



CO₂-2 / CO₂ & Atmosphere Controller

The CO₂-2 CO₂ & Atmosphere Controller is a very simple and effective way to control the Temperature, Humidity and Carbon Dioxide levels within your growing area .
The CO₂-2 can be used with our PPM-1c, CO₂ Part Per Million sensor / monitor to provide an extremely accurate method of controlling CO₂.

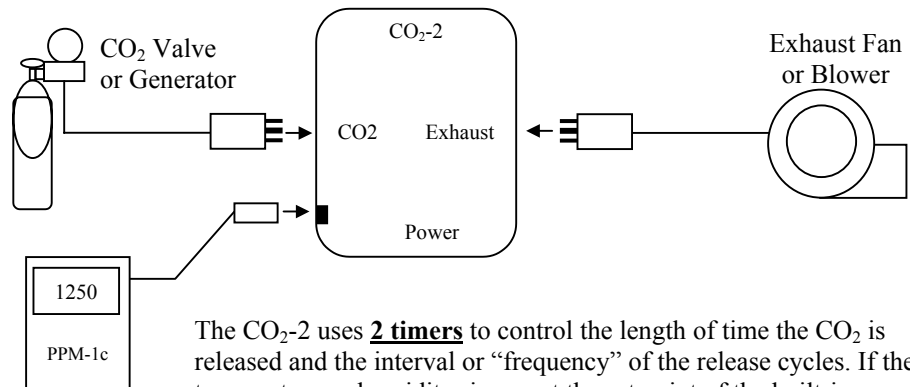
- ✓ Controls temperature, humidity and CO₂ by coordinating exhaust fan(s) and your CO₂ device using standard 120vac outlets.
- ✓ External remote temperature probe is highly accurate & reliable.
- ✓ Three indicator lights verify Exhaust, CO₂ "ON" and PPM level.
- ✓ Photocell ensures CO₂ valves or generators operating on 120vac are only active during the "day" when HID lights are ON.
- ✓ Optional Part-Per-Million controller (PPM-1c) can be combined with the CO₂-2 for an extremely accurate method of controlling CO₂.



* CO₂-2 Example

The CO₂-2 Atmosphere / CO₂ controller controls CO₂ simply and efficiently. It is designed to control and coordinate the Temperature, Humidity and Supplemental CO₂ with or without PPM accuracy.

The PPM-1c Infrared Carbon Dioxide sensor / monitor can be connected to control CO₂ levels within the growing area from 0-5000 Parts Per Million.



The CO₂-2 uses **2 timers** to control the length of time the CO₂ is released and the interval or "frequency" of the release cycles. If the temperature or humidity rises past the set point of the built-in **thermostat or humistat**, the CO₂ is disabled and the exhaust fans are turned on to exhaust the warm humid air.

It also has a built-in **Photocontroller**, which disables the CO₂ function at night while maintaining control of the atmosphere.

INSTALLATION / START-UP

There are six requirements for a successful installation and start-up.

- 1) The CO₂-2 must be mounted in a vertical position. Mounting feet are included to allow you to secure the unit to a wall.
- 2) The CO₂-2 requires "free air movement" to maintain temperature and humidity accuracy. The top and bottom of the enclosure has ventilation slots to provide air flow through the unit. We greatly recommend using an oscillating fan or similar air movement device to provide fresh air for the internal temperature sensor and provide adequate ventilation for the internal electrical components.
- 3) The photocell, which controls the CO₂-2, must be facing a source of light. If the light level is too low, the CO₂ function will not be enabled.
- 4) A ground wire (3-wire outlet) must be used. **Do not use 2-wire adapters or cords to operate the CO₂-2.**
- 5) The CO₂-2 must be protected from water. **Do not** mount the unit where it can be exposed directly to water.
- 6) Read the rest of the manual!!! It has been designed to take you through step-by-step to make start-up a breeze. You will have to make several educated decisions in order to utilize the CO₂-2 to it's potential.

“FRONT PANEL”

OVERVIEW

“THE CO₂-2 HAS BEEN DESIGNED TO CONTROL YOUR COMPRESSED CO₂ OR GENERATOR IN A WAY YOU’VE ONLY DREAMED OF. A THERMOSTAT, HUMISTAT, 2-TIMERS AND THE OPTIONAL PPM-1c MONITOR, COMBINE TO PROVIDE A HIGHLY EFFICIENT CO₂ DELIVERY SYSTEM.



MAKING CONNECTIONS

The CO₂ and Exhaust functions controlled by the CO₂-2 are accessed using (2) standard 120vac receptacles mounted on the sides of the enclosure. This allows you to simply plug in any standard device without hardwiring or hassles. Printed labels on the front face of the enclosure identify the receptacles.

We highly recommend using only 3-wire devices with a ground. Suitably double-insulated devices are acceptable. To connect your equipment, press the plug with even and firm pressure into the appropriate receptacle.

PPM OPTION QUICK DISCONNECT

The CO₂-2 comes standard with a very effective timed CO₂ control system. However if you want to control CO₂ levels to actual Parts Per Million, it's as simple as plugging in our PPM-1c CO₂ monitor / controller. Connecting the PPM-1c to the IEC-320 Quick Disconnect on the side of the enclosure automatically switches the CO₂-2 to control CO₂ levels by PPM. (Refer to CO₂ control for details)

You must also connect the PPM-1c power supply to a **constant source of 120vac power.**

START-UP SEQUENCE

OVERVIEW

“THERE IS NO SUBSTITUTE FOR READING AND UNDERSTANDING THE OPERATING MANUAL HOWEVER... YOU CAN USE THE INSTRUCTIONS ON THIS PAGE FOR A TROUBLE -FREE START-UP”.

HOW TO START-UP THE CO₂-2

- 1) Secure the enclosure to a wall using the enclosed mounting brackets. The CO₂-2 requires a vertical orientation for proper internal ventilation. If proper ventilation is not provided, the humistat and thermostat may not be able to properly control the temperature of the growing area.
- 2) Locate a suitable constant source for power. Because CO₂ is normally used only during the day, our built-in photo control will disable the CO₂ function at night, while the thermostat and humistat continue to control the atmosphere 24 hours a day. Locate the unit where the photo controller will get enough light to enable the CO₂.
- 3) **IMPORTANT!!!** **If you are not using the optional PPM-1c CO₂ controller**, the “jumper-plug” supplied with the unit must be plugged into the Quick Disconnect for the CO₂ function to operate. **If you are using the optional PPM-1c controller**, connect it now by installing the quick-disconnect into the side of the CO₂-2. Next plug the PPM-1c’s 18-24vdc power supply to a source of constant 120vac power.
***Note:** The PPM-1c must remain powered up at all times! The PPM-1c takes between 10-20 minutes to warm-up properly.
- 4) Plug the CO₂-2 main power cable into a grounded 120vac power source.
- 5) You can now set the thermostat and de-humistat to the approximate settings you would like to use. Because the dials of the CO₂-2 are small to conserve space, the setting may have to be adjusted to an actual temperature and humidity level. A small, inexpensive combination thermometer and hygrometer works just fine to “dial in” the exact settings. Just compare the reading on the thermometer to what the CO₂-2 is set at and adjust as required.
- 6) There are 2 timers on the CO₂-2, which are used to control your CO₂ valve or generator. To fully understand the timers that control the CO₂-2, refer to the Timers section of this manual. Set the CO₂ timers to your desired settings before continuing. (Refer to Timed CO₂ control mode)
- 7) You can now plug the exhaust fan and the CO₂ valve or generator into the appropriate receptacles. Remember that the CO₂-2 can handle a combined load up to 10-amps. Select and size your fans appropriately or use our UPM-1 to increase power capacity.
- 8) Monitor the equipment connected to the CO₂-2 to ensure proper operation. Small adjustments are likely to be made until you find the right combination of controls. Once you are happy with the settings sit back and enjoy the show!

For more details concerning any of the CO₂-2 functions, refer to the appropriate section of this manual.

“CONTROLS / TIMERS”

OVERVIEW

“IN ORDER TO MAIXIMIZE THE BENEFITS OF CO₂ ENRICHMENT, YOU MUST FIRST CONTROL THE AIR TEMPERATURE AND HUMIDITY LEVELS... THEN AND ONLY THEN YOU CAN CONTROL THE CO₂ LEVEL. THE CO₂-2 HAS THE RIGHT TOOLS FOR THE JOB... ALL IN A 8” X 6” X 3 1/2” PACKAGE.”

TEMPERATURE CONTROLLER

The CO₂-2 utilizes a remote-bulb thermostat with a 30” lead to control ventilation and cooling functions. This allows you to place the temperature sensor up to 30” away from the CO₂-2. The thermostat can be set to control temperature from 50 – 115° F.

The thermostat is coordinated with the CO₂ control system and the exhaust receptacles to maintain a constant temperature. When the temperature rises above the set point selected on the thermostat, the CO₂ system is disabled and the Exhaust receptacle is enabled. When the temperature level drops below the set point, the CO₂ system is re-activated.

IMPORTANT: To achieve the greatest accuracy, provide the CO₂-2 with plenty of fresh air. The enclosure is designed to allow air to pass over the humidity sensor.

HUMIDITY CONTROLLER

The CO₂-2 utilizes a de-humistat to control ventilation and humidity levels. The de-humistat can control humidity levels from 20% - 80%.

The de-humistat is coordinated with the CO₂ control system and the exhaust receptacles to maintain a constant humidity. When the humidity rises above the set point selected on the de-humistat, the CO₂ system is disabled and the Exhaust outlet is enabled. When the humidity level drops below set point, the CO₂ system is re-activated.

Set the de-humistat to the desired maximum humidity level you would like the exhaust fan to come on. When the fan is running the CO₂ will be interrupted.

THE CO₂-2 ALSO USES 2 TIMERS TO GIVE YOU PRECISE CONTROL OF CO₂ LEVELS AND CYCLES.

ADJUSTABLE TIMERS

The 2-adjustable timers onboard the CO₂-2 are set using the dial on the front face of the enclosure. The timer name and range of each timer is printed around the timer dials. Because the dials of the CO₂-2 are small to conserve space, the settings may have to be adjusted to an actual time setting. Use a watch or stopwatch to confirm the settings are correct. Once the timers are set, they are repeatable to +/- .5%.

The timers are designed to finish the cycle they are presently timing which means adjustments made to the timers during a cycle will not affect the present cycle.

IMPORTANT: In order for the timers to accept a new setting, the timer must either complete it’s present cycle or, power must be cycled off, then on. Follow the procedures below to set the CO₂ timers correctly.

PPM SENSOR OPTION

The CO₂-2 controller combines all of the necessary components to give you the most efficient method of controlling CO₂ available today. Let’s call it “Smart CO₂”! As with all of CAP’s greenhouse and CO₂ controllers, a thermostat and a de-humistat are used to interrupt CO₂ use if the temperature or humidity rises above the preset level. Sounds fairly common right?

How does the CO₂-2 separates itself from the competition... the CO₂-2 can be used with our PPM-1c “Part-per-million” sensor / monitor! The PPM-1c accurately measures the CO₂ level and commands the CO₂-2 timers to cycle only when required.

For more detailed information about the CO₂ timers and sequence, refer to the CO₂ Control section of this manual.

CO₂ CONTROL

OVERVIEW

“POUND FOR POUND, DOLLAR FOR DOLLAR, THE CO₂-2 OFFERS THE ONE OF THE MOST ADVANCED CO₂ CONTROL SYSTEM ON THE MARKET”.

“PREMIUM AIR”

Let's talk about ... Carbon Dioxide. CO₂ is present in relatively low quantities, (300-600 PPM) in your normal, generic, run of the mill everyday air. But plant growth can be increased and accelerated if the level of CO₂ is increased to, let's say... 1000 -1500 PPM. For this reason, we designed the CO₂-2.

There are some inherent dangers associated with using CO₂.

Here are some of the rules to remember when using CO₂:

- A) Cylinders (bottles) of compressed CO₂ should never be stored inside the growing area or anywhere else where the temperature may rise above 100'f.
- B) The growing area should not be occupied while CO₂ is in operation.
- C) Do not enter the growing area until the CO₂ has been exhausted.
- D) CO₂ is heavier than air and will accumulate towards the ground.
- E) In high enough concentrations CO₂ can kill!!! The OSHA maximum “Personal Exposure Level” is 5000 PPM.

***Note:** The CO₂-2 CO₂ control system was designed to be used for both compressed CO₂ cylinders, and CO₂ generators. The CO₂ receptacle is 120vac. It can run any load up to 10-amp. Compressed CO₂ cylinders require an approved regulator / flow gage and a valve.

If optimum CO₂ “mileage” is desired, a self contained air conditioner or other “Closed loop” cooling method is highly recommended. A closed loop system will regulate temperatures within the zone allowing you to extend the CO₂ maximum cycle time thus reducing CO₂ use dramatically.

Another method of reducing heat build up includes utilizing “Ventilated light hoods”. Just be sure to make the ventilation system of the hood as airtight as possible so that your precious CO₂ is not being drawn out of the area by the ventilated hood exhaust fan.

If sufficient CO₂ is used and the proper level of nutrients and light is available, a 35% increase in growth rate is possible. However if you suspect the higher temperatures are adversely affecting the plants, a shorter CO₂ cycle may produce better results. Remember that a shorter CO₂ cycle duration translates to increased CO₂ usage. Each application is different, so there is some work involved in finding the optimum set-up.

CO₂ CONTROL MODES

The CO₂-2 provides both a standard timed CO₂ mode and an optional integrated CO₂ PPM control mode. The optional PPM-1c controller is the most precise and efficient method of distributing Co₂.

***NOTE:** If the PPM-1c is not being used, the jumper-plug supplied with the CO₂-2 must be plugged into the Quick Disconnect on the lower left side of the enclosure in order for the CO₂ outlet to function.

TIMED CO₂ CONTROL MODE

- 1) The CO₂ Inject Duration timer can be set from 30 seconds to 20 minutes. As long as the exhaust fan is not running and the photocell detects adequate light, the CO₂ timed cycle will run. The CO₂ outlet is turned ON for a predetermined amount of time using the CO₂ Inject Duration timer.
- 2) The CO₂ Frequency timer works in conjunction with the CO₂ Injection timer. This timer can be set from 3 to 120 minutes. During the CO₂ cycle, the CO₂ outlet will be turned OFF for the amount of time set on this timer. The CO₂ Inject Duration timer and the Frequency timer continue to recycle until the Exhaust fans are energized.

***Note:** The CO₂ Frequency timer also doubles as a CO₂ sample timer when using the PPM-1c controller.

Because it may take a couple of minutes from the time CO₂ is released for the PPM-1c to detect a higher CO₂ level, this

timer will provide a delay for the PPM controller to sense this increase in the CO₂ level before releasing more CO₂.

If you find the CO₂ level is “overshooting” the CO₂ set point, try increasing the CO₂ sample timer. This will give the PPM-1c more time to sense the rise in CO₂.

CO₂ CONTROL (continued)

PPM CO₂ CONTROL MODE

As mentioned previously, the CO₂-2 can control CO₂ levels within the growing area with “part-per-million” accuracy when used in conjunction with the PPM-1c controller. Simply replacing the “jumper-plug” with the PPM-1c standard quick-disconnect on the side of the CO₂-2, instantly gives you the ability to fully control all atmospheric conditions which affect timed CO₂ systems.

*Note: The CO₂ Frequency timer acts as a CO₂ sample timer when using the PPM-1c controller. Because it may take a couple of minutes from the time CO₂ is released for the PPM-1c to detect a higher CO₂ level, this timer will provide a delay for the PPM controller to sense this increase in the CO₂ level before releasing more CO₂. If you find the CO₂ level is “overshooting” the CO₂ set-point, try increasing the CO₂ sample timer or decrease the CO₂ Inject timer. This will give the PPM-1c more time to sense the rise in CO₂ resulting in reduced “overshoot”.

Let me explain the overall function of our “State of the art” **PPM-1c**, CO₂ PPM sensor / monitor.

THE PPM-1c

The PPM-1c sensor / monitor is a remote carbon dioxide sensor which consists of an infrared detector capable of measuring atmospheric CO₂ levels from 0 to 5000 PPM. The PPM-1c is powered by a 18-24vdc power supply. A Quick Disconnect cable is used to integrate the PPM-1c with the CO₂-2. The cable that connects the PPM-1c to the CO₂-2 replaces the jumper-plug which came with the CO₂-2.

When the power supply is plugged into a 120vac source, the PPM-1c will enter a “warm-up” mode. The “warm-up” may take from 10-20 minutes to complete depending on the ambient air temperature. During this time, the digital readout may be fluctuating, this is normal. When the digital readout stabilizes, a level between 250 to 650 should be displayed. Be careful however, simply breathing on the PPM-1c controller will greatly increase the CO₂ level in the air resulting in a higher reading.

IMPORTANT!!! Do not start a CO₂ cycle until the PPM-1c has completed the “warm-up” and the display has stabilized.

VERY IMPORTANT!!! Failure to follow these instructions may result in unexpected operation.

Once the PPM-1c has been connected, it remains powered as long as it is plugged in. The controller will continuously display the exact CO₂ PPM level in **PPM**. It is a portable device and comes with a 5-foot cable so that spot checks can be made.

Warning: Be careful not to expose the **PPM-1c** to water, as it is **not water-resistant!**

OPTIONS

OVERVIEW

THE CO₂-2 CAN BE UPGRADED AND EXPANDED BY USING OUR OPTION KITS INCLUDING THE UPM-1 AND THE PPM-1c. THE UNIVERSAL POWER MODULE (UPM-1), ALLOWS YOU TO RUN MULTIPLE EXHAUST DEVICES.

UNIVERSAL POWER MODULES (UPM-1)

Even though the CO₂-2 can control up to 10-amp equipment, our Universal Power Module, also known as **UPM-1**, give you the ability to control higher amperage loads by simply plugging in to the receptacles on the CO₂-2.

Our UPM-1 is a high power relay designed to control your larger fans or other high amperage loads. It is rated at 15 amp @ 120vac.



CO₂ SENSOR / MONITOR (PPM-1c)

To take full advantage of supplemental CO₂, you must be able to precisely control the level of CO₂. This is made possible by plugging in our “CO₂ Monitor”, the **PPM-1c**. The **PPM-1c** controller is constantly sampling the level of CO₂ in the growing area and can measure from 0 to 5000 PPM. The **PPM-1c** displays the current CO₂ level in PPM using a 4-digit LCD display. It then transmits that information to the CO₂-2.

When the quick disconnect plug is connected and the power supply is plugged in, the CO₂-2 automatically switches over to PPM Control. Refer to the CO₂ Control section of this manual for more information.



TROUBLESHOOTING

Problem

Suggested Action

- | | |
|---|---|
| <ul style="list-style-type: none">◆ I have no lights and no function at all.◆ The fuse continues to blow.◆ My CO₂ outlet never comes on.◆ The fans are running so often, the CO₂ is hardly ever ON.◆ My CO₂ consumption seems to be quite high.◆ The CO₂ level “overshoots” the PPM-1c set point considerably. | <ul style="list-style-type: none">◆ Check the fuse and main power. Replace the fuse if required with the correct rated fuse.◆ Check the equipment connected to the CO₂-2 for problems and/or short circuits.◆ If the fuse blows repeatedly, verify the devices connected to the unit are working properly and that they are not too large for the CO₂-2 to safely control.◆ You may need to consider using expansion modules, (UPM / HPR / MLC) to decrease the amperage (load) on the CO₂-2 fuse.◆ Verify the PPM-1c jumper or the PPM-1c is connected. If you are using a PPM-1c, the “PPM level low” light will be on when the actual measured CO₂ level is below your desired set point. If the “PPM level low” light is not “ON” the CO₂ outlet will not energized.◆ If the Exhaust outlet is ON, the CO₂ will not be allowed to run. Turn up the Temperature and Humidity to a higher setting.◆ Check the function of the photocell by shining a flashlight on it. If the Exhaust is OFF and the PPM Level Low light is ON, the only other cause may be a faulty photocell.◆ You may have too much heat building up in your area or too small of an exhaust fan. Reduce the heat sources or increase your fan size.◆ You may also consider using a “closed-loop” air conditioner to keep the temperature and humidity below the set points so that CO₂ is allowed to run for longer amounts of time.◆ Make sure your area is sealed. You may want to install a motorized damper to seal your exhaust fans when they are “OFF”. Even though the CO₂-2 operates a standard “timed-release” sequence, you may still be “wasting” CO₂.◆ If you are operating compressed CO₂ valves, consider purchasing the optional PPM-1c “Part-Per-Million” sensor to upgrade to PPM control. The PPM-1c offers a significant improvement in CO₂ efficiency.◆ When using the PPM-1c, the CO₂ timers still control the “duration” of the “ON” and “OFF” time of the CO₂ valve or generator. Small areas need less “Inject Duration” time than do larger areas. Larger areas need more “Inject Frequency” time in order to give the CO₂ time to “mix” properly with the ambient air and measured by the PPM sensor. |
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- ◆ Start with lower CO₂ timer settings for small areas and increase the timer settings for larger ones.

MAINTENANCE / SPECIFICATIONS

SPECIFICATIONS:

System operating voltage	120vac +/- 20% @ 50-60 Hertz
Maximum amperage	10-amps @ 120vac
Overload protection	10-amp normal blow fuse
Operating temperature	30 - 120° F
Maximum humidity	95% RH (Non-condensing)
Thermostat type / control range	External bulb, 7 degree F differential, adjustable 30-120°F
Humidity control range	20 - 80% RH with a 5% differential
Photo controller operation	“Close” on light “Rise”
Adjustable timer repeatability	+/- .5% under fixed conditions
Timer setting accuracy	+/- 10%
CO ₂ Inject duration timer	30 seconds to 20 minutes
CO ₂ Inject frequency timer	3 minute to 120 minutes
Dimensions	8” X 6” X 3.5”
Weight	Less than 3 lbs.
Relay operations	Minimum 100,000 electrical / 10,000,000 mechanical

MAINTENANCE:

Although the unit is maintenance-free, here are a few words of wisdom, which may help, resolve minor problems. First, do not clean the unit or service while the unit is plugged in. Second, disconnect power before making any wiring connection changes. And finally, when cleaning the exterior of the unit, use a damp cloth with water only.

DO NOT allow water to directly enter the enclosure!

- 1) Read the manual. A lot of perceived problems are simple misunderstandings.
- 2) Consult the troubleshooting chart for a listing of the most common problems.
- 3) **DO NOT** open the enclosure!!! There are no components that require maintenance.
- 4) Do not use this equipment for purposes other than what it is designed for. It will provide many years of trouble-free service when used properly.
- 5) In the event you cannot solve the problem, first consult the distributor who sold the unit then contact the factory for instructions on how to return it to the factory for repair.

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