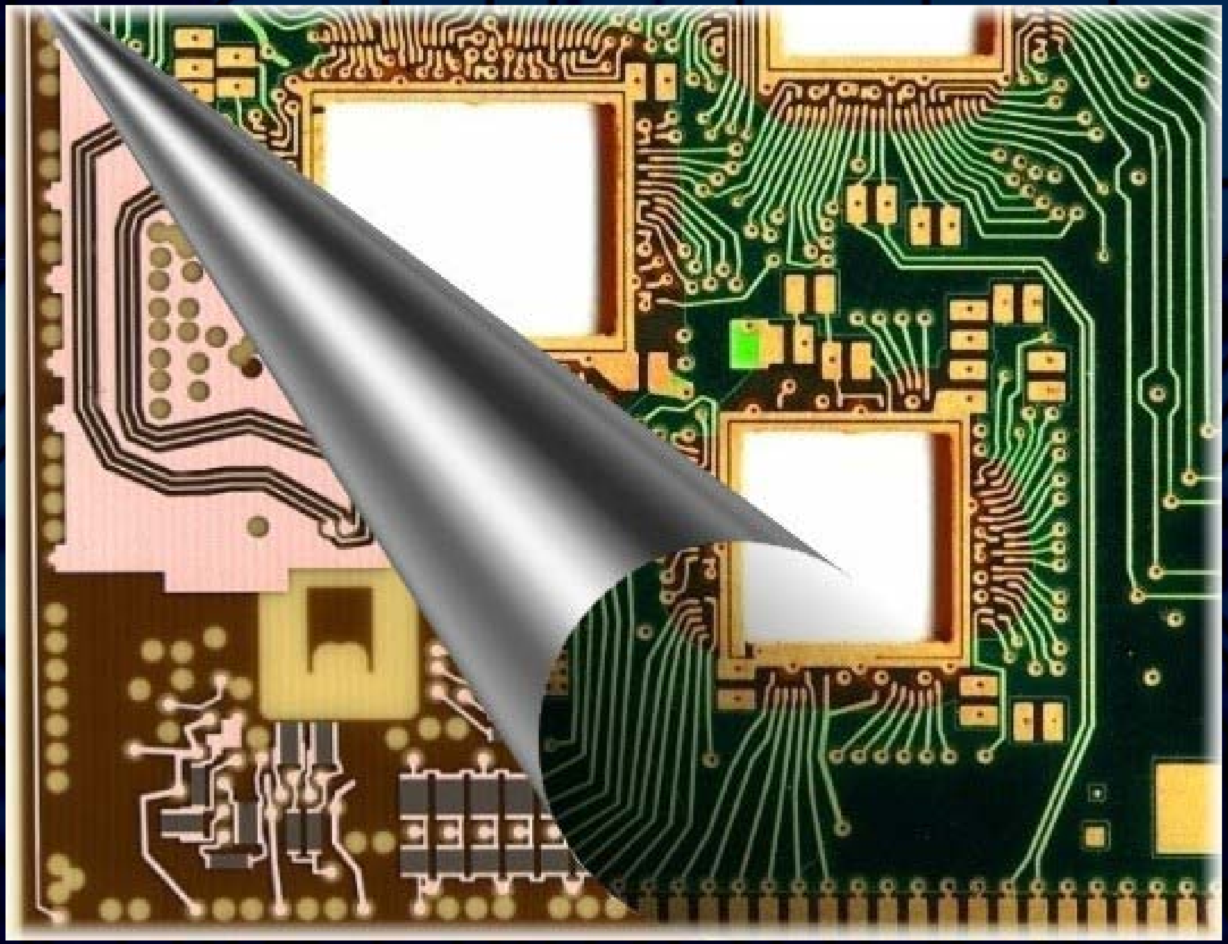
Ohmega Technologies, Inc.



Overview of OhmegaPly® Design Guide

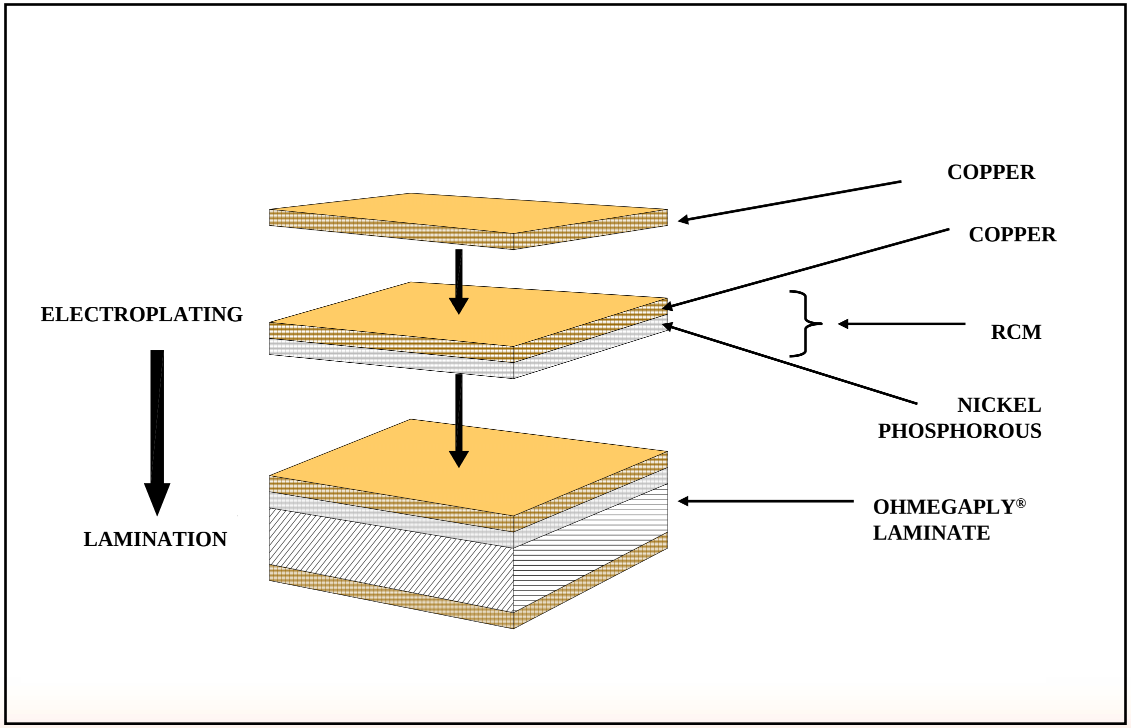
Ohmega Technologies, Inc.

OhmegaPly® Embedded Resistor Technology

1. Electrodeposited thin film resistive material for planar resistor
2. Standard subtractive PCB processing
3. Surface or embedded resistors
4. Mature technology (46 years)
5. Field proven, excellent long term reliability
6. Performance enhancing, cost effective resistor technology in high speed/high density circuit designs

OhmegaPly® Manufacturing Overview

OhmegaPly® is a Nickel Phosphorous (NiP) metal alloy that is electrodeposited onto the matte, or tooth side of copper foil. The thin film NiP metal alloy/copper foil combination is called OhmegaPly RCM (RESISTOR-CONDUCTOR MATERIAL). The RCM is laminated to a dielectric material (like any other copper foil) and subtractively processed to produce copper circuitry and planar resistors. Because of its thin film nature, it can be embedded within layers without increasing the thickness of the board or occupying any board surface area as is required for discrete chip resistors.



OhmegaPly ® Sheet Resistivity Offerings

COPPER TYPE	SHEET RESISTIVITY (OHMS PER SQUARE)					
	10	25	40	50	100	250
PT GRADE						
1/2 oz (18 micron)	0.5R10PT/0.5A10PT	0.5A25PT	0.5A40PT	0.5A50PT	0.5A100PT	0.5A250PT
1 oz (35 micron)	1A10PT	1A25PT		1A50PT	1A100PT	1A250PT
TOC GRADE						
1/2 oz (18 micron)		0.5R25TOC		0.5A50TOC	0.5A100TOC	
1 oz (35 micron)		1R25TOC		1A50TOC	1A100TOC	
MTR TOC GRADE						
3/8 oz (12 micron)	12M10TOC	12M25TOC	12M40TOC	12M50TOC	12M100TOC	12M250TOC
1/2 oz (18 micron)	18M10TOC	18M25TOC	18M40TOC	18M50TOC	18M100TOC	18M250TOC

OhmegaPly® Basic Design Overview

A. Explanation of Ohms-Per-Square

The resistance of a OhmegaPly® resistor:

$$R = R_S \frac{Length\ of\ Resistor}{Width\ of\ Resistor}$$

Equation.1

Where R_S is the sheet resistance (in ohms per square) of the PRT material. The resistance value of the resistor can be determined by sheet resistance and geometry of the resistor according to the formula above.

$$R = R_S \times N$$

Equation.2

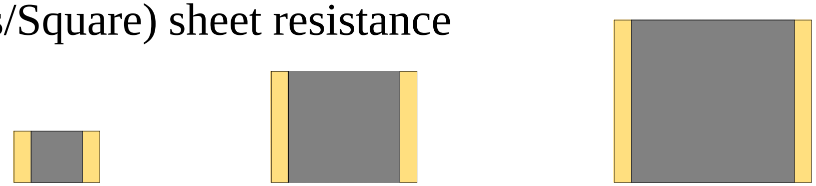
Where N is the number of squares ($N = L/W$)

OhmegaPly® Basic Design Overview

Sheet resistivity (stated in Ohms per square) is dimensionless

- A square area of resistive material = sheet resistivity of resistive material

  E.g., a 25 Ω/□ (Ohms/Square) sheet resistance



L1 = W1
N1 = 1
R1 = 25 Ohms

L2 = W2
N2 = 2
R2 = 25 Ohms

L3 =W3
N3 =3
R3 = 25 Ohms

- Resistor value = sheet resistivity x ratio of element length to width (R =Rs x L/W)

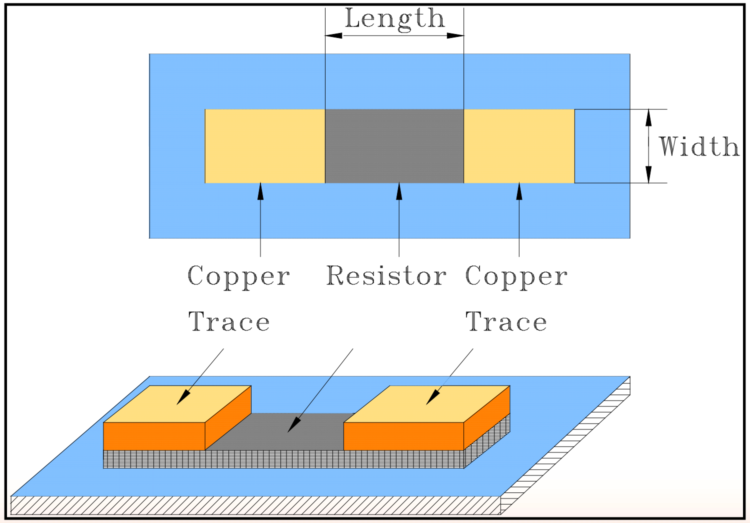
  E.g., a 25 Ω/□ sheet resistivity

  Length = 0.030” (30 mils)

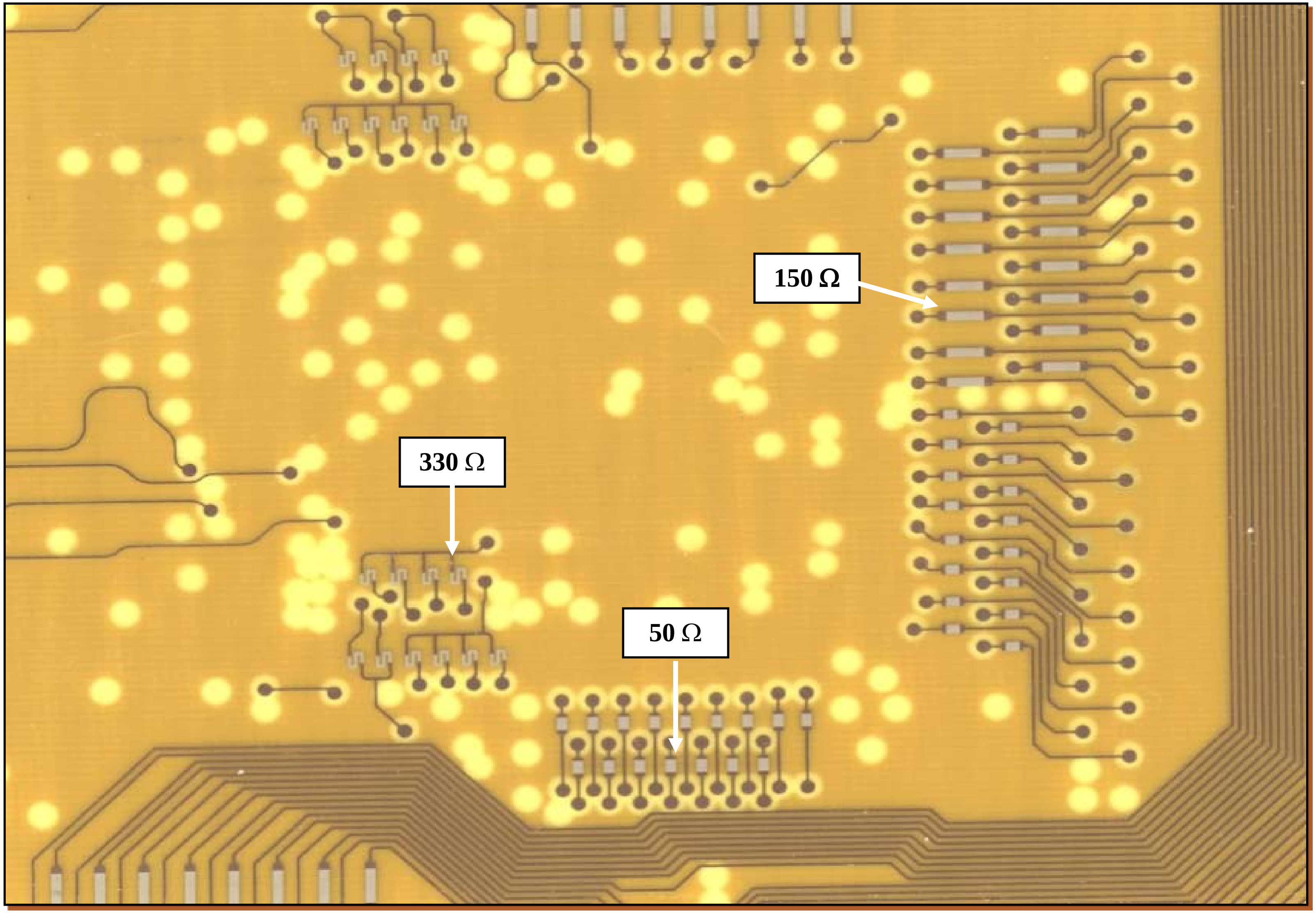
  Width = 0.015 “ (15mils)

  Resistor value = 25 Ω/□ x (30mils/15mils)

  = 25 Ω/□ x 2 squares = 50 ohms



Ohms Per Square

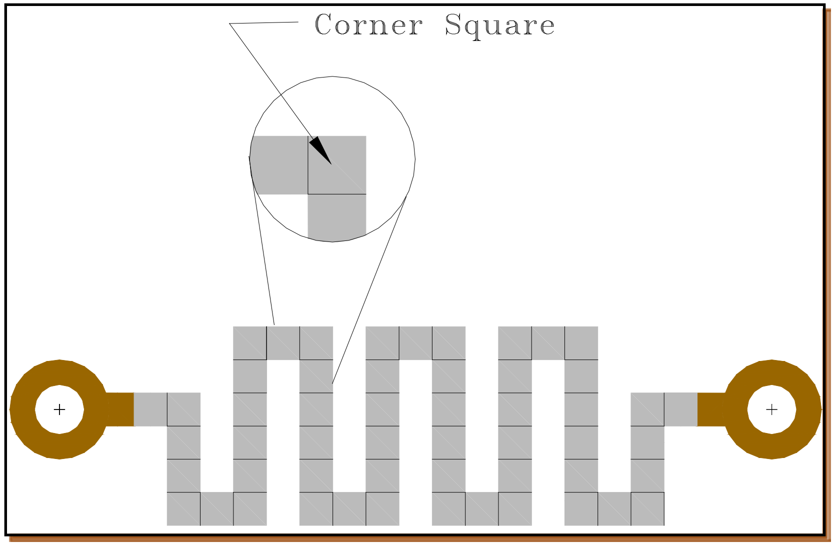


Termination and pull-up resistors in an ATM switching card.

OhmegaPly® Basic Design Overview

2. Meander Type

Basically, a meander resistor can be considered as a bar resistor with the exception of the corner squares (right-angle bends). Due to the change in current density at right-angle path, the effective number of square is ***0.56.***



e.g., sheet resistance (R_S) = 100 Ω/☐

No. of squares = 37

No. of corner squares = 16

Total No. of effective squares = 37 + (16 x 0.56)

= 45.9

≅ 46

Resistance value = 46 x 100

= 4.6 KΩ

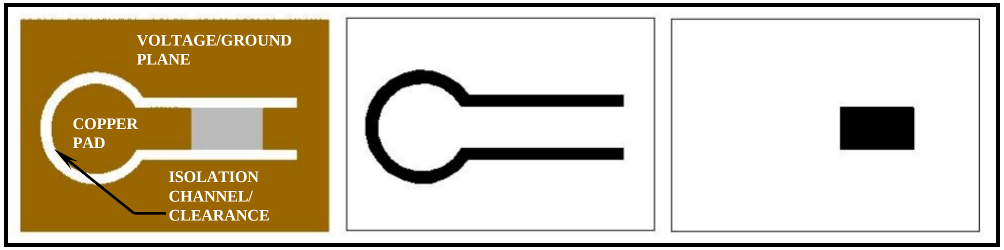
PCB processing of OhmegaPly®

Artwork layout

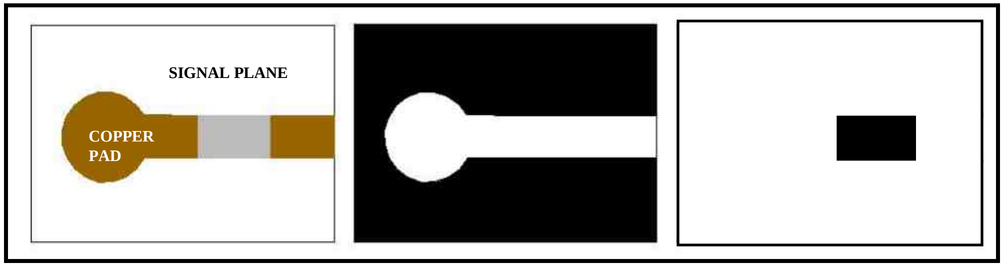
PRT resistors processing consists of two prints:

1st print – COMPOSITE image of conductors and resistors

2nd print – RESISTOR DEFINE image of resistor elements, which is commonly used for voltage or ground plane with most of the copper preserved or CONDUCTOR PROTECT image of conductor, commonly used for signal plane



▲ *Composite (negative film) resistor define*



▲ *Composite (negative film) conductor protect*

Standard CAD Layout Tools

Instructions are available for Ohmega resistor design with the following CAD tools:

1. Mentor Boardstation
2. Allegro
3. Intergraph, Classic
4. PAD Power PCB

The above tools used in conjunction with the Ohmega Design Calculator achieve fully defined planar resistors from schematic to layout.

Ohmega Design Calculator

A - DESIGN SPECIFICATION

Please enter the resistance value (***R***) in Ohm**,** power rating ***(P)*** in milliWatt, and *maximum* tolerance (***t***) in percent for each desired resistor (R_1, R_2, R_3, R_4 & R_5) in table 1 below, and exit the cell to allow the program performs the calculations.

	R_1	R_2	R_3	R_4	R_5
Resistance Value ***(R)*** in Ohm	22	33	125	1000	4700
Power Rating ***(P)*** in mW	65	65	125	125	125
Maximum Tolerance ***(t)*** in %	12	12	12	15	15

Table 1. For designer to enter the resistance, power rating and percent tolerance values of desired resistors

B - RECOMMENDED MINIMUM WIDTH AND LENGTH OF DESIRED RESISTORS

Sheet Resistivities (Ohm/Sq.)	R_1			R_2			R_3			R_4			R_5		
	W_1 (Mil)	L_2 (Mil)		W_2 (Mil)	L_2 (Mil)		W_3 (Mil)	L_3 (Mil)		W_4 (Mil)	L_4 (Mil)		W_5 (Mil)	L_5 (Mil)	
10	11.0	24.2	*t**	10.0	33.0	*t**	8.0	100.0	*t**	6.0	600.0	*t**	6.0	2820.0	*t**
25	21.0	18.5	*t**	18.0	23.8	*t**	12.0	60.0	*t**	7.0	280.0	*t**	7.0	1316.0	*t**
50	33.0	14.5	*t**	25.0	16.5	*t**	18.0	45.0	*P**	7.0	140.0	*t**	7.0	658.0	*t**
100	55.0	12.1	*t**	40.0	13.2	*t**	32.0	40.0	*P**	11.0	110.0	*P**	7.0	329.0	*t**
250	433.0	38.1	*P**	300.0	39.6	*t**	105.0	52.5	*t**	19.0	76.0	*P**	15.0	282.0	*t**

Table 2. The recommended minimum width and length for each desired resistor which is calculated by the program base on the given values by the designer in table 1.

This is for example only. A free functional calculator is available on Ohmega website

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