SOLOHEAT

THE UK'S SOLE REMAINING CAST HEATER MANUFACTURER since 1980

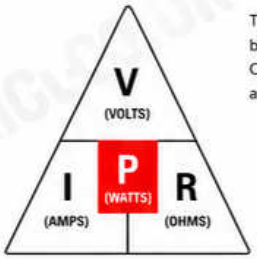
ELECTRICAL ENGINEERING ESSENTIALS

FUNDAMENTAL PRINCIPLES FOR EVERY DESIGN




A quick reference guide to core electrical engineering principles commonly used in the design and application of industrial heating systems and electrical components.

OHM'S LAW



The relationship between Voltage (V), Current (I), Resistance (R) and Power (P).

FORMULAS

$V = I \times R$

$I = V / R$

$R = V / I$

$P = V \times I$

$P = I^2 \times R$

$P = V^2 / R$

POWER CALCULATIONS

For resistive loads (e.g. heaters):

$$P\ (W) = \frac{V\ (V)^2}{R\ (\Omega)}$$

or

$$P\ (W) = I\ (A)^2 \times R\ (\Omega)$$

Where:

- P = Power (Watts)
- V = Voltage (Volts)
- I = Current (Amps)
- R = Resistance (Ohms)

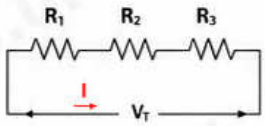
SERIES & PARALLEL CIRCUITS

SERIES CIRCUIT

Resistance adds:

$R_T = R_1 + R_2 + R_3 + \ldots$

Current is the same through all components.

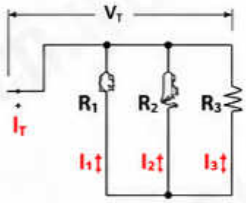


PARALLEL CIRCUIT

Reciprocal of resistance adds:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

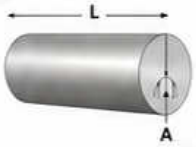
Voltage is the same across all components.



RESISTANCE & RESISTIVITY

RESISTANCE

$$R = \rho \times \frac{L}{A}$$



Where:

- R = Resistance (Ω)
- ρ = Resistivity (Ω·m)
- L = Length (m)
- A = Cross-sectional Area (m²)

TYPICAL RESISTIVITY (ρ at 20°C)

Copper	1.72×10^{-8} Ω·m
Nichrome	1.10×10^{-6} Ω·m
Stainless Steel (304)	7.20×10^{-7} Ω·m

POWER DENSITY

Important for heating elements to ensure performance and life.

Power Density (W/cm²) = Power (W) / Surface Area (cm²)

GUIDELINE (Heater Elements)

Low	Up to 3 W/cm²
Medium	3 – 8 W/cm²
High	8 – 15 W/cm²
Very High	15+ W/cm²

Always refer to material and application limitations.

TEMPERATURE COEFFICIENT

Resistance of most conductors increases with temperature.

$$R_T = R_{20}\ [1 + \alpha\ (T - 20°C)]$$

Where:

- R_T = Resistance at temperature T
- R_{20} = Resistance at 20°C
- α = Temperature coefficient (1/°C)
- T = Temperature (°C)

Typical α Values

Copper	0.00393
Nichrome	0.00017
Stainless Steel (304)	0.00072

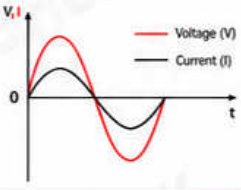
AC POWER BASICS

For single phase AC circuits:

$$P\ (W) = V_{rms} \times I_{rms} \times PF$$

Where:

- V_{rms} = RMS Voltage (V)
- I_{rms} = RMS Current (A)
- PF = Power Factor (0–1)



For purely resistive loads, PF ≈ 1

ENERGY CALCULATIONS

Energy used over time:

$$E\ (kWh) = P\ (kW) \times t\ (h)$$

Where:

- E = Energy (kilowatt-hours)
- P = Power (kilowatts)
- t = Time (hours)

TIP
1 kW heater running for 5 hours consumes 5 kWh of energy.

USEFUL CONVERSIONS

1 W	=	1 J/s
1 kW	=	1000 W
1 MW	=	10^6 W
1 A	=	1 C/s
1 V	=	1 J/C
1 Ω	=	1 V/A

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ENGINEERED FOR RELABILITY
Precision design and manufacturing for demanding industrial environments.

OPTIMISED PERFORMANCE
Efficient thermal performance through accurate electrical design and material selection.

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All heaters manufactured to relevant UK and international standards.

CUSTOM SOLUTIONS
Tailored electrical solutions to meet your exact applicatiort requirements.

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