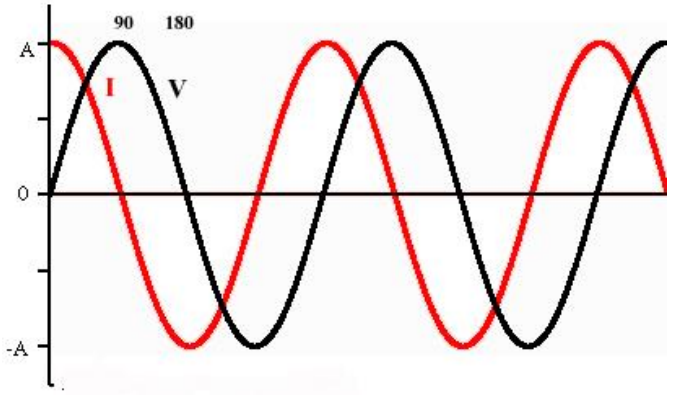
Module 4 Theory

- IRTS Region 4

Capacitive Reactance



- When a.c. is applied to a capacitor it will charge it, first in one direction, then the other; max. current flows when the voltage is changing most rapidly, least as voltage peaks
- The current leads the voltage by 90°

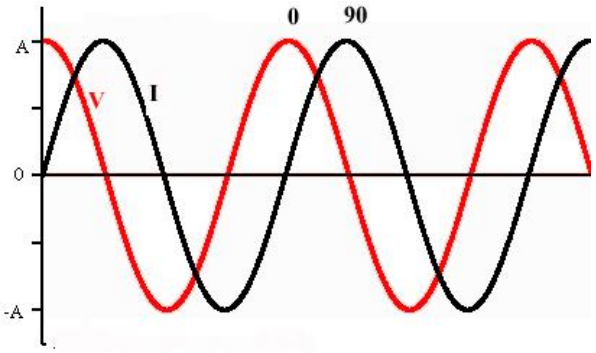
Capacitive Reactance

- The ratio of voltage to current is the reactance (X_C) measured on Ohms (Ω)
- $X_C = V / I$; $I = V / X_C$; $V = IX_C$

  V, I are rms values

- $X_C = \dfrac{1}{(2\pi f C)}$ Reactance decreases as frequency increases

Inductive Reactance



- If an a.c. voltage is applied to an inductor the reverse voltage (back emf) generated causes the current to lag the voltage by 90°
- The ratio of voltage to current is the reactance (X_L) measured on Ohms (Ω)
- $X_L = V / I$; $I = V / X_L$; $V = I X_L$
  [V, I are rms values]

- $X_L = 2\pi f L$ Reactance increases with frequency

Q-factor

- An ideal inductor has no resistance to d.c. In practice there will be losses due to wire resistance, core losses (due to induced currents in conductive cores) and skin effect, whereby as frequency increases a.c. tends to flow only on the conductor surface
- The ratio of reactance to resistive losses for either a capacitor or inductor is called the Q-factor $Q = X / R$ [Q has no units]

Shielding & Earthing

- Equipment should be adequately shielded, generally in an earthed metal enclosure.
- This prevents radiation leaving or entering the device
- A separate RF earth will prevent signals flowing on the mains (safety) earth; it will also reduce noise pick-up by the amateur station
- This separate earth should consist of several earth rods, connected by thick wire or braid

Screening

- Screening is used to prevent coupling between circuits.
- Magnetic screens:
  - **A soft magnetic material is introduced to concentrate the flux lines leaving the field weaker elsewhere. Materials such as Mu-metal may be used for this.**
- Electrostatic screening:
  - **Is when a conductor is surrounded completely by another conductor which has the same potential along its whole length - sometimes called a Faraday Cage**
- Take care that screens are not too close and unduly influence circuitry they are meant to protect.

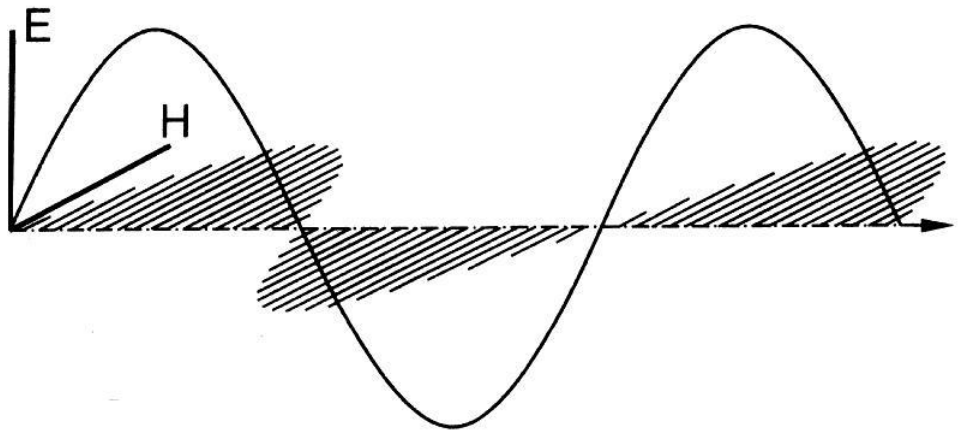
Electric field

- An electric field is the force resulting from electric charges
- Field strength is measured in volts/meter
- The effects of spurious electric fields can be reduced by screening equipment with earthed conductive material

Magnetic Field

- Every current-carrying conductor has a magnetic field around it caused by the current
- Unwanted effects can be reduced by shielding with a magnetic shielding alloy called Mumetal

Electromagnetic Field



- A radio wave is an electromagnetic wave, consisting of electric (E) and magnetic (H) fields at right angles to each other, both at right angles to the direction of travel
- The E-field determines polarisation and field strength (example is vertically polarised)

Propagation Velocity

- The speed at which the wave travels (propagation velocity) depends on the medium in which it is travelling
- In free space it travels at the speed of light (300×10^6 m/s). In air velocity is slightly less
- *velocity* = *frequency* × *wavelength*
- $v = f \times \lambda$; λ (meters) = 300 / f (MHz)
- 6 MHz is a wavelength of 50 meters

Power Supplies

- Mains On/Off switch should be double pole isolating both the live and the neutral

- A mains fuse of appropriate value should be fitted in the live lead only on the equipment side of the mains switch

- A fuse or fuses of appropriate value should be fitted on the output/s of the power supply

Mains Plugs Fitting

- Flex Colours:-
- Live=Brown,
- Neutral=Blue
- Earth=Green / Yellow
- Avoid whiskers, trapped wires, and ensure that Cord Grips are secure, but don’t pierce the insulation.
- Fuses are to protect the equipment and you.
- ALWAYS FIT THE RIGHT FUSE FOR THE EQUIPMENT

Power Supplies

- Micro switches should be installed so that high voltage supplies for valve power amplifier stages are automatically disconnected when the cover is removed

- In high voltage power supplies a bleeder resistor should be connected across each smoothing capacitor to allow them to discharge after the power is switched off

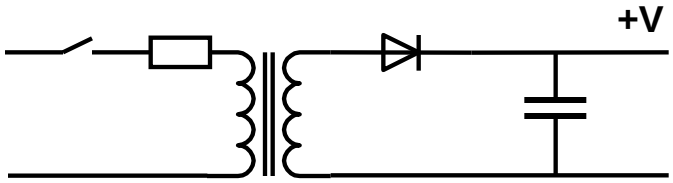
Power Supplies

- Do not rely on bleeder resistors. They can go open circuit. Use a shorting stick to ensure high voltage smoothing capacitors are discharged

- **Switch off before replacing fuses**

Power Supplies - 1

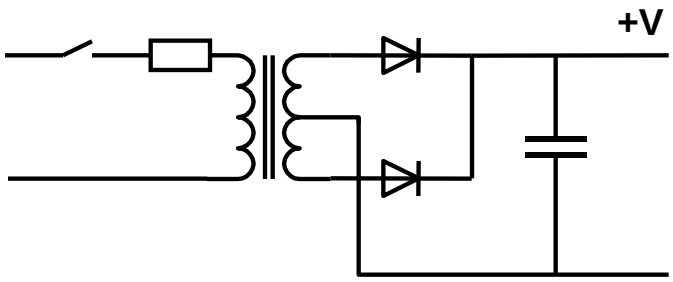
Half Wave Rectification



Best suited to low current applications

- High Ripple Current and Low Efficiency.
- Diode PIV = 2.8 . Vac

Full Wave Rectification

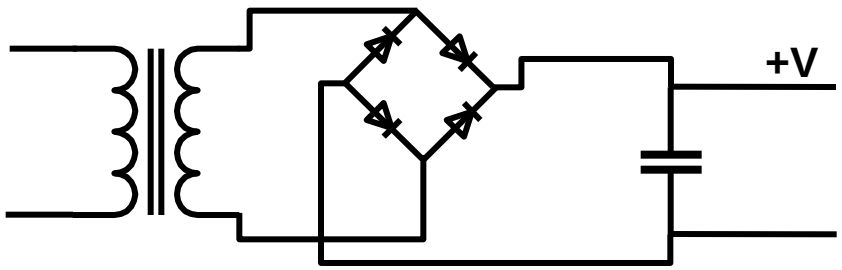


Circuit also known as Bi-Phase rectification. Each diode conducts on one half cycle. DC component of load flows through the secondary in such a direction to cancel magnetising current.

- Diode PIV = 2.8 . Vac

Power Supplies - 2

Bridge Rectification



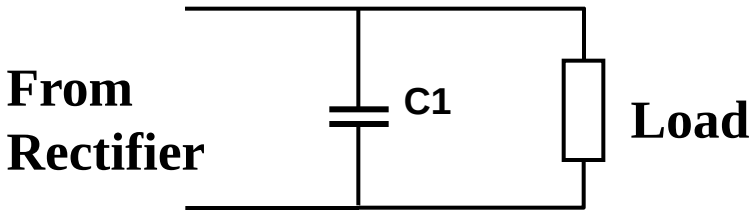
Preferred for high voltage, and does not need a centre-tapped transformer.

During each half cycle of the input voltage two of the diodes are conducting.

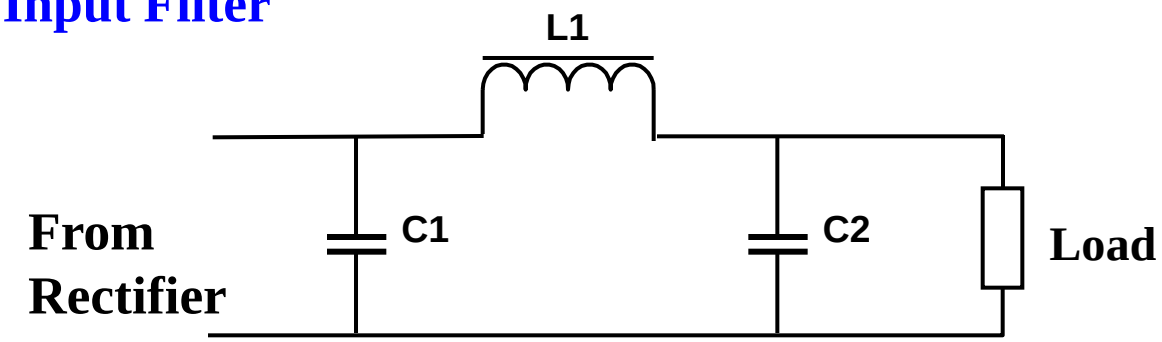
- PIV is half per diode.
- Diode PIV = 1.4 . Vac

Smoothing Circuits - 1

Simple Capacitor Filter

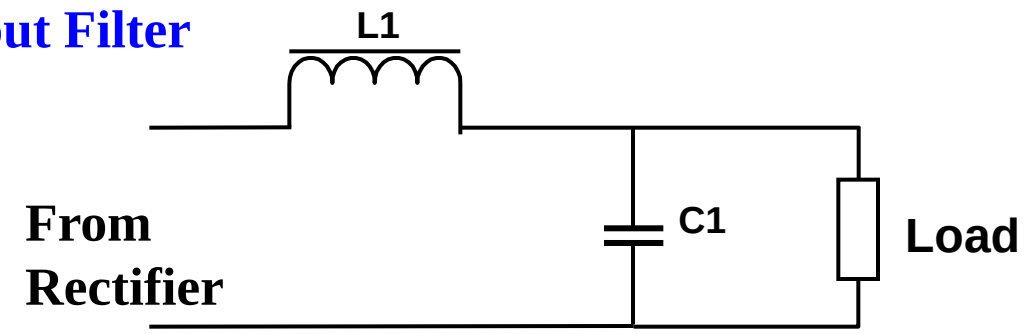


Capacitor Input Filter

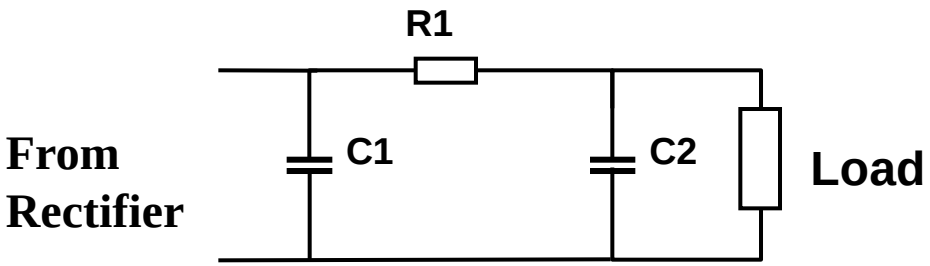


Smoothing Circuits - 2

Choke Input Filter

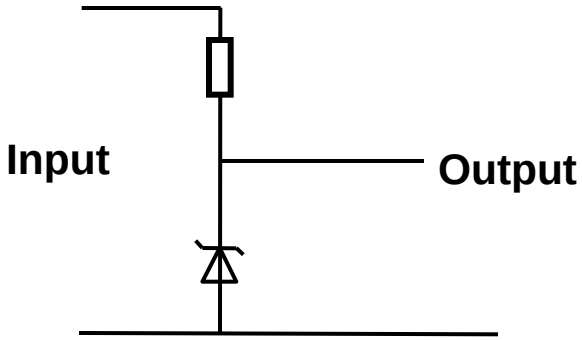


Resistance Capacitance Filter

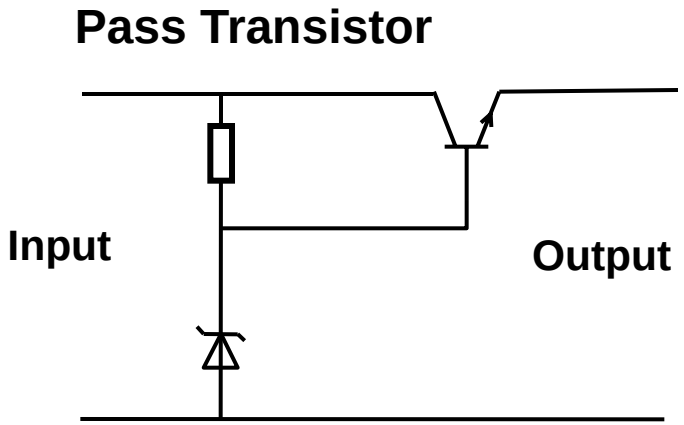


Stabilising Circuits

Zener Diode



Pass Transistor



IC Regulator