

# Accutron Inc.



## **Fiducial Mark Design Guidelines**

## Fiducial Mark Design Guidelines

These guidelines are intended to provide a generic outline for the design and layout of circuit pattern recognition marks, commonly called Fiducial Marks. The guidelines adhere to design rules standardized by the Surface Mount Equipment Manufacturers Association and are supported by IPC.

### 1. FIDUCIAL MARKS

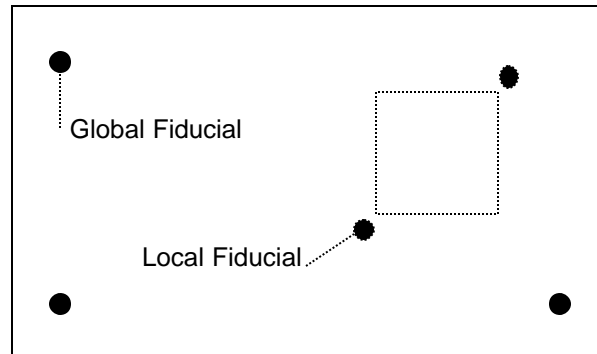
- 1.1. Fiducial Marks are a feature of the printed circuit board artwork, created in the same process as the circuit artwork. The circuit pattern and fiducial should be etched at the same step.
- 1.2. Fiducial Marks provide common measurable points for all steps in the assembly process. This allows all automated assembly equipment to accurately locate the circuit pattern. Fiducial Marks are generally categorized in two types:
  - 1.2.1. Global Fiducials

Fiducial marks used to locate the position of all features on an individual printed circuit board. When multiple boards are processed as a panel, the global fiducials may also be referred to as panel fiducials if used to locate the circuits from the panel datum.
  - 1.2.2. Local Fiducials

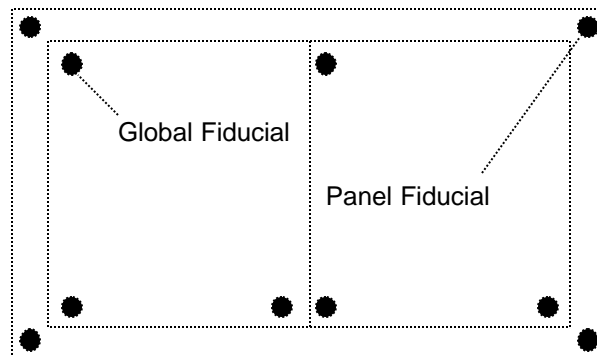
Fiducial marks used to locate the position of an individual component that may require more precise location, such as a .020" pitch QFP.
- 1.3. Global and/or panel fiducials should ideally be located on a three point grid based system, with the lower left fiducial located at the 0,0 datum point and the other two fiducials located in the positive X and Y directions.
- 1.4. Global fiducials should be located on all PCB layers that contain components to be mounted with automated equipment. This is true even if the circuit design contains no fine pitch ( $\leq .020$ " pitch) components, as most modern assembly equipment uses vision recognition for PCB alignment. While other circuit objects (via-holes, etc.) can be used, this can compromise accurate component placement.
- 1.5. All Fine Pitch components should have two local fiducials designed into the land pattern of the component.

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- 1.6. Fiducials should have a soldermask opening large enough to provide good contrast and keep the fiducial clear of soldermask to enable accurate identification by all vision alignment systems.



Global & Local Fiducials



Panel Fiducials

- 1.7. A minimum of two global fiducial marks is needed for correction of translational offsets (x and y position) and rotational offsets (theta position). These should be located diagonally opposed and as far apart as possible on the circuit or panel.
- 1.8. A minimum of three fiducial marks is required for correction of non-linear distortions (scaling, stretch and twist). These should be located in a triangular position as far apart as possible on the circuit or panel.
- 1.9. A minimum of two local fiducial marks are required for correction of translational offsets (x and y position) and rotational offsets (theta position). This can be two marks located diagonally opposed within the perimeter of the land pattern.
- 1.10. If space is limited, a minimum of one local fiducial mark may be used to correct translational offsets (x and y position). The single fiducial should be located in the center of the land pattern.
- 1.11. The minimum recommended size for fiducials is 1.0mm. It is good practice to keep all fiducial marks the same size as some assembly equipment is less flexible in its ability to recognize different size marks on the same printed circuit board.

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### 2. FIDUCIAL MARK DESIGN SPECIFICATIONS

#### 2.1. Shape

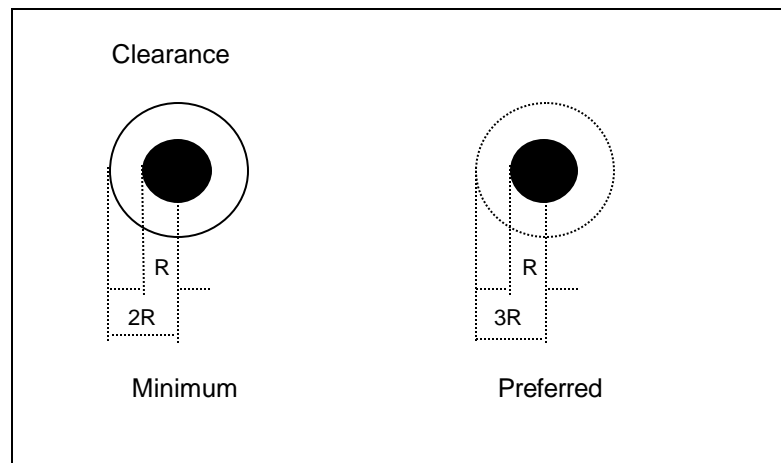
The optimal fiducial mark is a solid filled circle.

#### 2.2. Size

The minimum diameter of the fiducial mark should be 1mm (0.040 in). The maximum diameter of the fiducial should be 3mm (0.120 in). Fiducial marks on the same PCB should not vary in size by more than 25 microns (0.001 in).

#### 2.3. Clearance

A clear area devoid of any other circuit features or markings should be maintained around the fiducial mark. The size of the clear area should be equal to the radius of the mark. A preferred clearance around the mark is equal to the mark diameter.



#### 2.4. Material

The fiducial may be bare copper; bare copper protected by a clear anti-oxidation coating, nickel or tin plated, or solder coated (HASL).

The preferred thickness of the plating or solder coating is 5 to 10 microns (0.0002 to 0.0004 in). Solder coating should not exceed 25 microns (0.001 in).

If solder mask is used, it should not cover the fiducial or the clearance area.

#### 2.5. Flatness

The flatness of the surface of the fiducial mark should be within 15 microns (0.0006 in).

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### 2.6. Edge Clearance

The fiducial marks should be located no closer to the PCB edge than the sum of 7.62mm (0.300 in) (SMEMA Standard Transport Clearance) and the minimum fiducial clearance required.

### 2.7. Contrast

Most machine vision recognition systems perform best when a consistent high contrast is present between the fiducial mark and the PCB base material.