



# TEST REPORT

## (Self-Tested Data)

**CLIENT:** IPC Validation Services  
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**TEST ITEMS:** Peel Strength, Volume Resistivity, Surface Resistivity, Moisture Absorption, Dielectric Breakdown, Permittivity @ 1 GHz, Loss Tangent @ 1 GHz, Flexural Strength, Arc Resistance, Thermal Stress, Electric Strength, Flammability, Glass Transition Temperature, Decomposition Temperature, CTE (TMA), Time to Delamination (T260, T288, T300), Dimensional Stability, Solderability, Chemical Resistance, Metal Surfaces Cleanability, Pressure Cooker Test.

**SAMPLE:** Copper-Clad Laminate

**TEST MATERIAL:** VT-901

**SPECIFICATION:** IPC-4101/40

**TEST RESULTS:** The specimens were tested by the indicated test methods within this report.  
The actual detailed test results are enclosed.

**DATE OF REPORT:** November 17, 2022



**SUMMARIZED TEST RESULTS:**

<b>Test Item</b>	<b>Thin</b>	<b>Thick</b>
Peel Strength	Pass	Pass
Volume Resistivity	Pass	Pass
Surface Resistivity	Pass	Pass
Moisture Absorption	--	Pass
Dielectric Breakdown	--	Pass
Permittivity @ 1MHz	Pass	Pass
Loss Tangent @ 1MHz	Pass	Pass
Flexural Strength	--	Pass
Arc Resistance	Pass	Pass
Thermal Stress	Pass	Pass
Electric Strength	Pass	Pass
Flammability	Pass	Pass
Glass Transition Temperature	--	Pass
Decomposition Temperature	--	Report Only
Z-Axis CTE	--	Report Only
Time to Delamination	--	Report Only
Dimensional Stability	Pass	Pass
Solderability	--	Pass
Chemical Resistance	Report Only	Report Only
Metal Surface Cleanability	--	Report Only
Pressure Cooker Test	--	Report Only



## Peel Strength

### Reference:

IPC-TM-650 Method 2.4.8 Peel Strength of Metal Clad Laminates

IPC-TM-650 Method 3.4.8.3 Peel Strength of Metal Clad Laminates at Elevated Temperature

IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 1 Peel Strength After Thermal Strength Thin**

Side A Cross-Wise and Length-Wise Average	1.12 N/mm	
Side B Cross-Wise and Length-Wise Average	1.11 N/mm	
Requirement	$\geq 0.90$ N/mm	Pass

**Table 2 Peel Strength After Thermal Strength Thick**

Side A Cross-Wise and Length-Wise Average	1.15 N/mm	
Side B Cross-Wise and Length-Wise Average	1.12 N/mm	
Requirement	$\geq 0.90$ N/mm	Pass

**Table 3 Peel Strength At Elevated Temperature Thin**

Side A Cross-Wise and Length-Wise Average	1.12 N/mm	
Side B Cross-Wise and Length-Wise Average	0.99N/mm	
Requirement	$\geq 0.70$ N/mm	Pass

**Table 4 Peel Strength At Elevated Temperature Thick**

Side A Cross-Wise and Length-Wise Average	1.26N/mm	
Side B Cross-Wise and Length-Wise Average	1.25 N/mm	
Requirement	$\geq 0.70$ N/mm	Pass



**Table 5 Peel Strength After Process Solutions Thin**

Side A Cross-Wise and Length-Wise Average	1.28 N/mm	
Side B Cross-Wise and Length-Wise Average	1.35 N/mm	
Requirement	$\geq 0.80$ N/mm	Pass

**Table 6 Peel Strength After Process Solutions Thick**

Side A Cross-Wise and Length-Wise Average	1.51 N/mm	
Side B Cross-Wise and Length-Wise Average	1.47 N/mm	
Requirement	$\geq 0.95$ N/mm	Pass

**Table 7 Peel Strength As Received Low Profile Copper Thin**

Side A Cross-Wise and Length-Wise Average	N/A
Side B Cross-Wise and Length-Wise Average	N/A
Requirement	<u>N/A</u>

**Table 8 Peel Strength As Received Low Profile Copper Thick**

Side A Cross-Wise and Length-Wise Average	N/A
Side B Cross-Wise and Length-Wise Average	N/A
Requirement	<u>N/A</u>

## Volume & Surface Resistivity

### Reference:

IPC-TM-650 Method 2.5.17.1 Volume and Surface Resistivity of Dielectric Materials  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results

**Table 9 Volume and Surface Resistivity Humidity Conditioning Thin**

Volume Resistivity	Average of three specimens	3.25 E+06	
Requirement		$\geq 6.00$ E+04	Pass
Surface Resistivity	Average of three specimens	1.77 E+06	
Requirement		$\geq 1.00$ E+04	Pass



**Table 10 Volume and Surface Resistivity At Elevated Temperature Thin**

Volume Resistivity Requirement	Average of three specimens	4.18E+06 ≥ 6.00 E+04	Pass
Surface Resistivity Requirement	Average of three specimens	2.32E+06 ≥ 1.00 E+04	Pass

**Table 11 Volume and Surface Resistivity Humidity Conditioning Thick**

Volume Resistivity Requirement	Average of three specimens	6.36 E+07 ≥ 1.00 E+06	Pass
Surface Resistivity Requirement	Average of three specimens	3.08 E+07 ≥ 1.00 E+06	Pass

**Table 12 Volume and Surface Resistivity At Elevated Temperature Thick**

Volume Resistivity Requirement	Average of three specimens	7.58E+07 ≥ 1.00 E+06	Pass
Surface Resistivity Requirement	Average of three specimens	1.98 E+07 ≥ 1.00 E+06	Pass

## Moisture Absorption

### Reference:

IPC-TM-650 Method 2.6.2.1 Water Absorption of Metal Clad Plastic Laminates  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 13 Moisture Absorption Thick**

Moisture Absorption Requirement	<1.55 mm Average of three specimens	0.45 % ≤ 1.0%	Pass
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Moisture Absorption	$\geq 1.55$ mm	Average of three specimens	0.22 %	
Requirement			$\leq 0.5\%$	Pass

## Dielectric Breakdown

### Reference:

IPC-TM-650 Method 2.5.6 Dielectric Breakdown  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 14 Dielectric Breakdown**

Dielectric Breakdown	Average of four specimens	43 kV	
Requirement		$\geq 40$ kV	Pass

## Permittivity and Loss Tangent

### Reference:

IPC-TM-650 Method 2.5.5.9 Permittivity and Loss Tangent, Parallel Plate 1 MHz to 1.5 MHz  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 15 Permittivity and Loss Tangent**

Permittivity @ 1 GHz Thin	Average of three specimens	4.17	
Requirement		$\leq 5.4$	Pass
Loss Tangent @ 1 GHz Thin	Average of three specimens	0.011	
Requirement		$\leq 0.035$	Pass
Permittivity @ 1 GHz Thick	Average of three specimens	4.51	
Requirement		$\leq 5.4$	Pass



Loss Tangent @ 1 GHz Thick      Average of three specimens      0.009  
Requirement       $\leq 0.035$       Pass

## Flexural Strength

### Reference:

IPC-TM-650 Method 2.4.4    Flexural Strength of Laminates at Ambient Temperature  
IPC-TM-650 Method 2.4.4.1    Flexural Strength of Laminates at Elevated Temperature  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 16 Flexural Strength**

Flexural Strength				
Length Direction	Average of two specimens	80252	lb/in <sup>2</sup>	
Requirement		$\geq 60190$	lb/in <sup>2</sup>	Pass
Flexural Strength				
Cross Direction	Average of two specimens	61150	lb/in <sup>2</sup>	
Requirement		$\geq 47140$	lb/in <sup>2</sup>	Pass
Flexural Strength at Elevated Temperature				
Length Direction	Average of two specimens	60425	lb/in <sup>2</sup>	
Requirement		$\geq 45110$	lb/in <sup>2</sup>	Pass

## Arc Resistance

### Reference:

IPC-TM-650 Method 2.5.1    Arc Resistance of Printed Wiring Material  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:



**Table 17 Arc Resistance**

Arc Resistance Thin Requirement	Average of three specimens	133 S ≥ 120 S	Pass
Arc Resistance Thick Requirement	Average of three specimens	147 S ≥ 120 S	Pass

## Thermal Stress

### Reference:

IPC-TM-650 Method 2.4.13.1 Thermal Stress of Laminates  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 18 Thermal Stress**

Thermal Stress Thin Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Etched B Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Etched B Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Un-Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Un-Etched B Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Un-Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Un-Etched B Side	No obvious blister, delamination or damage	Pass

## Electric Strength

### Reference:

IPC-TM-650 Method 2.5.6.2 Electric Strength  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board



**Results:**

**Table 19 Electric Strength**

Electric Strength Thin Requirement	Average of three specimens	60 kV/mm ≥ 30 kV/mm Pass
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## Flammability Vertical Burning

**Reference:**

UL94 Section 8 50W (20mm) Vertical Burning Test; V-0, V-1, V-2  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

**Results:**

**Table 19 Vertical Burning Test Thin**

The specimens were tested by the methods given above.  
The flammability Classification Condition A of specimens is V0  
The flammability Classification Condition A of specimens is V0  
The specimens pass.

**Table 20 Vertical Burning Test Thick**

The specimens were tested by the methods given above.  
The flammability Classification Condition A of specimens is V0  
The flammability Classification Condition A of specimens is V0  
The specimens pass.

## Glass Transition Temperature

**Reference:**

IPC-TM-650 Method 2.4.25 Glass Transition Temperature and Cure Factor by DSC  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board



**Results:**

**Table 22 Glass Transition Temperature**

Glass Transition Temperature	256.26°C	
Requirement	≥ 200°C	Pass

## Decomposition Temperature

**Reference:**

IPC-TM-650 Method 2.4.24.6 Decomposition Temperature of Laminate Material Using TGA  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

**Results:**

**Table 23 Decomposition Temperature**

Glass Transition Temperature 5% Weight Loss	397 °C	
Requirement	<u>N/A</u>	Record

## Z-Axis CTE (TMA)

**Reference:**

IPC-TM-650 Method 2.4.24. Glass Transition Temperature and Z-Axis Expansion by TMA  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

**Results:**

**Table 24 Z-Axis CTE (TMA)**

Z-Axis CTE Alpha 1	Average of two specimens	37.83 ppm/°C	
		<u>N/A</u>	Record



Z-Axis CTE Alpha 2	Average of two specimens	187.52 ppm/°C	
		<u>N/A</u>	Record
Z-Axis CTE 50-260°C	Average of two specimens	1.853 %	
		<u>N/A</u>	Record

## Time to Delamination

### Reference:

IPC-TM-650 Method 2.4.24.1 Time to Delamination (TMA Method)  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 25 Time to Delamination (TMA)**

Delamination T260	Average of two specimens	60 min	
	Requirement	<u>N/A</u>	Record
Delamination T288	Average of two specimens	39.45 min	
	Requirement	<u>N/A</u>	Record
Delamination T300	Average of two specimens	21.69 min	
	Requirement	<u>N/A</u>	Record

## Dimensional Stability

### Reference:

IPC-TM-650 Method 2.4.39 Dimensional Stability, Glass Reinforced Thin Laminates  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 26 Dimensional Stability Thin**



Dimensional Stability Bake Thin	Average of three specimens		
	Machine direction	105 ppm	
	Requirement	-300 to +300 ppm	Pass
Dimensional Stability Stress Thin	Average of three specimens		
	Cross direction	68 ppm	
	Requirement	-300 to +300 ppm	Pass

**Table 27 Dimensional Stability Thick**

Dimensional Stability Bake Thick	Average of three specimens		
	Machine direction	21 ppm	
	Requirement	-300 to +300 ppm	Pass
Dimensional Stability Stress Thick	Average of three specimens		
	Cross direction	69 ppm	
	Requirement	-300 to +300 ppm	Pass

## Solderability (Edge Dip Test)

### Reference:

IPC-J-STD-003C; Method 4.2.1 Edge Dip Test

IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 28 Solderability**

Solderability Thin	Sample surface exhibited good wetting	Pass
Solderability Thick	Sample surface exhibited good wetting	Pass



## Chemical Resistance

### Reference:

IPC-TM-650 Method 2.3.4.2 Chemical Resistance of Laminates, Prepreg and Coated Foil Products by Solvent Exposure.  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 29 Chemical Resistance**

Chemical Resistance Thin	Average of three specimens		
	Weight increase (Check & Record)	0.13%	
Requirement	Appearance after bake	No change	Pass
Requirement	Appearance after solvent	No change	Pass
Chemical Resistance Thick	Average of three specimens		
	Weight increase (Check & Record)	0.09%	
Requirement	Appearance after bake	No change	Pass
Requirement	Appearance after solvent	No change	Pass

## Metal Surface Cleanability

### Reference:

IPC-TM-650 Method 2.3.1.1 Chemical Cleaning of Metal-Clad Laminate  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 30 Metal Surface Cleanability**

Metal Surface Cleanability	Three specimens		
Requirement	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the surface does not bead or form puddles.		Pass



## Pressure Cooker Test

### Reference:

IPC-TM-650 Method 2.6.16 Pressure Vessel Method for Glass Epoxy Laminate Integrity  
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

### Results:

**Table 31 Pressure Cooker Test**

Pressure Cooker Test	Five specimens	
Requirement	The samples shall have no measles, blisters or surface erosion	Pass

## CERTIFICATE OF CONFORMANCE

Ventec Electronics (Suzhou) Co. Ltd. certifies that the test equipment used complies with the requirements of correlation criterion and that data contained in this report is accurate within the tolerance limitation of the equipment.

The report is invalid without the signature of the reviewer and the approver.

Reviewed by:

*John. Yi*

John Yi

QA Engineer

November 17, 2022

Approved by:

*HJ Chen.*

HJ Chen

QA Manager

November 17, 2022