

METRIC PREFIXES

in Basic Electricity

A Self-Study Tutorial

Core Prefixes Covered:

milli • centi • kilo • mega

Applied to: Voltage (V) • Current (A) • Resistance (Ω)

Name: _____

Date: _____

Section 1: Why Do Electricians Use Metric Prefixes?

Electrical measurements span an enormous range. A thunderbolt carries millions of volts; the signal in a computer chip might be a few millivolts. Writing all those zeros — or all those decimal places — is slow, error-prone, and hard to read at a glance.

Metric prefixes solve this. They replace long strings of digits with a short, standard label that every engineer, technician, and student understands instantly.

Key Idea

A metric prefix is a multiplier placed in front of a unit symbol. It scales the unit up or down by a power of ten, making measurements easier to read and write.

The three electrical quantities in this tutorial are:

Quantity	Unit (symbol)	What it measures
Voltage	Volt (V)	The electrical 'push' or potential difference in a circuit
Current	Ampere (A)	The flow of electric charge through a conductor
Resistance	Ohm (Ω)	Opposition to the flow of current in a circuit

1.1 The Four Core Prefixes

Prefix	Symbol	Multiplier	Electrical Example
milli	m	0.001 (10^{-3})	1 millivolt (mV) = 0.001 V — e.g. sensor output
centi	c	0.01 (10^{-2})	1 centiampere (cA) = 0.01 A — rarely used but valid
kilo	k	1,000 (10^3)	1 kilohm (k Ω) = 1,000 Ω — resistors in electronics
mega	M	1,000,000 (10^6)	1 megohm (M Ω) = 1,000,000 Ω — insulation testing

Memory Tip 

milli and centi make things SMALLER (below 1 of the base unit). kilo and mega make things BIGGER (above 1 of the base unit). In electronics you will use milli and kilo the most — they appear on almost every circuit diagram and data sheet.

Section 2: Each Prefix in Electrical Measurements

2.1 milli (m) — one thousandth

Rule: 1 milli-unit = 0.001 base units — 1 base unit = 1,000 milli-units

In electricity

millivolt (mV): Output of a thermocouple temperature sensor is typically 1–70 mV.

milliampere (mA): A typical LED operates at 10–20 mA. A USB port supplies up to 500 mA. **milli-ohm (mΩ):** Resistance of a good solder joint or wire bond is measured in milli-ohms.

2.2 centi (c) — one hundredth

Rule: 1 centi-unit = 0.01 base units — 1 base unit = 100 centi-units

In electricity

Note: centi is rarely used for electrical units on its own, but it appears in combined measurements. For example, power cable specifications may quote resistance in milli-ohms per centimetre (mΩ/cm). Understanding centi is also essential for reading component physical dimensions (PCB trace widths in cm) and for converting between units when centi appears in a formula.

2.3 kilo (k) — one thousand

Rule: 1 kilo-unit = 1,000 base units

In electricity

kilohm (kΩ): The most common resistor range in electronics. A 10 kΩ pull-up resistor is standard on digital input lines. **kilovolt (kV):** Mains power transmission lines operate at 11 kV to 400 kV. **kiloampere (kA):** Short-circuit fault currents in industrial switchgear are rated in kA.

2.4 mega (M) — one million

Rule: 1 mega-unit = 1,000,000 base units

In electricity

megohm (MΩ): Insulation resistance of a healthy cable is typically 100 MΩ or higher. **megavolt (MV):** Lightning bolts can produce up to 1,000 MV (1 gigavolt) — megavolt-level transients are studied in surge protection. **mega-ohm meter:** A 'megger' test instrument measures insulation resistance in MΩ to confirm electrical safety.

Section 3: Converting Electrical Units — Step by Step

The conversion method is the same for all electrical units: identify the prefix, decide whether to multiply or divide, then calculate.

3.1 The Golden Rules

Going from BIGGER to SMALLER unit	Going from SMALLER to BIGGER unit
MULTIPLY × e.g. volts → millivolts: × 1,000	DIVIDE ÷ e.g. millivolts → volts: ÷ 1,000

3.2 Worked Examples

Example A: Convert 47 kΩ to ohms

1. Identify the prefix: kilo = 1,000
2. Direction: kΩ → Ω is going SMALLER (more ohms than kilohms), so MULTIPLY
3. Calculate: $47 \times 1,000 = 47,000 \Omega$

Context: You would see 47 kΩ printed on a resistor's colour-coded body.

Example B: Convert 250 mV to volts

1. Identify the prefix: milli = 0.001 (1 V = 1,000 mV)
2. Direction: mV → V is going BIGGER (fewer volts than millivolts), so DIVIDE
3. Calculate: $250 \div 1,000 = 0.25 \text{ V}$

Context: A typical thermocouple produces around 250 mV = 0.25 V at working temperature.

Example C: Convert 0.033 A to milliamperes

1. Identify the prefix: milli = 0.001 (1 A = 1,000 mA)
2. Direction: A → mA is going SMALLER, so MULTIPLY

3. Calculate: $0.033 \times 1,000 = \mathbf{33 \text{ mA}}$

Context: *33 mA is a typical forward current for a standard red LED.*

Example D: Convert 2.2 MΩ to ohms

1. Identify the prefix: mega = 1,000,000
2. Direction: MΩ → Ω is going SMALLER, so MULTIPLY
3. Calculate: $2.2 \times 1,000,000 = \mathbf{2,200,000 \text{ } \Omega}$

Context: *2.2 MΩ is the insulation resistance of a mains cable — high resistance means good insulation.*

Quick Conversion Reference

mV ↔ V: × or ÷ 1,000 mA ↔ A: × or ÷ 1,000 kΩ ↔ Ω: × or ÷ 1,000
MΩ ↔ Ω: × or ÷ 1,000,000

Section 4: Activities

Activity 1: Match the Prefix to the Electrical Example

Draw a line connecting each prefix to the electrical measurement it most commonly appears in.

PREFIX	(draw your line here)	EXAMPLE
kilo		mA — LED current
milli		MΩ — cable insulation
mega		mV — sensor signal
centi		kΩ — resistor value
milli		cm — PCB trace width

Activity 2: Electrical Unit Conversions

Convert each measurement. Show your working in the space provided.

1. $15 \text{ k}\Omega = \underline{\hspace{2cm}} \Omega$ Working:

2. $500 \text{ mV} = \underline{\hspace{2cm}} \text{ V}$ Working:

3. $0.025 \text{ A} = \underline{\hspace{2cm}} \text{ mA}$ Working:

4. $3.3 \text{ M}\Omega = \underline{\hspace{2cm}} \Omega$ Working:

5. $12,000 \Omega = \underline{\hspace{2cm}} \text{ k}\Omega$ Working:

6. $0.5 \text{ V} = \underline{\hspace{2cm}} \text{ mV}$ Working:

Activity 3: Electrical Scenarios

Read each situation and answer the question, showing your reasoning.

Scenario 1 — The Resistor

A circuit diagram shows a resistor labelled 4.7 k Ω . Your digital multimeter measures resistance in ohms (Ω).

Question: What reading do you expect to see on your multimeter?

My answer: _____

Explanation:

Scenario 2 — The LED

A data sheet says a green LED has a maximum forward current of 20 mA. Your power supply is set to deliver 0.020 A.

Question: Is the current from your power supply safe for the LED? Explain how you know.

My answer: _____

Explanation:

Scenario 3 — The Insulation Test

An electrician tests a cable and gets a reading of 150 M Ω on the megger. The minimum safe insulation resistance is 1,000,000 Ω .

Question: Is this cable safe to use? Show how you compare the two values.

My answer: _____

Explanation:

Scenario 4 — The Sensor

A temperature sensor produces an output of 0.045 V. The display panel shows voltage in millivolts.

Question: What value will appear on the display?

My answer: _____

Explanation:

Activity 4: True or False?

Circle TRUE or FALSE. If false, write the correct version on the line below.

1. 1 kilohm = 1,000 ohms

TRUE / FALSE

Correction if false:

2. The symbol for milli is uppercase M

TRUE / FALSE

Correction if false:

3. To convert mV to V you divide by 1,000

TRUE / FALSE

Correction if false:

4. A reading of 2.2 MΩ means the resistance is 2,200,000 Ω

TRUE / FALSE

Correction if false:

Section 5: Self-Check Quiz

Instructions

Answer all 10 questions without referring to earlier sections. When finished, turn to Section 6 for the answer key.

Part A: Multiple Choice (1 point each)

1. Which prefix means one thousandth (0.001)?
 - a) a) mega
 - b) b) kilo
 - c) c) milli
 - d) d) centi

2. 1 kilohm ($k\Omega$) is equal to:
 - a) a) 0.001Ω
 - b) b) 100Ω
 - c) c) $1,000 \Omega$
 - d) d) $1,000,000 \Omega$

3. An LED requires 15 mA. Expressed in amperes this is:
 - a) a) 15 A
 - b) b) 0.15 A
 - c) c) 0.015 A
 - d) d) 1,500 A

4. The symbol for mega is:
 - a) a) m
 - b) b) M
 - c) c) k
 - d) d) c

5. To convert 33 k Ω to ohms you:

- a) a) divide by 1,000
- b) b) multiply by 1,000
- c) c) divide by 100
- d) d) multiply by 100

Part B: Short Answer (2 points each)

6. A data sheet lists a resistor as 470 k Ω . Express this value in ohms.

Answer: _____

7. A voltmeter reads 0.350 V. Convert this to millivolts.

Answer: _____

8. A cable insulation test gives 56 M Ω . Express this in ohms.

Answer: _____

9. A circuit draws 85 mA. Convert this current to amperes.

Answer: _____

10. List the four prefixes covered in this tutorial from smallest to largest multiplier.

Answer: _____

My Score: _____ / 15

Section 6: Answer Key

For Students

Only turn to this page after completing the quiz. Honest self-checking is the most effective way to learn!

Activity 2: Electrical Unit Conversions — Answers

1. $15 \text{ k}\Omega = 15,000 \text{ }\Omega$ ($15 \times 1,000$)
2. $500 \text{ mV} = 0.5 \text{ V}$ ($500 \div 1,000$)
3. $0.025 \text{ A} = 25 \text{ mA}$ ($0.025 \times 1,000$)
4. $3.3 \text{ M}\Omega = 3,300,000 \text{ }\Omega$ ($3.3 \times 1,000,000$)
5. $12,000 \text{ }\Omega = 12 \text{ k}\Omega$ ($12,000 \div 1,000$)
6. $0.5 \text{ V} = 500 \text{ mV}$ ($0.5 \times 1,000$)

Activity 3: Electrical Scenarios — Answers

Scenario 1

$4.7 \text{ k}\Omega = 4,700 \text{ }\Omega$ ($4.7 \times 1,000$). You expect to see $4,700 \text{ }\Omega$ (or $4.7 \text{ k}\Omega$) on the multimeter display.

Scenario 2

$0.020 \text{ A} = 20 \text{ mA}$ ($0.020 \times 1,000$). This is exactly the maximum rated current, so it is at the safe limit. In practice, a slightly lower current (e.g. 15 mA) is safer.

Scenario 3

$150 \text{ M}\Omega = 150,000,000 \text{ }\Omega$ ($150 \times 1,000,000$). The minimum is $1,000,000 \text{ }\Omega$. Since $150,000,000 > 1,000,000$, the cable is safe.

Scenario 4

$0.045 \text{ V} = 45 \text{ mV}$ ($0.045 \times 1,000$). The display will show 45 mV .

Activity 4: True or False? — Answers

1. TRUE

2. FALSE — The symbol for milli is lowercase m. Uppercase M is the symbol for mega.
3. TRUE
4. TRUE

Quiz Answer Key

Q	Answer	Q	Answer
1	c) milli	6	470,000 Ω ($470 \times 1,000$)
2	c) 1,000 Ω	7	350 mV ($0.350 \times 1,000$)
3	c) 0.015 A	8	56,000,000 Ω ($56 \times 1,000,000$)
4	b) M	9	0.085 A ($85 \div 1,000$)
5	b) multiply by 1,000	10	milli, centi, kilo, mega

Scoring Guide

Score	Level	Next Step
13–15	Excellent!	Explore power (watts) and frequency (Hz) with prefixes
9–12	Good — almost there	Review the sections for the questions you missed
0–8	Keep practising	Re-read Sections 2 & 3, then redo the activities

Great work completing this unit! ⚡💡