

$$R = ?$$

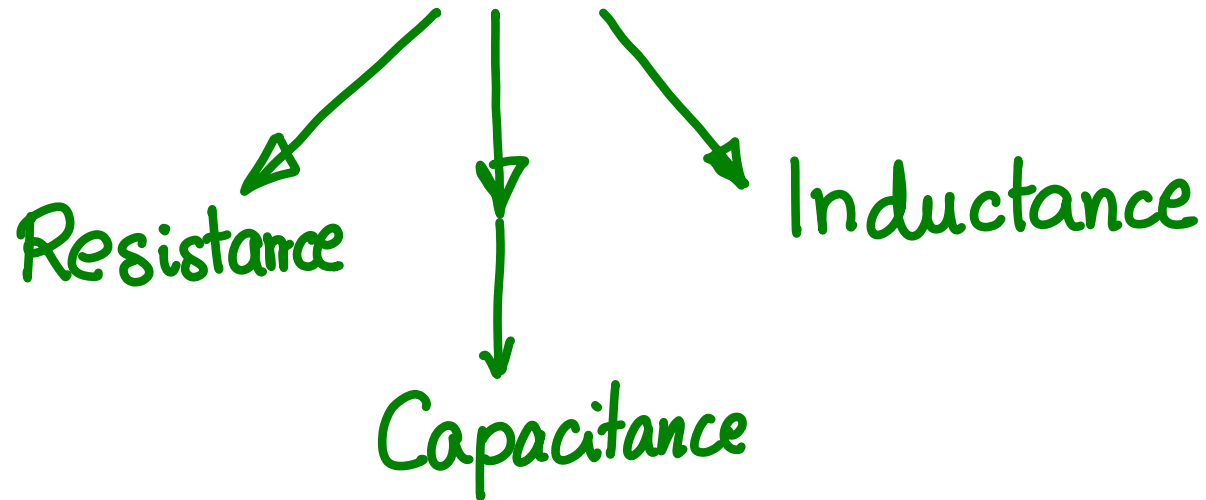
$$0.0049 \Omega$$

$$\approx 5 \text{ m}\Omega$$

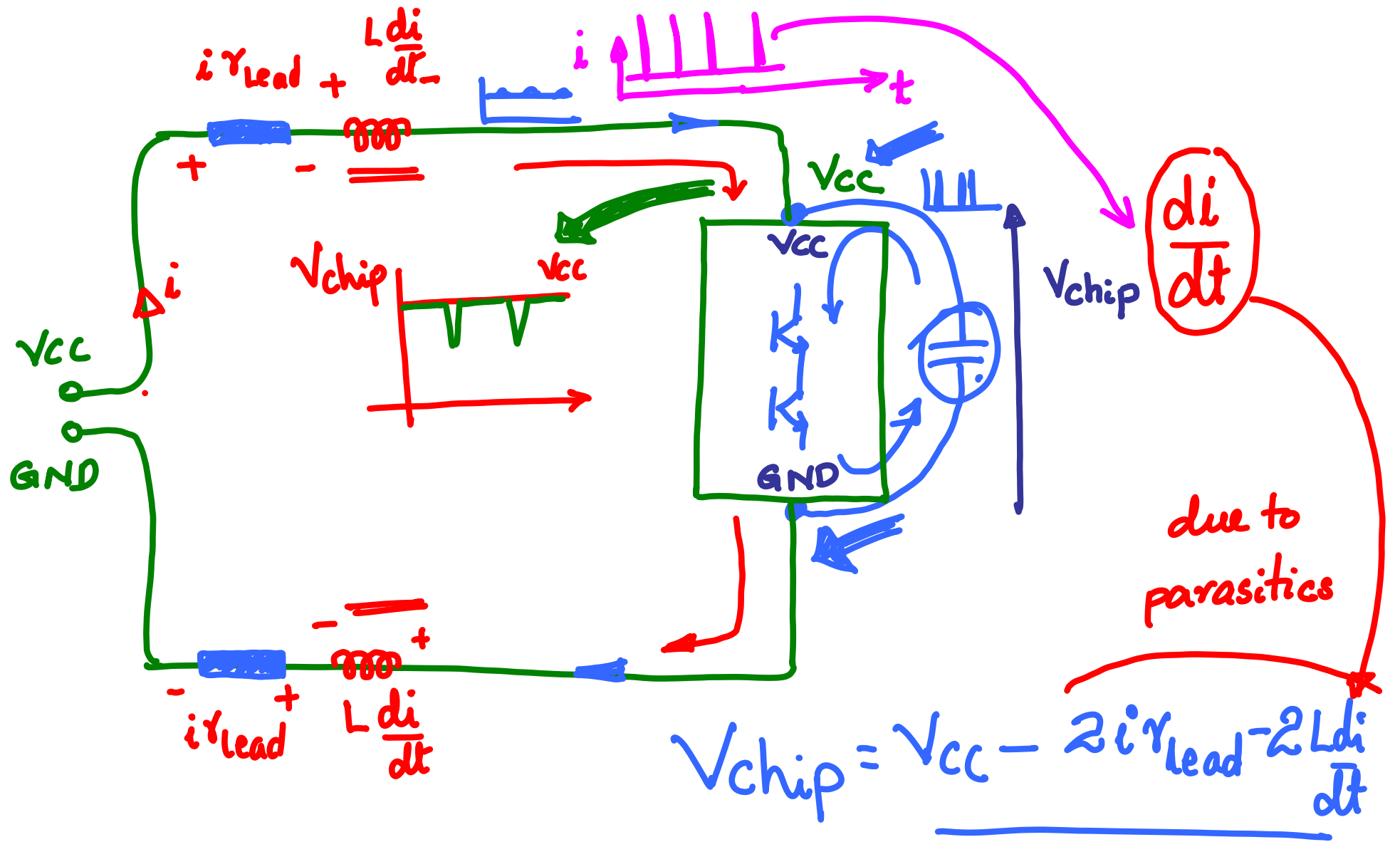
5 mΩ / 1mm width track

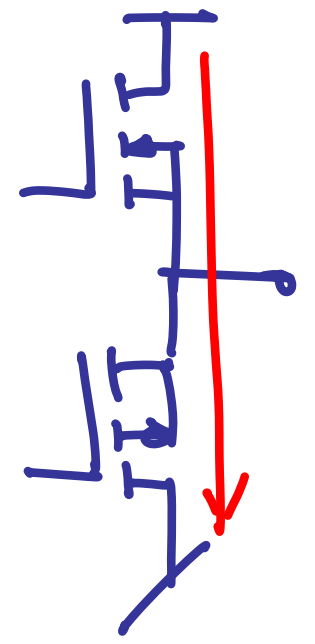
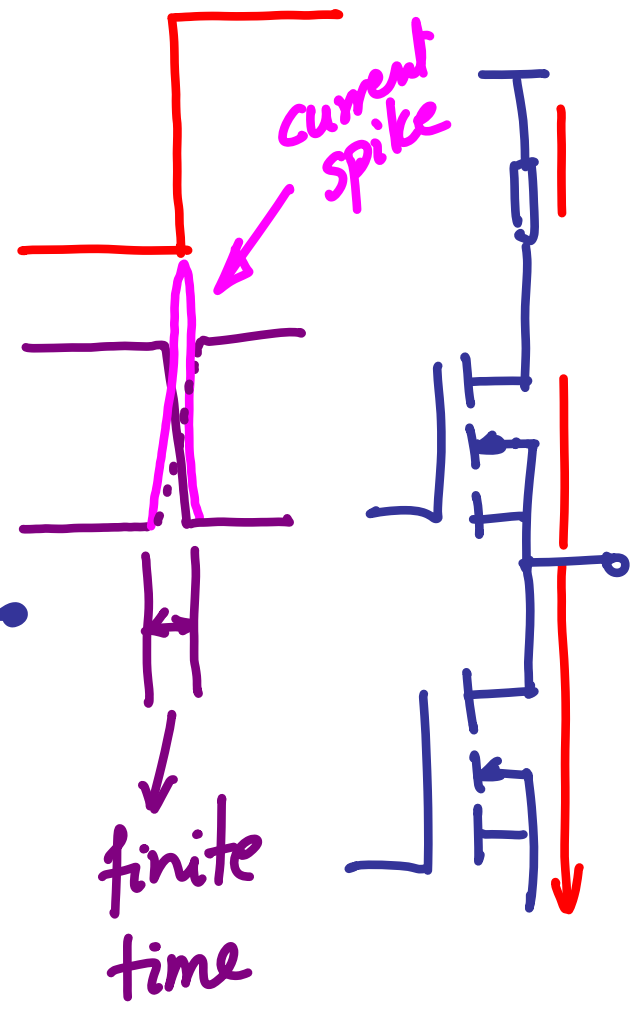
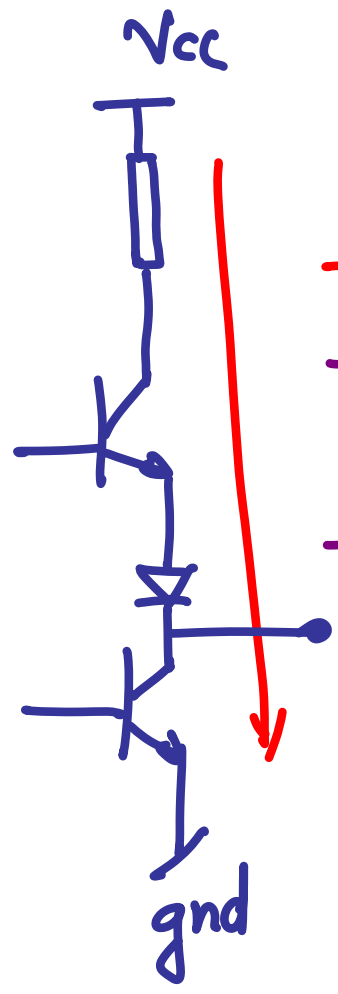
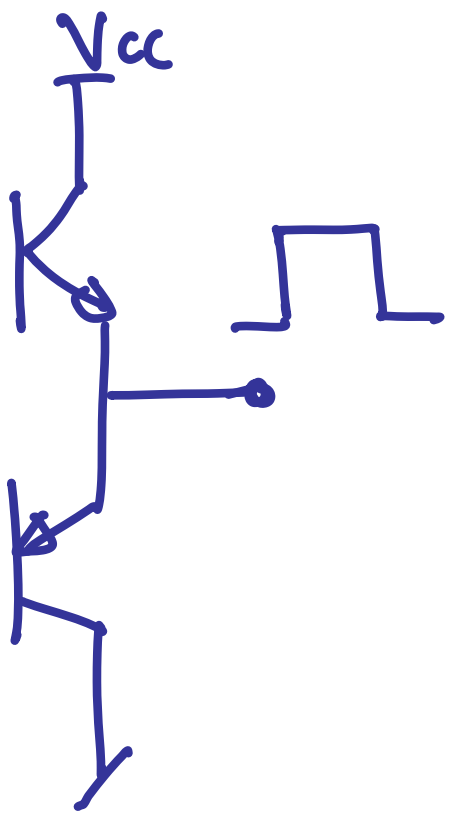
for every 1cm
length

Problem (Parasitics)



1. Resistance drops
2. Capacitance – capacitive coupling
3. Inductive coupling ; Inductive drops
4. Reflection





De-coupling Capacitors

RESISTANCE OF COPPER TRACKS

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$$R =$$

RESISTANCE OF COPPER TRACKS

$$R = \frac{\rho l}{A}$$

RESISTANCE OF COPPER TRACKS

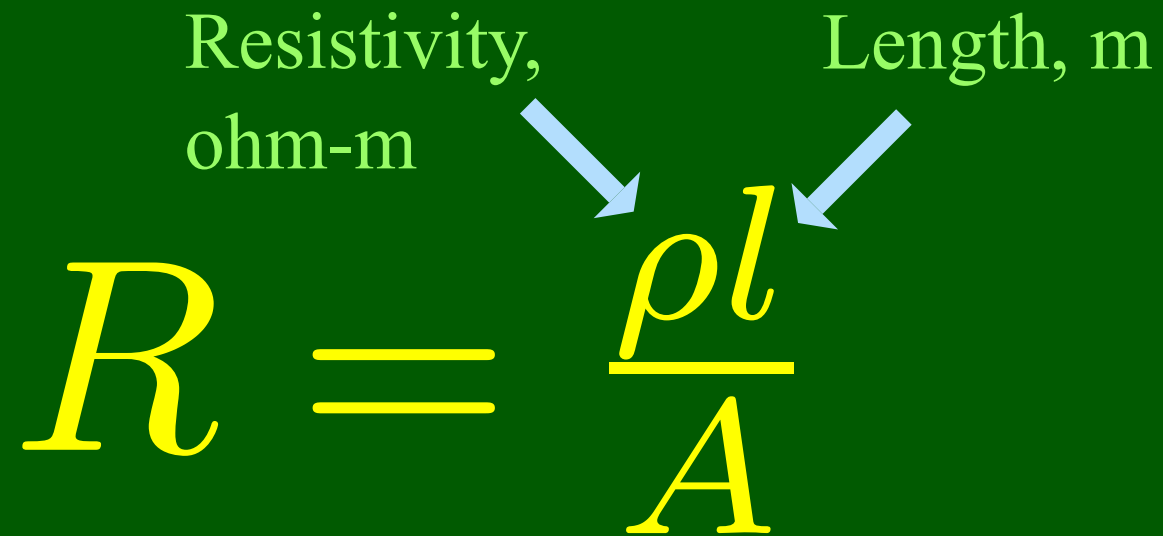
Resistivity,
ohm-m

$$R = \frac{\rho l}{A}$$

RESISTANCE OF COPPER TRACKS

Resistivity, ohm-m

Length, m

$$R = \frac{\rho l}{A}$$


RESISTANCE OF COPPER TRACKS

$$R = \frac{\rho l}{A}$$

Resistivity, ohm-m

Length, m

Area, m²

The diagram illustrates the formula for the resistance of copper tracks, $R = \frac{\rho l}{A}$. The variables are defined as follows: ρ is Resistivity in ohm-m, l is Length in meters, and A is Area in square meters. Blue arrows point from the text labels to their respective variables in the formula.

RESISTANCE OF COPPER TRACKS

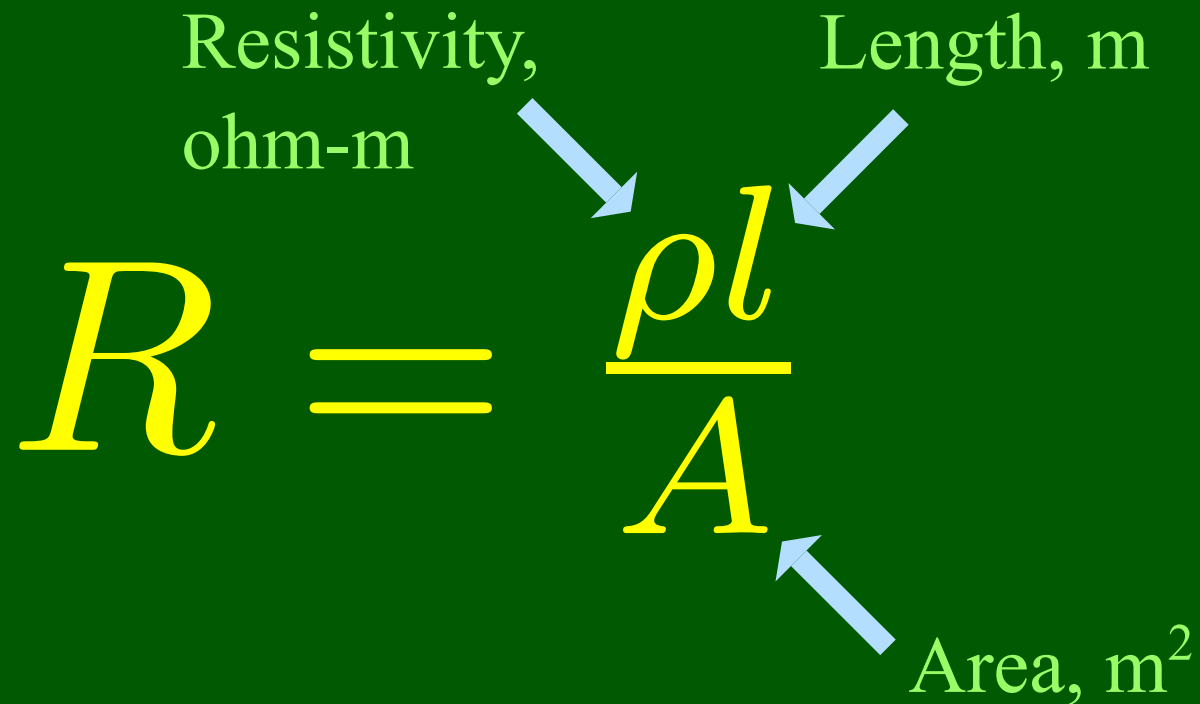
For Copper @20oC,
1.7241e-8 ohm-m

$$R = \frac{\rho l}{A}$$

Resistivity, ohm-m

Length, m

Area, m²

The diagram shows the formula R = rho*l/A in a large, bold, black font. Three blue arrows point from text labels to the variables in the formula: one from 'Resistivity, ohm-m' to the Greek letter rho, one from 'Length, m' to the variable l, and one from 'Area, m^2' to the variable A.

RESISTANCE OF COPPER TRACKS

For Copper @20oC,
1.7241e-8 ohm-m

For a track length,
1cm = 1e-2m

Resistivity,
ohm-m

Length, m

$$R = \frac{\rho l}{A}$$

Area, m²

A diagram illustrating the formula for resistance. The formula is $R = \frac{\rho l}{A}$. Three blue arrows point from labels to the variables in the formula: one from 'Resistivity, ohm-m' to ρ , one from 'Length, m' to l , and one from 'Area, m²' to A .

RESISTANCE OF COPPER TRACKS

For Copper @20oC,
1.7241e-8 ohm-m

For a track length,
1cm = 1e-2m

Resistivity,
ohm-m

Length, m

$$R = \frac{\rho l}{A}$$

Area, m²

For a 35μm laminate,
1mm track width
= 35e-6 x 1e-3 m²

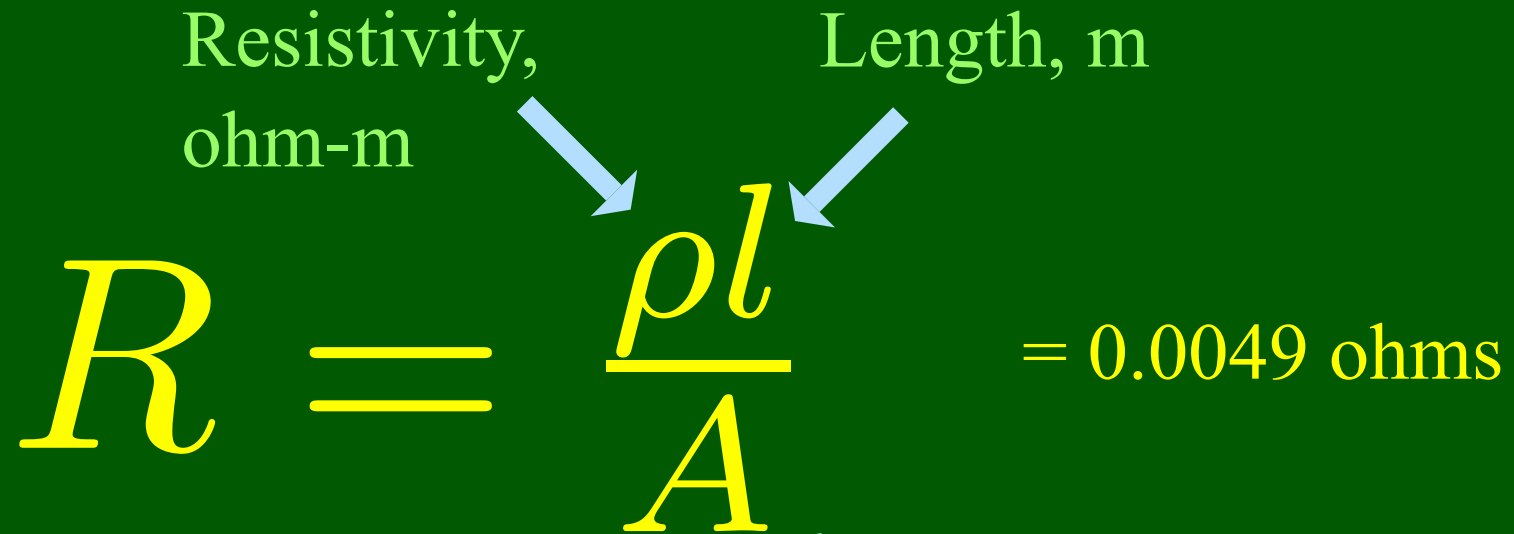
RESISTANCE OF COPPER TRACKS

For Copper @20oC,
1.7241e-8 ohm-m

For a track length,
1cm = 1e-2m

Resistivity, ohm-m

Length, m

$$R = \frac{\rho l}{A} = 0.0049 \text{ ohms}$$


Area, m²

For a 35μm laminate,
1mm track width
= 35e-6 x 1e-3 m²

EFFECT OF TEMPERATURE

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$$R_{T1} =$$

EFFECT OF TEMPERATURE

$$R_{T1} = R_{T0}$$


EFFECT OF TEMPERATURE

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

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R at temp
T₀



EFFECT OF TEMPERATURE

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T₀

Change in R due to temp.
difference

EFFECT OF TEMPERATURE

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

Temp difference

R at temp T₀

Change in R due to temp. difference

EFFECT OF TEMPERATURE

temperature coefficient of
conductivity

Temp difference

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T₀

Change in R due to temp.
difference

EFFECT OF TEMPERATURE

For Copper,
+0.0039/°K

temperature coefficient of
conductivity

Temp difference

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T₀

Change in R due to temp.
difference

EFFECT OF TEMPERATURE

For Copper,
+0.0039/°K

85°C - 20°C,
 $\Delta T = 65^\circ\text{K}$

temperature coefficient of
conductivity

Temp difference

$$R_{T_1} = R_{T_0} + R_{T_0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T₀

Change in R due to temp.
difference

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Temp difference

$$R_{T1} = R_{T0} + R_{T0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T0

Change in R due to temp.
difference

For a 35 μm laminate,
1mm track width
= 0.0049 ohms @20°C

EFFECT OF TEMPERATURE

For Copper,
+0.0039/°K

85°C - 20°C,
 $\Delta T = 65^\circ\text{K}$

temperature coefficient of
conductivity

Temp difference

$$R_{T1} = R_{T0} + R_{T0} \cdot c_T \cdot (T_1 - T_0)$$

R at temp
T0

Change in R due to temp.
difference

For a 35 μm laminate,
1mm track width
= 0.0049 ohms @20°C

= 0.00614
~25% more