

DEnM *Drosophila Environment Monitor*

The *Drosophila Environment Monitor* continuously measures the temperature and relative humidity of its surrounding air, and the visible-band illumination of its top surface. These parameters are reported periodically to the DAMSystem host computer, providing an archival record of the environmental conditions within an incubator chamber over the course of an experimental run.

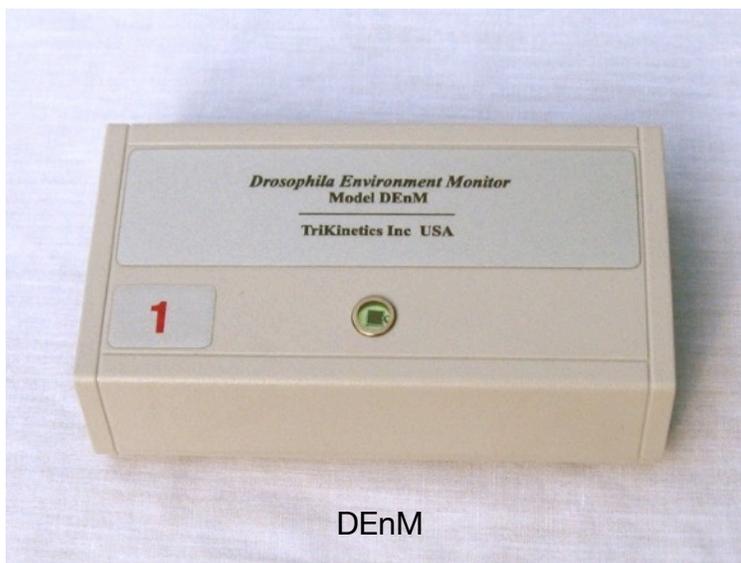
Temperature and relative humidity are measured by precision sensors located just beneath perforation holes in the ends of the unit.

Incident light intensity is measured by the round photodiode sensor on the top surface. A visible-wavelength filter rejects IR and UV light, providing a sensitivity curve which approximates the photopic response.

In each case, the instantaneous values are reported along with their minimum, average, and maximum values over the measurement period, allowing for detection of short-term upsets and characterization of environmental performance and stability.

Specifications

- Dimensions: 4.25 x 2.60 x 1.12" LWH (108 x 66 x 29 mm)
- Mass: 115 g
- Temperature: 0-70, +/- 0.1 °C
- Relative Humidity: 0-100, +/- 3.5% non-condensing
- Incident Light: 0-2500 lux +/- 5%
Photopic response, 550nm peak
Off axis sensitivity: 50% at 55 degrees
- Interconnect: 4 wire, 6 position, RJ-11 modular telephone line jack to PSIU9 / DAMSystem3 network for 9V DC power input and data transmission
- Case material: ABS plastic



Features

- Accurately measures temperature, relative humidity, and incident ambient light.
- Precision temperature measurement verifies incubator setpoint accuracy and stability.
- Ambient light sensor verifies proper on/off light cycling, and detects inadvertent door openings, confirming true-dark conditions.
- Accurate lux measurement checks lighting intensity and uniformity.
- Min/Max readings detect short-term upsets to average conditions.
- Small unit size allows parameter measurement at various points within a chamber interior.
- Telephone-type wiring jack allows easy connection to DAMSystem wiring network.
- Data acquisition via standard DAMSystem software provides seamless archival record of environmental conditions.

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Data Collection

The Drosophila Environment Monitor continuously measures the temperature and relative humidity of its surrounding air, and the illumination of its top surface. At the end of each reading interval, the monitor reports not only the current state of the 3 sensed parameters, but also their respective minimum, average, and maximum values during the interval. In addition, the average illumination level for a succession of 2-minute bins is reported in channels 17-32, as shown below.

Channel 17 reports the average light level measured during the first 2 minutes of the interval, channel 18 reports the average level for minutes 3 and 4, and so on. These 2-minute averages allow for detailed monitoring of the light level in an incubator, where the door may be briefly opened, or the interior lights cycled on or off during the bin period. By comparing these 2-minute averages to the overall bin average (channel 4), a good profile of the lighting activity may be obtained.

Data Format (32 channels)

1	0	
2	Lnow	current illumination level (lux)
3	Lmin	minimum over the current bin
4	Lavg	average
5	Lmax	maximum
6	0	
7	Tnow	current temperature (degC x 10)
8	Tmin	minimum over the current bin
9	Tavg	average
10	Tmax	maximum
11	0	
12	Hnow	current relative humidity (percent)
13	Hmin	minimum over the current bin
14	Havg	average
15	Hmax	maximum
16	0	
17	minutes 1:2, average illumination level	
18	minutes 3:4	
19	minutes 5:6	
20	minutes 7:8	
21	minutes 9:10	
22	minutes 11:12	
23	minutes 13:14	
24	minutes 15:16	
25	minutes 17:18	
26	minutes 19:20	
27	minutes 21:22	
28	minutes 23:24	
29	minutes 25:26	
30	minutes 27:28	
31	minutes 29:30	
32	minutes 31:32	

Light Measurement

Incident light intensity is measured by the round silicon photodiode sensor on the top surface. The green filter absorbs wavelengths outside of the visible band, providing a sensitivity curve which approximates the photopic response of the human eye. The sensor is calibrated to a fluorescent light, and will be accurate over the range of 1:2500 lux to 5% for any light of this

type. Incandescent lights will read higher because of their substantial infrared energy output and the imperfect attenuation of these wavelengths by the sensor filter.

The light sensor will not be damaged by illumination levels which exceed 2500 lux, but the numeric output will eventually saturate, going no higher. The wavelength of maximum sensitivity is 550 nm, falling to 10% of maximum at 350 and 820 nm. Linearity is 1% or better.

Note that the specified sensitivity is measured along the axis of the sensor, directly perpendicular to the plane of the front surface. Off-axis sensitivity will be lower, decreasing to 50% at 55 degrees away from the axis.

Temperature Measurement

Ambient temperature is measured by a precision thermistor, which sits just under the perforation holes in the end of the unit. It is calibrated to 0.1 degrees Centigrade, and should be accurate to this level over the range of 0 to 70 degrees. The time constant of the sensor is largely determined by the thermal mass of the unit enclosure, though any airflow through or over the unit will significantly speed up the response. A large temperature change in still air will take over 1 hour to stabilize to 0.1 degC, but smaller changes to less precision will occur much more quickly.

Negative temperature values are not output, the lower limit being set at 0.0 degC, and no damage will occur if the unit is exposed to lower temperatures than this. Elevated temperatures above 70 degrees C should be avoided.

Humidity Measurement

Relative Humidity is measured by an electronic sensor which is mounted under the perforation holes of the case end. Its range of operation is 0 to 100%, with a calibrated accuracy of +/- 3.5%. Its speed of response is also determined by the diffusion rate into the unit interior, measured in minutes. The unit will not be damaged by condensation, but its output will saturate at 100% until the surface moisture evaporates. Be aware that moving a unit to or from cold environments may precipitate condensation, and the resulting saturated readings.

Temperature-controlled incubators often use fans to circulate heated or cooled air into the interior chamber. The temperature and relative humidity of such circulating air may be substantially different from the air of the bulk interior, and will oscillate over time as the incubator controller adds or removes heat from this air to maintain the temperature and/or humidity setpoints. If the Environment Monitor is placed in this airflow, it will record these oscillations of the control air rather than the temperature and humidity of the bulk interior air. To avoid these effects, place the monitoring unit out of the circulating air path, and consider using the 'average' values rather than the 'now' values if there is substantial variation in the latter.

Barometric Pressure Measurement

The DEnM-P measures barometric pressure instead of light, temperature, and relative humidity. Its output replaces the light output in channels 2-5, in units of inches of mercury x 100, so 2992 equals 29.92 in Hg. Calibration against an airport altimeter is quite good.

Packaging

The unit is packaged in a rectangular plastic enclosure of nominal size: 108 x 66 x 29 mm, and connects to the DAMSystem3 monitoring system using the standard 4-wire telephone jack. The case is perforated on the ends to provide convection airflow over the temperature and humidity sensors, which are internal to the box.