The ALBA Interface and Logger

djb microtech ltd

Contents

Manual Version 2.00

Guarantee

djb microtech ltd guarantees the ALBA Interface and Logger against any manufacturing defect for a period of one year from the invoice date. This guarantee is valid provided the ALBA Interface and Logger is operated in accordance with the procedures outlined in this manual and that the unit has not been tampered with.

Introduction

Congratulations on your purchase of the ALBA Interface and Logger. We hope that it adds an additional dimension to your teaching and to your students' learning.
To help you learn about the features of this package there are six tutorials. These should be worked through sequentially.

The following items should have been supplied:
- The ALBA Interface and Logger
- USB cable
- CD-ROM.

Hardware Requirements

The following are the recommended minimum hardware requirements:
- PC (150MHz or faster)
- Windows XP
- 32MB of RAM
- CD ROM Drive
- A free USB port
- Approximately 1MB of hard drive space for each Application
- Colour monitor
- High colour video card 16 bit or greater.

Connecting ALBA to the Outside World

Before launching the software connect the USB cable to the ALBA Interface and Logger and the other end to a free USB port on your PC. It is advisable to connect directly to the PC and not to a USB hub as some may be unable to supply the necessary power.

Installing the Software

The software is supplied on CD-ROM.
Ensure that you have no other programs running.
Place the CD ROM in your drive. If you have 'CD Autorun' enabled then the setup program will start automatically. If this does not happen then from the Start menu select Run and type D:\Setup.exe. You will have to change this if 'D' is not your CD ROM drive.
The installation has three parts:
- The ALBA core
- The Applications
- Acrobat Reader.

The CD-ROM contains a pdf version of this manual and the Acrobat Reader lets you examine the manual. This manual is installed along with the software in the Alba folder.
As new versions of the core program become available you can download them along with the updated manual at no additional cost.

The ALBA Interface and Logger
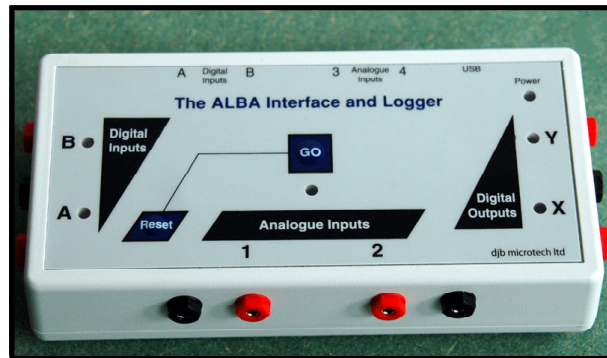
Analogue Inputs

There are two channels (1 and 2) with 4mm connectors on the front of the unit for collecting analogue data. In addition there are a further two channels (3 and 4) at the rear of the unit for connecting self-identifying and precalibrated sensors. These inputs may be mono or bipolar with the range on each channel being individually selected from 5V, ±5, 10V, ±10V. The inputs are protected against an overvoltage - up to ±16V

Digital Inputs

There are two digital input channels (A and B) which have 4mm connectors. These inputs are for the user's light gates and switches. The inputs are protected to 16V and for reverse polarity. The inputs A and B are also duplicated at the rear of the unit and these are for connecting **djb microtech's** sound switches and light gates.

Digital Outputs

There are two digital outputs (X and Y) with 4mm connectors on the right hand side of the unit. These outputs can be controlled using our Investigator Software – if the voltage falls outwith certain limits then the outputs can be switched on/off or latched if required.

The Front Panel

The GO switch is used to start data capture. In Remote Logging the green LED flashes approximately once every second during data capture.
When the unit is waiting for the trigger to fire the green LED is permanently on.
The two LEDs at the digital inputs are normally off. When the input goes low then the appropriate LED will come on.
The two LEDs at the digital outputs indicate the state of these outputs. When a LED is on, the output is high.
Pressing the Reset switch on its own will do nothing. This avoids accidental Reset. To reset the unit hold down the Reset switch then press and release the GO switch. The unit may also be reset by disconnecting then reconnecting the USB cable.

Power Requirements

The ALBA Interface and Logger receives its power directly from the USB connection to your computer. The unit has an internal 300mA fuse. If remote logging is required then you must use our external portable power supply - see the website for details.

The LED at the top right of the front panel indicates the status of the power.

The ALBA Software

The ALBA Interface and Logger is supplied with 10 Applications and the general purpose logging package called 'The Investigator'. Each package enables you to capture, display and analyse data. The list below describes the Applications supplied with the ALBA Interface and Logger.

It is important to note that the tutorials in this manual make use of these Applications to enable you to familiarize yourself with the ALBA software. You do not need a knowledge of Physics to learn about the software.

Capacitor Charging Voltage
Investigates how the voltage across a charging capacitor changes in a series RC circuit.

Capacitor Charging Current
Investigates how the charging current changes in a series RC circuit.

Capacitor Discharging Voltage
Investigates how the voltage across a discharging capacitor changes in a series RC circuit.

Capacitor Discharging Current
Investigates how the discharging current changes in a series RC circuit.

Capacitor Charge / Discharge
This is a summary program of the other four capacitor experiments and it reinforces the salient teaching/learning points.

Cooling by Evaporation
An experiment which enables pupils to examine the cooling effect of a liquid which is evaporating.

Change of State
An experiment which enables pupils to examine the temperature of a liquid as it cools to a solid.

Speed of Sound
An experiment which enables pupils to measure the speed of sound.

A Sound Investigation
The time for sound to travel between two sound switches various distances apart is measured and a graph of distance against time is plotted. The slope of the graph is now a meaningful number i.e. the speed of sound. This experiment is seen as an introduction to the slopes of graphs in the kinematics section of a second level Physics course.

Light Intensity and Distance
This experiment enables students to study the Inverse Square Law.

T**he Investigator**
A general purpose data-capture tool allowing you to use ALBA as an interface or logger.

The software allows you to use two distinct approaches to using I.C.T.
- • The use of the ALBA Applications offers positive support to students in their learning.
- • The use of the Investigator enables sudents to work independently on their own ideas.

The tutorial examples which follow show you how to use the features of the package. It is assumed that you are familiar with the Windows environment on a PC.

Tutorial 1

This tutorial covers: Loading an Application, Loading and Editing a Table, Drawing Quick Graphs.

Figure 1

Getting Started

For this tutorial you do not need to use the ALBA Interface and Logger.
Double click on the ALBA icon on your desktop (Figure 1).

The ALBA software looks to see if the ALBA Interface and Logger is connected and it displays a dialogue box if it cannot find it (Figures 2a & 2b).
Select Cancel to continue without using the ALBA Interface and Logger.

Figure 2a

Figure 2b

Loading an Application

When the Alba software is loaded, select *Load Application* from the *ALBA Startup* dialogue box (Figure 3).

Figure 3

Figure 4 shows the list of Applications.
Click the Physics radio button to select the Physics Applications.
Select 'CoolingCurve' then click on 'Load Application'
When the Application is loaded you will see a splash screen with the title of the Application. Press 'OK' to proceed.

Figure 4

From the *Experiment* menu select *Notes* (Figure 5).

Figure 5

Use the arrow buttons to read through the notes.
All Applications have notes similar to this to guide the student through an experiment. Later you will learn to edit these notes to suit your own style of teaching (Figure 6).
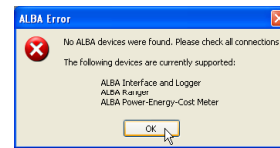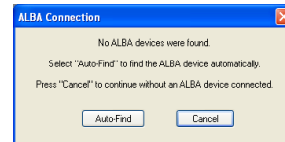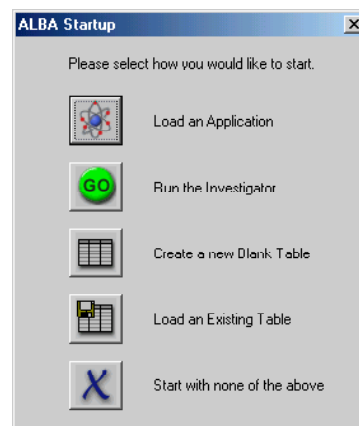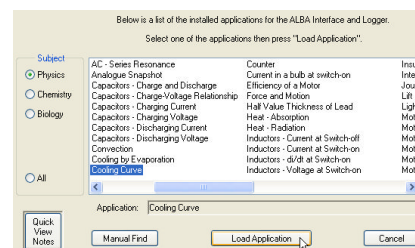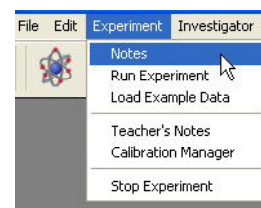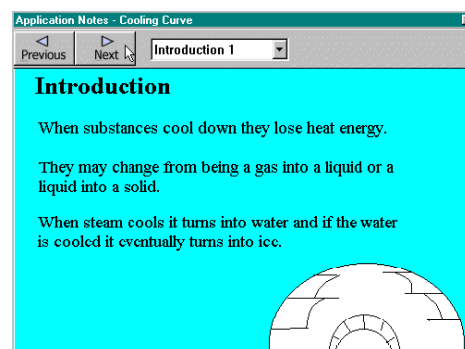

Figure 6

Figure 7

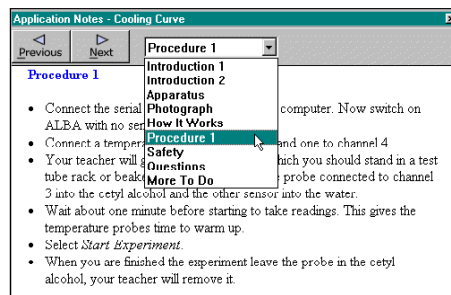Note that the drop down menu enables you to jump quickly between pages (Figure 7).

Loading Data

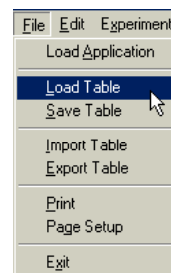To load previously saved data select *Load Table* from the *File* menu (Figure 8).

Figure 8

Navigate to the ALBA folder then open the 'Physics_Apps' folder.
Now open the 'Cooling Curve' folder.
Select the file 'Cooling_Curve_Data.atb'
A Table is now shown on your screen (Figure 9).
The above method of loading data lets you see the structure of the folders. However there is a quick way for loading the sample data files that are supplied with each Application. Once the Application has been loaded click on the *Experiment* menu and then select *Load Sample Data*. Close the Table (shown in Figure 9) and try this alternative method for loading a file.

Figure 9

Editing the Table

Select the Cetyl Alcohol column by clicking in the very top part of the column, i.e. the column heading (Figure 10). When the column is selected it is highlighted in black.
To de-select a column click on the heading again – try this but when finished leave the column selected.

Figure 10

Now select *Column Properties* from the *Table* menu (Figure 11).
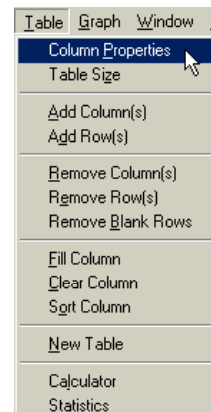

Figure 11

Experiment by changing some of the properties. Remember that if you make mistakes and/or want to start again you can always reload the data file.

Click OK to see the results of your experimentation.

A quick way to open the Properties dialogue box is to double click on the column heading. Try it now.

Note that you can resize your table in the usual way by clicking anywhere in it, to select it, then drag the corners to the required size. The table can be minimized by clicking on the minimize button (Figure 12).

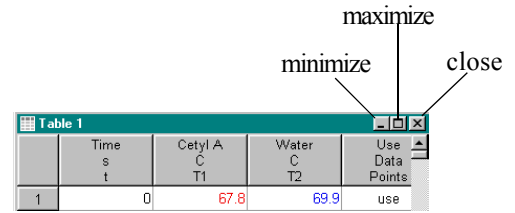Ignore the end column in the table at present.

Figure 12

Drawing a Graph

Select the Time and the Cetyl Alcohol columns by clicking on their headings (Figure 13).

Figure 13

From the *Graph* menu select *Quick Graph* (Figure 14).

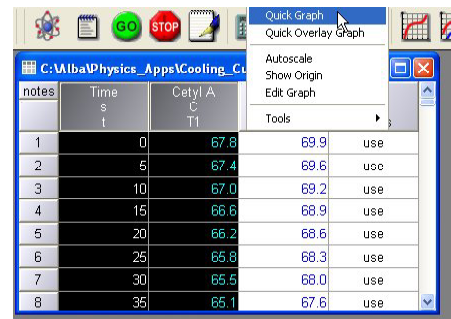Alternatively you may click the Quick Graph icon.

Figure 14

When you use 'Quick Graph' the column in the table which is furthest to the left becomes the X axis (Figure 15).
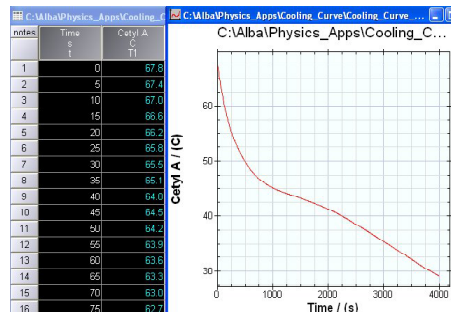

Figure 15

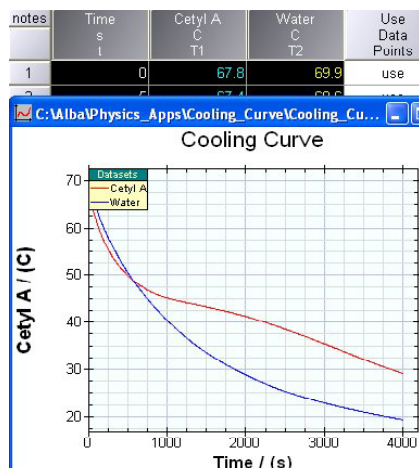Select all three data columns in your table then select *Quick Graph* again (Figure 16).

Figure 16

Basic Principle

The basic principle of operation of the ALBA software is that you select what you wish to operate on e.g. if you want to work with a table you click anywhere in the table to select it. If you now wish to work with a column of data you click on the heading of that column to select it. Similarly if you wish to work with a graph you click anywhere on the graph to select it.

Close the Table and Graph windows.

Running Another Application

To run another Application select *Load Application* from the *File* Menu (Figure 17).

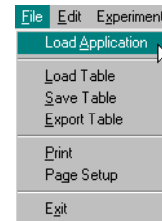Try loading an Application and examining the Notes.

Figure 17

The Structure of the ALBA Software

Consider the ALBA software to be in two parts - Applications and ALBA Core.

The Applications communicate with the data logger and set it up to take a number of readings at a selected time interval. The data that returns is passed to the ALBA Core where it is displayed in tabular and graphical form. The Core enables the data to be manipulated and explored. The Core can be used on its own to manually enter data in a table and to draw graphs.

The ALBA Core is regularly and freely updated on the website and users should make a point of keeping themselves up to date with the latest version.

End of Tutorial 1: Close all Table and Graph windows.

Tutorial 2

This tutorial covers: Statistics, Use/Ignore point, Curve Fitting, Graph Editing, Zoom and the Toolbar.

From the *File* menu select *Load Table*.
Within the folder 'Physics_Apps' there is a folder called 'Tutorials' and in this folder there is a file called 'Tutorial2.atb'. Load this file. You now have the Table shown in Figure 18.

Select columns x and y1 then select 'Quick Graph'.
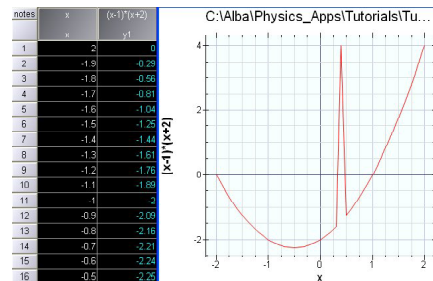Note that there is a glitch in the data set (Figure 19).

Use / Ignore Point

Scroll down your table until you can see the x value 0.4.
This is the point that causes the glitch.
In the end column (scroll if necessary) double click on the 'use'. It changes to 'ignore' and is greyed out (Figure 20).
Note also that the glitch has been removed from your graph.
If you examine the Statistics for this column (see below) you will see that the effect of this bad point has been removed.
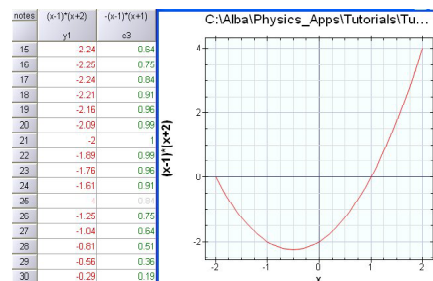
This feature proves useful in an Application where the results give a best-fit line which does not quite pass through the origin. If there are one or two 'rogue' points then their effect can be removed and the line examined again. In this way students can critically evaluate their results and where necessary repeat the measurements or offer explanations for the irregularities.
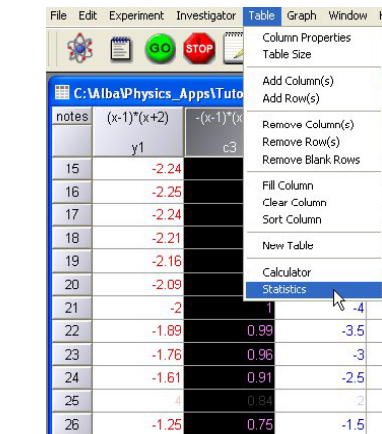
Statistics

Select the Table by clicking anywhere in it then select the column C3.

Select *Statistics* from the *Table* menu (Figure 21).

Alternatively you may click the Statistics icon Σ

Figure 22 shows the statistics offered by this package. Users wishing to do extensive statistical analysis can export their data (see page 30) and after manipulation import it back into the ALBA software.

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22

Curve Fitting

Select the Table.
Select columns x, y1, y2 and y3.

Select *Quick Graph* from the *Graph* menu to obtain the plot in Figure 23. Alternatively you may click the Quick Graph icon.
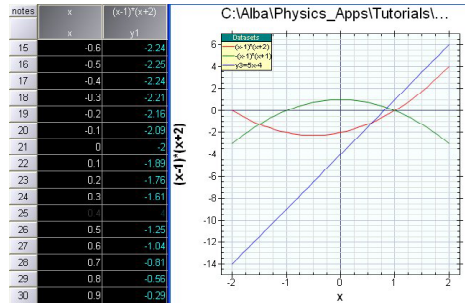
Figure 23

Click anywhere in the graph window and note that the first plot (red) is highlighted. Clicking again highlights the second plot (green) and one more click highlights the third plot.
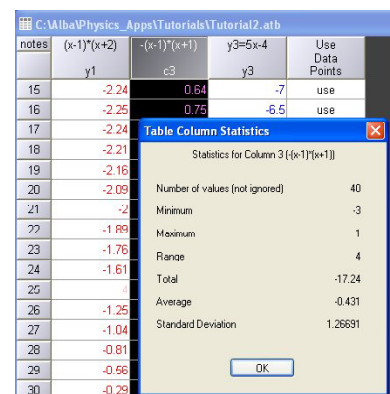

Figure 24

Leave the red plot highlighted.
From the *Graph* menu select *Tools* then *Curve Fit* (Figure 24).
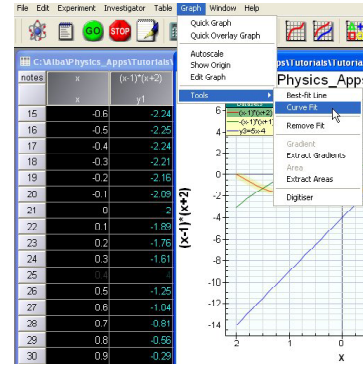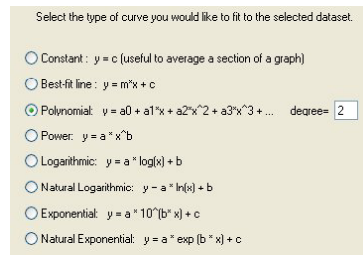
Select 'Polynomial' and set the degree to be 2 and click OK (Figure 25).

Figure 25

The equation of the fit is displayed in a small box that can be dragged around (Figure 26). The curve fit has a thicker (and darker) line than the dataset "curve" or line.
Note that the curve-fit is expressed in increasing powers.

At the end of the curve fit equation is information on the quality of the fit (fit = 3.25 x 10^{-19}). The smaller this number the better the fit.

Select each of the other curves in turn and fit them.

To remove the information on the curve fit select *Tools* from the *Graph* menu then select *Remove Fit*.

Figure 26

11

Edit Graph

The *Edit Graph* facility enables you to:
- • Change the ranges on each axis or autoscale them.
- • Choose the symbol for your points.
- • Choose to connect points with a straight line.
- • Assign a name for your graph.
- • Swap axes.
- • Display error bars.

Select the graph window.
From the *Graph* menu select *Edit Graph* and change the values to those shown in Figure 27. Remember to uncheck Autoscale on both axes by clicking the tick mark.

Click OK to see your graph.

Figure 27

Click on the Tab *Data Styles* and check the box Draw Symbols.
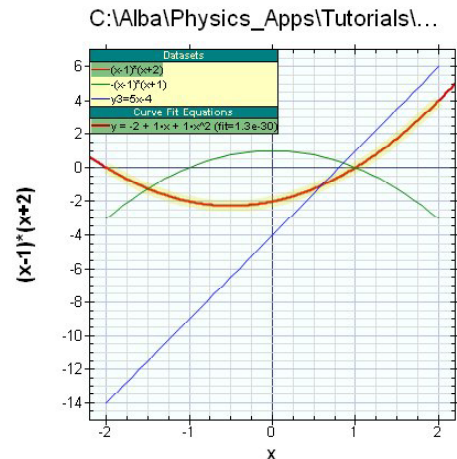
Explore each option in turn (Figure 28) and put symbols on your graph, clicking Apply to see the effect of your choices.
Click *Next Dataset* and put symbols on the next graph plot.

Figure 28

Click the Tab *Graph Title* and enter a title for your graph.

Note that *Swap Axes* and *Data Error Bars* will be dealt with later.

Zoom

To zoom in on a graph, drag over the area of interest with the left mouse button held down (Figure 29). When you release the mouse button a new graph is drawn. You may zoom in through many levels.

To return to the original graph select *Autoscale* from the *Graph* menu or alternatively you may click the ⊞ icon.
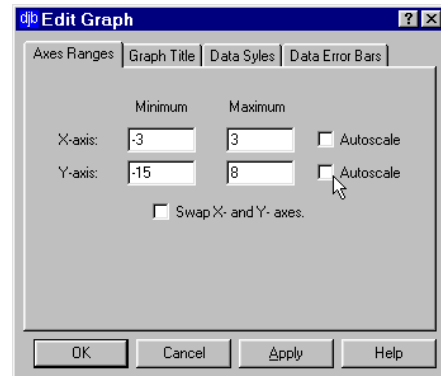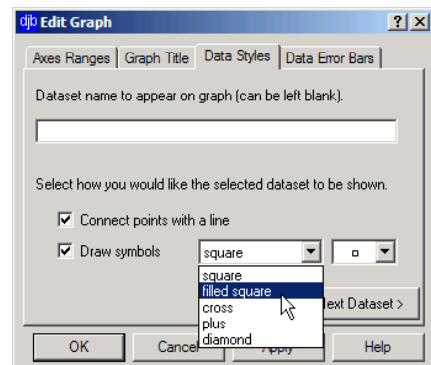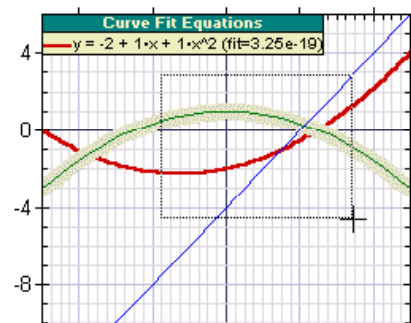
Figure 29

The Toolbar

Clicking on an icon in the Toolbar offers you a quick way of making selections. The function of each icon is listed below.

Load an ALBA Application

Experiment notes for the student

GO - run the experiment or the Investigator

Stop the experiment

Open WordPad

Column Calculator

Column Statistics

Column Properties

Add a Column

Quick Graph

Quick Overlay Graph

Edit Graph

Show Origin

Autoscale Graph

Dragging the cursor over the icons on the Toolbar displays the function of each.

In the remaining tutorials you may choose to use the icons on the Toolbar or select from the menus.

End of Tutorial 2.

Tutorial 3

This tutorial covers: Manual data entry, Adding a column, the Column Calculator, Overlaying graphs, Swaping graph axes, Error Bars and Changing the size of a Table.

If you have any tables or graphs on the screen from the previous tutorial then remove them by clicking on the close button ('X') at the top right of the Table window. All plots formed from columns in this table will be removed as well as the table itself.

Entering Data Manually

From the *Table* menu select *New Table*.

Change the number of rows to 8 and the number of columns to 2 (Figure 30).
Enter the column headings as previously in Tutorial 1, page7. This time ensure that the Volume column is set to two decimal places as shown in Figure 31.

Click on the first cell to select it, type your number and when you press Enter the cursor moves to the cell below.
Enter the numbers in Figure 32 into your Table.

Adding a Column

Suppose that you wish to investigate the numbers because you think the relationship between them is inverse proportion. You could tackle this problem by multiplying the two columns to see if the product is a constant.

From the *Table* menu select *Add Column(s)* and add one column. (Figure 33) or alternatively select the *Add Column* icon.
Double click on the column heading or use the *Properties* menu item and set the title of this new column to 'Product' and the column symbol to 'z' - leave the units blank.

Using the Column Calculator

Select the column in which you wish to put the results of your calculation. In this case it is the newly created column. Ensure that no other columns are selected - this is important.
Now select *Calculator* from the *Table* menu or click on the Column Calculator icon.
The name of the symbol at the top of each Table column appears on a button on the left side of the calculator (Figure 34). Suppose that you wished to form a new column PV. To do this click on the 'P' button then the multiplication sign and finally click on the 'V' button. On selecting OK the product PV will be entered into the selected column.
If there were ever more than twelve variables then they could be selected from the variables drop down menu.
You may type any formula or enter it by selecting the buttons.

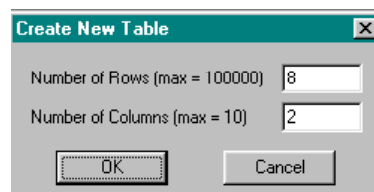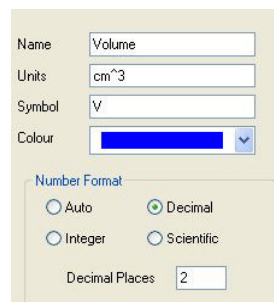Note that the multiplication sign is the asterix and it sits high on the line.

Figure 30

Figure 31
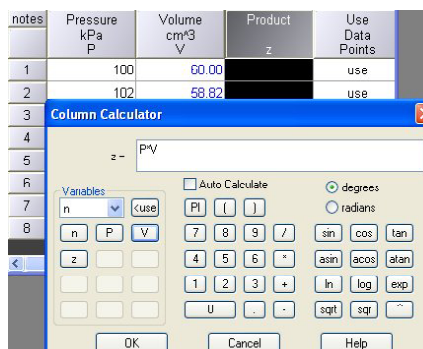

Figure 32

Figure 33

Figure 34

Entering Functions using the Calculator

Functions may be typed or entered by clicking on the buttons.
The following exemplifies how formulae are entered:

4b	is entered as 4*b
3(a+b) +c	is entered as 3*(a+b) +c
$2c^2$ +a/3b	is entered as 2*c^2 + a/(3*b)
2sin3x	is entered as 2*sin(3*x)
$2\pi fL$	is entered as 2*PI*f*L
Loga +sinx	is entered as Log(a) + sin(x)

Swap Axes

Select the Pressure and Volume columns and draw a graph.
Click on the graph window to select it.
Click on the *Edit Graph* icon on the Toolbar.
With the Tab *Axes Ranges* selected tick *Swap X -and Y-axes* then click *Apply* (Figure 35).

Note that you can only swap axes if there is one graph plot.
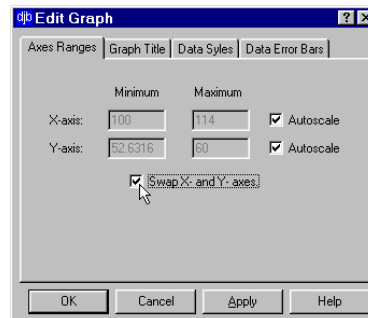
Figure 35

Error Bars

Before drawing the error bars use your knowledge from Tutorial 2 and put a square symbol at each of your points.
Select the Tab *Data Error Bars* (Figure 36) and explore the various options. Figure 37 shows a graph with error bars.
If there were several data sets then the button *Next Dataset* would let you select them in turn.
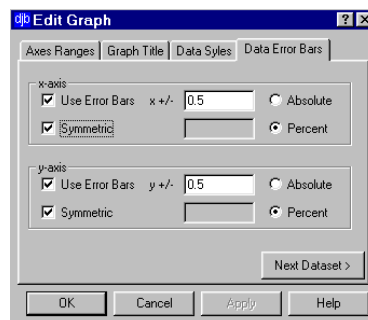
Figure 36

Table Size

Click on the Table to select it.
Select *Table Size* from the *Table* menu and change the size to 200%.

Maximize your Table window and this time check the box *Automatically fit to Window*. This could be useful if demonstrating to a class.
Note that the display will only be large if there are a few columns to fit into the window. If you had 10 colums in your Table then they would be 'squeezed' to fit the window.

Figure 37

15

Overlaying Graphs

Close the PV table.

Suppose that you have done an experiment charging a capacitor with the charging voltage set at 3 volts and then repeated it with the voltage set to 1.5 volts.
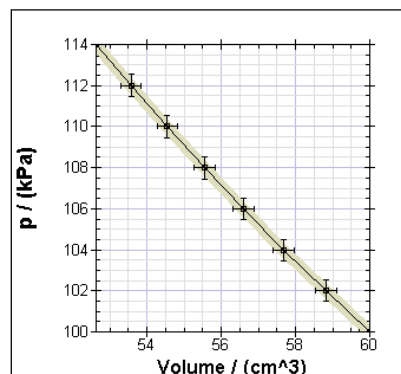
From the 'Tutorials' folder load each of the files Cap1 and Cap2 in turn. You now will have two tables.

Select each table in turn and using the *Quick Graph* facility draw two separate graphs for the two experiments (Figures 38and 39). Ideally you wish to see these graphs on the same set of axes so that it is easier to make a comparison. To do this select the two columns in the first table and select the two columns in the other table. There are now four selected columns. From the *Graph* menu select *Quick Overlay Graph,* Figure40 or alternatively click the *Quick Overlay Graph* icon.

Figure 41 shows the overlay.

Note that you could have many more than two tables and you may select more than two columns from each.

As in *Quick Graph* the selected column on the left of each table forms the x-axis.
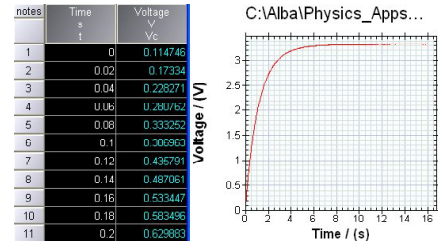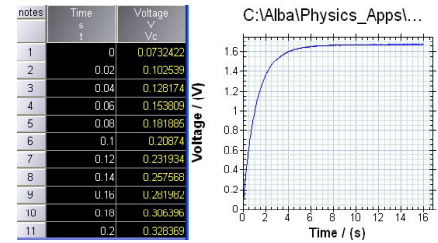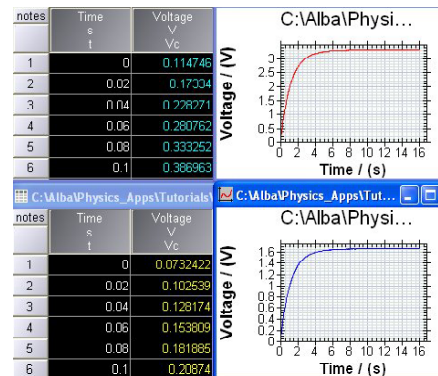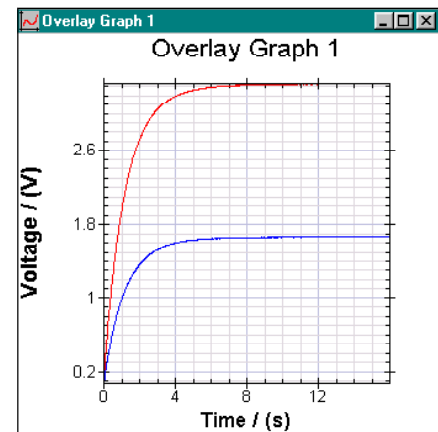
End of Tutorial 3.

Figure 38

Figure 39

Figure 40

Figure 41

Tutorial 4

This tutorial covers: Using Help, Report Writing, Printing, Copying and Pasting data, Gradients, Areas and Suggestions for Graph Plotting.

Using the Help File

Help files are there to assist you so do not be reluctant to use the Help facility.

Select Help from the Help menu (Fifure42).

Figure 43 shows the contents of the Help. Explore this by clicking on one of the underlined sections.

Use the buttons at the top of the Help page to navigate. Remember that if you click on any text which is underlined then you will jump to information on the selected item. You may use the *Back* button to return to where you came from.

If this is the first time that you are using the ALBA Help then you may find that the *How To* section is a good starting point.
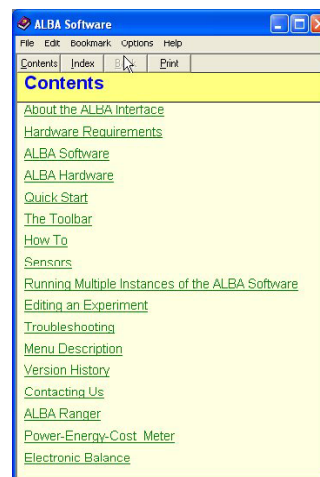
If you are unsure where to look then select *Index* and type in the word you require information about. The Help file will search for the information. If you cannot find what you require try some synonyms (Figure 44).

Report Writing

To facilitate report writing the ALBA software makes use of the word processor which is supplied with Windows.
To understand how to use this
- Load the table 'Magnet.atb' from the 'Tutorials' folder.
- Draw a voltage/time graph (Figure 45).
- Click on the Table to select it.
- Select *Copy* from the *Edit* menu.
- Click on the WordPad icon.
- Select Paste from the Edit menu in WordPad. Your table is now added to the WordPad document.
- To resize your table, select it, grab the corner and holding down the shift key drag it to the required size.
- Place your cursor at the bottom right-hand side of the table and press the Enter key a few times. This is to leave a few empty lines between the table and the graph which you are now going to paste into WordPad.
- Minimize WordPad.
- In a similar manner paste the graph into Wordpad.
- Resize the graph.

Text can now be added to form the basis of a report. This report may be printed from within WordPad.

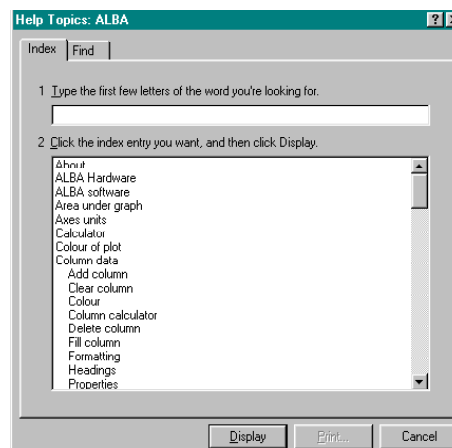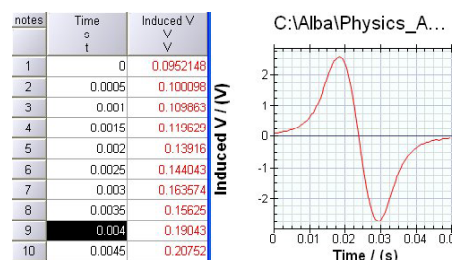Close WordPad since you are now finished with it.

Figure 42

Figure 43

Figure 44

Figure 45

17

Printing a Graph or Table

If you wish to print a graph from within the ALBA software then:
- Select the graph which you wish to print.
- Select *Page Setup* from the *File* menu.
- The position on the page where the graph will be printed is adjusted by changing the numbers in the four boxes in the Margins panel. Change 'Bottom' to 120.
- Select *Print* from the *File* menu.

To print all the data in the Table select *Print* from the *File menu.* Alternatively you may print part of the Table as a graphic in WordPad (see previous part of this tutorial).

Gradient

- From the *Table* menu select *New Table* and make it 21 rows and 2 columns.
- Select the first column then from the *Table* menu select *Fill Column.*
- Set the start value=0 and the step value=1.
- Using the Column Properties replace c1 with the variable 'x' .
- De-select column x and select column c2.
- Using the Column calculator fill this column with x^2 and change the variable name to 'y'.
- Draw a quick graph (Figure 46).
- Click on the graph to select the plot.
- From the *Graph Tools* menu select *Extract Gradients.* This tool calculates the gradient at each point and places the result in a separate table (Figure 47).
- Using this new table draw a Quick Graph.

This should be a straight line through the origin with a gradient of 2. The program calculates the gradient at a point by looking at the data before and after the point. As values of the data set beyond the end points are unknown the program makes an estimate of the gradients at the end points and the estimates are greyed out. You may change the 'ignore' to 'use', if you think these values are good estimates. Note that the x co-ordinate of first and last point have been changed to give the best approximation.

The best way of reducing the end point error is to have the interval between the x values as small as possible.

Pasting and Copying Data

Select the column of Gradients.

Select *Copy* from the *Edit* menu.

Click on the first table and select *Paste As New* from the *Edit* menu. This pastes the column of gradients into the original table (Figure 48). It is possible to paste parts of columns into a new table and also to move the positions of columns around within a table.

If you use *Paste* rather than *Paste as New* then the the position in the column(s) where the data is to be pasted must be selected first e.g. if you are copying five x,y values then five rows from the two columns must be selected first then copied. The position in the new table must be selected i.e. five rows and two columns then select *Paste* to place the data in the required position in the table.
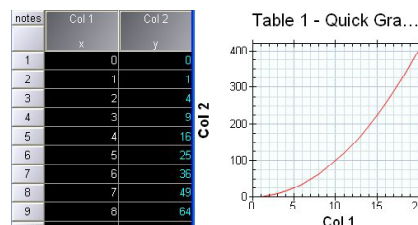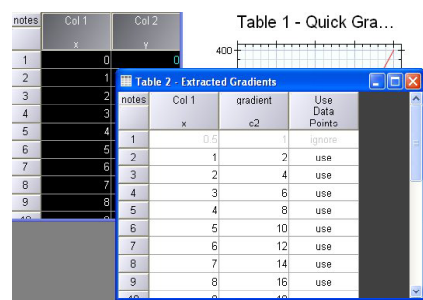

Figure 46

Figure 47

Figure 48

Area

You should still have the gradient graph available to you from the previous work.
- Click on the Gradient graph plot to select it.
- Select *Extract Areas* from the *Graph Tools* menu.
- Select the *Absolute area*.

What you have done is start with a parabola $y=x^2$, differentiated it, then integrated these results to arrive back where you started. Comparing the first table with this one you will see slight differences caused by the end point approximations.

Suggestions for Graph Plotting

The ALBA software has been designed for ease of use. Drawing a graph takes literally three mouse clicks. This makes it easy for pupils to examine their data. However two situations can arise where some thought is required before drawing a graph. The following discussion should clarify how to handle these situations.

Consider the table shown in Figure 49. Selecting columns d and t1 then clicking *Quick Graph* will put the variable 'd' on the x-axis. The left most selected column is always the x-axis. If you require to have 'd' on the y-axis then select *Axes Ranges* tab in the *Edit Graph* dialogue box. Click *Swap X and Y axes*.

Note that this only works if the table has two columns selected.

Now consider the situation where there are three columns of data and the middle column has to become the x-axis (Figure 50). This is easily handled by :
- Copy column 'd'.
- Select *Paste As New* from the *Edit* menu. Column 'd' data is now pasted into an additional column in the table (Figure 51).
- Select column 'd' then from the *Table* menu select *Remove Column(s)*.
- Using the Column Properties change the variable name in the end column from c4 to 'd'.

Note that the shortcut keys <Ctrl '+' C> and <Ctrl '-' V> for 'copy' and 'paste' may be used to speed up the above process.

You can now draw graphs with t1 on the x-axis.

It is also possible to create a blank table by selecting *New Table* from the *Table* menu. You can now paste columns of data into this table in any order.

Showing the Origin

To show the origin of a graph click the *Show Origin* icon or select *Show Origin* from the *Graph* menu. This is particularly useful when 'best fit' lines have to be extended back to see if they pass through the origin.

End of Tutorial 4.

notes	d	t1
1	U	U
2	1	2
3	2	4
4	3	6
5	4	8
6	5	10
7	6	12
8	7	14
9	8	16
10	9	18

Figure 49

notes	d	t1	t2
1	0	0	0
2	1	2	4
3	2	4	8
4	3	6	12
5	4	8	16
6	5	10	20
7	6	12	24
8	7	14	28
9	8	16	32
10	9	18	36

Figure 50

notes	d	t1	t2	c4
1	0	0	0	0
2	1	2	4	1
3	2	4	8	2
4	3	6	12	3
5	4	8	16	4
6	5	10	20	5
7	6	12	24	6
8	7	14	28	7
9	8	16	32	8
10	9	18	36	9

Figure 51

Tutorial 5

This tutorial covers: Running an Application, Stopping an Experiment, Using the Investigator, Applying a Calibration, File Names and Editing the Student Notes.

This tutorial requires the use of hardware. If you do not have the required hardware then follow the text below to get a feeling for the steps involved in running an Application.

Running an Application

For this tutorial you will require the following:
- 1K resistor, 1000μF and 470μF capacitors
- push switch, 3V battery
- ALBA with USB lead.

If you have djb microtech's Capacitor Investigations board then use it instead of discrete components.

Connect the USB cable to The ALBA Interface and Logger and the other end to your PC.

If you have arrived here directly from Tutorial 4 then close the ALBA software. Click on the ALBA icon on your desktop to load the program. The first thing the program does is to look and see if ALBA is connected and if it does not find it then it displays a dialogue box (Figure52).
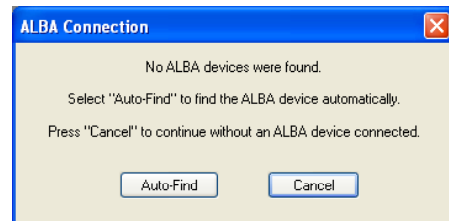

Figure 52

Should the software have problems finding the ALBA Interface and Logger ensure that the USB cable is connected then try resetting the Interface. To reset ALBA hold down the Reset switch, press and release the GO switch. Finally release the Reset switch. If reset fails then reload the ALBA software and try again.

Load the Application 'Capacitor Charging Voltage'.
From the *Experiment* menu select *Teacher's Notes*.
The password is **JohnLogieBaird** (no spaces and case not important) – the famous inventor and pioneer of television. The Teachers' Notes in each Application will have this password. These notes are suggestions regarding use of apparatus and possible teaching points.
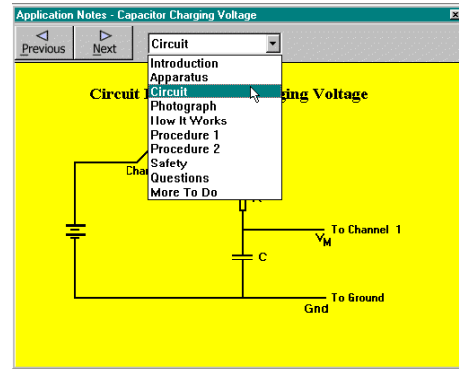

Figure 53

From the *Experiment* menu select *Notes*. Examine them and set up your circuit using the diagram (Figure 53).

When you are ready to begin, select *Run Experiment* from the *Experiment* menu.
Follow the instructions on the screen. Note that the pressing of the switch S_{RD} is just to rapidly discharge the capacitor.

Note that the Green LED is on when the ALBA Interface and Logger is waiting for the trigger voltage to be reached.

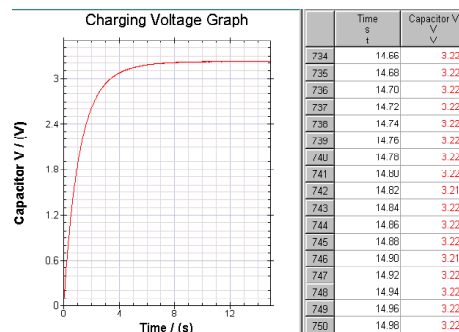You should now have a Table and Graph of a charging capacitor (Figure 54).

Figure 54

Repeat the experiment using a smaller value capacitor (Figure 55).

Using your previous experience overlay the graphs by selecting the Time and Voltage columns in each table.
Explore changing:
- the colours of the graphs
- the number format in the Tables
- the Table Headings,
- naming your graph
- Zoom.

If you are unsure of any of the above then refer back to previous tutorials or use the Help.
Note that when you repeat an experiment the results of the first experiment are minimized.

When your students use this package they are totally sheltered from any setting up of the ALBA Interface. The number of readings, logging interval, trigger level etc are all transparent to the user. In this way students ought to obtain a set of results relatively quickly and from these results the Physics can be studied.

You may explore the other Applications which are supplied with the package.

Stopping an experiment

To stop an experiment before all the readings are taken, select *Stop Run* from the *Experiment* menu or click the *STOP* icon. The data which has already been captured will not be lost by stopping an experiment early.
If ALBA is reset during data capture and it is connected to the PC then data will be lost.

Calibrating a Sensor

Channels 3 and 4 are for self-identifying sensors. Connect a temperature sensor to channel 3. From the *Experiment* Menu select *Calibration Manager*.
Select *New* (Figure 56).
If you were calibrating a homemade sensor or a Philip Harris Blue Box sensor, which would be connected to channel 1 or 2, you would specify the voltage range. This information is not required for self-identifying sensors. Click OK (Figure 57).
Give your calibration a name (Temperature Demo) and enter the units (Figure 58).
Prepare three beakers of water (cold, tepid and hot) and a thermometer. Put the temperature sensor and thermometer into the first beaker of water. Enter the thermometer reading and click 'Take Measurement'. Repeat for the other two beakers. You should end up with a Table similar to that in Figure 59.
Select a linear fit and you will see the equation of the fit displayed in the box on your graph.
The following points should be noted:
- If you have more than two points then you will have the option of fitting a straight line or a quadratic. The sensors supported by djb microtech are designed to be linear.
- It is now possible to have a one point calibration. It is assumed that zero volts corresponds to zero on your sensor's scale. Where possible use two or more points for calibration.
- The file 'Calibration.cal' contains all of the calibrations for the Calibration Manager. This may be copied between computers if required. Alternatively, importing/exporting allows single calibrations to be exchanged between computers.
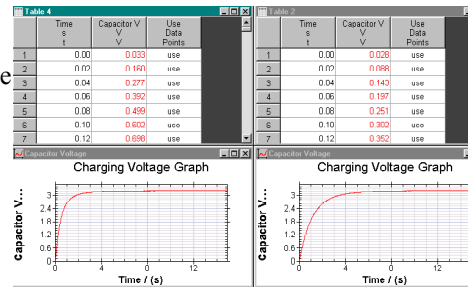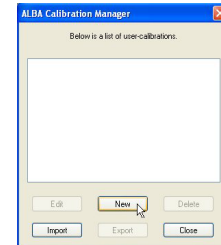You will learn how to apply the calibration in the next section.
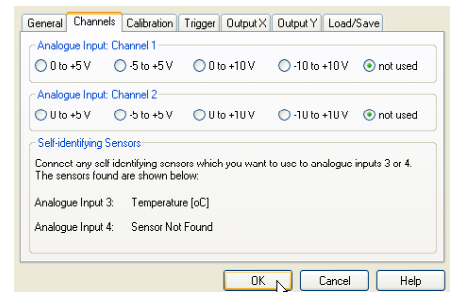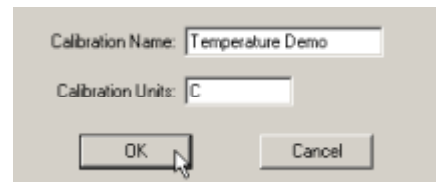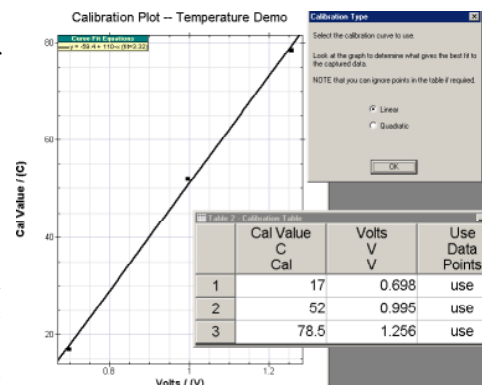

Figure 55

Figure 56

Figure 57

Figure 58

Figure 59

21

Using the Investigator

This is an open-ended application which enables students to set up their own experiments with direct control over logging interval, channel, range, trigger etc.

To examine how to set up the Investigator connect a temperature sensor to channel 3. You will set up the Investigator to log at 0.5s intervals and to start logging after the temperature has increased by 0.5°C

From the *Investigator* menu select *Setup and Go*

You have to make a number of choices. Click on each Tab in turn and look at the choices available to you when designing the data capture for your experiment.

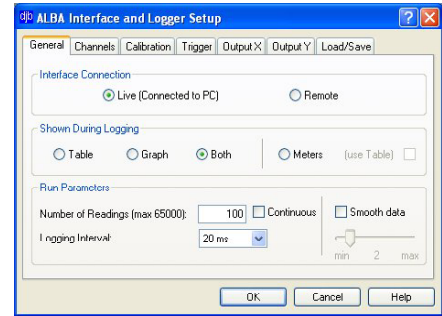Click on the General tab to select it (Figure 60).

Figure 60

Interface connection

Select the *Live* button because you are going to gather data with the ALBA Interface and Logger connected to your PC.

Shown during logging

This option lets you choose how you wish the results of your experiment to be displayed. Note that if you select *Graph* to display your results, a table will also be available to you should you require it. However the table will be minimised during data capture.

Select '*Both*'.

Number of readings

The *Number of Readings* available to you depends on the number of channels being used, the type of logging, the logging period and the speed of data capture. Set the number of readings to 120.

The maximum number of readings that can be entered is 65,000. If more readings are required then use the Continuous Logging option - see below.
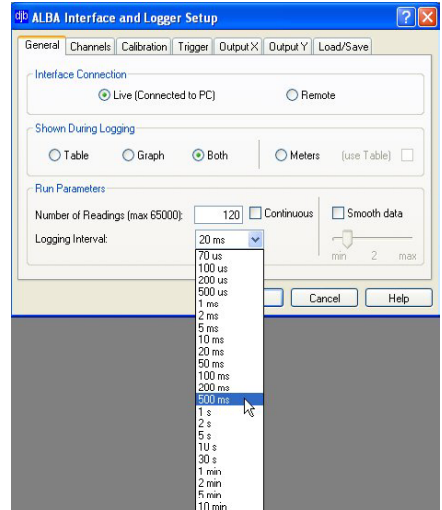

Figure 61

Continuous Logging

If you are uncertain about the number of readings that you require then select 'Continuous'. When you have sufficient readings you can click the 'Stop' icon. The maximum number of readings is limited by the size of your computer's RAM. Over one million readings have been successfully logged.

Logging Interval

The Logging interval is the time between readings.

Set the logging interval to 500ms (Figure 61).

Selecting channels - Select the *Channels* Tab.

The software identifies the sensor connected to channels 3 or 4 (Figure 62). If using channels 1 or 2 always use the smallest range possible. Do not use a bipolar range if it is not required. In this way more accurate readings will be obtained.
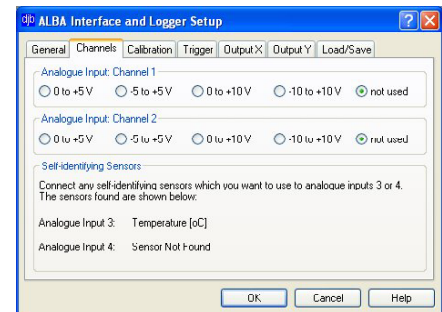

Figure 62

Trigger selection - Select the *Trigger* Tab (Figure 63)

There are two types of trigger that can start ALBA gathering data:

(1) An analogue trigger

The analogue trigger channel may be any of the channels in use.

Logging will commence if:

the input on the trigger channel is greater than or less than a desired value, or

the input increases or decreases by a desired value.

(2) A digital trigger

Logging will commence if:

the selected digital input channel (A or B) is at the required logic level.

Using this type of trigger, a switch can be used to start the data capture.
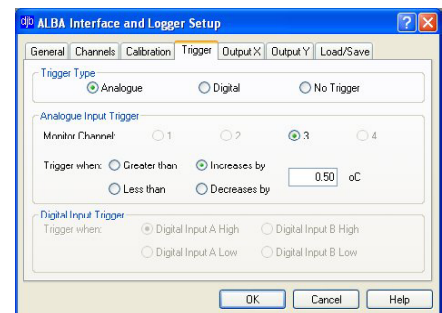

Figure 63

Trigger selection contd.

Set up the Analogue trigger as shown in Figure 63 so that when the temperature increases by 0.5°C then data capture will commence.
By setting the trigger this way it means that you do not need to know the exact temperature at the start - as long as it increases by 0.5°C.

Controlling the Outputs - Select the *Output X* Tab
When the logging period is greater than or equal to 10ms then the digital outputs can be controlled by the value of the voltage on an analogue channel. Note that when controlling the outputs the minimum logging period is dependent on the number of channels selected.
In order to see how to use the control feature you will set outputs X and Y to go on and off at specific temperatures.

If the temperature on analogue input 3 is greater than 30°C then set output X high and do not latch it (Figure 64).

Select the *Output Y* Tab
If the temperature on analogue input 3 is less than 20°C then set output Y high and do not latch it (Figure 65).

Review all of your settings and when you are satisfied with them select OK.

In preparation for testing your settings obtain a beaker of hot water and one of cold water.

Load/Save Settings
The settings that you have selected may be Saved by clicking the Save button (Figure 66). Saved setups will have the file extension 'set'. If a channel has had a calibration assigned to it then this information is not saved.
Previously saved settings may be loaded by clicking the Load button.

Investigator Table headings

This screen lets you enter the name, unit, symbol and colour for each column.
To change the name of a channel, select it by dragging over it and once highlighted type your text.
All columns must have a unique symbol. This enables each column to be used by the calculator.
The colour used to fill a column in the Table will also be used to draw any graphs that use the column on the y-axis.
Enter the information shown in Figure 67.
When you select OK a blank table and graph will be set up for you.
You are now ready to run your experiment.
Press GO to start the data capture - the green GO LED will come on because the software is waiting for a trigger - an increase in temperature of 0.5°C. Hold the temperature probe in your hand to start the data capture. Place the temperature sensor in the hot and cold water to test the switching of outputs X & Y.
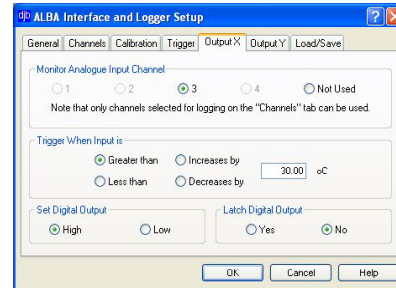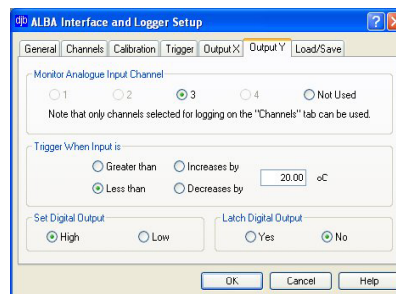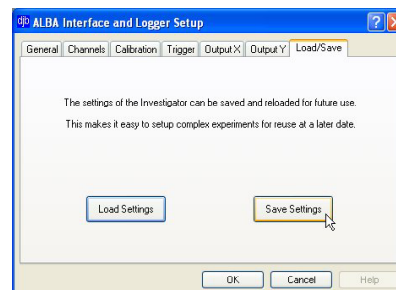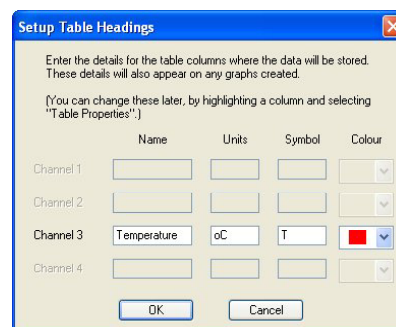

Figure 64

Figure 65

Figure 66

Figure 67

Applying a Calibration

Keep the temperature probe connected to channel 3.

Click on the *General* Tab and set up the Investigator to take 20 readings at 1 second intervals.

Click on the *Channels* Tab and you will see that the Investigator knows that a temperature sensor is connected. Ensure that channels 1 and 2 are not used (Figure 68).

Now select the *Calibration* Tab (Figure 69) and check *Use* box. In this case the drop down box has only one calibration which is the *Temperature Demo*. This is the calibration that you generated previously in this tutorial.

If you now click OK and complete the *Table Headings* dialogue box, your data will be displayed having had the selected calibration applied to it.

If you wished to use four temperature sensors then you would have to connect our Sensor Extension Unit to channels 1 & 2. Sensors on these channels can have the Factory Calibration assigned (Figure 70). Alternatively if No Calibration (the default) is selected then you can apply your own calibration. To do this click in the *Use* box and then select your calibration from the drop down menu.

Note that the appropriate voltage range for the sensor would have to be selected using the Channels Tab. All djb sensors have a 0-5V output.
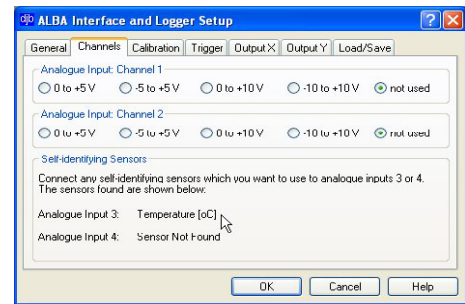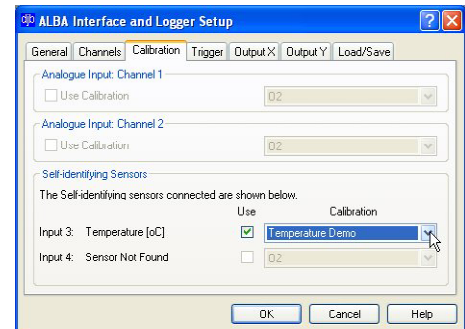
Remote Logging

The ALBA Interface and Logger can be used to gather data remotely (i.e. not connected to the PC) using the Investigator program. Connect a temperature sensor to channel 3.

Click the 'General' tab and select the Remote button. With Remote logging there is no Ouput control or trigger facilities. The Logging interval may be 100ms or greater.

Set up ALBA :

   • Remote logging on channel 3
   • 60 readings at 1 second intervals (Figure 71).

Once ALBA has been set up remove the USB cable. Now connect your ALBA Portable USB Power Supply.

When you are ready to start the remote logging hold down the GO switch until the green LED comes on and then release the GO switch. Remote logging has now started and the LED will flash approximately every second to indicate that data capture is in progress. (The green LED always flashes at the same rate no matter how quickly or slowly the data is being captured.) When the data capture is finished the LED stops flashing. You may reset ALBA and start the experiment again. Note that this will overwrite any previously stored data. When data capture is finished the power to the unit may be removed with no loss of data.

Normally remote data capture would be used with slowly varying analogue quantities like temperature.

If at any time you wish to stop the data capture early then Reset ALBA. The data which is already stored will be retained and may be extracted later. Note that the remote logging setup will be retained indefinitely until over written. This means that next time the unit is brought out of the cupboard and powered, holding down the GO button will start the remote logging.

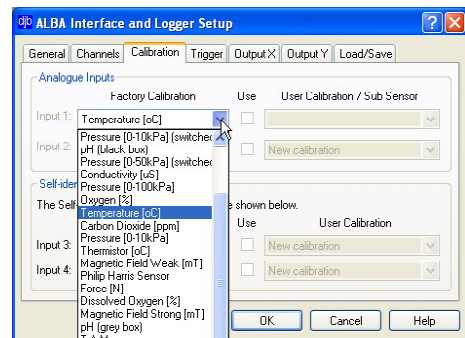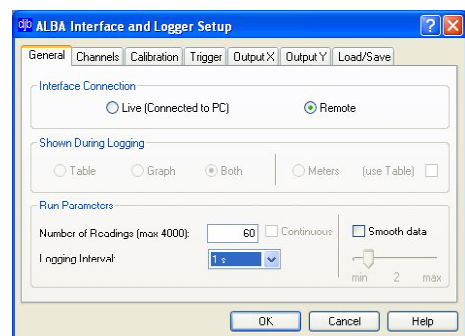The Remote Logger can store 4000 readings on one channel or 2000 on two channels.

Figure 68

Figure 69

Figure 70

Figure 71

Retrieving Remote Data

The following steps should be carried out to retrieve data which has been captured remotely:

- Connect the USB cable.
- Launch the ALBA software.
- From the *Investigator* menu select *Extract Remote Data*

Sensors

Inputs A and B are for connecting digital sensors e.g. sound switches and light gates.

Inputs 1 and 2 are the analogue inputs and these may come from any analogue sensor producing a voltage which can be connected to the 4mm sockets.

Inputs 3 and 4 are for self-identifying sensors which have a calibration associated with them e.g. temperature sensor and linear light sensor.

When a sensor is connected to input 3 or 4, ALBA automatically recognizes it and will use the calibration for that sensor.

File Names

Figure 72 shows where the Applications are stored and Figure 73 shows the typical structure within an Application.

The file extensions used are:

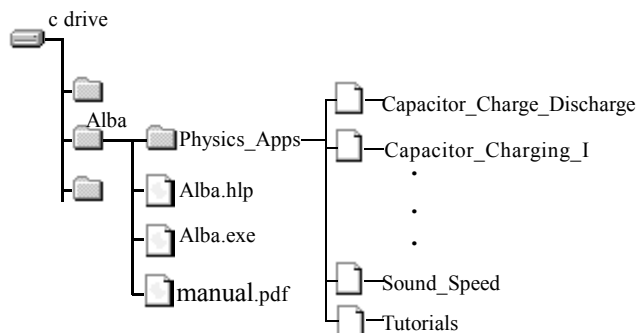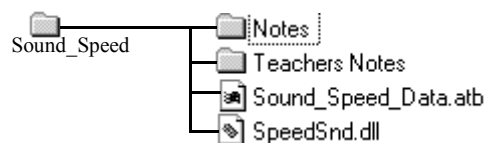|	
rtf	rich text file: Student and Teacher notes
bmp	graphics file: Student and Teacher notes
atb	ALBA Table: Saved Table data
dll	ALBA Application
exe	the main ALBA program
pdf	Adobe Acrobat® version of the manual
aiv	internal ALBA program
cal	user's calibration data
set	user's saved ALBA Investigator setups

It is strongly recommended that before you start using ALBA with any classes that you give some thought to where data files for each class will be stored.

Figure 72

Figure 73

25

Editing the Notes

The Notes for the student may be edited thus enabling you to tailor any Application to your own style of teaching and the department's apparatus.

Changing the Text

A special file is supplied for you to practise editing.

From the *File* menu select *Load Application*. Load the *Tutorial* Application in the Physics section (Figure 74).

Select Notes (Figure 75) from the Experiment menu and examine the notes which you are going to edit. Close ALBA by clicking on the Close button on the top right of the window.

Before changing a page in an Application you must know the name of the page. To see the page name navigate to the folder *Notes* in the *Trial* directory - do this by opening the ALBA folder in your C drive and clicking on the following folders: *Physics_Apps, Tutorials, Trial* and double click *Notes* to give a list of its contents. The files with the extension rtf are the ones that you can edit (Figure 76). You may not be able to see the file extensions if this feature has been switched off in Windows. The other way to identify these files is by the document icon. Double click on '1Intro.rtf' - this should open the file in Microsoft Word® if it is on your computer or in Wordpad which is supplied with Windows. (If it fails to open, load your wordprocessor then load the file.) Add some text and save when you are finished. The file **must** be saved with the same name and file type. In a similar way you can edit the other text pages. To see the results run the ALBA software, load the Application 'Tutorial' and examine the Notes.

Changing a Photograph

This is achieved in a similar way to changing text.

Identify the photograph which you wish to change, write down its name, then delete it from the folder.

The replacement photograph must be a standard Windows bitmap; 256 colours or 24 bit colour and the same size as the one it is replacing.

Give the replacement photograph exactly the same name as the old one. Note that photographs have the file extension bmp.

Copy the photograph into the Application folder.

You cannot remove a page from an Application. You can only replace it or leave it blank.

Pages may contain text or a graphic but not both.
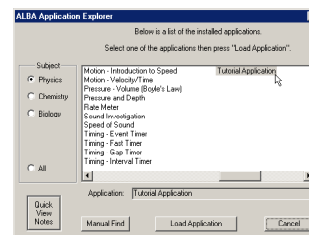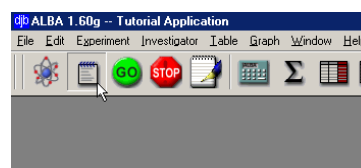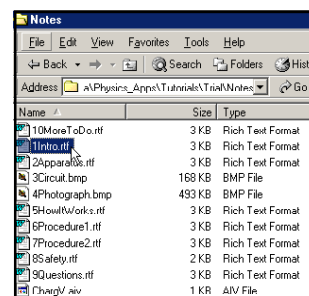
End of Tutorial 5.

Figure 74

Figure 75

Figure 76

Tutorial 6 - Other Features

This Tutorial enables the user to explore some additional features of the ALBA Core. It is assumed that the user is familiar with the content of the previous Tutorials.

Connect the USB cable from your PC to the ALBA Interface and Logger then launch the ALBA software.

Column Formula and Auto Calculate
From the *Table* menu select *New Table.* Change the number of rows to 10 and the columns to 2 then click OK.
Click on the first column to select it then select *Fill Column* from the *Table* menu. Make the Start Value=1 and the Step Value=2 then click OK.
Deselect Column 1 then select the second Column and click on the *Column Calculator* icon. Enter the formula '3*c1^2' and click on the *Auto Calculate* box. Now click OK.
Change the Column headings so that they are the same as those in Figure 77.
Select the second column and click on the Column Calculator icon again. Note that the formula is displayed in the calculator window and that the change in the column 1 variable from c1 to x is reflected in the formula (Figure 78).

Double click on the '9' in the first column, drag over it to highlight it then change it to '10'. When you press the return key the value in the second column is automatically updated.
If a column has Auto Calculate selected then, when a value is changed anywhere in a Table **the whole Table is re-calculated**. Autocalculate cannot be used in certain situations where a column references itself. Suppose that you had a column c2 where you wished to replace all the values in this column by the original value plus one. You enter the formula c2+1 and tick Auto Calculate. This would be an example of a column referencing itself and in cases like this a warning message would be displayed.
If you are pasting data between tables turn Auto Calculate off.

Sort
From the Table menu select Add Row(s) and add two rows to your Table. Scroll to the first blank cell in column 1 and double click on it then enter a value of 0.5. Enter the text 'Demo' in the blank cell below. It is a good idea when gathering experimental data to note starting conditions, parameters etc at the bottom of the Table. Any text is ignored when performing calculations (Figure 79).
Click on the column 1 to select it then select *Sort* from the *Table* menu. Explore the choices available to you to see the effect on the data.
Note that instead of writing text at the bottom of a column of data you can click on the *notes* button at the top left of the Table. This opens up a window and you can write a note to yourself. This note will be saved with the table.

Graph Panning
When you have finished investigating the Sort facility remove the two rows which were added. Select both columns and draw a graph. Zoom in on the origin of the graph. Now, with your cursor over the graph, hold down the Ctrl key - the cursor changes to a small hand - drag with the left mouse button held down. Note that your graph scrolls.
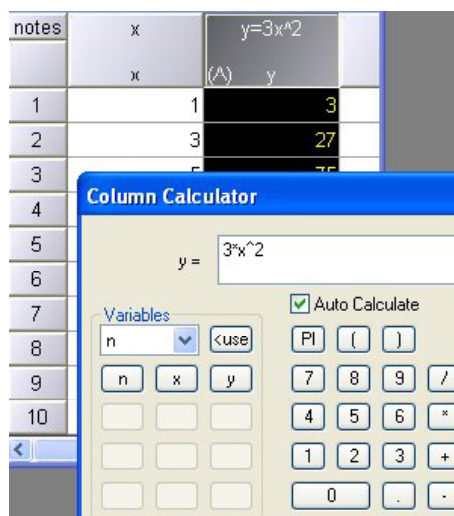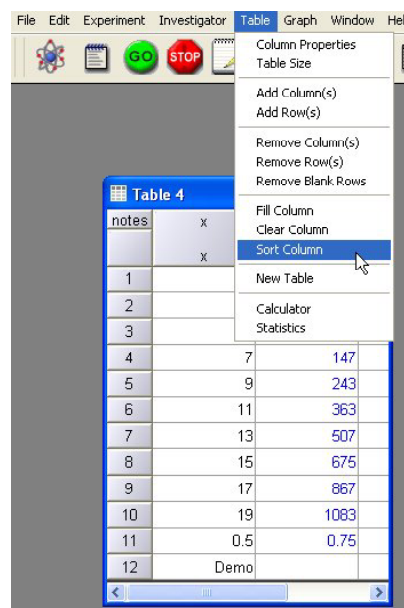

Figure 77

Figure 78

Figure 79

Drag and Drop

Select *Load Application* from the *File* menu.

Double click on 'Capacitors - Charge and Discharge'. Note that you no longer have to click the Load Application button. Reduce the size of the ALBA window. Open Windows Explorer, navigate to the ALBA folder and open the Capacitor - Charge and Discharge folder. Drag the data file Cap_Charge_Discharge_Data.atb into the ALBA window.
The Table is displayed with the path name in the title bar.

Useful Menu Items

If you wish to remove all the open Tables and Graphs then select *Close All* from the *Windows* menu. Note that minimized Tables will also be removed.

If you have several Tables open you can tidy the screen by selecting *Minimise All* from the *Windows* menu.

Figure 80

Analogue Meter Display

Select the *General* Tab in the Investigator. Click *Live, Meters* and *use Table* (Figure 80). Connect two sensors to channels 3 and 4 then select the *Channels* Tab. Click OK then enter names and symbols for your sensors (Figure 81). Select the number of decimal places for the digital display and if you require smoothing click the box and adjust the slide bar to a suitable position (Figure82). Note that smoothing applies to the digital display only and not to the data in the Table. Smoothing is achieved by taking a running average. The table is updated every 50 ms. To stop the display click the *STOP* icon on the toolbar. The maximum number of readings is imited only by the RAM size.

While data capture is in progress:

> • a Table may be minimized and the meter display re-sized
> • two or more columns in the Table may be selected and
>   the *Graph* icon clicked to display a graph.

Repeat the above but this time do not click *use Table*. Two meters will fill your screen. This is an excellent way of checking your sensors before starting an experiment.

Figure 81

Gradient Smoothing

A dialogue box has been added which allows users to smooth the values when extracting gradients from graphs (Figure83). This could be useful if you have noisy data.
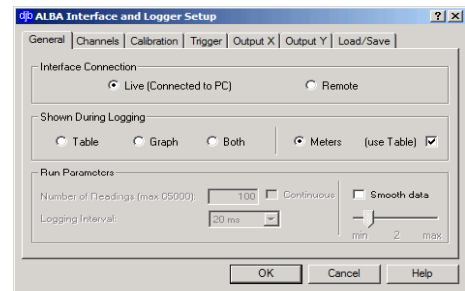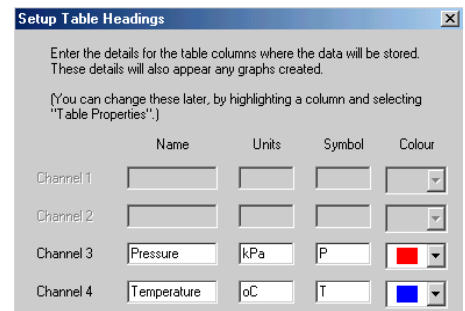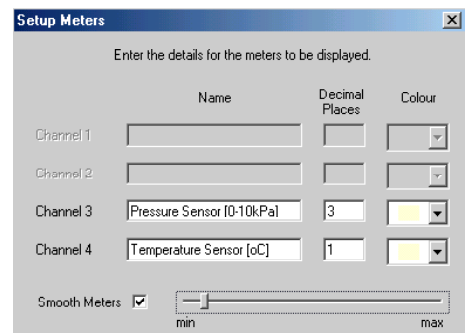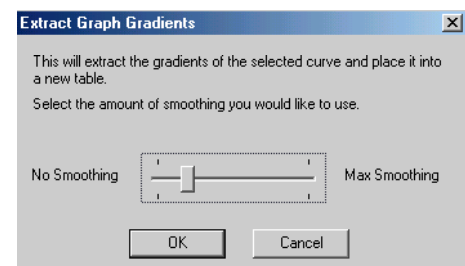

Figure 82

Figure 83

Fitting a Curve to a Subset of the Data

This allows you to fit a curve to part of a graph i.e. a subset of your data. From the *Table* Menu select *New Table* and enter the numbers shown in Figure 84.

Draw a graph (Figure 85). Notice that the graph has two distinct sections. The following steps enable you to fit a straight line to each section in turn:

- Click on the Graph window to select the plot.
- Decide what kind of fit you are going to do and from the *Graph* Menu select *Tools* and then *Best Fit Line* (in this case). The best fit line is shown in Figure 86.
- Now hold down the shift key and the left mouse button and notice that the cursor changes to a small box. Position the cursor just below the origin and drag the cursor so that there is a rectangular box over the first section of the curve then let go of the mouse button (Figure 87). A straight line will be fitted to the points that lie within the selected range (Figure 88).
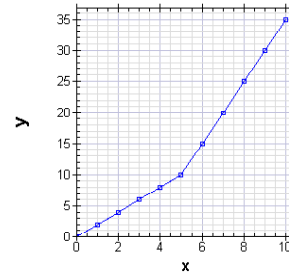
The equation of the line is shown in the usual place. In a similar fashion you can find the gradient of the second section.

When you are finished you must select *Remove Fit* from the *Graph Tools* Menu.
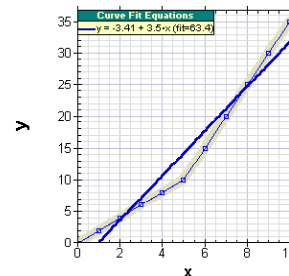
Note:
- You can still zoom when you are fitting a section of a curve.
- You are not restricted to a linear fit.

Using the ALBA Explorer Window to View the Notes

Figure 89 shows the new ALBA Explorer window. Clicking the Quick View Notes button lets you examine the contents of the Student Notes of a selected file. If the Application Explorer window is selected then using the up/down arrow keys lets you quickly view the Introduction for each application.
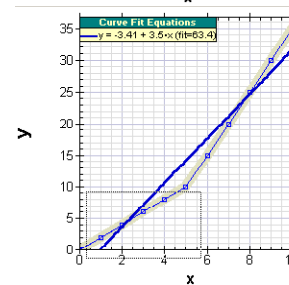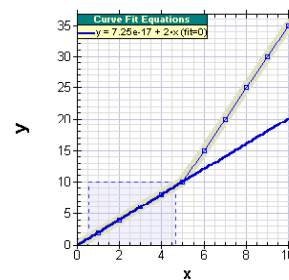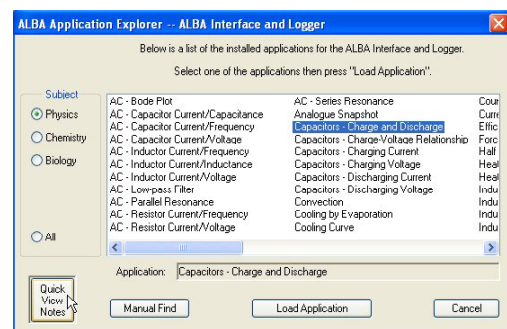

Figure 84

Figure 85

Figure 86

Figure 87

Figure 88

Figure 89

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Graph Digitiser

The Digitiser enables you to put selected points from your Graph into a separate Table.
Consider the graph in Figure 90.
Suppose that you require to fit an envelope equation. To do this select *Tools* from the *Graph* menu then select *Digitiser*. Click on the points of interest (Figure 91).

When you select the close button a Table (Figure 92) containing your points will be displayed. You can then proceed to analyse your new data set (Figure 93).

Import/Export of Data

To import data from other Applications such as Microsoft's Excel, first save the data as text (Tab delimited) (*.txt) then close the workbook. Now run the ALBA software and select *Import Table* from the *File* menu. Note that only numeric data is imported – all headings must be added manually to the imported Table.

To export the data in the Table, select *Export* from the *File* menu. The data is saved as a text file which can then be imported into Excel as Tab delimited data.

Table Notes

Selecting the Notes button at the top left hand side of the Table opens a window where you can write notes about your experiment (Figure 94). To close the Notes window select the Close button at the top right of the window.

Printing a Table

There are several ways of printing a Table:

• Select the Table then select *Print* from the *File* menu. If you have previously selected the Notes button at the top left hand side of the window then anything typed here will be printed out at the top of your Table.

• Export the Table to Excel and print the data from within Excel.

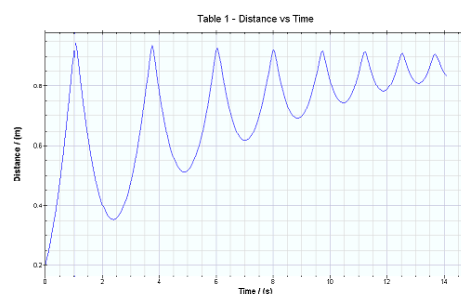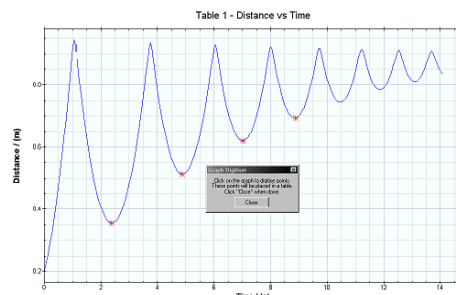• If it is a small table it can be printed as a graphic from within WordPad.

Figure 90

Figure 91

Figure 92

Figure 93

Figure 94

djb microtech
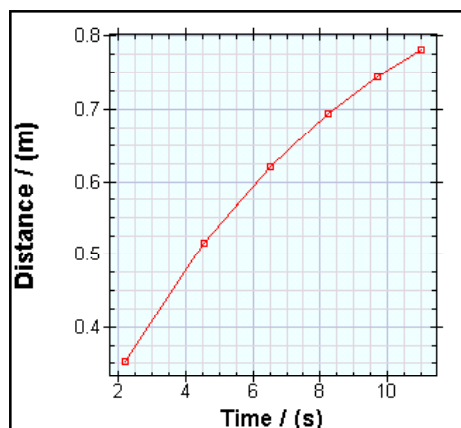
Running Multiple Instances of the ALBA Software

It is possible to run up to eight copies of the ALBA Software on the one computer thus enabling more complex experiments to be performed e.g. the Power-Energy-Cost Meter and an ALBA interface could both be connected to the same PC. The temperature rise of water could be logged as well as the energy supplied.

Any combinations of currently supported ALBA hardware may be used e.g. the ALBA Interface, the A & D range of Electronic Balances, the ALBA Ranger and the *Power-Energy-Cost* Meter.

Note that any combination of USB ports and/or serial ports with or without a USB/serial converter lead may be used. The steps below show how to set up two instances of the ALBA software - one with a light sensor and the other with an Electronic Balance - this could be the setup for a transpiration experiment in Biology.

Step 1: Ensure that all hardware is properly powered and connected to your PC.

Step 2: Hold down the Ctrl key while launching the ALBA Software from the Start Menu. Note that launching from the Start menu is recommended as opposed to clicking on the ALBA desktop icon.

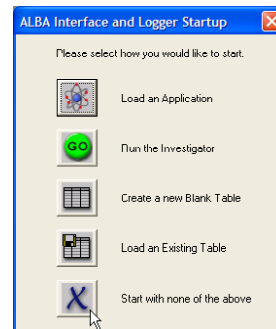**Step 3**: Select the icon *Start with none of the above* - Figure 95.

Figure 95

Step 4: Click the Restore Down icon (middle icon at the top right of window) and resize the window so that it fills the top half of the screen - Figure 96.
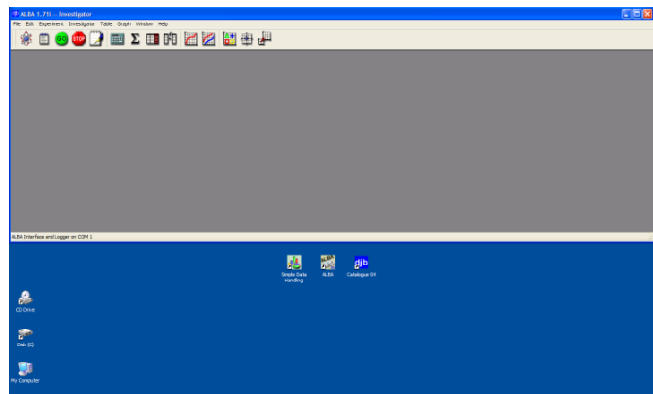

Figure 96

Step 5: Hold down the Ctrl key and launch a second instance of the ALBA Software.The first time you launch a second instance the software will ask you to select what ComPort you are using – select Autofind. Now Select the icon *Start with none of the above* then resize the window to fill the lower part of the screen - Figure 97.
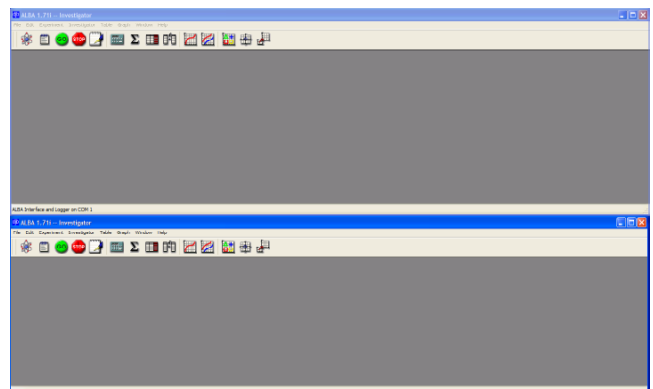

Figure 97

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Step 6: Click in the top window to select it then click the GO icon to set up the Investigator. Continue setting up the Investigator until you get to the screen that requires you to press GO to start the data capture. Do not press GO yet if you wish both instances of the software to start at the same time. The two screen-shots below show the setup for the light sensor - Figures 98 & 99.
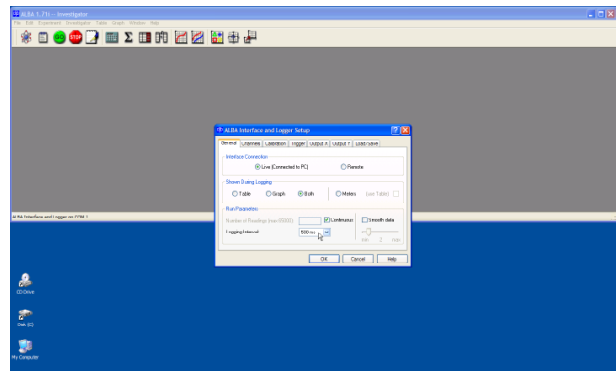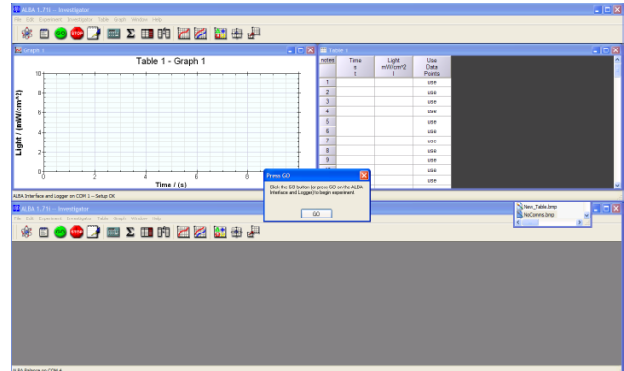

Figure 98

Figure 99

Step 7: Click in the lower window to select it. Now click the GO icon and set up Balance Software - Figure 100.
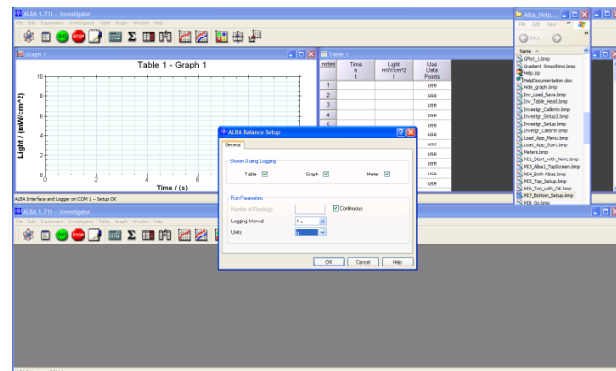
Figure 100

Step 8: Click the Go, Figure 101. Both instances of the software will start the data capture at the same time.
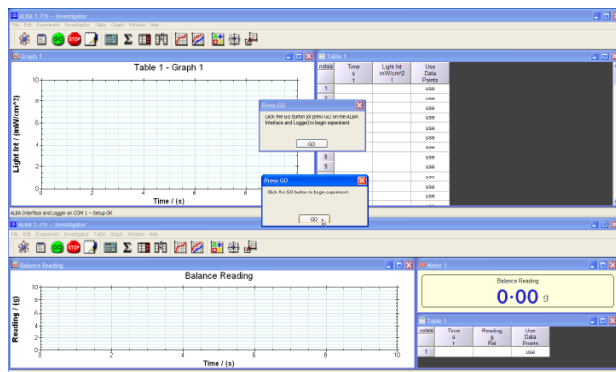
Step 9: When the experiment is finished click the Stop icon in both windows and save your results. Both Tables may be loaded into the one instance of the ALBA software. Columns may be copied and pasted between Tables; graphs overlayed where appropriate etc.

Figure 101

Troubleshooting

No power at switch on
Check that the USB lead is connected to ALBA and your PC and that your PC is switched on.
Check the 300mA internal fuse. To do this, remove the four screws from the base and gently lift up the top. The fuse is situated at the front right hand side of ALBA. Remove the fuse and if it is faulty replace it.
If you are experiencing difficulties with remote logging then check the batteries in the exteral portable power supply.

Unable to communicate with ALBA
Check that the USB cable is connected to the host and to ALBA.
Disconnect the USB cable from ALBA and close the software. Now reconnect the USB cable to ALBA and restart the software.

Experiment will not start
If an experiment will not start it could be that the trigger conditions are not satisfied. If this is the case the GO LED will be on. If you are using the Investigator, check the setting of your trigger. If you are running an Application then check your circuit/hardware.

Additional ALBA Hardware

The ALBA Interface and Logger is currently supported with the following sensors from djb microtech:
- Digital   Light Gate, Sound switch, Timing Plate, P.E.T. (these units also work with TSA), GM Tube.
- Analogue   Temperature, Light, Pressure, Energy, Power, Force, pH, Conductivity, Oxgygen gas, Dissolved Oxygen, Carbon dioxide, Heart Rate, Respiration, Skin temperature, Muscle fatigue, Spirometer, Biofermenter control.

This range of sensors will grow.
In addition to the above sensors the Unilab alpha boards could be used for digital triggering of the analogue data capture. They can also be driven by the output from ALBA. This offers some interesting possibilities for experimenting. Note that the Philip Harris 'Blue Box' sensors can be connected directly to the 4mm inputs.
Boards for studying AC Investigations, Internal Resistance and DC Inductors are also available - see our website for details.
The hardware listed below also uses the ALBA software:
The ALBA Ranger: an ultrasonic measuring device
The *Power – Energy – Cost* Meter: displays RMS Voltage, Current and Power of mains appliances as well as cost, running cost, energy and time.
A&D Electronic Balance

The Future

The ALBA Interface and Logger with its Applications software has the potential for being a major force in supporting the Science curriculum.

djb microtech wants to get this software just right for you and your students. Should you encounter problems it would be helpful if you could email or fax the information to us.
If your LEA have software requirements which are not currently being met and you feel that this Applications approach could help, then please contact us.

All updates to the ALBA core software will be placed on the website for you to download. In this way you can stay abreast of developments to the software without incurring additional costs.
As the software is updated new versions of this manual, which can be read with Adobe's Acrobat Reader, can be downloaded from our website. A copy of the Acrobat Reader is supplied on the CD-ROM.

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