MB Win475-TS

Measuring Transverse Sensitivity of Vibration Sensors

Real-world vibration is always multi-axial

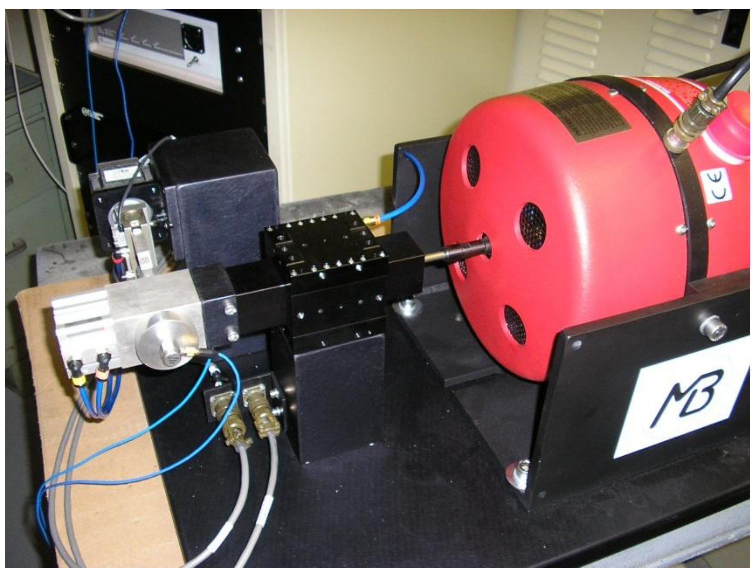
Vibration sensors are designed to measure motion in one principal axis, usually perpendicular to the mounting base. But an accelerometer or velocity pick-up's output in mV or pC is contaminated by motion in other directions. The transverse effect varies depending on the direction of side vibration. Transverse sensitivity refers to such output caused by cross-axis motion, expressed as a % of the nominal sensitivity with direction dependence.

Innumerable types of vibration sensors have been developed and provided by different companies worldwide, with variable quality. Measured transverse sensitivity characteristics might not be available for each sensor. Generally, transverse sensitivity varies with frequency. When measured, it is only at one, often low, frequency.

The unwanted sensor output due to off-axis vibration varies with the vibration direction. So, knowing the most- and least-sensitive radial directions of transverse sensitivity for each sensor helps to locate and orient that sensor on the test article. Vibration pick-ups have different specs requiring careful selection of the right sensor for a given test application. Using a sensor with known and minimal transverse sensitivity in a multi-axial vibration environment can be critical to reliable test results. It is good practice to measure transverse sensitivity annually when an accelerometer is otherwise re-calibrated. Misuse of accelerometers is a risk and having better information about a sensor's performance can lower measurement uncertainty. The MB Dynamics Win475-TS Option enables measuring a sensor's transverse sensitivity in accordance with ISO 16063-31, "Testing of transverse vibration sensitivity, Section 4, Determination of transverse sensitivity using a single-axis vibration generator".

Jobs-to-be-done to measure transverse sensitivity

- Automatically rotate sensor & acquire data at different rotation angles about its sensing axis
- Measure frequency-based transverse sensitivities at any user-selectable frequencies from 30 Hz to 2000 Hz
- Report the amplitude in % of nominal sensitivity and the radial direction of max transverse sensitivity
- Print amplitude vs. frequency plots, and typical "figure 8" shaped polar plots
- Automatically position the sensor with its radial direction of max transverse sensitivity pointing "UP", for marking
- Archive the data in the same database created during normal Win475 frequency-based calibrations



CAL 110 Exciter with TS Fixture and TS Rotator

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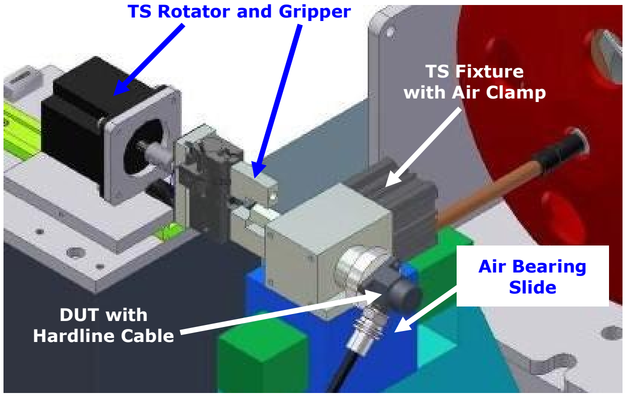
MB Win475-TS Deliverables and Test Procedure



The Win475-TS Measurement Option for MB's Win475 Automated Vibration Transducer Calibration System transforms accelerometer transverse sensitivity measurement because it measures at multiple, user-selectable frequencies – low frequencies for servo, seismic and modal accelerometers; higher frequencies for general-purpose sensors. Frequency-response plots show how the transverse sensitivity amplitude varies.

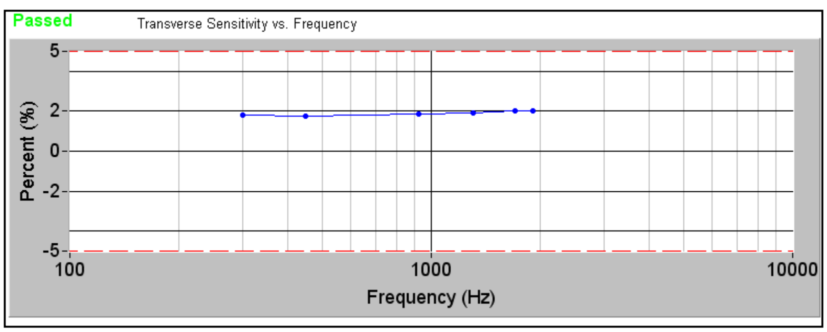
The Win475-TS option calculates transverse sensitivity based on a thoroughly-tested algorithm that automatically rotates and measures at 4 complimentary pairs of angles, performs vector math on the data, and applies narrow-band, frequency-domain filtering just like normal calibrations with the Win475. The option is fully automatic: input the transducer properties, pick the first frequency, and software-controlled measurements follow.

A stepper-motor-actuated TS Rotator positions the transducer being measured (DUT). The TS Fixture with air clamp firmly holds the DUT and its rotation cylinder during each data acquisition step. The CAL ENERGIZER RED exciter provides the vibration. No special signal conditioning is needed beyond what is normally provided in the Win475. At the conclusion of a test the TS Rotator puts the axis of maximum sensitivity vertically so the user can mark the transducer for future reference. The software displays the sensitivity as a percentage and the angle in degrees from the starting location. Other frequencies may then be repeated. Results are archived as part of that DUT's Win475 calibration history.

MB Win475-TS Reproducibility Results: 300 Hz to 1900 Hz

Sensor S/N	Sensitivity	Sensor Mass	No. of measurements	Amplitude Mean	Amplitude Std. Dev.	Angle Mean	Angle Std. Dev.
1685	102.3 mV/g	10 gm	115	1.95 %	0.23 %	-7 deg	4 deg
1813	100.3 mV/g	10 gm	92	0.44 %	0.14 %	4 deg	13 deg
1610166	1.23 pC/g	25 gm	68	1.04 %	0.31 %	170 deg	5 deg
1502	100.5 mV/g	10 gm	74	5.62 %	0.47 %	10 deg	2 deg

MB Win475-TS Typical Results



Typical plot created by Win475 software showing one measurement at each frequency step for S/N 1685 (see Reproducibility table above). All data collected at 10 g's peak, nominally 100 m/s^2 of vibration amplitude. Frequency range available is 30 Hz to 2000 Hz at 10 g's. Data were also collected at 15 g's and 20 g's peak with no apparent improvement in signal-to-noise or reduction in measurement uncertainty.

Polar plots for S/N 1685 (in above table) show the maximum transverse sensitivity amplitude and radial direction from the known starting position for a given frequency and vibration amplitude. The red dots below show the data points used to compute the "figure 8" shape from which amplitude and angle are computed.