Selecting
Overall Type

vibDaq
vibration monitoring systems

Description

Vibration signals are commonly evaluated using an overall value to describe some basic characteristic of the signal measured. This document was written to describe the technical details and influence of the chosen type, and to suggest common applications for various sensor and test types.

Software Application

Each channel configured within the software is defined to have an associated overall type as shown in Figure 1 below:

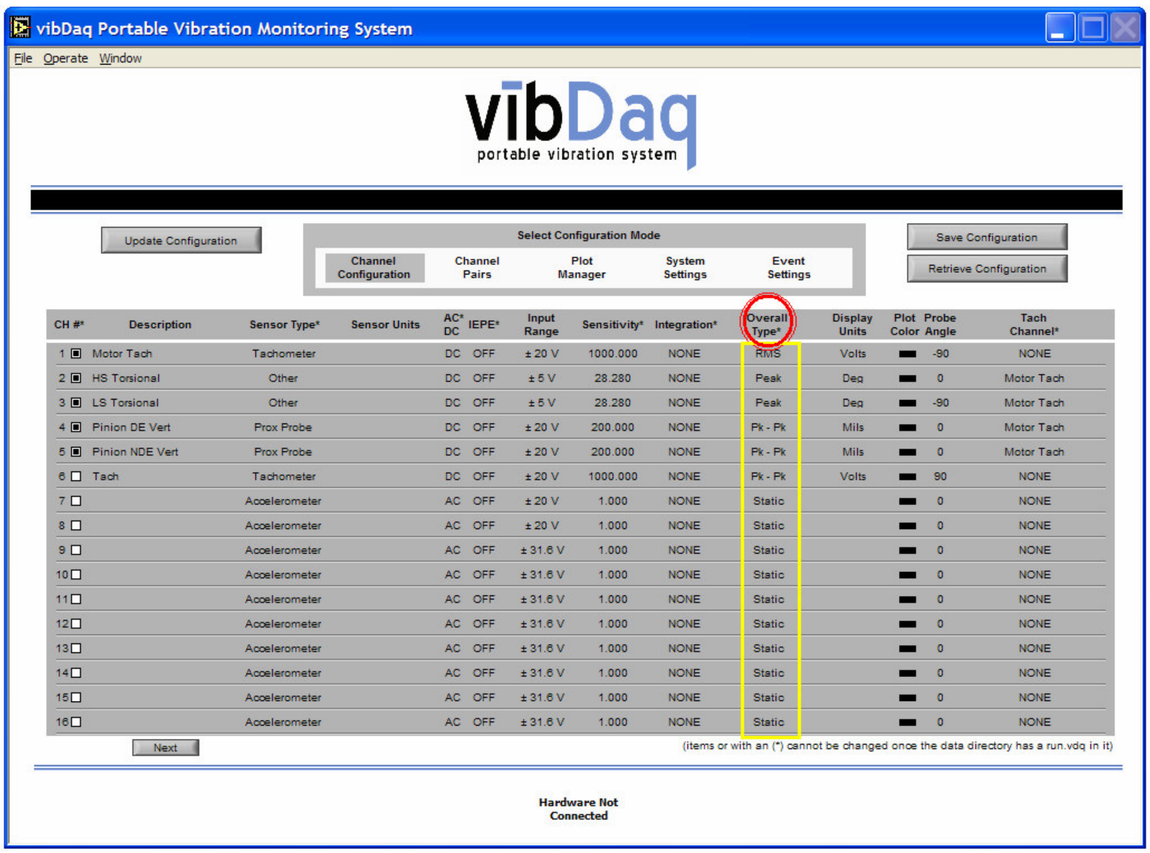

Figure 1 - Location of Overall Type Definition in User Interface

The available selections are included in Table 1, with a basic technical description for each overall type. The general selection is normally done based on the signal type and/or the purpose of measurement. A detailed description for each data type follows Table 1.

Table 1 - Overall Type Summary

Overall Type	Technical Description	Application
Static	DC value of signal in engineering units	For trending of a DC level such as thrust position using a proximity probe, or pressure using a 4-20 mA static pressure sensor
RMS	RMS energy of the input time waveform over the trend update time span (normally 1 second) with the DC voltage component removed.	Amperage reading using a current clamp, comparison of voltage inputs to common volt meters, and commonly used for velocity and acceleration measurements using European standards. Generally not used in the US for vibration measurements.
Peak	Derived peak value of the input time waveform signal over the trend update time span (normally 1 second). Derived peak is the rms value times 1.414 with the DC voltage component removed. This value is always 1.414 x RMS.	Common selection for velocity and acceleration readings for US area. Peak amplitudes will be the same as an energy level calculated from the associated FFT plot for the same time series, provided that he FFT plot is in peak units. This is the common US standard for velocity measurements used by most portable data collection equipment.
True Peak	½ of the (max – min) sample values for the time series for a single point. Depending on the nature of the signal components including the presence of spikes, the relationship of phase between various frequency signals, transient events, etc. This value will always be higher than the peak value unless the input signal is a pure sine wave.	Used by Bently Nevada hardware for velocity and acceleration signals unless RMS options are specified. True peak will produce amplitudes as much as 3-5 times higher for equipment that generate impacting type forces such as reciprocating compressors and engines.
Pk-Pk	Derived peak to peak value of the input time waveform signal over the trend update time span (normally 1 second). Derived peak-peak is the rms value times 2.828 with the DC voltage component removed. This value is always 2.828 x RMS.	Used for proximity probe readings so that displacement values are representative of the actual minimum to maximum travel of the shaft monitored. This method does not correctly represent total shaft movement, since it is an RMS measurement that is scaled. True Pk-Pk is a better choice for proximity probes.

Table 1, continued…

True Pk-Pk	The total range of sample values (max – min) for the time series for a single point. Depending on the nature of the signal components including the presence of spikes, the relationship of phase between various frequency signals, transient events, etc. This value will always be higher than the Pk-Pk value unless the input signal is a pure sine wave.	This is the standard measurement method for Bently Nevada systems for proximity probe systems. This value represents the actual minimum to maximum travel of the shaft including any measured anomalies due to glitch or "runout". Measured signals with narrow spikes (glitch) will produce much higher values than are representative of true shaft motion.
RPM	The RPM value determined from the tach if a tach is assigned to the channel.	

Overall values are often described in technical literature using standard conversions that relate the dynamic overall types for pure sine waves as follows (refer to Figure 2):

$$RMS = \frac{1}{\sqrt{2}} \times Peak = 0.707 \times Peak = \frac{0.707}{2} \times Peak - Peak$$

$$Peak = \sqrt{2} \times RMS = 1.414 \times RMS = \frac{Peak - Peak}{2}$$

$$Peak - Peak = 2 \times \sqrt{2} \times RMS = 2.828 \times RMS = 2 \times Peak$$

These relationships seem to represent well the correlations between each data type. However, these relationships only work for pure sine wave signals.

WARNING: Standard conversions ONLY work for pure sine waves

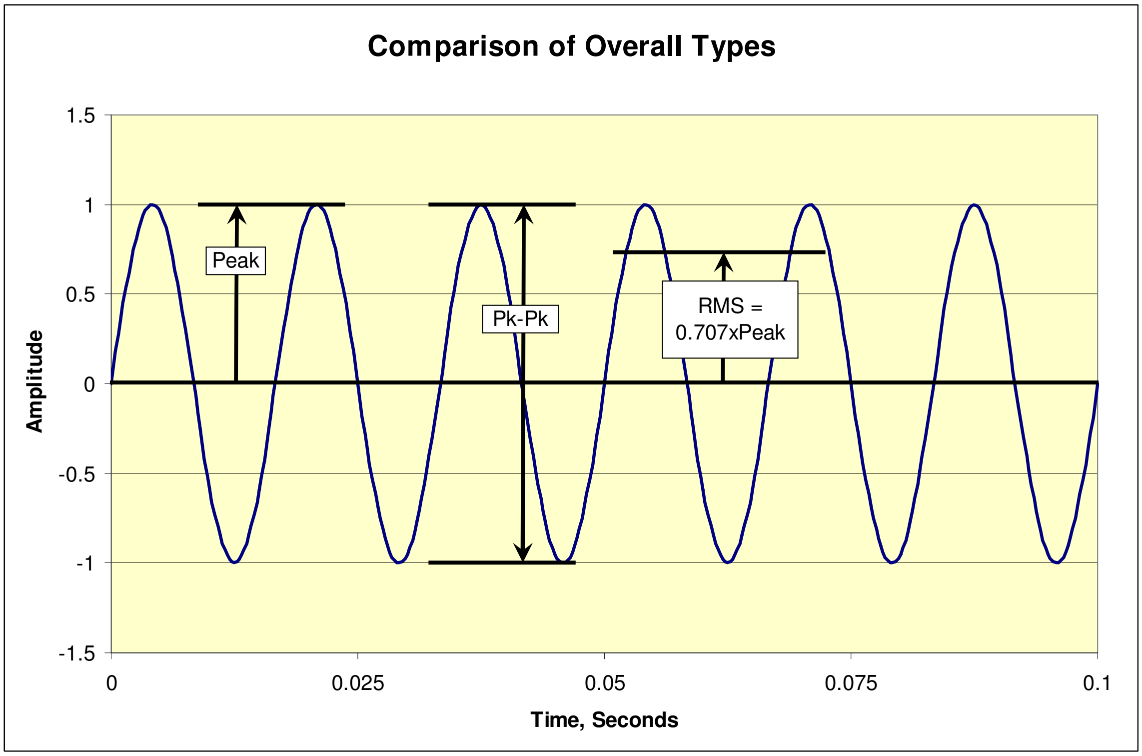

Figure 2 - Overall Type Comparison for Sine Wave

Unfortunately, real signals are almost never pure sine waves. It then becomes the burden of the analyst to fully understand the influence of the signal characteristics on the overall value calculated.

“Real” Signals from Accelerometers

Accelerometers by design measure acceleration of the sensor mounting location. If there are mechanical faults present in the equipment the sensor is connected to, it is common to have acceleration impacts present in the signal. The type of faults that will produce spikes include antifriction bearing damage, mechanical looseness, gross misalignment, rubs, etc. Since vibration measurements are frequently done when faults are expected, these influences will have a strong impact on the overall values calculated.

Figure 3 shows a signal with some impacts present. Since the impacts are rather narrow signals components (short time duration), the RMS calculation will not consider these features to add much to the RMS amplitude. In reality, very narrow spikes will add almost no RMS energy to a typical signal. When this occurs, the spikes will cause the derived peak and peak-peak values to be less than the “true” peak or “true” peak-peak. The derived values are the RMS values converted by the sine wave scaling factors to peak or peak-peak units.

WARNING: "True" values are always higher than derived values

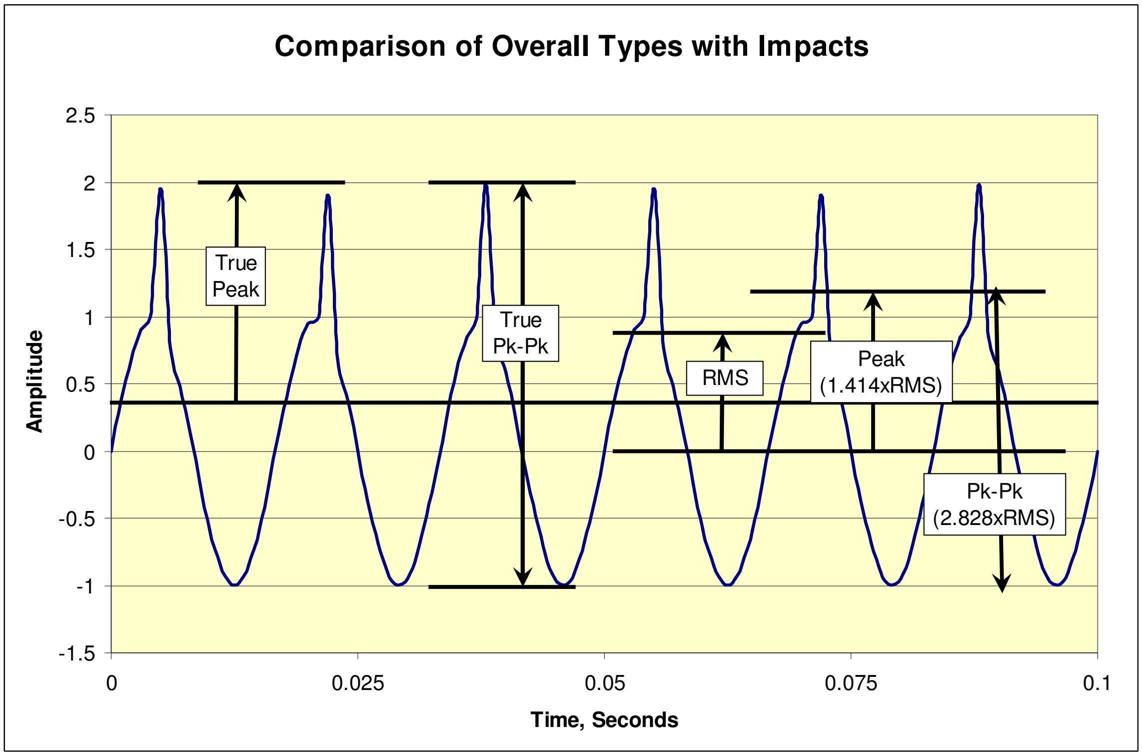

Figure 3 - Input Signal with Impacts Present

The primary result from spikes in the signals is that the “true” peak or “true” peak-peak values will ALWAYS be higher than the derived peak or derived peak-peak. If the signals are pure sine waves, the derived and “true” values would be identical. Any variation from pure sine waves will result in higher “true” values.

Comparison to Other Supplier’s Readings

Due to the difference in calculation methods that can be chosen for overall values, there are some generally accepted rules that can be done to compare vibDaq values with other suppliers of signal measurement equipment as shown in Table 2. These comments are historically accurate, but may vary with current offerings from other suppliers.

vibDaq instruments have been designed with enough flexibility to allow configurations that will produce overall values very similar to those generated by other suppliers. Please note that the difference between derived and “true” values should not be present for filtered values such are those calculated using order extraction routines, or those displayed in FFT’s.

WARNING: Filtered values are always the same whether "true" or derived overall is selected

Table 2 - Comparison of Other Supplier Overall Values

Supplier	Comments
General volt meters including Fluke, Radio Shack, etc.	Voltmeters always read in RMS units. Even when set in the peak hold mode, they still record the RMS value (peak hold just saves the largest RMS value). Some less expensive instruments don't use true RMS detection circuits, which will produce less consistent values compared to those that do. One simple circuit for determining a value is an "average" circuit which measures to nearly an RMS value, and is scaled in the display to produce an equivalent RMS level. These instruments will generate moderate levels for signals other than pure sine waves (triangle wave, square wave, and real vibration signals). Voltmeters are set to measure either DC or AC values. When the AC mode is selected (to compare to dynamic signal overall values), the AC coupling filter on the voltmeter will have implement a high pass filter to remove the DC component. The presence of these filters will make measurement of AC values for signals other than 50 to 60 Hz (common electrical frequencies) unpredictable.
CSI, IRD, SKF, etc.	Most portable vibration meters measure velocity and acceleration levels using either RMS values (for European standards) or derived peak. Many of these units can be configured to read true peak when certain selections are chosen. The actual comparison to overall values can only be made when defining the method used in the data collector. Values referred to as "digital" overall are derived peak values that are calculated from an FFT plot. These values will be very similar in amplitude to vibDaq peak values. Portable data collectors can be used to measure either derived or true peak-peak values for proximity probes. Most default to derived values, which will produce lower values than observed on Bently Nevada monitoring devices. vibDaq can be configured to measure either derived or "true" values.
Bently Nevada	Bently Nevada monitors and acquisition equipment by default measures true peak velocity and true peak-peak displacement values. It is possible with some of their monitors to configure acceleration readings to display RMS values. Historically they have not provided an instrument to display derived values. vibDaq overall values will match Bently Nevada monitors when either True Peak (for velocity) or True Peak-Peak (for displacement) is selected.