Roland

COMPUTER AIDED MODELING MACHINE **PNC-300**

CAMM-3

by ROLAND DIGITAL GROUP

User's Manual

Thank you very much for purchasing the CAMM-3 Model PNC-300.

- To ensure correct and safe usage with a full understanding of this product's performance, please be sure to read through this manual completely and store it in a safe location.
- Unauthorized copying or transferral, in whole or in part, of this manual is prohibited.
- The contents of this operation manual and the specifications of this product are subject to change without notice.
- The operation manual and the product have been prepared and tested as much as possible. If you find any misprint or error, please inform us.

Roland DG Corporation

For the USA

FEDERAL COMMUNICATIONS COMMISSION RADIO FREQUENCY INTERFERENCE STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.
However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Unauthorized changes or modification to this system can void the users authority to operate this equipment.

The I/O cables between this equipment and the computing device must be shielded.

For Canada

CLASS B NOTICE

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

CLASSE B AVIS

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

NOTICE

Grounding Instructions

Do not modify the plug provided - if it will not fit the outlet, have the proper outlet installed by a qualified electrician.

Check with qualified electrician or service personnel if the grounding instructions are not completely understood, or if in doubt as to whether the tool is properly grounded.

Use only 3-wire extension cords that have 3-prong grounding plugs and 3-pole receptacles that accept the tool's plug.

Repair or replace damaged or worn out cord immediately.

Operating Instructions

KEEP WORK AREA CLEAN. Cluttered areas and benches invites accidents.

DON'T USE IN DANGEROUS ENVIRONMENT. Don't use power tools in damp or wet locations, or expose them to rain. Keep work area well lighted.

DISCONNECT TOOLS before servicing; when changing accessories, such as blades, bits, cutters, and like.

REDUCE THE RISK OF UNINTENTIONAL STARTING. Make sure the switch is in off position before plugging in.

USE RECOMMENDED ACCESSORIES. Consult the owner's manual for recommended accessories. The use of improper accessories may cause risk of injury to persons.

NEVER LEAVE TOOL RUNNING UNATTENDED. TURN POWER OFF. Don't leave tool until it comes to a complete stop.

ROLAND DG CORPORATION
1-6-4 Shinmiyakoda, Hamamatsu-shi, Shizuoka-ken, JAPAN 431-2103
MODEL NAME : See the MODEL given on the rating plate.
RELEVANT DIRECTIVE : EC MACHINERY DIRECTIVE (89/392/EEC)
EC LOW VOLTAGE DIRECTIVE (73/23/EEC)
EC ELECTROMAGNETIC COMPATIBILITY DIRECTIVE (89/336/EEC)

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How to Read This Manual

This manual is organized in the following format. Please use it in the way that best matches your needs.

Part 1 Startup

Basic operation, and the procedures to follow when finished cutting are explained here. Please read this section if you are using the PNC-300 for the first time.

Part 2 User's Reference

Usage of the PNC-300's functions, daily care, and an overview if instruction sets sent from the computer are explained here.

Typographic Conventions

This manual uses certain typographic symbols, outlined below.

⚠ This indicates a point requiring particular care to ensure safe use of the product.

⚠DANGER	: Failure to heed this message will result in serious injury or death.
⚠WARNING	: Failure to heed this message may result in serious injury or death.
⚠CAUTION	: Failure to heed this message may result in minor injury.
NOTICE	: Indicates important information to prevent machine breakdown or malfunction and ensure correct use.
	: Indicates a handy tip or advice regarding use.

The names of keys on the control panel are printed in bold type and enclosed in square brackets.

Example: **[ENTER]** key

Messages that appear on the liquid-crystal display are enclosed in quotation makes.

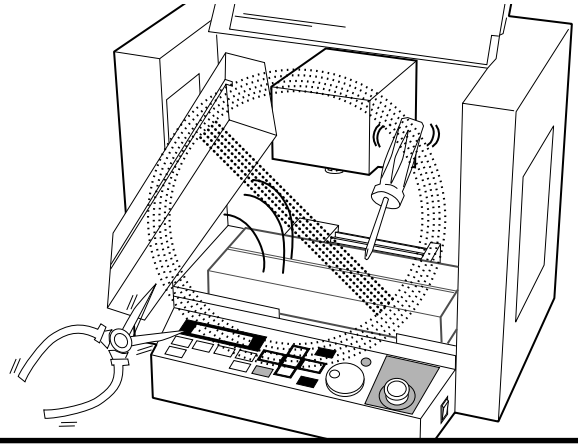
Example: "**OTHERS**"

⚠ To Ensure Safe Use

⚠ WARNING

Do not disassemble or remodel the machine.

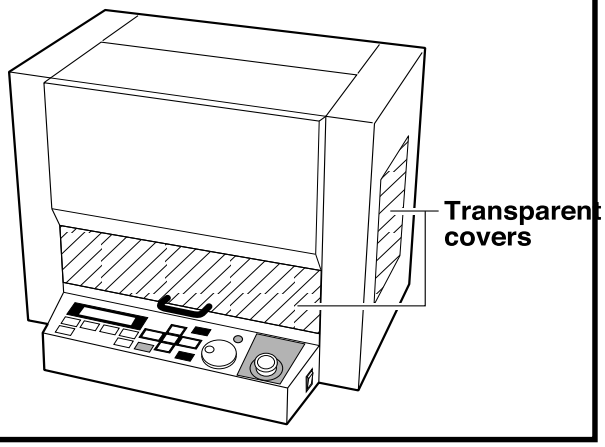
If the safety device is removed, the spindle rotates while the cover is open, which is very dangerous.



⚠ WARNING

Do not operate if a transparent cover is cracked or broken.

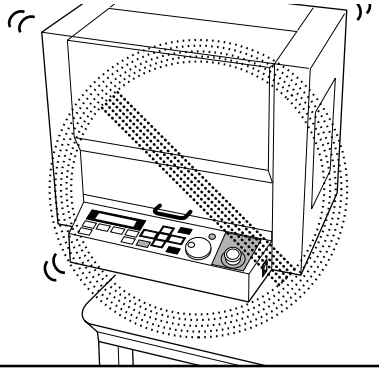
If the transparent cover at the front or the side of the unit is cracked, contact a service agent immediately for repairs.



⚠CAUTION

Do not install in an unstable or high location.

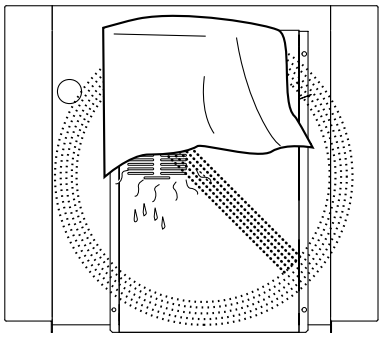
Do not installation the machine on the edge of a table, or it may fall.



⚠CAUTION

Do not block the ventilation holes.

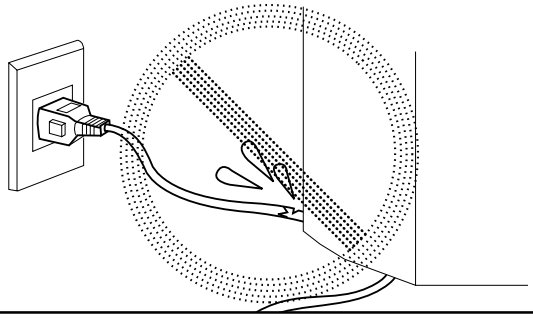
Blocking the ventilation holes at the rear of the unit may prevent heat radiation and cause fire.



⚠CAUTION

Handle the power cord with care.

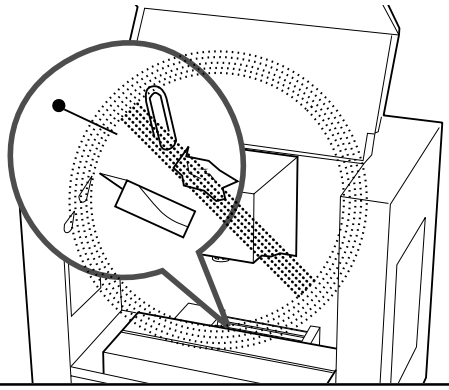
Do not step on or damage the power cord, or allow heavy objects to be placed atop it. Failure to heed this may result in electrocution or fire.



⚠CAUTION

Do not allow liquids, metal objects or flammables inside the machine.

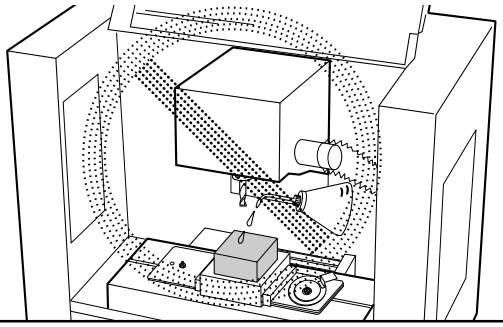
Fire or breakdown may result.



⚠CAUTION

Do not use cutting oil when performing cutting.

Perform dry cutting with no cutting oil. Use of cutting oil may result in fire or machine failure.



⚠CAUTION

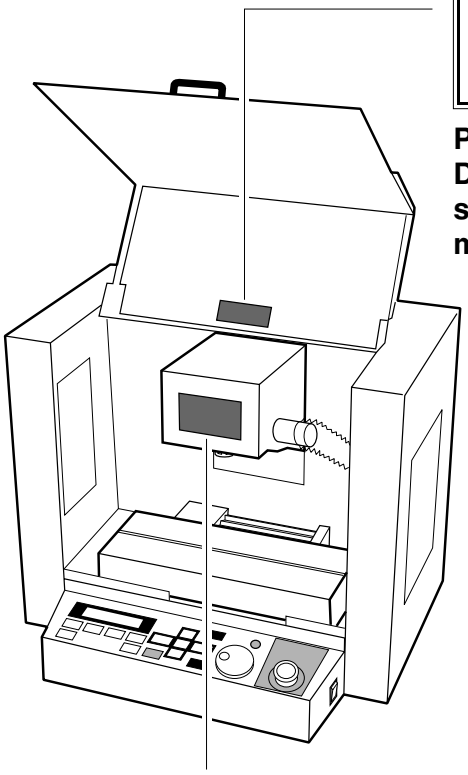
Wash hands when finished.

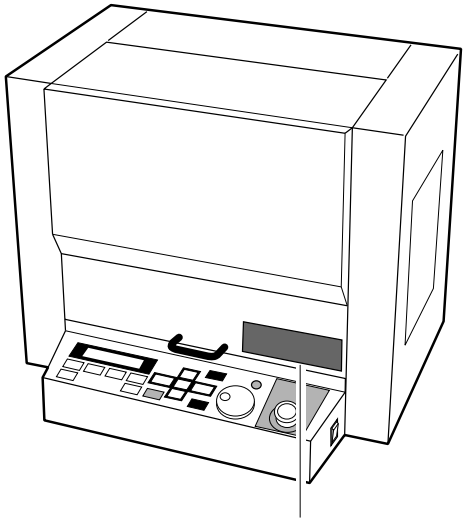
Wash hands with water to remove any adhering cutting chips.

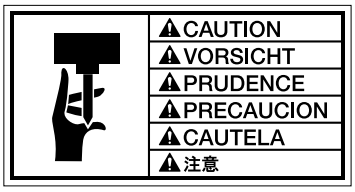
⚠ About the Labels Affixed to the Unit

These labels are affixed to the body of this product. The following figure describes the location and content of these messages.

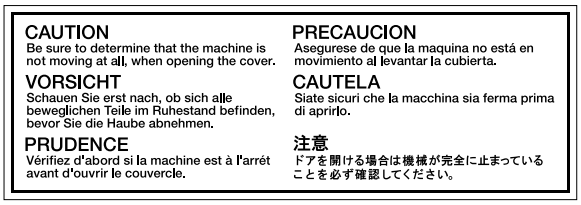
Please use a vacuum cleaner to remove cutting dust. Do not use any blower like airbrush. Otherwise, dust spread in the air may harm your health or damage this machine.





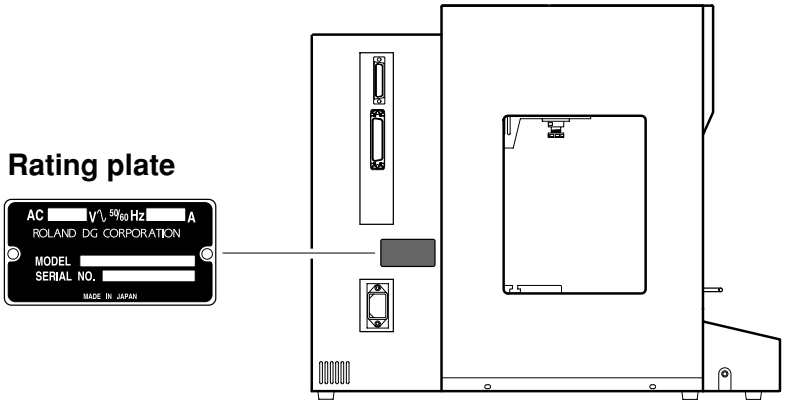


Handle tool with care.



Be sure to determine that the machine is not moving at all, when operating the cover.

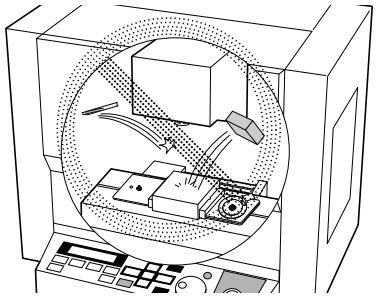
Rating plate



To Ensure Correct Use

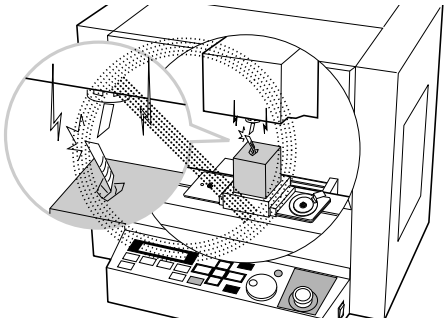
NOTICE

Fasten the tool and material securely in place.



NOTICE

Do not operate beyond capacity or subject the tool to undue force.
The tool may break. If machining operation beyond capacity is started inadvertently, immediately press the EMERGENCY STOP switch.

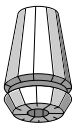


- MEMO -

Part 1 Startup

1. Checking the Accessories

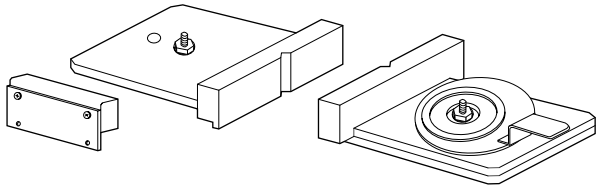
◄ These are installed on the unit. ►



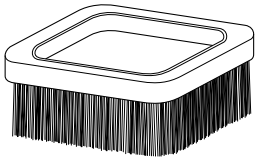
Collet cap

Collet chuck

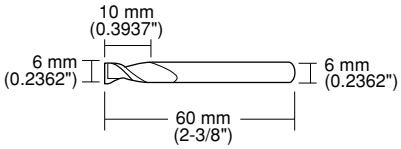
Z0 position sensor



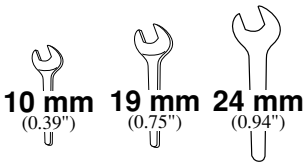
Machine vice



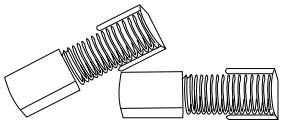
Brush adapter (for chip-cleaning)



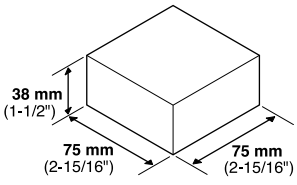
Straight end mill



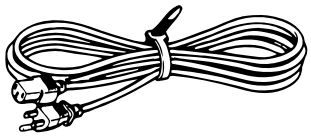
Wrenches



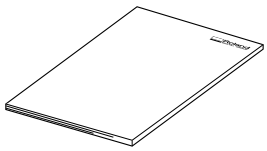
Motor brushes



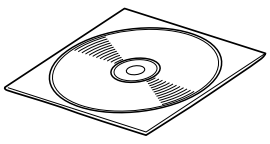
Workpiece



Power cord



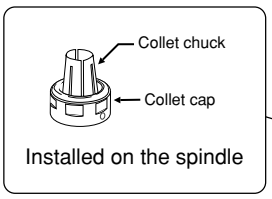
User's manual



Roland Software Package CD-ROM

2. Part Names and Functions

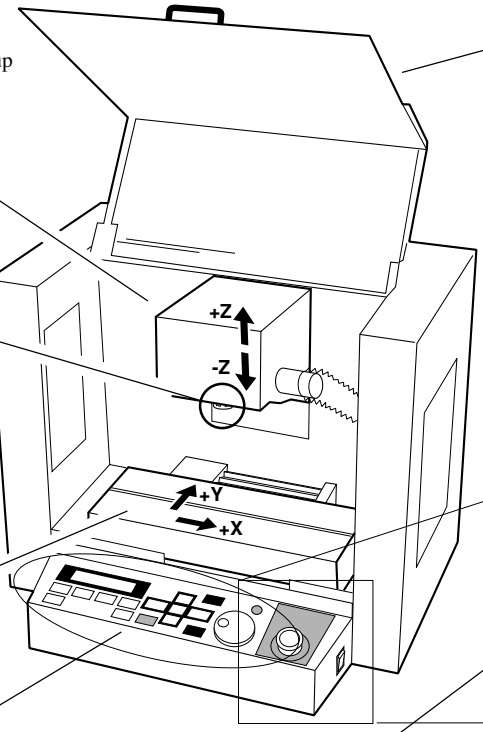
Head
This moves the spindle (cutting tool) up and down). The head performs Z-axis movement.



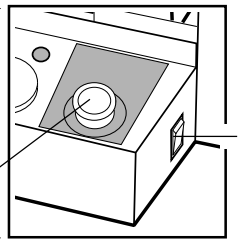
Collet chuck and collet cap
These secure the cutting tool (blade) to the spindle.

XY table
The XY table grips the workpiece to be cut, and shifts it forward, backward, and to the sides. The XY performs X- and Y-axis movement.

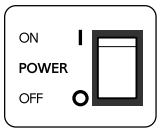
Described on the following page



Cover
Opening the cover during cutting results in an emergency stop. Any cutting data in use becomes invalid, and cutting cannot be continued.
If the cover must be opened during cutting, first press the **[ENTER/ PAUSE]** key to pause the PNC-300, then open the cover. After the cover has been closed, cutting resumes when the paused state is canceled. The spindle will not rotate while the cover is open.



Power switch



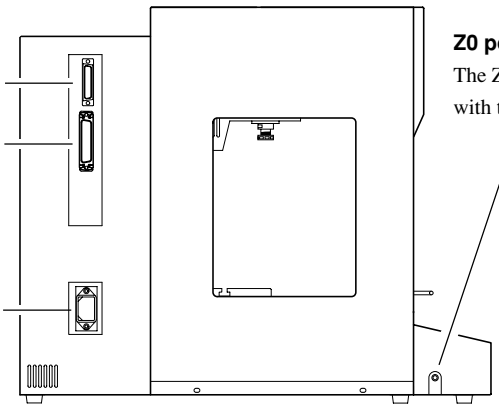
EMERGENCY STOP switch
This switch cuts the power supply and forces the machine to stop, regardless of whether operation is in progress. Press the EMERGENCY STOP switch immediately if dangerous or abnormal operation occurs.

Canceling an emergency stop
Rotate the red portion of the switch clockwise.

Serial connector
A serial (RS-232C) cable is connected here.

Parallel connector
A parallel (printer) cable is connected here.

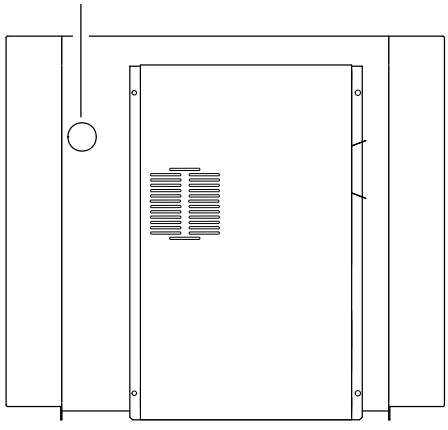
Power connector
The power cord included with the machine is connected here.



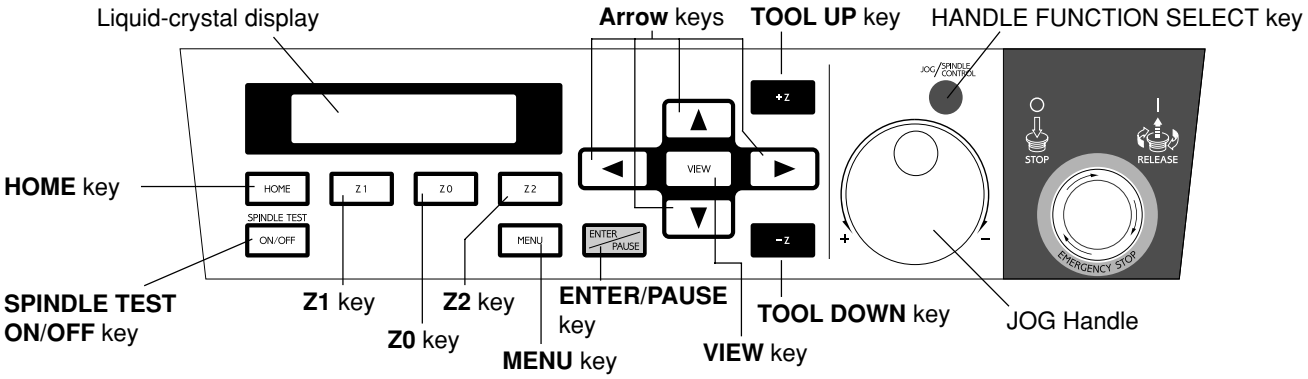
Left side view

Z0 position sensor jack
The Z0 position sensor included with the unit is connected here.

Vacuum cleaner mounting port
* A vacuum cleaner is not included with the unit.
The suction nozzle of a commercially available vacuum cleaner can be inserted into this port. This allows the vacuum cleaner to remove cuttings during operation.



Rear view



* A confirmation beep is produced whenever a key is pressed.

Liquid-crystal display — The settings and selection choices (or values) for the PNC-300 are shown on this display. Error messages also appear here in the event of a problem.

Arrow keys — Pressing an arrow key causes the XY table to move in the corresponding direction. Holding down the key makes the XY table move faster (except during spindle rotation, when the speed of movement does not change).
The arrow keys are also used together with the liquid-crystal display to manipulate settings, select items, display other choices, and change values.

TOOL UP key — This key makes the cutting tool (blade) move in a positive direction on the Z axis (i.e., upward). Movement is always at a constant speed.

TOOL DOWN key — This key makes the cutting tool move in a negative direction on the Z axis (i.e., downward). Movement is always at a constant speed.

HOME key — This key moves the cutting tool to the current home position (XY origin point).

Z0 key — This key moves the cutting tool to the current Z-axis origin point.

Z1 key — This key starts the spindle motor and moves the tool to the current tool-down position. Spindle rotation and tool changing do not take place while the cover is open.

Z2 key — This key moves the tool to the current tool-up position.

MENU key — This key scrolls through the menu on the liquid-crystal display (i.e., it changes the panel display).

ENTER/PAUSE key — This key is used to confirm settings, values, and selections made with the liquid-crystal display.
When pressed during cutting, operation is paused.

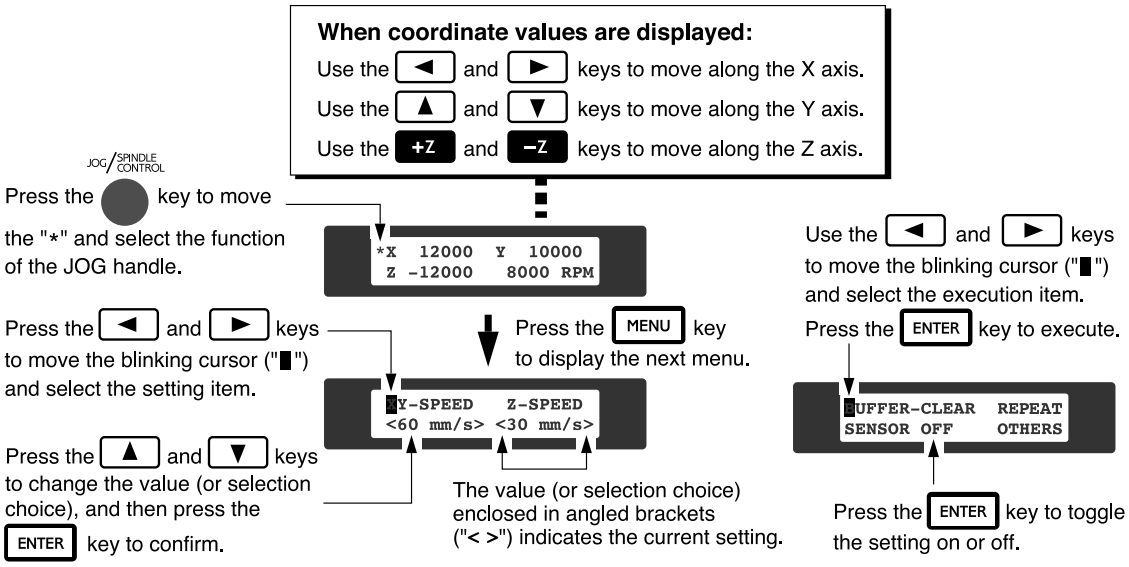
SPINDLE TEST ON/OFF key — This key is used to start and stop the spindle motor. The spindle will not rotate while the cover is open.

VIEW key — This key raises the cutting tool to its highest point and moves the XY table to the front left.

JOG handle — This is used for inching the XY table and cutting tool (in steps of 0.01 mm (0.00039")), and also to set the speed of the spindle motor.

HANDLE FUNCTION SELECT key — This key is used together with the liquid-crystal display to select the function of the JOG handle.

Making Settings with the Liquid-crystal Display



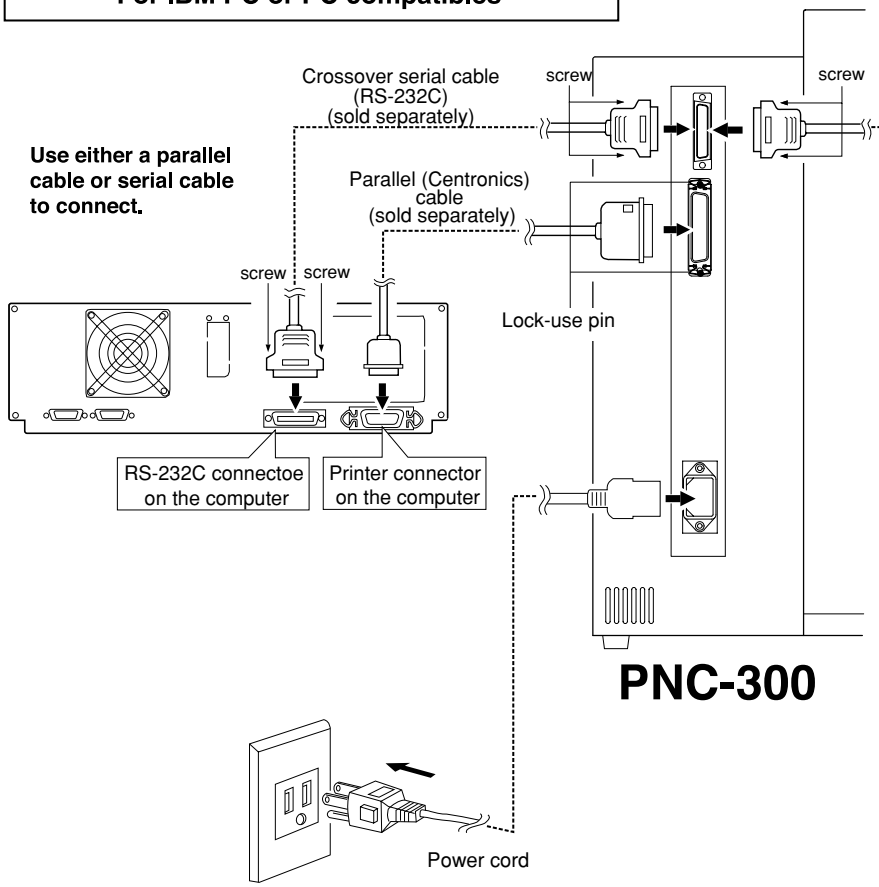
3. Power Cord and Computer Connections

NOTICE

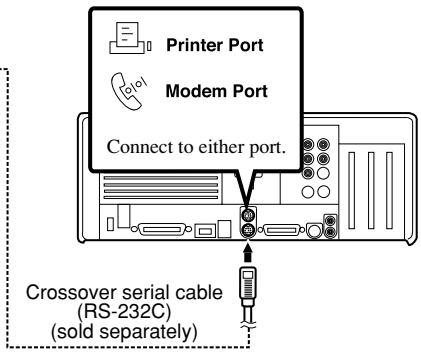
Ensure that the power supply voltage is within ±10% of the machine's rated voltage.
Connect the cables only when the PNC-300 and the computer power sources are OFF.
Connect the power supply cord and the computer-use input/output cable firmly so that they don't come loose or cause a poor connection.

The cable for computer connection is optional. Please purchase the appropriate cable for the type of computer and software used.

For IBM PC or PC compatibles

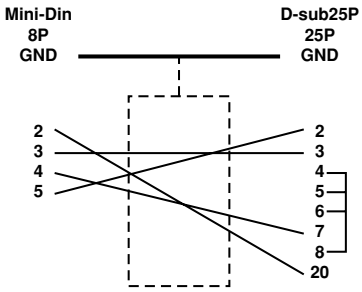


For Macintosh

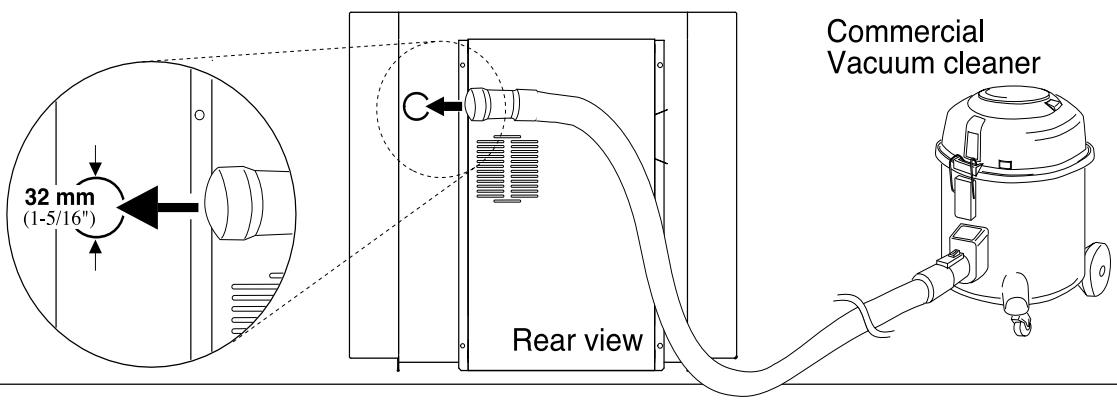


Use a cable with the following specifications.

Mini-Din 8-pin male connector -
D-sub 25 pin male connecter
Apple crossover cable (JCRC01 compliant)



Vacuum Cleaner Connection



4. Installing the Software

Using with Windows®

The included CD-ROM contains several pieces of software for operating the PNC-300.
For information on how to use the programs, and for detailed information about their commands, see the help for the programs.

Operating environment

	MODELA Applications	Dr. Engrave	3D Engrave	Virtual MODELA
Computer	Personal computer running Windows 95, Windows 98, or Windows NT 4.0			
CPU	If you're using Windows 95: i486SX or better (Pentium 100 MHz recommended) If you're using Windows 98 or Windows NT 4.0: i486DX or better (Pentium 100 MHz recommended)			
System Memory	If you're using Windows 95: 8 MB or more (10 MB or more recommended) If you're using Windows 98 or Windows NT 4.0: 16 MB or more (32 MB or more recommended)			
Hard Disk	7 MB or more of free space	10 MB or more of free space	10 MB or more of free space	5 MB or more of free space

Setting Up the Program

* If you are installing under Windows NT 4.0, you need full access permissions for the printer settings.
Log on to Windows NT as a member of the “Administrators” or “Power Users” group.

1 Switch on the computer and start Windows.

2 Place the CD from the Roland Software Package in the CD-ROM drive.
The Setup menu appears automatically.

3 When the screen shown below appears, click the ▼ in [Click here], then choose [PNC-300].
Click [Install].
To view the description of a program, click the ⓘ button. To view the manual, click the ? button.
(There are manuals in PDF format for the programs that the ? button references. Acrobat Reader is required to view PDF files.)
If Acrobat Reader is not set up on your computer, you need to set it up.
The included CD-ROM also contains Acrobat Reader.
The locations are as shown below.

[Acrobat] - [English] - [ar302.exe]
(This runs under Windows 95, Windows 98, or Windows NT 4.0.)

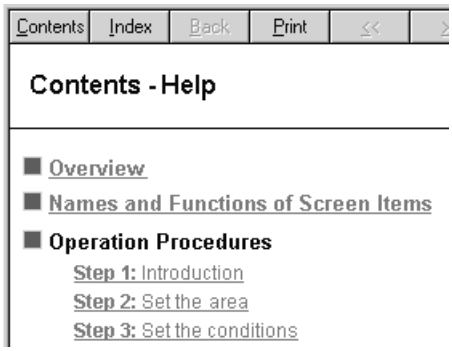
If there are programs you don't want to install, then clear their check boxes before you click [Install].

How to use Help

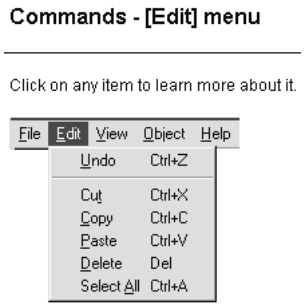
If you have trouble using the program or driver, see the help screens. Help contains information such as descriptions of software operation, explanations of commands, and tips for using the software more effectively.

1 From the [Help] menu, clik [Contents].

2 Clicking on text that is green and underlined (by a solid or dotted line) displays an explanation.



3 Clicking on an image area that contains an explanation displays the explanation.



Tip

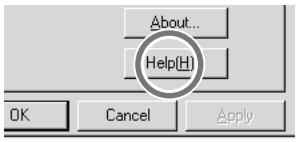
- When the pointer moves over green underlined text, it changes to a pointing hand ( ).
- When the pointer moves over a location where an explanation is included, it changes to a pointing hand ( ).

When there's a [?] button on screen

Clicking [?] in the upper-right corner of the window makes the mouse pointer change to a question mark ( ). You can then move the pointer over any item you wish to lean more about, then click on the item to display an explanation of it.

When there's a [Help] button on screen.

Clicking [Help] lets you view help for the window or software.



Using with Macintosh

The included CD-ROM contains programs for the Macintosh that output cutting data to modeling machines from Roland DG Corp. (such as the MODELA, CAMM-2, and CAMM-3). Set up MODELA Player for Mac OS from the included CD-ROM.
For more information and details of commands on how to use MODELA Player for Mac OS, see the help screens.

Operating environment

●Computer	A Power Macintosh, or PowerBook with a PowerPC processor.
●System	Mac OS 7.5 or higher
●System Memory	20 MB or more (40 MB or more recommended)
●Hard Disk	3 MB or more of free space

Setting Up the Program

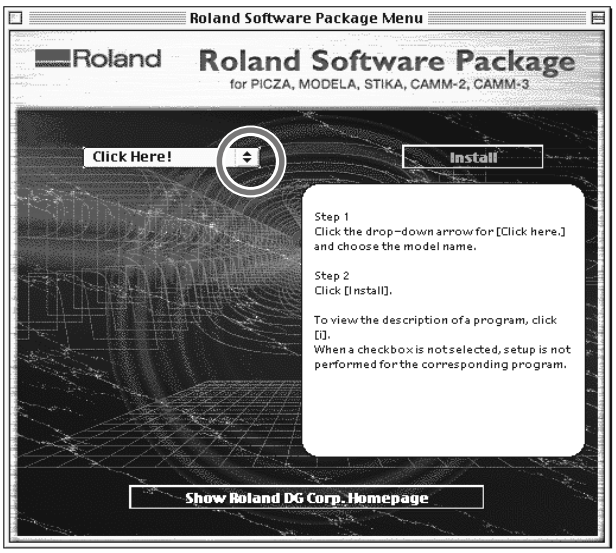
1 Turn off any virus-detection software.

2 Insert the included CD-ROM into the CD drive.

3 Double-click the CD icon to open.

4 Double-click the [Menu] icon.

5 When the screen shown below appears, click the allow in [Click here], then choose [PNC-300].
Click [Install].
To view the description of a program, click the [i] button.



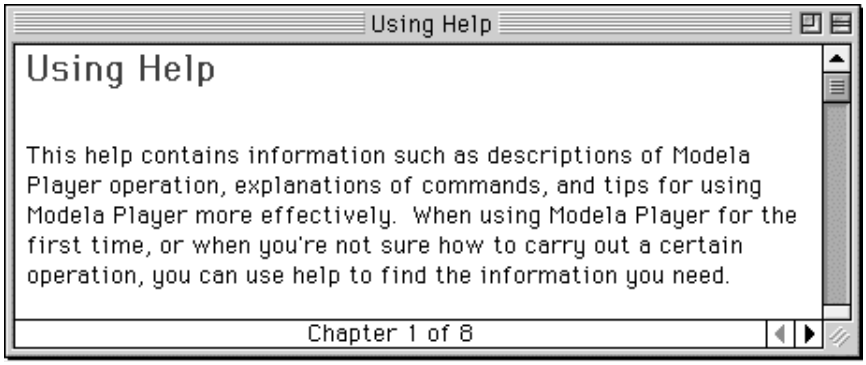
6 Follow the messages to carry out setup and finish setting up the program.
When installation is completed, remove the CD-ROM form CD-ROM drive.

How to use Help

Help contains information such as explanations of MODELA PLAYER commands and tips for using MODELA PLAYER more effectively.

1 Open the [ ] menu and choose [MODELA PLAYER Help].
The MODELA PLAYER help screen appears.

2 For information on how to use help, see "Using Help."



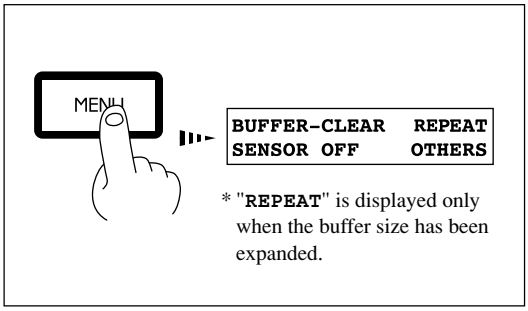
Settings for Communication Parameters

The settings are fixed at no parity, 8 bits, and one stop bit. For information about setting the bit rate (transmission speed), see the help screens.

5. Setting the Connection Parameters

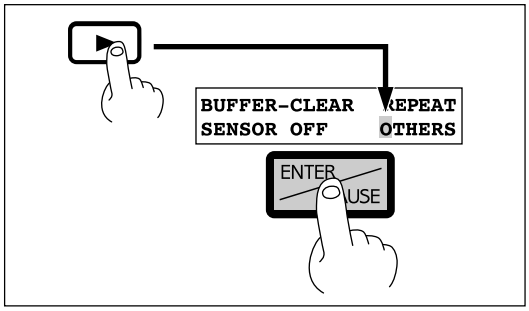
Connection with a parallel cable is called a "parallel connection," and connection with a serial cable is called a "serial connection." Make the appropriate settings on both the computer and the PNC-300 to configure the equipment for the type of connection that has been made. Normally, the setting on the PNC-300 should be made to match the setting on the computer. The steps below describe how to set connection parameters on the PNC-300. To make the settings on the computer, refer to the manual for the computer or the software in use.

1 Press the **[MENU]** key to make the following screen appear on the display.

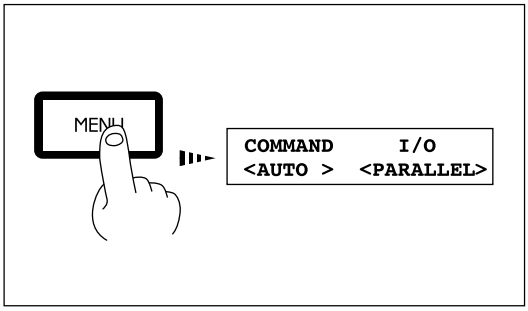


* "**REPEAT**" is displayed only when the buffer size has been expanded.

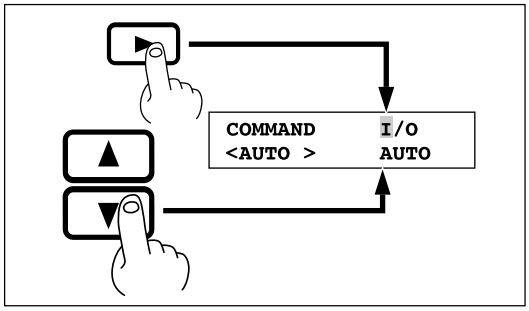
2 Press the **[►]** key to move the blinking cursor ("**▮**") to "**OTHERS**," and then press the **[ENTER]** key.



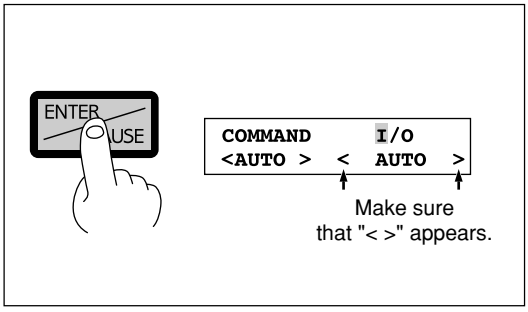
3 Press the **[MENU]** key to make the following screen appear on the display.



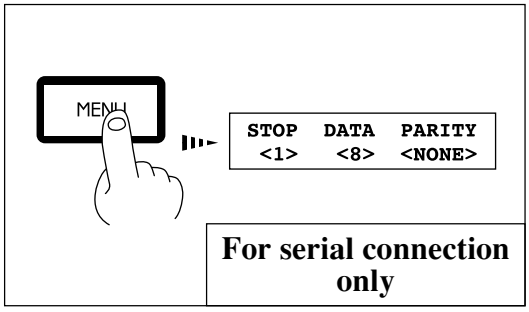
4 Press the **[►]** key to move the blinking cursor ("**▮**") to "**I/O**," then use the **[▲]** or **[▼]** keys to select "**AUTO**."



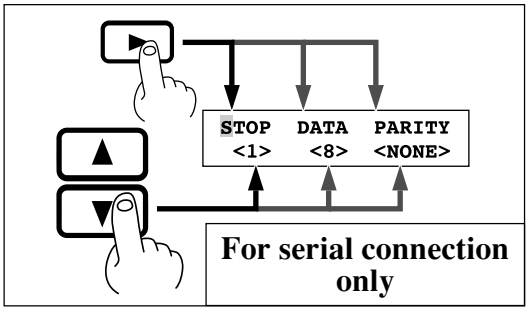
5 Press the **[ENTER]** key.



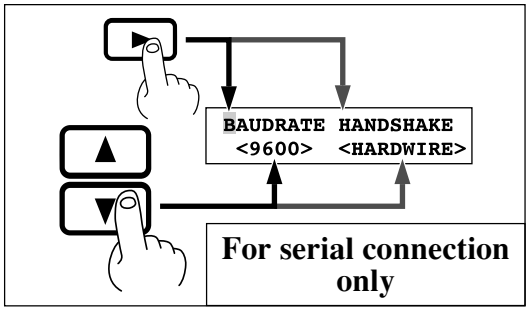
6 Press the **[MENU]** key once.



7 Make the settings for stop bit, data bits, and parity check, then press the **[MENU]** key once.

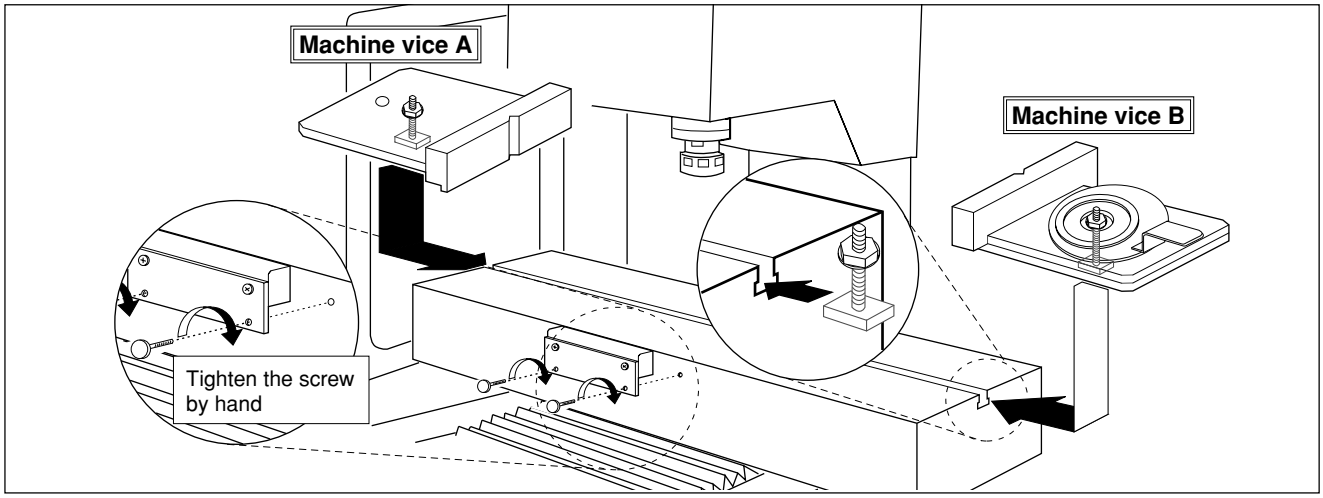


8 Make the settings for baud rate and handshake.



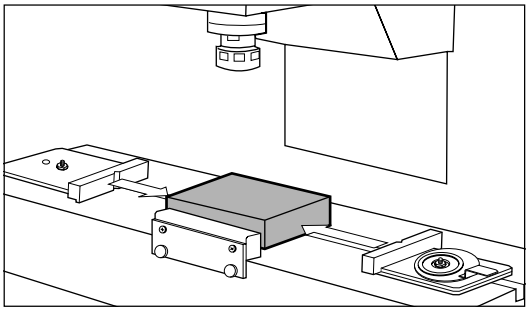
6. Loading a Workpiece for Cutting

Installing the Machine Vise

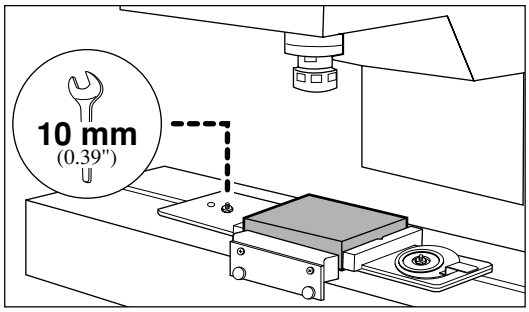


How to Secure a Workpiece in the Machine Vise

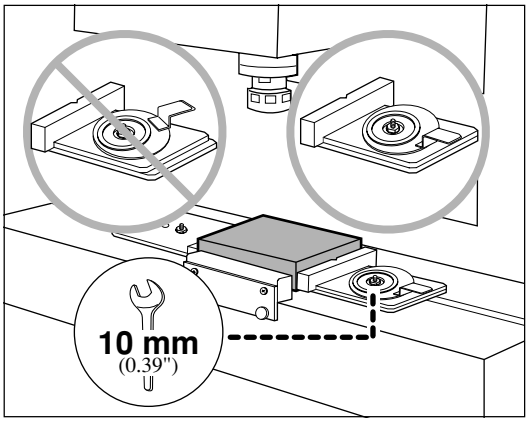
1 Place the workpiece on the XY table, and move the machine vise so that it lightly touches both sides of the workpiece.



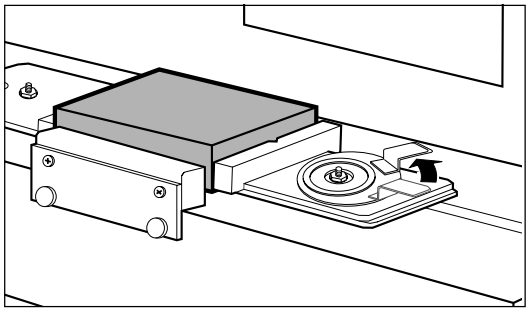
2 Use the wrench included with the unit to secure machine vise A.



3 Use the wrench to secure machine vise B.



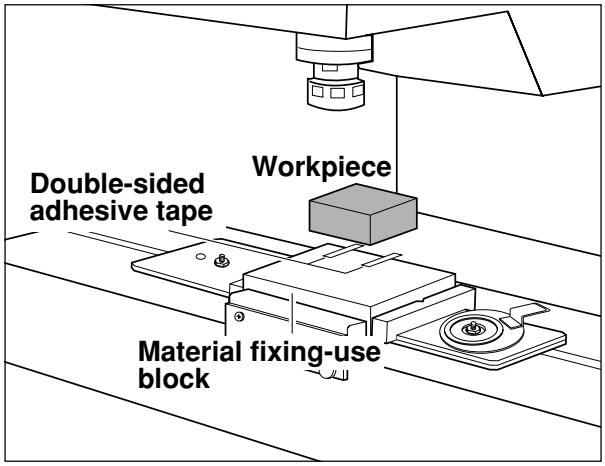
4 Secure the workpiece in place.



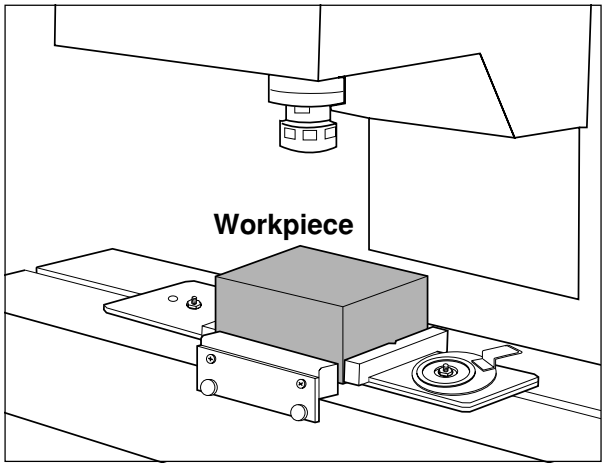
Examples of Workpiece Loading

This section is an explanation of the cutting workpiece attachment method when a machine vice is used. If employing an alternative attachment method, fix the workpiece firmly in place using the following explanation for reference.

Under the standard workpiece attachment method, a block is attached to the vice, then the workpiece is fixed to the block with double-sided adhesive tape. This is the most suitable method when cutting comparatively small workpieces. For the fixing-use block, it's better to choose a workpiece that can be cut and aligned horizontally with precision. (So that after attachment with the vice, accuracy can be improved when the surface is cut.) When cutting complicated shapes, it can be difficult to fix the workpiece to accommodate the cutting process. But with this method you can fix the workpiece setting position by cutting the block itself to the required shape.
Before fixing the workpiece in place, take away any foreign matter such as cutting waste from the surface of the fixing-use block. If foreign matter remains, the workpiece may not be properly fixed and also the finished dimensions may not be precise.

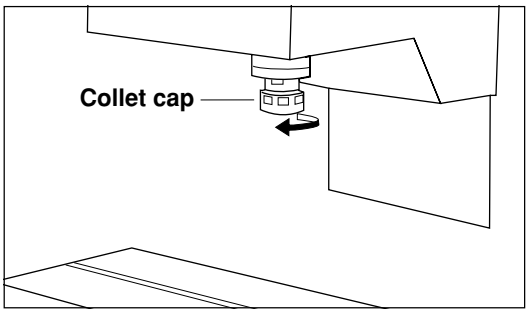


As an alternative, it is possible to attach the workpiece to the vice directly. Because no fixing-use block is utilized, this method is capable of accommodating larger workpieces. In addition, attachment and detachment are easy. However, this method is not suitable for very complicated shapes or for cases where the strength of the part held in the vice is weak.
In cases where the workpiece is attached to the vice directly, be careful to adjust the cutting depth (the total Z axis feeding amount) so that the part of the workpiece held in the vice is not cut. If the tool cuts the vice, the cutting edge of the tool will be damaged and it will be impossible to use. Also, in the case of a very thin tool, the cutting edge may break and become very dangerous.

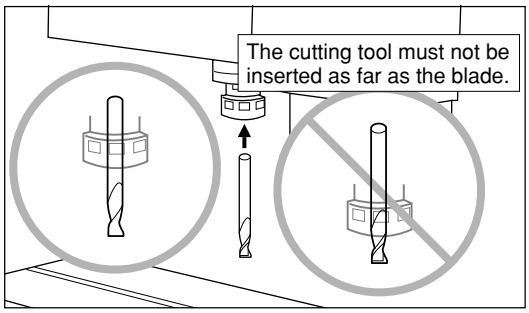


7. Cutting Tool Attachment

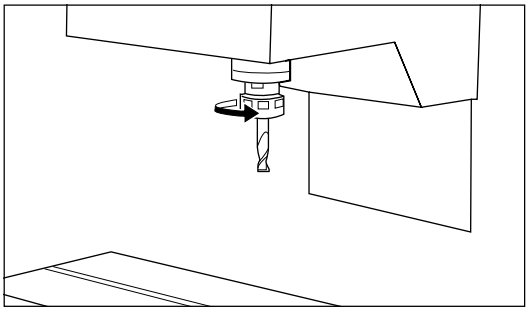
1 Loosen the collet chuck.



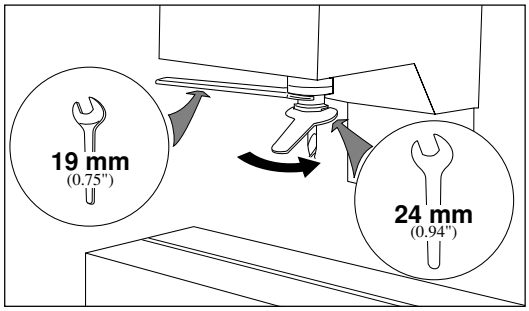
2 Insert the cutting tool.



3 Tighten the collet chuck by hand to provisionally secure the cutting tool to the spindle motor.

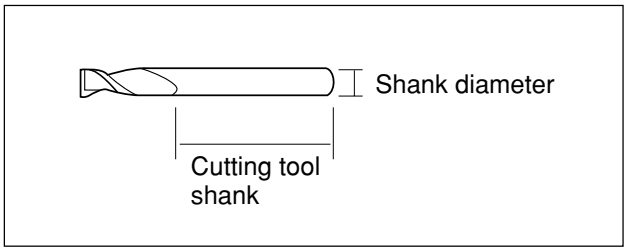


4 Secure the spindle motor so that it does not rotate, and use wrenches to tighten securely.

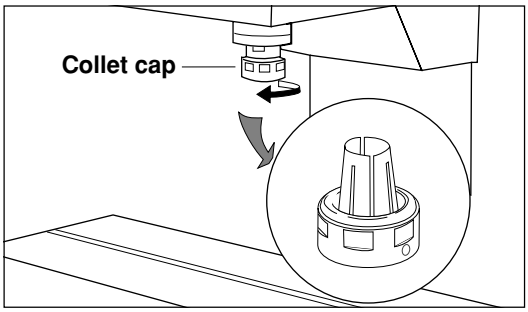


Changing the Collet Chuck

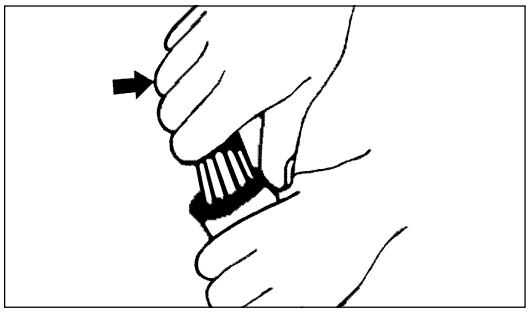
The collet chuck included as standard equipment with the machine can hold a cutting tool with a shank that is 6 mm (0.24") in diameter. When using a cutting tool that has a different shank diameter, be sure to replace the collet chuck with one suited to the cutting tool's shank diameter. (Collet chucks for shank diameters other than 6 mm (0.24") are available separately.)



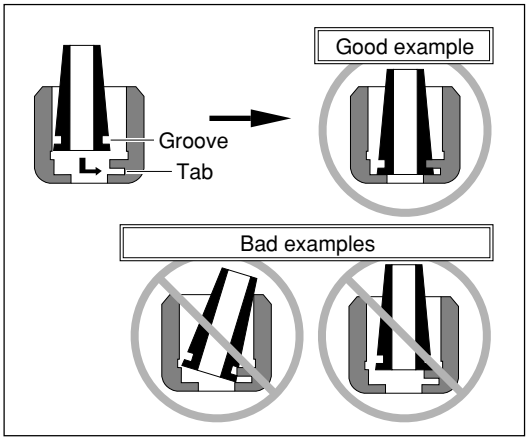
1 Rotate the collet cap to remove it.



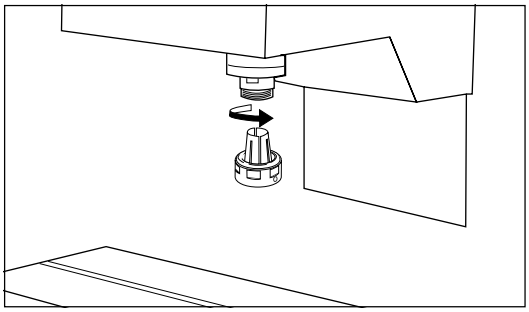
2 Tilt the collet chuck at an angle and remove while twisting.



3 Securely fit the groove on the collet chuck to the tab on the cap.



4 Install on the spindle.



8. Setting the Origin (Home Position and Z0)

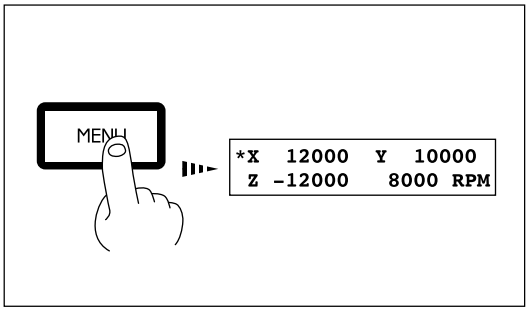
The PNC-300 are suitable for use with a versatile range of workpiece shapes and a wide variety of tools, so determine the standard points for cutting each time a new workpiece is set. Set the home position (origin point for X an Y axes) and Z0 (Z axis origin point). (If these points can be set with your current software, they should be set using the software.)

Setting the Home Position

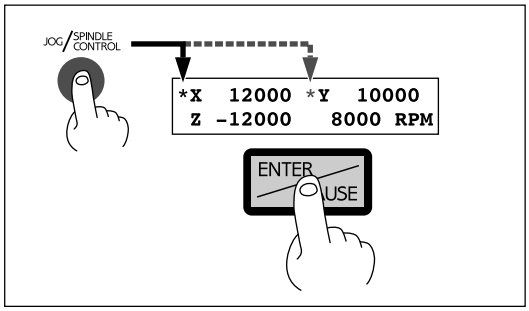
The home position is the point that becomes the origin point in the X and Y directions. Usually, this point is set at the front left corner of the fixed workpiece. The setting method explained here, uses the left, bottom corner (nearest the operator) of the workpiece as the home position.

The home position points are registered in the PNC-300 memory right after power is turned on and before power is turned off.

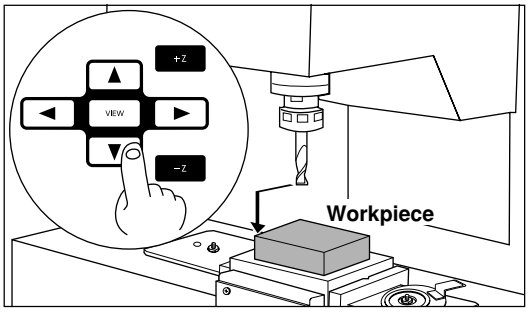
1 Press the **[MENU]** key to make the following screen appear on the display.



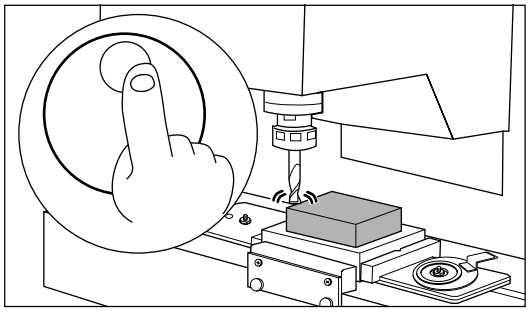
2 Press the HANDLE FUNCTION SELECT key to move the "*****" on the screen to "**X**" or "**Y**," then press the **[ENTER]** key.



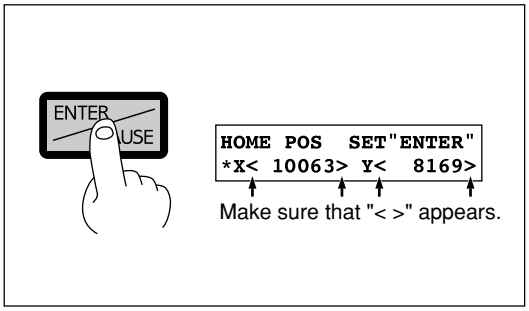
3 Press the arrow keys and the TOOL UP/DOWN keys to move the cutting tool to a position close to the front left corner of the workpiece.



4 Use the HANDLE FUNCTION SELECT key and the JOG handle to align the cutting tool with the front left corner of the workpiece.



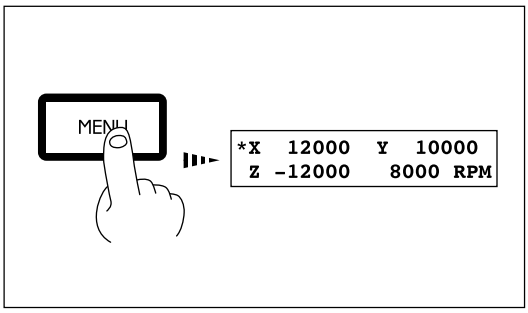
5 Press the **[ENTER]** key.



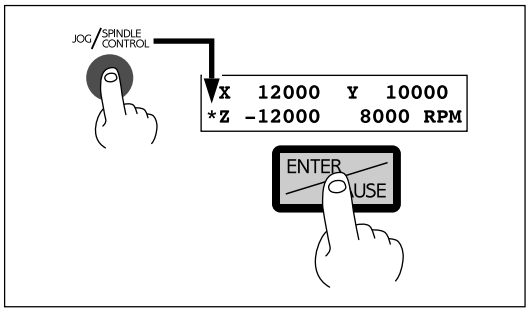
Setting the Z0 Position

The Z0 position is the point that becomes the origin point in the Z directions. Usually, this point is set at the surface of the fixed workpiece. The following explains the method for setting the workpiece surface Z0 position. If "**Z0_MEMORY**" is off, then the Z0 position is set to the mechanically uppermost position immediately after the power is switched on.

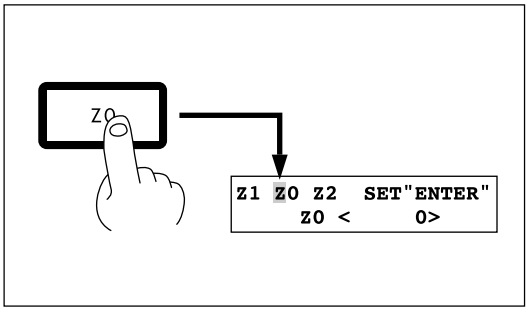
1 Press the **[MENU]** key to make the following screen appear on the display.



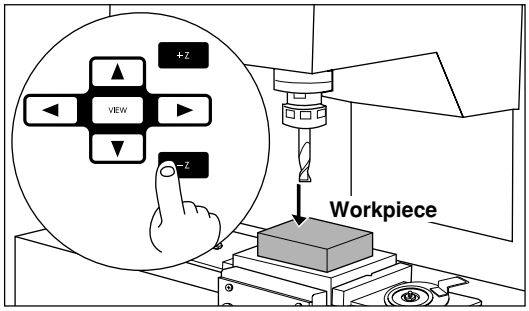
2 Press the HANDLE FUNCTION SELECT key to move the "*****" on the screen to "**Z**," then press the **[ENTER]** key.



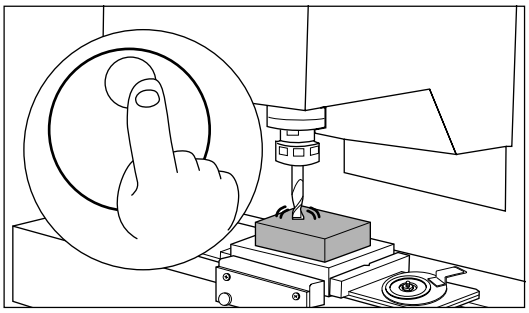
3 Press the **[Z0]** key to move the blinking cursor ("**▉**") to "**Z0.**"



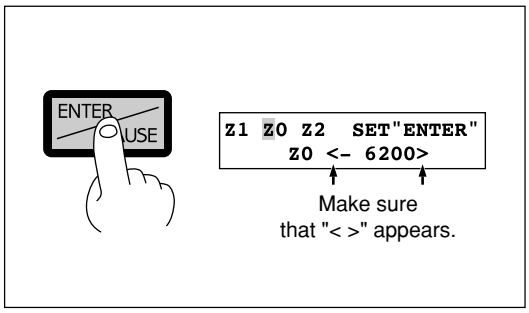
4 Press the arrow keys and the TOOL UP/DOWN keys to move the cutting tool close to the surface of the workpiece.



5 Rotate the JOG handle to align the tip of the cutting tool with surface of the workpiece.

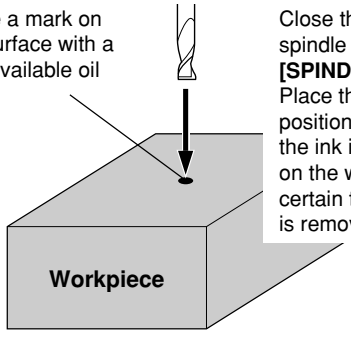


6 Press the **[ENTER]** key.



The following method can be used to set the Z0 position even more precisely. This method is suitable for cases where the position is marked with an oil pen and later cut off.
Set Z0 as the position where the ink was cut off.

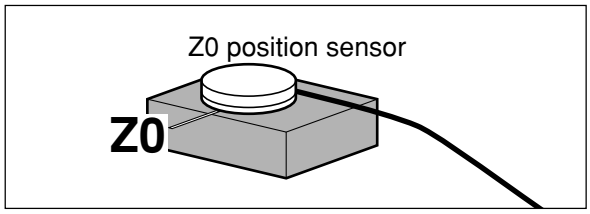
First, make a mark on the work surface with a generally available oil pen, etc.



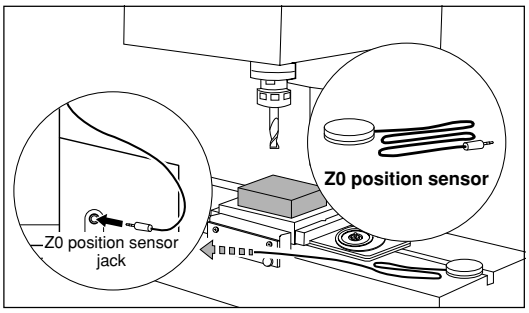
Close the cover and rotate the spindle by pressing the **[SPINDLE TEST ON/OFF]** key. Place the tool in the marked position, then lower the tool until the ink is cut off. The ink mark on the work surface has a certain thickness, so only the ink is removed.

Setting Z0 with the Z0 Position Sensor (Included with the Unit)

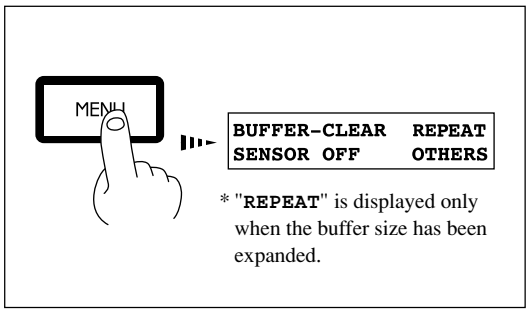
The Z0 sensor included with the unit is used to set the Z0 point on the surface of the workpiece. The Z0 sensor is placed on the location which is to serve as the Z0 point, and the Z0 point is set.



1 Install the Z0 position sensor.

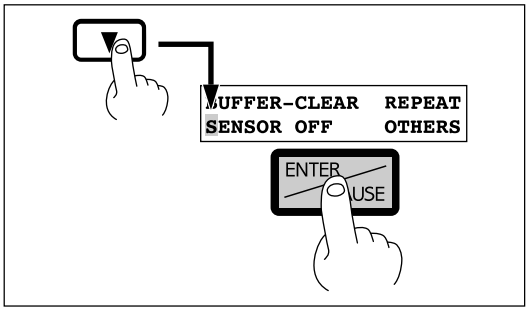


2 Press the **[MENU]** key to make the following screen appear on the display.

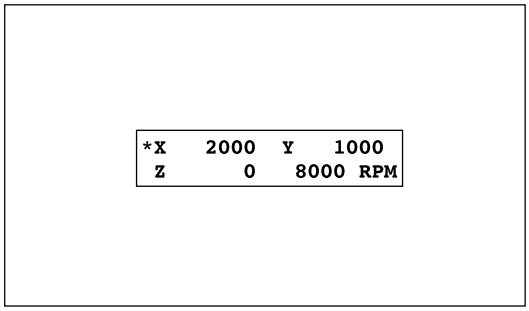


* "**REPEAT**" is displayed only when the buffer size has been expanded.

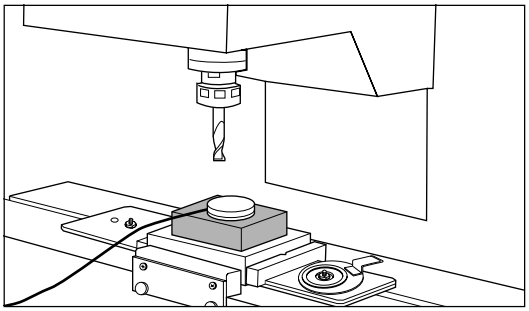
3 Press the **[▼]** key to move the blinking cursor ("▉") to "**SENSOR OFF**," then press the **[ENTER]** key.



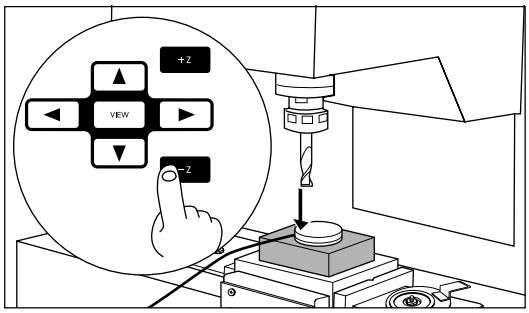
4 The display changes to indicate the message shown below.



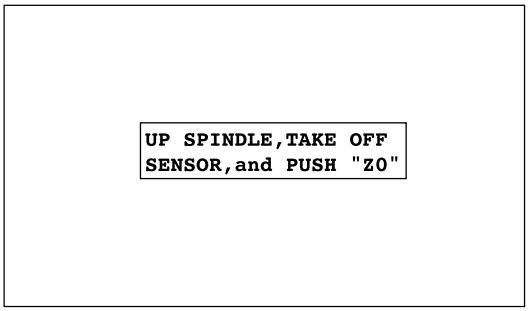
5 Place the Z0 position sensor on top of the workpiece.



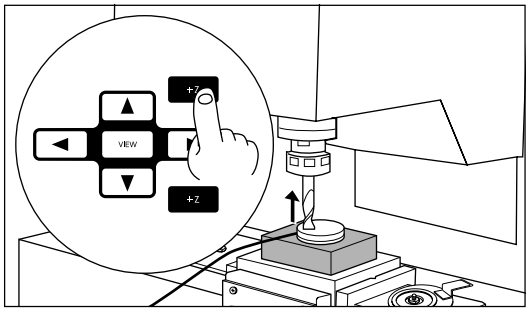
6 Press the arrow keys and the TOOL UP/DOWN keys to move the cutting tool until its tip comes into contact with the Z0 position sensor. Movement of the cutting tool stops when it touches the Z0 position sensor.



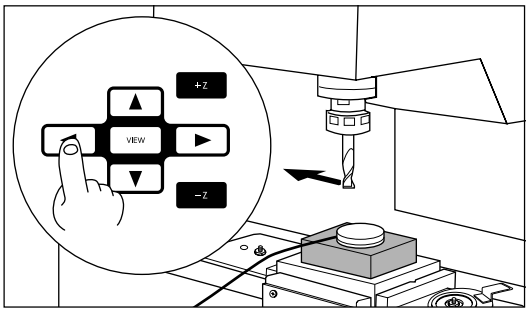
7 The display changes to indicate the message shown below.



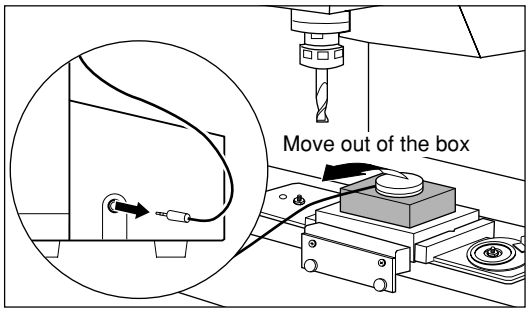
8 Press the TOOL UP key to raise the cutting tool.



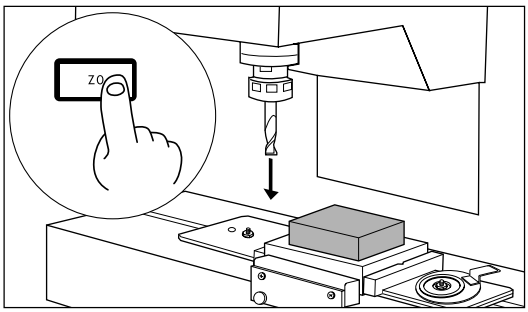
9 Press the arrow keys to move the tool away from the top of the workpiece.



10 Detach and remove the Z0 position sensor.



11 Press the **[Z0]** key. The tool descends automatically to the Z0 position, and the Z0 point is set.



9. Cutting Condition Setting

Before you begin the actual cutting process, the cutting conditions such as the revolution speed of the spindle motor and the feeding speed of each axis must be designated according to the quality of the workpiece and the type of tool used. There are several deciding factors to be taken into account when designating the cutting conditions.

1. The quality of the workpiece **4. The cutting method**

2. The type of tool used **5. The cutting shape**

3. The diameter of the tool used

Designate the cutting conditions in consideration of the above factors by performing the following three PNC-300 setting operations.

1. The spindle motor revolution speed (tool revolution speed)
2. The feeding speed (tool moving speed)
3. The cutting-in amount (depth of one cutting operation)

Note : When settings have been made with both the software and the PNC-300, the last settings made have priority.

In this manual, these three conditions are called the cutting conditions. The characteristics and points to consider for each of these conditions are as follows.

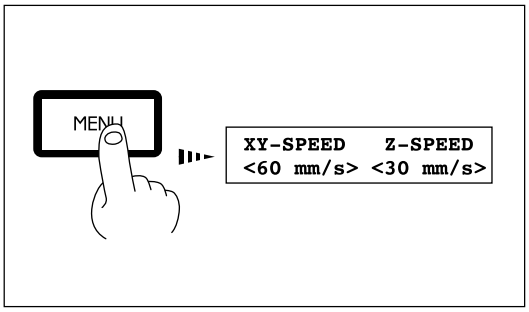
Item	Characteristics/Points to Consider
Spindle motor revolution speed	The bigger this number, the faster the cutting speed. However, if this number is too large, the work surface may melt or burn due to excessive friction. Conversely, if this number is made smaller, the time taken for cutting becomes too longer. Generally speaking, the entire cutting speed is determined by the cutting edge speed, so the smaller the tool diameter, the higher the spindle revolution speed required. (When performing engraving without rotating the cutting tool, set "REVOLUTION" to "OFF.") Revolution speed : 3000—8000 rpm
Feeding speed	When the feeding speed is high, processing becomes rough and flash marks tend to remain on the cut surface. On the other hand, when the feeding speed is slow, processing takes more time. Be careful because a slower feeding speed does not always result in improved finishing.
Cutting-in amount	When the cutting-in amount is deeper, the cutting speed increases, but the cutting-in amount is limited by the quality of the workpiece. In cases where the required depth can not be cut at once, repeat cutting several times to depth that does not breach the limit.

Manual Setting of Cutting Conditions

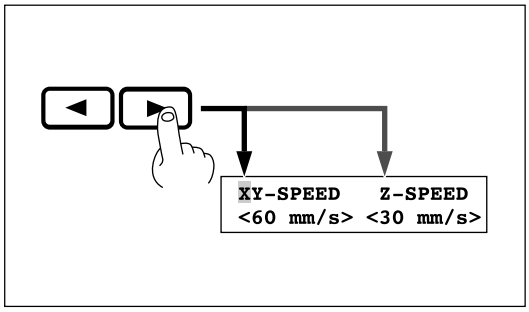
The cutting conditions can be set manually according to the method described below.
If the cutting conditions can be set with your current software, this is a faster and more efficient method than manual setting. It makes no difference when you come to construct a program. The following method is appropriate for making delicate halfway adjustments to conditions previously set using software, etc.

Feeding Speed

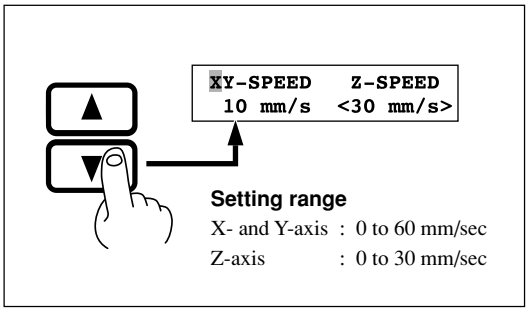
1 Press the **[MENU]** key to make the following screen appear on the display.



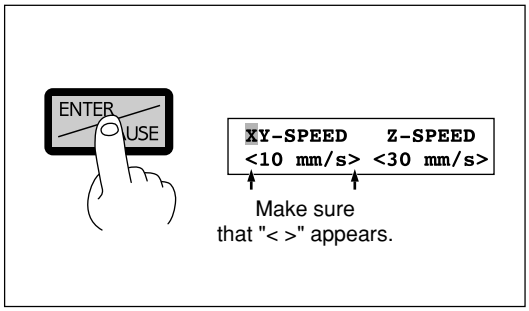
2 Press the **[◄]** or **[►]** key to move the blinking cursor ("**▉**") to "**XY-SPEED**."
To set the lowering speed of the head, move the blinking cursor ("**▉**") to "**Z-SPEED**."



3 Press the **[▲]** or **[▼]** key to set the feed rate.

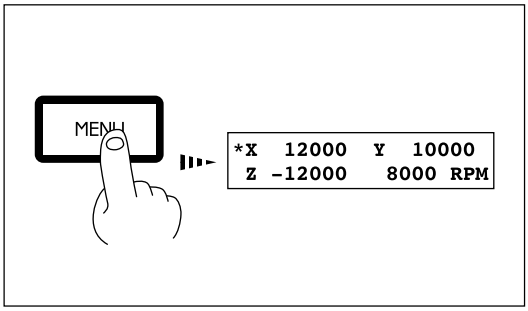


4 Press the **[ENTER]** key.

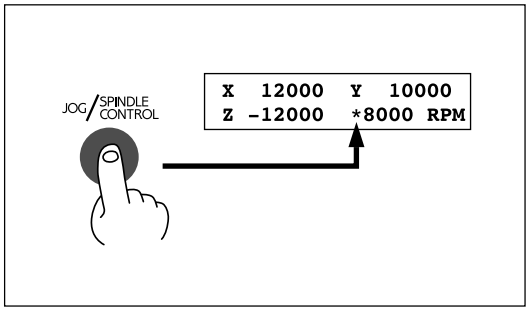


Spindle Motor Revolution Speed

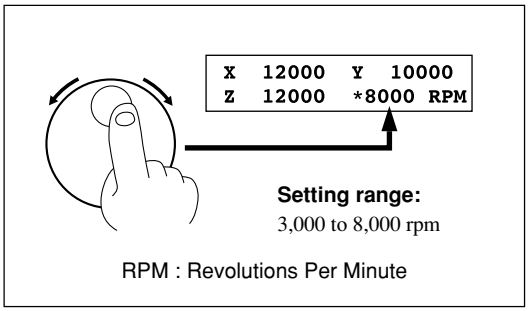
1 Press the **[MENU]** key to make the following screen appear on the display.



2 Press the HANDLE FUNCTION SELECT key to move the "*****" on the screen to "**??00 RPM**."



3 Rotate the JOG handle to set the speed of rotation.



Cutting-in Amount

The cutting-in amount is set by setting Z1. (Refer to next page.)

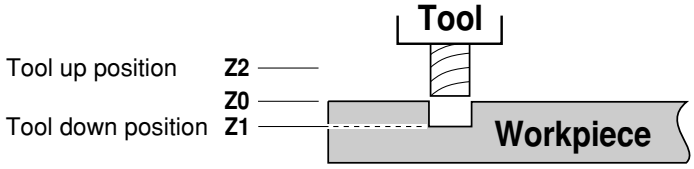
Cutting Condition Setting Examples

The chart below contains reference examples of the appropriate cutting conditions for several types of workpiece material. In the case that the conditions are input using software or when constructing your own programs, set the cutting conditions with reference to the chart. However, because conditions differ depending on tool sharpness and workpiece hardness, cutting performance may not always be optimal when adhering to the conditions specified below. In such a case, delicate adjustment should be performed at the time of actual cutting.

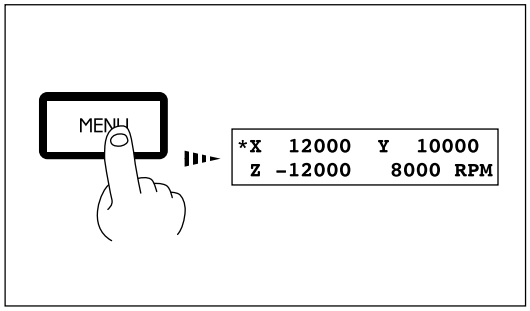
Workpiece	Tool (option)	Spindle revolution speed [RPM]	Cutting-in amount [mm]	Feeding speed [mm/sec.]
Modeling wax (option)	ZUS-600	8000	2.5	14
Chemical wood	ZUS-600	8000	0.6	14
Acrylic resin	ZUS-600	8000	0.3	14
ABS plastic	ZUS-600	8000	0.7	14
Aluminum	ZUS-600	8000	0.1	14
Brass	ZUS-600	8000	0.1	14

10. Setting the Z1 and Z2 Position

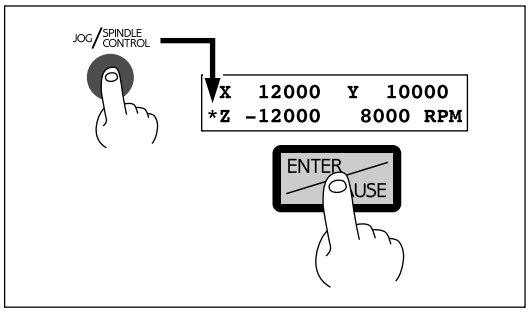
The cutting tool up position (Z2 point) and down position (Z1 point) are normally set with the software. If they cannot be set with your current software then set them manually using the keys on the switch panel.



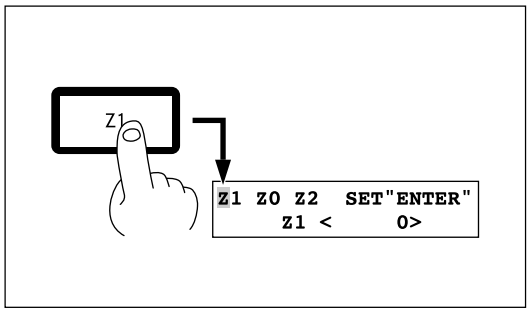
1 Press the **[MENU]** key to make the following screen appear on the display.



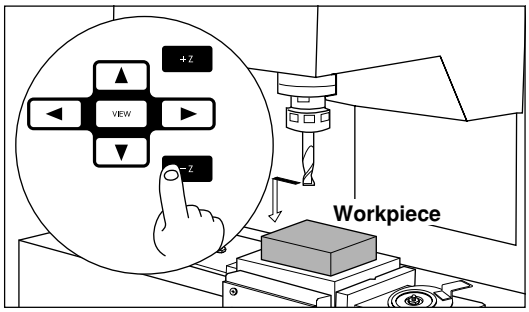
2 Press the HANDLE FUNCTION SELECT key to move the "*****" on the screen to "**Z**," then press the **[ENTER]** key.



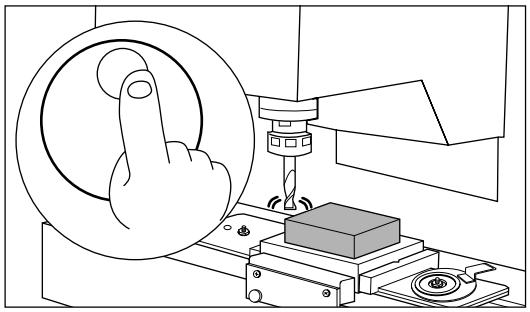
3 Press the **[Z1]** key to move the blinking cursor ("**▉**") to "**Z1**."
When setting the Z2 point, press the **[Z2]** key to move the blinking cursor ("**▉**") to "**Z2**."



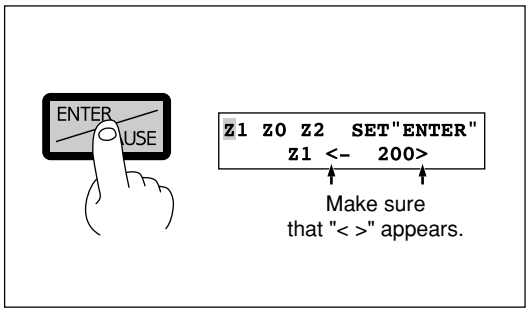
4 Press the arrow keys and the TOOL UP/DOWN keys to move the cutting tool close to the point where Z1 will be set.
When setting Z1, move the cutting tool to a position away from the loaded workpiece.



5 Rotate the JOG handle to gradually move the cutting tool to the height where the Z1 point is to be set.

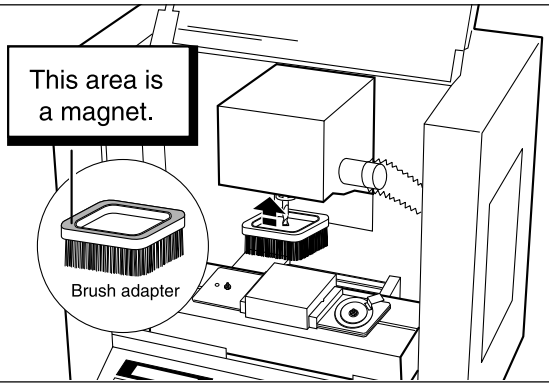


6 Press the **[ENTER]** key.



11. Attaching a Brush Adapter for Chip Cleaning

A commercially available vacuum cleaner is used during cutting to keep chips from flying into the box. Attaching the brush adapter included with the PNC-300 can enhance chip-cleaning performance.
Before attaching the brush adapter, first clean away any chips that may be present on the mounting surface.



NOTICE

You should never bring floppy disks close to brush adapter, since the data on them could be erased.

12. Sending Cutting Data

The PNC-300 performs cutting after receiving cutting data from the computer (application software).
Data may be output, for example, after it has been created using any of a number of applications, or from driver software.
In this section, general matters related to data output are explained. Refer to this section when carrying out data output. For details of the cutting data output method, refer to the operation manual for the application software or driver software used.

Setting the Output device

Please select from among the models shown below when making the settings for output device with the application software.

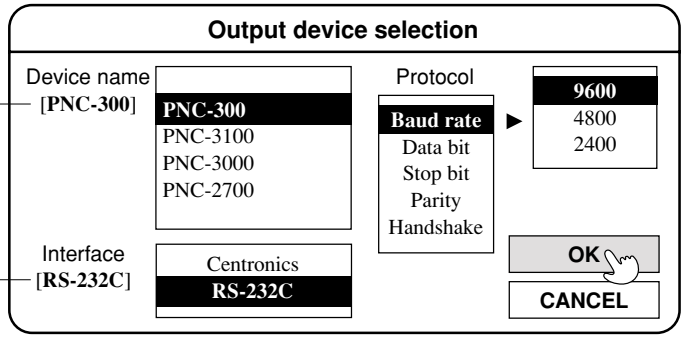
Output model	Instruction system	Command setting on the PNC-300	Coordinate unit setting on the PNC-300
PNC-300	CAMM-GL Ⅰ (mode1, mode2)	"AUTO"	"0.01 mm"
CAMM-3 Series	CAMM-GL Ⅰ (mode1, mode2)	"AUTO"	"0.01 mm"

* When set to "**AUTO**," the machine automatically determines whether the mode 1 or mode 2 instruction system is used.

Sample Settings for Application Software

Select PNC-300. If it is not listed, select CAMM-3 series.

Select either the parallel (Centronics) or the serial (RS-232C) interface. Choose the one that the host computer and the PNC-300 are connected by.



Cautions During Cutting

Opening the cover during cutting results in an emergency stop. Any cutting data in use becomes invalid, and cutting cannot be continued.
If the cover must be opened during cutting, first press the **[ENTER/PAUSE]** key to pause the unit. Confirm that operation has stopped, and then open the cover. After the cover has been closed, cutting resumes when the paused state is canceled.
The spindle will not rotate while the cover is open.

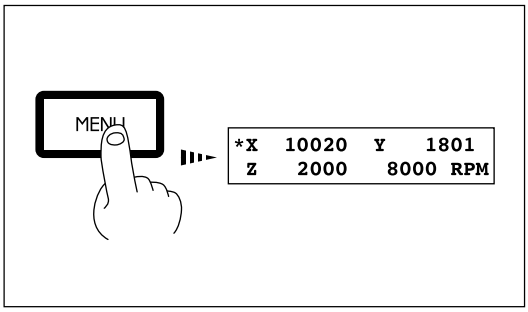
13. Finishing

After cutting has been finished, detach the tool, remove the material, and clean away chips.

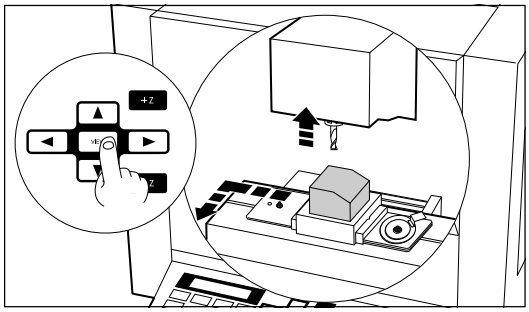
⚠CAUTION

The tool blade can cause injury to the hand even when not in motion.

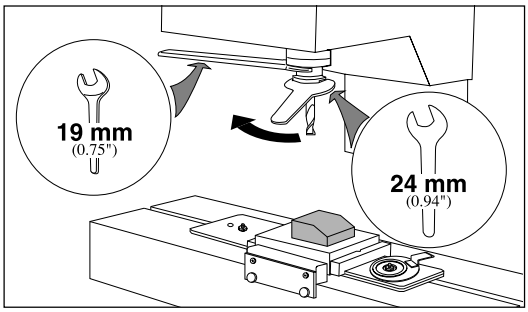
1 Press the **[MENU]** key to make the following screen appear on the display.



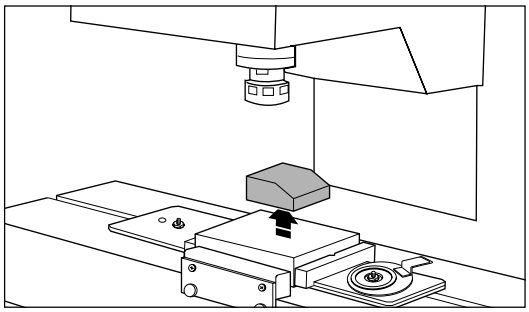
2 Press the **[VIEW]** key for at least 0.5 seconds.



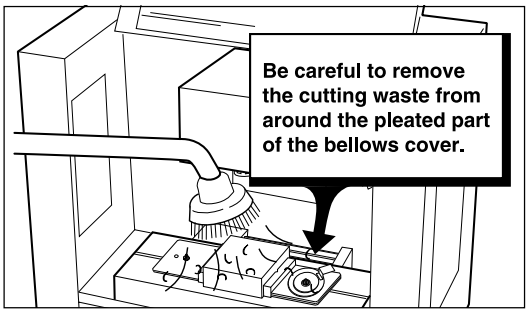
3 Open the cover and detach the tool.



4 Remove the material.



5 Use a commercially available vacuum cleaner to remove chips inside the box.



NOTICE

Do not use a compressed air for such cleaning. Cutting chips in the air may attach to a portion of the machine and cause malfunctions or breakdowns.

⚠CAUTION

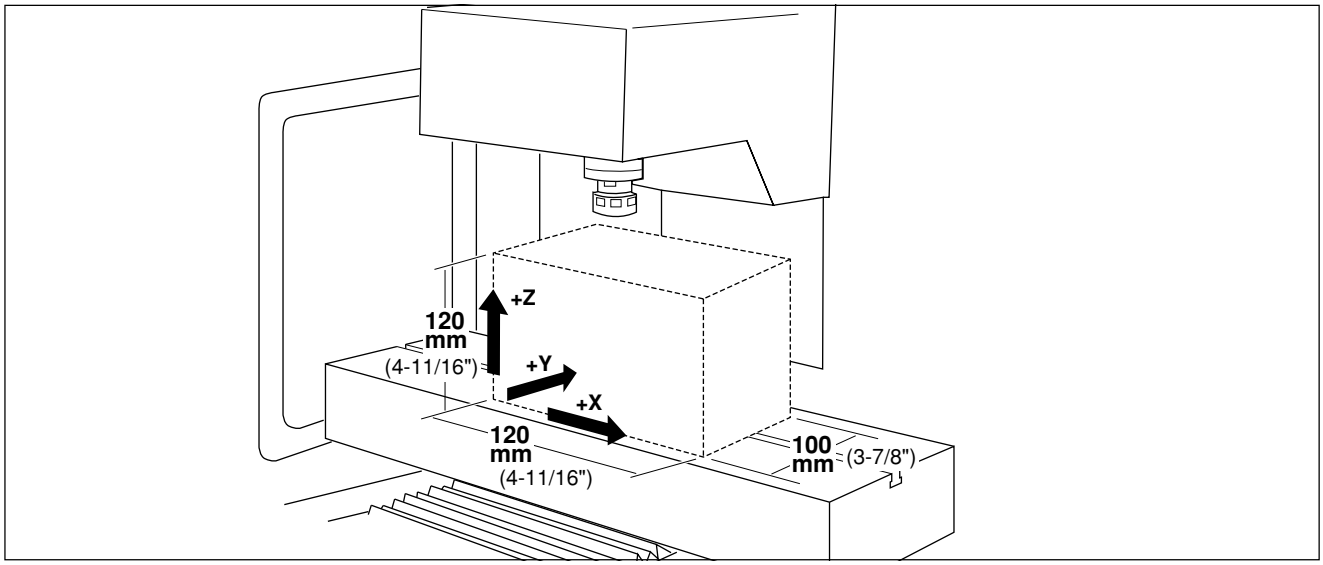
After finishing, be sure to wash the hands with water to remove any adhering cutting chips.

Part 2 User's Reference

Cutting Area

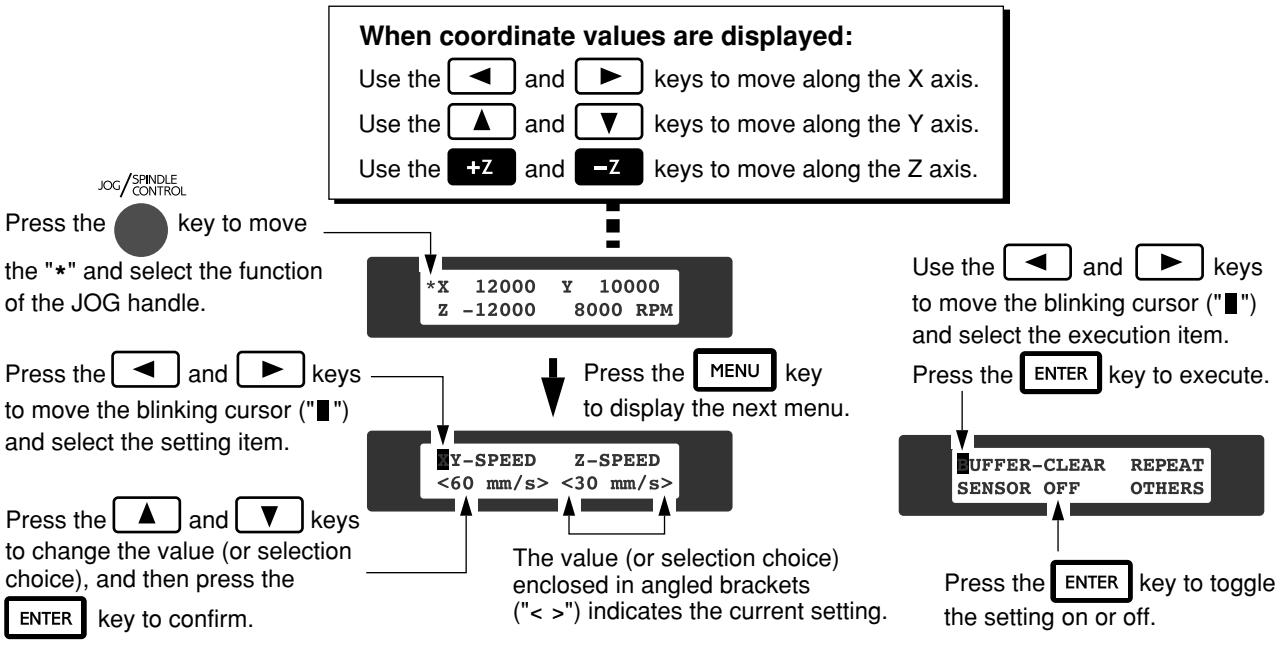
The maximum cutting area of the PNC-300 is 120 mm × 100 mm × 120 mm (4-11/16" × 3-7/8" × 4-11/16"). When converted to coordinate values, this corresponds to (x, y, z) = (12000, 10000, 12000) when the coordinate unit is 0.01 mm, or (x, y, z) = (4800, 4000, 12000) when the coordinate unit is 0.025 mm. Changing the coordinate unit causes only the coordinate units for the X and Y axes to change. The coordinate unit along the Z axis is always 0.01 mm/step.

The actual available cutting area is subject to restrictions according to the length of the attached tool, the X table position at which the workpiece is fixed, and the vice height (in the case that the vice is used); and in some cases it may be larger than the maximum operating area.



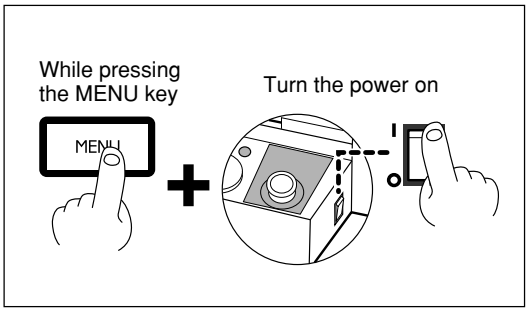
Operating Each Function

Making Settings with the Liquid-crystal Display

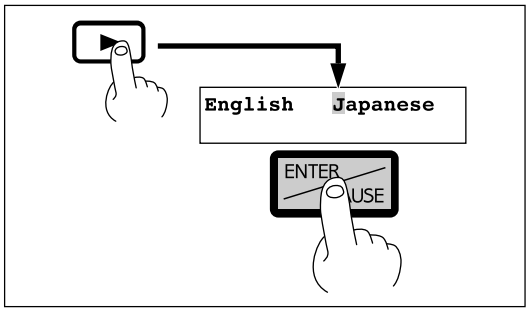


Changing to Other-language Messages on the Liquid-crystal Display

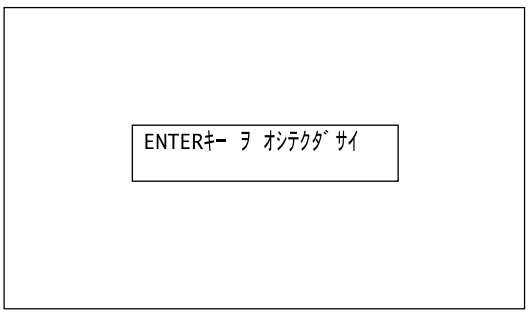
1 Switch on the power while holding down the **[MENU]** key.



2 Press the **[►]** key to move the blinking cursor ("▮") to "**Japanese**," and then press the **[ENTER]** key.



3 Messages on the display now appear in Japanese.

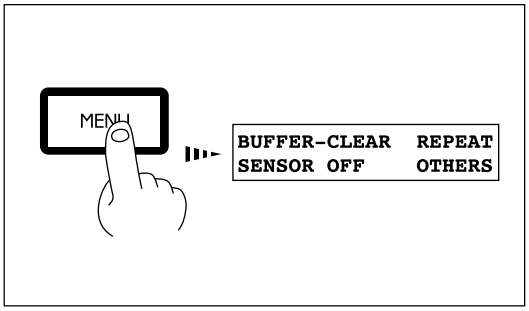


* To return the display to English-language messages, carry out Step 1 again. When the language-selection menu appears (similar to the one in Step 1, but in Japanese), move the cursor to "ｴｲｺﾞ" and press the **[ENTER]** key.

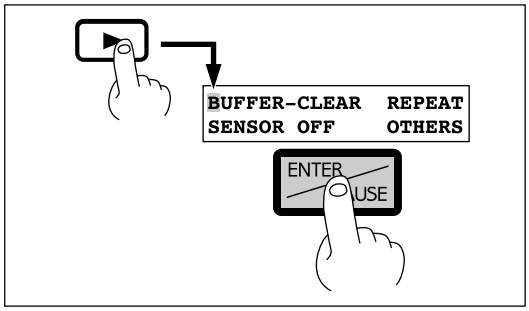
Performing Repeat Cutting

The repeat cutting function cannot be used unless the PNC-300's memory buffer has been expanded to 1 MB.
The data buffer is the place where data received from the computer is stored temporarily. (The data in the data buffer can be erased by switching off the power or executing the "**BUFFER-CLEAR**".)
Executing the "**REPEAT**" calls up the cutting data stored in the PNC-300's data buffer and executes the replotting procedure.
When replotting is executed, the entire data content of the data buffer is called up. When you perform replotting, clear the data from the data buffer before sending the cutting for replotting from the computer.

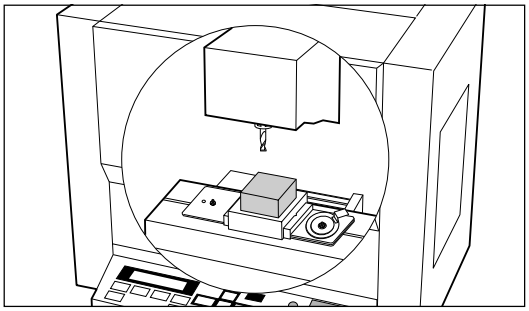
1 Press the **[MENU]** key to make the following screen appear on the display.



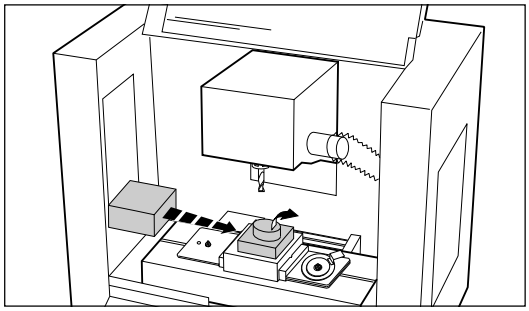
2 Press the **[►]** key to move the blinking cursor ("▉") to "**BUFFER-CLEAR**," and then press the **[ENTER]** key.



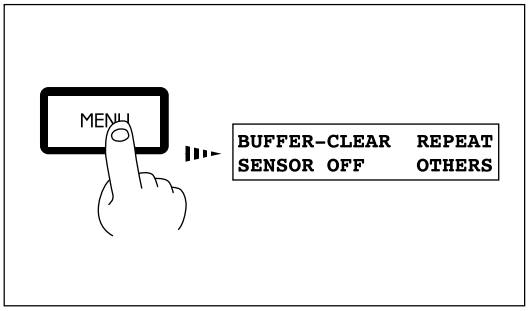
3 Install the tool (blade) and load the material. After closing the cover, use the software to send cutting data.



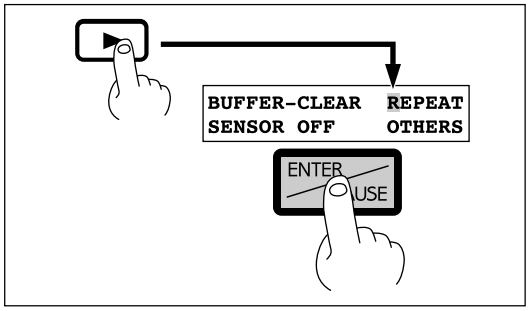
4 After cutting has finished, remove the cut material and load a new piece. Set the origin point if necessary.



5 Press the **[MENU]** key to make the following screen appear on the display.



6 Press the **[►]** key to move the blinking cursor ("▉") to "**REPEAT**," and then press the **[ENTER]** key.

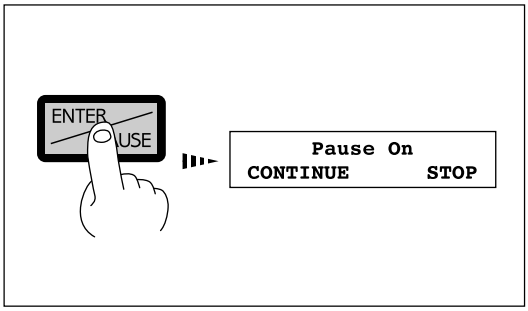


Changing the Feed Rate or Spindle Speed During Cutting

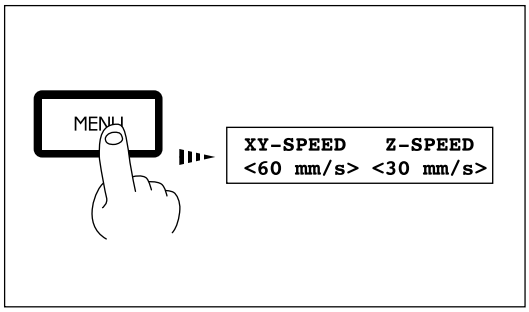
The feed rate and spindle rotating speed set by the software can be changed while cutting is in progress.
This is done by first pausing the PNC-300 during cutting, then changing the feed rate or spindle speed. However, if the computer subsequently sends a command to change the feed rate or spindle speed, the setting will change as specified by the new command. When set by software or set directly on the PNC-300, the setting made last takes precedence.

Changing the Feed Rate

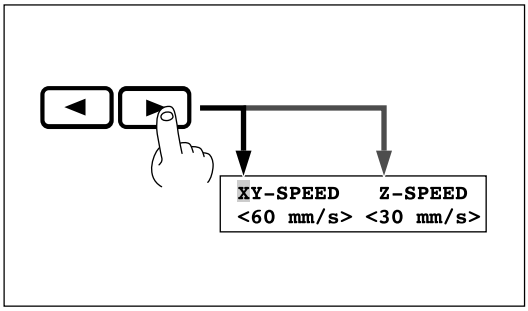
1 Press the **[ENTER/PAUSE]** key while cutting is in progress. One cutting step is performed, after which operation stops. The display changes to show the following message.



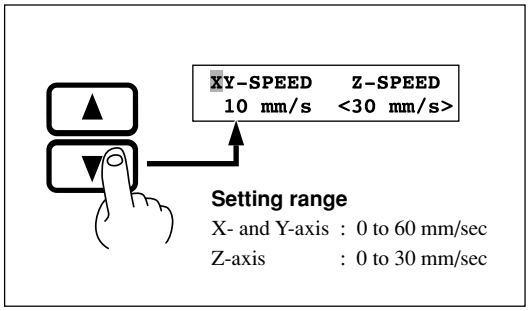
2 Press the **[MENU]** key to make the following screen appear on the display.



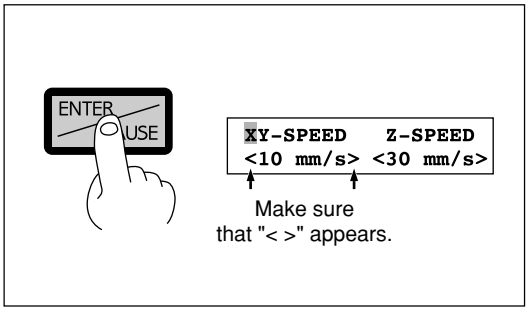
3 Press the **[◄]** or **[►]** key to move the blinking cursor ("**_**") to "**XY-SPEED**."
To set the lowering speed of the head, move the blinking cursor ("**_**") to "**Z-SPEED**."



4 Press the **[▲]** or **[▼]** key to set the feed rate.

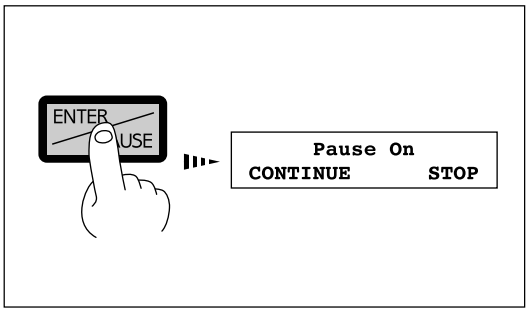


5 Press the **[ENTER]** key.

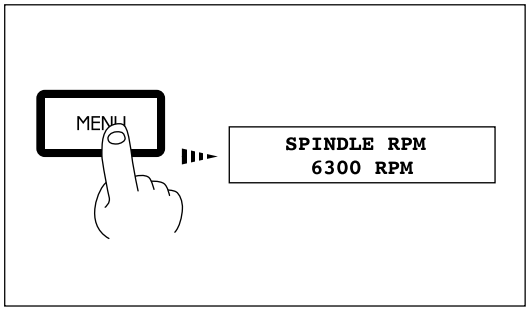


Changing the Spindle Speed

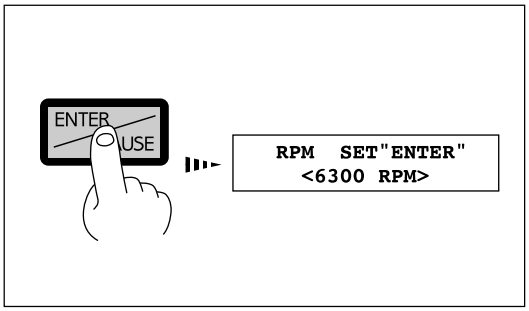
1 Press the **[ENTER/PAUSE]** key while cutting is in progress. One cutting step is performed, after which operation stops. The display changes to show the following message.



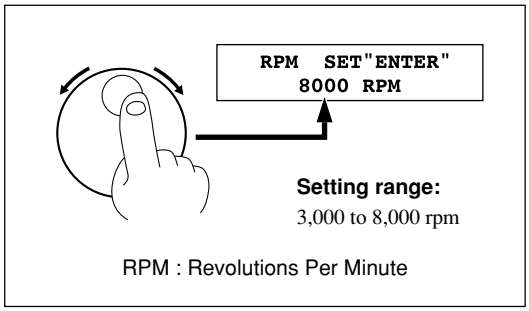
2 Press the **[MENU]** key to make the following screen appear on the display.



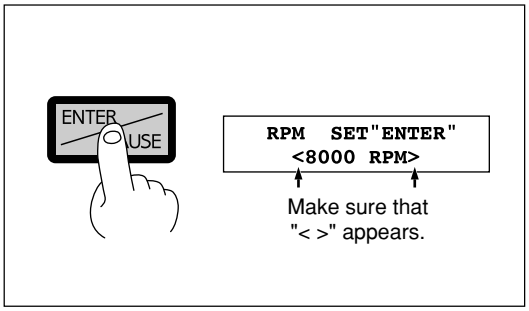
3 Press the **[ENTER]** key.



4 Use the jog handle to set the spindle speed.



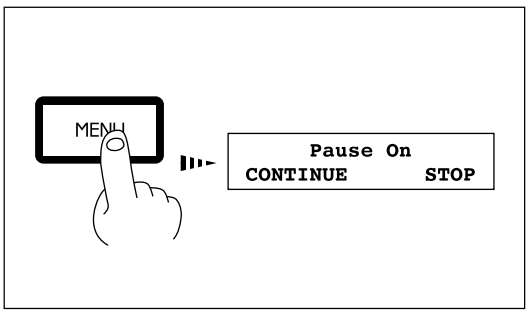
5 Press the **[ENTER]** key.



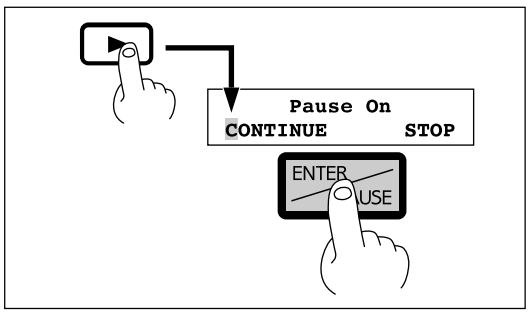
Canceling the Paused State to Resume Cutting

After changing the feed rate or spindle speed, cancel the paused state. Cutting then resumes at the new feed rate or spindle speed.

1 Press the **[MENU]** key to make the following screen appear on the display.



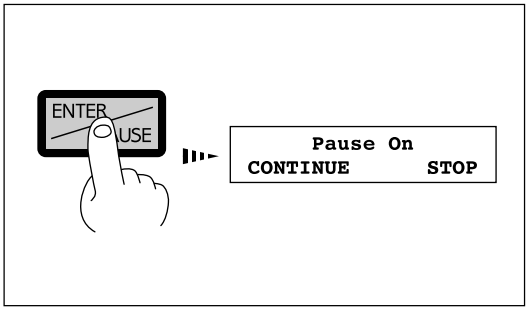
2 Press the **[►]** key to move the blinking cursor ("**▮**") to "**CONTINUE**," and then press the **[ENTER]** key.



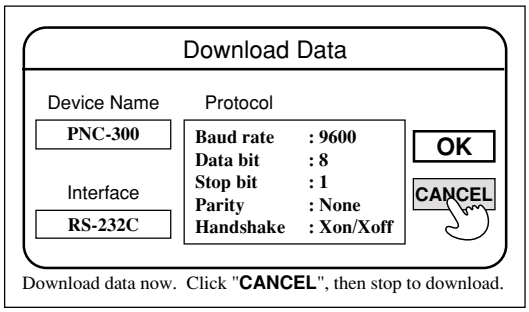
Stopping the Cutting Process

In the case that you begin cutting and then find that you have sent the wrong cutting data, perform the following operation.

1 Press the **[ENTER/PAUSE]** key while cutting is in progress. One cutting step is performed, after which operation stops. The display changes to show the following message.

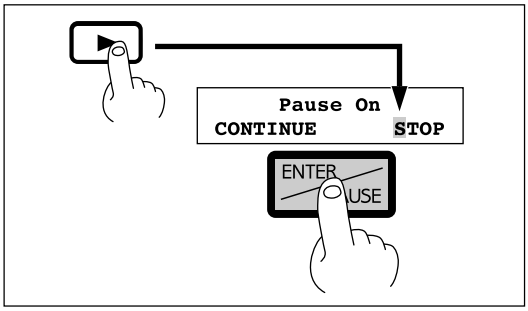


2 Use the software to stop data output.

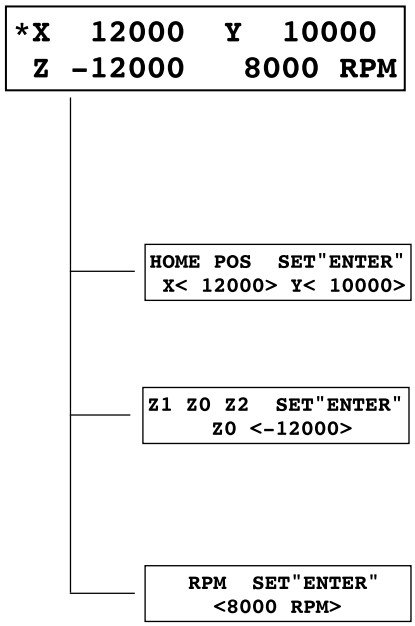


Download data now. Click "**CANCEL**", then stop to download.

3 Press the **[►]** key to move the blinking cursor ("**_**") to "**STOP**," and then press the **[ENTER]** key.



Explanation of the Display Menus

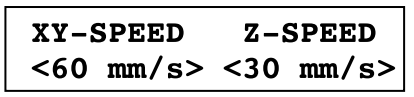


This shows the current position of the tool (in coordinates) and the spindle speed. The coordinate values indicate the home position as the origin point on the X and Y axes, and the Z0 point as the origin point on the Z axis. "**RPM**" is an abbreviations for "revolutions per minute."
It is possible to move from this menu to submenus for setting the X- and Y-axis origin point (home position), the Z-axis origin point (Z0), the tool-up position (Z2), the tool down position (Z1), and the spindle speed.

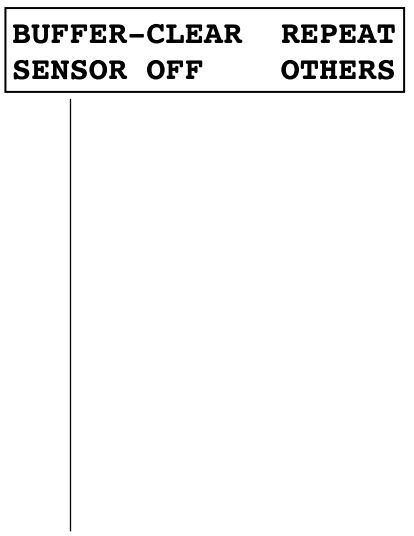
This sets the X- and Y-axis origin point (home position). Use the arrow keys to move the tool to the desired location for the home position, and press the **[ENTER]** key.
For details, see "Setting the Home Position" on page 10.

This sets the Z-axis origin point (Z0), tool-up position (Z2), and tool down position (Z1). Move the blinking cursor ("**_**") on the display to "**Z0**," "**Z1**," or "**Z2**," align the tip of the tool to the height to be set, then press the **[ENTER]** key.
For details, see " 8. Setting the Origin (Home Position and Z0)--Setting the Z0 Position--" or " 10. Setting the Z1 and Z2 Position" .

This sets the spindle speed. Turn the jog handle to set the desired speed.
For details, see "Spindle Motor Revolution Speed" on page 15.



This shows the X/Y-axis feed rate and the Z-axis feed rate.
Move the blinking cursor ("**_**") on the display to "**XY-SPEED**" or "**Z-SPEED**" use the **[▲]** or **[▼]** key to set the speed, and press the **[ENTER]** key.
For details, see " 9. Cutting Condition Setting--Feeding Speed--".



"**BUFFER-CLEAR**"
This deletes any cutting data stored in the data buffer.

"**REPEAT**"
This loads cutting data that is stored in the data buffer and performs cutting. This makes it possible to cut multiple copies of the same shape.
"**REPEAT**" is displayed only when the data buffer has been expanded to 1 MB.
For details, see "Operating Each Function --Performing Repeat Cutting--".

"**SENSOR OFF**"
This switches on a Z0 sensor connected to the PNC-300. "**SENSOR ON**" is displayed when the Z0 sensor is used to set the Z0 point.
For details, see " 8. Setting the Origin (Home Position and Z0)--Setting Z0 with the Z0 Position Sensor (Included with the Unit)--" .

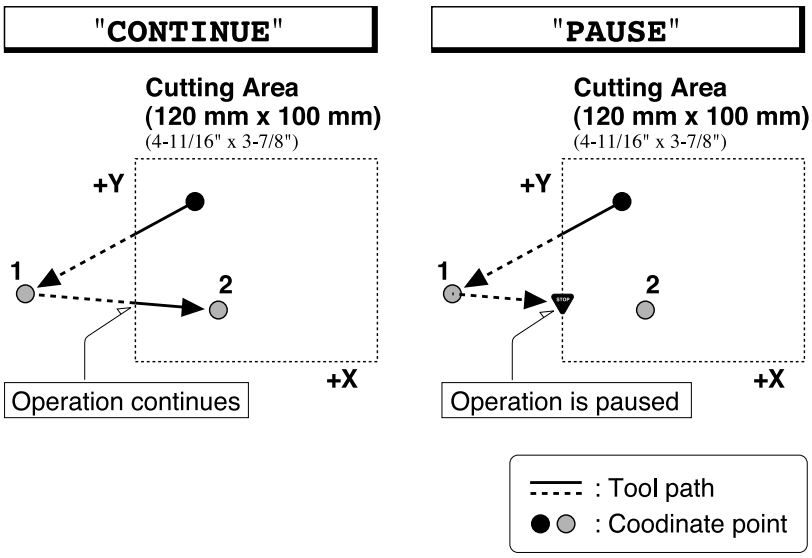
"**OTHERS**"
This switches to the submenu for setting communication parameters when a serial connection is used.

The submenus for "**OTHERS**" are described on the following page.

REVOLUTION OVER_AREA
<ON> <CONTINUE>

"**REVOLUTION**"
Default : ON
When set to "**OFF**," cutting can be performed without rotating the spindle.

"**OVER_AREA**"
Default : CONTINUE
This selects the action when the tool returns from a coordinate outside the cutting range to a coordinate inside the range. (The tool cannot actually be moved outside the cutting range, but the PNC-300's internal processing handles this as if it had.)
"**CONTINUE**" : Operation is not paused upon return to the cutting range. Cutting continues without interruption.
"**PAUSE**" : Operation is paused when the tool returns to the cutting range.



RESOLUTION Z0_MEMORY
<0.01 mm> <OFF>

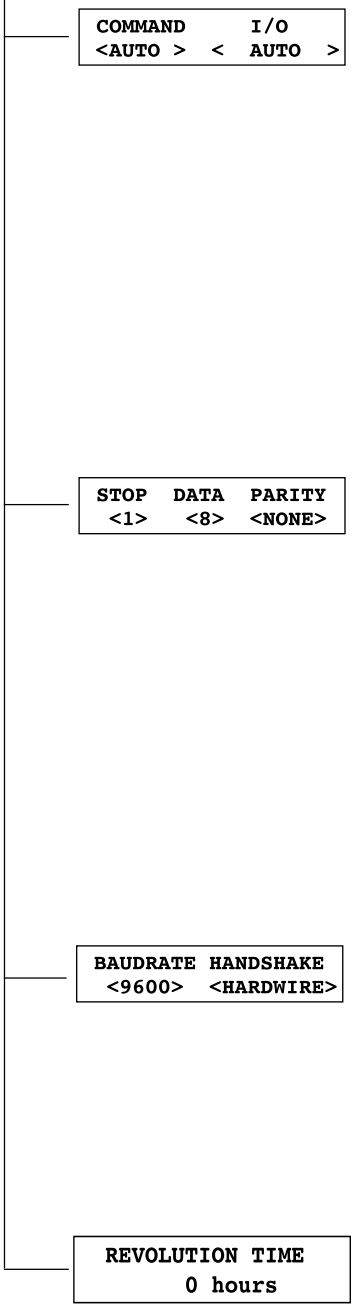
"**RESOLUTION**"
Default : 0.01 mm/step
This selects the unit used for coordinates. Either 0.01 mm/step or 0.025 mm/step can be selected.

"**Z0_MEMORY**"
Default : OFF
This toggles the Z0 point memory function on or off. When set to "**ON**," the Z0 point remains in memory even after the power is switched off.

SENSE_HEIGHT SMOOTH
< 8.00mm> <TYPE2>

"**SENSE_HEIGHT**"
Default : 8.00 mm/step
The thickness of the Z0 sensor can vary slightly due to conditions of temperature or humidity. This allows the sensor thickness to be adjusted to match actual thickness.

"**SMOOTH**"
Default : TYPE2
Smoothing is a function for cutting smooth arcs and circles. This selects the type of smoothing. Smoothing can also be switched off.
When shipped from the factory, the PNC-300 is set for "**TYPE 2**" smoothing. If arcs cannot be cut well using this setting, try changing it to "**TYPE 1**" or to "**OFF**."



"**COMMAND**"
Default : AUTO
This selects the instruction system for data sent from the computer. When set to "**AUTO**," the instruction system is determined automatically. If automatic determination is not made correctly, find out what instruction system the application software (or driver software) uses for data that is sent, and change this setting to "**MODE1**" or "**MODE2**." refer to the manual for the software to determine the instruction system of sent data.

"**I/O**"
Default : AUTO
This sets the type of interface connected to the computer. When set to "**AUTO**," the interface type (parallel or serial) is determined automatically. However, serial communication parameters (baud rate, parity checking, stop bit, data bit, and handshaking settings) are not determined and must be set.

"**STOP**"
Default : 1
This sets the number of stop bits when using a serial connection. Either 1 bit or 2 bits can be selected.

"**DATA**"
Default : 8
This sets the data bit length when using a serial connection. A length of either 7 bits or 8 bits can be selected.

"**PARITY**"
Default : NONE
This makes the setting for parity checking when using a serial connection. The available selections are no parity ("**NONE**"), even parity ("**EVEN**"), and odd parity ("**ODD**").

"**BAUDRATE**"
Default : 9600
This sets the baud rate when using a serial connection. The available selections are 9600, 4800, and 2400 bps.

"**HANDSHAKE**"
Default : HARDWIRE
This sets the handshaking mode when using a serial connection. Either hardwire handshaking or Xon/Xoff control can be selected.

This shows the rotation time of the spindle. The spindle rotation time cannot be returned to "0" (zero).
For details, see "Maintenance --Display of Spindle Rotation Time--" .

Maintenance

NOTICE

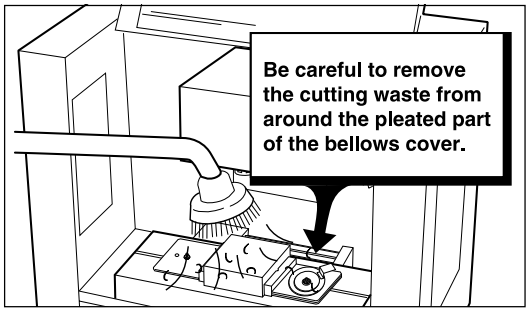
When cleaning the PNC-300, make sure that the main unit's power OFF.

Cleaning the Main Unit

When the main unit becomes dirty, use a dry cloth to wipe it.

Cleaning After Operation

After cutting work is completed, use a vacuum cleaner to clean the PNC-300 main unit and the surrounding area of cutting dust. Be especially careful to remove the cutting waste from around the pleated part of the bellows cover. If necessary, move the XY table to the front and rear, and clean the entire cover. Except when moving the XY table, carry out all cleaning work with the PNC-300's power OFF.



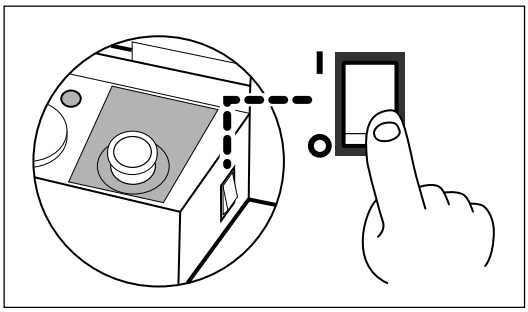
NOTICE

Do not use a compressed air for such cleaning. Cutting chips in the air may attach to a portion of the machine and cause malfunctions or breakdowns.

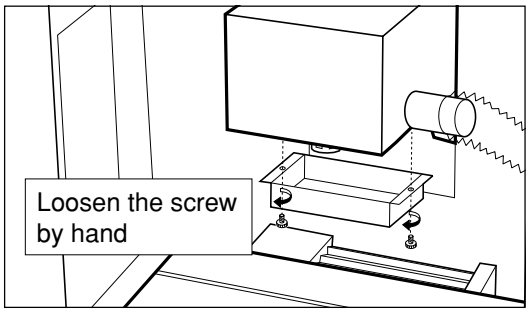
Replacing the Motor Brushes

The brushes for the spindle motor should be replaced periodically. As a general guide, replacement after every 1,000 hours of spindle rotation is suggested. For an explanation of how to check the spindle rotation time, see "Display of Spindle Rotation Time" on page 31.

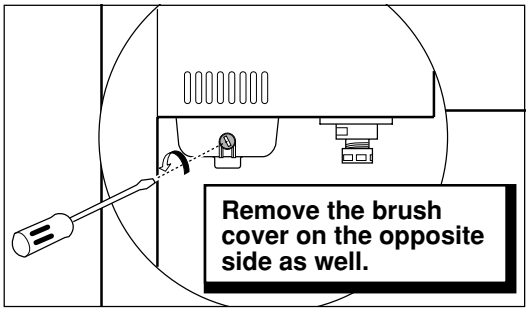
1 Turn the power OFF.



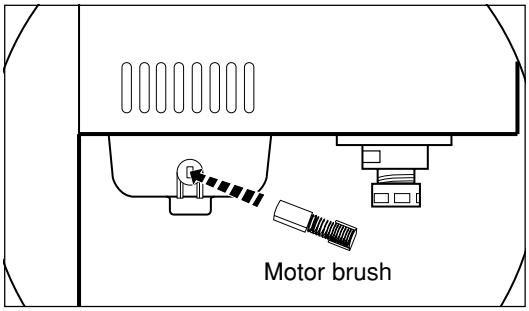
2 Loosen the screws under the head and remove the spindle cover.



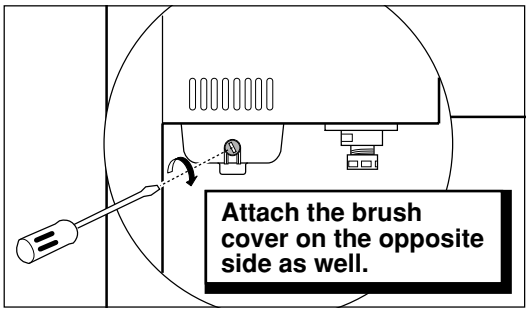
3 Use a commercially available flathead screwdriver to remove the right and left brush covers.



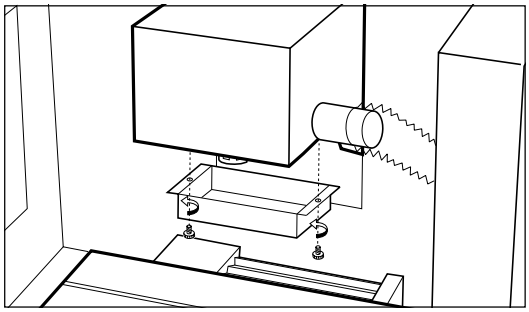
4 Remove the old motor brush and replace with a new one.



5 Reattach the brush covers.



6 Reattach the spindle cover.



Included with the PNC-300 are two motor brushes (one set) which can be used the first time the motor brushes are replaced. Contact Roland DG Corp. when replacing for the second time or after.

The above three cleaning operations are the only maintenance procedures that the customer needs to perform. Oil supply and other maintenance are not required.

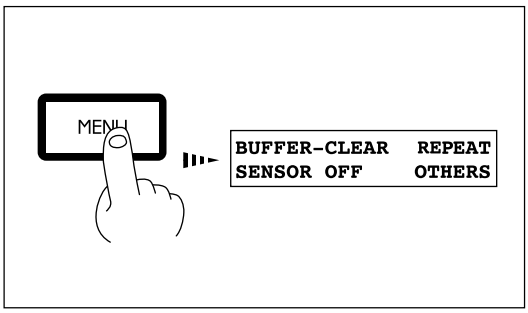
Checking the Spindle Motor

Operate the spindle motor alone, with no tool installed or material loaded. If the rotation speed is uneven or marked noise is produced, be sure to contact a service technician.

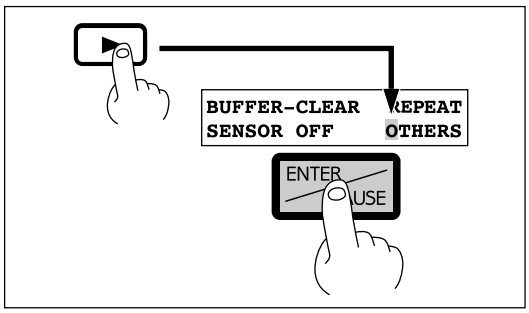
Display of Spindle Rotation Time

The PNC-300 has a function for the displaying the total rotation time of the spindle. The service life of the unit can be extended by carrying out periodic inspection. As a general guide, this inspection should be performed after every 500 hours of use.

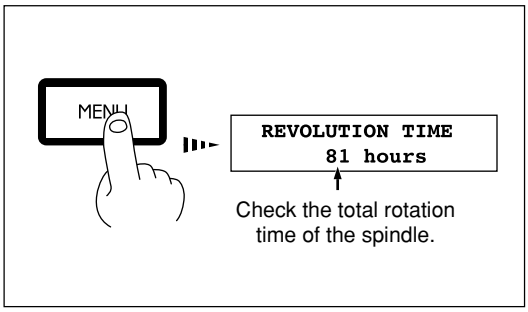
1 Press the **[MENU]** key to make the following screen appear on the display.



2 Press the **[►]** key to move the blinking cursor ("▉") to "**OTHERS**," and then press the **[ENTER]** key.



3 Press the **[MENU]** key to make the following screen appear on the display.



Recommended Service Checking

The PNC-300 is a precision machine. In order to maintain it safely for operation over the long term, we recommend that it should be checked by a qualified serviceman. There is a charge for this service. Please take note of this in advance.

Maintenance to Be Performed by a Service Technician

- Inspection and maintenance at every 500 hours of spindle rotation time (refer to “Display of Spindle Rotation Time”)
- Checking and adjustment of the spindle belt
- Replacement of consumable parts (spindle belt, spindle motor, and spindle unit)

Troubleshooting

When the PNC-300 does not work...

Is the cover open?	The PNC-300 will not operate when the cover is open. Close the cover and try again.
Is operation paused?	Cancel the paused state. For details, see "Canceling the Paused State to Resume Cutting".
Do the PNC-300's connection parameter settings match the settings for the computer?	Refer to "Setting the Connection Parameters" to make the correct settings.
Is the power for the PNC-300 switched on? Has the connection cable come loose?	Make sure the PNC-300 is powered up. Make sure the connection cable is plugged in securely with no looseness at either end.
Is the correct connection cable being used?	The type of connection cable varies according to the computer being used. Also, some application software requires the use of a special cable. Make sure the correct cable is being used.
Is the correct output device set for the application or driver software?	Refer to the manual for the application or driver software to set the output device correctly.

When the spindle does not rotate ...

Is "**REVOLUTION**" set to "**OFF**?"	If "**REVOLUTION**" is set to "**OFF**," the spindle will cut without rotating. Refer to " Explanation of the Display Menus" and change the setting for "**REVOLUTION**" to "**ON**."

The power does not come on...

Is the EMERGENCY STOP switch set to STOP (◯)?	If the EMERGENCY STOP switch has been depressed, the power will not come on when the power switch is turned on. Refer to " 2. Part Names and Functions" to set the EMERGENCY STOP switch to RELEASE (▏).
Has the power cord come loose?	Make sure the power cord is plugged in securely with no looseness at either end.

Error Messages

An error message will appear if incoming data has any of the errors listed in table. Since the error is shown in the display for informational purposes, the data transfer continues and you are allowed to perform the next operation.
To get the error message to go away, press the **[MENU]** key.
Note that even though the error message is no longer displayed after you press the **[MENU]** key, the PNC-300 will retain in memory the fact that the error occurred. To clear the error internally, you can give the default instruction, IN; or the error code output instruction, OE. (The error can be cleared by turning the power off.)

Error message	Meaning
`Err1: Command Not Recognized`	Appears if an instruction that the PNC-300 cannot interpret is sent. This error is generated if an instruction from the "mode2" set is sent when the unit has been set to recognize "mode1," or viceversa. Change the setting for the recognized instruction set, using the control panel, and this error should no longer occur.
`Err2: Wrong Number of Parameters`	Appears if the number of parameters differs from the permissible number.
`Err3: Bad Parameter`	Appears if the value specified for a parameter is out of the permissible range.
`Err5: Unknown Character Set`	Appears if an unusable character is specified.
`ESC.E Err10: Output Request Overlap`	Appears if an output instruction is sent from the computer during execution of a previous output instruction. More precisely, there is a certain amount of delay between the moment an output instruction is given and the instant actual output begins. This error message appears if the new output request arrives during this delay time. (The delay time can be set using the [ESC].M instruction.)
`ESC.E Err11: Command Not Recognized`	Appears if a device control instruction that the PNC-300 cannot interpret is sent.
`ESC.E Err12: Wrong Parameter`	Appears if an invalid parameter has been specified for a device control instruction.
`ESC.E Err13: Out of Parameter range`	Appears if the value for a device control instruction parameter exceeds the permissible limit.
`ESC.E Err14: Termination Error`	Appears if the number of parameters for a device control instruction is more than that permissible.
`ESC.E Err15: Framing/Parity Error`	Appears if a framing error, parity error, or overrun error occurs at the time of data reception. (There is a problem with one of these settings: Baud Rate, Parity, Stop Bits, or Data Bits. The protocol settings for the PNC-300 must be made correctly in order to match the settings your computer is set to use.)
`ESC.E Err16: Buffer Overflow`	Appears if the I/O buffer has overflowed. (There is a problem with the connecting cable, or the settings for Handshaking. Make sure you are using a cable appropriate for the computer being used. Also, check that the setting for Handshaking is correct.)
`ESC.E Err18: Indeterminate Error`	Appears if a communication error other than "`Err10`" through "`Err16`", one uninterpretable by the PNC-300, occurs during data communications.

Other Messages

Besides error messages related to commands or communication parameters, the following messages may also appear on the display.

Message	Meaning
CAN'T REPEAT TOO BIG REPEAT DATA	This message appears if repeat cutting is attempted when the cutting data exceeds 1 MB. The data cannot all fit in the PNC-300's data buffer, so repeat cutting cannot be performed. The display can be cleared by pressing the **[MENU]** key.
CAN'T REPEAT COVER OPEN	This message appears if cutting is attempted while the cover is open. The display can be cleared by pressing the **[MENU]** key.
CAN'T REPEAT REPLOT DATA EMPTY	This message appears if repeat cutting is attempted when the data buffer is empty. Send cutting data before performing repeat cutting. The display can be cleared by pressing the **[MENU]** key.
EMERGENCY STOP SPINDLE MOTOR LOCK	The PNC-300 stops automatically if an excessive load is placed on the spindle during cutting. The message shown at right appears at this time. The overload may be due to excessive hardness of the material, an excessive amount of cutting, or a feed rate that is too fast. Investigate the problem and eliminate the cause of the overload. The error can be cancelled by switching the power to the unit off and then on again.
EMERGENCY STOP COVER OPEN	If the cover is opened during cutting, an emergency stop is performed and this message appears. All cutting data stored in the PNC-300 is deleted, and cutting cannot be continued. If this message appears, stop sending data from the computer. Switch the power off and back on again to cancel the error.
CHECK Z0 POSITION SENSOR JACK	This message appears if the connector terminal for the Z0 sensor starts to come loose from the unit. The message disappears and the error is canceled by completely detaching the Z0 sensor terminal from the unit, or by inserting the terminal securely to obtain a stable connection.

List of CAMM-GL I Instructions

* 1 : $-(2^{26}-1)$—$+(2^{26}-1)$
* 2 : 0—$+(2^{26}-1)$
* 3 : $-(2^{26}-1)°$—$+(2^{26}-1)°$

A "CAMM-GL I Programmer's Manual" is available for separate purchase for those wishing to create their own programs for this machine. For further information, please contact the nearest Roland DG Corp. dealer or distributor.

mode1

Instruction	Com.	Format	Parameter		Range [Default]
@ Input Z1 & Z2	O	@ Z1, Z2	Z1	Position on Z1	-12000—0 [0]
			Z2	Position on Z2	0—+12000 [0]
H Home	O	H	None		
D Draw	O	D x1, y1, x2, y2, ... , xn, yn	xn, yn	Absolute coordinate	* 1
M Move	O	M x1, y1, x2, y2, ... , xn, yn	xn, yn	Absolute coordinate	* 1
I Relative Draw	O	I Δx1, Δy1, Δx2, Δy2, ... , Δxn, Δyn	Δxn, Δyn	Relative coordinate	* 1
R Relative Move	O	R Δx1, Δy1, Δx2, Δy2, ... , Δxn, Δyn	Δxn, Δyn	Relative coordinate	* 1
L Line Type	O	L p	p	Line pattern	-5—+5 [Solid line]
B Line Scale	O	B l	l	Pitch length	* 2 [1.5% of (P2-P1)]
X Axis	O	X p, q, r	p	Coordinate axis	0, 1
			q	Tick interval	* 1
			r	Repeat number	1—32767
P Print	O	P c1c2.....cn	cn	Character string	
S Alpha Scale	O	S n	n	Character size	0—127 [3]
Q Alpha Rotate	O	Q n	n	Rotation angle	0—3 [0]
N Mark	O	N n	n	Number of special symbol	1—15
U User	O	U n	n		1 or 2 [1]
C Circle	O	C x, y, r, Ø1, Ø2 (, Ød)	x, y	Center coordinate	* 1
			r	Radius	* 1
			Ø1	Start angle	* 3
			Ø2	Completion angle	* 3
			Ød	Resolution	* 3 [5°]
E Relative Circle	O	E r, Ø1, Ø2 (, Ød)	r	Radius	* 1
			Ø1	Start angle	* 3
			Ø2	Completion angle	* 3
			Ød	Resolution	* 3 [5°]
A Circle Center	O	A x, y	x, y	Center coordinate	* 1 [x=0, y=0]
G A + Circle	O	G r, Ø1, Ø2 (, Ød)	r	Radius	* 1
			Ø1	Start angle	* 3
			Ø2	Completion angle	* 3
			Ød	Resolution	* 3 [5°]
K A + %	O	K n, l1, l2	n	Angle of segment line	* 1
			l1	Length to end of segment line	* 1
			l2	Length to beginning of segment line	* 1
T Hatching	O	T n, x, y, d, t	n	Hatching pattern	0—3
			x, y	Length of rectangle side	* 1
			d	Intervals between hatching lines	* 1
			t	Hatching angle	1—4
Y Curve	O	Y m, x1, y1, x2, y2, ... , xn, yn	m		0—3
			xn, yn	Absolute coordinate	* 1
_ Relative Curve	O	_ m, Δx1, Δy1, Δx2, Δy2, ... , Δxn, Δyn	m	Open or closed curve	0—1
			Δxn, Δyn	Relative coordinate	* 1
V Velocity Z-axis	O	V f	f	Feed rate for Z axis	0—30 [mm/sec] [2 [mm/sec]]
F Velocity X,Y-axis	O	F f	f	Feed rate for X and Y axis	0—60 [mm/sec] [2 [mm/sec]]
Z XYZ Axis Simultaneous Feed	O	Z x1, y1, z1, ... , xn, yn, zn	xn, yn	XY coordinate	* 1
			zn	Z coordinate	* 1
O Output Coordinate	O	O	None		
W Dwell	O	W t	t	Dwell time	0—32767 [msec] [0 [msec]]
!	O	! n	n	Turns or stops the spindle motor	-32767—+32767 [0]
^ Call mode2	O	^ [mode2] [parameter] ..... [parameter] [;]			

mode2

Instruction	Com.	Format	Parameter		Range [Default]
AA Arc Absolute	O	AA x, y, Øc (, Ød);	x, y	Center coordinate	* 1
			Øc	Center angle	* 3
			Ød	Chord tolerance	* 1 [5°]
AR Arc Relative	O	AA Δx, Δy, Øc (, Ød);	Δx, Δy	Center coordinate	* 1
			Øc	Center angle	* 3
			Ød	Chord tolerance	* 1 [5°]
CA Alternate Character Set	O	CA n; CA	n	Character set No.	0—4, 6—9, 30—39 [0]

mode2

Instruction		Com.	Format	Parameter		Range [Default]
CI	Circle	O	CI r (, Ød) ;	r	Radius	* 1
				Ød	Chord tolerance	* 3 [5°]
CP	Character Plot	O	CP nx, ny ;	nx, ny	Number of character in X or Y-axis direction	* 1
			CP ;			* 1
CS	Standard Character Set	O	CS n;	n	Character set No.	0—4, 6—9, 30—39 [0]
			CS ;			
DF	Default	O	DF ;	None		
DI	Absolute Direction	O	DI run, rise ;	run	X-axis direction vector	-128—+128 [1]
			DI ;	rise	Y-axis direction vector	-128—+128 [0]
DR	Relative Direction	O	DR run, rise ;	run	X-axis direction vector	-128—+128 [1]
			DR ;	rise	Y-axis direction vector	-128—+128 [0]
DT	Defined Label Terminator	O	DT t ;	t	Label terminator	[[ETX] (03h)]
EA	Edge Rectangle Absolute	O	EA x, y ;	x, y	Absolute coordinates of rectangle	* 1
ER	Edge Rectangle Relative	O	ER Δx, Δy ;	Δx, Δy	Relative coordinates of rectangle	* 1
EW	Edge Wedge	O	EW r, Ø1, Øc (, Ød) ;	r	Radius	* 1
				Ø1	Start angle	* 3
				Øc	Center angle	* 3
				Ød	Chord tolerance	* 3 [5°]
FT	Fill Type	O	FT n (, d (,Ø)) ;	n	Pattern	1—5 [1]
			FT ;	d	Spacing	* 2 [1% of (P2x-P1x)]
				Ø	Angle	* 3 [0°]
IM	Input Mask	O	IM e ;	e	Error mask value	0—255 [223]
			IM ;			
IN	Initialize	O	IN ;	None		
IP	Input P1 & P2	O	IP P1x, P1y (, P2x, P2y) ;	P1x, P1y	XY coordinates of P1	* 1
				P2x, P2y	XY coordinates of P2	* 1
IW	Input Window	O	IW LLx, LLy, URx, URy ;	LLx, LLy	Lower left coordinates	* 1
				URx, URy	Upper right coordinates	* 1
LB	Label	O	LB c1c2.....cn [label terminator]	cn	Character string	
LT	Line Type	O	LT n (, l) ;	n	Pattern number	0—6 [Solid line]
			LT ;	l	1 pitch length	* 2 [%] [1.5 % of (P2-P1)]
OA	Output Actual Position	O	OA ;	None		
OC	Output Commanded Position	O	OC ;	None		
OE	Output Error	O	OE ;	None		
OF	Output Factor	O	OF ;	None		
OH	Output Hard-Clip Limits	O	OH ;	None		
OI	Output Identification	O	OI ;	None		
OO	Output Option Parameter	O	OO ;	None		
OP	Output P1 & P2	O	OP ;	None		
OS	Output Status	O	OS ;	None		
OW	Output Window	O	OW ;	None		
PA	Plot Absolute	O	PA x1, y1 (, x2, y2....., xn, yn) ;	xn, yn	Absolute XY coordinates	* 1
			PA ;			
PD	Pen Down	O	PD x1, y1 (, x2, y2....., xn, yn) ;	xn, yn	XY coordinates	* 1
			PD ;			
PR	Plot Relative	O	PR Δx1, Δy1 (, Δx2, Δy2....., Δxn, Δyn) ;	Δxn,Δyn	Relative XY coordinates	* 1
			PR ;			
PT	Pen Thickness	O	PT d ;	d	Tool width (diameter)	0—5 [mm] [0.3 [mm]]
			PT ;			
PU	Pen Up	O	PU x1, y1 (, x2, y2....., xn, yn) ;	xn, yn	XY coordinates	* 1
			PU ;			
RA	Shade Rectangle Absolute	O	RA x, y ;	x, y	Absolute coordinates of rectangle	* 1
RR	Shade Rectangle Relative	O	RR Δx,Δy ;	Δx,Δy	Relative coordinates of rectangle	* 1
SA	Select Alternate Set	O	SA ;	None		
SC	Scaling	O	SC Xmin, Xmax, Ymin, Ymax ;	Xmin, Ymin	User XY coordinates of P1	* 1
			SC ;	Xmax, Ymax	User XY coordinates of P2	* 1
SI	Absolute Character Size	O	SI w. h ;	w	Character width	-30—+30 [cm] [0.19 [cm]]
			SI ;	h	Character height	-30—+30 [cm] [0.27 [cm]]
SL	Character Slant	O	SL tanØ;	tanØ	Character slant	* 1 [0]
			SL ;			
SM	Symbol Mode	O	SM s ;	s	Character or symbol	21h—3A, 3C—7E
			SM ;			[Clears symbol mode]
SR	Relative Character Size	O	SR w, h ;	w	Character width	-128—+128 [%] [0.75 [%]]
			SR ;	h	Character height	-128—+128 [%] [1.5 [%]]
SS	Select Standard	O	SS ;			
TL	Tick Length	O	TL lp (, ln) ;	lp	Tick length in positive direction	-128—+128 [%] [0.5 [%]]
			TL ;	ln	Tick length in negative direction	-128—+128 [%] [0.5 [%]]
UC	User Defined Character	O	UC (c,) Δx1, Δy1 (,(c,) Δx2, Δy2...Δxn, Δyn) ;	c	Tool control value	—-99, +99—
			UC ;	Δxn,Δyn	Units of movement	-99<Δxn, Δyn<+99
VS	Velocity Select	O	VS s ;	s	Feed rate for X and Y axis	0—60 [mm/sec] [2 [mm/sec]]
			VS ;			
WG	Shade Wedge	O	WG r, Ø1, Øc (, Ød) ;	r	Radius	* 1
				Ø1	Start angle	* 3
				Øc	Center angle	* 3
				Ød	Chord tolerance	* 3 [5°]
XT	X-Tick	O	XT ;	None		
YT	Y-Tick	O	YT ;	None		

mode1, mode2 common instruction

Instruction		Com.	Format	Parameter		Range [Default]
!DW	Dwell	O	!DW t [terminator]	t	Dwell time	0—32767 [0]
!IO	Input Home Position	O	!IO x, y [terminator]	x, y	Coordinates of home position (designate by machine coordinate)	* 1
!MC	Motor Control	O	!MC n [terminator] !MC [terminator]	n	Motor ON/OFF switching	-32768—32767 [motor ON]
!NR	Not Ready	O	!NR [terminator]	None		
!OZ	Output Z-coordinate	O	!OZ [terminator]	None		
!PZ	Set Z1&Z2	O	!PZ z1 (, z2) [terminator]	z1 z2	Z1 coordinates Z2 coordinates	-12000—0 [0] 0—12000 [0]
!RC	Revolution Control	O	!RC n [terminator]	n	Spindle motor revolution speed	0—15 [Value set by using panel keys]
!VZ	Velocity select Z-axis	O	!VZ s [terminator]	s	Feed rate (Z axis)	0—30 [mm/sec] [2 [mm/sec]]
!ZM	XYZ Axis Simultaneous Feed	O	!ZM z [terminator]	z	Z coordinate	-12000—0
!ZO	Set Z0	O	!ZO z [terminator]	z	Z machine coordinate	-12000—0
!ZZ	Z	O	!ZZ x1, y1, z1, ... , xn, yn, zn [terminator]	xn, yn zn	XY coordinate Z coordinate	* 1 * 1

* 1 : $-(2^{26}-1)$—$+(2^{26}-1)$
* 2 : 0—$+(2^{26}-1)$
* 3 : $-(2^{26}-1)°$—$+(2^{26}-1)°$

Device Control Instructions

The Device Control instructions determine how communication between the PNC-300 and the computer will be handled using the RS-232C interface; and also are employed when relaying to the computer the status of the PNC-300. Some of them can be used to format the output for CAMM-GL I instructions.
A Device Control instruction is composed of three characters: ESC (1Bh), a ".", and an uppercase letter. There are also two types of device control instructions: one carries parameters and the other does not.
Parameters can be omitted. Semicolons, " ; " are used as separators between parameters. A semicolon without parameters means that parameters have been omitted. Device Control instructions with parameters require a terminator to indicate the conclusion of the instruction. A colon " : " is used as the terminator, and it must not be omitted.
No terminator is necessary for Device Control instructions without parameters.

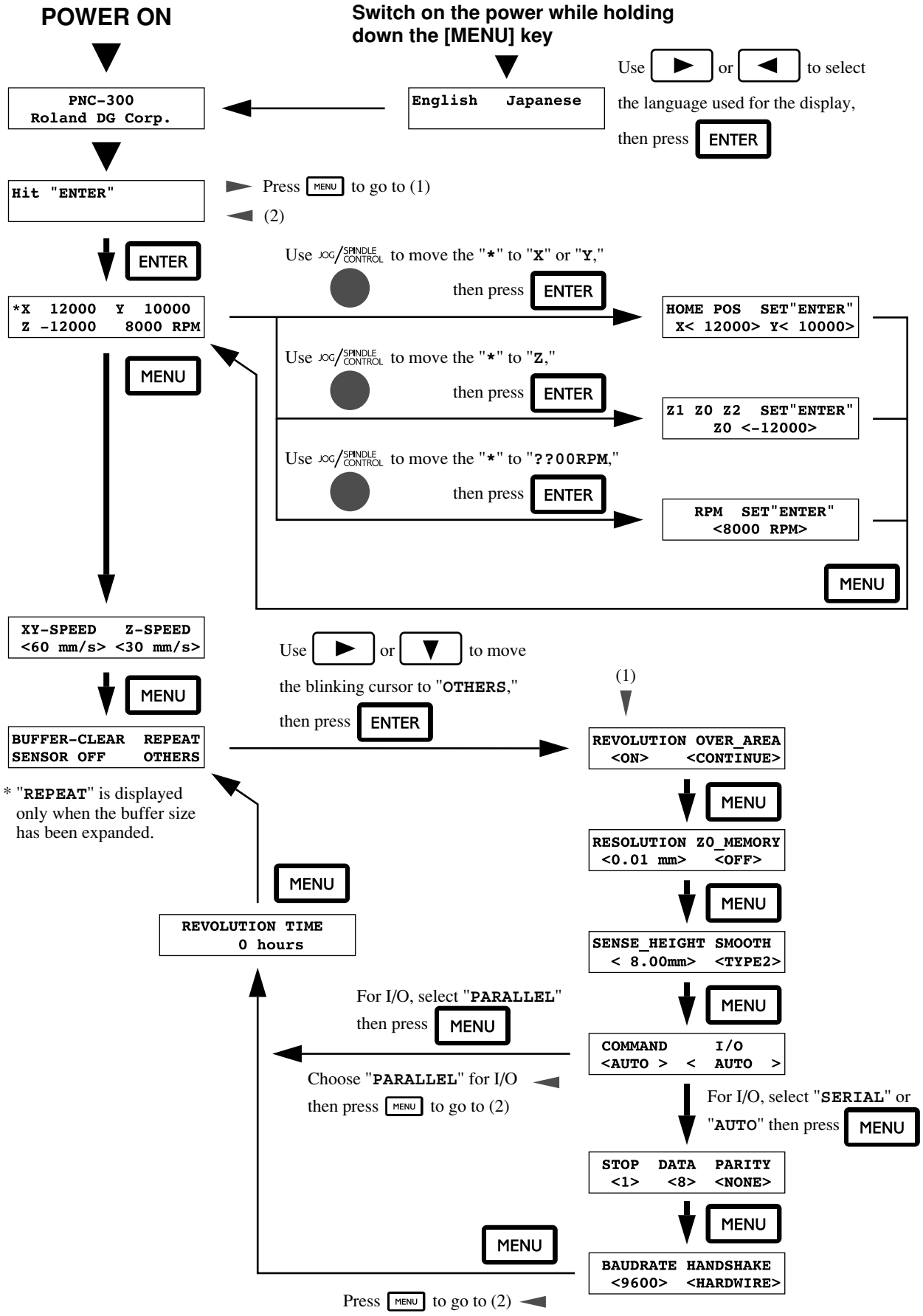
Instruction	Format	Parameter	Range ([ ] is default)	Explanation
Handshake Instructions				
ESC .B Output Remaining Buffer Capacity	[ESC].B:	None		Outputs the current remaining buffer capacity. Returns the login buffer size to the host computer until remaining capacity becomes below the logic buffer size set by the parameter <P1> of the [ESC].@ instruction.
ESC .M Set Handshake Output Specifications (1)	[ESC].M<P1>;<P2>;<P3>;<P4>;<P5>;<P6>:	P1 : Delay time P2 : Output trigger character P3 : Echo terminator P4 : Output terminator P5 : Output terminator P6 : Output initiator	0—32767(msec) [0(msec)] [0(Sets nothing)] [0(Sets nothing)] [13([CR])] [0(Sets nothing)] [0(Sets nothing)]	Sets handshake output specifications. Note:When you specify some values to <P4> and <P5>, always set 0 to <P6>. When you specify Sets an interchara-cter delay, and also an Xoff chara-
ESC .N Set Handshake Output Specifications (2)	[ESC].N<P1>;<P2>;<P3>;••••;<P11>:	P1 : Intercharacter delay data block P2—P11 : Xoff character (for Xon/Xoff) Immediate response character (for ENQ/ACK)	0—32767(msec) [0(msec)] [All 0(Sets nothing)]	Sets an intercharacter delay, and also an Xoff character for performing the Xon/Xoff handshake.
ESC .H Sets ENQ/ACK Handshake Mode1	[ESC].H<P1>;<P2>;<P3>;••••;<P12>:	P1 : The number of bytes for data block P2 : ENQ character P3—12 : ACK character (only when <P2> is set)	0—15358(byte) [80(byte)] [0(Sets nothing)] [All 0(Sets nothing)]	When receiving the ENQ character set by <P2>, compares the value set by <P1> and the remaining buffer capacity, and returns the ACK character to the host computer when the remaining buffer capacity is larger. The [ESC].H with no parameter performs a dummy handshake.

<table>
<tr><th>Instruction</th><th>Format</th><th>Parameter</th><th>Range ([ ] is default)</th><th>Explanation</th></tr>
<tr><td>ESC .I
Set Xon/Xoff Handshake and ENQ/ACK Handshake Mode2</td><td>[ESC].I<P1>;<P2>;
<P3> ;••••••••;<P12>:</td><td>P1 : Limit of the remaining buffer capacity (for Xon/Xoff)
The number of data block bytes (for ENQ/ACK (mode2))
P2 : ENQ character
(for ENQ/ACK (mode2))
:0 (for Xon/Xoff)
P3—P12
: Xon character (for Xon/Xoff)
ACK character
(for ENQ/ACK (mode2))</td><td>0—15358(byte) [80(byte)]

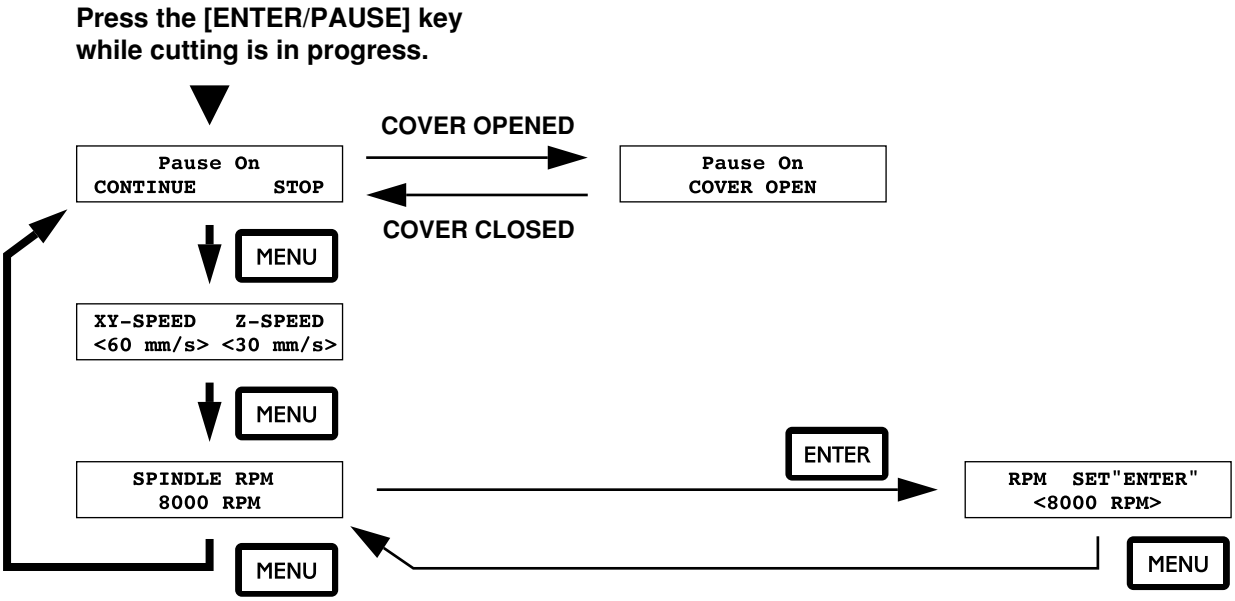
[0 (Set nothing)]

[All 0 (Set nothing)]</td><td>Used for performing the Xon/Xoff handshake and the ENQ/ACK handshake mode 2.
The [ESC].I instruction with no parameter performs a dummy handshake. In a dummy handshake, always returns the ACK character to the host computer, regardless of the remaining buffer capacity, when receiving the ENQ character.</td></tr>
<tr><td>ESC .@
Set Physical I/O Buffer and DTR control</td><td>[ESC].@<P1>;<P2>:</td><td>P1 : Physical I/O buffer
P2 : DTR signal control</td><td>0—1024 [1024]
0—255 [1]</td><td><P1> sets the I/O logic buffer device. 1024 will be set even if a larger number is designated. If <P2> is even value, the DTR signal will always be HIGH, and hardwire handshaking is not performed. If <P2> is odd value, hardwire handshaking is performed.</td></tr>
<tr><td colspan="5">Status Instruction</td></tr>
<tr><td>ESC .O
Output Status Word</td><td>[ESC].O:</td><td>None</td><td></td><td>Outputs the value that represents the status of buffer and pause. This value is shown in the table below.
<table><tr><th>Code</th><th>Status of buffer and pause</th></tr><tr><td>0</td><td>Buffer contains data.</td></tr><tr><td>8</td><td>Buffer empty.</td></tr><tr><td>16</td><td>Buffer contains data. PNC-300 paused.</td></tr><tr><td>24</td><td>Buffer empty. PNC-300 paused.</td></tr></table></td></tr>
<tr><td>ESC .E
Output RS-232C Error Code</td><td>[ESC].E</td><td>None</td><td></td><td>Outputs an error code related to RS-232C interface (see the table below), and clears the error simultaneously. At the same time, the error being displayed is canceled.
<table><tr><th>Error code</th><th>Meaning</th></tr><tr><td>0</td><td>No I/O errors</td></tr><tr><td>10</td><td>During an output instruction being executed, another output instruction is sent (only the current instruction is effective)</td></tr><tr><td>11</td><td>An error occurs in a device control instruction.</td></tr><tr><td>12</td><td>Incorrect parameters are set to a device control instruction (the default value is set to the erroneous parameter)</td></tr><tr><td>13</td><td>Parameters are overflowing</td></tr><tr><td>14</td><td>The number of the parameters set is more than specified or a colon ':' was not used to terminate</td></tr><tr><td>15</td><td>Framing error, parity error or over-run error at the time of data receipt</td></tr><tr><td>16</td><td>The I/O buffer overflows</td></tr></table></td></tr>
<tr><td>ESC .L
Output I/O buffer size</td><td>[ESC].L</td><td>None</td><td></td><td>Outputs the current logic size of the I/O buffer. Note that the output is done only when the I/O buffer is empty.</td></tr>
<tr><td colspan="5">Abort Instruction</td></tr>
<tr><td>ESC .J
Abort Device Cotrol Instruction</td><td>[ESC].J</td><td>None</td><td></td><td>Aborts both the currently executed device control instruction and output.</td></tr>
<tr><td>ESC .K
Abort CAMM-GLI Instruction</td><td>[ESC].K</td><td>None</td><td></td><td>After executing only the current CAMM-GLI instruction, clears the data buffer.</td></tr>
<tr><td>ESC .R
Initialize Device Control Instruction</td><td>[ESC].R</td><td>None</td><td></td><td>Initializes all settings established by the device control instructions.</td></tr>
</table>

Display Menus Flowchart



Menu Flowchart When Paused



Specifications

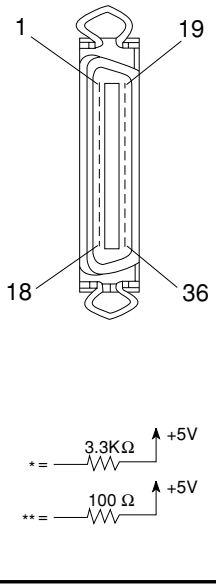
• Hardware Specification

	PNC-300
XY table size	320 mm x 120 mm (12-9/16" x 4-11/16")
Max. cutting area	120 mm (X) x 100 mm (Y) x 120 mm (Z) (4-11/16" (X) x 3-7/8" (Y) x 4-11/16" (Z))
Software resolution	0.01 mm/step (0.00039") or 0.025 mm/step (0.00098")
Mechanical resolution	X, Y-axis : 0.00125 mm/step (micro-step control) Z-axis : 0.01 mm/step
Feed rate	X, Y-axis : Max. 3.6 m/min. (11' 9-3/4"/min.) Z-axis : Max. 1.8 m/min. (5' 10-7/8"/min.) Minimum rate : 0.03 m/min. (1-3/16"/min.)
Spindle motor	26 W (DC motor)
Revolution speed	3000—8000 rpm (variable manually or via instruction)
Tool chuck	Collet system
Interface	Parallel (in compliance with the specification of Centronics) Serial (under RS-232C standard)
Buffer size	1 KB (expandable up to 1 MB)
Instruction system	CAMM-GL I (mode1, mode2)
Control keys	Z0, Z1, Z2, HOME, ENTER/PAUSE, MENU, SPINDLE TEST ON/OFF VIEW, ▲, ▼, ◄, ►, +Z, -Z, JOG/SPINDLE CONTROL, JOG HANDLE EMERGENCY STOP switch
Source	1.7 A / 117 V 1.0 A / 220—230 V 0.9 A / 240 V
Acoustic noise level	Cutting mode : under 60 dB (A) Stanby mode : under 55 dB (A) (According to ISO 7779)
External dimensions	496 mm (W) x 454 mm (H) x 528 mm (D) (height is 791 mm (31-3/16") when cover is open) (19-9/16" (W) x 17-7/8" (H) x 20-13/16" (D))
Weight	36 kg (79.4 lb.)
Operation temperature	5—40°C (41—104°F)
Operation humidity	35 %—80 % (no condensation)
Accessories	ø6 collet chuck, collet cap (these are installed on the unit), straight end mill (ø6), workpiece Z0 position sensor, motor brushes : 2, wrenches : 3 (10 mm, 19 mm, 24 mm each) machine vice, power cord, user's manual, Roland Software Package CD-ROM

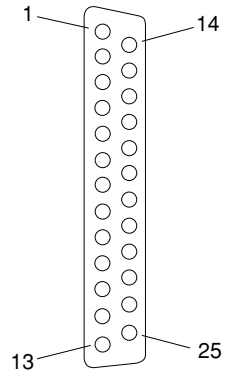
• Interface Specification

[Parallel]	
Standard	In compliance with the specification of Centronics
Input signal	$\overline{\text{STROBE}}$(1BIT), DATA(8BIT)
Output signal	BUSY(1BIT), $\overline{\text{ACK}}$(1BIT)
I/O signal level	TTL level
Transmission method	Asynchronous
[Serial]	
Standard	RS-232C specification
Transmission method	Asynchronous, duplex data transmission
Transmission speed	2400, 4800, 9600 (Selected using panel keys.)
Parity check	Odd, Even, None (Selected using panel keys.)
Data bits	7 or 8 bits (Selected using panel keys.)
Stop bits	1 or 2 bits (Selected using panel keys.)

Parallel connector (in compliance with specifications of Centronics)

Signal number	Terminal number		Signal number	Pin Connection
NC	36	18	HIGH**	
HIGH*	35	17	GND	
NC	34	16	GND	
GND	33	15	NC	
HIGH*	32	14	NC	
NC	31	13	HIGH*	
GND	30	12	GND	
	29	11	BUSY	
	28	10	$\overline{\text{ACK}}$	
	27	9	D7	
	26	8	D6	
	25	7	D5	
	24	6	D4	
	23	5	D3	
	22	4	D2	
	21	3	D1	
	20	2	D0	
	19	1	$\overline{\text{STROBE}}$	

Serial connector (RS-232C)

Signal number	Terminal number		Signal number	Pin Connection
NC	25	13	NC	
NC	24	12	NC	
NC	23	11	NC	
NC	22	10	NC	
NC	21	9	NC	
DTR	20	8	NC	
NC	19	7	SG	
NC	18	6	DSR	
NC	17	5	CTS	
NC	16	4	RTS	
NC	15	3	RXD	
NC	14	2	TXD	
		1	FG	

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