CONTROLLING LED LIGHTING

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Learning Objectives

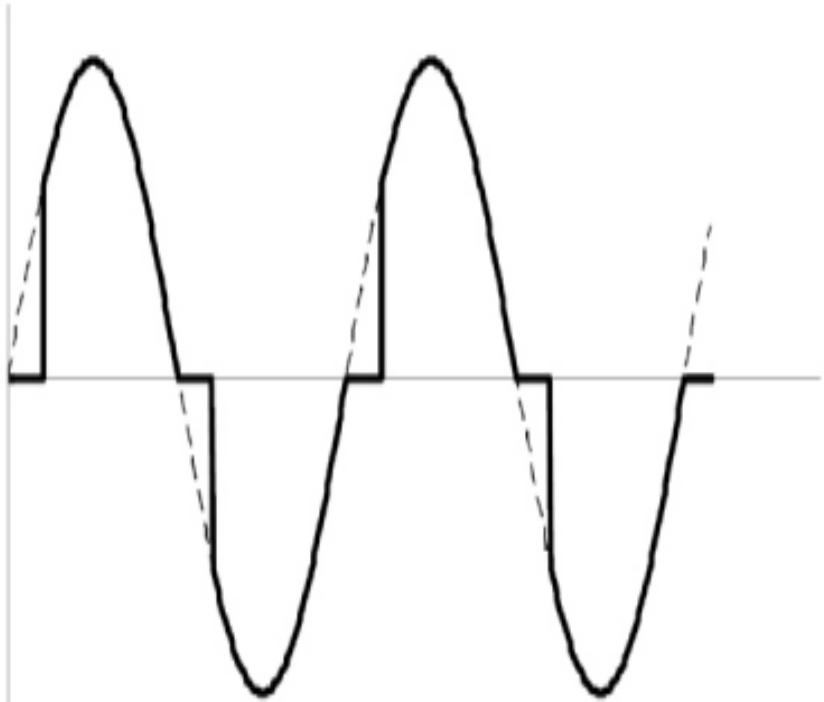
At the end of this program, participants will be able to:

- Understand the difference between intensity controlled and dimmed lighting fixtures
- Understand the differences in control protocols used in lighting controls
- Recognize some of the hurdles and pitfalls faced when choosing a lighting control system
- Identify where lighting controls can be used and how to begin conversations about application

Dimming

- Line Voltage
  - Reduction of voltage or current to control intensity also known as phase control
  - Intensity change is controlled at the dimmer/electrical source
    - Choke dimmer with Silicon Controller Rectifier (SCR)
      - Forward phase
      - Magnetic Low-voltage
      - May effect ballasts and transformers in negative ways

Dimming



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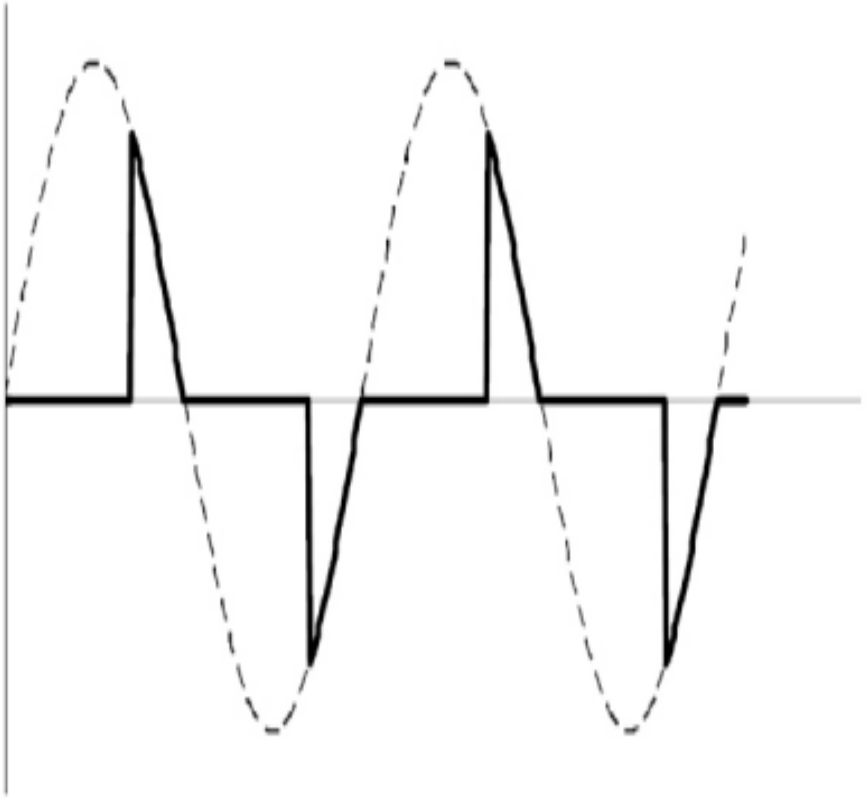

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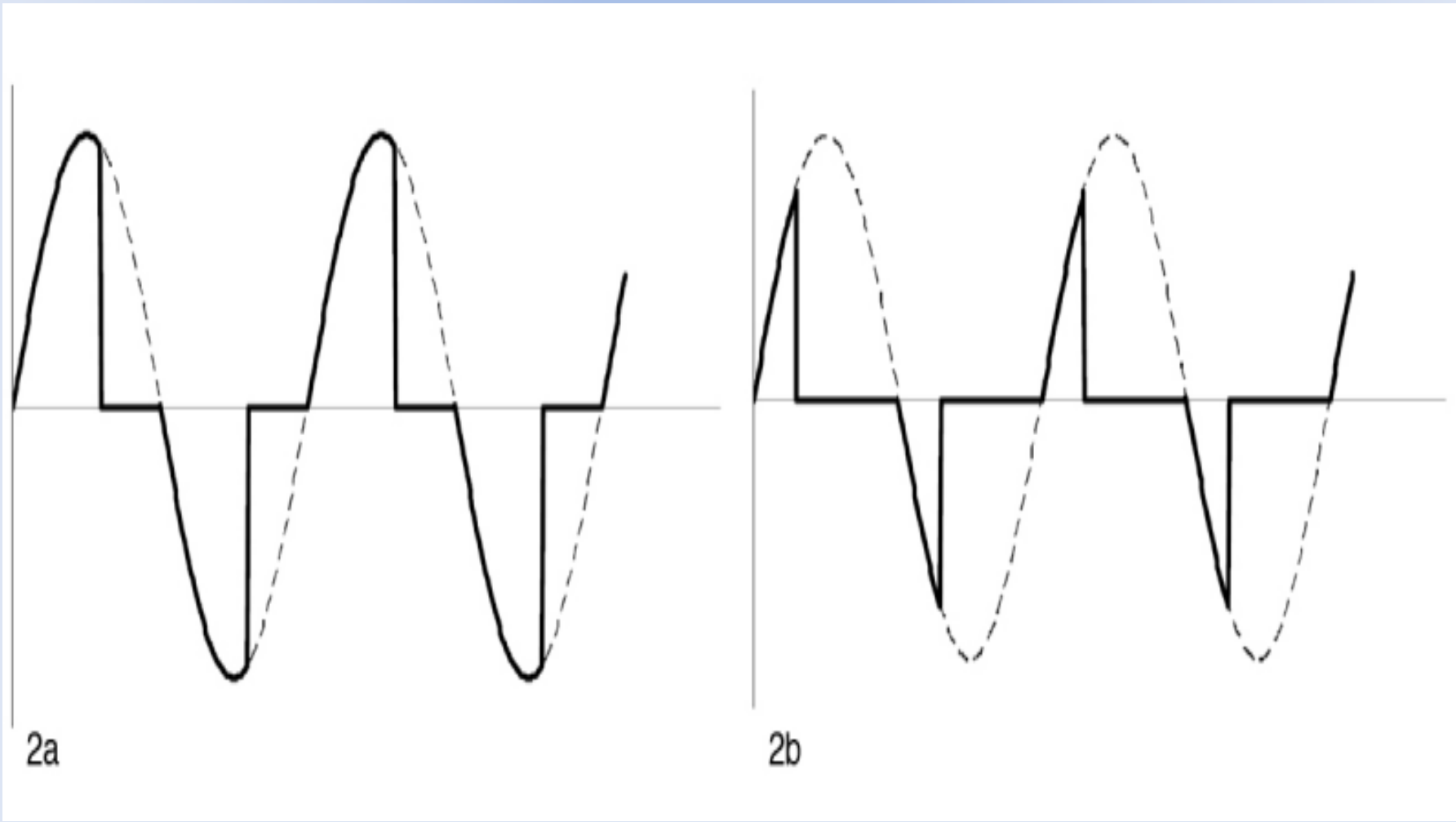
    - Insulated Gate Bi-polar Transistor (IGBT) Dimmer
      - Typically less noise from dimmer and fixture being controlled
      - Reverse phase or Electronic low-voltage
      - When used as a switch it is less likely to effect ballasts and transformers
      - More electronics equals higher failure rate and more expensive

Dimming



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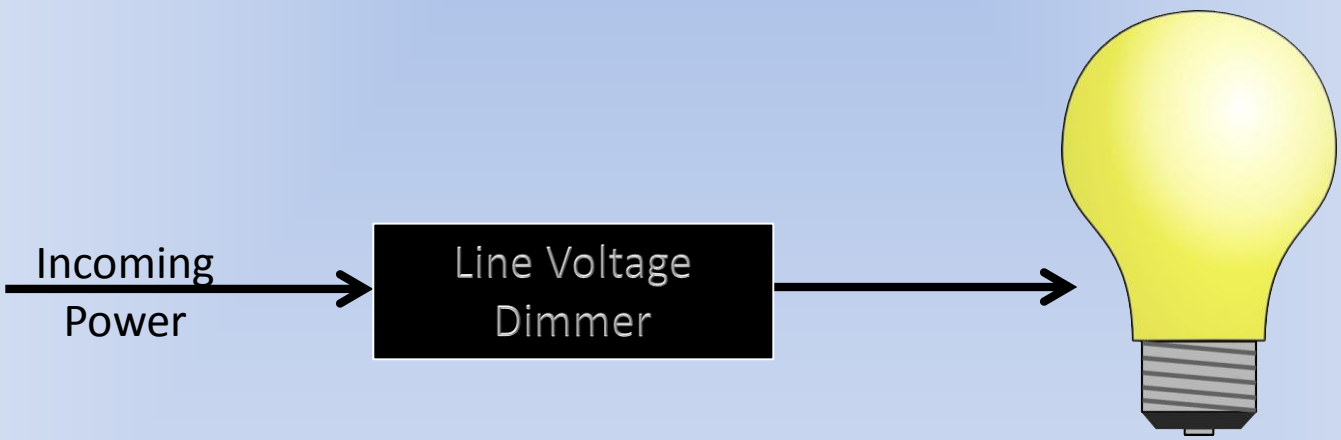
    - Sine Wave
      - $$$$$$$$$$

Dimming

(in line or wall box dimmer)



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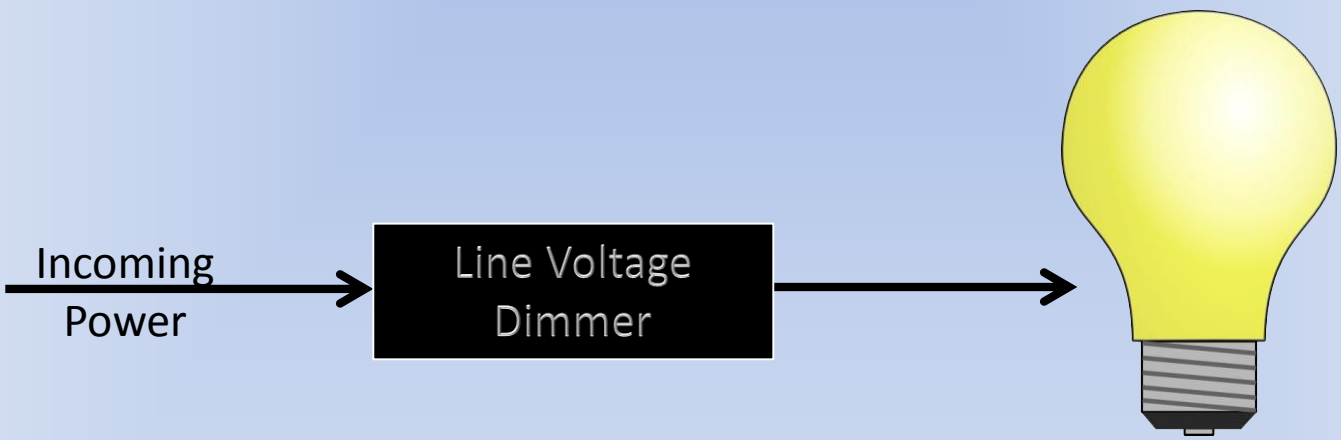
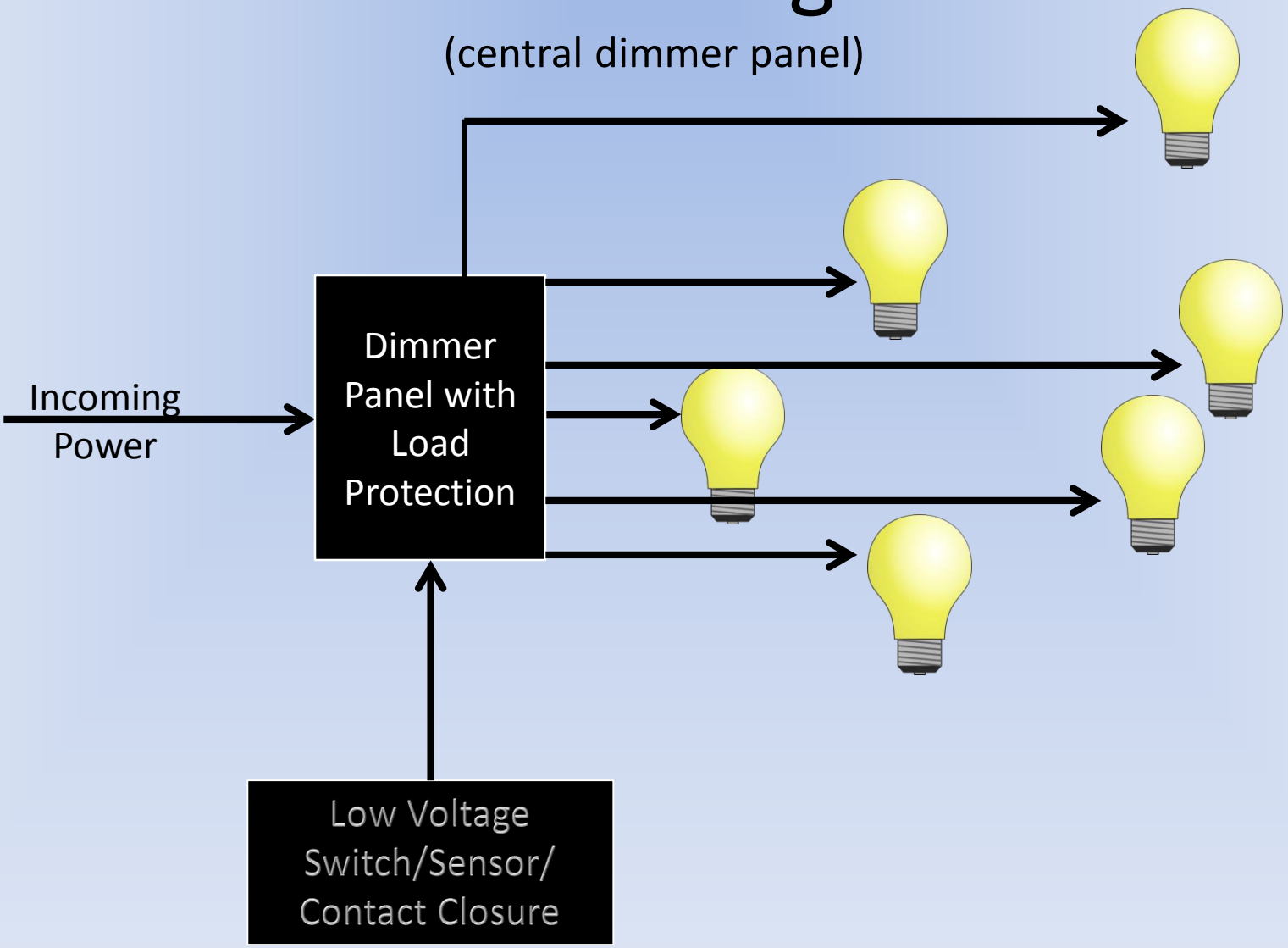


Dimming

(central dimmer panel)

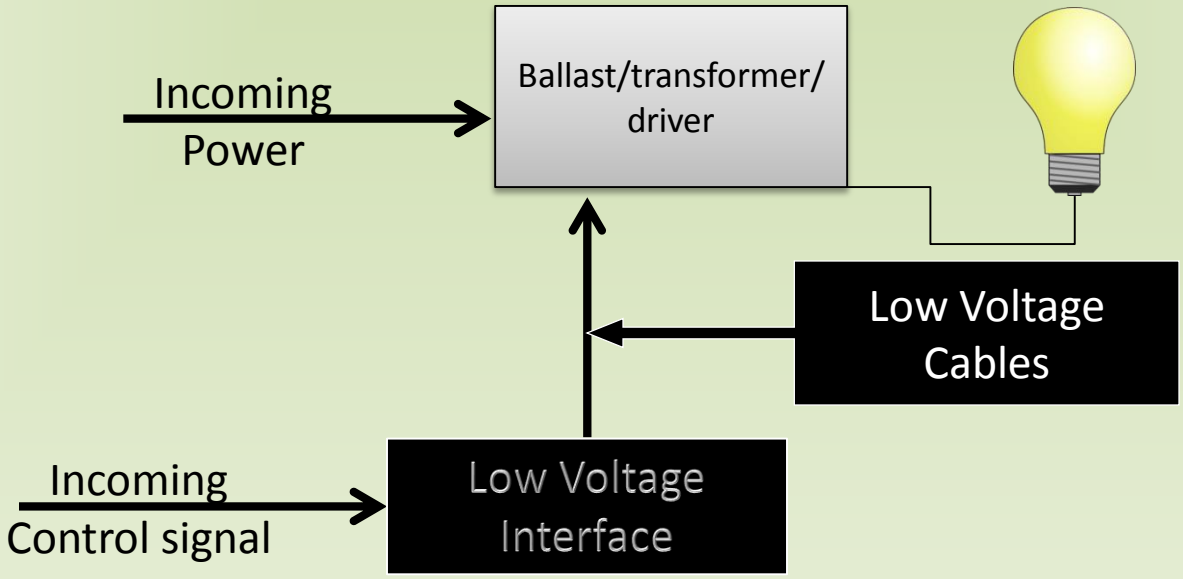


Intensity Control

- Low voltage control signal used to communicate with ballast, transformer, or fixture to control intensity
  - Fixtures are fed with constant power.
  - The intensity change is handled at the fixture via ballast, transformer, driver, or other internal electronics.
  - Things to be aware of:
    - Fixtures do not always fade at the same rate or levels even if they are from the same manufacturer.
    - Communication Language
      - 0-10 volt
        - » Sink
        - » Source
      - Digital Multiplex (DMX)
      - Digital Addressable Lighting Interface (DALI)
      - Proprietary

Intensity Control

(Low voltage dimming)



Intensity Control: Concerns

Ballasts and Drivers still draw power even if the intensity is at 0!

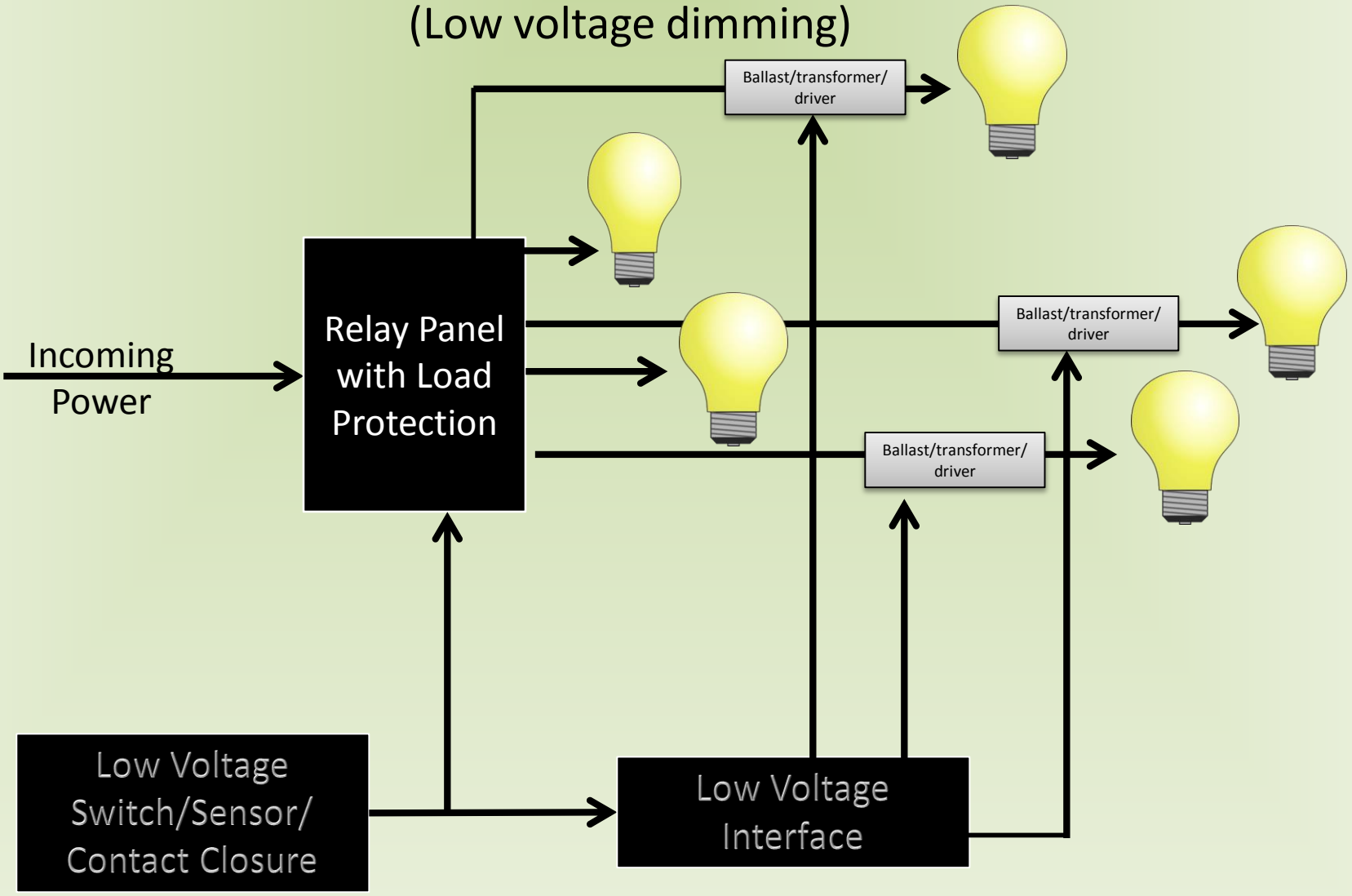
Some fixtures do not turn off when the control signal is at 0.

Unlike line voltage dimming, there is a risk of surge/spike damaging the ballasts and drivers even when there is no light output because power is still going to the fixture!

It is recommended to power your fixtures thru a relay so power can be shut off when the fixtures are not needed and to insure there is no light output when it is not desired.

Intensity Control

(Low voltage dimming)



Inrush Current

- What is “inrush current”?
  - The maximum current drawn by an electrical device when it is first turned on
- Transformers and ballasts may draw as high as 50 times their rating for a first few cycles when initially turned on
- LED fixtures with a 40w rating may have as high as an **8 amp** inrush rating!!!

Inrush Current

- What does this mean for you?
  - Although you may be using a lamp or fixture with less than 1 amp draw, you need to plan your circuits for the maximum in rush current.
  - Think about using a control system with a fixed fade rate to control the inrush.
    - Slowing the initial fade up by as little as 2 seconds will greatly reduce the inrush
    - Remember to use the fade rate on any intensity changes both up and down

Inrush Current

- Example:
  - A 600w wall mounted dimmer is to be used to control LED recessed cans which are dimmable (do you remember the difference?)
  - How many 18w LED fixtures can be put on the 600w dimmer?
    - » 33
    - » 6
    - » 27
    - » As many as needed to make it work

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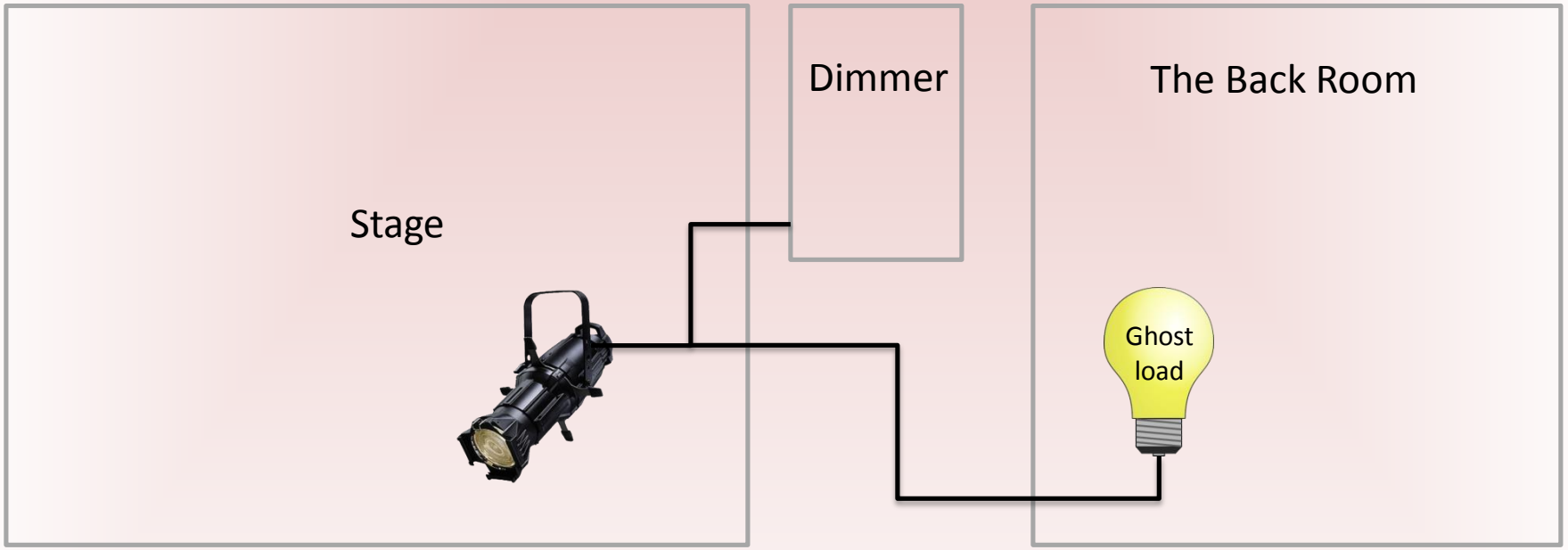
The fixture used in the example has a **100w** inrush!

Minimum Load

- The lowest current draw which will close the contact on a relay, power pack, or dimmer and allow current to pass thru
- Most of the lighting control equipment in today's market was designed around the incandescent lamp and maximizing the load potential
- Most manufacturers list maximum load but not minimums
- You may need to add resistance into the circuit to get the controller to work correctly

Minimum Load

Here is an old Theatre trick which added resistance to the circuit in order to eliminate “ghosting” or bleed on incandescent fixtures:



In today’s world, you would put a resistor on the circuit to accomplish the same thing. The point is to increase the total resistance/load enough to have the control system operate correctly


Confused Yet?

Control Language

- Control Languages
- Analog (0-10vDC is most common but others exist)
  - Sink (+10vDC is provided by the ballast/driver)
  - Source (+10vDC is provided by the controller)
  - Multi-conductor cable requiring 1 common plus 1 conductor for each control channel
- Digital
  - Digital Multiplex (AKA:DMX)
    - 8 bit resolution providing 256 steps but can do 16 bit if 2 channels are used
    - 512 channels of control per cable/output
    - One cable with 1 twisted and shielded pair (Belden 9729 or equivalent)
  - E1.31 Streaming CAN (sACN)
    - TCP/IP protocols
    - 20,000 channels of control (or more) per cable/output
    - Uses standard CAT5e or CAT6 cable
  - Ethernet Digital Multiplex (EDMX)
    - See Above
  - Digital Addressable Lighting Interface (DALI)
    - Broadcast: everything on one loop/channel is controlled together
    - Multicast: individual control over each address on each loop/channel
    - 64 channels of control per cable/output
    - One pair (2 conductors) cable which can be run in with line voltage conductors

Analog

Goods:

- Time tested technology
- Simple wiring
- Can run many fixtures on one loop/channel
- Low voltage DC wiring
- Lots of compatible controllers and equipment

Bads:

- Lots of wires for multiple control zones
- Are we providing the volts or do we have to sink it?
- If we are sinking the current, how much current is being sourced? And is the control system rated for that much current?
- Low resolution (roughly 10 steps of dimming)

Digital Multi-plex (DMX)

Goods:

- One Cable with a good amount of control channels (512 channels)
- Has been standardized since the mid 80's
- Robust Language
- Lots of compatible controllers and equipment
- Uses shielded cable so less likely to have interference
- Offers Bi-directional communication via RDM support

Bads:

- Cable path MUST daisy chain or go through a splitter
- Must use shielded cable to maintain good signal quality which makes terminations longer to do
- 8 bit resolution standard
- Most Electrical Contractors are unfamiliar with it

Streaming ACN/EDMX

Goods:

- One cable with tons of control channels
- Is being standardized (version 1 has been ratified)
- Robust language (up to 256 bit dimming)
- Simple wire topology (standard network rules which most Electrical Contractors are familiar with)
- Standard wire type of CAT5e (easy to locate)
- Standard switch gear
- Lots of compatible controllers and equipment

Bads:

- Cables MUST home run to network switch gear with 100m length limits
- Cable is fragile
- Not all equipment is compatible

DALI

Goods:

- Can operate as broadcast or multicast
- Has been standardized since 2002
- Allows 8 bit dimming (256 steps)
- Simple wire topology. Uses no specific cable and is polarity free. Cable can be run in the same conduit as line voltage
- Provides bi-directional communication
- Many of compatible controllers and equipment

Bads:

- Ballasts and components are not typically shelf items for the US market
- Most contractors know it exists but have little to no experience with it
- Maintenance is not as simple as swapping out a bad device. Each device must be addressed and replacements must be given the same address as the original. Addressing is typically done from the management software
- 64 channels per loop is small for todays systems.

No, they don't all play together!

But which do I use?

- Analog (0-10 volt)
  - Small Systems
  - Common in Fluorescents (Mark VII Ballasts)
  - Common in LED transformers/drivers
- Digital Multiplex (AKA: DMX)
  - Medium Systems
  - Mainly in color changing LED systems but becoming more popular in all LED fixtures
  - Being used by many LED manufacturers
- DALI
  - Medium and large systems
  - Good for open office areas where reconfiguring the lighting may be necessary after installation
- Streaming ACN (sACN)/EDMX
  - Large Systems
  - Newer Theatrical and Entertainment settings
  - Large LED displays

LEDs and Emergency Lighting

Just because to your LED Lighting has power doesn't mean it is outputting light!

- What if your fixture only outputs via a low voltage control signal?
  - Just because you apply power doesn't mean the fixture will turn on. Most LED fixtures to date do NOT have a contact for detecting emergency power verse normal power.

SOLUTION:

- There are a few manufacturers that have Emergency Power Detection AND provide a control signal which will drive the lights to full when activated!

Questions you should be asking:

- LED Fixtures:
  - What are the options for intensity control?
  - What is the range of the dimming/intensity control?
  - What is the in-rush current?
  - If the fixtures are multi-color: How many colors? (this will determine how many control channels are required and the control protocol)
  - Are there any hidden control attributes or special function channels?
  - Will the fixture turn on when emergency power is active?
- LED Lamps or Bulbs (replacement lamps):
  - Can they be used on the existing control/dimming system?
  - What is the in-rush current?
  - What is the range of the dimming?
  - Is there an internal transformer/driver which may be damaged by heat or “bad power”?

Questions ?

Just remember the right control system may just be…….