



# Circuit Board Inspection Gets a Quality Boost

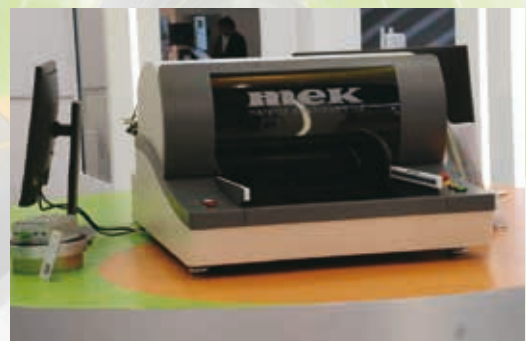
## 3D Color Inspection with Hard- and Software from Silicon Software

*For optical PCB inspection in 3D with 24 bit color resolution, Japanese company MEK Marantz Electronics uses Silicon Software's LightBridge external image processing device. The device enables easy connection of AOI (Automated Optical Inspection) devices to host PCs running Apple's Mac OSX operating system via Thunderbolt™ cables. For special inspection tasks, MEK has programmed appropriate image processing applications and measurement procedures individually on the LightBridge FPGA using VisualApplets with no hardware programming knowledge whatsoever.*



**Optical unit in the inspection device with nine cameras/ Photo: MEK Marantz Electronics**

To achieve high-resolution, broadband image processing for PCB quality control, even with Apple computers, the LightBridge external vision device offered all the characteristics that MEK wanted for high image quality at reasonable cost. This integrated image acquisition and processing device was connected to the MEK PowerSpector GTAz inspection system via Camera Link to a Mac computer via optical Thunderbolt™ cables. Since Apple computers have no slots for PCI Express (PCIe) technology and are only compatible with USB cameras and Thunderbolt™ technology, now different camera interfaces could be used and, with Thunderbolt™ technology, higher bandwidths and speeds.



**Demonstration of an MEK inspection device with LightBridge/ Photo: Silicon Software**

Concurrently, the host PC was relieved of image processing calculations.

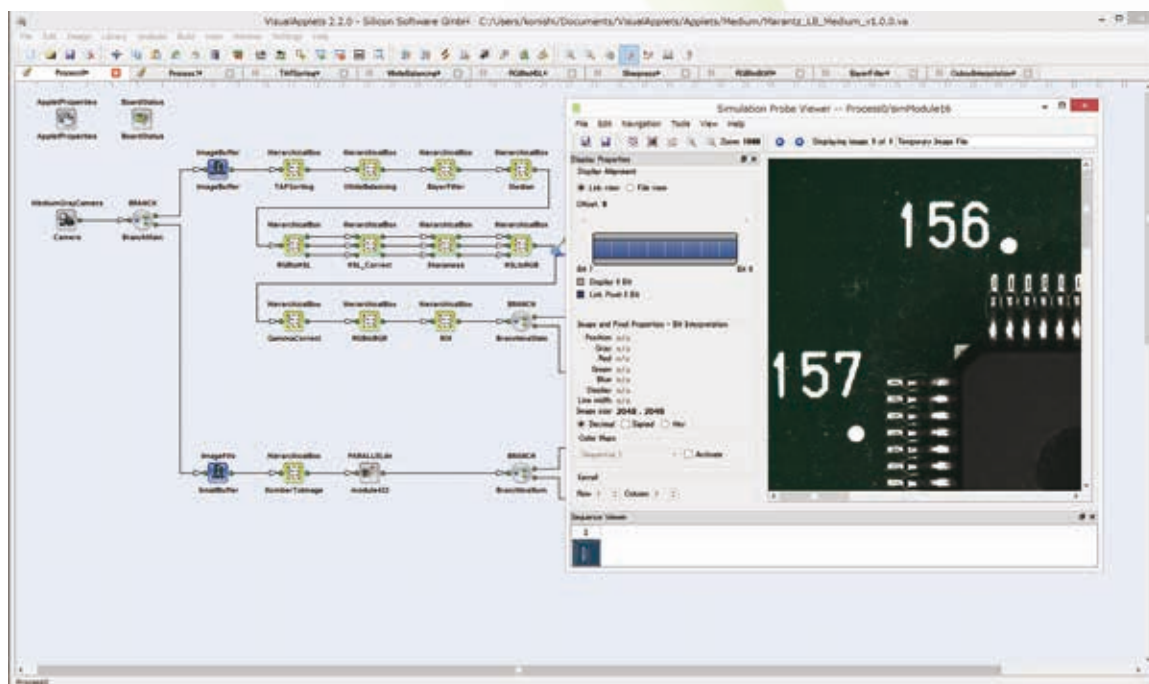
Thunderbolt technology, promoted by Intel and Apple, enables data transfer of up to 4 GB/sec. In its current version, LightBridge is available in a 2 GB/sec variant, thus offering sufficient bandwidth for Camera Link. Thanks to comprehensive support from Silicon Software, MEK Marantz Electronics was able to write drivers independently for Mac's OSX operating system. The software connection then functioned seamlessly.

### LightBridge synchronizes nine cameras as well as data signals

The inspection system processes images from a total of nine 24-bit color cameras: a 4 megapixel main camera with a 60 fps (frames per second) image rate, and eight surrounding side cameras. LightBridge synchronizes image processing of the main and secondary cameras and sends results to the host PC. In so doing, the dedicated interface can be replaced by LightBridge, a small, compact device located in the inspection system and protected from dust by its own housing. Instead of a frame grabber installed in the host PC, the FPGA in LightBridge is used for image processing intelligence.

For inspection, printed circuit boards are oriented in the system with millimeter precision based on 2 to 4 fiducial markers, inspecting over 2000 points within a few seconds. "Our customers no longer have to do elaborate programming in a short period of time because the inspection system compares the points with error-free sample boards", explained Henk Biemans, Managing Director of MEK Europe BV. The system analyzes SMT and THT components based on presence, type identification, polarity, offset, text, and color, as well as solder joints using reflow, wave, and selective processes. 3D solder joints are measured with 4-angle multicolor illumination with a meniscus profiler using light reflection. In the system, synthetic image comparison as well as spectral analysis and grayscale verification run as measurement procedures via analysis of brightness, color tone and saturation.

### Individual graphical FPGA programming ...



Simulation of the image processing application in VisualApplets/  
Photo: MEK Marantz Electronics

Image preprocessing, such as white balancing, noise suppression, and gamma correction (modification of brightness differences in color reproduction) takes place on the FPGA in LightBridge. In the actual image processing, color corrections are performed first and foremost to replace inauthentic colors with high-quality ones. Following color reconstruction using a Bayer filter, conversion of RGB into HSL color space follows, and other color filters are used thereafter.



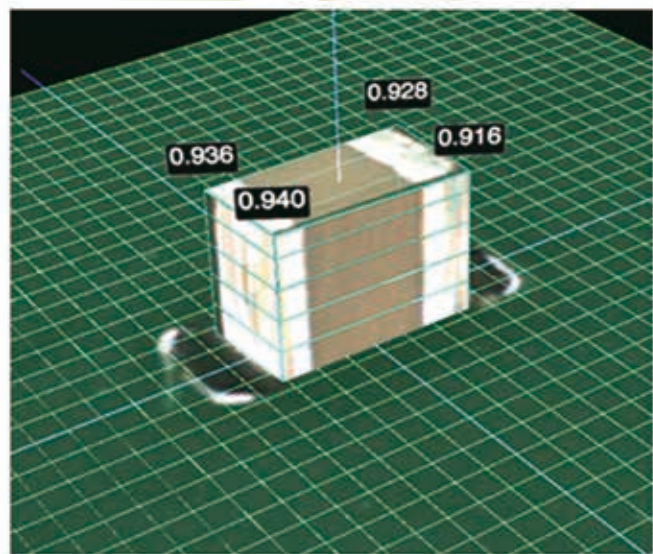
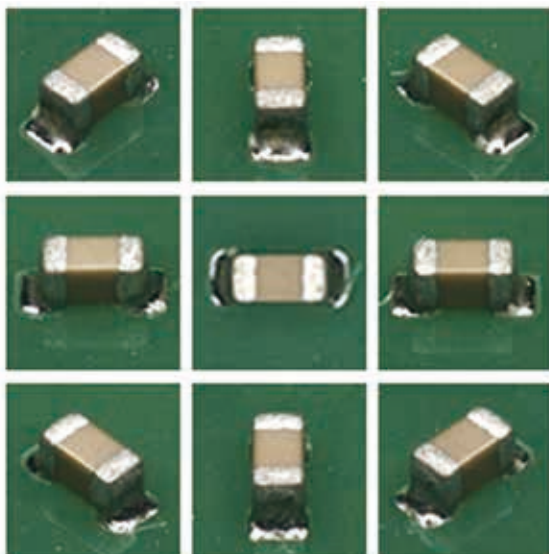
**Henk Biemans, Managing Director of MEK Europe BV & MEK Americas LLC:**

*“The system, built together with Silicon Software, delivers highly precise 3D images for the inspection of components and solder joints on circuit boards. LightBridge offers higher performance and increases reliability at the same time.” Photo: MEK Marantz Electronics*

The FPGA can be programmed using VisualApplets from Silicon Software with the aid of graphical data flow diagrams. “VisualApplets allows us to develop the needed image processing applications ourselves instead of being dependent on support as we were before. The entire system thus becomes an open platform upon which we can modify individual applications at any time and add new ones”, explained Hideki Konishi, Project Leader at Marantz Electronics in Japan.

Following classification of mated image elements with the aid of the side cameras, the images are evaluated. The recordings from the main camera are displayed on a monitor in a zoomable overall view with marked errors, while the eight side cameras provide additional zoomed individual recordings of errors from different perspectives. Since all errors are represented in 3D close-ups, it is no longer necessary to manually inspect the circuit boards microscopically.

**... for first-class 3D color images and error detection**



**3D inspection of components and solder joints/ Photo: MEK Marantz Electronics**

“This system for Apple computers, built together with Silicon Software, delivers highly precise 3D images for inspecting components and solder joints on circuit boards. LightBridge offers higher performance and

increases reliability at the same time with use of optical Thunderbolt™ cables, as well as the elimination of multicore copper cables. As a result, we were able to increase the main camera's total resolution from 2 to 4 megapixels, enabling higher data throughput", Konishi emphasized. In Japan, the MEK inspection system has already been modified and successfully delivered, and is expected to now be offered worldwide, at which point porting onto further inspection systems will follow in the future.

Training employees on the operation of the VisualApplets graphical programming environment proceeded swiftly and overall very positively. "The software can be operated intuitively with no special hardware programming knowledge. Our employees were able to learn how to set up synchronous image and signal processing for parallel processes quickly with the aid of distributors and by using support . Special user training was not necessary here", Biemans said.

In the future, the cooperation between the two companies is expected to expand, with the goal of inspecting circuit boards from both sides. A new LightBridge Version 2 could then offer higher bandwidths for use of even faster cameras.



**About MEK Marantz Electronics :**

At Mek (Marantz Electronics) they are an industry leader in Automatic Optical Inspection (AOI) solutions. With over 5000 AOI machines in use worldwide, Mek's 24-bit imaging technology is driving powerful process control and maximum production yield for Mek electronics assembly and microelectronics customers everywhere.

**microEnable 5 LightBridge VCL (Pre-Production) for high-speed-image processing**

- ◆ External Frame Grabber with Camera Link interface (all configurations)
- ◆ Support of Camera Link Power Over / PoCL Safe Power
- ◆ Up to 60 meter optical connection to host PC, noise immunity, up 940 MB/s
- ◆ Plug & Play Real-Time Image and Signal processing
- ◆ Custom Programming with VisualApplets
- ◆ Compact and Fanless Housing, IP40 pending
- ◆ GPIO (5V - 24V opto-decoupled) for communication and synchronization with external devices
- ◆ Mounting options: Din rail and wall
- ◆ 100% compliant with Silicon Software SDK and GUI control and service tools
- ◆ Third-party imaging tool interface: Halcon, Common Vision Blox and others



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