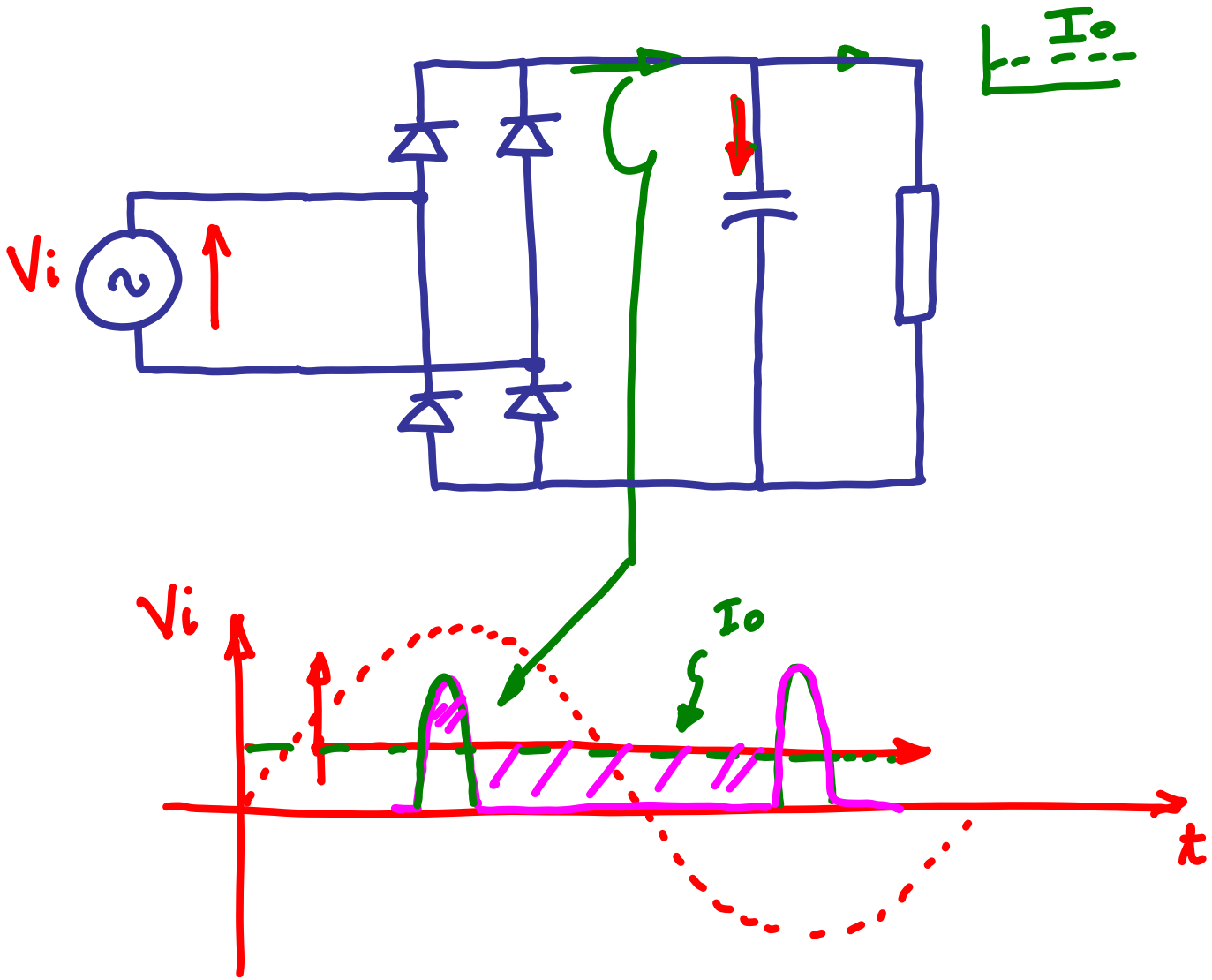
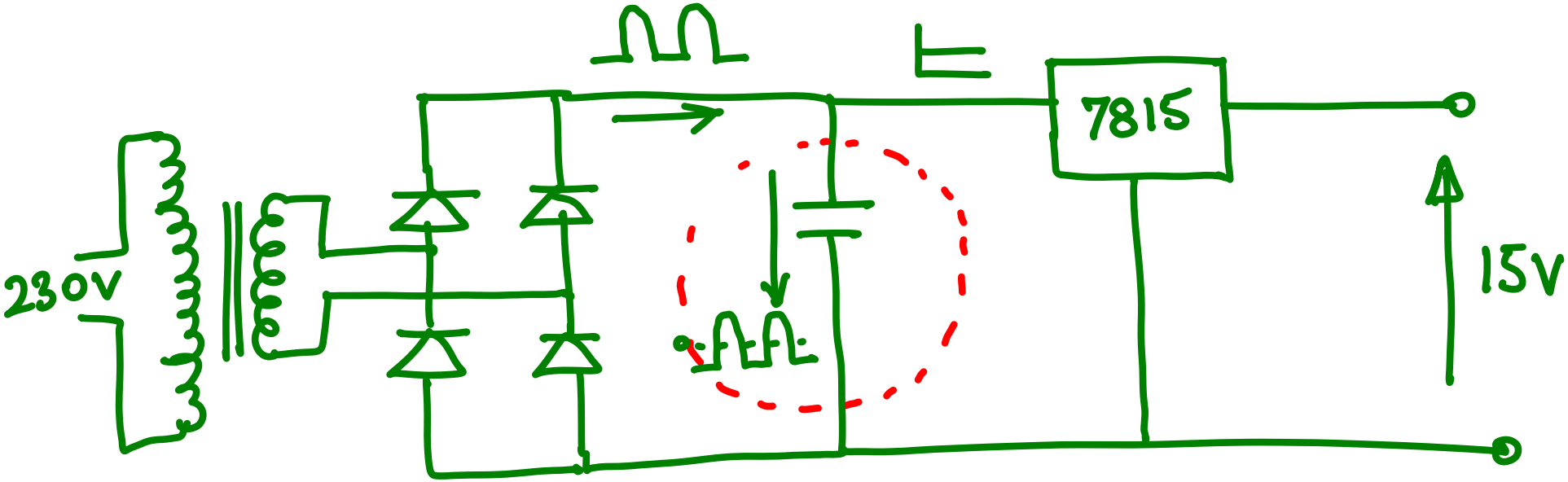
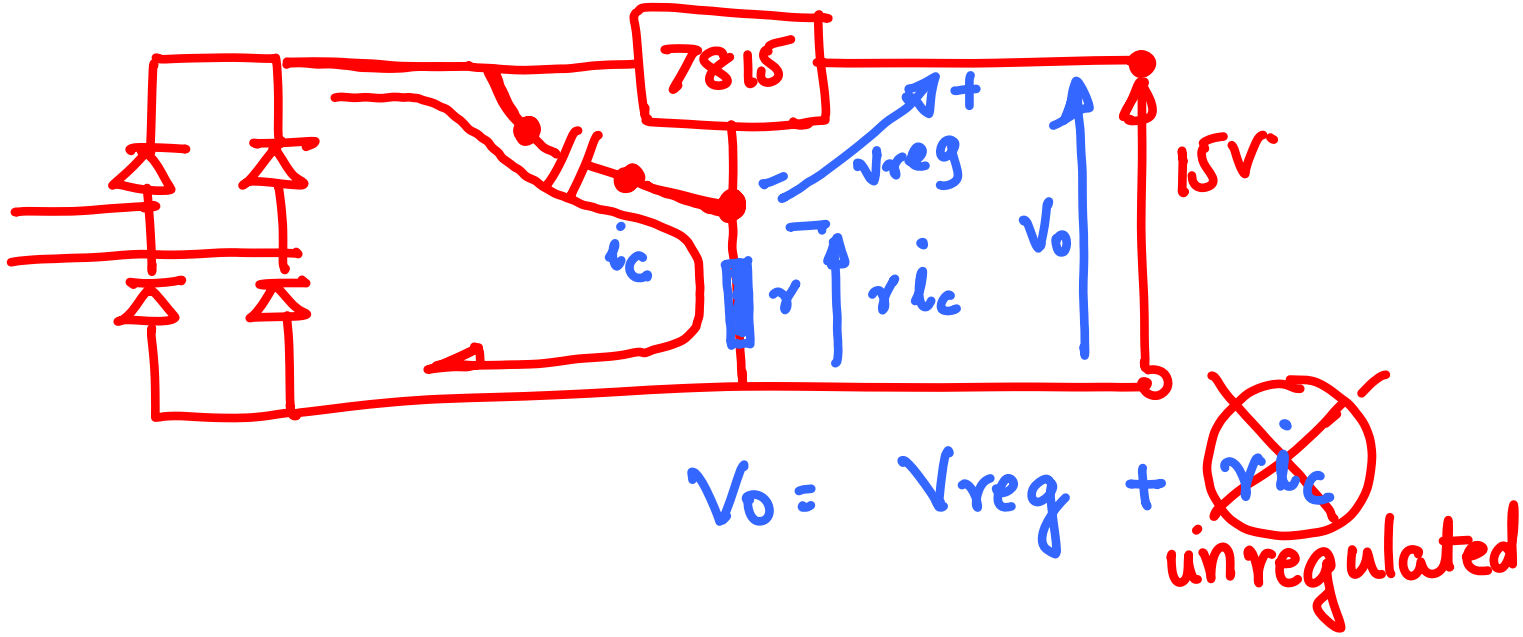
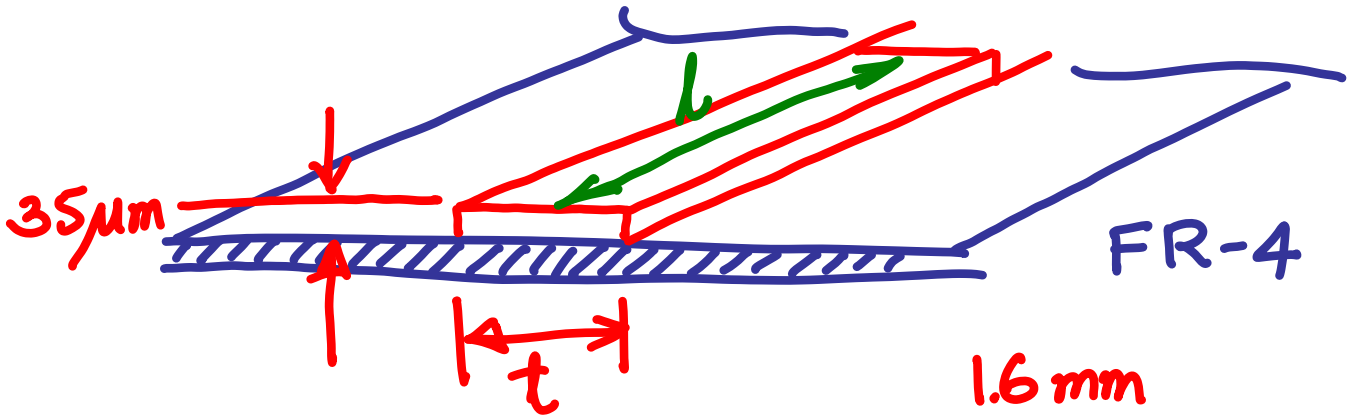

Io
Vi
Vi
Io
t





$V_o = V_{reg} + r i_c$

unregulated



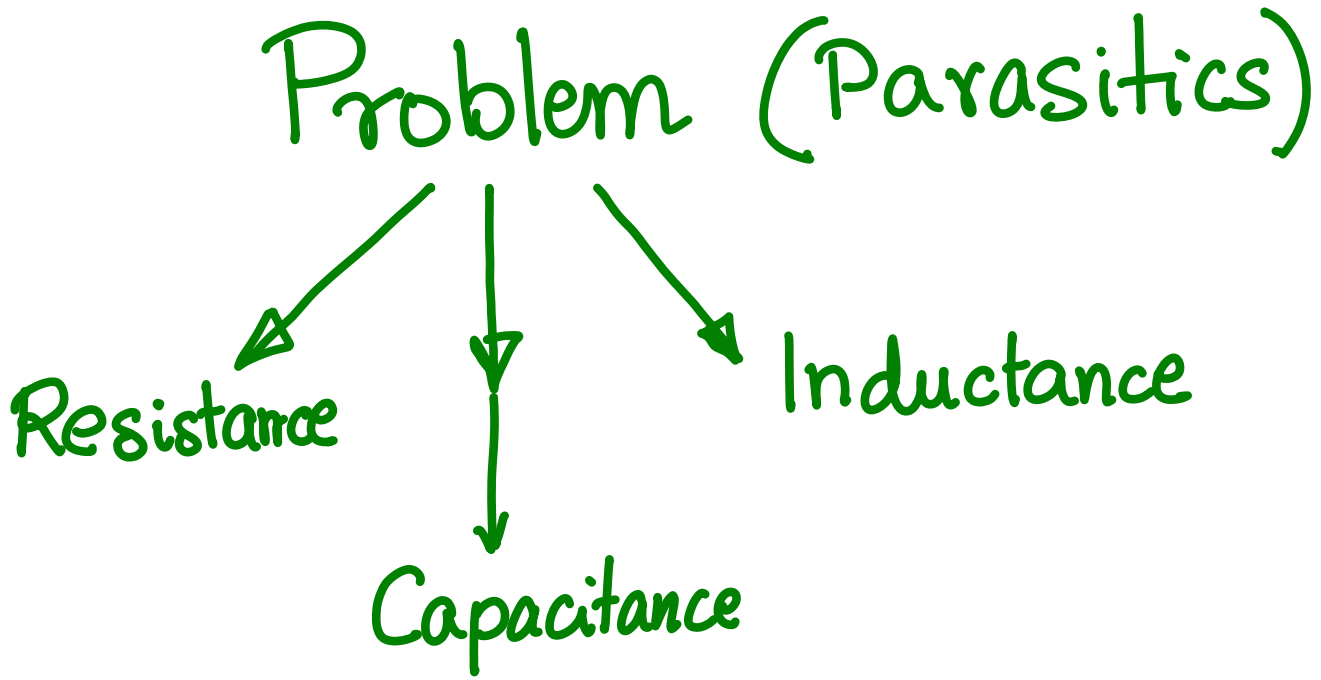
$$R = ?$$

$$0.0049\ \Omega$$

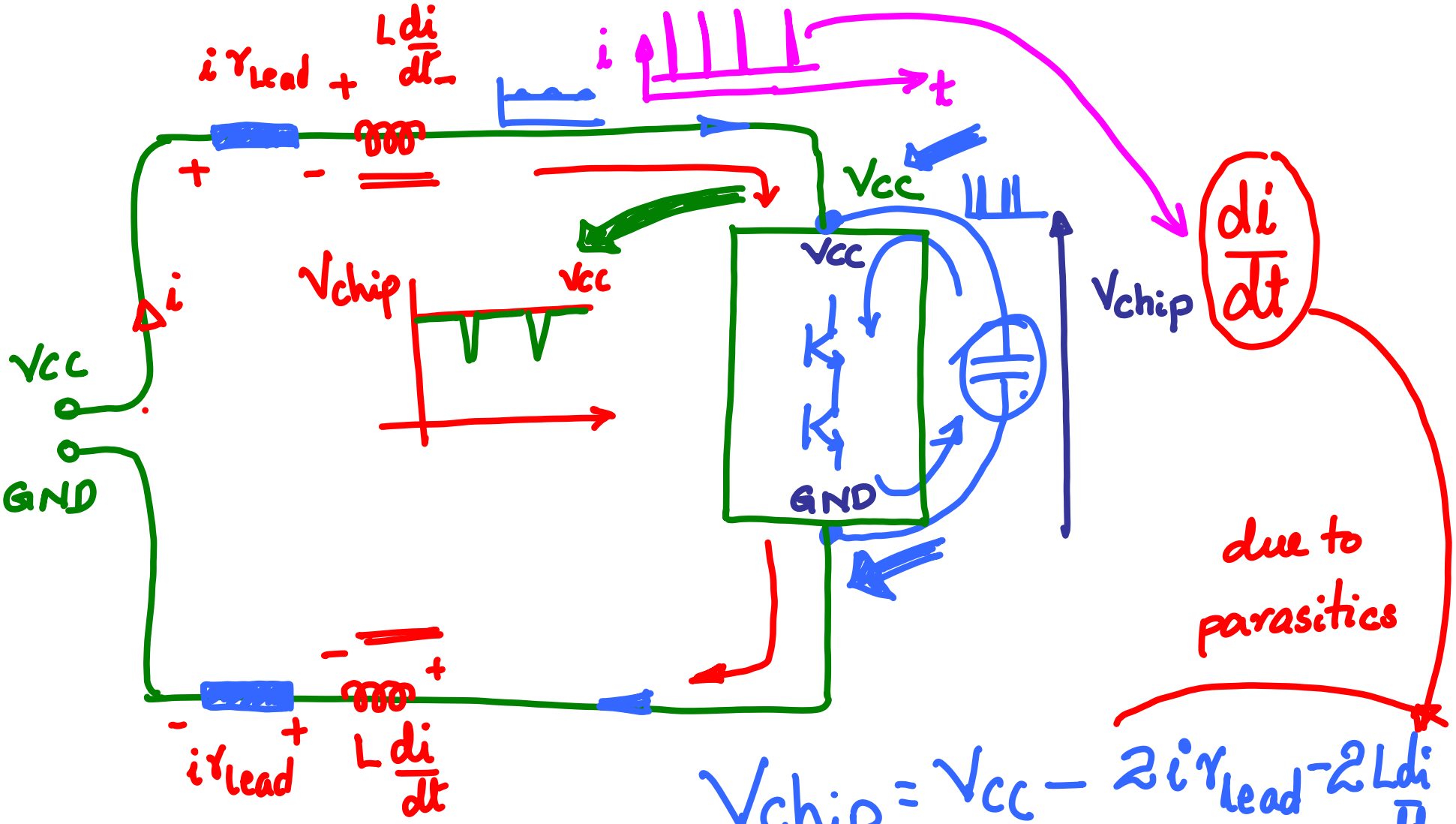
$$\simeq 5\ m\Omega$$

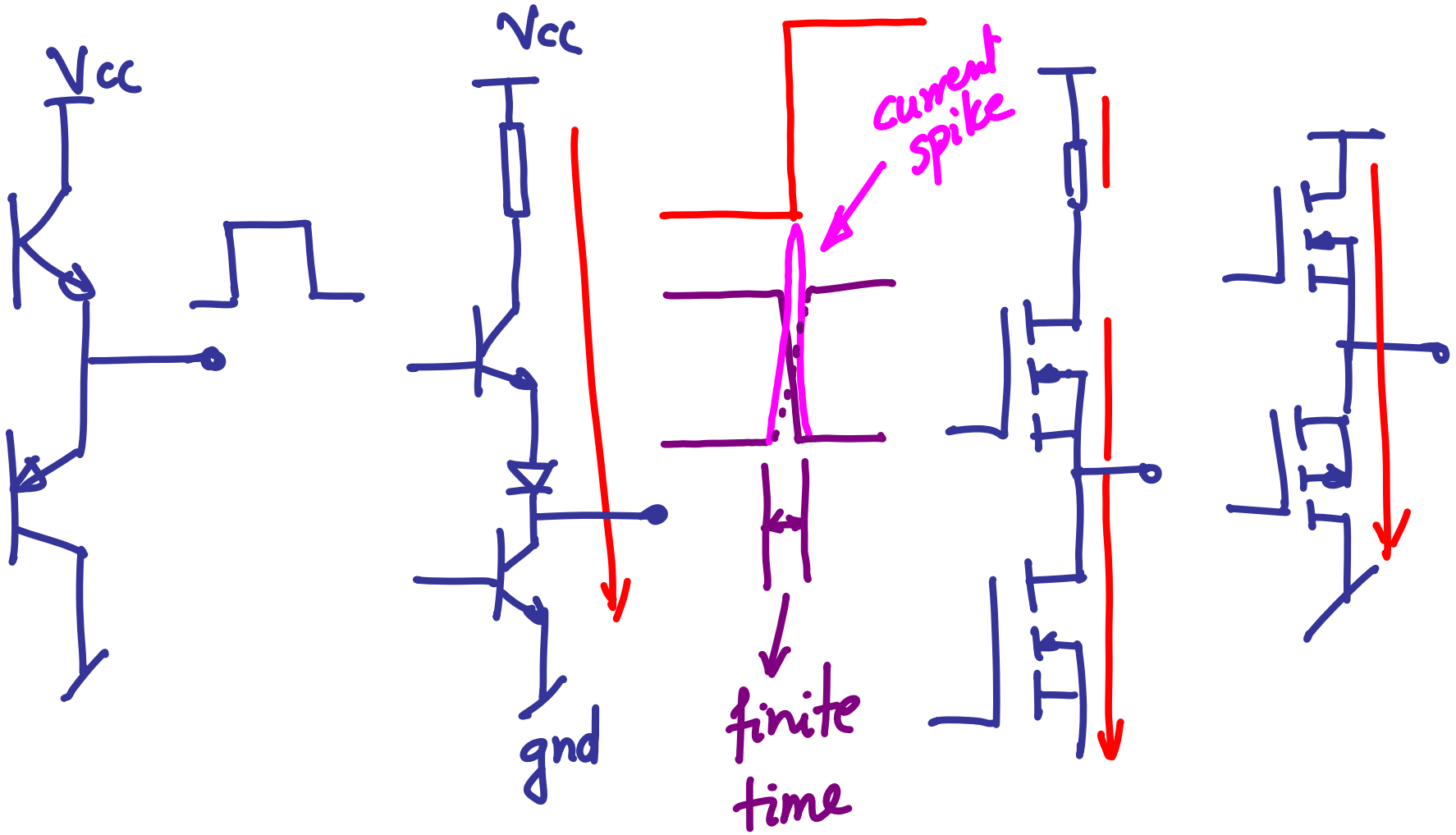
5 mΩ / 1mm width track

for every 1cm length



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


$i r_{lead} + L\frac{di}{dt}$
i
t
Vcc
Vchip
Vcc
GND
$\frac{di}{dt}$
due to parasitics
$V_{chip} = V_{cc} - 2 i r_{lead} - 2L\frac{di}{dt}$


Vcc
Vcc
current spike
gnd
finite time

De-coupling Capacitors

RESISTANCE OF COPPER TRACKS

RESISTANCE OF COPPER TRACKS

$$R =$$

RESISTANCE OF COPPER TRACKS

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

RESISTANCE OF COPPER TRACKS

Resistivity, ohm-m

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

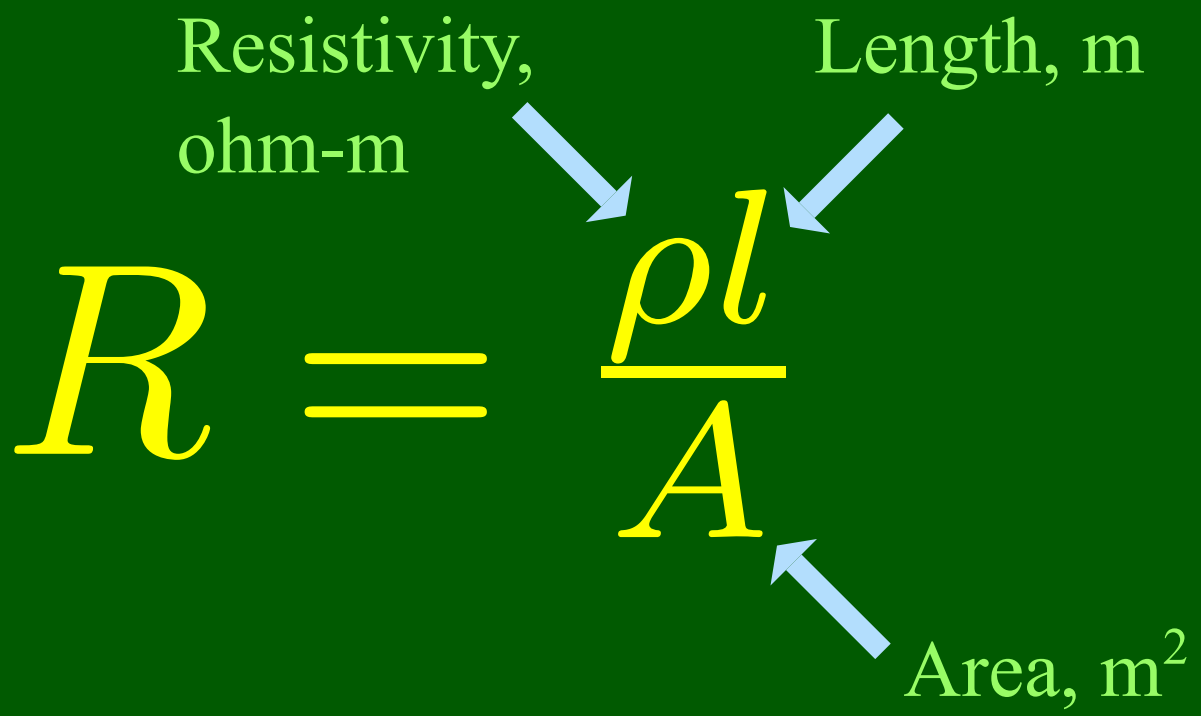
RESISTANCE OF COPPER TRACKS

Resistivity, ohm-m

Length, m

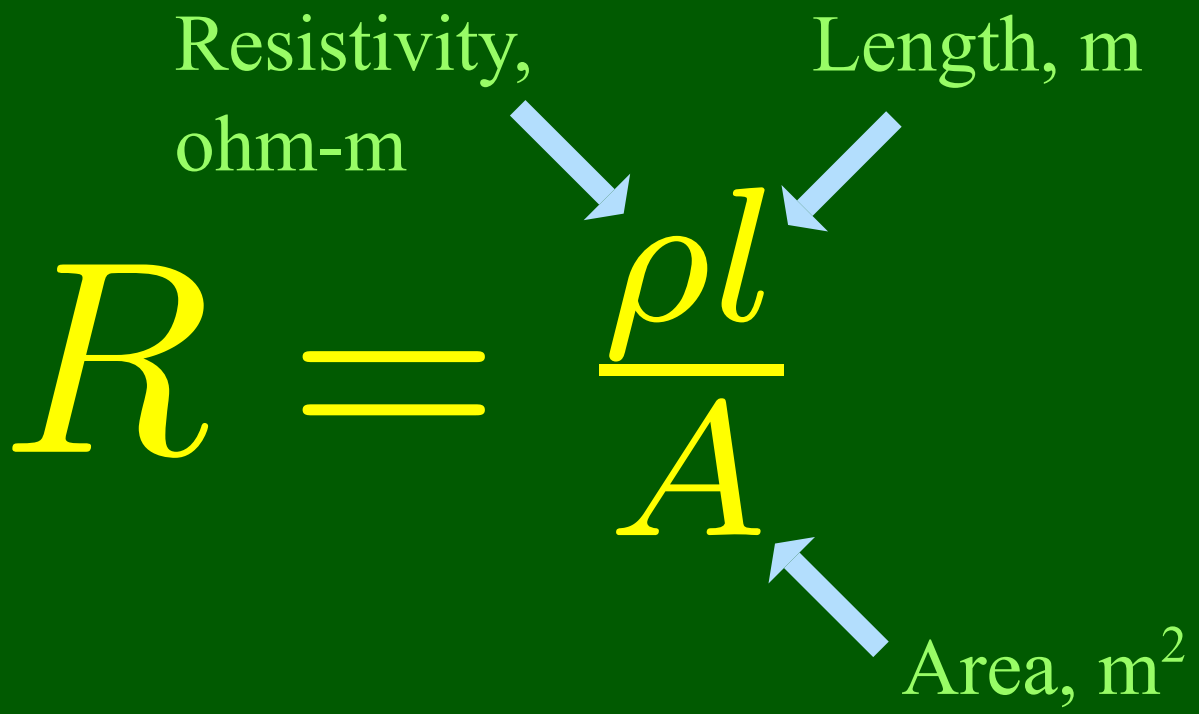
$$R = \frac{\rho l}{A}$$

RESISTANCE OF COPPER TRACKS



RESISTANCE OF COPPER TRACKS

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



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, m^2

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, m^2

For a 35µm laminate,
1mm track width
= 35e-6 x 1e-3 m^2

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 ohms

Area, m^2

For a 35µm laminate,
1mm track width
= 35e-6 x 1e-3 m^2

EFFECT OF TEMPERATURE

EFFECT OF TEMPERATURE

$$R_{T1} =$$

EFFECT OF TEMPERATURE

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

EFFECT OF TEMPERATURE

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

EFFECT OF TEMPERATURE

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

R at temp
T0

EFFECT OF TEMPERATURE

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

R at temp T0

Change in R due to temp. difference

EFFECT OF TEMPERATURE

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

Temp difference

R at temp T0

Change in R due to temp. difference

EFFECT OF TEMPERATURE

temperature coefficient of conductivity

Temp difference

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

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

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

R at temp T0

Change in R due to temp. difference

EFFECT OF TEMPERATURE

For Copper,
+0.0039/°K

85°C - 20°C,
ΔT= 65°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

EFFECT OF TEMPERATURE

For Copper,
+0.0039/ºK

85ºC - 20ºC,
ΔT= 65ºK

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 35µm laminate,
1mm track width
= 0.0049 ohms @20ºC

EFFECT OF TEMPERATURE

For Copper,
+0.0039/ºK

85ºC - 20ºC,
ΔT= 65ºK

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 35µm laminate,
1mm track width
= 0.0049 ohms @20ºC

= 0.00614

~25% more