DataMate user guide
Vibration monitoring and analysis software

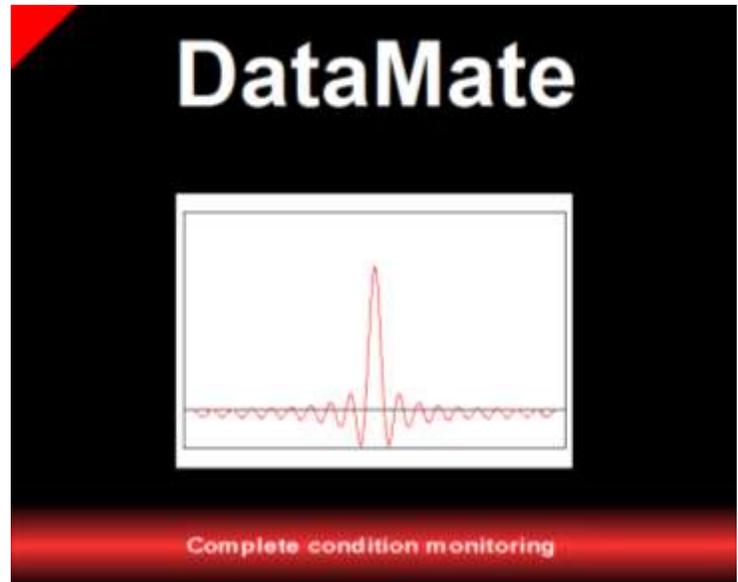# Table of contents

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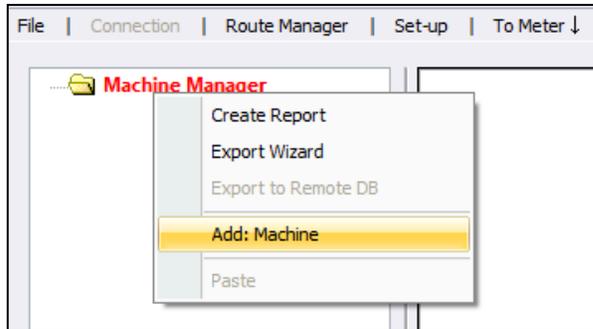
1. Overview

DataMate is the extremely powerful vibration and analysis software tool designed to be used with the MachineryMate™ 800 (MAC800) handheld vibration meter.

DataMate will run on any Windows based PC and can be easily installed from the Meggitt Sensing Systems download site:

http://meggitt.pocketvibradownload.com/

Asset routes (motors, pumps, fans, etc.) are downloaded from DataMate to the MAC800, via its USB docking cradle for vibration readings of those assets. After readings have been taken they can be uploaded to DataMate (via the USB docking cradle) for display, analysis and report generation.

Reports can be generated automatically using a variety of formats, including automatic emailing of alerts when readings have exceeded alarm values.

DataMate is available free of charge as a restricted version that supports up to 10 assets with 10 measurement points per asset. The DataMate Pro version supports an unlimited number of assets, each with up to 10 measurement points. DataMate Pro works across computer networks to allow access to remote databases and readings that are stored on other computers. This powerful feature enables users to monitor machinery at more than one site. Upgrading from the standard version to DataMate Pro can be done at purchase of the MachineryMate™ 800 or at a later date.

1.1. Getting started with DataMate

Visit the following site to download a copy of the software.

http://meggitt.pocketvibradownload.com/

If you have purchased the Datamate Pro version, you will be given a product code that unlocks the full professional version of the software.

This is done using the DataMate **Help** menu (top right of screen) and by selecting **Activate** from the dropdown menu. The screen to the right will appear.

Enter the product key when connected to the Internet so the product key can be authenticated automatically. If you must activate offline, you must send your product key to MachineryMate@meggitt.com in order to receive an unlock key that can be entered manually.

2. Setting up DataMate
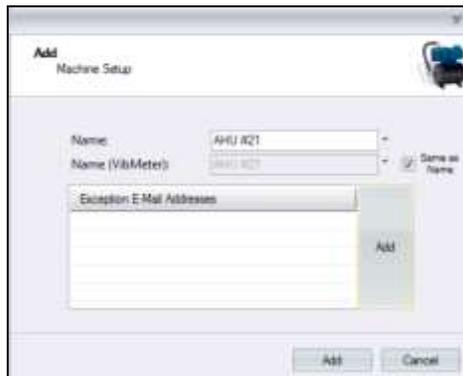
2.1. Setting up assets

Begin setting up the software by entering the assets (machines) you are going to monitor.

2.1.1. Adding machines

Add machines by by right clicking on **Machine Manager** and selecting **Add: Machine** from the drop down menu (as shown below):

This brings up the following window where details of the machine can be added:

Each machine can be given a name (any length) and also a name to be used by the MachineryMate™ 800, which must be a maximum of 14 characters long.

Enter in email addresses of people to be notified if any readings exceed alarm values. These people will be notified when the readings are uploaded to DataMate from a MAC800 when it is docked.

2.1.2. Adding Vib Points

Add some Measurement Points (Vib Points) to each machine by right clicking on the machine name.
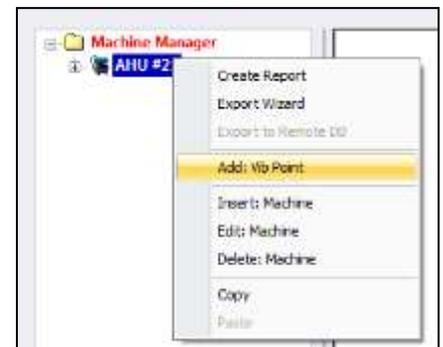
Select **Add: Vib Point** to bring up the **Add: Vib Point Setup** window:

Each Vib Point is given a name (using the same convention as for naming machines). Other details like run speed and alarm levels can also be added.
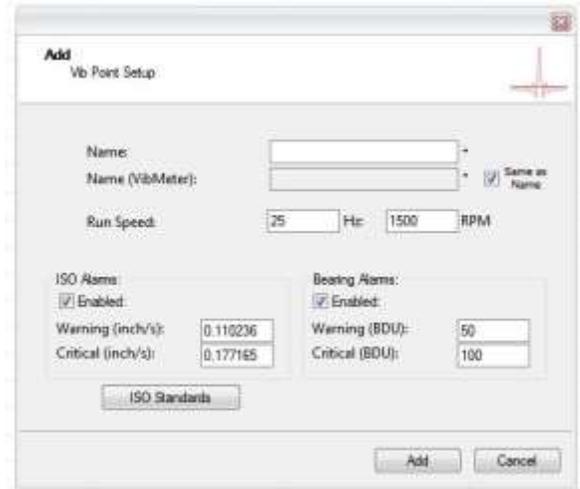
2.1.2.1. Setting Vib Point run speed
It is not essential to set the correct machine running speed, it can be entered later or when using the MAC800 while taking vibration readings. Ensure that the machine run speed is correct so that vibration analysis can be performed reliably.

2.1.2.2. Setting Vib Point ISO alarm levels
The ISO reading for a Vib Point should be compared with the recommended ISO alarm settings. Details on ISO alarm levels are provided in the MAC800 user guide.
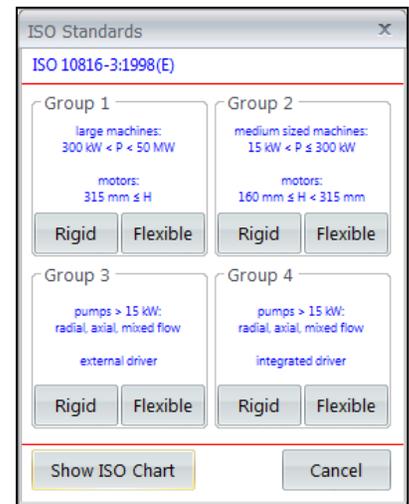
Clicking on the **ISO Standards** button brings up the following window that can be used to set the appropriate ISO alarm levels for any type of machine.

A color coded ISO chart showing all the various alarm levels can also be viewed by selecting the **Show ISO Chart** button.

2.1.2.3. Setting Vib Point BDU alarm levels
Bearing alarm levels are set in Bearing Damage Units (BDU), where 100 BDU corresponds to 1 g RMS (average) vibration measured above 1 kHz. 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 1 g of high frequency vibration (100 BDU) corresponds to a relatively high level of bearing noise and can be considered indicative of a damaged bearing. Bearing noise can be considered 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. The BDU alarm levels can be changed to suit different machines where normal levels of bearing noise are higher than the default values.

2.1.3. Copying and pasting assets

Once machines have been set up it very easy to copy and paste them to set up similar machines with different names. These copies will have all the same attributes as the original: names of Vib Points, run speeds, alarm levels etc.

When a machine is first copied it will have the same name as the original followed by **(c)** for copy. The machine name can be editing by right clicking and selecting **Edit: Machine** from the drop down menu, as shown below:
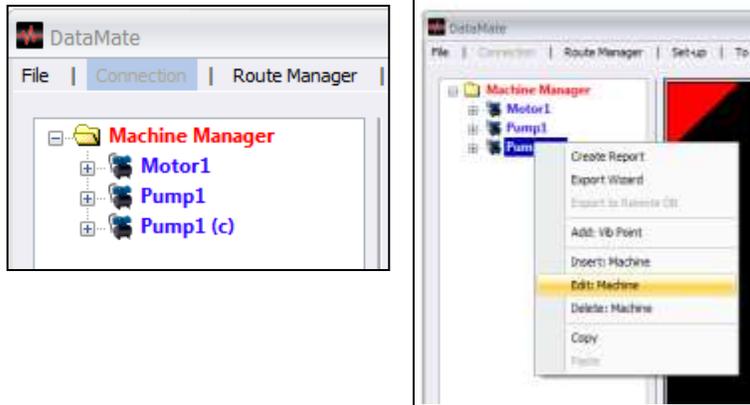
2.2. Setting up routes

Downloading machines to the MAC800 requires the machines to be first added to a route.

Routes are set up using the **Route Manager** menu at the top of the screen, which causes the following window to appear:

New routes are added by right clicking in the new route column and selecting **Add**. The route can then be given a name and it will be added to the list of available routes. Right clicking on a route name allows it to be edited and have machines added to that route.

2.3. Downloading routes to a MachineryMate 800

Downloading routes to a MAC800 can only be done while the unit is docked via its USB docking cradle. To dock a MAC800 simply place it in its docking cradle and plug the cable into a USB port on your PC.

Select the tab on the menu bar that says **To Meter↓** to bring up a window that can be used to select the route to be downloaded:
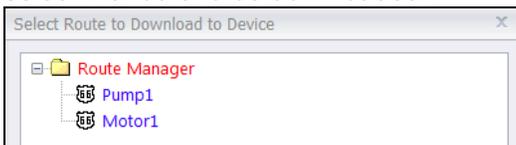
In addition to the machines that are listed in the chosen route, an additional machine named 'Off Route' that contains 10 Vib Points will also be downloaded. This is designed to facilitate the taking of any off-route readings that the user wishes to capture for later transfer to new or existing Vib Points when the readings are subsequently uploaded.

2.4. Uploading readings from a MachineryMate 800

Readings that have been captured on a MAC800 can be transferred to DataMate simply by clicking the **From Meter** ↑ tab on the menu bar.

This also uploads any off route readings that were taken causing a message to be displayed in the bottom left of the DataMate screen to say that off route readings have been uploaded and are available for transfer to Vib Points. Moving off route readings to Vib Points is done by right clicking on the off route reading and selecting **Move to…**
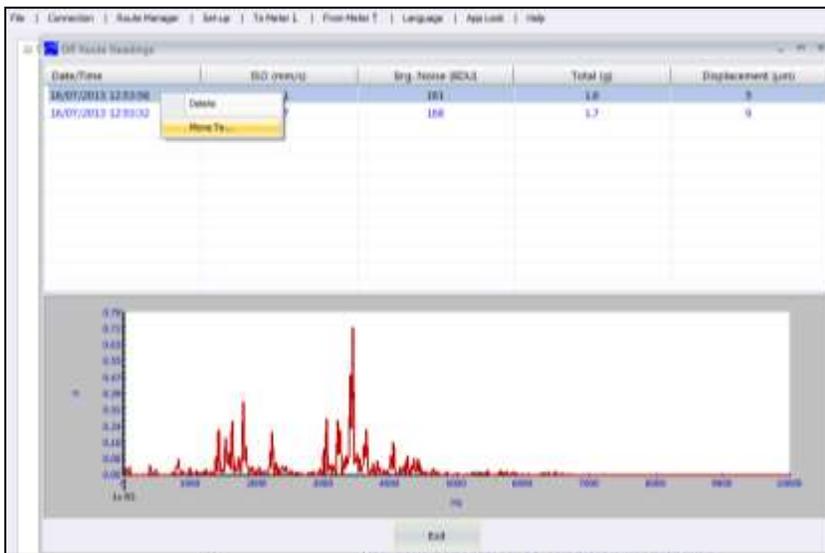
3. Using DataMate

3.1. Screen layout and menu bar

The opening screen of DataMate is shown below. The asset manager window, showing the currently installed machines, is visible on the left hand side with the DataMate menu bar visible along the top of the display.
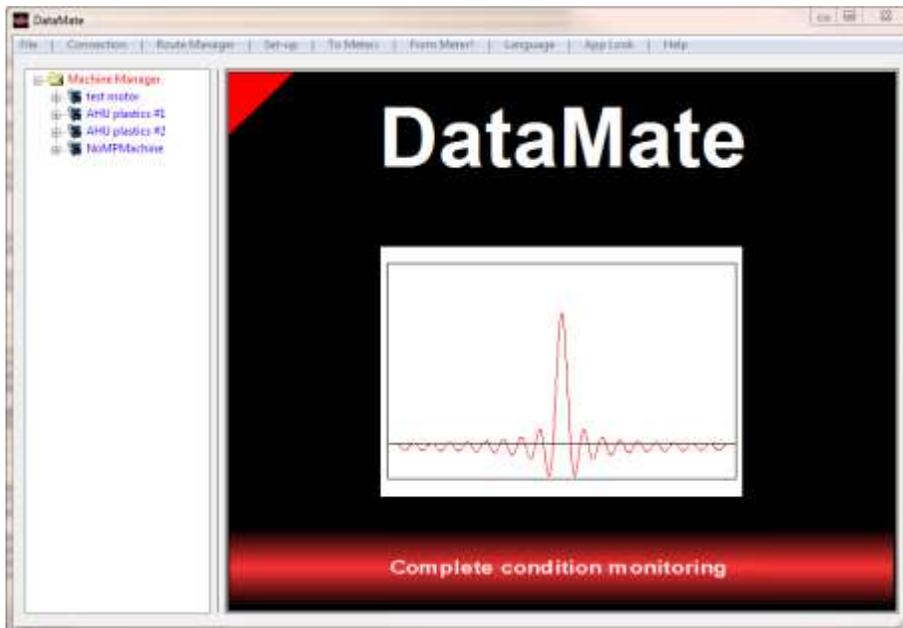
3.2. Interpreting readings

3.2.1. Machine status

Click on the name of a machine to open up a status window to the right of the asset manager window which shows the current alarm status for each of the Vib Points on that machine. The alarm status is displayed in the appropriate colours for OK (green), warning (amber) or critical (red).

The alarm status table for each measurement point can be user-configured to display up to 3 different parameters in columns to the right of the Status column. The parameters to be displayed in the table are chosen from a drop-down menu that is accessed via the Set up menu.

Note: the most useful set of parameters describing machinery health would typically be the ISO reading and bearing noise.
The ISO value tells you the overall vibration levels of the asset due to running speed related faults such as unbalance, misalignment, looseness etc.

The bearing noise value (and its trend) indicates the degree of bearing wear. This figure can be used as a means of estimating bearing lifetime using Trend Lines.

Clicking on the machine status will open up a status bar display for that Vib Point and show all its readings as shown below:


Clicking on any of the Vib Points will open up a window for that particular Vib Point and display all its readings graphically as shown below. Individual graphs of the various readings taken on the Vib point can be selected using the row of tabs displayed above the graphs.
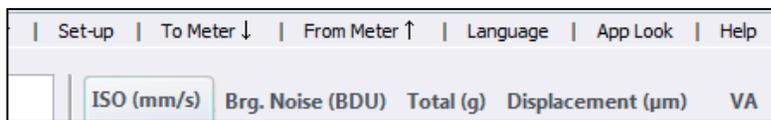
3.2.2. Vib Point readings
Selecting any of the tabs along the top of the Vib Point reading display window ISO (in/s), Bearing Noise (BDU), total (g), Displacement (um), VA causes that particular reading to be displayed in the window, as shown in the example screen.

By default a trend plot for that particular Vib Point is displayed in the top half of the screen that is the trend of the average (or RMS) value for each reading (depending on which plot has

been selected from the menu tab at the top of the screen). The bottom half of the screen will show the frequency plot for the currently selected reading (identified by the green marker in the trend plot).
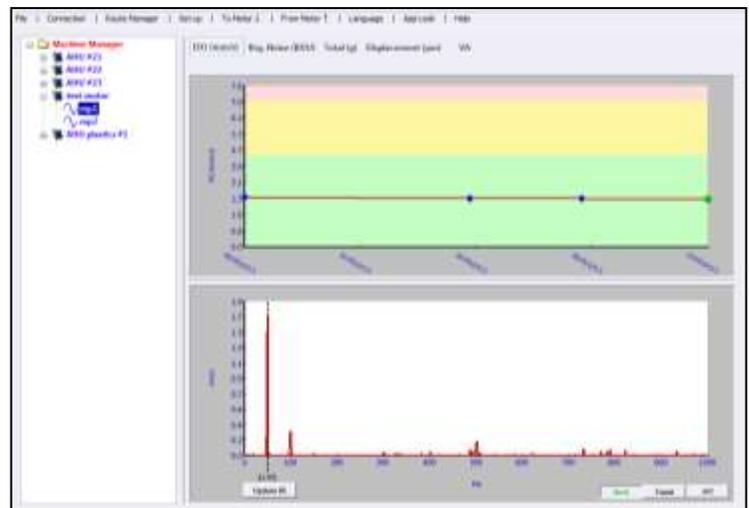
Readings taken on other dates/times can be displayed as frequency spectrum (FFT) plots in the lower window simply by clicking on the markers in the trend plot with the mouse. This will cause the trend plot marker for that measurement to change from a blue diamond to a green circle and the appropriate FFT plot will appear in the bottom

half of the screen.

Positioning the mouse over a reading on the trend plots will cause a box to appear that contains the exact value of the measurement, the date and time the reading was taken, and the serial number of the MAC800 that was used to take the reading.

Note: Bearing Noise and Displacement do not have an associated FFT plot.

Other information on the plots includes the running speed of the asset shown as a vertical black dashed line if it was entered during set up, and any alarm levels that have been set. The alarm levels (if activated) are shown as a color coded background to the graph in red, yellow and green, corresponding to Critical, Warning and OK.

Zooming on any of the graph plots can also be achieved simply by drawing a rectangle from top left to bottom right of the area to be zoomed. This is achieved simply by holding the left mouse button down as the zoom window is dragged.

It is sometimes useful to lock the zoom level when moving between different graphs. This can be achieved by holding down the control key when selecting the next graph.

Double clicking the mouse on a graph will reset the zoom level to the original default value.

The user can choose to display only the trend plot or the frequency plot or both by selecting the desired view from the 3 buttons at the bottom right of the display window.

## 3.3. Analysis of asset readings

3.3.1. Trend lines

As a means of predicting breakdowns, the use of trend lines can be a very powerful tool. Right clicking the mouse on a trend graph brings up a menu box that allows the user to choose from adding a trend line to the plot, zooming on the x and y axes, or adding the plot to the PC's clipboard.

If Trend Line is selected, a window opens that allows the user to specify the type of trendline to be displayed.

In the example shown here a linear trendline has been selected to commence at the first data point on the plot and continue up until the alarm level (as indicated by the red zone on the graph).

In this example the trend line is predicting that if the machinery continues at its present rate of trend, the measured value would reach the alarm level after two months from the date of the last reading.

It is entirely up to the user's experience and interpretation of the shape of the trend to determine exactly which type of trend line should be selected (linear, polynomial etc.) The exact choice could significantly
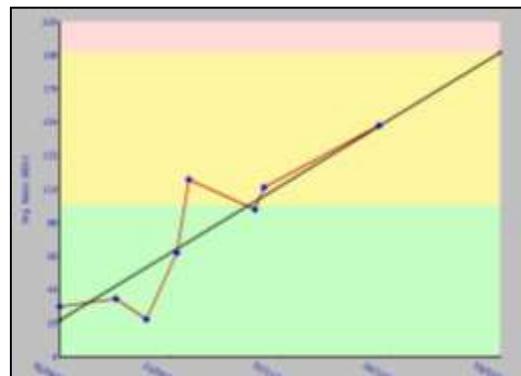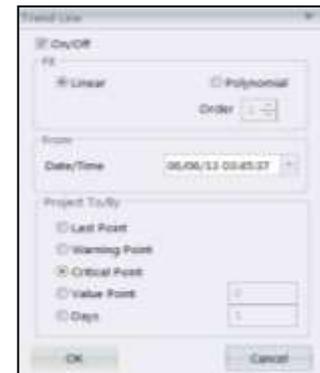
affect the predicted time to any particular point. For this reason trend lines should be used only for rough guidance and should never assume that the data will in fact follow the predicted pattern.

3.3.2. Harmonic cursors

Another powerful technique for fault finding is to use harmonic cursors to show frequency components that are multiples of other frequencies (running speed for example).

Cursors are selected by right clicking on the frequency spectrum plot, which brings up the cursor select menu box.

In the example the first three harmonic cursors have been turned on, by selecting add harmonic from the drop down menu.
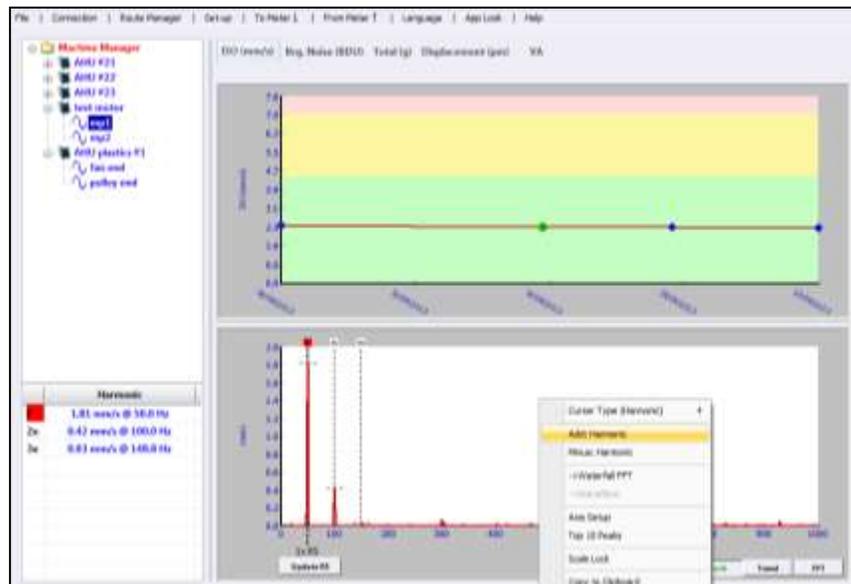

Adjustments to the position of any of the cursors can be made by clicking on a cursor and dragging it with the mouse, or by clicking on it (so that the top of the cursor turns red) and then positioning it with the PC keyboard arrow keys. Whenever a cursor is moved, the other cursors will move with it to maintain the harmonic ratio (x1, x2, x3, etc.)

3.3.3. Waterfall diagrams

A useful means of determining exactly how a measurement point reading is changing is by viewing it on a pseudo 3D diagram called a waterfall plot.

This technique enables the trend of the individual frequency components in a frequency spectrum to be seen at a glance. The example illustrates increasing levels of vibration on a measurement point starting from the oldest reading (at the back) to the newest reading (at the front). Each of the waterfall plots is color coded to correspond to its position on the trend plot.
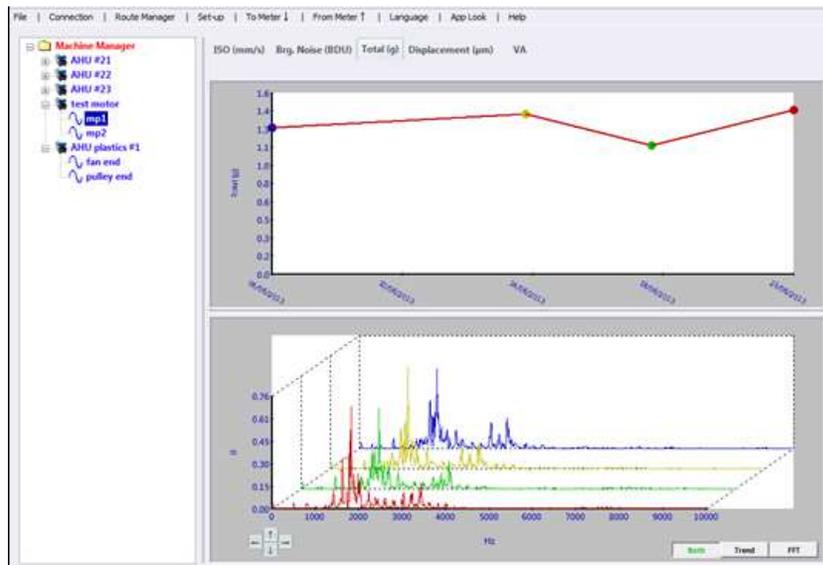
Plots can be added or removed from the waterfall diagram by holding down the control key and drawing a box on the trend plot around the points to be added or removed. Consequently this feature toggles the display of points on and off. Trend points displayed on the waterfall diagram are shown as colored dots on the trend plot (with the colors of the dots corresponding to the colors on the waterfall plot) and trend points not currently displayed are shown as blue diamond shapes.

Note: The waterfall diagram can be zoomed using a mouse drawn window as previously described. It can also be rotated in 3 dimensions by cliking on the arrows bottom left of the waterfall display or by using the PC keyboard arrow keys while pressing the control key.

3.4. System set up

The Set-up menu is accessible on the top menu bar of the DataMate screen. The drop down menu enables the user to do any of the following:
- Change units - (Hz, RPM or CPM, mm/s or inch/s) and the number of decimal points for displaying readings
- Choose whether to display trend or frequency plots (or both) for Vib Points
- Choose line or bar graphs for the frequency spectrum (FFT) plots and turn Intelli FFT on or off.
    - o Intelli FFT sharpens up the results of an FFT analysis of a waveform by reducing

the blurring effect that the FFT algorithm has on the frequency spectrum. In order to view any small signals that are immediately adjacent to large signals Intelli FFT should be switched off.
- Assign user defined names to the 3 VA frequency bands
  - Default names: Unbalance (1x run speed), Misalignment (2x run speed) and Looseness (3x run speed)
- Choose which parameters (readings) will be displayed in the asset status (alarm) tables
- Turn on or off the automatic emailing of alarm information after an upload of MAC800 readings
- Display and edit the list of names of MAC800 units that are being synchronized with this copy of DataMate

3.5. Shortcut keys

In addition to being able to turn features on and off using the Set-up menu as described, some features can be enabled using the PC keyboard as shown in the chart below. This screen is accessed from the "**Help**" menu at the top of the DataMate screen.

Key	Action
F1	Help
CTRL + b	Toggle: Bold On/Off
CTRL + x	Toggle: X-Axis Units
CTRL + y	Toggle: Y-Axis Units
CTRL + f	Toggle: FFT Bar/Line
CTRL + m	Toggle: Vib Display
CTRL	Scale Lock

3.6. Help menu

The **Help** menu gives access to information about the current version number of DataMate, contact information for Meggitt Sensing Systems, shortcut keys, installed language packs, activation of additional software modules and allows a copy of this user guide to be opened on screen.
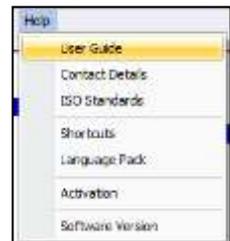

3.7. Import and export of data

Clicking on the **File** menu (top left of DataMate screen) allows all the data currently contained within a DataMate database to be saved to file (Backup Data). This is a useful feature for making backup copies of the entire database and should be done on a routine basis to guard against data loss.

Additional data can be imported from a file (Restore Data) and added to the existing data within a DataMate database.

Note: Any conflicting data will be over-written by the Import function, this feature should be used carefully.

Another way to save data is to use the **Export Wizard**, which is accessed by right clicking on the asset name. This opens up a window that allows readings from individual assets to be selectively exported and saved to a file. This feature is useful for saving data to be emailed.
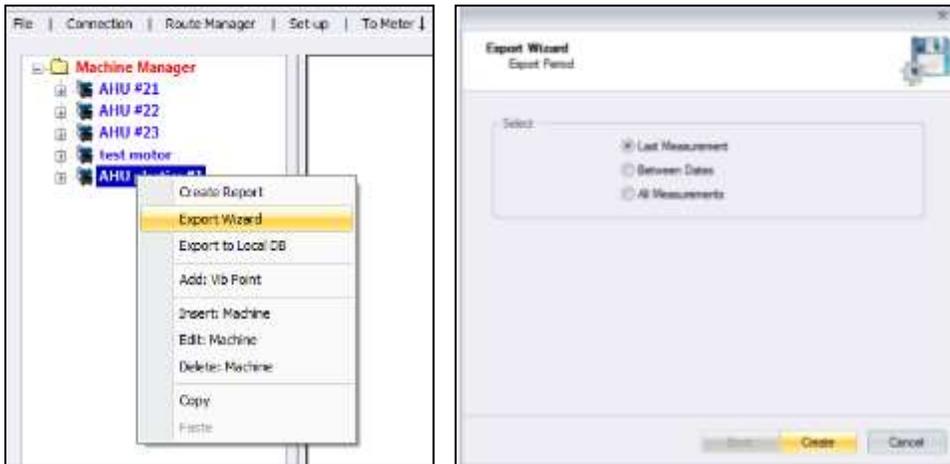
3.8. Automatic report generation

DataMate also has the ability to automatically generate reports on an asset by asset basis. This is achieved by right clicking on the machine name and selecting **Create Report** from the drop down menu.

The report is produced as a Word document that can be edited with comments if desired and then printed or saved as a DOC file. The report is generated by the Report Wizard that allows the user to specify which assets are to be reported on and what status tables, trends and FFT plots are required for the chosen assets.

In order to generate a report automatically, DataMate needs access to Microsoft Word and Excel. A valid copy of Microsoft Office needs to be installed on the PC.

The first screen of the report wizard allows the user to specify whether the report will contain only items that are in alarm (Warnings or Critical) by selecting an Exception Report, or to manually specify what the report content will be. Other screens will allow the selection of what is to be reported on and the final screen of the report wizard allows the user to specify what period of time the report should cover.
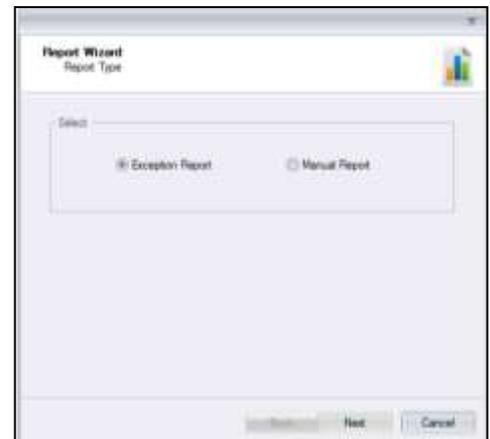
Note: The asset status tables included in the report will contain the same information as the status tables current displayed in DataMate and as selected by the user in the asset status set-up.

Note: The Report Wizard should be used thoughtfully if reasonable length reports are to be produced. Refrain from checking everything as this will generate reports of excessive length with large numbers of graphs.

A useful tip is to start off with minimal information and gradually expand the size of the report by including graphs only where they are necessary. For example, by only including FFT plots when a trend plot indicates there might be a problem with a particular measurement point.

Another way to do this is to generate a report that simply consists of the asset status tables and paste in graphs that have particular relevance (e.g. where there is an alarm condition or other significant feature) using the Copy to Clipboard function as illustrated below.
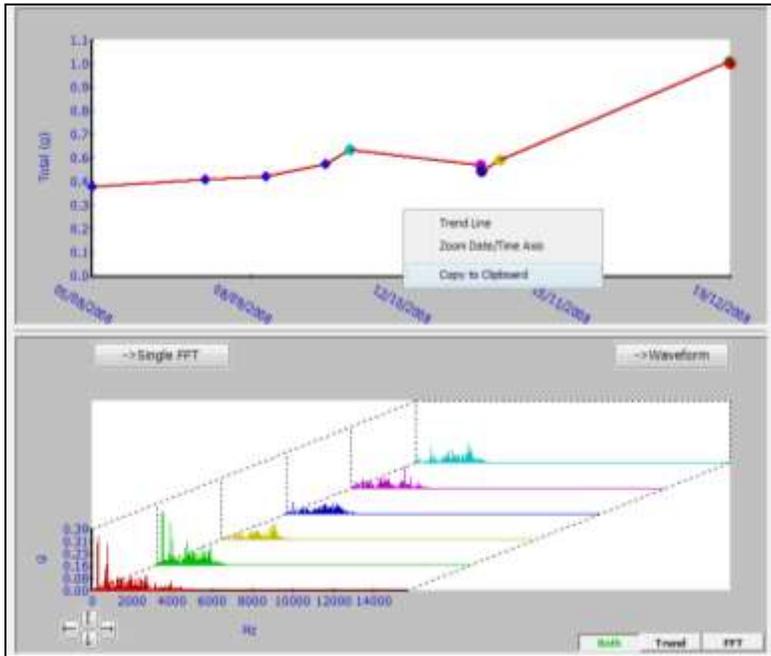
3.9. Language selection

Clicking on **Language** on the top menu bar causes a drop down menu to appear that allows a choice of different languages to be made.

The list of available languages is continuously being expanded. Please contact Meggitt Sensing Systems to arrange to receive a language file if a particular desired language is not displayed in the drop down menu.

3.10. Moving data around in DataMate

DataMate contains many powerful features for organizing data including the ability to drag machines around in the machine manager menu (by using the mouse and holding the left button). This is useful for organizing the way the list is displayed into a particular order for example.

It is also possible to move Vib Points between machines by right clicking on the Vib Point name and selecting the **Move to…** function. This then opens up a list of all the machines to allow the Vib Point to be assigned to another machine.

Appendix

1. Vibration readings

1.1. The **ISO value** (in/s) is the large number at the top of the screen, which is the RMS of the vibration velocity in the frequency band 10 Hz (600 RPM) to 1 kHz (60,000 RPM), as specified by the ISO standard.

1.2. **Total acceleration** – this is the RMS value of the total vibration in the frequency range 10 Hz to 15 kHz. This reading is shown in units of g (Earth's gravitational constant, where g = 9.81 m/s^2).

1.3. **Crest Factor** – this is a measure of the shape of the vibration waveform and is defined as the peak of the waveform divided by its RMS value. Crest Factor is sometimes used as a measure of the quality of a machine's bearings. This is based on the fact that high Crest Factor is often associated with high frequency bearing noise as illustrated in the following diagrams.

The following diagram (Figure 1) shows a vibration waveform with a crest factor of 1.47, which is very close to that of a pure sine wave. Crest factor can never have a value lower than 1.414, which is the value for a pure sine wave.

This particular vibration waveform was taken from a brand new bench grinder with good bearings and shows a waveform with a period of 0.02 seconds, which is due to run speed vibration at 50 Hz (3,000 RPM). There is very little high frequency bearing noise visible on the waveform.
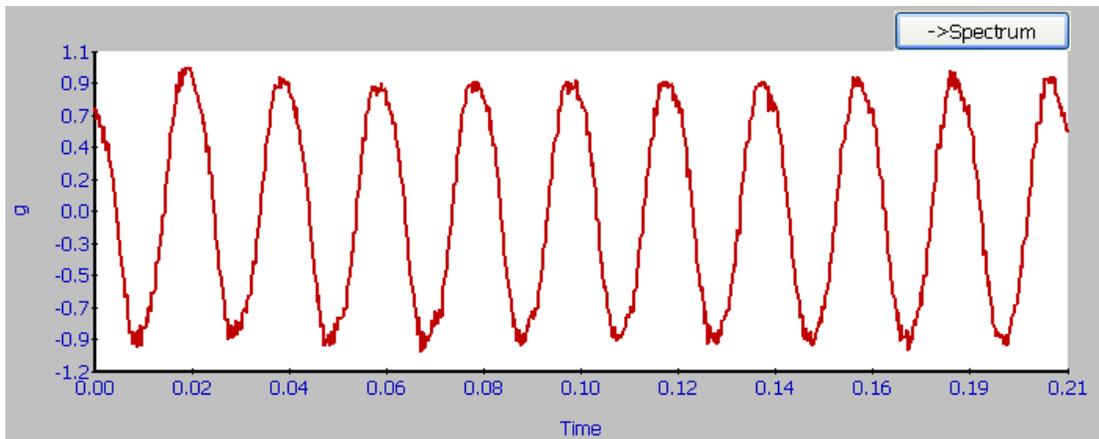

Figure 1 – vibration waveform from a good bearing

By comparison the waveform shown below (Figure 2) has a crest factor of 8.83 and shows noisy "spikes" typical of worn bearings. This waveform was in fact taken from a deliberately damaged bearing on an identical bench grinder to the one producing the waveform in Figure 1.
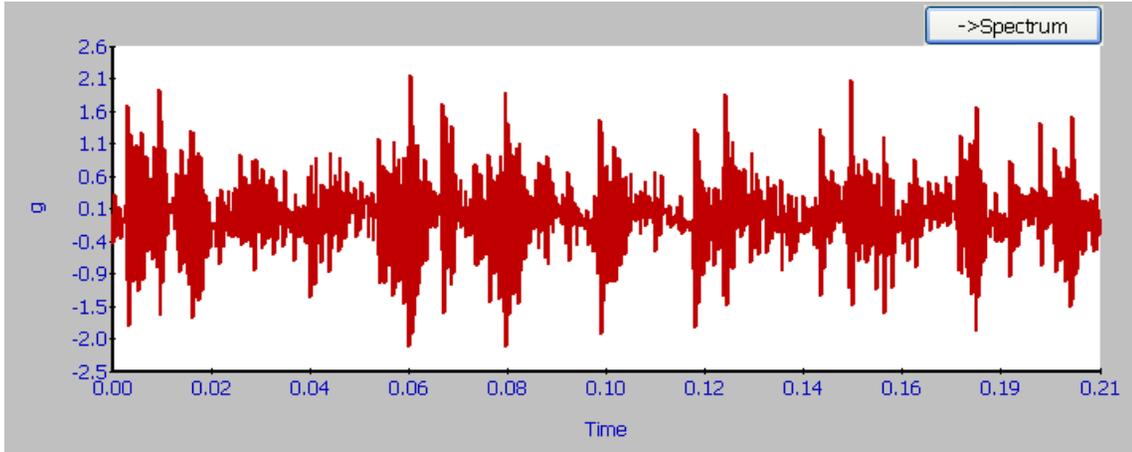

Figure 2 – vibration waveform from a damaged bearing

You can just about see the run speed vibration waveform (still with a 0.02 second period) but it is "buried" underneath all the high frequency bearing noise.

1.4. **Brg Noise** - the final reading shown is the value of high frequency noise in Bearing Damage Units (BDU), where 100 BDU corresponds to 1g RMS vibration. This is a measure of the wear on the bearings in the equipment being monitored. The higher the number the more worn is the bearing.

1g of vibration (100 BDU) generally corresponds to a 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.

For example the bearing waveform shown in Figure 1 above for a good bearing gave a Bearing Noise figure of 1.66 BDU.

However the Bearing Noise figure for the damaged bearing waveform in Figure 2 above was 101.2 BDU.

2. Vibration analysis

N.B. in order to perform a vibration analysis it is important that the running speed of the machine is entered correctly. This is done in "Setup" as described in Section 3.3 of this guide.

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

Instability: 10 Hz (600 RPM) up to 0.75 times running speed
Unbalance: 0.75 to 1.5 times running speed
Alignment: 1.5 to 2.5 times running speed
Looseness: 2.5 to 3.5 times running speed

The following descriptions of these frequency bands show why they are based on these particular frequencies.

2.1. Instability

Vibration in the frequency band 10 Hz (600 RPM) up to 0.75 times running speed means the vibration is occurring at less than the running speed of the machine. This not usual for a normal machine and may be an indication of an electrical fault, looseness, rubbing or some such problem that is causing uneven running. Because of the difficult of classifying them separately, these types of fault are often grouped together into the category of Instability.

2.2. Unbalance

The level of vibration in the frequency band 0.75 to 1.5 times running speed is usually indicative of how well balanced the machine is. A large vibration at the running speed indicates that the machine is out of balance. However even a very well balanced machine will usually show some vibration at the running speed but this figure should ideally be quite low (e.g. typically less than 2 mm/sec for a medium sized machine).

2.3. Alignment

Vibration in the frequency band 1.5 to 2.5 times 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 centers of gravity (one from each shaft). In other words the accelerometer picks up a peak as each center 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.

2.4. Looseness

Vibration in the frequency band 2.5 to 3.5 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.