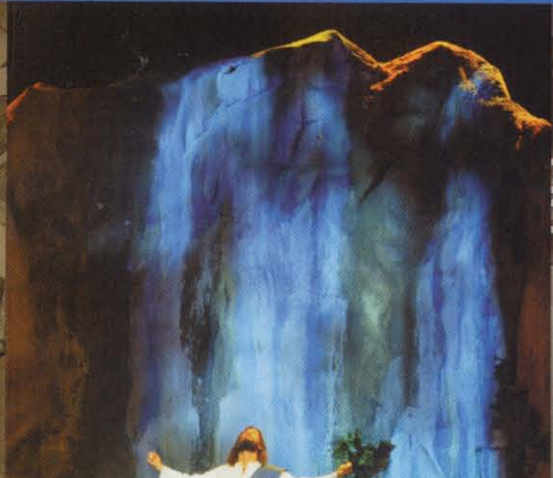
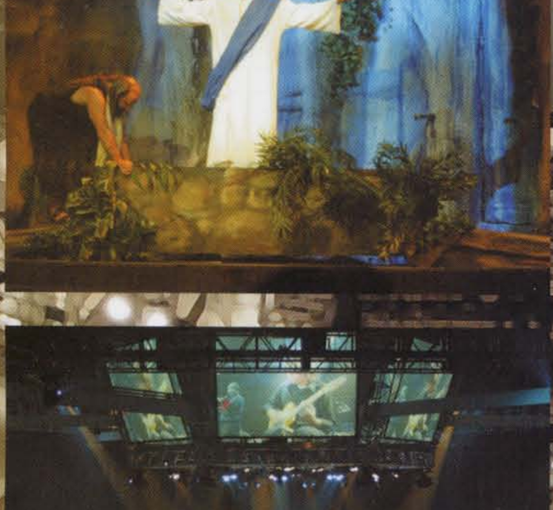
JULY/AUG 2005

LIVE EVENT PRODUCTION ISSUE

Church Production *Magazine*

The Educational Magazine for Houses of Worship Covering Audio, Video and Lighting Technologies





New Life Church

Theatrical Lighting Drives New Auditorium Design

VCA's and Mute Groups: making audio mixing more manageable

Company Profile: Jireh Supplies

Video Camera Techniques: IMAG and Broadcast Video

Welcoming Big Daddy Weave

St. Timothy Lutheran Church meets the challenges of hosting a tour

CPM REVIEWS:

ETC Source Four Revolution Automated Lighting Fixture

HITACHI CP X1250 Video Projector

SHURE SLX Wireless Microphone System

SOUNDCRAFT GigRac 600 Powered Mixer

$4.95

Don't Blow It!

How to figure your lighting loads to keep from tripping breakers

by Greg Persinger

So I am in the middle of a concert with a major Christian act on stage. We were in the home stretch with the group's three signature songs left in the show and the sold-out audience was excited. The audience's energy was infectious, and although I knew better, I decided to push the lighting a little bit brighter at one of the song's peaks to add to that energy. The energy built, the lights got brighter, and then darker. Much, much, darker. All of the lights had gone out. The music was still playing and the group was still singing, but it was all being done in the dark. It was a show stopper as the group ended the song and waited for the lights to come back on before they continued. As for me, I had a sick feeling in my stomach as I knew what I had done.

The church we were playing in didn't have a breaker panel with enough power in it to fully power my lighting rig, but in the spirit of showmanship, with its motto of "the show must go on", the electrician found the largest breaker there was and tied me into it. If I was careful about not turning on too many lights at one time, I wouldn't trip the breaker. I did well for an hour and forty-five minutes but blew it – well, actually tripped it – in the last fifteen minutes of the concert. After a quick reset of the breaker I was able to get the system up and going again and we finished out the show with no additional problems.

My story isn't unusual. If you do lighting long enough it is just a matter of time before you trip a breaker or blow a fuse. It's almost inevitable. In fact, there is this guy named Murphy and he passed a law that pertains to this, but with a little bit of knowledge you can minimize the chances of having the lights go out at an inopportune time.

How do you know how much power you are consuming or how many lights you can put on a circuit? To be able to understand this, we must first take a look at the different measurements involved with power.

First there is the volt, which is the difference in electrical potential between two points in a circuit. Voltage can be viewed as the pressure behind electrical flow similar to the pressure in a water hose.

In the United States we consider 120 volts to be the standard voltage for most of our electrical appliances and lighting. The voltage actually ranges anywhere from 108 volts to 123 volts because of various factors involved with the power distribution system but we still consider 120 volts the standard.

The next unit of measure is the ampere that measures the rate of flow of current passing through a conductor. This is comparable to the amount of water actually coming out of your water hose. This measure of amperage (or amps) is important as it is used to rate a circuit's electrical carrying capacity. Most breakers are rated by the amount of amperage they will supply to the circuit before they trip. Most electrical outlets, extension cords, and main power services are rated in amps.

The last unit of measure is watts, which measures the rate of doing work or the consumption of electricity. With wattage, the higher the number, the greater the electrical consumption and the more work that is being done.

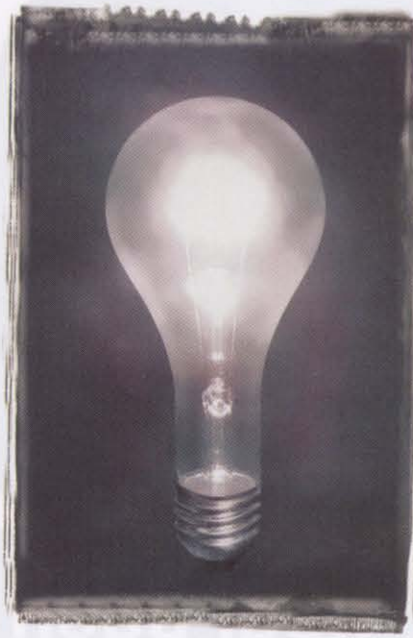
All lighting lamps are rated in watts with the higher wattage lamps typically producing more light then the lower wattage lamps of the same type.

So, the typical voltage in the United States is 120 volts, amps indicate the capacity of the circuit, and watts tell us how much work is being done.

These are the basic concepts when dealing with electricity. However, to prevent tripping your circuit beakers, you need to know about "West Virginia". No, not the state – the formula.

The "West Virginia" formula (actually the nick name for the power formula) states the following:

watts = volts * amps or W=V*A



WVA, get it? "West Virginia". Now that you've seen the formula, let's do the math.

To keep the breaker from tripping on your dimmer or other power circuit, you need to make sure you don't overload it. You find out the circuit's load rating by checking the amperage of the fuse or breaker. Remember, we know that amperage rates the capacity of the circuit. Since most lighting circuits typically have an amperage rating of 20 amps, we will use this figure in our example.

Say we want to know how many 575-watt lighting fixtures we can place on this 20-amp circuit. Here is what we know.

W = 575 watts per fixture

V = 120 volts (US Average)

A = 20 amps (the rating for our dimmer)

X = the number of fixtures we can place on the circuit

To ensure we don't overload the dimmer, the number of fixtures (X) times their power rating (575 watts) can't exceed the total power capacity of the dimmer (V*A). Thus,

X * 575 Watts <= 120 Volts * 20 Amps

Using algebra, we solve for X:
X = (120 * 20) / 575
X = 4.174

As we can't have only part of a fixture, we round the answer down to the nearest whole number, and see that we can place four 575-watt fixtures on a 20-amp circuit.

Another way to use the "West Virginia" formula is when you know the amperage rating of the circuit but you have a group of fixtures with a variety of wattage ratings. In this instance you can calculate your maximum wattage for the circuit and then subtract your mixed fixture wattages as you put them on the circuit. Once again for this example we will use a 20-amp dimmer circuit.

W = ? Watts

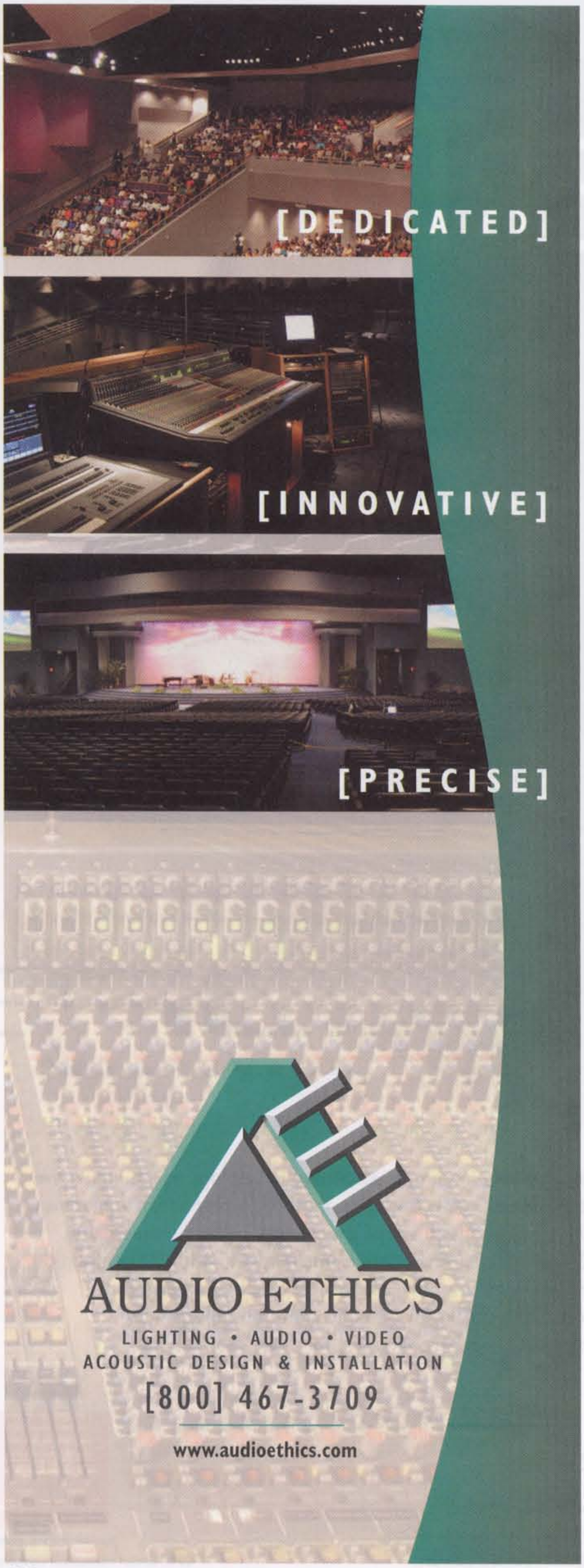
V = 120 Volts

A = 20 Amps

W = 120 Volts * 20 Amps (or 2,400 watts)

If fixture 1 is 1,000 watts, fixture 2 is 575 watts, fixture 3 is 500 watts and fixture 4 is 600 watts, then adding the wattages together yields the entire load on the circuit:

1,000 + 575 + 500 + 600= 2,675 Watts



Since our fixtures add up to more wattage than our 2,400-watt capacity, we will have to leave one fixture off of this circuit and put it on another circuit to prevent the dimmer's circuit breaker from tripping.

Let's break away from the power formula for a minute and let me show you how you can cheat on the math a little.

Typical dimmer ratings are 600 watts with a five-amp breaker, 1,200 watts with a 10-amp breaker, 2,400 watts with a 20-amp breaker or 5,000 watts with a 50-amp breaker. Many times these ratings are marked on the dimmer. If you do have a dimming system with the ratings marked on the dimmer you can use the wattage rating from the dimmer and not have to do the math.

Also, a quick rule-of-thumb for 120-volt power systems is when you are working with your lighting system is you can figure that one amp of capacity is used for every 100 watts of consumption. This would mean that a 500-watt fixture would be estimated as having a five-amp current draw, and a 1,000-watt fixture would be estimated as having a 10-amp current draw.

This works well (as a general rule) as it gives you a very conservative estimate of your current draw in quick round numbers However, let's use the power formula and figure out what the current draw of a 1,000-watt lighting fixture actually is.

W	**=**	**1,000 watts**
V	**=**	**120 volts**
A	**=**	**watts / voltage**
A	**=**	**1,000 watts / 120 volts**
A	**=**	**8.3 amps**

So 8.3 amps is the actual current draw of a 1,000-watt fixture. If we consider that our rough rule-of-thumb assumes it to have a 10-amp current draw, there is 1.7 amps of extra capacity that is not being used. Using this method for estimation is great on a small scale. However, a problem arises when you use it on a large lighting rig. If you use this estimate in a lighting system with one hundred 1,000-watt fixtures, you will decide that you need 170 amps more than are actually required to power your lighting system. This is why an understanding of the power formula is important.

Chances are good that you won't use the power formula much if your lighting system is permanently installed and you don't change things frequently. However, if you use portable lighting systems, rent equipment on a regular basis, or move fixtures around in your lighting system on a regular basis, you will find the power formula to be a helpful formula to know. It's easy, just remember "West Virginia" or W=VA and keep the lights from going out on you.

Greg Persinger is the owner of Vivid Illumination. He can be reached at greg@vividillumination.com. CPM