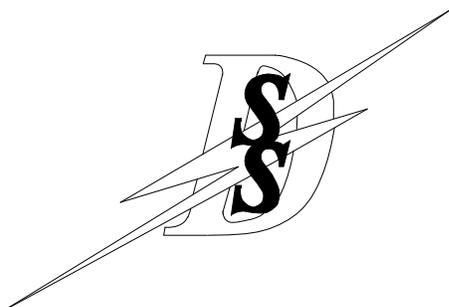


**MicroVib II
Aircraft Analyzer
PN 1300**

Users Manual PN 1318

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Chapter 1 Basics

1.1 Introduction

At first glance, this manual might overwhelm the new user with the sheer number of functions and choices available with the MicroVib II Analyzer. Don't despair, all of the standard choices have already been made for you in the "as received" condition of the unit. All the new user will have to do to begin using a new MicroVib II is to pick the unit up and use it. These choices that are already made for you are referred to as the "Factory Default" setup. In the event that you change the unit's setup parameters and wish to restore the Factory Defaults, this setup can be quickly recalled in the control panel.

This unit contains many functions that you may never use. If you find that you only use 10 or 20 percent of the features of the unit, don't worry, this is entirely normal. Modern technology allows us to pack tremendous power and functionality into this compact unit without detracting from it's ability to perform the function you need.

If you have used any modern computer program like a word processor or spreadsheet, you know that the program has hundreds of features and capabilities you may "never" use. The fact that these additional features exist should not get in the way of using the tool. They are there should you ever need them.

1.2 Quick Start

If you need to use the MicroVib II immediately, you may need an application note for the aircraft you are working. Generic procedures can be found in Chapters 2 and 3, but if an app note exists for your type of aircraft, it can save some time. App Notes are available on-line to customers.

1.3 How to Use This Manual

Chapter 1 provides information about the basic features common to all modes of operation. Equipment lists, Battery care, Power on self test, Saving, Recalling and Deleting files, Entering numbers and letters and Printing.

- Chapter 2** Balance Mode
- Chapter 3** Spectrum Mode
- Chapter 4** Waveform Mode
- Chapter 5** Tach Ratio Mode
- Chapter 6** Optical Tracking Mode.
- Chapter 7** Strobe Tracking Mode
- Chapter 8** Scan Modes

1.4 Equipment Lists

Unpack the Analyzer and compare the contents of the package with your shipping invoice. A list of standard and optional items follows.

Standard Equipment

PN	Description
1300	MicroVib II Aircraft Analyzer
1460-3	Accelerometer, Top Exit
1008-1	Accelerometer bracket, .25 Hole
1008-2	Accelerometer bracket, .31 Hole
1015	Photo Tach
1520	Photo sensor bracket
1254	Reflective tape (1 roll)
1377	Electronic Gram Scale
1010	Prop/Rotor Protractor
1309	Battery Charger 120/240 Vac
1341	Charger Power Cord 120Vac
1311	Serial Interface Cable 9 pin
1600	MicroBase Pro Software
1318	MicroVib II Operation Manual

Prop Balance Accessories

1310	Case, Single/Dual Prop Balance
1007	Cable Set Single Prop Balance
1880	Accelerometer, Side Exit

Helicopter/Multi-Engine Accessories

1096-15	Accelerometer Cable Assy, 15 ft.
1096-50	Accelerometer Cable Assy, 50 ft.
1097-50	Photo Tach Cable Assy, 50 ft.
1450	Mux Unit, 4x4 for Optical Tracker
1145-5	Optical Tracker
1990	Carrying Case, Large
1131	Breakout Cable Acc-Tach

Strobe Tracking Accessories

1680	Mux Unit, 4x4 for Strobe
1123	DC Power Cable, Strobe Mux

Other Accessories

1560	Mux Unit A+B, A-B
1062	Hardware Kit with Case
1507	Hi Temp Accel Cable 10 ft.
1498	Hi Temp Charge Amplifier
1500	Hi Temp Accel, Hi-Temp
1106	Balance Simulator
1117-2	Signal Simulator Acc-Tach
1147-1	MicroTach
1170	Mag Pickup Cable
1176	Mag Pickup
1216	Gaffer's Tape
1280	Signal Simulator Tracker-Tach
1426	Charger Cord Euro
1635	Charger Cord UK
1725	Charger Cord Aus/NZ

1.5 Firmware Versions

DSS is continually improving the MicroVib II via EPROM upgrades. The firmware version number can be seen on the right center area of the LCD display when the unit is powered up and goes through it's normal power on self test function.

This manual describes version 1.33, 1.34, & 1.35 of the firmware. As eprom upgrades are made, manual revisions will be made. If you would like information regarding the current production firmware available as an upgrade to your MicroVib II, please contact us.

1.6 Customer Support

If you should find a discrepancy in your kit or have a technical problem, contact DSS as follows:

- Corporate Headquarters - Sales/Engineering
(760) 598-4000 Fax: (760) 598-4009
- Email Sales: Sales@dssmicro.com.
- Email Support: Support@dssmicro.com
- Software/Applications Engineering (714)
898-7087 Fax: (509) 6963436
- Email Applications:
Applications@dssmicro.com

1.7 Battery Use and Care

A NiMH rechargeable battery pack is used to power the Microvib II. Before starting a task, verify that the battery has enough charge to operate properly.

The battery needs to be recharged if:

- The analyzer will not power up
- The analyzer displays a low battery warning and turns off.
- The battery bargraph indicator shows less than 10% capacity.

Note: Longest battery life is achieved if the battery is allowed to run down to 10% before recharging .

Battery Self-Discharge

The battery will self-discharge even with no use at a rate of about 4% per week at 70F (10% per week at 113F). This is normal and should not be of concern. During times of little usage, recharge the battery about once every 3 months for best results.

Checking the Battery

The Battery level is displayed in all measurement modes as a battery shaped icon with bargraph in the upper right portion of the LCD display. The battery voltage is displayed along with a bargraph that provides a 0-100% relative indication of battery charge status.

This bargraph will normally give a good indication of battery status, but it can be misleading under certain conditions. It will be misleading for the first 15-30 minutes after a change of charge state has occurred. For example, if the battery is on the charger and has been charging for the last ½ hour, you can turn the unit on and get a good idea of the charge status. But if you unplug the charger, this is a change of state and the readings will be way off (high) for about ½ hour. Conversely if the unit has not been on charge for at least ½ hour, the bargraph readings will be correct, but if you plug in the charger, the readings will be way low for about ½ hour.

When the battery charge drops below 0%, the analyzer will display “Low Battery Shutdown” and turn itself off. There is no risk of data loss when this occurs, as the memory in the MicroVib II is nonvolatile and does not require battery power to remain intact. The collected data are retained in memory and can be accessed after the analyzer is connected to the charger. The charger will provide enough power to operate the MicroVib II and charge the battery at the same time.

Battery Charging

To recharge the battery, plug the charger into 90-250V 50/60Hz AC mains power, and then plug the charger into the battery charger input located on the right end of the unit. The LED next to the charger jack on the unit will light up indicating fast charging has begun. The supplied battery charger will completely recharge a fully discharged battery pack in about 4 hours. We recommend you wait until the battery capacity is below 20% and then put the battery on the charger at the end of the day and allow it to charge. The fast charge will automatically terminate in about 3-4 hours. The LED will go off when the battery is fully charged, but the charger will continue to trickle charge the battery indefinitely. It is due to this “trickle charge” that we do not recommend leaving the battery on the charger continuously.

Longest battery life will be achieved if the charger is used sparingly. NiMH batteries do not have a "memory", but trickle charging a fully charged battery does reduce its life.

The MicroVib II, with a charged battery, will operate for approximately 18-24 hours of normal use. The exact operational time will vary depending on the operations being performed, photocell use, LCD backlight use, etc.

Battery Life

The battery is rated to last for 500-1000 complete charge discharge cycles. The first symptoms of battery end of life will be premature charge termination. This is an indication the battery may soon fail to work entirely. We recommend replacing the battery pack when you notice the

pack did not re-charge fully and as a result only lasts a very short time after charging.

Changing the NiMH Battery

We do not recommend the user attempt to replace the battery. During normal annual calibration, DSS will perform a test and replace the battery if it is at or near the end of life.

1.8 Power On Self Test

To turn the MicroVib II on, press the **ON OFF** key. When turned on, the unit will perform power on self test and then begin operating the last mode used when power was turned off.

Self test performs the following checks:

1. Battery is checked for voltage in range
2. LCD Processor is checked
3. RAM is checked.
4. Disk (Flash) is checked
5. I/O System is checked
6. CPU Processor is checked
7. DSP Processor is checked
8. Externally connected equipment is checked.
9. Serial Number is displayed
10. Firmware version is displayed
11. Time and Date is displayed.

1.9 Front Panel Keys

Following are brief descriptions of the function keys on the front panel of the unit.

1.9.1 ON OFF Key

1. When the analyzer is off, pressing the ON OFF key briefly will turn the unit on and will initiate the power on self test function, leading to normal operation.
2. When the analyzer is on, pressing the ON OFF key down and holding it down for 1 second will turn the analyzer off. The screen will briefly display “MicroVib II User Requested

Shutdown” during turnoff. This delay allows the unit to close all files and shut down properly without losing any data.

3. When the analyzer is off, pressing the ON OFF key down and holding it down for 8 seconds and then releasing the key will perform a cold boot. This will create a new balance history and restore factory defaults.

Note: If the unit will not turn on, the battery may be fully discharged. Plug in the charger and wait one minute and try again

1.9.2 Arrow Keys, Backlight

The four Arrow keys have several functions:

1. The primary function of the arrow keys is to move the cursor around the screen to highlight various graphical elements like spectral peaks in the Spectrum mode.
2. Simultaneously pressing the left and right arrow keys will turn on the backlight. Doing it again will turn it off. The backlight is not visible in normal room light, so don't use the backlight unless it is hard to read the display due to very low lighting.
3. When entering numeric data, the down arrow key serves as a minus sign key.

1.9.3 Function Keys

The twelve function keys on the sides of the LCD screen perform the function described on the screen next to the key. In each operating mode, any action you can perform will be available on these keys.

1.10 Control Panel

The Control panel menu contains functions that define and control the operation of the analyzer. To access the control panel: Press the **MODE** key, then press the **CONTROL PANEL** key.

1.10.1 Set LCD Contrast Level

Press the Right Arrow key to darken the screen and press the Left Arrow key to lighten the screen. A bar graph will indicate the current value of LCD contrast from 0-100%. The RIGHT and LEFT arrow keys act as a coarse adjust. The UP and DOWN arrow keys act as a fine adjust.. The LCD contrast is temperature compensated, so it shouldn't change very much as the unit gets hot or cold.

1.10.2 Set Owner Name

Normally this name has already been entered and this selection is not available, but if it is shown, you can press this key and enter the owners name. Be sure to carefully check the spelling and title before pressing this key, as once entered, this value cannot be changed except by the factory. If you accidentally go into this screen, just turn the unit off and the owner name will be left blank

1.10.3 System Parameters

The system parameters screen provides some important information about the unit. It displays the Owner Name, Unit Serial Number, Firmware version, System RAM size, Micro-Disk (Flash) size, Real Time Clock Time and Date, Last calibration date, Total time since new, Total time since last calibration, and Battery voltage. Version 1.34 & 1.35 add a countdown timer to auto-shutoff.

The bottom line on the screen is a live display of the type of peripheral that is connected to the unit. You can connect and disconnect peripherals while watching this display and it will immediately identify and display the peripheral that is attached

1.10.4 Set Date and Time

Press the **SET DATE AND TIME** key to set the Year, Month, Day, Hour, Minute and Second. All data captured by the unit will be tagged with this information, so it is important to set it properly. The time is in 24 hour (military) format. The unit will be factory preset to the current time at the factory in California, but you will want to change it to your local time. Once set, the clock will run on the very small internal 3V Lithium battery, which is independent of the large NIMH battery pack. The Lithium battery is designed to run the clock for at least 10 years. The Lithium battery is soldered to the PC board.

Note: If you set the time a little bit ahead and then monitor your watch, you can press the OK key when the time is exactly right and the clock will be in sync with your watch (or computer clock etc.).

1.10.5 Printing

The MicroVib II can print by downloading your data to a PC and using MicroBase to print via your PC printer.

1.10.6 Restore Factory Defaults

Pressing this key will reset all system settings like Mode, RPM range, Sample Rate etc to their factory default settings. When this is done, one more selection is displayed. **RESTORE INPUT DEFAULTS** will reset the sensor type, sensor sensitivity, and ICP power on/off settings for all inputs to the factory defaults.

1.10.7 New History File

When you are finished with the current history file and want to start fresh with a new file, this key saves the current history file and opens a new file. This will lead to a screen where you are asked to select a template or group file. See section 2.10 for more on templates and group files.

1.10.8 Create Group File

If the group files or templates listed do not cover your application, you can create a new group file

based on an existing group file or template using this key. See section 2.10.1.

1.10.9 Frequency Scale in CPM (Hz)

Press the **FREQUENCY SCALE IN CPM** key to change the frequency scale in all modes to Hz. When this key is dark, units are CPM, when the key is light, units are in Hz. This key is a toggle. CPM means cycles per minute and Hz means cycles per second.

1.10.10 Set Input Parameters

To choose the type of sensor, sensitivity, and sensor power, press this key. You can enter different parameters for each of the 16 possible channels. The default values are Accelerometer, 20mv/g, ICP sensor power ON.

1.10.11 Advanced Controls

By pressing the **ADVANCED CONTROLS** key, you get access to several more optional settings:

1.10.12 Show Time Stamp

This option disables the date and time display on all analysis screens. Default is on.

1.10.13 Save (Export) Group

After you have created a new group file in the current history, you can save this group file by itself on the disk. You will be prompted to name the group file.

1.10.14 Load (Import) Group

If you selected the wrong group file when you first created the current history file, you can delete the current group and load another group file from the disk into the current history with this function. We do not recommend this after any data has been saved in the current history.

1.10.15 Set Max Input Signal

Pressing this key allows you to disable the auto range function and set the unit to fixed gain mode. The desired full scale range of the display can be entered. If a value over the spec limit is entered, the unit will set the level to the maximum allowable. If a value less than the minimum level is entered, the minimum will be used. The unit will automatically choose the lowest input signal range that includes the display range. This key will be dark if a fixed gain setting has been entered. To return to normal auto range mode, enter a full scale value of 0 or press the **RESTORE FACTORY DEFAULTS** key.

1.10.16 Analog Integration

This key enables and disables analog or digital integration when converting acceleration units to velocity units and then in turn to displacement units. Default is analog integration (key dark).

1.10.17 Format (Erase) Disk.

This option allows you to erase all the data that has accumulated on the nonvolatile disk (Flash memory). This does not erase calibration data.

1.10.18 Init DSP Unit:

This option allows you to initialize the DSP unit. This is not required for normal use.

1.11 Sensor Installation

Installing The Vibration Sensor

The vibration sensor should be mounted securely to the aircraft near the target rotor, prop or engine. Find an appropriate location and attach the bracket PN 1008-1 or 1008-2 to the aircraft. Mount PN 1880 or 1460-2 Accelerometer to it using the captive bolt on the bracket. Tighten the bolt to approx. 6-8 ft-lb torque. The sensor sensitive axis must be mounted in the plane perpendicular to the rotation axis, but it can be mounted in any convenient orientation. Up or down at 3, 6, 9 or 12 o'clock, all will work fine.

If manufacturer procedures or application notes already exist for the subject aircraft it is strongly recommended that those procedures be followed.

Installing a Magnetic Pickup

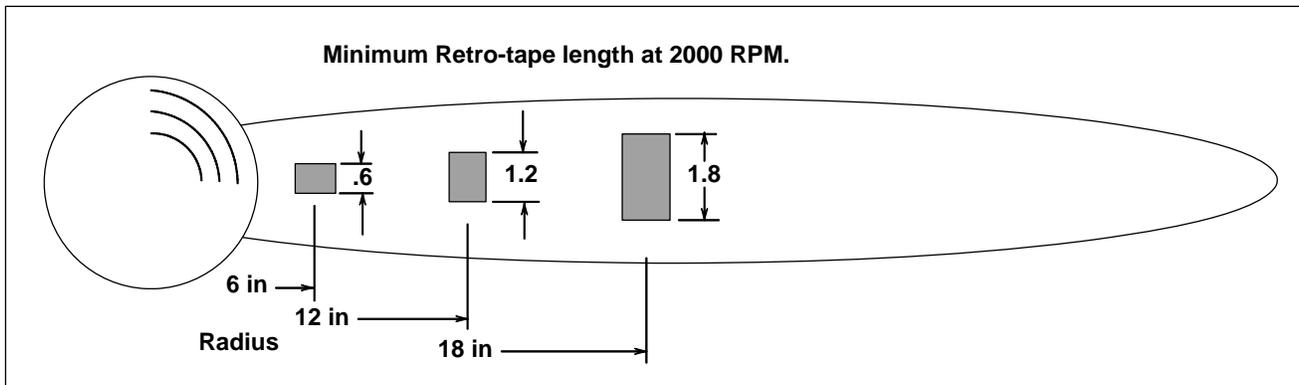
Many aircraft come from the factory with provisions (bracketry) for mounting a magnetic pickup and interrupter. The magnetic pickup is installed securely near a rotating component like the swashplate or spinner. A ferrous metal object (interrupter) must pass very close to the tip of the magnetic pickup to generate a usable signal. This function is usually provided by a small metal bracket attached to the rotating part of the rotor. Use PN 1176 Magnetic Pickup and PN 1170 Mag P/U cable. The rotor must have only one interrupter to be compatible with the Microvib II.

Installing the Photo Sensor

The photo tach is mounted securely to the aircraft and aimed at the rotor/blade path. A patch of reflective tape is applied to a blade to intercept the photo tach beam. The reflective tape must intersect the photo tach beam for at least 300 microseconds. The minimum tape length may be computed using the following formula:

1.12 Averaging Data

Pressing the **AVG DATA** key during a measurement enables or disables the averaging of data. It is important to verify that the RPM is stable before averaging is started.



$$\text{Tape length} = (\text{Radius(in)} \times \text{RPM}) / 20,000$$

Note: The older retro-tape PN 1014 was very hard to remove. The newer type of tape PN 1254 is easy to remove.

Connecting the Sensors

Connect the Accelerometer and Photosensor to the MicroVib II using either PN 1007 Cable Set or PN 1096 & 1097 Cables and MUX Unit, or PN 1096 & 1097 Cables and PN 1131 Breakout Cable. Each of these options includes an 18 pin MS Bayonet type plug that mates to the MicroVib II.

Secure the Cables

Be sure to route and secure the cables to prevent them from touching any hot surfaces or interfering with any control lines. If the cable is in the path of any strong air flow, secure it so it cannot bang against any painted surface and cause damage.

Spectrum Averaging

In the default averaging mode, the Microvib II will complete four averages and then update the display. The analyzer will then immediately start a new set of averages. In between these updates, the last averaged spectrum is displayed.

The number of averages is shown at the bottom of the screen slightly left of center. You can change the number of averages, type of averaging, or peak hold display from the **SPEC OPTS** (Spectrum Options) screen, which is an option on the Spectrum Analysis screen.

Waveform

Averaging is not available in this mode.

Balance Mode Averaging

Using the **BAL OPTS** (Balance Options) screen, the averaging used in balance mode can be set to linear (default) or exponential.

Linear Averaging

Linear averaging is very simple: Each successive measurement is added and the result is divided by the number of measurements. In this mode very erratic data will usually average out to a very steady result. This is the mode recommended for reciprocating engine propeller work or any other application which produces unsteady vibration readings. The recommended number of times to average the data is 8 in balance mode.

Exponential Averaging

Exponential averaging places more weight on the most recent measurements compared to the older measurements. In this way a feel for how the data is changing is retained no matter how long the data is averaged. This mode will greatly reduce the large jumps of erratic data, but will not get progressively smoother with time as with linear averaging.

1.13 Working with Files

Any display from an analysis mode (balance, spectrum, waveform, track or tach ratio) can be stored in the analyzer's disk and recalled later for viewing or printing. History files can also be saved or recalled.

1.13.1 Saving Screen Image

To store a screen, press the **SAVE PLOT** key. You will be prompted to give the data item a file name. You can enter a name or you can let the unit automatically assign the name. The default name will be on the screen, but you can type over it. (For instructions on how to enter data into an alphanumeric menu, see "Entering Data" in section 1.15.)

Press the **OK** key to store the data. After the item has been stored, the screen will display the saved data in the Hold mode. You may resume analysis by pressing the **START STOP** key.

1.13.2 Recalling Stored Data Files

To recall stored data from the analyzer's memory, from any analysis screen press the **FILE** key to access the File directory. Use the **UP** and **DOWN ARROW** keys to highlight the desired data file and press the **OPEN FILE** key; the analyzer will then

display the selected data. All appropriate function keys and cursor controls are available to manipulate the recalled record.

When a stored data file is selected for display, the current user settings are temporarily stored. The settings that were active when the recalled record was saved are in effect while that file is being viewed. The current settings will be restored after exiting the file.

1.13.3 Erasing Data Files

The File directory screen, obtained by pressing the **FILE** key, can also be used to erase files from the disk. Use the **UP** and **DOWN ARROW** keys to highlight the desired data file and press the **ERASE FILE** key; the analyzer will then erase the selected file. To erase all files, see section 1.10.17.

1.13.4 Renaming Data Files

The File directory screen, obtained by pressing the **FILE** key from any analysis screen, can be used to rename files on the disk. Use the **UP** and **DOWN ARROW** keys to highlight the desired data file and press the **RENAME FILE** key; the analyzer will then prompt you to give the file a new name. Enter the new name and press **OK**.

1.13.5 Navigating the File Directory

Since files are kept on disk indefinitely, the file list may become quite long. It may span many screens of file names. You can use the **NEXT PAGE** and **PREV PAGE** keys in the file directory screen to quickly move through a long list

1.13.6 File Types

Several different types of files are used:

History Files (Suffix HST) Each history file can contain data from up to 10 tasks. Task details are as defined in the group file contained in each history file. The history file is limited to 64 balance runs.

Spectrum Plot Files (Suffix SPC). Spectrum files are saved in this format. The amount of space used on the disk will be a function of the number of lines.

Waveform Plot Files (Suffix WAV) Waveform plot files are saved in this format. The size of the wave file is a function of the number of points.

Balance Plot Files (Suffix PKP) The balance screen can be saved in this format. This will not normally be used as this data is saved in the history file already.

Track Plot Files (Suffix TRK) Track data is saved in this format. Track data will be annotated with the task and time for later identification.

Tach Plot Files (Suffix TAC) Tach Ratio scans are saved in this format.

Group Files (Suffix GRP) Every history file contains a group file, but the group file can be saved separately and used for new history files. Group files are a collection of tasks along with the details about each task.

1.13.7 MicroBase

MicroBase is a database program that runs on your PC using the Windows operating system. It provides a means of storing and organizing all the data you collect with the Microvib II. It also allows you to print your data using your computer printer. It also provides a means of sharing data with DSS, Aircraft manufacturers and other users. MicroBase comes with a powerful help system that serves as its user manual .

1.14 Printing Data

The MicroVib II prints by downloading your data to the MicroBase program running on a Windows PC, then printing to your computer printer.

1.15 Entering Data

1.15.1 Alphanumeric Data

Some display screens of the MicroVib II allow you to enter alphanumeric characters; for example: to give a file a name other than the automatically assigned name.

To enter a character, repeatedly press a key to step through its assigned characters (for example A B C D E F) until the desired character is displayed. The cursor will then automatically advance to the next space after a one second pause or after another key has been pressed. Numbers from zero through nine can be entered in a similar manner.

The **Left Arrow** key may be used to backspace the cursor, and the **Right Arrow** key may be used to advance the cursor through the field. The **ADD CHR** key inserts a blank at the current cursor location and shifts the remaining right side characters to the right. The **DEL CHR** key deletes the character at the current cursor location and shifts the remaining right side characters to the left. The **CLR CHR** key deletes the character at the current cursor position and leaves the space blank. The **CLR ALL** key deletes the entire string shown. Press the OK key to accept the text shown and return to the previous screen.

Special Characters

The only special characters shown on function keys are ^ _ ` ! # & () - There are 4 more special characters available \$ % ' @. To enter these characters, use the up and down arrow keys and the character at the cursor location will scroll thru all the available characters, including these special characters.

1.15.2 Numerical Values

Many functions of the unit require you to enter numbers. When this is required a screen will appear where each function key is labeled with a number. To enter a number like 125, just press the 1, 2 and 5 keys in that order. Enter decimal points as required. The Right and Left arrow keys can be used to edit any errors you might have made. Just move the cursor to the errant digit and type in the correct value. The Up and Down arrow keys will change the sign of the number. When you are certain the value is correct, press the **OK** key.

1.16 MODE Screen

The primary menu screen is the MODE screen titled Select Operating Mode. From this screen you can select one of the six analysis modes or the control panel.

Press the appropriate menu item key to select one of the following modes.

- **Spectrum Analysis** - Measures the Vibration vs. Frequency signature produced by the sensor currently selected.
- **Waveform Analysis** - Measures the Vibration vs. Time signature produced by the sensor currently selected.
- **Scan Modes** - Provide a simple overall value of the vibration at the sensor.
- **Control Panel** - Provides a means to control the various optional settings used to operate the unit..
- **Tach Ratio Display** - Measures the rate of the incoming tach signal and displays it relative to %RPM values specified.
- **Prop/Rotor Balance** - A system for balancing all kinds of rotors and props using vibration and tach sensors.
- **Rotor Blade Tracking** - A system for measuring the visual track of any helicopter rotor system. Either the DSS Optical Blade Tracker or a compatible strobe light can be used.

1.17 Calibration

DSS recommends the MicroVib II be calibrated once per year at a factory certified calibration facility. If no such facility is available near you, return the unit to DSS for annual calibration. Calibration normally includes updating firmware to most current version and any necessary hardware upgrades.

1.17.1 Cal Flag

1 year after calibration, the MicroVib II will show a “NO CAL” flag on the screen. This is just a reminder to have the unit calibrated. It has no effect on the instrument accuracy. When the unit is calibrated, this flag is reset.

1.18 Field Cal Check

Using the Signal Simulator PN 1117-2 you can perform a quick cal check to be sure your MicroVib II is reading correctly.

Procedure:

1. Turn unit on, Press MODE, CONTROL PANEL, RESTORE FACTORY DEFAULTS, RESTORE INPUT DEFAULTS, DONE, DONE, START.
2. Connect the Signal Simulator. The vibration level should read between .765 and .845 IN/S. The phase reading should be between 270 and 274 degrees. The Tach reading should be between 1919.5 and 1920.5 RPM.

If your unit does not read properly, repeat the above procedure to be sure and then return the unit to DSS for calibration.

1.19 Auto Shutoff

To maximize battery life, the unit shuts itself off after 5 minutes with no user key presses (V1.33) Firmware versions 1.34&1.35 added the ability to control this auto-shutoff delay from 1 to 60 minutes. This feature is accessed from the Control Panel by pressing Advanced Options, Set Auto Off.

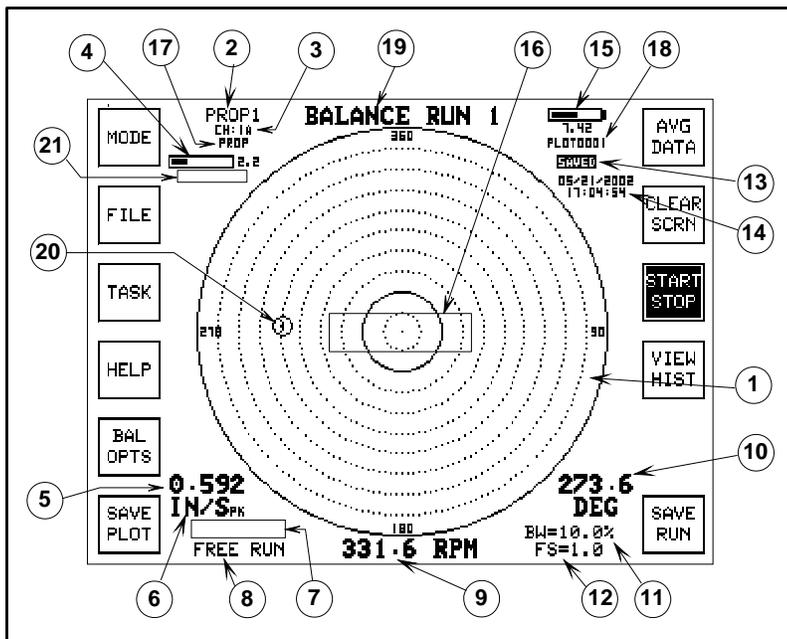
Chapter 2 Balance Mode

This mode is used for balancing rotors and propellers. It requires a tach sensor (photocell or mag pickup) as well as a vibration sensor (accelerometer) mounted near the target rotor in order to function. See Section 2.6 for procedure.

To access the balance mode from any analysis screen, press the MODE key, press the Prop/Rotor Balance Key, and press Start Analysis.

this will indicate which of the sensors have been selected for the current task. (See 2.9.1)

4. **Signal level bargraph:** In the upper left corner is a bargraph display that indicates the current full scale range selected by the auto range function, and the level of the incoming signal as a percentage of that range.
5. **Vibration Amplitude:** A digital readout of the current vibration level at the tach rate is in the lower left corner of the screen.



6. **Vibration units:** The current vibration units and units type are displayed just below the vibration amplitude readout.

7. **Alarm Indicator:** If the current vibration level is higher than the user set alarm level. A reverse video ****ALARM**** will appear just below the vibration readout in the lower left corner. (See balance options 2.2.1 to set the alarm)

8. **Free Run/Averaging Indicator:** This indicator will read FREE RUN until you press the AVG DATA key. Then it will start indicating the total number of samples in the current averaged display values. This will continue until the Save Run or Clr Scrn keys are pressed.

2.1 On Screen Data

The Balance mode provides the following data on screen.

1. **Polar Plot of Vibration Data:** Dominating the screen is a large polar plot of the vibration level and the phase angle of the vibration relative to the tach signal. This data will update sample by sample in real time.
2. **Task Name:** The current task name is displayed. This name is user definable. See task setup to name the task.
3. **Sensor Channels:** the current sensor channels are indicated. If a single accelerometer and tach sensor are connected, this will indicate CH: 1A. But if a MUX type unit is connected,

9. **RPM Indicator:** A digital readout of the tach RPM is provided. This can be in RPM or Hz as selected in the control panel. (Sect 1.10.9)
10. **Phase Readout:** A digital readout of the phase angle of the vibration signal relative to the tach signal is provided. Units are also displayed.
11. **Bandwidth:** The current filter bandwidth is displayed. This is user selectable in the balance options menu.
12. **Full Scale Range:** The full scale level of the polar plot is displayed here. Note that this level is independent of the current full scale range selected by the auto range function.

This value can be changed at any time using the up and down arrow keys.

13. **Update/Freeze Indicator:** This is a small flashing indicator that blinks “update” for every data sample that is collected and displayed. It changes to “Freeze” when the Start/Stop key is pressed. It shows “SAVED” when the screen is a recalled file.
14. **Time and Date** - Optionally as selected in Control Panel. (Sec 1.10.4)
15. **Battery Status Indicator** - Voltage and analog bargraph of battery energy remaining along with “Charging” status.
16. **Status Indicator Area** - This part of the screen will indicate “Auto Ranging In Progress” or “Initializing Fixed Gain” during the autorange period. It will indicate “No Tach” if tach signal is not present. It will indicate “Changing Tach” if tach rate is changing too rapidly to display. It will indicate “Lost Tach” if the tach signal is lost.
17. **Template name.** This is the name of the template or group file used when this history file was created.
18. **File Name** - Currently open history file name.
19. **Screen Title** - The balance run number will increment for each new balance data point.
20. **Current plotted data point** - This is the plot point, IPS and Phase plotted in real time. The run number will appear in the circle.
21. **Low Input and Overload Indicator** - This flag will occur during normal operation if the unit is set for automatic gain ranging (the default setting). The autoranging function raises and lowers the gain as the input changes amplitude in order to obtain the best signal to noise ratio. This flag is just an advisory and does not mean anything is wrong.

2.2 Balance Function Keys

The Prop/Rotor Balance Mode provides the following function keys:

Mode - This key allows you to change modes

File - This key provides access to the File Directory Screen.

Task - This key allows you to select the task or setup the tasks as explained in section 2.9.

Help - This key provides information about the current function.

Bal Opts - Balance Options: This key is described in the next section

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the auto-assigned name.

Avg Data - This key will engage averaging of the vibration data. The kind of averaging used is user selectable in the balance options menu.

Clear Screen - This key clears the data buffer and starts the measurement over. It also clears any averaged data and starts averaging over.

Start Stop - This key freezes and unfreezes the screen. Useful for saving a screen plot.

2.2.1 Balance Options

This key leads to a screen where you can control how the Prop/Rotor Balance Mode operates.

Set Sens Factor - This function allows you to enter an adjustment sensitivity. This is normally used when you have balanced this type of rotor before and you know the adjustment sensitivity. This will avoid the first “Learning Run” and possibly save a run

Sens Factor is the factor used by the MicroVib II to calculate the amount of adjustment (weight, pitch link, tab sweep etc.) to be applied to the subject in order to balance it. If this key is pressed, you will be prompted to enter a new value (Limits .1 to 9999) or press enter to leave the value alone. This number is a ratio and therefore unitless. You can think of it as the number of grams per IPS or flats per IPS if these are the units you want to work in. If your preference is the number of pounds per g or degrees per IPS, this will work equally well. If you have balanced the subject aircraft before and you remember the Sens factor determined before (this

Chapter 2 Balance Mode

value is printed on the history report), this number should be keyed in to save time and engine starts.

Set Tach Offset - From here you can enter a tach offset. This is normally used when you have balanced this type of rotor before and you know the tach offset. This will avoid the first “Learning Run” and possibly save a run.

Tach Offset is the phase angle offset the Microvib II uses to determine where to add the correction weight after the phase measurement is made. If this key is pressed, you will be prompted to enter a new value (Limit 1 to 360) or press enter to leave the value alone. For most propeller systems with the vibration sensor mounted vertically at the propeller end of the engine and the photo tach at 3:00 (viewed from the front) this angle will be 90 degrees. If you have balanced the subject aircraft before and you remember the Tach Offset determined before (this value is printed on the history report), this number should be keyed in to save time.

As a general rule, you can estimate the tach offset by considering the photobeam intercept location to be zero and determining how many degrees the target blade must go through before it aligns with the vibe sensor sensitive axis.

Set Display Units - This leads to a menu that allows you to select display units (Sensor, Acceleration, Velocity, Displacement) or select Metric Units, or select units type (RMS, Peak, Peak to Peak, Average). The currently selected units are show as black (reverse-video) keys.

Overlay Balance History - This option will plot all data points on the screen and connect the points with lines as you perform the balance. Turning this option off will only plot the current reading for a cleaner looking display. (Default is on)

Linear (Block) Averaging - This type of averaging treats every data point equally usually leading to a very stable reading after many averages. (Default)

EXP (Smooth) Averaging - This type of averaging weights the most recent data points heavier than older data points. If the data is unsteady, this type

of averaging will continue to vary even with many averages.

Start Analysis - This simply exits this menu back to the Balance Screen.

Advanced Options - Leads to the following additional balance options.

Set Alarm Level - This function lets you set the alarm level to any desired value. Setting the level to 0.0 disables the alarm function. Default = 1.2

Set Target Level - You can enter any value here to use as a target level you want to achieve when balancing. A solid line will be displayed on the polar plot at the target level. Setting the target level to 0.0 disables this function. Default = 0.2

Hann Window - This key disables the Hann window function in the balance filter. Turning off the Hann window enables a rectangular window function. Default window is Hann.

Computer- This function is a specialty calculator that makes adding and subtracting weights (vectors) very easy. (See Section 2.4)

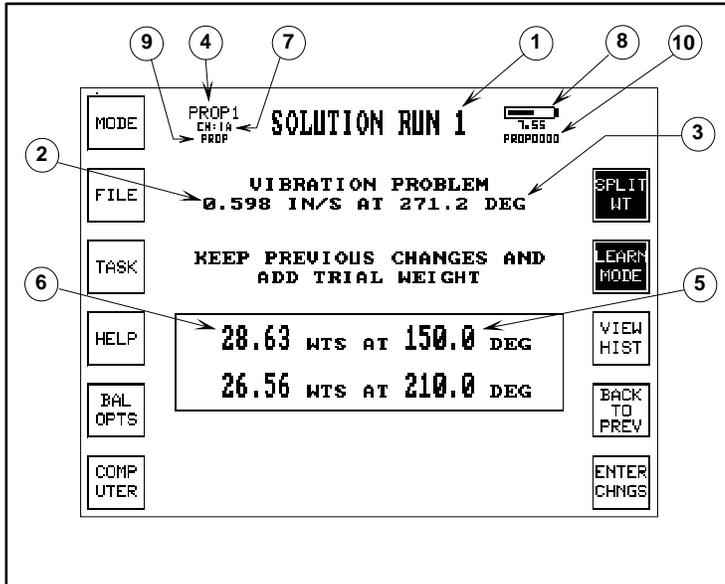
Set Min (Learn) Moveline. This function allows the user to specify the minimum moveline required before the unit will learn. The default setting is .1. Do not change this unless you understand the effects.

Set Order - This function allows the unit to take a balance type vibration reading of an object that is turning at a different speed but locked to the rotor the tach is sensing. Example: If the tach is detecting the 1 per rev of the rotor on a two blade helicopter, by setting the order to 2, you can take a balance reading of the blade rate vibration. This function is limited to integer multiples of the tach rate. Default = 1

Set Filter Bandwidth: This function allows you to set the filter bandwidth used in balancing. A narrow filter takes more time for each sample. Bandwidths of 20%, 10%, 5%, 2% are available. 10% bandwidth works fine in almost every case. .

2.3 The Balance Solution Screen

The solution screen displays a suggested balance solution. This solution consists of the amount of adjustment to be made and the location for it.



2.3.1 Solution Screen Data

1. Run number.
2. Vibration Level stored for this run.
3. Phase angle stored for this run.
4. Task Name (User definable in task setup).
5. Location (angle) where adjustment is to be made.
6. Amount of adjustment.
7. Sensors currently active.
8. Battery Status.
9. Template or Group File name.
10. History File Name.

2.3.2 Solution Function Keys

The Solution Screen also has a menu of selections to manipulate the solution for ease of implementation. In Standard Rotor mode the solution screen initially shows a single adjustment at a single angle location. For the **first run** making exactly this adjustment at exactly this location is

NOT important. What is VERY important is that whatever adjustment and location you use, be sure to enter that data accurately.

Split Weight

In Standard Rotor mode, when a solution is presented initially it will always be a single adjustment at a single location. The SPLIT WT key allows you to split that adjustment into two nearby locations that you find practical on the subject. This can eliminate the need for drilling new holes if nearby locations are already available. The screen shown here is after the split weight key has been pressed.

In Program Rotor mode, the available weight or move locations are pre-programmed in the task setup, so all solutions are presented already split. Pressing the SPLT WT key (or the UP and DOWN arrows) will scroll thru all the available combination that will work.

Learn Mode

This key turns learn mode on and off. With learn mode on, the MicroVib II will learn from the adjustments and measurements to automatically correct the aircraft factors on each run. If the vector length of the move line from one run to the next is less than .1 vibration units the learning mode is disabled. This minimum move line is adjustable in Balance Options, Advanced Options. With learn mode off, the unit will never change the aircraft factors.

The **VIEW HIST** key is used to display the history screen for the current task. While balancing the subject, the Microvib II is automatically making a complete documented record of all the levels measured and adjustments made on the aircraft. This display shows the Run number, Measurement RPM, Vibration level with units of measure, Phase, Sensitivity Factor, and Tach Offset. The detail window at the bottom of the screen also shows the amount of adjustment made and its location as well as the time the adjustment data was entered.

The **BACK TO PREV** key acts like an undo key. It takes you back to the previous step in the balance process and lets you do that step over.

The **ENTER CHGS** key is like an enter key. It means you are ready to go to the next step, which is to actually enter the amount and location of the adjustment you have made to the rotor.

Remove Previous Changes Key

After the first run, the solution screen will have another key available, the **RMOVE PREV CHNGS** key

Pressing the **RMOVE PREV CHNGS** key tells the MicroVib II that you are removing the trial move done after the first run. The solution displayed after you press this key will be a solution to the original vibration reading of run 1 corrected for "learned" aircraft factors. If you don't press the **RMOVE PREV CHNGS** key, you must leave the trial move alone and carry out the new solution displayed.

In this way the **RMOVE PREV CHNGS** key allows the user to choose the vibration for which a solution will be computed. The first solution is usually based on "average" aircraft factors most commonly found in the field (Factory defaults). This solution is a "trial" move to accurately measure the true aircraft factors for this subject. Often this trial move is not at a good location, so the **RMOVE PREV CHNGS** key allows you to tell the Microvib II to compute the solution for the original reading using the just learned factors.

It is strongly recommended that the **RMOVE PREV CHNGS** key be only used once, immediately after the Analyzer has characterized the rotor being balanced (Normally after Run 2). After this, use of the **RMOVE PREV CHNGS** key should be avoided. (If this key is used after Run 2, the weight computer is locked out.)

Weight Computer

Pressing the **COMPUTER** key in the solution screen transfers the currently displayed solution into the Weight Computer. See next section for an explanation of the Weight Computer.

The remaining function keys work just as explained in section 2.2.

Enter Changes Screen

From the Solution Screen, pressing the **ENTER CHGS** key advances the MicroVib II into the Enter Weight screen (if Learn Mode is on) and then into the Enter Location screen. After entering the weight and location, pressing the OK key leads to the Verify Screen.

Verify Screen

The Verify Screen will display all weight changes that have been entered. These values should be checked very carefully before proceeding to the next measurement. This is extremely important for the MicroVib II to be able to learn.

The Verify Screen also displays a predicted vibration at the bottom of the screen. This prediction is based on the assumption that the Sens and Tach values are correct for this rotor, everything up to this point has been done correctly and the rotor has a linear response.

If Learn Mode is off, the weight changes are not entered and therefore the Verification screen will display "Previous Changes Were Retained and Trim Weight Added".

Back to Previous

Pressing the **BACK TO PREV** key in the Verify Screen will cause the Microvib II Analyzer to return to the Balance Solution screen seen previously. This key should be pressed if incorrect weight and/or location information has been entered.

Start Analysis

Pressing the **START ANLS** key will store all particulars of the current solution to the History and begin a Balance Measurement for the next run.

2.4 Weight Computer

The Weight Computer functions can be used in a variety of ways to calculate balance solutions.

2.4.1 Enter Weight

The ENTER WT allows the user to clear the current display and enter an amount of weight to be manipulated. The weight to be entered may be a single or a split weight. If the Weight Computer is in single weight mode, the user will be prompted to enter the amount of the weight and the angle location. If the Weight Computer is in split weight mode the new weight will be automatically split to the two angles currently in memory.

2.4.2 Split Weight

The **SPLIT WT** key allows the user to manipulate a single weight and angle solution and convert it into a split solution, calculating the equivalent amount of weight to be added to two real available locations on the rotor.

After a single weight and location have been entered, the computer can calculate the amount of weight to be added to two nearby angle locations on either side of the current angle to produce the same balance solution. This is done by pressing the split key and entering the two desired angle locations. The split key will appear in reverse video whenever two locations are displayed

Un-splitting Weights

If two weights and locations are displayed, the weights can be combined back into a single weight and location by pushing the **SPLIT WT** key again. The **SPLIT WT** symbol will return to normal video. The weights can be quickly split by pushing **SPLIT WT**, **OK**, and **OK** again. This will re-enter the two weight locations stored in memory from the previous screen.

The **SPLIT WT** key is a toggle. Feel free to use this function to experiment with split and unsplit solutions which utilize different split weight locations until the most easily realized final solution is determined.

2.4.3 New Radius

The **NEW RAD** key allows the user to transfer the amount of weight at one radius to a new radius. This is often useful when moving weights from temporary locations to final flight worthy locations. By pressing the new radius key you will be prompted to enter the old (temporary) radius and the new (final) radius (limits .1 to 9999). This function is a ratio, so the unit of length used is unimportant, so long as the same unit is used for both the new and old radius. The new radius function will work for both split and single solutions.

2.4.4 Add Weight

The ADD WT key allows the user to add weight vectors to the currently displayed values. In doing so, the currently displayed weights will be combined with the weight to be added. This is particularly useful when entering weights which have been accumulated at temporary locations and it is desired to transfer the temporary weights and the "residual" solution generated on the last run to a new, permanent location.

2.5 Weight Computer Procedures

The most common uses of the weight computer are described here. You may find other uses not listed.

Moving from Temporary locations to permanent locations.

After good balance has been achieved using temporary weight locations. The Weight Computer is used to transfer the weights added to balance a rotor from temporary (easy access) locations to final (flight worthy) locations.

For example, a balance is performed on a small fixed wing prop by adding washers under the heads of two spinner attachment screws. When the balance is complete, the Weight Computer can be used to combine the weights into a single imaginary location, then change the radius to the final location radius and then split the weights onto two "real" locations available for flight worthy weights.

Smallest Weights Too Big

In some cases, the smallest weight that can be attached is a short bolt and nut. But a bolt and nut are more weight than you need at each of the two split weight locations. By unsplitting the solution and then re-splitting it to a wider angle, the solution will call for more weight at each location, solving the problem.

Removing more Weight than is there.

Problem: The solution is telling me to remove more weight than is there. What do I do?

This problem can occur if you pick split locations that are too close to the ideal single weight location. Example: The ideal single weight is 29.44 grams at 244.9 degrees. You pick split locations of 240 and 270 degrees. The unit will tell you to put 25 grams at 240 degrees and 5 grams at 270 degrees. If the rotor is slightly nonlinear, the next solution could be +8 grams at 240 and -8 grams at 270 degrees. An impossible solution. Go to the weight computer and:

1. Press **ENTER WT** and enter the weight currently at 240 degrees. Enter 25 at 240 degrees.
2. Press **ADD WT** and add the weight at 270 degrees. Enter 5 at 270 degrees.
3. Press **ADD WT** and add the new solution at 240 degrees. Enter 8 at 240 degrees.
4. Press **ADD WT** and add the new solution at 270 degrees. Enter -8 at 270 degrees.
5. Display should show 33 at 240 and -3 at 270. Press **SPLIT WT** key and the single weight solution will be displayed 30.44 at 237.2.
6. Press **SPLIT WT** again and key in better split locations 210 and 270.
7. Now solution is 19.05 at 210 and 16.05 at 270 degrees. Remove the weights that are on the rotor and implement this new solution.

If you want the Microvib II to learn from this solution, you have to enter the original solution you were trying to implement. In this example that was +8 at 240 degrees and -8 at 270 degrees. Otherwise, just turn the learning mode off.

Spreading Weights over Many Locations

A problem occurs when you have a large number of weight locations, but each one is limited to a very small amount of weight. A simple two location split will not allow you to add enough weight. Example; Your rotor has 36 weight locations (every 10 degrees) but the max weight at each location is 20 grams. The solution calls for 50 grams at 90 degrees, which is more than you can place at two locations. Use the Weight computer as follows:

1. Press **ENTER WT** and enter the solution. Enter 50 grams at 90 degrees.
2. Press **ADD WT** and enter the max weight at the location closest to ideal. In this case enter -20 at 90. Entering the weight as a negative value is the same as subtracting this weight from the solution. Now the screen shows the remaining weight to be added, 30 grams at 90 degrees.
3. Press **SPLIT WT** and enter two split angles on either side of the ideal. In this case we choose 80 and 100 degrees.
4. The solution now presented is 15.23 at 80 and 15.23 at 100 degrees. This is a realistic solution. You can use this method to spread the solution over as many locations as needed. You just have to remember that as you add weight to the rotor, you have to subtract each weight from the solution until you have a weight that can be split across two locations.

If you want the Microvib II to learn from a solution spread over many locations, use the Weight Computer function **ENTER WT** to enter one of the weights and angles, and then use the **ADD WT** function to add the additional weights in until you have the sum of all the weights. This sum should match closely with the original solution you were

trying to implement. Enter this sum of weights into the unit in **ENTER CHGS** at the solution screen. Otherwise, just turn learning mode off.

2.6 Balancing Procedure

The MicroVib II can be used to balance just about any form of prop or rotor system.

2.6.1 Generic Balance Procedure

Following is the simplest form of balance procedure. This procedure can be used to balance any constant speed spinning mass in one plane. This procedure assumes:

1. You have or can make weight attachment locations on the machine as required.
2. The accelerometer and photocell are mounted properly and connected to the unit as required.
3. You will use the Prop/Rotor Protractor.
4. The weight or adjustment locations are all at the same radius.

Setup

First you must create a new balance history. Press **ON OFF** key, **MODE**, **CONTROL PANEL**, **NEW HISTORY FILE**, select a template or group file that is appropriate. See section 2.10.

Procedure

1. Start machine to be balanced. Allow system to thermally stabilize and operate at RPM commonly used to perform balance.
2. Press **ON OFF** key. Wait for RPM reading to stabilize.
3. Press **AVG DATA** key. Wait for at least 8 averages. More if unstable conditions.
4. Press **SAVE RUN** key. Solution on screen IS NOT a correct solution.
5. Select a reasonable trial weight and add it to the machine. Note angle location.
6. Press **ENTER CHNGS** key and enter exact weight amount and location. Press **OK**.
7. Start machine and press **START ANLS** key. Wait for RPM to stabilize.
8. Vibration level may be higher or lower than before. This is irrelevant.
9. Press **AVG DATA** key, wait for at least 8 averages.
10. Press **SAVE RUN** key. Verify Microvib II learned by pressing **VIEW HIST**, **VIEW LIST**, see that Sens and Tach values have changed. If they have press **DONE** and continue on to step 11. If not press **REMOVE PREV CHNGS** key and increase the amount of weight added to the same location to be sure the vibration level changes more than .1. Press **ENTER CHGS** and enter this weight and location. Press **OK**. Return to step 7.
11. Press **REMOVE PREV CHNGS** key. Note ideal single weight location angle. Inspect rotor and find two real locations on either side of ideal. Use Prop Protractor to measure angles accurately.
12. Press **SPLIT WT** Key. Enter two weight locations that are available on either side of ideal location just noted.
13. Screen will show solution. Write down solution. Remove the trial weight you placed on rotor in step 5 above. Implement new solution as accurately as you can on rotor.
14. Write down the actual weights and locations used.
15. Press **ENTER CHGS** key. Enter actual weights used at each location.
16. Verify Screen. Double check that screen agrees *exactly* with what you did. Note that predicted vibration should be very low.
17. Start machine and Press **START ANLS** key. Wait for RPM to stabilize.
18. Press **AVG DATA** key, wait for at least 8 averages.
19. Press **SAVE RUN** key. Solution will be displayed.

20. If IPS level is acceptable, you are done. Press **VIEW HIST** and **VIEW PLOT** to see a graphic plot of the action.
21. If IPS came down substantially and you want to lower it more, implement the solution shown by adding to or subtracting from the weights previously applied. Example: If you previously placed 23 grams at 60 degrees and now the solution says +1.2 grams at 60 degrees. This means you add 1.2 grams to the 23 grams already there. If the solution is telling you to remove more weight than is there, or is telling you to add more weight than is allowed at the location, you can use the weight computer to finish the job (Sect 2.5)
22. If the IPS level did not come down substantially or got worse, either a mistake was made in the procedure, or the machine is mechanically damaged and will not balance. Inspect the View Hist screen to see if the Sens and Tach Offset columns make sense* and check the View Plot screen to see if the move lines went in the expected direction and length. Evaluating these two screens will usually lead to what may have gone wrong. Start over and repeat the procedure. If repetition does not work, ask for help or carefully inspect machine for damage.

* On first line, sens and tach should be the default or initial values. They should change from line 1 to line 2 as the Microvib II has learned. From line 2 to 3 and forward, the sens and tach values would ideally remain constant, but you should expect them to vary slightly. Sens usually will vary +/- 25% and Tach will usually vary as much as +/- 25 degrees.

2.7 Weighing Procedures

Reducing the Effect of Wind

When weighing out balance weights using the gram scale, shelter the scale from any wind as readings will be much more stable.

Changing bolt length using Tare.

You will often be faced with using a longer bolt to hold new balance weights. You can weigh the old bolt, weigh the new bolt and then subtract the difference, but there is a simpler method.

Place the old bolt on the scale and press the TARE key on the scale. Wait for the scale to read 0 and then remove the old bolt and add the new bolt and new weights. The scale will read the net weight added to the location.

Weighing Very Light Weights

To weigh very small weights accurately, weigh 10 of the weights and divide the reading by 10.

2.8 History File

The MicroVib II stores the complete history of the balancing operation including task, measurement RPM, vibration level, phase angle, adjustments made, time, date and the aircraft factors (Sensitivity Factor and Tach Offset) for each balance run. Each History file can have up to 10 tasks. Each task can have a unique name, can use different sensors, can have names for adjustment locations (Red Blade, Target Blade, Chord Arm etc.) and names for the type of move (flats, degrees, placquettes etc) and can have different initial aircraft factors. The unit can store a large number of history files indefinitely.

2.8.1 View History

To view the current task history from the Balance Run, Solution or Verify screen, press the **VIEW HIST** Key. To view the history for another task, you must change tasks by pressing the **TASK** key.

2.8.2 Default History Files

When the unit is first received it always starts out with an initial history file called DEFAULT.HST. New balance data will be stored in this default history until a new history file is created. When the Disk is formatted (erased) the default history file is DEFAULT.HST. The current history file is not written to disk until you create a new history file or turn the unit off.

2.8.3 Printing History (See Section 1.14)

2.8.4 Clear History

History files will be retained indefinitely, but if you want to erase a history, there are three ways.

1. If you want to clear only the history for the current task, view the history, press the **CLEAR HIST** key and then the **DOWN ARROW** key as prompted.
2. If you want to clear the history for all tasks in this history file, you can erase the file. See section 1.13.3.
3. If you want to clear (erase) all balance histories and all other files as well, you can format the disk. See Section 1.10.17.

2.8.5 New History File

If you want to close the current history file and start fresh with a new one, press the **MODE** key in any screen, then press the **CONTROL PANEL** key and then **NEW HISTORY FILE** key. This will save the current history file to disk and the Select Group screen will prompt you to choose a group file or a template for a group file. If the aircraft you are working fits any of the templates or group files listed, choose that template or file. If the aircraft does not match any of the templates or group files shown, try to pick the template of the type of aircraft that is most similar to the one you are working. You can modify the task settings in the group file after you have chosen it. Once you get the task settings the way you want them, you can save the settings by the **SAVE(EXPORT) GROUP** function.

2.8.6 Evaluating History Data

The view history screen data can provide very useful insight when balancing problems arise. The columns labeled Sens and Tach are the ones to watch. The Sense and Tach of the first line should be the default values from the group or template file used or they may be the values keyed in or the starting values from the App note. The values should change from the first line to the second line. This means the MicroVib II “learned” the response of the rotor. If the values did not change, an error was made. Either learning mode was turned off, or the first trial adjustment was too small. If the move

line from vibration point 1 to point 2 is less than .1 IPS, the unit will not learn. This minimum moveline can be adjusted in Balance Options, Advanced Options.

If learning mode was kept on during the rest of the balancing process the Sens and Tach value should have stayed pretty much the same. It is normal for the Sense value to vary up to about 25% and the Tach value to vary up to about 30 degrees, but if they vary much more than these “fuzzy” values, either a mistake was made or the rotor is mechanically unsound or “nonlinear”. Experience will lead you to find what kind of wear or damage causes what kind of balancing problems. Nonlinear rotors are generally well known among mechanics with balancing experience on that rotor or shaft.

2.9 Task Functions

Each History can have up to 10 tasks. Tasks are used on multi-engine prop aircraft to keep all the data on that aircraft in one history. This function is also used to keep all the tasks involved in working a helicopter in one history. A typical helicopter history might include five tasks: Ground Track, Tail Rotor Balance(T/R), Main Rotor Hover Lateral Track & Balance(HoverLat). Main Rotor Mid Speed Vertical Track & Balance (MidSpeed), Main Rotor High Speed Vertical Track & Balance (HiSpeed). The **TASK** key leads to the Select Task screen where you can select tasks or setup tasks. The balance task names are defined by the group file selected when the history file is first created. The task names and details can be changed in Task Setup (see below).

The Task function also helps keep data organized. Every time a waveform, spectrum or track plot is saved using the **SAVE PLOT** function, the current history name and task name is recorded and displayed when that plot is recalled.

2.9.1 Task Setup

In the Select Task screen, the currently selected task is darkened. If you press the **TASK SETUP** key, it will lead to the Task Setup screen. This screen has five function keys as follows:

Set Task Name - This key leads to an alphanumeric data entry screen where you can enter the name you want for the current task.

Set Input Channels - You can select which accelerometer and tach sensor is to be used for this task.

Set Initial Sensitivity Factor- This data is usually printed in the app note for the target aircraft rotor. Or you may have balanced a rotor of this same type before and this value is in your records.

Set Initial Tach Offset - Same as above.

Restore Task Defaults - If you want to return the task setup values to their factory default values, press this key.

2.10 Group Files

Group files are a way of setting up the MicroVib II to perform a set of track & balance tasks with task names, adjustment location names, adjustment unit names, location angles and radii. These setups help the user understand the solutions provided by presenting them in a clear fashion. These files can contain up to 10 predefined tasks. Each task can be either a standard rotor or a program rotor.

A **standard rotor** is one where all adjustment locations have the same radius. Solutions will be presented as a single adjustment at a single location and you can then split that solution to any two angles. Two examples of standard rotors are most propellers and Bell 206 tail rotors with balance wheel.

A **program rotor** is one with 3-8 locations on the rotor where adjustments can be made. Program rotors can have adjustment locations at multiple radii. Solutions will be presented already split between the available locations and you can scroll thru the various possible solutions without ever keying in any split angles.

Every history file has a group file contained within it. The group file can be thought of as the structure for the history file. When you create a new history file, you will have to specify a group file or template to be used. Once this is done, you can modify the current group file by selecting the **TASK** key available in any balance screen.

2.10.1 Creating a Group File

Although you can create a group file by itself, it is easier to create a new history file and then change the task definitions in that history file. When you are happy with the task definitions, you can then use the **SAVE (EXPORT) GROUP** function in the Advanced Controls section of the control panel to save the group file to disk by itself.

Procedure:

1. Press **MODE, CONTROL PANEL, NEW HISTORY FILE**.
2. Select Group screen is displayed. Choose a template or group file that is most like the aircraft you are working.
3. Enter History Name screen is displayed. Press **OK** to use the name automatically created or enter a name of your choice.
4. Select Operating Mode screen is shown. Select Prop/Rotor Balance and press **START ANALYSIS** key.
5. Balance Run screen is shown. Press **TASK** key.
6. Select Task screen is shown. Select the task you want to set up first and press the **TASK SETUP** key.
7. Task Settings are shown. At this point you can select **STANDARD ROTOR** or **PROGRAM ROTOR**, you can **SET TASK NAME** to change the task name. You can **SET INPUT CHANNELS**, to select the acc and tach channels to be used. You can **SET INITIAL SENS FACTOR** or **SET INITIAL TACH FACTOR** if you know the correct values.

8. If you have chosen **PROGRAM ROTOR** in step 7, you can change the program values by pressing the **SET ROTOR PROGRAM** key.
9. Rotor Setup Screen is shown. You can change the number of locations by pressing the **SET NUMBER OF LOCATIONS** key and entering 3-8. You can select a particular location to modify using the UP and DOWN arrow keys. An arrowhead on the screen will indicate which location you are currently modifying. You can change the adjustment units, location name, location angle or radius value by pressing the appropriate key shown and entering the new value or name.
10. At this point you can also use the **COPY LOCATION** function key to copy the information from one location over to another location. You do this by positioning the arrow on the location you want to change and pressing **COPY LOCATION**, you will be prompted to enter the location of the source of the data to be copied
11. At this point you can use the **RESET LOCATION** key if you want to reset the current location to default values. Default values for adjustment units are Grams, for adjustment location is LOC(X) where (X) is the location number. For radius, the default value is 1.
12. At this point you can set the Skip Factor* If the number of locations is 5 or 6, you can set the Skip Factor to 1 by pressing the **RIGHT** arrow key. If the number of locations is 7 or 8, you can set the skip factor to 1 or 2 by pressing the **RIGHT** arrow key.
13. When the task setup is finished, press the **DONE** key to exit back to the Select Task screen. Repeat steps 5-12 for the rest of the tasks.

*The Skip Factor is a device used (in program rotor) to tell the Microvib II to present all solutions split wider than just two adjacent locations. A skip factor of one will force all solutions to skip over one blade and split the solution between blades 1

and 3 for example instead of 1-2 or 2-3 on a 5 blade rotor.

2.10.2 Templates

Templates are group files that are included in the firmware for the unit. They cannot be modified or erased. They can be thought of as basic starting points to make group files for the most common kinds of helicopters. The MicroVib II includes templates for the Eurocopter AS350, Bell 206/206L, Bell 205/Huey, Bell 222, Hughes 500C, McDonnell/Douglas MD500D/E, Robinson R22, Schweizer S300C, Augusta A109, Sikorsky S-76, and any fixed wing prop aircraft. Virtually any aircraft can be accommodated by starting with one of these templates and then modifying the task settings to match the target aircraft. When the tasks are correct, you can save the group file as follows:

2.10.3 Saving A Group File

After you have made changes to the group file in the current history file, you can save this group file as a separate item on the disk.

1. Press **MODE, CONTROL PANEL, ADVANCED CONTROLS, SAVE (EXPORT) GROUP.**
2. Enter Group Name screen is displayed. You can accept the name automatically assigned or enter any name you like. Press **OK, DONE** and **DONE** to get back to the Select Operating Mode Screen.

2.10.4 Printing Out the Group File

Group files can get pretty involved, so it is helpful to be able to print out the group file on single sheet of paper. This makes it easier to check to be sure all the details of the group file are correct.

You can print out a group file by downloading the group file to MicroBase and print from there to your PC printer.

2.10.5 Editing Group Files

It is easier to edit group files on your PC using MicroBase. You can also share group files with other users via email with MicroBase. See the help file in MicroBase.

2.11 Reference Information

2.11.1 Propeller-Rotor Protractor

Adjustment location angles must be determined accurately in order for the MicroVib II to learn accurately. This task can be confusing as the direction of rotation is a critical factor. The Propeller/Rotor Protractor is designed to make this task very straightforward.

Following is a procedure for determining the angle location of a weight attachment point.

1. Check the rotor's direction of rotation. For rotors which turn CCW, the BLUE side of the Protractor must be used. For rotors which turn CW, the RED side must be used.
2. Next rotate the Protractor until the 360 degree "pointer" is aligned with the phase reference (this will usually be the reflective tape).
3. Center the protractor on the spinner or rotor disk.
4. Now sight along the protractor's edge to identify the proper angular location of the weight addition points. Alternately, visualize an imaginary line from the attachment point to the center of rotation. Note where this line intersects the protractor.

Alternate Method for Measuring Angles.

Another method for measuring angles on fixed wing props is to use the Prop-Protractor to get a rough idea where the angles are, but to use a narrow blade tape measure to more accurately measure location angles.

1. Use the protractor to mark one location on the perimeter of the spinner, typically one screw location. This is the reference location.
2. Measure the distance from one blade to the next and divide the angle between blades by

this distance. The resulting value is the number of degrees per inch. Example: A 14.3 inch diameter 3 blade spinner has a circumference of 45 inches. Blade to blade distance is 15 inches. $120 \text{ degrees} \div 15 \text{ inches} = 8 \text{ degrees per inch}$.

3. To measure any other location on the spinner, measure the distance from the reference location to the new location and multiply this distance by the degrees per inch determined in step 2.
4. Double check the new location angle by verifying that the prop-protractor is in approximate agreement with your tape measured angle. Be sure to pay attention to the rotation direction. The locations determined by tape measure will be more accurate than measurements made by sighting using the prop-protractor.

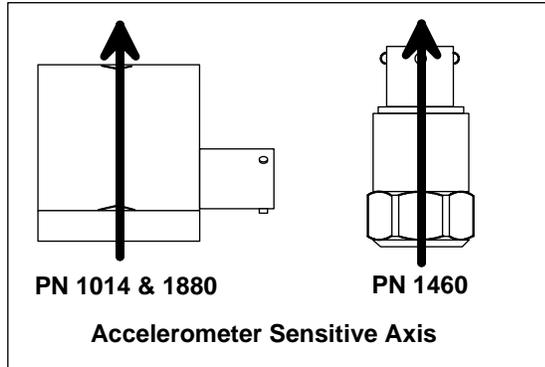
2.11.2 Estimating Tach Offset (Props)

The tach offset is used by the MicroVib II when calculating the angle where the weight or move is to be applied to the rotor. Unless you enter a tach offset when you start a balance job, the first weight location will be based on the default tach offset, which is usually not correct. The MicroVib II will automatically learn the tach offset after the first balance move, but you can save time by estimating the tach offset from the geometry of the installation.

Procedure :

1. Using the prop protractor (while facing the propeller from in front of the aircraft), align the zero degree mark with the sensitive axis of the mounted accelerometer.
2. Note the angle of the mounted photocell. This angle is a good estimate of the tach offset.

It is important to use the side of the protractor that matches the direction of prop rotation.



2.11.3 Estimating Sensitivity Factor

The sensitivity factor is used by the MicroVib II when calculating the amount of weight or adjustment that is to be applied to the rotor. Unless you enter a sensitivity factor when you start a balance job, the first weight amount will be based on the default factor (80), which is usually not correct. The MicroVib II will automatically learn the sense factor after the first balance move, but you can save time by estimating it using the following guidelines.

The sensitivity factor is a function of the mass of the engine-prop combination, the radius of the weight attachment point and stiffness of the engine mounts. This information is not usually available to the user, so we offer here a set of guidelines.

1. Most common piston prop single and twin engine aircraft adding weight to spinner screws or spinner backing plate. Sens Factor = 50-80, (80 is the default).
2. Medium sized aircraft with turboprop power plant. Sens factor 100-120.
3. Large turboprop aircraft, like C-130, E2-C2, P3 etc. Sens factor 250-300.
4. Tail Rotors, Drive shafts, Helicopter Main Rotors etc. Sens factors vary widely, see app note or ask experienced users.

WARNING: *It can be dangerous to add too much weight to a rotor, so unless you have experience, start with a small amount of weight and let the MicroVib II learn the response. Keep in mind that the move line must be greater than 0.1 IPS for the unit to learn. This minimum moveline value can be adjusted in Bal Opts, Advanced Options.*

2.12 Helicopter Track & Balance

Helicopter Main Rotor Track and Balance can seem complicated at times, but if you break it down into a series of small steps, each step is simple and understandable. We have produced a flow chart that depicts all the steps in the process. If you will read this text over, and go over the flow chart a few times, all the pieces will fit together in a logical manner.

Basics.

This flow chart uses short phrases like "Select Midspeed Task" or "Measure Vibration", or "Measure Track". We assume you know how to operate the MicroVib II to do each of these things. If you are not familiar enough to do these things on the unit without getting stuck, it is best to go to the end of this section and familiarize yourself with each of these procedures.

The key points in the flow chart are the decision points. These are labeled with numbers that we will refer to here in the text. Following is a discussion of each of these decisions to be made during the balancing process.

Safety Statement (1)

If an aircraft is shaking badly on the ground, it is best to get the ground track and ground lateral vibration down to a reasonable level before proceeding. Performing a ground lateral balance is very simple, just like balancing a propeller. Once you go to a hover, if the hover lateral is severe, you should probably balance out the hover lateral to a reasonable level before proceeding to forward flight. If the hover track is really bad, you should adjust pitch links to get it within reason before going to forward flight. In forward flight, if the midspeed track or vibration is severe, it is wise to make a pitch link move to get the midspeed track and vibration within reason before going to high speed.

Decision 2

You need to start with good ground track, so this step is necessary. If you are doing the tail rotor balance, you can gather ground track readings and make adjustments at the same time as doing the tail

rotor balance. Do not try to get ground track "perfect", as it will be changed somewhat during the rest of the process. A track reading of 1/2 inch or less is fine.

Decision 3

This is the point you decide whether to stop making pitch link or tab adjustments or continue to make them. Remember, the track may not be perfect, but if the midspeed and high speed vertical vibration levels are below target levels, we recommend you say yes at this point and go on to finish up by doing the hover lateral balance. Never work the hover lateral first, it is a waste of time.

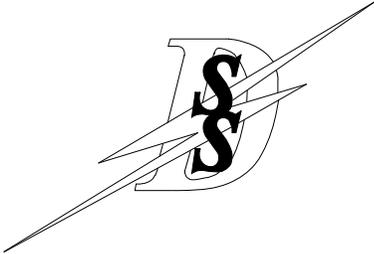
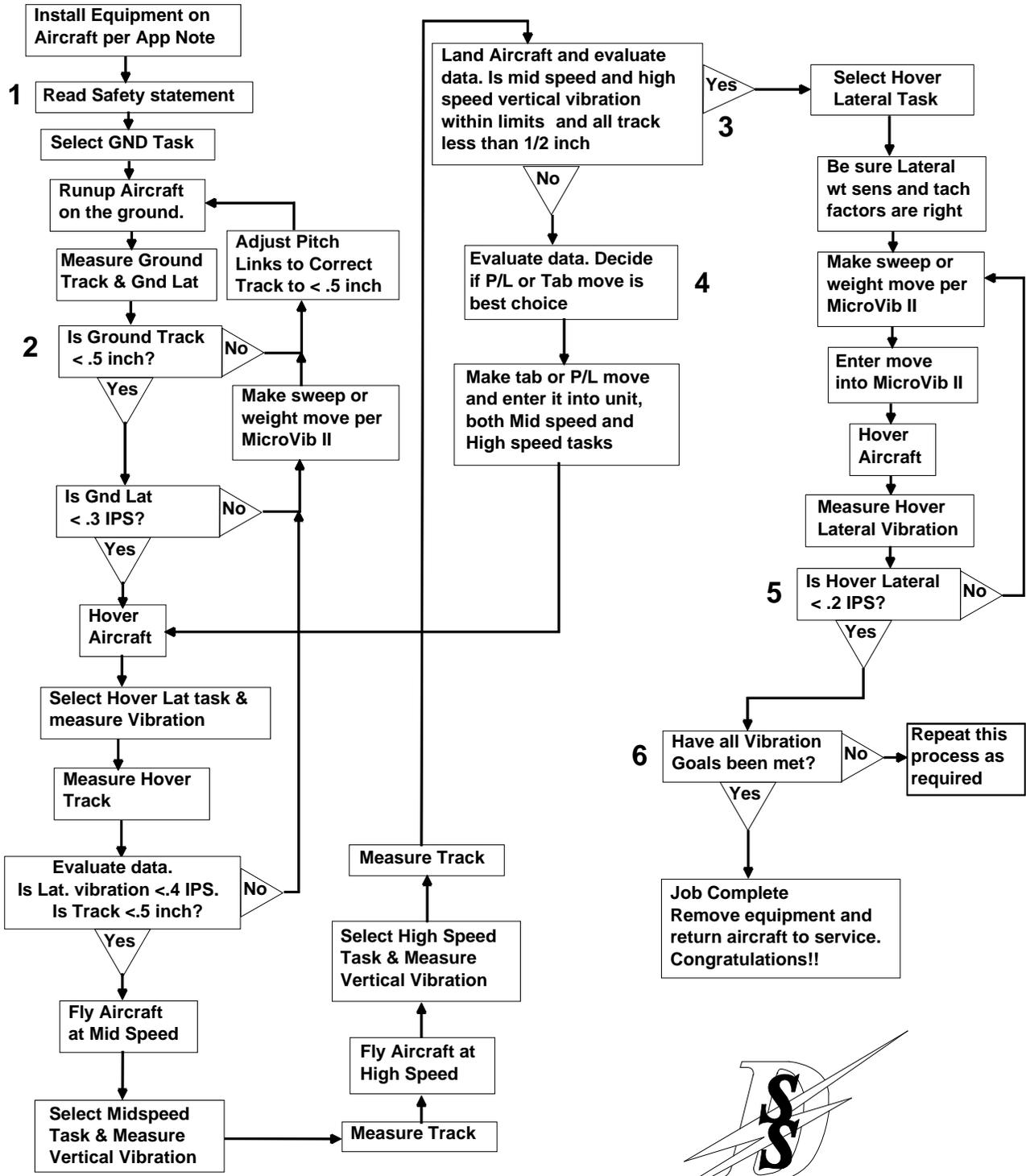
Decision 4

This is the heart of the process. You must look at both the track data and the vibration data to make this decision. Viewing the track data, if a blade is slightly out of track at hover, and gradually more out of track at mid speed and high speed, it is best to make a pitch link change. If a blade is fine in hover and midspeed, but sharply climbing or diving at high speed only, a tab move is best. After the first flight, use only the track data to decide which blade to tab or P/L. Make only a single move, and enter that move into both midspeed and highspeed task. Each blade has a location name and an angle in degrees.

After the second flight, the Microvib II will have learned based on the move entered and it will provide a solution for the next flight. The solution will be in the same form as the move entered before the flight (e.g. tab = tab, p/l = p/l). If the task is setup as a program rotor, the solution will normally be split between two adjacent blades (Read about skip factor in Section 2.10.1). You can scroll thru all possible solutions by pressing the SPLIT key. Look at the solution and the track data to see if the solution will make the track better or worse. If the solution is going to make the track worse, press the SPLIT key until you find a solution that will make the track better.

Main Rotor Track and Balance Procedure with MicroVib II

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Dynamic Solutions Systems Inc.

Also if you are working the pitch link and midspeed solution is radically different from the high speed solution, you should implement the solution for midspeed and then go on to tab to resolve the high speed vibration.

Alternately, if you are working the tab and the midspeed solution is radically different from the high speed solution, you will probably need to split the difference to keep the vibration at both speeds within spec.

When shifting from p/l to tab moves, you should once again make the first tab move based on track data only, and enter the move into the MicroVib II. After the next flight, the Microvib II will present a solution in terms of tab.

Remember, perfect visual track and minimum vibration only occur simultaneously with perfect blades. ***There are no perfect blades.*** You will find it is common for blades to be slightly out of track when minimum vibration is achieved. It is a very common mistake to achieve good vibration levels and then make one final tab move to sharpen up the visual track, only to find the vibration is now out of spec. You will almost never have both perfect visual track and minimum vibration, you must choose one or the other as a goal. We recommend you aim for minimum vibration and not be concerned about a small out of visual track condition (1/2 inch).

Decision 5 and 6

Experience has shown that a moderate amount (.3-.6 IPS) hover lateral can be corrected with blade sweep or adding weight at the end of the process. This correction will not change the track or forward speed vertical vibrations.

Ground Rock

It is common to correct the hover lateral and find that you now have a “ground rock” or ground lateral vibration. This can be caused by unequal dampers on articulated rotors. It is possible to use lead-lag data to find the damper that is causing the problem. Just take a lead-lag reading at 100% on the ground and compare it to a lead-lag reading in hover. Ideally the two readings will be identical,

but if not, you can see which blade is moving out of the pack. If you choose to live with the existing dampers, you can equalize the vibration between ground and hover by producing a solution for both and then splitting the difference.

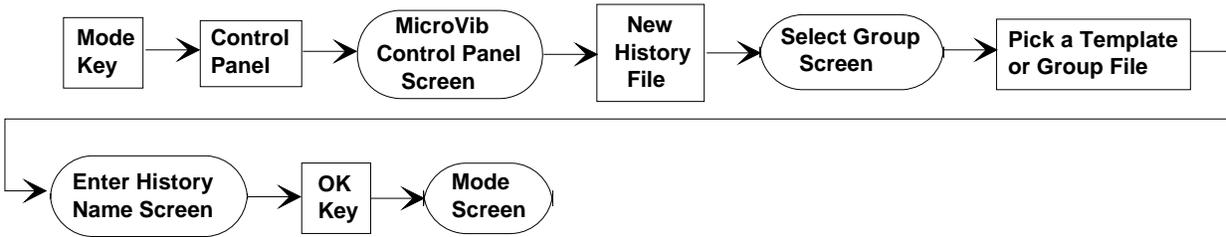
Common Myths about Pitch Link Adjustments

It is a commonly held belief that pitch links should be adjusted to produce flat track on the ground at either 65% or 100% and then LEFT ALONE. Experienced mechanics have taught us that this is a myth. The pitch link ground adjustment should be thought of as just a coarse setting and the mid and high speed track and vibration data may indicate that the pitch link should be fine tuned for forward flight. The key relationship to remember is that the pitch link will effect track at hover, mid speed and high speed in gradually increasing amounts, while tab will only effect mid speed track moderately and high speed track strongly. We have found that starting out with minimum tab and pitch linking to get the mid speed track and vibration good will leave only a small tab move required to finish the rotor. This will put the hover and ground track slightly out, but this is not crucial and hover vertical vibration is very low under these conditions.

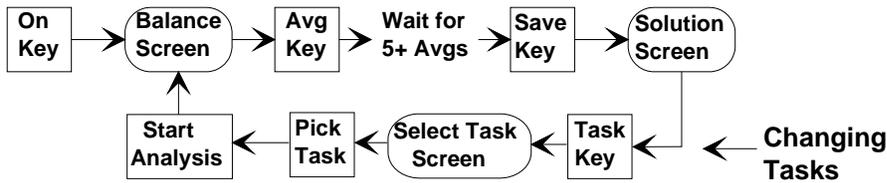
Why? Our theory is that blades only show their true colors when loaded up. The dynamic loading of hover and flight will show up a pitch link that needs to be adjusted even though it was "perfect" on the ground. The alternative is to try and put a large tab adjustment in to correct the small pitch link error. This condition will be accompanied by data that shows more tab will improve track, but make vibration worse. This is often accompanied by a mechanic who claims "these blades just won't fly together".

This procedure covers the basics for all standard type helicopters, but each type has unique traits. See our app notes for tips and hints on each type of helicopter.

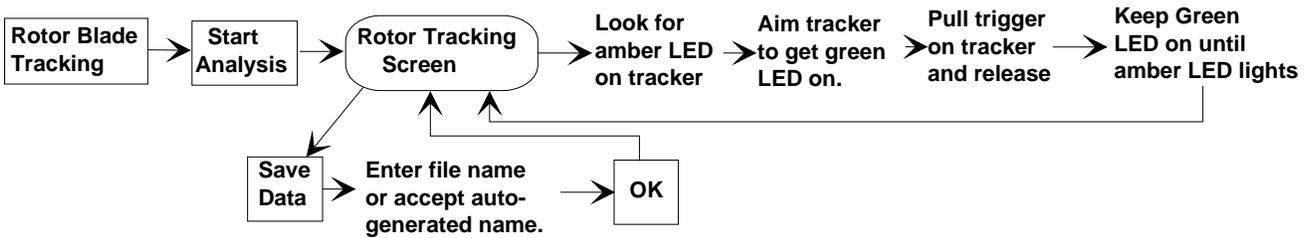
Getting Started



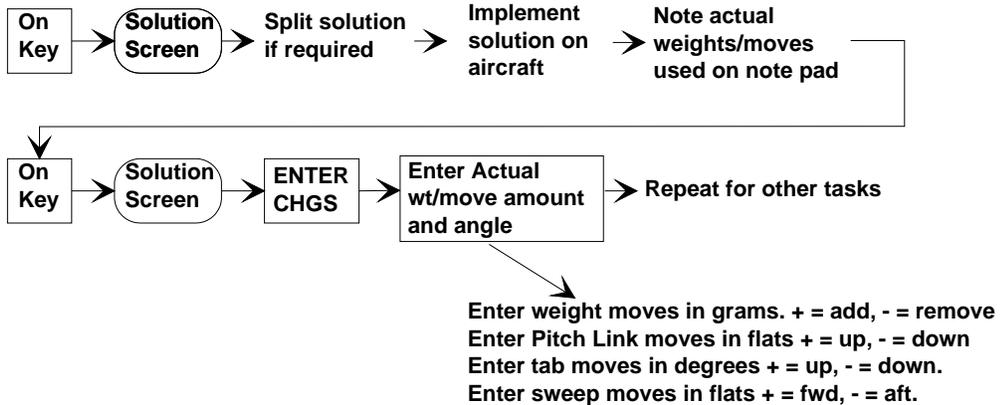
Gathering Balance Data In Flight



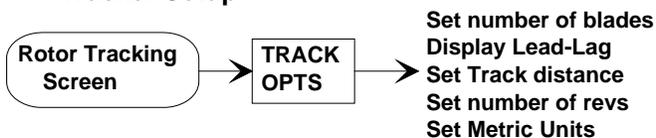
Gathering Track Data in Flight



Implementing Balance Solutions on Ground



Tracker Setup



Chapter 3 Spectrum Mode

The Spectrum Analysis mode of the Microvib II displays a spectrum plot of the input signal. A spectrum plot shows the vibration amplitude vs. frequency on a graph. To accomplish this we use the FFT algorithm. The FFT algorithm divides up the current frequency range into 50, 100, 200, 400 or 800 bins. Each bin is a narrow band filter. It is important to understand that the bin frequency is not the same as the signal frequency. Many FFT analyzers only provide the frequency and amplitude of each bin and cannot accurately measure the actual signal frequency and amplitude. The MicroVib II provides a Peak Locate algorithm that calculates the actual signal frequency and amplitude using the known relationship between bin values and the signal.

In addition to the spectrum plot, the display provides additional information pertaining to the input signal and spectrum as described below.

3.1 On Screen Data

1. Full-scale amplitude level on spectrum plot
2. Graphically represents the available signal dynamic range and current peak input signal with a 0 to full scale bar graph.
3. Shows the Data Units and the Units Type.
4. Indicates the ACTIVE or FREEZE display status.
5. Indicates frequency units - Hz or CPM.
6. Indicates the Max and Min frequency of the current spectrum plot.
7. Indicates the frequency and amplitude at the current cursor location.
8. Indicates the cursor mode.
9. Indicates the window type.
10. Indicates the number of bins

11. Optionally can show time and date on screen
12. Shows current task and sensor selection
13. Shows current charge status of battery.
14. Indicates if data averaging is on or off.

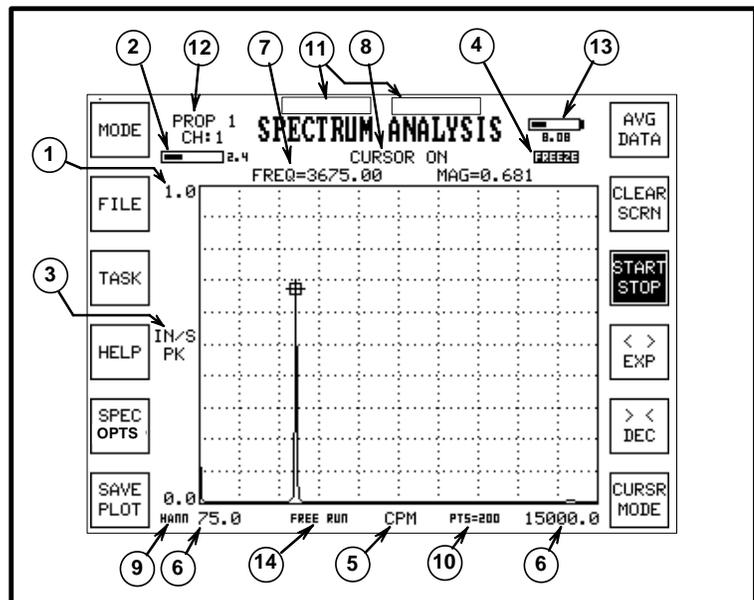
3.2 Function Keys

The analyzer's function keys provide the following actions in spectrum mode.

The **AVG DATA** key enables and disables the averaging function. The maximum number of averages can be set using the **SPEC OPTS** key.

The **CLEAR SCREEN** key empties the data buffer and starts the autorange process over again. If the unit is averaging, this key empties the current average data buffer and starts the averaging process over.

The **LEFT** and **RIGHT** arrow keys position the cursor to the frequency of interest on the spectrum plot. You may press the key once for an incremental cursor movement, or press the key and hold to continuously move the cursor across the plot. The cursor status and present frequency location and amplitude are indicated at the top of the plot.



The < > **EXP** key zooms in the view and centers it on the current cursor location. This is useful to examine several tightly bunched spectral lines.

The > < **DEC** key zooms the view back out to see a larger range of bins.

The **START STOP** key freezes the display for closer analysis or to file or print the spectrum shown. Press the key again to return to live mode.

The **UP** and **DOWN ARROW** keys change amplitude full scale value of a spectrum plot. This is to get a better view of smaller signals in the presence of a large signal.

3.2.1 Cursor Modes

The **CURSR MODE** key activates additional cursor modes that can be used to identify frequencies more accurately within the spectrum plot. Press the **CURSR MODE** key repeatedly to step through the five modes described below. The four cursor "on" modes are indicated at the top of the display.

Cursor Off - Cursor is not displayed on the screen and the cursor mode indication is blank.

Cursor On - The cursor is always placed on an actual FFT bin and the cursor detail will show the actual FFT bin amplitude and frequency. This mode is indicated by a square crosshair cursor depicting the bin location. **It is important to remember that the FFT bin frequency and amplitude are not the same as the incoming signal frequency and amplitude.**

Peak Locate - The cursor position and cursor detail are interpolated between adjacent bins in order to show the actual vibration peak amplitude and frequency. The Peak Locate mode should be used whenever high accuracy vibration amplitude and frequency are desired. This mode is indicated by a round crosshair cursor depicting the actual vibration peak. Note: The interpolation algorithm will sometimes be unable to discern the peak value based on adjacent FFT bins and will be shown as the square crosshair as described in the Cursor On section above.

Harmonic - This cursor mode will display the previously described Peak Locate cursor along with up to 16 harmonic markers. Harmonic markers will be round only if the harmonic peak can be interpolated by the peak locate algorithm and square if not. The harmonic markers are locked in position when this mode is entered and moving the cursor will not change their locations.

Move Harmonics - This mode marks the harmonics just as the Harmonic mode did, but in this mode, when you move the cursor, all the harmonic markers move with the cursor. Anytime a harmonic marker lands on a peak, its shape will change from square to round.

Mode - This key allows you to change modes

File - This key provides access to the File Directory Screen.

Task - This key allows you to select the task. Task setup is only available in Balance Mode.

Help - This key provides information about the current function.

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the automatically assigned name.

SPEC OPTS key is described in the next section.

3.3 Spectrum Options

This key takes you to a screen where you can adjust the way the Spectrum mode works. The following selections and changes can be made:

3.3.1 Frequency Ranges & FFT Bins

Set Frequency Range and Number of Lines - This screen allow you to pick from 50-800 lines of resolution and from 250Hz thru 20KHz Fmax.

Set Minimum Frequency - This screen allows you to enter the minimum frequency you want to display on the screen. Moving the cursor left will override this limit when desired. The lowest bin frequency is always Fmax/Number of lines, so you cannot go below this frequency in any case.

3.3.2 Trigger Setup

Set Trigger - This key leads to a menu of options called Trigger Settings. **TACH TRIGGER** will synchronize the data collection to the tach input. **AUTO TRIGGER** will attempt to automatically synchronize the data collection to the incoming signal. **LEVEL TRIGGER** allows the user to set a signal level that will initiate data gathering. **SET TRIGGER LEVEL** presents a data entry screen for setting the trigger level in display units. Entering zero for the trigger level will cause the unit to automatically set the trigger level to 25% of the input signal range. **SET TRIGGER DELAY** leads to a data entry screen where the user can enter a time delay (in milliseconds) between the trigger event and the start of data collection. **MAXIMUM INPUT** presents a data input screen where the user can disable the autorange function and set the full scale range to a fixed value. Entering zero enables autoranging. **AUTO-REPEAT** will start a new data gathering cycle on the next trigger after the data has been displayed. In **SINGLE SHOT** mode, the unit will trigger once and then hold the data, ignoring subsequent triggers until **START/STOP** key is pressed.

3.3.3 Display Units & Units Type

Set Display Units - This screen allows you to select the units of the vertical scale on the

spectrum. Sensor units, Accel units, Velocity units, Displacement units, Metric units, Log Scale, dB units. It also allows you to select the units type: RMS, Peak, Average or Pk-Pk.

Advanced Options - See next section.

3.3.4 Averaging Setup

Maximum Number of Averages - This screen allows you to select the number of averages you want the unit to take before it terminates averaging and starts a new average. You can enter a value of up to 99.

Average Type - Three keys: Linear, Exponential, or Peak Hold allow you to select what kind of averaging the unit will use.

Linear averaging is simply adding all the data up and dividing by the number of averages. The unit will count up to the Maximum Number of Averages and then automatically start over. The number of averages is displayed on the screen in this mode.

Exponential averaging is more of a "smoothing" function that provides more weight to recent data and assigns a lower weight to older data as time passes. The screen indicates EXP for this mode.

Peak Hold Averaging is not really averaging at all. In this mode the unit records the highest reading each bin has received since the **PEAK HOLD** key was pressed. This mode is useful for monitoring turbine engine spool-ups to see if any rotor in the engine is going through a seriously high transient vibration as the shafts pass through critical speeds.

Advanced Options

3.3.5 Flat Top, Hann or Rect Window.

A window function is a mathematical process which is applied to the sampled vibration data before it is converted from the time domain (waveform) to the frequency domain (spectrum) via the Fast Fourier Transform (FFT). A window function is applied to the data in order to reduce undesirable effects of the sampling process in the computed spectrum. These "real world" effects are

caused by sampling discontinuities which unavoidably occur at the beginning and end of the sampling period. The user can optimize the performance of the spectrum analysis function for a particular job by selecting the most appropriate window function for that job.

FFT windows are basically compromise functions balancing the need for amplitude accuracy and the ability to resolve the frequency value accurately. Fundamentally the window function determines the shape of each of the 400 or 800 etc filters in the FFT spectrum.

The Flat Top window provides a slightly wider bandwidth compared to other windows but the highest amplitude bin will always be very close to the actual amplitude of the signal. This more accurate amplitude value comes at the price of lower frequency resolution. That is, the displayed bin value data will not show you clearly what the RPM of the signal is. There will be at least two adjacent bins with virtually the same amplitude value, so from these bin values alone, you will not be able to determine what the frequency of the signal is with much resolution. This also means that if you are trying to see sidebands near a peak, they will probably not be visible with this window.

The Hann Window (aka Hanning Window) is much narrower when compared to the Flat Top window. One bin will usually be the highest in amplitude, and this will be a pretty accurate measure of the frequency of the signal. However, even the highest bin value will be less than the true amplitude of the signal. This window is good for giving you an accurate picture of sidebands around a peak, while compromising the amplitude accuracy.

Rectangular Window (aka Boxcar Window or “No” Window). This window provides a filter shape which is even narrower than the Hann window near the peak of the signal, but the skirts of the filter are not very steep out away from the peak. This window will tell you you have some energy 10% away from the actual signal value, when there is no energy there at all. This is only true with continuous signals however. It is not true if the signal itself is a transient type of signal. This window is actually the best choice for transient

type signals like hammer tuning as it provides the best frequency resolution of all.

The Peak Locate cursor function of the MicroVib II corrects several of the compromises of each of these windows. It looks at the value of the adjacent bins near the peak of a signal and then determines both the exact amplitude and frequency of the signal itself. Thus eliminating most of the drawbacks associated with the compromises mentioned above. It is for this reason we use the Hann window as the default window type and provide the peak locate function to determine exact amplitude and frequency values.

3.3.6 Show Overall

When “Show Overall” box is dark, the spectrum screen will be annotated with the overall vibration level in the upper right corner of the data area. Overall is an algebraic sum of all the displayed peaks in the spectrum. (default is on). The overall function can be used to measure the broadband vibration amplitude between any two frequencies by setting an Fmin and an Fmax. This allows the MicroVib II to provide readings of engine vibrations equivalent to very old vibration instruments used for turbine engine testing.

3.3.7 10 Hz High Pass Filter

This option puts a 10 Hz high pass filter in the signal path. There are many cases where the random low frequency vibration data is very large compared to the vibration of interest. Engaging this filter will greatly improve signal to noise ratio in this case and you will be able to make more accurate low level readings. Aircraft aerodynamic turbulence is dominated by low frequency random vibrations. (default is off)

Note: This high pass filter should never be used on Helicopter Main Rotor work.

3.4 Spectrum Procedures

This section covers vibration spectrum measurement only.

Taking a Spectrum

The following procedure assumes you have properly mounted the vibration sensor securely using an appropriate bracket and have routed the sensor cable and connected it to the MicroVib II.

1. Operate the engine for a minute or so to warm it up to normal operating temperature.
2. Operate the engine at the RPM of interest and press the **ON OFF, MODE, SPECTRUM ANALYSIS,** and **START ANALYSIS** keys on the analyzer.
3. Press the **AVG DATA** key if an average is desired.
4. After the averaging is complete, or when the data appears valid, press the **START STOP** key to freeze and analyze the data.
5. Press the **SAVE PLOT** key to store this spectrum plot in memory. You will be prompted to name the plot or accept the auto-generated name.

Note: We recommend you take a Spectrum reading before and after you balance any rotor and keep these records in MicroBase for future reference.

Chapter 4 Waveform Mode

The waveform mode displays the amplitude of the input signal versus time rather than versus frequency. This is useful under certain special conditions. For the most part it is used in the same way an oscilloscope is used to examine any kind of signal.

4.1 On Screen Data

The Waveform Analysis screen provides the following on-screen information

Task Name - Selectable using the Task Key. Task names can only be changed in the Balance mode, Task, Task Setup screen

Sensor channel - Selectable by selecting tasks. Sensor channel assignments can only be changed in the Balance mode, Task, Task Setup screen.

Full scale A-D range and current peak value of signal in bar graph form.

Full scale Amplitude Value

Display Units - Default type is Acceleration in G. Velocity, Displacement or Sensor units can be selected in Wave Options.

Time Axis - Provides start time and end time of the data block.

Time units - Milliseconds

Points - Number of data points in the data block.

Sample Rate - Rate at which the data was sampled. Units are Sample/Sec.

Time and Date - Optionally selected in the control panel.

Battery Voltage and Bargraph.

4.2 Function Keys

The waveform analysis screen provides the following function keys:

Mode Key - Allows user to select other modes

File Key - Allows user access to the file directory

Task Key - To change tasks.

Help Key - Provides information about the current function.

Wave Options - This key is described in the next section.

Save Plot Key - Used to save the current waveform plot to disk. User is prompted to enter a name if desired or the automatically assigned name will be used.

Anti-Alias Key - In waveform mode, the default setting has the Anti-Alias filter off (Bypassed). By pressing this key you can put the anti-alias filter in the signal path.

Clear Screen - Erases the data buffer and starts over.

Start-Stop Key - Freezes the screen. Useful when printing or saving a screen.

< >EXP Key - Zooms in on the waveform to get a closer view of a time space.

> < DEC key - Zooms out to get a wider view of the data.

Cursor Mode - Scrolls thru the following Cursor Modes:

Cursor Off - No cursor shown

Cursor On - Turns on cursor and displays the time and magnitude of the signal at the cursor location. Left and Right arrow keys allow you to position the cursor in time.

Delta Cursor - In Delta Cursor Mode, the current location of the cursor becomes the first cursor location. By using the right or left arrow keys the Delta cursor may be positioned independently of the first cursor. Along the top edge of the screen will be displayed DT which is the time difference between the first cursor and the delta cursor, F which is the frequency that would correspond to DT ($F=1/DT$) and DM which is the amplitude difference between the two cursors. DM is useful if you are trying to position the delta cursor at the same amplitude on the next cycle of the signal

600 CPM (10Hz) Min Freq - If this key is dark, a 10 Hz high pass filter is in the signal path. Default is off. Aircraft vibrations are often dominated by very low frequency random noise caused by aerodynamic forces. In order to see the vibrations of interest, it is often helpful to filter out these very high amplitude low frequency signals.

120 CPM (2Hz) Min Freq - If this key is dark, the 10 Hz high pass filter is bypassed, allowing viewing of very low frequency signals down to the lower input limit of 2 Hz. This is the default setting.

4.3 Waveform Options

The Waveform Options key provides a means to control the way the Waveform mode works.

Set Sample Rate and Number of Points:

You can select sample rates of 1024 Hz, 5120 Hz, 25.6KHz, and 51.2 KHz. You can select 128 thru 2048 points in four binary steps. The data can be put through an anti-alias filter before sampling to prevent the waveform mode from displaying false alias signals. See Section 4.2. The anti-alias filter will remove higher frequency components of any signal, which will often appear to be introducing “ringing” distortion of sharp edged signals.

Set Display Units - This screen allows you to select the units of the vertical scale on the display. Sensor units, Accel units, Velocity units, Displacement units and Metric units.

Set Trigger - This key leads to a menu that allows you to setup how the unit triggers the data capture. See section 3.3 Set Trigger.

Chapter 5 Tach Ratio

The tach ratio display provides a display of actual rotor or engine rpm even when the tach generator runs at a different speed than the target rotor. It also provides a display of %RPM once the user has specified the 100% RPM of the target rotor or device.

5.1 On Screen Data

The Tachometer Rate screen provides the following data on screen.

Target Speed in %RPM Digital Readout

Target Speed in %RPM in Analog Bargraph Form with 110% max.

Actual RPM of the Target, Digital Readout RPM or Hertz (RPM or Hz is selected from Control Panel)

Actual Input signal rate in RPM (RPM only)

User Entered 100% RPM of Target. (RPM only)

Task Name - Selectable using Task Key

Tach Sensor Channel - Selectable via task. Task Sensors can only be changed from Balance Mode, Task, Task Setup screen.

Time and Date - Optionally as selected in Control Panel.

Battery Voltage and analog bargraph of battery energy remaining

5.2 Function Keys

The Tach Ratio Mode provides the following function keys:

Mode - This key allows you to change modes

File - This key provides access to the File Directory Screen.

Task - This key allows you to link any saved screens to particular tasks.

Help - This key provides information about the current function.

Tach Options - This key is described in the next section

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the automatically assigned name.

Avg Data - This key will engage exponential averaging of the Tach data. This will smooth out any rapid changes in the tach rate display.

Clear Screen - This key clears the data buffer and starts the measurement over.

Start Stop - This key freezes the screen. Useful for printing or saving a screen plot.

5.3 Tach Options

This key leads to a screen where you can control how the Tach Rate function operates.

Set Input RPM - Enter the 100% RPM of the Tach Generator. If the tach signal is 1 pulse per rev of the target rotor, then this value is the same as the 100% RPM of the target rotor. Normally the signal out of the tach generator will not be at the same rate as the target rotor.

Set Target RPM - Enter the 100% RPM of the target rotor. This is the rotor you are interested in. The large bargraph will be displaying the RPM of this rotor.

If you only know the 100% RPM of the Target Rotor and the Gear Ratio of the tach generator to the Target rotor, you can calculate the 100% RPM of the generator using simple math.

Chapter 6 Optical Tracking

Blade Tracking is the process of measuring the physical location of the blade tips when the rotor is turning. It is important to remember that zero blade track does not normally coincide with equal blade loading. Our goal in measuring blade track is not to minimize blade track, but rather to minimize vertical vibration which does coincide with equal blade loading. We use the track information to help us decide which blade needs an adjustment, but our goal is always minimum vibration and not minimum track.

The MicroVib II supports two methods of blade tracking: Optical Tracking and Strobe Tracking. The selection of which type of tracking is done is made by the kind of MUX unit that is connected to the MicroVib II. Tracker MUX PN 1450 and MicroTrack PN 1145-X are used to perform optical blade tracking. Strobe MUX PN 1680 and a compatible strobe are used to perform strobe blade tracking.

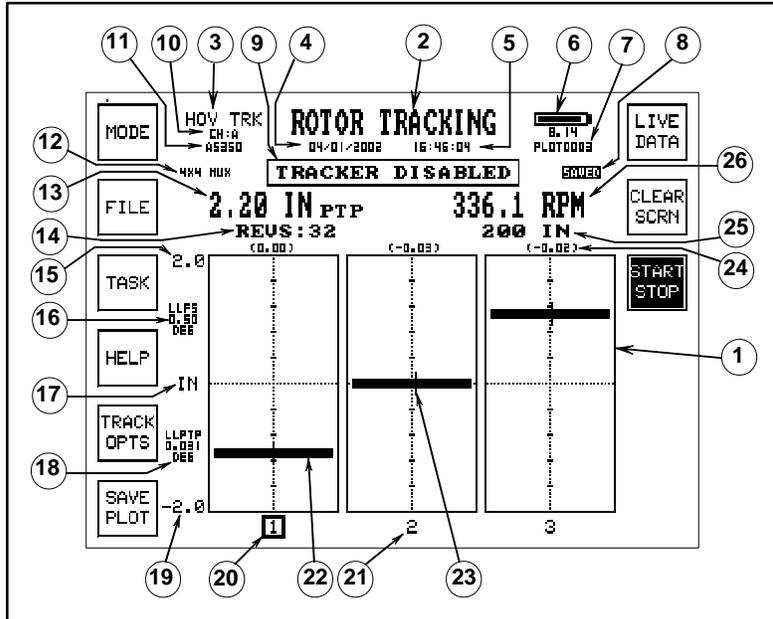
In either case, to access the Blade Tracking Mode from any analysis screen press the **MODE** key, press the **ROTOR BLADE TRACKING** key and press **START ANALYSIS**.

6.1 On Screen Data

Optical Track Mode provides the following on-screen data

1. Graphical Display of Track Data: Data is relative to the average of all blades. If data goes off screen, a bold arrowhead will indicate data is off-screen

2. Screen Title.
3. Task Name: The current task name is displayed. This name is user definable.



See task setup to name the task

4. Current Date - Optional See 1.10.12
5. Current Time - Optional See 1.10.12
6. Battery Status Indicator - Digital readout of voltage, bargraph of battery energy and charging status.
7. Current history file name or saved plot file name.
8. Freeze/Saved Indicator: This is a small indicator that indicates FREEZE after the data gathering is complete. It indicates SAVED when a screen has been recalled from disk.
9. Status Indicator Area - This part of the screen will indicate "READY FOR TRIGGER" when the unit is ready to

- gather track data. It will indicate “PROCESSING TRACK” while the unit is gathering track data. It will indicate “TRACKER DISABLED” when viewing a saved plot.
10. Tach Channel Indicator - The current tach channel is shown here. The tach channel selection is made in the Task Setup (Sec 2.9.1). When a track screen is recalled from disk, the tach channel used when the data was collected is displayed.
 11. Group File Name - The group file name is shown here. The group file name is selected as part of creating a new history file. (See Sect 2.8.5)
 12. MUX Indicator - If a MUX unit is connected, this indicator will show it.
 13. Digital readout of blade track amplitude. The difference between the highest blade and the lowest blade.
 14. Number of Revs: The number of revs of data that will be collected before the data is displayed. This value is user selectable in the Track Options screen.
 15. Track full scale amplitude at top of display.
 16. Lead Lag full scale amplitude.
 17. Track data unit of measure - User selectable to inches or mm in Track Options screen.
 18. Digital Readout of Lead Lag Amplitude in degrees peak to peak.
 19. Track full scale amplitude at bottom of display.
 20. Lead Lag Reference Blade - Rectangular box indicates which blade is being used as the reference blade for Lead Lag calculations. User selectable with Right or Left Arrow.
 21. Blade Number - The blade identified as number 1 in the track display is the blade which is positioned closest to the point at which the MicroTracker is pointing when the rotor is static (non-turning) and the photo-tach is aligned with the reflective tape. Blade order is defined as the order in which the blades pass a particular point on the disk. Blade 2 is the next blade to pass after blade 1.
 22. Blade height indicator - Provides a visual display of the blade height.
 23. Lead Lag Indicator - Provides a visual display of lead lag data. Leading blades are shown to the left and lagging blades are shown to the right.
 24. Digital Readout of blade lead or lag as compared to the reference blade. Lead lag data can be turned on or off in the Track Options screen.
 25. Camera to Blade Tip distance. The default value is 200 inches. User can enter this value in Track Options. Units are fixed as inches.
 26. Digital Readout of Rotor RPM. This data is derived from the tach signal.

6.2 Function Keys

The Rotor Tracking Screen provides the following function keys:

Mode - This key allows you to change modes.

File - This key provides access to the File Directory Screen. (See Section 1.13)

Task - This key allows you to select the task or setup the tasks as explained in section 2.9.

Help - This key provides information about the current function.

Track Opt - Track Options: This key is described in the next section

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the automatically assigned name.

Live Data - This key will enable on-screen live display of blade track data as it is being gathered. This mode is not normally used as you must aim the tracker.

Clear Screen - This key will empty the data buffer and start the process over.

Start (TRG) - This key performs the same function as the trigger button on the tracker camera unit. It is mainly useful when using the Tracker Simulator for training.

Start Stop - When viewing a saved track plot, this key will terminate viewing and return the unit to live mode.

Arrow Keys - The amplitude scale can be changed with the Up and Down arrows. The Right Arrow key changes the reference blade for Lead-Lag measurement.

6.3 Track Options

The Track Options function key leads to the Blade Tracking Options screen. From this menu, you can setup the tracker to match the helicopter in use.

6.3.1 Number of Blades

You must enter the number of blades for the tracker to work properly. Keys are available for 2, 3, 4 or 5 blade rotors. If you have more than five blades, press the ENTER NUMBER BLADES key and enter a number from 2-7.

If you enter the wrong number of blades, the unit will indicate *** INVALID DATA *** Check Number of Blades.

6.3.2 Display Lead Lag

This key will enable the display of lead lag data. Lead Lag data is normally displayed relative to the average of all blades, but by pressing the Right arrow key, you can select a

reference blade. Lead/Lag full scale range is autoranged, and is not adjustable.

6.3.3 Set Track Distance

Press the **SET TRACK DIST** key to set the Track Distance. This is the distance from the MicroTracker's position to the ends of the rotor blades in inches. The Track Distance is used to calculate the track sensitivity. For example, entering a larger Track Distance will cause the unit to compute larger blade track differences (blades will appear farther apart).

6.3.4 Set Number of Revs

Press the SET NUMBER OF REVS key item to set the Number of Revolutions to collect track data before updating the display. The default Number of Revs is 32. At 400 RPM, 32 revs will take about 10 seconds to collect.

6.3.5 Metric Units

The Metric Units key enables the display of track amplitude in mm instead of inches. This key is dark when Metric is selected.

6.4 Equipment Setup

For the tracker to work, you have to satisfy a number of requirements.

6.4.1 Tach Signal

A once-per-rev signal from the main rotor must be provided. This can be from a photosensor, magnetic pickup or similar device. This signal must be connected to a Tach Input on the MUX unit. Normally Tach A. This is the same signal required to balance the main rotor

6.4.2 Adequate Light Level

Normally, as long as the sun is up, even on a very cloudy day, the light level will be adequate. You can check the light level by aiming the tracker up into the rotor blades and confirming that the upper red LED's light. If you can't get the upper RED led's to light up, the light level is too low.

6.4.3 Background

The background you are aiming the tracker into must be the sky. Blue sky or clouds. If you are on the ground and aiming into a hangar wall or a nearby tree, the tracker will not work. Trying to track with the aircraft diving so the background is the ground will not work either.

6.4.4 Aiming the Tracker

You must aim the MicroTracker at the correct point on the rotor disc for the system to identify the blades correctly. To do this you must first position the rotor statically on the ground with the phototach or mag p/u aligned with the retro-tape or interrupter. This position we call the “static position”. Next you must decide which blade will be the easiest to point the tracker at in flight. This is usually the blade over the nose in the “static position”. You must point the tracker at this blade location when gathering track data. If you point in any other location, you will scramble the sequence of the data. The blade you are pointing at in the “static position” becomes by definition the number one blade in the data display on the screen of the MicroVib II. The next blade to come by in time is by definition the number 2 blade and so on. See Figure 6-1

6.4.5 Tracker Location

The tracker itself must be located properly for the tracker to work. The tracker must be within 15 degrees of the line from the blade tip to the mast. See Figure 6-1.

6.4.6 Orientation to the Sun.

Once the sun is 30 degrees or more up in the sky, you must avoid pointing the tracker toward the direction of the sun. Shadows of the blades can strike the front of the tracker producing false signals. On the other hand, toward the end of the day, as the sun is setting, the sky will be sufficiently bright if

you aim the tracker more toward the sun. You should verify that you can get the upper red LED's to light when working at the end of the day. This is done by pointing the tracker just a little too high and the red led's should come on.

6.4.7 Holding the Tracker

One mistake users make is holding the tracker very rigidly and even bracing against a bulkhead or placing the elbow on the knee as a brace. What you must keep in mind is that you are trying to isolate the tracker from the aircraft using your arms as a kind of soft suspension. So relax a bit and hold your elbows out away from your body so they can work freely and easily. Use both hands.

6.4.8 Clean the Canopy

If the window or canopy the tracker is aimed thru is dirty, this dirt can pick up shadows of the blades and introduce false signals. Be sure to clean the canopy before the flight.

6.4.9 Blade Color

The most ideal condition for the tracker is for the last 6 feet of each blade bottom to be uniformly flat black. The worst condition is with the blade bottoms painted white or yellow, very bright ground color (like sandy desert) and very deep blue sky. Also it is important that the blades be uniform in color from blade to blade. Also, if only the blade tips (last 2-3 feet) are much darker or lighter than the rest of the blade, this can cause problems.

6.4.10 Equipment Hookup

The MicroTracker plugs into a dedicated 15 pin connector on the PN 1450 MUX unit. The MUX unit plugs into the MicroVib II.

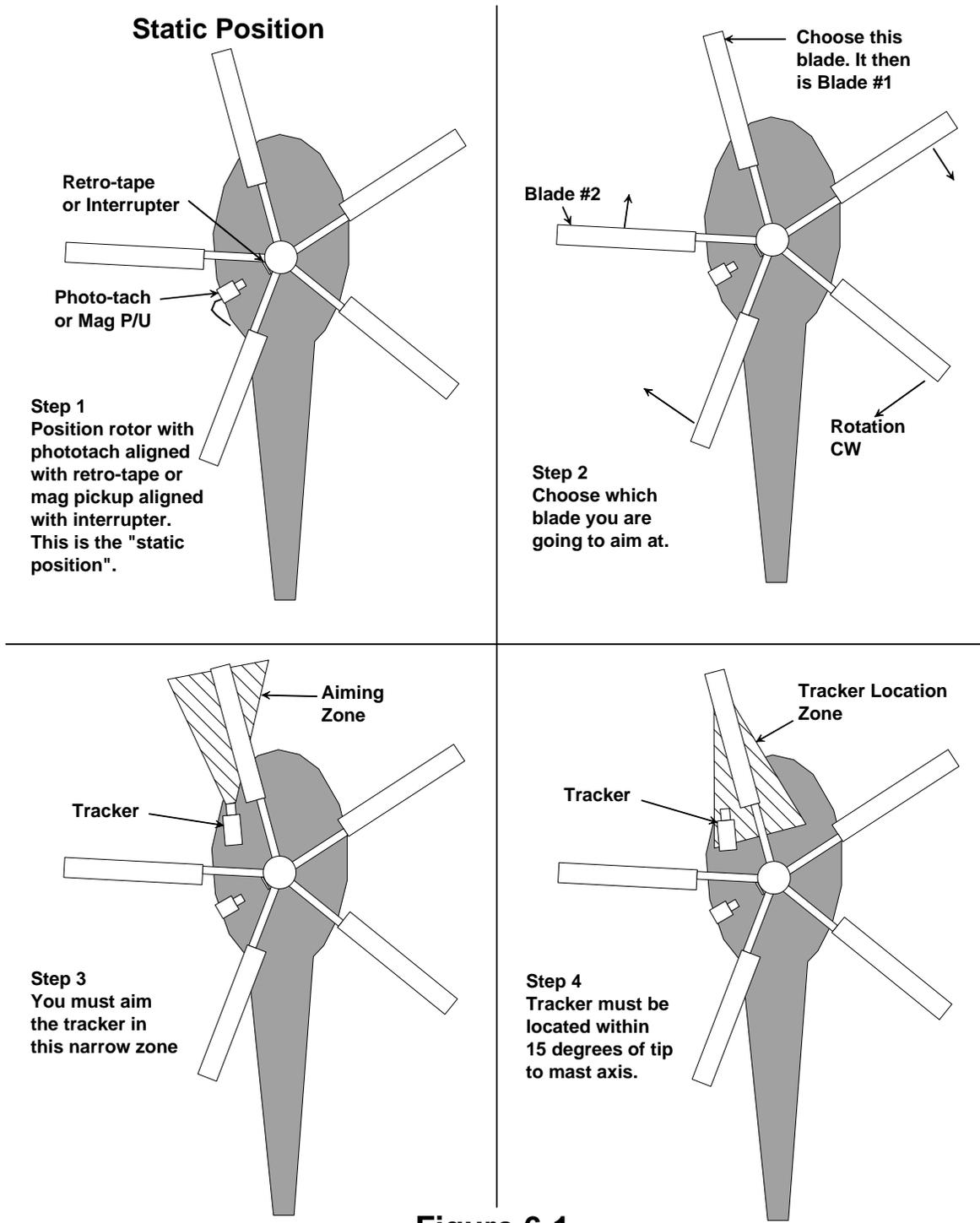


Figure 6-1

6.5 Tracking Procedure

1. Setup equipment per section 6.4 above.
2. Operate the aircraft rotor at desired RPM.
3. Turn on MicroVib II. Press **MODE** key and select **ROTOR BLADE TRACKING** and **START ANALYSIS**.
4. MicroVib II screen should say “Ready for Trigger”.
5. Press **TRACK OPTIONS** and verify Number of Blades, Track Distance, and Number of Revs are correct. Press **START ANALYSIS** to continue.
6. Grip the handle of the MicroTracker with two hands and hold it up in front of your face with your arms away from your body. Suspend the tracker with your arms to help isolate it from aircraft vibrations.
7. Notice the bargraph display on the back of the MicroTracker. Verify the Yellow LED at the bottom of the bargraph is ON.
8. Aim the MicroTracker at the correct azimuth location and aim it up and down to get the green LED’s in the bargraph to light up. .
9. When the bargraph is in the Green, momentarily pull the trigger switch on the MicroTracker and release it.
10. You will notice the yellow LED begin to blink once per revolution. Keep the bargraph in the green as best you can until the yellow LED comes back on steady.
11. View the Rotor Tracking Screen and verify the data looks OK and the RPM is correct. Press the **SAVE PLOT** key to store the data. You can name the data plot or just let the MicroVib II give it a name. The data will be annotated with the current task name and time for easy identification. Press **OK**
12. The screen you just saved will now be on the screen and the **SAVED** indicator will be shown and the status indicator will show “Tracker Disabled”. Press the **START STOP** key to return to live mode. The data will disappear and the “Ready for Trigger” status will be shown. Now you are ready to gather more track data.

MD500 Note;

It has been found experimentally that the MD500/600 track data is most accurate when the Track Distance is set to 50.

6.6 Tracker Configurations

PN 1145 - Original Version.

PN 1145-1 - Improved low light level performance.

PN 1145-2 - Improved stability under bright light conditions. All original and -1 units shipped were recalled and upgraded to -2 .

PN 1145-3 - Special OEM version.

PN 1145-4 - Minor change to allow use of ceiling fan for training and simulations.

PN 1145-5 - Improved accuracy over a wider range of camera azimuth locations.

The -5 version requires a change to the mating MUX box firmware. Once the MUX is upgraded to this newer version, the MUX will no longer work with previous versions of trackers.

Older trackers can be upgraded to be compatible with the new MUX firmware.

Older MUX units can be upgraded to latest firmware also.

MUX firmware is identified with MicroVib II in the System Parameters screen. Display will show Tracker-D for new firmware and just Tracker for older firmware.

Chapter 7 Strobe Tracking

Blade Tracking is the process of measuring the physical location of the blade tips when the rotor is turning. It is important to remember that zero blade track does not normally coincide with equal blade loading. Our goal in measuring blade track is not to minimize blade track, but rather to minimize vertical vibration which does coincide with equal blade loading. We use the track information to help us decide which blade needs an adjustment, but our goal is always minimum vibration and not minimum track.

The MicroVib II supports two methods of blade tracking: Optical Tracking and Strobe Tracking. The selection of which type of tracking is done is made by the kind of MUX unit that is connected to the MicroVib II. Tracker MUX PN 1450 and MicroTrack PN 1145-5 are used to perform optical blade tracking. Strobe MUX PN 1115-1 and a compatible strobe are used to perform strobe blade tracking.

In either case, to access the Blade Tracking Mode from any analysis screen press the **MODE** key, press the **ROTOR BLADE TRACKING** key and press **START ANALYSIS**.

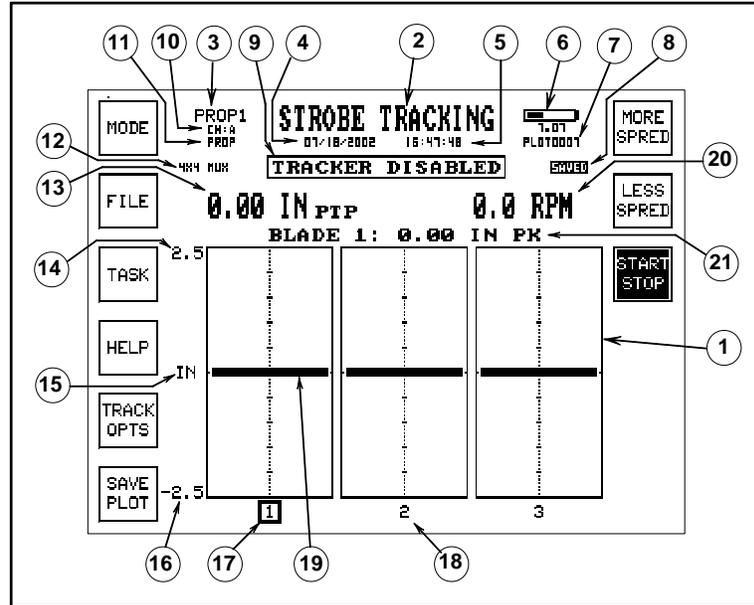
7.1 On Screen Data

Strobe Track Mode provides the following on-screen data

1. Graphical Display of Track Data:
Dominating the screen are several large

rectangular blocks that graphically depict the track data as manually entered.

2. Screen Title.



3. Task Name: The current task name is displayed. This name is user definable. See task setup to name the task.
4. Current Date - this is optional as selected in Control Panel. (1.10.12)
5. Current Time - This is optional as selected in Control Panel (1.10.12)
6. Battery Status Indicator - Digital readout of voltage and bargraph of battery energy remaining along with charging status.
7. Current history file name or saved plot file name.
8. Update/Saved Indicator: This is a small indicator that indicates UPDATE every second or so as the RPM data is updated. It indicates SAVED when a screen has been recalled from disk.

9. Status Indicator Area - This part of the screen will indicate "READY TO FIRE STROBE" when the unit is ready. It will indicate "TRACKER DISABLED" when viewing a saved plot.
10. Tach Channel Indicator - The current tach channel is shown here. The tach channel selection is made in the Task Setup (Sec 2.9.1). When a track screen is recalled from disk, the tach channel used when the data was collected is displayed.
11. Group File Name - The group file name is shown here. The group file name is selected as part of creating a new history file. (See Sect 2.8.5)
12. MUX Indicator - If a MUX unit is connected, this indicator will show it.
13. Digital readout of blade track amplitude. The difference between the highest blade and the lowest blade as manually entered.
14. Track full scale amplitude at top of display.
15. Track data unit of measure - User selectable to inches or mm in Track Options screen.
16. Track full scale amplitude at bottom of display.
17. Selected Blade - Rectangular box indicates which blade is currently selected for data entry using the UP and DOWN arrow keys. User selectable with Right or Left Arrow.
18. Blade Number - Corresponds to tip target numbers when used.
19. Blade height indicator - Provides a visual display of the blade height as entered manually.
20. Digital Readout of Rotor RPM. This data is derived from the tach signal. This area

is also used to indicate Tach status. When tach signal is first applied this will indicate "ACQ TACH", if tach signal is lost, it will indicate "NO TACH". If tach signal is too high in frequency it will indicate "HIGH TACH".

21. Digital Readout of the height of the selected blade. This data is entered manually.

7.2 Function Keys

The Strobe Tracking Screen provides the following function keys:

Mode - This key allows you to change modes.

File - This key provides access to the File Directory Screen. (See Section 1.13)

Task - This key allows you to select the task or setup the tasks as explained in section 2.9.

Help - This key provides information about the current function.

Track Opts - Track Options: This key is described in the next section

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the automatically assigned name.

More Spread - This key will spread out the tip target images as viewed using the strobe.

Less Spread - This key will reduce the spread of the tip target images as viewed using the strobe.

Clear Spread - This key cancels the target spread function and will superimpose all the tip targets at the same azimuth location as viewed using the strobe.

7.3 Track Options

The Track Options function key leads to the Strobe Tracking Options screen. From this menu, you can setup the tracker to match the helicopter in use.

7.3.1 Number of Blades

You must enter the number of blades for the tracker to work properly. Keys are available for 2, 3, 4 or 5 blade rotors. If you have more than five blades, press the ENTER NUMBER BLADES key and enter a number from 2-7.

7.3.2 Double Images

This key will double the flash rate of the strobe, which will put additional groups of tip target images half way between the normal locations.

7.3.3 Metric Units

The Metric Units key enables the display of track amplitude in millimeters instead of inches. This key is dark when Metric is selected.

7.4 Equipment Setup

For the tracker to work, you have to satisfy a number of requirements.

7.4.1 Tach Signal

A once-per-rev signal from the main rotor must be provided. This can be from a photosensor, magnetic pickup or similar device. This signal must be connected to a Tach Input on the MUX unit. Normally Tach A. This is the same signal required to balance the main rotor

7.4.2 Azimuth Location

You must aim the Strobe at the correct point on the rotor disc to see the tip target images. Aim the tracker at the point where blade 1 is when the photocell is aligned with the retro-reflective tape. You can also view the track at the locations of the other blades. You

can get an image of the tip targets at 3:00 and 9:00 on a two blade ship by using the Double Images function key.

7.4.3 Equipment Hookup

The Strobe plugs into a dedicated 5 pin connector on the PN 1115-1 MUX unit. The MUX unit plugs into the MicroVib II.

A source of 24-28 VDC 3 amps must be connected to the MUX unit to power the Strobe. Use DC Power Cable PN 1123 and required adapters to connect to ship DC power.

7.5 Tracking Procedure

1. Setup equipment per section 7.4 above.
2. Operate the aircraft rotor at desired RPM.
3. Turn on MicroVib II. Press **MODE** key and select **ROTOR BLADE TRACKING** and **START ANALYSIS**.
4. MicroVib II screen should say "READY TO FIRE STROBE".
5. Press **TRACK OPTIONS** and verify Number of Blades is correct. Press **START ANALYSIS** to continue.
6. Grip the handle of the Strobe firmly and hold it up in front of your face and sight just over or to the side of the strobe at the tip target zone. Since the tip targets are retro-reflective, they will appear very bright if you sight close to the edge of the strobe housing.
7. Pull the trigger on the strobe handle to display the tip targets. They will appear superimposed or "stacked" on top of each other. Press the "MORE SPRED" key to spread out the images for easier identification. Make a mental note of the tip target display
8. Using the right and left arrow keys and up and down arrow keys, you can record

the strobe image on the screen. When the screen looks like your mental image, press the SAVE PLOT key to store the image. You can name the data plot or just let the MicroVib II give it a name. The data will be annotated with the current task name and time for easy identification. Press **OK**

9. The screen you just saved will now be on the screen and the SAVED indicator will be shown and the status indicator will show "Tracker Disabled". Press the **START STOP** key to return to live mode. The data will disappear and the "READY TO FIRE STROBE" status will be shown. Now you are ready to gather more track data.

7.6 Notes

Track scale will automatically change when you manually enter a track value over full scale. Scale will automatically change to minimum full scale level that the current data will fit into. Full scale values of 2.5, 5, 10, and 20 inches are supported.

Lead/Lag data is not supported. User will have to judge lead lag values from the tip target image directly.

Chapter 8 Scan Modes

Scan Modes provide a means of measuring the total vibration level at the sensor. In contrast with the Spectrum mode, which provides a detailed breakdown of every spectral line detected by the sensor, the scan mode computes the total value of vibration at the sensor in a meaningful way to give you a single number that is proportional to the vibration.

8.1 Overall Scan

The overall scan uses the spectrum data and sums the vibration for all spectral lines between the user selectable lower and upper limit. The summation is the square root of the sum of the squares of all spectral lines.

On Screen Data

1. Bargraph of Overall Value
2. Digital Readout of Overall Value
3. Display Units and Units Type
4. Min and Max Frequency
5. Full scale value of Bargraph
6. Balance History Filename
7. Vibration Sensor Channel Number
8. Current task name
9. Date and Time
10. Battery Voltage and Bargraph
11. Bargraph of Dynamic Signal Range

Function Keys

The Overall Scan Mode provides the following function keys:

Mode - This key allows you to change modes

File - This key provides access to the File Directory Screen.

Task - This key allows you to link any saved screens to particular tasks.

Help - This key provides information about the current function.

Overall Options - This key provides access to menu of options: Set Max Freq, Set Min Freq, Set Display units (Acc. Velocity, Displacement, Pk, RMS, Pk-Pk, Avg, Metric) Fast Update option and Averager type..

Save Plot - This key will save the current screen. It will prompt you to enter a name for the plot file, or you can simply accept the automatically assigned name.

Avg Data - This key will engage averaging of the reading. This will smooth out any rapid changes in the vibration level.

Clear Screen - This key clears the data buffer and starts the measurement over.

Start Stop - This key freezes the screen. Useful for printing or saving a screen plot.

8.2 True Peak Hold

Peak Hold is a function often used to find the highest level a vibration value reaches, even if it is only a transient event. This mode does not use the Spectrum data, but rather evaluates the time domain data directly using the built-in analog high pass filters and anti-alias low pass filters to limit the frequency range

On Screen Data

1. Bargraph of Peak Value
2. Digital Readout of Peak Value
3. Display Units and Units Type
4. Digital Readout of RMS Value
5. Digital Readout of Crest Factor
6. Min and Max Frequency
7. Full scale value of Bargraph

8. Balance History Filename
9. Vibration Sensor Channel Number
10. Current task name
11. Date and Time
12. Battery Voltage and Bargraph
13. Bargraph of Dynamic Signal Range

Function Keys

The Peak Hold Scan Mode provides the following function keys:

Mode, File, Task, Help, Save Plot, Clear Screen and Start Stop are the same as in section 8.1 above.

TRPK OPTS - This key provides access to menu of options: 10 Hz Min Freq, 2 Hz Min Freq, EXP Averaging On or Off, 250 Hz Max Freq, 1KHz Max Freq, 5KHz Max Freq, 20 Khz Max Freq. Set Display units (Acc. Velocity, Displacement, Pk, Pk-Pk, Metric) and Fast Update.

Avg Data/Peak Hold - This key will engage averaging of the reading if EXP averaging is selected in the TRPK OPTS menu. This key will enable PEAK HOLD if EXP averaging is turned off.

8.2 True RMS Scan

True RMS is a function often used to find the total power in a vibration reading. This mode does not use the Spectrum data, but rather passes the filtered time domain data to a true RMS converter IC. The frequency range is determined by user selectable analog high pass filters and anti-alias low pass filters.

On Screen Data

1. Bargraph of RMS Value
2. Digital Readout of RMS Value
3. Display Units and Units Type
4. Min and Max Frequency

5. Full scale value of Bargraph
6. Balance History Filename
7. Vibration Sensor Channel Number
8. Current task name
9. Date and Time
10. Battery Voltage and Bargraph
11. Bargraph of Dynamic Signal Range

Function Keys

The True RMS Scan Mode provides the following function keys:

Mode, File, Task, Help, Save Plot, Clear Screen and Start Stop are the same as in section 8.1 above.

TRMS OPTS - This key provides access to a menu of options: 10 Hz Min Freq, 2 Hz Min Freq, 250 Hz Max Freq, 1KHz Max Freq, 5KHz Max Freq, 20 Khz Max Freq., Set Display units (Acc. Velocity, Displacement, Metric) and Fast Update.

Avg Data - This key will engage averaging of the reading. This will smooth out any rapid changes in the vibration level.

Specifications

Physical Properties

Length: 8.25 inches (210 mm) (less connector)
 Width: 4.25 inches (108 mm)
 Depth: 1.7 inches (43.2 mm) less feet
 Weight: 36.8 oz. (1.04kg)

Environmental Limits

Temperature: 15 to 120 F (-10 to 50 C).
 Relative Humidity: 0 to 95%

Enclosure

Dust tight aluminum case.

Battery Power Source

NiMH Rechargeable. 7.2 volt nominal.
 3.7 A-hrs
 Operation time: 18-30 Hours of continuous use depending on mode and use of backlight, etc.
 Recharges in 4 hours with Charger PN 1309
 Charger power 90-250VAC 50/60 Hz.

LCD Display

Dot Resolution: 240 Vert. x 320 Hor.
 Dot pitch .012 in (.3 mm)
 Viewing area 3.14 Vert X 4.13 Hor.
 (80mm Vert X 105 mm Hor)
 S/N 1001-2299 EL Backlight (Green)
 S/N 2300 fwd. LED Backlight (Orange)

Input/Output Connector

Side-mounted 18-pin MS3112E14-18S connector provides access to all inputs/outputs and serial port for communication with peripherals and host PC software.
 Mates with MS3116F14-18P connector.

Input Specifications

Sensor Power

A 2mA constant current power supply inside the analyzer powers ICP type accelerometers and sensors. The power supply provides 2 mA constant current from a 20 volt source. +5V and -5V are also available to power other types of sensors/strain gauges.

Input Range

User selectable or auto range from 16 volts pk-pk down to 160 mV pk-pk full-scale;
 Minimum measurable level is .05mV. (With a 20mV/g accelerometer at 100 Hz, the input ranges are 0-400 G; 0-250 IPS; and 0-800 mils.)

Dynamic Range

72dB from full scale level.

AC Input Coupling

Less than 2 Hz (-3dB) cutoff AC coupling on all frequency ranges. User selectable 10 Hz Hi-pass filter.

Frequency Ranges

Fmax: 250 Hz, 1 KHz, 5 KHz, 20 KHz

Measurement Specifications

Spectral Resolution 50, 100, 200, 400, or 800 Lines. Peak locate function provides an effective resolution of 600,000 lines at 100 Hz with no delay.

Averaging

Spectrum Mode: Linear, Exponential or Peak Hold with selectable no. of averages.
 Balance Mode: Linear or Exponential.
 User selectable

Appendix 1 Specifications

Integration

Analog or digital integration from acceleration to velocity, acceleration to displacement or velocity to displacement. User selectable.
2 Hz or 10 Hz high pass filter. User Selectable

Measurement Modes

Balance, Spectrum, Waveform, Tach Ratio, Blade Track & Lead Lag (Optical Tracker or Strobe), Overall (Scan)

Cursor Functions

Frequency of Bin (Cursor on)
Frequency of Signal (Peak Locate)
Center for expand and compress

Output

Via host PC and MicroBase companion software of History Report including polar plot, Spectrum Plot, Waveforms and any screen plot. Saved data can be uploaded to host computer via Interface Cable PN 1311 using MicroBase program running under Windows.

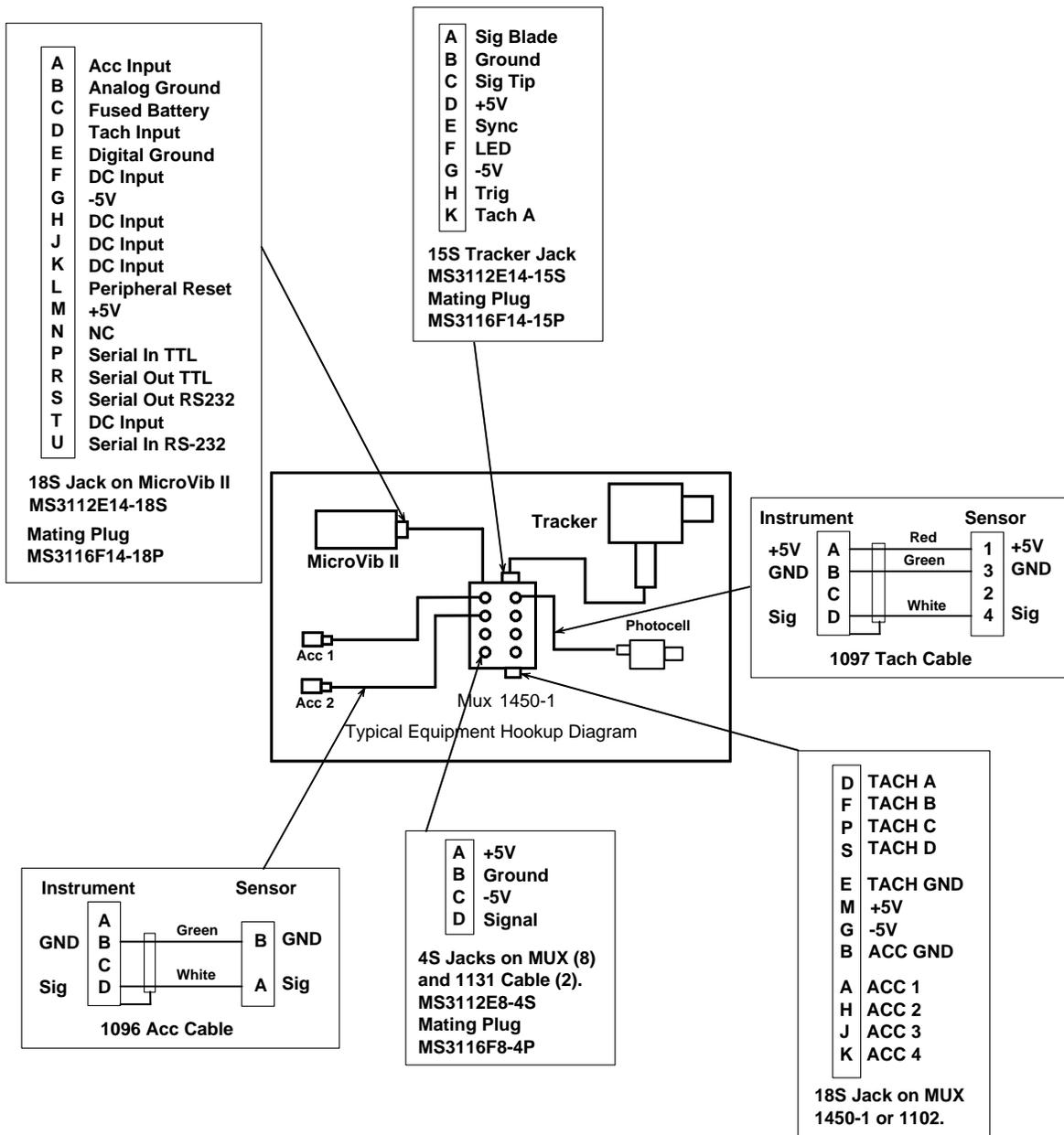
Data Storage Capacity

512KB nonvolatile user storage (Limit of 256 file entries). History file 11.5K; 400 line spectrum 1.6K.
Automatic Erasure Protection
Nonvolatile storage of calibration, programs and setup parameters.

Real Time Clock

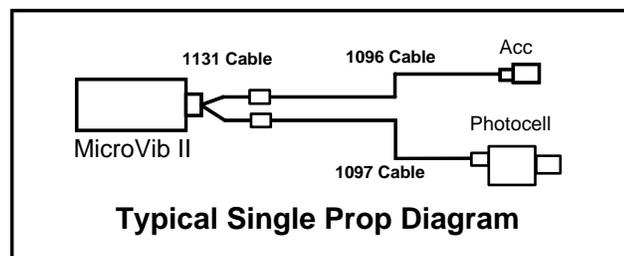
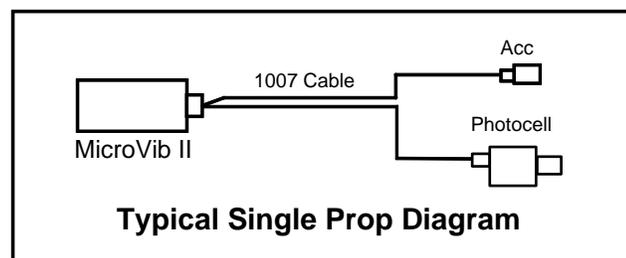
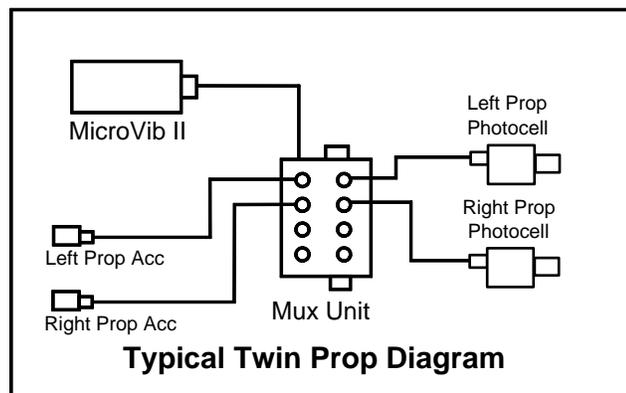
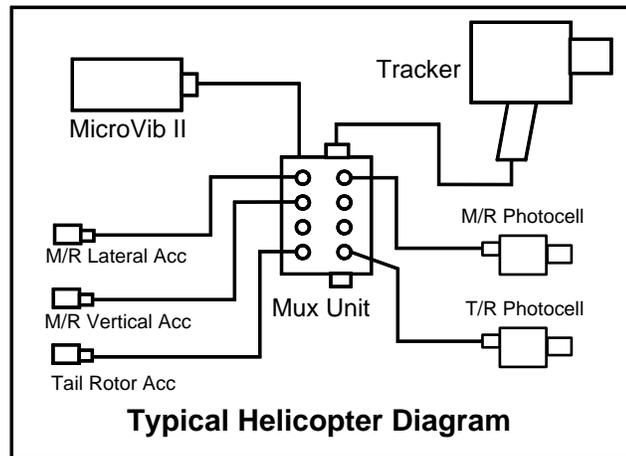
All data automatically tagged with real-time hour, minute, day, month, year. PC mounted independent Lithium power source powers clock at all times.
Clock Battery life expectancy >10 years.

Connector Pinouts



Connector Pinouts

Cable Hookup Diagrams



Charge Amplifier PN 1498

The DSS PN 1498 Charge Amp is designed to interface high temperature piezo-electric accelerometers made by Dytran, PCB, Endevco, Vibro-Meter and B&K to the DSS MicroVib II™ Aircraft Vibration Analyzer. The unit features rugged construction, wide dynamic range, and excellent frequency response. A balanced differential input is designed for use with sensors providing an output impedance of 100K ohms or greater.

The 1498 is compatible with accelerometers producing levels ranging from 10 thru 200 pC/g. The output of the unit is an acceleration signal proportional to the charge sensitivity of the sensor. The output signal level (in mV) will be typically .4 times the charge sensitivity of the accelerometer (in pC). This .4mV/pC cal factor will vary slightly from unit to unit. Its exact value is determined during factory calibration and is printed on a label permanently attached. This cal factor is not subject to significant drift over time since it is based on very stable components. DSS recommends the cal factor be verified every two years.

EXAMPLE

The accelerometer has a sensitivity of 49.8 pC/g. The Charge Amp cal factor is .42mV/pC. The resulting signal level will be $49.8 \times .42 = 20.92$ mV/g. This value should be entered into the MicroVib II with the following key strokes:

On, Mode, Control Panel, Set Input Params, Setup CH 1 Sensor, Special Sensitivity, .02092, OK, Sensor Power (off), Done, Done, Done. This will put you in the Select Mode Screen.

NOTE

The charge amp does not use ICP Sensor Power, so it is best to turn it off as above. (Unit will read correctly with sensor power on or off, but sensor power consumes battery power.)

The Charge Amp is connected to the accelerometer using DSS High Temp Cable PN 1084-10, 1492 or 1507. The unit connects to the MicroVib II via an integral 15 foot cable that mates to the accelerometer input of either a PN 1131 Breakout Cable, or a Signal Multiplex (MUX) Unit.

Multiplex Units

The Multiplex unit (MUX) connects to the MicroVib II and allows the user to connect numerous vibration sensors and tach sensors. The MicroVib II automatically selects the correct sensors for each task as programmed by the group file. The user can also manually select sensors via the MicroVib II keypad. The MUX also provides a means of tracking helicopter blades via Optical Tracker or Strobe light. Some versions of the MUX can provide the sum or difference between two vibration signals. Some versions can provide a single connector interface for up to 4 vibration signals and 4 tach signals for pre-wired aircraft. MUX Version Matrix:

P/N	Vib. Ch.	Tach Ch	Tracker	Multi-Input	A+B A-B
'1102 (OBS)	4	4	Optical	Yes	No
'1115 (OBS)	4	4	Strobe	Yes	No
'1440	16	4	Optical	No	No
'1440-1	16	4	Optical	Yes	No
'1450	4	4	Optical	No	No
'1450-1	4	4	Optical	Yes	No
'1560	4	4	Optical	No	Yes
'1560-1	4	4	Optical	Yes	Yes
'1680	4	4	Strobe	No	No
'1680-1	4	4	Strobe	Yes	No
'1700	6	4	Optical	No	No
'1700-1	6	4	Optical	Yes	No

Vibration Sensors

The vibration inputs are compatible with ICP type sensors, self generating Velocity Sensors, Low impedance velocimeter type sensors. When DSS Accelerometers are used, no special settings are required. If other types of sensors are used, the parameters for the sensor must be keyed in to the MicroVib II.

Tach Sensors.

The tach sensor interface is compatible with DSS PN 1015 Photo sensor, as well as commonly used magnetic pickups, synchrophaser pulses, hall effect sensors and any other sensor that can produce a 150mv or greater sine or pulse type waveform.

Optical Tracker Interface. (1440, 1450, 1700 MUX types)

A microprocessor in the MUX processes analog blade height data along with Tach and Blade pulse timing data to provide digital track information to the MicroVib II. The Optical Tracker PN 1145-5 connects to the MUX and is powered by the MicroVib II battery via the MUX cable.

Strobe Interface (1680 MUX only)

The microprocessor in the MUX unit measures the tach signal period and generates a pulse train of equally time spaced pulses at any multiple of the tach pulse rate. This signal is optically coupled to the strobe jack to drive strobes commonly used for helicopter blade tracking. DSS does not make a strobe. The microprocessor can also slightly offset the time signals to stack or spread the blade tip target images. The number of blades and blade stacking functions are controlled from the MicroVib II keypad.

DC Power for Strobe (1680 MUX only)

A two pin MS receptacle is provided to route DC power to the strobe unit being used. DC Power cable DSS PN 1123 is available which has a commonly used 16-2P DC power plug which mates to several Bell Aircraft. DC power cable PN 1123A is also available which provides bare leads..

Multi-Input Connector Interface (All -1 versions)

An 18 socket MS Bayonet type Receptacle is provided to connect to aircraft that are pre-wired for multiple sensors. DeHavilland Dash 8, Beech 1900, Eurocopter AS365 and EC135 are a few of the aircraft that can benefit from this feature.

A+B A-B Function (1560 MUX Only)

Several helicopter types use a balancing algorithm that requires a sum of two vibration signals as well as the difference between two vibration signals. This signal math is performed using precision op amps before the signal is sent along to the MicroVib II.

Special Modified MUX Units.

DSS can modify MUX units as required for specific cases. MUX P/N 1450D is specially modified with a higher input impedance on the tach input, but also requires a much higher tach signal amplitude. This was done to make it compatible with the Dornier 328 Aircraft.

Signal Simulator

The Signal Simulator PN 1117-2 provides an accurate vibration amplitude signal, accurate tach frequency source with a known phase angle between the two signals. This device is often used for troubleshooting and a simple field cal check to be sure the MicroVib II is working properly. The vibration signal level will read between .765 and .845 IN/S, the phase will read between 270 and 274 degrees, and the the tach speed will read between 1919.5 and 1920.5 RPM.

Customizing Group files

One of the most powerful features of the MicroVib II is its ability to precisely learn the response of a particular aircraft. For fleet operators this capability can save hundreds of man-hours per year. This power is only unleashed when group files for each individual aircraft are created and used. This app note sets out the steps needed to create these individualized group files.

Overview of the required steps

Step 1: Work the aircraft normally using the “standard” group file.

Step 2: View the data and identify new Tach Factors and Sensitivities.

Step 3: Edit the Group File with new values and re-name it.

Step 4: Print out and file the new group file.

Step 5: Upload the new Group File to the MicroVib II.

Step 6: Use the new group file the next time.

Details of Each Step

Step 1 Work the Aircraft Normally

Work the aircraft normally using the “standard” group file for that type of aircraft. This group file is available for download from the DSS website using MicroBase. Use the most up-to-date group file if possible.

Note: If you are using one of the built-in templates to work the aircraft, you will need to export the group file first in order to be able to edit it later. To export the group file, open the balance history and then press MODE, CONTROL PANEL, ADVANCED CONTROLS, SAVE (EXPORT) GROUP, enter a name for the group file and press OK.

Step 2: View the data and identify new Tach Factors and Sensitivities

Download the History files you just completed to MicroBase using the MicroBase Data Manager. Annotate the files normally and add them to the database. Also download the group file that was used. Then select the history file and view the data.

Note: These steps are clearly illustrated in the MicroBase help section.

This screen should come up:

In this screen we can edit the group file. Click on the Next Task and Previous task keys to get to the correct task. In this example it is Hov Lt. You can see the Sens and Tach are 12 and 320. Put the cursor in the data box and key in the new values we determined earlier 13.5 and 309.

Do the same for the other tasks that you have good data for.

When the Group file is fully corrected, click on the “Save” button. This will save the changes and bring you back to the previous screen, the Data Manager. Select the newly edited group file and click on the “Rename” button. Enter the tail number of the aircraft as the name for the new group file.

Step 4: Print Out and File the new Group File

In the Data Manager, select the newly re-named group file and click the “Open Group” button. The screen above will come up again. Click on the “Print Group” button and print out a paper copy of the new group file. File this copy as a means of controlling the data in these “custom” group files.

Step 5: Upload the new Group File to the MicroVib II.

Re-connect the MicroVib II to your computer and close and then re-open the data manager. Select the newly re-named group file in the left side of the screen and click on the right arrow button. This will upload the new group file to your MicroVib II.

Step 6: Use the new Group File next time

The next time you need to work that aircraft, be sure to select the special group file you have created with that aircraft tail number on it. Work the aircraft normally and then repeat step Two thru Five again. Every time you work the aircraft, you may find an improvement in the group file. Any time the first solution is not accurate, the tach factor and sensitivity need to be corrected*. Eventually the group file will match the aircraft precisely and the first moves will be extremely accurate. Of course every time a major aerodynamic component is changed, you can expect the factors to shift some.

** The only exception to this “general rule” is when you have a non-linear responding system. Example: The Astar Short Shaft. In non-linear responding systems, the sens and tach factors shift depending on the vibration amplitude. In these cases, leave the sens and tach values alone unless you really understand the impact of your changes.*

Keep in mind that the quality of the data in these “custom” group files is totally under your control. You must take this task very seriously to have good success. Making errors in this process will increase man-hours rather than save them. If you cannot keep this data under tight control, you are better off to just use the “standard” group files.

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Troubleshooting

Problem/Symptom	Likely Cause	Remedy
No vibration data, strange characters for vibration units	Input units data corrupted	Restore defaults including input defaults or do a Cold boot. <i>Note 1.</i>
Strange characters in task names	Group file data in history file corrupt.	Reload group file (Mode / Control Panel / Advanced Controls / Load (Import) Group or Cold boot.
Screen blank or black, but unit beeps normally.	LCD contrast set too low or too high.	Do a Cold boot. <i>Note 1.</i>
Unit won't turn on.	Keypad ribbon worn or loose	Inspect keypad ribbon and re-install or replace keypad.
Unit won't turn on	Dead battery.	Check battery & charge or replace. <i>Note 2</i>
Unit acts flakey or intermittent.	CPU socket connections not good.	Return to DSS for CPU socket update. <i>Note 3</i>
Charge light won't come on.	Normal if temp below 32F (0C) otherwise, bad connection in charger circuit.	Return to DSS for repair.
Storage Error during POST	MicroDisk (U5) defective	Return to DSS for repair.
Vibration amplitude seems wrong.	Input settings incorrect or unit out of calibration.	Use Signal Simulator to verify signal levels.

Note 1: To perform a Cold boot: (1) Turn unit off. (2) Press and hold down the ON/OFF key for 10 seconds and release. Unit will start in a normal fashion, but all settings will be default settings and a new default balance history will be created. These settings are being read from the EPROM chip, which cannot be changed and are therefore virtually guaranteed to be free of any corruption.

Note 2: To get battery replaced, return to factory..

Note 3: This only applies to serial numbers 1004 thru 1051, and most of these early units have already been updated. Units after serial 1051 have the CPU chip soldered in.

Warranty

Dynamic Solutions Systems, Inc. (DSS) warrants its MicroVib II and Accessories to be free from defects in material and workmanship for a period of twenty four (24) months from the date of receipt by its original purchaser. This warranty covers hardware, firmware and software products. This warranty is not transferable.

This warranty is limited to repair or replacement, at DSS option, of any component or assembly which in the opinion of DSS is defective. This warranty does not apply to items subjected to misuse or abuse. This warranty applies only to DSS products and does not apply to consequential damages that may result from any use or misuse of the product(s).

Customers desiring warranty service shall obtain a return authorization number from DSS or one of its authorized representatives. This return authorization number shall be referenced on the outside of the package used to return the product for service. Upon receipt and inspection of the returned product, DSS will promptly inform the shipper of an anticipated return date. If warranty service is required, the repaired unit will be returned prepaid to the originator.

Revision History

4-2-07 Rev B: Removed battery replacement instructions & added note indicating DSS will test battery during routine calibration.

4-24-07 Rev C. Add mention of Weight Computer Lockout after run2 when REM PREV Weights key is active. Page 2-5.

7-6-07 Rev D. Add note after Direct Printing procedure explaining how to printout complete balance history. Pg 1-9.

4-27-08 Rev E. Remove all references to direct printing, 1352 Cable and 1224 Adapter.

7-3-10 Rev F. Add info about tracking setup & use including illustration. Update Customizing Group files using MicroBase Pro screens.

5-17-11 Rev G: Add info about Signal Simulator and MUX units.

9-18-12 Rev H: Add info about firmware V1.34 & 1.35.

7-19-13 Rev I: PN 1312 (UK) Case replaced by PN 1990 Case. (Pelican)

2-10-14 Rev J Add section 5.2 Warranty.