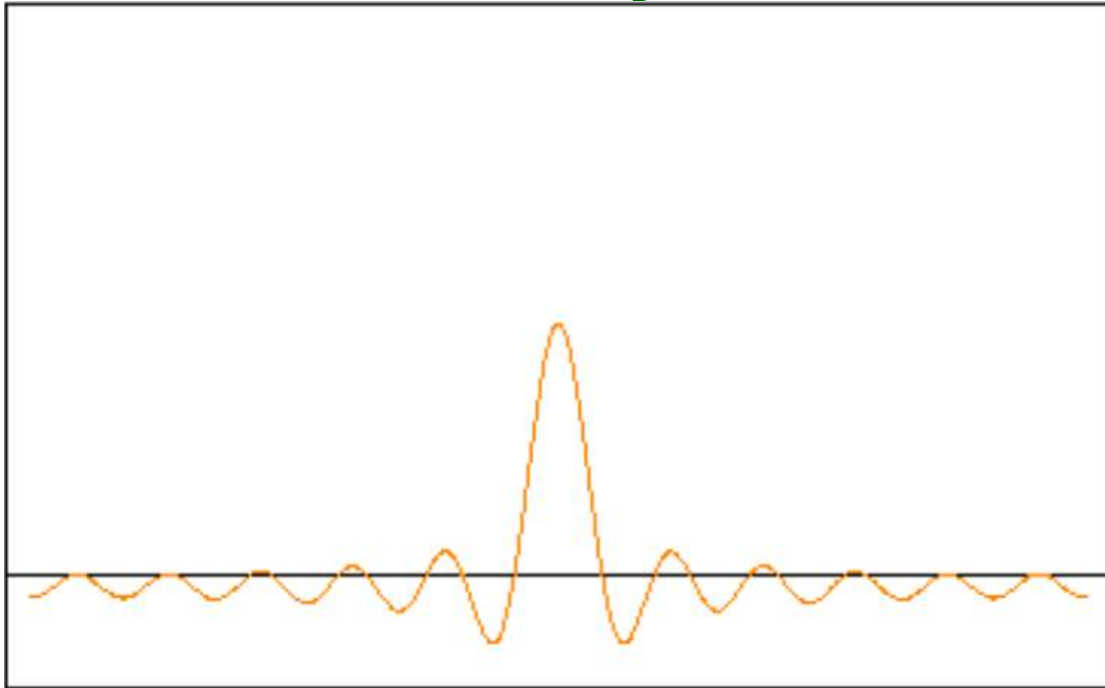


C-Trend II

Powered by C-Trend



The new generation of condition monitoring

User Guide: Version 1

DRAFT 5.3

TPI Limited

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1 Software – C-Trend II™

This user guide describes the operation of **C-Trend II™** PC-based trending software.

1.1 Screen layout and data display

Within the **C-Trend II™** screen (*fig 1.1*), the left-hand side of the screen, by default, displays the Asset Manager window, showing information for any currently installed plants. Each plant which is set up within the asset will contain a hierarchy of assets (which can include Area, Location, Sub-Location, Machine Train, Machine and Component) culminating in vibration measurement points (at any level from Machine Train down) and inspection measurement points (at any level). The + and – signs to the left of each asset allow the expansion or collapse of a display of that item's subsidiary assets.

Each asset within the Asset Manager 'tree' is colour coded to indicate the worst status returned for the most recent measurement taken for any point within this asset. (Red/Amber/Green represent Critical/Warning/OK.) The percentage figure displayed to the right of each asset represents the percentage of measurement points within this asset for which the most recently recorded status, whenever this was taken, is OK. Any bracketed figures appearing to the right of this percentage represent the total number of points within the asset for which the current status is either Critical (shown in red), or Warning (amber).

The right-hand side of the screen here shows the default **C-Trend II™** welcome screen, which is displayed on initially accessing the system, and also when any asset is selected for which there is no currently-available data.

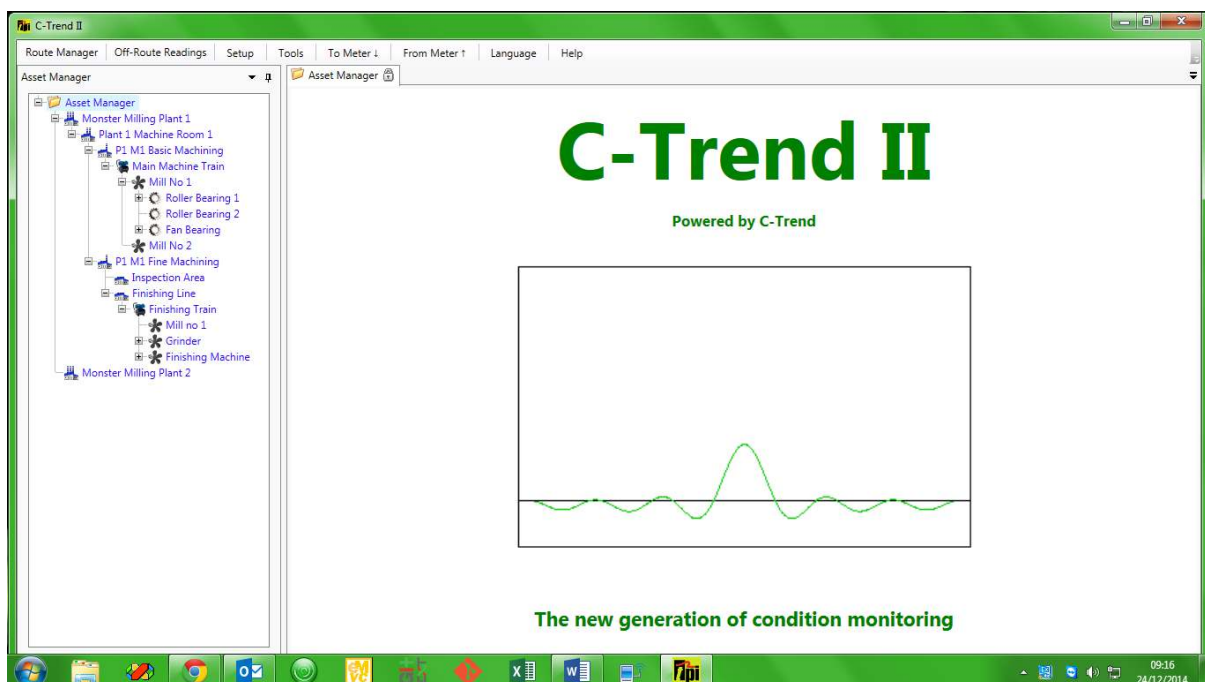


Fig 1.1

1.1.1 Useful Techniques

1.1.1.1 Zooming

Zooming on any of the graph plots within **C-Trend II™** can 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.

Double clicking the mouse on the graph will reset the zoom level to the original default value. (This functionality can be overridden in some cases, when a plot has Scale Lock as an option in its 'right click' menu.)

1.1.1.2 Window Position

The user can control how subsidiary windows within the **C-Trend II™** system behave, in that they can be allowed to float, hidden, docked or docked as a tabbed window within the Dashboard (see section 1.1.2 below). This is accomplished by clicking on the small downward-pointing triangle at the top of the window (*fig 1.1.1.2.1*) and using the menu options provided.

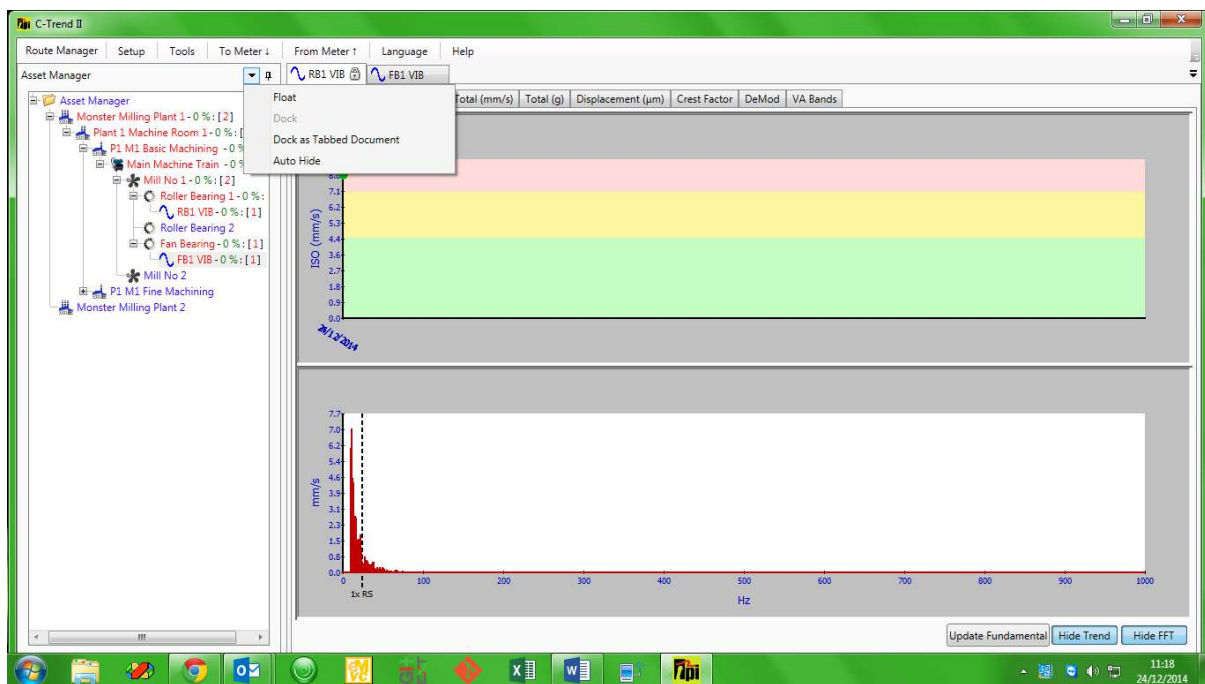


Fig 1.1.1.2.1

Alternatively, a window can be positioned and docked, by dragging it (using the held-down left mouse button) and positioning the mouse cursor over the appropriate portion of the 'guide diamond', which will appear on-screen as the window is dragged. The area into which the window will dock will be highlighted, and releasing the mouse button will allow it to dock into this position (*fig 1.1.1.2.2*).

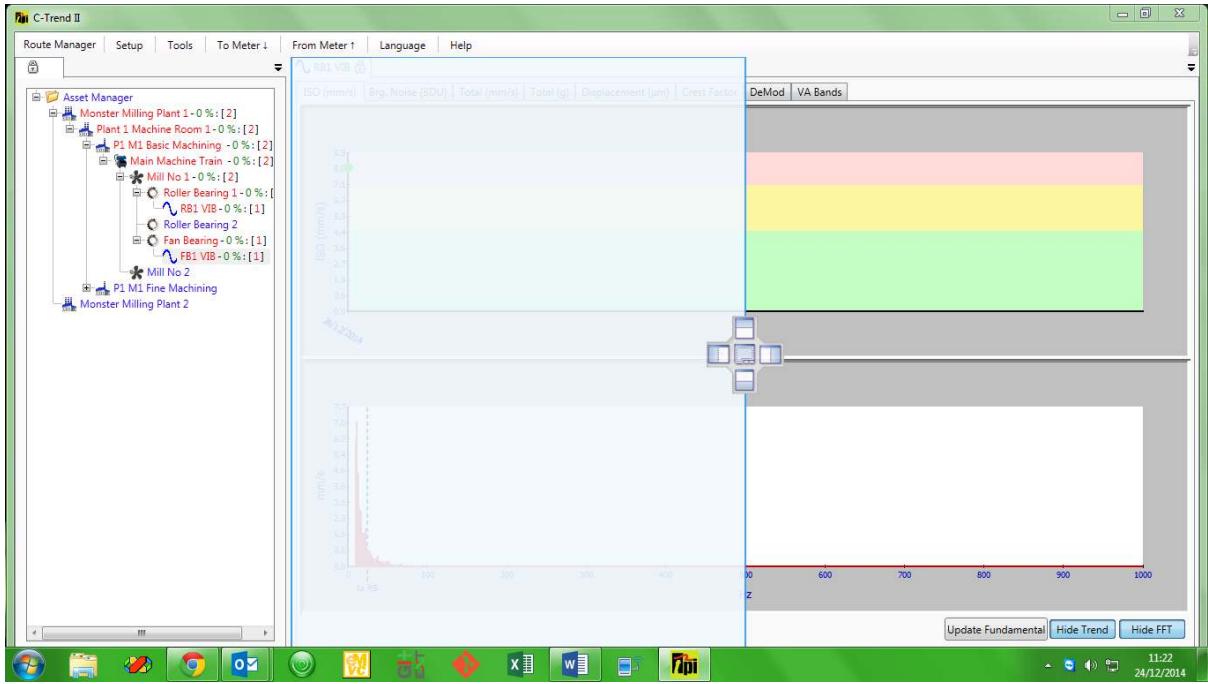


Fig 1.1.1.2.2

1.1.2 Dashboard

Left clicking (single click of left hand mouse button) on the name of any item within the Asset Manager screen, apart from an individual inspection point or vibration point (dealt with in section 1.1.3 below), opens up the Dashboard to the right of the Asset Manager window. (Left clicking while holding down the keyboard 'Ctrl' key will open a separate, tabbed, Dashboard window for any selected asset.) For each selected asset, this window has two tabs, labelled 'Overview' and 'Status'.

1.1.2.1 Overview

The Overview tab displays data in the format shown (fig 1.1.2.1). This gives a graphically presented, at-a-glance, picture of the status of this asset, incorporating the relevant data from all its component assets.

The headline section across the top of the dashboard screen displays "Latest Status Data" for the asset. On the left is the current worst measurement status associated with the asset, on the right is the percentage of measurements within the asset which are currently OK. This status and KPI (Key Percentage Indicator) figure match those shown for the asset within the asset manager.

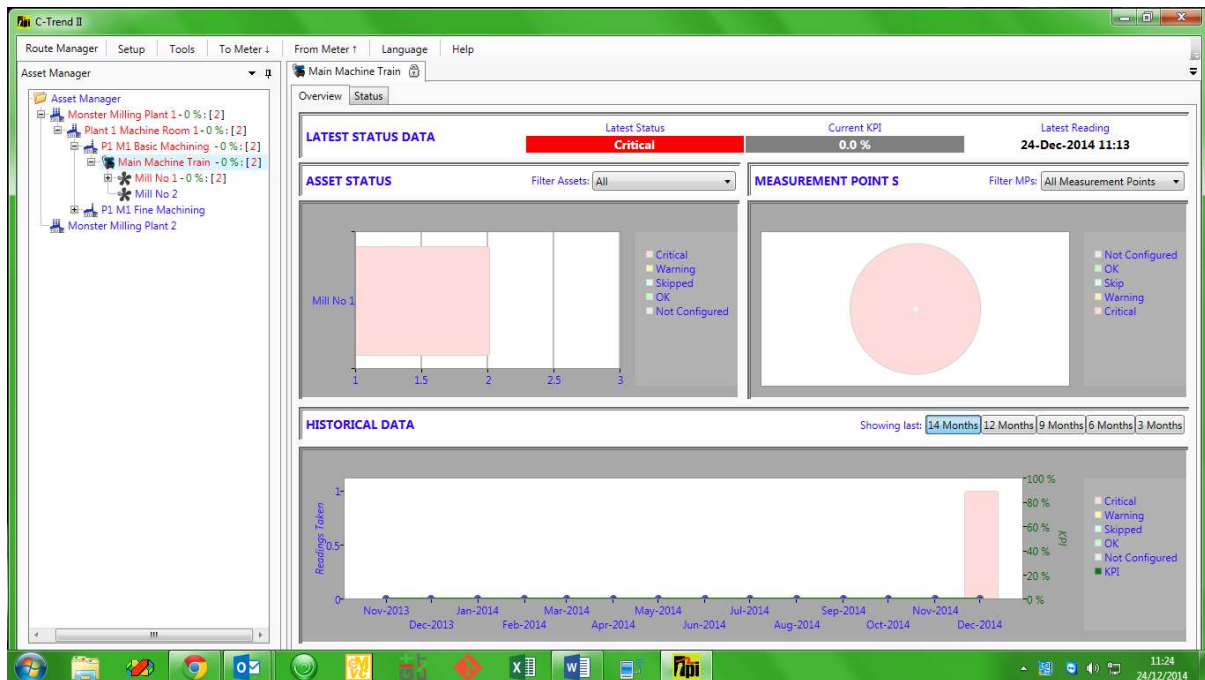


Fig 1.1.2.1

The upper left portion of the Dashboard displays the current status of each 'child' Asset of the one currently selected. The data is represented according to status, using the standard **C-Trend II™** colour coding system as described in section 1.1.

The upper right portion displays a pie-chart, giving an up-to-date breakdown, coloured by status, of all individual readings contained within this asset.

The lower half of the dashboard shows historical data for this asset.

Status readings are recorded as a stacked-column bar-chart, showing the numbers of Alarm, Warning, OK and Skipped readings within this asset over time. As with all displays within **C-Trend II™** the data is colour-coded by status, with any skipped readings appearing in Blue.

The second plot in the historical display is the green KPI (Key Percentage Indicator) line graph, which shows the percentage of measurements pertinent to this asset which, during the month shown, have achieved an 'OK' status.

1.1.2.2 Status

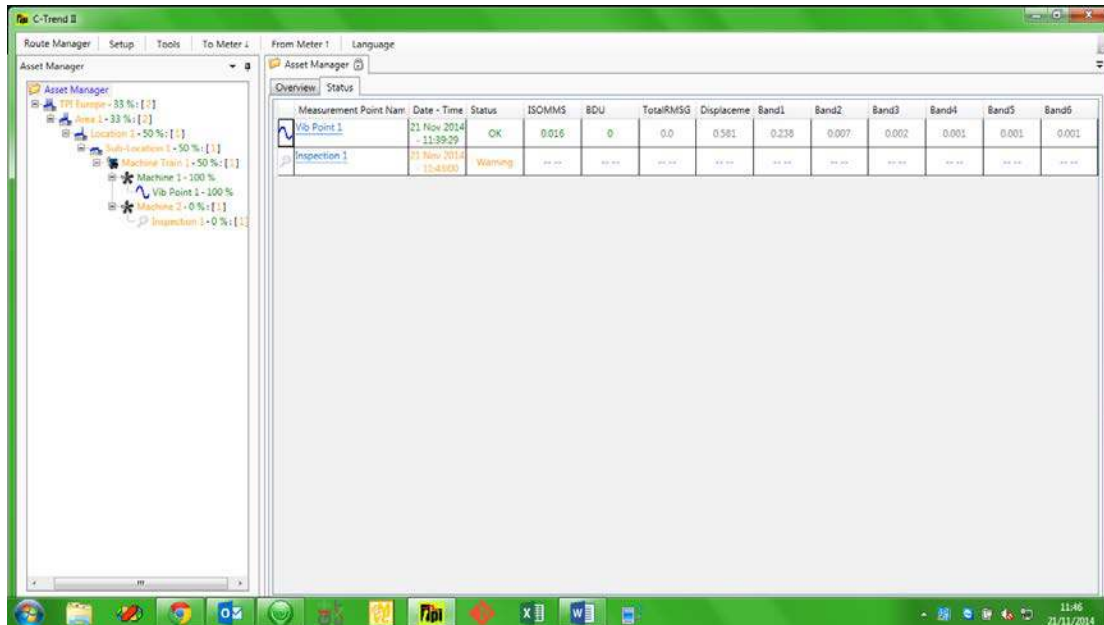


Fig 1.1.2.2

The Status tab within the Dashboard window displays detailed data for the most recent reading taken at each measurement point within the selected asset (*fig 1.1.2.2*)

1.1.3 Measurement point data display

Clicking on an individual measurement point within this window, or within the Asset Manager window on the left of the screen, will display a trend plot and additional data, specific to the type of measurement point selected.

1.1.3.1 Vibration point data display

For a vibration point, the top half of the screen will display a data trend chart corresponding to the option which has been selected from the menu tab at the top of the screen. The lower portion of the vibration point data display screen displays a frequency (FFT) plot for the selected vibration point (fig 1.1.3.1). The units displayed on the two charts are dictated by the parameters set up for the machine train. The user can also elect to show or hide the trend plot and/or the frequency plot by selecting from the two buttons on the right of the display.

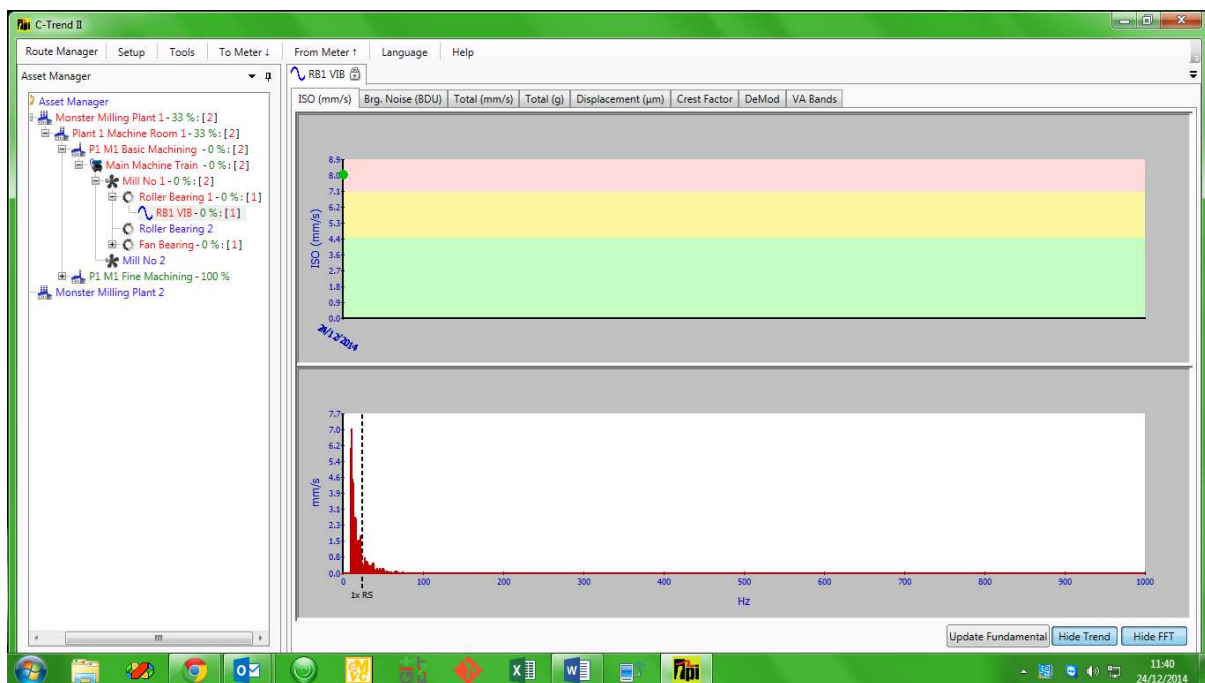


Fig 1.1.3.1

1.1.3.1.1 Vibration point trend chart

Positioning the cursor 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. The alarm levels are shown as a colour-coded background to the graph in red, yellow and green, corresponding to Critical, Warning and OK.

1.1.3.1.2 Vibration point FFT chart

On initial display, the FFT plot shows the data for the most recent reading at this point. An FFT plot for any reading taken at a different date or time can be displayed simply by clicking on the required marker on the associated 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 corresponding FFT plot to appear in the bottom half of the screen.

If it has been set, the running speed of the asset appears on the FFT as a vertical black dashed line.

A right mouse-click anywhere on the FFT plot displays a menu offering the user a number of additional diagnostic tools (*fig 1.1.3.1.2*).

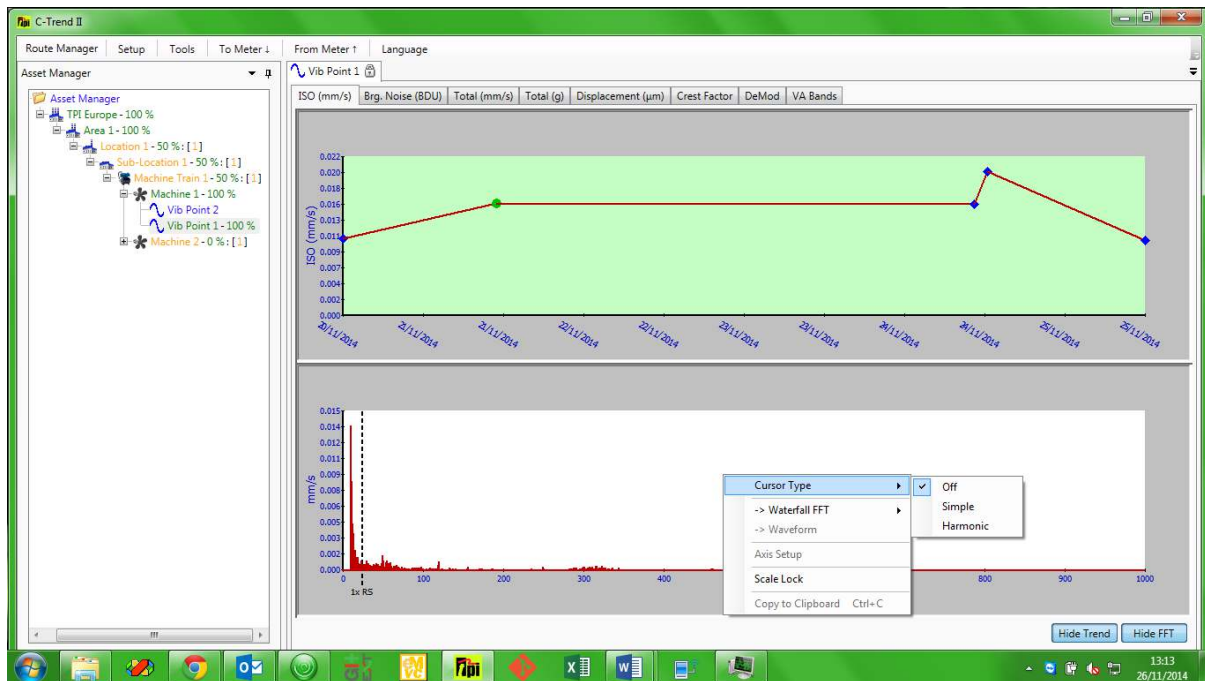


Fig 1.1.3.1.2

1.1.3.1.2.1 Cursor Type

When initially displayed, the FFT plot for a vibration plot appears with Cursor Type set by default to 'Off', which is as displayed (*fig 1.1.3.1.2*).

1.1.3.1.2.1.1 Simple Cursor

Selecting 'Simple' displays a cursor (*fig 1.1.3.1.2.1.1.1*) which is initially located at the asset's run speed. The intersecting grey dotted lines on the plot show the precise vibration reading at this frequency.

By clicking and holding down the left mouse button on the cursor control (the red square containing a black 'P' at the top of the plot), the cursor can be moved left and right through the frequency spectrum, to select points of interest for analysis. This functionality can be used, particularly in conjunction with the Zoom function, to precisely identify the magnitude and associated frequency of any point on the FFT plot (*fig 1.1.3.1.2.1.1.2*).

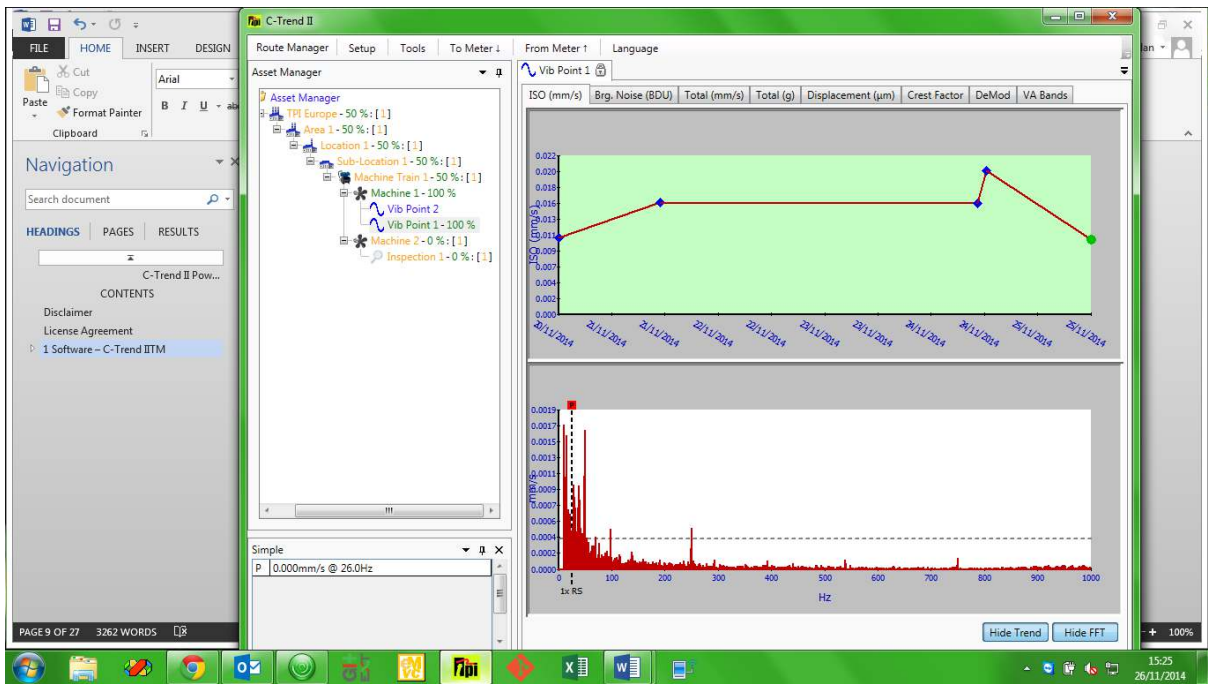


Fig 1.1.3.1.2.1.1

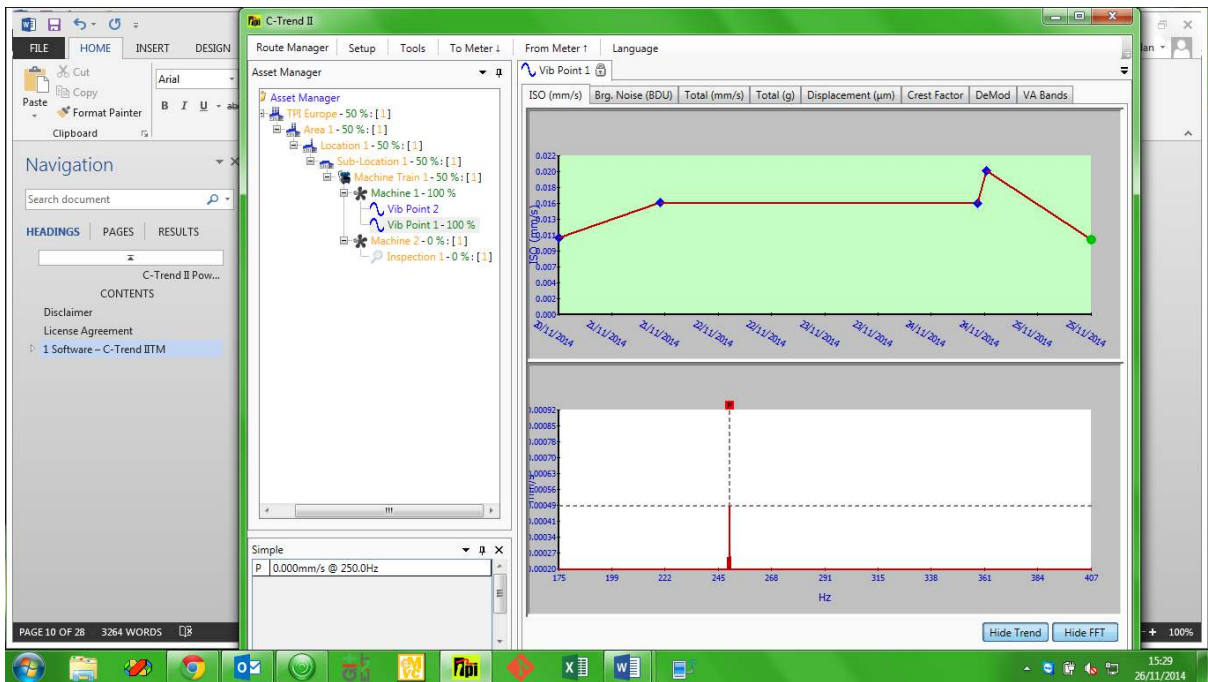


Fig 1.1.3.1.2.1.1.2

1.1.3.1.2.1.2 Harmonic Cursors

Another very powerful technique for fault-finding is the use of harmonic cursors. These can be an enormous help in identifying vibration frequency components which are multiples of other frequencies, such as the asset's running speed. Upon selecting harmonic cursors, the Fundamental harmonic cursor is initially shown at

the mid-point of the displayed frequency spectrum. The user then moves this to the selected 'base frequency', which is typically, but not always, the asset's running speed. Selecting "Add harmonic" from the menu adds a second cursor, at a frequency of 'base x2'. Further harmonics up to 'base x8' can be sequentially added as required.

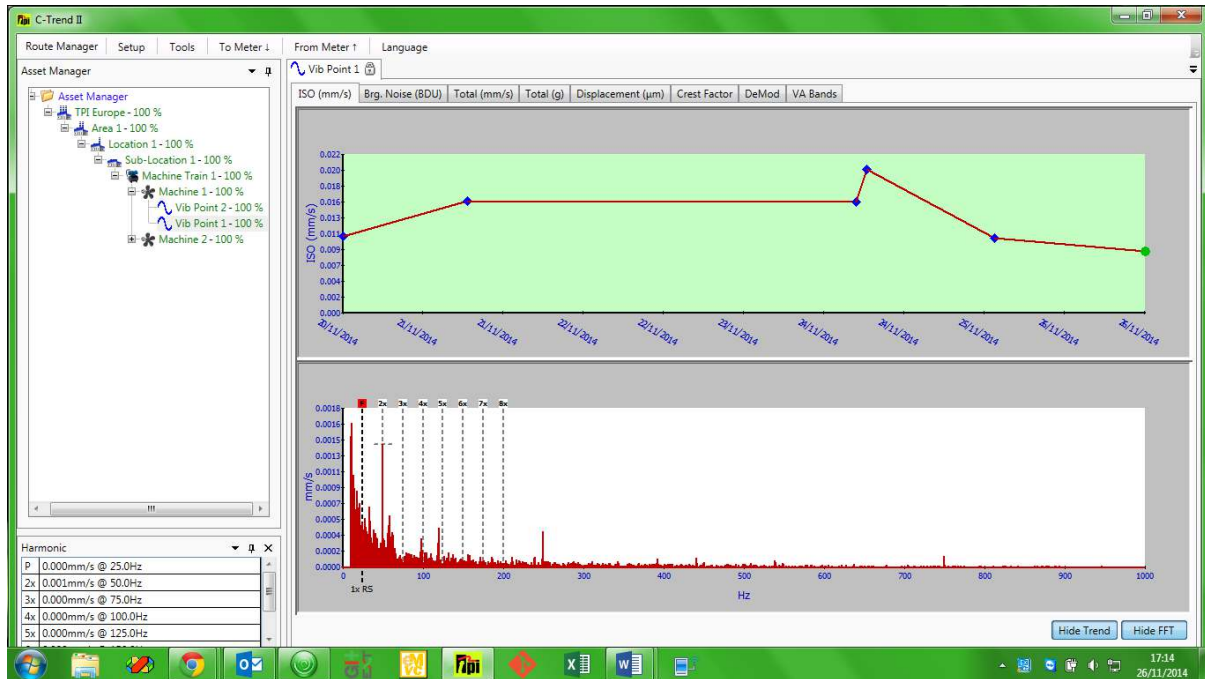


Fig 1.1.3.1.2.1.2

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 keyboards arrow keys. Whenever any cursor is moved, the other cursors will move with it, maintaining the harmonic series ratio (x1, x2, x3, etc.) A window is also displayed showing the current values corresponding to each active harmonic cursor.

Where the series of harmonic cursors forms a good fit with the peak values of the FFT spectrum, it is indicative of a harmonic component in the measured vibration.

1.1.3.1.2.2 Waterfall FFT

The Waterfall FFT option from this menu allows the user to evaluate the FFT plot for this vibration point by comparison against either historic data for the same vibration point, or the current FFT plots for other vibration points open on the system (fig 1.1.3.1.2.2).

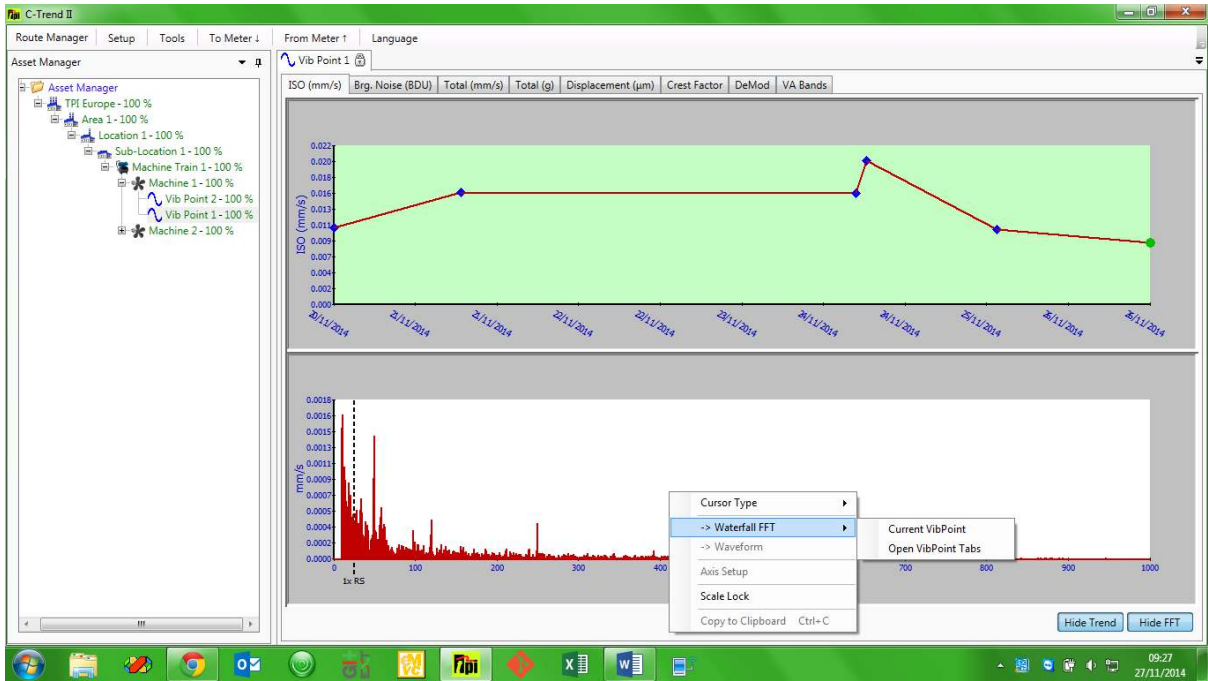


Fig 1.1.3.1.2.2

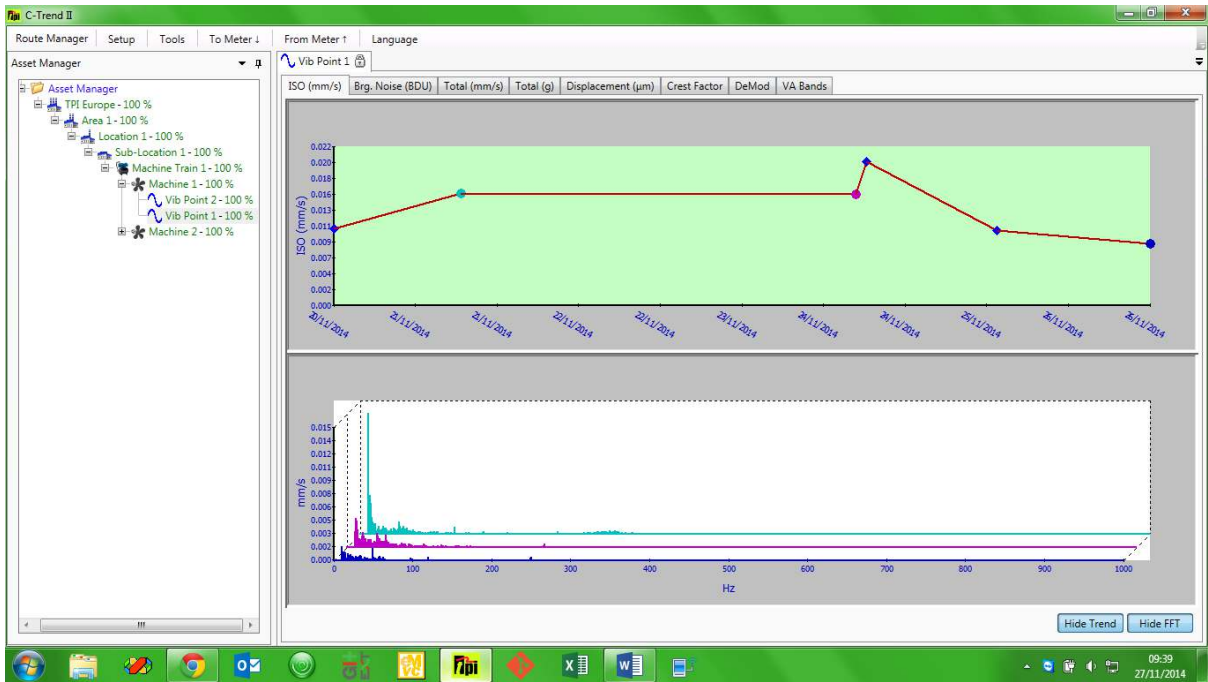


Fig 1.1.3.1.2.2.1

1.1.3.1.2.2.1 Current vibration point

When this option is selected, the user can add historic FFT plots for the currently selected vibration point simply by clicking the left mouse button on the required point on the trend plot in the top part of the screen.

In this instance the blue diamond in the trend plot changes into a circle, colour-coded to match the corresponding plot, which now appears in the FFT window (fig 1.1.3.1.2.2.1). Additional plots (up to a maximum of ten) can be added to the waterfall in the same way, always appearing in chronological order, with the most recent at the front. This allows the visual identification of anomalies or trends which may not otherwise be apparent. The view of the waterfall plot can also be swivelled horizontally using the computer keyboard left and right arrow keys, with the Ctrl key held down.

1.1.3.1.2.2.2 Open vibration point tabs

This option opens a waterfall FFT plot in a separate window. This includes the FFT plot for the currently selected measurement, together with one for the selected measurement for each vibration point with a currently open dashboard tab. The FFT plots are again colour coded, this time to match the text in the dashboard tab for each vibration point. The individual plots appear in the waterfall in tab order (fig 1.1.3.1.2.2.2).

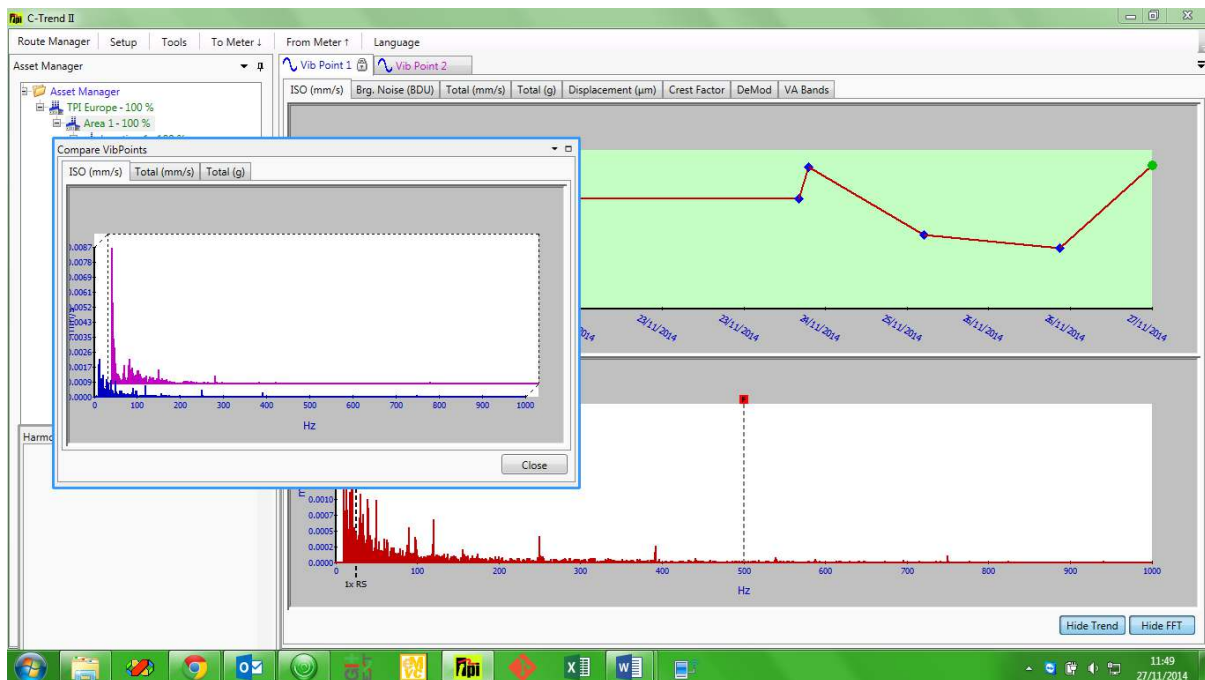


Fig 1.1.3.1.2.2.2

1.1.3.1.3 Bearing Noise Analysis

Selecting the Bearing Cursor option allows the user to examine bearing wear for this vibration point, by comparison of the measured vibration against the known characteristics of the type of bearing in use. Each vibration point can be linked within **C-Trend II™** to a comprehensive database of bearing types (sections 1.3.1 & 1.5.2.1).

The Bearing Noise plot displays a fundamental cursor, at the run speed (R). If a bearing type has been linked to this vibration point, four additional cursors appear, at multiples of the fundamental which are defined in the database as representing wear to each of: **the rolling element (RE), the bearing cage (CG), the inner race (IR) and the outer race (OR)** for this type.

The fundamental cursor can be moved by the user, to align with a selected point on the frequency (FFT) plot, which will typically be typically a peak representing the true run-speed, where this differs from the nominal speed. The bearing-noise cursors will move in conjunction with the fundamental, maintaining the ratios defined in the database, thus allowing peak vibrations matching the selected criteria to be identified.

For more detailed examination, harmonic cursors can be added to the plot by choosing “Add Harmonic” on the right-click menu. This will incrementally display up to eight harmonic cursors, at integer multiples of the cursor values for the four types of wear.

An example of a plot with bearing cursors enabled, and showing a first harmonic (2 x frequency) is given in *fig 1.1.3.1.3*.

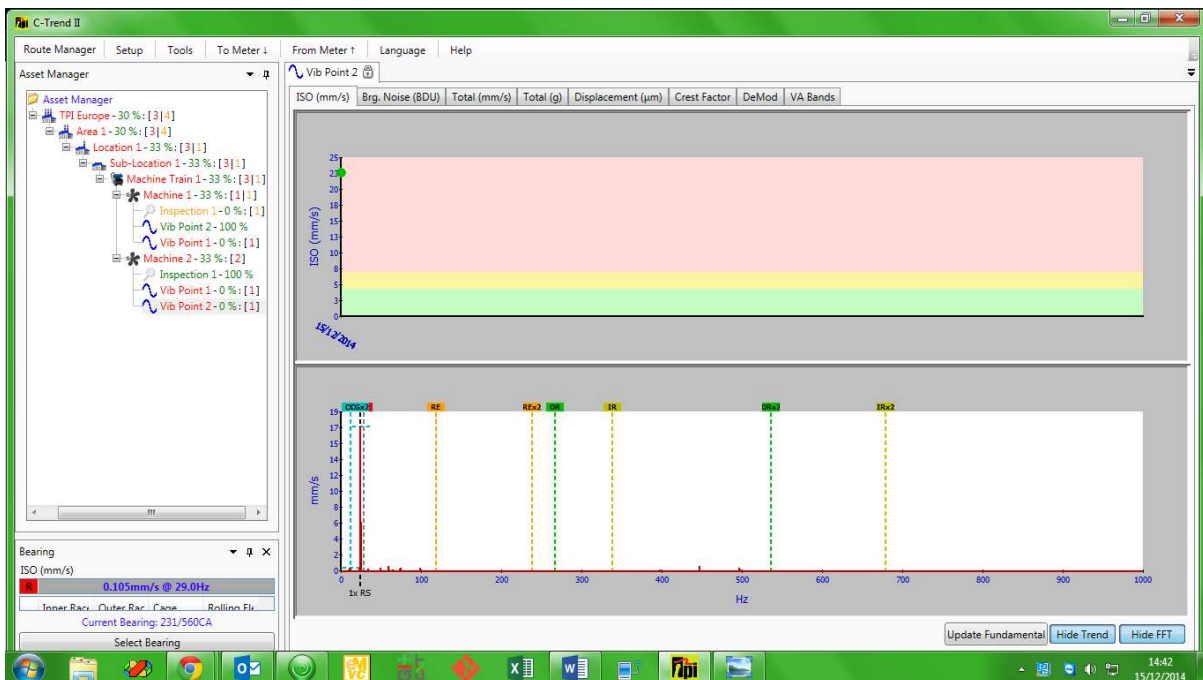


Fig 1.1.3.1.3

1.1.3.2 Inspection point data display

Where the selected measurement point is an inspection point, the top portion of the screen again displays a trend graph for the status of this point, plotted over the familiar Green, Amber and Red alarm bands.

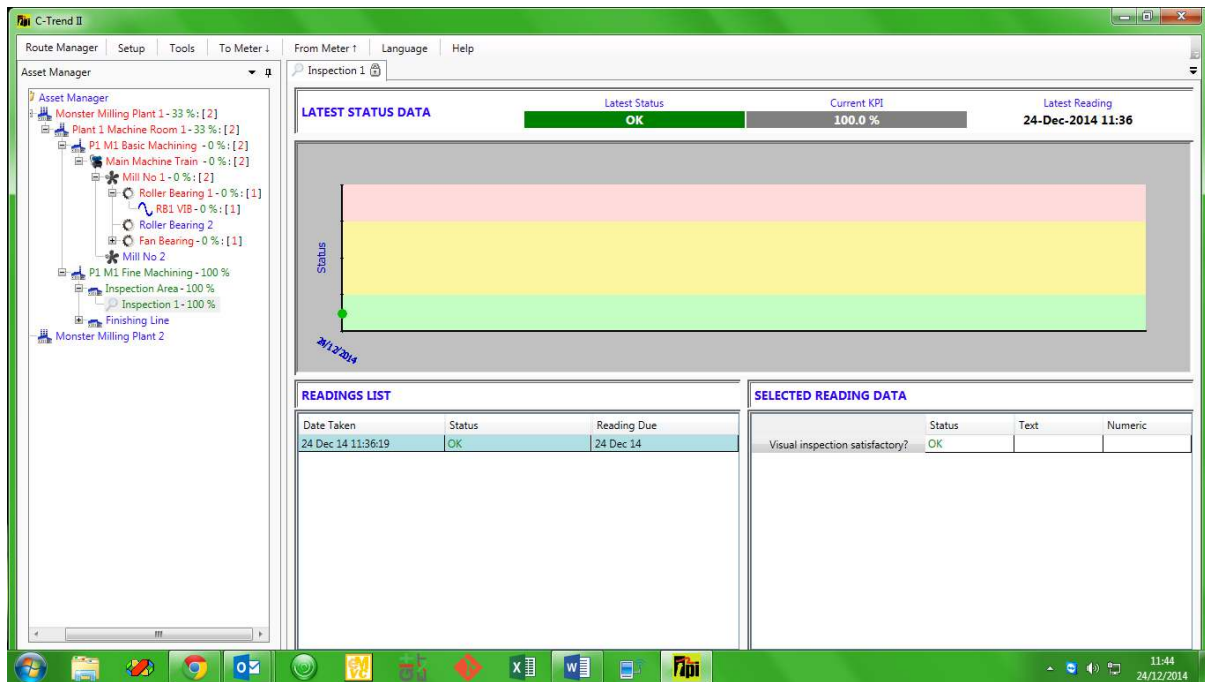


Fig 1.1.3.2

The lower portion of the window, in this instance, is split vertically into two sections. On the left is chronological list of readings for this point (oldest first). This displays the date and time when the reading was taken, the reading's status and the date upon which it was scheduled to be taken, to indicate whether it was early, on time or late.

Viewing and selecting the data for a specific reading is achieved exactly as described for vibration points.

The lower right quarter of the screen holds the status responses to the questions specified for any selected reading.

1.2 Asset Addition/Editing/Deletion

Right clicking the mouse on the name of any asset within the Asset Manager menu, in addition to showing the dashboard for this asset, displays a menu of the available edit options (fig 1.2.1).

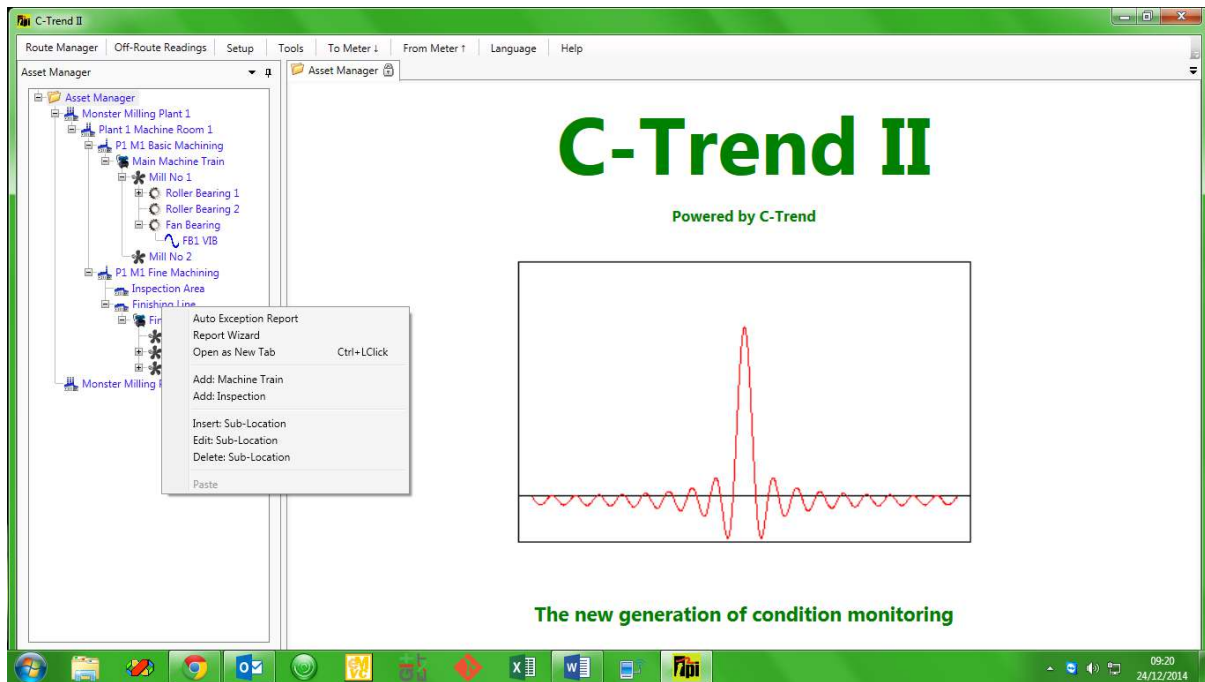


Fig 1.2.1

The first two items, Auto Exception Report and Report Wizard are covered later, in section **1.4 Reporting**.

The remaining options allow:

- The addition of additional subsidiary assets within this one.
- The insertion of an additional asset at the same level in the hierarchy as this one.
- Editing of the data held to define and describe this particular asset.
- Deletion of this asset from the system.

A particularly useful feature is the ability to add email addresses to each asset. This allows emails to be automatically issued to all relevant and responsible parties, immediately upon **C-Trend II™** encountering any warnings and alarms when readings are uploaded.

The criticality of any asset on the system can be individually set through this screen, or, below plant level, it can be defaulted to inherit from its parent asset.

Figures 1.2.2 and 1.2.3 illustrate the 'general' and 'additional info' tabs within the 'edit' option for the selected asset.

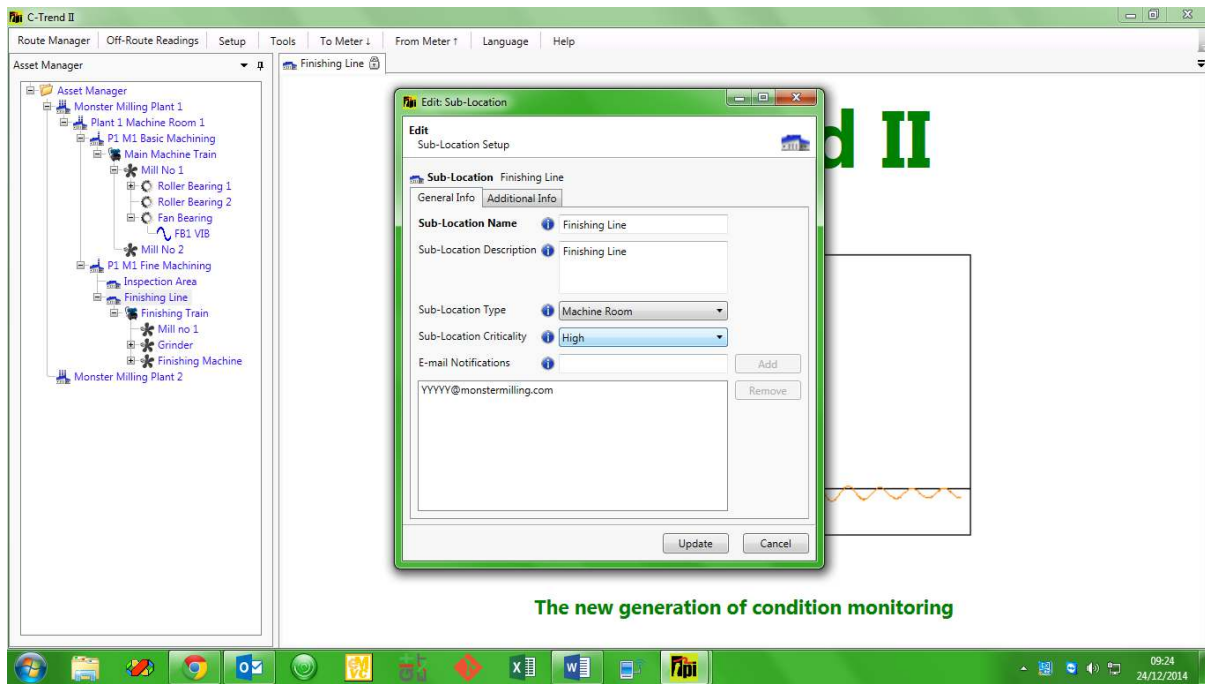


Fig 1.2.2

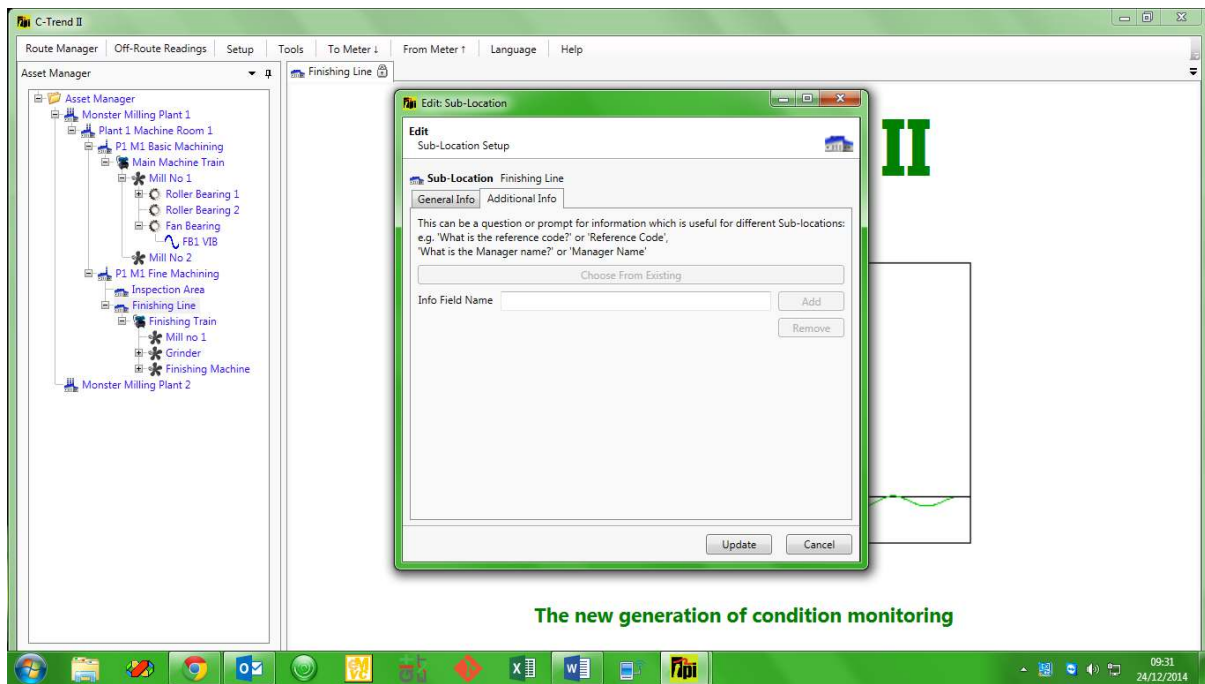


Fig 1.2.3

1.2.1 Machine Train addition/editing and deletion

This is special case of asset maintenance. Default parameters can be set at this level for all machines within the train. There is a “Setup” tab (shown in fig 1.2.1.1), giving access to the screen in fig 1.2.1.2. This allows default units, run speed etc. to be set on the dashboards of all vibration points within this machine train.

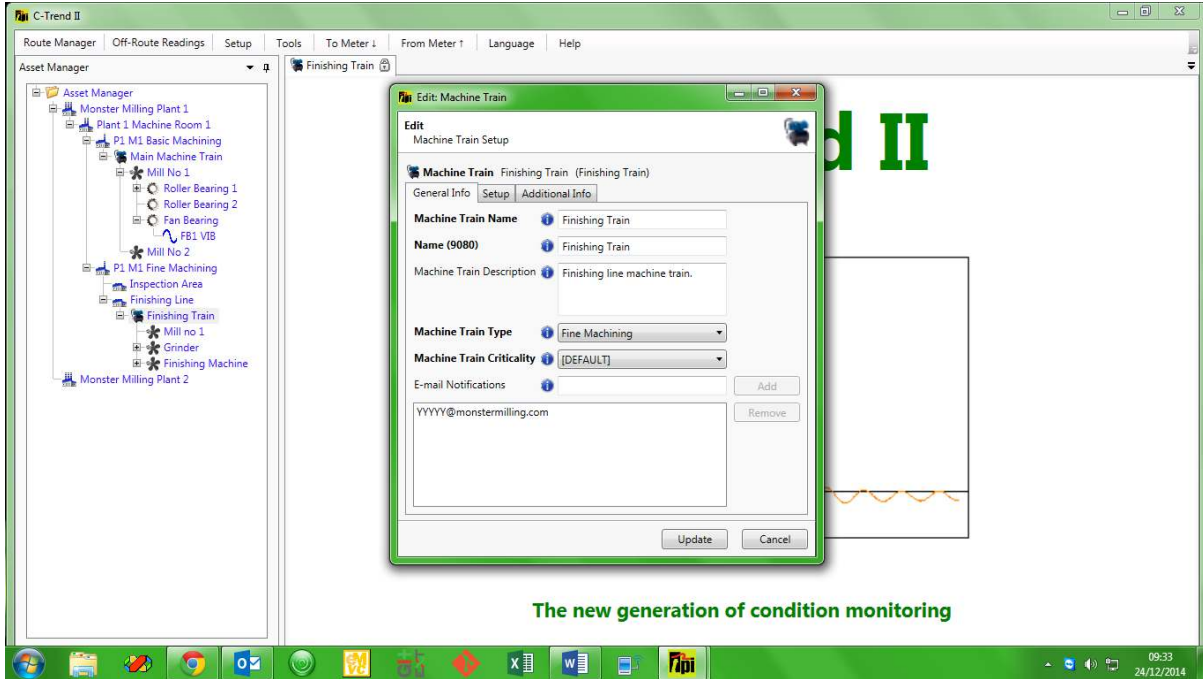


Fig 1.2.1.1

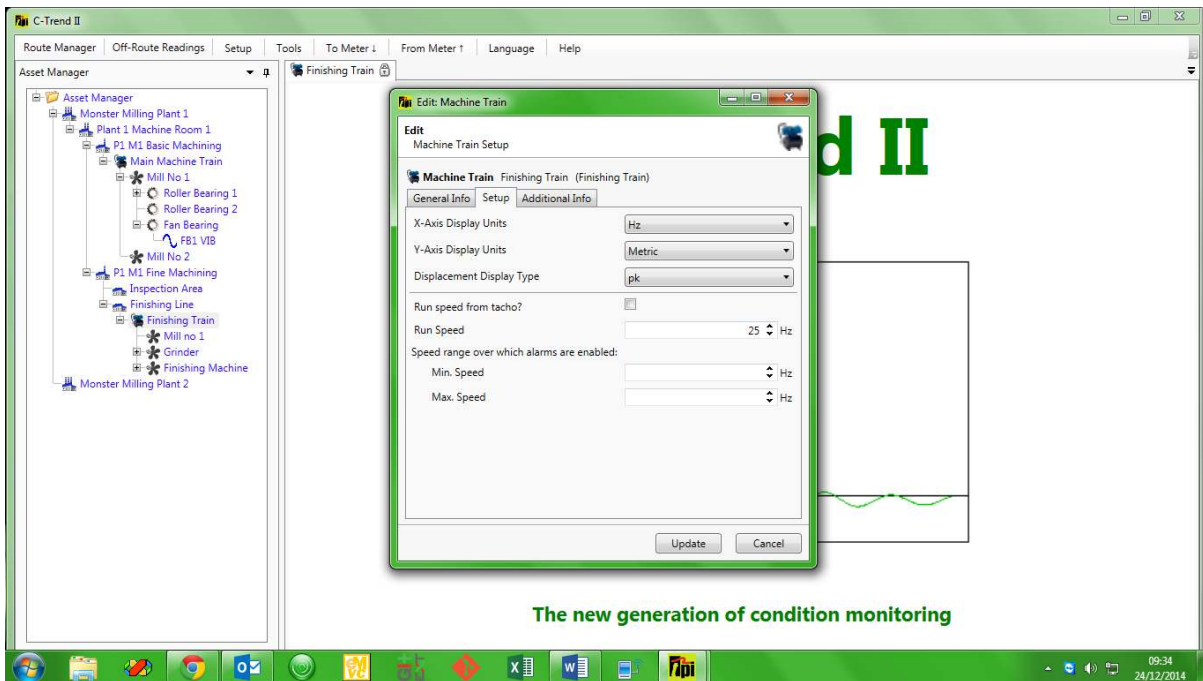


Fig 1.2.1.2

1.3 Measurement point addition/editing and deletion

In the same way that right-clicking on any asset presents the user with add, delete and edit options, the same is true of measurement points. The specific activities associated with the options for a vibration point and an inspection point are demonstrated in sections 1.3.1 and 1.3.2 below.

1.3.1 Adding/editing a vibration point

The vibration point add/edit options display four tabbed windows, as shown in figs 1.3.1.1 to 1.3.1.4.1.1

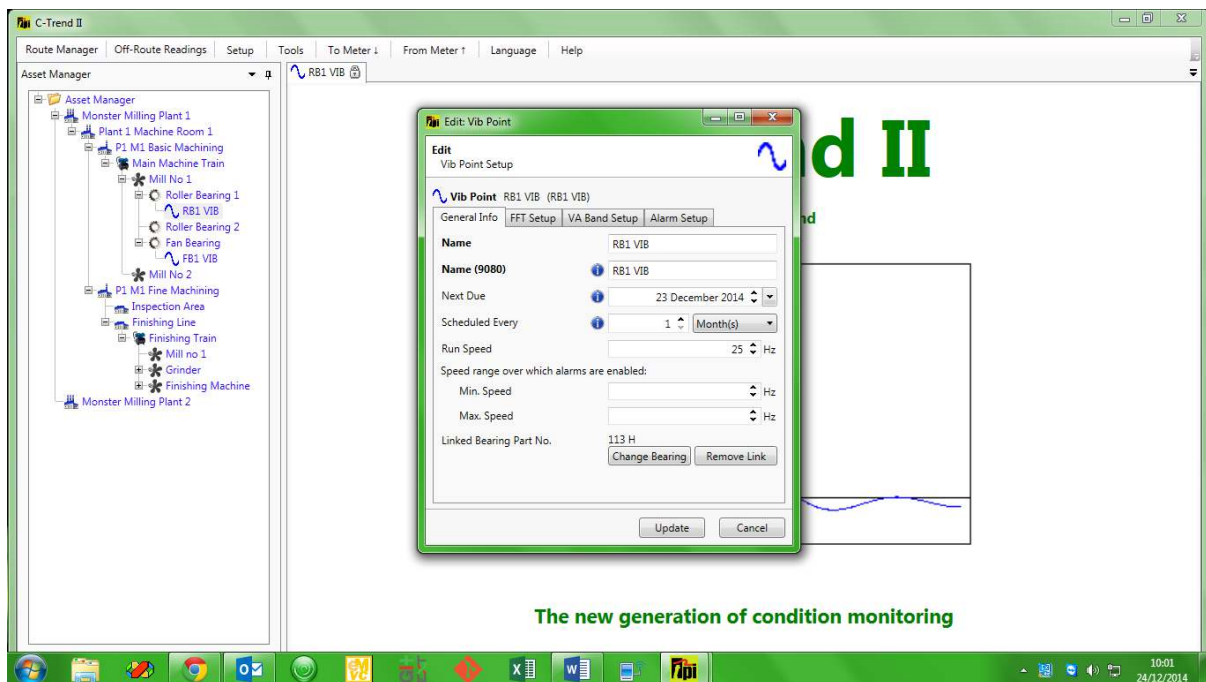


Fig 1.3.1.1

The first tab (*fig 1.3.1.1*) allows the maintenance of general information for this vibration point.

The button giving an option to link or change a bearing part number gives the user access to the bearings database (*fig 1.3.1.1.1*).

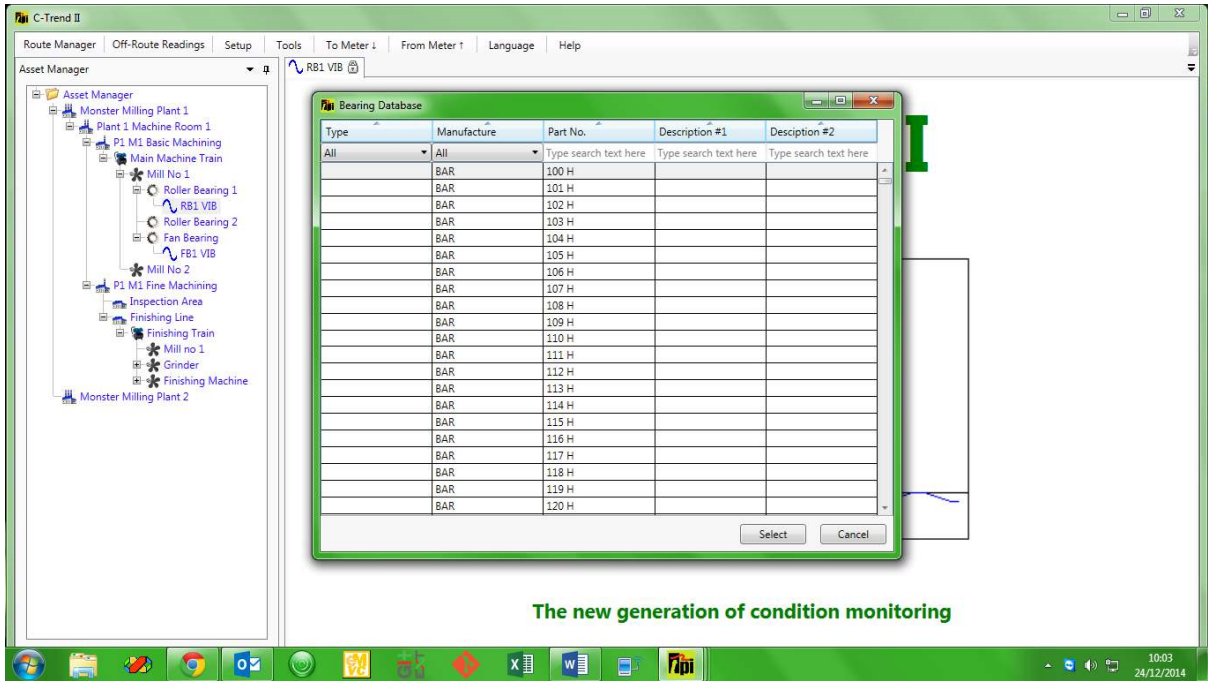


Fig 1.3.1.1

This database is searchable on any or all of: type, manufacturer, part number and two search text fields. Selecting an entry from the database will link this bearing type to the vibration point, allowing detailed bearing noise analysis (see section 1.1.3.1.3)

The second tab (*fig 1.3.1.2*) handles the set-up of the frequency analysis (FFT) parameters for this vibration point.

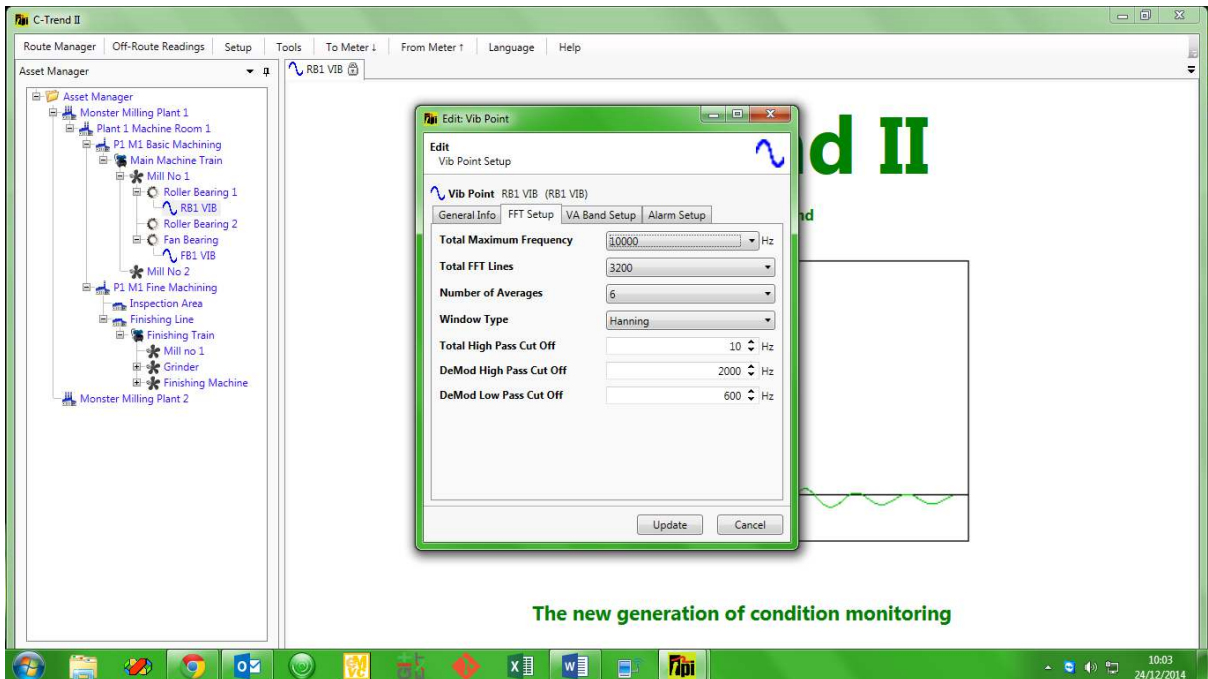


Fig 1.3.1.2

The third, VA (Vibration Analysis) band, editor tab (*fig 1.3.1.3*) allows for the specification of particular frequency bands for different potential problem types, tailored to the known characteristics of this vibration point, thus allowing for accurate diagnostics.

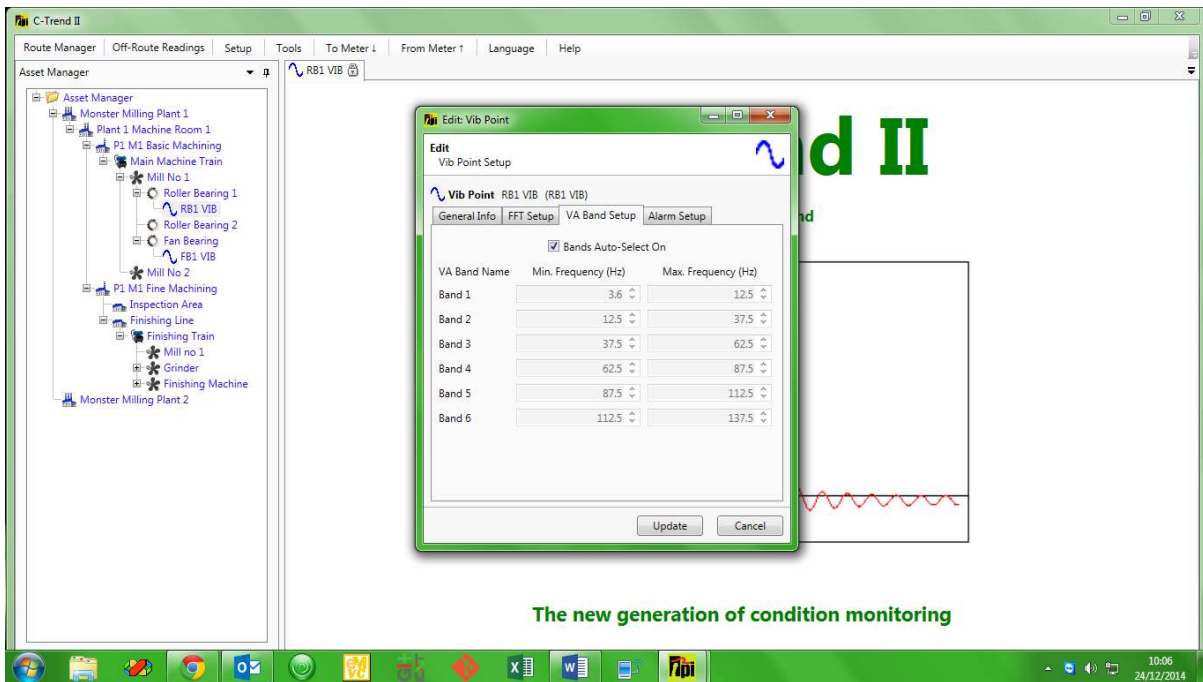


Fig 1.3.1.3

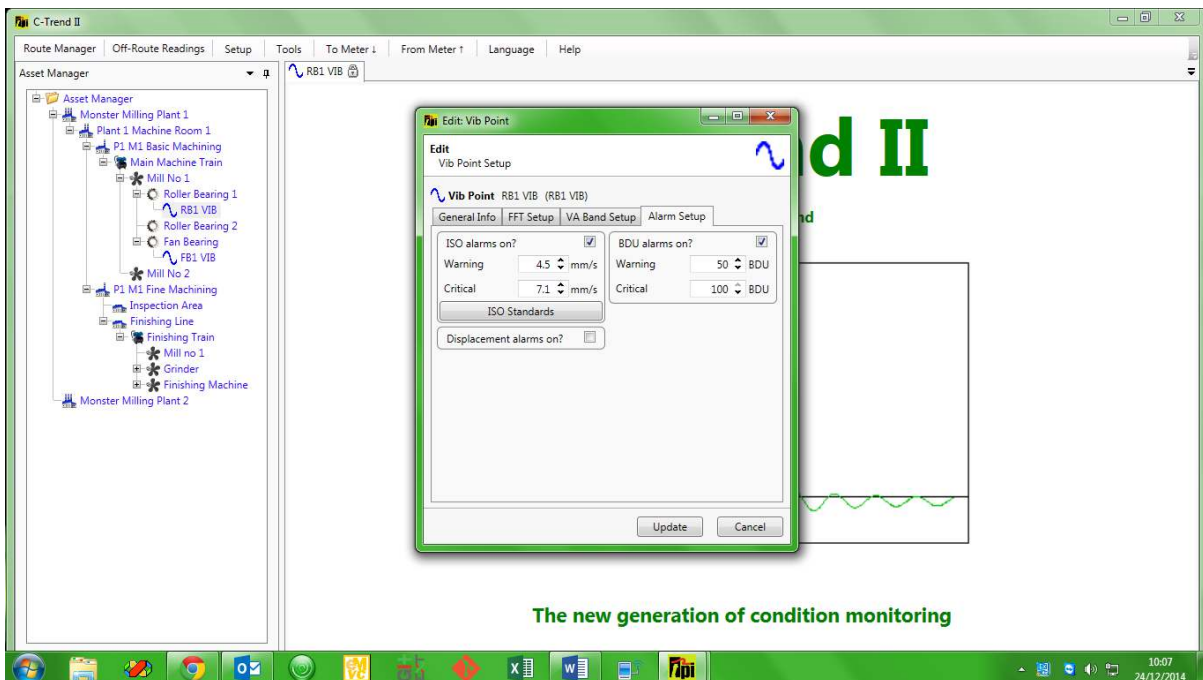


Fig 1.3.1.4

The alarm setup window for vibration point editing allows the activation and deactivation, plus the setting of alarm criteria, for a range of alarm types. In this instance (*fig 1.3.1.4*), the screen is showing ISO, BDU (Bearing Damage Unit) and displacement alarms.

The ISO Standards button allows the selection of the appropriate ISO alarm levels for this situation from the ISO Standards machine groups window (*fig 1.3.1.4.1*)

The Show ISO Chart button within the ISO Standards machine groups window displays the standard ISO machine-type recommendations (*fig 1.3.1.4.1.1*).

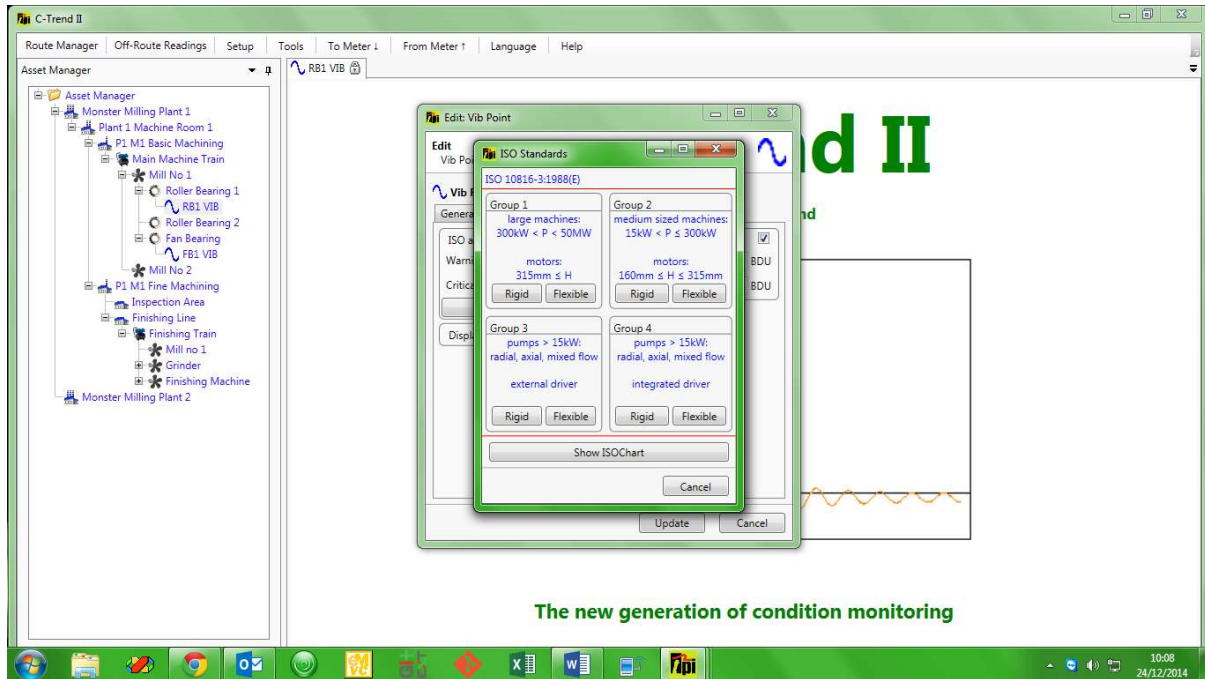


Fig 1.3.1.4.1

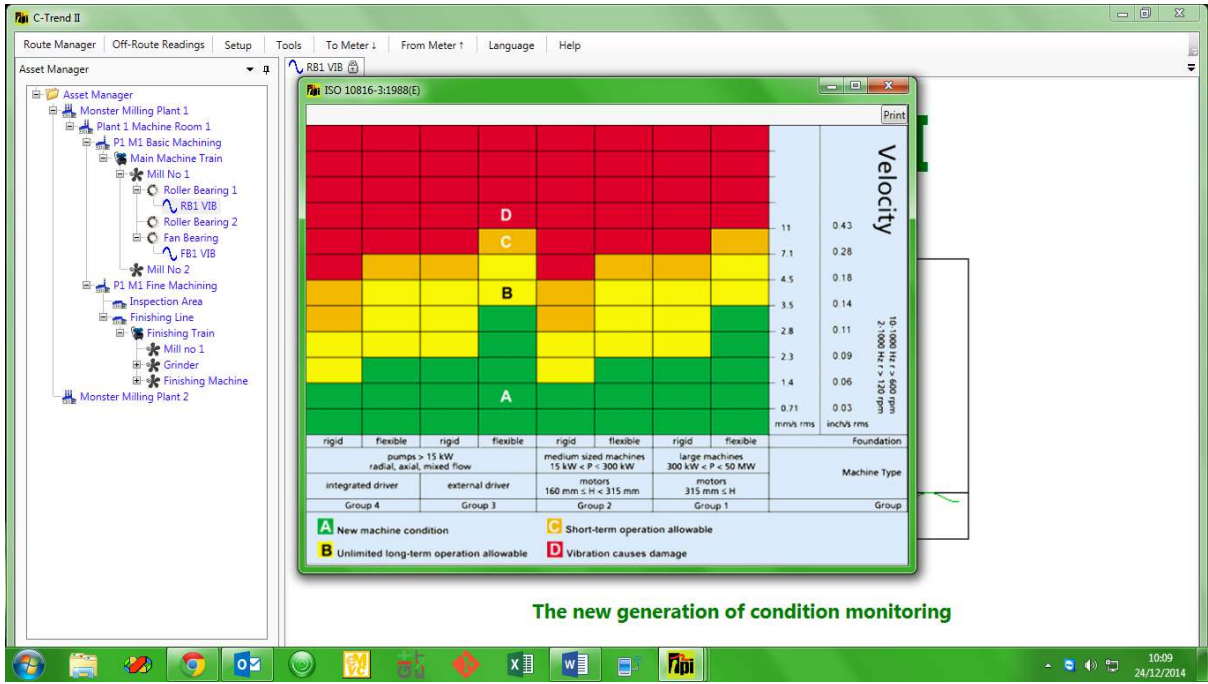


Fig 1.3.1.4.1.1

1.3.2 Adding/Editing an inspection point

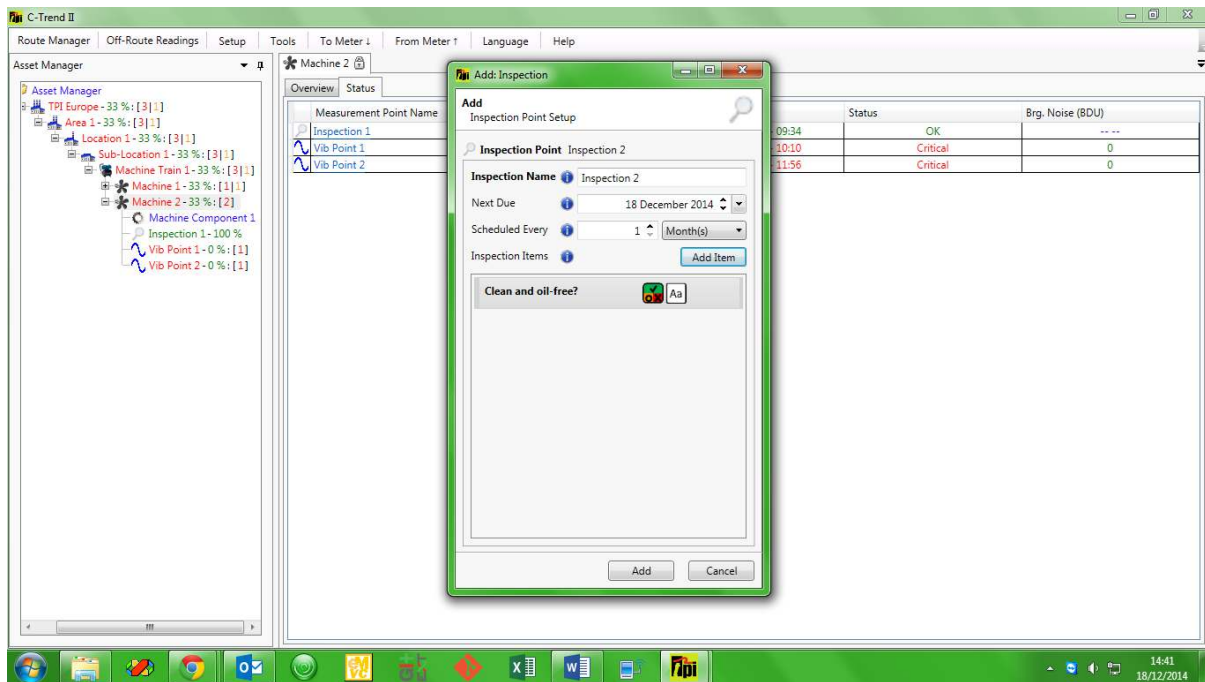


Fig 1.3.2

In addition to maintaining the general information for the selected inspection point, this option (*fig 1.3.2*) allows the creation and editing of a list of inspection items within this inspection. Right clicking on any existing item gives access to the Edit Item window (*fig 1.3.2.1*) It is worth noting that, whilst 'Item Name' can be edited at any time, 'Answer Type' and 'Answer Data' cannot be changed once the item has been incorporated into trending data.

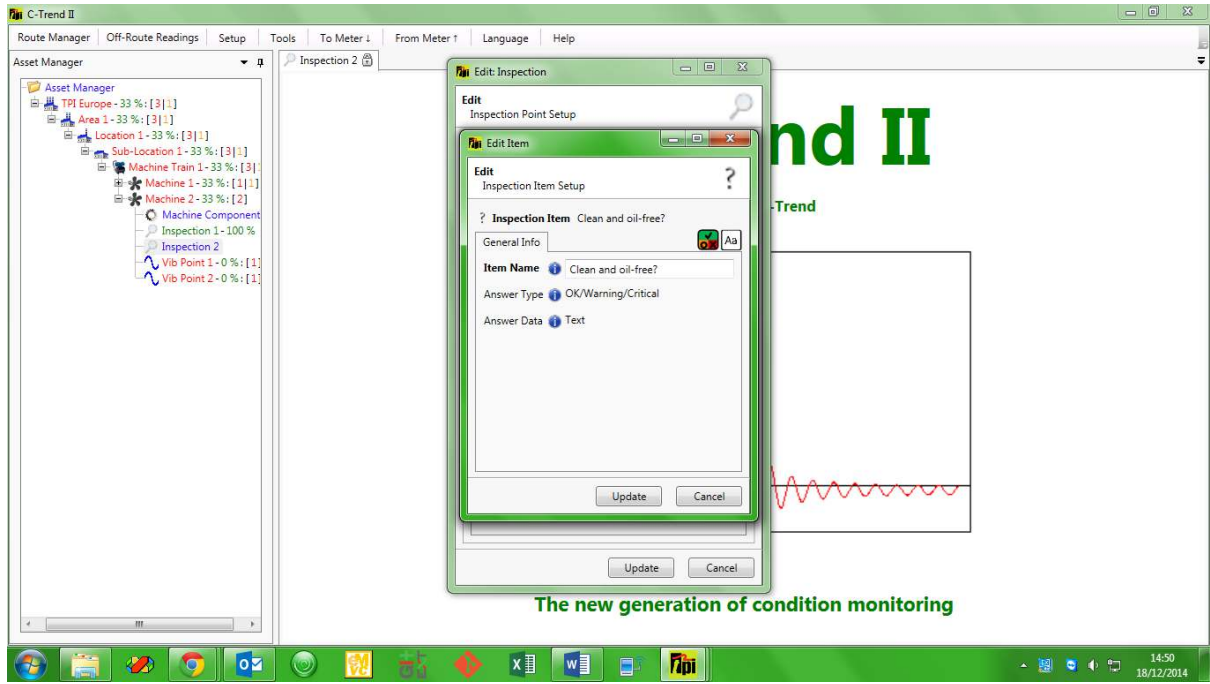


Fig 1.3.2.1

1.4 Reporting

1.4.1 Auto Exception Report

C-Trend II™ has a built-in facility to automatically generate an exception report for all measurement points returning Warning or Critical values within any selected asset. This is achieved simply by right-clicking on the required asset and selecting the **Auto Exception Report** function from the drop down menu.

The report is produced, without any further user action, as an open, unsaved **WORD™** document, which can be edited, with comments if desired, and then printed or saved as a DOC file.

1.4.2 Report Wizard

The second option on the right-click menu for a selected asset is the **Report Wizard**. This allows the flexibility for the user to exercise considerably more control in specifying which assets are to be reported on, and what status tables, trends and FFT plots are required within the chosen asset. This displays the **Report Type** window, which offers the choice between Exception Report and New Manual Report (*fig 1.4.2*).

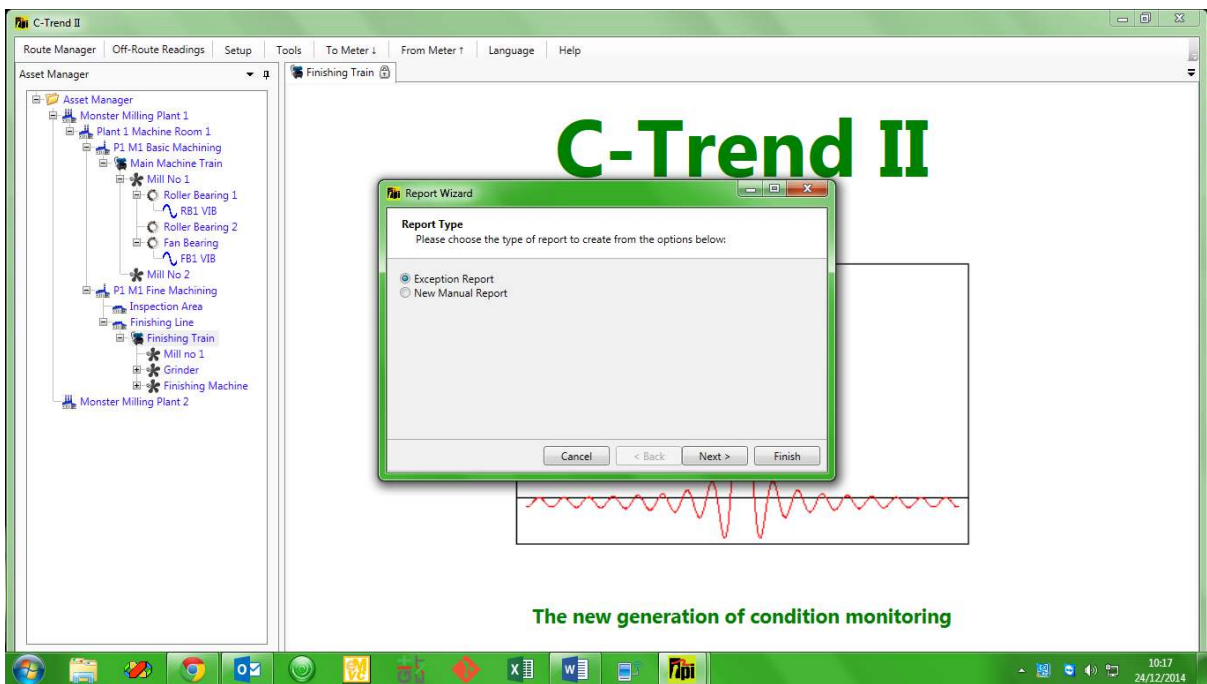


Fig 1.4.2

1.4.2.1 Exception Report

This option allows the user to specify that the report will contain only items that are registering an alarm status (Warning or Critical). The user is at this point offered the option to report on all measurement points, only vibration points or only inspection points (*fig 1.4.2.1*). On clicking Finish, the report is again generated as an open, unsaved **WORD™** document.

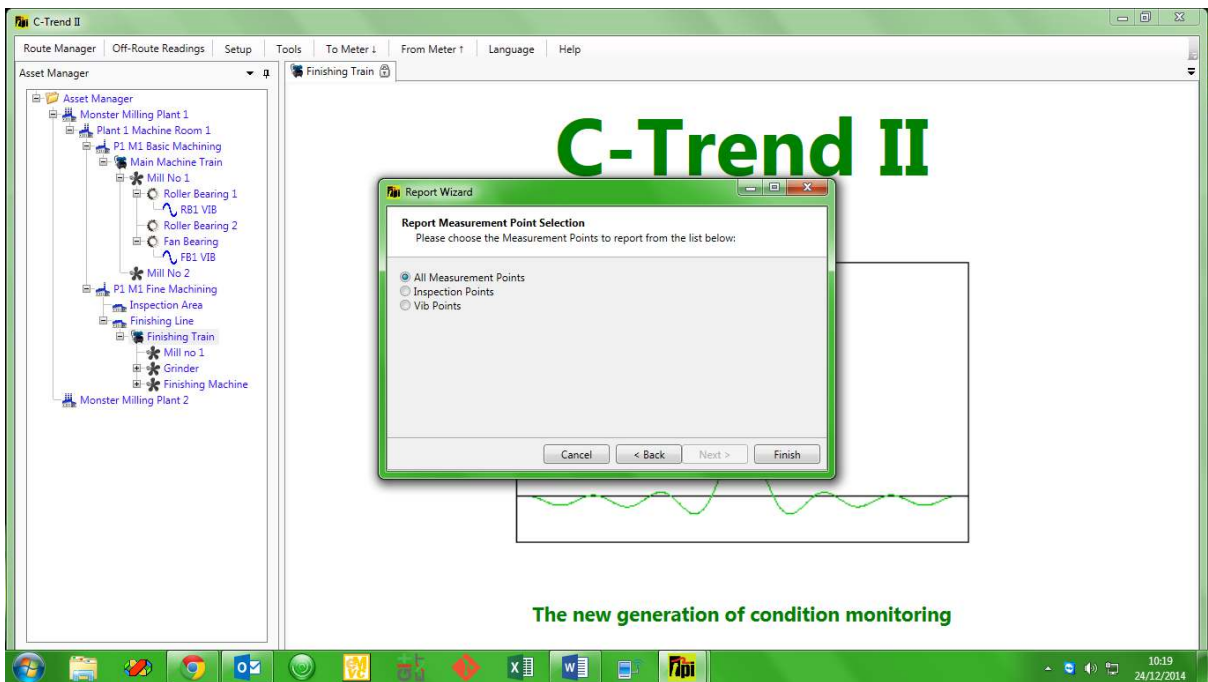


Fig 1.4.2.1

1.4.2.2 New Manual Report

Selecting the **New Manual Report** option from the **Report Type** screen allows the user maximum scope to specify manually what the report content will be.

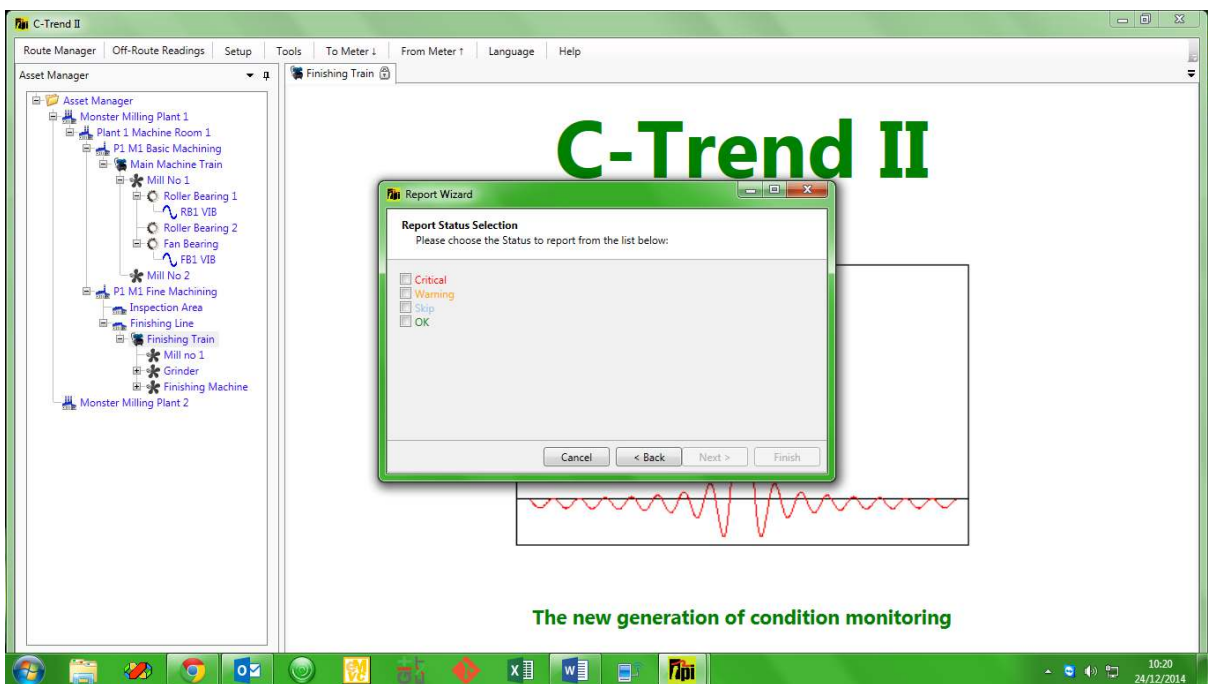


Fig 1.4.2.2.1

The user is now asked to select which of the available statuses (Critical/Warning/Skip/OK) are to be included in the report. Any or all of these options may be selected (fig1.4.2.2.1). Similarly, the user is now given the choice between all measurement points, inspection points only, or vibration points only (fig 1.4.2.2.2).

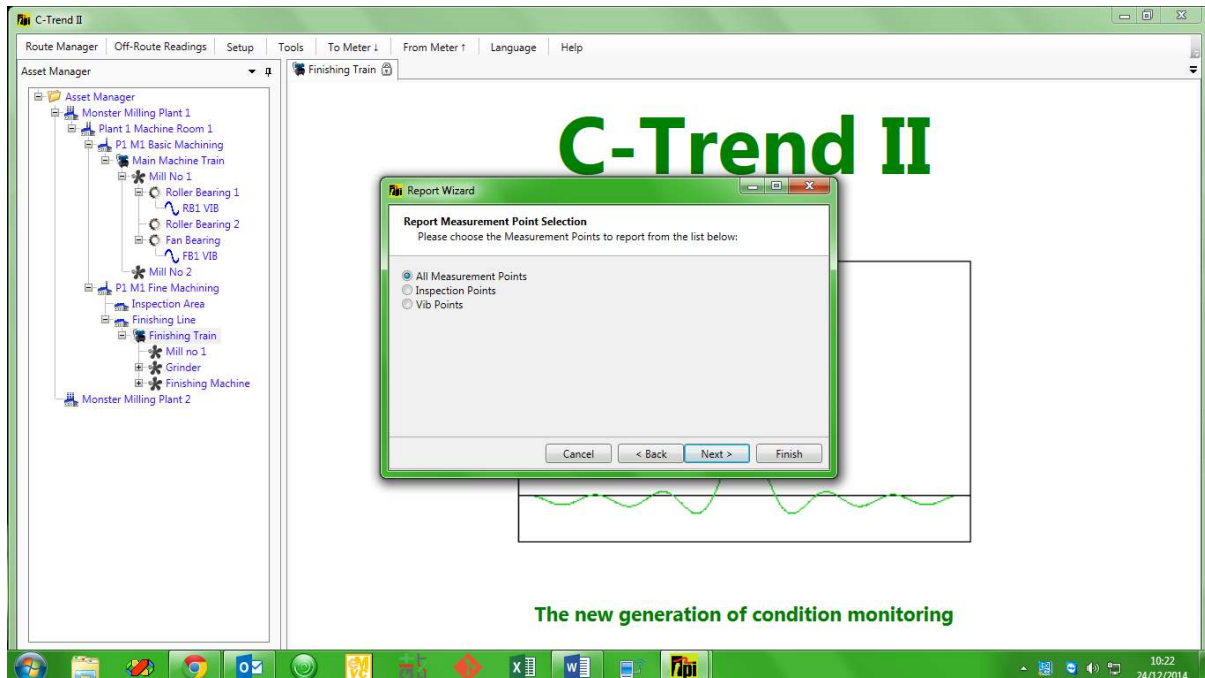


Fig 1.4.2.2.2

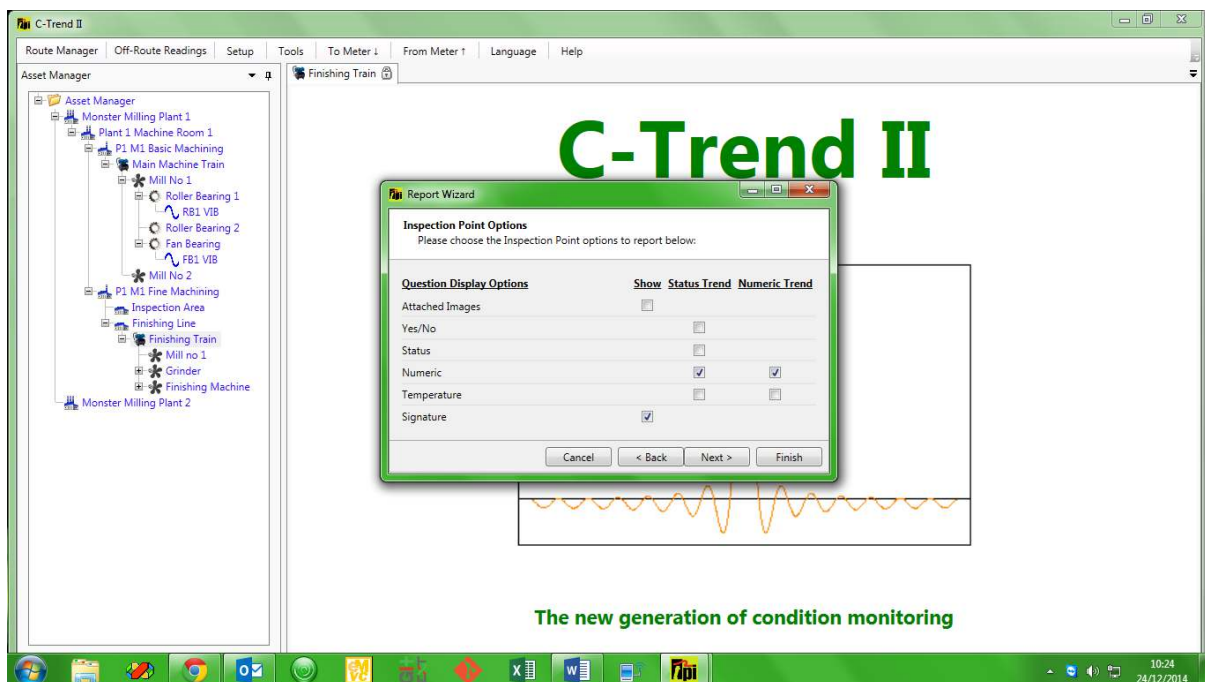


Fig 1.4.2.2.3

Next, the user can select from a range of options for Inspection Point question display (fig 1.4.2.2.3), Vibration Point display (fig 1.4.2.2.4) and VA Band trend and FFT (fig 1.4.2.2.5).

Finally, the report dates can be selected (fig 1.4.2.2.6). The choice here is between the most recent measurements, a data range, or all available measurements for the selected options.

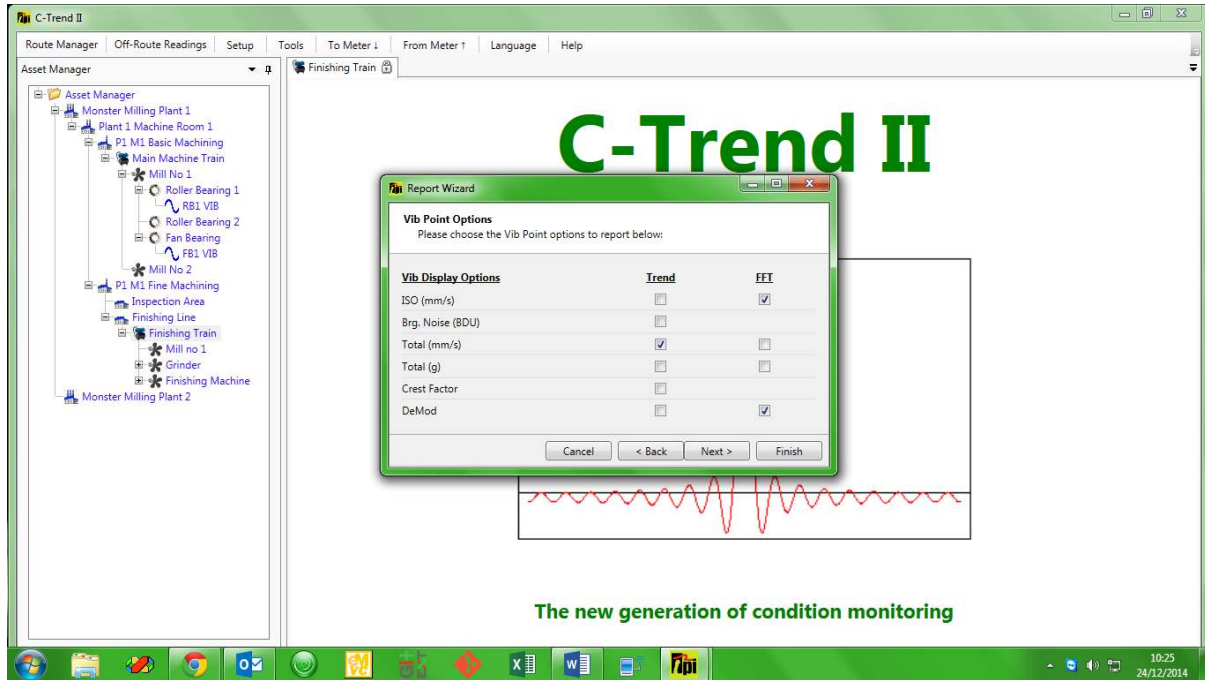


Fig 1.4.2.2.4

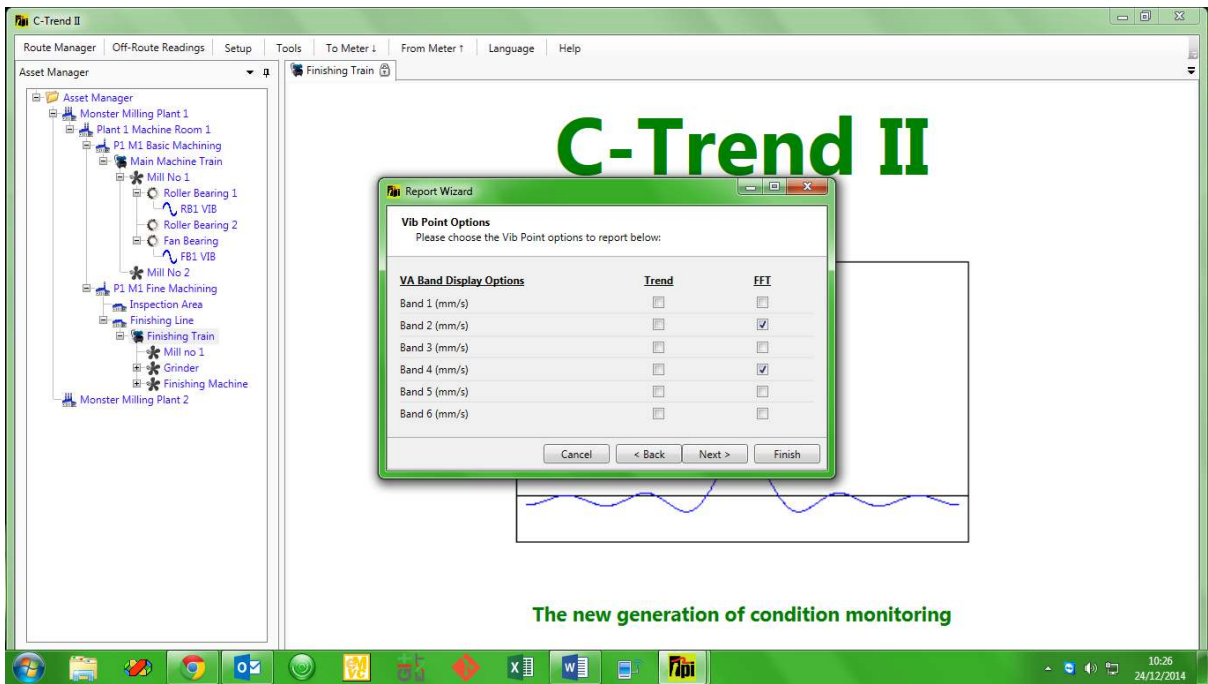


Fig 1.4.2.2.5

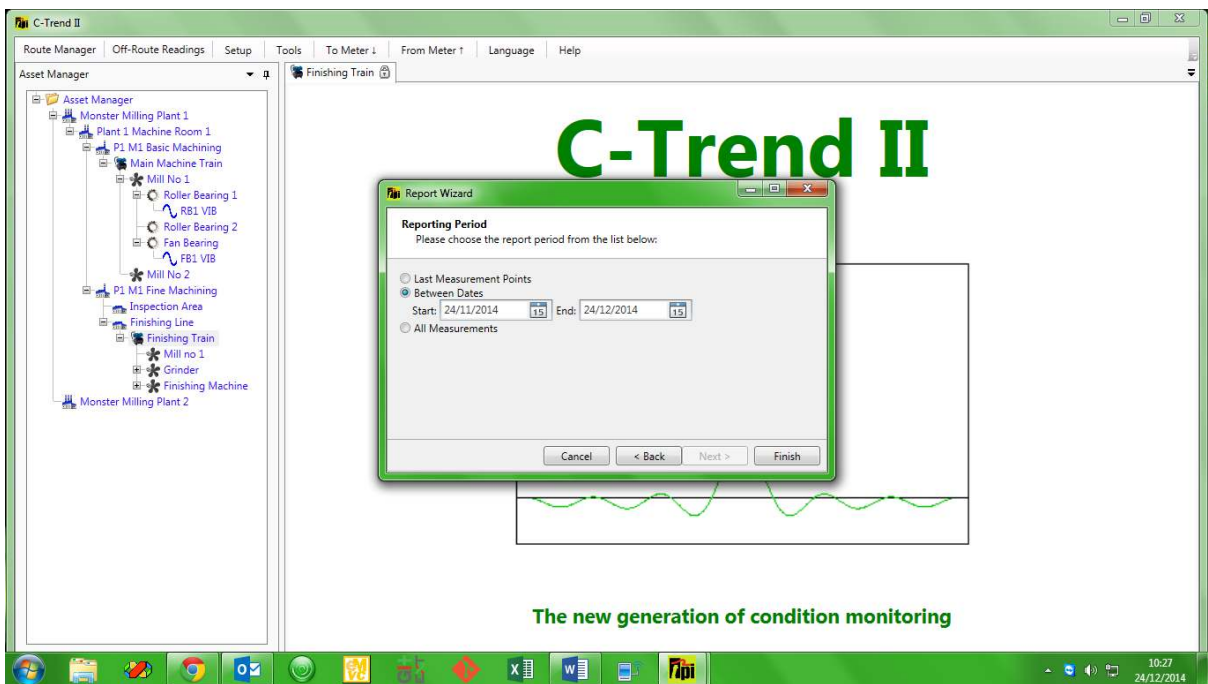


Fig 1.4.2.2.6

N.B. The asset status tables included in the report will contain the same information as the status tables displayed in C-Trend and as selected by the user in the asset status set-up.

Tip: The Report Wizard should be used thoughtfully if reasonable length reports are to be produced. The temptation to simply tick everything should be resisted, as this will generate reports of excessive length when large numbers of assets are included. A useful strategy is to start off with the minimum of 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.

1.5 App Menu Options

The App Menu located at the top of the screen contains a range of functions which are mainly concerned with administrative and interface activities.

1.5.1 Route Manager

This option allows the user to assign measurement points to a route, which can then be downloaded to a specified measurement device to carry out the assigned measurements (Fig 1.5.1). This screen follows the C-Trend II™ standard of providing an Add/Edit/Delete menu when the user right-clicks in the appropriate position.

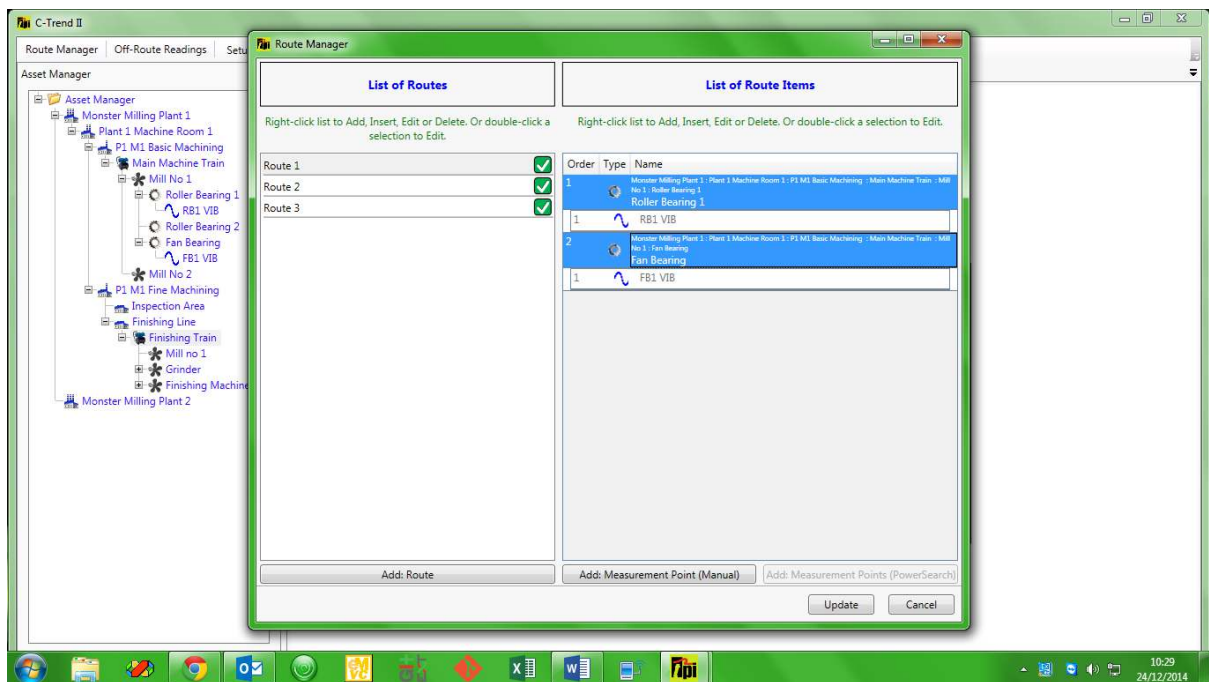


Fig 1.5.1

1.5.2 Setup

1.5.2.1 Bearing Database

The bearing database (fig 1.5.2.1.1) holds frequency criteria, based upon the specific bearing part involved, to identify different types of bearing wear. It holds a comprehensive list of bearings, searchable by type, manufacturer, part number and two optional search text fields.

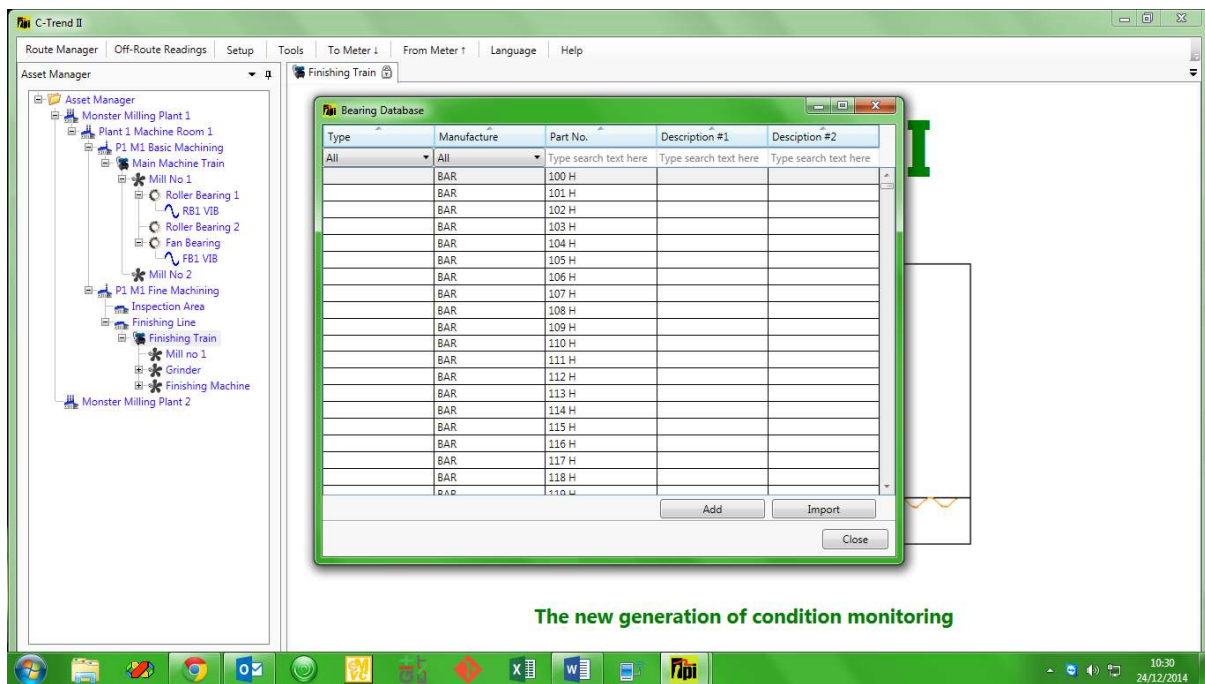


Fig 1.5.2.1

Four fault frequency values are held (as multiples of the run speed) for each part, representing the diagnostic frequencies for faults with: the inner race, the outer race, the cage and the rolling element.

Selecting an existing entry, by double clicking, or clicking the Add button allows the user to edit, or add, an individual item within the database (fig 1.5.2.1.1).

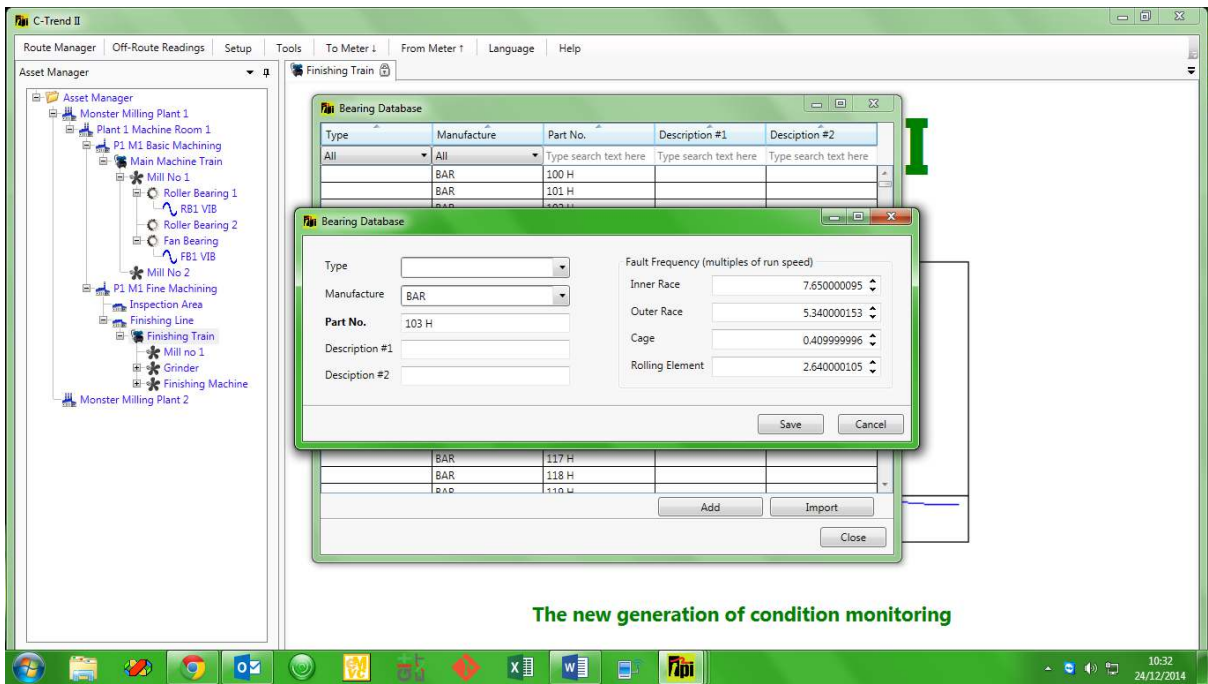


Fig 1.5.2.1.1

The Import option in the main bearings database screen (Fig 1.5.2.1) allows for the import of **additional** bearing types from a CSV (Comma Separated Values) file, formatted as described in Fig 1.5.2.1.2.

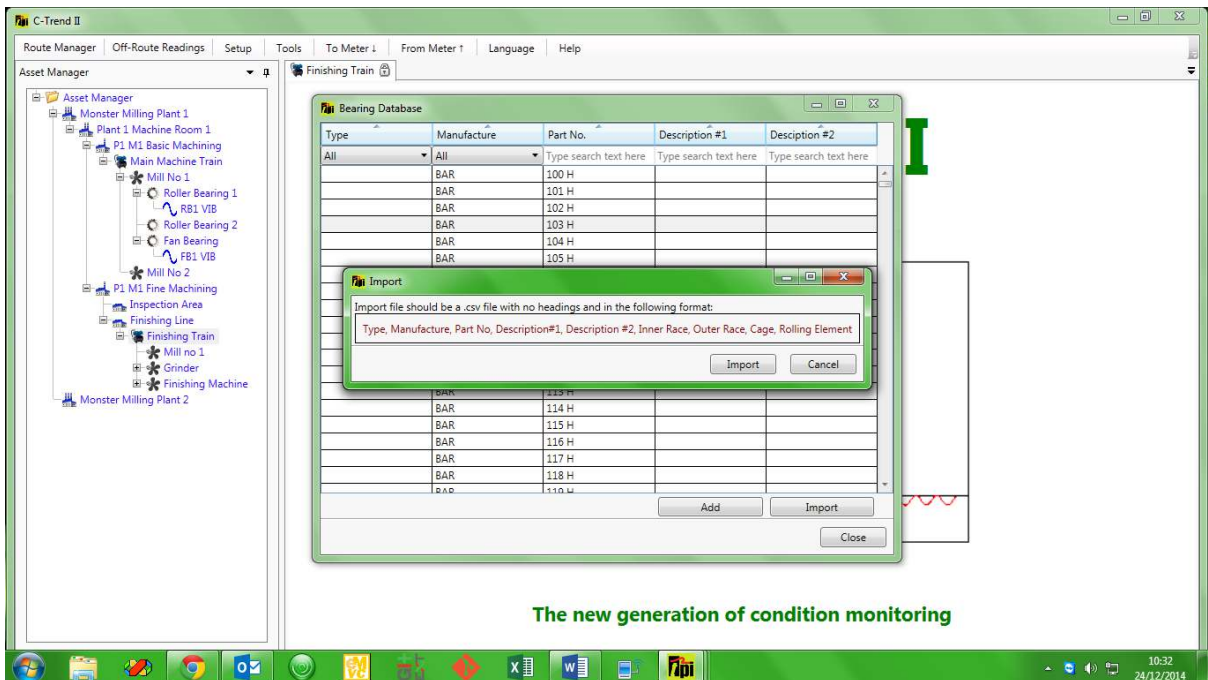


Fig 1.5.2.1.2

1.5.2.2 Default App Units

This option allows the user to choose default display units for: machine trains, vibration point FFT comparisons, reports and latest status (*fig 1.5.2.2*).

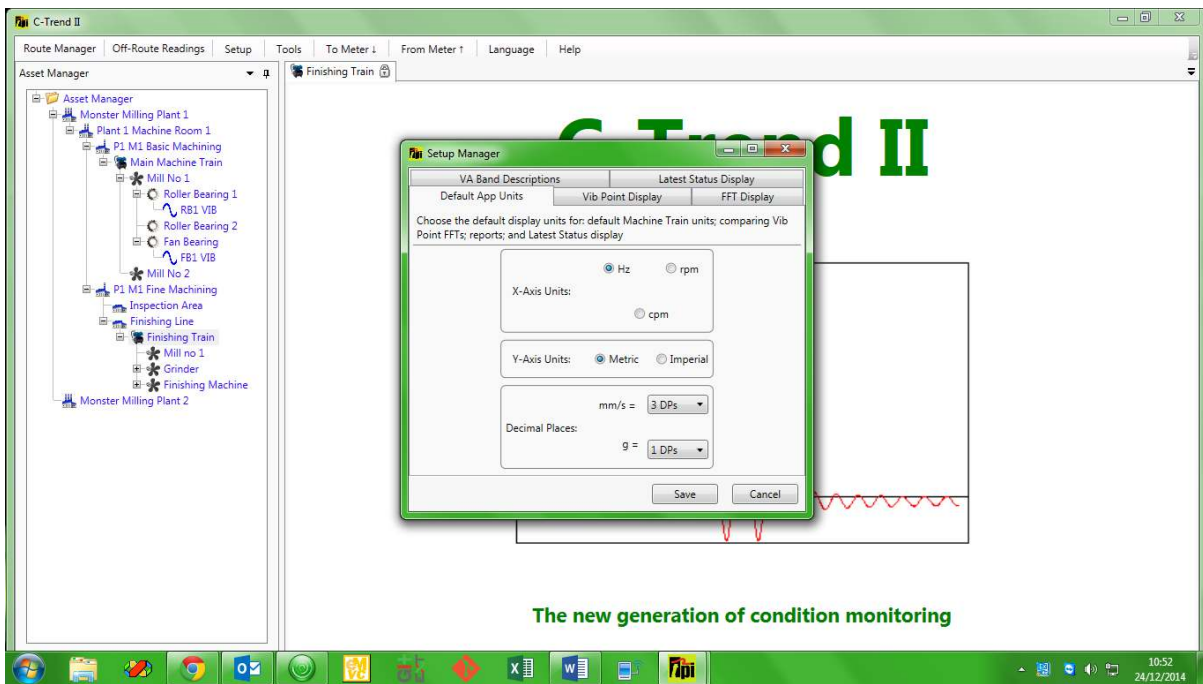


Fig 1.5.2.2

1.5.2.3 Vibration Point Display

This sets the default options for the vibration point dashboard display (*fig 1.5.2.3*).

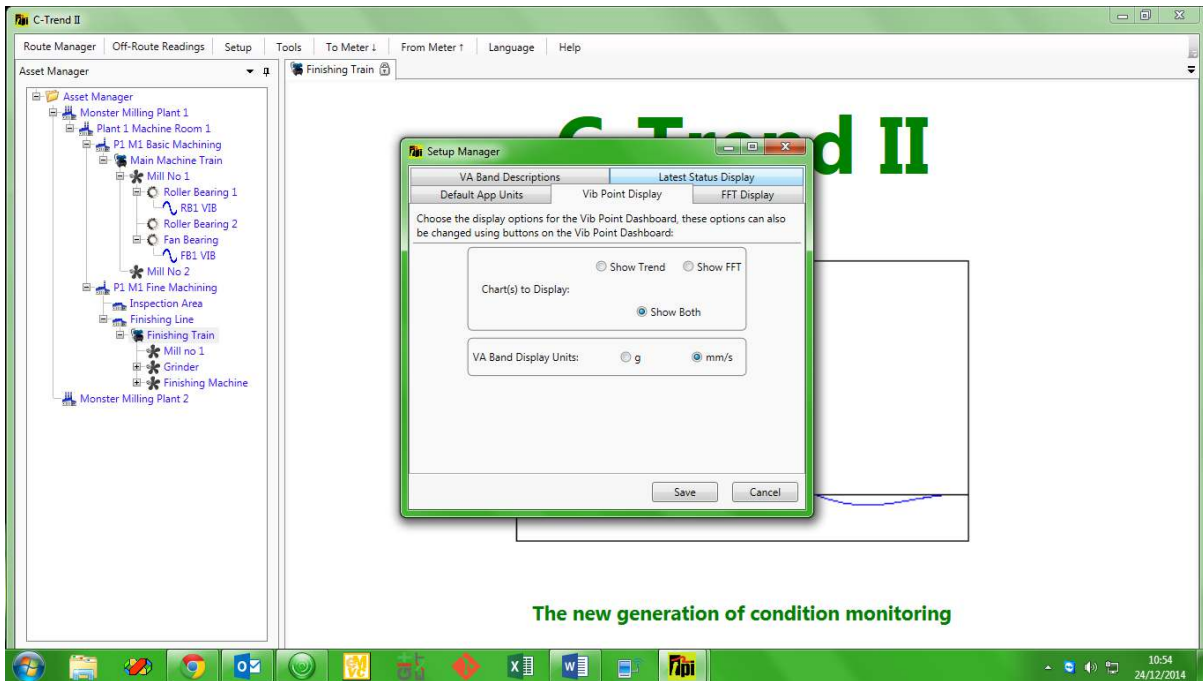


Fig1.5.2.3

1.5.2.4 FFT Display

The style of FFT display (bars or lines) can be selected from this option (fig 1.5.2.4).

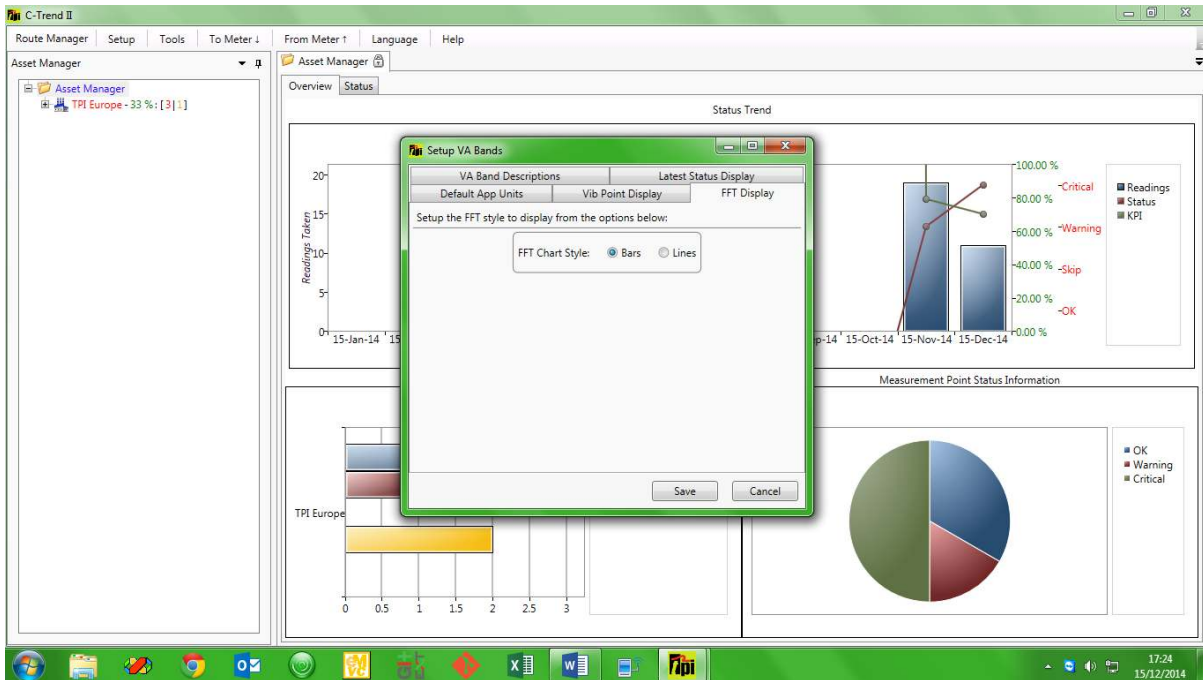


Fig 1.5.2.4

1.5.2.5 VA Bands

This option allows the user to assign meaningful names to the selected VA Band ranges (fig 1.5.2.5).

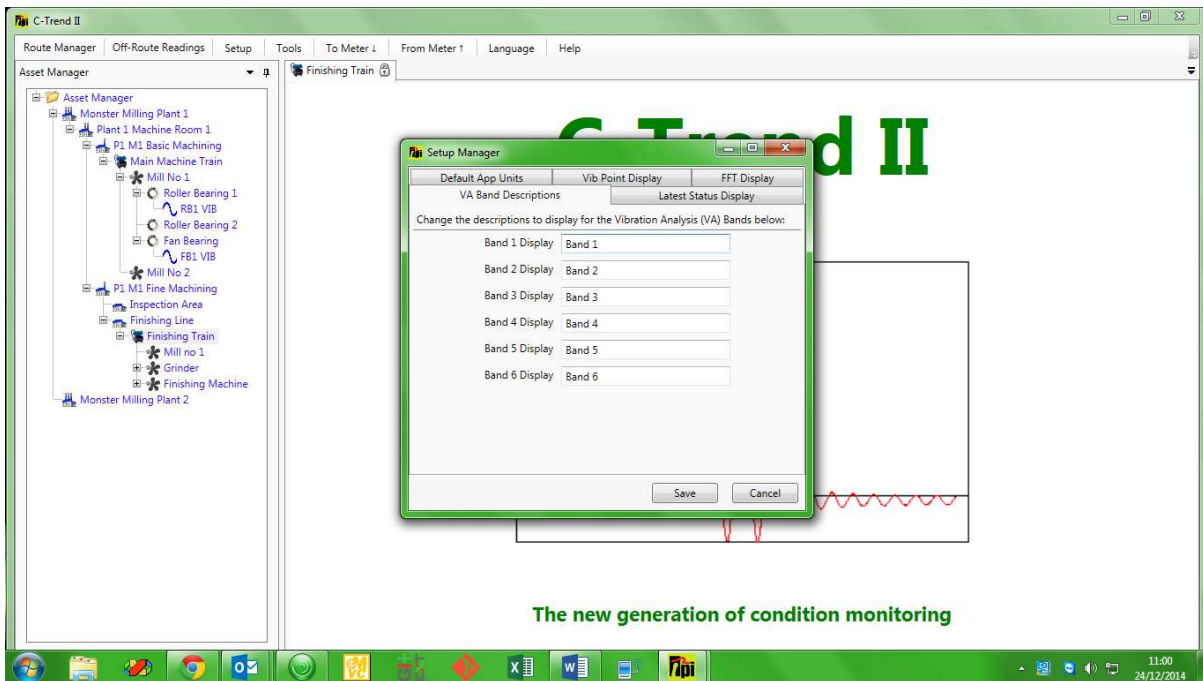


Fig 1.5.2.5

1.5.2.6 Latest Status Display

Here the user can choose which columns will be displayed upon selecting the latest status option from the dashboard screen, up to a maximum of three (fig 1.5.2.6).

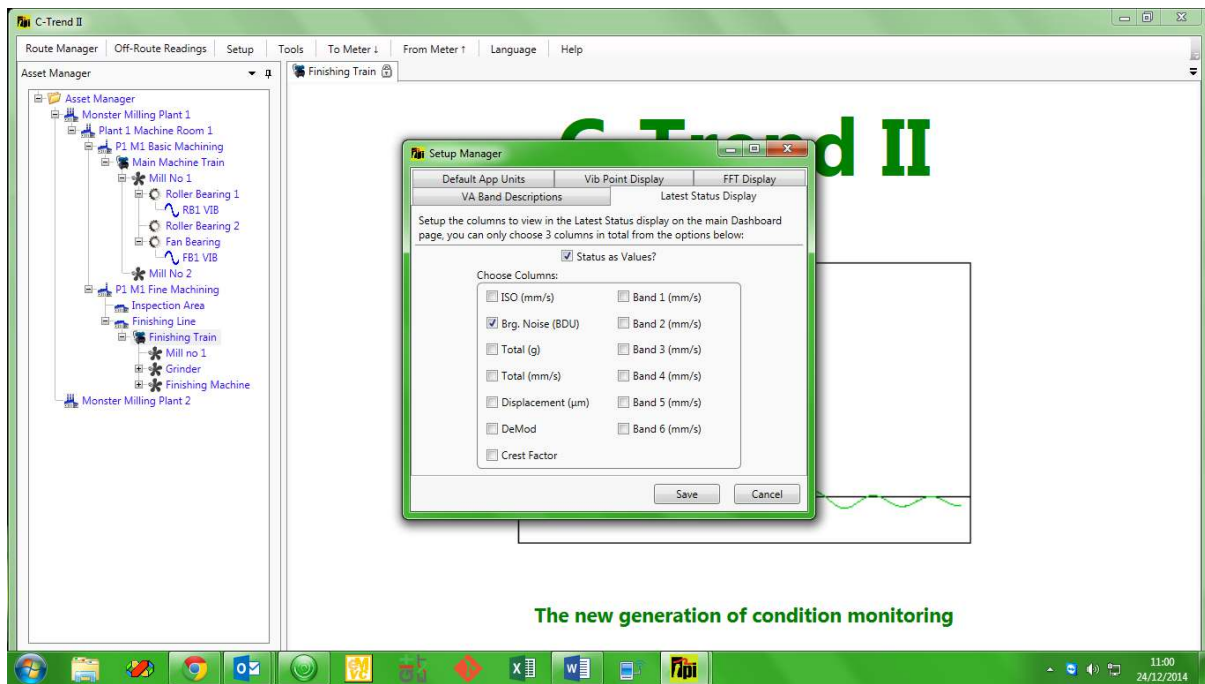


Fig 1.5.2.6

1.5.2.7 Email exceptions on upload

Provides the user with the option to automatically generate an email to the responsible stored address (see section 1.2), upon any exceptions being encountered during data upload to the C-Trend II™ system.

1.5.2.8 Reset 9080

This option resets the route information on a connected 9080 device.

1.5.3 Tools

1.5.3.1 Route Manager

See section 1.5.1.

1.5.3.2 Type Manager

This allows the user to assign different 'asset types' to each level within the hierarchy in Asset Manager (fig 1.5.3.2).

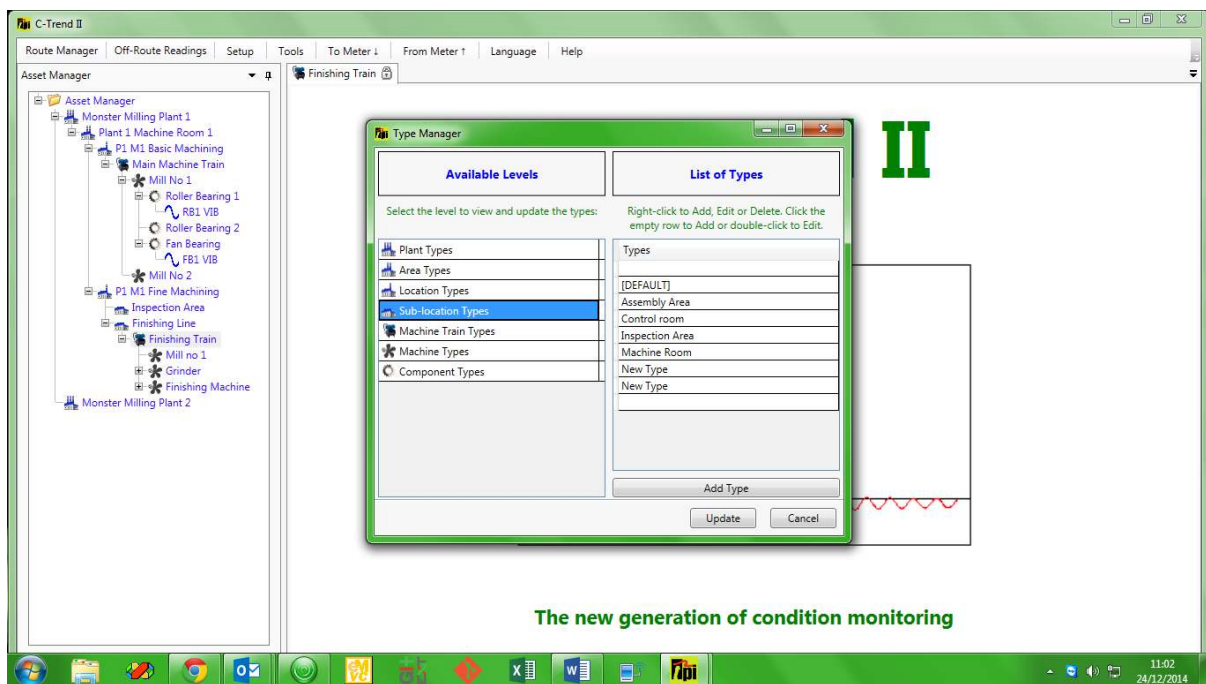


Fig 1.5.3.2

1.5.3.3 Answer List Manager

This allows the user to maintain lists of questions which can be assigned to an inspection, with a list of acceptable/valid answers to provide a dropdown list of responses at the point of inspection (fig 1.5.3.3).

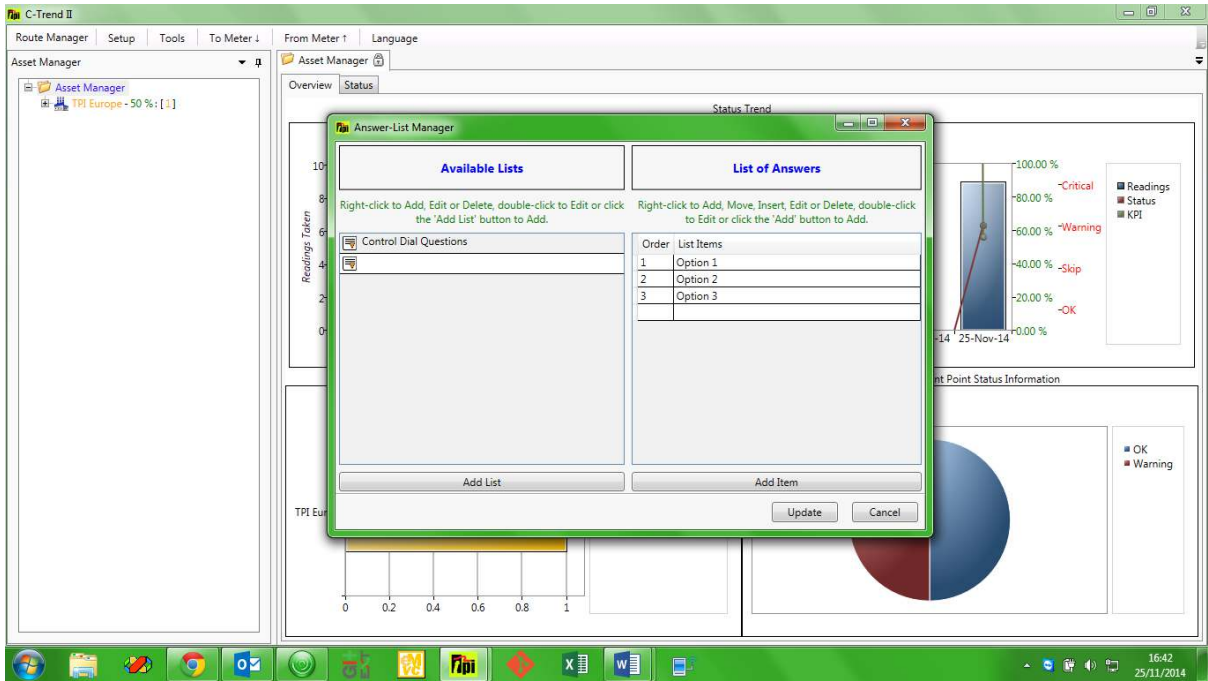


Fig 1.5.3.3

1.5.4. To-Meter

This option allows the user to select a meter type and download a route to a connected device of the chosen type (fig 1.5.4)

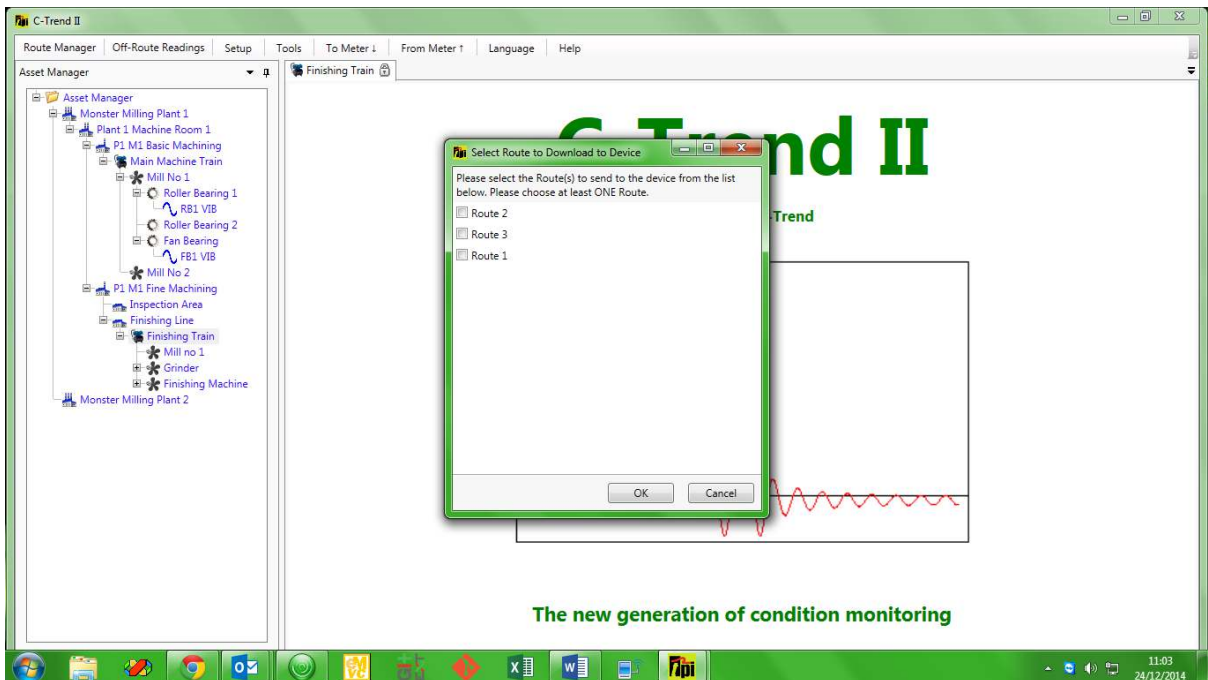


Fig 1.5.4

1.5.5. From-Meter

This allows the user to select a meter type, and automatically upload any available measurement data from a connected device of the chosen type.

1.5.6 Help

1.5.6.1 ISO Standards

See fig 1.3.1.4.1.1.

1.5.7 Off Route Readings

In addition to the route-based information already covered, the vibration data uploaded from a meter may include off route readings. These are ad-hoc measurements taken outside the scope of regularly scheduled testing. Once any off route readings have become available for viewing within C-Trend II™, an additional “Off Route Readings” tab will appear at the top of the screen alongside the other app menu options. Selecting this option displays the Off Routes Readings screen (fig 1.5.7.1).

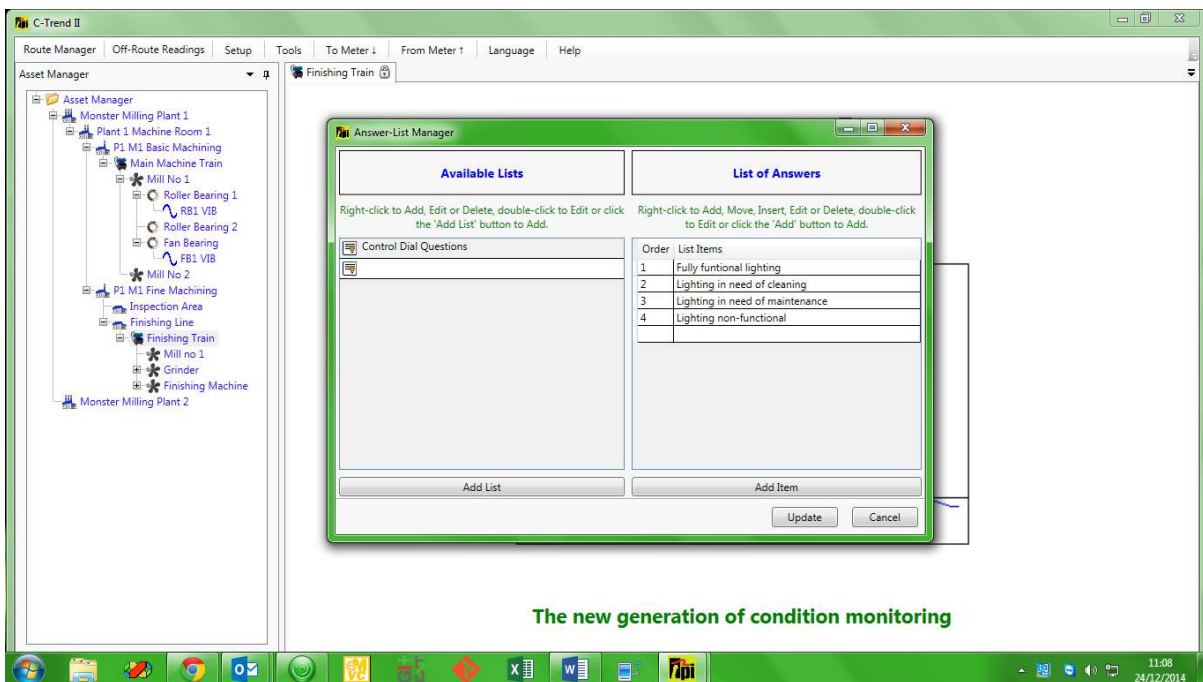


Fig 1.5.7.1

A list of available readings is produced, identified by a reading name, together with date, time and source device information. Four vibration figures representing, ISO, Bearing Noise, Total(g) and Displacement are held for each reading. Selecting any item from the list will display a frequency (FFT) chart for the reading in the lower part of the screen. Right clicking on a reading allows the user to either delete a reading, or move it to the vibration point to which it relates (figs 1.5.7.2 & 1.5.7.3).

Selecting the “Move to...” option presents the user with a copy of the Asset Manager hierarchy, which allows navigation to the vibration point at which the off route reading was taken. The “Move” button on this screen only becomes enabled when a vibration point is selected from the tree. Clicking “Move” will remove this reading from off route readings and incorporate it into the data held for the selected vibration point.

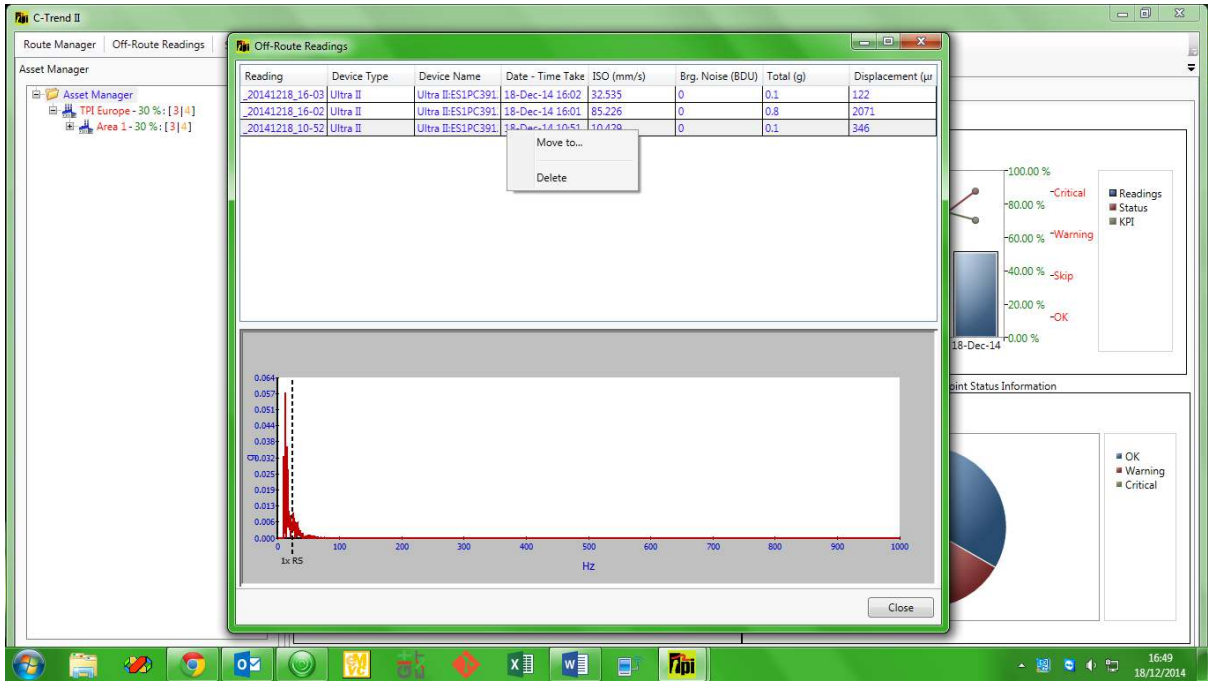


Fig 1.5.7.2

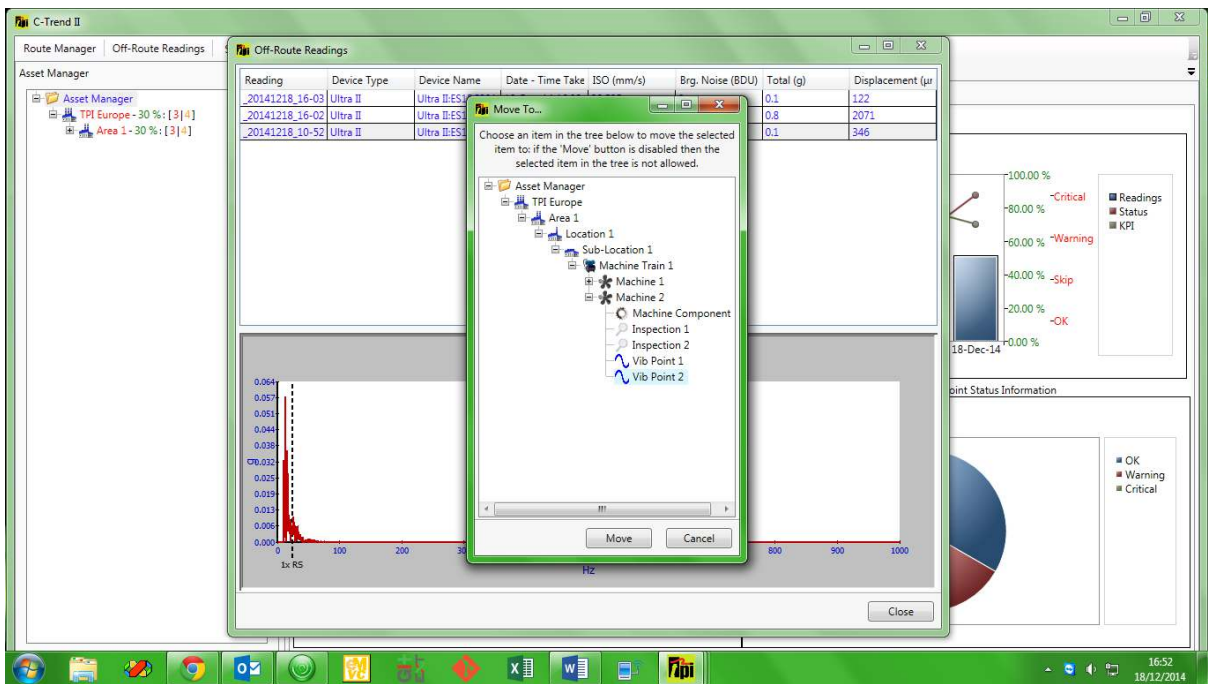


Fig 1.5.7.3

Revision History

ISSUE	PAGES	DATE	NOTES
1.0	46		First Issue