

Vishay Electro-Films

GENERAL INFORMATION

Vishay Electro-Films (EFI) has produced high quality, patterned thin-film substrates in volume since 1974 for both the hybrid circuit and the microwave industries. These products are used in both military and industrial hybrid circuit applications. Our unique volume capability is achieved through the use of high capacity metalizing systems and patterning processes providing tight process parameter control, product uniformity, and production flexibility. This long term experience with engineering and manufacturing of these products has naturally evolved into the expertise necessary to engineer and manufacture high density multi-layer products, flip chip and ball grid array technologies and specific application oriented devices.

Although a high percentage of hybrid or microwave substrates are produced with conductor patterns only, the majority have associated circuit resistors deposited as well. Customers can add active devices and any other passive components as required.

High density and multi-layer products are developed with Vishay EFI and the customer working as a team. Because of the high complexity of these devices and their close relationship to end product performance, this team approach assures the optimum performance and price.

Vishay EFI's processes and equipment have been designed to support the production of small lots as well as high volume runs on the same production and class 1000 lines. All processing is performed in contiguous class 100 clean rooms.

Substrates are available in a wide variety of materials, conductor and adhesion metals and with either nichrome or tantalum nitride resistors depending on the application, customer preference, and manufacturing requirements. Other options include: metalized-through holes, filled vias, backside metalization and patterning, wrap around patterned edges, thick copper power line conductors, and both aluminum and gold wire bond pads on the same substrate to provide monometallic interfaces in very high temperature applications.

- Vishay EFI manufactures patterned substrates for the hybrid circuit industry as large as 4 inches x 4 inches, many with high density fine lines and sometimes with hundreds of resistors.
- Patterning on both surfaces, interconnections by metalized through holes or patterned wrap-around edges.
- Vishay EFI proprietary, military approved, patterned, resistor overcoat protection (required for 0.1 % or tighter tolerances). Polyimide available where possible at additional cost.
- Overcoat or polyimide insulation for wire bonding over conductors.
- Special bond pad metalization for very high temperature applications.
- In-house laser machining of specially shaped substrates.
- Beryllium Oxide or Aluminum Nitride substrate material for very high power applications.
- Multi-level metalization using polyimide insulation.

Vishay EFI's high quality is maintained by the extensive use of statistical process controls in league with product assurance teams composed of production, engineering and product assurance personnel. As an added control, 100 % of all substrates are visually inspected to MIL-STD-883 Method 2032, level H or K or to the Vishay EFI standard industrial specification as required. 100 % of resistors are tested for value and tolerance. Customer-specific inspection and test requirements can also be included.

DESIGN AND LAYOUT

Most customers provide their own layout design, leaving appropriate space for Vishay EFI to design-in the resistors at the proper locations. Vishay EFI guidelines provide the parameters required for calculating the resistor areas as well as design parameters necessary for proper thin film processing and manufacture. After order placement Vishay EFI will design the resistor details and review the layout design sometimes suggesting small modifications to facilitate manufacture.

If required, Vishay EFI can provide the layout design for hybrid substrates from a schematic. In either case the completed layout design is always sent to the customer for final approval prior to mask fabrication.

CAD SYSTEMS

Vishay EFI CAD systems are compatible with DXF and AUTOCAD, thus designs are often received from the customer by direct data link. Additionally, Vishay EFI assembles all resistor probe cards for laser trimming and testing in-house.

This extensive internal production tooling capability enables Vishay EFI to focus on new designs and initial delivery requirements, free from the difficulties that sometimes arise from subcontractor delays.

MASK FABRICATION

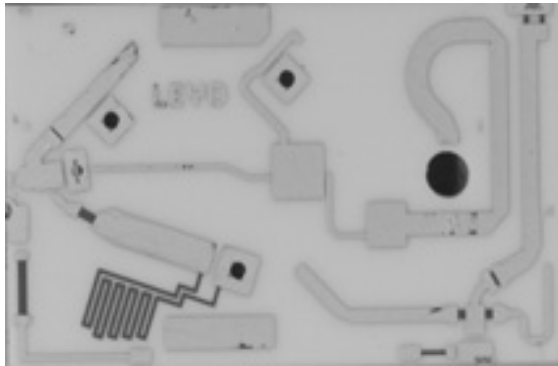
Vishay EFI has masks fabricated by outside vendors. Vishay EFI has developed working arrangements and direct data links with select vendors for quick turn around of mask sets.

PRICE QUOTATION

If your layout is complete, send it with the appropriate data to the Vishay EFI Application Engineering Department (401) 738-9150 FAX: (401) 738-4389. If you do not already have a completed layout, contact our Application Engineers to discuss your requirements. Please include a table of resistor values, tolerances, temperature coefficients of resistance (TCR) and power dissipations.

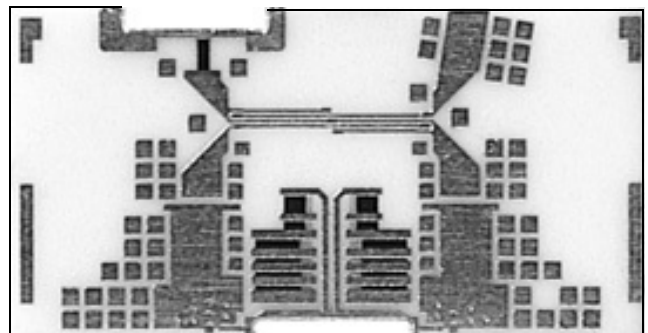


SUBSTRATE CHARACTERISTICS	
Material	Al ₂ O ₃ , BeO, AlN, Quartz, Silicon, Sapphire, Ferrite
Surface Finish Al ₂ O ₃	As Fired, 2 microinches maximum; Polished, to 0.5 microinches
Dimensions	0.02 inches x 0.02 inches to 4 inches x 4 inches
Dimensional Tolerance	± 0.005 inches scribed; (± 0.001 inches saw cut)
Thickness	0.005 inches to 0.050 inches
Thickness Tolerance	0.002 inches standard to as tight as 0.0005 inches
Sputtered Resistor Material	NiCr, Ta ₂ N
Sputtered Metalization	Ti, TiW, Pd, Ni, Au, Al
Electro-Plated Metals	Au, Cu, Ni, Solder
Electroless Plated Metals	Sn, Ni, Au



PATTERN CAPABILITIES	
Conductor Line Width	0.002 inches, most economical; 0.001 inches, available
Conductor Line Thickness	50 to 300 microinches; 0.002 inches thick Cu standard; up to 0.006 inches available
Line Width Tolerance	0.0001 inch at 150 microinches thickness
Through Hole Minimum Diameter	0.005 inches dependent on substrate thickness
Through Hole Tolerance, Diameter and Position	± 0.002 inches
Metalized Hole Diameter to Substrate Thickness Ratio	0.8 minimum or greater preferred

RESISTOR PARAMETERS	
Value Range	1 Ω to 10 MΩ
Absolute Tolerance	to ± 0.05 %
Ratio Tolerance	to ± 0.01 %*
Absolute TCR	± 50 ppm/°C standard; ± 25 and ± 10 ppm/°C available
Ratio TCR	± 5.0 ppm/°C standard; ± 1.0 ppm/°C available
Long Term Stability	Absolute and Ratio, see graphs in Resistor Long Term Stability datasheet



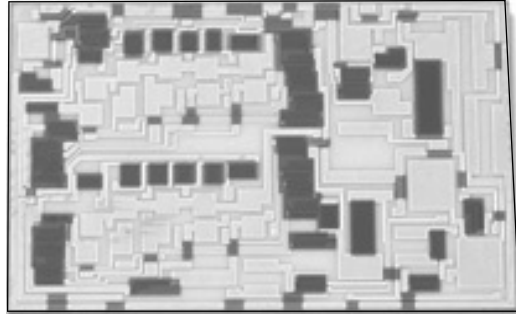
*Contact Applications Engineering for tighter tolerances.

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PROTECTIVE COATING

In 1975, Vishay Electro-Films (EFI) developed a low cost patternable overcoat to protect the resistors and other critical areas from mechanical damage during handling. It is essential to overcoat resistors of 0.1 % or tighter tolerances to maintain tolerance during assembly and test of the hybrid, and it is beneficial to overcoat all resistors. This overcoating material was evaluated by the Rome Air Force Development Laboratory and approved for use under MIL-STD-883.

In this photograph the dark areas are where the patterned overcoating has been applied over the resistors.



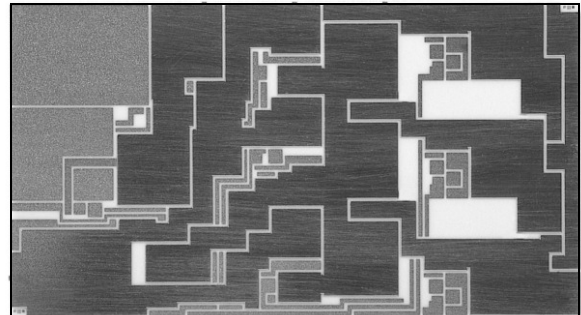
HIGH CONDUCTANCE POWER LINES

For high power applications, Vishay EFI can provide power lines with up to 0.006 inches thick copper.

Copper conductors to 0.002 inches thickness can be integrated on substrates in relatively close proximity to the fine line patterns without any degradation of the patterning capability.

Copper lines are isolated with nickel barrier layers to prevent copper oxidation and intermetallic diffusion during high temperature processing and operation.

This photograph illustrates thick conductor bonding pads and interconnects. Thin small-signal lines can easily be incorporated on the same substrate.



LASER MACHINED SHAPES

In house laser machining of ceramic provides Vishay EFI with the ability to offer custom shaped ceramic substrates, cut outs and holes for special applications.

LINE WIDTH CONTROL

Vishay EFI's tight process controls and extensive class 100 clean room facilities, provide the capability for maintaining superior line width and line edge definition for critical elements such as couplers and filters. Lines of 500 microinches with spaces of 400 microinches and tolerances of ± 50 microinches can be supplied in volume.

