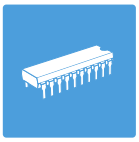
MEI® Motion Application

Automated Optical Inspection Machines

Agilent Technologies

SJ50 Series II Automated
Optical Inspection Machines



Surface Mount Technology Applications

Agilent Technologies

SynQNet
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"Cut Costs, Build Profits, Compete to Win."

Agilent Technologies is in a demanding electronics manufacturing test market, and they promise to help their customers "Cut Costs, Build Profits, Compete to Win". So when Agilent's engineering team began a re-design of their flagship automated optical inspection system for printed-circuit boards, their customers' demands were clear: higher performance, higher throughput, increased reliability and lower costs. Agilent's customers perform high precision surface mount PCB assembly, and look to Agilent for AOI (automated optical inspection) systems throughout their SMT lines.

The Agilent SJ50 Series II is a sophisticated optical based inspection tool, which uses breakthrough Solid Shape Modeling - an industry first - to measure and characterize components and solder joints with lifelike 3D visualization. The SJ50 is applied at multiple locations in the SMT line including post-reflow solder joint inspection, pre-reflow component location measurement, and post-paste 2D solder paste inspection. It identifies missing, offset and skewed components, tombstones, lifted and bent leads, excess and insufficient solder, bridging and polarity. It also performs OCR and OCV to validate components.

In 2002 Agilent chartered a team to design the new Series II, as the first stage in a redesign of the entire PCB test family. This SJ50 design team would make architectural decisions that would be carried through the whole product family, and would be the basis for its AOI systems for years to come.

mei Motion Engineering

Design Considerations

The project had two additional demanding constraints: The design team was scattered around the world, with the mechanical platform being engineered in Ireland and the controls engineering being done in Colorado. And the schedule was tight: 13 months from project kickoff to initial product shipments.

Barry Eppler was motion control engineer on the project. “Unifying the control architecture was a key goal of the project. With the right motion system, one that could be reused for multiple products, we would be able to simplify the product line and reduce our manufacturing costs and development times. We would also reduce our customers' operating costs, by simplifying training and support, and reducing support parts inventories.”

Eppler quickly surveyed the market. “We looked at the entire range of motion solutions, from classic analog motion controllers, the latest networked controls, software based solutions, and even chip level solutions from an Agilent division.” They quickly decided there were three core requirements:

1. **The motion architecture would be based on a digital network.**
2. **The entire architecture would have to be open, including the motion network.**
3. **The motion system would have to be high performance to meet Agilent application requirements.**

Selecting a digital network would be key, as it enabled reduced material costs, improved reliability, and more sophisticated hardware communications. “Cable reduction is an obvious cost benefit, but it doesn’t stop there. Fewer cables mean fewer connector points and increased reliability. Eppler also noted that in a digital servo network, the network itself takes the place of the traditional controller chassis and backplane, making the design scalable without the baseline costs of a chassis, power supply and connectors. Long term, Agilent wanted a “communication rich data path”, as they expected to add additional intelligence and functionality throughout the machine. Using this richer communication, Agilent is able to implement sophisticated automated configuration and download functions, and automated diagnostics. The team also was clear from the early stages of the project that the entire control architecture needed to be as open as possible, not just the PC and motion subsystem. Barry Eppler explained “The goal for the digital motion network was to be open, and interoperable – truly capable of supporting plug and play replacement of drives.” This was key to applying this new control architecture across the range of Agilent AOI product lines, and to controlling costs.

High Performance Motion

The Agilent team set aggressive performance standards for the motion system. The SJ50 consists of a 600mm x 600mm gantry mechanism with linear motors and linear scales on both X and Y axes. This mechanism carries a proprietary lighting solution and imaging head over the PCB to complete the inspection cycle, with demanding precision and a constant need for inspection speeds up to 21cm^2/sec (3.25in^2/sec) to reduce cycle times. The SJ50 Series II would also include new ultra high precision encoders, with submicron resolution. “High performance” meant the ability to handle high encoder data rates, high analog to digital resolution, and high servo sampling rates to maximize machine throughput.

SynqNet® & MEI

With the design goals set, Agilent began formally evaluating motion vendors. Barry Eppler elaborated, “We identified all the potential motion network architectures first, including the established suppliers, those that were new to the market but up and coming, and even some that were still in development. We chose the SynqNet® digital motion network architecture and an XMP-SynqNet solution from Motion Engineering, Inc (MEI®). We qualified several different servo drives and ultimately used CD SynqNet drives from Kollmorgen.”

MEI’s XMP SynqNet product, with the SynqNet digital motion network interface, met the design goals across the board. “SynqNet is a well conceived network, clearly developed with the drive manufacturers in mind, and this enables an extremely high level of interoperability." The motion software code was developed with MEI’s MPI (Motion Programming Interface), MotionConsole™, and MotionScope™ development tools. “MEI provides very up to date tools to help the developer build very advanced motion

applications," said Eppler. "We like the fact that there are both C libraries for our customer-shippable application code, and ActiveX® tools for engineering tests and prototyping."

MPI C/C++ libraries are supported across multiple operating systems and computing platforms so Agilent can select the platform and operating system for next generation machines without being tied to a single solution.
Barry explains further, "We have already successfully integrated the MPI C libraries into not only the SJ machine but also application code for other new products under development."

Fast Integration

With the basic control architecture set with SynqNet and MEI, and initial programming started, the Agilent controls team began integration with the hardware platform. For the first phase, they re-instrumented a SJ50 Series I machine with the new controls architecture – in an amazing one-day effort. "Using the very first Kollmorgen SynqNet drives, and the first generation MEI XMP-SynqNet product, everything came together very quickly." With the first phase success, the team quickly moved to the new platform, with new linear modules and the high-resolution encoders. Again, the results were impressive as the new platform was running with new drives and new controller in 1 week.

The entire project, from kickoff to initial shipments, took less than a year, with impressive results. The new design eliminated extensive cabling and the traditional motion chassis, and dropped the cost of the control system. And as Eppler notes "We are delivering near metrology level precision from a high speed machine, a big win for our customers. The SJ50 Series II is delivering more throughput and precision, while holding system prices down."

"MEI makes complex applications possible, and they're helping us deliver on our promise to our customers: Cut Costs, Build Profits, Compete to Win."

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-Barry Eppler,
Hardware Design Engineer
Agilent Technologies

About the SJ50 Series II Machines

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For more information:

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SynqNet™ Technology
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