



Fact Sheet: 08010

Virtual Sensors

Virtual Sensors

Virtual Sensors provide readings of physical properties that are not measured directly but derived from the readings of other sensors. The readings are calculated by the logger firmware, but the data created by them is handled in exactly the same way as for ordinary sensors.

Virtual sensors are turned on or off by setting the logger option register. Once a virtual sensor is turned on, and a search is made for new sensors, it appears in the list of sensors and can be set to any logging schedule in the normal way.

Virtual Sensor addresses are fixed. They use addresses that are symbols and therefore cannot clash with normal sensors.

Virtual Sensors derive their readings by a combination of mathematical formulae and empirical data. They do not require calibration and carry no date of last calibration.

Virtual sensor readings will not be correct if the supporting real sensors are not connected to the logger, or have incorrect addresses. It is necessary for the real sensor address to be set to the default address for that sensor.

The reading from a Virtual Sensor is only as current as the data from which it is derived. It is therefore necessary to log the temperature and humidity at least as frequently as the derived reading.

An example ...

If it is desired to log the dew point temperature, and there is a temperature sensor and a humidity sensor already on the system, it is only necessary to set logger option G1, and search for new sensors, to make the Dew Point Virtual Sensor appear and to start logging the dew point temperature. The temperature sensor must be on address 1 and the humidity sensor on address 8. These are the standard addresses for those sensors. There may be more than one temperature sensor on the system, but only the data from the temperature sensor using address 1 will be used to derive the dew point temperature. Address 1 is normally used for the air temperature sensor and address 2 is reserved for a second temperature sensor.

If there is a grass temperature sensor on address 2, and the data from this is preferred to calculate the dew point temperature, it would be necessary to change the grass temperature sensor address to 1.

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Evapotranspiration Virtual Sensor – Penman-Montieth

Address = :

Sensors required	Temperature sensor	address = 1
	Solar radiation sensor	address = 5
	Anemometer	address = 6
	Humidity sensor	address = 8

This Evapotranspiration virtual sensor calculates the Evapotranspiration according to the Penman-Montieth model.

To switch the Virtual Sensor on, set logger option F1 and search for new sensors.

Logger option F3 controls the albedo coefficient ...

For forests or over open water set logger option F3 to use an albedo coefficient of 0.05.

For crops or grasslands clear logger option F3 to use an albedo coefficient of 0.2

Evapotranspiration Virtual Sensor – Priestly-Taylor

Address = :

Sensors required	Temperature sensor	address = 1
	Solar radiation sensor	address = 5

This Evapotranspiration virtual sensor calculates the Evapotranspiration according to the Priestly-Taylor model. This is less accurate than the Penman-Montieth model.

To switch the Virtual Sensor on, set logger option F1 and search for new sensors.

Logger option F3 controls the albedo coefficient ...

For forests or over open water set logger option F3 to use an albedo coefficient of 0.05.

For crops or grasslands clear logger option F3 to use an albedo coefficient of 0.2

Battery Voltage Virtual Sensor

Address =]

No external sensors are required to make use of the Battery Voltage Virtual Sensor. The battery voltage being logged is the logger internal six-volt battery

To switch the Virtual Sensor on, set logger option F7 and search for new sensors.

Battery Current Virtual Sensor

Address = ^

No external sensors are required to make use of the Battery Current Virtual Sensor. The battery current being logged is the logger internal six-volt battery current.

A positive value of current indicates that the battery is being charged. A negative value indicates that the battery is being discharged.

Note: When the logger [Read] button is pressed the Battery Current can be expected to show a discharge of 40 or 50 mA greater than normal. This is caused by the additional current used by the LCD back light.

To switch the Virtual Sensor on, set logger option F8 and search for new sensors.

Dew Point Virtual Sensor

Address = =

Sensors required	Temperature sensor	address = 1
	Humidity sensor	address = 8

To have the Dew Point Sensor report in degrees Fahrenheit, set logger option register G2. Leaving G2 clear will result in the Dew Point being reported in degrees Centigrade.

NOTE: It is important to set the required units before the Sensor is turned on. To change the units on a Sensor that is already operating will require the Sensor to be turned off and removed from the current list by conducting a new search, then making the units change.

To switch the Virtual Sensor on, set logger option G1 and search for new sensors.

When the Sensor's reporting units are changed, all data, including historical data, will be presented in the new units, correctly converted. The Dew Point Virtual Sensor will operate below zero degrees Centigrade, hence becoming a frost point sensor, although accuracy is reduced. When operating in this mode, the equations are changed to adjust for the vapour pressure over ice and not meta-stable super cooled water.

Stress Index Virtual Sensor

Address = ;

Sensors required ...

Black Globe Temperature sensor	address = 2
Anemometer	address = 6
Humidity	address = 8

Or...

Solar radiation sensor	address = 5
Temperature sensor	address = 1
Anemometer	address = 6
Humidity	address = 8

This sensor is also known as the Heat Load Index or Cattle Comfort Index Virtual Sensor.

If no black globe temperature is present, the logger will use solar radiation and air temperature to estimate the black globe temperature as follows:

$$\text{TBG } (^{\circ}\text{C}) = (1.33 \cdot \text{TA}) - (2.65 \cdot \text{TA}^{\frac{1}{2}}) + (3.21 \cdot \log(\text{SR}+1)) + 3.5$$

The logger then calculates the Heat Load Index using:

Below 25°C

$$\text{Heat Load Index} = 10.66 + (0.28 \cdot \text{RH}) + (1.3 \cdot \text{TBG}) - \text{WS}$$

Above 25°C

$$\text{Heat Load Index} = 8.62 + (0.38 \cdot \text{RH}) + (1.55 \cdot \text{TBG}) - (0.5 \cdot \text{WS}) + (\exp(2.4 - \text{WS}))$$

Where TA = temperature in °C, RH = relative humidity in %, WS = Wind speed in m/s, SR = Solar Radiation in W/m².

To turn on this Virtual Sensor set logger option F5, and search for new sensors.

The original Stress Index formula of is still available by setting logger option F4, in addition to F5.

$$\text{Stress Index} = 0.8 \cdot \text{TA} + (\text{RH} (\text{TA} - 14.4)/100) + 46.4$$

A reading much higher than expected usually indicates that one or more of the physical sensors required is missing or on the wrong address.

Accumulated Heat Load Units Virtual Sensor

Address = <

Sensors required ...

Stress Index Virtual Sensor address = ;

This virtual sensor requires that the Heat Load Index Virtual sensor be turned on and all its required physical sensors be present. This virtual sensor MUST be left on its default schedule of one reading per hour (schedule m).

At each hour, the Accumulated Heat Load Units will be calculated according to the following rules:

If Heat Load Index > 86 , then new AHLU = previous AHLU + (HLI - 86)

If Heat Load Index < 86 and > 77 , then AHLU does not change.

If Heat Load Index < 77 , then new AHLU = previous AHLU - (77 - HLI)

The calculations are done to a resolution of one hundredth of a AHLU, but displayed as whole units.

To turn on this virtual sensor set logger option F5 and F6, and search for new sensors