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# SPRING SEMINAR

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Emergency LED Lighting

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## Speaker

Dr. Maa received his Ph.D. in Electrical Engineering from Michigan State University and holds 12 patents in LED lighting, circadian lighting, and antiviral lighting technologies. Dr. Maa provides training and serves as the go to expert for lighting agencies, distributors, and other lighting professionals on LED technologies, applications, and industry trends. He has made over 50 presentations at various professional conferences.



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# Emergency Lighting Standards

- Is there any LED Emergency Lighting Standard?
  - No, there is no *LED* Emergency Lighting Standard *per se*.
  - There are Emergency Lighting Standards:
    - OSHA 2 CFR 1910.36(b)(6)
    - NFPA 101 2006 Section 7.9
    - UL 924 (emergency lighting equipment testing requirements)
      - Applicable to lighting equipment *affixed* to the building
      - Thus it is not applicable to emergency LED T8 even though if EM T8 meets the technical requirements.



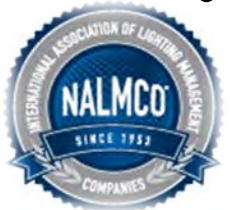
# Emergency Lighting Requirements

- In general:
  - Emergency lighting to be provided over 90 minutes in the event of failure of normal lighting
  - Emergency lighting to provide no less than an average of 1 foot-candle illumination
- Remarks:
  - Check your local building codes, since local municipal building codes for specific requirements occupancy may vary
  - Classroom/office: 30-50 FC (5% of regular light level will do.)
  - Emergency lighting equipment lasting 30-min fails UL294
  - Emergency lighting equipment over 180-min is unnecessary in most cases



# Emergency Lighting Requirements

- Emergency Lighting Equipment Audit:
  - Monthly test: 30-second battery test, for ensuring the emergency lighting equipment is functional
  - Annual test: 90-minutes battery test, for ensuring the battery performance meets the codes
- Audit requirements overlooked by most lighting project team when selecting emergency lighting equipment
- Auditing is very labor intensive and time-consuming:
  - Climb up the ladder to push the test switch manually
  - Or, turn off the circuit breaker
  - Not feasible in some cases
  - Need to be incorporated into lighting design best practices



# Traditional Emergency Lighting Options

- Emergency power generation
- Battery bank
- Dedicated emergency lighting equipment
- Designated emergency lighting fixtures



# Emergency Power Generation

- Standalone power generator
- Dedicated emergency circuit for mission critical lighting applications
- Used by large organization
- Very costly
- Fixed capacity
- Auditing is daunting





# Battery Bank

- Bank of battery units + inverter
- Dedicated emergency circuit for mission critical lighting applications
- Used by medium-size organization
- Costly
- Scalable capacity
- Auditing is daunting



# Dedicated Emergency Lighting Equipment

- Located at building egress
- For egress lighting during emergency
- Not for general lighting



# Designated Emergency Lighting Fixtures

- Designated fixtures with emergency ballast
- Used for general lighting during normal operation
- Becomes emergency lighting equipment during power outage
- Cost is acceptable
- Labor intensive to install/replace
- Wiring variation nightmare
- **Won't work on LED**



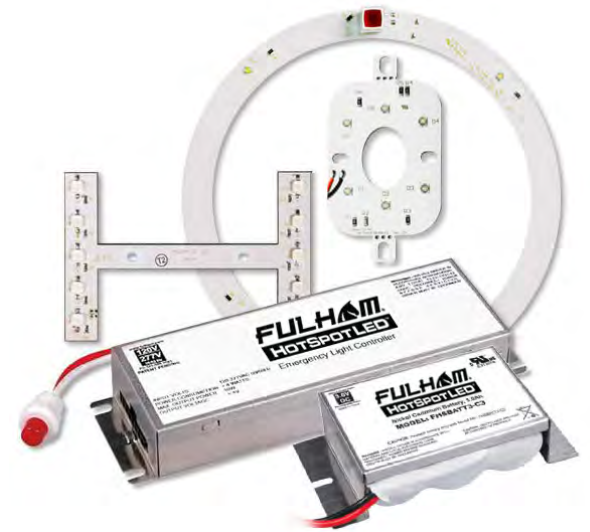
# EM Ballast Won't Work with LED Lamp

- More accurately, EM ballast won't work with LED drivers in the LED lamps
- EM ballasts weren't designed to support LED drivers to begin with
- Emergency ballast provides partial power to light up fluorescent lamp partially
- LED driver normally would require *full* power to light up, unless the driver is a dimmable driver that could accept partial power
- 5 years ago, most fluorescent lamp retrofit project would leave the emergency ballasted fixtures alone
- Some used LED lamp with EM Ballast resulting in fire hazard.



# 1<sup>st</sup> Gen. Emergency LED Lighting

- A parallel LED lighting sub-system installed inside a lighting fixture
- During power outage, the battery powers the LED strip.
- Not used for general lighting
- Suitable for fixtures with large housing – linear troffers
- Costly



# Emergency LED Lighting - Today

- Linear T8/T5 lamps
- Non-linear LED lamps – PL, PAR, BR, HID, etc.
- LED fixtures with small housing space - downlight, drum light, panel light, lowbay, UFO highbay, etc.
- LED fixtures with large housing space – troffer, linear vapor tight, linear highbay, etc.



# Emergency LED T8 Lighting

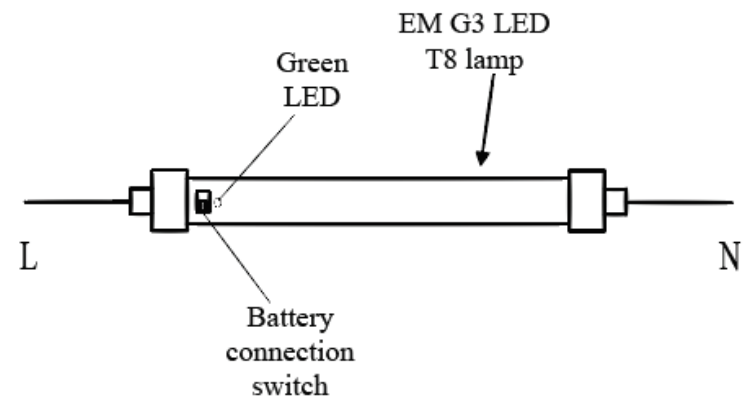
- Always-on Emergency LED T8
- On/off Emergency LED T8
- External EM Pack for LED T8



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# Always-on Emergency T8

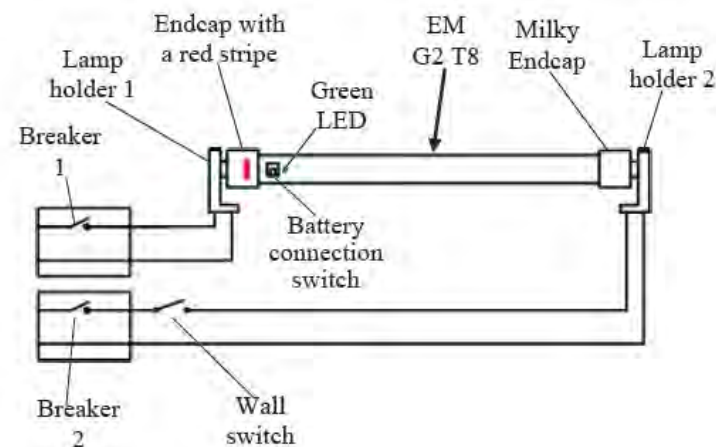
- 2-in-1 T8 with built-in battery
- 100% light level on normal operation
- **Partially lit** on battery at 3W-11W
- 90+ minutes on battery
- Quick ballast-bypass
- Simple double-end wiring
- Can't be switched off
- Good for hallway
- **Cost 50% less than EM ballast**
- *Demo*





# On/off Emergency T8

- 2-in-1 T8 with built-in battery
- 100% light level on normal operation
- **Partially lit** on battery at 3W-11W
- 90+ minutes on battery
- Single-end wiring on two endcaps
- Ballast-bypass
- On/off by a wall switch
- Good for classroom/office
- Can be wired for always-on or for emergency lighting only
- **Cost 50% less than EM ballast**
- *Demo*



# External EM Pack for LED T8

- External to the LED T8 but inside troffer housing
- 100% light level on normal operation
- 100% light level on battery
- 90+ minutes on battery
- Ballast-bypass
- Work with wall switch
- Work with sensor
- Same cost as EM ballast
- *Demo*



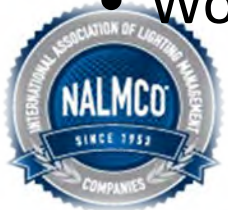
# External EM Pack for Non-linear LED lamps

- Non-linear LED lamps with integrated driver: PL, PAR, BR, HID, etc.
- EM Pack external to these lamps (up to 40W only)
- 100% light level on normal operation
- 100% light level on battery
- 90+ minutes on battery
- Ballast-bypass
- Work with wall switch
- Work with sensor



# External EM Pack for LED Fixtures with Small Housing Space

- For downlight, drum light, panel light, lowbay, UFO highbay, etc.
- EM Pack external to these fixtures
- 100% light level on normal operation
- Non-dimmable driver: 100% light level but the max driver wattage must be less than the max battery wattage
- Dimmable driver (0-10V dimming): partially lit to be determined by the max battery wattage
- Verify 40W+ driver dimmability
- Ballast-bypass
- Work with wall switch
- Work with sensor



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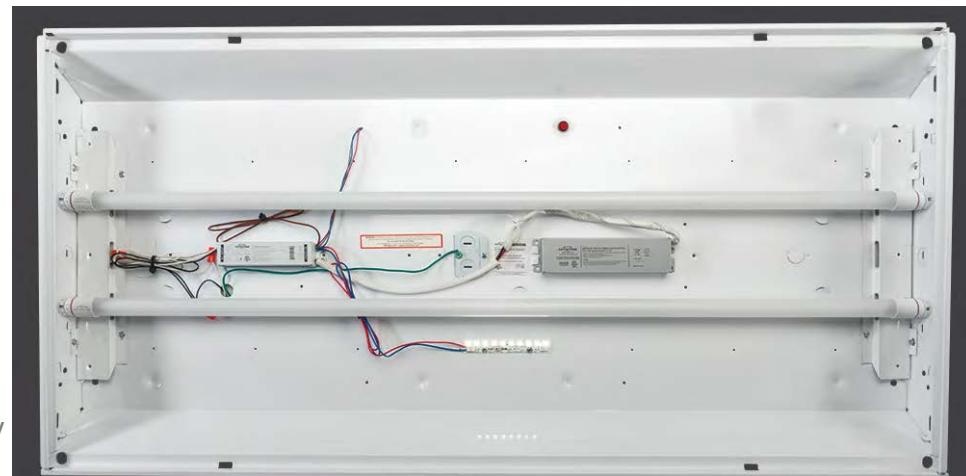
# External EM Pack for UFO Highbay Fixtures

- Standard EM Pack needs additional mounting bracket and may put weight on the UFO highbay, messing up lighting distribution
- Inline design style offer easy installation
- Doesn't put EM Pack weight on UFO fixture
- Battery wattage up to 40W
- Works with 0-10 dimmable drivers only
- Verify dimmable driver compatibility
- Work with wall switch & sensor



# Internal EM Pack for LED Fixtures with Large Housing Space

- For troffer, linear vapor tight, linear highbay, etc.
- EM Pack installed inside the housing of the fixture
- Comes with emergency driver and battery pack
- Emergency driver powers LED's directly during emergency (*not relying on the original driver at all*)
- **Battery wattage range: 10W-30W**
- Ballast-bypass
- Bypass wall switch
- Bypass sensor



The Standard for Lighting Management Quality

# EM Pack Selection Cheat Sheet

LED Lamps/Fixtures	Built-in Battery	External EM Pack 5W-40W	Internal EM Pack 10W-30W
T8 & T5	√	√	
PL		√	
PLL		√	
A19	√	√	
PAR, BR		√	
Corn Lamp		Up to 40W	
Downlight, Recess Can		√	
Decorative light		Up to 40W	
Ceiling/Drum Light		√	√
Shop Light		√	
Linear strip fixture		Up to 40W	
Wraparound fixture		Up to 40W	√
Troffer		Up to 40W	√
Panel Light		Up to 40W	
Linear Highbay		Up to 40W	√
Vapor Tight		Up to 40W	√
Lowbay		Up to 40W	
UFO Highbay		Up to 40W	



# Frequently Asked Questions

- Minimum light level for emergency lighting: 1 FC
- Minimum battery time: 90 minutes
- EM Pack must be compliant with **UL 924**.
- However, UL 924 is **NOT** applicable to emergency LED T8 because it is a replaceable lamp and not affixed to the building.
- Monthly EM lighting audit: 30-second test
- Annual EM lighting audit: 90-minute test
- EM Pack with auto-test & self-diagnosis is a HUGE PLUS





# Frequently Asked Questions

- Emergency LED lighting doesn't work with ballast or EM ballast.
- Select EM T8 according to application: always-on vs. on/off (e.g., hallway vs. classroom)
- The battery capacity of EM T8 is not the key issue; the key is to meet 1 FC requirement & last over 90-min
  - Remember classroom/office: 30-50 FC
- When more than one EM T8 is needed to meet 1 FC, consider using External EM Pack to power one LED T8 at 100% light level (2000+ lm).
- Some EM T8 on the market is overweight (violating UL weight limit 17.6 oz on T8)



# Frequently Asked Questions

- External EM Pack can't support a fixture with a higher wattage rating, unless the fixture has a compatible 0-10V dimmable driver, for example:
  - 25W External EM Pack can't support 100W fixture unless the fixture has a compatible 0-10V dimmable driver.
- Verify driver compatibility:
  - Check the driver part number, not the fixture part number, when verifying driver compatibility
- EM Pack rating should be at least 15% of the max fixture wattage, thus operating at 15% dim level at EM mode:
  - 100W fixture should use >15W EM Pack
  - 200W fixture should use >30W EM Pack



# Frequently Asked Questions

- External motion sensor of a fixture won't interfere with EM Pack during EM mode, because the motion sensor is dead during outage
- Built-in motion sensor of a fixture may interfere with EM Pack during power outage
- How often should the emergency lighting equipment be replaced?
  - Answer: it depends ... on what?



# Frequently Asked Questions

- The lifetime of the rechargeable battery depends on the full charge-discharge cycle.
- It is better to replace equipment lighting equipment when its warranty expires (normally 5 years), unless you want to assume the liability



# Reference

- Aledra emergency lighting products: [www.aledra.com/emergency-lighting/](http://www.aledra.com/emergency-lighting/)
- Demonstration videos: [www.youtube.com/aledra](http://www.youtube.com/aledra)
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