Installation Instructions

TRANSFORMER INSTALLATION

WARNING: Transformers must be installed in accordance with the National Electrical Code (NEC) and local codes. Failure to do so will void the warranty and may result in serious injury and/or damage to the transformer.

1. Find a suitable, flat-surfaced location to mount transformer, taking in to consideration proximity to 120-volt AC power source.
2. Should be mounted at least 1.5' from the ground for safe and convenient operation.
3. Hang transformer case securely with screws.

TRANSFORMER SIZING: Low voltage lighting systems require the use of a transformer to reduce the standard 120-volt power from ordinary household electricity to the 12-volt needed to power low voltage lamps. Transformers vary in size or capacity. The total lamp wattage (load) of all fixtures connected to one transformer must not exceed the wattage capacity of the transformer. Therefore, to determine the transformer size needed, simply add up the wattage of all lamps you plan to use +10% for cable & connection factor. (Low voltage cable and fixture connections add hidden watts to your system.)

TRANSFORMER SIZE = TOTAL FIXTURE WATTS x 1.1

TIP: All low voltage connections must be tight and waterproof. Select a transformer that matches as closely as possible your total lamp wattage. For example: if you have 24 fixtures all rated at 5 watts, you will need a 150-watt transformer (24 x 5 = 120 watts plus 10% = 132). If your total wattage is too great, either divide the total load between two transformers or use a more powerful model. Selecting a transformer with about 20% higher capacity than your total lamp wattage will allow for adding a few fixtures later.

LOW VOLTAGE CABLE LENGTH: In planning a low voltage system, it is necessary to consider the impact of voltage drop. Because of cable's inherent resistance, voltage drops along its length: the end-of- run lamps will be dimmer than those at the beginning. Since voltage drop is a function of cable length and cable size and total fixture wattage, voltage drop can be minimized in several different ways.

- Use multiple cable runs
- Use heavier gauge cable (12 or 14 gauge)
- Shorten cable lengths or runs
- Reduce wattage of individual fixtures
- Reduce the total number of fixtures on a run
- Use multiple transformers in different locations

Cable is measured by gauge. The lower the number, the thicker the cable and the more current it carries. Cable for low voltage lighting is available in three gauges: #14-2, #12-2, #10-2, and #8-2. As noted, #8-2 gauge is the largest and is capable of carrying the most current. Refer to the Cable Length Guide below to estimate the maximum allowable cable length that will keep the farthest fixture from the transformer from becoming too dim (below 10.5 volts). In addition, your transformer's output options, the design of your lighting system and corresponding cable layout can help minimize voltage drop (see 12-Volt Cable Layout Options, Output Adjustment Switch, and Multi-Tap Installation sections).

TIP: Expect a voltage drop of greater than 1.5 volts when cable length is longer than recommended. Use the formula below to calculate maximum cable length.

$Vd = L \times W \times 2 / Kc$

Voltage drop in the section of cable, in volts.

L = Length of the section of cable (one way distance), in feet.

W = Total Watts carried by the section of cable for the lamps it supplies.

Kc = 'Cable Constant', as follows:

Cable Size AWG	Kc
14	3500
12	7500
10	11920
8	18960

TROUBLESHOOTING CHECKLIST

Although low voltage lighting systems operate with a minimum of maintenance, occasionally some problems will occur. Here are solutions to some of the most common problems.

Entire system will not operate

1. Check 120-volt outlet to ensure you have power to outlet.
2. Check or reset circuit breakers on transformer.
3. Check low voltage cable connection at transformer.
4. Check transformer alone by disconnecting low voltage cable from output terminals, by passing timer and/or photocell as explained previously, and checking Input and Output power with your electrical tester.

II. System operates for 15 minutes, and then turns off.

1. Timer incorrectly set. See setting procedure.

III. Circuit breaker on transformer trips

1. Check end of cable to ensure copper strands are not touching.

2. Check connection of cable at transformer to ensure copper strands are not touching.

3. Recalculate total wattage to ensure that you have not exceeded rated wattage of transformer. 4. Check for other shorts at fixture connection points.

WIRE METHODS

"T" Method installation (RECOMMENDED) Allows more equal distribution of power to the center of the run, or to run some distance away. Cable running from the transformer must be a heavier gauge (12 AWG Wire).

Important: Group fixtures into distance zones from the transformer (examples: 0-50', 50-75' and 75-100'). Do not have a fixture that is 10' away from the transformer on the same cable run as a fixture that is 100' away. Try to center load your runs as much as possible to minimize the voltage differential between the first and last light (one volt difference is optimum; two volts is too much). All the lights can be in the 50-75' zone but you still need to run several separate cable runs to reduce the load per cable, thereby minimizing voltage loss. Typically, a 300-watt transformer has three separate cable runs with about 80 to 120 watts on each cable - a 600-watt transformer has about five separate cable runs, again, with about 80 to 120 watts on each cable.

- After you have determined the location(s) where you will be installing your Transformer(s) and fixtures, draw lines on your plan to indicate your cable runs.
- Keep your runs as short as possible by avoiding unnecessary backtracking.
- There are at least five different ways to layout your cable paths:

Remember: For maximum light output and lamp life, the goal in low voltage systems is to provide each lamp with between 10.5 - 11.5 volts. To stay within this 1 volt optimum differential, you must group the fixtures into distance zones from the transformer and not overload the cable with excessive wattage. When it's possible, center feed the zone as this will provide a much more even voltage to each fixture.

1. **Series** - Most common. The cable is laid as one long run with lights located along the run. Other words for this are "Snake" or "Daisy Chain" - e.g. you have one long snake of lights.
2. **Hub** - The hub method is when several lighting fixtures are connected to a single junction. A wire then connects the junction to the transformer to supply the power. A lighting system may use several hubs - all connected to a single transformer. Back In the day when all lighting used incandescent or halogen bulbs, hubs were needed to ensure that every fixture received exactly the same voltage. Now, with LED systems, the acceptable voltage range is much wider (8V to 15V compared to the previous 10V to 12V). This means that hubs are no longer needed to equalize the voltage. But there are many other reasons why hubs are smart for all systems - even LEDs. **Ideal for use of equal diming of wire zones.**
3. **Tee** - Allows more even distribution of power to the center of a run or to a run some distance away (e.g. across a driveway or under a sidewalk). Heavier gauge cable or a double run of cable should be used to make the tee.
4. **Loop** - Allows for relatively uniform light output - However, you must be extremely careful to connect the same wire ends to the proper transformer terminals. **Ideal for use of equal diming of wire zones.**