

# TERAGON

## LS2 LIQUID NITROGEN SENSOR USER GUIDE

### 1. LS2 Specifications

Applied Voltage: 5-15 VDC (from GND to V+)

Quiescent current (typical): 21mA @ 5VDC  
25mA @ 15VDC

Sensor type: Thermally biased Teristor

Sensor bias at 77 Kelvin: 44 mW

Output type: Open collector, grounded when submerged

Output Current Sinking (output in low state):

Do NOT exceed 25mA

Response time (see discussion below):

dry to wet, quasistatic: 1 sec max.

dry to wet, submerged from 20°C: 5 sec max.

wet to dry, quasistatic: 10 sec typical

wet to dry, sudden removal: 60 sec max.

Operating Pressure Range: 15 ± 4 PSIA

LS2 Head Temperature Range: 0 to 70°C

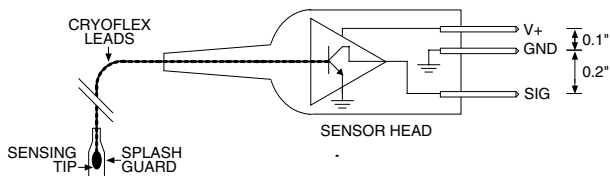
### 2. LS2 Operation

The Teragon LS2 Liquid Nitrogen Sensor is a low cost means of determining the presence of liquid nitrogen (LN<sub>2</sub>). The sensor provides a digital output which indicates whether the sensing tip is submerged.

#### 2.1 Operating Principle

The LS2 operates by detecting the different thermal conductivities of liquid and gaseous nitrogen. This is done by biasing the sensor tip with a small amount of heat input (44 mW). If the sensor is submerged in LN<sub>2</sub>, the heat is conducted away from the sensor with negligible temperature rise. However, if the sensor is uncovered, a small but measurable temperature rise occurs at the sensor tip.

This temperature change enables the LS2 to distinguish between the liquid and gas phases. Note that the sensor tip's thermal bias results in an insignificant amount of LN<sub>2</sub> evaporation: 44mW corresponds to a boil-off rate of 1 liter every 6 weeks.



LS2 Pinout Diagram

The figure above shows the pinout of the LS2 Sensor. The voltage applied between the V+ and GND pins must be in the range of 5 VDC to 15 VDC. The open-collector output signal is provided on the SIG pin. During operation, the output is grounded when the sensor tip is submerged in LN<sub>2</sub>. In this low state, the output can sink up to 25 mA. The output returns to the open state when the sensing tip is no longer submerged. An integral splash guard inhibits premature triggering in applications involving turbulence.

#### 2.2 Response time

The response time of the LS2 is defined as the time lag between the wet/dry change at the sensing tip and the

corresponding change in the LS2 output. The response time depends on how the wet-to-dry or dry-to-wet transition occurs; the transition can be either quasistatic or sudden.

A quasistatic situation is defined as the sensor being at thermal steady state in a position just above (or just below) a calm liquid-gas interface. This will normally be the case when the LS2 is used to monitor a wet-to-dry transition in a slowly evaporating dewar. A quasistatic transition requires the making or breaking of a liquid meniscus, with the sensor being quasistatic before and after the change.

Under these conditions, the LS2 will have the fastest response time. For a quasistatic dry-to-wet transition, the maximum response time will be 1 second. A quasistatic wet-to-dry transition will typically require a 10 second response time.

Longer response times are required for sudden transitions. For sudden dry-to-wet transitions the extra time is required to cool the sensor down to the liquid temperature. For example, plunging a room temperature sensor into LN<sub>2</sub> may require up to 5 seconds for the LS2 output to change.

A sudden wet-to-dry transition can take even longer because the sensor must first boil-off the liquid film of LN<sub>2</sub> that clings to the sensing tip and the splash guard. The worst case is when the sensor tip, having been deeply submerged, is suddenly raised so that the sensor tip is just above the liquid. In this case the response time may be as long as a one minute.

#### 2.3 Pressure range

The LS2 Sensor is designed to operate with LN<sub>2</sub> at atmospheric pressure (14.7 PSIA). However, the sensor can be used to monitor LN<sub>2</sub> over the limited pressure range of 15 PSIA ± 4 PSIA. Custom LS2 can be fabricated for use with pressures beyond this range; contact Teragon for more information.

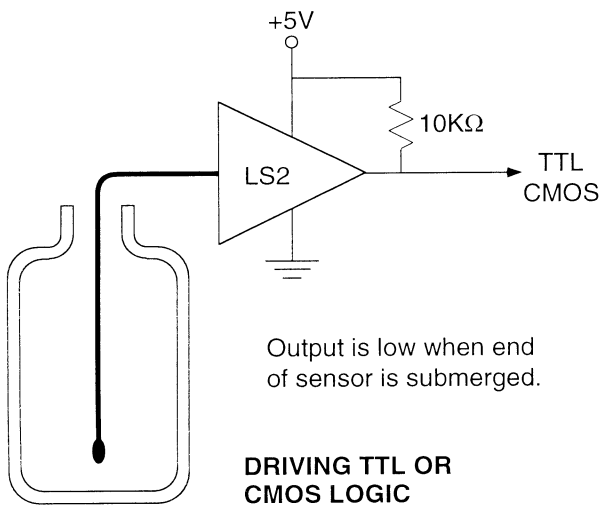
### 3. Installation

The LS2 head is designed to operate in an ambient temperature of 0 to 70°C. The head should not be exposed to liquid nitrogen or cold nitrogen vapor. In particular, cold exhaust vapors generated during fill operations must be directed away from the LS2 head.

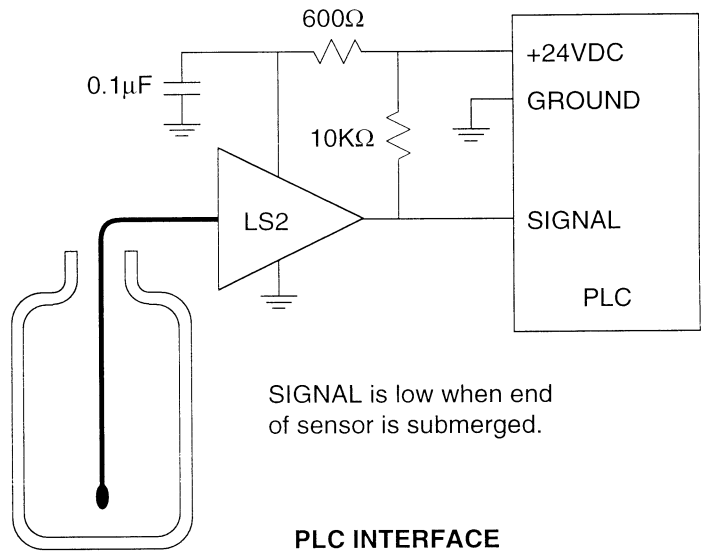
In many applications the LS2 sensing tip can be positioned at the proper height in the dewar by simply hanging the sensor leads over the lip of the dewar. In applications involving pressured fill lines, the sensors must not be allowed to move due to the turbulence generated during the fill operation. 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, FEP, and phenolic.

### 4. Applications

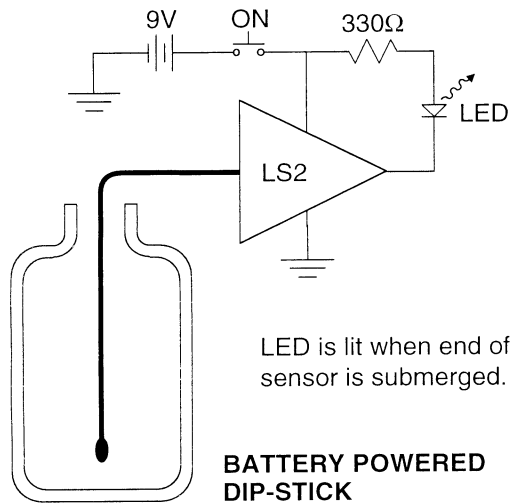
A few example applications, as well as the LS2 dimensions, are shown on page 2 of this user guide.



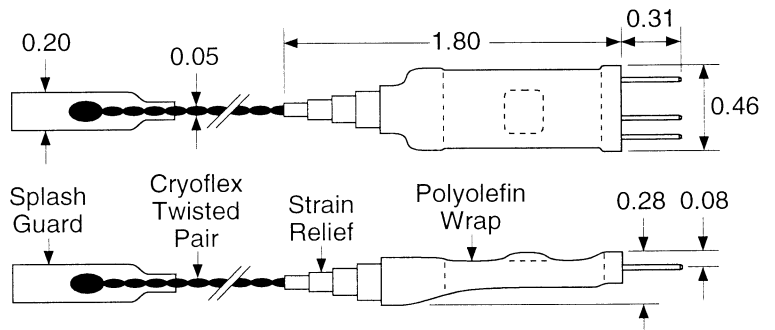
**DRIVING TTL OR CMOS LOGIC**



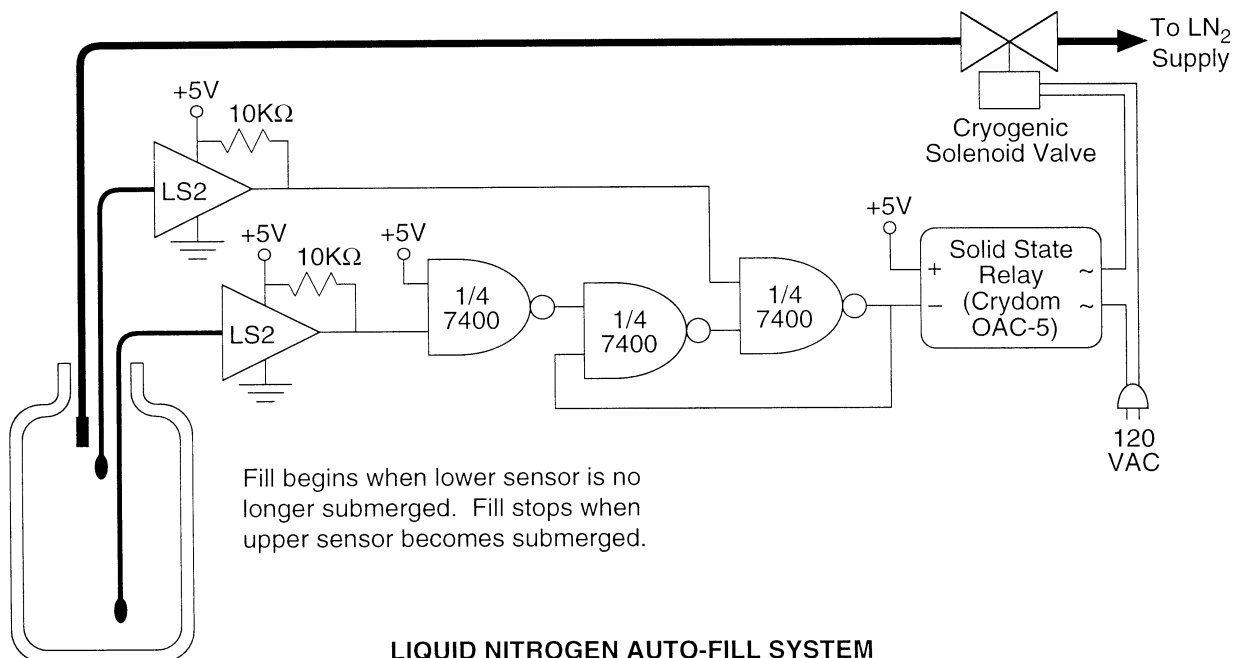
**PLC INTERFACE**



**BATTERY POWERED DIP-STICK**



**ALL DIMENSIONS ARE IN INCHES AND ARE TYPICAL**



**LIQUID NITROGEN AUTO-FILL SYSTEM**