

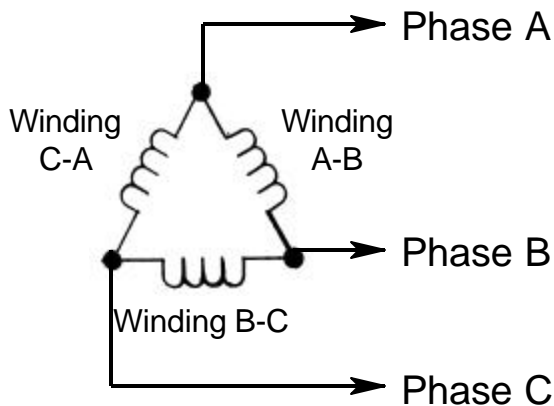
## Delta and Wye Power

Three-phase power is required for almost all industrial and high power commercial equipment. There are many economic benefits that make three phase power attractive for this type of equipment. Transformers, filters, power supplies, and conductors can all be smaller and less costly with a three phase system than with a single phase system of equivalent power.

In the United States, there are two main types, or topologies, of three phase power. These are called **Delta** connected power, and **Wye** connected power. There are some similarities between Delta connected power and Wye connected power, and many differences. It is important to understand these two varieties of three phase power in order to properly specify power for your critical loads.

### Delta Connected Power

Delta connected power is developed from three, independent transformer or generator windings that are connected head to toe. There is no single point common to all phases. Delta power is named after the schematic resemblance of the windings to the Greek letter Delta ( $\Delta$ ).



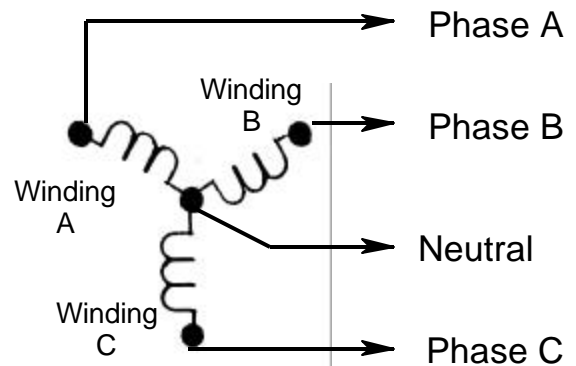
**A Delta Connected Source**

Delta connected power is not commercially used in Europe. Three-phase European equipment requires Wye-connected power.

## Application Note - AN-15

### Wye Connected Power

Wye connected power is developed from three, independent transformer or generator windings that are connected at a common point, called a neutral or star point. Wye power is named after the schematic resemblance of the windings to the Greek letter Wye ( $Y$ ).



**A Wye Connected Source**

### Delta vs. Wye Power

Wye connected power has two different voltages available. The Phase to Phase voltage is the main system voltage (typically 208 VAC or 480 VAC in the United States). The Phase to Neutral voltage is also available, and is typically used for small single phase loads (120 VAC or 277 VAC).

Delta connected power only has a single voltage level available: the Phase to Phase voltages. Other voltages can be obtained only by using step-up or step-down transformers.

Equipment designed to operate from Delta connected power, such as air conditioners or motors, can also operate from Wye connected power without a problem, since the Phase to Phase voltages are available in both systems. However, equipment that requires Wye connected power cannot operate from a Delta connected source. The Phase to Neutral voltages are not available. A special isolation transformer, designed to convert Delta to Wye, is used in this case.

### Grounding of Delta and Wye Systems

It is common practice to ground the neutral, or center point of a Wye connected source. In most cases, this grounding is required by the United States' *National Electric Code* (NFPA-70). By grounding a Wye system, the voltages to ground are stabilized and controlled. This makes a system much less susceptible to impulses, ringing transients, and faults that cause high voltages to ground.

A Delta system is not required to be grounded, although some Delta systems are grounded. Usually these are grounded to one phase or to a center tap of one of the phases. This type of grounding is rare, however. In most cases, Delta systems are not grounded.

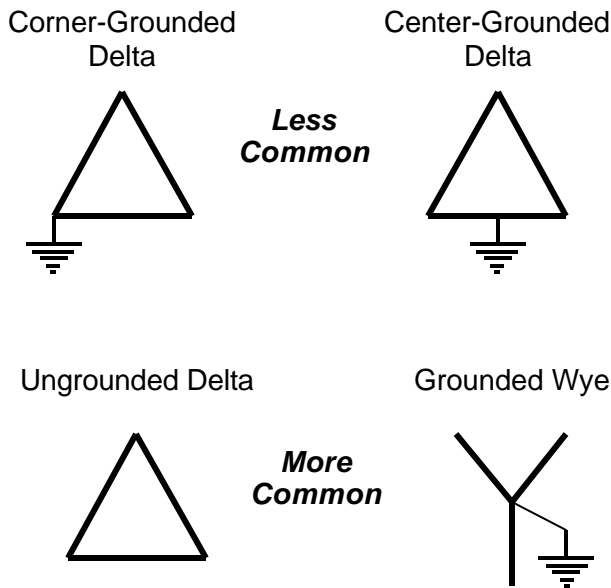
### Ungrounded or Floating Sources

Ungrounded sources are often called *Floating*, because they float with reference to earth ground. System and wiring capacitance determines the voltage on any system point with reference to ground. As a result of this, the Phase-Ground voltages on an ungrounded source are very susceptible to power quality disturbances. These include:

- Voltage transients
- High frequency noise

Because of this susceptibility, Delta connected power is not commonly used to power sensitive electronic systems unless special power conditioning (filters, transformers) is used to attenuate these types of disturbances.

Ungrounded sources are sometimes used in special industrial systems such as paper mills, glass furnaces, etc., where power continuity is critical. An ungrounded source will not trip a circuit breaker until two phase to ground faults occur. However, in these cases, special fault monitoring circuits inform the facility personnel when a single fault occurs so that it may be corrected at the next scheduled shut-down.



*Delta and Wye Grounding*

### Delta or Wye Connected Power ?

It is common to find either Delta or Wye connected power within North American facilities. If a piece of equipment is designed to operate from a Wye connected source, using a Delta source can cause safety, reliability, and operation problems.

In these cases, a Delta-Wye transformer, such as found in many power conditioning devices, will convert the facility Delta connected power to a Wye connected source. Unfortunately, it is not always easy to determine which type of power is found within a particular facility until the actual equipment installation is underway. As a result, if equipment requires Wye connected power, adding a Delta-Wye transformer makes sense to improve system performance and to minimize unexpected site problems.

**TEAL Electronics** designs three phase power conditioners which are based on a low-impedance, Delta-Wye transformer. TEAL units accept either Delta or Wye power.