

**REVISIONS**

LTR	DESCRIPTION	DATE	APPROVED
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Requirements of DLA Land and Maritime drawing 10012 are applicable.

Prepared in accordance with ASME Y14.100

Detail drawing

REV																		
PAGE																		
REV STATUS OF PAGES	REV																	
	PAGE	1	2	3	4	5	6	7	8	9	10	11	12					

<b>PMIC</b> N/A	<b>PREPARED BY</b> David J. Corbett		<b>DLA LAND AND MARITIME</b> COLUMBUS, OHIO 43218-3990															
Original date of drawing  15 April 2012	<b>CHECKED BY</b> Joshua Civiello		<b>TITLE</b> PRINTED WIRING BOARD, RIGID, MULTILAYERED, TYPE 4 WITH BLIND AND BURIED VIAS															
	<b>APPROVED BY</b> Thomas M. Hess																	
	<b>SIZE</b> <b>A</b>	<b>CAGE CODE</b> 67268  REV	<b>DWG. NO.</b>				<b>10014</b>				<b>PAGE</b> 1 <b>OF</b> 12							

1. SCOPE

1.1 Scope. This drawing outlines the requirements for a type 4 rigid multilayer printed wiring board to be used for qualifying to DoD printed board specifications.

1.2 Part or Identifying number (PIN). The complete PIN for the printed wiring board shall be in accordance with 6.2.

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-55110 – Printed Wiring Board, Rigid, General Specification for.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-130 – Identification Marking of U.S. Military Property.

(Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch/> or <https://assist.daps.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DRAWINGS

10012 – Printed Wiring Board, Rigid, Multilayered, General Drawing.

(Copies of drawing 10012 is available online <http://www.landandmaritime.dla.mil/programs/milspec/ListDwgs> or can be obtained from DLA Land and Maritime (ATTN: code VAC), P.O. Box 3990, Columbus, OH 43218-3990.)

PUBLICATIONS

DLA Land and Maritime Form 19W – PWB-QPL Application/Authorization to Test.

(Copies of this publication are available online at [http://www.landandmaritime.dla.mil/Offices/Sourcing\\_and\\_Qualification](http://www.landandmaritime.dla.mil/Offices/Sourcing_and_Qualification) or can be obtained from DLA Land and Maritime (ATTN: code VQE), P.O. Box 3990, Columbus, OH 43218-3990.)

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>2</b>

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

IPC – ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

- IPC-2220 – Design Standards Series.
- IPC-2221 – Printed Board Design, Generic Standard on.
- IPC-2222 – Sectional Design Standard for Rigid Organic Printed Boards.
- IPC-2511 – Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer XML Schema Methodology.
- IPC-2615 – Printed Board Dimensions and Tolerances.
- IPC-T-50 – Terms and Definitions for Interconnecting and Packaging Electronic Circuits.
- IPC-D-325 – Documentation Requirements for Printed Boards, Assemblies, and Support Drawings.
- IPC-D-350 – Printed Board Description in Digital Form.
- IPC-OI-645 – Standard for Visual Optical Inspection Aids.
- IPC-9252 – Guidelines and Requirements for Electrical Testing of Unpopulated Printed Boards.
- J-STD-003 – Solderability Tests for Printed Boards.
- J-STD-609 – Marking and Labeling of Components, PCBs and PCBAs to Identify Lead (Pb), Pb-Free and Other Attributes.

(Copies of these documents are available online at <http://www.ipc.org> or should be addressed to IPC – Association Connecting Electronics Industries, 3000 Lakeside Drive, Suite 309 S, Bannockburn, IL 60015-1249.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements for the printed wiring board shall be as specified herein and the associated electronic files (see 6.3). The finished printed wiring boards shall meet the requirements of this detail drawing, DLA Land and Maritime drawing 10012, and MIL-PRF-55110, type 3 with blind and buried vias.

3.1.1 Dimensions and tolerances. The dimensions and tolerances shall be in accordance with IPC-2615. Unless otherwise specified herein, all dimensions are in inches. Unless otherwise specified, tolerances are ±.01 inch (0.25 mm) for two place decimals, ±.005 inch (0.12 mm) for three place decimals, and ± 2 degrees for angles.

3.1.2 Qualification inspection. Qualification inspection for the printed wiring board specified herein shall be required.

3.2 Definitions and terms. The definitions for all terms used herein shall be as specified in IPC-T-50, IPC-D-325, and those contained herein.

3.3 Conflicting requirements. In the event of conflict between the requirements of this drawing and other requirements of the qualifying approved DLA Land and Maritime Form 19W, the precedence in which documents shall govern, in descending order, is as follows:

- a. The qualifying activity approved DLA Land and Maritime Form 19W.
- b. This drawing.
- c. Specifications, standards, and other documents referenced in section 2.

3.4 Material. Materials shall be as defined on DLA Land and Maritime drawing 10012 and herein. Unspecified materials shall be selected by the printed board manufacturer and shall be specified on DLA Land and Maritime Form 19W.

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>3</b>

3.4.1 Base material and prepegs.

3.4.1.1 Copper clad laminates. Copper clad base material used in the manufacturing of the printed wiring board shall have a minimum starting foil of 3/8 oz/ft (12 microns) or greater for internal layers. For external layers, any starting copper foil thickness is permissible. Copper film for semi-additive and full additive copper plating is permitted provided the final conductor thickness is met. The copper clad base material used as the dielectric in the printed wiring boards shall be included in the PIN (see 6.2).

3.4.1.2 Prepegs. Unless otherwise specified, the prepreg used in the manufacturing of the printed wiring board shall be of the same resin type and reinforcement media as the copper clad laminates.

3.4.1.3 Material selection. The printed wiring board manufacturer shall select the base material and prepegs needed to create the board stack-up requirements of 3.5.1. Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), the base materials shall be of the natural color system of primary resin.

3.4.2 Conductor surface finish. The conductor surface finish shall be in accordance with DLA Land and Maritime drawing [10012](#). The conductor surface finish used on the printed wiring board shall be included in the PIN (see 6.2).

3.4.3 Copper plating. Copper plating shall be in accordance with DLA Land and Maritime drawing [10012](#).

3.4.4 Metallic foils. Copper foil and resin coated foils, if used, shall be in accordance with DLA Land and Maritime drawing [10012](#).

3.4.5 Marking ink. Marking ink shall be in accordance with DLA Land and Maritime drawing [10012](#).

3.4.6 Solder mask. Solder mask shall be in accordance with DLA Land and Maritime drawing [10012](#).

3.5 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified herein and on [figures 1, 2, and 3](#) herein. Unless otherwise specified, if individual design details are not specified on this detail drawing, then the baseline design parameters to be used for acceptability of finished printed wiring board requirements shall be the default design shall be performance class 3 of [IPC-2221](#).

3.5.1 Board construction (cross sectional view). A cross sectional view of the stack-up of the finished printed wiring board shall be as depicted on [figure 1](#).

3.5.1.1 Dielectric separation between layers. Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), the minimum dielectric thickness between layers shall be .0035 inch (0.089 mm).

3.5.1.2 Overall printed board thickness. Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), the finished printed wiring board thickness, when measured across the conductor surfaces including plating, shall be .055 to .075 inch (1.4 to 1.9 mm).

3.5.2 Bow and twist. Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), the maximum allowable bow and twist of the finished printed wiring board shall be no greater than .005 inch/inch (0.127 mm/mm).

3.5.3 Conductor pattern. The conductor patterns shall be generated from the supplied master pattern database (see 6.3) and represents the finished printed wiring board requirements with zero process allowance added for etch.

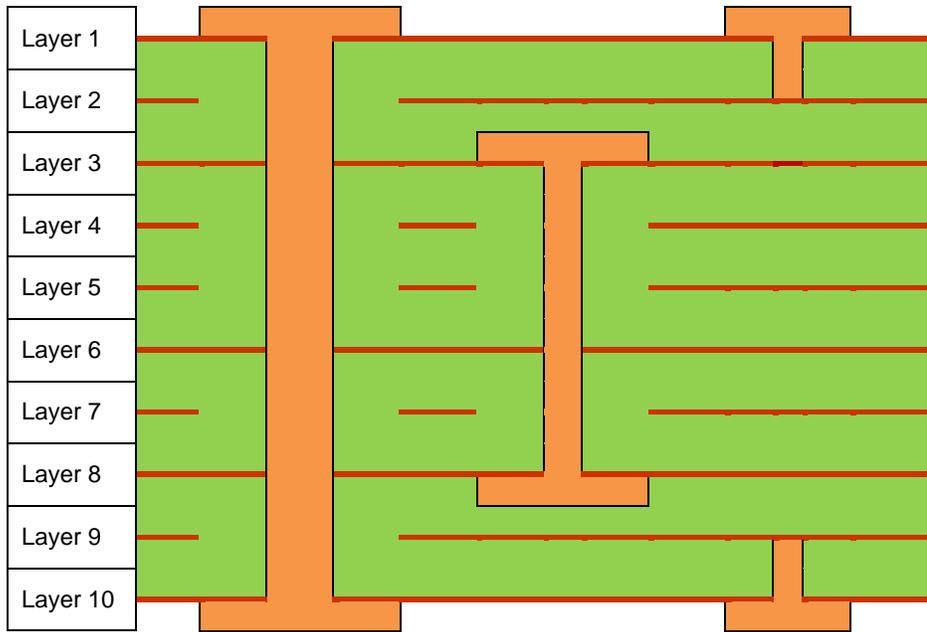
3.5.3.1 Annular ring. The minimum finished printed wiring board annular ring shall be .001 inch (0.025 mm) for internal lands and .002 inch (0.051 mm) for external supported holes.

3.5.3.2 Conductor spacing. The minimum finished printed wiring board conductor spacing shall be .005 inch (0.127 mm) for external conductors and .004 inch (0.102 mm) for internal conductors.

3.5.3.3 Conductor width. The finished printed wiring board conductors shall be within ± 20 percent of the positions specified by the master pattern database.

3.5.3.4 Surface mount lands. The finished printed wiring board surface mount lands shall be located within +.002 inch (0.051 mm) and -.001 inch (0.025 mm) of the positions specified by the master pattern database.

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>4</b>



NOTE: Layers 1 and 10 may be constructed using foil lamination (prepreg and metal foil) or cap laminate.

Key:

Base material =

Plated copper =

Copper foil =

FIGURE 1. Cross sectional view (stack-up) without soldermask.

### 3.5.4 Holes and vias.

3.5.4.1 Hole diameter and tolerance. The diameter and tolerances of all holes on the printed wiring board are listed in [table I](#) and their general location shown on [figure 2](#). The hole diameters specified in [table I](#) shall be the diameter of the finished hole after all plating processes.

3.5.4.1.2 Hole location. Unless otherwise specified, the coordinates for un-dimensioned drill hole locations shall be determined from the supplied drill report database and the hole data chart.

3.5.4.2 Hole plating. All holes identified as plated in [table I](#) shall contain a minimum of .001 inch (0.025 mm) of electrolytic deposited copper plating. Unless otherwise prior approved by the qualifying activity, the total copper (plating and foil) on the surface of the printed wiring boards shall not exceed .003 inch (0.08 mm). The copper plating shall have the following characteristics: a purity of 99.5 percent minimum, the elongation shall be 12 percent minimum, and the tensile strength shall be 248 MPa (36,000 psi) minimum.

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>5</b>

TABLE I. Hole schedule data chart.

Symbol	Description	Diameter inch (mm)	Design diameter inch (mm)	Quantity	Tolerance (+/-)	Notes
+	Plated	.002 to .006 (0.051 to 0.152)	.004 (0.102)	384	.002	BZ
⊕	Plated	.010 to .016 (0.254 to 0.406)	.013 (0.33)	1248	.003	B, BX, BY
X	Plated	.020 to .028 (0.51 to 0.71)	.024 (0.61)	66	.004	A
⊗	Plated	.028 to .036 (0.71 to 0.91)	.032 (0.81)	56	.004	E, D
⊕	Plated	.036 to .044 (0.91 to 1.11)	.040 (1.02)	64	.004	S
⊗	Plated	.018 to .022 (0.46 to 0.56)	.020 (0.51)	12	.002	G
▣	Non-plated	78.7 (2.00)	78.7 (2.00)	24	.0005	T
All				1854		

3.5.5 Profile (board outline). [Figure 3](#) depicts the routing profile with test specimen identifiers. The minimum finished printed wiring board profile tolerance shall be in accordance with [3.1.1](#).

3.5.6 Solder mask. The solder mask shall be applied on the external layers over bare copper (SMOBC). The printed wiring board shall meet the contamination requirements of [3.6.4](#) prior to the application of solder mask.

3.5.6.1 Color. Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), the solder mask shall be either clear or light green in color.

3.5.6.2 Misregistration and overlap. Solder mask overlap is permitted on circular pads only and shall not exceed .001 inch (0.025 mm). Solder mask overlap on rectangular SMT pads shall not be acceptable.

3.5.6.3 Tenting. Solder mask shall be used to tent the vias on test coupon "T" up to a maximum hole diameter of .028 inch (0.71 mm).

3.5.6.4 Thickness. Solder mask thickness shall be measured.

**DLA LAND AND MARITIME  
COLUMBUS, OH 43218-3990**

SIZE  
**A**

CAGE CODE

**67268**

REV

DWG NO.

**10014**

PAGE

**6**

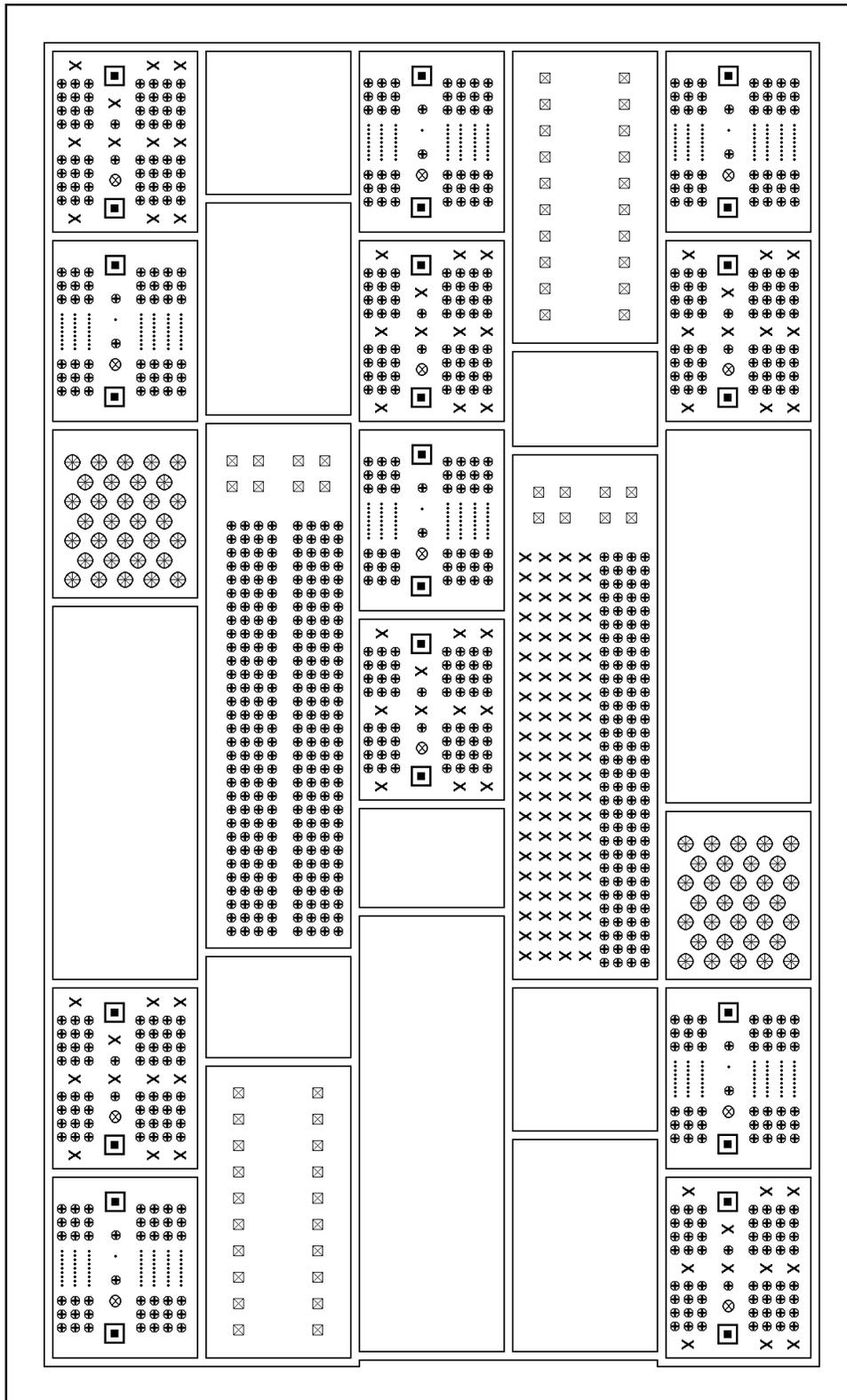


FIGURE 2. Hole locations (viewed from layer 1).

DLA LAND AND MARITIME  
COLUMBUS, OH 43218-3990

SIZE  
**A**

CAGE CODE

**67268**

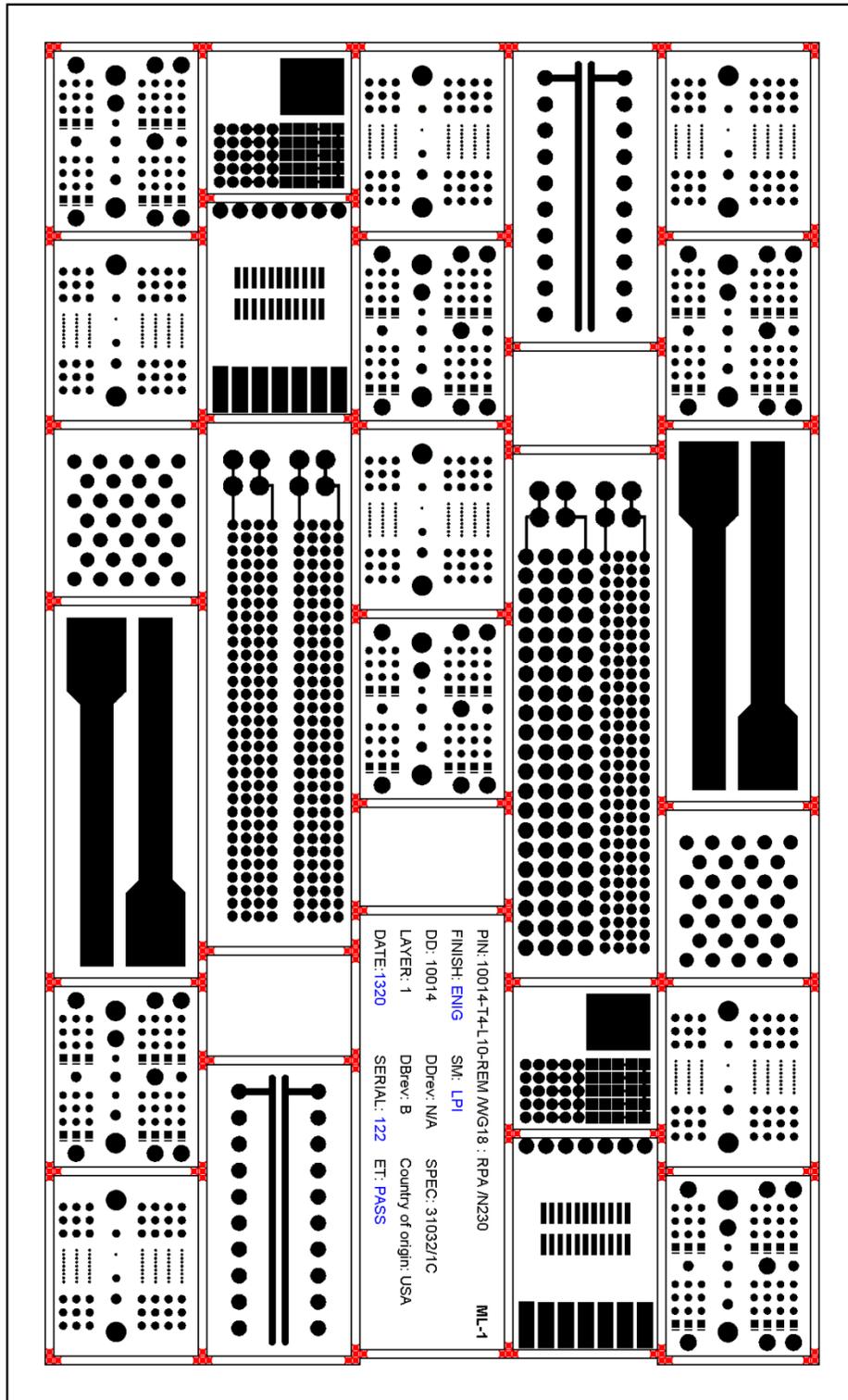
REV

DWG NO.

**10014**

PAGE

**7**



NOTES:

1. Conductor patterns are shown for reference only.
2. Red blocks between test coupons represent break-away tabs.

FIGURE 3. Printed wiring board profile (viewed from layer 1).

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE <b>A</b>	CAGE CODE <b>67268</b>	DWG NO. <b>10014</b>
		REV	PAGE <b>8</b>

3.6 Processes.

3.6.1 Cap lamination. No special testing is required to qualify qualification test specimens using cap lamination construction; however, foil lamination construction cannot be used for subsequent fabrication of compliant QPL–55110 printed wiring boards until qualified.

3.6.2 Foil lamination. To qualify the foil lamination process, peel strength coupons shall be added to the production panel test coupon strips. At least one test coupon "P" shall be added on each side of the production panel to each foil outer layer.

3.6.3 Hole cleaning (desmear/etchback).

3.6.3.1 Desmear. After hole cleaning by desmear, there shall be no evidence of negative etchback.

3.6.3.2 Etchback. When etchback is to be qualified, it shall be no greater than .0005 inch (0.0137mm).

3.6.4 Ionic contamination. The level of ionic contamination on the printed wiring board shall not exceed an equivalent of 5.03 micrograms/square in. (0.78 micrograms/square centimeter) of sodium chloride.

3.7 Electrical requirements.

3.7.1 Electrical test. Each printed wiring board delivered shall be electrically tested for proper continuity using the provided documentation (Gerber or CAD extracted netlist or equivalent). A physical stamp or mark on the printed wiring board indicating such verification is required.

3.7.2 Impedance. Impedance testing is not required.

3.7.3 Maximum rated voltage. The minimum rated voltage of the printed wiring board is 40 volts DC.

3.8 Product identification marking. The product identification marking shall include the complete DLA Land and Maritime PIN, the manufacturer's CAGE code, lot date code, and serial number. The following product identification codes may be part of the etched pattern: DLA Land and Maritime drawing number (DD), the DLA Land and Maritime drawing PIN (PIN), the manufacturer's CAGE code (CAGE), the performance specification status that the printed wiring board is tested to (SPEC). Unless otherwise specified on the qualifying activity approved [DLA Land and Maritime Form 19W](#), when ink marking is used, is shall be of a color contrasting the material it is applied (base material or solder mask as applicable) and at least .06 inch (1.5 mm) in height.

3.8.1 Location. The Part or Identifying Number (PIN) shall be placed on the printed wiring board approximately where shown on coupon ML–1.

3.8.2 Lot date code. The lot date code shall be assigned to identify the week of final copper plating.

3.8.3 Serialization. Each printed wiring board on the panel shall be identified by a unique serial number code. When more than one printed wiring board is included on a panel, then each printed wiring board shall be traceable to its location on the production panel.

3.9 Quality conformance test circuitry (test coupons). The printed wiring board manufacturer shall place quality conformance test coupons on the production master and fabrication panel such that the design, location, and quantity meet the requirements for lot and periodic conformance inspection of the applicable performance specification (i.e. groups A and B inspection of [MIL–PRF–55110](#)).

3.10 Permissible fabricator allowances. The conductor patterns shall be generated from the supplied master pattern database (see [6.3](#)) and represents the finished printed wiring board requirements with zero process allowance added for etch. The printed wiring board manufacturer can adjust the core and prepreg to achieve the desired impedance (if applicable) and final overall board thickness.

3.11 Configuration control. Configuration control shall be in accordance with DLA Land and Maritime drawing [10012](#).

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218–3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>9</b>

#### 4. VERIFICATION

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the drawing where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsible for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this drawing shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the performance specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material, either indicate or actual, nor does it commit the Government to accept defective material.

4.2 Qualification inspection. Qualification inspection for printed wiring boards specified herein is required.

4.3 Test coupon requirements. The number of test coupons present on the inspection panel to be used for the manufacturers test routine portion of qualification inspections shall be in accordance with appendix H of MIL-PRF-55110. The manufacturer may include additional test coupons for use in performing in-process testing.

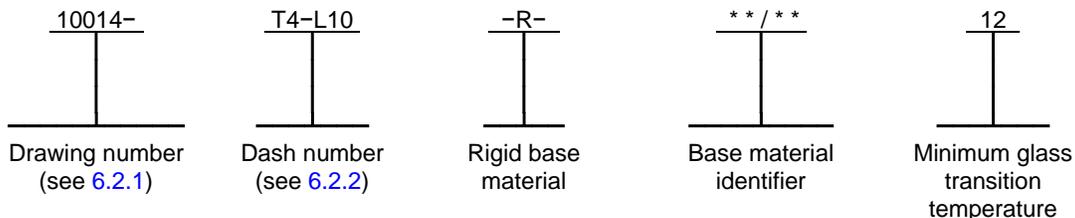
#### 5. PACKAGING

5.1 Packaging. Packaging shall be as specified in DLA Land and Maritime drawing 10012.

#### 6. NOTES

6.1 Intended use. Printed wiring boards conforming to this drawing are intended for use in qualifying to Department of Defense printed board specifications.

6.2 PIN construction. The PIN shall be constructed using the following format:



6.2.1 Drawing number. The drawing number specifies what the general design and classification of the printed board described by the drawing. For this drawing, the design is a multilayered rigid printed wiring board with blind and buried vias. The printed board type shall be type 4 as defined in IPC-2222.

6.2.2 Dash number. The dash number specifies how many conductor layers the printed wiring board shall have. Currently only one dash number representing 10 conductor layers is available.

6.2.3 Base material identifier. The base materials (copper clad laminates and prepregs) shall be as identified on DLA Land and Maritime Form 19W. The codes used to describe the base material shall be as defined in DLA Land and Maritime drawing 10012. When two different base materials are used in the stack-up, place the top layer codes first, then the subsequent layer base material codes next separated by a colon.

6.2.4 Minimum glass transition temperature. The minimum glass transition temperature of the base materials shall be as identified on DLA Land and Maritime Form 19W. The codes used to describe the minimum glass transition temperature of the base material shall be as defined in DLA Land and Maritime drawing 10012.

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>10</b>

6.3 Electronic data for 10014.

6.3.1 IPC-D-350 format (Gerber) files. The electronic data in IPC-D-350 format that are associated with this drawing shall be as identified with tables II and III. All values in the electronic data for conductor widths, pad sizes, and hole size are finished dimensions.

TABLE II. Electronic data.

File name	Description	File type	Field
10014.PDF	This file	PDF	N/A
DL10014.DF1	Layer 1 through 10 unplated drill file (tooling)	Gerber	N/A
DL10014.DF2	Layer 1 through 10 drill file (through holes and vias)	Gerber	N/A
DL10014.DF3	Layer 3 through 8 drill file (through holes for buried vias)	Gerber	N/A
DL10014.DF4	Layer 1 blind via drill file	Gerber	N/A
DL10014.DF5	Layer 10 blind via drill file	Gerber	N/A
DL10014.RF1	Route file	Gerber	N/A
DL10014.SMB	Bottom-side solder mask	Gerber	Dark
DL10014.SMT	Top-side solder mask	Gerber	Dark
DL10014.L01	Layer 1	Gerber	Dark
DL10014.L02	Layer 2	Gerber	Dark
DL10014.L03	Layer 3	Gerber	Dark
DL10014.L04	Layer 4	Gerber	Dark
DL10014.L05	Layer 5	Gerber	Dark
DL10014.L06	Layer 6	Gerber	Dark
DL10014.L07	Layer 7	Gerber	Dark
DL10014.L08	Layer 8	Gerber	Dark
DL10014.L09	Layer 9	Gerber	Dark
DL10014.L10	Layer 10	Gerber	Dark

6.3.1.1 Route file information. The layer identified as "DL10014.RF1" is the route file in Gerber format. The path delineates the outline of the finished printed wiring board.

6.3.1.2 Gerber data format. The Gerber data formats associated with this drawing shall be as identified with table III. The Gerber data is in RS-274X format.

TABLE III Gerber data format.

Attribute	Value
Character set	ASCII
Units	Inch
Format	2.5
Zero suppression	Leading
Mode	Absolute
EOL	* (asterisk)

6.3.2 Other types of data formats. Other data formats will be made available in the future. Please contact the preparing activity regarding the formats and availability.

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE <b>A</b>	CAGE CODE <b>67268</b>	DWG NO. <b>10014</b>
		REV	PAGE <b>11</b>

6.3.3 Modifications. Requests for modifications to the qualification test specimens described on this drawing shall be made prior to, or at the time of, the request for qualification testing. Changes to the design or requirements of this detail drawing shall be listed on the authorization to test form, [DLA Land and Maritime Form 19W](#) and approved by the qualifying activity.

6.4 Comments. Comments or suggestions on improving this drawing should be directed to DLA Land and Maritime, ATTN: code VAC, P.O. Box 3990 Columbus, Ohio 43216 or telephone (614) 692-0526, facsimile (614) 693-1642, or sent by electronic mail to: [5998.Documents@dla.mil](mailto:5998.Documents@dla.mil).

<b>DLA LAND AND MARITIME COLUMBUS, OH 43218-3990</b>	SIZE	CAGE CODE	DWG NO.
	<b>A</b>	<b>67268</b>	<b>10014</b>
		REV	PAGE <b>12</b>