Neon Transformer Q & A

What is a transformer?
A transformer is a device used to step up or step down (transform) voltages by magnetic means.

How do standard transformers work?
Alternating Current (AC) flowing through an input coil (the primary) creates an alternating magnetic flux in the core. When another coil (the secondary) is positioned on the core near the primary coil, the magnetic flux will travel through the core magnetically linking the secondary to the primary coil. This magnetic coupling to the secondary coil will induce a voltage across the secondary coils output terminals. The voltage present at the secondary terminals will be determined by a ratio of the number of secondary coil turns to the number of primary coil turns. Coil turns are sometimes referred to as windings. A larger number of windings on the secondary coil than the primary coil will result in a step up in voltage while fewer windings result in a step down in voltage.

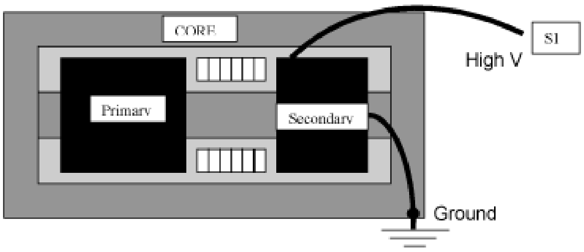
Are transformers used for luminous tubing different than transformers used for other electronic applications?
Yes, luminous tubing transformers, sometimes referred to as high leakage reactance transformers, differ from power transformers.

Power transformers are designed to have good voltage regulation over varying load conditions where the output voltage varies only slightly from no load to full load conditions. Luminous tube transformers have deliberately poor output regulation due to magnetic shunts designed into the construction of the transformers. Poor regulation is necessary to limit the current for proper operation of luminous tubing. The reason for this is because luminous tubing requires a high voltage to start the flow of current, but the transformer must maintain output load current within a narrow range.

How do magnetic shunts work?
The shunt assembly will bypass some magnetic flux away from the secondary coil. This allows a lower voltage across the load while limiting the required current.

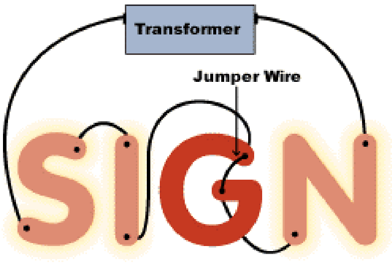
What is End Grounding?
Lower voltage luminous tube transformers (typically less than 5000V) will often use a grounding technique called End Grounding (EG). This design utilizes one primary coil and one secondary coil with one end of the secondary coil connected to the core of the transformer (ground) with the remaining lead used as the high voltage lead.

END GROUNDING



What is Mid-Point Grounding?
A mid-point grounded (MPG) transformer consists of a primary coil and two secondary coils. The two basic configurations for Mid-Point Grounding are Unbalanced and Balanced.

Unbalanced Mid-Point Grounding: Transformers used to drive luminous tube at mid-level voltages (typically between 4000- and 9000-Volts) are often of an unbalanced mid-point ground design. In this type of design the secondary coils are both mounted next to each other at one end of the core with the primary coil at the opposite end of the core. One end of each secondary is bonded to the core and the case as the ground reference. This design must be series wired to the tube load (S1 to S2).



Balanced Mid-Point Grounding: A balanced mid-point ground neon transformer consists of a primary coil in the center of the core and a secondary coil located on each side of the primary. One end of each secondary is bonded to the core and the case as the ground reference. This design may be series wired or mid-point wired to the tube load(s). Although used mainly for the higher voltages, the balanced mid-point ground design covers a broad range of voltages (4,000-Volts to 15,000-Volts). The maximum allowable voltage from any secondary to ground is 7,500-Volts. To achieve 15,000-Volts for the tube load this type of transformer must be wired with the tube load in series between the two secondary terminals (S1-S2).

What are the different styles of luminous tube transformers?
The three basic designs are Indoor Open Core and Coil, Outdoor- and Self-Enclosed-Non-Weatherproof, and Indoor Pendant-

(Hanger type) and Indoor Frame-Mount Transformers (Window Frame/"Beer Sign" type).

• Indoor Open Core and Coil: These are open core and coil units without encapsulation or protective enclosures.
• Outdoor-Non-Weatherproof and Self-Enclosed-Non-Weatherproof: These luminous tube transformers are designed for protected outdoor use and built in traditional metal cans. They must be installed in enclosures that will protect them from the environment.
• Indoor Pendant- and Indoor Frame-Mount Transformers: Also referred to as Hangar ("Beer Sign") and Window Frame type transformers, these units are designed for hanging or suspending the transformer or for mounting to a metal frame. These units are listed for indoor usage only.

How do you dissipate the heat generated by a luminous tube transformer?
Core losses and wire resistance both contribute to transformer losses that create heat in a transformer. The three ways a transformer dissipates heat are through radiation, conduction and convection.
• Radiation: Proper ventilation will help a transformer dispel heat into the surrounding air.
• Conduction: Conduction provides the most efficient means of dissipating heat from a transformer. The method used for mounting the transformer within the transformer box will determine the effectiveness of conducted heat dissipation. Maximum surface to surface contact (one or more sides of the transformer box to the sign enclosure) will ensure optimum heat transfer and maximum cooling. Double nut mounting of the transformer will reduce the effectiveness of conduction, so always properly mount transformers using only single nuts.
• Convection: In an enclosed cabinet proper positioning of the transformer along with strategic positioning of vents will help to create an airflow through the enclosure. This is usually achieved with a vent at the bottom and another vent at the top of the cabinet.

What is Power Factor?
Power Factor (PF) is the ratio of real power (measured as watts) to apparent power (volts x amps). 1.0 is an ideal power factor. High Power Factor (HPF) is any PF above .90. HPF means less line current per watt consumed, which means more transformers per power branch circuit.

Actual Power (Watts RMS) / Apparent Power (Volts x Amps)

"Normal" operation of a neon transformer is low power factor. Additional capacitor and windings are needed for HPF. Since utility bills are based on kilowatt-hours, HPF yields no savings on electricity bills.

What happens when a luminous tube transformer is overloaded?
Overloading occurs when more tubing than a transformer is designed to drive is attached to the transformer. Overloading the secondary of a luminous tube transformer will produce higher voltages across the secondary that result in increased stress on the insulation system. The increased stress can lead to insulation failure and reduce transformer life. Luminous tube may flicker from the high voltage spikes produced when the transformer is overloaded which again will damage the insulation system and reduce transformer life.

What happens when a luminous tube transformer is under-loaded?
Under-loading occurs when less tubing than a transformer is designed to drive is attached to the transformer. Under-loading forces the transformer to supply excessive tube current resulting in increased wire losses and high operating temperatures in the transformer. The high operating temperatures of the transformer will reduce its expected life.

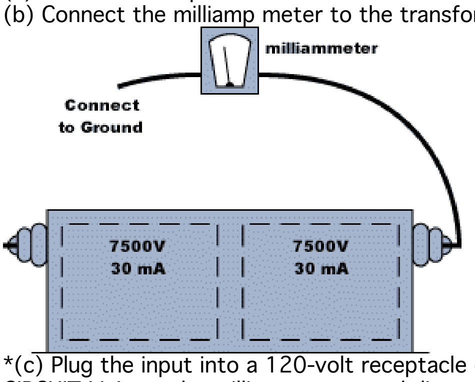
How do you determine proper loading for a luminous tube transformer?
Approximate loading can be determined by use of the Luminous Tube Footage Chart supplied with the Universal Lighting Sign Illuminating Products catalog. You'll need to determine Neon or Mercury/Argon tubing, tubing diameter, total tubing footage and current rating. When using the chart deduct one foot from the chart figures for each pair of electrodes. For approximating volt-ampere ratings of High Power Factor type transformers, multiply the listed volt-amperes by 55 percent.

Warning: Potentially hazardous high voltages may be present. Only Qualified Service Personnel should test or service these products.

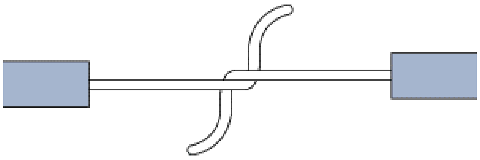
The procedure to determine exact loading is the % I.S.C. (percent short-circuit current) test.

% I.S.C. for Neon Transformer Loading
With Power Off:

(a) Connect the input leads and voltmeter to the transformer primary terminals.
(b) Connect the milliamp meter to the transformer high voltage terminals.



*(c) Plug the input into a 120-volt receptacle or adjust Powerstat to read 120 volts on the voltmeter. Read the SHORT CIRCUIT M.A. on the milliamp meter and disconnect input plug.
(d) Connect the tube load in series with the transformer high voltage terminals and the milliamp meter.



*(e) Plug in the input cord; adjust Powerstat for 120 volts and read LOAD M.A. on milliamp meter.
(f) Calculate for Percent of Short Circuit (%I.S.C.):

A. % I.S.C = (LOAD M.A. / SHORT CIRCUIT M.A.) X 100

EXAMPLE:
LOAD M.A. = 24
SHORT CIRCUIT M.A. = 30

% I.S.C. = (24/30)X 100 = 80%

B. Proper % I.S.C. Ranges:
77.5% to 82.5% (Indoor and Outdoor Enclosed)
82.5% to 85% (Cold Weather – Mercury filled tubing)

**This description is for a transformer with rated input voltage of 120. Refer to the nameplate of the transformer under test and use input voltage shown.*

What is RFI?
RFI stands for Radio Frequency Interference. Radio interference is any signal, whether radiated as radio waves or conducted on the power lines that interfere with radio or television reception.

The arc of a luminous tube generates radio noise in a fashion similar to the way the original spark gap transmitters for radio functioned. Spark gap transmitters utilized antennas to radiate radio waves for broadcast. Like the spark gap transmitter antenna, a luminous tube acts as an antenna, which broadcast RFI over some unknown distance. RFI can also be conducted back through the transformer to the power lines. Sometimes a filter may be used to reduce the affects of RFI on the power lines.

What is the "capacitance" effect?
Stray capacitance is present in all wire. In cable attached to the secondary outputs of a transformer the sum of this capacitance (according to total cable length) shows up at the transformer terminals.

The effect of this capacitance is a reduction of the transformer's ability to limit current. This will cause an increase in current in both the tubing and the transformer, the same effect as underloading the transformer. When secondary leads are placed in conduit the additional capacitance causes higher voltage stress on the insulation system and an increase in operating temperature.

How do you check the capacitive current on a transformer?
With a True R.M.S. voltage meter measure the output voltage with the load attached to the secondary terminals. If the voltage is more than 60 percent of the rated open circuit voltage, the capacitive current will negatively affect the system.

To minimize the effects of additive capacitance the cables tied to the secondary terminals should be kept as short as possible. Short lead lengths and mid-point grounding will help minimize capacitive effects.

Why does a sign still flicker when only one lead is connected?
Current can still flow through luminous tube when only one lead is connected to and energized transformer. The tubing and secondary lead act like one plate of a capacitor while the disconnected secondary lead acts like the other plate of the capacitor. A small amount of leakage current will flow between the two disconnected elements. This flow of current while not high enough to completely illuminate the tube can still be high enough to cause the tube to flicker.

Are Normal Power Factor and High Power Factor transformers interchangeable?
Possible, but not a good idea. When going from NPF to HPF utilizing the same OCV and output current there should be no problems. In fact, when going in this direction you can actually install more transformers to the branch circuit without overloading.

MAYBE. When going from HPF to NPF utilizing the same OCV and output current you must keep in mind that the input current will almost double. It would be possible to overload the branch circuit if there is not sufficient current capacity available in the circuit.

Can you exchange a 30mA with a 60mA transformer?
Not a good idea. For a given type of tubing, 60mA will cause the tube to burn approximately twice as bright as 30mA tube. In some cases the tube may not appear brighter to the human eye.

When going from 30mA to 60mA keep the following in mind:
• When increasing the mA rating on a sign with a plastic face, the increased brightness may make the tubing's outline apparent.
• Tubing electrodes are designed for specific mA ratings – 60mA electrodes will usually not be installed with a 30mA transformer.
• 60mA transformers require higher input current.

• 60mA transformers will be physically larger than 30mA units.

What is UL-2161?
UL-2161 establishes the criteria that "secondary fault protection" products must meet. UL-2161 is a new UL Standard that covers both Neon Transformers and Electronic Neon Power Supplies.

The 1996 National Electrical Code contains revisions to Article 600 (Electric Signs and Outline Lighting) that affect the design of some neon transformers. The changes require that some neon transformers must possess "secondary fault protection." These changes were implemented to minimize the possibility of fire as the result of improperly installed luminous tube signage.

Does Universal Lighting Technologies have transformers listed to UL-2161?
We have two new product lines NOT YET listed to UL-2161, which we plan to have listed in the near future. (UL-2161 testing is tentatively set for April 1998.) The new units (M___I___N-C's and M___I___N-T's) are UL Listed for compliance with UL Standard UL-506 for Specialty Transformers. This is the same standard to which all our "traditional" neon transformers are listed.

How does Universal Lighting Technologies plan to meet UL-2161?
Our Isolated Design Outdoor Non-Weatherproof (secondary open circuit voltages from 3000- to 7500-volts) and TriFormer™ (secondary open circuit voltages from 9000- to 15000-volts) luminous tube transformers are both designed to comply with UL-2161. Both of these transformers are designed to meet UL-2161 by utilization of isolation of the secondary windings.

What does "Isolated Secondaries" refer to?
Traditionally, neon transformers were constructed with the secondary winding either "End Grounded" or "Mid Point Grounded." This refers to an electrically conductive connection of the secondary coil to "ground" potential. In an "Isolated" design, there is no connection between the secondary coil and ground. The secondary is essentially floating with respect to the primary. The advantage to this design is that the secondary will not arc to ground under any circumstances, even in a broken tube situation.

How does an "Isolated" type design differ from the Mid-Point or End Grounded type transformers?
There are several differences worth noting:

(1) If you were to short one output terminal to "ground":

... a secondary grounded transformer would produce a current flow though the short circuit to ground.

... an Isolated transformer would not produce a current flow through the short circuit to ground.

(2) If you were to take a lead connected to the output terminal and bring it near "ground":

... a secondary grounded transformer WILL produce a CONTINUOUS ARC due to its voltage-to-ground potential. The higher the voltage rating, the greater the distance through which it will arc.

... an Isolated transformer MAY produce an INTERMITTENT SPARK due to capacitive coupling. The distance through which the spark could be generated is a function of the coupling.

(3) In order to operate the neon tubing load,

a) The isolated transformers (M___I___N-C's) require the tubing to be connected in "series" from output bushing S1 to S2, with no grounding of the tube load. This is the same as our existing 725 Series product line. This differs from Mid-Point Grounded transformers in which the tube load may be mid-point wired to ground.
b) The isolated TriFormer™ (M____I___N-T's) products require that the tubing be wired in a mid-point wiring configuration (bushing "S1" – tube – bushing "M" – tube – bushing "S2) with no grounding of the tube load. This differs from Mid-Point grounded transformers in which the tube load may be mid-point wired to ground.