Indigo-Clean®

Dual-Mode ICT Controls Application Guide



KENALL®

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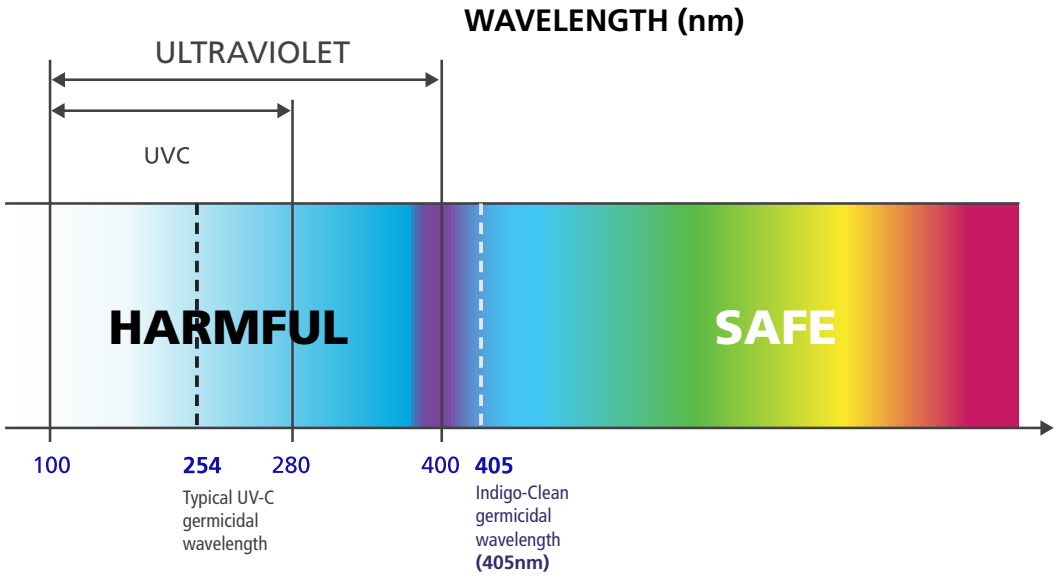
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1.0 Introduction

Indigo-Clean, a continuous disinfection technology, is patented and proven to kill harmful bacteria linked to healthcare acquired infections (HAIs). Using a combination of 405nm Indigo and White LEDs, Indigo-Clean emits narrow spectrum light that kills bacteria while providing ambient illumination for the space.

Unlike UV light, Indigo-Clean uses safe, visible light to automatically and continuously kill harmful bacteria in the air, and on hard and soft surfaces.

Visible light spectrum showing the active element in Indigo-Clean®



Indigo Clean products contain NO UV and are safe for room occupants.

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2.0 About Indigo-Clean Technology

Indigo-Clean Dual Mode ICT is a Continuous Environmental Disinfection System that employs both blended—white + 405nm Indigo—light, and full 405nm Indigo light via a lighting control system to disinfect the space. This dual-mode system delivers blended white light when the room is occupied, and full 405nm Indigo light when it is not.

The Dual-Mode ICT product is best suited for applications in which disinfection is critical. The luminaires installed into the application are expected to be operating in white disinfection mode during occupied conditions and provide a higher level of disinfection during unoccupied conditions. A low-voltage signal input from a room controller or occupancy sensor is required to trigger the operating module, but otherwise the electrical inputs are identical to a typical LED luminaire. This application guide is intended to assist in the specification of these components to ensure a successful implementation of this technology.

Common use locations include:

— Non Acute Care Areas of Healthcare Facilities

— Educational Facilities

— Office Spaces

— Parks & Rec/ Municipal Facilities

— Retail Spaces

Indigo-Clean Single Mode ICT, while not covered under the scope of this document, is a Continuous Environmental Disinfection System that employs blended white + 405nm visible light, exclusively, to disinfect the space. When the light is on, disinfection is active.

Single-Mode ICT is best suited for applications with a high-rate of occupancy, meaning that the luminaires installed into the application are expected to be operating in white disinfection mode over a 24-hour period. The electrical inputs of these products are identical to a typical LED luminaire in that only it requires an AC source and optionally, connection to a 0-10V DC dimmer. No additional inputs are necessary.

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3.0 Basic Operation Principles

Kenall's Indigo-Clean Dual-Mode ICT system disinfects the space using the following three basic steps:

1) Mount sensors to provide full occupancy detection coverage in the space and at egress points
2) Run sensor wires/CAT5 to the lighting control module(s)
3) Run 0-10 dimming signal wires to the luminaires, controllers, and wall dimmers

System components briefly described below:

Sensor
Delivers occupancy detection signal to room controller



Room Controller
Receives occupancy and dimming input from sensors and changes light modes and dim levels accordingly



Luminaire
Operating state changes based upon signal received from room controller



Description of General Operation

1. A person exits the space
2. After a set occupancy timeout period, the Indigo-Clean Dual-Mode ICT luminaires switch from White Disinfection Mode to Indigo Disinfection Mode.
3. A person enters the space
4. The system detects occupancy
5. Immediately, the Indigo-Clean Dual-Mode ICT luminaires switch from Indigo Disinfection Mode to White Disinfection Mode

A control system design that incorporates a timeclock system, either as a standalone control method or in conjunction with occupancy sensors, is another acceptable strategy. In this scenario, the programming of the timeclock should be set to ensure the maximum amount of Indigo Mode operation for the highest level of germicidal effectivity. 12 hours of White Mode operation and 12 hours of Indigo Mode operation (per day) should be the design target for a timeclock-based system.

Note: In the event of damage to the Occupancy wiring or power loss to the control device, the fixture will fail in white mode.

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4.0 System Components

4.1 Sensor

The occupancy sensor detects motion in the space, which causes the Indigo-Clean Dual-Mode ICT luminaire to switch between White and Indigo Disinfection Mode.

When occupancy is detected by the sensor, a 10-24V DC signal is sent to the room controller, indicating that someone has entered the space. When the occupants leave the space, there is a timeout period before the sensor switches to an unoccupied state, which switches the output occupancy signal voltage from 10-24V DC down to 0V DC.

Each sensor has a configurable timeout period that allows the user to adjust how long the lights in the space remain in White Disinfection Mode before switching to Indigo disinfection mode.

4.1.1 General Sensor Positioning Recommendations

The following are general recommendations that would apply to all layouts:

- Sensors should be positioned to provide occupancy coverage of the entire space
- Optionally, sensors may be placed at entry/egress points into the space

4.2 Room Controller

The room controller is the centralized control hub for the Indigo-Clean Dual-Mode ICT system. It contains all of the control logic for interpreting the occupancy and dim level information received from the occupancy sensors and 0-10V wall dimmers.

When a 10-24V DC signal is received (indicating occupancy) the room controller switches the mode of the luminaire by setting the luminaire control voltage to 0V DC. When the room controller sees an unoccupied 0V DC signal, the room controller sets the luminaire control voltage to 10-24V DC.

Note: This is different from other control systems. The occupancy logic is reversed. Please see Section 4.4 for further details.

4.3 Luminaire

Each Indigo-Clean Dual-Mode ICT luminaire has the capability to output either blended white light or 405nm Indigo light, depending on the space's occupancy status.

Inside each luminaire there is a switching module that receives two different signals from the room controller. A 0-24V DC input signal determines whether the fixture is occupied or not, while the 0-10V DC DIM input signal determines the dim level of the fixture.

Dimming capability is only available while in blended white mode. The fixture will not dim when in Indigo Disinfection Mode, so that maximum disinfection of the space can occur.

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4.4 Luminaire Input Requirements

Table 1 describes the electrical input requirements for both the 0-10V dimming input, which is an optional connection, and the Occupancy input, which is a requirement for Dual-Mode functionality.

Electrically, the dimming function is nearly identical to a typical LED luminaire with 0-10V dimming capability, meaning that a typical current sink-type dimmer would be required for this function. Please refer to the individual luminaire data sheets for details on the dimming range. Where the dimming functionality differs is that while in Indigo Mode, the existing dimming level is ignored, thus bringing the luminaire to 100% output.

The Occupancy control input determines the operational state of the luminaire - White Mode or Indigo Mode. Unlike the dimming input, the connected control device must *supply* electrical current to the luminaire. This, along with the required voltage state of the Occupancy Input, requires care in the selection, layout and programming of the control devices as these requirements may differ from typical practices.

Table 1: Control Input/Output Description

Control Input	Input Electrical^	Output Response
Dimming (White Mode Only)	0-10V DC, 0.495mA max. (Source)	0V DC = Max. Dimming (0% output)
		10V DC = No Dimming (100% output)
Occupancy	0-24V DC, 3.0mA max. (Sink)	0V DC = White Mode (Occupancy)
		10-24V DC = Indigo Mode (No Occupancy)

^See Table 2 for further detail

The electrical requirements of each respective control device are dependent on the quantity of luminaires and the Lamp Power of each luminaire. Please refer to Table 2 as a guide for the layout and specification of the control devices within a room. Be careful to not exceed the specified ratings of the devices within each respective control circuit.

Table 2: Control Input Current Requirements, per Luminaire

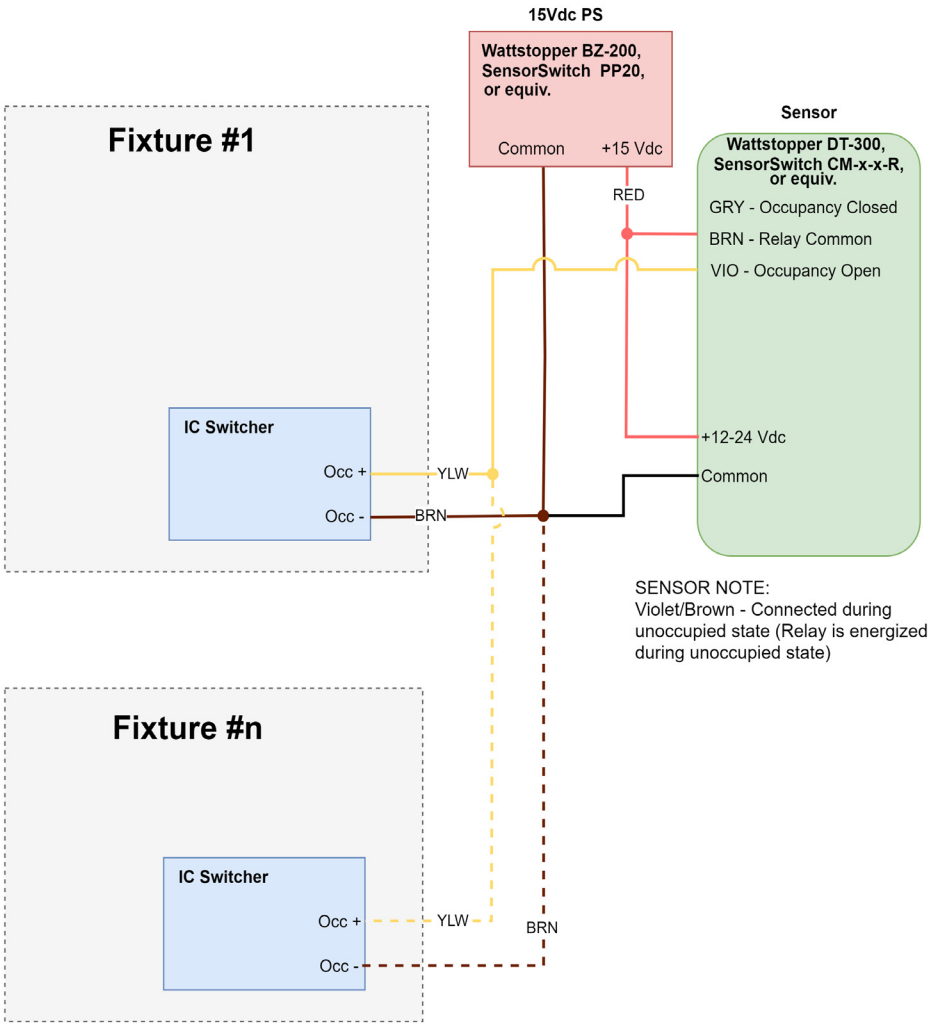
Luminaire Lamp Code	Max. Dimming Source Current from Luminaire (mA)	Min. Occupancy Input Current from External Controller (mA)
23I/55C	0.165	1.0
34I/82C	0.330	2.0
46I/110C	0.330	2.0
68I/165C	0.495	3.0

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5.0 Room Level Control Examples

Indigo-Clean Dual-Mode ICT luminaires can be controlled with low-voltage signal inputs from various control system providers. The default operating mode (without an Occupancy connection) is White Disinfection Mode. The following section is intended to provide examples of possible

5.1 Room Level Control - Single Sensor Example



Sequence of Operation: Occupancy

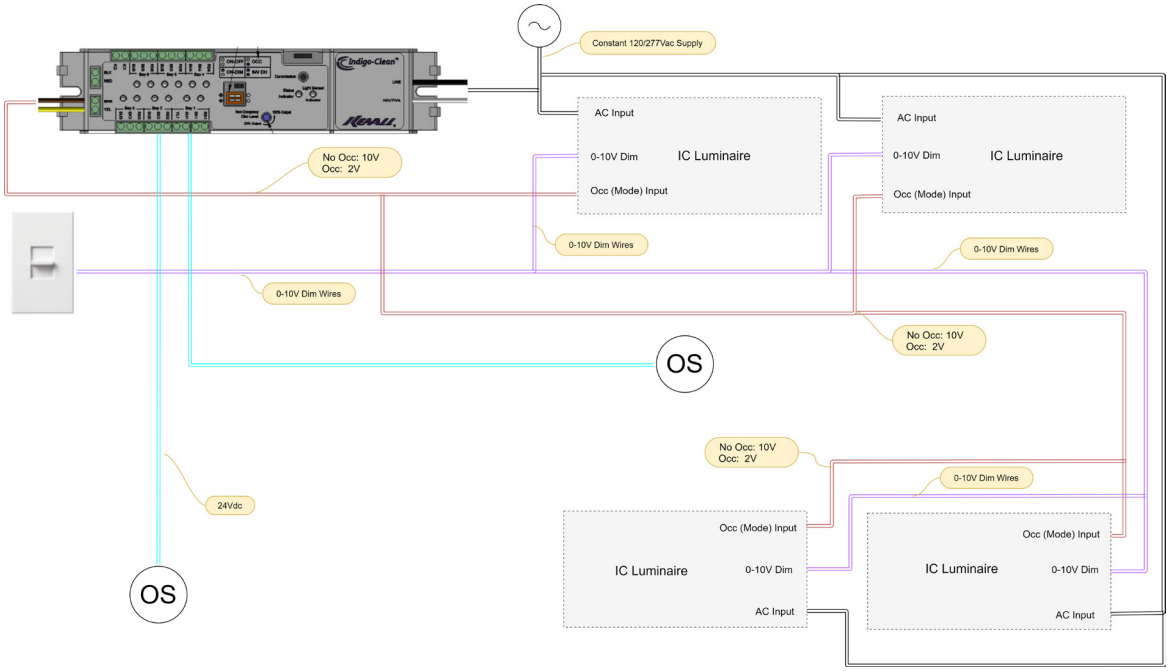
1) Sensor detects occupancy
2) Sensor relay opens
3) ICT Switcher module Occupancy Input is de-energized
4) Light fixture goes into White Disinfection mode

Sequence of Operation: No Occupancy

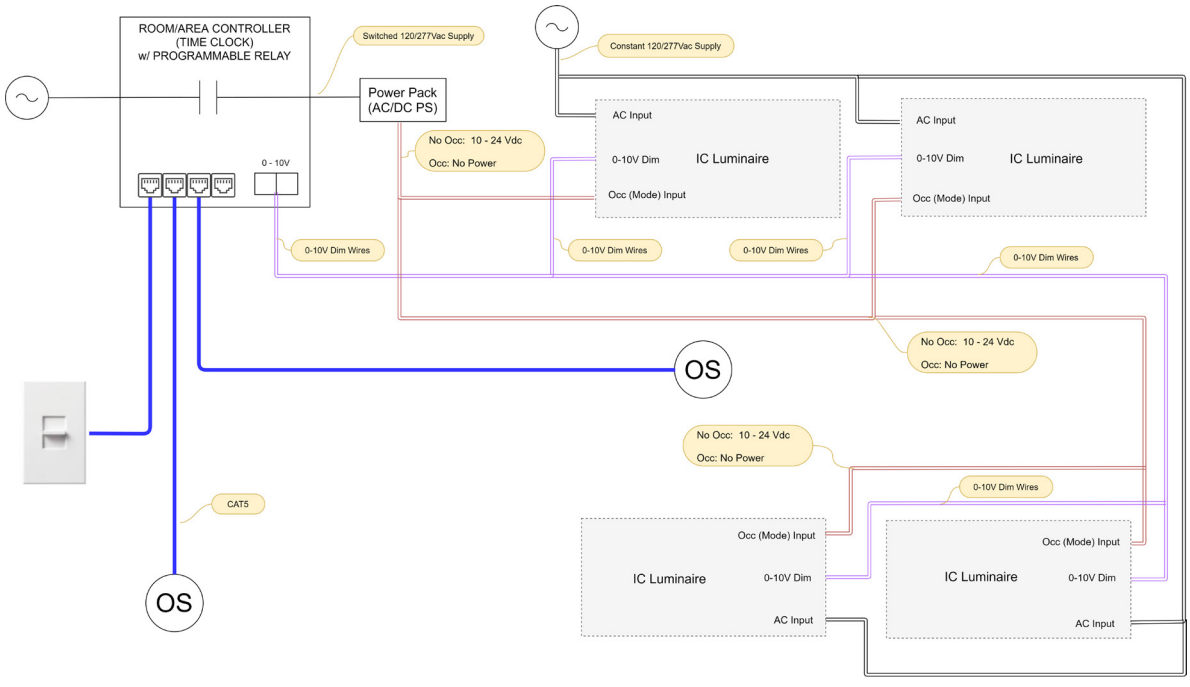
1) Sensor time-out period expires (no occupancy detected)
2) Sensor relay closes
3) ICT Switcher module Occupancy Input is energized (15Vdc)
4) Light fixture goes into Indigo Disinfection mode

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5.2 Room Level Control - IC150 Example



5.3 Room Level Control - 3rd Party Example



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