

**Control & Instrumentation Principles
Installation and Commissioning Manual
33-033-1C**

 **Feedback**



Electricity & Electronics



Control & Instrumentation



Process Control



Mechatronics



Telecommunications



Electrical Power & Machines

Technology Training for tomorrow's world



Control & Instrumentation Principles

Installation and Commissioning Manual

33-033-IC



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Notes



CONTROL & INSTRUMENTATION PRINCIPLES INSTALLATION AND COMMISSIONING MANUAL

Preface

THE HEALTH AND SAFETY AT WORK ACT 1974

We are required under the Health and Safety at Work Act 1974, to make available to users of this equipment certain information regarding its safe use.+

The equipment, when used in normal or prescribed applications within the parameters set for its mechanical and electrical performance, should not cause any danger or hazard to health or safety if normal engineering practices are observed and they are used in accordance with the instructions supplied.

If, in specific cases, circumstances exist in which a potential hazard may be brought about by careless or improper use, these will be pointed out and the necessary precautions emphasised.

While we provide the fullest possible user information relating to the proper use of this equipment, if there is any doubt whatsoever about any aspect, the user should contact the Product Safety Officer at Feedback Instruments Limited, Crowborough.

This equipment should not be used by inexperienced users unless they are under supervision.

We are required by European Directives to indicate on our equipment panels certain areas and warnings that require attention by the user. These have been indicated in the specified way by yellow labels with black printing, the meaning of any labels that may be fixed to the instrument are shown below:



CAUTION -
RISK OF
DANGER



CAUTION -
RISK OF
ELECTRIC SHOCK



CAUTION -
ELECTROSTATIC
SENSITIVE DEVICE

Refer to accompanying documents

PRODUCT IMPROVEMENTS

We maintain a policy of continuous product improvement by incorporating the latest developments and components into our equipment, even up to the time of dispatch.

All major changes are incorporated into up-dated editions of our manuals and this manual was believed to be correct at the time of printing. However, some product changes which do not affect the instructional capability of the equipment, may not be included until it is necessary to incorporate other significant changes.

COMPONENT REPLACEMENT

Where components are of a 'Safety Critical' nature, i.e. all components involved with the supply or carrying of voltages at supply potential or higher, these must be replaced with components of equal international safety approval in order to maintain full equipment safety.

In order to maintain compliance with international directives, all replacement components should be identical to those originally supplied.

Any component may be ordered direct from Feedback or its agents by quoting the following information:

- | | |
|------------------------|----------------------------|
| 1. Equipment type | 2. Component value |
| 3. Component reference | 4. Equipment serial number |

Components can often be replaced by alternatives available locally, however we cannot therefore guarantee continued performance either to published specification or compliance with international standards.



CONTROL & INSTRUMENTATION PRINCIPLES INSTALLATION AND COMMISSIONING MANUAL

Preface

OPERATING CONDITIONS

WARNING:

This equipment must not be used in conditions of condensing humidity.

This equipment is designed to operate under the following conditions:

Operating Temperature	10°C to 40°C (50°F to 104°F)
Humidity	10% to 90% (non-condensing)

CE DECLARATION CONCERNING ELECTROMAGNETIC COMPATIBILITY

Should this equipment be used outside the classroom, laboratory study area or similar such place for which it is designed and sold then Feedback Instruments Ltd hereby states that conformity with the protection requirements of the European Community Electromagnetic Compatibility Directive (89/336/EEC) may be invalidated and could lead to prosecution.

This equipment, when operated in accordance with the supplied documentation, does not cause electromagnetic disturbance outside its immediate electromagnetic environment.

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1 General Information

1.1 Equipment Required

To operate the 33-033 Control & Instrumentation Principles trainer you will require:

- The Mechanical Unit 33-100
- Control & Instrumentation Principles workboard 33-125
- The Discovery Software
- A PC running Windows 2000, XP or Vista with two USB sockets available.

IMPORTANT NOTE:

It is important that all software packages and components are installed **BEFORE** any USB hardware is connected and switched on.

Connecting the USB hardware before installing the software causes 'unknown device' messages to be displayed, since the computer will not know of the USB devices.

If the hardware has been connected by accident, it should be uninstalled as follows:

1. From the 'Start' menu select 'Settings' → 'Control Panel' → 'System'.
2. Access the 'Device Manager' utility.
3. Select 'View' → 'Devices by type'.
4. In the Device Manager tree expand the 'Other devices' entry and select the 'USB Device' entry that has a question mark icon.
5. Right click on the entry and select 'Uninstall' (or 'Remove') and click OK.

Disconnect the USB hardware and reboot the computer.

Install the appropriate software and reconnect the USB hardware to a different USB port.

When the computer is switched on, a normal 'connection process' will occur.

This procedure is appropriate to the Windows XP operating system; however, it may differ for other operating systems



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**Chapter 1
General Information**

Notes



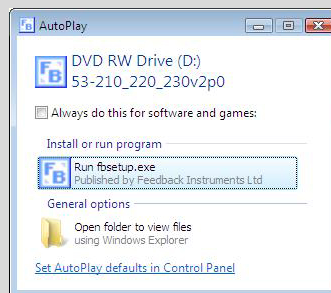
2 Installing the Discovery Software

2.1 Getting Started

The following instructions and illustrations are for Windows XP based systems (except where noted) and generally apply to any of the products in the Discovery range. There may be minor variations for other operating systems.

If you have a 33-100 Mechanical Unit and 33-125 workboard connected to your computer, make sure that they are disconnected before you begin the software installation. Installing the software will take several minutes on each computer. When you are ready to begin, insert the Discovery installation CD into the CD-ROM drive of your computer.

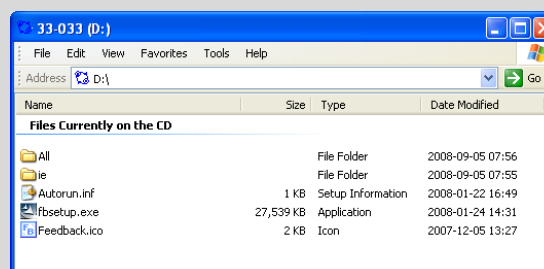
If you are using the Vista operating system, you may be prompted to run the setup program 'fbsetup.exe'. Typically the dialog will look similar to this:



This is because Vista has more stringent security than its predecessors. If you see a dialog similar to this, you should select the **Run fbsetup.exe** option.

The 'InstallShield Wizard' should now launch.

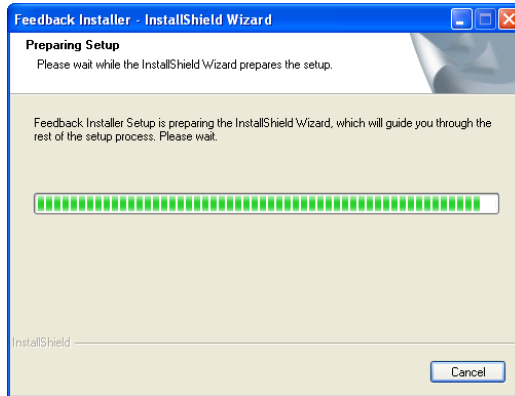
If nothing happens after inserting the CD then the AutoPlay feature has probably been disabled on your computer. If this is the case, you should open an explorer window and browse to your CD drive. You should see a window similar to this:



Locate and open the file named **fbsetup.exe** to manually launch the setup program. Vista users will be prompted to confirm this action.

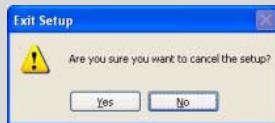


The 'InstallShield Wizard' will guide you through the setup process.



You can abort the setup at this stage by selecting the **Cancel** button.

If you select the **Cancel** button, you will be prompted to confirm this action.



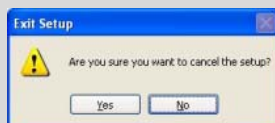
Select **No** to resume the installation or **Yes** to quit the setup program.

Next, the Licence Agreement dialog will be displayed.



You can abort the setup at this stage by selecting the **Cancel** button.

If you select the **Cancel** button, you will be prompted to confirm this action.



Select **No** to resume the setup. If you select **Yes**, the next dialog will verify that the



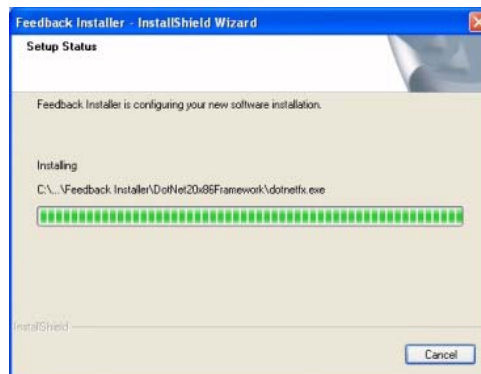
'InstallShield Wizard' has completed without having modified your system.



After aborting the setup, you must select the **Finish** button to quit the setup program.

Select the **Print** button if you prefer to read a paper copy of the agreement. After reading the agreement, you should select whether or not you accept it. You can proceed with the installation only after you have accepted the terms of the licence agreement. You will then be able to select the **Next** button.

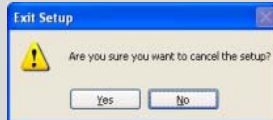
You may briefly see a progress dialog similar to this:



You can abort the setup at this stage by selecting the **Cancel** button.



If you select the **Cancel** button, you will be prompted to confirm this action.



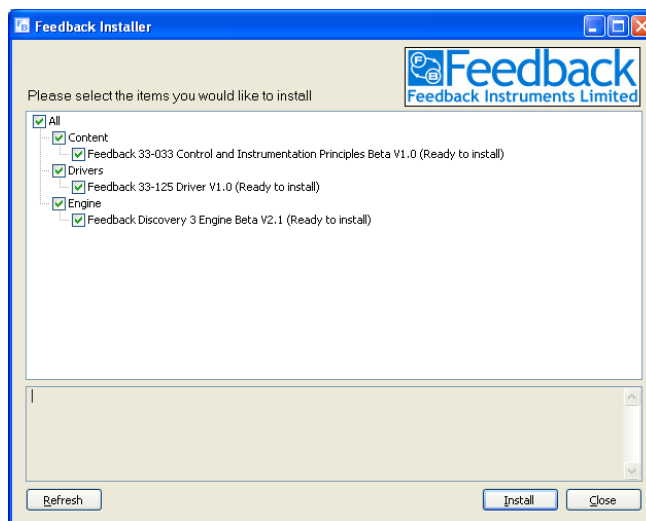
Select **No** to resume the setup. If you select **Yes**, the next dialog will verify that the 'InstallShield Wizard' has completed without having modified your system.



After aborting the setup, you must select the **Finish** button to quit the setup.

2.2 Using the Program Installation Manager

After launching the setup program, the program installation manager dialog will appear on the screen for the remainder of the setup, until you select its **Close** button.



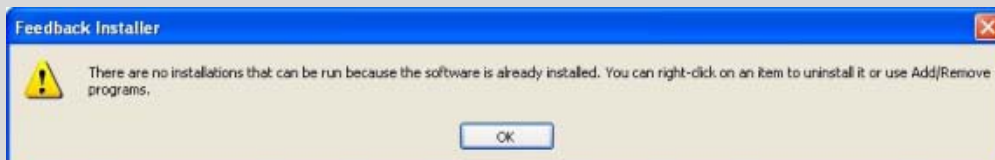
Note that this dialog has two main panels, one above the other.



- The upper (white) panel contains a list of items, any of which you can select to install or uninstall. Items which can be installed are shown in black text, and items that are already installed are shown in grey text. The **Refresh** button forces an immediate update of this panel (useful if you change anything externally, i.e. not by way of this setup program).
- The lower (grey) panel is initially blank, but will display various status messages as subsequent actions are performed. You will be able to review those messages by using the scroll bar on the right-hand side of this panel.

By default, every item that can be installed will have a tick mark shown in the relevant check box in the upper panel. Each item that has a tick mark will be installed in turn after you select the **Install** button. If you prefer not to install a specific item at this time, you should un-tick its check box (you will be able to install items later by running the setup program again).

When you run the setup program again, items that have previously been installed will be shown in grey text. If all of the available items on the CD are already installed, then a message will advise you that no installations can be run.



If you see this message then you will only be able to uninstall items (as described on the next page) or quit the setup program, but you must first click the **OK** button before you can continue.

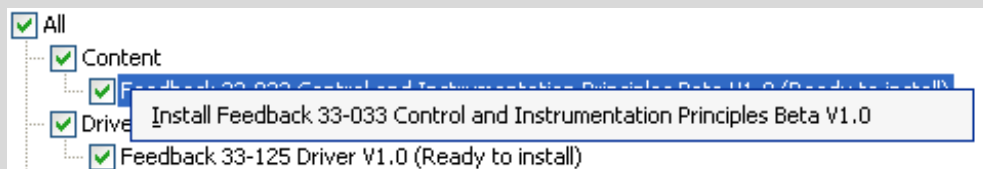
The software is divided into 3 groups, shown in the upper panel. The **Content** contains the course material for each product. **Drivers** are necessary to support the hardware (i.e. the workboard) that is used with each Discovery product. The **Engine** is necessary to be able to use any of the Discovery products.

Ticking a group box will select all the installable items in that group. Ticking the top-level **All** box will select all the installable items in all the groups.

You may load any, or all, of the software items from the setup disk. However, only the software related to the workboards that you have will be fully operational and allow you to perform practical work.

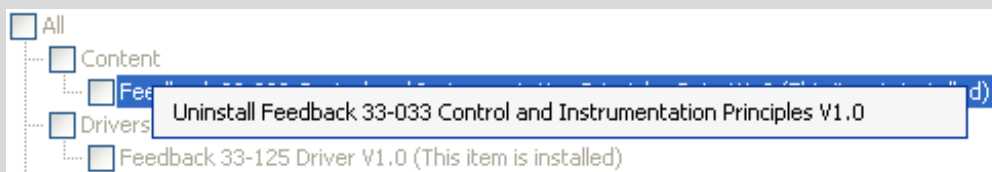


If you wish to install only one item at his time, you can right-click on its black text. It does not matter whether or not the item is ticked. A pop-up menu will appear, which enables you to install just that item.



For each item you install this way, you will be prompted to accept the licence agreement again. It is therefore preferable to use the **Install** button, especially when installing multiple items, because the licence agreement is then suppressed.

If you want to uninstall an item, you can right-click on its grey text. A pop-up menu will appear, which enables you to uninstall that item. Only one item can be removed at a time. It is not possible to uninstall multiple items.



Alternatively, you can use 'Add or Remove Programs' in your Windows Control Panel to uninstall Discovery programs.

Warning!

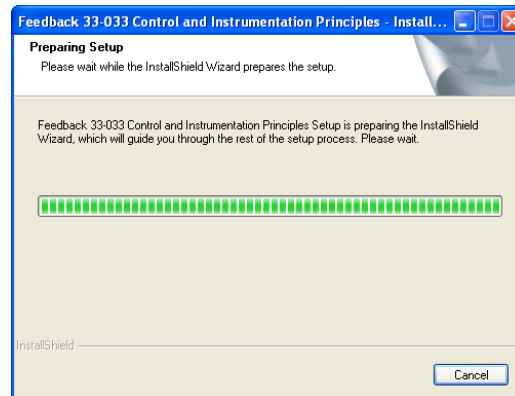
When you uninstall the content from a server or a stand alone machine, the files that were originally installed in the product's folder on that computer will be deleted, including any course material that you have modified (files that you have created will not be deleted). Therefore it is recommended that you back-up a product folder before uninstalling its content. This does not apply to client machines, since they only have short-cuts to files that are located elsewhere, on a server.

If an earlier version of Discovery is installed on your computer, the previous version will be identified and the text will be shown in red. The software will automatically be updated when you install the new version; you do not need to uninstall the old version first.

After selecting which of the items you want, click the **Install** button (or the appropriate right-click menu option to install or uninstall a single item, as described above).

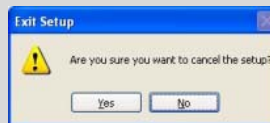


You may briefly see a progress dialog (remember, if you are installing a single item by using a right-click menu option, you will first be presented with a licence agreement).



You can abort an install or uninstall at this stage by selecting the **Cancel** button.

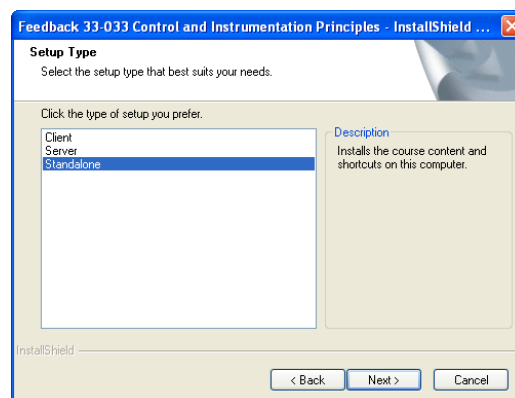
If you select the **Cancel** button, you will be prompted to confirm this action. If you were installing several items, you will cancel only those items that have not yet been installed.



Select **No** to resume the setup or **Yes** to return to the program installation manager.

2.3 Selecting the Setup Type

Discovery software can be used in stand alone, network and intranet environments. If you are installing new content (as would normally be the case in a new installation) then the next dialog will prompt you to specify which type of setup is required for this computer.

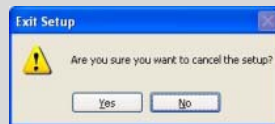


Note that you will only see this dialog if you are installing course content. If you are not installing any content at this time then you can skip to section 2.4.

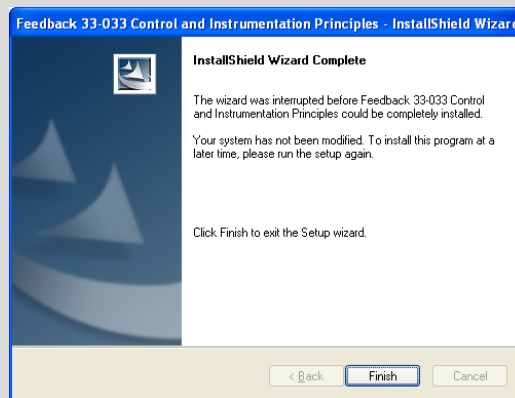


You can abort an install at this stage by selecting the **Cancel** button.

If you select the **Cancel** button, you will be prompted to confirm this action.



Select **No** to resume the setup. If you select **Yes**, the next dialog will verify that the 'InstallShield Wizard' has completed without having modified your system. If you were installing several items, you will cancel only those items that have not yet been installed.



After aborting the installation, you must select the **Finish** button to return to the program installation manager.

Select **Client** for each computer in a network that should have short-cuts to the course content, but the course files will be stored on a server. In order for the appropriate short-cuts to be created, you must have ticked the relevant Content boxes in the program installation manager. The drivers and engine must be installed on each client. On a client machine, the software can be started either using an icon on the desktop of that computer, or by using the Programs menu via the Windows start button.

Select **Server** for the single computer in a network on which the course content is to be stored, but will be accessed only from short-cuts on each of the client computers. It is not necessary to install the drivers and engine on a server. The software will be installed in a folder named **[drive]:\Program Files\Feeback Instruments\D3** on the server.

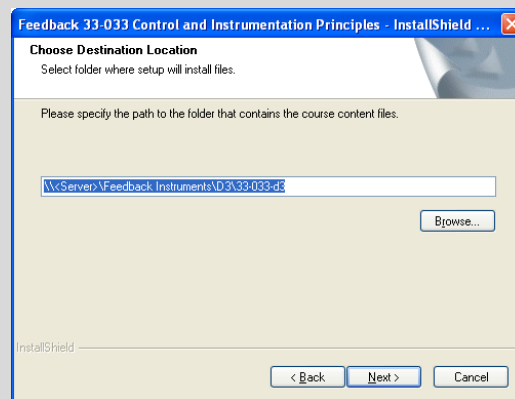
Select **Standalone** for a computer that will run independently of any other computer or network. A stand alone machine must have the drivers and engine, and will also contain the course content with short-cuts to it. On a stand alone machine, the software can be started either using an icon on the desktop of the computer, or by using the Programs menu via the Windows start button. The software will be installed in a folder named **[drive]:\Program Files\Feeback Instruments\D3** on the stand alone machine.



Consider a network environment where the course content will be kept on a server. If you intend to manage the courseware using the server machine itself, it is recommended that you select the **Standalone** option in order to install everything you will need on that server. Otherwise, if you intend to manage the courseware from a client machine, you should select the **Client** option to install just the components you need on the client machine, and the **Server** option to install just the course content on the server machine.

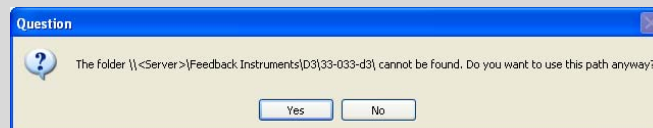
After selecting the setup option that is suitable for this computer, select the **Next** button.

If you have selected the Client setup, you will now be prompted to specify the path to the folder on the server containing the course content files for the product being installed.



If you are installing several Discovery-based products, you will be prompted to repeat this for each product for which you are installing course content. This will configure a short-cut on the client computer to the course content on the server for each Discovery product.

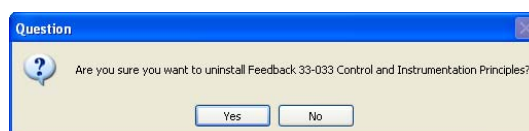
A warning will be displayed if the path you specify is invalid (for instance, if you have not yet installed the course content on the server).



You will need to respond to this dialog and then take corrective action.

2.4 Finishing the Setup

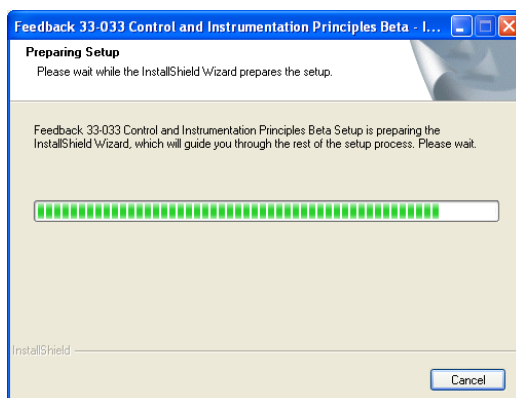
If you have chosen to uninstall an item, you will now be prompted to confirm that option.





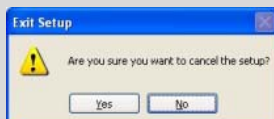
Select **Yes** to proceed or **No** to return to the program installation manager.

The 'InstallShield Wizard' will now prepare to install (or uninstall) the selected files on the computer. You may briefly see a progress dialog.



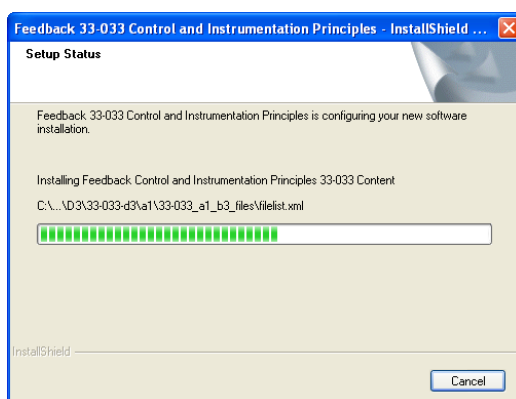
You can abort an install at this stage by selecting the **Cancel** button.

If you select the **Cancel** button, you will be prompted to confirm this action. If you were installing several items, you will cancel only those items that have not yet been installed.



Select **No** to resume the installation or **Yes** to return to the program installation manager.

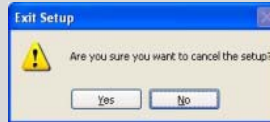
You may briefly see a progress dialog while files are being added or removed.



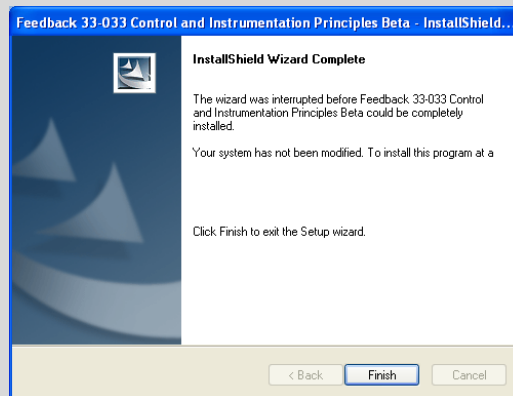
You can abort an install at this stage by selecting the **Cancel** button.



If you select the **Cancel** button, you will be prompted to confirm this action.

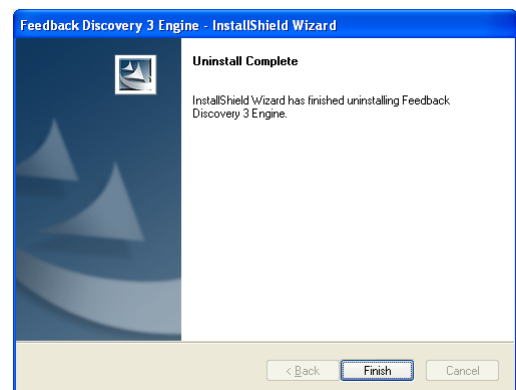
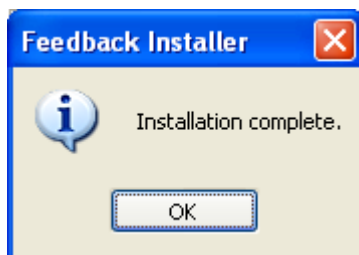


Select **No** to resume the setup. If you select **Yes**, the next dialog will verify that the 'InstallShield Wizard' has completed without having modified your system. If you were installing several items, you will cancel only those items that have not yet been installed.



After aborting the installation, you must select the **Finish** button to return to the program installation manager.

When the setup has finished, a dialog box will confirm that the task is complete. Which of the following dialogs appears will depend on whether items have been installed or uninstalled on the computer:

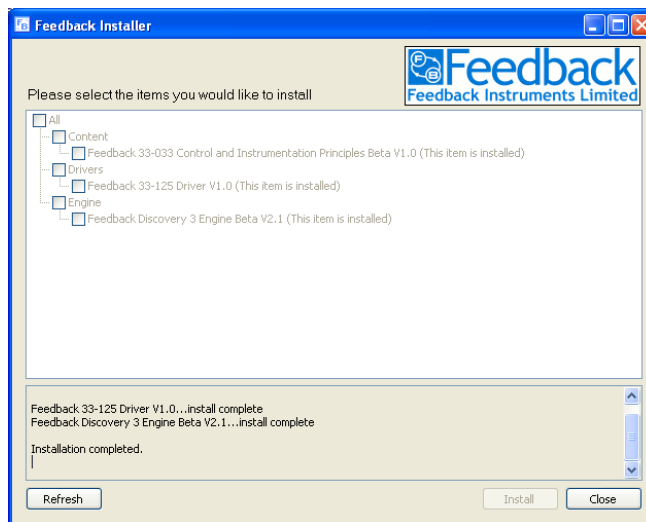


You must select the **OK** button (installed items dialog) or **Finish** button (uninstalled items dialog) to return to the program installation manager dialog.



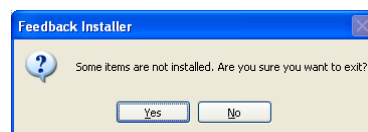
The selected software (contents, drivers and engine) and program short-cuts (where appropriate) have now been added (or removed) on this computer.

After a few seconds, the program installation manager will be updated. You can then review the status messages shown in the lower panel of the dialog.



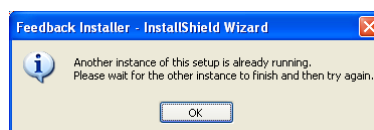
You can continue to add or remove software, as previously described, or quit the setup program by selecting the **Close** button.

In the event that any installable items are not installed, you will be notified (this will happen if you un-ticked one or more of the items that were available to install, or if you have uninstalled any items).



Select **Yes** to quit the setup program or **No** to return to the program installation manager.

You may run the setup program as often as you wish to add or remove software. However, if you attempt to launch the setup program again while it is still running, a message will warn you that you can run only one instance of the program at any time.



If you see this message then you must select the **OK** button.



3 The Workboard

3.1 Description

A 33-125 workboard is shown in Figure 3-1. It contains a number of circuit blocks that may be interconnected in many ways to demonstrate control and instrumentation principles.

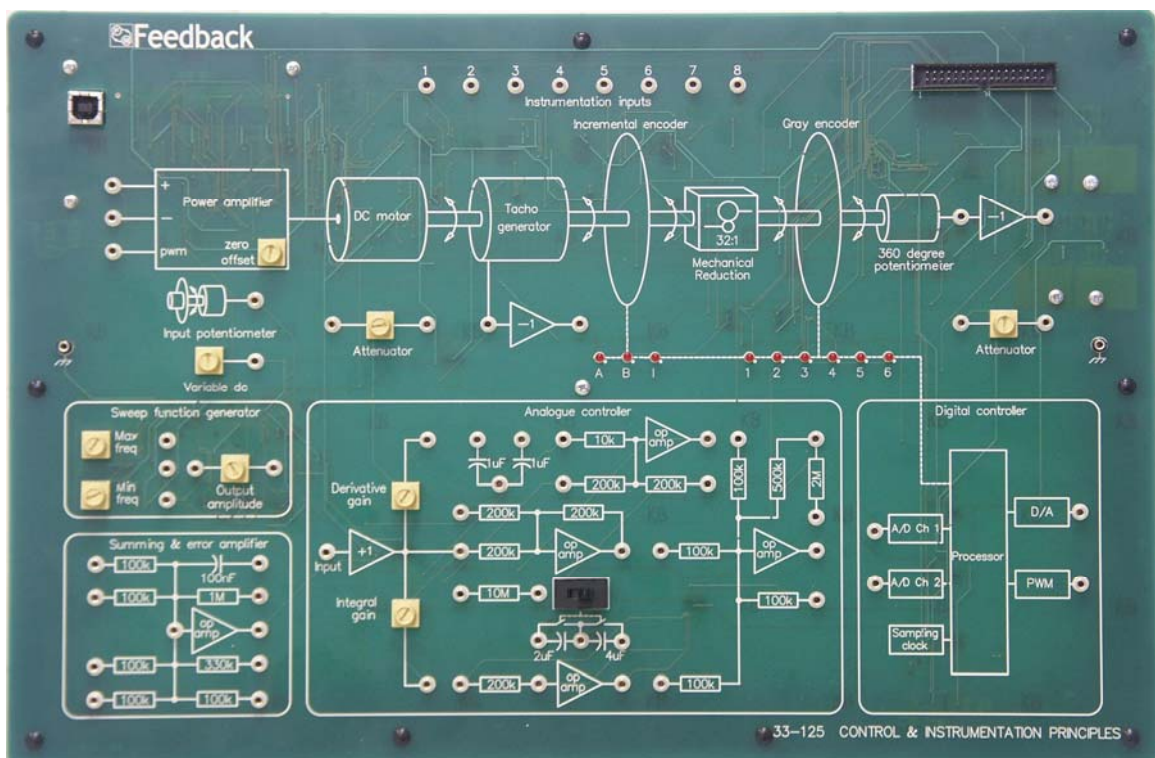


Figure 3-1: A 33-125 workboard

The 33-125 Workboard is designed to operate with the 33-100 Mechanical Unit, and with a personal computer (not supplied). The instrumentation required by the assignments is provided by the Discovery program on the PC.

Interconnection between the various circuit blocks on the workboard is by 2 mm, stackable patchleads. It is recommended that no more than two leads be stacked, as more than this is mechanically vulnerable and can lead to damage of the lead or the workboard.



3.2 Connecting to a PC and Mechanical Unit

The following description will familiarise you with the connections required to operate a 33-125 Workboard.

Identify the multiway connector at the top right-hand side of the workboard as indicated in Figure 3-2. A ribbon cable is plugged into this connector and into its counterpart connector on the rear of the Mechanical Unit.

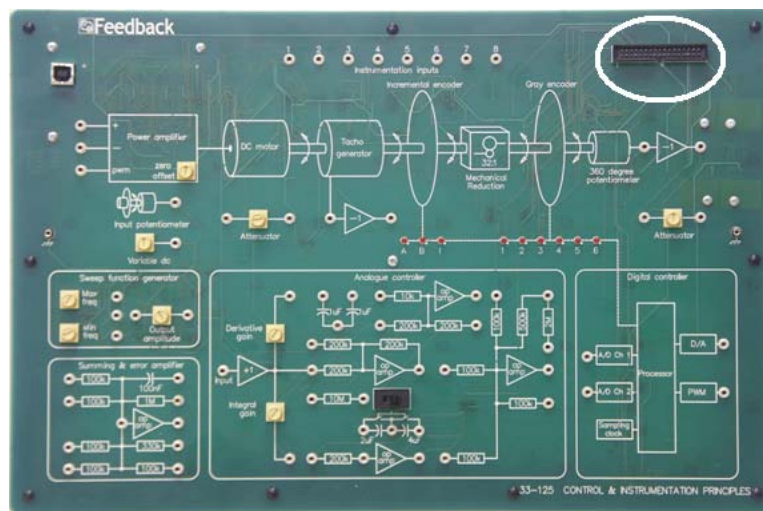


Figure 3-2: Workboard Multiway Connector Location

Figure 3-3 shows the workboard plugged into a Mechanical Unit and a laptop PC.



Figure 3-3: Workboard, Mechanical Unit and PC Connection

The workboard requires USB connection to the PC via the socket at the top left-hand side of the board. The USB port on the PC may be USB1 or USB2.



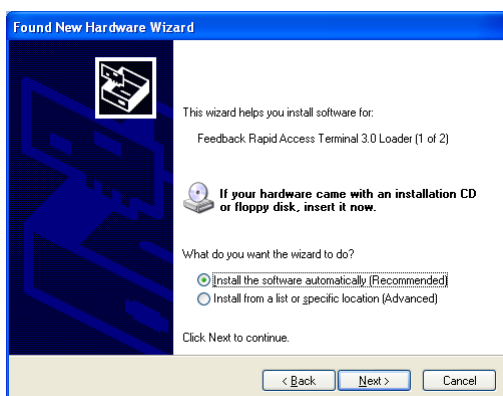
For correct operation the PC must have the relevant Discovery software installed. If it does not, you will need to refer to Chapter 2 'Installing Discovery Software'. When the software has been installed you can then connect the hardware to the computer. It is recommended that you follow this sequence:

1. Connect the workboard to the Mechanical Unit, but do not switch on the power.
2. Connect the workboard to computer with the USB cable.
3. Switch on the power to the Mechanical Unit.

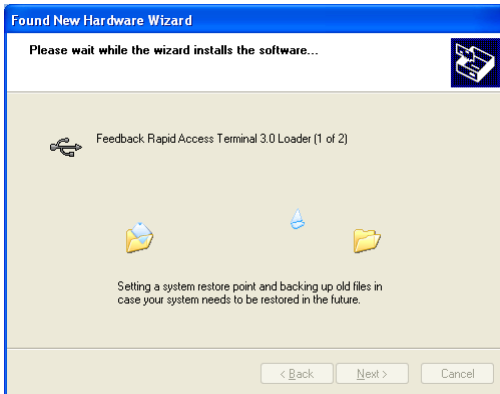
When you connect a workboard for the first time, the computer will report that it has found new hardware for which you will be prompted to provide the software. Windows needs to match the device driver to the hardware. Assuming you have already installed the driver as described in Chapter 2, you simply need to respond to the 'Found New Hardware Wizard' dialogs as follows. These instructions and illustrations are typical for Windows XP based systems and Discovery hardware. There may be minor variations for your system.



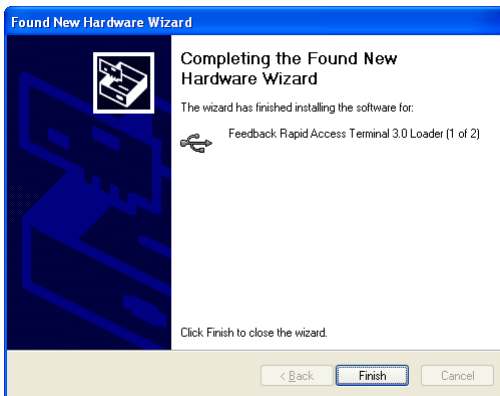
On the first dialog, select the **No, not this time** option and then select the **Next** button.



On the next dialog, select the **Install the software automatically (Recommended)** option and then select the **Next** button (it is not necessary to insert the installation CD).



The next dialog will appear briefly and asks you to wait while the software is being installed.



On the final dialog, select the **Finish** button.

If the Discovery software and the hardware have been installed correctly, the hardware should now be recognised automatically on subsequent switch-on and the system will be ready for use.

It is recommended that you always use the same USB port when you next set up the equipment. Otherwise, Windows will report that it has found new hardware and you will be prompted to install the device driver again as described above. This is because drivers are matched to specific USB ports. When you install a new USB device, it is installed to use a specific USB port (not the others). If you unplug it and then plug it into a different USB port, Windows reports that new hardware has been found and will launch the 'Found New Hardware Wizard'; the software is already on the PC, but Windows still needs to match the drivers to the USB port being used.



4 Operational Check

This section describes a very simple operational check to confirm that the PC, the Mechanical Unit and the workboard are communicating with each other and that the set-up is ready to perform an assignment.

Ensure that you have installed the software and connected the equipment as described in the preceding sections.

Ensure that the PC is switched on.

Launch the Discovery software associated with your 33-series product. The software can be started either using the appropriate icon on the desktop of your computer, or under the Programs menu via the Windows start button. After a 'Discovery Courseware' splash screen has been briefly displayed, you should see a window showing all the assignments that are available for the product, similar to this:

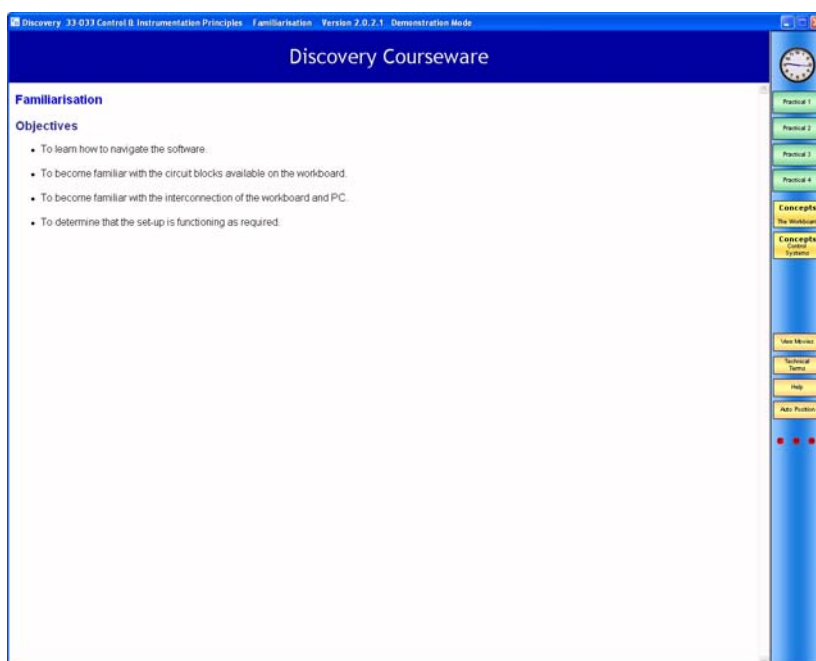


There may be a different number of assignments available to you than shown. The precise appearance of this window, such as the choice of colours and how the buttons are arranged, is determined by your tutor. Note that you cannot close this window while any assignment is open, and you can have only one assignment open at any time.

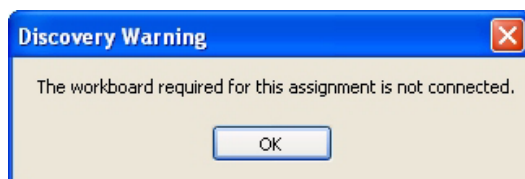
To select an assignment to perform, left-click on the appropriate button.



After an 'Assignment loading' dialog has been briefly displayed, the assignment window should appear. The assignment window is full-screen, consisting of a title bar across the top, a side bar at the right-hand edge, and the main working area. Initially the overall objectives for the chosen assignment are shown in the main working area. A typical screen shot is shown below. The precise appearance of the assignment window can be determined by the tutor.



If the hardware has not been connected properly, the following Discovery Warning message is immediately displayed on the screen:



If this warning message is shown, you must acknowledge it by clicking the **OK** button before you can continue. In this event, it is recommended that you resolve the problem before attempting to perform the assignment. You will need to close the assignment, correct the hardware problem and then restart the assignment.



On the previous screen shot of the assignment window, notice the three red indicators within the side bar. These are marked 'F', 'H' and 'A'. These are warning indicators. If any one of them is visible on your screen then you have a fault condition, as follows:

- indicates that there is a firmware communications error;
- indicates that the hardware is incorrectly connected, probably your workboard is incorrectly connected to your PC, or that the workboard driver is not installed correctly;
- indicates that there is a data acquisition error, probably your workboard is incorrectly connected to the PC or the driver for it is incorrectly installed.

If you do not see any of these warning indicators on your screen then your set-up is correct and you may perform any of the practicals in the assignment. You can still open a practical when a fault condition exists, but you will not be able to use any test equipment that may be required to perform that practical. The hardware must be correctly connected before starting an assignment in order to use the test equipment in any of the practicals within that assignment.

Chapter 5 takes you through the navigation of the software.



Notes



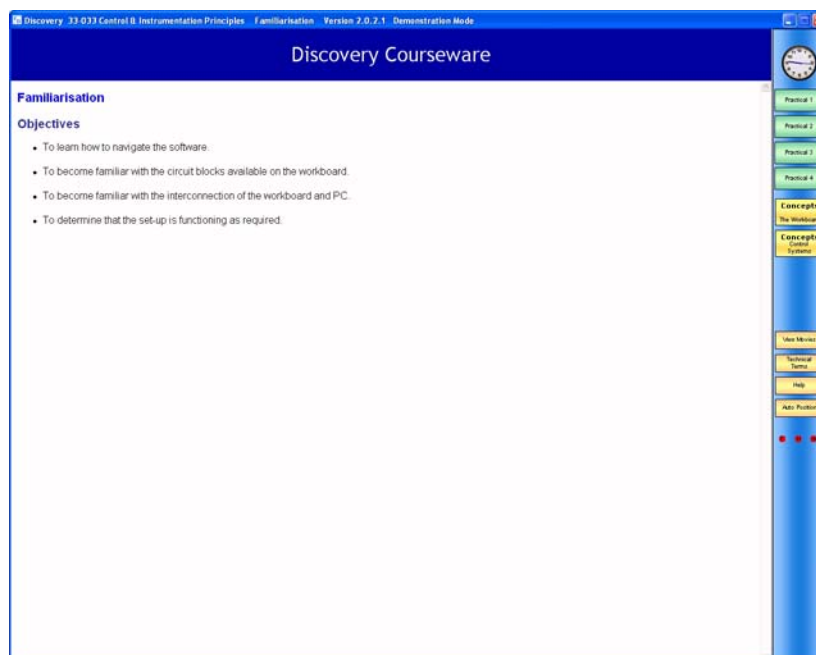
5 Navigating the Discovery Software

The Discovery environment is easy to operate. The following notes will help you to quickly familiarise yourself with all of its facilities.

If there is a demonstration assignment, slider controls in the software perform functions that would normally be performed on the hardware. In normal assignments, if the any of hardware systems fail to initialise then the system reverts to demonstration mode. This means that none of the test equipment will be available.

5.1 The Assignment Window

The assignment window opens when an assignment is launched as described earlier. The assignment window consists of a title bar across the top, an assignment side bar at the right-hand edge, and the main working area. By default, the overall assignment objectives are initially shown in the main working area whenever an assignment is opened. The assignment window occupies the entire screen space and it cannot be resized (but it can be moved by 'dragging' the title bar, and it can be minimised to the task bar). The title bar includes the name of the selected assignment. The side bar contains the practicals and any additional resources that are relevant for the selected assignment. The side bar is anchored on the right-hand edge of the assignment window; it cannot be repositioned. An example of an assignment window is shown below.



The precise appearance of the assignment window will depend on the skin that is selected by the tutor. However, the behaviour of each of the buttons and icons will remain the same, irrespective of this.



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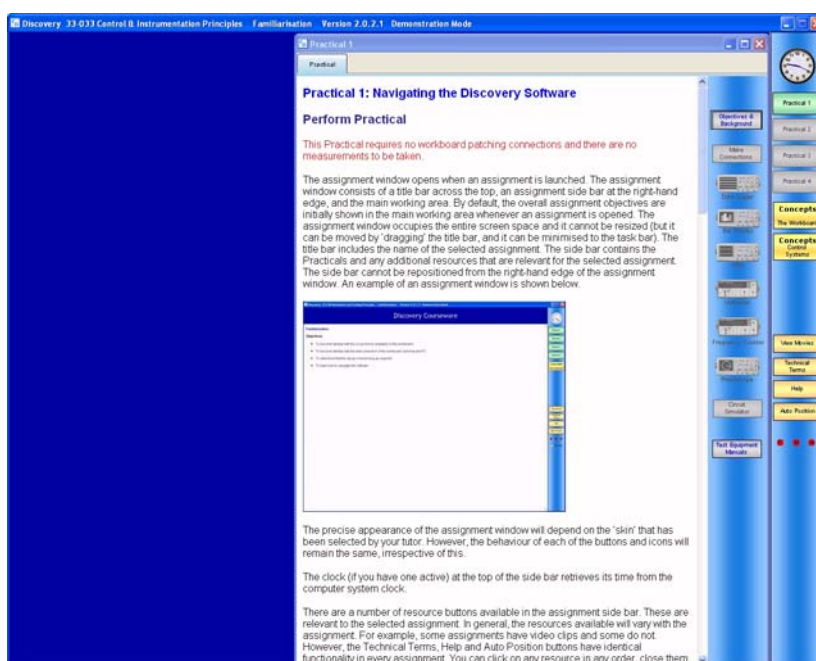
Chapter 5 Navigating the Discovery Software

The clock (if you have one active) at the top of the side bar retrieves its time from the computer system clock.

There are a number of resource buttons available in the assignment side bar. These are relevant to the selected assignment. In general, the resources available will vary with the assignment. For example, some assignments have video clips and some do not. However, the **Technical Terms**, **Help** and **Auto Position** buttons have identical functionality in every assignment. Students can click on any resource in any order, close them again, or minimise them to suit the way they work.

Practicals are listed in numerical order in the side bar. When you move the mouse over a practical button, its proper title will briefly be shown in a tool-tip. There can be up to four practicals in any assignment. You can have only one practical window open at any time.

To perform a practical, left-click on its button in the assignment side bar. The assignment objectives, if shown in the main working area, will close, and the selected practical will appear in its own window initially on the right-hand side of the main working area, as shown below. You can move and resize the practical window as desired (even beyond the assignment window) but its default size and position allows the test equipment to be displayed down the left-hand side of the main working area without overlapping the instructions for the practical.



Again, the precise appearance of the practical window can be determined by the tutor but the behaviour of each of the buttons and icons will remain the same, irrespective of this. Whatever it looks like, the practical window will have icons for the test equipment, together with buttons for **Objectives & Background**, **Make Connections**, **Circuit Simulator** and **Test Equipment Manuals**.



These resources are found in side bar, located on the right-hand edge of the practical window. The resources will depend on which practical you have selected. Therefore not all the resources are available in every practical.

If a resource is unavailable, it will be shown greyed out. To open any resource, left-click on its icon/ button. Note that when you close a practical window, any resources that you have opened will close. You may open any resource at any time, provided it available during the practical. The **Circuit Simulator** will only be available if you have one loaded.

Note that if the hardware is switched off, unavailable, or its software driver is not installed, all the test equipment is disabled. However, you can open any other window. If you then switch on the hardware it will be necessary to close the assignment window and open it again to enable the test equipment.

5.2 Resource Windows

These windows can be moved, resized and scrolled. You may minimise or maximise them. The system defaults to 'Auto Position', which means that as you open each resource window it is placed in a convenient position. Most resource windows initially place themselves inside the practical window. Each one lays over the previous one, selectable using tabs at the top of the practical window. You can select which one is on top by clicking the appropriate tab. You can see how many windows you have open from the number of tabs. If you want to see several windows at once then drag them out of the practical window to anywhere you wish on the screen. If you close a window it disappears from the resources tab bar.

If you want to return all the windows to their default size and position simply click the **Auto Position** button in the assignment side bar.

5.3 Make Connections Window

This movable and resizable window shows the wire connections (2 mm patch leads) you need to make on the hardware to make a practical work. Note that some of the wires connect the monitoring points into the data acquisition switch matrix. If this is not done correctly the monitoring points on the practical diagram will not correspond with those on the hardware. The window opens with no connections shown. You can show the connections one by one by clicking the **Show Next** button or simply pressing the space bar on the keyboard. If you want to remove the connections and start again click the **Start Again** button. The **Show Function** button toggles the appearance of the block circuit diagram associated with the practical.

5.4 Test Equipment

The test equipment will auto-place itself on the left of the screen at a default size. You may move it or resize it at any time. Note that below a useable size only the screen of the instrument will be shown, without the function buttons. Each piece of test equipment will launch with default settings. You may change these settings at any time.



There is an auto anti-alias feature that prevents you setting time-base or frequency settings that may give misleading displays. If auto anti-alias has operated the button turns red. You can turn off the anti-aliasing feature, but you should be aware that it may result in misleading displays.

You may return to the default settings by pressing the **Default** button on each piece of test equipment. If you wish to return all the equipment to their original positions on the left of the screen click **Auto Position** on the side bar of the assignment window.

Note that if you close a piece of test equipment and open it again it returns to its default position and settings.

If you want more information on how a piece of test equipment works and how to interpret the displays, see the **Test Equipment Manuals** resource in the practical side bar.

On slower computers it may be noticeable that the refresh rate of each instrument is reduced if all the instruments are open at once. If this is an issue then only have open the instrument(s) you actually need to use.

5.5 Test Equipment Cursors

If you left-click on the display of a piece of test equipment that has a screen, a green cursor marker will appear where you have clicked. Click to move the cursor to the part of the trace that you wish to measure. If you then move the mouse over the cursor a tool-tip will appear displaying the values representing that position. Note that if you resize or change settings any current cursor will be removed.

5.6 Perform Practical Window

This window contains the instructions for performing the practical, as well as a block, or circuit, diagram showing the circuit parts of the hardware board involved in the practical. On the diagram are the monitoring points that you use to explore how the system works and to make measurements. The horizontal divider bar between the instructions and the diagram can be moved up and down if you want the relative size of the practical instruction window to diagram to be different. Note that the aspect ratio of the diagram is fixed.

5.7 Information Buttons on Practical Diagrams

On many of the symbols on the diagram you will find a button that gives access to new windows that provide more information on the circuit that the symbol represents. Note that these windows are “modal”, which means that you can have only one open at a time and you must close it before continuing with anything else.


A ‘Further Information Point’ looks like this 





5.8 Probes

The practical diagram has probes on it, which start in default positions. These determine where on the hardware the signals are being monitored.

5.9 Selecting and Moving the Probes

Probes are indicated by the coloured icons like this .

If this probe is the selected probe it then looks like this  (notice the black top to the probe). You select a probe by left clicking on it.

Monitor points look like this .

If you place the mouse over a monitor point a tool-tip will show a description of what signal it is.

You can move the selected probe by simply clicking on the required monitor point. If you want to move the probe again you do not have to re-select it. To change which probe is selected click on the probe you want to select.

You can also move a probe by the normal 'drag-and-drop' method, common to 'Windows' programs.

5.10 Probes and Test Equipment Traces

The association between probes and traces displayed on the test equipment is by colour. Data from the blue probe is displayed as a blue trace. Yellow, orange and green probes and traces operate in a similar way. Which piece of test equipment is allocated to which probe is defined by the practical.

Note that the phasescope shows the relative phase and magnitude of the signal on its input probe using another probe as the reference. The reference probe colour is indicated by the coloured square to the top left corner of the phasescope display.

5.11 Practical Buttons

On some practicals there are buttons at the bottom of the diagram that select some parameter in the practical. These can be single buttons or in groups. Only one of each button in a group may be selected at one time.

5.12 Slider Controls

Where slider controls are used you may find you can get finer control by clicking on it and then using the up and down arrow keys on your keyboard.



Notes



6 Managing Courseware using Discovery Tools

The supplementary *Discovery Tools* package allows a tutor to manage the courseware for your Discovery products.

Using Discovery Architect, a tutor can select which assignments the students can have access to, allowing a tutor to focus classes on particular topics. Other tools allow the course content to be modified and tailored precisely to the curriculum.

The Discovery Tools software must be installed on the computer that a tutor will use to manage the Discovery courseware. It should not be installed on any client machines in a network that are used by students. For more information about Discovery Tools, please read the corresponding Discovery Tools manual, 93-400.



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