



OLED Track II: Product Design and Integration

# OLED Luminaire with Individually Addressable Panels

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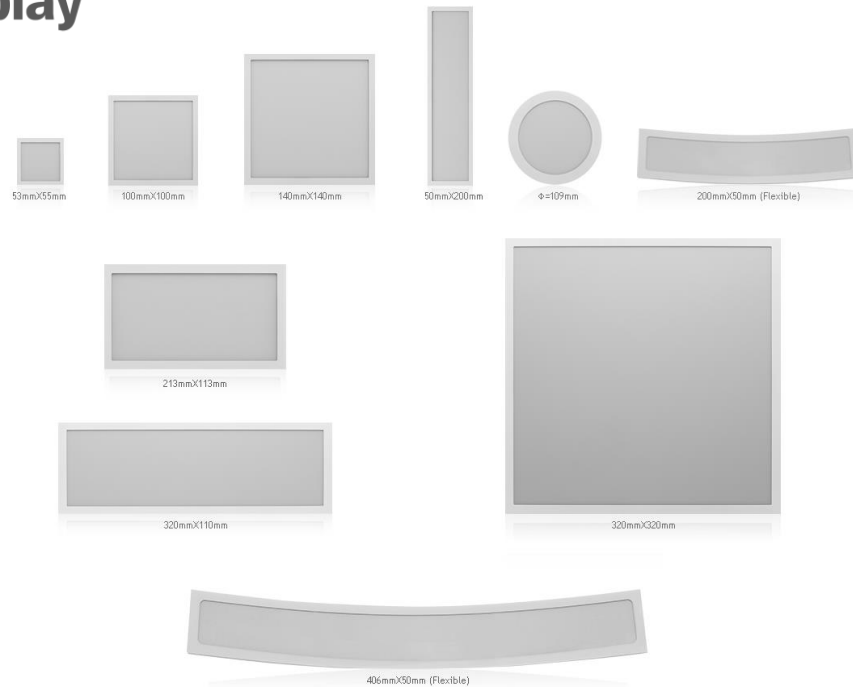
Mike Lu

Director Electronics Engineering

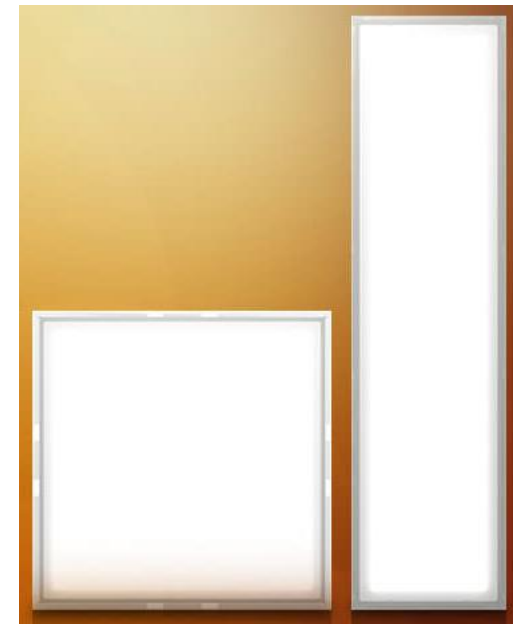
Horizon Group, Acuity Brands Lighting

 **Acuity**Brands.

# Commercial OLED Panels

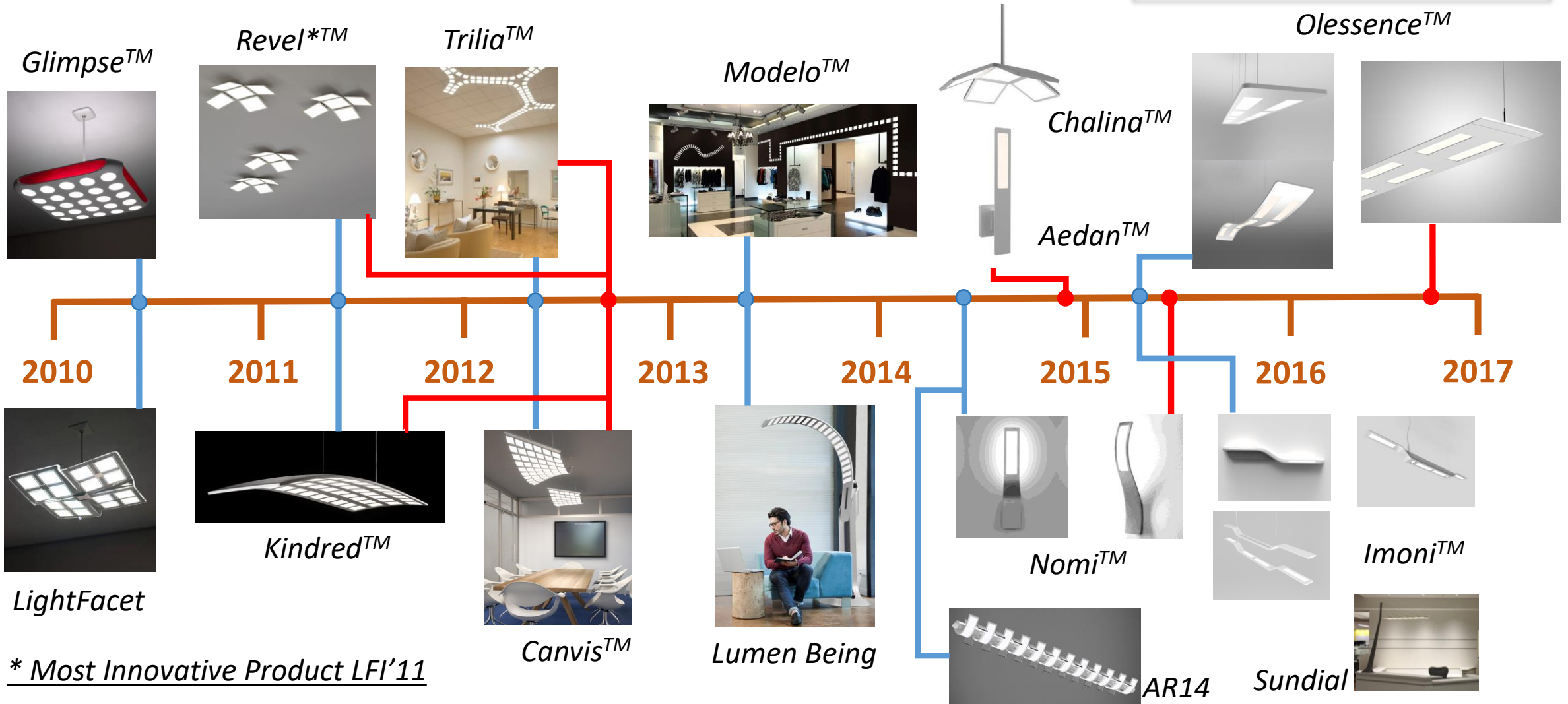
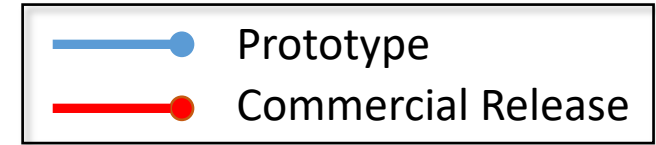


Current Gen: 55-60 LPW; Next Gen: 75-90 LPW  
2700, 3000, 3500, 4000K  
3000 cd/m<sup>2</sup>, L<sub>70</sub> = 30-40Khrs  
Rigid and bendable/flexible substrates



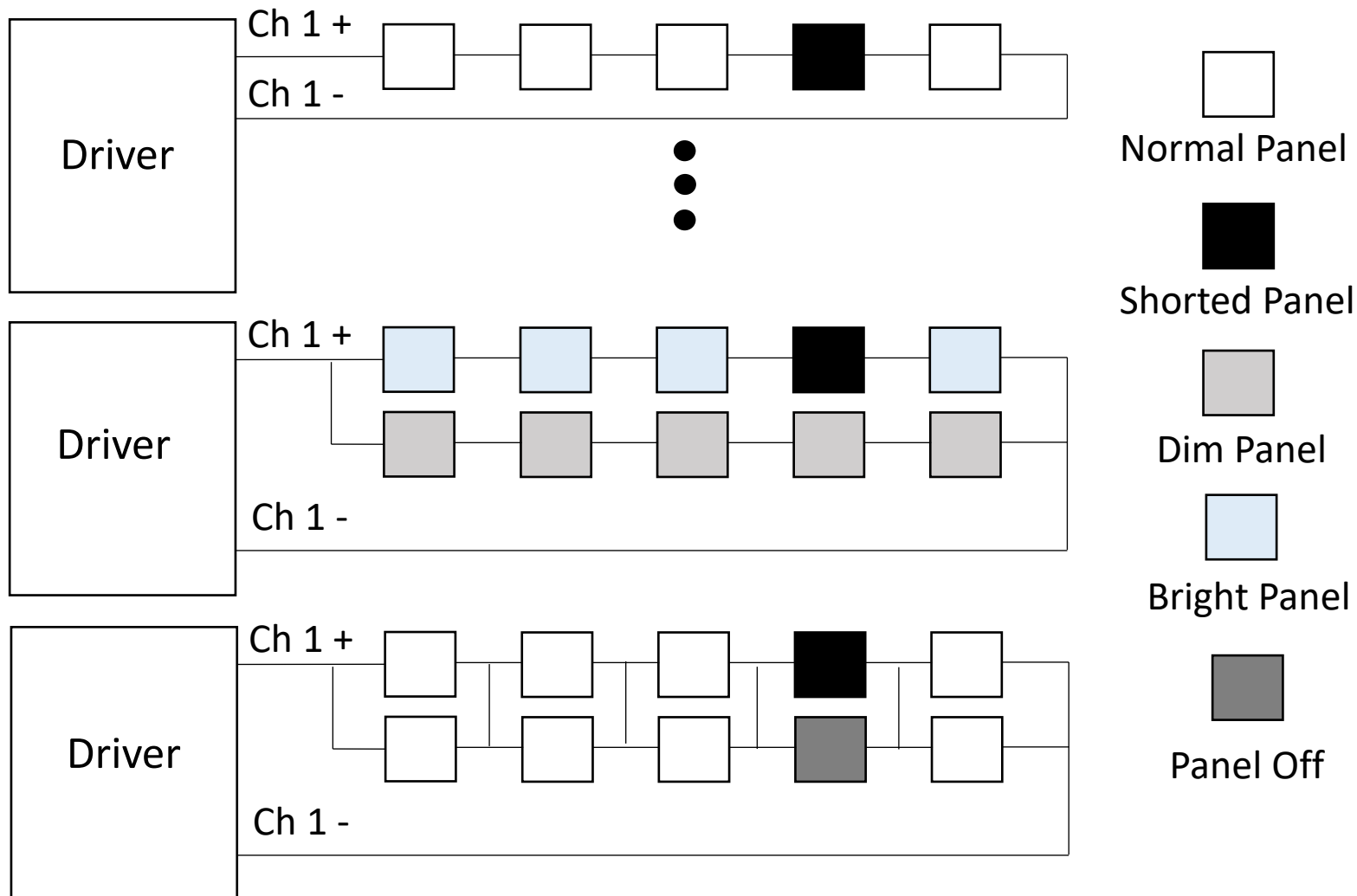
Brite2: 57-63 LPW  
3000, 4000K  
L<sub>70</sub> = 50Khrs @ 2800 cd/m<sup>2</sup>, 10 khrs @ 8300 cd/m<sup>2</sup>  
Rigid substrate

# Acuity OLED Luminaires



\* Most Innovative Product LFI'11

# OLED Driver Challenges – Panel Shorts



- UL Class 2 limit is 60VDC (most drivers max out at 55 VDC)
- Panel voltages are approximately 3V/stack
- Panel voltage will increase due to aging
- Limited number of serially connected panels
- Paralleling panels need to account for possible shorts

# Current Acuity Driver Solutions for OLED Luminaires



## 10 Watt

Natural Dimming to 0% for most demanding indoor applications. Different form factors are available for the perfect fit with your luminaire.

[Read more →](#)



## 20 Watt

20-watt SOLOdrive are ideal for small lumen package indoor applications. Offering Natural Dimming to 0% and two different form factors.

[Read more →](#)



## 30 Watt

Natural Dimming to 0% for most demanding indoor applications. Different form factors are available for the perfect fit with your luminaire.

[Read more →](#)



## 50 Watt

Ideal for higher lumen package indoor applications. Offering dual outputs and Natural Dimming to 0%. Different form factors are available for the perfect fit with your luminaire.

[Read more →](#)



## 100 Watt

Ideal for higher lumen package indoor applications. Offering four outputs and Natural Dimming to 0%. Different form factors are available for the perfect fit with your luminaire.

- Used in LED luminaires, equally applicable to OLED luminaires 7-100 W
- eldoLED programmable drivers (150-1400mA), 55V max, up to 87% efficient, Hybrid HydraDrive

- For low wattage OLED luminaires <5W
- 0-10V, phase cut dual dimming, CCR
- PF > 0.9, THD < 20%, 120-277V input
- Fits in a 2" x 4" single gang switch box



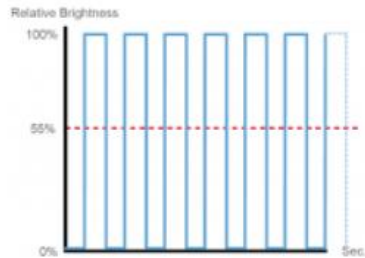
Aedan Sconce



2<sup>nd</sup> Gen

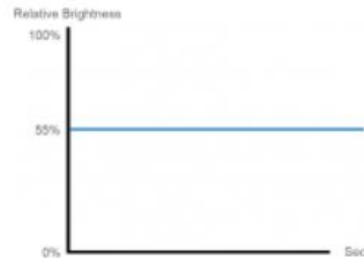
# eldoLED Drivers: Flicker-Free Hybrid HydraDrive

Pulse Width Modulation



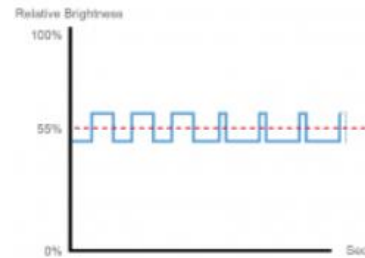
0-100 PWM

Constant Current Reduction



CCR

Hybrid HydraDrive



Hybrid HydraDrive



Trilia driven by eldoLED drivers, dimmed to 2.5%



Flicker checker

Driver	Dim Level	Percent Flicker	Flicker Index	Frequency
eldoLED	100%	3.9%	0.01	305 Hz
eldoLED	80%	9.2%	0.03	306 Hz
eldoLED	50%	4.0%	0.01	307 Hz
eldoLED	30%	11%	0.03	2450 Hz
eldoLED	20%	4.0%	0.01	832 Hz

*As measured by VISO Systems Flicker Checker App*

# Next-Gen Driver Development

- Increasing luminaire functionality has meant increasing the number of independently controlled groups of light sources.
  - Warm-white/cool-white LEDs for tunable CCT
  - RGB LEDs for full color control
  - Spatial control, e.g. OSRAM Omnipoint
- If we take this trend to its logical conclusion
  - Each and every light source is addressable



*OSRAM Omnipoint*

# DOE Project

- DE-EE0007073 “OLED Luminaire with Panel Integrated Drivers and Advanced Controls”
- Work spans 9/1/2015-10/31/2016, with OLEDWorks as subcontractor
- The proposed architecture is to have a base station that performs AC/DC voltage conversion and integrated driver at each panel that performs DC/DC current regulation.
- But how about dimming?

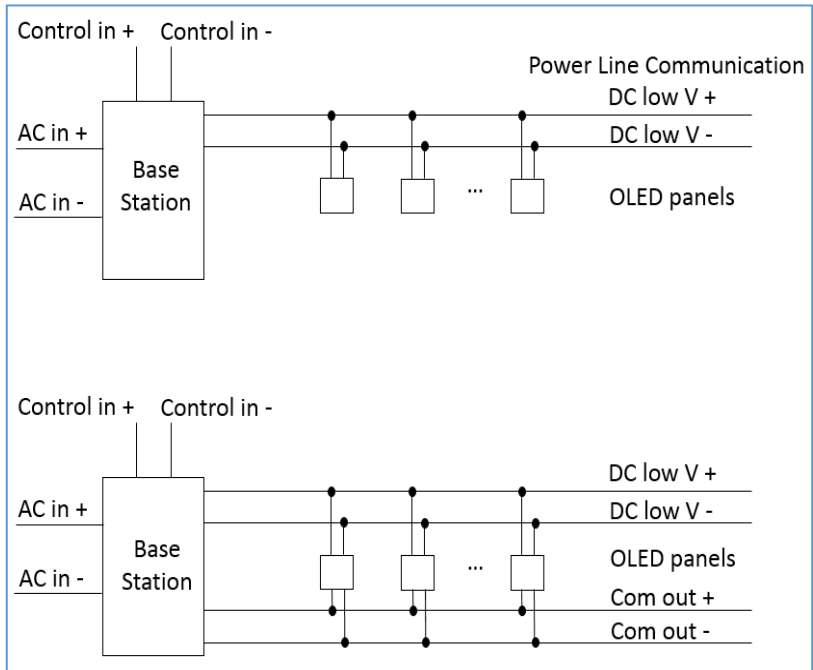
Proposed  
Deliverable

Luminaire  
Platform:  
Canvis

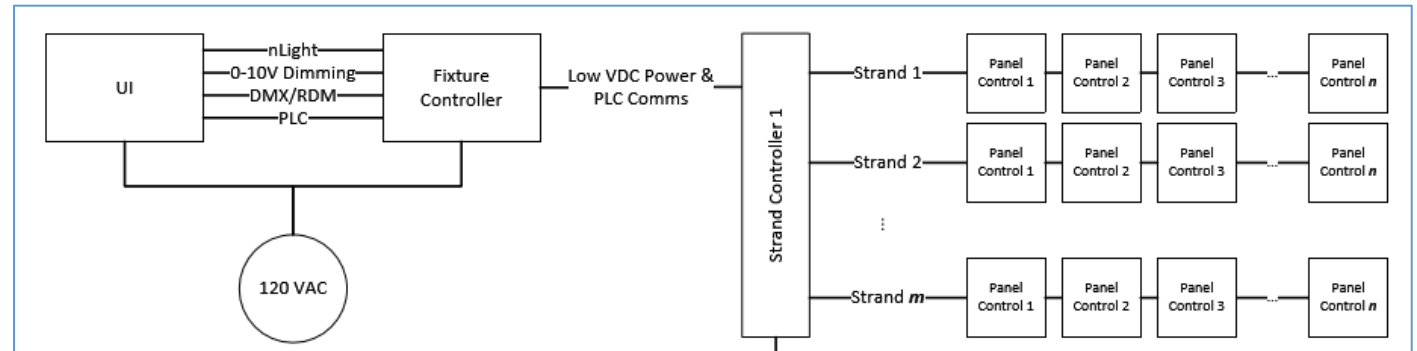
<b>Panel CCT</b>	<b>3000K (3500/4000K optional)</b>
<b>Panel Luminance</b>	2500-3000 cd/m <sup>2</sup>
<b>Panel CRI</b>	>85
<b>Panel Lifetime (L<sub>70</sub>)</b>	>25,000 hrs
<b>Panel Efficacy</b>	80 lm/W
<b>Total Luminous Output</b>	4000-5000 lm
<b>Luminaire Efficacy</b>	65 lm/W
<b>Luminaire Control (option 1)</b>	0-10V dimming, global
<b>Luminaire Control (option 2)</b>	DMX or other protocols, individual panel addressable



# System Architecture

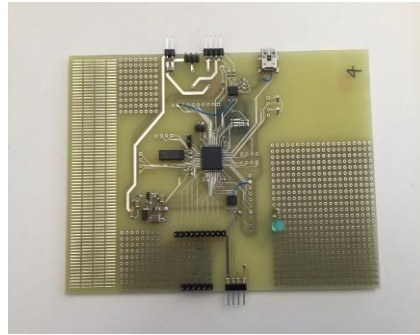


Original proposal, options for wired control and PLC (power line communication)

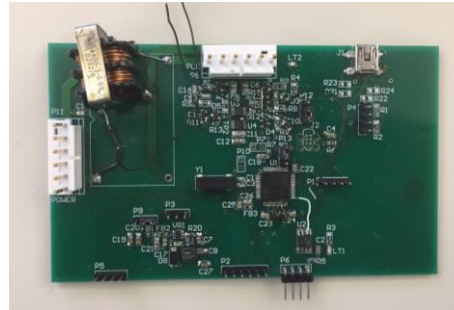


Current system architecture: PLC communication, with strand controllers to expand the number of panels in the system

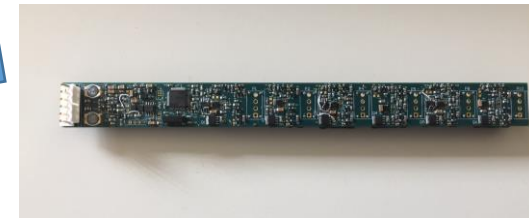
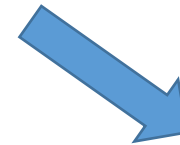
# Hardware Development



Gen 1 base station transceiver



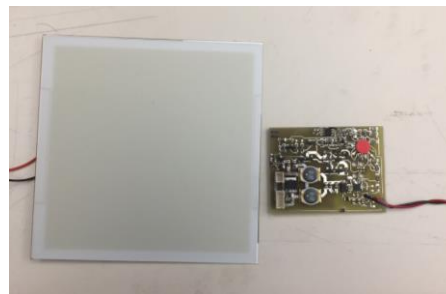
Gen 2 base station transceiver



Strand controller



Gen 1 panel transceiver and driver



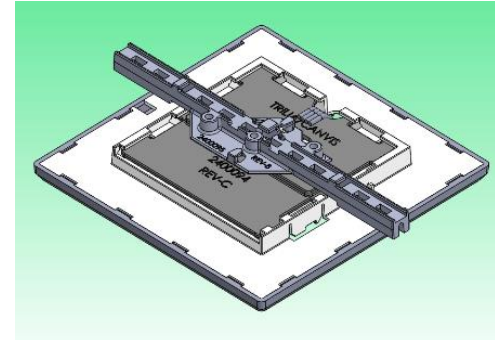
Gen 2 panel integrated driver (next to a 4" square panel)



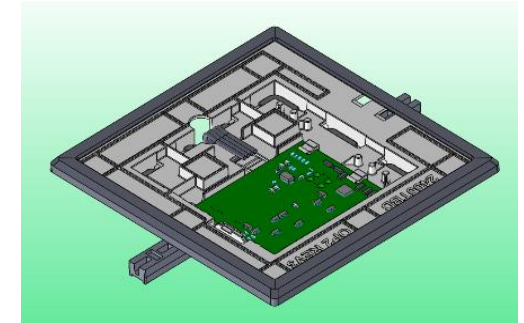
Gen 3 panel integrated driver (~0.25" total thickness)

# New Cassette Design for Integrated Driver

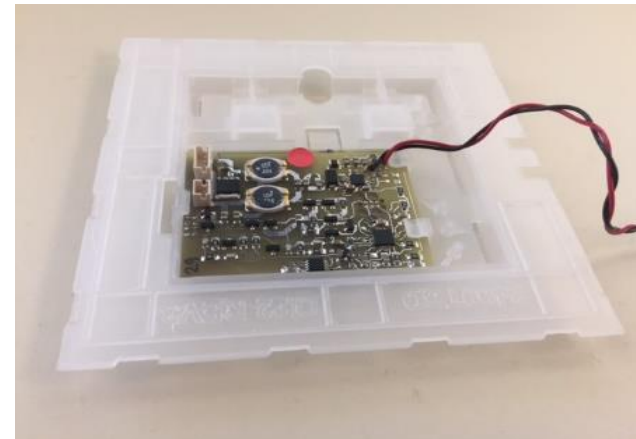
- Cassette holds driver in the backside
- Driver NOT in contact with OLED panel
- Less thermal management requirements and greater flexibility in replacing driver or panel
- Cassette compatible with existing holders in Acuity OLED products



Backside View

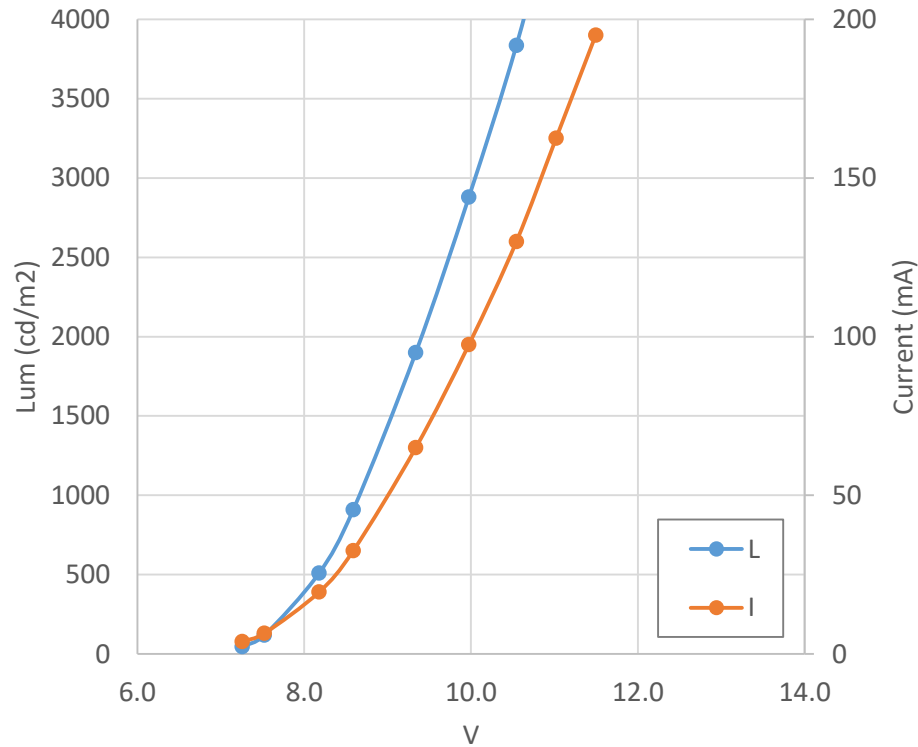


Top View without panel



Panel driver held by cassette back

# OLED Panel Development



IVL of OLEDWorks panels  
3000K, 64 lm/W average, 73 lm/W max

Flexibility	Efficacy	Shape	Name	Size(diagonal)
				inch
Rigid	90 ㎥	Square	SA	5.5

Model	CCT	Efficacy	Flux
	K	lm/W	lm
LL055RS1-92P1-OY1	2700 ± 150	86 ± 10	75 ± 10

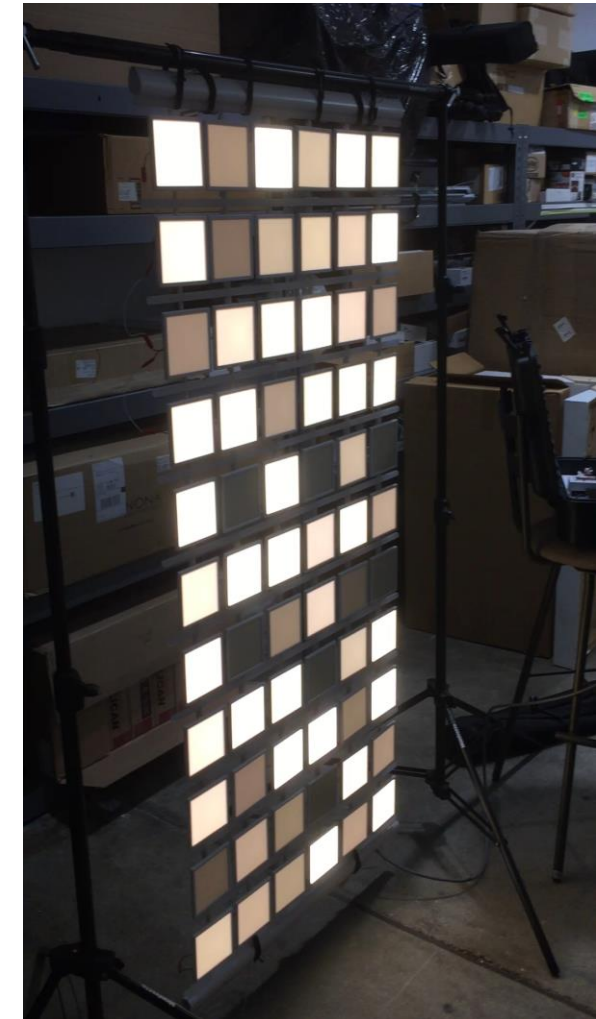
Uniformity	CRI	Voltage	DC Current	LT70
%		V	mA	Hrs
>85	>85	8.6± 0.5	100	40000

Thickness	Active size	Outer size
mm	mm	mm
1.97	90x90	99x99

LGD panel specification  
2700K, 86 lm/W

# Individually Addressable Panels

- Full-size Canvis fixture with 66 OLED panels
- DMX/RDM control
- Multiple custom patterns, including
  - Text
  - Rain drop

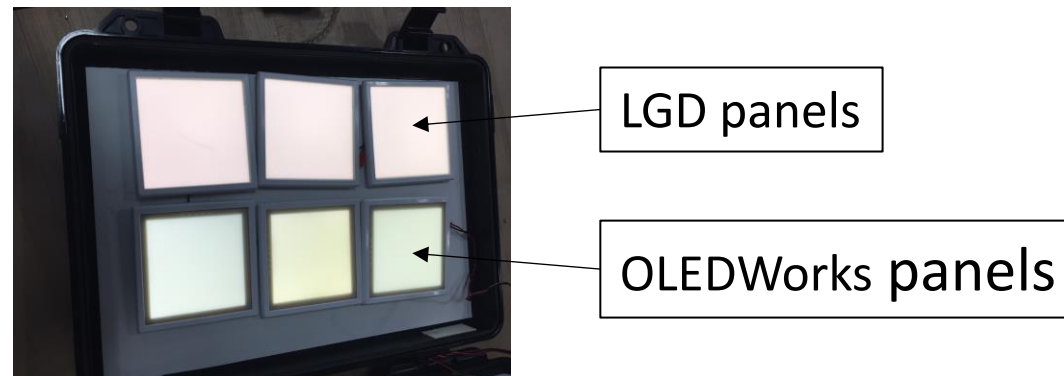


*Full-size demo shown at the reception*

# Panel Replaceability and Forward Compatibility

- The panel driver has two main modules: communication module and power conversion module
- For different panels, only settings for the power conversion module need to be adjusted
- Allows different types of panel to co-exist in the same system. Similarly for future panel replacements – forward compatible

Mixing different panels in the same system



# System Power Measurements

- Existing commercial 66-panel Canvis based on LGD panels (55-57 lm/W) and OSRAM driver (~84% efficient): 44-47 lm/W
- With 86 lm/W panels and combined driver and optical efficiency of 85% we can expect an updated Canvis to be at 73 lm/W
- Current system
  - Luminous output: 4871 lm
  - Efficacy: 49.3 lm/W
  - OLED panel power consumption: 0.85W
  - Panel driver efficiency 72%
  - Power supply efficiency 88%
- Panel driver efficiency can be improved by using microprocessors using less idle power and a more efficient power conversion module

# Summary and Future OLED Luminaire Development

- Under the DOE contract, Acuity developed an OLED luminaire with distributed, panel-integrated drivers enabled by a PLC protocol
- A full-size, 66-panel Canvis was constructed to demonstrate the panel addressability
- Drivers should not be considered an insurmountable impediment to commercializing OLED lighting.
- OLED panel performance need to improve to compete with LEDs.





Thank You!

<http://www.acuitybrands.com/oled>

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