

TERAGON

AL10 LIQUID NITROGEN LEVEL ALARM USER GUIDE

1. Overview

The Teragon AL10 Liquid Nitrogen Level Alarm continuously monitors the liquid level in cryogenic reservoirs. The alarm can be used to warn of the impending loss or overflow of liquid nitrogen (LN₂). Applications include the protection of cryobiological samples and high-voltage radiation detectors. The alarm can also be used to prevent the hazardous overfilling of dewars.

The alarm uses an LS10 Sensor; the end of which is placed at the desired alarm level. As the liquid level passes the sensing tip, the AL10 Alarm will sound. The alarm can be user configured as either a low-level alarm (sensor dry) or a high-level alarm (sensor wet). In either configuration, the alarm is also activated if the sensor is damaged or unplugged.

The AL10 Alarm uses an LS10 Sensor to 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 in gas, a small but measurable temperature rise occurs at the sensor tip. An integral splash guard on the end of the LS10 Sensor inhibits accidental wetting in applications involving turbulence.

During normal operation, the AL10's Status LED glows green to indicate that the sensor is operating properly and that the liquid level is normal. When an alarm condition occurs, the Status LED glows red and a siren is activated. An alarm condition can be due to the LN₂ level, an unplugged sensor, a shorted sensor, or a noisy sensor. The red Status LED flashes a pattern to indicate which condition is causing the alarm.

When the AL10 is powered up, it immediately checks that the sensor is installed and operating properly. It then begins analyzing the sensor signal to determine if the sensor is submerged. The first wet/dry determination occurs 23 seconds after the AL10 is powered up. During this start up period, the Status LED glows yellow.

An alarm relay allows the AL10 to activate a remote alarm or an auto-dial phone system. The SPST relay can be user configured as a conventional or a fail-safe relay. The AL10's features include:

- Audible and Visual Alarm Signals
- High or Low Level Alarms
- Detailed Sensor Diagnostics
- Fail-Safe Relay for External Use

2. Installation

The AL10 Alarm system includes: 1 alarm module, 1 level sensor, 1 AC power adapter, solderable relay plug, Velcro mounting strips, and this guide. Before installation, the alarm system should be checked for proper operation at room temperature. Connect the power adapter to the alarm module and plug the adapter into the

appropriate mains power. The alarm should sound and the Status LED should blink red once per second. This indicates that the sensor is missing.

Insert a sensor into the sensor jack and the Status LED will turn yellow for 23 seconds indicating that it is analyzing the sensor signal. If the AL10 is configured as a LOW level alarm, the yellow LED will blink once per second. After 23 seconds the LED will turn red and the alarm will sound. If the AL10 is configured as a HIGH level alarm, the yellow LED will burn steady for 23 seconds and then turn green. If the alarm fails to operate as indicated, please suspend installation and contact Teragon immediately.

The small size of the AL10 alarm module often permits it to be mounted directly on the side of the monitored dewar. This is easily done using the adhesive-backed Velcro strips provided with the AL10. In many cases, the position of the mounting can be chosen so that the sensor will freely hang at the desired alarm height within the dewar. The sensor's thin flexible leads can often be hung over the lip of the dewar and then the dewar lid closed without damaging the leads. Alternately, the sensor can be attached (using small nylon cable ties) to a thin stainless steel rod that is bent into an inverted hook. The hook is then hung from the lip of the dewar opening. In any case, the user must ensure that there is adequate clearance for the dewar cap once the sensor is in place.

If the AL10 is used to monitor a dewar with a pressurized filling system, the sensors must not be permitted to move due to the turbulence generated during the filling. The sensor 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, FEP, and phenolic. Be aware that inserting a warm tube into LN₂ is hazardous; liquid will spout from the upper end of the tube due to the boiling that occurs within the tube.

Proper site selection for the alarm module is important. The module is designed to operate at or near room temperature; it should not be placed where liquid nitrogen OR COLD NITROGEN VAPOR will fall on it. In particular, cold exhaust vapors generated during automated fill operations must be directed away from the alarm module.

3. Operation

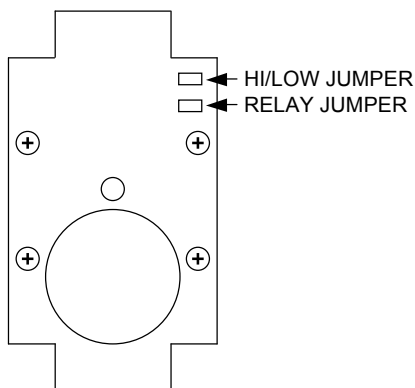
When power is applied to the AL10 Alarm, it first checks that the sensor is installed and then begins analyzing the sensor signal to determine if the sensor is wet. The first wet/dry analysis requires 23 seconds; during which the Status LED glows yellow. The Status LED will then turn solid green to indicate a normal condition or solid red (with the siren activated) to indicate a level alarm condition.

If the AL10 determines that the sensor is faulty, the siren will immediately activate and the Status LED will blink red to indicate the type of fault. This is true even during the initial 23 second analysis period. The following table summarizes the possible states of the AL10 Status LED and the corresponding alarm condition. Note that the Status LED also functions as a "power on" indicator since it is always lit (either steady or blinking) when power is applied to the AL10.

Status LED	Siren	System Condition
Green, Steady	Off	Normal
Yellow, 1/sec	Off	Power Up, Low Level Alarm Mode
Yellow, Steady	Off	Power Up, High Level Alarm Mode
Red, Steady	On	Level Alarm, High or Low
Red, 1/sec	On	Unplugged Sensor
Red, 2/sec	On	Shorted Sensor
Red+Green, 2/sec	On	Noisy Sensor

Once a sensor fault (e.g. unplugged or shorted) is corrected, the AL10 Alarm will reset itself, restart the 23 second sensor analysis, and display a yellow LED. Restarting the AL10 (by momentarily unplugging the sensor or the power plug) is also a convenient way to check if the Alarm is configured for Low or High Level Alarms: blinking yellow means Low Level and solid yellow mean High Level. Although this check requires a sensor to be plugged in; it does not require opening the AL10 enclosure to inspect the High/Low jumper setting.

The figure below shows the position of the High/Low jumper on the AL10 circuit board. If the jumper is installed (the default configuration), the AL10 operates as a Low Level Alarm (alarm sounds when sensor is dry). If the jumper is removed, the AL10 operates as a High Level Alarm (alarm sounds when sensor is wet). The jumper can be accessed by removing the 4 screws from the back of the AL10 and then removing the cover.



4. Alarm Relay

The alarm relay allows the AL10 to interface with external equipment. The SPST relay can switch external loads of up to 0.5 Amps at up to 200 VDC. The alarm comes with a solderable relay plug that mates with the relay jack on the AL10 module. A jumper on the AL10 circuit board allows the relay to operate in one of two modes: either conventional or fail-safe.

In the conventional relay mode (the default mode), the alarm condition is signaled by closed relay contacts. The relay is open when there is no alarm condition or if power is removed from the AL10. In the fail-safe mode, the alarm condition is signaled by open relay contacts. The relay is closed only when there is no alarm. If power is removed from the AL10, the relay will open to indicate a potential hazard.

The previous figure shows the positions of the Relay jumper on the AL10 circuit board. If the jumper is installed, the conventional relay mode is selected. If the jumper is removed, the fail-safe mode is selected. The Relay jumper can be accessed by removing the 4 screws from the back of the AL10 and then removing the cover.

5. AL10 Specifications

Power Supply: 9-12 VDC @ 0.1 Amp

Power Jack: 2.1 mm x 5.5 mm, Center Positive

Audible Tone: 2000 Hz, 88 dBA @ 10 cm

Visual Indicator: Tri-Color LED

Alarm Dimensions: 3.63 in. x 2.28 in. x 1.11 in.

Sensor Type: Teragon LS10 (Thermally biased Teristor)

Sensor Bias: 44 mW, average @ 78 Kelvin

Standard Sensor Lengths: 2, 3, and 4 feet

Alarm Relay: SPST, 0.5 A @ 200 VDC

Relay Jack: 2.5 mm x 5.5 mm

Your AL10 alarm is warranted to be free from defects in materials and construction for one year from the date of purchase. Neither the alarm nor its sensor contain any user serviceable parts and they must be returned to Teragon for any required service.

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