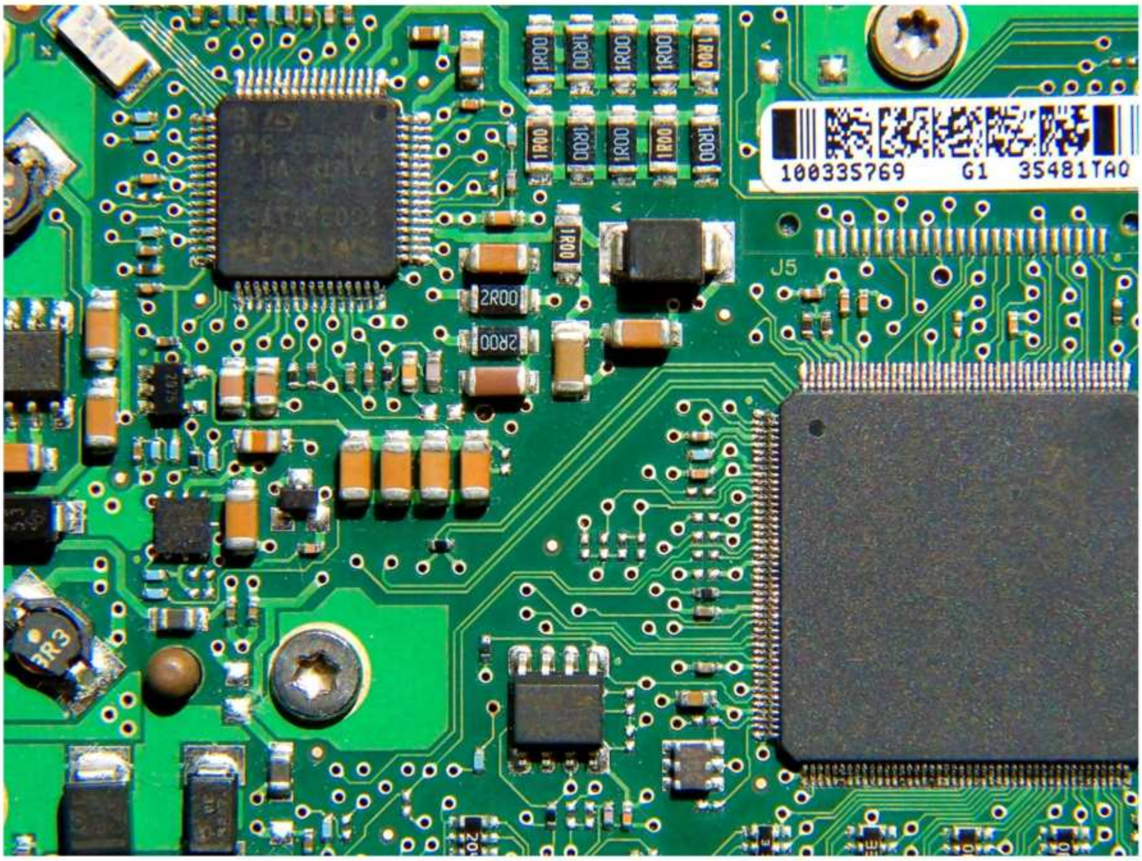
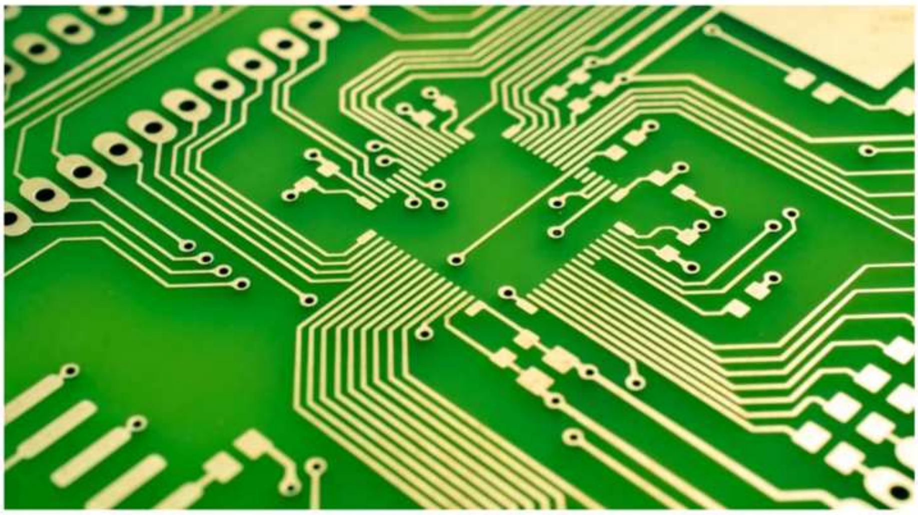
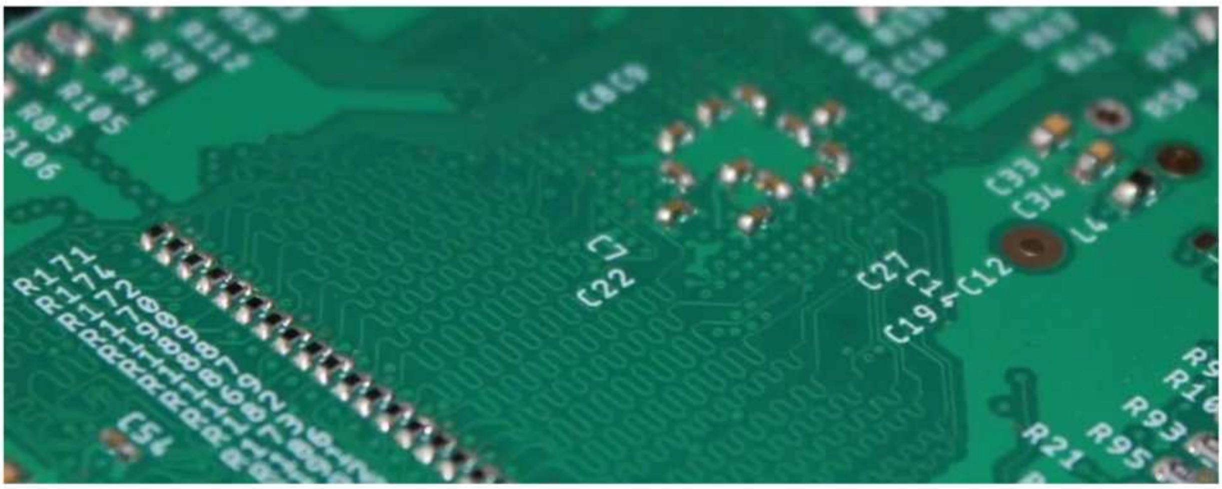
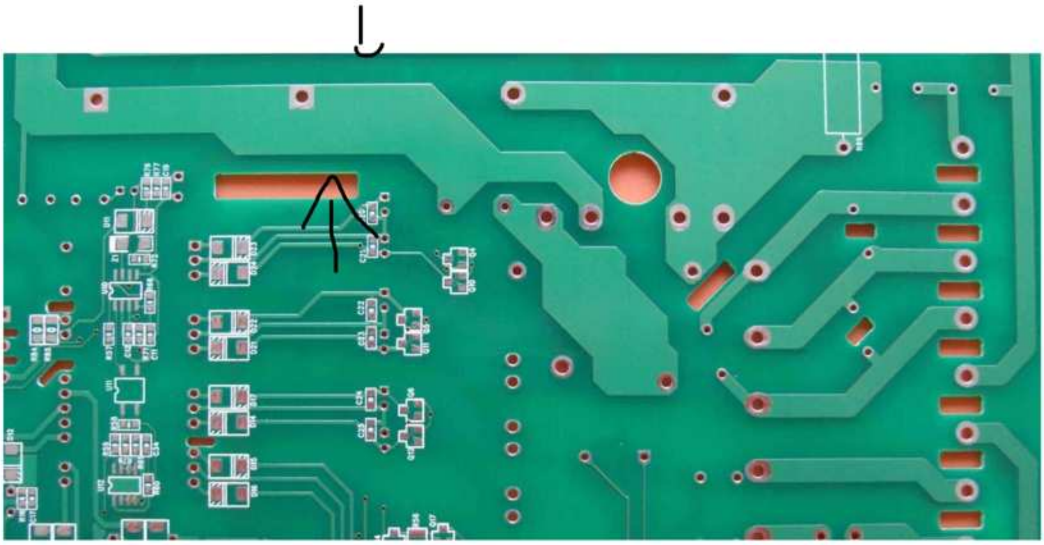
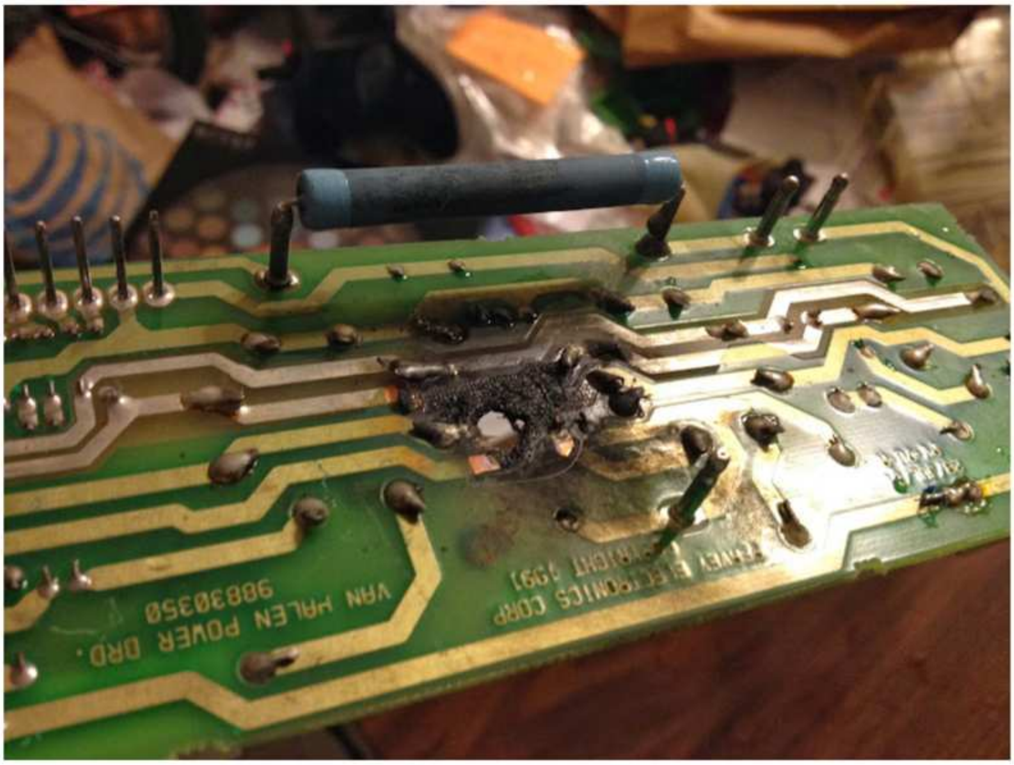

1R00
2R00
J5
100335769 G1 35481TA0

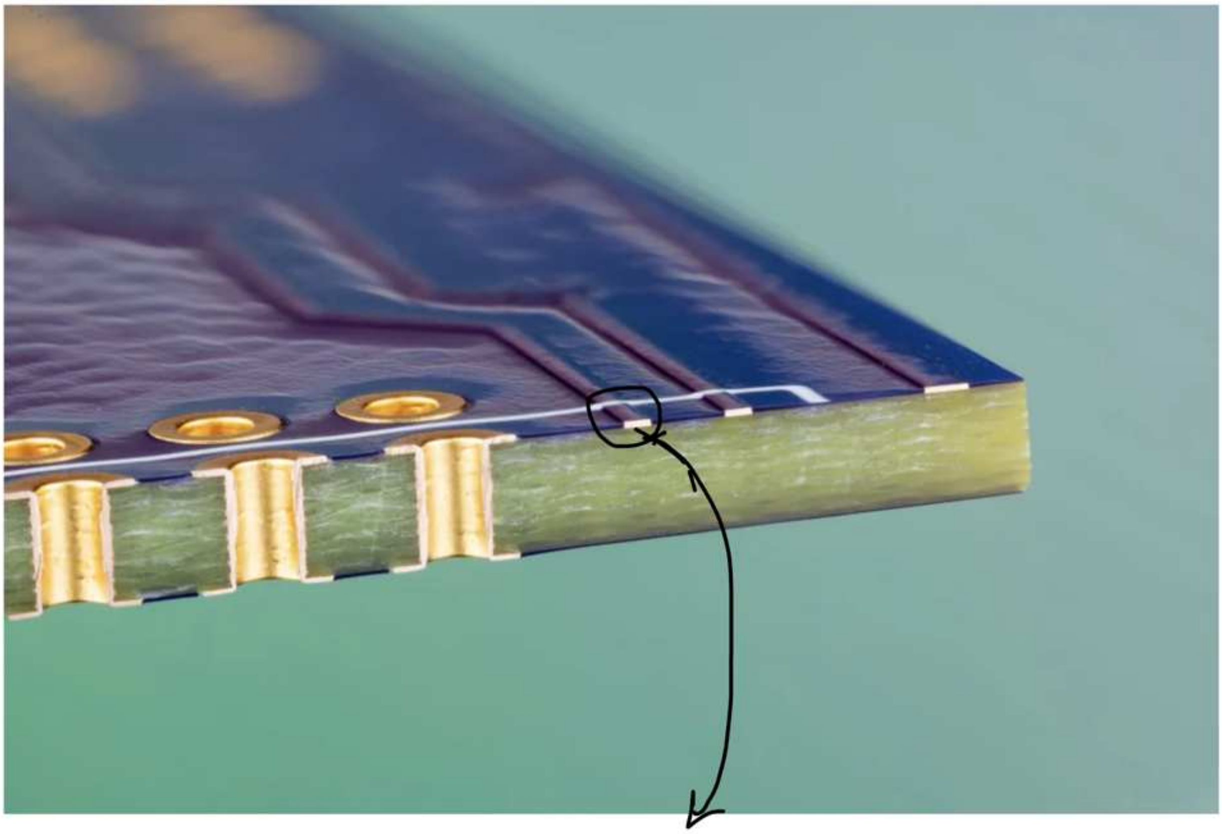


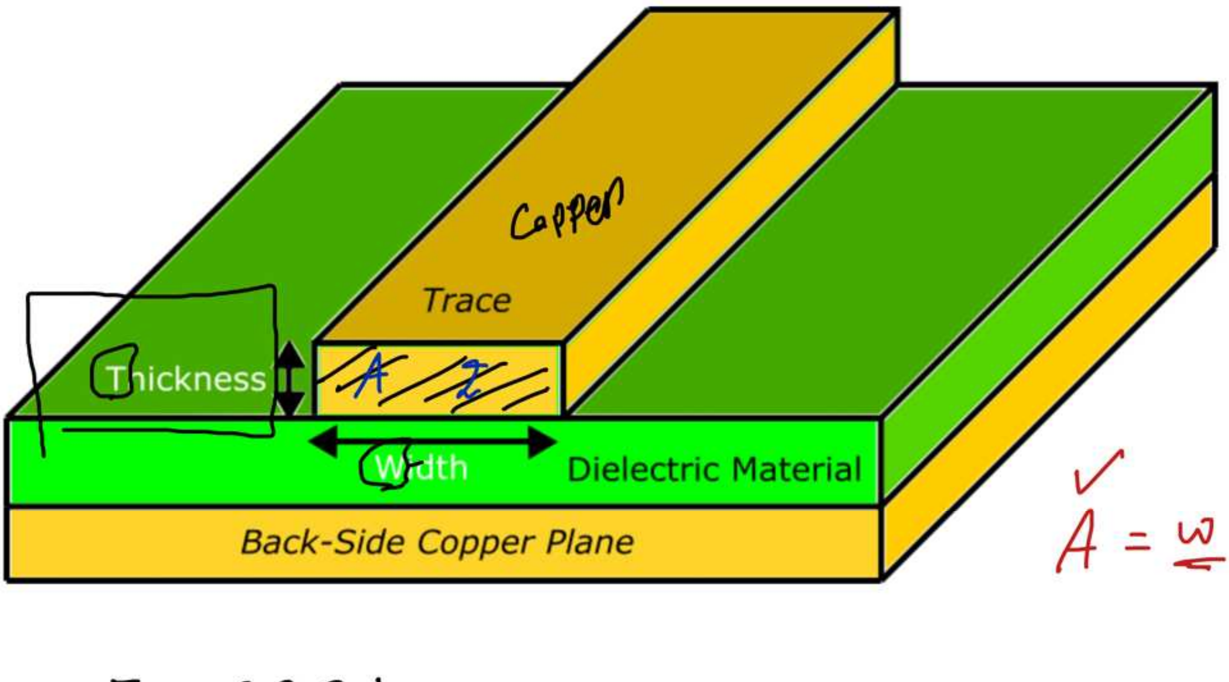

R105
R83
R106
C22
C27
C1
C12
C19
C33
C34
L4
R21
R95
R93
C54




VAN HALEN POWER BRD.
98830350


0.508 mm
1.27 mm



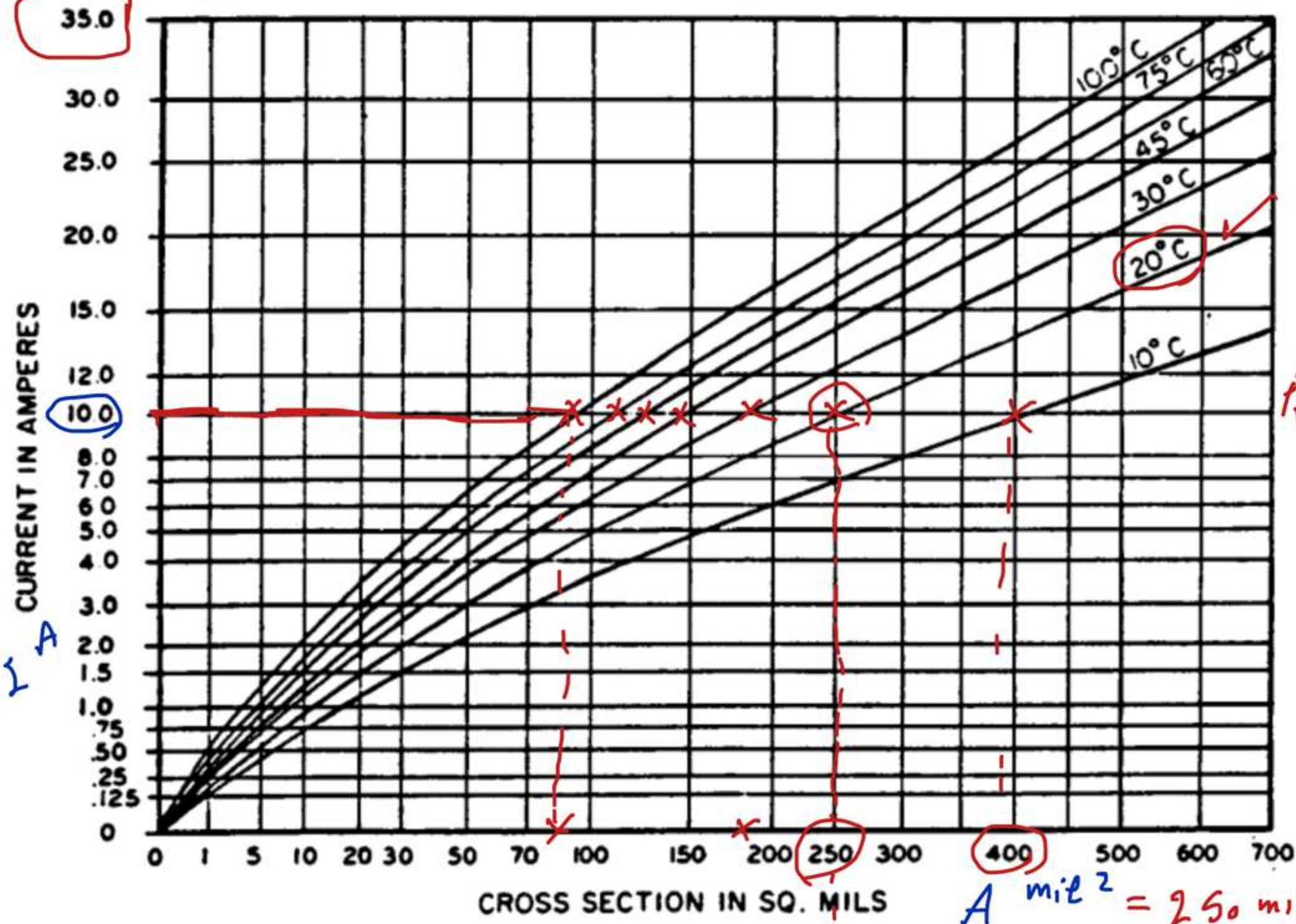


$A = \underline{W} \cdot \boxed{T}$

IPC-2221 ← $I = 10A$, $L = 100mm$, $T_a = 25°$

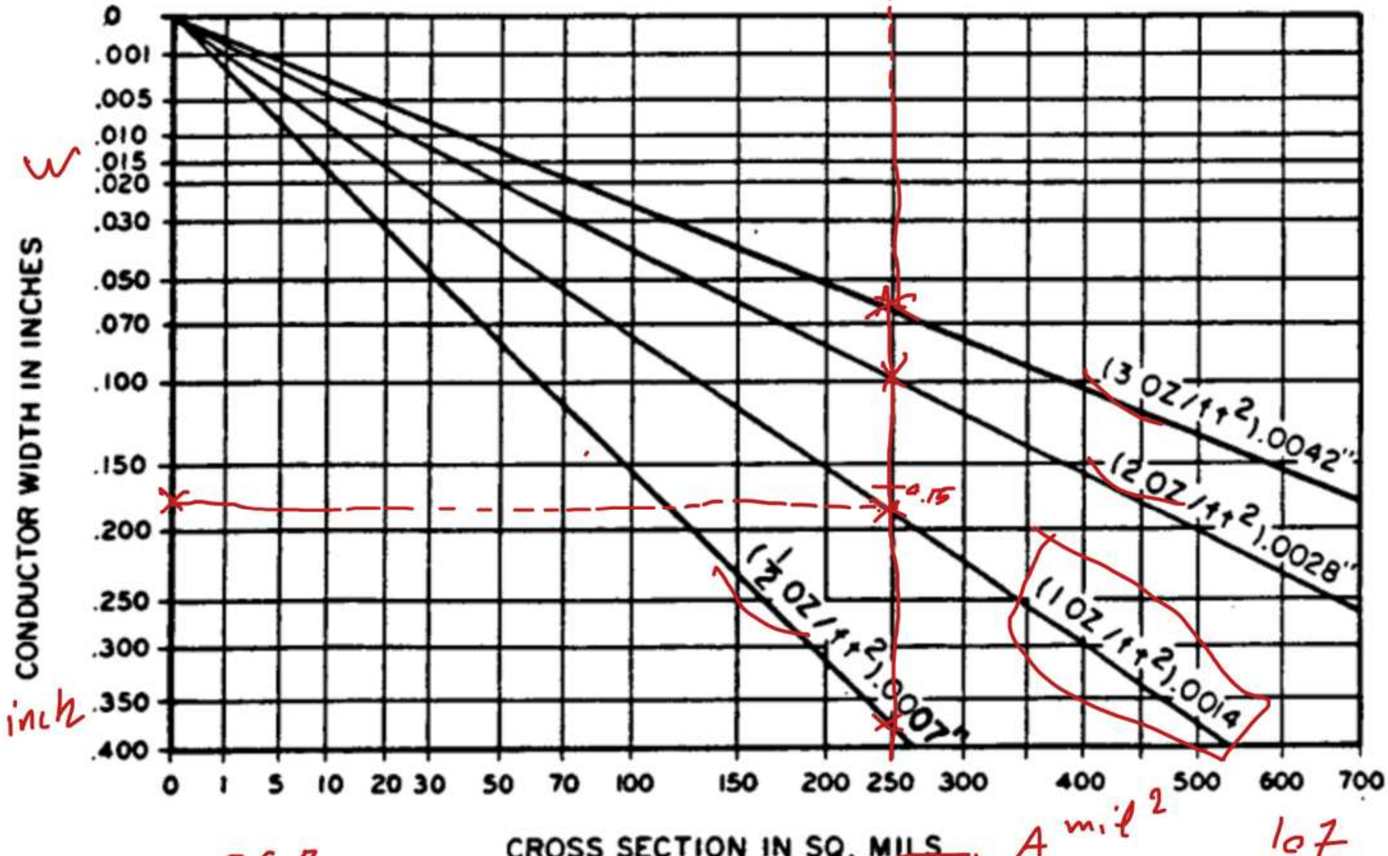
↳ W?

(For use in determining current carrying capacity and sizes of etched copper conductors for various temperature rises above ambient.)



$T_n = 20°C$

$A\ \text{mil}^2 = 250\ \text{mil}^2$



1oZ

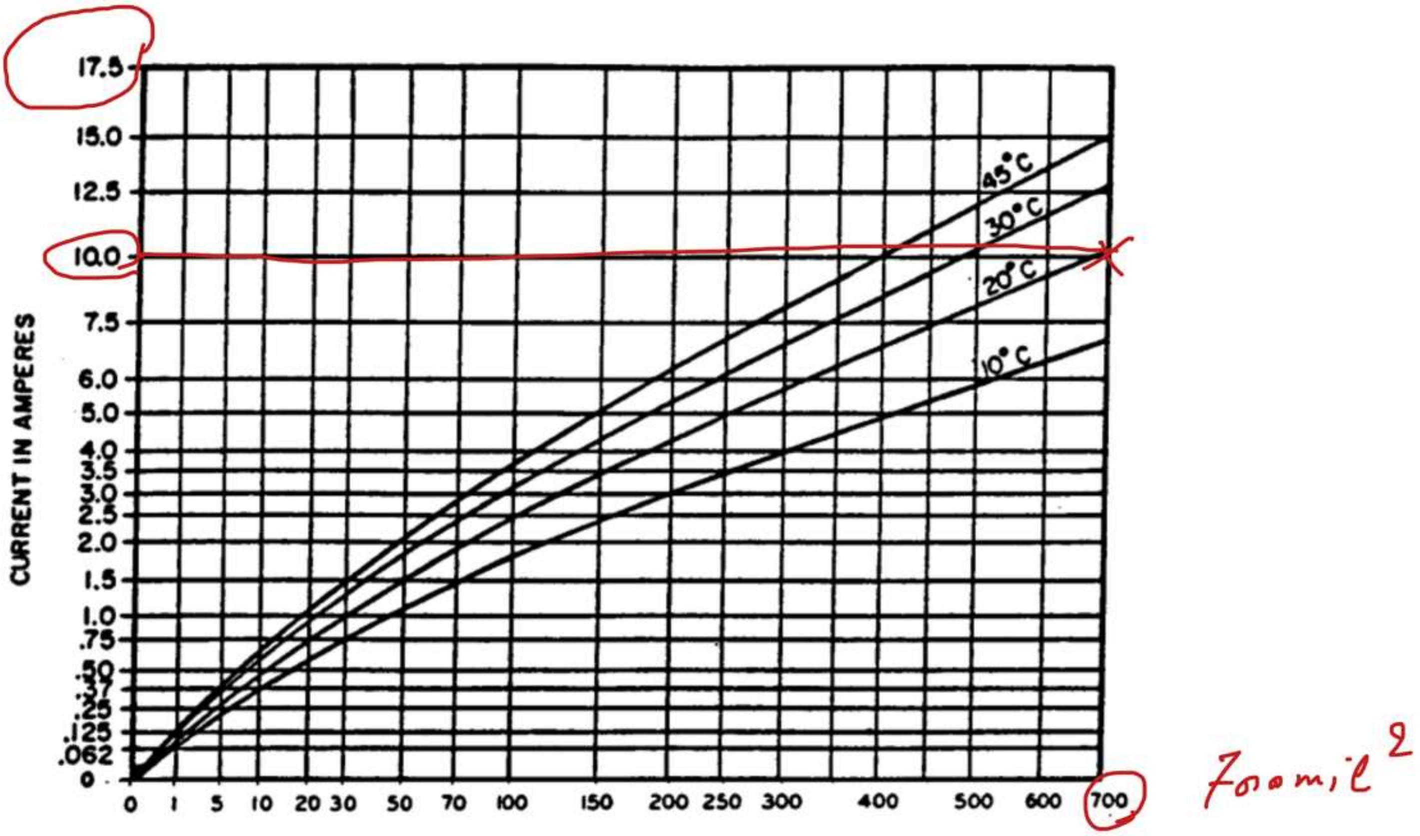
0.18 inch

$0.18 \times \frac{25.4\,mm}{1\,inch} \Rightarrow \boxed{w = 4.572\,mm^2}$

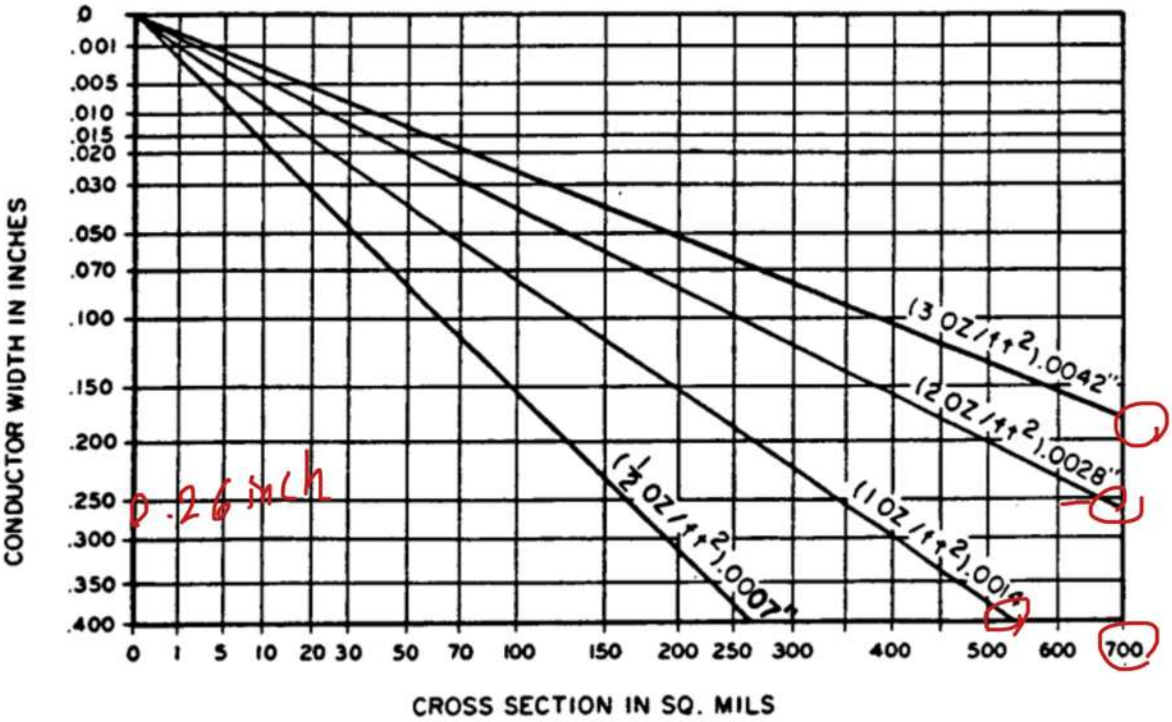
$A\ \text{mil}^2$

1oZ

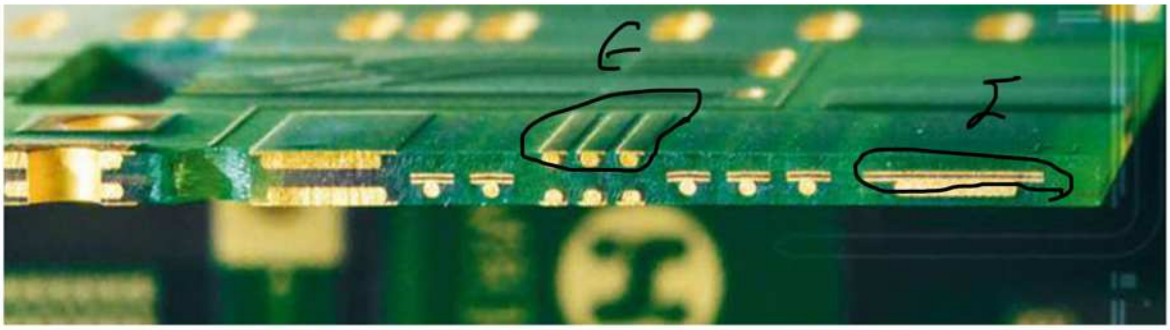
$I = 10A \Rightarrow T_r = 20°C$



CURRENT IN AMPERES
17.5
15.0
12.5
10.0
7.5
6.0
5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.75
.50
.37
.25
.125
.062
0
0 1 5 10 20 30 50 70 100 150 200 250 300 400 500 600 700
45°C
30°C
20°C
10°C
700mil²



CONDUCTOR WIDTH IN INCHES
0
.001
.005
.010
.015
.020
.030
.050
.070
.100
.150
.200
.250
.300
.350
.400
0.26 inch
(3 OZ/ft²).0042"
(2 OZ/ft²).0028"
(1 OZ/ft²).0014"
(1/2 OZ/ft²).0007"
0 1 5 10 20 30 50 70 100 150 200 250 300 400 500 600 700
CROSS SECTION IN SQ. MILS



E
I

$$A = 250\,mil^2 \times \Big(\frac{25.4\,mm}{\underbrace{1000\,mil}_{k}}\Big)^2 \Rightarrow \boxed{A = 0.161\,mm^2}$$

$$\boxed{k = 6.451 \times 10^{-4}}$$

$$A = w \cdot t \Rightarrow w = \frac{A}{t} = \frac{0.161\,mm^2}{35\,\mu m}$$

$$\Rightarrow w \simeq \frac{0.161\,mm^2}{35 \times 10^{-3}\,mm} \Rightarrow \boxed{w \simeq 4.6\,mm}$$

$$I = 0.048 \times \Delta t^{0.44} \times A^{0.725} \qquad \boxed{\Delta t = 20}$$

$$I = 0.048 \times 20^{0.44} \times A^{0.725} \Rightarrow I = 0.179\,A^{0.725}$$

$$\Rightarrow A^{0.725} = \frac{I}{0.179} \Rightarrow A = \sqrt[0.725]{\frac{I}{0.179}} \Rightarrow A^{mil^2} = 10.728\sqrt[0.725]{I}$$

$$A^{mm^2} = 10.728 \times 6.451 \times 10^{-4}\sqrt[0.725]{I} = 6.922 \times 10^{-3}\sqrt[0.725]{I}$$

$$w = \frac{6.922 \times 10^{-3}}{35 \times 10^{-3}}\sqrt[0.725]{I} \Rightarrow w^{mm} = 0.198\sqrt[0.725]{I}$$

1oz - $T_r = 20°C$ - External

$$\Rightarrow \boxed{w^{mm} \simeq 0.2\sqrt[0.725]{I}} \xRightarrow{I = 10A} w = 0.2\sqrt[0.725]{10}$$

$$\Rightarrow \boxed{w = 4.79\,mm}$$

$$R^{\Omega} = \frac{\rho . L^{m}}{A^{m^2}}$$

$$\rho_{(T)} = \rho_0 (1 + \alpha(T - T_0))$$

$T_0 = 25^{\circ}$, $\rho_0 = 1.68 \times 10^{-8}$, $\alpha = 0.00386$

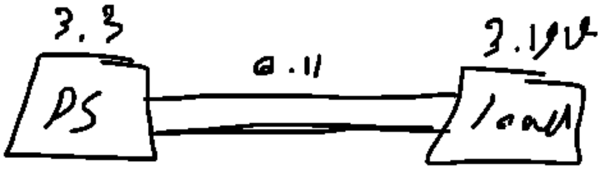
$T = 25 + 20 \Rightarrow \boxed{T = 45}$ $\boxed{\rho_{(45)} = 1.81 \times 10^{-8}}$

$$R = \frac{1.81 \times 10^{-8} \times (100 \times 10^{-3})}{0.165 \times 10^{-6}} \Rightarrow \boxed{R \cong 0.011 \Omega}$$

$P_{loss} = Ri^2 = 0.011 \times 10^2 \Rightarrow \boxed{P_{loss} = 1.1 W}$

$P_{loss} = 10 \log (1100) \Rightarrow \boxed{P_{loss} = 30.4 \, dBm}$

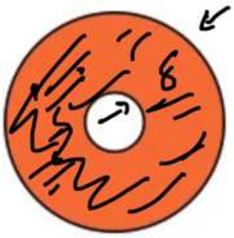
$V_{drop} = Ri = 0.011 \times 10 \Rightarrow \boxed{V_d = 0.11 \, v}$



skin effect

Cross-sectional area of a round conductor available for conducting DC current

“DC resistance”



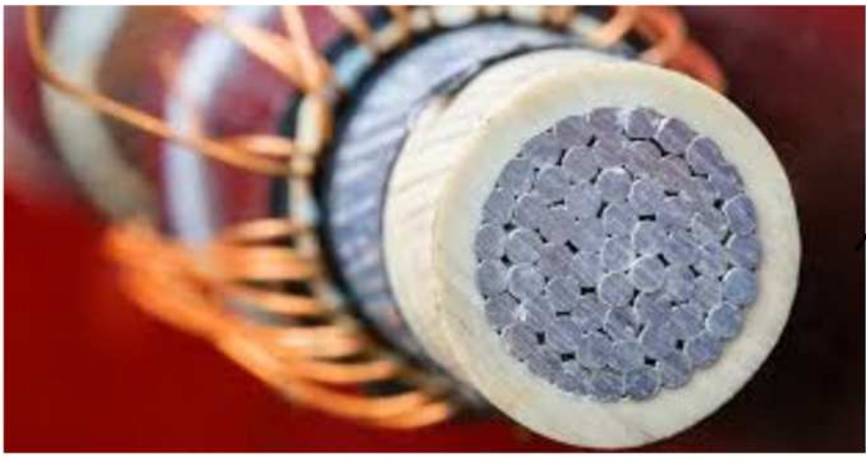
Cross-sectional area of the same conductor available for conducting low-frequency AC

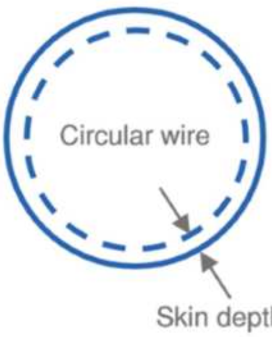
“AC resistance”

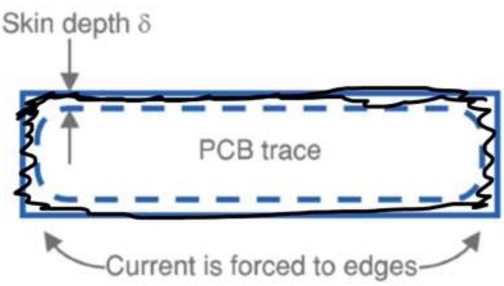
$\delta = 9.2\,\mu m$

Cross-sectional area of the same conductor available for conducting high-frequency AC

“AC resistance”







$$\delta = \frac{\sqrt{\rho}}{\sqrt{\pi \mu_r \mu_0 f}}$$

$\rho = 1.68 \times 10^{-8}$

$\mu_0 = 1.256637 \times 10^{-6}$

$\mu_r = 1$

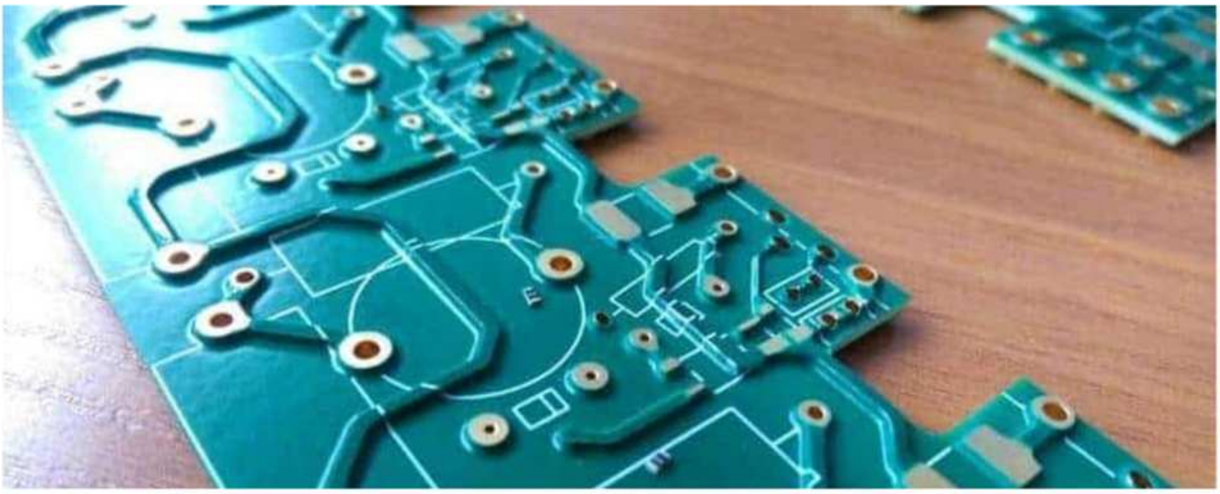
$$\delta = \frac{\sqrt{1.68 \times 10^{-8}}}{\sqrt{\pi \times 1 \times 1.256637 \times 10^{-6}}}$$

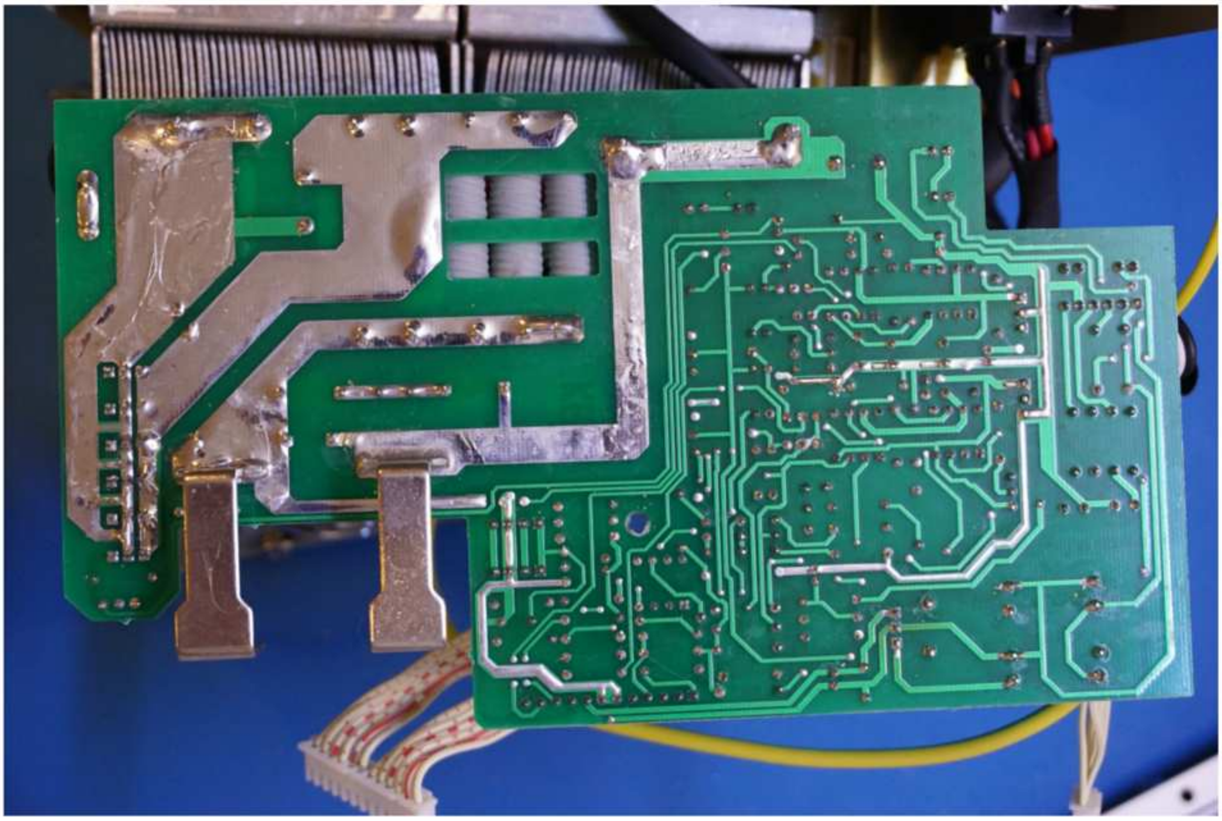
$$\Rightarrow \boxed{\delta = \frac{0.065}{\sqrt{f}}} \qquad f = 50\,MHz$$

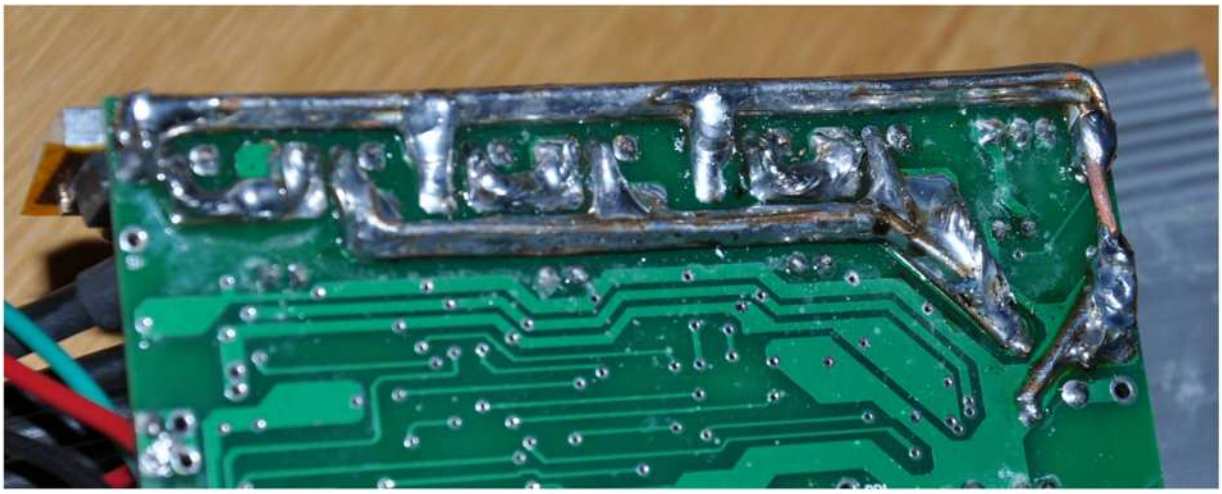
$$\delta = \frac{0.065}{\sqrt{50 \times 10^{6}}} \Rightarrow \boxed{\delta \simeq 9.2\,\mu m}$$

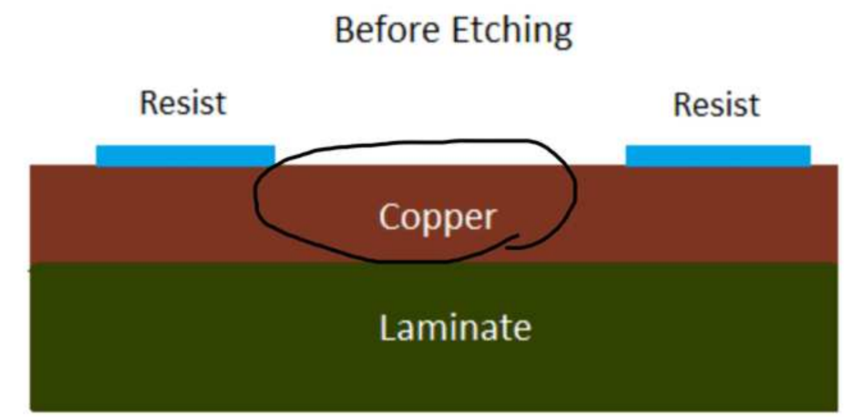
$$P = \frac{2 \times 9.2\mu}{35\mu} \times 100$$

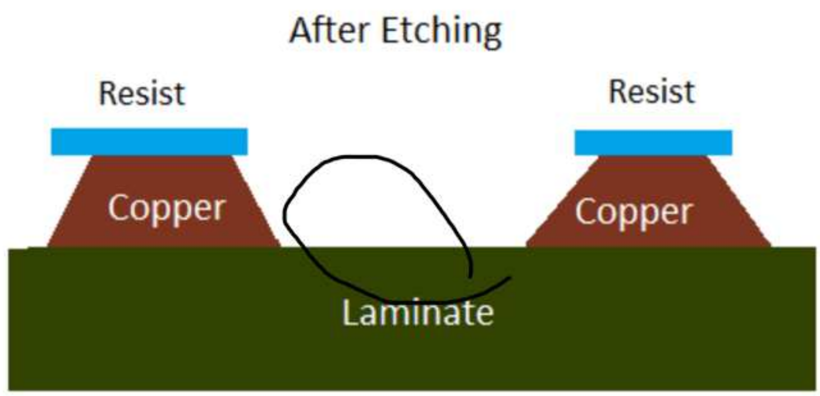
$$\Rightarrow \boxed{P \simeq 52\%}$$

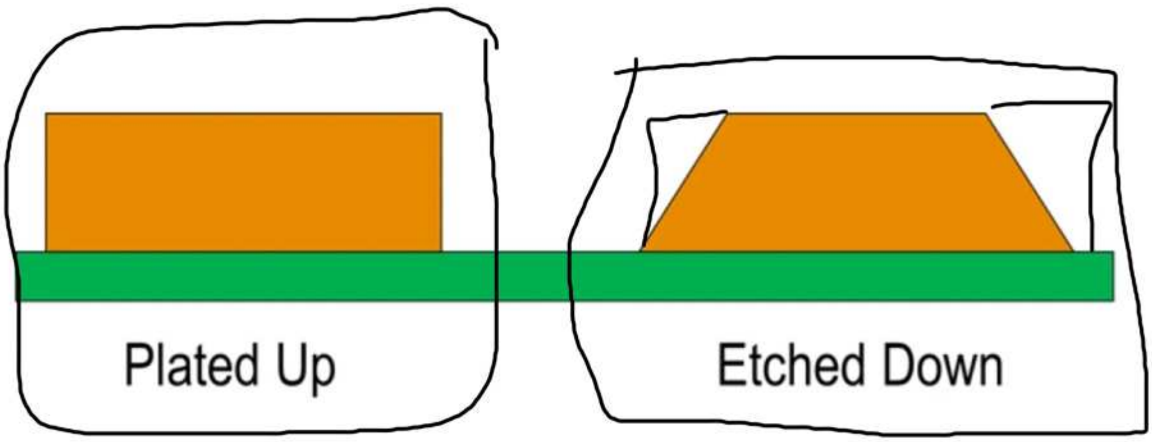


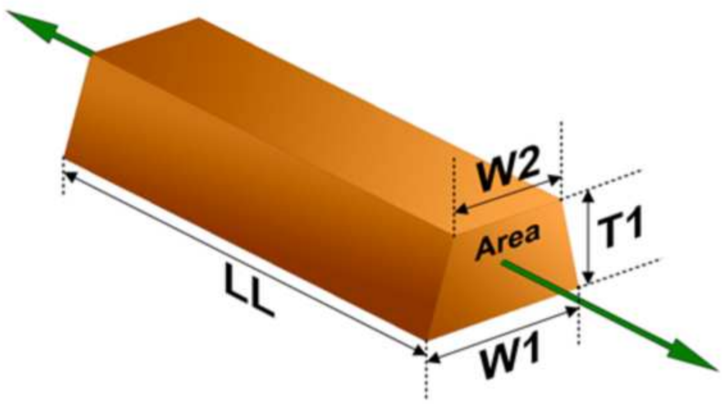


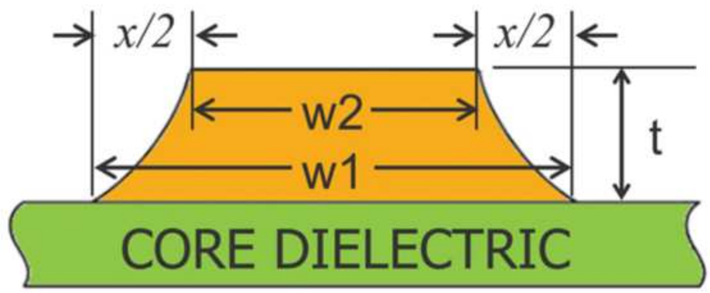



Before Etching
Resist
Resist
Copper
Laminate


After Etching
Resist
Resist
Copper
Copper
Laminate


Plated Up
Etched Down


W2
T1
Area
LL
W1


x/2
x/2
w2
w1
t
CORE DIELECTRIC