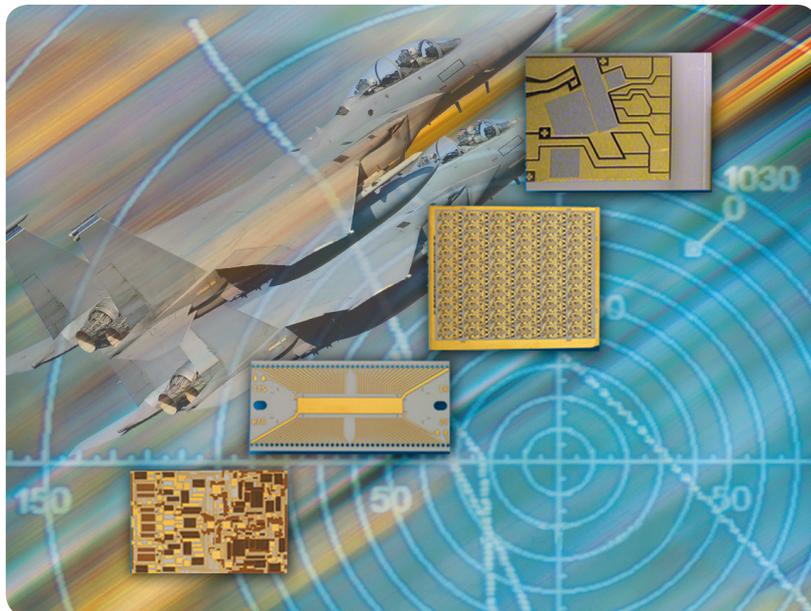




RF FILTERS - CUSTOM RF DESIGNS

Vishay Electro-Films

Uncompromised Quality Characterizes Vishay Electro-Films Filter Products



BUILD-TO-PRINT SERVICES

Vishay EFI is a well-established source of thin film products for RF applications. The EFI division was established by a series of acquisitions incorporating the portfolios of companies such as Electro-Films, MIC, and Semi-Films. Our products include many legacy projects dating as far back as the 1970s. The majority of the existing business is based on a build-to-print model where the design parameters are determined by our customers and critical dimensions and metal thicknesses are communicated via source-controlled drawings.

BUILD TO SPEC

As an additional service, EFI offers RF testing and qualification for a wide variety of RF products. Other products such as couplers, circulators, resonators, and power amplifiers can also be sourced through Vishay EFI. Uncompromised quality will continue to characterize filter products designed and manufactured by Vishay EFI.

RESOURCES

- For technical questions, contact efi@vishay.com.

A **WORLD OF**
SOLUTIONS



RF FILTERS - CUSTOM RF DESIGNS

Vishay Electro-Films

Why Use Vishay EFI's Build-to-Print Services?

1. Broad product offering:

Vishay EFI's wide selection of substrate and metallization materials can be used to manufacture a selection of thin film distributed element filters in a wide variety of topologies. In addition, Vishay's thin film inductors and capacitors can be embedded into the substrate to create lumped element assemblies. In cases where higher density of capacitance or inductance is required, Vishay's ceramic capacitors and air core inductors can be included.

2. Low inductance via technology:

Vishay EFI offers a unique filled via process capable of producing solid-filled gold vias. These vias are characterized by lower parasitic inductance when compared to other via filling techniques. Using EFI's filled vias eliminates most of the parasitic inductance, resulting in tighter manufacturing tolerances and measured responses closer to the simulated values.

3. Ultra-low thermal resistance:

Substrates for high-power amplifiers combine RF circuitry with power management requirements. EFI has extensive experience working with highly thermal conductive ceramic substrates such as BeO and AlN. In addition, precision patterning of thick copper traces in conjunction with solid-filled, pure-copper vias further improves thermal characteristics.

4. RF testing:

Vishay EFI is capable of making functional measurements on RF circuits at frequencies of up to 50 GHz. Vishay EFI is equipped with a wide selection of probes, probe stations, and test fixtures.

The RF testing capability available at EFI allows for the delivery of 100 % yielded products according to customer test specifications. Measured S parameter results, traceable to the individual component, can be delivered upon request.

5. Environmental testing and qualification:

A wide range of environmental testing such as stability, thermal shock, and temperature responses are also available per MIL-PRF-38534 and MIL-PRF-55342.

6. Packaging and assembly:

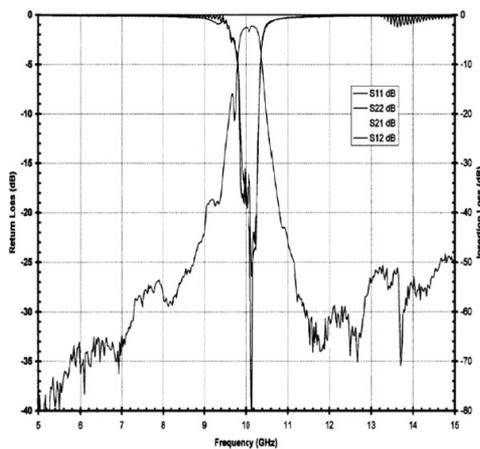
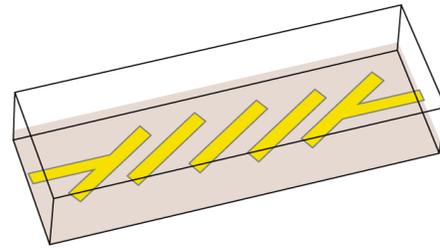
Vishay EFI has the capability to assemble/package the filters in custom-designed RF packages. Both epoxy and solder die attach is available. Manual wire bonding with both aluminum and gold wire is used to complete the assembly process.

Distributed Element Filters

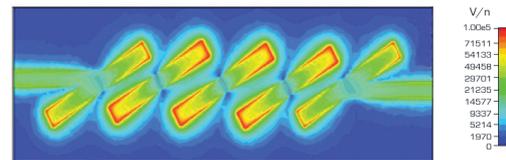
The superior performance of high-grade substrate materials and thin film metallization becomes significant at frequencies higher than a few GHz.

Ceramic Material Selection					
Material	Surface Finish (μ)	Dielectric Constant	Standard Thickness (mils)	Thermal Conductivity (W/mk)	CTE (ppm/ $^{\circ}$ C)
Alumina (99.6 %)	< 4	9.9	15, 25	35	8.4
Quartz	< 1	3.8	20	2	0.5
BeO	< 20	8.6	15, 25	250	7
AlN	< 20	8.6	15, 25	170	4.6
Barium Titanate	< 20	50 < er < 1000	15, 25	5	10

Standard Metallization				
Application	Adhesion (Å)	Conductor (μ)	Barrier (μ)	Bond (μ)
Weak Signal	TiW	Au		
Strong Signal	Cr 750 ± 250	Cu 2000 max	Pd	Au 50 min



Clamp to range: (Min: 0/Max: 100000)



Type = E-Field (peak)
 Monitor = e-field (f = 10)
 Component = Abs
 Plane at z = -0.47576
 Frequency = 10
 Amplitude Plot
 Maximum - 2d = 462599 V/n at -220.488/-36.604/-0.47576

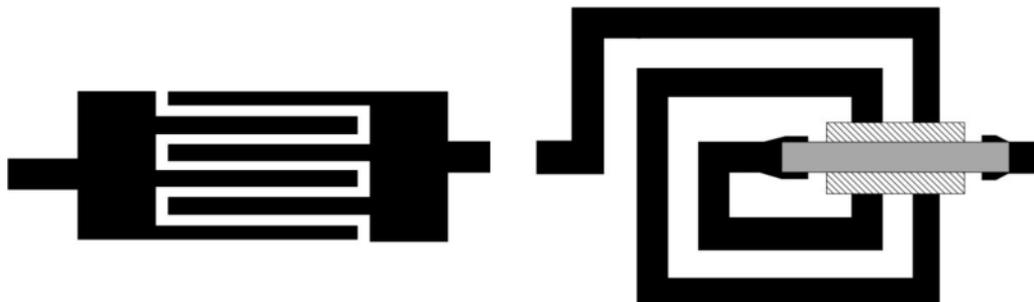
Lumped Element Filters

Vishay EFI's technical advantage is its well-established thin film process. The low capacitance and inductance densities achievable with thin film limit the frequency range of these products to frequencies higher than 1 GHz.

Thin film components are characterized by their high mechanical precision and their low losses. However, the capacitance and inductance density of thin film is limited when compared with discrete component technologies such as multi-layered ceramic capacitors or air core wire wound inductors.

Fully integrated lumped element filters, where both inductive and capacitive elements are fabricated using thin film technology, are typically limited to applications operating at frequencies higher than 1 GHz.

Filters for lower frequencies can be designed and manufactured by assembling Vishay discrete components, such as multi-layered ceramic capacitors and air core wire wound inductors, on thin film substrates. Combining the precision of Vishay EFI's thin film process with the established quality of Vishay's discrete components allows the design and fabrication of high-performance filter structures.



Testing and Characterization

Vishay EFI offers full testing and characterization capabilities for RF products at frequencies up to 50 GHz. A dedicated data acquisition setup can log measured S parameters and perform pass / fail and binning analysis. Logged S parameter results, traceable to the individual component, can be provided upon request. A wide selection of probes can accommodate a range of component terminations.

RF Filter Ground Patterns

Recommended test fixture terminations are described in the following table.

Parameter	Description	Min (μm)	Typical (μm)	Max (μm)
A	Coplanar probe: ground-to-signal distance			800 / 1150
B	Coplanar probe: ground-to-ground distance			1600 / 2300
C	Wave guide width	250	Application-specific	
D	Coplanar ground pad height	250	500	
E	Coplanar ground pad width	250	500	
F	Substrate thickness – limitation applies for micro-strip only		250 or 375	

Note: Custom probes can be obtained if required by specific designs.

