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Article Topic: Guidelines for Integrating a Bar Code Reader
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Critical Factors in Embedding Bar Code Readers into Robotic Assembly Equipment

As manufacturing becomes increasingly automated, bar codes and other symbols are relied upon to provide a dependable, inexpensive form of machine readable identification. Bar code readers are often embedded within manufacturing equipment, such as assembly robots and robotic arms, to maximize benefits like rapid data capture and automatic repetitive tasks. The readers are commonly integrated with self-contained instruments or fully automated systems. For example, a robotic assembly line with embedded bar code readers can build and test an electronic assembly with 100 percent validation of each action tracked within the work-in-progress. The inclusion of the readers allows real-time quality control data to be provided and reduces the opportunity for errors.

The benefits of a bar code reader within a manufacturing system are clear. However, these benefits are difficult to realize if the reader's functionality is compromised.

Design Considerations

Bar code system performance is critical to successful robotic automation, yet often no thought is put into the integration process beyond physical dimensions. Embedding a reader entails much more than simply leaving a place to insert it. There are four key areas to address when embedding a bar code reader into robotic assembly equipment: scan envelope, shock and vibration, moving mass, and electrical functionality.

Scan Envelope

The scan envelope is the total dimensional space required by the reader to decode a bar code at a specified distance. The scan envelope varies widely between readers so it must be precisely calculated in advance, especially in space constrained applications such as robotic arms. The dimensional size of the envelope is gauged by the depth of the reader, the scan angle, and the distance between the reader and the bar code. The depth is easily found by measuring the actual physical case of the reader. The angle of the scan is important because it directly determines the width of the reader's field of view. The scan distance is the required distance between the front of the reader and the symbol, and varies from reader to reader due to differing optics between brands. Smaller scan envelopes have the advantage of less physical space required between the reader and the bar code.

Shock and Vibration

The abrupt, uneven movements of robotic arms can affect the performance and longevity of a bar code reader. To determine a reader's compatibility with the equipment, shock and vibration tests should be evaluated. These three separate tests, which should be performed under operational conditions, include shock, sinusoidal vibration, and random vibration. The shock test measures the effect of sudden movement, such as the rapid acceleration and stop of a robotic arm. The sinusoidal vibration test evaluates behavior at pre-determined frequency levels. The random vibration test uses uneven vibration to simulate "real world" conditions that the reader is more likely to experience. To ensure proper function and life of the bar code reader, it should be tested a minimum of twice the equipment's calculated shock and vibration loads at the location the reader will be mounted.

Moving Mass

In high-speed automated applications, robots will typically require a low moving mass, and the size and construction of the bar code reader will play important roles. Accurate speed and movement of a robotic arm can be compromised by the addition of a bulky bar code reader that affects the moving mass. All-in-one readers, combining the light source, decoder and camera into one unit, feature a small case size and nominal mass. Adding these ultra-compact devices will have minimal impact on the force required to move the arm, and also maximize mounting options. The case of the reader should be constructed of lightweight material, yet strong and resilient

enough to ensure proper function within the demanding environment of automated assembly. The latest technology in bar code readers is a magnesium alloy metal case that provides the ideal hybrid of strength, durability and minimal weight.

Electrical Functionality
Electrical functions such as power requirements, connectivity cables and trigger methods should be considered when planning the integration of a bar code reader. Most readers require 5 to 28 volts of electricity. Those designed with minimal power requirements will reduce the drain on the host instrument. The routing of connectivity cables should be carefully designed. In addition to planning the location and adequate space, the repetitive flexing of robotic arms could require the availability of special high-flex cables.

Triggers tell the scanner when to look for the bar code and are divided into two categories: discrete (external) and serial (software). Which type of trigger to include is usually determined by a preference for programming or wiring. Discrete triggers are separate sensors, or object detectors, that can be wired directly into the reader. They require much less programming than serial triggers. Serial triggers are dispatched from an external device, such as a PLC or host PC, which tells the reader to look for a bar code. Serial triggers are often used in embedded applications to provide more control.

Additional considerations
Successful integration also includes consideration of the software interface. Today's bar code readers function like independent computers, reducing the amount of programming required on the host to process the data. Once the bar code is decoded, the reader can output the data in the exact format required for a specific process. Interface software should be designed to initialize the reader, check for status, and create a robust real-time communication protocol between reader and host.

The environment where the bar code reader will be operating should be evaluated. Temperature, ambient lighting, electrical noise, and dust or water exposure must all be considered to avoid potential read rate issues. Make sure the housing of the reader meets the necessary industrial rating or build an enclosure to protect the reader from the environment. In addition to affecting the reader's performance, the environment can also affect the quality of the bar code itself. Invest the time to find a label adhesive that will withstand the various processes to which the bar code label will be subjected.

Summary
Effective integration of the bar code reader is critical to the success of the manufacturing process. As a unique application, robots require special consideration and planning. By anticipating the technical requirements of the reader in advance and incorporating process specifications into the design, engineers will dramatically increase the performance and accuracy of their data capture while significantly lowering the total cost of ownership of the equipment.