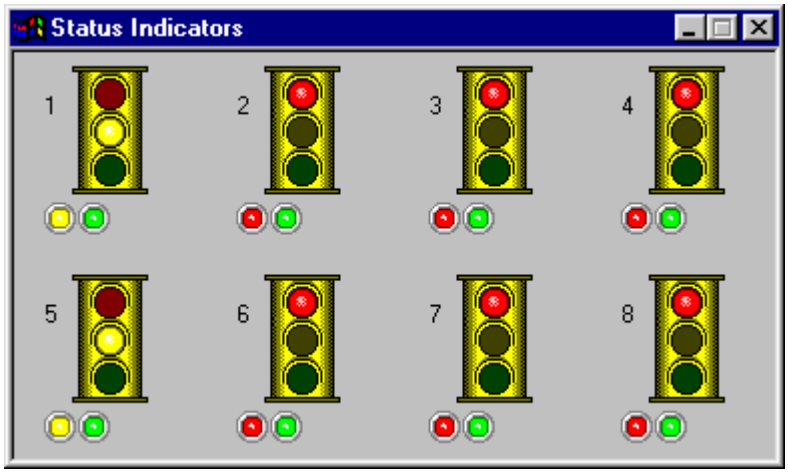
Vibration Analyzer

Version 1.0.2



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File menu

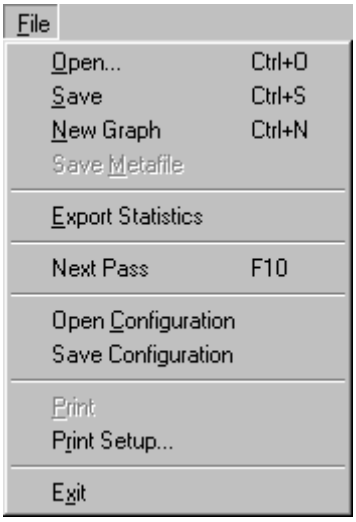
The File menu is use for reading and writing data, configuration, statistics, and meta files, and for making printouts of the graphs.

Data files are files in which the measurement data are stored for later retrieval, as a record of the test. Data files use the extension `.vad`.

Configuration files are files in which the test specification (status indicator layout, spectrum definitions, spectrum assignments, channel assignments, and other test parameters) are stored. These files are used to select which test configuration is to be used. When the program starts up, it will read the configuration from the last configuration file used. Configuration files use the extension `.vap`.

Statistics files are text files in which a portion of the data may be saved for import into other programs. These files contain the statistic information show which amplitude and frequency combinations are likely for a given input type. Statistics files use the extension `.csv` (comma-separated-value). surements.

Metafiles contain just the graphic information for the selected graph, and are used to import a graph into another program such as a word processor. Metafiles use the extension `.csv`.



Open (Ctrl+O) (yellow folder)

Load a previously stored data set in order to view and/or print the data and statistics information, and to export the statistics information from the data file (using the File..Export Statisics menu option). Data files use the extension `.vad`.

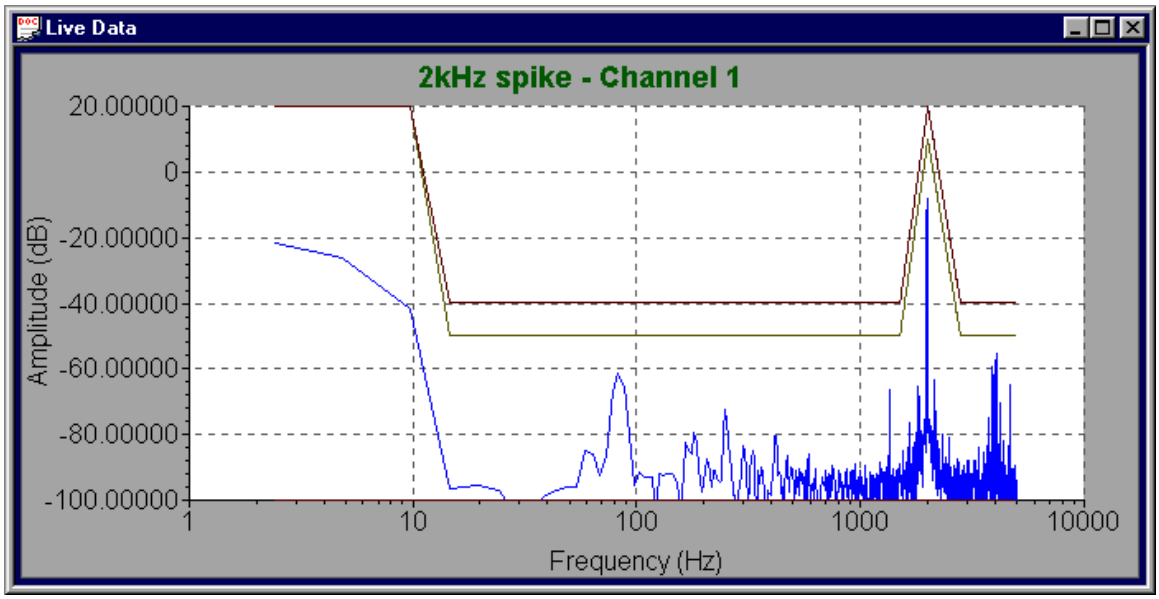
Save (Ctrl+S)

Save the current data set to a binary format file for later retrieval. Data files use the extension `.vad`.

New Graph (Ctrl+N)

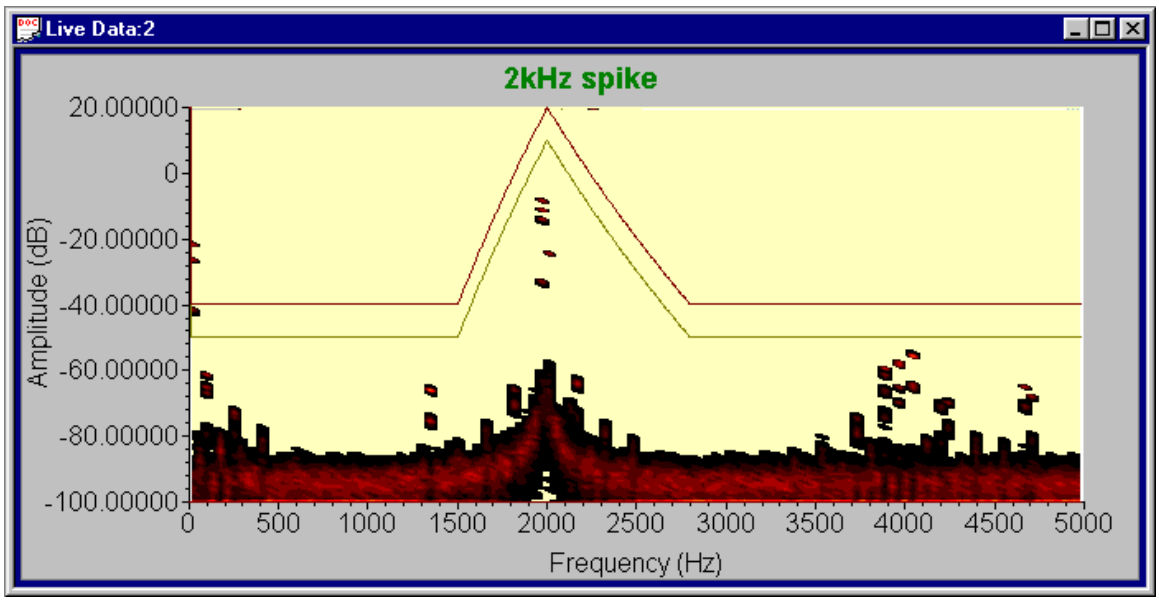
Open a new graph window of the current measurements. This will bring up a dialog box which allows selection of which spectrum type to use, and which channels of that spectrum type to plot. The data can be displayed in the form of either a spectrum plot or a density plot.

Figure 1: Spectrum Plot



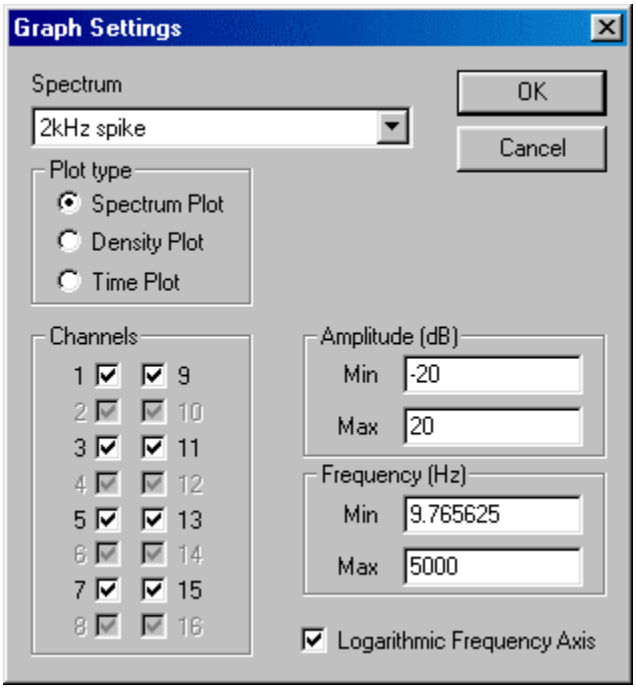
A Spectrum Plot displays one line for each channel, along with the Upper and Lower Tolerance (yellow) and Failure (red) lines.

Figure 2: Density Plot



A Density Plot displays the accumulated statistics information as a color-coded density value. The colors progress from black to red to bright yellow. Pixels which are black indicate frequency/amplitude combinations which rarely occur; those which are bright yellow indicate that most the measurements have a component at that frequency/amplitude combination. Red indicates that the frequency/amplitude combination occurs somewhere in between rarely and often. Frequency/amplitude combinations which have not occurred are displayed with a pale yellow background color.

Figure 3: Graph Settings dialog box



Spectrum: Selects the spectrum type, as defined in the Configuration..Define Spectra dialog box, to display in the new graph.

Plot type: Selects either a Spectrum Plot, a Density Plot, or a Time Plot.

Spectrum Plots show the amplitude vs. frequency.

Density Plots show the accumulated statisitic as an intensity map on an amplitude vs. frequency axis.

Time Plots show the amplitude vs. time, and are used only for debugging purposes. No statistical information is generated from the time waveform, nor is the time waveform data saved in any data files.

Channels: Selects which input channels are displayed in this graph. Channel selections are ignored for Density Plots. For Spectrum Plots and Time Plots, only the channels assigned the selected spectrum type may be selected (the others will be grayed out.)

Amplitude (dB): Selects the default Y-axis minimum and maximum values for the new graph.

Frequency (Hz): Selects the default X-axis minimum and maximum values for the new graph.

Logarithmic Frequency Axis: Select this check box to use a logarithmic scale for the X-axis (Frequencies)

Save Metafile

Save the currently active graph to a file using the Windows MetaFile (`.wmf`) format. These files may be inserted into various word processing programs. Note that saving the data in this form saves a copy of the current graph, but does not save the raw data. To save the raw data for later loading into the program, use the File..Save menu option.

Export Statistics

Export the statistics from an open data file to a comma-separated-value (`.csv`) text file. Such a file may be imported into a spreadsheet program or similar for further analysis and documentation.

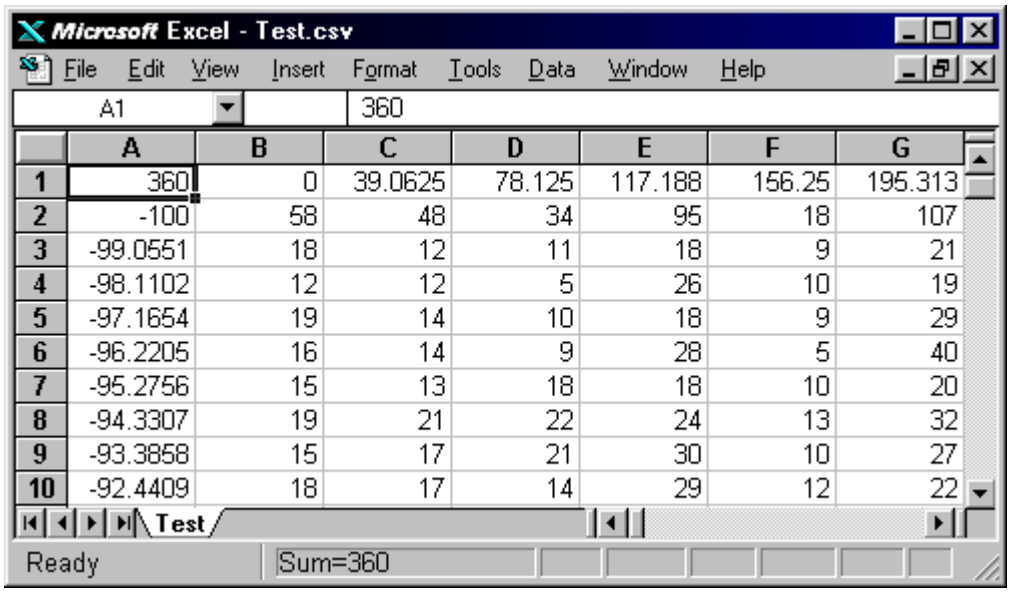
The first column of the file contains the amplitude values (the values -100, -99.0551, -98,1102 … in Figure 4.) The first row of the file contains the frequency values (the values 0, 39.0625,

78.125, 117.118, … in Figure 4.) These divide the spectrum into a grid of frequency/amplitude pairs.

The rest of the rows and columns contain the number of spectrum values that fell into the corresponding frequency/amplitude range.

The very first value in the file (row 1, column A - the number "360" in Figure 4) contains the maximum number of counts possible. If the Frequency Bins configuration parameter is equal to the Data Length parameter, then this value will be the number of measurements processed. If the Frequency Bins parameter is coarser (smaller) than the Data Length parameter, this will be (Data Length)/(Frequency Bins) times the number of measurements.

Figure 4: CSV format file loaded into Microsoft Excel

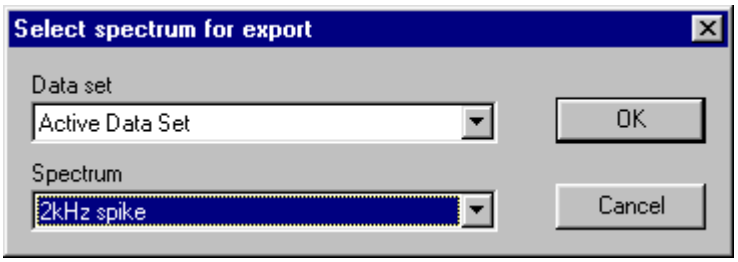


	A	B	C	D	E	F	G
1	360	0	39.0625	78.125	117.188	156.25	195.313
2	-100	58	48	34	95	18	107
3	-99.0551	18	12	11	18	9	21
4	-98.1102	12	12	5	26	10	19
5	-97.1654	19	14	10	18	9	29
6	-96.2205	16	14	9	28	5	40
7	-95.2756	15	13	18	18	10	20
8	-94.3307	19	21	22	24	13	32
9	-93.3858	15	17	21	30	10	27
10	-92.4409	18	17	14	29	12	22

After the Export Statistics menu item is selected, a spectrum selection dialog box (Figure 5) will be displayed to allow selection of the data set and spectrum type from which the exported data is to be extracted. The current measurements appear under the data set named "Active Data Set". If other data sets have been loaded, they will appear in the Data set drop-down listbox, listed using their respective file names.

Select the data set and spectrum type for which you want to export the statistical data, and then press the "OK" button. A File Save dialog box will appear allowing selection of the filename under which to store the data.

Figure 5: Select spectrum for export dialog box



Next Pass (F10) 

Read and process the next set of measurements, and update the Indicator Lights accordingly. Every time this is selected, a new set of measurements will be made for the channels configured as

“Manual Trigger”, and the cumulative statistic information will be updated. This operation may also be done by pressing <F10> or clicking on the "GO" icon on the toolbar.

Open Configuration (blue folder)

Read in a previously defined and saved (using the File..Save Configuration menu item) configuration. The last configuration loaded will always be automatically loaded every time the program is started.

Save Configuration

Save the current configuration to a file so that it can be loaded again at a later time using the File..Open Configuration menu item.

Print

Print the currently active graph. A printer selection dialog box will appear, allowing choice and configuration of the printer to which to send the output, and selection of the paper type and orientation.

Print Setup

Open just the print setup dialog box, allowing choice and configuration of the printer, and selection of the paper type and orientation. No output will be made, but the changes here will apply to print requests made later.

Exit

Exit from the program.

Edit menu

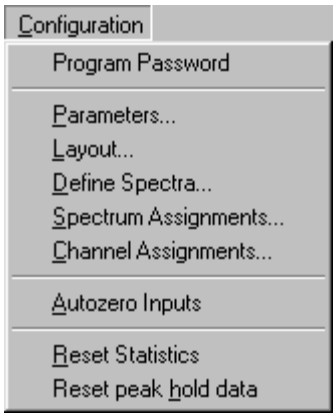
The edit menu provides cut-and-paste operations. Currently the only supported operation is to copy the active graph into the Windows clipboard, making it available for pasting into another application such as a word processor.

Copy

Copy the currently active graph into the Windows clipboard, in Windows Metafile Format, for pasting into another application such as a word processor or spreadsheet.

Configuration menu

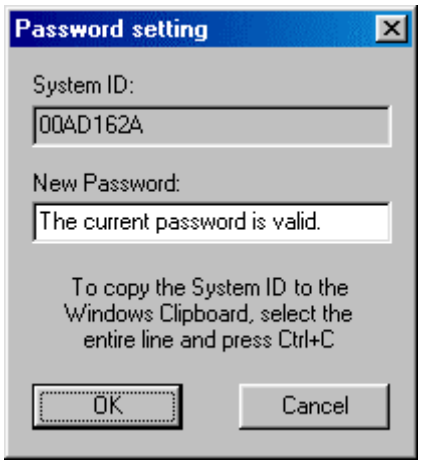
The configuration menu provides the functions used for customizing the processing performed by the program.



Program Password

Set the password used by the program. When a valid password has already been entered, the dialog will appear as shown in Figure 6. When the program is first run, a password must be entered to enable the program. To get this password, copy the contents of the edit box underneath "System ID:" (it will be an 8-character hexadecimal string) and e-mail a copy of this string to Vibration Research Corp. (by e-mail to support@vibrationresearch.com, or by FAX to (616) 669-5337). Vibration Research Corp. will reply with a password string to enter into the edit box underneath "New Password". After entering a new password, click on the "OK" button, exit the Vibration Analyzer program, and then start the Vibration Analyzer program up again. The password setting dialog box should then appear as shown below, indicating that the password entered is valid.

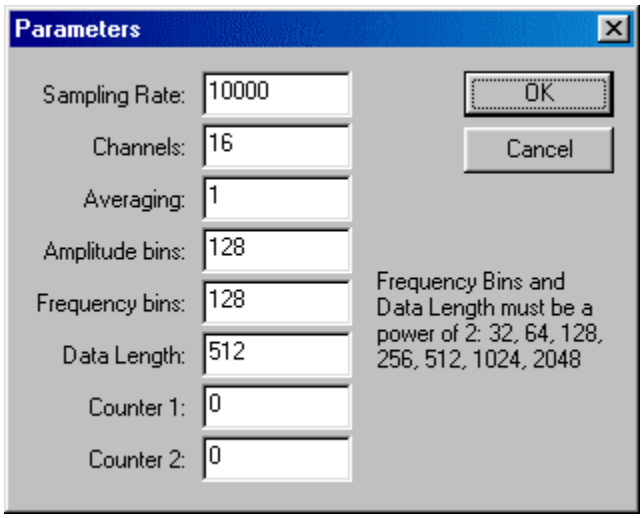
Figure 6: Password setting dialog box



Parameters

Select the general parameters used in handing the input data.

Figure 7: Parameters dialog box



Sampling Rate: This sets the rate of sampling of the input signals, in Hz. The maximum analysis frequency will be half of this value.

Channels: This sets the maximum number of channels to use. This number must be 16 or less for the PC-LPM-16PNP data acquisition board. If fewer than 16 channels are needed, set this parameter to the number of channels actually used. The channels used are always the first N channels. For example, selecting 4 channels will result in inputs being taken only from channels 1, 2, 3, and 4. Channels 5 through 16 will be ignored.

Amplitude bins: This sets number of partitions along the amplitude axis defining the grid used for accumulating statistical information. The partitions are evenly divided between a spectrum definition's minimum and maximum dB levels.

Frequency bins: This sets the number of partitions along the frequency axis defining the grid used for accumulating statistical information. The value must be less than or equal to the Data Length value, and must be a power of 2 (i.e. 32, 64, 128, 256, 512, 1024, 2048, …)

Data Length: This sets the length of each data set. The frequency resolution of the data set will depend on both the Sampling Rate and the Data Length, and is equal to (0.5*Sampling Rate)/(Data Length).

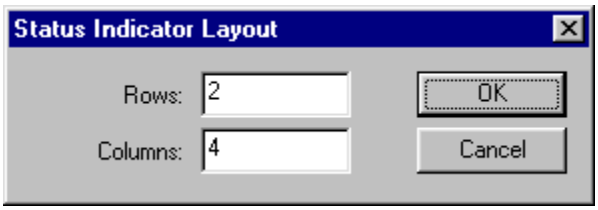
Counter 1: The output signal "OUT1" on the PC-LPM-16 connector will output a pulse when the specified number of low-to-high transitions are counted on the CLK1 input while GATE1 is high. This may be used to create a trigger signal on every Nth (N>=2) external event. The GATE1 signal can be used to start and stop the counting (i.e. counting only occurs while GATE1 is high).

Counter 2: This configures the behavior of OUT2, CLK2, and GATE2 as described for counter 1, above.

Layout

Select the number of rows and columns to display in the Indicator Lights dialog box.

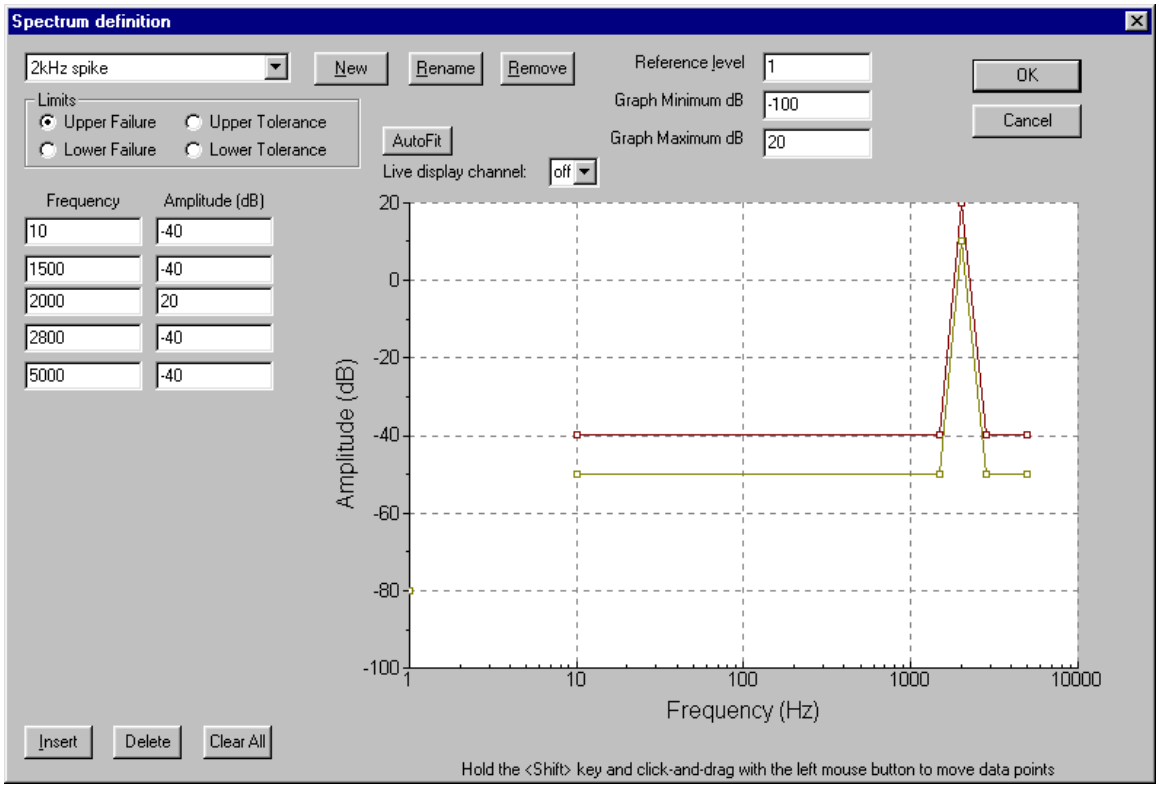
Figure 8: Status Indicator Layout dialog box



Define Spectra

Define the names and upper/lower failure/tolerance lines for the types of spectra measured by the program. For example, you can define one spectrum type for audio data, and one type for accelerometer data, and thereby define different limits for different types of inputs.

Figure 9: Spectrum Definition dialog box



The listbox in the upper left corner of the dialog is used to select one of the defined spectra. Clicking on the New button will create an additional spectrum definition, using the values from the currently selected spectrum for the default values. Clicking on the Rename button will change the name of the currently selected spectrum. Clicking on the Remove button will remove the currently selected spectrum definition. Note that you must always have one spectrum definition, so this button will only work if more than one spectrum is defined.

The Reference Level setting is used to adjust the 0-dB level of the graphs. A reference level of 1 will result in a 1V (peak) input being plotted at the 0-dB level on the plot. For example, if the inputs are being taken from an accelerometer with 100mV/g output levels, then setting the reference level to 0.1 (0.1V = 100mV) will result in a 1g (peak) input being plotted at the 0-dB level on the plot.

The Graph Minimum dB and Graph Maximum dB settings are used to set the range of amplitude levels over which the statistic information will be gathered. The statistic bins will be evenly divided (on the dB amplitude scale) between the minimum and maximum values. These values are also used to set the default range of a graph.

The four limit lines are defined by selecting one of the four items in the Limits group, and then setting the frequency and amplitude breakpoints for the selected limit line. Clicking the Insert button will add an additional breakpoint between the currently selected breakpoint and the following one. Clicking the Delete button will remove the currently selected breakpoint. Clicking the Clear All button will remove all except the first and last breakpoints.

The breakpoints may also be modified directly on the graph by holding down the Shift key, and using the right mouse button to click on, drag, and release the squares indicating the breakpoints.

Note that it is possible to have non-monotonically increasing frequency values, but the resulting limit curves might not be as you would expect, so it is advisable to keep the frequency values in increasing order.

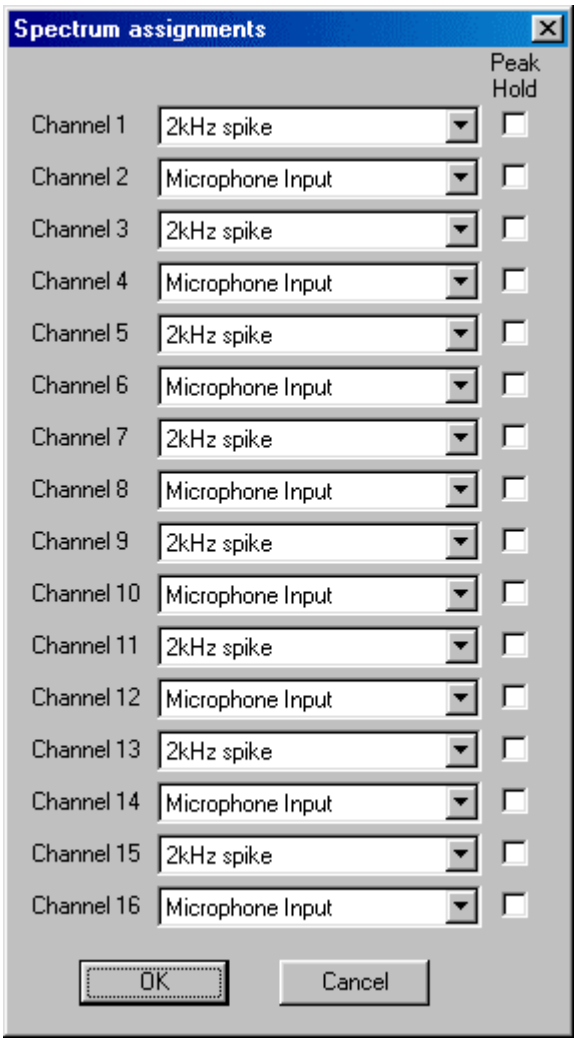
The “Live display channel” selector allows display of one of the input channels on the graph, to use as a guide in setting the tolerance and failure lines. When a live display channel is selected, the “AutoFit” button may be pressed to automatically fit a curve at a user-specified dB level above (or below, for the lower limits) the live display channel. The averaging and peak-hold configuration defined using the Configuration..Parameters and Configuration..Channel Assignment commands will apply to the data shown for the live display channel.

Spectrum Assignments

Assign a spectrum to each of the available channels, and enable/disable the peak-hold feature for each channel. The spectrum options listed will be as defined using the Configuration .. Define Spectra menu option. This selects which type of input is expected on each channel. The spectra may be assigned to the channels in any combination, and the same spectrum may be used for several channels. The inputs on the channels will be compared to the limit lines of the selected spectrum type to determine whether the channel passes or fails.

If the peak-hold box is checked for a channel, the data for that channel will retain the maximum values found for each of the frequency bins until the Configuration..Reset peak hold data menu command is used.

Figure 10: Spectrum Assignments dialog box



Channel Assignments

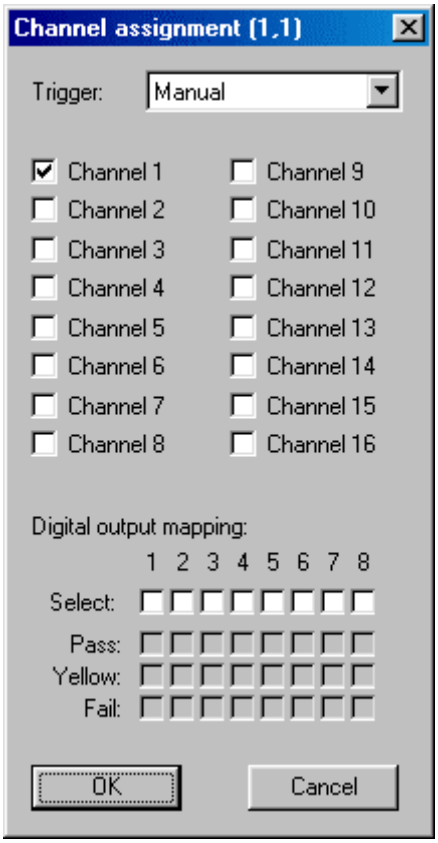
Assign which channels (may be more than one) are assigned to each of the Indicator Lights. When this dialog is opened, the Status Indicators dialog will be reset to gray indicators, and the first light will be highlighted with a green light. After selecting the desired channels to map to this light, click on OK to advance to the next light. Repeat until the channel mappings for all of the lights are defined. The title bar of the dialog box indicates the (row,column) of the light currently being configured.

The triggering method for this light is configured using the drop-down listbox at the top of the dialog box. Manual triggering relies on the operator pressing the <F10> key to start a measurement. Continuous triggering will acquire data continuously. In addition, high-low or low-high transitions of the individual digital inputs may be used to trigger a measurement. Remote File based triggering allows another program to trigger a measurement. See the Remote File Control section, below, for more details.

This dialog also configures the mapping of the light color (Green=Pass, Red=Fail) to the digital outputs of the PC-LPM-16 data acquisition board. The output lines to be used for this light are selected by placing a check in the corresponding column, in the “Select” row. When a digital output line has been selected, the output level for that line can be configured to be either high (checked) or low (unchecked) for each of the three indicator light states (Pass, Yellow, and Fail).

For example, suppose there are check marks in the “Select” row for columns 1, 2, and 3, and in column 1 of the “Pass” row, column 2 of the “Yellow” row, and column 3 of the “Fail” row. Then digital output 1 will be high when the indicator light is green (Pass), digital output 2 will be high when the indicator light is yellow, and digital output 3 will be high when the indicator light is red (Fail).

Figure 11: Channel Assignment dialog box



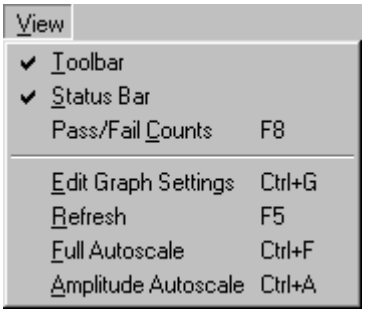
Reset Statistics

Clear out all of the accumulated statistic information. Use this to reset the program before starting the processing of a new set. Be sure to save the data before clearing the statistics if you later will want to review the data.

Reset peak hold data

Clear out all of the accumulated peak information, and start accumulating a new set of peak information.

View menu



Toolbar

Display or hide the button toolbar.

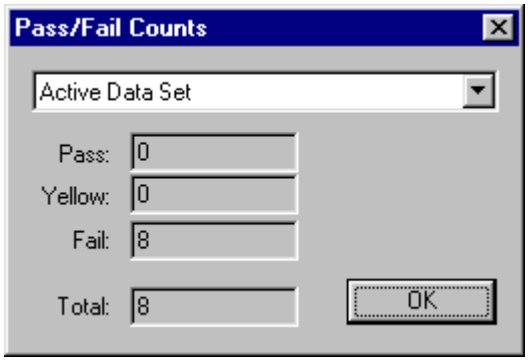
Status bar

Display or hide the status bar on the bottom edge of the window.

Pass/Fail Counts (F8)

Display information on the number of items which have passed and failed the test during the current session. If multiple data sets have been loaded, the list box allows selection of the data set from which the count values are taken.

Figure 12: Pass/Fail Counts dialog box



Edit Graph Settings (Ctrl+G)

Open the Graph Settings dialog box, allowing modification of the traces displayed on the active graph window. This action may also be performed using the keyboard shortcut Ctrl+G.

Refresh (F5)

Redraw the active graph window. Use this option to update the density graphic when displaying the density information for the active data set, or to force a complete redraw of a spectrum graph. This action may also be performed using the keyboard shortcut <F5>.

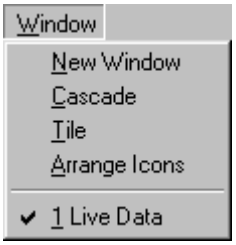
Full Autoscale (Ctrl+F)

Autoscale both the frequency and amplitude axes of the active graph window. This action may also be performed using the keyboard shortcut Ctrl+F.

Amplitude Autoscale (Ctrl+A)

Autoscale the amplitude axis (Y axis) of the active graph window. The frequency axis will not be affected. This action may also be performed using the keyboard shortcut Ctrl+A.

Window menu



New Window

Create a new graph window using the data set associated with the active graph window. The new window will be created with the default format and trace settings. The traces displayed in this new window may then be modified using the View..Edit Graph Settings menu option.

Cascade

Rearrange all of the graph windows such that they are layered one on top of and shifted slightly down and to the right of the underlying graph window.

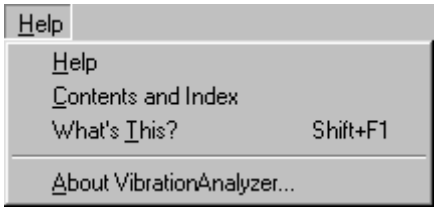
Tile

Rearrange all of the graph windows such that all windows are visible on the screen.

Arrange Icons

Move all of the iconized windows to the lower left corner of the screen.

Help menu



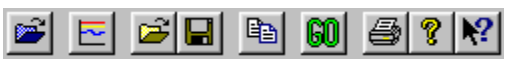
Help Topics 

Open up the help contents window.

About VibrationAnalyzer

Open up a window giving the copyright and version information for VibrationAnalyzer.

The Toolbar



 File … Open Configuration

 File … New Graph
 File … Open
 File … Save
 Edit … Copy
 File … Next Pass
 File … Print
 Help … Help Topics
 Context-sensitive help

Configuration procedure

To configure the program for a new type of test, the following sequence may be used:

- Configuration … Parameters
  Select the sampling rate, number of channels, length of the data set, and the number statistics bins to use in the frequency and amplitude directions.
  The *sampling rate* should be set to at least double the highest frequency in the signal to be analyzed.
  The *data length* will determine the resolution of the frequency data, where a longer data length will give a higher resolution in the frequency data. Typically this value should be between 512 and 2048. Higher data length values will result in longer test times.
  The number of amplitude and frequency bins will determine how coarse or fine the accumulated statistic information will be. Typical values would be 128.
  Note that both the data length and the frequency bins values must be powers of 2 (i.e. 32, 64, 128, 256, 512, 1024, 2048, 4096, …) and the number of frequency bins must be less than or equal to the data length.
  Counter 1 and *Counter 2* values may be ignored unless you desire to use the advanced triggering capabilities of the system.
- Configuration … Layout
  Select the number and arrangement of the test stations. The indicator light dialog box will be arranged with the number of rows and columns specified here.
- Configuration … Define Spectra
  Define the limit lines for which a spectrum is deemed acceptable, and those for which the test fails. All spectra which lie between the yellow (Tolerance) line will pass with a green indicator. All tests which exceed the red (Failure) lines will fail with a red indicator. All tests which exceed the yellow lines, but not the red lines, will pass with a yellow indicator.
  More than one spectrum type may be defined, up to one spectrum type per channel. Typically you would define one spectrum type per type of input (for example, one for microphone inputs, one for accelerometer inputs).
- Configuration … Spectrum Assignments
  After defining the types of spectra, use this option to assign one spectrum type to each input channel. Several inputs may use the same spectrum type, or you could have one spectrum type for each channel.
  In general, the peak hold boxes should not be checked. The peak hold feature enables accumulating the peak values from multiple data sets.
- Configuration … Channel Assignments
  Use this option to assign channels to the corresponding station location in the indicator lights dialog box. More than one channel can be assigned to a light, in which case the large light will show the worst case of the set of associated channels.
  The type of triggering is also selected here. Manual triggering relies on the operator

pressing the <F10> key to start a measurement. Continuous triggering will acquire data continuously. In addition, high-low or low-high transitions of the individual digital inputs may be used to trigger a measurement.
This dialog also allows mapping of the light status to the digital outputs. This feature may be used to control external circuitry, or to turn on external indicator lamps.

- File … Save Configuration
  After the configuration has been defined, be sure to save it so that it can be restored the next time the program is run.

Test procedure

Use the following procedure when running a test:

1. Reset the statistics using the Configuration .. Reset Statistics menu option.
2. Connect the devices to test to the test fixture
3. Press <F10> to start a measurement. The indicator lights will turn gray.
4. After the measurement is complete, the indicator lights will light up to show the status of the test. You may click on any of the smaller lights to view the spectrum for the channel indicated by that light.
5. Remove the tested devices and separate based on the indicators.
6. Go to step 2 and repeat until all devices are tested.
7. Save the data file for documentation using the File .. Save menu option.

Remote File Control

The Vibration Analyzer program can be controlled from another application through a remote-control input file called "C:\Program Files\VibrationAnalyzer\RemoteInput". The results of the remote-control commands are output to the remote-control output file called "C:\Program Files\VibrationAnalyzer\RemoteOutput". To use the remote control, write one of the following command strings to the RemoteInput file. The command must appear on the first line of the file, and are case-sensitive. The first letter of all commands must be upper-case, and the remaining letters lower-case.

Reset: This command clears the current light status information and all of the peak-hold information.

Load filename.vap: This command will load the configuration which was previously saved in the file called "filename.vap".

Trigger: Trigger all stoplights which are configured for file-based triggering.

Save filename.vad: This command saves the current data set to a file named "filename.vad". If not filename is given, the Vibration Analyzer program will automatically generate a filename based on the current date and time.

Status: Report the overall status of the indicator lights. If any light is red, this will report "Fail". If any light is yellow and none are red, this will report "Yellow". If all lights are green, this will report "Pass".

Each command will write either a confirmation that the command succeeded, or a "Error" message to the RemoteOutput file. In the case of the Status command, the current stoplight status will be written to the RemoteOutput file.

I/O Connections

The analog input signals connect to the "Analog Input N" inputs. The ground reference for all inputs should be connected to the AIGND input.

To test the system to verify the input connections, first run the test and configuration software supplied by National Instruments. For NI software versions prior to 6.1:

Start … Programs … National Instruments DAQ … NI-DAQ Configuration Utility

Start … Programs … National Instruments DAQ … NI-DAQ Test Panels

For NI software versions 6.1 and later, double-click the “Measurement & Automation” icon, located either on the desktop or in “My Computer”.

Refer to the National Instruments documentation for details on how these programs operate. Once the National Instruments software is operational, the program should find the data acquisition card and read inputs properly. In particular, make sure that “Continuous” data acquisition works in the National Instrument software. If “Continuous” data acquisition is not working, the probable cause is an interrupt conflict. Verify that the National Instruments board is installed and configured properly, and that it has an interrupt number assigned to it.

Note: In some cases the PC-LPM-16 card might not be initialized properly when doing a soft reboot of the computer (i.e. using the “Restart” option in the Start..Shutdown menu). If you have problems with the PC-LPM-16 card not being detected, shut down Windows and turn the computer completely off for 5 seconds, then turn it back on.

Figure 13: PC-LPM-16 Connector Diagram

Analog Ground	1	2	Analog Ground
Analog Input 1	3	4	Analog Input 9
Analog Input 2	5	6	Analog Input 10
Analog Input 3	7	8	Analog Input 11
Analog Input 4	9	10	Analog Input 12
Analog Input 5	11	12	Analog Input 13
Analog Input 6	13	14	Analog Input 14
Analog Input 7	15	16	Analog Input 15
Analog Input 8	17	18	Analog Input 16
Digital Ground	19	20	-12 volts DC
+12 volts DC	21	22	Digital Input 1
Digital Input 2	23	24	Digital Input 3
Digital Input 4	25	26	Digital Input 5
Digital Input 6	27	28	Digital Input 7
Digital Input 8	29	30	Digital Output 1
Digital Output 2	31	32	Digital Output 3
Digital Output 4	33	34	Digital Output 5
Digital Output 6	35	36	Digital Output 7
Digital Output 8	37	38	OUT1*
EXTINT*	39	40	EXTCONV*
OUT0	41	42	GATE0
OUT1	43	44	GATE1
CLK1	45	46	OUT2
GATE2	47	48	CLK2
+5 volts DC	49	50	Digital Ground