

00.037.701**Rigid Printed Circuit Board Requirements****Issued by: Engineering****Effective Date: 4/21/2017****Rev. F****Pg. 1 of 7**

Approved: 4/21/2017 2:52 PM - Christy King, Quality Engineer

I Purpose

The purpose of this procedure is to communicate DCA Manufacturing's requirements and expectations for rigid printed circuit boards to rigid printed circuit board suppliers.

II Application

This procedure applies to all rigid printed circuit board suppliers.

III References

IPC-1601, *Printed Board Handling and Storage Guidelines*
IPC-A-600, *Acceptability of Printed Boards*
IPC-6011, *Generic Performance Specification for Printed Boards*
IPC-6012, *Qualification and Performance Specification for Rigid Printed Boards*
IPC-A-610, *Acceptability of Electronic Assemblies*
IPC-9252, *Requirements for Electrical Testing of Unpopulated Printed Boards*
J-STD 003, *Solderability Tests for Printed Boards*

IV Responsibilities

PCB supplier:

- Contact respective DCA Account Manager for all written authorizations, deviations, clarifications, and approvals prior to production
- Verify compatibility with specifications, master drawings and patterns, and specific manufacturing facilities and processes used

DCA Engineering:

- Compile documentation package: DCA specifications, DCA array/rail drawing, customer Gerber file, customer artwork with fabrication notes, customer PCB specifications as noted in customer artwork
- Review documentation package and clarify discrepancies with customers
- Review if board supplier has capabilities to manufacture to customer requirements

DCA Account Managers:

- Ensure PCB suppliers have current requirements
- Point of contact for PCB suppliers
- Obtain all necessary internal approvals prior to responding in writing to a PCB supplier request

DCA Receiving Inspection:

- Receive and inspect to this work instruction and record data as required

V ProcedureDocumentation Control

1. Order of documentation precedence:
 - a. DCA Specifications (NOTE: at any time, customer specifications may override DCA specifications)
 - b. DCA Drawings
 - c. DCA Purchase Order
 - d. Artwork
 - e. Customer Engineering Drawings
 - f. IPC-A-600 and IPC 6011/6012
2. Upon documentation review, suppliers shall notify DCA in writing of any changes in capability or industry standards that are obsolete, review discrepancies, and list the current standards.
3. For compliance questions regarding documentation issues of the following, request clarification in writing:
 - Not able to meet DCA or customer specifications
 - Contradictions (DCA and customer specifications are different), order of precedence
 - Missing information identified in definitions or documentation package
4. No changes in materials will be made without prior written notification.
5. No processes may be outsourced without prior written notification.
6. No documentation changes (Gerber, CAD, drill files, etc.) will be made without prior approval.
7. No changes in the place of manufacture will be made without prior written approval.
8. Any special requirements will be referenced on the purchase order and/or DCA drawings.

Arrays

9. The DCA drawing must be followed if provided. If a DCA drawing is not provided or available, the listed are typical requirements:
 - a. PCB tooling holes on the breakaway are not required by DCA but may be added at the supplier's discretion.
 - b. Fiducials (filled circle) are required on both sides of an array, three fiducials per array. Fiducials must be 1.0 mm (0.039 inch) diameter with a suitable mask relief. The center of the Fiducial should be located 0.400 x 0.200 inches from the corners of the panel. The preferred corners for the top side are lower left, upper right, and upper left.
 - c. Fiducial spacing for the top side and bottom side should be the same but have mirrored symmetry. (i.e., lower right, upper left, and upper right)
 - d. The minimum breakaway width is 0.300 inches for panels with scored separation and 0.350 inches for panels that include routed separation. Rails can be made larger to provide additional rigidity as long as it does not adversely affect the yield from the production panel.
 - e. The minimum Y dimension for a panel is 4.000 inches. The X dimension should be at least 100% of the Y dimension, and is preferred to be greater than the Y dimension.
 - f. When sizing a multi-board panel the Y dimension should be kept as small as possible while maintaining a 4.00 inch minimum. The panel array should be optimized to provide the best yield from the production panel.
 - g. A 1.000" x 0.250" silkscreen outlined area (or opening in the mask) free of thieving should be provided:

- i. On the component side, within the lower rail, 2.000" x 0.050" from the lower left corner of the panel; and
- ii. On the solder side 2.00" x 0.050" from the lower right corner.

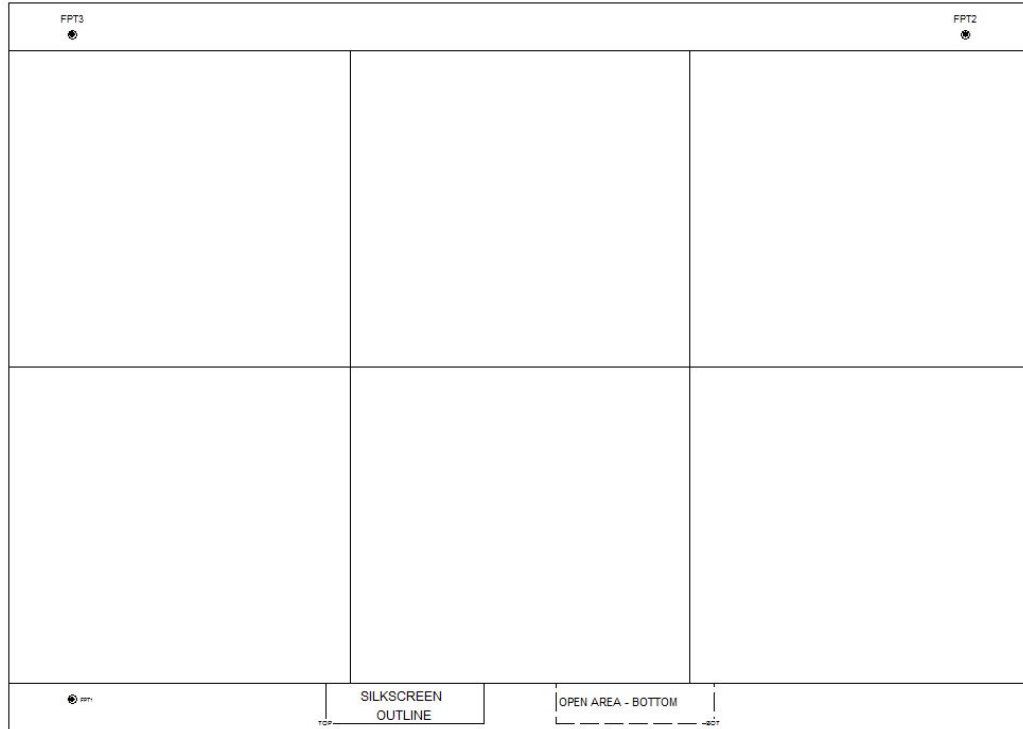


Figure 1

- h. The production panel perimeter must be routed with 0.06" (1.5mm) corner radii.
Example:

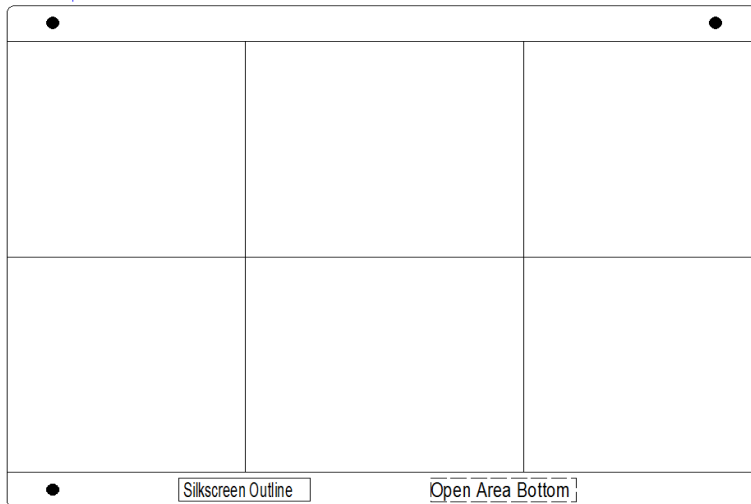


Figure 2

NOTE: array drawing will not typically show radii

- i. The preferred method for individual board separation is scoring. The specification of the V-score can be seen in Figure 3 shown below. The orientation of the boards in the panel should provide a minimum number of horizontal scores.

Scoring Specifications			
Board Thickness	Score Web Thickness	Tolerances	Displacement
0.031"	0.010	+/- 0.003	+/- 0.005
0.062"	0.012	+/- 0.003	+/- 0.005
0.093"	0.022	+/- 0.005	+/- 0.005
0.125"	0.030	+/- 0.005	+/- 0.005

Figure 3

- j. If a board will have components that are within 0.040 inches of the edge or will hang over the edge, the corresponding edges should be routed instead of scored. It is preferred to have the route slots oriented vertically on the panel with no tabs.
10. Breakaways can have supplier processing panel robbers on them, no burrs or high spots that are above the board surface are allowed.
 11. Quote the PCB per documentation provided. Supplier may also submit an alternative quote with suggestions for lower PCB cost.
 12. If copper thieving is used it must not be the same size and shape as the fiducials.

PCB Dimensional Requirements

13. Maximum Bow and Twist shall be 0.75% or less for boards that use surface mount components and 1.5% or less for all other boards. Determined by physical measurement and percentages in accordance with IPC-TM-650, Method 2.4.22. Panels that contain multiple printed boards, which are assembled on the panel and later separated, shall be assessed for Bow and Twist in panel form.
14. All un-plated 3.18mm (0.125 inch) hole diameters will have a manufacturing tolerance of -0.000mm, +0.076mm (-0.000, +0.003 inch), unless the customer manufacturing tolerance is less.

Traceability

15. The date code of each individual board will be in the silkscreen unless otherwise specified.
16. Manufacturer’s identification logo with facility designator is required in copper or silkscreen on each PCB and must be legible.
17. Boards with a date code over six months old shall not be supplied without prior written approval from DCA Account Manager, Engineering, or Quality.

Exposed Surface Features

18. Unless otherwise specified, the Lateral Conductor Spacing is 100 micro-meters (0.004 inch) minimum per IPC-6012, Table 1.2.

Solder Mask

19. Unless otherwise specified, the solder mask will be green Liquid Photo Imageable and finish will be semi matte. Solder mask must conform to IPC-SM-840 Class T for assemblies that are IPC performance class 2, and IPC-SM-840 Class H for assemblies with that are IPC performance class 3. Preference is for a semi matte finish when several mask options are specified.
20. No solder mask can be on any exposed copper areas as defined within the Gerber or CAD.

21. If via masking under any array package (BGA) is required; a minimum of 100% coverage of the annular ring by the masking is required.
22. DCA Engineering must ensure that the arrayed PCBs are supplied with solder mask dams between all pads, and annular rings. If these features are missing from the 1-up Gerbers they must be reconstructed in the array Gerbers by the PCB supplier.
23. Unless otherwise stated, follow IPC-600, Section 2.9, Solder Mask.

PCB Finish

24. If a HASL finish is applied, the solder coating thickness must meet IPC 6012 *Qualification and Performance Specification for Rigid Printed Boards* requirements.
25. A HASL solder finish containing lead will be a Tin/Lead (Sn63/Pb37) alloy unless otherwise specified by customer documents.
26. If no-lead finish is required but the type is not specified, the preferred type is ENIG (Electroless Nickel Immersion Gold).

Nomenclature Ink

27. Nomenclature ink (silkscreen) must be non-conductive and permanent, unless otherwise specified.
28. Nomenclature cannot cover any exposed electrical network conductive features.
29. Nomenclature markings must meet IPC-A-600, section 2.8 Marking.

Solderability

30. The Supplier must warranty the final finish plating (or surface protectant) applied meets the manufacturer's requirements for solderability and has a six month shelf life from the date of application.
31. If solderability testing is requested, adhere to J-STD 003, *Solderability Tests for Printed Boards*.

Cleanliness

32. Boards must be visually free of particulate material (per IPC -A-600, section 5.0) such as:
 - Flux residue
 - Particulate matter
 - Chemical salt residues
 - Finger prints
 - Corrosion (oxides)
 - White residues
33. Boards must have less than 0.8 micrograms/square cm (5.0 micrograms/square inch) Sodium Chloride (NaCl) equivalent ionic contamination or ionizable flux residue. Cleanliness requirements above shall be per IPC 6012B, section 3.9 and 3.9.2.

Electrical Testing

34. For test requirements reference IPC-9252, *Requirements for Electrical Testing of Unpopulated Printed Boards*.
35. 100% Continuity and Isolation Electrical Testing required of all electrical connections (nodes), reference IPC-9252, Guidelines and Requirements for Electrical Testing of Unpopulated Printed Boards. Nodes tested must match a proven functional reference source, including but not limited to CAM/CAD digital data, master pattern artwork, or released drawings of boards.

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36. An Electrical Test Stamp, applied during the electrical testing process as an indication of passing must be visible on each board.
37. Test stamps must not be placed on breakaways unless approved in writing by the DCA Account Manager.
38. If there is not sufficient space available on the PCB for a test stamp, a deviation must be obtained in writing from the DCA Account Manager.
39. Alternative marking methods possible if approved by DCA Quality.

PCB Shipping and Packaging

40. Board Orientation must be the same in all PCB package bundles.
 41. The Supplier must follow First In, First Out (FIFO) practices for Date/Lot Code shipments. Supplier's shipping product with Date/Lot Codes prior to the last Date/Lot Code received will be subject to lot rejection, unless prior written approval is granted by the Account Manager.
- ESD approved materials must be used for wrapping PCBs and leave no residue on the PCBs. Some "Pink Poly Bags" leave a contaminating residue on the PCBs and must not be used.
42. All boards must follow all guidelines set forth in the current revision of IPC-1601, Printed Circuit Board Handling and Storage.
 43. All boards must be delivered in dry packaging. Dry packaging is defined by IPC-1601 as "packaging that consists of desiccant material and a Humidity Indicator Card (HIC) sealed with the printed boards inside a Moisture Barrier Bag (MBB)."
 44. An example of a Humidity Indicator Card can be found in the specification IPC/ JEDEC J-STD-033A, number 3.3.2.3 Humidity Indicator Card.
 45. Desiccant containers should be placed along one side of each PCB stack before sealing.
 46. When PCB stack arrangements are sealed in multiple stacks, sealing should allow at least 12.7 mm (0.5 inch) of clearance between each stack. The edges of the vacuum tray must maintain an airtight seal and create a cushioning bubble border.
 47. PCBs with holes greater than 6.4 mm (0.25 inch) must have the top and bottom PCB in the stack covered with slip paper that is sulfur free.
 48. PCB packages received with tears, rips, or pinholes, are subject to rejection and return.
 49. Shipping box may contain multiple packages of a single part number however each package shall contain only one Date Code. Quantity and Date Code must be marked on the package and the box.
 50. Shipping boxes must be marked with the total number of packages, quantities, and Date Code of packages contained within.
 51. The maximum weight of a box must be equal to or less than 25 pounds. Over pack container for boxes is allowed, however individual box weight must not exceed stated maximum.
 52. No Styrofoam, peanuts, chips, or any small particle or static generating material can be used for dunnage or padding in shipping boxes.

Miscellaneous

53. When an Edge Card Connector is on the edge of a PCB and is in line with a breakaway outside edge, the Chamfer of the Edge Card Connector may extend into the breakaway a maximum of 6.4mm (0.25 inches), the balance of the breakaway edge must be square.

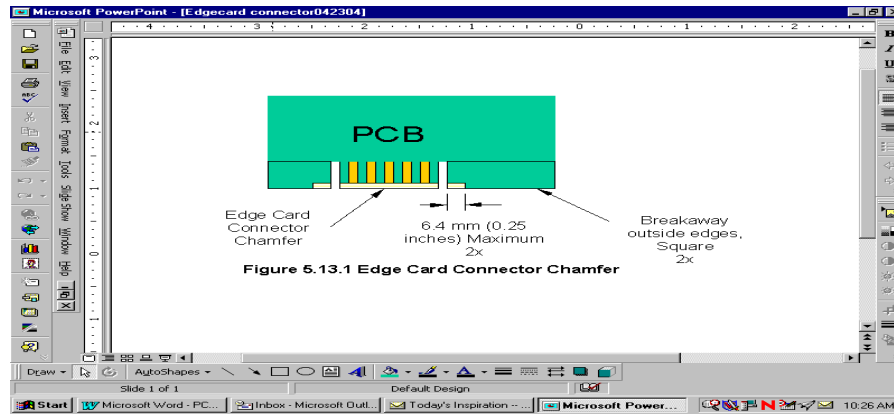


Figure 4

Repair and Rework

54. Repair: Welds are not allowed for repairing etch-outs or opens.

Certificate of Compliance

55. A Certificate of Compliance (C of C) must be sent with each shipment of PCBs.
56. PCB supplier shall be able to produce C of C for 5 years after shipment.

First Article Requirements

57. First Articles will be addressed on the purchase order as required.
58. New revisions and new purchase orders shall require a general inspection report, cross section report, and solder sample board.
59. General Inspection Report: A report covering the specified and actual requirements of material used:
- Laminate
 - Copper weights
 - Masking
 - Finish
 - Silkscreen
- Often referred to as a first article inspection report.
60. Cross-section Report: A report that documents the thickness of each layer, CU thickness, inner-connect defects, etc. Often referred to as a microsection report.
61. If the cross-section report has a high quality, blown-up view of the cross section, a coupon does not need to be provided.

Quality Documents/Records

62. PCB supplier must be able to produce quality records for 5 years after shipment.
63. Exception may be given by the DCA quality manager.