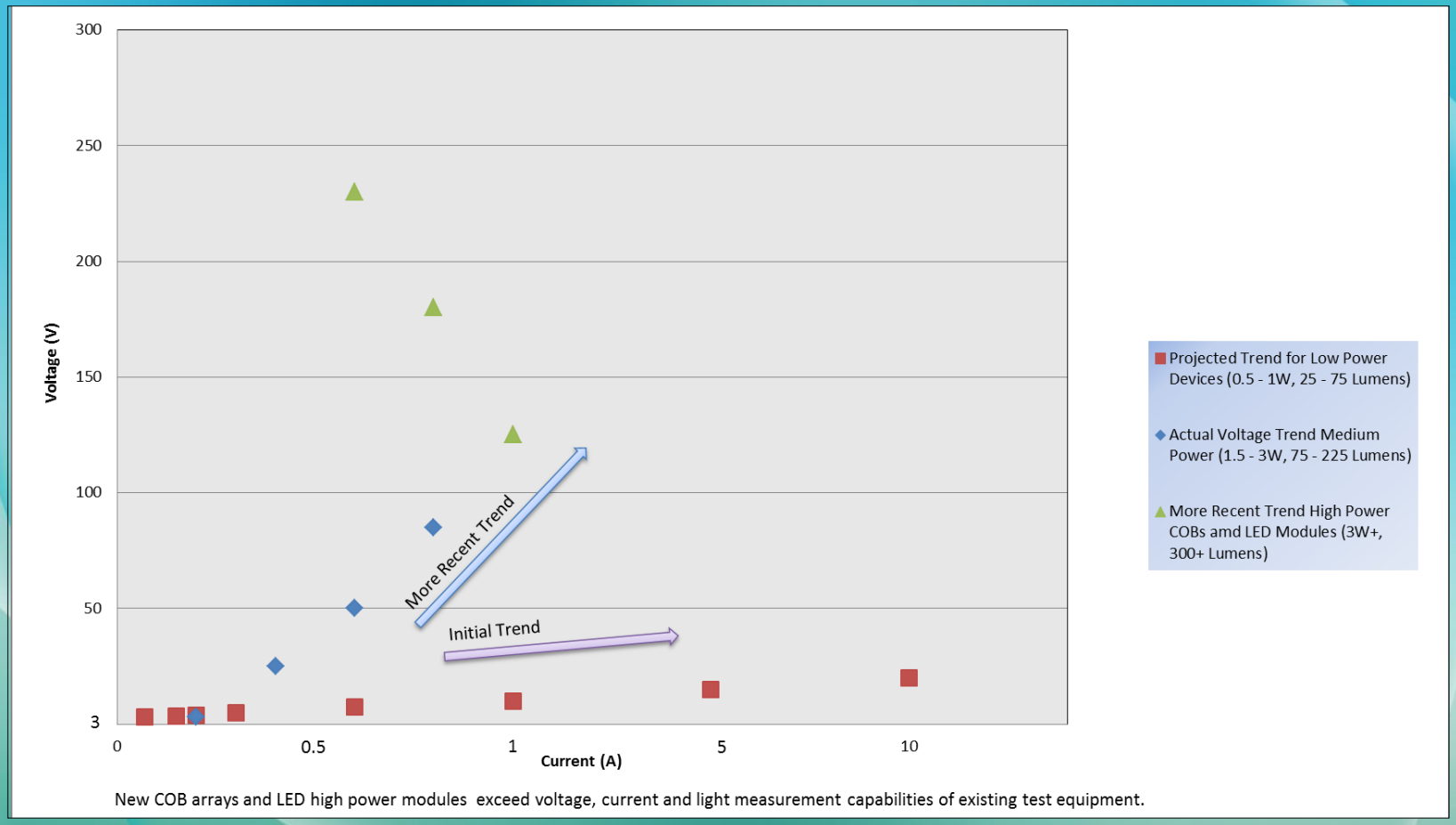
Recent developments in equipment for measuring LED light sources

Outline

- LED Device Trends
- LED Measurement Applications
  - Key requirements
  - Testing standards
  - New equipment
- Conclusion

LED device trends are driving measurement equipment



New COB arrays and LED high power modules exceed voltage, current and light measurement capabilities of existing test equipment.

Typical LED measurements

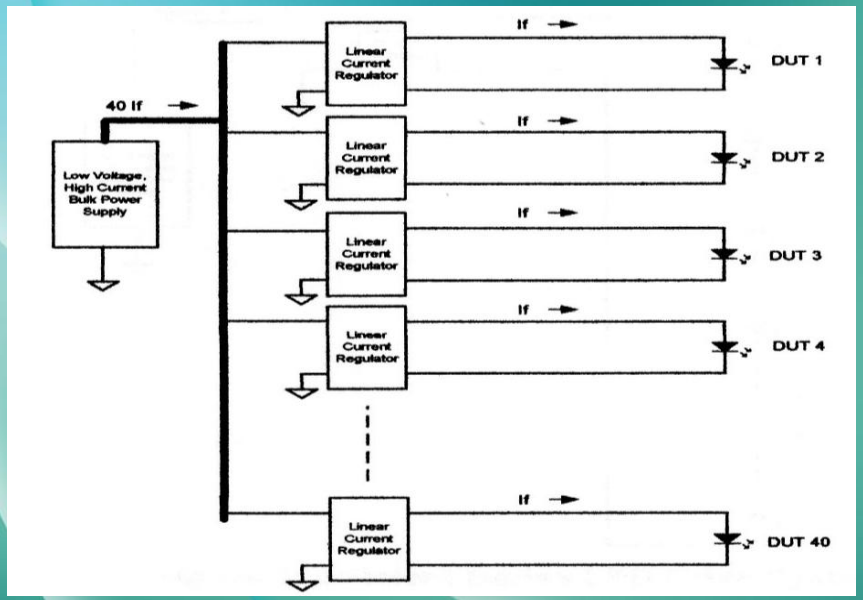
- Reliability, Lumen Maintenance Testing
  - HTOL, PTMCL, LM-80
- Electro-optical Characterization
  - L-I, L-I-V, Quantum Efficiency,
- Production Testing
  - Vf sorting, color binning
- Thermal Characterization
  - RΘ, Thermal Impedance

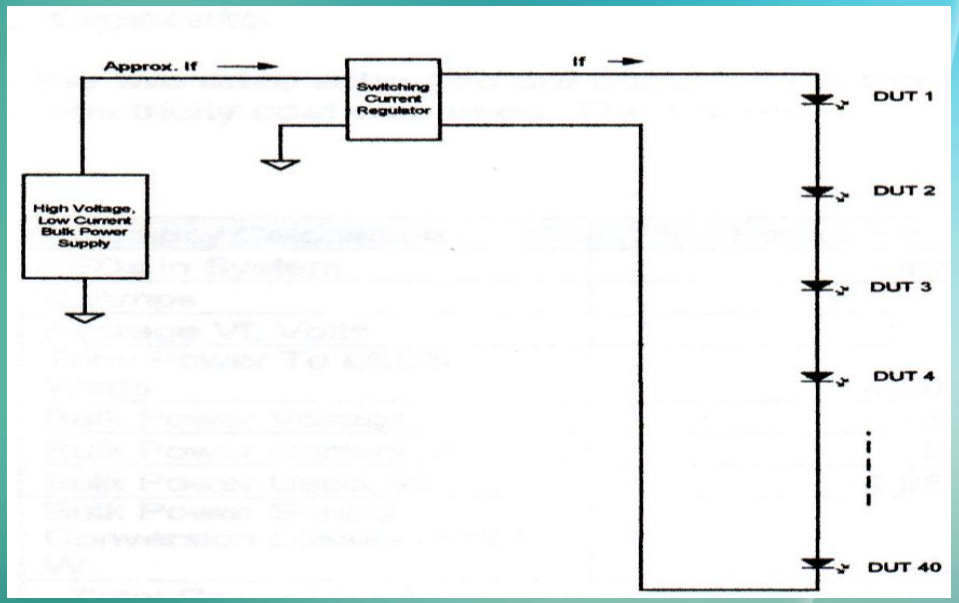
Lumen maintenance & reliability testing

- Key Standards:
  - IES LM-80 Lumen Maintenance Test
  - IES TM-21 Lumen Maintenance Projection
- Testing Requirements
  - Multiple testing temperatures
  - Temperature monitoring
  - Multiple devices (DUTs) – sometimes hundreds

Series drive is now typical for reliability testing

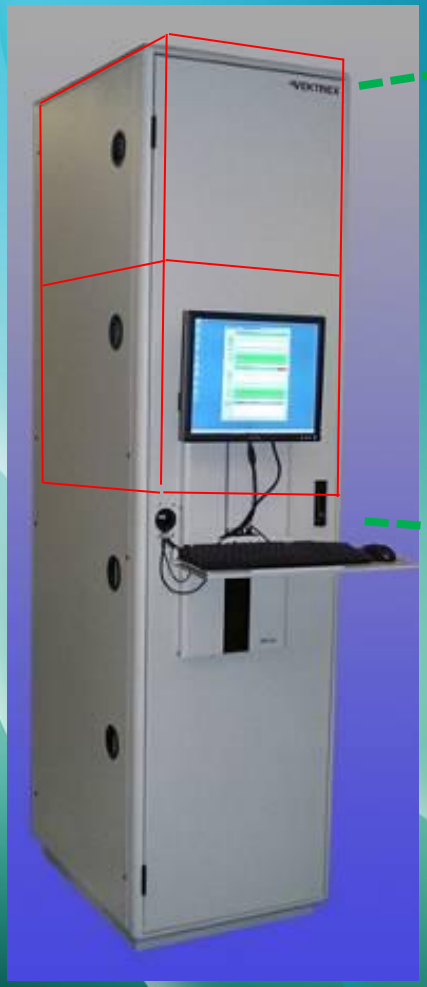
- Series drive is more efficient
- Supports many more DUTs
- More sophisticated circuit

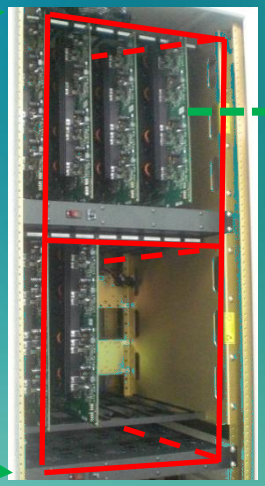


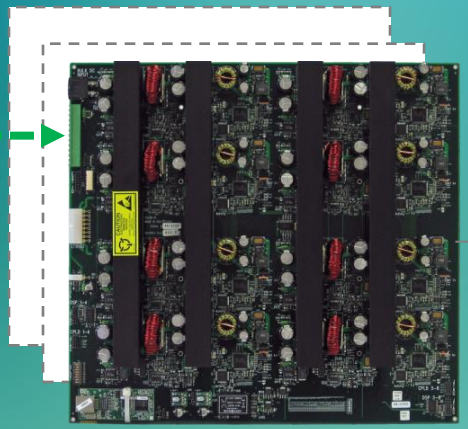


SpikeSafe Drivers: Modular Expandable Power

Driver Cabinet — **Plug-in SpikeSafe Modules** — **Load Boards**

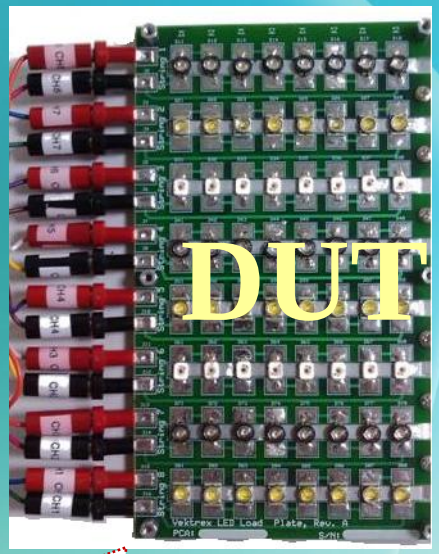






Channels

1
2
3
4
5
6
7
8



Models from 50V-400V, 10mA-64A
DC, Pulsed current
Individual current control

Up to 120 3V LEDs/channel, 960 LEDs/module, 30,720 LEDs/system

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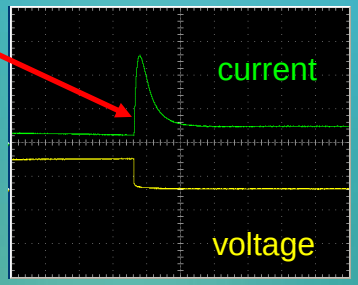
LED failure modes must be considered

- Short circuit – LED Vf drops to near 0V, light output decreases or stops
- Open circuit – LED Vf increases to near infinity, no light output
- Many open circuit failures are preceded by a short circuit failure

SpikeSafe rapid shutdown limits current spikes caused by DUT failures

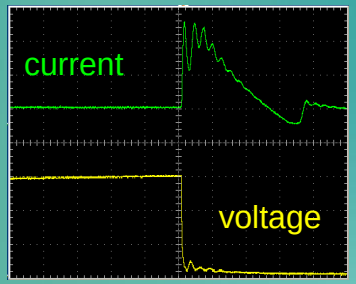
Single DUT Short Failure

Typical Constant voltage sources run in constant current mode



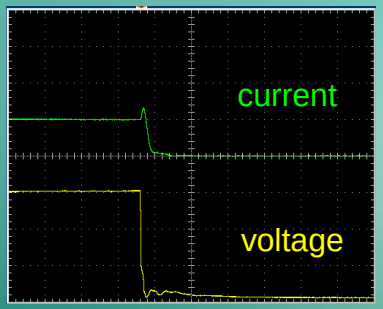
Current is green
See 2mS spike duration
1000% over current
All devices destroyed

Low capacitance constant current sources

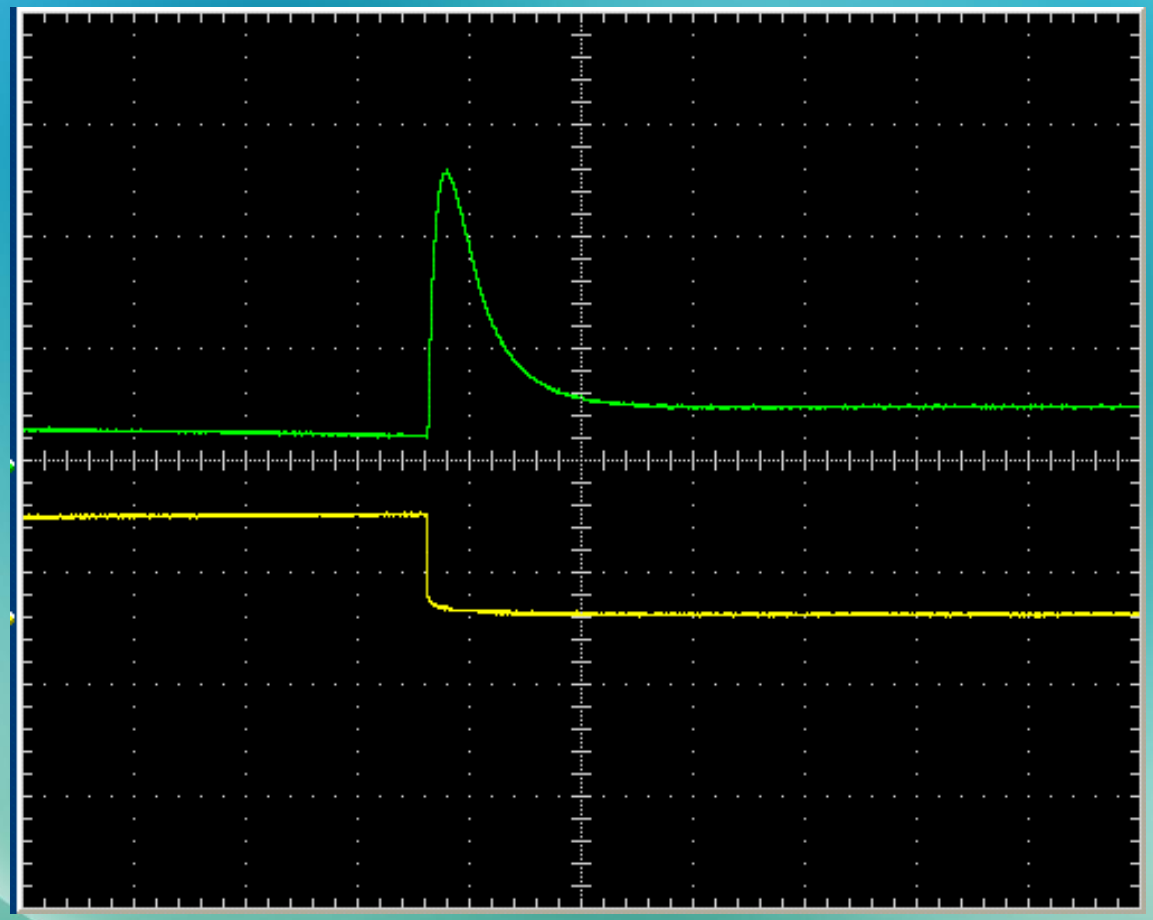


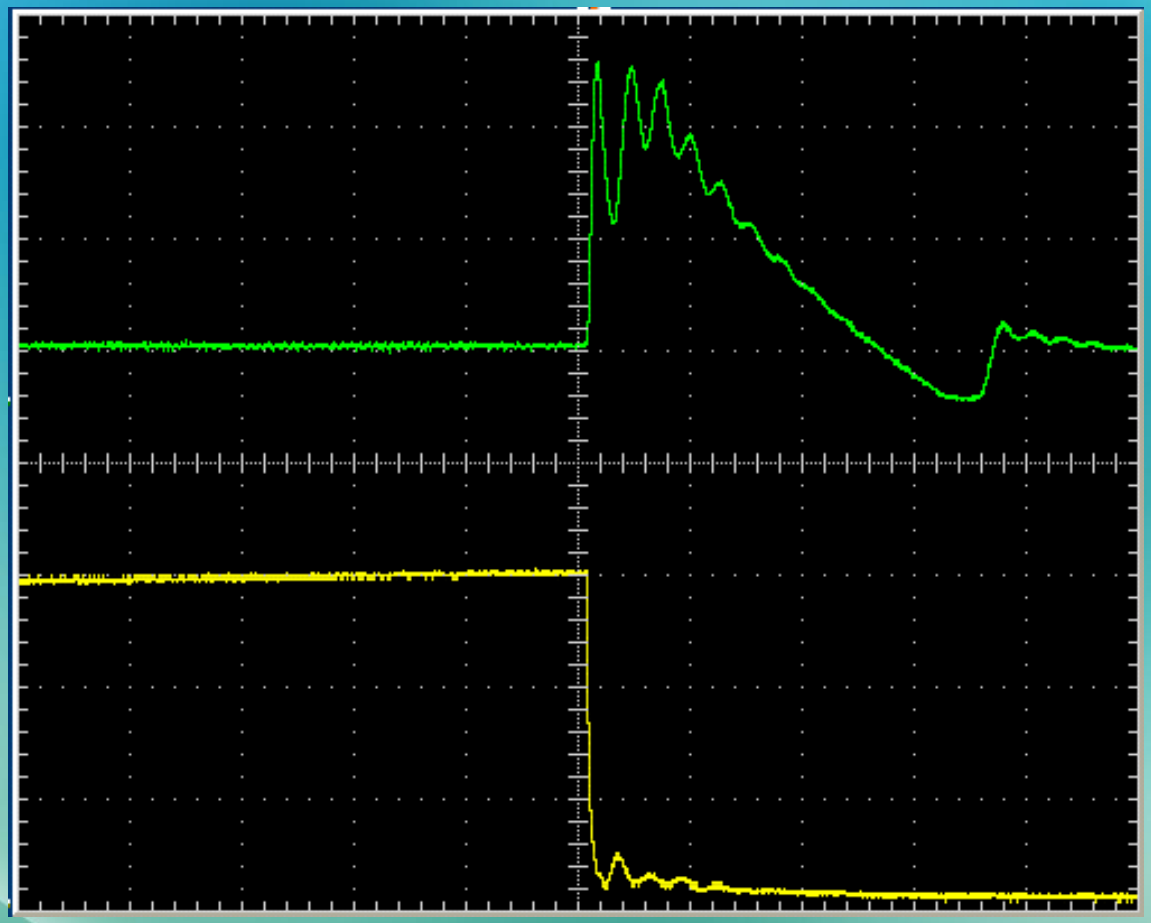
400uS spike duration
400% over current
All devices destroyed

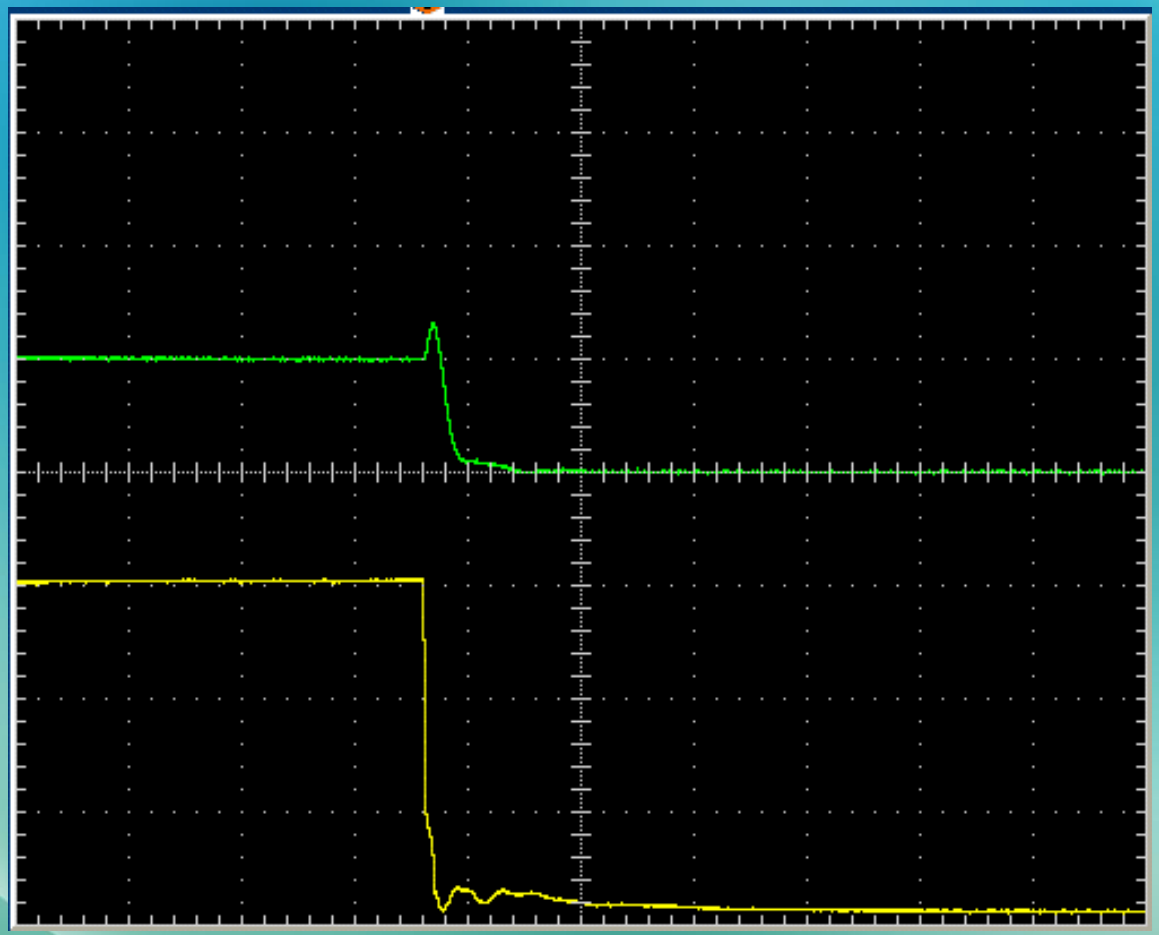
SpikeSafe; Digitally- controlled current sources with fast protection



10uS spike duration
30% over current
One device failure

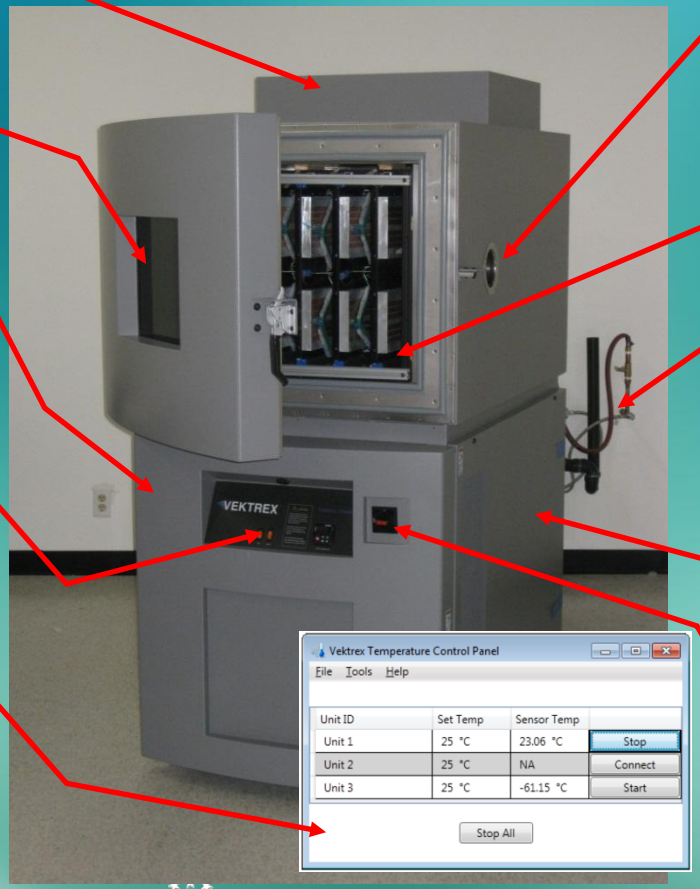






Integrated Thermal Control System (ITCS): all features needed for LED reliability stress

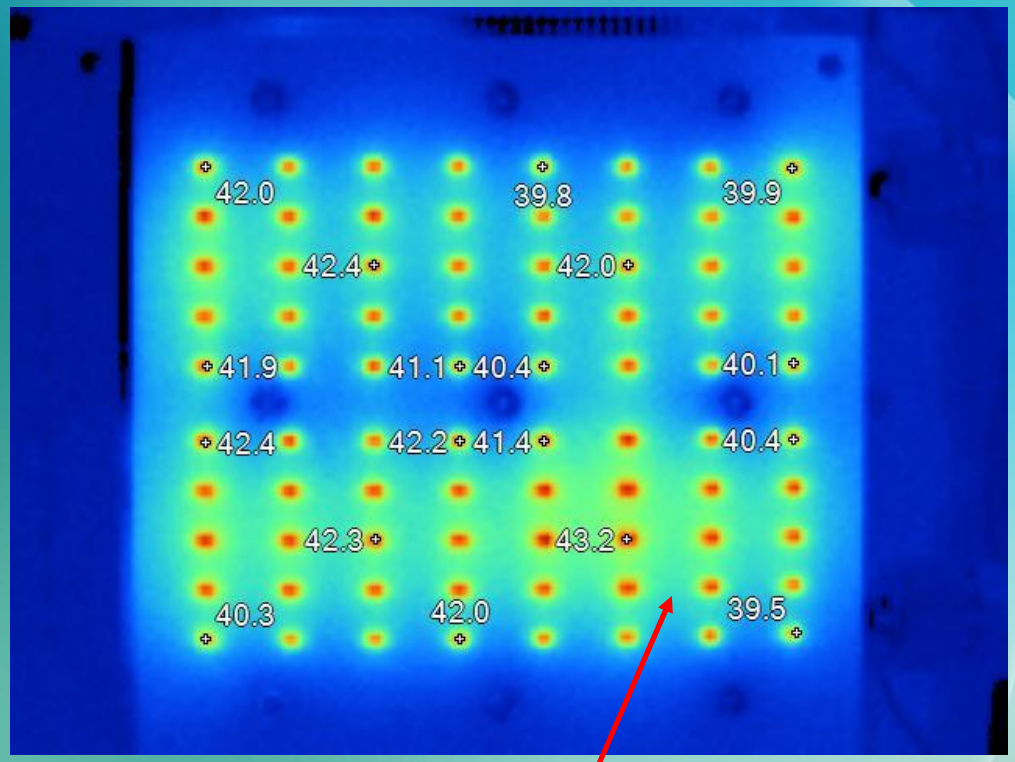
- Variable Air Circulation
- Light Protected View Port
- Thermocouple Logging System
- Settable Over Termperature Limit
- Remote Control Software



- Adjustable Vent Ports
- Load Rack With Power & Thermocouples
- Plant Chill Water Connections
- Ts, Ta Thermal Control System
- Configurable AC Input Power

ITCS Performance
Example 1 - 80 3W LEDs

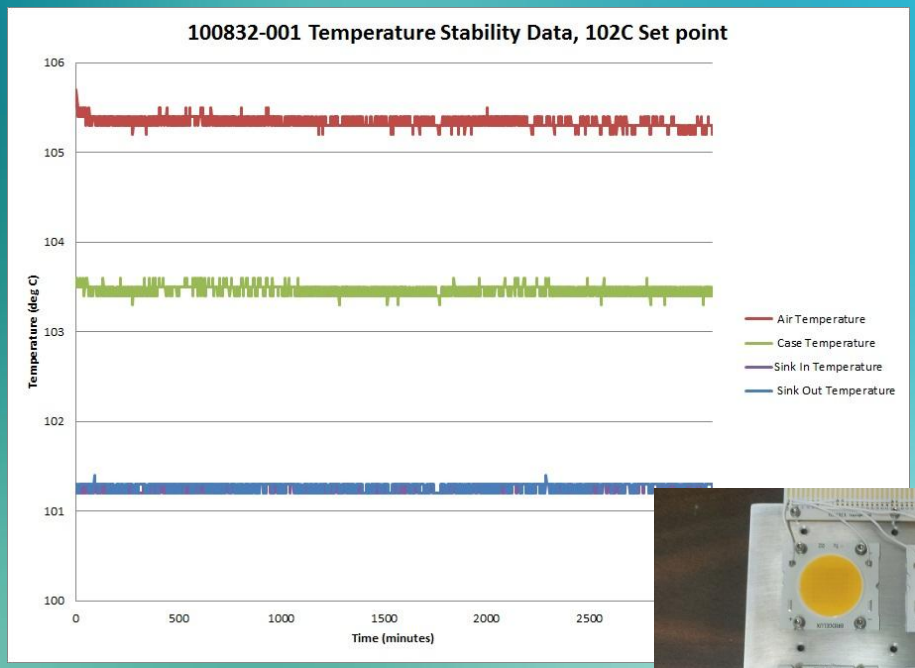
- IR camera image shows max temp of each LED
- Excellent temperature uniformity – tight Ts control to meet LM-80 requirements

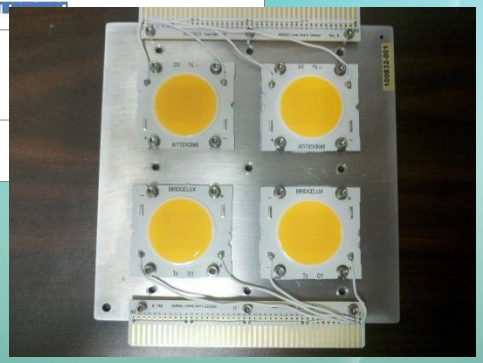


ITCS Performance
example 2: 4, 50W, 4500 Lumen arrays

50W Array on N+1 load board

- Ts, Tair within LM-80 specifications
- Only 2C rise in Ts over thermal platform
- Temperature stability <<1C





Automatic Light Measurement System

- LM-79, LM-80, high power LED measurements
- Designed to test standard 150mm x 150mm N+1 load board
- Fully automatic, tests a load board in 10 minutes

HalfMoon is best suited for 2π geometry lighting

HM series

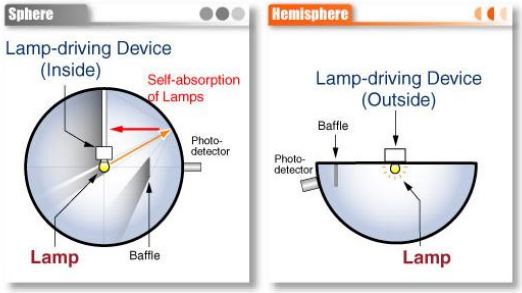
Integrating Hemisphere Type

Total Luminous Flux Measurement System

Totally Totally New Concept Device Ensures the Accurate and Reliable Measurements for Surface Illuminants such as a Backlight

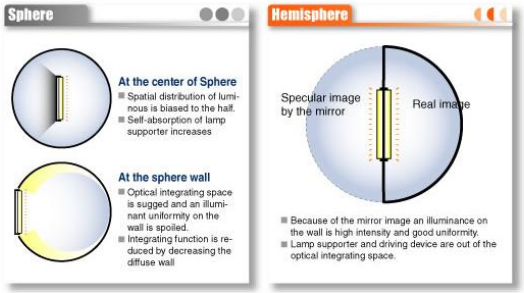
Feat.1 Maximized Data Accuracy

- No self-absorption errors because only the illuminants is located in the optical integrating space.
- Sensitivity is doubled by utilizing the mirror reflection.



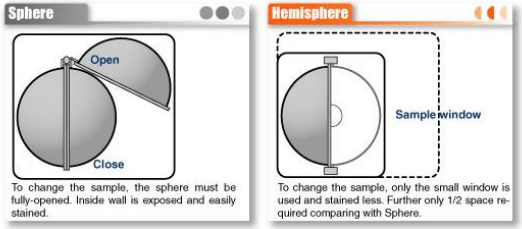
Feat.2 Easy Operation to Measure Surface Illuminant

- Symmetrical light distribution by the specular and real image minimizes integrating error.
- Backlight-like surface illuminants are accurately measured.



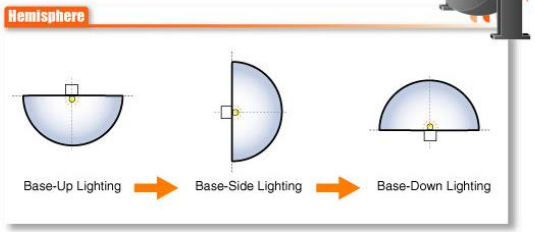
Feat.3 Compact

- Only 1/2 space required comparing with Sphere type.
- To change the sample only the small window is used.

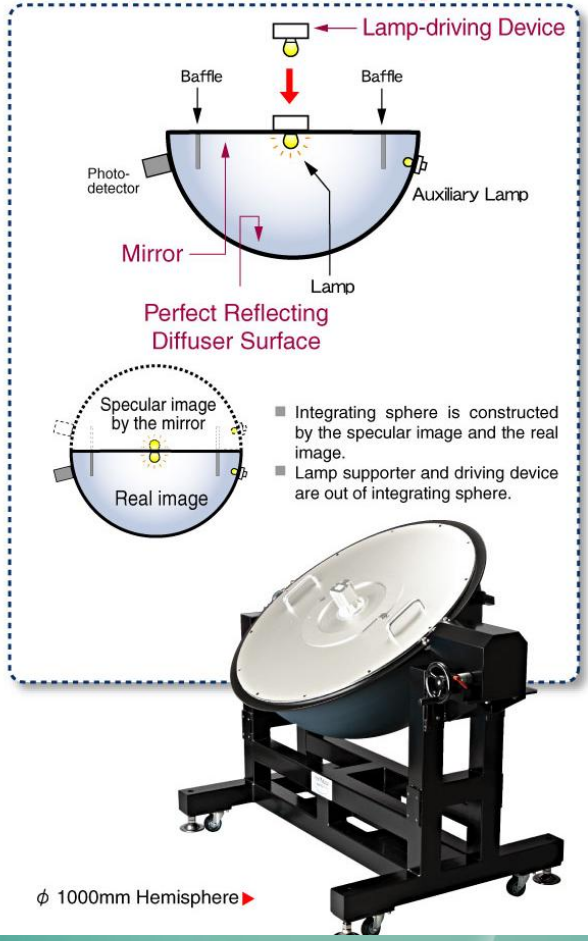


Feat.4 Changeable the Operating Direction of a Lamp

- Changeable on the lighting



Hemisphere Geometry



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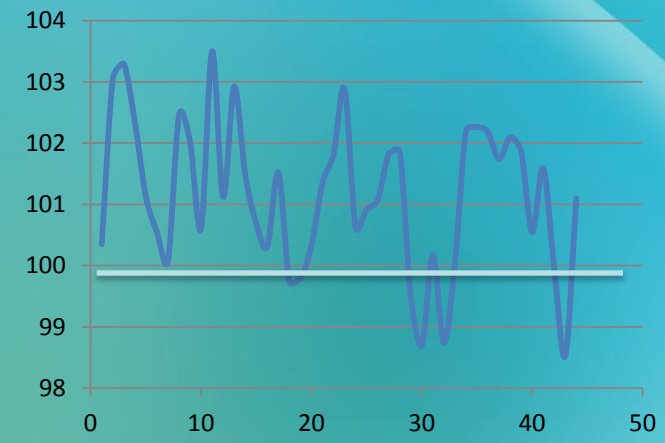
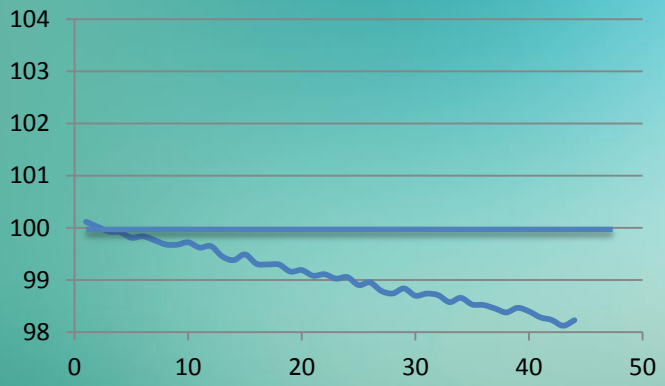
ALMS allows you to see trends sooner

- Typical photometric systems have variability of 1-2%
- The variability makes it difficult to spot trends, requiring longer test times
- ALMS variability is 0.05-0.1%
- With the ALMS you can see trends sooner allowing you to shorten test times and make more rapid process changes



Other



ALMS

Typical LED Measurements

- Reliability, Lumen maintenance testing
  - HTOL, PTMCL, LM-80
- Electro-optical characterization
  - Flux, Chromaticity , L-I, L-I-V, Quantum Efficiency,
- Production testing
  - Vf sorting, color binning
- Thermal characterization
  - RΘ, Thermal Impedance

Electro-Optical Characterization

Key standards:

- CIE 127 Measurement of LEDs
- IES LM-79 Electrical and Photometric Measurements
- IES LM-85 High Power LED Electrical and Photometric Measurements
- IES LM-82 Characterization of LED Light Engines

Electro-Optical Characterization

- New testing requirements:
  - Pulsed optical measurements
  - Temperature control
- Trends impacting instruments:
  - Higher voltages
  - Higher currents
  - Higher luminous flux

SpikeSafe 400 Benchtop, ideal drive for optical testing

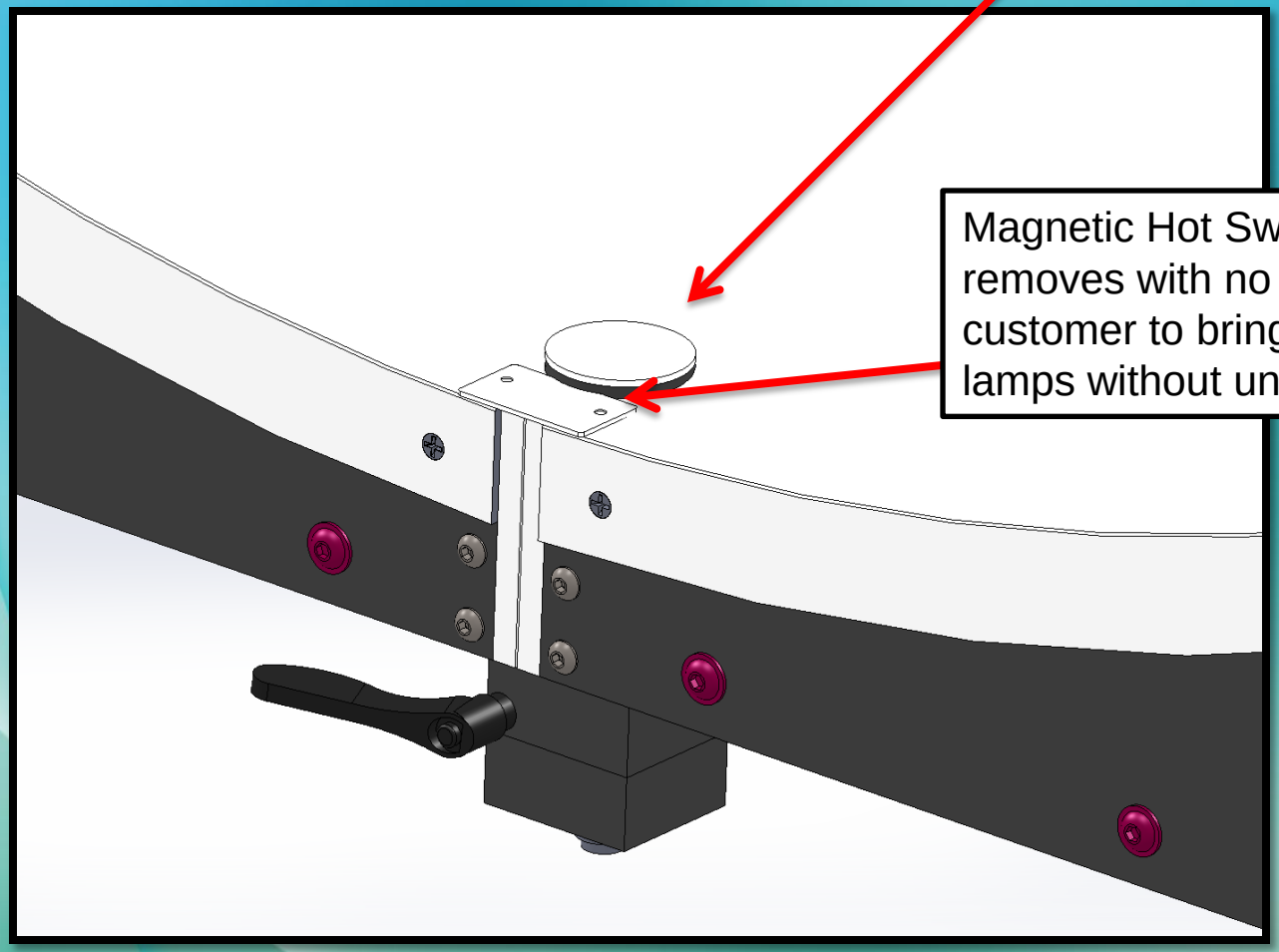
- 4 or 8 channels
- Current from 10mA – 15A
- Compliance Voltage up to 400V
- Pulsing down to 10uS
- DC, modulated current modes

The SpikeSafe 400 supports the new single pulse and continuous pulse drive required by LM-85

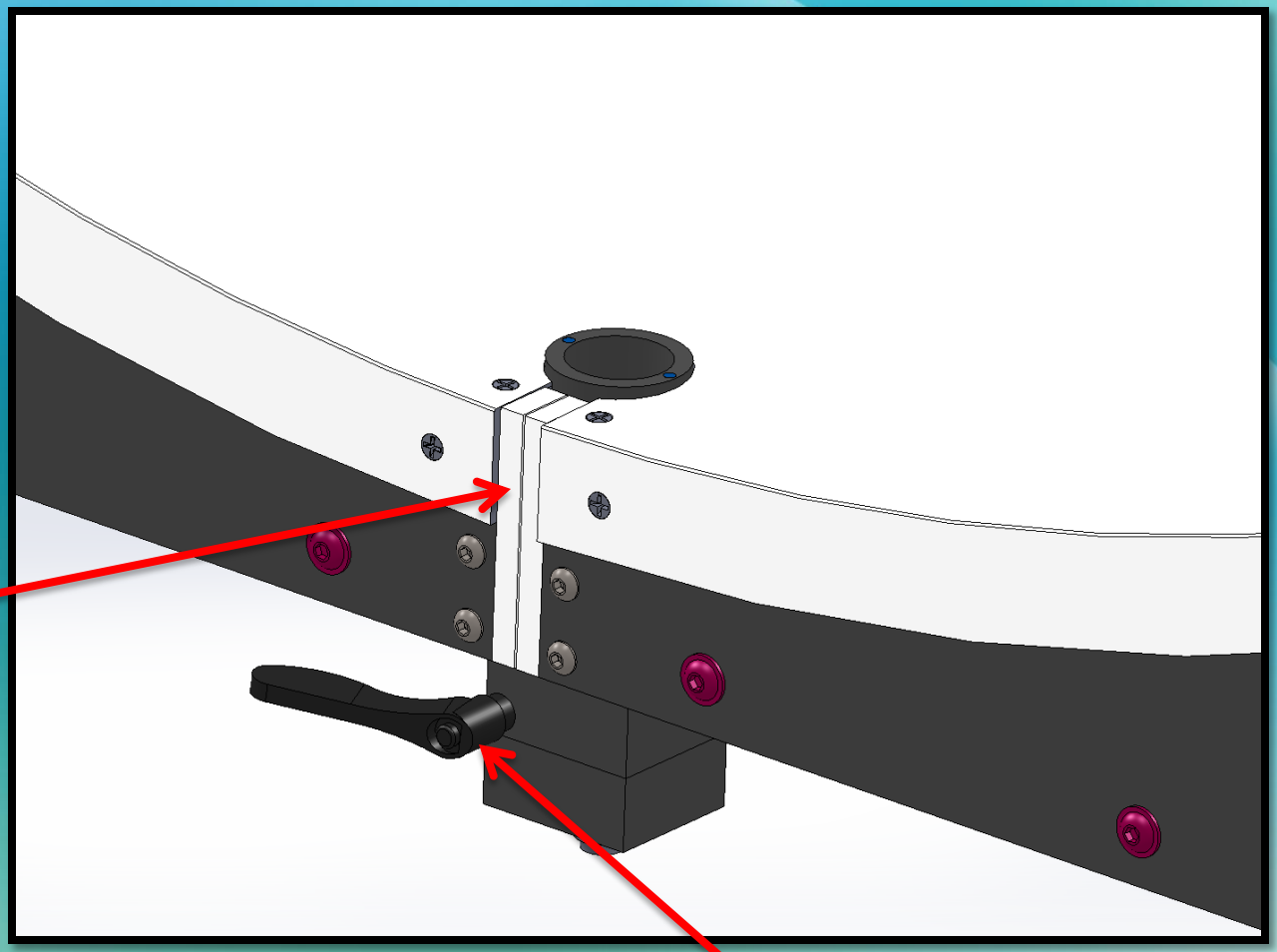
Additional

- Warming up of DUT in integrating sphere can take a lot of time.
- Normally: many tests to be done; limited number of sphere available.
- Solution: pre-stabilize outside sphere and mount luminaire that might be on into sphere

Magnetic 4Pi post baffle installs in seconds with no tools needed.

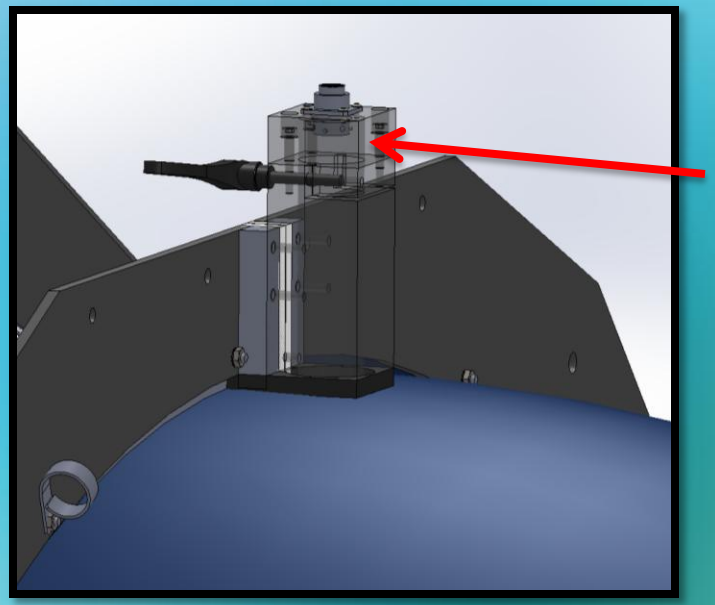


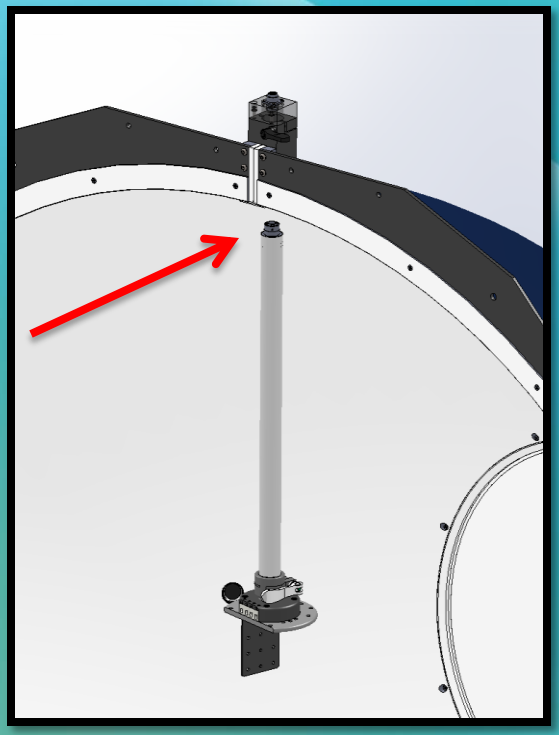
Magnetic Hot Swap slot baffle removes with no tools allowing customer to bring in pre burned in lamps without unplugging them!

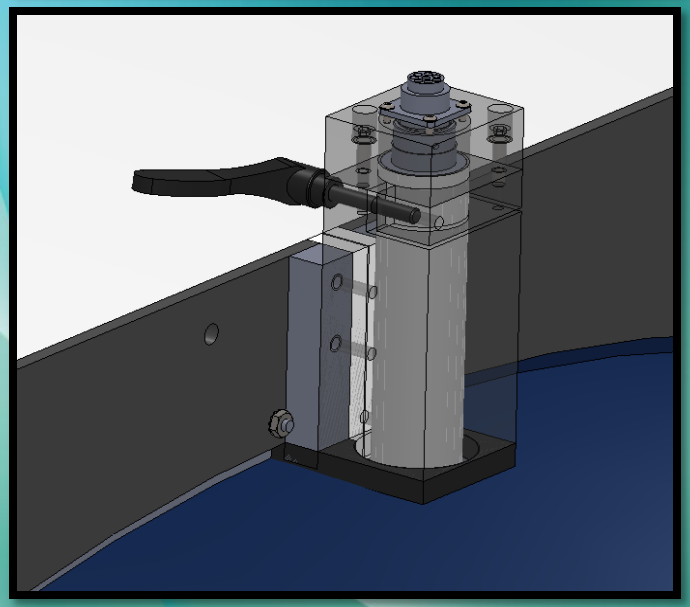


White foam fills the gap.
The parting line between the foam will hold the DUT wires in place when opening and closing the sphere!

Adjustment Lever allows installing 4Pi post to be done tool free







4Pi post will have a built in electrical connector. The mating connector will be hardwired into each of the two mounting blocks. This will allow the post to simply ‘plug’ into the mounting block and eliminate feeding banana plugs through the block along with bundles of wire.

Conclusion

- LEDs are trending to higher voltages and higher powers
- Measurements that used to be easy are now challenging
- Standards bodies have developed new testing methods using pulsing and thermal control to meet these challenges
- Lab managers should ensure equipment has the capability to meet these standards and the capacity to grow to meet future testing needs.

Thank you for your attention

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