

## COMPETENCIES

- Basic theory behind dimmers
- History of dimmable light sources
- Resistance Dimmers and their operation and limitations
- Autotransformer dimmers features and advantages
- Mechanical mastering of individual dimmers
- Design theory of electronic control
- Advantages of electronic control devices
- First generation electronic control devices
- SCR dimmer theory
- Interconnect systems
- Electronic control systems
- Preset operations
- Manual and computer controlled systems

## Introduction

Another controllable property of light is intensity, which refers to the brightness of a source. Intensity is controlled by using dimmers. To dim a tungsten-filament lamp, the Voltage to the lamp is reduced and the metal will glow less brightly as well as give off a warmer light (the Kelvin temperature is reduced).

The minimum requirement for any dimming apparatus is the capability of dimming a lamp to black in a smooth and even manner. When this is possible, dimmers can be used to alter the composition of the stage or television setting by dimming (up or down) one or a whole series of lighting instruments. Such movement of light can suggest time change, alter the mood of feeling, or shift emphasis from one area to another.

## History of Intensity Control

The history of the use of dimming is a long one. On seventeenth-century stages, cans on cables were lowered over candles to vary the light. In the eighteenth century, candles were mounted on vertical boards and hung in the wings, allowing the light to be shifted to or away from the stage. In the nineteenth century the gas table; a complex of pipes, rubber

tubes, and valves; adjusted the flow of gas to the various jets about the stage and provided good control over intensities.

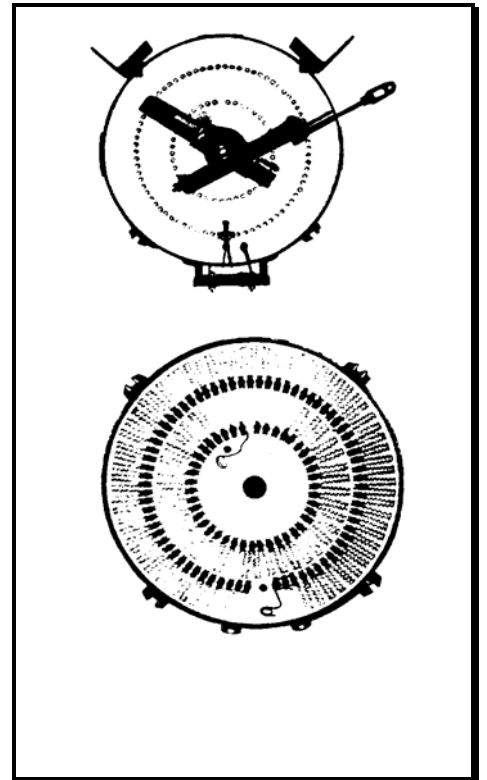
## Resistance Dimmers

With the advent of the incandescent lamp, crude forms of dimming control were introduced. They all utilized the principle of placing some form of resistance in series with the lamp. The carbon pile and salt-water dimmers were among these. Large cans of carbon or tanks of salt water were placed in the basement of the theater to provide the needed resistance.

Another type of resistance dimmer contains two coils of resistance wire placed parallel to each other and a short distance apart. The circuit enters at the top end of the end of one coil and leaves at the top of the other. A conducting shoe slides up and down between the two coils, bridging the gap.

The other form of resistive dimmer has its wire in the shape of a multi-pointed star. The wire is attached to a ceramic plate and the shoe rotates over the exposed contacts.

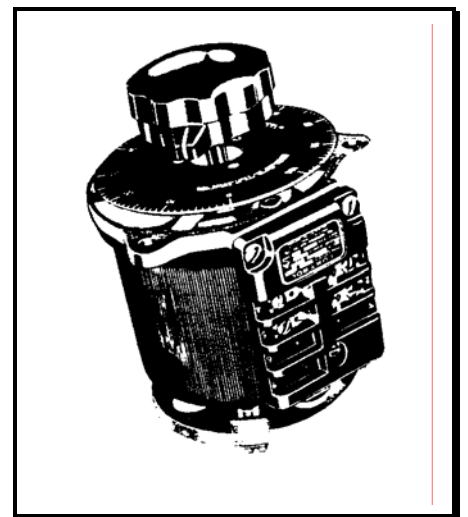
Because the resistance dimmer consumes full current when it is switched on; whether the lamp is burning or other otherwise; it is extremely wasteful of electric power. The coils also generate a massive amount of heat. Additionally, the exact wattage of the lamp must be known and matched to the dimmer size. If the lamp is a larger wattage, the dimmer cannot go to black.



## Autotransformer Dimmers

This device consists of a mass of copper wire wound around a wire core. It works similar to a transformer. By means of sliding shoe moving over the bared turns of the coil, the exact voltage is drawn off.

The autotransformer works with various wattage bulbs and uses only the actual current drawn by the lamp. Much less heat is produced.



## Mechanical Mastering

Dimmers can also be connected together so that one operator can control several dimmers at once. The simplest method of mastering autotransformer dimmers is by interlocking. A number of dimmers mounded side-by-side may have their handles locked to shaft that runs the length of the dimmer bank. By twisting the handle, the individual dimmer can be connected to the shaft.

## Electronic Control

### Elements of Electronic Control

There have been huge advances in lighting control over the past fifteen years thanks to the advancement of solid-state devices.

The difference with electronic control systems is that various elements of the system can be physically apart from each other. The control unit can be connected to the dimmer panel by low-voltage (11-20 volts) multi-conductor wire. The control signal is then sent to the remotely located dimmers. This signal is either generated by a small fader controller or by a computer-stored intensity level in a memory system. The remotely located electronic dimmer handles the full voltage and alters the flow of this current to the lighting instrument.

### Advantages of Electronic Control

Under the older mechanical methods of control, a change in lighting cues took several operators and a director to coordinate the change. Most of the time, the operators could not even see what was happening on stage.

With the low-voltage miniaturized control systems, any portion of lights can be grouped together (mastered). Readings for future changes (cues) can also be pre-programmed and brought up at a specified rate. Because of the portability of the control unit, the operator can have a view of the stage or studio, and get a feel of the action.

## Early Types of Electronic Dimmers

### Saturable-Core Reactors

This was the first attempt at electronic dimmers. It consisted of a figure-eight transformer. DC current was passed through the common point and “gated” to the other half of the transformer. (These dimmers could be located anywhere.)

### Thyratron Tubes

This dimming device is a pair of thyratron vacuum tubes that are controlled by varying their grid voltages. They required a warm-up time and give off much heat.

## Magnetic Amplifier

A refinement of the saturable-core reactor, this dimmer had none of the disadvantages of previous types except for bulk, weight and cost.

## Silicon Controlled Rectifier

Usually referred to as the SCR dimmer, its name means “a silicon rectifier under control.” A kind of large capacity transistor, this device presents all the advantages of the magnetic amplifier but is quite small, light in weight and less expensive. The SCR performs its dimming task by very rapidly switching on and off, thereby “chopping” the a-c sine wave. Two SCR's are needed for each dimmer, but they are quite small (nickel-sized) and mounted in larger heat sinks.

A welcome result of the SCR's gain in popularity was the steadily drop in cost to the point where today patch and interconnect panels are being replaced by dimmer-per-circuit systems.

## The Interconnect System

An interconnect system or patch panel is used to connect dimmers to individual circuits. Usually there are many more outlets than dimmers and the active circuits must be attached to the dimmers.

The most common form of cross-connecting panel is the type that has all the stage circuits terminating in plugs at the end of retractable cables like an old telephone switchboard. There are usually several input jacks for each dimmer, so the dimmer could be loaded with several instruments. Care must be taken because the dimmer can be easily overloaded.

The slider patch is a full-voltage sliding contact system arranged on a grid. Stage circuits are normally represented by vertical sliding clips while each dimmer is assigned a horizontal bus bar. One must align the circuit slider with the individual dimmer to complete the patch. This connection is not always a good one and it is easy to make a poor contact. It is also easy to overload a circuit because it is possible to connect every stage circuit just one dimmer.

## Dimmer-per-Circuit System

Newest installations provide for a dimmer for every circuit. Patching still exists, but it is of a different kind. The dimmer is placed after the patch--not before. This system provides the greatest flexibility and is less likely to be overloaded.

## Types of Electronic Control

### Manual System

This system consists of one controller per dimmer as well as a master controller. It may be quite sophisticated, with a great number of possible presets, master, submasters and group masters.

The advantage over the older systems is compactness, lightness, electronic mastering, and ability to move the controller apart from the dimmers.

### Presets

Preset systems provide, in addition to direct, manual control of each dimmer, one or more additional sets of controllers. A two-scene preset board provides for two controllers per channel and method of activating each channel (split-faders). Up to ten-scene presets have been sold but a memory system is less expensive and has many more features.

### Group Mastering

Another method of designing a control board does not depend exclusively on separate preset panels but divides the board into various groups. This is helpful when various functions are using the system and their particular needs can be grouped.

## Computerized Memory Systems

The combination of the SCR dimmer, low-voltage control circuits, and miniaturized parts has led to a computerized control of lighting. The ability of the computer to store information enables it to hold preset and cue information in whatever quantities a production situation might desire. A computer can be programmed with the digital information of a cue that is randomly recalled with push-button speed.

### Types of Systems

Early systems were large and bulky. Today's systems can be classified as small or large, depending on physical size and capabilities. All provide for library storage of cues, video display(s), timed split cross-faders, external control (MIDI or other protocol), group or Sub-masters, and keypad access to memory.