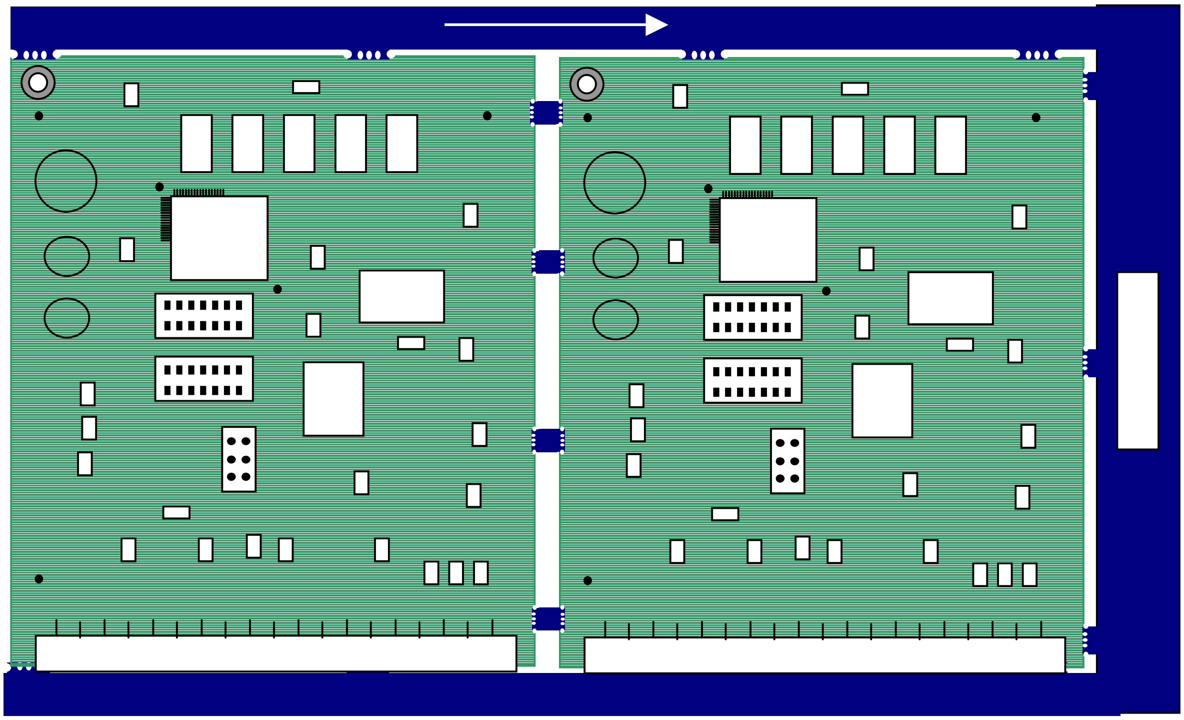
MEC INNOVATION

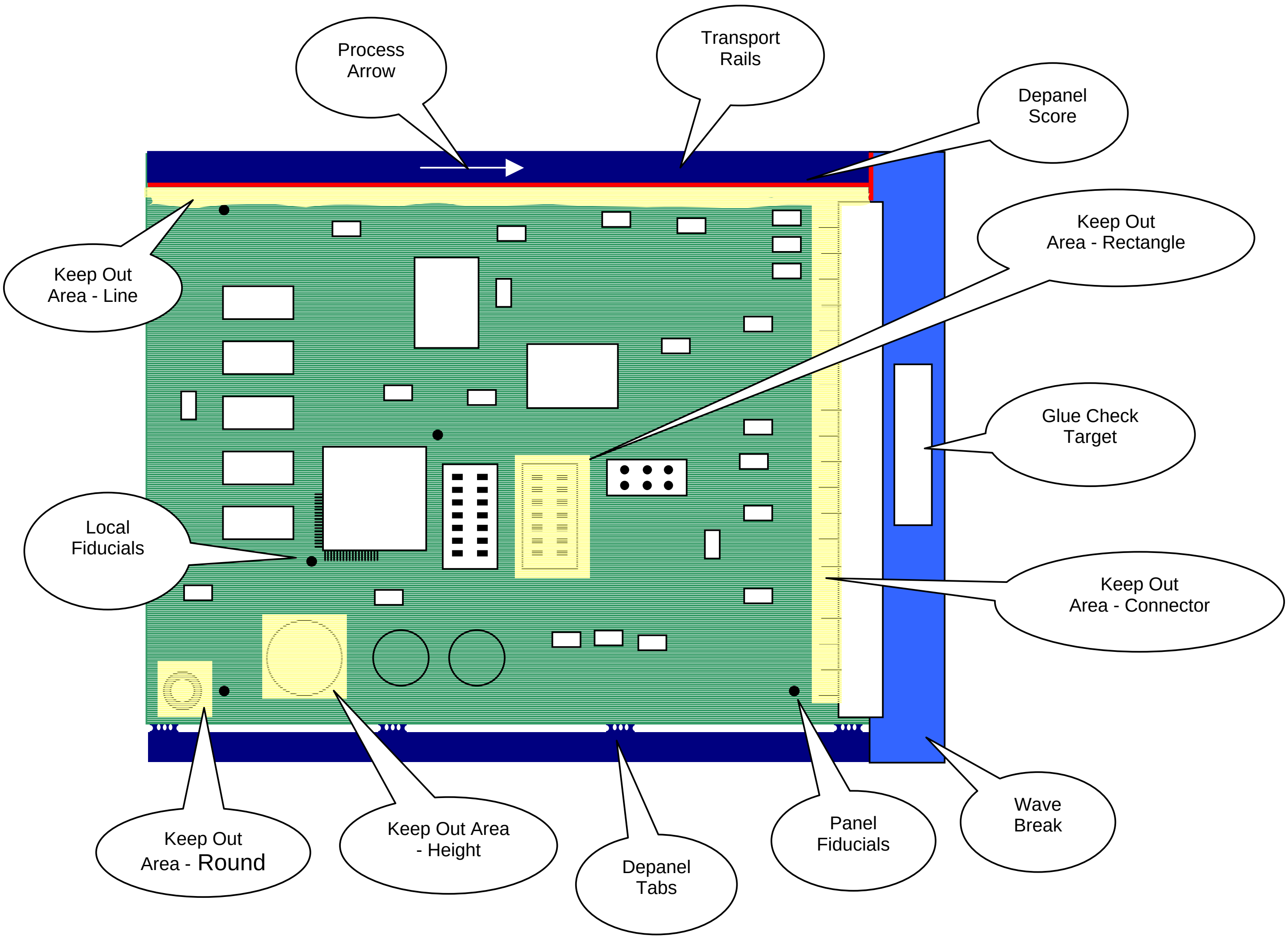
Design Features and Considerations for Manufacturability



Circuit Board and Multi-Board Array Layout

Transport (Process) Rails – Most PCB assembly equipment (surface mount placement machines, reflow ovens, wave solder machines, precision coaters) require an area on the edges of the board that is free of components or leads. These areas are used to interface with the edge conveyors required to transport the product through the equipment. Often times this transportation keep out area is obtained by adding rails to the edge of the circuit board that are discarded after processing. This design feature eliminates the need for custom fixtures and tooling that is often times cost prohibitive for low volume production runs. The width of transport or process rails is typically .250."

Multi-Board Array – Circuit board designs that can be arrayed to fit standard fiberglass laminate sizes can result in significant material cost savings and reduce processing labor for end item customers. This is accomplished by minimizing wasted material in the PCB fabrication process and eliminating unnecessary handling and transport times during board assembly. When multi-board arrays are considered, care should be taken to insure the overall panel width does not exceed 12.5." This will guarantee the array can be processed through the various types of automated equipment currently in use.



De-panelization Tabs, Scores and Routing – The removal of transport (process) rails is generally accomplished with one of three techniques; break out tabs, scoring or routing. The technique selected should be based on the end item application and the final edge profile required for the finished circuit board.

The least expensive method to attach and subsequently remove Transport Rails from a product is to incorporate break out tabs. This technique is accomplished by fabricating the circuit board with a series of small holes or perforations along the area where the circuit board and process rails are connected. After automated assembly the break out tabs are simply broken along the perforation and the process rails are discarded. Before incorporating break out tabs consideration should be given to the weight of the components on the board. Often times heavy components like transformers or large relays prevent the use of tabs because they do not provide enough support to the circuit board during processing. The use of break out tabs may result in a rough edge profile after break out. The effect of this characteristic should be considered before incorporating break out tabs in the PCB design. Care should also be taken to insure there is ample room between break out tabs and adjacent circuit traces to minimize the potential for damage during depanelization.

A scoring technique can be used when the weight of the components on the circuit board is relatively high or a smooth edge profile on the circuit board is required i.e. circuit card assemblies that are mounted in card racks or chassis. Scoring is also preferred when conformal coat coverage of a circuit board assembly must cover all the way to the board edge. The score is initially partially cut into the circuit board laminate during the PCB fabrication process. After automated assembly a secondary operation is performed to complete the score and remove the transport rail. Scoring is only marginally more expensive than break out tabs.

Routing is the third method used to remove transport rails after assembly and it is the most expensive method currently in use. Routing is a secondary operation that is performed after automated assembly and normally requires custom fixtures and machine programs for each board size and shape. The assembly is loaded into the fixture and a computer controlled (X, Y and Z axis) cutting tool is used to remove the excess laminate from the edge of the circuit board assembly. This process provides the end item user great flexibility in designing boards with irregular outline shapes. It is also excellent for insuring smooth edge profiles.

Wave Break – Whenever possible new designs should include a piece of laminate on the front of the circuit board or panel assembly that is approximately .5" wide. This laminate is often referred to as a wave break and is an important feature during wave solder and aids processing through other types of automated equipment. When properly designed the wave break will knock down the molten solder encountered during wave solder and redirect the solder flow under the board assembly. This greatly reduces the risk of solder flowing over the top of the assembly and allows for improved hole fill and top pad wetting. The wave break is discarded after processing and is attached and removed using the same techniques for transport rails. The addition of a wave break in conjunction with transport rails often times eliminates the need for costly custom pallets.

Surface Mount Design Features

Panel and Local Fiducials – Fiducials are targets (usually tin lead plated) that are placed on the circuit board artwork to improve the precision of automated, vision corrected placement equipment. Vision corrected equipment is recognized as the most accurate form of equipment on the market today. This technology depends on the availability of targets (fiducials) that can be used to determine the dimensional variation in each individual circuit board prior to assembly. The variation is calculated by comparing the actual position of the fiducial, which is viewed by a camera to the programmed coordinates stored in the machine placement program. The offset between where the fiducial is supposed to be and where it is can then be used to correct the placement location for all of the active electronic components to be placed. In most cases (3) three fiducials – referred to as **panel** fiducials, placed in the corners of the circuit board assembly offer adequate targets for vision compensation. When fine pitch (<20 mils pitch) or BGA style packages are being placed additional targets are preferred. These **local** targets should be located directly adjacent to the package and be located on the diagonal from each other. All fiducials should be laid out in copper and should be tin lead plated to provide adequate contrast for the machine vision systems.

Glue Check Target – Automated adhesive dispensing is a common method to adhere surface mount devices to circuit board assemblies during processing. The success of this operation depends upon controlling the viscosity and diameter of the adhesive being dispensed. The equipment in use at MEC has the ability to compare a set of trial dots dispensed on each board to a rigid specification for diameter. The dot size is then adjusted based upon this comparison to insure maximum accuracy. To accommodate this process an area on each board should be designated to dispense trail dots. This target area can be placed on the wave break or transport rail. Ideally the glue check target would have a white background that would be printed as part of the board legend during the fabrication process.

Selective Conformal Coating

Precision conformal (or selective) coating is a process that incorporates a fluid dispense valve mounted on a programmable 3 axis robot and is integrated with an IR cure oven. The robot can be programmed to selectively apply (paint) material in various patterns to specific coordinates on the circuit board.

Precision coating is an effective process for coating PCBs that have specific areas of the PCB layout that require coating. Based on the positional tolerances described below, the process does not provide full coverage to the entire PCB surface to be coated. Instead, the programmed robot applies coating to selected areas while avoiding coating contamination of defined no-coat areas. The process eliminates or minimizes masking requirements by applying coating materials only to specified areas. Depending on specific PCB layout characteristics, the following positional coating tolerances can typically be achieved:

1. +/- .060” along straight edges
2. .060” +. 030”/-0 along square/rectangular no-coat areas
3. .075” +. 075”/-0 along circular/irregular shaped no-coat areas
4. .125” + .050”/-0 along non-sealed components (connectors, terminal strips, etc.)

