

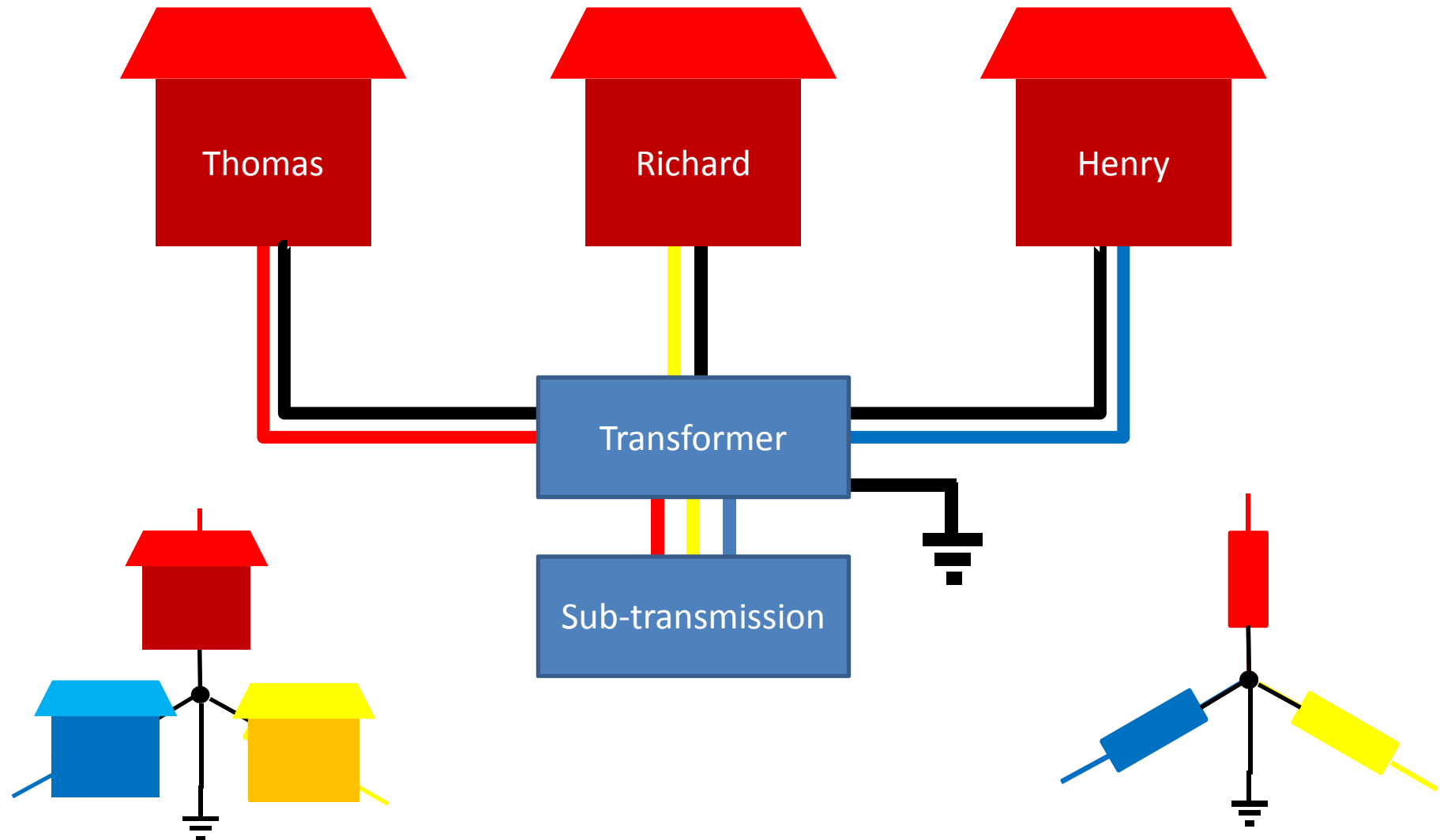
# Electricity in the home

Infrastructure and  
Electrical safety

# Bibliography

- <http://www.tlc-direct.co.uk/Book/1.1.htm>

# 3 phase residential distribution



# Single Phase: Live, Neutral and Earth

- Live
  - 230/240Vac single phase
- Neutral
  - is it actually neutral? i.e. 0V
- Earth
  - Physically pinned to the electric potential of the ground



# Earth wire (1)

- Physical contact to earth
- Safety
  - Prevent build up of static
  - Path to ground in case of insulation failure
- Measurement
  - Potential reference
  - Infinite sink source
  - Low impedance



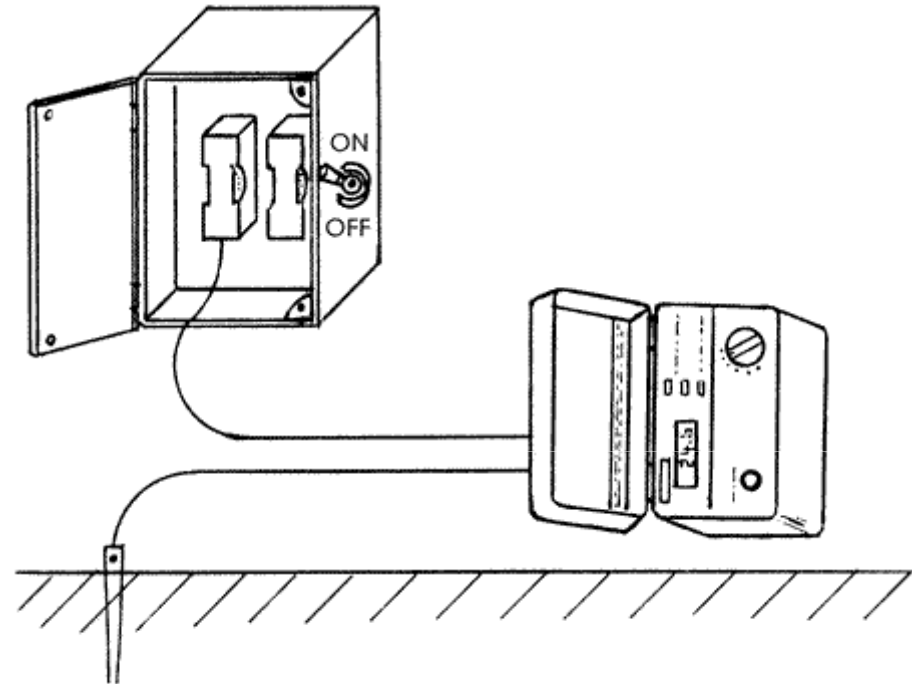
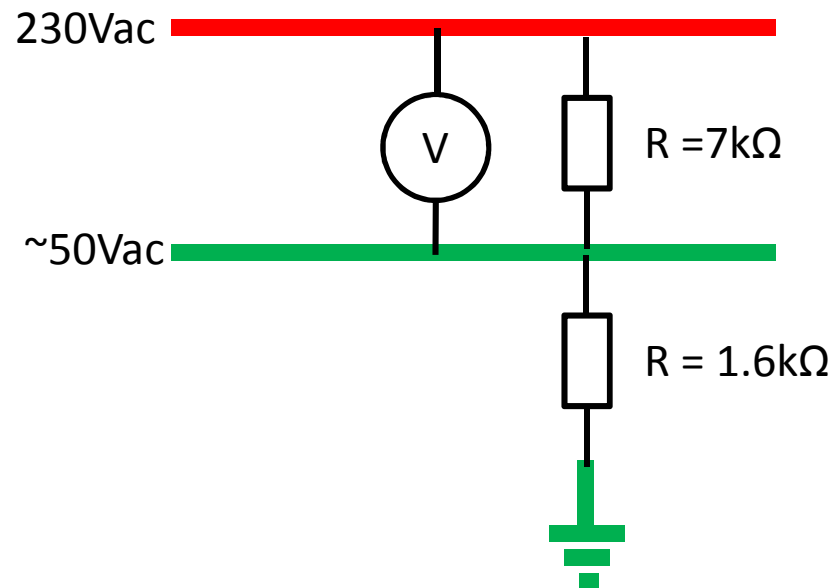
# Earth wire (2)

- Cable
  - Overhead
    - Live and Neutral only
    - DIY Earth
  - Underground
    - Metal sheath, armoured, cable



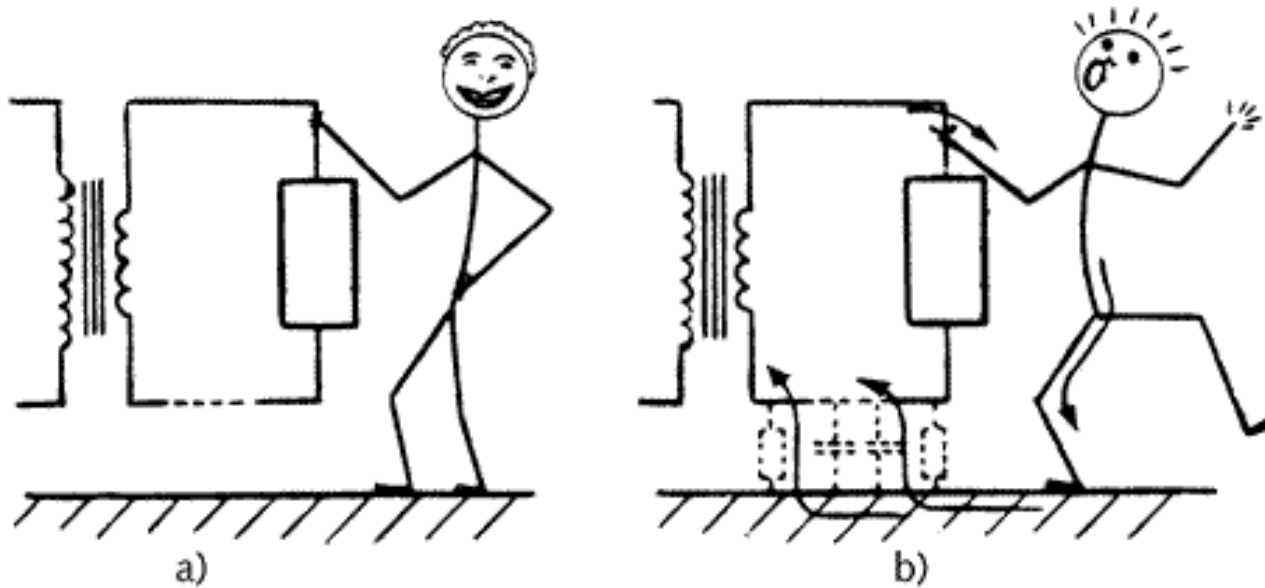
# Earth wire (3)

- Earth loop impedance tester



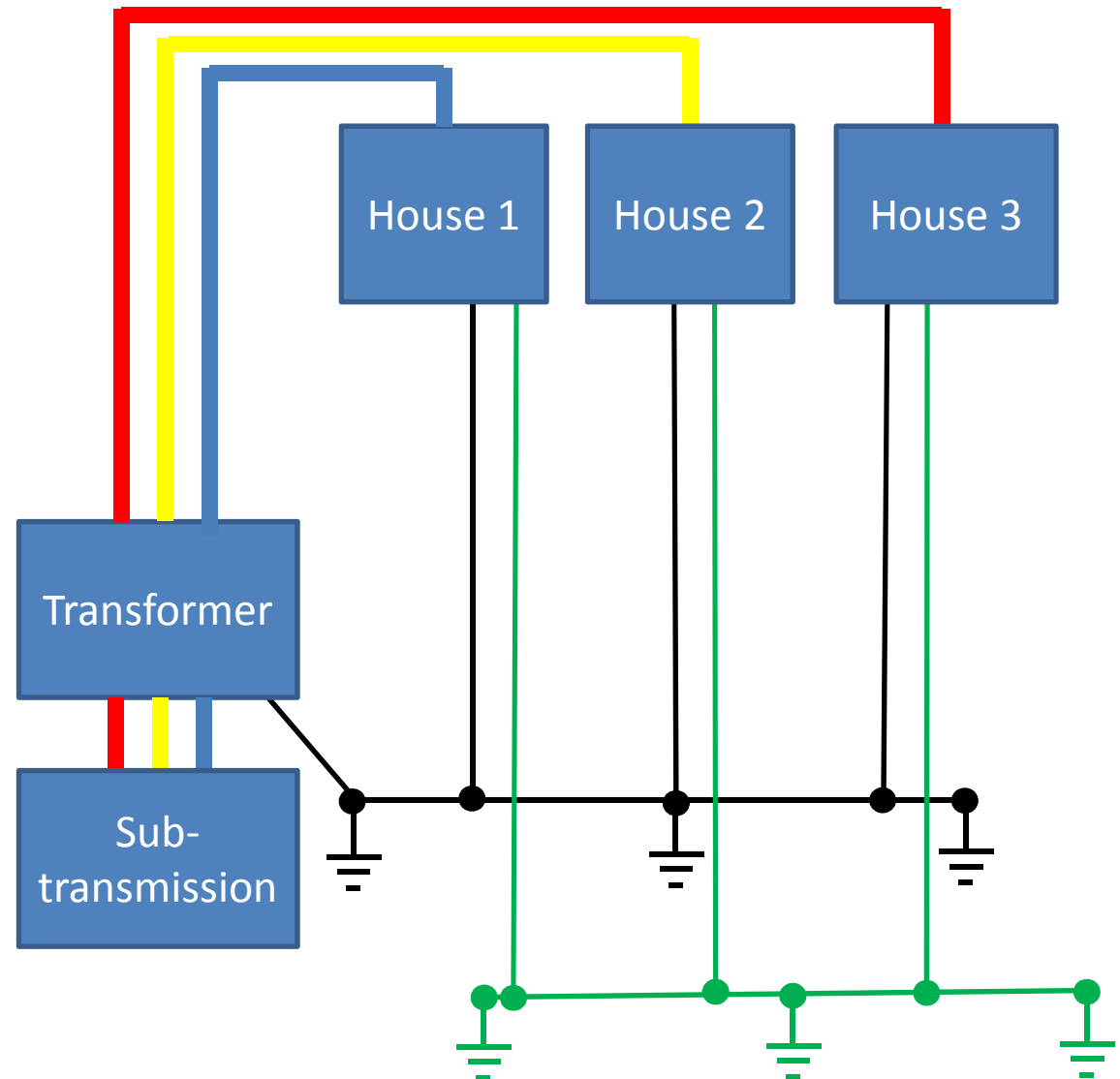
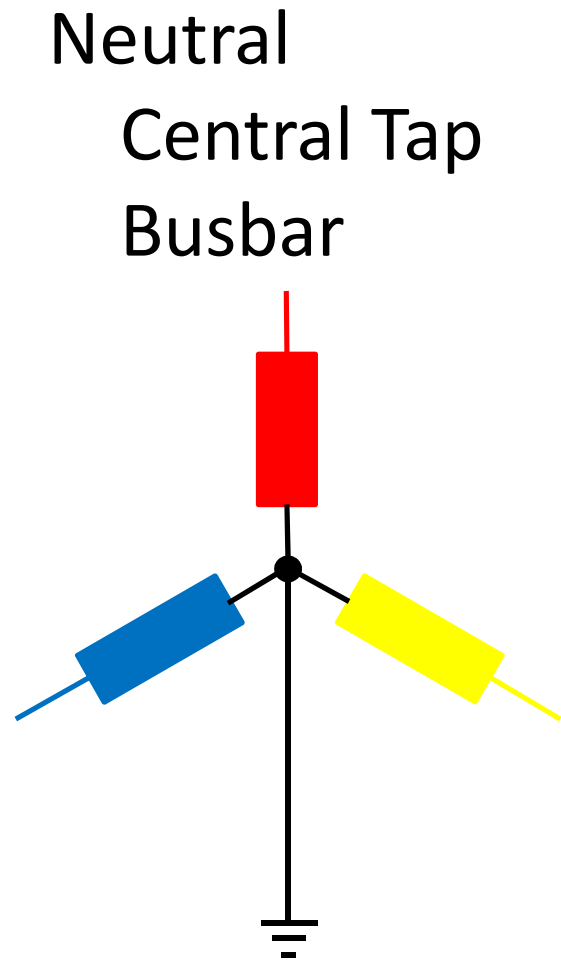
# Earth wire (4)

- Floating vs grounded
  - Grounded: Completely define all points on a circuit
    - Expensive infrastructure
    - “Guaranteed” safety
  - Floating: Define nothing respect to anything!
    - “Complete” isolation from earth
    - Cheaper

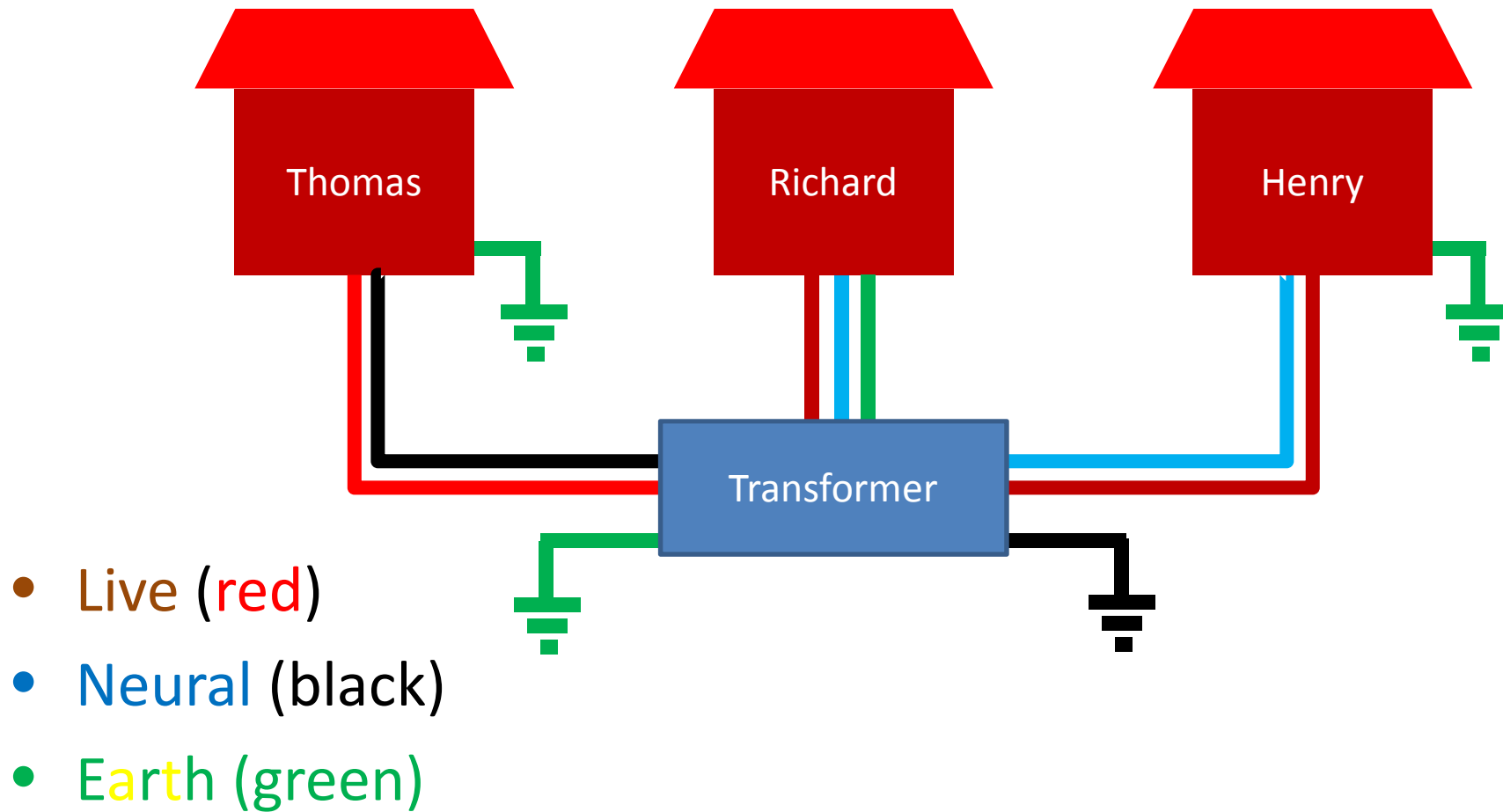




# Neutral wire

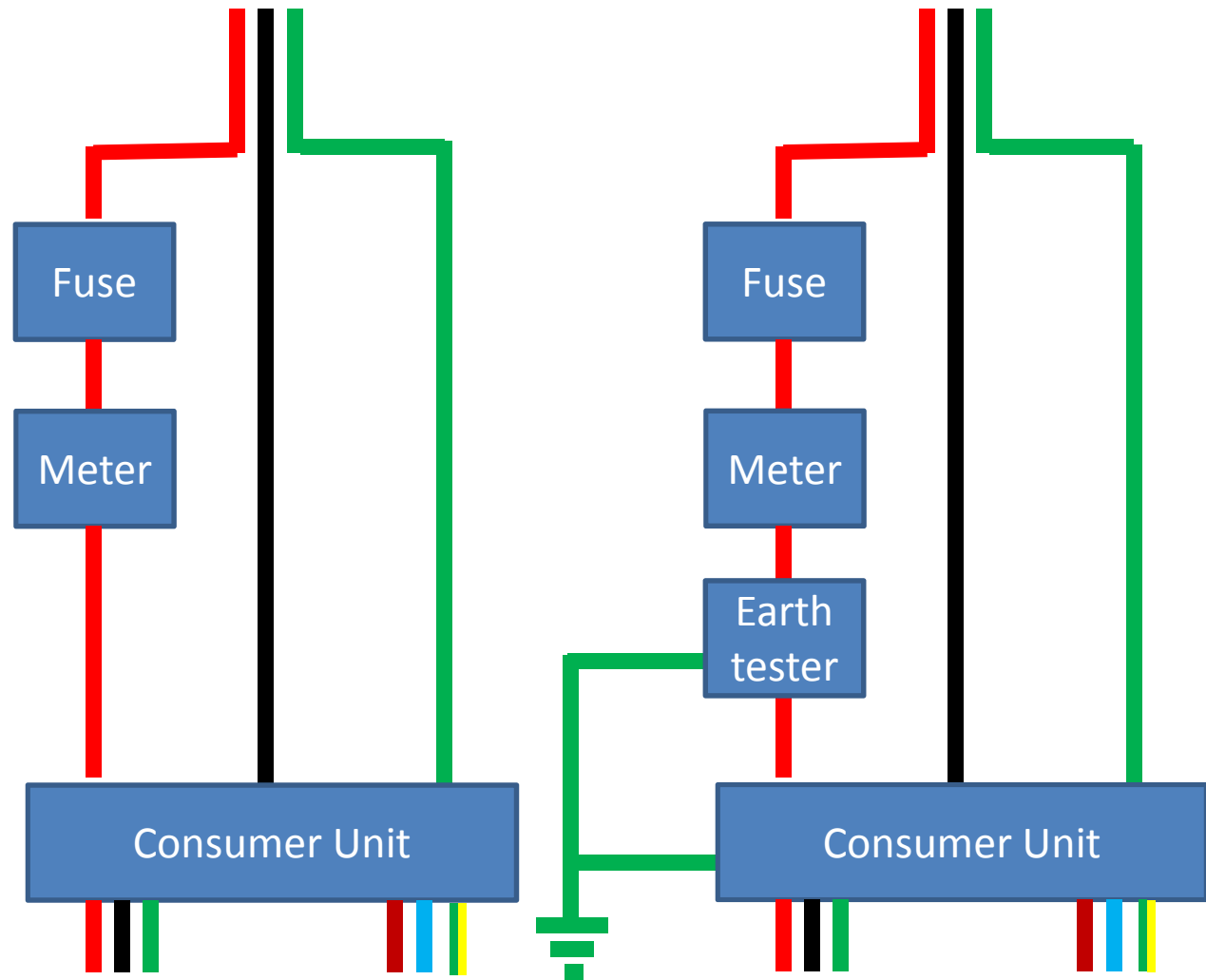


# Residential wiring



# Electricity in the home

- Single phase cable
- 60 – 100A fuse
- Electricity meter
- Consumer unit
- Circuits:
  - Lighting
  - Radial
  - Ring
  - Cooker
  - Shower



# Fuse

- Fuse is a sacrificial device for over current detection
- First “fuse” proposed by Breguet in 1847
- Modern fuse patented by Edison in 1890
- Construction
  - Wire: small cross section
  - Wire material: Zn, Cu, Al, Ag
  - Housing: Glass, ceramic, plastic, fibreglass
  - Inner medium: Air, sand (HV)
  - Variations: solder fuse, spring fuse



# Types of Fuse

- Rated current
- Rated voltage
- Speed
- $I^2t$  value
- Voltage drop
- Break capacity



# Circuit Breaker

3 Phase 110kV oil drum circuit breaker

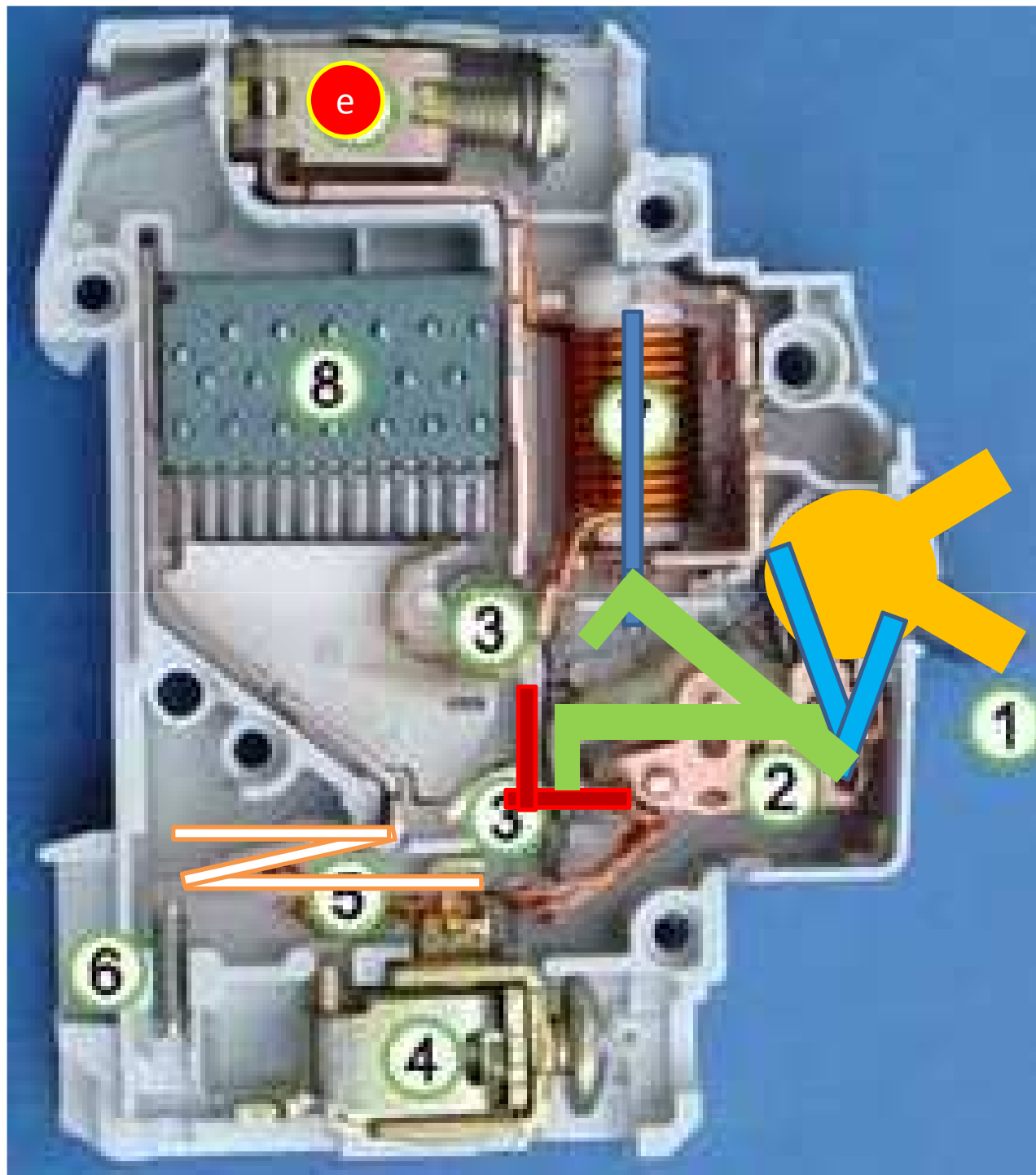


Mechanical (Miniature) Circuit Breaker (MCB)



Circuit breakers operate on the same principle regardless of their size

- Detect fault condition
- Cut off (break) current flow
- Suppress arcs



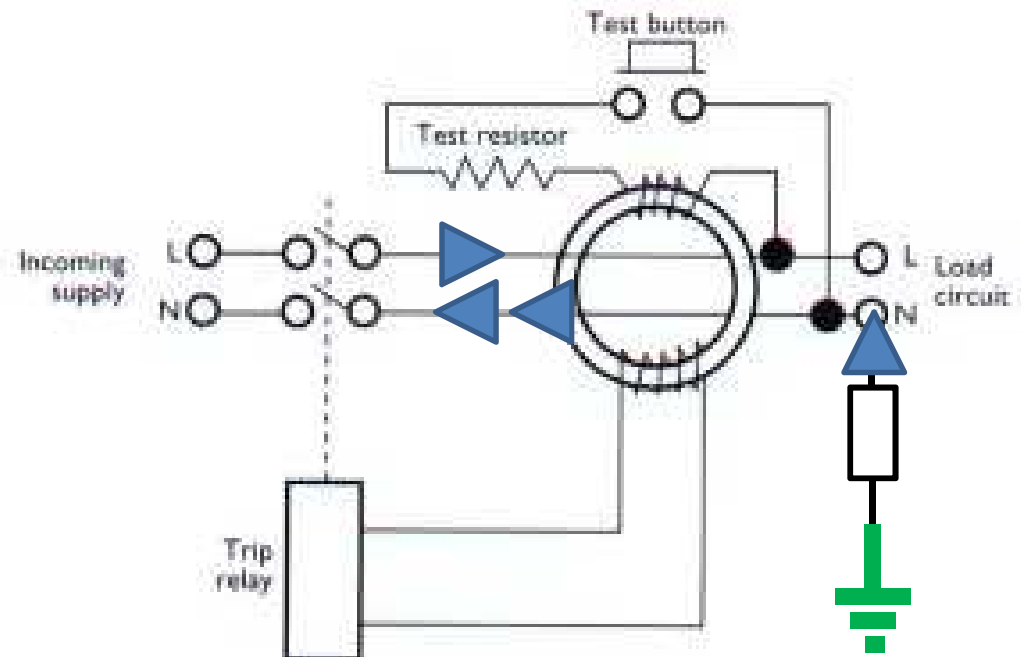
MCB:

How it works

1. Actuator lever
2. Actuator mechanism
3. Contacts
4. Terminals
5. Bimetallic strip
6. Calibration screw
7. Solenoid
8. Arc divider / extinguisher

# Residual Current Detector

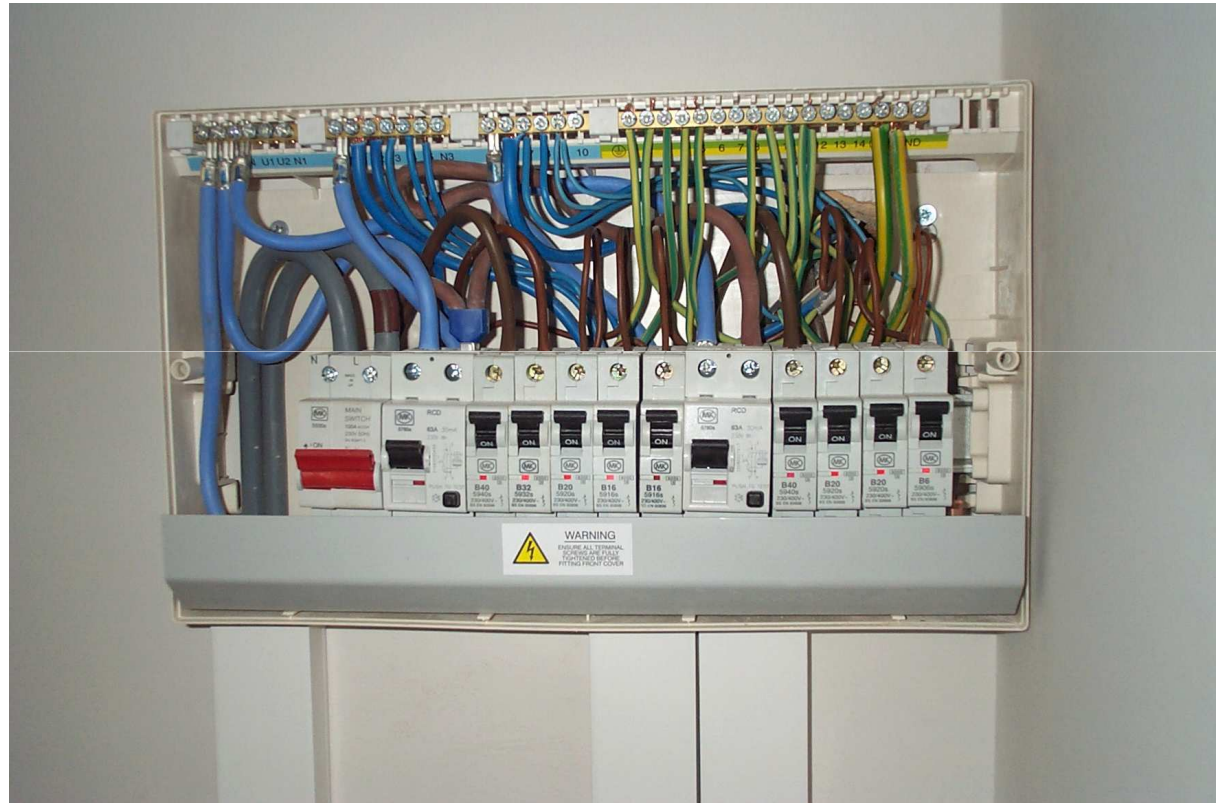
- Residual current circuit breaker
- Kirschoff's first law
- Trips on an imbalance between the current's in the L and N lines





# Consumer Unit

- MCB
- RCCD
- Busbar
  - Split Neutral
- Wiring Considerations



# Wires and loops

## Purpose

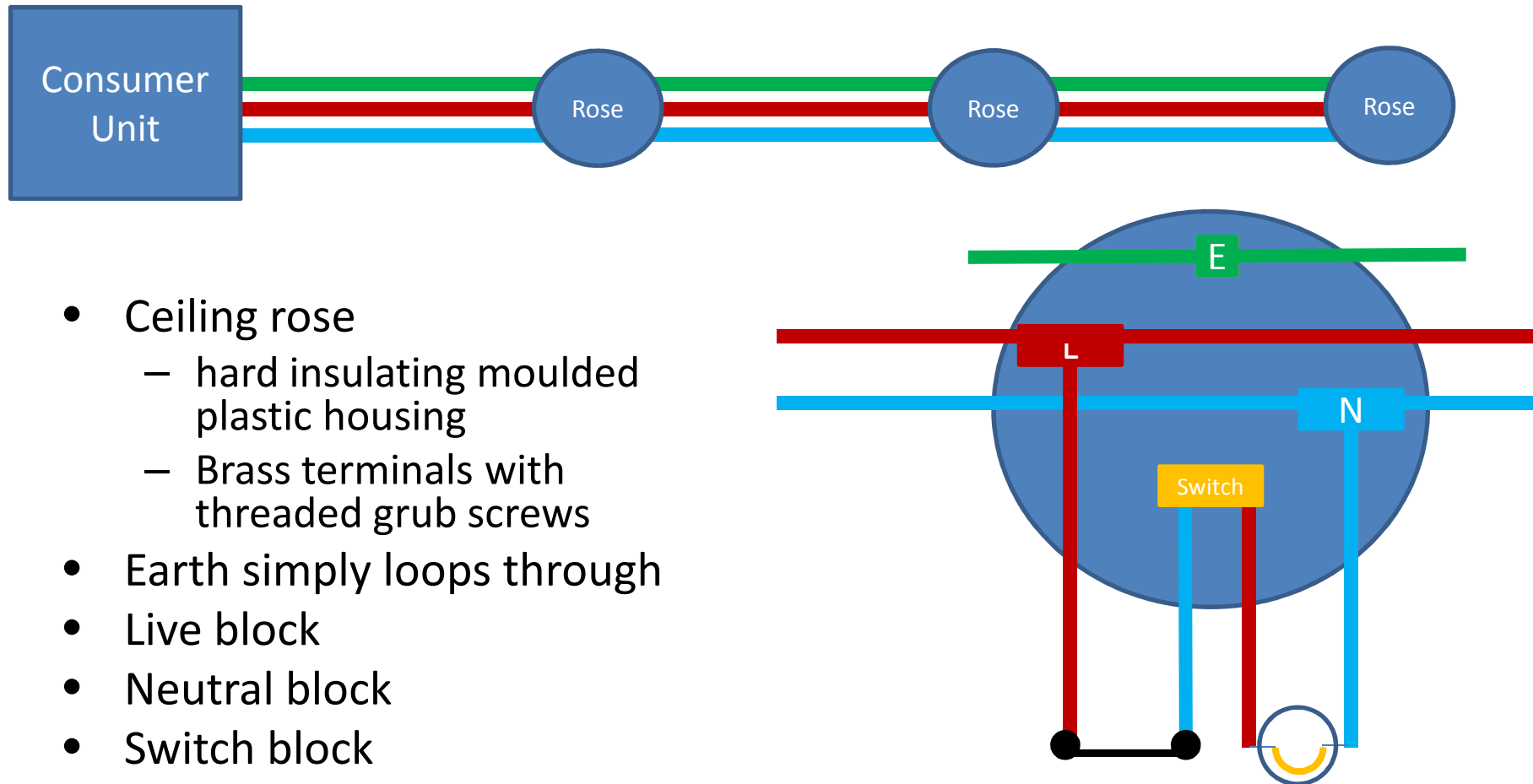
- Lighting
  - Ceiling rose
- Radial
- Ring
  - Spurs
- Special cases
  - Immersion heater
  - Showers
  - Cookers
  - Out buildings

## Wire rating

	$I_{app} / A$	$I_{max} / A$	$CSA / mm^2$
Lighting (100 W)	0.4 (4)	13.5 to 17.5	1 to 1.5
Sockets (double)	26 (18.2)	24!	2.5
Shower (8.5KW)	35	41	6
Shower (11.5KW)	48	57	10
Cooker (14KW)	29 (58)	32	4
Garage	16 – 26	24 - 32	2.5 – 4

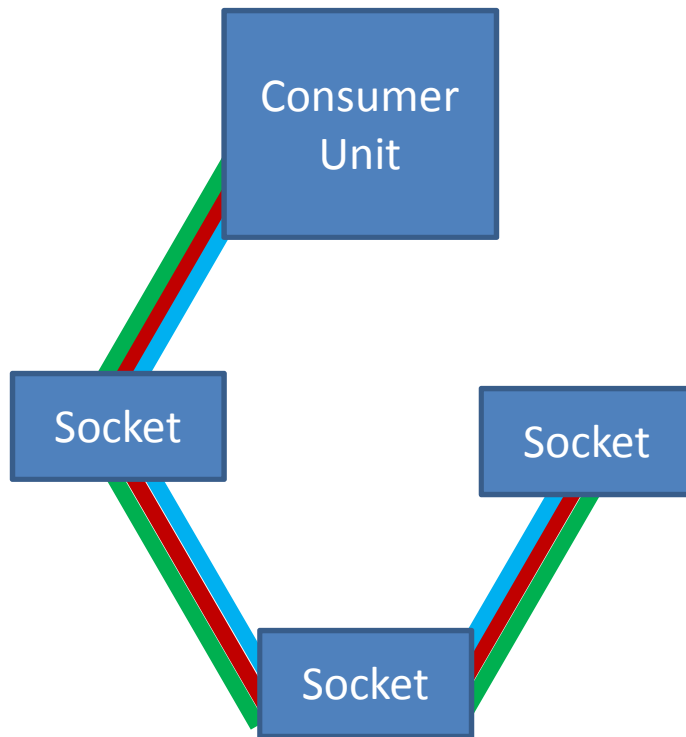
- **Diversity: Likelihood of having max demand**
- **X** is the full load current of the largest appliance or circuit
- **Y** is the full load current of the second largest appliance or circuit
- **Z** is the full load current of the remaining appliances or circuits
- $100\%X + 40\%(Y+Z)$

# Lighting



# Radial vs Ring

**Radial Circuit (20A)**



**Ring Circuit (32A)**

Spur  
Break

