Capturing the Sense of Touch!

CHAMELEON TVR SOFTWARE

For FingerTPS

OPERATOR'S GUIDE

PPS Advanced Real-Time Visualization & Acquisition

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This document provides basic instructions for using PPS's real-time visualization and acquisition software, Sapphire. It covers startup, shutdown, and basic operations such as recording data and comparing files.

TABLE OF CONTENTS

About this Manual

This manual describes the functionality of the ***FingerTPS System*** and ***Chameleon*** software. It also provides a glossary of commonly used terms as well as a primer on how capacitive sensors work.

FingerTPS™ Wireless Tactile Force Measurement System

The all-new, redesigned **FingerTPS™** *(Finger Tactile Pressure Sensing)* ***System*** utilizes highly sensitive *capacitive-based pressure sensors* to reliably quantify forces applied by the human hand. It's the only practical and *comfortable sensor solution* that also connects wirelessly to your PC. With our powerful new ***Chameleon*** software, *FingerTPS Systems* can be easily reconfigured and recalibrated for different uses of the hands on the fly.

FingerTPS Systems also include synchronized video recording to match *tactile data* with actual use. Precise force data and video images can be captured and displayed in real-time via PPS's Chameleon Software, which has Tivo®-like versatility in recording time-series, average and peak force measurements.

KEY FEATURES AND BENEFITS:

- *Comfortable tactile sensors* that are wearable on the hand
- *User configurable* with up to 6 *capacitive sensors* per hand
- *Video recording,* editing, and playback are synchronized with tactile data
- *Wireless Bluetooth* connectivity allows user mobility and freedom
- *Simple calibration* procedure using an included electronic reference sensor
- API available for custom configuration and system integration
- Improved repeatability
- Reduced creep

SPECIFICATIONS	
Sensor Thickness	2 – 3 mm
Full Scale Range	10 – 50 lbs (4.55 – 22.73 kg)
Sensitivity	0.1 lbs (.045 kg)
Temperature Range	0 - 50
Repeatability	< 4% FSR
Creep @ 3 lb load (FSR)	2% @ 1 sec, 8% at 10 sec
Scan Rate	40 Hz
Power	USB rechargeable
Operation Duration	~ 4 hours

SYSTEM CONTENTS

A Standard System consists of:

a. 2 FingerTPS sensors (any 2 of 6 shown in photo)
b. 2 Piece Acrylic Hand Stand
c. Capsense Wrist Module
d. Rechargeable Wireless Bluetooth Interface Electronics Box
e. Calibration and Reference Load Cell
f. BlueTooth Dongle
g. USB to Mini USB cable (not shown) for recharging d.
h. Hi-Res USB Logitech 2.0 Camera
i. Chameleon Software installation CD (not shown)

Minimum Computer Requirements:

- XP, Vista or Windows 7 Operating system

- If using the USB camera and reference sensor simultaneously, at least 3 available USB ports.

INSTALLATION/STARTUP PROCEDURE

Install Software and Drivers

Insert the provided CD into your computer and run the Chameleon installer executable program. The software and all necessary drivers will be installed automatically. A shortcut to the software will be created in your Start Menu under "Programs >> Pressure Profile Systems."

Notes: Microsoft .NET Framework 4.0 Client Profile or higher is needed to run the Chameleon software. The Chameleon installer will notify you if .NET 4 is not detected. The CD includes .NET Framework 4.0 installer in a separate file from the Chameleon installer file.

Connect Hardware

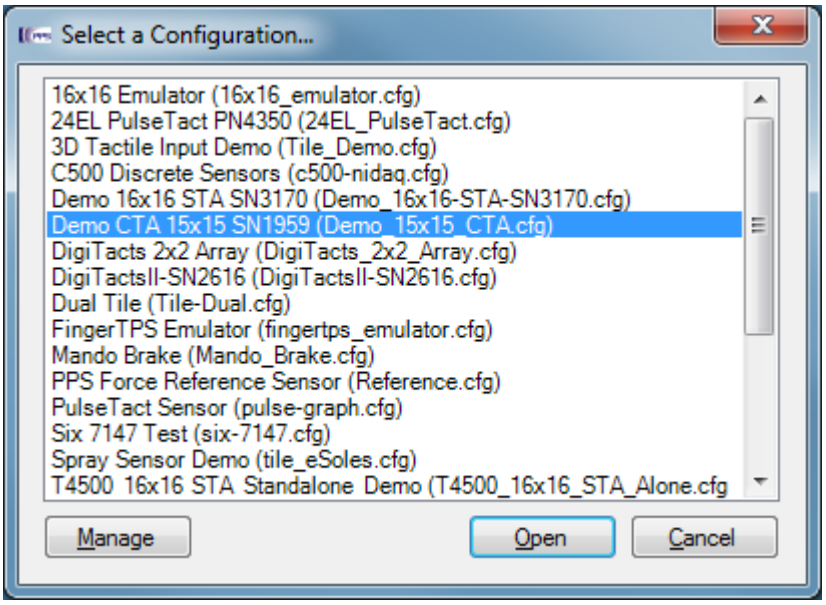
The electronics must be powered on and connected via USB to an open port on your computer before the software is started. Hardware components should be connected as follows:

1. Plug the BlueTooth dongle into an open USB port on your computer.
2. Turn the FingerTPS electronics power switch on (next to the USB port) prior to launching the software. When the power electronics has finished initializing, the LED should blink in a green color indicating it is ready to communicate with the software. If the color of the LED is not green, then plug in the Mini USB to recharge the electronics battery.
3. Locate the USB to Mini USB cable and plug the small mini end in to the reference load. A red LED should begin blinking to indicate the device is ready.
4. Launch Chameleon software.

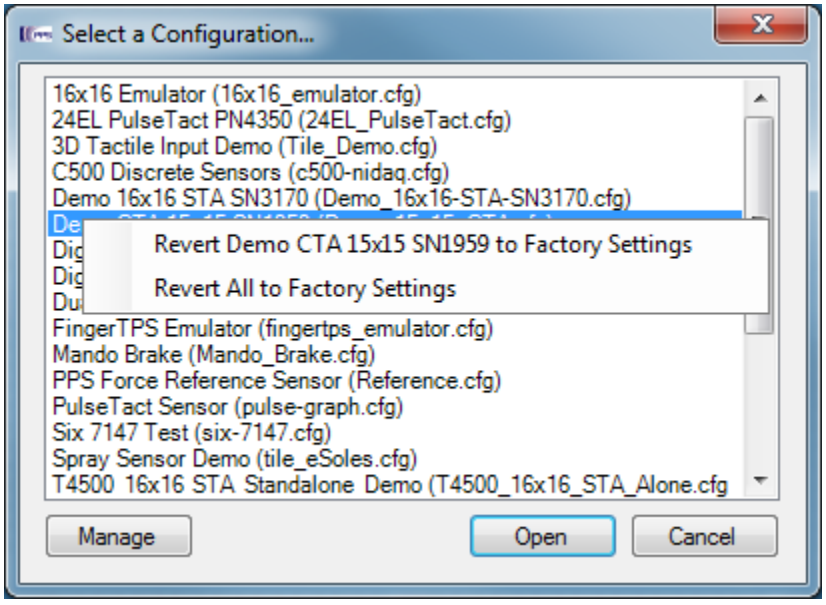
NOTE: Battery life is about 4 hours. Battery can be recharged using the USB to Mini USB cable and a USB port on your computer. Charging takes 2 – 3 hours.

Start Software

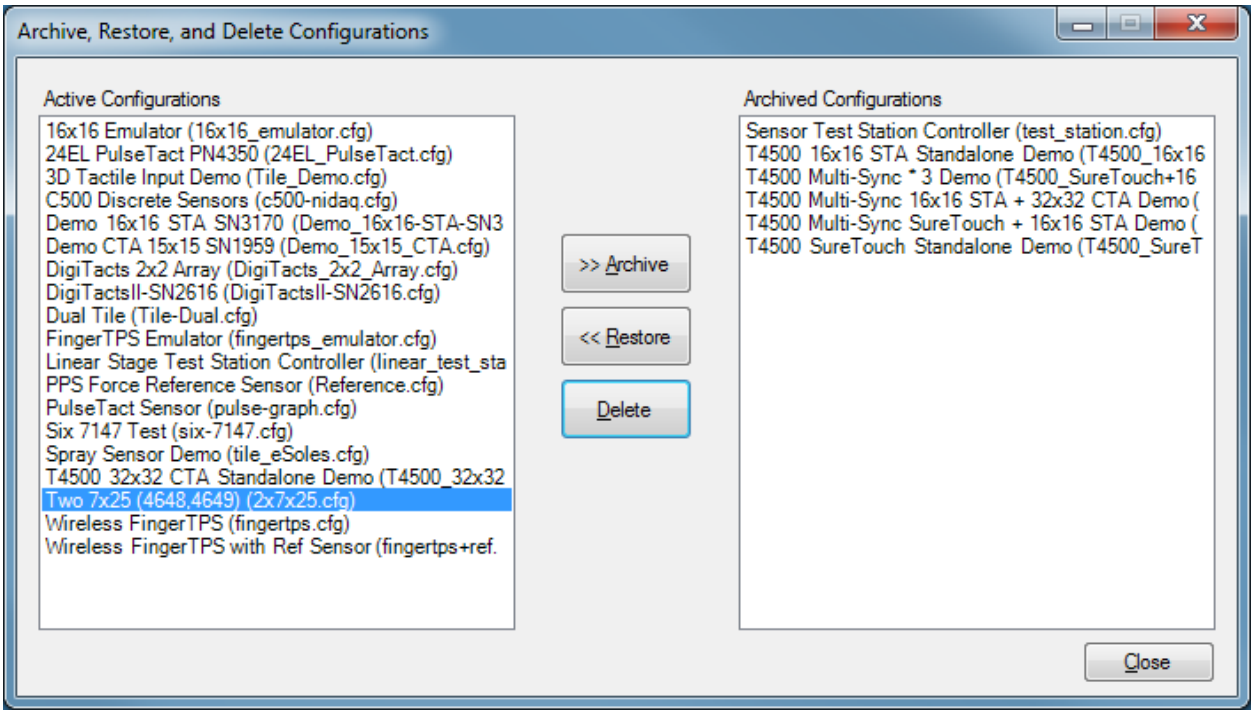
Launch the application by choosing "Chameleon TVR" from the Pressure Profile Systems program folder in your Start Menu. You will initially be prompted with a list of all configurations installed on your computer. Choose a configuration and click "Open" to connect to your hardware and begin viewing real-time data, or click "Cancel" to start Chameleon without connecting to hardware to review saved data files.



If a particular configuration is not operating correctly, it may be necessary to revert it to its factory-supplied defaults. To do this, right-click on a configuration and choose the option from the pop-up menu. You may also choose to reset Chameleon and all configurations to factory settings as well.



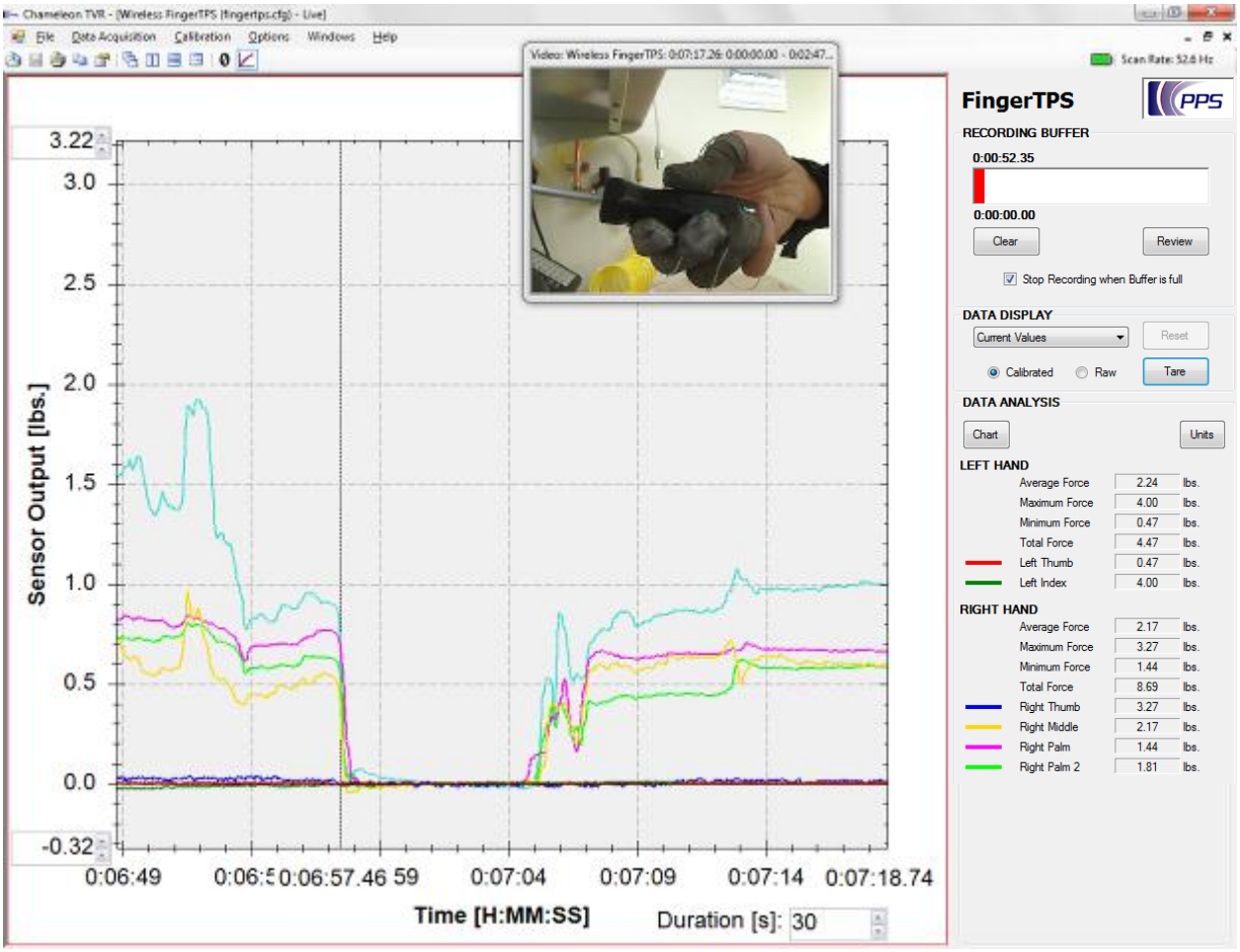
If you have a large number of configurations, you can manage them by clicking the “Manage” button:



From here you may Archive and Restore configurations or delete them entirely. Note that once a configuration is deleted it can only be restored from the original PPS installation materials.

MAIN PROGRAM SCREEN

The main program screen is divided into 6 areas:

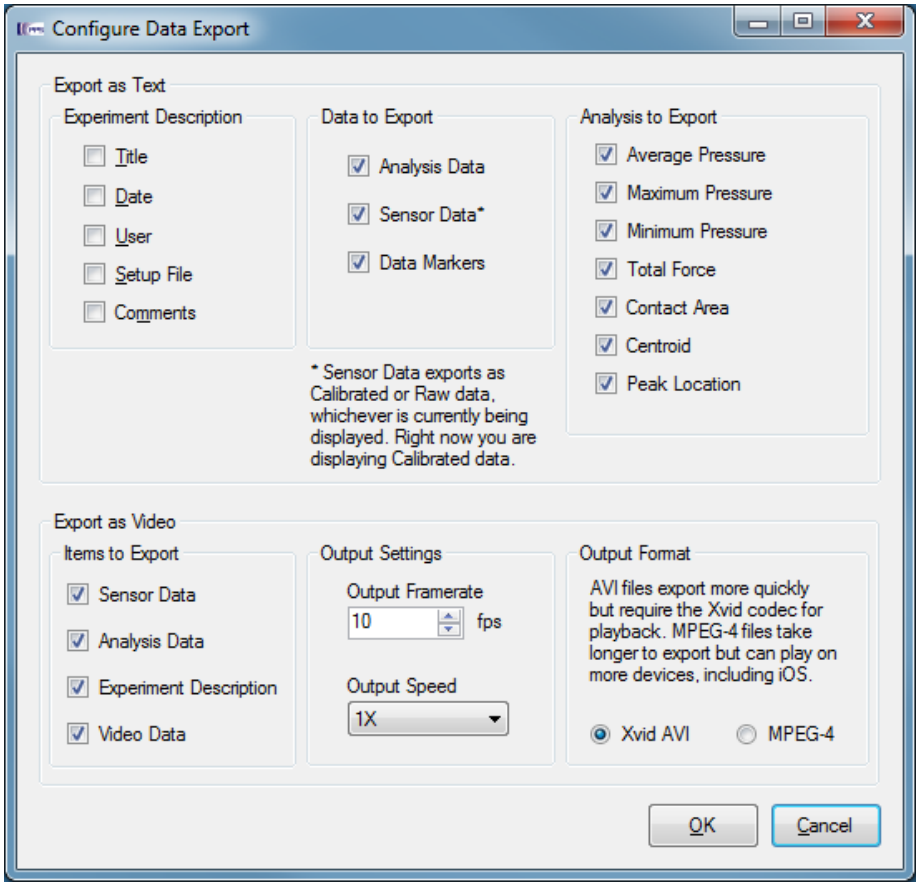


1. Menus and Toolbars
2. Sensor Display
3. Recording Buffer
4. Data Display
5. Data Analysis
6. Webcam Window (if enabled)

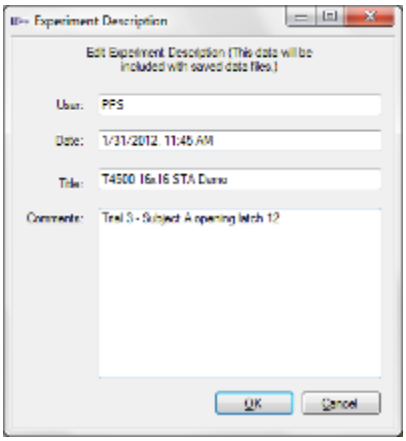
Menus and Toolbars

File Menu

- **Open… (Ctrl+O)**: Opens a saved data file for comparison and/or analysis.
- **Save As… (Ctrl+S)**: Saves the current data with video feed if available in the buffer while in Review Mode.
- **Export as Text…**: Exports the currently selected data in Review Mode to a file in ASCII-delimited format for import into Microsoft Excel, MATLAB, or other analysis packages. If selection mode is not active, the entire sensor array is saved. Export files can be saved as 1D or 2D files csv or txt files. 1D will save files to show a single frame of data in a row starting with a time stamp followed by individual sensor element outputs recorded at that point in time. 2D will show each data frame of sensor element outputs arranged in a 2-dimensional matrix similar to the 2D view on the Chameleon display.
- **Export as Video...**: Exports data in a video format that can be viewed on any computer. Sensor data, analysis data, video data, and experiment description may all be exported in either AVI or MP4 format. AVI files will export slightly faster, but require the Xvid codec for viewing. MP4 files can be viewed on most computers, including iOS devices.
- **Configure Export**: Allows the user to control the sensor data that will be exported as text. Any boxes that are checked will be data that is exported.



- **Print Screen… (Ctrl+P)**: An image of the entire Chameleon window with a snapshot of the accompanying webcam screen will be sent to the printer.
- **Export Screen to File…**: Allows an image of the entire Chameleon window with a snapshot of the accompanying webcam screen to be saved to a PNG, JPG,GIF or BMP file format.
- **Copy Screen to Clipboard (Ctrl+C)**: Allows an image of the entire Chameleon window with a snapshot of the accompanying webcam screen to be copied to a clipboard and be pasted into another document.
- **Experiment Description…**: Allows viewing and/or editing of the current file's properties and annotations. This information will be recorded with saved data files.



- **Exit**: Closes the program and exits.

Data Acquisition Menu

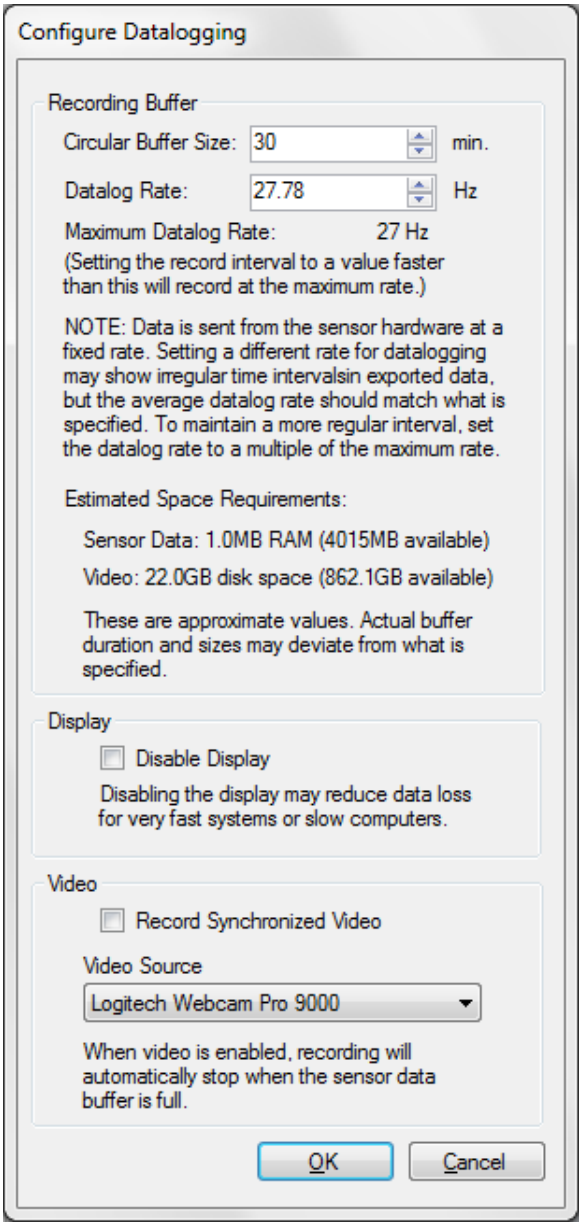
- **Connect to Hardware:** If the Live data window is not active, connection to the Live Data can be achieved by selecting the desired configuration file.

- **Disconnect Hardware:** Any hardware connected to the computer will be disconnected.

- **Configure Data Acquisition (see right)**:
  The **Circular Buffer Size** can be adjusted in the increment of minutes. An estimation of storage space required will be displayed below.
  The **Scan Rate** can be controlled by changing the frequency the software will wait before collecting sensor data. Please note that due to rate at which the hardware sends data to the computer, the scan rate may vary slightly from frame to frame from the specified value. Setting a scan rate below 1Hz will initially delay Chameleon in resetting the data buffer before it updates the screen with new data.
  The **Strip Chart Display** can be disabled if a computer does not have sufficient processing power to show real time data.
  Webcam feed can be enabled by checking the box next to "Record Synchronized Video." The default webcam will be set to "Logitech Webcam Pro 9000."
  *NOTE: Not all webcams will be compatible with Chameleon so it is recommended to use the provided Logitech Webcam Pro 9000 with the Chameleon software.

- **Change to Review Mode (Ctrl+M):** Enters review mode to allow saving of data files

- **Clear Live Buffer (Ctrl+R):** Clears the Live mode Data Buffer

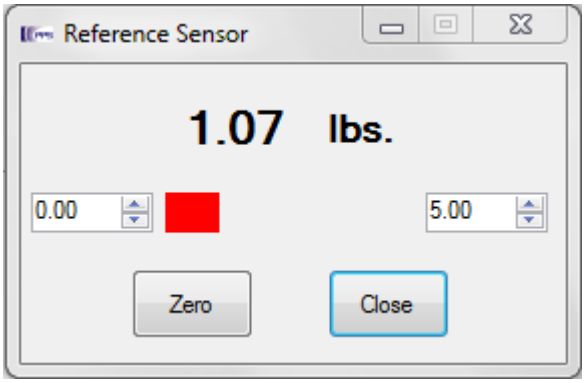


Calibration

- **Zero Sensor Output (Ctrl+T):** Zeroes the sensor offset using the current data (Only available with calibrated data).
- **Reset Sensor Baseline (Ctrl+Shift+T):** Removes any software offset applied to the sensor output. (Only available with calibrated data).
- **Show Raw Data/Calibrated Data:** Allows user to toggle between view the raw sensor counts and the calibrated sensor output.
- **Clear FingerTPS Configuration:** Resets software of any existing calibration and reverts data to show uncalibrated raw signal.
- **Calibration FingerTPS System…:** Allows user to perform a multi-point calibration on their system. Further details on how to perform a calibration is covered in detail later in this document.

Options

- **Show Reference Sensor:** Enables a small popup window to display the reference sensor data.



Windows Menu

- **Cascade Windows:** Shows all open document windows in an overlapping fashion.
- **Tile Horizontally:** Shows all open document windows with maximum width.
- **Tile Vertically:** Shows all open document windows with maximum height.
- **Arrange Icons:** Arrange all minimized window icons.
- **Minimize Windows:** Minimize all the windows.

Help

- **About Chameleon:** Displays information about Chameleon version.
- **Chameleon Manual Shortcut:** Click on any of the listed documents to launch the Chameleon manual pertaining to a system in use.

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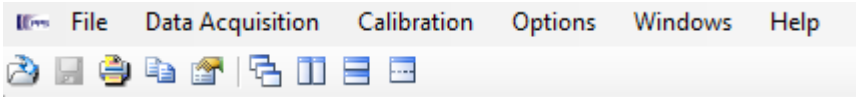
Toolbar



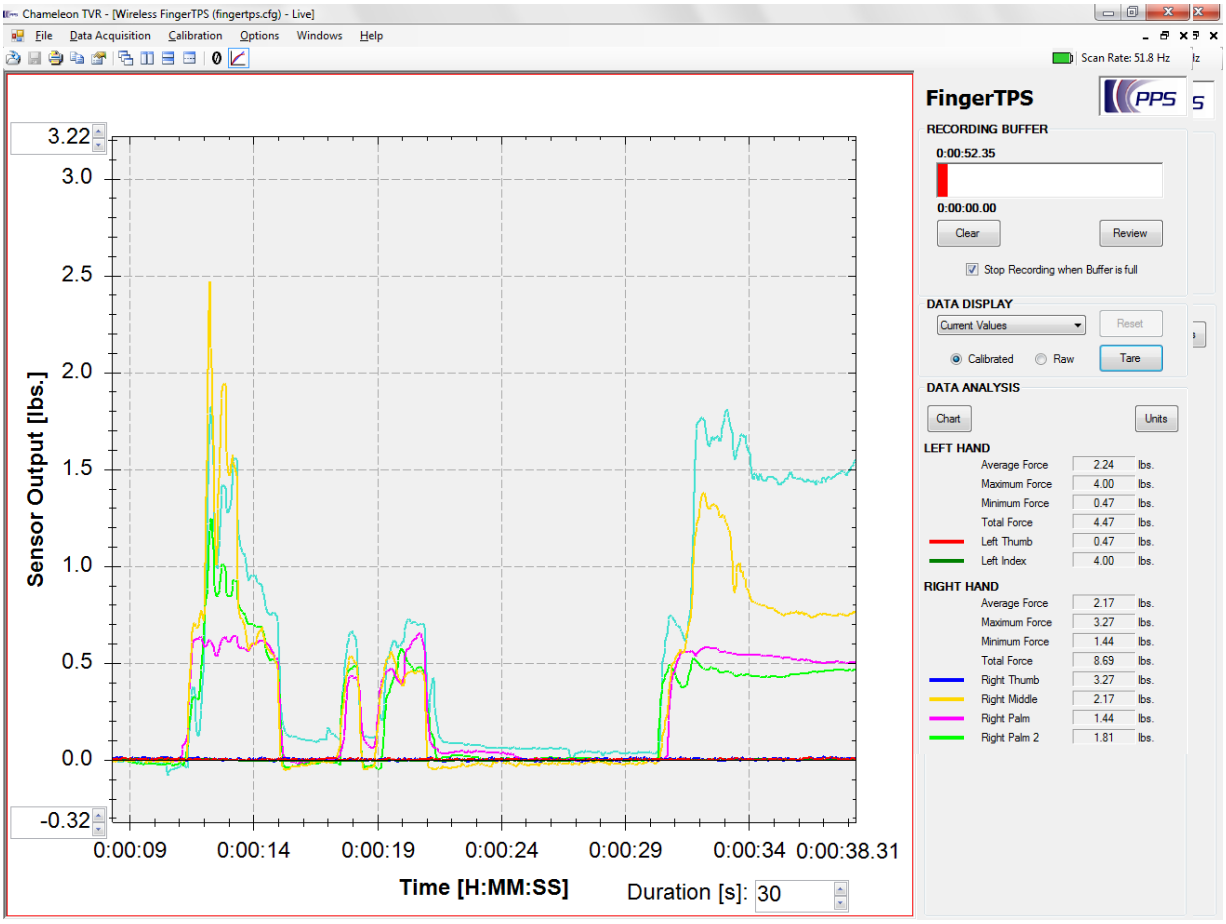
From left to right:

- **Open:** Opens a TVR data file
- **Save:** See "Save As…" under "File Menu" above
- **Print:** Sends snapshot of Chameleon Window to printer
- **Experiment Description:** See "Properties" under "File Menu" above
- **Cascade Windows:** See "Cascade Windows" under "Windows Menu" above
- **Tile Vertically:** See "Tile Vertically" under "Windows Menu" above
- **Tile Horizontally:** See "Tile Horizontally" under "Windows Menu" above
- **Split View:** Splits the current view window into two display areas, both showing the same data, but which can each be display in different orientations or display types if available

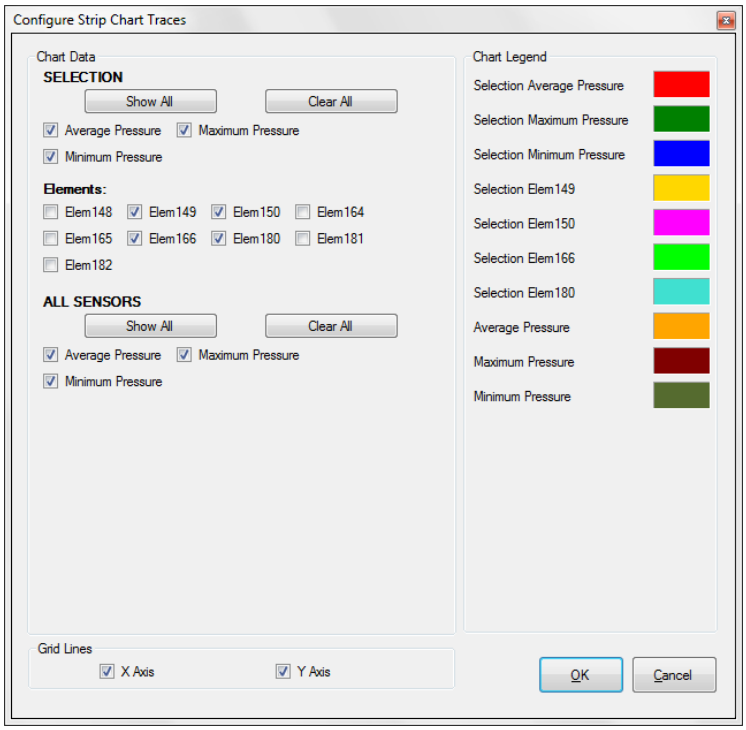
Main Sensor Display

The main sensor display area can contain one or more windows showing live, recorded, saved, or video captured data. Only Strip Chart view is available for FingerTPS Systems. Live data has a red border, while recorded (saved or unsaved) data has a green border, which matches the datalog buffer display (see below). Clicking in a particular window or view makes it active (signified by the red or green border).

Strip Chart

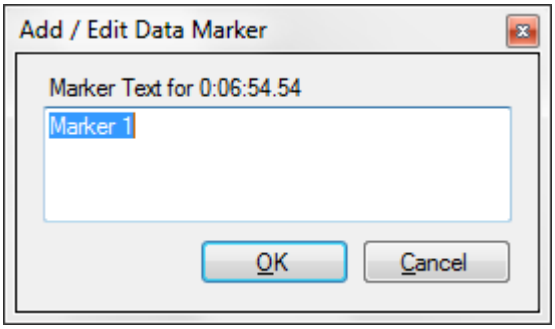


The graphical output shows a Force vs Time graph of the FingerTPS sensor output. Strip chart scales for time and force can be manually changed by modifying the values in the 3 increment boxes along the x and y axes within the strip chart. Clicking on the “Chart” button for located in the Complete System Data section of the software will launch the chart configuration window.



Desired outputs can be added to the strip chart by checking the box next to the item of interest. Up 16 strip traces can be displayed at any given time. Strip colors can also customized by doubling clicking on the color box located next to trace a trace name.

Event Markers



Event markers can be added to the strip chart by double clicking on the display and entering information into the dialog box. The information in the event markers will be visible for review by double clicking again on the marker in review mode and will also be listed within an exported data file.

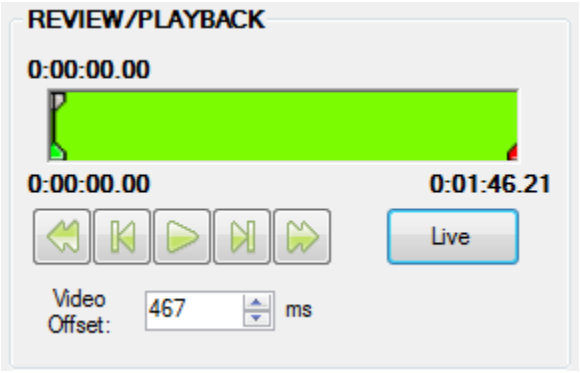
Recording Buffer

The Chameleon Software is constantly recording data whenever live data is being viewed. At any point, you can review the most recent data and choose which portions, if any, to save.

In Live Mode, the datalog indicator uses a red bar to indicate how full the datalog buffer is. When the bar is completely red, it means the buffer is full and the oldest data is being discarded. The live mode will automatically switch to review mode if the check box next to "Stop Recording when Buffer is Full" is enabled. Chameleon will also provide a warning if the buffer is nearly full if the user chooses to have the software notify them. Clicking "Clear" will empty the data buffer and "Review" will switch Chameleon to review mode for saving data.

Review/Playback

In Review Mode, the datalog indicator uses a green bar to show which data is selected for saving or exporting.

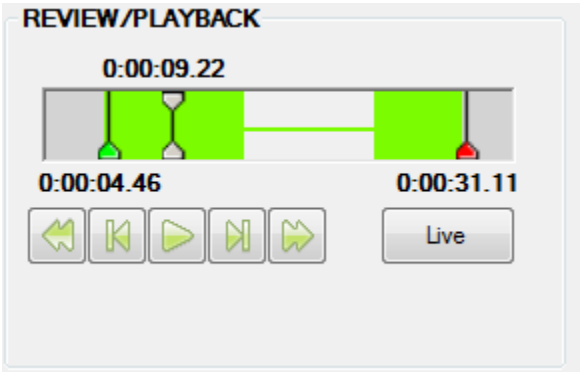


If video mode was enabled before entering review mode, a video offset feature to compensate for any time delay between the sensor data and recorded video will appear. Increase/decrease values in milliseconds to help synchronize video

- **Display Slider (Grey):** Shows which data is currently being displayed in the main display window. Drag the grey slider or use the arrow keys to find a particular location in the data buffer.
- **Start Slider (Green):** Indicates the start point for the subset of data that will be saved or exported. Drag the green slider to adjust the start point. If the slider is double clicked, it will snap to the position of the grey slider.
- **End Slider (Red):** Indicates the end point for the subset of data that will be saved or exported. Drag the red slider to adjust the end point. If the slider is double clicked, it will snap to the position of the grey slider.

Once you are in Review Mode and the green and red sliders are positioned where you want, you can Save or Export data. (See above)

Playback and Review Controls

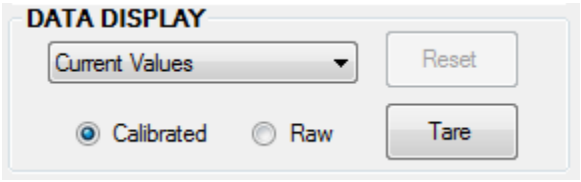


Bottom row from left to right:

- **Rewind:** Click to play data in reverse. Multiple clicks will speed up the display at a rate indicated at the far right of the playback buttons. Shift +click will play back below normal 1x speed.
- **Step Back:** Advances the current position one frame backward
- **Play / Pause:** Click to stop or halt playback on the current frame. Shift + Click to play in reverse.
- **Step Forward:** Advances the current position one frame forward
- **Forward:** Click to speed up the playback speed. Multiple clicks will increase speed. Shift +click will play back below normal 1x speed.
- **Live:** Click to reconnect to the hardware and show live data. If video is not enabled, you will have the option of appending new data to your existing data. The resulting gap in data will show as a thin line in the review display, as shown above.

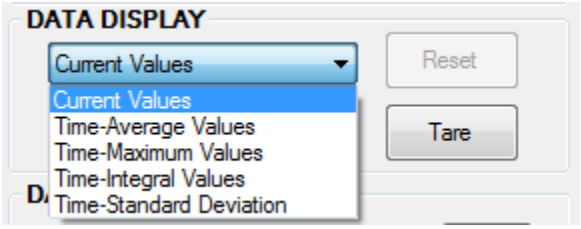
Data Display

The Data Display controls allow you to control what information is shown on the graphical and analysis displays.



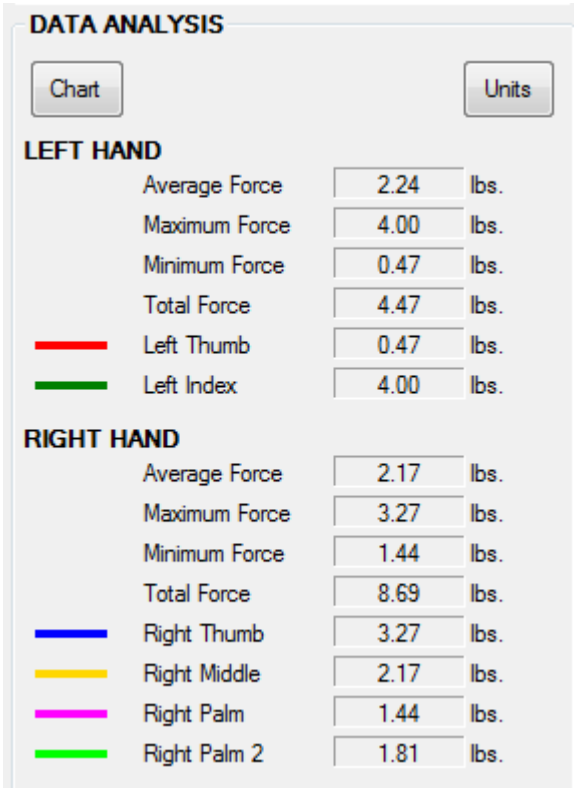
Click “Calibrated” or “Raw” to toggle between calibrated and uncalibrated output. Click “Tare” to set a new sensor baseline using the current values, or Shift+Click “Tare” to reset the sensor baseline.

The Data Display menu allows different time-based analysis to be applied to the data instead of viewing the data for the current time. Time-based values are calculated from when the selection was made from the menu or when you last clicked the “Reset” button.



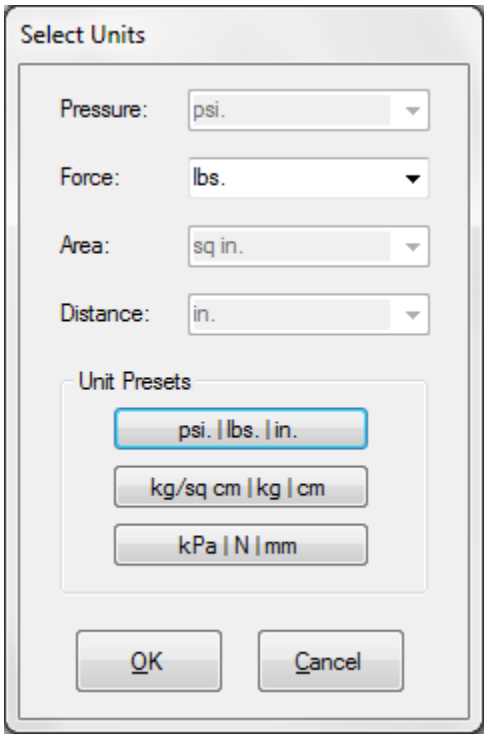
Data Analysis

The system data field shows the values of basic computations performed in software for the elements whose values are above the baseline. The Centroid field provides the coordinates of the Elements are grouped into left and right hand, and Auxiliary data, if available, is shown beneath the sensor data.



Units

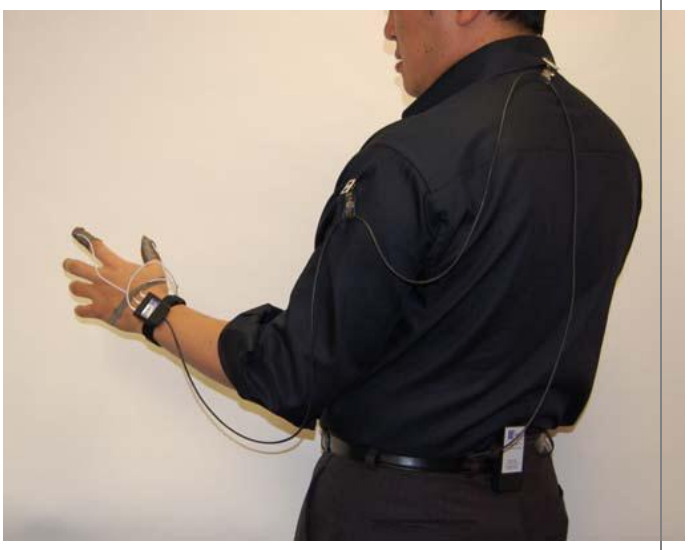
For calibrated data only, the units for the Analysis data can be changed as desired by selecting from the various units available in the drop down menus. Unit Presets can be selected for the most common units used.



SETTING UP SENSORS & HARDWARE

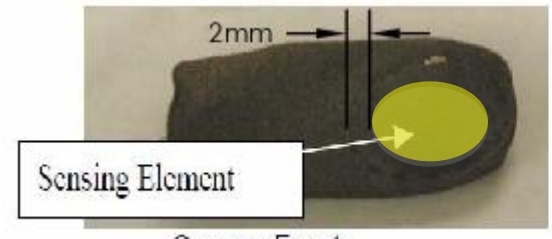
It is recommended that two people be involved in setting up the FingerTPS system. One person can perform the experiment, while the other assists in fitting the system and controlling the data acquisition software.

1. Attach the ***FingerTPS*** **Rechargeable Wireless Bluetooth Interface Box** to the back of the operator's belt, pocket or waistband.
2. Connect the **Capsense Wrist Module** cable to the **Rechargeable Wireless Interface Box**
3. Fasten the **Capsense Wrist Module** around the wrist(s) of the hand(s) the sensors will be used.



Setting Up the FingerTPS sensors

The finger sensors are carefully crafted for pressure measurements. Care must be taken in putting them on, using them and storing them. The sensing element (Sensor Front) will be used for pressure measurements and will be worn on the grasping side of your hand(s). The sensing element is physically located 2mm within the oval shaped stitch pattern on the Sensor Front. No sensing elements are located on the back of the sensor and should not be loaded.



Sensor Front

Sensor Back

First, attach the palm sensor (optional) first using the strap provided. Then slip on the finger sensors starting at the thumb and moving towards the pinky.	
Verify that the sensors have the correct orientation; the wires coming from the sensors should come from the top when the hand is placed face-down. Connect sensors to FingerTPS Sensor device, as shown below.	
Carefully fit a surgical glove over the sensors. Although a surgical glove is not mandatory, our clients have found that it helped them get a better grip and more realistic interaction with their test environment.	

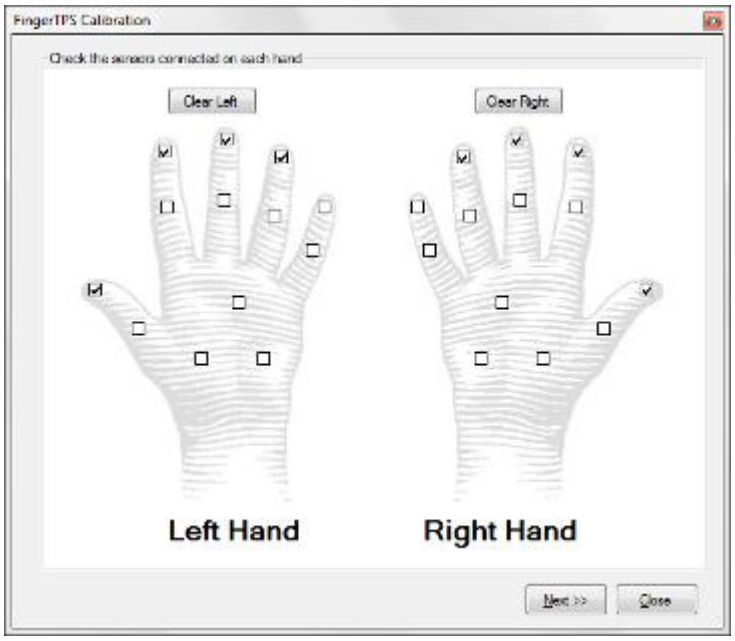
Removing the FingerTPS sensors

Carefully remove the glove and sensors off from the hand(s) while leaving the sensors inside the glove.

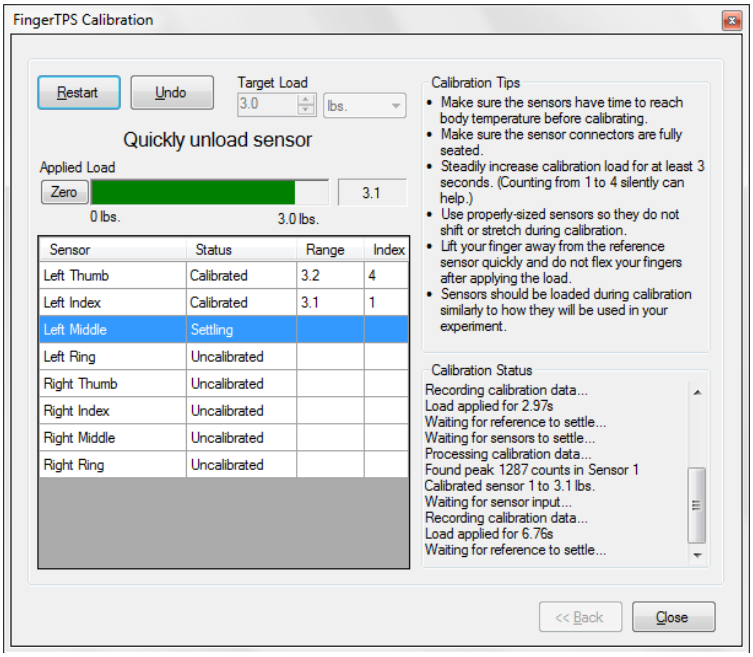
Remove the FingerTPS sensors from the glove
Disconnect sensors one by one from the FingerTPS Sensor Device

CALIBRATION PROCEDURE

PPS Visualizer Software allows for easy calibration of the FingerTPS sensors. To begin calibration, go to menu Data Acquisition / Calibrate System.
Select the sensors that are physically available to you and click Next to start calibration.



Sensor Selection Menu



Calibration Window

NOTE: The FingerTPS Calibration sensor is a very sensitive device. Do not overload with more that 10lbs or press down hard on it unless a custom high pressure sensor is in use. Please store in a safe place.

Find the Target Load field, enter a desired force level (default is 3lb), and set the units as needed. Click the Begin button to start calibrating.

Note: Click on Tare button in case the reference sensor is not reading at 0 prior to beginning a calibration.

Press the center of the designated Finger/Palm sensor slowly over the center of FingerTPS Calibration sensor raised pad until the Applied Load bar turns green. Then remove the Finger/Palm sensor from the Calibration sensor.

For best calibration results, please follow the tips displayed in the calibration window carefully. Ensure that the sensor fits snugly on a user's hand and warmup the sensor materials to body temperature when first worn by pressing on the sensing element repeatedly for a minimum duration of 1 minute.

GLOSSARY

It is important to understand the terminology used in this manual. Terms and definitions include:

Accuracy: Accuracy and repeatability interact with other factors such as temperature and placement of the sensor on the fingertips.

Baseline: The response from the sensor with no force acting upon it.

Calibration: The comparison of a pressure sensor output against the output of a reference standard.

Creep: The change in a sensors output occurring with time while a steady load has been applied for a specific period.

Force: Force can also be described by intuitive concepts such as a push or pull that can cause an object to begin moving from a state of rest or causes the object to deform. A force has both magnitude and direction which means it is important during calibration

that the force on the reference sensor is made perpendicular to the sensor and not sideways as the additional force may result in erroneous calibration.

Full Scale Range: The maximum measurement range for which a pressure sensor is calibrated.

Linearity: Pressure sensors are not linear which is why a calibration is performed. The force applied to the sensor is plotted on several points resulting in a calibration curve which then results in a linear response from

Pressure: Pressure is an effect which occurs when a *force* is applied on a surface. Pressure is the amount of force acting on a unit area. The amount of force or load applied to a unit area; Force divided by Area = Pressure.

Repeatability: The amount of change of a measured reading at exactly the same pressure and ambient conditions over a series of pressure cycles from zero to full scale pressure and back to zero again. To ensure no Pressure Hysteresis is introduced into Repeatability measurement, readings are always taken during an increase in pressure or a decrease in pressure but never a mixture of the two.

Sensitivity: The minimum amount of force required to see a change in display readings

Temperature Stability: Sensors are affected by temperature changes. A cold sensor, out of the box will changed in sensitivity and calibration when warmed to body temperature after being placed on the hand. It is suggested that prior to any critical experiments, the sensors be warmed up and "exercised" by pressing and releasing the fingertips against each other for about one minute

Zero Tare: The operation of removing any Baseline Offset to obtain the optimum measurement at zero pressure.

SHUTDOWN

To shutdown the software, simply click the "Close" box in the upper right or select "Exit" from the File Menu.

QUESTIONS AND SUPPORT

For questions and technical support regarding the Sapphire software, contact PPS via email at support@pressureprofile.com or via phone at 310-641-8100.