

**SMEMA FIDUCIAL MARK STANDARD**  
**Standard 3.1**

**1.0 SCOPE:** This SMEMA standard is for fiducial marks. It was developed to facilitate the accurate placement of components on printed circuit boards.

SMEMA standards have also been developed for Mechanical/Electrical Equipment Interfaces (1.1) and for Software/Communications Interfaces (2.0). Equipment and printed circuit board features may conform to one or more of these standards. Only some of these requirements may be applicable to a specific application.

**1.1 Purpose:** The purpose of this standard is to provide common measurable points for all steps in the printed circuit board assembly process. Compliance with these requirements will allow each piece of equipment used for surface mount assembly to accurately locate component land patterns.

**1.2 Terms and Definitions:** The definition of terms used herein shall be in accordance with the requirements of IPC-T-50 and the following.

**1.2.1 FiducialMark-**A printed board artwork feature (or features) that is created in the same process as the printed circuit board conductive pattern and that provides a common measurable point for component mounting with respect to a land pattern or land patterns.

**1.2.2 Global Fiducials -** Fiducial Marks that are used to locate the position of all of the land patterns on a printed circuit board.

**1.2.3 Image Fiducials -** Global fiducial marks on a multiple printed circuit board fabrication panel that are located within the perimeter of an end-product printed circuit board.

**1.2.4 Local Fiducial -** A fiducial mark (or marks) used to locate the position of an individual land pattern on a printed circuit board.

**1.2.5 Panel Fiducials -** Global fiducial marks on a multiple printed circuit board fabrication panel that are located outside the perimeters of the end-product printed circuit boards.

**2.0 APPLICABLE DOCUMENTS:** The following documents of the issue currently in effect form a part of this standard to the extent specified herein.

**2.1 Institute for Interconnecting and Packaging Electronic Circuits**

**IPC-T-50** Terms and Definitions for Interconnecting and Packaging Electronic Circuits

**IPC-SM-782** Surface Mount Land Patterns (Configurations and Design Rules)

(Application for copies should be addressed to IPC, 7380 North Lincoln Avenue, Lincolnwood, IL 60646-1 705.)

**3.0 REQUIREMENTS:** The use and design of fiducial marks shall be in accordance with the following requirements.

**3.1 Global Fiducials:** (See Figures 1 and 2.)

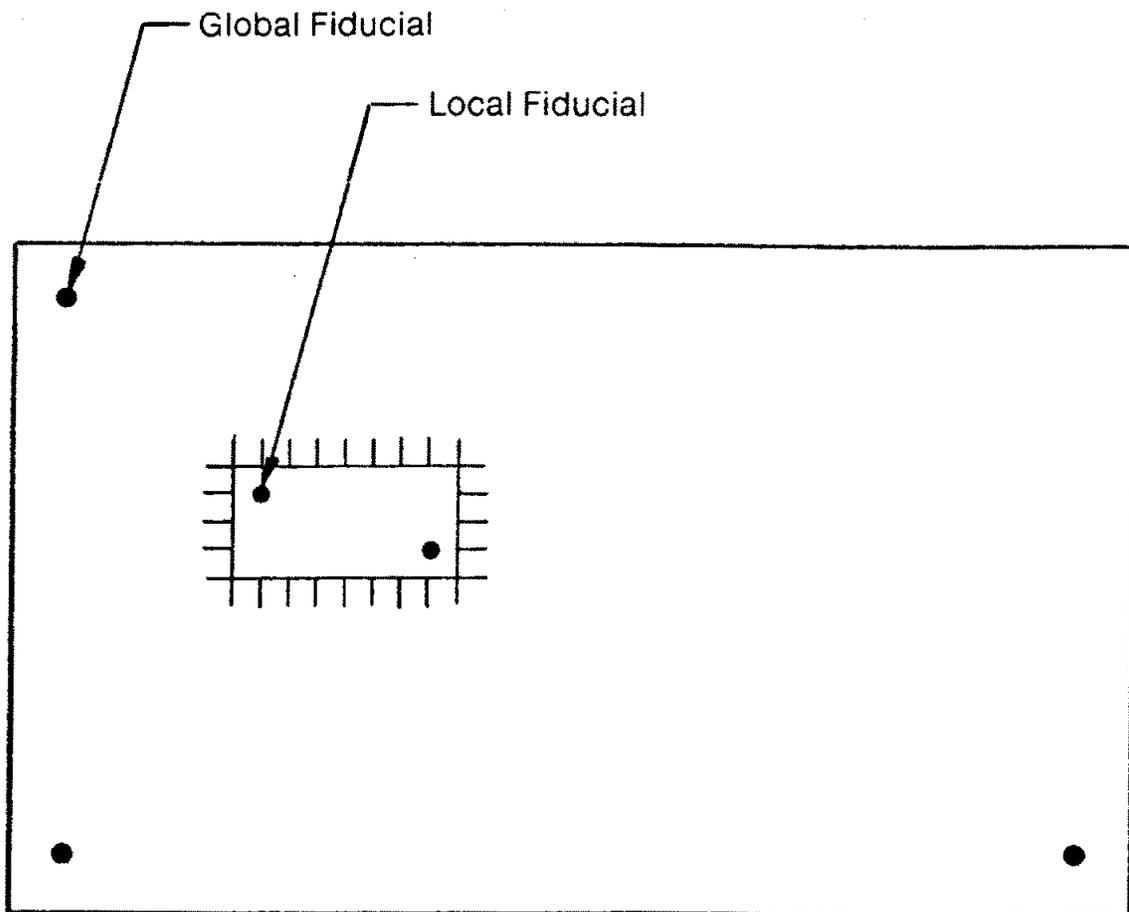
**3.1.1 Offsets -** A minimum of two global fiducial marks shall be provided when it is necessary to correct for translational (X- and Y-position) and rotational offsets (theta-position). These global fiducial marks should be located diagonally opposite one another and as far apart as possible on the printed circuit board or fabrication panel.

**3.1.2 Nonlinear Distortions** - A minimum of three global fiducial marks shall be provided when it is necessary to correct for nonlinear distortions, such as scaling, stretch and twist. These global fiducials should be located in a triangular pattern and should be located as far apart as possible on the printed circuit board or fabrication panel.

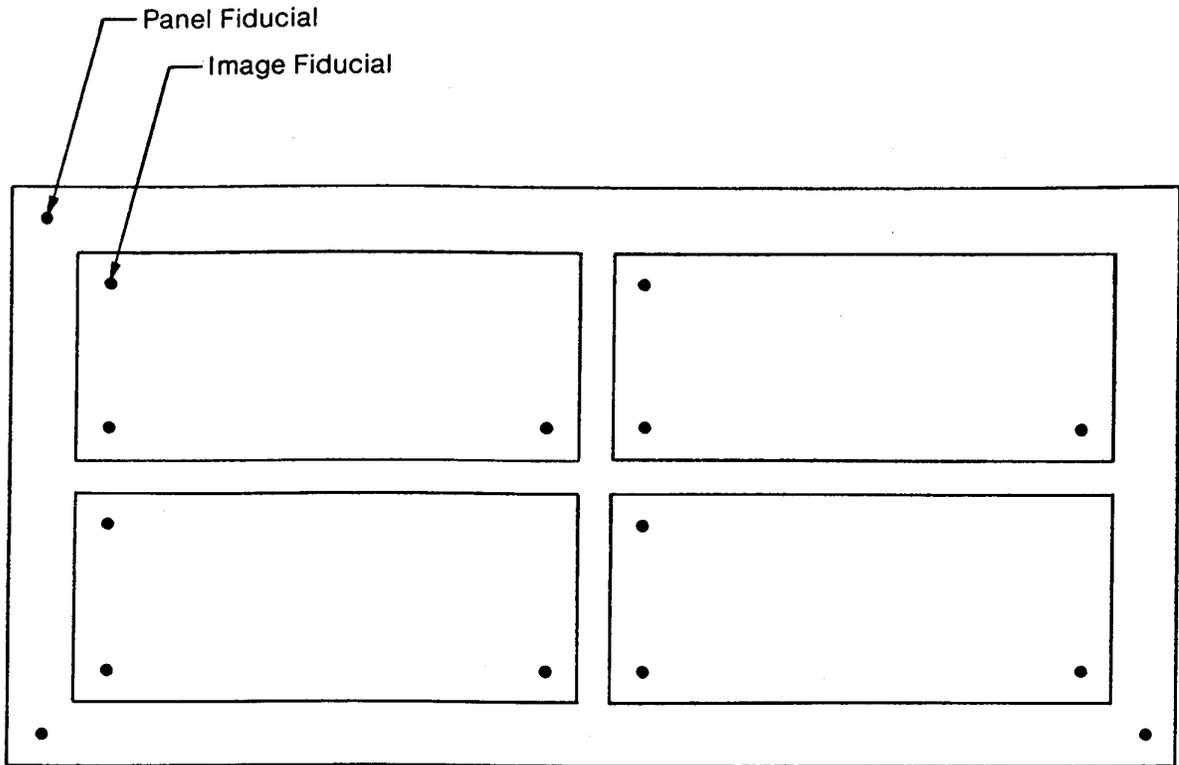
**3.2 Local Fiducials:** (See Figure 2.)

**3.2.1 Translational Offsets** - One or more local fiducial marks shall be provided when it is necessary to correct for translational (X- and Y-position). These local fiducial marks shall be located inside the perimeter of the land pattern, preferably at the center of the land pattern.

**3.2.2 Translational and Rotational Offsets** - A minimum of two local fiducial marks shall be provided when it is necessary to correct for both translational (X-and Y-position) and rotational offsets (theta-position). These local fiducial marks should be located either diagonally opposite one another inside the perimeter of the land pattern or one should be located in accordance with the requirements of paragraph 3.2.1 and the other located on the conductive pattern of the printed circuit board.



**Figure 1. Printed Circuit Board Global and Local Fiducial Marks.**



**Figure 2. Fabrication Panel and Printed Circuit Board Image Global Fiducial Marks.**

Three local fiducial marks should be provided when it is necessary to provide the most accurate correction for both translational and rotational offsets. For these applications the three local fiducial marks should be in a triangular pattern and should be located as far apart as possible within the perimeter of the land pattern.

### **3.3 Fiducial Mark Design:**

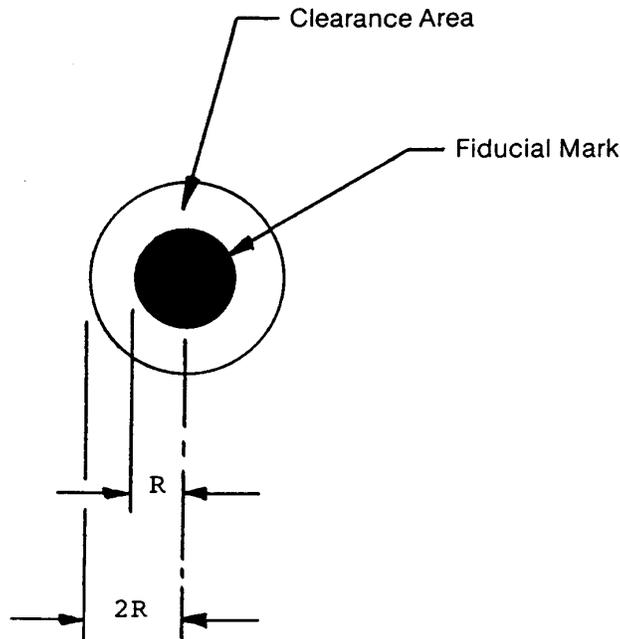
**3.3.1 Shape** - The shape of the fiducial shall be a solid filled circle, see Figure 3.

**3.3.2 Size** - The minimum diameter of the fiducial mark shall be 1.00 mm [0.040 inch]. The maximum diameter of the fiducial mark shall be 3.00 mm [0.118 inch].

**3.3.3 Tolerances** - The fiducial marks on the same printed circuit board should not vary in size by more than 0.025 mm [0.001 inch].

### **3.3.4 Clearances**

**3.3.4.1 Fiducial Mark Clearance**-There shall be a clearance area around each fiducial mark that is devoid of any other conductive patterns or markings. The size of the clearance area shall have a radius that is at least twice that of the fiducial mark and shall be concentric with the center of the fiducial mark, as shown in Figure 3.



**Figure 3. Fiducial Mark and Its Clearance Area.**

**3.3.4.2 Edge Clearance** - The distance from a fiducial mark to the edge of a printed circuit board or fabrication panel shall not be less than the sum of 4.75 mm [0.187 inch] (the SMEMA Standard Transport Clearance) and the fiducial mark clearance (paragraph 3.3.4.1).

**3.3.5 Base Material** - The fiducial mark should be bare or covered copper. For optimum performance, there should be a high degree of contrast between the surface of the fiducial mark and the adjacent printed circuit board base material.

**(Note:** Care should be taken to ensure that the "readability" of the surface of the fiducial mark is not oxidized or otherwise degraded.)

**3.3.6 Coverings** - The covering may be a clear anti-oxidation coating, nickel plating, tin plating, or a hot-air leveled solder coating.

**3.3.6.1 Plating and coating Thickness** - When used, the thickness for the bare-copper fiducial mark plating or coating should be from 0.005 to 0.010 mm [0.0002 to 0.0004 inch]. The thickness of a solder coating should never exceed 0.025 mm [0.001 inch].

**3.3.6.2 Solder Resist Coatings (Masks)** - Solder resist coatings (masks) should not cover a fiducial mark and its clearance area.

**3.3.7 Flatness** - The surface of the fiducial mark should be flat within 0.015 mm [0.0006 inch].

**3.4 Land Patterns** - The fiducial marks should be used in conjunction with land patterns that have been designed in accordance with the requirements of IPC-SM-782.