Low Voltage System Design and Installation

Incandescent & LED

Step 1

MAKE A PLAN

What do you want to light? Pick favorite trees, interesting plants, fountains or statues, or attractive architectural elements. These items will be the focus of your lighting plan. Think about how you use the property. Are there areas you would like to illuminate for recreation, entertaining, or work? Think about areas in which added light would enhance safety - steps, or a dark wall around the side of your home.

Step 2

PREPARE YOUR EQUIPMENT

LOW VOLTAGE SYSTEMS
Most residential landscape lighting is done with 12-volt distribution. The system consists of a central transformer, weatherproof cable and low voltage fixtures and accessories.

FIXTURES
Decide on what fixtures you will be using as part of your complete lighting plan. Choose styles you like that accept lamps that are appropriate for the application.

TRANSFORMERS
Transformers convert your 120-volt household current to 12-volts. Outdoor transformers can be installed on the side of your house and plug into an exterior outlet. They must mount at least 12" above the ground.

Transformers used indoors (such as in a garage or basement) must be listed for that application. For indoor usage, UL requires an additional mounting plate to guard against fire and conduit must be used. Calculate the total lamp wattage (or VA for LED) your system requires. Then, choose a transformer powerful enough to handle the total wattage/VA and still have some extra capacity.

CABLE
12-volt fixtures take power from a weatherproof, flexible cable that can be used above or below ground and generally does not need to be housed in conduit or buried as deep as 120-volt wiring. 12 AWG cable is the most standard. However, for cable runs of over 100', we recommend 10 AWG or 8 AWG.

Measure the distance from the last fixture on the run to the transformer to calculate the amount of cable needed. Add 1'-2' of cable per fixture to allow for repositioning.

Step 3

WIRING YOUR SYSTEM

CABLE FIXTURE AND LAYOUT
If your lighting plan requires more than one transformer, you will need to divide the fixtures into groups or zones. To do so, consider the many areas of your property and how they are used. You may want all of the front yard lighting on one transformer, patio and deck lighting on another transformer, etc. The location of your electrical outlets will also help you to determine how to group the fixtures.

Maximum Cable Length per Total Fixture Watts/VA							
Cable Size	**50w VA**	**75w VA**	**100w VA**	**150w VA**	**200w VA**	**250w VA**	**300w VA**
12-2	300'	200'	150'	100'	75'	60'	-
10-2	475'	318'	240'	160'	120'	100'	80'
8-2	750'	506'	380'	250'	190'	150'	125'

DETERMINING VOLTAGE DROP

VOLTAGE DROP
Excessive voltage drop occurs when too much wattage is placed on a cable that is too long or too small for the load. Voltage drop causes lamps furthest from the transformer to be dimmer than those near the transformer. To help minimize voltage drop among each group of fixtures, use the following information to assist you:

Total Watts/Volt Amps = sum of wattage/VA on a single run of wire.

Cable Length = length of cable run (feet) from transformer to the last fixture on that run.

Cable Constant = thickness of copper wire. The thicker the wire, the lower the conductive resistance, resulting in a lower drop in voltage.

CALCULATING VOLTAGE DROP
You can calculate voltage drop in volts using the formula below. It also shows the relationship of wattage/VA, run length and two-conductor cable size (given by the cable constant). Adjust lamp wattage/VA, number of fixtures per run, or the length of the run to maintain the right relationship.

$$\text{Voltage Drop} = \frac{\text{Total Watts/VA x Cable Length}}{\text{Cable Constant}} \times 2$$

The cable constant is based on wire size. (Remember that larger wires have lower AWG sizes).

Cable	Constant
18 AWG	1,380v
16 AWG	2,200v
14 AWG	3,500v
12 AWG	7,500v
10 AWG	11,920v
08 AWG	18,960v

EXAMPLE:

$$\text{Voltage Drop} = \frac{\text{150w/VA x 75}}{\text{7500 (12 AWG Cable Constant)}} \times 2$$

Then, subtract the voltage drop from transformer output to operate in desired range:

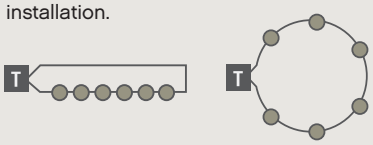
15-volt tap – 3 (voltage drop) = 12 (actual voltage)

Voltage should not drop below 10.8-volts. In this case you should choose to use higher outputs to **keep voltage in desired range of 11.2-volts–11.6-volts.**

Lighting fixtures will generate heat. To avoid excessive heat be sure to keep all lamps clear of dirt and debris. Input voltage at the lamp on low voltage fixtures should never exceed 12-volts.

The following diagrams will help you wire your system. The black box represents the transformer:

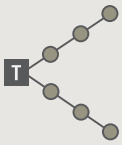
LOOP INSTALLATION
Here, fixtures are arranged in a loop, reducing voltage drop. It is essential that cable polarity be maintained in the installation.



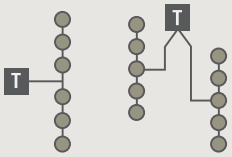
HUB INSTALLATION
With a Hub installation, fixtures in a group are connected at a central hub. The voltage drop will be virtually identical for each fixture, which makes this installation option optimal. Fewer connections are needed, simplifying troubleshooting and servicing the system.

STRAIGHT RUN INSTALLATION
Fixtures run in sequence directly from the transformer.

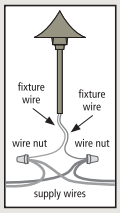
SPLIT LOAD INSTALLATION
With a Split Load installation, fixtures run in two or more directions from transformer. Locating the transformer in the center of the run reduces the effect of voltage drop. Be sure to connect wires to the transformer as you would when using straight run installation.



"T" INSTALLATION
A "T" installation allows more equal distribution of power to the center of the run, or to the run some distance away. If lengthy runs, Use 8 AWG cable to split. Use 12 AWG cable to cross the “T” between fixtures.



FIXTURE CONNECTION
Hinkley low voltage fixtures come standard with a connection kit, (2) wire nuts and silicone caulk. Fixtures should be attached by splicing them into main supply cable. Wire nuts should be filled with silicone. Twist the wires, then screw on the wire nut. Wrap with electrical tape. Bury any extra wire at the base of fixture to allow for relocation or adjustment.



After wiring your lighting plan, turn the transformer on and check the lamp voltage at each fixture:

Effect of Voltage on Lamp Life/Light Output

Voltage at Lamp	Life Expectancy of Lamp	% of Rated Candlepower
13.2	2/3 rated life	350
12.6	¾ rated life	180
12.0	as rated	100
11.5	2 x rated	80
11.0	3 x rated	75
10.75	4 x rated	70
10.5	5 x rated	65*
10.0	9 x rated	50

* Lowest recommended candlepower output

MOUNTING
Hinkley low-voltage fixtures come standard with the 0014 BZ ground spike (see accessories, page 51) and can be easily relocated every several years to adjust for the natural growth of trees and plantings.

Step 4

CONSIDER ACCESSORIES

CONTROLS
Controls enhance landscape lighting, just as they do interior lighting. Photocells, timers and special lenses can help control your lighting plan.

PHOTOCELLS
Photocells turn the lighting on when the sun goes down. You can combine a photocell (on) and a timer (off) to avoid wasting energy after the household has retired for the night.

TIMERS
Timers provide automatic on/off control, according to how you program them and can be used in conjunction with photocells.

LENSES
Hinkley lenses are available for use with spotlights to create directional beams of light, diffuse lamp beam spread, enhance color and to reduce overall glare.

Troubleshooting

Some of the more obvious reasons why a landscape lighting system will not operate are:

- The 120-volt power source is off, disconnected or the breaker/GFCI is tripped.
- The 120-volt source is on a switched receptacle and the switch is in the off position.
- The Transformer has an on/off switch and it is in the off position.
- If unit has a built in timer and the timer is in the off position.
- If the unit has a built in photocell and the photocell is receiving light and is therefore in the off position.
- If the transformer has a built in secondary or primary fusing device that has blown due to a system problem.
- If the cables leading from the transformer out into the landscape have been cut.
- If the cables entering the transformer are wired incorrectly.

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For Nexus 15v High Performance LED installation instructions, contact Hinkley Lighting direct.