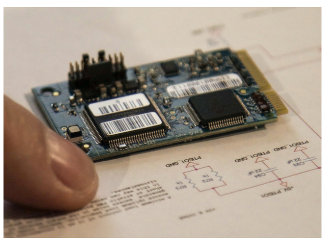
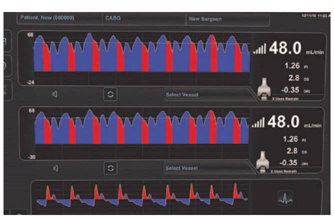
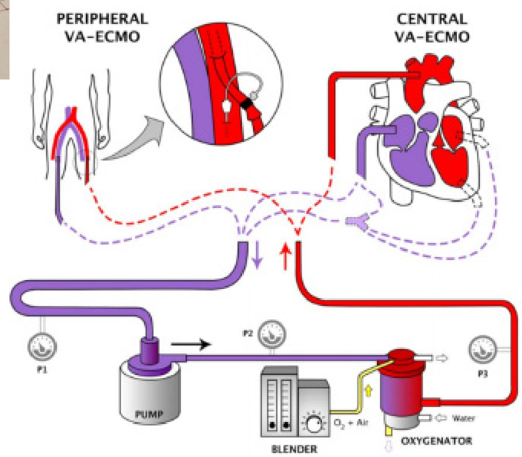
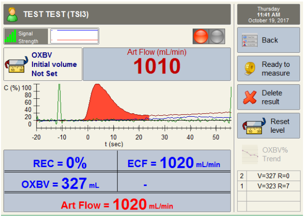
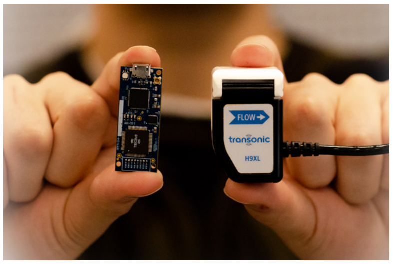
Transonic Inside™ Measurement Solutions for ECMO

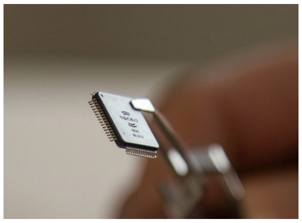












transonic
THE MEASURE OF BETTER RESULTS.
transonic.com/oem

ECMO Experts

Transonic is proud to have been part of some of the most important ECMO developments.

2020

Krivitski N et al, *"New noninvasive methodology to measure cardiac output in veno-venous extracorporeal membrane oxygenation patients. Perfusion. 2020 May;35(1_suppl):73-80.*

2018

Krivitski N et al, *"In vitro and in vivo assessment of oxygenator blood volume for the prediction of clot formation in an ECMO circuit (theory and validation)," Perfusion 2018; 33(IS): 51-56. (Transonic Reference # ELS11317)*

2016

Palmér O et al, *"Cannula Design and Recirculation During Venovenous Extracorporeal Membrane Oxygenation,"* ASAIO J. 2016; 62(6): 737-742. (Transonic Reference # EC11034AH)

2015

Said MM *et al, "Precision & Accuracy of the New Transonic ELSA Monitor to Quantify Oxygenator Blood Volume (in-vivo and in-vitro studies),"* 2015 PAS Annual Meeting and Eastern SPR Annual Meeting. (Transonic Reference # ELS10230V)

2012

Körver EP et al, *"Quantification of recirculation as an adjuvant to transthoracic echocardiography for optimization of dual-lumen extracorporeal life support,"* Intensive Care Med. 2012 38(5): 906-909. (Transonic Reference # ELS9679AH)

2006

Darling EM, Crowell T, Searles BE, *"Use of dilutional ultrasound monitoring to detect changes in recirculation during venovenous extracorporeal membrane oxygenation in swine,"* ASAIO J 2006; 52(5): 522-4. (Transonic Reference # 7309A)

2001

Van Heijst AF *et al, "Recirculation in double lumen catheter veno-venous extracorporeal membrane oxygenation measured by an ultrasound dilution technique,"* ASAIO J, 2001; 47(4): 372-6. (Transonic Reference # HD49V)

1997

Snyder EJ *et al, "Setting roller pump occlusion with the Transonic HT109 Flowmeter,"* ASAIO J 1997; 43: 60-64. (Transonic Reference # 517AH).

1996

Berube MC *et al, "Ultrafiltration in the Cardiac ECMO Patient: Use of the Transonic HT109 Flowmeter to Determine Hemofilter Shunt and Actual Flow,"* 12th Annual CNMC Symposium on ECMO & Advanced Therapies for Respiratory Failure, Keystone, CO, Feb 25-29, 1996. (Transonic Reference # 715A)

1990

Akers T *et al,* "In Vitro Comparison (electromagnetic, Doppler, pump occlusion & transit-time) of ECC Blood Flow Measurement Techniques," Proceedings of the ASET, 1990; 17-22. (Transonic Reference # 28V)

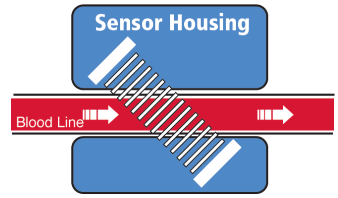
1987-89

Vilard J, Powers RJ, *"Relationship of Temperature and Hematocrit to the Accuracy of Flow Measurement by Transit Time Ultrasound,"* ELSO Extracorporeal Life Support Organization, 1989; 1:23. (Transonic Ref # 16V) Dr. Robert Bartlett write Flowsensor into ECMO protocol to measure pump flow. C-Series Clamp-on sensors introduced or noninvasive sterile tubing use; adopted by ASAIO for TAH, VADs, CPB and ECMO

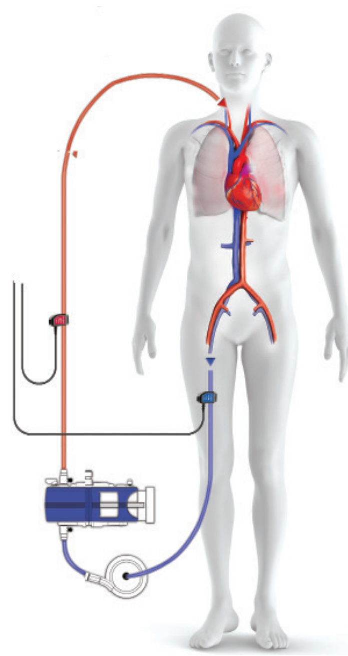
ECMO Measurement Technology

Transit-time Ultrasound
+
Ultrasound Dilution Technology
=
A Uniquely Powerful Combination!

Flow/ Dilution Sensor: The blood line is inserted into the channel of the flow/dilution sensor body. The direction of flow is indicated by arrows. Ultrasonic beam is shown emanating from the two transducers in the



Transit-time Ultrasound Flow Measurement Methodogy



Using wide-beam illumination, transducers pass ultrasonic signals back and forth, alternately intersecting flowing liquid in upstream and downstream directions. The transit time of the ultrasonic beam is decreased when traveling downstream and increased when traveling upstream.

The integrated differences between the upstream and downstream transit times over the distance of the tubing/vessel provide a measure of volume flow. The sum of the transit times yields information about liquid properties that affect ultrasound velocity and allow for a suite of ultrasound dilution measurements.

Ultrasound Dilution Technology Measurement Methodology

1. A bolus of isotonic saline is introduced into the extracorporeal circuit, diluting the blood. A corresponding drop in protein concentration reduces the liquid's ultrasound velocity.
2. Paired flow/dilution sensors (arterial and venous) attached to the extracorporeal circuit sense this decrease in velocity. Indicator dilution curves can then be produced and displayed.
3. This flow-derived measurement data allows for a variety of parameters to be calculated including recirculation, clotting indication, cardiac function measures and much more.

The Krivitski Method®

Nikolai Krivitski

Pioneered by Nikolai Krivitski, PhD, DSc, the Krivitski Method® marries transit-time ultrasound and indicator dilution principles. It can be used in any situation involving an extracorporeal blood circuit and leverages Transonic's highly accurate tubing flow sensors. Measurements are immediate, non-invasive, and can provide a wide variety of clinically valuable data points for healthcare providers. It is commonly used today in the hemodialysis and ECMO fields.

ECMO Parameters

Through the use of UDT technology leveraging dual sensors and bi-directional flows, it becomes possible to acquire many parameters beyond just volume flow:

Standard Measurements Taken During ECMO

- ✓ Mean Arterial BP (MAP)
- ✓ Oxygen Saturation
- ✓ CO2, End-tidal CO2
- ✓ Central Venous Pressure (CVP)
- ✓ SVO2 (venous sat)
- ✓ Pressure pre- and post-oxygenator
- ✓ Estimated flow based on pump data (RPM's)

Additional Measurements Possible Using UDT

- Recirculation
- Oxygenator Blood Volume (clotting indicator)
- Cardiac Output and other cardiac function parameters*
- Lung function assessment*
- Additional custom parameters*

* Transonic R&D work ongoing

Recirculation

During venovenous ECMO, some reinfused oxygenated blood can be withdrawn through the drainage cannula, thus not contributing to systemic oxygen delivery. Knowing the amount of recirculation helps clinicians make informed judgements relative to treatment efficacy and adjustments that can be made (e.g. cannula positioning, pump settings, tubing issues, etc.)

Oxygenator Blood Volume/Clotting Indicator

Oxygenator clotting is a major concern in medical devices circulating blood for any length of time. A quantitative indicator of clotting provides the ability to identify issues early and avoid adverse or catastrophic outcomes. Knowing OXBV brings objective data to the bedside, rather than having to rely only on subjective visual cues for decision making.

Cardiac Output and Other Cardiac Function Parameters

When managing hemodynamically unstable patients, it can be important for clinicians to recognize changes in cardiac function. Transonic's R&D team has discovered simple, non-invasive methodologies to accurately measure Cardiac Output (CO) and other cardiac function parameters. This information can contribute to recognizing potential warning signs and improving overall therapy effectiveness.

Additional Parameters

Research is ongoing with regard to many additional parameters and Transonic is committed to exploring and developing clinically meaningful measurements that can be utilized by our OEM partners.

Let’s Get Started

Transonic can help you develop meaningful ECMO measurements that will set you apart from the competition. The top flow minds in the business are at your disposal – scientists, engineers, and clinical specialists. Put us to the test with any project – big or small!

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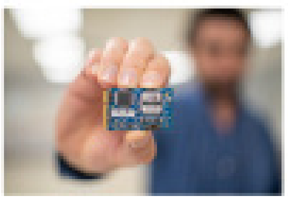

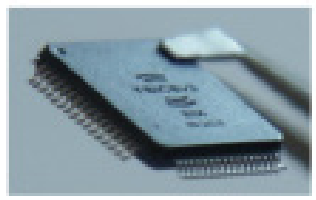

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