

WHAT MAKES RFID SYSTEMS INDUSTRIAL STRENGTH?

Determining if Equipment will Survive in True Industrial Environments

White Paper

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The retail environments where products are sold look nothing like the industrial environments where they are produced (think of the difference between a new car dealership and an automotive manufacturing plant). Yet the same RFID products developed for retail stores and supply chain operations are heavily marketed to manufacturers for production operations. These products may have different housings or IP ratings than their general-purpose cousins and may work fine in warehouses, but that does not necessarily qualify them as industrial grade.

Production environments often have their own ruggedness, performance and connectivity requirements that only purpose-built industrial equipment can reliably satisfy. For example, general-purpose RFID equipment may have the physical Ethernet port needed to connect to a PLC, but will not support EtherNet/IP, Profibus or other industrial protocols that run PLCs and other industrial automation equipment. The reader will need to be supported with additional protocol conversion, which slows system performance and adds to implementation time and expense.

EtherNet/IP and other industrial protocol support is just one example of the many features that separate true industrial RFID solutions from products that can be used in industrial environments. When evaluating RFID equipment, it is important to make the distinction between what is possible for use in the environment and what is optimal. This white paper helps system planners make that distinction, by providing an overview of the features and capabilities that differentiate true industrial RFID equipment. Three fundamental qualities determine if RFID systems will perform reliably in demanding production environments:

- Will the RFID system integrate seamlessly with industrial control systems?
- Will it provide the reliability and speed that production and information systems require?
- Can it maintain uptime and performance long term – will it last as long as the production line?

Will it Integrate Seamlessly?

RFID is often marketed as a “solution,” but in manufacturing operations it is almost always used as a supporting technology to provide data and visibility to the MES, ERP, e-Kanban, robotics, asset tracking, material handling, quality control and other systems that run production facilities. The first requirement for any industrial RFID system is to be able to seamlessly integrate with the enterprise’s production control systems, including PLCs, sensor networks and HMIs – and the industrial protocols that run them. Failure to accurately provide data to these systems, at the reliability and speed levels they require, eliminates the value to using RFID.

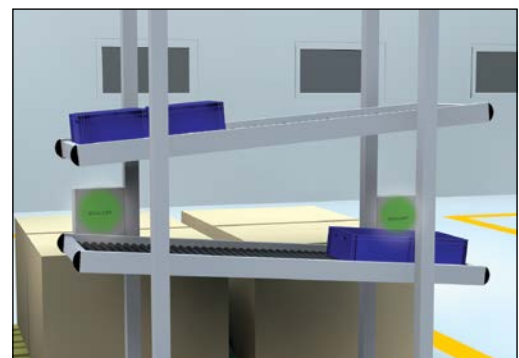
The need to support control systems produces a fundamental disconnect between supply chain-oriented RFID products and industrial user requirements. Most RFID readers are programmed to process ASCII data, yet PLCs and other industrial automation equipment run on industrial protocols like Ethernet/IP, Profibus, Profinet, CC-Link, DeviceNet, EtherCat, etc. Industrial protocols are binary and thus can transfer data much more quickly than ASCII-based systems, because ASCII characters consist of more bytes. The time required to process the additional ASCII bytes can lead directly to throughput problems. Converting data streams to ASCII and processing the extra bytes for ASCII characters introduces an extra step, which adds time and therefore limits productivity. The delay caused by protocol conversion is often unacceptable in automated production environments where, for example, a work-in-process item may need to be identified, recorded and routed to the next process, all in three seconds or less.



Machine Tool RFID requires the most rugged and survivable RFID on the market today. It must survive harsh cooling chemicals and impact from metal objects such as cut metal “chips”.



Standard industrial WIP (work-in-progress) applications require hardened RFID tags that can withstand impacts and light liquid exposure.



e-Kanban can combine several types of RFID tags including disposable paper tags to be printed on, and hardened tags that resist light impact.

There are RFID readers with native support for industrial automation protocols, but it is not a common feature. Some vendors do not even offer industrial protocol support as an option, which is a key indicator that the products and vendor are not focused on the industrial market.

The alternative to native RFID support for the necessary industrial protocol is to execute protocol conversion. This is typically done by developing software code to convert the RFID data string to the specific protocol, and installing it on the RFID reader and/or industrial automation equipment. The software development time is often a hidden cost that is not considered during system planning and hardware evaluation. Developing, testing and installing the code increases the time needed for system implementation. These cost and time factors illustrate why it is difficult to make apples-to-apples cost comparisons between industrial and general-purpose RFID readers.

Even with protocol conversion software, RFID readers that do not have native support for industrial protocols cannot operate as fast as those that do, because they require the added step of converting ASCII data to the binary protocol. (Incidentally, this reduction in performance speed would not be reflected in the product spec sheet, which may list how quickly tags are identified, not how quickly the data can be processed and presented to the host system.) As noted, any slowdown in performance represents a risk to automated production systems. RFID readers without direct support for native protocols introduce risk, cost and performance limitations without providing any additional benefits.

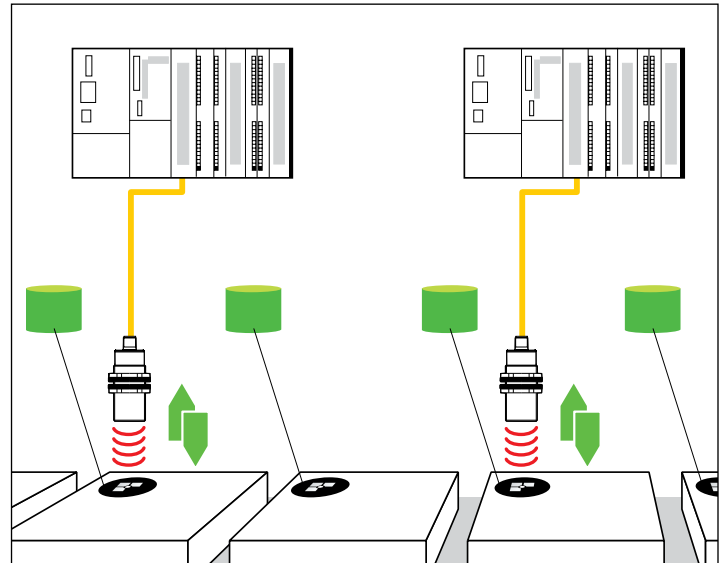
Will it Be Reliable at Production Speeds?

The physical environments in industrial and supply chain settings causes RFID to perform differently. The primary source of potential interference in retail supply chain environments derives from having hundreds or thousands of tags proximity. Tag density is also a consideration for industrial RFID users, but their environment has much more challenging and powerful potential interference sources. These include electromechanical equipment, sensors, wireless controls and other automation equipment, whose signals can impede RFID performance. Metal is a leading source of interference for ultrahigh frequency (UHF) RFID technology for example, so many production facilities are very challenging environments because of the many metal products, equipment and tooling that are present.

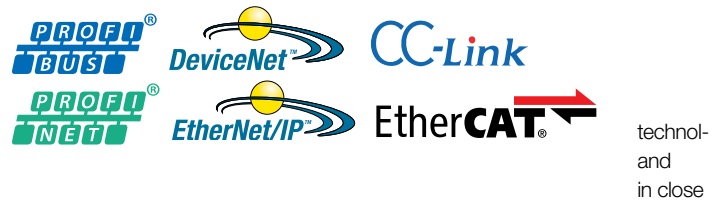
RFID systems for industrial environments should have built-in protections against these potential interference sources. As noted earlier, it is essential for RFID systems that support industrial automation systems to be extremely accurate and reliable. An RFID misread at a library checkout counter or retail store is an inconvenience; in a factory it could cause production line delays that cost thousands of dollars resulting from lost productivity.

RFID systems are most reliable when tags and readers are matched to the environment. While the retail and supply chain industries have standardized on EPCglobal Gen 2 and ISO 18000-6 standard UHF technology, industrial systems often require a range of RFID technologies including UHF, high frequency (13.56 MHz), low frequency (125 KHz), microwave (2.45 GHz) and real time locating systems (RTLS), which are available in multiple frequencies. High frequency (HF) tags are especially effective for production operations because they are resistant to interference from metal and have the memory capacity to carry production data other than a serial number. However HF has limited read range, typically less than two feet, so the technology may be appropriate for tracking carriers that convey items through controlled locations in production processes. UHF is favored when readers or personnel can't be positioned near production or for intra-logistics purposes. UHF technology can be used to provide much more ranges from approximately three to 18 feet, but is limited in memory (typically 512 bit user memory).

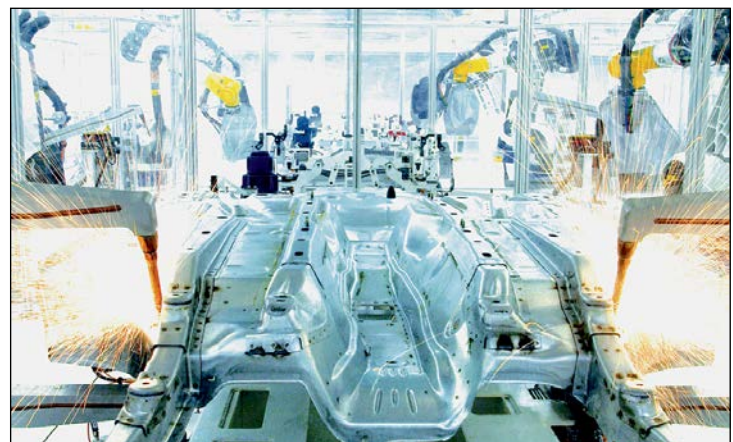
Taking a best-of-breed approach to the frequencies and tags that are selected enables companies to automate more operations with RFID and get more value from the system. For example, some manufacturers use HF tags on the conveyors that route assemblies through production process. The tag is encoded with the assembly serial number and is updated with variable production information such as build data, error proofing results, configuration information, etc., during the manufacturing process. When production is completed and the part is ready to be shipped to the next stage of production, the part ID or other data from the HF tag can be automatically collected and used to encode a UHF tag on the RTI (returnable transport item) or other container used for logistics, without any manual data entry or operator intervention required. The UHF tag could also be used for internal material handling, storage and shipping processes.



Industrial networks differ greatly from standard office or home networks. Balluff provides the greatest number of supported industrial and business network enabled RFID products on the market today.



technol-
and
in close



HF technology is ideal for welding applications because of its resistance to interference from metal and its high memory capacity.

One of the best ways to minimize interference and maximize reliability is to use RFID tags that are optimized for the objects they are identifying and the environments where they are read. Low cost, general-purpose, one-size-fits-all tags and labels that work on mass merchandise consumer products are often not appropriate for work-in-process tracking and other industrial applications. Multiple tag types may be required, including specialty tags designed to be read when applied on or near metal. Tag designs can overcome some environmental challenges, but different RFID frequencies may also be required to get the required performance in different process areas.

Since a range of RFID technologies is typically required for industrial operations, selecting a vendor capable of supporting multiple options like LF, HF and UHF is critical. Most UHF vendors only support that technology because high-profile, mass-market RFID programs are based on EPCglobal Gen 2/ISO 18000-6 UHF standards. These standards can also be used in production applications, but the industrial environment is much less homogenous, and UHF systems are often used together with other RFID technologies and sensors. Some industrial RFID readers even have the ability to simultaneously support input from different frequencies (e.g. HF and LF) and integrate with I/O modules that support sensors, PLCs and other industrial automation components.



UHF technology is ideal for logistics tracking because of its long ranges, from three to 18 feet.

Will it Last as Long as the Production Line?

Companies are accustomed to having their PLCs and other industrial automation systems last for many years, and have similar expectations for RFID equipment. Reliable performance and a long product lifespan are attainable in production environments, but will require purpose-built equipment. There are a few telltale features that differentiate rugged RFID products. These include objective ratings and certifications, base materials and fundamental product design.

Products that are marketed as “rugged” or offer an optional protective casing are not necessarily appropriate for an industrial environment. IP, IEC and EN ratings and other independent certifications provide some insight into ruggedness and suitability, but they are just a starting point, and not a guarantee that the equipment will function reliably. RFID products designed for use in a distribution center will not be exposed to the same levels of shock, vibration, humidity, temperature, radiation and interference as units that are used in production processes, which may include assembly, paint, stamping, grinding, welding, chemical treatment, cleaning, sterilization, freezing, heat treatment, vibration testing and exposure to hazardous materials. For reference, many UHF RFID readers developed for warehouse and supply chain operations have an IP54 rating, whereas IP65 and EN60068 rated RFID systems are preferable for many production environments.

While IP ratings do not guarantee performance, IP65-rated RFID systems do have advantages over IP54 models in real-world production environments. IP65 devices, and individual parts that are EN 60068 rated, provide superior protection because they can withstand more shock and vibration. They are sealed against liquids, dust, dirt and other substances that could potentially penetrate a device and cause it to fail.

Smaller, subtler differences between products often have a larger impact on reliability and performance. For example, cable connections are a common point of failure for all types of electronic equipment. RJ45 and other connectors that snap in or clip in are particularly vulnerable. They can easily become broken or unplugged if the cable is tripped over or otherwise disturbed. Industrial products should be protected against this potential point of failure with threaded connectors that screw in (e.g. M12 type) and will not detach or break because of vibration or incidental contact.

Fundamental industrial product design calls for all components to be housed internally so that exposure to hazards is minimized. Unfortunately, RFID antennas often must remain external for maximum performance, and thus represent a vulnerability. Damage risk can be reduced by constructing antennas from durable materials, including secure connectors and by offering multiple mounting options. RFID antennas are available with IP65 ratings and certifications to withstand various levels of shock and vibration.

When determining whether RFID products are suitable for a specific environment, it is important to look beyond published marketing hype and misleading specifications. Consider the design and construction of the product and how it could be affected by various work processes. Whenever possible, products should be tested where they will be used rather than in a lab or demonstration area, because the actual work location has interference and environmental conditions that may be overlooked and impossible to duplicate elsewhere. It is very important for example, to have a professional RFID site survey conducted when using UHF before systems are installed. During a site survey professional RFID technicians or engineers will identify potential sources of interference,



The Balluff BIS V series RFID processors for example, provide high impact and liquid resistance up to IP65 with standardized industrial connectors.

evaluate location options for installing equipment, measure signal strength and collect other information so the UHF RFID system can be tuned and optimized for the specific facility. The skill of the person who conducts the site survey – as well as the overall skill, experience and breadth of product options of the RFID system provider – can greatly improve system performance and reliability.

Summary

It takes more than product packaging, ambiguous specification and clever marketing to make RFID products truly industrial. To meet the operational and business requirements of production facilities, RFID equipment needs to seamlessly integrate with industrial automation systems, and work reliably in challenging conditions, and do so for years without causing unplanned downtime. The key attributes that differentiate industrial RFID equipment from supply chain oriented alternatives include:

- Native support for industrial protocols;
- High tag read reliability and the ability to continuously operate at speeds that won't slow production systems;
- Durable housing with secure connectors;
- IP65 rating and relevant certifications for shock, vibration and temperature resistance;
- The ability to support multiple RFID technologies and supporting devices as needed, including sensors, PLCs and other industrial automation equipment.

Compromising on any of these criteria will likely result in unnecessary implementation, support and replacement costs and raise the risk of system failure. These risks are greatly minimized when appropriate equipment is used, as industrial RFID systems have proven their reliability and value in a wide range of challenging environments.

About Balluff

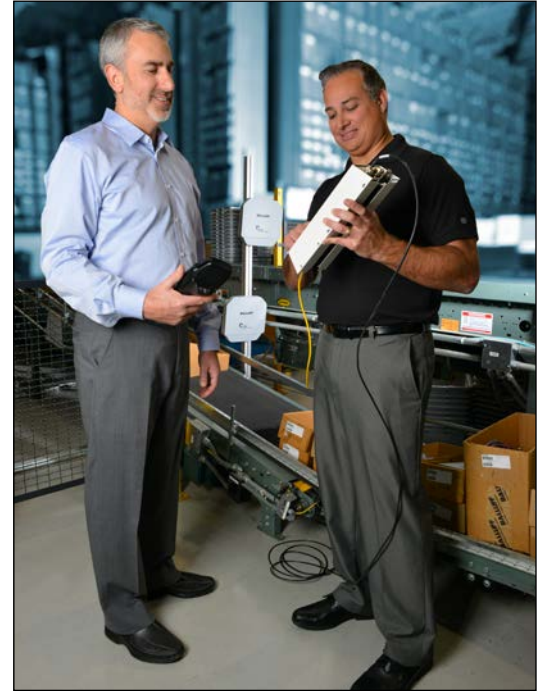
Balluff has more than 30 years of experience providing industrial RFID solutions and supports a range of technologies and products so systems can be optimized for each customer's environment. Our industrial RFID systems offer data tracking and error proofing solutions for asset tracking, machine tool, flexible assembly, factory automation, warehousing, logistics, and distribution tracking. Balluff's BIS series of RFID offers maximum application flexibility using a variety of components including data carriers, metal and plastic processor housings, and read/write heads to data carrier combinations. We are a global leader in tool identification, asset tracking and work-in-progress tracking applications. Balluff supports multiple RFID technologies and industrial protocols, offers the complementary products and services needed to develop complete solutions, and has extensive experience in many production processes and environments.

Contact Balluff to learn more about how your operations could benefit from RFID and what systems are right for your environment.

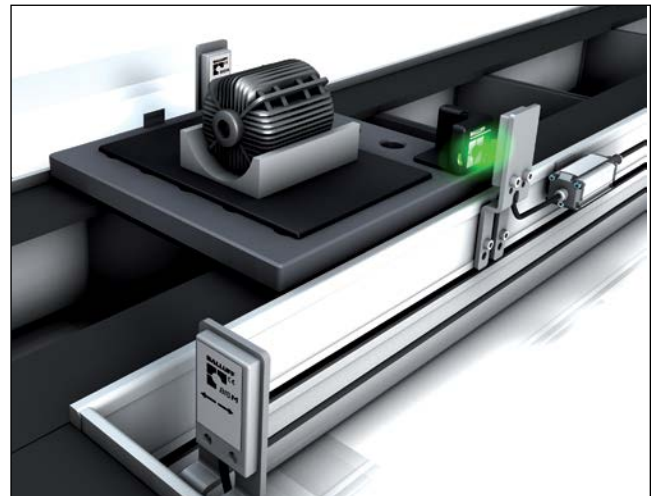
Phone: 1-800-543-8390

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Balluff preforms UHF based site surveys to test on-site and make sure that a customers application has the proper installation and operational recommendation to maximize reliability and ROI.



Balluff's RFID systems have been optimized for industrial installations based on years of experience and know-how in providing the right solution and reliability for most industrial applications.

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