Application of the RVSS to replace wye-delta motor starting

Replacing a wye-delta motor starter with an RVSS soft starter

Application

The wye-delta method of motor starting has been established for many years. It is today still a viable and reliable method of motor starting. Replacing a wye-delta starter with a reduced-voltage solid-state soft starter (RVSS) brings new features and benefits to an existing application, allowing the system to benefit from new controls and protections.

Overview

A wye-delta starter generally consists of several contactors with mechanical and electrical interlocks, and a timing system. In its simplest form, a timer is used to control the length of time the motor is first started using the wye winding contactors of a six-lead motor, and then switched to "rewire" the motor using the delta winding contactors. The start time is selected based on experience and/or observation of how much time the motor takes to reach synchronous speed. Another function of the timer is to control the transition time between releasing the start contactor and energizing the run contactor. An open or closed transition method may be employed. A separate timer may also be used for this purpose. There are several variations of this procedure, but the process is that of timed control of contactors to start and run the motor.

The tried-and-true functionality of the wye-delta starter is offset somewhat by the requirement of external functions such as contactor control, overload protection, and interface timing, to name a few. In some cases, such as in older systems, the motor is no longer able to reach synchronous speed on the wye windings due to electrical and mechanical deterioration of components in the system and the constant reduced torque. This leads to electrical and mechanical stress on the system during the transition. Additionally, this starting system does not offer protection against hazards that may develop during operation such as jam conditions and line faults, including phase loss, line voltage issues, and motor deceleration control during the stop sequence, to name only a few.

Replacing the wye-delta starting system with an RVSS is a straightforward process. In most cases, locating the soft starter in the enclosure is simple, as several contactors that are now unnecessary will be removed. External overload devices may also be removed as the S811+ has built-in overload protection. If so desired, the contactors may be retained as an isolation contactor for the soft starter, or used to switch power factor correction capacitors if installed in the system.

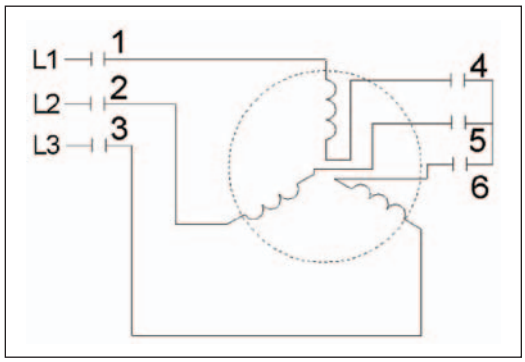

Figure 1. Wye Connection (Start)

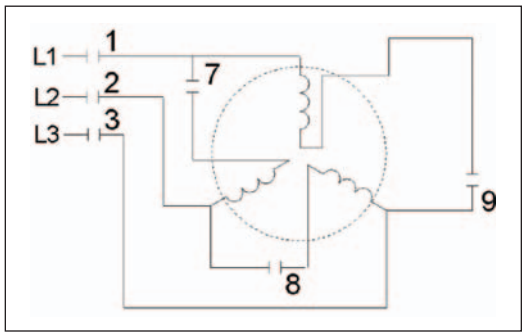

Figure 2. Delta Connection (Run)

Figures 1 and **2** depict a basic configuration for a wye-delta starting system. An isolation contactor controls contacts 1, 2, and 3; the start (or shorting) contactor controls contacts 4, 5, and 6; and a run contactor controls contacts 7, 8, and 9. If the system is a closed transition, a transition contactor with inline resistors to control current inrush is also required (not shown).

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When converting to a reduced-voltage soft starter, these contactors will be eliminated and removed from the enclosure. The isolation contactor (contacts 1, 2, and 3) may be retained. The run contactor that is removed during the conversion may also be retained and rewired as an external bypass contactor for emergency use (not shown).

Two soft starter wiring configurations are possible with the six-lead motor:

Line—connected: In **Figure 3**, leads are connected in pairs as shown. The cables will be connected in parallel between the soft starter and the motor. Ensure that these cables are of the same approximate length to avoid excessive current imbalance between the motor leads when the motor is wired in the delta configuration.

Inside-the-delta: In **Figure 4**, this method as shown may allow utilizing a smaller soft starter for a given size motor when compared to being line connected.

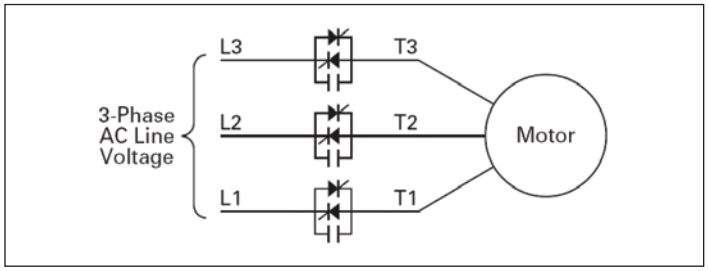

Figure 3. Line Connected

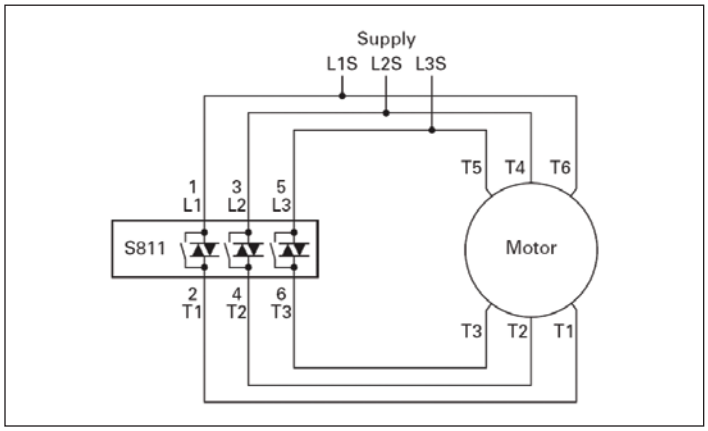

Figure 4. Inside the Delta Connected

Current and torque

The reduced-voltage soft starter (RVSS) initial torque parameter may be adjusted to 30 percent to approximate the same initial torque as would be developed with a wye-delta system starting in the wye configuration. However, due to the rate of (phase) voltage increase during the start ramp time of the RVSS, motor torque is also increasing from increased phase voltage and torque increases relative to the motor torque curve. The net result is quicker motor acceleration and significantly reduced start ramp time when compared to the wye configuration timer setting. In the event that this increased motor acceleration poses an issue for the application, the acceleration rate may be modified by the use of the current limit function of the RVSS. Initial torque settings of higher values may be used to achieve the desired start ramp characteristics.

Start current: Due to the difference of phase voltages when comparing wye and delta windings, it is known that to achieve the same torque developed with a delta configuration as would be with a wye configuration, the delta configuration current increases by a factor of three. Attempts to limit delta configuration currents to similar values of wye configuration currents typically will not result in a successful motor start. Please refer to the values of locked rotor amps (LRA) and locked rotor torque (LRT) in Example 1.

Example 1:

200 hp motor with 1327 LRA at 460V, Locked Rotor Torque = 957 lb-ft.

Wye configuration = 33 percent of full voltage LRA = 435A ➡ 307 lb-ft torque

Delta configuration = 435A ➡ 102 lb-ft torque, insufficient to start motor.

Delta configuration = 435A x 3 = 754A ➡ 307 lb-ft torque.

When converting a wye-delta system to an RVSS, the cables from the RVSS to the motor are doubled (paralleled) as the motor is at least a six-lead motor. Cable sizing is normally adequate to meet the demands of the delta configuration start. Remember that while the delta starting current is higher, the connections have doubled the conductors. Ensure that the cables are of approximately equal length.

Verify that protection devices such as breakers and fuses are sized appropriately for the higher starting currents. In some cases, higher fuse and/or breaker rating may be required.

Consult the soft starter product documentation for additional details in adjusting operating parameters.

Supporting documentation

Manuals	Reference Number
S811+ User Manual	MN03900001E

Additional Help

In the event that additional help is needed, please contact the Technical Resource Center at 1-877-ETN-CARE, Option 2, Sub Option 2.

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