Scisense ADV500

Pressure-Volume Measurement System for Cardiac Function Research in All Sizes of Hearts



- True volume in real-time with Admittance technology
- Variable Segment Length (VSL) Catheters ensure proper fit and accurate results
- Compatible with virtually any data acquisition system and software package



Why PV Loops?

In the realm of heart function and hemodynamics, scientists have historically relied on systemic blood pressure, blood flow, and ventricular pressure to report changes in heart performance.

Applications in this field of study include phenotyping, the study of drugs and their possible cardiac-protective effects, and the genetic/ environmental factors linked to heart disease.

Advancing the limits of science, we strive for better understanding, better treatments, and ultimately possible cures for heart disease. To achieve this goal researchers need to quantify performance, including subtle changes in contractility, elastance, power, energetics and efficiency. Fortunately, there is an answer to this demand - the Pressure-Volume Loop.

By plotting ventricular pressure and volume in the XY plane, a researcher can study individual cardiac cycles or a family of loops. Ejection fraction, cardiac output, max & min dP/dt, stroke volume, and tau are just a small example of the many parameters that can be reported. Additionally, valuable measurements of contractility and elastance are obtained by creating 'pressure-volume relationship curves'. Derived only by PV Loop analysis, these relationships are crucial to cardiovascular studies to generate a full report of heart function.

Simply put, PV loops are essential in the study of hemodynamics and cardiac function.



ADV500 Design & Technology



PRESSURE-VOLUME LOOP MEASUREMENTS

VARIABLE	DESCRIPTION	
ESP	End-Systolic Pressure	
EDP	End-Diastolic Pressure	
ESV	End-Systolic Volume	
EDV	End-Diastolic Volume	
HR	Heart Rate	
Max dP/dt	Maximum Derivative of Pressure	
Min dP/dt	Minimum Derivative of Pressure	
Max dV/dt	Maximum Derivative of Volume	
Min dV/dt	Minimum Derivative of Volume	
CO	Cardiac Output	
EF%	Ejection Fraction	
SV	Stroke Volume	
SW	Stroke Work	
Ea	Arterial Elastance	
maxPwr	Maximum Power	
plPwr	Preload Adjusted Power	
Eff	Efficiency	
PE	Potential Energy	
PVA	Pressure-Volume Area	
ESPVR	End-Systolic PV Relationship	
EDPVR	End-Diastolic PV Relationship	
PRSW	Preload Recruitable Stroke Work	
E(t)	Time-Varying Elastance	
Tau	Isovolumic Relaxation Constant	

SOFTWARE MODULES

Flexibility is important. This is why the ADV500 has been developed with individualized options for animal operation mode and volume measurement process. This design allows researchers to have a customized system specific to their needs and budget.

There are 3 software modules available, all designed to improve system accuracy and user experience over the basic conductance operation mode:

- Rodent Admittance Module
- Large Animal Admittance Module
- Variable Segment Length (VSL) Catheter Module

ADMITTANCE VOLUME... THE NEW GOLD STANDARD

Admittance is our patented technology for calculating absolute volume in real-time.

Part 1: Automatic Isolation of the Blood Signal

Using a traditional PV Catheter inserted into the ventricle, Admittance allows for the detection of overall conductance and 'parallel conductance' coming from the surrounding muscle tissue. We call this muscle measurement 'Phase'. This is extremely important because the muscle contribution changes during the cardiac cycle and during the course of an experiment - therefore, it must be removed in order to accurately report volume. With parallel conductance automatically quantified, the system can isolate the blood signal.

Part 2: Conversion to Volume

Taking things one step further, the ADV500 onboard processor uses Wei's equation¹ to convert the isolated blood signal to true volume: the result is a real-time streaming signal presented in μ L or mL. When paired with an appropriate data acquisition system, researchers can view PV loops and calculate hemodynamic reports in real-time. This allows you to confirm quality data and start analysis at the bench-top, ultimately increasing throughput.



BASELINE PRESSURE-VOLUME DATA FROM A HEALTHY MOUSE

In Admittance mode, the system outputs four signals: Pressure (mmHg), Volume (μ L or mL), Phase (degrees), and Magnitude (μ S or mS).

No post processing is required to obtain accurate volume. In addition, researchers can view the Phase signal to confirm proper and consistent Catheter location in the center of the ventricle.



HIGH-RESOLUTION ECHO COMPARISON FROM A HEALTHY MOUSE

On the far left, XY plots show Admittance (blue) and Conductance (black) PV loops in two different scenarios: central Catheter position (top) and off-center position (bottom). Vertical dashed lines show endsystole and end-diastole, as measured by high-resolution echo. In both scenarios, Admittance data better correlates with echocardiography.



CORRELATION WITH MRI IN SHAM AND HF PIGS

Bland Altman plots show strong correlation between MRI volumes and Admittance volume measurements in sham pigs (blue dots) and pigs following 2 hour myocardial infarction by left circumflex coronary artery occlusion (red dots).

Suitable for use in a variety of animal models and different heart sizes

• Provides the flexibility needed to customize your research program

Variable Segment Length (VSL) Catheters provide flexibility

- Ensures an accurate fit for larger hearts and dilation studies
- One Catheter is suitable for a wider range of applications and animal types

Pre-amplified analog outputs (Pressure, Volume, Phase, Magnitude, Pressure 2)

• Can be integrated with virtually any data acquisition system (± 5V range minimum)

Includes Additional Volume (AdVol) Admittance software

• Recalculate volume while having control over the coefficients in Wei's equation

Digital controls and LCD display

- Intuitive menu design makes set-up and system use easy
- Key system settings are displayed during acquisition to keep the researcher informed

Two pressure inputs

- Acquire PV loops and blood pressure simultaneously via two Catheters
- Calculate pressure gradients or pulse-wave velocity

"The ADV500 system is both effective and reproducible in measuring LV function and dysfunction in the mouse, without the need for complicated interventions to calibrate the measurements."

James E. Clark Ph.D, Kings College London

"This system is easy to use and provides clear and concise control features. The ability to generate true-volume in real time makes the system invaluable."

Pamela Lucchesi Ph.D, Nationwide Children's Hospital

Ordering Information

CATALOG #	DESCRIPTION	COMMON ANIMAL TYPES	FEATURES
FFS-097-A001	Admittance PV Foundation System for Small Animals	Mouse, Hamster, Rat, Guinea Pig	True-volume in real time; no saline bolus required; Catheter position feedback; VSL Catheters optional
FFS-097-A004	Admittance PV Foundation System for Large Animals	Rabbit, Dog, Pig, Sheep	True-volume in real time; no saline bolus required; Catheter position feedback; VSL Catheters standard
FFS-097-A007	Admittance PV Foundation System for All Animal Sizes	Mouse, Hamster, Rat, Guinea Pig, Rabbit, Dog, Pig, Sheep	True-volume in real time; no saline bolus required; Catheter position feedback; VSL Catheters standard

LIMITED WARRANTY & RECALIBRATION

- Transonic[®] warrants for a period of two (2) years from date of shipment that ADV500 hardware, cables, power supply, and
 associated hardware accessories, purchased through Transonic[®] or its duly appointed distributor or licensed representative, are free
 from defects that result from faulty material or workmanship by Transonic[®]
- Transonic[®] warrants for a period of twelve (12) months from date of shipment that Catheters less than two French (<2F) are free from defects that result from faulty material or workmanship by Transonic[®]. Transonic[®] warrants for a period of three (3) months from date of shipment that Catheters greater than two French (<2F) are free from defects that result from faulty material or workmanship by Transonic[®]. Transonic[®] warrants for a period of three (3) months from date of shipment that Catheters greater than two French (>2F) are free from defects that result from faulty material or workmanship by Transonic[®]. Warranty is only valid if Catheters are purchased through Transonic[®] or its duly appointed distributor or licensed representative.
- The Transonic[®] warranty does not apply to: defects caused by abuse, neglect or misuse; damage due to accident or casualty; or unauthorized alterations by anyone other than Transonic[®] or an appointed repair center.
- The Buyer pays shipping charges to the Transonic® plant or repair center; Transonic® will pay for return shipment charges.
- If measurement accuracy is questioned during the two year warranty period, Transonic[®] shall inspect and recalibrate ADV500 hardware free of charge provided that the Buyer pays for all shipping charges.

REFERENCE

1. Porterfield JE, Kottam AT, Raghavan K, Escobedo D, Jenkin JT, Larson ER, Trevin⁻o RJ, Valvano JW, Pearce JA, Feldman MD. Dynamic correction for parallel conductance, Gp, and gain factor, α, in invasive murine left ventricular volume measurements. J Appl Physiol 107: 1693–1703, 2009.



Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.