



**Where there's flow,**  
there's life

Measuring flow and pressure together,  
**for even greater control**



# Introducing the CardioQ-ODM+

## The CardioQ-ODM+ is the world's first fluid management and cardiac output monitoring system to measure both flow and pressure directly.

An exciting new upgrade to the proven Doppler technology, the monitor combines Doppler measurement of blood flow with Pulse Pressure Waveform Analysis (PPWA). This provides users with a proven highly sensitive "Flow Monitoring Mode" to guide intervention, and the simplest calibration of a "Pressure Monitoring Mode" for extended continuous monitoring yet devised.

Previous cardiac output monitors have either been ideal intervention devices, fast precise responsive flow based measurement but non-continuous, or less responsive pressure based continuous monitors requiring complex calibration and frequent recalibration to be effective.

In bringing together simple, minimally invasive oesophageal Doppler monitoring (ODM) flow based technology with a PPWA system, the CardioQ-ODM+ provides an unparalleled range of functional haemodynamic parameters. Patients can be continuously monitored for extended periods between intervention and calibration episodes.

Designed for intensive care and high risk surgical applications, Deltex Medical has chosen the most stable and extensively researched PPWA algorithm currently available <sup>1-2</sup>.

## Flow Monitoring Mode to guide SVO

The CardioQ-ODM+ has the precision and responsiveness to guide the clinically proven >10% change Stroke Volume Optimisation (SVO). The device has established an incomparable evidence base that is today acknowledged and endorsed by the National Institute for Health and Clinical Excellence (NICE MTG3) <sup>3</sup>. The clinical benefits of the CardioQ-ODM+ stem directly from the use of a low-frequency ultrasound signal to measure blood flow directly in the central circulation.

The evidence in support of Intra Operative Fluid Management (IOFM) is centred on the implementation of oesophageal Doppler monitoring (ODM), using the Doppler mode of the CardioQ-ODM+.

No other haemodynamic monitor provides the benefits of both the clinically proven Doppler based intervention mode and a stable, easily calibrated continuous monitoring system.

### CardioQ-ODM+ provides:

- Flow Monitoring Mode utilising oesophageal Doppler to guide intervention using a 10% Stroke Volume Optimisation (SVO) protocol
- Quick, easy calibration of PPWA algorithm at no additional cost
- Pressure Monitoring Mode using arterial access for extended continuous monitoring by PPWA

No other **cardiac output device** has the same precision.

### CardioQ-ODM+ is ideal for:

- Intensive care
- High risk surgical patients transferring to overnight surgical recovery units, or ICU for postoperative monitoring
- Surgical cases where displacement of the oesophagus may interrupt Doppler measurement
- Prolonged periods of diathermy

# a world first

## Easiest calibration of PPWA

The CardioQ-ODM+ uses the proven Doppler technology to control both its Flow Monitoring Mode of use and the calibration of the chosen PPWA algorithm for its Pressure Monitoring Mode of cardiac output.

Uncalibrated PPWA algorithms have been shown to be prone to drift due to changes in vascular tone, arterial compliance and the consequent arterial blood pressure variation. These changes have been reported to be clinically significant. Leaders in the field of PPWA technology have also strongly recommended calibration before major clinical decisions are taken <sup>4</sup>.

Recalibration may therefore be even more important than initial calibration. The inability to recalibrate easily before intervention has resulted in limitations in the use and precision of PPWA.

The CardioQ-ODM+ solves the PPWA calibration problem at the highest level of precision in a matter of seconds. Simply focus the Doppler signal and calibrate the PPWA algorithm at the touch of a button.

Studies of PPWA devices recommend that in critically ill patients the device should be recalibrated at least every four hours <sup>7</sup> and that recalibration should be performed before major clinical decisions are made <sup>4-6</sup>.

The CardioQ-ODM+ follows this clinical advice but now provides the capability to recalibrate at any moment using a quick, easy, minimally invasive and clinically proven method at no additional cost.

“ The **Enhanced Recovery Partnership** fully supports the use of intraoperative fluid management technology to deliver individualised goal-directed fluid therapy. This is recommended in the 2012-13 NHS Operating Framework, in the Innovation, Health and Wealth Review, and in NICE Guideline MTG3. ”

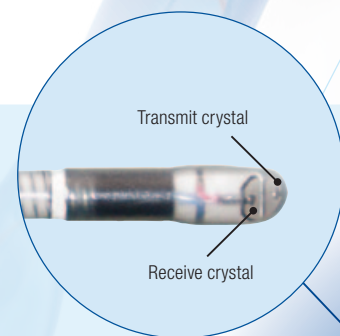
(Fulfilling the Potential: A Better Journey for Patients and a Better Deal for the NHS (2012), NHS Enhanced Recovery Partnership)

## Pressure Monitoring Mode for PPWA

The CardioQ-ODM+ achieves its Pressure Monitoring Mode through the use of the most stable and extensively researched PPWA algorithm currently available <sup>1-2</sup>.

Deltex Medical has chosen the algorithm proposed by Liljestrand & Zander <sup>1</sup>. Trials of this algorithm have been reported in the literature. Deltex Medical has also performed its own extensive evaluations of its performance in a wide range of clinical situations. The Liljestrand & Zander algorithm has been shown to be superior to eight other investigational algorithms and MAP as a quantitative estimator of CO <sup>2,7</sup>.

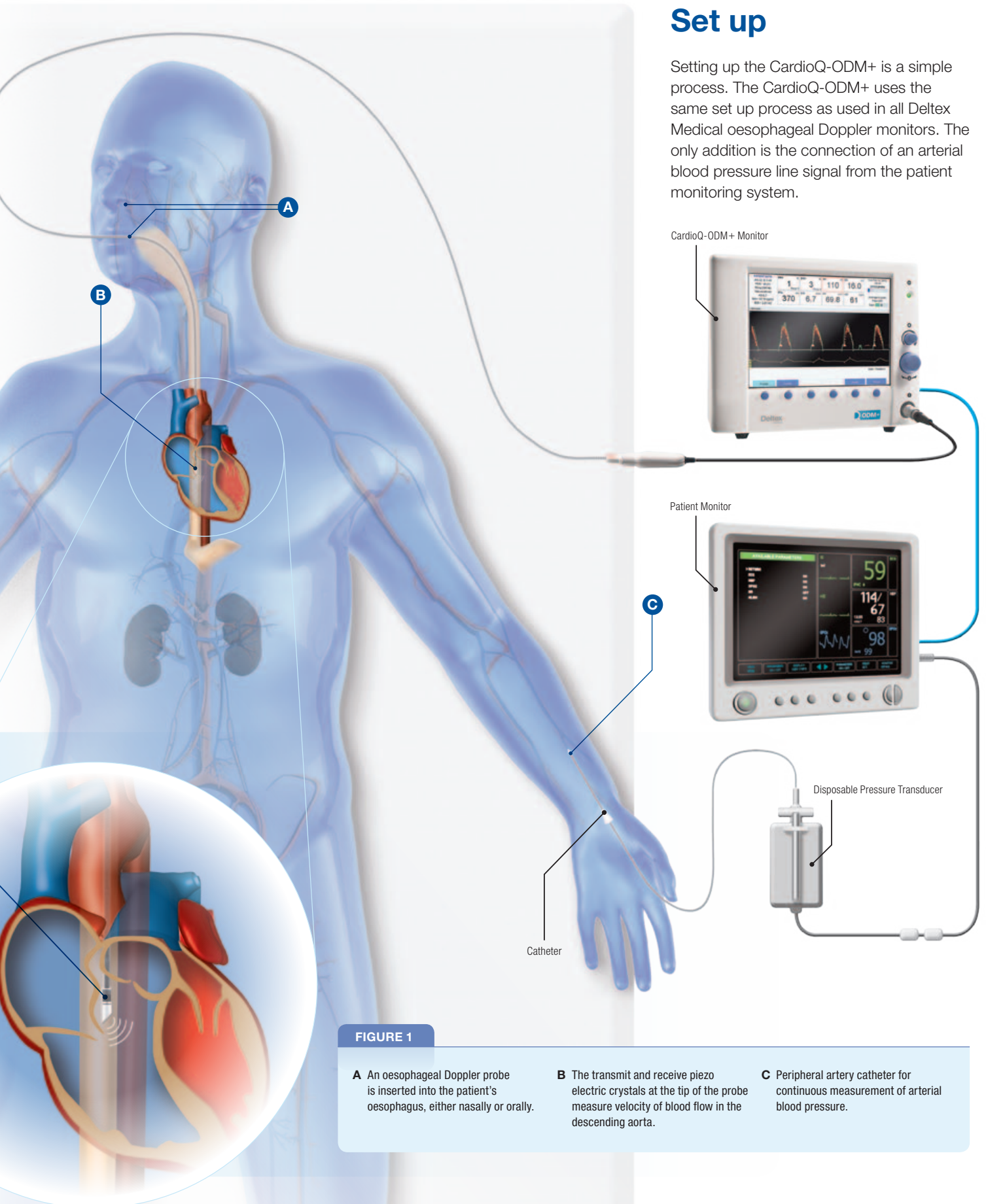
Even so all PPWA algorithms have limitations particularly in periods of haemodynamic instability. The CardioQ-ODM+ allows the user to switch between modes of use. Clinicians can use the proven flow-based Doppler technology to guide intervention, to calibrate the PPWA algorithm for continuous monitoring in periods of stability or when it is anticipated that Doppler flow measurement may be temporarily unavailable (e.g. fully conscious patients not tolerating awake Doppler probes (I<sub>2</sub>n), oesophagectomy, periods of diathermy).



CardioQ-ODM+ provides the simplest calibration system for a PPWA algorithm at no additional cost.

## Set up

Setting up the CardioQ-ODM+ is a simple process. The CardioQ-ODM+ uses the same set up process as used in all Deltex Medical oesophageal Doppler monitors. The only addition is the connection of an arterial blood pressure line signal from the patient monitoring system.



**FIGURE 1**

**A** An oesophageal Doppler probe is inserted into the patient's oesophagus, either nasally or orally.

**B** The transmit and receive piezo electric crystals at the tip of the probe measure velocity of blood flow in the descending aorta.

**C** Peripheral artery catheter for continuous measurement of arterial blood pressure.

# a world first

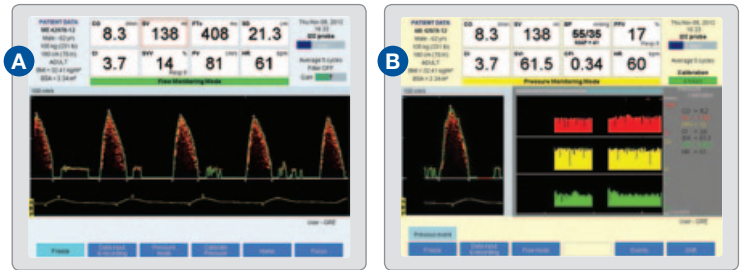


FIGURE 2

**A** Flow Monitoring Mode screen as it appears on the CardioQ-ODM+. Users can select their preferred parameters to guide intervention during fluid management. Calibration of Pressure Monitoring Mode (PPWA) is also effected from this screen.

**B** Pressure Monitoring Mode and trend display as it appears on CardioQ-ODM+. Once calibrated users can select their preferred pressure based parameters to trend continuous monitoring or use it to provide estimated readings for short periods when Doppler is temporarily unavailable.

## The CardioQ-ODM+ provides all the standard Doppler parameters:

- Cardiac Output (CO), Cardiac Index (CI)
- Stroke Volume (SV), Stroke Volume Index (SVI), Stroke Distance (SD)
- Stroke Volume Variation (SVV), Stroke Distance Variation (SDV)
- Flow Time corrected (FTc), Flow Time to peak (FTp)
- Peak Velocity (PV), Peak Velocity Variation (PVV)
- Mean Acceleration (MA), Minute Distance (MD)
- Systemic Vascular Resistance (SVR), Systemic Vascular Resistance Index (SVRI)
- Delivered Oxygen ( $DO_2$ ), Delivered Oxygen Index ( $DO_2I$ )
- Heart Rate (HR)

## CardioQ-ODM+ provides pressure-based parameters:

- Cardiac Output (CO), Cardiac Index (CI)
- Stroke Volume (SV), Stroke Volume Index (SVI)
- Pulse Pressure Variation (PPV) or Stroke Volume Variation (SVV) (only one can be selected at any one time), Systolic Pressure Variation (SPV)
- Systemic Vascular Resistance (SVR), Systemic Vascular Resistance Index (SVRI)
- Mean Arterial Pressure (MAP) and Blood Pressure (BP)
- Heart Rate (HR)

## CardioQ-ODM+ flow and pressure combined parameters:

- Cardiac Power Output (CPO) and Cardiac Power Index (CPI)

The CardioQ-ODM and the CardioQ-ODM+ together with Deltex Medical's full range of single patient disposable ultrasound probes can be purchased from **NHS Supply Chain** at [www.supplychain.nhs.uk](http://www.supplychain.nhs.uk).

(German-Austrian guidelines have indicated CPO and CPI to be important parameters in the diagnosis, monitoring and treatment of cardiogenic shock<sup>8</sup>).



## References

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2. **Sun, J.X.** Cardiac Output Estimation using Arterial Blood Pressure Waveforms. Thesis for Master of Engineering in Electrical Engineering and Computer Science. Massachusetts Institute of Technology Sept. 2006.
3. **NICE medical technology guidance 3**, CardioQ-ODM oesophageal Doppler monitor March 30, 2011 <http://guidance.nice.org.uk/MTG3>
4. **Linton, N.W.F. & Linton, R.A.F.** Estimation of changes in cardiac output from the arterial blood pressure waveform in the upper limb. British Journal of Anaesthesia 2001; 86 (4): pp 486-496.
5. **Cecconi, M., et al.** Lithium dilution cardiac output measurement in the critically ill patient: determination of precision of the technique. Intensive Care Med. 2009; 35 (3): pp 498-504.
6. **Cecconi, M., et al.** A prospective study to evaluate the accuracy of pulse power analysis to monitor cardiac output in critically ill patients. BMC Anesthesiology 2008, 8:3 <http://www.biomedcentral.com/1471-2253/8/3>
7. **Sun, J.X., et al.** The cardiac output from blood pressure algorithms trial. Crit Care Med 2009; 37(1): pp 72-80.
8. **Dtsch Arztebl Int.** 2012 May; 109(19): 343-351. (Published online 2012 May 11). <http://www.ncbi.nlm.nih.gov/pubmed/22675405>

## Product Description

### CardioQ-ODM+ Monitor

(Product Code: 9051-7104)

For adult use in operating theatre and critical care. Managed care service and rental option available upon request.

### Surgical Probes

**DP6 Doppler Probe** (Product Code: 9070-7001)

6-hour oral/nasal Doppler probe for patients under anaesthesia or full sedation.

**DP12 Doppler Probe** (Product Code: 9070-7003)

12-hour oral/nasal Doppler probe for patients under anaesthesia or full sedation.

**I2S Doppler Probe** (Product Code: 9090-7012)

6-hour oral/nasal Doppler probe for anaesthetised, sedated and awake patients.

**I2P Doppler Probe** (Product Code: 9090-7013)

24-hour oral/nasal Doppler probe for anaesthetised, sedated and awake patients.

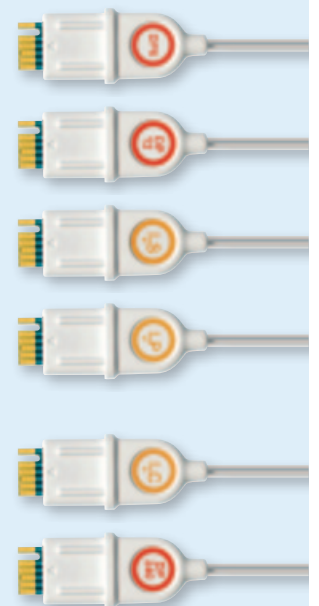
### Critical Care Probes

**I2C Doppler Probe** (Product Code: 9090-7014)

72-hour oral/nasal Doppler probe for anaesthetised, sedated and awake patients.

**DP240 Doppler Probe** (Product Code: 9070-7005)

10-day oral/nasal Doppler probe for patients under anaesthesia or full sedation.



**When fluid management really matters, think Doppler**

### Deltex Medical

Terminus Road, Chichester, West Sussex PO19 8TX

To order please contact:

Customer Service: 0845 085 001

Email: [uksales@deltexmedical.com](mailto:uksales@deltexmedical.com)

For enquires please contact:

General Enquiries: +44(0) 1243 774 837

Fax: +44(0)1243 532 534

[www.deltexmedical.com](http://www.deltexmedical.com)

