

Most modern Amateur Radio equipment operates from a low voltage power supply, usually 12 Volts DC. The current demand will, however, be quite high - often up to 20 Amps! When operating the equipment out of doors the power is most conveniently obtained from a car battery. It should be remembered that such batteries give off explosive Hydrogen and no-one should smoke nearby.

When indoors it is best to use a power supply unit to convert the 230 Volt AC "mains" to 12 Volt DC.

A Mains to 12v Power Supply Unit is made up of the following:

| | | | | | |
|---------|-------------|-----------|--------------|------------|--------|
| Mains | Transformer | Rectifier | Smoothing | Stabalizer | Output |
| 230v AC | Step - down | Diodes | or filtering | Regulator | DC |

A transformer is used to step-down the 230v mains to a low voltage. The transformer must be capable of handling the required power. If a transformer is over-run it will heat up and could catch fire!

The primary winding of the transformer usually has a few "taps" so that various mains voltages can be used.

It is then necessary to convert this low AC voltage into a Direct Current. This conversion from AC to DC is called rectification and utilises one or more diodes.

As will be explained in Lesson 6 a diode is a device that will only permit electricity to flow in one direction.

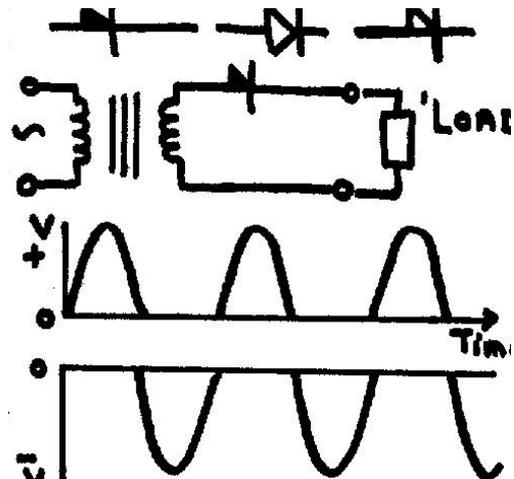
A diode is represented by one of these symbols in a circuit diagram

Half-wave Rectification

This simple rectifier circuit will give half wave rectification. Current will only flow through the load during the positive half cycles.

There is no current during the time of the negative half cycles.

If the diode is connected the other way round the output will be negative. This negative current will only flow during the negative half cycles.



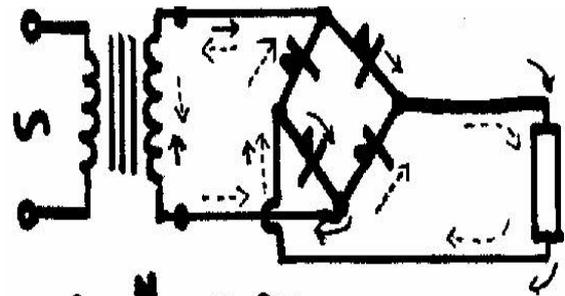
This very simple circuit will produce a great deal of hum at the supply frequency (50 Hz).

Full-wave rectification

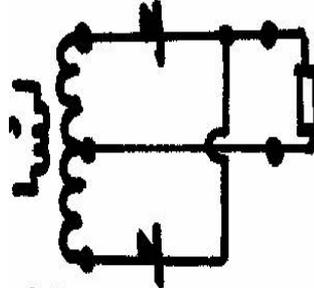
In full-wave rectification each half cycle is used to produce the required output.

This circuit uses 4 diodes in what is known as a *diode bridge configuration*.

The diode bridge can be made from four individual diodes or a pre-made unit with four external connections: Two would be marked AC, one marked + and one -



If a centre tapped transformer is used the only two diodes are needed.



In both of the above circuits the voltage across the load would look like this.



(For a negative output all the diodes would be reversed.)

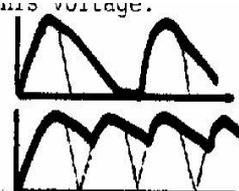
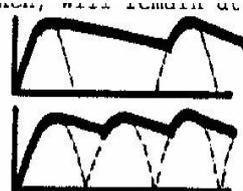
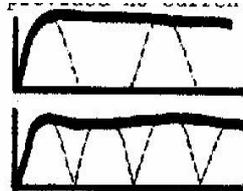
A full wave rectifier circuit gives an out put that contains hum at twice the supply frequency. (Usually 100 Hz).

Smoothing (filtering)

The output from the rectifier will have a great deal of hum at either 50 Hz or 100 Hz, depending on whether it is half or full-wave rectification. It is therefore necessary to *smooth* (or filter) the output.

This can be achieved by connecting a large capacitor across the output. This will charge to the peak value of the output wave-form and, provided no current is taken, will remain at this voltage

HALF WAVE



WAVE

FULL

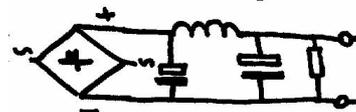
WAVE

NO LOAD

LIGHT LOAD

HEAVY LOAD

The above shows that the capacitor has more time to discharge during half-wave rectification and this results in excessive hum (or ripple) except when a very small current flows through load. In order to further reduce the hum an inductor and a another large capacitor are added.



These components form a low pass filter which will pass DC (zero frequency) but present a high impedance to 50 Hz or 100 Hz.

Stabalization (Regulation)

Many low cost Power Supply Units give an output voltage that will drop as the current demand is increased. Both diodes and inductors have internal resistance so an increase in current means that the "drop" in voltage across them also increases.

The output voltage therefore falls.

If it can be arranged that the Power Supply Unit always supplies the **same** current, then the "volts drop" will remain the same and the output voltage remains constant. This is the simple principle behind Zener Diode (and neon) stabalization.

A zener diode utilises the reverse characteristic of a diode.

If a zener diode is reversed biased there is a critical voltage at which the current flow increases dramatically. Beyond this "knee" in the characteristic, a very small change in voltage will result in a large change in the current passed.

The circuit is arranged to take advantage of this.

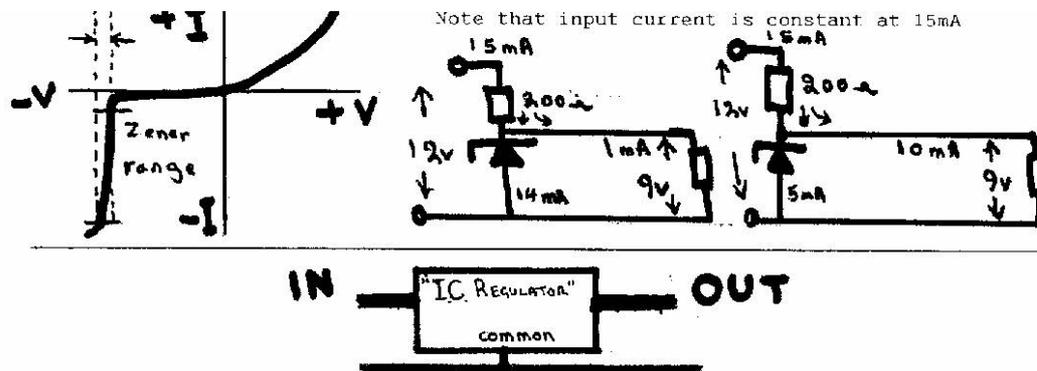
If the current taken by the load falls the zener will experience a small increase in voltage. This will cause the zener current to rise to compensate for the current not flowing through the load.

Thus the current taken by the zener plus the current flowing through the load will remain constant.

Even a simple PSU will give a stable output voltage if the current drawn remains the same.

If the load is completely disconnected, the whole output current will flow through the zener diode. The zener must be adequately rated (in Watts) so that it does not overheat.

Zener diodes are manufactured in various Powers and Voltages



Integrated circuit Voltage Regulators

Complicated voltage regulators are available for various voltages. Although their design is complex, they are simple to use.

They only have 3 terminals: Input, Ground or common and Output.

QUESTIONS

For some of the answers you may have to dig into your RAE Manual and "How to become a Radio Amateur", as well as studying this lesson!

- 5.1 Why is it easier to remove hum from a power supply unit that uses *full wave rectification* rather than *half wave rectification*?
- 5.2 What are the regulations regarding Amateur Radio operation in a boat?
- 5.3 A simple Zener Voltage Stabilizer (as shown on page 3 of this lesson) has a 12V input and a 9V output and a 200 Ohm series resistor. What "wattage" rating would you choose for the Zener Diode so that it will be safe under *no load conditions*?
- 5.4 Why suffix should be added to an Amateur callsign when operating as "Maritime Mobile"?
- 5.5 What is purpose of a fuse?
- 5.6 The symbol of an *electrolytic capacitor* has one "open" or white plate and one black plate. Which is the negative plate?
- 5.7 If electrolyte level, in a lead/acid accumulator, has dropped due to evaporation. Would you replenish with water or acid? Why ?
- 5.8 Draw the *symbol* for each of the following: Microphone; fuse; zener diode and potentiometer.
- 5.9 To whom should an Amateur Radio Class B license be returned to when it has expired or has been revoked?
- 5.10 What *log entries* are required by mobile or pedestrian Amateur Radio operators?
- 5.11 Which has the greater heating effect: 12 volts RMS and 1.5 Amps RMS @100 Hz OR 12 volts DC at 1.5 Amps DC ?
- 5.12 What is the *lowest frequency* covered by an Amateur License "B" ?
- 5.13 What is the *lowest frequency* covered by an Amateur License "A" ?
- 5.14 Why is a *bleed resistor* incorporated into the design of a high voltage power supply unit?

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