

Guide to Dimming Low-Voltage Lighting

Overview

This guide answers typical questions encountered by Lutron's Technical Assistance and Applications personnel concerning low-voltage dimming applications. Lutron manufactures low-voltage dimmers for low-voltage fixtures that use magnetic transformers.

To control electronic (solid-state) transformer-supplied low-voltage lighting, Lutron developed special dimming circuitry after an extensive engineering research and development program. This technology has been built into a series of dimmers specifically for ELV transformer loads.

Lutron offers dimmers for both load types in a variety of product families.

Facts About Low-Voltage Lighting

Why Use Low-Voltage Lighting?

- Low-voltage lighting provides an excellent source of illumination when a precise, concentrated beam of light is required.
- Low-voltages contribute to extended lamp life and increased safety.
- Small fixture sizes permit lamps to be easily aimed and reconfigured.
- Common applications include residences, display lighting, task lighting, and product highlighting.

What is Low-Voltage Lighting?

Low-voltage lighting uses a transformer to reduce a 120VAC line voltage to 12VAC or 24VAC. This lower voltage is then used to power an incandescent low-voltage lamp. Examples of low-voltage lamps are AR111, MR16, MR11, PAR36, T3-1/4, T5, striplites, etc. Many, but not all low-voltage lamps are tungsten halogen.

Where is the Transformer Located?

A low-voltage transformer may be mounted remotely or as an integral part of the fixture.

Does Dimming Affect Lamp Life?

Dimming will increase the life expectancy of low-voltage lamps. Occasionally, darkening of a low-voltage halogen lamp may occur. If this happens, simply turn on the lamp at 100% illumination for 10 minutes and the black residue (the result of tungsten evaporation) will nearly be eliminated.

Dimming Low-Voltage Lighting

When dimming a low-voltage fixture, the dimmer controls the line voltage (120VAC) input to the transformer powering the low-voltage lamps. There are two types of transformers manufactured for low-voltage lighting:

- Magnetic (core and coil) - MLV
- Electronic (solid-state) - ELV

Important: Before selecting a dimmer, determine what type of transformer is in the lighting fixture.

Different characteristics of the two transformer types require special dimming considerations. If you have a question concerning what type of transformer a fixture uses, refer to the fixture manufacturer's literature.

Note: Line voltage incandescent and low-voltage fixtures can be mixed on the same circuit, but the correct low-voltage dimmer (for the given low-voltage load) must be used. The total load **must not** exceed the dimmers capacity. **Do not** mix magnetic and electronic transformers on the same dimming circuit.

Note: Some low-voltage fixtures cannot be dimmed. Read the literature from the fixture manufacturer for details.

Differences Between Magnetic and Electronic Transformers

Magnetic:

Magnetic transformers step down 120VAC line voltage to 12VAC or 24VAC. Magnetic transformers use copper, wound around a steel core which is inductive by nature (inductance is the ability of a device to store energy in the form of a magnetic field). Magnetic transformers are relatively large and heavy. Magnetic transformers are primarily available in two types of construction; toroidal and laminated EI core. For these types of transformers, use one of Lutron's magnetic low-voltage dimmers. These products are rated in volt-ampere (VA), which is explained in Dimming Magnetic Transformers on the next page.

All MLV transformers should be equipped with a primary fuse to protect against over heating.

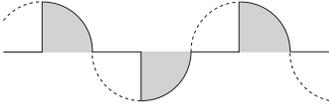
Electronic:

Electronic transformers also step down 120VAC line voltage to 12VAC or 24VAC. This is done with electronic circuitry which is capacitive by nature (capacitance is the ability of a device to store energy in the form of an electric field). Electronic transformers are compact and lightweight. Due to the higher efficiency of ELV transformers, Lutron ELV dimmers are rated in watts, which is the lamp load connected to the transformer.

Differences Between MLV and ELV Dimmers

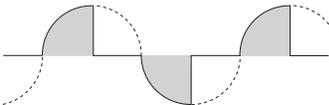
Dimmers for use with magnetic low-voltage transformers use a technology known as standard phase control or “leading edge,” where as dimmers for electronic low-voltage transformers use reverse phase control or “trailing edge.” Standard phase control is for use with either inductive (MLV transformers, fans) or resistive (incandescent) loads. Reverse phase control is for use with either capacitive (ELV transformers) or resistive (incandescent) load types.

Standard phase control or “leading edge.”



With standard phase control, the dimmer does not provide power until sometime later into the line cycle. Once the dimmer starts to provide power, it will do so until the zero cross. Dimming is achieved by delaying the time at which the dimmer starts conducting.

Reverse phase control or “trailing edge.”



With reverse phase control, the dimmer starts to provide power immediately after the zero cross. Dimming is achieved by delaying the time at which the dimmer stops conducting.

Dimming Magnetic Transformers

Why Use Lutron Magnetic Low-Voltage Dimmers?

Magnetic transformers are inductive loads and are sensitive to DC voltages. A magnetic transformer subjected to DC voltage can overheat.

Do not use regular incandescent dimmers for magnetic low-voltage lighting. Regular incandescent dimmers often contain a small amount of DC voltage, which is harmless to a regular incandescent load but may damage magnetic transformers. Lutron MLV dimmers are specifically designed to prevent DC voltage from being applied to the transformer.

Certain MLV transformers may not be compatible with all Lutron dimmers. MLV transformers with built-in input chokes or “debuzzing coils” may not be compatible with certain microprocessor based dimmers. In order to address this compatibility, Lutron offers microprocessor dimmers with a neutral connection. Check with Lutron’s Customer Service or your local Lutron representative for

availability. These transformers should be compatible with standard (non-microprocessor) two wire controls such as Diva®, Nova T★®, and Skylark®.

Some MLV transformers have secondary side protection such as PTC, fuses, circuit breakers or in some cases an electronic overload/fault detection circuit. In almost all cases PTCs, fuses, and circuit breakers are compatible with Lutron dimmers. Check with the Lutron Technical Support Center for compatibility, especially with MLV transformers equipped with electronic overload/fault detection circuits.

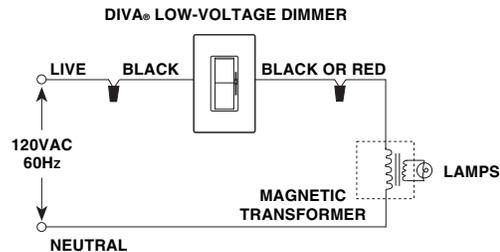
A dimmer controlling an inductive load such as a magnetic transformer is also subjected to large voltage spikes and current surges. Lutron magnetic low-voltage dimmers are designed to withstand these spikes and surges.

The stated VA (volt-ampere) rating is the rated capacity of the magnetic low-voltage dimmer. The wattage rating is provided only as a reference and indicates the lamp wattage that can be placed on a UL approved (80% efficient) magnetic low-voltage transformer without exceeding the dimmer’s VA rating.

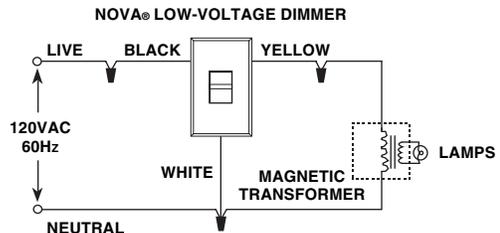
Power to Transformer (Primary)		Transformer Efficiency		Lamp Load (Secondary)
1000VA	x	80%	=	800W

Wiring

Typical wiring for magnetic low-voltage dimmers.



Wiring for a Nova® magnetic low-voltage dimmer (NLV-600, NLV-1000, NLV-1500). Note that only the Nova® single pole, slide-to-off series requires a neutral wire.



Dimming Electronic Transformers

Why Use Lutron Electronic Low-Voltage Dimmers?

Lutron's electronic low-voltage dimmers are designed specifically for the special electrical requirements of electronic transformers. The electrical characteristics of an electronic transformer are capacitive (as opposed to an inductive magnetic transformer) and require special dimming considerations.

Do not use regular incandescent dimmers for electronic low-voltage lighting. When a magnetic low-voltage or incandescent dimmer is used on electronic transformers, there is interaction between the fixture and the dimmer. This interaction will cause any combination of the following: dimmer buzz, fixture buzz, lamp flickering, interaction between circuits, Radio Frequency Interference (RFI), and may damage the dimmer or transformer. To eliminate these problems, use Lutron ELV (electronic low-voltage) dimmers.

Lutron's reverse phase control dimmers for ELV transformers do not expose the transformers to the sharp rise of voltage present in standard phase control (high dV/dT). High dV/dT of voltage can shorten the life of the components in the ELV transformer or create acoustic noise. Lutron's electronic low-voltage dimmers are UL listed for both ELV transformers and incandescent loads.

One advantage of using ELV dimmers on an incandescent load is that it can completely eliminate "AM" radio interference, but they do not provide any advantage at controlling lamp buzz. If you experience lamp buzz refer to Application Note #3.

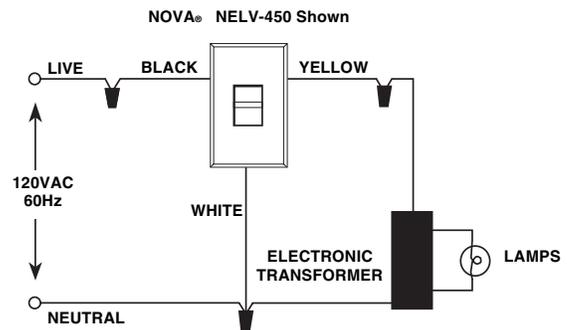
While some electronic low-voltage transformers are labeled as "dimnable with standard incandescent dimmers" Lutron does not recommend this because the best dimming performance is achieved with Lutron ELV dimmers or GRAFIK Eye® system controls. While some GRAFIK Eye® systems use standard phase control for controlling ELV loads, but a large inductor is used to limit the rise time to the load and the system has a neutral connection for accurate zero cross information.

Lutron's ELV dimmers have overload protection. This protection reduces power to the lighting circuit when dimmer capacity is exceeded, thus preventing problems that could occur if the circuit is overloaded.

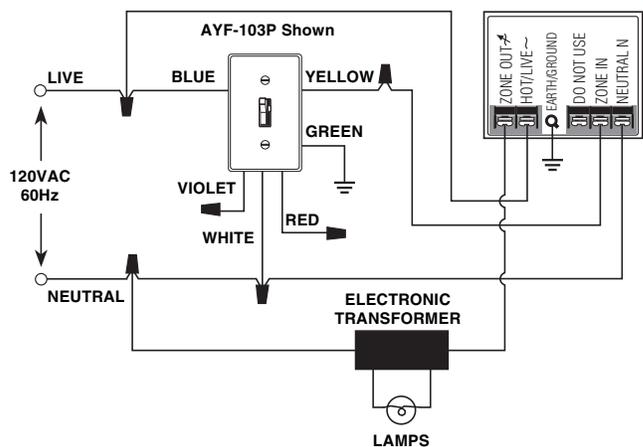
Wiring

Typical wiring for electronic low-voltage dimmers. **Note:** All electronic low-voltage dimmers require a neutral wire.

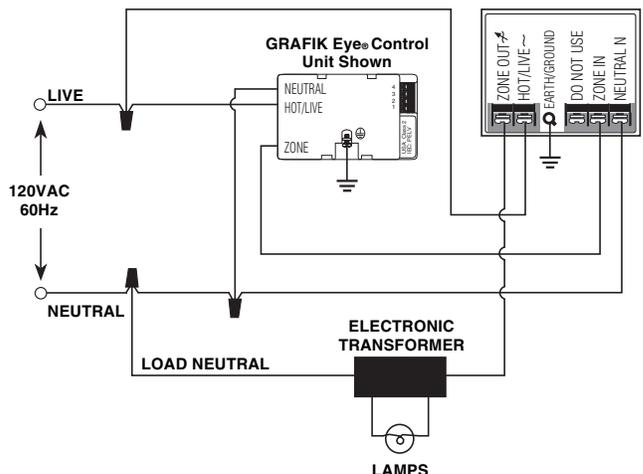
Wallbox Electronic Low-Voltage Dimmer



Fluorescent Dimmer with an ELVI-1000



GRAFIK Eye® with an ELVI-1000



Control Options for Low-Voltage Lighting

Product Family	Magnetic Low-Voltage				Electronic Low-Voltage			
	600VA	1000VA	1500VA	2000VA	300W	450/500W	600W	1000W to 2000W
Ariadni® Single Pole 3-Way	AYLV-600P* AYLV-603P*	HP-2/4/6 ¹			ELVI-1000 ²			
Diva® and Diva Satin Colors™ Single Pole 3-Way	DVLV600P* DVLV603P*	DVLV-10P* DVLV-103P*	HP-2/4/6 ¹		DVELV-300P DVELV-303P	ELVI-1000 ²		
Faedra™ Single Pole Multi-location	FALV-600 FALV-600M	FALV-1000 FALV-1000M	HP-2/4/6 ¹		FAELV-500 FAELV-500M			
Glyder® Single Pole	GLV-600*	HP-2/4/6 ¹			HP-2/4/6 ¹			
Grafik Eye® 3000 Series	Direct	NGRX-PB	NGRX-PB	NGRX-PB	ELVI-1000			
HomeWorks Interactive™ Vareo® Single Pole/Multi-location	HWV-600D	HWV-1000D	NGRX-PB	HP-2/4/6 or NGRX-PB	HWV-600D with ELVI-1000			
Lumea2® Single Pole/3-Way	LTLV-603P*	HP- 2/4/6 ¹			LTELV-303PH			
Maestro® Single Pole/Multi-location	MALV-600	MALV-1000	HP-2/4/6 ¹		MAELV-600			
Nova® Single Pole 3-Way	NLV-600* NLV-603P*	NLV-1000* NLV-1003P*	NLV-1500* NLV-1503P*	NLV-2003P*	NELV-450		ELVI-1000 ²	
Nova T*® Single Pole 3-Way	NTLV-600* NTLV-603P*	NTLV-1000* NTLV-1003P*	NTLV-1500* NTLV-1503P*	HP-2/4/6 ¹	NTELV-300	NTELV-600		ELVI-1000 ²
RadioRA® Single Pole Multi-location	RALV-600L RALV-600LM RAN-600LM*	RALV-1000L RALV-1000LM	HP-2/4/6 ¹		RAELV-500L RAELV-500LM		RAN-600LM with ELVI-1000	RAN-600LM with ELVI-1000
Skylark® Single Pole 3-Way	SLV-600P* SLV-603P*	HP-2/4/6 ¹			SELV-300P SELV-303P	ELVI-1000 ²		
Spacer® Single Pole Multi-location	SPLV-600 SPLV-600M	SPLV-1000 SPLV-1000M	HP-2/4/6 ¹		HP-2/4/6 ¹			
Spacer System™ Single Pole Multi-location	SPSLV-600 SPSLV-600M	SPSLV-1000 SPSLV-1000M	HP-2/4/6 ¹		SPSELV-600			SPSFTU-5A with ELVI-1000
Vareo® Single Pole Multi-location	V-600* V-600*	V-1000* V-1000*	HP-2/4/6 ¹		HP-2/4/6 ¹			

NOTES:

- Use a Hi-Power 2•4•6™ Dimming Module with a 600W incandescent dimmer in this product family; when dimming ELV with a Hi-Power 2•4•6™ Dimming Module, transformer **must** be approved for use with standard incandescent dimmers.
- To dim electronic low-voltage lighting with this control type, use of an electronic low-voltage interface (ELVI-1000) is required in addition to a fluorescent dimmer in this product family. Up to 2 ELVI-1000 may be connected to a single dimmer, this will provide dimming for up to 2000W of an ELV load.

For loads other than those listed, please contact the toll-free Lutron Technical Support Center.

* To reduce acoustic noise a Lamp Debuzzing Coil (LDC) may be used with these products.

Worldwide Technical and Sales Assistance

If you need assistance call the toll-free **Lutron Technical Support Center**. Please provide exact model number when calling.

24 hours/day + 7 days/week

(800) 523-9466 (U.S.A. and Canada)

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Lutron Electronics Co., Inc.
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Made and printed in U.S.A. 5/02 P/N 362-219 Rev. B