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The elements of a lighting system, simple to sophisticated

As an introduction for those new to lighting systems, or as a refresher for the more experienced, **John Black** offers this guide to lighting fundamentals.

ALL LIGHTING SYSTEMS, WHETHER YOU WORK in a small house of worship with just a few fixtures or in a large venue with concert-grade lighting, share many of the same elements. And though the difference primarily lies in the scale of the solution, all lighting systems share the same purpose – to illuminate, provide focus, and affect the mood or atmosphere.

As a lighting technician or volunteer, understanding the individual elements of the lighting system and how they work together is highly beneficial in being able to effectively set up, operate and troubleshoot the system. In this article, we'll explore the parts that make up a lighting system and how they work together to allow you to create the visual magic on stage.

The basics

In its simplest form, a lighting system will consist of some lanterns, a controller, a dimmer rack, and cabling to connect these components together. Well, actually it could be simpler. You could just connect lanterns to a wall outlet and point it towards the area you want lit, but then you would lose the ability to control the intensity of the fixture. So for our simple system, we are going to include a controller and power pack as is present in the simplest theatrical lighting package.

In our basic system, all of the lanterns would be conventional units (non-automated, non-LED) and utilise incandescent lamps, such as an ETC Source 4 Ellipsoidal, an Altman 65Q Fresnel, or a ProCan Par Can unit. Another distinction of these fixtures is that they are single-parameter units – they only have one parameter controllable by the lighting controller, which is the lamp intensity. These lanterns all offer different means of affecting the projected beam – such as shutters, patterns, or colour filters – but are otherwise similar in that they utilise a dimmable lamp. These fixtures are the main workhorses of many facilities and are used to achieve most every lighting goal.

As with any light source, power is needed. In a theatrical lighting system, a central power source called a dimmer rack is employed. As opposed to simply plugging a lantern into a wall outlet with control from a basic on/off switch, a dimmer affects the voltage being sent to the lanterns, enabling the intensity (or brightness) to be adjusted. The dimmer rack itself may house a large number of individual dimmers – all with the ability to be individually controlled. For example, the ETC Sensor dimmer rack can be configured according to the number of dimmers needed in your facility. Each dimmer is hardwired to a connector circuit somewhere in your facility where a lantern is able to be plugged in.

Finally, there needs to be a way to communicate with the dimmers how much voltage to send out to each circuit. This controller is the lighting console, a computer that communicates with the lighting system and is the 'messenger' between the lighting technician and the lanterns. Consoles come in many shapes and sizes and the user interface and operational methods vary between brands and models. As such, personal preference and comfort with the way a particular console operates typically factors in heavily when considering a console purchase.

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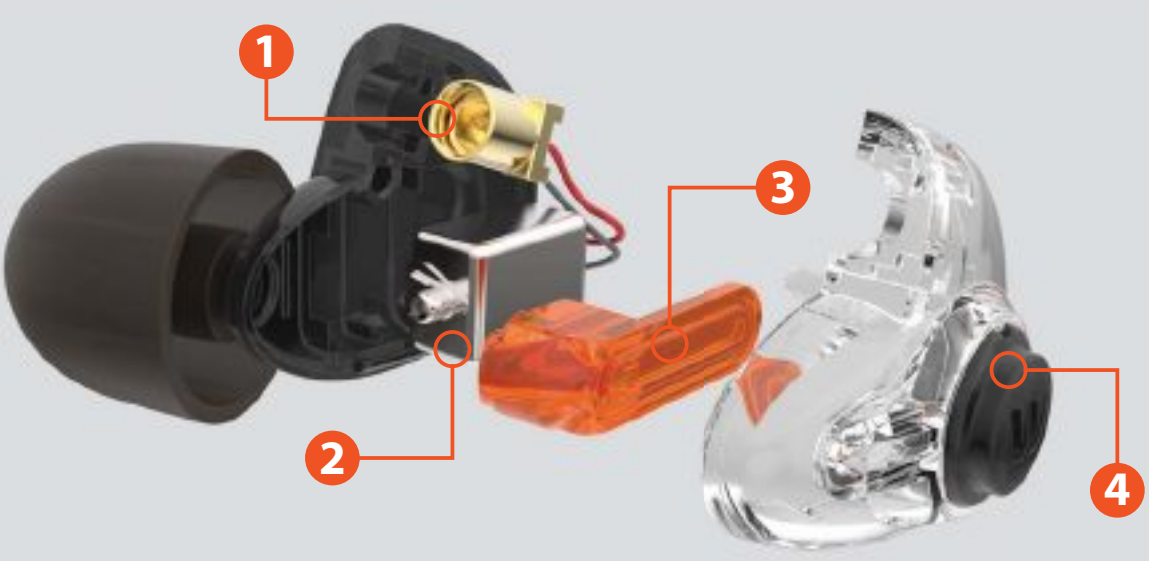

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Expanding the system

The system just described details in brief the basic elements of a theatrical lighting system. As systems expanded due to increasing lighting rig sizes, as well as technological advancements and new products, there are additional system elements that have come into common use – both as additions to basic systems or as retrofits to existing system infrastructure.

One of the most obvious additions seen in almost every lighting rig now are the addition of multi-parameter lanterns. These units, whether using a discharge lamp or LED lamp source, have many mechanical parts that are controllable from the lighting console, such as' pan, tilt, iris, pattern wheels, colour wheels, and more. Whereas a conventional lantern is a single parameter unit, many automated lanterns operate in excess of 20 controllable parameters per lantern! Not only are they useful in producing effects and movement of the light beam, but they can allow you to achieve a number of lighting looks from a single unit that would otherwise have needed many conventional lanterns to achieve. For instance, during a single service, a single lantern could play the part of wash light, spot light and effect.

ETC's Source Four

Along with the greater quantities of lanterns comes the increased need to power all of them. Unlike conventional lanterns, the electronics in automated units require a constant, non-dimming power source. In many facilities, this has led to the installation of a secondary power system – either permanently installed or temporarily set up for each lighting rig's needs. This power system typically involves connecting a power distribution rack to a company switch (mains power interface). From the distribution rack, power cabling is run to positions in the rig where power for lanterns is needed.

An alternative to using a power distribution rack is to utilise the cabling infrastructure in your lighting system that already exists. Many manufacturers of dimming systems produce alternative modules that can be inserted into an existing dimmer rack. For instance, ETC produces ThruPower Modules for use in their Sensor dimming racks. This unit features a number of operation modes including switched power, constant-circuit power and dimming. By using this module, you can safely power automated lanterns, effects

Strand Lighting's C21 dimming system

machines or other equipment requiring constant voltage through the existing system infrastructure. In many cases this reduces the total quantity of cabling needed in your setup.

In addition to expanded power needs for these larger rigs is the need to be able to communicate with the lanterns. Each unit requires being connected to the control console, and a number of products are available that expand the data communication network such that you don't have to use long cable runs to every element requiring a data connection. At the most basic, a simple DMX splitter may be employed, which distributes a DMX universe over a number of cables running to different locations in the rig. In an installation, you may have a DMX splitter installed in a rack and connected to DMX receptacles installed around your facility. If your rig changes frequently, you may have a DMX splitter mounted in a portable rack sitting on stage, from which data cables are run to rigging positions on an event-by-event basis.

Of course, this is only a brief overview of lighting system elements that you probably will find in your facility. There are always new products coming onto the market that increase the flexibility and capabilities of lighting systems, many of which also address the goal of improving energy efficiency. One of the newest products out from ETC I am excited about is its Source 4WRD lamp source, which provides an LED-source retrofit for existing Source 4 incandescent lanterns. It can be installed in existing fixtures and even be controlled by standard dimmers, therefore negating the need to run data cabling to the units (though that is an option if you need). There are lots of products on the market, all of which fit more or less into the system elements covered here. My hope is that those who are less experienced with lighting systems will now be able to identify the elements and know their general purpose in the system.

All lighting systems share the same purpose – to illuminate, provide focus, and affect the mood or atmosphere

ETC's Sensor 3 dimmer rack

The ProCan PR64SU is an example of a parabolic aluminised reflector light fixture, often used for coloured washes of light