

## Inspection Facilities and Specifications for Automatic Optical Inspection Machines from DCB Automation

The software has been designed and developed by DCB Automation over many years and the features are regularly updated ensuring we offer solutions to the latest manufacturing techniques employed in the population of printed circuit boards. We detail below the main facilities currently available on both the EasyVision and UltraVision systems.



EasyVision



UltraVision

### Inspection Programming

To perform an automatic inspection, an inspection program must be prepared. This consists of generating a series of models for each different component part used on the board. To facilitate this process a series of standard programming parameters have been prepared for common package types. For packages not covered the user can generate their own test procedures, which are then stored for future use. All completed test procedures can be stored in a library for use on other boards based on their part number. Program generation for these parts is then automatic.

#### **Optimisation**

After completing an inspection program, it is advisable to optimise the program by inspecting 4 or 5 boards to adjust for and/or compensate for any optical variations. It is important however to give careful consideration when compensating to ensure that defects will not be missed. If during optimisation a better optical representation of a part becomes available this can then be used to replace the existing one.

#### **Alternative Models**

Alternative criteria can be attached to each model to take into account differing identification parameters that may be associated with that particular model. For example a chip capacitor may have differing body

colours for the same value. Rather than reduce a pass score to accommodate this difference, it may be better to attach an alternative.

### **Double Sided Boards**

Double-sided boards are programmed in a similar manner to a conventional single-sided board. Generally the component data will indicate on which side the component is placed. During inspection however the inspector can select either side to inspect or to inspect both sides together, which requires manually flipping the board over.

### **Panels**

Where several boards are on a single panel it is only necessary to program one board. After creating the main program, details of the panel layout including board spacing are defined so multiple inspections can be carried out within the same panel. Individual boards within the overall panel can be skipped if required. Panels with multiple circuits are fully supported, including circuits at differing rotations.

### **Large Component Programming**

Components that are larger than a standard inspection window are programmed transparently by “stitching” neighbouring images together. There is no loss in inspection resolution.

### **Solder Inspection**

Full solder inspection is provided including presence/absence and profile. This is accomplished using a multi-tiered lighting ring. Standard parameters are supplied for the most common packages.

### **Fiducials**

Ideally boards that are being inspected will have 3 corner fiducial marks, which support a triangulation mapping for the best accuracy. This allows the inspection system to verify accurately the board position on the tooling table. If a fiducial is not available, then a unique mark on the board can be used, for example a track corner but accuracy will be reduced.

### **Board Alignment**

During inspection similar boards are automatically aligned using the fiducial marks, however should a board be presented in a different format, possibly with waste strips attached then re-alignment tools are provided in the software.

## **Tooling**

Careful consideration has been taken when designing tooling for both Vision systems. Standard tooling supplied with the Vision systems will handle boards with bowing in any direction, edge connectors and will securely clamp the board ready for inspection. The UltraVision has the added benefit of being able to handle multiple single boards as if they were a panel to reduce handling time during inspection. Additional tooling is available to support differing thicknesses of boards, 2mm up to 7mm.

## Libraries

Multiple part libraries are supported and each program can link to any specified library (normally customer based) according to the requirements of the user. To assist in this process unique part numbers will be required.

## Automatic Inspection

To perform automatic inspection, supports within the tooling tray can be adjusted to accommodate the board. The board should be held firmly but the locations should not be too tight to deform the board. To inspect a board, it is placed on the tooling plate, the batch and serial number entered and the process is started (if a serial number is not present on the board a default one will be allocated). On completion, if any part does not match the programmed parameters then a review screen is displayed. The operator can then step through the issues and make a decision to accept or reject each one, if a program parameter requires modification this can also be updated at this point. All indicated issues are saved even if the operator accepts them and will be recorded.

## Component Data Import

We recommend that where possible prime data be used. Most PCB layout packages will generate a text file giving location, rotation and value against a component identification number. In the case of double-sided boards the component placement side will also be available. Within the programming package there are tools to size and manipulate the information as required to align it with board images.

If this data is not available then as an alternative placement machine data can be used but it must be remembered that if there has been an error in setting up the placement machine this will be transferred to the inspection machine.

### **Parts Lists**

In addition to positional data it may also be necessary to relate the component identification number to a descriptor, which would ideally be a unique part number. This is normally contained in a "bill of materials" file. There must however be a relationship link between sets of data from multiple files, which is usually the circuit reference.

### **Exporting Placement Data**

It may often be more convenient to bring data information together on the inspection machine and export it to a placer machine. It is often easier to separate layers on the inspection machine than on the placer.

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## **1<sup>st</sup> off Inspection**

There are 2 types of first off inspection, the 1<sup>st</sup> off for a completely new board and the 1<sup>st</sup> off for each subsequent batch of boards manufactured. Ideally to perform a 1<sup>st</sup> off inspection of a completely new board, component data from the PCB design package and a bill of materials will be available. The system also supports the import facility of build document images that can be overlaid to show component polarity, hand fits, or customer agreed modifications. The board to be verified is imaged by the inspection machine and component data imported then aligned to these images.

The inspection system will then step through and locate each component in turn presenting the expected part value and polarity if applicable for the operator to verify. Each component is accepted (a circle appears on the screen) or rejected (a cross appears on the screen). After completing all components the board images can be finally reviewed to ensure all components have been identified and suitably marked. An inspection report can then be generated.

Subsequent 1<sup>st</sup> off inspections for new batches of boards can then be carried out as a standard board inspection.

## **Manual Prototype Assembly**

If component data and a bill of materials are available then the manual population of boards can be greatly assisted with the use of the inspection machine. To perform this task, a bare board is imaged and the expected component positions aligned to this image. The location of all components to place can now be identified on screen and stepped through in a logical manner usually by grouping all part numbers together. There is an option of a foot pedal switch to assist in the automation of this process. Also note this can be carried out remotely using the off-line software.

## **Comparator Inspection**

This technique offers the simplest form of inspection. Under control of the operator a master board commonly referred to as a “golden board” is compared to a board under test. The two images are overlaid and rapidly switched which highlights any differences/defects very effectively.

### **Set Up**

Comparator inspection requires no programming it is only necessary to image the master board, which is then stored on disk as a permanent reference. If a component location data file is available this can be optionally imported for automatic generation of defect information. Additional facilities also exist to enter inspection notes associated to a specific component or area, these must be acknowledged by the operator before continuing further. Finally areas of the board, which are unpopulated, can be optionally masked so they will not be presented to the inspector.

### **Inspection Process**

The tooling system is designed to hold the board firmly and repeatedly in the inspection position selected. Inspection can now begin. The board under test is arranged as a sequence of areas in a standard grid pattern. For each area the images of the master and test boards are overlaid and presented to the inspector, any differences show as a flickering effect on the display. This flickering rate can be adjusted to suit by the operator, also either image can be individually selected for closer inspection. When the inspector has acknowledged the completion of a frame the next image area is presented. This sequence is controlled by the inspection machine ensuring that should the inspection process be interrupted the current inspection position is maintained and that no areas are missed. If a fault exists in a particular frame then the inspector can assign and enter details of the defect in a dialog box, a set of standard descriptions are available but alternatives can be added if required.

Areas that are masked will automatically be skipped and ignored. Areas that call for special attention must be acknowledged by the inspector as being checked before the next set of images are presented.

At the end of the inspection, data can either be printed out on a built in tally roll printer or downloaded to an off-line rework station. This package is included with all inspection systems supplied by DCB Automation.

### **Barcode Reading (Option on EasyVision)**

Boards can either be identified manually with their batch and serial number entered before inspection is started or automatically if a barcode label is present. Most common formats are supported including both one and two-dimensional arrays.

### **Conformal Coating (UltraVision Only)**

Where UV sensitive conformal coating is employed an array of UV sensitive LED's can be utilised to perform conformal coating inspection. Both the presence and absence of coating can be checked and discontinuities in the coating identified.

### **Reporting**

All the information including defect images collected during inspection is stored so that it can be used for the preparation of reports for quality purposes or for the resolution of queries at a later date. A set of standard reports is available in the software package of the inspection machine.



See what you've been missing

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A complementary output to a standard database format i.e. Access/SQL Server is supported for users who wish to integrate the inspection information into their own quality system.

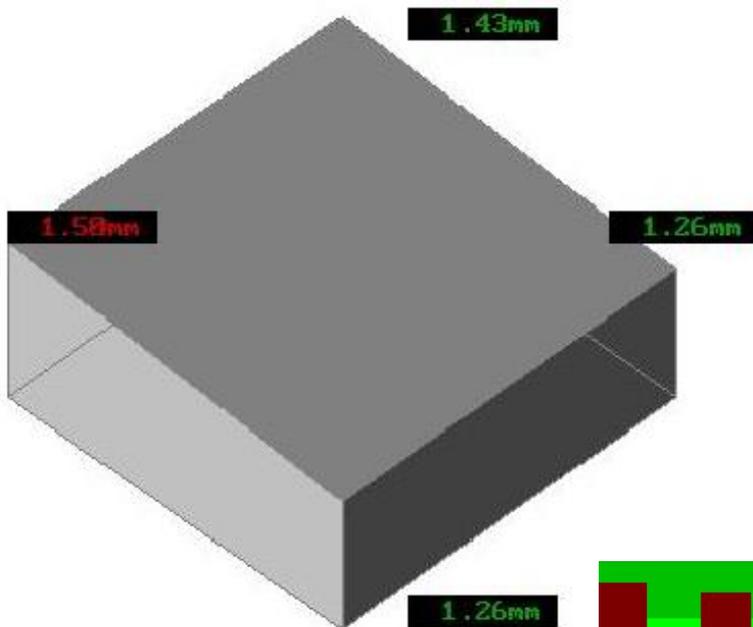


## Complete Board Image

After final inspection a complete image of the board can be generated for archival purposes if required. It is stored as a jpeg image at high enough resolution so that even small components can be identified without having a significant impact on resources. The complete board image is stored at ¼ full optical resolution.

## Laser Checking (Option on EasyVision)

The laser can perform 2 inspection functions



### Surface Co-planarity

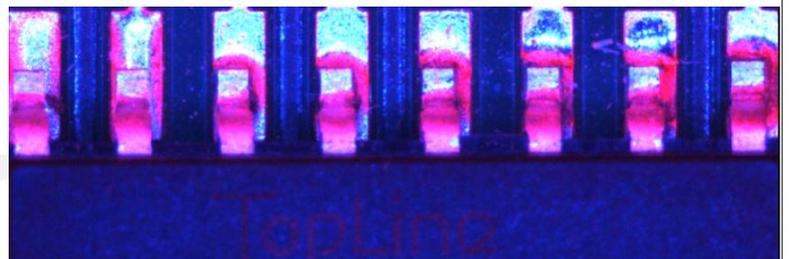
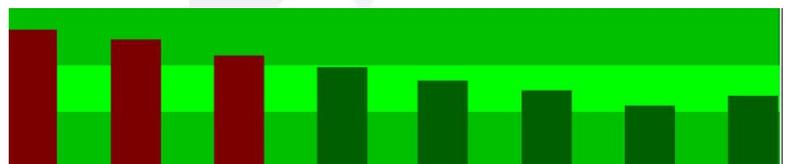
The laser can be used to confirm component top surfaces are parallel to the board substrate according to tolerances set by the user. To eliminate the problems of board warp, board reference points are taken as close to the corners of the component as possible.

Co-Planarity : 0.24mm

### IC Leg Co-planarity

Options exist to either force the inspection system to deploy the laser to inspect all legs of a component or to let the system decide to use the laser if visual inspection of a lifted lead is inconclusive.

No extra programming is required for this feature.



## Data Retrieval

All the data and images associated with a particular board are stored on the inspection machine. This means that any queries regarding a particular board can usually be answered by interrogating the relevant files stored on the inspection machine.

## **Off Line Software**

As a standard an Off-line software package is included with both EasyVision and UltraVision. This allows the user to perform many functions remote from the inspection machine including 1<sup>st</sup> off inspection, prototype manufacture, programming and fault review. Data can be transferred over either a local network or the customer's main network as appropriate.

## **Alternative Platforms Only Available on UltraVision**

UltraVision has been designed to facilitate its mounting on to either a Cassette Feeder or Conveyor System for in line applications. By removing the drawer assembly from the bench top version of UltraVision the inspection system can be mounted on either platform option.

### **Cassette Feeder**

A standard Cassette feeder unit will normally hold up to 50 assembled boards on 10mm centres. For boards with a higher profile the cassette will hold fewer boards. The vision system calls for boards to be inspected from the cassette and returns them to the same holding position after inspection. While fault data is kept in the same order as the inspection process, board identification is ideally suited to barcode marking.

### **Conveyor Mounting**

DCB Automation has developed its own conveyor system onto which UltraVision can be mounted. The conveyor meets the requirements of the IPC SMEMA standard. The conveyor controls are separate from those on the inspection system. A Siemens PLC is used for control purposes. If required the conveyor can run in pass-through mode without the intervention of the inspection system. The conveyor also includes a Hand function, allowing boards to be fed in by the user, eliminating the need for a SMEMA connection with another conveyor.

The inspection system when mounted on a conveyor will accommodate boards up to 450mm wide by 425mm long.

### **Onsite Conversion**

A bench top system can usually be retrofitted onto either a cassette feeder or conveyor.

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