VIBRATION DESIGN CENTER

Converting Among Acceleration, Displacement, Velocity and Frequency

As accelerometers measure acclerations, 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/s^2)
V = velocity, inches per second, peak

Table 1. Formulas

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

$V = gA/2\pi F$
$V = 386.0886*10/2*22/7*5$
$V = 3860.886/(2*3.142 * 5)$
$V = 3860.886/31.42$
$V = 122.88$ (inches per second)

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

$D = gA/2\pi^2 f^2$
$D = (386.0886*10)/(2*(22/7)^2 * 5^2)$
$D = 3860.886/(2*484/49*25)$
$D = 3860.886/2*9.87776*25)$
$D = 3860.886/493.888$
$D = 7.817$ (inches)

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

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

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

$V = \pi FD$
$V = 22/7 * 5 * 7.817$
$V = 3.142 * 5 * 7.817$
$V = 122.81$ (inches per second)

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