Just once in a while, some technological device turns up in the educational marketplace which strikes us as a ready-made answer to a particular curriculum development. Not infrequently, we at SSERC may enthuse over just such a device (sad, eh?). Teachers, however, whilst they may well agree that this is the greatest thing since the Tunnock's Teacake, may also see the price as too high, the learning curve too steep or the understanding demanded of the children as too great. This time, with a device known as the *iButton*, we judge that the price is right and that the learning curve is almost horizontal. Educational applications of the device and of the ideas underpinning its use are well within the capabilities of many children from Primary 4 upwards. Given such an educational endorsement it may come as a surprise that the device in question is put to serious commercial use in the food processing sector and in other manufacturing industries. The *iButton* is a simple, miniature data logging device. Those of you who have read the revised 5-14 documents may have noted that data logging is now mentioned - albeit only at level F. However if we examine, at level C, Skills in Science - Investigating: "select and use appropriate measurement devices or make appropriate observations" and "record findings in a greater range of ways" and in the ICT strands, "Collecting and Analysing" and "Creating and Presenting" then we find several reasons to use a simple data logger in investigative work. A recent survey on ICT in Science Education has shown up the paucity of such activity - especially in S1/S2 - and the hiatus in such investigative work between P6/P7 and Standard Grade (see SSERC Bulletin 202).

Right-on, the iButton!

What is an iButton? It is a programmable microprocessor in a 16mm diameter stainless steel can. It is durable and waterproof. It can be left outside in the worst of conditions, and can even be left totally immersed in water. The secrets of the iButton lie in its simplicity and its ability on the one hand to steal power from the computer and on the other to transmit data to the computer through a single connection. The chip inside the steel case is connected to the computer by only two wires. When the iButton is touched to a probe connected to a computer, the device can transmit data through the single connection. Because of this transfer of data and power this type of connection is often described as a '1-wire' interface.

Figure 1   An iButton port connected to a laptop computer with an iButton, in its holder, on the reader's right.

The data logging iButton for temperature recording is a simple device to program and use. The temperature range on the particular button we used is from - 40°C to 80°C[1]. Figures 1 and 2 show the complete kit. This consists of a serial cable connector for the computer, one iButton device, an iButton port and a CD ROM with software etc (see Figure 2).

1. Footnote °C - degrees Celsius (centigrade)

Figure 2   An iButton kit: iButton port and serial lead, iButton and CD ROM.

Fish and chips

This iButton is an extremely useful device. It is used for serious commercial applications in industry, yet it's cheap enough to be used also in schools. The iButton temperature chip is used commercially by food producers. Fresh Scottish salmon sent to, say, Japan may have an iButton placed in a carcase in a refrigerated box. (cont.)

When the consignment arrives at its destination, the recorded data is downloaded and a graph plotted to ensure that the temperature has not risen above food safety levels. Environmental Health officers also use the iButton in a similar way. You may even have seen them in a refrigerated display in your local shop (the iButtons that is). These devices are ideal for use in investigative work with the pupils. Because they're relatively inexpensive, a number of iButtons can be used. Inside and outside temperatures could be recorded, or one placed on an exposed flowerbed the other sheltered under a bush, so that one's in sunlight the other in shade. Differences in readings could be discussed before and after the data had been downloaded. A range of other environmental niches and associated micro-climates could be investigated.

If your school has a suitable refrigerator this may be a good place to start investigations. A reading over 24 hours should give an indication of the efficiency of the thermostat. The temperature inside the 'fridge should be a steady four degrees Celsius (+4°C). Perhaps the results could lead to a discussion on the safety of food product storage.
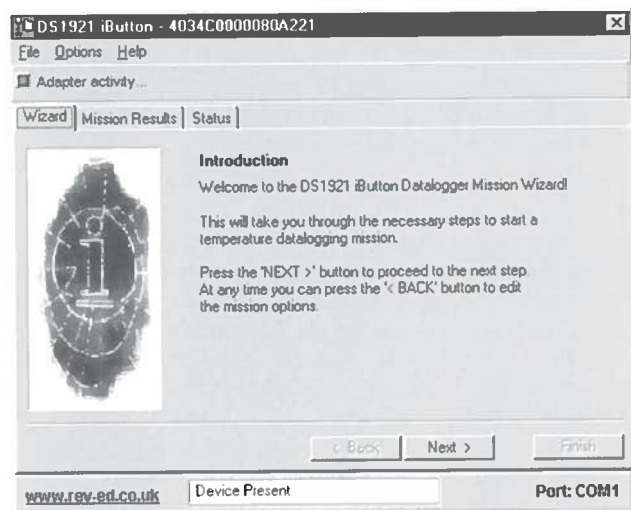
If there is no access to a refrigerator then at Primary level one could try recording the classroom temperature overnight or from early morning to lunchtime. How do the pupils predict that the temperature will change? How will it rise or fall over this time? Why should there be a difference? Similarly the probe could be left over-night to test childrens' ideas of when the room will be at its coolest. The pupils should be asked for their own ideas for other interesting investigations which exploit the relative simplicity and small size of this device.

Pottering around

The sequence shown as Figures 3 through to 7 illustrates the series of on-screen prompts available with the iButton software. The intention is to show the helpful *Wizard* feature and to provide examples of just how easy it is to set this device up for a datalogging application. The application in question is a simple temperature measurement exercise over a 34 hour period.

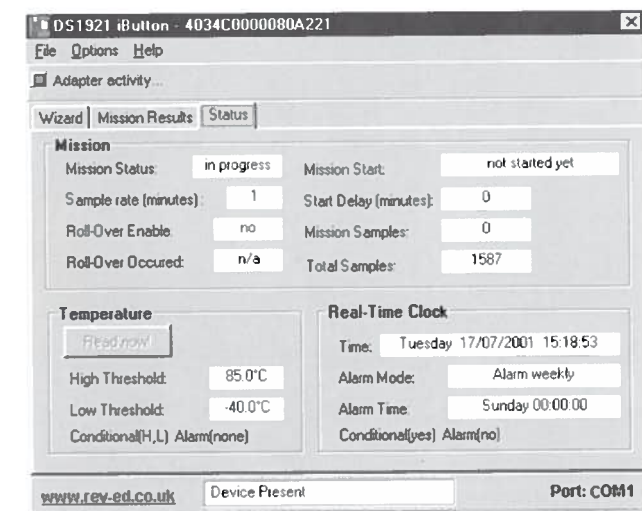**Figure 3**   Introductory screen showing the *Wizard* icon and accompanying simple set-up instructions.

Figure 4   Setting up the sampling rate using information from the *Wizard*. (It's a pity this wizard can't spell "occurred" though).
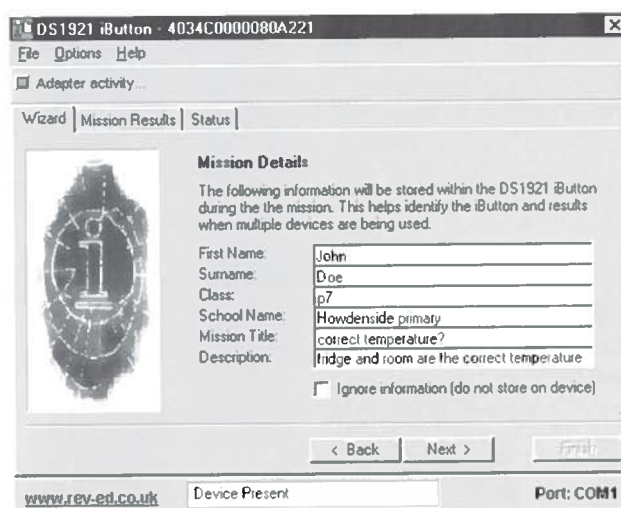
Figure 5   Storing user information alongside a title for, and description of, the specific investigation to be carried out.
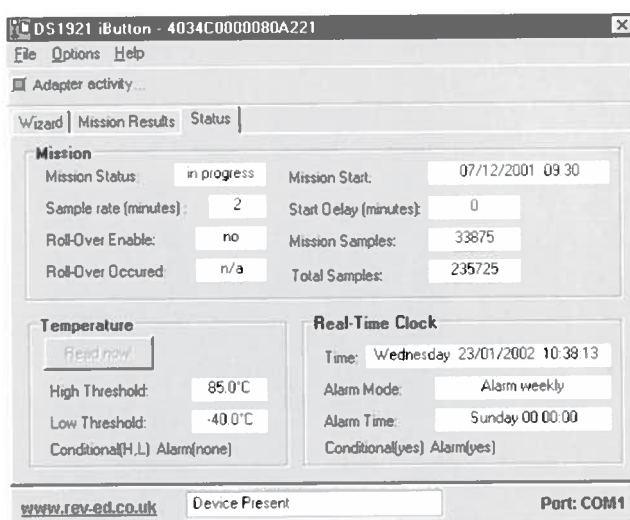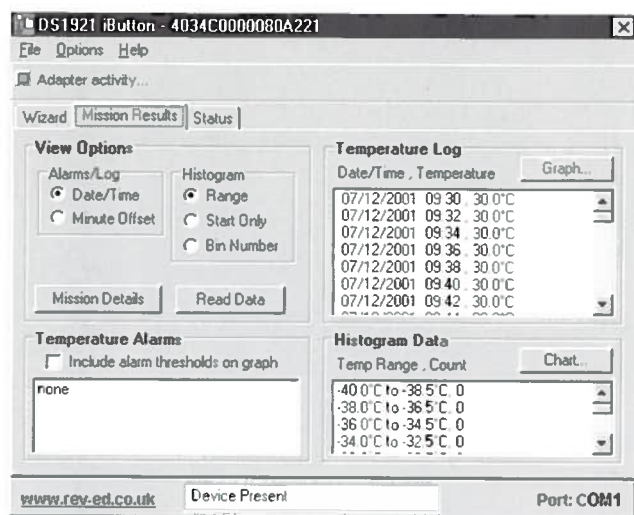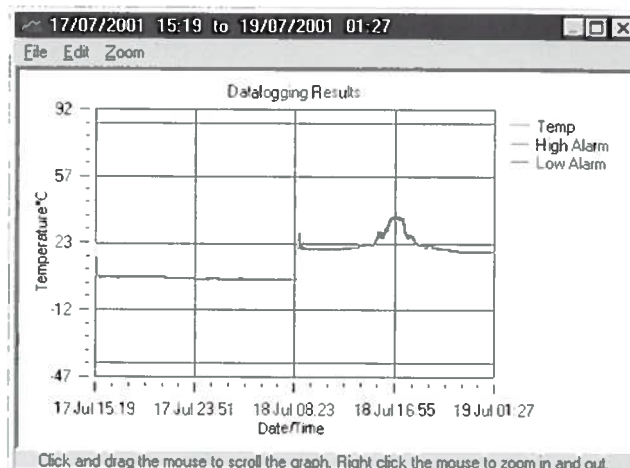
Figure 6   Setting up the start conditions for the actual datalogging exercise.

Figure 7 Downloading the results. Note the options of "Graph" (see Figure 8 opposite) or "Chart".

Figure 8 Temperature record for a room in SSERC's premises over an approximately 34 hour period.

Figures 7 and 8 show a sample of the actual data and a graph respectively, for a temperature record of a room in SSERC's premises over an extended period (approximately 34 hours). The 'blip' on the afternoon of the 18th is explained by a move of the iButton sensor to a window sill. The graph in Figure 8 is, admittedly, somewhat crudely scaled. Note, however, the facilities to click and drag the mouse to scroll the graph and, by right-clicking the mouse, to zoom in and out of areas of particular interest. Extra iButtons are available as spares at £10 each and this would widen the investigative possibilities.

Because they are programmable devices the applications of iButton technology are, of course, not restricted to temperature measurement. Also available are iButtons which can act as switches or operate locks. They are already used in the *Big Idea* Inventor Centre, Irvine in Ayrshire, for such purposes.

Applications of this sort are described in a companion article in SSERC Bulletin 204, which is also being published at this time. Secondary technology teachers should find the iButton concept also of use for learning and teaching about control applications.

A technical resumé with supplier details and prices is given below. Should any school feel they would like first to try a sample temperature iButton, we will be happy to lend one out for a week or so. We would also offer a certain amount of telephone or E mail based technical backup and support. We only have a few, so it's first come first served and we would need the device to be returned promptly so we can offer it to others. The only condition of such a loan service is that we are told about any investigative work which is done by the pupils.

Technical resumé

The iButton is a coin-sized temperature datalogger sealed in a waterproof stainless steel can. It contains a lithium battery that powers the device during the experiment. When the investigation is complete the data is extracted via an RS 232 serial link and processed with easy to use Windows software. (We've used it successfully with both Windows '98 and NT 4.0).

The DS1921 iButton houses a thermometer, a clock/calendar, a thermal history log, and 512 bytes of additional memory to store a record (in commercial use this is usually a shipping manifest). The thermometer measures temperature from -40°C to +85°C in 0.5° increments, while the clock measures seconds to years accurately to plus or minus 1 minute per month (quoted for 0°C to 45°C). The recyclable iButton logs data for more than 10 years or up to 1 million temperature measurements (measuring at 50°C or less).

Supplier

The iButton is supplied by Revolution Education, at:

BIC, Innova Park, Mollinson Avenue, Enfield, EN3 7XU

and with an information and online shopping service at :

www.rev-ed.co.uk

Prices

Starter pack : Contains iButton datalogger, serial port adapter, Windows software and documentation.

£28.00 (£32.90 inc. VAT)

Spare DS1921 iButtons

Each - £10.00 (£11.75 inc. VAT)

Endpiece: For an interactive version of this and other Newsletters and for much else of interest to those invloved with 5-14 Science and Technology, see our web site at : www.sserc.org.uk For our specialist 5-14 Science online Support Network website see also www.solsn.org.uk Please note also that as part of the Scottish component of the National Grid for Learning (NGfL), LT Scotland has set up a 5-14 micro-site with web page versions of the revised guidelines etc and links to a number of relevant external sites including SOLSN. This micro-site is part of the Scottish NGfL site, and is to be found at : http://www.ngflscotland.gov.uk/5-14/guidelines/

Components & Materials

Item	Description	Price
593	Miniature motor, 1.5V to 3V, 2mm dia. shaft	30p
614	Miniature motor, 3V to 6V, 2mm dia. shaft. Both motors above can be used for project work but they run at fairly high speeds, some gearing will be required. See worm/gear, item 811.	45p
621	Miniature motor, 1.5V to 3V, now with 8 tooth pinion. The open body of this motor makes it ideal for showing how such a motor is constructed	25p
798	Pack of 24 gears, 6 each of 12, 20, 30 or 40 teeth, dia.15, 22, 32 and 40 mm. 12 tooth gear fits motor shaft and 40 tooth gear push fits in cotton reel	£2.00
799	Pack of 24 cams, 6 of each of 4 shapes	£1.00
800	Pack of 100 wheels, 39 mm dia., assorted colours, 3 mm axle hole	£5.25
811	Worm and gear, 34 to 1 speed reduction	35p
817	Axles 3 mm dia., nickel plated, round ends, push fit on SSERC plastic wheels, gears and pulleys: 70 mm long, per pack of 4	40p
818	As above but 95 mm long, pack of 4	40p
819	As above but 12 mm long, pack of 4	40p
820	Worms to fit 2 mm electric motor shaft, pack of 5	£1.00
821	Reducers 3mm to 2mm enables gears, pulleys and wheels, to be fitted to motor shaft, per 5	25p
867	Reducers, 4 mm to 2mm, as above, per 5	25p
868	Reducers, 4 mm to 3 mm, as above, per 5	25p
710	Sonic switch.Clap your hands, the motor starts, clap again the motor reverses and on the third clap the motor stops. Needs 4 AA cells.	85p
723	Microswitch miniature, lever operated	40p
822	Plastic toggle switch, low voltage	40p
688	Crocodile clips, red, miniature, insulated	5p
759	As above, but black.	5p
788	Crocodile leads, assorted colours, insulated croc. clips at ends,36 cm long. Pack of 10	£1.35
835	2 x AA Cell ('battery') holder	15p
845	2 x C Cell ('battery') holder	20p
729	Battery connector, PP3 type, snap-on press-stud, suitable for Items 835 and 845	5p

Item	Description	Price
789	MES (miniature Edison screw) bulbs 3.5 V	10p
691	MES battenholders for above.	20p
866	Lens end lamps, 1.2 V MES. Ideal for use where a narrow, concentrated beam of light is needed. Bargain pack of 100	£3.50
508	LED (light emitting diode) 3 mm, red, per 10	50p
761	LED 3 mm, yellow, per 10	60p
762	LED 3 mm green, per 10	60p
790	3V buzzer (works with solar cell see Item 838)	55p
846	Sound module with 'melody' chip	£1.00
838	Solar cell, 100 x 60 mm, 3.75 V per cell, max.	£2.10
839	Solar motor, body 25 dia.12 mm long with shaft 2 mm dia 6 mm long	£1.70
840	Solar pack : one of each solar cell, solar motor propeller (801), and 3 V buzzer - with notes.	£3.75
836	Motor mounts, plastic, push-fit with self adhesive base pad for SSERC motors 593 & 614, 10pk	£2.35
801	Propeller, 3 blade, to fit 2 mm shaft. Blade 62 mm long	35p
792	Propeller kit with hub and blades for ten 3 or 2 bladed propellers	£3.50
794	Cotton reels (for making buggies, rubber powered tanks etc.) pack of 20*.	75p
796	Pack of 20 pulleys, 5 of each of 10, 20, 30 and 40 mm diameters.	£2.50
837	Ring magnet, 40 mm o.d., 22 mm i.d.	35p
815	Ceramic square magnet, 19 x 19 x 5 mm	15p
823	Ceramic magnets, poles at ends, 10 x 6 x 22mm	12p
824	Ceramic magnets, poles on face, 25x19x6mm	35p
861	Bimetallic strip, 10 cm length	30p
882	Quartz clock movement, dimensions 56x53x17mm, with wall hanging bracket. Suitable for dial thickness up to 10mm. Includes plastic hands suitable for dial diameter to 200mm. Requires an AA battery. See CD Clocks, Newsletter 18.	£1.75
884	Onager kit. Wood cut to length etc.	£2.00
885	Chariot kit. Templates and parts.	£2.00

*Item 794 **Not** 200 as previously stated in error*

An interactive, fully illustrated, version of this list is posted on the SSERC site at:

http://www.sserc.org.uk/Members/Primary/Surplus/body.htm

Prices do not include VAT which will be charged at the ruling standard rate. Cash with order only when total value is less than £5 and please add £1 for carriage solely to these small orders (except where an inclusive price is indicated eg kits, etc). For orders totalling more than £5 please do not send payment etc but await delivery and then pay on our advice note or invoice.

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