

UNIT 6

POWERS

Practical Maths for Electrical Installation Students and Apprentices

$\frac{10^3}{10^{-3}}$

POWERS OF TEN

k M
m μ

ENGINEERING PREFIXES

$a \times 10^n$
 $1 \leq a < 10$

STANDARD FORM



CONVERSIONS & NOTATION



ELECTRICAL APPLICATIONS

$a \times 10^n$
 $1 \leq a < 10$

- 10³ —
- 10² —
- 10¹ —
- 10⁰ —
- 10⁻¹ —
- 10⁻² —
- 10⁻³ —

LARGER
(×10)

SMALLER
(÷10)



Symbol	Prefix	Multiplier
G	giga	10 ⁹
M	mega	10 ⁶
k	kilo	10 ³
-	base	10 ⁰
m	milli	10 ⁻³
μ	micro	10 ⁻⁶
n	nano	10 ⁻⁹
p	pico	10 ⁻¹²

STANDARD FORM
Example:
0.000000123 = 1.23 × 10⁻⁷

ENGINEERING FORM
Example:
1.23 × 10⁻⁷ = 123 n

Unit 6 Content

01 Learning Objectives

02 Why It Matters

03 Mathematical Symbols

04 Understanding Powers

05 Standard Form

06 Worked Examples (Standard Form)

07 Engineering Form

08 Converting Between Forms

09 Electrical Applications

10 Worked Examples (Applications)

1
1 Practice Questions

1
2 Answers and Recap

Learning Objectives

What learners should be able to do

- Understand powers of ten and indices.
- Convert numbers to and from standard form.
- Use engineering notation and common prefixes.
- Apply conversions to voltage, current, resistance, power and capacitance.
- Recognise key mathematical symbols used in engineering.

Why It Matters

Electrical work often uses very large values such as **60,000,000 W** and very small values such as **0.000000000005 F**, so learners must move confidently between ordinary numbers, powers of ten and engineering prefixes.

Large

60,000,000 W

Standard

6.0×10^7

Engineering

60 MW

Use

**Power station
output**

Mathematical Symbols

6.1 Symbols learners must recognise



Add / positive



Multiply



Equals



Approximately equal



means do this first.



are useful in angle work and right angles.



Subtract / negative



Divide



Not equal



Greater or less than or equal to



means plus or minus.

Understanding Powers

Positive, zero and negative indices

- **Positive powers:** multiply by 10. Example: $10^3 = 1000$.
- **Zero power:** $10^0 = 1$.
- **Negative powers:** divide by 10. Example: $10^{-3} = 0.001$.
- **Pattern:** the power tells you how many places or zeros are involved.

Powers ladder

10^3		1000
10^2		100
10^1		10
10^0		1
10^{-1}		0.1
10^{-2}		0.01
10^{-3}		0.001

Standard Form - The two key rules

Large numbers

Move the decimal point left until the number is between 1 and 10. The number of moves becomes a positive power.

$$4800 = 4.8 \times 10^3$$

Small numbers

Move the decimal point right until the number is between 1 and 10. The number of moves becomes a negative power.

$$0.00123 = 1.23 \times 10^{-3}$$

- Final number must be between 1 and 10.
- Left movement gives a positive power.
- Right movement gives a negative power.

Worked Examples - Standard Form

Example 1

3891

Move 3 places left

→ 3.891×10^3

Example 2

0.003764

Move 3 places right

→ 3.764×10^{-3}

Example 3

60,000,000

Move 7 places left

→ 6.0×10^7

Example 4

0.000000000005

Move 12 places right

→ 5.0×10^{-12}

Engineering Form

Prefixes electricians use every day

G

giga

10^9

M

mega

10^6

k

kilo

10^3

base

unit

10^0

m

milli

10^{-3}

μ

micro

10^{-6}

n

nano

10^{-9}

p

pico

10^{-12}

Note: Engineering form uses groups of three decimal places.

Example: 48,000 = 48 k, while 4.8×10^4 is standard form.

Converting Between Forms

Whole number to engineering form

5837 g → 5.837 kg
60,000,000 W → 60 MW

Small decimal to engineering form

0.0415 g → 41.5 mg
0.00123 A → 1.23 mA

Teach the conversion method

- ✓ kilo, mega, and giga are for larger values
- ✓ milli, micro, nano, and pico are for smaller values
- ✓ Always keep the base unit with the prefix

Electrical Applications

6.6 Examples learners will recognise

Voltage

230 V mains

400 kV transmission

50 mV signals

Current

32 A ring circuit

6 A lighting

500 mA electronics

100 μ A microelectronics

Resistance

0.5 Ω cable

10 k Ω resistor

2.2 M Ω high resistance

100 m Ω low resistance

Power

3 kW kettle

500 MW station

5 W LED

50 mW indicator

Capacitance

100 μ F start capacitor

100 nF ceramic

10 pF timing

Frequency

50 Hz mains

1 kHz audio

100 MHz radio

Worked Examples - Applications

24578 W

move 3 places left → **24.578 kW**, or **24.6 kW** rounded

340 mm

$m = 10^{-3}$, so
 $340 \times 10^{-3} m = 0.34 m$

2500 mA

$2500 \times 10^{-3} A = 2.5 A$

450 MW

$450 \times 10^6 W = 450,000,000 W$

Practice Questions

- 1 Write 10^4 and 10^{-2} as decimal values.
- 2 Write 3891 in standard form.
- 3 Write 0.0046 in standard form.
- 4 Convert 400 kV to volts.
- 5 Convert 0.075 A to mA.
- 6 Convert 4700 Ω to k Ω .
- 7 Express 0.000125 A in standard form and engineering form.
- 8 Convert 50 Hz to kHz.

Answers and Recap

Key answers to review

$$10^4 = 10,000$$

$$10^{-2} = 0.01$$

$$3891 = 3.891 \times 10^3$$

$$0.0046 = 4.6 \times 10^{-3}$$

$$400 \text{ kV} = 400,000 \text{ V}$$

$$0.075 \text{ A} = 75 \text{ mA}$$

$$4700 \ \Omega = 4.7 \text{ k}\Omega$$

$$50 \text{ Hz} = 0.05 \text{ kHz}$$

Reminder:

- Large numbers move left for positive powers
- Small decimals move right for negative powers
- Engineering form works in groups of three

Thank You!

Questions?