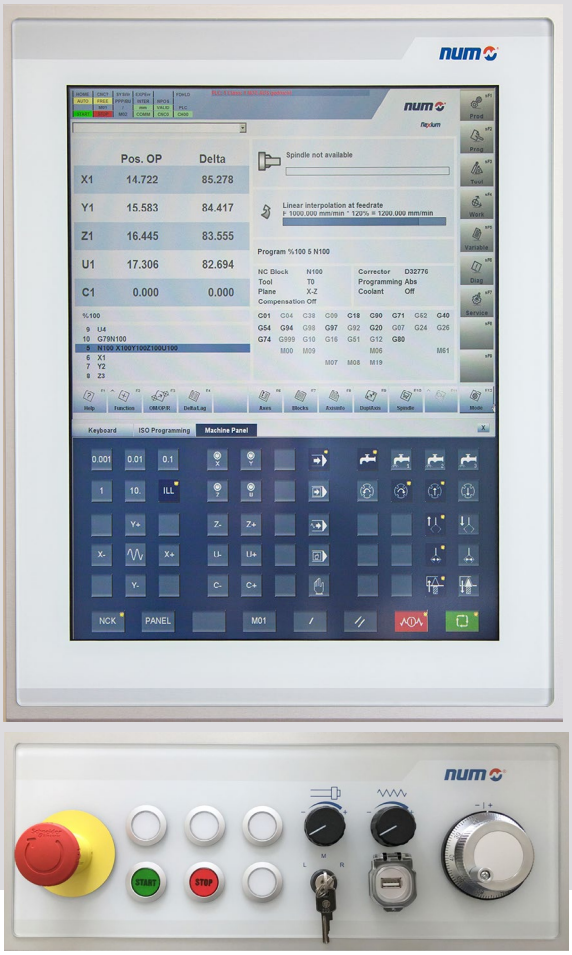
Flexium+

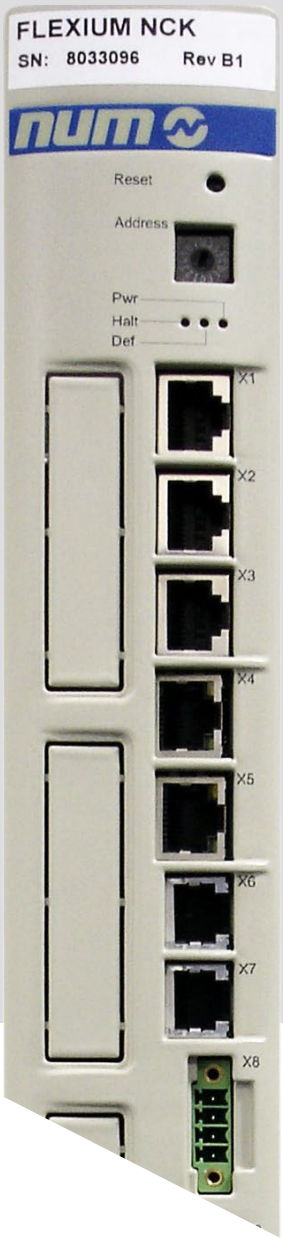
Parameters manual

(for software release 4.2.0.0)

M00041EN-03

Edition 01.2023





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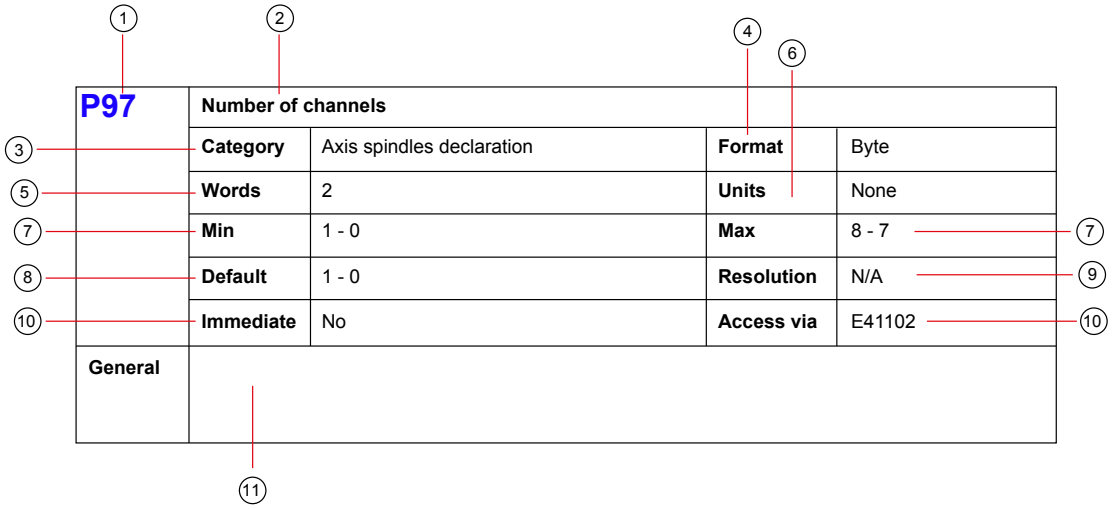
1 Foreword

1.1 Generalities

- This documents describes the machine parameters of Flexium⁺ .
- The parameters are mostly set in a transparent manner via the graphic editors of Flexium tools.
- Knowledge of the different parameters can however be very helpful to better understand the system or fine adjust the values.
- The parameters in this manual are regrouped by their function in the most logical manner for a standard machine.
- Each parameter is defined by the letter " **P** ". They may contain one value or a set of values.
- The term " **Word** " will be used for each component of a parameter.
  This term should be taken as generic and does not reflect the type of this component (e.g. 8 bit, 32 bit, ASCII value etc.). The real type is given in the cell " **Format** ".
- Each word is addressed by the letter " **N** " . *e.g. P25 N18 : word 18 of parameter P25.*

1.2 How to read a P parameter table description



1	**Parameter number**	
2	**Parameter function**	Function of the particular parameter.
3	**Category**	Category of functions (axes declaration, spindle characteristics, servos, etc.).
4	**Format**	Type of each word: Please refer the table in the next page.
5	**Words**	Number of words (N) of this particular format.
6	**Units**	Type of units (increments, µs, rpm, etc.)
7	**Min - Max**	Parameter range values.
8	**Default**	Parameter default values.
9	**Resolution**	Minimal increment related to the unit type (N/A = Not Available).
10	**Immediate**	Can be modified per request (FXTools / HMI) and taken into account immediately.
11	**Access via**	Access possible via E parameter (Parameter name - access type [Read (R), Write (W), Read/Write (R/W]). Access N/A = Not Available. In case of write access the new value will be taken into account immediately but NOT STORED in parameters. Access via ENA is possible for all parameters.

Parameters format

Format	Definition	Range	Type	Bytes
Type 0	8 bits Hexadecimal	00 → FF	byte	1
Type 1	16 bits signed Decimal	-32768 → 32767	int	2
Type 2	32 bits signed Decimal	-99999999 → 99999999	dint	4
Type 3	8 bits signed Decimal	-128 → 127	sint	1
Type 4	32 bits unsigned Decimal	00 → 99999999	dword	4
Type 5	16 bits unsigned Decimal	00 → 65535	word	2
Type 6	32 bits Hexadecimal	00000000 → FFFFFFFF	dint	4
Type 7	16 bits Hexadecimal	0000 → FFFF	int	2
Type 8	ASCII String	- - - -	string	--
Type 9	Floating point	-9999999.99999999 → +9999999.99999999	LREAL	8
Type 10	Unsigned Floating point	0 → 9999999.99999999	LREAL	8

- **Format**: Parameter format as indicated in the field “Format”.
- **Definition**: For information.
- **Range**: Maximum range of this format – The range for a parameter can be different (smaller)
- **Type**: Type of data – Important information for ENA (Extended NCK Access) functions relative to machine parameters.
- **Byte**: Occupation in memory – Also important for ENA function.

1.3 Parameters - Main summary table

Click on **Pxxx** to give the detailed information.

Parameter	Description
P0	Displayed axes
P1	Modulo or limited excursion rotary axes
P4	Axes programmable by diameter - Internal measurement - Dimension format for acquisition and display
P5	Channel configuration
P6	Spindle definition and assignement to channels
P7	Miscellaneous functions
P8	Axis with clamps
P9	Axis assignment to a channel
P11	Measurement conversion coefficient for analog axes
P13	Handwheel measurement conversion coefficient
P14	Handwheel declaration
P15	Homing direction
P16	Machine home position
P17	Axes travel limits
P18	Backlash error compensation
P19	High Speed Cutting: Feed-forward acceleration time constant - Dry friction correction time constant
P20	Dry friction correction amplitude
P22	In-position window
P23	Maximum following error
P24	Synchronised axes characteristics coefficien
P25	Synchronized axes characteristics thresholds
P27	Coupling assignment for duplicated and synchronized axes
P28	Enable slave axis synchronization
P29	Lubrication pulse distance
P30	Maximum axes traverse rate
P31	Jog and reduced speeds
P32	Maximum permissible acceleration
P33	Approach speed
P34	Reduced speeds per axes
P35	Subroutine call by M function
P37	Maximum number of M function with acknowledge
P40	Number of sensor spindle pulses by revolution
P41	Spindle reference reversal

P42	Spindle origin
P43	Spindle indexing speed and spindle speed limits
P44	Spindle indexing in-position window
P45	Spindle indexing gain
P46	Speed range for spindles @0 ... @7
P47	Speed range for spindles @8 ... @15
P48	Speed range for spindles @16 ... @23
P49	Speed range for spindles @24 ... @31
P50	Sampling period
P51	Minimum block execution time
P52	Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radius
P53	Acceleration profile
P54	Number of blocks in the look ahead buffer
P55	Speed anticipation coefficient - High Speed Cutting: number of filter terms
P56	Channel specific time constant
P57	Dynamic lag control
P58	Interaxis calibration table and program stack reservation
P59	Memory segments for symbolic variable storage
P62	Rigid tapping setting
P63	Servo adjustment for rigid tapping
P64	Carrier or carried axes
P65	Axes with quantified movements
P66	Time constant for axis
P67	Potentiometer min-max range
P68	Modulo for roatry axis (could be <> 360)
P70	Analog ports configuration
P71	Axis associated with an analog port connected spindle
P72	Direction of axis speed reference for analog axes
P73	Servo system loop coefficent for analog axes
P74	Absolute sensor resolution bit number for analog drive.
P75	PLC EtherCAT analog drives zero shift absolute sensor
P77	Axes with measure stored
P78	Modulo of the absolute sensor axis and maximum position tolerance
P85	Drives coupling assignment for anti-backlash function
P86	Drives coupling assignment for torque-duplication function
P87	Drives coupling assignment for winding-duplication function
P95	Memory zones allocation (Part program)
P97	Number of channels

P98	Number of origins DAT2
P99	CNC - PLC communication setting
P114	Backup on path, Auto recall after INTERV
P115	Final distance at work rate for recall
P116	EGB function
P117	SSB function
P120	Machine configuration

1.4 Use of the manual

This manual is for use by qualified personnel only.

To reduce the risk due to an improper use of the product, do not perform any servicing other than that contained in this manual unless you are qualified to do so.

To ensure proper use of these products, please always read this User's manual carefully and retain for future reference. Should the unit require maintenance, please contact a NUM authorized service center only.

1.5 Use of symbols in the manual

Symbol	Meaning of the symbol
	Important notes on product use.
STOP	You may find this symbol whenever a wrong operation may damage the product.

1.6 Document revisions

Date	Index	Reason for revision	See chapter
04 - 2014	00	Document creation	-
03 - 2015	01	Complies to software revision 4.0.10.0: - P120: new Word N8, N9, N10. - P99: new Word N4. - P7: new Word N3. - New P59: Memory segments forsymbolic variable storage. - New P34: Reduced speeds per axes. • P43 new label : - Spindle indexing speed and spindle speed limits and new notes in the Word N0 point (2, 4), - New Word N33 to Word N63, - New Word N64 to Word N95, - New Word N96 to Word N127, - New Word N128 to Word N159. - P45 new note in the Word N0. - P114 new Word N2 and Word N3 to N9.	 3.2 6.2 6.3 6.10 7.8 10.4 10.6 12.3
01 - 2022	02	Parameters aligned to 4.1.30.00 software release P68 Rotary axis modulo P77 Axes with measure stored P78 Modulo of the absolute sensor axis and maximum position tolerance P29 Lubrication pulse distance P116 Synchro tolerance for axis P74 Absolute sensor resolution bit number for analog drive P75 PLC EtherCAT analog drives zero shift absolute sensor	 4.7 4.8 4.9 6.14 12.6 12.3 13.1.5
01 - 2023	03	Parameters aligned to 4.2.0.0 software release P120 Machine configuration - Word N12 SSB function activation P7 Miscellaneous functions - Word N1 - Word N3: .b5 Word N4: .b6 .b7 - Word N5 Miscellaneous functions P35 Subroutine call by M fuction - Word N63 P33 Approach speed - Word N0 Worning P117 Smart Servo Balance (SSB) P115 Final distance at work rate for recall - Word N1, Word N2 removed	 3.2 6.3 6.4 9.3 9.8 12.4

1.7 How to read the manual

The Flexium+ Parameters Manual gives information on how to set the parameters to customize the Flexium+ for a particular Milling and Turning machine-tool.

Chapter	Description
1	**Foreword** This chapter introduces the use of the Parameters manual. - P parameters - Main summary table parameters selection.
2	**General CNC configuration with Flexium Tools** This chapter introduces and shows the most usefull customer examples with Flexium Tools: - Open or Create a Project - NCK selection and address. - Settings. - Programming. - Memory. - Miscellaneous. - Handwheel configuration. - Channels configuration. - other....
3	**Axis and Spindle declaration** This chapter introduces the Machine configuration - Number and type of channels, - Number and type of axes, - Number and type of spindles.
4	**Axis initial settings** This chapter introduces the base characteristics of the axes : - Displayed, - Modulo, - Radius or Diameter, - Clamps, - Carrier/carried.
5	**Spindle initial settings** This chapter introduces the base characteristics of the spindles : - Logical address, - Channel assignment, - Indexing, - Speed format, - Sensor, - Switchable.
6	**System configuration** This chapter introduces the configuration parameters : - Timing, - Memory sizes, - Buffers, - Datums, - M codes etc....

7	**Axis characteristics** This chapter introduces the Individual axes characteristics : - Homing, - Travels, - Positionning, - Backlash, - Speeds, etc. - Lubrication pulse distance
8	Axis dynamics This chapter introduces the axes dynamic characteristics : - Following errors, - Acceleration, - Acceleration profile.
9	**Performance** This chapter introduces the axes performances: - Speed and acceleration anticipation, - Dry friction compensation, - Time constants (gain), etc.
10	**Spindle characteristics** This chapter introduces the spindle static characteristics : - Sensor counts, - Origin, - Indexing, - Speeds, - Ranges, etc.
11	**Synchronization; Duplication** This chapter introduces the duplicated and synchronized axes characteristics : - Lists, - Coupling, - Coefficients, - Thresholds.
12	**Cycles** This chapter introduces cycles characteristics: - Rigid tapping, - Backup and Retrace.
13	**Analog Axes and Spindle, Handwheel** This chapter introduces the the analog axes characteristics: - Measurement, - Direction, - Gain, - Handwheels declaration.

1.8 NUM Agency

The list of NUM agencies is given click here http://www.num.com

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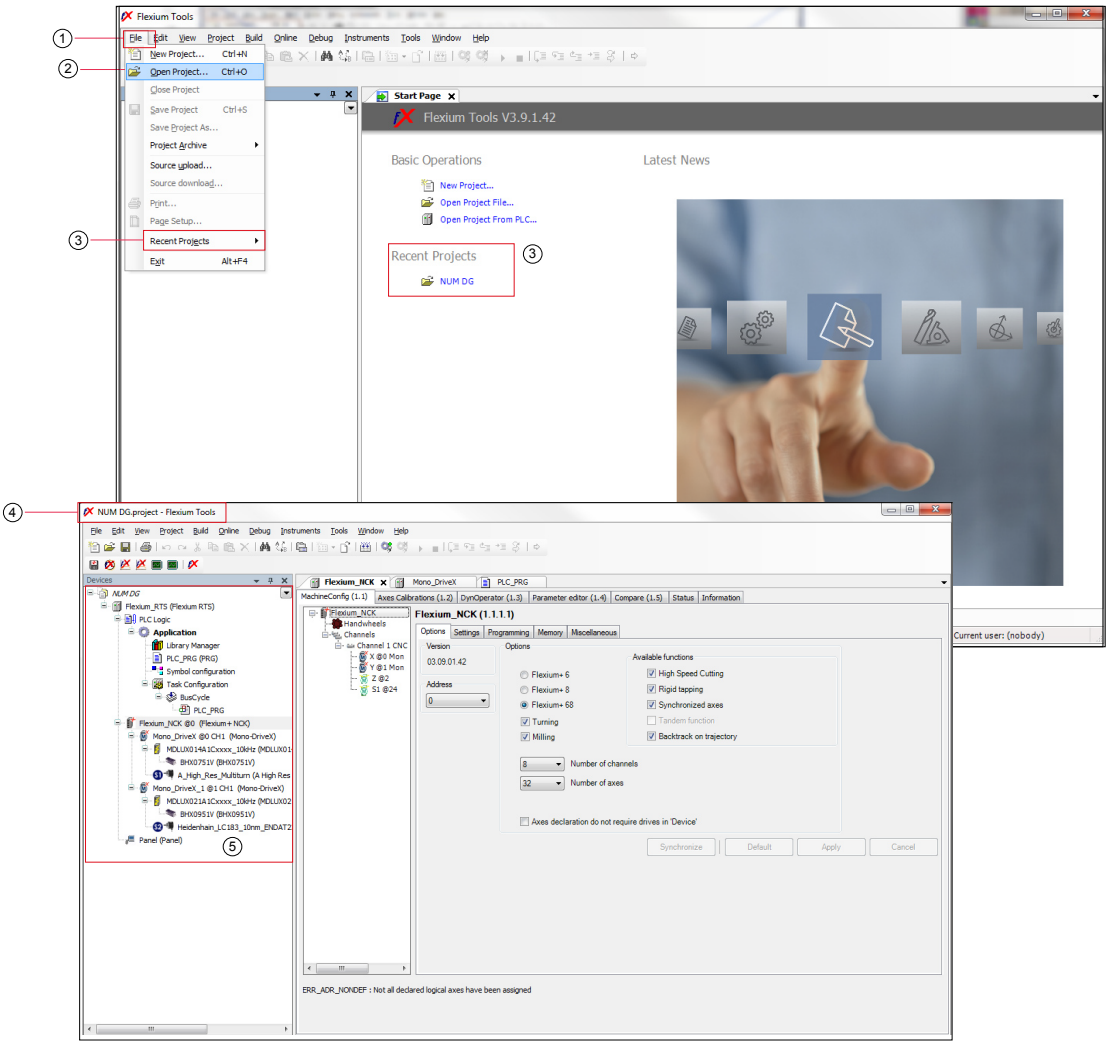
2 General CNC configuration with Flexium Tools

This chapter introduces and shows the most usefull CNC customer examples with Flexium Tools. Concerning the NUMDrive X examples with Flexium Tools please refer to MDLUX Parameters manual M00031.

2.1 Open or Create a project

2.1.1 Open a Flexium+ Project

Open Flexium Tools and follow the here under instruction:

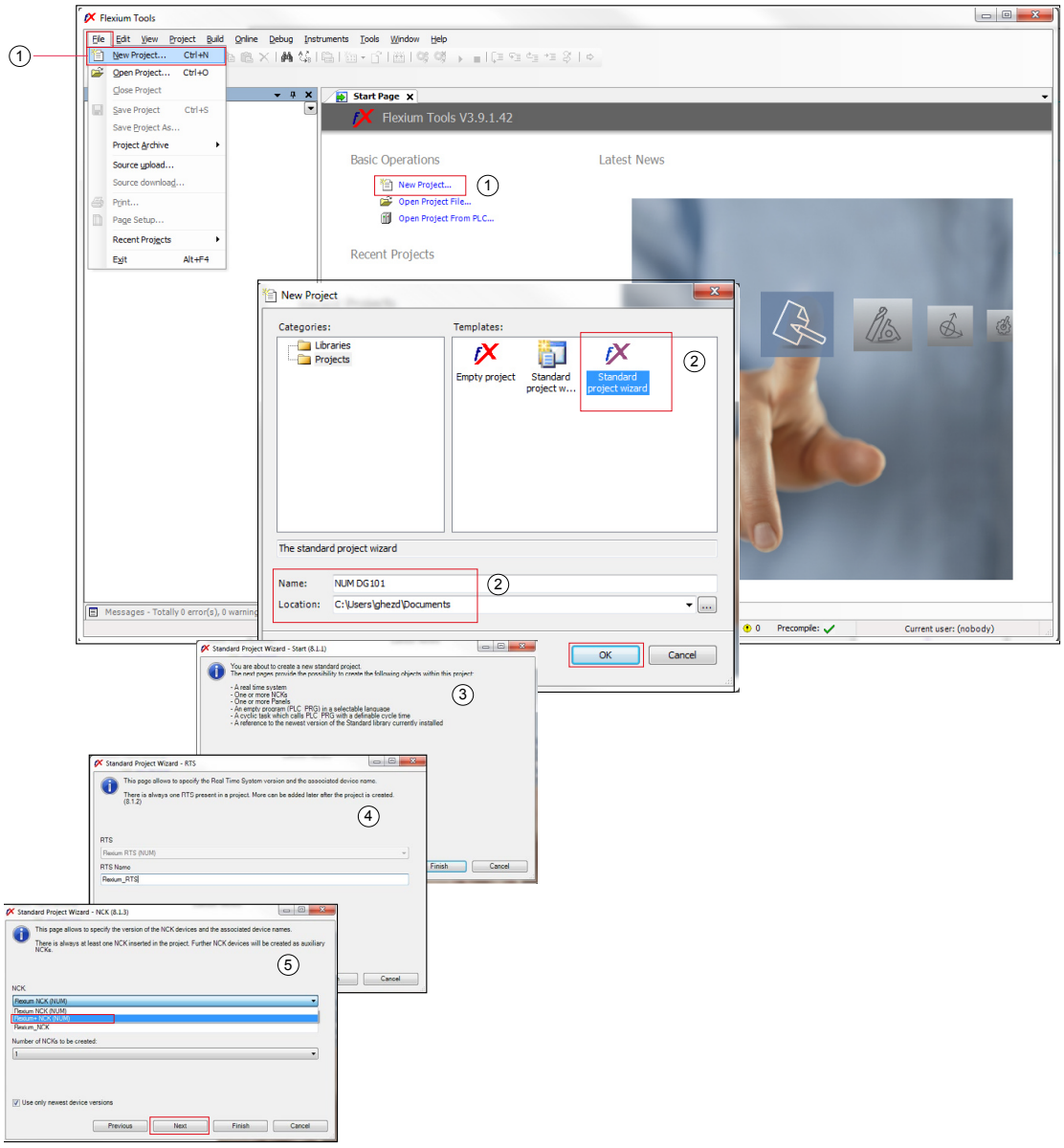


1	Select → *"File"*
2	Select → *"Open Project"* in the folder.
3	or → select *"Recent Project"* to open a recent one, then click on → *"NUM DG"* to open the project and wait few second the loading..
4	*"NUM DG"* project page visualization.
5	Project structure with Flexium NCK, NUM Drive, motors and sensors configuration.

2.1.2 Create a Flexium+ Project

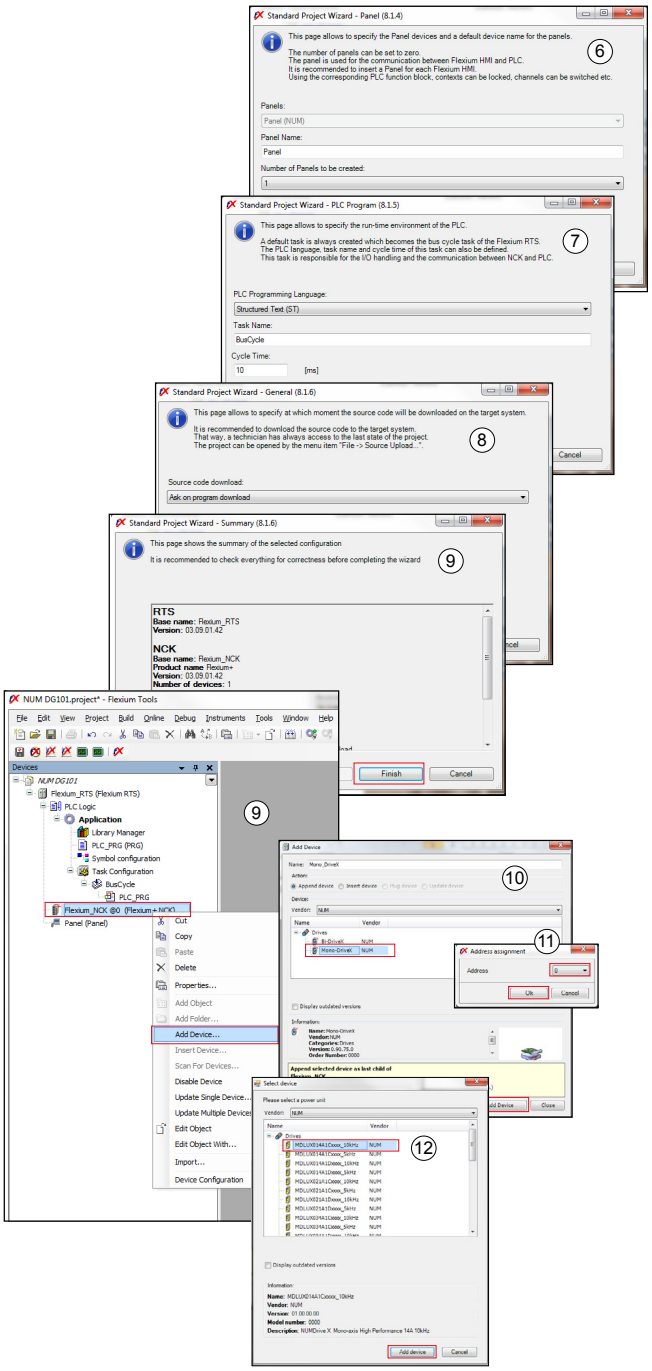
Follow the here under instruction to create a new project using Flexium Tools:

Enter a new Flexium NCK in the project



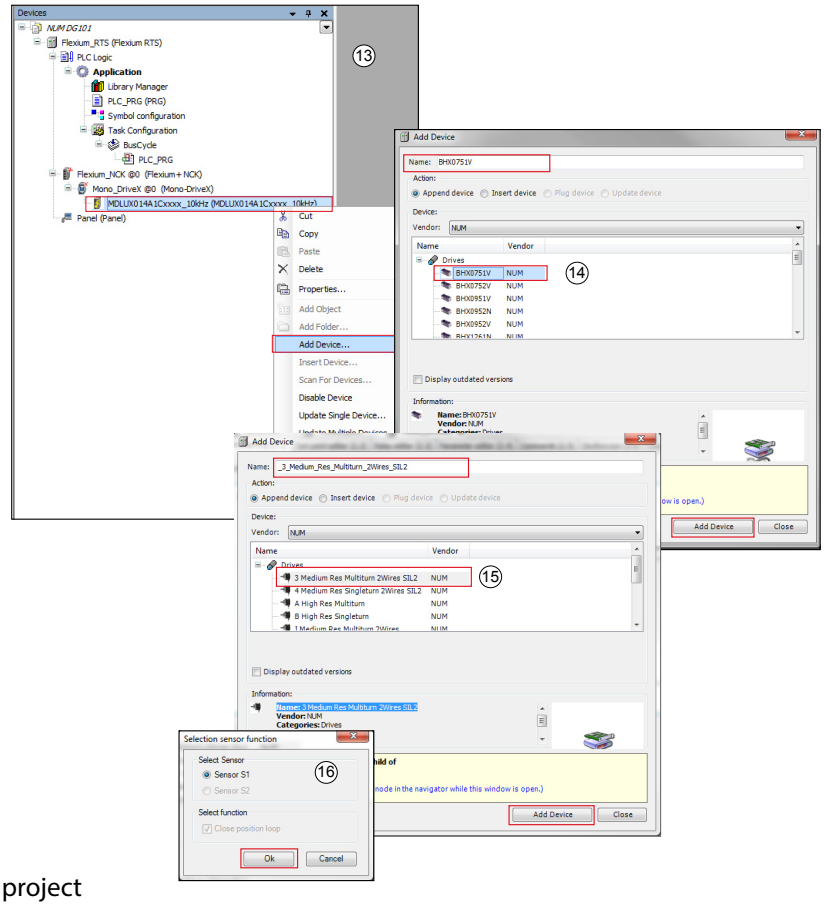
1	Select → *"File"* then click on → *"New Project"*
2	Click on → *"Standard project wizard"* icon and enter the New project name *"Name"* and likewise enter the folder *"Location"*.
3 4	Click on → *"Next"* to enter a standard project configuration.
5	Click on → *"NCK"* tabbed window, then select *"Flexium+NCK (NUM)"*

Enter a new "NUM Drive" selection

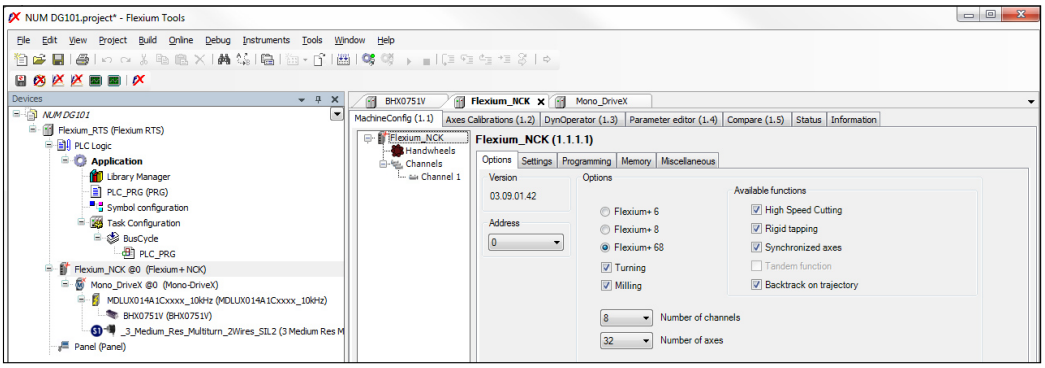


6 7 8	Click on → *"Next"* to enter a standard project configuration.
9	Click on → *"Finish"* to complete the Flexium_NCK configuration then the first tree configuration will appear in the main page. Click on → *"Flexium_NCK@0..."* then right click to open the window. Click on → *"Add Device"* to enter a new device.
10	Click on → *"Mono-Drive"* then click on → *"Add Device"* to enter a new NUM Drive selection.
11	Click on → the tabbed window and select the drive address, *"xx"* then click on → *"OK"*.
12	Click on → the *"Drives"* tabbed window and select the drive size then click on → *""Add Device"* to enter the new Drives size selection.

Enter a new "NUM Motor and sensor" selection



End project



13	Click on → *"MDLUX014A1Cxxx..."* then right click to open the window. Click on → *"Add Device"* to enter a motor configuration.
14	Click on → *"BHX0751V"* then click on → *"Add Device"* to enter the motor selection.
15	Click on → *"MDLUX014A1Cxxx..."* then right click to open the window. Click on → *"3 Medium Res Multiturn 2Wires...."* sensor . Click on → *"Add Device"* to enter the motor sensor configuration.
16	Click on → radio button *"Select Sensor"* to select the S1 or S2 sensor configuration.

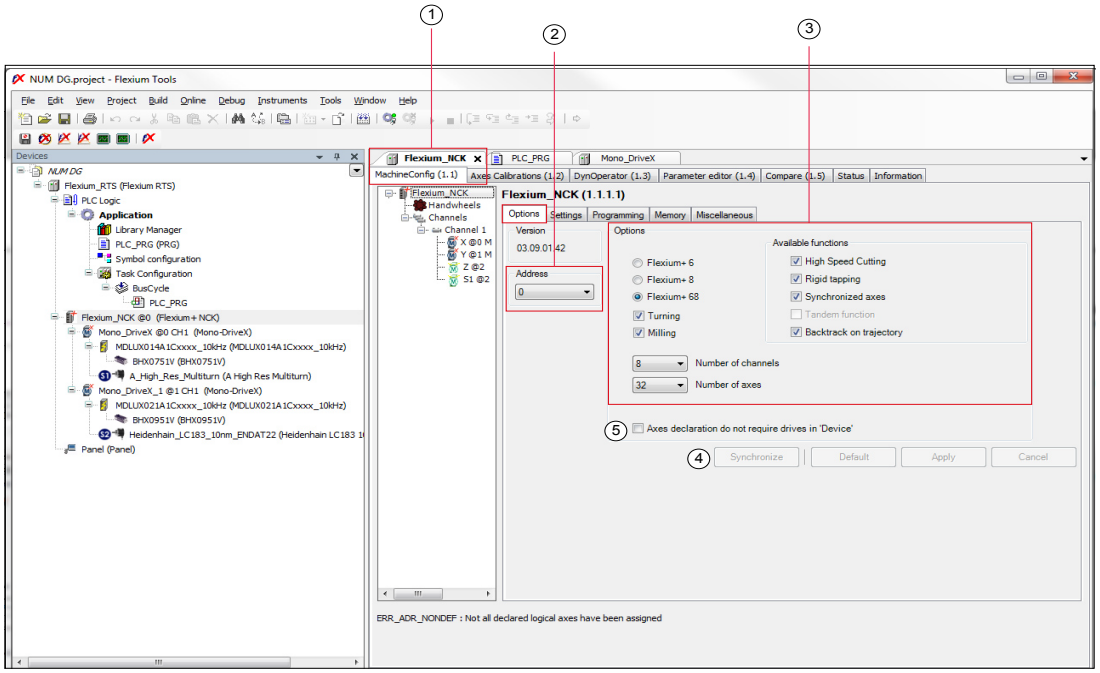
For more detailed information upon the drive configuration, drive parameters, drive test point and measure point, Multi/Divi, Programmable relay, filters... please refer to NUMDriveX Parameters manual M00031.

2.2 Machine configuration

2.2.1 Options

The tab "Options" gives access to:

- NCK address.
- Define the functions that you want to use or parameterize.
- Declare the axes.

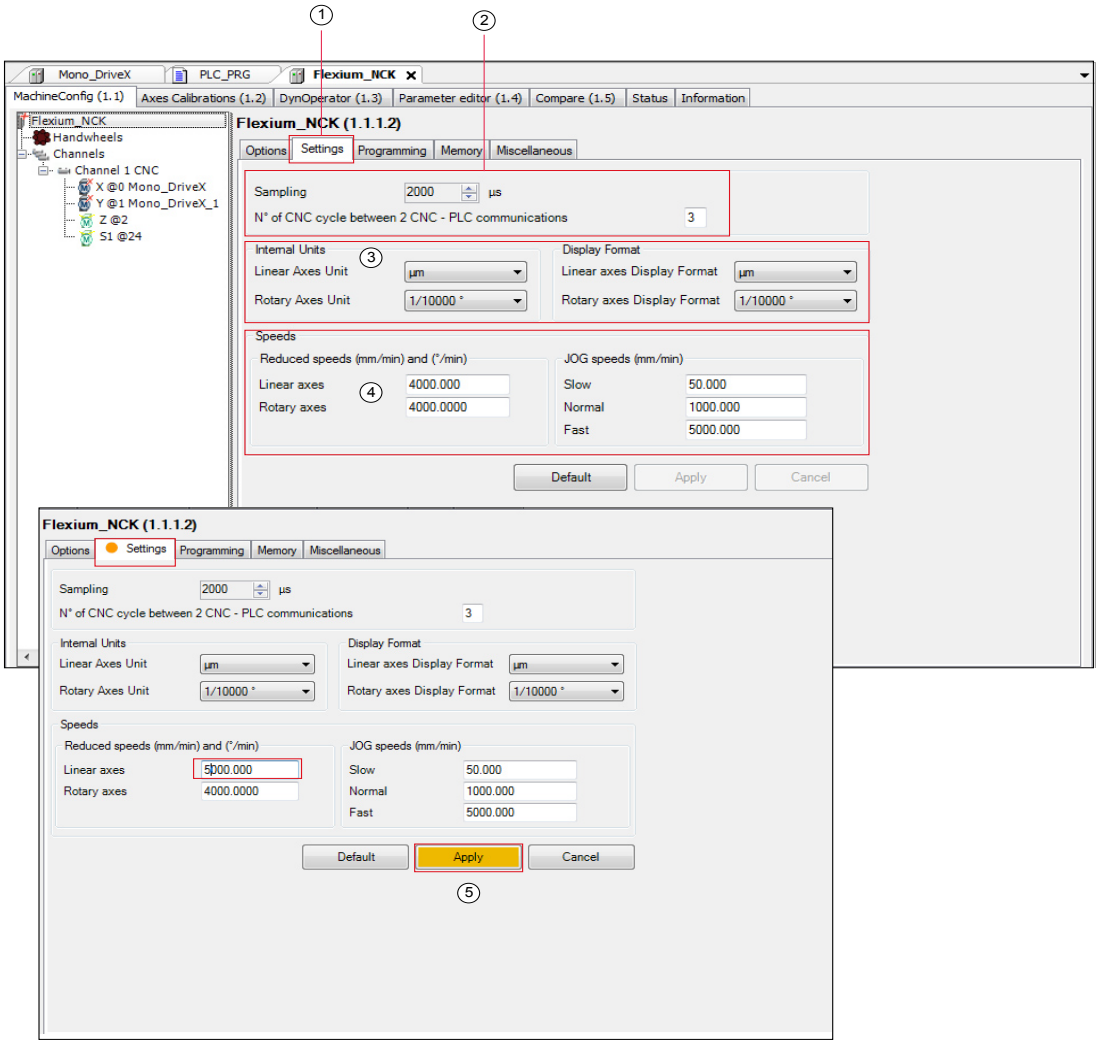


1	Select → *"Flexium_NCK"* and click → *"MachineConfig"* → *"Options"* to open the dedicated editor.
2	Select → *"Address"* to select the NCK address according to the rotary switch in front of the NCK. Please refer to Flexium System Installation manual M00009.
3	Click on tick box (✓) → *"xxxxx"* functions to define the functions that you want to use or parameterize.
4	If the system is On Line, the button *"Synchronize"* will retrieve automatically the options available in the system N.B. This definition has no effect on the system features it just gives access to option specific pages.
5	Select → *"Axis declaration ....."* if you haven't declared Drives in the Device window, click on → the check box to be able to declare axes.

2.2.2 Settings

The tab "Settings" gives you access to:

- xis sampling and PLC exchange timings.
- Units of measure and display.
- Global speeds characteristics.

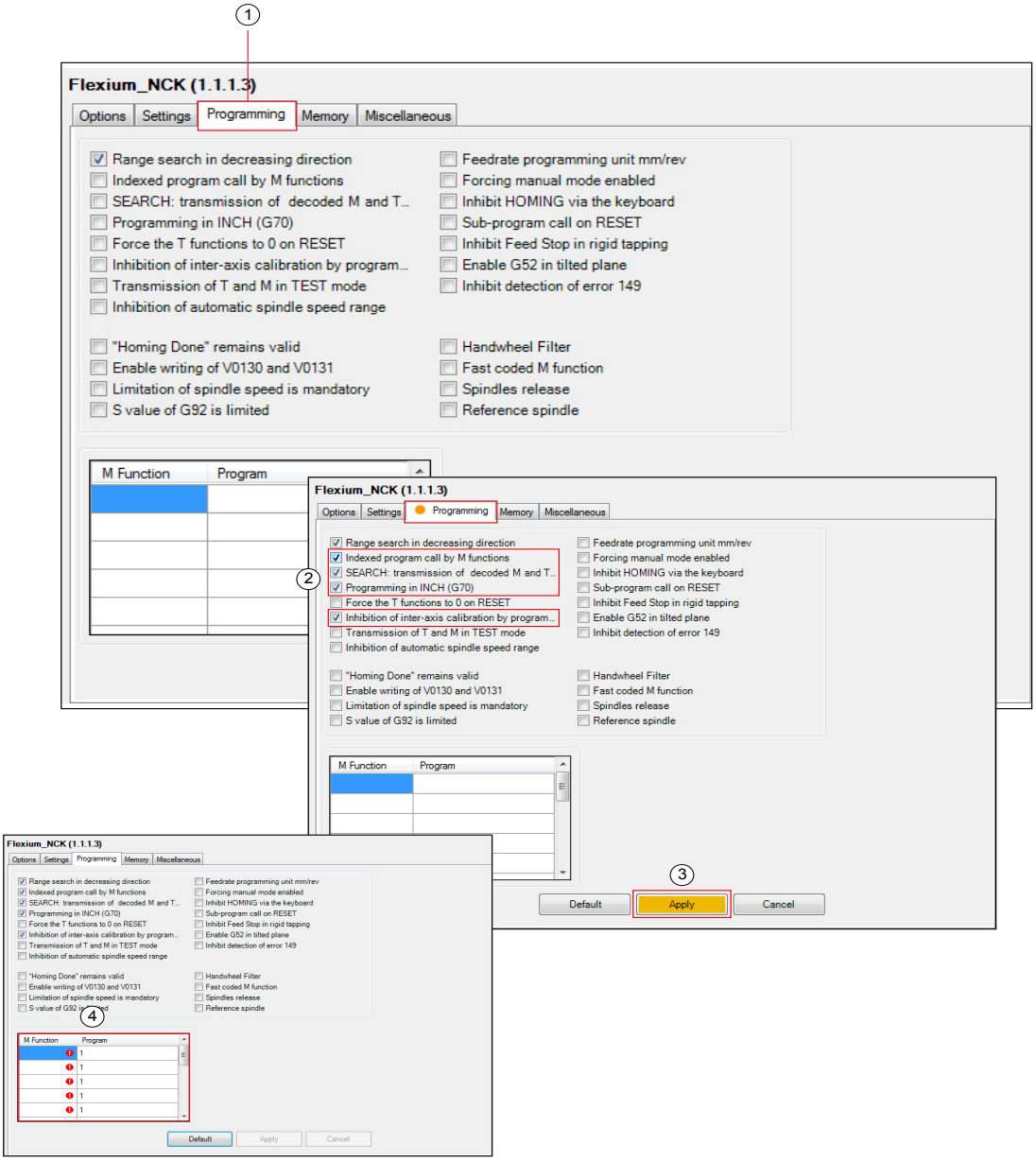


1	Select → *"MachineConfig"* and click → *"Settings"* to open the dedicated editor.
2	Select → *"Sampling"* to select the axis samplig and PLC exchange timinings.
3	Select the tabbed window → *"Internal Units"* to select the Units of measure. Select the tabbed window → *"Display format"* to select the internal units visualization format.
4	Select → *"Speed"* to define the Safety and Jog speeds.
5	Click on → *"Apply"* to enter all the modifications in this page, then a orange icon appears during the modification. (After the modification it returns grey)

2.2.3 Programming

The tab "Programming" gives access to:

- Comprehensive set of adjustments and parameterization.
- Definition of subroutines invoked by M functions.

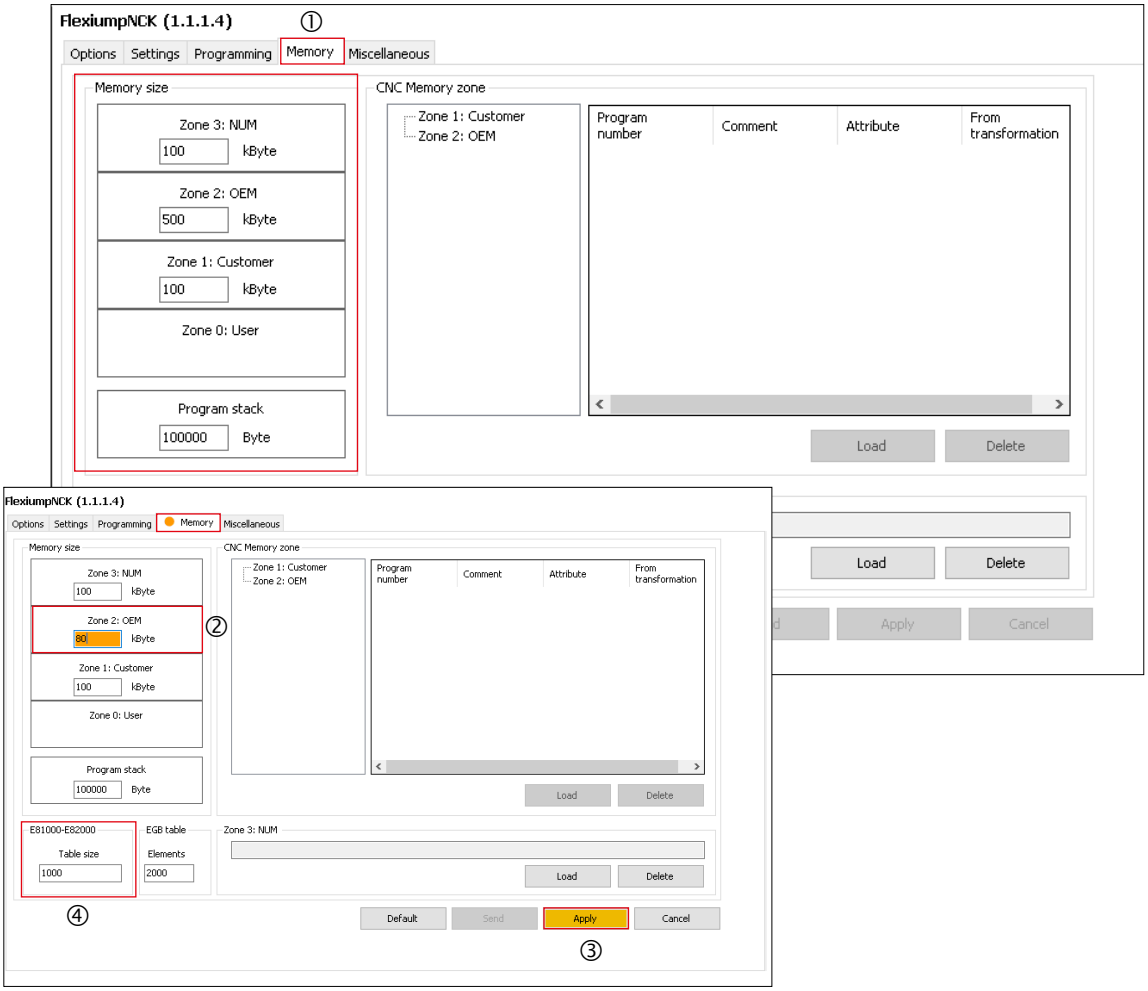


1	Select → *"MachineConfig"* and click oon → *"Programming"* to open the dedicated editor for a comprehensive set of adjustments and parameterization.
2	Click on tick box (✓) to set the functions.
3	Click on → *"Apply"* to enter all the fuction modifications in this page, then a orange icon appears during the modification. (After the modification it returns grey)
4	This tab shows the definition of subroutines invoked by M functions.

2.2.4 Memory

The tab "Memory" gives access to the parameterization of the different memory zones:

- Zone NUM reserved by NUM for specific part programs or macros.
- Zone OEM reserved by the OEM for machine specific part programs or macros.
- Zone Customer reserved for customer specific macros.
- The size of zone 0 is linked to what has been used for the other zones. It is the area where the part programs are stored and executed from.
- Table size configuration.

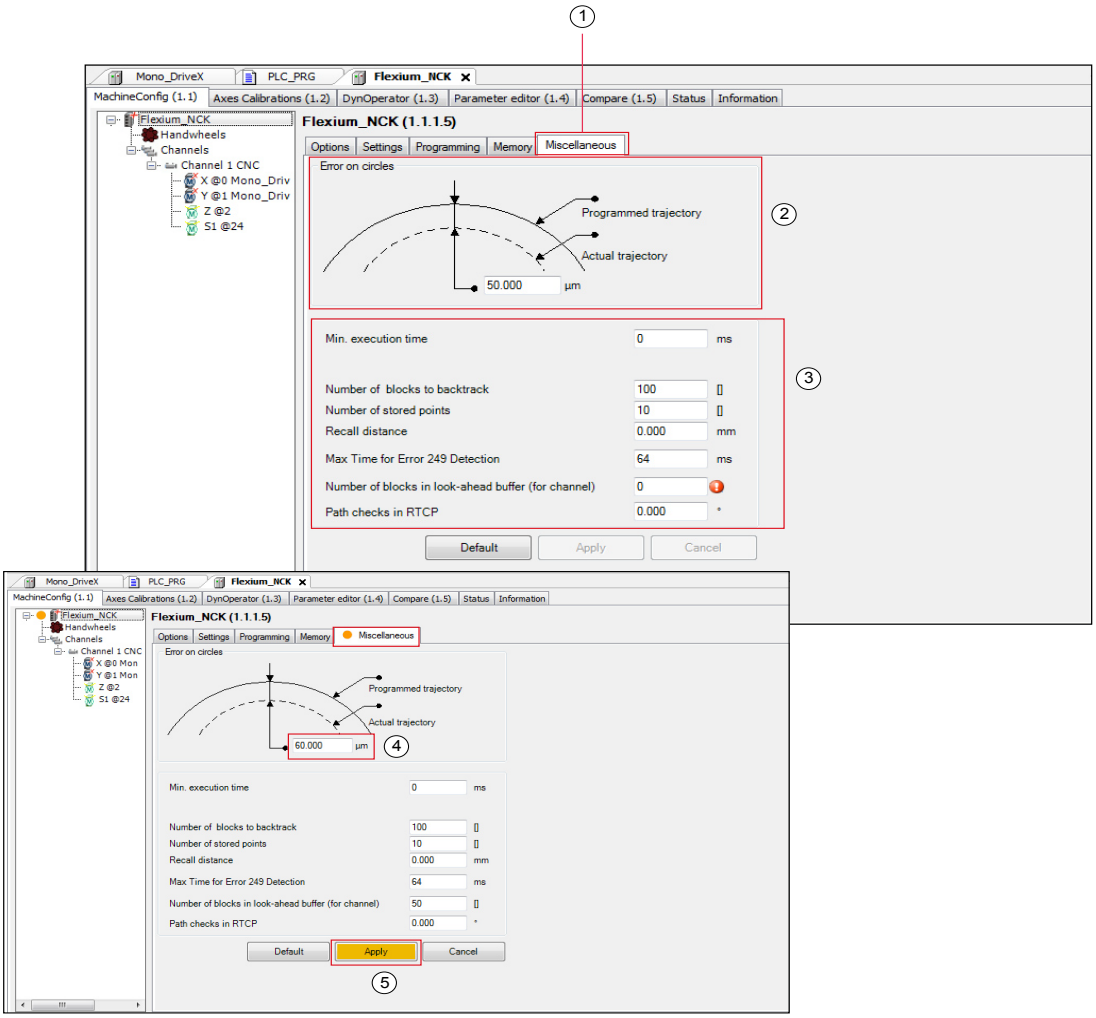


①	Select → *"MachineConfig"* and click → *"Memory"* to open the dedicated page for the parameterization of the different memory zones.
②	Click on → *"Zone"* area then insert the new value, then a orange icon appears during the modification.
③	Click on → *"Apply"* to enter the modification. After the modification the icon returns grey.
④	Table size: keep the default value.

2.2.5 Miscellaneous

The tab "Miscellaneous" is reserved for final adjustments:

- Error tolerated on circles (see P52).
- Minimum time to execute a block (see P51).
- Backtrack and retrace (see P114).
- Time for error 249 (see P99).
- Size of the look ahead buffer (see P54)
- RTCP path checking (see P52 N1).



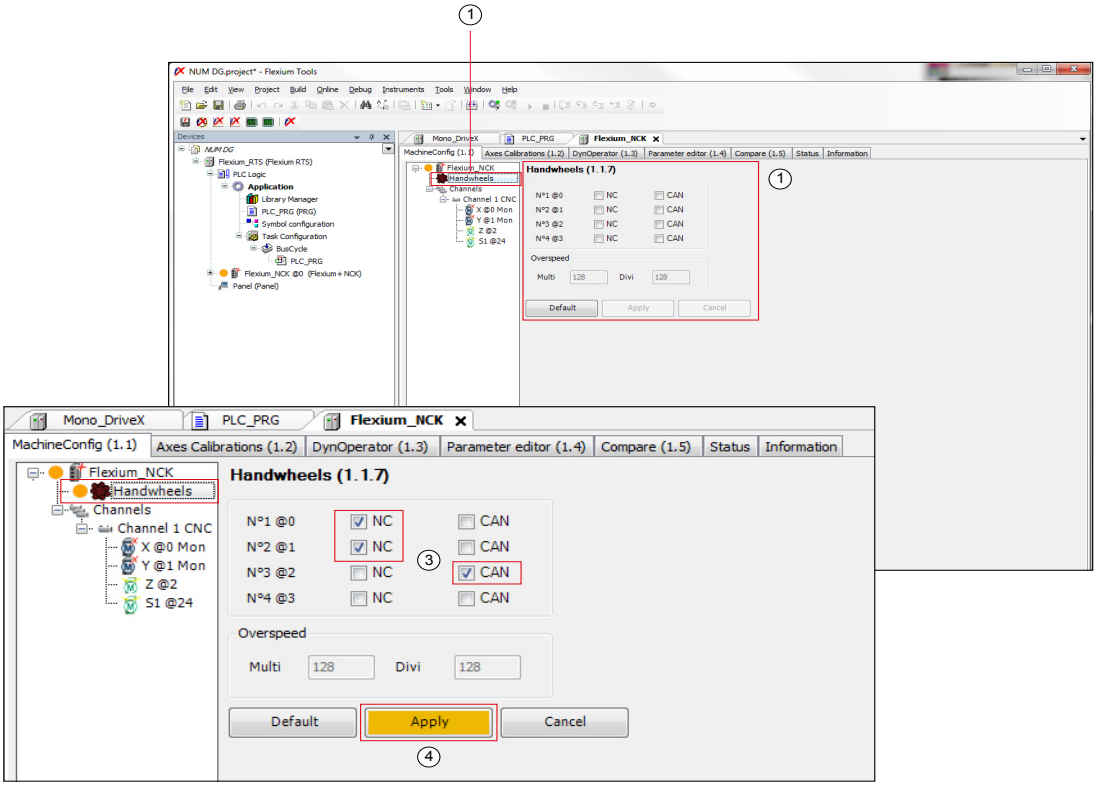
1	Select → *"MachineConfig"* and click → *"Miscellaneous"* to open the dedicated page for the final adjustments.
2 3 4	Click on → *"xxxx"* function to modified the functions values. Insert the new value then a orange icon appears during the modification.
5	Click on → *"Apply"* to enter the modification. After the modification the icon returns grey.

2.2.6 Handwheels

Clicking on "Handwheels" gives access to defining the handwheels used whether NC connected or CAN connected.

A handwheel cannot be both CAN and NC.

Additionally this tab gives the possibility to define the overspeed coefficient used with G12 function (see Flexium⁺ Programming manual M00040).

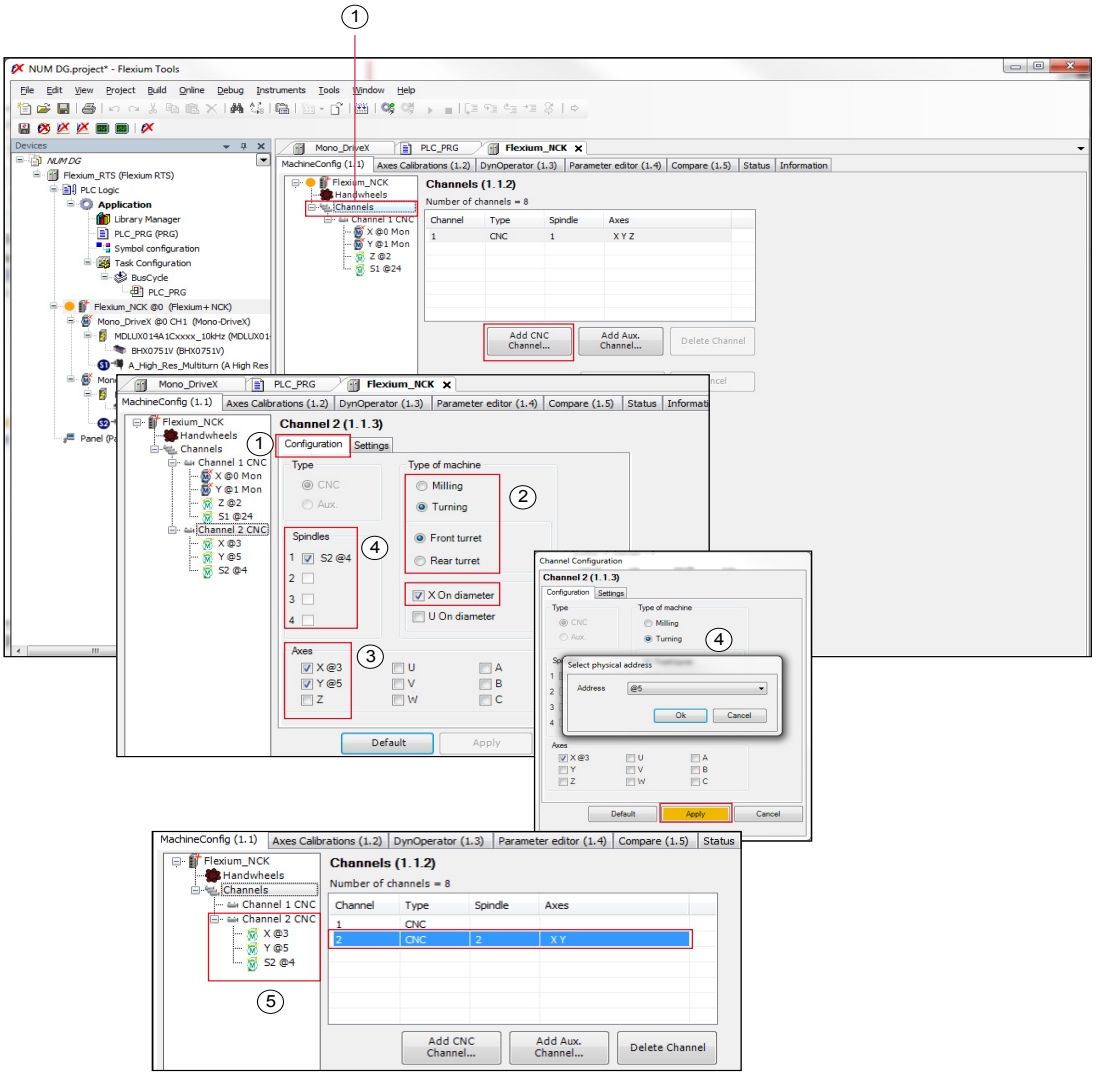


1	Select → *"Handwheels"* to open the dedicated page for the handwheels configuration.
2	Click on → tick box (✓) to set the handwheels configuration, then a orange icon appears during the modification.
3	Click on → *"Apply"* to enter the modification. After the modification the icon returns grey.

2.3 Channels

2.3.1 Channels Configuration

Click on "Channels Configuration" and add as many CNC or Auxiliary channel as required in your configuration.



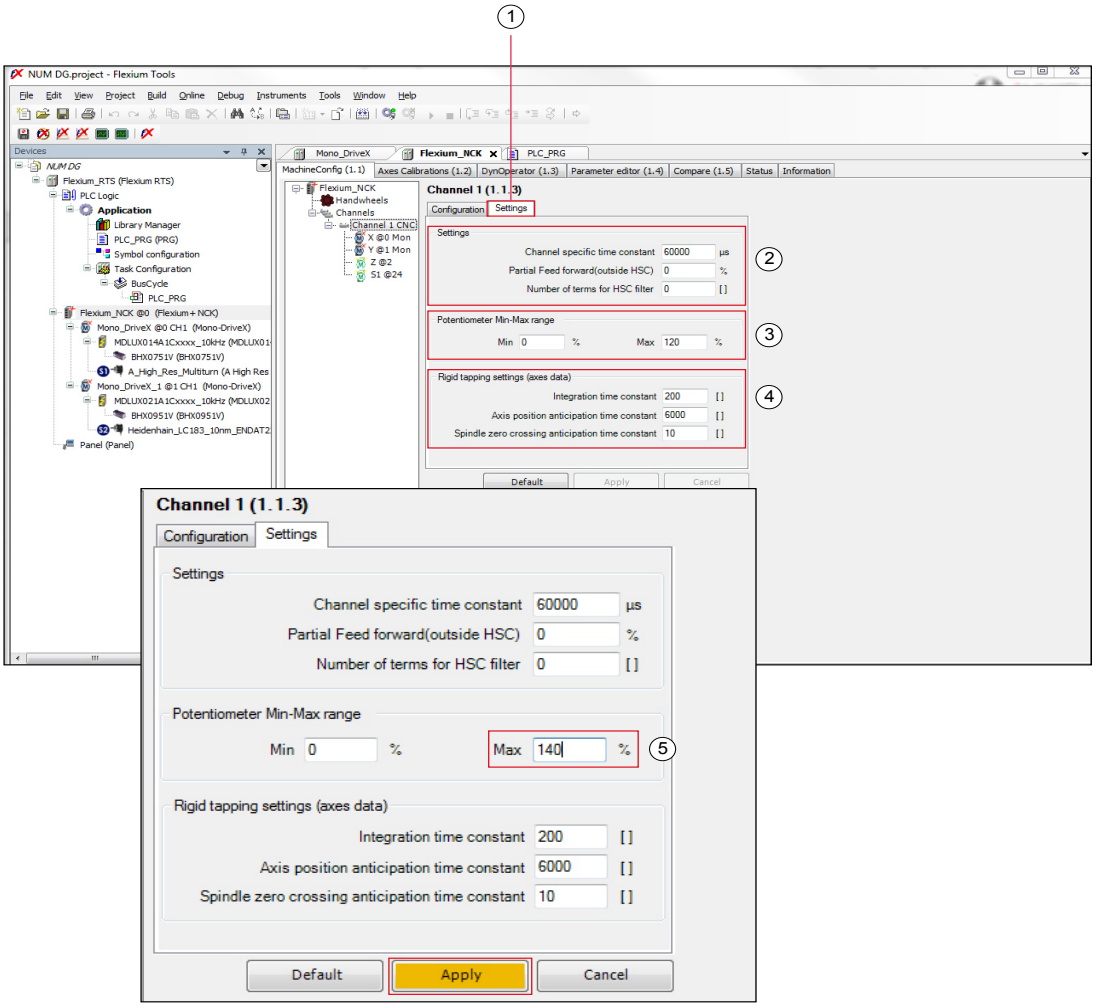
1	Click on → *"Channels"* to open the dedicated channels page configuration. Click on → *"Add CNC Channel or Aux Channel"* to create a new channel and add as many CNC or Auxiliary channel as required in your configuration.
2	Click on → tick box (✓) to set the *"Type of machine"* (Milling or Turning).
3	Click on → tick box (✓) to set the *"Axes"* addresses selection. Note. Up to 9 axes each one linked to a particular drive or address.
4	Click on → tick box (✓) to set the *"Spindles"* addresses selection (up to four spindles). Select with the tabbled window the *"Logic"* and *"Physical address"* then click on → *"Apply"* to enter the modification.
5	New Channel 2 CNC page.

It is not possible to declare more channel than defined on the NCK / Options screen.

2.3.2 Channels Settings

The tab "Settings" gives access for each channel individually to:

- Channel specific dynamic (Time constant → gain and High Speed Cutting parameters).
- Feed override range.
- Rigid tapping settings .

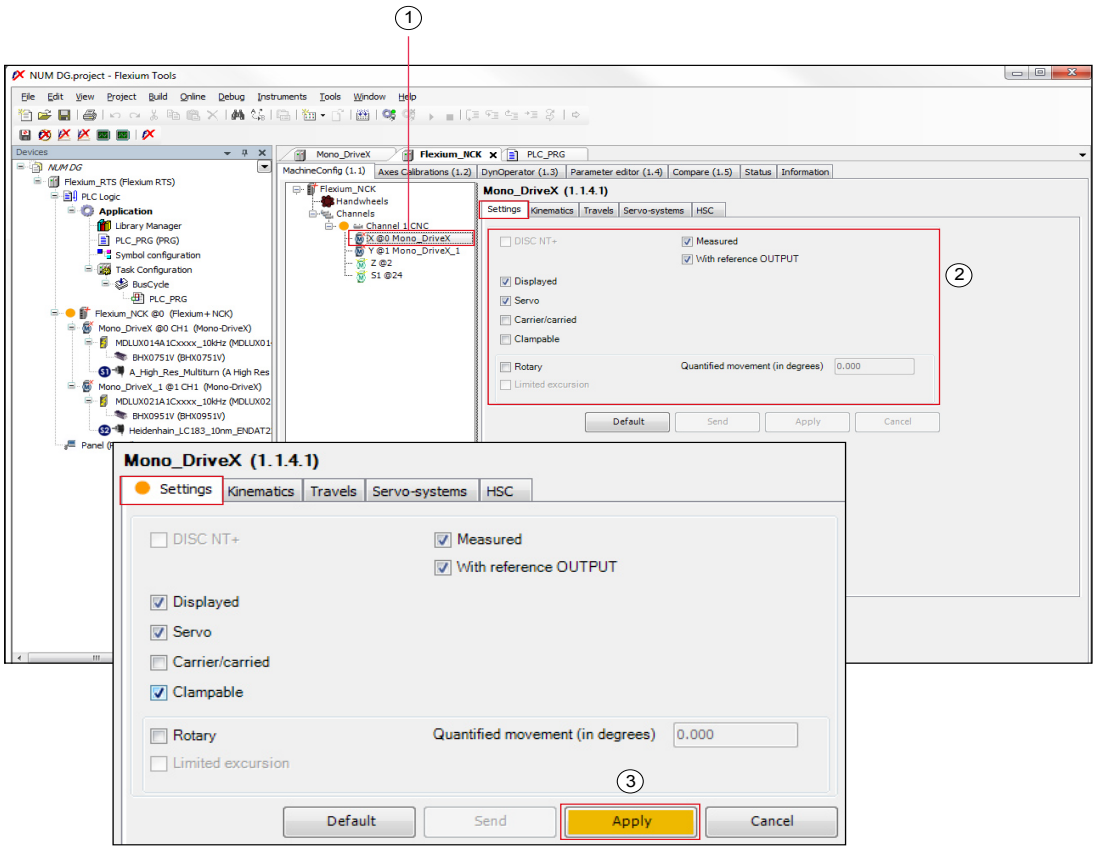


1	Click on → *"Settings"* to open the dedicated channels page settings.
2	Enter the new value for the *Channel specific dynamic,* then click on → *"Apply"* to enter the modification
3	Enter the new value for the *Feed override* range, then click on → *"Apply"* to enter the modification.
4	Enter the new value for the *Rigid tapping* settings, then click on → *"Apply"* to enter the modification.
5	Example of Feed override range modification.

2.3.3 Axis channels

2.3.3.1 "Settings"

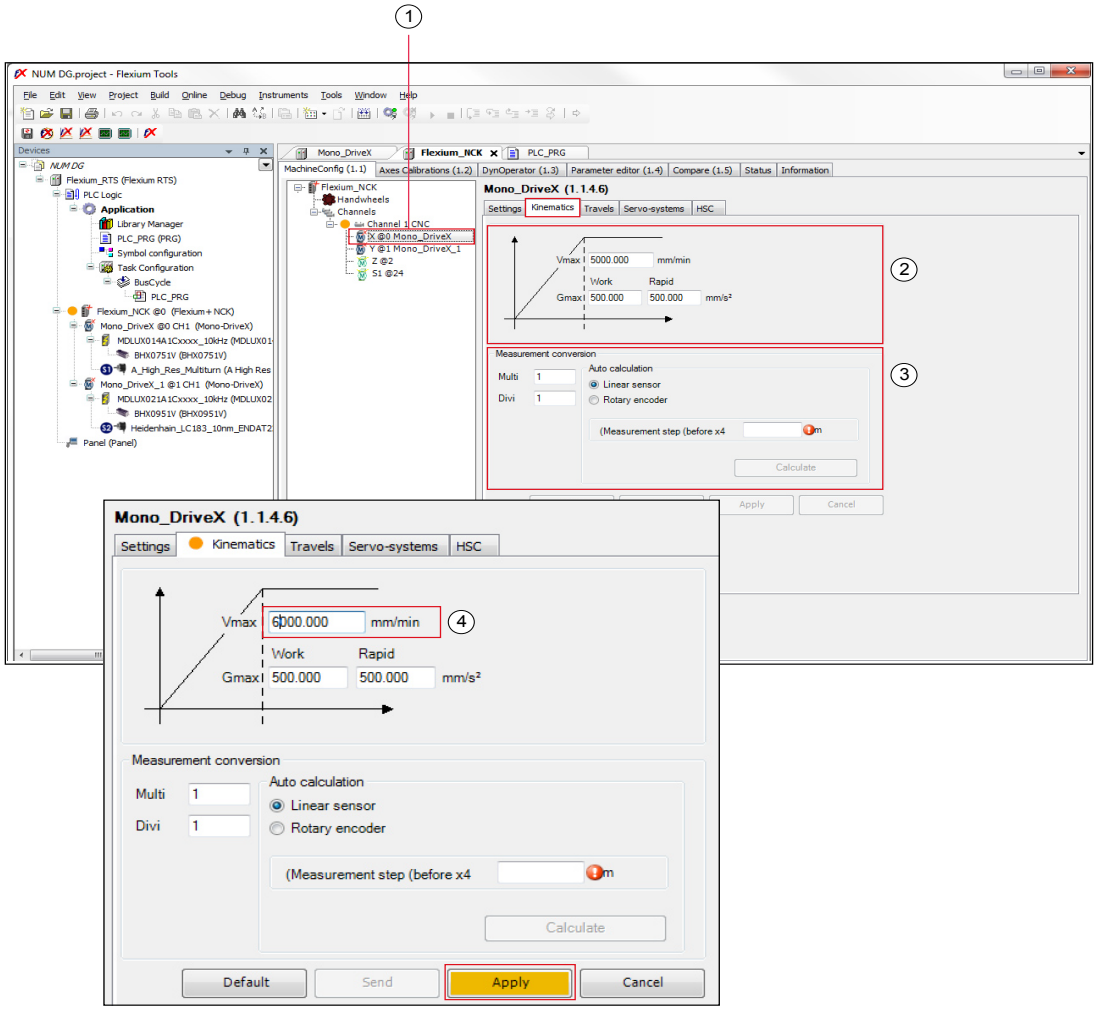
Select each axis individually and enter its structural characteristics.



1	Click on → *"X@0Mono_Axis"* to open the dedicated axis page settings.
2	Click on → tick box (✓) to set the *Axis configuration*, then a orange icon appears during the modification.
3	Click on → *"Apply"* to enter the modification. After the modification the icon returns grey.

2.3.3.2 "Kinematics"

The tab "Kinematics" gives access to the speed and acceleration characteristics of each particular axis.

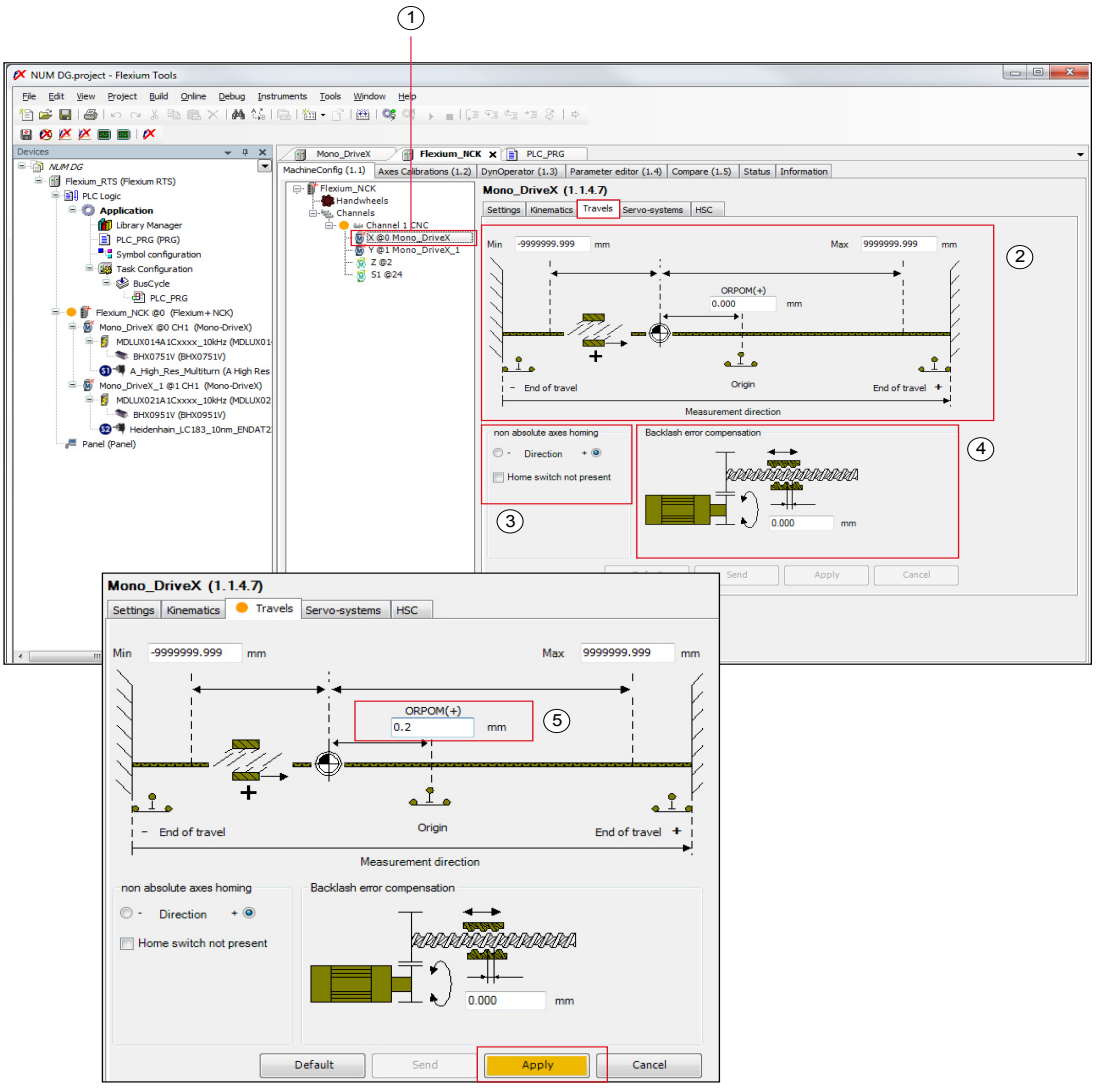


1	Click on → *"X@0Mono_Axis"* then click on *"Kinematics"* to open the dedicated configuration page.
2	Enter the new modification, then a orange icon appear during the modification..
3	For Analog Axis only! Please refer to MDLUX parameters manual M00031 for more detailed information upon the "Measurement conversion Multi / Divi".
4	Click on → *"Apply"* to enter the modification. After the modification the icon returns grey.

2.3.3.3 "Travels"

The tab "Travels" gives access to:

- Software travel limits.
- Homing characteristics for non-absolute measured axes.
- Backlash value.

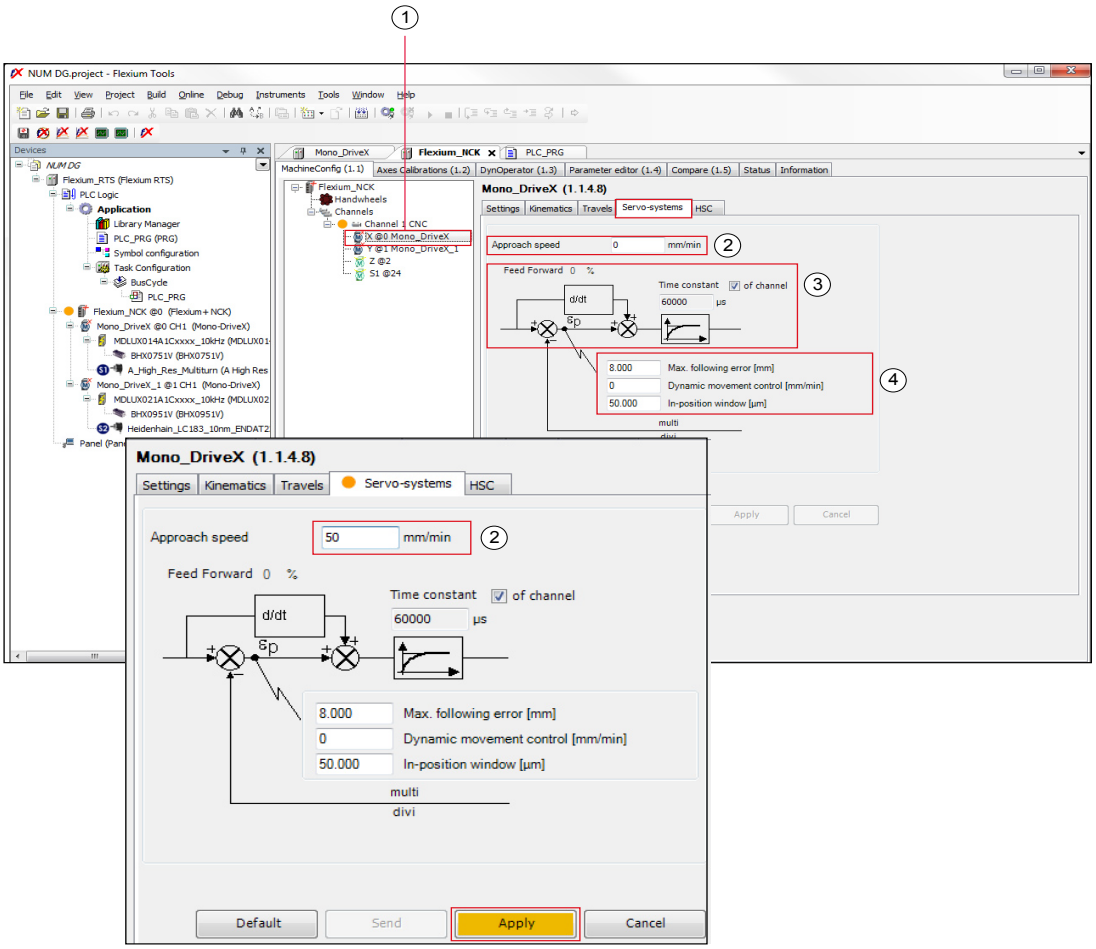


1	Click on → *"X@0Mono_Axis"* then click on on → *"Travels"* to open the dedicated configuration page.
2	Enter the new value modification on *"Measurement direction"* , then a orange icon appear during the modification. Click on on → *"Apply"* to enter the modification.
3	Click on → *"Direction"* radio button to select *"- / + direction"*, then a orange icon appears during the modification. Click on → *"Apply"* to enter the modification. Click on → tick box (✓) *"Home switch not present"* to set the homing switch, then a orange icon appears during the modification. Click on → *"Apply"* to enter the modification.
4	Enter the new value modification on *"Backlash error compensation"*, then a orange icon appears during the modification. Click on → *"Apply"* to enter the modification.
5	Modification example.

2.3.3.4 "Servo-systems"

The tab "Servo System" gives access to:

- Approach speed (see P33).
- Axis specific time constant if required.
- Axis dynamic characteristics.

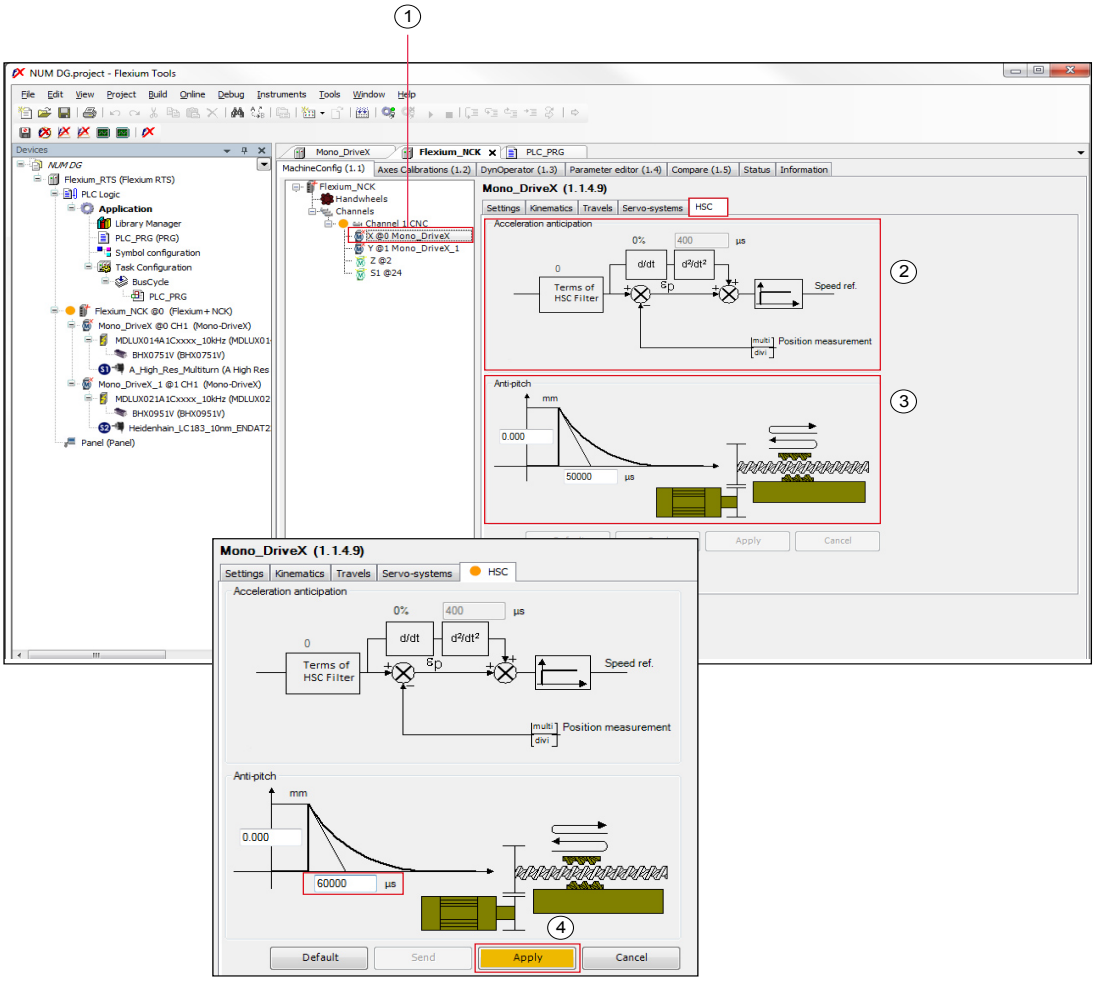


1	Click on → *"X@0Mono_Axis"* then click on → *"Servo-systems"* to open the dedicated configuration page.
2	Enter the new value modification on *"Approach speed"*, then a orange icon appears during the modification. Click on → *"Apply"* to enter the modification.
3	Click on → tick box (✓) *"Time constant"*, then a orange icon appears during the modification. Click on *"Apply"* to enter the modification.
4	Enter the new value modification on *"Feed Forward"* , then a orange icon appears during the modification. Click on → *"Apply"* to enter the modification.

2.3.3.5 "HSC" High Speed Cutting

The tab "HSC" gives access to:

- Acceleration anticipation active only if **H**igh **S**peed **C**utting is validated at the channel level.
- Anti pitch characteristics.



1	Click on → *"X@0Mono_Axis"* then click on → *"HSC"* to open the dedicated configuration page.
2, 3	Enter the new value modification on *"Acceleration anticipation"* and *"Anti-pitch"* functions, then a orange icon appear during the modification.
4	Click on → *"Apply"* to enter the modification.

2.4 Other tabs of NCK device

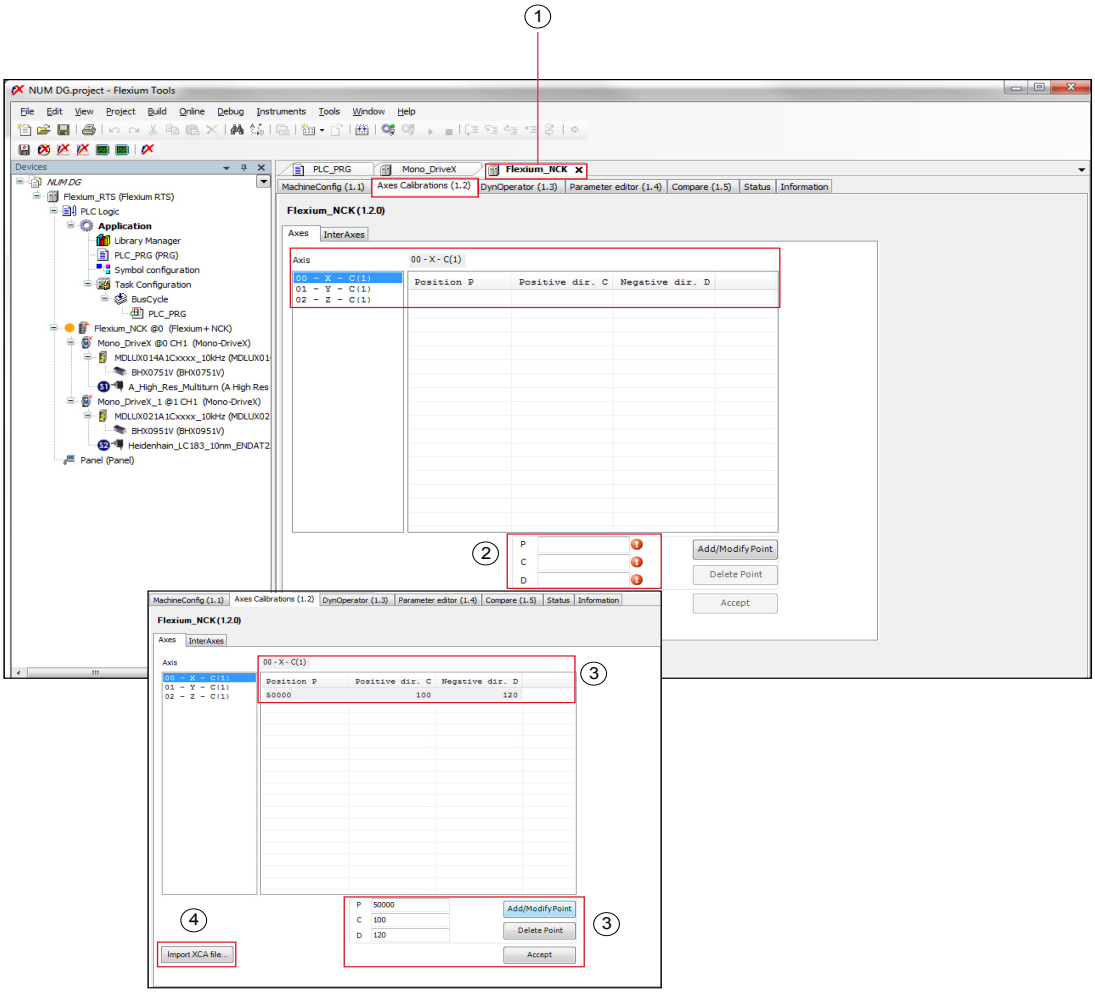
2.4.1 Axis calibration

2.4.1.1 Axes

Axes calibration: correction of positioning errors on the travel of each axis individually.

The possibilities are:

- Import directly a calibration table (ASCII format).
- Enter the points individually; the correction can be different according to the direction.



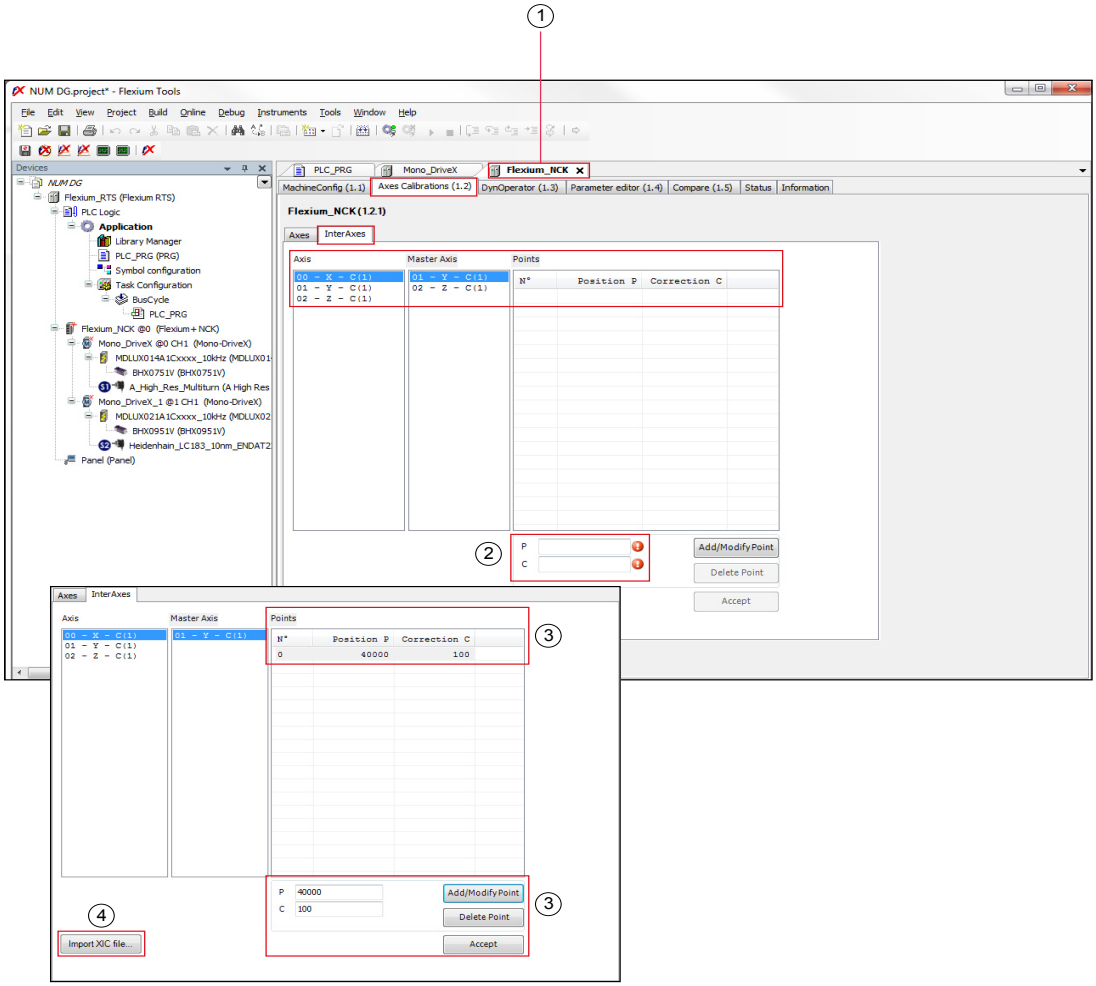
1	Click on → *"Flexium_NCK X"* then click on → *"Axis Calibration"* to open the dedicated axis page settings.
2	Enter individually the axis modification values on: - *"P"* Position travel, - *"C"* Positive direction correction, - *"D"* Negative direction correction.
3	Click on → *"Add"* to enter the modification and the new values will appears in the table .
4	Click on → *"Import XCA file..."* to import directly a calibration table (ASCII format) .

2.4.1.2 InterAxes

Inter axes calibration gives the compensation of positioning error of an axis according to the position of another axis (Master Axis).

The possibilities are:

- Import directly a InterAxes calibration table.
- Enter the points individually.

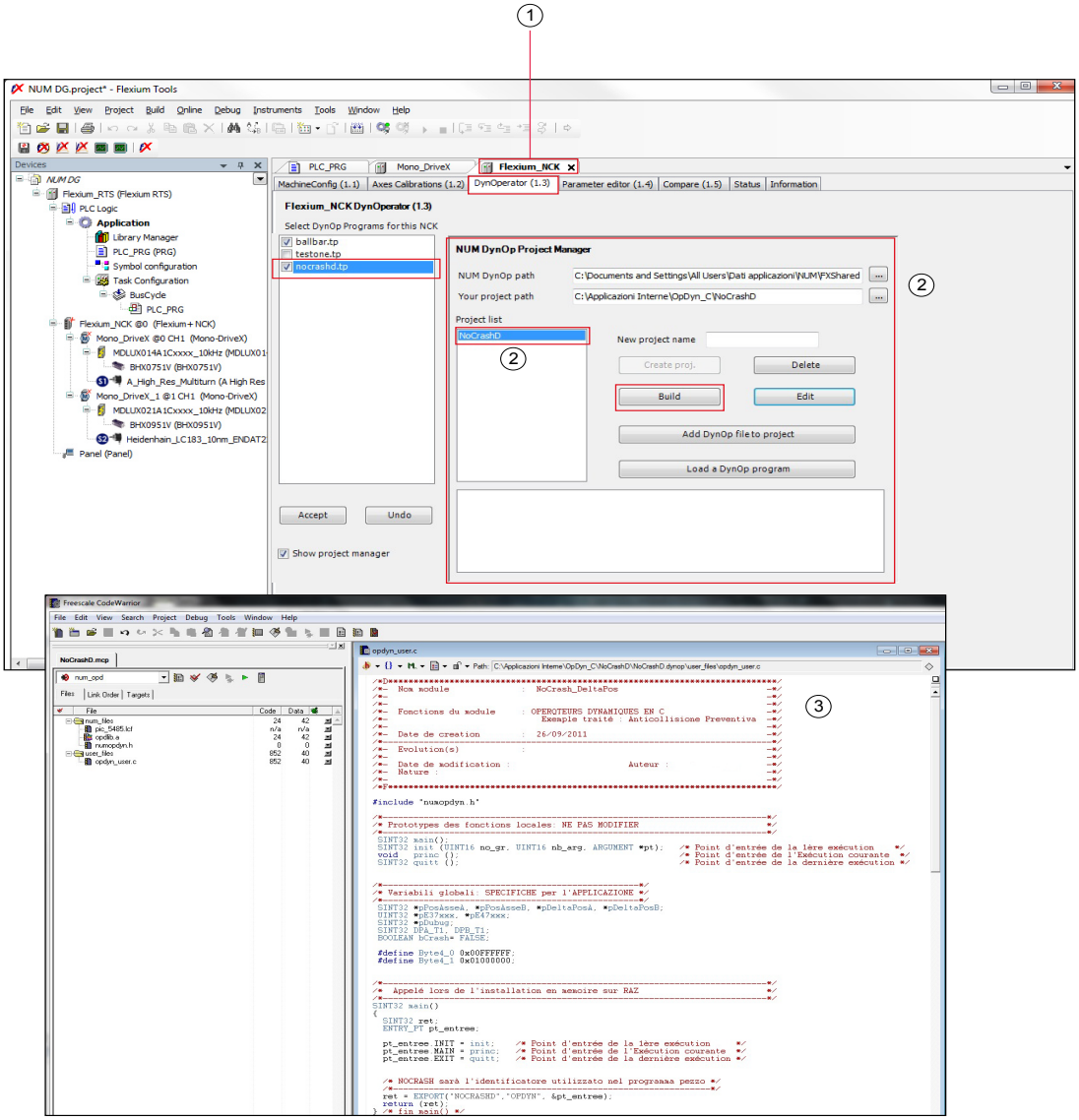


1	Click on → *"Flexium_NCK X"*, then click on on → *"Axis Calibration"* and click on → *"InterAxis"* to open the dedicated axis page settings.
2	Enter individually the axis modification values on: - *"P"* Master axis position, - *"C"* Correction on the slave axis.
3	Click on → *"Add"* to enter the modification and the new values will appear in the table.
4	Click on → *"Import XIC file..."* to import directly an inter-axes calibration table.

2.4.2 DynOperator (Dynamic operators)

"Dynamic operators": this tab is used to create and store dynamic operators in C program into the CNC memory.

- It is not related to machine parameters.
- Additional information on how to create, compile and store dynamic operators in C is given in the Flexium Extended Programming Manual M00020.



1	Click on → *"Flexium_NCK X"* then click on → *"DynOperator"* to open the dedicated Dynamic Operators page settings.
2	Select → the *project* then → double click to *open the project* .
3	Example of project.

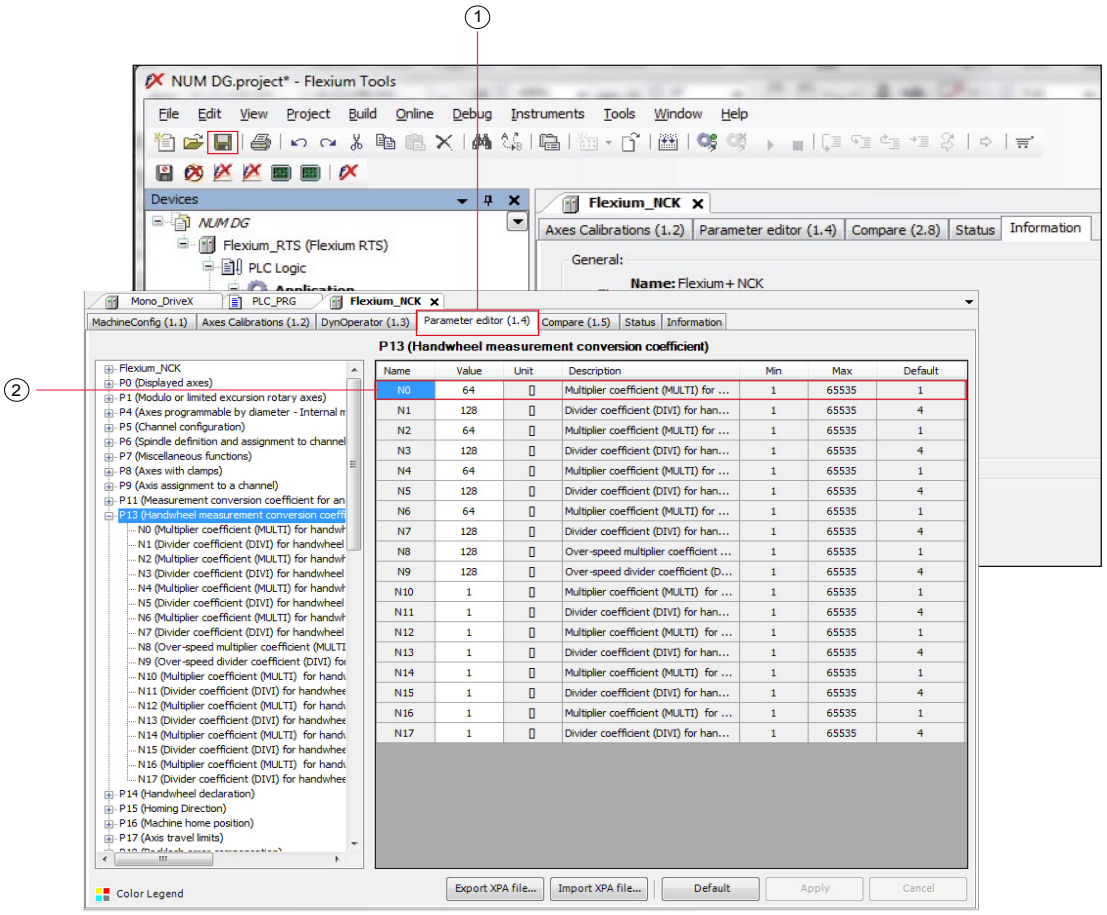
2.5 Parameter editor

2.5.1 Parameter selection (i.e. P13N0)

The parameter editor gives the possibility to enter parameters values directly without the help of the graphic editors. It can be used to adjust out of standard configuration.

Please note that the parameter editor adjust one parameter at a time; there is no interaction between all of them (Gain and Time constant for example).

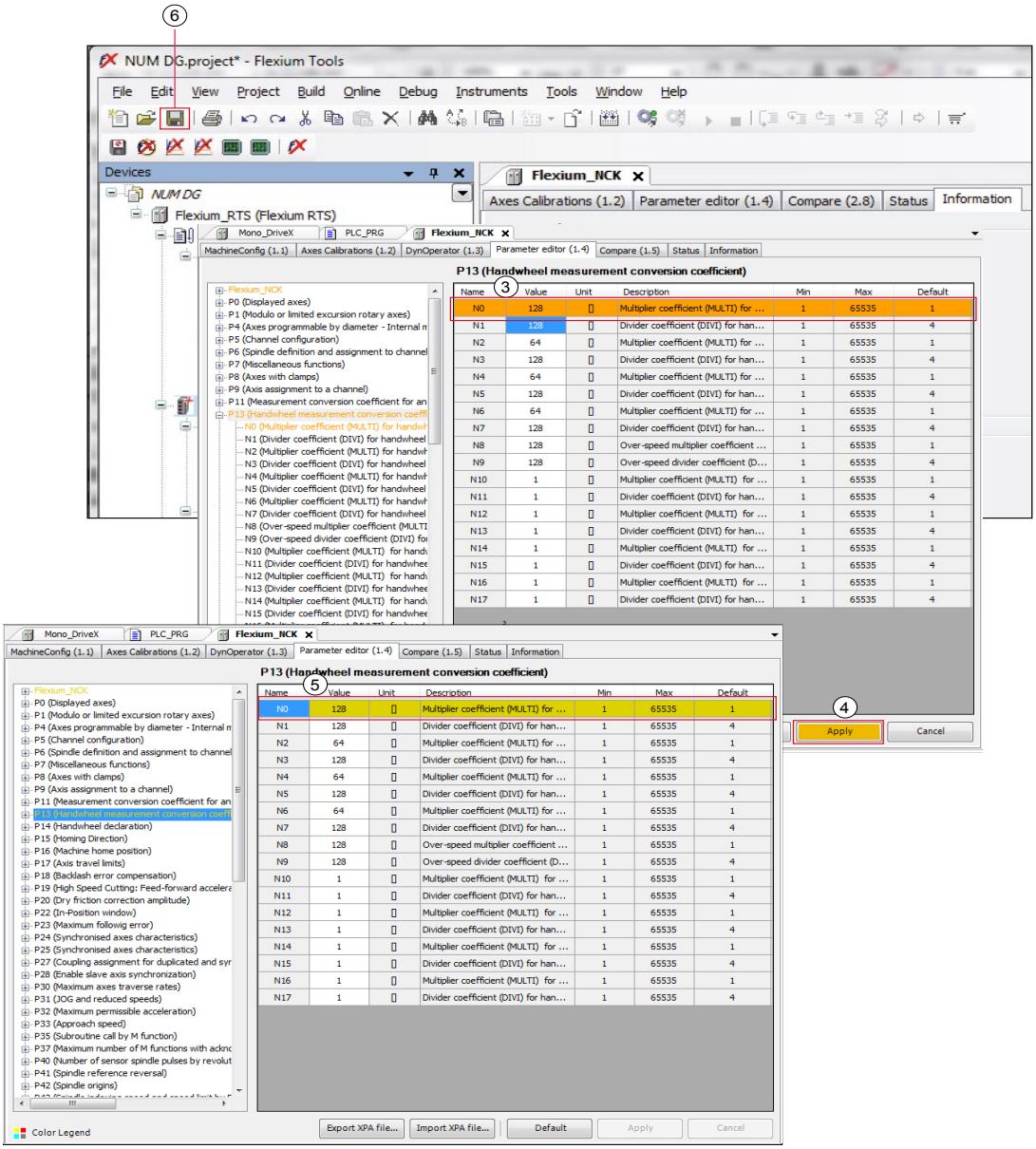
It is the responsability of the programmer to make sure the parameters are coherent.



1	Click on → *"Parameter editor"* and the parameters list will appear in the right side.
2	Click on → *"P13 (Handwheel measurement conversion coefficient)"* on the left side of the page and the parameter will appear as blue selection in the right side of the page.

- It is possible to edit parameters *"OnLine"* or *"OffLine"*.
- When *"OnLine"* only the parameters that can be changed immediately are accessible.
- Pressing *"Apply"* will send the parameters to the NCK; it is not possible to edit an other parameters as long as the changes on the current one have not been applied or cancelled.
- Color codes show the parameters that were changed and not applied or changed and applied.
- When saving the project all parameters are displayed on a white background again.

2.5.2 Parameter modification (i.e. P13N0)



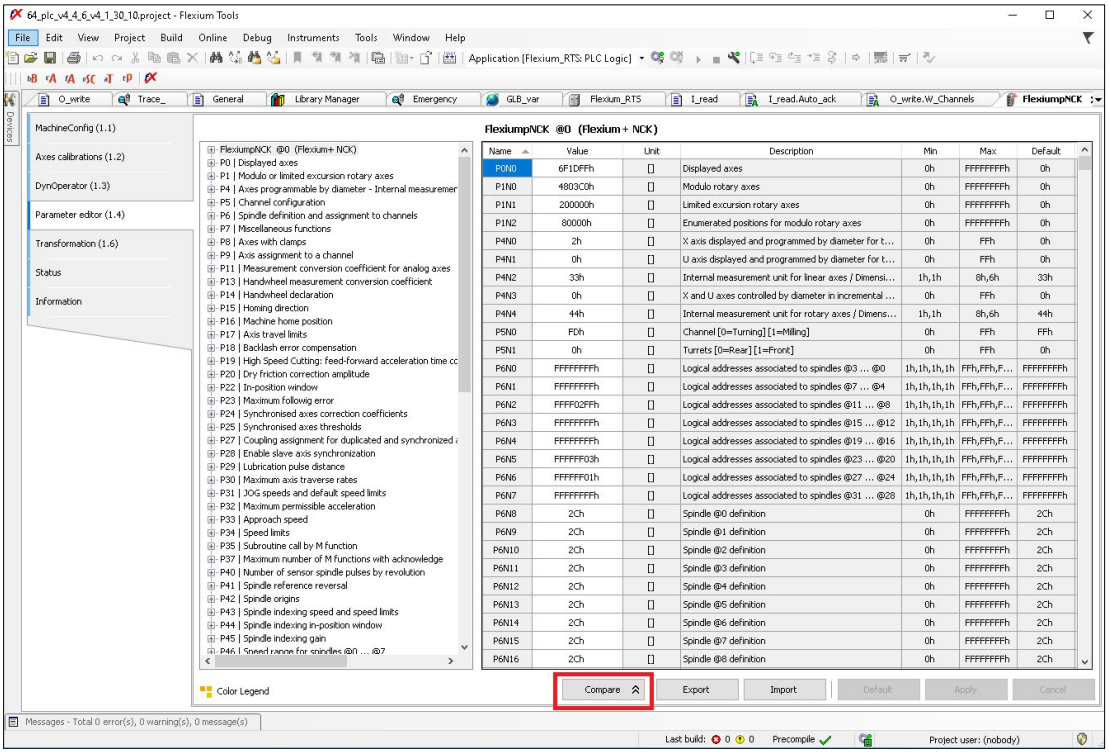
3	Now if you want to modify the *"Word N0"* click on → *"N0"*. Click on → *"Value"* box enter the new value then press *"Enter"* and the parameter will be indicated in orange icons as in the figure.
4	Now → click on *"Apply"* to set the modification.
5	Now the modified parameter is indicated in green icons as in the figure.
6	Click on → *"Save"* icon to save the modification in the project and the saved parameter will appears as grey icons.

STOP

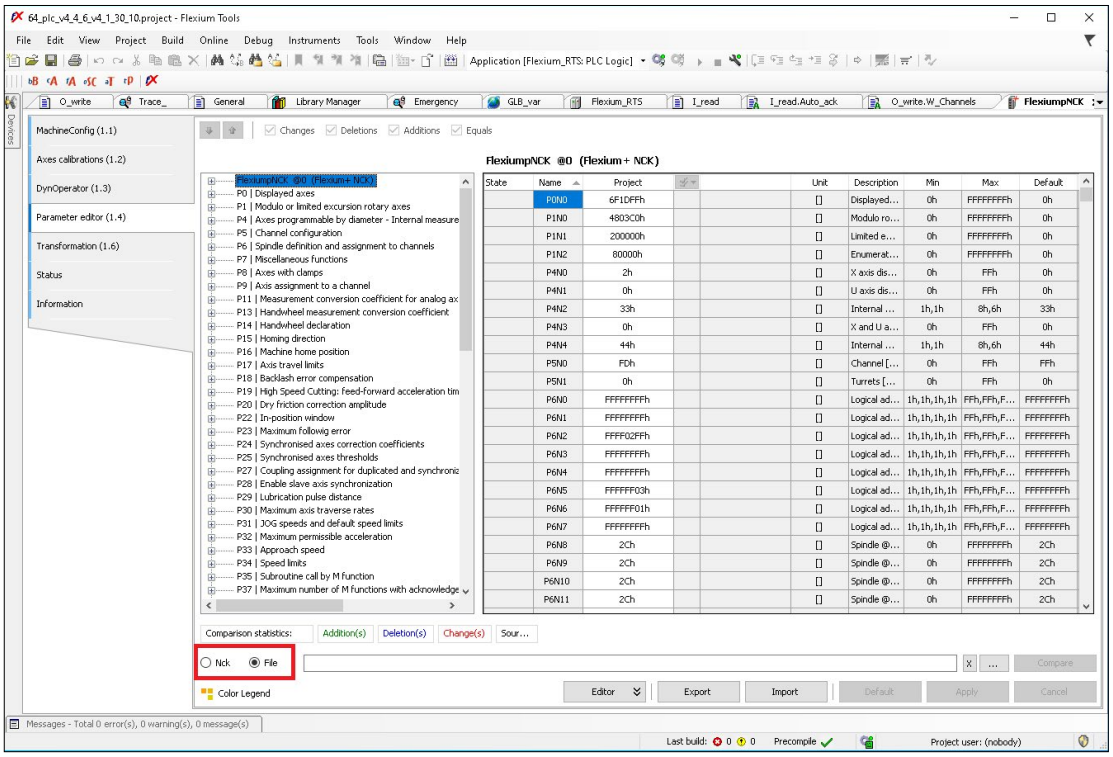
When the CNC is in OnLine some parameters will not be accessible. It means they cannot be modified on fly in the CNC.
If they can be modified, then the modification will be carried out at the time you press "Apply".

2.6 Compare

This page allows to compare the NCK parameters with a previously saved parmeters' file or with the current parameters in the NCK (only in online mode)

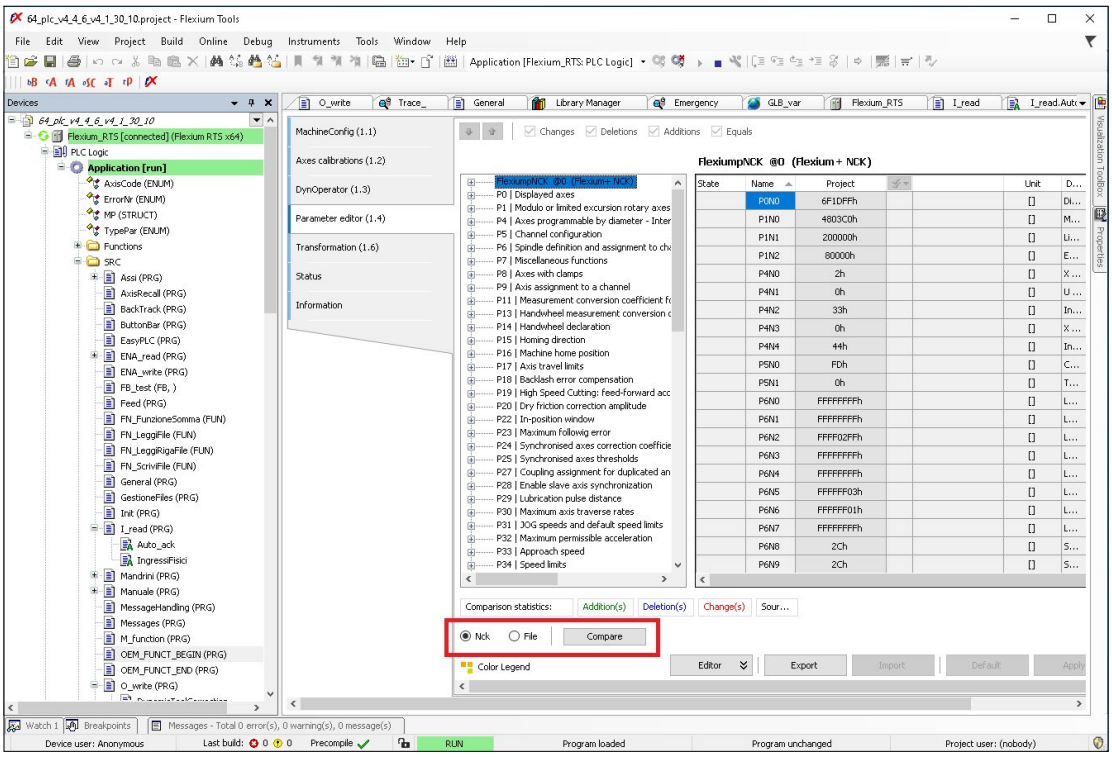


The Editor page can switch into Compare page by a specific button.

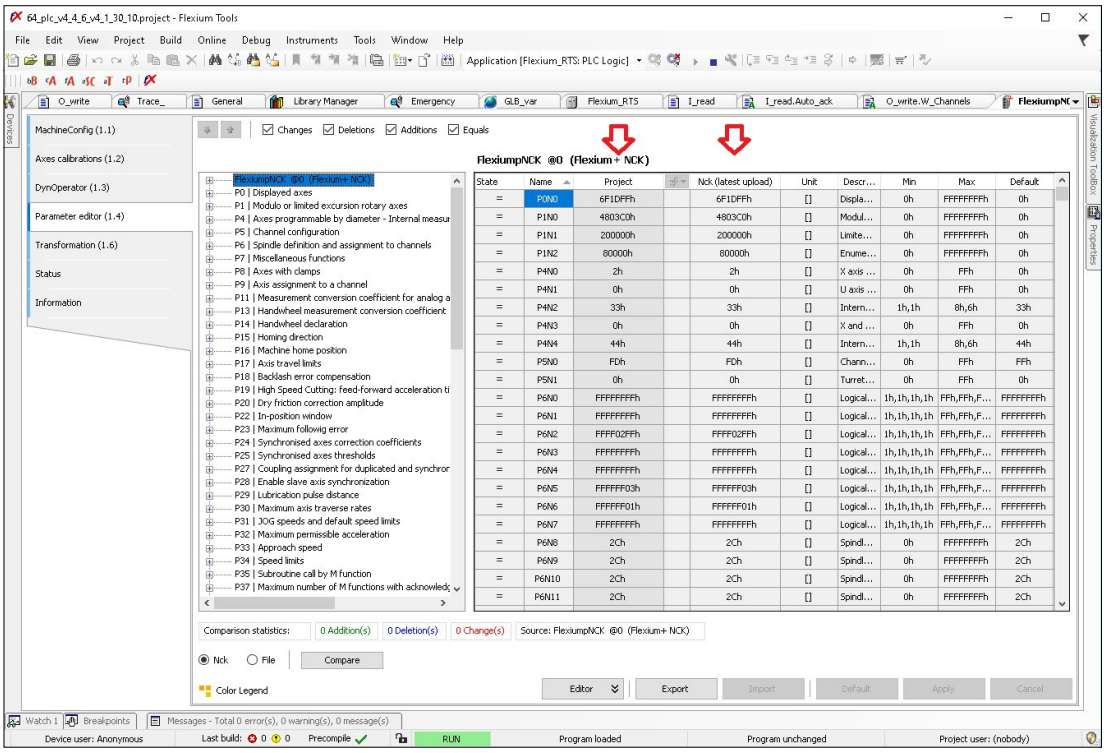


The selection buttons NCK and File enable the comparison between project parameters with file or with NCK

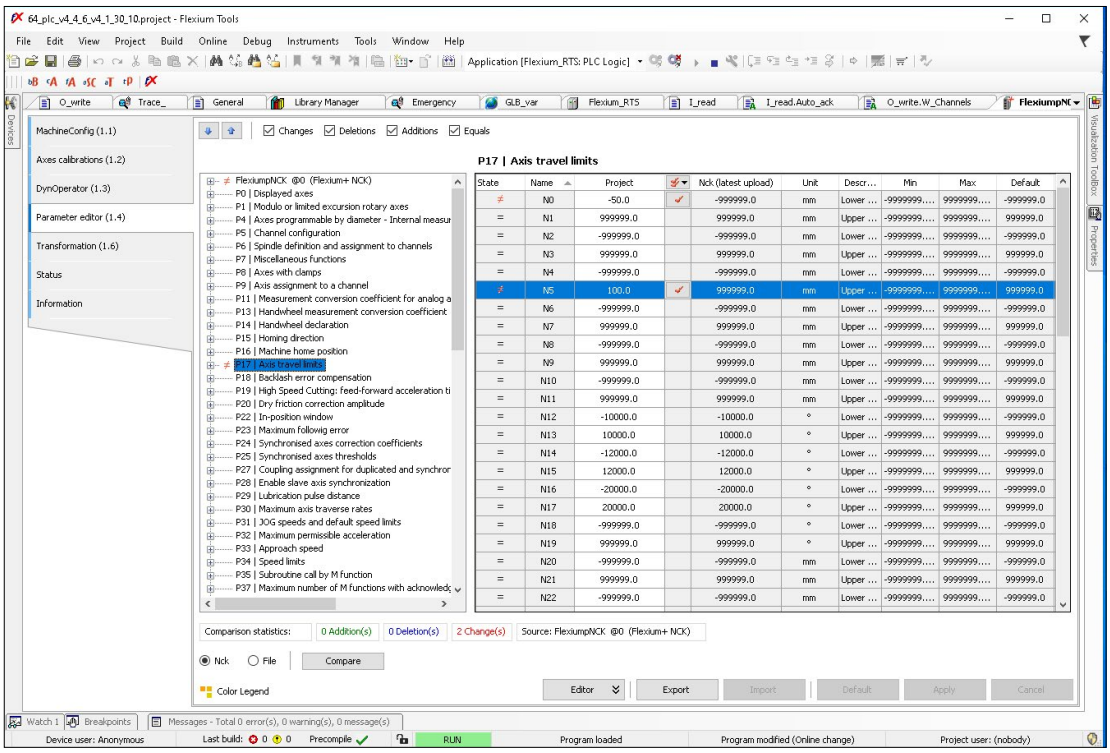
2.6.1 Compare project ⇔ NCK (online mode)



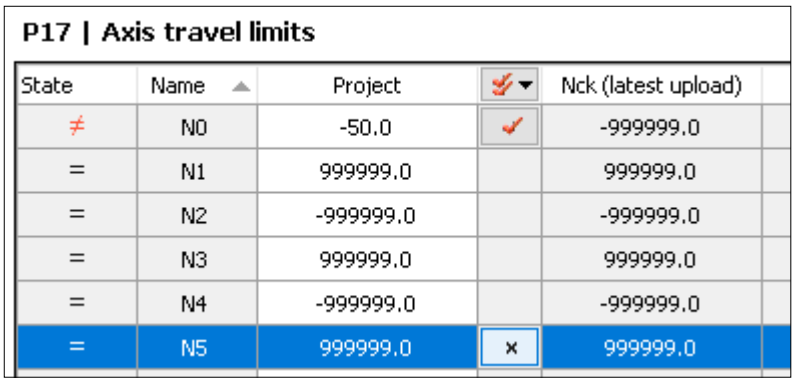
In online mode the button “Compare” and the selection “NCK” actives the parameter comparison between the parameters located in the project and the parameters active on NCK connected.



The differences are marked with a red ≠ in the parameters tree, the differences are marked by a red check mark ✓



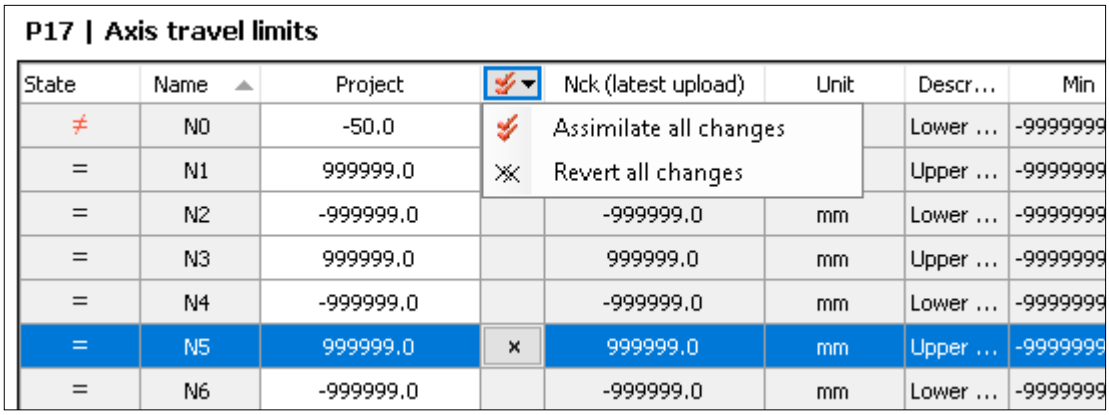
The copy values from NCK to project is possible by pressing the check mark in parameter list, the undo is allowed to click on X sign:



P17 | Axis travel limits

State	Name	Project		Nck (latest upload)
≠	N0	-50.0	✓	-999999.0
=	N1	999999.0		999999.0
=	N2	-999999.0		-999999.0
=	N3	999999.0		999999.0
=	N4	-999999.0		-999999.0
=	N5	999999.0	×	999999.0

A completely update from NCK to project is available by check mark at header column



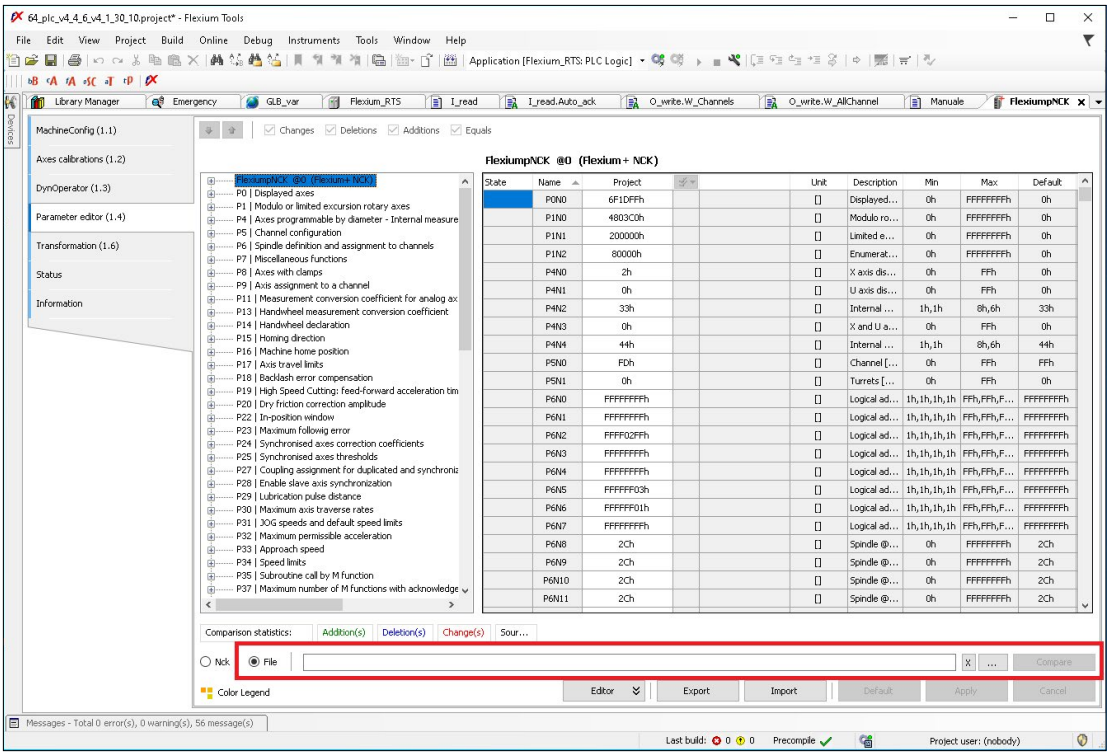
P17 | Axis travel limits

State	Name	Project		Nck (latest upload)	Unit	Descr...	Min
≠	N0	-50.0				Lower ...	-9999999
=	N1	999999.0				Upper ...	-9999999
=	N2	-999999.0		-999999.0	mm	Lower ...	-9999999
=	N3	999999.0		999999.0	mm	Upper ...	-9999999
=	N4	-999999.0		-999999.0	mm	Lower ...	-9999999
=	N5	999999.0	×	999999.0	mm	Upper ...	-9999999
=	N6	-999999.0		-999999.0	mm	Lower ...	-9999999

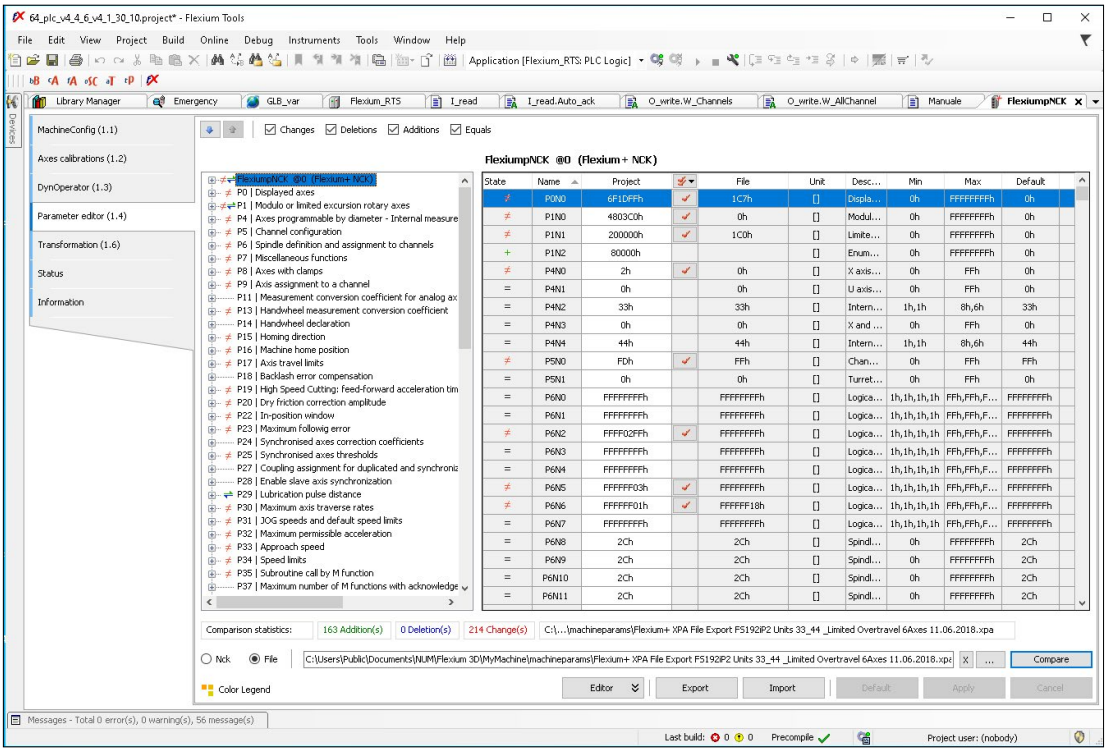
Assimilate all changes
Revert all changes

2.6.2 Compare project ⇔ File

The option File enable a comparison between project parameters with a parameter file selected by button:



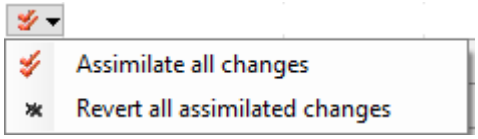
The result marks the differences between the project and file selected by red flags.



2.6.2.1 Assimilate values

There are different possibilities to take over the compare value.

Assimilate all parameter values listed below in the list.
This button (by clicking the triangle on the right side of the button) gives also the possibility to revert all assimilated values listed below in the list.



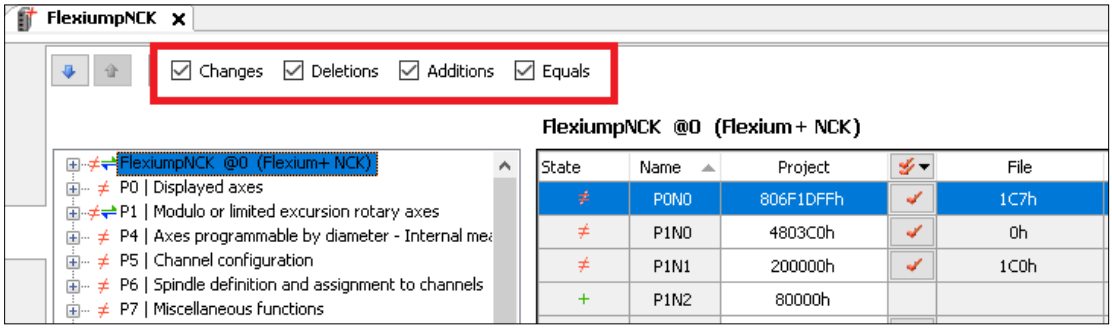
Assimilate a single parameter value from right (compare value) to left (device value)

All assimilated values can revert via the -Button.

After assimilate a value, the background colour of the row and the “Apply” Button change to orange colour. The “Cancel”-Button will enable. The foreground colour of the related node in the parameter tree view also change to orange colour.

2.6.2.2 View filters

Some filters are available at top left page by checkboxes the page show or hide the parameters with desired condition.



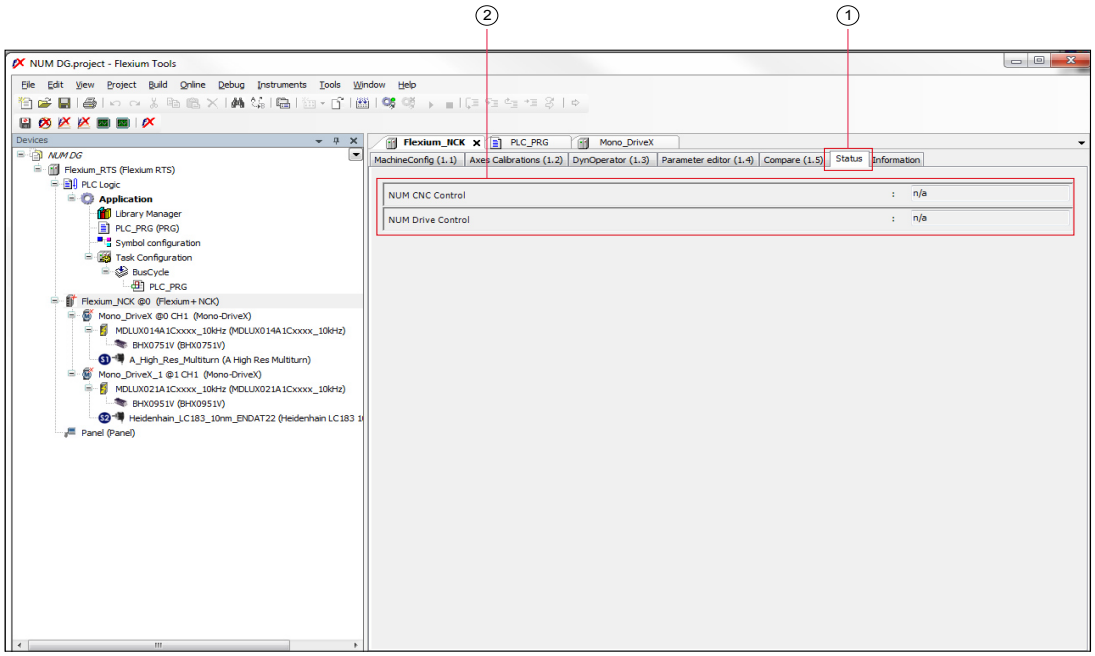
2.6.2.3 Comparison statistic

The comparison statistic shows the counts of comparison states and source of comparison.
The source on NCK parameter editor is always a xpa-file.

Comparison statistics:	7 Addition(s)	7 Deletion(s)	7 Change(s)	Source: D:\Div\FxTools\XPA\xp

Addition (s) = Parameters not found in the project but present in the file (or NCK in online).
Deletion (s) = Parameters found in the project but not present in the file (or NCK in online).
Change (s) = Parameters not equal between project and file (or NCK in online).
Source = File selected for the comparison.

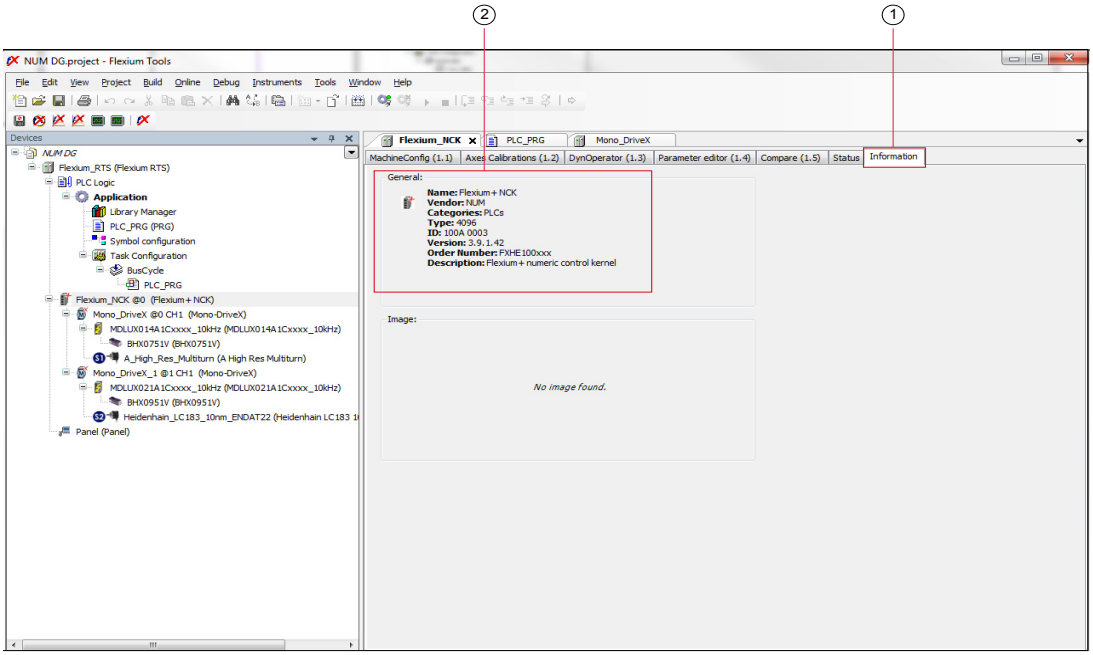
2.7 Status



1	Click on → *"Status"* to open the status page.
2	Status informations

STOP This page is reserved for debug and is not used in configuring the machine.

2.8 Information



1	Click on → *"Information"* to open the information page.
2	General system information

This page is reserved for debug and is not used in configuring the machine.

Page deliberately empty

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3 Axes and Spindles declaration

3.1 Prerequisite

In a Flexium+ system all axes and spindles are associated with a unique number.

Later in this document this number will be called "Physical address".

- The Physical addresses range from 0 to 31, for the digital devices the address should match the setting on the corresponding drive.
  For the analog devices (no more than 2), this physical address is defined by a machine parameter in association with one of the analog connector (X11 or X12).
- The physical address selection is absolutely free considering that two devices (axes or spindles) cannot have the same number.
- It is important to have defined the physical address of each device before setting the other machine parameters as this value is often used as an index.

A Flexium+ CNC can handle a maximum of 32 devices (a device being an axis or a spindle).
Further in this manual such devices will be called "Drive Interface" regardless of their status:
Axis or Spindle – Analogue or Digital.

The axes are assigned to channels; there is a maximum of height channels, each one including up to a maximum of 9 axes named X, Y, Z, U, V, W, A, B, C.

To enhance the possibilities, this assignation to channels can be modified via specific parameters (E parameters) while the machine is running.

In a first step it is necessary to declare all "Drives Interfaces" used on the system and their structure.

Axes declaration relies on the following parameters and in the following order:

P120	Machine configuration
P0	Displayed axes
P97	Number of channels
P5	Channel configuration
P9	Axis assignment to a channel
P70	Analog ports configuration
P24..P28	Axes synchronization and duplication : see chapter 11
P85..P87	Drives coupling assignment: see chapter 11

P120	Machine configuration			
	Category	Axes and spindles declaration	**Format**	Type 6
	Words	12	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	Yes : N2, N5	**Access via**	E910xx, E931xx. See description.

General

This parameter is used to define the machine configuration in regard to axes and spindles.

Flexium plus handles the following configurations:

- *Standard axes*:
  Axes that can be programmed and interpolated, servo controlled and connected to a drive (analog or digital).
- *Measuring device*:
  Measuring system; cannot be programmed and do not control a motor (on analog or digital port).
- *Open loop axis*:
  Device without feedback – can control an actuator, generally on analog port but this is not mandatory.
- *Virtual axis*:
  Not connected to a physical device (digital or analog). Can be programmed and interpolated – Generally used with dynamic operators.
- *Standard spindle*:
  Spindle connected to a Drive and a measuring device. Can be used for threading or rigid tapping.
- *Non measured spindle* :
  Spindle without measuring device (analog or asynchronous sensor-less). Cannot be used for threading or rigid tapping.
- *PLC only spindle*:
  Non measured and not connected to a Drive interface.
  The spindle speed is available in the PLC and can optionally be output on an analog PLC output. Cannot be used for threading or rigid tapping.

A spindle switchable with an axis should be declared twice (with the same address) as a spindle and as an axis.

Slave axes in Anti-backlash, Torque duplication or Winding duplication are not declared in P120. However the address of the drive on which they are connected is reserved and cannot be used.

If the total number of axes and spindles is higher than that permitted by system customization, the message "TOO MANY AXES OR SPINDLES" is displayed at initialization.

After acknowledgement, the "PRSOV" indicator is displayed in the CNC screen status window and AUTO, SINGLE, DRYRUN, and MDI modes are inhibited.

Description	This parameter contains 8 words of 32 bits each. In each word the rank of the bit corresponds to the physical address of the said drive: • **Word N0** Axes • **Word N1** Spindles • **Word N2** Servo controlled and interpolated axes • **Word N3** DISC NT+ bus digital drives • **Word N4** Axes without measure INPUT • **Word N5** Spindles without measure INPUT • **Word N6** Axes without set value OUTPUT • **Word N7** Spindles without set value OUTPUT • **Word N8** DISC NT+ drives shared by master NCK (Shared axes preliminary) • **Word N9** Remote DISC NT+ drives imported (Shared axes - preliminary) • **Word N10** EtherCAT analog axes (preliminary) • **Word N11** EGB leader on transducer • **Word N12** SSB function activation When EGB option "Leader on transducer" (P120N11=1) on the leader axis, the NCK should use the position of the leader axis as a reference for the slaves

3.2.1 Different "Drives Interfaces" configurations

Type		List Axes	List Spindles	Axes servo	Digital Drives	Axes without IN	Spindle without IN	Axes without OUT	Spindle without OUT
		N0	N1	N2	N3	N4	N5	N6	N7
Digital axis	Full axis	1		1	1				
	Measuring device	1			1				
Digital slaves [1]	Synchronized	1			1				
	Anti-backlash[1]	1			1				
	Torque duplication[1]	1			1				
	Winding duplication[1]	1			1				
Analog axis	Full axis	1		1					
	Measuring device	1							
	Slave synchronized [2]	1							
Virtual axes	Programmable	1		1		1		1	
	Dyn OP controlled	1				1		1	
Digital spindle	Full spindle		1		1				
	Non measured		1		1		1		
	PLC only		1		1		1		1
Analog spindle	Full spindle		1						
	Non measured		1				1		
	PLC only		1				1		1

(1) Anti -backlash - Torque duplication and winding duplication are also available for spindles. In this case declare the configuration in Word N1 instead of Word N0.

(2) It is possible to declare two analog axes as synchronized. However this is not a recommended configuration.

3.2.2 Structure of a word

@ 31	@ 30	@ 29	@ 28	@ 27	@ 26	@ 25	@ 24	@ 23	@ 22	@ 21	@ 20	@ 19	@ 18	@ 17	@ 16	@ 15	@ 14	@ 13	@ 12	@ 11	@ 10	@ 9	@ 8	@ 7	@ 6	@ 5	@ 4	@ 3	@ 2	@ 1	@ 0

Example

Machine with :

- Three standard digital axes (@ 0,1,2)
- One digital spindle (@20)
- One non measured analog spindle (@21)
- One in process measuring gauge (@31) connected as a TTL sensor:

P120 (Machine configuration)

Name	Value	Unit	Description	Min	Max	Default
N0	80000007h	[]	Axes	0h	FFFFFFFFh	0h
N1	300000h	[]	Spindles	0h	FFFFFFFFh	0h
N2	7h	[]	Servo-controlled and inte...	0h	FFFFFFFFh	0h
N3	100007h	[]	DISC NT+ bus digital drives	0h	FFFFFFFFh	0h
N4	0h	[]	Axes whitout measure IN...	0h	FFFFFFFFh	0h
N5	200000h	[]	Spindles whitout measure...	0h	FFFFFFFFh	0h
N6	80000000h	[]	Axes whitout set value O...	0h	FFFFFFFFh	0h
N7	0h	[]	Spindles without set valu...	0h	FFFFFFFFh	0h

3.3 Number of channels ► P97

P97	Number of channels			
	Category	Axes and spindles declaration	**Format**	Type 3
	Words	2	**Units**	None
	Min	1 - 0	**Max**	8 – 7
	Default	1 – 0	**Resolution**	N/A
	Immediate	No	**Access via**	E41102 (Read) : See description
General	The system can control a maximum of eight channels. There two types of channels: • *CNC channels* • *Auxiliary channels*: Auxiliary channels are generally used for machine functions like tool or pallet changer. They can run independently of the CNC channels under control of a particular part program (%9998.i). They cannot execute machining cycles.			
Description	This parameter contains 8 words of 32 bits each. In each word the rank of the bit corresponds to the physical address of the said drive:			
	• **Word N0**	Number of CNC channels (min 1, max 8). This value can be read in the external parameter E41102.		
	• **Word N1**	Number of of Auxiliary channels (min 0, max 7). The channels are assigned in numerical order, starting with the first CNC channel (channel 1) and then the Auxiliary channels after the last CNC channel.		

Maximum number of channels

Product	CNC channels	Auxiliary channels
Flexium 6	1	0
Flexium 8	2	1*
Flexium 68	8	7

(*) for Flexium 8 the number of channels (CNC + Auxiliary) cannot exceed 2.

Example

Machine with 3 CNC channels and two additional auxiliary channels

P97 (Number of channels)

Name	Value	Unit	Description	Min	Max	Default
N0	3	[]	Number of CNC channels	1	8	1
N1	2	[]	Number of auxiliary channels	0	7	0

3.4 Channel configuration ► P5

P5	Channel configuration			
	Category	Axes and spindles declaration	**Format**	Type 0
	Words	2	**Units**	None
	Min	Word dependent	**Max**	Word dependent
	Default	0/0	**Resolution**	N/A
	Immediate	No	**Access via**	E11016 (R/W) see description
General	This parameter is used to define the machine configuration: • Lathe and milling machine channels • Front and rear turrets.			
Description	Each bit of each word is associated with a channel as described here below: Chnl 8 | Chnl 7 | Chnl 6 | Chnl 5 | Chnl 4 | Chnl 3 | Chnl 2 | Chnl 1 Bit 7 … Bit 0			
	• **Word N0**	Channel. A bit set (=1) means a milling channel when reset (=0) means a turning channel. • A milling channel will be initialized in G17, a turning channel in G20. • A milling channel will include the milling canned cycles a turning channel the turning cycles in particular all roughing cycles.		
	• **Word N1**	• Turrets. A front turret is defined by the channel associated bit set (1). • A rear turret by the channel associated bit reset (0) N.B.: It is possible to overwrite this status by program parameter E11016: • E11016 = 1 for a front turret • E11016 = 0 for a rear turret. The selection front or rear turret has an effect on the radius correction (G41 /G42 inverted). This configuration is for lathe configurations only.		

P5 (Channel configuration)

Name	Value	Unit	Description	Min	Max	Default
N0	1h	[]	Channel [0=Turning] [1=Milling]	0h	FFh	FFh
N1	0h	[]	Turrets [0=Rear] [1=Front]	0h	FFh	0h

3.5 Axes assignement to a channel ► P9

P9	Axis assignement to a channel			
	Category	Axes and spindles declaration	**Format**	Type 0
	Words	32	**Units**	None
	Min	0 / 0	**Max**	8 and $FF
	Default	FF for each word	**Resolution**	N/A
	Immediate	No	**Access via**	E7x005 (R/W) : See description

General

This parameter is used to associate the physical address of each axis to its symbolic name and channel.

Description

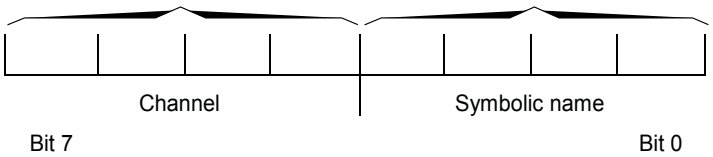
The system can control up to 32 axes. These axes are assigned to eight channels with a maximum of nine axes in a channel.

Each word is linked to a physical axis address. The first nibble specifies the channel of belonging and the second the axis symbolic name.

- **Word N0**

Symbolic name and channel assignment (for axis @0)

Channel number		**Symbolic name**	
Channel 1 :	**1**	Axis X:	**0**
Channel 2 :	**2**	Axis Y:	**1**
Channel 3 :	**3**	Axis Z:	**2**
Channel 4 :	**4**	Axis U:	**3**
Channel 5 :	**5**	Axis V:	**4**
Channel 6 :	**6**	Axis W:	**5**
Channel 7 :	**7**	Axis A:	**6**
Channel 8 :	**8**	Axis B:	**7**
		Axis C:	**8**
No channel:	**F**	No name:	F



- **Word N1 to Word N31**

Identical to N0 for axes @1 respectively to @31.

Remarks

- The association to a channel can be modified by the external parameters E7x005 (please refer to Programming Manual M00028). A reset reconfigures the axes as in P9.
- It is obviously not possible to have the same assignment for two different physical addresses except in case of synchronized axes where it is allowed.
- The value FF means that the specified physical address has no symbolic name and does not belong to any channel.
- The value Fx (x = 0 to 8) indicates that the specified axis address has a symbolic name but does not belong to any channel.

Example

- Channel 1 : 3 axes X@0, Y@1 and Z@2
- Channel 2 : 2 axes X@3 and Y@4
- Channel 3 : 3 axes X@5, Y@6 and C@7
- Channel 4 : 3 axes X@8, Y@9 and Z@10

P9 (Axis assignment to a channel)

Name	Value	Unit	Description	Min	Max	Default
N0	10h	[]	Symbolic name and channel assignment for axis @0	1h,0h	Fh,Fh	FFh
N1	11h	[]	Symbolic name and channel assignment for axis @1	1h,0h	Fh,Fh	FFh
N2	12h	[]	Symbolic name and channel assignment for axis @2	1h,0h	Fh,Fh	FFh
N3	20h	[]	Symbolic name and channel assignment for axis @3	1h,0h	Fh,Fh	FFh
N4	21h	[]	Symbolic name and channel assignment for axis @4	1h,0h	Fh,Fh	FFh
N5	30h	[]	Symbolic name and channel assignment for axis @5	1h,0h	Fh,Fh	FFh
N6	31h	[]	Symbolic name and channel assignment for axis @6	1h,0h	Fh,Fh	FFh
N7	38h	[]	Symbolic name and channel assignment for axis @7	1h,0h	Fh,Fh	FFh
N8	40h	[]	Symbolic name and channel assignment for axis @8	1h,0h	Fh,Fh	FFh
N9	41h	[]	Symbolic name and channel assignment for axis @9	1h,0h	Fh,Fh	FFh
N10	42h	[]	Symbolic name and channel assignment for axis @10	1h,0h	Fh,Fh	FFh
N11	FFh	[]	Symbolic name and channel assignment for axis @11	1h,0h	Fh,Fh	FFh
N12	FFh	[]	Symbolic name and channel assignment for axis @12	1h,0h	Fh,Fh	FFh
N13	FFh	[]	Symbolic name and channel assignment for axis @13	1h,0h	Fh,Fh	FFh
N14	FFh	[]	Symbolic name and channel assignment for axis @14	1h,0h	Fh,Fh	FFh
N15	FFh	[]	Symbolic name and channel assignment for axis @15	1h,0h	Fh,Fh	FFh
N16	FFh	[]	Symbolic name and channel assignment for axis @16	1h,0h	Fh,Fh	FFh
N17	FFh	[]	Symbolic name and channel assignment for axis @17	1h,0h	Fh,Fh	FFh
N18	FFh	[]	Symbolic name and channel assignment for axis @18	1h,0h	Fh,Fh	FFh
N19	FFh	[]	Symbolic name and channel assignment for axis @19	1h,0h	Fh,Fh	FFh
N20	FFh	[]	Symbolic name and channel assignment for axis @20	1h,0h	Fh,Fh	FFh
N21	FFh	[]	Symbolic name and channel assignment for axis @21	1h,0h	Fh,Fh	FFh

P70	Analog ports configuration			
	Category	Axes and spindles declaration	**Format**	Type 6
	Words	9	**Units**	None
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	N/A
	Immediate	Yes : N1, N5	**Access via**	N/A

General

For the analog ports (axes or spindles), the physical address is not given by the drive but is rather defined at the connector on which this drive is connected.

As this connector can also be used for a spindle or a handwheel (no more than two devices) such peripherals are also described here.

Description

- **Word N0** X11 connection (back socket):
  - Bit 0 - 7: Address of handwheel (0 to 3) if any handwheel is connected
  - Bit 8 - 15: Not used
  - Bit 16 - 23: Address of analog axis or spindle (0 to 31) if any is connected
  - If there is no device connected the corresponding value should be FF.

  It is obviously not possible to have both a handwheel and an axis/spindle declared on the same connector.
- **Word N1** X11 input configuration:
  - Bit 0: Measurement direction
  - Bit 2: Enable sensor complementarity check
  - Bit 3: Enable sensor dirty signal check
  - Bit 1 and 4 to 31: Currently not used.
- **Word N2** Reserved
- **Word N3** Reserved
- **Word N4** Identical to N0 but for X12 connector (forward socket)
- **Word N5** Identical to N1 for X12 connector
- **Word N6** Reserved
- **Word N7** Reserved.
- **Word N8** X10 output configuration.

Example

- Analog axis @6 connected on X11
- Direction inverted – Complementarity and dirty signal check activated
- First Handwheel (n°0) connected on X12.

P70 (Analog ports configuration)

Name	Value	Unit	Description	Min	Max	Default
N0	FF06FFFFh	[]	X11 connections	0h,0h,0h,0h	FFh,FFh,FFh,FFh	FFFFFFFFh
N1	Dh	[]	X11 input configuration	0h	FFFFFFFFh	0h
N2	0	[]	Reserved	0	4294967295	0
N3	0	[]	Reserved	0	4294967295	0
N4	FFFFFF00h	[]	X12 connections	0h,0h,0h,0h	FFh,FFh,FFh,FFh	FFFFFFFFh
N5	0h	[]	X12 input configuration	0h	FFFFFFFFh	0h
N6	0	[]	Reserved	0	4294967295	0
N7	0	[]	Reserved	0	4294967295	0

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Summary

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4.9 Modulo absolute sensors and maximum position tolerance ► P78 80

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4 Axis initial settings

This part will define the base characteristics of all axes controlled by the CNC, such characteristics are generally defined by the machine construction and do not require further adjustments.

Performances and tuning will be addressed in the chapters 7 "Axes dynamics" and in the chapter 8 "Performances".

Such characteristics can be defined in the following order:

P0	Displayed axes
P1	Modulo or limited excursion rotary axes
P4	Axes programmable by diameter - Internal measurement - Dimension format for acquisition and display
P8	Axes with clamps
P64	Carrier or carried axes
P65	Axes with quantified movements
P68	Rotary axis modulo
P77	Axes with measure stored
P78	Modulo of the absolute sensor axis and maximum position tolerance.

4.1 Displayed axes ► P0

P0	Displayed axes			
	Category	Axes initial settings	**Format**	Type 6
	Words	1	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	This parameter is used to define which axes will be displayed in the HMI pages. The Production page of the HMI displays the axes position value independently for each channel.			
Description	To be displayed an axis should be assigned to a channel (see P9) and declared in the list of axes (see P120 N0). This parameter is based on the axes physical address.			
Example	• Axes with physical address 0, 1, 2, 31 displayed			

@ 31 = 1	@ 30	@ 29	@ 28	@ 27	@ 26	@ 25	@ 24	@ 23	@ 22	@ 21	@ 20	@ 19	@ 18	@ 17	@ 16	@ 15	@ 14	@ 13	@ 12	@ 11	@ 10	@ 9	@ 8	@ 7	@ 6	@ 5	@ 4	@ 3	@ 2 = 1	@ 1 = 1	@ 0 = 1

P0 (Displayed axes)

Name	Value	Unit	Description	Min	Max	Default
N0	80000007h	[]	Displayed axes	0h	FFFFFFFFh	0h

4.2 Modulo or limited excursion rotary axes ► P1

P1	Modulo or limited excursion rotary axes			
	Category	Axes initial settings	**Format**	Type 6
	Words	2	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	E932xx (R/W): See description

General

This parameter is used to declare the rotary axes either as modulo 360 degrees or with limited excursion.

It is based on the axes physical address.

Description

- **Word N0**

Modulo rotary axes.

Such axes can execute an unlimited number of revolutions.
The direction of rotation is defined according to program parameter E11010:

- If E11010 = 1 (default) the direction is defined by the sign of the value, the value gives the angular position:
  e.g: C-90: go to position 90° by rotating in negative direction.
- If E11010 = 0 then the position is reached via the shortest path.

Reprogramming the current position has different effects according to the status:

- In G0: No move at all: the movement is considered already executed.
- In G1:
  - If E11009 = 1 (default) execution of a complete turn in the direction as defined above.
  - If E11009 = 0 the axis does not move as in G0.

@ 31	@ 30	@ 29	@ 28	@ 27	@ 26	@ 25	@ 24	@ 23	@ 22	@ 21	@ 20	@ 19	@ 18	@ 17	@ 16	@ 15	@ 14	@ 13	@ 12	@ 11	@ 10	@ 9	@ 8 = 1	@ 7 = 1	@ 6	@ 5	@ 4	@ 3	@ 2	@ 1	@ 0

Example: Axes with physical address 7, 8 are rotary ➔ P1 N0 = $00000180

N.B. : The rotary status of the axes can be read and written by part program parameter E932xx .

- **Word N1**

Limited excursion rotary axes.

A rotary axis with limited excursion is controlled like a linear axis. It has over-travels, it can be defined over a fraction of revolution or several revolutions.

The value programmed is in degrees regardless of the system units (inches or metric) and the scaling factor does not affect the position to reach.

It is not recommended to declare axes both modulo and with limited excursion; in such case, the axis will be considered modulo.

- **Word N2**

Enumerated positions for modulo rotary axes.

This field is axis bitmap wich specified the axes wit enumerating programming

The program and display positoin axes dipendiding by P65 Axes with quantiied movements.

Easier and more intuitive programming for special kind of axes, typically the tool carrier chain.

In enumerated programming the only values that uses this special unit are: displayed position, distance to go and programmed position. All the others remain in degrees as usual (following error, offset etc).

Example

- Machine with one modulo axis (C - @8) and two limited excursion rotary axes (A - @6 and B - @7)

P1 (Modulo or limited excursion rotary axes)

Name	Value	Unit	Description	Min	Max	Default
N0	100h	[]	Modulo rotary axes	0h	FFFFFFFFh	0h
N1	C0h	[]	Limited excursion rotary axes	0h	FFFFFFFFh	0h

4.3 Axes programmable by diameter - Internal measurement - Dimension format for acquisition and display ► P4

P4	Axes programmable by diameter - Internal measurement - Dimension format for acquisition and display			
	Category	Axes initial settings	**Format**	Type 0
	Words	5	**Units**	None
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	N/A
	Immediate	No	**Access via**	E11005 partially (R/W): see description

General

This parameter has different functions relative to the axes dimensions:

- Declare the X and/or U axes of each channel as programmed by the radius or the diameter for lathes machines.
- Define the internal system measurement unit and the format used for acquisition and display of the dimensions.
- Specify that, in incremental JOG and handwheel mode, the control of the X and/or U axes of each channel is referenced to the radius or diameter (including N/M auto).
- Specify the divider for the rotary axes.

Description

- **Word N0**

  X axis displayed and programmed by diameter for turning.

  If the bit is set to 1, the X axis for the specified channel will be displayed at the diameter and programmed at the diameter in G20 state (turning).

  This feature is linked to the X axis, regardless of its physical address.

- **Word N1**

  U axis displayed and programmed by diameter for turning.

  If the bit is set to 1, the U axis for the specified channel will be displayed at the diameter and programmed at the diameter in G20 state (turning).

  This feature is linked to the U axis, regardless of its physical address.

- **Word structure for N0 and N1**

  Each bit of these two words represent the channel on which the function applies:

Chnl 8	Chnl 7	Chnl 6	Chnl 5	Chnl 4	Chnl 3	Chnl 2	Chnl 1
Bit 7							Bit 0

If diameter programming is activated by P4, it is possible to temporarily suspend this function through parameter E11005.

Example

E11005 = 0: Programming by diameter inhibited.

E11005 = 1: Programming by diameter enabled in G20 on the X and U axes (if declared in P4).

A reset forces E11005 to 1.

Descripti

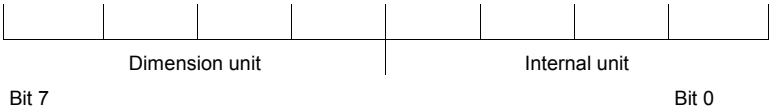
- **Word N2**

Dimension format for display / Internal measurment unit for linear axes.

Defines the internal system measurement unit (always metric) and the dimension unit used for linear axis dimension acquisition and display.

The system uses the internal unit defined and works internally in floating point with a 1nm resolution.

The value entered in each nibble basically defines the number of decimal digits:



Value	Dimension unit	Internal unit
1	1 decimal digits	0.1mm
2	2 decimal digits	0.01 mm
3	3 decimal digits	0.001 mm (1 µm)
4	4 decimal digits	0.0001 mm (0.1µm)
5	5 decimal digits	10 nm
6	6 decimal digits	1 nm

For the dimension Unit it is possible to have up to 8 digits (10^{-9} m)

Example : P4 N2 = 34

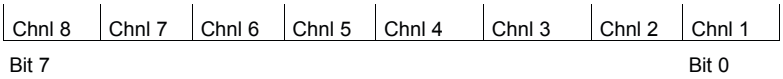
- Dimension unit (display of values) 0.001mm (1µm)
- Internal unit 1/10 µm.

- **Word N3**

X and U axes controlled by diameter in incremental JOG and Handwheel

The structure is identical to N0 and N1 (a bit for each channel) except that the characteristic applies for both X and U axes simultaneously.

The parameter format is as below:



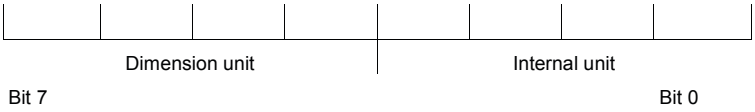
N.B.: If the jogs are set at the radius while the display is set at the diameter, then for the smallest increment, only every second demand will be taken into account.

- **Word N4**

Dimension format for display / Internal measurement unit for rotary axes

This word is common to all the rotary axes of the machine, whether or not they are modulo. It specifies the internal unit for the rotary axes (therefore the machine parameters units) as well as the dimension entry and display unit for these axes.

The parameter format is as below:



Example	• N0 : X axis in channel 1 programmed by diameter • N1 : U axis in channel 2 programmed by diameter • N2 : Linear axes resolution 0.1 µm – Display 1µm • N3 : In Jog and Handwheel X and U (channel 1 and 2) by the diameter • N4 : Rotary axes resolution 1/10000 of degree – Display 1/10000 ° **P4 (Axes programmable by diameter - Internal measurement - Dimension format for acquisition_** Name: N0 — Value: 0h — Unit: [] — Description: X axis displayed and programmed by diameter for... — Min: 0h — Max: FFh — Default: 0h Name: N1 — Value: 0h — Unit: [] — Description: U axis displayed and programmed by diameter for... — Min: 0h — Max: FFh — Default: 0h Name: N2 — Value: 33h — Unit: [] — Description: Dimension format for display / Internal measurem... — Min: 1h,1h — Max: 8h,6h — Default: 33h Name: N3 — Value: 0h — Unit: [] — Description: X and U axes controlled by diameter in increment... — Min: 0h — Max: FFh — Default: 0h Name: N4 — Value: 44h — Unit: [] — Description: Dimension format for display / Internal measurem... — Min: 1h,1h — Max: 8h,6h — Default: 44h

4.4 Axes with clamps ► P8

P8	Axes with clamps			
	Category	Axes initial settings	**Format**	Type 6
	Words	1	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	E913xx (R/W)

General

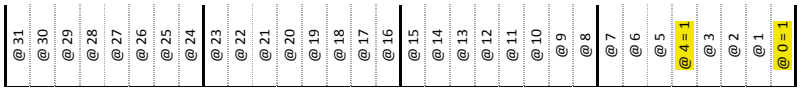
This parameter is used to declare the machine axes equipped with mechanical clamps.

When an axis is declared with clamps:

- Status M10 will be initialized by default (can be overwritten by program)
- If M10 is active : at each bloc transition were the moving status of this axis changes, the system will generate an halt long enough for the PLC to clear the flag … *WCNC.Channel[i AckMFunction*. When all appropriate actions are taken, the PLC will raise this flag again and motion will resume
- If M11 is active the motions is continuous, the axes are supposed unclamped all the time.

Description

- **Word N0** — Each bit of this word corresponds to the physical address of an axis.

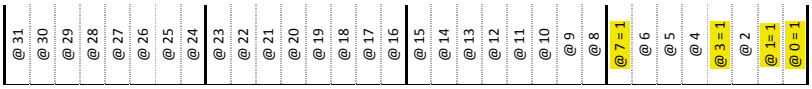


Example

- Axis of address 0 and 4 declared with clamps P8 N0 = 11h

P8 (Axes with clamps)

Name	Value	Unit	Description	Min	Max	Default
N0	11h	[]	Axes with clamps	0h	FFFFFFFFh	0h

P64	**Carrier or carried axes**			
	Category	Axes initial settings	**Format**	Type 6
	Words	1	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	E7x006 (RW)
General	This parameter is used to declare couples of carrier/carried linear axis pairs by associating a primary axis with a secondary axis (X/U, Y/V or Z/W). The program parameter E7x006 can be used to modify such coupling (x = physical address of the carrier axis) Example of usage of E 7x006 parameter • E70006 = 0 The X and U axes are independent. • E72006 = 1 Carrier/carried Z and W axis pair.			
Description	• **Word N0**	Carrier or carried axes. To declare a couple of axes as carrier/carried, the bit associated with the physical address of at least one of the two should be set to 1. If the bits of the axis pair are set, then the axis is declared as carrier or carried axis according to its declaration in P9 as primary (X, Y, Z) or secondary (U, V, W).		
Example	• Assuming @X = 0, @Y=1, @Z=2, @U=3, @V=4, @W= 5 @A=6, @B=7 and @C=8:  **P64 (Carrier or carried axes)** Name: N0 · Value: 8Bh · Unit: [] · Description: Carrier or carried axes · Min: 0h · Max: FFFFFFFFh · Default: 0h The couple X/U and Y/V are declared Carrier/Carried (even though V is not declared) Bit 7 (@B) is ignored.			

4.6 Axes with quantified movements ► P65

P65	Axes with quantified movements			
	Category	Axes initial settings	**Format**	Type 10
	Words	32	**Units**	degrees
	Min	0	**Max**	65.0
	Default	0	**Resolution**	10^{-8} °
	Immediate	No	**Access via**	N/A

General

This parameter is used to define the axis minimal positioning increment (step). It applies only to the axes declared as modulo in P1 and equipped with mechanical clamps.

For instance, this parameter applies to the movements of a turntable controlled by 1/2 degree and measured to one ten-thousandths of a degree (HIRTH coupling).

Each of the 32 words of this parameter applies to a particular physical address.

Description

- **Word N0:** Step increment for axis @0
- **Word N1 to N31** Identical to N0 for the other axes.

The values are expressed in decimal degrees. A value of 0 means that the positioning increment has no minimal step.

When a minimal positioning increment is defined for an axis

- If a programmed value (in Auto, MDI etc.) is not a multiple of this increment then an error will be generated.
- In Jog (unlimited or incremental) when an axis is stopped at a position which is not a multiple of the positioning increment, the motion will be continued till the next multiple except in incremental jog where the system will not request clamping
- …*NCK.RCNC.Axis[i].Moving* remains Set to 1. However additional move in manual or programmed remains authorized.

Example

- Machine with a B table at @7. The positioning is every 2.5 degrees:

P65 (Axes with quantified movements)

Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm	Step increment for axis @0	0.0	65.0	0.0
N1	0.0	mm	Step increment for axis @1	0.0	65.0	0.0
N2	0.0	mm	Step increment for axis @2	0.0	65.0	0.0
N3	0.0	mm	Step increment for axis @3	0.0	65.0	0.0
N4	0.0	mm	Step increment for axis @4	0.0	65.0	0.0
N5	0.0	mm	Step increment for axis @5	0.0	65.0	0.0
N6	0.0	°	Step increment for axis @6	0.0	65.0	0.0
N7	2.5	°	Step increment for axis @7	0.0	65.0	0.0
N8	0.0	°	Step increment for axis @8	0.0	65.0	0.0
N9	0.0	mm	Step increment for axis @9	0.0	65.0	0.0
N10	0.0	mm	Step increment for axis @10	0.0	65.0	0.0
N11	0.0	mm	Step increment for axis @11	0.0	65.0	0.0
N12	0.0	mm	Step increment for axis @12	0.0	65.0	0.0
N13	0.0	mm	Step increment for axis @13	0.0	65.0	0.0
N14	0.0	mm	Step increment for axis @14	0.0	65.0	0.0
N15	0.0	mm	Step increment for axis @15	0.0	65.0	0.0
N16	0.0	mm	Step increment for axis @16	0.0	65.0	0.0
N17	0.0	mm	Step increment for axis @17	0.0	65.0	0.0
N18	0.0	mm	Step increment for axis @18	0.0	65.0	0.0
N19	0.0	mm	Step increment for axis @19	0.0	65.0	0.0

4.7 Rotary axis modulo ► P68

P68	**Rotary axis modulo**			
	Category	Axes initial settings	**Format**	Type 10 (LREAL)
	Words	32	**Units**	°
	Min	1.0	**Max**	100000.0
	Default	360	**Resolution**	10^{-6}
	Immediate	No	**Access via**	E93232-93263 (R)
General	The modulo of the programmed and displayed position axis will not be done at 360 degrees as usual but at the value specified. Valid only with P1 N0 Modulo rotary axes active. (New as to 4.1.20.00 software version) (see Commissioning Manual M00044).			
Description	• **Word N0**	Modulo value for axis @0		
	• **Word N01 to Word N31**	Identical to Word N0 for the other axes.		
Example	• Axes @ 6 = modulo 40°			

P68 | Rotary axis modulo

Name	Value	Unit	Description	Min	Max	Default
N0	360.0		Modulo for rotary axis @0	1.0	100000.0	360.0
N1	360.0		Modulo for rotary axis @1	1.0	100000.0	360.0
N2	360.0		Modulo for rotary axis @2	1.0	100000.0	360.0
N3	360.0		Modulo for rotary axis @3	1.0	100000.0	360.0
N4	360.0		Modulo for rotary axis @4	1.0	100000.0	360.0
N5	360.0		Modulo for rotary axis @5	1.0	100000.0	360.0
N6	40.0		Modulo for rotary axis @6	1.0	100000.0	360.0
N7	360.0		Modulo for rotary axis @7	1.0	100000.0	360.0

The typical application could be a tool magazine with 40 pockets.

4.8 Axes with measure stored ► P77

P77	**Axes with measure stored**			
	Category	Axes initial settings	**Format**	Type 6 (DINT)
	Words	1	**Units**	N/A
	Min	0h	**Max**	FFFFFFFFh
	Default	0h	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	This parameter is used to enable the store measure function for specific axes. Save the measure needed the multi turn absolute sensor emulation by single turn absolute sensor (New as to 4.1.30.00 software version) (see Commissioning Manual M00044).			
Description	• **Word N0**	Value in hexadecimal code to enable measure store of the axes.		
Example	N0 = 3h means store function active for @0 and @1 axes. **P77 | Axes with measure stored**			

Name	Value	Unit	Description	Min	Max	Default
N0	3h	[]	Axes with measure stored	0h	FFFFFFFFh	0h

4.9 Modulo absolute sensors and maximum position tolerance ► P78

P78	**Modulo of the absolute sensor and maximum position tolerance**			
	Category	Axes initial settings	**Format**	Type 9 (LREAL)
	Words	64	**Units**	mm or °
	Min	-9999999.999999	**Max**	9999999.999999
	Default	360 (N0-31) 0.0 (N32-63)	**Resolution**	10-6
	Immediate	No	**Access via**	N/A
General	This parameter is used to set modulo values of the absolute sensor for the stored function (P77) and the maximum tolerance at wake up position error at switch on. (New as to 4.1.30.00 software version) (see Commissioning Manual M00044).			
Description	• **Word N0 to Word N31**	Modulo value for axis @0 to @31		
	• **Word N32 to Word N63**	Maximum position error at power on for specific axis @0 to @31		
Example				

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Summary

5 Spindle initial settings 85

5.1 Spindle definition and assignement to channels ► P6 86

5.2 Axis associated with an analog port connected spindle ► P71 89

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5 Spindle initial settings

Flexium+ is able to control up to 32 spindles[1] with a maximum of 4 simultaneously controlled spindles per channel. To deal more easily with all spindles they are given a "*Logical address*" (1 to 32).

This logical address is used for programming. For parameters definition the spindles are considered according to their "*Physical addresses*" as defined in the prerequisite above

During the declaration, the spindles are assigned to a channel but can be freely exchanges between them via part programming in two steps

- The channel who "owns" the spindle will release it via M61:<Logical address>
- The channel who needs the spindle will take control via M62:<Logical address> .

Spindle declaration relies on the following parameters:

P6	Spindle definition and assignment
P71	(eventual) Axis/ Spindle switching: Axis address associated with an analog spindle
P120	(see Axes and Spindle declaration) Spindles configuration

[1] In a first step the number of spindles is limited to 8 (one per channel).

P6	Spindle definition and assignement to channel			
	Category	Spindle initial settings	**Format**	Type 6
	Words	48	**Units**	None
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	N/A
	Immediate	Yes	**Access via**	N/A

General

General

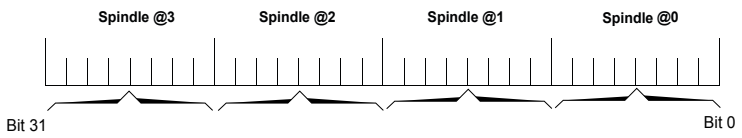
P6 presents three different functions

- N0 to N7 : Assignation to a logical address
- N8 to N39 : Spindle characteristics
- N40 to N48 : Assignation to a channel.

Description

- **Word N0**

Logical addresses assigned to spindles "Physical address"



Please note that the values are ordered from @3 to @0

Minimal value per byte: 0

Maximal value per byte: 31

Default values: Sp@7= 0, Sp@4 FF

- **Word N1 to Word N7**

Identical to Word N0 for the other spindles physical addresses:

- N1 : Sp@7 to Sp@4
- N2 : Sp@11 to Sp@8
- N3 : Sp@15 to Sp@12
- N4 : Sp@19 to Sp@16
- N5 : Sp@23 to Sp@20
- N6 : Sp@27 to Sp@24
- N7 : Sp@31 to Sp@28.

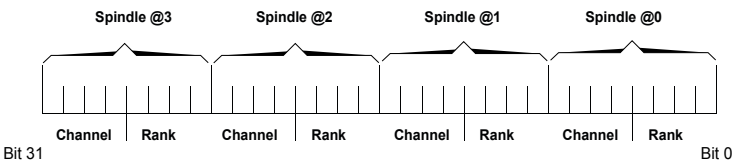
Example

A machine with two spindles:

- First spindle: @24 we define it as the first logical spindle
- Second spindle: @25 we define it as the second logical spindle.

P6 | Spindle definition and assignment to channels

Name	Value	Unit	Description	Min	Max	Default
N0	FFFFFFFFh	[]	Logical addresses associated to spindles @3 ... @0	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N1	FFFFFFFFh	[]	Logical addresses associated to spindles @7 ... @4	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N2	FFFF02FFh	[]	Logical addresses associated to spindles @11 ... @8	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N3	FFFFFFFFh	[]	Logical addresses associated to spindles @15 ... @12	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N4	FFFFFFFFh	[]	Logical addresses associated to spindles @19 ... @16	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N5	FFFFFF03h	[]	Logical addresses associated to spindles @23 ... @20	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N6	FFFFFF01h	[]	Logical addresses associated to spindles @27 ... @24	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh
N7	FFFFFFFFh	[]	Logical addresses associated to spindles @31 ... @28	1h,1h,1h,1h	FFh,FFh,FFh,FFh	FFFFFFFFh

Description	• **Words N8 to Word N39**	Spindle @0 definition Spindle characteristics for addresses @0 respectively to @31. Format: • Bit 0: Reserved • Bit 1: Reserved • Bit 2: Indexing type [0= turning, 1=milling] : A turning spindle is indexed by M19 {C…}, a milling spindle by M19 {EC…} • Bit 3: Indexing by CNC (M19) if set • Bit 4: Speed programming format (0= S5.0, 1=S3.2) • Bit 5: Indexing (0= No deceleration (quick) [P45], 1= Controlled deceleration [P32]) • Bit 6: Speed programming format (1= S6.0) • Bit 7 to 9 and 11 to 31: Reserved. • Bit 10: Sensor coupled on the motor shaft [0 = Not coupled] [1 = Coupled]. This is useful in case of several spindle ranges. When the sensor is coupled on the shaft, then the gear reduction is taken into account to measure the speed. Generally the sensor is connected on the spindle itself. **Example** • Spindle @24 (logical 1): Milling, can be indexed at constant gain, standard format • Spindle @25 (logical 2: Milling, speed format 6.0
	• **Word N40**	Spindle rank and assignment to the channels  • Bit 0-3: Spindle@0 rank (0 = Main, 1 = Aux1, 2 = Aux2, 3 = Aux3, F = None) The main spindle is addressed directly with M3/4/5, 19, 40,… Auxiliary spindles needs to be declared main first (M62:… or programmed with advanced syntax . • Bit 4-7: Channel to which the spindle is assigned (1 to 8, F = not assigned) Other values not authorized. • Bit 8 to 31: Same structure for spindle@1 to spindle@3.

P6 (Spindle definition and assignment to channels)

Name	Value	Unit	Description	Min	Max	Default
N8	0h	[]	Spindle @0 definition	0h	FFFFFFFFh	0h
N9	0h	[]	Spindle @1 definition	0h	FFFFFFFFh	0h
N10	0h	[]	Spindle @2 definition	0h	FFFFFFFFh	0h
N11	0h	[]	Spindle @3 definition	0h	FFFFFFFFh	0h
N12	0h	[]	Spindle @4 definition	0h	FFFFFFFFh	0h
N13	0h	[]	Spindle @5 definition	0h	FFFFFFFFh	0h
N14	0h	[]	Spindle @6 definition	0h	FFFFFFFFh	0h
N15	0h	[]	Spindle @7 definition	0h	FFFFFFFFh	0h
N16	0h	[]	Spindle @8 definition	0h	FFFFFFFFh	0h
N17	0h	[]	Spindle @9 definition	0h	FFFFFFFFh	0h

	• **WordsN41 to Word N47**	Word N41 : Same structure for spindle @4 to spindle @7 Word N42 : Same structure for spindle @8 to spindle @11 Word N43 : Same structure for spindle @12 to spindle @15 Word N44 : Same structure for spindle @16 to spindle @19 Word N45 : Same structure for spindle @20 to spindle @23 Word N46 : Same structure for spindle @24 to spindle @27 Word N47 : Same structure for spindle @28 to spindle @31. **Example** • Spindle @24 (logical 1): Main spindle in channel 2 • Spindle @25 (logical 2: First auxiliary spindle in channel 2

P6N46 (Spindles from @24 to @27 assignment to a channel)

Value	Unit	Description	Min	Max	Default
0h	[]	Spindle @24 rank in the channel	0h	Fh	Fh
2h	[]	Spindle @24 assigned to channel	1h	Fh	Fh
1h	[]	Spindle @25 rank in the channel	0h	Fh	Fh
2h	[]	Spindle @25 assigned to channel	1h	Fh	Fh
Fh	[]	Spindle @26 rank in the channel	0h	Fh	Fh
Fh	[]	Spindle @26 assigned to channel	1h	Fh	Fh
Fh	[]	Spindle @27 rank in the channel	0h	Fh	Fh
Fh	[]	Spindle @27 assigned to channel	1h	Fh	Fh

5.2 Axis associated with an analog port connected spindle ► P71

P71	Axis associated with an analog port connected spindle			
	Category	Spindle initial settings	**Format**	Type 3
	Words	32	**Units**	None
	Min	-1	**Max**	31
	Default	-1	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	This parameter is used in case a digital axis can be switched with a spindle connected to an analog port. For other axis/spindle switching structure the address should be declared in both P120 N0 and P120 N1.			
Description	• **Word N0 to Word N31**	Axis address associated with the spindle. Enter in the word corresponding to the spindle address the address of the associated axis.		
Example	• Spindle @24 (analog) can be switched with axis @8.			

P71 (Axis address associated to the analog port connected spindle)

Name	Value	Unit	Description	Min	Max	Default
N28	-1	[]	Axis address associated to the spindle @28	-1	31	-1
N29	-1	[]	Axis address associated to the spindle @29	-1	31	-1
N30	-1	[]	Axis address associated to the spindle @30	-1	31	-1
N31	8	[]	Axis address associated to the spindle @31	-1	31	-1

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Summary

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6.1 Sampling period ► P50 94

6.2 CNC - PLC communication setting ► P99 95

6.3 Miscellaneous functions ► P7 96

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6.6 Minimum block execution time ► P51 102

6.7 Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radius ► P52 103

6.8 Number of blocks in the look ahead buffer ► P54 105

6.9 Interaxes calibration table and stack reservation ► P58 106

6.10 Memory segments for symbolic variable storage ► P59 107

6.11 Potentiometer min-max range ► P67 108

6.12 Memory zones allocation (Part program) ► P95 110

6.13 Number of origins DAT2 ► P98 111

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6 System configuration

This category of parameters describes NCK characteristics.

Even though they are not all necessary at this stage, it is recommended to define them before entering axes characteristics and performances as the first ones (P50, P99 and P7) may have influence on the rest of the commissioning.

This category contains the following parameters:

P50	Sampling period
P99	CNC - PLC communication setting
P97	Miscellaneous functions
P35	Subroutine call by M function
P37	Maximum number of M function with acknowledge
P51	Minimum block execution time
P52	Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radius
P54	Number of blocks in the look ahead buffer
P58	Interaxis calibration table and program stack reservation
P59	Memory segments for symbolic variable storage
P67	Potentiometer min-max range
P95	Memory zones allocation (Part program)
P98	Number of origins DAT2

P50	**Sampling period**			
	Category	System configuration	**Format**	Type 5
	Words	1	**Units**	µs
	Min	2000	**Max**	10000
	Default	2000	**Resolution**	200 µs
	Immediate	No	**Access via**	E41005 (R)
General	This parameter defines the CNC sampling period.			
Description	• **Word N0**	Defines the CNC sampling period (T) in µs. The value must be a multiple of 200 µs. The minimum sampling period accepted by the system is 2000 µs and the maximum is 10000 µs. If the value entered is outside these limits, the system forces the limit values. It is possible to read the value of P50 via program parameter E41005.		
Example	**P50 (Sampling period)**			

Name	Value	Unit	Description	Min	Max	Default
N0	2000	µs	Sampling period	2000	10000	2000

6.2 CNC - PLC communication setting ► P99

P99	CNC - PLC communication setting			
	Category	System configuration	**Format**	Type 5
	Words	5	**Units**	None, none, ms, ms
	Min	0	**Max**	Word specific
	Default	Word specific	**Resolution**	N/A, N/A, 1, 1
	Immediate	No	**Access via**	N/A

General

This parameter has the following functions:

- To define the communication period between NC and PLC.
- To specify the address of master NC.
- To define the timeout used to monitor CNC ⇔ PLC communication.
- To delay the apparition of a CNC ⇔ communication error.

Description

Word N0

Number of CNC cycles between 2 CNC-PLC communications

Communication period between the NC and PLC in numbers of NC sampling periods (P50). This value should be short enough to make sure a new update has been performed between to PLC main tasks. A too small value brings no advantage.

Example: PLC Scan =10 ms (standard), NC Scan = 2ms (standard)

- Good value for P99 N0 = 3 (⇔ 6ms) or 4 (⇔ 8 ms).
- A value of 5 (10 ms) is not recommended as the PLC and NC real time clocks are not synchronized.
- In a multi-NC system, this value must be greater than the number of NCs.
- 3 <= Value <= 6 Default = 3, Resolution = 1.

• **Word N1**

Identifier of the master CNC.

The address on the physical NCK unit is selected by means of the rotary switch on the front.

In a multi-NC system, there is a different value for each NCK.

0 <= Value <= 15 Default = 0, Resolution = 1.

• **Word N2**

Maximum time for the detection of the machine error 249.

Defines the timeout in number of NC sampling periods (P50) used to monitor the communications between PLC and CNC. If this value is exceeded without NC ⇔PLC communication, then error 249 will be issued.

0 <= Value <= 65535 Default = 64, Resolution = 1 Units = ms

• **Word N3**

Delay time for the machine error 249 issue.

Possibilities to delay the issue of alarm 249 in order to trigger an emergency retract.

- Value = 0 : Error 249 issued immediately
- Value >0: In case of communication error, an emergency retract is generated automatically (No PLC action required) and after <value> ms the error will be issued triggering a machine power down.

This feature is especially important when it is necessary to disengage tool and part in case of a dangerous situation (e.g. Grinder, Gear Hobber etc…)

0 <= Value <= 65535 Default = 0, Resolution = 1 Units = ms.

• **Word N4**

Number of CNC controlled by the PLC.

This parameter is related tio the analog axes functions. It stipulates how many CNC are communicating with the PLC in order to calculate the refresh rate.

Example

P99 (CNC - PLC communication setting)

Name	Value	Unit	Description	Min	Max	Default
N0	3	[]	Number of CNC cycles between 2 CNC-PLC communication	2	6	3
N1	0	[]	Identifier of the master CNC	0	15	0
N2	64	ms	Maximum time for the detection of the machine error 249	0	65535	64
N3	0	ms	Delay time for the machine error 249 issue	0	65535	0

6.3 Miscellaneous functions ► P7

P7	Miscellaneous functions			
	Category	System configuration	**Format**	Type 0
	Words	4	**Units**	None
	Min	0	**Max**	FF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	N/A

General

General

This parameter regroups different validations and selection for system configuration.

Description

- **Word N0** Miscellaneous functions

b7	b6	b5	b4	b3	b2	b1	b0

- b0: Search direction for automatic spindle range detection
  (0 → M40 to M45, 1 M45 → M40)
- b1: Subroutine call by M functions for PLC channels
  (0 → without channel index [%xxx], 1→ with channel index [%xxx.i]
- b2 : Decoded M and T functions transmitted to the PLC in Search mode
  (0 → No transmission, 1 → functions transmitted)
- b3 : Default programming unit
  (0 → Metric : G71, 1→ Inches : G70)
- b4 : Clears the T value during reset (Flexium_NCK.RCNC.Channel[x].ToolNumber=0)
  (0 → No, 1 → Yes)
- b5 : Authorization to write E940xx parameters by part program (1)
  (0 → Writing authorized, 1 → writing inhibited)
- b6: M and T functions transmitted to the PLC in TEST mode (1)
  (0 → No transmission, 1 → functions transmitted)
- b7: Inhibition of the automatic spindle range detection (1)
  (0 → Enabled, 1 → Disabled).

  b7 = 1 --> no automatic spindle range detaction

  b7 = 0 --> automatic spindle range detection

(1) b5: Such parameters can be used for interaxes calibration. In this case, a modification could have undesired results : therefore the possibility of preventing any change.

(1) b6: Transmit such functions can be necessary if they request a specific action from the PLC (calling sub routine, setting parameters etc…). However this transmission will increase the time required for testing the program.

(1) b7: Automatic spindle gear change dipending by spindle speed programmed.

Description	• **Word N1**	Miscellaneous functions b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 • b0 : Feed rate initialization (0 → G94 1/min, 1 → G95 1/rev) • b1 : M12 activates manual intervention (0 → No M12 like any other M code, 1 → Yes M12 specific: refer to M00012) • b2 : Axes homing via keyboard (0 → Authorized, 1 → Inhibited) • b3 : Subroutine %11000 executed on Reset (0 → No, 1 → Yes) • b4 : Rigid tapping : Feed stop authorization (0 → Authorized, 1 → Inhibited) • b5 : Radius calculation on the rajectory. The radius value is stored in E32014 (0 → Inhibited, 1 → Authorized) • b6 : Move in G52 (relative to machine referential) when inclined plane active (0 → Inhibited, 1 → Authorized) • b7 : Detection of tool interference (error 149) (0 → Enabled, 1 → Disabled).
	• **Word N2**	Miscellaneous functions b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 • b0 : Homing requested when switching a rotary axis from "Limited excursion" to "Modulo" (0 → Requested, 1 → Home status maintained) • b1 : Authorization to write drive parameters V130, V131 via E352xx (0 → Inhibited, 1 → Authorized) • b2 : A spindle speed limitation (G92 S…) in CSS (G96 S… is mandatory) (0 → Not mandatory, 1 → Mandatory) • b3 : Maximum programmable spindle speed in the current range (0 → Max speed, 1 → Limit speed defined in P46 – P49) • b4 : Averaging filter for the handwheels (0 → Disabled, 1 → Enabled) • b5 : Fast coded M functions(1) (0 → Disabled, 1 → Enabled) • b6 : Spindle release by M61 requires the spindle to be stopped (0 → Stop required, 1 → Stop NOT required) • b7 : Selection of the reference spindle (M66) (1) (0 → automatically main spindle, 1 → ONLY selected by M66). (1) b3 : b3 is only significant if b2 is set. (1) b5 : When enabled two consecutive M codes will be transferred to the PLC without a code 0 between them (except if the two codes are identical). (1) b7 : It is always possible to select the reference spindle by M66, when this bit is cleared such selection will be automatic at each new master spindle selection.
	Word N3	Miscellaneous functions • b0 : .b0 Force the D number to zero during a reset [1 = Reset D] • b1 : Block skip activation during part program execution [1 = Authorized]. • b2 G75 available before the START • b3 Tool management activation • b4 G76 in zone 1, 2, 3 (0=Inhibited 1= Authorized • b5 Handwheel moving with multiple of the increment (0=Disabled 1= Enabled) Reminder that If the handwhell turning speed cause an over speed of the axes (exced P30 or acceleration exced P32) the CNC reduce the speed and the end point could be not a multiple of the increment selected. The b5 anable the end positoin as multiple of increment by an automatic CNC computation. In the version 4.2.00.00 the function is automatically activated, the b5 is not working. • b6 Force minimum indexing speed (1=Forced) • b7 Potentiometer resolution (0=1/228 1=1/16384

	Word N4	Miscellaneous functions • b0 Expansion factor (0=Disabled, 1= Enabled) • b1 Reduced speed (P34) with RTCP at pivot poin (0=Disabled 1=Enabled) • b2 Indexed programming of axes function (0=Disabled 1=Enabled). New programming sintax: X1=100 (X100) • b3 Detection of minimum spindle speed range (Err29) [0=Activated 1=Not activated) • b4 G21 Enhanced • b5 EGB loader with many followers (with tables) [1=Enabled
		(New as to 4.2.0.0 software version) • b6 G77 in Zone 0 for auxiliary channels (0=Inhibited 1=Autorised) • b7 Alarms at channel level) (0=Inhibited 1=Autorised) With b7=1 the channel alarm doesn't stop the othere channels (only for independent groups).
	Word N5	Word N5 Miscellaneous functions (New as to 4.1.20.00 software version) • b0 Spindel speed range change with plc M acknowuledge 0=not mandatory 1=mandatory The CNC will activate the new speed range only at .WCNC. Channel[x].AckMFunction = True.
Example		

P7N0 (Miscellaneous functions)

Bit	Value	Description
0	☑	Automatic spindle speed range search direction [0=Increasing direction] [1=Decreasing direction]
1	☐	Program call by M functions [0=Unindexed] [1=Indexed]
2	☐	SEARCH mode: transmission of decoded M and T functions to PLC
3	☐	Programming unit [0=Millimeters] [1=Inch]
4	☐	Forcing T functions to 0 during RESET %11000
5	☐	Inhibition of writing E940xx parameters (interaxis calibration table)
6	☐	TEST mode: transmission of M and T functions to PLC
7	☐	Inhibition of automatic spindle speed range search

P7N1 (Miscellaneous functions)

Bit	Value	Description
0	☐	Feed rate initialisation in [0=(G94 = 1/min)] [1=(G95 = 1/rev)]
1	☐	M12 activates manual intervention
2	☐	Inhibition HOMING via keyboard
3	☐	Subroutine call on RESET %11000
4	☐	FEED STOP inhibited during rigid tapping
5	☐	Not used
6	☐	G52 (Prog/OM) in inclined plane [0=Inhibited] [1=Authorised]
7	☐	Tool interface detection (Err 149) [0=Activated] [1=Not activated]

Example

P7N2 (Miscellaneous functions)

Bit	Value	Description
0	☐	Status "Homing completed" when switching from "Limited excursion" to "Modulo" [0=Lost] [1=Maintain
1	☐	Writing the drive parameters V130, V131 via E352xx [0=Inhibited] [1=Authorised]
2	☐	G92 S...(speed limitation) when G96 programmed [0=Not mandatory] [1=Mandatory]
3	☐	Maximum programmable speed of the current range [0=Max speed] [1=Limited speed]
4	☐	CAN handwheel filter [0=Disabled] [1=Enabled]
5	☐	Fast coded M functions [0=Disabled] [1=Enabled]
6	☐	Spindles release [0=With stop] [1=Without stop]
7	☐	Reference spindle [0= Main spindle] [1=Selected by M66]

P7N3 | Miscellaneous functions

Bit	Value	Description
0	☐	Forcing D number to 0 during RESET
1	☐	Block skip control function "/" during the Part Program execution [0=Inhibited] [1=Authorise
2	☐	G75 available before the START
3	☐	Tool management activation
4	☑	G76 in Zone 1, 2, 3 [0=Inhibited] [1=Authorised]
5	☑	Handwheel moving with multiple of the increment [0=Disabled] [1=Enabled]
6	☑	Force minimum indexing speed [1=Forced]
7	☑	Potentiometer resolution [0=1/128] [1=1/16384]

P7N4 | Miscellaneous functions

Bit	Value	Description
0	☑	Expansion factor [0=Disabled] [1=Enabled]
1	☑	Reduced speed (P34) with RTCP at pivot point [0=Disabled] [1=Enabled]
2	☐	Indexed programming of axes function [0=Disabled] [1=Enabled]
3	☐	Detection of minimum spindle speed range (Err 29) [0=Activated] [1=Not acti
4	☐	G21 Enhanced
5	☐	EGB leader with many followers (with tables) [1=Enabled]
6	☐	Not used
7	☐	Not used

6.4 Subroutine call by M fuction ► P35

P35	Subroutine call by M function			
	Category	System configuration	**Format**	Type 5
	Words	32	**Units**	None
	Min	0	**Max**	899 / 29999
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	N/A

General

This parameter is used to declare up to 16 M functions that will activate the execution of a subroutine and the subroutine in question.

Description

- **Word N0 :** M function number.
- **Word N1 :** Subroutine number.

  ...
- **Word N62 :** M function number.
- **Word N63 :** Subroutine number.

Each even word will contain the number of an M code and the following even word the number of subroutine executed.

As M0 cannot trigger a subroutine, each unused word should be set to 0.

It is not necessary to sort the M function in ascending order.

Only codes up to 899 can request execution of a subroutine.

The subroutine number is limited to 29999.

Example

P35 (Subroutine call by M function)

Name	Value	Unit	Description	Min	Max	Default
N0	6	[]	M function number	0	899	0
N1	9106	[]	Subroutine number	1	29999	1
N2	75	[]	M function number	0	899	0
N3	9175	[]	Subroutine number	1	29999	1
N4	0	[]	M function number	0	899	0
N5	1	[]	Subroutine number	1	29999	1

- M6 will trigger %9106, M75 %9175

P.S. For PLC axes according to P7 N0 b1, the call to a subroutine will be with or without channel index. The channel index will not be defined in P35.

6.5 Maximum number of M function with acknowledge ► P37

P37	Maximum number of M function with acknowledge			
	Category	System configuration	**Format**	Type 5
	Words	1	**Units**	None
	Min	199	**Max**	899
	Default	199	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	This parameter is used to define the higher M function with acknowledge number. M codes above this value will be without acknowledge also named "On the fly" function.			
Description	• **Word N0** • **Word N1**	Maximum number of M functions with acknowledge. M function for workpiece change.		
Example	**P37 (Maximum number of M functions with acknowledge)**			

Name	Value	Unit	Description	Min	Max	Default
N0	220	[]	Maximum number of M functions with acknowledge	199	899	199

- M functions up to M220 will be sent with acknowledge request.
- M functions from M221 and above will be sent on the fly.

6.6 Minimum block execution time ► P51

P51	Minimum block execution time			
	Category	System configuration	**Format**	Type 5
	Words	1	**Units**	1 ms
	Min	0	**Max**	65535
	Default	0	**Resolution**	1 ms
	Immediate	No	**Access via**	E32000 (R/W)
General	This parameter is used to define the minimum time to execute a block. By defining a minimum time we can be sure that the following block to be executed can be prepared in full. When set to 0, Flexium adapts dynamically this value to achieve the best performances. Therefore except particular situation, this parameter should be left to its default value.			
Description	• **Word N0** Minimum time for executing a block by interpolation Smallest number of "ms" requested to execute a block in interpolation.			
Example	**Example**: Standard value			

P51 (Minimum block execution time)

Name	Value	Unit	Description	Min	Max	Default
N0	0	ms	Minimum time for executing a block by interpolation	0	65535	0

6.7 Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radius ► P52

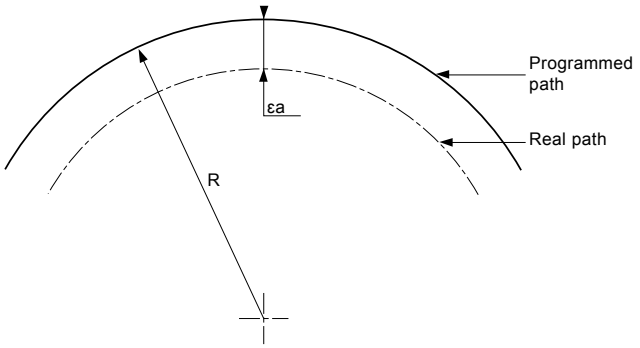
P52	Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radius			
	Category	System configuration	**Format**	Type 10
	Words	3	**Units**	mm / °
	Min	0	**Max**	Word specific
	Default	Word specific	**Resolution**	10^{-6} mm
	Immediate	No	**Access via**	E32002 , E32012 (R/W) See description
General	This parameter is used to define several types of precision during machining.			

Description

- **Word N0**

Radial error tolerated on circles

Defines the maximum servo error allowed for circles by limiting the feed rate.



εa (servo-loop error) is the error in mm between a programmed path and the real path.

εa is approximated by the following equation:

$$\varepsilon a = \frac{Vmax^2 * T^2}{2R}$$

- εa = Servo-loop error (in m),
- Vmax = Max speed (in m/s),
- T = Time constant (in µs),
- R = Radius (in m).

This equation can be reformulated to give the maximum tolerated speed:

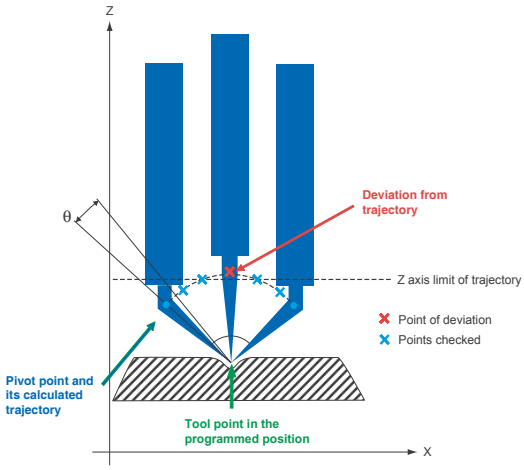
$$Vmax = \frac{\sqrt{2R * \varepsilon a}}{T}$$

- Application: maximum tolerated speed for εa = 50 µm T= 60 ms and R = 50 mm.

$$Vmax = \frac{\sqrt{2 * 50 * 10^{-3} * 50 * 10^{-6}}}{60 * 10^{-3}} = \frac{\sqrt{5 * 10^{-6}}}{60 * 10^{-3}} = 0.037 \frac{m}{s} = 2.236 \frac{m}{min}$$

In case of High Speed Cutting (HSC) this parameter must be set to a low value, especially for finishing (a few units).

Please note that it is not only applied to circles but also to curves programmed by small segments (TABCYLS). The setting is adjusted via the external parameter E32002.

Description	• **Word N1**	Path checking in RTCP: Max angular value between 2 check points. To verify that the trajectory just calculated does not exceed the travel limits, the numerical control will test the conditions to be met over a number of check points. These points are specified so that they are uniformly distributed along the trajectory with angular distance between two of them less or equal to the angular distance defined in P52N1. For each point thus specified, checks are carried out for the axes of the pivot point. The checks are valid for the following types of interpolated trajectories: - Linear interpolation, - Circular interpolation, - Segmented polynomial interpolation (Smoothed polynomial interpolation is not covered). Parameter P52N1 is set in degrees. The system allows values from 5° to 45°. Outside this range, the checks are not carried out. The value of parameter P52N1 is a compromise between the precision required in checking the trajectories and the additional computation time required.  θ: The angle θ is calculated by the CNC so that the check points are uniformly distributed along the circular trajectory and the angular distance between two consecutive points is less than that given by P52N1.
	• **Word N2**	Programming precision in circle radii. This word defines the maximum tolerated difference between the Ending radius and the Starting radius on a circle. Error 107 is generated if this value is exceeded. External parameter E32012 is the image of this parameter. Default value = 20 internal units. Range of values 20 to 255.
Example		**P52 (Radial error tolerated on circles - Path checks in RTCP - Programming precision on circle radii)**

Name	Value	Unit	Description	Min	Max	Default
N0	0.05	mm	Radial error tolerated on circles	0.0	65.0	0.05
N1	2.5	°	Path checks in RTCP	0.0	45.0	0.0
N2	0.02	mm	Programming precision on circle radii	0.02	0.255	0.02

6.8 Number of blocks in the look ahead buffer ► P54

P54	**Number of blocks in the look ahead buffer**			
	Category	System configuration	**Format**	Type 5
	Words	1	**Units**	None
	Min	50	**Max**	1000
	Default	200	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	Defines the number of NC blocks in the look-ahead buffer. The look ahead permits to anticipate the change of speeds and direction. If this value is too low especially for small blocks, there is a risk of limited speed capacities to prevent shocks at changes of direction. A too high value will result in additional computing without practical interest; therefore it is recommended that this size is dynamically adjusted.			
Description	• **Word N0**	Number of blocks in look-ahead buffer (per channel) Size of the buffers for blocks ready to be executed (prepared). This is a global value that will be dynamically distributed over all channels for optimal performances. A value of 0 means this size will be dynamically adjusted. Therefore it is suggested not to change the default value. The minimum number of blocks per channel is 10 and the maximum is 1000. If the value of P54 is outside these limits, the system forces the limit value.		
Example	**P54 (Number of blocks in look-ahead buffer)**			

Name	Value	Unit	Description	Min	Max	Default
N0	200	[]	Number of blocks in look-ahead buffer (for channel)	50	1000	200

P58	Interaxes calibration table and stack reservation			
	Category	System configuration	**Format**	Type 4
	Words	2	**Units**	None
	Min	0/5000	**Max**	1000/131072
	Default	1000/20000	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	This parameter is used to define the number of E81xxx/E82xxx parameters as well as the size of part program stack.			
Description	• **Word N0**	**Interaxis calibration table** This word defines the number of parameters E81xxx / E82xxx. They can be used either to define an Interaxis calibration table but more and more used as generic as the calibration is also available through Flexium Tools. Decreasing the default value may help to gain some room in the NCK NVRAM which is not really an issue. For this reason it is strongly suggested to keep the value at the default. Entering a value higher than 1000 has no effect.		
	• **Word N1**	**Program stack size for each channel** This word is used to define the size of the program stack size of each channel. All channels will get the same amount. This stack is used to save symbolic variables as well as data for some dynamic operators (please refer to the Flexium+ Extended Programming manual M00020). The value entered corresponds to the size in words (2 bytes) per channel. The minimum stack size must be above 10 kBytes. This stack is taken on the part program memory, therefore especially in case of multi channels machine it may be interesting not to reserve the maximum amount. N.B.: The extended programming manual describes the relation between number of variables and memory allocation.		
	• **Word N2**	EGB table elements The N2 can reserved a predefined memory for EGB table.		
Example	**P58 (Interaxis calibration table and program stack reservation)**			

Name	Value	Unit	Description	Min	Max	Default
N0	1000	[]	Interaxis calibration table	0	1000	1000
N1	20000	[]	Program stack size for channel	0	65535	20000

6.10 Memory segments for symbolic variable storage ► P59

P59	Memory segments for symbolic variable storage			
	Category	System configuration	**Format**	Type 5
	Words	32	**Units**	KByte
	Min	0	**Max**	65535
	Default	0	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	This parameter is used to define up to 32 segments of memory for saving symbolic variables. The values of the variables are kept even after a Reset The main use of these segments is related to dynamic operators in C program that need to save variables over a complete work power on session of the machine. (see Flexium+ Programming manual M00040 G76+ and G76- functions) The total size of the segments can not exceed 1024 kBytes.			
Description	• **Word N0**	Size of memory segment #1 in Kbytes		
	• **Word N1 to N31**	Same as N0 for memory segments 2 to 32		

Example

P59 (Memory segments of the symbolic variables)

Name	Value	Unit	Description	Min	Max	Default
N0	0		Quantity of memory reserved for the segment 1	0	1000	0
N1	0		Quantity of memory reserved for the segment 2	0	1000	0
N2	0		Quantity of memory reserved for the segment 3	0	1000	0
N3	0		Quantity of memory reserved for the segment 4	0	1000	0
N4	0		Quantity of memory reserved for the segment 5	0	1000	0
N5	0		Quantity of memory reserved for the segment 6	0	1000	0
N6	0		Quantity of memory reserved for the segment 7	0	1000	0
N7	0		Quantity of memory reserved for the segment 8	0	1000	0

6.11 Potentiometer min-max range ► P67

P67	Potentiometer min-max range			
	Category	System configuration	**Format**	Type 5
	Words	80	**Units**	%
	Min	According to word considered	**Max**	255
	Default	According to word considered	**Resolution**	1
	Immediate	No	**Access via**	E79005 – E79008 (R/W)
General	This parameter defines the range of values for the different overrides. The values are specified as percentages in 16-bit words.			
Description	The feed override values are defined par channel whereas the speed override values are defined per spindle. All the values must be positive or zero. • The highest possible value is 255% • The lowest possible value is 0% • 100% must be within the min-max range. • The max values must always be higher than the min values • If these conditions are not satisfied, at power on, the default values will be set: - 0-120% for feed rate potentiometers - 50-100% for spindle speed potentiometers.			
	• **Word N0**	**Min feed percentage for channel 1** 0< = value <= 100; default = 0.		
	• **Word N1**	**Max feed percentage for channel 1** 100< = value <= 255; default = 120.		
	• **Word N2/3** up to **Word N14/15**	Identical to Word N0/N1 for channels 2 to 8.		
	• **Word N16**	**Min percentage for spindle @0** 0< = value <= 100; default = 50.		
	• **Word N17**	**Max percentage for spindle @0** 100< = value <= 255; default = 100.		
	• **Word N18** to **Word N78**	Even words: Identical to Word N16 for spindles @1 to @31		
	• **Word N19** to **Word N79**	Odd words: Identical to Word N17 for spindles @1 to @31		

Example

P67 (Potentiometer min-max range)

Name	Value	Unit	Description	Min	Max	Default
N0	0	%	Min feed percentage for channel 1	0	100	0
N1	120	%	Max feed percentage for channel 1	100	255	120
N2	0	%	Min feed percentage for channel 2	0	100	0
N3	120	%	Max feed percentage for channel 2	100	255	120
N4	0	%	Min feed percentage for channel 3	0	100	0
N5	120	%	Max feed percentage for channel 3	100	255	120
N6	0	%	Min feed percentage for channel 4	0	100	0
N7	120	%	Max feed percentage for channel 4	100	255	120
N8	0	%	Min feed percentage for channel 5	0	100	0
N9	120	%	Max feed percentage for channel 5	100	255	120
N10	0	%	Min feed percentage for channel 6	0	100	0
N11	120	%	Max feed percentage for channel 6	100	255	120
N12	0	%	Min feed percentage for channel 7	0	100	0
N13	120	%	Max feed percentage for channel 7	100	255	120
N14	0	%	Min feed percentage for channel 8	0	100	0
N15	120	%	Max feed percentage for channel 8	100	255	120
N16	50	%	Min percentage for spindle @0	50	100	50
N17	100	%	Max percentage for spindle @0	100	255	100
N18	50	%	Min percentage for spindle @1	50	100	50
N19	100	%	Max percentage for spindle @1	100	255	100
N20	50	%	Min percentage for spindle @2	50	100	50
N21	100	%	Max percentage for spindle @2	100	255	100
N22	50	%	Min percentage for spindle @3	50	100	50
N23	100	%	Max percentage for spindle @3	100	255	100
N24	50	%	Min percentage for spindle @4	50	100	50
N25	100	%	Max percentage for spindle @4	100	255	100
N26	50	%	Min percentage for spindle @5	50	100	50

P95	Memory zones allocation (Part program)			
	Category	System configuration	**Format**	Type 5
	Words	3	**Units**	Kbytes
	Min	0	**Max**	40960
	Default	100/80/0	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	This parameter is used to allocate memory areas for part programs.			
Description	The part program memory is divided into four areas: • Free access area 0 • Zone 1: User • Zone 2: OEM • Zone 3: NUM The different zones (except zone 0) are intended to store specific or proprietary programs. Programs in these zones can be protected so as not to be editable or visible (the NUM Zone is always protected). There is a hierarchy between the different zones. A program is searched for in zone 0 at first, then zone 1, 2 and finally 3. This way it is always possible to overwrite an existing program by another with the same number existing in a lower zone. N.B: This feature is very useful to add or change some functionality but could lead to a malfunction if improperly used. Refer to the programming manuals to know which program number you can use. The sizes (in Kbytes) of the zones 1 to 3 are described with this parameter. Zone 0 gets the remaining memory.			
	• **Word N0**	Size of zone 1: Customer (Kbyte)		
	• **Word N1**	Size of zone 2: OEM (Kbyte)		
	• **Word N2**	Size of zone 3: NUM (Kbyte)		
Example	**P95 (Memory zones allocation (Part program))**			

Name	Value	Unit	Description	Min	Max	Default
N0	100	kB	Size of zone 1 : Customer (kbyte)	0	40960	100
N1	80	kB	Size of zone 2 : OEM (kbyte)	0	40960	80
N2	0	kB	Size of zone 3 : NUM (Kbyte)	0	40960	0

6.13 Number of origins DAT2 ► P98

P98	Number of origins DAT2			
	Category	System configuration	**Format**	Type 5
	Words	8	**Units**	None
	Min	1	**Max**	99
	Default	50	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	Flexium+ offers the possibility of up to 99 program offsets (DAT2). In order to limit the complexity of the system, it is possible to define for each channel the number of program offsets that will be used.			
Description	• **Word N0** **....**	Number of origins DAT2 for channel 1 1 <= value <= 99; default = 50		
	• **Word N7**	Number of origins DAT2 for channel 8 1 <= value <= 99; default = 50		
Example	**P98 (Number of origins DAT2)**			

Name	Value	Unit	Description	Min	Max	Default
N0	20	[]	Number of origins DAT2 for channel 1	1	99	50
N1	5	[]	Number of origins DAT2 for channel 2	1	99	50
N2	5	[]	Number of origins DAT2 for channel 3	1	99	50
N3	5	[]	Number of origins DAT2 for channel 4	1	99	50
N4	5	[]	Number of origins DAT2 for channel 5	1	99	50
N5	5	[]	Number of origins DAT2 for channel 6	1	99	50
N6	5	[]	Number of origins DAT2 for channel 7	1	99	50
N7	5	[]	Number of origins DAT2 for channel 8	1	99	50

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7 Axis characteristics

This category of parameters describes the static characteristics of the axes. They should be filled before adjusting the dynamics.

This category contains the following parameters:

P15	Homing direction
P16	Machine home position
P17	Axes travel limits
P18	Backlash error compensation
P22	In-position window
P29	Lubrication pulse distance
P30	Maximum axes traverse rate
P31	Jog and reduced speeds
P34	Reduced speeds per axes

P15	Homing direction			
	Category	Axes characteristics	**Format**	Type 6
	Words	2	**Units**	None
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	Yes	**Access via**	N0 : E933xx (R) N1 : E934xx (R)

General

This parameter is useful for axes not equipped with absolute measurement systems. It has two functions:

- Define the direction from which the datum switch is approached in homing mode.
- Declare if a home switch is required or not. If the home switch is required, the system will make this switch is not open at start of the homing procedure (Error 32). Home switch is not required if there is only one marker (top zero) over the full travel or in case of measure system with coded reference mark.

Description

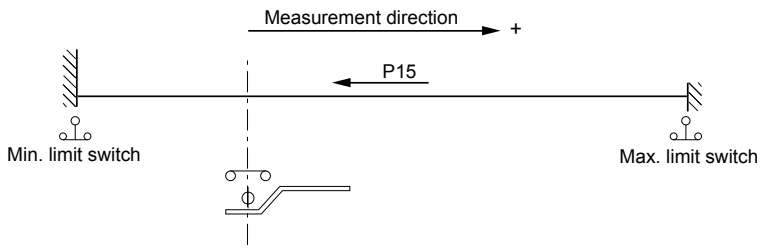
- **Word N0**

Datum switch approach direction in HOMING mode

The bit position gives the physical axis address.

Bit Set means homing is in the negative direction on the particular axis.

The homing direction can be checked in E933xx.



- **Word N1**

Ignore the datum switch in HOME mode

The bit position gives the physical axis address.

Bit Set means the datum switch is not tested on the corresponding axis.

In Homing mode, homing is complete when on the first marker pulse is encountered.

The status of the switch can be checked in E934xx.

Example

- Axes @2 and @3 homed in the negative direction
- Axis @0 do not require a datum switch.

P15 (Homing Direction)

Name	Value	Unit	Description	Min	Max	Default
N0	Ch	[]	Datum switch approach direction in HOMING mode ...	0h	FFFFFFFFh	0h
N1	1h	[]	Ignore the datum switch in HOME mode	0h	FFFFFFFFh	0h

7.2 Machine home position ► P16

P16	Machine home position			
	Category	Axes characteristics	**Format**	Type 9
	Words	32	**Units**	mm / °
	Min	-9999999.99999999	**Max**	+9999999.99999999
	Default	0	**Resolution**	10^{-6} mm
	Immediate	Yes	**Access via**	E951xx
General	This parameter is used to set the measure origin of an axis. The word number gives the physical address of the axis.			
Description	• **Word N0**:	Machine home position for axis @0 The values are expressed in mm for linear axes or degrees for rotary axes. The word contains the position of the datum switch on the corresponding axis in machine dimensions.		
	• **Word N1 to Word N31**	Identical to N0 for the other axes.		
Example	**P16 (Machine home position)**			

Name	Value	Unit	Description	Min	Max	Default
N0	613.22	mm	Machine home position for axis @0	-9999999.99999999	9999999.99999999	0.0
N1	372.5	mm	Machine home position for axis @1	-9999999.99999999	9999999.99999999	0.0
N2	-10.0	mm	Machine home position for axis @2	-9999999.99999999	9999999.99999999	0.0
N3	0.0	mm	Machine home position for axis @3	-9999999.99999999	9999999.99999999	0.0
N4	0.0	mm	Machine home position for axis @4	-9999999.99999999	9999999.99999999	0.0
N5	0.0	mm	Machine home position for axis @5	-9999999.99999999	9999999.99999999	0.0

7.3 Axis travel limits ► P17

P17	Axis travel limits			
	Category	Axes characteristics	**Format**	Type 9
	Words	32	**Units**	mm / °
	Min	-9999999.99999999	**Max**	+9999999.99999999
	Default	+/- 9999999.99999999	**Resolution**	10^{-9} mm
	Immediate	Yes	**Access via**	E7x002 – E7x003 (R)
General	This parameter is used to define the static axes travel limits.			
Description	The values are related to the physical address of the axes.			
	• **Word N0**	Lower travel limit for axis @0		
	• **Word N1**	Upper travel limit for axis @0		
	• **Word N2/N3 up to Word N62/N63**	Identical to N0 / N1 for the other axes		

Example

P17 (Axis travel limits)

Name	Value	Unit	Description	Min	Max	Default
N0	-580.0	mm	Lower travel limit for axis @0	-9999999.99999999	9999999.99999999	-9999999.999...
N1	271.55	mm	Upper travel limit for axis @0	-9999999.99999999	9999999.99999999	9999999.999...
N2	-250.0	mm	Lower travel limit for axis @1	-9999999.99999999	9999999.99999999	-9999999.999...
N3	250.0	mm	Upper travel limit for axis @1	-9999999.99999999	9999999.99999999	9999999.999...
N4	0.0	mm	Lower travel limit for axis @2	-9999999.99999999	9999999.99999999	-9999999.999...
N5	320.0	mm	Upper travel limit for axis @2	-9999999.99999999	9999999.99999999	9999999.999...
N6	-9999999.99999999	mm	Lower travel limit for axis @3	-9999999.99999999	9999999.99999999	-9999999.999...

7.4 Backlash error compensation ► P18

P18	Backlash error compensation			
	Category	Axes characteristics	**Format**	Type 9
	Words	32	**Units**	mm / °
	Min	-5.0	**Max**	+5.0
	Default	0	**Resolution**	10^{-6} mm
	Immediate	Yes	**Access via**	N/A
General	Used to correct positioning errors due to backlash.			
Description	The word number gives the physical axis address			
	• **Word N0**	Backlash error compensation for axis @0 The values are expressed in the mm for linear axes or degrees for rotary axes. The absolute value contained in a word gives the maximum backlash on the corresponding axis. The sign determines the direction of backlash correction. - Value > 0: Positive correction applied when the axis moves in the positive direction. - Value < 0: Negative correction applied when the axis moves in the positive direction. In principle the sign should be opposite to the homing direction .		
	• **Word N1 to Word N31**	Identical to Word N0 but for the other axes.		
Example	**P18 (Backlash error compensation)**			

Name	Value	Unit	Description	Min	Max	Default
N0	0.002	mm	Backlash error compensation for axis @0	-5.0	5.0	0.0
N1	-0.004	mm	Backlash error compensation for axis @1	-5.0	5.0	0.0
N2	0.0	mm	Backlash error compensation for axis @2	-5.0	5.0	0.0

7.5 In-position window ► P22

P22	In-position window			
	Category	Axes characteristics	**Format**	Type 10
	Words	32	**Units**	mm / °
	Min	0	**Max**	65.0
	Default	0.05	**Resolution**	10^{-6} mm
	Immediate	No	**Access via**	N/A
General	Used to define the following error threshold below which the CNC considers the movement to be finished or the axis stopped. If an axis exceed this limit when it should be stopped (e.g. Clampable axis) the status NPOS will be shown on the HMI and further movement will be impossible until the axis position returns within the limits.			
Description	• **Word N0**	In-position window for axis @0 The axis is considered in position when the following error is within + /- the value of the parameter.		
	• **Word N1 to Word N31**	Identical to Word N0 for the other axes		
Example	**P22 (In-Position window)**			

Name	Value	Unit	Description	Min	Max	Default
N0	0.05	mm	In-position window for axis @0	0.0	65.0	0.05
N1	0.05	mm	In-position window for axis @1	0.0	65.0	0.05
N2	0.05	mm	In-position window for axis @2	0.0	65.0	0.05
N3	0.05	mm	In-position window for axis @3	0.0	65.0	0.05
N4	0.05	mm	In-position window for axis @4	0.0	65.0	0.05

7.6 Lubrication pulse distance ► P29

P29	Lubrication pulse distance			
	Category	Axes characteristics	**Format**	Type 10
	Words	32	**Units**	mm / °
	Min	0	**Max**	9999999.0
	Default	0	**Resolution**	10^{-9}
	Immediate	No	**Access via**	N/A
General	Used to define the distance at which the lubrication pulse for the axis guideways is to be output. When the cumulative displacement of an axis will be greater than the value in the parameter P29 the NCK will set the relative bit FlexiumpNCK.RCNC.Axis[0..31].LubricationPulse for **two** PLC cycles and the cumulate distance will be cleared. (New as to 4.1.20.00 software version)			
Description	• **Word N0**	Lubrication pulse distance for axis @0		
	• **Word N1 to Word N31**	Identical to Word N0 for the other axes.		
Example	• Axes @ 0 = 1000mm			

P29 | Lubrication pulse distance

Name	Value	Unit	Description	Min	Max	Default
N0	1000.0	mm	Lubrication pulse distance for axis @0	0.0	9999999.0	0.0
N1	0.0	mm	Lubrication pulse distance for axis @1	0.0	9999999.0	0.0
N2	0.0	mm	Lubrication pulse distance for axis @2	0.0	9999999.0	0.0
N3	0.0	mm	Lubrication pulse distance for axis @3	0.0	9999999.0	0.0
N4	0.0	mm	Lubrication pulse distance for axis @4	0.0	9999999.0	0.0
N5	0.0	mm	Lubrication pulse distance for axis @5	0.0	9999999.0	0.0

7.7 Maximum axes traverse rate ► P30

P30	**Maximum axes traverse rate**			
	Category	Axes characteristics	**Format**	Type 10
	Words	32	**Units**	mm/min or °/min
	Min	0	**Max**	99999999
	Default	5000	**Resolution**	10^{-6} mm
	Immediate	Yes	**Access via**	E970xx (R)
General	Used to define the maximum axis traverse rates.			
Description	• **Word N0**	Maximum traverse rate for axis @0 Maximum traverse rate for axis @0. This value should be such as not to exceed the maximum rpm of the motor and no more than 65000 increments / NC scan (P50).		
	• **Word N1 to Word N31**	Identical to Word N0 for the other axes.		
Example	• X axis driven by a 6000 rpm motor on a 10 mm pitch ball screw. • P50 = 2ms – Units mm • Max speed is 60000 mm/min. • Distance per scan = 2000 increments /2ms well below the limit of 65000.			

P30 (Maximum axes traverse rates)

Name	Value	Unit	Description	Min	Max	Default
N0	60000.0	mm/min	Maximum traverse rate for axis @0	0.0	99999999.0	5000.0
N1	5000.0	mm/min	Maximum traverse rate for axis @1	0.0	99999999.0	5000.0
N2	5000.0	mm/min	Maximum traverse rate for axis @2	0.0	99999999.0	5000.0
N3	5000.0	mm/min	Maximum traverse rate for axis @3	0.0	99999999.0	5000.0
N4	5000.0	mm/min	Maximum traverse rate for axis @4	0.0	99999999.0	5000.0
N5	5000.0	mm/min	Maximum traverse rate for axis @5	0.0	99999999.0	5000.0

7.8 Jog and reduced speed ► P31

P31	Jog and reduced speed			
	Category	Axes characteristics	**Format**	Type 10
	Words	5	**Units**	mm /min or °/min
	Min	0.1	**Max**	99999999
	Default	Word dependent (see example)	**Resolution**	0.1 mm/min
	Immediate	No	**Access via**	N/A
General	Used to defined three different speed in manual mode (speeds selected by the PLC). As well as the limit of speed for the linear and the rotary axis in speed limitation condition (information from the PLC). The data are active for all channels.			
Description	• **Word N0**	Slow JOG speed (linear or rotary axes)		
	• **Word N1**	Normal JOG speed (linear or rotary axes)		
	• **Word N2**	Fast JOG speed (linear or rotary axes)		
	• **Word N3**	Reduced speed on linear axes requested by PLC function This is activated by the PLC flag : *NCK.W_ALLCNC.ReducedSpeed*		
	• **Word N4**	Reduced speed on rotary axes requested by PLC function		
Example	**P31 (JOG and reduced speeds)**			

Name	Value	Unit	Description	Min	Max	Default
N0	50.0	mm/min or °/min	Slow JOG speed	0.1	99999999.0	50.0
N1	1000.0	mm/min or °/min	Normal JOG speed	0.1	99999999.0	1000.0
N2	5000.0	mm/min or °/min	Fast JOG speed	0.1	99999999.0	5000.0
N3	4000.0	mm/min	Reduced speed on linear axes requested by PLC function	0.1	99999999.0	4000.0
N4	4000.0	°/min	Reduced speed on rotary axes requested by the PLC function	0.1	99999999.0	4000.0

7.9 Reduced speeds per axes ► P34

P34	Reduced speeds per axes			
	Category	Axes characteristics	**Format**	Type 10
	Words	128	**Units**	mm /min or °/min
	Min	0.1	**Max**	99999999
	Default	0	**Resolution**	1
	Immediate	No	**Access via**	E973xx

General	This parameter is used to define up to four speed limits per axis. If the value for an axis is zero then the limit will be the one defined in P31. The choice of a particular limit will be done by the PLC variable *Flexium_NCK.WCNC.Axis[0..31]. SpeedLimit* With Flexium version 4.0.10.00 only the first set of limits (N0 to N31) will be taken into account.	
Description	• **Word N0**	First speed limit for axis @0
	• **Word N1 to N31**	Same as N0 for axes @1 to @31
	• **Word N32 to N63**	Identical to N0 to N31 but for the second speed limit
	• **Word N64 to N95**	Identical to N0 to N31 but for the third speed limit
	• **Word N96 to N127**	Identical to N0 to N31 but for the fourth speed limit

Example

P34 (Reduced speed)

Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm/min	Reduced speed for axis @0	0.0	99999999.0	0.0
N1	0.0	mm/min	Reduced speed for axis @1	0.0	99999999.0	0.0
N2	0.0	mm/min	Reduced speed for axis @2	0.0	99999999.0	0.0
N3	0.0	mm/min	Reduced speed for axis @3	0.0	99999999.0	0.0
N4	0.0	mm/min	Reduced speed for axis @4	0.0	99999999.0	0.0
N5	0.0	mm/min	Reduced speed for axis @5	0.0	99999999.0	0.0
N6	0.0	mm/min	Reduced speed for axis @6	0.0	99999999.0	0.0
N7	0.0	mm/min	Reduced speed for axis @7	0.0	99999999.0	0.0
N8	0.0	mm/min	Reduced speed for axis @8	0.0	99999999.0	0.0

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Summary

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8.1 Maximum following error ► P23 130

8.2 Maximum permissible acceleration ► P32 131

8.3 Acceleration profile ► P53 132

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8 Axis dynamics

This set of parameters is used to define the dynamic characteristics of the axes. It should be set before adjusting the axes.

This category contains the following parameters:

P23	Maximum following error
P32	Maximum permissible acceleration
P53	Acceleration profile

8.1 Maximum following error ► P23

P23	Maximum following error			
	Category	Axes dynamics	**Format**	Type 10
	Words	32	**Units**	mm or °
	Min	0	**Max**	10000
	Default	8	**Resolution**	10^{-6}
	Immediate	Yes	**Access via**	N/A
General	Defines the maximum following error (Lag value) permissible for each axis individually.			
Description	Each word corresponds to the physical address of an axis. The value is function of the maximum speed and the gain of the axis. E.g. max speed =8 m/min gain = 2 → Lag at max speed = 8/2 = 4. With a safety factor of 10%, the value for P23 will be set to 4.4.			
	• **Word N0**	Maximum following error for axis @0 The values are expressed in mm or degrees. If the value is exceeded, the CNC triggers a machine error 40 to 71 according to the axis in fault.		
	• **Word N1 to Word N31**	Identical for the other axes.		
Example	• Default values.			

P23 (Maximum followig error)

Name	Value	Unit	Description	Min	Max	Default
N0	8.0	mm	Maximum following error for axis @0	0.0	10000.0	8.0
N1	8.0	mm	Maximum following error for axis @1	0.0	10000.0	8.0
N2	8.0	mm	Maximum following error for axis @2	0.0	10000.0	8.0
N3	8.0	mm	Maximum following error for axis @3	0.0	10000.0	8.0
N4	8.0	mm	Maximum following error for axis @4	0.0	10000.0	8.0

8.2 Maximum permissible acceleration ► P32

P32	Maximum permissible acceleration			
	Category	Axes dynamics	**Format**	Type 10
	Words	96	**Units**	mm/s² or °/s²
	Min	0	**Max**	10000
	Default	Word dependent	**Resolution**	10^{-6}
	Immediate	Yes	**Access via**	E971xx / E972xx / E907xx (RW)

General

Used to define the maximum permissible accelerations (in work rate and rapid) for each of the axes or each of the spindles.

Description

The first 32 pairs of word correspond to the physical address of an axis. The following words are related to the spindles.

The values are expressed in mm/s² or °/s² .

• **Word N0**	Maximum acceleration in work rate (G1.. G3) for axis @0
• **Word N1**	Maximum acceleration in rapid (G0, Dry Run, Fast Manual) for axis @0
• **Word N2/N3 up to Word N62/N63**	Identical for the other axes.
Word N64	Maximum acceleration for spindle @0 The value is function of the speed format: - S5 : Value in °/s² - S6 : Value in 10°/s² - S3.2: Value in .01°/s²
• **Word N64 to Word N95**	Identical to N64 for the other spindles

Example

- Default values.

P32 (Maximum permissible acceleration)

Name	Value	Unit	Description	Min	Max	Default
N0	500.0	mm/s²	Maximum permissible acceleration at work feed-rate for axis @0	0.0	99999999.0	500.0
N1	500.0	mm/s²	Maximum permissible acceleration in rapid for axis @0 (DRYRUN, FAST JOG and G0 modes)	0.0	99999999.0	500.0
N2	500.0	mm/s²	Maximum permissible acceleration at work feed-rate for axis @1	0.0	99999999.0	500.0
N3	500.0	mm/s²	Maximum permissible acceleration in rapid for axis @1 (DRYRUN, FAST JOG and G0 modes)	0.0	99999999.0	500.0
N4	500.0	mm/s²	Maximum permissible acceleration at work feed-rate for axis @2	0.0	99999999.0	500.0
N5	500.0	mm/s²	Maximum permissible acceleration in rapid for axis @2 (DRYRUN, FAST JOG and G0 modes)	0.0	99999999.0	500.0
N6	500.0	mm/s²	Maximum permissible acceleration at work feed-rate for axis @3	0.0	99999999.0	500.0

P32N64 (Maximum permissible acceleration for spindle @0)

Value	Unit	Description	Min	Max	Default
20000.0	°/s²	Maximum permissible acceleration for spindle @0	0.0	99999999.0	20000.0

8.3 Acceleration profile ► P53

P53	Acceleration profile			
	Category	Axes dynamics	**Format**	Type 5
	Words	24	**Units**	Word dependent
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	Word dependent
	Immediate	No	**Access via**	E11013, E32006, E32008 (R/W) : see description
General	This parameter defines the type of acceleration profile and sets the corresponding parameters. Flexium+ basically handles 4 different types of acceleration. • Constant acceleration: speed buildup is minimal but the Jerk (derivative of acceleration is very high (theoretically infinite). • Triangular (Saw-tooth) acceleration: jerk is square but depends of the trajectory – maximum acceleration is available for a very short time therefore speed buildup is long. • Trapezoidal acceleration: Jerk is still square but its shape is constant. Max acceleration is reached over a longer time giving a shorter speed buildup. • Parabolic acceleration (trapezoidal jerk). Jerk variation is smoother and its maximum can be slightly higher giving a smoother speed build-up with almost the same performance than trapezoidal acceleration.			
Description	Word N0 to N2 applied for channel 1.			
	• **Word N0**	Acceleration profile for channel 1. - [0 = step][1 = triangle][2 = trapezoidal or parabolic] - This parameter can also be accessed (R/W) via E11013 - [0 = step][1 = triangular][-1 = trapezoidal or parabolic] - Min 0, Max 2, Default 0, Units N/A, Resolution N/A.		
	• **Word N1**	Minimal time to settle speed [case N0 =1] or to settle maximal acceleration [case N0=2]. - This parameter can also be accessed (R/W) via E32006 - Min 0, Max 65535 Default 100, Units ms, Resolution 1ms.		
	• **Word N2**	Time to settle jerk [case N0 = 2]. Generally set to N1/2 to get a trapezoidal jerk curve. - This parameter can also be accessed (R/W) via E32008 - Min 0, Max 65535, Default 0, Units ms, Resolution 1ms.		
	Note	The Word N3-N5, N6- N8, N9-N11, N12-N14, N15-N17, N18-N20, N21-N23: Identical to Word N0- N2 respectively but relative to the other channels.		

Recommendations

The trapezoidal acceleration profile is defined by parameter P53 N2 (assuming N0 = 1 and N1 <> 0.

This jerk profile allows faster speed buildups and stopping, especially for high speeds of movement (e.g. positioning blocks).

It allows a speed buildup profile with gradual acceleration and deceleration especially well-suited to high speed cutting (HSC) by:

- Decreasing mechanical jerks and stresses on the machine
- Decreasing profile errors and synchronization errors.

P53 N2 (or E32008) is adjustable between 0 and (P53 N1) / 2:

- If P53 N2 = 0, the jerk profile is constant by segments, which produces a trapezoidal acceleration.
- If P53 N2 = (P53 N1) / 2, the jerk profile is a saw-tooth, which produces a parabolic acceleration by segments.

It is recommended to set:

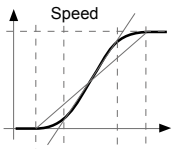
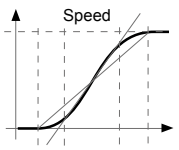
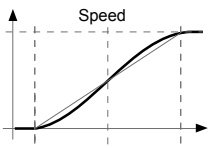
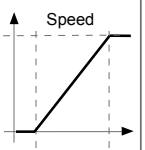
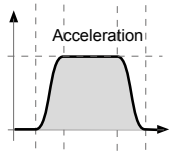
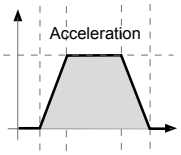
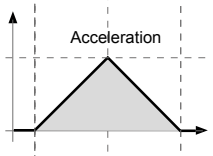
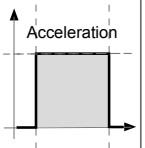
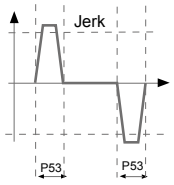
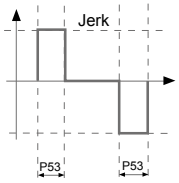
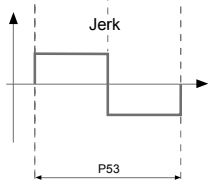
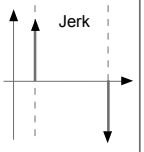
- Parameter P53 N1 to two or three times the position loop time constant (P56), and
- Parameter P53 N2 between (P53 N1) / 3 and (P53 N1) / 2.

Smoothing the acceleration buildup profile (increasing P53 N1 and N2) increases the speed buildup time.

To reduce the machining time, it is often preferable to increase the maximum acceleration (P32) within the limit of the machine performance rather than increasing the jerk.

Trapezoidal acceleration cannot be used with sequenced thread cutting.

In G38, E11013 is forced to 0. It is necessary to reset E11013 to -1 after thread cutting. In G33, trapezoidal acceleration is cancelled during the cycle, but is resumed automatically at the end.

Word N0	**2**	**2**	**1**	**0**
Word N1	**Z ms**	**Y ms**	**X ms**	**-**
Word N2	**Z/3 ms**	**0**	**-**	**-**
Speed curve				
Acceleration curve				
Jerk Curve				
Role of P53	P53 sets the acceleration buildup time		P53 sets the minimum speed buildup time	P53 is not significant
Acceleration	The maximum acceleration P32 is reached for a long time, giving a short speed buildup time.		The maximum acceleration P32 is reached only for a very short time	The speed buildup time is at minimum level
Calculation of $J_{MAX\ AXE}$	$J_{MAX\ AXIS} = \frac{P32_{AXIS}}{P53 - E32008}$	$J_{MAX\ AXIS} = \frac{P32_{AXIS}}{P53}$	$J_{MAX\ AXIS\ maximum} = \frac{2 \times P32_{AXIS}}{P53}$	–
Type of Jerk	The shape and level of the trapezoidal jerk can be set	The square jerk has a constant level which can be set	The jerk is square but the jerk level varies according to the geometric profile and the speed variations required	The jerk level is very high (theoretically infinite)
Type of machine	HSC	HSC	HSC	Conventional

Example	• Channel 1:Parabolic acceleration – acceleration buildup 30 ms, jerk buildup 10 ms • Channel 2: Trapezoidal acceleration – Acceleration buildup 40 ms • Channel 3: constant acceleration.

P53 (Acceleration profile)

Name	Value	Unit	Description	Min	Max	Default
N0	2	[]	Acceleration profile for channel 1 [0=Step] [1=Triangular] [2=Trapezoidal]	0	2	0
N1	30	ms	Time minimal to settle speed (N0=1) or time to settle maximal acceleration (N0=2) for channel 1	0	65535	100
N2	10	ms	Time to settle jerk (only if N0=2) for channel 1	0	65535	0
N3	2	[]	Acceleration profile for channel 2 [0=Step] [1=Triangular] [2=Trapezoidal]	0	2	0
N4	40	ms	Time minimal to settle speed (N0=1) or time to settle maximal acceleration (N0=2) for channel 2	0	65535	100
N5	0	ms	Time to settle jerk (only if N0=2) for channel 2	0	65535	0
N6	0	[]	Acceleration profile for channel 3 [0=Step] [1=Triangular] [2=Trapezoidal]	0	2	0
N7	100	ms	Time minimal to settle speed (N0=1) or time to settle maximal acceleration (N0=2) for channel 3	0	65535	100
N8	0	ms	Time to settle jerk (only if N0=2) for channel 3	0	65535	0

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Summary

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9 Performances

This set of parameters is used to adjust the performances of the axes.

This category contains the following parameters:

P19	High Speed Cutting: Feed-forward acceleration time constant - Dry friction correction time constant
P20	Dry friction correction amplitude
P33	Approach speed
P55	Speed anticipation coefficient - High Speed Cutting: number of filter terms
P56	Channel specific time constant
P57	Dynamic lag control
P66	Time constant for axis

9.1 High speed cutting: Feed-forward acceleration time constant – Dry friction correction time constant ► P19

P19	High speed cutting: Feed-forward acceleration time constant – Dry friction correction time constant			
	Category	Performances	Format	Type 4
	Words	64	Units	µs
	Min	0	Max	Word dependent
	Default	Word dependent	Resolution	Word dependent
	Immediate	Yes	Access via	E981xx, E983xx
General	This parameter is used to set: - The acceleration anticipation for each axis, - The dry friction correction time constant for each axis.			
Description	The words refer to the physical address of each axis.			
	• **Word N0 to Word N31**	Feed-forward acceleration time constant for axis @0 to @31 Each word corresponds to the physical address of an axis. The acceleration anticipation is expressed in µs. The order of magnitude is 400 µs. The speed anticipation corrector "Kv" is set to 100 percent and cannot be modified. Min 0, Max 65535, Default 400, Resolution 1 Unit µs. These words can also be accessed (RW) via external parameter E981xx.		
	• **Word N32 to Word N63**	Dry friction correction time constant for axis @0 to @31 Each word corresponds to the physical address of an axis. The dry friction correction time constant is expressed in micro-seconds. The order of magnitude is 50000 µs. Min 0, Max 655350, Default 50000, Resolution 1, Units µs. These words can also be accessed via external parameter E983xx.		
Example	• Default values.			

P19 (High Speed Cutting: Feed-forward acceleration time constant - Dry friction correction time constant)

Name	Value	Unit	Description	Min	Max	Default
N0	400	µs	Feed-forward acceleration time constant for axis @0	0	65535	400
N1	400	µs	Feed-forward acceleration time constant for axis @1	0	65535	400
N2	400	µs	Feed-forward acceleration time constant for axis @2	0	65535	400
N3	400	µs	Feed-forward acceleration time constant for axis @3	0	65535	400
N4	400	µs	Feed-forward acceleration time constant for axis @4	0	65535	400
N5	400	µs	Feed-forward acceleration time constant for axis @5	0	65535	400
N6	400	µs	Feed-forward acceleration time constant for axis @6	0	65535	400
N7	400	µs	Feed-forward acceleration time constant for axis @7	0	65535	400
N28	400	µs	Feed-forward acceleration time constant for axis @28	0	65535	400
N29	400	µs	Feed-forward acceleration time constant for axis @29	0	65535	400
N30	400	µs	Feed-forward acceleration time constant for axis @30	0	65535	400
N31	400	µs	Feed-forward acceleration time constant for axis @31	0	65535	400
N32	50000	µs	Dry friction correction time constant for axis @0	0	655350	50000
N33	50000	µs	Dry friction correction time constant for axis @1	0	655350	50000
N14	400	µs	Feed-forward acceleration time constant for axis @14	0	65535	400

9.2 Dry friction compensation amplitude ► P20

P20	Dry friction compensation amplitude			
	Category	Performances	Format	Type 10
	Words	32	Units	mm / °
	Min	-65.0	Max	65.0
	Default	0	Resolution	10-6 mm
	Immediate	Yes	Access via	E982xx
General	This parameter is used to set the amplitude of the pulse generated at each quadrant change in circular interpolation. It is linked to P19.			
Description	The words refer to the physical address of each axis.			
	• **Word N0 to Word N31**	Dry friction correction amplitude for axis @0 to @31 The order of magnitude is 10 µm. These words can also be accessed (RW) via external parameter E982xx.		
Example	• Default values.			

P20 (Dry friction correction amplitude)

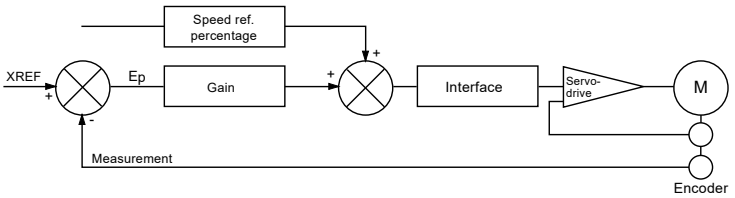
Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm	Dry friction correction amplitude for axis @0	-65.0	65.0	0.0
N1	0.0	mm	Dry friction correction amplitude for axis @1	-65.0	65.0	0.0
N2	0.0	mm	Dry friction correction amplitude for axis @2	-65.0	65.0	0.0
N3	0.0	mm	Dry friction correction amplitude for axis @3	-65.0	65.0	0.0
N4	0.0	mm	Dry friction correction amplitude for axis @4	-65.0	65.0	0.0
N5	0.0	mm	Dry friction correction amplitude for axis @5	-65.0	65.0	0.0
N6	0.0	°	Dry friction correction amplitude for axis @6	-65.0	65.0	0.0
N7	0.0	°	Dry friction correction amplitude for axis @7	-65.0	65.0	0.0
N8	0.0	°	Dry friction correction amplitude for axis @8	-65.0	65.0	0.0

P33	Approach speed			
	Category	Performances	Format	Type 10
	Words	32	Units	mm /min , ° /min
	Min	0	Max	999999999
	Default	0	Resolution	1
	Immediate	Yes	Access via	E973xx
General	Specifies the maximum speed variation when passing from one block to another.			
Description	• **Word N0**	Approach speed for axis @0 Each word corresponds to the physical address of an axis. The value is expressed in mm/min or in deg/min. The default value is 0. The approach speed is defined by the equation: $P33 = \gamma * \tau$ where: - γ is the maximum permissible acceleration in mm/s² or deg/s² (P32). - τ is the servo-loop time constant in ms (P56). If high speed machining is active the value of P33 should be about 9 times smaller. Worning: For virtual axis the value 0 doesn't enable the automatic computation.		
Example	Where γ = 1000 mm/s² and τ = 60 ms, we have: P33 = 60 mm/s = 3600 mm/min			

P33 (Approach speed)

Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm/min	Approach speed for axis @0	0.0	99999999.0	0.0
N1	0.0	mm/min	Approach speed for axis @1	0.0	99999999.0	0.0
N2	0.0	mm/min	Approach speed for axis @2	0.0	99999999.0	0.0
N3	0.0	mm/min	Approach speed for axis @3	0.0	99999999.0	0.0
N4	0.0	mm/min	Approach speed for axis @4	0.0	99999999.0	0.0
N5	0.0	mm/min	Approach speed for axis @5	0.0	99999999.0	0.0
N6	0.0	°/min	Approach speed for axis @6	0.0	99999999.0	0.0

9.4 Speed anticipation coefficient – High Speed Cutting: number of filter terms ► P55

P55	Speed anticipation coefficient – High Speed Cutting: number of filter terms			
	Category	Performances	Format	Type 5
	Words	16	Units	%, None
	Min	0	Max	Word dependent
	Default	Word dependent	Resolution	Word dependent
	Immediate	Yes	Access via	E32005
General	This parameter is used for **H**igh **S**peed **C**utting (HSC). It has two functions: Define the percentage of the speed reference re-injected in the position servo-loop so that it operates with a small following error, for words N0 to N7, The number of terms used to calculate the filtered reference for very high speed machining, in words .			
Description	Each word represents a channel.			
	• **Word N0 to Word N7**	Speed anticipation percentage for channel 1 to Channel 8 Speed reference correction expressed as a percentage between 0 and 100. If a value higher than 100 is set in P55, the system will clamp the correction to 100% If HSC is active the value is internally forced at 100% but the parameter should be set at 0 (to prevent overshoots). A value of zero has no effect on the system. Min 0, Max 100, Default 0, resolution 1, Units %.  			
	• **Word N8 to Word N15**	Number of filter terms for channel 1 to channel 8 Used when HSC is active. For high speed machining, a filter smooth the speed reference. This filter averages several consecutive reference values. Words N8 to N15 define the number of terms of this filter: The number should be odd (in case of even number the CNC will use the next odd number. A standard value for these words is 5 To enable HSC and Anti Pitch correction these words should have a non-zero value. These words can be accessed (RW) via parameter E32005. This parameter can be read and written and retains the last value programmed after a reset. It can be written if: - The high-speed machining option is present; otherwise error 4 is declared. - Anticipation is disabled (E11012 = 0), otherwise error 95 is returned. - Its value is less than 14; otherwise error 94 is declared. Min 0, Max 13, Default 0, resolution 1, Units None.			

Example	• Channel 1 : speed anticipation 100%, Filter with 5 terms. • Channel 2 : No HSC but speed anticipation 80%.

P55 (Speed anticipation coefficient - High Speed Cutting: number of filter terms)

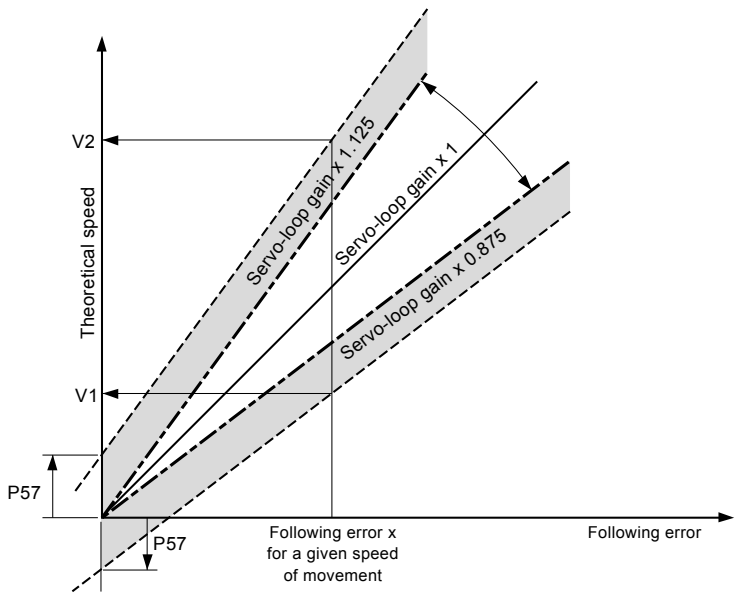
Name	Value	Unit	Description	Min	Max	Default
N0	100	%	Speed anticipation percentage for channel 1	0	100	0
N1	80	%	Speed anticipation percentage for channel 2	0	100	0
N2	0	%	Speed anticipation percentage for channel 3	0	100	0
N3	0	%	Speed anticipation percentage for channel 4	0	100	0
N4	0	%	Speed anticipation percentage for channel 5	0	100	0
N5	0	%	Speed anticipation percentage for channel 6	0	100	0
N6	0	%	Speed anticipation percentage for channel 7	0	100	0
N7	0	%	Speed anticipation percentage for channel 8	0	100	0
N8	5	[]	Number of filter terms for channel 1	0	13	0
N9	0	[]	Number of filter terms for channel 2	0	13	0
N10	0	[]	Number of filter terms for channel 3	0	13	0
N11	0	[]	Number of filter terms for channel 4	0	13	0
N12	0	[]	Number of filter terms for channel 5	0	13	0
N13	0	[]	Number of filter terms for channel 6	0	13	0
N14	0	[]	Number of filter terms for channel 7	0	13	0
N15	0	[]	Number of filter terms for channel 8	0	13	0

9.5 Channel specific time constant ► P56

P56	Channel specific time constant			
	Category	Performances	Format	Type 4
	Words	8	Units	µs
	Min	2	Max	2500000
	Default	60000	Resolution	1
	Immediate	Yes	Access via	E41006
General	Defines the position servo-loop time constant.			
Description	Each word corresponds to a channel.			
	• **Word N0**	Time constant for channel 1 - The time constant is defined by the following equation: T = 60000 / Gain (in µs) - The value is in µs with a basic value of 60000 µm <-> gain of 1. - This parameter is used for dynamic movement control and speed control at the end of a block. The value applies for all axes of the channel except for axes where a specific time constant will be defined by P66. If P66 of a particular axis is non zero its value will supersede P56 for this axis channel.		
Example	• Channel 1: gain of 2 other channels gain of 1			

P56 (Channel specific time constant)

Name	Value	Unit	Description	Min	Max	Default
N0	60000	µs	Time constant for channel 1	2	2500000	60000
N1	60000	µs	Time constant for channel 2	2	2500000	60000
N2	60000	µs	Time constant for channel 3	2	2500000	60000
N3	60000	µs	Time constant for channel 4	2	2500000	60000
N4	60000	µs	Time constant for channel 5	2	2500000	60000
N5	60000	µs	Time constant for channel 6	2	2500000	60000
N6	60000	µs	Time constant for channel 7	2	2500000	60000
N7	60000	µs	Time constant for channel 8	2	2500000	60000

P57	Dynamic lag control			
	Category	Performances	Format	Type 10
	Words	32	Units	mm/min, °/min
	Min	0	Max	999999999
	Default	0	Resolution	10-6
	Immediate	Yes	Access via	N/A
General	This parameter is used to compare the real speed of the axis (deduced from the lag value) versus the theoretical speed. If a deviation is found, the system will generated error 40 to 71 according to the axis considered.			
Description	Each word is associated with the axis physical address.			
	• **Word N0**	Dynamic lag control for axis @0 For a correct use of the settings of this parameter, the position servo-loop time constants must be accurately specified in parameter P56. A value of zero in a word disables dynamic control on the corresponding axis. The system surrounds the theoretical Lag vs Speed curve by two lines whose slope is +/- 12.5 %. If the real following error is out of this surrounding an error will be triggered.  		
	• **Word N1 to Word N31**	To be efficient the value of P57 must be small enough not to trigger an error in normal conditions. If errors are triggered too often, verify the settings of P56 and/or P66 matches accurately the gain setting if the machine. Dynamic movement control can be modified by the ENA function. A reset (CNC reset) resets the CNC to the state specified by P57.		

Example

- Control active on axes 0 1 and 2.

P57 (Dynamic lag control)

Name	Value	Unit	Description	Min	Max	Default
N0	1.0	mm/min	Dynamic lag control for axis @0	0.0	99999999.0	0.0
N1	1.0	mm/min	Dynamic lag control for axis @1	0.0	99999999.0	0.0
N2	1.0	mm/min	Dynamic lag control for axis @2	0.0	99999999.0	0.0
N3	0.0	mm/min	Dynamic lag control for axis @3	0.0	99999999.0	0.0
N4	0.0	mm/min	Dynamic lag control for axis @4	0.0	99999999.0	0.0
N5	0.0	mm/min	Dynamic lag control for axis @5	0.0	99999999.0	0.0
N6	0.0	°/min	Dynamic lag control for axis @6	0.0	99999999.0	0.0
N7	0.0	°/min	Dynamic lag control for axis @7	0.0	99999999.0	0.0
N8	0.0	°/min	Dynamic lag control for axis @8	0.0	99999999.0	0.0
N9	0.0	mm/min	Dynamic lag control for axis @9	0.0	99999999.0	0.0
N10	0.0	mm/min	Dynamic lag control for axis @10	0.0	99999999.0	0.0
N11	0.0	mm/min	Dynamic lag control for axis @11	0.0	99999999.0	0.0
N12	0.0	mm/min	Dynamic lag control for axis @12	0.0	99999999.0	0.0
N13	0.0	mm/min	Dynamic lag control for axis @13	0.0	99999999.0	0.0

9.7 Time constant per axis ► P66

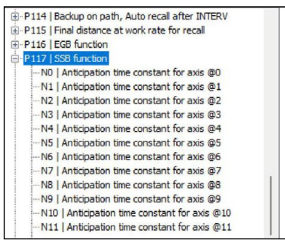
P66	Time constant per axis			
	Category	Performances	Format	Type 4
	Words	32	Units	µs
	Min	2	Max	2500000
	Default	0	Resolution	1
	Immediate	No	Access via	N/A
General	Defines the position servo-loop time constant for each axis. If this value is no-zero it will supersede the value given by P56 for this particular axis .			
Description	Each word corresponds to the physical address of an axis.			
	• **Word N0**	Time constant for axis @0 - The time constant is defined by the following equation: T = 60000 / Gain (in µs) - The value is in µs with a basic value of 60000 µm <-> gain of 1 - This parameter is used for dynamic movement control and speed control at the end of a block.		
	• **Word N1 to Word N31**	Identical to N0 for axes @1 to @31.		
Example	• Axis 2: Gain of 1, other axes will get the gain defined in the channel.			

P66 (Time constant for axis)

Name	Value	Unit	Description	Min	Max	Default
N0	0	µs	Time constant for axis @0	0	2500000	0
N1	0	µs	Time constant for axis @1	0	2500000	0
N2	60000	µs	Time constant for axis @2	0	2500000	0
N3	0	µs	Time constant for axis @3	0	2500000	0
N4	0	µs	Time constant for axis @4	0	2500000	0
N5	0	µs	Time constant for axis @5	0	2500000	0
N6	0	µs	Time constant for axis @6	0	2500000	0
N7	0	µs	Time constant for axis @7	0	2500000	0
N8	0	µs	Time constant for axis @8	0	2500000	0
N9	0	µs	Time constant for axis @9	0	2500000	0
N10	0	µs	Time constant for axis @10	0	2500000	0
N11	0	µs	Time constant for axis @11	0	2500000	0
N12	0	µs	Time constant for axis @12	0	2500000	0
N13	0	µs	Time constant for axis @13	0	2500000	0
N14	0	µs	Time constant for axis @14	0	2500000	0
N15	0	µs	Time constant for axis @15	0	2500000	0
N16	0	µs	Time constant for axis @16	0	2500000	0

9.8 Smart Servo Balance (SSB) function ► P117

P117	SSB function			
	Category	Performances	Format	Type 5 (word)
	Words	95	Units	µs
	Min	2000 (N0-63) 0 (N64-95)	Max	65535
	Default	2000 (N0-63) 0 (N64-95)	Resolution	1
	Immediate	No	Access via	E98600 to E98631 (N0-31) E98632 to E98663 (N32-63) E92300 to E92331 (N64-95)
General	This parameter is used to set the SSB function, activation dependent on the parameter P120N12 (New as to 4.2.0.0 software version).			
Description	• **Word N00 to Word N31**	Anticipation time constant for axis @0 to @31		
	• **Word N32 to Word N63**	Delay time constant for axis @0 to @31		
	• **Word N64 to Word N95**	Acceleration anticipation time constant for axis @0 to @31		
Example				



Name	Value	Unit	Description	Min	Max	Default
N0	60000	µs	Anticipation time constant for axis @0	2000	2500000	2000
N1	60000	µs	Anticipation time constant for axis @1	2000	2500000	2000
N2	2000	µs	Anticipation time constant for axis @2	2000	2500000	2000
N3	2000	µs	Anticipation time constant for axis @3	2000	2500000	2000
N4	2000	µs	Anticipation time constant for axis @4	2000	2500000	2000
N5	2000	µs	Anticipation time constant for axis @5	2000	2500000	2000
N6	2000	µs	Anticipation time constant for axis @6	2000	2500000	2000
N7	2000	µs	Anticipation time constant for axis @7	2000	2500000	2000
N8	2000	µs	Anticipation time constant for axis @8	2000	2500000	2000
N9	2000	µs	Anticipation time constant for axis @9	2000	2500000	2000
N10	2000	µs	Anticipation time constant for axis @10	2000	2500000	2000

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Summary

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10 Spindle characteristics

This series of parameters groups the spindle characteristics. The different words always relate to the spindle Physical Address.

This category contains the following parameters:

P40	Number of sensor spindle pulses by revolution
P41	Spindle reference reversal (according to the range selected)
P42	Spindle origin
P43	Spindle indexing speed and spindle speed limits
P44	Spindle indexing in-position window
P45	Spindle indexing gain
P46	Speed range and max speed for spindles @0 ... @7
P47	Speed range and max speed for spindles @8 ... @15
P48	Speed range and max speed for spindles @16 ... @23
P49	Speed range and max speed for spindles @24 ... @31

10.1 Number of sensor spindle pulses by revolution ► P40

P40	Number of sensor spindle pulses by revolution			
	Category	Spindle characteristics	**Format**	Type 4
	Words	32	**Units**	N/A
	Min	0	**Max**	8388608 (2^23)
	Default	8000	**Resolution**	1
	Immediate	Yes	**Access via**	E90432, .., E90463

General

This parameter is used to define the number of measurement counts given by the spindle sensor, taking into account a multiplier of 4 for compatibility with TTL encoders.

The internal units for spindle measurement depend on the entered values.

The system automatically determines the spindle modulo (number of measurement units per revolution). The spindle modulo is the power of two just above or equal to the number of increments per encoder revolution.

The spindle modulo cannot be less than 4096.

In case of spindle and C axis switching this parameter defines the required spindle resolution (as the real precision comes form the C axis measurement unit).

For additional information please refer to the Flexium+ Comissioning Manual M00044.

Description

• **Word N0**	Number of sensor pulses for spindle @0
• **Word N1 to Word N31**	Identical to N0 for spindles @1 to @31.

Example

- Spindle @ 0 : J sensor (128 periods per revolutions if V306 / V307 = 1/1)
- Spindle @1 : TTL encoder 2500 counts/rev

Internal measurement

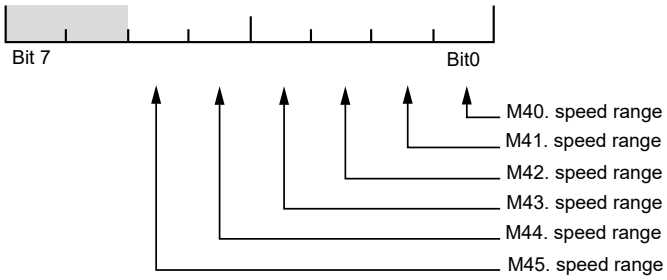
- Spindle @ 0 360/4096° Minimal value
- Spindle@ 1 360/16384° 16384 is the power of two immediately higher than 10000.

P40 (Number of sensor spindle pulses by revolution)

Name	Value	Unit	Description	Min	Max	Default
N0	512	[]	Number of sensor pulses for spindle @0	0	8388608	8000
N1	10000	[]	Number of sensor pulses for spindle @1	0	8388608	8000
N2	4000	[]	Number of sensor pulses for spindle @2	0	8388608	8000
N3	4000	[]	Number of sensor pulses for spindle @3	0	8388608	8000
N4	4000	[]	Number of sensor pulses for spindle @4	0	8388608	8000
N5	4000	[]	Number of sensor pulses for spindle @5	0	8388608	8000
N6	4000	[]	Number of sensor pulses for spindle @6	0	8388608	8000

10.2 Spindle reference reversal ► P41

P41	Spindle reference reversal			
	Category	Spindle characteristics	**Format**	Type 0
	Words	32	**Units**	N/A
	Min	0	**Max**	FF
	Default	0	**Resolution**	N/A
	Immediate	YES	**Access via**	N/A
General	This parameter is used to define the spindle direction according to the range selected to take into account the possibility of reversing the direction in some range.			
Description	Each word corresponds to a spindle address 0 to 31. Only bit 0 to 5 of each word are significant. The bits of each word are addressable by spindle ranges M40 to M45. The bit is set to 1 to indicate that the spindle reference is reversed in that particular range.			
	• **Word N0**	Spindle reference reversal for spindle @0		
	• **Word N1 to Word N31**	Identical to Word N0 for spindles @1 to @31		
Example	• Spindle @0 : Direction reversed in range M44 : Value of N0 = 10h			



P41N0 (Reference reversal for spindle @0)

Bit	Value	Description
0	☐	Speed range M40
1	☐	Speed range M41
2	☐	Speed range M42
3	☐	Speed range M43
4	☑	Speed range M44
5	☐	Speed range M45
6	☐	Not used
7	☐	Not used

10.3 Spindle origin ► P42

P42	Spindle origin			
	Category	Spindle characteristics	**Format**	Type 4
	Words	32	**Units**	Internal spindle Units
	Min	0	**Max**	999999999
	Default	0	**Resolution**	1
	Immediate	YES	**Access via**	N/A
General	This parameter defines the spindle origin in **Internal spindle Units** (see P40).			
Description	The words relate to the spindle physical address.			
	• **Word N0**	Value of the spindle @0 position effective on the zero sensor encountered during the first revolution.		
	• **Word N1 to Word N31**	Origin position for spindle @0 Identical to N0 but for spindles @1 to @31.		
Example	• Spindle @ 0 has 4096 internal counts – value 2048 sets the origin at 180°			

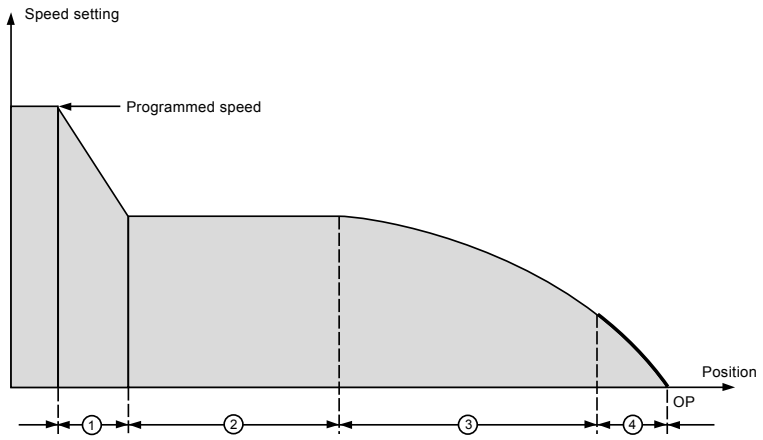
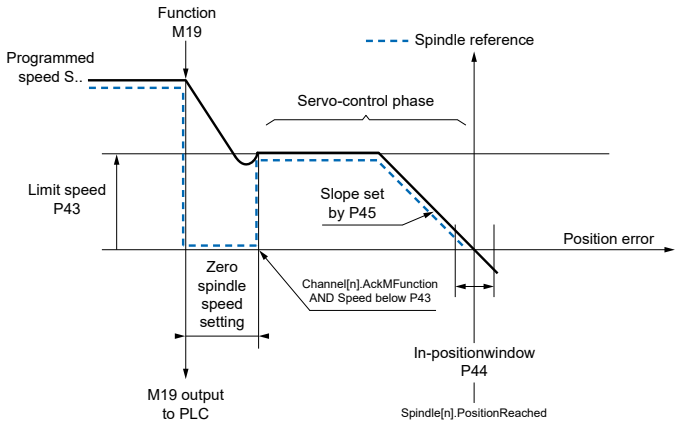
P42 (Spindle origins)

Name	Value	Unit	Description	Min	Max	Default
N0	2048	IU	Origin position for spindle @0	0	99999999	0
N1	0	IU	Origin position for spindle @1	0	99999999	0
N2	0	IU	Origin position for spindle @2	0	99999999	0
N3	0	IU	Origin position for spindle @3	0	99999999	0
N4	0	IU	Origin position for spindle @4	0	99999999	0
N5	0	IU	Origin position for spindle @5	0	99999999	0

10.4 Spindle indexing speed and spindle speed limits ► P43

P43	Spindle indexing speed and spindle speed limits			
	Category	Spindle characteristics	**Format**	Type 5
	Words	191	**Units**	Rpm (see description)
	Min	1	**Max**	65535
	Default	200	**Resolution**	1
	Immediate	Yes	**Access via**	E906xx
General	This parameter defines two types of spindle limit speeds: - Limit speed for indexing. - Speed limitation. N0-N 31 Speed for indexing N32-N63 Speed limit1 N64-N95 Speed limit2 N96-N127 Speed limit3 N128-N159 Speed limit4 N160-N191 Jog speed			
Description	The words are related to the spindle physical address. The speed unit depends about the spindle speed programming format.			

Format	Unit	Max speed
S3.2	Rpm/100	655.35
S5.0	Rpm	65535
S6.0	Rpm*10	655350

Description	• **Word N0**	Spindle indexing speed for spindle @0. This chart illustrates the indexing most commonly used : at controlled deceleration.  Indexing at constant deceleration : (1) The speed reference decreases along the deceleration slope (parameter P32) up to the limit speed. (2) The speed reference remains equal to the limit speed: - Until arriving in the deceleration region (if the *AckMFunction = 1*), and - As long as the PLC flag *AckMFunction = 0*. (3) The speed reference decreases to the indexing point along a deceleration slope with constant "gamma". This limit speed should be low enough so that the spindle can stop in less than 1/2 turn. (4) The servo-control gain is constant up to the indexing point. NB: For a good management of M19 it is necessary to manage the PLC flag *EndExtMovement* and keep it clear until the spindle is in position. Phases (3) and (4) are normally carried out within one spindle revolution. For light spindles it is possible to use an other algorithm slightly quicker but that could result in some shocks as the initial phase is conducted without controlled deceleration. This algorithm is maintained mostly for compatibilty and is alsmost not used anymore on machines. See picture below. 

Description	• **Word N1 to Word N31**	Identical to Word N0 for other spindle addresses
	• **Word N32**	First speed limit for spindle @0 It is possible to limit the spindle speed under certain conditions. This is triggered by the PLC variable *Flexium_NCK.WCNC.Axis[0..31]. SpeedLimit*. They are up to four possible limits. Word N32 and following define the first speed limit value.
	• **Word N33 to Word N63**	Identical to Word N32 for spindles addresses @1 to @31
	• **Word N64 to Word N95**	Identical to words N32 to N61 but for the second speed limit.
	• **Word N96 to Word N127**	Identical to words N32 to N61 but for the third speed limit.
	• **Word N128 to Word N159**	Identical to words N32 to N61 but for the fourth speed limit.
Example	• Spindle speed fort indexing	

P43 (Spindle indexing speed and speed limit by PLC)

Name	Value	Unit	Description	Min	Max	Default
N0	200	Rpm	Indexing speed for spindle @0	1	65535	200
N1	200	Rpm	Indexing speed for spindle @1	1	65535	200
N2	200	Rpm	Indexing speed for spindle @2	1	65535	200
N3	200	Rpm	Indexing speed for spindle @3	1	65535	200
N4	200	Rpm	Indexing speed for spindle @4	1	65535	200
N5	200	Rpm	Indexing speed for spindle @5	1	65535	200

• Spindle speed limit

P43 | Spindle indexing speed and speed limits

Name	Value	Unit	Description	Min	Max	Default
N29	200	Rpm	Indexing speed for spindle @29	1	65535	200
N30	200	Rpm	Indexing speed for spindle @30	1	65535	200
N31	200	Rpm	Indexing speed for spindle @31	1	65535	200
N32	1	Rpm	Speed limit 1 for spindle @0	1	65535	1
N33	1	Rpm	Speed limit 1 for spindle @1	1	65535	1
N34	1	Rpm	Speed limit 1 for spindle @2	1	65535	1
N35	1	Rpm	Speed limit 1 for spindle @3	1	65535	1
N36	1	Rpm	Speed limit 1 for spindle @4	1	65535	1
N37	1	Rpm	Speed limit 1 for spindle @5	1	65535	1

10.5 Spindle indexing in-position window ► P44

P44	Spindle indexing in-position window			
	Category	Spindle characteristics	**Format**	Type 5
	Words	32	**Units**	360° = 65535
	Min	1	**Max**	16384
	Default	10	**Resolution**	1
	Immediate	Yes	**Access via**	E906xx + 32
General	Defines the spindle servo-loop accuracy for spindles.			
Description	The values are expressed in 1/65535 of a turn. They related to the spindle physical address.			
	• **Word N0**	In-position window for spindle @0 indexing.		
	• **Word N1 to Word N31**	Identical to Word N0 for spindles @1 to @31.		
Example	• With default values			

P44 (Spindle indexing in-position window)

Name	Value	Unit	Description	Min	Max	Default
N0	183	IU	In-position window in indexing for spindle @0	1	16384	183
N1	183	IU	In-position window in indexing for spindle @1	1	16384	183
N2	183	IU	In-position window in indexing for spindle @2	1	16384	183
N3	183	IU	In-position window in indexing for spindle @3	1	16384	183
N4	183	IU	In-position window in indexing for spindle @4	1	16384	183
N5	183	IU	In-position window in indexing for spindle @5	1	16384	183

10.6 Spindle indexing gain ► P45

P45	**Spindle indexing gain**			
	Category	Spindle characteristics	**Format**	Type 5
	Words	32	**Units**	1/min
	Min	1	**Max**	65535
	Default	1000	**Resolution**	1
	Immediate	Yes	**Access via**	E90664 to E90695
General	Define the spindle indexing gain (value x 1000). See graphic below.			
Description	The words are related to the spindle physical address.			
	• **Word N0**	Indexing gain for spindle @0 Please refer to the P43N0 drawing in the previuos pages.		
	• **Word N1 to Word N31**	Identical to Word N0 for spindles @1 to @31		
Example	• With default values			

P45 (Spindle indexing gain)

Name	Value	Unit	Description	Min	Max	Default
N0	1000	1/min	Indexing gain for spindle @0	1	65535	1000
N1	1000	1/min	Indexing gain for spindle @1	1	65535	1000
N2	1000	1/min	Indexing gain for spindle @2	1	65535	1000
N3	1000	1/min	Indexing gain for spindle @3	1	65535	1000
N4	1000	1/min	Indexing gain for spindle @4	1	65535	1000
N5	1000	1/min	Indexing gain for spindle @5	1	65535	1000

10.7 Speed range for spindles @0 ... @7 ► P46

P46	Speed range for spindles @0 ... @7			
	Category	Spindle characteristics	**Format**	Type 5
	Words	144	**Units**	Rpm (see description)
	Min	0	**Max**	65535
	Default	0	**Resolution**	1
	Immediate	Yes	**Access via**	N/A
General	This parameter is used to define the limits of each programmed range as well as the maximum speed in each range. It is used to calculate the range to select according to the speed (the search direction is defined in parameter P7). It is also used to verify that range and speed are compatible is expressly programmed. The max of the range is used to compute the reference sent to the drive whereas the limit will clamp the value.			
Description	The speed unit depends about the speed programming format:			

Format	Unit	Max speed
S3.2	Rpm/100	655.35
S5.0	Rpm	65535
S6.0	Rpm*10	655350

• **Word N0**	Minimum speed in range M40 for spindle @0.
• **Word N1**	Maximum range M40 for spindle @0. This is the theoretical spindle speed when the motor is running at its maximum rpm.
• **Word N12**	Limit speed in range M40 for spindle @0. If Zero the limit speed is the max speed of the range.
• **Word xxx**	**N2, N3, N13** : Identical for spindle @0 in M41 **N4, N5, N14** : Identical for spindle @0 in M42 **N6, N7, N15** : Identical for spindle @0 in M43 **N8, N9, N16** : Identical for spindle @0 in M44 **N10, N11, N17** : Identical for spindle @0 in M45 **N18, N19, N30** : Identical for spindle @1 in M40 **N20, N21, N31** : Identical for spindle @1 in M41 **N22, N23, N32** : Identical for spindle @1 in M42 **N24, N25, N33** : Identical for spindle @1 in M43 **N26, N27, N34** : Identical for spindle @1 in M44 **N28, N29, N35** : Identical for spindle @1 in M45

Description	• **Word xxx**	**N36, N37, N48** : Identical for spindle @2 in M40 **N38, N39, N49** : Identical for spindle @2 in M41 **N40, N41, N50** : Identical for spindle @2 in M42 **N42, N43, N51** : Identical for spindle @2 in M43 **N44, N45, N52** : Identical for spindle @2 in M44 **N46, N47, N53** : Identical for spindle @2 in M45 **N54, N55, N66** : Identical for spindle @3 in M40 **N56, N57, N67** : Identical for spindle @3 in M41 **N58, N59, N68** : Identical for spindle @3 in M42 **N60, N61, N69** : Identical for spindle @3 in M43 **N62, N63, N70** : Identical for spindle @3 in M44 **N64, N65, N71** : Identical for spindle @3 in M45 **N72, N73, N84** : Identical for spindle @4 in M40 **N74, N75, N85** : Identical for spindle @4 in M41 **N76, N77, N86** : Identical for spindle @4 in M42 **N78, N79, N87** : Identical for spindle @4 in M43 **N80, N81, N88** : Identical for spindle @4 in M44 **N82, N83, N89** : Identical for spindle @4 in M45 **N90, N91, N102** : Identical for spindle @5 in M40 **N92, N93, N103** : Identical for spindle @5 in M41 **N94, N95, N104** : Identical for spindle @5 in M42 **N96, N97, N105** : Identical for spindle @5 in M43 **N98, N99, N106** : Identical for spindle @5 in M44 **N100, N101, N107** : Identical for spindle @5 in M45 **N108, N109, N120** : Identical for spindle @6 in M40 **N110, N111, N121** : Identical for spindle @6 in M41 **N112, N113, N122** : Identical for spindle @6 in M42 **N114, N115, N123** : Identical for spindle @6 in M43 **N116, N117, N124** : Identical for spindle @6 in M44 **N118, N118, N125** : Identical for spindle @6 in M45 **N126, N127, N138** : Identical for spindle @7 in M40 **N128, N129, N139** : Identical for spindle @7 in M41 **N130, N131, N140** : Identical for spindle @7 in M42 **N132, N133, N141** : Identical for spindle @7 in M43 **N134, N135, N142** : Identical for spindle @7 in M44 **N136, N137, N143** : Identical for spindle @7 in M45

Example	• Spindle @ 0 • Range M40 : 5 to 500 – Limit 500 • Range M41 : 100 to 6000 – Limit 4000

P46 (Speed range for spindles @0 ... @7)

Name	Value	Unit	Description	Min	Max	Default
N0	5	Rpm	Min speed of range M40 for spindle @0	0	65535	0
N1	500	Rpm	Max speed of range M40 for spindle @0	0	65535	6000
N2	100	Rpm	Min speed of range M41 for spindle @0	0	65535	0
N3	6000	Rpm	Max speed of range M41 for spindle @0	0	65535	0
N4	0	Rpm	Min speed of range M42 for spindle @0	0	65535	0
N5	0	Rpm	Max speed of range M42 for spindle @0	0	65535	0
N6	0	Rpm	Min speed of range M43 for spindle @0	0	65535	0
N7	0	Rpm	Max speed of range M43 for spindle @0	0	65535	0
N8	0	Rpm	Min speed of range M44 for spindle @0	0	65535	0
N9	0	Rpm	Max speed of range M44 for spindle @0	0	65535	0
N10	0	Rpm	Min speed of range M45 for spindle @0	0	65535	0
N11	0	Rpm	Max speed of range M45 for spindle @0	0	65535	0
N12	500	Rpm	Limit speed of range M40 for spindle @0	0	65535	0
N13	4000	Rpm	Limit speed of range M41 for spindle @0	0	65535	0
N14	0	Rpm	Limit speed of range M42 for spindle @0	0	65535	0
N15	0	Rpm	Limit speed of range M43 for spindle @0	0	65535	0
N16	0	Rpm	Limit speed of range M44 for spindle @0	0	65535	0

10.8 Speed range for spindles @8 ... @15 ► P47

P47	Speed range for spindles @8 ... @15			
	Category	Spindle characteristics	**Format**	Type 5
	Words	144	**Units**	Rpm (see description)
	Min	0	**Max**	65535
	Default	0	**Resolution**	1
	Immediate	Yes	**Access via**	N/A

General

This parameter is identical to P46 except that it concerns spindles @8 to @15.

This parameter is used to define the limits of each programmed range as well as the maximum speed in each range.

It is used to calculate the range to select according to the speed (the search direction is defined in parameter P7). It is also used to verify that range and speed are compatible is expressly programmed.

The max of the range is used to compute the reference sent to the drive whereas the limit will clamp the value.

Description

The speed unit depends about the speed programming format:

Format	Unit	Max speed
S3.2	Rpm/100	655.35
S5.0	Rpm	65535
S6.0	Rpm*10	655350

• **Word N0**	Minimum speed in range M40 for spindle @8
• **Word N1**	Maximum range M40 for spindle @8 This is the theoretical spindle speed when the motor is running at its maximum rpm.
• **Word N12**	Limit speed in range M40 for spindle @8 If Zero the limit speed is the max speed of the range.
• **Word xxx**	**N2, N3, N13** : Identical for spindle @8 in M41 **N4, N5, N14** : Identical for spindle @8 in M42 **N6, N7, N15** : Identical for spindle @8 in M43 **N8, N9, N16** : Identical for spindle @8 in M44 **N10, N11, N17** : Identical for spindle @8 in M45 **N18, N19, N30** : Identical for spindle @9 in M40 **N20, N21, N31** : Identical for spindle @9 in M41 **N22, N23, N32** : Identical for spindle @9 in M42 **N24, N25, N33** : Identical for spindle @9 in M43 **N26, N27, N34** : Identical for spindle @9 in M44 **N28, N29, N35** : Identical for spindle @9 in M45

Description	• **Word xxx**	**N36, N37, N48** : Identical for spindle @10 in M40 **N38, N39, N49** : Identical for spindle @10 in M41 **N40, N41, N50** : Identical for spindle @10 in M42 **N42, N43, N51** : Identical for spindle @10 in M43 **N44, N45, N52** : Identical for spindle @10 in M44 **N46, N47, N53** : Identical for spindle @10 in M45 **N54, N55, N66** : Identical for spindle @11 in M40 **N56, N57, N67** : Identical for spindle @11 in M41 **N58, N59, N68** : Identical for spindle @11 in M42 **N60, N61, N69** : Identical for spindle @11 in M43 **N62, N63, N70** : Identical for spindle @11 in M44 **N64, N65, N71** : Identical for spindle @11 in M45 **N72, N73, N84** : Identical for spindle @12 in M40 **N74, N75, N85** : Identical for spindle @12 in M41 **N76, N77, N86** : Identical for spindle @12 in M42 **N78, N79, N87** : Identical for spindle @12 in M43 **N80, N81, N88** : Identical for spindle @12 in M44 **N82, N83, N89** : Identical for spindle @12 in M45 **N90, N91, N102** : Identical for spindle @13 in M40 **N92, N93, N103** : Identical for spindle @13 in M41 **N94, N95, N104** : Identical for spindle @13 in M42 **N96, N97, N105** : Identical for spindle @13 in M43 **N98, N99, N106** : Identical for spindle @13 in M44 **N100, N101, N107** : Identical for spindle @13 in M45 **N108, N109, N120** : Identical for spindle @14 in M40 **N110, N111, N121** : Identical for spindle @14 in M41 **N112, N113, N122** : Identical for spindle @14 in M42 **N114, N115, N123** : Identical for spindle @14 in M43 **N116, N117, N124** : Identical for spindle @14 in M44 **N118, N118, N125** : Identical for spindle @14 in M45 **N126, N127, N138** : Identical for spindle @15 in M40 **N128, N129, N139** : Identical for spindle @15 in M41 **N130, N131, N140** : Identical for spindle @15 in M42 **N132, N133, N141** : Identical for spindle @15 in M43 **N134, N135, N142** : Identical for spindle @15 in M44 **N136, N137, N143** : Identical for spindle @15 in M45

10.9 Speed range for spindles @16 ... @23 ► P48

P48	Speed range for spindles @16 ... @23			
	Category	Spindle characteristics	**Format**	Type 5
	Words	144	**Units**	Rpm (see description)
	Min	0	**Max**	65535
	Default	0	**Resolution**	1
	Immediate	Yes	**Access via**	N/A

General

This parameter is identical to P46 except that it concerns spindles @16 to @23

This parameter is used to define the limits of each programmed range as well as the maximum speed in each range.

It is used to calculate the range to select according to the speed (the search direction is defined in parameter P7). It is also used to verify that range and speed are compatible is expressly programmed.

The max of the range is used to compute the reference sent to the drive whereas the limit will clamp the value.

Description

The speed unit depends about the speed programming format:

Format	Unit	Max speed
S3.2	Rpm/100	655.35
S5.0	Rpm	65535
S6.0	Rpm*10	655350

- **Word N0**: Minimum speed in range M40 for spindle @16
- **Word N1**: Maximum range M40 for spindle @16
  This is the theoretical spindle speed when the motor is running at its maximum rpm.
- **Word N12**: Limit speed in range M40 for spindle @16
  If Zero the limit speed is the max speed of the range.
- **Word xxx**:
  N2, N3, N13 : Identical for spindle @16 in M41
  N4, N5, N14 : Identical for spindle @16 in M42
  N6, N7, N15 : Identical for spindle @16 in M43
  N8, N9, N16 : Identical for spindle @16 in M44
  N10, N11, N17 : Identical for spindle @16 in M45

  N18, N19, N30 : Identical for spindle @17 in M40
  N20, N21, N31 : Identical for spindle @17 in M41
  N22, N23, N32 : Identical for spindle @17 in M42
  N24, N25, N33 : Identical for spindle @17 in M43
  N26, N27, N34 : Identical for spindle @17 in M44
  N28, N29, N35 : Identical for spindle @17 in M45

Description	• **Word xxx**	**N36, N37, N48** : Identical for spindle @18 in M40 **N38, N39, N49** : Identical for spindle @18 in M41 **N40, N41, N50** : Identical for spindle @18 in M42 **N42, N43, N51** : Identical for spindle @18 in M43 **N44, N45, N52** : Identical for spindle @18 in M44 **N46, N47, N53** : Identical for spindle @18 in M45 **N54, N55, N66** : Identical for spindle @19 in M40 **N56, N57, N67** : Identical for spindle @19 in M41 **N58, N59, N68** : Identical for spindle @19 in M42 **N60, N61, N69** : Identical for spindle @19 in M43 **N62, N63, N70** : Identical for spindle @19 in M44 **N64, N65, N71** : Identical for spindle @19 in M45 **N72, N73, N84** : Identical for spindle @20 in M40 **N74, N75, N85** : Identical for spindle @20 in M41 **N76, N77, N86** : Identical for spindle @20 in M42 **N78, N79, N87** : Identical for spindle @20 in M43 **N80, N81, N88** : Identical for spindle @20 in M44 **N82, N83, N89** : Identical for spindle @20 in M45 **N90, N91, N102** : Identical for spindle @21 in M40 **N92, N93, N103** : Identical for spindle @21 in M41 **N94, N95, N104** : Identical for spindle @21 in M42 **N96, N97, N105** : Identical for spindle @21 in M43 **N98, N99, N106** : Identical for spindle @21 in M44 **N100, N101, N107** : Identical for spindle @21 in M45 **N108, N109, N120** : Identical for spindle @22 in M40 **N110, N111, N121** : Identical for spindle @22 in M41 **N112, N113, N122** : Identical for spindle @22 in M42 **N114, N115, N123** : Identical for spindle @22 in M43 **N116, N117, N124** : Identical for spindle @22 in M44 **N118, N118, N125** : Identical for spindle @22 in M45 **N126, N127, N138** : Identical for spindle @23 in M40 **N128, N129, N139** : Identical for spindle @23 in M41 **N130, N131, N140** : Identical for spindle @23 in M42 **N132, N133, N141** : Identical for spindle @23 in M43 **N134, N135, N142** : Identical for spindle @23 in M44 **N136, N137, N143** : Identical for spindle @23 in M45

10.10 Speed range for spindles @24 ... @31 ► P49

P49	Speed range for spindles @24 ... @31			
	Category	Spindle characteristics	**Format**	Type 5
	Words	144	**Units**	Rpm (see description)
	Min	0	**Max**	65535
	Default	0	**Resolution**	1
	Immediate	Yes	**Access via**	N/A

General

This parameter is identical to P46 except that it concerns spindles @24 to @31.

This parameter is used to define the limits of each programmed range as well as the maximum speed in each range.

It is used to calculate the range to select according to the speed (the search direction is defined in parameter P7). It is also used to verify that range and speed are compatible is expressly programmed.

The max of the range is used to compute the reference sent to the drive whereas the limit will clamp the value.

Description

The speed unit depends about the speed programming format:

Format	Unit	Max speed
S3.2	Rpm/100	655.35
S5.0	Rpm	65535
S6.0	Rpm*10	655350

- **Word N0**: Minimum speed in range M40 for spindle @24
- **Word N1**: Maximum range M40 for spindle @24
  This is the theoretical spindle speed when the motor is running at its maximum rpm.
- **Word N12**: Limit speed in range M40 for spindle @24
  If Zero the limit speed is the max speed of the range.
- **Word xxx**:
  N2, N3, N13 : Identical for spindle @24 in M41
  N4, N5, N14 : Identical for spindle @24 in M42
  N6, N7, N15 : Identical for spindle @24 in M43
  N8, N9, N16 : Identical for spindle @24 in M44
  N10, N11, N17 : Identical for spindle @24 in M45

  N18, N19, N30 : Identical for spindle @25 in M40
  N20, N21, N31 : Identical for spindle @25 in M41
  N22, N23, N32 : Identical for spindle @25 in M42
  N24, N25, N33 : Identical for spindle @25 in M43
  N26, N27, N34 : Identical for spindle @25 in M44
  N28, N29, N35 : Identical for spindle @25 in M45

Description	• **Word xxx**	**N36, N37, N48** : Identical for spindle @26 in M40 **N38, N39, N49** : Identical for spindle @26 in M41 **N40, N41, N50** : Identical for spindle @26 in M42 **N42, N43, N51** : Identical for spindle @26 in M43 **N44, N45, N52** : Identical for spindle @26 in M44 **N46, N47, N53** : Identical for spindle @26 in M45 **N54, N55, N66** : Identical for spindle @27 in M40 **N56, N57, N67** : Identical for spindle @27 in M41 **N58, N59, N68** : Identical for spindle @27 in M42 **N60, N61, N69** : Identical for spindle @27 in M43 **N62, N63, N70** : Identical for spindle @27 in M44 **N64, N65, N71** : Identical for spindle @27 in M45 **N72, N73, N84** : Identical for spindle @28 in M40 **N74, N75, N85** : Identical for spindle @28 in M41 **N76, N77, N86** : Identical for spindle @28 in M42 **N78, N79, N87** : Identical for spindle @28 in M43 **N80, N81, N88** : Identical for spindle @28 in M44 **N82, N83, N89** : Identical for spindle @28 in M45 **N90, N91, N102** : Identical for spindle @29 in M40 **N92, N93, N103** : Identical for spindle @29 in M41 **N94, N95, N104** : Identical for spindle @29 in M42 **N96, N97, N105** : Identical for spindle @29 in M43 **N98, N99, N106** : Identical for spindle @29 in M44 **N100, N101, N107** : Identical for spindle @29 in M45 **N108, N109, N120** : Identical for spindle @30 in M40 **N110, N111, N121** : Identical for spindle @30 in M41 **N112, N113, N122** : Identical for spindle @30 in M42 **N114, N115, N123** : Identical for spindle @30 in M43 **N116, N117, N124** : Identical for spindle @30 in M44 **N118, N118, N125** : Identical for spindle @30 in M45 **N126, N127, N138** : Identical for spindle @31 in M40 **N128, N129, N139** : Identical for spindle @31 in M41 **N130, N131, N140** : Identical for spindle @31 in M42 **N132, N133, N141** : Identical for spindle @31 in M43 **N134, N135, N142** : Identical for spindle @31 in M44 **N136, N137, N143** : Identical for spindle @31 in M45

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Summary

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11.7 Drives coupling assignment for winding-duplication function ► P87 182

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11 Synchronization, Duplication

Flexium+ offers several possibilities for axes duplication and synchronization.

This list of parameter describes the possibilities offered by machine parameters.

The difference compared to the synchronization made by external parameters is that the couplings cannot be modified during operation. Therefore, the preferred use is for gantry axes.

The list also describes the functionalities of Anti-Backlash and Torque duplication and contains the following parameters:

P24	Synchronized axes characteristics coefficient of correction
P25	Synchronized axes characteristics thresholds
P27	Coupling assignment for duplicated and synchronized axes
P28	Enable slave axis synchronization
P85	Drives coupling assignment for anti-backlash function
P86	Drives coupling assignment for torque-duplication function
P87	Drives coupling assignment for winding-duplication function
P116	Electronic Gear Box (EGB)

P24	Synchronized axes characteristics: coefficients			
	Category	Synchronization - Duplication	**Format**	Type 5
	Words	32	**Units**	1/1000
	Min	0	**Max**	65535
	Default	250	**Resolution**	1
	Immediate	Yes	**Access via**	N/A
General	Defines the coefficient of correction for each axis slave axis in a gantry structure.			
Description	Each word corresponds to the physical address of an axis. The word number corresponds to the physical address of the driven axis of a pair.			
	• **Word N0**	Correction coefficient for axis @ 0 (in 1/1000). It is a fraction of the error re-injected into the driven axis servo-loop to achieve synchronization. The default value is 250.		
	• **Word N1 to Word N31**	Identical to Word N0 for driven axis @1 to @31.		
Example	• With default values			

P24 (Synchronised axes characteristics)

Name	Value	Unit	Description	Min	Max	Default
N0	250	[]	Correction coefficient for axis @0	0	65535	250
N1	250	[]	Correction coefficient for axis @1	0	65535	250
N2	250	[]	Correction coefficient for axis @2	0	65535	250
N3	250	[]	Correction coefficient for axis @3	0	65535	250
N4	250	[]	Correction coefficient for axis @4	0	65535	250
N5	250	[]	Correction coefficient for axis @5	0	65535	250
N6	250	[]	Correction coefficient for axis @6	0	65535	250
N7	250	[]	Correction coefficient for axis @7	0	65535	250

11.2 Synchronized axes characteristics: thresholds ► P25

P25	Synchronized axes characteristics: thresholds			
	Category	Synchronization - Duplication	**Format**	Type 10
	Words	33	**Units**	mm / °
	Min	0	**Max**	65.0
	Default	0.16 / 0.6	**Resolution**	10^{-6}
	Immediate	Yes	**Access via**	N/A

General

Defines the maximum synchronization error.

The synchronization uses two thresholds:

- Threshold 1: If passed, an error is triggered but this error can be canceled.
- Threshold 2: Error triggered if passed, this error cannot be cancelled.
  It require a new homing of the machine.

Description

Each word corresponds to the physical address of an axis.

The word number corresponds to the physical address of the driven axis of a pair.

• **Word N0**	Threshold 1 for axis @0 – Maximum permissible error Defines the value threshold 1 for driven axis @0, which is the maximum permissible error after synchronization. Above this threshold, the system generates an error but allows the driven axis to be resynchronized on its driver axis. The default value is 160 µm.
• **Word N1 to Word N31**	Identical for driven axes @1 to @31.
• **Word N32**	Threshold error for all axes – Maximum synchronisation error Defines the value for threshold 2 valid for all axes. If this threshold is passed the axes alignment requires to be checked before re-enabling synchronization. The default value is 600µm.

Example

P25 (Synchronised axes characteristics)

Name	Value	Unit	Description	Min	Max	Default
N0	0.16	mm	Threshold 1 for axis @0 - Maximum permissible error	0.0	65.0	0.16
N1	0.16	mm	Threshold 1 for axis @1 - Maximum permissible error	0.0	65.0	0.16
N2	0.16	mm	Threshold 1 for axis @2 - Maximum permissible error	0.0	65.0	0.16
N3	0.16	mm	Threshold 1 for axis @3 - Maximum permissible error	0.0	65.0	0.16
N4	0.16	mm	Threshold 1 for axis @4 - Maximum permissible error	0.0	65.0	0.16
N5	0.16	mm	Threshold 1 for axis @5 - Maximum permissible error	0.0	65.0	0.16
N6	0.16	°	Threshold 1 for axis @6 - Maximum permissible error	0.0	65.0	0.16
N7	0.16	°	Threshold 1 for axis @7 - Maximum permissible error	0.0	65.0	0.16
N8	0.16	°	Threshold 1 for axis @8 - Maximum permissible error	0.0	65.0	0.16
N24	0.16	mm	Threshold 1 for axis @24 - Maximum permissible error	0.0	65.0	0.16
N25	0.16	mm	Threshold 1 for axis @25 - Maximum permissible error	0.0	65.0	0.16
N26	0.16	mm	Threshold 1 for axis @26 - Maximum permissible error	0.0	65.0	0.16
N27	0.16	mm	Threshold 1 for axis @27 - Maximum permissible error	0.0	65.0	0.16
N28	0.16	mm	Threshold 1 for axis @28 - Maximum permissible error	0.0	65.0	0.16
N29	0.16	mm	Threshold 1 for axis @29 - Maximum permissible error	0.0	65.0	0.16
N30	0.16	mm	Threshold 1 for axis @30 - Maximum permissible error	0.0	65.0	0.16
N31	0.16	mm	Threshold 1 for axis @31 - Maximum permissible error	0.0	65.0	0.16
N32	0.6	mm or °	Threshold error for all axes - Maximum synchronisa...	0.0	65.0	0.6

11.3 Coupling assignment for duplicated and synchronized axes ► P27

P27	Coupling assignment for duplicated and synchronized axes			
	Category	Synchronization - Duplication	**Format**	Type 3
	Words	32	**Units**	N/A
	Min	-1	**Max**	31
	Default	-1	**Resolution**	N/A
	Immediate	No	**Access via**	E941xx

General	Used to assign a slave axis to a master axis. Concerns the different types of coupling: • Simple coupling (drive axis reference copied to driven axis). • Coupling with symmetry (reverse of the drive axis reference copied to the driven axis). • Coupling with synchronization (the error of synchronization is minimized).	
Description	• **Word N0**	Axis master address for slave @0 Contain the physical address of the master axis of axis @0 in a master slave configuration. The value -1 specifies the absence of a master axis. Parameters E94100 to E94131 are used to assign a driven axis to a drive axis by programming.
	• **Word N1 to Word N31**	Identical to Word N0 for slave axes @1 to @31.
Example	• Axis @3 is slave of axis @0 who is master.	

P27 (Coupling assignment for duplicated and synchronized axes)

Name	Value	Unit	Description	Min	Max	Default
N0	-1	[]	Axis master address for slave @0	-1	31	-1
N1	-1	[]	Axis master address for slave @1	-1	31	-1
N2	-1	[]	Axis master address for slave @2	-1	31	-1
N3	0	[]	Axis master address for slave @3	-1	31	-1
N4	-1	[]	Axis master address for slave @4	-1	31	-1
N5	-1	[]	Axis master address for slave @5	-1	31	-1
N6	-1	[]	Axis master address for slave @6	-1	31	-1
N7	-1	[]	Axis master address for slave @7	-1	31	-1

11.4 Enable slave axis synchronization ► P28

P28	Enable slave axis synchronization			
	Category	Synchronization - Duplication	**Format**	Type 6
	Words	1	**Units**	N/A
	Min	0	**Max**	FFFFFFFFh
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	E962xx (R/W) : see description
General	Enables synchronization of a driven axis with a drive axis.			
Description	• **Word N0**	Enable slave axis synchronization The bit position gives the physical address of the driven axis of a pair. By convention, it is also the coupling number. If the bit is SET, the driven axis is synchronized with its master axis declared in P27. If the synchronization is enabled by machine parameters, it is not possible to inhibit it by E parameters. @ 31 @ 30 @ 29 @ 28 @ 27 @ 26 @ 25 @ 24 @ 23 @ 22 @ 21 @ 20 @ 19 @ 18 @ 17 @ 16 @ 15 @ 14 @ 13 @ 12 @ 11 @ 10 @ 9 @ 8 @ 7 @ 6 @ 5 @ 4 @ 3 @ 2 @ 1 @ 0		
Example	• To synchronize axis 3 to its master axis 0 (see example of P27) bit 3 should be set.			

P28 (Enable slave axis synchronization)

Name	Value	Unit	Description	Min	Max	Default
N0	8h	[]	Enable slave axis synchronization	0h	FFFFFFFFh	0h

11.5 Drives coupling assignment for anti-backlash function ► P85

P85	Drives coupling assignment for anti-backlash function			
	Category	Synchronization - Duplication	**Format**	Type 3
	Words	32	**Units**	N/A
	Min	-1	**Max**	31
	Default	-1	**Resolution**	N/A
	Immediate	Yes	**Access via**	N/A
General	Specifies the master and slave axes to be associated by coupling. This parameter defined the coupling authorized for Anti-Backlash (torque synchronization with a preload current value).			
Description	• Each word corresponds to the physical address of the slave axis. • The value of the word is the physical address of the master axis. • A setting of -1 indicates the absence of coupling. • Further adjustments (if required) for this function are made at the drive level.			
	• **Word N0**	Drive master address for slave @0 Physical address of the master axis for anti-backlash function. A value of -1 means no coupling.		
	• **Word N1 to Word N31**	Identical to Word N0 for slave axes @1 to @31.		
Example	• Axes 1 and 3 slaved in anti-backlash to axes 0 and 2 respectively.			

P85 (Drives coupling assignment for anti-backlash function)

Name	Value	Unit	Description	Min	Max	Default
N0	-1	[]	Drive master address for slave @0	-1	31	-1
N1	0	[]	Drive master address for slave @1	-1	31	-1
N2	-1	[]	Drive master address for slave @2	-1	31	-1
N3	2	[]	Drive master address for slave @3	-1	31	-1
N4	-1	[]	Drive master address for slave @4	-1	31	-1
N5	-1	[]	Drive master address for slave @5	-1	31	-1
N6	-1	[]	Drive master address for slave @6	-1	31	-1
N7	-1	[]	Drive master address for slave @7	-1	31	-1

11.6 Drives coupling assignment for torque-duplication function ► P86

P86	**Drives coupling assignment for torque-duplication function**			
	Category	Synchronization - Duplication	**Format**	Type 3
	Words	32	**Units**	N/A
	Min	-1	**Max**	31
	Default	-1	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	Specifies the master and slave axes to be associated by coupling.			
Description	• Each word corresponds to the physical address of the slave axis. • The value of the word is the physical address of the master axis. • A setting of -1 indicates the absence of coupling. • Further adjustments (if required) for this function are made at the drive level.			
	• **Word N0**	Drive master address for slave @0 Physical address of the master axis for anti-backlash function. A value of -1 means no coupling.		
	• **Word N1 to Word N31**	Identical to Word N0 for slave axes @1 to @31.		
Example	• Axis 4 slaved in torque duplication to axis 3.			

P86 (Drives coupling assignment for torque-duplication function)

Name	Value	Unit	Description	Min	Max	Default
N0	-1	[]	Drive master address for slave @0	-1	31	-1
N1	-1	[]	Drive master address for slave @1	-1	31	-1
N2	-1	[]	Drive master address for slave @2	-1	31	-1
N3	-1	[]	Drive master address for slave @3	-1	31	-1
N4	3	[]	Drive master address for slave @4	-1	31	-1
N5	-1	[]	Drive master address for slave @5	-1	31	-1
N6	-1	[]	Drive master address for slave @6	-1	31	-1
N7	-1	[]	Drive master address for slave @7	-1	31	-1

11.7 Drives coupling assignment for winding-duplication function ► P87

P87	Drives coupling assignment for winding-duplication function			
	Category	Synchronization - Duplication	**Format**	Type 3
	Words	32	**Units**	N/A
	Min	-1	**Max**	31
	Default	-1	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	Specifies the master and slave axes to be associated by coupling. This parameter defined the coupling authorized for Winding Duplication.			
Description	• Each word corresponds to the physical address of the slave axis. • The value of the word is the physical address of the master axis. • A setting of -1 indicates the absence of coupling. • Further adjustments (if required) for this function are made at the drive level.			
	• **Word N0**	Drive master address for slave @0 Physical address of the master axis for Winding Duplication function. A value of -1 means no coupling.		
	• **Word N1 to Word N31**	Identical to Word N0 for slave axes @1 to @31.		
Example	• Drives 1 and 2 slaved in winding duplication to drive 0.			

P87 (Drives coupling assignment for winding-duplication function)

Name	Value	Unit	Description	Min	Max	Default
N0	-1	[]	Drive master address for slave @0	-1	31	-1
N1	0	[]	Drive master address for slave @1	-1	31	-1
N2	0	[]	Drive master address for slave @2	-1	31	-1
N3	-1	[]	Drive master address for slave @3	-1	31	-1
N4	-1	[]	Drive master address for slave @4	-1	31	-1
N5	-1	[]	Drive master address for slave @5	-1	31	-1
N6	-1	[]	Drive master address for slave @6	-1	31	-1
N7	-1	[]	Drive master address for slave @7	-1	31	-1

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Summary

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12.3 Backup on path, Auto recall after INTERV ► P114 192

12.4 Final distance at work rate for recall ► P115 193

12.5 Electronic Gear Box (EGB) function ► P116 194

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12 Cycles

This series of parameters is related to cycles. It contains:

Rigid tapping

Backup and retrace

Auto recall after intervention.

Electronic gear box (EGB)

The list of parameters covered is:

P62	Rigid tapping setting
P63	Servo adjustments for rigid tapping
P114	Backup on path, Auto recall after INTERV
P115	Final distance at work rate for recall
P116	Electronic Gear Box (EGB) function

12.1 Rigid tapping setting ► P62

P62	Rigid tapping setting			
	Category	Cycles	**Format**	Type 1
	Words	64	**Units**	Word dependent
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	Word dependent
	Immediate	No	**Access via**	N/A
General	This parameter is used to define the spindle acceleration and minimum spindle speed reference at the bottom of the hole.			
• **Word N0**	• **Word N0**	Deceleration before bottom of the hole for spindle @0 Used to calculate the position where the deceleration should start, the value is given in rpm/s. This value is generally equal or slightly higher than the spindle deceleration parameter (P32). A too high value (higher than the system capacity) might result in an overshoot at the bottom whereas a too low will increase the cycle time. Min: 1, Max: 32767, Default: 10, Resolution: 1, Units: rev/s^2.		

- **Word N1**

Speed at reversal for spindle @0.

This value given in 1/10000 of the max speed of the range is used to prevent any stopping of the spindle that will result in a halt as the feed is synchronized to the spindle speed.

A too low value might generate this stopping whereas a too high could lead to an abrupt inversion.

Min: 1, Max: 10000, Default: 100, Resolution: 1, Units: None.

Cycle

At the beginning of infeed, the cycle axis is synchronised on the spindle zero pulse. This synchronisation is repeated for each cycle.

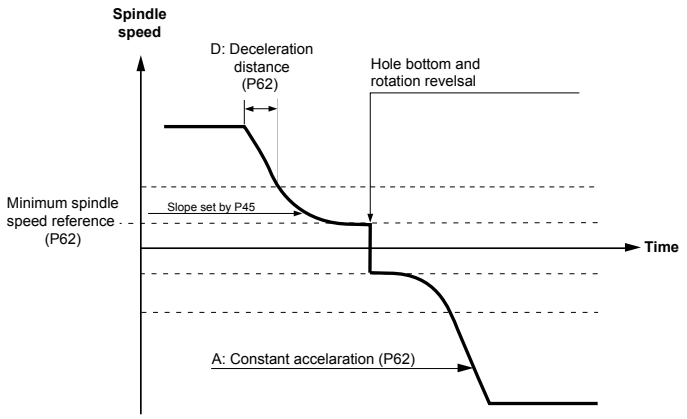
The start of movement is anticipated with respect to the spindle zero pulse in order to obtain a gradual acceleration (parameter P63, spindle crossing anticipation time constant).

When approaching the bottom of the tapped hole, the spindle slows down according to the preset deceleration value (parameter P62, spindle deceleration).

In the hole bottom, a minimum spindle speed is applied to effectively reach the hole bottom (parameter P62, minimum speed reference in the hole bottom).

The spindle then reverses and accelerates up to the programmed speed. The infeed and outfeed speeds may be different. At the end of outfeed, the spindle reverses and the axis/spindle coupling is cancelled.

It is possible to inhibit the feed-stop during the tapping. In this case it will be memorized and taken into account at the end of the current hole (see P7 N2 B4).



- **Word N2-N3 to Word N62-N63**

Identical to Word N0, N1 for spindles @1 to @ 31 respectively.

Example

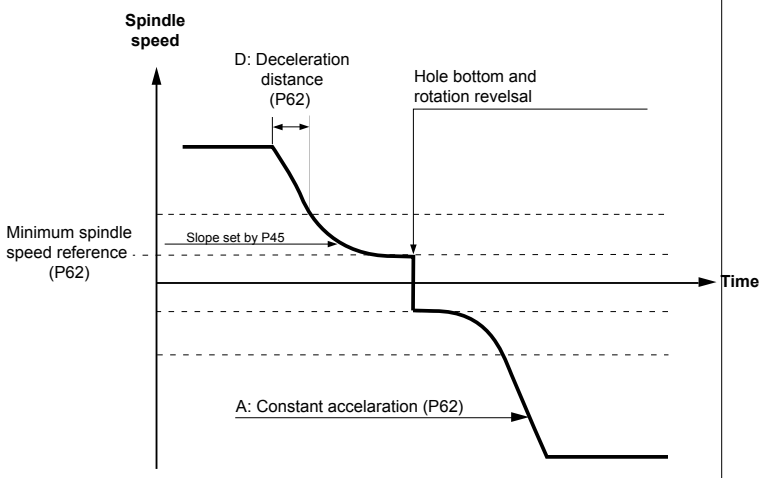
- With default values

P62 (Rigid tapping setting)

Name	Value	Unit	Description	Min	Max	Default
N0	10	rev/s²	Deceleration before bottom of the hole for spindle @0	1	32767	10
N1	100	[]	Speed at reversal for spindle @0 (in 1/10000 of the max speed of the range)	1	10000	100
N2	10	rev/s²	Deceleration before bottom of the hole for spindle @1	1	32767	10
N3	100	[]	Speed at reversal for spindle @1 (in 1/10000 of the max speed of the range)	1	10000	100
N4	10	rev/s²	Deceleration before bottom of the hole for spindle @2	1	32767	10
N5	100	[]	Speed at reversal for spindle @2 (in 1/10000 of the max speed of the range)	1	10000	100
N6	10	rev/s²	Deceleration before bottom of the hole for spindle @3	1	32767	10
N7	100	[]	Speed at reversal for spindle @3 (in 1/10000 of the max speed of the range)	1	10000	100
N8	10	rev/s²	Deceleration before bottom of the hole for spindle @4	1	32767	10

12.2 Servo adjustment for rigid tapping ► P63

P63	**Servo adjustment for rigid tapping**			
	Category	Cycles	**Format**	Type 1
	Words	24	**Units**	Word dependent
	Min	Word dependent	**Max**	Word dependent
	Default	Word dependent	**Resolution**	Word dependent
	Immediate	No	**Access via**	N/A
General	This parameter is used to adjust the servo response in each channel to optimize the rigid tapping by setting three parameters in order cancel the following error on the tool axis during the cycle and anticipate the spindle zero for starting the descent. • Integral time constant • Anticipation time constant • Spindle zero anticipation time constant.			
Description	• **Word N0**	Tool axis integration time constant for channel 1 Defines the integral time constant for the cycle axis for channel 1 to fine tunes the cancelation of the cycle axis following error with respect to the spindle speed. The time constant is expressed in number of samples and the value entered is 1000 / number of samples. Min: 1, Max: 500, Default: 200, Resolution: 1, Units: [ ]		
	• **Word N1**	Tool axis position anticipation time constant for channel 1 Defines the cycle axis position anticipation time constant for channel 1. It is used for the rough cancelation of the following error on the cycle axis. The time constant T is expressed in number of samples and the value entered is: 1000 * T Min: 1, Max: 32767, Default: 6000, Resolution: 1, Units: None. The value to enter is P56 / P50 * 1000.		

Description	• **Word N2**	Defines the spindle zero crossing anticipation time constant for channel 1. It is used to define the start of the axis with respect to the spindle zero crossing in order to gradually accelerate and be fully synchronized at this zero position. The value is expressed as a number of samples. The faster the accelerations allowed on the cycle axis, the lower the value programmed in this constant. The value to enter is 16 * P30 / P32 / P50. **Tuning**: (If required - generally the default values provide a good result) • Set word 0 to 0, • Start with the calculated values in words 1 and 2 • Search for the optimum value of word 0 in by gradually increasing the setting without exceeding 1000 until instability appears. Enter the maximum value obtained divided by 2. The result should be less than 500. • Check that the following error is small on reversal. If not, decrease the value of word 0 of P62. See P62 for cycle explanations. 
	• **Word N3-N5 to Word N21-N23**	Identical to Word N0 – N2 for the other channels.
Example	• With standard values	

P63 (Servo adjustment for rigid tapping)

Name	Value	Unit	Description	Min	Max	Default
N0	200	[]	Tool axis integration time constant for channel 1	0	500	200
N1	6000	[]	Tool axis position anticipation time constant for channel 1	1	32767	6000
N2	50	[]	Spindle zero crossing anticipation time constant (CNC sampling period) for channel 1	1	32767	50
N3	200	[]	Tool axis integration time constant for channel 2	0	500	200
N4	6000	[]	Tool axis position anticipation time constant for channel 2	1	32767	6000
N5	50	[]	Spindle zero crossing anticipation time constant (CNC sampling period) for channel 2	1	32767	50
N6	200	[]	Tool axis integration time constant for channel 3	0	500	200
N7	6000	[]	Tool axis position anticipation time constant for channel 3	1	32767	6000
N8	50	[]	Spindle zero crossing anticipation time constant (CNC sampling period) for channel 3	1	32767	50
N9	200	[]	Tool axis integration time constant for channel 4	0	500	200
N10	6000	[]	Tool axis position anticipation time constant for channel 4	1	32767	6000
N11	50	[]	Spindle zero crossing anticipation time constant (CNC sampling period) for channel 4	1	32767	50

12.3 Backup on path, Auto recall after INTERV ► P114

P114	Backup on path, Auto recall after INTERV			
	Category	System configuration	**Format**	Type 5
	Words	10	**Units**	None
	Min	0	**Max**	8000/10/8000...
	Default	100/10	**Resolution**	1
	Immediate	No	**Access via**	N/A

General

Defines the number of stored blocks that can be backed up in the path, the number of points that can be stored during axis retraction in INTERV mode and the distance after which approach to the recall point is carried out at the work rate.

This function is only available in channel 1.
INTERV mode is activated by a PLC command. It is the possibility of manual control of axes after a Feed Stop.

Description

• **Word N0**	Number of blocks memorised for backup on path after a Feed Stop Defines the number of blocks stored during backup along the path after a feed stop. Backup and return are carried out at the speed programmed in the blocks stored (see Flexium+ HMI Operator Manual M00039). A maximum of 8000 blocks can be stored.
• **Word N1**	Number of points stored during axis retraction in INTERV mode Defines the number of points to be stored during axis retraction in INTERV mode. This to allow axis recall on the same path (see Flexium+ HMI Operator Manual M00039). A maximum of 10 points can be stored. Auto recall can be combined with backup and return in the path.
• **Word N2**	Number of blocks memorized for backup on path Channel 1.
• **Word N3 to N9**	Identical to N2 for channels 2 to 8.

Example

P114 | Backup on path, Auto recall after INTERV

Name	Value	Unit	Description	Min	Max	Default
N0	100	[]	Number of blocks memorised for backup on path after a Feed Stop for all the channels	0	8000	100
N1	10	[]	Number of points stored during axis retraction in INTERV mode	0	10	10
N2	0	[]	Number of blocks memorised for backup on path after a Feed Stop for channel 1	0	8000	0
N3	0	[]	Number of blocks memorised for backup on path after a Feed Stop for channel 2	0	8000	0

12.4 Final distance at work rate for recall ► P115

P115	Final distance at work rate for recall			
	Category	System configuration	**Format**	Type 10
	Words	1	**Units**	mm/°
	Min	0	**Max**	65.0
	Default	0	**Resolution**	10^{-6}
	Immediate	No	**Access via**	N/A

General

While in INTERV mode, the system stores a certain number of points (see P114) in order to retrieve the initial position.

The Auto-recall feature will be executed under the operator surveillance at the jog feed rate up to a certain clearance distance where the feed rate will be the programmed feedrate.

The parameter defines such clearance.

INTERV mode is activated by a PLC command. It is the possibility of manual control of axes after a Feed Stop.

Description

- **Word N0** — Final distance at work rate for recall.

Example

P115 (Final distance at work rate for recall)

Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm	Final distance at work rate for recall	0.0	65.0	0.0

P116	**Electronic Gear Box (EGB) function**			
	Category	Axes initial settings	**Format**	Type 10 (LREAL)
	Words	64	**Units**	mm or °
	Min	0.01 (N0-31) 0 (N32-63)	**Max**	360 (N0-31) 50 (N32-63)
	Default	0.2 (N0-31) 0 (N32-63)	**Resolution**	10^{-6}
	Immediate	No	**Access via**	**E7x206** (P116 N0 to N31)
General	The parameter P116 N0-N31 contains the synchro tolerance. If the synchro error exceeds this parameter the machine goes in emergency. The parameter P116 N32-N63 contains the cut frequency for the transducer filter. If is set to 0 the filter is disabled. (New as to 4.0.30.00 software version)			
Description	**Word N00 to Word N31**	Servo tolerance for axis @0 to @31		
	Word N32 to Word N63	Transducer filter cut frequency for axis @0 to @31		
Example				

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13 Analog Axes and Spindle, Handwheel

13.1 Analog Axes and Spindle

The following parameters are required for analog axes (see P70).

Flexium+ can handle a maximum of two analogue axes or spindles.

The list of parameters covered is:

P11	Measurement conversion coefficient for analog axe
P72	Direction of speed reference for analog axes
P73	Servo-system loop coefficent for analog axe
P74	PLC EtherCAT analog drives absolute sensor resolution bit number for analog drive
P75	PLC EtherCAT analog drives zero shift absolute sensor
P14	Handwheel declaration
P13	Handwheel measurement conversion coefficien

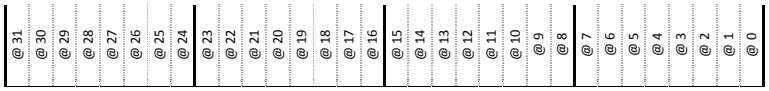
13.1.1 Measurement conversion coefficient for analog axe ► P11

P11	Measurement conversion coefficient for analog axe			
	Category	Analog axes	**Format**	Type 5
	Words	64	**Units**	N/A
	Min	1	**Max**	65535
	Default	1	**Resolution**	1
	Immediate	Yes	**Access via**	N/A
General	Adapts the measurement supplied by the position encoder to the internal CNC measurement. Each pair of words corresponds to the values assigned to an axis. The first word of the pair indicates the multiplier coefficient (MULTI) and the second the divider coefficient (DIVI).			
Description	• **Word N0**	Multiplier coefficients (MULTI) for axis @0.		
	• **Word N1**	Divider coefficient (DIVI) for axis @0.		
	• **Word N2-N3 to Word N62-N63**	Identical to Word N0 – N1 for axes @1 to @31.		
Example	• With default values			

P11 (Measurement conversion coefficient for analog axes)

Name	Value	Unit	Description	Min	Max	Default
N0	1	[]	Multiplier coefficient (MULTI) for axis @0	1	65535	1
N1	1	[]	Divider coefficient (DIVI) for axis @0	1	65535	1
N2	1	[]	Multiplier coefficient (MULTI) for axis @1	1	65535	1
N3	1	[]	Divider coefficient (DIVI) for axis @1	1	65535	1
N4	1	[]	Multiplier coefficient (MULTI) for axis @2	1	65535	1
N5	1	[]	Divider coefficient (DIVI) for axis @2	1	65535	1
N6	1	[]	Multiplier coefficient (MULTI) for axis @3	1	65535	1
N7	1	[]	Divider coefficient (DIVI) for axis @3	1	65535	1

13.1.2 Direction of axis speed reference for analog axes ► P72

P72	**Direction of axis speed reference for analog axes**			
	Category	Analog axes	**Format**	Type 6
	Words	0	**Units**	N/A
	Min	0	**Max**	FFFFFFFF
	Default	0	**Resolution**	N/A
	Immediate	No	**Access via**	N/A
General	Used to reverse the direction of the axis speed reference sent to the axis servo-drive. N.B. : For digital axes the speed reference reversal is defined by the sign of parameters V306 (V1306).			
Description	• **Word N0**	Direction of axis speed reference The bit position gives the physical axis address. If the bit is SET, a positive speed reference applied to the servo-drive results in a negative movement of the axis.  		
	• **Word N1**	PLC EtherCAT analog drivers measurement direction (1= Reverse) Bitmap of physucal axes address, if the bit is SET indicate the axes with inversed measure direction.		
	• **Word N2**	PLC EtherCAT analog drivers with absolute measure sensor Bitmap of physucal axes address, if the bit is SET indicate the axes with absolute measure sensor.		
Example	• Axes @ 5 and @6 are analog and run in inverted direction			

P72 (Direction of axis speed reference for analog axes)

Name	Value	Unit	Description	Min	Max	Default
N0	60h	[]	Direction of axis speed reference	0h	FFFFFFFFh	0h

13.1.3 Servo-system loop coefficent for analog axes ► P73

P73	Servo-system loop coefficent for analog axes			
	Category	Analog axes	**Format**	Type 4
	Words	32	**Units**	N/A
	Min	0	**Max**	999999999
	Default	3000	**Resolution**	N/A
	Immediate	No	**Access via**	E980xx

General

Defines the coefficient used by the CNC to calculate the reference supplied to the servo-drive according to the following error.

Before parameter P73 can be set, it is first necessary to set parameter P56 or P66.

Description

- **Word N0**

Servo-system loop coefficient for axis @0

Proportional action coefficient applied to the following error of axis @ 0 to obtain the speed reference.

Calculation:

The CNC function generates a theoretical speed reference voltage of 10V maximum.

This voltage is provided by a DAC on an axis encoder card.
Generally, the servo-drives are set so that the axis speed is obtained for a servo-drive input voltage of 9V.

The 15-bit DAC of the axis encoder card provides an output voltage of 10V for 32768 DAC points. The output is therefore 9V for 29491 DAC points.

According to the expected gain this maximal speed will be achieved for a following error of :

ε (in mm) = Max speed (in m/min) / Gain.

The value of P73 is then given by: P73 = 29491 / $\varepsilon_{\text{max speed}}$.

Example

- Considering an axis running up to 12 m/min with a gain of 1.5 and a resolution of 1µm.
- The following error at max speed will be 12/1.5 = 8 mm = 8000 internal counts.
- The 12 m/min are achieved with a reference of 9V (drive tuning) = 29491 DAC points
- P73 = 29491/8 = 3686

- **Word N1 to Word N31**

Identical to Word N0 for axes @1 to @31 respectively.

Example

- With default values.

P73 (Servo-System loop coefficient for analog axes)

Name	Value	Unit	Description	Min	Max	Default
N0	3000	[]	Servo-system loop coefficient for axis @0	0	99999999	3000
N1	3000	[]	Servo-system loop coefficient for axis @1	0	99999999	3000
N2	3000	[]	Servo-system loop coefficient for axis @2	0	99999999	3000
N3	3000	[]	Servo-system loop coefficient for axis @3	0	99999999	3000
N4	3000	[]	Servo-system loop coefficient for axis @4	0	99999999	3000
N5	3000	[]	Servo-system loop coefficient for axis @5	0	99999999	3000
N6	3000	[]	Servo-system loop coefficient for axis @6	0	99999999	3000

13.1.4 PLC EtherCAT analog drives absolute sensor resolution bits ► P74

P74	**PLC Ethercat analog drives absolute sensor resolution bit**			
	Category	Analog axes	**Format**	Type 3 (SINT)
	Words	32	**Units**	N/A
	Min	10	**Max**	40
	Default	13	**Resolution**	1
	Immediate	No	**Access via**	N/A
General	Used to define the bit resolution of the absolute sensor, information needed by NCK to calculate the mesure (New as to 4.1.10.00 software version)			
Description	• **Word N0**	Absolute sensor resolution bit number for analog drive.		
	• **Word N1 to Word N31**	Identical to Word N0 for the other axes.		
Example	P74 | PLC EtherCAT analog drives absolute sensor resolution bits			

Name	Value	Unit	Description	Min	Max	Default
N0	13	[]	Absolute sensor resolution bit number for analog drive @0	10	40	13
N1	13	[]	Absolute sensor resolution bit number for analog drive @1	10	40	13
N2	13	[]	Absolute sensor resolution bit number for analog drive @2	10	40	13
N3	13	[]	Absolute sensor resolution bit number for analog drive @3	10	40	13
N4	13	[]	Absolute sensor resolution bit number for analog drive @4	10	40	13
N5	13	[]	Absolute sensor resolution bit number for analog drive @5	10	40	13
N6	13	[]	Absolute sensor resolution bit number for analog drive @6	10	40	13
N7	13	[]	Absolute sensor resolution bit number for analog drive @7	10	40	13
N8	13	[]	Absolute sensor resolution bit number for analog drive @8	10	40	13

13.1.5 PLC EtherCAT analog drives zero shift absolute sensor ► P75

P75	**PLC Ethercat analog drives absolute sensor resolution bit**			
	Category	Analog axes	**Format**	Type 9 (LREAL)
	Words	32	**Units**	mm or °
	Min	-9999999.999999	**Max**	9999999.999999
	Default	0.0	**Resolution**	10^{-6}
	Immediate	No	**Access via**	N/A
General	This parameter is used to set the measure origin of an axis. The word number gives the physical address of the axis. (New as to 4.1.10.00 software version)			
Description	• **Word N0**	PLC EtherCAT analog drives zero shift absolute sensor.		
	• **Word N1**	Identical to Word N0 for the other axes.		
Example				

P75 | PLC EtherCAT analog drives zero shift absolute sensor

Name	Value	Unit	Description	Min	Max	Default
N0	0.0	mm	Zero shift absolute sensor for analog drive @0	-9999999.999999	9999999.999999	0.0
N1	0.0	mm	Zero shift absolute sensor for analog drive @1	-9999999.999999	9999999.999999	0.0
N2	0.0	mm	Zero shift absolute sensor for analog drive @2	-9999999.999999	9999999.999999	0.0
N3	0.0	mm	Zero shift absolute sensor for analog drive @3	-9999999.999999	9999999.999999	0.0
N4	0.0	mm	Zero shift absolute sensor for analog drive @4	-9999999.999999	9999999.999999	0.0
N5	0.0	mm	Zero shift absolute sensor for analog drive @5	-9999999.999999	9999999.999999	0.0
N6	0.0	°	Zero shift absolute sensor for analog drive @6	-9999999.999999	9999999.999999	0.0
N7	0.0	°	Zero shift absolute sensor for analog drive @7	-9999999.999999	9999999.999999	0.0

13.2 Handwheel

Flexium+ can handle up to 4 handwheels either interfaced by CAN or connected on the analog ports of the NCK (only two ports are available, consider that they can be occupied by analog axes or spindles).

The CAN handwheels provide an averaging filter that can be activated by P7 N2 b4.

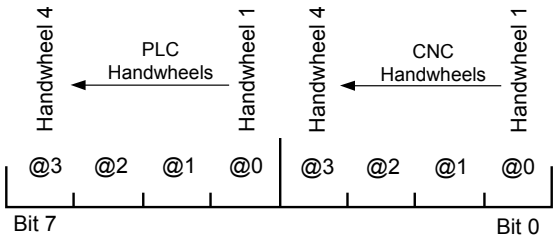
Handwheel are identified by a number (0 to 3) that has no interaction with the axes addresses.

This category contains two parameters:

P14	Handwheel declaration
P13	Handwheel measurement conversion coefficient

13.2.1 Handwheel declaration ► P14

P14	Handwheel declaration			
	Category	Handwheels	**Format**	Type 0
	Words	0	**Units**	N/A
	Min	0	**Max**	FF
	Default	0	**Resolution**	N/A
	Immediate	Yes	**Access via**	N/A
General	Declare the presence and type of handwheel.			
Description	• **Word N0**	Handwheel declaration The bit position defines the presence and type of handwheel. One handwheel cannot be both CNC and CAN.		
Example	• With default values.			



P14 (Handwheel declaration)

Name	Value	Unit	Description	Min	Max	Default
N0	61h	[]	Handwheel declaration	0h	FFh	0h

13.2.2 Handwheel measurement conversion coefficien ► P13

P13	Handwheel measurement conversion coefficient			
	Category	Handwheels	**Format**	Type 5
	Words	18	**Units**	N/A
	Min	1	**Max**	65535
	Default	1	**Resolution**	N/A
	Immediate	Yes	**Access via**	N/A

General

Adapts the measurement supplied by the handwheel sensor.

Each pair of words corresponds to the values assigned to an handwheel.

The first word of the pair indicates the multiplier coefficient (MULTI) and the second the divider coefficient (DIVI).

The handwheel coefficients in Automatic Mode are related to the overspeed function (G12 Feed Increase by handwheel).

For additional information about the G12 function please refer to the Flexium+ Programming manual M00040.

Description

• **Word N0**	Multiplier coefficient (MULTI) for the first handwheel for linear axes
• **Word N1**	Divider coefficient (DIVI) for the first handwheel for linear axes
• **Word N2- N3 to Word N6 - N7**	Identical to Word N0-N1 for the other handwheels (for linear axes)
• **Word N8**	Overspeed multiplier coefficient (MULTI) for handwheels in automatic mode (G12)
• **Word N9**	Overspeed divider coefficient (DIVI) for handwheels in automatic mode (G12)
• **Word N10**	Multiplier coefficients for the first handwheel (for rotary axes)
• **Word N11**	Divider coefficient for the first handwheel (for rotary axes)
• **Word N12- N13 to Word N16-N17**	Identical to Word N10-N11 for the other handwheel (for rotary axes)

Example

- Standard values.

P13 (Handwheel measurement conversion coefficient)

Name	Value	Unit	Description	Min	Max	Default
N0	1	[]	Multiplier coefficient (MULTI) for handwheel 1 (linear axes)	1	65535	1
N1	4	[]	Divider coefficient (DIVI) for handwheel 1 (linear axes)	1	65535	4
N2	1	[]	Multiplier coefficient (MULTI) for handwheel 2 (linear axes)	1	65535	1
N3	4	[]	Divider coefficient (DIVI) for handwheel 2 (linear axes)	1	65535	4
N4	1	[]	Multiplier coefficient (MULTI) for handwheel 3 (linear axes)	1	65535	1
N5	4	[]	Divider coefficient (DIVI) for handwheel 3 (linear axes)	1	65535	4
N6	1	[]	Multiplier coefficient (MULTI) for handwheel 4 (linear axes)	1	65535	1
N7	4	[]	Divider coefficient (DIVI) for handwheel 4 (linear axes)	1	65535	4
N8	1	[]	Over-speed multiplier coefficient (MULTI) for the handwheels in automatic mode	1	65535	1
N9	4	[]	Over-speed divider coefficient (DIVI) for the handwheels in automatic mode	1	65535	4
N10	1	[]	Multiplier coefficient (MULTI) for handwheel 1 (rotary axes)	1	65535	1
N11	4	[]	Divider coefficient (DIVI) for handwheel 1 (rotary axes)	1	65535	4
N12	1	[]	Multiplier coefficient (MULTI) for handwheel 2 (rotary axes)	1	65535	1
N13	4	[]	Divider coefficient (DIVI) for handwheel 2 (rotary axes)	1	65535	4
N14	1	[]	Multiplier coefficient (MULTI) for handwheel 3 (rotary axes)	1	65535	1
N15	4	[]	Divider coefficient (DIVI) for handwheel 3 (rotary axes)	1	65535	4
N16	1	[]	Multiplier coefficient (MULTI) for handwheel 4 (rotary axes)	1	65535	1
N17	4	[]	Divider coefficient (DIVI) for handwheel 4 (rotary axes)	1	65535	4

To avoid shock on the axes due too big handwhell step movement, the CNC reduces the increment from the handwheel when the speed and/ or the acceleration, in the sample, is bigger than the values set in P30 (Max Axes speed) and P32 (Max Axes acceleration) .

For example with an Axes with P30 = 2500 mm/min and P50 = 2ms, the maximum speed in 1 sample is:
P30 -> 2500/60000 * 2 = 0,0833333 mm

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Published by NUM Spa

Via F. Somma 62
20012 Cuggiono (MI) (Italy)
Tel. : +39 02 979 691
website: www.num.com

Printed January 2023

CNC HighEnd Applications