

1.4.38. MICROELECTRONIC DEVICE INSPECTION SYSTEM

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In the present report a system for the technological inspection of printed circuit boards and its electronic components by methods of high-resolution rentgenoscopy and digital laminography and tomography is described.

Inspection system consist of: an X-Ray protected box with door's locking; a micro-focus X-Ray generator and a power supply unit with an integrated control unit for maximal voltage 150 kV; an X-Ray detector (cooled CCD-camera TSNK or flat-panel X-Ray detector of Varian or Thales); 2 drives to move the test object; 2 drives to move detector; drive of X-Ray unit; remote control unit for all drives; computer to control the inspection system to acquire and process data; software "Diada". Optionally, a high-precision drive for rotation of the test object to acquire the projection data for tomography may be added.

The system has sizes $2000 \times 2000 \times 1700$ mm and can test objects with sizes 400×400 mm (the maximal thickness of an objects from Fe is 18 mm). It supports the following possibilities:

- inspection with geometrical magnification (from 2,5 to 50) of X-Ray images of test objects with spatial resolution up to 20 mkm;
- automatic selection of a region of interest on a test object;
- checklist of creation for automatic inspection;
- scanning of lengthy objects with high resolution;
- reconstruction of the 3D internal structure of the test object by methods of digital laminography and tomography;
- digital X-Ray image processing (16 bits per pixel): noise suppression, digital filtration, contrast enhancement, arithmetical image operations, image jointing, contour extraction and so on;
- full biological shielding of personnel in work conditions;
- automatic search and recognition of main technological defects of assemblage of electronic components on a printed circuit board.

Software of the inspection system can perform an automatic quality analysis of BGA and mBGA soldering by its X-Ray images (fig. 1).

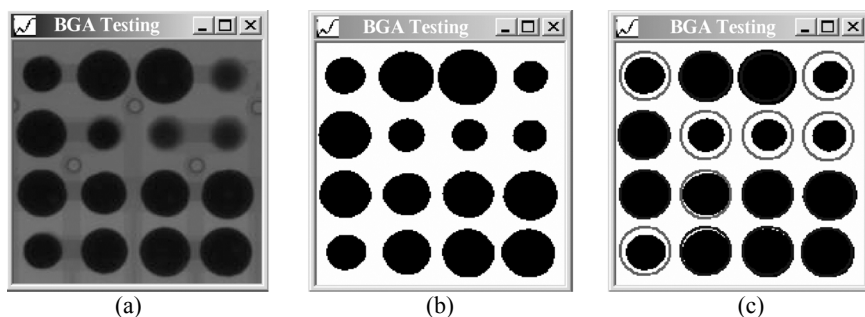


Fig. 1. Steps of the automatic quality estimation of BGA-soldering:

- (a) – original digital X-Ray image; (b) – the same image after digital filtering and binarization; (c) – the same image after recognition and quality estimation.

Blue color marks the good contacts, red color marks the ones with defects

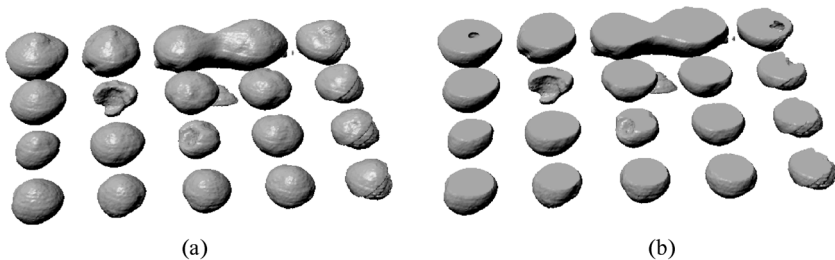


Fig. 2. 3D reconstruction of BGA- soldering:
 (a) Ball's shapes; (b) Cavities within the balls

The digital laminography method reconstructs a 3D internal structure of BGA soldering (see fig. 2).

The described inspection system was successfully used for testing: critical components of aero-space industry, welded and glued joints, cell structures, and also small diameter tubes.

The system advantages are: variety of realized inspection methods, reasonable price (due to domestically production of components) and gathering by customer requirements.