

Intelligent, High-Speed Component Counting with X-ray Technology

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The term “line down” should be used only for planned set-up, changeover, etc., and not caused by poor planning and inventory control. Including accurate component counting as part of daily inventory management is key for continuous operation.

Maintaining correct materials and quantities is a critical part of the SMT process. More often than not, even at the highest-producing companies, procuring and managing materials is a job that lacks core competence and often is overlooked. This article addresses the importance of accurate inventory management and how a high-speed intelligent component counter can contribute to this effort.

Benefits of Accurate High-Speed Component Counting and Inventory Management

When machines are not running, money is being spent and resources are being wasted. If a company is willing to maintain SMT equipment in a proactive, preventive manor to have continuous operation, doesn't it make sense to maintain the materials that are being fed into an SMT line? Too often, time is spent looking for extra components, ordering replacements for lost components, and procuring safety stock. This involves other costs such as overnight deliveries and additional premiums. When properly storing components with an accurate count, all of this can be avoided.

In addition to the obvious problems of inventory, the wasted time manually counting components could be converted into a better use of resources. Manually counting components often takes up to 5 minutes per reel, especially when considering that results must be recorded and updated on paper and/or digitally.

To solve these significant industry challenges, optical control GmbH Co. KG worked with leading electronics manufacturers to develop the OC-SCAN® CCX, a maintenance-free X-ray system developed and optimized for parts counting, and software that optimally reflects customers' processes and requirements.



Specially Developed Intelligent Algorithms

The OC SCAN® CCX technology does not use a generic image analysis package modified to fit the task of counting SMD reels. The counting algorithms are developed and optimized specifically, from scratch, for the task of component counting. This leads to an extremely flexible, powerful image analysis performance, while remaining both fast and efficient. The goal from the time of the technology's development was to fulfill the electronic industry's requirement with its wide variety of SMD components. Therefore, the machine is equipped with a unique model-free approach to parts counting that does not require a pre-installed database or component models. Instead, the software automatically analyzes the images, senses the parts and sets itself up fully automatically. It also continuously builds up its reel and part number databases, and reuses counting information it has gathered to decrease cycle time on follow-up counts. This means that users teach the software as they go, during normal operation and without disruption. Keep in mind, however, that any automatic procedure has its limits and may fail to generate the correct result occasionally. If this happens, the CCX offers a unique integrated example-based teaching mode. Typically, users will be amazed at how easy and quick it is to teach a complex image analysis system. It is the easiest, quickest and most convenient teaching mode available on the market. Additionally, should a company not want their general operators to perform teaching, the teaching jobs can be saved for processing by specially trained personnel.



CCX.3 is the latest model in the OC-SCAN® lineup

ROI Example from OC SCAN® CCX

| Manual counting | | Automated counting | |
|--|---------------------|--|------------|
|  | |  | |
| Cycle time per reel | Two to Five minutes | Cycle time per reel | 7 seconds |
| Lot size: 200 reels | 200 | Lot size: 200 reels | 200 |
| Total count time | 7-17 hours | Total count time | 33 minutes |

Small Footprint Combined with Smart Design

The outer cell combines a compact footprint (2.84 ft²) with high flexibility and fits nicely into existing work environments. The ability to adjust the working height for standing or sitting, or switch machine orientation allows users to customize comfort preferences, regardless of surroundings. The height of the machine is a quality feature: creating a large distance between the X-ray source and detector reduces image parallaxing effects to a minimum. Put simply, this means that the CCX performs better at counting large components, especially when they are packed together densely.

The use of flat-panel detectors enables a “one-shot” still image capture up to 17". The image detector is mounted with no moving axis that affect movement, settling and jittering, and does not require stitching multiple images together. Ultimately, the smart design results in a short acquisition time leading to the shortest overall counting cycle time on the market. As an approved technology, the standard cassette-type detectors used in the CCX are rooted in medical applications, but have been enhanced to be suitable for the industrial field of application. This guarantees a machine with well-tested and designed devices with excellent durability, availability and a future-proof design since these types of detectors come in standard sizes, are available from a variety of suppliers and are continuously updated as technology advances.



CCX.3 shown in a typical setting near inventory

Software Flexibility

From the beginning, continuing through the process of software development, it has been critical to integrate all customer feedback into the design of the software user interface and features. The result is a software package that is easy to use while being extremely flexible and fitting the requirements of the electronics industry. The development team incorporated an easy, user-friendly interface with a widely configurable and customizable software to meet virtually any customer process and requirement. The CCX can be linked to any third-party software system over a variety of interfaces to automatically update quantities or request batch data. It also is possible to alter or extend the default software logic to fit customers' needs. In EMS, it is a common request to adjust to a large variety of working processes while seamlessly integrating into a manifold IT infrastructure. The CCX's software design guarantees a quick, suitable solution and reaction to customer demands.

EMS Software for the Electronics Industry

As a persistency of the demand of the electronics industry, optical control focuses on the needs of the customer, learning from market feedback over the years. Equally important, development and optimization of the CCX is performed in direct collaboration with optical control's affiliated company elektron systeme, a midsize German EMS provider that is continuously using and testing the newest version of the CCX in its own production. Having an endless supply of most SMD reels is a great advantage compared to testing a few random selections. The software is evaluated and validated daily by operators and first-level supervisors in an actual electronics production process. The ancillary effect is that the CCX has been facing a vast variety of components and requirements over the course of several years. Additional options were added to make the CCX effective in the logistics and production process. For example, a Group Counting mode enables customers to create two ways of grouping counting results and related information: Inventory counting and generic group counting. Inventory counting allows customers to collect all available information about the reels during an inventory counting process, and generates a final report for the end user. The generic group counting allows for cluster counted reels with additional flexibility of result handling afterwards. Additionally, the CCX offers an inspection mode for basic 2D quality inspection of electronic components and PCBs.

OC-SCANCCX



Inventory report: Reels grouped by article

Name: Inventory 2017
Description: <no data>
Begin: 1/18/2018 End: 01.12.9279 Base data deleted: No

Article 008

| | | | |
|------------|-------|-------------|----------------------|
| A008G015 | 2,001 | CCXService | 1/18/2018 11:12:00AM |
| Reel count | 1 | Total stock | 2.001 |

Article 009

| | | | |
|------------|-------|-------------|----------------------|
| A009G016 | 4,791 | CCXService | 1/18/2018 11:13:15AM |
| A009G017 | 5,002 | CCXService | 1/18/2018 11:13:55AM |
| Reel count | 2 | Total stock | 9.793 |

Article 011

| | | | |
|------------|-------|-------------|----------------------|
| A011G021 | 1,776 | CCXService | 1/18/2018 11:12:28AM |
| A011G020 | 1,778 | CCXService | 1/18/2018 11:12:51AM |
| Reel count | 2 | Total stock | 3.554 |

Article 019

| | | | |
|------------|-----|-------------|----------------------|
| A019G031 | 704 | CCXService | 1/18/2018 11:07:45AM |
| Reel count | 1 | Total stock | 704 |

Article 024

| | | | |
|------------|-------|-------------|----------------------|
| A024G037 | 1,051 | CCXService | 1/18/2018 11:13:30AM |
| Reel count | 1 | Total stock | 1.051 |

Article 030

| | | | |
|------------|-------|-------------|----------------------|
| A030G045 | 1,319 | CCXService | 1/18/2018 11:09:11AM |
| A030G047 | 1,100 | CCXService | 1/18/2018 11:09:45AM |
| A030G062 | 135 | CCXService | 1/18/2018 11:10:16AM |
| Reel count | 3 | Total stock | 2.554 |

Article 039

| | | | |
|------------|-----|-------------|----------------------|
| A039G056 | 384 | CCXService | 1/18/2018 11:08:42AM |
| Reel count | 1 | Total stock | 384 |

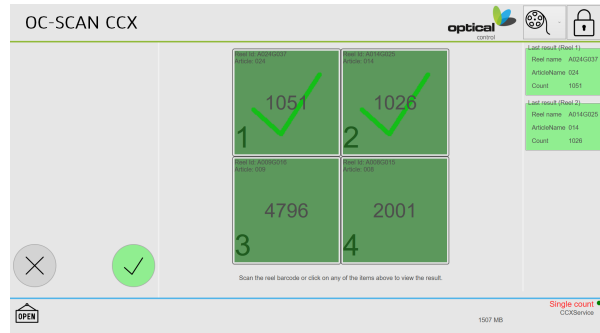
Report generated after group/inventory counting

Accelerating the process: Four Reels Simultaneously

A standard feature on all CCX.3 counters, is the “Quad Count” mode with sensor-based detection of the inserted reels to ensure correct handling. After scanning the barcode of the reel, operators can place the reel in one of the marked quadrants in the machine. Sensors now detect the reel’s placement and the software visualizes the correct position. The Quad Count significantly increases the counting. For four 7” reels, the CCX.3 takes less than 20 seconds to show the result.



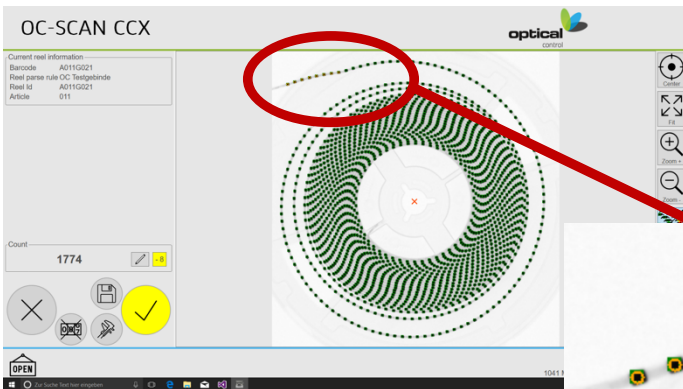
Quad count with (4) 7” reels



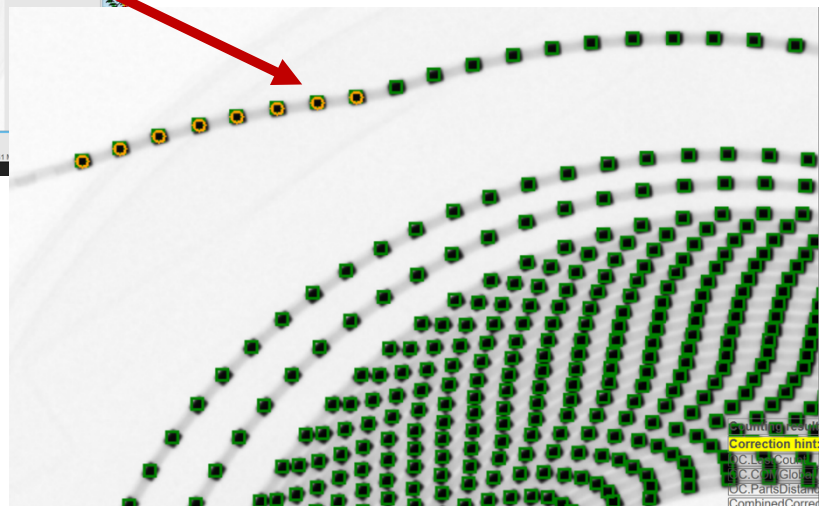
Quad count results

Plausibility Check, Post-Processing and Operator Support

Since its development in 2013, the component counter has been able to perform barcode format checking and rules-based barcode parsing. With a preconfigured rule, the software verifies that operators scan the correct barcode on the reel. It also is possible to consecutively scan several barcodes on a reel to get full traceability. Additionally, the CCX features an integrated plausibility check that supports the operator while verifying that the counting result is correct and sensible. Possible error positions are visually marked. This is a precondition for fully automatic use and handling of counting. The software helps operators avoid mistakes and ensure correct counting results and persistent data. We specifically concentrated on making counting as fail-safe as possible to prevent transferring the wrong results to an ERP system because of operating errors. The CCX also offers multiple possibilities for results post-processing and handling, including the option for full customer-specific logic. This makes the CCX a key module for efficient production planning and SMD component logistics.



Automatically does plausibility test on every reel



Different spacing is ok, but machine “suggests” viewing by operator



Manufactured and Tested to Highest Quality and Safety Standards

With an X-ray system, radiation safety is a predominant topic. optical control takes no chances: All OC-SCAN CCX models exceeds the safety requirements of the FDA and the German RoV.

The FDA requires an emission of less than 0.5 mR/h (approx. 5 μ Sv/h) at any accessible surface. The German regulations are stricter, setting the limit at 3 μ Sv/h. optical control's internal acceptance limit is set even lower than that, to 0.5 μ Sv/h, and any OC-SCAN CCX that exceeds this value at any point during typical operation will not be cleared for deliverance. Actual measurements show that the radiation leakage of the OC-SCAN CCX is close to zero.

Conclusion

From the beginning, optical control was the worldwide pioneer that invented and introduced automatic component counting based on X-ray technology. In cooperation with the experts of Fraunhofer EZRT and German Federal Ministry of Economics, optical control brought a technological innovation to the market for the electronic and SMD logistics process. Now, with several years' experience in this application field, the company has expanded its reach globally with the goal of helping clients save time and money while increasing efficiency through accurate inventory management.

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