

1 Purpose

- 1.1 This specification defines the minimal requirements for the manufacture of general purpose rigid and rigid flex Printed Circuit Boards (PCB) for WATERS Corporation

2 Scope

- 2.1 This specification covers end product workmanship and acceptability for rigid and rigid flex Printed Circuit Boards manufactured for WATERS Corporation. It is not intended to dictate specific methods or processes beyond those required to obtain consistent fabrication of quality Printed Circuit Boards.

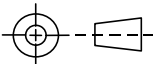
3 Supplier Qualification

- 3.1 Each fabricators manufacturing facility, including manufacturing operations and quality assurance organization, shall be subject to audits by Waters when necessary.

4 Specifications

4.1 General:

- 4.1.1 See Fabrication Drawing for specific PCB manufacturing instructions.
- 4.1.2 In case of discrepancy between Fabrication notes and this PCB specification, the Fabrication drawing takes precedence.
- 4.1.3 Except as noted in sections 4.2.1, 4.4.1, 4.5.3, 4.6.3 and 4.7.4, WATERS Corporation must approve any modifications to the artwork or deviation from these notes in writing.
- 4.1.4 If copper balancing has been added by Waters, this must not be changed.
- 4.1.5 No individual part of the fabrication process can be outsourced without prior written authorization from WATERS Corporation.
- 4.1.6 Manufacturer shall manufacture printed circuit boards to a minimum UL rating of UL-94V0.
- 4.1.7 Manufacturer shall manufacture printed circuit boards to IPC 6011 / 6012 / 6013 class 2 unless otherwise specified. Qualification and Performance Specification latest revision and IPC-A-600 Acceptability of PCB's latest revision, unless otherwise specified.
- 4.1.8 Any exceptions to IPC-A-600 will be defined on the Fabrication Drawing notes.
- 4.1.9 Manufacturers shall test manufactured PCB's conforming to the latest IPC-TM-650 Test Methods.
- 4.1.10 Any exceptions to IPC-TM-650 will be defined on the fabrication drawing.
- 4.1.11 Manufacturer must retain PCB files, process documentation, test certifications, and cross section reports for a minimum of 5 years. All these records must be traceable to

For Dimensioning and Tolerancing Use Ansi Y14.5M 1982	Unless Otherwise Specified All dimensions are in inches. Dimensions in brackets [] are in metric. Remove all burrs and sharp edges. Tolerances: Decimals .XX = $\pm .01$.XXX = $\pm .005$ Angles = $\pm 1^\circ$ Surface Roughness 63 Do not scale print.	Design:	Waters Corporation 34 Maple Street Milford, Ma. 01757-3696 U.S.A					
		Drawn:				Title: PCB FABRICATION NOTES & SPECIFICATIONS		
THIRD ANGLE PROJECTION		Checked:	Size: A Dwg. No.: 735001870 Rev.: E					
Next Assy:		Engr.:						
This drawing and all information hereon is the property of Waters Corporation. Any copying, reproduction or unauthorized use is forbidden without written consent.		Engr.:						

manufacturer's facility code, date code and PCB part number and shall be made available to Waters upon request.

4.1.12 WATERS considers its CAD data to be proprietary and confidential information. For that reason, only WATERS personnel or WATERS approved contract manufacturers are authorized to distribute CAD data for any purpose including quoting, DFM/DFT and fabrication.

4.1.13 WATERS has the right to request all artwork from manufactures.

4.2 Markings:

4.2.1 If space is available, manufacturer shall permanently mark printed circuit boards in silkscreen with Vendor ID, Manufacturers UL Logo, Flammability Rating, and Date code (wwyy) and Lot code. Location shall be visible after components are assembled.

4.3 Materials:

4.3.1 All materials shall be an accordance with:
IPC-4101C Specification for Base Materials for Rigid and Multilayer Printed Boards.
IPC-4203 Adhesive Coated Dielectric Films for Use as Cover Sheets for Flexible Printed Circuitry and Flexible Adhesive Bonding Films.
IPC-4204A Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Circuitry.

4.4 Stackup:

4.4.1 See detailed stack up view, on the Fabrication Drawing for copper weight, overall thickness and layer construction. Unless otherwise stated on fab drawing, core/prepreg thickness can be adjusted to suit available stock of material, providing overall thickness stated is maintained.

4.4.2 Board thickness tolerance shall be +/- 10%

4.4.3 Unless otherwise stated, copper weight is finished size.

4.5 Annular Ring /Conductor :

4.5.1 The external layer minimum annular ring shall be 0.001 inches (0.02 mm).

4.5.2 The Internal layer minimum annular ring shall be tangency, no breakout allowed.

4.5.3 Unless otherwise specified the manufacturer may add tear dropping to prevent breakout to internal and external layer pads. Teardrop shall be added at pad to trace junction to maintain annular ring requirements.

4.5.4 Conductor width tolerance is +/- 0.001 inches (0.02 mm) or +/- 20% whichever is less on all layers as defined by artwork unless otherwise specified.

4.5.5 No inner or outer layer etch repairs allowed without prior written authorization from WATERS Corporation.

Waters Corporation Milford, Massachusetts 01757 USA	Size	Dwg. No.:	Rev:	Ver:
	A	735001870	E	05
	Sheet:			
			2	of 4

4.6 Drilling:

- 4.6.1 All holes must be located from the x-y coordinates provided in the NC drill data +/- .004 inches (0.1 mm) from datum
- 4.6.2 See hole legend for finished hole sizes, quantities and tolerances.
- 4.6.3 Manufacturer may remove non-functional inner layer pads without approval from WATERS Corporation.
- 4.6.4 The copper plating thickness, for plated thru-holes, shall be 0.0008 inches (20um) minimum average throughout the entire hole wall as measured per IPC-6012 class 2

4.7 Soldermask:

- 4.7.1 Primary and Secondary sides require permanent Liquid Photoimageable green soldermask per IPC-SM-840 class T over bare copper.
- 4.7.2 The Comparative Tracking Index (CTI) shall be 175 or greater.
- 4.7.3 Soldermask location tolerance to be +/- 0.004 inches (0.1 mm) of its nominal circuit location.
- 4.7.4 Manufacturer may change soldermask openings to meet their process capabilities.

4.8 Silkscreen:

- 4.8.1 Primary and/or secondary side must use permanent non-conductive epoxy ink (Photoimageable preferred). Lines to be 0.005 inches (0.127 mm) minimum.
- 4.8.2 Color: White
- 4.8.3 Maximum silkscreen height/thickness shall be < .002 inches (0.05 mm).
- 4.8.4 Markings must not cover or be within 0.100 inches (2.54 mm) from the center of the fiducials
- 4.8.5 Markings must not cover conductive pads, test points or holes.
- 4.8.6 Manufacturer shall use silkscreen rated to a minimum UL rating of UL-94V0

4.9 Test/Inspection:

- 4.9.1 Printed Circuit Boards to be subject to 100% continuity and isolation electrical test per IPC class 2 minimum or class 3.
- 4.9.2 Test impedance and time domain reflectometry (TDR) in accordance with IPC-2141 / IPC-TM-650.
- 4.9.3 Test Fixture/program to be generated from IPC-D-356 netlist, ODB++ Format, GenCAD or neutral file.
- 4.9.4 Warp, bow and twist shall not exceed 0.0075 inches (0.2 mm) per linear inch or be greater than 0.090 inches (2.2 mm) across any dimension

Waters Corporation Milford, Massachusetts 01757 USA	Size	Dwg. No.:	Rev:	Ver:
	A	735001870	E	05
	Sheet:			
			3	of 4

4.10 Packaging and shipping requirements:

- 4.10.1 All finished Printed Circuit Boards shipped to Waters or any of its sub-contractors shall be clean, dry, free of moisture and cooled to room temperature before packing.
- 4.10.2 The Printed Circuit Boards shall be packaged with a vacuum or heat sealable plastic bag, in such a way as to prevent any movement or damage to the boards. Desiccant and color moisture indicators shall be placed inside bag prior to sealing.
- 4.10.3 If any of the following documents are supplied with a shipment of PCB's to Waters or its subcontractors certificate of conformance, Micro sections, Solder samples, impedance test results, then a label MUST be attached to the outside of the package stating what documents are enclosed. i.e. "certification of conformance/micro-section/solder sample/impedance information enclosed" as applicable. Note if none of the mentioned documents are supplied a label does not need to be attached.

4.11 Electrical requirements:

- 4.11.1 All PCB's that pass this Electrical test shall be stamped with an approved marking
- 4.11.2 Finished boards with an open or short on any internal layer are unacceptable and must not be repaired or shipped. Rework prior to lamination is permitted.
- 4.11.3 Finished boards with shorts or opens on outer layers must be re-tested (100 percent electrical test) after repair or rework.

4.12 Micro-section and Certification requirements

- 4.12.1 For all multi-layer boards, micro sections shall be required to be held by the supplier for a minimum of 5 years for each new date code and part number shipped.
- 4.12.2 A first article micro-section and report is required only in conjunction with the first lot of boards manufactured by the supplier for that part number.
- 4.12.3 All finished micro-sections shall be in accordance with IPC 650.

Waters Corporation Milford, Massachusetts 01757 USA	Size	Dwg. No.:	Rev:	Ver:
	A	735001870	E	05
	Sheet:			
	4	of	4	