BirdTechnologies®

Virtual Power Meter

Operations Manual

Model VPM3

About This Manual

This manual covers the operating and maintenance instructions for the following models:

VPM3

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Solon, Ohio factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

Literature Contents

Chapter Layout

Introduction — Describes the features of the VPM3, lists compatible sensors and provides installation instructions.

Displays — The VPM3 provides a variety of display types for viewing measurement data, the displays are described in this chapter.

Menus — Menus are used in VPM3 for the purpose of sensor configuration and viewing measurement data.

Measurement Modes — Most Bird sensors operate in Average Power mode, but recent sensors have additional capabilities, this chapter describes the varies modes available in VPM3.

Theory of Operation — This chapter provides in depth descriptions of VPM3 concepts.

Operating Procedures — This chapter provides procedures for operating VPM3 with the compatible Bird Sensors, creating presets, making measurements, and viewing saved data.

Specifications — Provides the PC requirements for VPM3 installation.

Table of Contents

Chapter 1   Introduction

Virtual Power Meter (VPM) 3 is a powerful tool used to turn a PC into a Power Meter. VPM3 is capable of displaying measurements from Bird's USB compatible Power Sensors. Figure 1 on page 2 shows the full line of USB compatible sensors.

> **Note:** *ONLY sensors that have USB connections or USB Interface cable can be used with VPM3 software.*

VPM3 sports the following features:

- Three display formats: Digital Display, Analog Display, and Chart Display.
- Supports all modes of operation available in Bird Power sensors: Average Power Mode, Time Domain Mode, Statistical Power Mode
- Displays the full range of capabilities for each sensor, such as: Forward Average Power, Reflected Average Power, Match Measurements, Forward Peak Power, Forward Burst, Crest Factor, CCDF, Statistical Power, Pulse Power, and Gated Average depending upon the capabilities of the connected sensor.
- Displays power measurements in Watts or dBm.
- Displays match units in VSWR, Return Loss, Rho, or efficiency %, reflected %.
- Log measurement data to a file.
- Playback Logged measurement Data.
- Save and recall sensor configuration setups.

Figure 1   VPM Compatible Sensors

402X Series
Directional
Power Sensors
(DPS)
402X sensors
require the use
of the Bird
Sensor Interface
Module
4421A540-2

7020
Wideband Power Sensors
(WPS)

501X Series
Wideband Power Sensors
(WPS)

7022
Statistical
Power Sensors
(STAT)

5014
Directional Power Sensors
(DPS)

7023
Pulse
Power Sensors
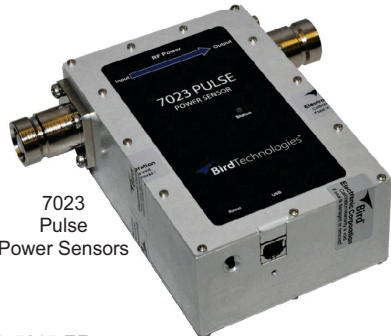
5015, 5015-EF
Terminating
Power Sensors
(TPS)

VPM Installation

1. Insert installation CD.
2. Select Install Software when prompted.

   > **Note:** *Set-up will inspect the computer for any missing operating system prerequisites. If all are present, skip to step 6.*

3. Select 'Next 'and the install utility begins the Prerequisites Installation process.

Figure 2   Install, Prerequisites Installation
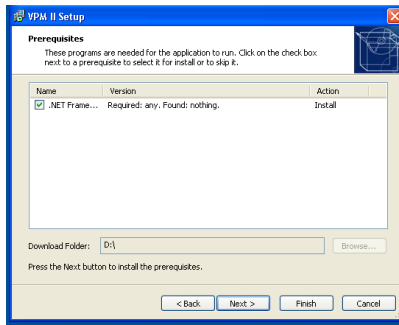
4. Review the End-User License Agreement, check "I accept the terms of the License Agreement" and select "Install."

   > **Note:** *The install Utility will install the prerequisites. This may take several minutes*

   > **Note:** *When completed, check with Microsoft® support center for any security updates. Typically, if "Automatic Updates" are configured on the host PC, these will be automatically flagged and selected for download and installation.*

   > **Note:** *The VPM3 installation utility will launch after the OS prerequisites are installed.*

5. Do one of the following:
   - Accept the default installation location
   - Select a different folder:
6. Select 'Next' and the installer will complete.
7. Select "Finish" to launch the VPM3 program:

   > **Note:** *When the VPM3 loads for the first time, the Preferences Dialog will prompt for a default log file save location. Perform the following to complete the process.*

8. Select the 'Logging' tab.
9. Enter a folder local to the PC to store log file data.

> **Note:** *This can be changed at any time in the Preferences. All active sensor sessions must be closed before Preferences Dialog can be opened.*

10. Select the Advanced Tab.
11. Select the language in the drop down menu.

> **Note:** *For any non-US English language setting, select 'Windows'. Any standard formats such as number and date formats from "Regional and Language Options" found in the Windows Control Panel will be mimicked in the VPM3 interface.*

Bird Power Sensors offer a variety of measurement capabilities. The modes and displays available in VPM3 will depend on the connected sensor. All of the display types discussed in this chapter are available in the VPM3 for all sensors.

Display Types — Measurements may be displayed using the following display types:

- Digital Display - Bar
- Analog Display - Meter
- Chart Display - X/Y Graph

Measurement Details — All sensor measurements are displayed in the details section just below the measurement display. The details section consist of the following tabs

- Measurements Tab
- Statistics Tab

Digital Display

The digital display shows the selected measurement type (Forward Average, Reflected Average, Match, etc.) in a numerical format at the top of the main power display over a bar graph. Ancillary readings are displayed under the bar graph. See Figure 3 and Table 1 on page 6 for a description of the display and its features.

Figure 3   Digital Display
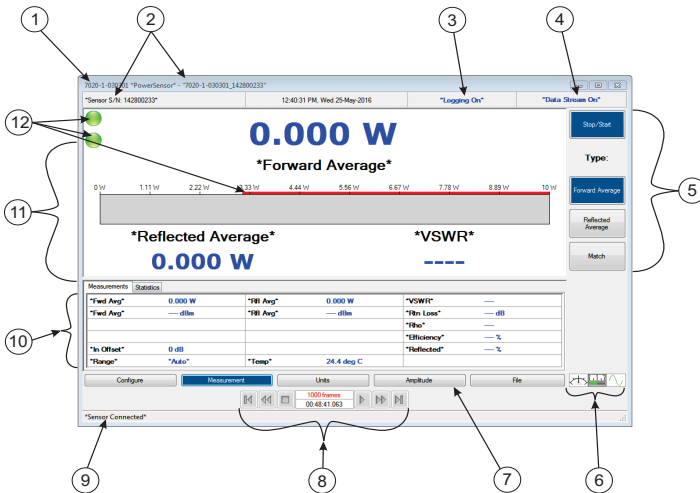
Table 1 - Digital Display Description

Item	Name	Description
1	Menu Bar	Menu bar contains menus for controlling VPM3 operation, measurement selection, and controlling sensor sessions. See "Menu Bar" on page 16.
2	Sensor Information	The selected sensor part number information is displayed in the window title bar, the sensors serial number is displayed in the top status bar.
3	Logging Status	Displays the current status of data logging. See "Logging" on page 58.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See "Data Buffering" on page 56
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See "Control Panel Menus and Options" on page 32.
6	Display Type Selection	Buttons allow the user to quickly select between digital, analog, and chart display types.
7	Control Panel Menu Buttons	Menu buttons allow the user access to menus for controlling VPM3 operation, the available menus are also available on the menu bar (1). See "Control Panel Menus and Options" on page 32.
8	Playback controls	Playback controls are used to replay buffered data or log files. See "Playback" on page 59.
9	Sensor Status	Indicates the connection status or zeroing progress of the sensor.
10	Sensor Readings	Displays all of the readings returned by the sensor in its current configuration. Two tabs are available one for measurements and one for measurement statistics. See "Measurement Details" on page 15.
11	Bar Graph	The bar graph gives a visual indication of the main reading as well as displaying the currently selected measurement in numerical format. The scale of the graph can be set to auto or full-scale.
12	Limit Indicators	Limit indicators give visual indication the measured signal is less than or greater than user selected limits. See "Limit Indicators" on page 55.

Analog Display

The analog display shows the selected measurement type (Forward Average, Reflected Average, Match, etc.) using a traditional meter style format. The numerical value of the meter reading is displayed under the meter. Ancillary readings are displayed to the left and right of the selected measurement. See Figure 4 and Table 2 for a description of the displays features.

Figure 4   Analog Display
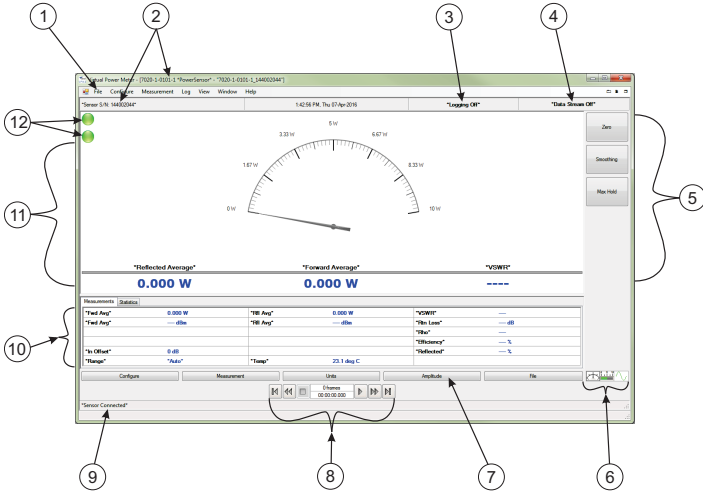
Table 2 - Analog Display Description

Item	Name	Description
1	Menu Bar	Menu bar contains menus for controlling VPM3 operation, measurement selection, and controlling sensor sessions. See "Menu Bar" on page 16.
2	Sensor Information	The selected sensor part number information is displayed in the window title bar, the sensors serial number is displayed in the top status bar.
3	Logging Status	Displays the current status of data logging. See "Logging" on page 58.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See "Data Buffering" on page 56.
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See "Control Panel Menus and Options" on page 32.

Item	Name	Description
6	Display Type Selection	Buttons allow the user to quickly select between digital, analog, and chart display types.
7	Control Panel Menu Buttons	Menu buttons allow the user access to menus for controlling VPM3 operation, the available menus are also available on the menu bar (1). See "Control Panel Menus and Options" on page 32.
8	Playback controls	Playback controls are used to replay buffered data or log files. See "Playback" on page 59.
9	Sensor Status	Indicates the connection status or zeroing progress of the sensor.
10	Sensor Readings	Displays all of the readings returned by the sensor in its current configuration. Two tabs are available one for measurements and one for measurement statistics. See "Measurement Details" on page 15.
11	Meter	The meter gives a visual indication of the main reading as well as displaying the currently selected measurement in numerical format. The scale of the meter can be set to auto or full-scale.
12	Limit Indicators	Limit indicators give visual indication the measured signal is less than or greater than user selected limits. See "Limit Indicators" on page 55.

Chart Display

The chart display shows running time trace of sensor data for the selected measurement type (Forward Average, Reflected Average, Match, etc.). The scale for each axis of the chart can be manually adjusted. Additionally, markers can be displayed on the chart to aid in signal analysis. See Figure 5 and Table 3 for a description of the displays features.

Figure 5   Chart Display
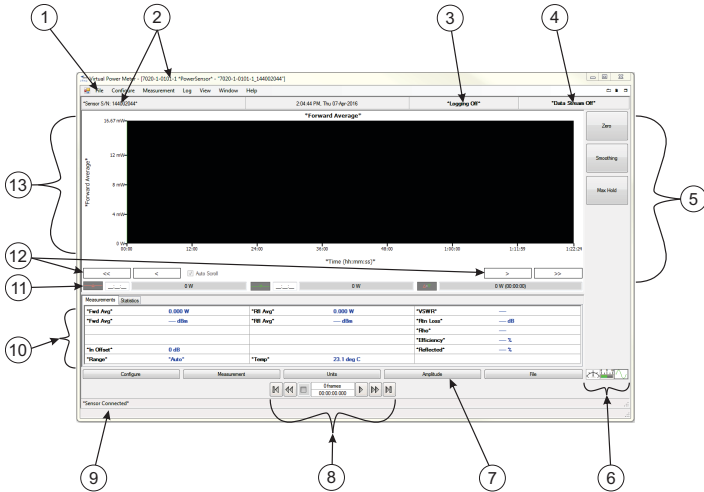
Table 3 Chart Display Explanation

Item	Name	Description
1	Menu Bar	Menu bar contains menus for controlling VPM3 operation, measurement selection, and controlling sensor sessions. See "Menu Bar" on page 16.
2	Sensor Information	The selected sensor Part number information is displayed in the window title bar, the sensors serial number is displayed in the top status bar.
3	Logging Status	Displays the current status of data logging. See "Logging" on page 58.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See "Data Buffering" on page 56.
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See "Control Panel Menus and Options" on page 32.

Item	Name	Description
6	Display Type Selection	Buttons allow the user to quickly select between digital, analog, and chart display types.
7	Control Panel Menu Buttons	Menu buttons allow user access to menus for controlling VPM3 operation, the available menus are also available on the menu bar (1). See "Control Panel Menus and Options" on page 32.
8	Playback controls	Playback controls are used to replay buffered data or log files. See "Playback" on page 59.
9	Sensor Status	Indicates the connection status or zeroing progress of the sensor.
10	Sensor Readings	Displays all of the readings returned by the sensor in its current configuration. Two tabs are available one for measurements and one for measurement statistics. See "Measurement Details" on page 15
11	Marker Information	Displays the values on the x and y-axis for the current marker position. There is also difference data displayed. See "Chart Markers" on page 12.
12	Scroll Buttons	Thew Scroll buttons allow the user to manually scroll along the x-axis when the x-axis scale is set to manual. See "X-Axis Scrolling" on page 13.
13	Chart	The chart displays the selected sensor reading on a two dimension chart. The Y-Axis scale shows the Power of the signal over time on the X-Axis. The Y-Axis scale can be set to auto or full-scale, using the menu options, or the scale can be manually entered by right-clicking on the chart's Y-Axis.

Chart Display Options

Right clicking inside the chart display will provide the following options:

Show Markers — Toggles markers on & off. See "Chart Markers" on page 12.

Show Grid — Turns major & minor grid on/off

Best Fit Data — Adjust scales to show entire range of data

Set Lower/Upper Delta Marker — Moves the marker to the location of the mouse pointer & automatically sets the position in time for the marker.

Figure 6   Chart Options Menu
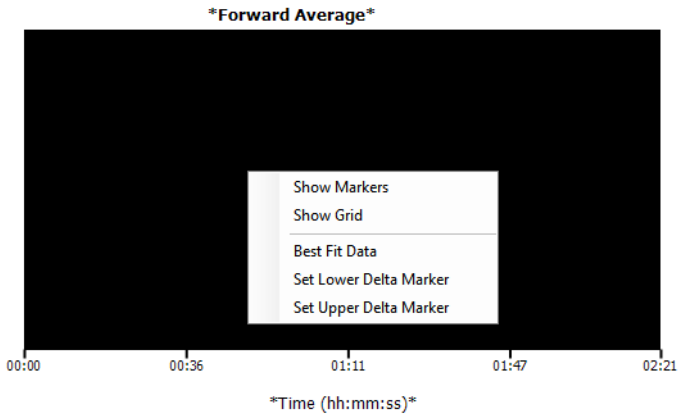
Chart Markers

There are two markers that may be displayed for the chart display. Both markers are either On or Off. Once displayed the time location and power level at each markers location will be displayed below the chart. See Figure 7.

If the data stream is on (or playback is initiated) the markers will move toward the left edge of the chart as time on the x-axis is updated.

Display Markers

To display the markers, right click on the chart and select "Show Markers."

Move Markers

The markers can be moved in three ways:

- Use the mouse cursor, click on the marker and drag the marker to the desired location.

- Type a new time into the time display text box for the marker to move the marker to an exact time location.

- Right click on the chart at the location in time you wish to move the marker and select "Set Lower Delta Marker" or "Set Upper Delta Marker."

Figure 7   Chart Markers

Chart Axis Scaling

The X and Y axis of the chart default to auto scaling, the y-axis is auto scaled to the signal power level and the x-axis typically begins at zero and time is added to the scale as the data stream is collected.

There are two ways to affect scaling.

- The View Menu option Meter Range, allows the range to be set to Auto or Full. When Auto is selected the scale is determined by the signal range, when set to Full, the full range of the connected sensor is displayed.
- Right clicking on either the Y axis or the X axis will display the appropriate Edit Axis dialog box.

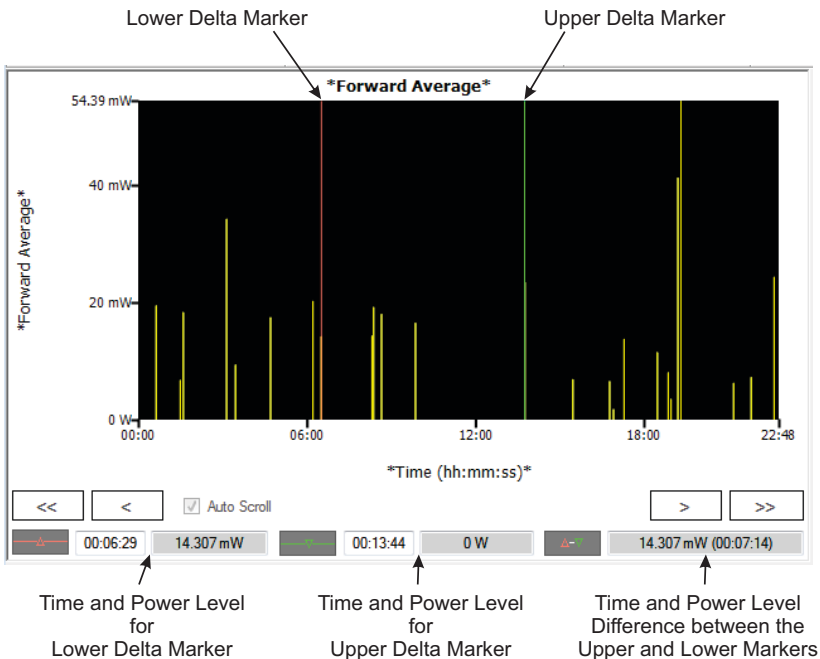### *Figure 8   Chart Axis Scaling Dialog Boxes*

Y-Axis Scaling Dialog Box   X-Axis Scaling Dialog Box
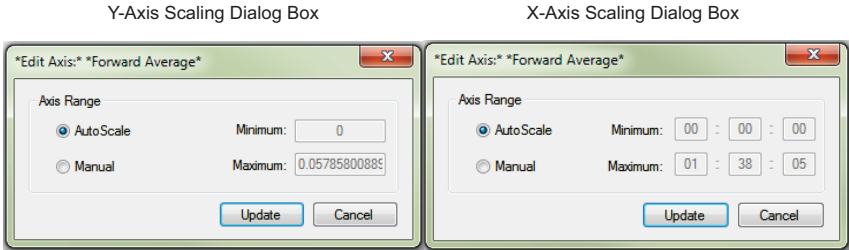
Manual Y-Axis Scaling

Right click on the y-axis to display the Edit Axis dialog box. Select the Manual radio button, and enter a minimum and/or maximum value for the y-axis scale.

Manual X-Axis Scaling

Right click on the y-axis to display the Edit Axis dialog box. Select the Manual radio button, and enter a minimum and/or maximum value for the y-axis scale.

X-Axis Scrolling

When the x-axis is set to manual using the Edit Access dialog box, the x-axis scrolling option is activated. When enabled the user may select to auto scroll or manual scroll the scale. See Figure 9 on page 14.

Auto Scroll — When checked, the chart will automatically advance forward in time maintaining the same interval specified in the x-axis manual scale entry.

When Auto Scroll is deselected the scroll buttons are operational and perform the following functions:

<<, >> — Moves chart to start, end of log

<, > — Moves chart one span to the left or right

Figure 9   Chart X-Axis Scrolling

Measurement Details

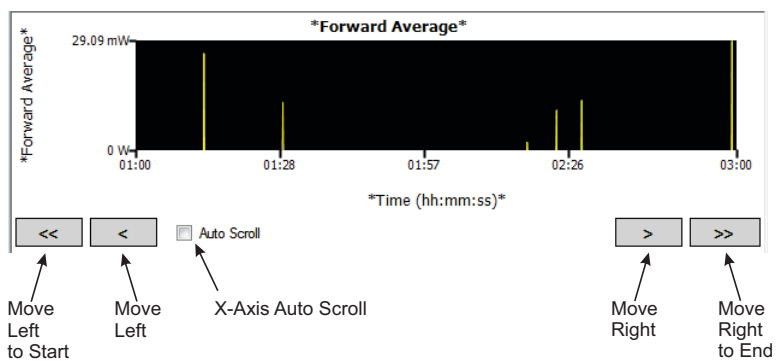All sensor measurements are displayed in the details section just below the measurement display. The details section consist of the following tabs:

Measurements Tab

The Measurement Details Tab displays the current measurements from the sensor and other calculated fields derived from sensor data. All of the sensors current readings are displayed (depending on mode/options). Readings displayed in red text are invalid or out of limits data.

Figure 10   Measurements Tab

Measurements	Statistics				
Fwd Avg	39.883 mW	*Rfl Avg*	605.489 uW	*VSWR*	1.281
Fwd Avg	16.008 dBm	*Rfl Avg*	-2.179 dBm	*Rtn Loss*	-18.187 dB
				Rho	0.123
		In Offset	0 dB	*Efficiency*	98.482 %
Frequency	4,561.17 MHz	*Freq Setting*	*Auto*	*Reflected*	1.518 %
Temp	27.2 deg C	*Range*	*Auto*		

Statistics Tab

The Statistics Tab displays the main sensor measurements for the current mode along with the mean, min, and max for each measurement.

Statistics are automatically reset if a change is made that affects power measurement such as adding an input offset.

Statistics can be manually reset by clicking **Reset (XXX)** in the top left corner of the statistics table.

Figure 11   Statistics Tab

Measurements	Statistics			
Reset (100)	*Fwd Avg* (W)	*Rfl Avg* (W)	*VSWR*	*Rtn Loss*
Current	41.073 mW	739.342 uW	1.310	-17.447
Mean	39.758 mW	787.607 uW	1.327	-17.062
Min	35.111 mW	521.461 uW	1.259	-18.809
Max	42.206 mW	952.947 uW	1.375	-16.037

Menus within the VPM3 are available in the menu bar and the control panel. The Menu Bar consists of menus with drop down options. Most of the options available on the menu bar are also available on the control panel. The control panel consists of menu selection buttons below the sensor readings and option buttons on the right side of the VPM3 window. The options displayed will change when menu selection buttons are pressed.

Figure 12   Menu Locations
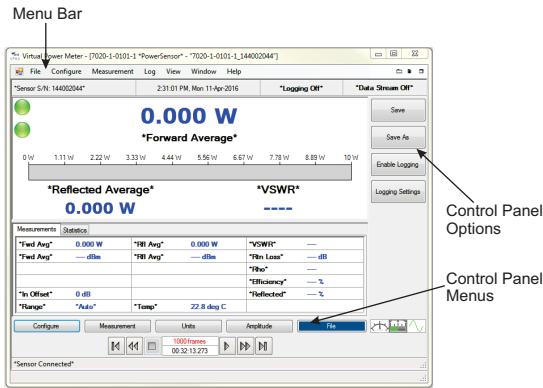
Menu Bar

The options displayed on the menu bar will vary greatly from one Bird Power Sensor to the next. All of the possible options are listed in this chapter, if menus or options do not apply for your sensor, those options will not be visible when your sensor is connected.

In this manual, menu items that are specific to one or more power sensors will include the sensor model number following the heading *(e.g. 7022).*

File Menu

Figure 13   File Menu
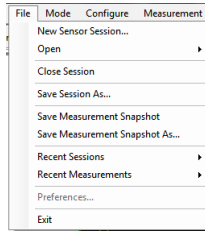
New Sensor Session

Displays the Select Sensor(s) dialog box (Figure 14). All Bird sensors connected to the computer will be listed. Selecting New Sensor Session does not close any active sensor window/connection.

Selecting a sensor from the list and clicking **Connect** will initiate a new session for the selected sensor. See "Preferences" on page 19 for information about automatically starting sensor sessions.

Figure 14   Select Sensor(s) Dialog Box
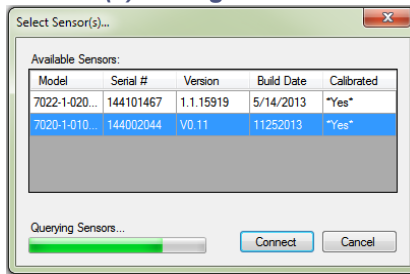
Open

Session — Displays the Select a session file dialog. Session files contain the configuration/settings for each Bird Sensor that has been connected to VPM3. The Open Session dialog allows the use of a "preset" configuration when connecting to a new sensor. See "Open Session File" on page 73

Measurement — Displays the Log Browser dialog box. The Log Browser lists all snapshot and logged measurements contained in the VPM3 Measurements folder. See "Open Measurement File" on page 73

Reference Measurement — Displays the Select a reference measurement dialog box. Reference Measurements are only used by the 7022 sensor in the statistical mode. See "Statistical Power Measurement" on page 50

Close Session

Closes the active session window. If more than one sensor session is open only the active session will close.

Save Session As...

Saves the current session under a different name. This allows the user to save a "preset" configuration for use when connecting to a new sensor or for recall as desired.

Save Measurement Snapshot

During data acquisition, saves the most recent measurement frame to a file without displaying the measurement file save dialog.

During playback, saves the currently displayed measurement frame to a file without displaying the measurement file save dialog.

Snapshots are saved in XML format. See "Snapshots" on page 57 for additional information.

Save Measurement Snapshot As...

Displays the Save Snapshot dialog box. Allows the use of a unique filename when saving a measurement snapshot to file. See "Snapshots" on page 57 for additional information.

Recent Sessions

Displays a list of recent session files, a sensor must be connected to open a recent session. Only sensor session created by the same type of sensor may be opened.

A Clear List option allows the recent session list to be deleted. This option does not delete any files. A new list will be started when the next sensor is connected.

Recent Measurements

Displays a list of recent measurement log files, a sensor is not required to display a saved measurement. Once a saved measurement is open the playback controls can be used to view the content of the log file.

A Clear List option allows the recent measurement list to be deleted. This option does not delete any files. A new list will be started when the next measurement is saved.

Preferences

Displays the Preferences dialog box. All session must be closed to open preferences.

The preferences dialog box has three tabs for options: General, File Locations, and Advanced.

Figure 15   Preferences, General Tab
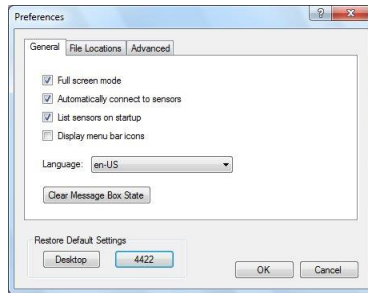
General Tab

Full screen mode — When selected, VPM3 will start in full screen mode. Full screen mode can also be toggled on or off using the View Menu.

Automatically connect to sensors — When selected, the VPM3 will connect to sensors when the program is launched. If more than one sensor is connected to the computer, a session will be opened for each sensor.

List sensors on startup — When selected, the VPM3 will display the Select Sensor(s) dialog box (Figure 14) at startup. All Bird sensors connected to the computer will be listed.

Language — VPM3 supports English and Chinese languages. English is the Default language selection. Click the drop-down menu to select option.

> **Note:** *Any language change requires VPM3 restart.*

Clear Message Box State — When pressed, all previously disabled information dialog boxes will be enabled.

Information dialog boxes are displayed in some circumstances to provide additional information to the user, in some dialogs there is a check box "Don't show this again" option to disable the dialog in the future. The "Clear Message Box State" resets all the disabled dialog boxes so they will be displayed when appropriate.

Restore Default Settings — When Pressed restores the General Tab settings to factory defaults for one of the following options:

- Desktop computers
- Bird 4422 Power Meter.

Figure 16   Preferences, File Locations
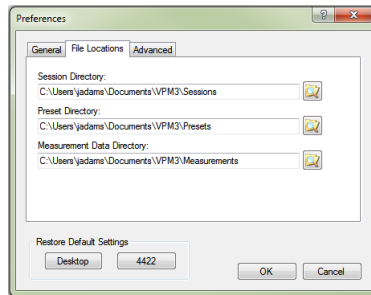
File Locations

Session Directory — Sets the location of the session directory. All Session files will be saved to the selected location. See "Sessions" on page 53 for additional information about Session Files.

Preset Directory — Sets the location of the preset directory. Preset Files are legacy VPM3 files. See "Convert Legacy Preset File to Default Session File" on page 74 for information on converting Presets to Session Files.

Measurement Data Directory — Sets the location of the data directory. See "Logging" on page 58 for additional information regarding measurement files.

Figure 17   Preferences, Advanced Tab
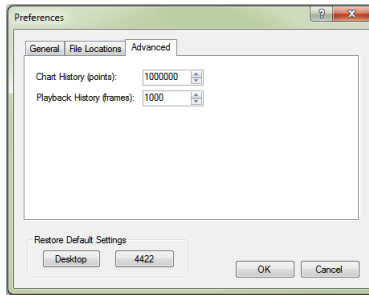
Advanced

Chart History (points) — Sets the number of points to be collected in a session. See "Data Buffering" on page 56.

Playback History (frames) — Sets the number of frames created during a session. See "Data Buffering" on page 56.

Exit

Closes the program and all open sessions.

Mode Menu

7022, 7023

The Mode Menu is only displayed if the sensor supports more than one measurement mode.

> **Note:** *The 7022 Statistical Power Sensor is currently the only sensor supporting multiple modes.*

A check mark indicates the current mode. When another mode is selected the check mark will move to the new mode.

Figure 18   Mode Menu
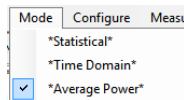
Statistical

7022

When selected, switches Sensor to Statistical Power Mode. See "Statistical Power Mode" on page 50

Time Domain

7022

When selected, switches Sensor to Time Domain Mode. See "Time Domain Mode" on page 48.

Average Power

7022, 7023

When selected, switches Sensor to Average Power mode. See "Average Power Mode" on page 43.

Configure

> **Note:** *This menu will change depending on the sensor and/or mode being displayed.*

Input Offset

Input Offset is used to enter the total value of all couplers and attenuators connected to the sensor (for example, the coupling factor of a directional coupler).

To read the true power when using a coupler or attenuator, VPM must compensate for them. Click Input Offset and enter (in dB) the total attenuation or coupling factor.

To convert percentages to dB, use the equation:

$$Attenuation(dB) = 10 \times Log10[Attenuation(percent)/100]$$

> **Note:** *The Bird 5015-EF uses frequency-dependent correction factors to provide more accurate measurements that are entered here. For more information, refer to the owners manual for the 5015-EF.*

Filter

5012, 5016, 5017, 5018, 5019

Selects the bandwidth for the video filter.

- Full (No Filter, Full bandwidth, 20 MHz)
- 400 kHz
- 4.5 kHz

Duty Cycle

5012, 5016, 5017, 5018, 5019, 7022

Sets the duty cycle of a measurement. If sensor is capable, the duty cycle will be inferred by the sensor hardware and reported. A user-defined duty cycle can be entered to override the sensor provided value.

> **Note:** If zero is entered, the duty cycle automatically sets to Auto.

> **Note:** *For best duty cycle measurement with the 7022, have at least 10 pulses on the time domain screen.*

- Auto (Sensor determines the duty cycle of the measurement.)
- Specify Duty Cycle (Manually enter the duty cycle. The specified duty cycle will be used to determine the Burst Average power.)

> **Note:** *Use Specify Duty Cycle for best accuracy when the duty cycle is known.*

CCDF Limit

5012, 5016, 5017, 5018, 5019

Sets the threshold, in Watts, for the CCDF measurement. The Sensor samples power over a 300 ms window and compares it to CCDF Limit. The time above the threshold relative to the total time is the CCDF.

Elements

5014

Selects the type of element being used in the 5014 Power Sensor.

- DPM
- 43

Forward Scale

5014

Selects wattage of the forward element being used in the 5014 Power Sensor. A list of common values is displayed, the value may be clicked to select, or click "Other..." to manually enter the element's value.

Reflected Scale

5014

Selects wattage of the reflected element being used in the 5014 Power Sensor. A list of common values is displayed, the value may be clicked to select, or click "Other..." to manually enter the element's value. This option is disabled if F/R Scale 10:1 Ratio is selected.

F/R Scale 10:1 Ratio

5014

Selects the value for the reflected element automatically based on the value entered for the forward element. The value for the reflected element will be set to 1/10th of the forward element.

Scale

7022

Selects the value for x or y-axis in the statistical and time domain modes.

For Statistical Measurements:

- Upper Range (Specifies the upper limit of the x-axis in dB)

For Time Domain Measurements:

- Time (Specifies the time per division (in seconds) of the x-axis)

- Power (Specifies the power per division (in watts) of the y-axis)

- Reference Level (Specifies the base line reference level for power)

Bandwidth

7022

Selects the bandwidth for the video filter.

- No Filter (full bandwidth, 20 MHz)

- 4.5 kHz

- 500 kHz

- 5 MHz

Run Mode

7022 Statistical Mode

During Statistical Measurements, Selects whether a single measurement is acquired, or measurements will automatically be repeated.

- Normal (single measurement)
- Clear Restart (measurements are automatically repeated)

Avg Smoothing

7022 Average Power Mode

Selects smoothing that is performed by the sensor for average forward.

> **Note:** *Avg Smoothing is performed in the sensor itself. It only effects the average power measurement in the forward direction and is used for very low rep rate signals (<200Hz).*

- None (No smoothing is performed.)
- Low (Uses a moving average of 8 samples.)
- Medium (Uses a moving average of 16 samples.)
- High (Uses a modified moving average (exponential average with alpha = 1/N).)

Freq. Setpoint

7022, 7023

- Auto (Sensor determines the frequency of the measurement)
- Specify Frequency Setpoint (Manually enter the frequency of the signal. The specified frequency will be used in correcting the power measurement.)

  > **Note:** *Use Specify Frequency Setpoint when the sensor is unable to measure the frequency of a signal.*

Confidence Factor

7022

Sets the duration of the statistical measurement using one of the following options:

- Percentage (Acquires sufficient samples to achieve an error tolerance of +/-0.1% with the specified confidence factor.
  Confidence percentage is a user selectable percentage: 80, 90, 95, 99, 99.9, or 99.99%.)
- Number of Samples (User entered value within a specified range between 1144900 and 288354000.)
- Time Duration (User entered value within a specified range between 26.1 ms and 6.5535 seconds.)

Measurement Menu

Type

Selects the type of measurement for the source of the data to be displayed on the analog, digital, or chart display.

- Forward Average
- Reflected Average
- Match

5012, 5016, 5017, 5018, 5019

- Forward Peak
- Forward Burst
- Crest Factor
- CCDF

Amplitude

Max Hold

Holds and displays the highest trace data points.

Zero

5012, 5016, 5015, 5017, 5018, 5019, 7020, 7022

Performs a zero calibration on the selected sensor. See "Zeroing a Sensor" on page 82.

Start Acquisition

Starts the Data Stream for the selected Session/Sensor.

Stop Acquisition

Stops the Data Stream for the selected Session/Sensor. The previously received data is retained until Start Acquisition is pressed or the session is ended.

Units

Power — Selects the unit of measure for the power level of the displayed signal.

- Watts
- dBm

Match — Selects the unit of measure for the match measurement displayed signal.

- VSWR
- Return Loss dB
- Rho
- Efficiency %
- Reflected %

> **Note:** *TPMs (5015) do not have match measurement as an option, this menu is not available.*

Limits

5012, 5014, 5015, 5016, 5015, 5017, 5018, 5019, 7020

Displays the Limits Dialog Box. Allows users to enter, enable, disable, or delete limits for any measurement. See "Limit Indicators" on page 55.

Show/Hide Reference

7022 Statistical Mode

Toggles the display of a reference measurement on and off.

Enable Pulse Measurement

7022 Time Domain Mode

Enables the measurement of pulse characteristics such as duty cycle, overshoot, pulse width, rise time, fall time, off time, edge delay, pulse period, and repetition rate.

Trigger Menu

7022 Time Domain Mode

Source

- Internal (Triggers are internally generated when the signal crosses the specified trigger level.)
- External (Triggers are controlled by an external source, input via the BNC connector on the 7022 Power Sensor.)
- Manual (Triggers are generated using the Manual Trigger menu option.)

Mode

The mode affects operation only when the selected source is Internal or External.

- Single (When triggered, one sweep is generated, the sweep will be displayed until another sweep is triggered.)
- Auto (The measurement is triggered automatically if the specified trigger event does not occur within the greater of 10ms or the acquisition interval of the last measurement.
- Normal (The measurement is not triggered until the specified trigger event occurs.)

Edge

When the selected source is Internal, this selects the direction that the signal crosses the specified trigger level to cause a trigger event.

- Rising (A sweep is triggered if the input goes from "Low" to "High".)
- Falling (A sweep is triggered if the input goes from "High" to "Low".)

Level…

- Auto (Sets the trigger level automatically half way between the max and min values of the previous time domain data set.)
- Specify Trigger Level (User entered, sets a specific the trigger power level when the trigger source is internal.)

Delay…

Length of wait after the trigger signal and before beginning a sweep. The range is -3600 to 3600 seconds.

0 - the trigger event occurs at the mid-point of the time axis.

Positive values - Trigger event shifts to the left on the display.

Negative values - Trigger event shifts to the right on the display.

Holdoff…

Specifies the minimum amount of time from the end of one measurement to the next trigger event.

Manual Trigger

Triggers a single measurement sweep.

Zero Delay

Resets any Trigger delay to zero.

Log Menu

Logging is a function within VPM3 that records sensor data to a file for preservation and analysis. Logs files are stored in the location specified in "File Locations" on page 20.

For additional information about logging see "Logging" on page 58.

Enable Data Logging

Used to toggle the logging function on or off. A check mark on the menu option indicates Logging is on, additionally "Logging On" is displayed at the top of the VPM3 measurement screen.
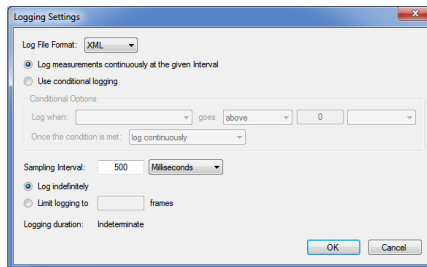
Restart Session

Clears the current session buffer and restarts the measurements.

Settings

Opens the Logging Settings dialog box. The Logging Settings dialog box is used to configure the logging parameters and select the log file type. See "Logging" on page 58 for detailed information on logging.

Figure 19   Logging Settings Dialog Box

View Menu

Fullscreen Mode

Toggles on and off full screen mode for the VPM3 display.

Control Panel

Toggles on and off the display of the control panel menus and options.

Playback Controls

Toggles on and off the display of the playback controls.

Details

Toggles on and off the display of the measurements and Statistics in the Sensor Readings area.

Display Style

Selects the display type used to graphically display measurement information. See "Displays" on page 5.

- Digital
- Analog
- Chart

Meter Range

Used to control the measurement range displayed for each Display Type. The Chart display includes additional controls for the range of the x and y axis. See "Chart Display" on page 9.

- Auto (Displayed range is controlled by the measurement value to provide increased granularity.)
- Full (Displayed range is the full range capability of the sensor)

Smoothing

Smoothing is performed by VPM3 software after receiving the power readings from the sensor.

- Enabled (Toggles on and off smoothing.)
- Specify Number of Readings (used to set the number of reading used for smoothing the display signal measurement.)

> **Note:** *The 7022 Sensor includes a feature to perform smoothing on the sensor (See "Avg Smoothing" on page 25). It is possible to apply both forms of smoothing together, take care when using a 7022 sensor.*

Playback

Playback is used to replay measurements. Playback can be used to playback measurements saved in the Frame buffer or for measurements saved in Log files. See "Viewing Data Using VPM3 Playback" on page 77 for detailed information about playback.

- Clear Buffer (Clears the Frame Buffer)
- No Delay (selects playback with no delay between frames)
- 1 sec (selects playback with a one second delay between frames)
- 2 sec (selects playback with a two second delay between frames)
- 4 sec (selects playback with a four second delay between frames)
- 8 sec (selects playback with a eight second delay between frames)

Measurements

402X Series Sensors

- Show/Hide Frequency (toggles on and off the display of the measured RF frequency in the Measurement results area.

Window Menu

Cascade Sessions

Organizes the sessions in a cascading, offset display.

Tile Sessions Horizontally

Organizes the sessions horizontally.

Tile Sessions Vertically

Organizes the sessions vertically.

List of Open Sessions

The Windows menu contains a sequential list of active sensor sessions.

Help Menu

User Manual

Opens a PDF of the VPM3 operation manual.

About Virtual Power Meter

Displays version info about the VPM.

About Sensor

Displays model information of the selected sensor.

Control Panel Menus and Options

Many of the menu bar menus and options associated with making measure-ments are repeated on the control panel.

The options displayed on the control panel will vary greatly from one Bird Power Sensor to the next. All of the possible options are listed in this chapter, if menus or options do not apply for your sensor, those options will not be visible when your sensor is connected. Any menu item that is specific to one or more power sensors will include the sensor model number following the heading *(e.g. 7022).*

Figure 20   Control Panel Menus
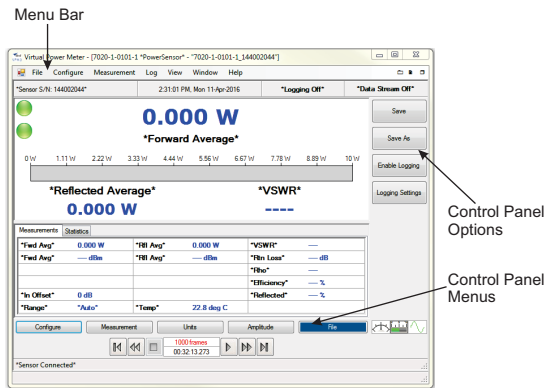
Control Panel menu options are displayed on the right side of the VPM3 screen. There are a variety of option selection buttons employed. Many of the option buttons are ON/OFF switches or Selection buttons, others have data entry on the option or when click open a dialog for data entry. See Figure 21 for exam-ples.

Figure 21   Menu Option Buttons
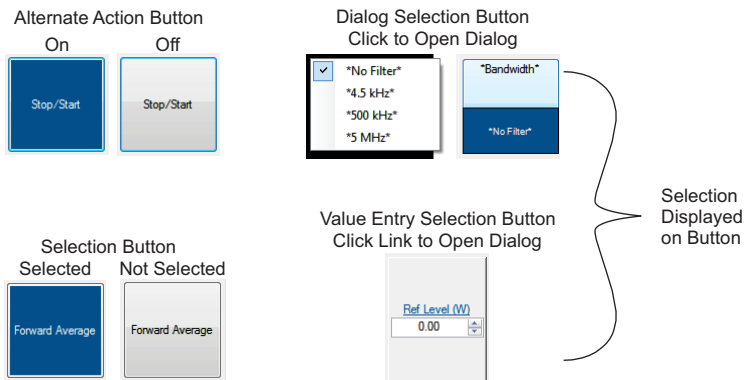
Configure Button

> **Note:** *This menu will change depending on the sensor and/or mode being displayed.*

Input Offset

Input Offset is used to enter the total value of all couplers and attenuators connected to the sensor (for example, the coupling factor of a directional coupler).

To read the true power when using a coupler or attenuator, VPM must compensate for them. Click Input Offset and enter (in dB) the total attenuation or coupling factor.

To convert percentages to dB, use the equation:

$$Attenuation(dB) = 10 \times Log10[Attenuation(percent)/100]$$

> **Note:** *The Bird 5015-EF uses frequency-dependent correction factors to provide more accurate measurements that are entered here. For more information, refer to the owners manual for the 5015-EF.*

Filter

5012, 5016, 5017, 5018, 5019

Selects the bandwidth for the video filter.

- Full (No Filter, Full bandwidth, 20 MHz)
- 400 kHz
- 4.5 kHz

Duty Cycle

5012, 5016, 5017, 5018, 5019, 7022

Sets the duty cycle of a measurement. If sensor is capable, the duty cycle will be inferred by the sensor hardware and reported. A user-defined duty cycle can be entered to override the sensor provided value.

> **Note:** If zero is entered, the duty cycle automatically sets to Auto.

> **Note:** *For best duty cycle measurement with the 7022, have at least 10 pulses on the time domain screen.*

- Auto (Sensor determines the duty cycle of the measurement.)
- Specify Duty Cycle (Manually enter the duty cycle. The specified will be used to determine the Burst Average power.)

> **Note:** *Use Specify Duty Cycle for best accuracy when the duty cycle is known.*

Meter Range

Used to control the measurement range displayed for each Display Type. The Chart display includes additional controls for the range of the x and y axis. See "Chart Display" on page 9.

- Auto (Displayed range is controlled by the measurement value to provide increased granularity.)
- Full (Displayed range is the full range capability of the sensor)

CCDF Limit

5012, 5016, 5017, 5018, 5019

Sets the threshold, in Watts, for the CCDF measurement. The Sensor samples power over a 300 ms window and compares it to CCDF Limit. The time above the threshold relative to the total time is the CCDF.

Elements

5014

Selects the type of element being used in the 5014 Power Sensor.

- DPM
- 43

Forward Scale

5014

Selects wattage of the forward element being used in the 5014 Power Sensor. A list of common values is displayed, the value may be clicked to select, or click "Other..." to manually enter the element's value.

Reflected Scale

5014

Selects wattage of the reflected element being used in the 5014 Power Sensor. A list of common values is displayed, the value may be clicked to select, or click "Other..." to manually enter the element's value. This option is disabled if F/R Scale 10:1 Ratio is selected.

F/R Scale 10:1 Ratio

5014

Selects the value for the reflected element automatically based on the value entered for the forward element. The value for the reflected element will be set to 1/10th of the forward element.

Bandwidth

7022

Selects the bandwidth for the video filter.

- No Filter (full bandwidth, 20 MHz)
- 4.5 kHz
- 500 kHz
- 5 MHz

Run Mode

7022 Statistical Mode

During Statistical Measurements, Selects whether a single measurement is acquired, or measurements will automatically be repeated.

- Normal (single measurement)
- Clear Restart (measurements are automatically repeated)

Avg Smoothing

7022 Average Power Mode

Selects smoothing that is performed by the sensor for average forward.

> **Note:** *Avg Smoothing is performed in the sensor itself. It only effects the average power measurement in the forward direction and is used for very low rep rate signals (<200Hz).*

- None (No smoothing is performed.)
- Low (Uses a moving average of 8 samples.)
- Medium (Uses a moving average of 16 samples.)
- High (Uses a modified moving average (exponential average with alpha = 1/N).)

Freq. Setpoint

7022, 7023

- Auto (Sensor determines the frequency of the measurement)
- Specify Frequency Setpoint (Manually enter the frequency of the signal. The specified frequency will be used in correcting the power measurement.)

> **Note:** *Use Specify Frequency Setpoint when the sensor is unable to measure the frequency of a signal.*

Confidence Factor

7022 Statistical Mode

Sets the duration of the statistical measurement using one of the following options:

- Percentage (Acquires sufficient samples to achieve an error tolerance of +/-0.1% with the specified confidence factor.
  Confidence percentage is a user selectable percentage: 80, 90, 95, 99, 99.9, or 99.99%.)

- Number of Samples (User entered value within a specified range between 1144900 and 288354000.)

- Time Duration (User entered value within a specified range between 26.1 ms and 6.5535 seconds.)

Average Count

7023

Specifies the amount of averaging applied for the measurement displayed value according to the formula below.

The average count selected is substituted for k in the following equation:

$$AVG_n = \frac{1}{k}X_n + \frac{k-1}{k}AVG_{n-1}$$

Pulse Gate Times

7023

Pulse gate times allows user to specify the measurement interval by selecting the delay after the pulse rising edge and the interval before the pulse falling edge. See "Gated Average" on page 38.

- Pulse Begin Gate Time
- Pulse End Gate Time

Measurement Button

> **Note:** *Specific measurement types depend upon the power sensor being used.*

Stop/Start

Toggles the Sensor Data Stream on and off for the selected Session/Sensor. When stopped the previously received data is retained until Stop/Start is pressed again or the session is ended.

Zero

7022

Performs a zero calibration on the selected sensor. See "Zeroing a Sensor" on page 82.

For other sensors Zero calibration is on the "Amplitude Button" on page 40.

Max Hold

7022, 7023

Holds and displays the highest trace data points.

For other sensors Max Hold is on the "Amplitude Button" on page 40.

Type:

Selects the type of measurement for the source of the data to be displayed on the analog, digital, or chart display.

Forward Average

- See "Forward and Reflected Power" on page 43.

Reflected Average

- See "Forward and Reflected Power" on page 43.

Match

- See "Match" on page 44.

Forward Peak

5012, 5016, 5017, 5018, 5019

- See "Forward Peak Power" on page 44.

Forward Burst

5012, 5016, 5017, 5018, 5019

- See "Burst Average Power" on page 44.

Crest Factor

5012, 5016, 5017, 5018, 5019

- See "Crest Factor" on page 45.

CCDF

5012, 5016, 5017, 5018, 5019

- See "Complementary Cumulative Distribution Function (CCDF)" on page 46.

Gated Average

7023

- See "Gated Average" on page 46.

Show/Hide Reference

7022 Statistical Mode

Toggles the display of a reference measurement on and off.

Pulse Meas.

7022 Time Domain Mode

Toggles on and off the measurement of pulse characteristics such as duty cycle, overshoot, pulse width, rise time, fall time, off time, edge delay, pulse period, and repetition rate.

Trigger Button

7022 Time Domain Mode

Source

- Internal (Triggers are internally generated when the signal crosses the specified trigger level.)
- External (Triggers are controlled by an external source, input via the BNC connector on the 7022 Power Sensor.)
- Manual (Triggers are generated using the Manual Trigger menu option.)

Mode

The mode affects operation only when the selected source is Internal or External.

- Single (When triggered, one sweep is generated, the sweep will be displayed until another sweep is triggered.)
- Auto (The measurement is triggered automatically if the specified trigger event does not occur within the greater of 10ms or the acquisition interval of the last measurement.
- Normal (The measurement is not triggered until the specified trigger event occurs.)

Edge

When the selected source is Internal, this selects the direction that the signal crosses the specified trigger level to cause a trigger event.

- Rising (A sweep is triggered if the input goes from "Low" to "High".)
- Falling (A sweep is triggered if the input goes from "High" to "Low".)

Level…

- Auto (Sets the trigger level automatically half way between the max and min values of the previous time domain data set.)
- Specify Trigger Level (User entered, sets a specific the trigger power level when the trigger source is internal.)

Delay…

Length of wait after the trigger signal and before beginning a sweep. The range is -3600 to 3600 seconds.

0 - the trigger event occurs at the mid-point of the time axis.

Positive values - Trigger event shifts to the left on the display.

Negative values - Trigger event shifts to the right on the display.

Zero Delay

Resets any Trigger delay to zero.

Holdoff…

Specifies the minimum amount of time from the end of one measurement to the next trigger event.

Manual Trigger

Triggers a single measurement sweep.

Units Button

Power:

Selects the unit of measure for the power level of the displayed signal.

Watts

dBm

Match:

Selects the unit of measure for the match measurement displayed signal.

VSWR

Return Loss dB

Rho

Efficiency %

Reflected %

> **Note:** *TPS (5015) does not have match measurement as an option, this menu is not available.*

Amplitude Button

Zero

5012, 5016, 5015, 5017, 5018, 5019

Performs a zero calibration on the selected sensor. See "Zeroing a Sensor" on page 82.

> **Note:** *For 7022 sensor Zero calibration is on the "Measurement Button" on page 36.*

Smoothing

Smoothing is performed by VPM3 software after receiving the power readings from the sensor.

- ● Enabled (Toggles on and off smoothing.)
- ● Specify Number of Readings (used to set the number of reading used for smoothing the display signal measurement.)

> **Note:** *The 7022 Sensor includes a feature to perform smoothing on the sensor (See "Avg Smoothing" on page 35). It is possible to apply both forms of smoothing together, take care when using a 7022 sensor.*

Max Hold

5012, 5014, 5016, 5015, 5017, 5018, 5019

Holds and displays the highest trace data points.

> **Note:** *For 7022, 7023 sensors Max Hold is on the "Measurement Button" on page 36.*

Scale Button

7022

Upper Range

7022 Statistical Mode

Specifies the upper limit of the x-axis in dB.

Time

7022 Time Domain Mode

Specifies the time per division (in seconds) of the x-axis.

Power

7022 Time Domain Mode

Specifies the power per division (in watts) of the y-axis.

Reference Level

7022 Time Domain Mode

Specifies the base line reference level for power.

File Button

> **Note:** *Save and Save As captures the most recent measurement readings. It will not store the time-chart information. To store time chart display, ensure logging is enabled. See "Logging" on page 58.*

Save

During data acquisition, saves the most recent measurement frame to a file without displaying the measurement file save dialog.

During playback, saves the currently displayed measurement frame to a file without displaying the measurement file save dialog.

Snapshots are saved in XML format. Each quick save is stored in a separate file that is named using the date-time file naming format:

MMMM_NNNNNNNN_YYYYMMDD_HHMMSS.xml

Model
Serial Number
Year
Month
Day
Hour
Minute
Seconds

Save As

Same as Save, only the Save Snapshot dialog box is displayed. Allows the use of a unique filename when saving a measurement snapshot to file.

Enable Logging

Used to toggle the logging function on or off. When menu option is blue Logging is on, additionally "Logging On" is displayed at the top of the VPM3 measurement screen.

See "Logging" on page 58.

Logging Settings

Opens the Logging Settings dialog box. The Logging Settings dialog box is used to configure the logging parameters and select the log file type. See "Logging" on page 58 for detailed information on logging.

Measurement Modes — The following sensor dependent measurement modes are available:

- Average Power Mode - All Sensors

- Time Domain Mode - 7022 Sensor Only

- Statistical Power Mode - 7022 Sensor Only
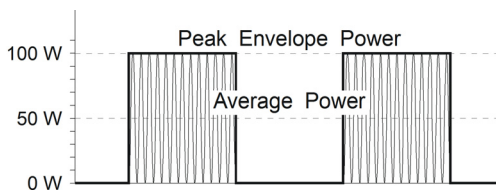
Average Power Mode

In average power mode sensor data may be displayed using any of the display types available in VPM3. See "Displays" on page 5. Depending on the capabilities of the connected sensor some or all of the following measurements may be displayed in Average Power Mode.

Forward and Reflected Power

Average power is a measure of the equivalent "heating" power of a signal, as measured with a calorimeter. It measures the total RF power in the system, and does not depend on number of carriers or modulation scheme.

Average power is the most important measurement of any transmission system since the average power is normally specified on the operating license. It is also valuable as a maintenance tool, showing overall system health, and for calibration.

Figure 22   Average and Peak Envelope Power, Square Wave Signal

Match

Match measures the relation between forward and reflected average power. The health of the feedline and antenna systems can be monitored using Match, or VSWR, measurement under full power operating conditions. High VSWR is an indicator of feed line damage, overtightened cable or feed line clamps, or antenna changes/damage due to weather conditions, icing, or structural damage to the tower.

Rho and Return Loss are also the same measurement, but in different units:

Rho — $Rho(\rho) = \sqrt{P_R / P_F}$

VSWR — $VSWR = \dfrac{1 + p}{1 - p}$

Return Loss (dB) — $ReturnLoss(dB) = 20 \times \log\rho$

Forward Peak Power

5012, 5016, 5017, 5018, 5019

Peak power measurements detect amplitude changes as a signal modulates the carrier envelope.

Transmitter overdrive can be detected with peak measurements. Common problems are overshoot at the beginning of burst packets, amplitude modulation, and excessive transients. These damage system components with excessive peak power and also cause data degradation, increasing the Bit Error Rate. For TDMA applications, Peak and Burst Power measurements are used to detect overshoot in single timeslots. Other timeslots must be turned off for this test.

Peak Average Power

5012, 5016, 5017, 5018, 5019

This displays the average of the positive and negative peak power readings.

Burst Average Power

5012, 5016, 5017, 5018, 5019

Burst width (BW) is the duration of a pulse. Period (P) is the time from the start of one pulse to the start of the next pulse. Duty cycle (D) is the percentage of time that the transmitter is on. To calculate the duty cycle simply divide the burst width by the period (D = BW / P). Low duty cycles mean that the burst width is much less than the period; a large amount of dead time surrounds each burst. For low duty cycles, the burst average power will be much larger than the average power.

After peak power is measured, a threshold of ½ the peak is set. The sampled power crosses that threshold at the beginning and end of each burst. The time between crossings is used to calculate the duty cycle. Burst Average Power is calculated by dividing the Average Power by the Duty Cycle.

Burst average power is calculated in the 7022 automatically using the average detector and the duty cycle.

Burst average power can also be calculated in the time domain mode using the average power between markers function.

Burst power measurements provide accurate, stable measurements in bursting applications such as TDMA and radar. Accurately measuring the output signal strength is essential for optimizing radar coverage patterns. Actual transmitted power in a single timeslot can be deter-mined in TDMA. The other timeslots must be off during this test.

Figure 23   Burst Average Power
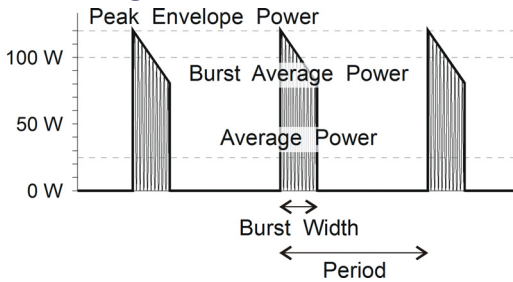
Crest Factor

5012, 5016, 5017, 5018, 5019

Crest factor (CF) is the ratio of the peak and average powers, in dB. The WPS cal-culates the Crest Factor from the Forward Peak and Average Power measure-ments.

Crest factor is becoming one of the most important measurements as communi-cation systems move into the digital age. For CDMA and similar modulation types the CF may reach 10 dB. If the crest factor is too large, the transmitter will not be able to handle the peak powers and amplitude distortion will occur. Crest factor can also detect overdrive and overshoot problems. Knowing the CF allows end-users to more accurately set base station power and lower operating costs.

*Figure 24   Crest Factor, 10 dB CDMA Signal, 100 W Peak, 10 W Ave*
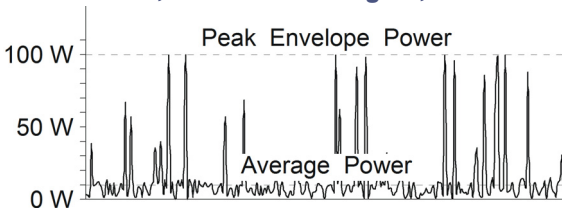
Complementary Cumulative Distribution Function (CCDF)

5012, 5016, 5017, 5018, 5019

CCDF measures the amount of time the power is above a threshold. This threshold is set in the Configure, CCDF Factor menu. Equivalently, it is the probability that any single measurement will be above the threshold. The WPS samples the power over a 300 ms window and compares it to a user-specified threshold, in Watts. The time above the threshold relative to the total time is the CCDF.

CCDF measurements are most useful for pseudo-random signals, such as WCDMA, where a high CCDF means that the transmitter is being overdriven. CCDF can also detect amplitude distortion within an envelope caused by unwanted modulating signals. In TDMA systems, CCDF indicates the health of power amplifier stages and their ability to sustain rated power over an appropriate timeframe. As a trouble-shooting aid, CCDF allows tracking of trends such as amplifier overdrive (which can cause dropped calls and high bit error rates).

Figure 25   CCDF, 100 W Signal, 80 W Threshold, 20% CCDF
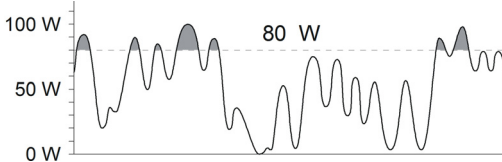

Gated Average

7023

Gated Average measures the average power of a pulse in a user defined interval referenced from the rising and falling edges of the pulse.

When the measurement is initiated 2.23 ms of the signal is sampled. The envelope of the signal must contain at least 3 edges within the acquisition window in order for pulse parameters to be measured. The edges can be rise-fall-rise or fall-rise-fall. The pulse repetition rate is measured between two rising edges or two falling edges, depending on which edge is detected first.

The measurement interval for the average pulse power begins at the user specified delay after the rising edge (positive integer) and ends at the user specified time interval before the falling edge (negative integer). These values are entered on the Configure Menu. See "Pulse Gate Times" on page 36.

The rising edge of the pulse is identified at the point where the power envelope rises to 10% of the pulse top amplitude. The falling edge of the pulse is identified at the point where the power envelope drops to 90% of the pulse top amplitude. See Figure 26 on page 47.

Figure 26   Pulse Gate Times
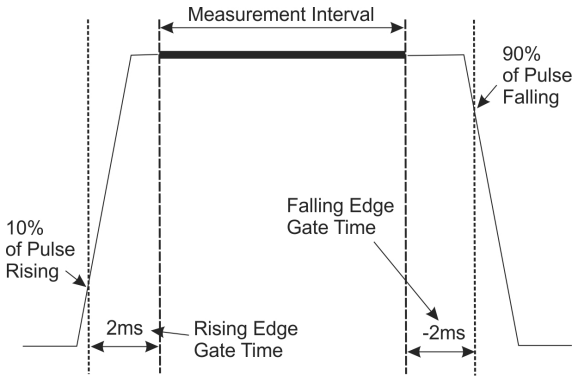
The sensor is capable of averaging measurements from pulse to pulse. See "Average Count" on page 36.

The average is an exponential where:

$$AVG_n = \frac{1}{k}X_n + \frac{k-1}{k}AVG_{n-1}$$

The Averaging Value parameter sets the k factor.

Time Domain Mode

7022

In Time Domain Mode, the amplitude of a single frequency is measured, rather than sweeping a range of frequencies. The Sensor measures the amplitude of the frequency for a specified period (sweep time) and refreshes during the next sweep. VPM3 displays the Time Domain trace on the Chart Display.

Figure 27   Time Domain Display
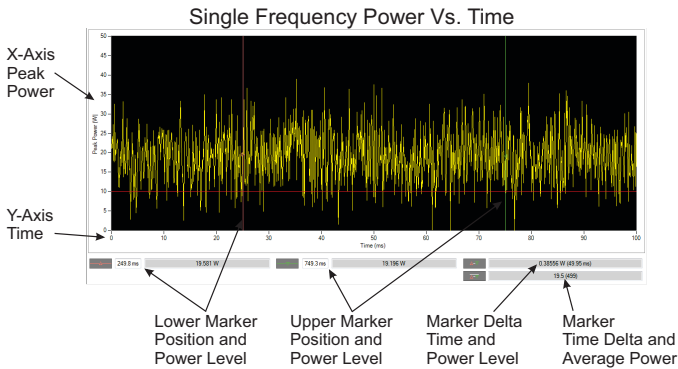
The Statistical Power Sensor time domain mode operates very much like a modern digital oscilloscope that has its vertical axis is accurately calibrated in power. The VPM3 can display the following 7022 Sensor measurements:

- Peak (Envelope) Power
- Burst Power
- Power at Marker
- Power between Markers

The 7022 Sensor can also measure and VPM3 display pulse characteristics such as:

- duty cycle
- overshoot
- pulse width
- rise time
- fall time
- off time
- edge delay

- pulse period

- repetition rate

See "Measurement Menu" on page 26 for additional information on 7022 Measurements.

Time base and trigger functions are available to present a stable time domain graphic. See See "Trigger Menu" on page 28.

Statistical Power Mode

Most modern wireless communication systems employ complex modulation and channel access methods like orthogonal frequency division multiplexing (OFDM), or code division multiple access (CDMA). These methods use a combination of amplitude and phase modulation to create symbol based multichannel or multicarrier systems that result in pseudo-random or noise-like power envelopes. The consequence is that modulation parameters such as AM depth or FM modulation index are not useful. Indeed, the peak-to-average power ratio of the modulated carrier is a complex function of the data stream content rather than just amplitude, and as such is not constant with time. Since digitally modulated signals often appear noise-like it makes sense to use statistical analysis in order to characterize them.

The most significant advantage RF Power meters that provide measurements based upon statistical methods is that they are capable of making meaningful power measurements of signals incorporating complex modulation methods. In essence, provide meaningful measurements *independent* of the modulation method used in the system.

Statistical Power Measurement

Provides statistical measurements to display the percentage of time that a particular waveform exists at a specific peak to average power ratio. The Figure 28 on page 51 illustrates this concept, as applied to an LTE-TDD waveform.

In Figure 28 the horizontal axis represents the peak to average power ratio of the waveform being measured. The vertical axis on the display represents time in percent. Reading a specific point on the graph provides information as to the percentage of time that the signal being measured exhibits a specific peak to average power ratio characteristic.

The performance curve illustrated in Figure 28 indicates that the maximum peak to average ratio of the waveform being measured is indicated at the point where the curve intersects the horizontal axis. This corresponds to a value of 11.5 dB.

Two movable cursors are available within the VPM3 display. These cursors may be located at any point on the curve, in order to determine specific values of the waveform peak to average ratio, and corresponding time.

me

Figure 28   VPM Statistical Power Display
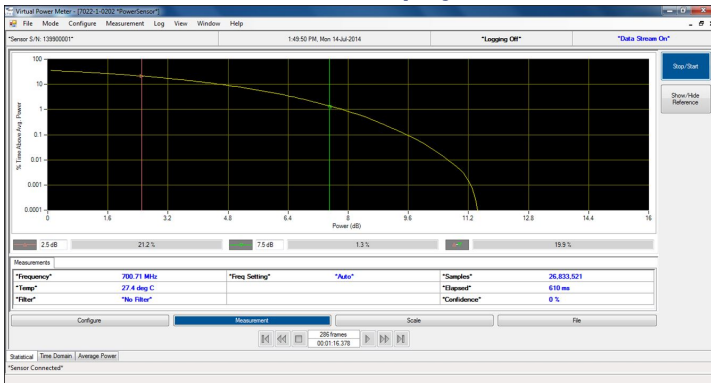
This table represents a few of the statistical curve data points in

numeric format.

Time (%)	Peak/Average Ratio (dB)
10%	4.8
1%	7.5
0.1%	9.6
0.01%	10.6

Interpreting Statistical Data

There are many factors that influence the performance of modern communications systems. Some examples:

- The presence of interfering signals within the operating bandwidth of the system.
- Transmission line discontinuities resulting in multiple reflections within the transmission system.
- Poor amplifier linearity caused by amplifier compression. This results in signal distortion and poor fidelity of transmitted waveforms.
- Antenna damage or degradation resulting in high transmission system reflections.
- Issues with transmitter modulator performance resulting in high error vector magnitude (EVM).

Many of the above transmission system issues may be identified through the use of the statistical techniques mentioned above. For example, if a particular LTE radio system was known to be dropping calls at a higher rate than expected, a service technician will need to know whether the problem is with the radio itself, or with some element of the transmission system, or with the air interface.

Measuring the statistics of the base station radio, while terminated with a high quality 50 ohm termination, and then again with the radio connected to the transmission and antenna system will provide clues as to where the issues may be.

Another useful technique is to compare live data from the system with a known "reference" transmission.

Loading a Reference measurement in VPM3

With a statistical measurement displayed a reference measurement may be displayed for comparison. A previous statistical measurement must have been saved and be accessible in the path selected in preferences for saving measurements, the default path is: \Documents\VPM3\Measurements.

1.   Click File, hover over Open, then select Reference Measurement.

Figure 29   Open File
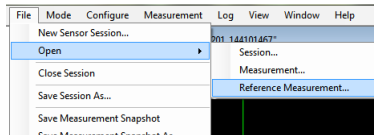
2.   Select the reference statistical measurement.

Figure 30   Reference Measurement File Selection

3.   Click Open.

Reference Measurement is displayed on the chart with the live measurement, a marker table displays the trace differences at the marker positions.

Figure 31   Reference Measurement Chart Display
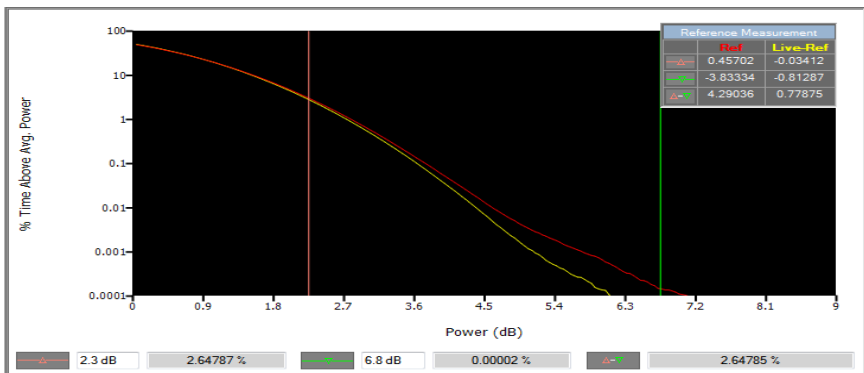
Sessions

Session files are used to initialize VPM3 when a Bird Power Sensor is connected.

Generic Session File

Initially when power sensor is connected to the VPM3, if it has never been connected to VPM3 before, a generic session file is used to configure the sensor. The initial settings for any sensor, the first time it is connected, is all settings are defaulted with data acquisition enabled.

When a first time sensor is initialized it will typically display forward average power on the digital display. Once the sensor session begins VPM3 automatically creates a Serial Number specific session file.

> **Note:** *Generic Session files cannot be modified, but a Default Session File with custom settings can be created to initialize sensor settings for sensors of the same type when first connected. See "Default Session Files" on page 53.*

Serial Number specific session files

Serial Number Specific Session Files are automatically created whenever a Power Sensor is connected to VPM the first time. Any changes made to the configuration of the power sensor will be saved in the Serial Number Specific Session File. When the sensor is connected to VPM3 in the future the serial number specific session file will be used and the sensor configuration will be initialized using the settings when the sensor's last session was closed.

Default Session Files

A Default Session File is a customized session file that may be created using a preferred setup for all sensors of the sensor type currently connected in active session.

If a default session file has been created for a type of sensor, when a sensor of that type is connected to VPM3 and has not been connected before, the default session file is used to initialize the sensor.

For details on how to create a default session file See "Save a Default Session File" on page 73.

New Sensor Session

Whenever a sensor is connected, before a session can begin, the sensor must be detected by VPM3. VPM3 uses a connection manager to display the Select Sensor(s) dialog box (Figure 32). All Bird sensors connected to the computer will be listed.

> **Note:** *If a sensor is already connected and in a session it will not be listed in the Select Sensor(s) dialog box.*

Depending on preferences, a sensor must be manually selected from the list, or VPM3 will automatically launch sessions for ALL the sensors in the list. See "Preferences" on page 19 for details about changing sensor connection behavior.

Selecting a New Sensor Session does not close any active sensor window/connection.

See "Connecting VPM3 to a Sensor" on page 60 for steps required to start a new session.

Figure 32   Select Sensor(s) Dialog Box
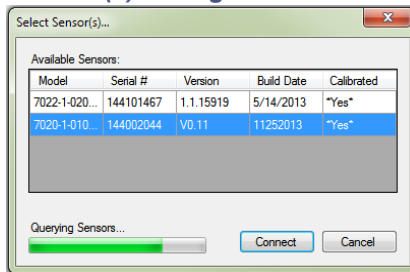
Legacy Preset Files

Preset files are a legacy file type previously used in VPM3. This file was used in previous versions in the same way that Default Session Files and Serial Number Specific Session Files are used in the current VPM3.

Legacy Preset files may be saved as a Default Session file for use in current versions of VPM3.

To convert a legacy preset to a Default Session File, see "Convert Legacy Preset File to Default Session File" on page 74.

Limit Indicators

The Analog and Digital Displays have limit indicators that may be set to provide a visual indication the measurement is above or below specified values.

Figure 33   Limit Indicators
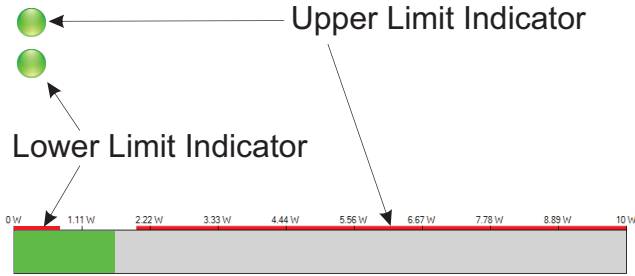
The circular limit indicators shown in Figure 33 are on both the Analog and Digital Displays in the upper left corner of the display. These indicators are normally green indicating the signal has not exceeded a user specified limit. When a limit is exceeded the indicator will change to red, see Figure 34.

Figure 34   Exceeded Limit Indications
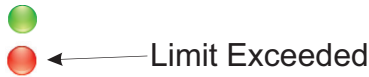
The Limit indicators on the Digital Displays bar graph (Figure 33, bottom) are static indicators only, they are simply mark the portion of the displayed range that is above or below the user specified limits.

See "Setting Limit Indicators" on page 75 for a procedure to set limits using the Measurement Menu.

Data Buffering

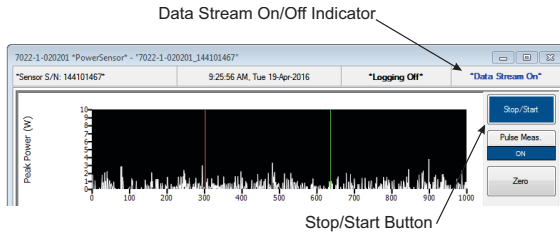When a sensor is connected to VPM3, and a measurement is started "Data Stream On" is displayed at the top of the sensor session window.

Figure 35   Data Stream On Indicator

When the data stream is on, all the data collected is buffered up to the limits set in the preferences dialog box. The Default settings for data buffering are:

- 1000000 Points (Chart History)
- 1000 Frames (Playback History)

Data is buffered to the limit set in preferences, once the limit is reached data continues to be buffered but the oldest data is dropped from the buffer. The purpose of data buffering is to provide the ability to playback data without opening a log file. See "Playback" on page 59 for details about the playback function.

Buffered data is only available while the sensor is connected and a session is active.

> **Note:** *Buffered data may be cleared at anytime during a session by clicking on the View menu, selecting Playback and Clear Buffer. Buffered data is also cleared when Restart Session on the Log Menu is used.*

Frames

Frames are similar to a snapshot of the data stream (see "Snapshots" on page 57). A frame is a set of measurement data viewed on one of the VPM3 displays. Each frame is a collection of the data received from the sensor.

Points

Points are equivalent to frames but are only relevant to the chart. Because of this data buffering can also be used to effect how measurements are displayed on the chart. The settings used in preferences can be used in a fashion similar to the Time/Division adjustment on an Oscilloscope.

For example the two displays shown in Figure 36 are of the same signal input at the sensor. The difference is the settings for Chart points and Playback settings. The settings for these values are can have a significant impact on the chart displays resolution.

Figure 36   Chart Points vs. Frames

Preferences Settings
Chart Points = 100 Playback Frames = 100

Preferences Settings
Chart Points = 250 Playback Frames = 100
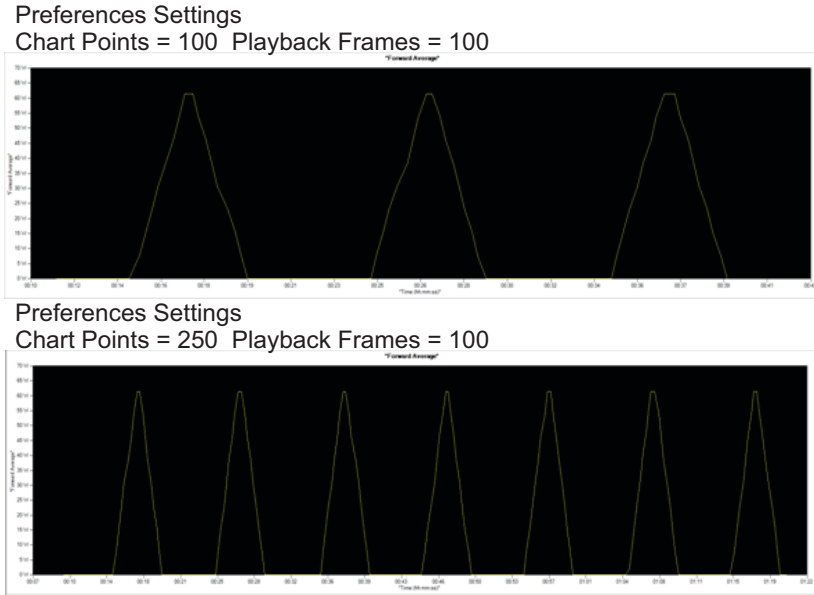
Snapshots

> **Note:** *Save Measurement Snapshot and Save Measurement Snapshot As capture the most recent measurement readings. It will not store the chart information. To store chart display, enable logging. See "Logging" on page 58.*

Save Measurement Snapshot

Save Measurement Snapshot is an option on the File Menu. This option is also available on the control panel File button, as Save option. Clicking the Save option or save measurement Snapshot option creates a snapshot of the data readings displayed on the screen (one frame). The data is saved as an XML file. The snapshot is saved in the measurement file folder (the default directory is \Documents\VPM3\Measurements).

Each snapshot is saved as a separate file that is named using the following format:

MMMM_NNNNNNNN_YYYYMMDD_HHMMSS.xml

| | | | | | |
Model ┊ ┊ Year ┊ Day ┊ Hour ┊ Seconds
 Serial Number Month Minute

Save Measurement Snapshot As

Save Measurement Snapshot As saves the same information as the Save Measurement Snapshot option, the difference is this option opens a dialog box so a unique name can be given to the snapshot.

Logging

Measurement logging is a powerful tool for monitoring and tracking system performance. Storing the readings enables the ability to graph the output over time, know the exact time of a failure, or compare systems.

The VPM3 can be set up to take many readings over a short test period, to take a few readings a day for long-term monitoring, to log only while the transmitter is on, or to log when power spikes or drops below a critical value, depending on specific needs.

Logs can be saved in the following formats:

- XML - XML is the only format that can be played back by VPM3. XML files can also be opened in spreadsheet software.
- CSV - Measurements are saved in a text file, these file cannot be opened by VPM3, they must be viewed in a spreadsheet or text reader.
- PDF - Measurements are saved in a timestamped-columnar format which can be read in a PDF reader.

Log files are stored in the default log file directory under Documents/VPM3/Measurements. See "Creating Log Files" on page 79 for instructions in saving logs.

VPM3 playback function may be used to display log files that have been saved in XML format.

Playback

The playback function within VPM3 allows the playback of either buffered data or log files.

Playback is controlled using the playback controls at the bottom of the Sensor's session screen. The function of each button is shown in Figure 37 on page 59.

Figure 37   Playback Controls
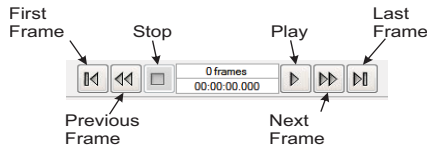
Buffered data can be viewed at any time by stopping data acquisition and using the playback controls. To playback click the First Frame or Previous Frame button to "rewind" the frames, then click play.

To playback a log file, the log file must be opened, then the playback controls may be used to navigate through the data. When playing back a log file the data may be viewed on any display normally available for the sensor that captured the data. For sensors that have different modes available, the mode cannot be changed, the playback mode is determined by the recorded data.

Connecting VPM3 to a Sensor

> **Note:** *Refer to the individual power sensor manual for specific information regarding sensor RF connections.*

1. Launch VPM3.

   > **Note:** *The power sensor may be connected prior to launching VPM3.*

2. Connect a power sensor to the computer's USB port with a USB cable.

   > **Note:** *Bird USB sensors are HID compliant devices and do not require any driver installation. The exceptions are the 7022 STAT power sensor and the 7023 pulse sensor which require an installed driver.*

   > **Note:** *The 5014 and 5015 sensors LED will illuminate continually when properly recognized by the host PC.*

   > **Note:** *The 5012B, 5016B, 5017B, 5018B, and 5019B sensors LED will blink when properly recognized by the host PC.*

   > **Note:** *The 402X series sensors require the use of the 4421A540-2 Sensor Interface Module.*

3. If Sensor does not connect automatically perform one of the following based on selected Preferences:

   - Select the sensor from the list of available sensors in the Select Sensor Dialog and click **Connect**.

   - Click **File > New Sensor Session...**. Select the sensor from the list of available sensors in the Select Sensor Dialog and click **Connect**.

     > **Note:** *For details about changing sensor connection behavior see "Preferences" on page 19.*

     > **Note:** *Multiple sensors can be connected and/or monitored simultaneously through multiple USB ports or via a powered USB hub. It can take up to 30 seconds to detect a sensor.*

Figure 38   Sensor Connection Manager
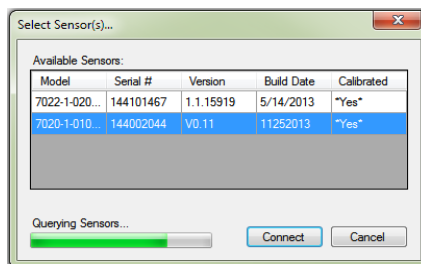
402X DPS Setup

Connecting the 402X Series DPS

1. Connect the Bird 402X Series DPS to the 4421A540-2 Sensor Interface Module using the sensor cable provided.
2. Connect the 4421A540-2 Sensor Interface Module to the a USB port on the PC using a USB cable.

Figure 39   402X Power Sensor Cable Connections

402X DPS Measurements

After VPM3 connection is established here are a few things to check:

- Click Configure button, If couplers or attenuators were used when making RF connections:
  - ✓ Enter the offset value, see "Input Offset" on page 22.

- Click Measurement button:
  - ✓ Select desired measurement type, see "Type:" on page 37.
  - ✓ Start Measurement (if not automatically started), see "Stop/Start" on page 36.

- Click Units button:
  - ✓ Select Power Units to display, see "Power:" on page 39.
  - ✓ Select Match Units to display, see "Match:" on page 40.

- Click File button:

    If you wish to save snapshots or log any measurements use this menu

    ✓ Establish Logging Settings, see "Logging Settings" on page 42.

    ✓ Enable Logging, see "Enable Logging" on page 42.

5014 DPS Setup

Connecting the 5014 DPS

1. Connect the Bird DPS to the a USB port on the PC using the sensor cable
    provided.

Figure 40   5014 Power Sensor Cable Connections
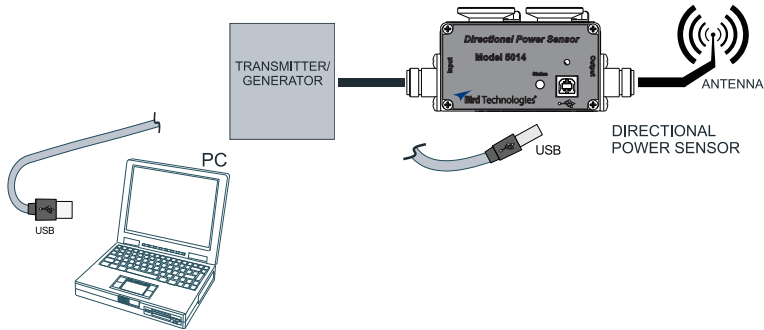
5014 DPS Measurements

After VPM3 connection is established here are a few things to check:

- Click Configure button:

    ✓ Enter the offset value (if couplers or attenuators were used when
    making RF connections), see "Input Offset" on page 33.

    ✓ Select Element type, see "Elements" on page 34.

    ✓ Enter Forward Scale (Forward Element), see "Forward Scale" on
    page 34.

    ✓ Enter reflected scale OR Click F/R Scale 10:1 ratio, see "Reflected
    Scale" and "F/R Scale 10:1 Ratio" on page 34

- Click Measurement button:

  ✓ Select desired measurement type, see "Type:" on page 37.

  ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 36.

- Click Units button:

  ✓ Select Power Units to display, see "Power:" on page 39.

 ✓ Select Match Units to display, see "Match:" on page 40.

- Click File button:

  If you wish to save snapshots or log any measurements use this menu
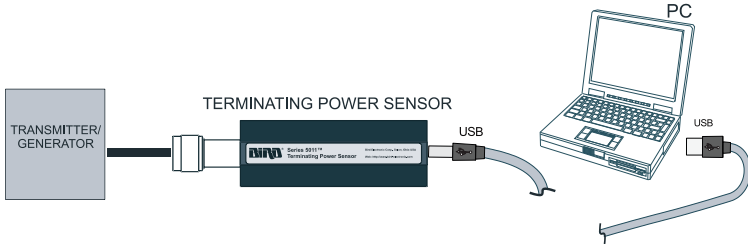
  ✓ Establish Logging Settings, see "Logging Settings" on page 42.

  ✓ Enable Logging, see "Enable Logging" on page 42.

5015, 5015-EF TPS Setup

Connecting the 5015, 5015-EF TPS

1. Connect the Bird TPS to the a USB port on the PC using the sensor cable provided.

Figure 41   *5015 Power Sensor Cable Connections*

5015, 5015-EF TPS Measurements

After VPM3 connection is established here are a few things to check:

*   Click Configure button, If couplers or attenuators were used when making RF connections:

    Note: *For TPS-EF sensors, correction factors are required when measuring RF above 4 GHz. See "5015-EF Correction Factors" on page 65.*

    ✓ Enter the offset value, see "Input Offset" on page 22.

*   Click Amplitude button:

    Before accurate measurements can be taken, "zero" the sensor.

    ┌───┐
    │   CAUTION   │
    │   Ensure RF Power is OFF before zeroing a sensor.   │
    └───┘

    ✓ Click Zero, see "Zeroing a Sensor" on page 82

*   Click Measurement button:

    ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 36.

*   Click Units button:

    ✓ Select Power Units to display, see "Power:" on page 39.

- Click File button:

  If you wish to save snapshots or log any measurements use this menu

  ✓ Establish Logging Settings, see "Logging Settings" on page 42.

  ✓ Enable Logging, see "Enable Logging" on page 42.

5015-EF Correction Factors

The Bird 5015-EF uses frequency-dependent correction factors to improve its accuracy. To use the correction factors:

1. Look at the Correction Factor table on the side of the TPS and find the correction factor corresponding to the frequency under test.
2. Add the correction factor to all other necessary offsets (for example, the coupling factor of a directional coupler).
3. Input the Offset on the VPM3. See "Input Offset" on page 33.

> **Note:** *Correction factors are only required above 4 GHz. Below 4 GHz, the TPS-EF can be used as a normal TPS.*

5012, 5016, 5017, 5018, 5019 WPS Setup

Connecting the 5012, 5016, 5017, 5018, 5019 WPS

Note: *WPS Firmware V1.45 or later is required to operate with VPM3. For the latest firmware upgrade, contact Bird Customer Service at (866) 695-4569 or visit the Bird website at http://www.birdrf.com.*

Figure 42   5012, 16, 17, 18, 19 Power Sensor Cable Connections
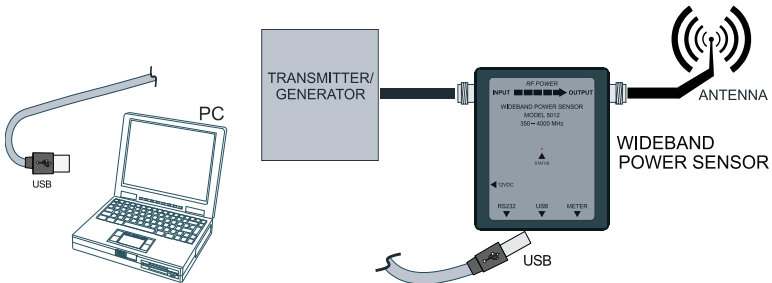
1. Connect the Bird WPS to the a USB port on the PC using the sensor cable provided.

5012, 5016, 5017, 5018, 5019 WPS Measurements

After VPM3 connection is established here are a few things to check:

-   Click Configure button, If couplers or attenuators were used when making RF connections:

    ✓   Enter the offset value, see "Input Offset" on page 22.

    Note: *Entries required on this menu will vary depending on the measurement type selected. see "Configure Button" on page 33 for details of the option available.*

-   Click Amplitude button:

    Before accurate measurements can be taken, "zero" the sensor.

    +---+
    | CAUTION |
    | Ensure RF Power is OFF before zeroing a sensor. |
    +---+

    ✓   Click Zero, see "Zeroing a Sensor" on page 82 for additional information.

- Click Measurement button:
    - ✓ Select desired measurement type, see "Type:" on page 37.
    - ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 36.
- Click Units button:
    - ✓ Select Power Units to display, see "Power:" on page 39.
    - ✓ Select Match Units to display, see "Match:" on page 40.
- Click File button:

    If you wish to save snapshots or log any measurements use this menu
    - ✓ Establish Logging Settings, see "Logging Settings" on page 42.
    - ✓ Enable Logging, see "Enable Logging" on page 42.

7020 WPS Setup

Connecting the 7020 WPS

Figure 43   7020 Power Sensor Cable Connections
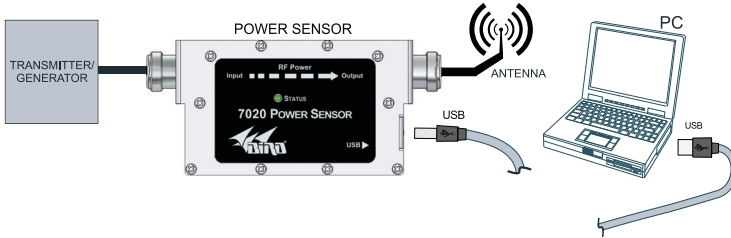
1. Connect the Bird 7020 WPS to the a USB port on the PC using the sensor cable provided.

7020 WPS Measurements

After VPM3 connection is established here are a few things to check:

- Click Configure button, If couplers or attenuators were used when making RF connections:

    ✓ Enter the offset value, see "Input Offset" on page 22.

- Click Amplitude button:

    Before accurate measurements can be taken, "zero" the sensor.

    > CAUTION
    > Ensure RF Power is OFF before zeroing a sensor.

    ✓ Click Zero, see "Zeroing a Sensor" on page 82 for additional information.

- Click Measurement button:

    ✓ Select desired measurement type, see "Type:" on page 37.

    ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 36.

- Click Units button:

    ✓ Select Power Units to display, see "Power:" on page 39.

    ✓ Select Match Units to display, see "Match:" on page 40.
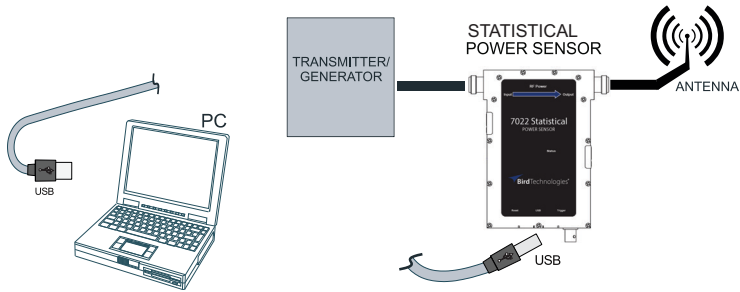
- Click File button:

  If you wish to save snapshots or log any measurements use this menu

  - ✓ Establish Logging Settings, see "Logging Settings" on page 42.

  - ✓ Enable Logging, see "Enable Logging" on page 42.

7022 Statistical Power Sensor Setup

Connecting the 7022 Statistical Power Sensor

Figure 44   7022 Power Sensor Cable Connections

1. Connect the Bird SPS to the a USB port on the PC using the sensor cable provided.
2. Verify the power sensor's device driver is installed correctly (\\Control Panel\Hardware and Sound\Devices and Printers).

7022 Statistical Power Sensor Measurements

> **Note:** *Firmware upgrades extending the SPS's capabilities may be periodically released. For the latest firmware upgrade, contact Bird Customer Service at (866) 695-4569 or visit the Bird website at http:// www.birdrf.com.*

After VPM3 connection is established here are a few things to check:

- Click on the Mode Menu:

  - ✓ Select the mode of operation, see "Mode Menu" on page 21

- Click Configure button, If couplers or attenuators were used when making RF connections:

     Note: *Entries required on this menu will vary depending on the measurement type selected. see "Configure Button" on page 33 for details of the option available.*

     ✓ Enter the offset value (Time Domain, Average Power Mode), see "Input Offset" on page 22.

- Click Measurement button:

 Before accurate measurements can be taken in Time Domain or Average Power Mode, "zero" the sensor.

  > CAUTION
  > Ensure RF Power is OFF before zeroing a sensor.

     ✓ Click Zero, see "Zeroing a Sensor" on page 82 for additional information.

     ✓ Select desired measurement type, see "Type:" on page 37.

     ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 36.

- Click Trigger button:

     ✓ Triggers are available in Time Domain Mode, see "Trigger Button" on page 38 for the options.

- Click Scale button:

     ✓ Scale may need to be adjusted in Statistical or Time Domain mode, see "Scale Button" on page 41.

- Click Units button:

     ✓ Select Power Units to display, see "Power:" on page 39.

     ✓ Select Match Units to display, see "Match:" on page 40.

- Click File button:

  If you wish to save snapshots or log any measurements use this menu

     ✓ Establish Logging Settings, see "Logging Settings" on page 42.

     ✓ Enable Logging, see "Enable Logging" on page 42.

7023 Pulse Power Sensor Setup

Connecting the 7023 Pulse Power Sensor

Figure 45   7023 Power Sensor Cable Connections
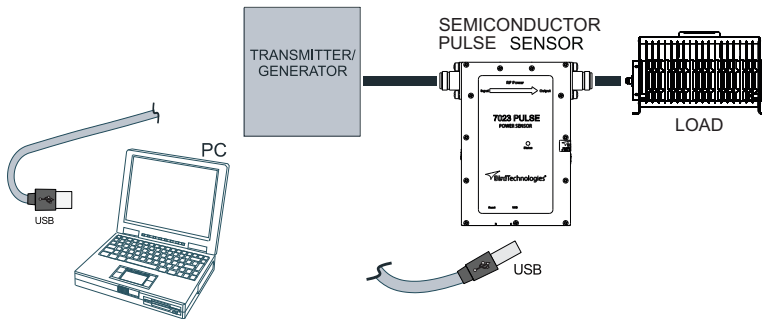
1. Connect the Bird Pulse Sensor to the a USB port on the PC using the sensor cable provided.
2. Verify the power sensor's device driver is installed correctly (\\Control Panel\Hardware and Sound\Devices and Printers).

7023 Pulse Power Sensor Measurements

> **Note:** *Firmware upgrades extending the Semiconductor Pulse Sensor's capabilities may be periodically released. For the latest firmware upgrade, contact Bird Customer Service at (866) 695-4569 or visit the Bird website at http://www.birdrf.com.*

After VPM3 connection is established here are a few things to check:

*   Click Configure button, If couplers or attenuators were used when making RF connections:

    > **Note:** *Entries required on this menu will vary depending on the measurement type selected. see "Configure Button" on page 33 for details of the option available.*

    ✓ Enter the offset value, see "Input Offset" on page 22.

*   Click Measurement button:

    ✓ Select desired measurement type, see "Type:" on page 37.

    ✓ Start Measurement (if not automatically started), see "Stop/Start" on page 36.

- Click Units button:
    - ✓ Select Power Units to display, see "Power:" on page 39.
    - ✓ Select Match Units to display, see "Match:" on page 40.
- Click File button:

    If you wish to save snapshots or log any measurements use this menu
    - ✓ Establish Logging Settings, see "Logging Settings" on page 42.
    - ✓ Enable Logging, see "Enable Logging" on page 42.

Open Session File

A session file contains configuration settings for a single type of sensor, or a specific serialized sensor. Session files, when opened, will modify the settings of the Bird Power Sensor currently connected to VPM3, these files may be used for a "preset" configuration. A detailed explanation of session files can be found in "Theory of Operation" on page 53.

> **Note:** *Opening a session file will modify current sensor settings (if different) to the settings saved in the session file being opened.*

> **Note:** *A sensor must be connected to open a session file.*

1. Click **File**, and hover the cursor over **Open**, then select **Session...**
2. Double click on the folder for the type of sensor (sensor family).
3. Select the session file that will be used to configure the currently connected sensor.
4. Click Open.

Save a Default Session File

A default session file can be used to save configuration settings for a single type of sensor. Session files, when opened, will modify the settings of the Bird Power Sensor currently connected to VPM3, these session files may be used as a "preset" configuration for other sensors of the same type. A detailed explanation of session files can be found in "Theory of Operation" on page 53.

1. Configure the currently connected sensor with the settings desired for use as the preferred initial settings.
2. Click **File**, and select **Save Session As...**
3. Click **Save** in the Save Session As dialog box, to save the session with the file name **defaultsession.xml**.

    defaultsession.xml is the default name assigned for the session file, this is the file name VPM3 will automatically search for and use when a new sensor is connected (unless a serial number specific session file is available). If the default name of the file is changed, the default session must be manually opened to effect new sensor connections, see "Open Session File" on page 73.

Open Measurement File

Measurement files consist of two basic types, snapshot and log. see "Snapshots" on page 57, and "Logging" on page 58. To open a measurement file in VPM3 it must be in XML format. Opening a measurement file will open a session window in playback mode.

Note: *Measurement files may be opened without a sensor connected to VPM3.*

1. Click **File**, and hover the cursor over **Open**, then select **Measurement...**
   A Log Browser will open with a table displaying all the saved measurements in the VPM3 measurements folder.

2. Click Refresh, to update the list of measurements.

3. Select the desired measurement from the list.
   If the measurement is not located in the VPM3 measurements folder click the browse button and navigate to the file.

4. Click Open.
   See "Viewing Data Using VPM3 Playback" on page 77 for details on using playback.

Convert Legacy Preset File to Default Session File

Legacy Presets are default preset (default Session) files used in previous versions of VPM3 (revision 3.2.22215 and earlier). This procedure provides the steps to convert presets to default session files for use in current versions of VPM3.

Note: *A sensor must be connected to open a session file.*

Note: *Opening a preset file will modify current sensor settings (if different) to the settings saved in the preset file being opened.*

1. Save the legacy preset file in the VPM3 Presets folder, if not already there (the default directory is \Documents\VPM3\Presets).

2. Click **File**, and hover the cursor over **Open**, then select **Session...**

3. Navigate to the Presets directory \Documents\VPM3\Presets.

4. Select the legacy preset.

5. Click **Open**.
   The preset file will open and update the current sensor session to settings specified in the preset.

6. Click **File**, and select **Save Session As...**

7. Click **Save** in the Save Session As dialog box, to save the session with the file name **defaultsession.xml**.

   Note: *The default session file will be saved in the appropriate folder for the current sensor family.*

Setting Limit Indicators

> **Note:** *Limits menu is NOT available for the 7022 or 7023 sensors.*

Limits can be used to aid in visual identification of measurements falling outside a desired range. Limit indicators are available on the Analog and Digital displays see "Limit Indicators" on page 55 for more information on the limit indicators.

Add a Limit

To add a measurement limit perform the following steps:
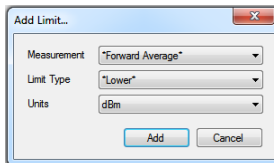
1. Click the **Measurement** menu and select **Limits...** to display the Limits dialog box.

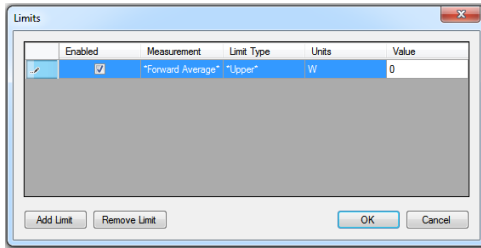*Figure 46   Limits Dialog Box*
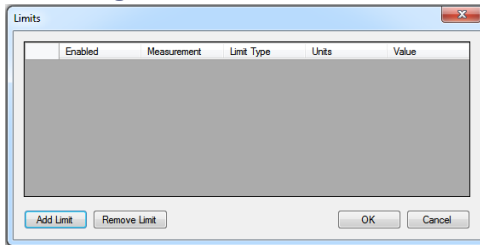
2. Click **Add Limit** to display the Add Limit... dialog box.

Figure 47   Add Limit Dialog Box

3. Select the Measurement for which the limit will apply.
4. Select the Limit Type.
5. Select the units to apply to the limit value.
6. Click **Add**.

Figure 48   Setting Limit Value

7. Click on the **Value** entry for the limit.

8. Type a value for the selected limit.

> **Note:** *The edit symbol in the first column indicates a change has been made but has not been "finalized" by pressing Enter or clicking OK.*

9. Click **OK**.

Edit a Limit

> **Note:** *Only the value of an existing limit may be changed.*

To change a measurement limit perform the following steps:

1. Click the **Measurement** menu and select **Limits...** to display the Limits dialog box.

2. Click on the **Value** entry for the limit to be changed.

3. Type a new value for the selected limit.

> **Note:** *The edit symbol in the first column indicates a change has been made but has not been "finalized" by pressing Enter or clicking OK.*

4. Click **OK**.

Remove a Limit

1. Click the **Measurement** menu and select **Limits...** to display the Limits dialog box.

2. Click on the limit to be removed to highlight the entry.

3. Click **Remove Limit**.

4. Click **OK**.

Viewing Data Using VPM3 Playback

VPM3 buffers active data and provides the ability to save and log measurement data. The playback function can be used to review both buffered data and/or logged data.

Viewing Buffered Data

Buffered data is not persistent. If a session is ended, the buffered data is erased.

> **Note:** *Buffered data may be cleared at anytime during a session by clicking on the View menu, selecting Playback and Clear Buffer. Buffered data is also cleared when Restart Session on the Log Menu is used.*

To review buffered data:

1. Click the **Measurement** menu and select **Stop Acquisition**.
2. Click the **First Frame** or **Previous Frame** button on the playback controls.
3. Click Play.

    Playback will start from the frame shown on the controls through the last frame buffered (default 1000 frames).

Figure 49   Playback Controls
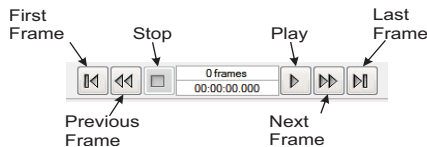
4. Click **Stop** at anytime to view a single frame of data.

During Playback these options are available:

- Save a snapshot of any frame, click the **File** menu, then **Save Measurement Snapshot**.

- Change Display Type, click the **View** menu, then hover over **Display Style** and select another display.

- Stop playback, click the **Measurement** menu and select **Start Acquisition**.

- End the session, click the **File** menu, then **Close Session.**

Viewing Logged Data

Logged data is persistent. Measurement Logs are saved in the VPM3 measure-ments folder (default \Documents\VPM3\Measurements). Log files may be played back anytime, there is no need to connect a sensor to view logged data.

> **Note:** *Only log files saved as .xml can be opened and viewed in the VPM3.*

> **Note:** *Logging must be enabled for log files to be saved, See "Creat-ing Log Files" on page 79.*

To display a log file for playback:

1. Open a Log file. See "Open Measurement File" on page 73.

    Select a measurement with "Log" in the Type column of the file list.

2. Click Play.

    Log files may be minutes or hours long. If searching for specific events it may be useful to view the logged data in the chart display.

3. Click the **First Frame**, **Previous Frame, Next Frame** buttons on the playback controls at anytime to change view.

4. Click **Stop** at anytime to view a single frame of data.

During Playback these options are available:

-   Set a delay between frames (Slow Mo), click the **View** menu, then hover over **Playback** and select a delay of 1, 2, 4, or 8 seconds between frames.

-   Save a snapshot of any frame, click the **File** menu, then **Save Measure-ment Snapshot**.

-   Change Display Type, click the **View** menu, then hover over **Display Style** and select another display.

-   End the session, click the **File** menu, then **Close Session.**

Creating Log Files

To begin logging:

1. Configure the logging options, click the **Log** menu, then select **Settings...**
2. Select the desired options:
   - Log File Format: XML, CSV, PDF.
   - Log Continuously or only under certain conditions.
   - Select duration of the Log.
3. Click **OK**.

Figure 50   Logging Settings
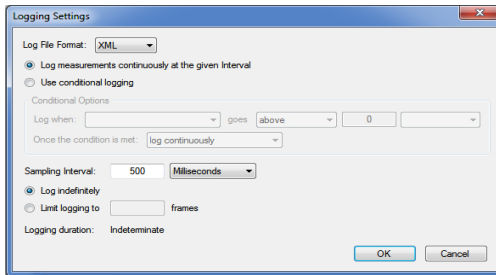
4. Begin logging by selecting **Enable Logging**.

> **Note:** *When logging is active, in the upper right of the sensor session will display "Logging On."*

5. Stop logging by selecting **Enable Logging**.
   Logging can be started and stopped as often as desired.

After logging is complete, XML data can be reviewed in VPM3, see "Viewing Logged Data" on page 78.

Logs may also be viewed as text or in spreadsheets. see "Viewing Measurement Logs Outside VPM3 " on page 80.

> **Note:** *Log files are stored in the default log file directory under :Documents/VPM3/Measurements.*

Viewing Measurement Logs Outside VPM3

The simplest way to view logged data is to recall in VPM3. See "Viewing Logged Data" on page 78.

> **Note:** *Only log files saved as .xml can be opened and viewed in the VPM3. Files saved in comma-separated format (CSV) can be read by most common spreadsheet programs.*

Logged data may be saved in one of three formats. PDF logs may be viewed in a PDF reader or in most web browsers. XML and CSV logs may be viewed most effectively in a spreadsheet application.

Each log file is stored in a separate file that is named using the same date-time file naming format used for snapshots.

Opening .xml Files in Excel

1. Open the file in Microsoft Excel.

   > **Note:** *The file will appear in Microsoft Excel with each field in its own column.*

2. Filter the data, since the Extensive Markup Language format is a hierarchical format.

   a. In the Measurement column, select the drop-down and check only the Forward Average label.

   b. In the Limit Type column, select the drop-down and check only the Lower label.

   > **Note:** *This will now show data in a time vs. power format. Additional filtering and sorting can be applied using the options in the column headers.*

Opening .csv Files in Microsoft Excel

1. Open the file in Microsoft Excel.

   > **Note:** *The file will appear in Microsoft Excel with each field in its own column. If all the data is in a single column, follow these steps to convert it:*

   a. Click on the column name, to select the entire column.

   b. Select **Text To Columns,** under the **Data** tab.

   > **Note:** *A conversion wizard should open.*

   c. Select **Delimited**, under Original Data Type.

   d. Click **Next**.

   e. Check **Comma,** under Delimiters.

   > **Note:** *All other delimiters should be unchecked.* ***Treat Consecutive Delimiters as One*** *should be unchecked.*

   f.   Click **Next**.

   g.   Click **Finish**.

2.   Create a graph of the forward and reflected average power as a function of time:

   a.   Select row **1** by clicking on the row name.

   b.   Select **Delete**, under the **Edit** tab.

   Note: *The first line of header information will be deleted.*

   c.   Click on cell **B1**.

   d.   While holding down the **Ctrl** key, select columns **B** (Time), **H** (Avg Fwd W), and **J** (Avg Rfl W).

   e.   Select **Chart,** under the **Insert** tab.

   Note: *The chart wizard should open.*

   f.   Select **XY (Scatter)**.

   g.   Select the **Line** subtype.

   h.   Click **Next**.

   i.   Click **Next** in the data range, which should already be set.

   j.   Enter a title and names for the X and Y axes.

   k.   Click **Finish**.

   Note: *Other data can be graphed by selecting the appropriate columns in step d.*
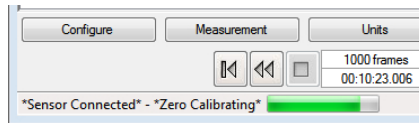
Zeroing a Sensor

5012, 5016, 5015, 5017, 5018, 5019, 7020, 7022

Over time, the sensor's "zero value" (reading with no applied RF power) can drift, making readings inaccurate.

For example, if the zero value is –0.02 W, measuring a 50 W signal will give a reading of 49.98 W, a 0.04% error. Measuring a 1 W signal will give a reading of 0.98 W, a 2% error.

Figure 51   Zeroing Sensor

To zero the sensor:

1. Ensure the sensor has reached a stable operating temperature.
2. Ensure no RF power is applied to the sensor.
3. Do one of the following:

    *   Click the Measurement menu, then select Zero (may be on the Amplitude submenu for some sensors).
    *   Click the Measurement button, Click Zero in the options control panel.

        Note: *Calibration will take about 40 seconds. Do not interrupt the calibration. A progress bar for the calibration will be displayed on the screen.*

4. Click **Stop/Start** to resume data collection.

Minimum PC Requirements

Operating System	Microsoft Windows Vista with service pack 1 Microsoft Windows 7 Microsoft Internet Explorer Adobe Acrobat reader		
Processor	512 MB RAM & Pentium 4/M or equivalent		
Display	800x600, 256 color display (1280x720, 16 bit or higher resolution recommended)		
Memory* Windows Vista Windows 7	.Net prerequsites 40.8 MB 0 MB	VPM3 30 MB 30 MB	TOTAL 70.8 MB 30 MB
Connections	1 available USB port		
Drives	Hard drive, CD-ROM (for installation)		
Accessories	Mouse or other pointing device		

*. These values represent the maximum disk space required to install the VPM3. Memory requirements for .NET prerequisites will vary depending on components that are previously installed.

Software Prerequisites

The VPM3 software requires the installation of the following prerequisites for operation.

- Visual C++ 2010 Redistributable or later (provided with VPM3 installer, requires approximately 11 MB disk space)
- .NET Framework 4.0 (provided with VPM3 installer)
- VISA Driver (NI-VISA 14.0.1 provided with VPM3 installer, requires approximately 65 MB disk space)

If any of these components are NOT installed on the target system, the prerequisite installer will install them prior to installing the VPM3 software. If any of these components are already installed on the target system the installer will skip installing them, and install the VPM3 software.

Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.