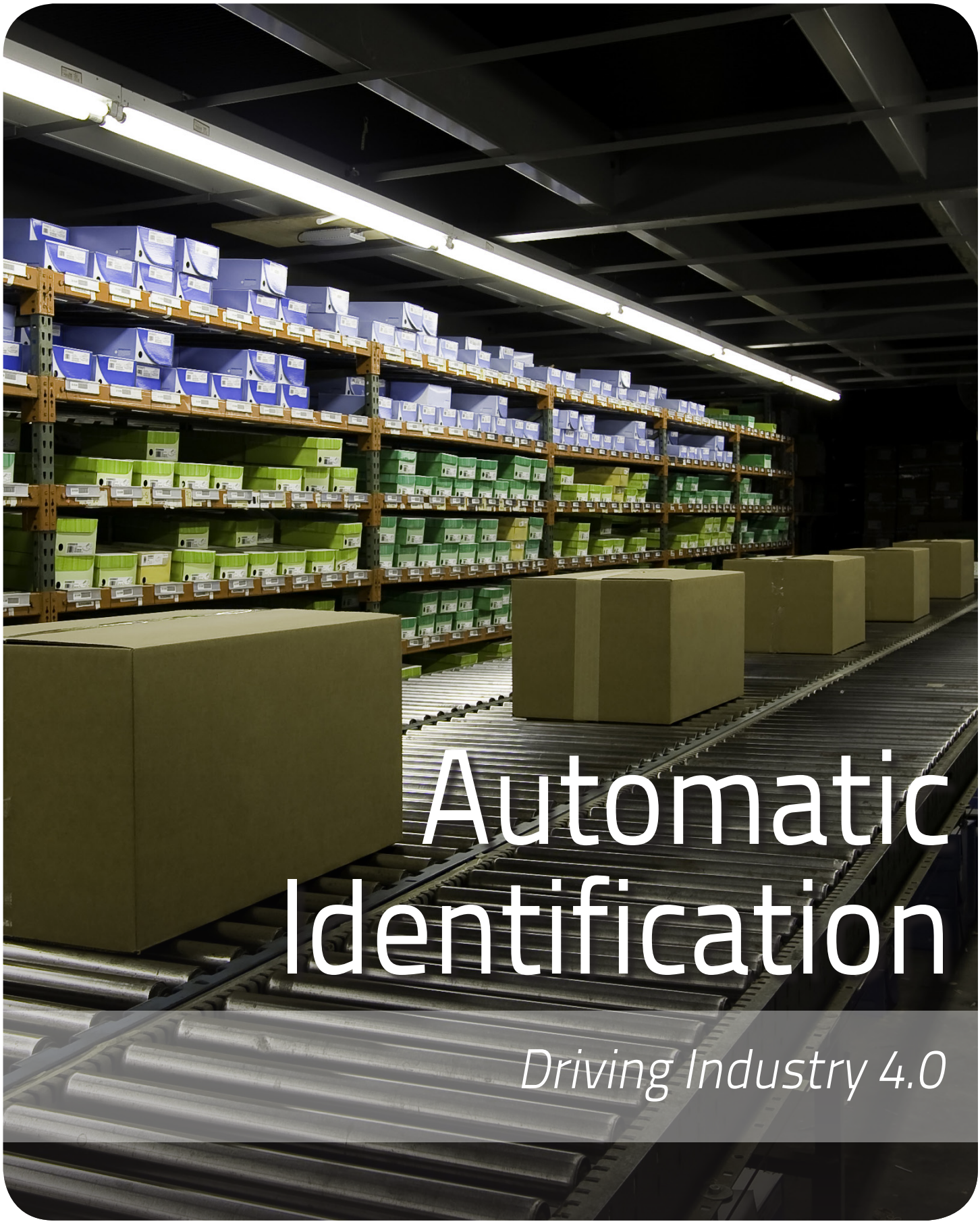
White Paper

DATALOGIC



Automatic Identification

Driving Industry 4.0

White Paper

DATALOGIC

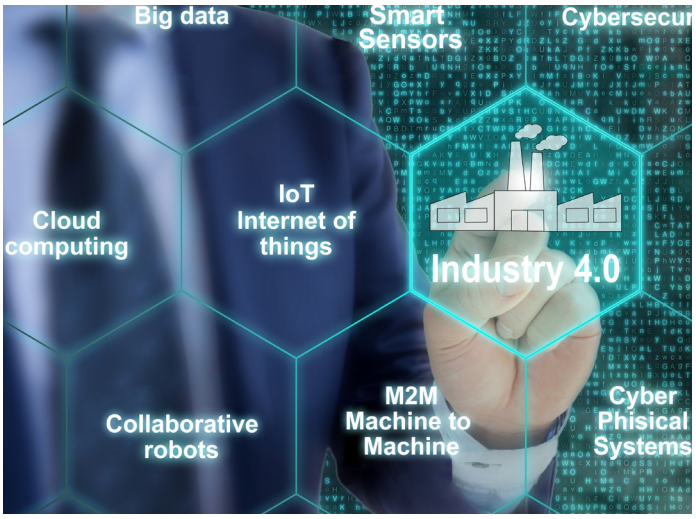
INTRODUCTION

Industry 4.0 and the Internet of Things are dominating today's technological innovations. "Smart factories" organise and optimise themselves so they can quickly react to changing requirements. Complete visibility of processes are the foundations for efficient planning and control procedures. At any given time, there needs to be visibility and traceability of components and materials including their processing status and location. This, however, is only possible if the objects are uniquely identifiable and tracked at every phase of the production and logistics process. The continuous identification of products across the supply chain will become critical to success in all industries in the future, making it possible to work faster, more efficiently and more flexibly. Where maximum process reliability and traceability are required, seamless automatic identification is an absolute must. This is especially true in the Healthcare sector. Over the past few decades, codes, identification processes and data collection solutions have evolved continuously. This White Paper provides an overview of the fundamentals of automatic identification; the different technologies available and the advantages and possibilities of each, but also highlights restrictions of the different systems.

1 FUNDAMENTALS OF AUTOMATIC IDENTIFICATION – "CORE CODES"

How can objects be identified? Natural characteristics like size, colour, weight or texture provide useful clues. In the case of metal parts, for example, a piece of work can be clearly identified on the basis of its unique surface texture, similar to a human fingerprint.

At the beginning of the 1950s in the technical-logistical area, objects started to be provided with artificial markers or bar codes. By the middle of the 1960s, automatic identification started to be used in the pharmaceutical industry.

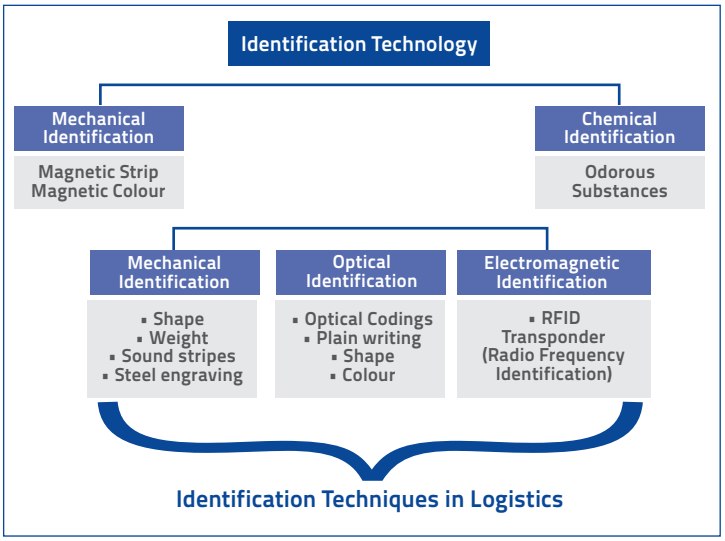


Bar codes represented the easiest way for machines to read printed data. The information encrypted in the bar code is scanned and recorded with the help of special scanning devices. Since these one-dimensional codes consist of simple, relatively short number sequences, they can generally only be used to detect limited information such as the price or location of the item. That is why, at the end of the 1980s, development began on multi-dimensional optical codes with higher information density, for example, two dimensional stacked codes and matrix codes.

In the networking world of Industry 4.0, all relevant data about a certain object will be available at every location throughout the system. This requires unique identification of the objects in every phase of the process – and that in turn requires a larger data volume during object labelling. This is where the simple bar code will reach its limits.

1.1 Forms of Labelling

Today, there are a variety of options in the manufacturing and logistics sectors to mark objects so they can be automatically read - mechanically, visually and electronically. Mechanical identification works with natural identification characteristics such as shape or weight. However, the scope is very limited, an example is the weighing of an object as a control measure during picking. Visual identification is by far the most common among all identification techniques used today and will continue to play a significant role in the future. Electronic identification via methods such as RFID (Radio Frequency Identification) is also experiencing strong growth. In this case, the information is stored on a semi-conductor chip commonly known as an RFID tag. If this is connected to an antenna, data can be read without contact by the corresponding RFID reader. This technology offers great potential, but it also requires higher investments and is partly limited due to physical conditions. Which identification technology is the right one for you depends on your requirements, feasibility, and the budget available. In the future, there will be an increasing number of hybrid identification concepts that combine, for example, optical codes and RFID tags.



Visually Detectable Codes and Characteristics

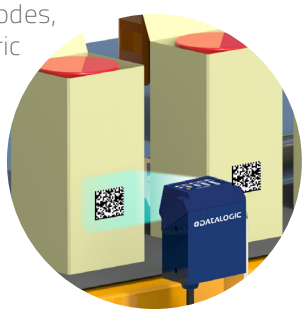
1D Codes – simple, proven, but limited

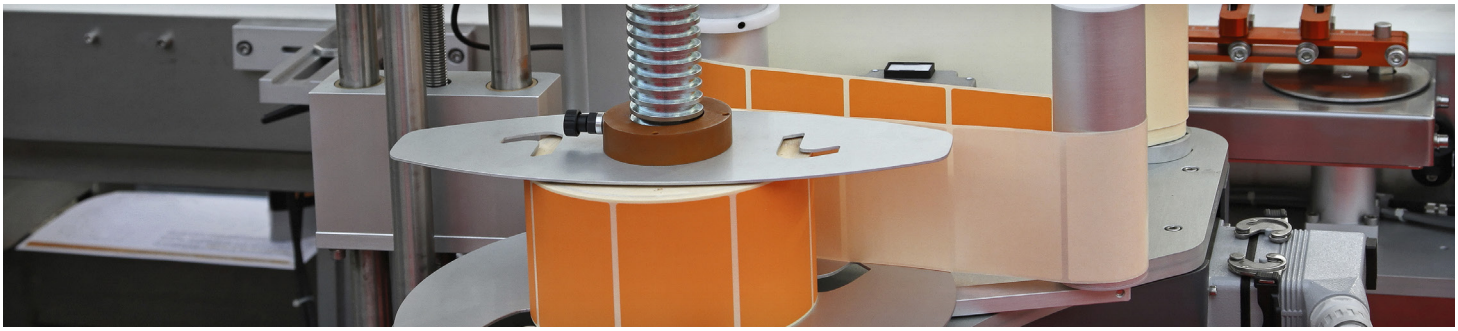
This is the classic bar code – a sequence of lines and gaps of different widths, sometimes supplemented by rows of characters. Because the bars are always arranged in a single, linear row, they are called one-dimensional bar codes.

The bar code system has been tried and tested for decades and is compatible with most scanners currently in use. It is easy to manufacture and reproduce. Due to the simple structure of the codes, the scanner's requirements are also quite low. That is why scanners for 1D codes are also generally not capable of reading 2D codes. The main limitation of the one-dimensional bar code lies in its maximum data volume. Since it is only capable of transmitting a two-digit number of characters, it needs to be linked to a database in order to query additional information.

2D Codes – versatile and error-tolerant

With 2D codes such as Matrix codes, several thousand alphanumeric characters can be encrypted in a small space. The requirements regarding printing quality and contrast are quite low. That is why they can be applied on almost all materials and are suitable for a range of applications including the permanent marking of tools or mechanical components. Even more application possibilities are derived from the fact that some 2D codes, such as the QR code, can be scanned by anyone using a smartphone app.

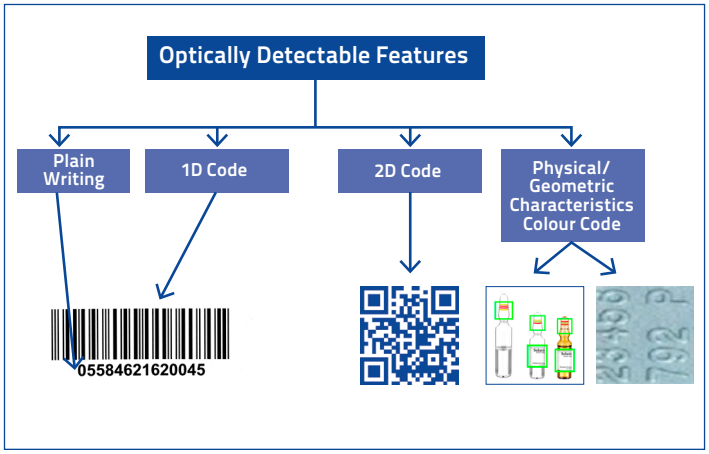




Because of the error correction procedures, many 2D codes can be decrypted even if they are damaged or dirty – even if up to 30 percent of the content is no longer legible. However, this also increases the demands on the scanner, which requires a digital camera with image capture software. On the one hand this means higher costs, but on the other hand it also brings advantages such as more information per scan and omni-directional scanning meaning the code can decrypted even when presented at an angle or upside-down. 2D scanners are also always capable of reading 1D bar codes.

Plain text, dimensions, defects and more – new possibilities beyond identification

Imprints in plain text, colour codes, the precise dimensions of objects or defects on products – all of these can be recorded with industrial image processing systems. They include smart cameras with particularly powerful processors, which can of course also decrypt 1D and 2D bar codes.



1.2 Marking Methods

The design and application of optical markings depends on, among other things, the type of the product, the process flow, the process environment or the subsequent use. The spectrum ranges from direct printing to labelling, embossing or laser marking.

Labelling

Typically, labelling calls for a paper or plastic label to be stuck to the object to be marked. Wet labelling with plastic or hot glue is one option, commonly used in the large-scale manufacturing of beverages or pharmaceutical products. Alternatively, self-adhesive labels offer numerous possibilities for codes to be affixed to different surfaces. They are ideal for codes or plain text and can also be combined with RFID technology.

Direct Print

In this method, the code is not printed on a label, but directly on the surface of the object. To make this possible, the structure and geometry of the surface must be suitable for process-safe printing with a corresponding printing ink. This type of labelling does not result in any additional costs, since it is usually associated with objects that need to be printed such as product packaging.

Direct Part Marking (DPM)

In Direct Part Marking (DPM), symbols, codes or plain text are applied directly to the surface of the object using different techniques, for example, through embossing, scoring or engraving. Dot Peen systems are used for embossing of robust materials including steel or aluminium, using mechanical movements of a needle. In stylus stamping systems, the needle isn't moved up and down, but is pressed into the workpiece. The direct marking of surfaces with the help of laser technology makes it possible to apply permanent labels to any kind of materials and components in miniaturised form - without tool wear, making the marks completely hygienic and forgery-proof.

2 DATA COLLECTION POSSIBILITIES/SYSTEMS

The automatic identification of bar codes and characteristics requires suitable devices and systems that are able to detect these characteristics quickly and safely. Depending on the application area, type of label and process conditions, different versions and technologies can be used – from laser scanners to cameras and from mobile devices to stationary systems.

2.1 Technologies for Automatic Visual Identification

Laser Scanners – extremely fast for 1D codes

A laser scanner scans 1D codes with a fine moving dot of light and reads the reflected rays of light with a photoelectric converter. The scanning speed is extremely high. That is why this technology is ideally suited to applications in which the objects to be captured are moving very quickly. Laser scanners can read across high ranges and have a large reading field. This is the minimum and maximum distance to the scanner. In hand held devices, laser scanners can hardly take full advantage of these strengths – due to restrictions caused by size, weight and energy consumption. That is why camera-based systems have become more prevalent in this area.

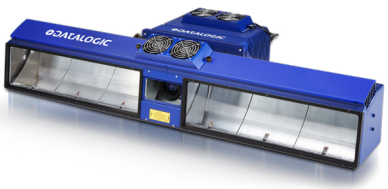
The wavelength of the laser is fixed and monochromatic. This results in special requirements regarding the colour and substrate of the code. The surface to be scanned should also be as free of reflections as possible.

DX8210 DS8110 DS5100

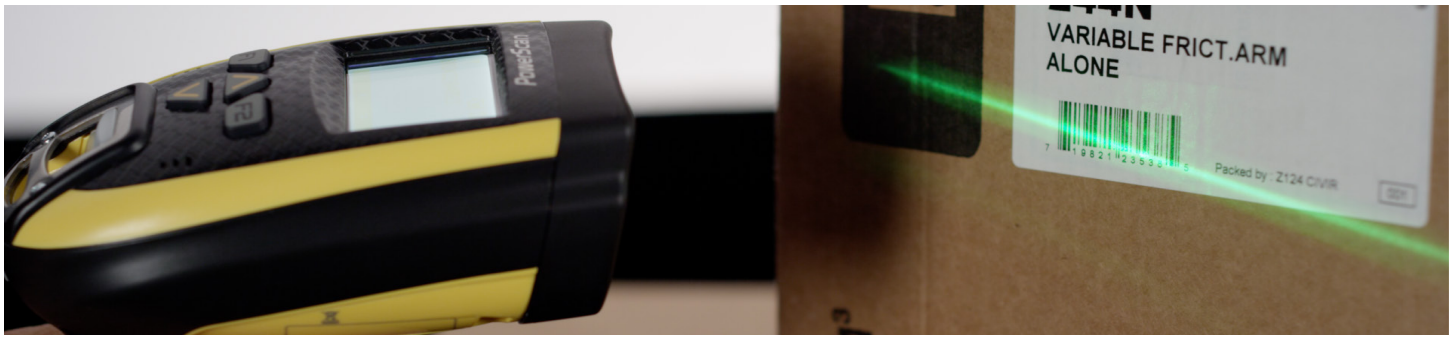
Camera/Imager – versatile and extremely flexible

Using cameras or imaging technology to capture codes and characteristics offers more and more possibilities because of new technological developments. High-resolution image recording chips, high-capacity LED light sources for optimal lighting and increasingly smaller microprocessor systems with higher image processing power, improve and expand application possibilities for this technology.

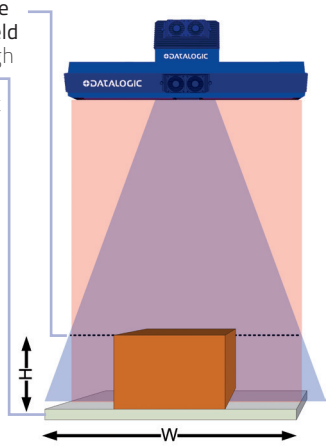
There are two basic forms: the linear camera and the 2D camera. Linear cameras generate a single repeating image line – just like a laser scanner. They can replace, for example, laser-based systems in applications in which installation space is limited. They are also used for very high object speed, since they are superior to 2D cameras in this regard.



A camera-based linear camera for the high-speed scanning of packages, for example



Maximum reading distance and maximum depth of field
Scans up to 1 m / 39 in high
Largest field of view
Up to 1,4 m / 55 in (largest conveyor belt width)



2D cameras can be used in extremely flexible ways. The hardware and software can be adjusted to different tasks and situations without a great deal of effort. They can decode 1D and 2D codes, for example Matrix codes, that require high information density on a small space, but characteristics such as shape, colour, dimensions or defects are also recorded with camera-based image processing.

A camera-based scanner detects both 2D and 1D codes.

2.2 Hand Held Devices and Stationary Systems

For identification tasks in production and logistics environments, both hand held scanners and stationary systems are used.

Hand held scanners – Recording objects quickly and flexibly

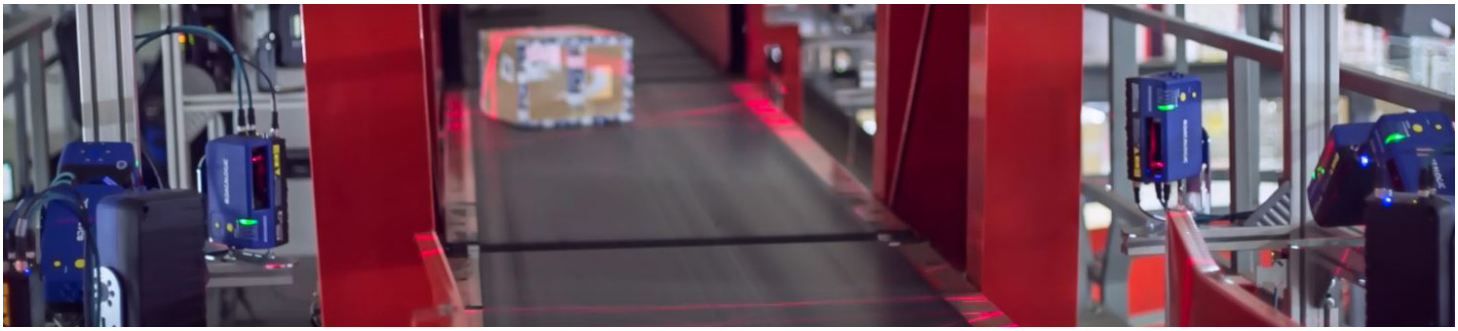
Hand held devices are reliant on human operation and are generally used in partly-automated or manual handling of goods and materials. The responsibility for the correct recording of objects lies with the operator. The device supports the operator with acoustic or visual feedback. There are corded versions for use at a firmly defined workplace and wireless devices for full mobility.

Modern hand held scanning devices are generally camera-based and permit multi-directional scanning of 1D and 2D codes. Depending on the resolution of the code, the reading distance ranges from direct contact to over 10 m.

For hand held scanning devices, ergonomic factors and user-friendliness play a very large role, so that even scan-intensive applications require as little effort as possible from the operator. An ergonomic grip and balanced weight distribution ensure that the device is easy to hold. An intuitive target system maximises first scan success rates. A lighting system with a calm, pleasant white light is easy on the human eye. A successful scan-process is generally confirmed by a beeping sound. In a loud or noise-sensitive environment, a clear visual feedback signal like 'Green Spot' technology is used, where a green dot is projected onto the code to confirm a successful scan. This can be very helpful.

Additional important features include, water and dust resistance with protection class IP65 or code reading with depth of focus in the warehouse and for pallets. Ethernet/ Profinet interfaces or a USB-HID interface are also crucial for easy integration of the devices.

A camera-based hand held scanning device for multi-directional scanning of 2D and 1D codes



Stationary Systems – for fully automated processes

Stationary systems are used in scenarios where the flow of materials is fully automated. With these powerful solutions, objects moving very quickly along conveyors can be identified with extremely high reliability.

Fixed scanners with laser technology are ideal for the identification of 1D codes and offer a very cost-effective and proven solution. Fixed scanners with camera technology also allow the scanning of 2D codes and directly marked codes. Solutions with industrial image processing capabilities go beyond that. They can detect plain text, possible defects or the dimensions of objects.

Powerful fixed scanners with camera technology are extremely versatile. Because of their compact form, they can be easily integrated in very confined spaces. Depending on their application, there are, different sensors, optics or an electronic focus control. IP65 protection and a large operating temperature range ensure faultless operation even under harsh industrial conditions. Integrated interfaces transmit the data and recorded images. An intuitive user interface facilitates setup, use and maintenance.

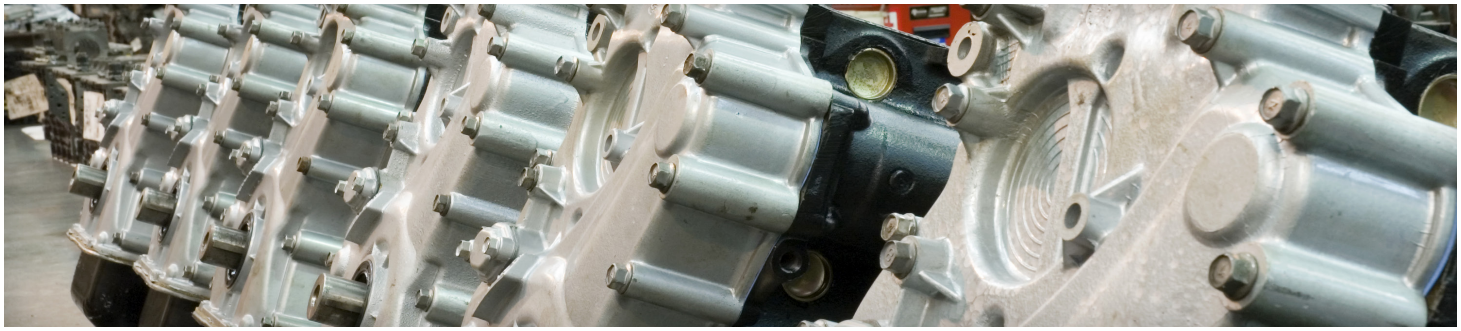
Interfaces – for the right connection

Suitable interfaces are crucial for the simple integration of data collection devices into the customer's system and reliable data transfer to the control level. Due to the

A machine vision solution:
The smart camera also detects plain text or defects on a product

Codes, characteristics and the right kind of recording technique

Functions	Hand Held Scanners, i.e. PowerScan™, Gryphon™	Stationary Systems Laser Technology, i.e. DS2100/2400, DS5100, DS8000	Stationary Systems Camera Technology, i.e. Matrix 120, 210N, 310N, 410N, 450N	Image Processing Smart Cameras, i.e. B. P-Series, T-Series
Read 1D Bar Codes	Yes	Yes	Yes	Yes
Automatically Reads 1D Bar Codes	No	Yes	Yes	Yes
Reads 2D BarCodes	Yes	No	Yes	Yes
Automatically Reads 2D Bar Codes	No	No	Yes	Yes
Reads Codes with Direct Part Marking (DPM)	Yes	No	Yes	Yes
Automatically Reads Codes with DPM	No	No	Yes	Yes
Reads Plain Text (OCR)	No	No	No	Yes
Measuring Parts and Detecting Defects	No	No	No	Yes
Simple Operating Software	Yes	Yes	Yes	No
Polarisation Filter Against Reflections	No	No	Yes	Yes
Infrared Devices to Protect Eyesight	No	No	Yes	Yes
Depth of Focus to Scan Codes in Warehouses/Pallets	Yes	Yes	No	No
USB-HID Interface Without Changing Software	Yes	No	Yes	No
Ethernet/Profinet Interfaces	Yes	Yes	Yes	Yes



Applications	Hand Held Scanners, i.e. PowerScan, Gryphon	Stationary systems laser technology, i.e. DS2100/2400, DS5100, DS8000	Stationary Systems Camera Technology, i.e. Matrix 120, 210N, 310N, 410N, 450N	Image Processing Smart Cameras, i.e. P-Series, T-Series
Commissioning in Goods Dispatch Areas	+	o	+	-
Automatic Product Tracing	-	+	+	-
Missing Parts Control	-	-	-	+
Checking Shelf Life	-	-	-	+
Scanning at Counter, i.e. Retail Trade	+	-	+	-
Pallet Identification and Tracing	-	+	o	-
Scanning Under Shrink Wrap	o	-	+	-
Label Checking with Automatic Labelling	-	o	+	-
Traceability in Goods Dispatch Area	o	+	o	-

wide-spread use of Ethernet and Profinet in the field of automation, having suitable interfaces is a must. The use of USB-HID interfaces is also wide-spread. For hand held devices, multi-interfaces with different connection options such as RS-232, Keyboard Wedge or USB are available. For wireless networks of the devices, Bluetooth® or W-LAN are used.

3 THE RIGHT SYSTEM FOR INDIVIDUAL APPLICATIONS

3.1 Automotive Applications

Just-in-time and just-in-sequence manufacturing, decentralisation, mass-individualisation, reduction of processing times and zero-error strategy – it's hardly a coincidence that automatic identification has played a key role in the automotive and supplier industry for a long time.

Here are three application examples:

Checking work progress

Bar code scanning and Auto-ID stations are placed along the entire production line. Compact laser scanners or camera-based code scanners can be installed flexibly and can reliably read 1D or 2D codes in order to check the work progress in every phase.

Tracing of parts

Stationary systems with camera technology detect parts based on 1D and 2D codes. The unique serial numbers are

stored in a production database. State-of-the-art image processing and decoding algorithms in connection with powerful lighting systems ensure excellent performance even on glossy, structured or brushed surfaces.

Tracing in manual assembly processes

Using modern camera-based hand held scanning devices, operators can manually trace automotive components during vehicle assembly. This allows direct marked codes (DPM) to be read out quickly and reliably – with

a range of up to one meter including in areas that are difficult to reach.

3.2 Pharmaceutical Applications

In the Healthcare sector, complete monitoring and high efficiency must be guaranteed for critical applications. Data recording technologies are of central significance. Since the middle of the 1960s, the pharmaceutical industry has been using automatic identification in the production and packaging of pharmaceutical products in order to prevent mix-ups. To protect against forgeries, according to an EU Guideline that will come into force in February 2019, prescription drugs may only be brought into circulation once they have been marked with serial numbers and provided with a 2D bar code.

Here are three pharmaceutical application examples:

Manual processing of product deviations

Product deviations or rejects can be quickly and safely traced using camera-based hand held scanning devices. The omni-directional scanning of 1D and 2D codes makes work easier. An intuitive targeting mechanism ensures high first scan rates. Bar codes marked with DPM are also reliably detected.

Track and Track

The pharmaceutical industry requires highly effective solutions so that products can be traced reliably throughout the supply chain. State-of-the-art laser scanners and 2D camera systems ensure error-free performance even at very high speeds – and in ultra-compact formats.

Monitoring of secondary packaging

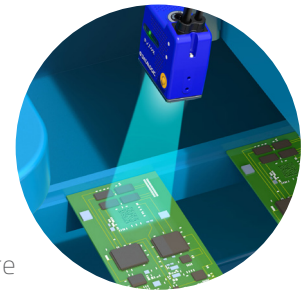
Recognition technology checks and controls the distribution network in supply chains that aggregate primary packaging into secondary packaging cartons. Compact camera-based systems with powerful image processing can also scan lower-quality codes error-free, with ink printed on cardboard boxes.

3.3 Electronics Applications

The electronics industry is a technological driver of digitalisation and of Industry 4.0. This is also reflected in the comprehensive utilisation of automatic identification in in-house manufacture and logistics: for verification, quality assurance and tracing in the entire production process.

Here are three application examples:

Monitoring of parts



Camera-based stationary systems detect and trace parts and sub-assemblies in the individual phases of the production process. The compact 2D scanning devices can scan large areas. Great depth of focus and dynamic focus functions ensure high process reliability. The image memory function makes quality checking possible.

Tracing of components

The detection of individual components is necessary to be able to generate complete reports ("Identity Cards") for the numerous categories of equipment and electronic devices. Powerful camera-based systems reliably identify high-resolution 2D codes, including codes marked with DPM (Direct Part Marking). These solutions are also suitable for use in high-speed pick and pack machines.

Installation of placement machines

Through the use of camera-based hand held scanning devices, the manual re-filling of placement machines can be handled in a way that ensures absolute process-reliability. Both the component container as well as the matching insertion point are reliably detected – regardless of whether one is dealing with a DPM code (direct marking) or a code printed on a label. Depending on the application area, a corded or wireless variant may be more practical or economical.

4 A SUITABLE SOLUTION FOR EVERY TASK

Every industry, every company and individual application has different requirements for automatic identification. Objectives and specifications, the processes and their environment, physical restrictions and technical possibilities impact the selection of codes, labelling procedures and data collection systems. There is no single solution that matches all requirements. A solution is only ideal if it is precisely tailored to the specific requirements and can integrate perfectly into the entire system.

That is why, as an international market leader in the area of automatic data collection and process automation, Datalogic offers the most extensive portfolio for automatic identification solutions – from bar code scanning devices, mobile computers, sensors, security technology and RFID solutions, to image processing systems and laser markers.

In terms of visual identification, the Datalogic portfolio ranges from laser to camera technology and from hand held devices to stationary systems – in a multitude of models and with virtually limitless customisation options.

DATALOGIC

Leader in all ID Applications

ALL YOU NEED

For Bar Code Reading and Identification

Additional information about Automatic Identification can be found at: **www.datalogic.com.**

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