BLE
LIGHTING & POWER

UNDERSTANDING POWER SYSTEMS

CONTENTS

SINGLE & THREE PHASE SUPPLIES

SINGLE-PHASE SUPPLY

- Typically residential.
- Three wires:
  - Live: carries the load
  - Neutral: carries current back to power source
  - Earth: provides a path to earth in case of fault.

THREE-PHASE SUPPLY

- Typically commercial and industrial.
- Five wires:
  - Live: three each carrying the same voltage but with 120 electrical degrees between allowing for load balancing and efficient power distribution.
  - Neutral: carries current back to power source if the phases are not balanced.
  - Earth: provides a path to earth in case of fault.

Both single & three phase use Alternating Current (AC).

Since 1988 voltage levels in Europe have been unified: Single-Phase: 230V
Three-Phase: 400V

STATIC INVERTERS & CENTRAL BATTERY SYSTEMS

Standard Input	230V 50Hz AC, commonly used in household and industrial applications.
For Larger Systems	A three-phase 400V 50Hz input may be used, requiring a transformer for adaptation.
Role of Phase Failure Relays	These devices monitor and protect against failures in the power supply, ensuring system stability.

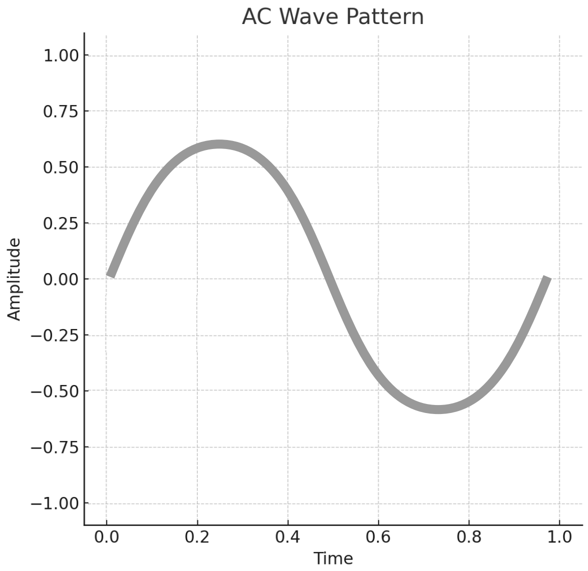
ALTERNATING & DIRECT CURRENTS

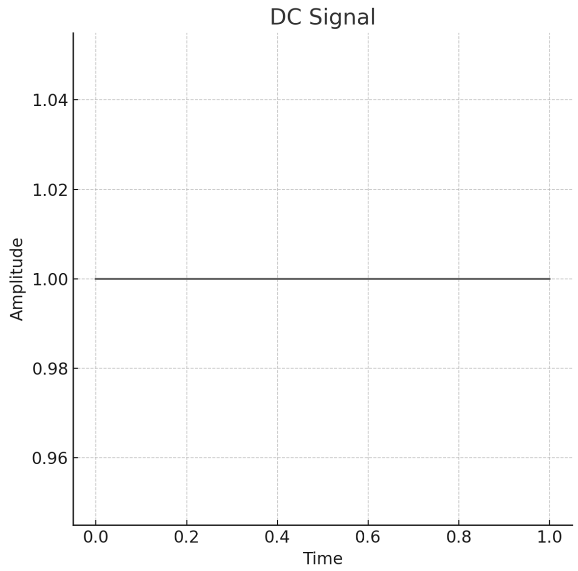
ALTERNATING CURRENT

- Electric charge (current) changes direction
- Frequency normally 50Hz
- Bi-directional electron flow

DIRECT CURRENT

- Electric charge (current) only flows in one direction.
- Has no frequency
- Electron flow is uni-directional





Comparison

Alternating Current	Direct Current
Can be easily transformed to DC using rectifiers	Can't be transformed to AC
Can be easily stepped up or down using transformers.	Not possible as DC has no frequency.
Cheaper to generate than DC	More expensive to generate than AC
More dangerous at high voltages	Less dangerous to work with at lower voltages (the converse is true at highter voltages)
Can't be used for electrodeposition processes such as electrorefining, electroplating etc.	Can be used for electrodeposition
Less risk of voltage drop	Operates at lower voltages than AC – can lead to voltage drop

REAL, APPARENT & REACTIVE POWER

REAL POWER

Definition	The part of total power in an AC circuit which is consumed by the equipment to do useful work.
Measure	Watts (W) or kilowatts (kW)
Application	The useful power an emergency lighting system consumes to produce light and maintain necessary functions during an outage.

APPARENT POWER

Definition	The total amount of power supplied to the circuit, including real and reactive power.
Measure	Volt-amperes (VA) or kilovolt-amperes (kVA)
Application	The overall load on your back-up power system, combining the energy used to produce light (Real Power) and the energy stored in reactive components.

REACTIVE POWER

Definition	Power that oscillates between the source and reactive components (e.g. inductors and capacitors) without doing any useful work.
Measure	Reactive volt-amperes (VAR)
Application	Does not contribute to lighting but is necessary for maintaining voltage levels that allow the system to function correctly.

POWER FACTOR

Definition	Ratio of real power to apparent power. Measures how efficiently the electrical power is used.
Calculations	Power Factor = Real Power / Apparent Power
Application	A high power factor (close to 1) means most of the apparent power is being effectively converted into real power, making the system more efficient.

INTRODUCTION TO MCBs

Understanding Miniature Circuit Breakers (MCBs).

- MCBs protect electrical circuits from overloads and short circuits.
- They automatically shut off electrical flow to prevent damage.

INPUT SUPPLY RATINGS

WHAT ARE INPUT SUPPLY RATINGS

- The specification/requirements for the electrical power supply required.

Rating	Measurement	Notes
Voltage	Volts (V)	Level of electrical potential required for the device.
Frequency	Hertz (Hz)	The cyclic oscillations of the electric current.
Current	Amperes (A)	Maximum flow of charge the device requires from the supply.
Power Consumption	Watts (W)	Specifies the amount of electrical power the device uses.

ELECTRICAL SAFETY IN SYSTEMS

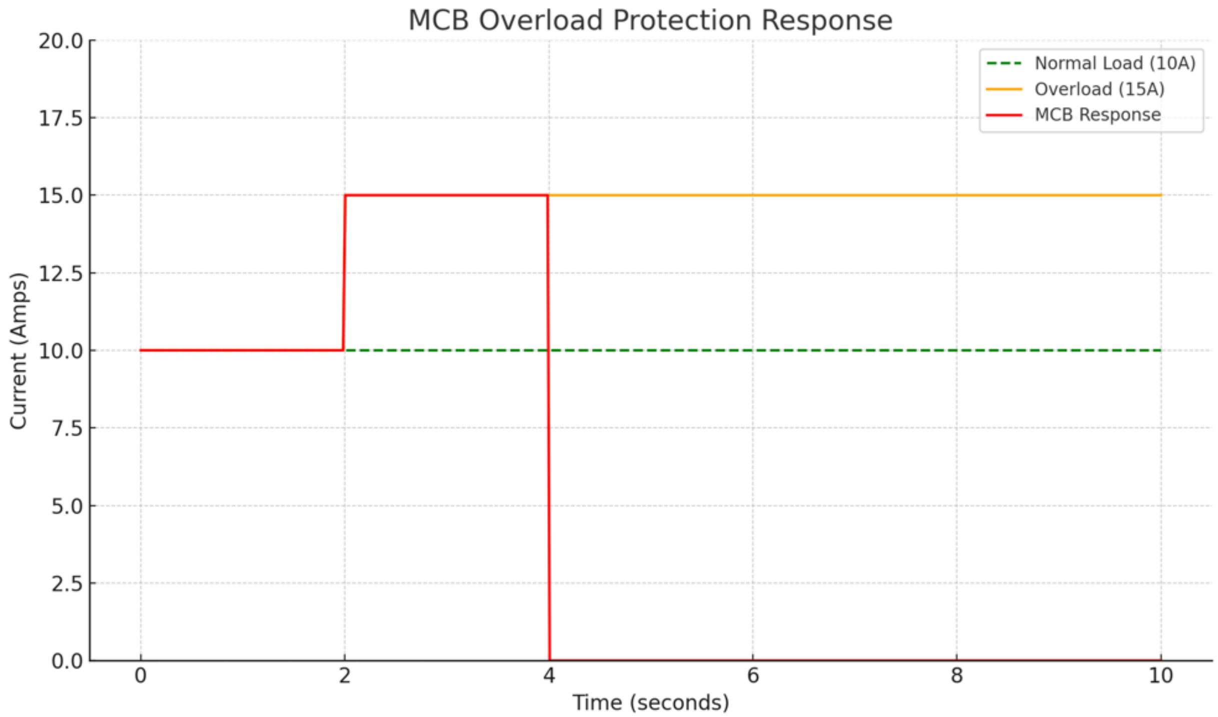
- Protecting against overcurrent.
- Context: Every electrical system and device is designed to operate within specific input supply ratings for safe and efficient performance.
- Challenge: Exceeding ratings can lead to overcurrent situations:
  - Short circuits
  - Overloads
- Protective measure: Miniature Circuit Breakers (MCBs)

WHY MCBs ARE ESSENTIAL

- Prevent damage to cables and equipment.
- Ensure safety by interrupting power in fault conditions.

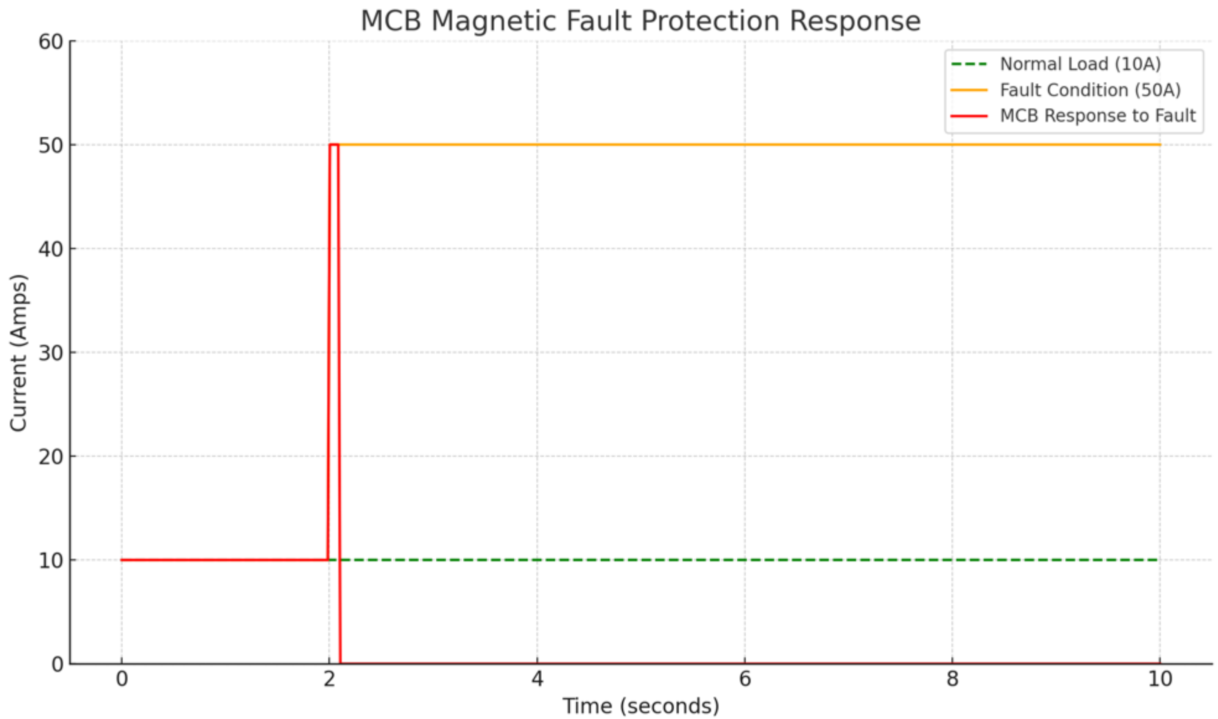
UNDERSTANDING OVERLOAD

- The circuit break occurs to prevent accidental overloading of the cable in a no-fault situation.
- Speed of tripping varies with degree of overload.
- Usually achieved with a thermal device.



MAGNETIC FAULT PROTECTION IN MCBs

- Operates under significant faults, tripping within 0.1 seconds.
- Predetermined levels set the type of MCB (B, C, D).



MCB CURRENT RATINGS AND TRIPPING MECHANISM

- Current ratings indicate the maximum current before tripping.
- MCBs trip to protect the circuit beyond these ratings.
- Due to the nature of the work we would normally recommend a Type C or Type D, especially for LED as every diode induces an initial in-rush current

Type	Tripping Current	Application
Type B	3-5 times	Low inrush currents
Type C	5-10 times	Moderate inrush currents
Type D	10-20 times	High inrush currents

EMERGENCY LIGHTING
BRITISH STANDARDS

BRITISH STANDARDS – EMERGENCY LIGHTING

BS 5266-1 (2016)	BS EN50171 (2021)
Guidance on the installation and maintenance of emergency lighting. It includes recommendations for lighting in areas requiring illumination for safety in the event of normal lighting supply failing.	Focusses on the specifics of the power supply systems for emergency lighting. Introduced three major changes to central power system design.
Code of practice. Are complementary standards.	Legislation.

CHANGES INTRODUCED IN BS EN 50171:2021 OVER & ABOVE BS5266

- Batteries in central power systems previously designated as 10 year design life, now designated as 10 year service life – effectively meaning a 12 year design life.
- Battery charger has to be capable of recharging the battery to 80% of nominal Ah capacity within 12 hours.
- The central power system has to be capable of continuously supplying 120% of the rated output under healthy mains conditions.

STATIC INVERTERS & CENTRAL BATTERY SYSTEMS

CENTRAL BATTERY SYSTEMS EXPLAINED

Modes of operation	These systems can be configured to provide a maintained supply or to only supply an output in the event of mains failure (non-maintained), offering versatility in application.
Bespoke Solutions	Depending on specific site requirements, these systems can also be engineered to provide either AC maintained, DC maintained, AC emergency or DC emergency, showing their adaptability.
Voltage Options	Output voltages can vary (24V, 48V, 110V or 230V), accommodating different requirements for the emergency lighting load.

UNDERSTANDING STATIC INVERTERS

Purpose	To convert DC power to AC.
Input	230V single phase & 400V three phase.
Output	Turns the DC battery bank into 230V AC.
Conversion Process	Utilises a double conversion process—first converting AC to DC (rectification), then back to AC (inversion)—to clean and stabilise the power supply.

MODES OF OPERATION - STATIC INVERTER

Responsive vs. Continuous	Static inverters can either stand by until needed (non-maintained) or continuously provide power (maintained), ensuring critical systems remain operational.
Output	Either maintained (the inverter feeding the load) or non maintained (inverter energised upon mains failure).
Output Always AC	Regardless of the operational mode, the output is always AC, catering to the general needs of most powered systems.
Critical for Reliability	These systems are integral to ensuring that the standby power supply remains available, crucial for a life safety system like emergency lighting.
Adaptable and Secure	They offer solutions that can be customized for specific needs, ensuring operational continuity even in the face of power disruptions.
Technological Backbone	Static inverters and central battery systems represent the technological backbone necessary for modern infrastructure’s resilience and reliability.

SIZING CENTRAL POWER SYSTEMS

CONSIDERATIONS WHEN SIZING A CENTRAL POWER SYSTEM

- Power of lamps
- Lamp rating will not be the same as the circuit wattage of the lamp due to power factor
- Good practise to allow a minimum of 20% spare capacity above total load profile
- Reminder: The power factor rating is the ratio of real power (Watts) used by the load compared to apparent power (Voltage x Current drawn) into the circuit: Power factor = Watts / (Volts x Amps). The power factor value is calculated by dividing real power and apparent value.

WORKED EXAMPLES

	Lamp A	Lamp B
Power Consumption	20 Watts	20 Watts
Power Factor	0.95 (0.092 Amps)	0.55 (0.16 Amps)
Load profile for 100no lamps	2105 Watts (9.2 Amps)	3636 Watts (16 Amps)
Apparent Power	2105 Watts	3636 Watts
Real Power	2000 Watts	2000 Watts

LOCAL / SUB CIRCUIT MONITORING & CHANGEOVER RELAYS

LOCAL / SUB CIRCUIT MONITORING & CHANGEOVER RELAYS

Emergency lighting shall be activated not only on complete failure of the supply to the normal lighting but also on a localised failure such as a final circuit failure.

BS EN50172:2004

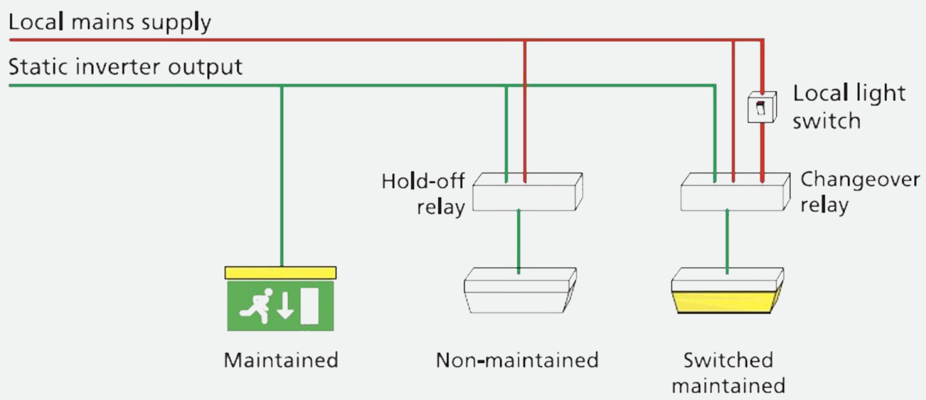
Sub-circuit Monitoring Relays	Changeover Relay
Non-maintained emergency lighting system	Luminaires supplied by central power supply
Luminaires are supplied by central power supply	Used as mains and emergency
Sub-circuit monitoring relays ensure emergency lighting is active upon local circuit failure	A changeover relay can be used

CHANGEOVER RELAYS

- Relay has three inputs:
    - Switched live
    - Unswitched live
    - Central power supply
- Both the switched and unswitched live are from the same final lighting circuit.
- Central power supply is available at all times, held off whilst relay is energised by mains lighting supply (unswitched live).

How it works:

- Switched live allows luminaire to be switched during normal operation.
- Upon local lighting circuit failure, relay de-energises and the luminaire is reactivated by the central power supply.



MANAGING LED IN-RUSH CURRENTS

- Shift in Focus:
    - Historically, power factor and crest factor were key concerns with fluorescent luminaires.
    - With LEDs, the focus has shifted to managing in-rush currents.
- LED In-Rush Currents
    - Despite low wattage, LED luminaires can have extremely high inrush currents.
    - Example: A 14W LED luminaire running at approximately 0.5 amps could generate an in-rush current of approximately 5 to 10 times that amount.
    - Duration: This surge typically lasts only 200-300 micro-seconds but is critical to consider.
- Impact on System Components:
    - Relays and Contactors: In-rush currents must be accounted for when selecting the current rating of changeover and hold-off relays.
    - Emergency Lighting Inverters: High in-rush currents can have an impact on inverters, especially in systems with a low overall current rating.
- Solution
    - Use a current limiting device within static inverter to manage initial in-rush current and protect from potential overload.

BLE LIGHTING & POWER

THANK YOU.