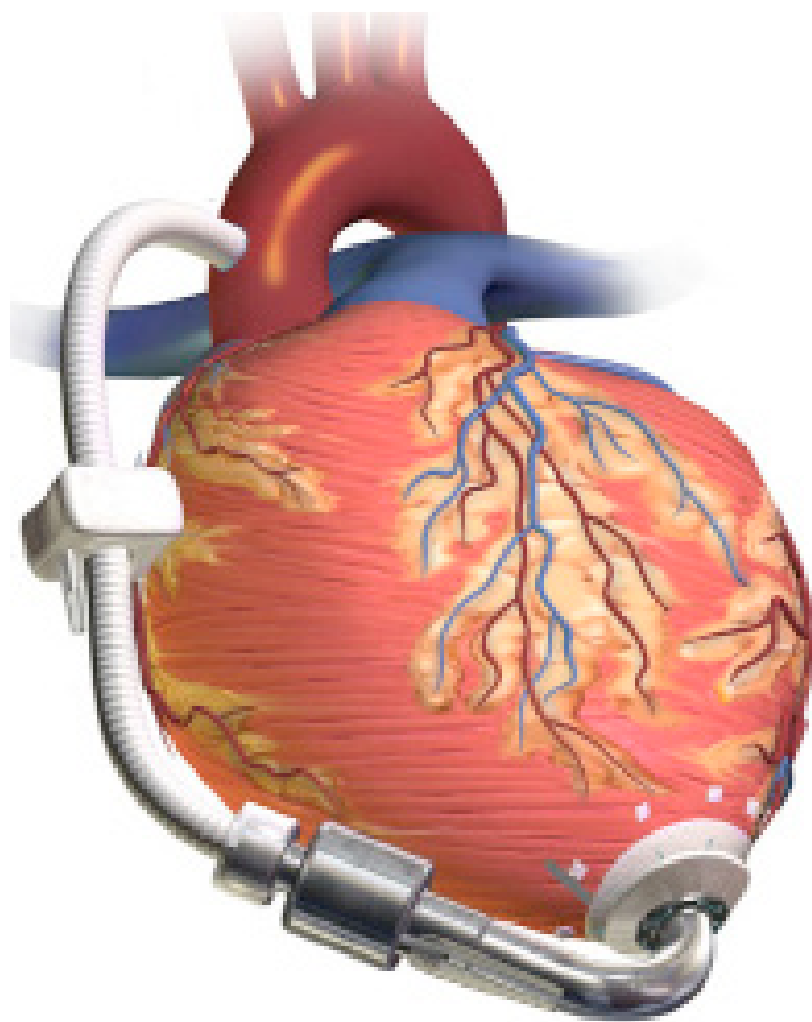


Know Real Flow in Ventricular Assist Devices (VADs)



& Detect Flow Compromise

INTRAOPERATIVE & EXTRACORPOREAL FLOW VERIFICATION

True VAD Circuit Flow with HXL Tubing Sensors

Delivered Blood Flow

Thrombosis is a dreaded complication of having a left ventricular assist device. However, with the unmatched accuracy of Transonic H-XL-Series Clamp-on Tubing Sensors, true blood flow through the circuit can be known at all times. By comparing actual delivered blood flow to the flow reading on the pump, flow limiting causes can be detected and corrected on the spot. Kinks and circuit blockages can be detected and corrected before catastrophic circuit failures with dire consequences can occur.

Transonic Tubing Sensors display true delivered blood flow through tubing circuits with gold standard transit-time ultrasound technology.

An external clamp-on Flowsensor clips onto the tubing to continuously monitor actual flow delivery to the patient. Measurements are non-invasive, continuous and bi-directional.



HXL-Series Tubing Sensor

HXL Clamp-on Tubing Sensors Attributes:

- Measure volume flow in mL or L/min non-invasively;
- Maintain sterility of liquids;
- Offer custom sensor calibration available for different fluids and temperature combinations

Transit-Time Ultrasound (TTU) Advantages

Transit-time ultrasound technology offers clear advantages over other flow measurement technologies.

TTU Directly Measures Volume Flow

Wide beam ultrasonic illumination of transit-time ultrasound Flowsensors measure the velocity of fluid across the entire vessel lumen and derive **VOLUME FLOW** in mL/min or L/min. Doppler derives flow from separate estimates of average **VELOCITY** in cm/sec of particles in a field. Doppler measures speed. TTU measures speed times cross section to arrive at volume flow.

TTU Measures Flow in All Fluids

TTU measurements are not dependent on particulate matter in the fluid in order to measure flow. Fluids such as saline, water and physiological buffers can be measured with TTU unlike Doppler measurements which require signals to bounce off moving particles within a fluid in order to measure flow.

Checksum Safety Feature

For volume flow measurements, Flowsensors are specifically calibrated for the mechanical properties of a specific tubing including a tubing's composition, its wall thickness and inside and outside diameters. A calibration factor or

"checksum" is stored in a Tubing Flowsensor's EEPROM memory. As a safety precaution, Transonic's Tubing Flowmodules are programmed to read the checksum of a specific Flowsensor and lock out any sensors that do not meet the right calibration specifications. Similarly, the checksum allows ease of interchangeability between sensors that do have the same calibration factor programmed in their EEPROM.

Unmatched Zero-Flow Stability

The acid test of any transit-time flowmeter design is its zero-flow stability in regards to time and temperature. A flowmeter's noisy oscillator drives its transmitting circuitry and functions as the phase reference signal for its sensitive receiver amplifiers and detectors. Direct pickup of an oscillator's signal into the received signal exhibits itself as a zero-flow offset.

If the phase relationship between the transmit and received signal fluctuates due to variations in acoustic transit-times as a result of temperature or other liquid property changes, this pick-up signal manifests in a varying zero flow offset which is indistinguishable from a change in true flow unless the flow is stopped and a meter is re-zero'ed.

CIRCUIT FAILURE & THROMBUS PREVENTION

VAD Implantation Surgery & VAD Outflow with COnfidence Flowprobes®

Implant Surgery

Surgery to implant a mechanical circulatory assist device such as a pVAD or LVAD is precise and precarious. Cannulas must be placed in major arteries, and the heart. Bleeding is a frequent complication, but flow can also be compromised at any moment. Measuring flow intraoperatively with a Transonic® Perivascular Flowprobe on the Aorta or Pulmonary artery keeps the surgeon appraised of the function of the heart at all times and allows for early intervention, if necessary.

True VAD Outflow

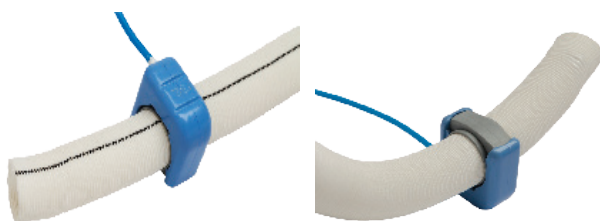
Management of acute right heart failure, a common complication following implantation of an VAD for left ventricular circulatory support, requires a reliable estimation of left ventricular preload and contractility. A Transonic® ultrasonic Flowprobe on a VAD's outflow line provides this information. A progressive decline in outflow accompanied by a loss of pulsatility and other indicators such as lower pressure and/or acute renal failure signals acute right heart failure and earlier measures can be taken to restore flow.

COnfidence Flowprobes®

COnfidence Perivascular Flowprobes® are designed for adult and pediatric, and neonatal intraoperative flow measurements. They can also be customized and calibrated for VAD dacron outflow (see figures). Their small footprint and slim profile permits measurement of volume flow in great arteries and veins with turbulent flow and where a compact flowprobe is needed.

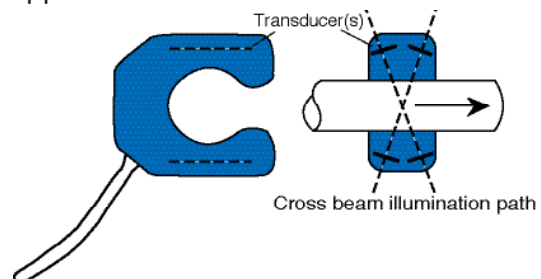
COnfidence Flowprobe® attributes:

- Measure volume flow, not velocity;
- Are available in a wide range of sizes including miniature 4 mm and 6 mm sizes for neonatal anatomy;
- Quick, measurements seconds after Flowprobe is applied.



COnfidence Flowprobes® on Dacron grafts:

COnfidence Flowprobes® consist of a Flowprobe shell and a single-use soft, flexible Ultrafit liner that slips into the transducer shell to encircle the vessel and keep the vessel in place.



Theory of Operation:

Two pairs of transducers positioned on the opposite sides of the vessel/tube alternately transmit in upstream and downstream directions. Positional sensitivity is eliminated by the use of custom designed crystals and the cross-beam pattern of ultrasonic illumination.

Annotated References

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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.

AMERICAS

Transonic Systems Inc.
Tel: +1 607-257-5300
Fax: +1 607-257-7256
support@transonic.com

EUROPE

Transonic Europe B.V.
Tel: +31 43-407-7200
Fax: +31 43-407-7201
europe@transonic.com

ASIA/PACIFIC

Transonic Asia Inc.
Tel: +886 3399-5806
Fax: +886 3399-5805
support@transonicasia.com

JAPAN

Nipro-Transonic Japan Inc.
Tel: +81 04-2946-8541
Fax: +81 04-2946-8542
japan@transonic.com