ELECTRIC VEHICLE BATTERY SOLUTIONS GUIDE

Electrode, Assembly, Formation, and Module & Pack Solutions

COGNEX

THE GLOBAL LEADER

IN MACHINE VISION AND INDUSTRIAL BARCODE READING

Cognex® the leading supplier of machine vision and industrial barcode reading solutions.

With over 2 million systems installed in facilities around the world and over thirty seven years of experience, Cognex is focused on industrial machine vision and image-based barcode reading technology. Deployed by the world's top manufacturers, suppliers and machine builders, Cognex products ensure that manufactured items meet the stringent quality requirements of each industry.

Cognex solutions help customers improve manufacturing quality and performance by eliminating defects, verifying assembly and tracking information at every stage of the production process. Smarter automation using Cognex vision and barcode reading systems means fewer production errors, which equates to lower manufacturing costs and higher customer satisfaction. With the widest range of solutions and largest network of global vision experts, Cognex is the best choice to help you **Build Your Vision.™**

$806 MILLION
2018 REVENUE

OVER 37
YEARS IN THE BUSINESS

500+
CHANNEL PARTNERS

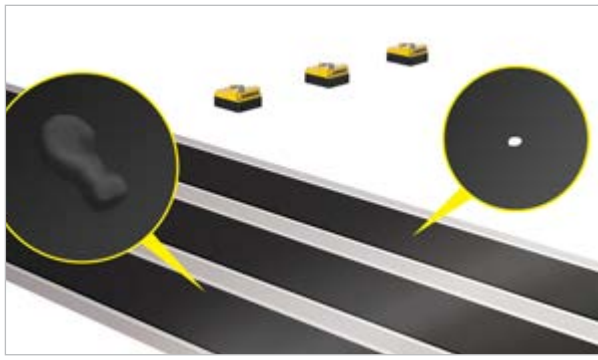
GLOBAL OFFICES IN
20+ COUNTRIES

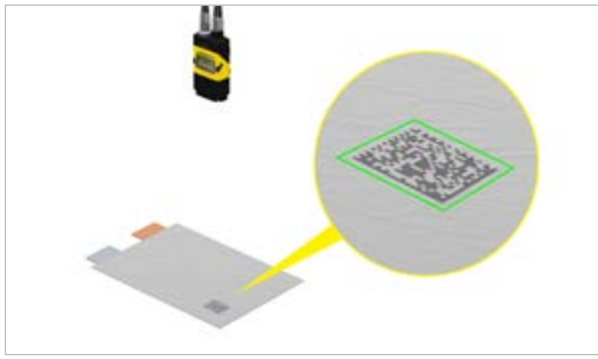
2,000,000+
SYSTEMS SHIPPED

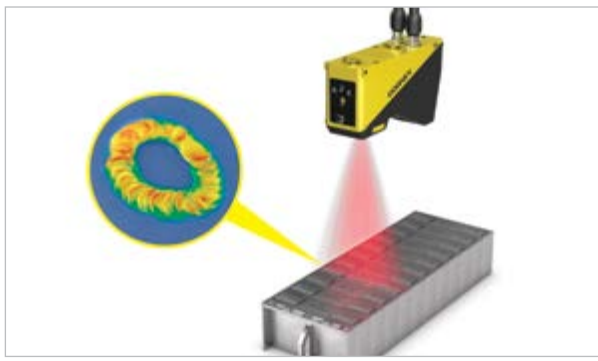
THE RIGHT CHOICE FOR EV BATTERY MANUFACTURING

BATTERIES THAT GO THE DISTANCE

Of all the technologies in an electric vehicle (EV), lithium-ion batteries are arguably the least standard, with significant differences in development and manufacturing practices. Today's battery-electric vehicles (BEVs) employ a wide variety of cell designs including cylindrical, pouch, and prismatic. Regardless of design, manufacturers are uniformly focused on achieving greater energy density, cycle life, and safety. During production, stable manufacturing processes are essential to prevent degradation and minimize waste. Cognex machine vision and barcode reading technologies help manufacturers adhere to the highest quality standards and ensure high performance. Machine vision is used throughout EV battery production to inspect materials for quality and consistency and to guide, align, and identify components. See how Cognex machine vision systems, barcode readers, and industry-leading software help EV battery manufacturers and automakers ensure quality and traceability throughout the supply chain.



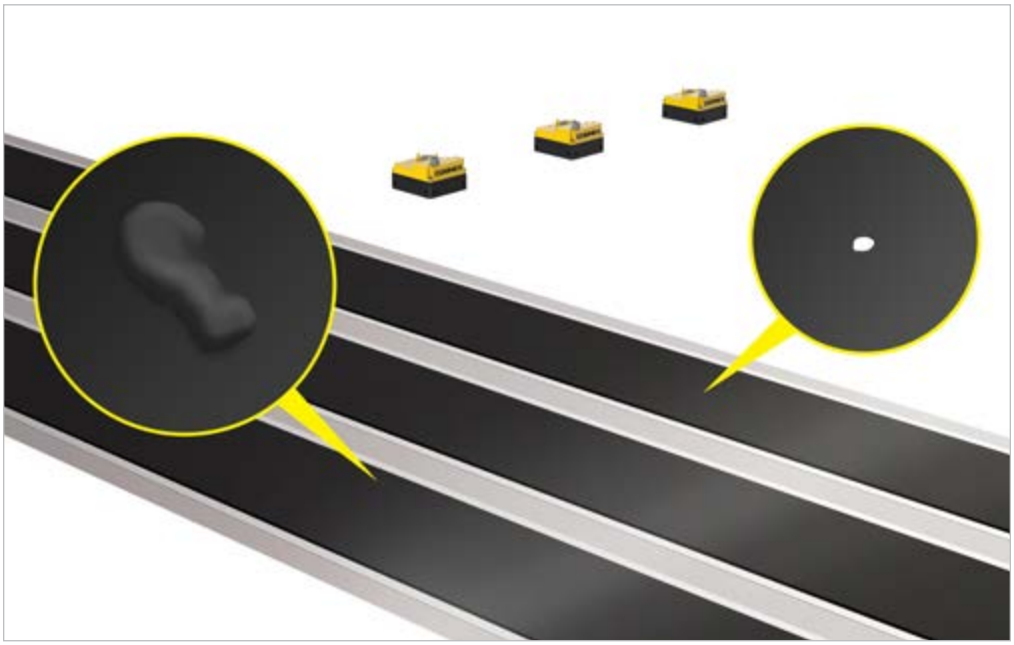




ELECTRODE

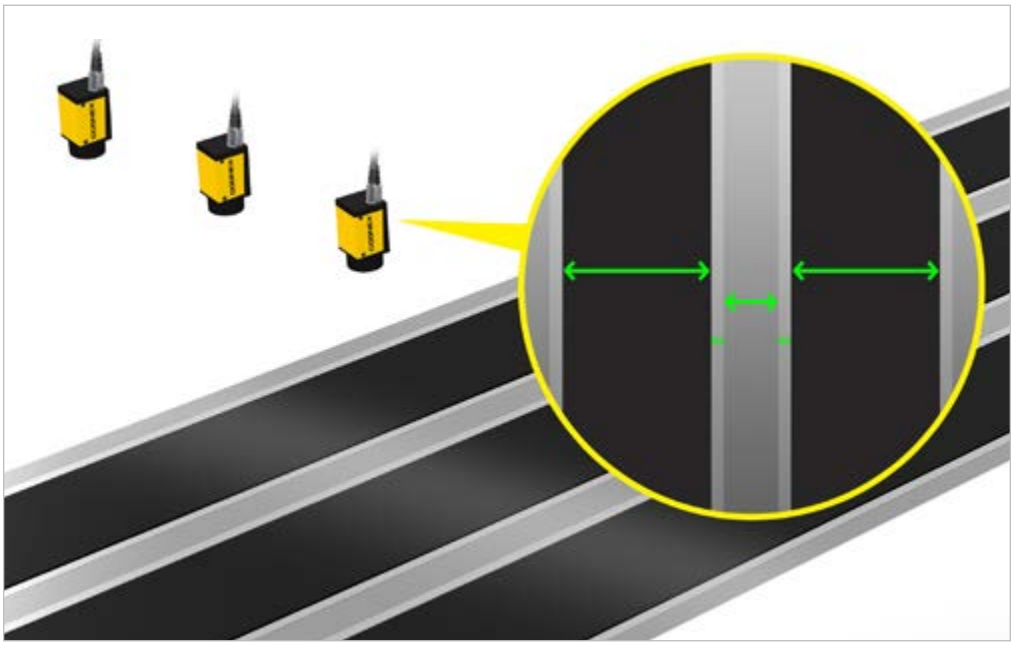
During the electrode manufacturing process, electrode material is coated onto copper and aluminum foil for electric flow. It is essential to check the metal surface, separator, and coating for any surface or edge defects as well as uniform shape and thickness. Cognex provides quality inspection and gauging solutions to ensure that electrode sheets meet exacting specifications before they are separated by an insulator and—depending on manufacturer and form type—rolled, wound, or stacked into a lithium-ion cell.

Coating Quality Inspection



Cognex Industrial Line Scan Cameras and VisionPro® software detect defects like craters, bubbles, and holes on electrode sheets.

Coating Width Gauging

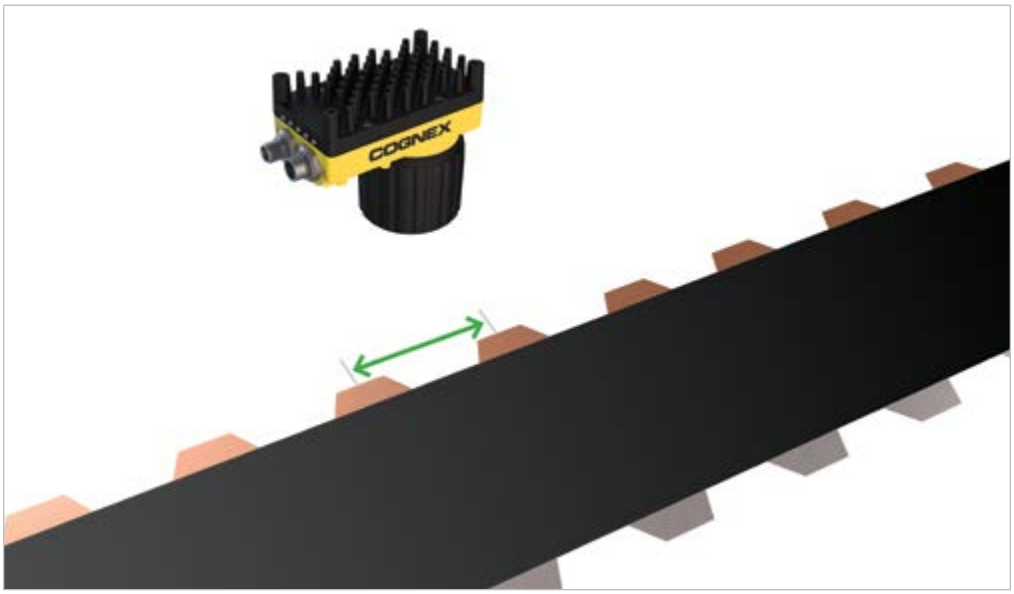


Cognex Industrial Area Scan Cameras and VisionPro software gauge the dimensions of the separator and electrode.

ASSEMBLY

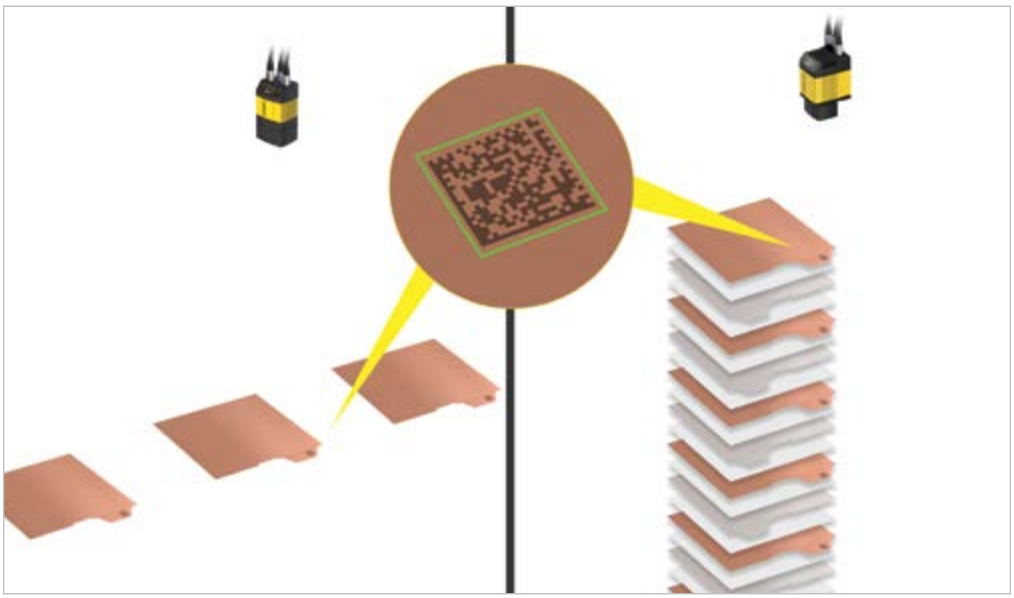
In cell assembly, a separator and electrode are joined together during vacuum drying. The joined cell of cathode and anode is either wound, rolled, or stacked. Lead tabs are attached to the folded cells. The process is complete when the cells are filled with electrolytes, vacuum-sealed, and dried. Cognex offers gauging, 2D code reading, alignment, guidance, and inspection solutions to ensure that lithium-ion cells can meet high energy density and performance demands. Cylinder-, pouch-, and prismatic- or can-type cells manufactured with Cognex technology are well-suited to mobile energy storage applications, including as automotive batteries for electric vehicles.

Electrode Tab Distance Gauging



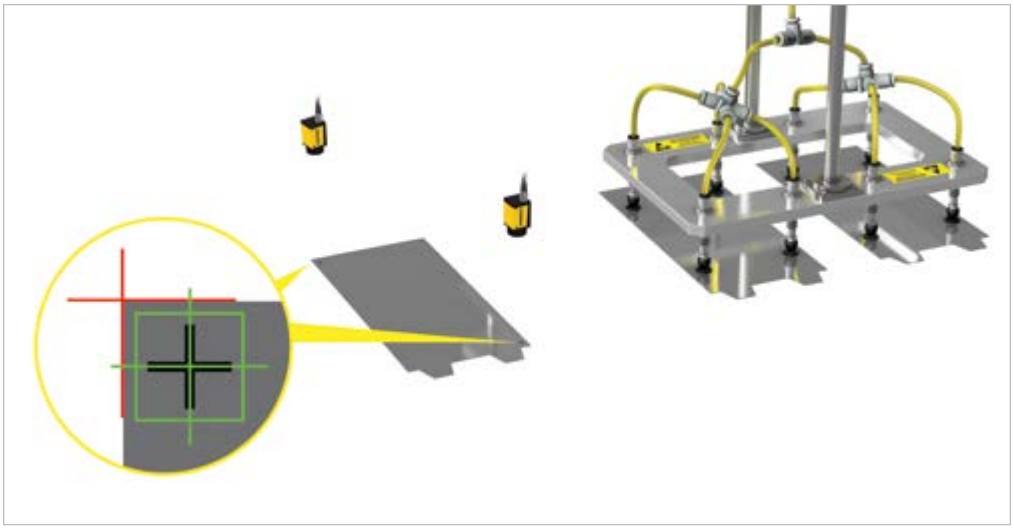
The In-Sight® 5000 vision system measures the distance between poles on a cell sheet.

2D Code Reading



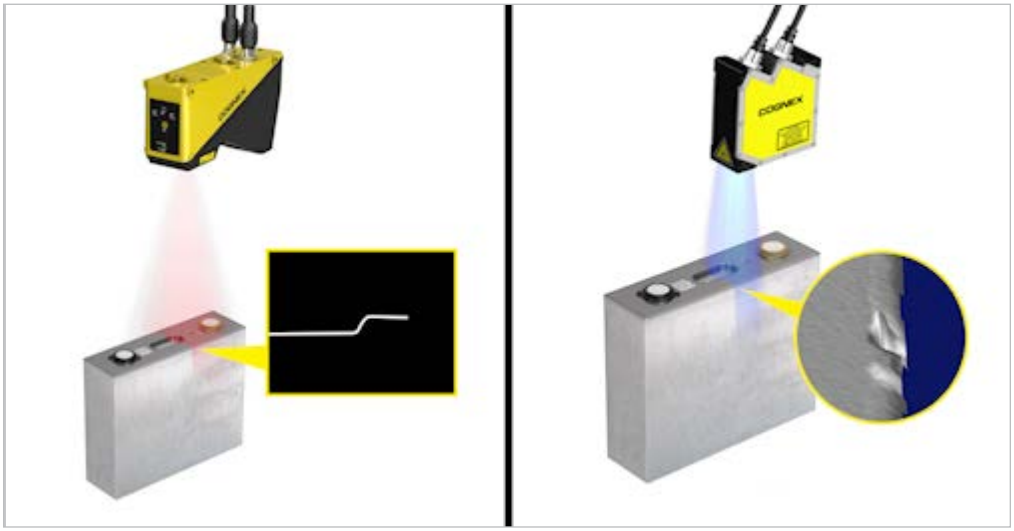
DataMan® image-based barcode readers read laser-etched DataMatrix codes on the copper sides of cell sheets and the top of stacked electrodes.

Stacking Alignment



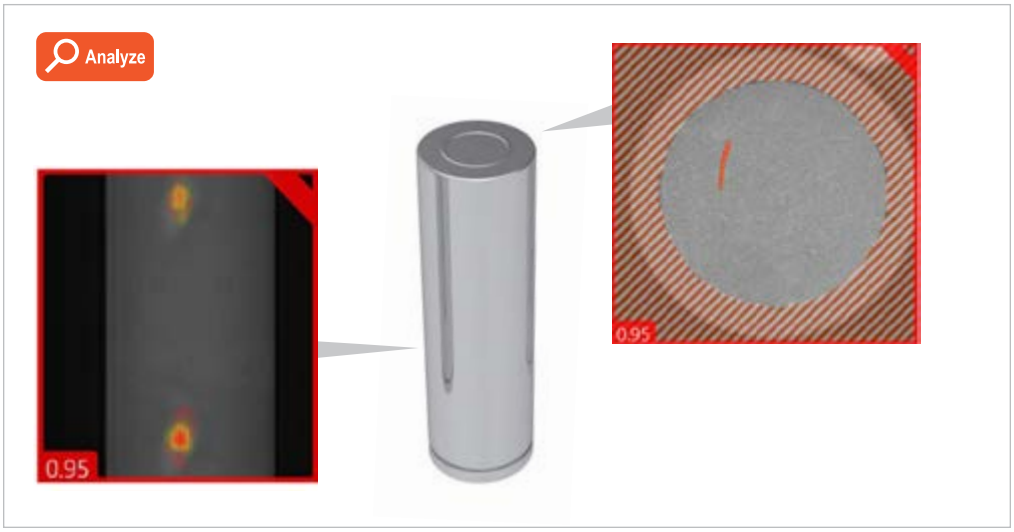
Cognex Industrial Cameras and VisionPro software align cell sheets for stacking.

Cap Welding Guidance and Inspection



The DS1000 3D laser displacement sensor measures the height difference between the cap and battery case prior to welding. Afterwards, the DS925 laser displacement sensor inspects the welded seams to ensure they are fully sealed and free of defects.

Cylinder Inspection

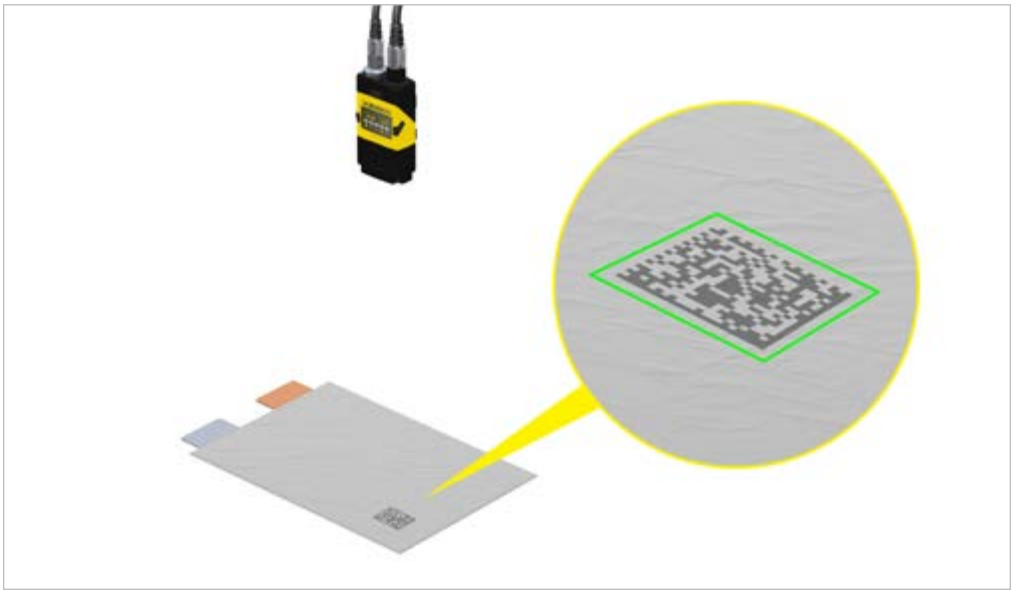


Cognex ViDi™ deep learning-based image analysis software inspects a cylinder battery for surface defects.

FORMATION

Lithium-ion cells are activated, packaged, and tested during the formation process. During this process, individual cells are charged to become EV batteries and tested for voltage, current, and cosmetic appearance. Completed EV cells are graded and tracked using barcodes before they are shipped to EV module and pack manufacturers. Cognex offers code reading, pouch surface inspection, cell stacking height measurement, and optical character recognition (OCR) solutions to help manufacturers ensure their lithium-ion cells can meet the demands of large-format battery pack manufacturers and energy storage system developers.

Code Reading

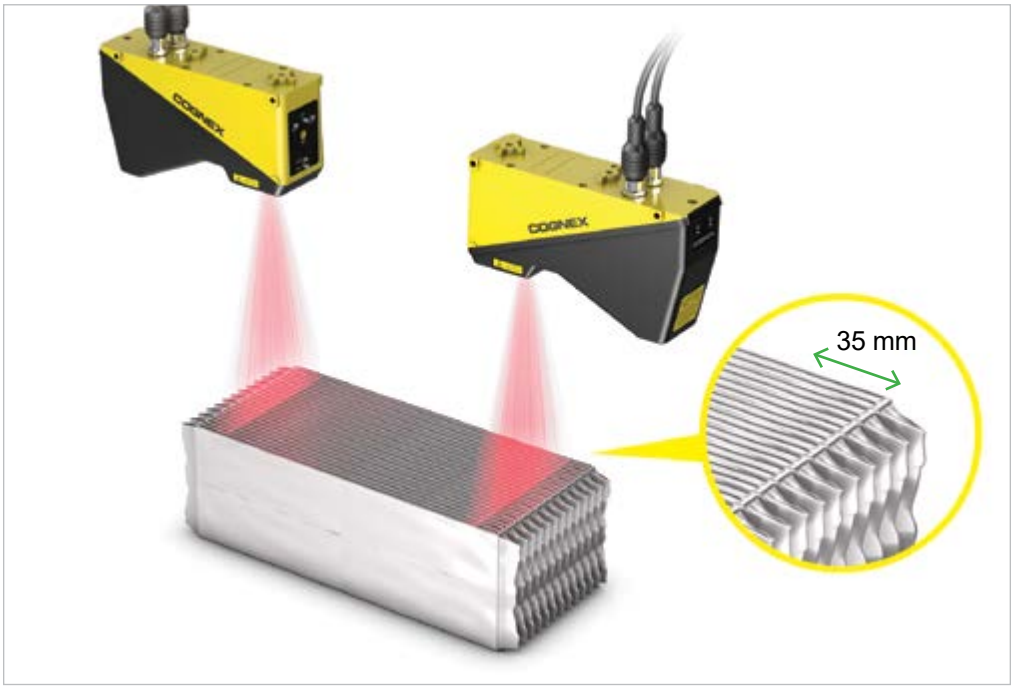


A DataMan 260 image-based barcode reader reads stretched DataMatrix codes on a pouch's surface.

Pouch Surface Inspection

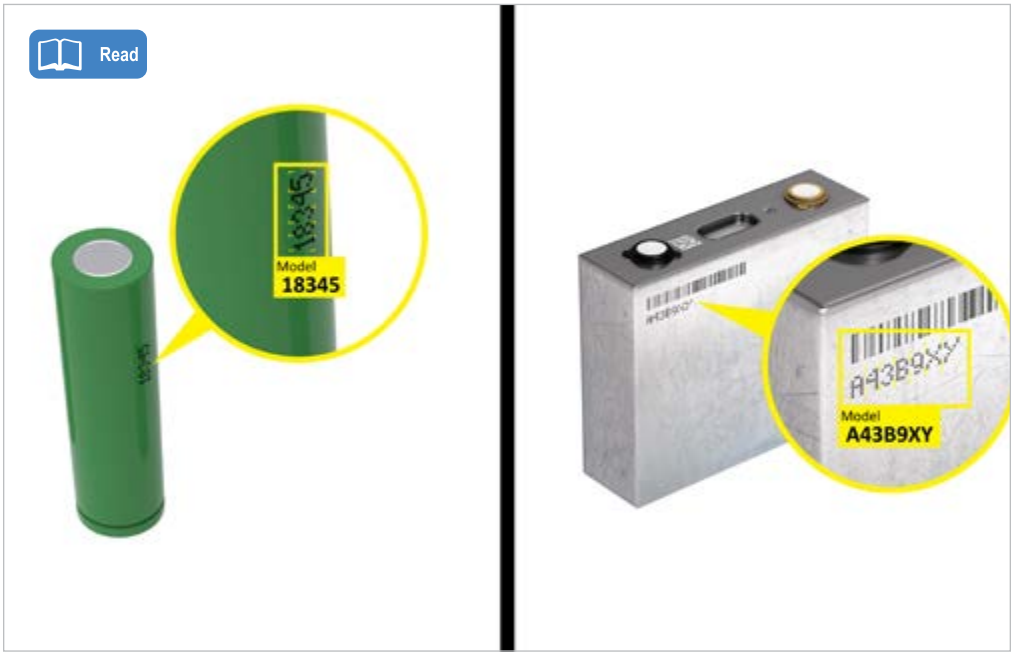
Cognex ViDi deep learning-based software identifies surface defects, like bubbles and wrinkles, on a pouch's surface.

Cell Stacking Height Measurement



Two DS1000 3D laser displacement sensors measure the profile of cell batteries stacked inside a module.

Battery Optical Character Recognition



Cognex ViDi locates and reads the alphanumeric codes on batteries using a pre-trained font library.

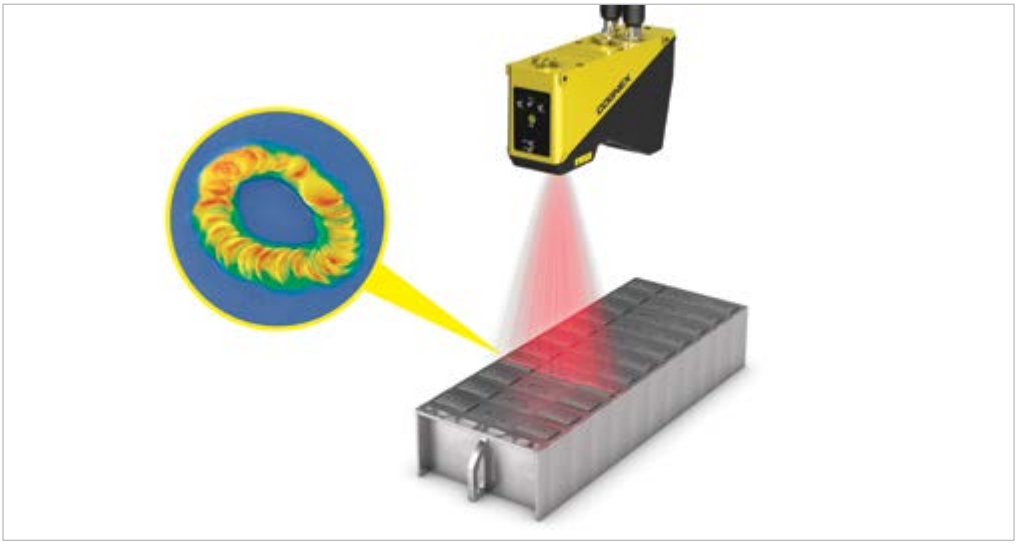
MODULE & PACK SYSTEM

EV module and pack systems are assembled by both OEMs as well as automotive makers. A module is composed of a few cells welded or otherwise physically attached to each other. Multiple battery cells are assembled into a module, wrapped in steel plates, and have their poles welded together to produce the correct voltage. Inspection during the assembly process ensures that both cells and packs are in the correct position, have strong contact, and are properly welded. Cognex offers machine vision solutions for module inspection, busbar welding inspection, module and pack (M&P) assembly, cable connector guidance, and code reading to guarantee proper function before EV modules and packs flow into general assembly.

Code Reading

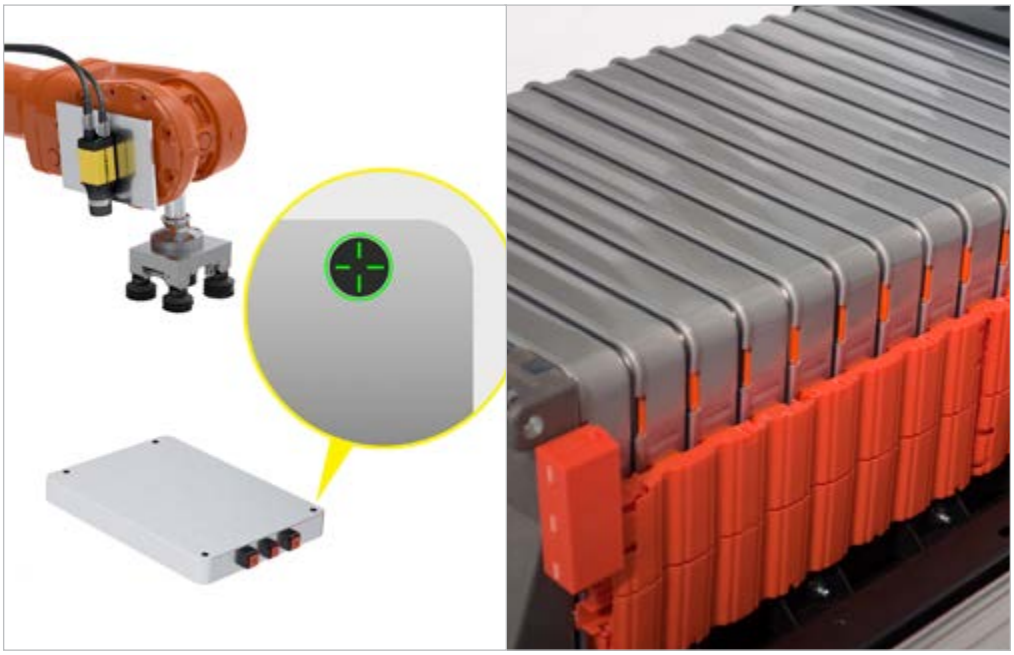
The DataMan 470 barcode reader reads a large array of codes on battery modules during testing.

Module and Busbar Welding Inspection



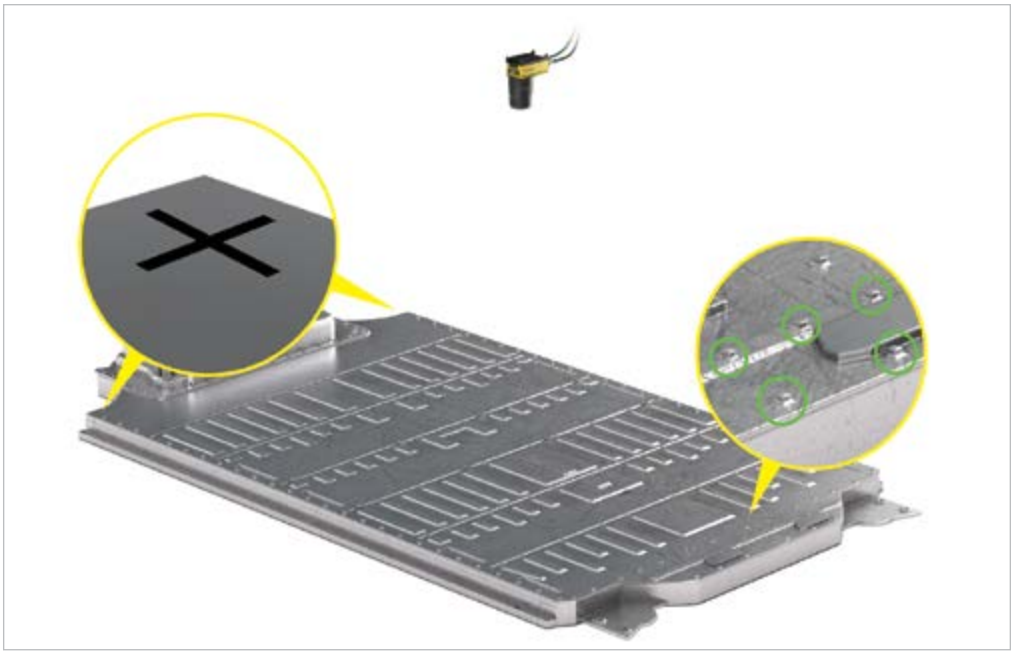
The DS1000 3D laser displacement sensor and Cognex ViDi deep learning-based software inspect the welds on a battery pack's modules and busbars.

M&P Assembly and Cable Connector Guidance



The In-Sight 8000 vision system guides the final assembly of modules and cable connectors into a pack.

Final Assembly Verification



The In-Sight 9912 vision system inspects the final battery pack for completeness and fixtures it for robotic placement.

INDUSTRY-LEADING VISION TECHNOLOGY

Cognex ViDi Deep Learning-Based Image Analysis

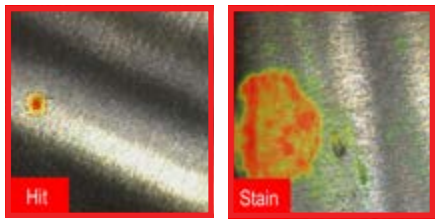
Deep learning technology uses neural networks that mimic human intelligence to distinguish anomalies, locate deformed parts, and read challenging characters while tolerating natural variations in complex patterns. Deep learning complements traditional machine vision approaches, which struggle to appreciate variability and deviation between visually similar parts. In factory automation, Cognex ViDi can now perform judgment-based part location, inspection, classification, and character recognition more effectively than humans or traditional machine vision solutions.

Locate

Finds and counts complex features and objects

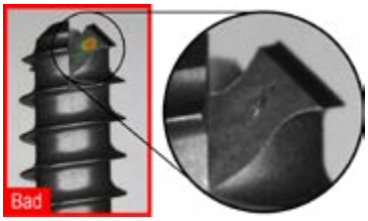
Classify

Classifies and sorts objects and complete scenes



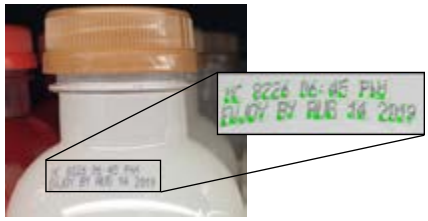
Analyze

Detects anomalies and cosmetic defects



Read

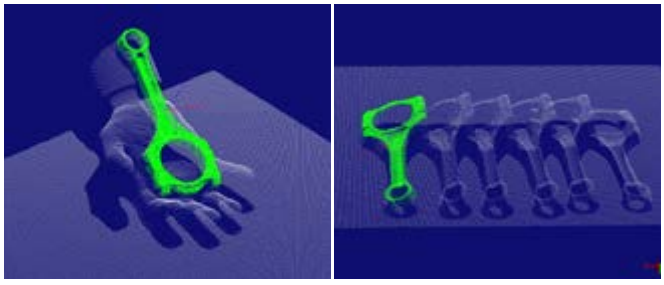
Reads challenging, deformed characters



Industry Leading Object Location

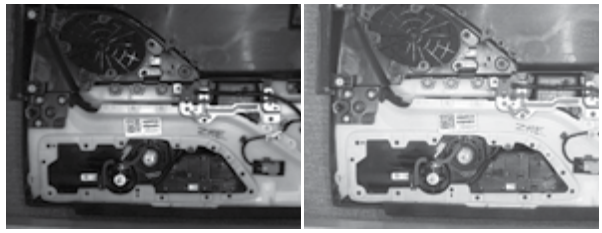
PatMax RedLine™ is an accurate, highly repeatable tool that locates trained patterns no matter the size, rotation, or location of the target part. It is ideal for industries and applications that require large fields of view, high accuracy, large angle and scale tolerances, and multiple targets.

PatMax® 3D is an accurate 3D vision tool that locates trained patterns based on its 3D geometry under 6 degrees of freedom (X, Y, Z, Rx, Ry, Rz). It finds 3D objects within a 3D point cloud image and is ideal for locating and identifying objects which are tilted, stacked or not properly seated with a fixture.



Advanced Image Formation

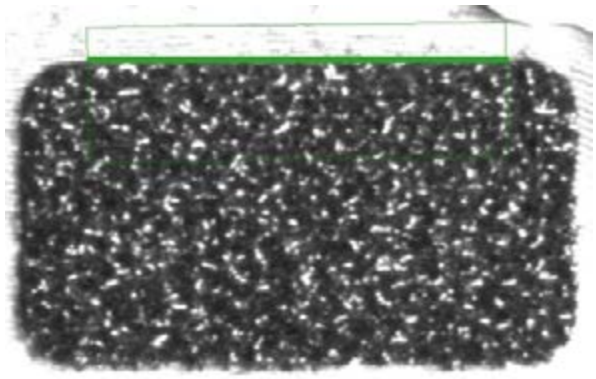
HDR+ is a patent-pending technology that delivers a high-contrast, uniform image in a single acquisition for multi-point inspections of parts with varying depths of field and lighting conditions.



SurfaceFX™ uses lighting and software algorithms to remove noise and clutter from the surface background and isolate features and defects that are recessed or embossed on parts. It highlights surface defects such as chips, wrinkles, punctures, stamped text, and codes so other vision tools can perform their tasks.

Edge Detection

This advanced line finding tool reliably and accurately extracts and locates edge features that make up lines in noisy or low contrast images. Used in applications where patterns or fiducials do not exist, LineMax™ handles beveled glass and other confusing edges with ease.



Code Reading

2DMax® with PowerGrid® is a breakthrough algorithm and technology designed to read 2D codes with significant damage to or complete elimination of a code's finder or clocking pattern, or quiet zone.

1DMax® with Hotbars® is an algorithm and technology optimized for omnidirectional 1D barcode reading, decoding up to 10X the speed of a conventional barcode reader.

OCRMax™, a font-trainable Optical Character Recognition and Verification (OCR and OCV) tool, has set industry records for ease of use, read rates and speed in complex images. This powerful algorithm prevents misreads, handles process variations, and provides easy font management.

MACHINE VISION SYSTEMS

Vision Sensors

In-Sight 2000 vision sensors perform simple pass/fail applications that help ensure products and packaging manufactured on an automated production line are error-free and meet stringent quality standards.

2D Vision Systems

Cognex In-Sight 2D vision systems are unmatched in their ability to inspect, identify, and guide parts. These self-contained, industrial-grade vision systems combine a library of advanced vision tools with high-speed image acquisition and processing.

3D Vision Systems

Cognex In-Sight laser profilers and 3D vision systems provide ultimate ease of use, power, and flexibility to achieve reliable and accurate measurement results for the most challenging 3D applications.

IMAGE-BASED BARCODE READERS

Fixed-Mount Barcode Readers

Compact but powerful DataMan barcode readers offer unmatched code reading performance with patented 1D and 2D code reading algorithms. The flexible options, easy setup, and quick deployment make them ideal for the most demanding industrial applications.

Handheld Barcode Readers

Versatile DataMan barcode readers provide best-in-class performance for 1D, 2D, and DPM codes, where ruggedness and speed are critical to success. A range of field-changeable communication options ensure these readers are ready to meet your application requirements.

Mobile Terminals

The MX series of vision-enabled mobile terminals leverage the latest iOS® and Android® smartphones in a rugged housing, tough enough to stand up to the most challenging environments—all while providing superior 1D, 2D, and DPM code read rates.

COGNEX GLOBAL SERVICES

Customers get more than software when they purchase from Cognex. They get a company focused exclusively on machine vision, with the most comprehensive application experience. Add direct, high-quality worldwide service and support, and it's easy to see why Cognex is the machine vision company that industries rely on.

TECHNICAL SUPPORT
PRODUCT TRAINING
HARDWARE PROGRAMS
PRODUCT LIFECYCLE

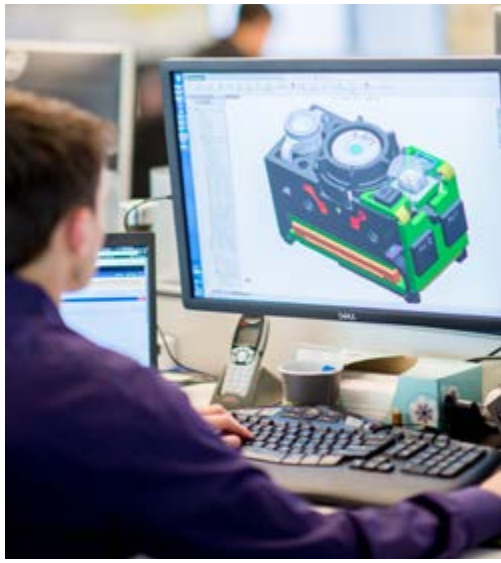
When it comes to protecting your machine vision investment, Cognex understands that responsive, expert service is an expectation all customers should have. Cognex serves an international customer base from offices located throughout the Americas, Europe, and Asia and through a global network of highly-trained partners, system integrators, and distributors.

From development to deployment, Cognex is there to help you get your vision systems up and running as fast as possible. Whether you're considering machine vision for the first time or are already an expert user, Cognex global services provide the expertise to help your organization succeed.

cognex.com/support/Cognex-services

OFFICES IN 20+ COUNTRIES

500+ GLOBAL PARTNERS IN 30 COUNTRIES



VISION FOR EVERY INDUSTRY

Cognex vision systems perform 100% inspection, ensure brand quality and improve your production processes. With over one million systems installed worldwide, Cognex machine vision systems are accepted in nearly every industry and used by most major manufacturers.

Automotive

The manufacturing processes for building virtually every system and component within an automobile can benefit from the use of machine vision.

Mobile Devices

Machine-vision-enabled robots provide scalable, final assembly of mobile phones, tablets, and wearable devices. Cognex vision technology enables high precision touchscreen display manufacturing and 3D quality inspection.

Medical Devices

Quality inspection is critical to success. Liability for defective products, inconsistent quality, rapidly changing costs and pending regulations, all challenge medical device manufacturers.

Consumer Products

Improve production and packaging operations with high-speed image acquisition, advanced color tools, and 3D inspection systems.

Pharmaceutical

The need to comply with patient safety and traceability requirements is imperative, and machine vision helps meet compliance goals.

Food & Beverage

Food and beverage applications require vision that can perform precisely, accurately and quickly to keep up with the fast-paced production lines.

Semiconductor

Cognex vision provides the precise, sub-pixel alignment and identification essential to every step of the semiconductor manufacturing process, despite increasingly fine geometries and process effect challenges.

Electronics

Machine vision provides the high-speed alignment and traceability for electronics assembly, even on the newest miniaturized components and flexible circuits.

COGNEX

Companies around the world rely on Cognex vision and barcode reading solutions to optimize quality, drive down costs, and control traceability.

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Lit. No. EVBSG-12-2018

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