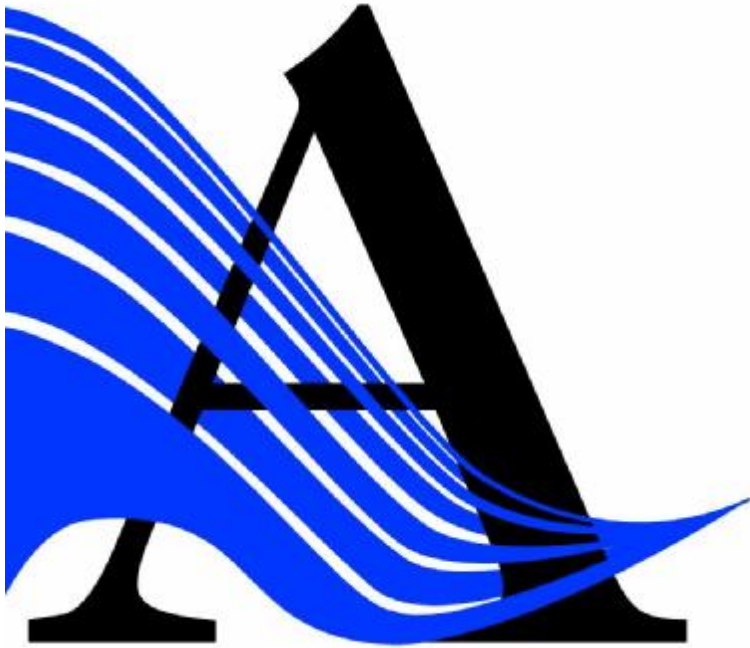


# **AEROPROBE SOFTWARE SUMMARY AND SPECIFICATIONS**



**Acoustic Recovery (ARC)  
Acoustic Transfer Function (ATF)  
AeroAcquire  
AirDataAcquire (ADA)  
AeroMove  
Multiprobe  
Omnipro**

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**AeroAcquire Data Acquisition Software:****Item:** SW-DAQ-E, SW-DAQ-P

**Description:** AeroAcquire is a general pressure data acquisition program specifically designed to integrate the Multiprobe and Omnipro P-V reduction algorithms as well as the AeroMove functionality for probe positioning. With Multiprobe and Omnipro reduction integration, AeroAcquire supports data acquisition for all 5-hole, 7-hole, 12-hole and 18-hole Aeroprobes. Integration of AeroMove allows control over the positioning of the Aeroprobes. AeroAcquire is available with support for either Ethernet interface data acquisition units, or PCI data acquisition boards (16-bit data acquisition is standard in either case).

AeroAcquire allows the user to: Control data acquisition for multiple probes; specify various pressure sensor modules and associated calibrations; specify traverse axes, coordinate frames and points at which to acquire data; control over the sampling rate, duration and triggering; and export pressure/velocity data to TecPlot (or other programs accepting generic columnar input data) for 3D visualization.

**Summary:****Supported Aeroprobe Pressure Input Modules:**

- AP3KTX Pressure Sensor Modules
- AP3KE Scanner Support Modules (Supports up to 4 Pressure Scanners)
- AP3KA Fast-Response Probe Amplifier Modules
- AP3KDK Series Multimedia Pressure Sensor Modules

**Probe Positioning:**

- Supports AP3KM and AP4KM Aeroprobe Motor Controllers
- 1, 2 or 3-Axis Systems Supported
- Typical Position Resolution of  $\pm 6.35 \mu\text{m}$
- Motor Encoder Support with AP4KM Controller

**Supported Probe Types:**

- 5/7-Hole Aeroprobes, All Geometries
- 12/18-Hole Omniprobes, All Geometries
- 5/7-Hole Fast Response Aeroprobes, All Geometries

**Data Acquisition:**

- Sampling Rates and Durations User-Specified
- Software, Manual and External TTL Triggers
- Single-Channel Rates up to 300 kHz
- Multiple Ensembles Enables Phase-Averaged Data Reduction

**I/O Text Data File Formats:**

- Time-Series Pressure
- Time-Series Velocity (w/Multiprobe, Omnipro)
- Avg. Pressure vs. Position

- Avg. Velocity vs. Position (w/Multiprobe, Omnipro)
- Export to TecPlot File Format

**External Channels:**

- Number of External Channels Depends on Pressure Input Module
- External Channel Voltage Can Correspond to User-Defined Variable (e.g. Pressure, Temperature)
- User-Defined Polynomial Calibration Input
- Results Displayed in Output Files

**Grid Definition:**

- User-Defined Cartesian and Polar Grids
- Automatic or Manual Traversing
- Match Probe Coordinates to Global Coordinates
- Integrated Probe Offset for Multiple Probes e.g. Probe Rakes)

**Sensor/Probe Calibrations:**

- Sensor Calibrations, Including w.r.t. Temperature
- Probe Calibrations
- Acoustic Response Calibrations (for Fast-Response Aeroprobes)
- Automatic/Manual Zeroing/Calibration of Pressure Sensors at User-Defined Intervals

**Miscellaneous:**

- User-Defined Data Acquisition Time Intervals
- Pitot-Static Probe Support (Wind-Tunnel Applications)

**AeroAcquire Specifications:**

<b>Application:</b>	Pressure Data Acquisition, with Integrated P-V Reduction (Multiprobe, Omnipro) and Probe Positioning (AeroMove)	<b>Probe Types:</b>	5-Hole, 7-Hole, 12-Hole and 18-Hole Probes of All Geometries, Including Fast-Response Probes
<b>Software Interface &amp; Integration:</b>	Integrates Multiprobe DLL, Omnipro DLL, AeroMove DLL (All Sold Separately);	<b>Number of Probes Supported:</b>	Up to 5 Standard, Additional Probe Support on Request
<b>Calibration Interface &amp; Integration:</b>	Multiple Probe Calibrations, Sensor Calibrations (Temperature Effects Optional), Probe Acoustic Calibrations (for Fast-Response Aeroprobes), Thermocouples	<b>Data Acquisition Modes:</b>	Automatic and Manual Grid Acquisition w/ User Defined Grids; Time-Series Data, Averaged Data, Continuous with Real-Time Display
<b>Traversing System Interface &amp; Integration:</b>	Communicate to Motor Controllers via RS232 (AP3KM) or Ethernet (AP4KM); 1, 2 or 3-axis Traversing System Support	<b>Data Acquisition Frequency:</b>	300 kHz, Max; 10 kHz, Max for Fast-Response Probes; 500 Hz Typical for Conventional Probes
<b>Triggering:</b>	Software, Manual, External TTL	<b>Input:</b>	Single-Ended or Differential Pressure Sensor Voltages, User-Specified Uni-directional or Bi-directional Ranges; Also External Voltages Corresponding to User-Specified Quantities
<b>Output:</b>	Time-Series of Pressure/Velocity; Averaged Pressure/Velocity vs. Position		
<b>Output Format:</b>	Various Tab-Separated Text-File Formats (see Aeroprobe File Formats Document for More Information); Data Export to TecPlot File Format	<b>Input Range:</b>	±5V, 0-5 V Typical for Sensors Available from Aeroprobe; Various Alternate Ranges Available Depending on Data Acquisition Device
<b>Operating Systems:</b>	Windows 95/98/2000/XP, Windows DLL	<b>System Requirements:</b>	7 MB Hard Drive, 256 MB RAM

**Multiprobe 5/7-Hole Pressure-to-Velocity Reduction Software:**
**Item:** SW-MP

**Description:** Multiprobe is the pressure-to-velocity reduction software used in conjunction with 5-hole and 7-hole Aeroprobes. The basic software is a post-processing, Windows-compatible package.

Multiprobe normally utilizes a local-least squares (LLS) fit of the closest (to the test point in question) calibration points, for each of the calibration variables. The LLS searching algorithm uses specialized multi-region search routines and angular range validation routines to improve accuracy. In addition, the user can specify use of a faster sector-fitting algorithm that is not as accurate as the LLS approach, but yields significantly higher data-reduction rates, which makes it more conducive to real-time data-reduction. Multiprobe has common file formats with AeroAcquire, the multi-hole probe pressure data acquisition software package. Multiprobe integrates seamlessly into AeroAcquire to provide accurate P-V reduction for the acquired pressure data.

All reduction algorithms have typical average errors in total velocity of  $< 0.8\%$  in the total velocity (including error propagation of flow pressures & angles) and  $< 0.4^\circ$  in the flow angles, when used with calibration data generated in our facilities and 0.1% accurate (or better) pressure sensors. In addition, all reduction algorithms have the ability to interpolate between multiple calibration files. This gives the user the ability to operate the probe over a wide range of speeds while maintaining the reduction accuracy and ease of use normally associated with the use of one calibration file.

**Interface and Integration:** Multiprobe is a GUI front-end that retrieves user input and then calls functions stored in a DLL. This DLL is available to the user for programming pressure-to-velocity reduction calls from custom software. Current language support for C/C++, Delphi, Visual Basic, and an Excel macro are included.

Multiprobe has the ability to pre-process calibration data and subsequently reduce test data corresponding to customer or third-party probes and/or calibrations.

**Multiprobe Specifications:**

<b>Application:</b>	Pressure-to-Velocity Data Reduction	<b>Probe Types:</b>	5-Hole and 7-Hole Probes of All Geometries
<b>P-V Reduction Algorithms:</b>	Local-Least Squares Surface Fit (LLS); Sector Surface Fit; Multiple Calibration File Access for Reduction with Wide Speed Ranges	<b>P-V Reduction Accuracy:</b>	$\pm 0.4^\circ$ Flow Angles, $\pm 0.8\%$ Velocity Magnitude**
<b>Interface &amp; Integration:</b>	Multiprobe GUI, Excel Macro, DLL Function Access from Custom Programs in C/C++, VB, Delphi		
<b>Input:</b>	Measured Port Pressures, Reference Pressure for Differential Pressure Sensors, Total or Ambient Temperature	<b>Output:</b>	V , Pt, Ps, Flow Angles, Mach; User-Specified Units
<b>Input Format:</b>	Text Files with Tab/Space Separated Columnar Data; Excel Columnar Data to Excel Macro; User-Specified Units	<b>Output Format:</b>	User-Specified Variables & Units Contained in Text Files with Tab/Space Separated Columnar Data; Excel Columnar Data from Excel Macro;
<b>Operating Systems:</b>	Windows 95/98/2000/XP, Windows DLL	<b>System Requirements:</b>	30 MB Hard Drive, 256 MB RAM

**Omnipro 12/18-Hole Pressure-to-Velocity Reduction Software:**
**Item:** SW-OMNI

**Description:** Omnipro is the second-generation pressure-to-velocity reduction software used in conjunction with 12-hole and 18-hole Omniprobes. The basic software is a post-processing, Windows-compatible package.

Omnipro utilizes a local-least squares (LLS) fit of the closest (to the test point in question) calibration points, for each of the calibration variables. The LLS searching algorithm uses specialized search routines and angular range validation routines to improve accuracy. Omnipro has common file formats with AeroAcquire, the multi-hole probe pressure data acquisition software package. Omnipro integrates seamlessly into AeroAcquire to provide accurate P-V reduction for the acquired pressure data.

All reduction algorithms have typical average errors in total velocity of  $< 0.8\%$  in the total velocity (including error propagation of flow pressures & angles) and  $< 0.4^\circ$  in the flow angles, when used with calibration data generated in our facilities. In addition, all reduction algorithms have the ability to interpolate between multiple calibration files. This gives the user the ability to operate the probe over a wide range of speeds while maintaining the reduction accuracy and ease of use normally associated with the use of one calibration file.

**Interface:** Omnipro is a GUI front-end that retrieves user input and then calls functions stored in a DLL. This DLL is available to the user for programming pressure-to-velocity reduction calls from custom software. Current language support for C/C++, Delphi, Visual Basic, and an Excel macro are included.

**Omnipro Specifications:**

<b>Application:</b>	Pressure-to-Velocity Data Reduction	<b>Probe Types:</b>	12-Hole and 18-Hole Omniprobes of All Geometries
<b>P-V Reduction Algorithms:</b>	Local-Least Squares Surface Fit (LLS); Multiple Calibration File Access for Reduction with Wide Speed Ranges	<b>P-V Reduction Accuracy:</b>	$\pm 0.4^\circ$ Flow Angles, $\pm 0.8\%$ Velocity Magnitude**
<b>Interface &amp; Integration:</b>	Omnipro GUI, Excel Macro, DLL Function Access from Custom Programs in C/C++, VB, Delphi		
<b>Input:</b>	Measured Port Pressures, Reference Pressure for Differential Pressure Sensors, Total or Ambient Temperature	<b>Output:</b>	V , Pt, Ps, Flow Angles, Mach; User-Specified Units
<b>Input Format:</b>	Text Files with Tab/Space Separated Columnar Data; Excel Columnar Data to Excel Macro; User-Specified Units	<b>Output Format:</b>	User-Specified Variables & Units Contained in Text Files with Tab/Space Separated Columnar Data; Excel Files from Excel Macro;
<b>Operating Systems:</b>	Windows 95/98/2000/XP, Windows DLL	<b>System Requirements:</b>	2 MB Hard Drive, 256 MB RAM