Newport XM Series Stage for High Speed Automated Optical Inspection (AOI) System

The semiconductor and microelectronics industries are continually evolving to meet the needs of advancing industrial and research applications. The push for miniaturization and expansion of capability continue to inspire new technologies for multi-layered fabrication processes. With the new development of processes and technology, Automated Optical Inspection (AOI) tools for early defect detection is becoming of critical importance for verification of prototype builds and high-volume production. AOI tools are currently used across technologies such as PCB, LCD, wire bonding, as well as wafer and photo-mask inspection.

To achieve high efficiency in test and manufacturing environment, AOI systems require robust motion systems that are highly accurate and fast. Scanning speed and accuracy requirements of the stages are determined based on inspection requirements and include the resolution of measurement devices and the density of inspected areas on the Device Under Test (DUT). Newport supplies various motorized stages for AOI system manufacturers which have a high level of accuracy, throughput and advanced synchronization control capability for scanning processes.

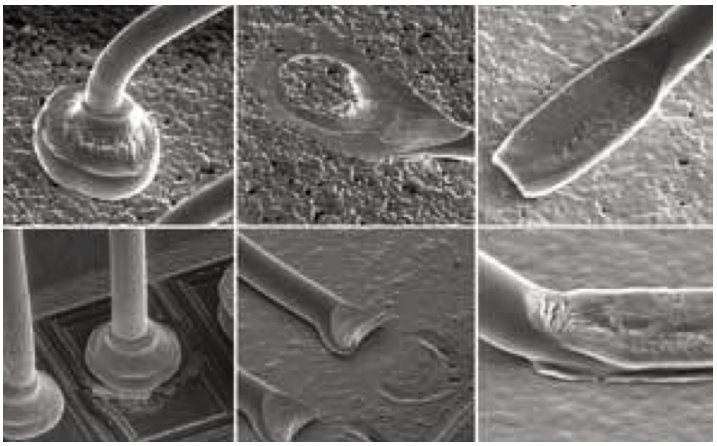

Fig. 1 Images of wire bonding inspection - ball, switch and wedge bonds (from VIVIEK DIXIT, HEIDI DAVIS, MEL CLARK, Wire Bonding Considerations, SolidStateTechnology)

A Newport customer in a renowned research institution in Southeast Asia has recently completed test and development of an AOI system prototype applied to the inspection and measurement of wire bonded interconnects on pre-encapsulated integrated circuits and microchips. The system uses an XM series Ultra Precision Linear Motor Stage and an XPS series Universal Controller to optimally address the motion requirements.

The test setup consists of IC devices placed on the XMS160 stage and multiple high speed cameras, one positioned above and the others at various angles. Images are taken while scanning at speeds of 30 mm/s or 300 mm/s. The scan speeds are held constant over varying distances within the inspected areas. The XMS160 has been selected for this application due to its excellent MIM, accuracy, straightness (or yaw specification) and dynamic performance with superior speed stability and high acceleration.

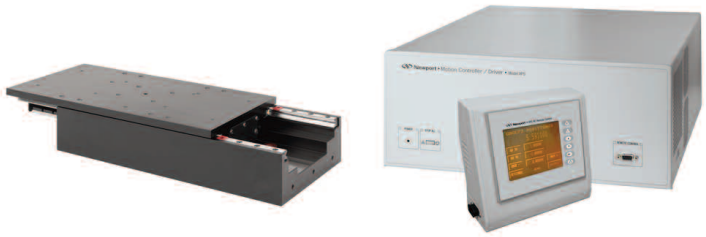

Fig. 2 Newport XM series stage and XPS series motion controller

The XM series have features specifically developed to meet ultra-precision motion requirements of high dynamics and reliability in high speed automated optical inspection. The frictionless center drive provides superior speed stability with minimal wear, and the innovative design surrounding the ironless linear motor provides excellent heat dissipation suitable for long duty cycles. The anti-creep crossed roller bearings provide ripple-free motion for exceptional straightness of 1.5 µm, which is important for acquiring good image quality. Fig. 3 shows the straightness of an XMS50 along the axis of travel is minimal, compared to a typical resolution of cameras down to 3 µm pixels, resulting in consistent scan images.

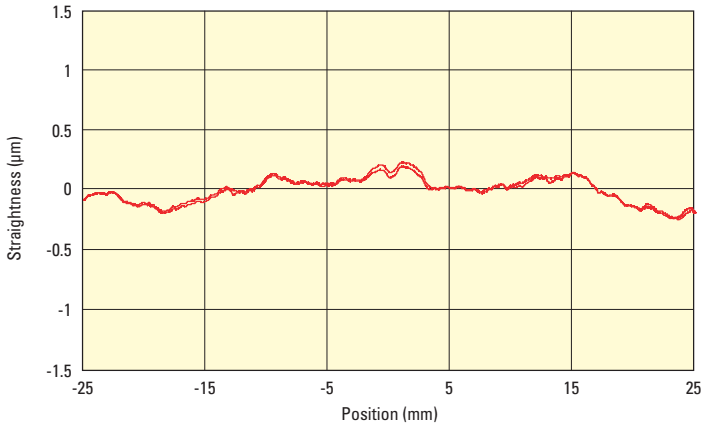

Fig. 3: Interferometer measurement for straightness of XMS50 stage over the full travel length

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Commercially available high speed cameras for vision inspection offer speeds of more than 100 kHz. For precise synchronization between the cameras and motion devices, fast processing time and minimal latency of the output signal from the motion controller are critical. The XPS controller provides distance-spaced trigger output pulses at a maximum of 2.5 MHz, which is 25 times faster than the 100 kHz capture rate of the cameras, thus enabling fast and precise capture synchronized at each scan position.

In this application, the XPS-C2 sends out a pulse every 3 µm of displacement. At each output pulse, the cameras acquire an image which then goes through a stitching process via software. After a complete scan of the DUT, full images are constructed and analyzed to determine whether the DUT is qualified. The Position Compare Output (PCO) feature of the XPS, provides the dedicated trigger outputs to synchronize the motion precisely with the high speed cameras. With 50 ns latency of the PCO, a scanning speed of 200 mm/s produces an uncertainty of 10 nm, which is equivalent to the Minimal Incremental Motion (MIM) of the XMS160 stage.

Newport offers various other options to meet the demanding needs of AOI applications. For more information, please contact Newport sales and applications engineers at tech@newport.com.

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