

ALL WEATHER TEMPERATURE SENSOR

- Wide temperature range: -20 Celsius to 133 Celsius
- Accuracy: $\pm 1^{\circ}\text{C}$
- Fast reading time: $<1\text{ ms}$
- Ultra low operating current: $6\ \mu\text{A}$
- Wide operating voltage range: 3.1V to 5.5V
- Maximum Vout = 3V
- Power supply can be sourced by a microcontroller I/O pin
- Sample code included in DataSheet
- Harsh environment ready
- NEMA 6P
- IP 68
- Shock resistant: 16,126,837 Pascals (2,339 pounds per square inch)
- Submersible
- Water Tight
- Dust Tight
- Ice/sleet tolerant
- Non reactive to salt water
- Sensor will sink when submerged
- Dimensions 12mm X 35mm (1/2" X 1.4")



Typical Applications:

Aquarium Environmental Monitoring
Storm-Water/CSO
Laboratory Equipment
Robotics

Fish Farming
Hydroponics
Swimming Pool
non solvent chemical manufacturing



The Atlas Scientific ENV-TMP temperature sensor is a rugged all weather temperature sensor specifically designed for environmental monitoring applications. The ENV-TMP temperature sensor exceeds the NEMA 6P and IP 68 standard for device enclosures - **Submersible, Water Tight, Dust Tight, & Ice/Sleet Resistant - Indoors/Outdoors**. The sensor can be submerged in both fresh and salt water for an indefinite amount of time and withstand temperatures of -20 Celsius to 133 Celsius.

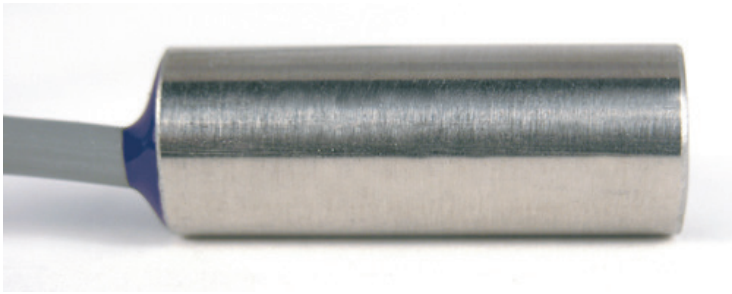
*For a quick explanation of operation see page 6

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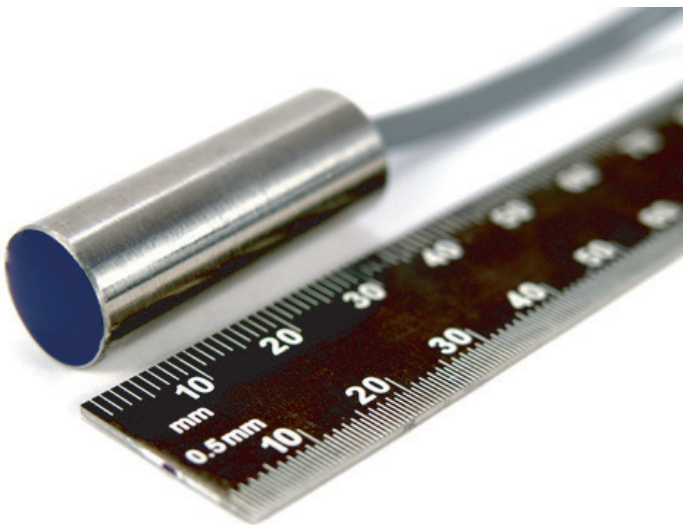
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Physical Properties

The sensor consists of a 34mm long (1.3 inch), 316 grade molybdenum bearing stainless steel tube. With a diameter of 12.7 mm (0.5 inches); the stainless steel tube is capable of withstanding a pressure of 16,126,837 Pascals (2,339 pounds per square inch).

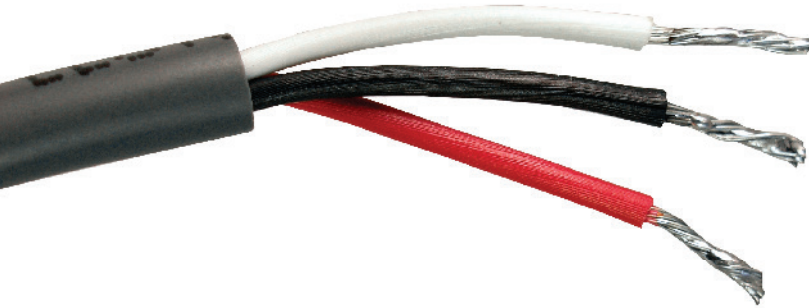


The bottom of the sensor is made of a high viscosity moderate porosity epoxy. This moderate porosity epoxy is further encased in a low viscosity no porosity black epoxy. This allows for high temperature and pressure resistance, as well as providing for 100% water impermeability.



The top of the ENV-TMP temperature sensor is made up of the same epoxy matrix as the bottom of the temperature sensor however a 1 meter (39.37 inch) gray cable exists from the center of the sensor.

The gray cable is a shielded 3 conductor cable with a 4.1 mm diameter (0.16 inches). Each conductor is a 24 AWG stranded copper conductor which terminates to 3 tinned conductors; **black** • **red** • **white**. Where **black** is GND, **red** is VCC and **white** is data out.



Cable Data Table

Parameter	SI (International System of Units)	Imperial system
Cable length	1 meter	39.37 inches
Cable diameter	4.1 mm	0.16 inches
Maximum Pulling Tension	73.395 Newtons	16.5 pounds force
Insulation wall thickness	0.254 mm	0.01 inches
Insulation wall material	PVC - Polyvinyl Chloride	N/A
Conductors X3	24 AWG	N/A
Max Cable Temperature	-30°C to 80°C	-22°F to 176°F

Sensor Enclosure Table

Parameter	SI (International System of Units)	Imperial system
Enclosure length	34mm	1.3 inches
Enclosure diameter	12.7 mm	0.25 inches
Enclosure burst pressure	16,126,837 pascals	2,339 psi

Sensor Operation

The Atlas Scientific ENV-TMP temperature sensor has been designed for easy use by the engineer and the microcontroller. The equation used to derive the temperature has been specially formulated to work well with 8-bit computer systems.

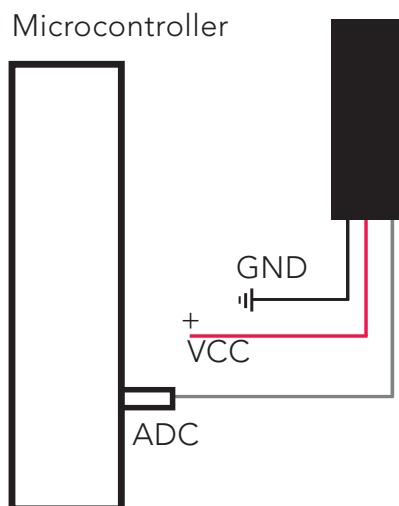
Wiring diagram

The ENV-TMP temperature sensor has 3 leads and can be connected to your microcontroller in a 1 or 2 pin configuration.

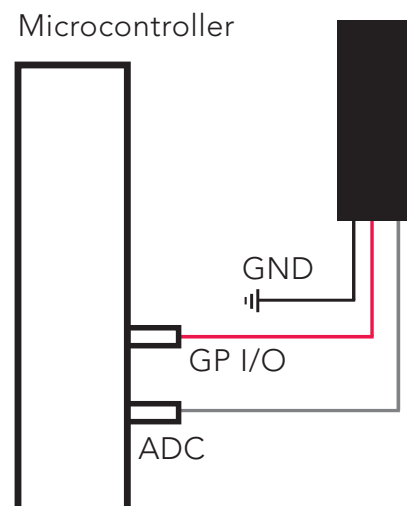
Lead Color	Function
BLACK	GND
RED	VCC 3.1V to 5.5V
White	DATA

The cable length of the ENV-TMP temperature sensor can be extended by 10 meters (32.80 feet) without data loss.

In 1 pin configuration VCC and GND are tied to your systems power bus. The white lead is connected to your microcontrollers ADC.



In 2 pin configuration the **RED** VCC lead is connected to one of the microcontrollers GP I/O pins and the **white** data lead is connected to your microcontrollers ADC.



Principle Methods of Operation

When a temperature reading is to be taken; the GP I/O pin is set high (2 pin mode). This will power the temperature sensor.

GPI/O source requirements

Operating voltage	Supply current
3.1V to 5.5V	6 μ A

Once the ENV-TMP temperature sensor has been powered, a reading cannot be taken until the power on stabilization time of 800 μ s has passed.

After 800 μ s has passed the microcontrollers ADC should be directed to take a single reading. The ADC will receive a voltage from the ENV-TMP from 0 mv up to 3,000 mv

The voltage must be read in millivolts and not in volts.

Once the ADC reading is complete the voltage read is stored as ADC points. These ADC points must be converted into millivolts. The following example is designed to demonstrate how this is done.

Example:

ADC resolution: 10 bit

ADC "points": 1023

ADC Vref: 5 volts

ADC point: 0.0048 (5/1024); this is the value of one ADC point.

Pseudocode:

```
Floating point variable ADC_VAL //make a var to hold the ADC reading
```

```
ADC_VAL= read_ADC(0) //Take a reading at ADC 0
```

Let's now assume that the ADC reading returned 500 and put that number in ADC_VAL.

```
ADC_VAL *= .0048 //multiply 500 by .0048
```

ADC_VAL now equals 2.4; and this tells us we just read 2.4 volts. However, we need millivolts not volts.

```
ADC_VAL *= 1000 // multiply by 1000 to convert volts to millivolts
```

Equation

Now that the input voltage has been read by the ACD and the ADC values have been converted to millivolts we put the millivolts into a small equation to get the temperature in degrees Celsius.

$$\text{Degrees Celsius} = 0.0512 * \text{ADC_VAL} - 20.5128$$

This equation is specifically designed to be easy for an 8 bit microcontroller to work with; the reoccurring number 512 is not accidental.

Quick Explanation of Operation

3 leads: **black** • **red** • **white**

black = GND

red = VCC

white =Data out.

Power through GP I/O pin

Operational voltage: 3.1V to 5.5V

Current draw= 6 μ A

White lead is connected to your ADC.

Power on

Wait 800 μ s

Take ADC reading

Power off

ADC to millivolts

$$\text{Degrees Celsius} = 0.0512 * \text{millivolts} - 20.5128$$

The cable length of the ENV-TMP temperature sensor can be extended by 10 meters (32.80 feet) without data loss

Warranty

Atlas Scientific warranty's the ENV-TMP Sensor to be free of defect during the debugging phase of device implementation, or 30 days after receiving the ENV-TMP Sensor (which ever comes first).

The debugging phase

The debugging phase is defined by Atlas Scientific as the time period when the ENV-TMP Sensor is inserted into a bread board or shield and is connected to a microcontroller according to this **wiring diagram**. Reference this **wiring diagram** for a connection to USB debugging device, or if a shield is being used, when it is connected to its carrier board.

If the ENV-TMP Sensor is being debugged in a bread board, the bread board must be devoid of other components. If the ENV-TMP Sensor is being connected to a microcontroller, the microcontroller must be running code that has been designed to drive the ENV-TMP Sensor exclusively and output the ENV-TMP Sensor's data as a serial string.

It is important for the embedded systems engineer to keep in mind that the following activities will void the ENV-TMP Sensor's warranty:

- Soldering any part of the ENV-TMP Sensor
- Running any code that does not exclusively drive the ENV-TMP Sensor and output its data in a serial string
- Embedding the ENV-TMP Sensor into a custom made device
- Removing any potting compound

Reasoning behind this warranty

Because Atlas Scientific does not sell consumer electronics; once the device has been embedded into a custom made system, Atlas Scientific cannot possibly warranty the ENV-TMP Sensor against the thousands of possible variables that may cause the ENV-TMP Sensor to no longer function properly.

Please keep this in mind:

1. All Atlas Scientific devices have been designed to be embedded into a custom made system by you, the embedded systems engineer.
2. All Atlas Scientific devices have been designed to run indefinitely without failure in the field.
3. All Atlas Scientific devices can be soldered into place.

*Atlas Scientific is simply stating that once the device is being used in your application, Atlas Scientific can no longer take responsibility for the ENV-TMP Sensor continued operation. This is because that would be equivalent to Atlas Scientific taking responsibility over the correct operation of your entire device.



