



*The CO<sub>2</sub>Vking is designed for Cavers !*



Designed by Nature-Témoin <http://lab.vking.earth>

### **CO<sub>2</sub>Vking Features**

CO<sub>2</sub>Vking was designed for speleologists, as no other commercially available device is adapted to the harsh environment of dust, humidity and mud in caves.

The solid, thick 3d-printed housing is protecting sensors and electronics during exploration or research.

CO<sub>2</sub>Vking is marking the end of complications by uncompensated metering, energy greedy electrochemical or IR-cells and imperfections due to warm-up.

This new generation of CO<sub>2</sub>-measurement is temperature, pressure and humidity compensated, thanks to a factory calibrated 0-5% or 0-20% gold plated tuned NDIR CO<sub>2</sub>-sensor with PTFE filter membrane, which is a long-life, maintenance-free, fast, ultra-low energy and low budget sensor.

The sensor LED and photodiode are tuned to a narrow bandwidth, further reducing cost and simplifying design. Narrowband photonics technology is operating at mid-infrared tuned wavelengths for specific gas detection. The 4.26  $\mu\text{m}$  narrow-bandgap wavelength absorption avoids spectral influence by other gases as water vapour, methane,  $\text{NO}_2$ ,  $\text{N}_2\text{O}$ , CO or NO. The measurement is particularly independent from any relative humidity for operation between 0 and  $50^\circ\text{C}$  and is offering advantages in lifetime and stability, compared to traditional optical structures. This is permitting an accuracy of 70 ppm, with a non-linearity of less than 3% full scale. The sensor manufacturer claims a calibration free minimum 15 years lifespan, as long as no physical sensor deformation takes place. It only needs periodical zero point calibration like ABC (automatic baseline calibration) in outside fresh air. At startup, the user can perform this calibration by holding down the plus(+)button.

Bosch high-definition BME Climatology sensors are measuring temperature, barometric pressure and relative humidity at positive and negative temperatures.

After switching on the power by a protected slider-switch, the instrument is operating in foolproof mode and can be controlled by two membrane push buttons.

No need to touch any button at all, as the unit's large display is alternatively showing battery voltage, temperature, pressure, humidity, gas level and the depth at which the maximum concentration has been found. The maximum concentration @depth can be reset by pressing the minus(-)key.

At startup and on reset, a full self-test cycle will be performed automatically. The red light will flash on error detection.

Buzzer alarm beeps on startup and to indicate presence of  $\text{CO}_2$  gas concentrations higher than 0.5%. As the buzzer can be annoying in caves and may be stressing team mates, it can be switched off.

The BMS battery management system takes care of energy by following up the internal lithium-polymer battery voltage, warning the user to charge or switch the pack, or to use an external power bank which can be connected through the micro-USB port. This port is also being used to recharge or top up the internal battery.

## CO<sub>2</sub>Vking Specifications

Narrowband IR CO<sub>2</sub> –sensor, factory calibrated, temperature and pressure compensated. Operating range 0-5% (400-50.000 ppm) or 0-20% (400-200.000 ppm) CO<sub>2</sub>, see 5 or 20 in serial number respectively.

Resolution: 10 ppm. Precision: +-70 ppm. Linearity: better than 3% full scale.

Anti-vapour screen PTFE membrane.

Bosch clima-module Temp: -15...+40°C (resolution 0.1°C, precision 0.5°C@25°C). Relative humidity 0...100% (resolution 0.1%, precision 3%). Barometric pressure: 850-1200 hPa (precision 0.12 hPa, compensation 1.5 Pa/°K).

Ultra Low Power 32-bits Atmel ATSAMD21G18 ARM Cortex M0 microcontroller @48MHz.

3D printed protective case in full density ABS (Acrylonitrile butadiene styrene), a light and durable tough impact-resistant polymer. Specific gravity: 1.03 g/cc. Impact strength: 36 kJ/m<sup>2</sup>.

Housing joints reinforced with ABS resin and painted base plate.

Slide switch for battery cut-off during transport and when unit is not in use.

Dual membrane switch keypad for foolproof operation.

Bright 1.3" 128x64 monochrome OLED display for:

CO2%	carbon dioxide percentage (1% = 10.000 ppm)
Prof	depth in meters below starting point 0m, at moment of measure
Tmp*°C	temperature in °C (after 60 mn equilibration time with cave atmosphere)
Pres-hPa	barometric pressure in millibars or hectoPascal
RH%	relative humidity percentage
MaxCO2	maximum gaz concentration measured at a certain depth in relation to point 0m
MProf	dept in m at which a maximum gaz concentration has been detected
VBat	battery voltage

Fresh air calibration check on reset and startup, assuming operator is outside cave entrance in clean air @410ppm CO<sub>2</sub> (as of 06/2018) and ABC (Automatic Baseline Calibration) option to perform once per month.

LiPo battery voltage test on startup, wakeup and reset.

Buzzer indicating presence of more than 0.5% carbon dioxide.

Buzzer can be deactivated through slider switch.

Low V warning <3.4 V ; high V means USB-power hooked up.

If battery capacity is insufficient, device can be powered or charged from Solar Powerbank through USB-jack.

Automatic hotswap 3.7/4.2 V LiPo BMS battery management system (cutoff <3.2 V); auto-recharge (yellow LED) when USB hooked up with automatic switchover to USB power when it's available.

Supplied micro-USB charging data cable. Any USB source can be used to charge an empty battery.

Information: <http://lab.vKing.Earth>

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