

Smart Trend Meter 9080

User Guide: Version 1

Vibration Monitoring & Analysis



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Disclaimer

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1 OVERVIEW

The **Smart Trend Meter 9080** is a simple to use vibration monitoring and analysis tool that allows easy display of vibration signals. The meter automatically performs vibration analysis functions based on machine running speed to help diagnose faults such as unbalance, misalignment and looseness.

The system is designed to enable a user to take vibration measurements from assets (e.g. pumps, motors, fans and bearings). The unit displays vibration frequency plots and allows vibration severity and bearing condition to be monitored.

The Smart Trend Meter 9080 also has an optional **strobe attachment** for determining machine speed and optional **Bluetooth connected headphones** for listening to bearing noise.

1.1 Control buttons

Turning the meter ON is achieved simply by pressing the power on  (circle) button. The unit will automatically turn OFF if not used for 1 minute (this time period can be increased up to 60 minutes using the Setup Wizard).

1.2 Batteries

The Smart Trend Meter 9080 requires two AA size batteries and these can be replaced by removing the battery compartment cover (held in place by 6 screws) as shown in the photographs below:



1.3 Service

The Smart Trend Meter 9080 contains no user serviceable parts. In the unlikely case of malfunction, please return the complete unit to your supplier for repair.

2 Operation


2.1 Fitting the sensor

The Smart Trend Meter 9080 is supplied with a cable connected sensor that connects to the BNC connector on the meter. The nominal sensitivity of the sensor is 100mV/g and this is the meter's default setting for sensor sensitivity.

The Smart Trend Meter 9080 can also accept any standard IEPE (constant current) accelerometer and the sensor sensitivity setting can be adjusted to accommodate other sensitivities (see section 2.3.3.3 in Manual Setup). The default setting is 100mV/g.



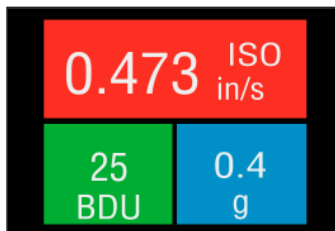
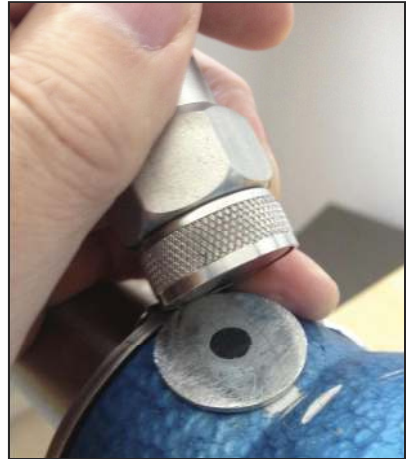
2.2 Taking a reading

To take a reading, press the circle button  to turn the unit ON. Place the sensor on a **rigid** part of the machine as close as possible to the desired measurement point (e.g. bearing block) using the magnet mount.

Pressing the circle button again takes the reading.

N.B. for best results the sensor should be placed gently onto the measurement point by “rolling” the magnet onto the machine.

This is in order to avoid any sudden shocks that would be seen as large acceleration peaks by the sensor and could take some time (several seconds) to die away.



Taking a reading causes the overall vibration numbers screen to be displayed as shown in the example screen left.

This screen gives an overall view of the machine's vibration condition as explained in the following section.

2.2.1 Vibration readings

Once a vibration reading has been taken, the display will show three values, as shown in the example screen opposite. The values are color coded to show their alarm status as explained in the following sections.

The three values shown in the readings screen are:

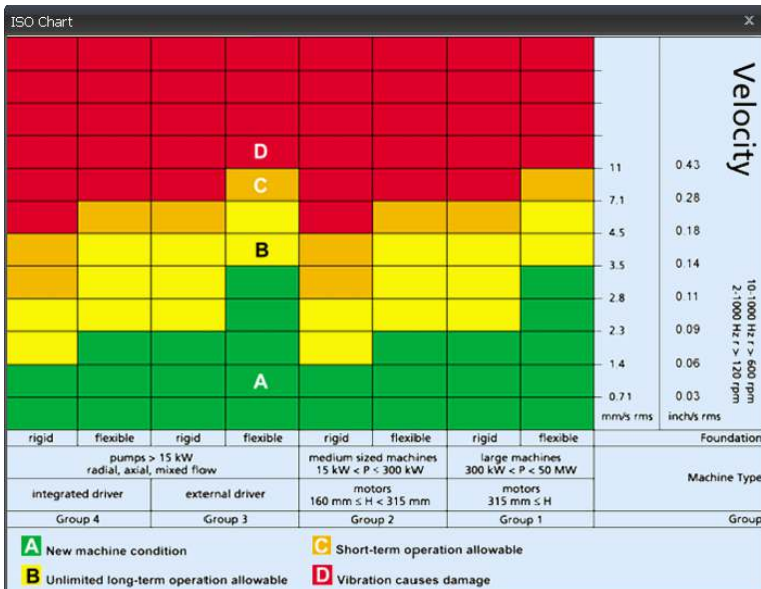
- ISO value (velocity in mm/second or inch/s)
- Bearing Noise in BDU (Bearing Damage Units)
- Total g (acceleration)

These readings are explained in more detail below with some examples of what they actually mean:

ISO value (mm/s)

The ISO value (in mm/s or inch/s) is the large number displayed at the top of the screen, which is the RMS (average) of the vibration velocity in the frequency band 10Hz (600 RPM) to 1kHz (60,000 RPM) or 2Hz (120 RPM) to 1kHz (60,000 RPM), as specified by the ISO standard . The correct frequency band is automatically selected by the meter based on running speed.

The ISO value background is colour coded according to the ISO 10816-1 vibration velocity level chart (see below). The colour coded background indicates the condition of the machine according to the size and type of machine selected with the **Setup Wizard** (see section 2.3.1).



¹ISO 10816-1:1995. Mechanical vibration -- Evaluation of machine vibration by measurements on non-rotating parts

Bearing Noise (BDU)

Below the displayed ISO value and to the left is the value of bearing noise (high frequency vibration) in **Bearing Damage Units** (BDU), where 100 BDU corresponds to 1g RMS (average) vibration measured above 1kHz. This is a measure of the wear state of the bearings in the equipment being monitored. The higher the number, the more worn the bearing.

It is commonly held that 1g of high frequency vibration (100 BDU) corresponds to a relatively high level of bearing noise and so can be considered indicative of a damaged bearing. In other words, it may be helpful to think of the Bearing Noise figure as being very roughly equivalent to “**percentage**” of bearing wear. By default, the bearing noise is displayed on a **Red** background if it is above 100 BDU, an **Amber** background between 50 and 100 BDU and a **Green** background below 50 BDU. However, the BDU alarm levels can be changed using the **Manual Setup** menu (see section 2.3.2.1).

Total acceleration (g)

This is the RMS (average) value of the total vibration acceleration measured by the meter over its entire frequency range (2Hz to 10kHz). This reading is shown in units of **g** (Earth’s gravitational constant, where 1g = 9.81 m/s²).

Displacement

Pressing either the left (<) or right (>) arrow button when the reading screen is displayed will cause the meter to display RMS displacement (in mm or thou) on a blue background. Pressing either left or right arrow button again will revert to display of the ISO value (mm/s or inch/s).

2.2.2 Vibration Analysis

Pressing the down arrow button brings up a display similar to that shown below, which shows the readings of vibration velocity (mm/s or inch/s), or displacement (mm or thou) if selected, broken down into each of 3 bands.

The display shows the vibration level in frequency ranges that are all based on multiples (1X, 2X and 3X) of the specified **Run Speed** of the machine as displayed beneath the 3 bar graphs.



N.B. in order to perform a vibration analysis it is important that the running speed of the machine is entered correctly. This can be done with the “Setup Wizard” as described in Section 2.3.1 of this user guide, or by using the strobe attachment (see Section 5.1)

The frequency ranges of the VA bands are based on the following multiples of running speed²:

1X = Unbalance:

The level of vibration in the frequency band based on the running speed is usually indicative of how well balanced the machine is. A **large** vibration at the running speed usually indicates that the machine is out of balance. However even a very well balanced machine will typically show some vibration at the running speed but this figure should ideally be quite low (e.g. typically less than about 2 mm/sec for a medium sized machine).

2X = Misalignment:

A high level of vibration in the frequency band centred at twice the running speed is a possible indication of misalignment. This is based on the fact that shaft misalignment can result in a double peak in the waveform due to there being two different centres of gravity (one from each shaft). In other words the accelerometer picks up a peak as each centre of gravity passes by and hence there will be two positive and two negative peaks each revolution of the shaft. This will typically give rise to a vibration signal at **double** the running speed of the machine.

3X = Looseness:

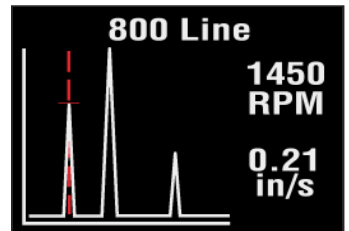
High vibration in the frequency band centred at 3 times running speed is a possible indication that something may be loose (e.g. loose mounting bolts, weak foundations etc.) as it is not usual to see third order vibration in a machine unless there is some structural looseness that is being “excited” by the vibration of the machine.

2.2.3 Frequency spectrum

Pressing the down arrow button once more brings up a display similar to that shown opposite, where the vibration levels are shown as a frequency spectrum in the range from 0 to 1kHz.

The heights of the peaks indicate the RMS vibration level (in mm/s or inch/s) at each frequency point in the spectrum.

The readings to the right of the screen show the frequency (in Hz or RPM) and the RMS vibration level (in mm/s or inch/s) at the position of the cursor (red dotted line). The cursor position can be moved by use of the left (<) and right (>) arrow buttons.



² Multiples of running speed are sometimes referred to as “orders”

Pressing the down arrow button increases the resolution of the frequency axis from 100 Lines (i.e. 10Hz or 600 RPM resolution) to 800 Lines (i.e. 1.25Hz or 75 RPM resolution). Increasing the resolution effectively **zooms** into the frequency spectrum. In order to display the full spectrum at the higher resolution the display must be **scrolled** using the left and right arrow buttons.

2.2.4 Live Update Mode

It is possible to have the meter continuously display readings that are taken at intervals of approx. 1 second.

Live Update is selected from the **Configuration menu**, which is entered by holding down the circle button for approx. 2 seconds

It is possible to use live update with the basic readings screen, the VA bands screen or 100 line frequency spectrum. Pressing the circle button at any time during live update will capture a full (800 line) resolution reading.

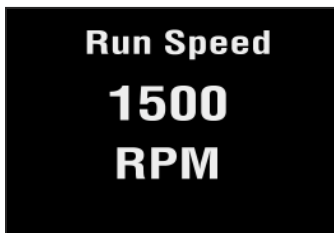
2.3 Configuration menus

The configuration menu is entered by pressing and holding down the circle button for **2 seconds**.

Moving up and down the menu is achieved by pressing the left (up) and right (down) buttons which causes the menu item to be highlighted. Pressing the circle button will select the highlighted menu item. Left and right arrow buttons can be used to move backward and forward through the menus.



2.3.1 Setup Wizard



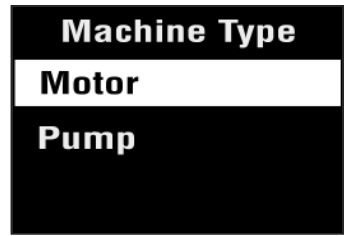
Selecting the Setup Wizard opens a dialogue that allows the machine running speed to be entered and the ISO alarm levels to be set automatically according to the size and type of machine to be monitored.

The first Setup Wizard screen to be displayed shows the currently selected running speed in the pre-selected units (Hz or RPM).

Changing the running speed is achieved by pressing the up arrow button (to increase run speed) or down arrow button (to decrease run speed).

Pressing the circle button again brings up the next screen which allows the machine type (motor or pump) to be selected.

If a **motor** is selected the size must be selected (under or over 300kW) or if a **pump** is selected, it must be specified whether it has an integrated or external drive unit.



Selecting the machine type and size allows the ISO alarm levels to be set accordingly, as does specifying the type of mounting (rigid or flexible).



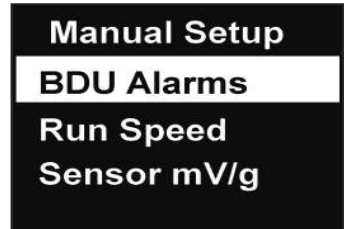
As a basic "rule of thumb", unless a machine is bolted down to a concrete floor, its mounting should be considered as being **flexible**.

Most motors and pumps are mounted on some kind of frame or structure and as such should definitely be considered as flexibly mounted.

2.3.2 Manual Setup

2.3.2.1 BDU alarm settings

Selecting **BDU Settings** allows the alarm levels at which the BDU readings change color to be altered by the user. Normal levels are displayed on a **Green** background.



BDU Alarms

Warning

Critical

The BDU threshold values are designated as Warning (where readings turn **Amber**) and Critical (where readings turn **Red**).

Both these threshold values can be set independently using the up and down arrow buttons.

The default BDU thresholds are 50 for **Warning** and 100 for **Critical**. These levels are typical for medium sized machine bearings operating at run speeds in the region of 1000 to 3000 RPM. Larger bearings or higher run speeds may need increased BDU threshold values to identify worn or bad bearings.

BDU Warning
Threshold

50

2.3.3.2 Run Speed

Run speed can also be set manually via the up and down arrow buttons.

2.3.3.3 Sensor mV/g

Accelerometer sensitivity (in mV/g) can be manually set using the up and down arrow buttons to allow use of any desired sensitivity sensor within the range 1mV/g to 1000mV/g. This enables the resolution and range of the meter to be set by the user.

Accelerometer
Sensitivity

101.4

mV/g

2.3.4 Device Settings

There are two pages of Device Settings menus. To advance to the second page the down arrow button should be used. Selecting a menu option is achieved by the up and down arrow buttons and by pressing the circle button.

Device Settings

Auto Off Time

Brightness

Languages

Factory Settings

Dev. Settings 2

Graph Mode

Color Scheme

Time & Date

Units

The **Auto Off Time** can be set from 1 minute up to a maximum value of 60 minutes, in increments of 1 minute.

The **Brightness** level can be set anywhere between 1 (least brightness) up to 10 (full brightness).

The operating **Language** can be selected from any one of a number of different languages depending on the exact model.

The **Graph Mode** can be set to display the frequency spectrum as either a Line graph or a Bar graph.

The display **Color Scheme** can be configured as standard (full colour) or monochrome, e.g. for convenient viewing in direct sunlight.

Time & Date setting can be achieved using the up, down, left and right arrow buttons.

Selecting **Units** from the Advanced Settings menu allows the velocity readings to be displayed in either mm/s or inch/s.

Run Speed units can be displayed in units of Hertz (Hz), revolutions per minute (RPM) or cycles per minute (CPM).



³Hertz are equivalent to, and also sometimes referred to as, cycles per second (CPS).

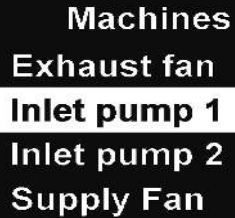
3 Asset Management

Pressing the Asset Manager button (fan icon, located just below the down arrow button) brings up the Machines menu.

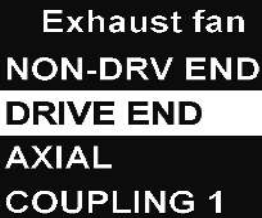
Machines have user-defined names **up to 16 characters long**.

Scrolling the list of machines is achieved with the up and down arrow buttons.

Selecting a machine is done with the circle button, which then brings up a list of **measurement points** for that machine.



Machines
Exhaust fan
Inlet pump 1
Inlet pump 2
Supply Fan



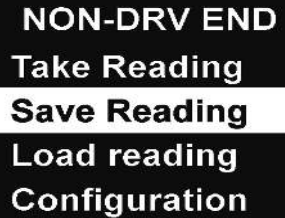
Exhaust fan
NON-DRV END
DRIVE END
AXIAL
COUPLING 1

Measurement points also have user-defined names up to 16 characters long.

The list of measurement points can also be scrolled by using the up and down arrow buttons and each measurement point can be selected using the circle button.

The various options for each measurement point (MP) are then displayed:

1. Take Reading – takes a new reading and saves it to this MP
2. Save Reading – saves the previously taken reading to this MP
3. Load Reading – loads a previous reading (e.g. for re-display)
4. Configuration - allows the run speed and alarm levels to be set independently for each individual MP.



NON-DRV END
Take Reading
Save Reading
Load reading
Configuration

Machines and their measurement points are downloaded from **Vib-Trend**, the supplied trending and asset management software for PC using the supplied USB docking cradle.

The exact list of machines to be downloaded is determined by the user in Vib-Trend.

There will also always be a machine downloaded named **'off route'** that contains 10 MPs. This is done to allow users to save readings for upload to Vib-Trend where they can then be saved to a new or existing machine.

4 Vib-Trend - Trending Software

Vib-Trend is the PC based software that allows users to view trends of vibration readings taken with the Smart Trend Meter 9080, in a way that enables predictions to be made about machine condition.

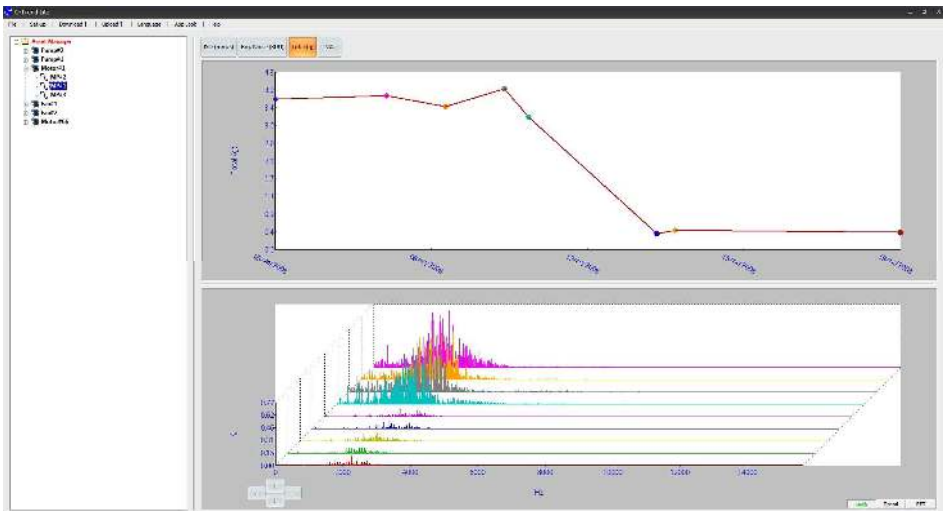
A limited version of Vib-Trend that can accommodate a maximum of 10 machines, each with 10 measurement points, is available free of charge from

<http://tpi.pocketvibradownload.com/>

For the full version for the Vib-trend software (A9084) contact TPI
tech@testproductsintl.com

Vib-Trend is very intuitive and very easy to drive and its full functionality is described in more detail in its built-in Help Guide.

In brief, Vib-Trend allows display of vibration data in a variety of different ways including vibration frequency spectra, bearing noise and ISO trend plots, waterfall diagrams (see figure below) and can generate reports either manually or automatically (e.g. by sending out **email alerts**).



5 Optional accessories



5.1 A9082 Strobe and flashlight attachment

Pressing the top left strobe button (see photo above) brings up the run speed display and causes the strobe to flash at the displayed rate. The flash rate can be increased or decreased with the up and down arrow buttons and the run speed will simultaneously update.

Holding the strobe button down for 2 seconds will put the strobe attachment into flashlight mode to give a continuous bright light.

WARNING: with strobe lighting moving parts can appear stationary and care should be taken not to touch moving parts when using the strobe attachment.

5.2 A9080 Bluetooth connected headphone

Pressing the headphones button (top right button) allows the Smart Trend Meter 9080 to wirelessly connect to the optional set of Bluetooth earphones. This enables the user to listen to an audio output of the accelerometer signals so that any bearing noise can be heard.

PAIRING SEQUENCE

1. Headset must be in pairing mode.
2. On the Meter, hold down the headset button until "Search" appears in the menu.
3. Follow the menu prompts. note: Headset and meter should be on for 15 seconds before pressing headset button to reconnect.
4. Before donning the headset, turn the volume down to it's lowest and then adjust to a comfortable level.

6 Specifications

| | |
|--|---|
| Size | 200 mm x 60mm x 26mm |
| Weight | 280g (not including magnet) |
| Environmental | |
| Water, Sand & Dust: | IP67 Waterproof |
| Operating | 0°C to 50°C |
| Storage: | -20°C to 70°C |
| Power supply | 2 x AA batteries |
| Battery life | Auto power OFF - typically 20 hours continuous operating time depending on brightness setting. |
| Frequency range | 2 Hz to 1 kHz (ISO) 1 kHz to 10 kHz (BDU) |
| Max frequency resolution | 1.25 Hz @ 800 lines FFT setting |
| | Acceleration in g Velocity in mm/s (or inch/s) Bearing noise in BDU (bearing damage units) Displacement (mm, microns, inch) |
| Displayed Frequency Units | Hertz (Hz), RPM or CPM |
| Input range | User selectable with accelerometer sensitivity |
| Dynamic range | 96 dB (0.01g resolution) |
| VA diagnostic bands (RPM = run speed) | Unbalance 1x RPM Alignment 2x RPM Looseness 3x RPM |
| Accessories | <ul style="list-style-type: none"> • A9081 PC docking cradle – USB connection • A9087 Nylon carrying case |
| Options | <ul style="list-style-type: none"> • A9082 Strobe attachment • A9080 Bluetooth ear defenders/ headphones • A9084 100mm (4 inch) stinger • A9084 Vib-trend software full version |

7 Revision History

| ISSUE | PAGES | DATE | NOTES |
|-------|-------|----------|-------------------|
| 1.0 | 16 | May 2013 | First Issue - JKA |
| | | | |
| | | | |

Color coded display shows ISO reading, bearing quality in Bearing Damage Units (BDU) and RMS acceleration (g)

ISO and BDU values are alarm colour coded in Green, Amber and Red

Additional screens show displacement (mm or microns), frequency spectrum with cursor, and diagnostics for unbalance, misalignment and looseness

Standard BNC connector for IEPE accelerometers - allows for any desired sensitivity

Press **Circle** button to power ON and to take readings - left, right, up and down arrows to navigate display

Separate buttons for Tacho Strobe/Flashlight and Bluetooth head phones

Asset manager button for downloading routes to the vib meter or transferring machine readings to PC for **TRENDING**

Accesses menu for editing or adding readings to machines (assets)

Vib-Trend Standard:
up to 10 machines

Vib-Trend Professional:
unlimited no. of machines

