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DYNAMIC DETAILS

IPC-6012B

RIGID PRINTED BOARD

STRUCTURAL INTEGRITY

Sample Identification: LUDY LINE

Report Number: 34681

TEST RESULTS SUMMARY:

| Serial Number | | Set 1 | Set 2 |
|--------------------------------|--------|-------|-------|
| Specification , class 3 | Accept | X | X |
| | Reject | | |
| Master | Accept | N/A | N/A |
| Drawing, class 3 | Reject | | |

* The master drawing was **not** supplied with the samples submitted for evaluation.



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SUBMISSION IDENTIFICATION

The following sample(s) were submitted and received in a suitable condition for testing as requested:

TEST SAMPLES SUBMITTED: 3/19/2009

REPORT DATE: 03/25/2009

PURCHASE ORDER NUMBER: 10059452

SAMPLE IDENTIFICATION: LUDY LINE

SERIAL NUMBER(s): Microtek marked set 1, set 2

* * * * *

IN ACCOUNT WITH:
DYNAMIC DETAILS
1200 SEVERN WAY
DULLES, VA 20166-8904
(703) 450-2600
Attention: Samuel Lee

RIGID PRINTED BOARD STRUCTURAL INTEGRITY

TEST SPECIMEN

Two sets of IPC-2221; Test Specimen, coupons A & B were submitted per the customer.

REFERENCE

Master Drawing; IPC-6012B; IPC-A-600; IPC-TM-650, Method 2.1.1.2.

IPC-6012B:

3.6 Structural Integrity Printed boards shall meet structural integrity requirements for thermally stressed (after solder float) evaluation test coupons specified in 3.6.2. Although the A and B or A/B coupons are assigned for this test, production boards may be used in lieu of the A and B or A/B coupons and are preferred for product that contains surface mount and vias or surface mount mixed with through-hole technology. Holes selected shall be equivalent to those specified for test coupons. The production boards and all other test coupons in the quality conformance test circuitry which contain plated-through holes shall be capable of meeting the requirements of this section.

Structural integrity shall be used to evaluate test coupons or production boards from Type 2 through Type 6 boards by microsectioning techniques. Characteristics not applicable to Type 2 boards (i.e., requirements for innerlayer separations, innerlayer inclusions, and inner foil cracks) are not evaluated. Dimensional measurements that are only possible through the use of microsectioning techniques are also defined in this section. Blind and buried vias shall meet the requirements of plated-through holes. Refer to IPC-2221 for appropriate coupon design of blind and buried vias for plated hole evaluation.

The evaluation of all properties and requirements shall be performed on the thermally stressed test coupon and all requirements must be met; however, per supplier election, certain properties and conditions as defined in the following paragraph(s), which are not affected by thermal stressing, may be evaluated in a test coupon(s) that has not been thermally stressed.

- a) When a supplier elects to evaluate the unstressed test coupon for the properties listed in (b), he may do so at any operation following the copper plating operation. If the board undergoes additional thermal excursions above the T_g (glass transition temperature) after copper plating, the unstressed test coupon being evaluated shall also be subjected to these thermal excursions.
- b) The properties which are not affected by thermal stress include but are not limited to: copper voids, plating folds/inclusions, burrs and nodules, glass fiber protrusion, wicking, final coating plating voids, etchback, negative etchback, plating/coating thickness, internal and surface copper layer or foil thickness.

RIGID PRINTED BOARD STRUCTURAL INTEGRITY

3.6.1 Thermal Stress Testing Test coupons or production boards shall be thermally stressed in accordance with IPC-TM-650, Method 2.6.8.

Following stress, test coupons or production boards shall be microsectioned. Microsectioning shall be accomplished per IPC-TM-650, Method 2.1.1, or 2.1.1.2 on test coupons or production boards. Evaluation of all applicable holes and vias, including blind and buried, for all such structures found on the finished printed board shall be inspected in the vertical cross section in accordance with Table 4-3. The grinding and polishing accuracy of the microsection shall be such that the viewing area of each of the holes is within 10% of the drilled diameter of the hole.

Plated-through holes shall be examined for foil and plating integrity at a magnification of $100X \pm 5\%$. Referee examinations shall be accomplished at a magnification of $200X \pm 5\%$. Each side of the hole shall be examined independently. Examination for laminate thickness, foil thickness, plating thickness, lay-up orientation, lamination and plating voids, and so forth, shall be accomplished at magnifications specified above. For foils less than 3/8 oz., higher magnifications may be required to confirm minimum thickness requirement. Plating thicknesses below $1.0 \mu\text{m}$ [$39.4 \mu\text{in}$] shall not be measured using metallographic techniques. Note: When agreed by user and supplier, alternate techniques may be used to supplement microsection evaluation.

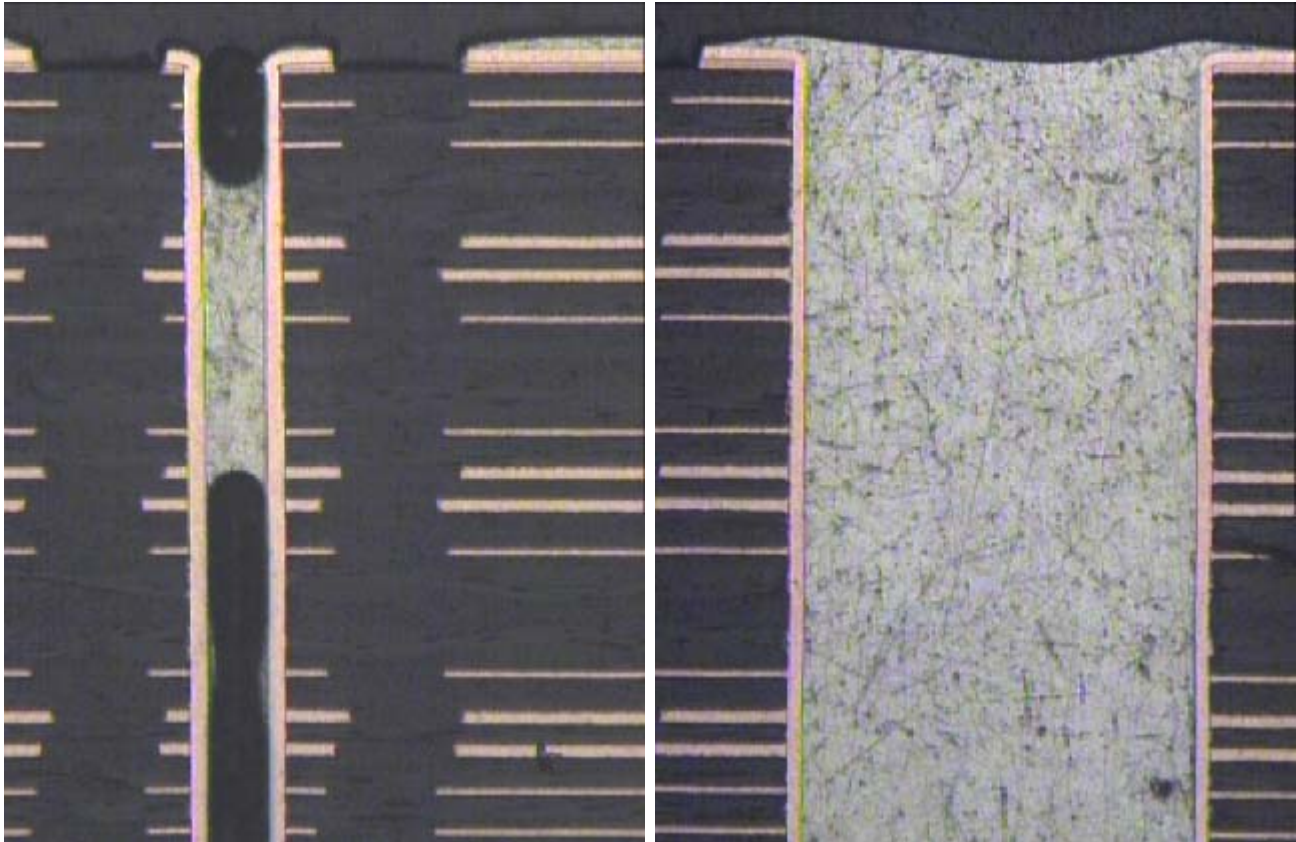


RIGID BOARD MICROSECTIONAL ANALYSIS

CUSTOMER NAME: DYNAMIC DETAILS
 SAMPLE IDENTIFICATION: LUDY LINE
 TEST TECHNICIAN: Sonny D.

REPORT DATE: 03/25/2009
 SERIAL NUMBER: SET 1 COUPONS

| PLATING THICKNESS | | | STRUCTURAL INTEGRITY | | | | | | |
|------------------------------|----------|-----------|---|-----------------------------|--|-----|-----|---------------------|--|
| PLATED-THRU HOLE THICKNESS: | | | PROPERTY | | REQUIREMENT (Class 2 and 3) | ACC | REJ | COMMENTS | |
| Hole #1 Average PTH Cu | 0.00168" | 3.6.2.1 | Plating Integrity | | No separation of plating layers, plating cracks or interconnection contamination or separation | X | | Meets Requirement | |
| Hole #2 Average PTH Cu | 0.00160" | | | | | | | | |
| Hole #3 Average PTH Cu | 0.00168" | 3.6.2.2 | Plating Voids | | One non-circumferential allowed <5% PWB Thickness | X | | None Found | |
| Average of Hole #'s 1, 2, 3 | 0.00165" | Table 3-6 | Plating Folds/Inclusions | | Must be enclosed and min Cu thickness is met | X | | None Found | |
| SURFACE CONDUCTOR THICKNESS: | | | Table 3-6 | Burrs and Nodules | Allowed if minimum hole diameter is met | X | | Meets Requirement | |
| Conductor #1 Cu | 0.00275" | Table 3-6 | Glass Fiber Protusion | | Allowed if minimum isolated plating thickness is met | X | | Meets Requirement | |
| Conductor #2 Cu | 0.00242" | Table 3-6 | Wicking | | 0.003937" max [Class 2]; 0.003150" max [Class 3] | X | | Meets Requirement | |
| FOILS AND DIELECTRICS | | | Table 3-6 | Interlayer Inclusions | None allowed | X | | None Found | |
| CONSTRUCTION | LYR | THICKNESS | Table 3-6 | Internal Foil Cracks | None allowed | X | | None Found | |
| COPPER FOIL | 1 | 0.00049" | Table 3-6 | External Foil Cracks | "D" & "B" cracks not allowed. "A" cracks allowed | X | | None Found | |
| DIELECTRIC | 1/2 | 0.00275" | Table 3-6 | Barrel/Corner Cracks(E/F) | None allowed | X | | None Found | |
| COPPER FOIL | 2 | 0.00062" | Table 3-6 | Interlayer Separation | None allowed | X | | None Found | |
| DIELECTRIC | 2/3 | 0.00353" | Table 3-6 | External Edge Separation | Allowed if it does not extend past vertical edge | X | | None Found | |
| COPPER FOIL | 3 | 0.00057" | Table 3-6 | Plating Separation | None allowed | X | | None Found | |
| DIELECTRIC | 3/4 | 0.00308" | Table 3-6 | Plated Barrel Separation | Dimensional and plating requirements must be met | X | | Meets Requirement | |
| COPPER FOIL | 4 | 0.00123" | Table 3-6 | Lifted Lands (After Stress) | Allowed if visual (section 3.3.4) are met | X | | Meets Requirement | |
| DIELECTRIC | 4/5 | 0.00205" | 3.6.2.3 | Laminate Voids | Voids in Zone B not greater than 0.003150" | X | | <0.00315" | |
| COPPER FOIL | 5 | 0.00119" | 3.6.2.4 | Laminate Cracks | Cracks in Zone B not greater than 0.003150" | X | | None Found | |
| DIELECTRIC | 5/6 | 0.00353" | 3.6.2.5 | Delamination or Blistering | No evidence of delamination or blistering; Class 2 & 3 | X | | None Found | |
| COPPER FOIL | 6 | 0.00062" | 3.6.2.6 | Etchback (When Specified) | 0.000197" to 0.003150"; Preferred depth 0.000512" | X | | No Etchback Present | |
| DIELECTRIC | 6/7 | 0.01214" | 3.6.2.7 | Smear Removal | Shall not be etched back more than 0.000984" | X | | Meets Requirement | |
| COPPER FOIL | 7 | 0.00062" | 3.6.2.8 | Negative Etchback | Shall not exceed requirements in Figure 3-6 | X | | Meets Requirement | |
| DIELECTRIC | 7/8 | 0.00373" | 3.6.2.9 | Annular Ring, Internal | 90° breakout [Class 2]; 0.000984" min [Class 3] | X | | Meets Requirement | |
| COPPER FOIL | 8 | 0.00115" | 3.6.2.10 | Lifted Lands | Lifted lands are allowed after thermal stress | X | | Meets Requirement | |
| DIELECTRIC | 8/9 | 0.00205" | 3.6.2.11 | Copper Plating, Average | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | X | | 0.00165" | |
| COPPER FOIL | 9 | 0.00119" | 3.6.2.11 | Copper Plating, Minimum | 0.000709" Min [Class 2]; 0.000787" Min [Class 3] | X | | Meets Requirement | |
| DIELECTRIC | 9/10 | 0.00345" | 3.6.2.12 | Internal Cu Foil Thickness | See IPC-6012, Table 3-7 and Master Drawing | X | | Meets Requirement | |
| COPPER FOIL | 10 | 0.00053" | 3.6.2.13 | External Conductor Thkns | See IPC-6012, Table 3-8 and Master Drawing | X | | Meets Requirement | |
| DIELECTRIC | 10/11 | 0.01112" | 3.6.2.14 | Metal Core Spacing | 0.003937" Minimum | | | Not Applicable | |
| COPPER FOIL | 11 | 0.00053" | 3.6.2.15 | Dielectric Thickness | Shall be specified in the procurement documentation | | | See drawing | |
| DIELECTRIC | 11/12 | 0.00382" | 3.6.2.16 | Material Fill | 60% min for buried; Blind vias per Master Drawing | | | Not Applicable | |
| COPPER FOIL | 12 | 0.00119" | 3.6.2.17 | Nail Heading | Allowed; Process Indicator | X | | Meets Requirement | |
| DIELECTRIC | 12/13 | 0.00217" | Table 3-2 | Wrap Copper | See Table 3-2 for requirements | | | Not Applicable | |
| COPPER FOIL | 13 | 0.00115" | ADDITIONAL REQUIREMENTS | | | | | | |
| DIELECTRIC | 13/14 | 0.00952" | Table 3-2 | Blind Vias | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | | | Not Applicable | |
| COPPER FOIL | 14 | 0.00057" | Table 3-2 | Blind Micro Vias | 0.000472" Avg [Class 2]; 0.000472" Avg [Class 3] | | | Not Applicable | |
| DIELECTRIC | 14/15 | 0.00353" | Table 3-2 | Buried Via Cores | 0.000592" Avg [Class 2]; 0.000592" Avg [Class 3] | | | Not Applicable | |
| COPPER FOIL | 15 | 0.00053" | Table 3-2 | Buried Vias >2 Layers | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | | | Not Applicable | |
| DIELECTRIC | 15/16 | 0.00283" | [X] SAMPLE MEETS THE APPLICABLE REQUIREMENTS OF IPC-6012B, CLASS 3. | | | | | | |
| COPPER FOIL | 16 | 0.00049" | Comments: | | | | | | |



10 Mils P.T.H
S/N: SET 1 COUPONS
Defects: None Found
Structural Integrity
Vertical Microsection @ 50X

44 Mils P.T.H
S/N: SET 1 COUPONS
Defects: None Found
Structural Integrity
Vertical Microsection @ 50X

Sample Identification: LUDY LINE
DYNAMIC DETAILS

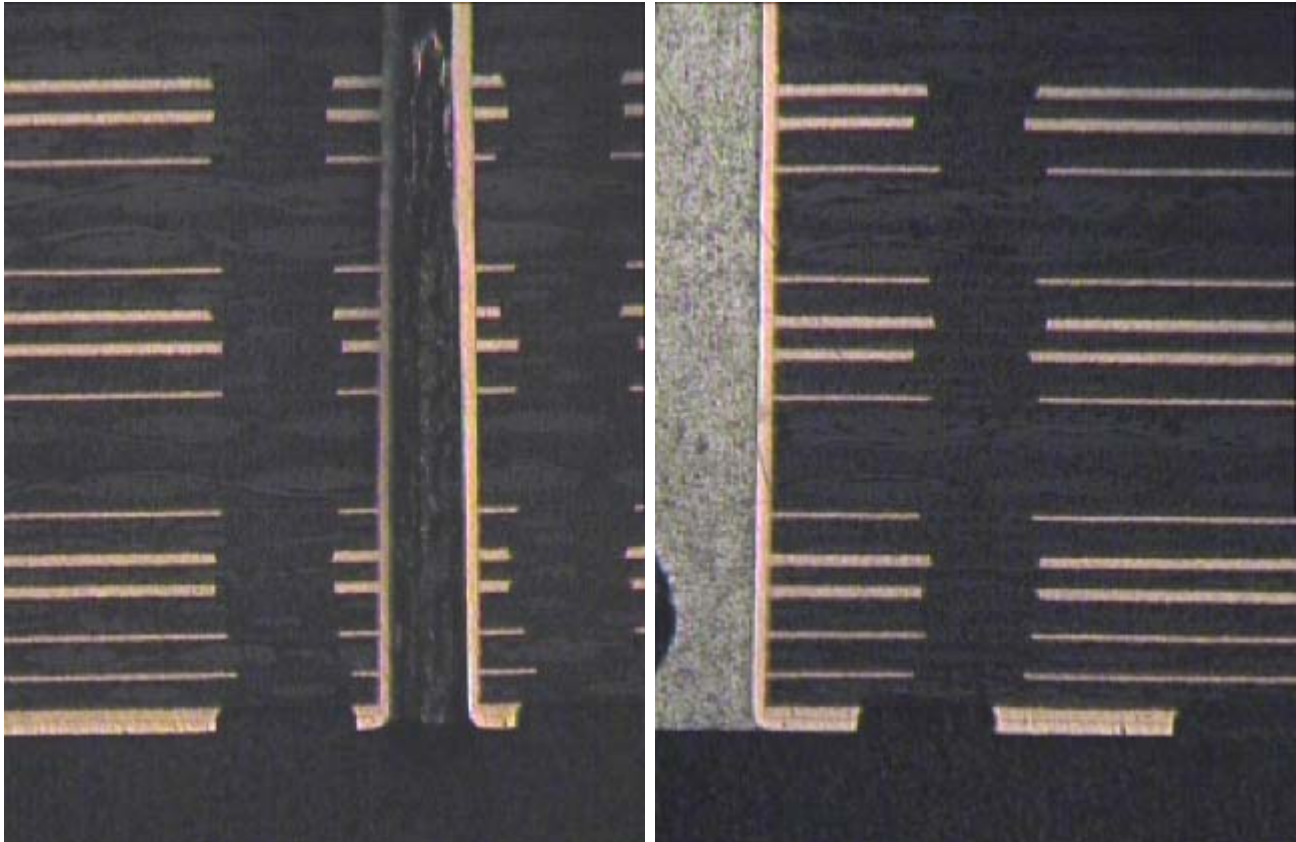


RIGID BOARD MICROSECTIONAL ANALYSIS

CUSTOMER NAME: DYNAMIC DETAILS
 SAMPLE IDENTIFICATION: LUDY LINE
 TEST TECHNICIAN: Sonny D.

REPORT DATE: 03/25/2009
 SERIAL NUMBER: SET 2 COUPONS

| PLATING THICKNESS | | | STRUCTURAL INTEGRITY | | | | | |
|------------------------------|----------|-----------|---|-----------------------------|--|-----|-----|---------------------|
| PLATED-THRU HOLE THICKNESS: | | | PROPERTY | | REQUIREMENT (Class 2 and 3) | ACC | REJ | COMMENTS |
| Hole #1 Average PTH Cu | 0.00172" | 3.6.2.1 | Plating Integrity | | No separation of plating layers, plating cracks or interconnection contamination or separation | X | | Meets Requirement |
| Hole #2 Average PTH Cu | 0.00168" | | | | | | | |
| Hole #3 Average PTH Cu | 0.00164" | 3.6.2.2 | Plating Voids | | One non-circumferential allowed <5% PWB Thickness | X | | None Found |
| Average of Hole #'s 1, 2, 3 | 0.00168" | Table 3-6 | Plating Folds/Inclusions | | Must be enclosed and min Cu thickness is met | X | | None Found |
| SURFACE CONDUCTOR THICKNESS: | | | Table 3-6 | Burrs and Nodules | Allowed if minimum hole diameter is met | X | | Meets Requirement |
| Conductor #1 Cu | 0.00263" | Table 3-6 | Glass Fiber Protusion | | Allowed if minimum isolated plating thickness is met | X | | Meets Requirement |
| Conductor #2 Cu | 0.00287" | Table 3-6 | Wicking | | 0.003937" max [Class 2]; 0.003150" max [Class 3] | X | | Meets Requirement |
| FOILS AND DIELECTRICS | | | Table 3-6 | Interlayer Inclusions | None allowed | X | | None Found |
| CONSTRUCTION | LYR | THICKNESS | Table 3-6 | Internal Foil Cracks | None allowed | X | | None Found |
| COPPER FOIL | 1 | 0.00049" | Table 3-6 | External Foil Cracks | "D" & "B" cracks not allowed. "A" cracks allowed | X | | None Found |
| DIELECTRIC | 1/2 | 0.00283" | Table 3-6 | Barrel/Corner Cracks(E/F) | None allowed | X | | None Found |
| COPPER FOIL | 2 | 0.00053" | Table 3-6 | Interlayer Separation | None allowed | X | | None Found |
| DIELECTRIC | 2/3 | 0.00361" | Table 3-6 | External Edge Separation | Allowed if it does not extend past vertical edge | X | | None Found |
| COPPER FOIL | 3 | 0.00053" | Table 3-6 | Plating Separation | None allowed | X | | None Found |
| DIELECTRIC | 3/4 | 0.00363" | Table 3-6 | Plated Barrel Separation | Dimensional and plating requirements must be met | X | | Meets Requirement |
| COPPER FOIL | 4 | 0.00119" | Table 3-6 | Lifted Lands (After Stress) | Allowed if visual (section 3.3.4) are met | X | | Meets Requirement |
| DIELECTRIC | 4/5 | 0.00206" | 3.6.2.3 | Laminate Voids | Voids in Zone B not greater than 0.003150" | X | | <0.00315" |
| COPPER FOIL | 5 | 0.00115" | 3.6.2.4 | Laminate Cracks | Cracks in Zone B not greater than 0.003150" | X | | None Found |
| DIELECTRIC | 5/6 | 0.00382" | 3.6.2.5 | Delamination or Blistering | No evidence of delamination or blistering; Class 2 & 3 | X | | None Found |
| COPPER FOIL | 6 | 0.00053" | 3.6.2.6 | Etchback (When Specified) | 0.000197" to 0.003150"; Preferred depth 0.000512" | X | | No Etchback Present |
| DIELECTRIC | 6/7 | 0.01165" | 3.6.2.7 | Smear Removal | Shall not be etched back more than 0.000984" | X | | Meets Requirement |
| COPPER FOIL | 7 | 0.00053" | 3.6.2.8 | Negative Etchback | Shall not exceed requirements in Figure 3-6 | X | | Meets Requirement |
| DIELECTRIC | 7/8 | 0.00361" | 3.6.2.9 | Annular Ring, Internal | 90° breakout [Class 2]; 0.000984" min [Class 3] | X | | Meets Requirement |
| COPPER FOIL | 8 | 0.00115" | 3.6.2.10 | Lifted Lands | Lifted lands are allowed after thermal stress | X | | Meets Requirement |
| DIELECTRIC | 8/9 | 0.00217" | 3.6.2.11 | Copper Plating, Average | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | X | | 0.00168" |
| COPPER FOIL | 9 | 0.00115" | 3.6.2.11 | Copper Plating, Minimum | 0.000709" Min [Class 2]; 0.000787" Min [Class 3] | X | | Meets Requirement |
| DIELECTRIC | 9/10 | 0.00353" | 3.6.2.12 | Internal Cu Foil Thickness | See IPC-6012, Table 3-7 and Master Drawing | X | | Meets Requirement |
| COPPER FOIL | 10 | 0.00062" | 3.6.2.13 | External Conductor Thkns | See IPC-6012, Table 3-8 and Master Drawing | X | | Meets Requirement |
| DIELECTRIC | 10/11 | 0.01108" | 3.6.2.14 | Metal Core Spacing | 0.003937" Minimum | | | Not Applicable |
| COPPER FOIL | 11 | 0.00057" | 3.6.2.15 | Dielectric Thickness | Shall be specified in the procurement documentation | | | See drawing |
| DIELECTRIC | 11/12 | 0.00382" | 3.6.2.16 | Material Fill | 60% min for buried; Blind vias per Master Drawing | | | Not Applicable |
| COPPER FOIL | 12 | 0.00119" | 3.6.2.17 | Nail Heading | Allowed; Process Indicator | X | | Meets Requirement |
| DIELECTRIC | 12/13 | 0.00209" | Table 3-2 | Wrap Copper | See Table 3-2 for requirements | | | Not Applicable |
| COPPER FOIL | 13 | 0.00119" | ADDITIONAL REQUIREMENTS | | | | | |
| DIELECTRIC | 13/14 | 0.00927" | Table 3-2 | Blind Vias | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | | | Not Applicable |
| COPPER FOIL | 14 | 0.00062" | Table 3-2 | Blind Micro Vias | 0.000472" Avg [Class 2]; 0.000472" Avg [Class 3] | | | Not Applicable |
| DIELECTRIC | 14/15 | 0.00357" | Table 3-2 | Buried Via Cores | 0.000592" Avg [Class 2]; 0.000592" Avg [Class 3] | | | Not Applicable |
| COPPER FOIL | 15 | 0.00057" | Table 3-2 | Buried Vias >2 Layers | 0.000787" Avg [Class 2]; 0.000984" Avg [Class 3] | | | Not Applicable |
| DIELECTRIC | 15/16 | 0.00279" | [X] SAMPLE MEETS THE APPLICABLE REQUIREMENTS OF IPC-6012B, CLASS 3. | | | | | |
| COPPER FOIL | 16 | 0.00053" | Comments: | | | | | |



10 Mils P.T.H
S/N: SET 2 COUPONS
Defects: None Found
Structural Integrity
Vertical Microsection @ 50X

44 Mils P.T.H
S/N: SET 2 COUPONS
Defects: None Found
Structural Integrity
Vertical Microsection @ 50X

Sample Identification: LUDY LINE
DYNAMIC DETAILS



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CERTIFICATE OF CONFORMANCE

Microtek Laboratories certifies that the test equipment used complies with the calibration requirements of ANSI/NCSL Z540-1, IPC-QL-653, and ISO/IEC-17025 and that the data contained in this report is accurate within the tolerance limitation of this equipment.

The materials and/or devices furnished on this order have been tested/analyzed/and inspected in accordance with all designated instructions and specifications. Physical reports and other data pertinent to applicable specifications are on file and available for inspection at this plant.

All test procedures detailed are complete. If any additional information or clarification of this report is required, please contact us.

Thank you for selecting Microtek Laboratories for your testing requirements.

Report Prepared By:

Report Reviewed By:

Sonny D.
Test Technician
MICROTEK LABORATORIES

Russell S. Shepherd
Laboratory Manager
MICROTEK LABORATORIES