CA5000-C

Liquid CO_2 Freezer Backup System

OPERATING INSTRUCTIONS MANUAL

HAMPSHIRE CONTROLS CORPORATION

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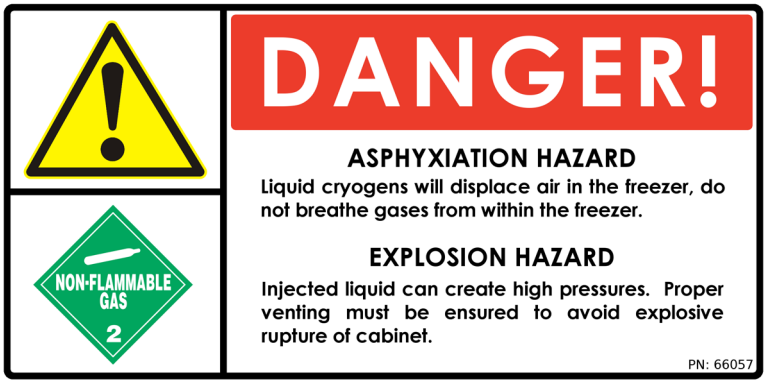
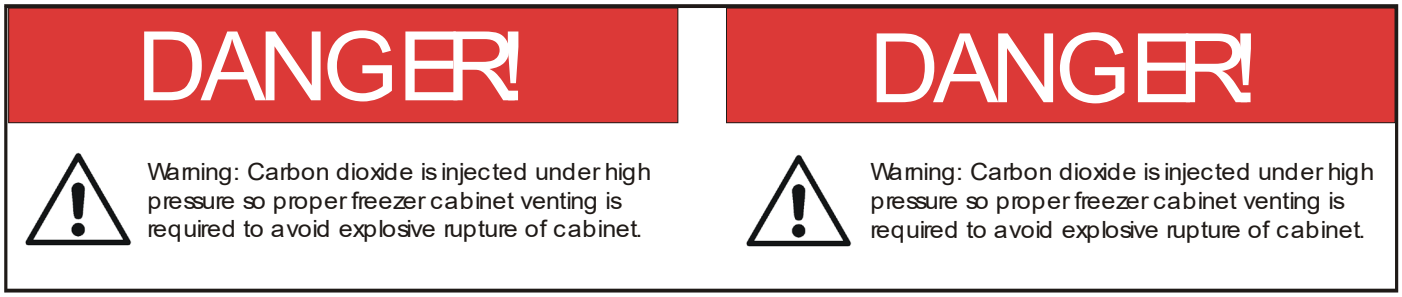
SAFETY WARNINGS

Please read this manual in its entirety before beginning installation.



Injected liquid CO_2 gas is under extremely high pressure, so proper system venting is required.

CO_2 gas exhaust from an operating CA5000-C Liquid CO_2 Freezer Backup System suppresses oxygen levels in enclosed spaces. The facility must have appropriate ventilation, and CO_2 and/or oxygen monitoring equipment should be installed in compliance with local, national, or regional regulations.



The CA5000-C Liquid CO_2 Freezer Backup System must be installed, and periodically tested, according to Hampshire Controls' instructions, by a qualified refrigeration technician, or other qualified personnel, in compliance with local, national, or regional regulations. The CA5000-C Liquid CO_2 Freezer Backup System will not operate during a power failure if it is not properly installed.

This product contains a sealed lead-acid rechargeable battery. Do not use if battery is damaged or leaking. Replace the battery with a Hampshire Controls' recommended battery only. Always recycle used batteries.

Do not modify or change system components. Using this equipment in a manner other than expressly intended may cause serious injury or death. Hampshire Controls shall not be liable for any incidental or consequential damages. The user assumes all risk and liability associated with the use of this product.

All connections from the CO_2 supply cylinder to the freezer require a minimum static pressure rating of 1500 psi.

Liquid CO_2 is extremely cold and can cause frostbite on unprotected skin. Always wear protective clothing and eyewear when working with liquid refrigerants. Liquid CO_2 must be handled safely by qualified personnel in compliance with local, national, or regional regulations.

O.S.H.A. regulations have been established for the safe handling, use, and storage of high-pressure gas cylinders. Please consult a current edition of the O.S.H.A. regulations to ensure compliance with applicable safety requirements and lockout/tagout requirements. Pressurized gas cylinders must be handled safely by qualified personnel in compliance with local, national, or regional regulations.

Empty the contents of the freezer and allow it to warm to ambient temperature prior to performing any work inside the enclosed space. Working in the freezer chamber at its operating temperature may result in frostbite or other physical harm.

Place the CA5000-C Liquid CO_2 Freezer Backup System Battery-Valve Module (BVM) in a secure, stable location 1) as close as possible to the ultra-low temperature (ULT) freezer inlet port to allow for maximum length of the CA5000 output tube within the freezer, and 2) where there is easy access to the POWER cord and CONTROL CABLE. Do not place the BVM in a location where there would be risk of the BVM falling or in a location where it would represent a tripping hazard.

The CA5000-C Liquid CO_2 Freezer Backup System has battery backup. Therefore, in the event of an emergency requiring the complete shutdown of the CA5000 system, both the POWER cord and the CONTROL CABLE must be disconnected, either on one end or the other. Place the CA5000-C Liquid CO_2 Freezer Backup System BVM in a secure, stable location with easy access to the POWER cord and CONTROL CABLE connections.

There are numerous interconnections between the CA5000-C Liquid CO_2 Freezer Backup System Controller and BVM, the liquid CO_2 supply, the ULT freezer, and line power, including: the tubing from the liquid CO_2 supply to the BVM, the liquid CO_2 output tubing from the BVM to the ULT freezer, the CONTROL CABLE from the CA5000 Controller to the BVM, the DOOR SWITCH cable from the BVM to the ULT freezer door, the POWER cord from line power to the BVM, and the type T THERMOCOUPLE PROBE from the CA5000 Controller to the ULT freezer. Place the CA5000-C Liquid CO_2 Freezer Backup System BVM in a secure, stable location as close as possible to the ULT freezer inlet port to minimize the distances of the interconnections. Organize and secure the interconnections in the safest possible configuration to minimize the risk of misidentifying the interconnections and to avoid tripping and/or equipment falling hazards.

Unpacking Information

The CA5000-C Liquid CO_2 Backup System is shipped in a single custom box. Please check the carton for the following:

- **CA5000 Controller:** alarm display module
- **CA5000 Battery-Valve Module (BVM)**
- **Control Cable:** CA5000 Controller to CA5000 BVM
- **Door Switch:** magnetic door interlock switch
- **Door Switch Cable**
- **Type T Thermocouple Probe**
- **Power Adapter:** input: 100-240 VAC, 50-60 Hz, 1 A maximum; output: 15 VDC, 2.4 A, 36 W
- **CO_2 Input Fitting:** 1/4" 45º flare nut CO_2 input fitting on CA5000 BVM (**LIQUID CO_2 FROM TANK**)
- **CO_2 Output Tubing:** 0.125" OD x 0.055" ID by 8' copper output tube with 1/8" female compression fitting connector for the CA5000 BVM (**GAS TO FREEZER**).

Customer Supplied Parts

Some parts and materials must be supplied by the installer or a gas supply company:

- CGA 320 CO_2 tank with **siphon feed**, 50 pounds or larger -OR-
  central **liquid** CO_2 supply (pressure <1000 psi)
- CGA 320 adapter for CO_2 tank*
- Copper tubing, flexible or semi-flexible to connect tank CGA 320 and Hampshire Controls supplied 1/4" 45º flare nut (**LIQUID CO_2 FROM TANK**)*
- Freezer vent to release excess pressure, preferably from the top of the cabinet.

Marked * are available as kit **A84000-19, CA5000-C Liquid CO_2 Freezer Backup System Installation Kit** from Hampshire Controls.

Introduction

The Hampshire Controls Corporation CA5000 system is a unique combination of field proven, highly reliable Hampshire Controls alarm systems and a liquid CO_2 injection system, providing security for your products stored at ultra-low temperatures. It offers multiple user-programmable control setpoints, alarm setpoints and alarm delay timers. Parameters are stored in non-volatile memory and are maintained even when power is lost.

The customer-supplied liquid CO_2 is maintained at high pressure, ready to be injected into an ultra-low temperature (ULT) freezer cabinet or other ULT storage system. When a malfunction occurs and the freezer warms above the user-defined setpoint, a controlled amount of liquid CO_2 is injected into the freezer. Since the boiling point of CO_2 is -78.5 °C, the injected CO_2 boils and absorbs heat, protecting your product by maintaining the cabinet at temperatures as low as -70 °C.

The CA5000 is simple to operate. Plug in the CA5000, place the temperature probe in the freezer chamber to be monitored, and the CA5000 will display the temperature at that location. Pushing combinations of the three CA5000 pushbuttons allows the user to program the alarm set points, CO2 injection temperature setpoint, and the other controls.

FEATURES

- Freezer cabinet temperature can be maintained as low as -70 °C. (Hampshire Controls recommends a -60 °C setpoint.)
- Backup times of 10 hours or more on one standard 50-lb. cylinder of CO_2 with a -60°C setpoint.
- Independent user-programmable controls for system alarms and liquid CO_2 injection.
- Visible and audible indicators for system status.
- Multiple programmable delays are available to minimize nuisance or false alarms.
- Relay output included for central alarm systems or automatic dialers.
- A door interlock switch prevents CO_2 injection while freezer door is open.
- An internal backup battery with integrated charger keeps the system running for at least 24 hours after a power outage.
- BAT indicator warns of a disconnected or low voltage backup battery condition.

SPECIFICATIONS

Table 1: CA5000-C Liquid CO_2 Freezer Backup System Specifications

CA5000-C Liquid CO_2 Freezer Backup System	
Backup Time (50-lb CO_2 cylinder)	>10 hours at -60 ºC setpoint
CO_2 Supply Pressure	<1000 psi (20 ºC)
Backup Temperature Setpoint Range	-70 ºC to 0 ºC
Type T Thermocouple Probe Range	-200 ºC to +50 ºC (factory calibration guaranteed for 1 year)
Accuracy	±2 ºC
Resolution	1 ºC
Freezer Door Switch Input (Interlock)	Door must be closed for CO_2 injection
Output Relay (SPDT Contact)	Normally open (NO) or normally closed (NC), 30 VDC/1 A max (non-inductive)
Power Adapter	
Input (Fluctuation)	100-240 VAC (fluctuation not to exceed ±10% of nominal), 50-60 Hz, 1A max
Output	15 VDC, 2.4A, 36 W
Battery Backup	12 VDC, 12 Ah sealed, lead-acid rechargeable. Typically, >48 hours backup. Replace the battery with a Hampshire Controls' recommended battery only.
CA5000 Controller	5.0" (w) by 4.25" (h) by 1.75" (d), black Bakelite case, 1 lb.
CA5000 BVM	6.25" (w) by 5.0" (h) by 10.0" (d), painted steel case, 14 lbs.
Environmental Conditions	
Facilities	Intended for indoor (laboratory) use
Altitude	Up to 2,000 meters (6,600')
Temperature Range	0 ºC to +40 ºC
Maximum Relative Humidity	60% (0 ºC to +40 ºC)
Ventilation	Compliance with ANSI/ASSP Z9.5-2022 recommended.
Pollution Degree	POLLUTION DEGREE 2: only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is expected.

Installation

NOTE: The CA5000-C Liquid CO_2 Freezer Backup System must be installed according to Hampshire Controls' instructions, by a qualified refrigeration technician, or other qualified personnel, in compliance with local, national, or regional regulations. Maintaining the safety of ULT freezer while installing the CA5000-C Liquid CO_2 Freezer Backup System, and when the installation is complete, is the responsibility of the installer.

NOTE: DO NOT USE AN IMPROPERLY RATED POWER ADAPTER. The CA5000-C Liquid CO_2 Freezer Backup System POWER adapter is compatible with 100-240 VAC, 50-60 Hz, 1 A max input and outputs 15.0 VDC, 2.4 A, 36 W.

INTERCONNECTIONS

Table 2: CA5000-C Liquid CO_2 Freezer Backup System Interconnections

CA5000 LABEL	FROM:	TO:	DESCRIPTION
THERMOCOUPLE	**CA5000 Controller**, 2-pin rectangular connector	ULT freezer	Type T thermocouple temperature probe, 10' lead, (**p/n 48264**)
GAS TO FREEZER	**CA5000 BVM**, 1/8" female compression fitting	ULT freezer	CO_2 delivery tube, 1/8" OD copper tubing, 8' length, (p/n **A84000-21**)
LIQUID CO_2 FROM TANK	CO_2 tank, CGA 320 siphon feed	**CA5000 BVM**, 1/4" 45º flare fitting	CO_2 supply tube, 1/4" OD copper tubing, 6' length, (p/n **A84000-19**)
DOOR SWITCH	ULT freezer door	**CA5000 BVM**, 3-pin circular connector	Door status monitor, 2-conductor cable, 10' lead, (p/n **A84000-22**)
CONTROL CABLE	**CA5000 Controller**, 6-pin circular connector	**CA5000 BVM**, 6-pin circular connector	Power from **BVM** to **Controller**, CO_2 valve control from **Controller** to **BVM**, 6-conductor cable, 10' lead, (p/n **A84000-06**)
RELAY: SPDT CONTACT	**CA5000 Controller**	Facility alarm, auto dialer, *etc*.	Rating 30 VDC, 1 A (non-inductive)
POWER	Line power, 100-240 VAC, 50-60 Hz, 1 A max	**CA5000 BVM**, power jack, 15.0 VDC, 2.4 A, 36 W	Power adapter, international blades included, 5' cord, (p/n **29032**)

SENSOR PROBE

The probe supplied with the CA5000 is a highly accurate type T thermocouple sensor. It has excellent long-term stability and should not need recalibration in normal usage. However, if the probe is subjected to temperature extremes outside of the normal operating range of the unit, or if the probe is damaged, it must be replaced.

If the CA5000 Freezer Backup display shows a continuous reading of an unreasonable value (for example, "1999"), then the probe has either failed or is disconnected. Verify proper connection, and replace

the type T thermocouple probe, as required (see **Table 4. Replacement Parts**, p/n **48264, Type T Thermocouple Temperature Probe**).

Due to differences in probe locations within the ULT freezer and in probe calibrations, the temperature on the CA5000 Controller temperature display might not directly agree with the interior temperature display for the ULT freezer. If the two temperatures are within 5 ºC of each other, then the CA5000-C CO_2 Freezer Backup System will perform as expected. However, if the separation between the two temperatures is greater than 5 ºC, then the CA5000-C CO_2 Freezer Backup System Controller and the Type T Thermocouple Temperature Probe should be returned to Hampshire Controls for temperature recalibration.

Probe Installation

NOTE: The probe MUST be installed in freezer cabinet air and cannot be used in simulated product bottles. Insertion of the probe in simulated product bottles will delay the response time of the CA5000 Backup System and place freezer contents at risk.

When installing the sensor in a cabinet or enclosure (particularly freezers), use proper techniques to prevent room moisture from getting into the cabinet. Whenever possible, install the probe through an existing access or pass-thru port provided by the freezer manufacturer and reseal the port.

Inside the cabinet, route the probe wire so that it will not become snagged during loading, unloading, maintenance, or cleaning procedures.

Probe Location

Install the sensor probe in a location where it will respond to the average temperature of the space being monitored, and not to local conditions caused by routine door openings. The probe location should be optimized to provide an accurate temperature reading for the freezer cabinet without generating false or nuisance alarms. For example, locating the sensor probe on the bottom of a chest freezer will result in delayed alarms relative to locating the sensor probe near the top of the freezer. However, locating the sensor too close to the top of the chest freezer could result in frequent nuisance alarms caused by lid openings. Choose a probe location that offers the desired storage temperature safety for the freezer contents while keeping nuisance alarms at a tolerable level. Do not install the probe in a location where the sensor will be subject to frost buildup. Routinely inspect the probe tip to ensure that it is not embedded in frost buildup.

CO_2 TANK AND DELIVERY TUBE

Install the CO_2 output tube (0.125" OD x 0.055" ID by 8' copper) onto the CA5000 BVM connector labelled “GAS TO FREEZER” using the 1/8" compression fitting and route the tubing into the ULT freezer. The output from the CO_2 delivery tube within the ULT freezer should be located near the CA5000 temperature probe, but the CO_2 flow should be directed away from the temperature probe. **For clarity, the CO_2 output flow must not directly impact the CA5000 type T thermocouple temperature probe**. The CO_2 delivery tube output and CA5000 temperature probe should be at approximately the same height within the freezer cabinet and near the back of the cabinet (opposite of the freezer door). Use care to install the CO_2 delivery tube where it will not be blocked by freezer contents. The cold CO_2 is heavier than air, so it will fill the freezer from the bottom up.

Install a 50 lb. (or larger) siphon-withdrawal liquid CO_2 tank with CGA 320 output fitting. Connect the CO_2 supply tubing to the CGA 320 tank output fitting first, then purge the supply tubing of any contaminates by rapidly cracking open, and then closing, the CO_2 tank valve. Finally, connect the CO2 supply line to the 1/4" 45º flare fitting on the CA5000 BVM labelled “LIQUID CO_2 FROM TANK.”

NOTE: THE CO_2 TANK MUST NOT EMPLOY A REGULATOR.

NOTE: DO NOT REPLACE THE 1/4" 45º FLARE FITTING WITH ANOTHER TYPE OF FITTING. The 1/4" 45º flare fitting and the CGA 320 tank output fitting require no Teflon tape or other thread sealant,

which if applied improperly can result in the contamination, and probable partial or complete failure, of the CA5000 BVM CO_2 injection valve.

Hampshire Controls recommends 1/4" OD – 3/16" ID copper tubing for the CO_2 supply line. A convenient installation kit is available, **A84000-19, CA5000-C Liquid CO_2 Freezer Backup System Installation Kit**, consisting of a CGA 320 fitting to mate to the CO_2 tank, 6' of 1/4" OD - 3/16" ID copper tubing, and a female 1/4" fitting to mate to the 1/4" 45º flare fitting on the CA5000 BVM labelled "LIQUID CO_2 FROM TANK." Make certain that there are no CO_2 leaks anywhere in the supply line. Typically, CO_2 leaks can be detected by ice or frost buildup or by condensation.

During a tank change, be certain to purge the delivery tubing of any high-pressure gas after closing the empty CO_2 supply tank valve. When installing the new tank, also be certain to purge the system of any air in the delivery tubing after opening the CO_2 supply tank valve. Purging is accomplished via manual valve control **Pur (Purge)** as described in this manual (p. 18).

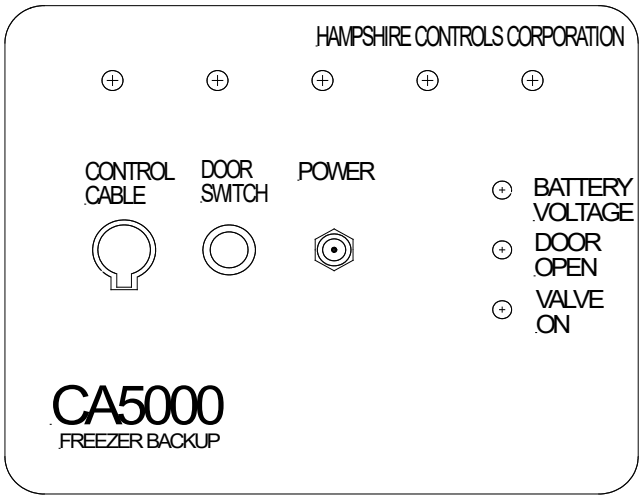
DOOR SAFETY SWITCH

Install the supplied CA5000 Door Switch so that it will activate upon the opening the freezer or cabinet door. When installed and properly wired, the CA5000 Door Switch will interrupt the injection of CO_2 into the freezer. The CA5000 Door Switch interlock circuit is factory shipped to accept a closed contact (NC) for normal operation. Verify this functionality by observing the visual "OPEN DOOR" LED indicator on the CA5000 BVM as described below. Confirm that the CO_2 injection halts when the red door-open LED indicator is illuminated.

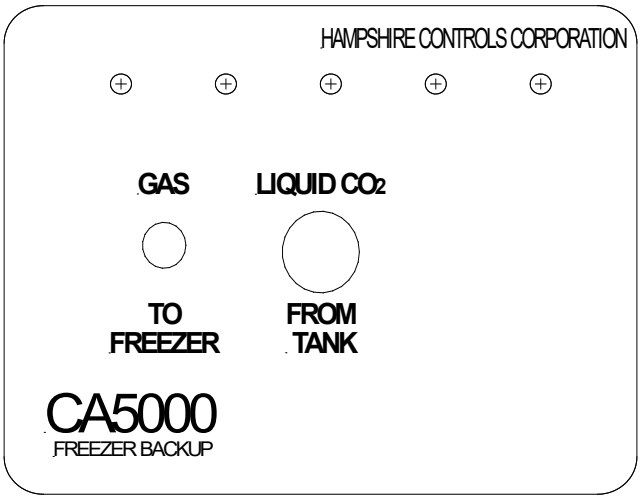
BATTERY-VALVE MODULE (BVM)

The CA5000 BVM contains the backup battery, the backup battery charging and logic circuits, and the liquid CO_2 injection valve. On the front face of the CA5000 BVM, there is a 6-pin CONTROL CABLE connector for the CA5000 Controller, a 3-pin connector for the DOOR SWITCH interlock cable, and a POWER jack for the supplied power adapter. The rear panel of the CA5000 BVM has LIQUID CO_2 FROM TANK connector for the siphon-feed liquid CO_2 tank and a GAS TO FREEZER connection for CO_2 output tube.

BVM FRONT VIEW



BVM REAR VIEW



Visual LED indicators display system status:

- BATTERY VOLTAGE: Green indicates the battery and charger are operating normally, flashing red indicates a low or discharged battery.
- DOOR OPEN: Red indicates that the door is open.
- VALVE ON: Yellow indicates that power is applied to the solenoid valve and, if a CO_2 tank is connected, open, and not empty, then CO_2 should be flowing.

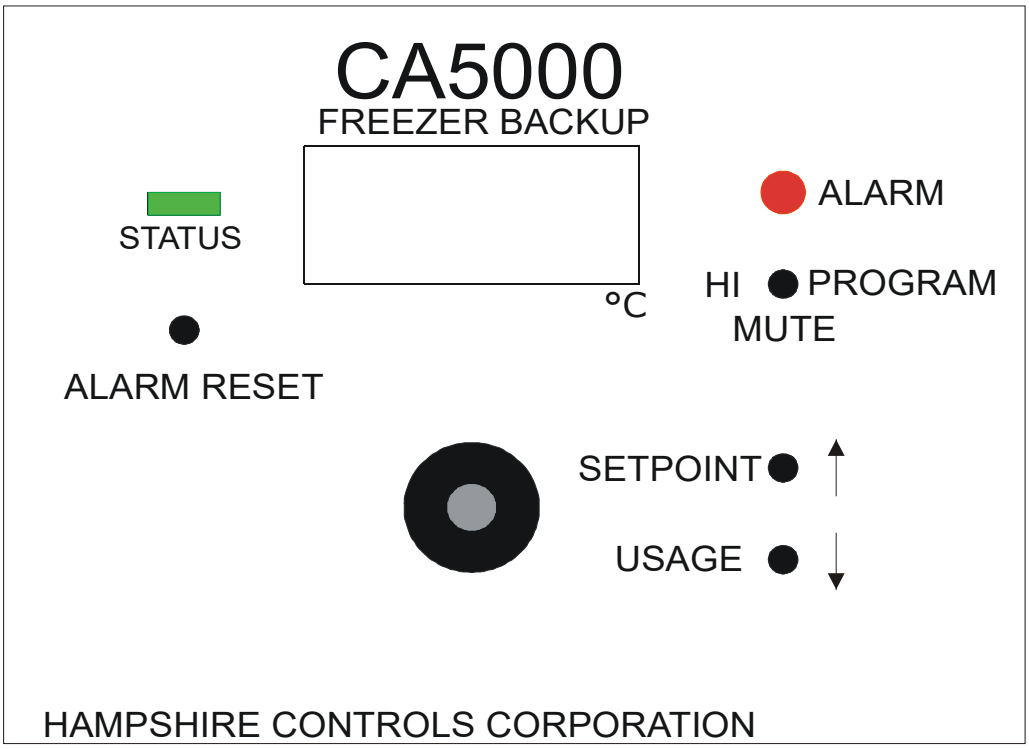
DOOR SWITCH, RELAY, CONTROL CABLE, POWER

Connect the DOOR SWITCH wiring to the CA5000 BVM and the CA5000 Controller output alarm RELAY to your facilities' systems as required. Connect the CONTROL CABLE to the CA5000 Controller and CA5000 BVM. Plug the CA5000 system AC adapter into a 100-240 VAC, 50-60 Hz outlet (international blades supplied) and into the POWER jack on the CA5000 BVM. If the temperature where the probe is located is within the CA5000-C Controller's operating range (-200 to +50°C), then the CA5000 Controller display will show the current probe temperature.

OPERATIONAL CHECK

If the display is blank, verify power is supplied to the CA5000 BVM. If the CA5000 Controller STATUS LED is lit, then the CA5000 Controller has power. If not, then verify that the power adapter is plugged into the CA5000 BVM and into line power, and that the CONTROL CABLE between the CA5000 Controller and the CA5000 BVM is connected on both ends.

The STATUS LED indicator flashes every second. This indicates that the CA5000 is operating normally.



FRONT PANEL DISPLAY

In Operating Mode, the CA5000 displays the temperature at the thermocouple probe location, and provides alarms and outputs based on user-specified parameters.

- The **ALARM RESET** button is a system reset, which clears alarms and sets the values of the **CCO (Current CO_2 Usage)** and **CSt (CO_2 Started 'CSt' Minutes Ago)** injection start times to 0 minutes.
- The **PROGRAM** button displays the **Hi (High Alarm Setting)** temperature at which a warning alarm is sounded. This button also mutes the beeper after an alarm for a preset time interval (**SIL (Alarm Silence or Mute Period)**). Each successive press of this button resets the mute timer. Additionally, this button accesses Programming Mode.
- The **SETPOINT/↑** button displays the **SP (Setpoint)** temperature at which CO_2 injection begins.
- The **USAGE/↓** button displays the **CCO (Current CO_2 Usage)** in minutes since the last **ALARM RESET**.

Operating Mode Instructions

The CA5000 constantly compares the probe's temperature to the user-specified **Hi (High Alarm Setting)** temperature to determine out-of-range status. An out-of-range state is a temperature that is equal to, or warmer than, the user-defined **Hi (High Alarm Setting)**. The STATUS LED flashes green when the temperature is in-range**.** The CA5000 will not alarm until the out-of-range state has continued for the specified **Ad (Alarm Delay Period)**.

When an alarm condition occurs, the beeper sounds, the ALARM LED flashes, and the STATUS LED blinks red. Pressing the **PROGRAM/MUTE** button silences the beeper for the user-specified time (**SIL (Alarm Silence or Mute Period)**) and changes the alarm sound to short chirps. After the user-programmed **SIL (Alarm Silence or Mute Period)** elapses, if the CA5000 is still in an alarm condition, the beeper will resume at full volume.

When the probe temperature exceeds the **SP (Setpoint)** temperature and both the **Ad (Alarm Delay Period)** and the **rd (Relay Delay Period)** have expired, CO_2 is injected into the freezer cabinet, and the alarm LED changes to blinking amber/red. The amber/red blinking LED indication persists and does not clear until the unit **ALARM RESET** is pressed. This provides the user with a visual indicator that a fault occurred, and CO_2 has been injected into the ULT freezer.

The **PROGRAM** button has the following functions:

- In Operating Mode, pressing the **PROGRAM** button displays the user defined **Hi (High Alarm Setting)**.
- When alarming, pressing the **PROGRAM** button mutes the beeper for the **SIL (Alarm Silence or Mute Period)**.
- Extended pressing of the **PROGRAM** button until **"Hi"** is displayed puts the CA5000 into Programming Mode and mutes the beeper.
- In Programming Mode, continued individual presses of the **PROGRAM** button will cycle through the list of user parameters (see **"Detailed Description of Programming Parameters"** p. 14 - 19).

The SETPOINT/↑ button has the following functions:

- In Operating Mode, pressing the button displays the CO_2 injection control **SP (Setpoint)**.
- In Programming Mode, pressing the button increases the displayed parameter value.

The **USAGE/↓** button has the following functions:

- In Operating Mode, pressing the button displays the **CCO (Current CO_2 Usage)** in minutes.
- In Programming Mode, pressing the button decreases the displayed parameter value.

Other Alarms

Should a problem arise with line power or the backup battery, a **"BAT"** indicator will be displayed on the CA5000 Controller, the ALARM LED will flash, and the beeper will sound. After confirming that the AC

adapter is powered and is connected (try re-plugging both ends), contact Hampshire Controls for service or for a replacement battery. Replace the battery with a Hampshire Controls' recommended battery only.

When the ULT freezer door has not been properly closed, after a fixed time of 15 minutes, the **"dor"** fault indication will be displayed on the CA5000 Controller, the red ALARM LED will flash, and the beeper will sound. Pressing the **MUTE** button will cause the beeper to sound short 'chirps', but the ALARM LED continues to flash, and the chirping remains audible, until the freezer door is closed.

Programming Mode Instructions

1. From Operating Mode, place the CA5000 in Programming Mode to access the desired parameters (see **Table 3. CA5000-C Liquid CO_2 Freezer Backup System – All Parameters and Settings**, p. 20) as follows. While in Programming Mode, a small arrow is shown in the upper-left corner of the LCD display:
   - **Standard Alarm Parameters:** Press and hold the **PROGRAM** button until **"Hi"** is displayed.
   - **CO2 Control Parameters:** Press and hold the **SETPOINT**↑ and **PROGRAM** buttons simultaneously until **"SP"** is displayed.
   - **Timers and Manual Valve Controls:** Press and hold the **USAGE**↓ and **PROGRAM** buttons simultaneously until **"SUS"** is displayed.
2. The LCD display will show the first parameter that may be programmed (see the **Detailed Description of the Available Programming Parameters** on p. 14 - 19). The name of the parameter will flash briefly on the display followed by the current value of the parameter.
3. The flashing **STATUS** tricolor LED indicates the current state of the CA5000:
   - **Green** = Operating Mode, freezer temperature displayed.
   - **Amber** = Programming Mode
   - **Red** = Alarming. Freezer temperature above **Hi (High Alarm Setting)**.
4. To change the value of any parameter, press the **SETPOINT**↑ or **USAGE**↓ buttons. Pressing either button will change the parameter value by ±1.
5. Pressing and holding either the **SETPOINT**↑ or **USAGE**↓ button for a half-second will change the parameter value by ±10. It will continue to step by ±10 on subsequent button presses, provided that the next button press occurs within approximately 1 second.
6. Waiting more than 1 second before the next press of the **SETPOINT**↑ or **USAGE**↓ button will cause the step size to revert to ±1.
7. Once the CA5000 is in Programming Mode, each time the **PROGRAM** button is pressed, the CA5000 steps to the next parameter. As the CA5000 steps to the next parameter, the value of the previous parameter is saved. Once the final parameter in the category (**Standard Alarm Parameters**, **CO_2 Control Parameters**, or **Timers and Manual Valve Controls**) is reached, pressing the **PROGRAM** button again saves the final parameter value and causes the CA5000 to exit Programming Mode and return to Operating Mode.
8. While in Programming Mode, if no buttons are pressed for approximately 30 seconds, then the CA5000 will revert to Operating Mode.
9. The **ALARM RESET** button is a system reset which clears alarms, returns the CA5000 to Operating Mode, and sets the **SUS (Suspend)**, **CCO (Current CO_2 Usage),** and **CSt (CO_2 Started 'Cst' Minutes Ago)** timers to 0 minutes.

The CA5000 functions as a freezer temperature monitor, a ULT freezer coolant injection device, and an audio, visual, and output relay alarm system. The CA5000 goes into alarm mode when the temperature

sensed by the type T thermocouple probe exceeds the **Hi (High Alarm Setting)**. Alarm system attributes are controlled by three additional **Standard Alarm Parameters**: **Ad (Alarm Delay Period)** – a delay (minutes) after the temperature first exceeds the **Hi (High Alarm Setting)** before the CA5000 goes into alarm mode, **Rd (Relay Delay Period)** – a delay (minutes) after the temperature sensed by the type T thermocouple probe exceeds the **SP (Setpoint)** before the CO_2 coolant injection valve and the output relay are engaged, and **SIL (Alarm Silence or Mute Period)** – the time (minutes) for which the audio alarm is muted (chirping) when the **MUTE** button is pressed.

There are three **Coolant Control Parameters**: **SP (Setpoint)**, **On (On Time)**, and **OFF (Off Time)**. When the temperature sensed by the type T thermocouple rises above the **SP (Setpoint)**, the CA5000 injects CO_2 for **On (On Time)** seconds, then waits **OFF (Off Time)** seconds before determining if more cooling is required to cause the temperature to fall below the **SP (Setpoint)**.

The CO_2 coolant injection valve can be manually controlled by the **Timers and Manual Valve Control** parameters **SUS (Suspend)** - disengages the CO_2 injection valve, and **Pur (Purge)** - engages the CO_2 injection valve. CA5000 firmware also monitors three timers: **CCO (Current CO_2 Usage)** – time (minutes) the CO_2 injection valve has been engaged since the **ALARM RESET**, **CSt (CO_2 Started 'CSt' Minutes Ago)** – time (minutes) since the **SP (Setpoint)** temperature was exceeded and the CO_2 injection valves was first engaged, and **tCO (Total CO_2 Usage)** – the total time (minutes) the CO_2 injection valve has been engaged since the CO_2 coolant tank was first installed.

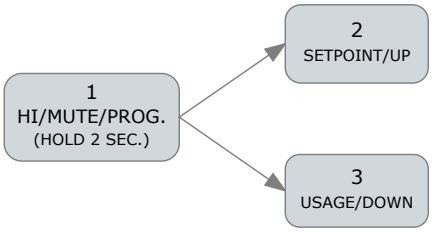
NOTE: In addition to clearing a CA5000 temperature alarm condition, pressing the **ALARM RESET** button will also reset the **CSt (CO_2 Started 'CSt' Minutes Ago)**, the **SUS (Suspend)**, and **CCO (Current CO_2 Usage)** timers to 0 minutes. Previous data related to CO_2 injection valve timing will be lost. Therefore, if this data is required for maintenance or engineering purposes, then these values should be recorded **BEFORE** the **ALARM RESET** button is pressed. However, the **tCO (Total CO_2 Usage)** timer continues to accumulate until it is manually reset to 0 minutes (typically upon the installation of a new CO_2 coolant tank). The **tCO (Total CO_2 Usage)** value can be reset to 0 minutes by following the **tCO (Total CO_2 Usage)** programming instructions on p. 19.

Detailed Description of the Available Programming Parameters

Standard Alarm Parameters

(Press and hold the PROGRAM button to activate)

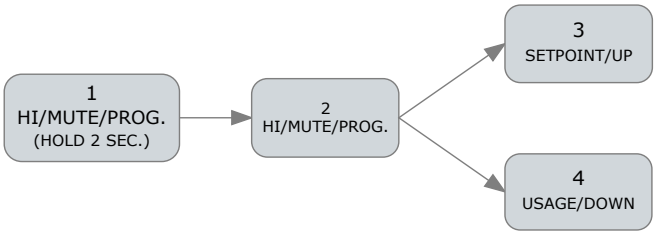
Hi (High Alarm Setting)
In Operating Mode, the ALARM will activate if the CA5000 temperature probe indicates a temperature greater than or equal to the **Hi (High Alarm Setting)** ºC. The **Hi (High Alarm Setting)** can be set between -200 ºC and 50 ºC. The CA5000-C **Hi (High Alarm Setting)** default is -65 ºC.



From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** button until the display reads **"Hi"**. Release the button, and the display will show the current **Hi (High Alarm Setting)**.
2. Press **SETPOINT/**↑ to increase the **Hi (High Alarm Setting)**.
3. Press **USAGE/**↓ to lower the **Hi (High Alarm Setting)**.

Ad (Alarm Delay Period)
If desired, the CA5000 will not provide an ALARM until the out-of-range state has continued for a specified time (**Ad (Alarm Delay Period)** minutes). The **Ad (Alarm Delay Period)** is used to prevent transient or nuisance alarms and may be set from 0 to 30 minutes. The CA5000 default **Ad (Alarm Delay Period)** is 5 minutes.

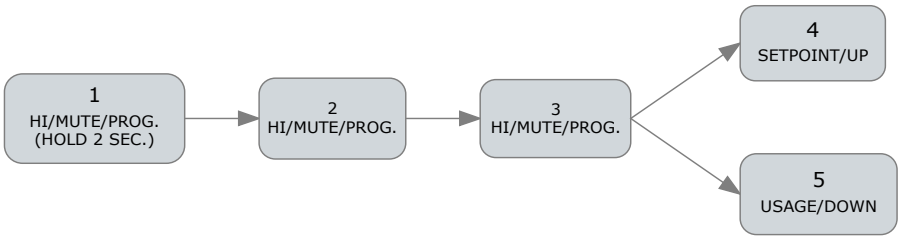


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** button until the display reads **"Hi"**.
2. Press the **PROGRAM** button a second time, the display will read **"Ad"** momentarily, and then display the current **Ad (Alarm Delay Period)** value.
3. Press **SETPOINT/**↑ to increase the **Ad (Alarm Delay Period)**.
4. Press **USAGE/**↓ to decrease the **Ad (Alarm Delay Period)**.

rd (Relay Delay Period)

The **rd (Relay Delay Period)** delays activation of both the CA5000 BVM CO_2 injection valve and the CA5000 Controller output RELAY. The **rd (Relay Delay Period)** may be set from 0 to 30 minutes. The CA5000 default **rd (Relay Delay Period)** is 5 minutes.

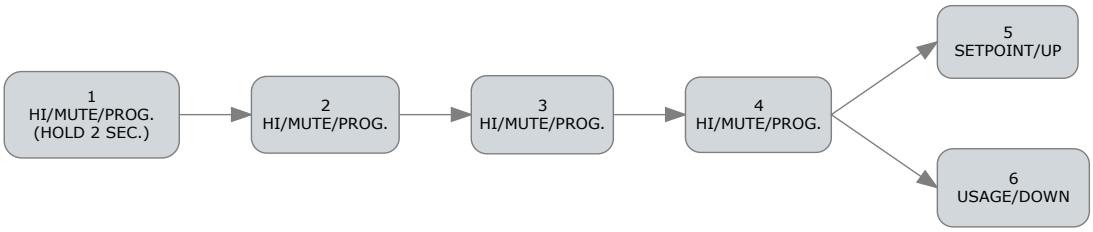


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** button until the display reads **"Hi"**.
2. Press **PROGRAM** a second time.
3. Press **PROGRAM** a third time, the display will read **"rd"** momentarily, and then display the current **rd (Relay Delay Period)**.
4. Press **SETPOINT/**↓ to increase the **rd (Relay Delay Period)**.
5. Press **USAGE/**↓ to decrease the **rd (Relay Delay Period)**.

SIL (Alarm Silence or Mute Period)

The **SIL (Alarm Silence or Mute Period)** sets the number of minutes the beeper will chirp after the **MUTE** button is pressed during an alarm condition. If the alarm condition persists after the **SIL (Alarm Silence or Mute Period)** elapses, then the beeper will resume at full volume. The **SIL (Alarm Silence or Mute Period)** may be set from 5 to 120 minutes. The CA5000 default **SIL (Alarm Silence or Mute Period)** is 25 minutes.



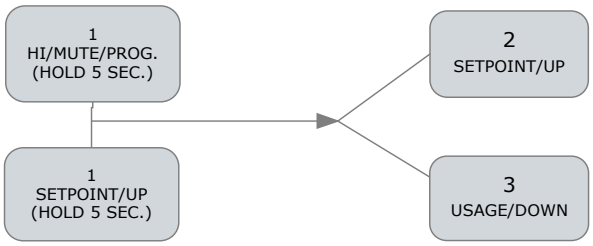
From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** button until the display reads **"Hi"**.
2. Press **PROGRAM** a second time.
3. Press **PROGRAM** a third time.
4. Press **PROGRAM** a fourth time, the display will read **"SIL"** momentarily, and then display the current **SIL (Alarm Silence or Mute Period)** value.
5. Press **SETPOINT/**↑ to increase the **SIL (Alarm Silence or Mute Period)**.
6. Press **USAGE/**↓ to decrease the **SIL (Alarm Silence or Mute Period)**.

CO_2 Control Parameters

SP (Setpoint)

The **SP (Setpoint)** is the temperature (ºC) at which CO_2 will be injected into the ULT freezer or other target cabinet. The **SP (Setpoint)** range is from the **Hi (High Alarm Setting)** up to +40°C. Note that if the **SP (Setpoint)** is encountered, activation of the CO_2 injection valve is delayed by the **rd (Relay Delay Period).**

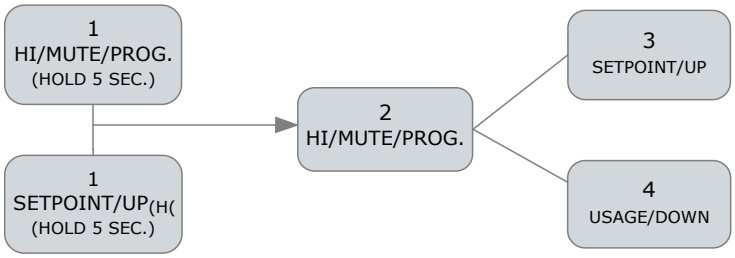


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **SETPOINT**↑ buttons simultaneously until the display reads **"SP"**. Release the buttons, and the display will show the current **SP (Setpoint)**.
2. Press **SETPOINT**↑ to raise the CO_2 injection **SP (Setpoint)** temperature.
3. Press **USAGE**↓ to lower the CO_2 injection **SP (Setpoint)** temperature.
4. Press the **PROGRAM** again to adjust the CO_2 injection **On (On Time)**.

On (On Time)

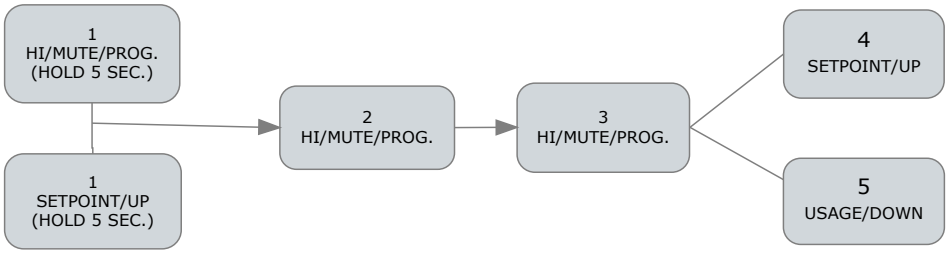
The **On (On Time)** is the CO_2 injection time interval into the ULT freezer or other target cabinet. The **On (On Time)** may be set from 5 to 900 seconds. The CA5000 default **On (On Time)** is 20 seconds.



From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **SETPOINT**↑ buttons simultaneously until the display reads **"SP"**. Release the buttons.
2. Press **PROGRAM**, the display will read **"On"** momentarily, and then display the current **On (On Time)**.
3. Press **SETPOINT**↑ to increase the CO_2 injection **On (On Time)**.
4. Press **USAGE**↓ to decrease the CO_2 injection **On (On Time)**.

OFF (Off Time)
The **OFF (Off Time)** is the time interval (seconds) between CO_2 injections. The **OFF (Off Time)** may be set from 10 to 900 seconds. The CA5000 default **OFF (Off Time)** is 40 seconds.

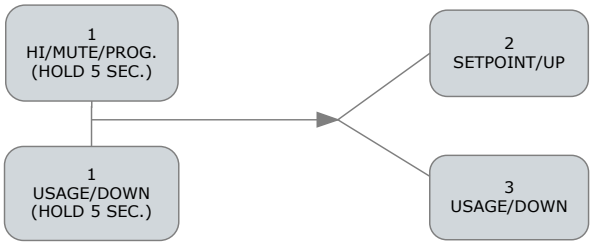


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **SETPOINT**↑ buttons simultaneously until the display reads **"SP"**. Release the buttons.
2. Press **PROGRAM**, the display will read **"On"** momentarily.
3. Press **PROGRAM** again, the display will read **"Off"** momentarily, and then display the current **OFF (Off Time)**.
4. Press **SETPOINT/**↑ to increase the **OFF (Off Time)** CO_2 injection interval.
5. Press **USAGE/**↓to decrease the **OFF (Off Time)** CO_2 injection interval.

Timers and Manual Valve Control

SUS (Suspend)
The **SUS (Suspend)** stops CO_2 injection for a specified time from 1 to 59 minutes. Both CO_2 injection **SP (Setpoint)** and **Hi (High Alarm Setting)** are ignored during the **SUS (Suspend)** period. The STATUS LED continues to flash green/red as normal, and a fast, short blink of the ALARM LED indicates this suspended 'no-alarm' mode. When the **SUS (Suspend)** time expires, the CA5000 system returns to normal monitoring mode. The **SUS (Suspend)** timer is displayed while in this mode, and the current freezer probe temperature can be displayed at any time by pressing the **USAGE/**↓ button. The timer is reset to zero by pressing the **ALARM RESET** button, or by manually setting the **SUS (Suspend)** time to 0 minutes.

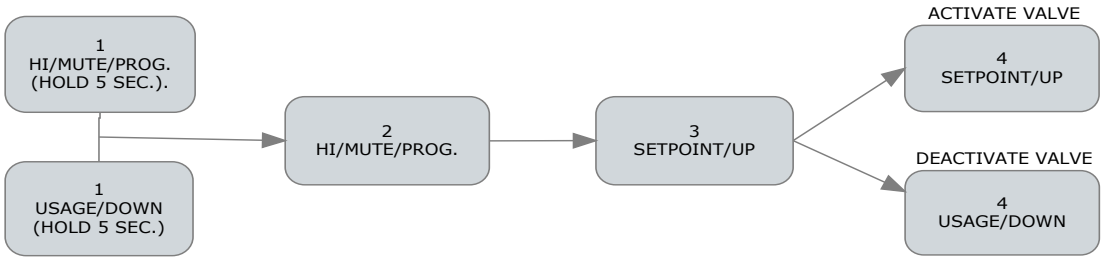


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **USAGE**↓ buttons simultaneously until the display reads **"SUS"**. Release the buttons, and the display will show the current **SUS (Suspend)** time.
2. Press **SETPOINT/**↑ to increase the **SUS (Suspend)** time.
3. Press **USAGE/**↓ to decrease the **SUS (Suspend)** time.

Pur (Purge)

The **Pur (Purge)** control activates the CO_2 injection valve. Use the **Pur (Purge)** to manually clear the CO_2 delivery tube of high-pressure gas and air when changing CO_2 tanks, for safety purposes, or maintenance purposes. **Pur (Purge)** can be set to 0 (CO_2 valve off) or 1 (CO_2 valve on). **Pur (Purge)** is only active while in Programming Mode, and upon exiting Programming Mode, the **Pur (Purge)** value always resets to 0 (CO_2 valve off). The user must confirm the **YES** prompt by hitting the **SETPOINT/↑** button before the **Pur (Purge)** is set to 1 (CO_2 valve on).

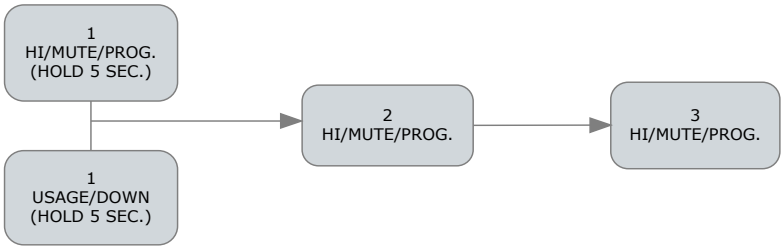


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **USAGE↓** buttons simultaneously until the display reads **"SUS"**. Release the buttons.
2. Press **PROGRAM** and the display will read "**Pur**".
3. Press **SETPOINT/↑** for a **YES** prompt to confirm the **Pur (Purge)** 'CO_2 valve on' request.
4. Press **SETPOINT/↑** to activate the CO_2 valve, and the CA5000 display will read **"1"**. Pressing the **USAGE/↓** button will set the displayed value to **"0"** and deactivate the CO_2 valve.

CCO (Current CO_2 Usage)

The **CCO (Current CO_2 Usage)** reports the amount of time in minutes the CO2 valve has been open since the last **ALARM RESET**. The **CCO (Current CO_2 Usage)** is reset to 0 minutes by pressing the **ALARM RESET** button.

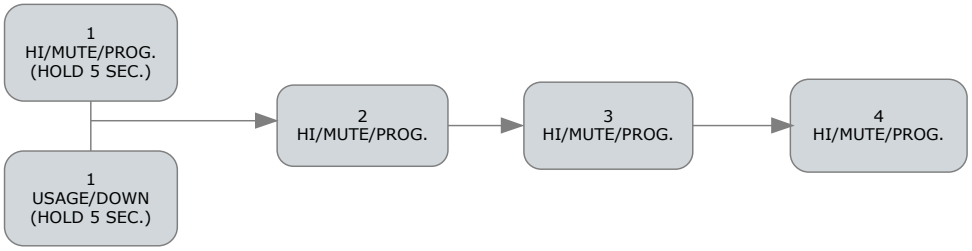


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **USAGE↓** buttons simultaneously until the display reads **"SUS"**. Release the buttons.
2. Press **PROGRAM** and the display will read **"Pur"**.
3. Press **PROGRAM** again, the display will read "**CCO"** momentarily, and then the current **CCO (Current CO_2 Usage)** time in minutes will be displayed.

CSt (CO_2 Started 'CSt' Minutes Ago)

The **CSt (CO_2 Started 'CSt' Minutes Ago)** reports the number of minutes since the start of the most recent CO_2 injection into the ULT freezer or target cabinet. The **CSt (CO_2 Started 'CSt' Minutes Ago)** value is reset to zero by pressing the **ALARM RESET** button.

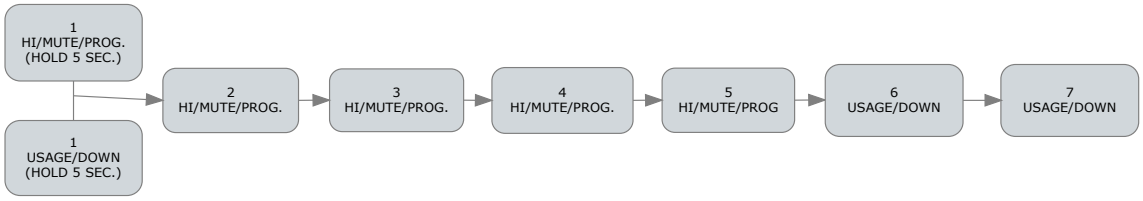


From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **USAGE**↓ buttons simultaneously until the display reads **"SUS"**. Release the buttons.
2. Press **PROGRAM** and the display will read **"Pur"**.
3. Press **PROGRAM** again and the display will read **"CCO"**.
4. Press **PROGRAM** again, the display will read **"CSt"** momentarily, and then the current **CSt (CO_2 Started 'CSt' Minutes Ago)** value will be displayed.

tCO (Total CO_2 Usage)

The **tCO (Total CO_2 Usage)** reports the total CO_2 usage in minutes since the current CO_2 tank was installed and the user or installer reset the **tCO (Total CO_2 Usage)** value to 0 minutes. **tCO (Total CO_2 Usage)** may only be reset to 0 minutes using the method described here.



From Operating Mode:

1. Place the system in Programming Mode by pressing and holding the **PROGRAM** and **USAGE**↓ buttons simultaneously until the display reads **"SUS"**. Release the buttons.
2. Press **PROGRAM** and the display will read **"Pur"**.
3. Press **PROGRAM** a second time and the display will read **"CCO"**.
4. Press **PROGRAM** a third time and the display will read **"CSt"**.
5. Press **PROGRAM** a fourth time, the display will read **"tCO"** momentarily, and then display the current **tCO (Total CO_2 Usage)** in minutes.
6. Press **USAGE/**↓ to display a **YES** prompt before resetting the **tCO (Total CO_2 Usage)** to 0 minutes, if desired.
7. Press **USAGE/**↓ a second time to reset **tCO (Total CO_2 Usage)** to 0 minutes.

All Parameters and Settings

Table 3: CA5000-C Liquid CO_2 Freezer Backup System – All Parameters and Settings

		Low Limit	High Limit	Factory Default	Unit	Resets?
Standard Alarm Parameters						
Hi	**High Alarm Setting** *Note that this temperature must be below the* **SP (Setpoint)** *injection temperature in* **CO_2 Control Parameters** (below).	-200	50	-65	°C	No
Ad	**Alarm Delay Period**	0	30	5	Minutes	No
Rd	**Relay Delay Period**	0	30	5	Minutes	No
SIL	**Alarm Silence or Mute Period**	5	120	25	Minutes	No
CO_2 Control Parameters						
SP	**Setpoint** Temperature at which to initiate liquid CO_2 injection. *Note that this temperature cannot be set below (colder) than the* **Hi (High Alarm Setting)** *temperature in* **Standard Alarm Parameters** (above).	**Hi**	40	-60	°C	No
On	**On Time** (for CO_2 valve)	5	900	20	Seconds	No
OFF	**Off Time** (for CO_2 valve)	10	900	40	Seconds	No
Timers and Manual Valve Control						
SUS	**Suspend** Deactivates CO_2 injection valve.	0	59	0	Minutes	Automatic
Pur	**Purge** Activates CO_2 valve to purge delivery tube	0	1	0	-	Automatic
CCO	**Current CO_2 Usage**	-	-	-	Minutes	Automatic
CSt	**CO_2 Started 'CSt' Minutes Ago** CO_2 injection timer	-	-	-	Minutes	Automatic
tCO	**Total CO_2 Usage**	-	-	-	Minutes	Manual

- To edit the **Standard Alarm Parameters**, press and hold the **PROGRAM** button until **"Hi"** is displayed.
- To edit the **CO_2 Control Parameters**, first press the **SETPOINT**↑ button, and while holding it, also press and hold the **PROGRAM** button until **"SP"** is displayed.
- To access the **Timers and Manual Valve Control**, first press the **USAGE**↓ button, and while holding it, also press and hold the **PROGRAM** button until **"SUS"** is displayed.

Periodic Maintenance

Hampshire Controls Corporation recommends the following monthly maintenance to ensure proper CA5000 operation:

- Test the system to verify proper injection of CO_2 into the ULT freezer or target cabinet. Use the **Pur (Purge)** command as described in the **Timers and Manual Valve Control** section (p. 18) of this manual.
- Inspect the type T thermocouple probe within the ULT freezer or target cabinet and confirm that there is no frost buildup on the tip of the probe.
- Test functionality of the DOOR SWITCH interlock circuit. Opening the ULT freezer door should cause the CA5000 BVM "DOOR OPEN" LED to illuminate and CO_2 injection, if active, should cease.
- Test all external systems activated by the CA5000 Controller output RELAY.
- Confirm that all CA5000 visual indicators function and illuminate properly at the expected times.
- Confirm that there is sufficient CO_2 remaining in the CO_2 cylinder. The 50-lb CO2 cylinder must be full or nearly full to provide the specified 10 hours of freezer backup time with a -60 ºC setpoint.
- After 3 years (36 months) of use, replace the internal battery in the CA5000 BVM. Replace the battery with a Hampshire Controls' recommended battery only (p/n **68112 CA5000 Battery, 12 V – 12 Ah, Lead Acid, Rechargeable**). Installation should be performed only by a qualified service technician. Recycle or dispose of the used battery properly.

Cleaning Instructions: Moisten a microfiber cloth with a mixture of 70% isopropyl alcohol and 30% water. Gently wipe the surfaces of the CA5000 Controller and CA5000 BVM. Clean the CA5000 Controller display screen, carefully wiping in one direction.

Replacement Parts

Table 4: CA5000-C Liquid CO_2 Freezer Backup System Replacement Parts

All replacement parts are exclusively sold by, and must be ordered from, Hampshire Controls. Part replacement, and any repairs, must be performed only by a qualified service technician. Replace the battery with a Hampshire Controls' recommended battery only.

HAMPSHIRE CONTROLS PART # (P/N)	DESCRIPTION
F84000	CA5000-C Liquid CO_2 Freezer Backup System
A84000-11	CA5000-C Liquid CO_2 Freezer Backup System Battery-Valve Module (BVM)
F82040-230	CA5000 Freezer Backup Controller
48264	CA5000 Type T Thermocouple Temperature Probe, 10' Lead
A84000-21	CA5000-C CO_2 Delivery Tube, 1/8" OD Copper Tubing, 8' Length
A84000-19	CA5000-C Liquid CO_2 Freezer Backup System Installation Kit
40052	CA5000 Door Switch
A84000-22	CA5000 Door Switch Cable, 2-Conductor, 10' Lead
A84000-06	CA5000 Control Cable, 6-Conductor Cable, 10' Lead
29032	Universal Power Supply, International Blades Included, 5' Cord Input: 100-240 VAC, 50-60 Hz, 1 A max Output: 15 VDC, 2.4A, 36 W
68112	CA5000 Battery, 12 V – 12 Ah, Lead-Acid, Rechargeable
68034	CA5000 Freezer Backup Controller Wall Mounting Bracket

Troubleshooting Guide

CA5000 Temperature Display Is Blank

- Verify power adapter is connected to line power and to the POWER connector on the Battery-Valve Module (BVM)
- Verify the CONTROL CABLE is installed between the CA5000 Controller and the CA5000 Battery-Valve Module (BVM).

CA5000 Temperature Display Reads '1999'

- If the display shows a continuous reading of **1999**, then the probe or associated wiring has failed. Confirm connections or replace the **Type T Thermocouple Temperature Probe (p/n 48264)** as necessary.

CA5000 Temperature Display Does Not Agree with ULT Freezer Temperature

- Due to differences in probe locations within the ULT freezer and in probe calibrations, the temperature on the CA5000 Freezer Backup Controller display might not directly agree with the interior temperature display for the ULT freezer. If the two temperatures are within 5 ºC of each other, then the CA5000 Freezer Backup System will perform as expected. However, if the separation between the two temperatures is greater than 5 ºC, then the CA5000 Controller and the Type T Thermocouple Temperature Probe should be returned to Hampshire Controls for temperature recalibration.
- If the temperature on the CA5000 Freezer Backup Controller display must be in direct agreement with the ULT freezer temperature display, and the temperatures are within 10 ºC of each other, then a temperature offset can be added to the CA5000 Freezer Backup Controller temperature display. To add a temperature offset, press **USAGE/↓**, then add **SETPOINT/↑** and then **PROGRAM**. Release **USAGE/↓** and wait for **"OFS"** on the display. Adjust the displayed temperature offset using the **USAGE/↓** (down) and **SETPOINT/↑** (up) buttons. Press the **PROGRAM** button to return to the temperature display.

CA5000 Display Reads: 'xx' (numeric value)

- The **SUS (Suspend)** timer is active. To view the actual CA5000 freezer probe temperature, press the **USAGE/↓** button.
- To exit **SUS (Suspend)** mode, press **ALARM RESET**, or press and hold the **USAGE/↓** and **PROGRAM** buttons simultaneously, to adjust the **SUS (Suspend)** timer to 0 minutes.

Constant Alarm Condition

- Verify that the parameters are programmed correctly for your CA5000 installation and for the ULT freezer or target cabinet being monitored. See p. 14 - 19 for programming instructions.

CA5000 Locks Up or Does Not Respond

- Pressing **ALARM RESET** might resolve the issue.
- If not, disconnect, and then reconnect, the CONTROL CABLE from the CA5000 BVM to reboot the CA5000 Controller.

Limited Warranty

Hampshire Controls Corporation warrants each manufactured item against defects in material and workmanship, when used as recommended, for a period of one year from original purchase. Products believed to have such defects must be returned to the factory by prepaid transportation.

Hampshire Controls' obligation under this warranty is limited to the repair or replacement, at its option, of those items which upon examination prove to be defective. Such repair or replacement will be made without charge.

This warranty will be void if repairs or alterations are made or attempted without factory authorization; or if the item has been subject to misuse, negligence or accident.

Hampshire Controls Corporation assumes no liability for consequential damages of any kind. The purchaser, by acceptance of the product, assumes all liability of the consequence of its use or misuse.

Hampshire Controls Corporation makes no other warranty, whether expressed or implied, in connection with the sale or use of its products.

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