PhaseBlue® 1500 Series Circuit Materials

Product Portfolio

Product Description

PhaseBlue® Series Circuit Materials represent a disruptive new technology, delivering substantial dielectric and thermal performance advantages over traditional circuit materials. Built on a polyimide aerogel core, PhaseBlue leverages the long-standing reliability of polyimide — a material that has been deployed in billions of circuits since the 1960s — while remaining fully compatible with modern thin-core PCB fabrication processes. Retaining many of the hallmark characteristics of polyimide, PhaseBlue offers high temperature tolerance, formability, and environmental responsibility. As a fluorine-free, U.S.-designed and manufactured copper-clad laminate (CCL), PhaseBlue not only addresses growing concerns regarding PFAS and polyhalogenated materials, but also ensures compliance with IPC-4202/15.

PhaseBlue's unique structure creates disruptive changes to the PCB industry. A processable laminate from a reticulated nanostructure (85% air and 15% polyimide) creates a dielectric constant (Dk) of <1.5 and a dissipation factor (Df) of < 0.001 (both at 1 GHz). These attributes provide great performance for antennas, RF, microwave, high-speed digital and other demanding applications. Incumbent materials at this performance level tend to be PTFE. PTFE is being phased out of many application types, because of its environmental impact and the new regulations being imposed on products made with the material. By coupling PhaseBlue's thickness (0.0065 - 0.030" / 165 - 750 µm) with its formability, three-dimensional and dense packaging solutions are easy to create. It has the lowest density of all common PCB materials and works wonderfully in space and aeronautical applications.

Assembly

Assembly is successfully accomplished through proper circuit design. Using FPCB techniques and consideration of heat flow in the material , most designs are easily assembled.

Processing

PhaseBlue's low density alters its physical characteristics, requiring minor modifications to standard PCB processing. It is a thin and light laminate. It needs to be framed to prevent damage. It processes much like a flexible circuit. Care in handling is important. The core polyimide aerogel is 85% air. While it is easy to bond to the polyimide portion of the material there is no bond to the air portion. This results in a relatively low peel strength of approximately 2 lb/in. Additionally, the mechanical Z-axis strength is provided by the polyimide content. Heat and pressure need to be tightly controlled to not crush the cell structure of the material in all but a few processes (including FR-4 processing, DES, etchback, excising, drill, etc.).

Storage

Recommended Storage Conditions:

- Temperature: 70 ± 5 °F (21 ± 3 °C)
- Relative Humidity: below 50%

5 South Spencer Road
Spencer, MA 01562 USA

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Electrical Properties	Method	PhaseBlue 1500 Typical Values	Core Aerogel Typical Values
Relative Permittivity (εr)	ASTM D150-11, 1 GHz / Ambient	1.53	1.37
Dissipation Factor (tan δ)	ASTM D150-11, 1 GHz / Ambient	< 0.001	< 0.001
Relative Permittivity (εr)	ASTM D150-11, 1 GHz / 35 °C, 90% RH	1.57	Not Measured
Dissipation Factor (tan δ)	ASTM D150-11, 1 GHz / 35 °C, 90% RH	< 0.001	Not Measured
Relative Permittivity (εr)	FPOR, 10.2 - 52 GHz, Ambient	1.52 ± 0.01	1.40 ± 0.02
Dissipation Factor (tan δ)	FPOR, 10.2 - 52 GHz, Ambient	0.0022 ± 0.0003	0.0024 ± 0.0003
Relative Permittivity (εr)	IPC-TM-650 2.5.5.15, 10 GHz, 100 °C	1.52 ± 0.01	Not Measured
Dissipation Factor (tan δ)	IPC-TM-650 2.5.5.15, 10 GHz, 100 °C	0.0013 ± 0.00002	Not Measured

Thermal Properties	Method	Value	Value
Decomp. Temp., 10 wt% Loss, Core Aerogel, °C (°F)	ASTM 2550 / Nitrogen	390 (734)	530 (986)
Glass Transition Temperature, Core Aerogel, °C (°F)	ASTM E1640	305 (580)	305 (580)
Thermal Conductivity, W/m·K	ASTM C518 / 25 °C	0.038	0.034
Coefficient of Thermal Expansion, Machine (0-100 °C) ppm/°C (ppm/°F)	ASTM E831-14	29 (16)	29 (16)
Coefficient of Thermal Expansion, Transverse (0-100 °C) ppm/°C (ppm/°F)	ASTM E831-14	31 (17)	33 (18)
Coefficient of Thermal Expansion, Z-Axis (0-100 °C) ppm/°C (ppm/°F)	ASTM E831-14	105 (58)	80 (44)

Mechanical Properties	Method	Value	Value
Copper Peel Strength, N/m (lb/in)	ASTM D3330 / 23 °C, 50% RH	250 (1.5)	N/A
Young's Modulus, MPa (ksi)	ASTM D882-18 / 23 °C, 50% RH	420 (61)	250 (36)
Tensile Strength, MPa (ksi)	ASTM D882-18 / 23 °C, 50% RH	10.7 (1.52)	7.2 (1.0)
Tensile Elongation at Break, %	ASTM D882-18 / 23 °C, 50% RH	5.4	6.0

Physical Properties	Method	Value	Value
Density, g/cm^3	ASTM D202 / 23 °C, 50% RH	0.39	0.27
Moisture Absorption, %	IPC-TM-650, Method 2.6.2.1	0.40	Not Measured
Rose Cleanliness Analysis, µg NaCl / cm^2, (µg NaCl / in^2)	IPC-TM-650, Method 2.3.25 D	0.018 (0.118)	0.046 (0.297)

PhaseBlue Series Circuit Materials are compliant with IPC-4202/15 Specification Sheet

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Available Configurations

Product Codes	Thicknesses, mil (µm)	Standard Cladding
3590-D1P1-216	8.0 (203)	Double Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-D2P1-216	14.3 (363)	Double Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-D3P1-216	20.6 (523)	Double Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-D4P1-216	26.9 (683)	Double Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-S1P1-216	6.9 (175)	Single-Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-S2P1-216	13.2 (335)	Single-Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-S3P1-216	19.5 (495)	Single-Sided 1/2 oz (18 µm) Rolled Annealed Copper
3590-S4P1-216	25.8 (655)	Single-Sided 1/2 oz (18 µm) Rolled Annealed Copper
1500-0000-216	6.5 (165)	Unclad (no copper)
1500-N2P1-216	12.2 (310)	Unclad (no copper)
1500-N3P1-216	18.5 (470)	Unclad (no copper)
1500-N4P1-216	24.8 (630)	Unclad (no copper)

Standard Panel Sizes: 12" x 18" (305 X 457mm)

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