Contact Image Sensor Streamlines Lithium-Ion Battery Production

Contact image sensor (CIS) increases lithium-ion battery (LiB) manufacturing consistency and reduces waste

Lithium-ion batteries (LiBs) are commonly integrated into a variety of products and applications, including children's toys, electric vehicles, and more. The LiB manufacturing and production process, however, tends to be highly cumbersome, resulting in high waste output and inconsistent yields. LiB manufacturers are always looking for ways to boost production and quality in order to meet increasing consumer demands. Contact image sensor (CIS) technology can accurately identify product defects, improving manufacturing efficiencies and simplifying quality and process inspection techniques.

CIS technology streamlines the LiB manufacturing process by increasing production speeds and minimizing waste. Although CIS applications have been in existence since the creation of fax machines, manufacturers and integrators are increasingly using CIS to improve line scan applications.

Traditional LiB production involves optical reduction systems that require multiple cameras, lens, brackets, and calibration procedures. CIS technology, on the other hand, uses single camera technologies that create more sustainable production cycles with less waste and higher efficiency rates. Higher image quality leads to improved inspection systems which in turn helps to create more efficient manufacturing techniques.

Optical Reduction System Challenges

LiB companies have long used traditional optical reduction systems for manufacturing. The complexity of optical reduction systems is that they require multiple cameras, lenses, brackets, and calibration procedures for wide field of view applications. A one-meter web might require two or three camera systems, making it difficult to create repeatable, accurate, and automated solutions.

Optical reduction systems utilize cameras and lenses that produce image distortion at the ends of the field of view. Furthermore, production inefficiencies are rampant with high waste outputs, low production speeds, and long changeover times for certain jobs.

Manufacturing of LiB electrode foils tends to be highly inefficient when using traditional optical reduction systems. These antiquated technologies have a large depth of focus (over 4 mm) and long optical path (300–1000 mm) that distorts the ends of the field of view due to variations in working distance from object to imaging sensor. Because of this, optical reduction system infrastructures generate large manufacturing footprint and spacing requirements.

Optical reduction system processes can also produce a variety of defects during assembly and production. A typical LiB process runs at 100 m per minute. A single minute of uninspected production can yield 100 m of scrap. Inspection systems that sort these defects can be challenging to manage and often result in subpar quality and control processes. CIS technologies are streamlining LiB manufacturing techniques, resulting in better production efficiency and decreased waste outputs.

Using CIS to Optimize Manufacturing

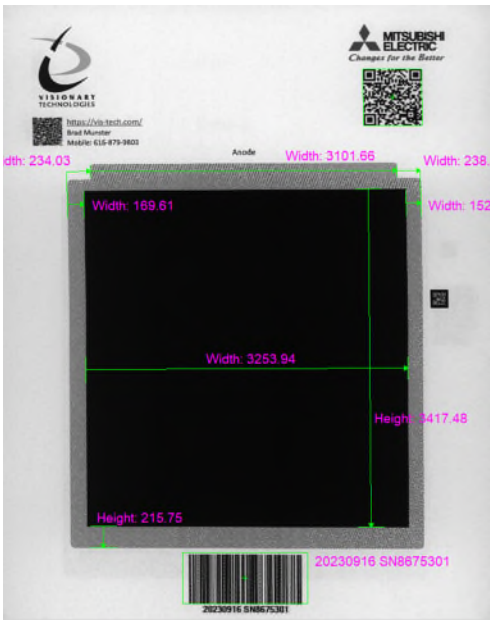
CIS can help maximize LiB manufacturing using repeatable, accurate, and automated solutions that result in more sustainable production, less waste, and higher efficiency. With the substrates for LiBs becoming increasingly thinner, more delicate and refined processes are necessitated to maximize production performance capabilities.

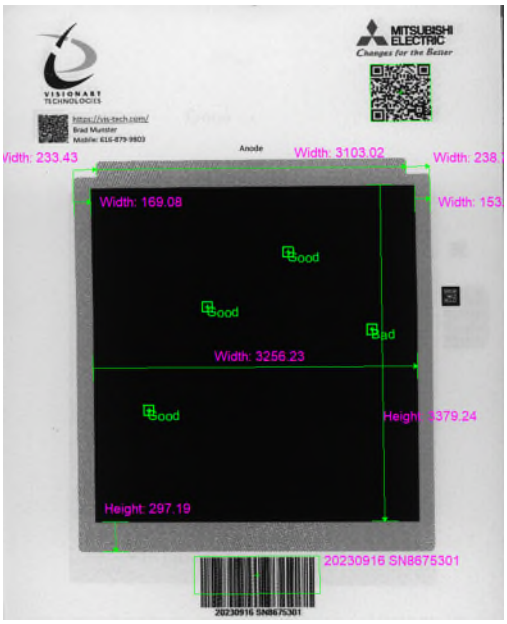
The KD Series CIS from Mitsubishi Electric uses LineScanBar™ technology with a highly compact design that can easily be applied to existing and new production lines. Its singular modular housing requires minimal space and provides all the elements of modern vision systems. The LineScanBar comes with an illumination system, a lens, and a sensor, all within a compact housing design. Maintenance is simple as modules can be exchanged within minutes.

The rod lens technology provides high image quality and 1:1 scaling created by a graded index rod lens array. Telecentric viewing angles also help to create distortion-free images, resulting in precise measurements. The pixel size is 42 micron x 42 micron, which results in true 600 dpi. Equipped with the trilinear CMOS sensor and RGB filters, the Mitsubishi LineScanBar ensures high color fidelity. Image acquisition speed is achieved using optimally aligned integrated white LED illumination and integrated binning. The resolution is adjustable from 150 dpi to 600 dpi with or without the integrated illumination system.

The KD Series CIS acquires undistorted images with sharp edge transitions which is key to the machine vision systems' ability to provide repeatable and reliable results. Machine controls provide real-time quality and production data, helping to improve manufacturing efficiency. The KD Series camera-based machine vision system flags defects, allowing continuous process improvements to be implemented than can minimize defects and improve yield.

By optimizing and digitalizing the manufacturing process with the help of machine vision technology, companies can sustainably produce LiBs with less waste and higher efficiency rates than those seen with optical reduction systems. In turn, CIS technology helps improve quality and process controls in LiB production environments while simplifying inspection techniques.





Common inspections in LiB applications are measurements of the anode/cathode, sort surface defects, barcode reading and grading.*

**Images courtesy of Visionary Technologies*
https://vis-tech.com/

Improve Quality and Process Control

When paired with factory automation components, KD Series solutions help to enable smart quality and process control. The closed loop of sensor data feeds machine controls with real-time quality and production data. Using smart data management and production transparency helps create more sustainable manufacturing capabilities with less waste and higher efficiency rates.

The KD Series integrates an array of sensor ICs, a rod lens array, and a light source located inside of a compact image sensor module. The rod lens arrays' 1:1 imaging ratio creates less distortion than ordinary line scan camera systems, improving accuracy. The KD Series CIS captures images with higher resolution making it easier to detect small defects in the quality and control part of the production process. This improves the accuracy of inspection systems in LiB manufacturing environments as defects can be sorted before material is used in final battery assemblies.

The KD Series includes two models: built-in illumination and non-illuminated. The built-in illumination model's structure includes a lens array, light source, and sensor ICs. The non-illuminated model allows for application-specific lighting geometries such as low-angle (darkfield) configurations. Both options come in various standard sizes to meet a variety of applications. For more detailed KD Series CIS model information and specifications, download the datasheet or visit the Mitsubishi Electric website.