Roland

CAMM-3
by ROLAND DIGITAL GROUP

# MODEL PNC-3100

## User's Manual

Thank you very much for purchasing the CAMM-3 Model PNC-3100.

- 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 A digital device, pursuant to Part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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 A NOTICE**

This digital apparatus does not exceed the Class A limits for radio noise emissions set out in the Radio Interference Regulations of the Canadian Department of Communications.

**CLASSE A AVIS**

Ce produit numérique ne dépasse pas les limites de la classe A au niveau des émissions de bruits radioélectriques fixés dans le Réglement des signaux parasites par le ministère canadien des Communications.

# Table of Contents

# 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

Installation, basic operation, and the procedures to follow when finished cutting are explained here.  Please read this section if you are using the PNC-3100 for the first time.

## Part 2  User's Reference

Usage of the PNC-3100'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.

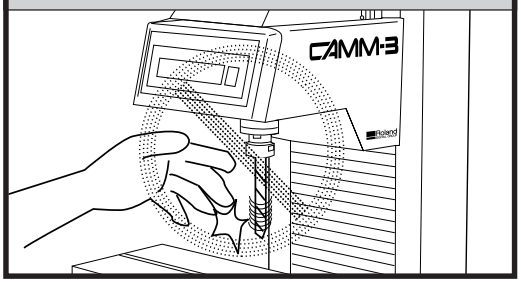
⚠ This indicates a point requiring particular care to ensure safe use of the product.

| | |
|---|---|
| ⚠ **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. |

# ⚠ To Ensure Safe Use

### ⚠ WARNING

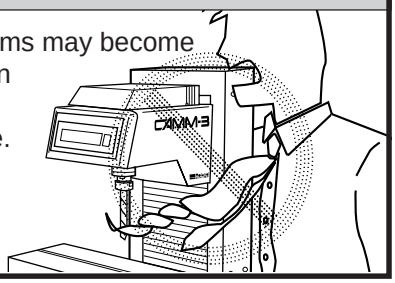
**Keep hands away from moving spindle.**




### ⚠ WARNING

**Do not wear gloves, a necktie or wide-sleeved clothing.**

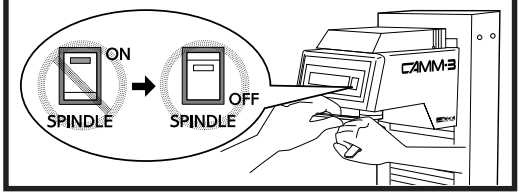
Such items may become caught in the machine.




### ⚠ WARNING

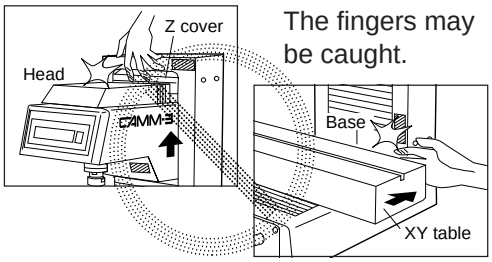
**Switch off spindle before attempting to access it.**

Switch off the spindle before mounting or removing a tool, and before cleaning. Sudden movement of the spindle may occur otherwise.



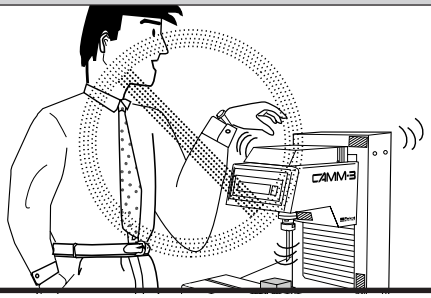

### ⚠ WARNING

**Do not insert the fingers between the XY table and base or between the head and Z cover.**



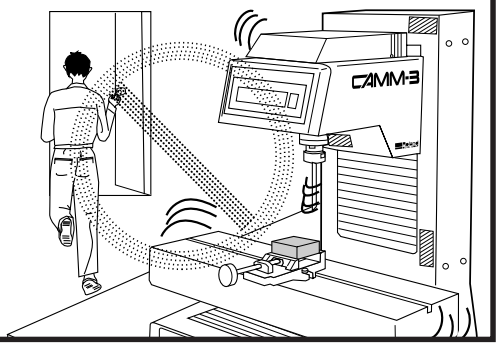

### ⚠ WARNING

**Do not allow persons with no knowledge of the CAMM-3 near the machine.**




### ⚠ WARNING

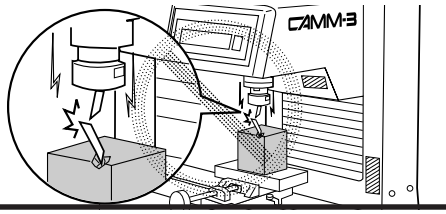
**Do not leave the CAMM-3 unattended during operation.**



## ⚠ WARNING

**Do not operate beyond capacity or subject the tool to undue force.**

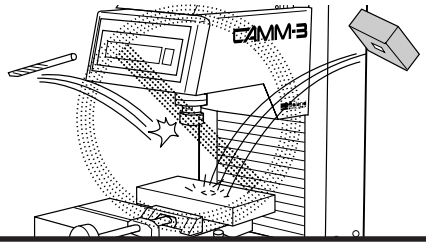
The tool may break or fly off in a random direction. If machining operation beyond capacity is started inadvertently, immediately switch off the power.




## ⚠ WARNING

**Fasten the tool and material securely in place.**

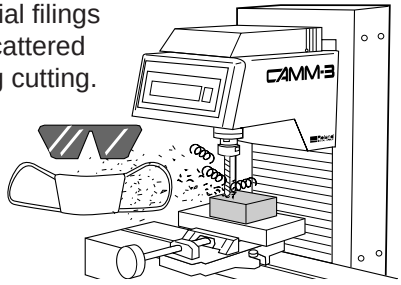
This items may come loose during cutting and fly off in a random direction.




## ⚠ WARNING

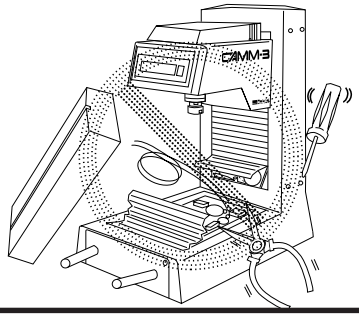
**Wear dust goggles and mask during use.**

Material filings are scattered during cutting.




## ⚠ WARNING

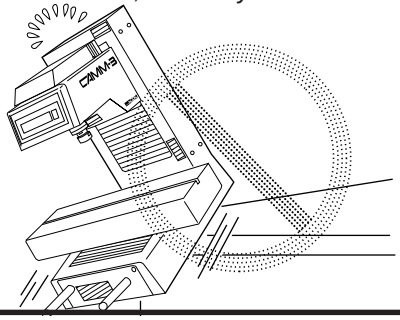
**Do not disassemble or remodel the machine.**




## ⚠ WARNING

**Do not install in an unstable or high location.**

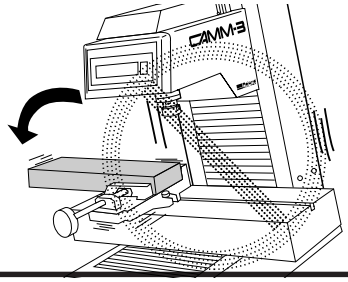
Do not installation the machine on the edge of a table, or it may fall.




## ⚠ WARNING

**Be aware of the center of gravity.**

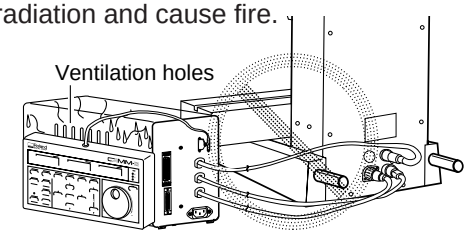
Do not attach the machine vise or material too far to either side of the XY table, or the machine may tip over.



## ⚠ CAUTION

**Do not block the ventilation holes.**

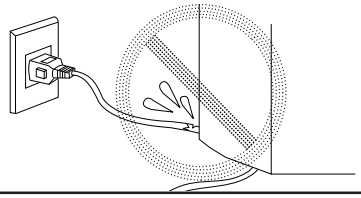
Blocking the ventilation holes at the rear of the controller may prevent heat radiation and cause fire.




## ⚠ CAUTION

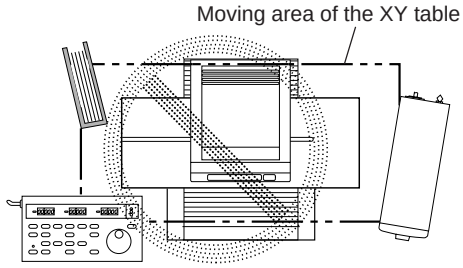
**Handle the power cord with care.**

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

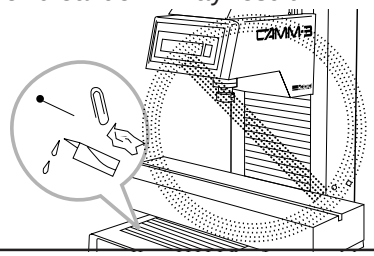
**Do not place anything within the moving area of the XY table.**




## ⚠ CAUTION

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

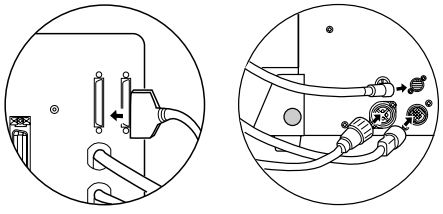
Fire or breakdown may result.



## ⚠ CAUTION

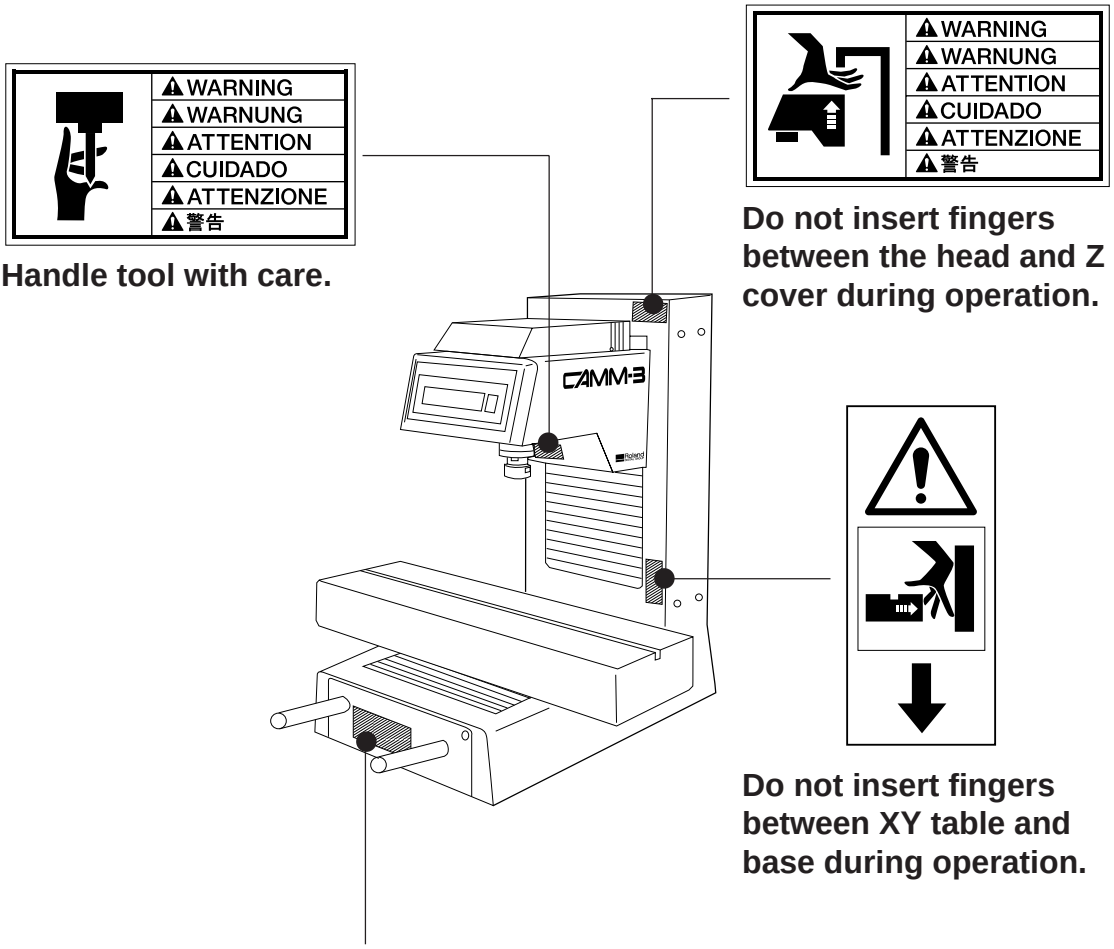
**Connect the main unit, controller, and switch panel correctly and completely.**

The head may descend rapidly if the power is switched on before all connections are made.



## About the Warning Labels Affixed to the Unit

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



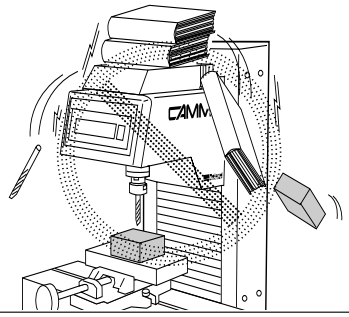


**Do not place anything within the moving area of the XY TABLE.**

## To Ensure Correct Use

NOTICE

Never pile things up on head of the PNC-3100. This can be very dangerous because of the possibility of vibration during operation.



# Part 1

# StartUp

## 1. Conditions for Installation

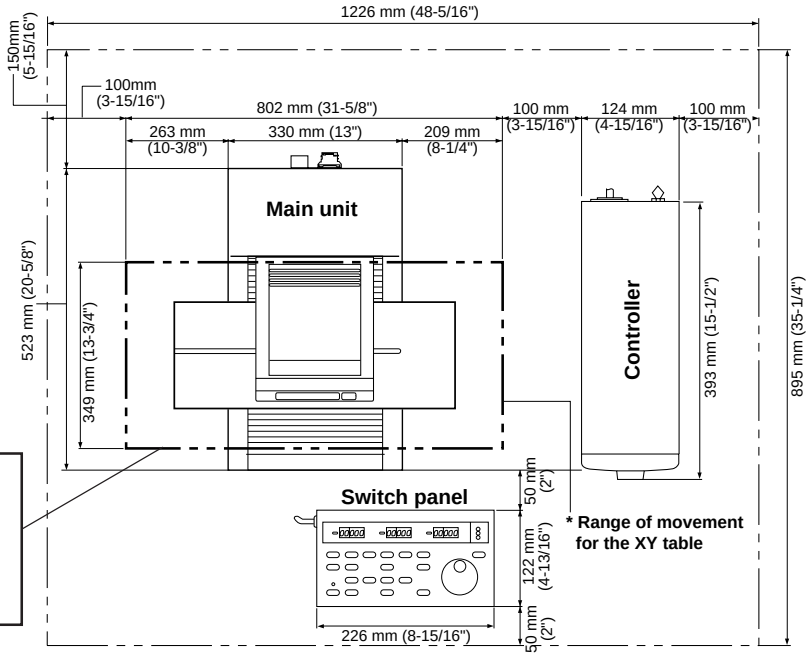
**⚠ WARNING**

Do not install the machine in a location where it may tip over, such as at the edge of a table.

NOTICE

- Install the machine on a stable stand for operation.
- Use within a temperature range of 5 to 40°C (41 to 104°F) and within a humidity range of 35 to 80%.
- Avoid installing the PNC-3100 in the following locations, as this may result in damage to the machine.
  - Avoid places subject to strong electrical noise.
  - Avoid excessively dusty or damp places.
  - The PNC-3100 generates heat during operation, so avoid poorly ventilated places.
  - Avoid places where strong vibration is likely to affect the machine.
  - Avoid places exposed to strong direct sunlight.

The space shown in the figure is required for installation.




**⚠ CAUTION**

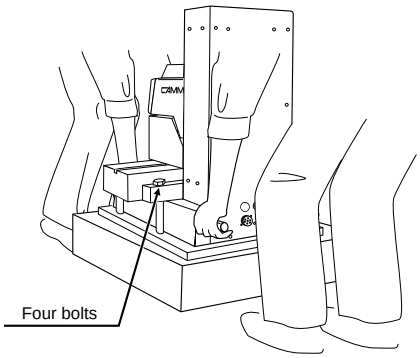
Do not place anything within the moving area of the XY table.

# 2. Removing the PNC-3100 from the Carton

**⚠ CAUTION**

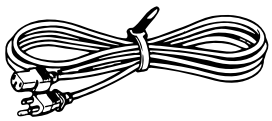
Two or more people are needed to take the PNC-3100 out of the carton.
The main unit weighs 52 kg (114.6 lb.), and the controller weighs 9 kg (19.8 lb.). For this reason, extreme care should be taken to avoid injury when installing.

Remove all packing material, except for the packing material underneath the main unit.
A securing board is attached to the unit. Use the 17 mm spanner included with the unit to remove the four bolts and detach the board. With one person grasping the carrying bars at the front of the unit, and the other person grasping the carrying bars at the rear, lift the unit straight up.
Gently set the unit down at the pre-determined site where the unit is to be installed.
Remove the controller from the box and set in place.

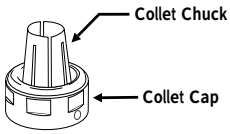



# 3. Checking Accessories

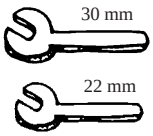
**Power Code**



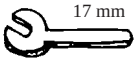
**Collet Chuck (ø6) and Collet Cap**
(Installed on the spindle.)



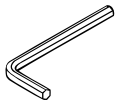

**Spanners**
(For tool attachment)



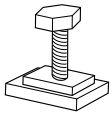

**Spanner**
(For removal of the securing board)



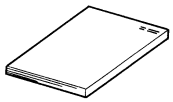

**Hexagonal Wrench : 2**



**T nuts : 2**
(For installing the work attachment)

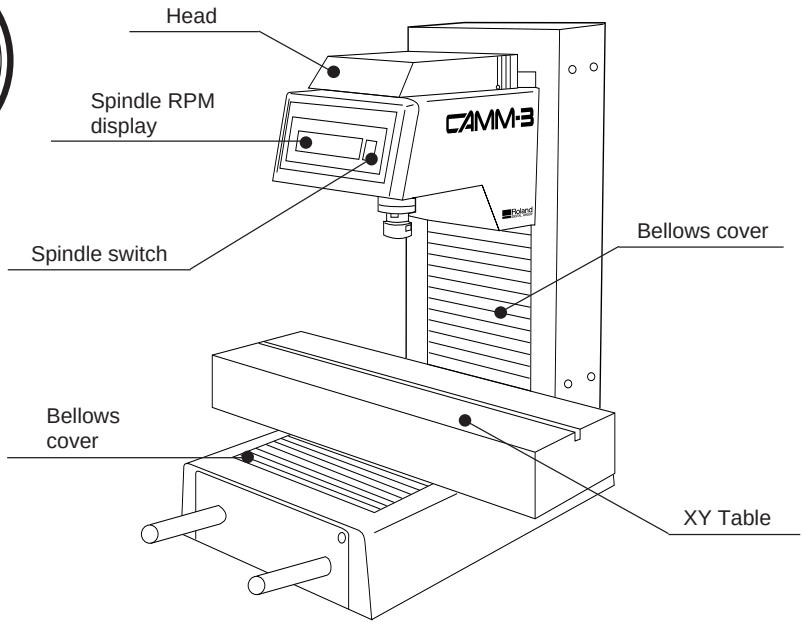


**User's Manual**

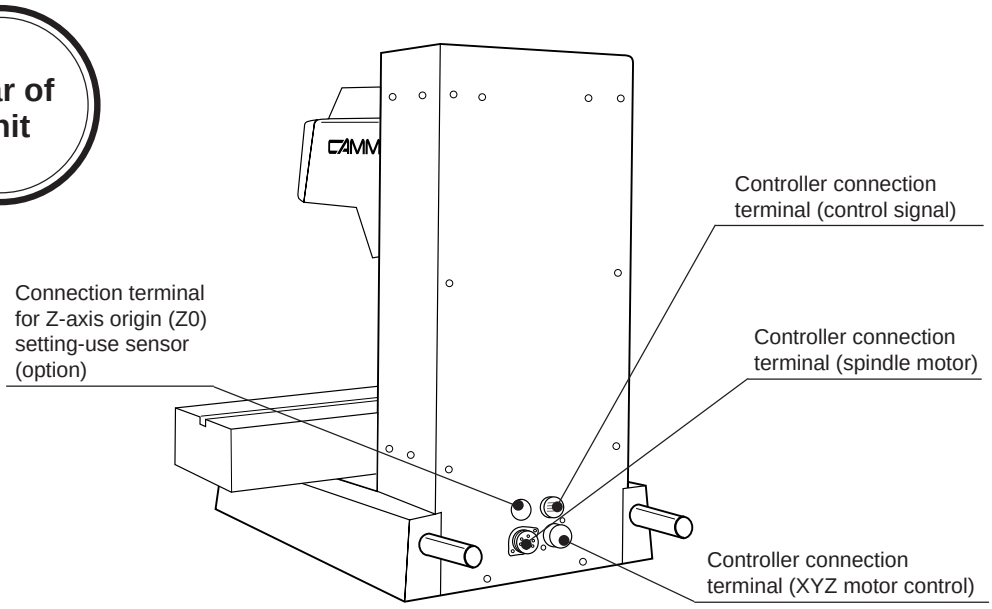


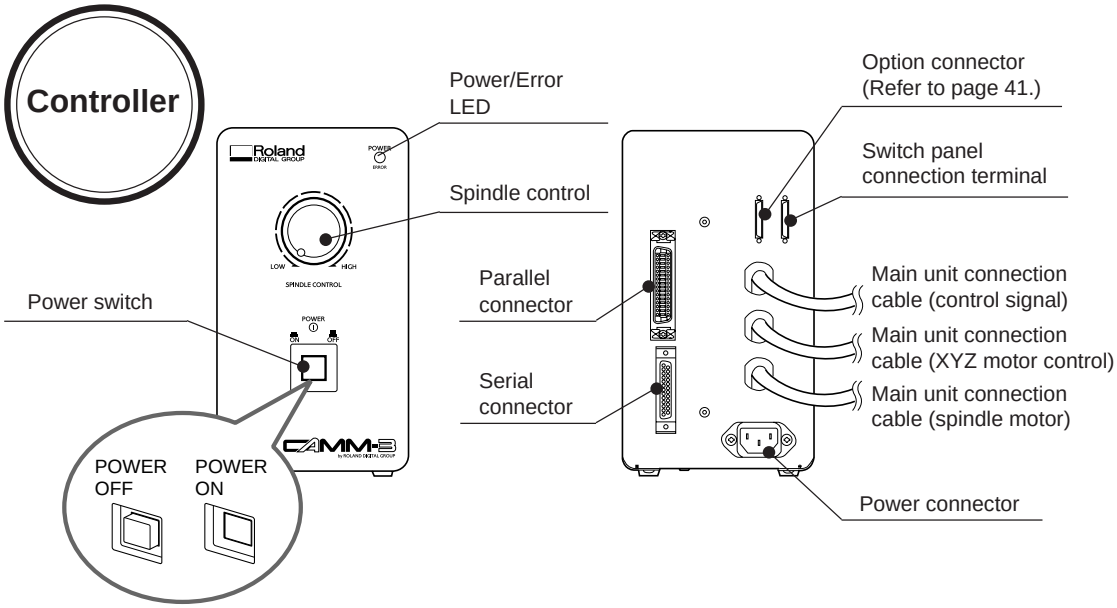
# 4. Names of Parts

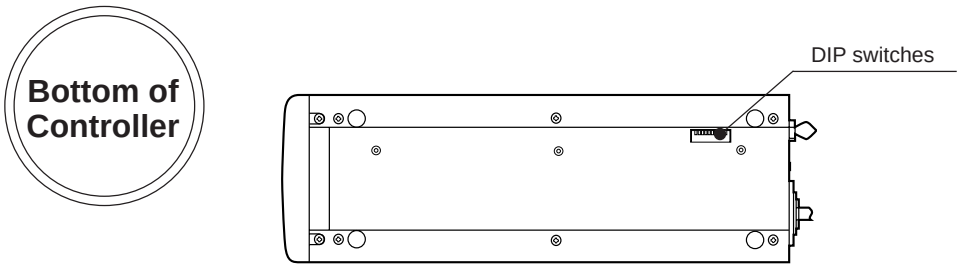
**Front of Unit**

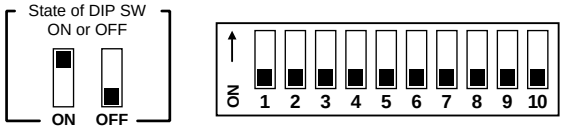



**Rear of Unit**






| Switch | Function | OFF | ON |
|---|---|---|---|
| 1 | Stop bits | 1 bit | 2 bits |
| 2 | Data bits | 8 bits | 7 bits |
| 3 | Parity check | ODD | EVEN |
| 4 | Parity check | DISABLE | ENABLE |
| 5 | Baud rate | 9600 baud | 4800 baud |
| 6 | Handshake | DTR | Xon/Xoff |
| 7 | Spindle revolution | ON | OFF |
| 8 | Over area | CONTINUE | PAUSE |
| 9 | Not used (always OFF) | | |
| 10 | | | |

### Switches 1—6

When connected to the computer via the serial (RS-232C) standard I/F, set the communication protocols of the stop bit, data bit, parity check, baud rate and handshake switches to match the settings at the computer side.

### Switch 7

Setting switch 7 to ON prohibits spindle rotation regardless of other settings.
Set switch 7 to ON to perform engraving without rotating the spindle.

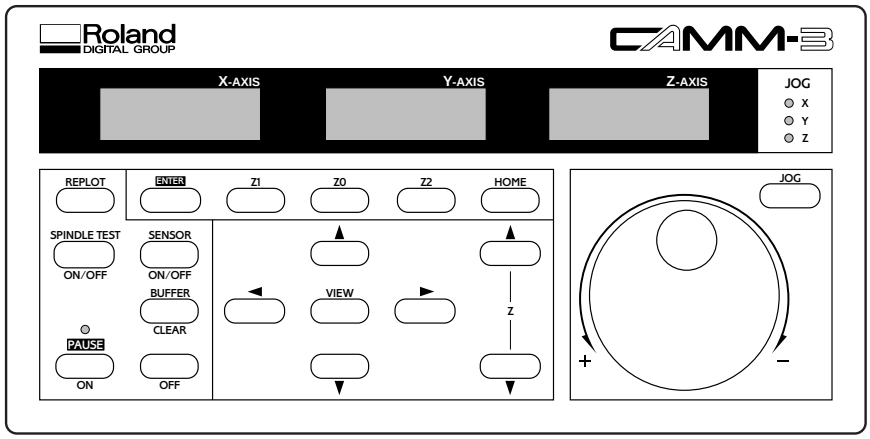
### Switch 8

Switch 8 allows the operator to select CONTINUE or PAUSE in the cutting operation when PNC-3100 movement has exceeded the coordinates set for the specified cutting range.

### Switches 9 and 10

These switches are not used. Make sure they are set to OFF.

## Switch panel





* This figure is X Coordinate Display.

### XYZ Coordinate Display

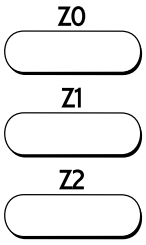
This display shows the coordinate values of each axis in 1/100 mm units. For the X and Y axes, the home position coordinates (refer to page 14) are (0, 0). For the Z axis, Z0 (refer to page 15) is displayed as "0."


### REPLOT Key

This keys carries out replotting (recutting) when cutting data is present in the PNC-3100 data buffer.


### ENTER Key

In combination with the **[Z0]** , **[Z1]** , **[Z2]** and **[HOME]** keys, the key designates the positions of Z0, Z1, Z2 and HOME. Also, if this key is pressed when PAUSE is ON, the moving speeds in each axis direction are shown on the XYZ coordinate display.

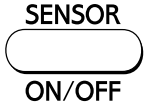



### Z Axis Position Keys

These keys are used to set the positions of Z0, Z1 and Z2 in combination with the **[ENTER]** key. Also, the tool is moved to the ZO, Z1 or Z2 position when the appropriate key is pressed. In the interests of safety, movement to Z1 does not begin until the **[Z1]** key is pressed for 0.5 seconds.

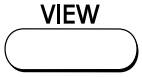

### HOME Key

This key is used to set the HOME position (refer to page 14) in combination with the **[ENTER]** key. Also, if you continue pressing this key for approx. 0.5 seconds, the tool is moved to the HOME position.



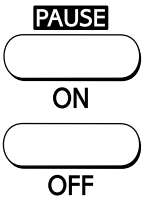

### SENSOR Key

In the case that Z0 setting is performed using the optional sensor, this key functions as the sensor ON/OFF switch.



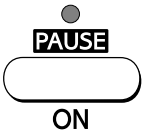

### VIEW Key

If this key is pressed for 0.5 seconds or more, the spindle raised and the XY table moves toward the front of the unit and stopped.



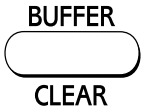

### PAUSE Keys

When the **[PAUSE ON]** key is pressed while operating under the instruction of a computer, the PAUSE LED comes ON and the PNC-3100 enters the temporary stop condition and all cutting operations are interrupted. When the **[OFF]** key is pressed, the temporary stop condition is cancelled and machine resumes cutting from the position at which operation was interrupted.



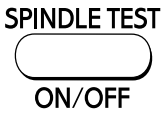

### PAUSE LED

This LED comes ON when the PNC-3100 enters the temporary stop condition as a result of the **[PAUSE ON]** key being pressed. This LED goes OFF when the temporary stop condition is cancelled by pressing the **[OFF]** key.



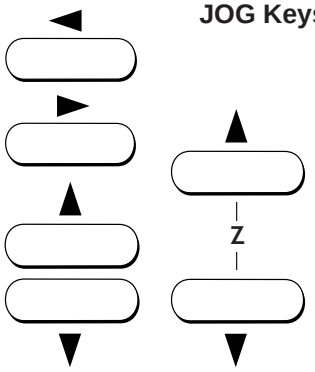

### BUFFER CLEAR Key

If this key is pressed for 0.5 seconds or more, erasing all data transferred from the computer.



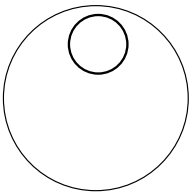

### SPINDLE TEST ON/OFF Key

When this key is pressed while the spindle revolution stops, the spindle is forced to rotate. When this key is pressed while the spindle is revolving, the revolution stops.



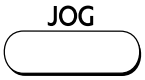

### JOG Keys

These keys move the tool in the + or - directions along the X, Y and Z axes. Perform rough position using these keys and then make delicate adjustments to the tool position using the jog handle. The tool moves approx. 30 steps (0.3 mm ( 0.12")) each time a key is pressed. The jog handle can move the tool one step (0.01 mm (0.00039")) at a time. Holding down the jog key for the X or Y direction allows rapid movement in that direction when the spindle is not rotating.
Because X, Y and Z movements are independently controlled, the keys for movement along each axis can be pressed simultaneously. In this manual, the Z-axis Jog key is represented in **[▲(Z)]** or **[▼(Z)]**.



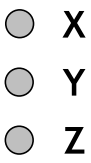
### JOG Handle

This handle moves the tool position on the X, Y or Z direction in units of 1 step (0.01 mm (0.00039")). Select the axis along which movement is desired using the **[JOG]** key. The jog handle can then move the tool along the selected axis




### JOG Handle Select Key

This key is used to select the axis along which the jog handle moves the tool. This key is referred to as the **[JOG]** key in this manual.




### JOG Handle LEDs

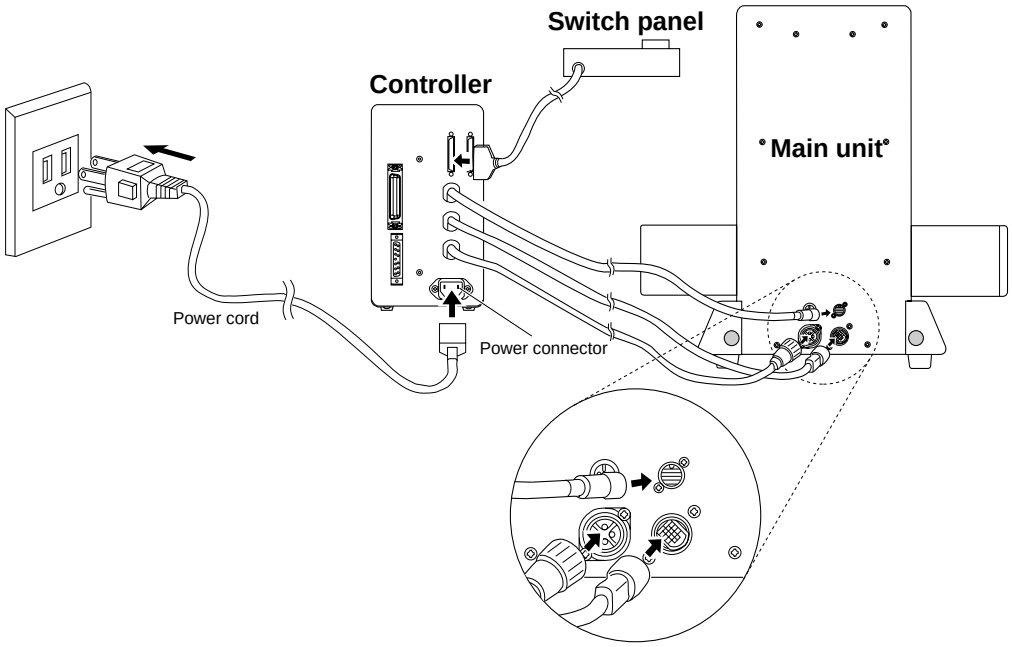
These LEDs provide an indication of the currently selected jog handle axis.

# 5. Connecting to a Computer

## Connecting the Main Unit, Controller, and Switch Panel

NOTICE

Connect the cables only when the PNC-3100 and the computer power sources are OFF.
Ensure that the power supply voltage is within ±10% of the machine's rated voltage.
Securely connect the power cord and cables for computer input and output to prevent them from coming loose or causing poor contact during use.



# Connecting to a Computer

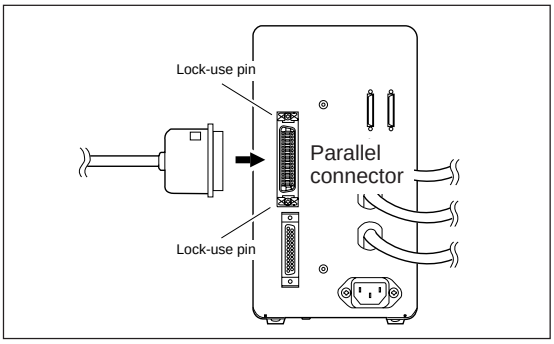
NOTICE

When connecting to a computer for the first time, be sure to perform an operation check to make sure the unit is operating correctly.

Connect the PNC-3100 to the computer using the cable.
The cable for computer connection is optional. Please purchase the appropriate cable for the type of computer and software used .

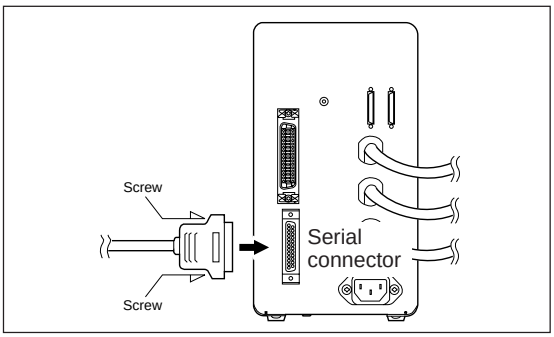
## Parallel Connection

Connect the printer-use connector of the computer and the parallel connector at the rear of the controller using a parallel cable. Fix the cable securely in place using the lock-use pins at both edges of the connector.




## Serial Connection

Connect the RS-232C terminal of the computer and the serial connector at the rear of the controller using a serial cable. Fix the cable securely in place by tightening the screws attached to the cable using a screwdriver.




NOTICE

When making a serial connection, set the same communication protocol (parameters) for both the computer and for the PNC-3100. Refer to page 9 for setting the PNC-3100 communication parameters (protocol).

# Communication Protocol Setting

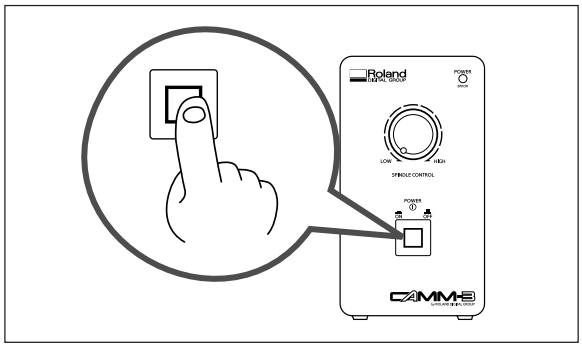
In the PNC-3100, the interface type (Parallel or Serial) is differentiated automatically. The distinguished interface is memorized until the power is turned OFF. It can not be varied while the power is ON. When changing the differentiated interface, turn the power OFF and then ON again, then transmit data.
In the case of serial connection, the controller sends and receives data under the communication protocols set using the PNC-3100 DIP switches.

**NOTICE**

The PNC-3100 cannot receive data properly when the computer software and PNC-3100 communication parameters differ.

**1** If the power was set to ON then switch it to OFF.

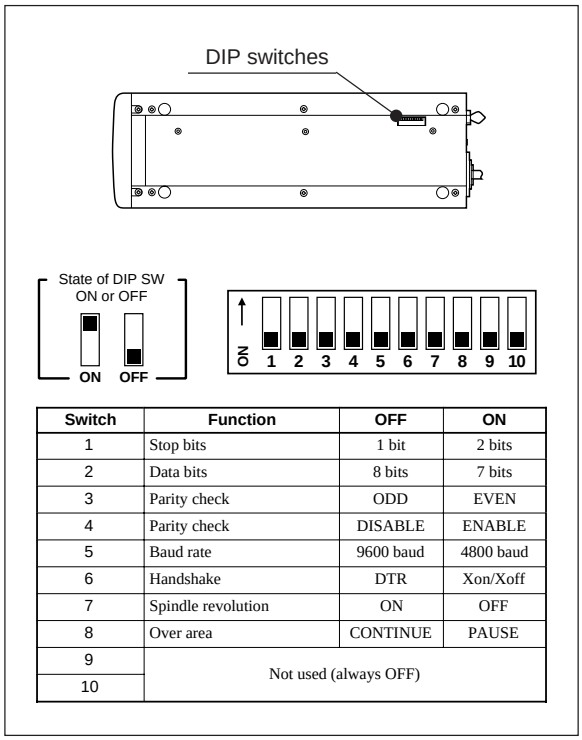
- The POWER/ERROR LED will turn off.



**2** Set the DIP switches on the bottom panel to the ON or OFF position as needed.

- Setting of the stop bit, data bit, parity check, baud rate and handshake can be done with these DIP switches.
- An object with a fine tip such as a ballpoint pen will make ON/OFF settings of the DIP switches easier.

Please use ample caution to avoid breaking the DIP switches by applying unnecessary force.




| Switch | Function | OFF | ON |
|---|---|---|---|
| 1 | Stop bits | 1 bit | 2 bits |
| 2 | Data bits | 8 bits | 7 bits |
| 3 | Parity check | ODD | EVEN |
| 4 | Parity check | DISABLE | ENABLE |
| 5 | Baud rate | 9600 baud | 4800 baud |
| 6 | Handshake | DTR | Xon/Xoff |
| 7 | Spindle revolution | ON | OFF |
| 8 | Over area | CONTINUE | PAUSE |
| 9 | Not used (always OFF) | | |
| 10 | | | |

# 6. Workpiece Set Side

**⚠ WARNING**

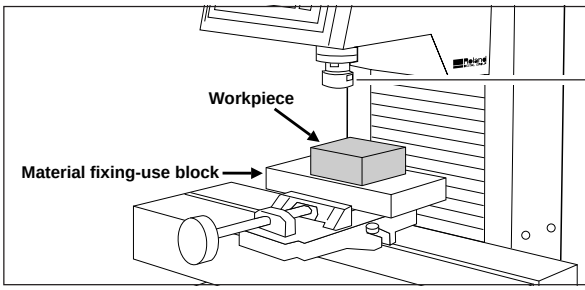
Detachment of the material during operation is extremely dangerous. Follow the procedure described below to fasten the material in place securely.

**NOTICE**

Do not place anything on the XY table except material to be cut.

This section is an explanation of the cutting workpiece attachment method when an optional machine vice ZV-1 is used. If employing an alternative attachment method, fix the workpiece firmly in place using the following explanation for reference.

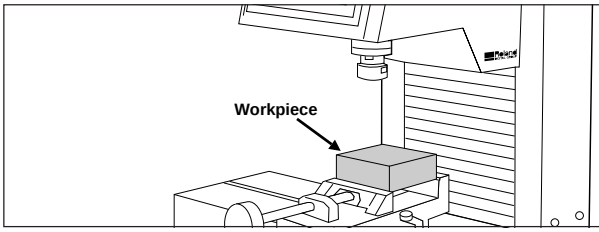
Under the standard workpiece attachment method, a block is attached to the vice, then the workpiece is fixed to the block with double-sided adhesive tape. This is the most suitable method when cutting comparatively small workpieces. For the fixing-use block, it's better to choose a workpiece that can 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.




**⚠ CAUTION**

Use caution to avoid injury when attaching or changing a vise or material while a tool is installed.

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.




**NOTICE**

Take care to avoid cutting the vise.

# 7. Cutting Tool Attachment

**⚠ WARNING**

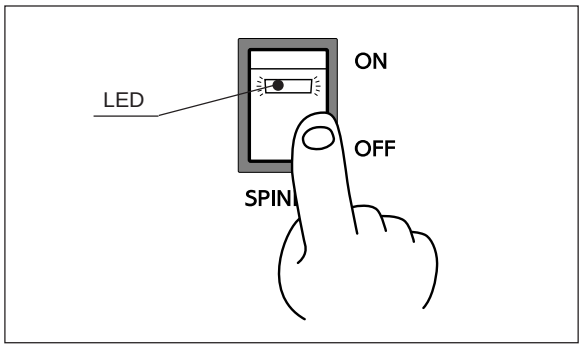
When you attach the cutting tool, make sure that the SPINDLE switch is OFF.

NOTICE

Use the correct tool for the material to be cut and the cutting method.

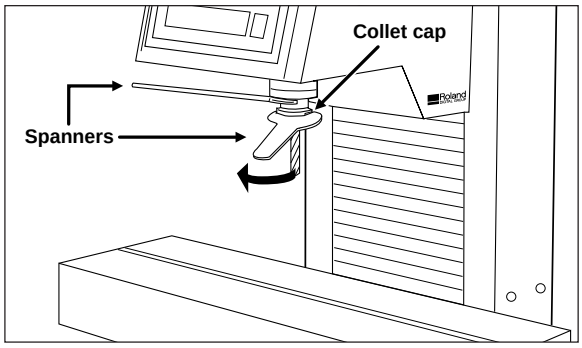
**1** Set the SPINDLE switch on the front of the PNC-3100 to OFF.

- The LED lamp in the SPINDLE switch flashes. (When power is applied.)




**2** If a cutting tool has been installed, remove it. Use the two spanners provided to loosen the collet cap.

- To keep the cutting tool from falling out, loosen only slightly.
- After loosening, then loosen the cap by hand and pull out the cutting tool.




**⚠ CAUTION**

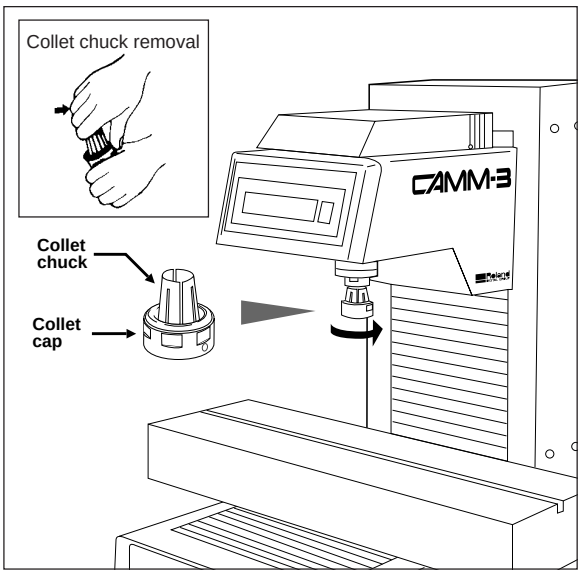
The tool becomes hot when metal is cut. Take care to avoid burns.

NOTICE

Be careful to keep the cutting tool from falling out, or the blade may break.

If the collet chuck has not been installed, install it. Fit the collet chuck in the collet cap as shown in the figure, and tighten provisionally on the spindle.

- Lightly tighten the collet cap to prevent it from falling off.
- The collet chuck included with the unit has a diameter of 6 mm (1/4"). If the shank diameter of the cutting tool does not match the diameter of the chuck, replace with a chuck of matching diameter (chucks with diameters other than 6 mm (1/4") are sold separately).
- The collet chuck can easily be removed from the collet cap by twisting it while pulling.



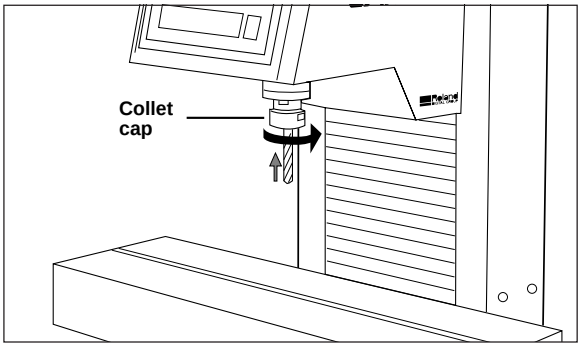

## 3

Adjust the height of the inserted tool as needed and tighten the collet cap by hand.

- Tighten the cutting tool enough to prevent it from falling out.

**NOTICE**

Use caution to prevent the cutting tool from falling out, otherwise the cutting tool may be damaged.




## 4

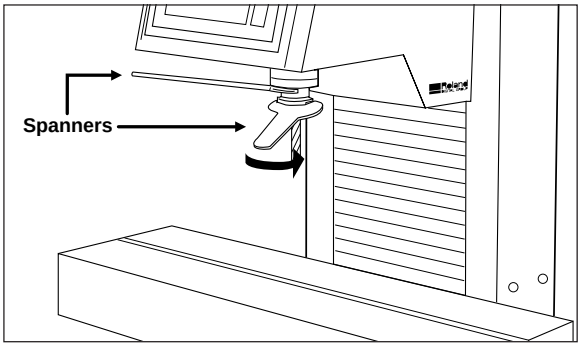
Tighten the collet cap using the two accessory spanners. Securely fasten the cutting tool to the spindle.

**⚠ CAUTION**

A cutting tool not securely fastened to the spindle is extremely dangerous. Make sure the collet cap is securely tightened!

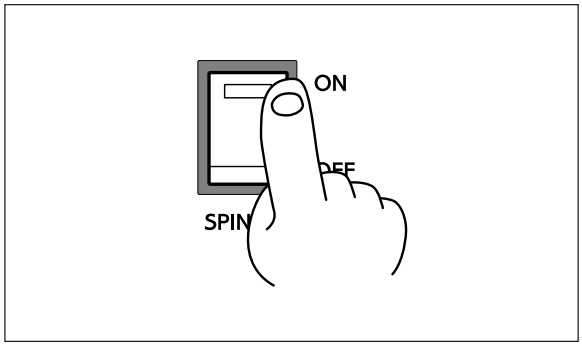
**NOTICE**

Do not install only the collet chuck (without a cutting tool) and tighten with a spanner. Doing so may make it impossible to install a cutting tool the next time the device is used.



5 Set the SPINDLE switch to ON.

- The LED lamp in the SPINDLE switch lights up. (When power is applied.)

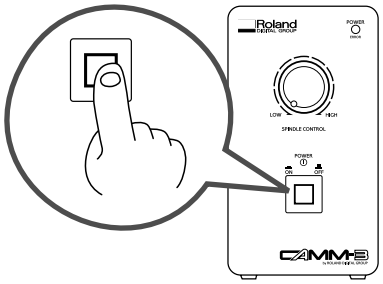



## 8. Power ON

**CAUTION**

Connection all cables securely. Normal operation may be impossible if the power is switched on while connections are incomplete.

Press the POWER switch on the front of the controller setting the power to ON. (In the PNC-3100 after setting the power to ON, proceed to turn on power to the computer.)



# 9. Setting the Cutting Origin

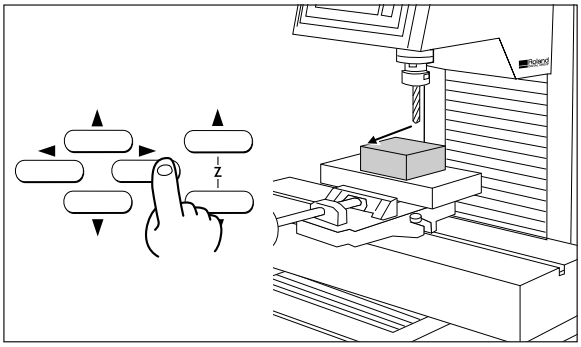
The PNC-3100 are suitable for use with a versatile range of workpiece shapes and a wide variety of tools, so determine the standard points for cutting each time a new workpiece is set. Set the home position (origin point for X an Y axes) and Z0 (Z axis origin point). (If these points can be set with 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.

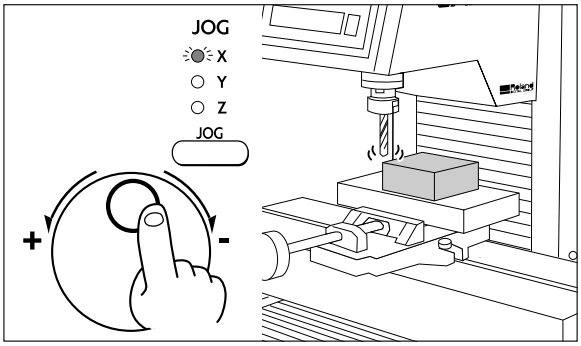
**The home position points are registered in the PNC-3100 memory right after power is turned on and before power is turned off.**

**1** Move the cutting tool tip close to the lower (nearest operator) left corner of the workpiece, using the **[◄] [►] [▲] [▼] [▲(Z)] [▼(Z)]** jog keys.



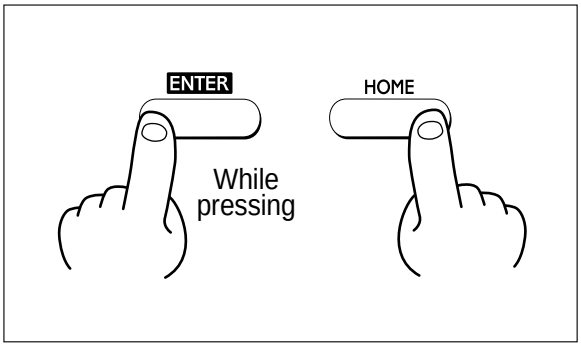

**2** Move the tool little by little with the **[JOG]** key and the jog handle.

- Line up the cutting tool tip with the lower left corner of the workpiece.




**3** Press the **[ENTER]** key while pressing the **[HOME]** key.

- Both the X and Y axis indicators on the coordinate display are displayed as "0".
- Once the home position is registered in the PNC-3100 it remains in the memory even when the power is turned off. The home position point will remain registered in the memory until a new home position setting is made.

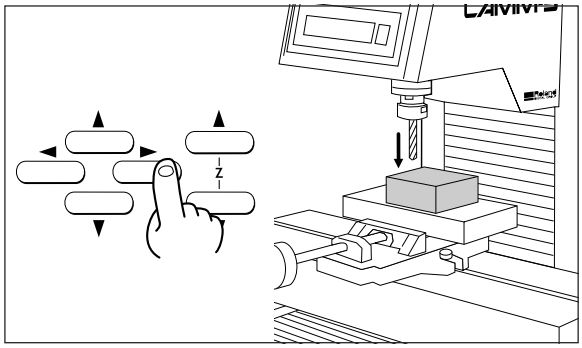


## Setting the Z0 Position

With some software, Z1 (the tool-down position) and Z2 (the tool-up position) are set by commands from the software (see page 28 for an explanation of Z1 and Z2).
Right after switching on the power, Z0 is set at the mechanically uppermost position. This means that if cutting data is sent from such software without setting Z0 first, the software will attempt to set Z2 at a position higher than the uppermost mechanical point, and an error will occur. (The POWER/ERROR LED flashes and operation pauses.) Be sure to set Z0 before sending cutting data.
If an error occurs, stop the transmission of data from the computer and cancel the error by clearing the buffer or by switching the power to the PNC-3100 off and on again (see page 32).

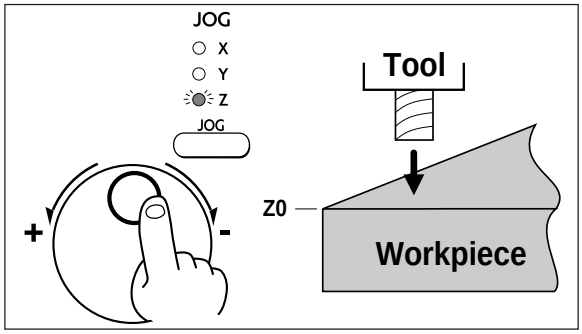
The home position is the point that becomes the origin point in the X and Y directions. Usually, this point is set at the front left corner of the fixed workpiece. The following explains the method for setting the workpiece surface Z0 position. The highest position mechanically, is set right after the power is turned on.

**1** Move the cutting tool tip close to the surface of the workpiece, using the **[◄] [►] [▲] [▼] [▲(Z)] [▼(Z)]** jog keys.



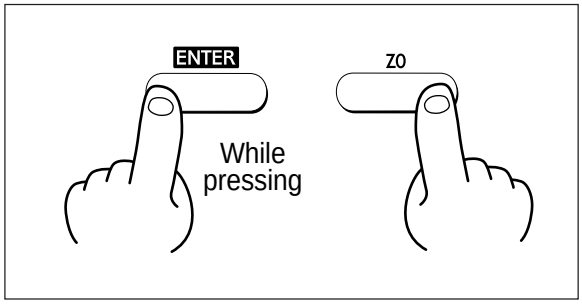

**2** Select the Z axis with the **[JOG]** key and move the cutting tool a little bit at a time with the jog handle.

- Line up the cutting tool tip with the surface of the workpiece.




**3** Press the **[ENTER]** key while pressing the **[Z0]** key.

- The Z axis indicator on the coordinate display are displayed as "0".



# 10. Cutting Condition Setting

**⚠ WARNING**

When using a small-diameter tool, do not apply an excessive feed speed or cutting-in amount while cutting, or the tool may break or fly off.

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
2. The type of tool used
3. The diameter of the tool used
4. The cutting method
5. The cutting shape

Designate the cutting conditions in consideration of the above factors by performing the following three PNC-3100 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-3100, 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 requied. (Note : Refer to page 4 for details on engraving without rotating the cutting tool.)<br>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.

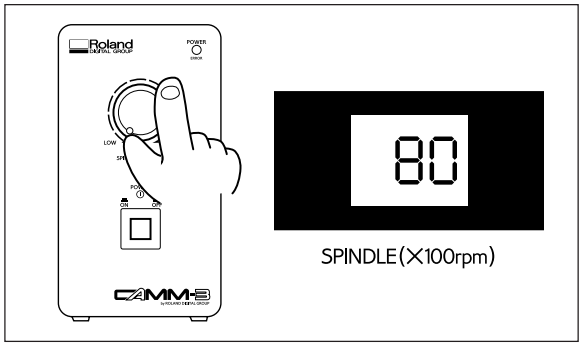
### Feeding Speed

Feeding speed setting is performed via a switch panel key operation. Refer to page 23; "Feeding Speed Manual Setting."

## Spindle Motor Revolution Speed

The spindle motor revolution speed can be set by turning the spindle control knob on the controller. Monitor the speed indicated on the Spindle RPM Display while making this setting.

Spindle Speed Ranges
3,000 to 8,000 rpm




## Cutting-in Amount

The cutting-in amount is set by setting Z1. (Refer to page 28; "Setting the Tool Up/Down Position Manually.")

# 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 | Cutting-in amount (ø x depth) | Feeding speed (mm/sec.) |
|---|---|---|---|---|
| Modeling wax (option) | ZHS-300 | 8000 | 3 x 3.0 | 5—12 |
| | ZHS-600 | 6000 | 6 x 6.0 | 4—10 |
| | ZUS-600 | 6000 | 6 x 6.0 | 4—8 |
| ABS plastic | ZHS-100 | 8000 | 1 x 0.5 | 2—8 |
| | ZHS-300 | 8000 | 3 x 3.0 | 8—10 |
| | ZHS-600 | 6000 | 6 x 4.5 | 5—8 |
| | ZUS-600 | 6000 | 6 x 4.0 | 4—8 |
| | ZUB-300 | 6000 | 3.0 x 3.0 (radius x depth) | 5—8 |
| | ZEC-100 | 8000 | 0.5 (depth only) | 4—10 (Z axis : 2) |
| Acrylic resin | ZHS-100 | 8000 | 1 x 0.5 | 7—10 |
| | ZHS-300 | 8000 | 3 x 1.5 | 4—6 |
| | ZHS-600 | 6000 | 6 x 2.0 | 2—4 |
| | ZUS-600 | 6000 | 6 x 3.0 | 2—3 |
| | ZEC-100 | 8000 | 0.3 (depth only) | 2—8 (Z axis : 2) |
| | | | 0.5 (depth only) | 2—6 (Z axis : 2) |
| Aluminum | ZHS-300 | 8000 | 3 x 0.5 | 1—2 |
| | ZHS-600 | 6000 | 6 x 0.5 | 1—2 |
| | ZUS-600 | 6000 | 6 x 0.3 | 1—2 |
| | ZUB-300 | 8000 | 3.0 x 0.2 (radius x depth) | 1—2 |
| Brass | ZHS-300 | 8000 | 3 x 0.5 | 1—3 |
| | ZHS-600 | 6000 | 6 x 0.5 | 1—2 |
| | ZUS-600 | 6000 | 6 x 0.5 | 1—2 |
| | ZUB-300 | 8000 | 3.0 x 0.3 (radius x depth) | 1—2 |

# 11. Downloading Cutting Data

The PNC-3100 performs cutting after receiving cutting data from the computer (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 software used.

## Software Setting

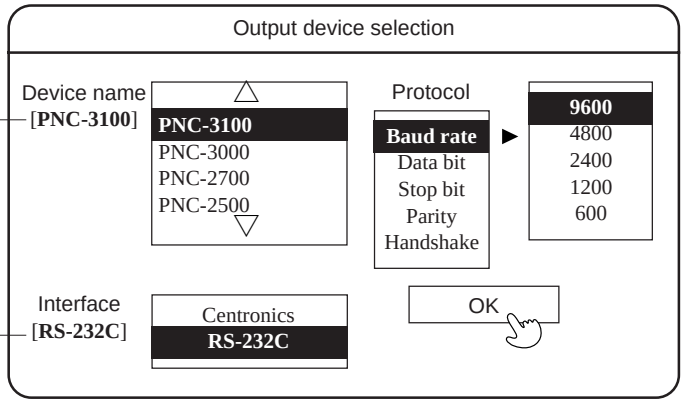
In cases where cutting is controlled by generally available application software, select PNC-3100 as the output equipment setting. In cases where it is not possible to select PNC-3100 , select PNC-3000 or PNC-2700 or PNC-2500R/2500.

Identification of the interface type (connected with computer) is done automatically in the PNC-3100. There is no need for the user to select the interface type. For serial connections, the communication parameters (protocol) must be set before sending cutting data (refer to page 9 for details.) The PNC-3100 uses the CAMM-GL I instruction set. When setting the output device software, select a type that is compatible with CAMM-GL I. (Modes 1 and 2 of CAMM-GL I are identified automatically. To change parameters during an ongoing instruction set, turn off the power once and then, after turning on the power, commence sending data.)

## [Example] Selecting application software output device

Select PNC-3100. If it is not listed, select PNC-3000 or PNC-2700 or PNC-2500R/2500.

Select either the parallel (Centronics) or the serial (RS-232C) interface. Choose the one that the host computer and the PNC-3100 are connected by.




* PNC-3100 communication protocol setting is performed by setting the DIP switches on the controller bottom. Refer to page 9 for details.

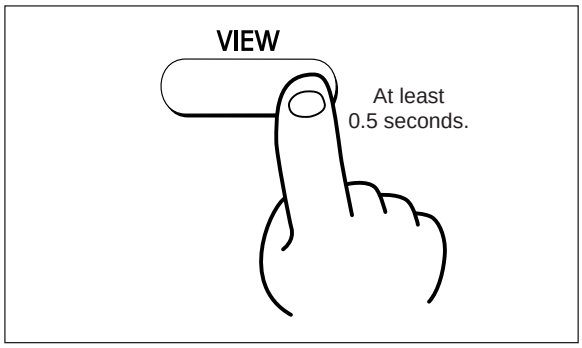
NOTICE

Clean the unit and its surrounding while in operation. Avoid using an air gun or cloth for cleaning; use a vacuum cleaner or brush.

# 12. Finishing

**1** When all cutting operations are complete press the **[VIEW]** key for at least half a second.

- Raise the cutting tool, move the XY table to the outer left (close to operator) and stop it.
- When the spindle is still rotating, press the **[SPINDLE TEST ON/OFF]** key in order to stop it.
- After turning off the power, removal of the workpiece and cutting tool will be easier now that the spindle has been moved out of the way.

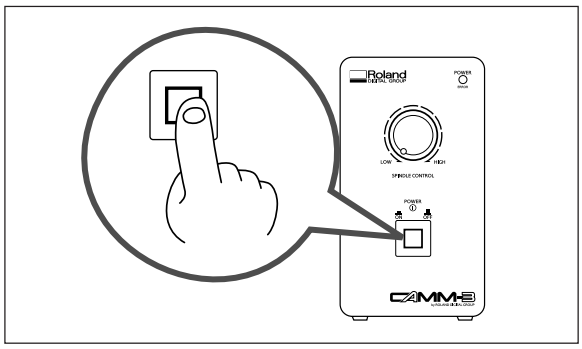



**2** After the power to the computer has been turned off, turn the power to the PNC-3100 off.

- The POWER/ERROR LED turns off.
- Next remove the completed workpiece and the cutting tool.
- Store the cutting tool that was just removed, carefully so it will be ready for use when needed.

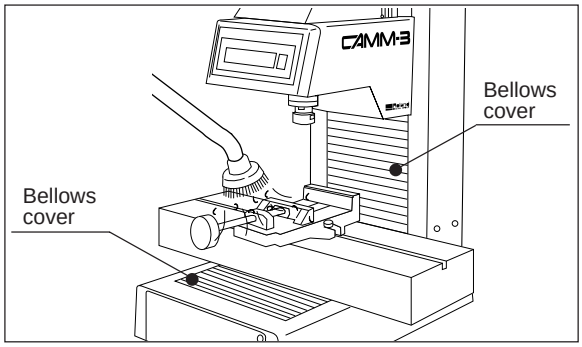
**⚠ CAUTION**

The tool becomes hot when metal is cut. Take care to avoid burns when detaching.




**3** Use an appliance such as a vacuum cleaner to remove cutting chips and grit from the machine and surrounding area.

- Do not use an compressed air for such cleaning. Cutting chips in the air may attach to a portion of the machine and cause malfunctions or breakdowns.
- Be especially careful to remove the cutting waste from around the pleated part of the bellows cover.
- Keep the PNC-3100 and its accessories in neat and proper order and use care to ensure normal work operations are carried out safely.

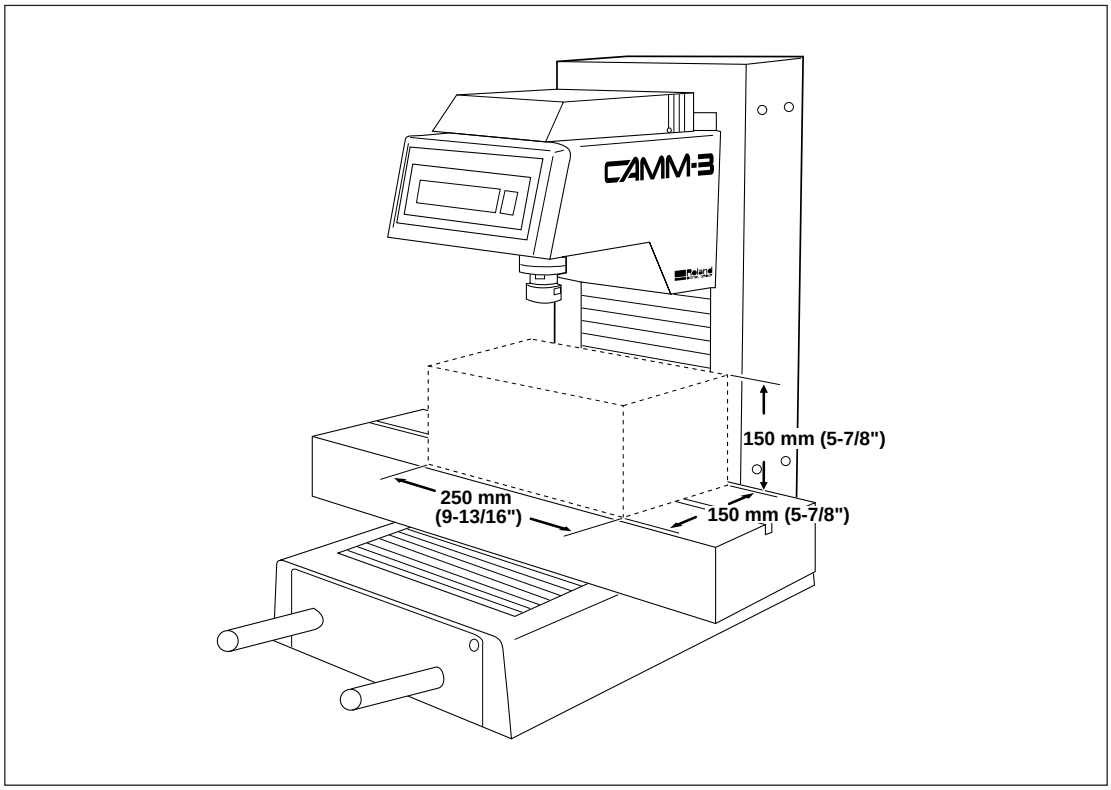


# Part 2

# User's Reference

## 1. Cutting Area

The maximum cutting area of the PNC-3100 is 250 mm × 150 mm × 150 mm (9-13/16" × 5-7/8" × 5-7/8"). Converting this into coordinate values based on the machine's step number (1 step = 1/100 mm (0.00039")), we obtain the coordinate system; (x, y, z)=(25000, 15000, 15000).
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.

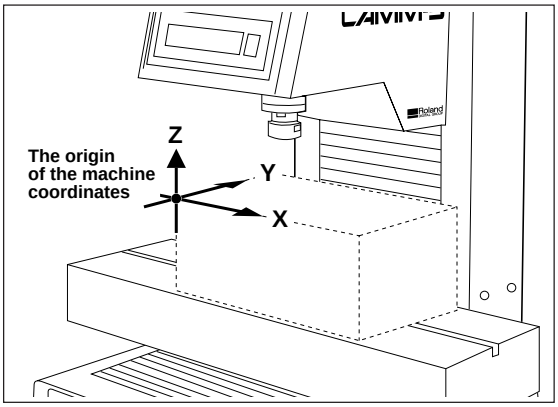


# 2. Coordinate System

The PNC-3100 employs three separate coordinate systems (described below) according to the application or purpose of use.

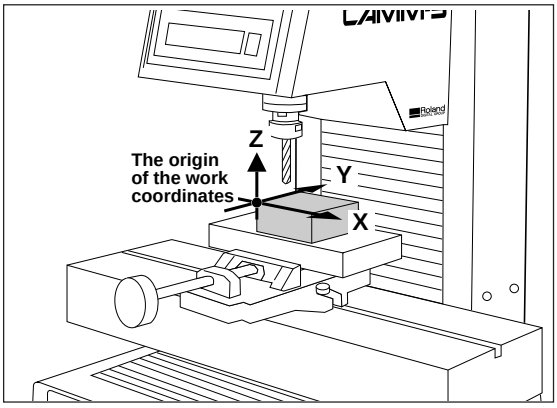
## Machine Coordinate

Under the machine coordinate system, the coordinates are determined mechanically against the PNC-3100. This system forms the basis of the "work coordinates" and "user coordinates" which are explained later. The machine coordinate range is equivalent to the PNC-3100's maximum operating range. The point to which the XY table and head move when the power is turned ON is the origin of the machine coordinate system (x, y, z)=(0, 0, 0). (The origin is fixed.)
The machine coordinate system basic unit is fixed as one step = 1/100 mm (0.00039").




## Work Coordinate

The origin of the machine coordinate system is fixed, but there is a coordinate system in which the origin can be moved relative to the machine coordinate system. This system is called the work coordinate system.
In the work coordinate system, the home position is the XY origin and Z0 is the Z axis origin. The origin of the work coordinates can be set by setting the home position (the XY axis origin) and Z0 (the Z axis origin).
The origin of the work coordinates is the standard point for cutting against the attached workpiece.
The work coordinate system basic unit is fixed as one step = 1/100 mm (0.00039").




## User Coordinate

* If you are using application software, there is no need to worry about the user coordinate system. You can ignore it completely.

Under the machine coordinate system and the work coordinate system, the unit value is fixed. In contrast, the user coordinate system allows the user to set the unit value freely. (However, the unit value can be set only for the XY axis. The Z axis unit value cannot be set.)
The user coordinate system unit is determined by replacing (converting) the work coordinate system unit with the user coordinate system unit. Also, the user can set the cutting data output to the position of the basic point of the workpiece on the XY axis. This operation is called scaling. It can be performed with the use instructions. For further details, please refer to the optional CAMM-GLI Programmer's Manual.
If scaling is not performed, the user coordinate system unit and the work coordinate system unit are equivalent.

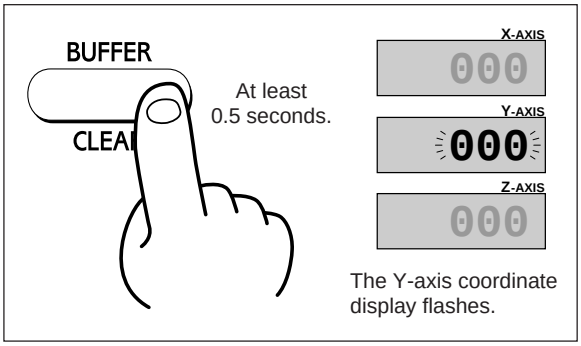
# 3. Operating Each Function

## Replotting (Recutting)

Pressing the **[REPLOT]** key calls up the cutting data stored in the PNC-3100's data buffer and executes the replotting procedure. 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 holding down the **[BUFFER CLEAR]** key for at least 0.5 sec.) 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.

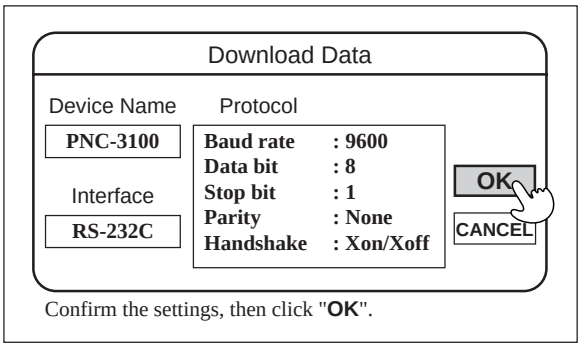
**1** Press the **[BUFFER CLEAR]** key for at least 0.5 seconds.

- The data buffer is cleared.
- When data in the buffer is erased, the coordinate display for the Y axis begins to flashes.



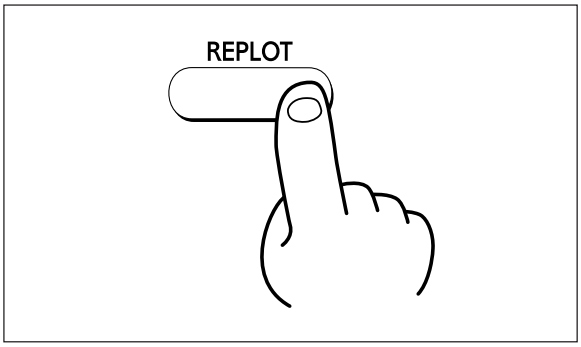

**2** Download the cutting data using the operating software of computer.

- When cutting is finished, replace the workpiece.
- If necessary set the home position (refer to page 14) and Z0 (refer to page 15).




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

- Replot (recutting) will start.

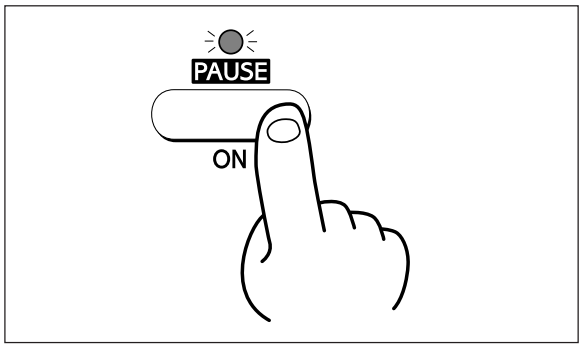


## Feeding Speed Manual Setting

At times when speed cannot be set with the software or when adjusting the speed during an ongoing cutting operation use the panel switch keys to set cutting tool movement speed.

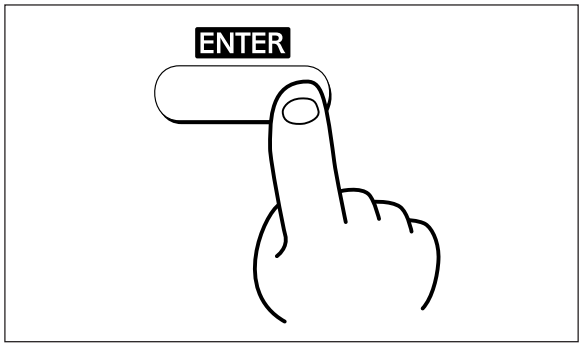
**1** Press the **[PAUSE ON]** key.

- PAUSE LED comes ON.



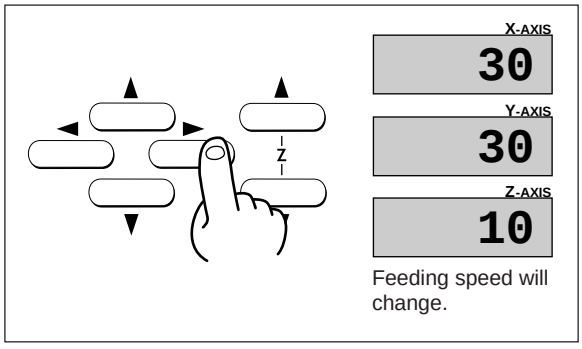

**2** Press the **[ENTER]** key.

- The current feeding speed of each axis is displayed on the coordinate display of the switch panel. (Units are in mm/sec.)



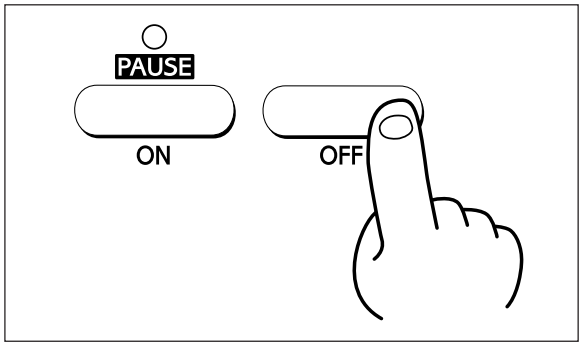

**3** Press the Jog key (**[◄]**, **[►]**, **[▲]**, **[▼]**, **[▲(Z)]**, **[▼(Z)]**).

- Use the **[◄]**, **[▼]**, **[▲(Z)]** jog keys for fast movement.
  Use the **[►]**, **[▲]**, **[▼(Z)]** jog keys for slow movement.
- The X axis and Y axis speeds cannot be set separately.




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

- PAUSE LED goes OFF.



## Operation Check

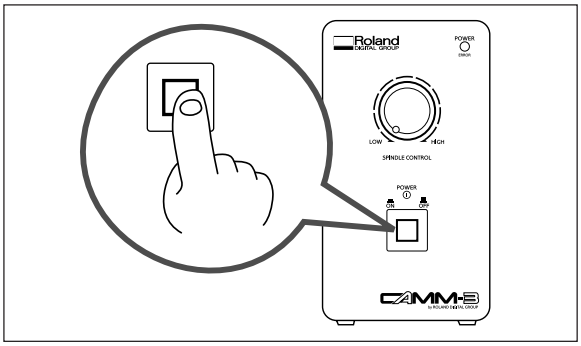
If the PNC-3100 operates abnormally, perform an operation check according to the instructions below. If, as a result of the check, no abnormality is found, check for abnormalities in the computer, software or cable.

**⚠ WARNING**

Remove the tool, workpiece and vice before beginning the operation check.

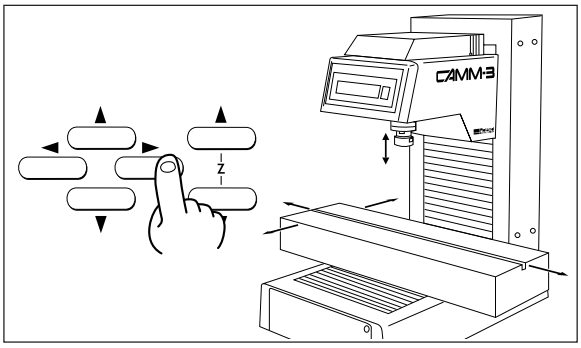
**1** Turn the power ON. (If the power has already been turned on, turn it off and then back on again.

- The POWER/ERROR LED will light up.



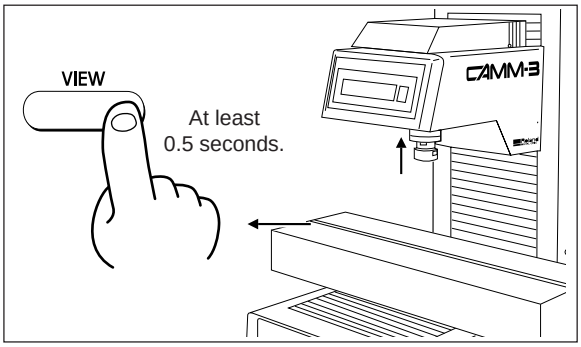

**2** Press the Jog key.

- Move the XY table to the front, back, left or right with the **[◄]**, **[►]**, **[▲]**, **[▼]** keys.
- Move the spindle up or down with the **[▲(Z)]**, **[▼(Z)]** jog keys.



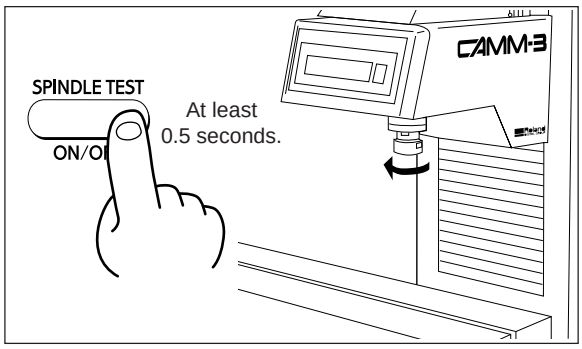

**3** Press the **[VIEW]** key for at least 0.5 seconds.

- The spindle rises and the XY table moves toward the front of the unit.



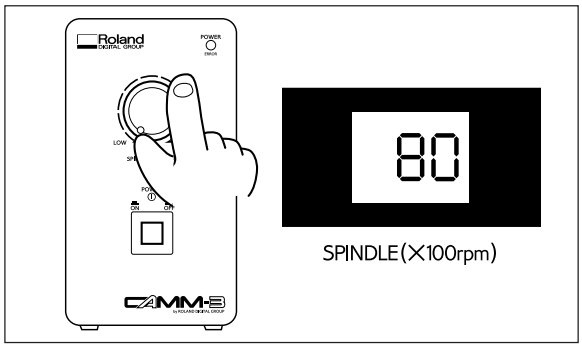
**4** Press the **[SPINDLE TEST ON/OFF]** key for at least 0.5 seconds.

- The spindle starts to rotate.



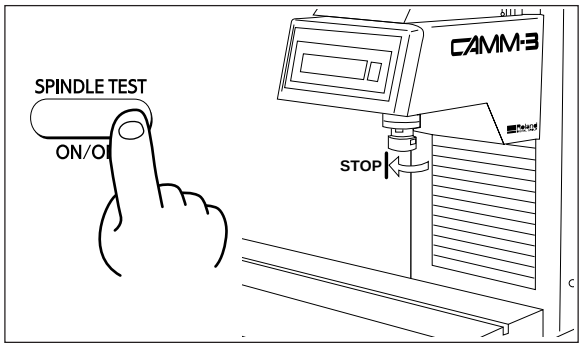

**5** Turn the Spindle Control knob to the left and right.

- Rotating the control clockwise raises spindle speed (rpm).
- Rotating the control counterclockwise lowers spindle speed (rpm).
- Make sure that the speed indicated on the Spindle RPM Display changes.



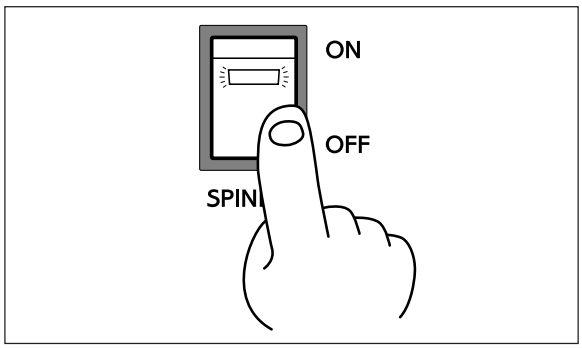

**6** Press the **[SPINDLE TEST ON/OFF]** key.

- Spindle rotation stops.



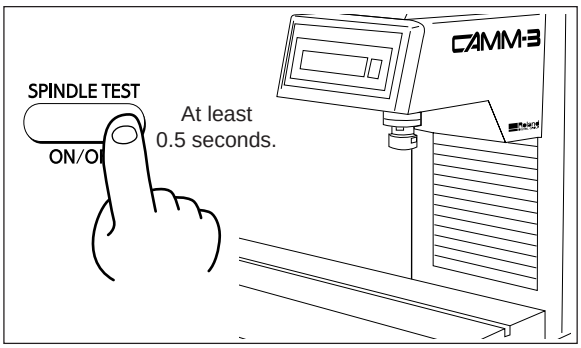

**7** Turn the Spindle switch OFF.

- The spindle switch LED flashes.



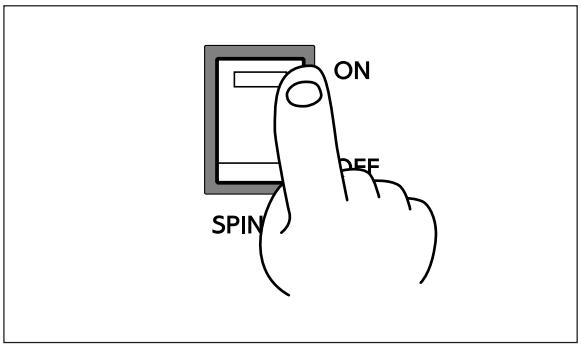
**8** Press the **[SPINDLE TEST ON/OFF]** key for at least 0.5 seconds.

- The spindle does not rotate.



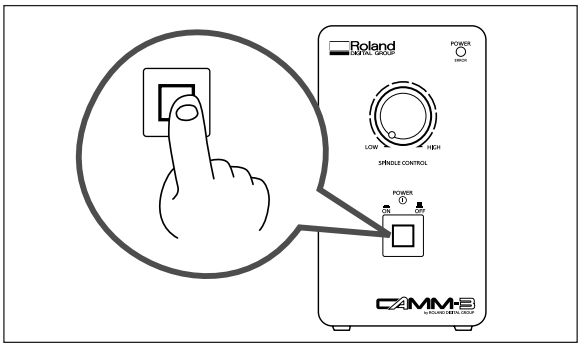

**9** Turn the Spindle switch ON.

- The spindle lights up after flashing.




**10** Turn the power OFF.

- The POWER/ERROR LED turns off.



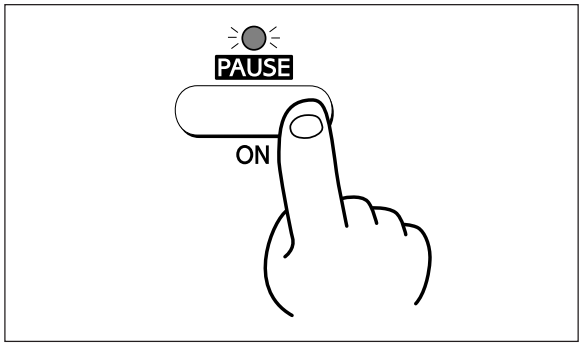

This completes the operation check. If no abnormalities are detected in the course of this check, the PNC-3100 is normal.

## Stopping the Cutting Process Immediately

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

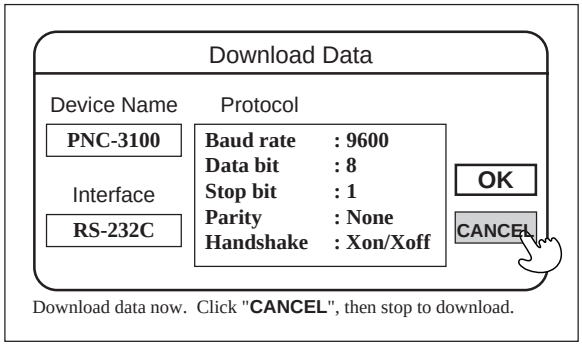
**1** Press the **[PAUSE ON]** key.

- PAUSE LED comes ON.
- The unit stops after completing the cutting operation in progress.



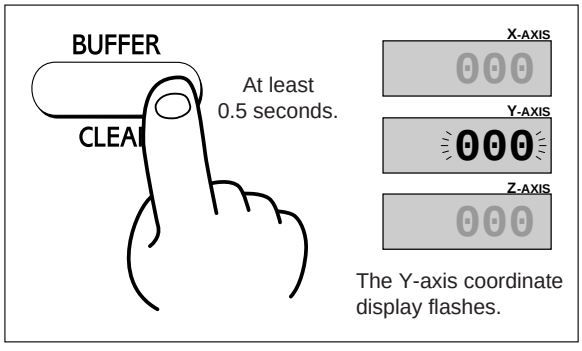

**2** Stop the transfer of data to the PNC-3100 by operating software of computer.

- For details of the data transfer stop method, refer to the manual of the computer or software you use.



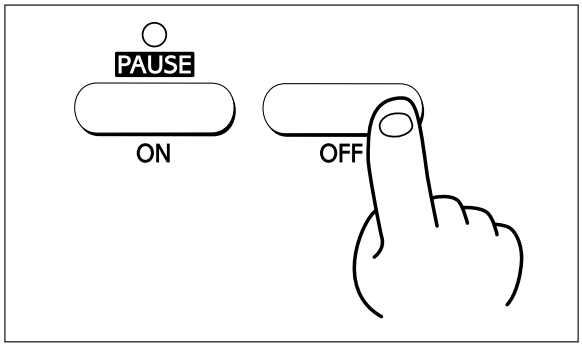

**3** Press the **[BUFFER CLEAR]** key for at least 0.5 seconds.

- The data buffer is cleared.
- When data in the buffer is erased, the coordinate display for the Y axis begins to flashes.



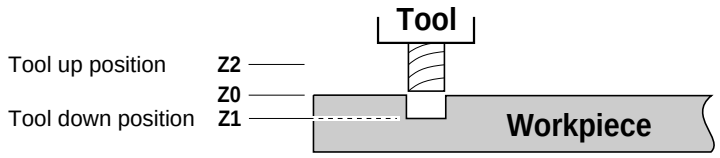

**4** Press the **[OFF]** key.

- PAUSE LED goes OFF.
- Download the current of data to the PNC-3100 by operating software of computer.
- If necessary set the home position (refer to page 14) and Z0 (refer to page 15).



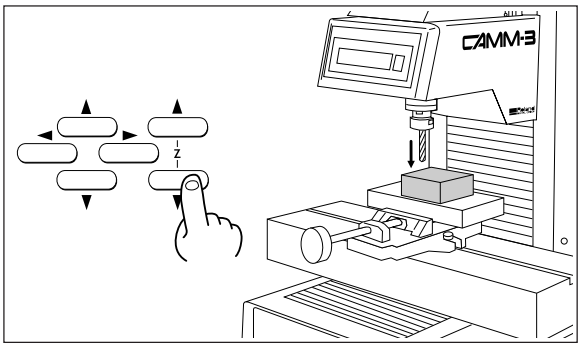
## Setting the Tool Up/Down Position Manually

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. Setting is done by determining the cutting tool up position Z2 and down position Z1.



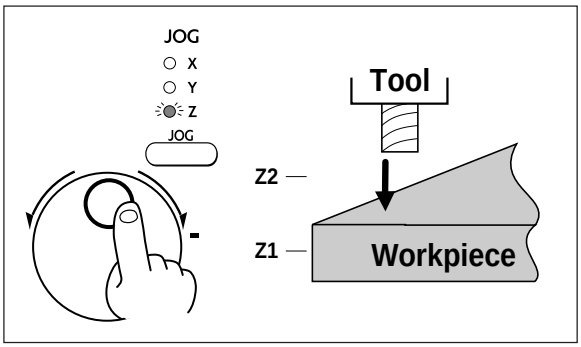

**1** Move the cutting tool tip to a position near Z1 (or Z2) with the jog keys **[▲(Z)]**, **[▼(Z)]**.

- Move the spindle to a spot away from the workpiece when setting Z1.



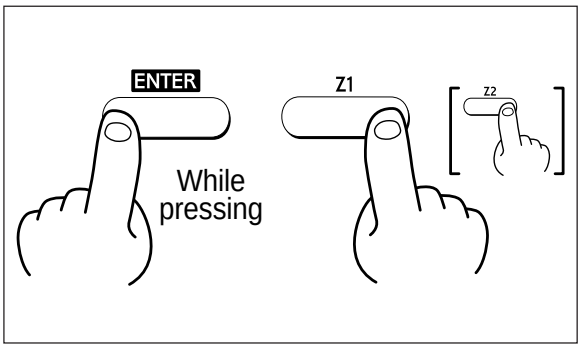

**2** Select the Z axis with the **[JOG]** key and move the cutting tool a little bit at a time with the jog handle.

- Line up the cutting tool tip at the height needed for Z1 (or Z2).
- The coordinates can be set at the same time while watching the coordinate display table.




**3** Press the **[Z1]** key (or **[Z2]** key) while holding down the ENTER key.

- Z1 (or Z2) has now been set.



# 4. Maintenance

**⚠ WARNING**

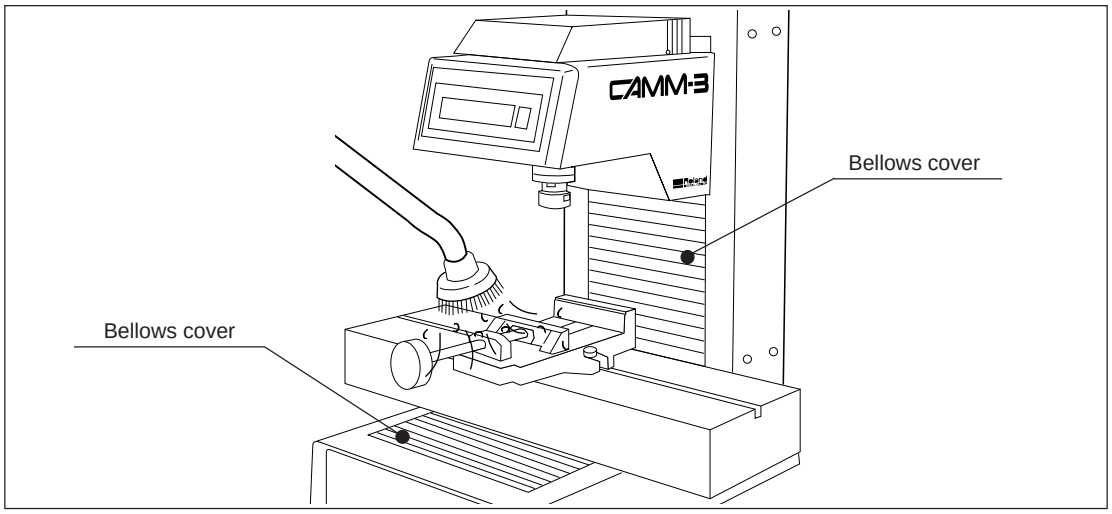
When cleaning the PNC-3100, make sure that the main unit's power is OFF.

## Cleaning the Main Unit

When the arm of the main unit (excluding the display section), controller or switch panel (excluding the display section) becomes dirty, use a cloth moistened with water or neutral detergent solution to wipe it lightly.
Use a dry cloth to wipe the display section on the main unit and switch panel.

## Cleaning After Operation

After cutting work is completed, use a vacuum cleaner to clean the PNC-3100 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-3100's power OFF. Also, if the PNC-3100 is used in a room equipped with a ventilation fan, rapid clogging by filing may occur. Perform cleaning during operation.




The above two 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

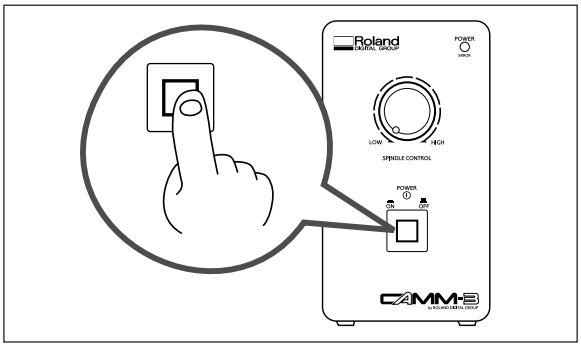
Operate the spindle motor alone, with no tool installed or material loaded. If the rotation speed is uneven or marked noise is produced, be sure to contact a service technician.

## Display of Spindle Rotation Time

The PNC-3100 has a function for the displaying the total rotation time of the spindle. Because the brushes and other components of the spindle motor are parts that wear out and require inspection at periodic intervals. This display is designed to serve as a guide for such inspection. (The motor brushes require replacement approximately every 500 hours.)

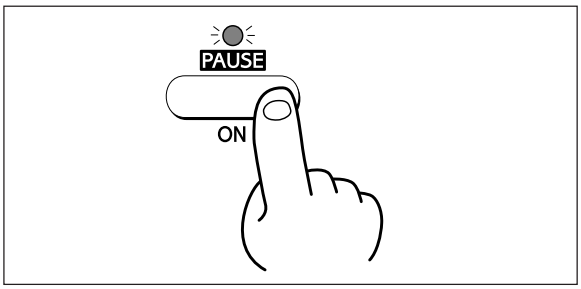
**1** Turn the power ON.

- The POWER/ERROR LED will light up.



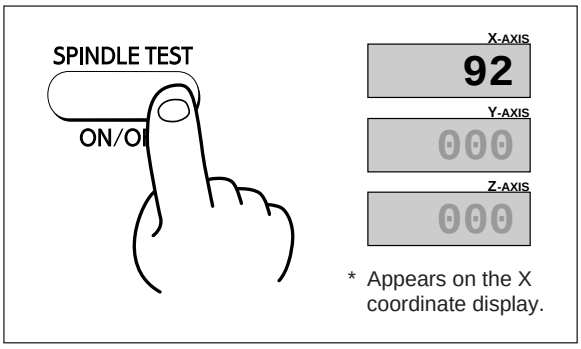

**2** Press the **[PAUSE ON]** key.

- PAUSE LED comes ON.




**3** Press the **[SPINDLE TEST ON/OFF]** key.

- The total rotation time (in hours) of the spindle appears on the coordinate display while the key is held down.
- When the key is released, the screen returns to a coordinate display.




# Recommended Service Checking

The PNC-3100 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 (brushes, spindle belt, spindle motor, and spindle unit)

# 5. Troubleshooting

## When the PNC-3100 does not work ...

The following causes should be considered.

### PNC-3100 Main Unit

| Checking Item | Remedy |
|---|---|
| Is the PNC-3100 damaged? | See page 24 "Operation Check" and perform the operation check procedure. |
| Is the PNC-3100 in the temporary stop condition? | When the Pause LED is ON, the main unit is in the temporary stop condition. Press the [OFF] key to cancel the temporary stop condition. |
| Is the PNC-3100's power OFF? | Turn the PNC-3100 power ON. |
| Is the PNC-3100 Spindle switch OFF? | Turn the Spindle switch ON. |
| Was DIP switch No. 7 on the bottom controller section switched to ON? | Set DIP switch No.7 to OFF. (Refer to page 4) |

### Computer

| Checking Item | Remedy |
|---|---|
| Are the computer settings correct? Check the following:<br>• DIP switches<br>• Memory switches<br>• Interface board<br>• Others | See the manual for the computer you use, and make sure that the settings are correct. |

### Software

| Checking Item | Remedy |
|---|---|
| Are the basic software settings correct? Check the following:<br>• Output port designation<br>• Output device<br>• Output port open<br>• Others | See the manual for the basic software you use, and make sure that the settings are correct. |
| Are the application software settings correct? Check the following:<br>• Output device designation (select the appropriate instruction system for the machine name. If the machine designation is not correct, totally different instructions will be sent, causing errors.)<br>• Communication protocol settings<br>• Others | See the manual for the application software you use, and make sure that the settings are correct.<br>Please refer the section entitled "Downloading Cutting Data" on page 18 or "Communication Protocol Setting" on page 9 of this manual. |

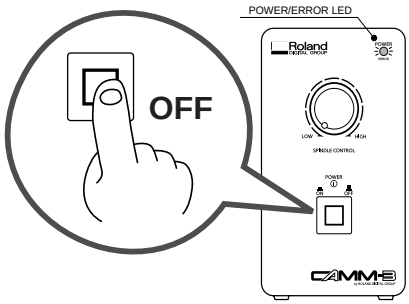
## Connecting Cable

| Checking Item | Remedy |
|---|---|
| Are the computer and machine connected with the correct cable? | The connection cable differs according to the type of computer and the software employed. Different software run on the same computer may require a different cable. Use the designated cable. |
| Is the cable connected correctly? | Connect the cable correctly. |

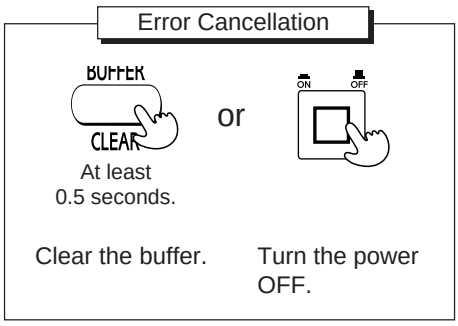
## When the POWER/ERROR LED Flashes

The POWER/ERROR LED flashes to indicate that an error has occurred in the PNC-3100. There are two kinds of error; namely instruction-related errors and communication-related (RS-232C) errors.
After the error occurs, there is a danger that the PNC-3100 will make unexpected abnormal movements. If such a movement occurs, turn the power OFF immediately.
The error may be caused by one of the following items. Check these and remove the cause of the error.

- **The output device setting of the software is incorrect.**
- **The communication protocol do not suit the computer.**
- **Z0 has not been set (see page 15 for details).**
- **The form of the sent instructions contains a mistake.**
- **The parameters of the sent instructions fall outside of the allowable range.**
- **The incorrect cable is used.**

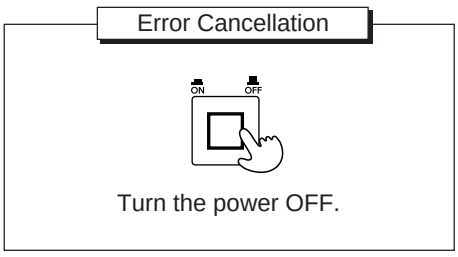



**If the machine makes an abnormal movement, turn the power OFF immediately**




## When the POWER/ERROR LED and PAUSE LED Flash

The PNC-3100 stops automatically if an excessive load is placed on the spindle during cutting. When this occurs, the POWER/ERROR LED and PAUSE LED flash at the same 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.



# 6. List of CAMM-GLI Instructions

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.

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

## • mode1

| Instruction | Com. | Format | Parameter | | Range [Default] |
|---|---|---|---|---|---|
| @ Input Z1 & Z2 | O | @ Z1, Z2 | Z1 | Position on Z1 | -15000—0 [0] |
| | | | Z2 | Position on Z2 | 0—+15000 [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 begining 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 | O | Z x1, y1, z1, ..... , xn, yn, zn | xn, yn | XY coordinate | * 1 |
| Simultaneous Feed | | | 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;<br>CA | n | Character set No. | 0—4, 6—9, 30—39 [0] |
| 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 Charcter Set | O | CS n;<br>CS ; | n | Character set No. | 0—4, 6—9, 30—39 [0] |
| 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](CHR$(3)) ] |
| 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 ;<br>IM ; | e | Error mask value | 0—255 [223] |
| 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 ;<br>PT ; | d | Tool width (diameter) | 0—5 [mm] [ 0.3 [mm] ] |
| 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 |
| | | | | | | |
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## • mode2

| Instruction | Com. | Format | Parameter | | Range [Default] |
|---|---|---|---|---|---|
| UC User Defined Character | O | UC (c,)Δx1,Δy1(,(c,)Δx2,Δy2...Δxn,Δyn) ;<br>UC ; | c<br>Δxn,Δyn | Tool control value<br>Units of movement | —-99, +99—<br>-99<Δxn, Δyn<+99 |
| VS Velocity Select | O | VS s ;<br>VS ; | s | Feed rate for X and Y axis | 0—60 [mm/sec] [2 [mm/sec]] |
| WG Shade Wedge | O | WG r,Ø1,Øc(,Ød) ; | r<br>Ø1<br>Øc<br>Ød | Radius<br>Start angle<br>Center angle<br>Chord tolerance | * 1<br>* 3<br>* 3<br>* 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<br>(designate by machine coordinate) | * 1 |
| !MC Motor Control | O | !MC n [terminator]<br>!MC [terminator] | n | Motor ON/OFF switching | -32768—32767 [motor ON] |
| !NR Not Ready | O | !NR [terminator] | None | | |
| !OJ Output Sensor Status | O | !OJ [terminator] | None | | |
| !OZ Output Z-ccordinate | O | !OZ [terminator] | None | | |
| !PZ Set Z1&Z2 | O | !PZ z1(, z2) [terminator] | z1<br>z2 | Z1 coordinates<br>Z2 coordinates | -15000—0 [0]<br>0—15000 [0] |
| !RC Revolution Control | O | !RC n [terminator] | n | Spindle motor revolution speed | 1—15<br>[Value set with spindle control] |
| !SZ Set Z0 Automatically | O | !SZ z [terminator] | z | Z direction maximum feed | -15000—0 |
| !VZ Velocity select Z-axis | O | !VZ s [terminator] | s | Feed rate (Z axis) | 0—30 [mm/sec] [2 [mm/sec]] |
| !ZM XYZ Axis<br>Simultaneus Feed | O | !ZM z [terminator] | z | Z coordinate | -15000—0 |
| !ZO Set Z0 | O | !ZO z [terminator] | z | Z machine coordinate | -15000—0 |
| !ZZ Z | O | !ZZ x1, y1, z1, ..... , xn, yn, zn [terminator] | xn, yn<br>zn | XY coordinate<br>Z coordinate | * 1<br>* 1 |

* Character set is the same as the Roland DG Corp. DXY-1000 series.

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

# 7. Device Control Instructions

The Device Control instructions determine how communication between the PNC-3100 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-3100. 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**<br>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**<br>Set Handshake Output Specifications (1) | [ESC].M<P1>;<P2>;<P3>;<P4>;<P5>;<P6>: | P1 : Delay time<br>P2 : Output trigger character<br>P3 : Echo terminator<br>P4 : Output terminator<br>P5 : Output terminator<br>P6 : Output initiator | 0—32767(msec) [0(msec)]<br>[0(Sets nothing)]<br>[0(Sets nothing)]<br>[13([CR])]<br>[0(Sets nothing)]<br>[0(Sets nothing)] | Sets handshake output specifications.<br><br>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- |

| Instruction | Format | Parameter | Range ([ ] is default) | Explanation |
|---|---|---|---|---|
| **ESC .N**<br>Set Handshake Output Specifications (2) | [ESC].N<P1>;<P2>;<P3>;<br>• • • • ;<P11>: | P1 : Intercharacter delay data block<br><br>P2—P11<br>: Xoff character (for Xon/Xoff)<br>Immediate response character<br>(for ENQ/ACK) | 0—32767(msec) [0(msec)]<br><br>[All 0(Sets nothing)] | Sets an intercharacter delay, and also an Xoff character for performing the Xon/Xoff handshake. |
| **ESC .H**<br>Sets ENQ/ACK Handshake Mode1 | [ESC].H<P1>;<P2>;<br><P3>; • • • • ;<P12>: | P1 : The number of bytes for data block<br>P2 : ENQ character<br>P3—12 : ACK character (only when <P2> is set) | 0—15358(byte) [80(byte)]<br><br>[0(Sets nothing)]<br>[All 0(Sets nothing)] | When receiving the ENQ character set by <P2>, com-pares 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. |
| **ESC .I**<br>Set Xon/Xoff Handshake and ENQ/ ACK Handshake Mode2 | [ESC].I<P1>;<P2>;<br><P3> ;••••••••;<P12>: | P1 : Limit of the remaining buffer capacity (for Xon/Xoff)<br>The number of data block bytes (for ENQ/ACK (mode2))<br>P2 : ENQ character<br>(for ENQ/ACK (mode2))<br>:0 (for Xon/Xoff)<br>P3—P12<br>: Xon character (for Xon/Xoff)<br>ACK character<br>(for ENQ/ACK (mode2)) | 0—15358(byte) [80(byte)]<br><br>[0 (Set nothing)]<br><br>[All 0 (Set nothing)] | Used for performing the Xon/Xoff handshake and the ENQ/ ACK handshake mode 2.<br>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. |
| **ESC .@**<br>Set Physical I/O Buffer and DTR control | [ESC].@<P1>;<P2>: | P1 : Physical I/O buffer<br>P2 : DTR signal control | 0—1024 [1024]<br>0—255 [1] | <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. |
| **Status Instruction** | | | | |
| **ESC .O**<br>Output Status Word | [ESC].O: | None | | Outputs the value that represents the status of buffer and pause. This value is shown in the table below.<br><br>Code / Status of buffer and pause<br>0 — Buffer contains data.<br>8 — Buffer empty.<br>16 — Buffer contains data. PNC-3100 paused (PAUSE On displayed).<br>24 — Buffer empty. PNC-3100 paused (PAUSE On displayed). |
| **ESC .E**<br>Output RS-232C Error Code | [ESC].E | None | | 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.<br><br>Error code / Meaning<br>0 — No I/O errors<br>10 — During an output instruction being executed, another output instruction is sent (only the current instruction is effective)<br>11 — An error occurs in a device control instruction.<br>12 — Incorrect parameters are set to a device control instruction (the default value is set to the erroneous parameter)<br>13 — Parameters are overflowing<br>14 — The number of the parameters set is more than specified or a colon ':' was not used to terminate<br>15 — Framing error, parity error or over-run error at the time of data receipt<br>16 — The I/O buffer overflows |
| **ESC .L** | [ESC].L | None | | Outputs the current logic size of the I/O buffer. Note that the output is done only when the I/O buffer is empty. |
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# APPENDIX

## Supplies

### < Tools>

| Name | | Product No. | Specifications |
|---|---|---|---|
| End mill | Conventional steel straight end mill | ZHS-100 | ϕ1 3 l x 6d x 45L x 2NT |
| | | ZHS-200 | ϕ2 5 l x 6d x 50L x 2NT |
| | | ZHS-300 | ϕ3 8 l x 6d x 50L x 2NT |
| | | ZHS-400 | ϕ4 8 l x 6d x 60L x 2NT |
| | | ZHS-500 | ϕ5 10 l x 6d x 60L x 2NT |
| | | ZHS-600 | ϕ6 12 l x 6d x 60L x 2NT |
| | Cemented carbide steel ball end mill (superfine particle) | ZUB-150 | R1.5 10 l x 3d x 65L x 2NT |
| | | ZUB-200 | R2.0 12 l x 4d x 65L x 2NT |
| | | ZUB-250 | R2.5 20 l x 5d x 65L x 2NT |
| | | ZUB-300 | R3.0 30 l x 6d x 65L x 2NT |
| | Cemented carbide steel straight end mill (superfine particle) | ZUS-300 | ϕ3 8 l x 6d x 60L x 2NT |
| | | ZUS-400 | ϕ4 8 l x 6d x 60L x 2NT |
| | | ZUS-500 | ϕ5 10 l x 6d x 60L x 2NT |
| | | ZUS-600 | ϕ6 12 l x 6d x 60L x 2NT |
| Character engraving cutter cemented carbide | | ZEC-100 | ϕ6 x 50L (resin plate exclusive) |

### < Materials >

| Name | Product No. | Specifications |
|---|---|---|
| Modeling-use wax | ZW-100 | 75 x 70 x 38 mm (t) (10 pcs.) |
| | ZW-200 | 75 x 176 x 40 mm (t) (10 pcs.) |

### < Others >

| Name | Product No. | Specifications |
|---|---|---|
| Machine vice | ZV-1 | Width 100 mm(X) x max. 125 mm(Y) x height 50 mm(Z) |
| Z0 setting-use sensor | ZSE-1 | Height 20 mm, Diameter 40 mm |

# *Collet chuck*

The collet chuck and collet cap included with the PNC-3100 are the EDC-0624 (diameter 6 mm (1/4") collet chuck) and KDP-2422 (collet cap) made by NT Tool Co., Ltd.
Please see the chart below for collet chucks with diameters other than 6 mm (1/4").

## < Collet chucks> (Not available from Roland DG Corporation)

| Name | Product No. | Tool shank diameter |
|---|---|---|
| Collet chuck | EDC-0324 | ϕ3.0—2.8 |
| | EDC-03324 | ϕ3.3—3.1 |
| | EDC-03624 | ϕ3.6—3.4 |
| | EDC-03924 | ϕ3.9—3.7 |
| | EDC-04224 | ϕ4.2—4.0 |
| | EDC-04524 | ϕ4.5—4.3 |
| | EDC-0524 | ϕ5.0—4.6 |
| | EDC-05524 | ϕ5.5—5.1 |
| | EDC-0624 | ϕ6.0—5.6 |
| | EDC-06524 | ϕ6.5—6.1 |
| | EDC-0724 | ϕ7.0—6.6 |
| | EDC-07524 | ϕ7.5—7.1 |
| | EDC-0824 | ϕ8.0—7.6 |
| | EDC-08524 | ϕ8.5—8.1 |
| | EDC-0924 | ϕ9.0—8.6 |
| | EDC-09524 | ϕ9.5—9.1 |
| | EDC-1024 | ϕ10.0—9.6 |

| Name | Product No. | Specification |
|---|---|---|
| Collet cap | KDP-2422 | Collet cap for the EDC- ØA24 series |

# Specifications

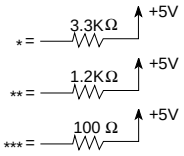
| | PNC-3100 |
|---|---|
| XY table size | 560 mm x 170 mm (22-1/16" x 6-11/16") |
| Max. cutting area | 250 mm(X) x 150 mm(Y) x 150 mm(Z) (9-13/16"(X) x 5-7/8"(Y) x 5-7/8"(Z)) |
| Software resolution | 0.01 mm/step (0.00039") |
| Mechanical resolution | 0.00125 mm/step (micro-step control) |
| Feed rate | X, Y-axis : Max. 60 mm/sec. (2-3/8"/sec.) Z-axis : Max. 30 mm/sec. (1-3/16"/sec.) |
| Spindle motor | 180W (AC commutator motor) |
| Revolution speed | 3000—8000 rpm (variable manually or via instruction) |
| Display function | X, Y and Z all-axis display function (0.01 mm unit), Spindle RPM (100 rpm unit) |
| Interface | Parallel (in compliance with the specification of Centronics)<br>Serial (under RS-232C standard) |
| Buffer size | 1Mbyte |
| Instruction system | CAMM-GLI (mode1, mode2) |
| Control keys | Z0, Z1, Z2, HOME, ENTER, PAUSE ON, OFF, SPINDLE TEST ON/OFF<br>SENSOR ON/OFF, REPLOT, BUFFER CLEAR, VIEW<br>▲, ▼, ◄, ►, ▲, ▼, JOG HANDLE, JOG, SPINDLE CONTROL |
| Source | 2.4 A / 117 V 1.4 A / 220—230 V 1.3 A / 240 V |
| External dimensions | Main unit : 560 mm(W) x 605 mm(H) x 540 m(D)<br>(22-1/16"(W) x 23-7/8"(H) x 21-5/16"(D))<br>Controller : 124 mm(W) x 221 mm(H) x 392 mm(D)<br>(4-15/16"(W) x 8-3/4"(H) x 15-7/16"(D))<br>Switch panel : 226 mm(W) x 48 mm(H) x 122 mm(D)<br>(8-15/16"(W) x 1-15/16"(H) x 4-13/16"(D)) |
| Weight | Main unit : 52 kg (114.6 lb.) Controller : 9 kg (19.8 lb.) Switch panel : 1.1 kg (2.4 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), power cord<br>spanners : 3, hexagonal wrenches : 2, T nuts : 2, user's manual |

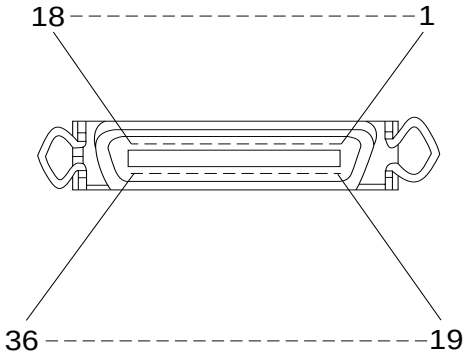
**• Interface Specification**

| | |
|---|---|
| [ 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 lebel | TTL level |
| Transmissinon method | Asynchronous |
| [ Serial ] | |
| Standard | RS-232C specification |
| Transmissinon method | Asynchronous, duplex data transmission |
| Transmissinon speed | 4800, 9600 (adjustable by DIP switch) |
| Parity check | Odd, Even, None (adjustable by DIP switch) |
| Data bits | 7 or 8 bits (adjustable by DIP switch) |
| Stop bits | 1 or 2 bits (adjustable by DIP switch) |

## • Parallel connector

| | | | |
|---|---|---|---|
| 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 | $\overline{\text{STROBE}}$ |

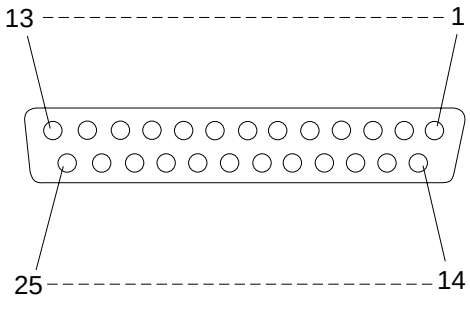



## • Serial connector

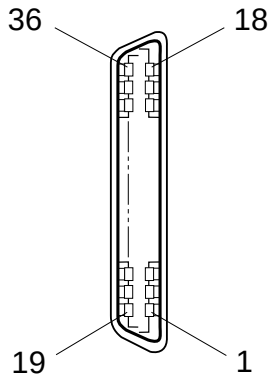
| Terminal No. | Signal |
|---|---|
| 1 | FG |
| 2 | TXD |
| 3 | RXD |
| 4 | RTS |
| 5 | CTS |
| 6 | DSR |
| 7 | SG |
| 8 | NC |
| 9 | NC |
| 10 | NC |
| 11 | NC |
| 12 | NC |
| 13 | NC |
| 14 | NC |
| 15 | NC |
| 16 | NC |
| 17 | NC |
| 18 | NC |
| 19 | NC |
| 20 | DTR |
| 21 | NC |
| 22 | NC |
| 23 | NC |
| 24 | NC |
| 25 | NC |

Pin connection



## • Option connector

| | | | |
|---|---|---|---|
| NC | 36 | 18 | NC |
| | 35 | 17 | |
| | 34 | 16 | |
| | 33 | 15 | |
| | 32 | 14 | |
| | 31 | 13 | |
| | 30 | 12 | |
| | 29 | 11 | |
| | 28 | 10 | |
| | 27 | 9 | |
| | 26 | 8 | |
| | 25 | 7 | |
| | 24 | 6 | |
| | 23 | 5 | |
| | 22 | 4 | |
| | 21 | 3 | |
| | 20 | 2 | |
| GND | 19 | 1 | SPINDLE ON/OFF |




Connector : JAE Co. (TX20A-36R-D2LT1-A1LH)
(paired connector : TX20A-36PHI-1-D2PI-D1)
Terminals : 36 pins
Spindle ON/OFF signal level : TTL level (H : ON, L : OFF)

# Index

Roland

PNC-3100

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R9-980216