



SUPERSCAPE



VIRTUAL REALITY ROBOT USER'S MANUAL.

Program Development by Mark Ward.

Testing and Installation by Andrew Gaze and Tim Bray.

Product Marketing by Emma Wild.

Helpfiles, Manuals and Packaging by Matthew Clayton and Ranjit Hayre.

Information in this manual and its accompanying documents are subject to change without notice. No part of this manual or its accompanying documents may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of Denford Limited.

Copyright Denford Limited 1998. All rights reserved.

Superscape and Viscape are the registered trademarks of Superscape Inc.

Mitsubishi and RVM-1 are the registered trademarks of the Mitsubishi Corporation.

CONTENTS.

SECTION 1 - INTRODUCTION.	
WHAT IS VIRTUAL REALITY?	1-1
THE DENFORD VR ROBOT SOFTWARE.	1-2
HOW TO USE THIS MANUAL.	1-3
CONVENTIONS USED IN THIS MANUAL.	1-4
SECTION 2 - QUICKSTART TUTORIAL.	
STARTING THE SOFTWARE.....	2-1
LOGGING ON.....	2-1
LOADING A ROBOT ROOM.....	2-2
FLYING AROUND A ROBOT ROOM.....	2-3
SWITCHING ON THE ROBOT.....	2-4
USING THE ROBOT TEACHBOX TO MOVE THE ROBOT.....	2-5
SETTING THE ROBOT POSITIONS.....	2-6
USING THE ROBOT SCRIPT EDITOR.....	2-7
LOADING THE EXEMPLAR FILES FOR ROBOT ROOM 1.	2-10
SECTION 3 - STARTING THE VR ROBOT SOFTWARE.	
LOGGING ON WITH A USER NAME.	3-1
LOGGING ON AS A DEFAULT USER.	3-2
STARTING THE VR ROBOT SOFTWARE.	3-3
SECURITY DONGLE CONNECTION.	3-3
USER FILES - STRUCTURE.	3-4
LOCATION OF PERSONAL USER DIRECTORIES.	3-5
LOADING EXEMPLAR FILES FOR COMPLETED TASKS.	3-6
HOW TO USE THE ON-LINE HELP SYSTEM.	3-7
CLOSING THE VR ROBOT SOFTWARE.	3-9
SECTION 4 - THE VISCAPE WINDOW.	
OPENING A VIRTUAL WORLD.	4-1
CLOSING A VIRTUAL WORLD.	4-2
GENERAL LAYOUT OF THE VISCAPE WINDOW.	4-3
THE VIEWBAR.	4-4
CHANGING THE VIEWPOINT.	4-5
THE MOVEBAR.	4-6
MOVING AROUND A VIRTUAL WORLD.	4-7
THE TOOLBAR ICONS.	4-8
THE MAIN VISCAPE MENU.	4-9
SWITCHING ON THE SOUND.	4-12

CONTENTS.

SECTION 5 - THE VR LINKER.	
STARTING THE VR LINKER.	5-1
OPENING A VIRTUAL WORLD.	5-1
SWITCHING ON THE DEVICES.	5-2
GENERAL LAYOUT OF THE VR LINKER.	5-3
THE FILE MENU.	5-4
THE SERVICE MENU.	5-5
THE OPTIONS MENU.	5-6
THE HELP MENU.	5-7
THE DEVICE PANEL.	5-8
THE ACTIONS PANEL.	5-9
CLOSING THE VR LINKER.	5-10
SECTION 6 - THE ACTIONS EDITOR.	
STARTING THE ACTIONS EDITOR.	6-1
GENERAL LAYOUT OF THE ACTIONS EDITOR.	6-2
THE COMMANDS PANEL.	6-4
THE INTERLOCKS PANEL.	6-7
SECTION 7 - THE SEQUENCE FILE EDITOR.	
STARTING THE SEQUENCE FILE EDITOR.	7-1
GENERAL LAYOUT OF THE SEQUENCE FILE EDITOR.	7-2
THE MENUBAR	7-3
THE MENUBAR AND DEVICE PANEL.	7-4
THE ACTIONS PANEL, DESCRIPTION PANEL AND SEQUENCE FILE DISPLAY	7-5
THE SEQUENCE FILE EDITING BUTTONS.	7-6
THE SEQUENCE FILE PLAY BUTTONS, OK AND CANCEL BUTTONS.	7-7
EXAMPLE OF HOW TO WRITE A SEQUENCE FILE.	7-8
SECTION 8 - THE ROBOT TEACHBOX.	
DISPLAYING THE ROBOT TEACHBOX.	8-1
GENERAL LAYOUT OF THE ROBOT TEACHBOX.	8-2
SWITCHING THE ROBOT TEACHBOX ON AND OFF.	8-3
THE EMERGENCY STOP BUTTON.	8-3
THE MEMORY MENU.	8-4
THE OPTIONS MENU.	8-6
THE SCRIPTS MENU.	8-9
THE EDIT ROBOT MEMORY WINDOW.	8-10
GENERAL LAYOUT OF THE POSITION EDITOR WINDOW.	8-12

CONTENTS.

SECTION 8 - THE ROBOT TEACHBOX.

ROBOT KEYPAD - ROBOT PART NAMES.	8-16
ROBOT KEYPAD - [INC] & [DEC] BUTTONS.	8-17
ROBOT KEYPAD - [PS] & [PC] BUTTONS.	8-18
ROBOT KEYPAD - [NST] & [ORG] BUTTONS.	8-19
ROBOT KEYPAD - [WRT] & [MOV] BUTTONS.	8-20
ROBOT KEYPAD - [PTP] & [XYZ] BUTTONS.	8-21
ROBOT KEYPAD - [ENT]&[TOOL] BUTTONS.	8-22
ROBOT KEYPAD - [X+/B+] & [X-/B-] BUTTONS.	8-23
ROBOT KEYPAD - [Y+/S+] & [Y-/S-] BUTTONS.	8-24
ROBOT KEYPAD - [Z+/E+/4] & [Z-/E-/9] BUTTONS.	8-25
ROBOT KEYPAD - [P+/3] & [P-/8] BUTTONS.	8-26
ROBOT KEYPAD - [R+/2] & [R-/7] BUTTONS.	8-27
ROBOT KEYPAD - [1] & [6] BUTTONS.	8-28
ROBOT KEYPAD - [< 0 > /Ø] & [> C < /5] BUTTONS.	8-29
ROBOT KEYPAD - NON FUNCTIONING BUTTONS.	8-30

SECTION 9 - MOVING AND STORING ROBOT POSITIONS.

DISPLAYING THE ROBOT TEACHBOX & NESTING THE ROBOT.	9-1
MOVING THE ROBOT WITH THE MOUSE.	9-2
SELECTING PTP MOVEMENT MODE.	9-3
SELECTING XYZ MOVEMENT MODE.	9-4
SELECTING TOOL MOVEMENT MODE.	9-5
MOVING THE ROBOT.	9-6
SETTING AND MOVING TO A STORED ROBOT POSITION.	9-7
SAVING THE ROBOT MEMORY.	9-9

SECTION 10 - THE ROBOT SCRIPT FILE EDITOR.

STARTING THE ROBOT SCRIPT FILE EDITOR.	10-1
GENERAL LAYOUT OF THE ROBOT SCRIPT FILE EDITOR.	10-2
THE FILE MENU.	10-3
THE OPTIONS MENU.	10-4
THE ROBOT SCRIPT FILE DISPLAY WINDOW.	10-7
THE [LINE EDITING] BUTTONS.	10-10
THE [PLAY] BUTTONS.	10-11
THE [OK] AND [CANCEL] BUTTONS.	10-12
EXAMPLE ROBOT SCRIPT FILE.	10-12
LOADING AN EXEMPLAR ROBOT SCRIPT FILE.	10-13

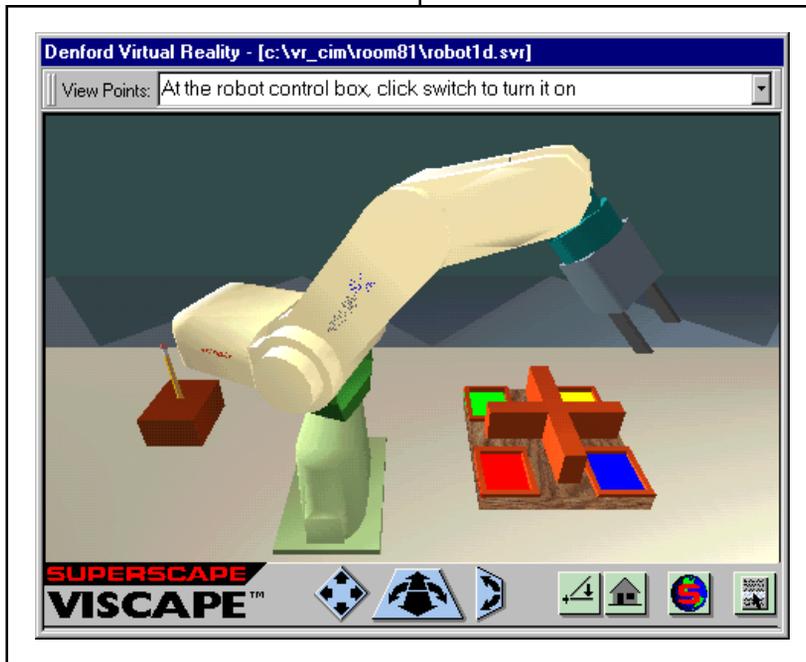
CONTENTS.

SECTION 11 - THE FIVE VIRTUAL WORLD ROBOT ROOMS.	
ROBOT ROOM STARTING POINT.....	11-1
VR ROBOT ROOM 1 - TASK.....	11-2
VR ROBOT ROOM 1 - INTELLIGENT OBJECTS.....	11-3
VR ROBOT ROOM 1 - HINTS AND TIPS.....	11-4
VR ROBOT ROOM 2 - TASK.....	11-6
VR ROBOT ROOM 2 - COLLISION DETECTION.....	11-7
VR ROBOT ROOM 2 - INTELLIGENT OBJECTS.....	11-8
VR ROBOT ROOM 3 - TASK.....	11-9
VR ROBOT ROOM 3 - INTELLIGENT OBJECTS.....	11-11
VR ROBOT ROOM 3 - HINTS AND TIPS.....	11-12
VR ROBOT ROOM 4 - TASK.....	11-15
VR ROBOT ROOM 4 - COLLISION DETECTION AND INTELLIGENT OBJECTS.....	11-16
VR ROBOT ROOM 5 - TASK.....	11-17
VR ROBOT ROOM 5 - INTELLIGENT OBJECTS.....	11-18
VR ROBOT ROOM 5 - DISPLAYING THE LATHE CONTROL PANEL.....	11-21
VR ROBOT ROOM 5 - LATHE CONTROL PANEL GENERAL LAYOUT.....	11-22
VR ROBOT ROOM 5 - ENTERING AN M CODE.....	11-22
VR ROBOT ROOM 5 - THE LATHE ACTIONS LIST.....	11-24
VR ROBOT ROOM 5 - HINTS AND TIPS.....	11-25
 SECTION 12 - INDEX.	
INDEX.....	12-1

WHAT IS VIRTUAL REALITY?

Virtual Reality, or VR, is where a Virtual World - a three dimensional environment or scenario created on a computer - can be freely explored, experienced and examined in real time. All actions occurring in the virtual world appear in the Superscape Viscap viewing window, shown below.

Through the use of VR, users can interact with the virtual worlds, as if they were really there, in "real" life. Items can be switched on, off and even broken. The forces of nature, such as gravity, can also play their part in upsetting the balance of any set tasks. The beauty of VR is that although set tasks might not go according to plan, first time, the virtual worlds can be reset for the users to try again. Therefore, VR proves to be the ideal medium for training purposes.



VR is also one of the safest and most cost effective ways to gain experience from using expensive pieces of equipment, such as robots and CNC machinery, before moving onto the "real" items in question.

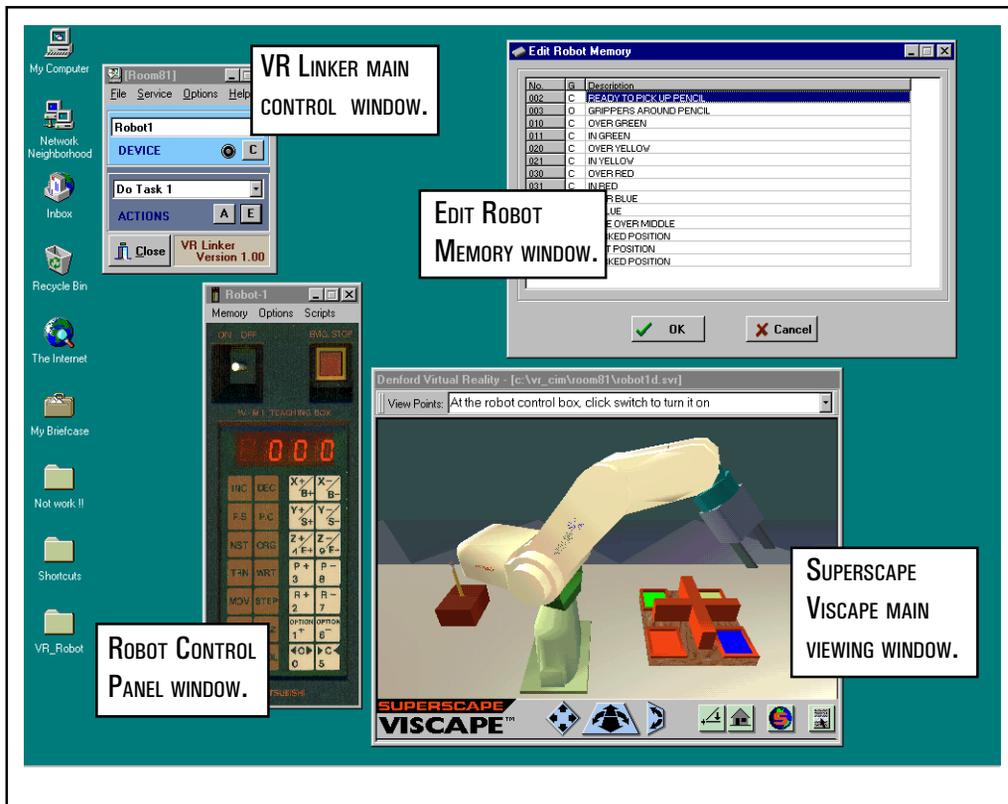
Anything can, and quite often does, happen in a virtual world. You don't have to follow any predetermined paths. What happens really is up to you !!

THE DENFORD VR ROBOT SOFTWARE.

Superscape Viscape is used as the runtime platform for showing the virtual worlds, which are loaded as five separate robot rooms.

These robot rooms contain Denford VR Robots, based upon true industrial Mitsubishi RV-M1 robots, with all the operating functions of the real machines.

The Virtual Reality Linker window provides the user interface for controlling and programming these robots, along with other devices present in the virtual worlds.



HOW TO USE THIS MANUAL.

The printed manuals, together with the on-line helpfile and hints system, provides a comprehensive guide to the use of the Denford VR Robot.

A separate printed guide contains information detailing the installation of the Denford VR Robot software.

This manual divides, broadly, into 4 areas of study:

- A quickstart tutorial, designed for those of you who just can't wait to be thrown in at the deep end.....
- A section describing the features, basic configuration and use of the Superscape Viscap software.
- The majority of the manual details the many components and windows of the VR Linker program, used to control and program the robots in the virtual worlds.
- A detailed reference section includes explanations and tips for completion of the tasks in all five virtual world robot rooms.

Information relating to setting up and using the Denford Virtual Reality Robot software with a "real" robot is included in a section of the VR Robot on-line electronic helpfile.

CONVENTIONS USED IN THIS MANUAL.

Conventions (shortcut commands) used in the manual follow this format:

When reference to either a left button or right button mouse click command is omitted, perform one click with the left mouse button.

For example - Click "File" on the VR Linker window - means click the left button of the mouse once, when the cursor is directly pointing over the the File Menu of the menubar in the VR Linker window.

When a select menu command is requested, the menu and option names are seperated by a vertical line, for example - Click "File|Open" - means open the File menu and click on the Open option.

[Text] - Square brackets containing text are used to show software screen buttons or qwerty keyboard keys that require either pressing or clicking on with the mouse.

QUICKSTART TUTORIAL.

STARTING THE SOFTWARE....

Denford VR Robot's successfully installed and you're ready to go!

To start the software, click on the "Start" button of your Windows 95 startbar:



Next, click on the "Programs" group, then "VR Robot" and finally "Start VR Robot" to start the software.

LOGGING ON....

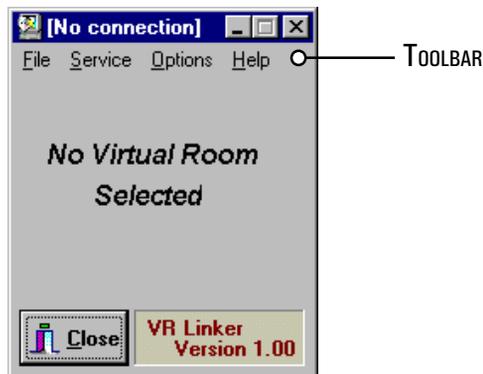
The User Identification window will appear. Click in the blank dialog box and type in your name (this will become your personal user name each time you use the software):



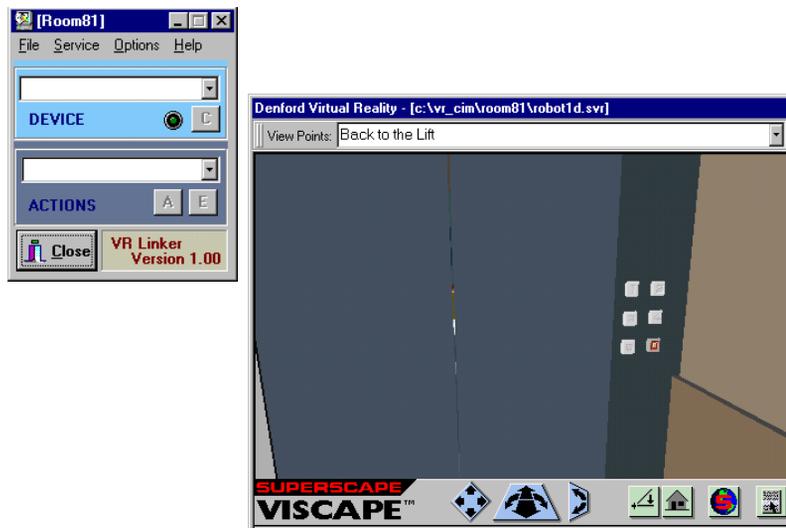
QUICKSTART TUTORIAL.

LOADING A ROBOT ROOM....

The VR Linker window is displayed with the message "No Virtual Room Selected". VR Linker is the program that lets you control devices in virtual worlds, called "Robot Rooms", that are open:



From the VR Linker toolbar, click on "File|Run Virtual World|Robot Room 1". The Viscap window will appear and automatically open Robot Room 1. All the Robot Rooms start from within a lift Note that the display on the VR Linker also changes:

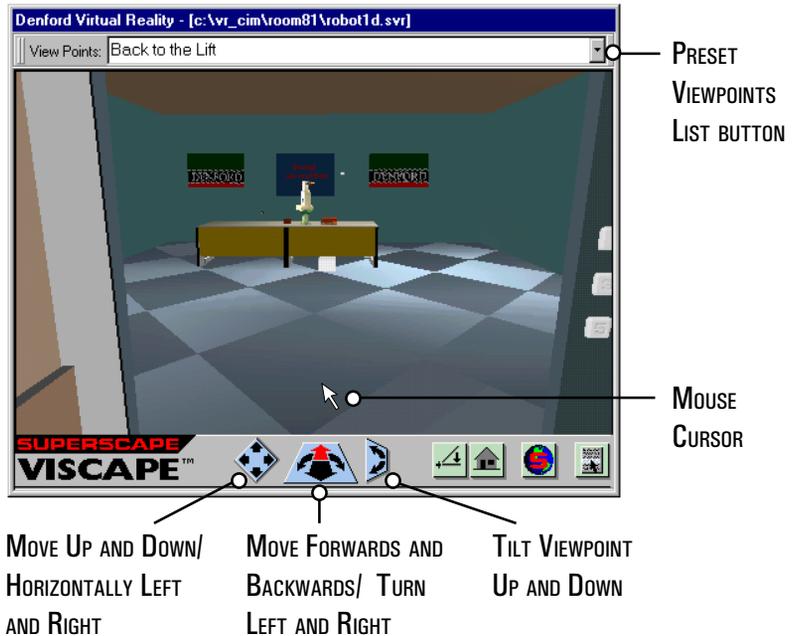


QUICKSTART TUTORIAL.

FLYING AROUND A ROBOT ROOM....

Many of the devices in the robot rooms can be operated as if you were in "real life". Don't be afraid to experiment - the robot room can always be reset!

Click on the lift doors to open them. Now click on the middle movebar icon, continue to hold the left mouse button down and gently move the mouse cursor up. You will start to move forwards into the room:



If you lose your bearings, click on the Preset Viewpoints List button (shown above), then click on one of the five preset viewpoints described in the dropdown list to change the view.

QUICKSTART TUTORIAL.

SWITCHING ON THE ROBOT....

Find the grey electrical control box, then click on the power switch - you will hear the robot "nest" (move to its datum position). To make it easier, a preset viewpoint is available of the robot control box switch:

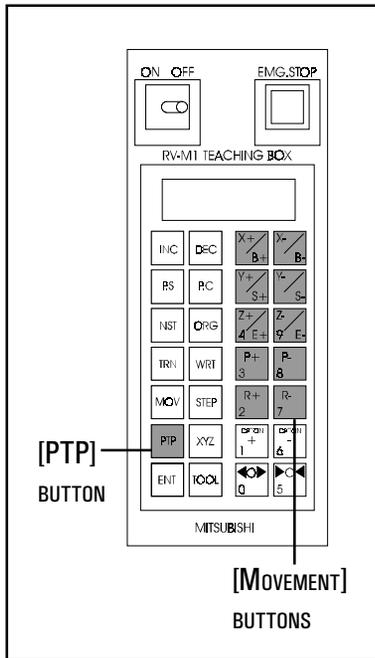


The name of the device you've just switched on appears in the "DEVICE" panel of the VR Linker window. Click on the [C] button to display the Robot Teachbox (the control pad for "Robot 1"):



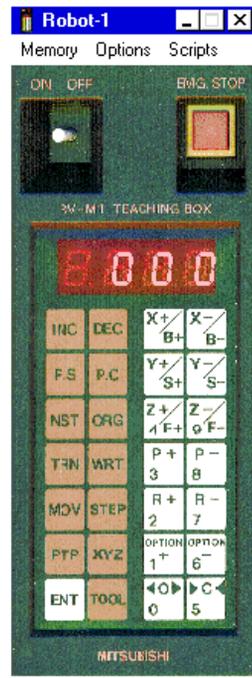
DISPLAY CONTROL
PAD BUTTON

QUICKSTART TUTORIAL.



USING THE ROBOT TEACHBOX TO MOVE THE ROBOT....

Click the On/Off switch on the Robot Teachbox to switch it "on".



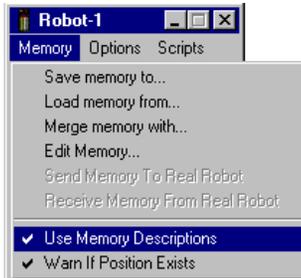
Click the brown [PTP] button to set the robot in "point-to-point" mode (sets the righthand movement buttons of the Teachbox to control the robot axes). Use these light beige coloured buttons to manually move the robot.

When a move command cannot be performed (eg, the axis hits its limit switch) a buzzer will sound.

You can also move the robot by clicking and holding the left mouse button on a robot axis (the pivot point), then dragging in the appropriate direction to move the robot arm.

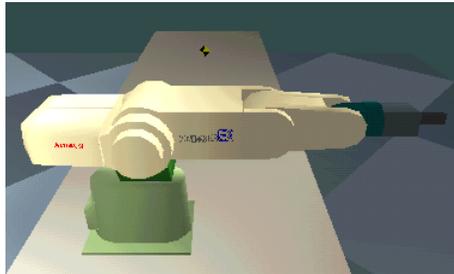
QUICKSTART TUTORIAL.

SETTING THE ROBOT POSITIONS....



Click on the "Memory" menu and check that the "Use Memory Descriptions" and the "Warn If Position Exists" options are switched "on" (indicated by a tick mark). Click on each option to switch it "on" or "off" (shown left).

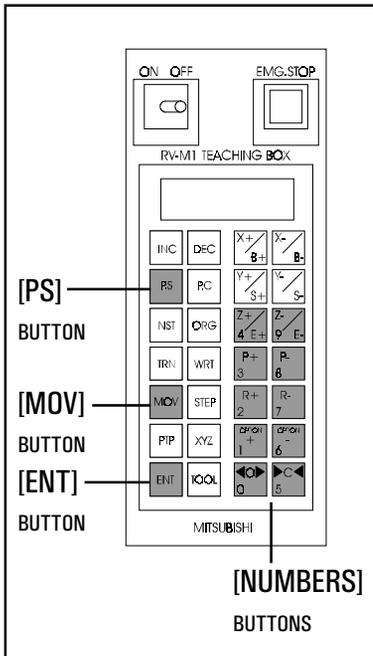
Move the robot so its arm is horizontally outstretched, using the Teachbox to control the robot axes:



To save this position in the robot memory, click the [PS] button, then enter the three digit number "123" using the Teachbox [NUMBERS] buttons and press [ENT]. Type in a Robot Position Description in the dialog box that appears and press the [OK] button to save the robot position:



Move the robot to a new position. Now click the [MOV] button, enter the number "123" using the Teachbox [NUMBERS] buttons and press [ENT]. The robot will move to the position you just saved.

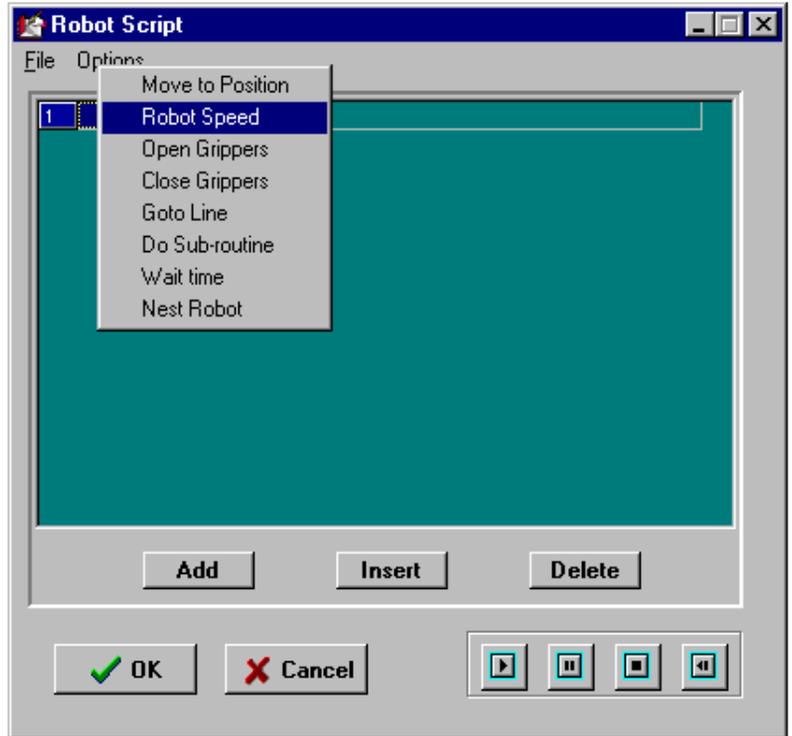


QUICKSTART TUTORIAL.

USING THE ROBOT SCRIPT EDITOR....

Click on "Scripts | Edit Script..." in the Robot Teachbox window toolbar to display the Robot Script Editor, used for building robot programs from positions saved in the robot memory.

Click with the right mouse button in the first box to the right of the program line number 1. Next, click with the left mouse button on the "Robot Speed" option in the pop-up menu that appears:



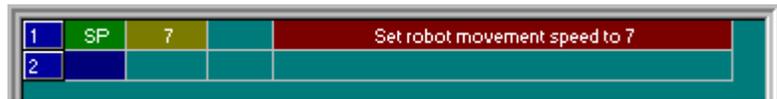
Click with the left mouse button on the number "7" from the next pop-up menu. The program line you have just written sets the speed at which the robot will perform any subsequent commands:



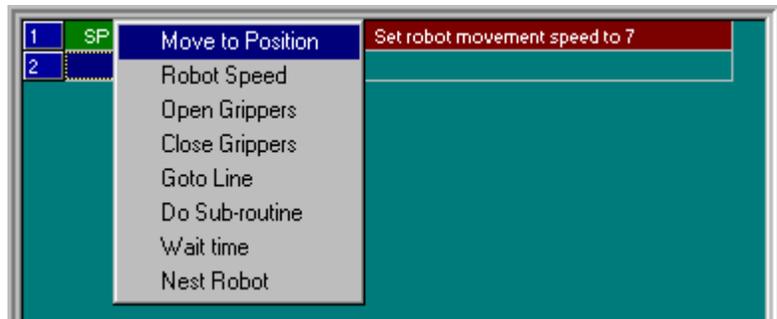
QUICKSTART TUTORIAL.

USING THE ROBOT SCRIPT EDITOR....

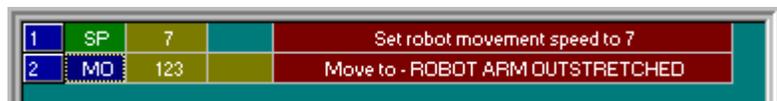
Click the [Add] button at the bottom of the Robot Script window to add a new blank program line:



Click with the right mouse button in the first box to the right of the program line number 2. Next, click with the left mouse button on the "Move to Position" option in the pop-up menu that appears:



Click with the left mouse button on the program number "123 - ROBOT ARM OUTSTRETCHED" from the next pop-up menu. The program line you have just written instructs the robot to move to position "123":



QUICKSTART TUTORIAL.

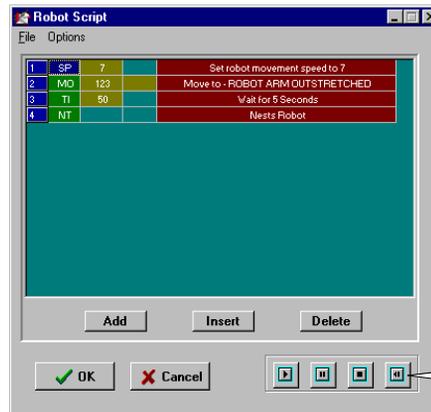
USING THE ROBOT SCRIPT EDITOR....

Click the [Add] button at the bottom of the Robot Script window to add a new blank program line.

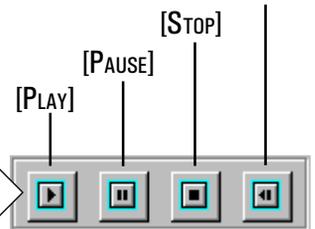
Continue to build the program adding a time delay of 5 seconds on program line 3 and a nest robot command on program line 4. Build program lines 3 and 4 using the same method as for program lines 1 and 2:

1	SP	7		Set robot movement speed to 7
2	MO	123		Move to - ROBOT ARM OUTSTRETCHED
3	TI	50		Wait for 5 Seconds
4	NT			Nests Robot

To test your "new" robot program, highlight program line number 1, by clicking the [Rewind to Start] button on the control panel in the righthand bottom corner of the Robot Script window. Start the program by clicking on the [Play] button:



[REWIND TO START]



Note - The programs can only be played when the Robot Teachbox is switched "off". If the Robot Teachbox is "on", the [Play] button will be greyed out.

To save your program, called a robot script file, click "File|Save As", enter a filename and press the [OK] button in the Save As window that appears.

QUICKSTART TUTORIAL.

LOADING THE EXEMPLAR FILES FOR ROBOT ROOM 1.

Note - Exemplar files to complete all the tasks in all five robot rooms are installed only if specified during the initial install of Denford Virtual Reality Robot.

To load the robot script file that successfully carries out the task in Robot Room 1, you must first load the robot memory that "matches" the robot script file.

Click on "Memory|Load memory from..." in the menubar of the Robot Teachbox window. Browse and open the folder numbered "10000" and load the exemplar memory file. Folder 10000 contains all the exemplar files required to complete the task in room 1. The completed task files for Robot Room 1 are installed by default to the following path:

C:\ProgramFiles\Denford\VirtualRobot\Room81\10000.

Click on "Scripts|Edit Script..." in the menubar of the Robot Teachbox window to display the Robot Script window.

Click on "File|Open" in the menubar of the Robot Script window. Browse and open the folder numbered "10000", then load the exemplar robot script file.

Check that the Robot Teachbox is switched "off".

Click the [Rewind to Start] button, then the [Play] button on the control panel of the Robot Script window, to start the program.

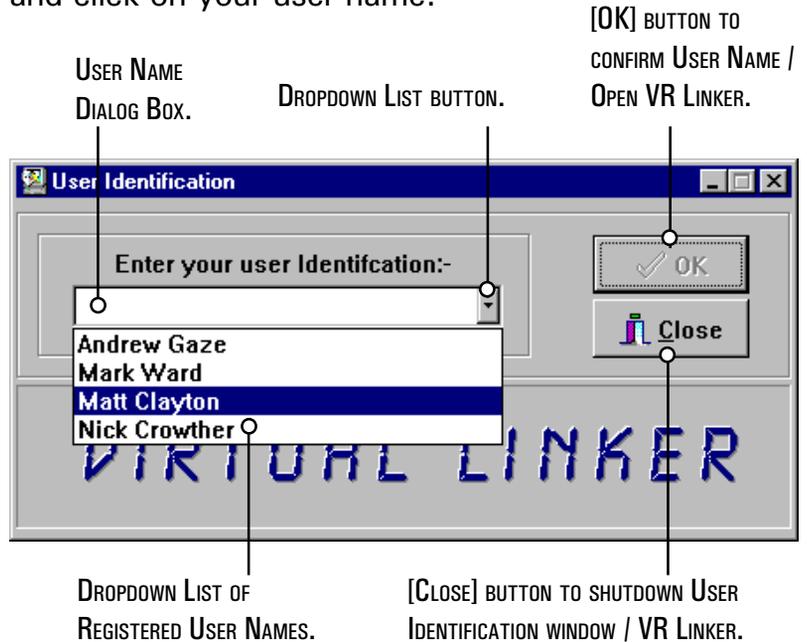
STARTING THE VR ROBOT SOFTWARE - LOGGING ON WITH A USER NAME.

The easiest way to start the Denford VR Robot software is through the Windows 95 startbar menu.

If the Denford VR Robot has been installed using the recommended program groups, the software can be started by clicking on the following:

- Startbar
- Programs
- Denford (program group name)
- Virtual Robot (program group name)
- Virtual Robot (shortcut to Cim_link.exe)

The program will ask you to log on with your user name. Click the list button to display the dropdown list of Virtual Robot users (shown below). Highlight and click on your user name.

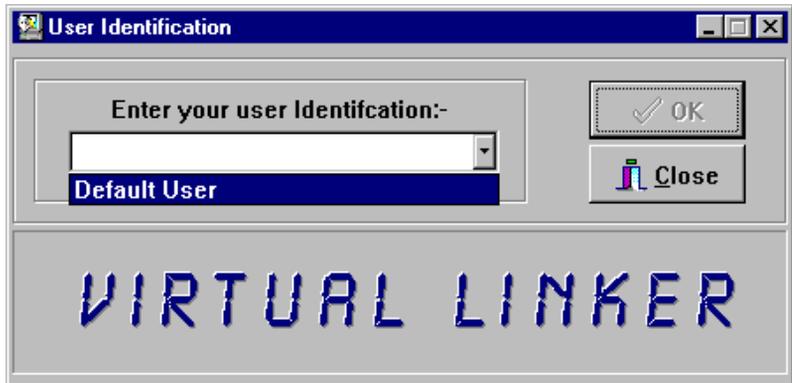


To add a new name to the Virtual Robot users list, simply click in the blank user name dialog box and type in your name.

LOGGING ON AS A DEFAULT USER.

Logging on as the "Default User" gives immediate direct access to all the exemplar files required to complete the tasks in all five robot rooms.

To log on as the "Default User", click the list button to display the dropdown list of Virtual Robot users, then highlight and click on "Default User" (shown below).



Using the robot rooms as a "Default User":

- When a robot is switched on, the memory required to complete the room task is automatically loaded.
- To load any exemplar sequence editor or robot script file to complete the room task, simply use the "File|Open" options in each respective menubar - the Open window should automatically display the contents of the correct folder (default user number "10000").

Note - Exemplar files to complete all the tasks in all five robot rooms are installed only if specified during the initial install of Denford Virtual Reality Robot.

STARTING THE VR ROBOT SOFTWARE.

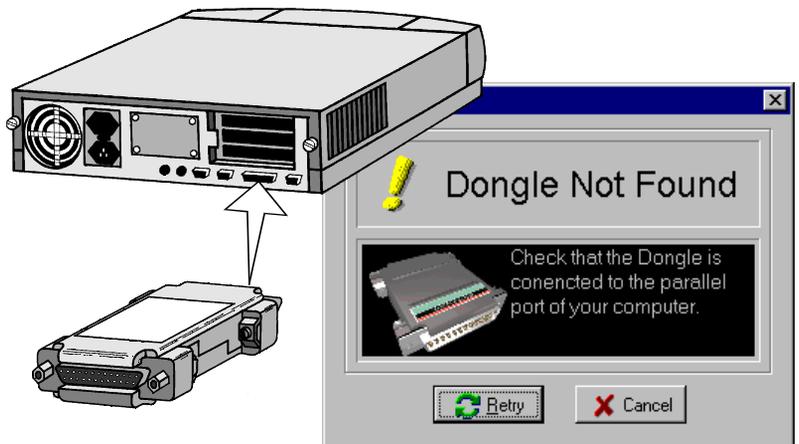
Clicking the [OK] button on the User Identification window will open the VR Linker window (shown below).



To load one of the five available virtual worlds, click on "File|Run Virtual World" in the VR Linker toolbar, then select and click on the required "Robot Room Number" from the list (see page 4.1).

SECURITY DONGLE CONNECTION.

The Denford Virtual Robot software will not run without the Security Dongle (shown below left). Fit the Denford Security Dongle to the parallel port of your computer.



USER FILES - STRUCTURE.

When you log on as a new user of the VR Robot software, a personal user directory is automatically created in the folders of any robot rooms you view.

These personal user directories are used to save any files created, required or saved in the virtual worlds viewed. All user directories are named with your personal user identification number.

To view your personal identification number, click "Help|User Information" (as shown below). Click on the [OK] button to remove this window.



LOCATION OF PERSONAL USER DIRECTORIES.

LOCATION OF PERSONAL USER DIRECTORIES.

The personal user directories are stored in the Virtual Linker folder, for example (by default install):

- C drive (hard disk)
 - Program Files folder
 - Denford folder
 - Virtual Robot folder
 - Room 81 folder (robot room 1)
 - 1 (personal directory for user 1)
 - 2 (personal directory for user 2)
 - 3 (personal directory for user 3)
 - 10000 (default files directory)
 - Room 82 folder (robot room 2)
 - Room 83 folder (robot room 3)
 - Room 84 folder (robot room 4)
 - Room 85 folder (robot room 5)

(Rooms 82 to 85 also contain the default files directory, along with any required personal user directories, automatically created when the robot rooms are used).

LOADING EXEMPLAR FILES FOR COMPLETED TASKS.

Note - Exemplar files to complete all the tasks in all five robot rooms are installed only if specified during the initial install of Denford Virtual Reality Robot.

Exemplar files used to complete the tasks in all five robot rooms can be loaded into the following:

- The Action Editor (see page 6.5).
- The Sequence File Editor (see page 7.3).
- The Robot Memory (see page 4.4).
- The Robot Script Editor (Page 8.9).

For each of the above options, browse for the folder relating to the robot room being viewed (ie, the "Room 82" folder for robot room 2), then open folder "10000" where all the exemplar files required to complete the tasks are stored.

Note - The exemplar files are not read only - they can be overwritten. To restore any incorrect or damaged exemplar files, copy them directly from the appropriate default user folder ("10000") on the cd-rom.

HOW TO USE THE ON-LINE HELP SYSTEM.

The VR Linker on-line helpfile and hints system provides context sensitive help on using all parts of the VR Linker program.

Simply press the [F1] on your keyboard to display the appropriate help pages (when available) for the window or component currently highlighted. The helpfile can also be accessed from the Help menu on the menubar of the VR Linker window.

When you hold the cursor still for two seconds over an unknown dialog box or button, a pop-up hint label will appear (shown below).

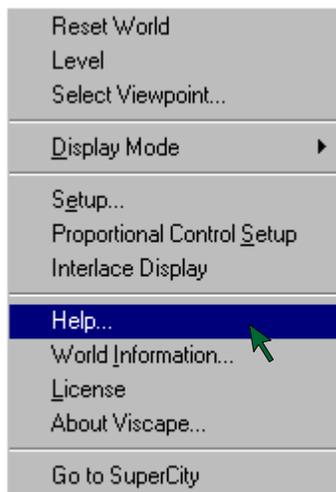


Detailed information relating to setting up and using the Denford Virtual Reality software with a "real" robot is included in a section of the on-line helpfile.

HOW TO USE THE ON-LINE HELP SYSTEM.

The on-line helpfile system for the Superscape Viscape software contains a wealth of information allowing the potential of the viewing software to be fully maximised.

Access the Viscape helpfile by clicking the Viscape Menu button, then highlighting and clicking on the Help option (shown below).

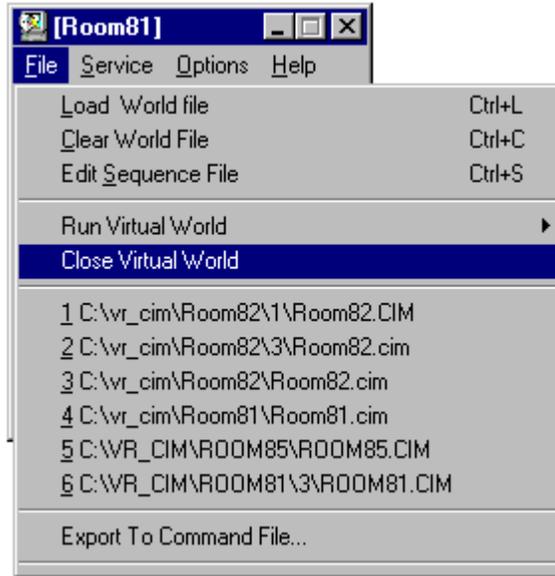


"DISPLAY THE VISCAPE MENU"
BUTTON, LOCATED IN THE LOWER
RIGHT AND CORNER OF THE MAIN
VISCAPE WINDOW. CLICK THIS
BUTTON TO SHOW THE VISCAPE
MENU.

CLOSING THE VR ROBOT SOFTWARE.

To close the VR Robot software:

- Close any active virtual world robot rooms by clicking on either the "zero" floor button in the lift, or clicking on "File|Close Virtual World" in the VR Linker toolbar (as shown below).



If you try to close the VR Linker with a virtual world robot room still active, a warning window will be displayed (as shown below).

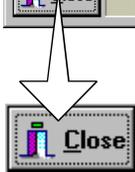


continued....

CLOSING THE VR ROBOT SOFTWARE.

continued....

- Click on the [Close] button in the VR Linker window to shutdown the VR Linker program (as shown below).



- Click on the [Close] button in the User Identification window to finish the shutdown of the VR Robot software (as shown below).

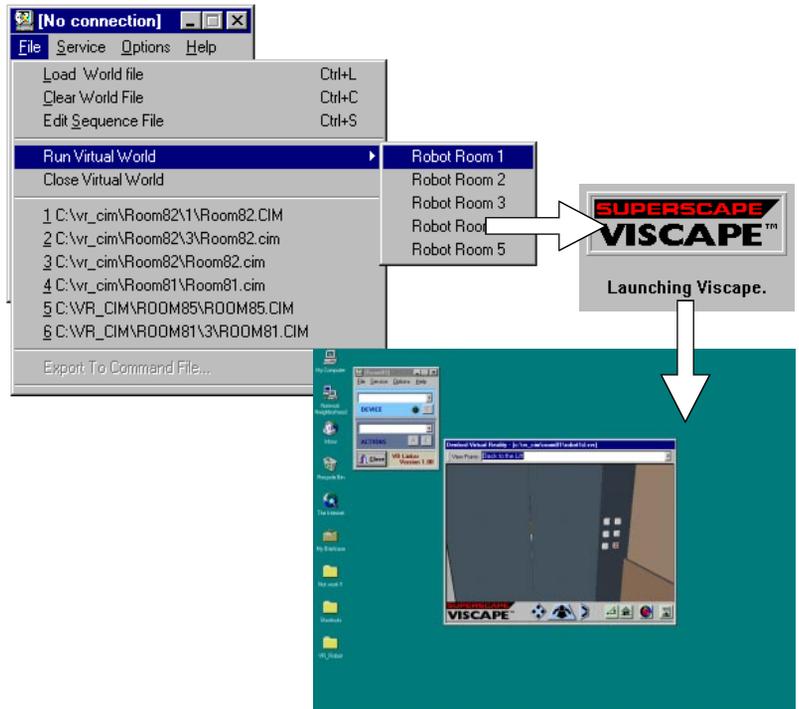


OPENING A VIRTUAL WORLD.

Superscape Viscap provides the main window for viewing any devices and actions in the virtual robot worlds. The Viscap window is automatically displayed when any of the five robot rooms are opened.

To open a virtual world robot room, click "File|Run Virtual World" in the menubar of the VR Linker window.

From the "Run Virtual World" menu click on the virtual world robot room you want to open (shown below).



Superscape Viscap will launch, automatically loading the required virtual world robot room number.

Note that the VR Linker changes from showing "No Virtual Room Selected", to displaying "DEVICE" and "ACTION" panels.

CLOSING A VIRTUAL WORLD.

A virtual world robot room can be closed using the following methods:

- 1) Click "File|Close Virtual World" in the menubar of the VR Linker window to shutdown the currently running robot room, along with the Viscape window.
- 2) Move back inside the lift (using the shortcut viewpoints, if available) and press floor button "Ø" (shown below). The Viscape window will remain open. A "new" robot room can be loaded from within the lift, by pressing the lift floor button representing the "new" robot room number to be loaded.



CLICK THE "ZERO"
BUTTON TO CLOSE
THE VIRTUAL WORLD

Note - The VR Linker window cannot be closed when the Viscape window is open.

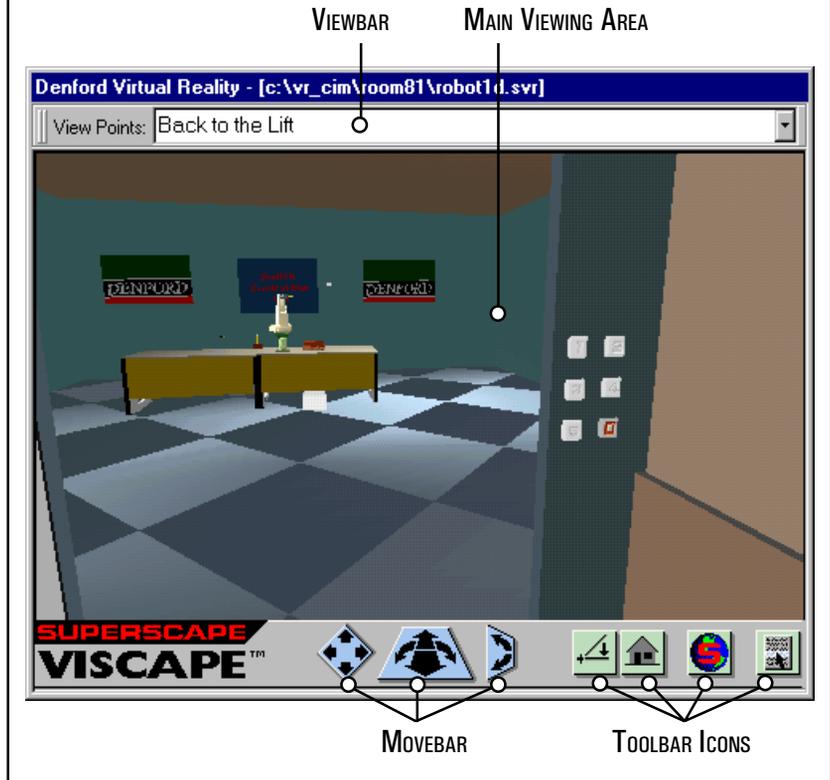
VISCAPE WINDOW - GENERAL LAYOUT.

The Viscape window is split into three basic areas, the largest and most obvious being the viewing area, where the objects and devices in the virtual worlds can be seen. Each robot room starts from within a lift - click on the lift doors to open them.

The viewbar is positioned above the main viewing area, containing a list of the preset views available for the virtual world.

The Movebar, used for navigating around the virtual world and the Toolbar icons, used for configuring and using Viscape, are positioned below the main viewing area.

VISCAPE WINDOW - GENERAL LAYOUT.



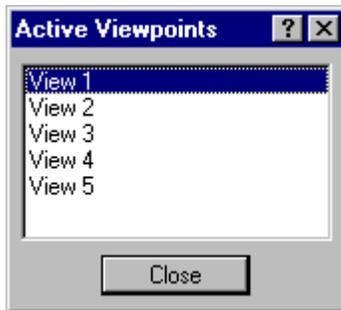
VISCAPE WINDOW - THE VIEWBAR.

THE VIEWBAR.

The viewbar contains a number of preset viewpoints in the virtual world. Viewpoints are particularly useful for navigating quickly, or regaining position when lost in the virtual worlds.

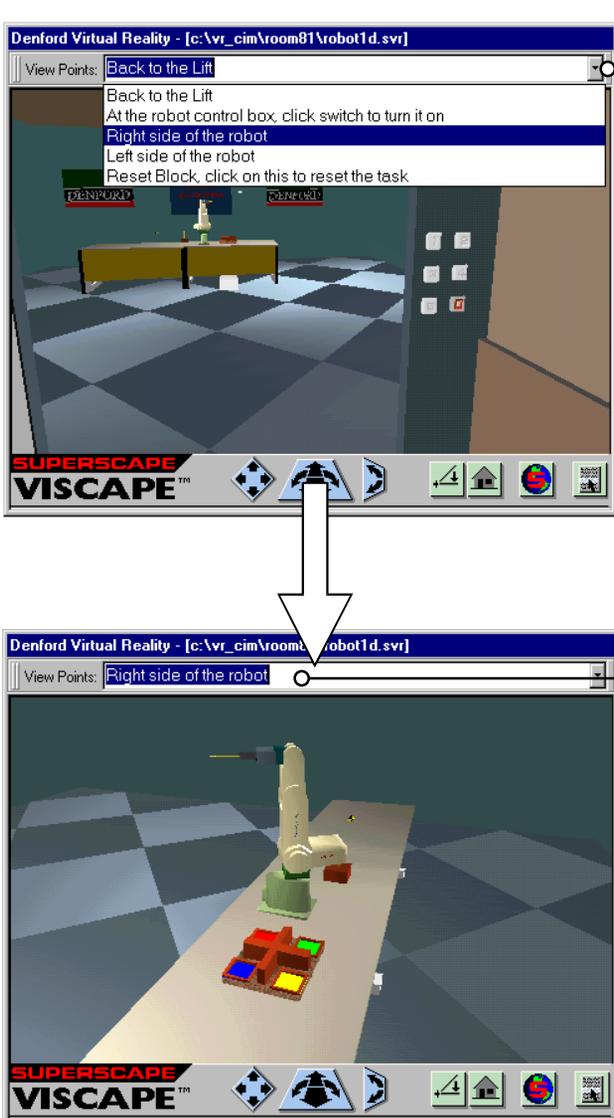
To select a viewpoint, click on the viewpoint list button to display the dropdown list of preset views. Highlight the required view description you require, then click the left mouse button to confirm and change the view (as shown in the righthand panel).

The same viewpoints can also be selected from the floating Active Viewpoint window, accessible by clicking on the "Viscape Menu" icon and selecting the "Select Viewpoint..." option (as shown below).



View 1 is the same as the top description in the viewpoints dropdown list, View 2 is the same as the second description down the list, etc....

VISCAPE WINDOW - CHANGING THE VIEWPOINT.



Denford Virtual Reality - [c:\vr_cim\room81\robot1.d.svr]

View Points: Back to the Lift

- Back to the Lift
- At the robot control box, click switch to turn it on
- Right side of the robot
- Left side of the robot
- Reset Block, click on this to reset the task

CLICK THE DROPPDOWN LIST BUTTON, HIGHLIGHT THE REQUIRED VIEWPOINT THEN CLICK

Denford Virtual Reality - [c:\vr_cim\room81\robot1.d.svr]

View Points: Right side of the robot

....TO CHANGE TO THE "NEW" VIEWPOINT.

SUPERSCAPE VISCAPE™

VISCAPE WINDOW - THE MOVEBAR.

THE MOVEBAR.

The movebar tools allow you to freely "fly" around the virtual world, using your mouse. Try to think of the display in the Viscape window as being the view from a floating camera head, which you can control using the three movement icons: vertical, horizontal and tilting.



Simply click and hold the left mouse button down over a movement icon, then drag the icon in the appropriate direction to move, according to the settings of the icon chosen (as shown in the righthand panel).

The icon being used will change colour to show which movement direction you are applying.

As you move your mouse cursor further away from the icon, whilst keeping the left mouse button depressed, your speed of movement will increase.

THE MOVEBAR ICONS.



The Vertical Movement icon mimics the camera moving from side to side, whilst looking straight ahead.

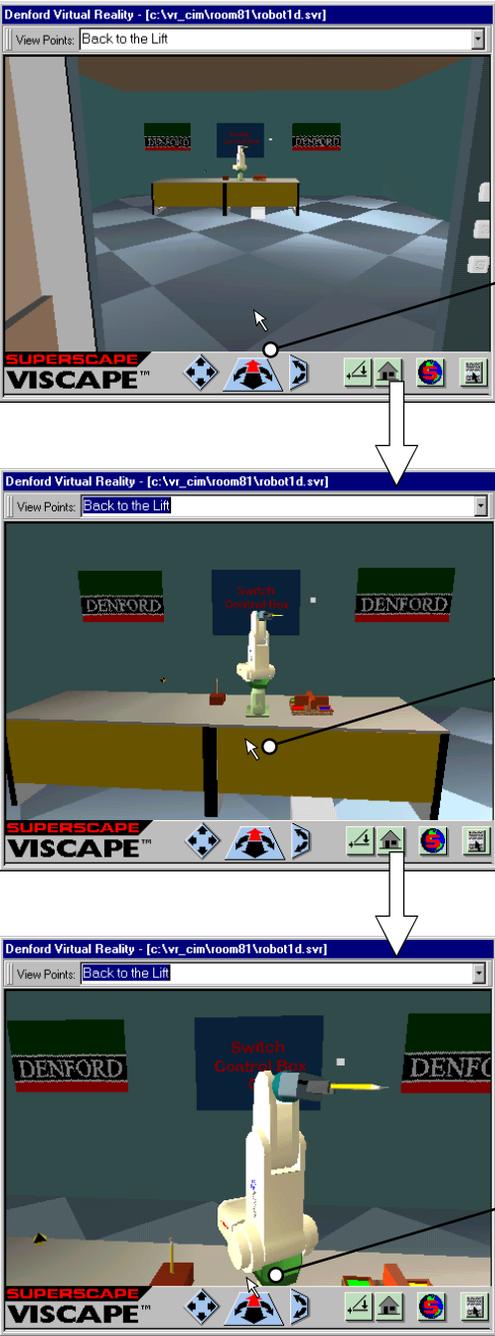


The Horizontal Movement icon mimics the camera moving forwards and backwards and/or turning whilst looking straight ahead.



The Vertical Movement icon mimics the camera tilting to look up or down.

VISCAPE WINDOW - MOVING AROUND A VIRTUAL WORLD.



The image consists of three vertically stacked screenshots of a virtual reality window titled "Denford Virtual Reality - [c:\vr_cim\room81\robot1.d.svr]". Each screenshot shows a 3D rendered room with a checkered floor, a table, and a robot. The interface includes a "View Points" dropdown menu set to "Back to the Lift" and a toolbar at the bottom with the "SUPERSCAPE VISCAPE" logo and several icons, including a movement icon with a red arrow. Arrows from the text blocks point to the movement icon in the first screenshot, the cursor in the second, and the movement icon in the third.



LEFT CLICK, HOLD AND DRAG THE REQUIRED MOVEMENT ICON IN THE DIRECTION YOU WANT TO MOVE. THE MOVEMENT DIRECTION IS SHOWN BY THE ICON ARROWS CHANGING COLOUR.

THE FURTHER YOU MOVE THE CURSOR AWAY FROM THE ICON, THE FASTER YOU WILL MOVE THROUGH THE VIRTUAL WORLD.

KEEPING THE CURSOR CLOSE TO THE MOVEMENT ICON ALLOWS PRECISE POSITIONING OF THE "CAMERA" VIEW.

VISCAPE WINDOW - TOOLBAR ICONS.

MENUICONS.

The lower righthand corner of the ViscAPE window contains the four toolbar icons....



LEVEL VIEW ICON.

RESET WORLD ICON.

SUPERCITY (INTERNET) ICON.

MAIN VISCAPE MENU ICON.



- THE LEVEL VIEW ICON.

Click the Level View Icon to reset the tilt angle of the "camera" view to horizontal, ie, level. The height of the "camera" view is not affected.



- THE RESET WORLD ICON.

Click the Reset World Icon to restore the settings of the currently loaded virtual world back to their default values.



- THE SUPERCITY (INTERNET) ICON.

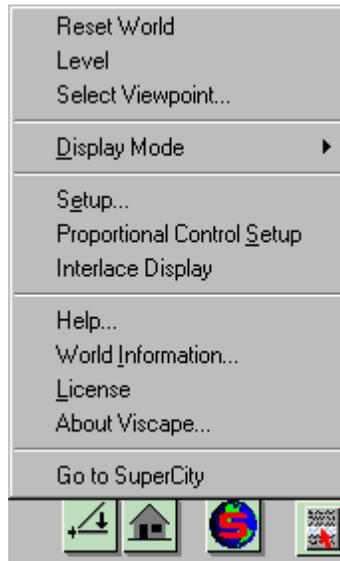
Click the Supercity (Internet) Icon to connect to the Superscape website via an internet connection.

VISCAPE WINDOW - THE MAIN VISCAPE MENU.



- THE MAIN VISCAPE MENU ICON.

Click the Main Viscape Menu Icon to display the main Viscape menu (shown below).



The options available in the main Viscape menu are as follows:

- **Reset World** - Click to restore the settings of the currently loaded virtual world back to their default values.
- **Level** - Click to reset the tilt angle of the "camera" view in the virtual world to horizontal, ie, level. The height of the "camera" view is not affected.

continued....

VISCAPE WINDOW - THE MAIN VISCAPE MENU.

continued....

- **Select Viewpoint...** - Click to display the Active Viewpoints window, from which preset viewpoints can be selected and applied to the currently loaded virtual world.
- **Display Mode** - Click to show the mode in which the virtual worlds are being displayed, indicated by the presence of a "tick mark" (shown below).



Some of the modes listed above may be available, depending on your system:

WinG - May increase the speed of the graphics on computers without Direct3D hardware acceleration, but at the loss of some graphics quality.

DirectDraw - Gives the best quality graphics on computers without Direct3D hardware acceleration.

RGB Emulation - A Direct3D software emulation mode. Worlds may run very slowly compared to worlds using any of the other modes. An MMX enhanced processor may improve performance in this mode if MMX Emulation mode is not available.

Direct3D HAL - This can provide good graphics and fast worlds, but it is only available if you have a Direct3D graphics card and software installed on your system.

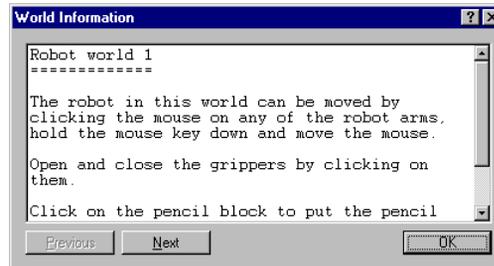
MMX Emulation - Same as RGB Emulation mode but uses an MMX enhanced processor.

continued....

VISCAPE WINDOW - THE MAIN VISCAPE MENU.

continued....

- **Setup...** - Click to display the Viscape Setup window, used to Enable/Disable devices (such as mouse control or sound effects) and configure the viewing screen display options.
- **Proportional Control Setup** - Click to display the Proportional Control Setup window, used for configuring multiaxis movement devices such as a Spacemouse or joystick.
- **Interlace Display** - Indicated by the presence of a "tick mark". Click to select an interlaced display (for virtual worlds designed to be used with 3d glasses).
- **Help...** - Click to view the on-line Superscape Viscape helpfile, containing detailed information on configuring and using Viscape.
- **World Information...** - Click to display the World Information window, containing an explanation, hints and tips for the currently loaded virtual world (shown below).



- **License** - Click to read the Superscape Viscape license agreement.
- **About Viscape...** - Click to display the version and user details for Viscape.
- **Go to Supercity** - Click to connect to the Superscape website via an internet connection.

VISCAPE WINDOW - SWITCHING ON THE SOUND.

To switch any sound effects in the virtual world on or off, click the Main Viscape Menu Icon, then select and click on the "Setup..." option to display the Viscape Setup window (shown below).

Select the "Devices" tab. Scroll down the options in the top window until the Sound settings are visible (shown below), then click on the [Enable] button to switch the sound on, or the [Disable] button to switch the sound off.

Finally, click on the [OK] button to apply any changes made to the setup.

The screenshot shows the 'Viscape Setup' dialog box. At the top, there are two tabs: 'Devices' and 'Display'. The 'Devices' tab is selected. Below the tabs is a list of device settings:

Sound:	Sound	Enabled
Display:	Enhanced	Enabled
Serial:	Serial Ports	Enabled
Network:	NetBios	Disabled

Below the list are four buttons: 'Enable', 'Disable', 'Reset', and 'Add'. The 'Enable' button is highlighted. At the bottom of the dialog are 'OK' and 'Cancel' buttons. A 'Save settings' checkbox is also present.

Numbered callouts on the right side of the image provide instructions:

- 1) SELECT THE DEVICES TAB.
- 2) SCROLL DOWN THE LIST UNTIL SOUND IS HIGHLIGHTED.
- 3) CLICK ON EITHER THE [ENABLE] OR [DISABLE] BUTTONS.
- 4) CLICK ON THE [OK] BUTTON TO APPLY THE CHANGES.

STARTING THE VR LINKER.

The VR Linker window is the main link between the user and the devices and objects in the Viscape window. You use the VR Linker to control the actions of chosen devices present in each of the virtual robot worlds.

After starting the VR Robot program, logging in your user name as described in section 2, the VR Linker window will appear, visible in the top lefthand corner of your screen.



The VR Linker will display "No Virtual Room Selected" because no virtual worlds (robot rooms) have been opened, ie, the VR Linker has not detected any devices to control. Whenever the link to a virtual world is cut the same "No Virtual Room Selected" screen will be displayed.

OPENING A VIRTUAL WORLD.

To open a virtual world robot room, click "File|Run Virtual World" in the menubar of the VR Linker window.

From the "Run Virtual World" menu, click on the virtual world robot room file you want to open. The Viscape window will now appear, automatically loading the correct virtual world, which opens to display a pair of lift doors.

SWITCHING ON THE DEVICES.

When a robot room is loaded, the "No Virtual Room Selected" message on the VR Linker window is replaced by the screen shown below. At the same time, the Viscape window appears, automatically loading the correct virtual world. All robot rooms start from within a lift. Click on either lift door to open the lift doors.

The VR Linker changes to to show a DEVICE panel and an ACTIONS panel. At this stage, all the smaller buttons in the device and actions panels are greyed out. This is because no devices in the virtual world have been switched on.



DEVICE -

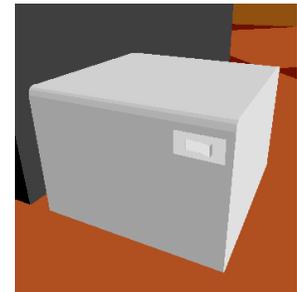
An object, such as a robot, that can be controlled in the virtual worlds, using VR Linker.

ACTIONS -

Pre-programmed operations or tasks that can be performed by devices in the virtual robot worlds.

TO START A ROBOT :

Find the rectangular electrical control box (usually on the floor) and switch the white mains power switch on (by clicking on the switch with your mouse). You will see and hear the robot nest (move to its datum position) automatically.



TO START A LATHE :

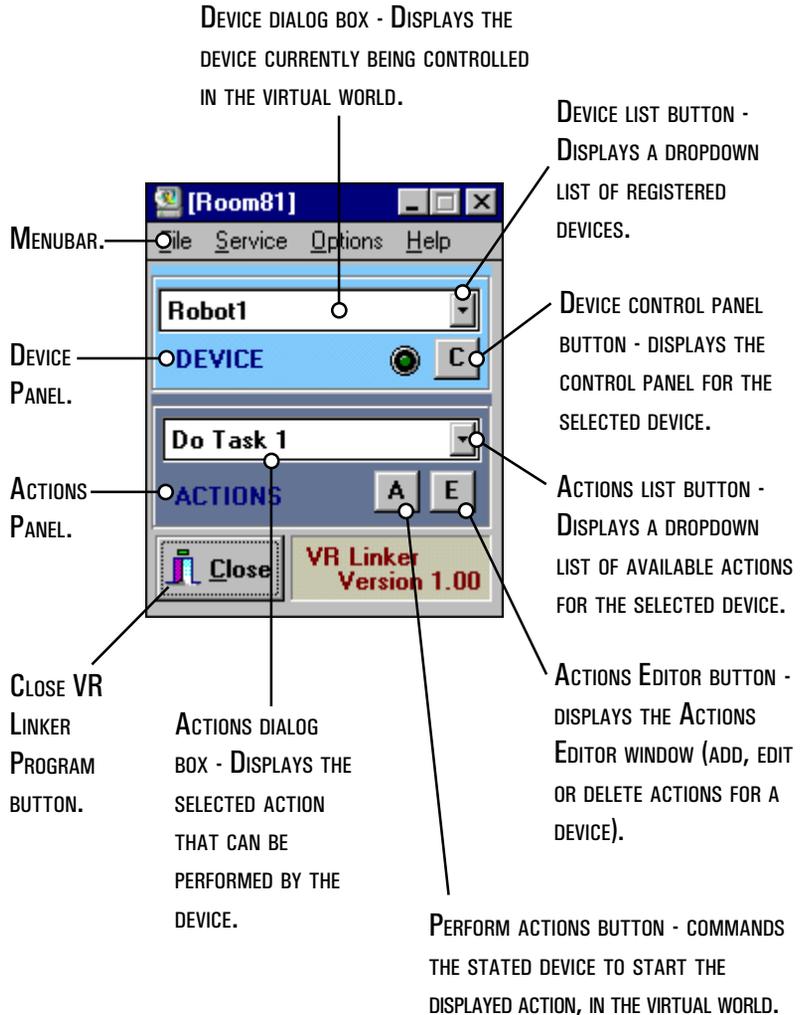
Find the large yellow and red mains power switch at the back of the machine and switch it on (by clicking on the switch with your mouse). The monitor screen on the front of the machine will power up and the guard door will open.



VR LINKER - GENERAL LAYOUT.

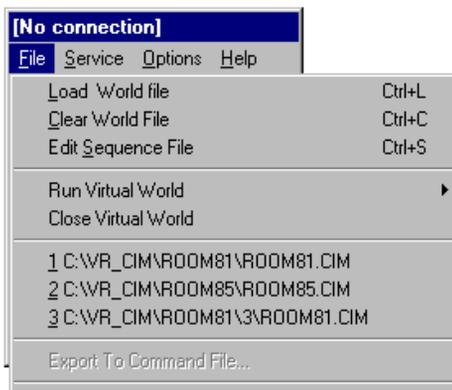
When the first device in the virtual world is switched on, the name of the device appears in the DEVICE panel and the green led will stop flashing. Any actions associated with the device appear in the ACTIONS panel. In the example below, a robot has been switched on in the virtual world.

VR LINKER WINDOW - GENERAL LAYOUT.



VR LINKER - FILE MENU.

FILE MENU.



The options available in the File menu are as follows:

- **Load World File** - Displays dialog boxes allowing a new world (".CIM") file to be loaded (used for editing robot memories, script files and sequence files without having to load the virtual world itself).
- **Clear World File** - Removes the currently loaded world file from the VR Linker.
- **Edit Sequence File** - Displays the Sequence File Editor window. The sequence files on the virtual CIM and the real CIM share the same (".SEQ") format.
- **Run Virtual World** - Move cursor to the right to display a list of the five Virtual World Robot Rooms. Click on a robot room to open it in the Viscap window.
- **Clear World File** - Closes the Viscap window containing the currently loaded robot room.
- **History** - Displays the history of any world files opened.
- **Export to Command File** - Exports the current list of actions for all the devices in the virtual world as a command (".CMD") file, which can be used by device drivers on a real CIM system. The option will be greyed out when unavailable.

VR LINKER - SERVICE MENU.

SERVICE MENU.



The options available in the Service menu are as follows:

- **Reset** - Resets all the values and properties of the currently loaded control link back to their original default settings.

VR LINKER - OPTIONS MENU.

OPTIONS MENU.



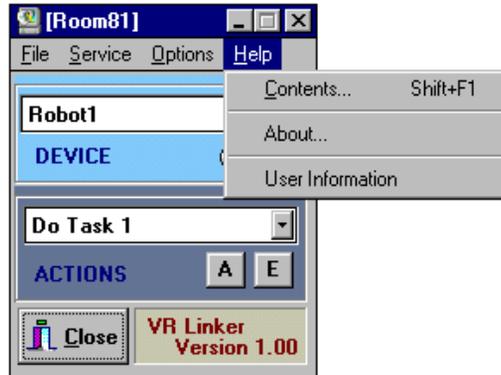
The options available in the Options menu are as follows:

- **Use Interlocks** - Allows any interlocks that have been entered into the Action Editor to be used when tasks are performed by the devices.

This option is greyed out (unavailable) unless interlocks are required in the currently opened virtual world (see section 6.7 for further information about using interlocks).

VR LINKER - HELP MENU.

HELP MENU.



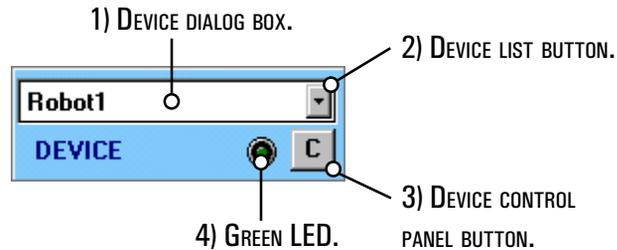
The options available in the Help menu are as follows:

- **Contents** - Displays the contents page of the on-line helpfile.
- **About....** - Displays the About information box for the VR Linker program. Click on the [OK] button to close the About.... window.
- **User Information** - Displays the user name and directory number associated with that user. Click on the [OK] button to close the User Information window. Any files required or saved by the user for particular virtual worlds are saved in their own directory.



For example, a file saved by user number 3 when using the first virtual robot world (Room 81) would be saved to the path C:\Program Files\Denford\Virtual Robot\room81\3\filename.

VR LINKER - THE DEVICE PANEL.



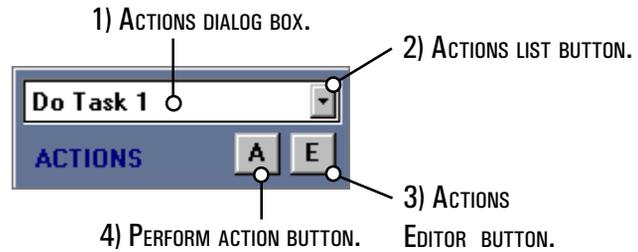
The DEVICE panel contains the following:

- 1) **The Device dialog box** - This dialog box displays the device currently being controlled in the virtual world.
- 2) **The Device list button** - Click this button to display a drop-down list of registered devices (shown below). Click on the required device to display it in the device dialog box.



- 3) **The Device control panel button** - Click this button to display either the robot or lathe control panel, according to the device shown in the device dialog box.
- 4) The green LED will light when the device stated in the device dialog box is active (ie, it is performing a program or operation in the virtual world).

VR LINKER - THE ACTIONS PANEL.



The ACTIONS panel contains the following:

- 1) **The Actions dialog box** - This dialog box displays the action that can be performed by the selected device.
- 2) **The Actions list button** - Click this button to display a drop-down list of the available actions for the selected device (shown below). Click on the required action to display it in the actions dialog box.

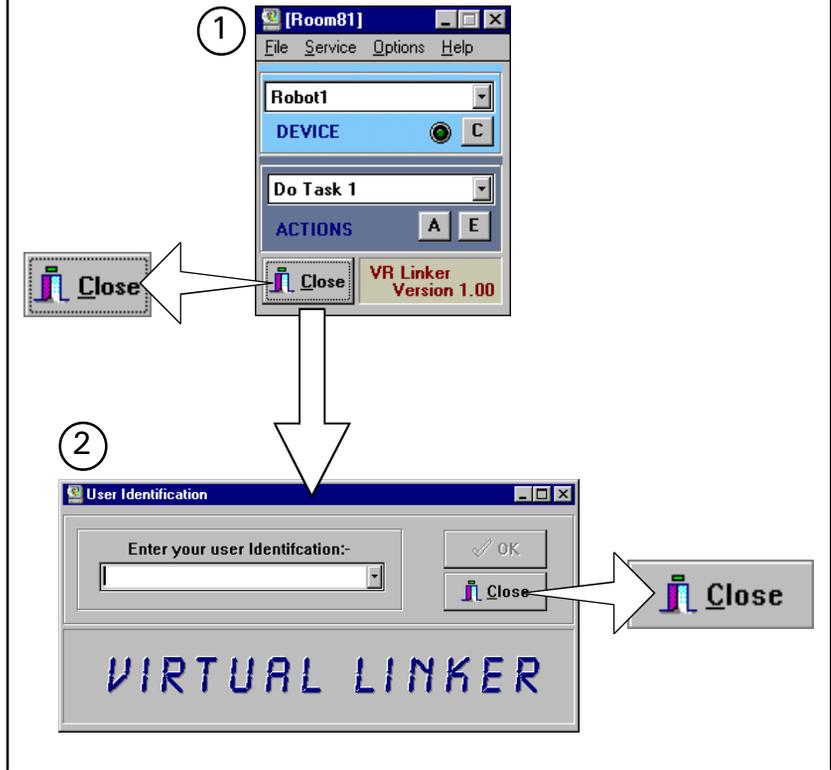


- 3) **The Actions Editor button** - Click the [E] button to display the Actions Editor window. The Actions Editor allows actions to be added, edited or deleted for the selected device.
- 4) **The Perform Action button** - Click the [A] button to carry out the action displayed in the actions dialog box for the selected device.

VR LINKER

- CLOSE PROGRAM.

To close the VR Linker program, click the close button on the VR Linker window, followed by the Close button on the User Identification window:



STARTING THE ACTIONS EDITOR.

The Actions Editor is used to add, edit or delete any of the action commands that appear in the drop-down list of actions from the VR Linker.

When different devices are used, the action editor is also used to manage any interlocks that apply to the action commands being edited.

To display the Actions Editor window, click the [E] button in the ACTIONS panel of the VR Linker window.



CLICK THE [E] BUTTON TO
DISPLAY THE ACTIONS
EDITOR WINDOW.

ACTIONS EDITOR - GENERAL LAYOUT.

Note - When no Interlock settings are available for the Virtual World, a smaller Actions Editor featuring just the Commands Panel is displayed....

ACTION EDITOR WINDOW (FEATURING COMMANDS ONLY) - GENERAL LAYOUT.

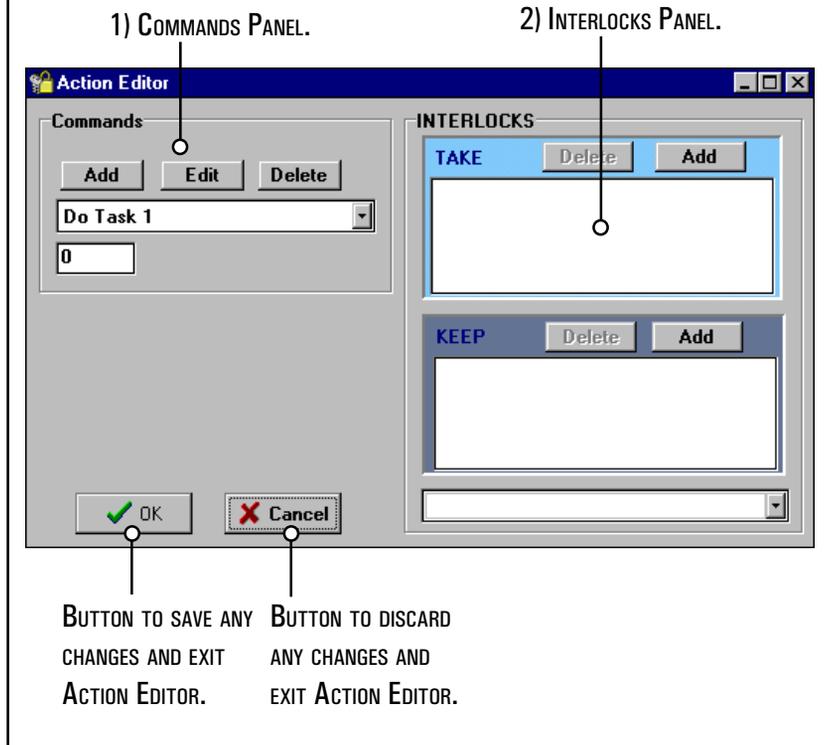


ACTIONS EDITOR - GENERAL LAYOUT.

The Actions Editor (shown below) is split into two main panels:

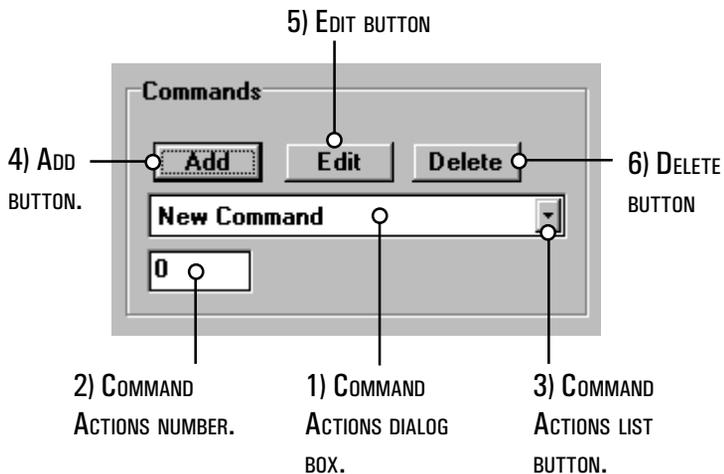
- 1) **The Commands panel** - used to add, edit or delete any of the actions for the device stated in the device dialog box of the VR Linker window. The actions listed in the Commands panel of the Action Editor are the same as the actions listed in the ACTIONS panel of the VR Linker.
- 2) **The Interlocks panel** - used to manage the interlock settings between the different devices in the virtual world, for the action stated in the Commands panel.

ACTION EDITOR WINDOW (FEATURING COMMANDS AND INTERLOCKS) - GENERAL LAYOUT.



ACTIONS EDITOR - COMMANDS PANEL.

COMMANDS PANEL - LAYOUT.



The Commands Panel (shown above) is positioned on the left side of the Action Editor window.

The Commands Panel contains the following:

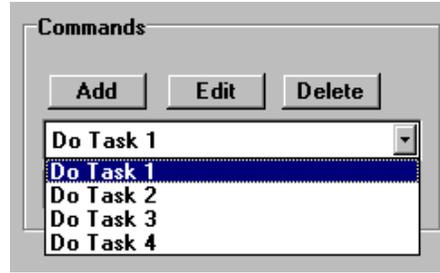
- 1) **The Commands Action dialog box** - This dialog box displays the current command action that can be edited or deleted.
- 2) **The Commands Action Number box** - This box displays the number currently assigned to the action in the commands action dialog box. Each action must have a different number (ie, numbers cannot be repeated within the same list of action commands).

continued....

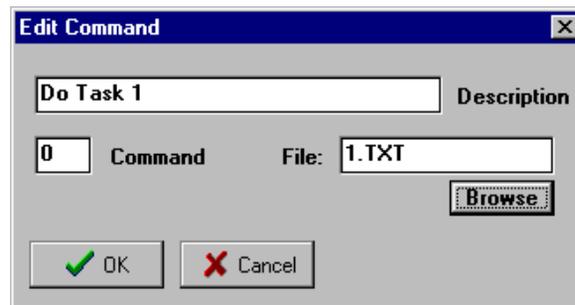
ACTIONS EDITOR - COMMANDS PANEL.

continued....

- 3) **Command Actions List button** - Click this button to display the drop-down list of current actions (shown below). Click on the required action from the list with the left mouse button to display it in the commands actions dialog box.



- 4) **[Add] button** - Click this button to add a "New Command" to the available list of actions. To assign a command description, number and program/script file to the new command click the [Edit] button. The new command action will also be added to the ACTIONS dropdown menu of the VR Linker window.
- 5) **[Edit] button** - Click this button to display the Edit Command window (shown below). This allows editing of the command action description, command action number and the program/script file (the command action program).



continued....

ACTIONS EDITOR - COMMANDS PANEL.

continued....

- 5) To change the command action name, click in the description dialog box and overtype with the new name.

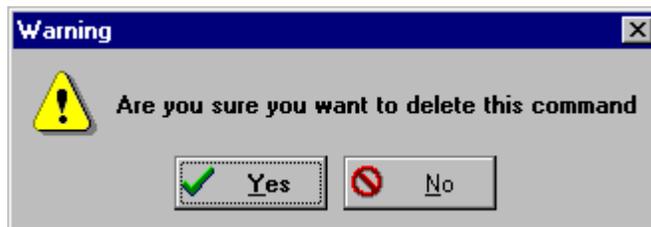
To change the command number, click in the Command dialog box and overtype with the new number.

Click on the [Browse] button to search for a new program /script ".txt" file.

Click on the [OK] button to confirm and apply any editing changes made to the command editor and close the Edit Command window.

Click on the [Cancel] button to ignore any editing changes made to the command editor and close the Edit Command window.

- 6) **[Delete] button** - Click this button, followed by the [Yes] button on their confirmation screen (shown below) to permanently remove the command action shown in the Commands panel dialog box.

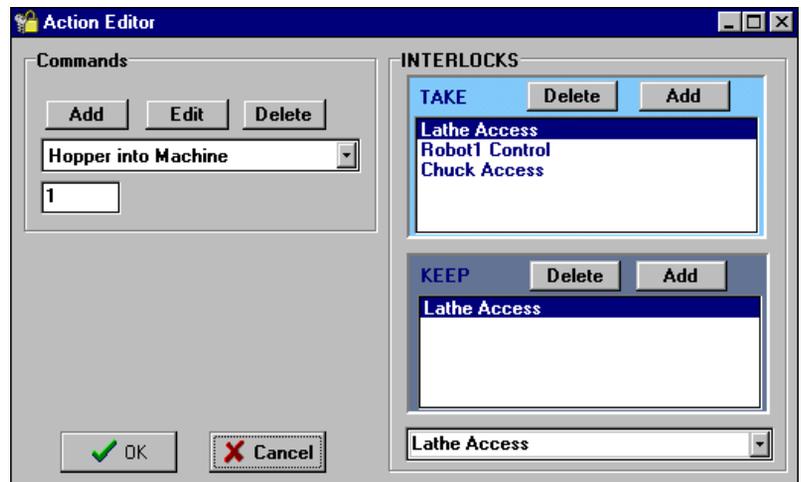


ACTIONS EDITOR - INTERLOCKS PANEL.

The Interlocks Panel displays any interlocks used by the action displayed in the Command panel.

An interlock is a "key" to control the functioning of a device, important when using multiple numbers of different devices, such as in CIM systems. Interlocks are "held" by an interlock manager and can be "taken" and "kept" by devices performing actions in the virtual world.

An interlock can only be assigned to one device at a time - if an interlock is being used, or kept by a device, a different device cannot use that particular interlock at the same time. Interlocks are used to prevent devices and machines from conflicting or damaging each other.



For example, the "Hopper into Machine" command (shown in the screenshot above) dictates that the robot will move into the lathe. The robot will therefore "take" the "Lathe Access" interlock "key" to ensure that the lathe door cannot be closed by the lathe as it is positioning inside the lathe cabinet.

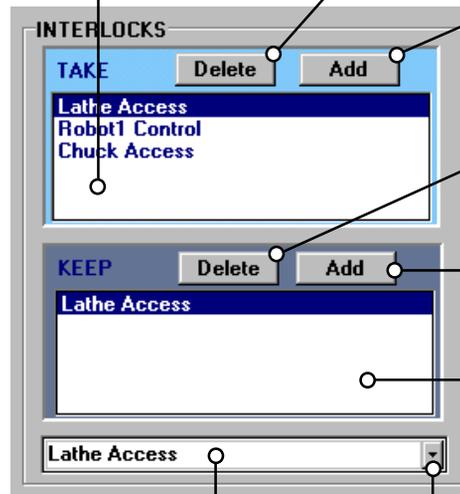
ACTIONS EDITOR - INTERLOCKS PANEL.

INTERLOCKS PANEL - LAYOUT.

1) TAKE INTERLOCK
DIALOG BOX.

2) TAKE INTERLOCK
DELETE BUTTON.

3) TAKE INTERLOCK
ADD BUTTON.



5) KEEP INTERLOCK
DELETE BUTTON.

6) KEEP INTERLOCK
ADD BUTTON.

4) KEEP INTERLOCK
DIALOG BOX.

7) INTERLOCKS AVAILABLE
DIALOG BOX.

8) INTERLOCK LIST
BUTTON.

The Interlocks Panel (shown above) is positioned on the right side of the Action Editor window.

The Interlocks Panel contains the following:

- 1) **Take Interlock dialog box** - This box lists the interlocks that must be "taken" by the device, in order to perform the command action shown in the command panel.

In the example shown above, the device "Robot 1" must take the interlocks "Lathe Access", "Robot 1 Control" and "Chuck Access" from the list of free interlocks in the interlock manager, before it can begin the command action "Hopper into Machine", stated in the command panel (shown on page 6.6).

continued....

ACTIONS EDITOR - INTERLOCKS PANEL.

continued....

- 1) By taking "Lathe Access", the robot can ensure that the lathe door is left open for it to gain access to the chuck. Similarly, "Chuck Access" allows the robot to place the billet in the chuck without fear of the machine either closing the chuck or switching the spindle on.
- 2) **Take Interlock [Delete] button** - Click this button to remove the interlock currently highlighted in the take interlocks list. To select an interlock, simply click on it with the left mouse button.
- 3) **Take Interlock [Add] button** - Click this button to add the interlock displayed in the interlock available dialog box (at the bottom of the interlocks panel) to the take interlocks list.
- 4) **Keep Interlock dialog box** - This box lists the interlocks that will be "kept" by the device, after the command action shown in the command panel has been completed. In the example shown on page 6.6, the "Robot 1" will continue to keep the interlock "Lathe Access" from the take interlocks list, after completing the command action "Hopper into Machine". The "Chuck Access" interlock is released so that the lathe can take this interlock and close its chuck. The "Lathe Access" interlock is kept by "Robot 1" to prevent the lathe from closing its machine door with the robot still in the machine.

continued....

ACTIONS EDITOR - INTERLOCKS PANEL.

continued....

- 5) **Keep Interlock [Delete]** - Click this button to remove the interlock currently highlighted in the keep interlocks list. To select an interlock, simply click on it with the left mouse button.
- 6) **Keep Interlock [Add]** - Click this button to add the interlock displayed in the interlock available dialog box (at the bottom of the interlocks panel) to the keep interlocks list.
- 7) **Interlocks available dialog box** - This dialog box displays the current interlock lists that can be added to the Take or Keep interlock lists.
- 8) **Interlock list button** - Click on this button to display the drop-down menu of available interlocks. Highlight and click with the left mouse button on the required interlock to display it in the interlocks available dialog box.

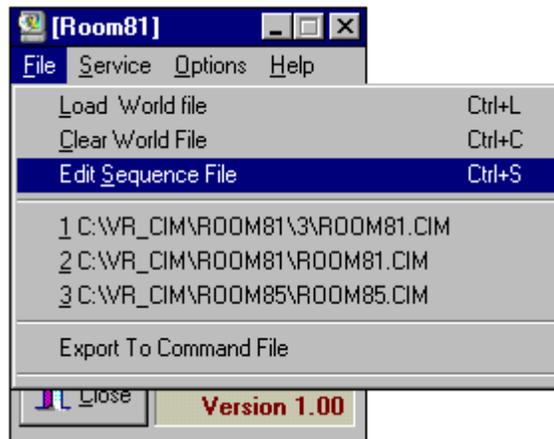
STARTING THE SEQUENCE FILE EDITOR.

Sequence files are used to link together a series of preprogrammed actions performed by devices present in the virtual robot world. As the sequence file plays, line by line, the stated actions will be performed by the devices in the virtual world.

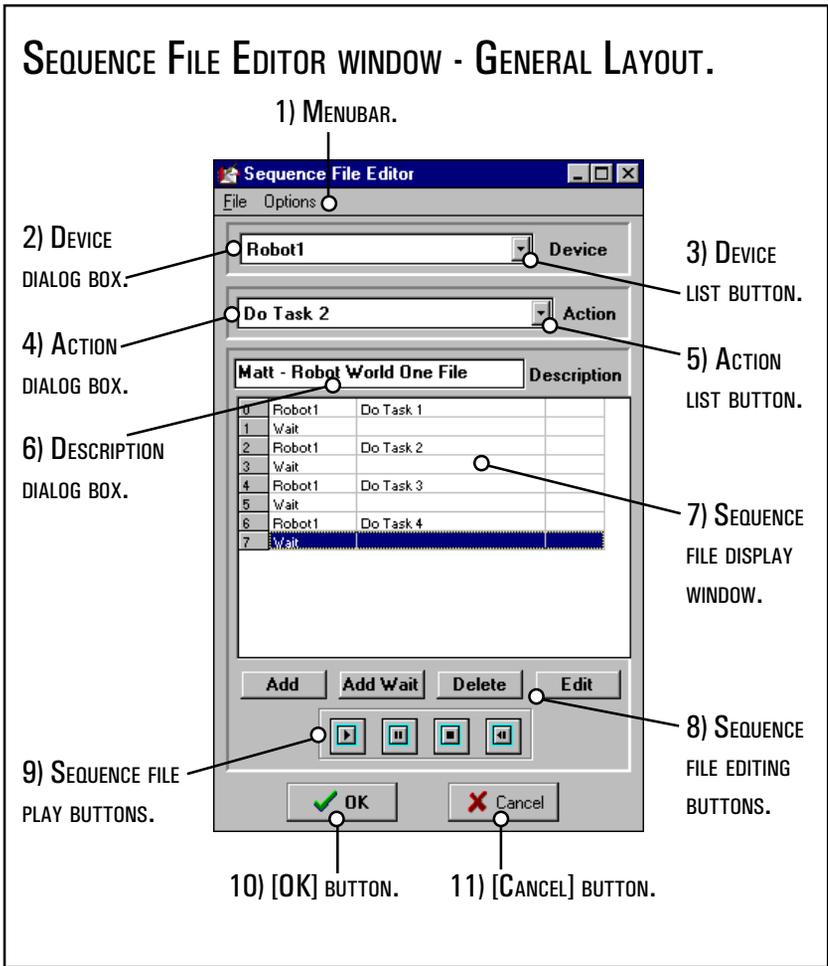
The actions and devices used in the sequence file are the same actions and devices used in the main VR Linker.

The Sequence File Editor allows complete control in the playing and composition of these sequence files.

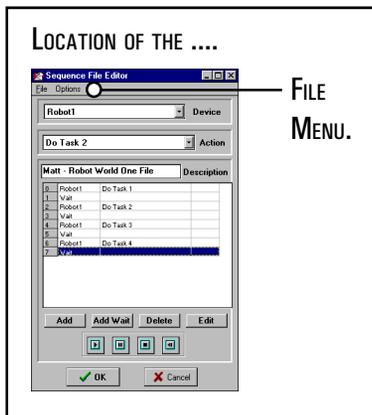
To display the Sequence File Editor window, select "File|Edit Sequence File" from the VR Linker menubar, as shown below.



SEQUENCE FILE EDITOR - GENERAL LAYOUT.



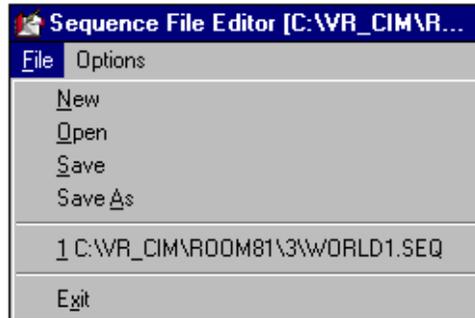
SEQUENCE FILE EDITOR - MENUBAR.



The Sequence File Editor contains the following:

1) **The Menubar** - There are two menus on the sequence file editor menubar:

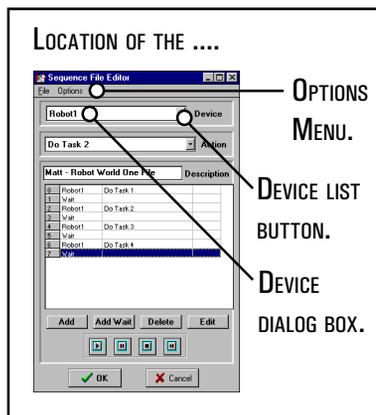
The File Menu (shown below) - which contains the following:



- **New** - Starts a new sequence file.
- **Open** - Displays the Open file window. Browse and open any previously saved (".SEQ" format) sequence files.
- **Save** - Autosave and overwrite a sequence file with the last used filename.
- **Save As** - Display a Save Sequence File window, allowing the file to be saved with a specific filename in a specific directory.
- **History** - Displays the history of any sequence files opened.
- **Exit** - Closes the sequence file editor window without saving any changes.

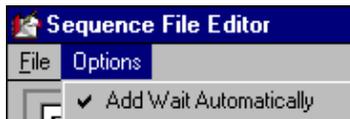
continued....

SEQUENCE FILE EDITOR - MENUBAR AND DEVICE PANEL.



continued....

- 1) **The Options Menu** (shown below) - which contains the following:



- **Add Wait Automatically** - The option is "on" when a "tick" mark is visible. When the [Add] button is clicked, to add a new sequence file line, an extra line containing a wait command is automatically inserted between the two.

The option can be ticked "on" and "off" by clicking on the "Add Wait Automatically" option with the left mouse button.

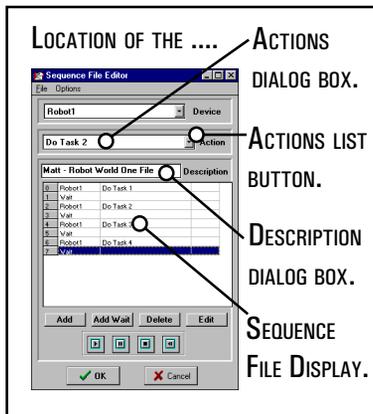
- 2) **The Device dialog box** - This dialog box (shown below) displays the name of the device controlled by the action stated in the actions dialog box.



- 3) **The Device list button** - Click this button to display a drop-down list of registered devices. Click on the required device to display it in the device dialog box.

continued....

SEQUENCE FILE EDITOR - ACTIONS PANEL, DESCRIPTION PANEL AND SEQUENCE FILE DISPLAY.



continued....

- 4) **The Actions dialog box** - This dialog box (shown below) displays the name of the action (to be performed by the device stated in the device dialog box) that can be added to the sequence file.



- 5) **The Actions list button** - Click this button to display a drop-down list of the actions available for the device stated in the device dialog box. Click on the required action to display it in the actions dialog box.

- 6) **The Description dialog box** - Click in the dialog box (shown below) to type a descriptive name for the sequence file.



- 7) **The sequence file display** - The sequence file (shown below) is displayed as a numbered series of lines, which run chronologically from top to bottom. Each line contains the nature of the task to be performed, action, wait, etc.... To highlight any sequence line, simply click the left mouse button, when the cursor is directly over the required line.

0	Robot1	Do Task 1	
1	Wait		
2	Robot1	Do Task 2	
3	Wait		
4	Robot1	Do Task 3	
5	Wait		
6	Robot1	Do Task 4	
7	Wait		

continued....

SEQUENCE FILE EDITOR - SEQUENCE FILE EDITING BUTTONS.

LOCATION OF THE



SEQUENCE
FILE EDITING
BUTTONS.

continued....

8) **The sequence file editing buttons** - There are four buttons (shown below) used when editing a sequence file:



- **[Add]** - Click this button to insert a sequence file line containing the action and device stated in the action dialog box and the device dialog box.

The information stated in the action and device dialog boxes form the basis of the data used in any sequence line you add or edit.

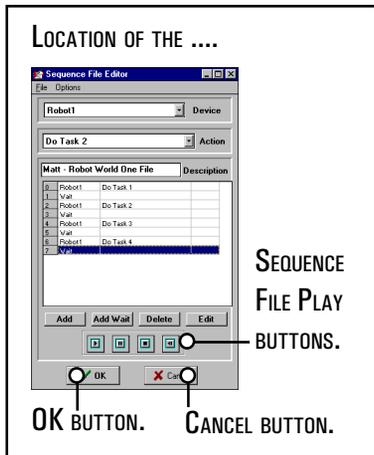
- **[Add Wait]** - Click this button to insert a wait sequence line. This instructs the sequence file to wait a set length of time before moving onto the next sequence line.

- **[Delete]** - Click this button to permanently remove the currently highlighted sequence line.

- **[Edit]** - Click this button to replace the information stated in the currently selected sequence line, for the action and device currently stated in the action and the device dialog boxes.

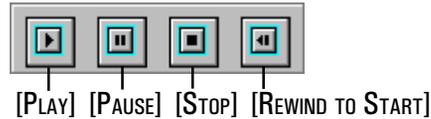
continued....

SEQUENCE FILE EDITOR - SEQUENCE FILE PLAY BUTTONS, OK AND CANCEL BUTTONS.



continued....

9) **The sequence file play buttons** (shown below) - There are four sequence file play buttons:



- **[Play]** - Click this button to play the sequence file from the currently highlighted sequence line onwards. As the the sequence file plays, line by line, the stated actions will be performed by the devices in the virtual world.

- **[Pause]** - Click this button to pause a sequence file that is playing. Click the [Pause] button to resume playing a paused sequence file.

- **[Stop]** - Click this button to stop the sequence file playing, at the end of the sequence line currently being performed.

- **[Rewind to Start]** - Click this button to return to the first sequence line of the sequence file.

10) **The [OK] button** (shown below) - Click this button to apply and/or save any changes made to the sequence file and close the sequence file editor window.



11) **The [Cancel] button** (shown below) - Click this button to close the sequence file editor window without saving any changes.



SEQUENCE FILE EDITOR - EXAMPLE.

The following example shows how to write a new sequence file from a set of preprogrammed actions:

- 1) Select "File|New" to display a blank sequence file.
- 2) Select and check that "Options|Add Wait Automatically" is "ticked on".

Note - when writing a sequence file, it is often easiest to add the lines to the file chronologically, ie, in the actual order you would expect to see them be performed.

- 3) Select the device to be controlled, so it is displayed in the device dialog box. Use the list button at the right of the dialog box to chose the device.
- 4) Select the action to be performed, so it is displayed in the device dialog box. Use the list button at the right of the dialog box to chose the action.
- 5) Click the [Add] button to insert a sequence line containing the information from 4) and 5).

An extra line containing a "Wait" command will be automatically inserted after your sequence file line.

If a line is incorrect, highlight the incorrect line by clicking on it with your mouse. Click the [Delete] button to remove it. Alternatively, change the information from 4) and 5), then click the [Edit] button.

- 6) Repeat steps 3) to 6) for all the actions and devices required in the sequence you have planned.
- 7) Click the [Rewind to Start] button, then the [Play] button. Edit any lines of your sequence file, if necessary.
- 8) Save your sequence file by selecting "File|Save As".

DISPLAYING THE ROBOT TEACHBOX.

The Robot Teachbox is used to control the manual movement, operating functions and programming of both the virtual robot and a "real" Mitsubishi RVM-1 (when linked to the computer).

Graphically, the layout and appearance of the teachbox is identical to the Mitsubishi RVM-1 robot teachbox. Users that can master the use the virtual robot teachbox can therefore use a "real" Mitsubishi RVM-1 with the same degree of confidence.

To display the Robot Teachbox window, check that the name of the robot you want to control is displayed in the DEVICE dialog box of the VR Linker window, then click the robot teach box - [C] - button.



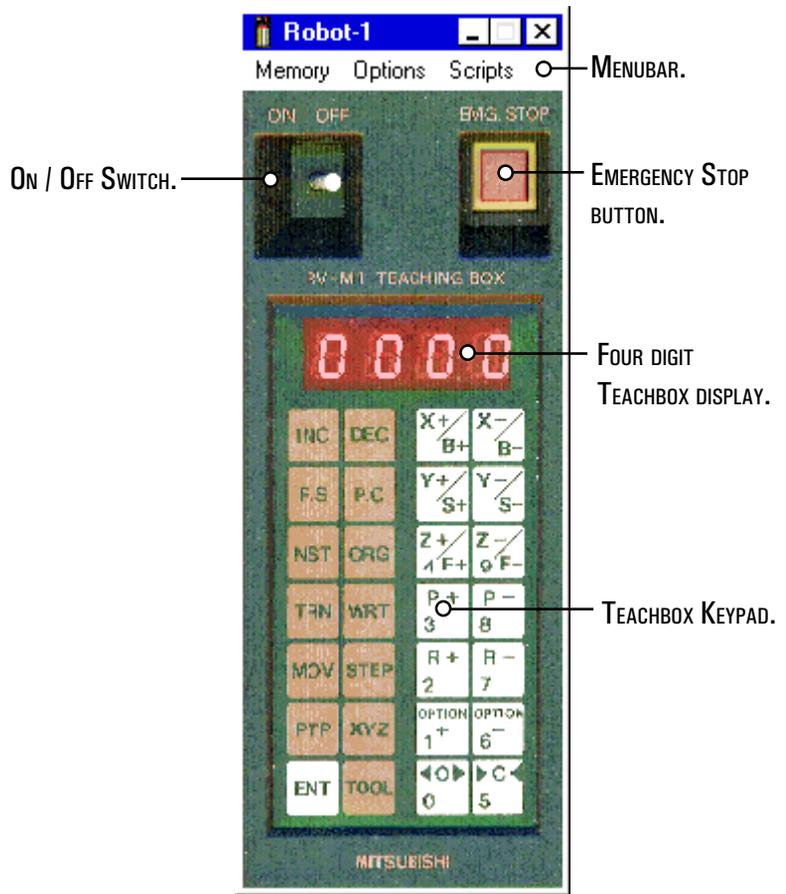
1) SELECT THE ROBOT YOU WANT TO CONTROL, SO IT IS DISPLAYED IN THE DIALOG BOX OF THE DEVICE PANEL.

2) CLICK THE [C] BUTTON TO DISPLAY THE ROBOT TEACHBOX.

Note - the robot teachbox button is greyed out (not accessible) if the robot itself is switched off. Click on the switch at the back of the robot electrical control box to power up the robot (as shown on page 5.2).

ROBOT TEACHBOX - GENERAL LAYOUT.

ROBOT TEACHBOX WINDOW - GENERAL LAYOUT.

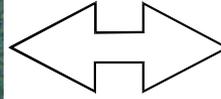


ROBOT TEACHBOX - SWITCHING ON AND OFF.

TEACHBOX OFF.



TEACHBOX ON.



To switch the robot teachbox on, click the on/off switch so it points to the "on" position.

To switch the robot teachbox off, click the on/off switch so it points to the "off" position.

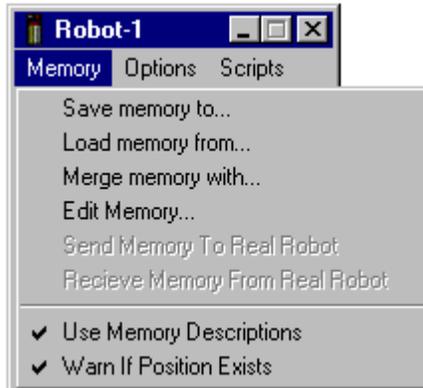
ROBOT TEACHBOX - EMERGENCY STOP BUTTON.



Pressing the Emergency Stop button will halt any virtual robot movements.

Note - when a "real" Mitsubishi RVM-1 robot is linked to the virtual robot software, pressing the Emergency Stop button on the virtual robot teachbox has **NO EFFECT** on the real robot. The real robot will carry on until the commanded move has been completed !!

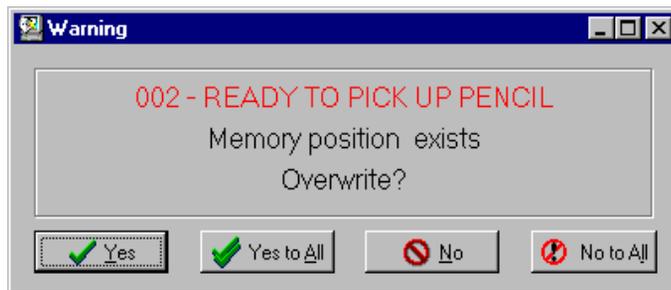
ROBOT TEACHBOX - MEMORY MENU.



The options available in the Memory menu are as follows:

- **Save Memory to...** - Displays the Save As window, allowing the memory to be saved to a set location as a Robot Memory File (".RTF" format).
- **Load Memory from...** - Displays the Open file window. Browse and open any previously saved Robot Memory Files (".RTF" format).
- **Merge Memory with...** - Displays the Open file window. The Merge function allows a saved RTF file to be combined with the existing Robot Memory File.

When robot postions with identical position numbers are found, a Warning window is displayed (shown below).



continued....

ROBOT TEACHBOX - MEMORY MENU.

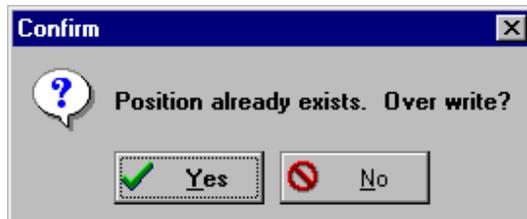
continued....

Click [Yes] to overwrite the existing robot position number with the new (displayed) position, [Yes to All] to overwrite all existing identical robot position numbers with their new positions, [No] to ignore the new identical robot position number or [No to All] to ignore all new identical robot positions.

- **Edit Memory...** - Displays the Edit Robot Memory window. This lists all the currently stored robot positions, with their position numbers, gripper state (O-open, C-closed) and descriptive comment.

See page 8.10 Edit Robot Memory window for further information.

- **Send Memory To Real Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.
- **Receive Memory From Real Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.
- **Use Memory Descriptions** - The option is "on" when a "tick mark" is visible. When a robot position is set, a window is displayed allowing a written description to be entered and stored with the robot position.
- **Warn If Position Exists** - The option is "on" when a "tick mark" is visible. A warning window (shown below) is displayed when a robot position is set with a position number already in use - Confirm whether to overwrite the current stored position with the new set position.



ROBOT TEACHBOX - OPTIONS MENU.



The options available in the Options menu are as follows:

- **Jog Speed - (1-9)** - Displays the current jog speed, the incremental speed at which the robot will move, when being manually positioned using the robot teachbox buttons.

Click on the option to display the Jog Speed window (shown below). Adjust the slider until the required jog speed is shown, then press the [OK] button.



Jog speed - 1 is slow but very accurate at positioning, whilst Jog Speed - 9 is fast but inaccurate when positioning.

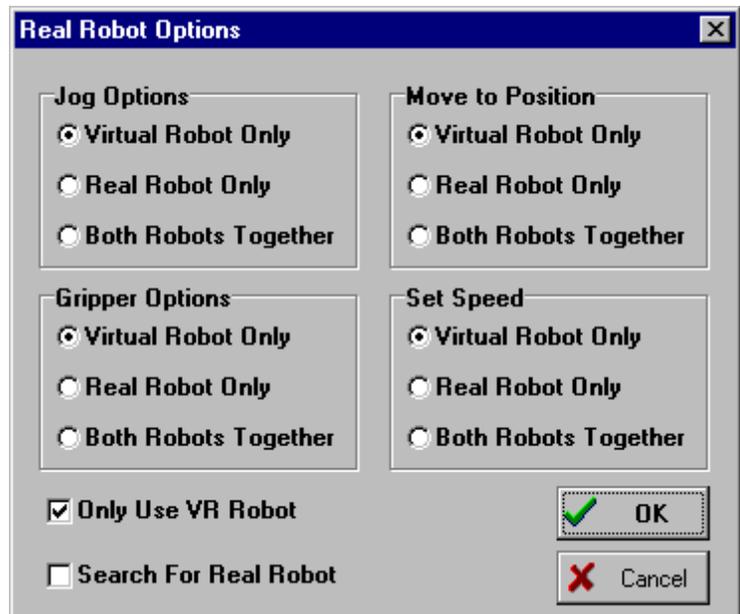
continued....

ROBOT TEACHBOX - OPTIONS MENU.

continued....

- **Collision Detection** - The option is "on" when a "tick mark" is visible. The virtual robot cannot "move through" other objects. If an object is hit by the robot, a warning sound is emitted and the robot stops.
- **Robot Control Mode** - Displays the Real Robot Options window, allowing you to configure the type of data to be sent to either the virtual robot, a "real" robot, or both.

If a "real" robot is not connected to the computer, each of the four panels should be set to the "Virtual Robot Only" option and a "tick mark" visible in the "Only Use VR Robot" box only (as shown below). This will allow the software to run faster.



- **Send Tool Length to Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.

continued....

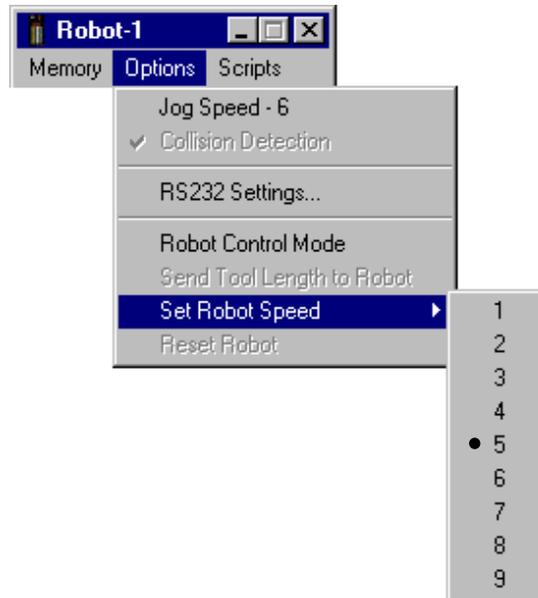
ROBOT TEACHBOX - OPTIONS MENU.

continued....

- **Set Robot Speed** - Displays a numbered "1 to 9" menu (as shown below), the numbers referring to the movement speed of the robot, when a move to position number command is issued.

A small "dot" is shown opposite the current setting for the robot speed.

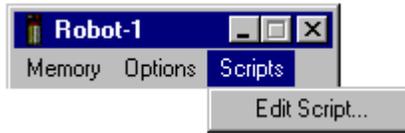
To set the movement speed, click on the required number, 1 is slow but very accurate at positioning, whilst 9 is fast but inaccurate when positioning.



Do not confuse this with Jog Speed, which is the incremental movement speed of the robot when manually positioned using the teachbox buttons.

- **Reset Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.

ROBOT TEACHBOX - SCRIPTS MENU.



The options available in the Scripts menu are as follows:

- **Edit Script...** - Displays the Robot Script Editor window, where robot programs (script files) that use the positions stored in the robot memory, are written and edited.

See section 10 for further information on how to use the the Robot Script Editor.

ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

The Edit Robot Memory window is accessed from the "Memory" menu in the robot teachbox menubar.

Clicking on the "Edit Memory..." option displays the Edit Robot Memory window (shown in the righthand panel). This lists all the currently stored robot positions, together with their position numbers, gripper state (O-open, C-closed) and a descriptive comment.

The Robot Memory can store between 1 - 629 robot positions (each with its corresponding 001 - 629 position number).



The [OK] button (shown above) will save any changes made in the Edit Robot Memory window to the current robot memory file, then close the Edit Robot Memory window.



The [Cancel] button (shown above) will close the Edit Robot Memory window without saving any of the changes.

ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

MEMORY MENU - EDIT ROBOT MEMORY WINDOW - GENERAL LAYOUT.

The screenshot shows a window titled "Edit Robot Memory" with a table of memory entries. The table has three columns: "No.", "G", and "Description". The entries are as follows:

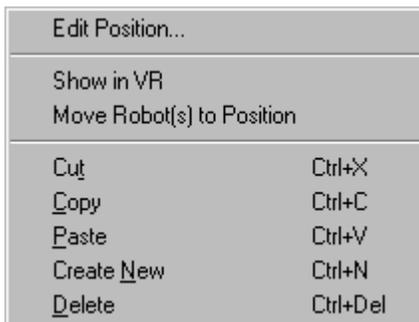
No.	G	Description
002	C	READY TO PICK UP PENCIL
003	O	GRIPPERS AROUND PENCIL
010	C	OVER GREEN
011	C	IN GREEN
020	C	OVER YELLOW
021	C	IN YELLOW
030	C	OVER RED
031	C	IN RED
040	C	OVER BLUE
041	C	IN BLUE
050	C	SAFE OVER MIDDLE
100	C	PARKED POSITION
101	O	TEST POSITION

Below the table are two buttons: "OK" (with a green checkmark icon) and "Cancel" (with a red X icon). Callout lines point from the following text to the corresponding parts of the window:

- ROBOT POSITION NUMBER. (points to the "No." column)
- GRIPPER OPEN/CLOSED. (points to the "G" column)
- ROBOT POSITION DESCRIPTION. (points to the "Description" column)
- CLOSE EDIT ROBOT MEMORY WINDOW SAVING ANY CHANGES. (points to the "OK" button)
- CLOSE EDIT ROBOT MEMORY WINDOW DISCARDING ANY CHANGES. (points to the "Cancel" button)

ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

To edit any of the stored positions, highlight the required position from the list shown in the Edit Robot Memory window, then click the right mouse button to display the Edit Position menu (shown below).



The options available in the Edit Position menu are as follows:

- **Edit Position...** - Displays the Position Editor screen (shown in the righthand panel), used to change the co-ordinate positions, angles and descriptions for the highlighted robot postion.

The options available on the Position Editor screen are as follows:

To change the description, click in the description dialog box and overtype with the new text. Note - the robot position number itself cannot be changed.

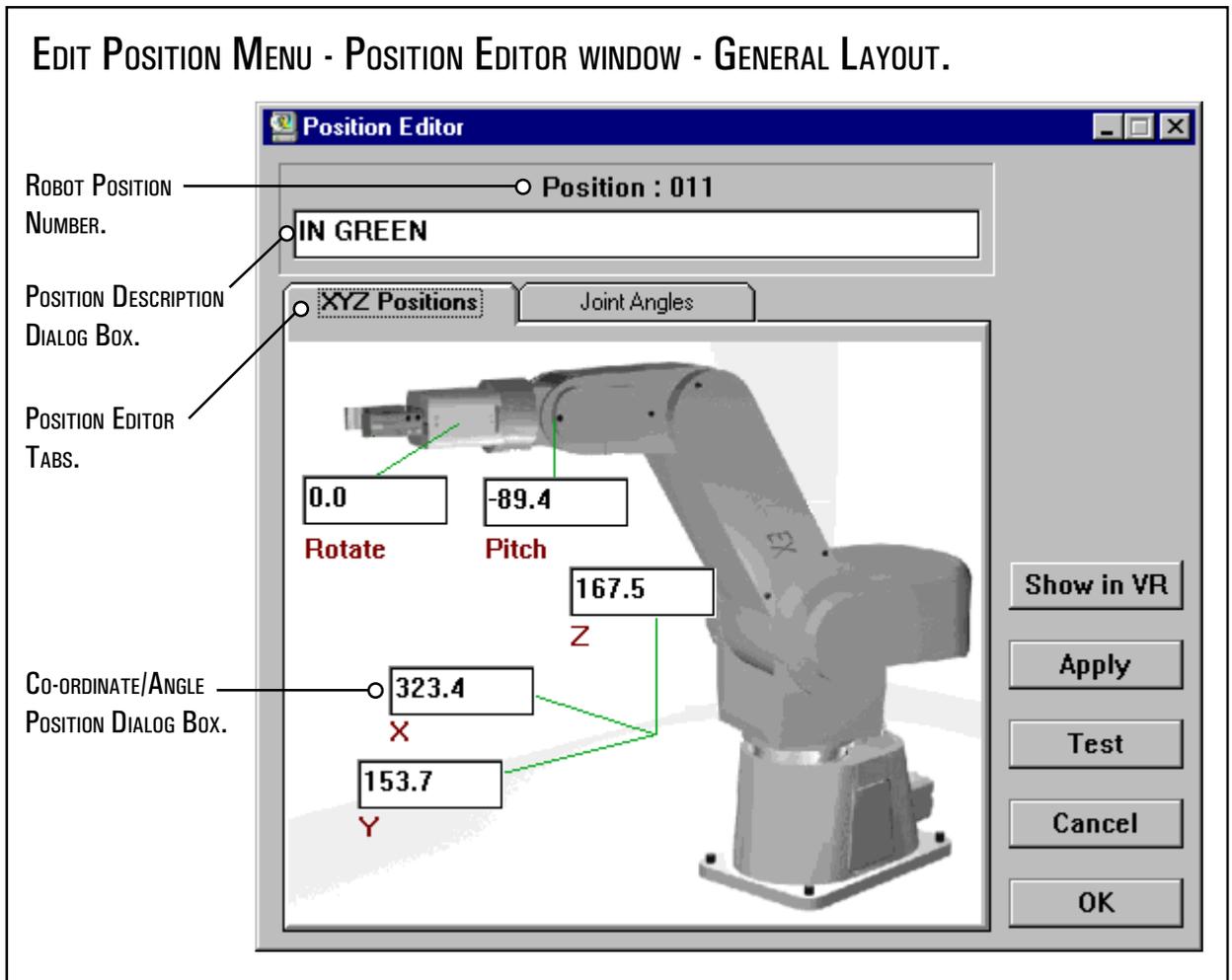
To change the X, Y and Z co-ordinate positions, click on the "XYZ Positions" tab, then click in the required co-ordinate dialog box and overtype with the new value.

To change the Joint Angles positions, click on the "Joint Angles" tab, then click in the required angle dialog box and overtype with the new value.

continued on page 8.14....

ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

EDIT POSITION MENU - POSITION EDITOR WINDOW - GENERAL LAYOUT.



ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

continued from page 8.12....

- **Edit Position...** - The options available on the Position Editor screen are as follows:

Click the [Show in VR] button to display the gripper reference point - a small red diamond shape - which represents the tip position of the robot grippers. The gripper reference point is used to show any highlighted or edited robot positions, without having to move the virtual robot itself. To hide the red diamond, click on it with the mouse.

When changes have been made to any coordinate or angle values the [Apply] button will become active. Clicking the button performs a Maths check to determine if the value entered can be reached by the robot. If the value entered is valid, the button will become greyed out (unavailable). If the value is not valid, an error message window is displayed - click the [OK] button on the error message window and enter a new value.

Click the [Test] button to move the virtual robot to any highlighted or edited robot positions.

Click on the [Cancel] button to close the Position Editor window without saving any changes made to the robot position.

Click on the [OK] button to save any changes applied to the robot position and close the Position Editor window.

The Options available in the Edit Position menu are continued on the next page....

ROBOT TEACHBOX - EDIT ROBOT MEMORY WINDOW.

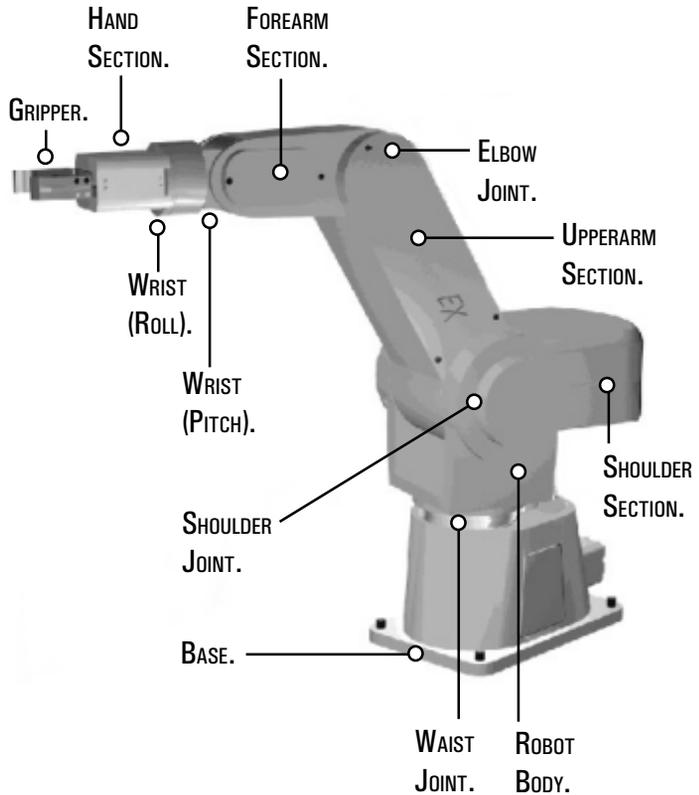
continued....

- **Show in VR** - Displays the gripper reference point - a small red diamond shape - which represents the tip position of the robot grippers. The gripper reference point is used to show any highlighted or edited robot positions, without having to move the virtual robot itself.
- **Move Robot(s) to Position** - Moves the virtual robot and the "real" robot (when connected to the computer) to the position highlighted in the list of stored robot positions.
- **Cut** - Cuts the highlighted robot position from the list of stored robot positions.
- **Copy** - Copies the highlighted robot position from the list of stored robot positions.
- **Paste** - Pastes a robot position previously cut or copied, over (replacing) the robot position currently highlighted in the list. If a robot position has not been cut or copied, the button will be greyed out (unavailable).
- **Create New** - Creates a new robot position, from a robot position previously cut or copied. A new robot position is placed at the next position number, immediately following the last robot position in the currently stored list. If a robot position has not been cut or copied, the button will be greyed out (unavailable).
- **Delete** - Permanently deletes the highlighted robot position from the list of stored robot positions.

ROBOT KEYPAD - ROBOT PART NAMES.

The following pages detail the keypad functions of the robot teachbox.

The diagram below shows a Mitsubishi RVM-1 robot, labelling the sections and joints, named after parts of the human arm....

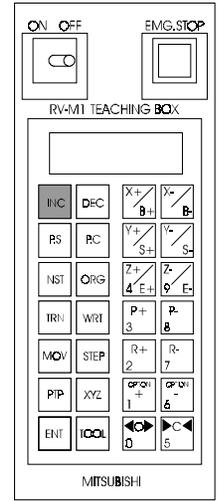


ROBOT KEYPAD - [INC] & [DEC] BUTTONS.

[INC] - Increment button.

Click the [INC] button to move the virtual robot from its current robot position number, to the next robot position number that appears in its stored robot positions memory.

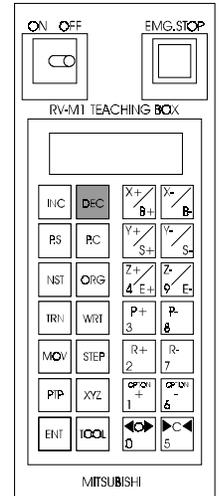
After clicking the [INC] button, click the [ENT] button to perform the command.



[DEC] - Decrement button.

Click the [DEC] button to move the virtual robot from its current robot position number, to the previous robot position number that appears in its stored robot positions memory.

After clicking the [DEC] button, click the [ENT] button to perform the command.

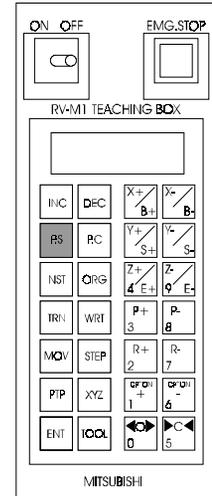


ROBOT KEYPAD - [PS] & [PC] BUTTONS.

[PS] - Position Set button.

Defines the current position of the robot, with a robot position number of your choice and adds it to the stored list of robot positions.

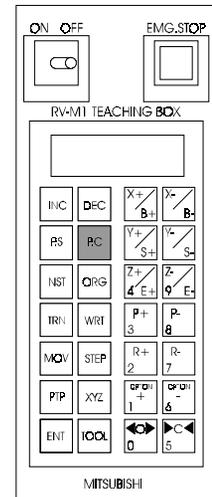
After clicking the [PS] button, enter a robot position number, then click the [ENT] button to save the robot position to memory.



[PC] - Position Clear button.

Permanently removes a robot position number of your choice from the stored list of robot positions.

After clicking the [PC] button, enter the robot position number you want to permanently remove, then click the [ENT] button to perform the command.

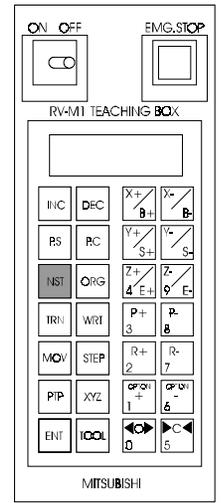


ROBOT KEYPAD - [NST] & [ORG] BUTTONS.

[NST] - Nest button.

Returns the robot to its origin (datum) point.

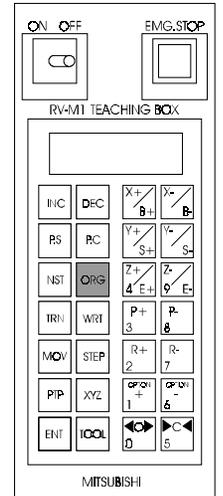
After clicking the [NST] button, click the [ENT] button to perform the command.



[ORG] - Decrement button.

Moves the robot to an outstretched horizontal position used for checking robot accuracy.

After clicking the [ORG] button, click the [ENT] button to perform the command.

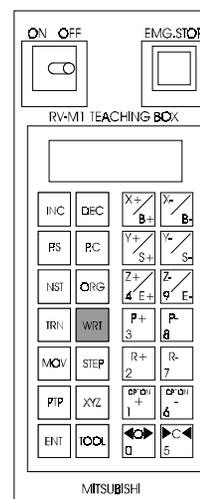


ROBOT KEYPAD - [WRT] & [MOV] BUTTONS.

[WRT] - Write button.

Used on the virtual teachbox to access the Edit Position window (see page 8.12), for any of the currently stored positions in the robot memory.

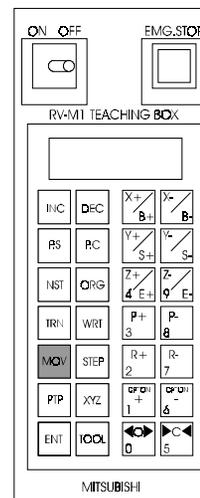
When the cursor is over the [WRT] button, click the right mouse button to display the list of robot positions that can be edited.



[MOV] - Move button.

Moves the virtual robot to a robot position number of your choice from the stored list of robot positions.

After clicking the [MOV] button, enter the robot position number you want to move to, then click the [ENT] button to perform the command.



ROBOT KEYPAD - [PTP] & [XYZ] BUTTONS.

Note - The functions of the wrist movement buttons are not affected by the setting of PTP or XYZ Modes:
[P+] & [P-]
[R+] & [R-]

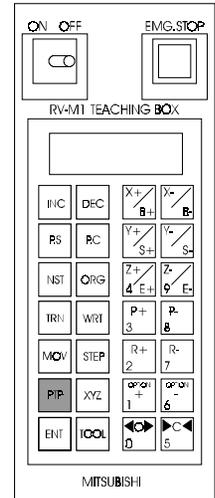
[PTP] - Point-to-point Mode button.

Point-to-point Mode instructs the virtual robot to jog (move) using its individual joints (axes) when the appropriate jog buttons are pressed:

[B+] & [B-]
[S+] & [S-]
[E+] & [E-]

After clicking the [PTP] button, any subsequent commands will be performed in Point-to-point Mode.

To cancel PTP Mode, click on one of the other available movement modes - Tool or XYZ.



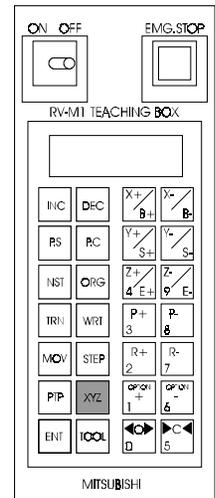
[XYZ] - XYZ Mode button.

XYZ Mode instructs the virtual robot to jog (move), using the tip of its grippers as a reference point, for moving around a three-dimensional X, Y and Z grid system.

[X+] & [X-]
[Y+] & [Y-]
[Z+] & [Z-]

After clicking the [XYZ] button, any subsequent commands will be performed in XYZ grid Mode.

To cancel XYZ Mode, click on one of the other available movement modes - Tool or PTP.

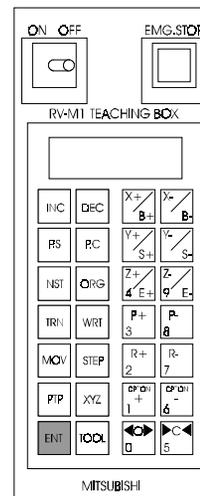


ROBOT KEYPAD - [ENT]&[TOOL] BUTTONS.

[ENT] - Enter button.

Used to confirm commands entered into the robot teachbox via the keypad buttons.

After completing all data entry using the robot teachbox keypad buttons, click the [ENT] button to perform the requested command.



[TOOL] - Tool Mode button.

Tool Mode instructs the virtual robot hand to advance or retract at a fixed height, in the direction in which the hand is pointing (ie, the robot base "locks" in position and does not move).

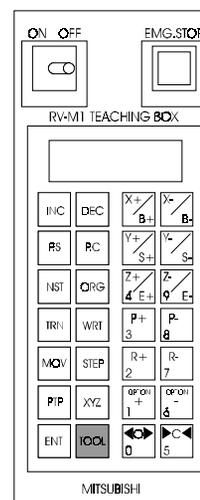
Tool Mode is not a general movement mode. It should be used for accurate positioning of the robot hand in a horizontal plane. The attitude/angle of the robot hand is fixed at the point when Tool Mode is selected.

Tool Mode operates using the following jog (move) keys:

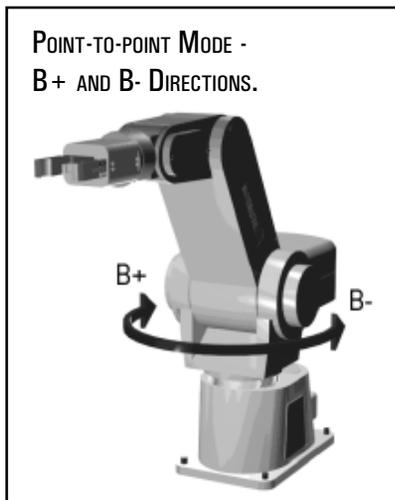
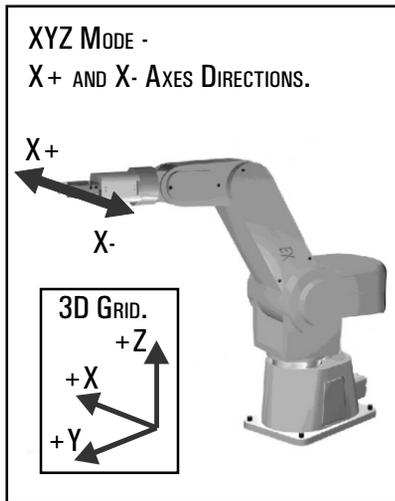
[Z +] & [Z -], [R +] & [R -]

After clicking the [TOOL] button, any subsequent commands will be performed in Tool Mode.

To cancel Tool Mode, click on one of the other available movement modes - PTP or XYZ.



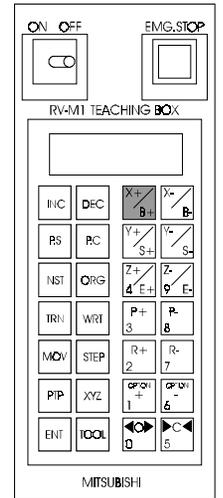
ROBOT KEYPAD - [X+ / B+] & [X- / B-] BUTTONS.



[X+ / B+] - Positive X or B button.

In XYZ grid Mode [X+], this button moves the tip of grippers in a positive direction along the X axis.

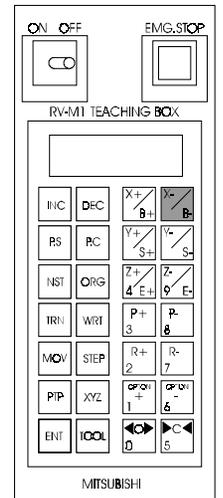
In Point-to-point Mode [B+], this button moves the robot base at the currently selected jog speed setting in the positive direction (clockwise when viewed from above).



[X- / B-] - Negative X or B button.

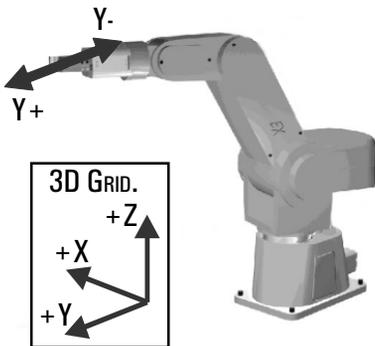
In XYZ grid Mode [X-], this button moves the tip of grippers in a negative direction along the X axis.

In Point-to-point Mode [B-], this button moves the robot base at the currently selected jog speed setting in the negative direction (anticlockwise when viewed from above).



ROBOT KEYPAD - [Y+ / S+] & [Y- / S-] BUTTONS.

XYZ MODE -
Y+ AND Y- AXES DIRECTIONS.



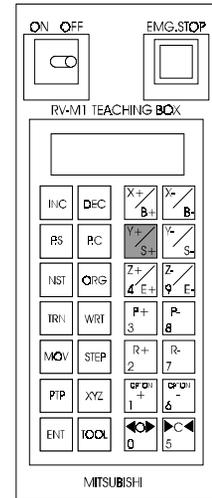
POINT-TO-POINT MODE -
S+ AND S- DIRECTIONS.



[Y+ / S+] - Positive Y or S button.

In XYZ grid Mode [Y+], this button moves the tip of grippers in a positive direction along the Y axis.

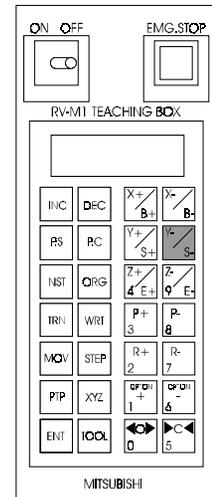
In Point-to-point Mode [S+], this button moves the robot upperarm section pivoting around the shoulder joint, at the currently selected jog speed setting in the positive direction (upwards).



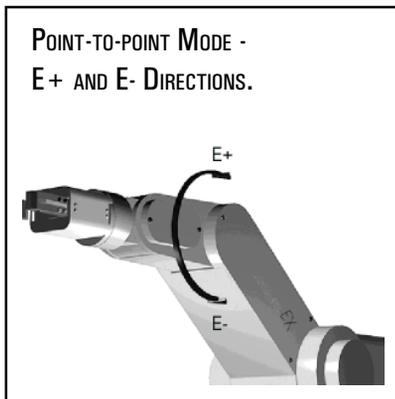
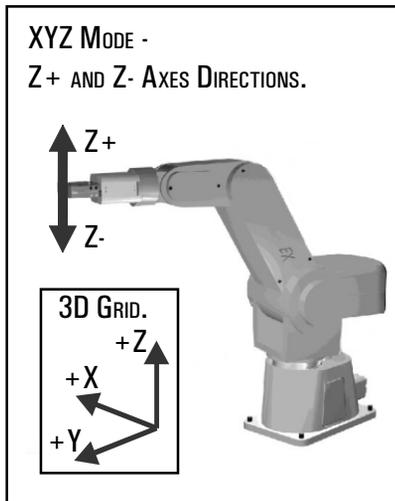
[Y- / S-] - Negative Y or S button.

In XYZ grid Mode [Y-], this button moves the tip of grippers in a negative direction along the Y axis.

In Point-to-point Mode [S-], this button moves the robot upperarm section pivoting around the shoulder joint, at the currently selected jog speed setting in the negative direction (downwards).



ROBOT KEYPAD - [Z+/E+/4] & [Z-/E-/9] BUTTONS.

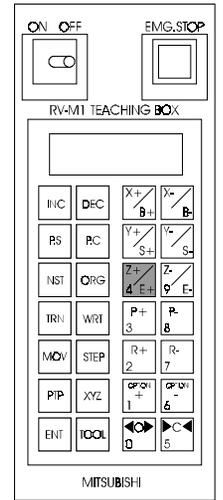


[Z +/E +/4] - Positive Z or E / 4 button.

In XYZ grid Mode [Z+], this button moves the tip of grippers in a positive direction along the Z axis (upwards).

In Point-to-point Mode [E+], this button moves the robot forearm section pivoting around the elbow joint, at the currently selected jog speed setting in the positive direction (upwards).

This button is also used for entering the numerical value [4].

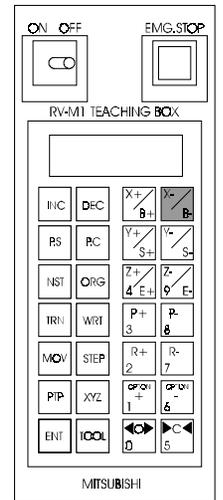


[Z-/E-/9] - Negative X or E / 9 button.

In XYZ grid Mode [Z-], this button moves the tip of grippers in a negative direction along the Z axis (downwards).

In Point-to-point Mode [E-], this button moves the robot forearm section pivoting around the elbow joint, at the currently selected jog speed setting in the negative direction (downwards).

This button is also used for entering the numerical value [9].

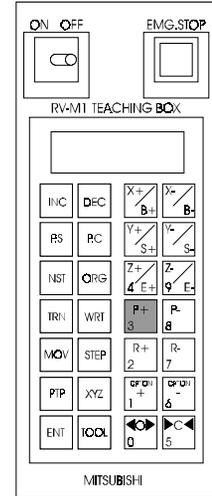


ROBOT KEYPAD - [P+/3] & [P-/8] BUTTONS.

[P+/3] - Positive P / 3 button.

When used as [P+], this button moves the robot hand section pivoting around the wrist (pitch) joint, at the currently selected jog speed setting in the positive direction. In Point-to-point Mode this is an upwards direction. In XYZ grid Mode, the gripper reference point is "locked" in position when the [P+] button is pressed and only the robot joint angles will move.

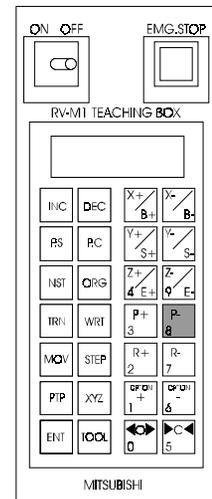
This button is also used for entering the numerical value [3].



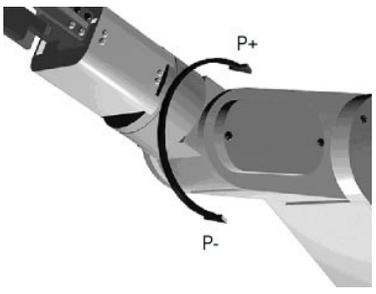
[P-/8] - Negative P / 8 button.

When used as [P-], this button moves the robot hand section pivoting around the wrist (pitch) joint, at the currently selected jog speed setting in the negative direction. In Point-to-point Mode this is a downwards direction. In XYZ grid Mode, the gripper reference point is "locked" in position when the [P+] button is pressed and only the robot joint angles will move.

This button is also used for entering the numerical value [8].



POINT-TO-POINT MODE -
P+ AND P- DIRECTIONS.

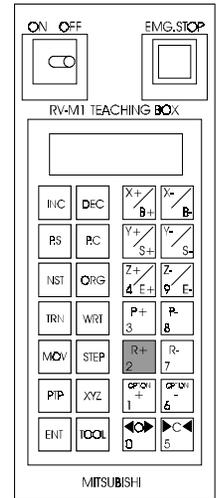


ROBOT KEYPAD - [R+/2] & [R-/7] BUTTONS.

[R + /2] - Positive R / 2 button.

When used as [R +], this button rotates the robot hand section pivoting around the wrist (roll) joint, at the currently selected jog speed setting in the positive direction. In Point-to-point Mode and XYZ grid Mode the wrist rotates in a clockwise direction, when viewed from the front of the grippers.

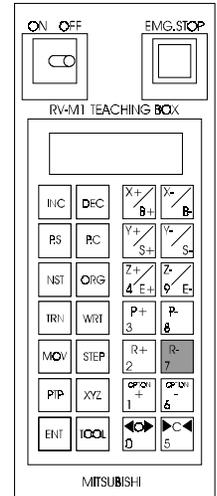
This button is also used for entering the numerical value [2].



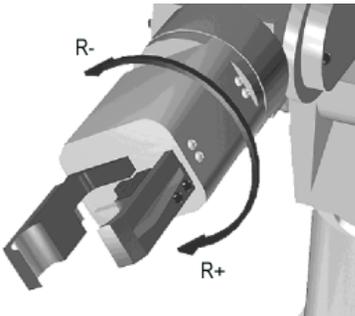
[R - /7] - Negative R / 7 button.

When used as [R -], this button rotates the robot hand section pivoting around the wrist (roll) joint, at the currently selected jog speed setting in the negative direction. In Point-to-point Mode and XYZ grid Mode the wrist rotates in an anticlockwise direction, when viewed from the front of the grippers.

This button is also used for entering the numerical value [8].



POINT-TO-POINT MODE -
R+ AND R- DIRECTIONS.

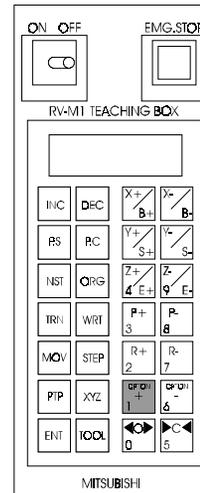


ROBOT KEYPAD - [1] & [6] BUTTONS.

[1] - 1 button.

This button is used for entering the numerical value [1].

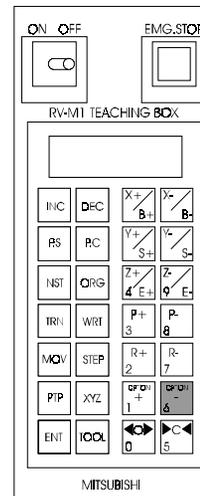
The [OPTION] and [+] functions are unavailable.



[6] - 6 button.

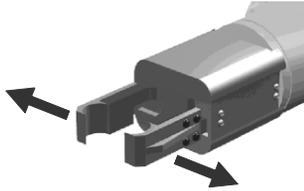
This button is used for entering the numerical value [6].

The [OPTION] and [-] functions are not supported by the VR Linker.

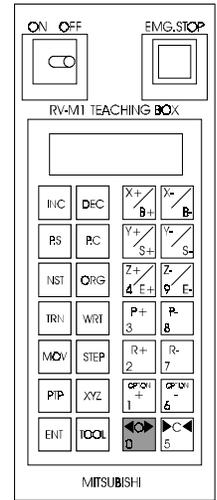


ROBOT KEYPAD - [<O>/Ø] & [>C</5] BUTTONS.

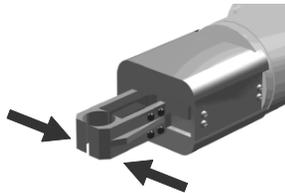
[<O>/Ø] - Open gripper / Ø button.
When used as [<O>], this button opens the robot grippers.



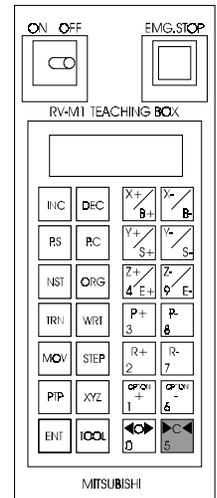
This button is also used for entering the numerical value [Ø].



[>C</5] - Close gripper / 5 button.
When used as [>C<], this button closes the robot grippers.



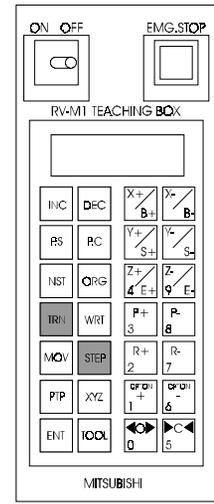
This button is also used for entering the numerical value [5].



ROBOT KEYPAD - Non FUNCTIONING BUTTONS.

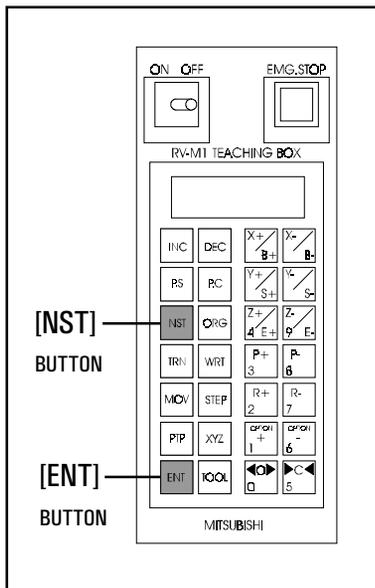
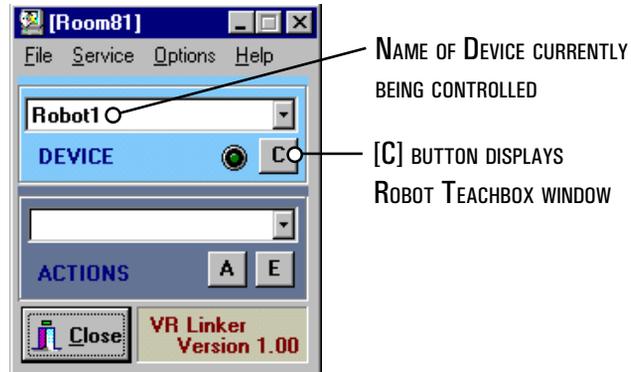
[TRN] button.
[STEP] button.

The functions on the buttons listed above are not supported on the Robot Teachbox, since their functions are supported in other areas of the software.



DISPLAYING THE ROBOT TEACHBOX & NESTING THE ROBOT.

The Robot Arm is moved using the buttons on the Robot Teachbox. To display the robot teachbox window, check the name of the robot you want to control is shown in the "DEVICE" dialog box of the VR Linker window (shown below). Press the [C] button to display the robot teachbox.



Click the On/Off switch on the robot teachbox to switch it "on". The robot must be nested (datumed) before jogging the robot to position or commanding any moves.

In Virtual Reality, the robot will automatically nest when the mains power is switched "on" (the switch on the grey rectangular electrical control box). In this particular case, the robot need not be manually nested.

When the robot teachbox has been switched "off", then switched back "on" again, you must manually nest the robot. Click the [NST] button followed by the [ENT] button. The robot will then move to its datum position.

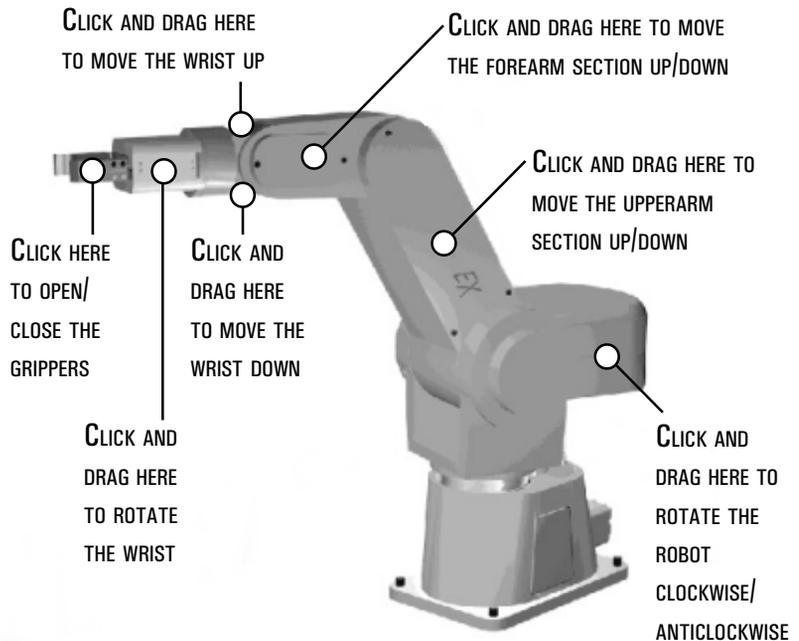
MOVING THE ROBOT WITH THE MOUSE.

You can move the robot quickly using the mouse.

Simply click and hold down the left mouse button when the cursor is directly over the axis you want to control. Drag the cursor in the direction you want the robot to move. To stop the robot moving, release the left mouse button.

As the cursor is dragged further away from the robot axis, the the robot part under control will move faster.

Click and drag the robot in the following areas, shown in the diagram below:



SELECTING PTP MOVEMENT MODE.

The robot can be moved using the following modes:

- PTP (Point-to-point) Mode.
- XYZ (grid) Mode.
- Tool Mode

[PTP] - POINT-TO-POINT MODE.

Point-to-point Mode instructs the virtual robot to jog (move) using its individual joints (axes) when the appropriate jog buttons are pressed:

- [B +] & [B -]
- [S +] & [S -]
- [E +] & [E -]

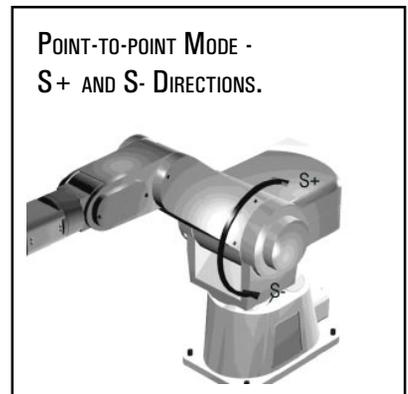
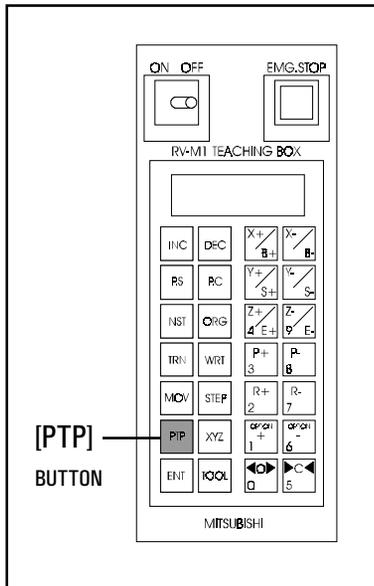
For example, if the [Y +/S +] button is pressed when the robot is set in PTP Mode, the button will be recognised as [S +]. The upperarm section will move in an upwards direction, pivoting around the shoulder joint.

To select PTP Mode, click the [PTP] button on the robot teachbox. All subsequent commands will be performed in PTP Mode.

Note - The functions of the wrist movement buttons are not affected by the setting of PTP Mode:

- [P +] & [P -]
- [R +] & [R -]

To cancel PTP Mode, click on one of the other available movement modes - XYZ or Tool.



SELECTING XYZ MOVEMENT MODE.

[XYZ] - XYZ MODE.

XYZ Mode instructs the virtual robot to jog (move), using the tip of its grippers as a reference point, for moving around a three-dimensional X, Y and Z grid system when the appropriate jog buttons are pressed:

[X +] & [X-]

[Y +] & [Y-]

[Z +] & [Z-]

For example, if the [Y +/S +] button is pressed when the robot is set in XYZ Mode, the button will be recognised as [Y +]. The tip of the grippers will move along the Y axis in a parallel and positive direction. All the sections and joints of the robot move independently of each other to keep the tip of the grippers as close to this Y axis as possible.

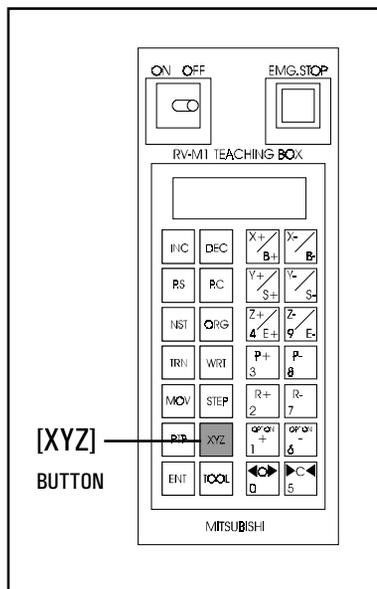
To select XYZ Mode, click the [XYZ] button on the robot teachbox. All subsequent commands will be performed in XYZ Mode.

Note - The functions of the wrist movement buttons are not affected by the setting of XYZ Mode:

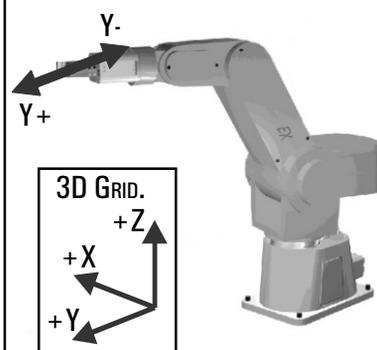
[P +] & [P-]

[R +] & [R-]

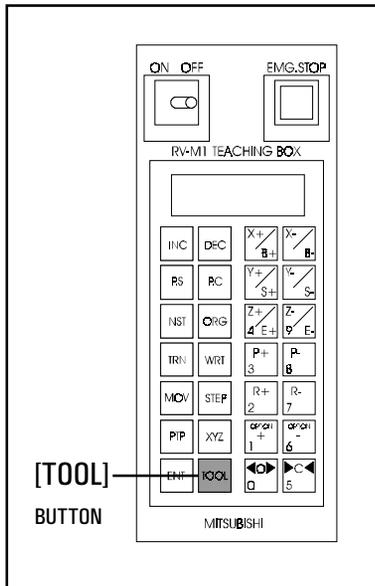
To cancel XYZ Mode, click on one of the other available movement modes - PTP or Tool.



XYZ MODE - Y+ AND Y- AXES DIRECTIONS.



SELECTING TOOL MOVEMENT MODE.



[TOOL] - TOOL MODE.

Tool Mode instructs the virtual robot hand to advance or retract at a fixed height, in the direction in which the hand is pointing (ie, the robot base "locks" in position and does not move).

Tool Mode is not a general movement mode. It should be used for accurate positioning of the robot hand in a horizontal plane. The attitude/angle of the robot hand is fixed at the point when Tool Mode is selected.

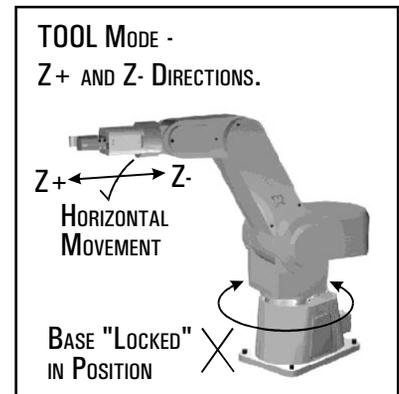
Tool Mode operates using the following jog (move) keys:

- [Z +] & [Z-]
- [R +] & [R-]

For example, pressing the [Z +] button when the robot is set in Tool Mode will extend the robot hand out (away from the base of the robot) in the direction in which it is facing. Following the setting of Tool Mode, the robot arm will try to maintain the height and angle of the robot hand.

To select Tool Mode, click the [TOOL] button on the robot teachbox. All subsequent commands will be performed in Tool Mode.

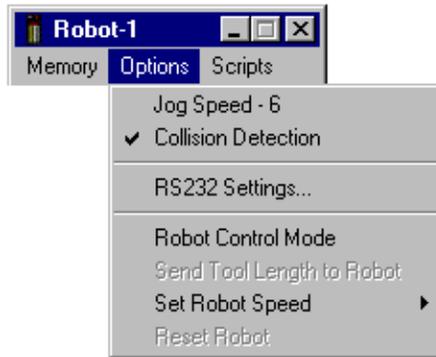
To cancel Tool Mode, click on one of the other available movement modes - PTP or XYZ.



MOVING THE ROBOT.

Once the Movement Mode has been selected, the robot can be moved manually, using the movement keys on the righthand side of the robot teachbox (see panel below left).

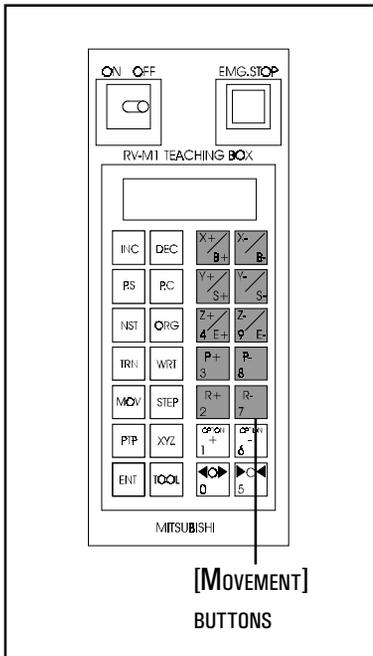
The speed at which the robot moves when being manually positioned is determined by the Jog Speed setting. To display the current jog speed, click on the "Options" menu in the menubar of the robot teachbox (shown below as a Jog Speed of 6).



To change the jog speed, click "Options|Jog Speed" in the toolbar of the robot teachbox window. Adjust the slider until the required jog speed is shown, then press the [OK] button (shown below).



Jog speed - 1 is slow but very accurate at positioning, whilst Jog Speed - 9 is fast but inaccurate when positioning.

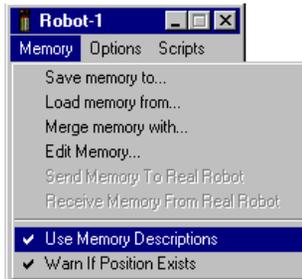


SETTING AND MOVING TO A STORED ROBOT POSITION.

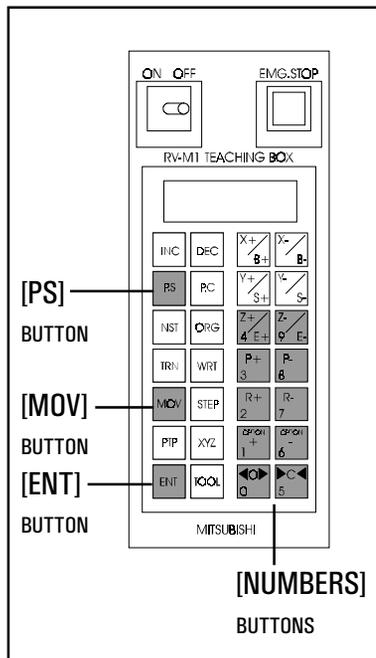
As the robot is manually moved, any positions reached can be stored in its memory. The Robot Memory can store between 1 - 629 robot positions (each with a corresponding 001 - 629 position number and a written description). The entire robot memory can be saved, to be edited or used by a robot program at a later date.

Click on the "Memory" menu in the robot teachbox menubar and check that the "Use Memory Descriptions" and the "Warn If Position Exists" options are switched "on" (indicated by a tick mark).

Click on each option to switch it "on" or "off" (shown below).



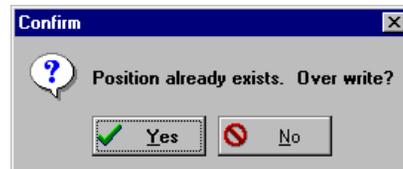
SETTING AND MOVING TO A STORED ROBOT POSITION.



To store the current robot position, click the [PS] button, position set, on the robot teachbox.

Enter a three digit number between 001 and 629, using the robot teachbox [NUMBERS] buttons and click on the [ENT] button. The numbers being entered will appear on the robot teachbox display.

If position number already exists a warning message will be displayed (shown below). Click the appropriate button to overwrite the existing position, or retype with a different position number.



The Robot Position Description window will appear (shown below). Type in a written description for the robot position, then click the [OK] button to store the robot position in its memory.



Note - To view the entire list of currently stored robot positions click "Memory|Edit Memory..." in the robot teachbox menubar.

To move the robot to a position previously stored in its memory, click the [MOV] button on the robot teachbox.

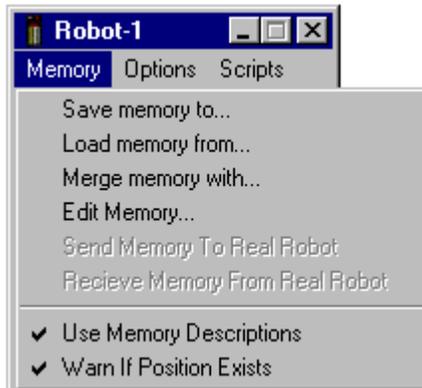
Enter the number of the position you want the robot to move to, using the [NUMBERS] buttons, then click the [ENT] button. The robot will now move to this "new" position.

SAVING THE ROBOT MEMORY.

It is important to save the Robot Memory if you want to edit any of the robot positions at a later date or if the robot positions are used by a robot script file.

To save the robot memory file, click "Memory|Save memory to..." in the robot teachbox menubar (shown below).

The Save As window is displayed, allowing the robot memory file (file extension ".RTF") to be saved to a set location.



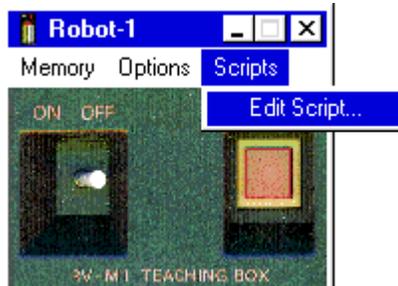
STARTING THE ROBOT SCRIPT FILE EDITOR.

The Robot Script File Editor is used to build robot programs (called robot script files), constructed from the robot position numbers stored in the robot memory. A robot script file describes the move sequences and functions required by the robot to perform a set task.

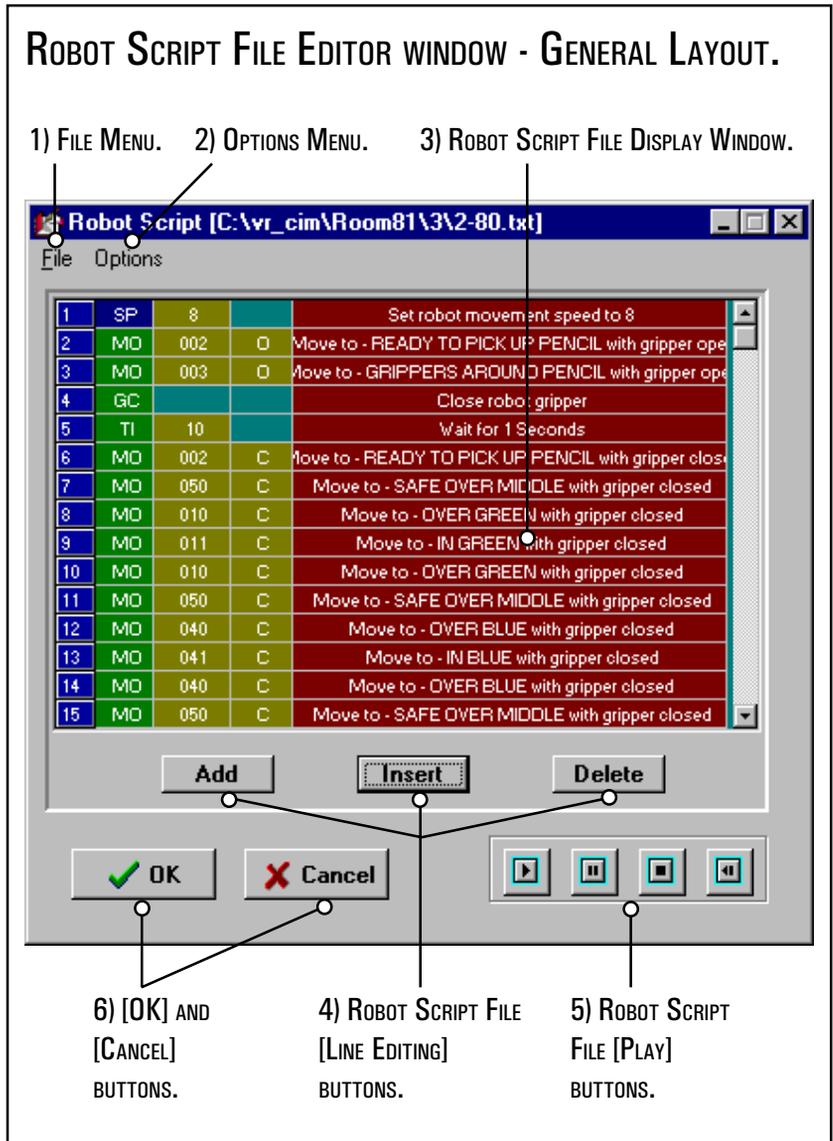
Saved robot script files can be sent to the virtual robot and/or a "real" robot connected to the computer.

Note - The Robot Memory File (containing all the stored robot positions used in the robot script file) must be loaded into the virtual robot and/or downloaded to the "real" robot before the robot script file is run.

To display the Robot Script File Editor window, click on "Scripts|Edit Script..." from the menubar on the Robot Teachbox window (shown below).



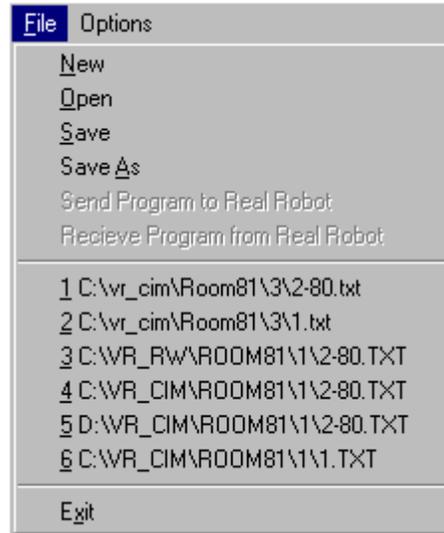
ROBOT SCRIPT FILE EDITOR - GENERAL LAYOUT.



ROBOT SCRIPT FILE EDITOR - FILE MENU.

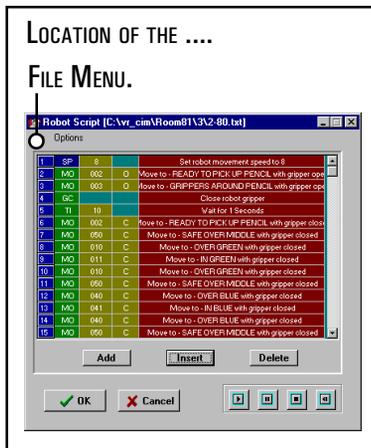
The Script File Editor contains the following:

1) **The File Menu** (shown below) - The options available in the File menu are as follows:



- **New** - Starts a new (blank) Robot Script File.
- **Open** - Displays the Open file window. Browse and open any previously saved (".TXT" format) robot script files.
- **Save** - Autosave and overwrite a robot script file with the last used filename.
- **Save As** - Displays the Save robot script file window, allowing the file to be saved with a specific filename in a specific directory.
- **Send Program to Real Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.
- **Receive Program from Real Robot** - This option is greyed out (unavailable) unless a "real" robot is connected to your computer.

continued....



ROBOT SCRIPT FILE EDITOR - FILE MENU AND OPTIONS MENU.

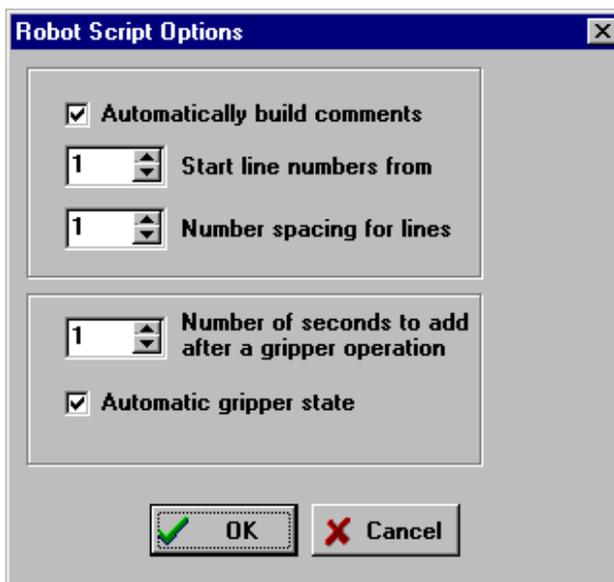
1) The File Menu continued....

- **History** - Displays the history of any robot script files opened.
- **Exit** - Closes the robot script file editor window without saving any changes.

2) The Options Menu (shown below) - The options available in the Options menu are as follows:



- **Configure** - Displays the Robot Script Options window (shown below), allowing selected areas of the Robot Script Editor to be arranged to suit the user.

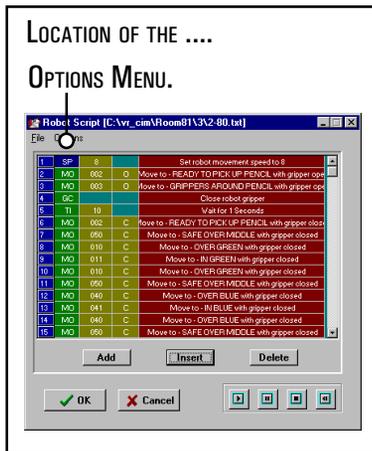


continued....

LOCATION OF THE OPTIONS MENU.



ROBOT SCRIPT FILE EDITOR - OPTIONS MENU.



2) The Options Menu continued....

The Robot Script Options window contains the following:

- **Automatically build comments** - Automatically inserts comments describing the actions occurring in the line currently being programmed.

Click in the box to switch the option on/off. A "tick mark" is visible when the option is switched "on".

- **Start line numbers from box** - The first line of any "new" (blank) robot script file begins with this number. Use the arrow buttons to increase or decrease the number.

- **Number spacing for lines box** - Shows the number of blank lines that are inserted following the completion of the current robot script file line. Note, the blank lines are not shown on the robot script file display window.

For example, if the current line being edited is 4Ø and this option is set to 15, the next program lines are numbered as follows: 55, 6Ø, 75 etc.

Use the arrow buttons to increase or decrease the number.

continued....

ROBOT SCRIPT FILE EDITOR - OPTIONS MENU.

2) The Options Menu (Robot Script Options window) continued....

- **Number of seconds to add after a gripper operation box** - When set at 1 or higher, this option automatically inserts a new robot script file line containing a "TI" wait command, after any line containing a gripper operation. The length of time waited before continuing to the next robot script file line is determined by the number.

For example, if the number is 5, then a 5 second wait is automatically inserted after any gripper operation command.

When the number is 0 (zero), no wait command will be added after any gripper operation command is completed.

Use the arrow buttons to increase or decrease the number.

- **Automatic gripper state** - Automatically inserts the letter "O" when the gripper is open or "C" when the gripper is closed, in the gripper state column of the robot script file display.

When the option is switched "on", it automatically recognises any change in the gripper state and updates the gripper state column accordingly.

Click in the box to switch the option on/off. A "tick mark" is visible when the option is switched "on".

- **[OK] button** - Applies any changes made and closes the Robot Script Options window.
- **[Cancel] button** - Ignores any changes made and closes the Robot Script Options window.

LOCATION OF THE OPTIONS MENU.



ROBOT SCRIPT FILE EDITOR - ROBOT SCRIPT FILE DISPLAY WINDOW.

3) **The Robot Script File Display Window** (shown below) - The robot script file display window shows detailed information about each line of the robot script.

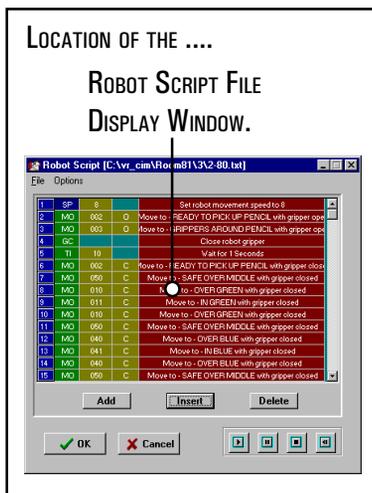
The display is split into five columns. When the robot script file exceeds the height of the display window, a scroll bar is automatically added to the righthand side of the window. Click and drag the slider, or click on the up/down arrow buttons to move between different areas of the robot script file.

Note that the information and layout of the robot script file can be changed using the Robot Script Options window, accessible by clicking "Options|Configure..." in the menubar of the main Robot Script window.

LINE NUMBER COLUMN.	ACTION COMMAND COLUMN.	ACTION INFORMATION COLUMN.	GRIPPER STATE COLUMN.	LINE DESCRIPTION COLUMN.	SCROLL BAR.
---------------------------	------------------------------	----------------------------------	-----------------------------	--------------------------------	----------------

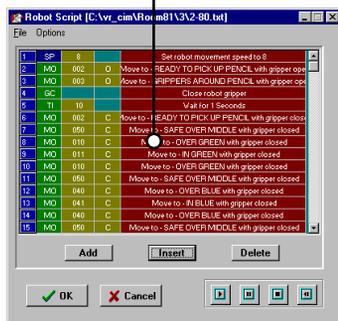
1	SP	8			Set robot movement speed to 8
2	MO	002	O		Move to - READY TO PICK UP PENCIL with gripper open
3	MO	003	O		Move to - GRIPPERS AROUND PENCIL with gripper open
4	GC				Close robot gripper
5	TI	10			Wait for 1 Seconds
6	MO	002	C		Move to - READY TO PICK UP PENCIL with gripper closed
7	MO	050	C		Move to - SAFE OVER MIDDLE with gripper closed
8	MO	010	C		Move to - OVER GREEN with gripper closed
9	MO	011	C		Move to - IN GREEN with gripper closed
10	MO	010	C		Move to - OVER GREEN with gripper closed
11	MO	050	C		Move to - SAFE OVER MIDDLE with gripper closed
12	MO	040	C		Move to - OVER BLUE with gripper closed
13	MO	041	C		Move to - IN BLUE with gripper closed
14	MO	040	C		Move to - OVER BLUE with gripper closed
15	MO	050	C		Move to - SAFE OVER MIDDLE with gripper closed

continued....



ROBOT SCRIPT FILE EDITOR - ROBOT SCRIPT FILE DISPLAY WINDOW.

LOCATION OF THE ...
ROBOT SCRIPT FILE
DISPLAY WINDOW.



3) The Robot Script File Display Window continued....

The five columns of the robot script file display list as follows (from left to right on the display):

- **Column 1 (Line Number box)** - Displays the line number of the robot script file.
- **Column 2 (Action Command box)** - Displays the shorthand for the action or operation to be performed. Action commands can be chosen and edited from a pop-up list, accessible by highlighting the required action command box, clicking with the right mouse button, then selecting one of the options:

Move to Position (MO) - Move the robot to a position stored in its memory.

Robot Speed (SP) - Set the speed at which the robot performs any action commands. This speed setting continues for all program lines until overridden by a "new" speed.

Open Grippers (GO) - Open the robot grippers.

Close Grippers (GC) - Close the robot grippers.

Goto Line (GT) - Goto the robot script file line number that you specify from the pop-up list.

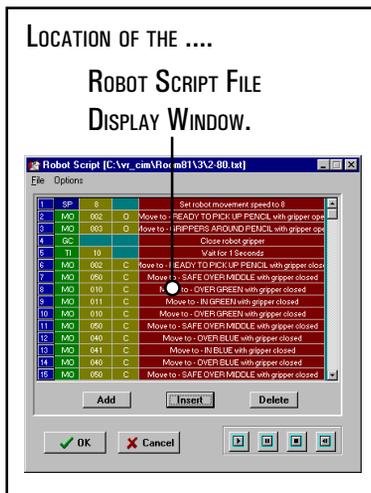
Do Sub-routine (GS) - Perform a sub-routine. Available preset sub-routines for virtual reality can be chosen from a pop-up list (Note - "real" sub-routines are normally written by the user and contain an "RT" return command).

Wait Time (TI) - Perform a time delay, specified in seconds from the pop-up list, before continuing to the next robot script file line.

Nest Robot (NST) - Move the robot back to its datum position.

continued....

ROBOT SCRIPT FILE EDITOR - ROBOT SCRIPT FILE DISPLAY WINDOW.



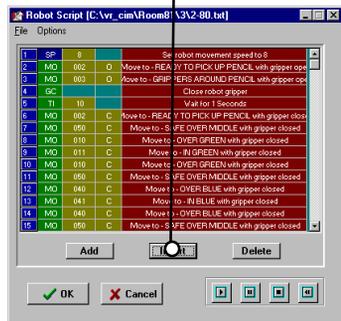
continued....

- **Column 3 (Action Information box)** - Displays information relating to the action command, ie, the length of waiting time for a "TI" command, or the robot position number for a "MO" move command. Action information can be chosen and edited from a pop-up list, accessible by highlighting the required action information box, clicking with the right mouse button, then selecting one of the options.
- **Column 4 (Gripper State box)** - Displays the current state of the robot grippers. "O" for open grippers and "C" for closed grippers. The gripper state can be chosen and edited from a pop-up list, accessible by highlighting the required gripper state box, clicking with the right mouse button, then selecting one of the options (Gripper Open, Gripper Closed or None).
- **Column 5 (Line Description box)** - Displays text describing the function of each robot script file line. The information in the line description box can be edited by clicking in the box then overtyping with new text.

continued....

ROBOT SCRIPT FILE EDITOR - [LINE EDITING] BUTTONS.

LOCATION OF THE
ROBOT SCRIPT FILE [LINE
EDITING] BUTTONS.



continued....

4) **The Robot Script File [Line Editing] buttons** (shown below) - Use these three buttons to edit the currently highlighted robot script file line.

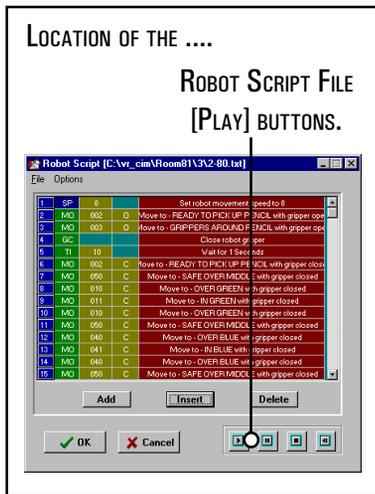


The three buttons list as follows (from left to right on the window):

- **[Add]** - Inserts a "new" (blank) robot script file line, after the last line in the robot script file.
- **[Insert]** - Inserts a "new" (blank) robot script file line, directly after the line currently highlighted.
- **[Delete]** - Permanently removes the robot script file line currently highlighted.

continued....

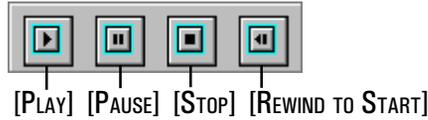
ROBOT SCRIPT FILE EDITOR - [PLAY] BUTTONS.



continued....

5) The Robot Script File [Play] buttons (shown below)

- There are four robot script file play buttons:



- **[Play]** - Click this button to play the robot script file from the currently highlighted robot script line onwards. As the the robot script file plays, line by line, the stated actions will be performed by the devices in the virtual world.

- **[Pause]** - Click this button to pause a robot script file that is playing. Click the [Pause] button to resume playing a paused robot script file.

- **[Stop]** - Click this button to stop the robot script file playing, at the end of the robot script line currently being performed.

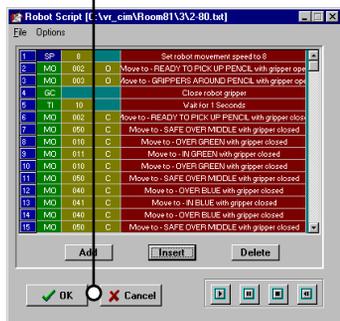
- **[Rewind to Start]** - Click this button to return to the first robot script line of the robot script file.

Note - The [Play] button is greyed out (unavailable) when the robot teachbox is operational, ie, a robot script file cannot be played when the robot teachbox switched "on".

continued....

ROBOT SCRIPT FILE EDITOR - [OK] AND [CANCEL] BUTTONS.

LOCATION OF THE
[OK] AND [CANCEL]
BUTTONS.



continued....

6)The [OK] and [Cancel] buttons (shown below).

The [OK] button - Click the [OK] button to apply and/or save any changes made to the robot script file and close the robot script file editor window.



The [Cancel] button - Click the [Cancel] button to close the robot script file editor window without saving any changes.



EXAMPLE ROBOT SCRIPT FILE.

A detailed example, showing how a robot script file is generated using the robot script file editor, is included in Section 2 - Quickstart Tutorial.

ROBOT SCRIPT FILE EDITOR - LOADING AN EXEMPLAR ROBOT SCRIPT FILE.

Exemplar Robot script files can be loaded for each of the five robot room virtual worlds.

The exemplar files are stored in the user folder "10000". There are five of these folders, one in each of the individual robot room folders (Room 81 - 85).

First, load the robot memory that contains all the robot positions required by the robot script file. The robot memory file (".RTF" format) is loaded by clicking on "Memory|Load memory from..." in the menubar of the robot teachbox window. Browse and open the correct room folder, then the folder labelled "10000" and load the exemplar robot memory file.

Next, click on "Scripts|Edit Script..." in the menubar of the Robot Teachbox window to display the Robot Script window.

Click on "File|Open" in the menubar of the Robot Script window. Browse and open the same room folder used for loading the robot memory file, then the folder labelled "10000" and load the exemplar robot script file (".TXT" format).

Check that the Robot Teachbox is switched "off" to allow access to the [Play] button of the robot script file window.

Click the [Rewind to Start] button, then the [Play] button on the control panel of the Robot Script window, to start the program.

ROBOT ROOM STARTING POINT.

THE LIFT.

You start each virtual world robot room from within a lift.

Click on the lift doors to open or close them.

To load a new robot room hit the appropriate floor button on the lift control panel (ie, floor button 4 loads virtual world robot room 4).

To close the currently loaded virtual world robot room at any time, click on the floor button \emptyset (zero) on the lift control panel.



TO OPEN AND
CLOSE LIFT DOORS,
CLICK ON THEM.

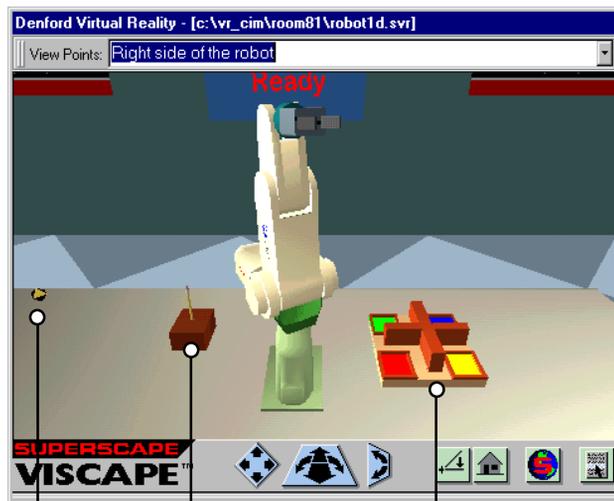
LIFT CONTROL PANEL
(LOADS AND CLOSES
ROBOT ROOMS).

VR ROBOT ROOM 1 TASK.

ROOM 1 TASK.

Room 1 contains a table with the robot upon it. On opposite sides of the robot are a collection of four coloured ink well squares and a block holding a pencil.

When each of the surfaces of the coloured ink well squares is touched, a sound is triggered. There are four different sounds, one for each of the coloured ink well squares.



RESET
BLOCK.

PENCIL IN
BLOCK.

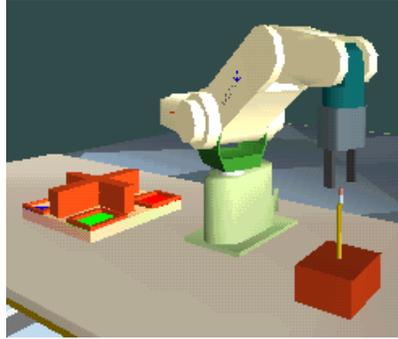
FOUR COLOURED INK
WELL SQUARES.

The task in room 1 is to program the robot so it picks up the pencil and then moves across to the coloured ink well squares. The robot must then be programmed to touch each of the four coloured ink well squares with the pencil, triggering the sounds.

VR ROBOT ROOM 1 INTELLIGENT OBJECTS.

INTELLIGENT OBJECTS.

By positioning the cursor over some of the objects in robot room 1, then clicking the mouse buttons, certain moves and operations can be implemented.



Left mouse click on the pencil in the block (shown left) - Moves the robot so the grippers are opened and positioned directly above the pencil (ready to approach pencil).

Right mouse click on the pencil in the block - Moves the robot so the grippers are opened and positioned around the pencil (ready to pick up pencil).

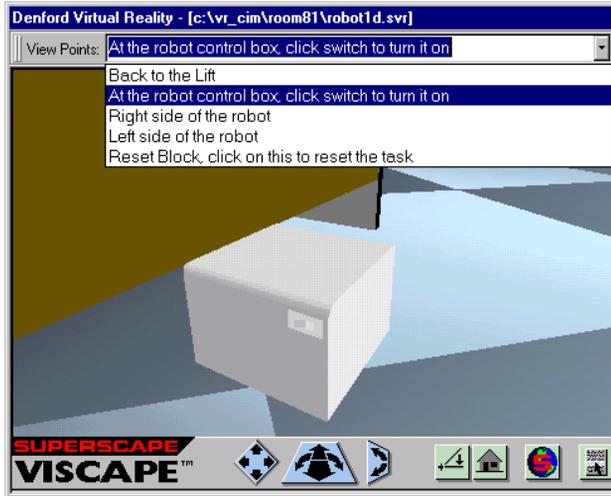
Left mouse click on the pencil when held by the robot grippers - Moves the robot so the pencil is held directly over the block (the grippers remain closed).

VR ROBOT ROOM 1 HINTS AND TIPS.

HINTS AND TIPS.

Many of the hints and tips listed here apply to the other four robot rooms.

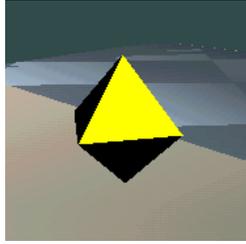
The viewpoints are designed to help you navigate quickly around important parts of the robot room. They can also contain help on what to do at each viewpoint (shown below).



The electrical control box (which switches the power to the robot on and off) is positioned on the floor in front of the table.

When setting each robot position - it is quicker to move the robot to roughly the right position by using the mouse (click and drag the appropriate part of the arm), then accurately position the arm using the teachbox jog buttons.

VR ROBOT ROOM 1 HINTS AND TIPS.



If you drop the pencil when positioning the robot, click on the yellow and black diamond (shown left) - this resets all the objects back to their default positions (robot position excluded).

Give each robot position a relevant description name and a complimentary robot position number. For example, robot positions near the blue ink well are numbered 1xx, robot positions near the red ink well are numbered 2xx etc.... This will make it easier to find robot positions when building a program with the robot script file editor.

Try to store robot positions that can be used more than once. For example, a robot position is stored at a set height above the ink well dividing walls and directly over the blue ink well. It could be used as a robot approach position before dipping the pencil into the ink well and as a return position for coming back out from the ink well to a safe height.

Use the intelligent objects feature to help set some of the robot positions.

Use the robot script file editor to build a program that completes the set task. To start writing a robot script file, click on "File|New" from the robot script file editor menubar. When writing a robot script file, the robot does not require datuming, since it automatically nests when it is first switched on.

VR ROBOT ROOM 2 TASK.

ROOM 2 TASK.

Room 2 contains a table with the robot upon it. On opposite sides of the robot are a drop off block and a hopper containing six cubes.



RESET
BLOCK ON
THIS SIDE.

HOPPER
CONTAINING
6 CUBES.

DROP
OFF
BLOCK.

The first task in room 2 is to program the robot so it removes each of the cubes from the dispensing point at the base of the hopper, then moves and stacks these cubes on the drop off block to form a six cube column.

After completing task 1, reset the room by clicking on the yellow and black diamond reset block.

The second task in room 2 is to program the robot so it removes each of the cubes from the dispensing point at the base of the hopper, then moves and builds three columns, each containing two identically coloured cubes, next to the drop off block.

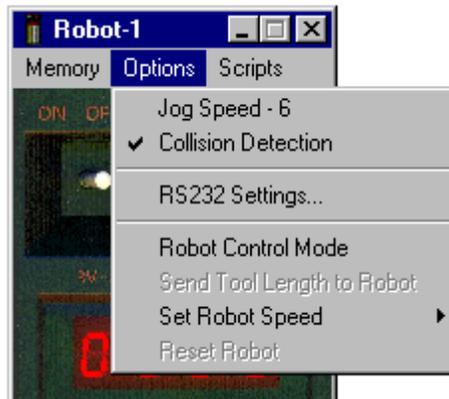
VR ROBOT ROOM 2 COLLISION DETECTION.

COLLISION DETECTION.

The objects in robot room 2 are designed with collision detection. This means if you drop a cube it will fall, hit and roll on the table surface in a realistic way. Dropped cubes can be pushed and picked up by the robot arm.

Similarly, with collision detection active, the robot arm will not move "through" the table and hopper. On hitting the table or the hopper a sound will be emitted and the robot arm will stop moving.

Robot room 2 starts, by default, with collision detection active. Collision detection can be switched on (tick mark visible) or off (tick mark invisible) by clicking on "Options|Collision Detection" in the menubar of the robot teachbox window (shown below).



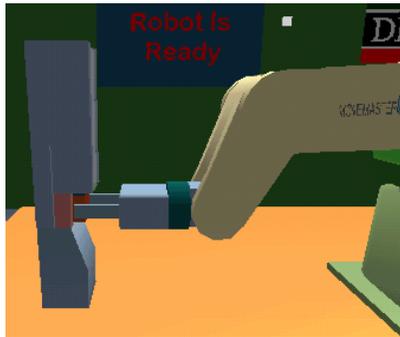
VR ROBOT ROOM 2 INTELLIGENT OBJECTS.

INTELLIGENT OBJECTS.

By positioning the cursor over some of the objects in robot room 2, then clicking the mouse buttons, certain moves and operations can be implemented.

Left mouse click on the hopper dispensing point (the purple section of the hopper) - Moves the robot so the grippers are positioned facing the hopper dispensing point (ready to approach cube). The angle of the robot arm is also automatically set to allow a cube to be easily and safely removed from the hopper dispensing point. The gripper state will be left according to the previous move.

Left mouse click on a cube not in the hopper - Moves the robot arm so it is positioned directly over the cube with the robot grippers open (ready to pick up the cube).

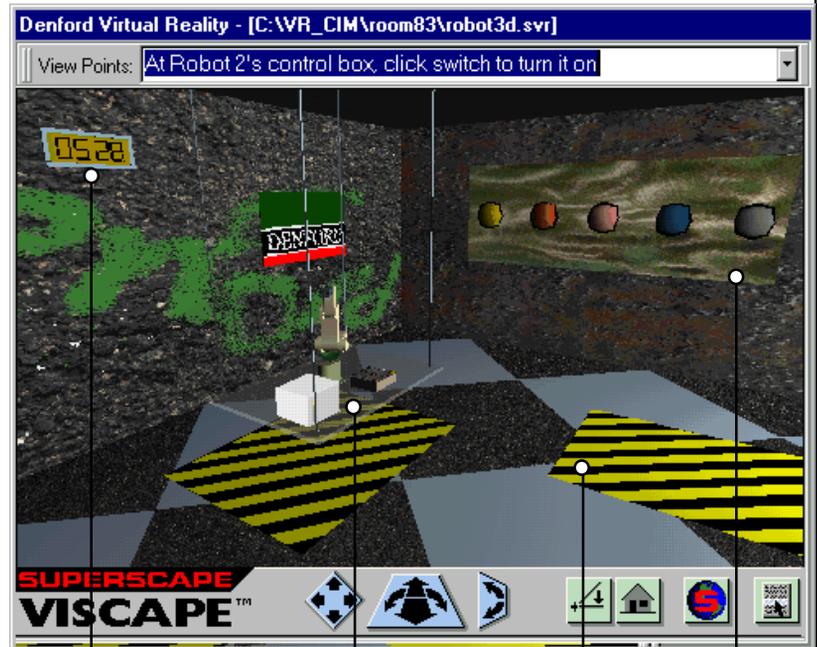


Right mouse click on a cube at the hopper dispensing point (shown left) - Moves the robot arm into the hopper dispensing point and opens the grippers so they are positioned around the cube in the hopper (ready to remove the cube).

VR ROBOT ROOM 3 TASK.

ROOM 3 TASK.

Room 3 contains three yellow and black striped floor grids and a colour sequence code mounted on the wall. Clicking on a striped floor grid activates the hydraulic table directly above it, which lowers from the ceiling. All three tables contain the same items - an electrical control box, a robot and a nine position colour keypad, used as a security switch.



ROOM
TASK
TIMER.

TABLE CONTAINING
CONTROL BOX,
ROBOT AND KEYPAD.

TABLE
ACTIVATION
FLOOR GRID.

COLOUR
SEQUENCE
CODE.

continued....

VR ROBOT ROOM 3 TASK.

continued....

Opening the lift doors activates an "intruder alarm". The task in room 3 is to deactivate the "intruder alarm" in the shortest possible time - a timer is positioned on the wall furthest from the lift doors.

To switch off the "intruder alarm" you must enter the correct colour sequence code into the nine position colour keypads on all three robot tables. To lower the robot tables, click on each of the striped floor grids. The colour sequence code (read from left to right) to successfully deactivate the "intruder alarm" is stated on a wall panel.

The colour sequence code must be entered one colour at a time, for each of the three robot tables.

VR ROBOT ROOM 3 INTELLIGENT OBJECTS.

INTELLIGENT OBJECTS.

By positioning the cursor over some of the objects in robot room 3, then clicking the mouse buttons, certain moves and operations can be implemented.

Note - Only table 1 has intelligent objects.



Left mouse click on a keypad button (shown left) - Moves the robot so the grippers are positioned directly over the keypad button chosen.

Right mouse click on a keypad button - Moves the robot so the grippers press the keypad button chosen.

Left mouse click on the grey keypad block (not one of the nine buttons) - Moves the robot to a safe clearance position. The clearance position is ideal for returning from or moving closer to the keypad buttons.

VR ROBOT ROOM 3 HINTS AND TIPS.

HINTS AND TIPS.

The colour sequence code must be entered one colour at a time, for each of the three robot tables in turn.

For example, if the first two numbers of the colour sequence code are yellow, blue.... then robots 1,2 and 3 must move in the following order to begin deactivating the "intruder alarm":

- Robot 1 touches the yellow button on its keypad.
- Robot 2 touches the yellow button on its keypad.
- Robot 3 touches the yellow button on its keypad.
- Robot 1 touches the blue button on its keypad.
- Robot 2 touches the blue button on its keypad.
- Robot 3 touches the blue button on its keypad.
- This continues for all the other required colours until the sequence has been completed.

Completing the entire colour sequence on robot 1, then robot 2 and finally robot 3 will not deactivate the "intruder alarm".

Only table 1 has intelligent objects. Tables 2 and 3 do not have any intelligent objects for a good reason....

The task requires you to program all the robots so that they press the keypad buttons in the correct sequence, in order to deactivate the "intruder alarm".

Once robot 1 has been programmed to press the keypad buttons in the correct order, robots 2 and 3 must also be programmed to press their keypad buttons in the same order as for robot 1 (since the deactivate code is the same for all three keypads).

Therefore, the memory for robot 1 can be saved and reloaded as the memory for robots 2 and 3. Similarly, the robot script files for robots 2 and 3 will be identical to those for robot 1.

continued....

VR ROBOT ROOM 3 HINTS AND TIPS.

continued....

Set all the required robot positions to complete the deactivation of the "intruder alarm" into the memory of robot 1, then save this memory file.

Next, open the robot script file editor and click on "File|New" from its menubar. Write and save the robot script files for all the moves required to complete the colour sequence code. For example:

- Move robot arm from parked position to safe position over keypad.
- Move robot arm down, press first colour button required, move back to safe position.
- Move robot arm down, press second colour button required, move back to safe position.
- Move robot arm down, press third colour button required, move back to safe position.
- Move robot arm down, press fourth colour button required, move back to safe position.
- Move robot arm down, press fifth colour button required, move back to safe position.
- Move robot arm from safe position over keypad to parked position.

Close the Robot teachbox window (currently controlling robot 1).

Switch on robot 2 and change the devices panel of VR Linker so it displays Robot 2. Load the robot memory (previously saved from robot 1) into robot 2.

Close the Robot teachbox window (currently controlling robot 2).

Switch on robot 3 and change the devices panel of VR Linker so it displays Robot 3. Load the robot memory (previously saved from robot 1) into robot 3.

Now all three robots have identical memories loaded with all the positions required to complete the deactivation of the "intruder alarm"

continued....

VR ROBOT ROOM 3 HINTS AND TIPS.

continued....

Change the DEVICES panel of VR Linker so it displays Robot 1. Click the [E] button in the ACTIONS panel of the VR Linker window to display the Action Editor window. Now add all the previously saved robot script files into the Action Editor, including appropriate descriptions to help identify them later.

When the Actions Editor window is closed, the list of actions available for robot 1 can be viewed using the dropdown list button in the ACTIONS panel of the VR Linker window.

Repeat the same process for robots 2 and 3 (by changing the DEVICES panel of VR Linker so it displays Robot 2 or 3). The robot script files written for use with robot 1 can also be used in the Actions Editor for robots 2 and 3.

Now all three robots have identical action lists in the VR Linker window.

Next, open the sequence file editor and click on "File|New" from its menubar. Use the actions from all three robots together, to produce sequence of events, occurring in the correct order to deactivate the "intruder alarm". Test and save the completed sequence file.

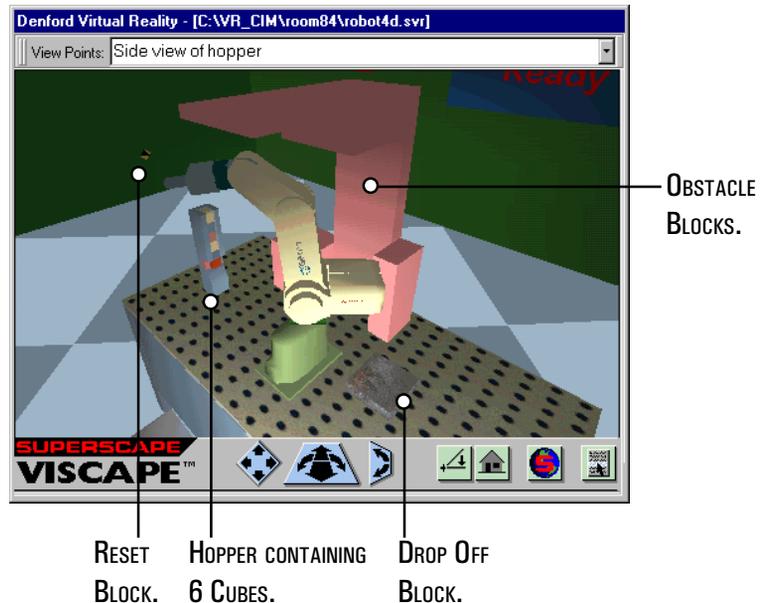
Reload robot room 3, switch on all three robots and load their memories, then load and run your saved sequence file. How quickly can you deactivate the "intruder alarm"?

VR ROBOT

ROOM 4 TASK.

ROOM 4 TASK.

Room 4 contains a table with the robot upon it. On opposite sides of the robot are a drop off block and a hopper containing six cubes. The robot is also partially surrounded by obstacle blocks.



To complete both the tasks below, the robot must avoid hitting any parts of the obstacle blocks with itself or any of the cubes being moved.

The first task in room 4 is to program the robot so it removes each of the cubes from the dispensing point at the base of the hopper, then moves and stacks these cubes on the drop off block to form a six cube column.

After completing task 1, reset the room by clicking on the yellow and black diamond reset block.

The second task in room 2 is to program the robot so it removes each of the cubes from the dispensing point at the base of the hopper, then moves and builds three columns, each containing two identically coloured cubes, next to the drop off block.

VR ROBOT ROOM 4 COLLISION DETECTION AND INTELLIGENT OBJECTS.

COLLISION DETECTION.

The objects in robot room 4 are designed with collision detection. This means a sound will be emitted and the robot will stop moving if it hits any of the obstacles, the hopper or the table. The hopper cubes can also be dropped, pushed and picked up.

Robot room 4 starts, by default, with collision detection active.

INTELLIGENT OBJECTS.

By positioning the cursor over some of the objects in robot room 2, then clicking the mouse buttons, certain moves and operations can be implemented.

Left mouse click on the hopper dispensing point (the purple section of the hopper) - Moves the robot so the grippers are positioned facing the hopper dispensing point (ready to approach cube). The angle of the robot arm is also automatically set to allow a cube to be easily and safely removed from the hopper dispensing point. The gripper state will be left according to the previous move.

Left mouse click on a cube not in the hopper - Moves the robot arm so it is positioned directly over the cube with the robot grippers open (ready to pick up the cube).

Right mouse click on a cube at the hopper dispensing point - Moves the robot arm into the hopper dispensing point and opens the grippers so they are positioned around the cube in the hopper (ready to remove the cube).

VR ROBOT

ROOM 5 TASK.

Room 5 Task.

Room 1 contains a robot mounted upon a column, six posts holding blank billets and a Denford Mirac CNC lathe.



EXAMPLE
COMPONENTS.

DENFORD MIRAC
CNC LATHE.

ROBOT MOUNTED
ON COLUMN.

BLANK BILLETS ON
STORAGE POSTS.

The task in room 5 is to program the robot so it picks up and places each blank billet into the lathe, then retreats to a safe parked position.

The lathe must be programmed to manufacture a component, using a program relating to the blank billet post colour (eg, a blank billet from the blue post would be used to make the blue component design). The robot must then remove and return the component to its original post.

This sequence of events must be repeated until all six different example components have been manufactured. Examples of the six components to be made are shown on top of the lathe cabinet.

VR ROBOT ROOM 5 INTELLIGENT OBJECTS.

INTELLIGENT OBJECTS.

By positioning the cursor over some of the objects in robot room 5, then clicking the mouse buttons, certain moves and operations can be implemented.



Left mouse click on a billet (shown left) - Moves the robot so the grippers are open and positioned directly above the billet (hand horizontal ready to approach billet).

Right mouse click on a billet - Moves the robot so the grippers are open and positioned around the billet (hand horizontal ready to pick up billet).

Click on the grippers to close them around the billet.

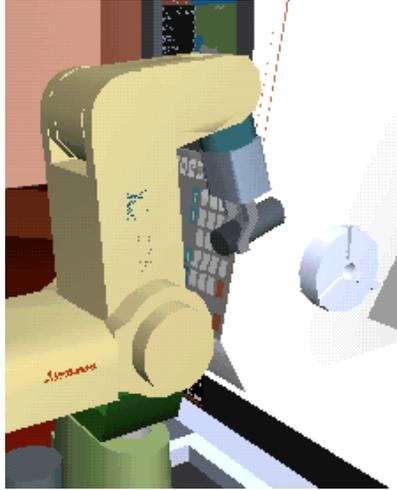
Left mouse click on a billet post - Moves the robot so the grippers remain closed around a billet previously picked up to a position directly above the billet post (hand horizontal ready to lower billet onto post).

Right mouse click on a billet post - Moves the robot so the grippers remain closed around a billet previously picked up and places the billet onto the billet post (hand horizontal ready to release billet onto the post).

continued....

VR ROBOT ROOM 5 INTELLIGENT OBJECTS.

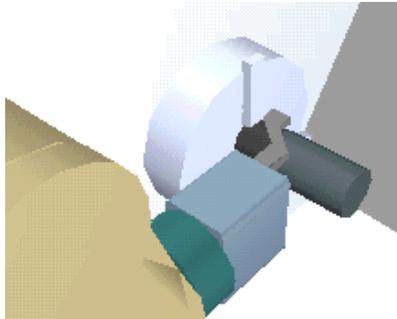
continued....



Left mouse click on the robot base - Moves the robot to a safe position (with the gripper state as in the previous move).

Right mouse click on the robot base (shown left) - Moves the robot to a position approaching the lathe door aperture (with the gripper state as in the previous move).

Left mouse click on the lathe headstock (white panel around the chuck) - Moves the robot with the gripper state as in the previous move, to a position approaching the chuck (billet aligned with spindle centreline).



Right mouse click on the lathe headstock (white panel around the chuck) - Places a billet held by the robot grippers into the lathe chuck (shown left).

continued....

VR ROBOT ROOM 5 INTELLIGENT OBJECTS.

continued....

Left mouse click on the lathe chuck - Opens the lathe chuck.

Right mouse click on the lathe chuck - Closes the lathe chuck.



Left mouse click on the lathe guard door - Opens the lathe guard door.

Right mouse click on the lathe guard door (shown left) - Closes the lathe guard door.

When a billet has been clamped in the chuck and the lathe guard door closed, left mouse click on one of the six example components (on top of the lathe cabinet). The lathe will automatically manufacture the component selected.

VR ROBOT ROOM 5 - DISPLAYING THE LATHE CONTROL PANEL.

The Lathe Control Panel is used to operate some of the functions on the virtual CNC lathe. Graphically, the layout and appearance of this panel is identical to the righthand section of a "real" Denford CNC lathe control panel.

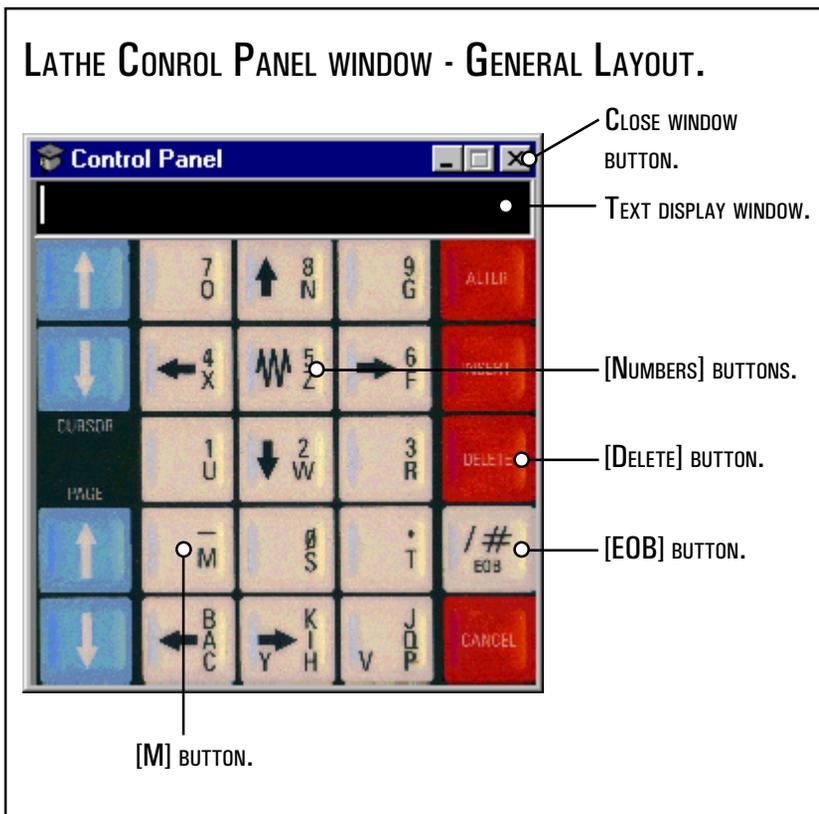
To display the lathe control panel window, check that the DEVICE dialog box of the VR Linker window displays the device name "lathe", then click the [C] button to display the lathe control panel window.



1) SELECT LATHE FROM THE LIST OF AVAILABLE DEVICES.

2) CLICK THE [C] BUTTON TO DISPLAY THE LATHE CONTROL PANEL.

VR ROBOT ROOM 5 - LATHE CONTROL PANEL GENERAL LAYOUT.



VR ROBOT ROOM 5 - ENTERING AN M CODE.

To enter an M code using the lathe control panel, click on the [M] button - the "M" prefix will appear in the text display window.

Click on the [Numbers] buttons to enter the two digit M code number, again displayed in the text display window. Use the [Delete] button to remove any incorrect characters.

Finally, click on the [EOB] button to confirm and execute the command.

continued....

VR ROBOT ROOM 5 - ENTERING AN M CODE.

continued....

The following M codes can be executed using the lathe control panel:

- **M10** - Opens the lathe chuck.
- **M11** - Closes the lathe chuck.
- **M38** - Opens the lathe guard door.
- **M39** - Closes the lathe guard door.

The lathe control panel window contains the following items:

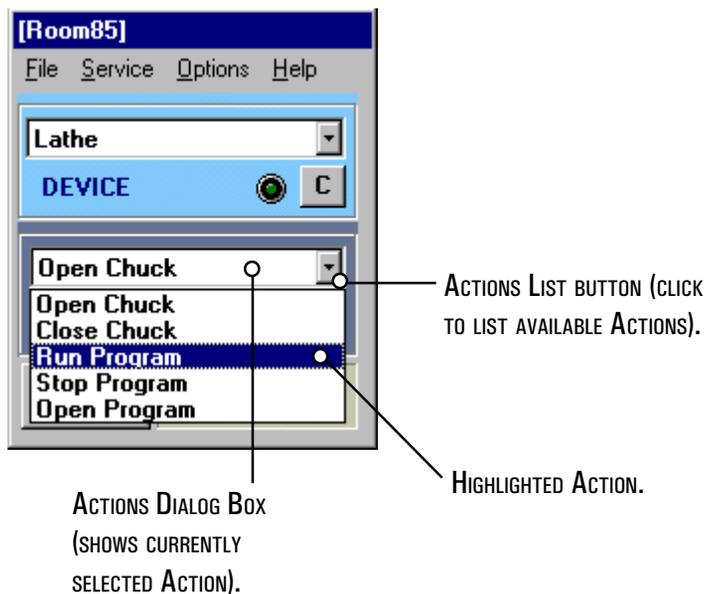
- **Close window button** - Click the [X] button to close the lathe control panel window.
- **Text display window** - Displays any commands, messages or information from any buttons pressed on the lathe control panel.
- **[Numbers] buttons** - Click on the ten numbers buttons when entering M codes - each number is displayed in the text display window.
- **[M] button** - Click on the [M] button to enter an M code - the "M" prefix is displayed in the text display window.
- **[Delete] button** - Click on the [Delete] button to remove any incorrectly entered characters from the text display window.
- **[EOB] button** - Click on the [EOB] button to confirm and execute any requested M code command.

VR ROBOT ROOM 5 - THE LATHE ACTIONS LIST.

All the lathe actions required to complete the task in room 5 are automatically added into the ACTIONS panel, unlike the robot actions which must be programmed and added to the ACTIONS panel by the user (unless logged on as the Default User).

Click on the actions list button in the ACTIONS panel of the VR Linker window, to display the dropdown list of available actions for the lathe (shown below).

Highlight the required action and click the left mouse button so it appears in the actions dialog box. Click the [A] button to perform the stated action.



VR ROBOT ROOM 5 HINTS AND TIPS.

HINTS AND TIPS.

Use the different viewpoints to help you switch on, then program, the robot and lathe.

The task can be made easier to manage by splitting it into six separate sub-tasks. Each sub-task is used to build a robot memory and robot script files specific to the manufacture of a particular component design.

Note - Some of the robot script files could be common to all six sub-tasks (ie, placing the blank billet into the lathe from a safe robot position, removing the chess piece from the chuck back to the robot safe position).

Set the robot positions and write robot script files for placing the billet in and taking the component out of the chuck, via a safe robot position. Remember to save the robot memory and robot script files !! Enter these robot script files into the ACTIONS panel of the VR Linker by using the actions editor (click on the [E] button in the VR Linker window).

Program each of the six sub-tasks (the sub-task example shown is for the blue component) as shown below:

Load the robot memory previously saved for placing the billet in and taking the component out of the chuck. You will now add more robot positions to this memory file specific to manufacture of the blue component.

continued....

VR ROBOT ROOM 5 HINTS AND TIPS.

continued....

Set the robot positions and write robot script files for picking up the billet up from the blue post and placing the blue component back onto the blue billet post. Remember to save the new robot memory and robot script files !! Enter the robot script files into the ACTIONS panel of the VR Linker by using the actions editor (click on the [E] button in the VR Linker window).

Open the sequence file editor and click on "File|New" from its menubar. Use the actions from the robot and lathe to produce sequence of events that manufactures the blue component.

When adding the "Run Program" action, you will be prompted for the name of the CNC file to be loaded. Use the file "blue.fnc", since it is the billet from the blue post being used. Test and save the completed sequence file.

The CNC files (format ".FNC") can be edited using Windows Notepad:

- The Billet Type number refers to the profile that will be cut - looking at the example components from the front of the lathe, they number from right to left as 1Ø (yellow), 2Ø, 3Ø, 4Ø, 5Ø, 6Ø and 7Ø (blank billet).
- The time taken to machine the component can also be edited, but must have a minimum value of 1ØØØ (1Ø seconds).

Repeat this procedure for programming the manufacture of the other five component designs.

INDEX.

A	
ACTIONS EDITOR	
- COMMANDS PANEL	6-4
- GENERAL LAYOUT	6-2
- INTERLOCKS PANEL	6-7
C	
CLOSING	
- A VIRTUAL WORLD	4-2
- THE VR ROBOT SOFTWARE	3-9
CONVENTIONS USED IN THIS MANUAL	1-4
D	
DISPLAYING THE ROBOT TEACHBOX & NESTING THE ROBOT	9-1
DISPLAYING THE ROBOT TEACHBOX	8-1
E	
EXAMPLE OF A ROBOT SCRIPT FILE	10-12
F	
FLYING AROUND A ROBOT ROOM (QUICKSTART TUTORIAL)	2-3
H	
HOW TO USE THE ON-LINE HELP SYSTEM	3-7
HOW TO USE THIS MANUAL	1-3
L	
LOADING A ROBOT ROOM (QUICKSTART TUTORIAL)	2-2
LOADING EXEMPLAR FILES FOR COMPLETED TASKS	3-6
LOADING THE EXEMPLAR FILES FOR ROBOT ROOM 1 (QUICKSTART TUTORIAL) ..	2-10
LOCATION OF PERSONAL USER DIRECTORIES	3-5
LOGGING ON (QUICKSTART TUTORIAL)	2-1
LOGGING ON AS A DEFAULT USER	3-2

INDEX.

M	
MOVING THE ROBOT WITH THE MOUSE.....	9-2
MOVING THE ROBOT.....	9-6
O	
OPENING A VIRTUAL WORLD.....	5-1
P	
POSITION EDITOR WINDOW - GENERAL LAYOUT.....	8-12
R	
ROBOT KEYPAD	
- [< 0 > /Ø] BUTTON.....	8-29
- [> C < /5] BUTTON.....	8-29
- [1] BUTTON.....	8-28
- [6] BUTTON.....	8-28
- [DEC] BUTTON.....	8-17
- [ENT] BUTTON.....	8-22
- [INC] BUTTON.....	8-17
- [MOV] BUTTON.....	8-20
- [ORG] BUTTON.....	8-19
- [P + /3] BUTTON.....	8-26
- [P-/8] BUTTON.....	8-26
- [PS] BUTTON.....	8-18
- [PTP] BUTTON.....	8-21
- [R + /2] BUTTON.....	8-27
- [R-/7] BUTTON.....	8-27
- [TOOL] BUTTON.....	8-22
- [WRT] BUTTON.....	8-20
- [X + /B +] BUTTON.....	8-23
- [X-/B-] BUTTON.....	8-23
- [XYZ] BUTTON.....	8-21

INDEX.

ROBOT KEYPAD	
- [Y+/S+] BUTTON.	8-24
- [Y-/S-] BUTTON.	8-24
- [Z+/E+/4] BUTTON.	8-25
- [Z-/E-/9] BUTTON.	8-25
- NON FUNCTIONING BUTTONS.	8-30
ROBOT PART NAMES.	8-16
ROBOT ROOM STARTING POINT.	11-1
ROBOT SCRIPT FILE EDITOR	
- [LINE EDITING] BUTTONS.	10-10
- [OK] AND [CANCEL] BUTTONS.	10-12
- [PLAY] BUTTONS.	10-11
- FILE MENU.	10-3
- GENERAL LAYOUT.	10-2
- LOADING AN EXEMPLAR ROBOT SCRIPT FILE.	10-13
- ROBOT SCRIPT FILE DISPLAY WINDOW.	10-7
ROBOT TEACHBOX	
- EDIT ROBOT MEMORY WINDOW.	8-10
- EMERGENCY STOP BUTTON.	8-3
- GENERAL LAYOUT.	8-2
- MEMORY MENU.	8-4
- OPTIONS MENU.	8-6
- SCRIPTS MENU.	8-9
- SWITCHING ON AND OFF.	8-3
S	
SAVING THE ROBOT MEMORY.	9-9
SECURITY DONGLE CONNECTION.	3-3
SELECTING PTP MOVEMENT MODE.	9-3
SELECTING TOOL MOVEMENT MODE.	9-5
SELECTING XYZ MOVEMENT MODE.	9-4

INDEX.

SEQUENCE FILE EDITOR	
- ACTIONS PANEL, DESCRIPTION	7-5
- EXAMPLE	7-8
- GENERAL LAYOUT.	7-2
- MENUBAR AND DEVICE PANEL.	7-4
- MENUBAR.	7-3
- SEQUENCE FILE EDITING BUTTO	7-6
- SEQUENCE FILE PLAY BUTTONS,	7-7
SETTING AND MOVING TO A STORED ROBOT POSITION.	9-7
SETTING THE ROBOT POSITIONS (QUICKSTART TUTORIAL).	2-6
STARTING	
- THE ACTIONS EDITOR.	6-1
- THE ROBOT SCRIPT FILE EDITOR.	10-1
- THE SEQUENCE FILE EDITOR.	7-1
- THE VR LINKER.	5-1
- THE VR ROBOT SOFTWARE.	3-3
SWITCHING ON THE ROBOT (QUICKSTART TUTORIAL).	2-4
T	
THE DENFORD VR ROBOT SOFTWARE - OVERVIEW.	1-2
U	
USER FILES - STRUCTURE.	3-4
USING THE ROBOT SCRIPT EDITOR (QUICKSTART TUTORIAL).	2-7
USING THE ROBOT TEACHBOX TO MOVE THE ROBOT (QUICKSTART TUTORIAL). ...	2-5
V	
VISCAPE WINDOW	
- CHANGING THE VIEWPOINT.	4-5
- GENERAL LAYOUT.	4-3
- MOVING AROUND A VIRTUAL WORLD.	4-7

INDEX.

VISCAPE WINDOW

- SWITCHING ON THE SOUND. 4-12
- THE MAIN VISCAPE MENU. 4-9
- THE MOVEBAR. 4-6
- THE VIEWBAR. 4-4
- TOOLBAR ICONS. 4-8

VR LINKER

- CLOSE PROGRAM. 5-10
- FILE MENU. 5-4
- GENERAL LAYOUT. 5-3
- HELP MENU. 5-7
- OPENING A VIRTUAL WORLD. 5-1
- OPTIONS MENU. 5-6
- SERVICE MENU. 5-5
- SWITCHING ON THE DEVICES. 5-2
- THE ACTIONS PANEL. 5-9
- THE DEVICE PANEL. 5-8

VR ROBOT ROOM 1

- HINTS AND TIPS. 11-4
- INTELLIGENT OBJECTS. 11-3
- TASK. 11-2

VR ROBOT ROOM 2

- COLLISION DETECTION. 11-7
- INTELLIGENT OBJECTS. 11-8
- TASK. 11-6

VR ROBOT ROOM 3

- HINTS AND TIPS. 11-12
- INTELLIGENT OBJECTS. 11-11
- TASK. 11-9

INDEX.

VR ROBOT ROOM 4

- COLLISION DETECTION AND INTELLIGENT OBJECTS. 11-16
- TASK. 11-15

VR ROBOT ROOM 5

- ENTERING AN M CODE. 11-22
- DISPLAYING THE LATHE CONTROL PANEL. 11-21
- LATHE CONTROL PANEL GENERAL LAYOUT. 11-22
- THE LATHE ACTIONS LIST. 11-24
- HINTS AND TIPS. 11-25
- INTELLIGENT OBJECTS. 11-18
- TASK. 11-17

W

- WHAT IS VIRTUAL REALITY? - OVERVIEW. 1-1