

REVISIONS

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PMIC N/A	PREPARED BY David J. Corbett								DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990											
Original date of drawing 29 February 2012	CHECKED BY Joshua Civiello								TITLE PRINTED WIRING BOARD, RIGID, MULTILAYERED, GENERAL DRAWING											
	APPROVED BY Thomas M. Hess																			
	SIZE A	CAGE CODE 16236								DWG. NO.				10012						
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1. SCOPE

1.1 Scope. This drawing describes the requirements for a family of rigid multilayered printed wiring boards that contain plated through holes. Some design may also have blind vias, buried vias, or a combination of both. Printed wiring boards conforming to this drawing can be used for qualification to Department of Defense performance specifications.

1.2 Part or Identifying Number (PIN). The complete PIN for the printed wiring board shall be in accordance with the detail drawing. A portion of the characters used in the PIN are detailed in section 6.3.

2. APPLICABLE DOCUMENTS

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.

SPECIFICATIONS

DEPARTMENT OF DEFENSE

- MIL-D-3464 – Desiccants, Activated, Bagged, Packaging Use And Static Dehumidification.
- MIL-DTL-45204 – Gold Plating, Electrodeposited.
- MIL-PRF-22191 – Barrier Materials, Transparent, Flexible, Heat-Sealable.
- MIL-PRF-55110 – Printed Wiring Board, Rigid, General Specification for.
- MIL-PRF-81705 – Barrier Materials, Flexible, Electrostatic Discharge Protective, Heat-Sealable.

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.

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

(Copies of Form 19W is available online at http://www.landandmaritime.dla.mil/Offices/Sourcing_and_Qualification or can be obtained from DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990.)

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.

ASTM INTERNATIONAL (ASTM)

- ASTM B488 – Standard Specification for Electrodeposited Coatings of Gold for Engineering Uses.
- ASTM B545 – Standard Specification for Electrodeposited Coatings of Tin.
- ASTM B579 – Standard Specification for Electrodeposited Coatings of Tin-Lead Alloy.
- ASTM D1867 – Standard Specification for Copper-Clad Thermosetting Laminates for Printed Wiring.

(Copies of these documents are available online at <http://www.astm.org> or should be addressed to ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

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SOCIETY OF AUTOMOTIVE ENGINEERS, INC (SAE)

- SAE-AMS-QQ-N-290 – Nickel Plating (Electrodeposited).
- SAE-AMS-P-81728 – Plating, Tin-Lead (Electrodeposited).
- SAE-AMS 2418 – Copper, Plating.
- SAE-AMS 2403 – Nickel Plating (Electrodeposited).
- SAE-AMS 2422 – Plating, Gold.

(Copies of these documents are available online at <http://www.sae.org> or should be addressed to Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

IPC – ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

- IPC-2220 – Design Standards Series.
- IPC-2221 – Printed Board Design, Generic Standard on.
- IPC-4101 – Specification for Base Materials for Rigid and Multilayer Printed Boards.
- IPC-4103 – Specification for Base Materials for High Speed/High Frequency Applications.
- IPC-4552 – Electroless Nickel/Immersion Gold Plating for Electronic Interconnections.
- IPC-4553 – Specification for Immersion Silver Plating for Printed Circuit Boards.
- IPC-4562 – Metal Foil for Printed Board Applications.
- IPC-4563 – Resin Coated Copper Foil for Printed Boards Guideline.
- IPC-4781 – Qualification and Performance Specification of Permanent, Semi-Permanent and Temporary Legend and/or Marking Inks.
- 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-SM-840 – Qualification and Performance Specification of Permanent Solder Mask.
- IPC-9252 – Guidelines and Requirements for Electrical Testing of Unpopulated Printed Boards.
- J-STD-003 – Solderability Tests for Printed Boards.
- J-STD-006 – Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications.
- 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 DLA Land and Maritime printed board requirements detail drawing. The individual requirements for the qualification printed board shall be in accordance with the applicable printed board requirements detail drawing.

3.2 Definitions and terms. The definitions for all terms used herein shall be as specified in [IPC-T-50](#) and those contained herein.

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3.3 Configuration control. The printed wiring board manufacturer shall use only configuration controlled engineering detail drawings, photo tools, or electronic design databases. When applicable, the printed wiring board manufacturer shall be responsible for insuring that the working film used to fabricate the printed wiring board matches the electronic design database provided by DLA Land and Maritime.

3.4 Material. The material for each qualification printed board shall be as specified on the applicable printed board requirements detail drawing, or on [DLA Land and Maritime Form 19W](#). Substitute material shall meet the performance requirements of this drawing and the printed board requirements detail drawing.

3.4.1 Reference materials, platings, and processes. The manufacturers of printed wiring boards supplied to this drawing are allowed to use alternate recognized industry standard materials, coatings, platings, and processes from those specified in this drawing. Alternate materials, platings, and processes used must be coordinated with the qualifying activity as part of the qualification process. Use of alternates to those referenced herein or on the applicable detail drawing by the printed board manufacturer shall not result in inferior short or long term performance or reliability of supplied printed boards as compared with printed boards manufactured using the referenced materials, coatings, platings, or processes. Short or long term failures or reliability problems due to use of these alternates shall be the responsibility of the printed board manufacturer.

3.4.2 Base materials. Metal clad laminates, unclad laminates, and bonding materials (prepreg) shall be selected by the printed board manufacturer. The base materials and bonding materials used shall be identified on [DLA Land and Maritime Form 19W](#).

3.4.2.1 Base material PIN designator. The base material designator shall be constructed using the format specified herein. The specifics of the base material used shall be listed in the PIN (see [1.2](#) and [6.3](#)).

3.4.2.2 Certificates of conformance for base materials. The printed wiring board fabricator shall include the base material manufacturer's certificates of conformance and lot test results with the deliverable printed wiring boards.

3.4.2.3 Manufacturing lots. All printed boards shall be manufactured using homogeneous manufacturing lots of base materials and bonding materials. If manufacturing lots of metal clad laminate or prepreg materials change within a manufacturing lot of printed boards, the lot of printed wiring boards shall be split and identified with a different lot number in order to maintain traceability of the base materials.

3.4.3 Metal foils. If used, copper foil shall be in accordance with [IPC-4562](#). If used, resin coated copper foil shall be in accordance with [IPC-4563](#). For either material, the foil type, foil grade, foil thickness, bond enhancement treatment, and foil profile shall be selected by the printed board manufacturer in order to meet the performance characteristic being qualified.

3.4.4 Conductor finish. The conductor finish shall be as specified on the applicable printed board requirements detail drawing and herein.

3.4.4.1 Electroless nickel immersion gold. Electroless nickel immersion gold coating shall be in accordance with [IPC-4552](#), or equivalent. Printed boards using electroless nickel immersion gold coating as a conductor finish shall include a suffix "EnG" in the PIN.

3.4.4.2 Gold (electrodeposited). Electrodeposited gold plating shall be in accordance with [ASTM B488](#), [MIL-DTL-45204](#), [SAE-AMS 2422](#), or equivalent. The purity and thickness shall be as specified on the applicable printed board requirements detail drawing. Printed boards using electrodeposited gold plating as a conductor finish shall include a suffix "SAu" in the PIN.

3.4.4.3 Immersion silver. Immersion silver deposits shall be in accordance with [IPC-4553](#) or equivalent. Printed boards using immersion silver deposits as a conductor finish shall include a suffix "IAg" in the PIN.

3.4.4.4 Tin-lead (electrodeposited). Tin-lead plating conductor finish shall be in accordance with [ASTM B579](#), [SAE-AMS-P-81728](#), or equivalent. The tin-lead plating composition shall be as specified on the applicable printed board requirements detail drawing. The thickness of unfused tin-lead plating shall be as specified in [table I](#). Fused tin-lead plating does not require a thickness measurement. Printed boards using fused tin-lead as a conductor finish shall include a suffix "FPb" in the PIN. Printed boards using unfused tin-lead as a conductor finish shall include a suffix "UPb" in the PIN.

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3.4.4.5 Solder coating.

3.4.4.5.1 Hot air solder level. The solder used for solder coating shall be in accordance with [J-STD-006](#), or equivalent. The ratio of tin-lead composition of the solder shall be as specified on the applicable printed board requirements detail drawing. Printed boards using solder coating as a conductor finish shall include a suffix "CPb" in the PIN.

3.4.4.5.2 Fused electrodeposited tin-lead. Fused electrodeposited tin-lead plating before fusing shall be in compliance with Printed boards using fused solder coating as a conductor finish shall include a suffix "FPb" in the PIN.

3.4.4.6 Nickel (electrodeposited). Electrodeposited nickel plating shall be in accordance with [SAE-AMS-QQ-N-290](#), class II, [SAE-AMS 2403](#), or equivalent. Printed boards using electrodeposited nickel plating as a conductor finish shall include a suffix "BNi" in the PIN.

3.4.4.7 Organic solderability protective (OSP) coatings. OSP coatings shall be in accordance with their vendor. Two types of OPS coatings shall be identified. Printed boards using high-temperature OSP coatings as a conductor finish shall include a suffix "HOS" in the PIN. Printed boards using low-temperature OSP coatings as a conductor finish shall include a suffix "LOS" in the PIN.

TABLE I. Conductor surface finish.

PIN designator	Description	Specification	Thickness ^{1/}	e Code ^{2/}
CPb	Tin-Lead solder coating	J-STD-006	Coverage	b0
FPb	Fused electrodeposited tin-lead	ASTM B579	Coverage	b3
UPb	Unfused electrodeposited tin-lead	ASTM B579 or SAE-AMS-P-81728	.003 (.008)	b3
CAu	Electroplated gold for edge board connectors	SAE-AMS 2422 or MIL-DTL-45204	Coverage	b4
SAu	Electroplated gold for areas to be soldered	ASTM B488 , MIL-DTL-45204 , or SAE-AMS 2422	Coverage	b4
CNi	Nickel for edge board connectors	SAE-AMS 2403	Coverage	N/A
BNi	Nickel as a barrier to copper-tin diffusion	SAE-AMS 2403	Coverage	N/A
LOS	Low temperature Organic Solderability Preservative	N/A	Coverage	b6
HOS	High temperature OSP	N/A	Coverage	b6
EnG	Electroless nickel / immersion gold	IPC-4552	Coverage	b4
IAg	Immersion silver	IPC-4553	Coverage	b2
Dig	Direct immersion gold	N/A	Solderable	b4

^{1/} Dimensions are in inches. Millimeters, in parenthesis, are given for general information only.

^{2/} These markings and labeling codes represent the codes for surface finish categories established in [J-STD-609](#).

3.4.5 Copper plating. Holes with interfacial connections shall be copper plated in accordance with [SAE-AMS 2418](#) or equivalent. Thickness requirements shall be in accordance with the detail drawing.

3.4.6 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. If tin is present, the tin content used as a conductor surface finished or in solder shall not exceed 97 percent by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see [6.4](#)).

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3.4.7 Solder mask. Permanent solder mask shall be in accordance with [IPC-SM-840](#), class H, or equivalent. Printed boards using a permanent solder mask as a conductor covering shall include a suffix from table II in the PIN.

TABLE II. Solder masks.

PIN designator	Description
DF	Dry film solder mask
LP	Liquid photoimageable solder mask
TM	Thermal mask solder mask

3.5 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in the applicable printed board requirements detail drawing and herein.

3.6 Performance characteristics and requirements. Unless otherwise specified on the applicable printed board detail drawing, the performance requirements and unique characteristic for the printed boards (requirements for external visual and dimensional acceptance, internal visual and dimensional criteria, chemical characteristics, physical characteristics, electrical characteristics, and environmental characteristics) shall be in accordance with the revision of the performance specification specified on the DLA Land and Maritime-VQ approved [DLA Land and Maritime Form 19W](#).

3.7 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.8 Marking. Marking shall be in accordance with the applicable printed board requirements detail drawing. The following details shall apply:

- a. The finished printed wiring board shall be marked in accordance with [J-STD-609](#) to identify the final finish applied to the conductor surfaces.
- b. The printed wiring board packaging shall be marked in accordance with [J-STD-609](#).
- c. Any additional RoHS and Pb-Free markings shall be contained in the electronic data.

3.8.1 Serialization for multi-up panels. Each printed board shall be identified by a unique serial number and lot date code. When more than one printed board is fabricated on a single panel, then each printed board shall be traceable to its location on the panel.

3.9 Quality assurance requirements. Printed boards furnished under this drawing shall have been subjected to, and passed all the inspections and tests detailed herein including conformance inspections.

3.10 Certificate of compliance. A certificate of compliance in accordance with the requirements of the applicable performance specification shall be supplied with the qualification samples.

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4. VERIFICATION

4.1 Sampling and inspection. Unless otherwise specified, sampling and inspection procedures shall be performed in accordance with the revision of the performance specification specified on the DLA Land and Maritime-VQ approved [DLA Land and Maritime Form 19W](#).

4.2 Conformance inspection.

4.2.1 Inspection of product for delivery (MTR). All qualification test samples in the lot shall be subjected to inspection of product for delivery. The inspection of product for delivery for qualification printed boards complying with this drawing shall consist of the examinations and tests of the in-process table and MTR column of the qualification inspection table of appendix A of [MIL-PRF-55110](#).

4.2.2 Qualification inspection (CTR). A DLA Land and Maritime-VQ certified suitable laboratory shall perform the inspections specified in the CTR column of the qualification inspection table of appendix E of [MIL-PRF-55110](#).

4.3. Quality conformance test circuitry (test coupon) requirements.

4.3.1 Design and placement. The printed wiring board manufacturer shall add quality conformance test coupons to the production panel in accordance with this drawing and when applicable, the detail drawing. The printed wiring board manufacturer shall design the test coupons to represent all of the conditions of the finished printed wiring board they represent. The test coupon strips shall be placed within .5 inch (12.7 mm) of the printed wiring board(s). All test coupons shall be identified and traceable to each production panel and its location on the production panel.

4.3.2 Quantity. Unless otherwise specified on the detail drawing, a minimum of three test coupon strips shall be included on each production panel. Two of the test coupon strips are for MTR testing and the number of test coupons on the test coupon strips shall satisfy the minimum number needed to perform group A and group B in accordance with appendix A of [MIL-PRF-55110](#). The extra test coupon strip shall not be tested. The test coupon strips shall be added by the printed wiring board manufacturer if they are not included in the DLA Land and Maritime supplied electronic database. The printed wiring board manufacturer may apply additional test coupons for their own in-process testing.

4.3.3 Test coupon deliverables. After the printed wiring board manufacturer has completed MTR testing of [MIL-PRF-55110](#), at least one untested test coupon strip from each production panel together with a Test Coupon Test Report (see Figure 2) shall be delivered to the qualifying activity prior to the commencement of CTR testing at a suitable laboratory. The test coupon strip delivered to the qualifying activity shall contain each [IPC-2221](#) test coupon used for groups A and B testing to [MIL-PRF-55110](#). When alternative test coupon testing is specified on [DLA Land and Maritime Form 19W](#), a qualifying activity approved third party test laboratory shall perform coupon testing as specified.

4.4 Qualifying activity on-site audit. Manufacturers applying for listing on QPL-55110 will be required to undergo periodic on-site audits of their facilities by the qualifying activity. The manufacturer shall demonstrate to the qualifying activity that controls have been implemented to assure compliance to the requirements of [MIL-PRF-55110](#). The qualifying activity reserves the right to perform on-site audits of any other facilities, such as contracted services, that the manufacturer uses for producing printed wiring boards to this drawing

5. PACKAGING

5.1 Packaging requirements. Prior to shipping, the printed wiring boards, test coupon strips, and separated untested test coupons shall be individually packaged with desiccant and humidity indicator in heat sealed plastic bags. Tested test coupons can be packaged as a group for each panel. The heat seal of the plastic bag must be intact and shall not exhibit melt through areas upon receipt of the shipment. The packaging shall meet the requirements of [MIL-PRF-22191](#), type III or [MIL-PRF-81705](#), type III. Included in the sealed bags with the samples shall be a desiccant in accordance with [MIL-D-3464](#), type II. Test coupons from the panel (tested or untested panel coupons) if in the same sealed bag, shall be kept separate from the untested printed wiring board. When more than one printed wiring board sample is contained in a package, adequate packaging material shall be placed between the samples to prevent damage during shipment. The label on the package shall include the following information:

- a. The supplier's name and address, including building and mail station.
- b. The DLA Land and Maritime drawing PIN and revision level of the printed wiring boards in the package.
- c. The serial numbers of the printed wiring boards in the package.

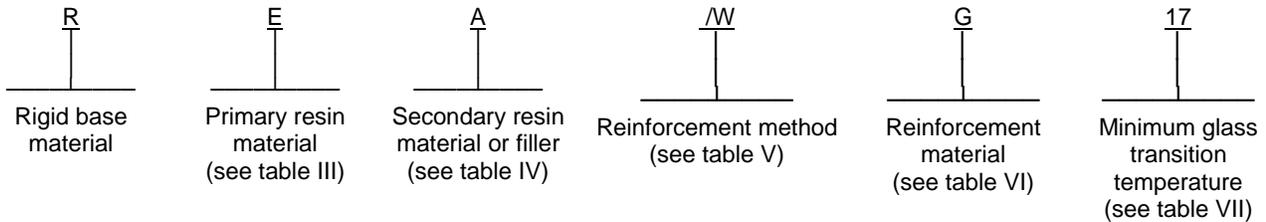
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6. NOTES

6.1 Intended use. Printed wiring boards conforming to this drawing are intended to be evaluated to the qualification requirements of [MIL-PRF-55110](#).

6.2 Submission of certificate of compliance. The certificate of compliance submitted to DLA Land and Maritime-VQE, prior to listing as an approved source of supply on QPL-55110, shall state that the manufacturer's product was inspected to the requirements of the applicable DLA Land and Maritime printed board requirements detail drawings and stated herein.

6.3 Base material PIN designator. The base material PIN designator shall consist of a dielectric material identifier (see tables III and IV), a reinforcement method (see table V), a reinforcement material (see table VI), and a minimum glass transition temperature (see table VII). An example of a base material identifier code is listed below.



6.3.1 Primary resin material. The type of resin used as the primary resin material shall be as specified in table III.

TABLE III. Primary resin material.

Designator	Dielectric material
B	Bismaleimide/triazine
C	Cyanate ester
E	Epoxy
H	Hydrocarbon
L	Liquid crystal polymer (LCP)
P	Polyimide
T	Polytetrafluorethylene
Y	Polyphenylene ether

6.3.2 Filler or resin modifying material. The type of filling material or resin modifying material shall be as specified in table IV.

TABLE IV. Secondary resin material or filler.

Designator	Filler or resin modifying material
A	Not filled or not modified
B	Bismaleide/triazine
C	Cyanate ester
F	Not sure or unknown
M	Multifunction epoxy
N	Polyfunctional epoxy
P	Polyethylene oxide
T	Inorganic filler (ceramic)
W	With or without Inorganic fillers

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6.3.3 Reinforcement method. The method of reinforcing the base material shall be as specified in table V.

TABLE 5. Reinforcement method.

Designator	Reinforcement method
N	Non-reinforced (film)
C	Combination of non-woven and woven reinforcement
R	Non-woven reinforcement (random)
P	Non-woven reinforcement (paper)
U	Non-woven reinforcement (unidirectional and cross plied)
W	Woven reinforcement

6.3.4 Reinforcement material. The type of reinforcement material shall be as specified in table VI.

TABLE VI. Reinforcement material.

Designator	Reinforcement material
A	Aramid
C	Cellulose
F	Film
G	E-glass
Q	Quartz
S	S-glass
P	Polyester

6.3.5 Minimum glass transition temperature. The minimum glass transition temperature shall be specified using the two digit codes listed in table VII.

TABLE VII. Minimum glass transition temperature.

Designator	Resin system glass minimum transition temperature
01	Minimum glass transition temperature not specified
11	110 degrees Celsius minimum
14	135 degrees Celsius minimum
15	150 degrees Celsius minimum
17	170 degrees Celsius minimum
18	180 degrees Celsius minimum
20	200 degrees Celsius minimum
23	230 degrees Celsius minimum
25	250 degrees Celsius minimum

6.4 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not always prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM B545 (Standard Specification for Electrodeposited Coatings of Tin).

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