



Most digital multimeters are equipped to measure frequency.

## What is frequency?

AC frequency is the number of cycles per second in an alternating current (ac) sine wave.

Said another way, frequency is **the rate at which current changes direction per second**. It is measured in hertz (Hz), an international unit of measure where 1 hertz is equal to 1 cycle per second.

At its most basic, frequency is how often something repeats. In the case of electrical current, frequency is **the number of times a sine wave repeats**, or **completes**, **a positive-to-negative cycle**.

Example: If an alternating current is said to have a frequency of 5 Hz (see diagram below), that indicates its waveform repeats 5 times in 1 second.



The following is some of the terminology of frequency:

Hertz (Hz): One hertz is equal to one cycle per second.Cycle: One complete wave of alternating current or voltage.Alternation: One half of a cycle.Period: The time required to produce one complete cycle of a waveform.

Frequency is typically used to describe electrical equipment operation. Below are some common frequency ranges:

- Power line frequency (normally 50 Hz or 60 Hz).
- Variable-frequency drives, which normally use a 1-20 kilohertz (kHz) carrier frequency.
- Audio frequency: 15 Hz to 20 kHz (the range of human hearing).
- Radio frequency: 30-300 kHz.
- Low frequency: 300 kHz to 3 megahertz (MHz).
- Medium frequency: 3-30 MHz.
- High frequency: 30-300 MHz.

Circuits and equipment are often designed to operate at a fixed or variable frequency.

Equipment designed to operate at a fixed frequency performs abnormally if operated at a different frequency than specified.

Example: An ac motor designed to operate at 60 Hz runs slower if the frequency drops below 60 Hz, faster if it exceeds 60 Hz.

For ac motors, any change in frequency causes a proportional change in motor speed.

**Example:** A 5% reduction in frequency produces a 5% reduction in motor speed.

A digital multimeter (DMM) that includes a Frequency Counter mode can measure the frequency of alternating current signals. A DMM may also offer these modes:

- MIN/MAX Recording: Permits frequency measurements to be recorded:
  - a. over a specific time period;

b. the same way voltage, current or resistance measurements are recorded.

• Autorange: Automatically selects the frequency range (unless the measured voltage is outside the frequency measurement range).

Power grids vary by nation. In the United States, the grid is based on a highly stable 60-hertz signal, meaning it cycles 60 times per second.

In the U.S., household electrical power is based on a single-phase, 120-volt AC power supply. Power measured at a wall outlet in a U.S. home will yield sine waves that oscillate between 170 and minus-170 volts, with the true-rms voltage measuring at 120 volts. The rate of oscillation will be 60 cycles per second.

Hertz is named after German physicist Heinrich Hertz (1857-1894), first to broadcast and receive radio waves. Radio waves travel at one cycle per second (1 Hz). (Similarly, a clock ticks at 1 Hz.)

Reference: Digital Multimeter Principles by Glen A. Mazur, American Technical Publishers.

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