Current Issue

Light On The Subject

Keeping It Clean

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Details
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Published: 05 May 2015

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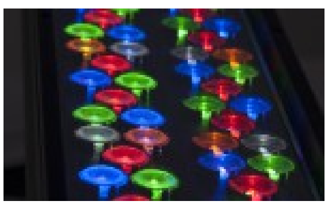

A close-up of the Chauvet Professional COLORado Batten 144 Tour wash light.

Lighting grids now are a mix of LED fixtures, movers and traditional incandescents—which muddies up your power requirements.

What type of power do we need for our new LED lighting units and systems? And how much of it? And how do we get it?

The answers to these questions are changing every day with all the new technology being developed by stage lighting manufacturers. Movers have better optics and are using brighter lamps. LED technology is constantly improving along the lines of Haitz’s Law. And mixing all this new gear with traditional fixtures makes things even messier—because we need more and more constant power.

But what is “constant power” and why do we want it? For that matter, what is “not-constant power?”

Power from the electric company comes into our facilities between 100-240 Volts in the form of an alternating current sine wave of either 50Hz or 60Hz. The standard for North America (all of the U.S. and Canada) and much of South America is 110-120 Volts at 60Hz. Most other countries and continents use 220-240 Volts at 50Hz.

The electricity coming into our theatres from the power

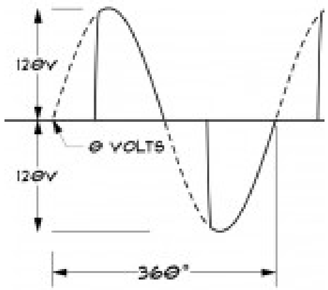

Figure 1: Sine wave from a dimmer

company is further measured in amps. Most power circuits in U.S. theatres are rated at 20 amps, which is quite enough to kill you, thank you very much. Even if there are minor fluctuations in the power that gets delivered to a theatre from the electric company (or from a generator), this, then is generally considered "constant" power: a steady 120V, 60Hz at 20 amps.

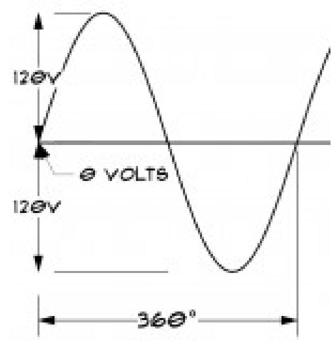

Figure 2: Constant power sine wave

Resistance Is Futile

It used to be in theatre lighting that we would limit the power to the lamps inside fixtures using resistance dimmers. Holding back 100% of the power from the lamp (full resistance) equals the lamp is off. Offering 0% resistance (no resistance), allows the power to flow freely, giving us a lamp at full brightness.

Nowadays, we manipulate the sine wave instead. Current dimmers change the structure of the sine wave in order to dim lamps more efficiently than resistance dimmers. In the dimming diagram (Figure 1), the dashed line represents the full sine wave reaching 120 Volts at 60Hz. The solid line of this illustration represents a dimmer sending an adjusted pattern of the electrical energy to the lamps in our lighting units. The top and bottom sections of our standard sine wave are being cut nearly in half, resulting in our lamp burning at approximately 50-60% of its potential full brightness. In other words, our light is "at 50." The term for this particular pattern is called "forward phase dimming." Other technologies include reverse phase dimming and sine wave dimming. All of these involve the manipulation of the sine wave in one way, or another.

Unfortunately for us, any flavor of sine wave-manipulated dimming will negatively impact the switching power supplies within moving and LED lighting units. In fact, just about any device that contains electronics prefers a smooth sine wave—constant power. Furthermore, dimmers parked at full are still limited in their ability to continually supply full power with a smooth sine wave. Which means that even if you pinky-swear promise to never dim a channel that an LED is plugged into, the mere fact that the circuit is run through a dimmer is enough to make the power on it non-constant and unusable for a whole host of fixtures.

Getting Creative (Safely)

Luckily, we do have some options to solve our power needs. Some solutions are being created and marketed by the dimmer manufacturers and some involve modifying your own dimmers or circuits in house. (As with anything involving the words "modifying" along with "dimmers" and "circuits" please keep in mind that any act of that nature should only be done by fully trained, competent and authorized personnel.)

Dimmer manufacturers now make constant power modules that can be swapped with existing dimmer modules. These constant power modules can be a simple circuit breaker switch that is controlled solely at the dimmer rack, or they can be an on/off switching relay module that can be controlled remotely via signals from a control board. Those that wish to be able to reset electronic units without a trip to the dimmer room will prefer the switching relay module.

Solutions that can be done in-house include bypassing the electronics within a dimmer module and wiring straight to the circuit breaker. This might be particularly advantageous for those theatres that have dimmer modules that are nonfunctional and/or in need of repair. (Again, if you are not appropriately trained and authorized to do this: Don't! Consult a professional.)

Figure 3: Strapped dimmer sending direct power.

For the annual Stage Lighting Super Saturday workshop, held in New York City, manufacturers showing their equipment often request constant power. When theatres in which the workshop is held do not have constant power modules, Lite-Trol Services comes in and "straps the dimmers." In other words: Lite-Trol hardwires jumpers to safely bypass the sine-wave altering electronics inside the dimmer modules of our hosting theatre. Without their assistance, we would need to rent power distribution boxes and tap into the building power in order to supply constant power to the manufacturers displaying their electronic equipment. And don't worry, facilities managers, they restored the dimmers afterwards.

A third option is to bypass the power to the lighting grid completely, and simply plug in fixtures to a standard building outlet in the wall. Depending on how your theatre was built, and where your grid was placed, there may be power outlets close enough to the grid for you to take advantage of.

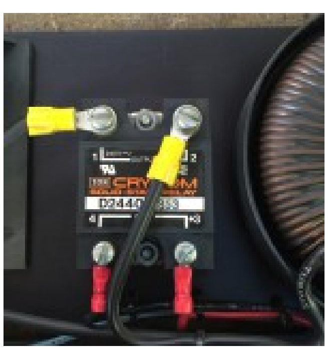
Figure 4: The restored dimmer.

Recently, I had the opportunity to design a production of *Joseph and the Amazing Technicolor Dreamcoat* in a large high school theatre that was built in the 1970s. Over the stage were three pipes, each containing 40 feet of R40-type strip lights as down lights and covering the cyc. Of course, being old fixtures in a school without a full-time tech staff, 90% of the lamps were burnt out. Renting MR16 strip lights for the cyc would have been an option—except that the existing strip lights were hardwired to the dimmers and I had no way of plugging rental units in.

My solution was to rent 40 feet worth of LED strip lights, daisy chain them together, and plug them all into a single wall outlet. The power consumption of these LED strip lights is so low that I could plug all nine of them together into a standard wall outlet at the back of the stage. To control them, a single 250-foot DMX cable was run over the ceiling from the booth to the back wall.

During the planning phase of the design, I had to calculate how many strips lights I needed. To cover the 40 feet of cyc, I needed nine units of the LED strip lights. Would they all work off of one outlet? Looking at the spec sheet for the LED strip lights, I figured out how many I could plug into the wall outlet by looking to see how many amps each unit requires. Each strip needed 1.2 amps and our outlet (in this theatre) was rated at 20 Amps. In theory, this meant we could plug 16 of these into our 20 Amp circuit. (16 units multiplied by 1.2 amps equals 19.2 amps.) But the NEC (National Electrical Code) calls for a 20% cushion when doing these calculations. This means no more than 16 amps on a 20-amp circuit—or a grand total of 13 units. (13 x 1.2 = 15.6) The manufacturer uses even more conservative guidelines, specifying daisy-chaining no more then 11 together. My nine units had room to spare. I plugged into the hardwired wall outlet and avoided the problem of dimmer power altogether.

Keeping Connected

There are other strategies for ensuring that you don't mess up your fixtures if you have a hybrid circuit or grid system of dimmed and constant power. Keeping paperwork up-to-date and clearly labeling cables and circuits is an important first step towards the proper circuiting of power plugs.

An almost guaranteed method of making sure that your expensive electronic lighting units are not accidentally plugged into a standard dimmer circuit is to use a different type of connector at the end of the power cable. For theatres that use traditional stage pin connectors (two pins plus ground) for their dimming circuit, using a round twist-lock type connector for all devices wanting constant power is a terrific solution. Another version of a twist lock is the PowerCon connector. This is becoming popular on newer LED and automated lighting units. These are color coded to show which goes with power in and power out.

A quick internet search reveals several new products designed to make using PowerCon connectors even easier. Lex products makes a new 20-amp "Breakout Box" to be used with multi-cable which has six individual circuits. Imagine using this with those LED strip lights mentioned earlier. We could daisy-chain 11 strip lights in a row on each circuit. With six circuits, we could have 66 strip lights on one multicable.

Cable runs, circuit plots, power and cable management is all made easier with preplanning and paperwork. Using the lighting designer's light plot allows the master electrician to figure out what type of power is needed where; a good reason for the lighting designer to have the plot in the hands of the electricians as early as possible. Gone are the days of simply hanging all the lights and figuring out how to plug them in later.

Scott C. Parker is a freelance lighting designer living in the Philly area. Parker has been a theatrical designer (lighting, sound and scenic), Equity stage manager and educator for more than three decades. His credits include Radio City Music Hall, the Lincoln Center Institute, Gene Frankle Theater, The Public, John Houseman Theater, American Place, Town Hall and other theaters from Boston to Nashville to Nebraska. Parker is a member of AEA, IES and USA829.

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