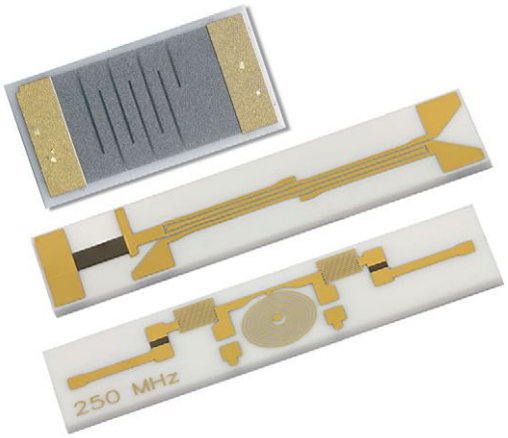
Custom Substrates - Conductor Resistor Pattern and Overcoat



FEATURES

- Precision conductor and resistor patterns
- TaN and NiCr resistor films
- Resistor tolerance down to 0.1 %
- Silicon nitirde, and polyimide overcoat coatings
- Metallization on 1 or 2 surfaces
- Various substrate materials
- Sputtered / plated metal systems
- Custom sizes from 0.020" x 0.020" to 4.000" x 4.000"
- Quick delivery available

APPLICATIONS

Vishay EFI conductor resistor patterned substrates with optional overcoat coatings are used in the hybrid circuit, microwave, and telecommunications industries. These conductor resistor patterns are precisely manufactured to be used for precision current flow, voltage division and RF / Microwave designs. Resistor overcoat options are used for resistor protection and can be applied and patterned to match the conductor and / or resistor pattern. The conductor resistor patterned substrates are manufactured using Vishay Electro-Films (EFI) sophisticated thin film equipment and manufacturing technology. The custom specialty film substrates are visually inspected to MIL-STD-883, method 2032 class H or K.

THIN FILM DESIGN GUIDELINES

For further detail, please reference document:
Thin Film Design Guide for RF and UWave Substrates (www.vishay.com/doc?49109).

SUBSTRATE MATERIALS

For substrate materials and their properties, please reference datasheet: SPF1 (www.vishay.com/doc?61105).

METAL SYSTEM AND CONDUCTOR PATTERNING

For metal system options and metal patterning guidelines, please reference datasheet: SPF2 (www.vishay.com/doc?61110).

INTEGRATING THIN FILM RESISTORS

Vishay EFI offers two thin film resistor film choices of lithographically patterned Tantalum Nitride (TaN) or Nickel Chromium (NiCr). The resistive film should be selected based upon application-specific requirements such as performance, assembly packaging needs, and temperature exposure. The table below summarizes the key standard parameters of these resistor materials.

STANDARD THIN FILM RESISTOR PARAMETERS

MATERIAL	TCR (ppm/°C)	STANDARD SHEET RESISTIVITY 99.6 % Al_2O_3 (Ω/sq)	STANDARD SHEET RESISTIVITY AlN, BeO (Ω/sq)	STABILITY (1)	TOLERANCE (2)
TaN	± 50	20 to 125	25 to 100	< 0.1 %	0.1 % to 20 %
NiCr	± 25	25 to 225	50 to 150	< 0.1 %	0.1 % to 20 %

Notes

(1) 1000 h at 125 °C in air

(2) Special tolerances available

CURRENT DENSITY

To ensure optimal Resistor performance, the design engineer must consider the self-heating effects of the operating resistor and understand the power dissipation characteristics of the environment. A complete thermal analysis should be performed by the design engineer to ensure proper thin film resistor design. The following table lists current density standards for common materials.

CURRENT DENSITY					
SHEET RESISTANCE	Al_2O_3	SILICON	QUARTZ	AIN	BeO
25 Ω/sq	4 mA/mil	20 mA/mil	0.5 mA/mil	19 mA/mil	32 mA/mil
50 Ω/sq	2 mA/mil	10 mA/mil	0.25 mA/mil	9.5 mA/mil	16 mA/mil
100 Ω/sq	1 mA/mil	5 mA/mil	0.125 mA/mil	4.7 mA/mil	8 mA/mil
200 Ω/sq	0.5 mA/mil	2.5 mA/mil	0.062 mA/mil	2.3 mA/mil	4 mA/mil

RESISTOR DESIGN

After the thin film resistor values have been determined and a metallization film selected per SPF1 and SPF2 datasheets, the thin film resistor layout can be designed. There are two typical approaches for accomplishing this: the block-style resistor (see Fig. 1) or serpentine- style resistor (see Fig. 2). With both design approaches, it is standard to employ a laser trim process to trim the resistor to the desired value and tolerance. Vishay EFI employs both scrub (edge) trimming and plunge trimming techniques to achieve the desired resistor value.

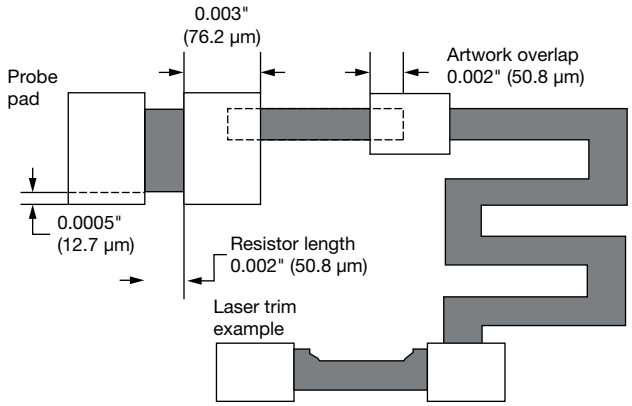


Fig. 1 - Probe pad and artwork overlap requirements (minimum)

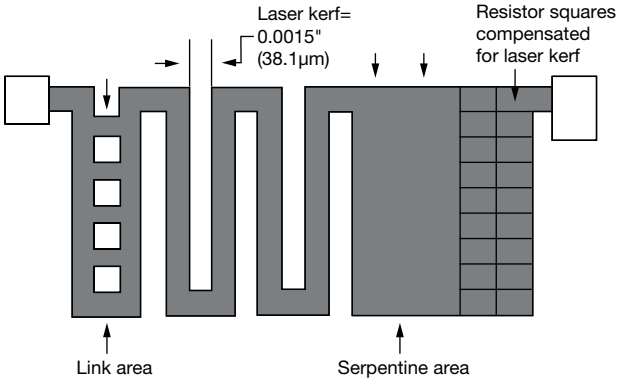


Fig. 2 - Serpentine resistor with two areas for laser trim

RESISTOR DESIGN RULES		
PARAMETER	VALUES	COMMENTS
Min. resistor dimension	0.002" x 0.002" (50 µm x 50 µm)	
Min. probe pad dimension	0.003" x 0.003" (75 µm x 127 µm)	For resistors < 1000 Ω, use probe pad size of 0.006" (152 µm) x 0.008" (203 µm)
Min. conductor/resistor design overlap	0.002" (50 µm)	See Fig. 1
Resistor layout dimensions (block resistor/serpentine resistor)	100 % of nominal value / 100 % of nominal resistor value plus laser kerfs of 0.5 mil^2/sq	
Resistor trim	Scrub, plunge, or bake to value	Bake to value ± 10 % or 20 %

All high frequency resistors should be Edge trimmed to value to preserve frequency response. VEFI can also supply resistors of 20 % tolerance (10 % special) or looser tolerances which are designed to 100 % of bake to value with no laser trimming.

PROTECTIVE COATING

Vishay Electro-Films (EFI) has developed several patternable overcoat options 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.

PROTECTIVE COATING APPLICATIONS

OVERCOAT	TYPICAL THICKNESS (Å)	APPLICATIONS
Silicone nitride	4000 to 6000	Resistor overcoat with fine trim capability and integrated capacitor
Polyimide	50 000 to 80 000	Resistor overcoat and solder dam

PROTECTIVE COATING GUIDELINES

OVERCOAT	TYPICAL THICKNESS (Å)	MIN. FEATURE SIZE	MIN. METAL OVERLAP	PATTERN TOLERANCE (1)
Silicone nitride	4000 to 6000	0.004" x 0.004"	0.002"	± 0.002"
Polyimide	50 000 to 80 000	0.004" x 0.004" (2)	0.001"	± 0.002"

Notes

(1) Special tolerance of ± 0.001" available

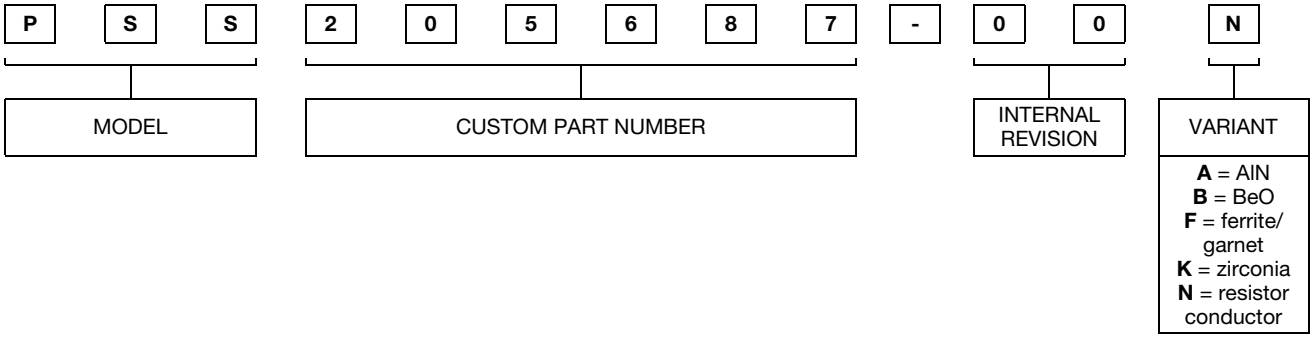
(2) Minimum gap in polyimide pattern is 0.0015" x 0.003"

In summary NiCr will perform at higher sheet resistance with lower TCR than TaN giving higher resistance values in less area. TaN will continue to perform in a moisture environment but NiCr will require a hermetic package to maintain resistance values. Both resistive films will work in highly demanding environments for a wide range of applications with VEFI thin film technology.

GLOBAL PART NUMBER INFORMATION

Custom Global Part Number: PSS205687-00N

Custom Global Part Number Description: Specialty Films Custom 205687-00N



CONTACT INFORMATION

For design assistance, contact: efi@vishay.com

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