Virtual Power Meter

Operation Manual

Model VPM3-MSP

Instruction Book Part Number 920-VPM3-MSP Rev. D

About This Manual

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

VPM3-MSP

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.

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.

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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.

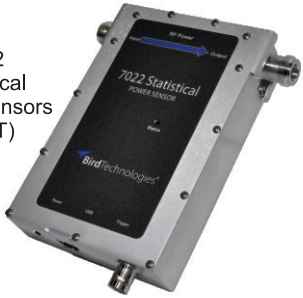
Figure 1 VPM Compatible Sensors

402X Series
Directional
Power Sensors
(DPS)
402X sensors
require the use
of the Bird
Sensor Interface
Module
4421B540-2

7020
Wideband Power Sensors
(WPS)

501X Series
Wideband Power Sensors
(WPS)

7022
Statistical
Power Sensors
(STAT)



5014
Directional Power Sensors
(DPS)

7027, 7029, 7037
Pulse
Power Sensors

5015, 5015-EF
Terminating
Power Sensors
(TPS)

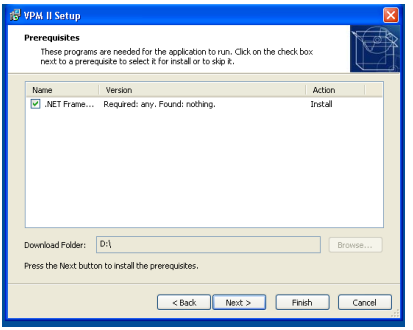
VPM Installation

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.*

Chapter 2 Displays

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
- States 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

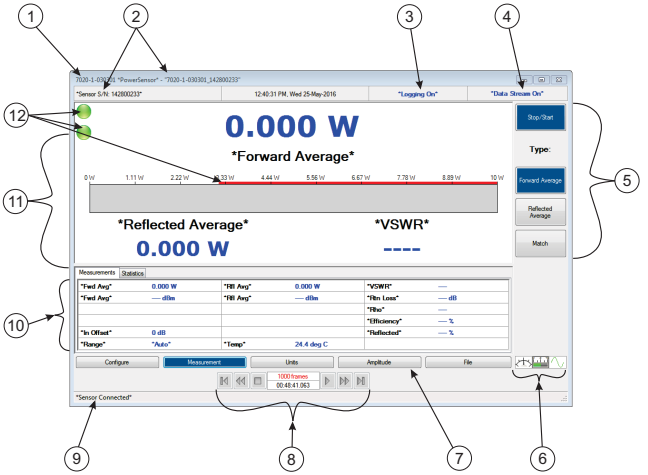


Table 1 - Digital Display Description

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 18.
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 71.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See “Data Buffering” on page 68.
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See “Control Panel Menus and Options” on page 36.

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 36.
8	Playback controls	Playback controls are used to replay buffered data or log files. See “Playback” on page 70.
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 16.
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 67.

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

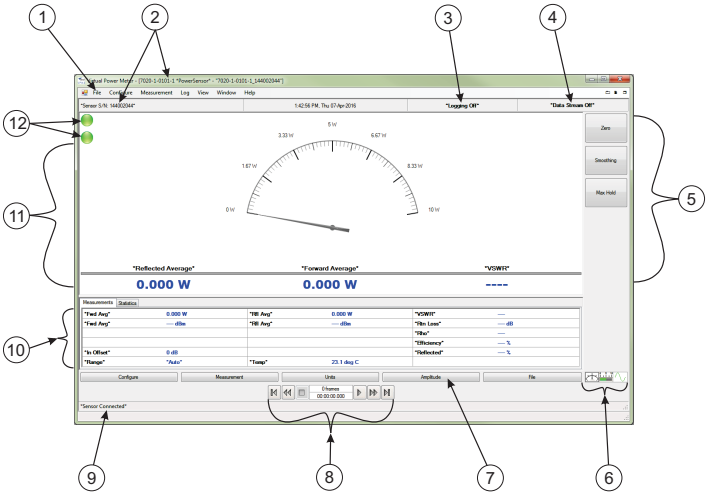


Table 2 - Analog Display Description

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 18.
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 71.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See “Data Buffering” on page 68.
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See “Control Panel Menus and Options” on page 36.

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 36.
8	Playback controls	Playback controls are used to replay buffered data or log files. See “Playback” on page 70.
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 16.
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 67.

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 18.
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 71.
4	Data Stream Status	Displays the current status of the data stream from the sensor. See “Data Buffering” on page 68.
5	Control Panel Menu Options	The options available for the currently selected Menu Tab (7). See “Control Panel Menus and Options” on page 36.

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 36.
8	Playback controls	Playback controls are used to replay buffered data or log files. See “Playback” on page 70.
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 16
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 13.
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 14.
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 13.

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

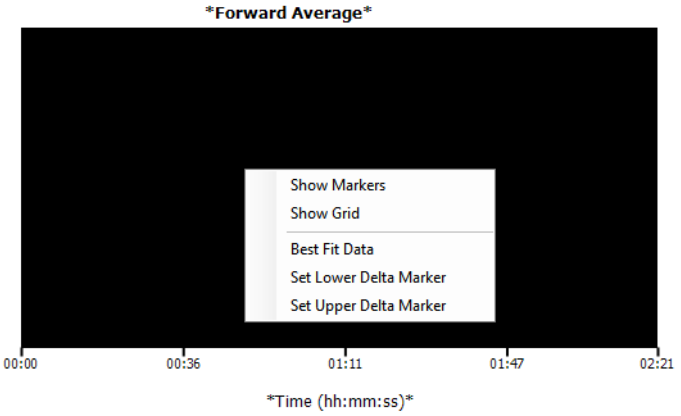


Chart Markers

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

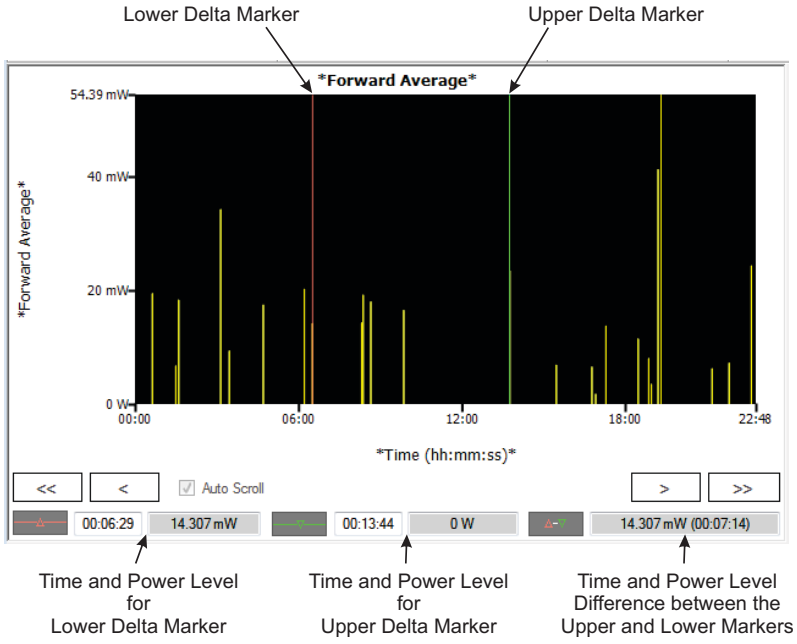


Chart Axis Scaling

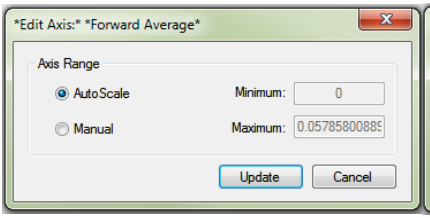
The X and Y axis of the chart default to auto scaling, the y-axis is auto scaled to the signal power level and the x-axis typically begins at zero and time is added to the scale as the data stream is collected.

There are two ways to affect scaling.

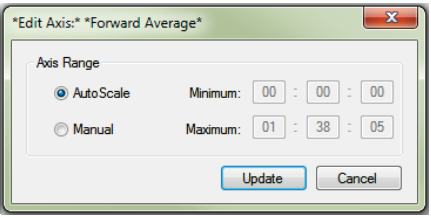
- The View Menu option Meter Range, allows the range to be set to Auto or Full. When Auto is selected the scale is determined by the signal range, when set to Full, the full range of the connected sensor is displayed.
- Right clicking on either the Y axis or the X axis will display the appropriate Edit 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 15.

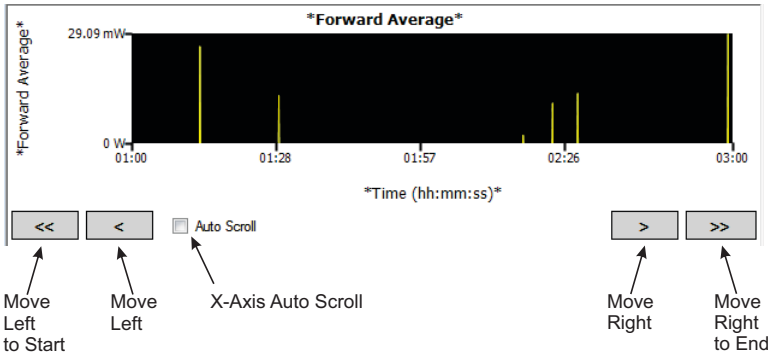
Auto Scroll — When checked, the chart will automatically advance forward in time maintaining the same interval specified in the x-axis manual scale entry.

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



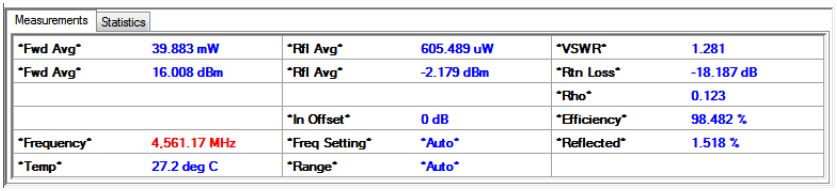
Measurement Details

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



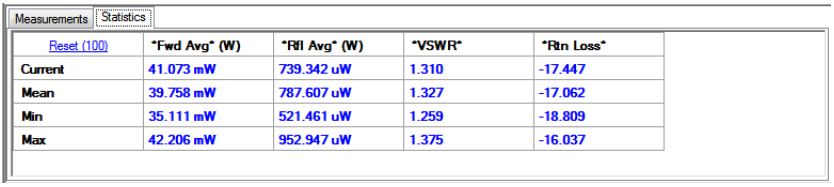
Statistics Tab

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



States Tab

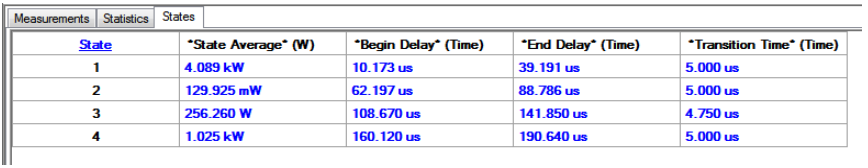
7027, 7029, and 7037 Series Sensors

The States Tab displays:

- Values for the Average pulse power measurement of all the enabled State Configurations.
- Begin and end time for each state.
- Transition time from one state to the following state.
- Duty Cycle for each state

See "State Average" on page 55.

Figure 12 States Tab

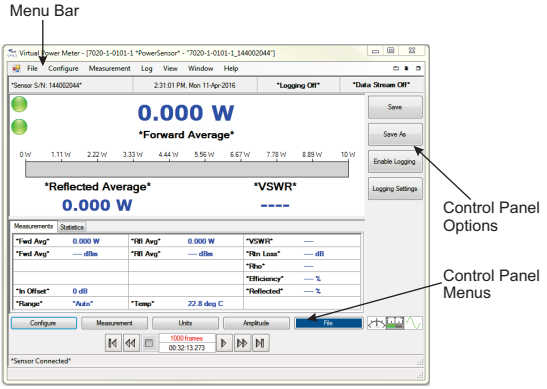


State	*State Average* (W)	*Begin Delay* (Time)	*End Delay* (Time)	*Transition Time* (Time)
1	4.089 kW	10.173 us	39.191 us	5.000 us
2	129.925 mW	62.197 us	88.786 us	5.000 us
3	256.260 W	108.670 us	141.850 us	4.750 us
4	1.025 kW	160.120 us	190.640 us	5.000 us

Chapter 3 Menus

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 13 Menu Locations



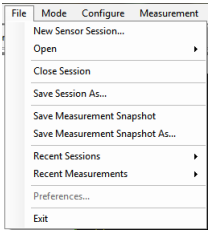
Menu Bar

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 14 File Menu

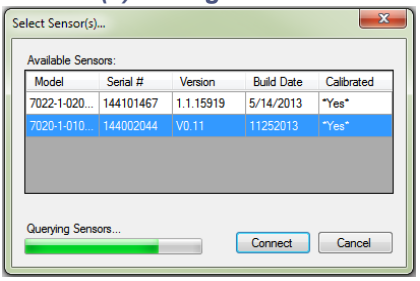


New Sensor Session

Displays the Select Sensor(s) dialog box (Figure 15). 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 21 for information about automatically starting sensor sessions.

Figure 15 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 88.

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 88.

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 62.

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 69 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 69 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.

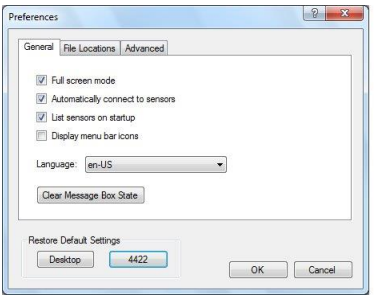
A Clear List option allows the recent measurement list to be deleted. This option does not delete any files. A new list will be started when the next measurement is saved.

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 16 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" on page 34.

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 15) 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.*

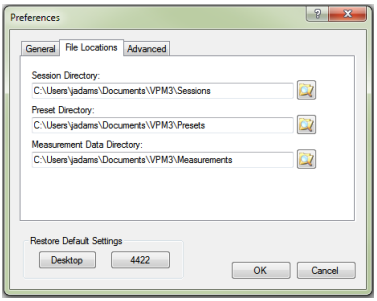
Clear Message Box State — When pressed, all previously disabled information dialog boxes will be enabled.

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 17 Preferences, File Locations



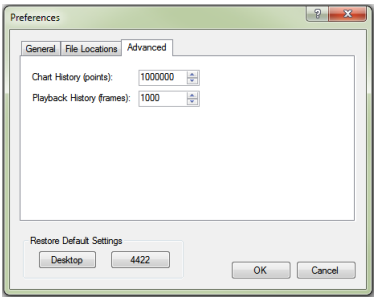
File Locations

Session Directory — Sets the location of the session directory. All Session files will be saved to the selected location. See "Sessions" on page 65 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 89 for information on converting Presets to Session Files.

Measurement Data Directory — Sets the location of the data directory. See "Logging" on page 71 for additional information regarding measurement files.

Figure 18 Preferences, Advanced Tab



Advanced

Chart History (points) — Sets the number of points to be collected in a session. See “Data Buffering” on page 68.

Playback History (frames) — Sets the number of frames created during a session. See “Data Buffering” on page 68.

Exit

Closes the program and all open sessions.

Mode Menu

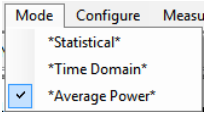
7022, 7023, 7027, 7029, and 7037

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 19 Mode Menu



Statistical

7022

When selected, switches Sensor to Statistical Power Mode. See “Statistical Power Mode” on page 62.

Time Domain

7022, 7027, 7029, and 7037

When selected, switches Sensor to Time Domain Mode. See "Time Domain Mode" on page 60.

Average Power

7022, 7023, 7027, 7029, and 7037

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

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, 7027, 7029, and 7037

- 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.)

Max Period

7027, 7029, and 7037

- Auto (Sensor determines the span (pulse period) for the time domain display, this may include multiple state changes).
- Specify Max Period (Manually enter the span (pulse period) for the time domain display, this may include multiple state changes)

> **Note:** *Use Specify* Max Period *when the sensor is unable to determine the span.*

State Configure Menu

7027, 7029, and 7037

This menu is used to configure the up to four pulse states when the State Average Measurement is selected using a Pulse Sensor.

State Select

Selects the pulse state to be configured. State 1 through 4.

State Enable

Alternate action button, used to enable or disable the selected state.

State Begin

Used to specify a measurement begin time for the selected state.

State End

Used to specify a measurement end time for the selected state.

> **Note:** *The begin and end times are relative to a synchronization reference point plus or minus an optional delay. See* "State Average" on page 55 *for a detailed explanation.*

Analysis Mode

Alternate action button, used set the Analysis Mode in Auto or Manual. See "Analysis Mode" on page 56.

Analysis Settings

Used to set the values for pulse state detection when Analysis Mode is set to Auto. See "Analysis Mode" on page 56.

- Specify state begin margin...(Specify the beginning margin for placement of the begin delay for each pulse, default is 10%).
- Specify state end margin...(Specify the ending margin for placement of the end delay for each pulse, default is 2%).

- Specify state upper reference...(Upper reference value is one of the reference points used to calculate transition time between states).
- Specify state lower reference...(Lower reference value is one of the reference points used to calculate transition time between states).
- Specify state sensitivity... (specifies a smoothing value to apply to pulse measurement data.)

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

7023

- Gated Average

7027, 7029, and 7037

- State Average

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 97.

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 67.

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 22.

For additional information about logging see "Logging" on page 71.

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.

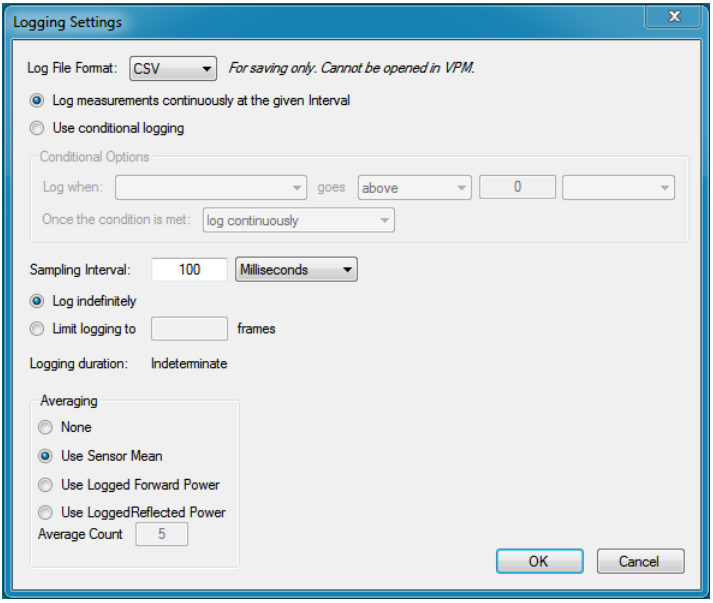
Restart Session

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 71 for detailed information on logging.

Figure 20 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 10.

- 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.)

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 92 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

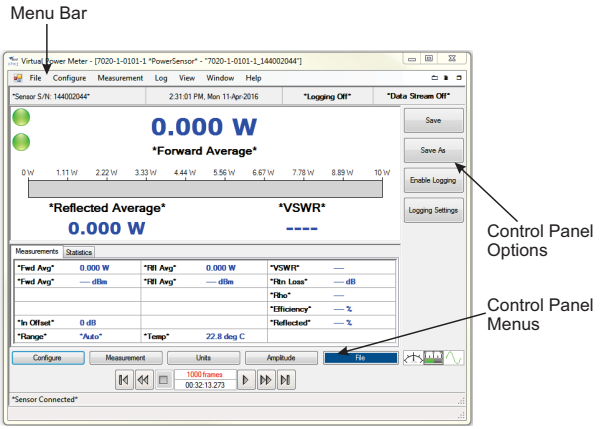
Displays model information of the selected sensor.

Control Panel Menus and Options

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

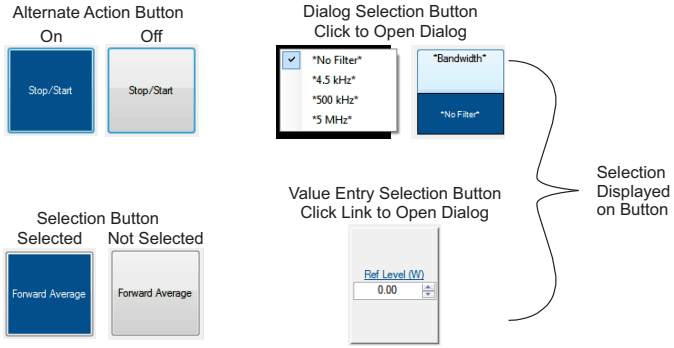
The options displayed on the control panel will vary greatly from one Bird Power Sensor to the next. All of the possible options are listed in this chapter, if menus or options do not apply for your sensor, those options will not be visible when your sensor is connected. Any menu item that is specific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

Figure 21 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 22 for examples.

Figure 22 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 10.

- 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 weighting factor used in the formula below to calculate an exponential moving average of the pulse related measurement values. See "Gated Average" on page 54 for additional details about the average count.

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 54.

- Pulse Begin Gate Time
- Pulse End Gate Time

Max Period

7027, 7029, and 7037

- Auto (Sensor determines the span (pulse period) for the time domain display, this may include multiple state changes).
- Specify Max Period (Manually enter the span (pulse period) for the time domain display, this may include multiple state changes)

> **Note:** *Use Specify* Max Period *when the sensor is unable to determine the span.*
>
> **Note:** *Specifying the Max Period will reduce the time for the initial measurement or when the pulse period changes*

State Configure Button

7027, 7029, and 7037

This menu is used to configure the up to four pulse states when the State Average Measurement is selected using a Pulse Sensor.

State Select

Selects the pulse state to be configured. State 1 through 4, when Analysis Mode is set to manual.

State Enable

Alternate action button, used to enable or disable the selected state, when Analysis Mode is set to manual.

State Begin

Used to specify a measurement begin time for the selected state, when Analysis Mode is set to manual.

State End

Used to specify a measurement end time for the selected state, when Analysis Mode is set to manual.

> **Note:** *The begin and end times are relative to a synchronization reference point plus or minus a optional delay. See* "State Average" on page 55 *for a detailed explanation.*

Analysis Mode

(default = auto)

- Auto (the VPM3 automatically configures begin and end delay times for up to four states in a pulse period (frame) based on Analysis Setting, see "Analysis Settings" on page 28.
- Manual (the operator provides the state configuration).

Analysis Settings

Used to specify reference points for measurement periods and transition times when Analysis Mode is set to Auto. See "Analysis Mode" on page 56 for a detailed explanation.

- Specify state begin margin... (Specifies the percentage of a states width to begin average power measurement.)
- Specify state end margin... (Specifies the percentage of a states width to end average power measurement.)
- Specify state upper reference... (Specifies the upper percentage of a transition between states for transition time measurement.)
- Specify state lower reference... (Specifies the lower percentage of a transition between states for transition time measurement.)
- Specify state sensitivity... (specifies a smoothing value to apply to pulse measurement data.)

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 97.

For other sensors Zero calibration is on the “Amplitude Button” on page 46.

Max Hold

7022, 7023

Holds and displays the highest trace data points.

For other sensors Max Hold is on the “Amplitude Button” on page 46.

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 50.

Reflected Average

- See “Forward and Reflected Power” on page 50.

Match

- See “Match” on page 51.

Forward Peak

5012, 5016, 5017, 5018, 5019

- See “Forward Peak Power” on page 51.

Forward Burst

5012, 5016, 5017, 5018, 5019

- See “Burst Average Power” on page 52.

Crest Factor

5012, 5016, 5017, 5018, 5019

- See “Crest Factor” on page 53.

CCDF

5012, 5016, 5017, 5018, 5019

- See “Complementary Cumulative Distribution Function (CCDF)” on page 53.

Gated Average

7023

- See “Gated Average” on page 54.

State Average

7027, 7029, and 7037

- State Average measures the average power of up to four states (signal Level) within a pulse period. See"State Average" on page 55.

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.

Sync Button

7027, 7029, and 7037

Source

- Internal (Sync event is internally generated when the signal crosses the specified Sync level, generated on the rising edge of the pulse.)
- External (Sync Pulse is generated by an external source, input via the BNC connector on the Pulse Sensor (TTL level pulse, see Pulse Sensor user manual).)

Edge

When the selected source is internal, this selects the direction that the signal crosses the specified Sync level to cause a sync event.

- Rising (The sync event occurs when the signal crosses the sync level on a transition from “Low” to “High”.)
- Falling (The sync event occurs when the signal crosses the sync level on a transition from “High” to “Low”.)

Level…

- Auto (Sets the sync 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 power level when the sync source is internal.)

Delay…

Length of wait after the trigger signal and before beginning a sweep. The range is -0.1 to +0.1 seconds. Default = 0

Specifies a time offset between the Sync Event and the Sync Reference Point.

A positive value offsets the Reference point to occur after the Event.

A negative value offsets the Reference point to occur before the Event.

State timing is specified relative to the Sync Reference Point. See Figure 28 on page 55.

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 97.

> **Note:** *For 7022 sensor Zero calibration is on the* “Measurement Button” on page 42.

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.)

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 42.

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.

Scale Button

7027, 7029, and 7037

Time

Pulse Sensor Time Domain Mode

Specifies the time per division of the x-axis.

Default = 10 ms, if Time is changed to a value larger than the current sweep time, the sweep time will increase to match.

Offset

Pulse Sensor Time Domain Mode

Specifies an offset for the x-axis, negative values will shift the displayed signal to the right, positive values will shift the displayed signal to the left.

Default = 0, changes to this setting may effect Sweep Delay if new setting is less than current Sweep Delay.

Power

Pulse Sensor Time Domain Mode

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

Reference Level

Pulse Sensor Time Domain Mode

Specifies the base line reference level for power on the y-axis.

Sweep Time

Pulse Sensor Time Domain Mode

Specifies the full range of the x-axis in either number of frames or time. Changes to this value can change the value of the time setting (time per division).

Sweep time default setting is “Number of Frames” in this mode the sweep time is determined by the Pulse Sensor sensor. Optionally the user may manually set the sweep time.

- Number of Frames (the Pulse Sensor sensor counts frames (pulse period) based on the sync to determine sweep time, default number = 1 frame)
- Sweep Time (fixed time period specified by the operator, default = 200 us)

Sweep Delay

Pulse Sensor Time Domain Mode

Specifies a delay of the displayed sweep information. This delay may be a positive or negative entry. A positive entry will shift the visible portion of the displayed signal to the left. A negative entry will shift the visible portion of the displayed signal to the right.

File Button

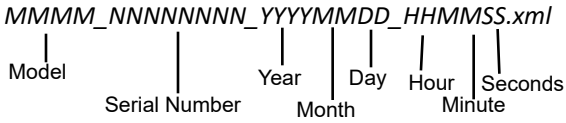
Note: *Save and Save As captures the most recent measurement readings. It will not store the time-chart information. To store time chart display, ensure logging is enabled. See* "Logging" on page 71.

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:



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.

Capture

Pulse Sensor Time Domain Mode

Captures the data used to display the measurement information currently displayed on the Time Domain Graph Display without displaying the measurement file save dialog.

Captures are saved in CSV format. Each Capture is stored in a separate file that is named using the date-time file naming format shown on the previous page.

Capture As

Pulse Sensor Time Domain Mode

Same as Capture, only the Capture As dialog box is displayed. Allows the use of a unique filename when saving a Time Domain Display Capture 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 71.

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 71 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

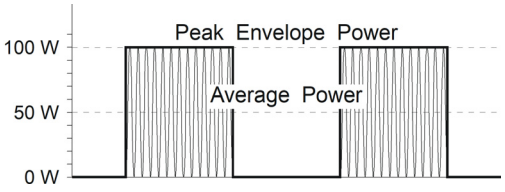
In average power mode sensor data may be displayed using any of the display types available in VPM3. See "Displays" on page 5. Depending on the capabilities of the connected sensor some or all of the following measurements may be displayed in Average Power Mode.

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 23 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 — $VSWR = \frac{1+p}{1-p}$

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.

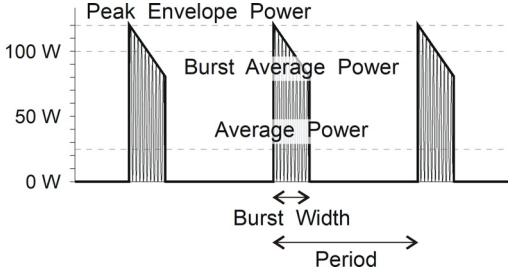
After peak power is measured, a threshold of ½ the peak is set. The sampled power crosses that threshold at the beginning and end of each burst. The time between crossings is used to calculate the duty cycle. Burst Average Power is calculated by dividing the Average Power by the Duty Cycle.

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 24 Burst Average Power



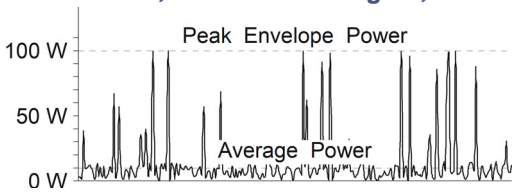
Crest Factor

5012, 5016, 5017, 5018, 5019

Crest factor (CF) is the ratio of the peak and average powers, in dB. The WPS calculates the Crest Factor from the Forward Peak and Average Power measurements.

Crest factor is becoming one of the most important measurements as communication 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 25 Crest Factor, 10 dB CDMA Signal, 100 W Peak, 10 W Ave



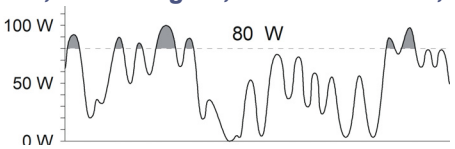
Complementary Cumulative Distribution Function (CCDF)

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 26 CCDF, 100 W Signal, 80 W Threshold, 20% CCDF



Gated Average

7023

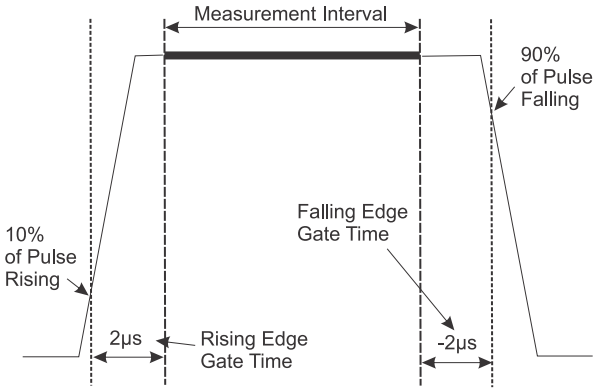
Gated Average measures the average power of a pulse in a user defined interval referenced from the rising and falling edges of the pulse.

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 40.

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 27 on page 54.

Figure 27 Pulse Gate Times



The sensor is capable of averaging measurements from pulse to pulse. See “Average Count” on page 40.

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.

The algorithm is an exponential moving average. Pulse related measurements (gated pulse power, width, duty cycle, & rep rate) are normally calculated from one complete pulse. When the exponential moving average is enabled, the pulse measurements are averaged over multiple pulses.

The averaging only applies to pulse related measurements. The moving average does not apply to the forward or reflected average power measurements.

State Average

7027, 7029, and 7037

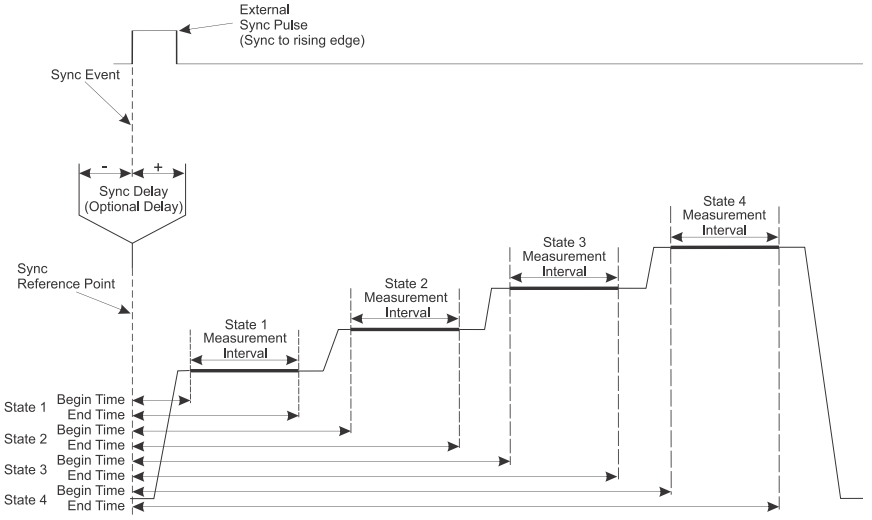
State Average measures the average power of up to four states within a pulse period (frame).

State Average measures:

- Average Power of up to four states within a pulse period (frame).
- Transition time between states within a pulse period.

Begin delay and end delay times are used to define each state. The begin and end delay times are referenced to an external sync pulse, or by an internal reference, see Figure 28.

Figure 28 State Average Measurements

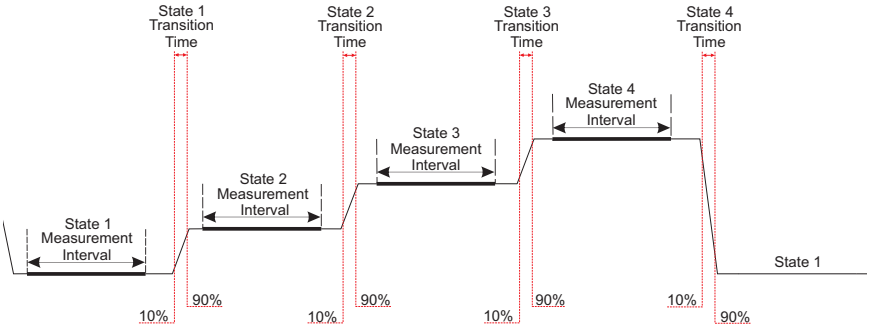


In addition to average power for each state, the Bird VPM will also measure the length of time it takes to transition from one state to the next. The transition times are calculated using the collected sensor data as viewed in the Time Domain Display. When a measured signal is transitioning from one state (signal level) to another state, user settable reference values are used during the transition, then the transition duration, in time, between the two reference values is calculated to determine the transition time.

> **Note:** *The user may set the reference values used for transition time measurement.*

As shown in Figure 29, for a positive going signal, (state 1 to state 2) the first reference value is taken at a level 10% above the previous state, the second reference value is take at 90% above the previous state. The transition time, is the rise time between the 10% value and the 90% value.

Figure 29 Transition Times



For a negative going signal, (state 4 to state 1) the first reference value is taken at a level 10% below the previous state, the second reference value is take at 90% below the previous state. The transition time, is the fall time between the 10% value and the 90% value.

The transition times are displayed on the States Tab in the Measurement Details area of the VPM3 display. See "States Tab" on page 17.

Analysis Mode

7027, 7029, and 7037

The configuration of the State Average measurement defaults to an automatic process called Analysis Mode. The Analysis Mode process automatically determines the begin and end delay times for all states within the pulse period. The automatic setting for Analysis Mode may be turned off and the begin and end delay times manually set if desired (see "Manually Determining Begin and End Delay Times" on page 59).

In time domain mode, clicking the Auto Config button (see "State Configure Menu" on page 28) will automatically configure:

- Begin and End delay times for up to 4 states.
- Reference points for transition time measurement.

There are four settings that may be adjusted by the user to customize the measurements.

> **Note:** *These settings are only active when Analysis Mode is set to Auto.*

- State Begin Margin: This setting specifies when a states average power measurement will begin. Expressed as a percentage of the states total width, the average power measurement will begin at the specified percentage from the beginning of the state. See Figure 30.
- State End Margin: This setting specifies when a states average power measurement will end. Expressed as a percentage of the states total width, the average power measurement will end at the specified percentage from the end of the state. See Figure 30.
- State Upper Reference: This setting specifies the upper reference point used when calculating transition times. Expressed as a percentage of the total transition, the transition time will begin (or end) at the specified percentage from the bottom of the transition. See Figure 31.
- State Lower Reference: This setting specifies the lower reference point used when calculating transition times. Expressed as a percentage of the total transition, the transition time will end (or begin) at the specified percentage from the bottom of the transition. See Figure 31.

Figure 30 State Measurement Interval Margin Settings

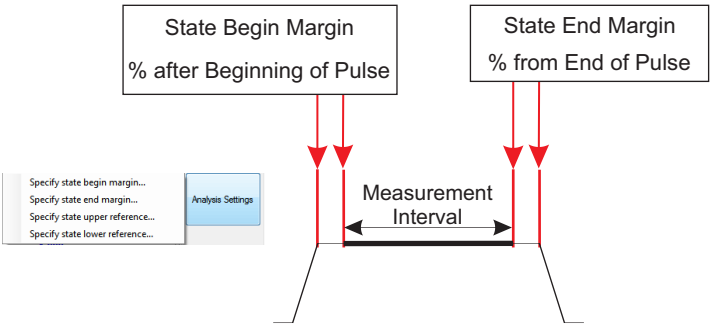
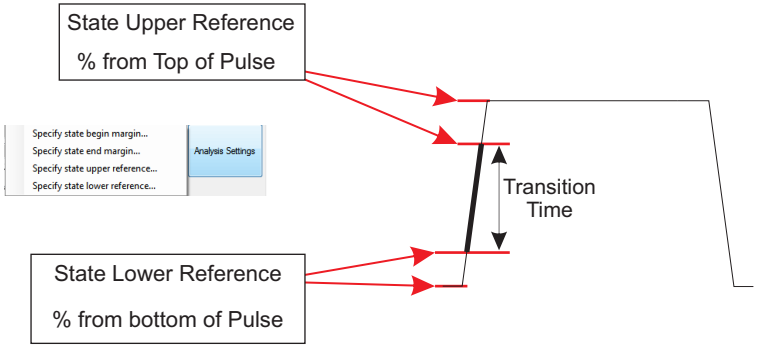


Figure 31 Transition Time Reference Settings



State Begin/End Delay Times Screen Annotations

7027, 7029, and 7037

After begin and end delay times are configured for a state, the begin and end delay times are displayed on the Time Domain Display in the format shown in Figure 32. In addition to changing these values using State Configure Menu ("State Configure Menu" on page 28), the begin and end times may also be changed by "dragging" the associated vertical line to a new position.

> **Note:** *If a begin or end time delay line is moved, Analysis Mode will be set to Manual Mode.*

Figure 32 State Begin/End Delay Time Screen Annotations

Manually Determining Begin and End Delay Times

7027, 7029, and 7037

In Manual Analysis Mode the average pulse power measurement interval for each state begins at the user specified begin time and ends at the user specified end time. There may be four different states specified, each with a begin and end time. These values are entered on the State Configure Menu, See Figure 33.

Once the Pulse Sensor is connected, begin and end delay times can be determined manually with Analysis Mode in Manual.

For each state to be measured within the pulse period, move the upper and lower markers to the beginning and end of a state, see Figure 33 State 1. The time displayed at the marker positions can be used to set the begin and end delay time for the state at the marker position. Move the markers to each state to be measured to determine begin and end delay times for all states.

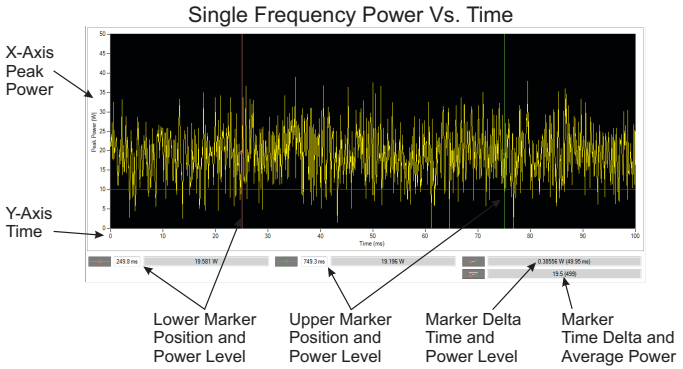
Figure 33 State Average Begin and End Times

Time Domain Mode

7022 (***7027, 7029, and 7037*** see "State Average" on page 55)

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 34 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 29 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 31.

Statistical Power Mode

7022

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

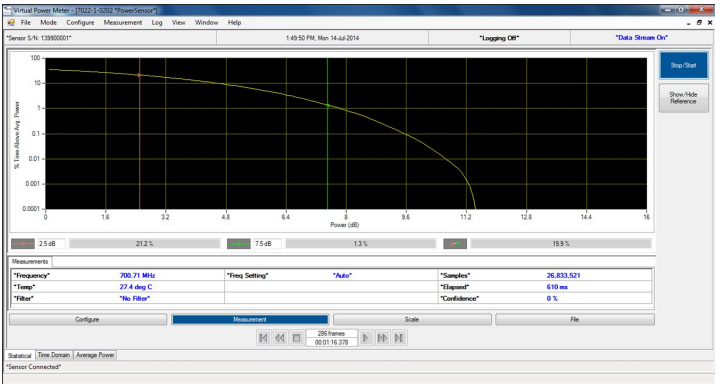
Provides statistical measurements to display the percentage of time that a particular waveform exists at a specific peak to average power ratio. The Figure 35 on page 63 illustrates this concept, as applied to an LTE-TDD waveform.

In Figure 35 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 35 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.

Figure 35 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.

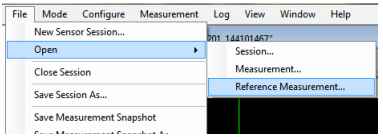
Another useful technique is to compare live data from the system with a known “reference” transmission.

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.

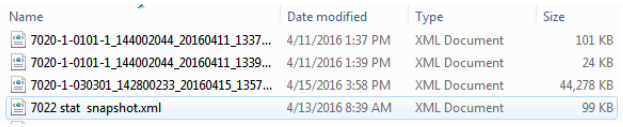
1. Click File, hover over Open, then select Reference Measurement.

Figure 36 Open File



2. Select the reference statistical measurement.

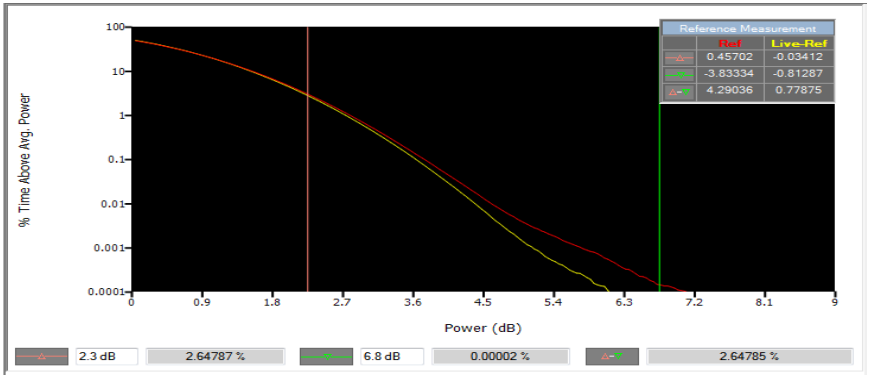
Figure 37 Reference Measurement File Selection



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 38 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 65.

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 88.

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 39). All Bird sensors connected to the computer will be listed.

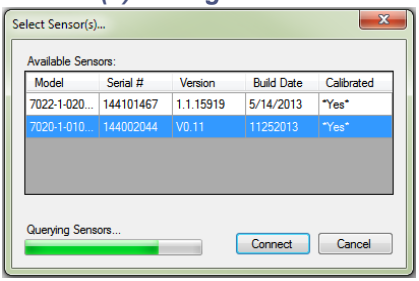
> **Note:** *If a sensor is already connected and in a session it will not be listed in the Select Sensor(s) dialog box.*

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 21 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 73 for steps required to start a new session.

Figure 39 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.

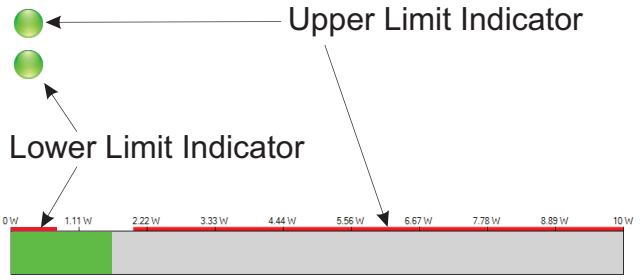
Legacy Preset files may be saved as a Default Session file for use in current versions of VPM3.

To convert a legacy preset to a Default Session File, see "Convert Legacy Preset File to Default Session File" on page 89.

Limit Indicators

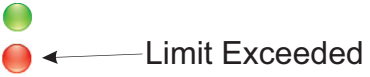
The Analog and Digital Displays have limit indicators that may be set to provide a visual indication the measurement is above or below specified values.

Figure 40 Limit Indicators



The circular limit indicators shown in Figure 40 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 41.

Figure 41 Exceeded Limit Indications



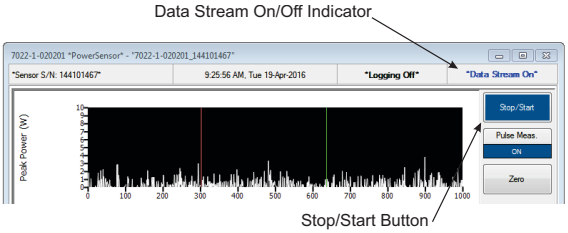
The Limit indicators on the Digital Displays bar graph (Figure 40, bottom) are static indicators only, they are simply mark the portion of the displayed range that is above or below the user specified limits.

See “Setting Limit Indicators” on page 90 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 42 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 70 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 69). 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.

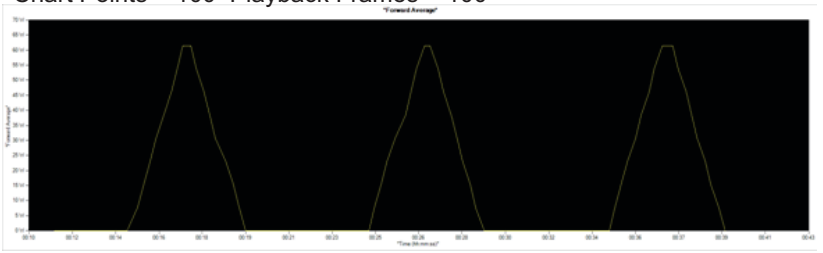
Points

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.

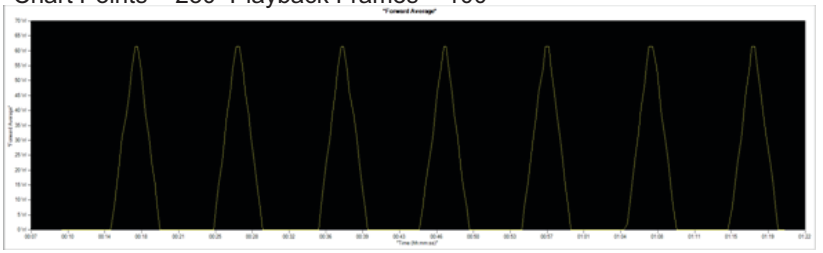
For example the two displays shown in Figure 43 are of the same signal input at the sensor. The difference is the settings for Chart points and Playback settings. The settings for these values are can have a significant impact on the chart displays resolution.

Figure 43 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 71.

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
Serial Number
Year
Month
Day
Hour
Minute
Seconds

Save Measurement Snapshot As

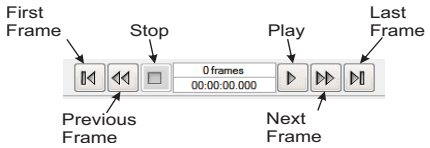
Save Measurement Snapshot As saves the same information as the Save Measurement Snapshot option, the difference is this option opens a dialog box so a unique name can be given to the snapshot.

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 44 on page 70.

Figure 44 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.

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 files 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 94 for instructions in saving logs.

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

Log Contents

Sensor readings may be logged to a file for future external analysis or archiving purposes. The logged data is in general a sampled subset of the data received from the sensor, selected by the log conditions specified in the Log Settings Dialog, see "Logging Settings" on page 72.

Each sensor provides readings to VPM3, some or all of these readings may be logged. The readings that are logged vary depending on the sensor attached to VPM3 and the selections made in logging settings.

Figure 45 on page 72 shows the contents of a typical log file (CSV file displayed in MS Excel).

Figure 45 Typical Log File Content

Session:
Session Start Time: 2016-10-24 14:46:05 -04:00
Log Created: 2016-10-24 14:46:05 -04:00
Sensor Model: 7023-1-594301-1212
Sensor SN: 162601564
Sensor Software Version: 1.2.21245 (2015/12/11 18:00:46)
Sensor Software Build Date: 7/21/2016
Properties:
Measurement ForwardAverage
Input Offset 0 dB
CorrectionFrequency 13.56 MHz
CorrectionFrequencyAutoEnabled TRUE
Edge Delay 9 us
Edge Delay -9 us
MeasurementMode AveragePower

Mode-specific Properties:

Limits:

Sensor Data:

Timestamp	ForwardPower	ReflectedPower	GatedPower	Frequency	Temperature	DutyCycle	PRF
540131	2.94E-03	2.79E-03	0.00E+00	0.00E+00	2.30E+01	2.02E+00	1.27E+05
540366	2.93E-03	2.79E-03	0.00E+00	0.00E+00	2.30E+01	2.02E+00	1.27E+05
540530	2.93E-03	2.79E-03	0.00E+00	0.00E+00	2.30E+01	2.02E+00	1.27E+05
540700	2.93E-03	2.79E-03	0.00E+00	0.00E+00	2.30E+01	2.02E+00	1.27E+05
540864	2.93E-03	2.79E-03	0.00E+00	0.00E+00	2.30E+01	2.02E+00	1.27E+05

Logging Settings

Logging settings can be used to change when a log file is started, ended, and the amount data collected.

There are three main options in the logging settings dialog:

- **When measurements are logged**, continuously or only under certain conditions.
- **How Long measurements are logged**, limited by time or indefinitely.
- **What additional measurement data is included**, averaging options allow the logging of additional variations of sensor data.

Continuous Logging.

Data may be logged continuously, by selecting **Log measurements continuously at the given Interval**, subject to a the interval set using the **Sampling Interval** setting. A complete set of data is recorded in the log repeating at the selected interval.

A selection is available to log data indefinitely or to limit logging to a specified number of frames. If frames are selected, the logging duration (HH:MM:SS) will be displayed below the option.

Conditional Logging.

When **Use conditional logging** is selected, data is only logged when the specified conditions are met. Any of the sensor measurements may be to set to trigger logging when the measurement goes above or below the selected value.

A selection is available to log a single measurement or log continuously once the condition is met.

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 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.*

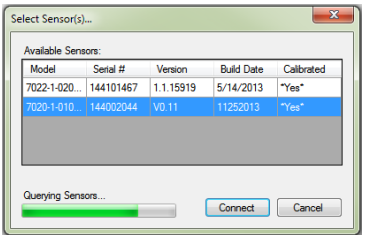
   Note: *The 402X series sensors require the use of the 4421B540-2 Sensor Interface Module.*

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 21.

     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 46 Sensor Connection Manager

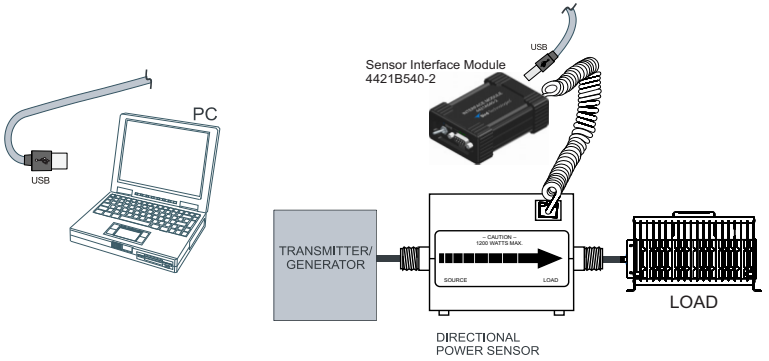


402X DPS Setup

Connecting the 402X Series DPS

1. Connect the Bird 402X Series DPS to the 4421B540-2 Sensor Interface Module using the sensor cable provided.
2. Connect the 4421B540-2 Sensor Interface Module to the a USB port on the PC using a USB cable.

Figure 47 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 24.
- Click Measurement button:
  - ✓ Select desired measurement type, see "Type:" on page 42.
  - ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 42.
- Click Units button:
  - ✓ Select Power Units to display, see "Power:" on page 46.
  - ✓ Select Match Units to display, see "Match:" on page 46.

- Click File button:

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

  ✓ Establish Logging Settings, see "Logging Settings" on page 49.

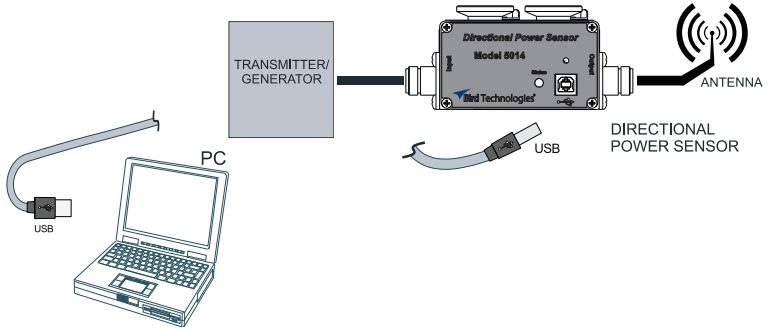
  ✓ Enable Logging, see "Enable Logging" on page 49.

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 48 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 37.

  ✓ Select Element type, see "Elements" on page 38.

  ✓ Enter Forward Scale (Forward Element), see "Forward Scale" on page 38.

  ✓ Enter reflected scale OR Click F/R Scale 10:1 ratio, see “Reflected Scale” and “F/R Scale 10:1 Ratio” on page 38

- Click Measurement button:
  - ✓ Select desired measurement type, see "Type:" on page 42.
  - ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 42.
- Click Units button:
  - ✓ Select Power Units to display, see "Power:" on page 46.
  - ✓ Select Match Units to display, see "Match:" on page 46.
- Click File button:

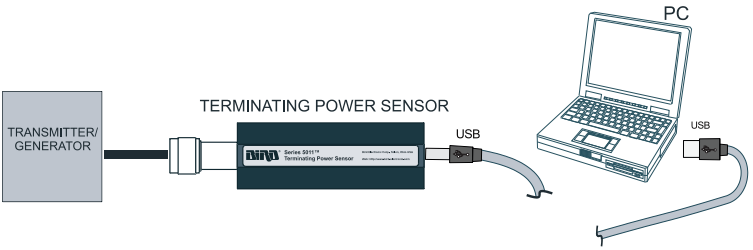
  If you wish to save snapshots or log any measurements use this menu
  - ✓ Establish Logging Settings, see "Logging Settings" on page 49.
  - ✓ Enable Logging, see "Enable Logging" on page 49.

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 49 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 78.

  ✓ Enter the offset value, see "Input Offset" on page 24.

- 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 97

- Click Measurement button:

  ✓ Start Measurement (if not automatically started), see "Stop/Start" on page 42.

- Click Units button:

  ✓ Select Power Units to display, see "Power:" on page 46.

- Click File button:

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

  ✓ Establish Logging Settings, see "Logging Settings" on page 49.

  ✓ Enable Logging, see "Enable Logging" on page 49.

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 37.

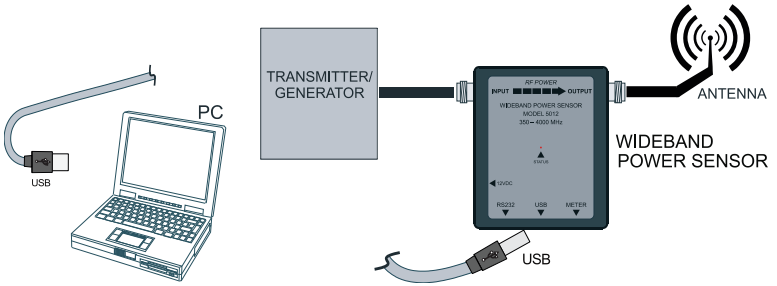
Note: *Correction factors are only required above 4 GHz. Below 4 GHz, the TPS-EF can be used as a normal TPS.*

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.bird-rf.com.*

Figure 50 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 24.

  Note: *Entries required on this menu will vary depending on the measurement type selected.* see "Configure Button" on page 37 *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 97 for additional information.

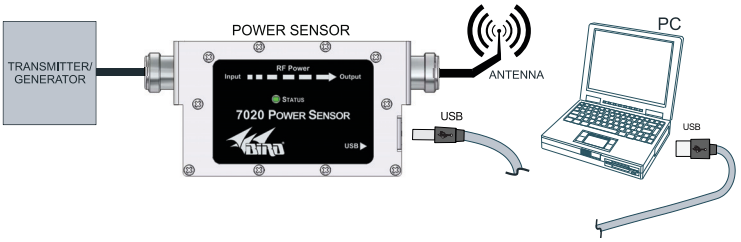
- Click Measurement button:
  - ✓ Select desired measurement type, see "Type:" on page 42.
  - ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 42.
- Click Units button:
  - ✓ Select Power Units to display, see "Power:" on page 46.
  - ✓ Select Match Units to display, see "Match:" on page 46.
- Click File button:

  If you wish to save snapshots or log any measurements use this menu
  - ✓ Establish Logging Settings, see "Logging Settings" on page 49.
  - ✓ Enable Logging, see "Enable Logging" on page 49.

7020 WPS Setup

Connecting the 7020 WPS

Figure 51 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 24.

- 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 97 for additional information.

- Click Measurement button:

  ✓ Select desired measurement type, see "Type:" on page 42.

  ✓ Start Measurement (if not automatically started), see "Stop/Start" on page 42.

- Click Units button:

  ✓ Select Power Units to display, see "Power:" on page 46.

  ✓ Select Match Units to display, see "Match:" on page 46.

- Click File button:

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

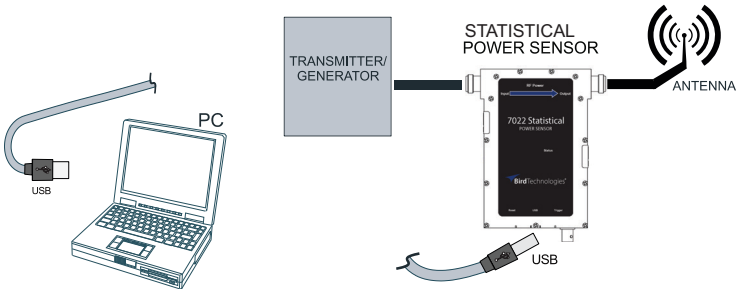
  ✓ Establish Logging Settings, see "Logging Settings" on page 49.

  ✓ Enable Logging, see "Enable Logging" on page 49.

7022 Statistical Power Sensor Setup

Connecting the 7022 Statistical Power Sensor

Figure 52 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 23

- 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 37 *for details of the option available.*

  ✓ Enter the offset value (Time Domain, Average Power Mode), see "Input Offset" on page 24.

- 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 97 for additional information.

  ✓ Select desired measurement type, see "Type:" on page 42.

  ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 42.

- Click Trigger button:

  ✓ Triggers are available in Time Domain Mode, see "Trigger Button" on page 44 for the options.

- Click Scale button:

  ✓ Scale may need to be adjusted in Statistical or Time Domain mode, see "Scale Button" on page 47.

- Click Units button:

  ✓ Select Power Units to display, see "Power:" on page 46.

  ✓ Select Match Units to display, see "Match:" on page 46.

- Click File button:

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

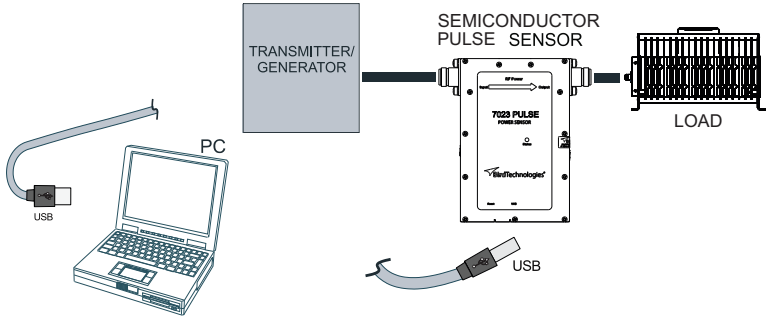
  ✓ Establish Logging Settings, see "Logging Settings" on page 49.

  ✓ Enable Logging, see "Enable Logging" on page 49.

7023 Pulse Power Sensor Setup

Connecting the 7023 Pulse Power Sensor

Figure 53 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 37 *for details of the option available.*

  ✓ Enter the offset value, see "Input Offset" on page 24.

- Click Measurement button:

  ✓ Select desired measurement type, see "Type:" on page 42.

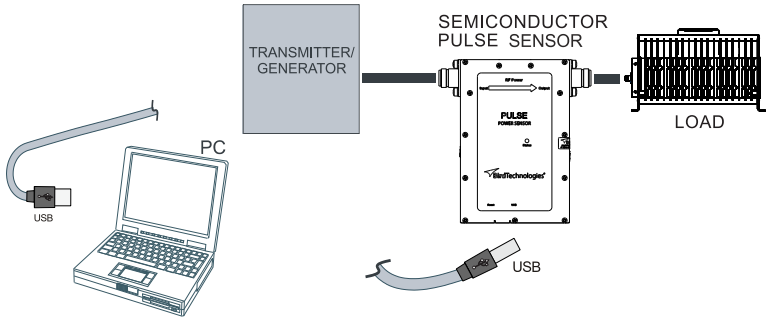
  ✓ Start Measurement (if not automatically started), see "Stop/ Start" on page 42.

- Click Units button:
  - ✓ Select Power Units to display, see "Power:" on page 46.
  - ✓ Select Match Units to display, see "Match:" on page 46.
- Click File button:
  If you wish to save snapshots or log any measurements use this menu
  - ✓ Establish Logging Settings, see "Logging Settings" on page 49.
  - ✓ Enable Logging, see "Enable Logging" on page 49.

7027, 7029, and 7037 Pulse Power Sensor Setup

Connecting the Pulse Power Sensor

Figure 54 7027, 7029, and 7037 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).

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 37 *for details of the option available.*

  ✓ Enter the offset value, see "Input Offset" on page 24.

- Click Sync button:

  ✓ Select sync source, "Sync Button" on page 45.

  ✓ (External Sync) Select Rising/Falling Edge.

  ✓ (Internal Sync) Select Auto or specify a power level for state measurement start.

- Click Scale button, if State Average measurement (see "State Average" on page 55) is chosen:

  ✓ Adjust Time, Offset, Power as necessary to display the signal.

  ✓ Adjust Sweep Time or Sweep Delay, if required, to display all state transitions.

- Analysis Mode Selection:

  o For Auto configuration, click Auto Config button.

  ✓ Click Analysis Settings (see "State Average" on page 55), accept the default auto configuration or specify the following:

  State Begin Margin
  State End Margin
  State Upper Reference
  State Lower Reference
  State Sensitivity

  o For Manual configuration, click State Configure button, if State Average measurement (see "State Average" on page 55) is chosen:

  ✓ Click State Select Option, select state to configure (1 -4).

  ✓ Enter a State Begin time.

  ✓ Enter a State End Time.

  ✓ Click State Enable.

  ✓ Repeat for up to four States.

- Click Measurement button:

  ✓ Select desired measurement type, see "Type:" on page 42.

  ✓ Start Measurement (if not automatically started), see "Stop/Start" on page 42.

- Click Units button:

  ✓ Select Power Units to display, see "Power:" on page 46.

  ✓ Select Match Units to display, see "Match:" on page 46.

- Click File button:

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

  ✓ Establish Logging Settings, see "Logging Settings" on page 49.

  ✓ Enable Logging, see "Enable Logging" on page 49.

  ✓ Use Capture to save data displayed in Time Domain graphical display, see "Capture" on page 49.

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 65.

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 65.

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 88.

Open Measurement File

Measurement files consist of two basic types, snapshot and log. see "Snapshots" on page 69, and “Logging” on page 71. 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 92 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.*

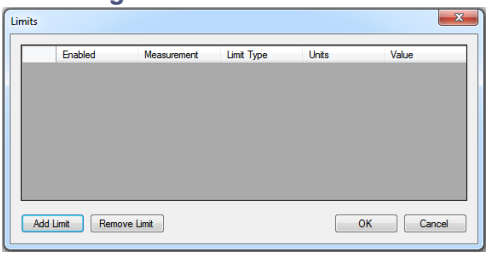
Limits can be used to aid in visual identification of measurements falling outside a desired range. Limit indicators are available on the Analog and Digital displays see "Limit Indicators" on page 67 for more information on the limit indicators.

Add a Limit

To add a measurement limit perform the following steps:

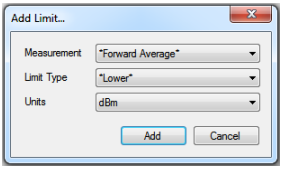
1. Click the **Measurement** menu and select **Limits...** to display the Limits dialog box.

Figure 55 Limits Dialog Box



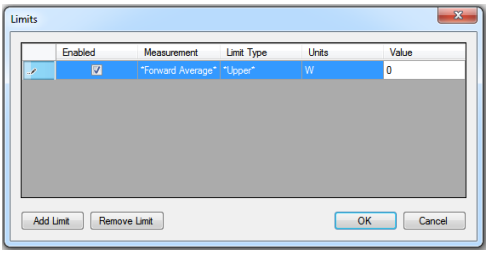
2. Click **Add Limit** to display the Add Limit... dialog box.

Figure 56 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 57 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.

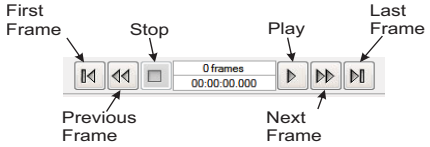
> **Note:** *Buffered data may be cleared at anytime during a session by clicking on the View menu, selecting Playback and Clear Buffer. Buffered data is also cleared when Restart Session on the Log Menu is used.*

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 58 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 measurements 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 "Creating Log Files" on page 94.

To display a log file for playback:

1. Open a Log file. See "Open Measurement File" on page 88.
   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:

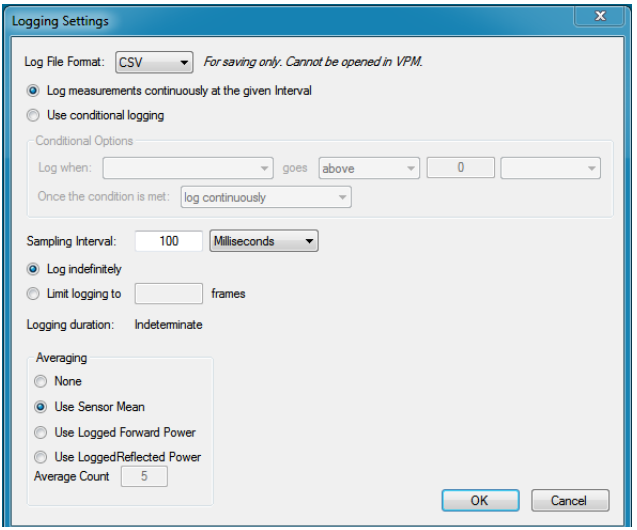
- Set a delay between frames (Slow Mo), click the **View** menu, then hover over **Playback** and select a delay of 1, 2, 4, or 8 seconds between frames.
- Save a snapshot of any frame, click the **File** menu, then **Save Measurement Snapshot**.
- Change Display Type, click the **View** menu, then hover over **Display Style** and select another display.
- End the session, click the **File** menu, then **Close Session.**

Creating Log Files

To begin logging:

1. To 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.
   - Configure Averaging ***(7023 Only)***
3. Click **OK**.

Figure 59 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 93.

Logs may also be viewed as text or in spreadsheets. see "Viewing Measurement Logs Outside VPM3 " on page 95.

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 93.

> **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.*

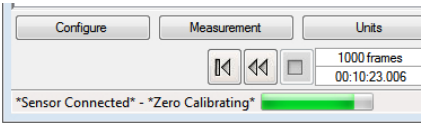
Zeroing a Sensor

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 60 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.