

# **NUM 1060**

## **RTCP FUNCTION INTEGRATION TOOL**

**en-938936/0**

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The programming examples described in this manual are intended for guidance only. They must be specially adapted before they can be used in programs with an industrial application, according to the automated system used and the safety levels required.

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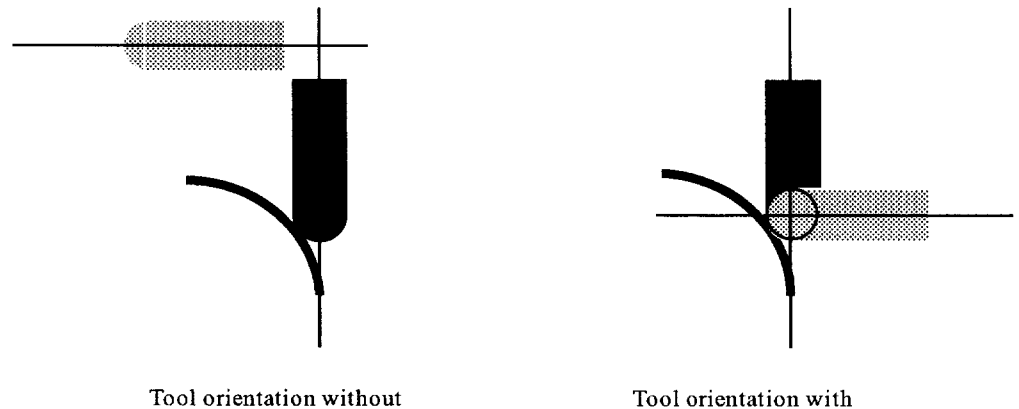
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## 1.1 Principle

The RTCP (Rotation around Tool Centre Point) option for NUM 1060 CNC is designed to compensate automatically for the offsets caused by moving the rotary axes of a five-axis machine. This compensation is achieved by moving the main machine axes. It preserves the position of the ball-end tool centre.

The figure below shows the difference between operation without RTCP and with RTCP.



When used alone, this function requires only an enable command and an inhibit command. However, a tool coordinate system can be defined in any position in space to be able to work on an inclined plane using a part programme written for the plane of the machine axes. It is then necessary to programme the characteristics of this coordinate system when enabling RTCP. The application applies the offsets due to movement of the rotary axes to the linear axes and thereby controls the speed and end of travel on each axis without requiring the OEM to reprogramme the machine processor.

Five functions are provided:

- Selection of one of a maximum of four head configurations
- Enabling of the RTCP function for an inclined plane by programming the origin of the new coordinate system
- Enabling of the RTCP function and operation on an inclined plane after positioning the tool in the origin or at a known dimension of the new coordinate system
- Inhibiting of the RTCP function and associated inclined plane (for instance, to return to the machine coordinate system for a tool change)
- Reenabling of the RTCP function with the last inclined plane programmed.

## 1.2 Operating Conditions

### 1.2.1 Tool Configurations Supported

The names of the axes and their directions of movements must comply with the customary standard:

- The A axis rotates around the X axis. The positive direction of movement is from Y to Z
  - The B axis rotates around the Y axis. The positive direction of movement is from Z to X
  - The C axis rotates around the Z axis. The positive direction of movement is from X to Y.
- If one of the rotary axes does not rotate around one of the main machine axes, its name is the one generally used on machines.

The following head structures are supported:

- Cartesian head, A axis carried by B axis (double twist A on B)
- Cartesian head, A axis carried by C axis (double twist A on C)
- Cartesian head, B axis carried by A axis (double twist B on A)
- Cartesian head, B axis carried by C axis (double twist B on C)
- Head with A axis inclined by  $\alpha$  degrees around the X axis carried by the B axis (double twist A with angle on B)
- Head with A axis inclined by  $\alpha$  degrees around the X axis carried by the C axis (double twist A with angle on C)
- Head with B axis inclined by  $\alpha$  degrees around the Y axis carried by the C axis (double twist B with angle on C)

### 1.2.2 RTCP Definition Convention

The RTCP function is used to change the tool orientation without changing the path of the contact point between the tool and part. This operation is only possible for a ball-end tool, i.e. whose radius R is equal to the tool tip radius @.

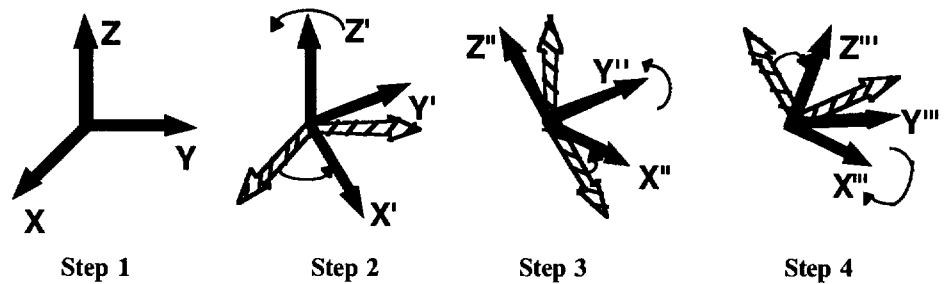
If the values of R and @ are different in the associated offset, the value of the tool tip radius is used to calculate the movements caused by the function.

### 1.2.3 Inclined Plane Definition Convention

The definition of a coordinate system in space based on a reference three-axis coordinate system requires knowing:

- A translation vector (EU, EV, EW) between the origin of the reference coordinate system and that of the one to be defined
- Three rotations around X, Y and Z, with values EA, EB and EC respectively, defining the orientation in space of the new coordinate system.

These four steps are carried out in the following order:



Step 1: Translation by the values EU, EV and EW on the axes of the machine coordinate system.

Step 2: Rotation of the coordinate system obtained in step 1 by EC around the Z axis.

Step 3: Rotation of the coordinate system obtained in step 2 by EB around the Y' axis.

Step 4: Rotation of the coordinate system obtained in step 3 by EA around the X'' axis.

**REMARK:** *It is important to note that the inclined plane application operates correctly only with this definition of the coordinate system offset angles (rotation around Z, then around Y, then around X).*

### 1.2.4 Configuration of the CNC

The RTCP function requires software at index G or above as well as commercial option xx154 (option bit 17).

In addition, the rotary axes must be declared as measured and/or servo-controlled.



### 2.1 Package Configuration

The RTCP application package includes:

- This installation and operating manual
- A 3 1/2" HD diskette including:
  - 29 files in the main directory
  - 9 files in the DOS subdirectory
  - 2 files in the AFFECTAX.MCH subdirectory.

### 2.2 Equipment Required for Installation and Operation

#### 2.2.1 Operation in DOS Environment

A PC or compatible computer including as a minimum:

- 8086 microprocessor
- 640-Kbyte RAM
- MS-DOS 3 operating system
- 3 1/2" diskette drive
- Serial port
- RS232 interface cable.

#### 2.2.2 Operation under Windows

A PC or compatible computer including as a minimum:

- 80386 microprocessor
- MS-DOS 5 operating system
- Windows 3.1 graphic user interface
- 4-Mbyte RAM
- 3 1/2" diskette drive
- Hard disk with 1 Mbyte free
- Serial port
- RS232 interface cable.

## 2.3 Installing the Software

Before installation, make a copy of the diskette supplied, store the original diskette and use the copy.

### 2.3.1 Installing under DOS

It is recommended to load the software onto the hard disk before customising the application, although operation from the diskette is possible. To do so:

---

**Create a working directory by the command "MD C:\APP\_TOOL".  
Go into the directory by the command "CD C:\APP\_TOOL".**

---

---

**Copy the files from the diskette to the hard disk by the command "COPY A:\DOS\\*.\*"**

---

For use on the diskette

---

**Enter the command "A:\DOS"**

---

### 2.3.2 Installing under Windows

Installation on the hard disk is mandatory. In this case, the procedure is automatic.

---

**If necessary, open Windows by entering "WIN".**

---

---

**If necessary, open the program manager.**

---

---

**Insert the installation diskette in the drive.**

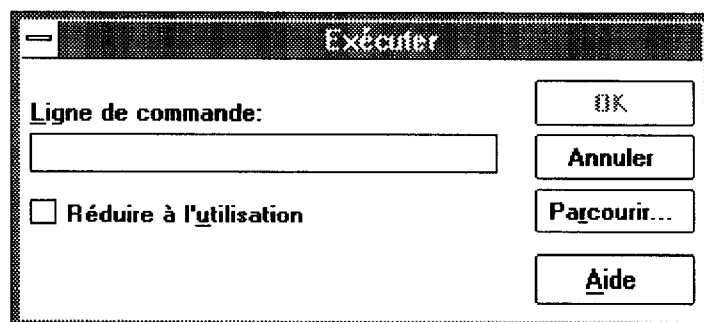
---

---

**Select the "Run..." command in the "File" menu.**

---

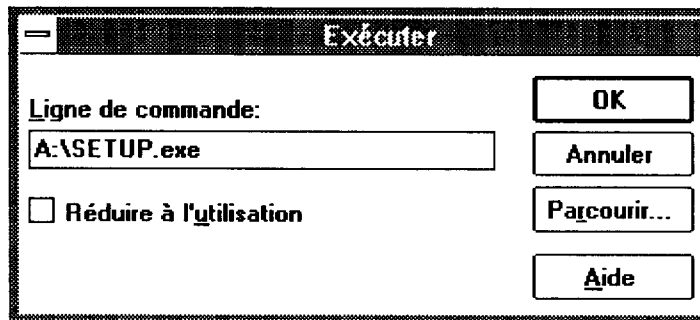
The "Run" dialogue box is displayed.



---

Enter the following command line.

---



*REMARK:* If you are using drive B, enter the command "B:\SETUP.EXE".

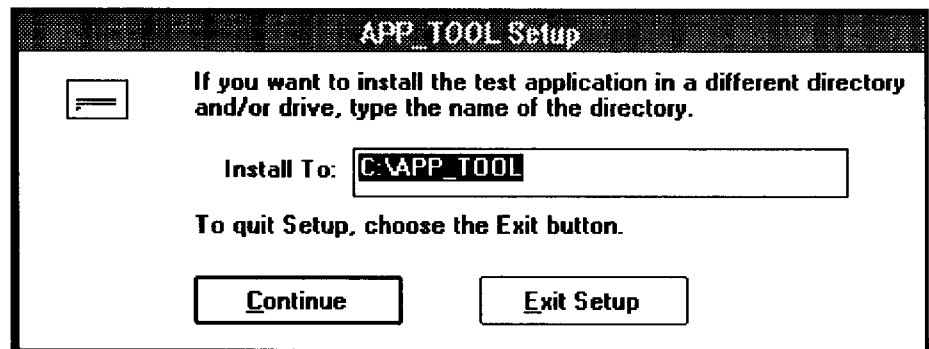
---

Confirm the command line by clicking "OK".

---

The message "Initializing setup" is displayed.

The dialogue box displayed contains the default path name for the software.



---

Modify the path name if required then continue by "Continue".

---

The "Install" programme is run.

If installation is successful, the following dialogue box is displayed.



---

**Acknowledge by clicking "OK".**

---

The program manager is displayed.

Exiting from the Procedure

In dialogue boxes containing the "Exit setup" command button, it is possible to exit from the installation procedure.

---

**Click the "Exit setup" command button.**

---

## **2.4 Interfacing with the CNC**

The interface is via the computer COM1 or COM2 serial port and the PERIPH connector on the CNC.

Refer to Section 6.12 of the Installation Manual for the wiring diagram and precautions for correct interference suppression on the system.

---

## 3 Customising the RTCP Function

### 3.1 General

The RTCP application is accompanied by a customising tool to adapt it to different machine structures.

After definition of a list of named variables, the tool creates three object programmes in ISO language to be loaded in the CNC memory:

- File %10151 containing the RTCP application as such
- A file whose name is to be defined (see the customisation procedure below) containing the machine structure mechanical data
- File %20x00 containing the error messages generated by the RTCP application (error numbers between x00 and x99, where x is a variable to be defined).

Since programmes %10151 and %20x00 are not subject to modification by the OEM and/or user once customisation is completed, they are advantageously loaded in area 1, 2 or 3. The loading method is described in the NUM 1060 CNC Operator Manual.

The third file can also be loaded in area 1, 2 or 3 but must remain available to be able to correct dimensions subsequent to maintenance operations, such as mechanical disassembly of one of the rotary axes.

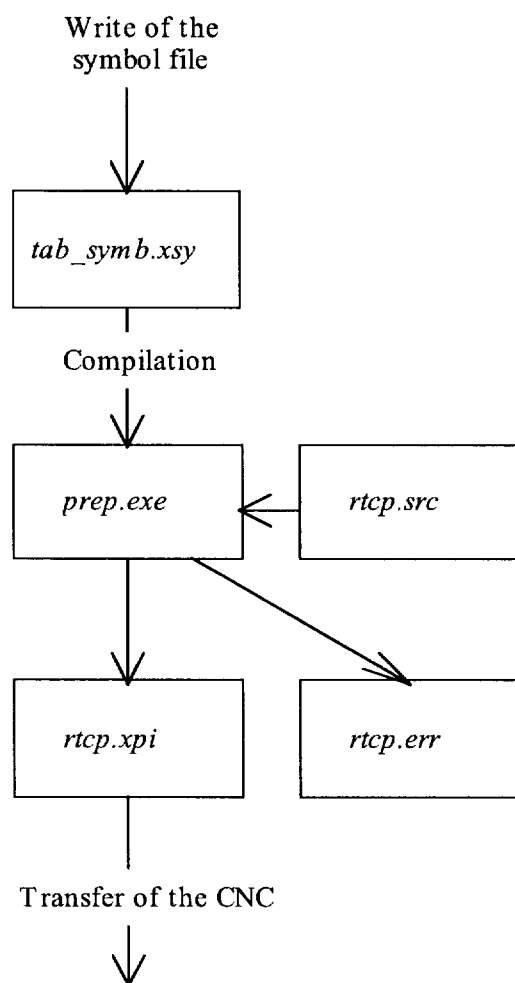
### 3.2 Customising under DOS

The customisation procedure is as follows:

- Description of the mechanical structures to be supported as well as the options to be enabled by writing variables in a symbol table
- Compilation of this symbol table with the RTCP tool. This operation creates an ISO object file including the three programmes mentioned
- Transfer of the files to the CNC.

The diagram below illustrates this procedure as well as the files used or generated:

- *tab\_symb.xsy* text file containing the customised symbol table
- *rtcp.src* text file containing the RTCP customisation tool. Do not modify this file
- *prep.exe* executable file containing the compiler
- *rtcp.xpi* ISO file resulting from compilation of the RTCP tool with the symbol table. This is the file that will be transferred to the CNC
- *rtcp.err* text file containing compilation errors. The errors are mainly due to incorrect spelling of a variable in the symbol table or to modification of the *rtcp.src* programme (in this case, copy the programme from the DOS directory on the diskette).



### 3.2.1 Symbol Table

The symbol table is a text file with an eight-letter name (MS-DOS filename format) whose extension is always .XSY:

example      *tab\_symb.xsy*

This symbol table contains only two types of items:

- Comments
- Variable assignments.

#### 3.2.1.1 Comments

Any line or part of line beginning with:

- // (2 consecutive slashes)
  - ; (semicolon)
- is considered a comment.

Example      *// This is a comment in the symbol table*  
                 *; and this is also a comment*

As well as any phrase used as third element of a variable assignment.

#### 3.2.1.2 Assigning Variables

A variable assignment statement has the following format:

*mnemonic      value      comment*

The mnemonic (first element in the line) is mandatorily one of the variables in the application list. It must begin in the first column and must be written as specified in Section 3.2.1.3. If it is omitted since declared as optional, its default value is assigned.

The value (second element in the line) can be a numerical or alphanumeric value. If it is omitted, a value of 0 is assigned. In this case, the comment is prohibited.

The comment (third element in the line) is optional. It can include several words separated by spaces and/or tabs. It does not have to begin with // or ;.

These three elements can be separated by spaces and/or tab characters.

Example      *num\_prog      10151      programme number definition*

File *rtcp.xsy* on the diskette is an example of symbol table.

### 3.2.1.3

## Variables of the Application

Each variable of the RTCP application is described below with its name, its meaning, possibly an example, whether or not it is optional, its type and its default value.

General variables:

|                     |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>num_prog</b>     | <p>This variable specifies the ISO programme number assigned to the file containing the machine structure engineering data. It is automatically followed by the extension .9 to make it inexecutable during a cycle.<br/><i>num_prog 1000</i> creates programme %1000.9<br/>Optional.<br/>Numerical.<br/>Default value: 10151.</p>                                                                            |
| <b>reference</b>    | <p>This variable specifies a free text appearing on the second line of the programmes generated. It can be used to identify the customisation.<br/>Optional.<br/>Text without spaces.<br/>Default value: none.</p>                                                                                                                                                                                            |
| <b>langue</b>       | <p>This variable specifies the language in which the error messages are written:<br/>Optional.<br/>Numerical:<br/>0      French<br/>1      English<br/>Default value: 0.</p>                                                                                                                                                                                                                                  |
| <b>num_mess_err</b> | <p>This variable specifies the hundreds block containing the inclined plane error messages. Care must be taken not to assign a digit corresponding to a hundreds block already used.<br/><i>num_mess_err 5</i> gives messages between 500 and 599.<br/>Optional.<br/>Numerical: Care must be taken not to assign the digit of a hundreds block already used.<br/>Default value: 5.</p>                        |
| <b>logiciel</b>     | <p>This variable specifies the CNC software index.<br/>Optional.<br/>A letter: F, G, ...<br/>Default value: G (minimum index).</p>                                                                                                                                                                                                                                                                            |
| <b>debug</b>        | <p>This variable is used to switch to debug mode and display the results of intermediate calculations in external parameters Exxxxx via the <i>p_debug</i> variable. During normal operation, this variable must not be defined, since it can modify the values of a number of these parameters when the inclined plane function is called.<br/>Optional.<br/>No value required.<br/>Default value: none.</p> |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>p_debug</b>        | <p>This variable used with the above variable gives the number of the first external parameter Exxxxx used by the debug mode.</p> <p>debug <i>p_debug 80000</i> defines E80000 as first parameter of the debug mode.</p> <p>Optional.</p> <p>Numerical.</p> <p>Default value: 80000</p>                                                                                                               |
| <b>M_valid_rtcp</b>   | <p>This variable specifies the number of the M function sent to the PLC by the application to enable the RTCP function.</p> <p>Optional.</p> <p>Numerical.</p> <p>Default value: 252.</p>                                                                                                                                                                                                             |
| <b>M_devalid_rtcp</b> | <p>This variable specifies the number of the M function sent to the PLC by the application to inhibit the RTCP function.</p> <p>Optional.</p> <p>Numerical.</p> <p>Default value: 253.</p>                                                                                                                                                                                                            |
| <b>def_tete</b>       | <p>This variable specifies the selection of one head configuration out of a maximum of 4.</p> <p>Optional.</p> <p>Numerical.</p> <p>0        The choice is made by programming Tx in the definition of the inclined plane, with x between 1 and 4</p> <p>1        The choice is made by the value of the parameter defined in param_tete</p> <p>Default value: 0.</p>                                 |
| <b>param_tete</b>     | <p>This variable specifies the choice of one head configuration out of a maximum of 4 only in the case where variable def_tete = 1.</p> <p>Optional.</p> <p>Programme parameter or variable.</p> <p>Default value: E42124.</p>                                                                                                                                                                        |
| <b>decal</b>          | <p>This variable specifies how DAT2 is applied for the inclined plane associated with the RTCP function.</p> <p>Optional.</p> <p>Numerical</p> <p>0        DAT2 is applied before declaration of the inclined plane</p> <p>1        DAT2 is applied after declaration of the inclined plane</p> <p>Default value: 0.</p>                                                                              |
| <b>H_rtcp</b>         | <p>This variable specifies the number of a programme called by the application just before the RTCP function is enabled (enabling of dynamic operators, etc.).</p> <p><b>CAUTION: If this programme does not exist, error 25 is generated in the inclined plane definition block.</b></p> <p>Optional.</p> <p>Numerical or programme parameter or programme variable.</p> <p>Default value: none.</p> |
| <b>param_sauv</b>     | <p>This variable specifies the number of the first E parameter used to back up the characteristics of the RTCP function and the associated inclined plane.</p> <p>Optional.</p> <p>Numerical.</p> <p>Default value: 80000.</p>                                                                                                                                                                        |

The following variables are directly related to the machine structure. Since it is possible to select one configuration out of a maximum of four, variables that are equivalent for the different configurations have the same name followed by the configuration number.

Example: *type\_1*, *nom\_R1*, *U1\_1* are variables related to configuration 1, whereas *type\_2*, *nom\_R2* and *U1\_2* are related to configuration 2.

All these variables are related to description of the head configurations supported (for these configurations, see Appendix 3).

In the variables listed below, the index is replaced by the character x, which can vary from 1 to 4.

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>type_x</b>    | <p>This variable specifies the number of the head configuration that will be characterised by the following variables. Configuration 1 must mandatorily be specified for correct operation of the application. The other configurations can be omitted to decrease the volume of ISO code generated.</p> <p>Optional except for <i>type_1</i>.</p> <p>Numerical.</p> <p>Default value: 0 (none).</p>                                                                                                                                                                                                                                                                                                         |
| <b>Nom_Rx</b>    | <p>This variable specifies the name of the R axis (see Appendix 3). It must mandatorily be assigned the value specified in the configuration name.</p> <p><i>Example:</i> Double twist A on B<br/>nom_Rx must equal B</p> <p>Mandatory.</p> <p>Letter: A, B or C.</p> <p>Default value: none.</p>                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>type_Rx</b>   | <p>This variable specifies the type of measurement associated with the R axis. This parameter must be equal to zero for customising the RTCP function. Otherwise, a runtime error is generated. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.</p> <p>Numerical:</p> <ul style="list-style-type: none"> <li>0 Measurement in ten-thousandths of a degree by encoder on the axis card</li> <li>1 Measurement in degrees by programme parameter or variable</li> <li>2 Measurement in ten-thousandths of a degree by programme parameter or variable</li> <li>3 Measurement forced to 0 in the absence of a rotary axis</li> </ul> <p>Default value: 0.</p> |
| <b>valeur_Rx</b> | <p>This variable specifies the programme parameter or variable containing the measurement defined by <i>type_Rx</i>. This parameter is not used for customisation of the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.</p> <p>Programme parameter or variable</p> <p>Default value: E421 25.</p>                                                                                                                                                                                                                                                                                                                                          |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------|---|-----------------------------------------------------------|---|-------------------------------------------------------------------------------|---|---------------------------------------------------------|
| <b>R0_x</b>      | <p>This variable specifies the offset between the physical zero of the measurement and the theoretical zero of the R axis (see Appendix 3). This parameter is not used for customisation of the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.<br/>Numerical in degrees.<br/>Default value: 0.</p>                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>vangle_1x</b> | <p>This variable specifies the angle of the S axis from horizontal for certain configurations (see Appendix 3).</p> <p>Optional.<br/>Numerical in degrees.<br/>Default value: 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>U1_x</b>      | <p>This variable specifies the dimension on the X axis of the vector between the pivot point of the R axis and the pivot point of the S axis (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>V1_x</b>      | <p>This variable specifies the dimension on the Y axis of the vector between the pivot point of the R axis and the pivot point of the S axis (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>W1_x</b>      | <p>This variable specifies the dimension on the Z axis of the vector between the pivot point of the R axis and the pivot point of the S axis (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>Nom_Sx</b>    | <p>This variable specifies the name of the S axis (see Appendix 3). It must mandatorily be assigned the value specified in the configuration name.</p> <p><i>Example:</i>      Double twist A on B<br/>                    nom_Sx must equal A</p> <p>Mandatory.<br/>Letter: A, B or C.<br/>Default value: none.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| <b>type_Sx</b>   | <p>This variable specifies the type of measurement associated with the S axis. This parameter must be equal to zero for customising the RTCP function. Otherwise, a runtime error is generated. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.<br/>Numerical:</p> <table> <tr> <td>0</td><td>Measurement in ten-thousandths of a degree by encoder on the axis card</td></tr> <tr> <td>1</td><td>Measurement in degrees by programme parameter or variable</td></tr> <tr> <td>2</td><td>Measurement in ten-thousandths of a degree by programme parameter or variable</td></tr> <tr> <td>3</td><td>Measurement forced to 0 in the absence of a rotary axis</td></tr> </table> <p>Default value: 0.</p> | 0 | Measurement in ten-thousandths of a degree by encoder on the axis card | 1 | Measurement in degrees by programme parameter or variable | 2 | Measurement in ten-thousandths of a degree by programme parameter or variable | 3 | Measurement forced to 0 in the absence of a rotary axis |
| 0                | Measurement in ten-thousandths of a degree by encoder on the axis card                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| 1                | Measurement in degrees by programme parameter or variable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| 2                | Measurement in ten-thousandths of a degree by programme parameter or variable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |
| 3                | Measurement forced to 0 in the absence of a rotary axis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                                                                        |   |                                                           |   |                                                                               |   |                                                         |

|                  |                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>valeur_Sx</b> | <p>This variable specifies the programme parameter or variable containing the measurement defined by <i>type_Sx</i>. This parameter is not used for customisation of the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.<br/>Programme parameter or variable<br/>Default value: E42126.</p>         |
| <b>S0_x</b>      | <p>This variable specifies the offset between the physical zero of the measurement and the theoretical zero of the S axis (see Appendix 3). This parameter is not used for customisation of the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p> <p>Optional.<br/>Numerical in degrees.<br/>Default value: 0.</p> |
| <b>vangle_2x</b> | Not used in the configurations supported.                                                                                                                                                                                                                                                                                                                            |
| <b>U2_x</b>      | <p>This variable specifies the dimension on the X axis of the vector between the pivot point of the S axis and the tool cone zero (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                             |
| <b>V2_x</b>      | <p>This variable specifies the dimension on the Y axis of the vector between the pivot point of the S axis and the tool cone zero (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                             |
| <b>W2_x</b>      | <p>This variable specifies the dimension on the Z axis of the vector between the pivot point of the S axis and the tool cone zero (see Appendix 3).</p> <p>Optional.<br/>Numerical in internal measurement units (micrometres)<br/>Default value: 0.</p>                                                                                                             |
| <b>valeur_Tx</b> | Not used in the configurations supported.                                                                                                                                                                                                                                                                                                                            |
| <b>U3_x</b>      | Not used in the configurations supported.                                                                                                                                                                                                                                                                                                                            |
| <b>V3_x</b>      | Not used in the configurations supported.                                                                                                                                                                                                                                                                                                                            |
| <b>W3_x</b>      | Not used in the configurations supported.                                                                                                                                                                                                                                                                                                                            |

### 3.2.2 Compile

When the symbol table is correctly filled in, customising continues by compiling the table with the RTCP tool.

---

**Enter the command "PREP RTCP" *tab\_symb***

---

- PREP is the compile command
- RTCP is the RTCP integration tool
- *tab\_symb* is the symbol table that was customised.

When compilation is completed, the message "Compilation OK" is displayed if compilation was successful. Otherwise, the number of errors detected is indicated.

In this case, error file *rtcp.err* is generated. It indicates the origin of the errors.

When compilation is successful, only ISO file *rtcp.xpi* is generated.

### 3.2.3 Transfer

Programme *transfer.bat* is included on the diskette to facilitate transfer of the ISO programme generated.

It configures the COM1 port of the computer as follows:  
9600 bauds, even parity, 7 bits, 1 stop bit.

Check that the data rate of the CNC PERIPH line is compatible or edit the transfer programme using a text editor.

---

**Enter the command "TRANSFER RTCP".**

---

---

**Select the file loading mode on the CNC.**

---

---

**Select 0 PROGRAMS.**

---

---

**Press "Return".**

---

The cycle LED comes on and remains lit until the transfer is completed.

The CNC is then ready to use the RTCP function.

### 3.3 Customising RTCP under Windows

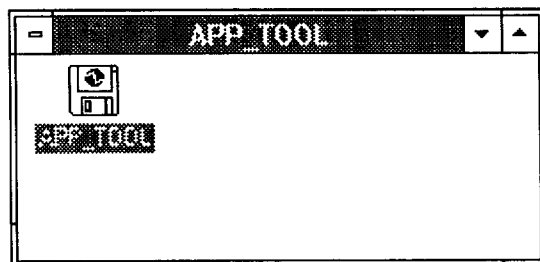
Requirements

Program manager open.

---

Select the APP\_TOOL application icon.

---



---

Select the "Open" command in the "File" menu

---

or

---

Press "Enter"

---

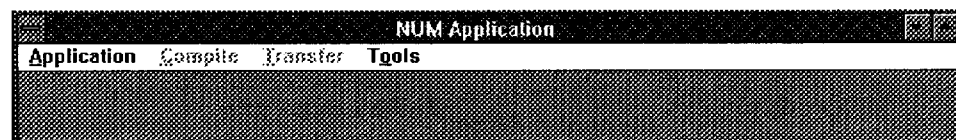
or

---

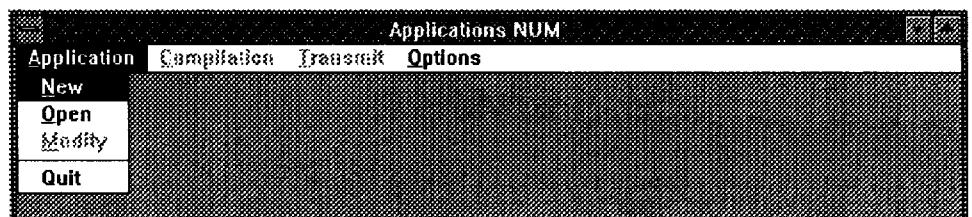
Double click the icon.

---

APP\_TOOL opens with the following menu.

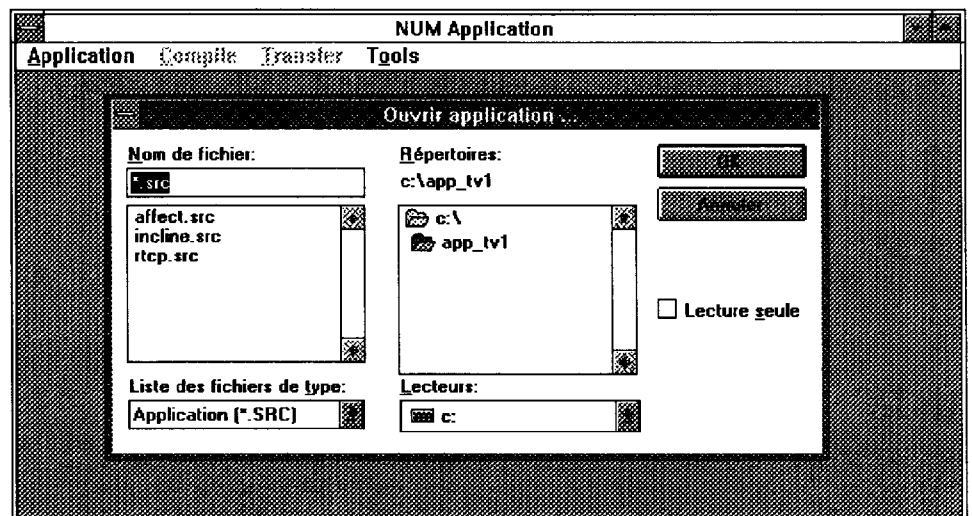


### 3.3.1 Application Menu



#### 3.3.1.1 Open

This command opens a dialogue box for selecting the application to be customised:

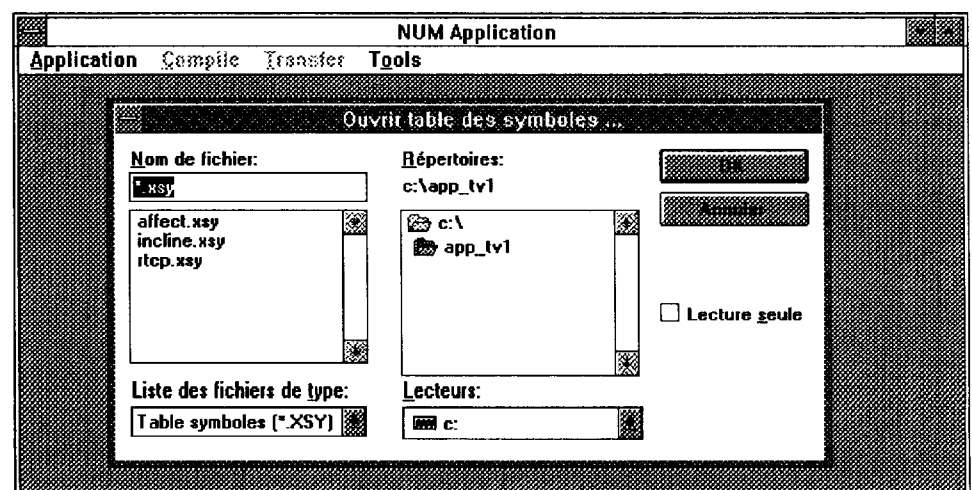


---

Select a symbol table and confirm by OK.

---

A dialogue box for selecting the symbol table is then displayed:



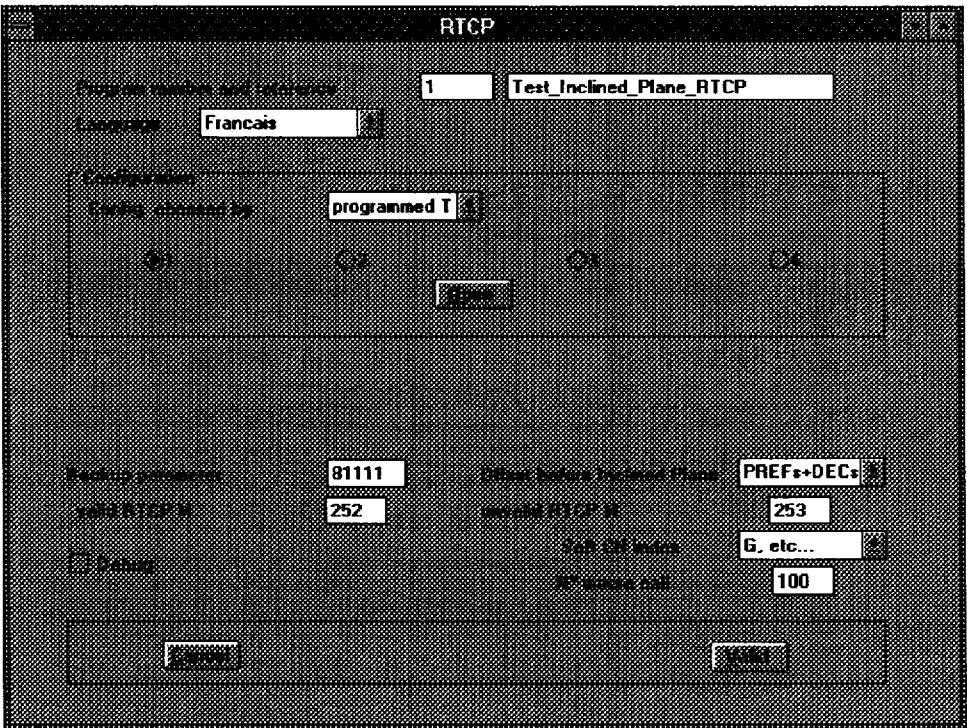
---

Select a symbol table and confirm by OK.

---

3.3.1.2 Modify

This command is not available until an application has been opened and the symbol table chosen.



|                                     |                                                                                                                                                                                                            |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Program number</b>               | This field specifies the ISO programme number assigned to the file containing the machine structure engineering data. It is automatically followed by extension .9 to make it inexecutable during a cycle. |
| <b>reference</b>                    | This field is for entry of a free text appearing on the second line of the programmes generated. It can be used to identify the customisation.                                                             |
| <b>Language</b>                     | This field specifies the language in which the error messages are displayed. Two possibilities are proposed: French or English.                                                                            |
| <b>Configuration chosen by</b>      | This field specifies how one of the four configurations is chosen. There are two possibilities: T programmed in definition of the inclined plane (programmed T) or by the PLC (PLC parameter).             |
| <b>Parameter</b>                    | This field appears on when the configuration is chosen by the PLC. It specifies the parameter that contains the configuration number.                                                                      |
| <b>Backup parameter</b>             | This field specifies the number of the first external parameter, Exxxxx, used to back up the characteristics of the RTCP function and the associated inclined plane.                                       |
| <b>Offset before Inclined Plane</b> | This field specifies the offsets taken into account before the change of coordinate system. There are two possibilities: PREF+DEC (DAT1+DAT2) or PREF (DAT1).                                              |

|                       |                                                                                                                                                                                                                                                                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>valid RTCP M</b>   | This field specifies the number of the M function sent to the PLC by the application to enable the RTCP function.                                                                                                                                                                                                                       |
| <b>invalid RTCP M</b> | This field specifies the number of the M function sent to the application to inhibit the RTCP function.                                                                                                                                                                                                                                 |
| <b>Debug</b>          | This command enables a mode in which the intermediate computation results are stored for display in external parameters Exxxxx. This command must not be used during normal operation as it can modify the values of a number of these parameters when the RTCP function is called.                                                     |
| <b>External</b>       | This field, which appears only when the debug function is enabled, gives the number of the first external parameter Exxxxx used by the debug mode.                                                                                                                                                                                      |
| <b>Soft CN index</b>  | This field specifies the CNC software index.<br>Two possibilities are proposed: F or G.                                                                                                                                                                                                                                                 |
| <b>N° macro call</b>  | This field specifies the number of a macro called by the application just before activation of the RTCP function (dynamic operator enable, etc.). It may be a programme number or a programme variable parameter number.<br><b>CAUTION: If this macro does not exist, error 25 is generated in the inclined plane definition block.</b> |

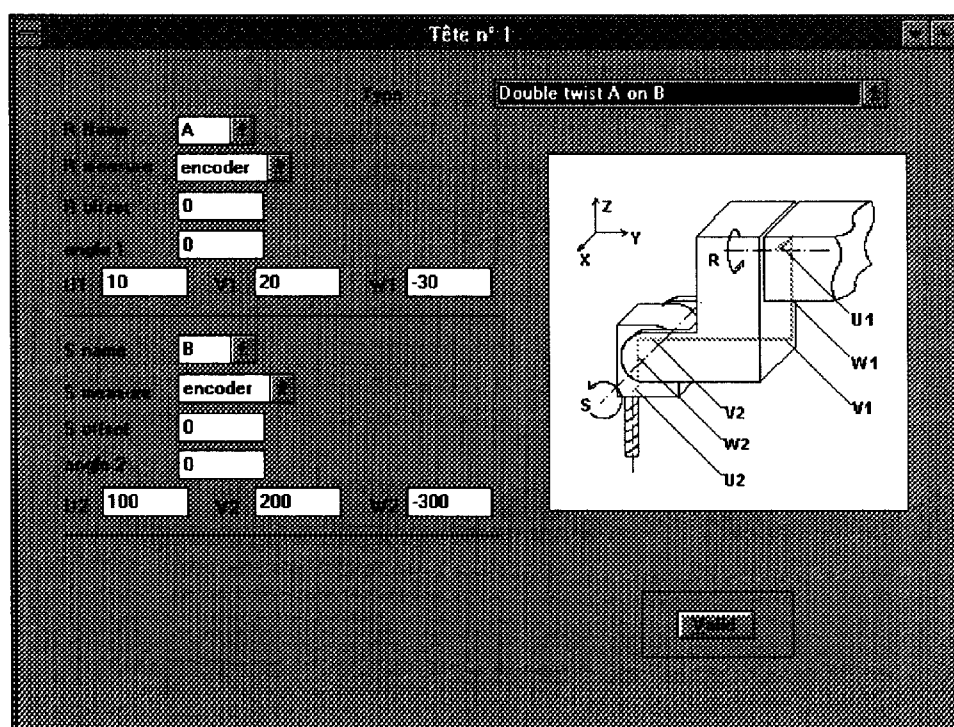
To customise the head assembly, first select the configuration number: 1, 2, 3 or 4.

---

**Then confirm by selecting the Open button.**

---

The following screen is displayed. The title indicates the current configuration.



|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>type</b>          | This field specifies the type of head configuration to be characterised by the variables. A diagram of the structure is displayed underneath showing the parameters to be specified.                                                                                                                                                                                                                                              |
| <b>R name</b>        | <p>This field specifies the name of the R axis.<br/> Three possibilities are proposed: A, B or C.<br/> For the RTCP function, the name of the axis corresponding to the type of configuration must be specified.<br/> <i>example:</i>      type: double twist A on B<br/>                      requires R name = B<br/> A choice remains possible for compatibility with the inclined plane application.</p>                      |
| <b>R measure</b>     | <p>This variable specifies the type of measurement associated with the R axis.<br/> There are four possibilities: encoder, L variable (measurement in degrees), Exxxxx parameter (measurement in ten-thousandths of a degree) or none (axis absent).<br/> For the RTCP function, it is mandatory to specify encoder measurement for an axis. A choice remains possible for compatibility with the inclined plane application.</p> |
| <b>(R parameter)</b> | <p>This field, which appears when the R measurement is supplied by a variable or a parameter, specifies this variable or parameter.<br/> This parameter is not used for the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p>                                                                                                                                                   |
| <b>R offset</b>      | <p>This field specifies the offset in degrees between the physical zero of the measurement and the theoretical zero of the R axis.<br/> This parameter is not used for the RTCP function. A choice remains possible for compatibility with the inclined plane application.</p>                                                                                                                                                    |
| <b>angle 1</b>       | This field specifies the angle in degrees of the S axis from horizontal for certain configurations.                                                                                                                                                                                                                                                                                                                               |
| <b>U1</b>            | This field specifies the dimension in internal measurement units (micrometres) on the X axis of the vector between the pivot point of the R axis and the pivot point of the S axis.                                                                                                                                                                                                                                               |
| <b>V1</b>            | This field specifies the dimension in internal measurement units (micrometres) on the Y axis of the vector between the pivot point of the R axis and the pivot point of the S axis.                                                                                                                                                                                                                                               |
| <b>W1</b>            | This field specifies the dimension in internal measurement units (micrometres) on the Z axis of the vector between the pivot point of the R axis and the pivot point of the S axis.                                                                                                                                                                                                                                               |
| <b>S name</b>        | <p>This field specifies the name of the S axis.<br/> Three possibilities are proposed: A, B or C.</p>                                                                                                                                                                                                                                                                                                                             |
| <b>S measure</b>     | <p>This variable specifies the type of measurement associated with the S axis.<br/> There are four possibilities: encoder, L variable (measurement in degrees), Exxxxx parameter (measurement in ten-thousandths of a degree) or none (axis absent).<br/> For the RTCP function, it is mandatory to specify encoder measurement for an axis. A choice remains possible for compatibility with the inclined plane application.</p> |

- Label12(S parameter)** This field, which appears when the S measurement is supplied by a variable or a parameter, specifies this variable or parameter.  
This parameter is not used for the RTCP function. A choice remains possible for compatibility with the inclined plane application.
- S offset** This field specifies the offset in degrees between the physical zero of the measurement and the theoretical zero of the S axis.  
This parameter is not used for the RTCP function. A choice remains possible for compatibility with the inclined plane application.
- angle 2** This field is not currently used.
- U2** This field specifies the dimension in internal measurement units (micrometres) on the X axis of the vector between the pivot point of the S axis and the tool cone zero.
- V2** This field specifies the dimension in internal measurement units (micrometres) on the Y axis of the vector between the pivot point of the S axis and the tool cone zero.
- W2** This field specifies the dimension in internal measurement units (micrometres) on the Z axis of the vector between the pivot point of the S axis and the tool cone zero.

---

**Return to the previous window by selecting the "Valid button".**

---

After filling in all the fields,

---

**Select the "Valid" button**

---

or, to abort the modifications

---

**Select the "Cancel" button.**

---

The main menu of APP\_TOOL is displayed.

### 3.3.1.3 Quit

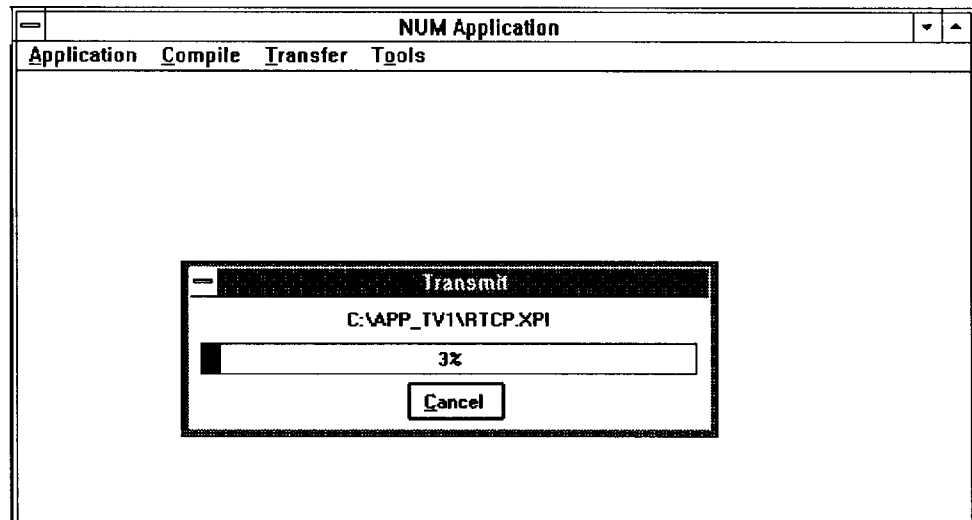
This command closes the main window of APP\_TOOL.

## 3.3.2 Compile Menu

This command is not active unless one of the applications and one of the symbol tables are open. It compiles the system and generates an ISO file *rtcp.xpi* on the hard disk.

### 3.3.3 Transfer Menu

The following window appears.



This window specifies the name of the programme transferred as well as the progress of transfer by display of a red bar and a percentage. When transfer is complete, the "Transmit" window is cleared.

To abort the transfer procedure:

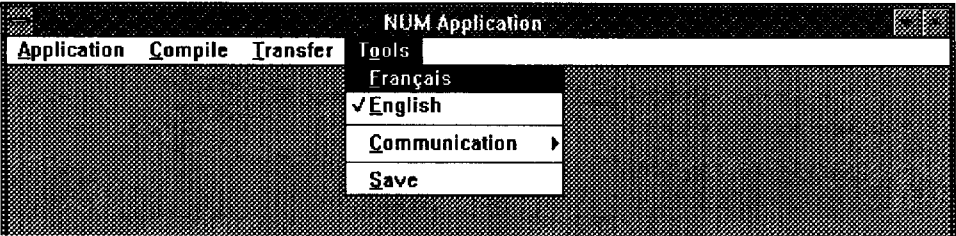
---

Select the "Cancel" button.

---

3.3.4 **Tools Menu**

The following menu is displayed.

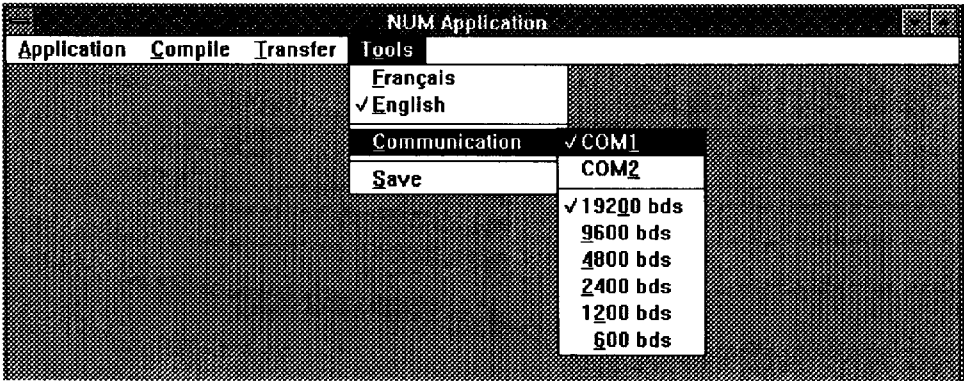


3.3.4.1 **Français / English**

This selection specifies the language in which the menus and texts of the APP\_TOOL tool are displayed. A tick appears opposite the current language.

3.3.4.2 **Communication**

This command opens the following menu



It is possible to select the COM1 or COM2 computer serial port to be used for the communication. The current port is ticked.

It is also possible to select a data rate of 600, 1200, 2400, 4800, 9600 or 19200 bauds. The current data rate is ticked.

3.3.4.3 **Save**

This command saves the current configuration of these options which are then restored the next time APP\_TOOL is run.



---

## 4 Programming RTCP

### 4.1 General

In the case of a ball-end tool, the RTCP function can be used to preserve the tool/part contact point on the programmed path during consecutive tool orientations. This function does not require any parameters to be enabled or inhibited. An inclined plane can be added to programme tool paths in a coordinate system oriented arbitrarily in space. All the movements requested in AUTO, SINGLE, MDI and MANUAL mode are carried out on the axes of this new coordinate system.

When specified, the function is transparent for the user and programmer. Its use therefore amounts to specifying a coordinate system as explained in Sec. 1.2.3 and enabling RTCP. The changes of coordinates to allow machining in this new coordinate system are then carried out automatically.

### 4.2 Programming Syntax

Since the RTCP function operates only in "on/off" mode, the programming syntaxes given below are used specify different ways of programming the inclined plane that can be added to it.

There are four possibilities:

#### 4.2.1 RTCP Enabled with Specification of a Coordinate System Inclined with Respect to the Machine Coordinate System

Syntax: ... G151 (EA... EB... EC...) \* EU... EV... EW...

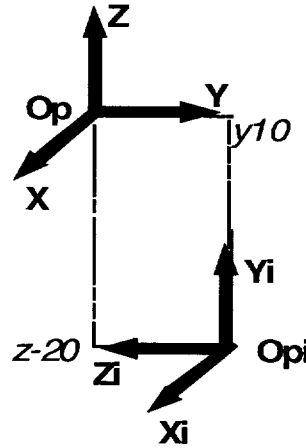
EA, EB and EC specify the angles of orientation of the new coordinate system (see Sec. 1.2.2). The presence of one of these three parameters is mandatory. If an angle is not specified, a value of zero is assigned to it.

**\* Caution:** Only two angles of orientation of the inclined plane are allowed in specification of the inclined plane. The syntax is therefore as follows:

**G151 EA... EB... EU... EV... EW...**  
or **G151 EA... EC... EU... EV... EW...**  
or **G151 EB... EC... EU... EV... EW...**

EU, EV and EW specify the position of the inclined coordinate system origin with respect to the initial programme origin (see Sec. 4.3.3). At least one of these three parameters must be specified. If a distance is not specified, a value of zero is assigned to it.

*Example:* **G151 EA90 EV10 EW-20** specifies a coordinate system whose origin is located at 10 mm in Y and -20 mm in Z from the initial workpiece origin. The new orientation is given by a rotation of 90 degrees around the X axis.



#### 4.2.2 RTCP Enabled with Specification of an Inclined Coordinate System after Positioning the Tool in a Known Point of the Inclined Coordinate System

Syntax: **G151 X... Y... Z... (EA... EB... EC...)\* D...**

X, Y and Z specify the tool tip coordinates in the inclined coordinate system. If one of the coordinates is not specified, a value of zero is assigned to it.

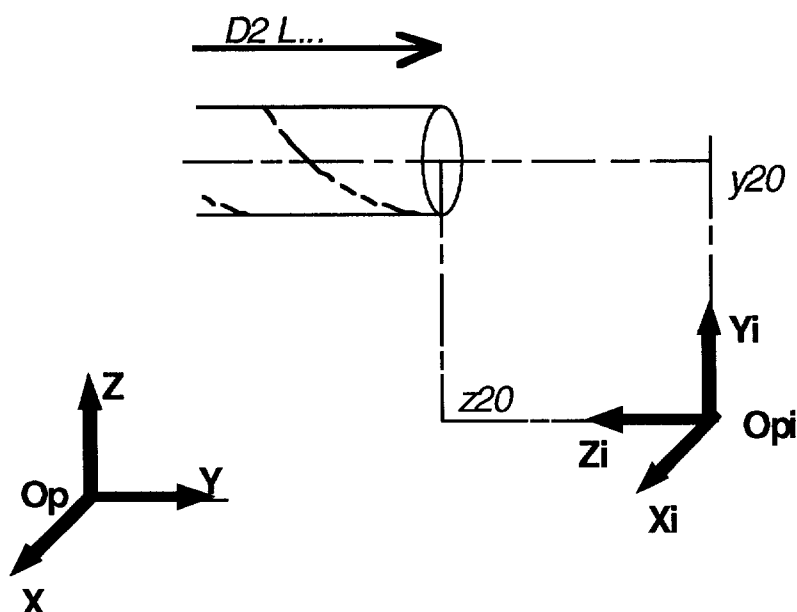
EA, EB and EC specify the angles of orientation of the new coordinate system (see Sec. 1.2.2). The presence of one of these three parameters is mandatory. If an angle is not specified, a value of zero is assigned to it.

**\* Caution:** Only two angles of orientation of the inclined plane are allowed in specification of the inclined plane. The syntax is therefore as follows:

**G151 X... Y... Z... EA... EB... D...**  
 or **G151 X... Y... Z... EA... EC... D...**  
 or **G151 X... Y... Z... EB... EC... D...**

D is the tool offset assigned to the tool. It must be specified.

*Example:* **G151 Y20 Z20 EA90 D2** specifies a coordinate system in which the tool tip is located at 0 mm in X, 20 mm in Y and 20 mm in Z in the inclined coordinate system, knowing that the current tool is characterised by offset D2.



### 4.2.3 Cancelling the RTCP Function and the Associated Inclined Plane

Syntax: **G151 S0**

This function cancels the RTCP function and the associated inclined plane. Subsequent programmed movements are in the initial machine coordinate system.

### 4.2.4 Reenabling the RTCP Function and Associated Inclined Plane

Syntax: **G151 S1**

This function reenables the RTCP function with the last active inclined plane (specified by syntaxes G151 EA... EB... EC... EU... EV... EW... or G151 EA... EB... EC... D...) and cancelled by G151 S0, a reset or a CNC initialisation.

*Example:* The RTCP function with inclined plane is enabled on a machine on which a tool change is necessary. The changer requires positioning and movements on axes with fixed dimensions with respect to the measurement origin.

|                  |                                                  |
|------------------|--------------------------------------------------|
| .....            |                                                  |
| G151 EA... EU... | RTCP and inclined plane enabled                  |
| Z...             |                                                  |
| X... Y...        | Machining on the inclined plane                  |
| .....            |                                                  |
| G151 S0          | Inclined plane cancelled                         |
| G G52 Z10        | Positioning for tool changer                     |
| T... D... M6     | Tool change                                      |
| G151 S1          | Inclined plane reenabled                         |
| .....            | Continuation of machining on the inclined plane. |

## **4.2.5 Notes on the RTCP Function and Associated Inclined Plane**

- The RTCP function and associated inclined plane are inhibited by action on the reset button or M02.
- An attempt to change the tool offset when RTCP is enabled generates error 16. The active tool offset must mandatorily be called before the block with G151...
- When power is restored after a power failure, the RTCP function and its associated inclined plane can be enabled or the last inclined plane can be reenabled before homing is completed on the linear axes (for instance to retract a tool in the same orientation after the power failure). Homing must however be completed on the rotary axes or error 159 is generated.
- Homing on an axis is prohibited when the RTCP function is enabled.
- Any change in the DAT1 or DAT2 datum shifts, either directly or by programming of the corresponding external parameters, is inhibited when the inclined plane is enabled. It is mandatory to completely redefine the new coordinate system so as not to generate incorrect positions.
- Programming of a movement in G52 (dimensions with reference to the measurement origin) is prohibited if the inclined plane associated with the RTCP is different from the machine coordinate system (defined by EA0 EU0).
- Programming of a movement in G53 (DAT1 and DAT2 offsets cancelled) is prohibited if the inclined plane associated with the RTCP function is different from the machine coordinate system (defined by EA0 EU0).

## **4.3 Integration Options**

The results of the inclined plane function may differ according to the customisation carried out by the manufacturer. Consult the machine manufacturer's manual.

### **4.3.1 Selecting a Configuration**

One out of four head configurations can be selected according to the tooling supplied with the machine (bevel gear, rotary table, etc.).

#### **4.3.1.1 Configuration Recognised by the PLC**

The machine processor programme recognises the head configuration either by direct identification of the tools or by interrogating a switch on the operator panel. It informs the inclined plane function transparently.

#### 4.3.1.2 Configuration Given by a Part Programme

In this case, it is necessary to add a command **T<sub>x</sub>**, where x is a digit between 1 and 4, when writing the RTCP function enable block.  
In the absence of this command, the default value is T1.

*Example:* **G151 EA90 EU10 T2** specifies an inclined plane with head 2.  
**G151 EA90 EU10** specifies the same inclined but with head 1.

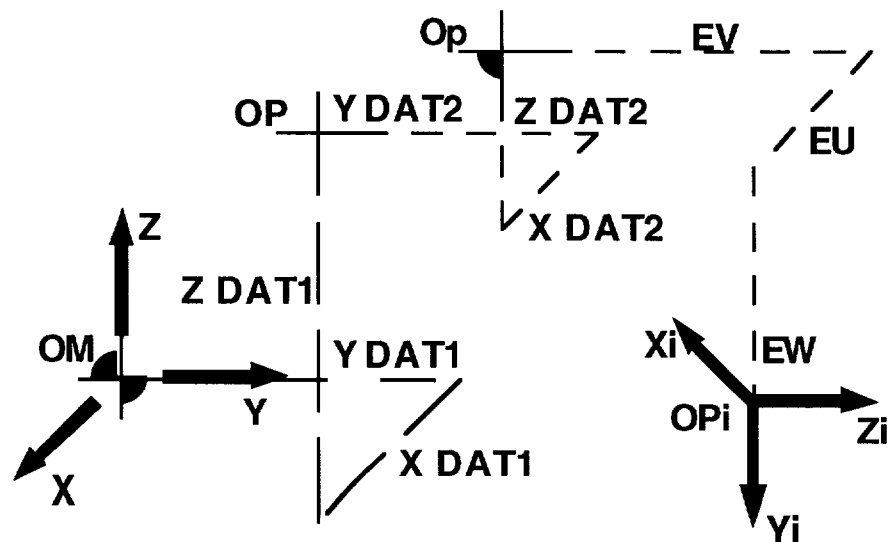
#### 4.3.2 Application of DAT1 and DAT2

During integration, it is possible to configure application of the datum shifts before or after the inclined plane.

##### 4.3.2.1 DAT1 and DAT2 Applied Before the Inclined Plane

The switch from the machine coordinate system to the inclined plane coordinate system takes place as follows:

- Switch from the measurement origin (OM) to the programme origin (OP) by adding the DAT1 datum shifts referenced to the machine coordinate system.
- Switch from the programme origin (OP) to the workpiece origin (Op) by adding the DAT2 datum shifts in the machine coordinate system
- Switch from the workpiece origin (Op) to the inclined plane origin (OPi) by adding the vector with coordinates EU, EV, EW in the machine coordinate system
- Rotation around OPi by two of the three rotations EC, EB and EA to obtain the new coordinate system.



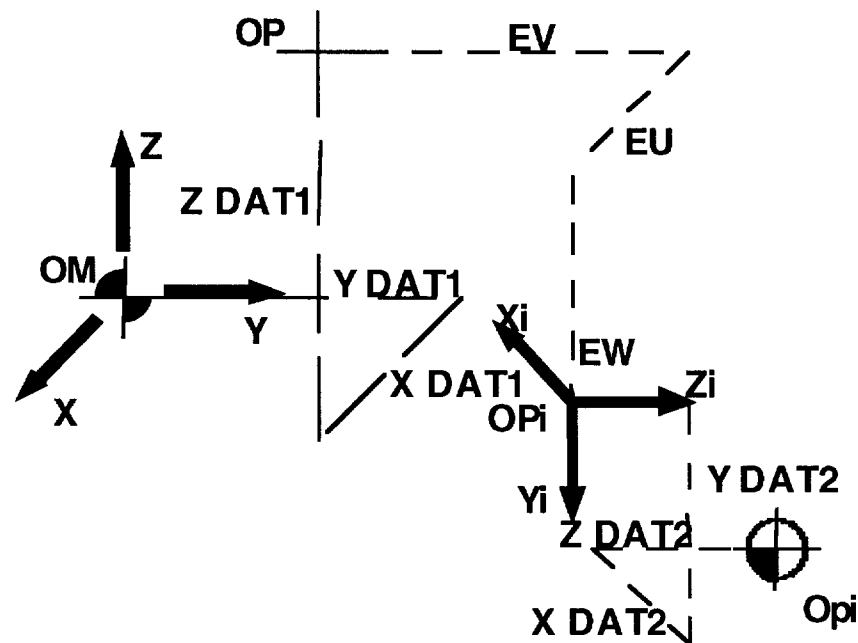
The offsets programmed by G59 X.. Y.. Z.. are in the new coordinate system (OPi, Xi, Yi, Zi).

#### 4.3.2.2

#### DAT1 Applied Before the Inclined Plane

The switch from the machine coordinate system to the inclined plane coordinate system takes place as follows:

- Switch from the measurement origin (OM) to the programme origin (OP) by adding the DAT1 datum shifts referenced to the machine coordinate system.
- Switch from the programme origin (OP) to the inclined plane origin (OPi) by adding the vector with coordinates EU, EV, EW in the machine coordinate system
- Rotation around OPi by EC, EB and EA to obtain the new coordinate system
- Switch from the inclined plane origin (OPi) to the workpiece origin on the inclined plane (Opi) by adding the DAT2 datum shifts in the inclined plane coordinate system.



## General Variables of the RTCP Tool

| variable name | type                   | défaul t value |
|---------------|------------------------|----------------|
| num_prog      | numerical              | 10151          |
| reference     | alphanumeric           | none           |
| langue        | numerical              | 0              |
| num_mess_err  | numerical              | 5              |
| logiciel      | alphanumeric           | G              |
| debug         |                        | not defined    |
| p_debug       | numerical              | 80000          |
| M_valid_rtcp  | numerical              | 252            |
| M_devalid_pi  | numerical              | 253            |
| def_tete      | numerical              | 0              |
| param_tete    | parameter              | E42124         |
| decal         | numerical              | 0              |
| H_rtcp        | numerical or parameter | not defined    |

## Configuration 1 Variables

| variable name | type         | défaul t value |
|---------------|--------------|----------------|
| type_1        | numerical    | 0              |
| nom_R1        | alphanumeric |                |
| type_R1       | numerical    | 0              |
| valeur_R1     | parameter    |                |
| R0_1          | numerical    | 0              |
| vangle_11     | numerical    | 0              |
| U1_1          | numerical    | 0              |
| V1_1          | numerical    | 0              |
| W1_1          | numerical    | 0              |
| nom_S1        | alphanumeric |                |
| type_S1       | numerical    | 0              |
| valeur_S1     | parameter    |                |
| S0_1          | numerical    | 0              |
| vangle_21     | parameter    | 0              |
| U2_1          | numerical    | 0              |
| V2_1          | numerical    | 0              |
| W2_1          | numerical    | 0              |
| valeur_T1     | not used     |                |
| vangle_31     | not used     | 0              |
| U3_1          | not used     | 0              |
| V3_1          | not used     | 0              |
| W3_1          | not used     | 0              |

# Configuration 2 Variables

| variable name | type         | défaul t value |
|---------------|--------------|----------------|
| type_2        | num erical   | 0              |
| nom_R2        | alphanumeric |                |
| type_R2       | num erical   | 0              |
| valeur_R2     | param eter   |                |
| R0_2          | num erical   | 0              |
| vangle_12     | num erical   | 0              |
| U1_2          | num erical   | 0              |
| V1_2          | num erical   | 0              |
| W1_2          | num erical   | 0              |
| nom_S2        | alphanumeric |                |
| type_S2       | num erical   | 0              |
| valeur_S2     | param eter   |                |
| S0_2          | num erical   | 0              |
| vangle_22     | param eter   | 0              |
| U2_2          | num erical   | 0              |
| V2_2          | num erical   | 0              |
| W2_2          | num erical   | 0              |
| valeur_T2     | not used     |                |
| vangle_32     | not used     | 0              |
| U3_2          | not used     | 0              |
| V3_2          | not used     | 0              |
| W3_2          | not used     | 0              |

## Configuration 3 Variables

| variable name | type         | défaul t value |
|---------------|--------------|----------------|
| type_3        | num erical   | 0              |
| nom_R3        | alphanumeric |                |
| type_R3       | num erical   | 0              |
| valeur_R3     | param eter   |                |
| R0_3          | num erical   | 0              |
| vangle_13     | num erical   | 0              |
| U1_3          | num erical   | 0              |
| V1_3          | num erical   | 0              |
| W1_3          | num erical   | 0              |
| nom_S3        | alphanumeric |                |
| type_S3       | num erical   | 0              |
| valeur_S3     | param eter   |                |
| S0_3          | num erical   | 0              |
| vangle_23     | param eter   | 0              |
| U2_3          | num erical   | 0              |
| V2_3          | num ercial   | 0              |
| W2_3          | num erical   | 0              |
| valeur_T3     | not used     |                |
| vangle_33     | not used     | 0              |
| U3_3          | not used     | 0              |
| V3_3          | not used     | 0              |
| W3_3          | not used     | 0              |

Configuration 4 Variables

| variable name | type         | défault value |
|---------------|--------------|---------------|
| type_4        | numerical    | 0             |
| nom_R4        | alphanumeric |               |
| type_R4       | numerical    | 0             |
| valeur_R4     | parameter    |               |
| R0_4          | numerical    | 0             |
| vangle_14     | numerical    | 0             |
| U1_4          | numerical    | 0             |
| V1_4          | numerical    | 0             |
| W1_4          | numerical    | 0             |
| nom_S4        | alphanumeric |               |
| type_S4       | numerical    | 0             |
| valeur_S4     | parameter    |               |
| S0_4          | numerical    | 0             |
| vangle_24     | parameter    | 0             |
| U2_4          | numerical    | 0             |
| V2_4          | numerical    | 0             |
| W2_4          | numerical    | 0             |
| valeur_T4     | not used     |               |
| vangle_34     | not used     | 0             |
| U3_4          | not used     | 0             |
| V3_4          | not used     | 0             |
| W3_4          | not used     | 0             |

### Variables Used in RTCP Debug Mode

A number of programme parameters are used in debug mode to store and display certain intermediate values and computation results.

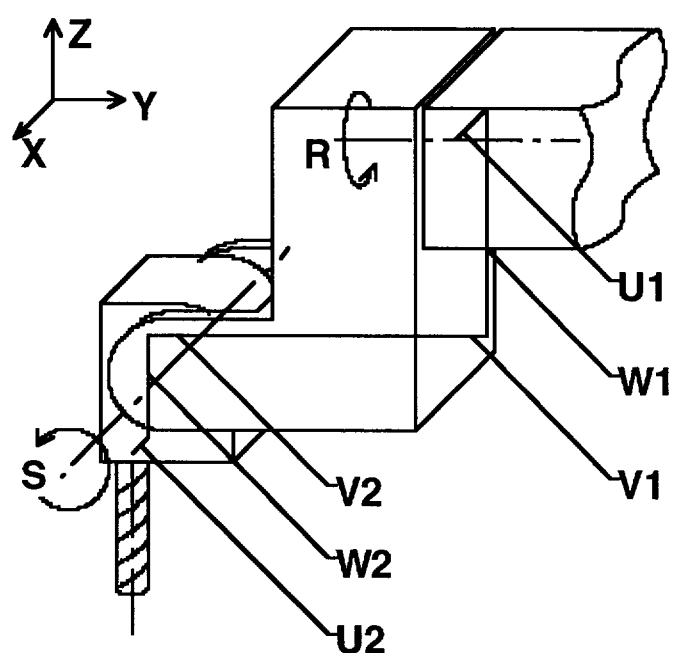
The number of the first E parameter used is given by the *p\_debug* variable (symbol table under DOS) or the **External** field that appears when the **debug** option is selected (screen under Windows).

|                    |                                                                                                          |
|--------------------|----------------------------------------------------------------------------------------------------------|
| <b>Exxxxx</b>      | value of the R axis measurement for the theoretical zero point (see Appendix 3)                          |
| <b>Exxxxx + 1</b>  | value of the S axis measurement for the theoretical zero point (see Appendix 3)                          |
| <b>Exxxxx + 2</b>  | not used.                                                                                                |
| <b>Exxxxx + 3</b>  | R axis measurement                                                                                       |
| <b>Exxxxx + 4</b>  | S axis measurement                                                                                       |
| <b>Exxxxx + 5</b>  | not used.                                                                                                |
| <b>Exxxxx + 6</b>  | value of the R axis measurement for the theoretical zero point (0)                                       |
| <b>Exxxxx + 7</b>  | value of the S axis measurement for the theoretical zero point (0)                                       |
| <b>Exxxxx + 8</b>  | not used.                                                                                                |
| <b>Exxxxx + 9</b>  | value of the angle between the R axis and S axis                                                         |
| <b>Exxxxx + 10</b> | value of the angle between the S axis and the tool cone axis                                             |
| <b>Exxxxx + 11</b> | not used.                                                                                                |
| <b>Exxxxx + 12</b> | offset on the X axis due to the tool orientation                                                         |
| <b>Exxxxx + 13</b> | offset on the Y axis due to the tool orientation                                                         |
| <b>Exxxxx + 14</b> | offset on the Z axis due to the tool orientation                                                         |
| <b>Exxxxx + 15</b> | datum shift on the X axis between the part origin and the origin of the inclined plane coordinate system |
| <b>Exxxxx + 16</b> | datum shift on the Y axis between the part origin and the origin of the inclined plane coordinate system |
| <b>Exxxxx + 17</b> | datum shift on the Z axis between the part origin and the origin of the inclined plane coordinate system |
| <b>Exxxxx + 18</b> | sum of the datum shifts on the X axis applied after the inclined plane                                   |
| <b>Exxxxx + 19</b> | sum of the datum shifts on the Y axis applied after the inclined plane                                   |
| <b>Exxxxx + 20</b> | sum of the datum shifts on the Z axis applied after the inclined plane                                   |
| <b>Exxxxx + 21</b> | correction in X due to application of the datum shifts after the inclined plane                          |
| <b>Exxxxx + 22</b> | correction in Y due to application of the datum shifts after the inclined plane                          |
| <b>Exxxxx + 23</b> | correction in Z due to application of the datum shifts after the inclined plane                          |

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| <b>Exxxxx + 24</b> | programmed offset between the part origin and inclined plane origin (EU) |
| <b>Exxxxx + 25</b> | programmed offset between the part origin and inclined plane origin (EV) |
| <b>Exxxxx + 26</b> | programmed offset between the part origin and inclined plane origin (EW) |
| <b>Exxxxx + 27</b> | value of X programmed in the inclined plane enable block                 |
| <b>Exxxxx + 28</b> | value of Y programmed in the inclined plane enable block                 |
| <b>Exxxxx + 29</b> | value of Z programmed in the inclined plane enable block                 |
| <b>Exxxxx + 30</b> | value of the X axis measurement when the inclined plane is enabled       |
| <b>Exxxxx + 31</b> | value of the Y axis measurement when the inclined plane is enabled       |
| <b>Exxxxx + 32</b> | value of the Z axis measurement when the inclined plane is enabled       |
| <b>Exxxxx + 33</b> | last programming of the R axis                                           |
| <b>Exxxxx + 34</b> | last programming of the S axis                                           |
| <b>Exxxxx + 35</b> | not used                                                                 |

## Double Twist A on B

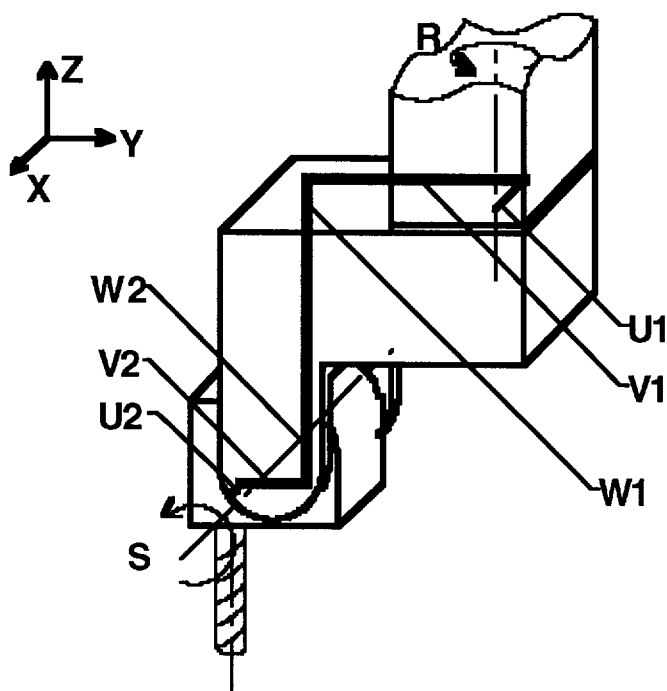
type\_x = 1



Position for  $R = 0$  and  $S = 0$

Double Twist A on C

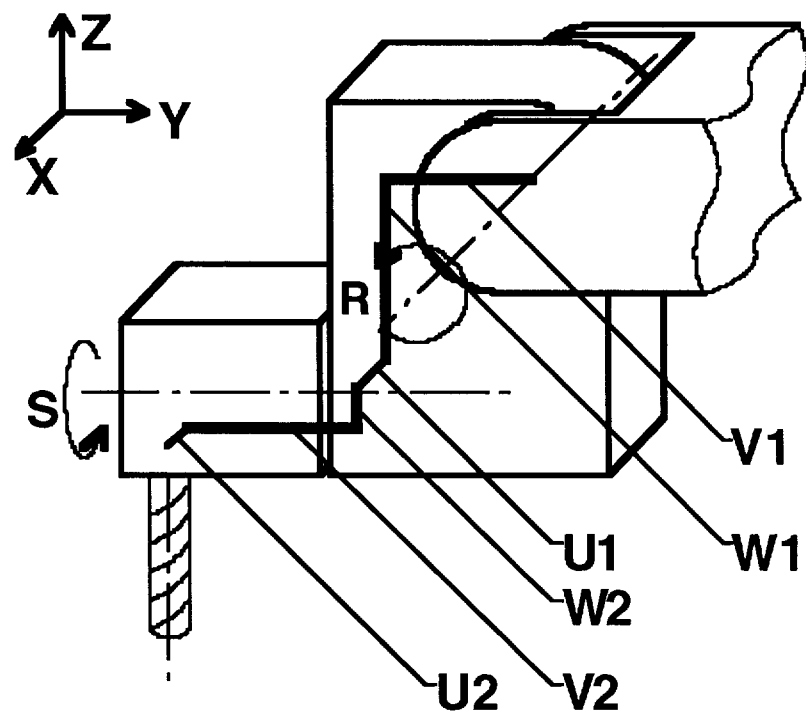
type\_x = 2



Position for R=0 and S=0

## Double Twist B on A

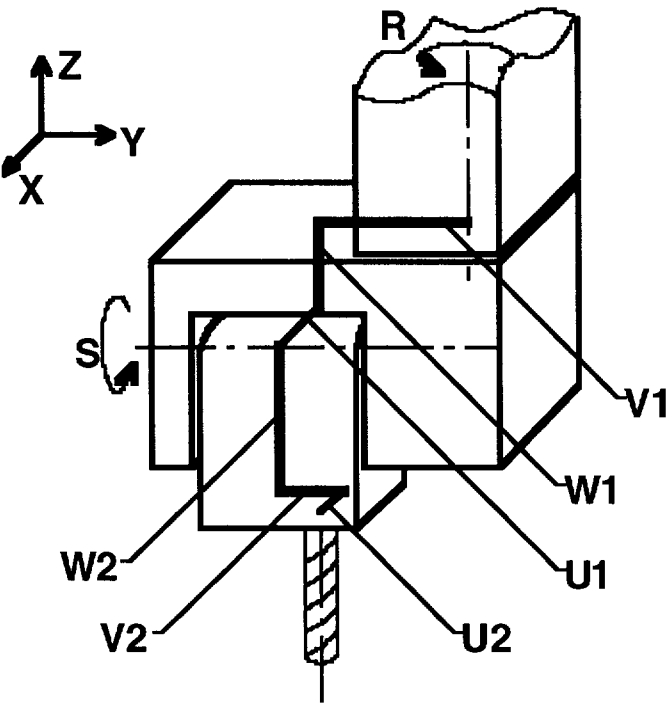
type\_x = 3



Position for  $R=0$  and  $S=0$

Double Twist B on C

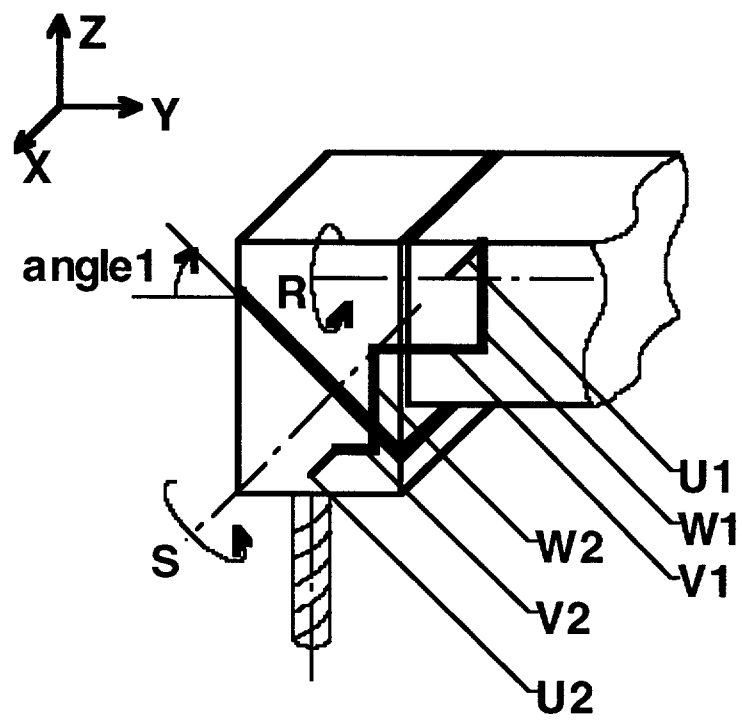
type\_x = 4



Position for R=0 and S=0

## Double Twist A with Angle around X on B

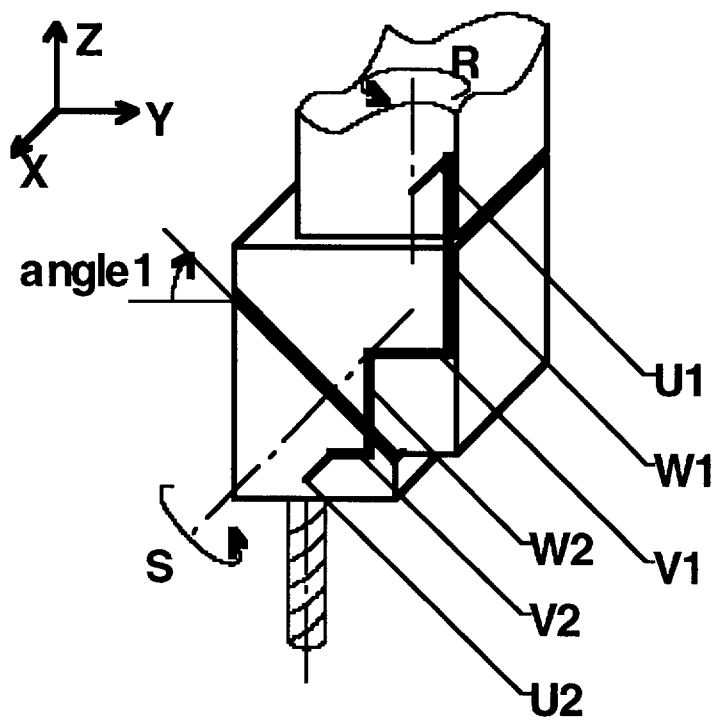
type\_x = 5



Position for  $R=0$  and  $S=0$

Double Twist A with Angle around X on C

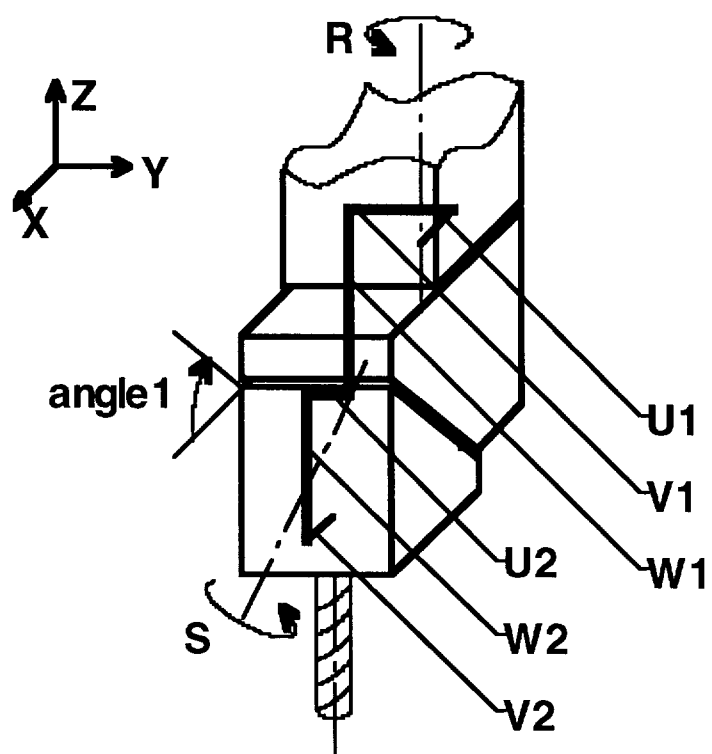
type\_x = 6



Position for R=0 and S=0

## Double Twist B with Angle around Y on C

type\_x = 7



Position for R=0 and S=0



### RTCP Function Backup Variables

To be able to restart the RTCP function and associated inclined plane after a reset or a power failure without having to respecify them, a number of programme parameters are used to save the characteristic values.

The number of the first E parameter used is given by the *param\_sauv* variable (symbol table under DOS) or the **Backup parameter** field (screen under Windows).

|                    |                                                                                                                                         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Exxxxx</b>      | U1 dimension save.                                                                                                                      |
| <b>Exxxxx + 1</b>  | V1 dimension save.                                                                                                                      |
| <b>Exxxxx + 2</b>  | W1 dimension save.                                                                                                                      |
| <b>Exxxxx + 3</b>  | U2 dimension save.                                                                                                                      |
| <b>Exxxxx + 4</b>  | V2 dimension save.                                                                                                                      |
| <b>Exxxxx + 5</b>  | W1 dimension save.                                                                                                                      |
| <b>Exxxxx + 6</b>  | save of the offset on the X axis between the part origin and the inclined plane origin.                                                 |
| <b>Exxxxx + 7</b>  | save of the offset on the Y axis between the part origin and the inclined plane origin.                                                 |
| <b>Exxxxx + 8</b>  | save of the offset on the Z axis between the part origin and the inclined plane origin.                                                 |
| <b>Exxxxx + 9</b>  | save of the cosine of the inclined plane orientation angle around the Y axis.                                                           |
| <b>Exxxxx + 10</b> | save of the sine of the inclined plane orientation angle around the Y axis.                                                             |
| <b>Exxxxx + 11</b> | save of the cosine of the inclined plane orientation angle around the X axis.                                                           |
| <b>Exxxxx + 12</b> | save of the sine of the inclined plane orientation angle around the X axis.                                                             |
| <b>Exxxxx + 13</b> | save of the cosine of the inclined plane orientation angle around the Z axis.                                                           |
| <b>Exxxxx + 14</b> | save of the sine of the inclined plane orientation angle around the Z axis.                                                             |
| <b>Exxxxx + 15</b> | save of the cosine of the angle between the R axis and S axis (if used).                                                                |
| <b>Exxxxx + 16</b> | save of the sine of the angle between the R axis and S axis (if used).                                                                  |
| <b>Exxxxx + 17</b> | save of the type of inclined plane declaration<br>- = 1 complete definition of the inclined plane<br>- = 5 definition after positioning |



### RTCP Function Error Messages

The RTCP function can generate error messages. The error number can be customised during integration (*num\_mess\_err* parameter in the symbol table under DOS).

The default start error number is 500.

- E.501**    CONFIGURATION NUMBER < 1  
--> VERIFY PROGRAMMED T    (if selection by programme)  
--> VERIFY PARAMETER ..... (if selection by parameter)
- E.502**    CONFIGURATION NUMBER > 4  
--> VERIFY PROGRAMMED T    (if selection by programme)  
--> VERIFY PARAMETER ..... (if selection by parameter)
- E.503**    NON AUTHORISED SECONDARY AXES  
--> Programming the U, V or W axes is not allowed with software 1060 ind. F
- E.550**    Commercial option 6x154 not present  
--> Option bit 17 absent
- E.16**    This error is generated by the CNC software, not by the application, when it is attempted to apply a tool offset with RTCP active.

