1945-2025

EMERGENCY LIGHTING:

Don’t Get Caught in the Dark

Understanding and applying NEC Sections 700.16 and 700.17

with

Garth Stevens, PE

Electrical Engineer

37 years in the industry

Morrison Maierle

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Thanks for joining us

Slide deck at: m-m.net/insights

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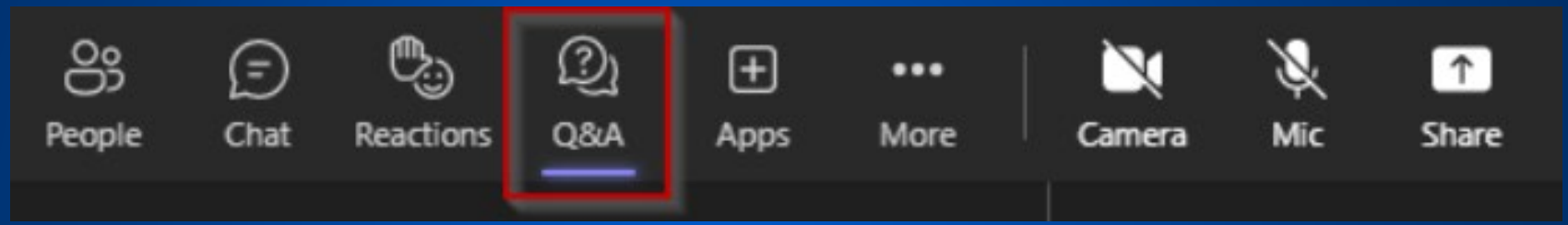


Q&A

About Garth Stevens

Garth Stevens, PE, is a Senior Electrical Engineer with Morrison-Maierle in Montana. He has 37 years of experience designing electrical systems for buildings. Along with his design responsibilities, he writes technical specifications and performs quality control checking for many of his colleagues' electrical plan sets. This article originally appeared in IAEI magazine.

Today, we will learn

1. Why emergency lighting?
2. Basic code considerations for emergency lighting
3. Pros and cons for various emergency lighting strategies:
   - Discrete battery backed up bugeye units
   - Standard luminaires with integral battery packs
   - Central inverter systems
   - Use of on-site generators
4. Making decisions that protect lives

Dealing with hours of darkness

Egress Lighting

Keeping the lights on so that people can safely get out of the building

- May be unsafe to stay in the building.
- Paths of egress may not be familiar to everyone.
- If you can’t work, you may as well head home.

But we have cell phones now, right?

Emergency Lighting Code Requirements

International Building Code (IBC)

Section 1008 – Means of Egress Illumination

NFPA 101 – Life Safety Code

7.8 – Illumination of Means of Egress

7.9 – Emergency Lighting

Emergency Lighting Code Requirements

NFPA 99 – Health Care Facility Code

6.7.6.2.1.5 and 6.7.5.1.2.2(3) – Life Safety Branch of the Essential Electrical System

NFPA 110 – Emergency and Standby Power Systems

7.3 – Lighting

NEC Article 700 – Emergency Systems

Code Disclaimer

- Codes are dynamic, living documents
- Authority Having Jurisdiction (AHJ) has final say – NEC 90.4
- Other authorities don’t have jurisdiction
- Request changes or express concerns to the appropriate Code-Making Panel (CMP)

Emergency Lighting System Reliability

Section 1008 of the International Building Code (IBC)

Chapter 7 of the NFPA 101 “Life Safety Code”

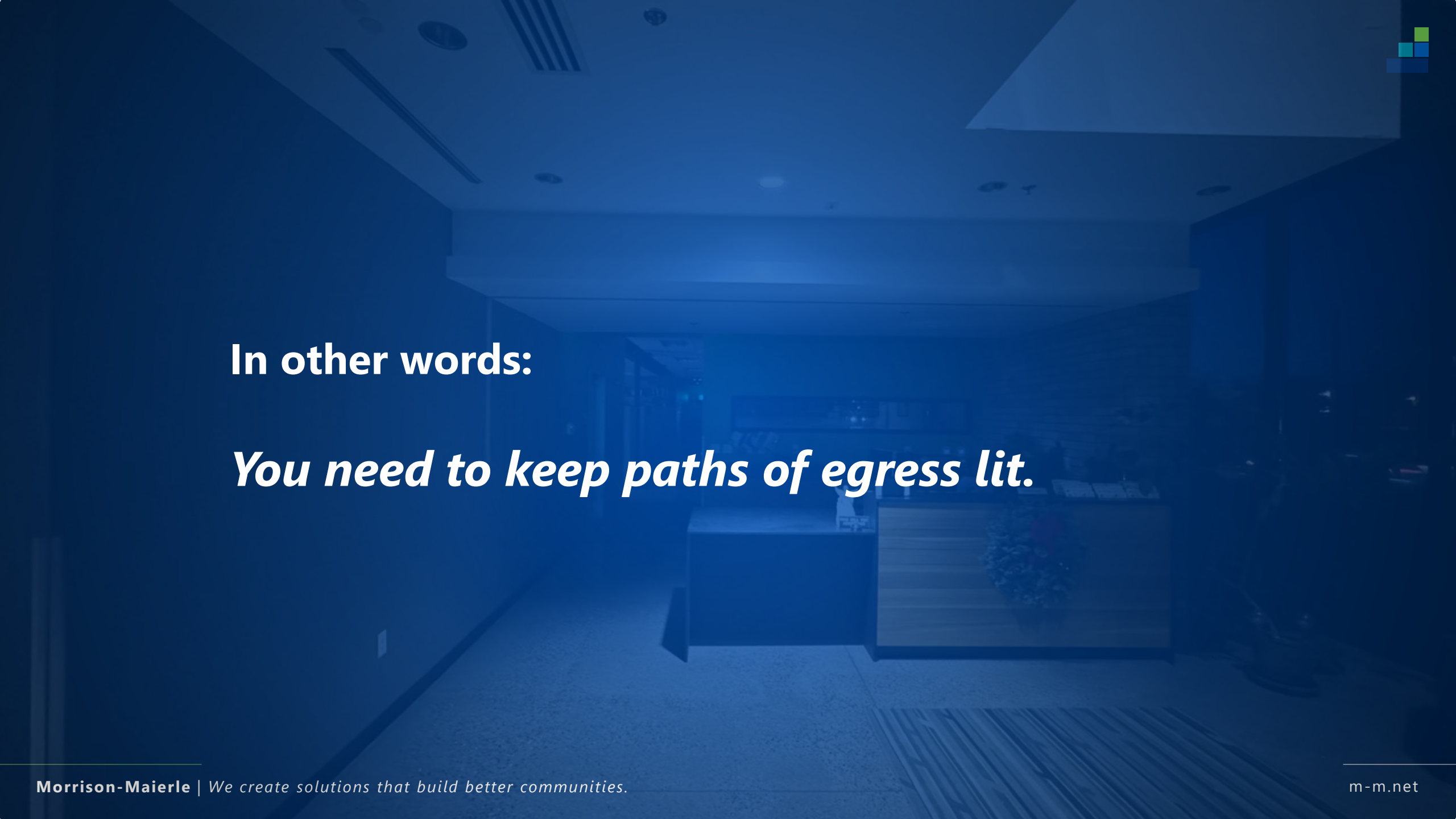
Emergency Lighting System Reliability

- Come on w/in 10 seconds of power outage.
- Stay on for at least 90 minutes, or until power is restored.
- Initial average of ≥ 1 foot-candle, with not < 0.1 ft-candle – any point at floor level.
- Average can degrade to 0.6 foot-candle over the 90 minutes – at floor level.
- Max. to Min. illumination ratio must not exceed 40 to 1.

Emergency Lighting System Reliability

NFPA 101, paragraph 7.9.3 - Maintenance

- Visual inspection every 30 days.
- Functional test for 30 seconds every 30 days.
- Annual 90-minute functional test.
- Written records for review by the Authority Having Jurisdiction (AHJ).



In other words:

You need to keep paths of egress lit.

Code Analysis

NEC 700.16 (B) System Reliability.

Emergency lighting systems shall be designed and installed so that the failure of any illumination source cannot leave in total darkness any space that requires emergency illumination.

Code Analysis

NEC 700.17 Branch Circuits for Emergency Lighting. Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted. Such installations shall provide either of the following:

We have two ways to meet the requirement

1 700.17(1)

"An emergency lighting supply, independent of the normal lighting supply, with provisions for automatically transferring the emergency lights upon the event of failure of the normal lighting supply."

We have two ways to meet the requirement

2 **700.17(2)**

Two or more branch circuits supplied from **separate and complete systems** with **independent power sources**. One of the two power sources and systems shall be part of the emergency system, and the other shall be permitted to be part of the normal power source and system. Each system shall provide sufficient power for emergency lighting purposes.

We have two ways to meet the requirement

2

700.17(2) Addresses emergency lighting powered by an inverter or generator

Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for **automatically energizing either system upon failure of the other**. Either or both systems shall be permitted to be a part of the general lighting of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of this article.

Battery Packs

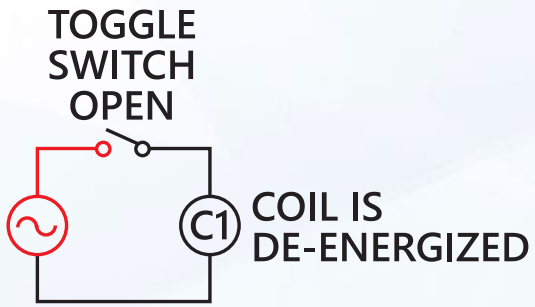
Battery Packs

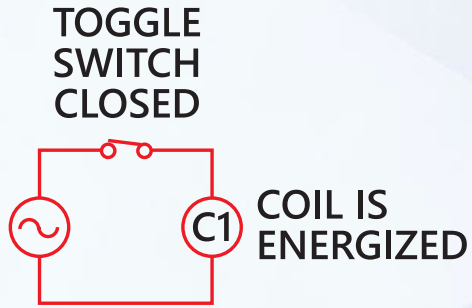
Battery Packs

Integral Battery Packs

The good ol' eggs in a basket analogy

Basic Relay Logic





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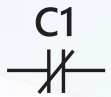

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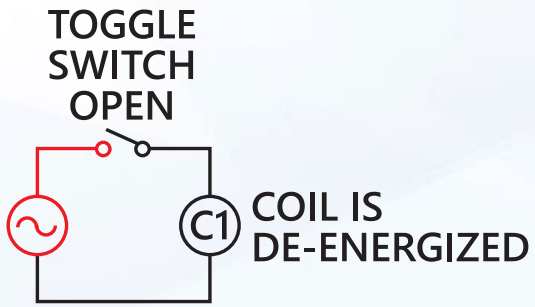

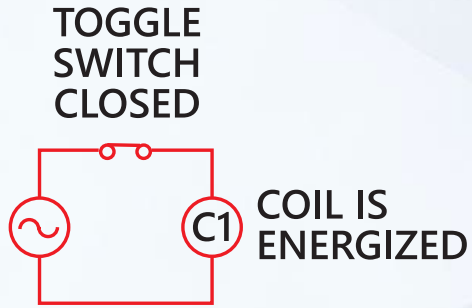

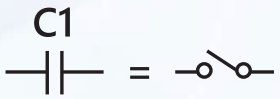

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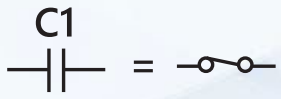

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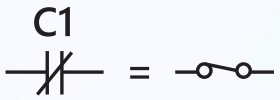

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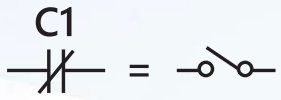

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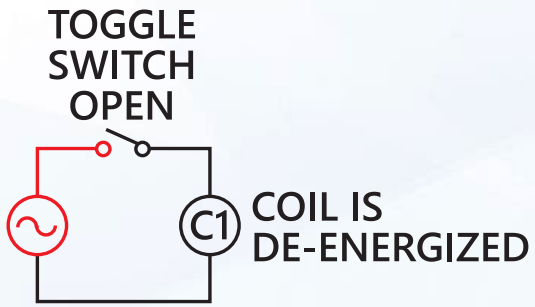

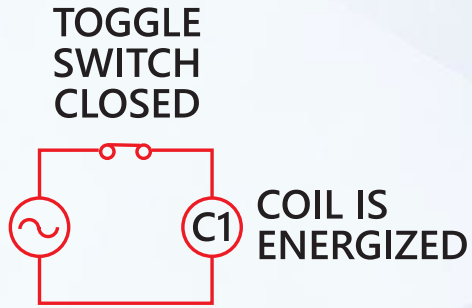

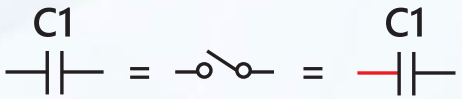

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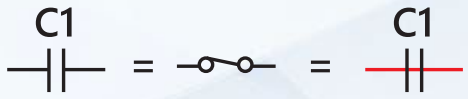

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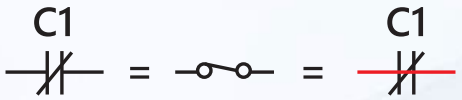

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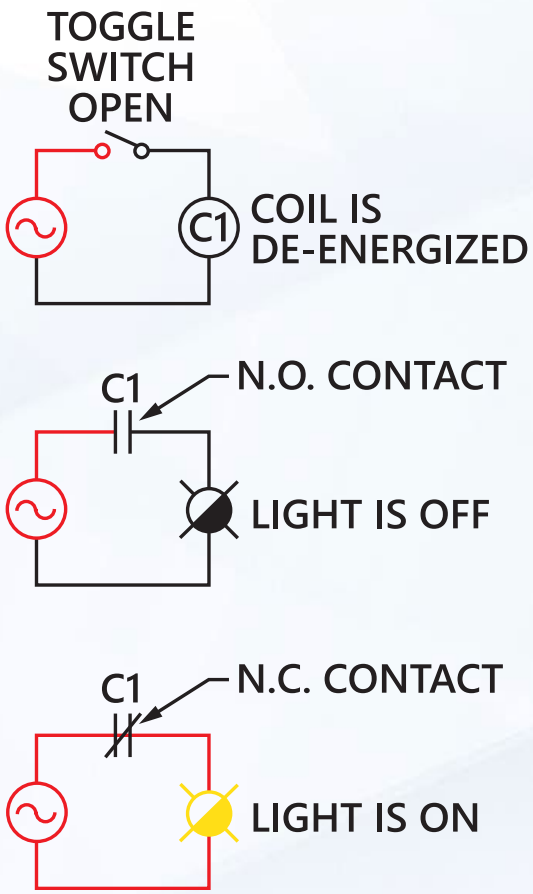
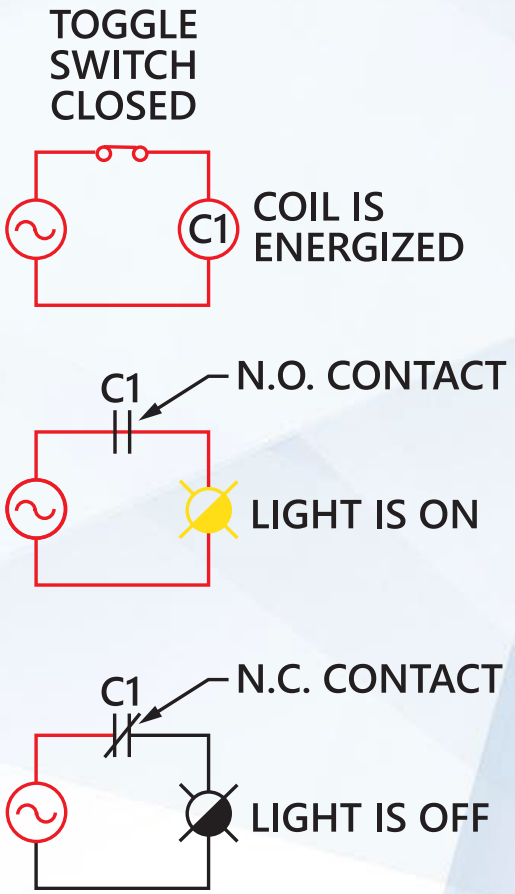
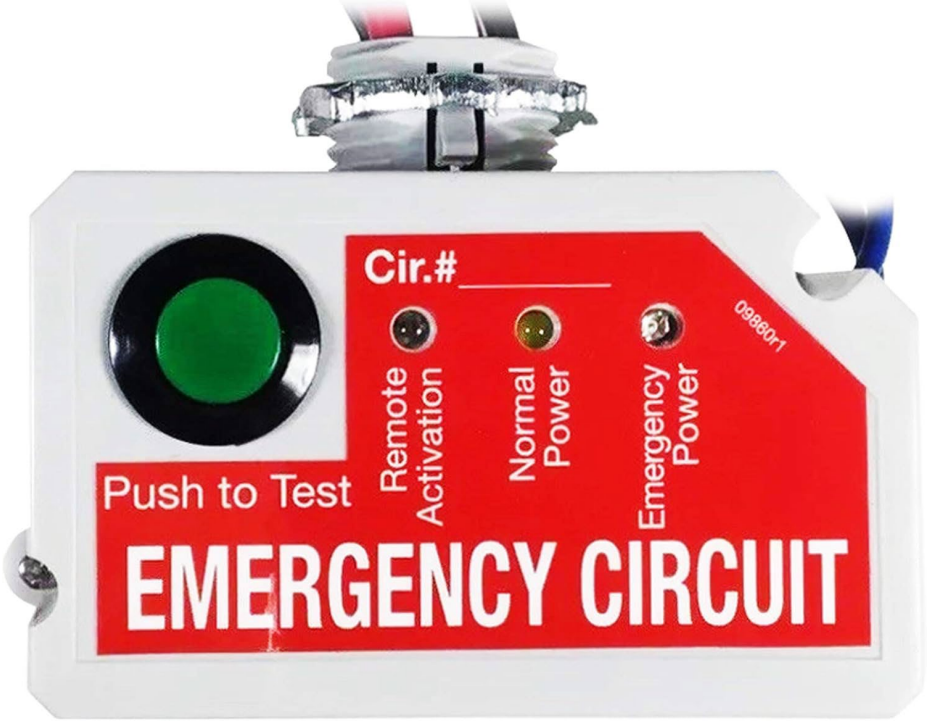




Automatic Load Control Relay (ALCR)



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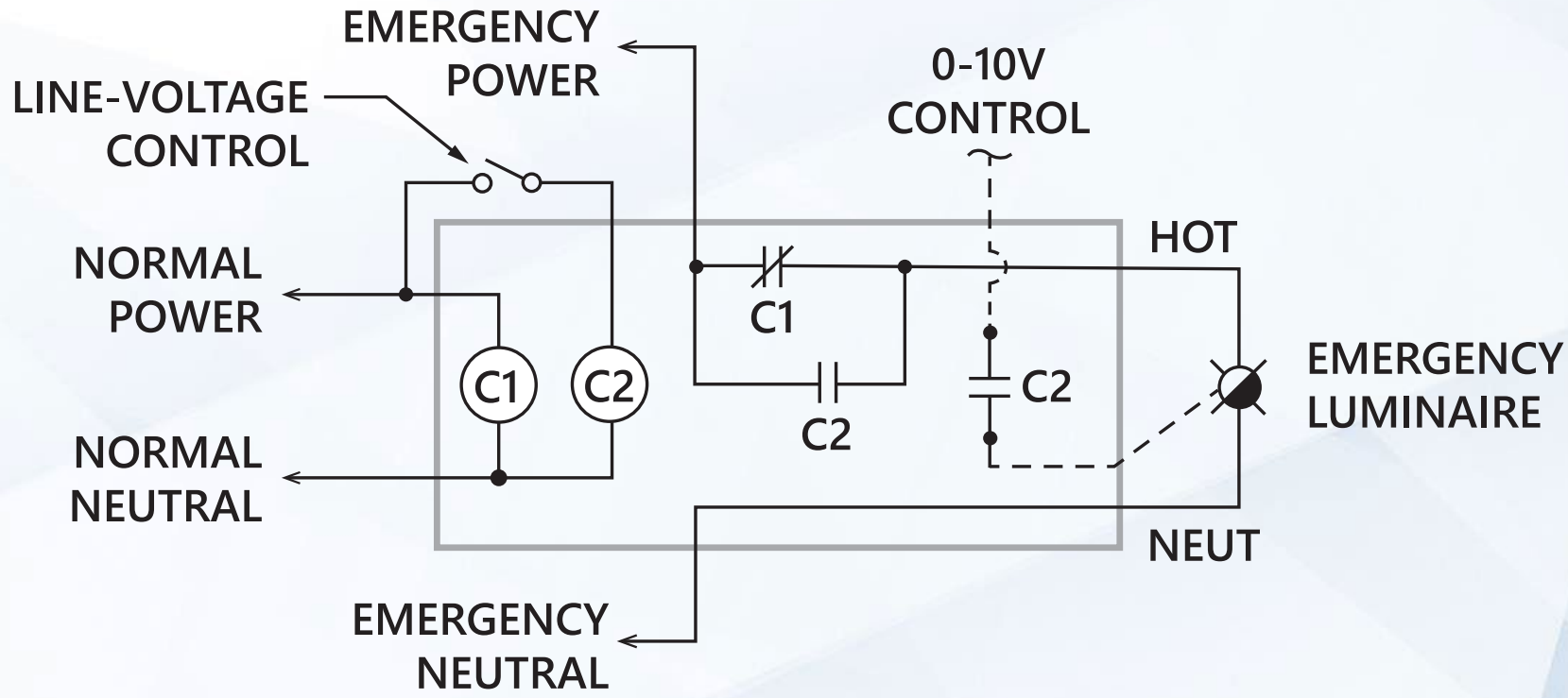
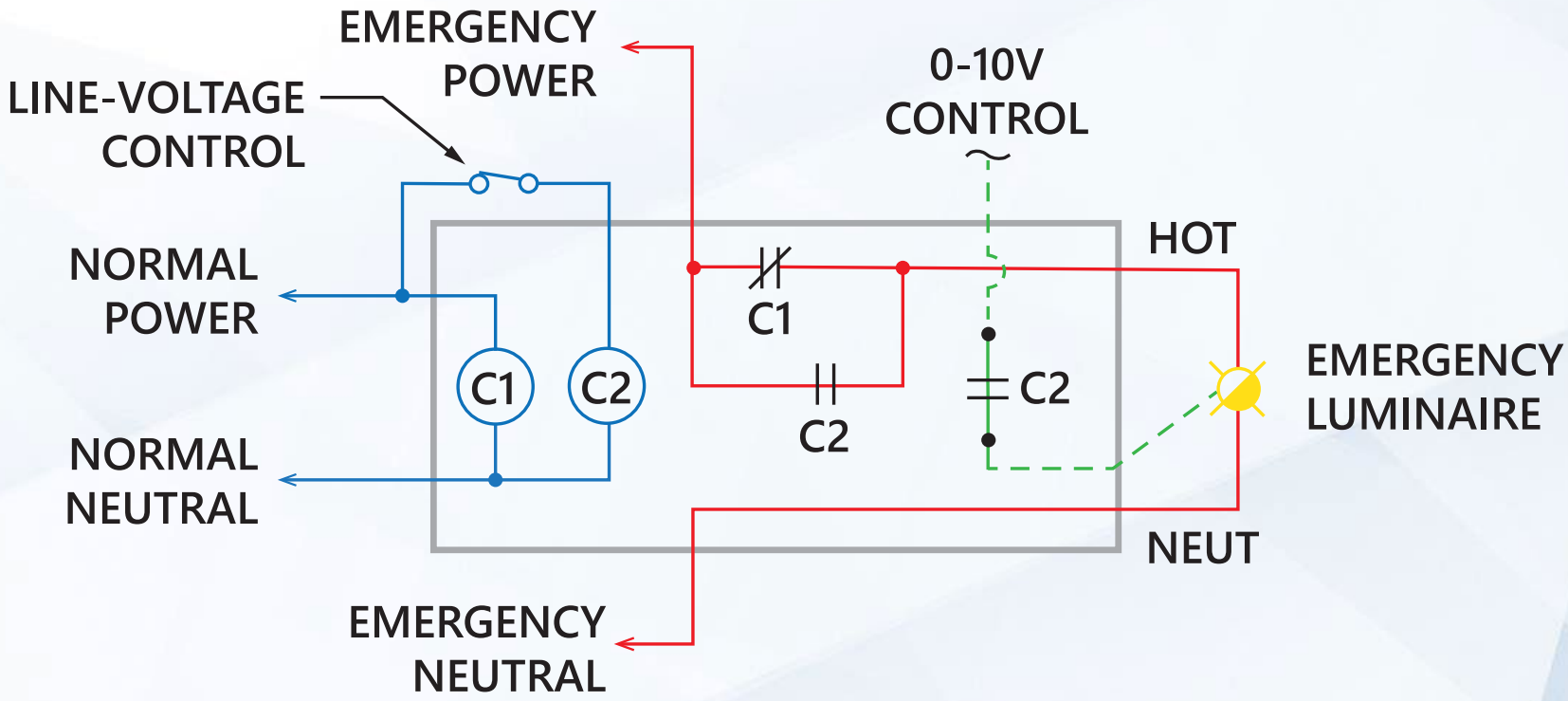


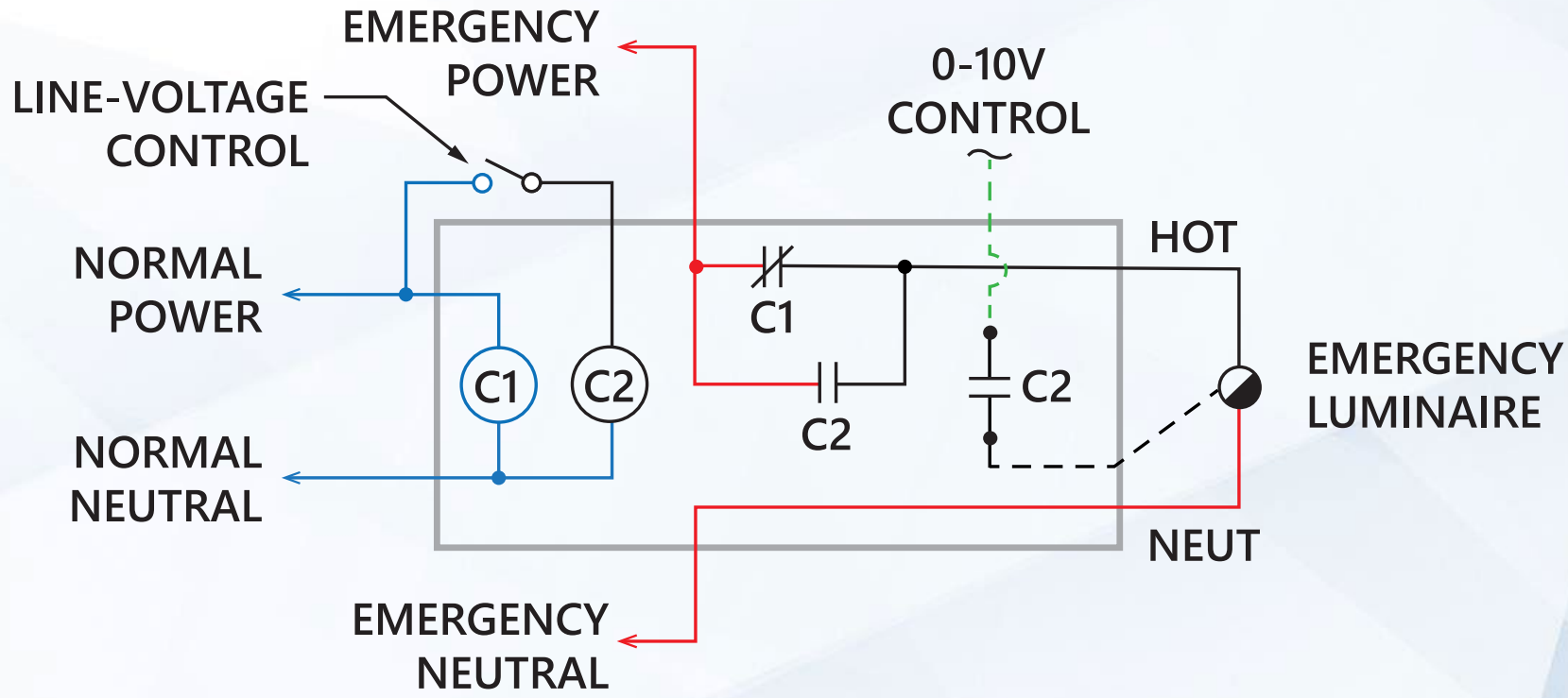
UL 924 ALCR UNIT

Automatic Load Control Relay (ALCR)



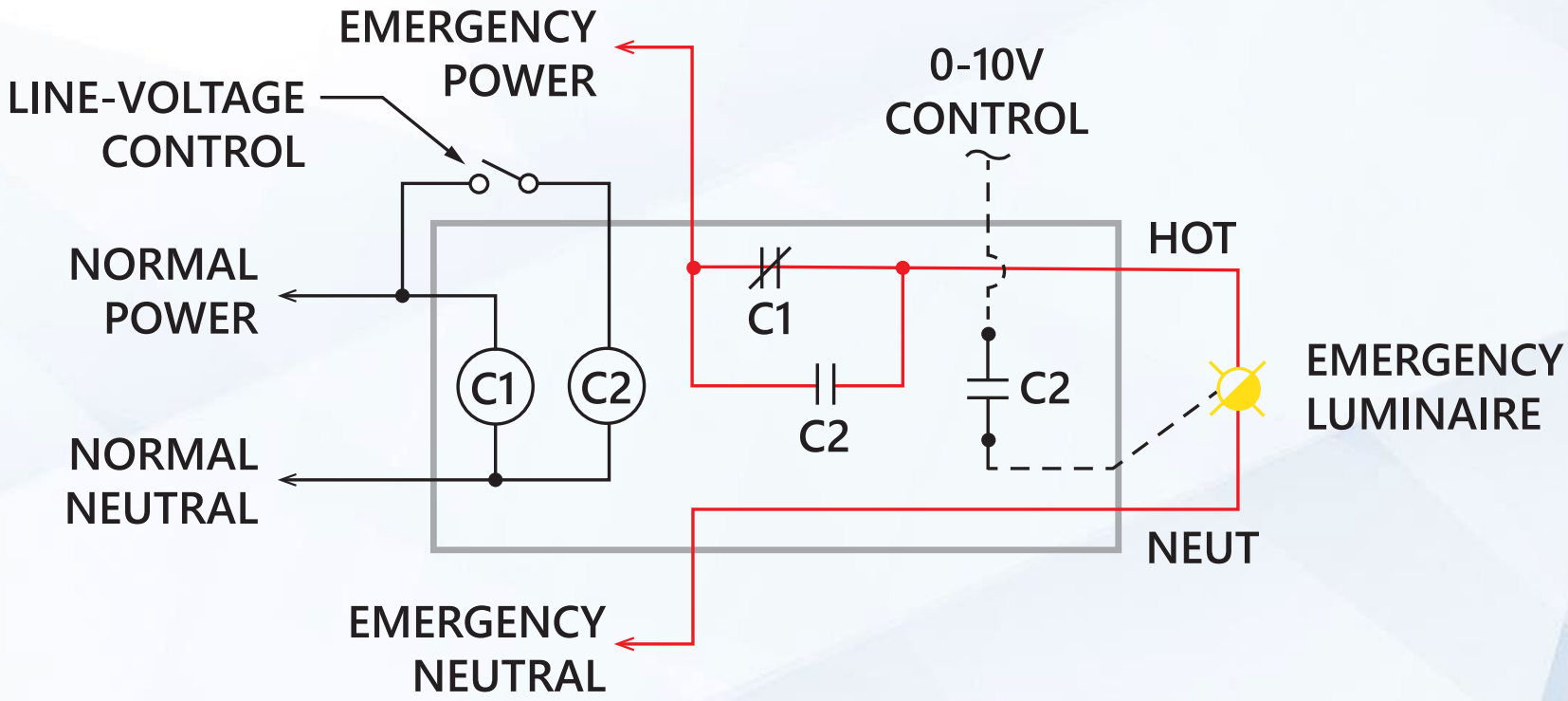
ALCR WITH SWITCH 'ON'

Automatic Load Control Relay (ALCR)



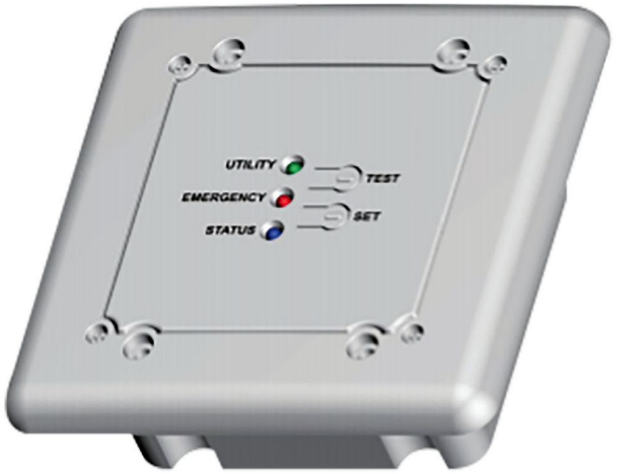
ALCR WITH SWITCH 'OFF'

Automatic Load Control Relay (ALCR)



ALCR EMERGENCY MODE

Branch Circuit Emergency Lighting Transfer Switches (BTS)



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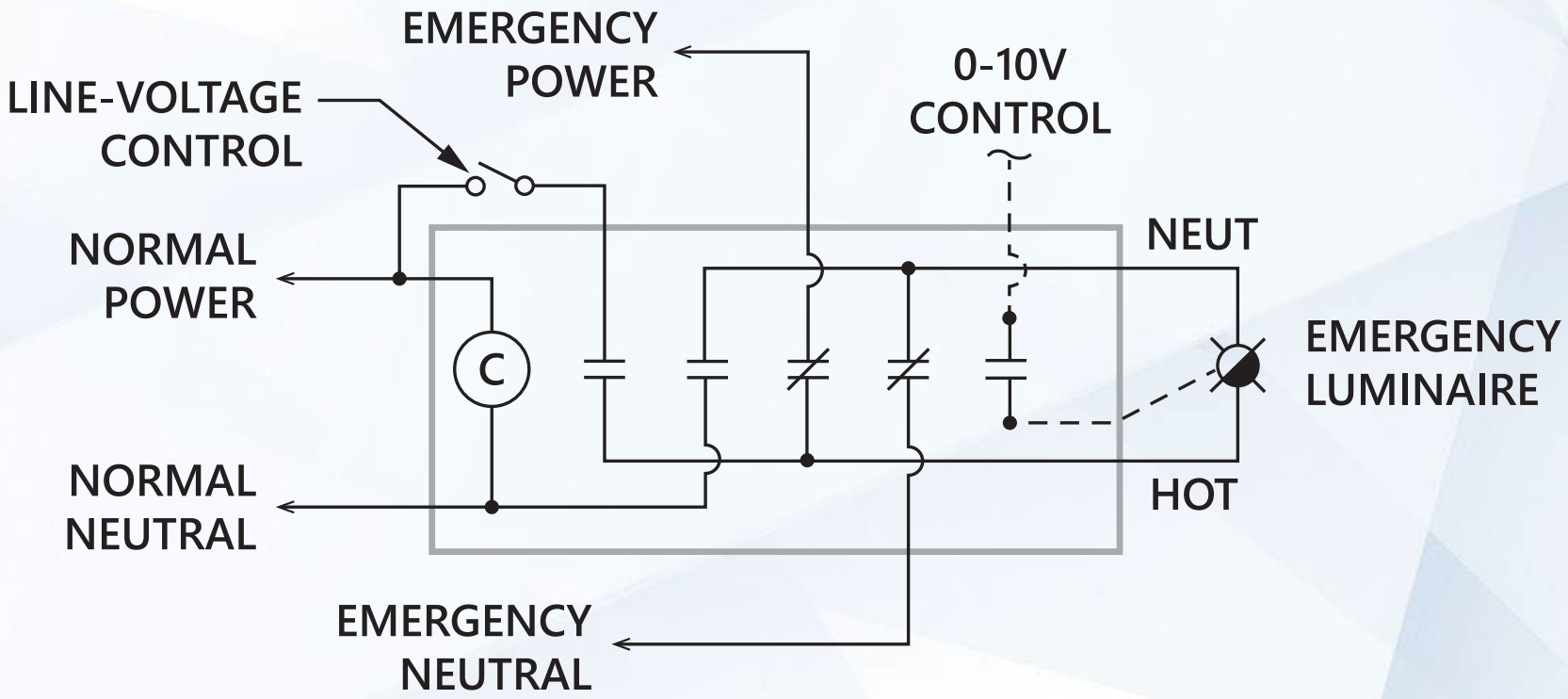
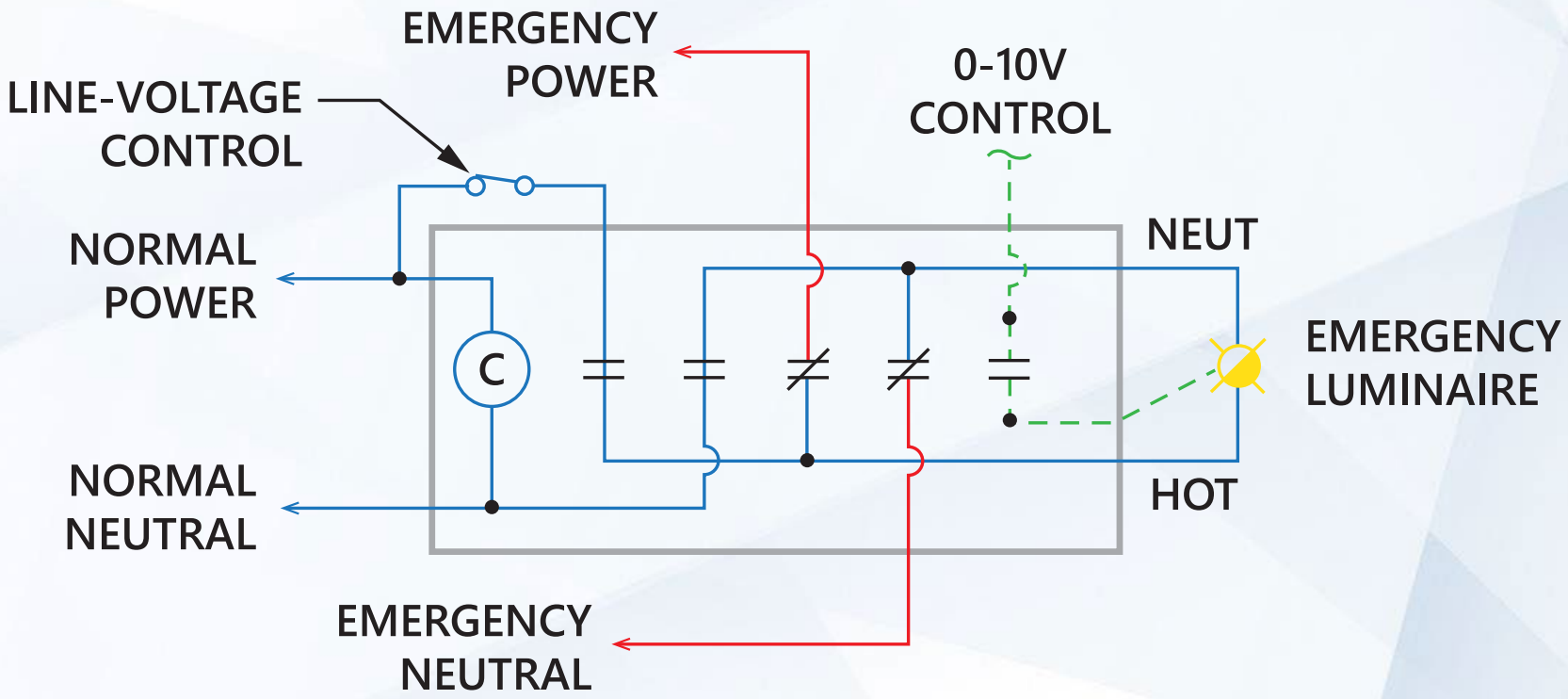


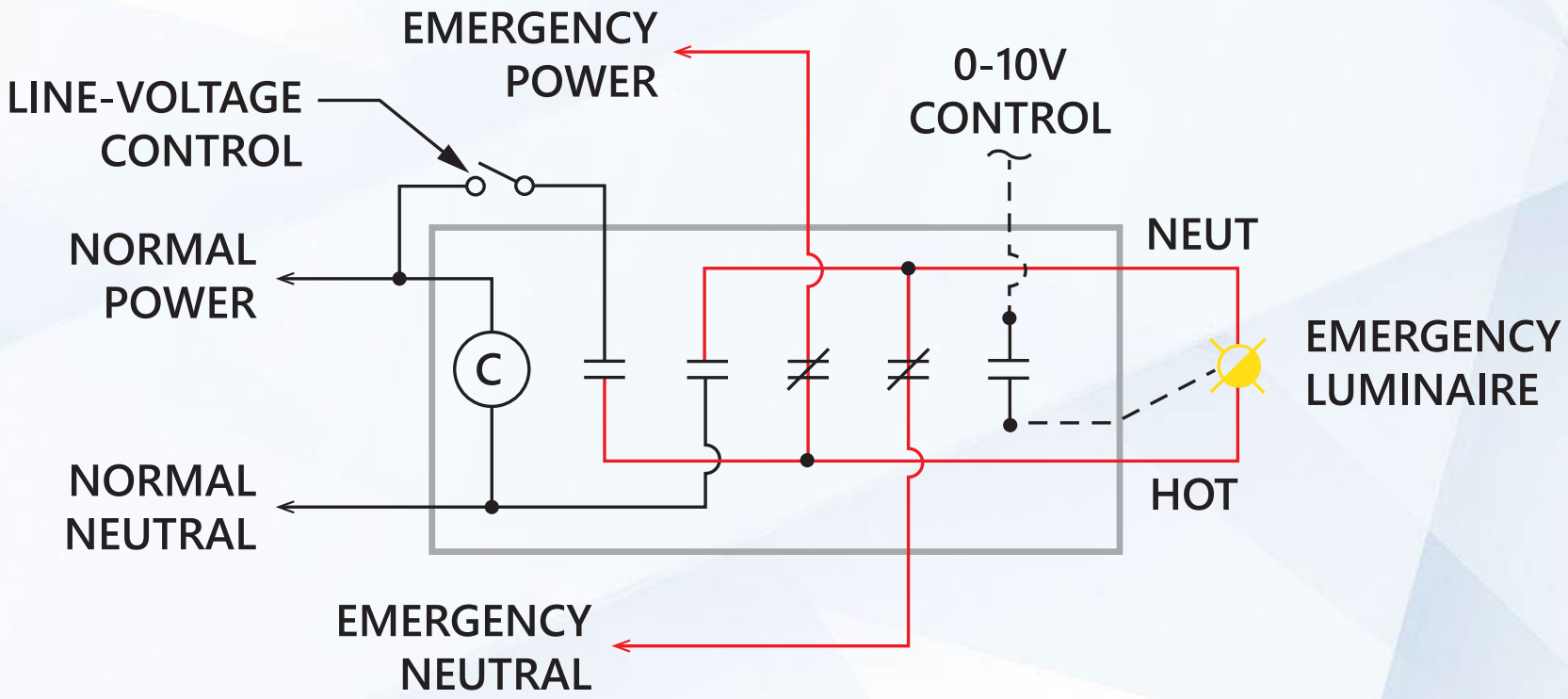
UL 1008 BTS UNIT

Branch Circuit Emergency Lighting Transfer Switches (BTS)



BTS NORMAL MODE

Branch Circuit Emergency Lighting Transfer Switches (BTS)



BTS EMERGENCY MODE

UL 924 vs. UL 1008

UL 924 ALCR – 700.26	UL 1008 BTS – 700.25
Luminaire is **always fed** from the emergency power circuit	Luminaire is fed from normal power and switches to emergency power **only when normal power is lost**
Controlled with other luminaires: 1. toggle switch 2. low-voltage dimming	Controlled with other luminaires: 1. toggle switch 2. low-voltage dimming **3. line-voltage dimming**
Luminaire comes on at full output when normal power is lost	Luminaire comes on at full output when normal power is lost

NEC 700.17(2)

Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for **automatically energizing either system upon failure of the other**. Either or both systems shall be permitted to be a part of the general lighting of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of this article.

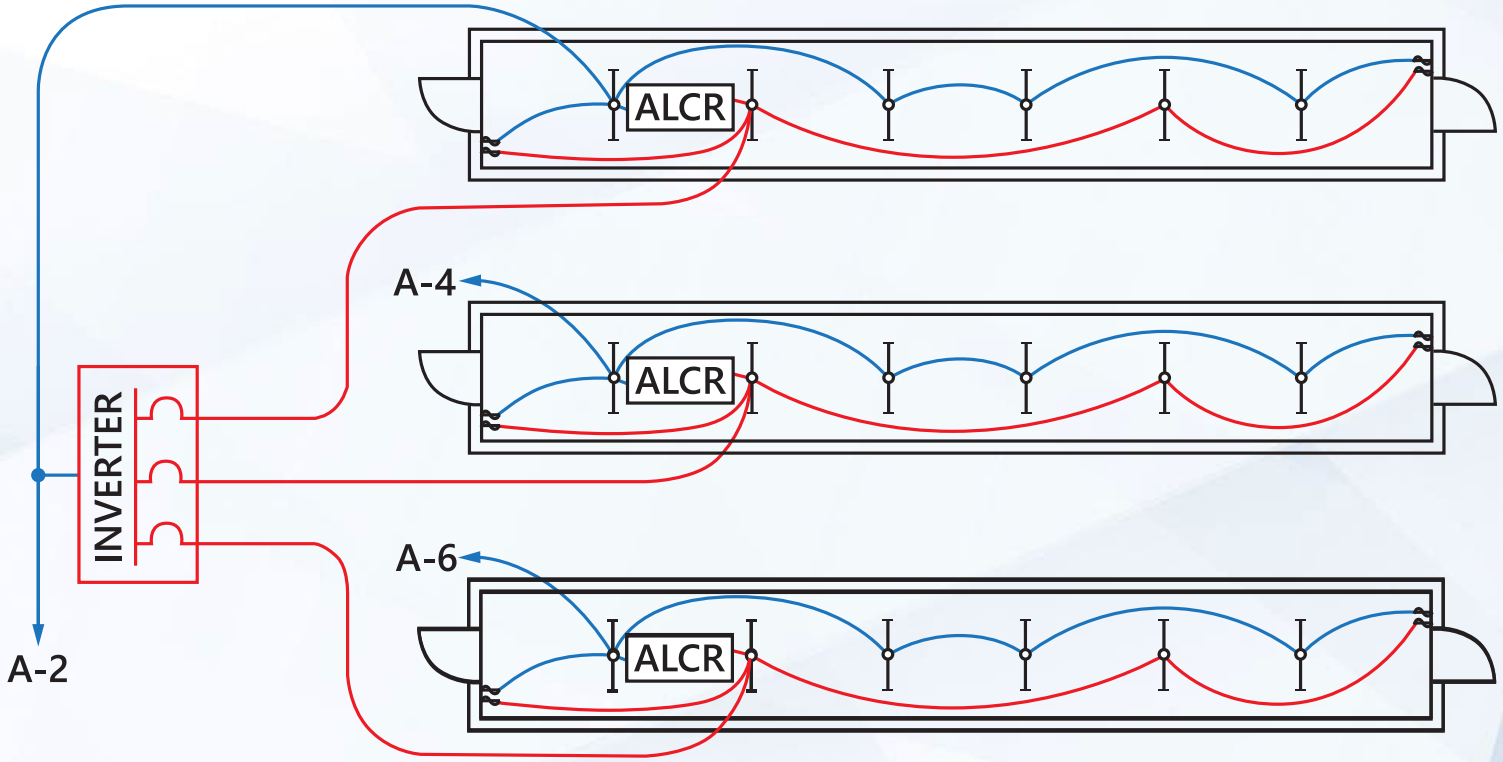
Central Inverter System

Circuiting for Central Inverter System

NEC 700.12(H)(2)(3) Must be one of the following:

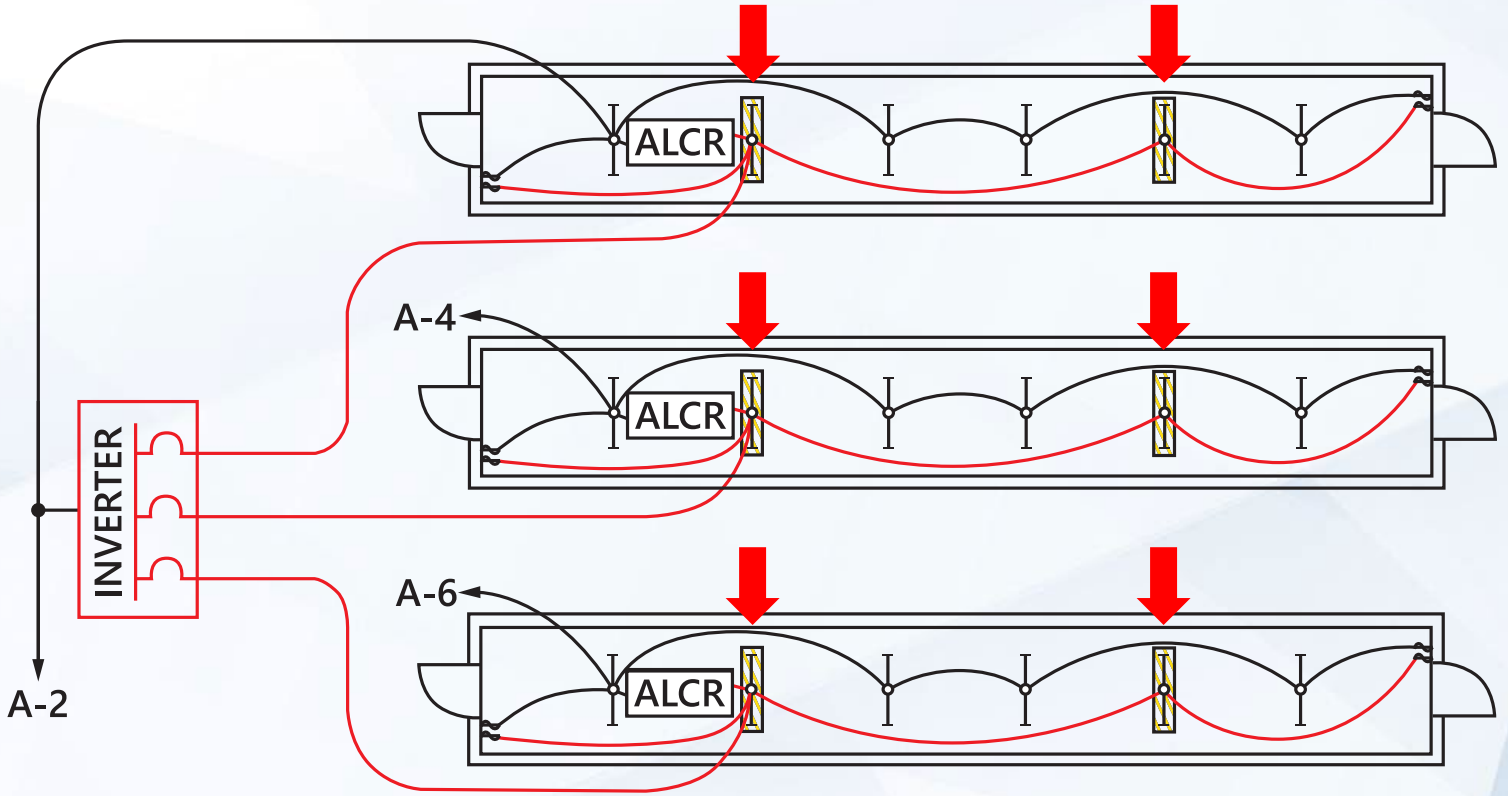
1. **Same branch circuit as normal lighting circuit**
2. **Different branch circuit (requires ALCR or BTS)**
3. **Separate branch circuit from the same panel as normal lighting circuits**
   - ✓ Breaker needs a lock-on device
   - ✓ Does not require ALCR or BTS

Automatic Load Control Relay (ALCR)



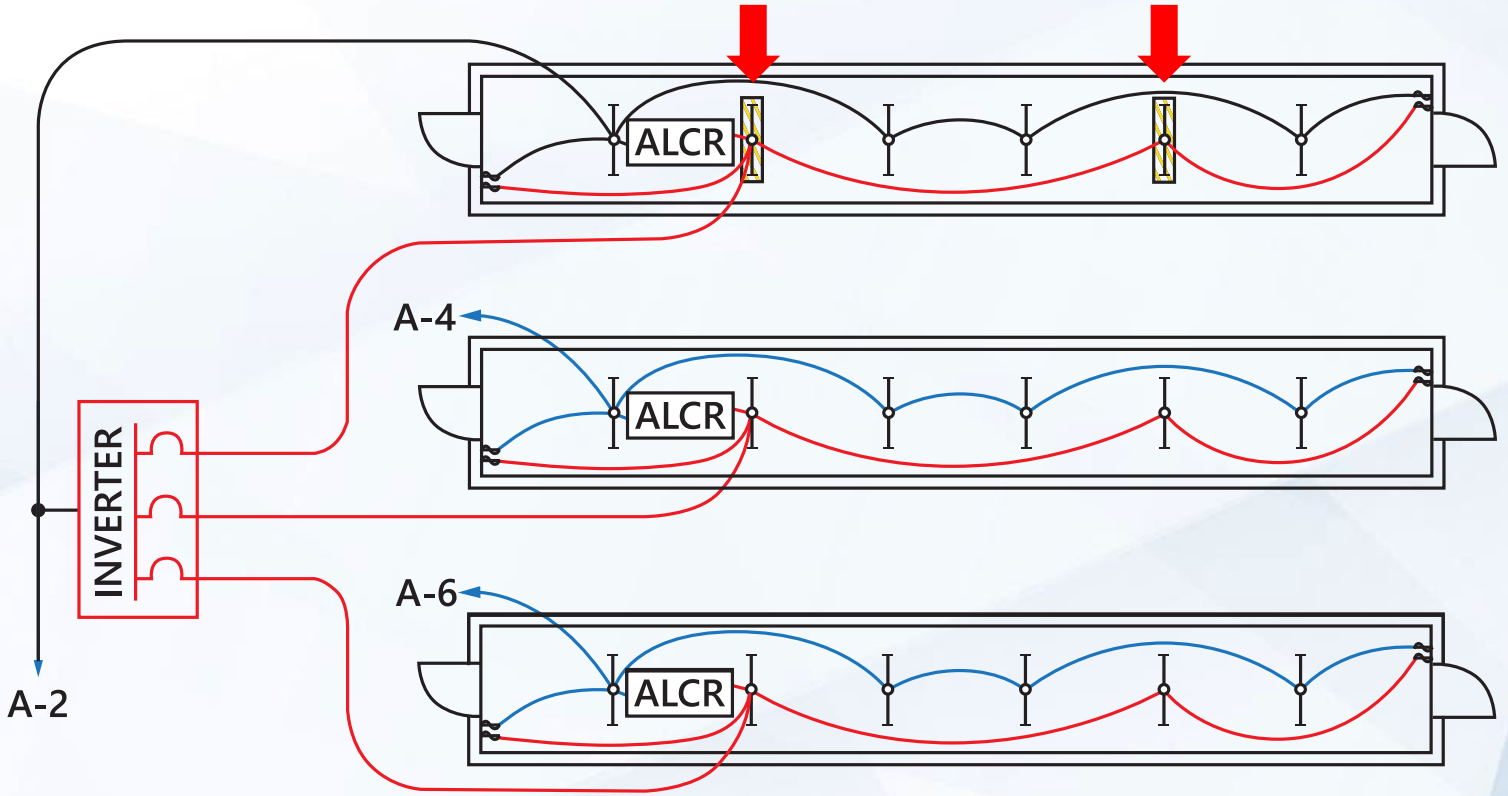
CENTRAL INVERTER SYSTEM

Automatic Load Control Relay (ALCR)



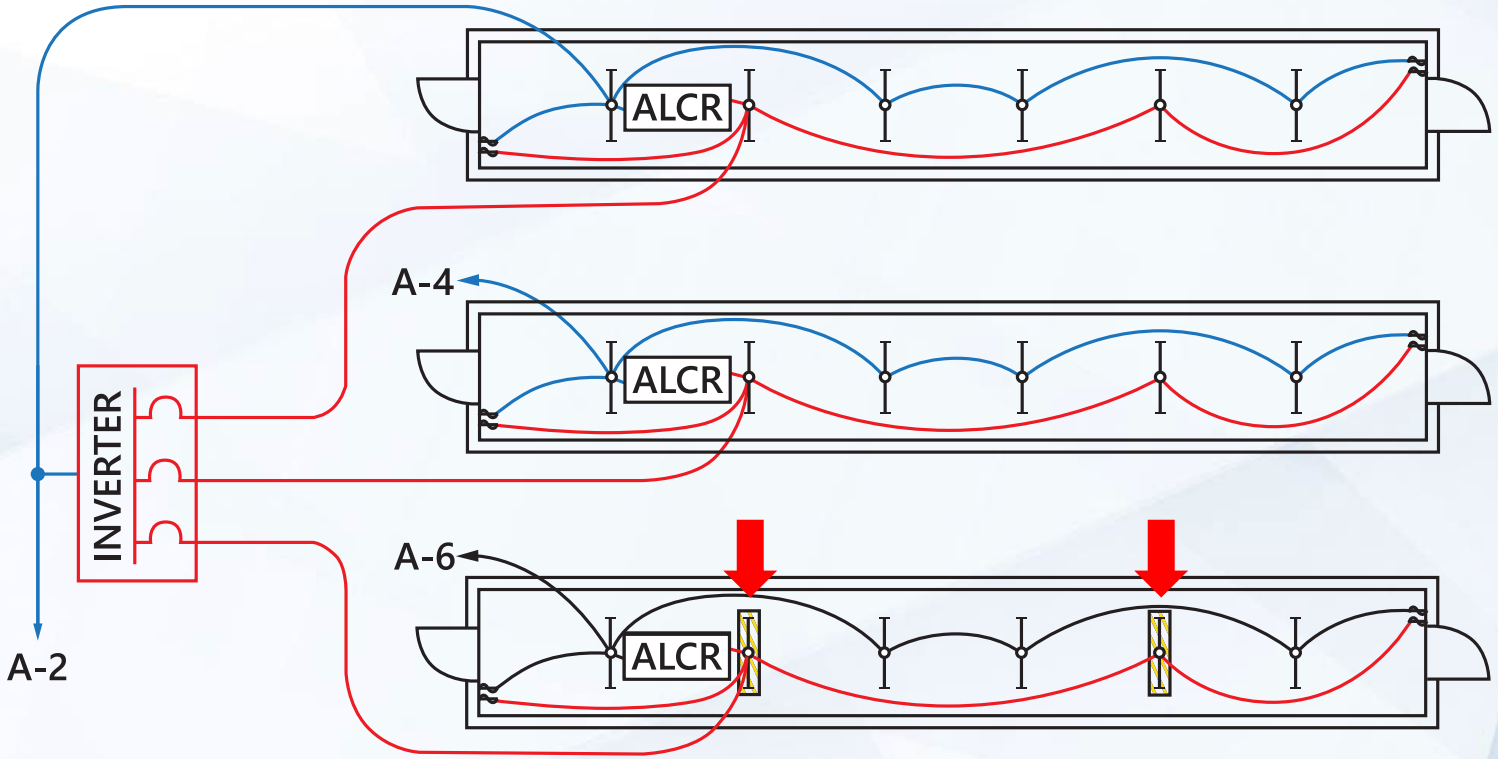
CENTRAL INVERTER WITH GENERAL POWER OUTAGE

Automatic Load Control Relay (ALCR)



CENTRAL INVERTER WITH CIRCUIT A-2 OUT

Automatic Load Control Relay (ALCR)



CENTRAL INVERTER WITH CIRCUIT A-6 OUT

Smaller Inverters

(up to about 250W)

- ✓ Single circuit
- ✓ ALCR function built-in
- ✓ Some can dim the emergency luminaires

Generators

- ✓ NEC 700 – Emergency Systems
- ✓ NEC 701 – Legally Required Standby Systems
- ✓ NEC 702 – Optional Standby Systems
- ✓ NEC 708 – Critical Operations Power Systems

Generators

- ✓ NEC 700 – Emergency Systems
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- ✓ NEC 708 – Critical Operations Power Systems





Generators Emergency Systems

NEC 700.3(F) – Permanent means for connection to portable/ temporary source to allow for maintenance.

NEC 700.5(D) – Separate emergency transfer switch.

NEC 700.8 – Surge Protection Device (SPD) for each panelboard.

NEC 700.10(B) – Wiring completely separated from all other wiring.

NEC 700.10(C) – Located to avoid adverse conditions.

NEC 700.10(D) – Additional fire protection requirements.

NEC 700.12 – Power transfer within 10 seconds from outage.

When the lights go out, how long is 10 seconds?

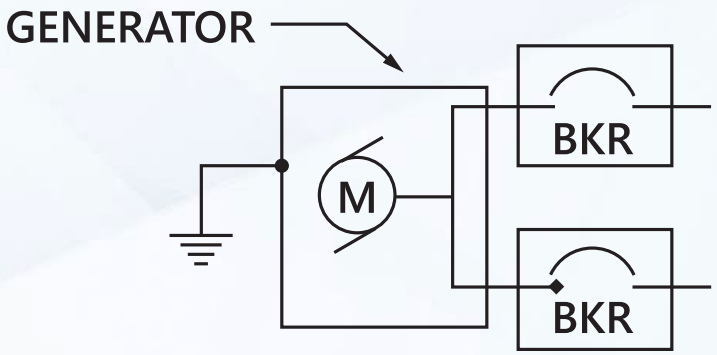
Generator Emergency Lighting in Healthcare

Generator Emergency Lighting in Healthcare

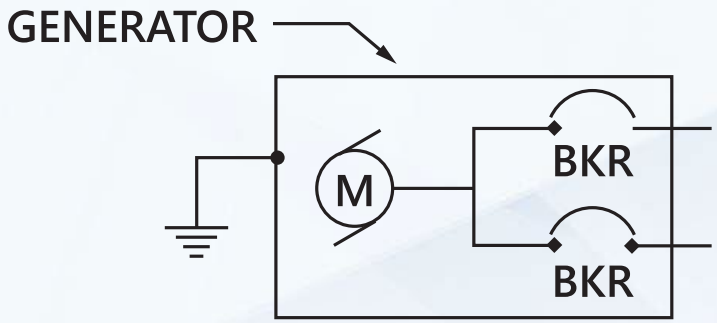
- ✓ NEC 517 – Health Care Facilities.
- ✓ Life Safety Branch, Critical Branch, Equipment Branch (Emergency System, Legally Required Standby, Optional Standby)
- ✓ Life Safety Branch – Means of Egress Illumination and Exit Signs Forced to come on via ALCR or BTS
- ✓ Critical Branch – Task Illumination No ALCR or BTS, may need to stay dimmed or off
- ✓ Need to ensure that the lighting controls are on Critical Branch

Generator Used for Emergency Lighting

NEC 700.10(B) – Wiring completely separated from all other wiring



PRIOR TO 2023 NEC

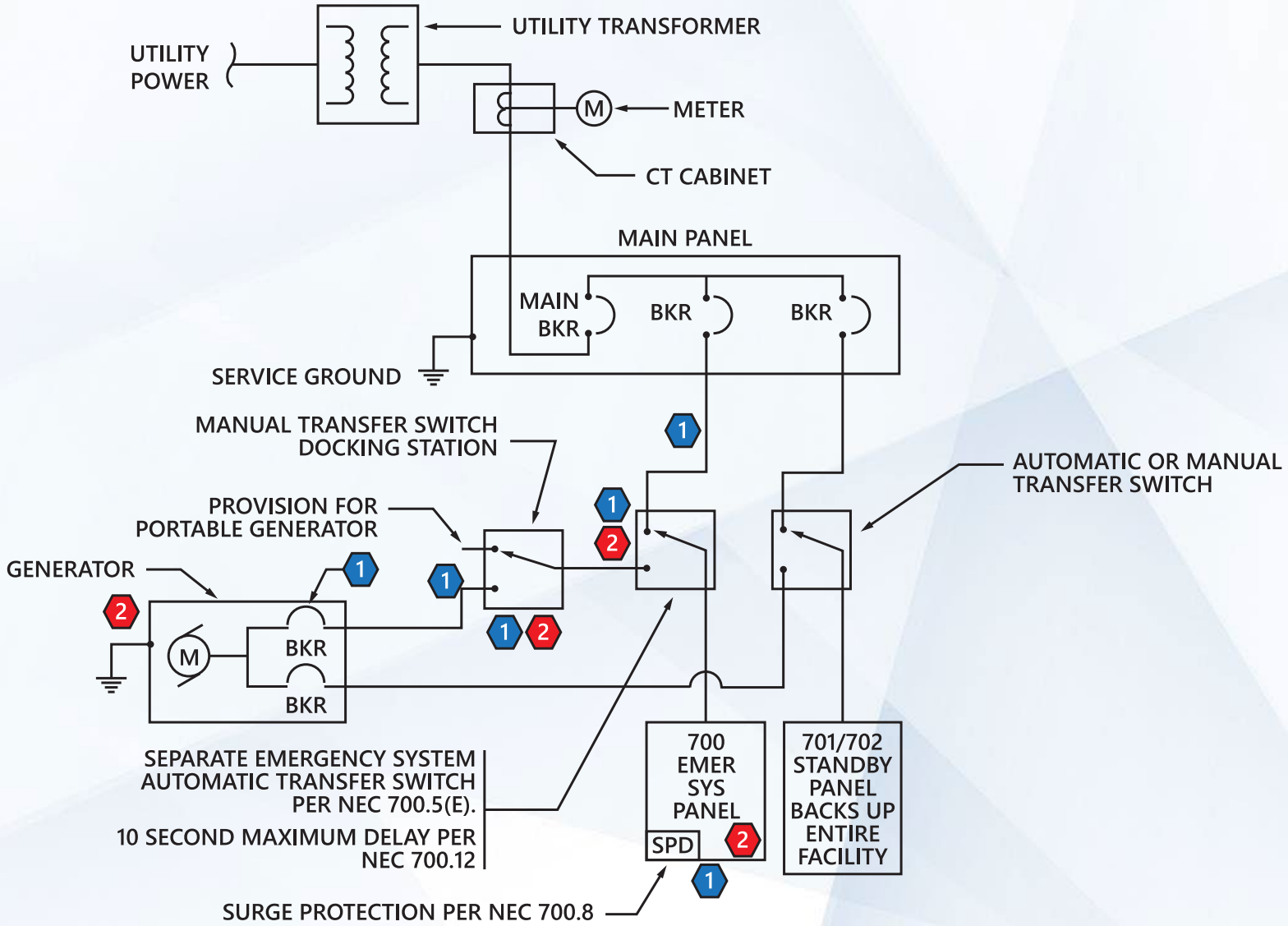


2023 NEC 700.10(B)(6)(e)

Generator Used for Emergency Lighting

1. WIRING FOR EMERGENCY SYSTEM KEPT ENTIRELY SEPARATE PER NEC 700.10(B)

2. LOCATED TO AVOID ADVERSE CONDITIONS PER NEC 700.10(C)/(D) AND NEC 700.12(B)

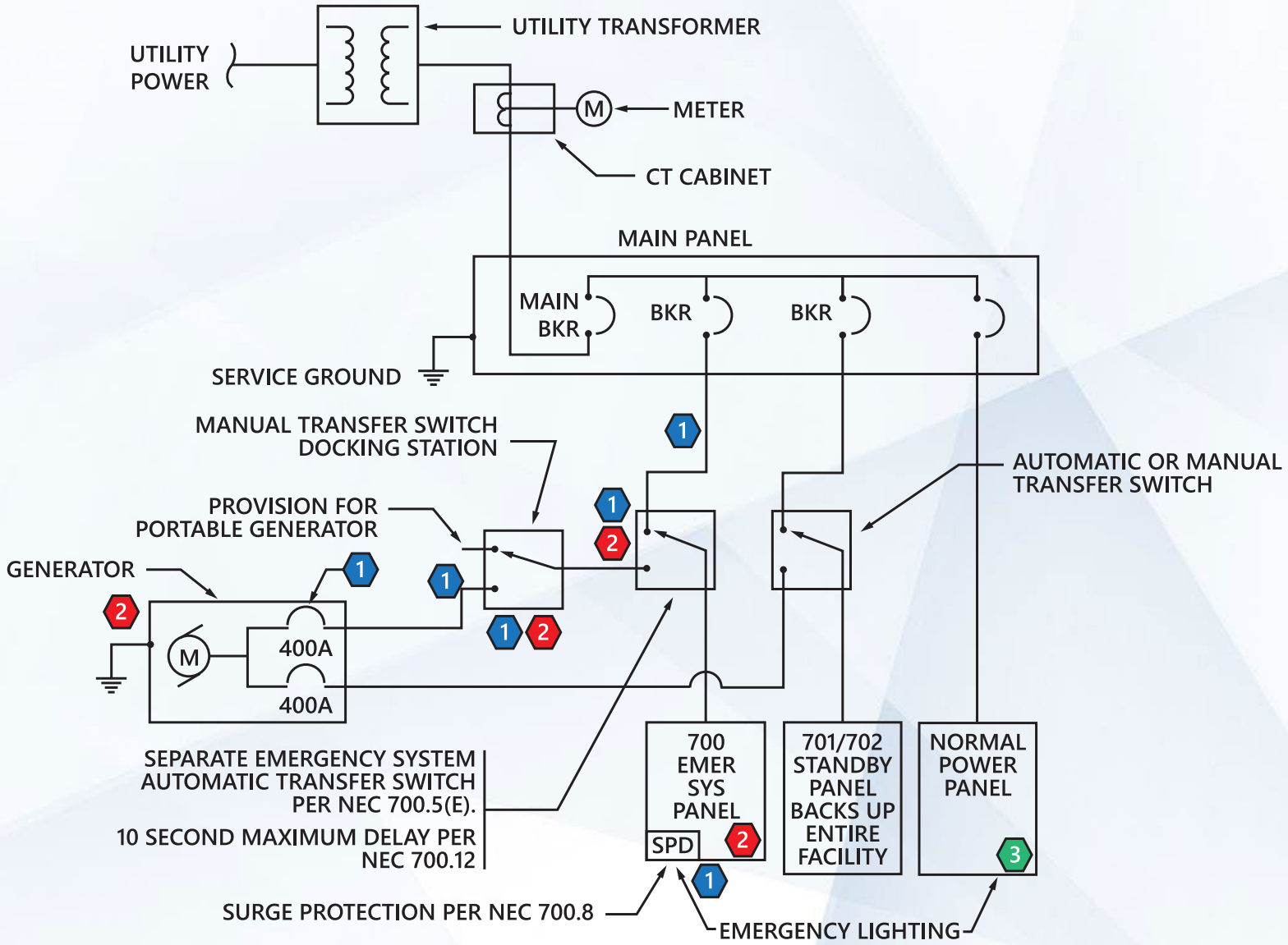


NEC 700.17(2)

Two or more branch circuits supplied from **separate and complete systems** with **independent power sources**. One of the two power sources and systems shall be part of the emergency system, and the other shall be permitted to be part of the normal power source and system. Each system shall provide sufficient power for emergency lighting purposes.

Generator Used for Emergency Lighting

1. WIRING FOR EMERGENCY SYSTEM KEPT ENTIRELY SEPARATE PER NEC 700.10(B)
2. LOCATED TO AVOID ADVERSE CONDITIONS PER NEC 700.10(C)/(D) AND NEC 700.12(B)
3. NEED FOR A NORMAL POWER BRANCH MAY BE ARGUED, BUT THIS SEEMS THE SAFEST WAY TO ALLOW FOR TWO SEPARATE SYSTEMS WITH INDEPENDANT POWER SOURCES PER NEC 700.17(2). VERIFY WITH LOCAL AHJ.



Pros, Cons, and Considerations

		Pros	Cons	Considerations
Discrete Battery Pack	Surface Bugeye	• Instant on. • Naturally wired to the local lighting circuit. • Stand out asking to be observed/ tested. • Inexpensive. • One egg per basket.	• Aesthetics issues. • Many batteries to maintain.	• Be sure to specify self-testing/self-diagnostic function. • Visual inspections with records required.
	Recessed Bugeye	• Instant on. • Naturally wired to the local lighting circuit. • Aesthetically fits in. • One egg per basket.	• Easier to miss in testing/maintenance. • Many batteries to maintain. • More expensive. • Additional mechanical failure point.	• Be sure to specify self-testing/self-diagnostic function. • Visual inspections with records required.
	Remote Heads	• Instant on. • Aesthetically fits in better than bugeye. • Fewer batteries to maintain.	• Care must be taken to circuit to the local lighting circuit. • Batteries are larger and more expensive to replace. • Voltage drop (distance) considerations. • More eggs per basket.	• Be sure to specify self-testing/self-diagnostic function. • Visual inspections with records required.
Luminaires with Integral Battery Pack		• Instant on. • Fixtures match other fixtures in area. • Simple installation and wiring for electrician. • One egg per basket.	• Can be hard to access and easier to miss for manual testing/maintenance. • Many batteries to maintain.	• Emergency portion of fixture is less than full fixture output. • Be sure to specify self-testing/self-diagnostic function. • Visual inspections with records required.
Central Inverter		• Instant on. • Fixtures are equal to other fixtures in area. • Less equipment to maintain.	• ALCR or BTS required (more complex wiring for electrician). • Batteries are larger and more expensive to replace. • Many eggs per basket.	• Be sure to specify self-testing/self-diagnostic function. • Visual inspections with records still required.

	Pros	Cons	Considerations
Generator Backup of Emergency Lighting	• Fixtures are equal to other fixtures in area. • Often generator is already being supplied for the building. • Less equipment to maintain.	• Separate Emergency System ATS is required. • Up to 10-second delay to come on. • ALCR or BTS required (more complex wiring for electrician). • Much more involved equipment maintenance. • All the eggs are in one basket.	• Must comply with requirements for NEC Article 700 system: o NEC 700.3(F). o NEC 700.5(D). o NEC 700.8. o NEC 700.10(B). o NEC 700.10(C). o NEC 700.10(D). o NEC 700.12(B). o NEC 700.12(D). • Visual inspections with records still required.

Questions?

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Thank you for attending my webinar on emergency lighting.

Feel free to reach out with any further questions.

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Thanks for joining us

Slide deck at: m-m.net/insights

Engineers: This session may meet requirements for PDHs depending on your professional registration and/or certification requirements.

Participation Certificate: hello@m-m.net

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