



SERVICE MANUAL

ST/7, ST/8 CNC LATHES

PROPRIETARY INFORMATION

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Lathe User's Service Manual
ST/7, ST/8 CNC lathes

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**Proprietary Information
About the Rhino ST/7 and ST/8.**

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ST/7, ST/8 Service Manual For Rhino ST/7, ST/8 Users

CAUTION

Anybody not trained in the service of high voltage computer controlled equipment should not attempt to service this equipment. Such equipment is very dangerous and can cause death or serious injury to those who are not properly trained.

Never make an attempt to defeat any of the safety interlocks provided on the lathe in any way. They are there for your safety. Interfering with them can cause death or serious injury.

This manual remains the property of Rhino Robotics Ltd. It is loaned to the user for the express purpose of helping the user in the upkeep of the equipment.

The contents of this manual are trade secrets and are the intellectual property of Rhino Robotics Ltd

No part of this manual may be copied, stored or transmitted in any form whatsoever without the written express permission of Rhino Robotics Ltd.

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Please note:

For legal purposes, all information in this manual is hereby defined as a trade secret and should be handled accordingly. Having access to trade secrets places certain legal obligations on you.

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Introduction

If you feel your equipment is in need of service, please contact Rhino Robotics Ltd **before beginning any disassembly.**

This equipment contains high voltages and is therefore not suitable for service by personnel that have not been trained in the service of high voltage computer controlled devices.

High voltages exist in the following areas:

- In the vicinity of the CRT and its power supply
- At all power supplies and related circuitry.
- At all transformers.
- At all amplifiers.
- At any and all relays
- At interfaces provided by the user at relays.
- At power receptacles and outlets.
- At the motors.

PC boards CAN NOT be assumed to have no high voltages on them

It is important to ground your body, to remove all static electricity, before starting to work on any sensitive electronic equipment. This can be done by touching a grounded metal plate before starting work. The lathe and controller chassis can be considered grounded only if the equipment is plugged into a grounded outlet. Use caution when servicing equipment which is plugged into a live outlet.

It is strongly recommended that the user have the latest version of the software installed in the lathe to make absolutely sure that any difficulties encountered are not software related. Yearly contracts are available to all users to keep their software updated to the latest version in use.

As of Jan 1 1995 the latest version of the operating system is 2.00.02

As of Jan 1 1995 the latest version of the diagnostics is 3.00.00

Your lathe may not be able to use the latest versions.

The ST/7, ST/8 service manual is divided into 4 major of sections.

- A. A system hardware description
- B. How the system works
- C. Mechanical Problems
- D. Computer related problems.
- E Maintenance

A. System Hardware Description

1. The controller

The central processing unit (CPU)

The heart of the controller is an IBM PC-XT compatible computer mother board with a number of standard commonly used cards and a number of custom made (by Rhino) cards in it. The major components of the controller are as follows:

1. IBM PC-XT compatible mother board with 640K of memory on it.
2. A Hercules Graphics Plus or compatible CRT card to provide high resolution graphics on the CRT.
3. A 9" CRT that can provide 25 lines of 80 characters each. This is used as a 41 character by 15 line display to emulate the Fanuc system. All conversions are done in software and with graphics. (Hercules card equivalent)
4. A Fanuc type keyboard. This is a proprietary Rhino Keyboard that is designed to work with an IBM PC-XT type computer. A standard IBM PC-XT keyboard can be used to replace this keyboard for testing purposes. The codes used are listed in the Appendix A at the back of this manual. This keyboard plugs directly into the mother board and has its own microprocessor. (It looks like an IBM-PC XT keyboard to the system)

5. A generic IBM PC-XT type power supply for the CPU and it's related devices. This power supply also serves a few items that are not in the CPU itself. This power supply should not be used to provide power for any devices not provided by Rhino.
6. A multi-purpose input/output board. This card performs four functions:
 - a) Floppy disk drive controller
 - b) Parallel port (IBM Centronics)
 - c) Serial port (RS-232C)
 - d) Clock/Calendar
7. A motor processor board. This card controls the 3 motors on the lathe. This is a proprietary Rhino Board
8. A data transceiver board. This card is the gateway, through which, the CPU communicates with the controls and peripheral I/O panel of the controller. This is a proprietary Rhino Board
9. One 5.25 inch, 360K floppy drive. IBM-PC standards. Some units also have a 3.5 inch, 720K floppy drive in them.
10. Newer units have two 3.5 inch, 1.44 meg floppy drives

The front panel of the controller

The front panel of the controller provides all the operator controls for the lathe. See the owner's manual for details on each of the controls on the front panel.

The rear panel of the controller

The rear panel of the controller provides all the peripheral connections. See the owner's manual for details on these connections.

The key, on-off panel.

The side panel controls on off operations and the disk drives.

All personal computer items can be checked with standard PC procedures and equipment.

B. How The System Works

Power up sequence:

1. Turn the key switch clockwise to the ON position.
2. Place the operating system disk into the 3.5" floppy drive.
3. Press the ON button.
4. The basic DOS system is loaded and a CPU, memory and system check is done.
5. The auto_exec file is read from the disk.
6. The system clock/calendar is loaded from battery back-up.
7. The lathe operating system is loaded from the disk. Latest systems use ROM disks for these functions.
8. The system parameters are loaded from eeprom.
9. The initial screen is displayed on the CRT. Position screen U and W.

Power down sequence:

1. Make sure any manual or automatic operation of the lathe have stopped before attempting a shut down procedure. The shut down is controlled by the computer.
2. Take the lathe carriage and cross slide to the hard home position.
3. Press the OFF button.
4. The work area lamps and the cooling fans will remain on for about 30 seconds.
5. After 30 seconds the system will be shut down completely.

6. Turn the key switch to the OFF position.

CAUTION: Never turn the key switch off without having taken the above steps one through five. This could result in uncontrolled motion of the motors, loss of offset changes or a crash.

7. Remove the operating system disk from the disk drive. All users should keep a master copy of their system disk in their possession at all times.

Emergency stop

Either emergency stop turns the power off at the motors only. This assures that no motion and no loss of position information will take place. After the emergency has been resolved, control of the system can be resumed by releasing the emergency stop button. However, the problem is usually such as to require starting from the beginning of the program after making the appropriate program changes.

Motion control system

Each motor is controlled directly from the motor processor card. Motor control information is sent to the motor processor for final processing before motion control signals are sent to the motor amplifiers. The motor processor sends the motor amplifier a PWM (pulse width modulated) signal (9.78 KHz) which regulates the percentage of power sent to the motor (0 to 100%). This signal is amplified by the amplifier and then fed to the motor windings. The longer the pulse width the faster the motor runs and/or the more load it can carry. You can detect the PWM and the encoder signals at the motor processor card. The motor processor also sends a direction signal which directs motor motion either in a clockwise or counter-clockwise direction. Feedback from the motor is received through an encoder mounted directly on the motor (or in the case of the spindle, driven directly by the spindle). The motor encoder sends back signals which gives the motor processor knowledge of the speed, the distance (revolutions) travelled, and the position. In addition to these signals, there is a third channel on the spindle motor called the index. This signal is seen three times per revolution. It is used to mark the absolute position of the spindle during thread cutting operations. The cross slide and carriage motors have their encoders mounted directly on them. The spindle, however, has its encoder attached by a pulley and non-slip, cogged belt system.

Motor amplifiers

The amplifier for each motor is located in the lathe cabinet. The motor processor card provides a PWM (pulse width modulated) signal and direction bit to the amplifier card of each motor in the lathe. This PWM signal (9.78 KHz) determines the strength of the power applied to the motor. The direction bit indicates clockwise or counter-clockwise rotation. Each amplifier card contains an "H" bridge with 4 transistors in it. One pair of transistors runs the motor in a clockwise direction and the other pair runs it in a counter-clockwise direction. The direction bit selects the pair to be used. The PWM signal determines the ON-OFF time ratio of the pairs and thus determines the level of motor power.

Motor amplifiers cannot be fixed in the field and can only be purchased from Rhino. DO NOT REPAIR IN THE FIELD.

Solenoid valves and relays

All solenoid valves and relays operate at 24 vdc. The TTL signal from the controller is opto isolated, (with the exception of User1, User2, and controller power relays), and then used to drive a transistor which in turn drives the solenoid valve or relay in question. Diodes are provided across coils where needed.

List of solenoid valves and relays:

User #1 and User #2 relays (Optional equipment)

Latching cylinder valve (Optional equipment) Turret

Ratchet cylinder valve (Optional equipment) Turret

Coolant valve (Optional equipment). The use of coolant is not recommended by Rhino.

Air valve (Optional equipment)

Chuck valve (Optional equipment)

Motor power relay

Controller main power relay

Programmable Logic Controller (PLC) and Robot Interfaces

Each interface has four lines: +IN, -IN, +OUT, -OUT.

At +IN and +OUT the minimum voltage is 1 vdc and the maximum voltage is 24 vdc. The current limit is 40 ma. Ground is connected to -IN and -OUT. On the front panel of the controller, LEDs are provided, to show the state of these lines. These LEDs are driven by the CPU and are not directly connected to the PLC and robot interfaces.

Door Guards:

All hinged doors on the lathe and controller have interlocks on them. If a door is opened during operation the motors will stop and an alarm will be displayed. For service purposes the switches that provide these interlocks can be defeated by opening the door and pulling the switch plunger out.

Under certain conditions MDI and manual operations are allowed with the door open.

C. Mechanical Problems

Spindle motor operation checklist:

CAUTION. The spindle motor is a 1/2 horse power motor and runs on 96 vdc. It is important that you be very careful when working around this motor and its amplifier. The spindle amplifier is on the extreme right as you look at it from the back.

1. The gear select switch must be set for the gear speed selected at the pulleys.
2. In the MDI mode start the motor at 200 rpm in the M03 direction.
3. Is a PWM signal being generated at the motor processor card?
4. Are all three encoder channels coming back from the lathe? **Be sure emergency stop is pressed if you are going to turn the spindle manually.** If needed, turn the spindle by hand to see the signals. Channels A and B should be 90 degrees out of phase. Channel I puts out three counts per revolution of the spindle.
5. Check belt for proper tension. The "V" belt has to be just tight enough to prevent slippage.
6. Next look at the amplifier for the motor. This is in the lathe cabinet.

Check the fuse on the board

Check for power coming to the amplifier.

Check for power leaving the amplifier.

Check for burned or physically damaged traces or components .

Check for the PWM signal at the amplifier.

Check for the direction signal at the amplifier.

Check to see that the motor works in both directions.

Check that the motor works at all speeds within a given range.

7. LEDs on the newer amplifier board provide the PWM signal and reversing signal indication.

Carriage and cross slide motor operation checklist:

CAUTION. The carriage and cross slide motors are 1/10 horse power motor and runs on 48 vdc. It is important that you be very careful when working on these motors and their amplifiers. The amplifiers are on the left and in the middle as you look at them from the back.

1. In the MDI mode start the motor at 0.5 ipm feed rate in the appropriate direction. (G01 W-1.0 F0.5)
2. Is a PWM signal being generated at the motor processor card?
3. Are both encoder channels coming back from the lathe? If needed, turn the motor by hand to see the signals. Channels A and B should be 90 degrees out of phase. **Be sure emergency stop is pressed.**
4. Next look at the amplifier for the motor. This is in the lathe cabinet.

Check the fuse on the board

Check for power coming to the amplifier.

Check for power leaving the amplifier.

Check for burned or physically damaged traces or components

Check for the PWM signal at the amplifier.

Check for the direction signal at the amplifier.

Check to see that the motor works in both directions.

Check that the motor works at all speeds.

Lathe door interlock checklist:

This can be checked with the diagnostics disk

1. Does door press in the switch enough to actuate it?
2. Does switch make contact?
3. Is the contact reflected on the diagnostics screen?

Controller door interlock checklist:

This can be checked with the diagnostics disk

1. Does door press in the switch enough to actuate it?
2. Does switch make contact?
3. Is the contact reflected on the diagnostics screen?

General Checklist:

These can be checked with the diagnostics disk.

D. Computer related problems

All controls and output devices, with the exception of the power on button and key switch, are memory mapped. This means that each control and each output is seen by the CPU as a bit in memory. Thus, it can be read or written to by the CPU.

Diagnostics

A comprehensive diagnostic program is provided on disk with the lathe. It can be used effectively to check all aspects of lathe operation.

The diagnostic screens allow you to look at all hardware functions on the screen. This means that you can see if any hardware function is being read by the CPU on the display screen. It is not necessary to follow the wires with a probe until you know that the CPU is not getting the information. If the CPU is getting the information, the problem is either in the software or in the output from the CPU. Since the ST/8 is of a modular construction, trouble shooting can be relatively straight forward. (At this stage it is probably not software).

All switches, LEDs, knobs, push buttons and other hardware conditions are reflected on the diagnostic screens. If you have suspicion about the operation of any panel device, the operation of the device can be confirmed with the diagnostics. This is the first thing that should be done. This confirms that the information is actually getting to the CPU. You then have to make sure that the appropriate output action is being taken. Since you are dealing with relatively new software, with relatively few users, there is the possibility that there is a software problem. For this reason it is imperative that you check with the factory whenever you have a problem. This will enable you to know if there is a known problem before you go any further with your trouble shooting.

Construction of the ST/8 is modular. Any control panel or I/O panel can be removed and replaced easily. Before removing any panels, contact Rhino Robots for guidance and instruction.

It is not advisable for the service technician to try to repair the Rhino boards in the field. They should be sent to the factory for service or exchange.

All IBM-PC boards and devices can be repaired by a trained technician with the proper equipment.

Diagnostic programs

Rhino provides a family of programs that allow you to check the operation of the system. This assumes that the CPU in the system is working. If the CPU is not working, the CPU has to be fixed first.

See diagnostics manual.

Factory assistance.

You are encouraged to call the factory first if you have a problem. We are always delighted to be of help to you. We want you to be happy with your lathe and to get the most out of it.

Our phone number is 513-353-9772.

We are open 8:00 am to 12:00 noon and 1:00 to 5:00 pm EST. Monday-Friday.

E. Lubrication

The ST/7.

Lubricate the ways regularly to maintain a thin coating of a light oil or fine grease on the carriage and cross slide ways.

Keep a light coating of grease on the lead screws and nuts.

Lubricate the quill of the tailstock once a month with a few drops of light oil.

Lubricate the spindle motor once a year with a few drops of oil.

All sealed bearings are lubricated for life and should not need any attention.

SAE 10 W 30 non detergent oil is recommended for all lubrication points.

The ST/8

Remove the way covers every 6 months and lubricate the ways to maintain a thin coating of a light oil or fine grease on the carriage and cross slide ways. Apply a few drops of oil to the felt wipers on the pillow blocks.

Keep a light coating of grease on the lead screws and nuts.

Lubricate the spindle motor and the servo motors once a year with a few drops of light oil.

All sealed bearings are lubricated for life and should not need any attention.

SAE 10 W 30 non detergent oil is recommended for all lubrication points.

End

Appendix A

Equivalent key codes used on ST/8 keyboard. The ST/8 keyboard emulates the operation of an IBM-PC XT keyboard. An IBM-PC XT keyboard can be used in place of the Rhino ST/8 keyboard for testing purposes.

ST/8	IBM PC-XT	ST/8	IBM PC-XT
a	a	Alarm	F7
d	d	Alter	F9
e	e	Cancel	Escape
f	f	Command	F4
g	g	Cursor down	Cursor down
i	i	Cursor up	Cursor up
k	k	Delete	Delete
l	l	Diagnostics	F8
m	m	EOB	Return
n	n	Input	[
o	o	Insert	Insert
p	p	Offset	F3
q	q	Origin	Home
r	r	Page down	Page down
s	s	Page up	Page up
t	t	Parameters	F6
u	u	Position	F1
w	w	Punch	,
x	x	Read	=
z	z	Reset	End
0	0	Settings	F5
1	1	Start]
2	2	Program	F2
3	3		
4	4		
5	5		
6	6		
7	7		
8	8		
9	9		
-	-		
/	/		
.	.		

The keyboard can be checked with page 3 of the INPUT diagnostics program.

Section 2 of Master Manual Program Manual ST/7, ST/8 Disk Based Diagnostics

Introduction

The ST/7 and ST/8 diagnostic programs are identical. All references are to the ST/8.

The ST/8 Diagnostics Program allows the user to do the following:

1. View numerous signals and settings within the lathe operating system.
2. Change selected output controls.
3. Perform miscellaneous functions helpful in the use of the ST/8.

The program resides on an automatically bootable disk and is invoked by inserting the disk into the system disk drive (A), turning on the power key switch and pressing the ON button. When the program has loaded the Main Menu screen will appear showing the functions which are selectable by the user.

All menu selections in the Diagnostics program are made by using the CURSOR UP and CURSOR DOWN keys to highlight the desired function then pressing the EOB key to execute it. Menu selections can also be made by pressing the key corresponding to the first letter of the function title. If more than one function has the same letter, the first function with the matching letter will be executed. Once a program has been loaded, the user can terminate it and return to the main menu by pressing the RESET key.

The Main Menu screen lists these functions:

- Input Data Display
- Output Data Display
- Tool Changer Diagnostics
- Disk Utilities
- File Utilities
- Set system Time and Date
- Lamp Test for all the lamps
- Quit program

Input Data Display -

This function displays values that are returned from the controller front panel, lathe sensors and other signals generated through out the ST/8. Since the number of signals exceed the displayable area of the CRT, this function uses three pages which are selected by pressing the PAGE UP and PAGE DOWN keys. The first and second pages display various self explanatory signals. To test, for example, the MODE SELECT switch simply turn the switch and watch the display to insure that the display matches the switch setting.

The third page allows the output of the system keyboard to be tested fully. Each key's function or character is displayed in its relative position on the screen when the key is pressed. Pressing the key again and again alternates between displaying and blanking the key description. The keyboard test can be exited by pressing the RESET key.

Output Data Display/Edit -

This function allows the user to manually set various signals to determine if the expected action takes place.

Note: One item is the Spindle Load output. This sets the controller front panel meter value. To set this output to various values, use the cursor keys to highlight the Spindle Load line and use the SPINDLE SPEED knob on the front panel to set a value. The output can be set from 0 to 255 which corresponds to a 0 to full scale deflection of the meter.

The remaining data items are strictly ON - OFF types. To change the output under consideration from one state to the other, highlight the item using the cursor keys and then press the red ALTER key. Care should be exercised on setting some of the output lines which result in undesirable effects. One such output line is the CONTROLLER OFF line. When this is set to the OFF state it will remove power to the controller by turning the power relay off. This will abort the test.

Press the RESET key as usual to return to the Main Menu.

Tool Changer Diagnostics -

This function permits manual operation of the tool changer through the diagnostics.

As indicated on the screen:

the USER #1 switch controls the Locking solenoid.

the USER #2 switch controls the Ratcheting solenoid.

Note: The Ratcheting solenoid should not be extended when the Locking solenoid is extended.

Press the RESET key to return to the Main Menu.

Disk Utilities -

These utilities are useful when there is no easy access to an appropriate IBM-PC computer. It is easier to perform all these functions on an IBM-PC.

Selecting this function provides the user with six basic commands that are helpful in disk management. The first two commands allow copying files from one disk drive to the other. The A: drive is the front (3 1/2") disk drive and the B: drive is the rear (5 1/4") disk drive. The command prompts for the file name to be copied; MS-DOS wild card specifiers * and ? may be used.

The next two commands display the contents of the specified drive.

The remaining commands allow the formatting of diskettes in the specified drive. Since the format command uses the DOS FORMAT command, you must first copy the FORMAT command from the DOS PROGRAM disk provided with the ST/8 Lathe to the Diagnostics disk before invoking this function. Be careful to insert your unformatted disk into the A: drive when prompted to do so when using the Format A; command **or you may erase your diagnostics disk.**

File Utilities

This function provides two utility programs for translating CNC programs between two formats. The ST/8 uses and produces CNC programs that are without separating spaces and contain no displayable EOB (end of block) characters. The CNC to DOC Translator function takes an existing CNC program file produced by the ST/8 (one that has a **.CNC** file extension) and produces a file of the same name on the same disk drive but which has a **.DOC** file extension. This function formats the file so that it is easily read and used with a standard (most) word processor(s) or text editor program on an IBM-PC. The function DOC to CNC Translator the document in the opposite operation.

Set System Time and Date -

Although the controller's internal time and date features are preset at the factory and should normally remain accurate, there may arise a situation when either or both need to be reset. Using this function allows the user to set the time and date in the same manner as is used in setting the same information on a IBM-PC.

Lamp Test -

This function provides a means to test all the controller's lighted switches and LED indicators. A sequence is performed where-in the indicators are illuminated one at a time until all are all on and then they are turned off one at a time till they are all off. The rate at which this sequence occurs is controlled by the SPINDLE SPEED rate knob.

Section 8 of Master Manual Signal Tracing

CONTROLLER MOUNTED PANELS AND PC BOARD SIGNAL TRACING INFORMATION

JOYSTICK PANEL signal tracing

INPUTS

For wiring harness color codes, see "ST/8 joystick panel wiring".

Axis select

axis select +

pin 1, J1, controller selector board

pin 15, U9

pin 13, U9

pin 4, U8

pin 16, U8

axis select -

pin 2, J1, controller selector board

pin 14, U9

pin 13, U9

pin 4, U8

pin 16, U8

Cycle start switch

cycle start +

pin 6, J1, controller selector board

pin 6, U9

pin 7, U9

pin 17, U8

pin 3, U8

cycle start -

pin 7, J1, controller selector board

pin 5, U9

pin 7, U9

pin 17, U8

pin 3, U8

Feed hold switch

feed hold +

pin 3, J1, controller selector board

pin 2, U9

pin 4, U9

pin 2, U8

pin 18, U8

feed hold -

pin 4, J1, controller selector board

pin 1, U9

pin 4, U9

pin 2, U8

pin 18, U8

Joystick X+

pin 12, J1, controller selector board

pin 13, U8

pin 7, U8

Joystick X-

pin 11, J1, controller selector board

pin 6, U8

pin 14, U8

Joystick Z+

pin 14, J1, controller selector board

pin 11, U8

pin 9, U8

Joystick Z-

pin 13, J1, controller selector board

pin 8, U8

pin 12, U8

Open jaws switch

open jaws +
pin 15, J1, controller selector board
pin 11, U9
pin 9, U9
pin 39, E1
pin 15, U8
pin 5, U8

open jaws -
pin 16, J1, controller selector board
pin 10, U9
pin 9, U9
pin 39, E1, controller selector board
pin 15, U8
pin 5, U8

Pulser knob

channel A
pin 18, J1, controller selector board
pin 8, U7
pin 7, U7

channel B
pin 19, J1, controller selector board
pin 11, U7
pin 9, U7

OUTPUTS**Cycle start lamp**

pin 13, U2, controller selector board
pin 12, U2
Resistor 14
base, Q5
collector, Q5
pin 8, J1

Feed hold lamp

pin 7, U2, controller selector board
pin 6, U2
Resistor 13
base, Q4
collector, Q4
pin 5, J1

Home X lamp

pin 4, U2, controller selector board
pin 5, U2
Resistor 9
pin 9, J1

Home Z lamp

pin 14, U2, controller selector board
pin 15, U2
Resistor 8
pin 10, J1

Open jaws lamp

pin 18, U2, controller selector board
pin 19, U2
pin 38, E1
Resistor 10
base Q1
collector Q1
pin 17, J1

Pulser active lamp

pin 8, U1, controller selector board
pin 9, U1
Resistor 7
pin 20, J1

SELECTOR PANEL signal tracing

INPUTS

Air

air auto
pin 6, U5, controller selector board
pin 14, U5

air on
pin 13, U5, controller selector board
pin 7, U5

Block delete

pin 6, U7, controller selector board
pin 14, U7

Coolant

coolant auto
pin 8, U5, controller selector board
pin 12, U5
coolant on

Dry run

pin 4, U7, controller selector board
pin 16, U7

Emergency stop

emergency stop +
Pad 4-2, controller selector board
pin 14, U13
pin 13, U13
pin 40, E1
pin 11, U3
pin 9, U3

emergency stop -
Pad 4-1, controller selector board
pin 15, U13
pin 13, U13
pin 40, E1
pin 11, U3
pin 9, U3

Feed rate ovr.

controller selector board

switch input

pin 1 - pin 10, U10

pin 2 - pin 11, U10

pin 3 - pin 12, U10

pin 4 - pin 13, U10

pin 5 - pin 1, U10

pin 6 - pin 2, U10

pin 7 - pin 3, U10

pin 8 - pin 4, U10

pin 9 - pin 10, U15

pin 10 - pin 11, U15

pin 11 - pin 12, U15

pin 12 - pin 13, U15

Encoded output

A= pin 3, U16 - pin 2, U4 - pin 18, U4

B= pin 6, U16 - pin 17, U4 - pin 3, U4

C= pin 11, U16 - pin 4, U4 - pin 16, U4

D= pin 14, U15 - pin 15, U4 - pin 5, U4

priority flag

pin 8, U16 - pin 11, U4 - pin 9, U4

Memory protect

pin 17, U7, controller selector board

pin 3, U7

Mode select

controller selector board

switch input

pin 1 - pin 10, U21

pin 2 - pin 11, U21

pin 3 - pin 12, U21

pin 4 - pin 13, U21

pin 5 - pin 1, U21

pin 6 - pin 2, U21

pin 7 - pin 3, U21

pin 8 - pin 4, U21

encoded output

A= pin 9, U21 - pin 2, U6 - pin 18, U6

B= pin 7, U21 - pin 17, U6 - pin 3, U6

C= pin 6, U21 - pin 4, U6 - pin 16, U6

priority flag

pin 14, U21 - pin 13, U4 - pin 7, U4

Optional stop

pin 15, U7, controller selector board

pin 5, U5

Rapid traverse ovrd.

controller selector board

switch input

pin 1 - pin 10, U11

pin 2 - pin 11, U11

pin 3 - pin 12, U11

pin 4 - pin 13, U11

encoded output

A= pin 9, U11 - pin 15, U6 - pin 5, U6

B= pin 7, U11 - pin 6, U6 - pin 14, U6

priority flag

pin 14, U11 - pin 8, U4 - pin 12, U4

Single block

pin 13, U7, controller selector board

pin 7, U7

Spindle direction

pin 2, U7, controller selector board

pin 18, U7

Spindle off

spindle off +

Pad 3-1, controller selector board

pin 11, U13

pin 9, U13

pin 13, U3

pin 7, U3

spindle off -
Pad 3-2, controller selector board
pin 10, U13
pin 9, U13
pin 13, U3
pin 7, U3

Spindle on

spindle on +
Pad 2-1, controller selector board
pin 6, U13
pin 7, U13
pin 6, U3
pin 14, U3

spindle on -
Pad 2-2, controller selector board
pin 5, U13
pin 7, U13
pin 6, U3
pin 14, U3

Spindle speed

controller selector board

analog to digital converter pin-out

100K pot wiper - pin 6, U23
D0= pin 18, U23
D1= pin 17, U23
D2= pin 16, U23
D3= pin 15, U23
D4= pin 14, U23
D5= pin 13, U23
D6= pin 12, U23
D7= pin 11, U23

Spindle speed ovrd.

controller selector board

switch input

pin 1 - pin 10, U17

pin 2 - pin 11, U17

pin 3 - pin 12, U17

pin 4 - pin 13, U17

pin 5 - pin 1, U17

pin 6 - pin 2, U17

pin 7 - pin 3, U17

pin 8 - pin 4, U17

encoded output

A= pin 9, U17 - pin 13, U6 - pin 7, U6

B= pin 7, U17 - pin 8, U6 - pin 12, U6

C= pin 6, U17 - pin 11, U6 - pin 9, U6

priority flag

pin 14, U17 - pin 6, U4 - pin 14, U4

Tool select

controller selector board

switch input

pin 1 - pin 10, U14

pin 2 - pin 11, U14

pin 3 - pin 12, U14

pin 4 - pin 13, U14

pin 5 - pin 1, U14

pin 6 - pin 2, U14

pin 7 - pin 3, U14

pin 8 - pin 4, U14

encoded output

A= pin 9, U14 - pin 2, U3 - pin 18, U3

B= pin 7, U14 - pin 17, U3 - pin 3, U3

C= pin 6, U14 - pin 4, U3 - pin 16, U3

User 1

user1 auto
pin 2, U5, controller selector board
pin 18, U5

user1 on
pin 17, U5, controller selector board
pin 3, U5

User 2

user2 auto
pin 4, U5, controller selector board
pin 16, U5

user2 on
pin 15, U5, controller selector board
pin 5, U5

LATHE OUTPUTS signal tracing**Machine failure lamp**

pin 18, U1, controller selector board
pin 19, U1
Resistor 2
LED 6

Memory lock lamp

pin 3, U1, controller selector board
pin 2, U1
Resistor 1
LED 5

PLC (from) lamp

pin 14, U1, controller selector board
pin 15, U1
Resistor 5
LED 2

PLC (to) lamp

pin 7, U1, controller selector board
pin 6, U1
Resistor 6
LED 1

Robot (from) lamp

pin 17, U1, controller selector board
pin 16, U1
Resistor 4
LED 4

Robot (to) lamp

pin 4, U1, controller selector board
pin 5, U1
Resistor 3
LED 3

Spindle load meter**Spindle off lamp**

pin 17, U2, controller selector board
pin 16, U2
Resistor 12
base, Q3
collector, Q3
Pad 3-3

Spindle on lamp

pin 3, U2, controller selector board
pin 2, U2
Resistor 11
base, Q2
collector, Q2
Pad 2-3

LATHE INPUTS

Air solenoid

- pin 14, U9, lathe I/O board
- pin 3, U9
- pin 4, U7
- pin 16, U7
- pin 2, U5
- pin 8, U5
- pin 9, U4
- pin 8, U4
- base, Q2
- collector, Q2
- pin 4, J4

Chuck solenoid

- pin 11, U9, lathe I/O board
- pin 6, U9
- pin 15, U7
- pin 5, U7
- pin 2, U3
- pin 8, U3
- pin 14, U4
- pin 3, U4
- base, Q6
- collector, Q6
- pin 6, J4 (Check)

Coolant solenoid

- pin 13, U9, lathe I/O board
- pin 4, U9
- pin 13, U7
- pin 7, U7
- pin 2, U6
- pin 8, U6
- pin 11, U4
- pin 6, U4
- base, Q3
- collector, Q3
- pin 5, J4

Current limit reset

pin 4, J1, lathe I/O board
pin 4, J2
pin 4, J3

Direction X

pin 2, J1, lathe I/O board

Direction Spindle

pin 2, J3, lathe I/O board

Direction Z

pin 2, J2, lathe I/O board

Latch solenoid

pin 16, U9, lathe I/O board
pin 1, U9
pin 8, U7
pin 12, U7
pin 3, U5
pin 5, U5
pin 12, U4
pin 5, U4
base, Q4
collector, Q4
pin 1, J4

Motor power

pin 10, U9, lathe I/O board
pin 7, U9
pin 17, U7
pin 3, U7
pin 1, J9
pin 2, J9
pin 3, U3
pin 5, U3
pin 16, U4
pin 1, U4
base, Q7
collector, Q7
pin 2, J10

Open jaws lamp

pin 12, U9, lathe I/O board
pin 5, U9
pin 11, U7
pin 9, U7
Resistor 1
base, Q1
collector, Q1
pin 6, J9
pin 5, J4

PWM X

pin 3, J1, lathe I/O board

PWM S

pin 3, J3, lathe I/O board

PWM Z

pin 3, J2, lathe I/O board

Ratchet solenoid

pin 15, U9, lathe I/O board
pin 2, U9
pin 6, U7
pin 14, U7
pin 3, U6
pin 5, U6
pin 12, U4
pin 5, U4
base, Q5
collector, Q5
pin 2, J4

OUTPUTS signal tracing**Current limit X**

pin 1, J1, lathe I/O board
pin 15, U8
pin 5, U8

Current limit S

pin 1, J3, lathe I/O board
pin 11, U8
pin 9, U8

Current limit Z

pin 1, J2, lathe I/O board
pin 13, U8
pin 7, U8

Emergency stop

emergency stop +
pin 3, J9, lathe I/O board
pin 15, U2
pin 13, U2
pin 17, U10
pin 3, U10

emergency stop -
pin 4, J9, lathe I/O board
pin 14, U2
pin 13, U2
pin 17, U10
pin 3, U10

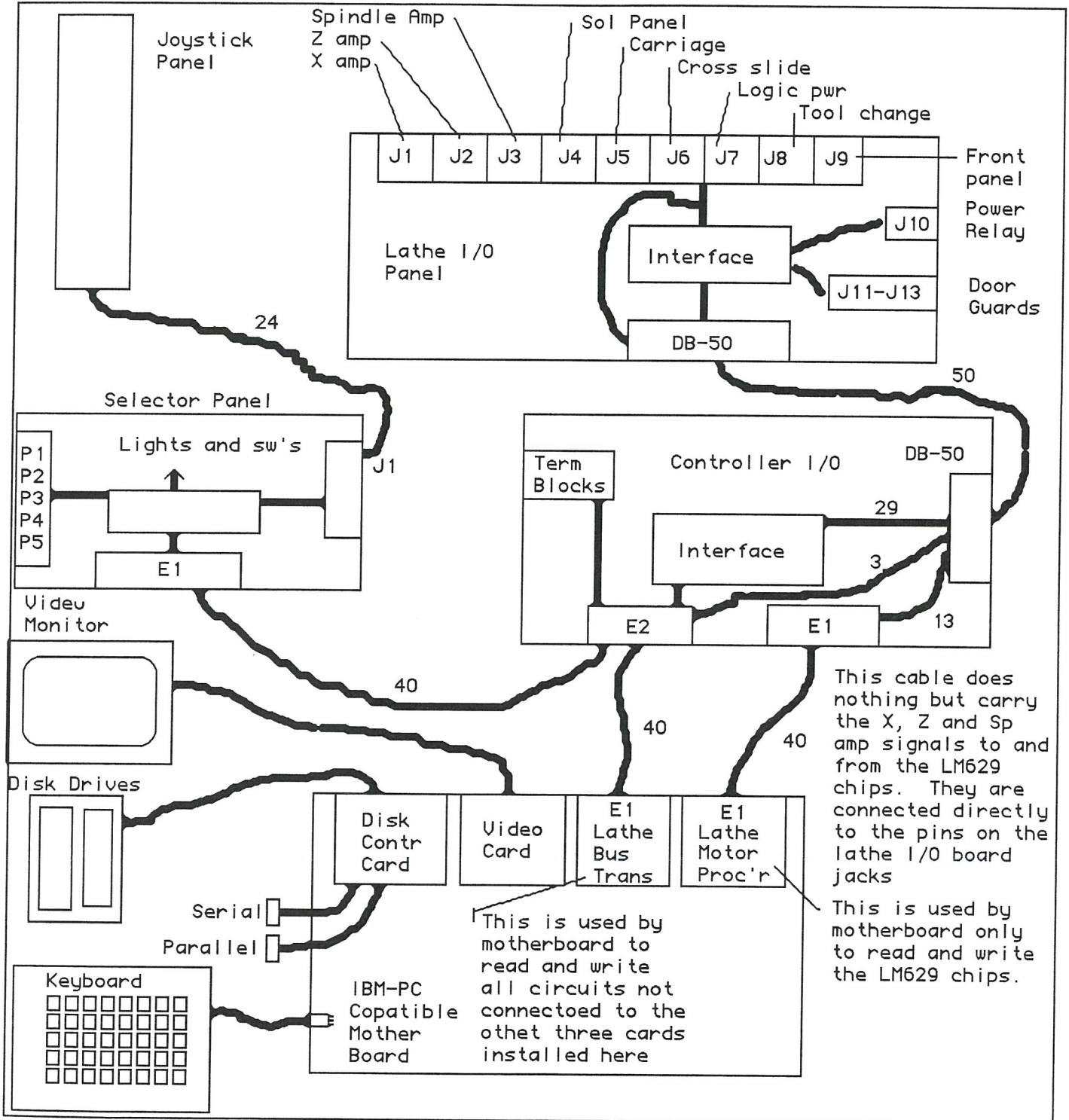
Front door guard

pin 2, J13, lathe I/O board
pin 1, U13
pin 4, U13
pin 2, U8
pin 18, U8

High gear

pin 6, J5, lathe I/O board
pin 8, U8
pin 12, U8

Diagrams



IBM I/O	Lathe Ckt board devices addressed
Base address	All except items below
C000	LM629 Chips
D000	EEPROM on buss transceiver bd
E000	

Keyboard, video and Disk drives
at standard IBM addresses.

Version 1.00 Feb 16 1990 Sandhu Tom Young
ST/8 Schematic-1 on HSS disk

Technical Notes

Controller/Lathe Interconnect Cable ST/7-8,

Thu, Jan 2, 1993

The 50 pin cable that goes from the controller to the lathe back panel carries the following signals. This cable is usually not the problem in that unless abuse is clearly visible, the cable integrity will be preserved.

DB-50 cable and connector specifications ver. 1.01
(Direction is stated with respect to the controller)

Pin	Signal	Direction
1	X Axis Channel A	Input to controller
2	X Axis Channel B	
3	Z Axis Channel A	
4	Z Axis Channel B	
5	Gnd	
6	Spindle Channel A	
7	Spindle Channel B	
8	Spindle Index	
9	Gnd	
10	X Axis PWM	Output from controller
11	X Axis DIR	O
12	Gnd	
13	Z Axis PWM	O
14	Z Axis DIR	O
15	Gnd	
16	Spindle PWM	O
17	Spindle DIR	O
18	Limit X+	
19	Limit X-	
20	Limit Z+	
21	Limit Z-	
22	Home X	
23	Home Z	
24	/ Emergency Stop	
25	/ Open Jaws Switch	
26	Latch retracted (A)	
27	Latch extended (B)	
28	Ratchet retracted (A)	
29	Ratchet extended (B)	
30	Tool A	

31	Tool B	
32	Tool C	
33	/ Rear Door Guard	
34	/ Latch	O
35	/ Ratchet	O
36	/ Air Solenoid	O
37	/ Coolant Solenoid	O
38	/ Open Jaws Lamp	O
39	/ Chuck Solenoid	O
40	/ Motor Power	O
41	X-CurLim	
42	Z-CurLim	
43	S-CurLim	
44	High Gear	
45	Low Gear	
46	Not Used	
47	/ CurLim Reset	O
48	Front Door Guard	
49	Not Used	
50	Not Used	

/ = Not

End of manual