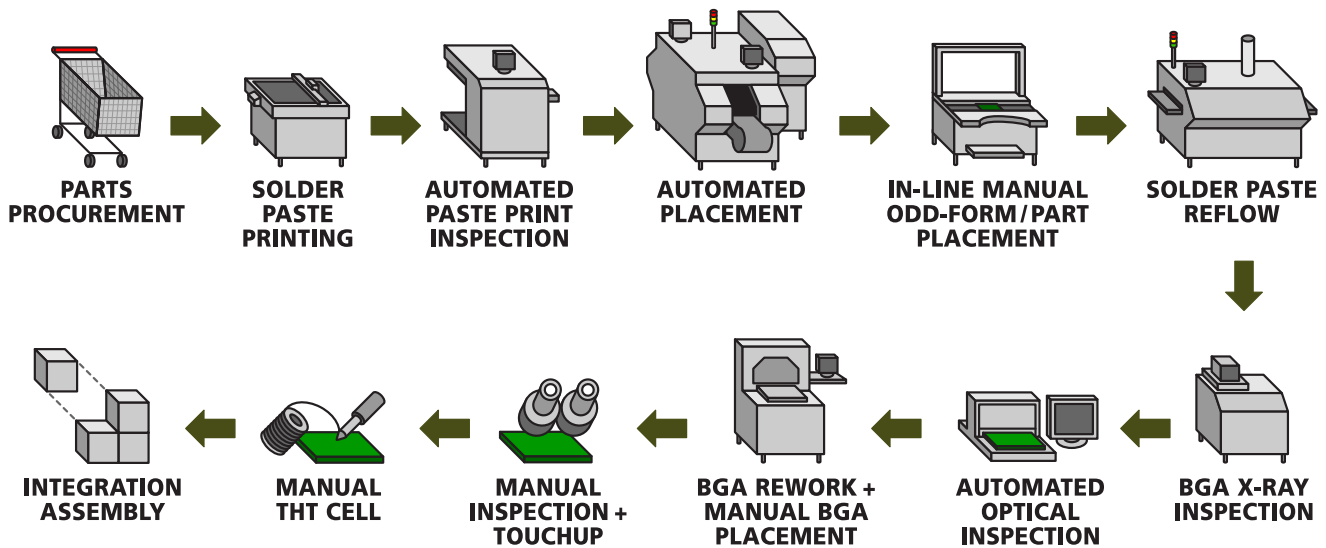


# Designing PCBs for Manufacture at IDERS

Strategies for optimizing cost, turn-around time, and yield



## IDERS PCB DESIGN GUIDELINES for DFM

Author: S. Dueck, A. McKay, R. Burchill, F. Sabet, J. Guay, and V. Barton

{sduECK | amckay | rburchill | fsabet | jguay | vbarton}@iders.ca

Document Number: pcbmech-01

Document Revision: 1.00

Filename: iders\_dfm-V1.00

# ATTENTION

In case of uncertainty, the following guidelines should be adhered to in their entirety to ensure part population, solder joint formation, board inspection, and functional testing can proceed as efficiently as possible. You may observe that some guidelines are slightly malleable. The following, however, are not: 2.1, 2.2, 4.1, 4.2, 4.3, 4.6, 4.9, 9.1, 9.2, 10.5, 12.1, 12.2, and 12.3.

Please contact IDERS before violating any requirement in this document.



# 1. PARTS PROCUREMENT

CONSEQUENCES OF NON-COMPLIANCE

REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
<b>1.1</b> Parts provided by customer are preferred in reel, tube, or matrix form - not cut tape or bulk. If cut tape absolutely necessary, must have 10" leaders.	None.	None.	Cost may increase as parts must be hand placed - a more timely and human resource intensive task than automatic placement.



# 2. SOLDER PASTE PRINTING

CONSEQUENCES OF NON-COMPLIANCE

REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
<b>2.1</b> Area of board/panel to be pasted and auto-placed must not exceed 12.75x16".	Boards in excess of these dimensions will not fit in the paste printer and/or GSM.	None.	Cost may increase as parts must be hand placed - a more timely and human resource intensive task than automatic placement.
<b>2.2</b> Solder paste layers must be size-on-size with pads and contain no paste for vias, test points, or through holes. Soldermask should be defined by pads and not vice versa.	Excess or inadequate solder applied.	Poor solder joint formation or tombstoning.	Paste foil redesign or board rework.



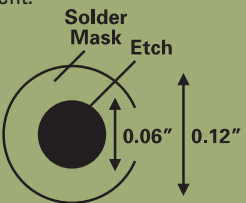
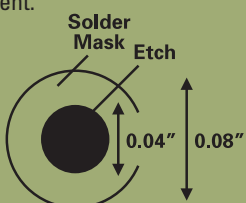
# 3. AUTOMATED PASTE PRINT INSPECTION

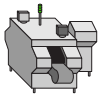
None.



# 4. AUTOMATED PLACEMENT

CONSEQUENCES OF NON-COMPLIANCE

REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
<b>4.1</b> Four global fiducials on each side of board that requires part placement. 	Component leads misaligned with pads.	Misalignment increases risk of open or short in fine pitch parts if not caught during manual inspection.	Increased part placement and/or re-work time and potential hand placement of many components.
<b>4.2</b> Parts with 50 thou pitch and finer require local fiducials in addition to global fiducials for accurate placement. 	Component leads misaligned with pads.	High unreliability increases risk of open or short in fine pitch parts if not caught during manual inspection.	Increased re-work time and potential hand placement of many components.



## 4. AUTOMATED PLACEMENT (con't)

### CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
4.3	No silk or etch may intrude in the soldermask of either local or global fiducials.	Component leads misaligned with pads.	High unreliability increases risk of open or short in fine pitch parts if not caught during manual inspection.	Increased re-work time.
4.4	Parts of identical height may be within 50 thou of each other. Parts of different heights must be 100 thou apart. Contact IDERS PCB/Mechanical department if tighter part spacing is required.	Placement nozzle of GSM will disturb already-placed parts during placement operation and/or incorrectly place parts.	None.	Cost may increase as parts must be glued down - a more timely and human resource intensive task than automatic placement.
4.5	For double-sided boards, the first side reflowed must contain parts either light enough or with sufficient pad-to-lead surface area to be inverse reflowed. Place all parts incapable of being inverse reflowed on one side of the board. If uncertain, send datasheet of part to IDERS PCB/Mechanical department.	Heavy parts will drop off underside of board when solder re-heated.	None.	Cost may increase as parts must be hand placed - a more timely and human resource intensive task than automatic placement.
4.6	Four unplated tooling holes placed at locations which are multiples of 400 thou in both the x and y direction are required. Holes must be 125 thou in diameter and be placed close to the corners of the board or fab rails.	Board will not fit board mounts in paste printer.	None.	Cost may increase as custom machined parts will be needed to adapt board to paste printer.
4.7	For boards without fab rails, components may be placed as close as 0.25" from the board edge parallel to the GSM conveyor line.	Components on edge of board parallel to conveyor cannot be automatically placed.	None.	Cost will increase as parts must be hand placed - a more timely and human resource intensive task than automatic placement.
4.8	For a board with fab rails, fab rails must be at least 0.25" wide.	Components on edge of board parallel to conveyor cannot be automatically placed.	None.	Cost will increase as parts must be hand placed - a more timely and human resource intensive task than automatic placement.
4.9	Pick and place data exported from CAD package must include x, y, and theta data, where theta is the number of degrees the part is rotated from its "standard" position as defined in the part footprint. Refer to document "IDERS' Preferred Package Orientation Standard." Note that x and y data must refer to the part geometric centre. If fiducial placement information not contained in placement file, information must be supplied separately.	Components will be placed incorrectly.	None.	Cost may increase as accurate automatic placement may be more time consuming and re-work will be needed.



## 5. IN-LINE MANUAL ODD-FORM / PART PLACEMENT

None.



## 6. SOLDER PASTE REFLOW

### CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
6.1	Soldermask should be placed between all pins to act as a solder dam, especially on BGAs.	Higher risk of shorts resulting from solder bridging pins.	Elevated risk of incorrect operation.	Increased cost if debug and rework is necessary.
6.2	Preference is for liquid photo imageable (LPI) soldermask.	Non-photoimageable masking does not possess sufficient resolution for most modern SMT parts.	Loose soldermask screening tolerance may obscure pads.	Potential increase in cost if poor soldermask resolution and many fine-pitch parts on board.
6.3	Preference is for LPI which is green.	Depending on the vendor, colors other than green may have significantly different thermal, anti-corrosive, and electrical properties.	Functional changes dependent on change in properties.	Vendors may charge a premium for non-standard colors - ask IDERS PCB/Mechanical department before proceeding.
6.4	Preference is for soldermask over bare copper.	Soldermask can peel if thick, finished traces or surface planes become heated.	Elevated risk of shorts and poor perceived value.	Dependent on extent of soldermask deformation.
6.5	Parts with pitch finer than 50 thou must have immersion Gold finish and not HASL.	High risk of non-wetting of solder and topographical inconsistencies of finish.	Potentially unacceptable joints and poor long-term reliability.	Potentially high cost if many surfaces unwettable and/or long-term maintenance required.
6.6	Soldermask on all vias - particularly underneath BGAs.	Higher risk for short circuits.	Spurious errors which are potentially unfixable in the case, for example, of a via field beneath a large BGA.	Dependent on density of vias and proximity to leads.
6.7	No silk within 10 thou of pads.	Non-wetting of solder.	Potentially unacceptable joint and poor long-term reliability.	Potentially high cost if many surfaces unwettable and/or long-term maintenance required.



## 7. BGA X-RAY INSPECTION

### CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
7.1	Avoid placing anything but small parts (e.g. decoupling caps) beneath BGAs as they obscure through-board x-ray images used during inspection.	None.	Effectiveness of BGA inspection reduced and risk of incorrect operation elevated.	BGA mechanical debug and rework is more difficult.



## 8. AUTOMATED OPTICAL INSPECTION

CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
8.1	All silk must be 10 thou away from pads.	Wide variations (up to 5 thou) in silk registration can cause a high number of false alarms during automated optical pad inspections.	None, as long as silk is not printed directly over top of pad.	May increase cost of board if more manual inspection is required to compensate for lack of ability to optically inspect.



## 9. BGA REWORK / MANUAL BGA PLACEMENT

CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
9.1	All parts must have pin 1 indicated outside the body of the part.	Potential incorrect part orientation.	Potential incorrect operation.	Potential for board re-work.
9.2	All fine pitch parts and, especially, BGAs must have silk outlines to aid their correct placement.	Pin mis-alignment.	Potential incorrect operation.	Potential for board re-work.



## 10. MANUAL INSPECTION AND TOUCH-UP

CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
10.1	All parts must be sufficiently spaced (sometimes in excess of 100 thou) to allow visual and physical access.	None.	None.	More manual inspection time required to ensure same reliability levels as compared to parts with sufficient spacing.
10.2	All parts (including connectors) must have pin 1 indicated <b>outside</b> the body of the part.	Potential incorrect part orientation.	Potential incorrect operation.	Potential for board re-work.
10.3	All parts should have a ref designator in silk unless high board density dictates the deletion of non-essential ref designators e.g. decoupling caps.	None.	None.	Customer must supply assembly drawings - board test and inspection times are slightly increased.
10.4	Each text character should be, at minimum, 30 thou high, 20 thou wide, and be drawn with a 8 thou thick pencil.	Text in silk which is done small may smear during the printing process (though photo liquid silk processes exist which can achieve line widths of down to 5 thou at an increased cost of approximately 2% per board).	None.	Board test and inspection times are increased if an assembly drawing is used in place of on-board silk.
10.5	For 2 pin polarized parts, (e.g. diodes, tantalum caps) the marked pin on the part itself and the footprint is pin. Pin 1 on diodes is typically the cathode and pin 1 on a cap is typically the anode. Despite these "typical" conventions, always mark pin 1 in the silk.	None.	Incorrect board operation.	May necessitate significant board re-work.



# 11. MANUAL THT CELL

None.



# 12. INTEGRATION ASSEMBLY

## CONSEQUENCES OF NON-COMPLIANCE

	REQUIREMENT	MECHANICAL	FUNCTIONAL	MANUFACTURING COST
12.1	<p>V-scored breakouts must conform to following specifications to operate correctly with IDERS pizza cutter depanelizer.</p> <p>*.012" deep cut with worn blade</p>	<p>Error tolerance in board outline may exceed specifications. Additionally, too thin of a web will result in panel board fragility and too thick of a rib will demand use of unnecessary force to depanelize boards potentially reducing solder joint mechanical reliability.</p>	<p>Low mechanical solder joint reliability implies low short and/or long term electrical reliability.</p>	<p>Boards will require hand placement if fab rails detach and re-work if mechanical reliability issues exist.</p>
12.2	<p>BGAs must be withdrawn 0.25" from edge of board being v-scored. Non-BGA parts must be 100 thou from edge. If spacing for BGAs not possible, v-score on panel must be replaced with a drilled out section near BGA.</p>	<p>Solder joint failure has been observed on BGAs close to v-scored edge.</p>	<p>Low mechanical solder joint reliability implies low short and/or long term electrical reliability.</p>	<p>Boards will require re-work if mechanical reliability issues exist.</p>
12.3	<p>V-scored breakouts preferred but, in the case of tab breakouts, following specifications must be adhered to:</p> <ul style="list-style-type: none"> <li>- web thickness: 100-150 thou</li> <li>- min. spacing: 800 thou</li> <li>- min route thickness: 104 thou if singulator to be used, 100 thou otherwise</li> </ul>	<p>Same consequences as 12.1.</p>	<p>Same consequences as 12.1.</p>	<p>Same consequences as 12.1.</p>