Indirect Calorimetry Module

OEM solution

Metabolic needs evaluation

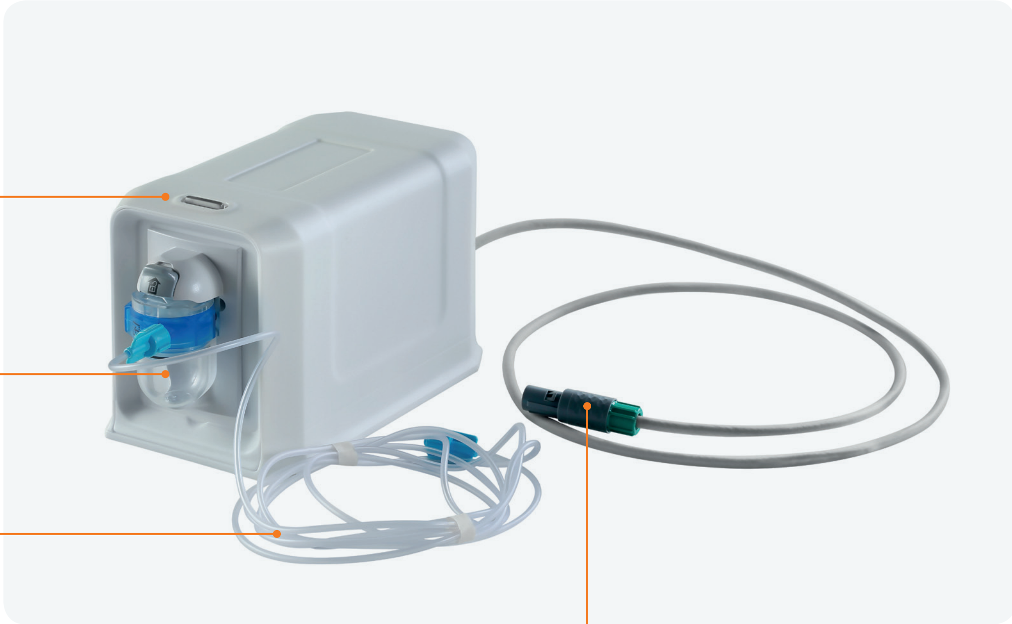
Triton Electronic Systems Ltd.

Intended Use

The device is intended for continuous non-invasive monitoring of carbon dioxide (CO_2) concentration and resting energy expenditure (REE) of ventilated patients.

Scope anesthesiology, resuscitation and intensive care departments of professional medical facilities, as well as at transportation within professional medical facilities. Applicable as a part of anesthesia and respiratory equipment and medical devices for patient monitoring.

Appearance



LED indicator

Water trap

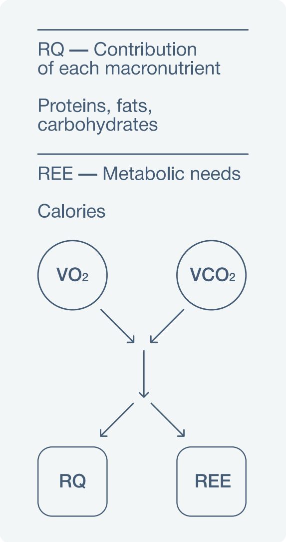
Sampling line

Interface cable

OEM Delivery Kit

Calorimeter module	TESN.650002	1 pcs.
Interface cable	TESN.704029	1 pcs.
Water trap	DRYLINE II	1 pcs.
Sampling line	DRYLINE	1 pcs.
Paracube® Sprint oxygen sensor	00502755	Option

Evaluation of Patient's Metabolic Needs



The peculiarity of patients in intensive care and resuscitation units is metabolic instability caused by the severity of the condition, artificial lung ventilation, sedation, analgesia and extracorporeal detoxification methods. Therefore, metabolic monitoring for such patients is of great importance.

The method of indirect calorimetry is considered the "gold standard" of metabolic monitoring. In addition to actual resting energy expenditure (REE), this method calculates the respiratory quotient (RQ) — the ratio of carbon dioxide release rate to oxygen consumption rate and assess the contribution of each macronutrient to the total metabolism.

The built-in metabolic module is convenient and easy to use because it requires minimal user effort.

The principle of the metabolic needs evaluation is based on measuring the volume of carbon dioxide released, the volume of oxygen absorbed and the subsequent calculation of energy costs using the Weir equation.

Experience has shown that the individualized program of nutritional support for 3–4 days of treatment in ICU using the metabolic module significantly reduces:

frequency of nosocomial infections; consumption of antibacterial drugs; duration of artificial ventilation.

Metabolic monitoring is used in programmes of early and resuscitation rehabilitation of patients. Its use makes it possible to shorten the time of rehabilitation and minimize complications after suffering strokes, spinal cord injuries, brain injuries, muscular dystrophies, etc.

Deficiency of Calories in Critical States Can Cause

- postoperative wound suppuration, failure of anastomoses;
- dysfunction of the respiratory musculature and diaphragm;
- hospital-acquired infections (tracheobronchitis, VAP, etc.);
- high consumption of antibiotics;
- greater consumption of blood components (FFP, albumin);
- pressure sores, anemia;
- prolonged bed rest in ICU and inpatient department.

Excess Calories in Critical States Lead To

- hyperglycemia;
- growth of CO_2 production;
- desynchronization with the ventilator;
- hyperthermia;
- aggravation of ALI / ARDS;
- fatty hepatosis.

Operation Principle

The Indirect Calorimetry Module provides continuous measurement of CO_2 partial pressure in patient's airway by infrared spectrophotometry. The method consists in measuring the absorption of infrared radiation with a certain wavelength by CO_2 molecules which is calculated on the basis of measured amount of light transmitted through the gas to the device. The oxygen concentration measures by O_2 paramagnetic sensor.

The real time flow data at the patient side (Y-piece) is transmitted to the module by the host device (ventilator). The sampling probe from the patient is fed into the measurement cuvette of the module by the integrated pump via sampling line, goes through the CO_2 cuvette (capnograph) and O_2 sensor. The module synchronizes the O_2, CO_2 and flow data in realtime by the patented algorithm to precise breath by breath measurements of minute volume of CO_2 elimination (VCO_2), and minute volume of O_2 consumption (VO_2) by the patient. The RQ (respiratory quotient) and REE (resting energy expenditure) are calculated by Weir equitation: REE (kcal/day) = $(3.941 \times VO_2 + 1.106 \times VCO_2) \times N$.

The essence of this method is to calculate a respiratory quotient (RQ) and a ratio of eliminated CO_2 to consumed O_2 per minute. The calculated indirect calorimetry parameters are then averaged and transferred via communication protocol to host-device (ventilator) for displaying.

Technical Specification

Operation principle	Non-dispersive infrared spectrophotometry (NDIR)
External interface	RS-232
Initialization time	Maximum 10 s
Gas sampling rate Admissible absolute deviation	50–250 ml/min ±10 ml/min in absolute terms or ±10% in relative one (the biggest from the values)
CO_2 concentration measurement range (CO_2 partial pressure) Admissible absolute deviation: CO_2 concentration CO_2 partial pressure	0–20 vol.% (resolution 0.01) 0–150 mmHg (resolution 0.01) ±(0.2 vol.% + 0.02 · C_{meas}) ±(1.5 mmHg + 0.02 · C_{meas})
O_2 concentration measurement range Admissible absolute deviation	0–100 vol.% (resolution 0.1) ±(2.5 vol.% + 0.025 · C_{meas})
Calculated REE parameters: O_2 consumption (VO_2) CO_2 elimination (VCO_2) Resting energy expenditure (REE) Respiratory quotient (RQ)	 10–1000 ml/min 10–1000 ml/min 72–7200 kcal/day 0.5–2
Measurement drift	±(0.2 vol.% + 0.02 · C_{meas}) or ±(1.5 mmHg + 0.02 · C_{meas})
Gas mixture parameter measurement accuracy	±(0.43 vol.% + 0.08 · C_{meas})
Response time	Maximum 3 s (at sampling rate 250 ml/min)
Rise time	Maximum 0.2 s (at sampling rate 250 ml/min)
Respiratory rate measurement range	3–160 breath per minute (BPM)
Respiratory rate measurement accuracy	±2 breath per minute (BPM)
Dimensions	90x98x160 mm

Voltage Current	5.0 V ± 5% maximum 0.8 A	Device weight	0.7 kg

Operation Conditions

Ambient air temperature	10–35°C
Relative humidity	10–80% (at the temperature 25°C)
Atmospheric pressure	600…800 mmHg

Transportation Conditions

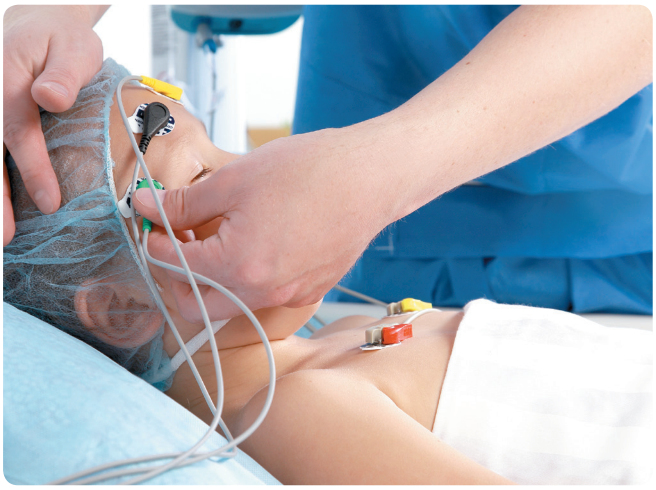
Ambient air temperature	(–50)°C–50°C
Relative humidity	< 80% (at the temperature 25°C)

Storage Conditions

Ambient air temperature	5–40°C
Relative humidity	< 80% (at the temperature 25°C)

OEM Solutions for Anesthesiology and Respiratory Support

In biomedical signal processing, gas monitoring and respiratory support since 1989



We continuously improve the technological principles and implement new profitable solutions based on market demands

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Quality management system certified as meeting the requirements of EN ISO 13485

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