Noninvasive Cardiac Output
Electrical Cardiometry™
**Electrical Cardiometry™ (EC™)**

Electrical Cardiometry™ is a method for the non-invasive determination of stroke volume (SV), cardiac output (CO), and other hemodynamic parameters in adults, children, and neonates. Electrical Cardiometry has been validated against “gold standard” methods such as thermodilution and is a proprietary method patented by Osypka Medical.

### How it works

The placement of four skin sensors on the neck and left side of the thorax allow for the continuous measurement of the changes of electrical conductivity within the thorax. By sending a low amplitude, high frequency electrical current through the thorax, the resistance that the current faces (due to several factors) is measured. Through advanced filtering techniques, Electrical Cardiometry™ (EC™) is able to isolate the changes in conductivity created by the circulatory system. One significant phenomenon, which is picked up, is associated with the blood in the aorta and its change in conductivity when subjected to pulsatile blood flow. This occurrence is due to the change in orientation of the erythrocytes (RBCs).

During diastole, the RBCs in the aorta assume a random orientation, which causes the electrical current to meet more resistance, resulting in a lower measure of conductivity. During systole, pulsatile flow causes the RBCs to align parallel to both the blood flow and electrical current, resulting in a higher conductivity state. By analyzing the rate of change in conductivity before and after aortic valve opening, or in other words, how fast the RBCs are aligning, EC technology derives the peak aortic acceleration of blood and the left ventricular ejection time (flow time). The velocity of the blood flow is derived from the peak aortic acceleration and used within our patented algorithm to derive stroke volume.
Applications

Advanced, Non-Invasive Hemodynamic Monitoring:
Blood pressure, heart rate and other vital signs typically available to clinicians do not give a complete picture of a patient’s hemodynamics. Guiding therapy by traditional parameters makes it very difficult to decide whether volume, inotropes, or vasopressors would be best for the patient.

With the ICON and AESCULON, the user gets a complete picture of the patient hemodynamics using a method that is quick, easy, safe, non-invasive and accurate. The parameters provided by EC fill in the blanks of traditional monitoring, helping physicians guide fluid resuscitation and drug therapy in a targeted, continuous manner. In addition to providing parameters such as Cardiac Output and Stroke Volume measurements, there are several parameters unique to EC that provide enhanced indications of preload, contractility, afterload and delivered oxygen.

Goal-Directed Therapy and Fluid Management in the OR, ICU and ED:
Goal-directed therapy is a technique to guide administration of fluid and drugs to achieve certain hemodynamic goals. Protocols based on goal-directed therapy have been proven to reduce morbidity and mortality rates for critical patients specially who are suffering from severe sepsis, septic shock and patients undergoing high to medium risk surgeries. EC monitors make it easy and safe to use these protocols into routine practice.

Shock Differential Diagnosis:
Differential diagnosis and treatment of shock can be extremely challenging with traditional parameters like blood pressure and heart rate. Clinicians need a complete picture of the patient’s hemodynamics (flow, preload, contractility and afterload) to identify the type of shock (cardiogenic vs. hypovolemic for instance) and continuous monitoring to guide therapy and assess the patient’s response. EC monitors are ideal for these patients and for Early Goal Directed Therapy (EGDT) protocol for shock patients.

Pediatrics and Neonates:
EC monitors are the ONLY FDA cleared easy to use, non-invasive monitors for pediatrics and neonates. Invasive monitors like pulmonary artery catheters are typically too dangerous or impossible to use these patients. EC monitors are ideal because they are safe and easy to use. The sensors are small and gentle enough to use on even the tiniest and most fragile neonate. The data provided by EC monitors can help clinicians distinguish warm vs. cold shock, guide therapy, titrate medications and potentially provide an early warning of adverse events, and most important is a perfect fluid management.

Heart Failure and Hypertension Management:
EC monitors are ideal for the management of heart failure and hypertension, especially in an outpatient and even in home care setting. In less than 3 minutes, physicians have access to advanced hemodynamic data that can be used to optimize treatment and even predict future events in HF patients. This practice can potentially reduce hospitalization and ER visits and improve the patient’s quality of life.

Pacemaker Optimization (Pacemaker Clinic™):
Physicians that perform pacemaker optimization of AV and VV delay can use EC monitors to get quick and immediate data on which settings provide the patient with the best hemodynamics. The AESCULON can even integrate with Osypka Medical’s PACE 203 / PACE 300 external chamber pacemakers using Pacemaker Clinic to automate the optimization process.

Predictive Parameters: Complexity Analysis:
EC monitors offer the parameter HRC which has been shown helping to predict the need for life saving intervention in trauma patients.
**AESCULON® Parameters**

**Blood Flow**
- SV/SI: Stroke Volume / Stroke Index
- HR: Heart Rate
- CO/CI: Cardiac Output / Cardiac Index

**Vascular System**
- NIBP: Non-invasive Blood Pressure
- SVR / SVRI: Systemic Vascular Resistance / SVR-Index, based on input of Central Venous Pressure (CVP)
- SSVR / SSVRI: Stroke System Vascular Resistance / SSVR-Index

**Contractility**
- ICON™: Index of Contractility
- VIC™: Variation Index of Contractility
- LCW / LCWI: Left Cardiac Work based on input of Wedge Pressure (PAOP)
- LSW / LSWI: Left Stroke Work
- STR: Systolic Time Ratio (PEP/LVET)
- CPI: Cardiac Performance Index

**Fluid Status**
- TFC: Thoracic Fluid Content
- SVV: Stroke Volume Variation
- FTc: Corrected Flow Time

**Oxygen Status (Pulse Oximetry)**
- SpO2: Oxygen Saturation
- SpHb™: Levels of Total Hemoglobin
- SpMet: Level of Methemoglobin Concentration
- SpCO: Level of Carbon Monoxide Concentration
- PI / PI Change: Perfusion Index / PI Percent Change
- Desat Idx: Desaturation Index
- DO2 / DO2I: Oxygen Delivery / DO2-Index

**AESCULON® Features**
- Pacemaker Clinic™ optimization of cardiac pacing and resynchronization therapy (CRT).
- 12" high resolution color display
- Rechargeable battery backup for 20 min. of operation
- Connectivity to Philips monitoring systems by supporting the VueLink and IntelliBridge interface protocol
- USB interface for convenient backup of patient data and printing
- Waveform Explorer™ PC-Software allows data export to Microsoft® Excel™
**Window to the Circulation®**

- **Blood Flow**
  - SV/SI: Stroke Volume / Stroke Index
  - HR: Heart Rate
  - CO/CI: Cardiac Output / Cardiac Index

- **Vascular System**
  - SVR/SVRi: Systemic Vascular Resistance / SVR-Index
    - Based on input of Blood Pressure (BP) and Central Venous Pressure (CVP)

- **Contractility**
  - ICON™: Index of Contractility
  - VIC™: Variation of Index of Contractility
  - STR: Systolic Time Ratio (PEP/LVET)
  - CPI: Cardiac Performance Index

- **Fluid Status**
  - TFC: Thoracic Fluid Content
  - SVV: Stroke Volume Variation
  - FTC: Corrected Flow Time

- **Oxygen Status**
  - DO2 / DO2i: Oxygen Delivery / DO2-Index
    - Based on input of Hemoglobin and SpO2

**ICON® Parameters**

- **Blood Flow**
  - SV/SI: Stroke Volume / Stroke Index
  - HR: Heart Rate
  - CO/CI: Cardiac Output / Cardiac Index

- **Vascular System**
  - SVR/SVRi: Systemic Vascular Resistance / SVR-Index
    - Based on input of Blood Pressure (BP) and Central Venous Pressure (CVP)

- **Contractility**
  - ICON™: Index of Contractility
  - VIC™: Variation of Index of Contractility
  - STR: Systolic Time Ratio (PEP/LVET)
  - CPI: Cardiac Performance Index

- **Fluid Status**
  - TFC: Thoracic Fluid Content
  - SVV: Stroke Volume Variation
  - FTC: Corrected Flow Time

- **Oxygen Status**
  - DO2 / DO2i: Oxygen Delivery / DO2-Index
    - Based on input of Hemoglobin and SpO2

**ICON® Features**

- 3.5” high resolution color display
- Rechargeable battery backup for 120 min. of operation
- Connectivity to Philips monitoring systems by supporting the VueLink and IntelliBridge interface protocol
- Internal data storage and wireless transmission to PC
- iControl™ PC-Software allows data export to Microsoft® Excel™
- Wireless printing with Bluetooth™
**Technical Data**

<table>
<thead>
<tr>
<th>Measurement Method</th>
<th>AESCULON®</th>
<th>ICON®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Cardiometry (EC)</td>
<td>Electrical Cardiometry (EC)</td>
<td></td>
</tr>
<tr>
<td>Electrical Velocimetry (Advanced Bio-Impedance)</td>
<td>Electrical Velocimetry (Advanced Bio-Impedance)</td>
<td></td>
</tr>
<tr>
<td>EKG</td>
<td>&lt;=2.0 mA RMS/50kHz</td>
<td>&lt;=2.0 mA RMS/50kHz</td>
</tr>
<tr>
<td>Non-invasive Blood Pressure (NIBP)</td>
<td>Oscillotoric systolic: 40 mm Hg ... 260 mm Hg diastolic: 25 mm Hg ... 200 mm Hg</td>
<td>Can be entered manually</td>
</tr>
<tr>
<td>Oxygen Saturation (SpO2) optional</td>
<td>1 % ... 100 %</td>
<td>Can be entered manually</td>
</tr>
<tr>
<td>AC Input</td>
<td>100 ... 240 VAC 47 ... 63 Hz</td>
<td>100 ... 240 VAC 47 ... 63 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>max. 100 VA</td>
<td>max. 15 VA</td>
</tr>
<tr>
<td>Internal Battery</td>
<td>NiMH, cap. &gt; 20 min</td>
<td>Lithium Ion, cap. &gt; 2 hours</td>
</tr>
<tr>
<td>Display</td>
<td>12” color TFT</td>
<td>3,5” color TFT</td>
</tr>
<tr>
<td>Enclosure Dimensions: height x width x depth</td>
<td>293 mm X 310 mm X 185 mm</td>
<td>205 mm x 110 mm x 38 mm</td>
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<tr>
<td>Weight</td>
<td>6 kg</td>
<td>750 g</td>
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<tr>
<td>Classification According to EC-Directive US. Regulatory Class Protection Type Standard Compliance</td>
<td>Class Ila</td>
<td>Class Ila</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>Class II</td>
</tr>
<tr>
<td></td>
<td>Class 1 equipment (Typ BF)</td>
<td>Class 11 equipment (Typ BF)</td>
</tr>
<tr>
<td></td>
<td>IEC 60601-1, IEC 60601-1-2 and more</td>
<td>IEC 60601-1, IEC 60601-1-2 and more</td>
</tr>
</tbody>
</table>

**Literature: Adult**


**Literature: Pediatric & Neonate**