Generator Information

Synchronous speeds

The output frequency of an alternator depends on the number of poles and the rotational speed. The speed corresponding to a particular frequency is called the *synchronous speed* for that frequency. This table gives some examples:

Poles	RPM at 50 Hz	RPM at 60 Hz
2	3,000	3,600
4	1,500	1,800
6	1,000	1,200
8	750	900
10	600	720
12	500	600
14	428.6	514.3
16	375	450
18	333.3	400
20	300	360

More generally, one cycle of alternating current is produced each time a pair of field poles passes over a point on the stationary winding. The relation between speed and frequency is $N = 120f / P$, where f is the frequency in Hz (cycles per second). P is the number of poles (2,4,6...) and N is the rotational speed in revolutions per minute (RPM). Very old descriptions of alternating current systems sometimes give the frequency in terms of alternations per minute, counting each half-cycle as one *alternation*; so 12,000 alternations per minute corresponds to 100 HZ.

Brushless Alternators

Construction

A brushless alternator is composed of two alternators built end-to-end on one shaft. Smaller brushless alternators may look like one unit but the two parts are readily identifiable on the large versions. The larger of the two sections is the main alternator and the smaller one is the exciter. The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on a plate attached to the rotor. Neither brushes nor slip rings are used, which reduces the number of wearing parts.

Main alternator

The main alternator has a rotating field as described above and a stationary armature (power generation windings).

Control system

Varying the amount of current through the stationary exciter field coils varies the 3-phase output from the exciter. This output is rectified by a rotating rectifier assembly, mounted on the rotor, and the resultant DC supplies the rotating field of the main alternator and hence alternator output. The result of all this is that a small DC exciter current indirectly controls the output of the main alternator.

Automatic voltage regulator (AVR)

An automatic voltage control device controls the field current to keep output voltage constant.