

DYNA VIBE



DynaVibe GX Series User Manual

Software Version 1.13

Revised: May 2017

Doc: RPX-AXU-RP-GX2-113-A



www.rpxtech.com

Table of Contents

1 Getting Started _____ **2**

 1.1 Using this Manual _____ **2**

2 Background Concepts _____ **2**

 2.1 Dynamic Balancing _____ **2**

 2.2 Spectral Analysis _____ **2**

3 Applications _____ **4**

 3.1 Propeller Balancing _____ **4**

 3.2 Rotorcraft Track and Balance _____ **5**

 3.3 Vibration Spectral Analysis _____ **6**

 3.4 Turbine Vibration Surveys _____ **7**

4 DynaVibe GX Operation _____ **8**

 4.1 Ports and Connections _____ **8**

 4.2 Accelerometer Ports _____ **8**

 4.3 SD Card Slot _____ **8**

 4.4 Optical Tach and Accessory Port _____ **9**

 4.5 USB Port _____ **9**

 4.6 Keypad _____ **9**

 4.7 Turning on the System _____ **10**

 4.8 Home Screen _____ **10**

 4.9 Mode Summary _____ **12**

5 Mode Specifics _____ **14**

 5.1 Settings Mode _____ **14**

 5.2 Measure Mode _____ **15**

 5.3 EZ Measure Mode _____ **17**

 5.4 AutoBalance Mode _____ **22**

 5.5 Spectrum Mode _____ **32**

 5.6 TotalVibe Mode _____ **34**

 5.7 VibeSurvey Mode (GX3 Only) _____ **35**

 5.8 Williams Mode (GX3 Only) _____ **38**

 5.9 Rotorcraft (GX3 Only) _____ **45**

6 System Maintenance _____ **54**

 6.1 Cleaning _____ **54**

 6.2 Battery Replacement _____ **54**

7 Troubleshooting _____ **55**

Important Notice

Any system that distracts a pilot while operating an aircraft is a safety hazard.

During the balancing procedure, please use extreme caution. Be very careful with cables and components, especially on pusher-type aircraft. **ALWAYS** confirm the ignition is off before rotating the propeller, main rotor, or tail rotor.

Areas of this manual will highlight some specific safety concerns while operating the dynamic balancing system. Before using this system, review and follow all safety instructions in this manual, the relevant application note(s), and the aircraft manufacturer's documentation.

This manual is for reference only and does not modify, replace, substitute for, or supersede official regulations or the aircraft manufacturer's instructions. There are risks and hazards associated with modifications to aircraft and these modifications are potentially dangerous and could cause harm. RPX Technologies, Inc. assumes no liability, either express or implied, in the use of this procedure.

1 Getting Started

1.1 Using this Manual

This document describes the general operation of the DynaVibe GX series of dynamic balancers (including the GX2 and GX3). Some modes are only available on specific model variants and will be marked accordingly, such as “GX3 Only”.

Because of the wide range of applications for this tool, use this manual in combination with one or more DynaVibe application notes or aircraft maintenance manuals that describe the setup and usage for specific applications.

2 Background Concepts

2.1 Dynamic Balancing

A rotating mass will always have small imbalances and tolerance variations. On a fixed wing aircraft, for example, the engine crank, spinner, propeller, propeller extension, and starter ring mass variations will cause vibrations that propagate through the engine, airframe, instruments, and passengers.

Vibration can cause damage throughout the aircraft. For example, vibration can damage the crank bearings, engine mounts, firewall, instrument panel, exhaust, air intake, and more. Vibration also causes accelerated wear and fatigue on equipment and passengers. The negative effects of vibration can be reduced by dynamically balancing the rotating assembly as a combined unit.

Dynamic balancing is accomplished by monitoring an accelerometer and an optical tachometer attached to the aircraft. The dynamic balancer uses these sensors to monitor assembly movement, rotational speed, and angular position as the assembly rotates. The balancer then quantifies the vibration magnitude and phase angle. Based on this measured vibration magnitude and phase angle, adding weight to the assembly at critical locations improves alignment of the center of mass to the rotational axis, thereby reducing the vibration magnitude.

While not all vibration can be eliminated, any reduction in vibration will reduce physical damage and passenger fatigue. Note that vibration from engine combustion, gear reductions, and accessories will not be affected by dynamic balancing. These additional vibration components can be identified and quantified using spectral analysis.

2.2 Spectral Analysis

Spectral analysis is a data processing technique that examines a broad range of frequencies simultaneously. Unlike dynamic balancing, where the magnitude and phase of a single vibration

frequency are determined, spectral analysis displays vibration magnitudes of a broad range of frequencies on a graph.

For example, in a fixed-wing piston-engine-driven aircraft, vibrations from engine misfire, prop imbalance, prop wash, imbalanced alternator, etc. will each occur at a different frequency and will be shown as individual peaks on the spectral graph. When performing spectral analysis with the optical tach installed, the source of each vibration peak can often be identified by comparing the ratio of the peak's frequency to the frequency measured by the optical tach. On a non-geared four-stroke airplane engine with a two-blade propeller, the propeller assembly vibration will be at 1x, weak cylinders will be at 1/2 x, prop wash will be at 2x, etc.

Refer to the sections below for more information on how to use the DynaVibe GX for spectral analysis and how it applies to your applications. RPX application notes, such as *RPX-AFA-PR-SPC-00 "Spectral Analysis of Piston Engine Aircraft,"* provide additional information.

3 Applications

3.1 Propeller Balancing

Process Overview

Balancing is an iterative process of vibration measurement and mass adjustments.

To balance a propeller, first mount an accelerometer to the engine and an optical tach to the aircraft as described in the application note(s) listed below, or as described by the aircraft manufacturer's maintenance procedure. The DynaVibe GX uses these sensors to measure the vibration magnitude and phase angle. Based on these measurements and information from previous runs, the balancer determines the location where dynamic balance weights need to be added or removed to balance the assembly.

DynaVibe GX Modes to Use

The DynaVibe GX has three modes useful for balancing propellers:

AutoBalance (recommended): This is the generally recommended mode for balancing propellers. Not only does it report vibration magnitude and phase angle in an easy-to-understand format (zero degrees is up and angles are always measured in the clockwise direction), this mode also recommends specific mass adjustments and “learns” from each run. This simplifies and accelerates the balancing process. When finished, the AutoBalance mode also generates a report for documentation.

EZ Measure: EZ Measure provides less automation than AutoBalance. While it does give vibration magnitude and phase angle in the same easy-to-understand format, it does not recommend mass adjustments. This mode is used to manually walk through the balancing process, compare front-to-back vibration magnitudes, and other applications where a quick reading is needed.

Measure: Measure mode gives raw vibration magnitude and phase angle measurements from one or two accelerometer channels. In Measure mode, the phase angle is not compensated for the setup (see the Measure mode section below for how to interpret the phase angle). Measure mode is useful for someone who has experience with a DynaVibe classic or another balancer that gives uncompensated vibration phase angle readings.

Spectrum (troubleshooting): Note that while propeller assembly imbalance is the most common cause of aircraft vibration, prop balancing only balances the propeller assembly. If vibration is still present after the propeller is balanced, then spectral analysis can help identify the source of vibration. Refer to the spectral analysis section below for more information.

Application Notes and Procedures

This manual is not intended to be a comprehensive guide to propeller balancing. For process details please refer to the following documents:

- Application Note: *RPX-AFA-PR-BAL-00 “Dynamic Propeller Balancing on Aircraft”*
- Aircraft manufacturer’s maintenance manual (if a procedure is available)

3.2 Rotorcraft Track and Balance

Process Overview

Rotocraft track and balance procedures vary by rotorcraft type and manufacturer recommendations. General overviews are provided in this document and in our application notes, but please refer to the manufacturer’s maintenance manuals for the exact track and balance procedure for your aircraft.

In general, main rotor track and balance procedures start on the ground with an initial dynamic balance and blade track. Once an initial track and balance is complete, the process is repeated in a hover, then in forward flight.

Other rotating components, such as fans, shafts, and tail rotors, can also be balanced using the DynaVibe GX.

DynaVibe GX Modes to Use

Note: *When using published track and balance charts or procedures from manufacturer’s maintenance manuals, use only Rotorcraft mode or Measure mode since these charts and procedures require raw phase angle readings.*

Rotorcraft Mode (recommended): Rotorcraft mode in the DynaVibe GX3 can be used with or without the DynaTrack. However, Rotorcraft mode is the ONLY mode that uses the DynaTrack for optical blade tracking. Rotorcraft mode first helps you set up the system, then allows several measurement conditions to be taken back-to-back, such as hover and multiple forward flight speeds. Blade track and up to two vibration measurements (i.e. vertical and/or lateral) are recorded simultaneously during each data set acquisition. This comprehensive set of measurements can then be used to determine what adjustments are needed between flights to track and balance the ship.

Measure: Measure mode can be used to take single vibration measurements on a rotating component using either one accelerometer alone or two accelerometers simultaneously. Please refer to the Measure description above in the Propeller Balancing section, as well as the Measure mode instructions below in the mode descriptions for more information.

AutoBalance (exercise additional caution when used with rotorcraft): Although AutoBalance mode is intended for propeller balance applications, it can be useful when balancing other rotating components on the helicopter such as tail rotors. Keep in mind that **the initial weight addition recommended by the AutoBalance mode should NOT be used on non-propeller applications because the weight recommendations are based on typical fixed-wing propeller/engine mass and are not appropriate for**

other applications. Installing excessive weight may damage the assembly and the aircraft. The user must estimate the first trial weight addition based on the particular assembly being balanced when using AutoBalance mode for non-propeller applications. A common initial estimate for the trial weight is 0.1% of the overall rotating mass (0.001 x mass).

Spectrum: Spectrum mode can be used to determine the source of various vibrations in the ship. Since the main-rotor, tail-rotor, engine fan, engine, weak cylinders, prop wash (e.g., 2-per-rev on a two-bladed propeller), etc. all occur at unique frequencies, spectral analysis can be used to identify the source and magnitude of each component.

Application Notes and Procedures

This manual is not intended to be a comprehensive track and balancing guide. For process details please refer to the following:

- **Refer to the rotorcraft manufacturer's maintenance manual for specific procedures!**
- Application Notes: Several application notes are available to provide guidance unique to each type of helicopter. Some examples include:
 - RPX-ARA-RB-R22-TB "Robinson R22 Track and Balance with the GX3"
 - RPX-ARA-RB-R44-TB "Robinson R44 Track and Balance with the GX3"
 - RPX-ARA-BE-206-TB "Bell 206 Track and Balance with the GX3"
 - Covers: Bell 206A, 206B3, 206 L1/L3/L4, OH-58 A/C
 - (refer to www.rpxtech.com for more rotorcraft-specific application notes)

3.3 Vibration Spectral Analysis

Process Overview

Spectral analysis, often referred to as an FFT, is performed with a single accelerometer and optional optical tach. Spectral analysis of the accelerometer signal results in a magnitude versus frequency plot of the vibration signal. When combined with an optical tach signal, these frequencies can be conveniently compared to the rotational frequency of a reference component, such as rotor, propeller, or engine RPM. Since many vibration sources have frequencies that are fixed ratios to a reference RPM, the source of each vibration peak can usually be determined.

DynaVibe GX Modes to Use

Spectrum (recommended): Spectrum mode is used for most spectral analysis with the exception of turbine engine vibration surveys, which require a wider frequency range.

TotalVibe (related): TotalVibe mode displays a graph of total vibration versus RPM. Although not a spectral mode, TotalVibe is often useful in applications that require spectral analysis when vibration magnitudes change significantly with RPM.

Application Notes and Procedures

- Application Note: RPX-AFA-PR-SPC-00 “Spectral Analysis of Piston Engine Aircraft”
- Application Note: RPX-ARA-PR-SPC-00 “Spectral Analysis of Rotorcraft”

3.4 Turbine Vibration Surveys

Process Overview

Vibration surveys are used to help verify turbine engine health. By monitoring a wide range of frequencies (up to 20 kHz) it is often possible to detect component balance issues, damaged bearings, and other turbine engine faults.

GX Modes to Use

VibeSurvey (GX3 Only): The VibeSurvey mode measures the high frequencies required for turbine vibration surveys. Note that the 20 kHz accelerometer (part number A20M0AS) and cable are required for VibeSurvey mode. These parts are available in the “Vibration Survey Accessory Kit.”

Williams (GX3 Only): The Williams mode, like VibeSurvey mode, measures the high frequencies required for turbine vibration surveys. However, Williams mode is customized for use with turbines manufactured by Williams International and applicable procedures. Note that the 20 kHz accelerometer (part number A20M0AS) and cable are required for Williams mode. These parts are available in the “Vibration Survey Accessory Kit.”

Application Notes and Procedures

- Refer to the engine manufacturer’s procedure and/or maintenance program specifications for procedures that are unique to each engine and maintenance program.

4 DynaVibe GX Operation

4.1 Ports and Connections



The DynaVibe GX ports are shown in the diagram above.

4.2 Accelerometer Ports

The left and right accelerometer inputs are on the left top face. The accelerometer cables are labeled “L” and “R” near the connectors. These labels indicate the proper input channel that should be used with each accelerometer so the factory calibration is matched to the correct accelerometer. When using the DynaVibe, the left channel is primary and used for most modes, such as AutoBalance mode. The right channel is used for secondary measurements when two accelerometers are needed to take simultaneous measurements. For example, when using the Rotorcraft mode, use the left channel for lateral measurements and right channel for vertical measurements. That will ensure that the sensor positions match what the software is expecting.

4.3 SD Card Slot

The SD memory card slot is in the center of the top face. Screen shots (using the camera button), reports, and CSV data files are saved to the SD card. The SD card is also used when upgrading the DynaVibe GX. The SD card slot is spring-loaded. With the DynaVibe turned off, gently press in on the SD card to eject it. The SD card must be inserted for system operation.

Do not remove the SD card while the unit is powered on.

4.4 Optical Tach and Accessory Port

The large circular port on the top face is for the optical tach and accessories, such as the DynaTrack. When not using the DynaTrack accessory, use this port for the optical tach. When using the DynaTrack, plug the DynaTrack into the GX using this accessory port and then plug the optical tach into the DynaTrack's optical tach connector.

4.5 USB Port

The USB port is for factory use only.

4.6 Keypad

The DynaVibe GX has several features to allow rapid access to desired functions. There are the four function keys along the top of the keypad that allow access to the modes available on the GX. Below the function keys is a keypad that allows you to enter numbers and text. Some keys also have arrow symbols indicating their use as directional and cursor keys. The <5> key has a check symbol <✓> indicating its secondary function as the Select key.



Keypad

The three keys along the bottom of the keypad provide access to screen image capture, the Home screen, and power functions.

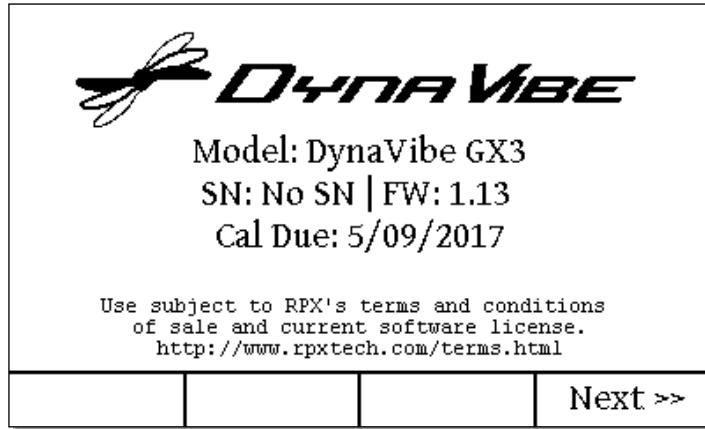
The first key in the lower left position of the keypad has a camera icon and is used for screen capture; it allows a user to take a snapshot of the current screen and save that image to the SD card. This is useful in circumstances where you wish to capture data on the screen. (The Camera key also functions as the decimal key when entering numeric data and as the period key when editing text.)

The Home key is in the center of the row and the graphic on the key resembles a small house. Home is a shortcut to the Home screen from most screens and is useful for quickly switching modes. (The Home key also functions as the zero key, <0>, when entering numeric data.)

The third key on the right of the bottom row is the Power key. Press and hold Power for a few seconds to turn the GX off. Press Power when the system is off to turn the system on.

4.7 Turning on the System

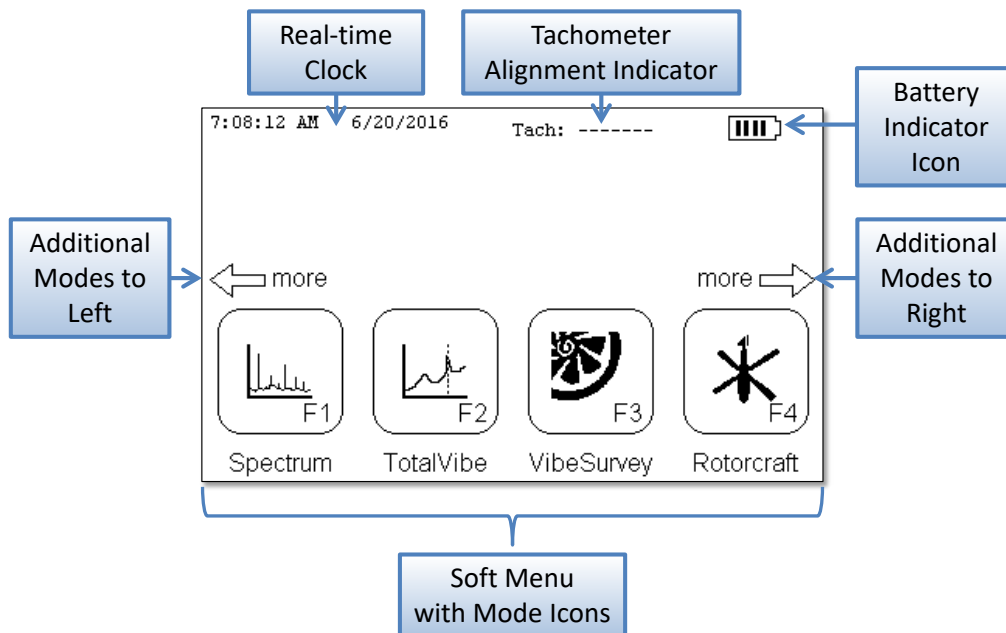
Turn on the DynaVibe GX by pressing the Power key in the lower right corner of the keypad; the DynaVibe logo screen will appear for a few seconds. On initial use and when the system is not resuming a mode, the Start-Up screen will appear after the logo screen. The Start-Up screen shows the DynaVibe model type, software version, calibration due date, and serial number of the system.



Start-Up Screen

4.8 Home Screen

From the Start-Up screen, press the <F4> function key (under the “Next” soft key label) to open the Home screen. Use the Home screen to start the system’s modes and view system status information. To return to this screen from most other screens, press the Home key.



Starting Modes

Press the function key directly below a “soft menu” mode icon to activate that mode. Most operations on the DynaVibe GX will utilize the soft menus.

Real-Time Clock

The system’s real-time clock keeps track of the time to provide time-stamped reports. This helps the operator keep a history of when the work was performed. Before use, verify that the real-time clock is set to the local date and time. To change the date or time, see 5.1 “Settings Mode” on page 14.

Tachometer Alignment

The tachometer alignment indicator is useful when the back of the optical tach is not visible and the tape needs to be aligned with the optical tach. The indicator shows “Tach: Aligned” when the optical tach is aligned with the reflective tape or “Tach: -----” when not aligned.

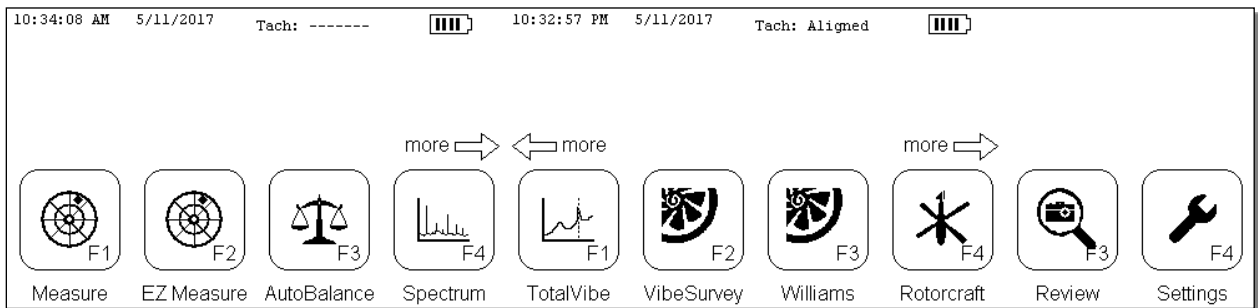
Battery Icon

The battery indicator icon shows a graphical representation of the amount of battery life remaining. Change the batteries if the battery icon shows less than two bars or when the “Low Battery” warning appears during use.

Soft Menu

The soft menu along the bottom of the Home screen contains mode icons that match up with the function keys (<F1> through <F4>). Press the corresponding function key to start a mode.




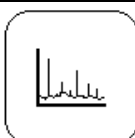


The “more” arrows indicates that there are additional modes available that are not currently shown. Press <3> (scroll right arrow) to access any additional modes to the right of the current screen. Press <1> (scroll left arrow) to access any additional modes to the left of the current screen. As shown below, the additional modes will appear as the menu scrolls to the right. VibeSurvey, Williams, and Rotorcraft modes only appear on the GX3.







Home Screen – Illustrated Across Multiple Screens to Show All Mode Icons

4.9 Mode Summary

The DynaVibe GX family supports task-specific modes. Some modes are model-specific. The major function of each DynaVibe mode is summarized in the following table:

Mode Name	Model	Purpose and Features
 AutoBalance	ALL	<ul style="list-style-type: none"> Automated weight solutions supporting multiple runs (up to 8) Vibration magnitude and phase angle (with polar charting) <u>Phase IS compensated for setup</u> Save HTML report with weight additions, vibration phase angle and magnitude, final spectrum, graphical summary, and run log Single accelerometer input (left channel)
 EZ Measure	ALL	<ul style="list-style-type: none"> Vibration magnitude and phase angle (with polar charting) <u>Phase IS compensated for setup</u> No automated solutions Single or dual-channel accelerometer input
 Measure	ALL	<ul style="list-style-type: none"> Vibration magnitude and phase angle (with polar charting) <u>Phase is NOT compensated for setup</u> No automated solutions Single or dual-channel accelerometer input Phase angle representation compatible with most third-party procedures
 Spectrum	ALL	<ul style="list-style-type: none"> Spectrum analysis up to 24,000 RPM Velocity (IPS) or Acceleration (G) views (plotted vs. frequency) Harmonic markers Switchable between left and right accelerometer inputs Identify vibration sources based on frequency
 TotalVibe	ALL	<ul style="list-style-type: none"> Acceleration (G) versus frequency with harmonic markers Sweep throttle to find high vibration RPM ranges Switchable between left and right accelerometer inputs
 VibeSurvey	GX3	<ul style="list-style-type: none"> Analyze high speed vibration up to 20 kHz Velocity and Acceleration views (plotted versus frequency) Configure up to three limit ranges (Velocity view) For use only with 20 kHz Accelerometer (available separately) Save spectra to CSV files on SD card

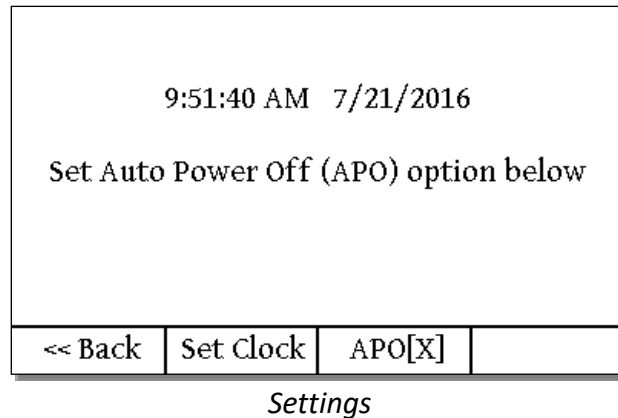
Mode Name	Model	Purpose and Features
 <p>Williams</p>	GX3	<ul style="list-style-type: none"> • Designed for use by Williams International Authorized Service Centers • Analyze high speed vibration up to 20 kHz • Velocity versus frequency with up to three limit ranges • For use only with 20 kHz Accelerometer (available separately) • Acquire multiple conditions and generate HTML reports
 <p>Rotorcraft</p>	GX3	<ul style="list-style-type: none"> • Methods specific to rotorcraft track and balance procedures • Supports measurements while on the ground, in a hover, and at varying forward flight speeds • Use with dual accelerometers and/or DynaTrack Blade Tracker • Supports Push-to-Talk (PTT) input for single-user operation
 <p>Review</p>	ALL	<ul style="list-style-type: none"> • Browse screenshots on the SD Memory Card
 <p>Settings</p>	ALL	<ul style="list-style-type: none"> • Change Date and Time • Disable or Enable Auto Power Off (APO)

5 Mode Specifics

5.1 Settings Mode

Use the Settings mode to set the real-time clock's date/time or adjust the Auto Power Off (APO) function.

Press <3> (scroll right arrow) several times to scroll to the right-most mode icon on the Home screen. Press the function key corresponding to the "Settings" entry to activate the Settings mode.



Press <F2> ("Set Clock") to set the real-time clock to your local date and time. This will initiate a series of input screens to set the year, month, day, a.m./p.m., hour, and minute.

If a value already has the correct setting, press <F4> ("Accept") to leave it unchanged and move on to the next setting. To change a value, press <F1> ("clear") to erase the current value or press <F2> ("←") to delete the rightmost character. Use the numeric keys to enter the new value. When "Accept" is pressed for the minutes' entry, the clock will be set to the time and date as specified. The seconds' field will be reset to 00.

APO is enabled by default each time the system is turned on and will allow the system to shut down and conserve battery power when the system is idle. APO[X] indicates Auto Power Off is active and the unit will shut down after a few minutes of inactivity (no button presses). Press <F3> to deactivate APO and change the label to APO[]. However, if the unit is accidentally left on while APO is disabled then the batteries will drain prematurely.

NOTE: VibeSurvey and Williams modes override the APO setting. VibeSurvey increases the APO timeout to 15 minutes. Williams mode disables APO.

5.2 Measure Mode

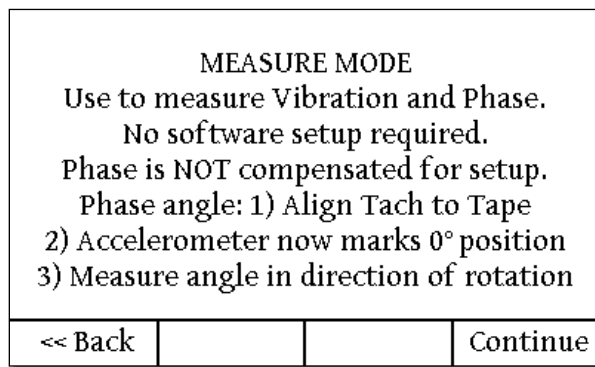
<i>Left Accel. Input</i>	<i>Right Accel. Input</i>	<i>Optical Tach</i>	<i>Resume After Power Off</i>	<i>DynaTrack Accessory</i>	<i>PTT Switch</i>	<i>APO (Auto Power Off) Setting</i>
Required: Standard (1 kHz) Accel.	<i>Optional: Standard (1 kHz) Accel.</i>	Required	Yes	Not Supported	<i>Optional</i>	Yes: Supports Global APO Setting

Measure mode supports one or two channels of vibration analysis. It is a quick way to plot vibration measurements from one or two channels simultaneously on a polar chart.

Measure mode generates raw vibration readings that are not compensated for sensor positions or the direction of assembly rotation. Therefore, readings from Measure mode are compatible with many adjustment charts and processes from other sources, such as maintenance manuals. This mode will generate data equivalent to the DynaVibe Classic, showing magnitude and phase relative to the accelerometer position when the assembly is aligned with the optical tach.

This mode requires that a standard DynaVibe accelerometer (1 kHz) is connected to the left input prior to activating the mode. A second standard accelerometer may optionally be connected to the right accelerometer input.

When using the Measure mode, the phase angle of maximum vibration is reported relative to the accelerometer position. In other words, the accelerometer position defines 0°. The phase angle is physically located, with the engine and ignition off, by aligning the reflective tape to the optical tach then using the accelerometer as the zero-degree reference and measuring the reported angle in the direction the assembly would rotate during operation. The phase angle typically indicates the heavy location.

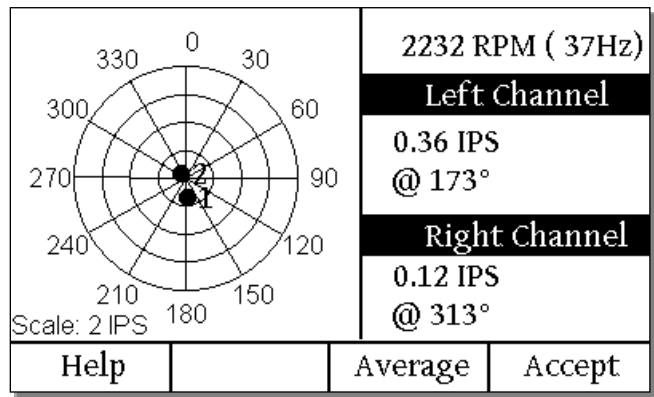


Measure Mode Description

Measure mode starts with a description screen as shown above. Press <F4> “Continue” to continue to the live polar chart.

The Measure mode polar chart screen plots live accelerometer reading(s) in a polar chart on the left and displays the tachometer and accelerometer readings on the right. In the following example screen, the motor is rotating at 2232 RPM and two accelerometers are mounted at different angular positions.

On the chart, the Left Channel accelerometer is labeled "1" and the Right Channel accelerometer is labeled "2".



Measure Polar Chart

F1:

Describes basic functions of the polar chart.

F3:

Begins an averaging cycle before proceeding to the “Measurement Results”. Since the averaging is a set number of rotations, the length of time to complete the average depends on the RPM, but is typically 5 to 10 seconds. Averaging can improve the accuracy of the magnitude and phase readings, especially at lower magnitude vibration levels. “Average” can also be started by holding in the optional PTT switch.

F4:

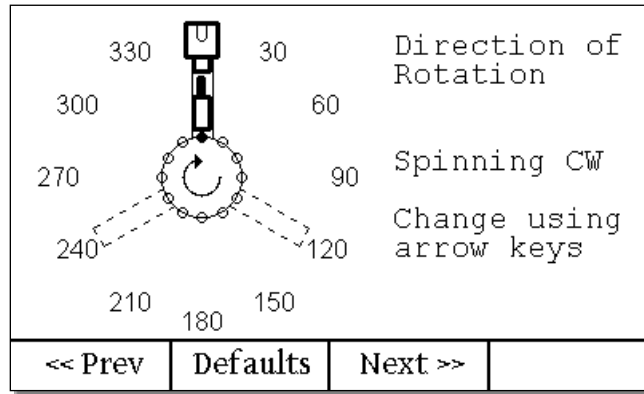
Proceeds to the “Measurements Results” screen using the readings. “Average” (<F3>) should typically be used instead of “Accept” (<F4> or a short press of the optional PTT switch).

The measurement results screen summarizes the final readings on the polar chart screen. Press <F1> “Back” to return to the live polar chart or <F4> “Menu” to return to the Home screen.

NOTE: In Measure mode, phase is NOT corrected for setup: the accelerometer position defines 0° and angular degrees increase in direction of rotation.

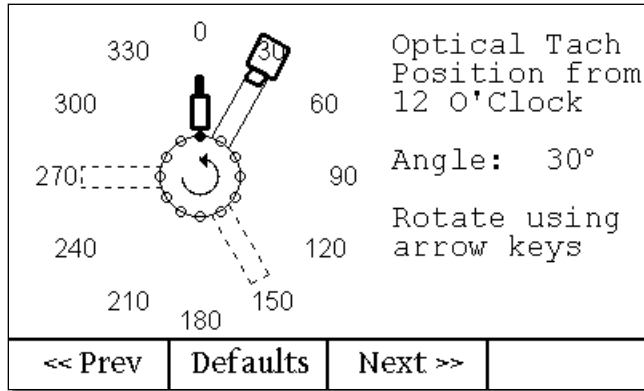
Configuration Examples

- Propeller balancing is typically performed by using a single accelerometer at the front of the engine.
- After balancing the propeller, Measure mode can be used to do a front-back survey of the engine using both accelerometers simultaneously. When propeller balancing is complete, it is possible that the back of the engine has residual imbalance. This can be caused by a number of complex interactions and further troubleshooting may be necessary.
- Helicopter track and balance procedures typically use one or two accelerometers.



EZ Measure Mode Setup – Direction of Rotation

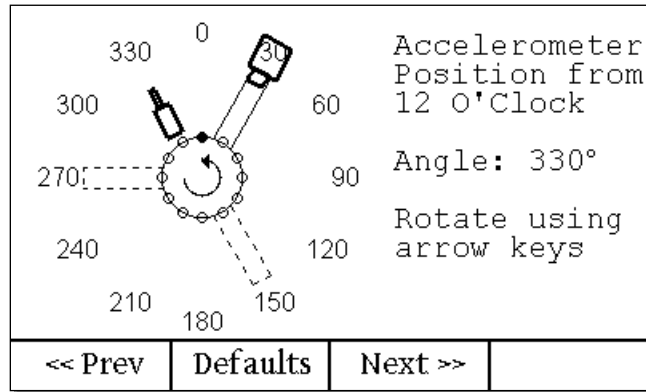
The next step is to configure the direction of rotation to clockwise (CW) or counterclockwise (CCW) as viewed from the mechanic’s side (spinner side) of the aircraft. Change the direction of rotation using the arrow keys so that the direction indicated by the circular arrow in the center of the diagram is the same as the direction of rotation on the propeller. Press <4> (left arrow) for CCW or <6> (right arrow) for CW. Press “Next” (<F3>) when the direction of rotation is correct.



EZ Measure Mode Setup – Optical Tach Position

NOTE: The “mechanic’s side” or “spinner side” of the aircraft is defined as if you are standing in front of the propeller, looking back at the aircraft, NOT the pilot’s view.

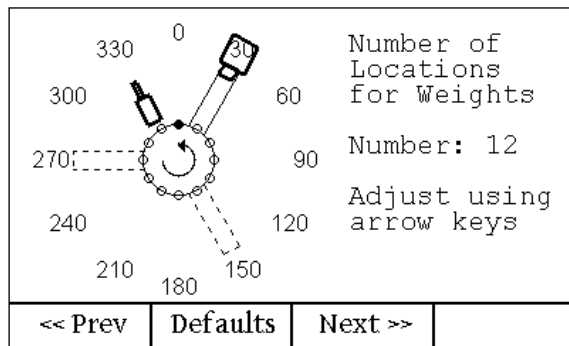
After setting the direction of rotation, configure the optical tach angular position as mounted on the aircraft. The optical tach is typically mounted at the top of the engine, but may be mounted at another position on the aircraft. Press the left or right arrow key to rotate the optical tach configuration into the as-mounted position, viewed from the spinner side. Press “Next” (<F3>) when the optical tach is configured in the correct location.



EZ Measure Mode Setup – Accelerometer Position

After configuring the optical tach angle, the next step is to configure the accelerometer angular position as mounted on the aircraft. The accelerometer is typically mounted at the top of the engine, but may be mounted at a different location. Press the left or right arrow key to rotate the displayed accelerometer position to the position as mounted on the engine, viewed from the spinner side. It is best to mount the accelerometer as close to the propeller as is practical. If using two accelerometers with EZ Measure mode, they must be positioned at the same angle with respect to the rotational axis, but can be mounted at different longitudinal locations. Press “Next” (<F3>) when the accelerometer is configured to the correct position. Note that the length and stiffness of the accelerometer mount are critical. Refer to RPX application notes or aircraft maintenance procedures for guidance.

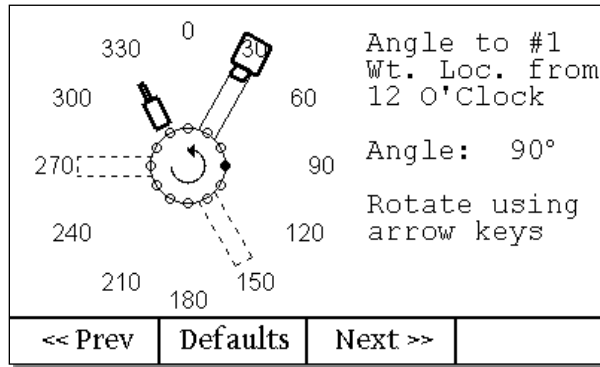
Next, the DynaVibe will ask for the number of weight locations.



Weight locations setup screen

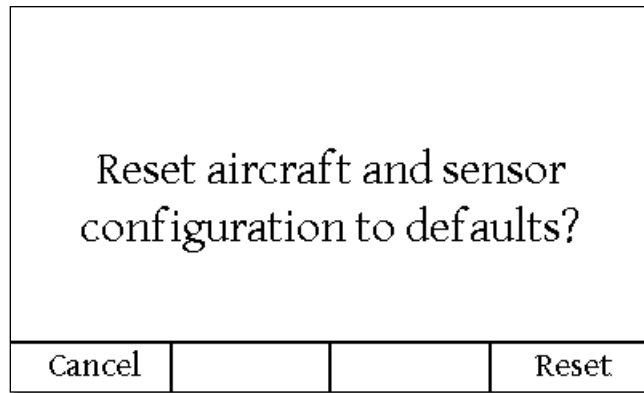
Press the left or right arrow key to adjust the number of weight locations to correspond to the number of weight location mounts available. Press “Next” (<F3>) to confirm the number of weight locations.

After entering the number of weight locations, the DynaVibe will ask for the angular position of the #1 location. This is used as a reference to number the mounting locations when reporting where to add weight. The #1 location is typically at 12 o’clock (0° at top center), but this may be set to any weight-mounting location. Press the left or right arrow to set the position of the #1 weight-mounting location.



Weight locations setup screen

Note: EZ Measure will start with the last used configuration. To reset to the default configuration, press "Defaults". This will bring up the reset aircraft and sensor configuration confirmation screen.



EZ Measure Mode Defaults

Select "Reset" (<F4>) to confirm resetting to defaults or "Cancel" (<F1>) to continue using the current configuration.

Once the number of weight locations and the position of the #1 location is set, press "Accept" to begin measuring. The system will display a "Tachometer Signal Required" screen until the optical tach detects blade rotations.

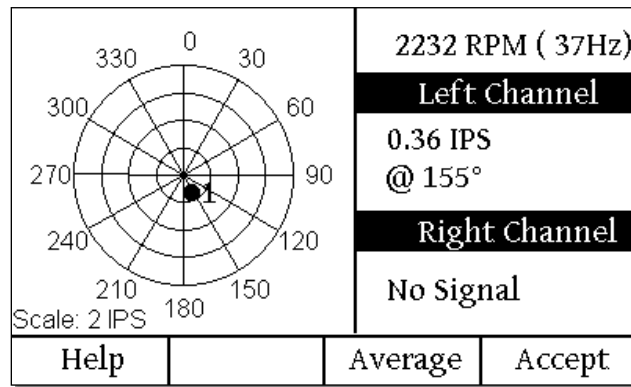
CAUTION:

Verify that the area around the propeller is clear of obstructions.

Verify that all cabling is secure.

Verify the propeller area is clear and the aircraft is ready for runup, then begin your runup procedure. When a tachometer signal is detected, the system will display the polar chart. Measurements are

typically taken at normal cruise RPM. If cruise RPM is not practical, full static RPM may typically be used. Press “Help” (<F1>) for a brief description of the available functions.



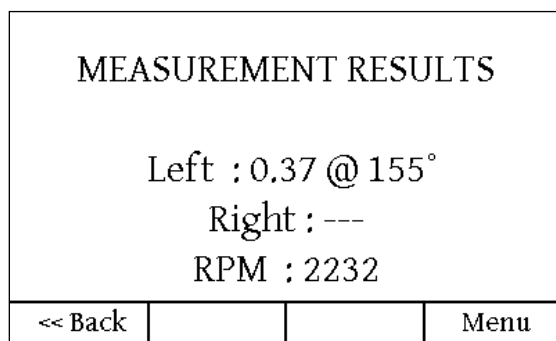
EZ Measure mode polar chart

The polar chart shows the vibration magnitude and phase angle. The current reading from the tachometer appears in the upper right in RPM units (with the same reading converted to Hertz units in parenthesis). Below the tachometer RPM reading is the “Left Channel” reading showing the measured peak magnitude (in IPS) at the measured phase angle (in degrees).

Most applications only require a single accelerometer, which should be connected to the left input channel. However, a second accelerometer may be connected to the right input channel and will be displayed in the “Right Channel” area. The right channel phase angle is calculated using the same installation reference angle as the primary “Left Channel” was configured. “No Signal” will be displayed for the right channel if an accelerometer is not connected to that input.

Once the RPM reading in the upper-right of the screen is stable at the target RPM, press “Average” (<F3> or hold the optional PTT switch) to collect a time-averaged reading. While averaging, the polar chart will continue to display live readings, but the text to the right will display “Wait” with a countdown. Note: “Accept” (<F4> or a short press of the optional PTT switch) may be used instead of “Average”, but averaging is recommended and can improve magnitude and phase accuracy.

Once averaging is completed (or if “Accept” is pressed), the system will advance to the “Measurement Results” screen showing a summary of the reading. The readings are now “locked in” and the aircraft can be shut down using the manufacturer’s standard cool down and shut down procedures, or the “Back” button can be used to replace the reading.



EZ Measure Measurement Results

Because the direction of rotation and locations of the accelerometer and optical tach were entered during configuration setup, the vibration position reported on the “Measurement Results” screen (and that was drawn on the polar chart) reflects the imbalance location as viewed under the following conditions:

- Engine and propeller stopped
- Viewed from the spinner-side
- Propeller rotated until the reflective tape is aligned with the optical tach

Under the above conditions, the 0° reference is at the top center of the propeller assembly (12:00 in clock-face notation). If the vibration is shown at 268° as in the above screenshot, then the maximum vibration will be at 268° from top-center in the clockwise direction (approximately 9:00 using clock-face notation). For most aircraft engine installations, the reported phase angle corresponds to the heavy location and dynamic balance weights will be added 180° opposite this point. In this example, this would be at 89° (269° - 180° = 89°) or approximately 3:00 in clock-face coordinates. If it is not possible to adjust weight at the exact location indicated, splitting the weight between two adjacent locations may be necessary.

For many propeller-balancing applications, EZ Measure mode may be used for a quick evaluation. AutoBalance mode (described in the next section) would provide a more efficient balance process by automatically calculating dynamic balance weights and locations after the initial trial weights.

5.4 AutoBalance Mode

<i>Left Accel. Input</i>	<i>Right Accel. Input</i>	<i>Optical Tach</i>	<i>Resume After Power Off</i>	<i>DynaTrack Accessory</i>	<i>PTT Switch</i>	<i>APO (Auto Power Off) Setting</i>
Required: Standard (1 kHz) Accel.	<i>Not used</i>	Required	Yes	Not Supported	<i>Optional</i>	Yes: Supports Global APO Setting

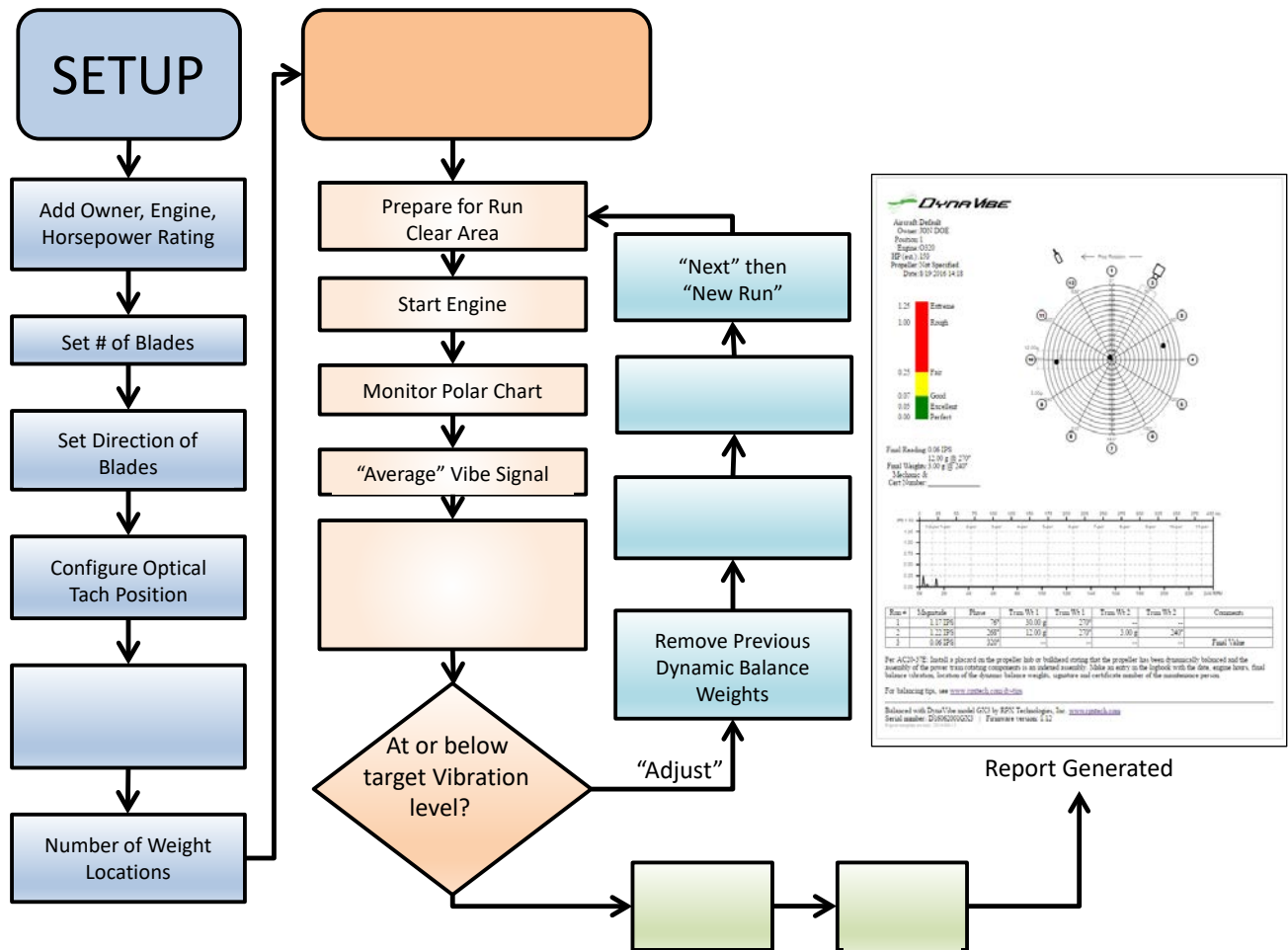
AutoBalance mode is specialized for balancing aircraft propellers. It assumes that the item to be balanced is an aircraft propeller assembly driven by an engine with greater than 25 hp. It is not for use on rotorcraft main rotors, tail rotors, industrial equipment, or non-aviation items without special consideration regarding the initial trial weight. (Contact RPX or see application notes for guidance.)

Using AutoBalance mode will require multiple engine runs to learn about the engine and propeller combination in use. An initial trial run is performed with all *dynamic* balance weights removed (do NOT remove or modify *static* balance weights). The accelerometer and optical tach should be mounted as outlined in *DynaVibe* application note listed below or the aircraft manufacturer’s recommendation.

- Application Note: *RPX-AFA-PR-BAL “Dynamic Propeller Balancing on Aircraft”*

Each run will provide an imbalance magnitude and phase and will give a recommendation for TOTAL weight additions to the mounting locations. After each run, review the results of that run and begin the next run. When you are satisfied with the results, typically when the vibration is 0.07 IPS or lower, press

“Finished” then press “Report” to save your results. Do not press “Finished” before you are satisfied with the balance results.



AutoBalance mode balancing process overview

Activating the AutoBalance mode will allow you to start a new job or continue the previous job (if available).

CAUTION:

Static balance weights applied by a propeller manufacturer or propeller repair facility should NOT be removed.

To start the process, remove all the dynamic balance weights currently installed. Never remove static balance weights. Removing any dynamic balance weights prior to the first run will allow the assembly to be dynamically balanced with the minimum necessary weight.

Owner	: JON DOE				
Aircraft#:	Default				
Engine	: 0320				
HP (est.):	150				
Propeller:	Not Specified				
Position	: 1				
Spinner Dia:	12				
<table border="1"> <tr> <td></td> <td>Defaults</td> <td>Edit</td> <td>Next >></td> </tr> </table>			Defaults	Edit	Next >>
	Defaults	Edit	Next >>		

Job Setup

The next step is to enter information for this particular balance job. Using the up and down arrows (<2> and <8>), move the cursor to choose an individual data field for editing. Once the desired data field is chosen, press "Edit" (<F3>) or Select (✓ on key <5>) to edit the chosen field value.

This information is primarily for record-keeping purposes and will be output to the final HTML report. However, the estimated engine horsepower is used when calculating an initial trial weight so it is important that this number is entered correctly. Once all the data is entered, press "Next" to continue.

The DynaVibe will now prompt you to enter the configuration information. This process is identical to editing the configuration information in EZ Measure mode (see Section 5.3 on page 17). Enter the number of blades, the direction of rotation, the angular positions of the accelerometer and optical tach, the number of weight positions, and the location of weight position #1.

After entering all the relevant setup information, the DynaVibe will prompt you to ensure the area is clear and prepare to run the engine.

<p>Prepare for runup. Clear the area. Runup at cruise RPM. RPM should be the same for each run.</p>			
<< Back		Next >>	

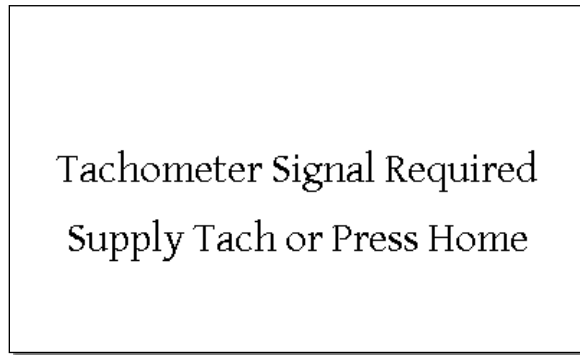
Prepare for Runup

CAUTION:

Verify that the area around the propeller is clear of obstructions.

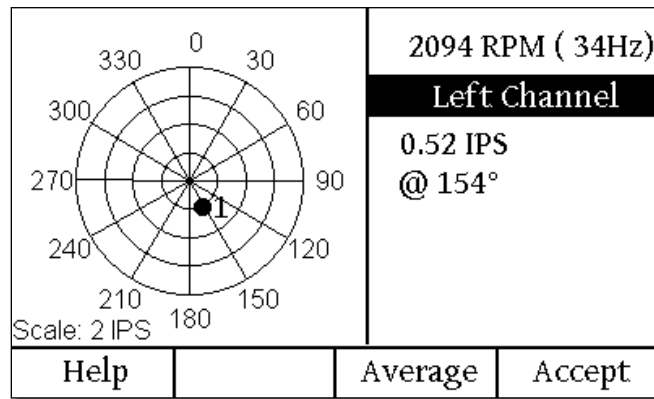
Verify that all cabling is secure.

Once all safety considerations have been met, select “Next” to continue and begin runup. The system will display the “Tachometer Signal Required” screen until the optical tach detects a valid RPM.



Tachometer Signal Required

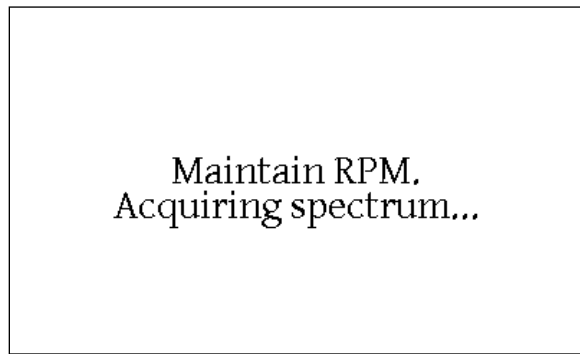
Once the engine is warmed up and running at cruise RPM, review the polar chart for the vibration magnitude and phase angle. Verify that the RPM is stable and "Check Tach" is not displayed. If "Check Tach" is shown, this indicates the optical tach is experiencing intermittent signals and may require a larger area of reflective tape or isolation from electrical wires.



AutoBalance Mode Polar Chart

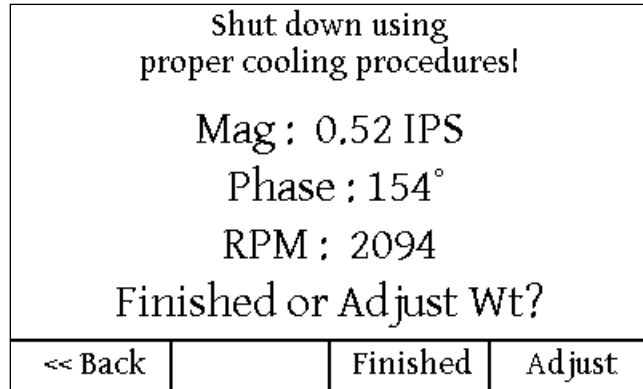
The example measurement above shows 2094 RPM, with a 0.52 IPS vibration at 112°.

Once the RPM reading in the upper-right of the screen is stable at the target RPM, press “Average” (<F3> or hold down the optional PTT switch) to collect a time-averaged reading. While averaging, the polar chart will continue to display live readings, but the text to the right will display “Wait” with a number counting down from 7.



Maintain RPM after Pressing "Accept"

Once averaging is complete, the DynaVibe will display "Maintain RPM. Acquiring spectrum..." as it records the engine's vibration spectrum. During this period, which should last a few seconds, maintain a stable RPM. This will allow the DynaVibe to record the vibration survey of the engine at the RPM of interest. After the spectrum is acquired, the DynaVibe will prompt you to shut down the engine using the engine manufacturer's recommended procedures. Once the engine is shut down, review the vibration magnitude and phase angle shown on screen.

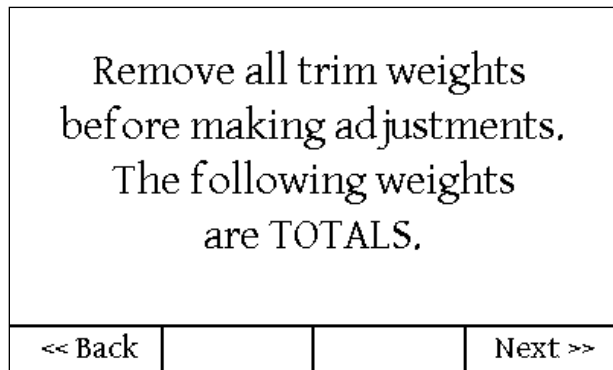


AutoBalance Measurement Review Screen

Once the vibration is very low, typically 0.07 IPS or less, there may be diminishing returns for attempting to achieve significantly lower vibration readings. On some aircraft, anything at or below 0.20 IPS may be an acceptable vibration target. Usually, 0.10 IPS is a reasonable goal.

If an acceptable vibration level has been achieved, press "Finished" to exit the balancing process then, on the "Exiting AutoBalance" screen, press "Report" (<F4>) to generate a report. Once the report is generated, the "Final Result" screen will appear summarizing the final vibration readings and the final dynamic balance weight(s) entered.

If the vibration magnitude is greater than your target vibration level, press "Adjust" to continue the balancing process by modifying the balance weight(s). "Remove all trim weights..." will prompt you to remove any installed dynamic balance weights before adding new weights.



Remove Dynamic Balance (Trim) Weights Reminder

After all dynamic balance weights have been removed, press "Next" to go to the weight addition screen. This screen shows the magnitude (IPS) and phase (angle) of the error and the suggested

correction solution. The weights shown on the following screen are the TOTAL dynamic balance weights, not incremental additional weights.

Vibration : 0.52 IPS @ 154°			
Solution : 23.6g @ 334°			
Split-Bolt 6: 22.6g @ 330°			
Split-Bolt 1: 1.9g @ 30°			
ENTER ACTUAL WEIGHTS (TOTAL)			
➤ Addition 1: ---g @ ---°			
Addition 2: ---g @ ---°			
NET : ---g @ ---°			
Help	Show	Rerun	Finished

AutoBalance Weight Addition

In this example AutoBalance run, the DynaVibe suggests 23.6 g correction weight at 334°, but there is not a weight-mounting location at that angle. However, from the configuration information entered, the DynaVibe determined that there are two suitable weight locations available: one at 330° and another at 30°. Therefore, the DynaVibe suggests splitting the weights between those two bolts: with 22.6 g on bolt #6 and 1.9 g on bolt #1 to produce the net 23.6 g at 334°.

Example: Bolt #6 previously had 15 grams of weight added. Our latest run indicates that bolt #6 requires 22.6 grams of weight. The 15 grams should have already been removed and a total of 22.6 grams should be added to bolt #6.

IMPORTANT! Enter the actual values of the weight used on each bolt on the "Addition 1" and "Addition 2" lines. It is important that you accurately measure the weights added and enter the exact adjustment made (total weights and exact locations). Use the digital scale to weigh the aircraft hardware being used as dynamic balance weights. Weigh the hardware for each location as a set. Subsequent solutions will be degraded or incorrect if the weight and locations are not accurately entered.

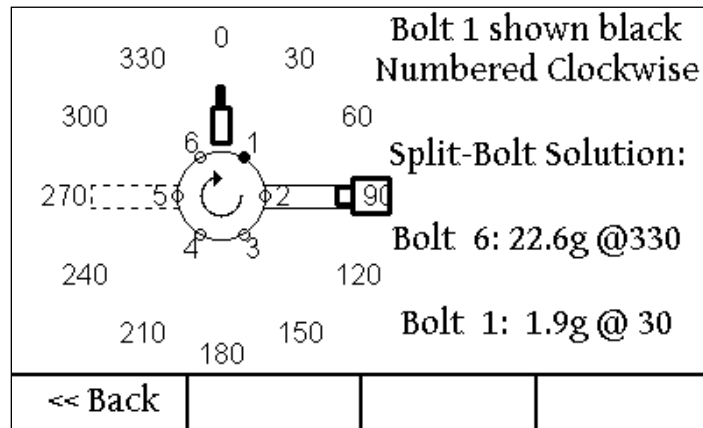
Example: The DynaVibe solution calculates 22.6 grams on bolt #6, but using available weights the actual weight added is 22.7 grams. Therefore, Addition 1 should be entered as 22.7 grams on bolt #6. Always enter the exact location and actual weight added, not the solution recommended.

The first weight addition is critical to quickly reaching a balanced solution. Pressing Select (the ✓ on key <5>) allows you to enter the mass in grams and the bolt-location number. Numbered locations are converted to angles when displayed on the Weight Addition screen.

Vibration : 0.52 IPS @ 154° Solution : 23.6g @ 334° Split-Bolt 6: 22.6g @ 330° Split-Bolt 1: 1.9g @ 30°			
ENTER ACTUAL WEIGHTS (TOTAL) Addition 1: 22.7g @ 330° ➤ Addition 2: ---g @ ---° NET : 22.7g @ 330°			
Help	Show		Next >>

Weight Addition Screen Showing the Installed Weight(s) and Location

The bolt-location numbers are indexed clockwise (as viewed from the spinner side) from the master bolt location as #1. Press "Show" on the Weight Addition screen to see a graphical representation of the setup along with numbered bolt locations used for the current job. The reflective tape must be aligned with the optical tach when using the graphical representation to determine the bolt locations.



"Show" (Solution and Setup)

Until a weight addition is entered, a "Rerun" soft key is available on the Weight Addition screen. This option is for discarding the current run data and returning to the Polar Chart to collect new data. This is useful if there was a problem during the data collection (such as running at the wrong RPM) and the data needs to be taken again before changing the dynamic balance weights. "Rerun" expects the previously used weights to be installed and is not available after "Addition 1" or "Addition 2" has been entered.

Once the mass and location of the dynamic balance weights have been entered, the net correction weight and angle will be displayed. Press "Next" to continue to the Review Runs screen. On the Review Runs screen you will see a list of runs. Each run has a row with the run number, the RPM, the measured vibration (IPS and angle), and the "NET" correction added (calculated using "Addition 1" and "Addition 2").

Run #	RPM	Vibration	Correction
		IPS @ Angle	g @ Angle
1	2094	0.52 @ 154°	23.8 @ 334°
> 2	2097	0.24 @ 146°	42.4 @ 326°
<< Back		Detail	Graph
			New Run

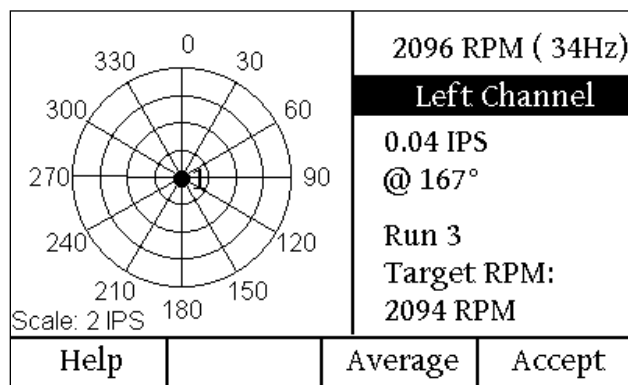
Review Runs Grid

Use the arrow keys to move the cursor between rows and press "Detail" (<F2>) or Select (✓ on key <5>) to review details on the chosen run as shown in the following graphic.

Run Number :	2 at 2097 RPM
Vibration :	0.24 IPS @ 146°
Sensitivity:	81.6 grams/IPS
Recommended:	42.8 g @ 327°
Added :	2.6 g @ 270°
Added :	41.0 g @ 330°
Net :	42.4 g @ 326°
<< Back	

Run Detail

Press "Back" (<F1>) or Select (✓ on key <5>) to exit the Run Detail screen. After confirming the information on the review runs grid screen, press "New Run" to start the next run.



Polar Chart, Run #3

Go through the runup safety procedure again then advance to the polar chart to show the new run's vibration level. Once the RPM and IPS readings are stable, press "Average" to proceed.

Shut down using proper cooling procedures!			
Mag : 0.04 IPS			
Phase : 171°			
RPM : 2096			
Finished or Adjust Wt?			
<< Back		Finished	Adjust

AutoBalance Run Summary Screen

When the vibration is at an acceptable level, press “Finished” to complete the process. A typical balance goal is a vibration at or below 0.10 IPS. In our example, the third run yielded 0.04 IPS and the balancing job is complete. If the vibration was above the target magnitude, then additional runs would be necessary and you would press “Adjust” <F4>. The system will allow up to eight runs.

When “Finished” is pressed, a confirmation screen allows the report to be generated.

Exiting AutoBalance			
Press BACK to Resume			
Press REPORT to Save Report			
Press HOME to Exit (no report)			
<< Back			Report

AutoBalance Finished: Option to Create Report

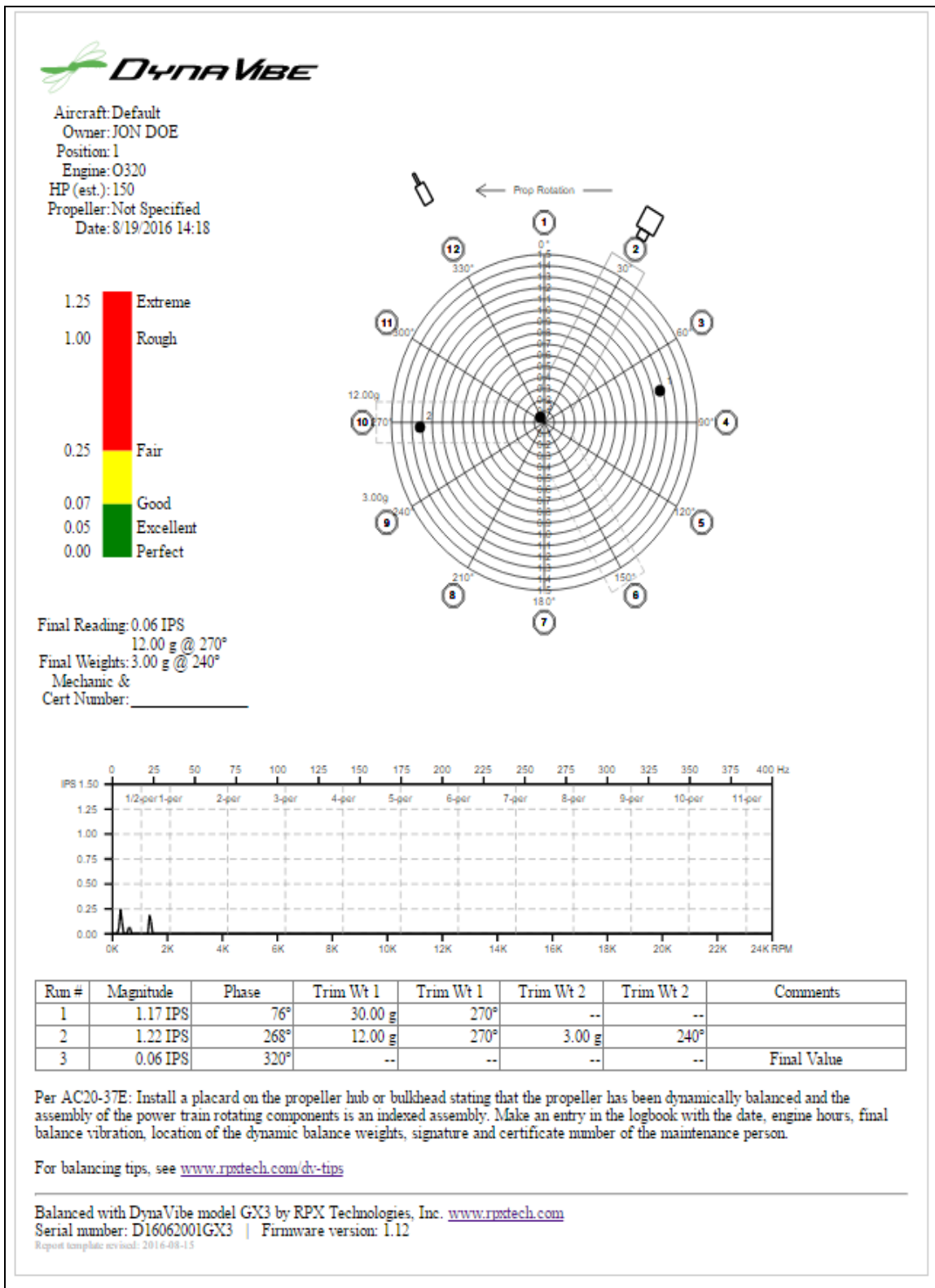
Press “Report” (<F4>) to generate the report.

FINAL RESULT			
Vibration : 0.04 IPS @ 171°			
Added	:	2.6 g @ 270°	
Added	:	41.0 g @ 330°	
Net	:	42.4 g @ 326°	
Report is on SD Card			
			Next >>

AutoBalance Final Result Screen After Report Is Generated

The report will be available on the SD card in HTML format. To review or print the report, turn off the DynaVibe then remove the SD card and insert into a computer’s SD card reader. Reports are named

based on the "Owner" field in the aircraft configuration and placed in the root folder of the SD card. Browse to the SD card then double-click a report to open it in your browser.



A typical DynaVibe GX report

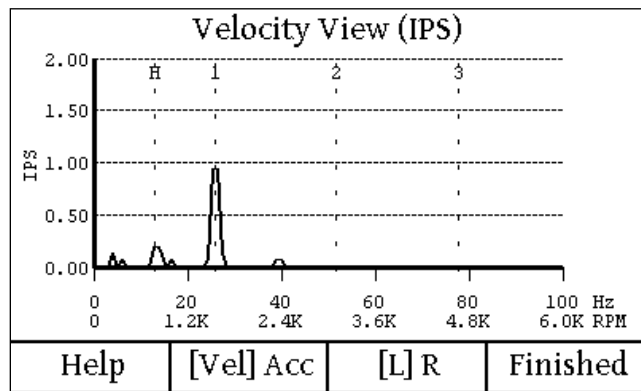
5.5 Spectrum Mode

Left Accel. Input	Right Accel. Input	Optical Tach	Resume After Power Off	DynaTrack Accessory	PTT Switch	APO (Auto Power Off) Setting
Required: Standard (1 kHz) Accel.	<i>Optional: Standard (1 kHz) Accel.</i>	<i>Recommended (To enable n-per-rev labels)</i>	No	Not Supported	<i>Optional (Screen shot)</i>	Yes: Supports Global APO Setting

Spectrum mode allows the user to analyze the full frequency range of vibrations in the engine or airframe as measured by the accelerometer. Spectrum mode can be used without a tachometer to give the vibration level in IPS versus frequency. However, using a tachometer in addition to the accelerometer will also mark harmonics.

When using a tachometer with Spectrum mode, the DynaVibe will show vertical dashed lines that correspond to the tachometer frequency. In the example below the optical tach is activated at around 26 Hz (1560 RPM). The once-per-revolution vibration or “1-per-rev” (with a frequency matching the RPM) is shown at the vertical dashed line with a "1" label.

In this example, there is also a vertical dashed line with a "2" label at 52 Hz, which is the "2-per-rev" frequency, meaning the vibration occurs at twice the tach frequency. The vertical line with an "H" label, which is a "½-per-rev" vibration, marks the vibration that occurs every other rotation.



Spectrum Mode: Velocity View Screen Showing a Significant 1-per-rev Vibration

The four function keys are:

- F1:** Help Describes basic functions such as how to zoom in and out, how to toggle the active accelerometer input, and how to switch between Velocity view and Acceleration view.
- F2:** [Vel] Acc Switches between Velocity view (indicated by [Vel] Acc) and Acceleration view (indicated by Vel [Acc]).

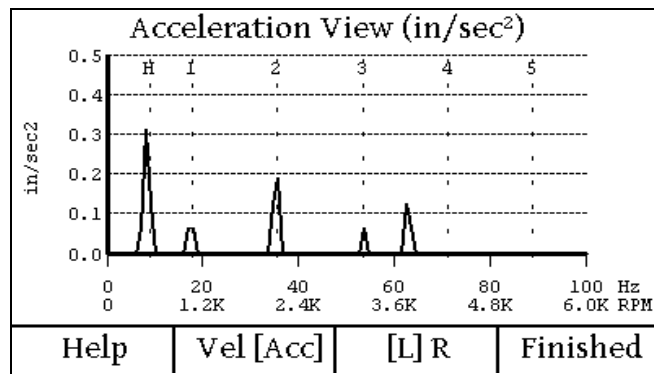
F3: [L] R Switches the active accelerometer input between the left channel input (indicated by [L] R) and right channel input (indicated by [L] R).

F4: Finished Returns the user to the Home screen.

Velocity view is useful for the lower frequencies typically encountered in reciprocating (piston) engines and is a good indicator of relative stress on the assembly. Acceleration view is useful for higher frequencies, such as ball bearings or turbo machinery.

Press the camera-icon key in the lower-left corner to save a screenshot of the spectra data to the “Screenshots” folder on the SD card.

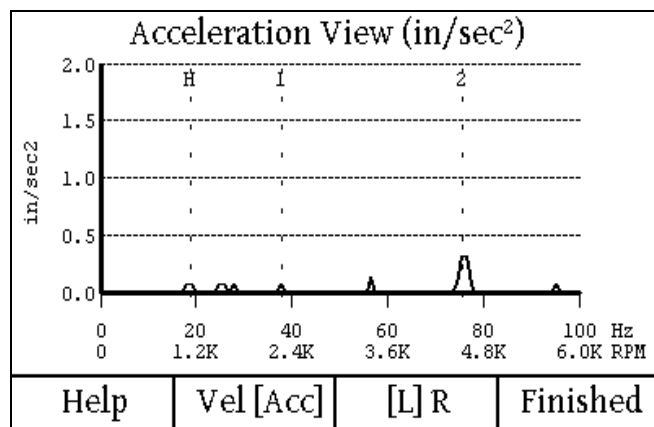
Interpreting spectra data can be complicated. However, the ratio lines shown on the screen can help significantly. For instance, below is an example of a spectrum from a Continental O-470 engine. The 1-per-rev vibration is the mass imbalance of the propeller. Since this spectrum is from a balanced engine, the 1-per-rev vibration is very low at 0.05 IPS. However, the ½-per-rev vibration shown under the “H” is 0.30 IPS. A ½-per-rev vibration in a 4-stroke reciprocating engine is typically from variations in cylinders firing and not from the rotating mass of the propeller assembly (which would appear as a 1-per-rev).



Tip: The gear ratios for engine components and accessories are found in the engine’s Type Certificate.

Spectrum from a Continental O-470 engine

This next spectrum is from a Lycoming O-290-D2. This particular example shows very good cylinder-to-cylinder balance due to the low “H” (½-per-rev). Also, the low 1-per-rev vibration indicates the propeller is well balanced. A 2-per-rev is visible which is caused by the two-bladed propeller prop wash.

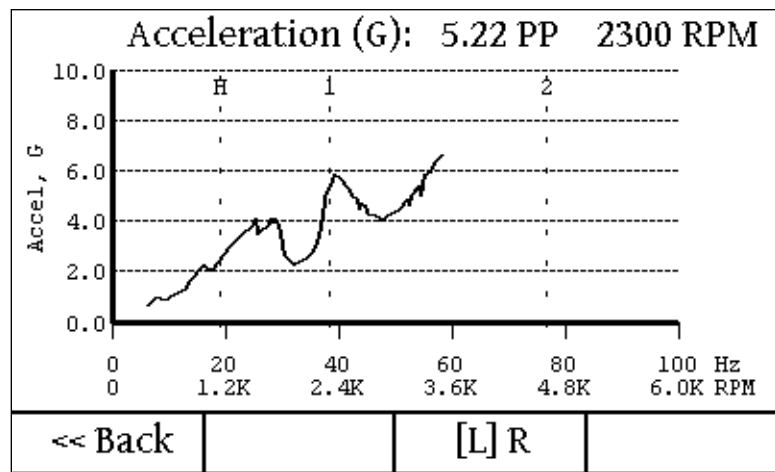


Spectrum from a Lycoming O-290-D2

5.6 TotalVibe Mode

Left Accel. Input	Right Accel. Input	Optical Tach	Resume After Power Off	DynaTrack Accessory	PTT Switch	APO (Auto Power Off) Setting
Required: Standard (1 kHz) Accel.	<i>Optional: Standard (1 kHz) Accel.</i>	Required	Restarts Mode (Previous Data Not Retained)	Not Supported	Not Used	Yes: Supports Global APO Setting

TotalVibe mode is used to identify RPM ranges that exhibit higher vibration. These are usually resonant frequencies. The TotalVibe survey is performed by slowly adjusting the engine throttle from low to high. The TotalVibe mode will plot the peak acceleration (from across the entire accelerometer frequency bandwidth) at each RPM traversed during the throttle ramp.



TotalVibe – Unbalanced Assembly

F1:

Returns the user to the Home screen.

F3:

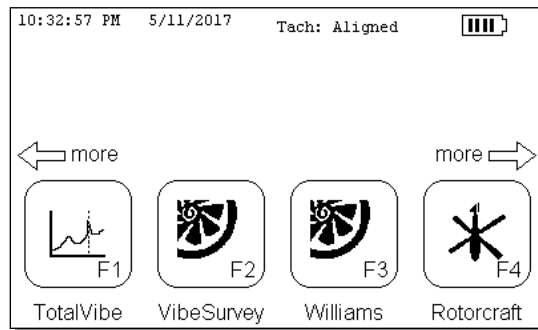
Toggles the active accelerometer input between the left channel input (indicated by) and right channel input (indicated by).

The above example shows the vibration on a motor that gradually increases in amplitude as the RPM increases; this is typical of a mass imbalance. This example also shows two peaks that center around 1400 RPM and 2400 RPM. These peaks correspond to resonances that cause the magnitude of the vibration to amplify at particular frequencies.

5.7 VibeSurvey Mode (GX3 Only)

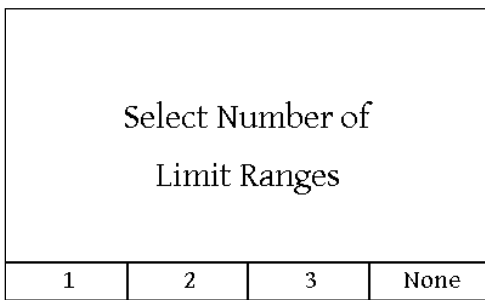
<i>Left Accel. Input</i>	<i>Right Accel. Input</i>	<i>Optical Tach</i>	<i>Resume After Power Off</i>	<i>DynaTrack Accessory</i>	<i>PTT Switch</i>	<i>APO (Auto Power Off) Setting</i>
Required: High Speed (20 kHz) Accel.	Not Used	Optional (Recommended)	No	Not Supported	Not Used	Yes: 15 Minute APO when Global APO Setting is Enabled

VibeSurvey mode analyzes vibration from 3 Hz to 20 kHz and is typically used for turbine engines. This wide frequency range requires an accelerometer specifically designed for these high frequencies. VibeSurvey mode will only work with the DynaVibe 20 kHz accelerometer (RPX Part Number: A20M0AS) and cable, available together as the “Vibration Survey Accessory Kit.”



Home Screen showing the VibeSurvey Mode Icon

After entering VibeSurvey mode the operator will have the option to set limit ranges. Choose “1”, “2”, “3”, or “None” for the number of vibration level limits. Each engine and gearbox combination may have its own specification for the number of limits and the limit magnitudes depending on the test procedure being followed. Contact the engine manufacturer or reference the applicable maintenance procedure for the appropriate limit settings.



VibeSurvey Limit Selection

- F1:** Enables one vibration limit range.
- F2:** Enables two vibration limit ranges.
- F3:** Enables three vibration limit ranges.
- F4:** Continue with no vibration limits selected.

Select the number of limits for your application and the screen will advance to the Limit Values screen.

```

>Limit 1 Min Freq.:    10 Hz <
          Max Freq.:    50 Hz
          Max IPS:      0.40

Limit 2 Min Freq.:    200 Hz
          Max Freq.:    3000 Hz
          Max IPS:      2.10

Limit 3 Min Freq.:    5000 Hz
          Max Freq.:    10000 Hz
          Max IPS:      1.90

[Hz]->CPM | Lim [3]->1 | Edit | Next>>
    
```

VibeSurvey Limit Values screen

- F1:** [Hz]→ CPM Switch units between Hz (indicated by [Hz]→ CPM) and cycles per minute (indicated by Hz ← [CPM]).
- F2:** Lim [3] →1 Cycles the number of active limits among 1, 2, and 3. The active number of limits is indicated within [] and the arrow indicates the next number to be cycled to upon pressing the key.
- F3:** Edit Opens the limit editor for the currently chosen line (indicated by the > < cursors).
- F4:** Next Initiates VibeSurvey mode with the limits as shown. (The help screen will appear next.)

Use the ↑↓ arrows to move the cursor and choose a limit to update and press ✓ (<5>) to edit the value. Units may be switched between Hz and CPM, as needed. Once the limit settings are configured, press “Next” (<F4>) to continue. A description of the graph view controls will be displayed.

```

Press LEFT: X-axis Zoom IN
Press RIGHT: X-axis Zoom OUT

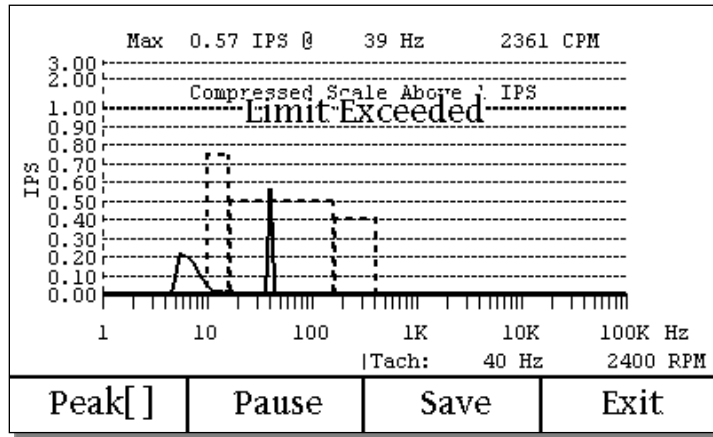
Press 1: X-axis Scroll Left
Press 3: X-axis Scroll Right

Press 5: Toggle View between
         Velocity and
         Acceleration

Next >> | Continue
    
```

VibeSurvey Reference Screen

Press <F2> “Next” or <F1> “Prev” to cycle through the VibeSurvey mode help pages. Press <F4> “Continue” to begin data acquisition.



VibeSurvey Graph of Velocity Data with Limits

- F1:** Peak[] Toggles peak capture for each frequency bin On (indicated by Peak[X]) or Off (indicated by Peak[]).
- F2:** Pause Freezes the current graph, peak reading, and tachometer reading.
- F3:** Save Saves the current data to a CSV file in the root folder of the SD card.
- F4:** Exit Exits to the Home screen.

The VibeSurvey graph of velocity data shows the frequency of vibration in Hz on the x-axis and the magnitude of the vibration in Inches Per Second (IPS) on the y-axis. The graph's y-axis scale is linear between 0.00 and 1.00 IPS and compressed from 1.00 IPS to 3.00 IPS per industry convention. This increases the displayed resolution for typical readings but still allows larger values to be shown. Dashed boxes indicate the limit values entered during the Limit Value Entry screen. "Limit Exceeded" is displayed when at least one peak went above a limit. The peak IPS value is shown at the top of the display along with the frequency of the peak in both Hz and CPM.

Press <F1> ("Peak []") to toggle the peak capture function between enabled and disabled. When enabled, DynaVibe captures and displays the peak value for each frequency and updates only when a higher value is registered. When peak capture is disabled, the current readings are shown without regard to previous readings.

Press <F2> ("Pause") to freeze the data currently on the graph, the peak display text (above the graph), and the tachometer reading (below the graph). Press <F2> again (now labelled "Resume") to resume real-time readings.

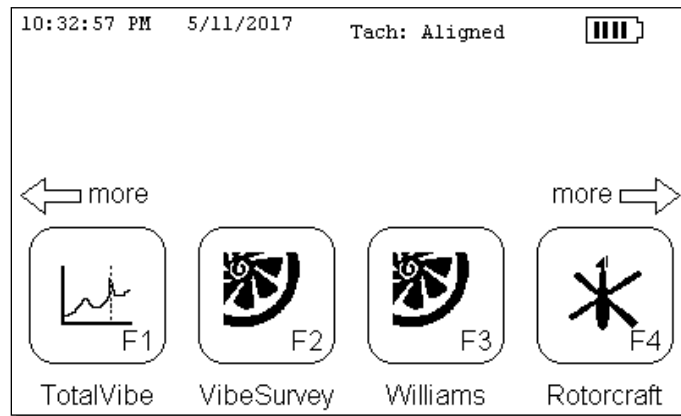
Press <F3> ("Save") to save the currently displayed data to a CSV (Excel compatible) file on the SD memory card. If Peak Capture is enabled, the peak capture data will be saved instead of the live data. If Peak Capture is disabled, then the live data will be saved. The filename of the most recently saved VibeSurvey data will be displayed below the lower left corner of the graph.

Press <F4> ("Exit") to exit the mode and return to the Home screen.

5.8 Williams Mode (GX3 Only)

Left Accel. Input	Right Accel. Input	Optical Tach	Resume After Power Off	DynaTrack Accessory	PTT Switch	APO (Auto Power Off) Setting
Required: High Speed (20 kHz) Accel.	Not Used	Optional: (Recommended)	No	Not Supported	Not Used	APO DISABLED

Williams mode is designed for use by Williams International Authorized Service Centers and analyzes vibration from 3 Hz to 20 kHz in Williams’ turbine engines. This wide frequency range requires an accelerometer specifically designed for these high frequencies. Williams mode will only work with the DynaVibe 20 kHz accelerometer (RPX Part Number: A20M0AS) and cable, available together as the “Vibration Survey Accessory Kit.”



Home Screen showing the Williams Mode Icon

After entering Williams mode, the operator will have the option to set limit ranges. Each engine and test procedure may have its own specification for the number of limits and the limit magnitudes. Refer to Williams’ maintenance procedures for the appropriate limit settings.

The Limit Values screen allows you to choose the number of limit ranges and configure the limits.

>Limit 1	Min Freq.:	10 Hz	<
	Max Freq.:	50 Hz	
	Max IPS:	0.40	
Limit 2	Min Freq.:	200 Hz	
	Max Freq.:	3000 Hz	
	Max IPS:	2.10	
Limit 3	Min Freq.:	5000 Hz	
	Max Freq.:	10000 Hz	
	Max IPS:	1.90	
[Hz]->CPM	Lim [3]->1	Edit	Next>>

VibeSurvey Limit Values screen

- F1:** [Hz]→ CPM Switch units between Hz (indicated by [Hz]→ CPM) and cycles per minute (indicated by Hz ← [CPM]).
- F2:** Lim [3] →1 Cycles the number of active limits among 1, 2, and 3. The active number of limits is indicated within [] and the arrow indicates the next number to be cycled to upon pressing the key.
- F3:** Edit Opens the limit editor for the currently chosen line (indicated by the > < cursors).
- F4:** Next Initiates VibeSurvey mode with the limits as shown. (The help screen will appear next.)

Use the ↑↓ arrows to move the cursor and choose a limit to update and press ✓ (<5>) to edit the value. Units may be switched between Hz and CPM, as needed. Once the limit settings are configured, press “Next” (<F4>) to continue. The Williams mode help will be displayed.

```

Williams Mode Information:
-Frequencies are in RPM units
-Zoom controls are disabled
-Velocity (IPS) view only

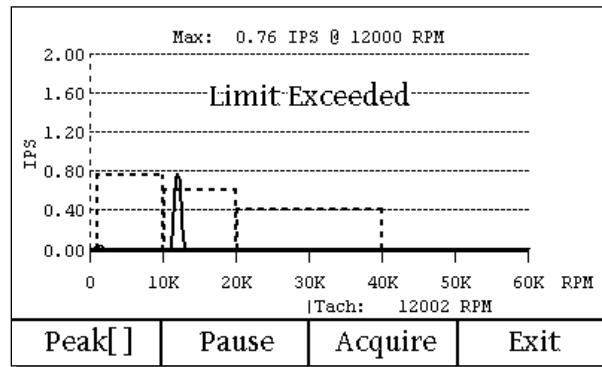
Peak[ ]: Peak Hold is OFF
Peak[X]: Peak Hold is ON

Pause  : Pause data collection
Resume : Resume real-time data

Next >>                      Continue
    
```

Williams Mode Help

Press <F2> “Next” or <F1> “Prev” to cycle through the Williams mode help pages. Press <F4> “Continue” to begin data acquisition.



Williams Graph of Velocity Data with Limits

- F1:** Peak[] Toggles peak capture for each frequency bin On (indicated by Peak[X]) or Off (indicated by Peak[]).
- F2:** Pause Freezes the current graph, peak reading, and tachometer reading.
- F3:** Acquire Begins an acquisition run set to capture acceleration, steady state, and deceleration conditions and create a report.

F4: Exit

Exits to the Home screen.

The Williams spectrum graph of velocity data shows the frequency of vibration in Hz on the horizontal axis and the magnitude of the vibration in Inches Per Second (IPS) on the vertical axis. The horizontal axis has a fixed scale of 0 to 60,000 RPM. The graph's vertical axis scale is 0.00 to 2.00 IPS. Dashed boxes indicate the limit values entered during the Limit Value Entry screen. "Limit Exceeded" is displayed when at least one peak went above a limit. By default, the maximum IPS value is shown at the top of the display along with the frequency of this peak in both Hz and CPM.

Press <F1> ("Peak []") to toggle the peak capture function between enabled and disabled. When enabled, DynaVibe captures and displays the peak value for each frequency and updates only when a higher value is registered. When peak capture is disabled, the current readings are shown without regard to previous readings.

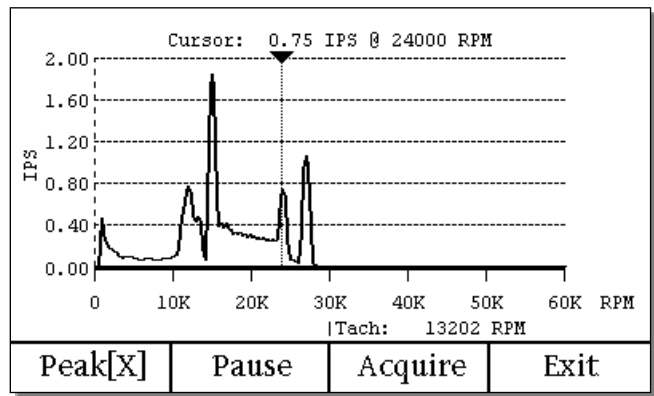
Press <F2> ("Pause") to freeze the data currently on the graph, the tachometer reading (below the graph), and the peak display text above the graph if the cursor is not active. Press <F2> again (now labelled "Resume") to resume real-time readings.

Press <F3> ("Acquire") to begin an acquisition run. Acquisition runs are explained in detail in section below.

Press <F4> ("Exit") to exit the mode and return to the Home screen.

The Williams mode also has a cursor feature activated by any of the following keys.

- <2>: ↑ Next Higher Peak: Move cursor to next peak found at a higher RPM.
- <8>: ↓ Next Lower Peak: Move cursor to next peak found at a lower RPM.
- <4>: ← Move cursor -300 RPM.
- <6>: → Move cursor +300 RPM.
- <1>: Move cursor -3000 RPM.
- <3>: Move cursor +3000 RPM.



Cursor Indicating Local Peak at 24000 RPM

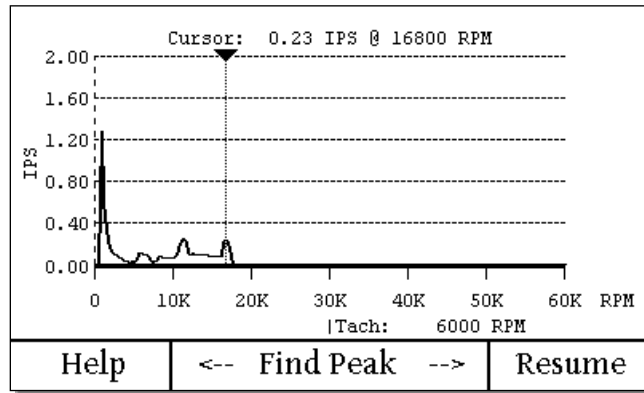
When the cursor function is active, a triangular cursor will be drawn on the top edge of the graph with a vertical dashed line at the cursor frequency. The "Max:" text normally shown above the graph is replaced with the "Cursor:" text indicating the magnitude at the cursor in IPS and the frequency at the cursor in RPM.

The up arrow (<2> key “next higher peak”) and down arrow (<8> key: “next lower peak”) will search in the indicated frequency range and move the cursor to the next local peak found in the indicated direction. Alternatively, the left and right arrows (<4> and <6>) will move the cursor in the direction indicated by 3000 RPM each time the key is pressed. Similarly, the alternate left and right arrows (<1> and <3>) will move the cursor 300 RPM per press.

To deactivate the cursor function, move the cursor to the far left of the frequency range. The cursor will be removed and the “Cursor:” text will be replaced with the “Max:” text indicating the largest peak across the measured frequency spectrum.

Williams Mode: Pause (GX3 Only)

Activating “Pause” <F2> in Williams mode will freeze the current spectrum. While paused, the peak search and cursor movement keys used in the live view mode discussed above continue to function the same.



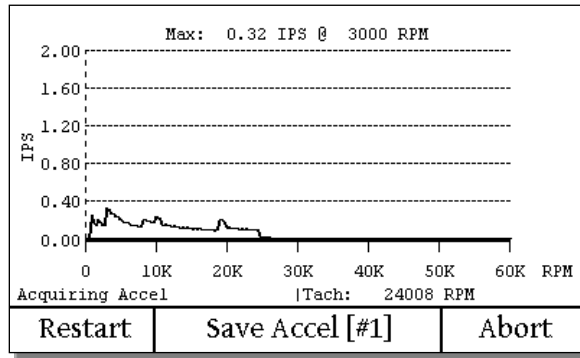
Cursor Indicating Local Peak at 24000 RPM

- F1:** Displays help pages with brief descriptions of key function in Williams mode.
- F2:** Find the next lower frequency peak (equivalent to the down arrow <8> key).
- F3:** Find the next higher frequency peak (equivalent to the up arrow <2> key).
- F4:** Resumes live readings.

Williams Mode: Acquire Condition Set (GX3 Only)

Activating “Acquire” <F3> in Williams mode will start a guided collection of three run conditions: Acceleration (“Accel”), Steady State (“Steady”), and Deceleration (“Decel”). After completion of the third condition (deceleration), the DynaVibe will create an HTML report on the SD card with graphs of all three conditions.

Upon activating “Acquire”, peak hold will be automatically enabled and any previously held peak data will be cleared.



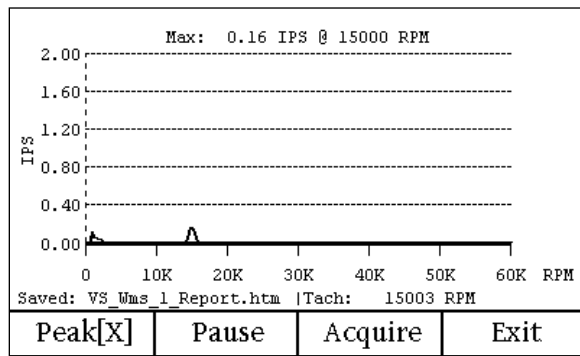
Williams Acquire: Accel Condition

- F1:** Restart Clears any previously held peak data.
- F2\F3:** Save Accel [#n] Saves the accumulated frequency response for the current condition (“Accel”, “Steady”, or “Decel”) to a CSV file on the SD card.
- F4:** Abort Cancels the in-progress condition set and returns to the primary Williams screen.

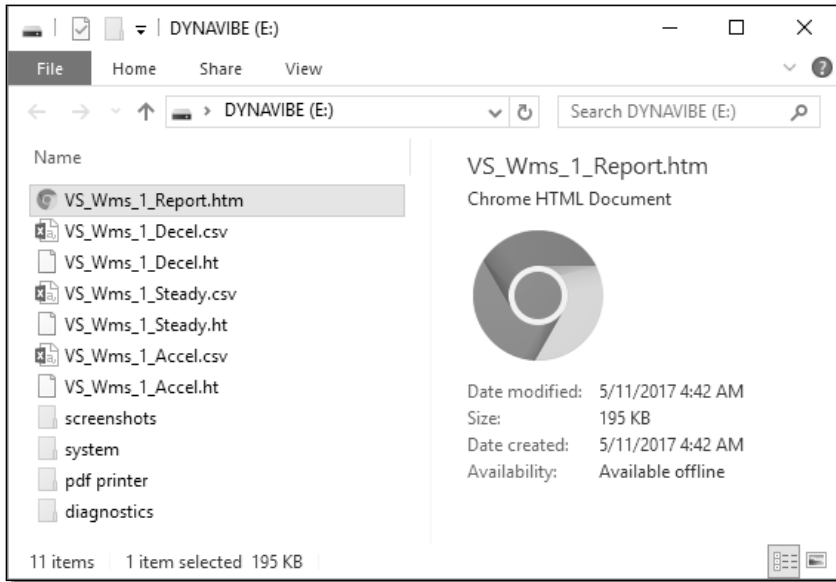
Although the held peak values are cleared at the start of each condition, the current condition spectrum can be cleared again as needed by pressing <F1> “Restart”. This will not affect any conditions for the set that are already saved. The first condition is acceleration (“Accel”).

- The label for the F2 and F3 keys will indicate “Save Accel [#1]” and acceleration data collection will begin. After the acceleration data collection is complete, press F2 or F3 and “Saving Acceleration” will be reported along the bottom of the screen while the condition data is saved to the SD card.
- The label for the F2 and F3 keys will change to “Save Steady [#1]” and deceleration data acquisition will begin. After the steady state data collection is complete, press F2 or F3 and “Saving Steady State (Max Power)” will be reported.
- The label for the F2 and F3 keys will change to “Save Decel [#1]” and deceleration data acquisition will begin. After the deceleration data collection is completed, press F2 or F3 and “Saving Deceleration” will be reported followed by “Saving HTML Report”.

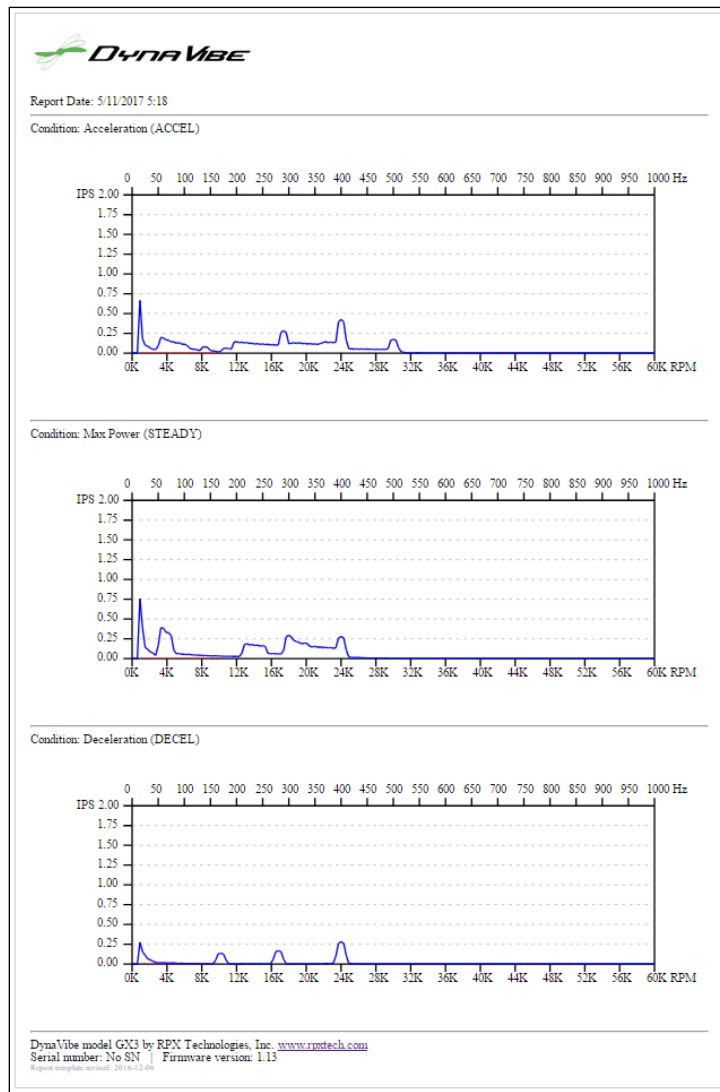
Once the HTML report is saved, the name of the saved HTML file will be displayed to the lower left of the graph (e.g., “Saved: VS_Wms_1_Report.htm”).



Williams Report Saved Filename: “VS_Wms_1_Report.htm”



Windows File Explorer: DynaVibe SD Card with Williams Report



Williams HTML Report Example

Note: Williams File Numbering

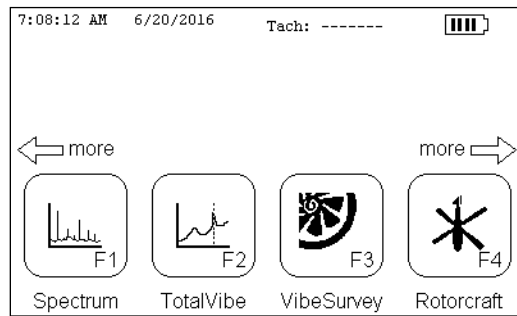
The number inside the square brackets (e.g., “[#1]”) while acquiring conditions indicates the number of the current condition set. This is the number that will be used to name the HTML report created after collecting spectra for all three conditions and to name the temporary files for each condition within the set.

The DynaVibe selects the lowest unused condition set number available on the SD card. A set number is considered unused if there is not a matching Williams HTML report file on the SD card. Therefore, a condition set number may be reused after you remove/delete the HTML report from the SD card or if you use a different SD card. Also, a condition set number may be reused and any temporary files overwritten if you abort a condition set before creation of the HTML report.

5.9 Rotorcraft (GX3 Only)

Left Accel. Input	Right Accel. Input	Optical Tach	Resume After Power Off	DynaTrack Accessory	PTT Switch	APO (Auto Power Off) Setting
Optional: Standard (1 kHz) Accel.	Optional: Standard (1 kHz) Accel.	Required	Yes	Recommended (Required for track)	Optional	Yes: Supports Global APO Setting

Rotorcraft mode supports track and balance procedures and is accessed from the Home screen by pressing the corresponding function key below the “Rotorcraft” icon.



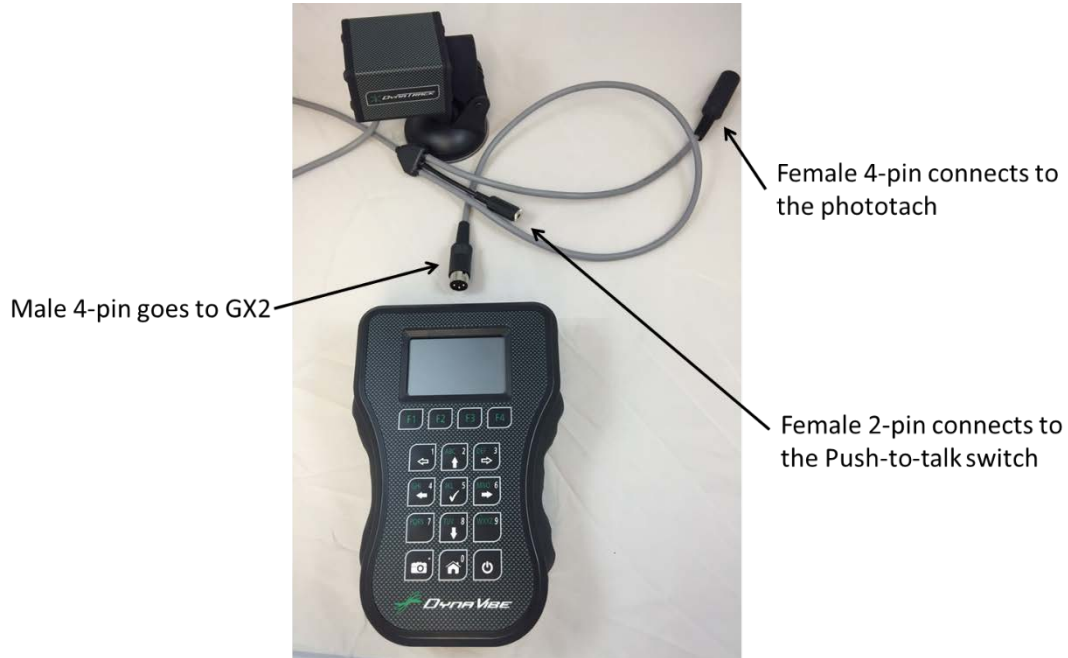
Home screen showing the Rotorcraft mode icon (bottom right)

Rotorcraft mode supports multiple flight conditions to determine corrective track and/or balance adjustments. Rotorcraft often need to be run on the ground, in a hover, and at varying forward airspeeds to determine the optimal corrective action. To aid in this data collection, Rotorcraft mode will allow the user to collect up to eight different flight conditions in one data set. This data set can then be reviewed to determine the required correction.

If a DynaTrack optical blade tracker is going to be used during the data collect, the DynaTrack should be mounted on the windscreen of the helicopter as described in the rotorcraft-specific application note.

- **Refer to the rotorcraft manufacturer’s maintenance manual for specific procedures!**
- Application Notes: Several application notes are available to provide guidance unique to each type of helicopter. Some examples include:
 - RPX-ARA-RB-R22-TB “Robinson R22 Track and Balance with the GX3”
 - RPX-ARA-RB-R44-TB “Robinson R44 Track and Balance with the GX3”
 - RPX-ARA-BE-206-TB “Bell 206 Track and Balance with the GX3”
 - (refer to www.rpxtech.com for more rotorcraft-specific application notes)

Warning: Always turn off the DynaVibe BEFORE connecting or disconnecting the DynaTrack into the DynaVibe.



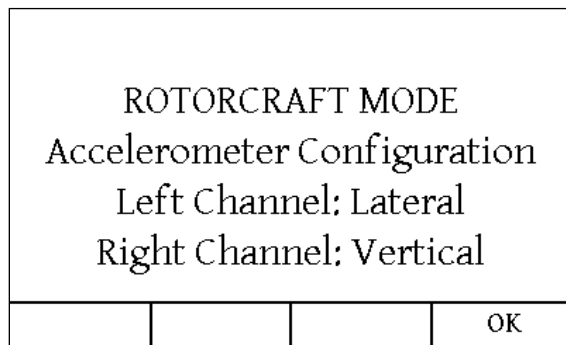
DynaTrack Cable Connections to DynaVibe GX3

The DynaTrack has a single cable that breaks out into three connectors. Do NOT connect or disconnect the DynaTrack while the DynaVibe is powered On.

- The male 4-pin connector goes into the top of the DynaVibe GX3, replacing the optical tach connector.
- The female 4-pin connector receives the signal from the optical tach.
- The female 2-pin connector supports the optional push-to-talk (PTT) switch. (The PTT *Y-adaptor cable* is NOT used when using the DynaTrack accessory.)

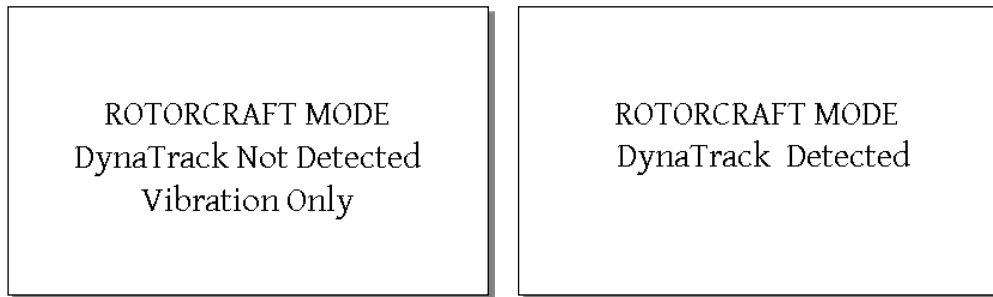
Note: The DynaVibe Rotorcraft mode may be used with or without the DynaTrack optical blade tracker. Without the DynaTrack, Rotorcraft mode will only collect vibration data. Alternatively, the DynaTrack can be used without accelerometers for cases when only track data is needed.

The first screen in Rotorcraft mode shows the accelerometer setup. For simplicity, the GX3 is set up so that the lateral accelerometer used on most helicopters is attached to the left channel of the GX3. The vertical accelerometer is attached to the right channel.



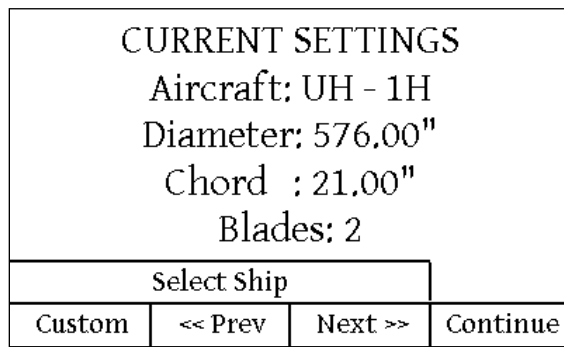
Preferred Accelerometer connections

Once the accelerometers are properly connected, press <F4> (“OK”) to continue. The “Connecting to DynaTrack” screen appears. If you have a DynaTrack connected to the GX3 and the screen displays “DynaTrack Not Detected” and then shows “Waiting for Tach,” power off the GX3 and check your connections. If the DynaTrack is connected, the screen will display “DynaTrack Detected.”



“DynaTrack Not Detected” and “DynaTrack Detected” screens

After the DynaTrack is detected, the DynaVibe displays the “Select Ship” screen. The DynaVibe has an internal database of rotorcraft with the rotor diameter and blade chord dimensions listed along with the name of each rotorcraft. Units are in inches.



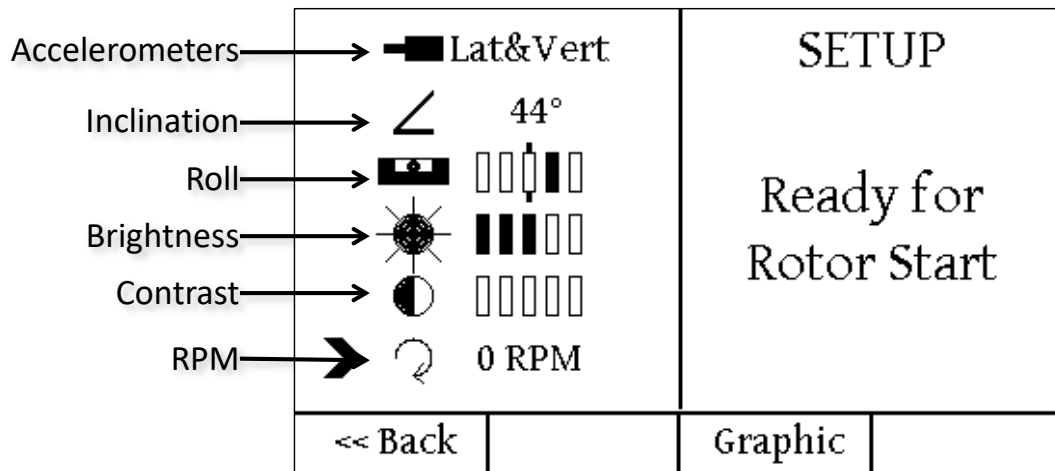
“Select Ship” screen

- F1:** Custom Press to manually enter the diameter and chord of the rotorcraft.
- F2:** <<Prev Press to show a previous rotorcraft in the database.
- F3:** Next>> Press to show the next rotorcraft in the database.
- F4:** Continue Press to use the currently displayed rotor diameter, blade chord, and number of blades.

Press “Next” (<F3>) or “Prev” (<F2>) to move through the database to determine if your rotorcraft model is listed. If your rotorcraft is listed, verify that the rotor diameter, blade chord, and number of blades are correct for your rotorcraft, as some rotorcraft have multiple possible blade types. If your rotorcraft is not listed or the blade dimensions in the database are not correct for your configuration, then press “Custom” (<F1>) to manually enter the rotor diameter, blade chord, and number of blades for your rotorcraft.

Note: To provide accurate blade track data, the DynaVibe requires accurate rotor diameter, blade chord dimension, and number of blades. Regardless of the rotorcraft selected, you must verify that these settings are correct for your ship.

Once the Rotor Diameter and Blade Chord are correct for your ship, press “Continue” (<F4>) to advance to the Setup screen.



Rotorcraft mode DynaTrack Setup screen

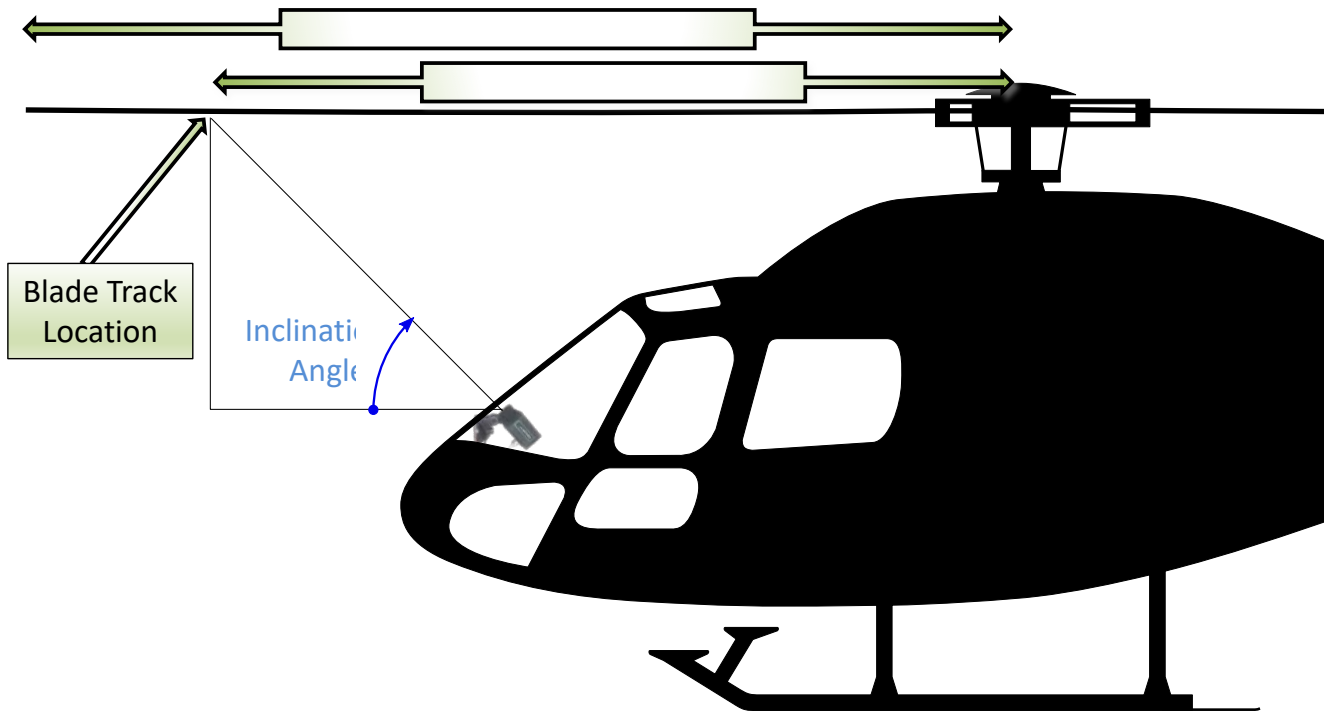
- F1:** <<Back This will return the user to the rotorcraft selection screen.
- F3:** Graphic This will provide a real-time display of rotorcraft track.

The screen will now advance to the DynaTrack Setup screen (above). This screen has several features to assist in configuring the system to collect the desired data.

Accelerometers: At the top of the screen is the Accelerometers indicator. This will show which accelerometers are currently connected: “Lateral” for Left, “Vertical” for Right, “Lat&Vert” for Left and Right, or “---” for none.

Inclination: Second is the Inclination indicator. The DynaTrack inclination can be adjusted by rotating the DynaTrack on the mount hinge then tightening the hinge lock knob to hold the inclination angle. Each rotorcraft will have a target inclination angle range listed in the corresponding application note.

Note: Once the rotor is started, the Inclination value is disabled and replaced by the Radial Focal Distance and Radial Focal Percentage. The Radial Focal Distance is the distance out from the rotor center to where the DynaTrack optically monitors the blade track.



The Radial Focal Percentage is the Radial Focal Distance divided by the rotor radius. For example, $\angle 106''/70\%$ would indicate that the DynaTrack is pointed at the blade 106 inches out from the rotor center, which for this rotorcraft is 70% of the rotor radius (151"). These values are calculated based on the blade chord and rotor diameter dimensions configured on the "Select Ship" screen. Application notes will specify the acceptable range for the Radial Focal Percentage. If the Radial Focal Percentage is outside of the specified range, the DynaTrack Inclination angle would need to be adjusted until it is within range.

Trim Tabs - Note that except for trim tabs that extend the entire length of the blade, the DynaTrack blade track location should be *INSIDE* the trim tab position. Do not track at trim tab locations.

Roll Angle: The Roll Angle indicator provides feedback on the roll position of the DynaTrack. For most applications, the DynaTrack should be positioned so the Roll Angle indicator is at the center marker.

Brightness: Since the tracker is looking up at the blades, the sky is the natural background. Brightness is an indicator of the amount of light detected from the area of sky where the DynaTrack is pointed. The sky may be too dim or too bright to effectively use the DynaTrack. If the sky is too dim or too bright, a corresponding error message will be displayed on the right side of the screen. You may also receive a brightness error if the DynaTrack is pointed so that a hanger or other large obstruction is in the background or if the rotor is stopped with one of the blades directly in front of the DynaTrack.

Contrast: Contrast is an indicator of the relative difference in brightness between the sky and the blades. For darkly painted blades, there will typically be three or four bars of contrast. The previous

example screen has zero bars of contrast because the rotor blades are not moving, therefore there is no change in brightness to compare. Contrast will not be measured until the rotor blades are moving.

CAUTION:

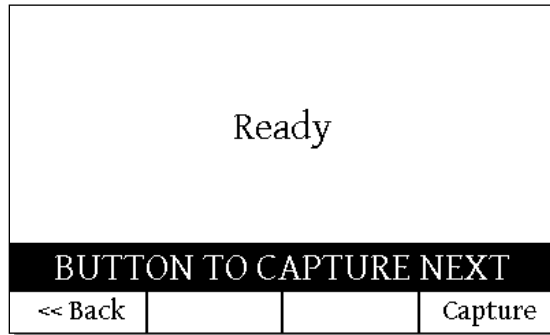
Verify that the areas around the rotorcraft’s main rotor and tail rotor are clear of obstructions before startup.

Verify that all cabling is secure.

Follow all standard safety, startup, and operational procedures.

The screen now shows “Ready for Rotor Start.” Once this is displayed and safe startup conditions are met, start the rotorcraft and begin the data collection. Check the individual application notes for additional information specific to individual helicopters.

Once the rotor is started, the Setup screen <F4> soft key will show “Continue.” Press “Continue” (<F4>) to proceed to the Capture screen. The lower part of the screen will flash “BUTTON TO CAPTURE NEXT.” When the rotorcraft is in a stable hover or forward flight condition, capture the data by pressing “Capture” (<F4>) or using the optional push-to-talk (PTT) button to activate capture.



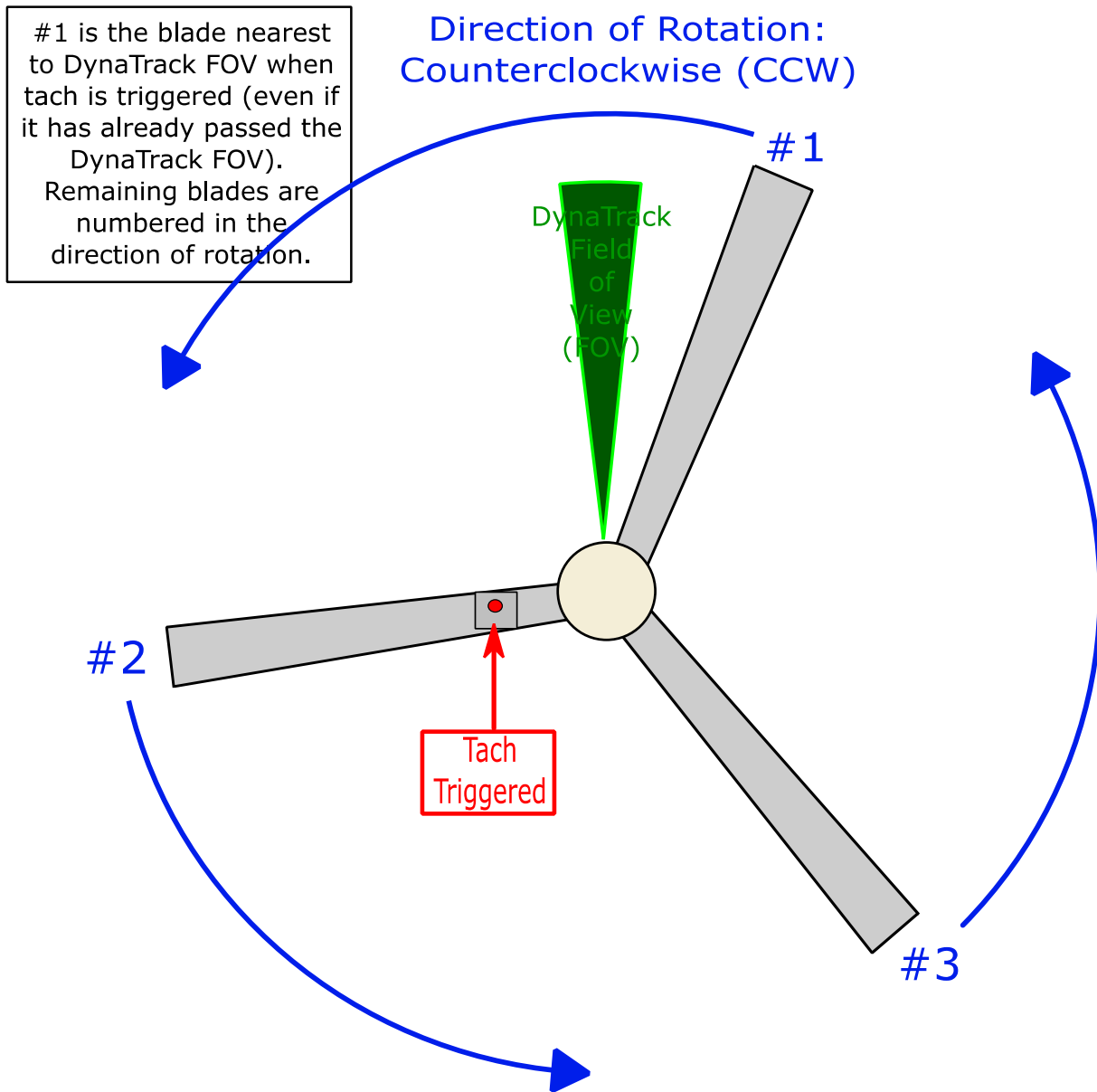
Capture screen: Ready to capture the first flight condition

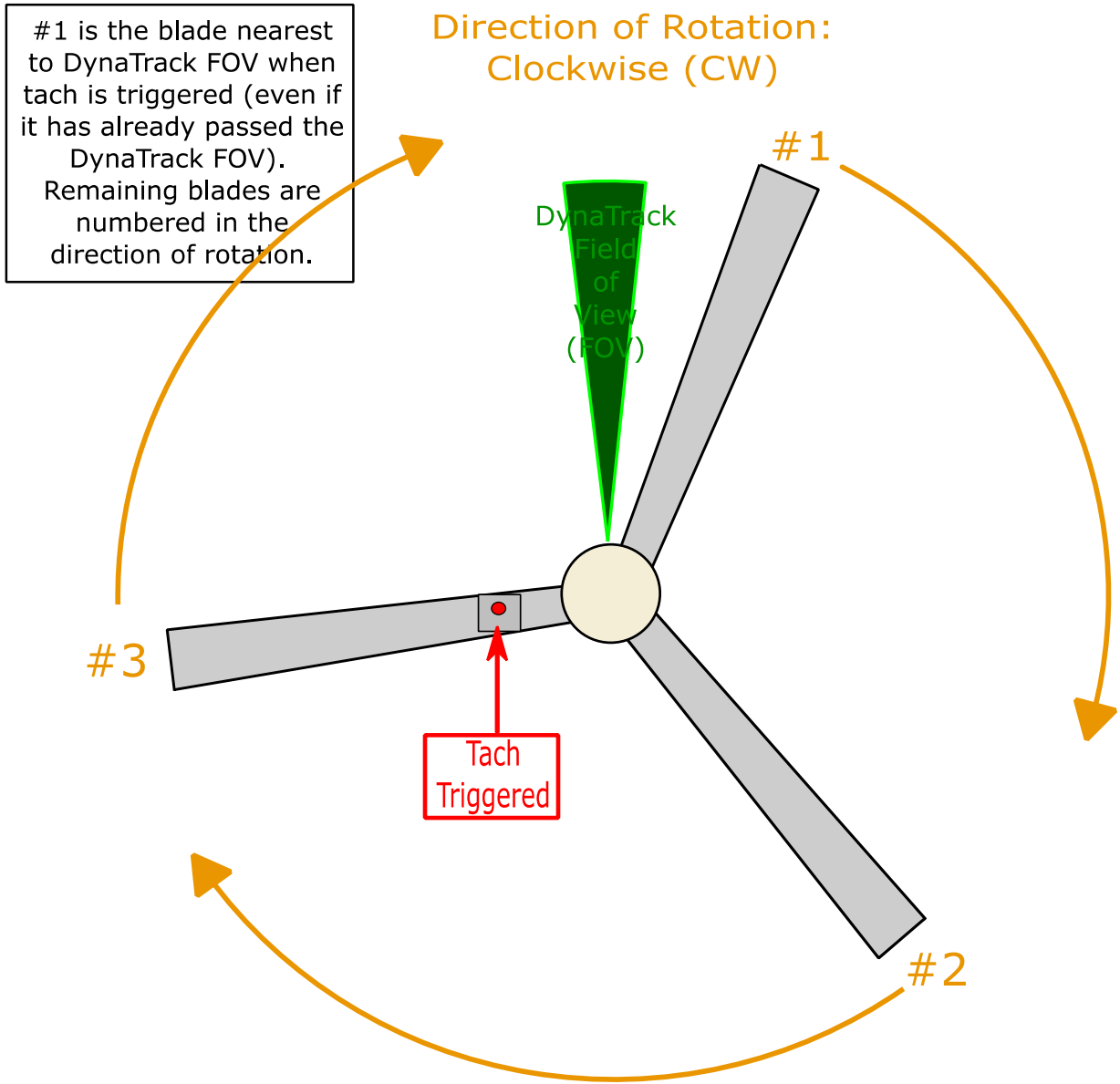
The DynaVibe will display “Measuring” while it captures track data, and will then briefly show that it is saving the data. After saving the data, the screen will report that it is collecting diagnostics from the run. During this entire period, attempt to maintain a consistent hover or airspeed with minimal variation in flight conditions.

Once the data capture and saving are complete for this condition, the screen will show the results. Blades are numbered as follows:

Blade #1 (master): The blade that is closest to directly out the front of the helicopter when the rotor is positioned such that the reflective tape triggers the optical tach.

Blades 2 through 6: Other blades are numbered from Blade 1 in the direction of rotor rotation. On a 2-bladed ship, blade 2 is considered the Slave Blade in this manual.





Note: The DynaVibe always reports the Blade 1 as zero track error since it is the reference. Positive track values indicate the blade is tracking higher than Blade 1 and negative track values indicate the blade is tracking lower than Blade 1.

Blade 1 is the front-most blade when the optical tach is activated.

The following graphic is an example of a collected flight condition showing Blade 2 tracking 0.06 inches lower than Blade 1. The reported track measurements always refer to the track of each blade relative to Blade 1.

Condition 4 (8 MAX)				
Lateral [Left]		Bld	Track	Qual
0.06 IPS @ 028° (12:56)		1	+0.00"	100%
		2 ↓	-0.06"	100%
Vertical [Right]				
0.08 IPS @ 023° (12:46)				
BUTTON TO CAPTURE NEXT				
		Finished	Capture	

Condition Report

The Condition Report also shows the quality of the collected data and the Lateral and Vertical vibration during the data collection for a track. Noise and quality give an indication of the percentage of rotations from which good blade track data was captured. Quality should be above 90% under most conditions. The quality percentage can be affected by lighting conditions, flight conditions, and the mounting position/angle of the DynaTrack.

The rotorcraft operator can now prepare for the next flight condition. Once that flight condition is stable, use “Capture” (<F4>) or the optional PTT button to collect the next condition.

Once all the flight conditions are collected, press “Finished” (<F3>) to review the Condition Reports. This is typically done once a correction is going to be made to the rotorcraft. Press “Next” (<F3>) or “Prev” (<F2>) to cycle through the Condition Reports. A maximum of 8 conditions at a time may be collected and reviewed.

Review: Condition 2 of 7				Review: Condition 7 of 7					
Lateral [Left]		Bld	Track	Qual	Lateral [Left]		Bld	Track	Qual
0.05 IPS @ 196° (06:31)		1	+0.00"	100%	0.05 IPS @ 092° (03:04)		1	+0.00"	100%
		2	+0.00"	100%			2 ↓	-0.22"	100%
Vertical [Right]					Vertical [Right]				
0.06 IPS @ 068° (02:15)					0.23 IPS @ 283° (09:26)				
		<< Prev	Next >>	Exit			<< Prev		Exit

Condition Report Review, #2 is from a hover, #7 is forward flight at 110mph

The Condition Report Review example shows two conditions of a 2-bladed rotorcraft. Condition #2 above was taken during a hover and shows 0.05 / 0.06 IPS with no track error. This rotorcraft is very smooth in a hover. Condition #7 was taken during forward flight at 110 mph and shows 0.05 / 0.23 IPS with a -0.22” track on Blade #2 (the slave blade). This shows blade 2 is flying lower than Blade 1 at forward flight speeds. In this example, blade 2 may need to be tabbed up or Blade 1 may need to be tabbed down depending on the rotorcraft manufacturer’s procedures.

Once the flight conditions are reviewed, the rotorcraft manufacturer’s maintenance manual can be used to determine corrective action. The relevant DynaVibe Application Note contains helpful information, but does not override the manufacturer’s documentation.

6 System Maintenance

6.1 Cleaning

DynaVibe GX Body

The case and keyboard can be periodically wiped with a clean, dry cloth. The screen window can be cleaned with clean cloth dampened with water. Do not use solvents or spray liquid directly on any part of the DynaVibe GX.

Accelerometers

Keep the mounting bolts installed in the standard accelerometers to prevent dirt from accumulating in the threads.

Cabling

Cabling can be cleaned by wiping the cable with a dry cloth. Do NOT pull the cables by the accelerometer, optical tach, or connector.

6.2 Battery Replacement

The unit requires two disposable 9V alkaline batteries that can be accessed by removing the two battery cover screws and the cover on the back of the unit. Batteries should be replaced with a new matched pair. Check for proper battery contact polarity (+ to +). Rechargeable batteries are not supported.



7 Troubleshooting

Symptom	Possible Cause	Action
Unstable IPS Readings	Problem with Accelerometer Mount	Be sure the accelerometer mount is short, stiff, and all bolts are securely tightened.
	Inconsistent Tach Signal	Tachometer signal fluctuations cause erratic IPS readings. If the indicated RPM is not stable, then do not use the IPS readings. Check the tachometer troubleshooting points in this document and applicable application notes.
	Component Movement	See “Inconsistent Vibration Readings Between Runs: Movement of Setup or Other Inconsistency” topic below.
Unstable Tach or “No Tach”	Tach Misaligned	Check optical tach alignment. Tach optics must be aligned with the reflective tape. Verify the red light on the back of the tachometer is illuminated when the red dot hits the tape.
	Reflective Target Problem	<p>If the reflective tape is on a curved surface, use a flat surface if available.</p> <p>Check minimum reflective tape width as indicated in corresponding application note or the manufacturer’s maintenance manual. Tach pulse widths may be too short.</p> <p>The reflective tape needs to be placed on a non-reflective surface. Check the background reflectivity, such as the reflectivity of the spinner backing plate when balancing a propeller. Sometime the target’s surface must be painted to provide adequate contrast.</p> <p>Check optical tach distance from the tape. The minimum distance is 6”. Verify that the red light on the back of the tachometer is illuminated when tach is aligned with tape.</p>
	Tachometer Movement	Verify the tach alignment is not being affected by movement during the runup.
System Indicates “No Tach”	Tach Signal Not Detected	<p>Tach pulses are necessary to get an RPM indication, not just a tach reflection. If verifying the tach <u>without a running assembly</u>, quickly shake your finger in the tachometer’s optical path while the tach is aligned with the reflective tape to provide a test signal. Do not attempt this test with a running propeller or rotor.</p> <p>See other tach-related troubleshooting tips above.</p>
IPS / Phase Angle Do Not Make Sense	Incorrect Interpretation of Phase Angle	<p>Be sure you understand how to interpret phase angle. Some operating modes compensate for setup and some do not. Double check the mode you are working with and pay close attention to the phase angle interpretation instructions in this document. Note that when balancing a prop, measure angles while looking at the “spinner side.” In other words, interpret the measurements as if standing in front of the plane looking back at it.</p> <p>If you are working with charts or operating procedures that are not directly generated by the DynaVibe, be sure you are using Measure or Rotorcraft modes which report raw, uncompensated phase readings.</p>

Symptom	Possible Cause	Action
		Check items in “Unstable IPS reading or No Tach Signal” above.
	Accelerometer Mount Problem	Use a shorter, stiffer mount for the accelerometer. If the mount is nearing resonance, then the phase angle will be unstable. Be sure the accelerometer axis is pointing directly toward the center of rotation.
	Component Movement	Totally shut down, restart, and take another reading. If readings are not repeatable then reference the “Inconsistent Vibration Readings Between Runs” section of troubleshooting.
	Signal Interference	Route sensor wires at least 4” away from harsh electrical signals such as spark plug wires and radios.
	Rough Engine	Do not try to balance a rough running engine. Check the spectrum for half-per-rev peaks which can inject noise into other frequencies.
Inconsistent Vibration Readings Between Runs	Movement of Setup or Other Inconsistency	Tighten all components that may be moving improperly or check for damage. Shifting spinners or spinner packing during engine startup are common culprits. Be sure other mounts, such as the alternator, etc., are not vibrating.
	Inconsistent RPM	The RPM must be the same for every run and stable while the DynaVibe is making measurements.
	Low Vibration Magnitude	Low vibration readings (below 0.10 IPS) are extremely susceptible to noise, secondary influences, and may also become nonlinear. Use the average function to reduce noise and be sure the engine is not running rough (use spectra mode). Also, try making smaller adjustments to “walk” the assembly into balance.
	Accelerometer Mount Issue	Check the accelerometer mount. Be sure it is short, stiff, and securely attached. Long mounts (longer than 1”) tend to resonate which will magnify the IPS reading and rotate the phase angle.
	Aerodynamic Imbalance	On propellers, check blade tracking and pitch. Aerodynamic imbalance will change the vibration magnitude with RPM. EAA publishes some great videos online on how to do this.
Mass Adjustments Do Not Yield the Anticipated Correction	Misinterpreted Phase Angle	When properly configured, the AutoBalance and EZ Measure modes will report angles with respect to vertical. Double-check that the mode is correctly configured for your physical accelerometer and optical tach locations. We recommend that you set up the unit while looking at the front (spinner side) of the propeller since this is the reference orientation that you will use when making adjustments.
	Setup Problem	Refer to “Inconsistent Vibration Readings Between Runs” troubleshooting points above.
	Resonance	The assembly may be running at a frequency above/below a resonant point which will rotate the vibration phase angle. Try making adjustments 180 degrees from the usual location.
	Incorrect mass adjustment in AutoBalance mode	When using AutoBalance mode, the recommended weights are the total weight amounts per location, NOT the incremental change.

Symptom	Possible Cause	Action
Vibration is Still Present After Balancing	Vibrations Present at Multiple Frequencies	<p>There are many sources of vibrations and dynamic balancing only addresses vibrations at the tach frequency. Troubleshoot using spectra mode.</p> <p>Verify compression on all cylinders, a weak cylinder will cause significant vibration.</p> <p>Significant mass mismatch in the axial direction can cause a two-plane out-of-balance condition that requires weights at multiple locations. To identify this condition, check vibration readings at both the front and back of the assembly after balancing.</p>
	Aerodynamic Imbalance	Balancing will not correct vibrations caused by aerodynamic imbalance and only reduce aerodynamic effects at the specific RPM used to balance the assembly. Also, check propeller blade tracking and pitch.
Assembly Does Not Balance as Expected	Rough-running Engine	Verify that all cylinders are operating correctly by reviewing cylinder head temperatures. If cylinder temperatures are drastically different, it may indicate bad spark plug wires, fowled plugs, intake leaks, poor fuel distribution, etc.
	Mechanical Noise Interfering with the Accelerometer Signal	<p>Check that the engine cowling does not show signs of significant wear caused by a part of the engine or component touching the cowling.</p> <p>Verify that the exhaust has not been in contact with the cowling.</p>
	Other Component Significantly Out of Balance	Propeller example: Verify that the spinner is balanced by placing it on a smooth surface and determine if it has a heavy position. The spinner must be statically balanced to balance the propeller. Unbalanced spinners may cause spinner plate cracks.
Additional Troubleshooting Resources		<p>We maintain troubleshooting and balancing tips on our website so they can be continually updated.</p> <p>Check www.rpxtech.com/dv-tips for the latest tips</p>

[End of Document]