

Using SNG-Q Series Quadrature Speed and Direction Sensors in AC Induction Motors

An Application Note

Background

AC Induction motors are used to power lift and drive components in a variety of heavy duty material handling equipment, such as the forklift on industrial lift trucks, and the track steering systems on construction and agricultural vehicles (see Figure 1).

Figure 1: Forklift on Industrial Lift Truck



In addition to detecting motor speed, certain applications may also require detecting direction, as well as the speed, of the AC motor. Speed and direction sensor information are important inputs to the system controller to provide appropriate vehicle control.

Solution

Honeywell SNG-Q Series Quadrature Speed and Direction Sensors are designed to measure both the rotational speed and direction of a ferrous material toothed gear mounted to the AC induction motor shaft.

AC Induction Motors

Due to their simplicity, reliability, and ruggedness, AC induction motors are popular in the industrial and transportation industries.

An AC motor has a simpler design, with its single moving part (rotor), versus the multiple moving parts (commutators and brushes) found in a DC motor (see Figure 2). These advantages add up to a more reliable, cost-effective design that can reduce the total operating cost over the

life of the equipment in which it is installed. Generally speaking, AC motors have the following advantages over DC motors:

- Require less maintenance
- Are more energy efficient
- Are simpler to run
- May be used in larger-sized motors
- Are more readily available
- Generate less electrical noise when running
- Offer better speed control

Figure 2: Basic AC Motor Rotor Shaft



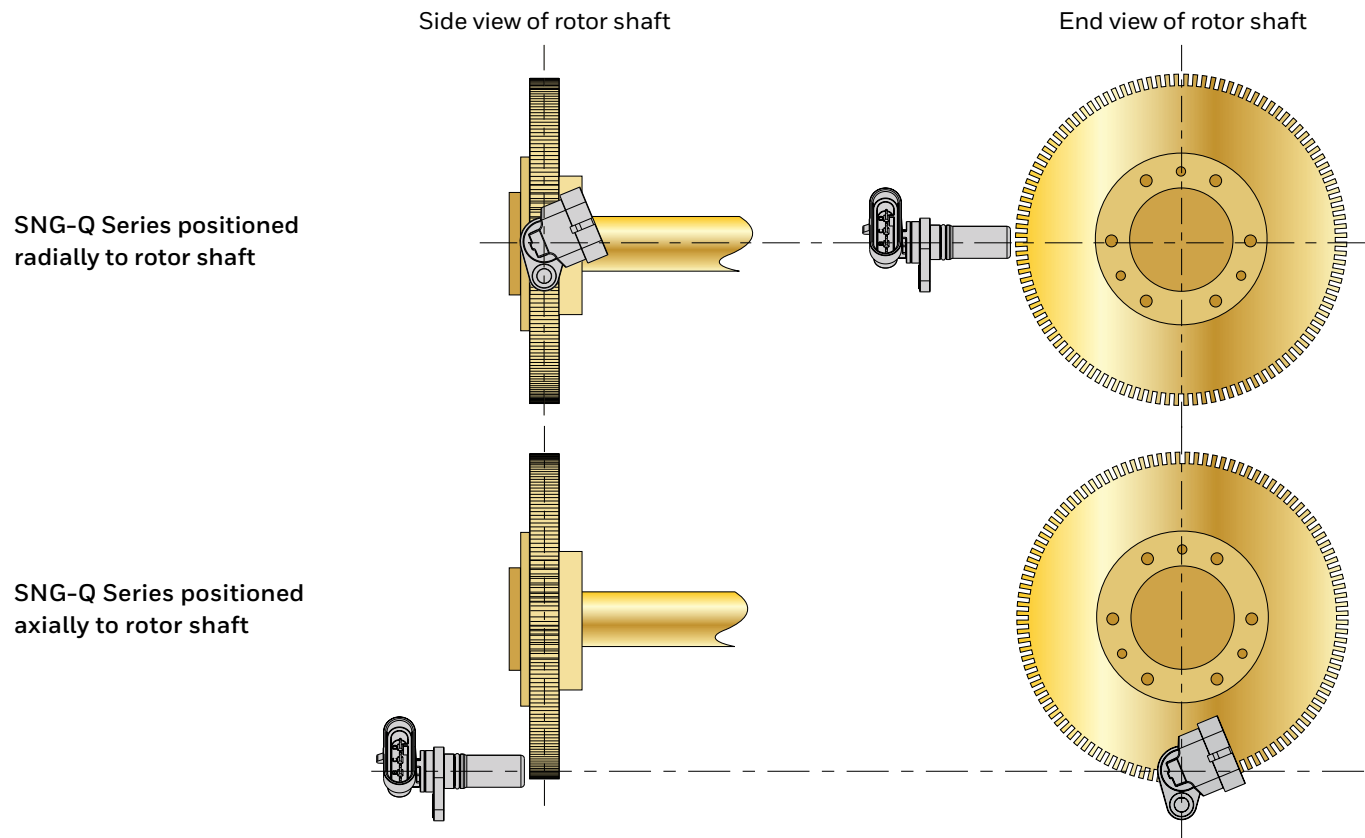
How SNG-Q Series Quadrature Speed and Direction Sensors Work

Speed detection: The SNG-Q Series uses Hall-effect technology to provide a non-contacting means of detecting the rotation of a target gear or similar mechanism. This rotating target must be made from a ferrous material and must have a gear tooth pattern of teeth and slots. An SNG-Q Series sensor positioned at the circumference of a rotating gear attached to the AC motor's rotor shaft detects the gear teeth and spaces, supplying a digital pulse output with a frequency proportional

to the gear wheel speed. This output signal is translated by the system controller into motor speed. Figure 3 shows how the SNG-Q Series maybe

positioned either radially or axially to a toothed gear on the rotor shaft.

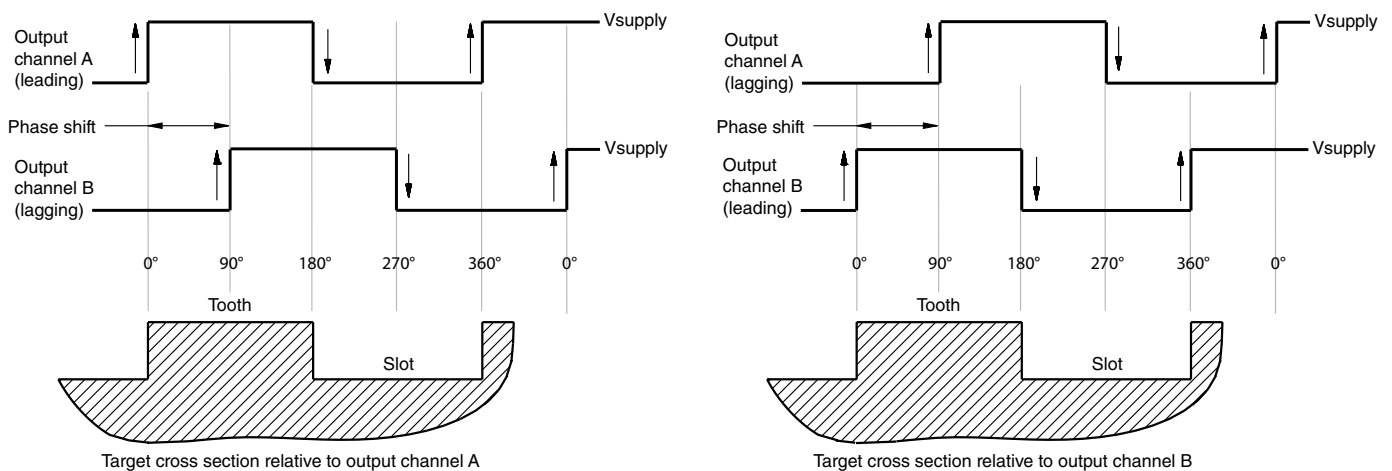
Figure 3: SNG-Q Series Mounting



Direction detection: The SNG-Q Series provides a quadrature dual output signal with the two signals 90° phase shifted from each other. The shifting of the output phase, as shown in Figure 4, determines target direction.

Lead/lag of the selected channel determines motor shaft rotation in one direction, lag/lead of the same channel determines motor shaft rotation in the other direction.

Figure 4: SNG-Q Series Quadrature Output



How SNG-Q Series Sensors Meet Customer Needs







- **Vehicle speed:** The vehicle operator presses an input device, such as a pedal or thumb throttle, which sends a signal to the AC motor to advance. Based on the position of the input device the vehicle management system then controls the motor speed to regulate the vehicle speed
- **Forward and backward vehicle motion:** AC motor direction detection may be used to monitor vehicle direction.
- **Up/down motion of equipment’s lifting fork or other load carrying devices:** An AC motor propels the drive mechanism of the fork. Other motors, such as those used in hydraulic systems and fork height control, also require speed and direction control.
- **Wheel speed direction that activates a vehicle’s back-up alarm system:** A back-up alarm, often required to meet governmental safety regulations, is designed to warn people near a vehicle that it is moving in reverse. An SNG-Q Series sensor may be mounted on the right and left wheel motors of the vehicle. When the control module recognizes backward movement on both motors, it activates the power to the back-up alarm.
- **Traction control:** May be used to monitor speed of traction motors in order to detect wheel slippage and lock the differential to improve traction.
- **Braking control:** A target gear is mounted on the vehicle axle and the SNG-Q Series sensor is mounted adjacent to the target gear. The detected wheel speed is used by the ABS (Automatic Braking System) controller to optimize vehicle braking, improve safety and minimize tread wear.
- **Environmental toughness:** Because equipment is often used in dirty environments, such as factories, construction sites and agricultural areas, as well as in both hot and cold environments, the speed and direction sensor needs to be durable, resistant to moisture intrusion, accommodate a wide operating temperature range, and be immune to dirt and dust.

- **Speed and direction sensing in one product:** The SNG-Q Series sensors provides these two capabilities in one, and aims to typically eliminate the cost, installation, maintenance, and space requirements needed for two separate sensors.

Value to Customers

- Higher reliability: IP69K rating, EMC radiated immunity protection, O-ring seal and wide operating temperature range:
 - Improves equipment uptime
 - Minimizes service costs
 - Provides more resistance to high electrical noise and moisture intrusion
- Cost-competitive: Designed and manufactured using a platform-based approach that enables cost-competitiveness and mechanical and electrical configurability for customers.
- Enhanced accuracy: Designed for applications where enhanced accuracy is required to detect small target features.
- Flexible: Wide operating temperature range, robust electrical noise immunity and enhanced environmental sealing capability allow flexibility of use in the application.
- Expedites installation: O-ring seal for use in pressure applications and a fixed mounting flange allow for simple installation using one fastener.

Table 1. SNG-Q Series

| SNG-Q SERIES | | KEY FEATURES |
|---|---|---|
| 35 mm housing length | 45 mm housing length | <ul style="list-style-type: none"> • Direction information: From phase-shifted dual output signals • Sensing air gap: 0,0 mm to 2,0 mm [0.0 in to 0.08 in] • Wide operating temperature range: -40°C to 150 °C [-40°F to 302°F] • Enhanced frequency switching capability: 3 Hz to 20 kHz • Supply voltage range: 4.5 V to 26 V • Robust electrical noise immunity: Electrical noise radiated immunity (EMC) rated to 100 V/m • Environmental sealing: Moisture ingress protection rated to IP69K • O-ring seal: Enables environmental sealing to mounting surface • Fixed mounting flange for simple installation using one fastener • Radial or axial mounting (depending on geometry envelope): Simplifies design-in |
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