

ภาคผนวก ก

ข้อมูลคุณลักษณะของเครื่องมือตรวจวัดก๊าซคาร์บอนไดออกไซด์

User's Guide

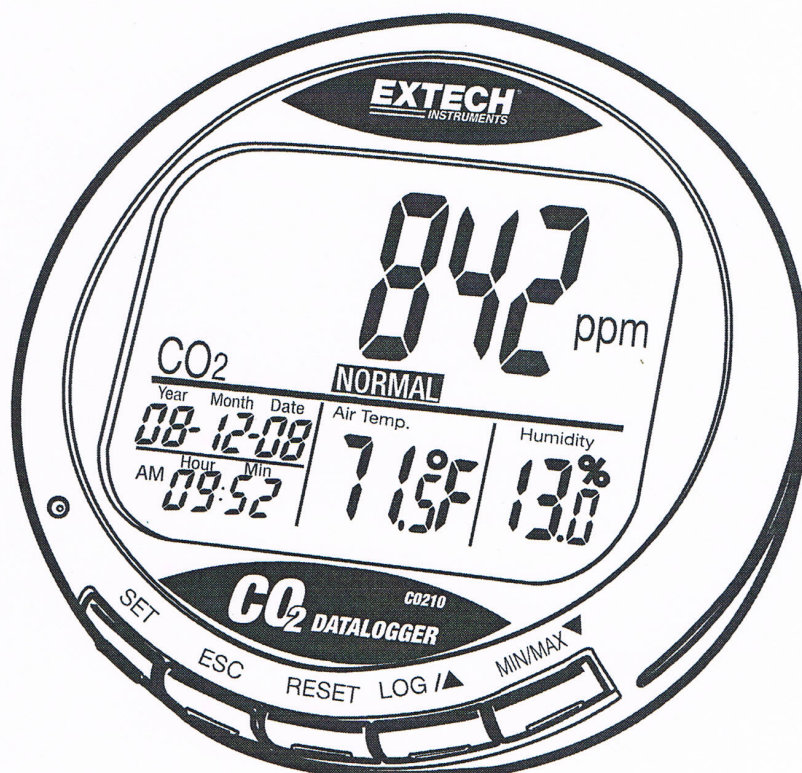
EXTECH[®]

INSTRUMENTS

A FLIR COMPANY

CO₂ Monitor and Datalogger

Model CO210



CE

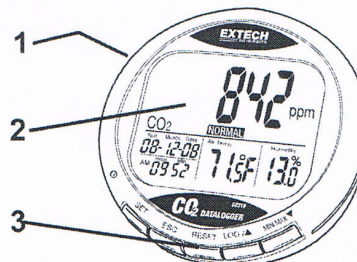
Introduction

Congratulations on your purchase of this Model CO210 Carbon Dioxide Meter. This meter measures and datalogs CO₂ level, air temperature, humidity, date and time. With visible and audible alarms, this is an ideal instrument for indoor air quality (IAQ) diagnosis. This meter is shipped fully tested and calibrated and, with proper use, will provide years of reliable service.

Meter Description

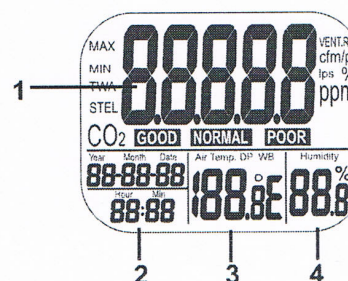
Meter

1. CO₂, Temp and RH sensors (rear)
2. LCD display
3. Controls



LCD Display

1. CO₂ concentration in ppm
2. Date and Time
3. Air Temperature
4. % Relative Humidity



Symbols

ppm	CO ₂ value
GOOD	CO ₂ air quality level
NORMAL	CO ₂ I air quality level
POOR	CO ₂ air quality level
Air Temp	Air Temperature
Humidity %	Relative Humidity
°C or °F	Celsius or Fahrenheit
MAX/MIN	Maximum or Minimum reading

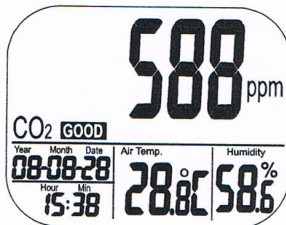
Controls

SET	Enters setup mode. Saves and finishes settings.
ESC	Exits setup page/mode. Terminates calibration / Datalogging
RESET	Press to clear the MAX/MIN. - Terminates during RH calibration.
LOG ▲	Selects mode or increases value in setup Start Datalogging
MIN/MAX ▼	Activates MAX, MIN function. Enters CO ₂ calibration with SET and ▲

Operation

POWER ON

Plug in the adaptor and the meter turns on automatically with a short beep. If the voltage is too high or low, "bAt" will display on the LCD and an LED will flash. The LCD will display current CO₂, temp., humidity, date and time. The air quality level is displayed as well



TAKING MEASUREMENT

The meter starts measurements when powered on and updates readings every second. If the operating environment changes (ex. from high to low temp.), it takes 2 minutes for the CO₂ sensor to respond and 10 minutes for RH change.

NOTE: Do not hold the meter close to your mouth or any other source of CO₂.

MAX/MIN

In the normal mode, press the MIN/MAX button to see the minimum and maximum of CO₂, Temperature and Humidity. Each press of MIN/MAX button will sequence through the MIN, MAX display and then returns to normal mode.

Press and hold the RESET button for more than 1 second to clear the minimum and maximum value from memory.

DATA LOGGING

The meter can record readings of CO₂, temperature and humidity for long time environment monitoring. The memory capacity is 15999 points (5,333 RH, Temperature and CO₂ records). The sample rate is adjustable from 1 second to 4 hours 59 minutes and 59 seconds.

After the sampling rate is selected, press the **LOG** button for 2 seconds in the normal mode to start logging. The green LED light blinks to indicate the logging status and the LCD main display will alternate between real time CO₂ value and "rEC". The lower displays are the real time temperature, humidity and clock.

To terminate data logging, press the **ESC** button for 2 seconds. The LED will stop blinking and the LCD main display will alternate between real time CO₂ value and "End". Hold down the ESC button for 2 seconds again and the meter returns to normal measurement mode.

Minimum and Maximum recall continues working during logging.

The memory is cleared whenever a new logging session is activated.

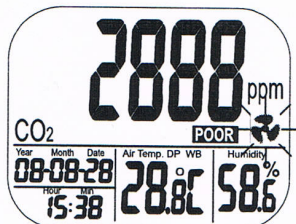
ALARM

The meter features an audible alarm which will give warnings when the CO₂ concentration exceeds the set limit. There are two settable limits, an upper limit that initiates the alarm and a lower limit to stop the alarm.

The meter emits beeps and displays the fan icon on the display when the CO₂ level goes over the upper limit. The audible alarm can be stopped by pressing any key or it automatically stops when CO₂ reading falls below the lower limit.

If the beeper is temporarily shut down, it will sound again when readings fall below lower limit and then go over the upper limit again or if the user presses the RESET button for more than 1 second to activate it.

The fan icon keeps flashing when beeps are manually shut down. It stops only when readings fall under the lower limit

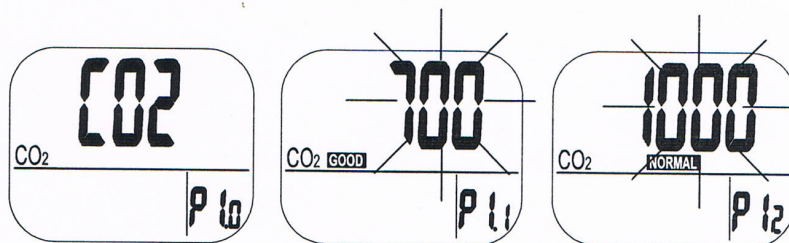


SETUP (Alarm level, Temperature scale, Real Time clock)

Hold the SET button, in the normal mode, for more than 1 second to enter the setup mode.

P1.1 CO₂ ALARM: GOOD LEVEL

When entering the setup mode, P1.0 and "CO₂" are displayed on the LCD. Press the SET button again to go into P1.1 for setting the CO₂ upper limit for the GOOD level. The current set value will be blinking on the display.



Press the LOG/▲ or MIN/MAX▼ button to increase or decrease the value. Each press adjusts in 100ppm increments. The alarm range is 0 to 700ppm.

When the value has been set, press the SET button to confirm the GOOD limit and to proceed to P1.2 for setting the upper NORMAL limit. Press the ESC button to exit without saving the setting.

P1.2 CO₂ ALARM: NORMAL LEVEL

P1.2 is used for setting the CO₂ upper limit for the NORMAL level. The current set value will be blinking on the display.

Press the LOG/▲ or MIN/MAX▼ button to increase or decrease the value. Each press adjusts in 100ppm increments. The alarm range is 700 to 1000ppm.

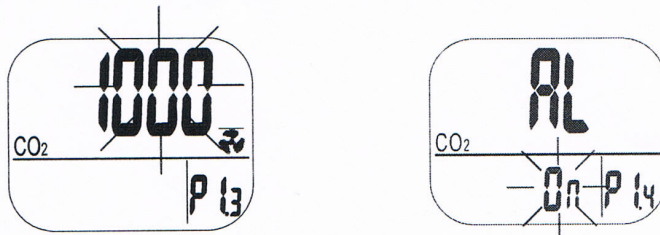
When the value has been set, press the SET button to confirm the NORMAL limit and to proceed to P1.3 for setting the upper POOR limit. Press the ESC button to exit without saving the setting.

P1.3 CO₂ ALARM: BEEP ALARM

P1.3 is used for setting the CO₂ upper limit for the BEEPER ALARM level. The current set value will be blinking on the display.

Press the **LOG/▲** or **MIN/MAX▼** button to increase or decrease the value. Each press adjusts in 100ppm increments. The alarm range is 1000 to 5000ppm.

When the value has been set, press the **SET** button to confirm the limit and to proceed to P1.4 or press the **ESC** button to return to P1.0.

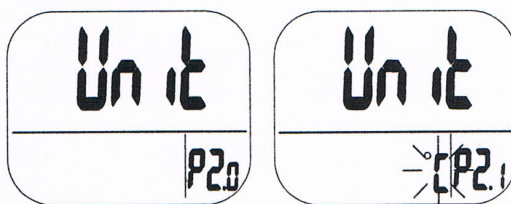


P2.0 TEMPERATURE SCALE

Press the **LOG/▲** button in P1.0 mode to access P2.0 for setting the temperature scale.

Press the **SET** button to go into the P2.1 setting mode. The °C or °F will blink.

Press the **LOG/▲** button to change the units. Press the **SET** button to confirm the setting or press the **ESC** button to exit without saving and return to P2.0.

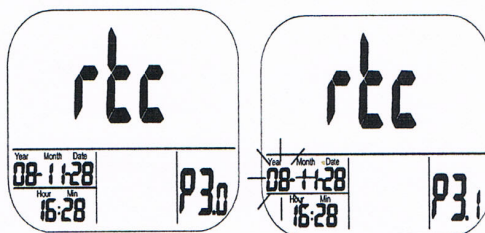


P3.0 REAL TIME CLOCK

Press the **LOG/▲** button in P1.0 twice to access P3.0 for setting up real time clock. Press the **SET** button and the meter goes into P3.1 with blinking year in the lower left display. To change the year, press the **LOG/▲** button or the **MIN/MAX▼** button. Press the **SET** button to save the setting and then enter P3.2 or press the **ESC** button return to P3.0 without saving the setting.

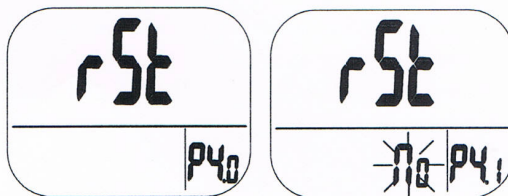
Press the **LOG/▲** button P3.1 to access P3.2. The current month setting will blink. To change the month, press the **LOG/▲** button or the **MIN/MAX▼** button. Press the **SET** button to save the setting and then enter P3.3 or press the **ESC** button return to P3.0 without saving the setting.

Repeat as above to finish the setting of P3.3 (Date), P3.4 (Hour) and P3.5 (Minute)



P4.0 RESET

Press the **LOG/▲** button in P1.0 three times to access P4.0 to reset the meter to default settings. Press the **SET** button and the meter will go to P4.1 with a blinking "No". Press the **LOG/▲** to switch the status then press either the **SET** button to save the settings or the **ESC** button to exit without saving the settings.

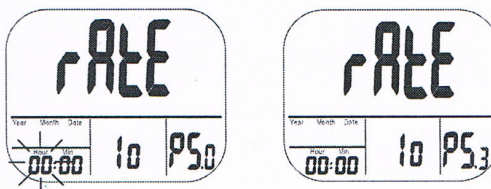


If "Yes" is selected the meter defaults to the following settings:

Parameter	Default
P1.1	700ppm
P1.2	1000ppm
P1.3	1000ppm
P2.1	°C
P4.1	No

P5.0 SAMPLING RATE

Press the **LOG/▲** button in P1.0 three times to access P5.0 to set the logging sample rate. The available range is 1 second to 4 hours 59 minutes. Press the **SET** button and the meter will go to P5.1 with blinking hour digits. To change the hour, press the **LOG/▲** button or the **MIN/MAX▼** button. Press the **SET** button to save the setting and then repeat the procedure for P5.2 minutes and P5.3 seconds. Press the **ESC** button return to P5.0 without saving the setting.



Calibration

CO₂ CALIBRATION

The meter is calibrated to a standard 400ppm CO₂ concentration at the factory

NOTE: When the accuracy becomes a concern or after a year of use, return the meter to Extech for calibration.

CAUTION: Do not calibrate the meter in an atmosphere of unknown CO₂ concentration.

ABC (Automatic Baseline Calibration)

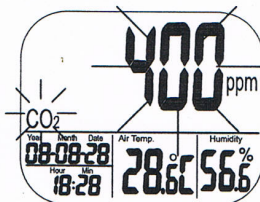
ABC (Automatic Baseline Calibration) establishes a baseline calibration to eliminate the zero drift of the infrared sensor. The ABC function is always "ON" when the meter is turned on. ABC is designed to calibrate the meter at the minimum CO₂ reading detected during 7.5 days continuous monitoring (power on). It assumes that the area being tested receives fresh air with a CO₂ level of approximately 400ppm at some period of time during the seven days. **It is not suitable to use desktop CO₂ in closed areas with consistently high CO₂ levels 24 hours a day.**

Manual Calibration

Manual calibration is suggested to be done outdoors on a sunny day with good ventilation and fresh air where the CO₂ level is approximately 400 ppm. Do not calibrate on a rainy day because high humidity will affect the CO₂ level in air.

Do not calibrate in places crowded with people or close to where high CO₂ concentrations may exist such as ventilating outlets or fireplaces.

Place the meter in the calibration site. Turn on the meter and hold down the **SET**, **▲** and **MIN/MAX▼** buttons simultaneously for more than 1 second to enter CO₂ calibration mode. "400ppm" and "CO₂" will blink while the calibration is in process.



The calibration will take about 30 minutes. When the calibration is complete, the blinking stops and the meter returns to normal operation. To abort the calibration, press the RESET button for more than 1 second.

Note: Keep away from any animal, human or plant which might affect the CO₂ concentration during the calibration.

Software

The Windows based pc software provided is used to set-up the datalogger, download data and to view the data in graphical or text format. After installing the software, view the HELP file for operational information.

Maintenance

CLEANING AND STORAGE

1. The meter should be cleaned with a damp cloth and mild detergent when necessary. Do not use solvents or abrasives.
2. Store the meter in an area with moderate temperature and humidity.

Specifications

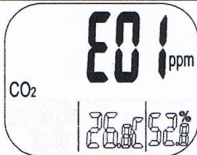
Function	Range	Resolution	Accuracy
CO ₂	0 to 9999ppm	1ppm	±(5%rdg +50ppm)
Temperature	-10 to 60°C 14 to 140°F	0.1°	±0.6°C/0.9°F
Humidity	0.1 to 99.9%	0.1%	±3%(10 to 90%) ±5%(< 10% or > 90%)

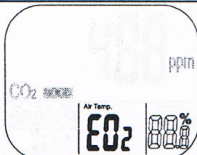
Display	LCD
Sensor Type	CO ₂ : NDIR (non-dispersive infrared) technology Humidity: Capacitance sensor; Temperature (air): Thermistor
Response	CO ₂ : <2min for 90% step change Temp: <2min for 90% step change %RH: <10min for 90% step change
Datalogging	Up to 15999 points
Sample rate	1 second to 4 hours-59 minutes-59 seconds
Operating Conditions	-10 to 60°C (14 to 140°F); < 90% RH non-condensing
Storage Conditions	-20 to 60°C (-4 to 140°F); <99% RH non-condensing
Power Supply	5VDC (±10%), ≥ 500mA (AC adaptor supplied)
Dimensions / Weight	117x102x102mm (4.6x4x4"); 204g (7.2 oz.)

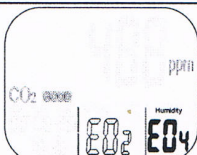
TROUBLESHOOTING

Can't power on:	Check whether the adaptor is properly plugged in.
Slow response:	Check whether the air flow channels on the rear of the meter are blocked.
"BA" and green LED keep flashing:	The adaptor output voltage is too high or too low. Please use the adaptor with correct output.

Error Codes:

CO2 Display		
E01	CO2 sensor is damaged	Send back for repair
E02	CO2 reading is under the lower limit	Re-calibrate the meter, if it still appears, return for repair
E03	CO2 reading is above the upper limit	Put the meter in fresh air and wait for 5minutes, if it still appear, re-calibrate the meter. If above two methods faile, return for repair
E17	ABC mode of CO2 sensor has failed and might cause wrong CO2 readings	Send back for repair

Temp Display		
E02	Air temp. measurement is under the lower limit	Put the meter in regular room temperature for 30 minutes, if it still appears, return for repair
E03	Air temp. measurement is over the upper limit	Put the meter in regular room temperature for 30 minutes, if it still appears, return for repair
E31	Temp. sensor or measuring circuit is damaged	Return for repair

Humidity Display		
E04	Air temp. measurement has error code	Refer to temperature error code for problem solving
E11	The RH calibration has failed	Please return for repair
E34	RH sensor or measuring circuit has failed	Return for repair

CO₂ Levels and Guidelines

Non-Enforced Reference levels:

- 250 - 350 ppm – background (normal) outdoor air level
- 350- 1,000 ppm - typical level found in occupied spaces with good air exchange.
- 1,000 – 2,000 ppm - level associated with complaints of drowsiness and poor air.
- 2,000 – 5,000 ppm – level associated with headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.
- >5,000 ppm – Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma and even death.

Regulatory exposure limits:

ASHRAE Standard 62-1989: 1000ppm: CO₂ concentration in occupied building should not exceed 1000ppm.

OSHA: 5000ppm: Time weighted average over five 8-hour work days should not exceed 5000ppm

Building bulletin 101 (Bb101): 1500ppm. UK standards for schools say that CO₂ at averaged over the whole day (i.e. 9am to 3.30 pm) should not exceed 1500ppm.

Germany, Japan, Australia, UK: 5000ppm, 8 hours weighted average occupational exposure limit is 5000ppm.

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