Application Note

Using XPoint Wireless Devices with Emergency Lighting

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XPoint Wireless and Emergency Lighting
Application Note

Introduction

This application note reviews the theory of operation and proper applications of XPoint Wireless lighting control devices when used with various emergency lighting strategies. This note includes guidance regarding the use of UL924-listed "ER" and "EM" options of XPoint Wireless lighting control devices that provide energy saving operation (such as shutoff or dimming) during normal power conditions and automatic full illumination override during typical loss of power scenarios. This note also discusses the use of standard XPoint Wireless lighting control devices with separately listed (by others) UL924-type devices, such as emergency battery drivers, generator transfer devices, emergency bypass relays, and AC micro-inverters.

Application Summary

Table 1 provides a summary of the recommended specification option for use with a given emergency lighting strategy. Each individual application is discussed in depth in the following sections.

Table 1 - Recommended Controller Specification Option for Emergency Lighting Strategy

Emergency Lighting Strategy	***Recommended Control Device Option***
• Diesel genset emergency backup supply • Slow transfer inverter (> 30 ms) emergency backup supply	**"EM" Option** • UL924 Listed. • Utilizes Power Interruption Detection to initiate lighting control override during loss of normal power scenarios. • Requires power interruption > 30 ms to luminaire during transfer to emergency backup supply.
• Fast Transfer (FT) inverter emergency backup supply • Uninterruptible Power System (UPS) emergency backup supply	**"ER" Option (UL 924 Listed)** • UL924 Listed. • Utilizes dedicated Normal Power sensing leads to initiate lighting control override during loss of normal power scenarios. • Requires connections to both emergency and normal power circuits.
• Luminaire-integral Battery Pack (BP) and emergency driver • Luminaire-integral AC micro-inverter • Generator Transfer Device (GTD) • Emergency Bypass Relay (separate from integral control device)	**Standard Option** • Not specifically listed for emergency use. • Wired such that a separately listed emergency device provides emergency lighting power and/or control during loss of normal power scenarios.

UL924 Standard Summary

The UL 924 standard applies to emergency lighting and power equipment for use in unclassified locations (meaning locations which are not specifically covered by other defined egress lighting requirements) and intended for connection to branch circuits of 600 volts or less. Such equipment is intended to automatically supply illumination or power or both to critical areas and equipment in the event of failure of the normal supply, in accordance with Article 700 or 701 of the National Electrical Code, NFPA 70; the Life Safety Code, NFPA 101; the Fire Code, NFPA 1; the International Building Code, IBC; and the International Fire Code, IFC.

ER Option - Normal Power Sensing Leads

ER Intended Applications

The XPoint Wireless "ER" models with normal power circuit sensing leads are intended to be powered by an emergency circuit and have an isolated AC power detection circuit that is intended to be connected to a normal power circuit. The ER model controller provides a flexible control solution for central emergency lighting power, suitable for traditional emergency power sources in addition to fast-transfer (FT) inverters or uninterruptible power systems (UPS).

ER Available Device Models and Wiring

XPoint Wireless light controllers and sensor/controllers are available in the following UL924 listed models that use normal power circuit sensing leads for override of lighting control:

- **XPA RP20 D__ ER**
  Externally mounted wireless controller, attached to luminaire or junction box. "#" indicates dimming option.

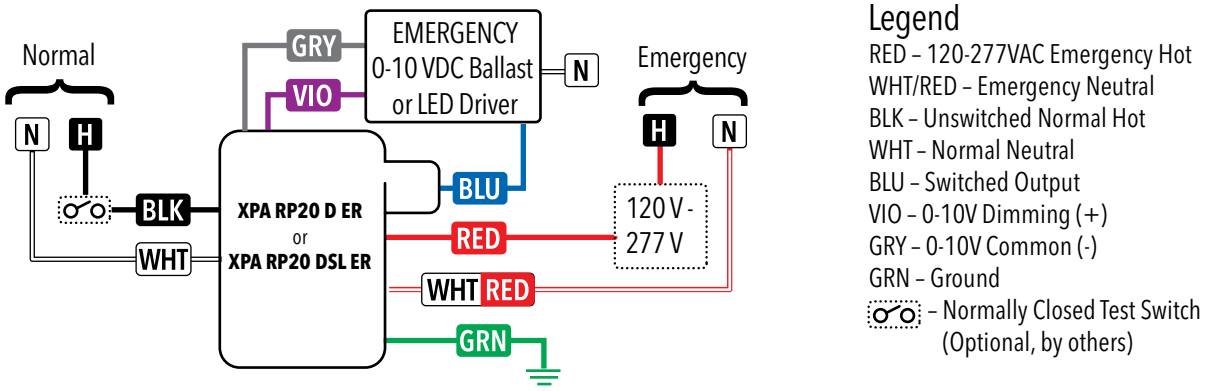

Figure 1 - Example Wiring Diagram: XPA RP20 D ER

ER Testing Note

The ER light controller may be tested by opening normal circuit breaker or through an optional test switch, provided by others. Test switch should be of type normally-closed with contacts and rated for line voltage. In the case of ER controllers, the test switch will only carry a small amount of current (less than 0.1A), as it is used only to interrupt AC line voltage to the ER controller's normal power circuit sensing leads.

ER Egress Mode Sequence of Operations

The UL924 XPoint Wireless ER Light Controllers are designed to drive the controlled luminaires to full light output (relay closed, dimming output at maximum trim setting) if there is no line voltage detected on the normal power circuit sensing leads. This operation is referred to as "Egress Mode," during which the control device ignores both manual and automatic dimming/occupancy/daylight control signals.

The ER Egress Mode Sequence of Operations is as follows:

- Normal Condition:
  - o AC line voltage is detected across normal hot and normal neutral (controller black and white wires)
  - o Controller can dim and turn off the load as normal, in response to automatic and manual control.
- Emergency Condition:
  - o Whether due to failure of utility power or opening of normal hot circuit breaker, the ER controller detects loss of AC voltage on the normal power circuit sensing leads.
  - o ER controller ignores all automatic and manual control commands and controls the driver or ballast to its fully tuned light output: the relay is closed and the 0-10V dimming signal is set at the maximum trim level (default 9.3 VDC, user programmable).
- Restoration of Normal Power:
  - o ER controller resumes normally programmed manual and automatic control sequences when AC voltage is restored to the normal power circuit sensing leads.

EM Option - Power Interruption Detection

EM Intended Applications

The XPoint Wireless "EM" models with power interruption detection are intended for use on central emergency power systems that interrupt AC voltage when transferring to the backup power source, such as diesel generators. The EM model controller provides a simple installation, not requiring a wiring connection to normal hot power. This model can be used on central emergency lighting power operating from diesel generators or other equipment with power interruption transfer times greater than 30 milliseconds. The power interruption requirement is necessary for the XPoint Wireless controllers to activate the Egress Mode functionality (see next section, "Sequence of Operations").

EM Available Devices Models and Wiring

There are two styles of XPoint Wireless EM power interruption detection devices available, those with relay and those without relay.

EM Light Controllers with Relay

Most applications are best served with Relay models, so that the lights may be completely turned off during normal power conditions. For example, California's Title 24 energy code indicates that luminaires in daylight zones of parking garages should be completely turned off when adequate daylight is available. If this daylight zone is powered by an emergency lighting circuit, a UL924 solution allows the luminaire and circuit design to be compliant with both the energy code and relevant life safety code.

The part numbers for XPoint Wireless UL924 power interruption detection controllers with relays are:

- **XPA RL1 DSI EM**
  Internally mounted wireless controller, integral to luminaire.

- **XPA SBOR# EM**
  Externally mounted wireless controller and sensor, attached to luminaire or junction box. "#" indicates occupancy sensor lens type.

- **XPA CMRB# EM**
  Externally mounted wireless controller and sensor, attached to luminaire or junction box. "#" indicates occupancy sensor lens type.

- **XPA RP20 D# EM**
  Externally mounted wireless controller, attached to luminaire or junction box. "#" indicates dimming option.

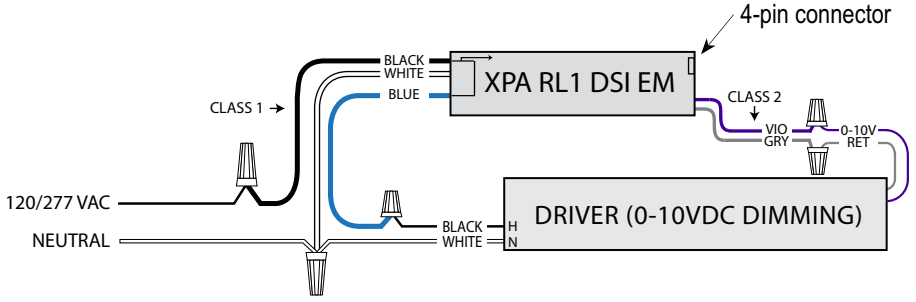

Figure 2 - Example EM Wiring Diagram: XPA RL1 DSI EM

EM Light Controllers without Relay

Applications where constantly powered luminaires are desired (applications in which the lights should never turn completely off) may consider using the XPoint Wireless controllers without relays. These are essentially dimming-only control devices with an internal shunt (in place of the relay) that passes uninterrupted line voltage directly to the LED drivers. While exact condition of the device cannot be guaranteed under all possible controller malfunction scenarios, this version of the controller is designed to open the dimming control signal (full light output) and pass uninterrupted line voltage to the LED driver under most typical controller malfunction scenarios (see Table 2 for additional details regarding controller malfunction scenarios). Non-relay models have a red wire that monitors the load current for power measurement purposes.

The part numbers for XPoint Wireless UL924 power interruption detection controllers without relays are:

- **XPA RL0 DSI EM**
  Internally mounted wireless controller, integral to luminaire, dimming only (no relay).

- **XPA SBON# EM**
  Externally mounted wireless controller and sensor, attached to luminaire or junction box, dimming only (no relay). "#" indicates occupancy sensor lens type.

- **XPA CMNB# EM**

  Externally mounted wireless controller and sensor, attached to luminaire or junction box, dimming only (no relay). "#" indicates occupancy sensor lens type.

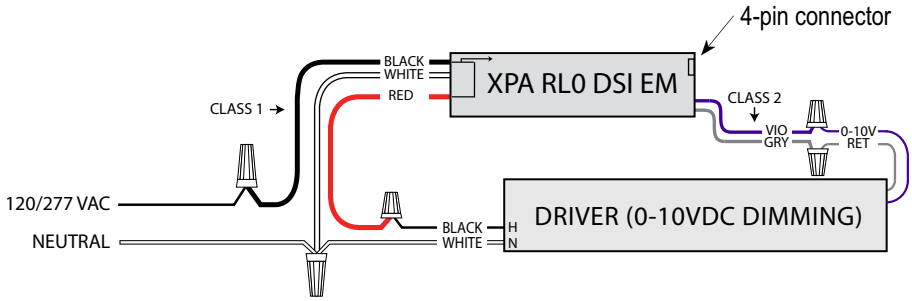

Figure 3 - Example EM Wiring Diagram: XPA RL0 DSI EM

Controller Model	*Relay Type*	*Typical Condition under Controller Hardware Malfunction*
RL1	Electrically held normally open (N.O.) relay	Relay Open (Lamp OFF); Dimming Circuit Open
CMRB, SBOR	Latching relay, no failure bias	Relay in Last State (Lamp can be ON if driver still functional, or OFF); Dimming Circuit Open (full light output, if relay is closed)
RL0, CMNB, SBON	There is no relay	Pass-through of line voltage (Lamp can be ON if driver still functional); Dimming Circuit Open (full light output)

Table 2 - Electrical Comparison of Relay vs. No-Relay Models

EM Testing Note

The EM light controller is typically tested by opening and then closing the emergency circuit breaker to simulate a transfer scenario. An optional test switch (by others) may be used; in this case a line voltage normally closed test switch, rated to carry the full load of the AC drivers in the luminaire, may be wired in series with the light controller unswitched hot input. Momentarily opening, then releasing the test switch, shall activate the controller Egress mode.

EM Egress Mode Sequence of Operations

The UL924 XPoint Wireless EM Light Controllers are designed to drive the controlled luminaires to full light output (relay closed, dimming output at maximum trim setting) for 90 minutes following AC power interruption. This operation is referred to as "Egress Mode," during which the control device ignores both manual and automatic dimming/occupancy/daylight control signals. Note that the sequence of operation described below applies following any interruption of AC input voltage greater than 30 ms, which may possibly include scenarios such as initial power-on, recovery to normal power conditions, and intermittent voltage conditions, in addition to a typical loss of power scenario.

The EM Egress Mode Sequence of Operations is as follows:

- Normal Condition:
  - o Controller can dim and turn off* the load as normal, in response to automatic and manual control.
- Emergency Condition:
  - o Utility power fails, and controller loses power.
  - o Backup power source activates, transfer switch moves the emergency circuit powering the controller onto the backup source, and controller regains power.
  - o The EM Controller detects voltage interruption > 30ms on its line voltage input wire.
  - o EM controller ignores all automatic and manual commands and controls the driver or ballast to its fully tuned light output for 90 minutes: the relay is closed and the 0-10V dimming signal is set at the maximum trim level (default 9.3 VDC, user programmable).
  - o EM controller resumes normally programmed manual and automatic control sequences after 90 minutes, regardless of whether normal utility power has been restored.
- Restoration of Normal Power:
  - o Utility power recovers, transfer switch moves the emergency circuit powering the controller onto the normal source.
  - o If the recovery transfer interruption is less than 30 ms then the 90-minute Egress Mode timer will continue from the time of initial backup power transfer.
  - o If the recovery transfer interruption is greater than 30 ms then the 90-minute Egress Mode timer shall restart.
  - o After the 90-minute Egress Mode timer expires the normally programmed control sequences shall continue.

** requires relay-equipped models (e.g., XPA RL1, XPA CMRB, XPA SBOR); Models without a relay can only dim the load to minimum (e.g., XPA RL0, XPA CMNB, XPA SBON)*

Emergency Driver with Standard XPoint Wireless Controller

Intended Applications

This application typically involves the following characteristics:

- The luminaire is fed by a normal power circuit unswitched hot line feed.
- When normal power fails, a battery-powered emergency driver is intended to supply DC power directly the light engine.

Wiring Instructions

Wiring instructions for this use case will vary with the specific model of battery driver but the following are general guidelines for how an emergency driver is typically connected. The installation instructions and wiring diagram supplied with the specific emergency driver being used should be followed.

- Controller line voltage input wire (black) should be connected in parallel with emergency driver or battery unswitched hot input wire.
- Controller switched relay output (blue) should be connected to line voltage input of standard AC LED driver(s) only.
- Controller 0-10V dimming wires (violet and gray) should be connected to 0-10V input of all LED drivers.

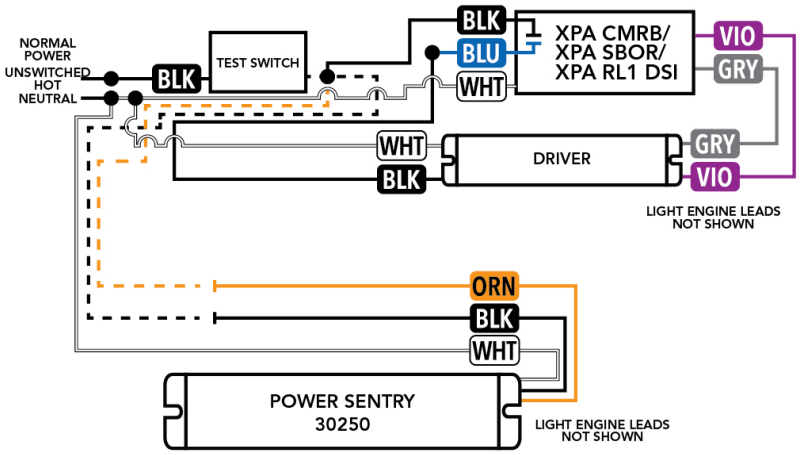

Figure 4: Example Wiring Diagram - Power Sentry PS30250 battery powered emergency driver with XPoint Wireless Controller

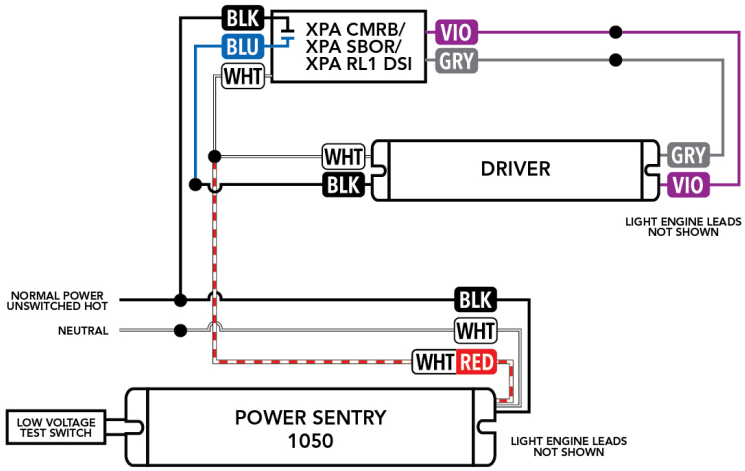

Figure 5: Example Wiring Diagram - Power Sentry PS1050 battery powered emergency driver with XPoint Wireless Controller

Testing Note

Follow the emergency driver manufacturer's instructions for installation and wiring of test switches. Some emergency drivers use low voltage test switches and others use line voltage test switches.

Where a line voltage normally closed test switch is supplied that is also intended (and rated) to carry the full load of the AC drivers in the luminaire, it is recommended to wire the unswitched hot connections of both controller and battery pack on the output side of this type of test switch, so that use of the switch has the following simultaneous effects: controller along with normal AC drivers are disabled, battery driver is enabled.

Sequence of Operations

- Normal Condition:
  - o Controller operates the standard AC LED driver(s) under normal power conditions and otherwise does not interfere with the unswitched hot connection to the emergency driver.
- Emergency Condition:
  - o Controller and standard AC LED drivers are de-energized by loss of normal power.
  - o Emergency driver detects the loss of normal power on the unswitched hot input, and provides power to the connected light engines to provide illumination.
- Restoration of Normal Power:
  - o Emergency driver detects the presence of line voltage on the normal power unswitched hot input, disables power to the connected light engines, and resumes charging.
  - o XPoint Wireless controller becomes re-energized and follows its normal default power-on sequence: relay is closed to switch on the AC driver(s) and dimming output is at maximum trim voltage (default 9.3VDC, user configurable) until further instructions are received by automatic or manual control measures.

Generator Transfer Device (GTD) with Standard XPoint Wireless Controller

Intended Applications

This application typically involves the following characteristics:

- The GTD is fed by both a normal power circuit and by an emergency power circuit.
  - o Confirm that the GTD being evaluated/installed is approved for use as a transfer device (and not a bypass device) featuring normal power switched hot & neutral inputs that are fully isolated from emergency power unswitched hot & neutral inputs.
  - o The normal power and emergency power circuits have both been sized to carry the load of this luminaire.

Note: if the normal power circuit has not been sized for this lighting load and is only intended to be used as a normal power unswitched hot sensing line, then a bypass relay should be used; see "Emergency Bypass Relay" section lower down for more details.

- GTD provides AC output power for emergency luminaire(s) or emergency driver(s).
- When normal power fails, the GTD transfers the emergency lighting load from the normal circuit (typically a controlled/switched hot and neutral pair) to the emergency circuit (unswitched hot and neutral pair).

Wiring Instructions

Wiring instructions for this use case will vary with the specific model of GTD but the following general guidelines for wiring a standard controller can be followed:

- Controller line voltage input wire (black) should be connected in parallel with GTD's normal power unswitched hot input wire.
  - o Do not connect standard model controller to emergency power unswitched hot when used with a transfer device. This is important to ensure that emergency AC drivers are not dimmed by the controller during loss of normal power.
- Controller switched relay output (blue) should be connected to switched hot line voltage input of GTD.
- Emergency AC driver(s) – to be powered during emergency power conditions – line voltage & neutral inputs should only be connected to line voltage & neutral driver output of GTD: there should be no direct line voltage connections between the XPoint Wireless controller and the emergency AC driver(s).
- Controller 0-10V dimming wires (violet and gray):
  - o If GTD does not provide 0-10V interrupt, controller 0-10V output should be connected to 0-10V input of all LED drivers.
  - o If the GTD unit offers a 0-10V interrupting capability, then controller 0-10V output may be wired to GTD.

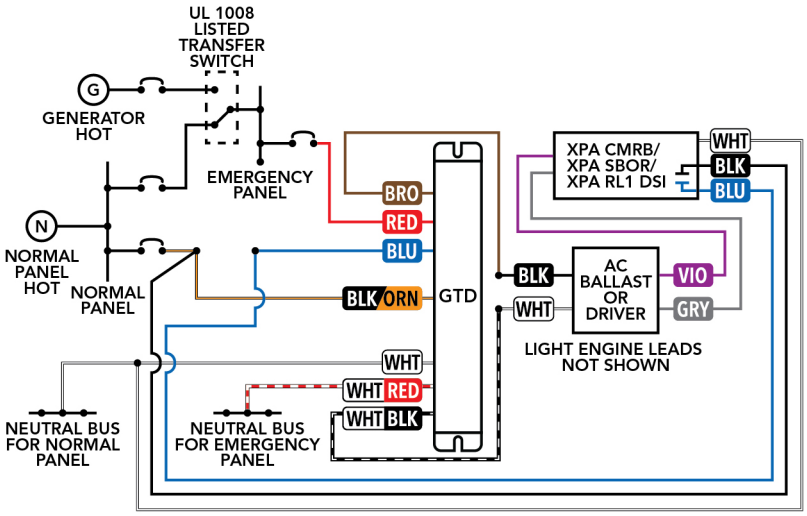

Figure 6: Example Wiring Diagram - GTD with XPoint Wireless Controller

Testing Note

The GTD may be tested by opening normal circuit breaker or through an optional test switch. Follow the GTD manufacturer's instructions for specification, installation and wiring of test switches.

Note that if the GTD's test switch mechanism does not de-power the XPoint Wireless controller or interrupt the controller's 0-10V output, it may be possible for the controller to maintain dimming control of the LED driver during a test. If this is the case, then opening of normal circuit breaker is the recommended testing procedure.

Sequence of Operations

- Normal Condition:
  - o Controller operates the standard AC LED driver(s) under normal power conditions and controller switched output does not impact on the status of the GTD.
- Emergency Condition:
  - o GTD detects loss of normal power unswitched hot and transfers emergency power unswitched hot and neutral directly to emergency AC drivers.
  - o Loss of normal power results in XPoint Wireless controller's dimming output opening (becomes uncontrolled).
  - o Emergency AC drivers operate at full uncontrolled output.
- Restoration of Normal Power:
  - o GTD detects presence of line voltage on normal power unswitched hot and transfers normal power switched hot and neutral to emergency AC drivers.
  - o XPoint Wireless controller becomes re-energized and follows its normal default power-on sequence: relay is closed to switch on the AC driver(s) and dimming output is at maximum trim voltage (default 9.3VDC, user configurable) until further instructions are received by automatic or manual control measures.

AC Micro-Inverter with Standard XPoint Wireless Controller

Intended Applications

This application typically involves the following characteristics:

- The AC inverter is fed by a normal power circuit unswitched hot line feed.
- When normal power fails, a battery pack and inverter are intended to supply unswitched AC power to the emergency AC drivers.

Wiring Instructions

Wiring instructions for this use case will vary with the specific model of AC inverter but the following general guidelines for wiring a standard controller can be followed:

- Controller line voltage input wire (black) should be connected in parallel with AC inverter's unswitched hot input wire.
- Controller switched relay output (blue) should be connected to switched hot line voltage input of AC inverter.
- Emergency AC driver(s) – to be powered during emergency power conditions – line voltage & neutral inputs should only be connected to line voltage & neutral driver output of AC inverter: there should be no direct line voltage connections between the XPoint Wireless controller and the emergency AC driver(s).
- Controller 0-10V dimming wires (violet and gray):
  - o If AC inverter does not provide 0-10V interrupt, controller 0-10V output should be connected to 0-10V input of all LED drivers.
  - o If the AC inverter offers a 0-10V interrupting capability, then controller 0-10V output may be wired to AC inverter.

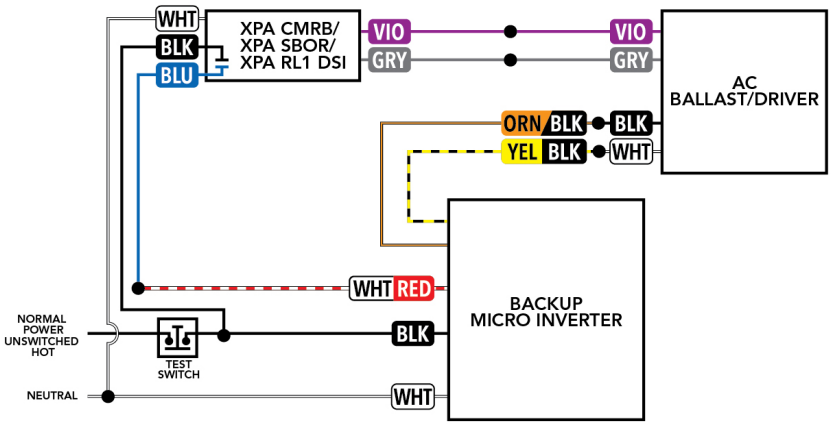

Figure 7: Example Wiring Diagram - Backup Micro Inverter with XPoint Wireless Controller

Testing Note

Follow the AC inverter manufacturer's instructions for installation and wiring of test switches. Some inverters use low voltage test switches and others use line voltage test switches.

Where a line voltage normally closed test switch is supplied, confirm whether the switch is rated to carry the full load of the AC drivers in the luminaire. If so, then it is recommended to wire the unswitched hot connections of both controller and battery pack on the output side of this type of test switch, so that use of the switch has the following simultaneous effects: controller along with normal AC drivers are disabled, battery driver is enabled.

Note that if the AC inverter's test switch mechanism does not de-power the XPoint Wireless controller or interrupt the controller's 0-10V output, it may be possible for the controller to maintain dimming control of the LED driver during a test. If this is the case, then opening of normal circuit breaker is the recommended testing procedure.

Sequence of Operation

- Normal Condition:
  - o Controller operates emergency AC LED driver(s) under normal power conditions and otherwise does not interfere with unswitched hot connection to AC inverter.
- Emergency Condition:
  - o AC inverter detects loss of normal power unswitched hot and provides unswitched AC power to emergency AC drivers.
  - o Loss of normal power results in XPoint Wireless controller's dimming output opening (becomes uncontrolled).
  - o Emergency AC drivers operate at full uncontrolled output.
- Restoration of Normal Power:
  - o AC inverter detects presence of line voltage on normal power unswitched hot and provides normal power switched hot and neutral to emergency AC drivers.
  - o XPoint Wireless controller becomes re-energized and follows its normal default power-on sequence: relay is closed to switch on the AC driver(s) and dimming output is at maximum trim voltage (default 9.3VDC, user configurable) until further instructions are received by automatic or manual control measures.

Emergency Bypass Relay with Standard XPoint Wireless Controller

Intended Applications

This application typically involves the following characteristics:

- The emergency bypass relay is fed by both a normal power circuit and by an emergency power circuit.
  - o The emergency power circuit is intended to carry the load of this luminaire.
  - o The normal power circuit is only intended to be used as a normal power unswitched hot sensing line.
- When normal power fails, the emergency bypass relay provides a path for AC voltage to reach the emergency AC drivers, regardless of whether the controller's relay is open or closed.
- Because XPoint Wireless controllers are typically used with 0-10V dimming, it is important to select an emergency bypass relay that can perform at least one of the following functions that will result in disabling/ opening of the dimming control:
  - o Normally open dry contact intended for use as 0-10V interrupt; This will break the positive leg of the 0-10V control signal (violet).
  - o Double-throw Form C contact (combination NO and NC line voltage bypass relay); This will simultaneously open unswitched emergency hot power input to control device while closing the emergency hot bypass to the lighting load, thereby disabling 0-10V dimming output.

Intended Applications

Wiring instructions for this use case will vary with the specific model of emergency bypass but the following general guidelines for wiring a standard controller can be followed:

- Controller line voltage input wire (black) should be connected as follows:
  - o Double-throw Form C contact available: connect controller line voltage input to emergency bypass relay Normally Open contact
  - o Single-throw Normally Closed contact: connect controller line voltage input to emergency power circuit unswitched hot (note that 0-10V interrupt must be used)
- Controller switched relay output (blue) should be connected in parallel to emergency bypass relay Normally Closed bypass relay contact and emergency AC drivers line voltage input wires.
- Controller 0-10V output (violet):
  - o If emergency bypass relay provides 0-10V interrupting capability, controller 0-10V output should be connected to normally open dry contact.
  - o If emergency bypass relay does not provide 0-10V interrupting capability, then controller 0-10V output may be wired directly to LED drivers (note that double-throw Form C contact must be used).

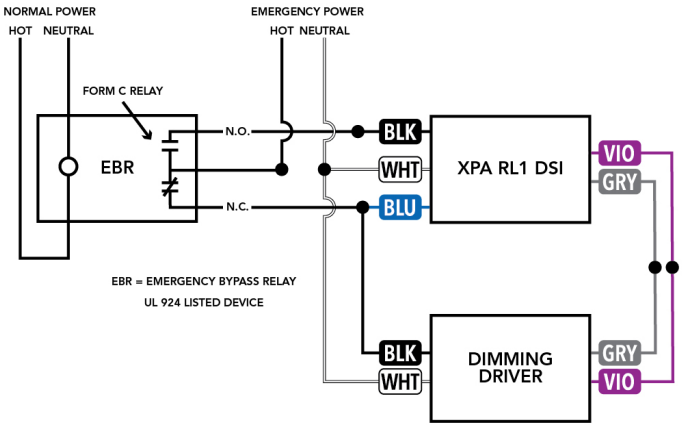

Figure 8: Example Wiring Diagram - Emergency Bypass Relay (Form C) with XPoint Wireless Controller

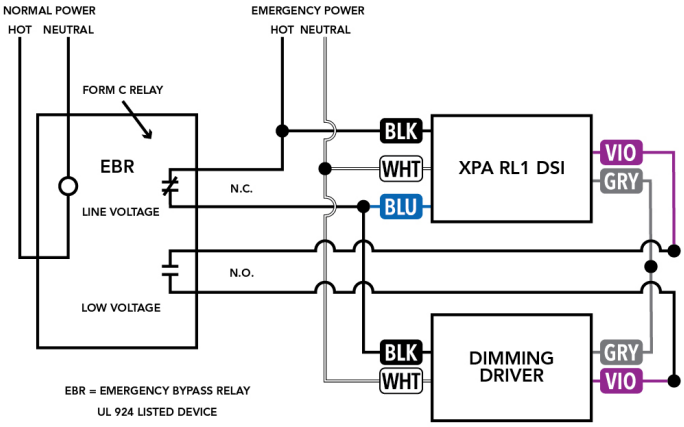

Figure 9: Example Wiring Diagram - Emergency Bypass Relay (0-10V Interrupt) with XPoint Wireless Controller

Testing Note

Follow the emergency bypass relay manufacturer's instructions for installation and wiring of test switches. Some emergency bypass relays use low voltage test switches and others use line voltage test switches. A typical line voltage test switch would consist of a normally-closed switch wired in series with the normal power unswitched hot connection to the bypass relay; opening the test switch would trigger the bypass relay to momentarily override the light controller.

Sequence of Operations

- Normal Power Conditions:
  - o Controller operates all standard and emergency AC LED driver(s) together under normal power conditions and controller switched output does not impact on the status of the Emergency Bypass Relay.
- Emergency Power Conditions
  - o Loss of power, or use of test switch, completely disables both the controller and standard AC drivers.
  - o Emergency Bypass Relay detects loss of normal power unswitched hot, or use of test switch, and provides emergency AC power to emergency AC drivers.
  - o Emergency AC drivers are at full uncontrolled output because XPoint Wireless Controller dimming wires are open (either due to de-powering of XPoint Controller by Form C contact, or due to interruption of dimming wire by N.O. relay).

