FAQ GENERAL
Residential Dimmers & Commercial Lighting Control Systems

Q. What is the function of dimmers?

A. dimmer varies the intensity of light emitted from an electric lamp and provides the flexibility to vary the amount of light in a given space, depending on the individual requirements, tasks or activities being performed.

Q. Where can dimmers be used?

A. Dimmers can be used to control lighting almost anywhere in a commercial building or residence: Commercial uses include hotel and hospitality, ballrooms, conference room, auditorium, cinema, health care, places of worship, restaurants, retail, office and other commercial spaces. Residential uses include living, dining and entertainment areas, bedrooms and bathrooms, kitchens and utility areas, family and game rooms, dens, home theater, hallways and exterior/ landscape/pool lighting.

Q. What makes the lights dim?

A. An electrical component in the dimmer, the semiconductor alternistor/triac, turns the light on and off very rapidly â€“ 100 or 120 times per second. The longer the light is 'on' versus 'off' (example A), the brighter the lights will be. Conversely, when the light is 'off' more than 'on' (example B), the lower the light output, making lights appear dimmer.

Q. If the lights are being turned on and off won't the lights seem to be flickering?

A. Due to the capacitive effect of a lamp's filament, it won't appear to flicker so long as the timing of the triac/thyristor control is accurate to the AC sine wave timing. If this timing is inaccurate or subject to noise then the triac/thyristor may conduct into the next timing period and cause flickering.

Q. Can dimmers increase lamp life?

A. Yes, heat and thermal shock decreases lamp life. By reducing these, the life is increased by as much as 20 times normal. A lamp fails when the tungsten wire filament breaks due to the coating on the filament boiling off over time. Dimmers reduce the power to the lamp and hence they operate at a lower temperature. Intelligent dimmers ramp or fade a lamp to a preset level. This is particularly important when the lamp is first turned on. Incandescent lamps tend to fail at this point due to thermal shock on the cold lamp filament due to the inrush current which is usually in the region of 14 to 17 times the running current. By fading the lamp to the set level, also know as 'soft start', a lamp's life is extended considerably. At 10% dimming, a lamp will last twice as long and at 50% dimming it will last 20 times as long. Voltage stabilization, available on more expensive systems, protects lamps against spikes and peaks in mains voltage.

Q. How important is it to use quality lamps with a dimmer?

A. It is important because when a lamp's filament breaks at the end of its life it can flash-over internally when a small arc forms into a plasma along the entire length of the filament. Due to the lower impedance of the plasma compared to the filament, a short circuit is created through which the current continues to flow, limited only by the supply impedance. This sequence causes a current to build up to a sufficient value and for a duration that can damage a dimmer. For this reason quality dimmers should have overrated power devices to withstand the high currents/voltage that derive from a short circuit. Quality lamps are fitted internally with a Ballotini fuse which prevents a short-circuit from happening.

Q.How do dimmers save energy?

A. All modern dimmers use semiconductor technology to accomplish dimming which makes for a very efficient design. Alternistor/triac or thyristor based dimmers are either ON or OFF and hence dissipate very little heat. A typical voltage drop from these units when the power is transferred to the load is only a few volts with most of this being lost through the electrical noise suppression part of the circuit. When the light is off, no energy is being used. The longer the triac/thyristor is off, the lower the light output, and the greater the energy savings. As a result, the more the lights are dimmed the more energy is being saved. Because the human eye perceives light non-linearly, it is possible to reduce light levels by over 10% before the reduction in brightness is noticed. This

would lead to a near 10% saving in energy consumption. At a dimmed level of 50%, a dimmer with 98% efficiency can save 40% of the energy.

Q. Are all lamps dimmable?

A. Not all lamps are dimmable. Some, like compact fluorescent lamps, can only be switched on or off. However, energy can still be saved even if they are turned off automatically when not required. For example, during a bright day the lamps near a window can be turned off where normally they would be left on. A sensor that measures daylight provides an input value to the controller that will measure the value over time and use that information to switch or dim circuits to pre-determined levels.

Q. How does a dimmer work?

A. Typically, light dimmers are manufactured using an alternistor/triac or thyristor as the power control device. They are used for resistive and inductive loads, such as incandescent, cold cathode and low voltage (inductive) lamp sources. Both act as high-speed switches, and in a dimmer are used to control the amount of electrical energy passing to a lamp. Mains power is comprised of an alternating current that flows in one direction, and then in the other, along the cable, at the rate of 50 or 60 cycles per second (known as Hertz or Hz). The value 50 or 60Hz is dependent on the country's power system. The current alternates back and forth, changing direction at the zero crossing point. At this instant in time no current is flowing in either direction. This is the point at which a dimmer is electronically synchronized to turn the power ON or OFF. By chopping the waveform at the zero-crossing point, smooth dimming can be achieved without the lamp flickering. This turning on and off of the power device occurs every time the mains crossing point is reached (half phase), 100 or 120 times per second depending on 50 or 60Hz.
A thyristor is a uni-directional device and hence, because AC power flows in both directions, two are needed. A triac is a bi-directional device, and therefore only one is needed. An electronic circuit determines the point in time at which they turn ON (conduct). The ON state continues until the next zero-crossing point, at which point the device turns itself OFF. The electronic circuit then provides a delay, which equates to the dimness of the lamp, before turning the control device back on. The slight capacitance of the load filters the chopped waveform resulting in a smooth light output. Some controllers use a microprocessor control, with the above timing function being handled by an analogue circuit. More sophisticated systems, called digital dimmers, operate the switching direct from a microprocessor. This has the advantage of greater reliability, quieter operation, lower cost and smaller units.

Q. What different types of dimmer are there?

A. Essentially there are three types of dimmer: LEADING EDGE, LAGGING EDGE and SINUSOIDAL. Leading Edge (as described above) delays the 'turn-on' time from the zero crossing point; Lagging Edge turns off after the desired time period has passed; and Sinusoidal alters the amplitude of the sinusoidal wave form. Leading Edge uses alternistor/triacs or thyristors while Lagging Edge uses transistors, as do Sinusoidal dimmers.

Q. Which of the three types of dimmer is better?

A. Sinusoidal is the most sophisticated, but also the most expensive and bulky. Trailing Edge is compatible with electronic capacitive transformers. Both of the above use IGBT transistors, which are not robust devices, and must be continually monitored by the microprocessor to prevent damage. They are particularly vulnerable to difficult mains power conditions and shouldn't be used with wire wound transformers due to their susceptibility to back-EMF. Leading Edge is the most accepted method of dimming and also the most robust if alternistors are used.

Q. What is the difference between triac, thyristor and alternistor dimmers?

A. Triacs and thyristors are similar components: A triac is essentially two thyristors combined in one package: Thyristors tend to be more expensive but more robust. Triacs have the advantage that they are less likely to 'half wave' on failure. Alternistors are a perfectly matched set of two thyristors (SCRs wired inverse parallel i.e. backto-back). This chip construction provides two electrically separate SCR structures, providing enhanced performance characteristics, and can be used with highly inductive loads â€“ often used in motor drive applications.

Q. What is an inductive load?

A. Mains voltage incandescent lamps have a resistive characteristic; the voltage and current waveforms are almost identical. On the other hand, a wire wound transformer is an inductive load and the current tends to lag behind the voltage.

Q. Do I need a special dimmer for transformer loads?

A. A quality leading-edge inductive dimmer should be used which is fully digital and has a symmetrical output voltage waveform. The majority of 'economy' domestic dimmers do not guarantee that the output waveform is symmetrical, and therefore may cause damage to the transformers.

Q. Do dimmers get warm and why?

A. Yes. Feeling warm to the touch is a normal phenomenon and common to all dimmers. All modern dimmers use semiconductor technology and during normal operation they generate heat. A semiconductor dimmer is roughly 98% efficient â€“ 2% of the power is dissipated as heat, causing the dimmer to feel warm to the touch. The closer a dimmer is run to full output the higher the current flow and hence the more heat will be generated. The components that Futronix use employ the highest standard cooling methodologies, meaning the units stay cooler than other models for their rating.

SCENE SETTING & ZONES

Q. What is a Lighting 'Zone'?

A. A lighting zone is a room or area that one or more circuits of lights resides in.

Q. What is a Lighting 'Scene'?

A. A lighting 'scene' is when two or more lighting circuits in a room fade to predefined lighting levels. Each circuit of lighting can be pre-programmed to a different level of brightness. All of these pre-set levels combined are stored as a 'scene' which can best be thought of as being a complete 'look' of a room or area. Once set up, scenes should be easily recalled by the user from wall mounted switch panels, infra-red remote controls, or touch screen. They can also be recalled automatically by time clock, or according to occupancy. Once a new scene is selected the lighting will fade to the new set of levels at the pre-determined fade rate.

Q. How are lighting 'scenes' programmed?

A. Programming of lighting scenes is done using either: hand-held remote control unit dimmer control panel buttons color touch screen PC or laptop which is removed once the programming is completed, or a dedicated computer for operation. A lighting control system should feature an easy way for an end user to re-program basic scenes using a hand-held remote control unit without the need to call in an expert.

Q. How are lighting 'scenes' selected?

A. Scenes can be selected from a push-button control panel, wall-mounted at a logical position within a room. In many applications there will be several controls operating in parallel as well as switch panels; there may be a time clock, remote control, LCD touch screen, central PC controller, PE/PIR units as well as Building Management Systems.

Q. How many scenes do I need?

A. A typical number of lighting scenes in a ballroom might be 20, whereas in a home theater it could be 8 scenes. Overall, the total memory should be around 128 scenes.

Q. Where are the scenes stored?

A. Scenes should be stored in a secure removable memory module (EEprom or Flash) so that in the event of a memory failure it can be exchanged. Most memory modules have a life span of 10 years or more.

Q. What is a Fade Rate?

A. A fade rate is the time taken for a circuit to change from one level of brightness to another one.

Q. Can a dimmer fade smoothly?

A. In sophisticated systems the computer should dynamically recalculate the fading time and corresponding fade rate of each circuit, so as to reach the end point for all circuit transitions at the same time, thus creating a smooth blending of light. A more basic system will just fade a single circuit at its own set rate â€“ without taking into consideration the other circuits that are part of the same scene.

Q. Why do some dimmers cause flicker?

A. In order to fade smoothly a dimmer must have good timing accuracy and a high number of digital steps. A good test of a dimmer is to look at a chandelier from the corner of your eye (using faster peripheral vision); while it is dimming you should not be able to notice any discernible stepping or flickering.

Q. What is a Touch Screen?

A. An LCD touch screen is a graphical user interface to lighting systems and other controls, providing a very flexible and intuitive method of operating and programming the lighting control system. It offers multiple control functions that have many advantages over conventional static control panels. It is ideal where a user may need simple control, while an installer needs access to more complex control and programming functions. Typical uses are selecting scenes, changing circuit levels, programming, setting the time clock, and other functions.

Q. What are typical features of a Touch Screen?

A. Typical Touch Screen features can include: virtual slider for manually changing circuit levels scene select buttons system master control astronomical time clock customizable welcome menu access protection programming menus Help pages.

TYPES OF LAMPS, TRANSFORMERS AND BALLASTS

Q. What light sources can be controlled by dimmers? A. A

A. A quality dimmer can control:

DIMMABLE LIGHT SOURCES

tungsten tungsten halogen 1-10v regulation HF fluorescent ballasts (with 1-10v converter card) PL/T fluorescent (dimmable ballast) neon/cold cathode

SWITCHABLE LIGHT SOURCES

compact fluorescent PL fluorescent metal halide sodium mercury

Q. How do I know the size of dimmer I need?

A. To calculate, simply multiply the wattage of each lamp by the number of lamps. This gives the total wattage on that circuit. The dimmer should match or exceed that wattage per circuit (dimmer channel).

Q. What kind of dimmer should be used to control low voltage lighting?

A. If low voltage lighting is used then a dimmer should be an inductive dimmer type. There are two types of transformer: electronic and magnetic.

Q. What are the concerns with electronic transformers?

A. Unlike wire wound transformers, which by their very nature are dimmable, electronic transformers may induce problems and care must be taken when selecting electronic transformers to ensure compatibility with dimmers in a control system. Some electronic transformers are non-dim types. These transformers should not be connected to a dimming controller unless it is configured as a switched output, or damage to the transformer may occur.

Q. How do I tell magnetic and electronic low-voltage tranformers apart?

A. Hint: the transformer type can often be determined by the transformer's weight. Magnetic (core and coil, toroidal) transformers are often heavy for their size. Electronic (solid-state) transformers tend to be smaller and are often light for their size.

Q. If one dimmer needs to control both mains voltage lamps AND a low voltage lighting system, what kind of dimmer should be used to control this combination?

A. Don't mix different types of lamps on the same circuit as its likely their dimming brightness will differ. Instead, use separate circuits on a multi-channel dimmer for each circuit.

Q. Is it best to use one large transformer or smaller multiple ones?

A. When dimming low voltage lamps, one transformer per lamp should be used instead of one large transformer, so that if a transformer fails only a single lamp is extinguished. Transformers can be easily changed, as being smaller they can be fitted through the same ceiling cut-out as the light fitting. Large transformers are also more prone to noise and nuisance tripping if the voltage drops for any reason.

Q. Why do light bulbs buzz or hum sometimes?

A. Occasionally, lamps may generate noise when dimmed. Light bulb hum is caused by vibration of the lamp filament as the dimmer rapidly switches the lamp on. Lamp buzz, if it occurs, is generally noisiest at the mid-range (50%) dimming level. Inexpensive household lamps are often the culprit because the filament is only supported at the ends. The 'sing' occurs when we turn the power on and off 100/120 times a second, pushing the filament back and forth from rest to positive to negative. A quality digital dimmer with high accuracy and good noise suppression should not produce much discernable noise with a good lamp and fitting.

Q. How sensitive is the system to surges?

A. The dimmer should be internally protected to withstand surges up to 6Kv. If the system is modular and some system components fail as a result of a severe power surge, the function of other components and of the system as a whole should not be affected. In a lightning-prone area, it is always recommended to add local surge protection before the dimmer, as electronic components can not survive a direct or near lightning strike.

Q. What happens to the system if electrical power is cut due to a storm?

A. During a loss of power, the system should retain all the programming information in internal memory (for up to 10 years). When power is restored, the system will automatically return all settings to their last state before power was lost. The system data should be stored in a secure removable memory module (EEprom or Flash) so that in the event of a system failure it can be simply exchanged without the need to reprogram the system.

Q. How do you dim fluorescents?

A. To dim fluorescent lamps, an electronically-dimmable ballast must be used. This should be of the correct wattage for the lamp being controlled. The dimming range of these lamps is due to the ballast's capabilities rather than the dimmer's. As a general rule, those lamps with four pins are dimmable. Those lamps with two pins and integral starters are not dimmable.

There are 3 types of dimmable ballasts with different control inputs available:

The 1-10v dimmable ballast is the most common type preferred due to its lower purchase price and greater economy. The intensity of the lamp is determined by a control voltage in the range 1-10 volts. These are the most economical and most interchangeable, and can be easily replaced at the end of their life. Units do require the mains power supply to be switched on or off. The second popular ballast is the digital ballast available from Tridonic. These are referred to as DSI ballasts. The primary advantage that these ballasts have over the 1-10 volt units is that they have an internal electronic switch. By using the digital control pair, the power can be switched on/off as part of a control message. However, standby power consumption of the ballast makes this less efficient. The minimum illuminance is generally 1% but because of a fluorescent's dimming curve, this is not that dim. Finally, there are DALI ballasts. These ballasts offer integral controls and scene setting functions. In practice, the concept requires software setup for each ballast including individual address, scene value and Power On level. This means that commissioning or maintaining of installed systems is complex and expensive. Fade rates are also restricted and each network is limited to a maximum of 64 ballasts. Standby power consumption of 7VA is quite high per ballast, and reduces energy efficiency for a whole installation. All the above types require a pair of cables, one pair for the control signal and the other for the mains power feed. The control and mains power should always be kept separate. Mains voltage must never be applied to the control signal terminals or cables. FAQ - Lighting Control Systems

Q. What connections are needed with 1-10v ballasts?

A. The dimming controller should provide a dedicated mains switching output per circuit as well as the 1-10 volt control pair. Due to the switching of high loads, arc-free relay switching controllers are recommended for this type of application.

Q. Are there any special considerations when dimming fluorescent ballasts?

A. Due to the fact that different type and wattage lamps may have different levels of luminance for a given input, it is advisable not to mix fixtures with different lamp types on the same dimmer channel.

Q. Can standard ballasts be dimmed?

A. These ballasts are not dimmable, but can be controlled by relay switching controllers.

Q. Can neon/cold cathode lamps be dimmed?

A. Yes. Neon/cold cathode lamps can be dimmed with special dimmers designed to operate on highly inductive magnetic (core and coil) step-up transformers. A dimming range of 95%-10% should be possible. Cold cathode lighting is common in coffer lighting applications and in signage. It is most useful in areas where access for re-lamping is restricted, as the tube life can exceed 80,000 hours.

Q. What is the difference between neon and cold cathode?

A. Neon is a generic term often used to describe all 3 types of lamp. These lamps contain Argon, Neon or Krypton gas depending on the desired color of light. Their ability to be dimmed is dependent on the materials and construction involved. Transformers, tube diameter, electrodes, gas, manufacturing practices, age, low temperature, cables and HT wiring connections will all affect the ability of the tube to be dimmed.
For dimming down to a low level, the transformer size should be carefully calculated by the installer. Argon gas-filled tubes are the easiest to dim. Neon tubes can be dimmed over a reduced range. Tube diameter is also significant to performance: the larger the diameter, the better the likely outcome for dimming. Leading Edge dimmers with a high current, inductive load and back-EMF capability are suitable for dimming cold cathode.

Q. What type of transformer should be used?

A. The transformer should be an electronic or wire wound type approved by the manufacturer for dimming with a Leading Edge dimmer. If using a dimmable electronic transformer, de-rate the dimmer channel by 10%. If using an iron-core transformer, de-rate the dimmer channel by 60% and ensure that any power factor correction capacitors are removed. This should be checked carefully, as some transformers have the power factor correction capacitor fitted inside the transformer casing (often embedded inside the resin fill), making it difficult to remove. If the transformer is an OCP (Open Circuit Protection) type, ensure that it is suitable for dimming, as many OCP transformers are not. This type of transformer has circuitry that will automatically disconnect the transformer's output in the event of a tube breakage.

Q. What type of cable should be used?

A. Cables should NOT be of the braided type. GTO cables between the neon tube electrodes and the transformer should not be longer than 6 metres, and should be separated from each other by at least 100mm. Avoid running cables near metal or in metal conduits. If metal conduit must be used, try to use a non-ferrous alloy type.

Q. Are there any other special considerations?

A. Consideration should be given to reducing capacitance coupling, which results from the electric field that surrounds every AC current carrying conductor. It has the ability to conduct AC current through air between the tubes, GTO, electronic power supply and any mounting surface. An example includes the dimming or tripping of a lit tube when you grasp it with your hand. Any high voltage wiring, as well as neon tubes, will have capacitance coupling to ground. In extreme cases this can cause neon power supplies with GFI to 'trip' due to excess ground fault current or over loading. False Tripping is a major problem caused by excessive capacitance coupling. Electronic Cross Talk can occur between power supplies, tubes, or GTO leads in multi-transformer applications.

Q. Can discharge lamps like metal halide and sodium be controlled?

A. The most economical way is to switch these lamps using arc-free relay/contactor switching. They are usually wired in alternate lamp configurations to allow for reduced light levels through switching circuits on or off as required. Expensive sine wave dimmers can dim these lamp types down to 40-50%, however there may be some variation in color temperature, and lamp life may be reduced. When calculating the REAL current for the switching device it is most important NOT to assume that the connected load can be calculated by multiplying the lamp wattage by the number of lamps. For example, a 150W Metal Halide lamp has 4x the starting current which can last throughout the entire striking cycle.

Q. Can LED lamps be dimmed?

A. LED lamps for architectural use are either mains voltage or contain a control circuit which is either a Voltage mode, Current mode or Input Nominal Supply Voltage and Current type. Some LED lamp transformers have a 1-10v control input, and some are mains dimmable. Mains voltage LED fittings that aren't dimmable may also be connected to a relay controller when simple ON/OFF control is required.
Voltage mode fittings incorporate integral current limiting devices and are designed for direct connection to a nominal supply voltage. Current mode fittings do not include the facility to limit current and therefore must be connected to a constant current supply, and rated Input Nominal Supply applies to multi channel fittings (i.e. RGB) designed for color mixing applications.

Q. Can my lighting control system control my blind/drapes or curtains?

A. Yes, using a compatible relay controller with two-way motorized lockout, it should be possible to control window treatments as part of a lighting scene. A typical application is in home theaters where the dimmer automatically closes the blinds and fades the lights with one touch.

Q. Can a lighting control system communicate with other systems such as a HA controller or home theater touchscreen?

A. Yes. There are widely available optional interfaces to other equipment using infrared (IR) and serial (RS232/485) controls.

Q. Can I control fan motors with a dimmer?

A. Yes, but you will need to use a quality inductive dimmer. An alternistor dimmer is the best choice for this application as they have a high Di/Dt immunity and are commonly used for motor drives. You must remove any power factor correction capacitors present in the motor. A speed controller should not then be used in conjunction with the dimmer. Where there are 2 speeds/windings on one motor being used, you must use a controller with 'motor lockout'.

Q. Can my lighting control system control my landscape lighting?

A. Yes. Landscape lighting benefits greatly from being controlled with the ability to dim and switch lighting from any convenient point. An astronomical time clock can be added to automatically adjust the scenes of your landscape lights according to sunset and sunrise times. For maintenance and safety purposes it is recommended that a separate system is used. Depending on the electrical code, a system controlling outside lighting should have MCBs/RCB for protection.

Q. What communication standard is best for controlling lighting?

A. Within the electronic building controls industry there are different standards and protocols used to communicate between devices. There are many different standards, and none which are used exclusively more than any other. Some standards are used more in certain industries because of having been originally developed for that market. Many of the more general 'building wide' standards are not specific enough to allow for detailed operation of a particular industry's equpiment. Others have a high level of overhead in the form of layers of software, silicon and power requirements needed to ensure some level of interoperability. Inevitably, no one standard is sophisticated enough to incorporate every conceivable system and function (present & future) into the protocol.
Often the most cost efficient and reliable method is for the lighting control system to use its' own dedicated manufacturers protocol, interfacing (if required) to touch screens or building controls as a sub-system using a long term reliable communication standard like RS232/485.