**GENERAL**®

# CDM77535
*USER'S MANUAL*

# Digital $CO_2$ Environmental Meter

*INTRODUCTION*

*Thank you for purchasing this portable $CO_2$ meter. The meter measures $CO_2$ level, air temperature, dew point, wet bulb temperature and humidity and is an ideal instrument for indoor air quality (IAQ) diagnosis.*

Poor indoor air quality is considered unhealthy because it causes tiredness, loss of ability to concentrate, and even illness (ex. Sick Building Syndrome). IAQ monitoring and survey, especially on $CO_2$ level and air ventilation, has become widely applied in public areas such as offices, classrooms, factories, hospitals and hotels. It is also used in the regulations of industrial hygiene in some countries. (Appendix)

The portable $CO_2$ meter uses NDIR (non-dispersive infrared) technology to ensure reliability and long term stability. It's useful in verifying HVAC system performance and air ventilation control.

### *FEATURES:*

- Triple displays of $CO_2$ level, temperature and humidity
- Stable NDIR sensor for $CO_2$ detection
- Statistics of weighted averages TWA (8 hours weighted average) STEL (15 minutes weighted average)
- Backlight for working in dark area
- Audile $CO_2$ warning alarm
- Battery and optional adaptor power supply
- Easy manual calibration on $CO_2$ and humidity
- PC connect via RS232 interface

### *MATERIAL SUPPLIED*

**This package contains:**
- $CO_2$ Meter
- 4 "AA" batteries
- Operation manual
- Hard carrying case

**Optional accessories:**
- 33% calibration salt
- 75% calibration salt
- Adaptor (9V/100-240Vac)
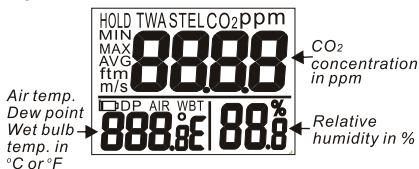- ASFT Kit, cable and software

### *POWER SUPPLY*

The meter is powered by either 4 "AA" batteries or a "DC" adaptor (9V/1A output).

Install the batteries into the battery compartment on the rear and make sure they are in correct polarity and good contact. When an adaptor is used, it will cut off the power supply from batteries. The adaptor can't be used as a battery charger.

When battery voltage gets low, ( ▭ ) and "Lob" will appear on the LCD (Fig. 1). And beeper sounds. The $CO_2$ sensor can't work under low voltage, so it beeps to indicate failed $CO_2$ measurement (press any key but ( ⓪$_{SET}$ ) to stop the beeps) and the readings won't be displayed. Please replace with fresh batteries or connect with an adaptor.

Fig.1

### *LCD DISPLAY*



*CO₂ concentration in ppm*

*Air temp. Dew point Wet bulb temp. in °C or °F*

*Relative humidity in %*

### *SYMBOLS*

| | |
|---|---|
| TWA . . . . . . . . . . | Time weighted average (8 hours) |
| STEL . . . . . . . . . | Short-term exposure limit (15 minutes weighted average) |
| HOLD . . . . . . . . . | Readings are frozen unchanged |
| MIN/MAX . . . . . . | Minimum/Maximum readings |
| (ICON) . . . . . . . . | Low battery indicator |
| DP . . . . . . . . . . . | Dew point temperature |
| AIR . . . . . . . . . . . | Air temperature |
| WBT . . . . . . . . . . | Wet bulb temperature |
| % . . . . . . . . . . . | Unit of relative humidity |
| °E (C/F). . . . . . . . | Celsius/Fahrenheit |
| AVG/ftm/m/s . . . | Vain icons in these models |

### *KEYPAD*

| | |
|---|---|
| $\textcircled{O}_{SET}$ | Turns on and off the meter. Enters setup mode. Sets as non-sleep mode with $\boxed{HOLD}$. |
| $\overset{CAL}{Esc}$ | Exits setup page/mode. Enters CO₂ calibration with $\boxed{MODE}$. Enters RH calibration with $\boxed{DP/WBT}$. |
| $\boxed{HOLD}$ | Freezes the current readings. Cancels data hold function. |
| $\boxed{MODE}$ | Activates or cancels the backlight. Selects unit or increases value in setup. |
| $\boxed{DP/WBT}$ | Selects AIR, DP, WBT temps display Selects unit or decreases value in setup. |
| $\boxed{M/AV}$ | Activates MIN, MAX, STEL, TWA function. Saves and finishes settings. |

## *OPERATION*
**POWER ON/OFF**

Press ( $\overline{\mathbb{Q}_{\text{SET}}}$ ) to turn the meter on and off. At power up, it emits a short beep and performs 30 seconds count down (Fig. 2) for meter warm up, then enters normal mode with current $CO_2$, temperatures, and humidity readings displayed (Fig. 3).



Fig. 2



Fig 3
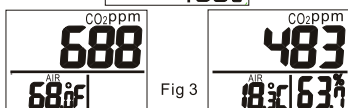
## *TAKING MEASUREMENT*

The meter starts measurement when powered on and updates readings every second. In the condition of operating environment change (ex. from high to low temperature), it takes 30 sec to respond for $CO_2$ sensor and 30 minutes for RH.

**NOTE:** Do not hold the meter close to anyyone's face in case exhalation affects $CO_2$ levels.

**AIR, DP, WBT**

Press ( $\overline{\text{DP/WB}}$ ) to switch temperatures display. The lower left display will cycle from air temperature, dew point temperature (Fig.4) and wet bulb temperature (Fig. 5).



Fig.4



Fig.5
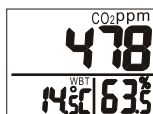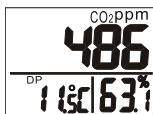
## *DATA HOLD*

Press ( $\overline{\text{HOLD}}$ ) to freeze the readings, "HOLD" icon is displayed on the left top of LCD (Fig.6). All current readings are kept unchanged, except STEL and TWA. Press ( $\overline{\text{HOLD}}$ ) again to cancel the hold function.



Fig.6
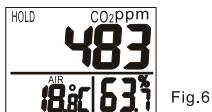
**BACKLIGHT**
Hold down ( (MODE) ) for more than 1 second to activate and cancel backlight function.

**MIN, MAX, STEL, TWA**
Under normal mode, press ( (M/AV) ) to see the minimum, maximum, and weighted average readings. Each press of ( (M/AV) ) displays MIN, MAX, STEL, and TWA in sequence and returns to normal mode.

In MIN and MAX modes, it shows the minimum and maximum readings of $CO_2$ on main display and of AIR or DP or WB temperatures and humidity on the lower displays. (Fig. 7)



Fig.7

In STEL and TWA modes, the main display shows the weighted average of $CO_2$ readings for the past 15 minutes (STEL) and 8 hours (TWA). The lower displays are the current AIR, DP/WB temperatures and humidity. (Fig. 8)



Fig.8

**NOTE:**
   1. If the meter is turned on for shorter than 15 minutes, the STEL value will be the weighted average of readings taken since power on. Same for TWA values appear before 8 hours.
   2. It takes at least 5 minutes to calculate STEL and TWA. The display shows "_ _ _" (Fig. 9) during the first 5 minutes from power on.



Fig. 9

   3. While all readings are held unchanged, STEL and TWA will keep updating every 5 minutes.

**ALARM**

The meter features an audible alarm to give warnings when $CO_2$ concentration exceeds the limit. (See P1.o in setup for setting alarm threshold). It emits beeps (Abt.80dB) when $CO_2$ level goes over the set value and stops when any key (except $\textcircled{\tiny{$\emptyset$}_{SET}}$ ) was pressed or readings fall below the set value. It beeps again when value goes over the limit. Restart the meter if beeper can't be stopped.

**AUTO POWER OFF**

The meter turns off automatically after 20 minutes of inactivity. To override the function, hold down ( $\textcircled{\tiny{$\emptyset$}_{SET}}$ ) and ( $\textcircled{\tiny{HOLD}}$ ) for 2 seconds to turn on the meter until "n" appears.

**NOTE:** Auto sleep function will be disabled during calibration mode.

### *SETUP*

Hold down ( $\textcircled{\tiny{$\emptyset$}_{SET}}$ ) under normal mode for more than 1 sec to enter setup mode. To exit setup, press ( $\textcircled{\tiny{CAL \\ Esc}}$ ) in P1.o or P3.o and it returns to normal mode.

**PROGRAMMING P1.o $CO_2$ ALARM**

When entering setup mode, P1.o and "AL" (Fig.10) are displayed on the LCD. Press ( $\textcircled{\tiny{M$^{\circ}$/AV}}$ ) to go into P1.1 for setting $CO_2$ alarm threshold. The current set value will be blinking on LCD (Fig11).
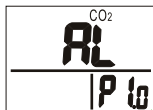


Fig. 10          Fig. 11

Press ( $\textcircled{\tiny{MODE}}$ ) to increase the value or ( $\textcircled{\tiny{DP/WB}}$ ) to decrease. Each press tunes 100 ppm and the alarm range is from 100 to 9900ppm. When the preferred alarm value is set, press ( $\textcircled{\tiny{M$^{\circ}$/AV}}$ ) to save the setting or ( $\textcircled{\tiny{CAL \\ Esc}}$ ) without saving and return to P1.o.

**NOTE:** P2.o is not applicable in this model.

**PROGRAMMING P3.o TEMPERATURE SCALE**

Press ( (MODE) ) or ( (DP/WB) ) in P1.o to access P3.o for setting up temperature scale (Fig. 12). Press ( (M'/AV) ) and it goes into P3.1 with blinking °C or °F current set (Fig.13) on the lower left display. To switch °C or °F,

Press ( (MODE) ) and ( (DP/WB) ). Then press ( (M'/AV) ) to save the setting or ( (CAL Esc) ) without saving and return to P3.o.


Fig. 12


Fig. 13

### *CO₂ CALIBRATION*

The meter defaults to be calibrated manually in the ambient air where $CO_2$ concentration is around 400ppm. It's suggested to do manual calibration regularly to maintain good accuracy.

> **CAUTION:**
> Do not calibrate the meter in air with unknown $CO_2$ concentration. Otherwise, it will be calibrated as 400ppm by default and will lead to inaccurate measurements.

**CALIBRATION SITE**

The manual calibration is suggested to be done in fresh outdoor air that is well ventilated and in sunny weather.

**PROCEDURE**

Place the meter in the calibration site. Turn on the meter and hold down ( (CAL Esc) ) and ( (MODE) ) simultaneously to enter $CO_2$ calibration mode (Fig.14). 400ppm and "CAL" are blinking on the LCD while performing calibration.


Fig. 14

Wait about 10 minutes until the blinking stops and the calibration is completed automatically and returns back to normal mode.
To abort the calibration, turn off the meter at any time.

**NOTE:** Ensure the batteries are with full voltage during the calibration cycle to prevent interruption or failed calibration.

**RH CALIBRATION**

The meter defaults to have the humidity calibrated with 33% and 75% salt solution. The ambient condition is recommended to be at 77°F (25°C) and stable humidity (better to be close to the calibrating value). To abort calibration, just turn off the meter.

> **CAUTION:**
> Do not calibrate the humidity without the default calibration salt. Otherwise, it will cause permanent damage. Contact the dealer for calibration salts.

**33% CALIBRATION**

Plug the sensor probe into 33% salt bottle. Hold down ($\overset{CAL}{\underset{Esc}{}}$) and ($\overline{DP/WB}$) under normal mode to enter 33% calibration (Fig. 15). "CAL" and calibrating value (32.7% if at 77°F (25°C)) are blinking on the LCD with current temperature at the left.

Meter is now calibrating, and will finish in about 60 minutes when "CAL" and humidity stop blinking (Fig. 16).



Fig. 15                     Fig. 16

**75% CALIBRATION**

After 33% calibration, plug the sensor probe into 75% salt bottle, then press ($\overline{M/AV}$) to enter 75% calibration (Fig.17).



Fig.17

"CAL" and calibrating value (75.2% if at 77°F (25°C) are blinking on the LCD with current temperature at the left. Meter is now calibrating. Wait about 60 minutes until the blinking stops, then calibration is completed and it returns to normal mode.

**NOTE:** Users can also calibrate either point. To calibrate 33% only, press ($\overset{CAL}{\underset{Esc}{}}$) and exit when 33% calibration is completed. To calibrate 75% only, press ($\overline{MODE}$) or ($\overline{DP/WB}$) within the 5 minutes while initializing 33% calibration.

### *TROUBLESHOOTING*
#### ? CAN'T POWER ON

Press ( $\textcircled{0}_{\text{SET}}$ ) for more than 0.3 seconds and try again. Check whether batteries are in good contact with correct polarity, or the adapter is plugged in properly.

#### ? FIXED READINGS

Check whether data hold function was activated. (HOLD icon at the top left)

#### ? SLOW RESPONSE

Check whether the airflow channels on the rear are blocked.

#### ? ERROR MESSAGES

E01: $CO_2$ sensor damaged
E02: The value is under range
E03: The value is over range
E04: The original data error results in this error (DP, WB)
E07: Too low a voltage to measure $CO_2$. Replace batteries or use the adapter
E11: Retry humidity calibration
E17: Retry $CO_2$ calibration
E31: Temperature sensor damaged
E34: Humidity sensor damaged

### *PC CONNECTION*
The meter can do PC link for on-line logging and data analysis via RS232 interface and software.

The protocol is as follows:

**A.** 9600 bps, 8 data bits, no parity.

**B.** Format (ASCII)
Cxxxxppm:Txxx.xC(F):Hxx.x%: dxxx.xC(F):wxxx.xC(F) LRC CRLF
Description: $CO2$:Air:RH:DP:WBT LRC CRLF

### *SPECIFICATION*

**$CO_2$**

| | |
|---|---|
| Range: | 0-5,000ppm |
| | 5,001-9,999 (out of scale) |
| Resolution: | 1ppm |
| Accuracy: | ±50ppm ±5%rdg (0-5,000ppm) |
| | Not specified for out-of-scale |
| Pressure | |
| Dependence: | +1.6% reading per kPa deviation from |
| | normal pressure, 100kPa |

**TEMPERATURE**

| | |
|---|---|
| Range: | 14º-140°F (-10.0º to 60.0°C) |
| Resolution: | 0.1°F (0.1°C) |
| Accuracy: | ±0.9°F (0.6°C) |

**HUMIDITY**

| | |
|---|---|
| Range: | 0.0 to 99.9% |
| Resolution: | 0.1% |
| Accuracy: | ±3% (10 to 90%) ±5% (others) |
| Warm up: | 30 seconds |
| Operating: | 32° to 122°F (0º to 50°C), 0 to 95%RH |
| | (avoid condensation) |
| Storage: | -4° to 140°F (-20º to 60°C), 0 to 99%RH |
| | (avoid condensation) |
| Power Source: | 4 "AA" batteries, DC adaptor |
| Battery life: | 24 hours (Alkaline) |

### *$CO_2$ LEVELS AND GUIDELINES*

**NON-ENFORCED REFERENCE LEVELS**

**NIOSH recommendations**

| | |
|---|---|
| **250-350ppm:** | Normal outdoor ambient concentrations |
| **600ppm:** | Minimal air quality complaints |
| **600-1000ppm:** | Less clearly interpreted |
| **1000ppm:** | Indicates inadequate ventilation; complaints such as headaches, fatigue, and eye/throat irritation will be more widespread. 1000ppm should be used as an upper limit for indoor levels. |
| **EPA Taiwan:** | 600ppm and 1000ppm |

| Type 1 | Indoor areas such as department stores, theaters, restaurants, libraries, the acceptable $CO_2$ concentration of 8 hours average is 1,000ppm. |
| Type 2 | Indoor areas with special requirements of good air quality such as schools, hospitals, day care centers, the suggested $CO_2$ level is 600ppm. |

**REGULATORY EXPOSURE LIMIT**

**ASHRAE Standard 62-1989:** 1,000ppm
$CO_2$ concentration in occupied building should not exceed 1,000ppm.

**Building Bulletin 101 (BB101):** 1,500ppm
UK standards for schools say that $CO_2$ at averaged over the whole day (i.e. 9:00am to 3:30pm) should not exceed 1,500ppm.

**OSHA:** 5,000ppm
Time weighted average over five 8-hour work days should not exceed 5,000ppm.

**Germany, Japan, Australia, UK...:** 5,000ppm
8 hours weighted average in occupational exposure limit is 5,000ppm.

**Canada:** 3,500ppm (Long Term)

**ACGIH:** 5,000ppm or 30,000ppm (15 min)
The American Conference of Governmental Industrial Hygienists (ACGIH)

**NOTES:**
- **TWA:** Time Weighted Average value stands for the average $CO_2$ level exposure during 8 hours (working day) is 5,000ppm/5 days

- **STEL:** Short Term Exposure Limit value shows the last 15 minutes $CO_2$ concentration is 30,000ppm

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