

IsoUS - Ultimate step
RTCP system

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1 PREFACE

This manual gives information on how to use RTCP algorithm in ISONS-ISOUS systems.

2 The meaning of RTCP in ISOUS system

In the tool machine world, RTCP means tool centre rotation point, the possibility for the machine to follow the trajectory of the profile, discarding the tool orientation and length.

There are many ways to make it, as there are many geometry types of tool machine: roto-tilting head with fixed table, tilting head with rotating table, rot-tilting table with fixed head and so on.

In the ISOUS system, every geometry can be developed inside the CNC logic, like a post-calculation of axes position over the interpolator sequence.

In this point of view, from the PC side, the instructions needed to activate the feature are always the same, because all the real management will be made by the code created inside the CNC.

Up to now, the ISOUS system has only the roto-tilting head system, but the use can be generalized for every geometry type, according the description below.

3 Supported machine structure

We have first to consider the axis orientation.

Our structure is built considering the right-hand strategy.

The verses of the axis are showed in the first picture.



fig. 1: orientation of axes

3.1 5 axis portal (gantry) vertical machine

5 axes CNC machines, usually lose one between A or B axis, because the rotation of C axis allow to move in the whole space around the workpiece.

One of the possible machine configuration, is the structure below.

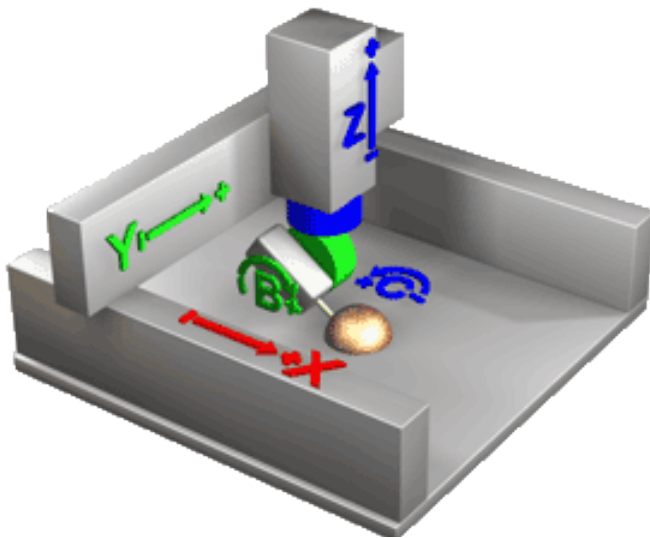


fig. 3: machine structure

In this case, we have B and C axis. It means that with the C axis (rotation) on 0, the tilting axis moves having Y as rotation's axis. Another possible configuration, is the schema on right, where the head has A axis instead of the B, means that when the C axis in on 0, the tilting axis moves having X as rotation's axis.

The 5 axes RTCP of ISOUS, supports both configurations, because there is the possibility to switch between A axis and B axis management, only changing one of the parameters that there are inside his setup.

With these structures we can see that the A-B axes are slaves of C axis, means that both of them changing their orientation, with the movement of c axis. While the C axis always maintains his orientation, even with a movement of A-B axes.

That's why the system can freely have A or b axis, because the movement of C axis, allow to have any possible configuration around the workpiece, with only one tilting axis.

To make the system works, some information are required, regarding the offsets between the tool centre and the rotation axis of the mechanics. All these offsets, are determined considering the tool normal to the work-plan (vertical) and with A-B and C axes on 0.

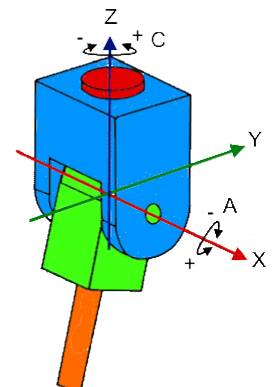


fig. 2: A-C axes head

We'll have three offsets:

- Offset on X, X part of offset around C axis;
- Offset on Y, Y part of offset around C axis;
- Offset on Z: offset around tilting axis. This is the more important one. This offset is composed by a "pivot", the distance between the rotation centre of tilting axis (A-B) and the spindle gage, and the tool length.

Spindle gage is the

The two parts of C offset and the pivot part of tilting offset, are fixed, determined by the machine mechanic and can be managed as fixed parameters.

The tool length, will be loaded dynamically during the PartProgram working, every time a new tool will be loaded.

The RTCP system will calculate the various offsets, considering the rotation of the axis, and the geometry of the machine.

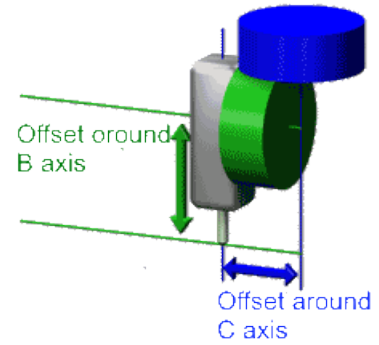


fig. 4: offset diagram of B-head machine

3.1.1 Parameters in ISOUS

As we have seen, the system need some fixed parameters to be able to make the right calculation.

These parameters must be set in the ISOUS configuration and must comply the properties set in the VTB2 object, that will be describe in the paragraph 3.1.2.

Configuratore IsoUs						
Utensili		Pause	Allarmi Interni	Allarmi User	Allarmi CN	Codici M
CPU-COM		Assi	Compilatore	Generale	Parametri	Define
Add CUSTOM		RIMUOVE CUSTOM	Add Par GEN.	Par P.I.D.	RIMUOVE TUTTI	POSIZIONATORI
Nome	Descrizione	Gruppo	Valore	CNC Addr	Tipo	
ACC_G0.1_&_2	Acc G0.1_&_2	Asse_&_2	20	-1	NUMERIC	1
ACC_G0.1_&_3	Acc G0.1_&_3	Axis_&_3	20	-1	NUMERIC	1
QY_SGANCIO_X	.....	Generali	60000	250	NUMERIC	-
QX_USCITA	.....	Generali	0	251	NUMERIC	-
QA_AGGANCIO	.....	Generali	50000	252	NUMERIC	-
DELTA_CX	X section of C axis Offset (um)	RTCP	120	375	NUMERIC	-
DELTA_CY	Y section o C axis Offset (um)	RTCP	123	376	NUMERIC	-
DELTA_CZ	Z axis Offset (pivot) (um)	RTCP	350000	377	NUMERIC	-
RESOLUTION	System Resolution (u)	RTCP	1000	378	NUMERIC	-

fig. 5 : UsConfig page for RTCP param

Here there is the UsConfig page, where the RTCP parameters can be added to the ISOUS parameter's list.

These parameters must be added as custom and must be fully described with name, description, group.

It must be clear that all of these things are not important for system working, but only to be easily found inside he ISOUS list. The important side is the "CNC addr", that must be strictly linked to the address set in the VTB object.

The indexes of the parameters, must be given in the usual way for custom parameters. In this showed example, the firsts free addresses started from 375 and here I've inserted the RTCP parameters.

After saving the cfg file and open ISOUS, you'll find the parameters in this way:



fig. 6: RTCP parameters in ISOUS interface

Remember that in ISOUS, all parameters are always “integer”, therefore they always be expressed in the measuring unit used in DSOF parameters. The resolution par, is used exactly for this use. It tell to the RTCP system, the measuring unit of all offsets. 1000, means that all parameters are in micro-meters (10^{-6} meters, 10^{-3} mm), usual way. If the system works in a different unit, this parameter must be changed accordingly: for ex. If the system works in tenth of micro-meters (10^{-7} meters, 10^{-4} mm), this parameter will be 10000.

3.1.2 RTCP in VTB2 project

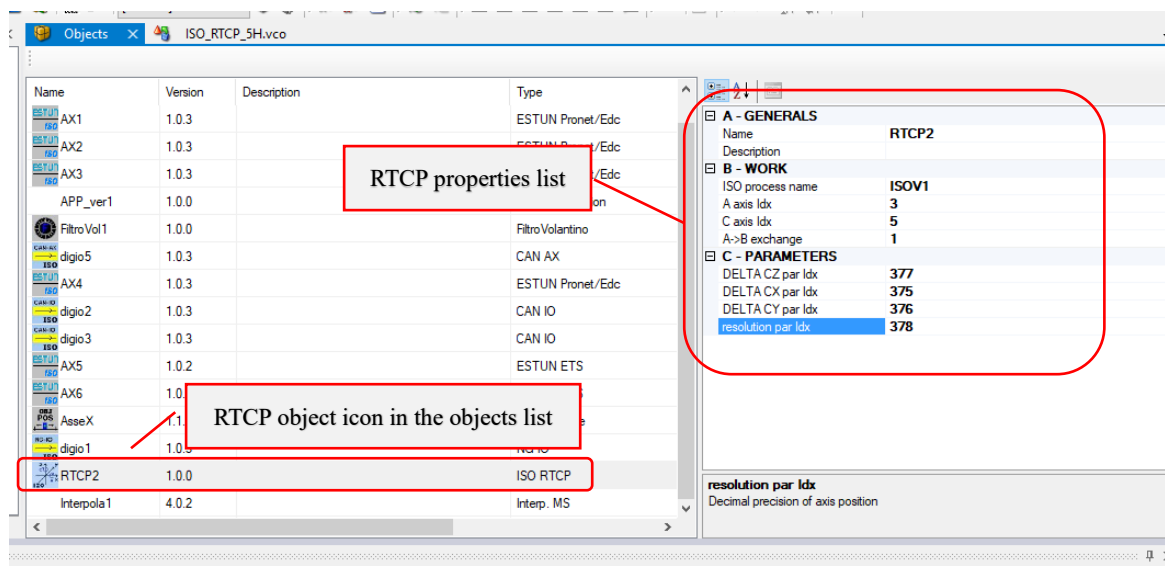


fig. 7: RTCP object in VTB2 IDE

The RTCP system is nothing more than an usual object that will be inserted inside the project's object list. According to the type of the geometry that has to be developed, the properties list can be different in properties numbers, types and use.

Concerning the roto-tilting head, that is the type we are describing now, this is what we can see:

- ISO process name: this is useful for multiprocesses systems. Every ISO process has a different name, and the RTCP can be related only at one of them. With this property we link the object to the related process;
- A axis id: the index of the axis, inside the interpolation axis set, that will be used as A axis. If the machine doesn't have a physics A (B) axis, set it to -1;
- C axis id: same as the previous parameters, but for C axis. If the machine doesn't have a physics C axis set it to -1;
- A->B exchange: setting to 0 this parameter, all calculations will be made considering A axis for tilting, otherwise, tilting will be as B axis;
- Delta parameters: here must be set the index inside the ISO parameters list, where can be found the displacement between tool centre and the rotation axis, see below for explanation;
- Resolution par idx: the index where can be found the resolution of the axes positions used for the machine;

As can be seen, there are not so many parameters to be set, the main part of the process is made by the object, without any other code to be added. The main problem is to have the right object, with the geometry that fit the machine mechanic. Finally, using this kind of parametrization, you don't have to access any time to the VTB code to change the offsets, you can easily make it using the std parameters plugin of ISOUS.

as can be seen, the indexes of the parameters in the VTB2 object, must reflects the indexes that have been set in the ISOUS cfg file. This is the most important thing in all process, because the process always will access to those indexes to find the data to be calculated to determine the offsets that must be added to the axes position according the tilting and rotation axes position.

3.1.3 How to activate it in g-code

The RTCP system works with the RTCP statements G103, G104, G105.

The first one is used to pass additional on-line parameters to the system.

In this case, must be passed the actual tool length.

To make it, use the next syntax:

```
$LEN=$[U1] //load the actual tool length, stored in the tool table, inside a support variable
G103 X[$LEN] //transfer the parameter to the CNC
```

The tool's length must be stored inside the tool table, expressed in mm, like this. In that way, the system will transfer the parameter in the right format and the calculations inside the CNC will be made in the right units.

Pos	Name	Diameter (mm)	Length (mm)	Speed (Rpm)	Tool Clone	USER
1	---	000	00	0	66	5
2	10 mm round	10	14.430	0	0	444
3	12 mm cone	12	35.494	0	0	4

fig. 8: Tool interface in ISOUS

After that, the RTCP system can be activated using the

G104 //RTCP activation statement.

Every time that it's needed to change the tool length, means on every tool change operation, the RTCP must be suspended and activated again.

The suspension, can be made using the

G105 //RTCP suspension

statement, then the sequence with the G103 and G104 must be inserted again.

An example of G-code with the RTCP management, is like this:

```
T9
G23
G17
G60
G65
G43 X0 K1 Z+ //TOOL LENGHT COMPENSATION
G90
G54.1 XYZ //ACTIVATE THE FIRST ORIGIN
G0 C-149.122 A-68.958
$LUNG=${U1}
G103 X[$LUNG]
G104 //RTCP ACTIVATE
G0 X5.731 Y19.161 C-149.122 A-68.958 //FIRST MOVEMENT ALSO INITIALIZE THE RTCP
G0 Z144.143
G0 X99.097 Y331.331
G1 X103.102 Y333.726 Z142.348 F995. //WORK
G1 X103.255 Y333.528 Z142.424 F1000.
G1 X103.41 Y333.34 Z142.52
G1 X103.566 Y333.165 Z142.636
G1 X103.723 Y333.003 Z142.769
G1 X103.878 Y332.857 Z142.92
G1 X104.032 Y332.726 Z143.087
```


Sommario

1	PREFACE	3
2	THE MEANING OF RTCP IN ISOUS SYSTEM	4
3	SUPPORTED MACHINE STRUCTURE	4
	3.1 5 AXIS PORTAL (GANTRY) VERTICAL MACHINE	4
	3.1.1 <i>Parameters in ISOUS</i>	5
	3.1.2 <i>RTCP in VTB2 project</i>	7
	3.1.3 <i>How to activate it in g-code</i>	7