



# **BENSHAW**

Applied Motor Controls

AN AMCONEX GROUP COMPANY

WHITE PAPER



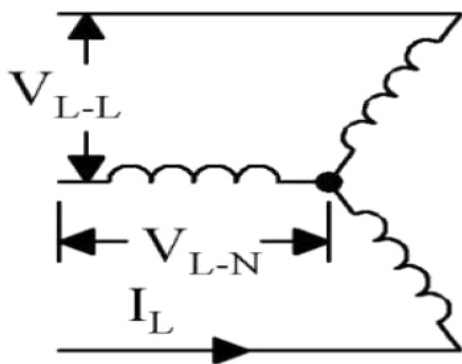
## Wye-Delta / Soft Starter Comparison Guide

*Rapid | Rugged | Global*

### Definition:

*A Wye-Delta starter (also known as Start Delta) is one of the most commonly used methods for the starting of a three phase induction motor. In this configuration of starting an induction motor, the motor is started in the Wye configuration. Once the motor has reached approximately 80% speed the motor is then connected in a Delta configuration.*

WYE Configuration



DELTA Configuration

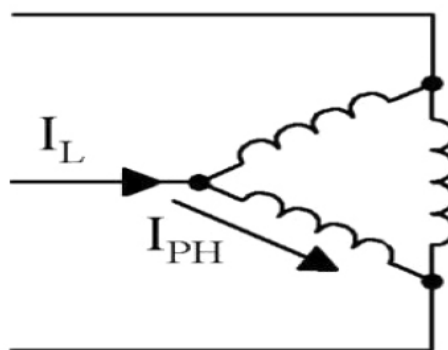


Figure 1.

## Theory of Operation: Wye-Delta Starter

This is considered an electrical / mechanical reduced voltage starter. Voltage is reduced during the start of the motor, connecting the motor in a Wye configuration will reduce the line current of the motor by a factor of 33%.

The torque of the motor is proportional to the square of the voltage applied, resulting in a reduction of 33% torque.

## Starting the Wye-Delta

When the start command is issued, contactor 1M is closed, connecting the motor in a Wye configuration. After a period of time (adjusted by timer, current sensor, etc.) or when the motor reaches approximately 80% full speed, contactor 2M & 1S are energized, connecting the motor in a delta configuration.

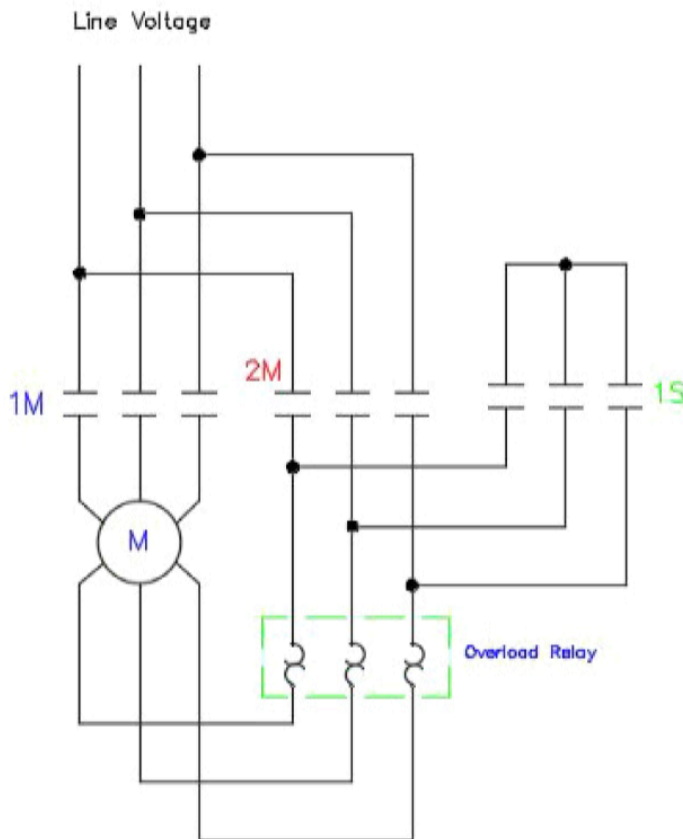


Figure 2. Basic Wye-Delta starter configuration

### Open Transition Wye-Delta Starter

Using this type of starting method, the typical circuit includes three separate contactors, an overload relay, a timer, and an interlock.

The term “open transition” is used to describe this method because the motor is momentarily disconnected from the line when changing from the Wye to the Delta configuration. This method has one important disadvantage. Depending on the loading of the motor and the timing of this transition, the resulting surge in current and torque could produce electrical and mechanical shocks on the system. In some cases the instantaneous current peaks can exceed even the locked rotor current for short durations.

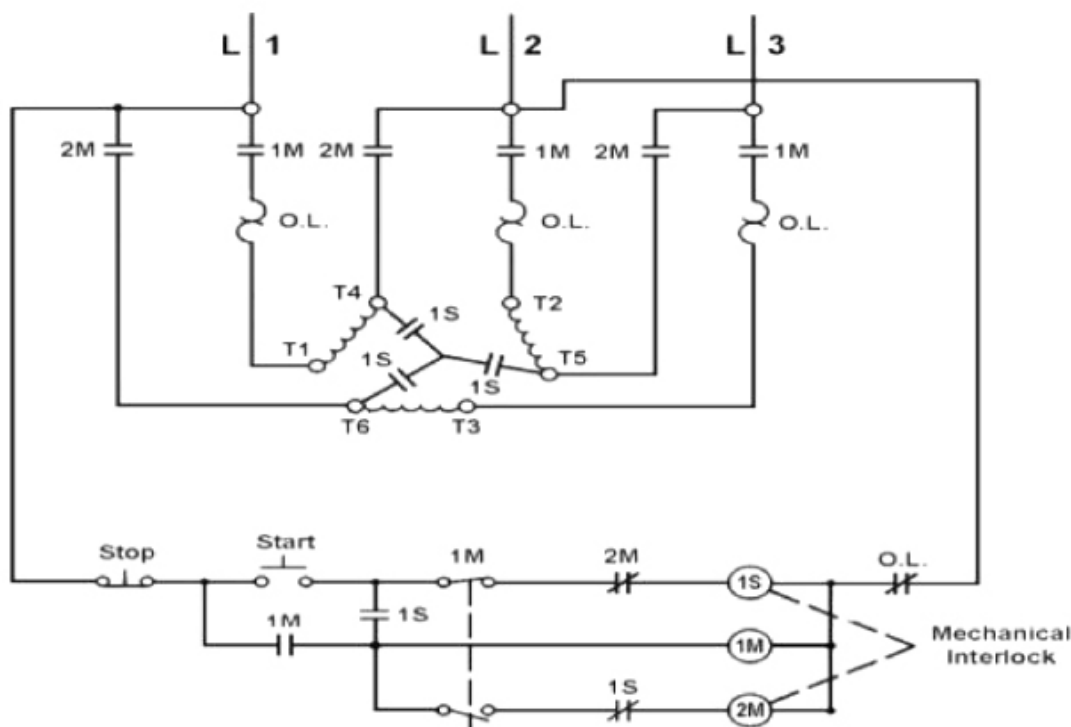


Figure 3. Typical – Open transition type Wye-Delta starter

## Closed Transition Wye-Delta Starter

In this type of starting method, the theory of operation is identical with the exception of a few added components. An additional contactor and a power resistor is added.

This will eliminate and reduce the surge associated with the open transition type.

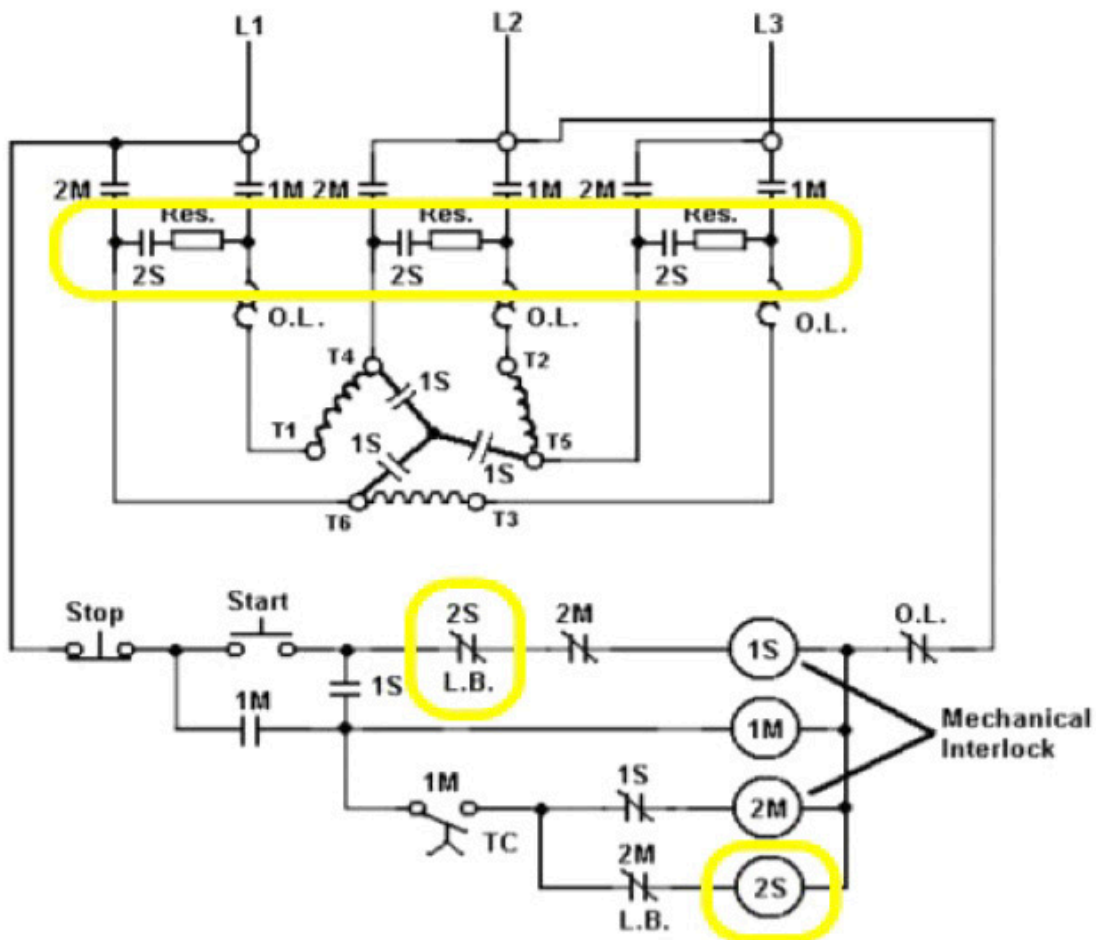


Figure 4. Typical – Closed transition type Wye-Delta starter.  
Added components: 2 S contactor, resistors.

### Solid State Starters - RVSS

A solid state starter or commonly referred to as RVSS – Reduced Voltage Soft Starter. Is another method of reduced voltage starting. Typically used on three lead, three phase motors, they can also be applied to six-lead motors. Wye-Delta starters reduce the voltage to the motor through an electrical mechanical method, while solid-state starters reduce the voltage using a solid stage device referred to as an SCR.

### Replacing a Wye Delta starter with a Soft Starter

When using this connection / configuration, all six motor leads are brought back to the control stack, just like they are with an electromechanical Wye-Delta starter. However, the motor is actually always connected in a delta configuration, and that means the starting line current-to-torque ratio is different than that of a traditional Wye-Delta starter.

For a soft starter to replace a Wye-Delta starter, the soft starter will reduce torque or limit current during the start mode and then once up to speed will run in bypass mode. (ref fig 4.). The Benshaw series soft starter line has many options for various start configurations. Typically (Benshaw Configuration / Setup) You would set up the RVSS in closed loop current limit mode. Maximum starting current to the motor is set, then during the start when the motor falls back to 175% of full load amps, an integral bypass contactor is pulled in running the motor at full speed, across the line. Benshaw soft starters all have built in (programmable) motor protection, so protection is on at all times.

When using the Wye-Delta configuration, it has one fixed output 57.7% voltage, however the Benshaw soft starter allows multiple output levels, easily adjustable, configurable and will match the load requirements.

The starting torque to current ratio for a soft starter that is wired to a six-lead motor varies as the square of the ratio of soft start starting current level (I<sub>cl</sub>) divided by the full-voltage starting current (ILRA), making it a simple transition.

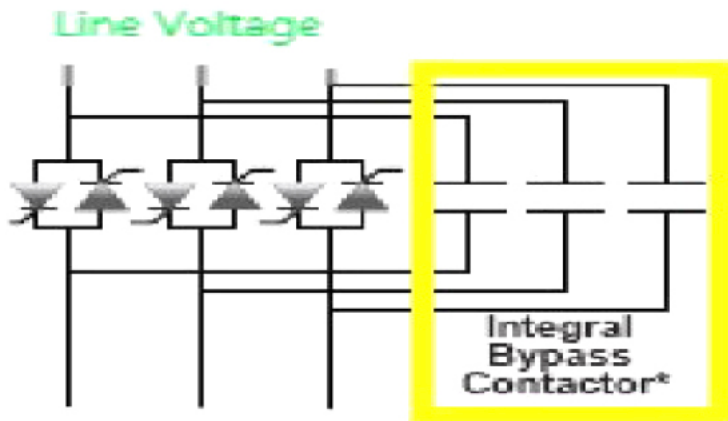


Figure 5. Typical – Basic soft starter configuration



Figure 6. A graphical representation of the current and speed relationships between the various methods.

## Conclusion

How does the Wye-Delta compare with a soft starter?

Compared with a Wye-Delta starter, soft starters are much more flexible and provide a smooth start with added protection to the load and motor. Completely programmable with a real time display showing metered voltages & currents, faults and history gives an added level of safety, troubleshooting and commissioning simplicity.

The soft starter is a solid state device, so mechanical issues and maintenance are dramatically reduced.

Solid state soft starters today are also competitively priced, and readily available.

### **Wye-Delta Advantages:**

- Inexpensive
- Starting / Torque is reduced to 33%
- Produce high torque per amp of line current
- No heat is produced, or tap changing of transformers – increases efficiency

### **Wye-Delta Disadvantages:**

- Starting torque is reduced to 33% and cannot be adjusted
- 6 lead motor required
- Transients and spikes during transition
- Provides little motor protection
- Two sets of cables from starter to motor



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