

# DRIVE ISOLATION TRANSFORMERS

## General

Motor drives, such as variable frequency and adjustable speed, are becoming more and more popular every day. They are used to adjust the speed of induction motors by varying the frequency. Motor drives are becoming more

popular because of their impact on energy savings, and because they are easy to control. Plant and facility managers are becoming aware that these motor drives cause harmonic voltage distortion, electrical noise, and line voltage

notching, but what is lesser known is that a drive isolation transformer placed in front of these motor drives is a simple, cost-effective solution to the power quality problems created by the motor drives.

## Motor Drives and Power Quality Problems

The basic motor drive uses a rectifier to convert AC to DC. Rectifiers are made up of diode bridges or silicon controlled rectifiers (SCR) which creates a non-linear current waveform. Most motor drives are three phase (6 pulse) devices. In three phase circuits, there is a brief moment when more than one SCR is on at the same time creating a momentary short. This short imposes mechanical stress on the upstream transformer and causes

a distorted voltage waveform as a notch. The number of notches per cycle is equal to the number of pulses or SCR's in the circuit. This distorted waveform and notching have serious effects on other equipment connected to the same circuit as the motor drive. The distorted waveform contains harmonics that can cause power factor correction capacitors to resonate. Notching causes CPU's to shut down, controllers to malfunction, synchronization

problems, UPS output voltage oscillation, and some digital clocks to run fast.

Motor drives also introduce large ground currents due to the rapid current changes in the SCR's that are capacitively coupled through ground. High frequency ground currents (noise) cause data disruption in digital communications.

## Solution

Inserting a drive isolation transformer in front of the motor drive reduces the harmonic distortion, attenuates electrical noise, and diminishes line voltage notching caused by motor drives. The addition of the inductive reactance from a transformer to the motor drives power source effectively reduces the notching effects it has on the power to other loads. In three phase applications, drive isolation transformers reduce

harmonic distortion by eliminating the triplen harmonics (when the transformer is connected delta - wye). The harmonics produced by the motor drive are trapped in the delta primary of the transformer. The transformer must be K-rated to handle the heat generated by the trapped harmonics in the primary. A reduction in harmonic distortion improves the power factor and reduces the harmonic effects on other loads.

Attenuation of electrical noise due to ground currents is achieved by isolation and shielding. The secondary of drive isolation transformers is isolated from the primary providing a good amount of noise attenuation. Multiple shielded drive isolation transformers provide excellent noise attenuation needed to prevent data disruption in digital electronic equipment.

## Drive Isolation Transformers vs. Standard Isolation Transformers

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Some isolation transformer manufacturers will take their standard transformers and re-label them as drive isolation transformers. They are able to do this because there are no standards to differentiate the two. That is why it is important to make sure the isolation transformer is able to operate as a drive isolation transformer when it comes time to make a purchase.

In order for a transformer to qualify as a drive isolation transformer, there are a few criteria it must meet. The transformer must: meet the IEEE 597 standard on overloads; be listed to UL 1561 for non-sinusoidal current loads; have an inductive reactance level of no less than 3%; and be designed to handle the thermal and mechanical

stresses of highly cyclic process control applications.

Standard isolation transformers do not meet the criteria of a drive isolation transformer. Some of these transformers may meet one or two of the drive isolation transformer criteria, but can not truly be used as a drive isolation transformer.

## Ultra-K

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The *Ultra-K* manufactured by Controlled Power Company meets the stringent requirements of a drive isolation transformer. It conforms to IEEE 597 standard on overloads; is offered in K-factors of K-4, K-7, K-13, and K-20 to handle

the heat generated by harmonics; has a typical inductive reactance of 3%; and is manufactured with extra braced coils to handle the mechanical and thermal stresses imposed by the short circuit conditions of the rectifier. The

*Ultra-K* has double or triple shielding for optimal electrical noise attenuation, and comes with the option of a high frequency filter and TVSS for additional surge suppression.

## Summary

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Today, motor drives are very popular in industrial applications. Rectifiers found inside of motor drives create line voltage notching, electrical noise, and harmonics wreaking havoc on electronic devices. Drive isolation transformers are needed to correct

for these power problems. The following conditions must be met in order for a transformer to be a drive isolation transformer: IEEE 597 standard on overloads; listed to UL 1561 for non-sinusoidal current loads; obtain no less than 3% inductive reactance; and built

for high mechanical and thermal stress. Controlled Power Company's *Ultra-K* is the only transformer that offers all of the important features of a drive isolation transformer all in one package.



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