Contents

Using the 10 Year Data Logger

Summary

Now you have the temperature logger, you can start to use it for measuring everything from weather to fridges, freezers and central heating.

At last I have a temperature logger which can be left to its own devices for several days without having to think about batteries failing or needing to read it every day.

Although I first wanted the logger to investigate what happens in my greenhouse, it has proved invaluable for a number of other uses. It must be one of the unwritten laws of the universe that as soon as you have a new gadget you look for new ways to use it. It's always hard to justify buying something, but once you have it, it can be put to use for all kinds of things.

I guess the difference between the logger and a thermometer is similar to the difference between a photograph and a video. You get to see things changing, not just what things are like at a particular time. Now I get to see how the temperature changes, not just what it is now and again.

I started looking in my fridge! Not at the food, but at a small liquid crystal thermometer that I'd had for a while. I always thought it seemed to read a bit high, but I could never work out how much difference having the fridge door open when I read the thermometer would make. There is also the point that I don't like to admit that the temperature really is a bit high.

The Fridge

I decided to be a bit scientific about the measurements. I know that cold air is heavier than warm air so it would seem that the bottom of the fridge should be colder than the top. I'd also made a second logger so I put one in the top of the fridge and the other near the bottom.

The first test didn't work very well. When I took the loggers out of the fridge they were cold enough to have moisture condense on the circuit. This stopped them working altogether, though they did recover when dried out. I guess there are different ways to get round the condensing moisture problem.

One would be to put the logger in a sealed container to prevent moisture getting in. This sounds simple but is really very difficult when you think about it in more detail. All air will have some moisture in it. So when you seal the logger in a plastic box the air with it is still moist. At the temperatures in the fridge, this condenses out onto the circuit and shorts out the signals. You

could put silica gel in the box to absorb the water but it is not always easy to get hold of. It is also quite large. We should all have seen the little 'tea bag' packets, which come in electronic goods these days. It will also need to be refreshed when it has become exhausted.

The more conventional approach is to prevent the condensation from stopping the circuit working. You can buy conformal coatings, which come in spray cans, and are used like paint or varnish. The coating is usually clear so that the circuit and components are still visible after it is applied. Beware that once it is applied, it is very difficult to remove, so use it only when the circuit is working correctly. Drying takes perhaps a couple of hours and the coating is a little sticky. It is designed to flex a little so that it does not crack as the circuit and components expand and contract with temperature changes.

I used the coating on my logger boards, and it works very well.

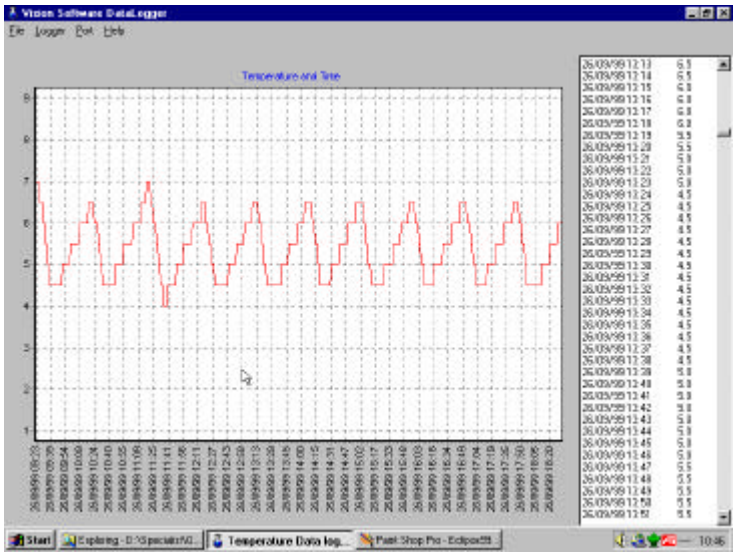

Figure 1 – Fridge Bottom

Back to the fridge and this time the loggers worked OK. Figure 1 shows the

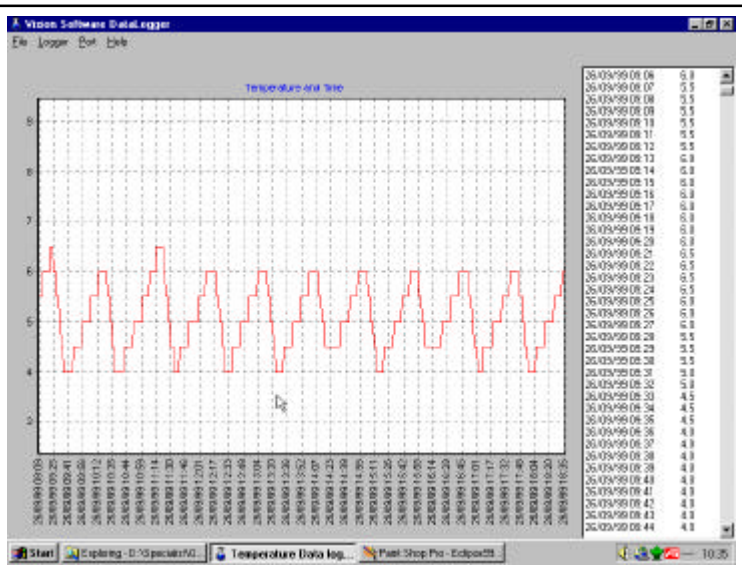

Figure 2 – Fridge Top

plot for the bottom of the fridge. I didn't expect to see the temperature cycle up and down quite so quickly. I suppose the more cycles, the more power is used, so a more efficient fridge would cycle less frequently. Figure 2 shows the plot for the top of the fridge, which shows it is slightly warmer than the bottom by about 0.5°C. This difference could just be the difference between the two loggers. They measure temperature in 0.5°C steps so they could easily be that different. The more general comment is that the top and bottom of the fridge do not seem to be different. So much for my cold air theory, perhaps the fridge isn't big enough to show any effect of heavier cold air. If any fridge experts read this, could they comment on the cycling and the top to bottom temperature differences?

The result of all my tests show that the thermostat should be set a little colder. Fridges should be colder than 4°C to preserve the food for a reasonable time.

Freezer

After seeing that the fridge needed to be a bit colder I started to worry about the Freezer, so the loggers ended up in the top and bottom of the freezer. It seems that a freezer should be at about -18°C or colder. The freezer differs from the fridge by having cooling plates at the bottom and the top of the freezer, where the fridge has one cooling plate down the back of the inside of the fridge.

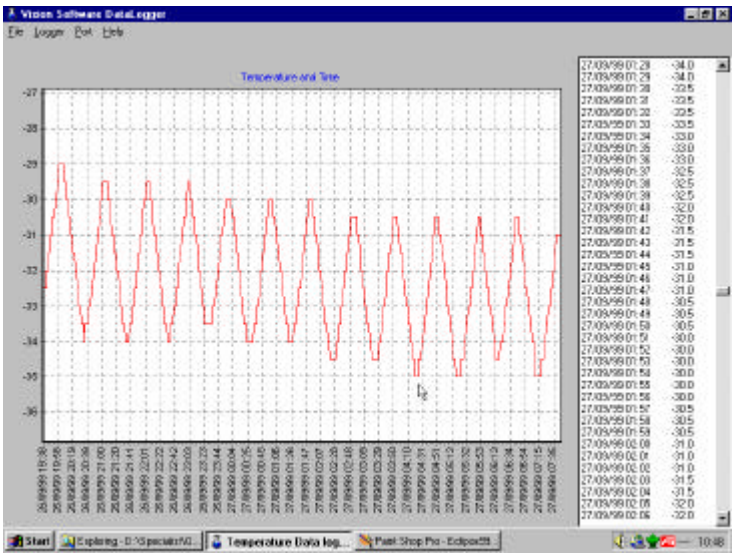

Figure 3 –Freezer Top

Figure 3 shows the plot of the top of the freezer. It shows a similar cycling effect to the fridge but the temperature difference is about 4°C compared with about 2°C for the fridge. The temperature is well below the -18°C target so the food should be OK. Figure 4 is a plot of the bottom of the freezer. It shows only a 0.5°C cycle so perhaps my cold air is showing its effect by falling to the bottom of the freezer! Any experts, could you please comment?

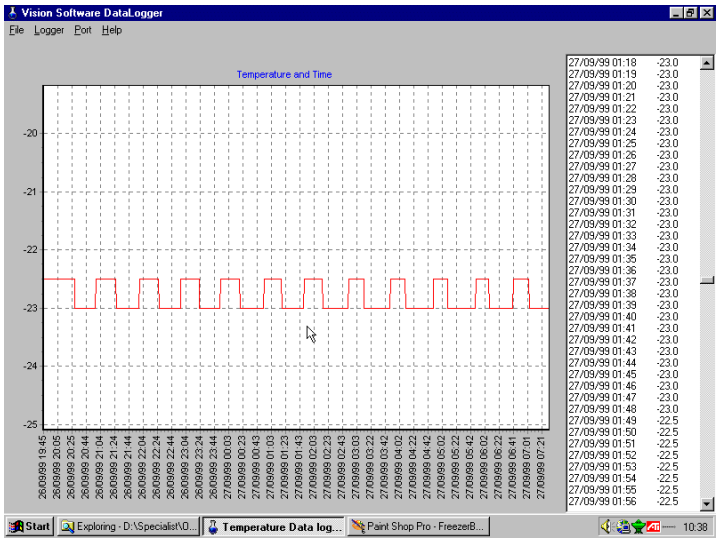

Figure 4 – Bottom of the Freezer

Central Heating

Fired by the results of the cold side of the house I turned to the hot side - the central heating.

The logger works up to 85°C so I should be able to put it on a radiator and see the temperature rise as the boiler heats the water in the heating system. I need to protect the bare circuit board, since it will not work if it is shorted out. I used a piece of cardboard for electrical insulation but angled the whole thing

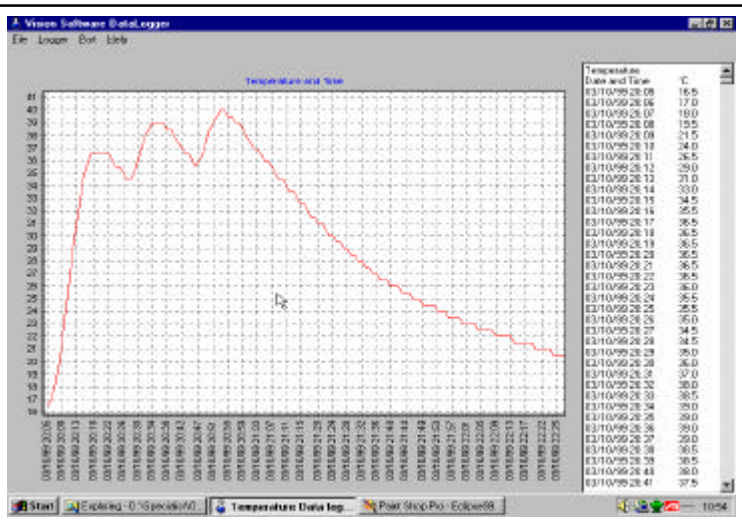
Figure 5 shows the result of a start from cold at 8.00pm

so that the warm air from the radiator metalwork would bathe the circuit with heat. Figure 5 shows the result of a start from cold at 8.00pm. The system warms up quite quickly, certainly more quickly that the fall in temperature as the boiler turned off at 9.00pm. Again the cycling of the boiler from on to off is clearly visible. The overall temperature rises over the hour; with the peaks continuing to rise.

There is a fault with my boiler, which shows as the boiler turning off for no

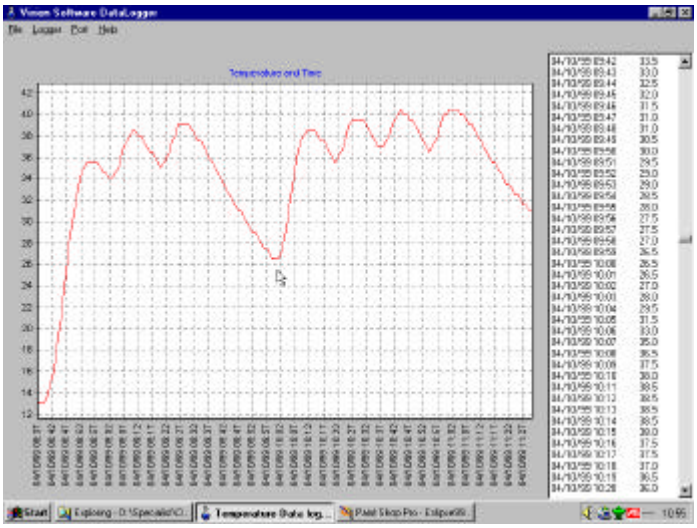

Figure 6 Heating Fault

apparent reason. Figure 6 shows this happening in the middle of the plot where the mouse pointer shows. I wondered if the over temperature sensor was tripping early but the plot shows that when I manually reset the boiler the radiator temperature continues to rise over time. I'll have to build another logger which can read voltage inputs so that I can monitor the boiler sensors to see which part may be failing!

Greenhouse

Back to my first reason for making the temperature logger.

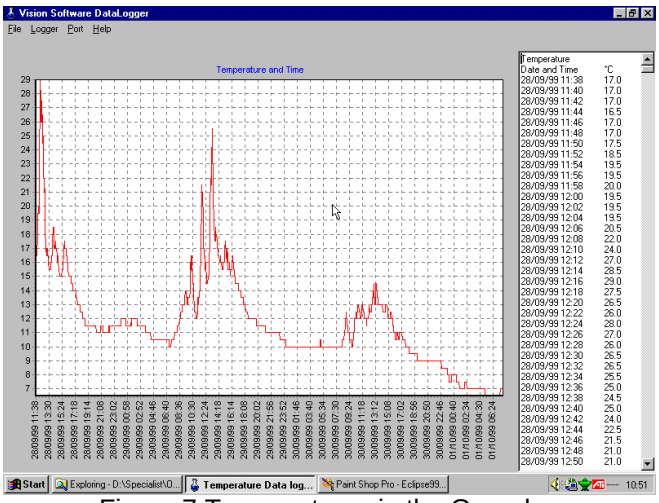

Figure 7 Temperatures in the Greenhouse

Figure 7 shows temperatures in the greenhouse over a couple of days. There is no shading on the glass of the greenhouse and its door is open. Despite this, a comparison with Figure 8, showing the temperatures outside for the same period shows that the inside temperature is between 1 and 5° C warmer

than outside. The lowest temperatures happen just before dawn and peak near the middle of the day, but there is considerable change caused by cloud cover reducing the amount of direct solar heating.

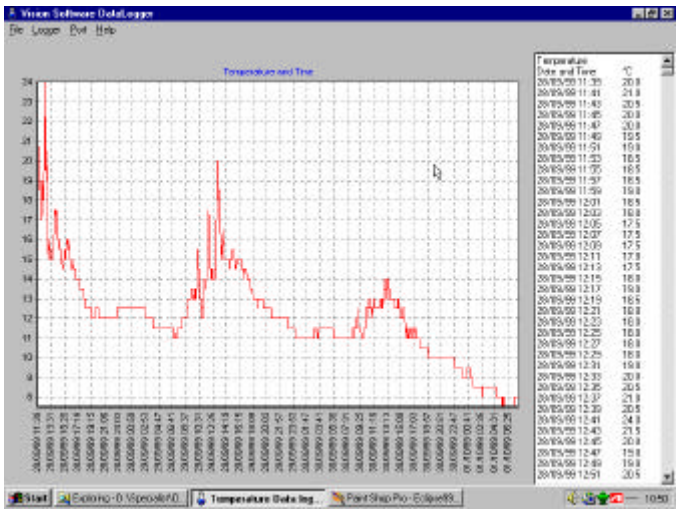

Figure 8, showing the temperatures outside

Closing the door should give much bigger changes particularly in the depths of winter.

Frosty Mornings Outdoors

When I heard the weather forecast was for a potential frost I rushed out to the garden to leave one of the loggers to try and see how long the frost might last.

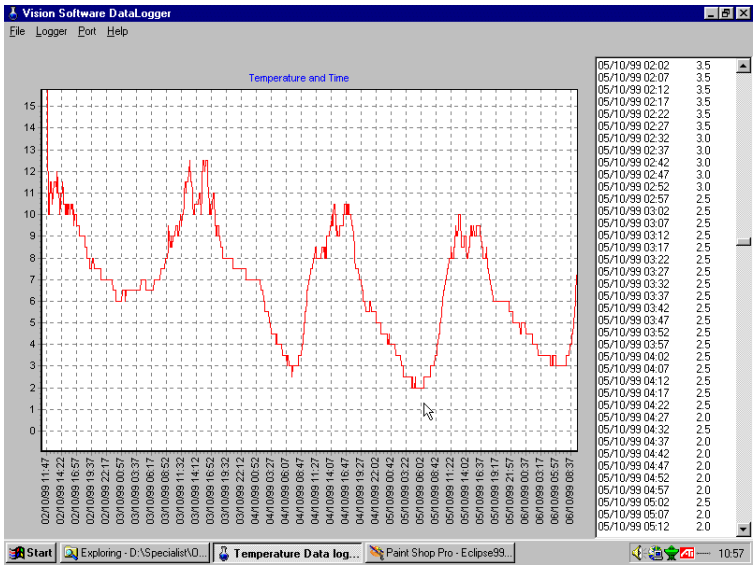

Figure 9 - Plot over Three Days

I chose a position, which was out of direct sunshine, on a concrete slab about 50mm above the level of the grass. Figure 9 shows the plot over three days or so. On each morning the temperature drops below 4°C but never gets to 0°C,

so the frost didn't happen. It looks as though the time just before dawn is the most likely time for the frost to form.

I'll have to wait for colder weather to complete the frost measurements.

Postal Transport

One of the more unusual measurements is shown in Figure 10. It shows the temperature of the logger I sent to be photographed by Maplin.

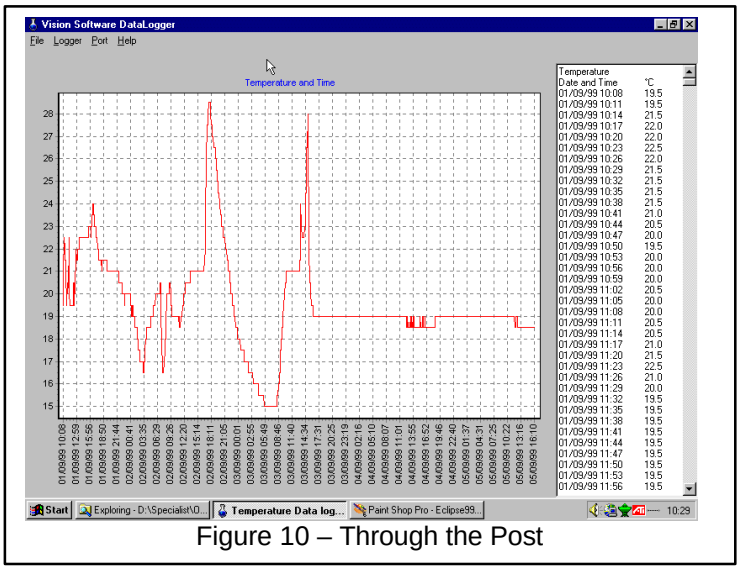

Figure 10 – Through the Post

It went through the post and shows the temperature varying widely from 15°C, to 28.5°C. The weather, as I remember it, was quite warm so the post must have been in a warm van for part of its journey. It didn't stop at a constant temperature for long until it reached Maplins. I guess their office is kept at about 19°C.

One of the manufacturers declared uses for the DS1615 chip is to monitor temperatures during transport of various materials. I guess sensitive food would be kept in a refrigerated vehicle and monitoring would be needed. Frozen food would suffer most from any temperature variation.

Eclipse 1999

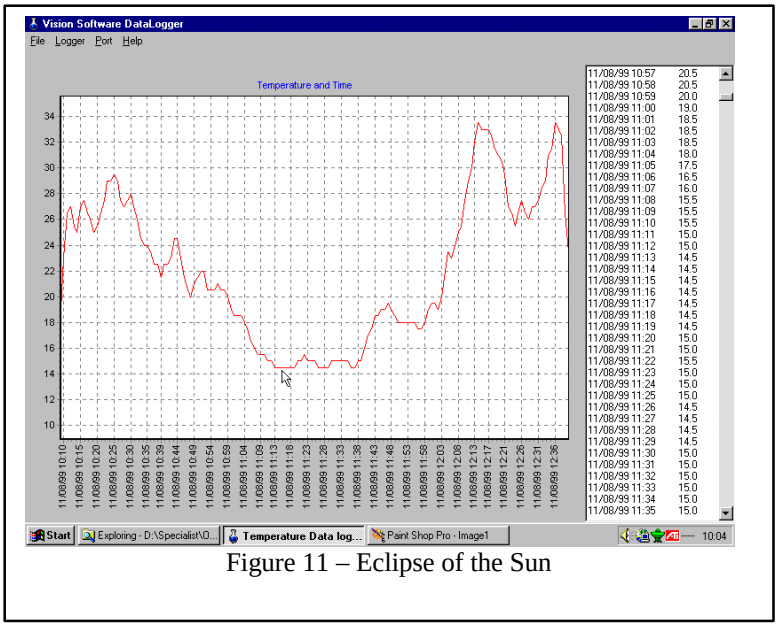

Figure 11 – Eclipse of the Sun

The last plot I have is in Figure 11. I was watching television on the run up to the eclipse of the Sun, and saw several people measuring temperature during previous eclipses. Why not try this myself?

The day of the eclipse in Macclesfield didn't promise very good weather. As it turned out the cloud was not very thick and the Sun was clearly visible during most of the eclipse. I put the logger in direct sunlight so that the maximum temperature difference would be seen. The plot shows some effects of cloud where the temperature produces peaks and dips in the plot. The overall shape shows the temperature falling until about 11:18a.m., which is the time of maximum cover from my garden. I don't know if it is important, but the chickens on the allotments next to the garden started crowing as the light fell at peak cover! Did they think it was night falling?

Well these applications of the logger may encourage you to have a go at using one. It would be interesting to see what you end up measuring. Good luck.