today, each user (lighting OEM, lighting designer, end user, etc.) must come up with their own method for securely mounting and electrically connecting these OLED panels (impediment to OLED adoption).
- Today, OLED drivers must be mounted remote to OLED panel

Need for Versatile Surface Mount OLED Mounting Method

Objectives of Mounting Frame Accessory

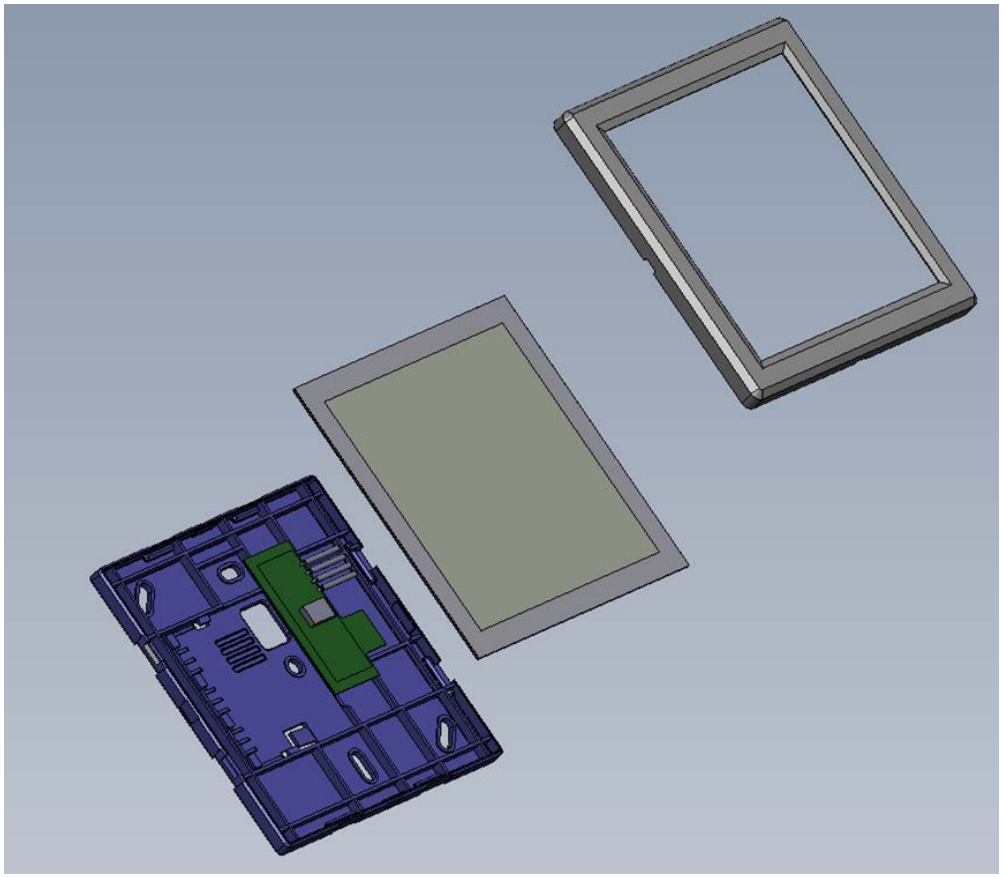
- Provide convenient methods to mount OLED panels to flat surface or install in a light fixture
  - Ceiling, wall, shelf, furniture, etc.
- Provide mechanical structural support and protection required of OLED
- Provide durable and flexible electrical interconnect while maintaining thin profile
- Provide means for optional integrated OLED constant current driver
- Support OLEDWorks Brite series:
  - Square and Rectangular panels
  - “Integration Level 1”

Design Considerations

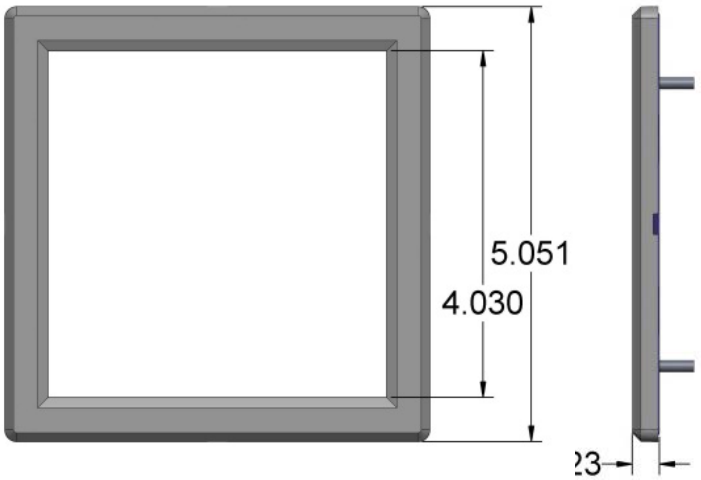
- Low Weight
- Very thin
- Low Cost
- Flexible mounting
- Modularity and scalability
- Minimize stress on OLED
- Ease of installation
- Serviceability
- Thermal management
- Containment of glass in case of breakage
- Electrical wiring routing and strain relief

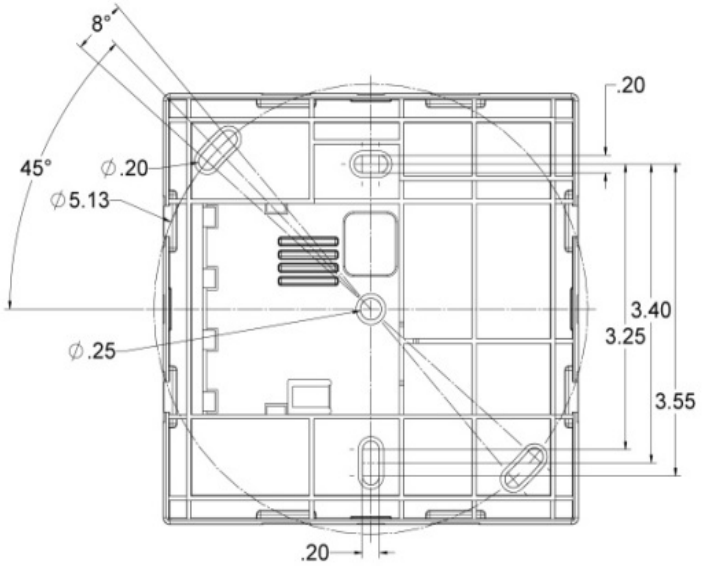
OLED Frame Design (Square)

- Mounting frame:
  - More rigid base
  - Flexible mounting holes
  - Driver (“slide and snap”, no hardware) pre-installed
  - Facility wiring can be attached before or after frame mounting
- Bezel:
  - Overall border thinner
  - Beveled design
  - OLED Panel preinstalled in Bezel under pre-molded tabs
  - Snaps engage mounting frame
  - Removable

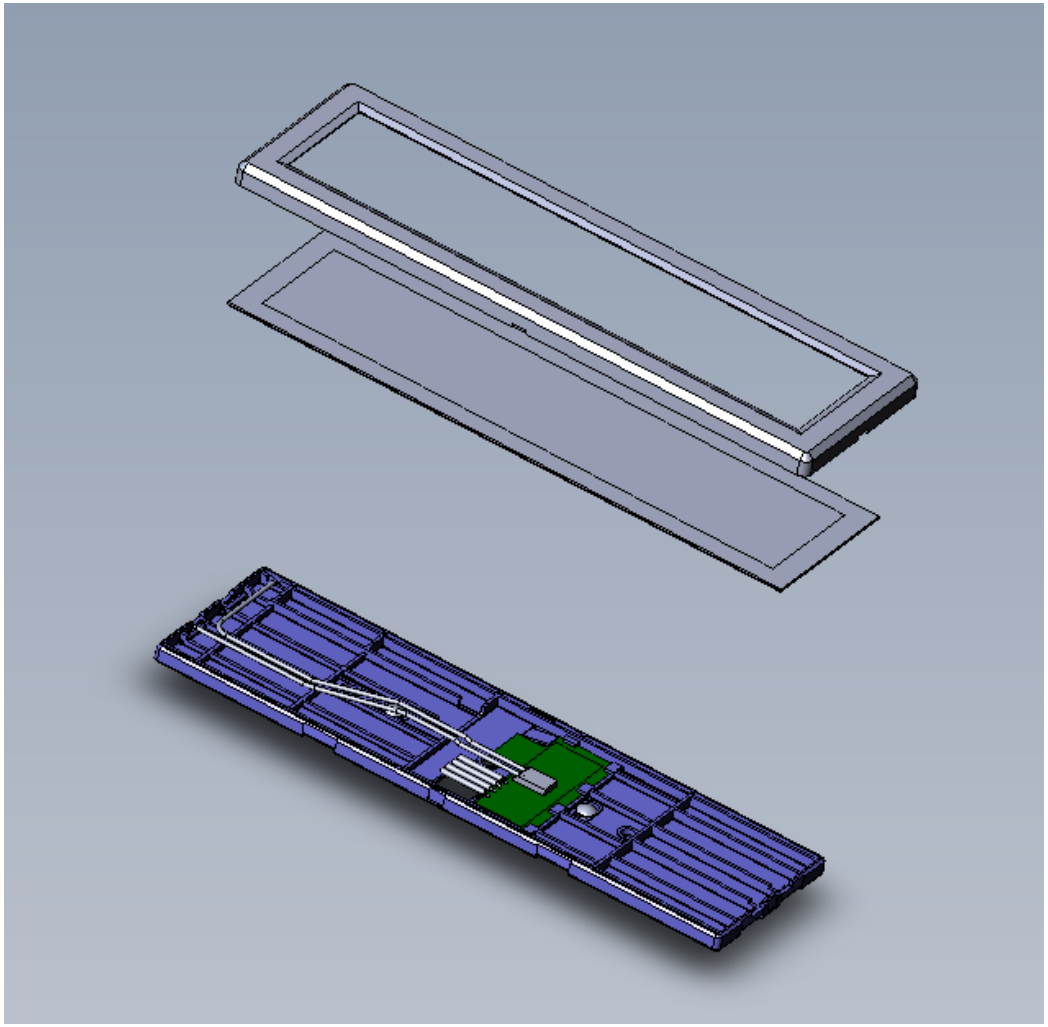


Square Module Dimensions

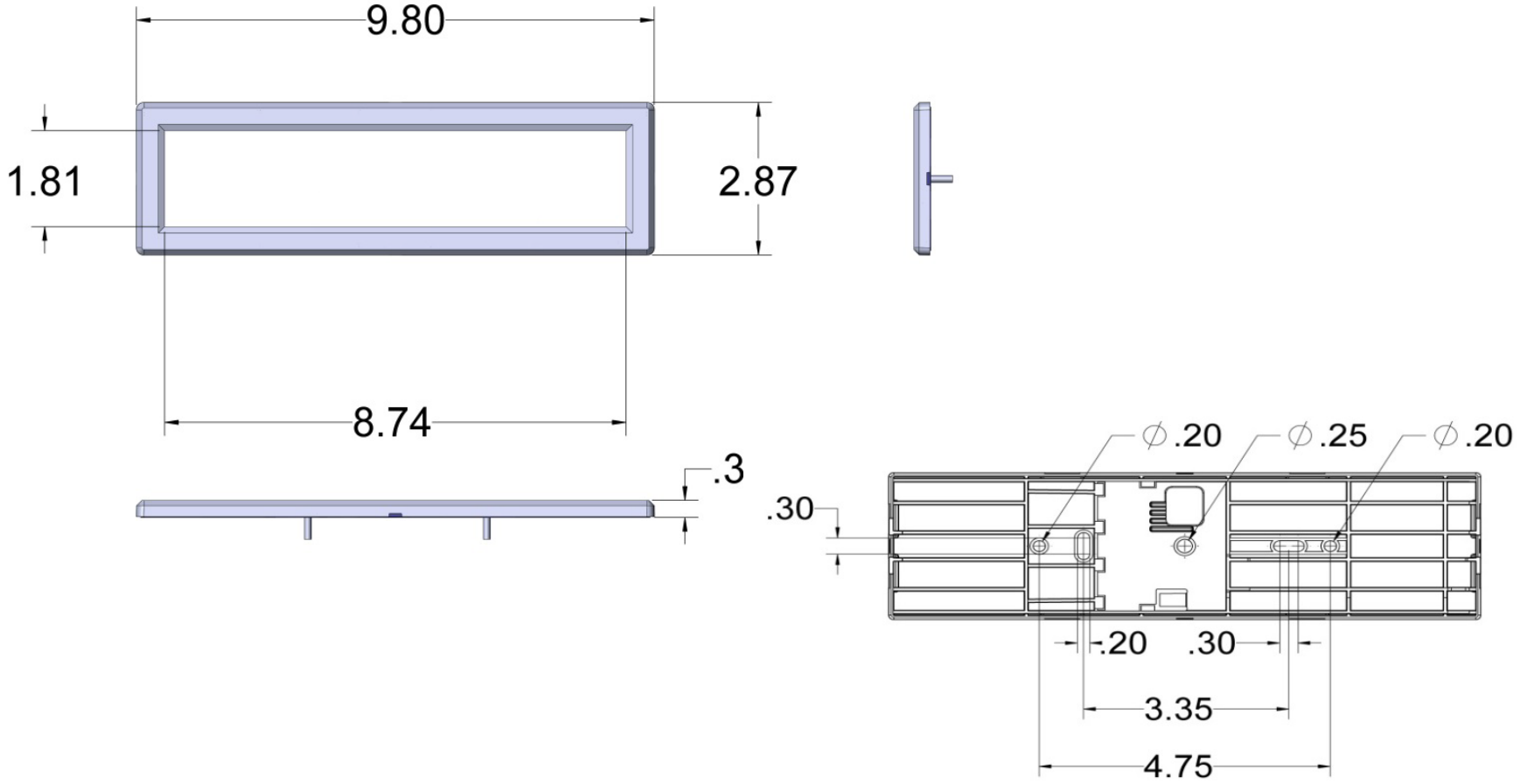




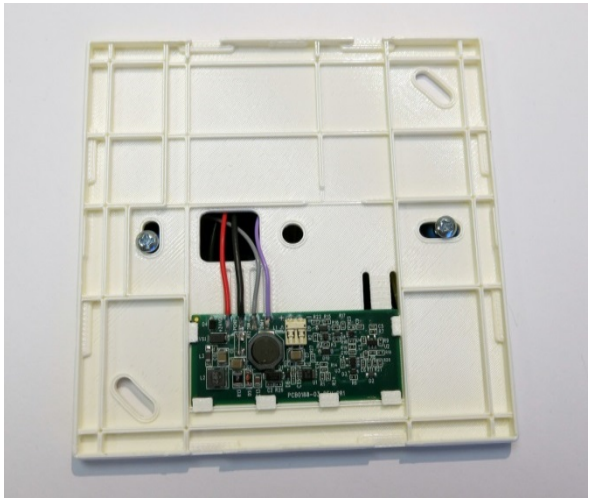
OLED Module Design (Rectangular)



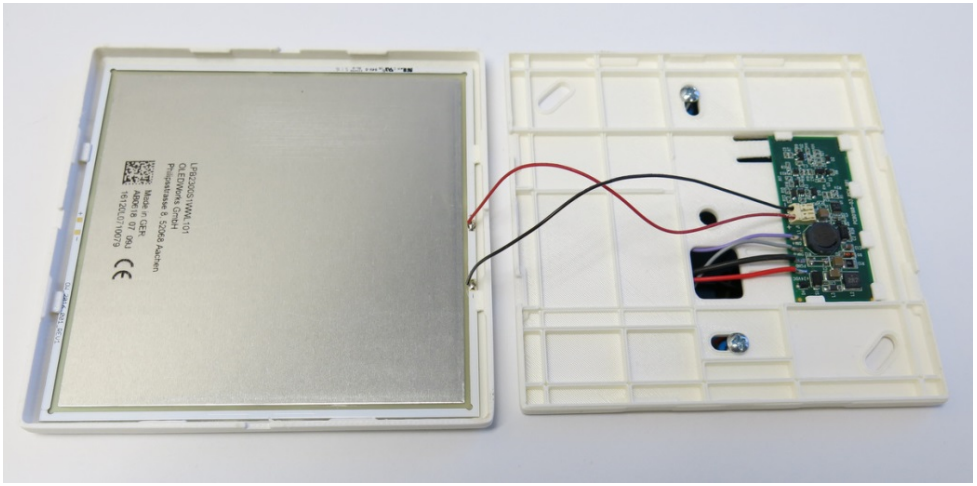
Rectangular Module Dimensions



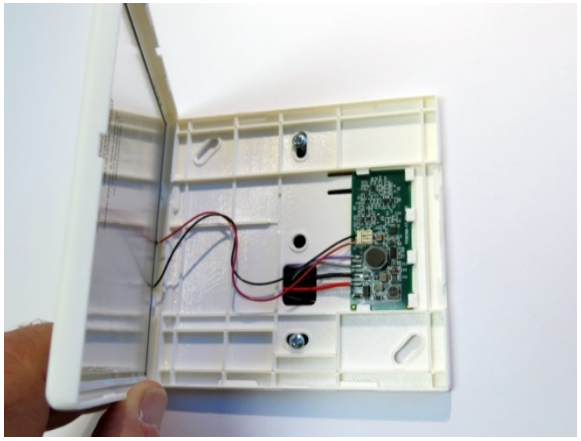
Installation – Square Module



1. Connect wiring, screw mount to flat surface (wall, ceiling)

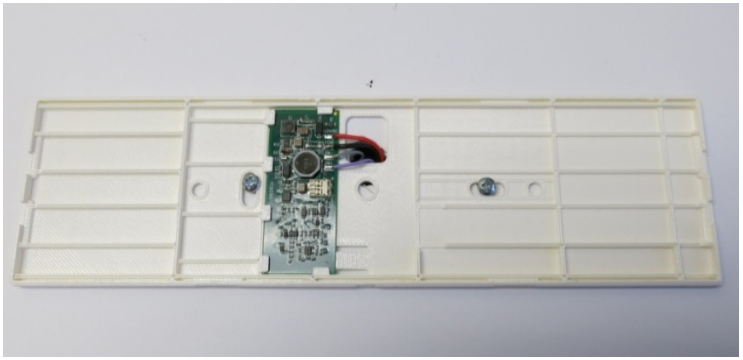


2. Connect OLED wires to driver, (push-in)

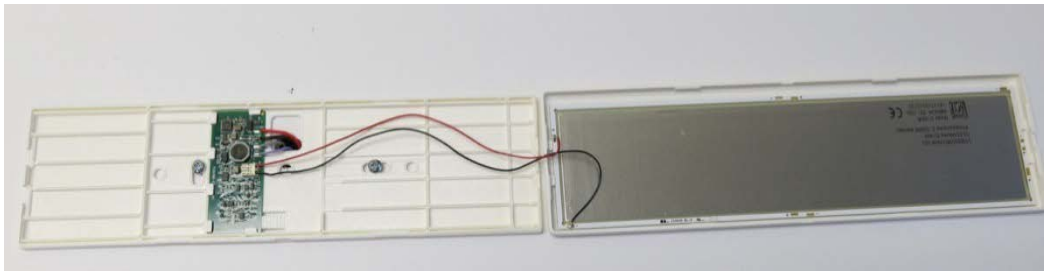


3. Align Bezel to mounting frame, snap in place

Installation – Rectangular Module



1. Connect wiring, screw mount to flat surface (wall, ceiling)



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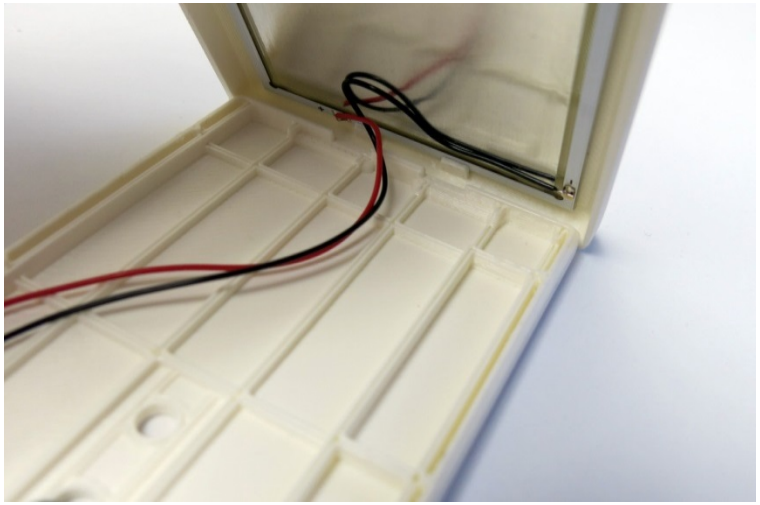

3. Align Bezel to mounting frame, snap in place

Further R&D Required

- Multi-channel Drivers
  - Low Voltage
  - Line Voltage
- Triac Dimmable Line Voltage Driver
- DMX Drivers
  - Low voltage and line voltage
- DALI Drivers
  - Low voltage and line voltage
- Mechanical components for multi-panel integration
- Rail Mounting Components
- Electrical Interconnect devices: Thin, robust
- Power Distribution “Configurator”
- POE

Contact info:

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Thank You!