

sentec

Digital Transcutaneous
Blood Gas Monitoring



SenTec V-Sign™ Illuminate Ventilation and Oxygenation



PCO2 | SpO2 | PR

Continuous | Noninvasive | Easy to use | Reliable | Accurate



Overcoming limitations of arterial blood gases, etCO₂ and SpO₂ monitoring

Arterial blood gas analysis is invasive and only provides snap-shot information on the patient's condition. It is vital to provide continuous monitoring of critically ill patients, whose condition may change rapidly. Furthermore, frequent arterial blood gas analysis is associated with blood loss.^{1*}

End-tidal CO₂ (etCO₂) monitoring has its limits for patients with chronic respiratory failure due to ventilation-perfusion (V/Q) mismatch. The monitoring of etCO₂ also depends on the gas sampling quality (leak-free masks and tubing) and requires regular/full breathing cycles to reflect alveolar CO₂.

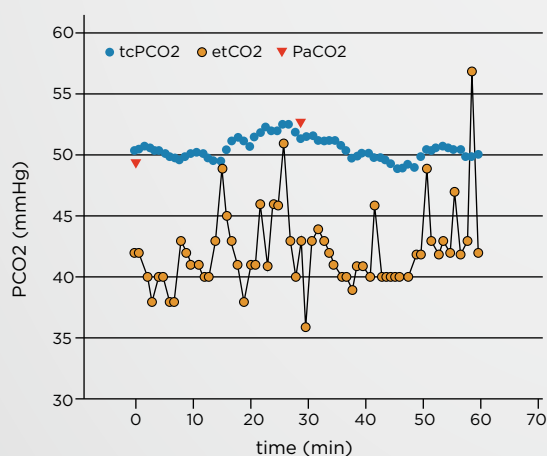


Fig. 1 etCO₂ and tcPCO₂ data from a COPD patient with invasive ventilation during weaning²

Measurement of etCO₂ is mostly suitable for patients with healthy lungs who have good lung perfusion and ventilation. This is, however, not true in cases such as patients suffering from COPD or ARDS, or patients undergoing one-lung ventilation. Capnography is sometimes inefficient to screen patients for nocturnal alveolar hypoventilation and hypercapnia. Furthermore, etCO₂ measurements are often inaccurate in patients receiving noninvasive ventilation (NIV) or in patients who are breathing spontaneously.

Measuring SpO₂ alone is not sufficient to detect hyperventilation or hypoventilation.

*Due to the S-shape of the oxygen dissociation curve, hypoventilation with a decrease in the PaO₂ may not be noticed over a period of time. Especially with the administration of supplemental oxygen, patients can show adequate arterial saturation during hypoventilation.*³

Changes of arterial CO₂ levels can never be detected by SpO₂ monitoring alone.

Pulse oximetry doesn't give information about hypoventilation and hyperventilation.

Even the combination of SpO₂ and daytime arterial blood gas are not reliable tools for detecting nocturnal hypoventilation, which can occur during long-term NIV and in patients with suspected ventilatory failure.⁴

*Please refer to the last page for full scientific references.

Noninvasive, continuous monitoring



Combined tcPCO₂ and SpO₂ measurement is an easy and reliable way to assess patients' ventilation and oxygenation status.

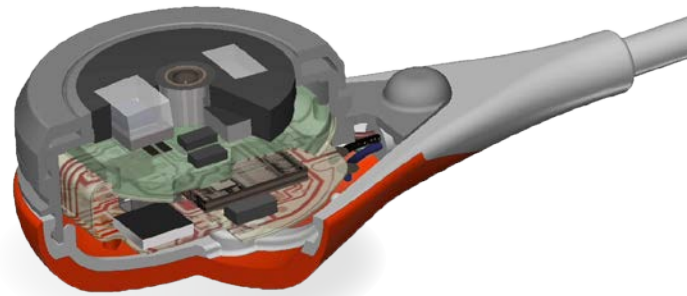
Advantages of digital tcPCO₂ and SpO₂ monitoring

The Digital SenTec **V-Sign™ Sensor 2** is a Stow-Severinghaus-type PCO₂ Sensor combined with reflectance 2-wavelength pulse oximetry.

The highly integrated **digital sensor head** comprises a micro pH-electrode and an optical oximetry unit. The sensor temperature is regulated by two independent temperature sensors. All data is digitized in the sensor head, allowing the transmission of robust, low-noise signals to the monitor.

Sensor sensitivity and calibration data is stored in the sensor head during manufacturing and regularly updated during use.

Automatic sensor calibration ensures that the system is "Ready for use" when needed and allows for a long measuring time of up to 12 hours.



Triple parameters – the V-Sign™ Sensor 2 provides continuous, noninvasive measurement of tcPCO₂, SpO₂ and pulse rate (PR). Information about the pulsation index and Heating Power are also available.

Accurate and reliable



Excellent accuracy

SenTec's sophisticated algorithms ensure high accuracy and minimal technical drift.⁵ Additionally, the V-STATS™ software provides a retrospective residual drift correction.

In a 2012 study, Prashant N. Chhajed et al. demonstrated that the SenTec Digital Monitoring System provided accurate results compared to conventional blood gas analysis.

Reliability

SenTec's unique transcutaneous artifact detection algorithm provides reliable data when conventional tcPCO₂ monitors tend to fail.

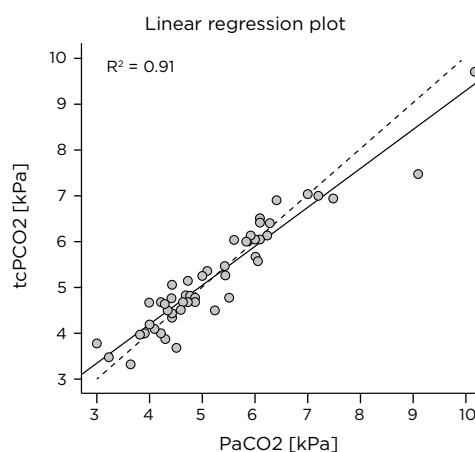
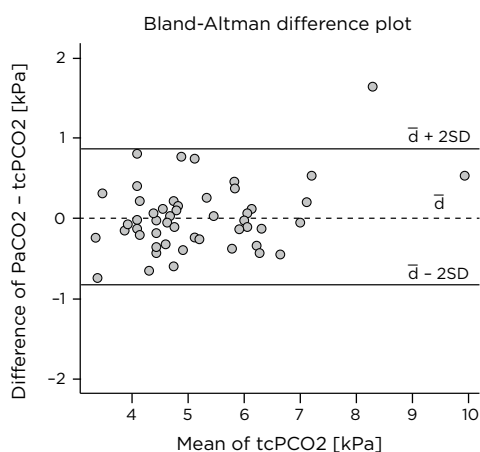


Fig. 2 40 patients were included in the study, tcPCO₂ and PaCO₂ data from 50 samples were available, tcPCO₂ was measured at the infraclavicular site

Fig. 2 above shows a comparison of tcPCO₂ and PaCO₂. Measurements were compared using both a Bland-Altman plot (left panel) and linear regression analysis. The Bland-Altman plot displays the mean

bias and limit of agreement (solid lines). The linear regression plot displays the line of best fit (solid line) and the identity line (dashed line).⁶

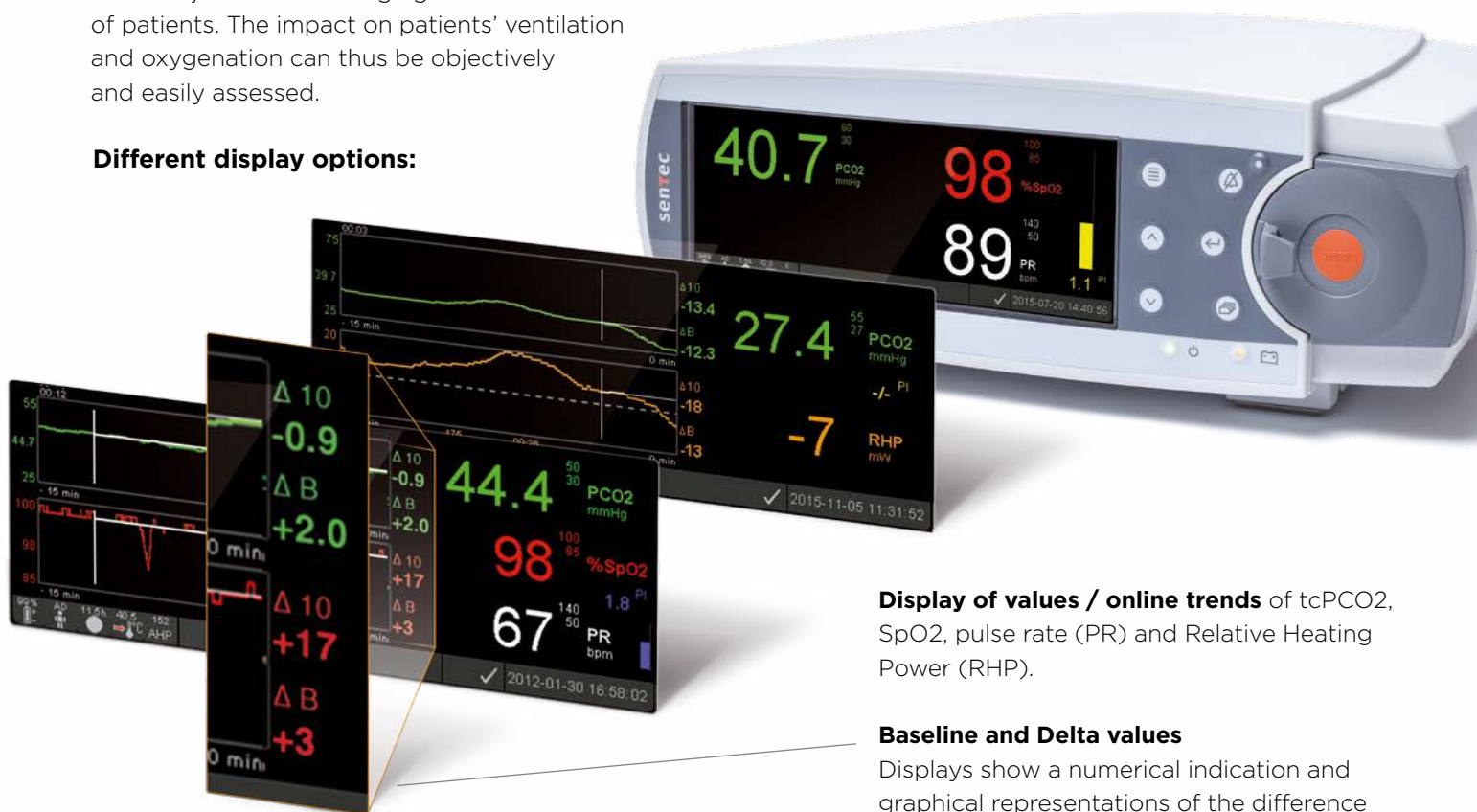


SenTec's Digital Monitoring System offers intuitive controls and easy-to-read displays.

Tracking changes in therapy

The monitor allows for setting a **baseline** and **markers** just before changing the treatment of patients. The impact on patients' ventilation and oxygenation can thus be objectively and easily assessed.

Different display options:



Display of values / online trends of tcPCO₂, SpO₂, pulse rate (PR) and Relative Heating Power (RHP).

Baseline and Delta values

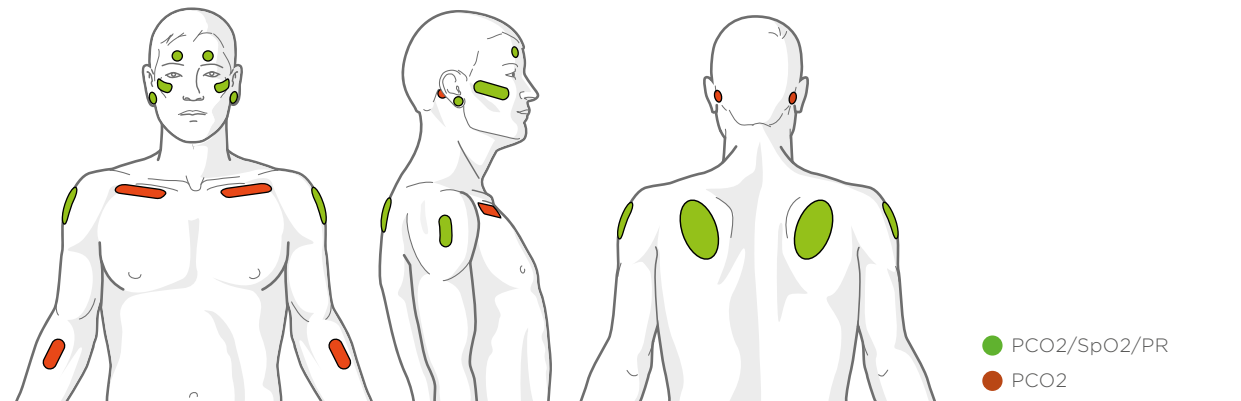
Displays show a numerical indication and graphical representations of the difference between the current reading and the previously set baseline.

Easy to use



The SenTec Digital Monitoring System has a number of practical and time-saving features.

Choose from multiple validated measurement sites



Safe and gentle sensor application



Multi Site Attachment Ring

Single-use ring for the attachment of SenTec transcutaneous sensors to various measurement sites.



Staysite™ Adhesive

Additional adhesive film to improve fixation of Multi Site Attachment Ring in challenging settings.



Ear Clip



A great solution for overnight monitoring in sleep labs as well as long-term use. Attached to the ear lobe, the sensor doesn't disturb sleep and is suitable for patients wearing masks.



Freely rotatable sensor

Once the sensor is inserted into the Multi Site Attachment Ring, it is rotatable. This gives the caregivers more flexibility to adjust sensor cable positioning during sensor attachment and monitoring.

Low maintenance

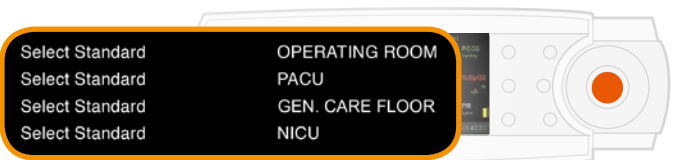
-  Recalibration intervals range up to 12 h.
-  Membrane change interval is normally 28 days and can be extended up to 42 days.

Portability and transportability

Lightweight monitor, mountable on rollstands or infusion stands, and battery life of up to 10 hours allows continuous patient monitoring during intra-hospital transport or in situations when no AC power is available.

Quick system setup

Up to four preset or customizable profiles can be stored and selected on the SenTec Digital Monitor.



Central monitoring

V-CareNet™ System enables remote monitoring and alarm surveillance for up to 40 SenTec Digital Monitors. This provides an increased level of safety to patients, disturbance free monitoring (e.g. in sleep lab settings) and improved workflow for caregivers.

The Smart Calmem

As the calibration data is stored in the sensor head, it can be disconnected for up to 30 minutes without the need for recalibration.



Wide range of medical applications

Clinical studies underscore the growing acceptance of transcutaneous CO₂ monitoring in many application areas.

For clinical studies, go to www.sentec.ch/application-areas/clinical-studies/



Pulmonology & sleep medicine

Continuous, overnight monitoring of tcPCO₂ has become essential for assessing nocturnal hypoventilation, screening for hypercapnia and titration of noninvasive ventilation (NIV). SenTec monitors are connectable to most polygraphic and polysomnography systems.



Homecare

Used under clinical supervision, the SenTec monitoring system allows detection of nocturnal hypercapnia in the patient's home. Data can be downloaded and sent to the referring physician for further analysis and therapy decisions.



Critical care for adults

Continuous transcutaneous monitoring is a promising tool to detect early changes of arterial PCO₂ for patients in critical care. This is particularly valuable in guiding mechanical ventilation or monitoring patients undergoing weaning from ventilator support.



General practitioners

The SenTec Digital Monitor can be used by physicians in their offices in **V-Check™** Mode⁷ for ventilation spot checks on patients. A statistical summary of key values (tcPCO₂, SpO₂, PR) facilitates analysis.





Neonatal intensive care unit (NICU)

Noninvasive, continuous transcutaneous monitoring supports therapy guidance for neonatals and may lessen the need for blood gas sampling, reducing the chance of infections. Please refer to the SenTec neonatal brochure for more information.



General anesthesia/procedural sedation/surgery

For patients on high frequency or jet ventilation, the use of continuous tcPCO₂ monitoring is indicated, as no reliable CO₂ values can be gained from etCO₂ monitoring. Sedated patients undergoing diagnostic interventions or minimally invasive surgeries are exposed to respiratory depressant drugs. The use of continuous tcPCO₂ measurement, therefore, increases the safety of the patients as the ventilation status can be continuously assessed, especially in spontaneously breathing patients.



Post anesthesia care unit (PACU)

Hypoventilation and related hypercapnia is a risk for patients after general anesthesia.⁸ Residual amounts of respiratory depressant drugs and opioids from patient controlled analgesia (PCA) systems can critically affect ventilatory drive. The Anesthesia Patient Safety Foundation (APSF) recommends to routinely monitor ventilation in such patients for increased safety.⁹ Transcutaneous PCO₂ is most suitable for that task, especially in view of the aforementioned limitations of etCO₂.



Emergency room

The reliability of transcutaneous CO₂ measurement in the emergency room has been proved in clinical studies. *It can be used as real-time guidance for treatment.*¹⁰



General care floor

In situations where nurse-to-patient ratios preclude direct surveillance, combined tcPCO₂/SpO₂ patient monitoring can be crucial.



Valuable insights

Making treatment decisions based on data analysis.

V-STATS™ software enables users to download trend data from the internal memory of the monitor and display it on the PC screen for further analysis, reporting, and generation of a printable report. Data download is possible via serial or LAN interface.

Parameters and safety relevant settings such as alarm system management, site time and temperature management are easily configured and saved/stored as user profiles within the V-STATS™ software. All departments can have their specific profiles to support their transcutaneous monitoring requirements - all within the same SenTec device. Profile settings and reports may be easily generated, duplicated, printed and emailed.

The V-STATS™ software streamlines processes and enhances workflow efficiency in multiple clinical settings such as respiratory care and sleep studies.

The V-CareNeT™ System enables remote monitoring and alarm surveillance for multiple SenTec Digital Monitors (SDMs). The central station is the PC running V-STATS™ with **activated V-CareNeT™ Package**.



Broad connectivity

Patient data from the SenTec Digital Monitor can be transferred to bedside monitors, PCs, nurse call systems, chart recorders or data loggers.

Polygraphic (PG) and polysomnography (PSG) systems

Various ready-made adapter cables and interfaces are available to connect the SenTec Digital Monitor to the most common PG or PSG systems, including innovative wireless solutions with Nox Medical.



For more information, please refer to the following link:
www.sentec.ch/fileadmin/PSG/ProductInfoPSGAdapterCables.pdf

Connectivity to patient monitoring systems and electronic medical record systems (EMR)

Monitored data from SenTec Digital Monitor can be transferred to selected

- patient monitoring systems (Philips, Dräger, Mindray and Spacelabs) or
- electronic medical record systems (e.g. via Capsule).



A current list of connectable patient monitoring systems is on our website:
www.sentec.ch/support-services/device-connectivity/

Clinically validated

Over 100 clinical studies have been conducted with the SenTec Digital Monitoring System.
www.sentec.ch/application-areas/clinical-studies/

Pneumology

1. Huttmann SE, Windisch W, Storre JH Techniques for the measurement and monitoring of carbon dioxide in the blood, *Ann Am Thorac Soc.* 2014 May;11(4):645-52, DOI: 10.1513/AnnalsATS.201311-387FR

2. Storre J, Dellweg D Monitoring des Beatmungspatienten - Monitoring of Patients Receiving Mechanical Ventilation, *Pneumologie* 2014, DOI: <http://dx.doi.org/10.1055/s-0034-1365742>

3. Mehta A, Chhajed P Cutaneous Capnography, in *Jindal SK, Textbook of Pulmonary and Critical Care Medicine, Vol. 2, 2011, p. 1841-1850*

Sleep, pediatrics, NIV

4. Paiva R, Krivec U, Aubertin G, et al. Carbon dioxide monitoring during long-term noninvasive respiratory support in children, *Intensive Care Med* 2009; 35: 1068-1074

Accuracy, sleep, NIV

5. Storre JH, Magnet FS, Dreher M, Windisch W Transcutaneous monitoring as a replacement for arterial PCO₂ monitoring during nocturnal non-invasive ventilation, *Respiratory Medicine* 2011, 105(1), 143-150

Accuracy, ICU, NIV

6. Chhajed PN, Chaudhari P, Tulasigeri C, Kate A, Kesarwani R, Miedinger D, et al. Infraclavicular sensor site: a new promising site for transcutaneous capnography, *Scand J Clin Lab Invest*, 2012, 72(4), 340-342

Accuracy, pneumology

7. Chaudhari P, Kate A, Baty F, Leuppi J, Chhajed P VentCheck: Spot measurement of combined oximetry & cutaneous carbon dioxide to screen for type II respiratory failure in respiratory illness, *European Respiratory Society, Annual Meeting 2011, (Vol. P907)*

PACU, Sleep

8. Soto R, Davis M, Faulkner M A comparison of the incidence of hypercapnea in non-obese and morbidly obese peri-operative patients using the SenTec transcutaneous pCO₂ monitor, *Journal of Clinical Monitoring and Computing*, 2014, 28:293-298

PACU

9. Stoelting RK, Weinger MB. Dangers of postoperative opioids-is there a cure? *APSF Newsletter, Summer 2009;24:25-6*

Accuracy, Emergency Department, NIV

10. Horvath C, Brutsche M, Baty F, Rüdiger J Real-time measurement of transcutaneous PCO₂ vs. arterial/venous PCO₂ during non-invasive ventilation on the emergency department in subjects with severe respiratory failure - an observational study, *European Respiratory Society, Annual Meeting 2015*

Anesthesia

Baulig W, Keselj M, Baulig B, Guzzella S, Borgeat A, Aguirre J Transcutaneous continuous carbon dioxide tension monitoring reduced incidence, degree and duration of hypercapnia during combined regional anaesthesia and monitored anaesthesia care in shoulder surgery patients, *Journal of Clinical Monitoring and Computing*, October 2014, DOI: 10.1007/s10877-014-9627-x

Accuracy, NICU

Bhalla A, Hotz J, Morzov R, Newth C, Khemani R The Correlation Between Arterial and Transcutaneous Carbon Dioxide Levels in Critically Ill Children, *Pediatric Academic Societies Annual Meeting San Diego 2015*

Pneumology

Heinzelmann I, Gloeckl R, Seeberg S, Damisch T, Stegemann A, Plagmann M, Jerrentrup A, Kenn K Changes in pCO₂ levels during 6-minute walking test in patients with very severe COPD, *European Respiratory Society, Annual Meeting 2014, (Vol. P 4495)*

SenTec is an ISO 13485 certified company and its Digital Monitoring System has been approved by regulatory authorities in the United States, Europe, Canada, Japan, South Korea, Taiwan, Australia and other countries.

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