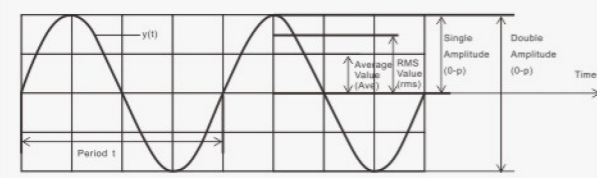


振动基本知识

Vibration Basic Knowledge



■ 振动的基本原理都是幅度随着时间变化的正弦函数，通常可以用加速度；位移；速度，这些物理量来表示振动的水平。
The basic principle is the amplitude of the vibration of a sine function with time, usually with an acceleration; displacement, speed, these quantities to represent the vibration is horizontal.

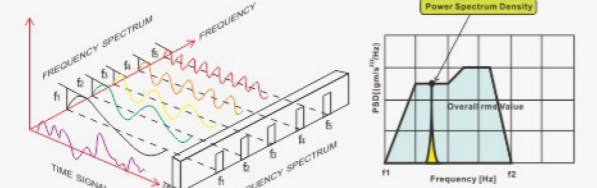
■ 正弦曲线参数示意图 Parameters of sine curve:
 Period(周期) $t=1/f$ (Frequency)
 Single Amplitude (单峰值) (0-p)
 Double Amplitude(峰峰值) (p-p)=Single Amplitude(单峰值) (0-p)×2
 Root-mean-square Value(均方根值) (rms)=Single Amplitude(单峰值) (0-p)×1/√2
 Average Value (平均值) (Ave)=Single Amplitude(单峰值) (0-p)×2/π
 基本公式 $y(t)=A \sin \omega t$ (ω : Angular Frequency 角频率)



■ 正弦扫频试验 Sine sweep test
以某种规律连续改变频率激励试验品，目的是在评估的频率范围寻找引起谐振的特有频率。
Some law continuously changing frequency of the excitation test product, aimed at the assessment of the frequency range to find cause-specific resonance frequency.

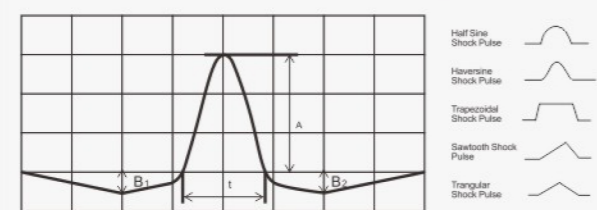
■ 主要参数 Main parameter
 • Frequency 频率 [Hz] • 试验时间 Test Time [t]
 • Acceleration 加速度 [m/s²] • Sweep Rate 扫频速率 (oct/min), [Hz/min]

■ 定频试验 Fixed frequency test
指定任意的一个频率值进行试验。目标是检出谐振点和评估特定规格下的耐久能力和强度(如 IEC、GB/T2423、MIL-STD、GJB150等对试验品进行扫频试验，共振驻留试验)
Specifies an arbitrary frequency tested. Goal is endurance and strength of the resonance point detection and assessment of a particular specification under (such as IEC, GB / T2423, MIL-STD, GJB150 and other tests on the sample frequency sweep, resonance dwell test)



■ 电子电子产品在运输过程所受的振动绝大多数是随机性质的振动，随机振动比正弦振动的频域宽，且是一个连续的频谱，它能同时在所有的频率上对产品进行振动激励，真实克隆现实环境。
Electronic and electrical products are subjected to vibration during transportation is the most random vibration properties, random vibration frequency sinusoidal vibration than wide, and it is a continuous spectrum, it can also carry out vibration excitation on the products in all frequencies, the real clone reality.

■ 主要参数 Main parameters:
 • 总均方根值 Overall RMS Value(rms) [Grms]
 • 功率谱密度值 Power Spectral Density(PSD) [g²/Hz]
 • 试验时间 Test Time [t]



■ 冲击与碰撞都属于冲击范畴，规定冲击脉冲波形的冲击试验，主要用来确定元件、设备和其他产品在使用和运输过程中经受多次重复（碰撞则是多次重复）机械冲击的适用性及评估包装保护。
The impact and collision impact all belong to the category, provisions of shock pulse impact test is used to determine the main components, equipment and other products in the use and transportation process subjected to repeated (collision is repeated) and evaluate the applicability of packaging to protect the mechanical shock.

■ 主要参数 Main parameters:
 • 脉冲类型 Main Shock Pulse • Pre-load[%] P1 p1=B1/A*100[%]
 • 脉冲宽度 Shock Pulse Duration[s] t • Post-load[%] P2 p2=B2/A*100[%]
 • 速度 Velocity[m/s] V • 峰值加速度 Acceleration [m/s²] A

国际通用单位 Universal International Units

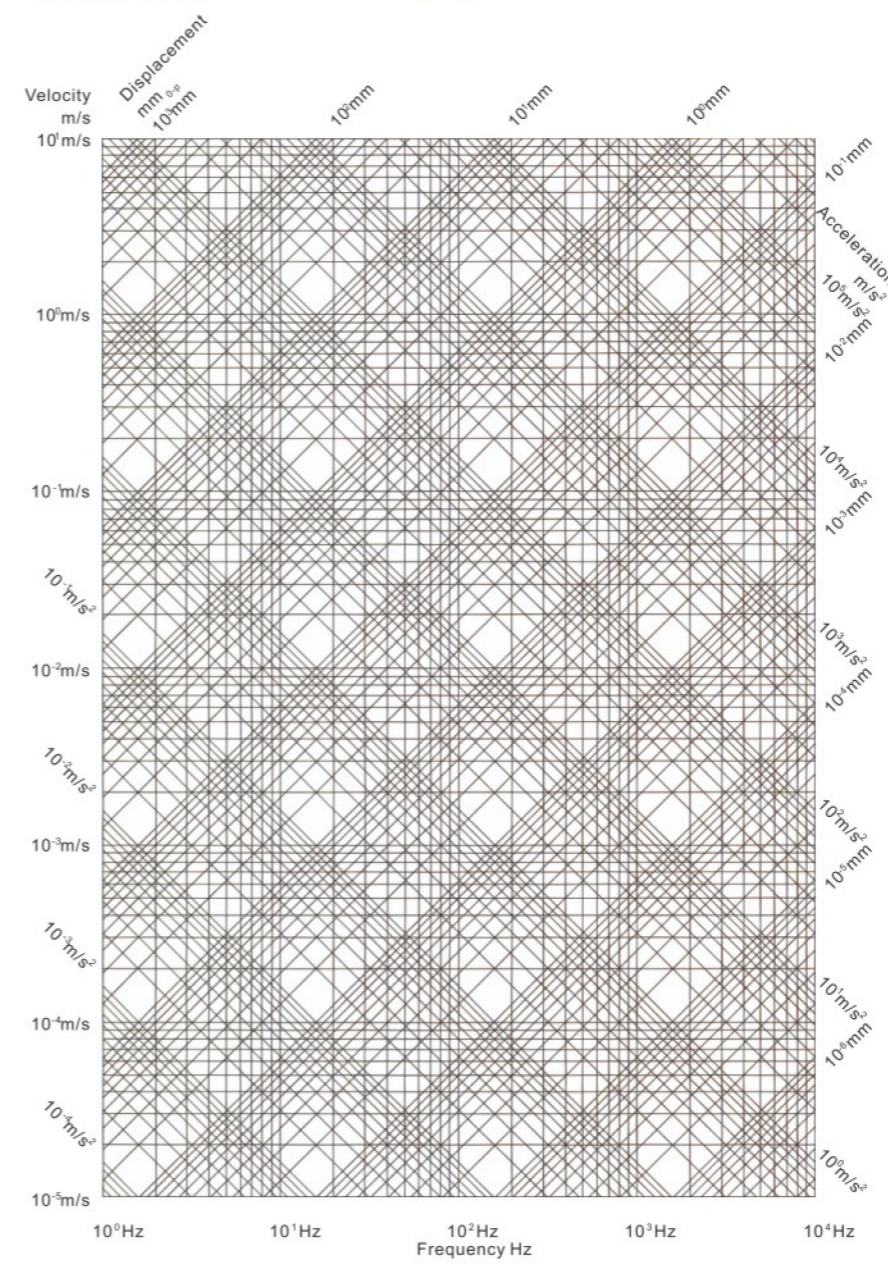
计量名称 Measure name	单位名称 Unit name	单位缩写 Unit abbreviation
长度 Length	米 Meter	m
质量 Mass	千克 Kilogram	Kg
时间 Time	秒 Second	S
速度 Velocity	米/秒 Meter per second	m/s
加速度 Acceleration	米/秒平方 Meter per second square	m/s ²
力 Force	牛顿 Newton	N
扭矩 Moment, Torque	牛顿·米 Newton-meter	N.m

换算公式 Conversion formula
 力(F) Force: 1kgf=9.80665N 1kgf=2.2lbf 长度 Length: 1inch=25.4mm
 重量(kg) Weight: 1kg=2.2lbs 速度 Velocity: 1m/s=39.37in/s
 加速度 Acceleration: 1g=9.80665m/s²

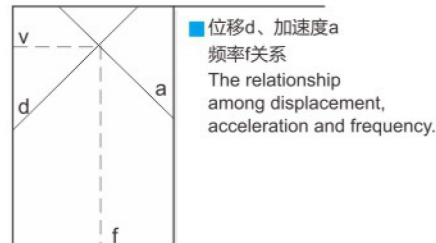
术语 The term

- Power Spectral Density 功率谱密度单位带宽具有的平均能量，它描述振动过程在不同频段的能量分布；
- Overall rms Value 总均方根值 加速度功率谱密度曲线在其规定的试验频率区间的曲线（功率谱）下面积的平方根，但不要将其跟正弦振动的峰值进行比较，他们之间没有任何关系；
- Pre-Pulse(前脉冲), post-pulse(后脉冲) 在主脉冲的前后分别增加前后补偿脉冲的作用是使速度和位移最后回归到零的位置。
- The average energy of Power Spectral Density has the units of bandwidth, which describes the process in the vibration energy distribution in different frequency bands;
- Overall rms Value curve in its predetermined test frequency range (power spectrum) under the square root of the area, but do it with the peak sinusoidal vibration were compared, there is no relationship between them;
- Pre-Pulse, post-pulse, respectively, before and after the increase in the compensation pulse before and after the main pulse is the role of the velocity and displacement finally return to the zero position.

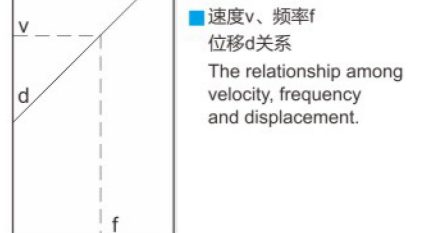
振动曲线图 Vibration nomograph



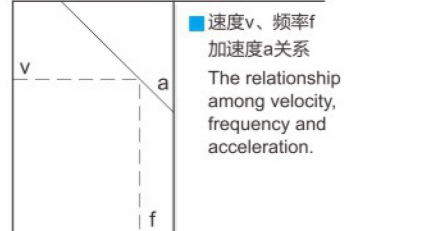
使用指导 Guidance



■ 位移d、加速度a
频率f关系
The relationship among displacement, acceleration and frequency.



■ 速度v、频率f
位移d关系
The relationship among velocity, frequency and displacement.



■ 速度v、频率f
加速度a关系
The relationship among velocity, frequency and acceleration.

D: 位移 Displacement
 v: 速度 Velocity
 a: 加速度 Acceleration
 f: 频率 Frequency

加速度、速度与位移之间关系 Relation among acceleration, velocity and displacement

关系 Relation	方程估计 Equation for Estimation
Acceleration $a[m/s^2]=(2\pi f)^2 d/1000=2\pi f v$	$A[m/s^2] 0.0394df \times 10^{-3} \quad 6.28fv \times 10^{-3}$
Velocity $v[m/s]=2\pi fd/1000=a/2\pi f$	$V[m/s] 0.00628fd \quad 0.159a/f \times 10^{-3}$
Displacement $d[mm]=1000a/(2\pi f)^2=1000v/2\pi f$	$d[mm] 25.5a/f^2 \times 10^{-3} \quad 159.2v/f$

※1 Divide the acceleration value by 9.8 when its unit is G
 ※2 Multiply the acceleration value by 9.8 when its unit is G