

Converting Among Acceleration, Displacement, Velocity and Frequency

Table 1. Formulas

Example 1: Calculating Velocity when acceleration (10 g's) and frequency (5 Hz) are known.

$$\begin{aligned} V &= gA/2\pi F \\ V &= 386.0886 * 10 / (2 * 22/7 * 5) \\ V &= 3860.886 / (2 * 3.142 * 5) \\ V &= 3860.886 / 31.42 \\ V &= 122.88 \text{ (inches per second)} \end{aligned}$$

Example 2: Calculating Displacement when acceleration (10 g's) and frequency (5 Hz) are known.

$$\begin{aligned} D &= gA/2\pi^2 f^2 \\ D &= (386.0886 * 10) / (2 * (22/7)^2 * 5^2) \\ D &= 3860.886 / (2 * 484/49 * 25) \\ D &= 3860.886 / (2 * 9.87776 * 25) \\ D &= 3860.886 / 493.888 \\ D &= 7.817 \text{ (inches)} \end{aligned}$$

Example 3: Calculating Frequency when acceleration (10 g's) and displacement (7.817) are known.

$$\begin{aligned} F &= \text{Square root of } gA/2\pi^2 D \\ F &= \text{Square root of } (386.0886 * 10) / (2 * (22/7)^2 * 7.817) \\ F &= \text{Square root of } (3860.886) / (2 * 484/49 * 7.817) \\ F &= \text{Square root of } (3860.886/2 * 9.87776 * 7.817) \\ F &= \text{Square root of } (3860.886/154.43) \\ F &= \text{Square root of } (25.00088) \\ F &= 5 \text{ Hz} \end{aligned}$$

Example 4: Calculating Velocity when frequency (5) and displacement (7.817) are known.

$$\begin{aligned} V &= \pi F D \\ V &= 22/7 * 5 * 7.817 \\ V &= 3.142 * 5 * 7.817 \\ V &= 122.81 \text{ (inches per second)} \end{aligned}$$



As accelerometers measure accelerations, how do end users calculate such things as displacement and velocity?

Acceleration, displacement and velocity are mathematically related to each other as a function of frequency. If two values are known, the other two can be calculated using simple formulas

Left (Table 1) are formulas based on sinusoidal equations of motion where:

D = displacement, inches, peak to peak
f = frequency, Hz
g = acceleration, g's peak (1G=386.0886 in/s²)
V = velocity, inches per second, peak

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