Power Systems

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Every piece of electronic equipment has a power source called a power supply. Most electronic circuits operate from some fixed value of DC voltage. Today, these voltages are somewhat standardized. Some typical values are 1.5, 1.8, 2.5, 3.3, 5, 6, 9, 12, 15, 24, and 48 volts. In some cases, two or more power supplies are needed. This power must be clean and stable. It must not vary from its stated value to any great degree and it must be free from noise and ripple.

In portable and mobile equipment, the power supply is a battery. This voltage is then translated into the desired voltages by one or more regulator or DC-DC converter circuits.

In most equipment, the DC voltages are supplied by a power supply that operates from the AC power line. Rectifiers convert the AC to DC while regulators and DC-DC converters supply the circuits with the needed voltages.

Power Consumption

Power consumption is important since it indicates how much energy is used and how much heat is produced. Low power consumption is important in any application but it is especially critical in battery operated equipment. The lower the power consumption, the longer the battery life and the longer the time between battery changes or charges.

The power consumption is sometimes stated directly in the IC or equipment specifications. The unit of power is the watt.

In other cases, power consumption can be computed from other specifications. For example, if an IC operates from 3.3 volts and has a current drain of 400 mA, the power is:

$$P = V \times I = 3.3 \times 0.4 = 1.32 \text{ watts.}$$

If an IC or other piece of equipment uses multiple power supplies, then the total power consumption is the sum of the power used from each source.

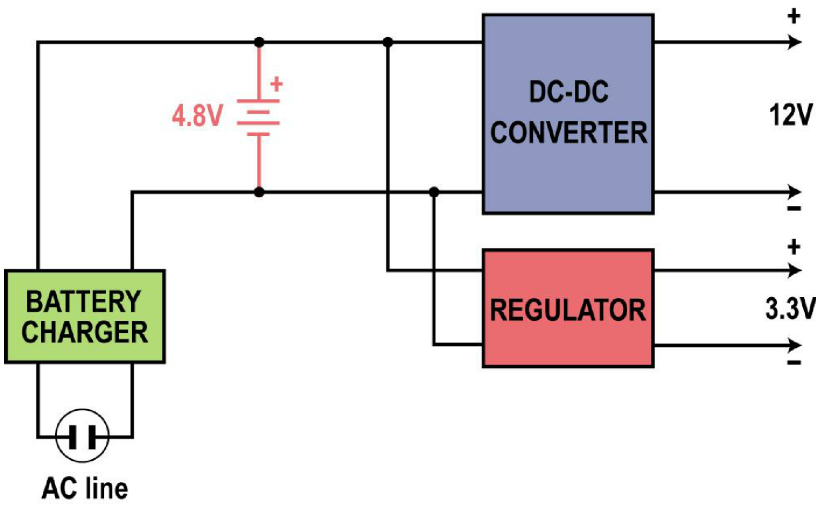
Power Consumption Produces Heat

A key factor related to power consumption the resulting heat. Remember that power dissipation creates heat. Heat is always a detrimental factor in any electronic equipment and elaborate steps are often taken to get rid of it.

Vented enclosures are critical. Heat sinks help remove the heat from an IC or power transistor to prevent it burning up. Many products have a fan to remove heat.

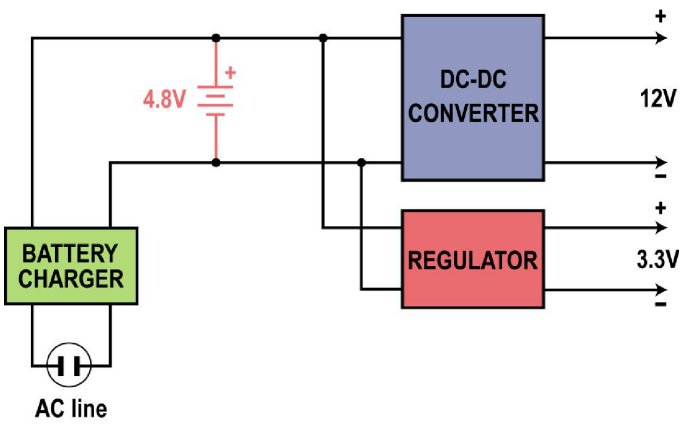
Even the larger ICs like Intel Pentium and AMD Opteron processors have attached heat sinks and fans. Larger more elaborate electronic equipment uses water cooling to remove heat.

Power Supplies



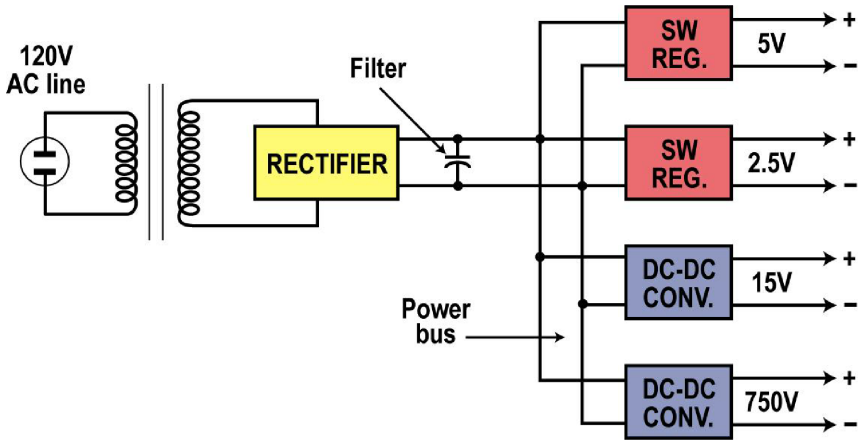
Examples of typical power supplies are discussed over the next few pages. These include battery operated, AC operated supply, and the uninterruptible power supply.

Power Supplies: Battery



This figure shows a typical battery operated supply. It starts with a 4.8 volt nickel-metal hydride (NMh) battery. The voltage is sent to a DC-DC converter where that develops a higher output voltage of 12 volts. It is also sent to a voltage regulator that produces an output of 3.3 volts. The regulator maintains this voltage over a wide range of input voltage variations and output load conditions. The circuit also includes a battery charger. The AC line voltage of 120 volts is rectified, filtered, and regulated down to the battery voltage level where it charges the battery.

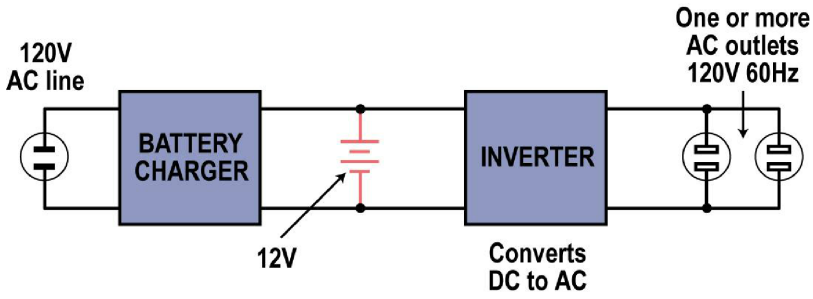
AC Supply with Power Bus



In a common AC operated supply, the 120 volt 60 Hz AC from the wall outlet is usually applied to a transformer to step it up or down as required. The rectifier converts the AC to puslating DC then a filter capacitor smoothes it into DC.

The unregulated DC from the filter capacitor goes to a power distribution bus. From there, the voltage goes to regulators and DC-DC converters where several different output voltages are developed for the circuits in the equipment.

Uninterruptible Power Supply



Another type of power supply is the uninterruptible power supply (UPS). The primary source of voltage is the battery which is kept charged by the AC operated battery charger.

The battery operates an inverter which is a circuit that converts the DC input into a 120 volt 60 Hz sine wave that is used to operate external equipment such as a personal computer or router. If the AC power fails, the PC and router continue to operate from the inverter powered by the battery.

A UPS is essential in critical systems such as networks which are so difficult to reboot if power fails. The UPS assures continuous power under any conditions.

Power Management

Many power supplies incorporate power management circuits. These circuits monitor the operation of the equipment and turn power off and on to selected circuits for the purpose of reducing overall power consumption or helping to prolong battery life. For example, in a cell phone, the display is turned off after a certain time if the phone is not being used. In a PC, power is often shut down after a certain period if the PC is not being used.

Power management is usually the function of a specific chip in the system designed for the purpose. In some cases, the power management circuits are designed into other ICs.

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Power Systems

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