Overview of OhmegaPly® Design Guide
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® 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 subductively 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

<table>
<thead>
<tr>
<th>COPPER TYPE</th>
<th>SHEET RESISTIVITY (OHMS PER SQUARE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>PT GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>1/2 oz (18 micron)</td>
<td>0.5R10PT/0.5A10PT</td>
</tr>
<tr>
<td>1 oz (35 micron)</td>
<td>1A10PT</td>
</tr>
<tr>
<td><strong>TOC GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>1/2 oz (18 micron)</td>
<td></td>
</tr>
<tr>
<td>1 oz (35 micron)</td>
<td>1R25TOC</td>
</tr>
<tr>
<td><strong>MTR TOC GRADE</strong></td>
<td></td>
</tr>
<tr>
<td>3/8 oz (12 micron)</td>
<td>12M10TOC</td>
</tr>
<tr>
<td>1/2 oz (18 micron)</td>
<td>18M10TOC</td>
</tr>
</tbody>
</table>
OhmegaPly® Basic Design Overview

A. Explanation of Ohms-Per-Square

The resistance of a OhmegaPly® resistor:

\[ R = R_s \frac{\text{Length of Resistor}}{\text{Width of Resistor}} \]  

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 \( (N = L/W) \)
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

\[
\begin{align*}
L1 &= W1 \\
N1 &= 1 \\
R1 &= 25 \text{ Ohms} \\
L2 &= W2 \\
N2 &= 2 \\
R2 &= 25 \text{ Ohms} \\
L3 &= W3 \\
N3 &= 3 \\
R3 &= 25 \text{ Ohms}
\end{align*}
\]

- 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/(30mils/15mils)
  = 25 Ω/ 2 squares = 50 ohms
Ohms Per Square

Termination and pull-up resistors in an ATM switching card.
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 $\Omega/$

No. of squares = 37
No. of corner squares = 16
Total No. of effective squares = 37 + (16 x 0.56)
≈ 46
Resistance value = 46 x 100
= 4.6 K$\Omega$
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
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.

<table>
<thead>
<tr>
<th></th>
<th>(R_1)</th>
<th>(R_2)</th>
<th>(R_3)</th>
<th>(R_4)</th>
<th>(R_5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance Value ((R)) in Ohm</td>
<td>22</td>
<td>33</td>
<td>125</td>
<td>1000</td>
<td>4700</td>
</tr>
<tr>
<td>Power Rating ((P)) in mW</td>
<td>65</td>
<td>65</td>
<td>125</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Maximum Tolerance ((t)) in %</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Sheet Resistivities</th>
<th>(R_1)</th>
<th>(R_2)</th>
<th>(R_3)</th>
<th>(R_4)</th>
<th>(R_5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(W_1) (Mil)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(L_1) (Mil)</td>
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<td></td>
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<tr>
<td>(W_2) (Mil)</td>
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<td></td>
<td></td>
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<tr>
<td>(L_2) (Mil)</td>
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<td></td>
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<tr>
<td>(W_3) (Mil)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(L_3) (Mil)</td>
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<td></td>
<td></td>
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<tr>
<td>(W_4) (Mil)</td>
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<td></td>
<td></td>
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<tr>
<td>(L_4) (Mil)</td>
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<td></td>
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<tr>
<td>(W_5) (Mil)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(L_5) (Mil)</td>
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</tbody>
</table>

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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