POSITIONING AND CONTOURING CONTROL SYSTEM
APCI-8001 and APCI-8008

TC Interface

Edition: 7/112018

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1 Introduction

The TC functionality of the APCI-8001 and APCI-8008 allows the tool radius correction and a tool length correction (Tool-Compensation). Furthermore, with this module you have the possibility to rotate a level around a defined rotation point.
For using this functionality, you firstly must initialise and select a "correction object". A "correction object" is a TC module and a data record in a tool table. Then the tool radius correction can be activated. The tool radius correction is only possible with interpolation commands (G01 / G02, G03) and not with JOG commands (G00). Different tool tables can be summarized to compensation groups. In most cases only one compensation group is required.
After the activation of the tool radius correction a spooler traverse profile is always kept in a buffer. After ending the following spooler traverse profile, the correction for the previous (buffered) traverse profile and for the profile transition to the current traverse profile is calculated and spooled. The current traverse profile is filed in a buffer. When deactivating the tool-radius compensation also the last buffered traverse profile is spooled.
When calling a direct command (e.g. JA or JS) the complete spooler content and the buffered traverse profile are rejected. If the last traverse profile that is in the temporary buffer should be executed at the end of a profile, the tool radius correction must be deactivated. As alternative also the SSF command 2001 can be sent to the corresponding axis.
This function is only available if the used operating system software RWMOS.ELF contains the option „option TC".

2 Using the TC functionality

2.1 Initialisation of TC

The following values for the Universal Object Interface must be used for the TC module:

Table 1: Object-Descriptor elements:

Object Descriptor Element	Value
BusNumber	1300
DeviceNumber	0 for initialisation commands (Table 2) 1 for accesses to tool tables (Table 3)
Index	If DeviceNumber = 0: 0, 1, ... according to Table 2 If DeviceNumber = 1: Current number of the compensation (1, 2 or 3; is given by the user). Each compensation group is referenced by a number **Caution:** Do not confuse with the tool index!
SubIndex	Function number according to Tables 2 and 3

Please find further information about Object Descriptor elements in the document "Universal Object Interface" (PDF file).

Table 2: Initialisation of the TC-module (DeviceNo = 0)

Index	Sub-Index	Name	Type	Description
1		*Clean*	*Integer w*	Parameter = 1 With this command all available objects of the TC interface in the operating system software RWMOS.ELF are rejected. Therefore, in PCAP programs, the handle of all initialised object-descriptor elements of the TC interface must be reset to 0.
2	0	*X-Axis-Nr*	*Integer r/w*	Index of the axis that is defined as X-axis (default = 0)
2	1	*Y-Axis-Nr*	*Integer r/w*	Index of the axis that is defined as Y-axis (default = 1)
2	2	*Z-Axis-Nr*	*Integer r/w*	Index of the axis that is defined as Z-axis (default = 2)
3	0	*TcPlane*	*integer r/w*	Selected level for circle and radius correction – possible values are 17 for X-Y, 18 for Z-X or 19 for Y-Z level (default=17, X-Y level)
11		*ReInit*	*integer w*	Reinitialising the tool radius correction: Internal saved shift values of the correction axes will be deleted. This command should be called before a system reinitialisation, eg. new reference travel. However, the programmed tools remain active. Subindex and parameter are of no importance.
12		*Reset*	*integer w*	Resetting the tool radius correction: All active corrections are stopped. Shift values of the correction axes and inter-profiles saved internally are deleted. Subindex and parameter are of no importance. The programmed tools are preserved.
20		*RotAngle*	*double r/w*	Rotation angle for coordinate turn read/write in degrees. This value is reset to 0 with the command rs().
21		*RotCenterX*	*double r/w*	Rotation point1.-axis for the coordinate turn read/write in interpolation unit; rotation level is the selected correction level. This value is reset to 0 with the command rs().
22		*RotCenterY*	*double r/w*	Rotation point 2.-axis for the coordinate turn read/write in interpolation unit; rotation level is the selected correction level. This value is reset to 0 with the command rs().

Via the allocation of the axes according to the table above the use of the axes of the driving engine is defined. Normally, this setting is given by the installation of the machine and the switching on of the control.

2.1.1 Coordinate turn

With Index 20, 21 and 22 a coordinate turn at interpolation commands can be realized in the selected main level. In simple cases the rotation angle has to be programmed in degrees. The coordinate turn only is effective at interpolation command not at JOG commands. The creation of a tool radius correction object is not necessary for using the coordinate turn.

2.2 Functions of the TC module

Table 3: Functions of the TC module (No. = SubIndex) for DeviceNo = 1

No	Name	Type	Description
1	ERROR	integer r/w	Error status of the tool radius correction read / reset Bit coding: See Table 4
2	RESET	integer w	Reset the tool compensation A writing call of this function terminates the tool compensation and rejects the programmed values. Now these can be reprogrammed. The index and transfer value are of no importance in this function. A writing call of this function terminates the tool compensation.
3	STATUS	integer r/w	Writing 1 activates the correction mode, under the condition that all other parameters are initialised correctly. By writing 0, the correction mode is switched off. If the parameters are wrongly initialised, InitError will be displayed.
4	XAxis	integer r/w	Index of the X-axis for the correction (level selection). This value may be changed only if the tool radius correction is not active, otherwise InitError will be displayed.
5	YAxis	integer r/w	Index of the Y-axis for the correction (level selection) This value may only be changed if the tool radius correction is not active, otherwise InitError will be displayed.
7	RADIUS	double r/w	Correction value for the current tool index read / write in the unit selected with PU.
8	WKZINDEX	integer r/w	Setting the tool index, may only be changed if the tool radius correction is not active. Valid values are 0 – 1023
9	Left	integer w	Select correction Left, this selection is realized only by the call, the transfer parameter is insignificant.
10	Right	integer w	Select correction Right, the selection is realized only by the call, the transfer parameter is insignificant.
11	ZAxis	integer r/w	Index of the Z-axis for the correction (tool length correction) This value may only be changed if the tool radius correction is not active, otherwise InitError will be displayed.
12	WkzLen	double r/w	Read/write tool length correction value in the unit selected with PU.

The TC module allows you to generate several tool tables. In the Index element of the corresponding object descriptor elements, the index of the tool table is indicated. Permitted values are integer and are superior to 0 (1, 2, 3, …). If an element is accessed through index = 0, the elements of the currently active compensation group are accessed. This group results from the main level indicated in "TC Plane" (17, 18 or 19).
However, the value "WKZINDEX" of the table elements (Subindex #8) indicates the index of the tool in a table. These indices must not be confused.
With the help of the allocations of the X-, Y- and Z-axes (Subindex 4, 5 and 11) a tool is allocated to a correction level. This setting may be not changed with the axis allocation according to table 2.

Important information: As soon as one of the elements above has been accessed, the programmed main axes are active for programming traverse commands, i.e. circles are always executed in the level that is active and not, as otherwise usual, in the level of the axes indicated first.

Table 4: Error status word *Error* of the TC-module

Bit No.	Name	Description	Value (hex)
0	*InitError*	Initialisation error	1
1	*KorrError*	Radius correction not possible	2
2	*CalcError*	Internal computation error because of unauthorized or not executable operation. Causes for this may be e.g.: The radius of the circle to be traversed is smaller than the tool radius to be corrected.	4
3	*PlaneError*	Operation in a wrong main level	8
4	*CenterError*	Circle center wrong defined, the radius at the circle start point and at the circle end point are different!	10

Table 5: Configuration register *STATUS (Function 3) of* the TC module

Bit No.	Name	Description
0	*Run*	Activate the tool radius correction
1	*ProfMarked*	A traverse profile to be corrected is in the buffer

2.3 Error query TC

For the error query the error-register must be read. The bit coding of this register is explained in Table 4.

2.4 Further characteristics of the tool compensation

If a JOG command is called up during active tool compensation, the correction mode is disabled.
With G-code traverse commands (McuWIN), the correction mode is disabled, too, by calling up a G00.
With subsequent interpolation profiles, the tool compensation path is approached again.

2.5 Using TC

Initialisation of the tool radius correction:

- Reset ToolCompensation (RESET)
- Define the compensation level (XAxis, YAxis, ZAxis)
- Define the tool table, hereto:
  Select the tool index – then program the tool radius
  The access to a tool table is defined by a value in the element index of the
  ObjectDescriptorElement > 0.

Using the tool radius correction:

- Select the tool index (WKZINDEX)
- Select correction right or left, the selection may be realized only if the correction is not active.
- Activate the correction (STATUS = 1)
- Spool and execute traverse profiles
- Deactivate the correction (STATUS = 0)

During the processing the status can be read at any time in order to detect programming / processing errors.