NOTE: MIL-STD-2198 has been redesignated as a Design Criteria Standard. The cover page has been changed for Administrative reasons. There are no other changes to this Document.

INCH-POUND

MIL-STD-2198
26 FEBRUARY 1990

DEPARTMENT OF DEFENSE
DESIGN CRITERIA

DESIGN REQUIREMENTS FOR METAL ELECTRICAL BACKPLANE ASSEMBLIES

AMSC N/A FSC 5998

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FOREWORD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command (SEA 55Z3), Department of the Navy, Washington, DC 20362-5101, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Scope. The purpose of this document is to establish general design requirements for metal electrical backplane assemblies of aluminum sheet or sheets on which separately manufactured component parts, qualified in accordance with MIL-C-28754, have been added.

1.1.1 Applicability. The metal backplanes of these assemblies are used to provide physical support and location for electronic contacts. The two layer metal electrical backplane assembly may also be used to distribute power or ground throughout the backplane. The electronic module blade contacts engage the tuning fork receptacles in the backplane and are interconnected to other electronic modules via the solderless wrap wire located on the side opposite the contacts on the backplane.

1.2 Classification. Metal electrical backplane assemblies shall be of the following types:

(a) Type 1: one layer.
(b) Type 2: two layer.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

L-P-509	Plastic Sheet, Rod and Tube, Laminated, Thermosetting.
QQ-A-250/8	Aluminum Alloy 5052, Plate and Sheet.
QQ-A-250/11	Aluminum Alloy 6061, Plate and Sheet.

MILITARY

MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-P-13949/12	Plastic Sheet, Laminated, Materials (For Printed Wiring Boards), GF Base Material, Glass Fabric, Woven, Majority Difunctional Epoxy Resin Preimpregnated (B-Stage).
MIL-A-24741	Assemblies, Metal Electrical Backplane, One and Two Layer, General Specification for.
MIL-C-28754	Connectors, Electrical, Modular, and Component Parts, General Specification for.
MIL-C-28754/39	Connectors, Electrical, Modular, Connector, Type III, Keying Pegs.
MIL-I-43553	Ink, Marking, Epoxy Base.

STANDARDS

MILITARY

DOD-STD-100	Engineering Drawing Practices.
MIL-STD-1130	Connections, Electrical, Solderless Wrapped.

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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 the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y14.5	Dimensioning and Tolerancing.
ANSI Y32.16	Standard Reference Designations for Electrical and Electronics Parts and Equipments.

(Application for copies should be addressed to the American National Standards Institute, Inc, 1430 Broadway, New York, New York 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

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

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of the applicable MIL-C-28754 specification sheet and this document shall take precedence in that order. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Metal electrical backplane assembly. The backplane assembly is an interconnection wiring panel into which functional circuit modules or cable connectors, built in accordance with MIL-C-28754, are plugged and secured. The assembly has tuning fork connector receptacles on one side and contact post ends (solderless wrapped connections) on the other side. The component parts are described in MIL-C-28754. The solderless wrapped wires provide paths for electrical interconnections external to the backplane. The two layer metal electrical backplane assemblies may also distribute voltages or grounds in each layer.

3.2 Solderless wrapped electrical connection. This connection consists of a helix of continuous, solid, uninsulated wire tightly wrapped around the wrappost of a solderless wrapped contact to produce a mechanically, environmentally, and electrically stable connection. The number of turns required will depend on the gage of wire used. The requirements of MIL-STD-1130 apply.

3.3 Ground plane. A conductive layer (usually a continuous sheet of metal with suitable ground plane clearances) used as a common reference point for circuit returns, shielding or heat sinking.

3.4 Voltage plane (V_{CC}). A conductor or portion of a conductor layer on or in a board which is maintained at other than ground potential. It can also be used as a common voltage source for heat sinking or for shielding.

3.5 Backplane. An interconnection device having terminals (such as solderless wrapped connections) on one side and having connector receptacles on the other side, used to provide point-to-point electrical connections.

3.6 Keying pegs. In accordance with MIL-C-28754/39, these inserts are required in each connector assembly allowing specific module connectors to be mated.

4. GENERAL REQUIREMENTS

4.1 Design requirements. The design requirements of this standard are for the assembly of connector tuning fork component parts into an aluminum backplane. The tuning fork component parts of the connector have been specifically designed to accommodate the blade component part of the connector specified in MIL-C-28754. Figure 1 is a pictorial illustration of this assembly and incorporates the required dimensions of the assembly. Interpret in accordance with ANSI-Y14.5.

4.1.1 Metal electrical backplane assembly design requirements. The design requirements of the metal electrical backplane assembly shall be in accordance with MIL-A-24741 and this standard.

4.2 Metal electrical backplane assembly drawing. The metal electrical backplane assembly drawing shall include separately manufactured connector component parts. The metal electrical backplane assembly drawing shall be in accordance with DOD-STD-100, and should include, as a minimum, the following:

(a) Location and identification of all connector component parts.

(b) Applicable ordering data.

(c) Electrical circuitry test requirements.

(d) Cleanliness requirements.

(e) Marking requirements.

(f) Number of layers.

(g) Mounting plate size and shape.

(h) Mounting and tooling hole location.

4.2.1 Conflict. In the event of any conflict between the metal electrical backplane assembly drawing, hereafter called backplane assembly drawing, and the requirements of this standard, a copy of the backplane assembly drawing shall be submitted to the government program manager, prior to release to manufacturing or procurement, with information justifying the deviation(s) from this standard, and with a request for approval of the deviation(s). If approvals for deviations from this standard have been given, the deviations shall be indicated on the backplane assembly drawing.

5. DETAILED REQUIREMENTS

5.1 Purpose. This section contains information necessary for the construction of the metal electrical backplane assemblies.

5.2 Backplane assembly construction. The metal electrical backplane assembly, consisting of a metal backplane per MIL-A-24741 and components per MIL-C-28754, shall be constructed by pressing the components into the metal backplane. Other components from MIL-C-28754, such as keying pegs, shall be added as required by the backplane assembly drawing. As required by the backplane assembly drawing, keying pegs in accordance with MIL-C-28754 shall be inserted into the keying bushing in the proper orientation and made a permanent part of the keying bushing by suitable processes which may include bonding or heat staking. The components for type II backplanes shall be designed such that the tuning fork contacts engage only the layers intended.

5.2.1 Material. The type of material shall be as specified herein. Acceptance or approval of any constituent material shall not be construed as acceptance of the finished product.

5.2.1.1 Components. The components shall be qualified in accordance with MIL-C-28754 and be listed on its Qualified Products List (QPL) or approved for listing at time of award.

5.2.1.2 Backplane, type 1. The material for the type 1 backplane shall be aluminum alloy sheet material in accordance with QQ-A-250/8, or QQ-A-250/11.

5.2.1.3 Backplane, type 2. The material for the type 2 backplane shall be as follows:

(a) The aluminum sheet shall be aluminum alloy 6061, temper T6 in accordance with QQ-A-250/11 or ASTM B209.

(b) The insulation layer, insulation sheet, and insulated areas (when specified on the drawing) shall be fabricated from plastic sheet conforming to L-P-509, type IV, grade G-10 (see figure 2). The layer thickness shall be 0.020 plus or minus 0.004 inch (0.508 plus or minus 0.102 mm).

(c) The adhesive material shall be preimpregnated glass cloth conforming to MIL-P-13949/12, type P-GFN-1080-R-28-XX-XX. Jell time and resin content are vendor options. The thickness shall be as required to meet the 0.180 plus 0.010, minus 0.005 inch (4.57 plus 0.25, minus 0.12 mm) overall thickness (see figure 2).

5.2.1.4 Material finish. The type of material finish shall be as specified herein. Acceptance or approval or any substitute finish shall not be construed as an acceptance of the finished product.

5.2.1.4.1 Backplane, type 1. The finish for the type 1 backplane shall be anodize in accordance with MIL-A-8625, type II, black seal or chemically treated in accordance with MIL-C-5541, class 3.

5.2.1.4.2 Backplane, type 2. The finish for the type 2 backplane shall be as follows:

(a) The aluminum ground plane shall be in accordance with MIL-C-5541, class 1A or 3, or MIL-A-8625, type II, black seal, after final machining. Depending on electrical requirements, the outside surface of the ground plane may be insulated with plastic sheet conforming to L-P-509, type IV, grade G-10. The overall thickness shall be in accordance with figure 2.

(b) The VCC (power) plane shall be anodized aluminum in accordance with MIL-A-8625, type II, class 1, non-dyed dichromate sealing.

(c) The aluminum sheet edge coating and tooling hole filler shall be a combination of insulator and prepreg material. The power plane edge shall have a minimum thickness of 0.008 inch (0.20 mm) (see figure 2).

5.2.2 Hole pattern. The holes for the location of the components shall be on a 0.100 (2.54 mm) grid system. The number of rows and columns per hole pattern shall be in accordance with the assembly drawing.

5.2.2.1 Hole pattern accuracy. The accuracy of the hole pattern in the backplane shall be in accordance with figure 3.

5.3 Assembly. The metal electrical backplane assembly shall meet the following requirements.

5.3.1 Components. When assembled into the metal electrical backplane, the component height above the backplane shall be in accordance with figure 1. The components shall be capable of individually being removed and replaced without disturbing the other components during the process.

5.3.1.1 Wrappost tail tip position. All wrappost tail tip positions shall be within a positional tolerance of 0.020 inches (0.51 mm) diameter to specified datums on the backplane assembly drawing.

5.3.1.2 Replacement. Insulator bushings and contacts, when once removed, shall not be reused in another backplane, but shall be discarded. New insulator bushings and contacts shall be purchased from a manufacturer as a set.

5.3.2 Electrical requirements. The assembly shall be designed to meet the following electrical requirements.

5.3.2.1 Insulation resistance. The insulation resistance for type one backplanes shall be 100,000 megohms before humidity testing, and for type two backplanes 100 megohms before humidity testing.

5.3.2.2 Dielectric withstanding voltage. A voltage of 500 Volts direct current (Vdc) shall be applied between the contacts and the backplane without evidence of arcing, breakdown or damage to the assembly.

5.3.2.3 Backplane to contact resistance (types 1 and 2). As a measure of the contact installation in the backplane, at 3 Amps (A) current, the voltage drop between a ground contact and the ground plane shall not exceed 5.0 millivolts (mV) and between a power contact and the power plane shall not exceed 12.0 mV.

5.3.2.4 Capacitance between layers (type 2). As a measure of the insulation between layers, the capacitance shall be less than 30 picofarads per square inch of power plane.

5.3.3 Mechanical requirements. The assembly shall be designed to meet the following mechanical requirements.

5.3.3.1 Bow and twist. The bow and twist of the assembly shall not be more than 1.5 percent.

5.3.3.2 Contact and bushing retention. The contact or bushing assembled in the backplane shall not evidence permanent displacement from an axial load of 7.5 pounds (3.3 newton).

5.3.3.3 Contact torque. The wrappost of the contact shall withstand a torque of 3.0 inch-ounces (0.02 newton-meter) without moving or deforming either the contact or bushing.

5.3.3.4 Keying peg retention. The keying peg shall withstand a removal force of 5 pounds (22 newton).

5.3.3.5 Engaging and separating forces. The assembled backplane shall have connector engaging and separating forces within specified limits.

5.3.3.5.1 Standard contacts. The force to engage a tuning fork contact shall be 6 ounces (1.66 newton) maximum and the force required to separate the blade from the tuning fork shall be 2 ounces (0.56 newton) minimum. Due to the large force which could be developed with this standard contact in an assembly, it is recommended that no connector assembly of standard tuning fork contacts contain more than 150 contacts.

5.3.3.5.2 Low Insertion Force (LIF) contacts. The average force to engage shall be 2.25 ounces (0.63 newton) maximum with random readings at 4.0 ounces (1.12 newton) maximum. The force to separate shall be 4.0 ounces (1.12 newton) maximum.

5.3.3.6 LIF normal force. The average force shall be greater than 3.5 ounces (0.98 newtons) with random readings of no less than 3.0 ounces (0.8 newtons).

5.3.4 Environmental requirements. The assembly shall be designed to meet the following environmental requirements.

5.3.4.1 Durability. Connector assemblies in the backplane shall be designed to withstand 500 cycles of engaging and separating.

5.3.4.2 Salt spray. The backplane shall withstand exposure to 48 hours of salt spray without corrosion.

5.3.4.3 Shock. The assembly shall be designed to withstand sawtooth shock pulses of 100 g's lasting for 6 milliseconds.

5.3.4.4 Humidity. The backplane assembly shall withstand corrosion and shall operate as designed under humidity conditions of 240 hours cycling between 71°C at 95 percent humidity and 28°C at 85 percent humidity.

5.3.4.5 Temperature cycling. The backplane assembly shall withstand 100 temperature cycles between minus 55°C and plus 125°C without damage which could be detrimental to the function of the assembly.

5.3.4.6 Vibration. The backplane assembly, along with mating connectors and frames, shall have no electrical discontinuities greater than 100 nanoseconds under vibration at a sinusoidal frequency of 10 to 2000 cycles with a 15 g input, and a random input frequency of 0.2 g^2 per hertz.

5.4 Marking. Metal electrical backplanes shall be marked with referenced designations in accordance with ANSI Y32.16 and as specified on the assembly drawing. All assemblies shall be identified for traceability to the production lot.

5.4.1 Marking ink. Marking ink shall be an epoxy based ink conforming to MIL-I-43553.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The metal electrical backplane assemblies covered by this standard are intended for use in ground support, airborne and shipboard electronic equipment.

6.2 Issue of DoDISS. When this standard is used in acquisition, the issue of the DoDISS to be applicable to this solicitation must be cited in this solicitation (see 2.1.1 and 2.2).

6.3 Data requirements: The following Data Item Description (DID) must be listed as applicable, on the Contract Data Requirements List (DD Form 1423) when this standard is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.2.1	DI-DRPR-80651	Engineering Drawings	Callout deviations from MIL-STD-2198

The above DID was cleared as of the date of this standard. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.3.1 Data for program manager. If this standard is specified, it is recommended that it be followed without deviation. However, if deviations are required to meet specific system constraints, it is recommended that the program manager be aware of such deviations by following 4.2, 4.2.1 and 6.3.

6.4 Subject term (keyword) listing.

Double layer metal boards
Solderless wrapped interconnections
Standard Hardware Acquisition and Reliability Program (SHARP)
Tuning fork contacts

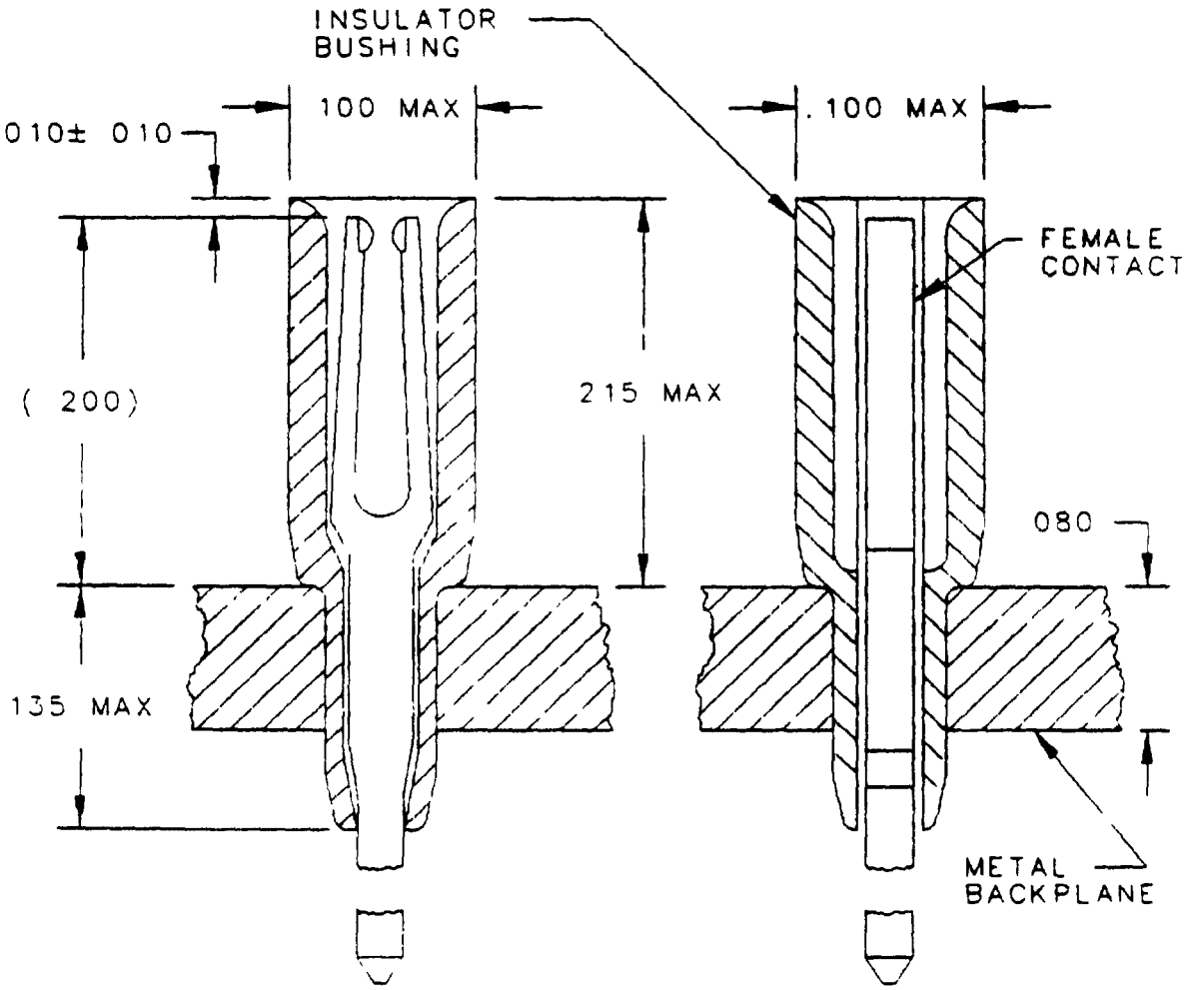
Custodians:
Army - ER
Navy - SH
Air Force - 85

Reviewing activity:
DLA - ES

Preparing activity:
Navy - SH

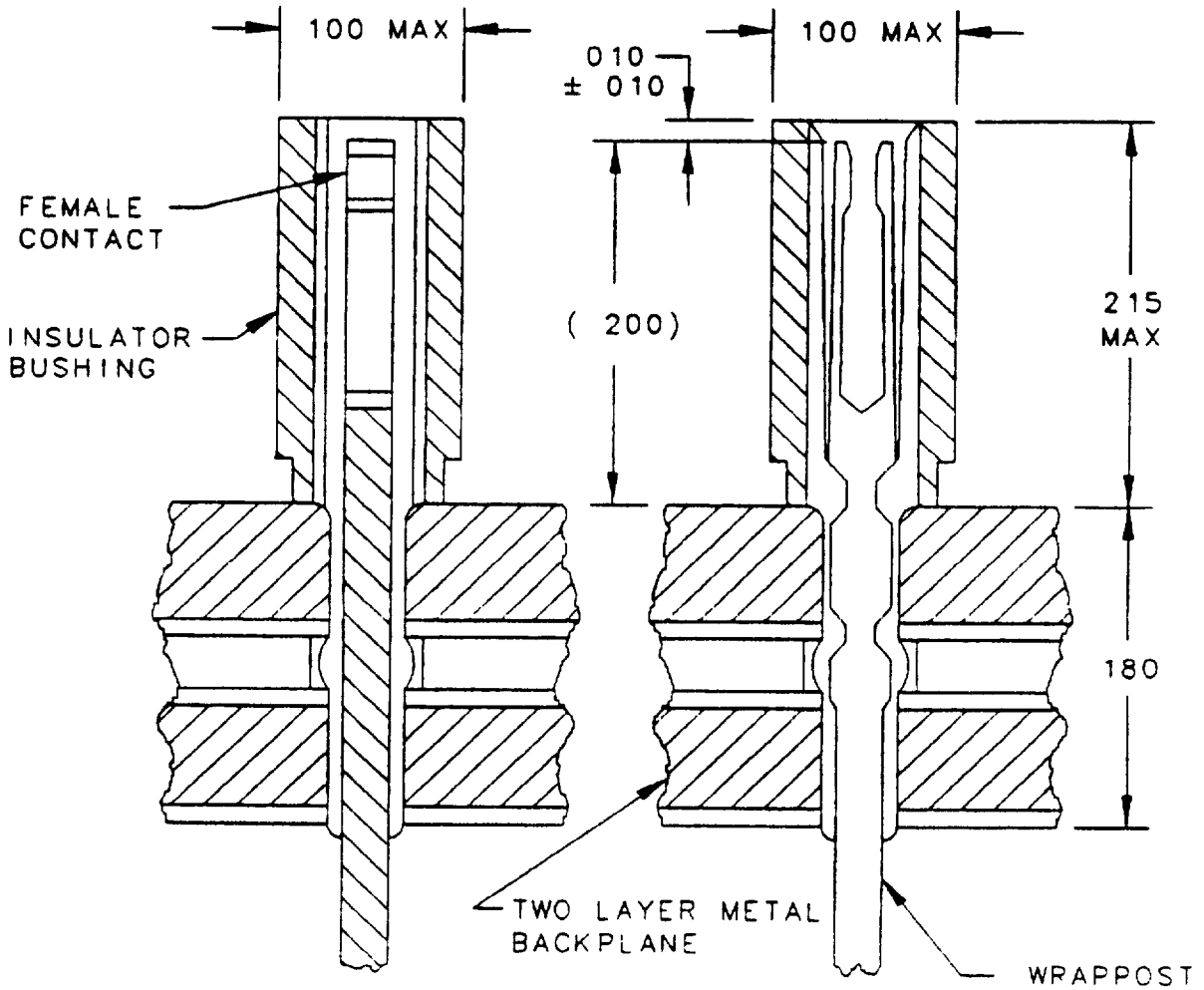
Agent: NW

(Project 5998-0007)



TYPE 1

FIGURE 1. Cross sectional view of a metal backplane assembly.



TYPE 2

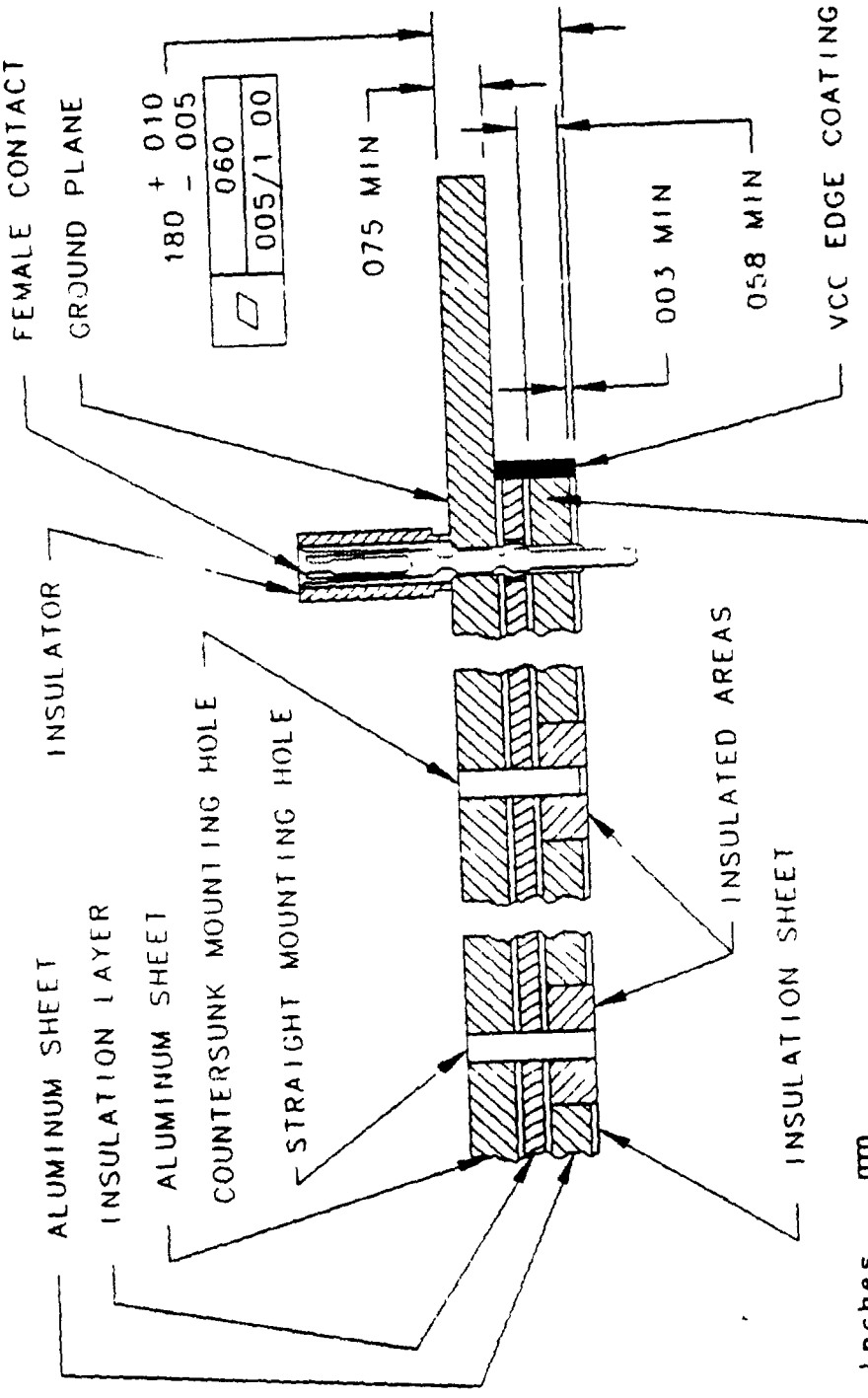
FIGURE 1. Cross sectional view of a metal backplane assembly - Continued.

Inches	mm
0.010	0.254
0.015	0.381
0.025	0.635
0.080	2.032
0.099	2.515
0.100	2.540
0.135	3.429
0.180	4.572
0.200	5.080
0.215	5.461

NOTES:

1. See MIL-C-28754/34 to /38.
2. Dimensions are in inches.
3. Metric equivalents are for general information only.

FIGURE 1. Cross sectional view of a metal backplane assembly - Continued.



Inches	mm
0 003	0 076
0 005	0 127
0 010	0 254
0 058	1 473
0 060	1 524
0 075	1 905
0 180	4 572
1 00	25 40

NOTES

1 Dimensions are in inches.
2 Metric equivalents are for general information only

FIGURE 2 Two layer backplane showing mounting holes

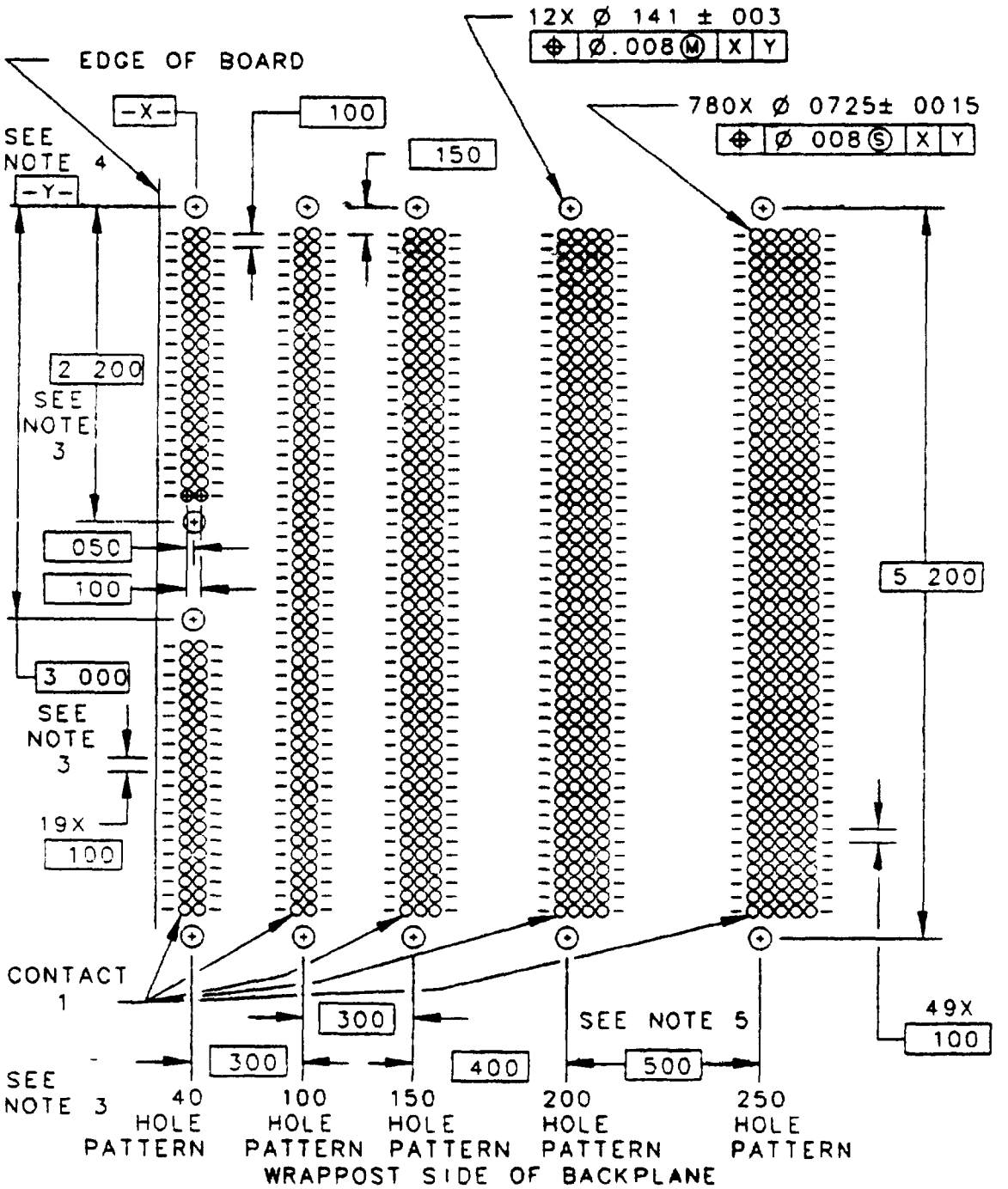


FIGURE 3. Typical hole pattern.

Inches	mm
0.0015	0.0381
0.008	0.203
0.050	1.270
0.0725	1.8415
0.100	2.540
0.150	3.810
0.300	7.620
0.400	10.160
0.500	12.700
2.200	55.880
3.000	76.200
5.200	132.080

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. 40 contact hole patterns may be nearer than 0.8 inch depending upon structural support in the system.
4. Datums X and Y are used to indicate a reference point for each hole pattern.
5. The basic dimension between the 0.141 inch holes may vary with module thickness and cooling provisions.

FIGURE 3. Typical hole pattern - Continued.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1 DOCUMENT NUMBER	2 DOCUMENT TITLE
MIL-STD-2198	Design Requirements for Metal Electrical Backplane Assemblies

3a. NAME OF SUBMITTING ORGANIZATION	4 TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)* _____

5 PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6 REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE