

Twin Rotor Mimo System

INSTALLATION AND COMMISSIONING

33-007-0M5



Feedback

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Notes



TWIN ROTOR MIMO SYSTEM INSTALLATION AND COMMISSIONING

PREFACE

THE HEALTH AND SAFETY AT WORK ACT 1974

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

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

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

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

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

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



CAUTION -
RISK OF
DANGER

Refer to accompanying documents



CAUTION -
RISK OF
ELECTRIC SHOCK



CAUTION -
ELECTROSTATIC
SENSITIVE DEVICE

PRODUCT IMPROVEMENTS

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

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

COMPONENT REPLACEMENT

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

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

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

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

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



CE DECLARATION CONCERNING ELECTROMAGNETIC COMPATIBILITY

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

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

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1. Introduction

This manual contains a description of the components of the Twin Rotor MIMO System (**TRMS**), and assembly and test procedures. It is intended to provide the means for validating the correct operation of the system, **before** proceeding to the more advanced functions and demonstrations using control software and MATLAB / SIMULINK.

The procedures described in this Section of the TRMS manual will ensure the correct:

- Assembly of the system
- Switch and Jumper settings of the PCL-812 interface card
- Cable connections between the PC and the TRMS

1.1 REQUIRED EQUIPMENT

The following items of equipment, software and documentation are required to use the system.

- **IBM Compatible PC** with minimum configuration:
8 Mb of memory, Math co-processor (included in 486 or Pentium processor)
VGA screen and mouse.
DOS version 5 or later, Windows 3.1 or Windows 95
- **MATLAB** Version 5.1 with SIMULINK 2.1 (from *Mathworks Inc*)
- **Advantech** PCL-812PG Enhanced Multi-Lab Card for installation in the PC with 2 x 20 way and 1 x 40 way ribbon cables
- **Feedback** Twin Rotor MIMO System consisting of rotor unit, base unit and remote power control box.
- **1 CD containing:**

Commissioning and Test software

TRMS Control software for use with MATLAB 5.1 and SIMULINK 2.1

Set of 6 manuals in Adobe Acrobat Format

33000M5 - Feedback Matlab Based Control Systems – Software
Installation

33-007-0M5 - Twin Rotor MIMO System - Installation and Commissioning

33-007-1M5 - Twin Rotor MIMO System - Getting Started

33-007-2M5 - Twin Rotor MIMO System - Reference Manual

33-007-3M5 - Twin Rotor MIMO System - External Interface

33-007-4M5 - Twin Rotor MIMO System - Advanced Teaching Manual

Adobe Acrobat Reader and installation utility



CHAPTER 1

Introduction

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

1.2 FEEDBACK LTD SUPPLIED ITEMS

The following items are supplied by Feedback under the following product codes

33-220	Twin Rotor Mechanical Unit with remote On/Off switch
33-945	Twin Rotor MIMO System Software pack including Advantech card
33-945I	Twin Rotor MIMO System Software pack excluding Advantech card
33-007	33-220 plus 33-945 (Composite product)
33-007I	33-220 plus 33-945I (Composite product)



2. Mechanical Assembly

The MIMO Unit is dis-assembled for transit. Follow the instructions below for re-assembly and refer to Fig. 2.1.

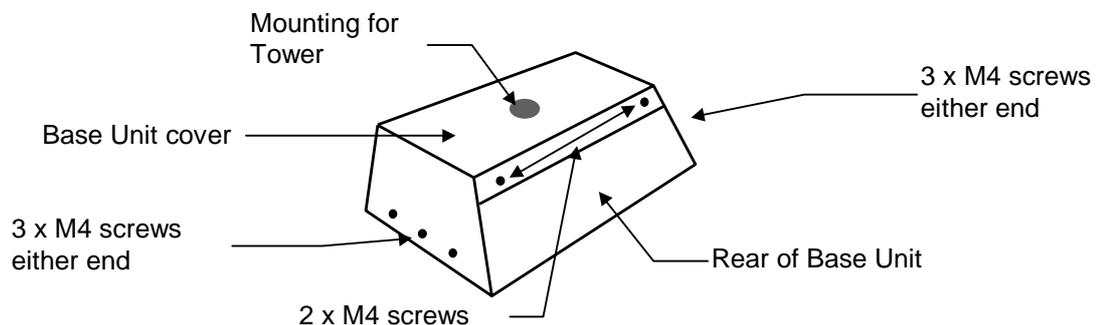


Fig 2.1: Showing position of base unit cover screws

- Remove the cover from the base unit by removing 8 x M4 screws.
- Remove 4 x M4 counter-sunk screws from the bottom of the tower.
- Attach the tower to the base cover using 4 x M4 counter-sunk screws with the tower on top of the base, ensuring that the vertical axis locking screw is on the right hand side viewed from the front of the base unit.
- The horizontal shaft, to which the rotor assembly attaches, has a flat, on which the horizontal axis locking screw locates when screwed down. Rotate the horizontal shaft until the locking screw locates on to the flat and screw the locking screw tight. Attach the rotor arm to the top of the tower so that the arm is **horizontal** and secure to the shaft using the Allen key provided.
- Locate the counter-weight pendulum into the hole in the rotor arm boss and secure using the Allen key provided. The pendulum should be on the front of the unit when viewed from the front of the base unit.
- Connect cables - there are two ribbon cable connections inside the base unit, and one ribbon cable connection at the top of the rotor boss.
- Replace the base cover, with the tower attached to the base unit, and secure using the 8 x M4 screws previously removed.



Figure 2.2 below shows the complete TRMS/MIMO assembly.

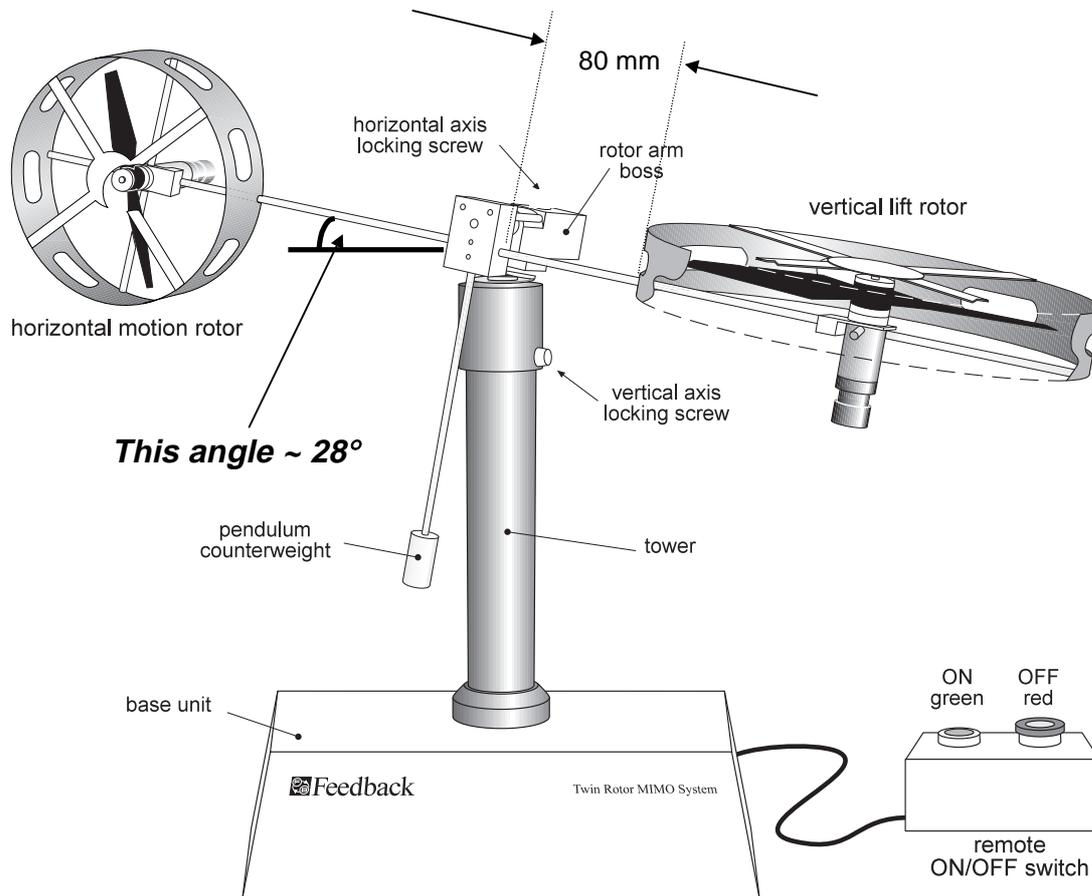


Fig. 2.2: The complete TRMS/MIMO Assembly

Note: The MIMO has two degrees of freedom - the rotors can rotate about a vertical and a horizontal axis. When not in use, or when setting control parameters, either or both axes of rotation can be locked by means of the two locking screws shown on the diagram above.

When the horizontal axis locking screw is released, the heavier weight of the vertical rotor should cause the rotor assembly arm to rest at an angle of approximately 28 degrees to the horizontal. This is correct and is required for the proper functioning of the system, as then power must be applied to the vertical motor in order to raise the arm to a horizontal position.

The distance between the plastic vertical rotor guard and the rotor arm boss should be approximately 80 mm.



3. Switch And Jumper Settings for the PCL-812 Card



The PCL-812 contains components which can be damaged by static electricity. Before removing the PCL-812 board from its conductive packaging, touch your hand on a grounded metal object such as the case of your PC. Avoid touching the components on the board or the plated edge connectors.

Before installing the PCL-812PG interface card into your computer make sure that the switches and jumpers shown in Fig. 3.1 are set correctly, as detailed in this section.

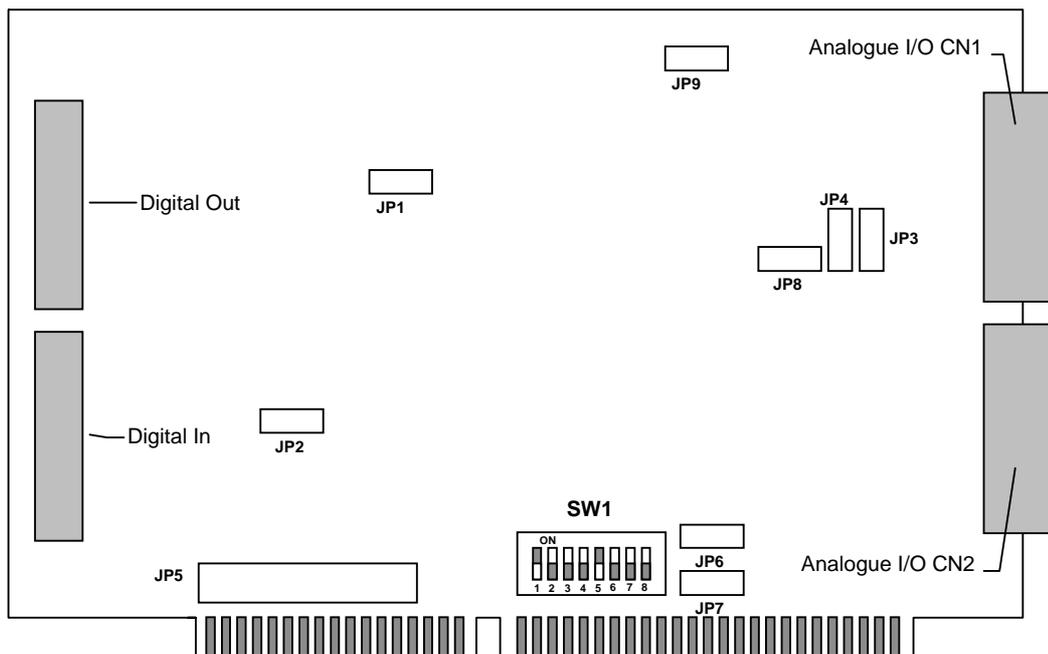


Figure 3.1: PCL-812PG Interface Card - Switch and Jumper positions



Note: *The board shown above is a 16 bit short board. Some users may have the 8 bit full length PCL- 812 board for which the SW1 switch settings are different. If you have this board refer to the settings in the following section for the 8 bit board.*

Other settings and cable connections are the same for both boards.



CHAPTER 3

PCL – 812 Card Settings

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

3.1 SWITCH SETTINGS - 16 BIT BOARD

Switch SW1 controls the base address for I/O transfer (switches 1-6), and the CPU wait states (Switches 7-8). They should be set as follows.

(Note that the MIMO software always refers to the decimal settings, whereas the manual on the PCL-812 board refers to hexadecimal settings. For convenience, both decimal and hex addresses are shown in the table below).

SW1 Base Address Selection

I/O Address Range (hex and decimal)	SW1 Switch position					
	1	2	3	4	5	6
200-20F (512-527 Dec)	OFF	ON	ON	ON	ON	ON
210-21F (528-543 Dec)	OFF	ON	ON	ON	ON	OFF
220-22F (544-559 Dec) *	OFF	ON	ON	ON	OFF	ON
230-23F (560-575 Dec)	OFF	ON	ON	ON	OFF	OFF
300-30F (768-783 Dec)	OFF	OFF	ON	ON	ON	ON
3F0-3FF (1008-1023 Dec)	OFF	OFF	OFF	OFF	OFF	OFF

* Factory default setting



Note that some video cards or floppy disk drives use the higher base addresses such as 1008 (Hex 3F0), and should be avoided if possible.

SW1 Wait State Selection

Time Delay	SW1 Switch Settings	
	7	8
0 *	ON	ON
2	OFF	ON
4	ON	OFF
6	OFF	OFF

* Factory default setting



CHAPTER 3

PCL – 812 Card Settings

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

JP8, JP9 - D/A Internal Reference, A/D Maximum Input Voltage Selection

	10	5	
JP8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
JP9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Depending on the specification and configuration of your PC you may need to change the Base Address and Wait State settings.



None of the other settings need to be changed.

3.3 SWITCH SW1 SETTINGS FOR 8 BIT FULL LENGTH PCL - 812 BOARD

I/O Address Range (hex and decimal)	SW1 Switch position					
	1	2	3	4	5	6
200-20F (512-527 Dec)	ON	ON	ON	ON	ON	X
210-21F (528-543 Dec)	ON	ON	ON	ON	OFF	X
220-22F (544-559 Dec) *	ON	ON	ON	OFF	ON	X
230-23F (560-575 Dec)	ON	ON	ON	OFF	OFF	X
300-30F (768-783 Dec)	OFF	ON	ON	ON	ON	X
3F0-3FF (1008-1023 Dec)	OFF	OFF	OFF	OFF	OFF	X

Note: An "X" in the table above means that this switch is not used.



4. Installation of the PCL-812 Card And Cables

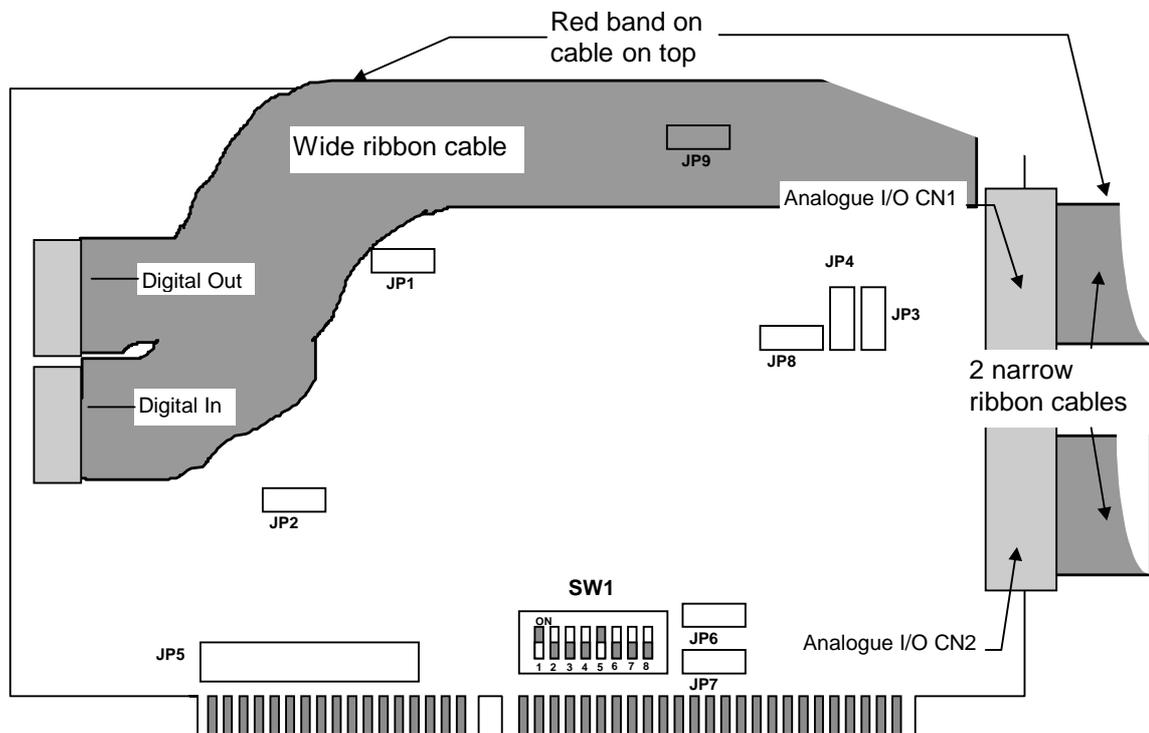


Figure 4.1: PCL- 812 Interface Card Ribbon Cable connections

Two slots are required at the rear of the PC - one for the two 20 way analogue port sockets, and one for the 40 way socket at the end of the wide ribbon cable for the digital ports. Use screws to secure the card and ribbon socket plates to the casing of the PC.

Carefully install the interface card in a spare slot on the PC motherboard (or in a slot on the passive backplane if your PC has this type of architecture - common with some 19 inch rack mounted PC's). If in any doubt as to the correct procedure consult the documentation supplied with the PC.



**Turn OFF and disconnect the mains power supply
BEFORE opening the computer**

Before opening the computer it is important to ensure that the computer is switched off and that the mains power supply is not connected.

Once you have opened the computer, check to see if there are any other cards installed, for example a network or sound card. It is important to determine the addresses of any such cards as your Twin Rotor MIMO System will not function correctly if there is another card using all, or part of, the address space assigned to the PCL-812PG interface card.



CHAPTER 4

PCL-812 Card Installation

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

Following the installation of the interface card into your PC, you are now ready to close the PC case and connect the ribbon cables to the 33-220 Twin Rotor MIMO System.

Refer to Fig 6.2 below for details.

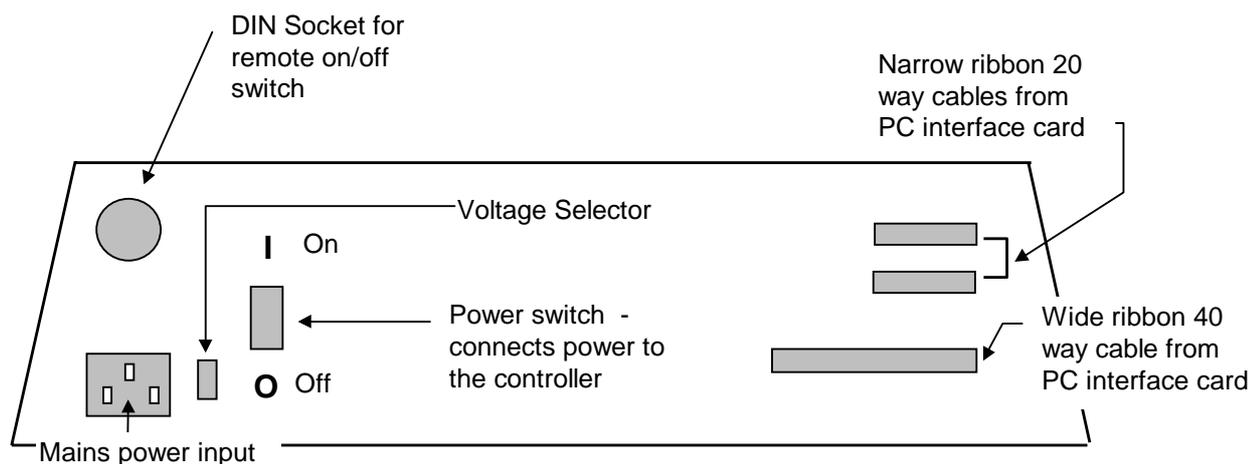


Fig 4.2: Twin Rotor MIMO System 33-220 - Rear Panel

Connectors and Switches

The connectors and switches are located at the rear of the 33-220 unit.

The sockets for the ribbon cables are on the back of the 33-220 unit. The 20-way connector from CN1 connects to the topmost connector on the 33-220. The 20-way connector from CN2 connects to the next connector and the 40-way connector connects to the lowest connector on the 33-220.

ON / Off switch

Connect the remote On/Off switch unit DIN connector to the rear of the 33-220.

Voltage selector

Set the voltage selector for the correct voltage in your area.

Mains power

Connect the mains power cable to the 33-220 and plug in to your mains supply.

Switch on

Switch on the mains supply to the 33-220 and your PC. Switch the 33-220 illuminated power switch on. If this switch does not light up check the mains power cable and mains power supply.



Do not at this stage press the round green start button.



TWIN ROTOR MIMO SYSTEM Installation and Commissioning

CHAPTER 4

PCL-812 Card Installation

Software Installation

Install the Commissioning / Test software as described in the next Chapter of this manual (Chapter 5).



It is important that the area of operation is free of obstruction and that users and observers are warned to keep clear of the immediate vicinity of the system, as the twin rotors can build up a significant amount of momentum.



CHAPTER 4

PCL-812 Card Installation

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

Notes



5. Commissioning and Test Software

5.1 STARTING THE SOFTWARE

Commissioning / Test software is supplied to check the operation of the Twin Rotor MIMO System, before using the MATLAB driven control software.

Windows 95 installation

Insert the MIMO Commissioning / Test software disk in drive A: From the Windows 95 **Start** menu click on **RUN** and use the browse feature to locate the **MIMOTST.EXE** program on drive A:

Windows 3.1 installation

Insert the MIMO Commissioning / Test software disk in drive A: Start **File Manager** and click on the **MIMOTST.EXE** program drive A:. Click on **RUN** from the File manager **File** menu.

DOS installation

Insert the MIMO Commissioning / Test software disk in drive A: Type in the following DOS commands.

```
>A:
```

```
>MIMOTST
```

5.2 SOFTWARE OPERATION

After starting the MIMO commissioning and test software you will see the following screen presented.



Fig 5.1. Start screen



CHAPTER 5

Commissioning and Test Software

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

Click **OK**. The following screen appears, *only if the card is not found at the factory default Base address of 544*.

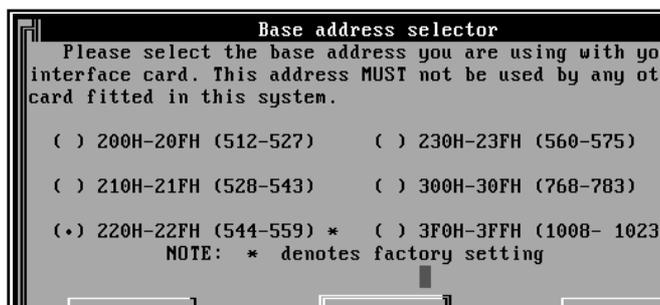
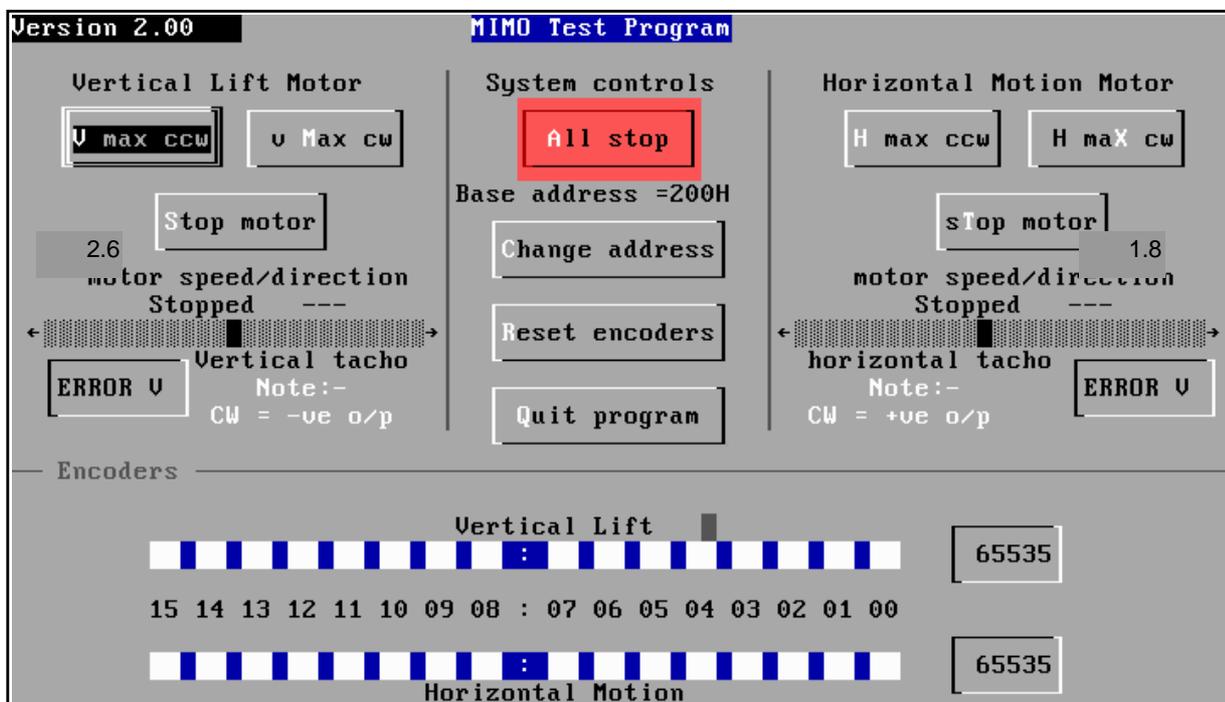


Fig. 5.2: PCL-812 Base address Selection

Use the mouse to select the base address of the PCL-812 interface card which has been set and checked in accordance with the procedure detailed in Chapter 3 of this manual.

If you do not know the Base Address, clicking on **Locate** will identify and set it automatically. (Note that **Locate** can only be used if there is only **one** PCL-812 board installed in your PC).

Having selected the correct base Address, click on **Close**. The screen shown below appears.





5.3 DESCRIPTION OF SCREEN CONTROLS AND DISPLAYS.

This screen allows you to interact with the Twin Rotor MIMO System, change the speeds of the motors on the rotors by changing the applied voltages, and display the outputs from the two rotary encoders, which measure angular displacements about a horizontal and a vertical axis.

V max ccw

v Max cw

Clicking these buttons applies the maximum voltage to the vertical axis rotor in either a counter clockwise or clockwise direction.

H max ccw

h maX cw

Clicking these buttons applies the maximum voltage to the horizontal axis rotor in either a counter clockwise or clockwise direction.

Stop motor

sTop motor

Clicking these buttons stops the vertical or horizontal axis motors.

All stop

Stops all input to the motors

Change address

Changes the base address of the PCL-812 board

Reset encoders

Clicking on the reset encoders button sets the rotary encoders to zero in any angular position. Subsequent encoder outputs are then angular deviations relative to the new set positions, and are shown in the lower part of the screen in binary format.

Quit Program

Exits the program.

Motor speed/direction

Dragging the slider bar to the left or right allows the motor speed to be varied in a clockwise or counter clockwise direction, in a number of discrete steps.

Vertical tachometer
Horizontal tachometer

The vertical and horizontal axis motors are each equipped with tachogenerators. The output from the tachogenerators is displayed immediately above the slider bar as a speed and below it in volts.



CHAPTER 5

Commissioning and Test Software

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

2.6 v

1.8 v

Shows the output voltages from the vertical and horizontal tachogenerators.



HOT KEYS

Note that as an alternative to using the mouse, the functions displayed on the screen can be activated by typing ALT + the highlighted letter displayed in reverse video on the screen. Thus, for example, to reset the encoders, press ALT + R



6. Test Sequence

When you have completed the installation of the system, execute the following test sequence to ensure that the system is functioning properly.

- Start MIMOTST commissioning software, and check correct base address
- Ensure that both motors are stopped, or rotating **very** slowly. If not click on **All stop**
- Switch on the mains power and the switch on the rear of the 33-220 rotor unit.

ACTION	RESULT
1. Press the green round start button on the remote ON/OFF switch.	The motors may rotate slowly.
2. Move the vertical lift rotor gently up and down.	Observe the changes in the vertical lift encoder readings.
3. Move the horizontal motion rotor gently back and forth.	Observe the changes in the horizontal motion encoder readings.
4. Turn the vertical axis locking screw to stop rotation about the vertical axis.	
5. Drag the slider on the vertical lift motor speed/direction bar one position to the right. Drag it further to the right.	The vertical lift motor starts to rotate counter clockwise viewed from the top. The rotational speed increases and the rotor starts to lift up.
6. Drag the slider on the vertical lift motor speed/direction bar, one position to the left. Drag it further to the left.	The vertical lift motor starts to rotate clockwise viewed from the top. The rotational speed increases and the rotor is forced downwards.



CHAPTER 6

Test Sequence

TWIN ROTOR MIMO SYSTEM Installation and Commissioning

ACTION	RESULT
7. Turn the horizontal axis locking screw to stop rotation about the horizontal axis.	
8. Drag the slider on the horizontal motion motor speed/direction bar one position to the right. Drag it further to the right.	The horizontal motion motor starts to rotate clockwise viewed from the front. The rotational speed increases and the rotor starts to rotate about a vertical axis with additional speed.
9. Drag the slider on the horizontal motion motor speed/direction bar one position to the left. Drag it further to the left.	The horizontal motion motor starts to rotate counter clockwise viewed from the front. The rotational speed increases and the rotor starts to rotate about a vertical axis with additional speed.



Always be prepared to press the round red STOP button to cut the power to the system if the rotational speed becomes excessive.

When you have completed the commissioning and test of your MIMO system, refer to the manual “Getting Started” – 33-007-1M5 to use the system under the control of MATLAB and the real time control software.