

TERAGON

LC2 Liquid Nitrogen Level Controller

User Manual

1. Overview

Congratulations on your acquisition of an LC2 Liquid Nitrogen Level Controller. Its unattended operation keeps your LN₂ reservoir filled – automatically and reliably – without the hazard of manual LN₂ transfers. The LC2 Controller maintains the liquid level between two user-defined setpoints. The setpoints are defined by placing two LS1 level sensors at the desired positions within the LN₂ reservoir. The LC2 will energize a solenoid valve when the lower sensor is no longer submerged in LN₂. Filling continues until the upper sensor becomes submerged. Filling is disabled if either sensor is unplugged or shorted.

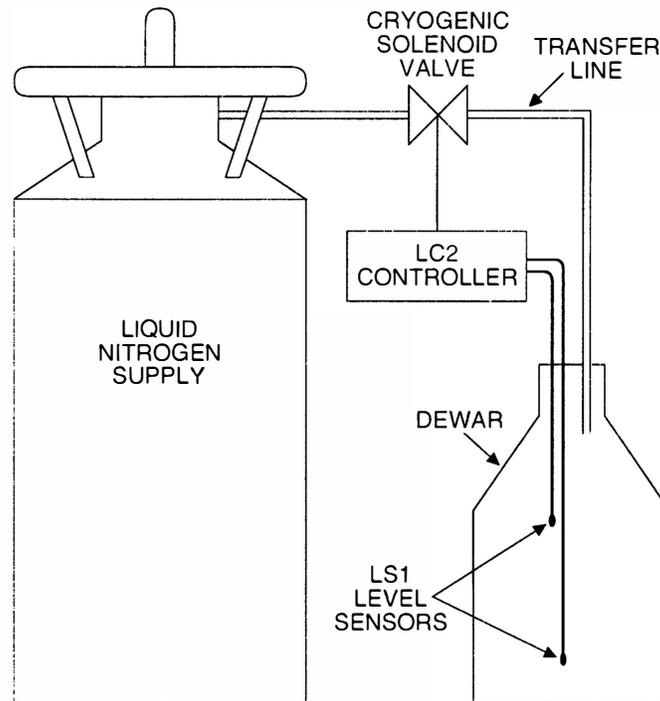


Figure 1. A typical LC2 application.

The status of the LC2 is indicated by lights on the front panel of the controller. When the controller is turned on, the illuminated power switch glows red. If both sensors are plugged in and operating properly, the green 'SENSORS' LED is lit. While filling, the red 'SOLENOID' LED is lit. The solenoid can also be activated from the front panel using the MANUAL switch.

2. Installation

Please inspect the shipping containers for any external damage. If visible damage exists, a claim should be filed with the carrier. Begin your installation by carefully unpacking the controller and sensors. Do not discard the shipping container or contents: they may be needed if the controller or sensors are to be stored or returned.

Before installation, the LS1 sensors should be checked for proper operation at room temperature. After unpacking the controller, ensure that the ON/OFF switch is in the off position (see figure 2). Connect the power cord to the POWER IN connector on the back of the controller and plug it into the appropriate mains power. Plug two LS1 sensors into the LEVEL SENSOR

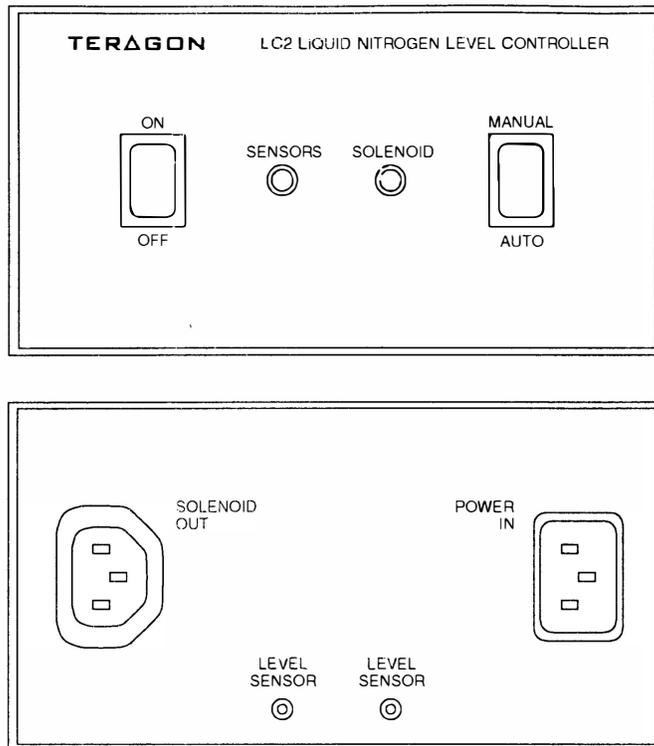


Figure 2. Front and back panels of the LC2 controller.

inputs on the back of the LC2 controller. Turn the power switch on. The power switch and both the SENSORS and SOLENOID LEDs should be lit. Turn off the power switch and unplug the sensors. If the controller fails to operate as indicated above, please suspend installation and contact Teragon immediately.

Proper site selection for the LC2 Controller is very important. The controller should not be placed where liquid OR COLD VAPOR will fall on it. In particular, cold exhaust vapors generated during the fill operation must be directed away from the controller.

Position the sensors at the desired high and low setpoints within the LN₂ reservoir. For proper operation, the sensors must not be allowed to move due to the turbulence generated during the fill operation. Sensors should either be anchored in place or shielded from the turbulence within a shroud or tube. Anchoring can be accomplished using a length of stainless rod and nylon cable ties. Suitable materials for a shroud or tube include metals, PTFE, PFA, and phenolic.

During normal operation, the solenoid is energized when both sensors become dry. Filling continues until both sensors are wet. Note that both level sensors are treated equivalently and either sensor can function as the high or low sensor. There is no need to determine which sensor is used for the upper or the lower position. Simply place the sensors at the desired high and low setpoints and then plug the sensors into either connector on the back of the LC2 controller.

Finally, connect the solenoid valve to the SOLENOID OUT connector on the back of the LC2 Controller. Turn on the LC2 power switch to begin automated filling of the LN₂ reservoir.

3. Operation

The LC2 controller uses two LS1 sensors to determine when filling should begin and end. The LS1 sensor can distinguish the different thermal conductivities of liquid and gaseous nitrogen. This is done by biasing the sensor with a small amount of heat input (44 mW). If the sensor is submerged in LN₂, the heat is conducted away from the sensor with negligible temperature rise. However, if the sensor is not submerged, a small but measurable temperature rise occurs at the end of the sensor.

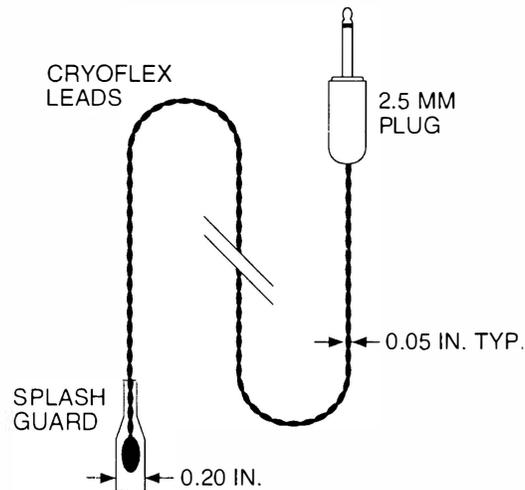


Figure 3. The LS1 Liquid Nitrogen Sensor.

The LC2 controller analyzes the sensor signals to determine if (1) the sensors are installed and operating properly and (2) if one, both or no sensors are submerged. If both sensors are installed and operating properly, the green 'SENSORS' LED is lit whether or not the sensors are submerged.

When the LC2 determines that both sensors are dry, power is routed to the SOLENOID OUT connector on the back of the LC2. Normally this power is used to actuate an external solenoid valve which allows LN₂ to fill the reservoir. The solenoid power is provided using a "zero-crossing" solid state relay. The red 'SOLENOID' LED is lit to indicate that the relay has been activated and that power is available at the SOLENOID OUT connector. The relay remains energized until both LS1 sensors become submerged. The relay is then opened, again at zero-crossing.

The MANUAL switch on the front of the LC2 permits forced filling of the reservoir, independent of the state of the sensors. The momentary switch must be held closed during the forced filling. The red 'SOLENOID' LED is lit while the MANUAL switch is depressed. Note that the MANUAL switch has no effect if the controller is already filling. If it is necessary to interrupt a normal fill operation, the ON/OFF switch should be used, not the MANUAL switch.

As a safety feature, the controller will not initiate (or continue) a fill operation if either sensor is disconnected or shorted. This feature prevents the controller from exhausting the LN₂ source in the event that a sensor becomes unplugged or damaged. If this is the case, the green 'SENSORS' LED will not be lit. Nonetheless, the manual override can be used to force the controller to activate the fill relay even if there are no sensors attached.

4. Troubleshooting

The following troubleshooting guide contains a list of symptoms with directions to the corresponding solutions. If you cannot find your particular symptom(s), see section 4.2.6.

4.1 Symptoms

ON/OFF switch will not light: see section 4.2.1.

ON/OFF switch lights but neither SENSOR nor SOLENOID LEDs are lit: see section 4.2.2.

LC2 will not start filling: see section 4.2.3.

LC2 will not stop filling: see section 4.2.4.

4.2 Solutions

4.2.1 Check that the power cord is attached to the LC2 and that the power cord is plugged into the appropriate mains power. If the power switch will not light when turned on, then check if the SOLENOID LED will light when the MANUAL switch is pressed. If the SOLENOID LED lights, then the problem is most likely that the lamp in the power switch is burned out. The controller should continue to function properly with the exception that power switch is not illuminated. If the SOLENOID LED will not light when the MANUAL switch is pressed then check the MAIN FUSE: see section 4.2.5.

4.2.2 Check if the SOLENOID LED will light when the MANUAL switch is pressed. If not, then check the AUXILIARY FUSE: see section 4.2.5. If the SOLENOID LED does light when the MANUAL switch is pressed, then check that the LS1 sensors are not unplugged or damaged. Unplug each sensor (and sensor extension, if used), wipe the plug with a clean cloth, and reinsert the plug back into the jack. Inspect the sensor leads and tip for mechanical damage. If this does not resolve the problem, or if the sensor is damaged, see section 4.2.6.

4.2.3 Check that both sensors are properly positioned within the LN₂ reservoir. Unplug each sensor (and sensor extension, if used), wipe the plug with a clean cloth, and reinsert the plug back into the jack. With the plugs inserted in the jacks, twist each plug back and forth a few times. If this does not resolve the problem see section 4.2.6.

4.2.4 Check that both sensors are properly positioned within the LN₂ reservoir. Check that the sensors are being used with liquid nitrogen and not liquefied air. Check that the sensor has not become covered with frost or ice. If this does not resolve the problem see section 4.2.6.

4.2.5 Access to the fuses requires opening the LC2 enclosure which should be done as follows: Turn off the controller and unplug all electrical cords and cables. Remove the two screws from the bottom of the enclosure. With the enclosure sitting upright, carefully remove the top *while leaving the front and back panels in the bottom section*.

Figure 4 is a diagram of the printed circuit board and shows the location of the fuses. There are two fuses on the LC3 circuit board: the main fuse (2.5A 250VAC Slow Blow, 5x20mm) and the auxiliary fuse (100mA 250VAC Slow Blow, 5x20mm). Before replacing any fuse, the fault condition that caused the fuse to blow must be corrected. Once the situation is corrected, the fuses

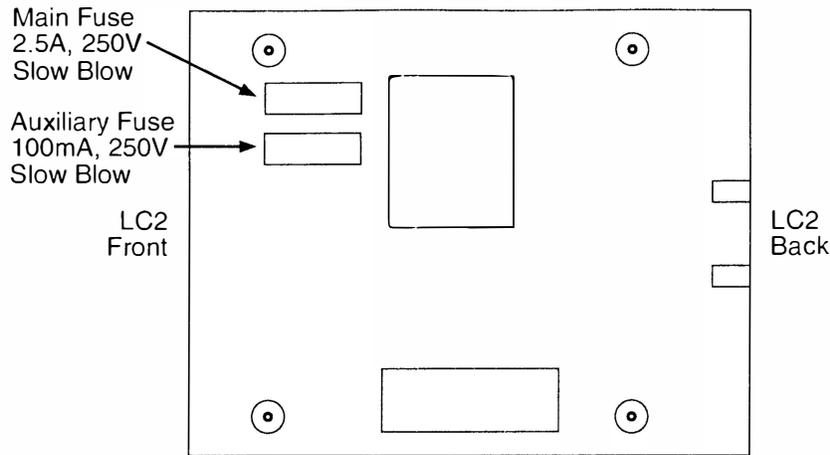


Figure 4. Fuse locations on the LC2 circuit board.

should only be replaced by parts of the correct current and voltage rating. Carefully replace the controller top and the screws that secure it.

4.2.6 Please contact Teragon with a detailed description of your symptoms. Our contact numbers are on the front of this manual.

5. Specifications

Power: 120 VAC @ 3 Amps, 50-60 Hz.

Fuses: 100 mA 250V Slow Blow 5x20mm, and
2.5 A 250V Slow Blow 5x20mm.

Visual Indicators:

Illuminated ON/OFF switch

Green SENSORS LED

Red SOLENOID LED

Solenoid output: 120 VAC @ 0.02-2.5 Amps

Sensor input: 2.5 mm audio jack.

Sensor type: Thermally biased Teristor

Sensor bias: 44 mW

6. Warranty

The LC2 Level Controller and LS1 Level Sensors are warranted to be free from defects in materials and construction for 1 year from the date of purchase. Neither the controller nor sensors contain any user serviceable parts and all warranty repairs must be performed by Teragon.

Every effort has been made to ensure the accuracy and completeness of both this manual and the LC2 system that it describes. Should you discover any error in either the manual or the LC2 system, we would be most grateful to hear from you regarding the oversight. Please contact us at tel: 415-664-6814, fax: 415-664-6745 or e-mail: sales@trgn.com. We thank you in advance for your assistance. The quality of our products and the satisfaction of our customers are our two greatest concerns.