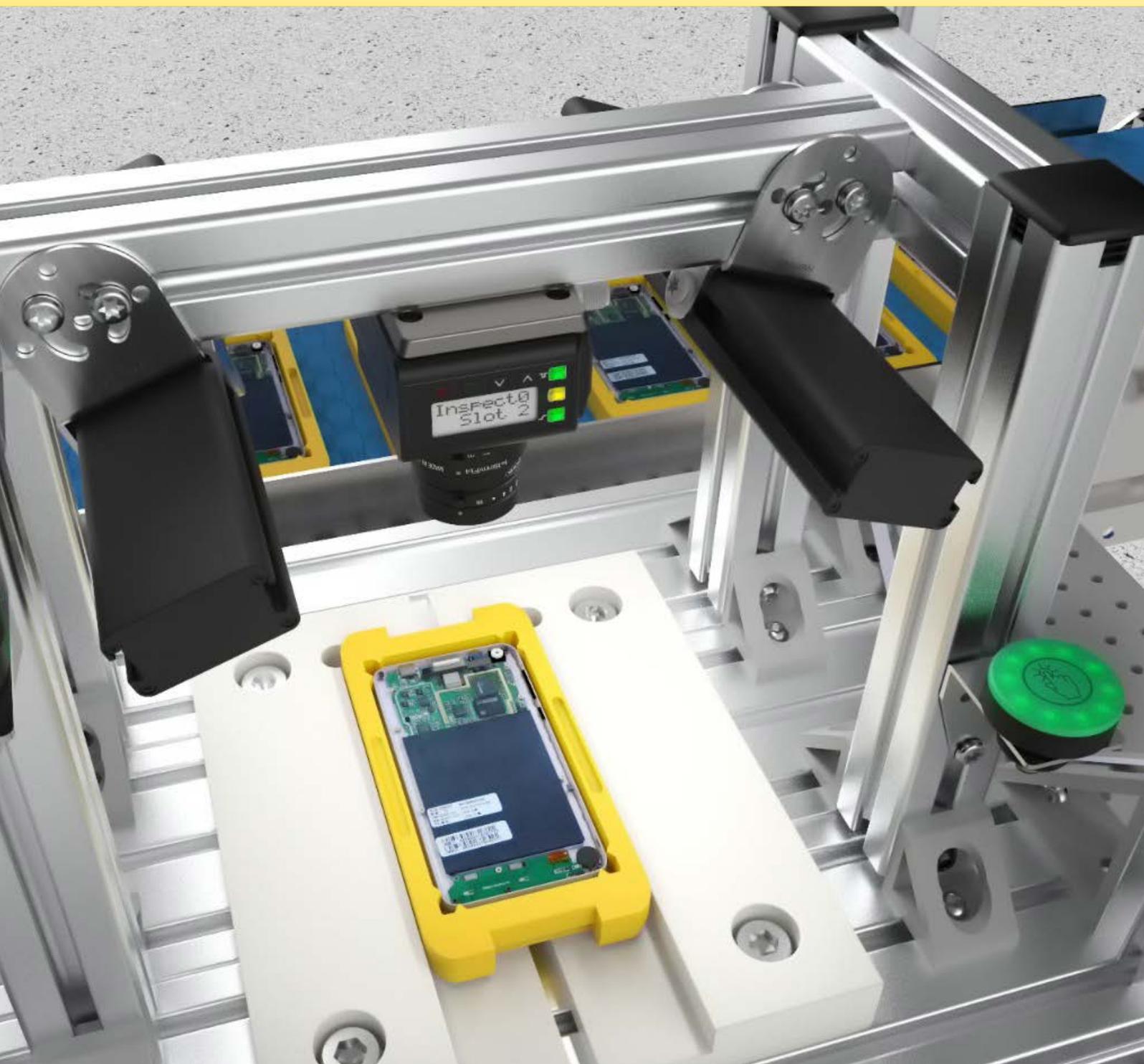


# Electronic Industry Solutions

**BANNER**<sup>®</sup>  
more sensors, more solutions





Banner International Headquarter

# Who is Banner?

---

Every 3.5 seconds, a Banner sensor is installed somewhere in the world. Banner solves problems for most of the manufacturing companies in the Fortune 500, who rely on Banner for reliable automation solutions.

Banner products help manufacture the cars you drive, the TVs you watch, the food you eat, the medicine you take and virtually every product you consume. Whatever the industry, Banner has a solution to help you automate your plants, improve efficiency and manufacture quality products.

## Manufacturing Specialists

Banner is a leading source for manufacturing needs with an extensive product line. With over 30,000 products, including our award-winning sensors, wireless solutions, vision sensors and lighting, machine safety, indicator lights and LED lighting, we have a solution for you.

## Application Solution Experts & Total Solution Provider

Our field sales engineers are the most highly-trained and experienced professionals in the industry. They can rapidly analyze an application to help you find the best solution. Banner China team can provide professional system integration and total solutions to customer needs in industry 4.0 and robot work station area.

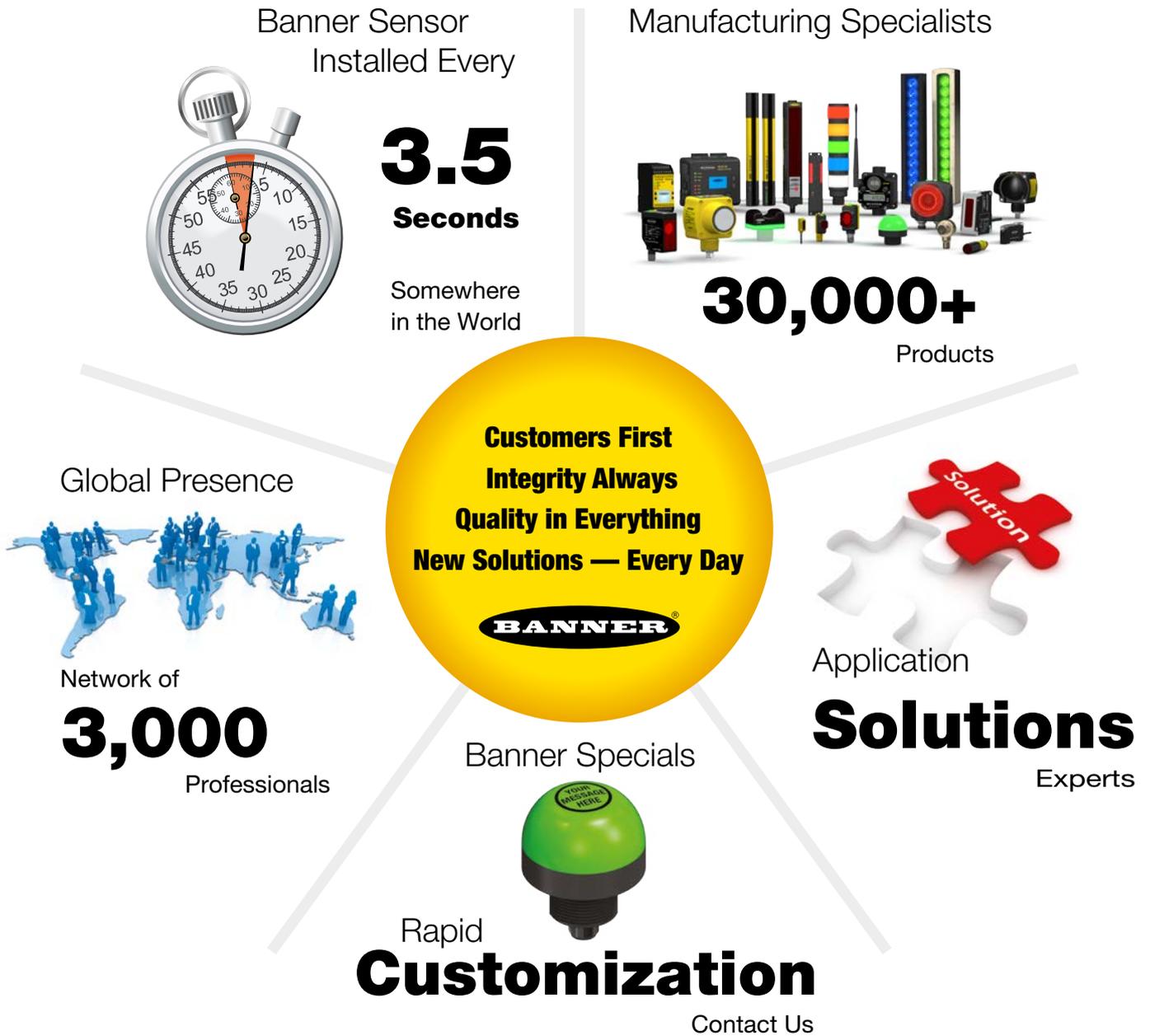
## Global Presence

We are a global company with a focus on our commitment to customers around the world. Banner has worldwide support with a network of 3,000 professionals who are ready to help you in your plant no matter where you are located.

## Banner Specials

Banner's growing product lines include thousands of standard products. However, if you have an application requiring a unique solution, contact one of Banner's Application Engineers and learn about our rapid customization and ability to deliver special product variations.

# Who is Banner?



## Solutions to Challenging Electronics Assembly Applications

Electronics equipment manufacturers and electronics manufacturing services (EMS) companies around the world choose products and solutions from Banner Engineering to help them reduce expenses, improve processes and increase product quality and output.

We are automation experts offering a broad range of sensors, vision sensors, safety control, LED lights and indicators, and a capacity for rapid customization. Combined with our rich industry and application knowledge, we are able to provide equipment manufacturers and manufacturing service companies with tremendous depth and flexibility to solve the most challenging electronics assembly applications.



# Contents



## Li-Battery

Level Measurement .....	<6>
Liquid Level Detection.....	<7>
Liquid Leaking Detection .....	<8>
Roll Diameter Detection .....	<9>
Edge Guiding .....	<10>
Dimension Detection For Li-battery Film.....	<11>
Thickness Detection .....	<12>
Glue Detection In Module .....	<14>
Tape Detection .....	<16>
Parts Detection In Assembly.....	<17>

## Solar & General Equipment For Electronic Industry

Defect Parts Detection .....	<18>
Solder Balls Inspection .....	<19>
Detection Chip Direction.....	<20>
Adhesive Verification.....	<22>
Reads Barcodes.....	<23>
Motor Vibration and Temperature Detection.....	<24>

## OLED

Clear Object Detection .....	<25>
------------------------------	------

## Smart Phone Process

Safeguarding .....	<26>
OCR Reading.....	<27>
Accurate Orientation/Alignment .....	<28>
Total Solution For Assembly.....	<30>

Globalization and the rapid pace of change in markets and technology challenge companies in virtually every industry. Every day, Banner Engineering helps companies all around the world implement automation technologies, improve processes and gain a competitive edge. Our industry-dedicated specialists work in close collaboration with our customers and partners to provide insights, identify problems and overcome challenges. We offer one of the most comprehensive and technologically advanced collections of automation products on the planet and are able to provide custom solutions quickly and cost-effectively. Companies from a diverse range of industries rely on the experience and expertise of our people and the quality and performance of our products to meet existing and emerging challenges and to achieve their automation goals.



## Level Measurement - QT50U

---

**Application:** Monitoring levels inside a tank

**Challenges:** Washdown environment, tanks can be filled with liquids or solids

**Solution:** QT50U Ultrasonic Sensor

**Benefits:** Available with a Teflon-coated cover for resistance to chemicals and uses ultrasonic waves to bounce off any solid surface.

In food and beverage applications where liquid and solid levels must be monitored, a long range sensor is needed that can reach the full depth of the tank without coming in contact with the tank contents.



QT50U Long-Range Ultrasonic Sensors



### Liquid Level Detection - 3 Type

PBE series has Teflon coating on the outside, which can penetrate into corrosive liquid/solid-liquid mixtures for liquid level detection.

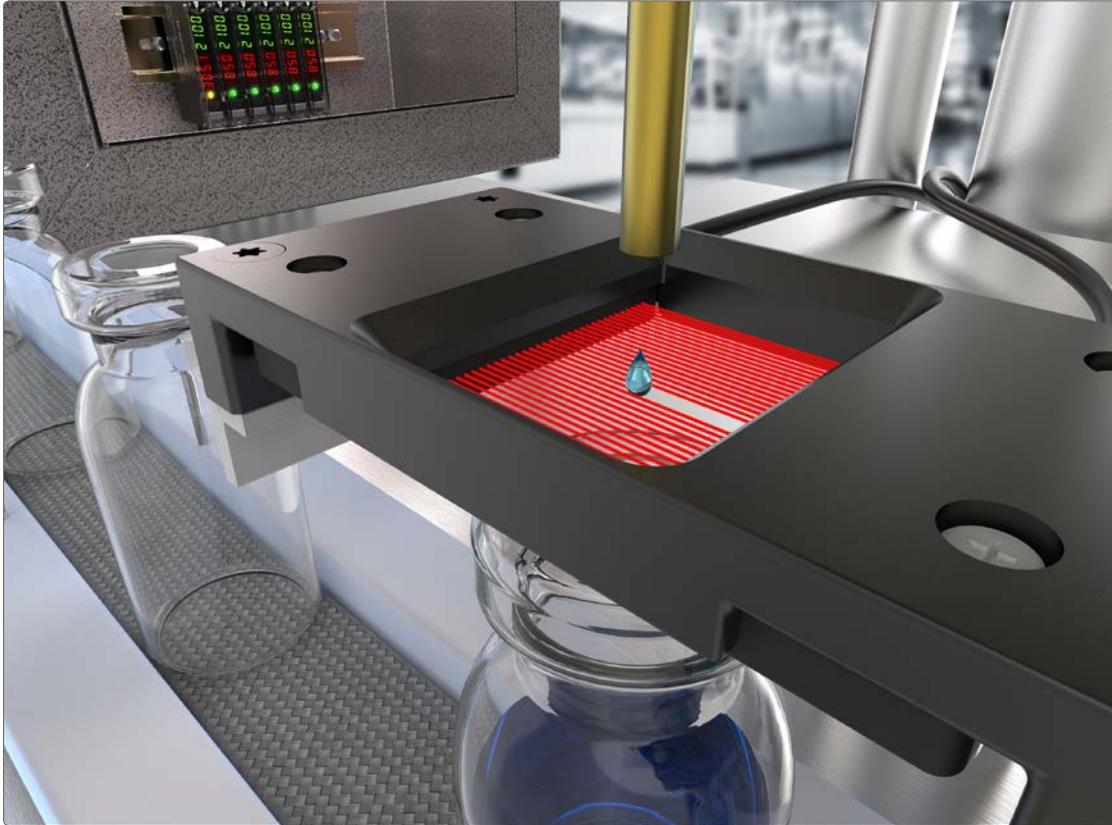
The PDI46U-LLD series is installed on the external conduit of the tank to synchronously detect the liquid level in the tank.



PDI46U-LLD



PBE46UIMLLP



## Liquid Leaking Detection / Chemical Drops Leaking Detection

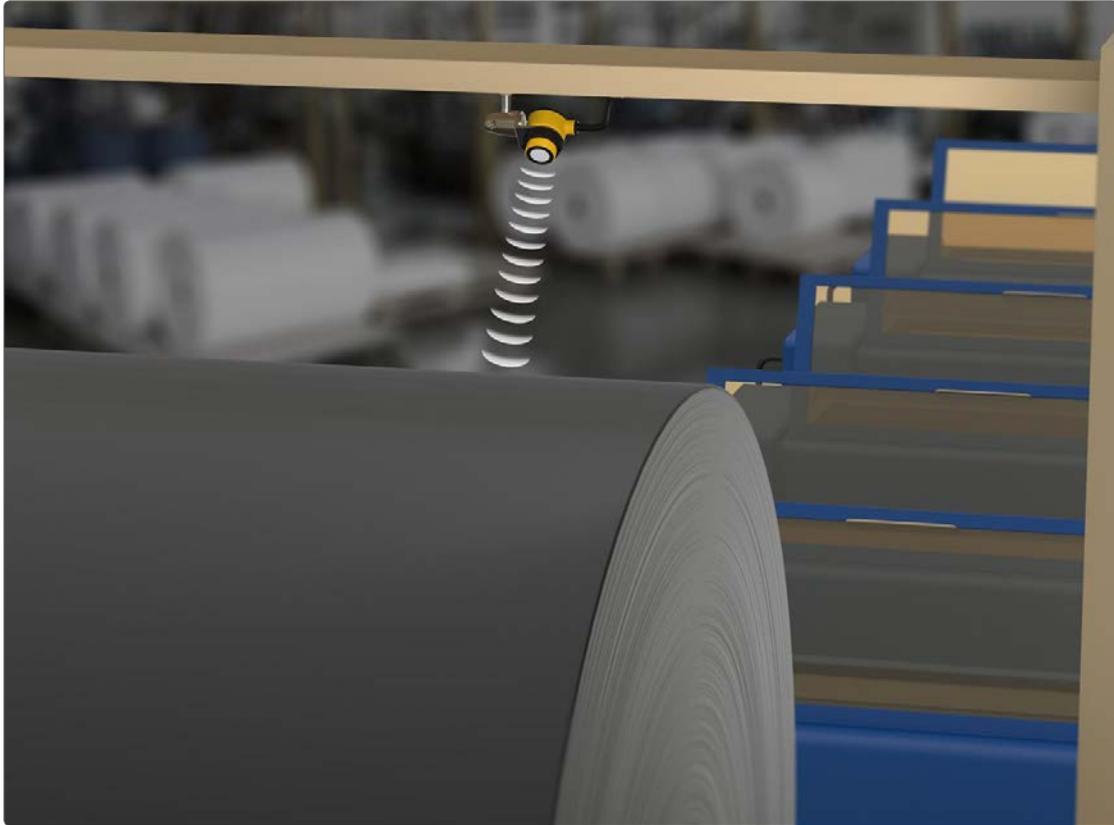
When chemical drops leaking from container , they will pass through Array and slot fibers , small object counter Dual Display Fiber Amplifier will sent out a signal.



Fiber Optic Sensing



DF-G Dual-Display Fiber Amplifiers



## Roll Diameter Detection - T30U or LE250 / LE550

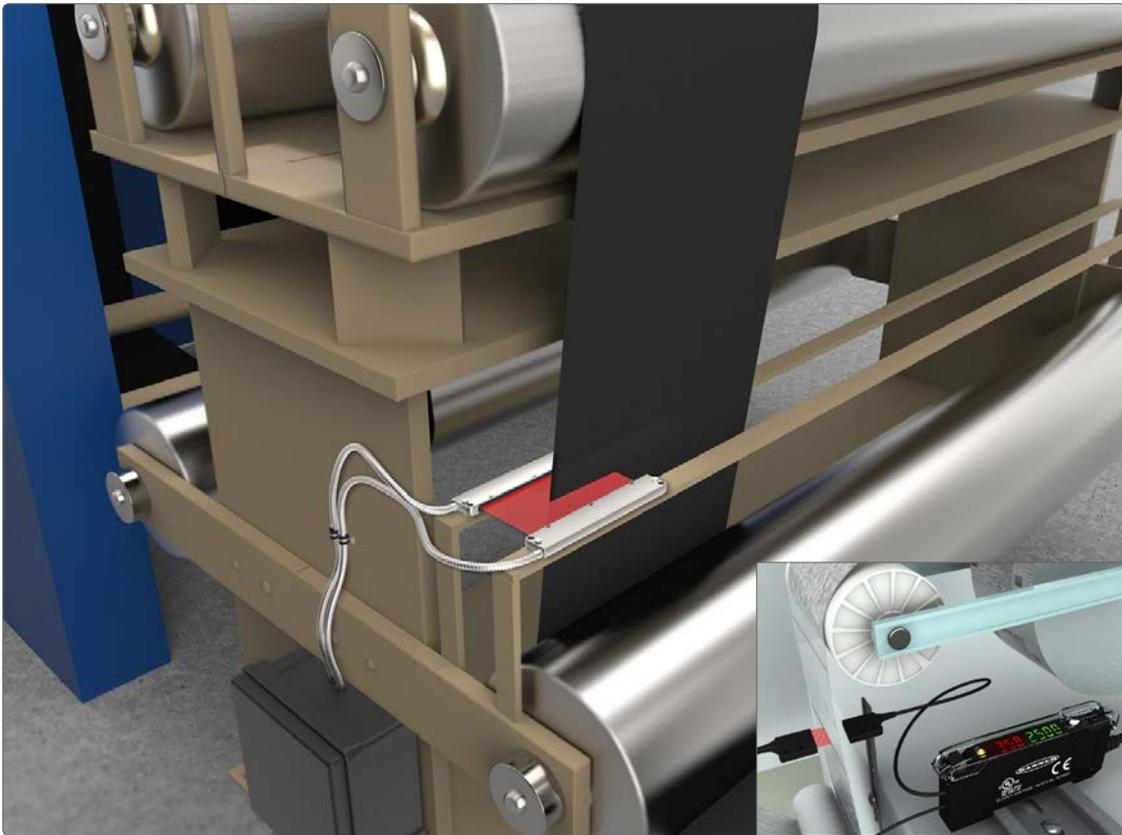
The film on a lithium-ion battery slitting and die-cutting machine needs to be monitored to avoid jams or unplanned downtime when the film levels run low. Banner's T30UX temperature compensation ultrasonic sensor works across a wide variety of temperatures to measure the diameter of the film roll to prevent a product run out from happening unexpectedly.



T30U\_UltrasonicSensors



LE Series Laser Measurement Sensors



## Edge Guiding - DF-G

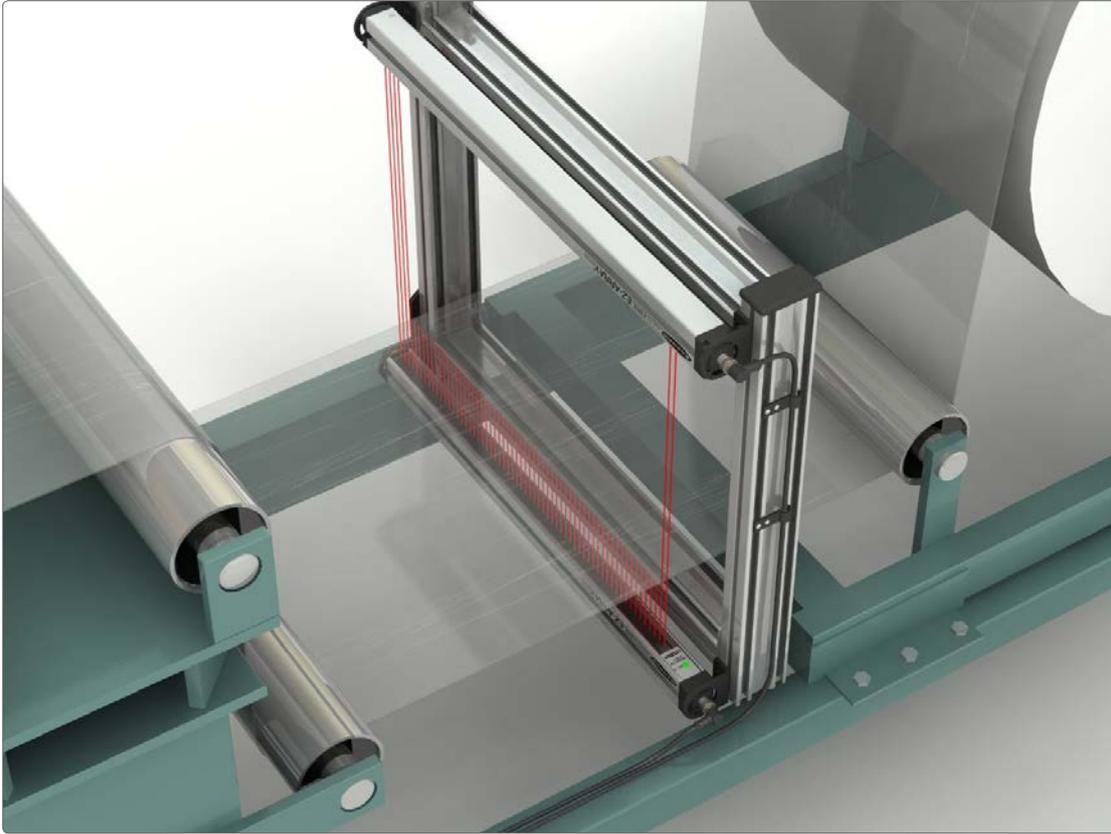
Automatic winding machines for lithium battery assembly combines anode, cathode, and separator film into a roll of battery cell material. Incorrect winding causes major issues with assembly and increased downtime to fix the film. The DF-G3 fiber optic amplifier used with plastic array fibers detects the edges of the film and guides it into proper position. The compact fibers can sense very slight changes in position.



Fiber Optic Sensing



DF-G Dual-Display Fiber Amplifiers



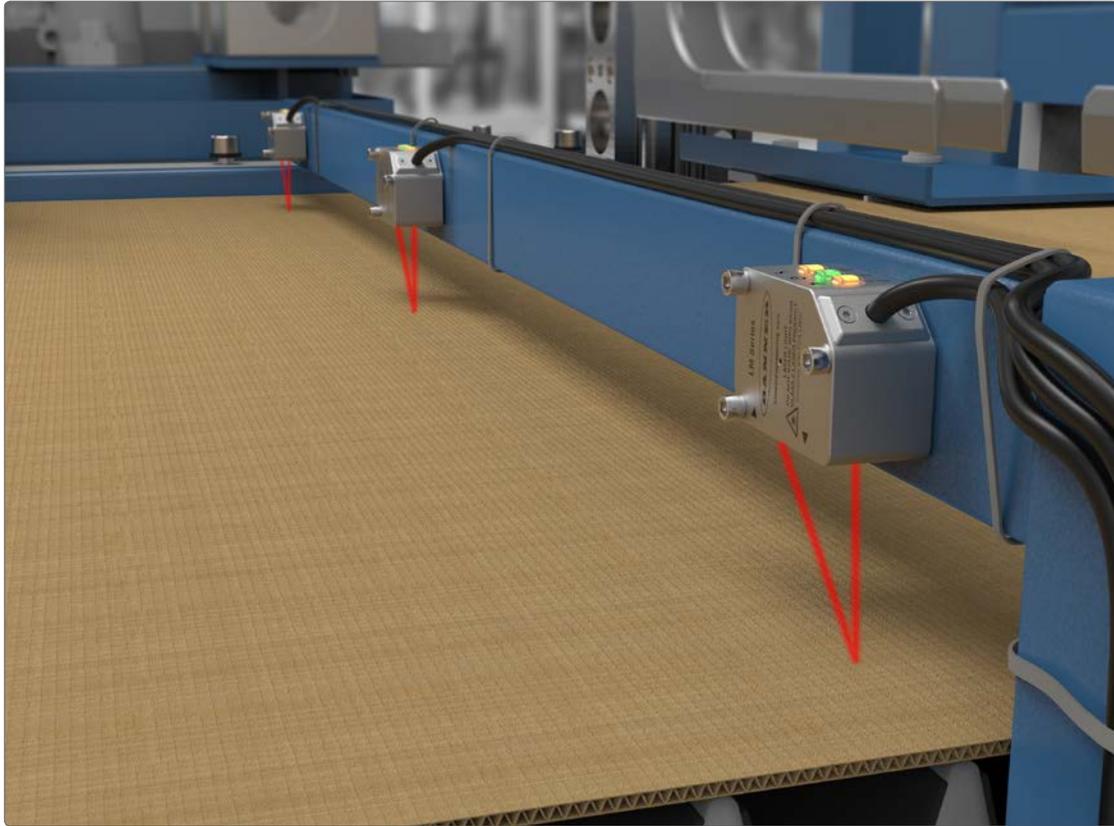
## Dimension Detection For Li - battery Film

To accurately perform sensing tasks including edge guiding, loop tension control, hole sizing, parts counting and on-the-fly product sizing and profiling.

**Solution:** Banner Engineering has created a special class of EZ-ARRAY specifically designed to detect clear objects in clean industrial environments. By customizing standard EZ-ARRAY receivers to successfully detect low contrast and operate at a lower sensing range (30 to 1500 mm), Banner has enabled EZ-ARRAY Clear Object Measuring Light Curtains to detect translucent objects such as glass and clear webbing.



EZ-Array Series Measuring Light Curtain

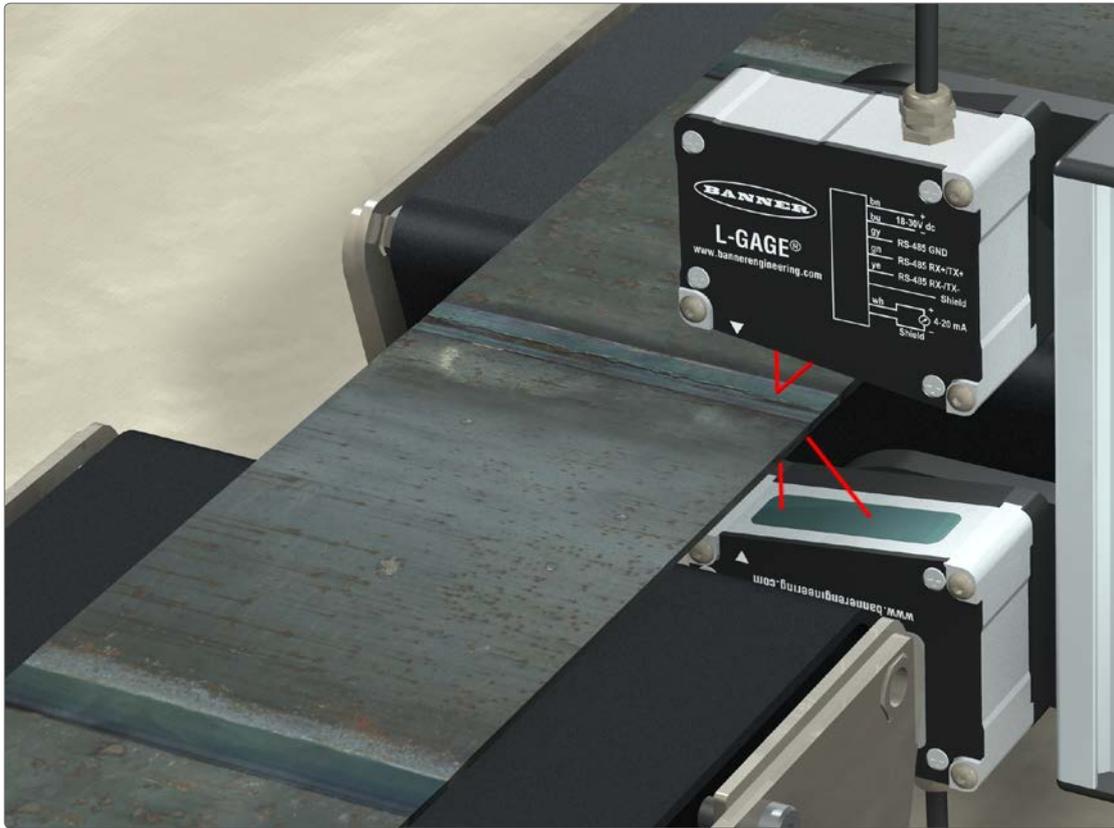


## Thickness Detection - LH/LM/Q4X

1 ) LM sensors monitor real-time changes in material thickness. The 0.004 mm resolution can detect very small changes in thickness. The extremely linear output of the LM is imperative when measuring long rolls of product. In addition, thermal stability ensures reliable performance in this environment.



LM Series Compact Precision Laser Measurement Sensor



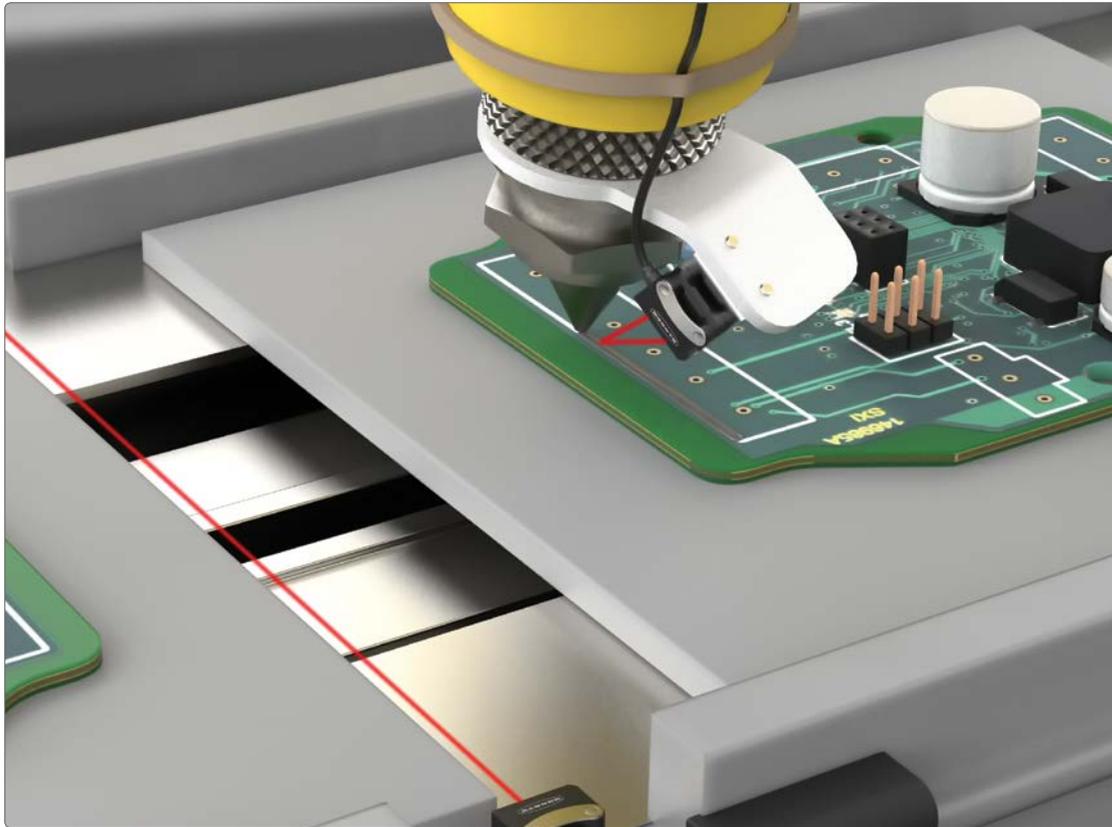
## Thickness Detection - LH/LM/Q4X

2 ) The LH laser displacement sensor is a perfect solution because it is highly accurate and measures thickness at micron levels. The L-GAGE LH Series can also consistently look at dark targets on these levels. The LH's 1024 pixel CMOS linear imager is capable of micrometer-level resolutions ranging from 1-10 microns, which gives it the ability to measure thickness of sheet metal quickly and accurately. Thickness measurements are available with 4-20 mA analog or RS-485 digital communication outputs.

The LH sensor pair self-synchronize to take measurements and calculate thickness within the sensors, without a controller. For this specific thickness measurement application, the "master/slave separation," which is two times the reference plus nominal distance, is the ideal separation between the two sensors.



LH Series Laser Sensors



## Glue Detection In Module / Pack - VS8 & VE / BVI

**Application:** Leading edge and glue detection during PCB assembly

**Challenges:** Fill level monitoring inside glue dispenser reservoir is not feasible; minimal space near robotic arm glue dispenser.

**Solution:** VS8 miniature sensor

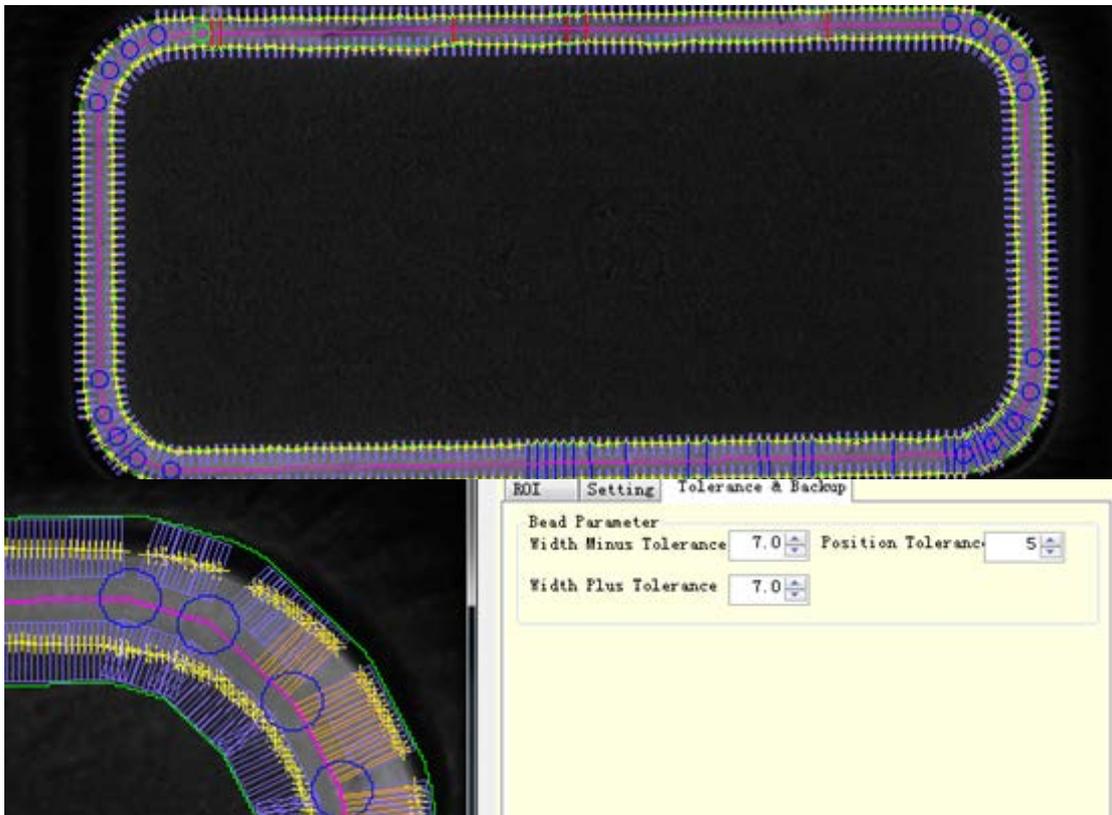
**Benefits:** Real-time detection of glue reduces wasted product and downtime; very compact sensor for confined spaces

The electronics industry is composed of incredibly small products and printed circuit boards (PCB) have numerous densely populated components on them. These boards are typically assembled in busy working environments with limited space. Errors on PCBs are easy to overlook if relying on manual assembly and inspections. There is also very little room on electronics applications for large automatic solutions. Systems with large sensors for inspection can easily get in the way and slow down machine performance with excessive downtime.

For more intricate components, soldering and adhesive can both be used to make the pieces sturdier. However, the adhesive station on PCB assembly presents unique challenges. Fill level monitoring is tough because it is not realistic to install solutions inside of the gun. The glue gun is small and uses pressure to apply the adhesive, making it nearly impossible to track fill levels. Any errors on glue application, such as bubbles or gaps, leads to major problems as parts of the PCB are not secure and can easily fall off during use and lead to widespread recalls.

Small Height Changes Indicate Presence of Adhesive

The convergent VS8 sensor is small enough to be installed on the robotic arm directly above the power control boards. The VS8 sensors are positioned to aim at the boards on the line, where the robot applies the adhesive. The sensor is taught the original distance of each passing board and recognizes the very small



## Glue Detection In Module / Pack - VS8 & VE / BVI

distance change after the glue has been applied, detecting the adhesive regardless of color. Any chattering on the sensor may indicate bubbles or gaps in the glue and may require a refill to perform properly.

Adhesive detection of this nature is helpful because it allows for issues to be resolved immediately. In this scenario, an operator can minimize downtime by reapplying the glue or refilling the glue gun before it moves onto a secondary station and completely dries. Poorly placed glue could easily cause PCB components to fall apart and lead to an increase in scrapped product or recalls.

Printed circuit board assembly stations have limited space that can make mounting difficult. The VS8 is small enough to be installed on the head of the glue gun without sacrificing the quality of a larger sensor and works well at a close range. The bracket is adjustable to 15 degrees in either direction to make mounting easy and versatile.

A pair of VS8 miniature sensors is also installed to detect the trays that hold the printed circuit boards. As the trays move on the conveyor, the VS8s detect the leading edge to confirm that they are in the correct placement for glue application. This ensures that the glue gets applied to the correct areas on each PCB.



VS8 Series Miniature Sensors



VE Series Smart Camera



## Tape Detection - R58

**Application:** Sensing splices on a roll of paper

**Challenges:** Detecting splices at a very high speed

**Solution:** The R58 Expert registration mark high color resolution sensor

**Benefits:** Creates optimal contrast and has a fast 10 kHz switching frequency

Identifying splices on a roll of paper quickly and reliably is vital, as it is now common to come across multiple splices on one roll. Splices and other defects need to be detected so they are not included as a part of the final product.

**Description:** Banner's R58 Expert registration mark high color resolution sensor is a high-performing sensor with an ultra fast 10 kHz switching frequency that quickly detects splices and other defects that are otherwise hard to detect. The high sensitivity of the R58 Expert detects the inconspicuous splice in a roll of paper to ensure the printer skips over the splice during the press process. The R58 Expert sensor makes it easy to create optimal contrast for splice detection applications because it automatically selects the appropriate LED, helping to increase product quality and minimize operator intervention. The R58 Expert also provides simple data monitoring with an easy-to-read 8-segment bargraph display indicator for TEACH and signal strength readout and for continuous readout of output status. The R58 Expert has a heavy-duty, rugged zinc alloy die-cast housing for use in industrial and wash-down environments. The R58 Expert has models available for a parallel or perpendicular sensing image, depending on the setup and application need.



R58 Expert Sensors Photo



## Parts Detection In Assembly - Q4X / Q3X

To detect whether shiny disks are properly seated. Because disk surfaces are shiny, many sensors have difficulty detecting whether a hard disk is properly seated in a hard drive.

Banner Engineering's Q3X and Q4X sensors are installed above a conveyor transporting hard disks. Typically, shiny material poses a problem for ordinary sensors. However, both the Q3X and Q4X were designed to detect shiny surfaces with a wide variety of colors, textures, and materials. When the sensing beam is directed onto a perpendicular specular surface, such as a properly seated hard disk, the sensor can determine if the disk has not been inserted correctly.

These high-performance sensors have an easy-to-read display and can be several inches away from the target and still detect smaller parts. Each sensor has a reliable sensing range up to 300 mm. They also work extremely well in conditions with very small contrast differences.



Q4X Series Laser Distance Sensor



Q3X Series Laser Contrast Sensor



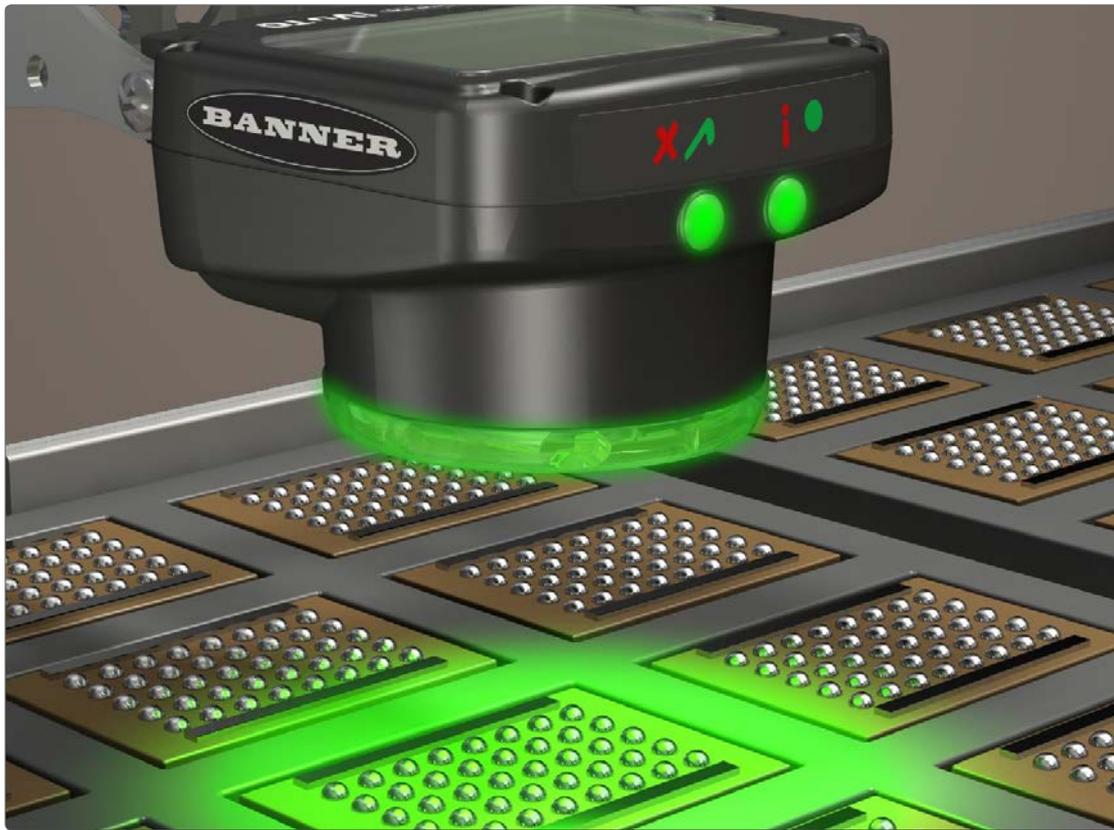
## Defect Parts Detection

---

To verify an electronic component like that shown, an image of a good part was captured using an iVu Series sensor configured for a Match inspection. If the sensor detects a part with a bent or missing connector, or if the part is wrong side up, the sensor sends a fail output to the line, and the part is rejected.



iVu Series Image Sensor



## Solder Balls Inspection

---

Electronic production and assembly operations often use integrated circuits that include BGAs (ball grid arrays). BGAs have solder balls that form the electrical bridge between the package and board assembly. It is critical that all the solder balls in the array exist and that there is no foreign matter that interferes with the circuitry.

**Solution:** To verify each integrated circuit, this application uses an iVu Series sensor configured for an Area with Motion application. If the sensor detects a part with missing or damaged solder balls, or if it detects any foreign material, the sensor sends a fail output to the line, and the part is rejected.



iVu Plus Remote Gen2



## Detection Chip Direction - Q4X & iVu

Customer Requirements: Confirm presence and correct orientation of an integrated circuit chip.

**Solution:** Q4X Laser Distance Sensor and iVu Vision System

Why Banner? Versatility – A Q4X can perform multiple functions at once, reducing the need for additional sensors

**Customer Benefits:** Cost savings – Using fewer sensors to solve the application reduces costs of purchasing or replacing parts

**Background:** Integrated circuit (IC) chips are tested prior to installation onto a circuit board. After they pass quality tests, they are placed into pocket tape and spooled onto a reel. The tape and reel make transport and storage for such small components easy and simplify the way that the product is fed into assembly machines.

**Challenges:** Each IC chip is placed onto the pocket tape by a high-speed machine. Incorrectly oriented chips will result in improper installation onto a circuit board. There are three common failure modes with pocket tape: no chip in pocket, two chips in pocket, and one chip upside down in pocket. To prevent these errors from happening, each chip's presence and orientation needs to be confirmed before it is sealed in the pocket tape. Multiple sensors are often used to identify these failures. Supporting multiple sensors can drive up expenses and lead to increased downtime required for maintenance and installation.

**Solution:** The Q4X laser distance sensor from Banner Engineering can complete all the functions previously performed by multiple sensors. This versatile sensor can be taught to recognize items at a specific distance, meaning that it can tell the difference between no chip, one chip, or two chips, in each slot as the chip passes. If the



## Detection Chip Direction - Q4X & iVu

sensor reads the correct distance, this means that one chip is placed into the pocket tape. If the distance read is too short, this means a duplicate chip has been placed on top of the first chip. If nothing is sensed, or the distance is too long, this indicates a missing chip. In addition, used in dual mode, the Q4X will also detect differences in contrast to determine if a chip is right side up or right side down. The Q4X can detect all of these conditions (missing, duplicate, or right side down chips) and trigger indication that operator attention is required.

In some instances text or images, such as logos or lot codes, may be printed on the chips and it may be necessary to have these features all oriented that same direction. An iVu vision sensor can be used to determine the correct orientation of the writing by utilizing the powerful match tool. If there is no match, an operator is notified of the fail.

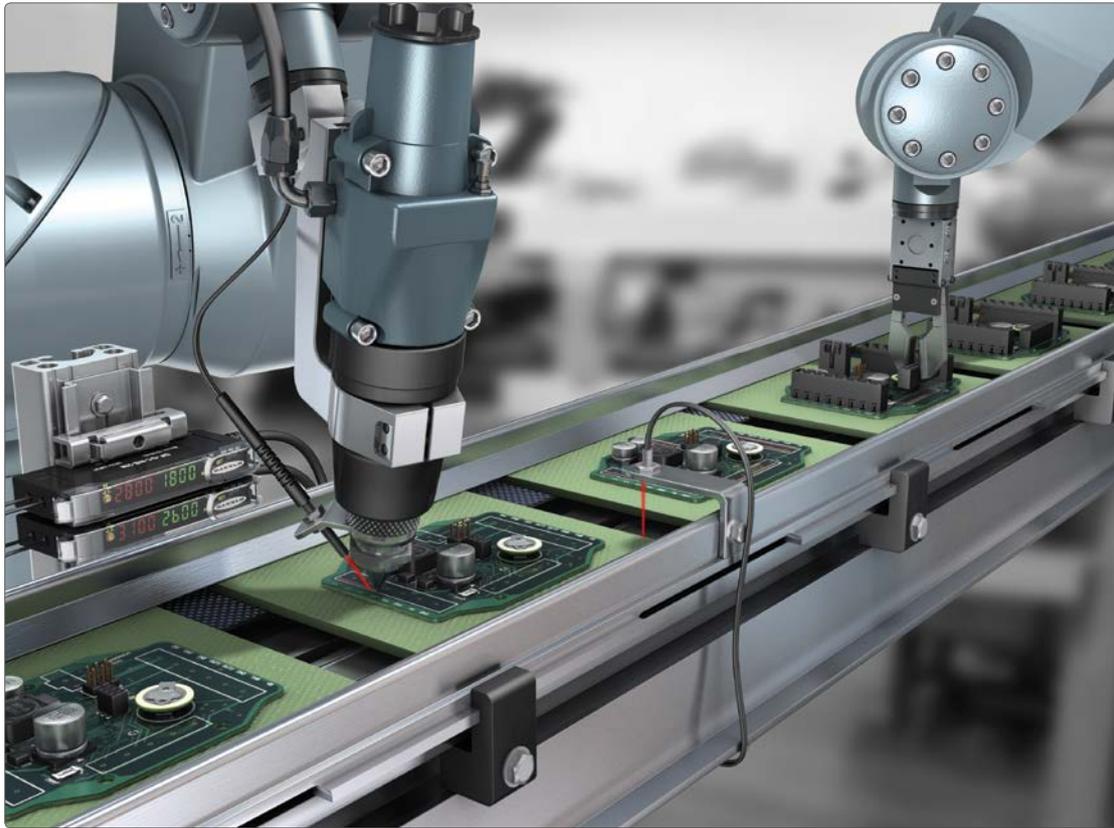
**Conclusion:** In an industry where components are required to be tremendously small, errors and bad product can be challenging to detect. Banner Engineering offers solutions that fit the needs of these applications. By using the Q4X and iVu vision sensor simultaneously, the manufacturer is able to detect three different types of errors and confirm writing orientation on integrated circuit chips. By using fewer devices, companies are saving time and money with an easy to use solution.



Q4X Series Laser Distance Sensor



iVu Plus Remote Gen2



## Adhesive Verification

---

**Application:** Verifying that adhesive is present

**Challenges:** Chips move at a fast speed along the production line

**Solution:** DF-G1 Fiber Optic Amplifier

**Benefits:** Fast response speed

To verify that adhesive is being applied properly to trays of IC chips.

**Description:** The DF-G1 fiber amplifier with the fiber optic sensing tip positioned near where the robot applies the adhesive, verifies that adhesive is applied to the IC chips. An additional DF-G1 is used to reliably detect the leading edge of the IC to trigger adhesive bead application.



DF-G1 Fiber Optic Amplifier



## Reads Both Linear and 2 - Dimensional Barcodes - VE / BVI / ABR

**Application:** Tracking components with barcodes on them

**Challenge:** Both 1D and 2D barcodes are present

**Solution:** Banner Engineering's PresencePLUS P4 BCR 1.3

**Benefits:** Reads both linear and 2-dimensional barcodes simultaneously

Tracking products is an important process in a wide variety of industries. With electronics, there are sometimes different types of barcodes present on the same product. Inspecting these codes accurately is crucial to avoid any errors further down the production line.

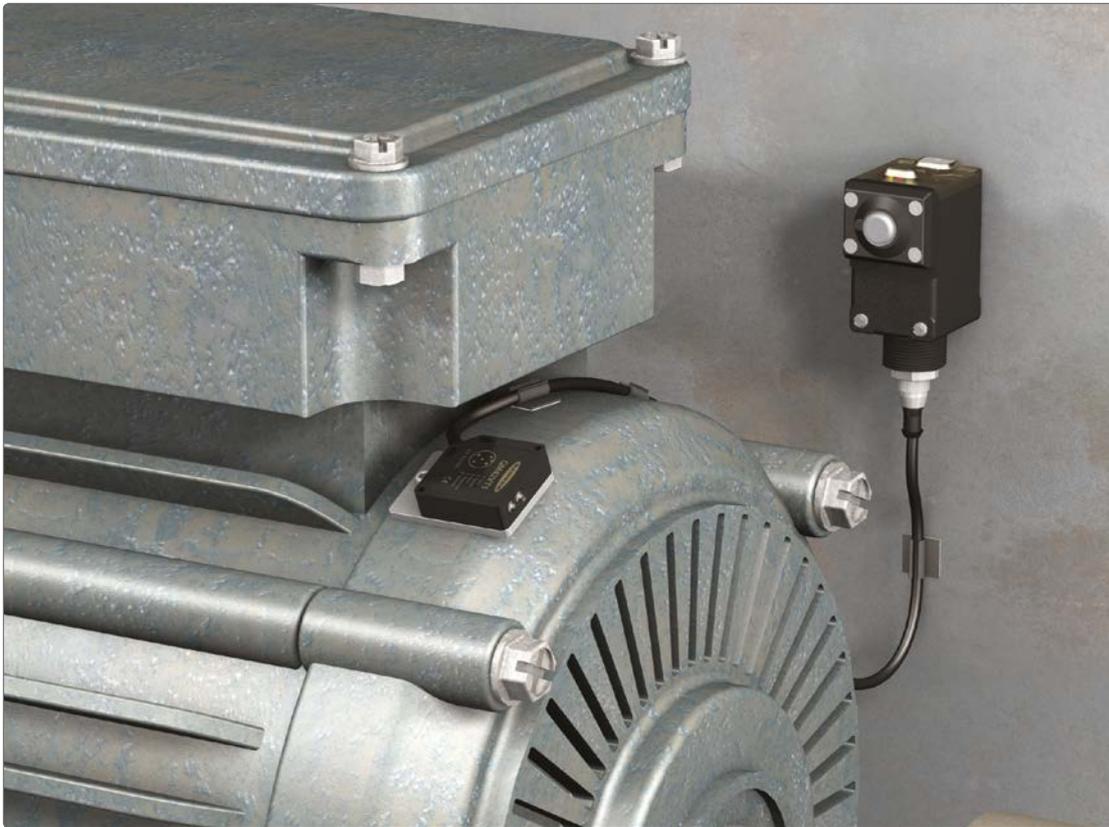
**Description:** A part is tracked using both a linear and a 2-dimensional barcode. The high-resolution PresencePLUS P4 BCR 1.3 reads both types simultaneously to verify that they are correct.



ResencePLUS P4 BCR



ABR Series Imager-Based Barcode Readers



## Vibration Monitoring For Stirring Motor - QM42VT1+DX80N2Q45VT

**Background** : Automatic electro-Plating Line for PC. Technical process contains washing-down/Chemical Cleaning/Etching/Recycling in different pool. To ensure each process stable, they need to use a motor to stir in each pool. To prevent the fault of motor, defect of products, need to find the fault motor and change it in time.

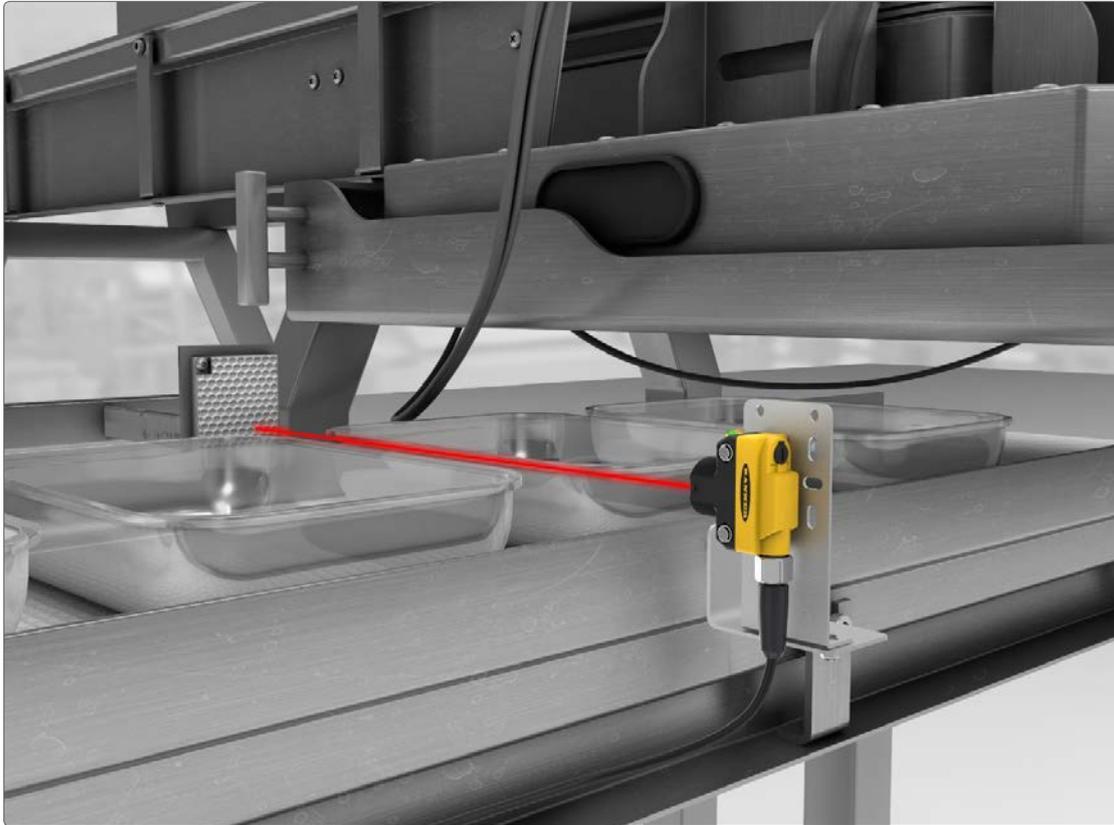
**Challenge** : Need to modify on existing lines, cannot do physical wiring

**Solution** :

- 1、QM42VT1+DX80N2Q45VT node , 20 PCS  
Battery powered, no need to do physical wiring
- 2、DX80 Gateway
- 3、BSP02PLC , Read vibration data from 20 nodes through DX80 Gateway



Wireless Vibration and Temperature Monitoring



## Clear Object Detection - QS18

**Application:** Ensuring proper staging of plastic trays during denesting process

**Challenges:** Trays that are made of clear plastic

**Solution:** QS18 Series Clear Object Detection Sensor

**Benefits:** Available in clear object sensing mode

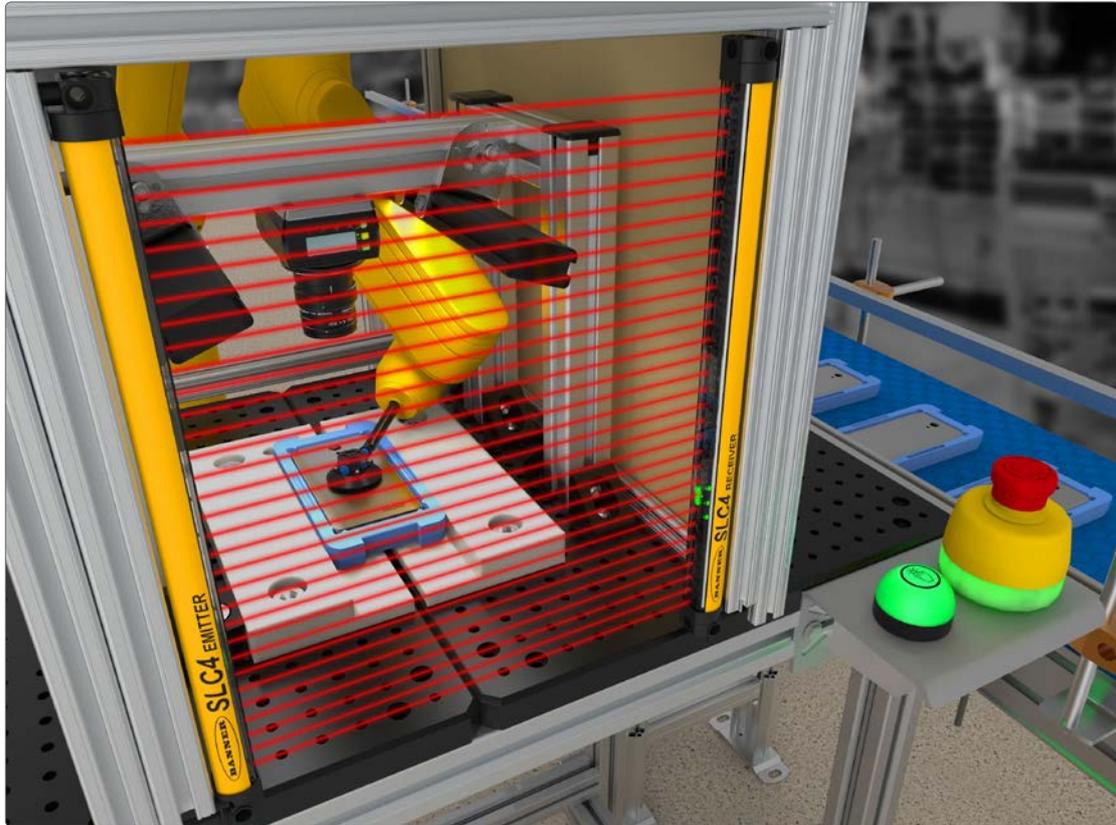
Tray denesters introduce food trays onto the conveyor system that leads to the filler. It is important that proper spacing is maintained between trays in order to maximize production and prevent too much line pressure. Incorrect line pressure can cause many errors and downtime if production is stopped in order to make the necessary corrections. A sensing solution is needed to consistently detect clear and opaque plastic trays to control the rate that trays are fed onto the conveyor belt.

**Description:** Clear or opaque plastic food trays are introduced to a production line at the denester machine. As the trays move out of the infeed area and proceed further down the conveyors, the spacing between each tray needs to be consistent. By using Banner Engineering's QS18 Clear Object Detection sensors, tray detection is reliable, quick, and easy. The sensors coaxial optic design reliably detects clear, translucent or opaque trays with a response time of 400 microseconds, ensuring proper staging. This makes it ideal for use in fast-paced environments. The threshold offset can be set for 8, 16, or 32 % for optimization to the target while maintaining resistance to contamination. The clear-tracking feature, which adjusts the threshold for contamination, can be used for additional protection of the sensor.



QS18 Series Clear Object Detection Sensor

# Smart Phone Process



## Safeguarding - EZ-SCREEN / SI-MAG2

**Application:** Safeguarding machine that could cause superficial injuries

**Challenges:** Need to detect hands or fingers

**Solution:** Banner Engineering's Type 2 EZ-SCREEN Safety Light Screens

**Benefits:** Resolution is small enough to the operator's hands and fingers

To protect personnel from a machine that can cause slight injuries with a safety light screen

**Description:** The Type 2 EZ-SCREEN safety light screen protects hands and fingers from being bumped, bruised, or pinched by the moving parts of a carousel.



Type 2 EZ-SCREEN Safety Light Screen

# Smart Phone Process

---



## OCR Reading - IVU / VE

---

**Application:** Verifying part identifier information on electronic components

**Challenges:** Proper lighting for inspection

**Solution:** iVu TG Plus with on-axis light

**Benefits:** Reliable detection and verification of identifier etching

To ensure that correct parts are being used in electronic assembly operations, it's necessary to verify that the part identifier information laser etched on components is correct.

**Description:** The solution uses an iVu Series sensor configured for a Match inspection. A reference "good" identifier is taught into the sensor. In service on the production line, the sensor detects when a component does not have the correct identifier, and sends a fail output to the line, and the part is rejected.

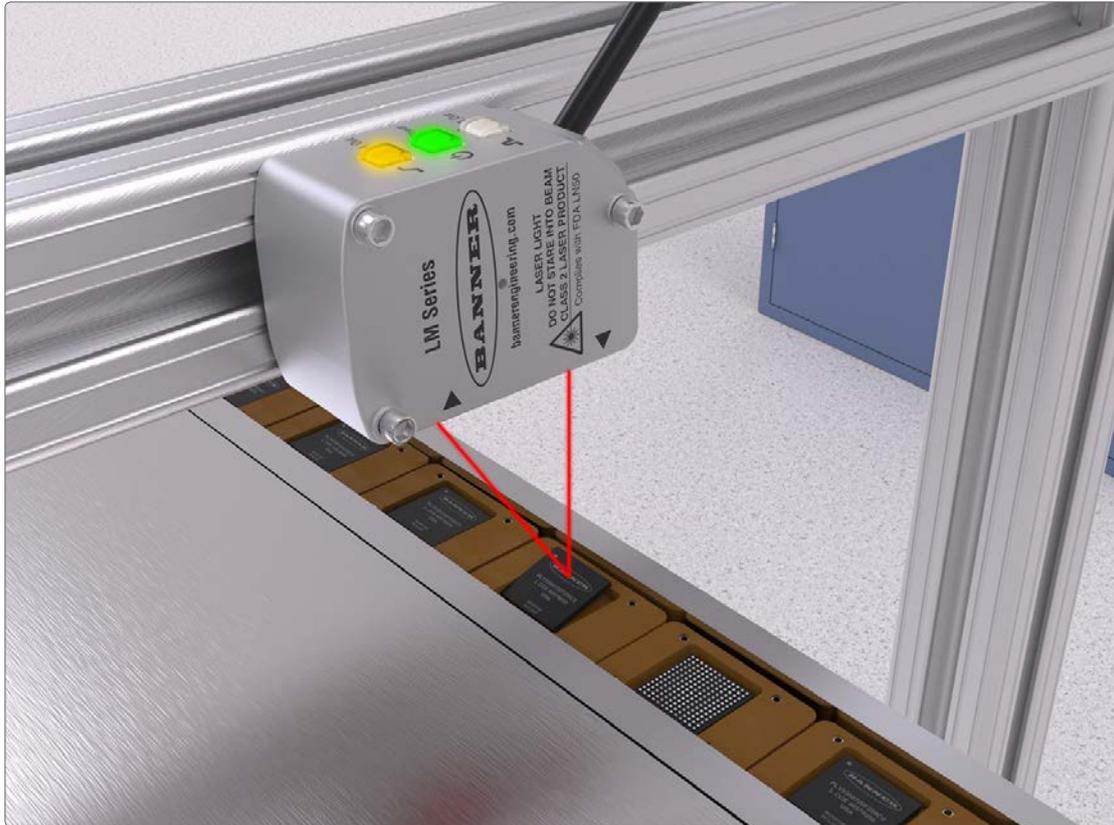
In any vision inspection, it's important to have correct lighting to optimize the inspection. In this case, the best choice is an on-axis light. The on-axis light provides even illumination on the flat components enabling the laser etching to stand out and be easily read.



iVu Plus Remote Gen2



VE Series Smart Camera



## Accurate Orientation / Alignment - LM

---

**Application:** Integrated Circuit (IC) Chip Inspection

In semiconductor manufacturing, integrated circuit chips are tested one at a time for functionality and performance. The IC chips are placed in a nest to be delivered to the test station. For test processes to be completed properly, the chips must be completely seated and right side up in the nests.

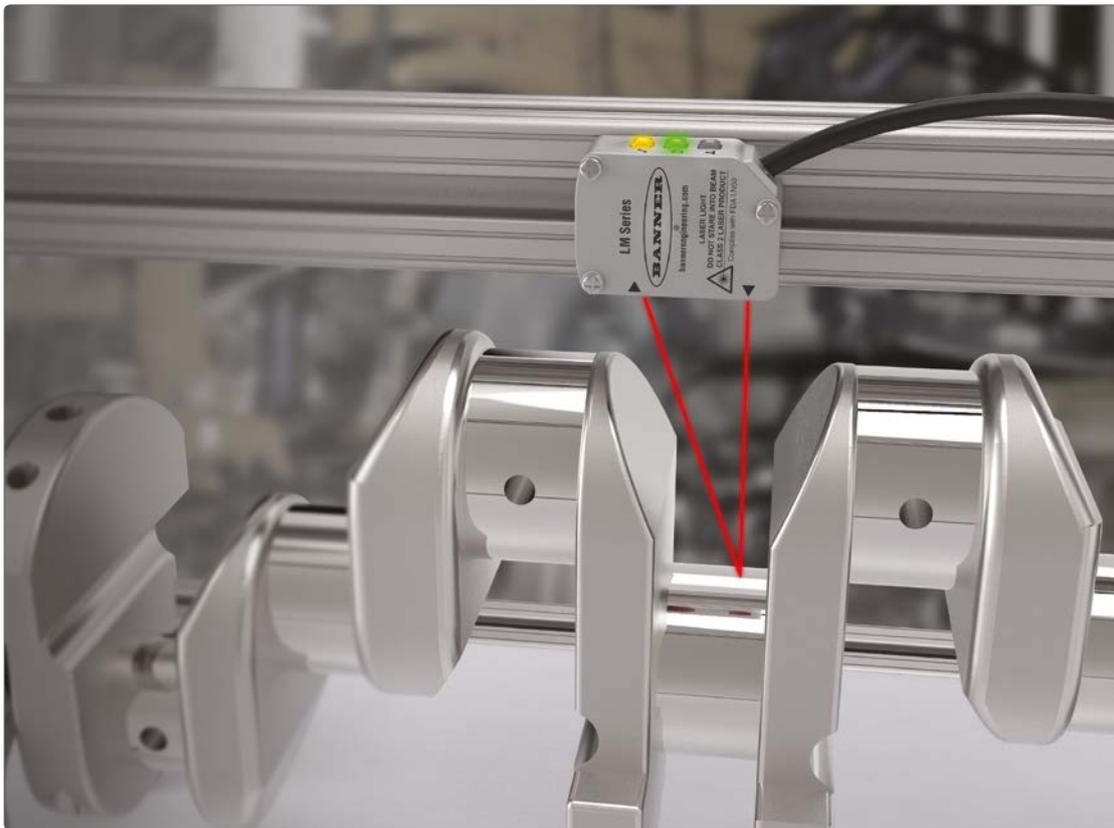
There are several common failure modes in this application: no chip in a nest, one chip tilted in the nest (creating a small height difference), two chips stacked in one nest, and a chip upside down in the nest. Multiple sensors are often required to identify these failures. However, test stations do not have space for large vision systems or many sensors. In addition, the nests of chips move quickly, which can be difficult for many sensors to track. A high-speed measurement solution is needed to ensure optimal machine throughput.

**Solution:** Precise Laser Measurement

The LM laser distance sensor from Banner Engineering reliably inspects multiple conditions with one compact device and can verify both chip presence and orientation. In addition, with a 4 KHz (0.25 ms) sampling rate, the LM can reliably solve this high-speed application with fast-moving targets.

Inspect Multiple Conditions with One Compact Device

The LM precision sensor can be taught to identify targets at a specific distance. If the sensor reads the correct distance, this means that one chip is present and properly seated in the nest. If the distance reading is smaller than expected, this means a duplicate chip has been placed on top of the first chip. If the distance is greater than expected, this indicates a missing chip. Thanks to a resolution of 0.004 mm and linearity of +/-0.06 mm, the LM can also measure very small distances that occur when a chip is present but slightly tilted (not fully seated) in the nest.



## Accurate Orientation / Alignment - LM

The LM also features dual teach mode. In this mode, the sensor measures both distance and light intensity. This means that the sensor can identify not only when the target is present within a specified distance, but also when it returns a certain amount of light to the receiver. Because of this, the LM can determine whether an IC chip is right side up, since one side of the chip is a darker color than the other. The intensity of light returning to the sensor's receiver is lower if the dark side of the chip is facing up.

Typically, an application like this would require multiple sensors: one to measure changes in distance, and one to detect contrast. However, the LM can identify all these conditions (missing, duplicate, incorrectly seated, and upside-down chips) with one reliable, compact device.

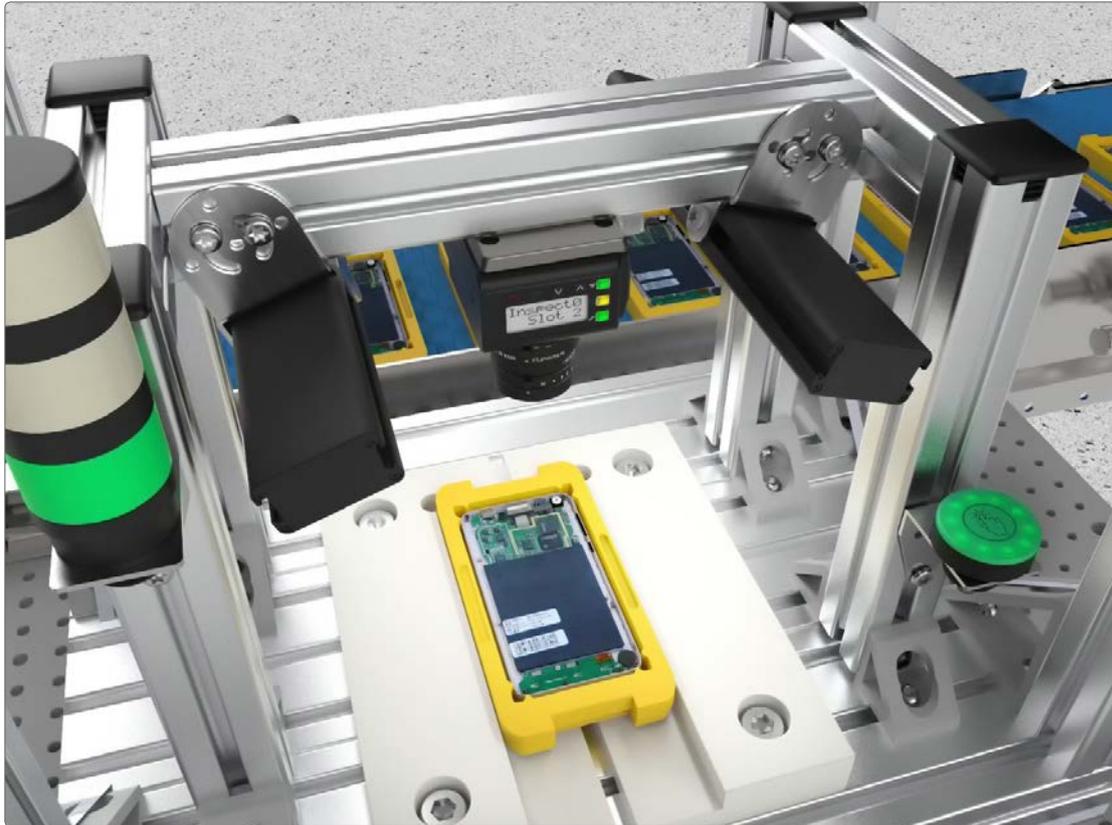
### Reliable Results with Unmatched Thermal Stability

In addition to measuring multiple conditions with one device, the LM also features exceptional thermal stability for reliable inspections regardless of ambient temperature fluctuations that affect the precision of other sensors. Even a few degrees of temperature change can cause other sensors' measurement error to double. In comparison, the LM has a temperature effect of just  $\pm 0.008 \text{ mm}/^{\circ}\text{C}$ . This enables the sensor to remain precise and continue to measure reliably regardless of external temperature changes.



LM Series Compact Precision Laser Measurement Sensor

# Smart Phone Process



## Total Solution For Assembly - VE / K50

**Application:** Confirm presence and correct orientation of very small electronic components on a printed circuit board

**Challenge:** Electronic components are very small and have tiny details

**Solution:** 5MP VE Series Smart Camera

**Benefits:** Fine levels of detection and wide field of view

The assembly of mobile electronics in a cleanroom environment, such as cell phones, requires very fine attention to detail. The densely populated electronic parts and connectors on circuit boards are incredibly small and errors are easily missed by manual inspection. Standard error proofing by employees is impractical and not reliable; however a parts analysis is required before electronics and cell phones move onto the next assembly station. Missing or improperly placed components leads to malfunctions and extra time and resources on recalls.

Small Part Error Proofing with Five Megapixel Imager

The new 5MP VE Series Smart Camera allows for high-resolution inspection of each cell phone during assembly. The versatile camera successfully detects incredibly small details and confirms that all electronic components are in the correct location and orientation with the match tool. The measure tool can also be used to verify that everything is in the proper position.

Using an automatic solution eliminates human error and provides a more reliable solution. The 5MP imager and wide field of view makes it possible for a camera to pick up finer detail in a single image capture and can be installed closer to the target without compromising quality results. VE smart cameras are easy to install and use. There are a wide variety of tools available, such as the match and blemish tools, to adapt to many different applications.



VE Series Smart Camera



K50 Serial Indicators & Pick-to-Light



Tower lights

# *Limited Warranty*

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

**THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.**

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**



Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.

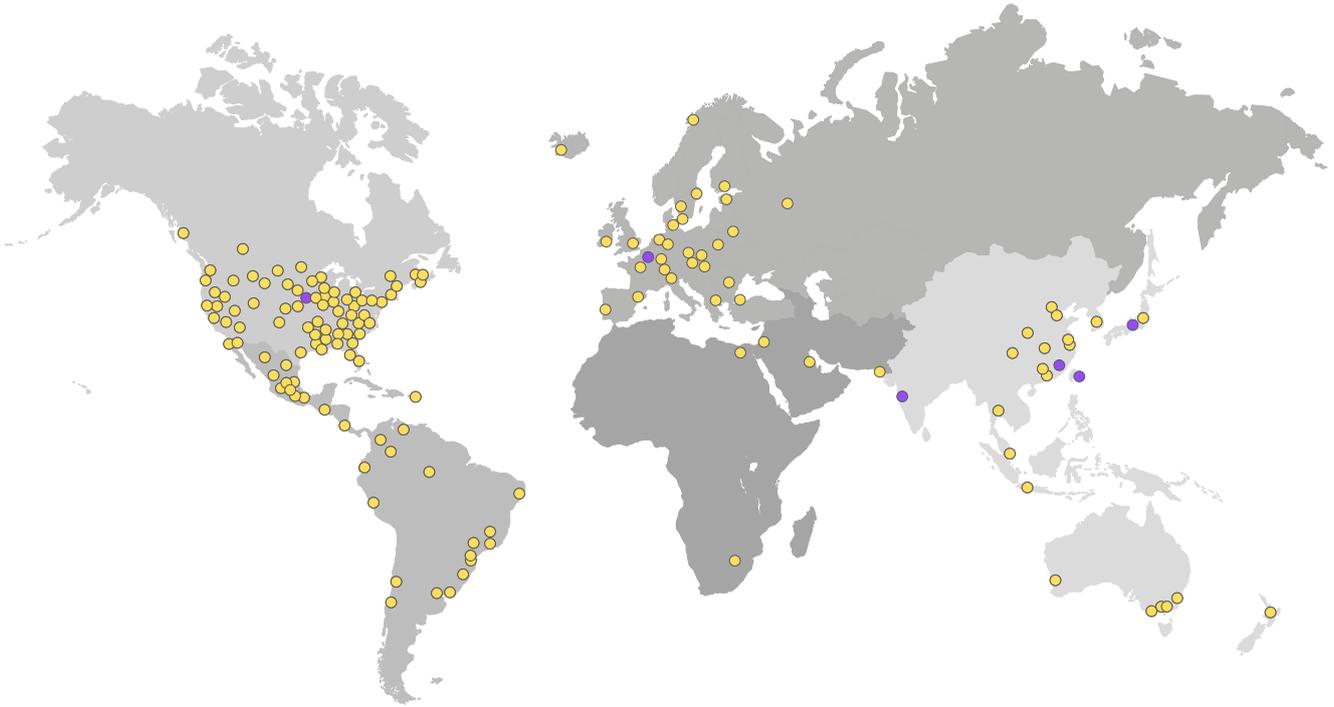
# How to Reach Us

---

## Global Sales and Support

Need additional assistance?

Banner has a network of more than 3,500 factory and field representatives around the world ready to help you. Our highly skilled application engineers and industry experts are ready to support you wherever you are. For a complete listing, go to [bannerengineering.com](http://bannerengineering.com) and find your local Banner Representative.



To contact a Banner Engineer about your application, visit our website at [www.bannerengineering.com](http://www.bannerengineering.com).

