

MT-CNC Follower and Gantry Axes

Applikation Manual

DOK-MT*CNC-FOL*GAN*V15-ANW1-EN-P

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1 Introduction

The function 'follower (synchronized) axis control' or 'gantry axes' referred to below as 'synchronized mode' allows up to four feed axes to be operated in synch.

Each feed axis can be declared a 'lead axis.' Up to three 'follower axes' (slave axes) can be assigned to run in synch with the lead axis. The lead axis and the follower axes work together to form a synchronized axis group. Synchronized axis groups can be activated or deactivated regardless of the operating mode active at any one time, or they can be maintained during the entire operation of the machine, including referencing. When they are in the inactive state, they can be reconfigured during machine operation from the SPS and the CNC as well as via the user interface (MUI/GUI). Up to 4 different synchronized axis groups can be active at the same time per process.

During synchronized operation, all the follower axes in the group traverse the distance traveled by the lead axis, taking into account their respective translation ratios and their direction of rotation.

Synchronized axis control (slaving) is used in a wide variety of applications, for example:

- Lathes having one or more follower rests (V1, V2, V3)
- Milling machines equipped with double tables (X, U)
- Twin lathes (Z1, X1, S1, C1, Z2, X2, S2, C2)
- Twin milling machines (X1, Y1, Z1, S1, X2, Y2, Z2, S2)
- Multiple-spindle lathes (Z, X1, S1, X2, S2, X3, S3) or
- Multiple-spindle milling machines (X, Y, Z1, S1, Z2, S2, Z3, S3).

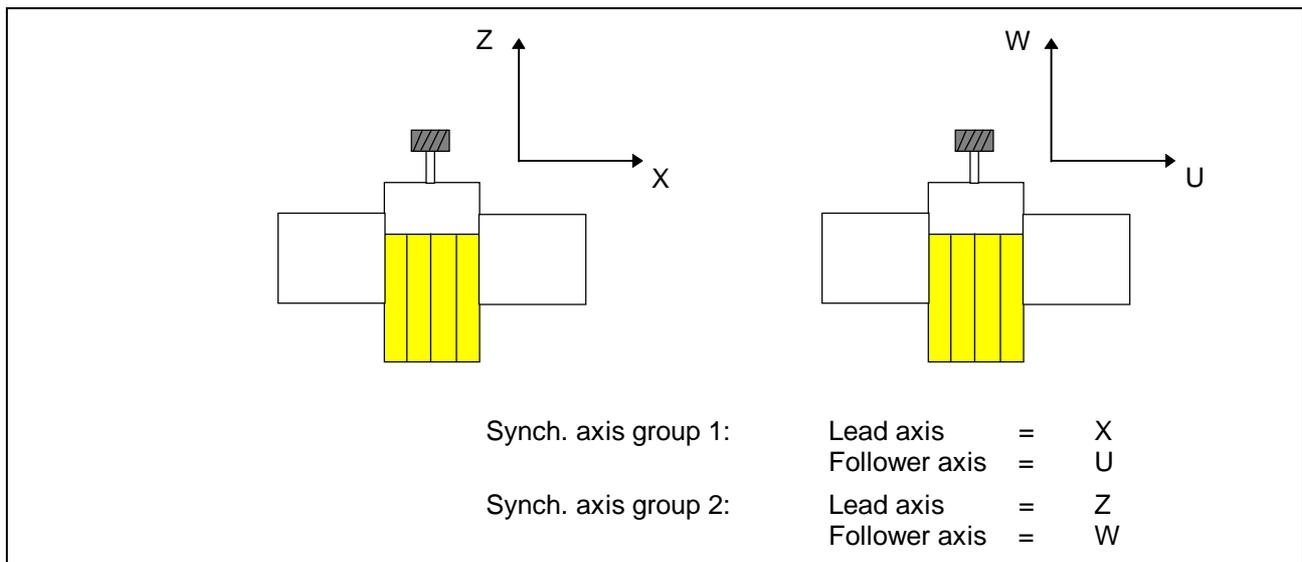


Fig. 1-1: Example of synchronizing lead and follower axes (no mechanical coupling is present).

Gantry axes are mainly used in applications in which the axes are mechanically coupled and not electronically synchronized. Typical applications are portal milling machines as well as machine tool tables and slides moved by a number of linear drives.

2 Scope of the Function

2.1 Linking of Lead and Follower Axes

The change in the position command values for the lead axis taking into account the respective translation ratios between the lead and follower axis is sent to the follower axes at the interpolation clock.

Offset registers for offsetting the follower axes relative to the lead axis are not provided since the lead and follower axes must always be traversed to their initial position before the synchronized mode is activated and since the CNC maintains the initial offset between the lead axis and the follower axis during the course of synchronized operation.

In addition to the translation ratio, the direction of rotation of the follower axes can be specified in the machine data.

2.2 Legal Configurations

The following rules describe the configurations which are legal for the synchronized mode. If the CNC detects a violation of these rules, it interrupts processing and generates an error message.

- One lead axis and at least one follower axis must belong to each synchronized axis group.
- A synchronized axis group must not contain more than one lead axis.
- In addition to the lead axis, a maximum of three follower axes may belong to each synchronized axis group. All axes in a synchronized axis group must belong to a single process.
 - ⇒ If an axis from a different process is to serve as a lead or follower axis in a synchronized axis group, this axis must be transferred to the respective process with the aid of the axis transfer commands.
- All axes in a synchronized axis group must be controlled by one Axis Processor module (APR).
- The lead axis must have a lower drive address number than the follower axes within the SERCOS drive interface loop.
- A single axis cannot simultaneously be both a lead axis and a follower axis.
- All axes in a synchronized axis group must be of the same axis type (linear, modulo or endless rotating rotary axes).
- NC-controlled tool storage axes must not be part of a synchronized axis group, either as lead or follower axes.
- If rotational axes form a synchronized axis group, they must be programmed using the same 'units per revolution' (axis parameter Cxx.006).
- The lead and follower axes in an active synchronized axis group must not be present in a different synchronized axis group either as lead or follower axes.

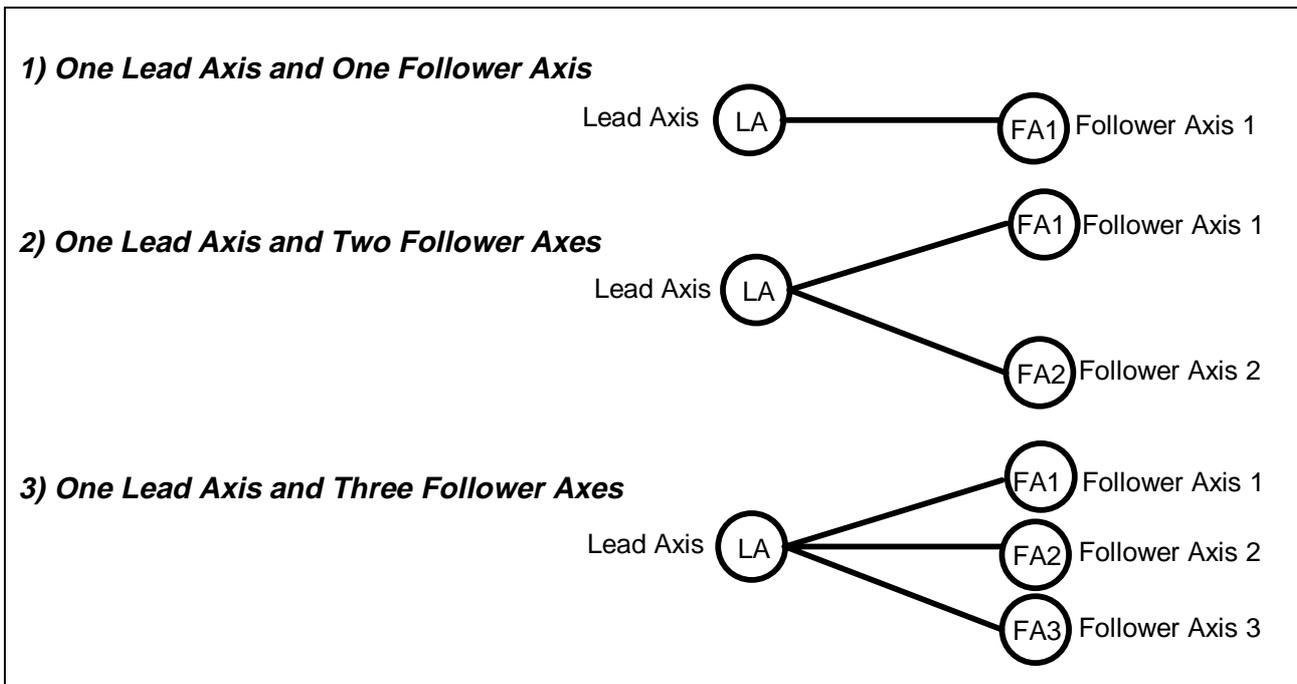


Fig. 2-1: Legal synchronized axis groups within a process for axis synchronization and for gantry mode.

2.3 Legal Axis Types

All axis types with the exception of tool storage axes, spindles, and combined spindle/turret axes may also be used in a synchronized axis group. Specifically, the legal axis types may be:

- digital linear axes
- digital modulo rotary axes
- digital limited rotary axes
- digital spindles capable of being rotational axes in the rotational axis mode or
- digital spindles to which a digital axis is assigned in the rotational axis mode

However, either only

- linear axes or
- endless (modulo) rotary axes or
- finite rotary axes

may belong to a synchronized axis group.

It is not possible to mix these primary groups. Digital modulo rotary axes, spindles capable of serving as rotational axes as well as spindles to which a rotational axis is assigned may belong to a synchronized axis group consisting of modulo rotary axes.

2.4 NC-programming

During synchronized operation, the user must not program any axis other than the lead axis of an active synchronized axis group. All other follower axes must not be programmed during synchronized operation. If the user attempts to do this, for example by mirror imaging or scaling a follower axes, the CNC interrupts program execution and generates a process error with message.

Zero offsets (including plane rotations) and tool corrections (including D corrections) are taken into account by the CNC solely for the lead axis. During synchronized operation, the follower axes are supplied with the command values for the lead axis, taking into account the respective translation ratio and direction of rotation.

2.5 Activate and Deactivate Synchronized Axis Group

A synchronized axis group can be activated and deactivated from the CNC-program using an auxiliary function. In manual mode, the user can activate and deactivate synchronized operation by means of a machine key or some other key.

A gateway signal between the SPS and the CNC allows synchronized operation to be activated and deactivated. It is important that the lead and follower axes be traversed to their initial position before activating synchronized operation and that the appropriate Machine Data be parameterized properly.

Once synchronized operation has been deactivated, all the axes in the synchronized axis group keep the same position.

2.6 Tests Performed at the Start of and During Synchronous Operation

When a synchronized axis group is activated, the CNC calculates the maximum velocity, the maximum intermittent speed, and the maximum acceleration of the lead axis for synchronized operation taking into account the appropriate parameters and the existing translation ratios of all axes belonging to the synchronized axis group.

In addition, during synchronized operation, as in all other forms of interpolation, the CNC checks to see if any of the axes in the group have exceeded their traverse range limits. This is done before the CNC processes an NC-block. If the CNC detects that one of the follower axes has exceeded the traverse range limits, it interrupts processing (as with all the other axes) and generates an error message.

3 Exception Conditions

3.1 End of Program and Control Reset

Synchronized operation remains active at end-of-program (BST, RET, JMP, M02 and M30), at Control Reset and during jog in the manual mode provided that the SPS does not use control signals to deactivate the synchronized axis groups.

3.2 Axis Transfer

During synchronized operation, the user may not transfer the axis involved in the synchronized axis group between processes. The use of the axis transfer commands on axes which are taking part in synchronized operation causes execution of the program to terminate and an error message to be issued.

Axes which are involved in synchronized operation and also belong to a different primary process therefore must be transferred to the respective process before the respective axis group is activated. These axes may not be returned to the primary process until the synchronized axis group has been deactivated.



WARNING

⇒ If axes which belong to a different primary process are involved in a synchronized axis group, the synchronization mode must be deactivated prior to the axis enable and thus prior to the end of the CNC-program (BST, RET, JMP, M02, M30), control reset or initial jogging (only if process parameter Bxx.036 'Manual Axis Jogging Causes Reset' is set to 'yes.')

At end-of-program (M02 and M30), Control Reset, and upon initial jogging (only if the process parameter Bxx.036 'Manual Axis Jogging Causes Reset' is set to 'yes'), the SPS can deactivate the respective synchronized axis group before the CNC enables the respective axes.

3.3 Axis Referencing (Homing)

Axes which are not linked mechanically can be referenced individually when the synchronized axis group is inactive.

However, mechanically linked axes (gantry axes) can only be referenced under certain very specific circumstances during synchronized operation.

The essential requirements for this to be done include correct encoder selection, proper parameterization of digital drives equipped with a SERCOS interface (see application description 'Intelligent Digital AC-Servo Drives Equipped with a SERCOS Interface', section on 'Drive-Controlled Referencing', and the section on 'Gantry Axes').

With very rigid links between gantry axes, such as those encountered on machine tool tables which are moved by a number of linear drives, a direct encoder which measures in relative terms (incremental linear scale) is sufficient.

With structures which can be compromised by torsion, for example on portal milling machines, an absolute measuring system is necessary for each axis. INDRAMAT recommends that an integrated multiturn encoder be used for each drive as well as an incremental scale for direct measurement.

A synchronized axis group which is used to operate mechanically linked axes in synch must be activated by setting the appropriate gateway signal after the drives have been supplied with power.

**WARNING**

- Before the synchronized axis group is activated, the SPS has to deactivate the integral action time component of the follower axes via the SERCOS service data channel (regardless of the type of feedback used). If this action is taken, the axes can also be jogged in manual mode when the axes are under mechanical load, which can sometimes occur following power-on, until they are aligned and, if need be, referenced in program-controlled mode.
- For reasons of safety, it may be necessary to align mechanically linked axes with one another and to monitor their torque loads.

Steps of the Referencing Operation1) Absolute Feedback Measuring System

If axes in an active synchronized axis group are equipped with absolute measuring systems, they do not need to be referenced, since as soon as power is supplied, the absolute measuring systems immediately send valid actual positions to the drive amplifier and the controller.

Because of possible stresses in the mechanical structure, it is suggested that gantry axes be aligned with one another under program control. The adjustment moves are best performed with the aid of the 'HOME' program.

Perform the following steps in the 'HOME' program:

- Deactivate the synchronized axis group.
- Activate the integral component of the follower axes.
- Move the follower axes to the position of the lead axis.
- Reactivate the synchronized axis group.

2) Incremental Feedback Measuring System

The referencing operation itself is initiated by means of the referencing command 'G74' for the lead axis, for by activating the Gateway interface signal 'AxxC.HOME' of the lead axis. The CNC then traverses the axes in the synchronized axis group in a synchronous manner until the reference switch is activated, all axes have reached their encoder zero mark, and their 'reference dimension offset 2' has been completely traversed.

The requirements necessary for this must be met as stated in the applications description 'Intelligent Digital AC Servo Drives Equipped with SERCOS Interface' in the sections on 'Drive-Controlled Referencing' and 'Gantry Axes.'

Any adjustment moves which may be required must be performed prior to referencing. For this reason, only program-controlled referencing should be allowed.

Perform the following steps in the 'HOME' program:

- Deactivate the synchronized axis group.
- Activate the integral component of the follower axes.
- Move the follower axes to the position of the lead axis.
- Reactivate the synchronized axis group.
- Reference axes ('G74' for lead axis).

3) Multiturn Encoder on Motor and Additional Incremental Measuring System

After being powered ON, the multiturn encoders immediately send valid actual values to the drive amplifiers and to the controller. The signaled actual positions do, however, deviate from the actual current position by the inaccuracy which results from the indirect form of measurement, which is why the gantry axes must be referenced in spite of the presence of an absolute encoder.

Since the actual values following power ON are not accurate enough with gantry applications and since the effect of strain within the mechanical structure must be minimized, it is a good idea before traversing to the reference point to traverse the follower axis to the position of the lead axis with the synchronized axis group deactivated.

Any adjustment moves which may prove necessary must be programmed in the 'HOME' program in addition to the referencing moves. In this program, use the same sequence of steps as with the incremental measuring system (see above).



WARNING

⇒ In some circumstances given the existing mechanical conditions—for example, linearity errors on scales—it may be necessary to set the integral component of the follower axes to a value lower than that of the lead axis.

3.4 Feed to Positive Stop

Feed to positive stop cannot be used with synchronized mode. If the user programs traversing to a positive stop for a lead or follower axis belonging to an active synchronized axis group, the CNC responds by terminating program execution and issuing a process error with message.

3.5 Coordinate Transformation Function

When coordinate transformation is active (G31), the axes which are involved in the transformation (axes whose meanings are X and C) must not participate in any active synchronized axis group.

3.6 Process Operating Mode Selection

Changing the operating mode does not have any effect on synchronized operation. The link between the axes remains intact.

3.7 'C-Axis' - Main Spindle and Main Spindle with Associated Rotary Axis

If 'C-axis' capable spindles or spindles to which a rotary axis has been assigned are involved in a synchronized axis group, these spindles must already be in rotary mode before the synchronized axis group is activated. If this is not the case, the CNC interrupts CNC-program execution and generates a process error with message.

Switching to spindle mode is permissible once the assigned synchronized axis group is no longer active.

instruction: Main spindle synchronization is necessary for synchronous operation in spindle mode (see Application Manual 'Main Spindle Synchronization').

3.8 Manual Traversing of Follower Axes



WARNING

⇒ If the user traverses a follower axis following an emergency stop, removal of process enable, or deactivation of servo enable, and if the user then resumes processing, the follower axis traverses the remaining distance to go starting from its new position. Unlike in normal operation, the follower axis then traverses to a different final position.

3.9 Process Enable

If the process enable signal is lost during a move, the CNC performs an immediate stop for the process, stopping all axes involved in the feed move via ramp.

3.10 Emergency Stop

In emergency stop, the controller initiates simultaneous braking of all the axes belonging to the synchronized axis group. However, the braking motion is dependent on the residual energy that is available in the DC bus circuit. If the digital AC servo drives equipped with a SERCOS interface can no longer conform to the command values output from the controller, they generate the drive error message 28 'excessive position deviation.'



WARNING

⇒ When operation under program control resumes, one can expect that the follower axis will traverse to a position which is different from that which occurs with normal program operation due in part to the uncontrolled braking.

3.11 Axis-Specific Status Signals

The CNC updates the axis-specific status signals, e. g., the motion notification or the axis way points — as in normal operation — for all axes belonging to the synchronized axis group.

3.12 Axis-Specific Control Signals

The CNC evaluates the following axis-specific signals for the lead axes only during the course of the synchronized operation:

- AxxC.JGPOS Jog positive,
- AxxC.JGNEG Jog negative,
- AxxC.HOME Referencing and
- AxxC.MHOLD Motion hold

The CNC does not consider the signals from the follower axes.

Axis enable	The axis enable signal (AxxC.ENABL) is evaluated by the CNC only in manual operating mode and only for the lead axis.
Regulator release (Ready to Operate)	Deactivation of drive enable (via ready to operate: AxxC.READY) for a follower axis causes the respective axis to stop moving as quickly as possible. Processing then continues with the CNC generating the mes-

sage 'Inactive axis programmed' and braking the remaining axes involved in the process.

The CNC responds in the same way if drive enable is removed from a lead axis during a move. The CNC then also immediately brakes the follower axes as well as the lead axis.

**WARNING**

- ⇒ If the SPS removes servo enable from one of the axes in a synchronized axis group, the CNC cancels synchronized operation so that the given axis can be stopped as quickly as possible.
 - ⇒ When operation under program control resumes, one can expect that the follower axis will traverse to a position which is different from that which occurs with normal program operation due in part to the uncontrolled braking.
-

4 Machine Data

4.1 Structure of Relevant Machine Data

The machine data for the follower and gantry axes occupy a page 40 designated 'Follower and Gantry Axes.' The following data structure is present in the page 40 for each process and for each synchronized axis group:

- 001 Axis Group switched on
- 002 Lead axis in Coord.Sys.
- 003 Follower axis 1 in Coord.Sys
- 004 RPM Lead axis 1 i_LA/FA1
- 005 RPM Follower axis 1 i_LA/FA1
- 006 Direction Follower axis 1
- 007 Follower axis 1 =Gantry axis
- 008 Follower axis 2 in Coord.Sys
- 009 RPM Lead axis 2 i_LA/FA2
- 010 RPM Follower axis 2 i_LA/FA2
- 011 Direction Follower axis 2
- 012 Follower axis 2 =Gantry axis
- 013 Follower axis 3 in Coord.Sys
- 014 RPM Lead axis 3 i_LA/FA3
- 015 RPM Follower axis 3 i_LA/FA3
- 016 Direction Follower axis 3
- 017 Follower axis 3 =Gantry axis

4.2 Modify Machine Data

The individual data elements can be reconfigured at any time from the SPS via the user interface or from the CNC-program provided that the corresponding synchronized axis group is not active. If the user attempts to access the data in an active synchronized axis group from the SPS or from the user interface, the CNC will generate a process error with message. If the user attempts to do this in the CNC-program, he will receive a process error with message, and the CNC will stop processing.

The synchronized axis groups can only be reconfigured from the user interface if the user knows the appropriate password and if the respective group is not active.

instruction: If corrupted data are present when a synchronized axis group is activated, e. g., lead axis specified as 0 in coordinate system, the CNC generates a process error with message and sets the interface signal error (PxxS.ERROR = '1') until activation of the group is canceled. If the operator does not correct this problem by the next attempt to activate a synchronized axis group, the CNC once again generates a process error with message upon the next activation attempt, and sets the gateway signal 'PxxS.ERROR'.

4.3 Description of the Individual Data Elements

Synchronized Axis Group Is Active

Name	Axis Group switched on
Number	1
Purpose	Data element indicates whether the respective synchronized axis group is active.
Value range	0: Synchronized axis group is not active 1: Synchronized axis group is active
Changes	The status information 'Synchronized axis group is active' is only updated by the CNC's operating system. All other subsystems can only access this data element on a read-only basis.

Lead Axis in Coordinate System

Name	Lead axis in Coord.Sys.
Number	2
Purpose	Each linear and rotary axis as well as each 'C-axis' capable spindle and spindle with assigned rotary axis (if in rotary mode) can be declared a lead axis.
Value range	0 - 9 0: No lead axis present 1: Axis in coordinate system X 2: Axis in coordinate system Y 3: Axis in coordinate system Z 4: Axis in coordinate system U 5: Axis in coordinate system V 6: Axis in coordinate system W 7: Axis in coordinate system A 8: Axis in coordinate system B 9: Axis in coordinate system C
Default	0 (a lead axis does not exist for the respective synchronized axis group)
Evaluation	If the data element 'Lead axis in coord. sys.' is set to the value '0' when the respective synchronized axis group is activated, the CNC interrupts processing and generates a process error with message.

Follower Axis in Coordinate System

Name	Follower axis 1, 2, 3, in Coord.Sys
Number	3, 8, 13
Purpose	Each linear and rotary axis as well as each 'C-axis' capable spindle can be declared a follower axis. by stating the appropriate coordinate system code.
Value range	0 - 9 0: No follower axis present 1: Axis in coordinate system X 2: Axis in coordinate system Y 3: Axis in coordinate system Z 4: Axis in coordinate system U 5: Axis in coordinate system V 6: Axis in coordinate system W

	7:	Axis in coordinate system A
	8:	Axis in coordinate system B
	9:	Axis in coordinate system C
Default	0	(the follower axis 1/2/3 does not exist for the respective synchronized axis group)
Evaluation		If no follower axis is entered when the respective synchronized axis group is activated, the CNC interrupts processing and generates a process error message.

Translation Ratio for Follower Axis

Name	Translation ratio
	$\text{Translation ratio} = \frac{\text{RPM of lead axis}}{\text{RPM of follower axis } j} \quad j \in \{1, 2, 3\}$
Number	4/5, 9/10, 14/15
Purpose	The translation ratios (i_LA/FA1, i_LA/FA2 and i_LA/FA3) are declared based on the machine data <ul style="list-style-type: none"> • RPM of lead axis and • RPM of follower axis 1/2/3 to avoid rounding errors.
Value range	1 - 65535 (for RPM speeds of lead and follower axes)



WARNING

⇒ The translation ratios (i_LA/FA1, i_LA/FA2 und i_LA/FA3) must lie within the range of 0.01 to 100.

Default 0 (for RPM speeds of lead and follower axes)

Direction of Follower Axis

Name	Direction Follower axis 1/2/3
Number	6, 11, 16
Purpose	'Direction Follower axis 1/2/3' permits the direction of rotation of follower axis 1/2/3 to be reversed relative to the lead axis.
Value range	0: No change in direction 1: Change in direction
Default	0

Follower Axis = Gantry Axis

Name	Slave axis 1/2/3 = gantry axis
Number	7, 12, 17
Purpose	The CNC does not evaluate this data element.
Value range	0/1
Default	0

5 Gateway Control Signals

5.1 Activate Synchronized Axis Group

Name	PxxC.SCON1,..2,..3,..4 (Synchronous Control 1/2/3/4 ON)
Type	Process-specific control signals
Purpose	By setting the control signal 'PxxC.SCON1,..2,..3,..4', the SPS activates the corresponding synchronized axis group. It deactivates this group by resetting the status signal.
Meaning	PxxC.SCON1,..2,..3,..4 = 1: Activate synchronized axis group 1/2/3/4 PxxC.SCON1,..2,..3,..4 = 0: Deactivate synchronized axis group 1/2/3/4

instruction: When axis synchronization is active, the CNC checks the respective configuration (see section 2.2). If the CNC detects an error during this check, it generates an error message and stops processing.



WARNING

⇒ If during program operation the SPS independently activates or deactivates a synchronized axis group in a manner that is not synchronized with program execution (without an auxiliary function with acknowledgment), the CNC does not perform the command until block preparation is interrupted.

5.2 Synchronized Axis Group Is Active

Name	PxxS.SCON1,..2,..3,..4 (Synchronous Control 1/2/3/4 ON)
Type	Process-specific status signals
Purpose	The CNC uses this status signal to report which synchronized axis groups are active in the process.
Meaning	PxxS.SCON1,..2,..3,..4 = 0: Synchronized axis group 1/2/3/4 is active. PxxS.SCON1,..2,..3,..4 = 1: Synchronized axis group 1/2/3/4 is active.

6 Example: Slaving a Follower Rest

Long shafts are machined on a lathe (X, Z, S and C). Two follower rests (U1 and U2) are slaved to traverse in a group on portions of the shaft in order to prevent the shaft from flexing.

Axis Designation	Axis Number	Axis in Coord. Sys.	Axis Processor
S	1	S1(10)	1
Z	2	Z(3)	1
U1	3	U(4)	1
U2	4	V(5)	1
X	5	X(1)	2
C	6	C(9)	2

6.1 NC-program

```

.
.
.
;
; Position follower rest U1 and activate synchronized control (slaving)
function
;
N0286 G00 Z1150 U1=1150 M301 ;Position Z-axis and follower rest
U1 and activate synchronized
axis group 1
;
; Machining
N0287 G00 X... ;Move in X
.
.
.
N0305 G00 X... M300 ;Withdraw in X and deactivate
synchronized axis group 1
.
.
.
;
; Position follower rest U2 and activate synchronized control (slaving)
function
;
N0346 G00 Z450 U2=450 M302 ;Position Z axis and follower rest
U2 and activate synchronized
axis group 2
;
; Machining
N0347 G00 X... ;Approach in X
.
.
.
N0365 G00 X... M300 ;Withdraw in X and deactivate
synchronized axis group 2
.
.
.

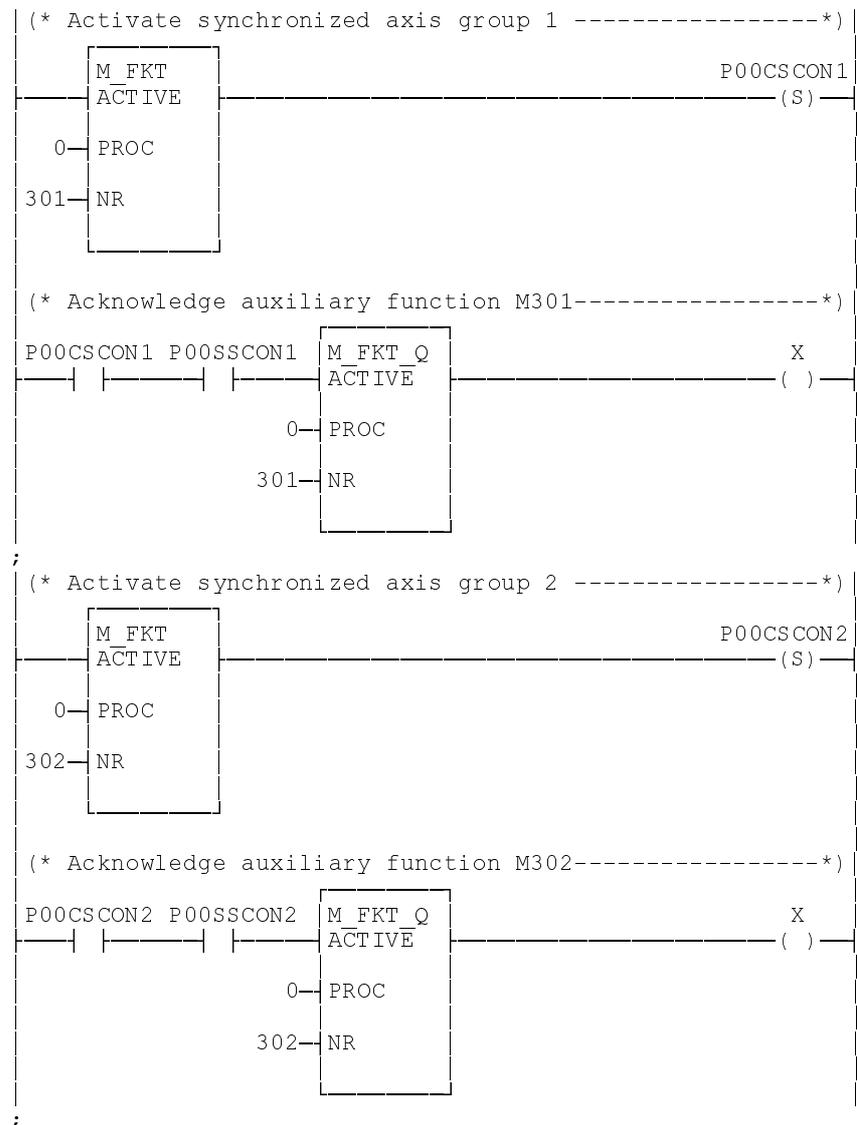
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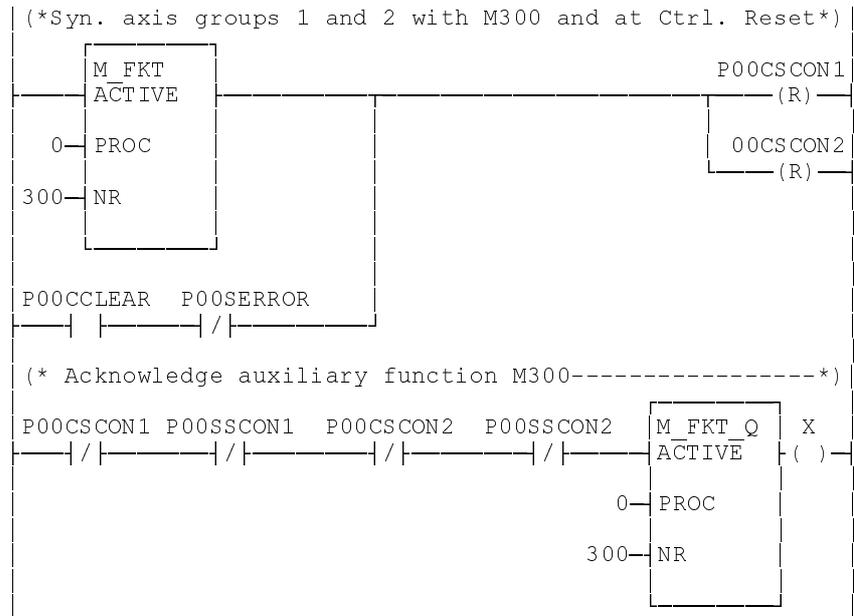
6.2 SPS Program

The following M-functions are programmed in the SPS program:

- 'M301' for activating synchronized axis group 1 (Z axis and follower rest U1),
- 'M302' for activating synchronized axis group 2 (Z axis and follower rest U2),
- 'M300' for deactivating all synchronized axis groups

It is important to know that the SPS does not acknowledge activation and deactivation of the synchronized axis groups until the CNC uses the corresponding interface signal to report that the required state has been achieved. The CNC will not resume program execution until the M-functions are acknowledged.





6.3 Machine Data

Since only two synchronized axis groups are required during operation of the machine, the machine manufacturer can place the data needed for the first synchronized axis group (Z axis and follower rest U1) and for the second axis group (Z axis and follower rest U2) in the machine data at start-up.

No.	Machine Data	Axis Group 1	Axis Group 2	Axis Group 3	Axis Group 4
001	Axis Group switched on	0	0	0	0
002	Lead axis in Coord.Sys.	3	3	0	0
003	Follower axis 1 in Coord. Sys	4	5	0	0
004	RPM Lead axis 1 i_LA/FA1	1	1	0	0
005	RPM Follower axis 1 i_LA/FA1	1	1	0	0
006	Direction Follower axis 1	0	0	0	0
007	Follower axis 1 = Gantry axis	0	0	0	0
008	Follower axis 2 in Coord. Sys	0	0	0	0
009	RPM Lead axis 2 i_LA/FA2	0	0	0	0
010	RPM Follower axis 2 i_LA/FA2	0	0	0	0
011	Direction Follower axis 2	0	0	0	0
012	Follower axis 2 = Gantry axis	0	0	0	0
013	Follower axis 3 in Coord. Sys	0	0	0	0
014	RPM Lead axis 3 i_LA/FA3	0	0	0	0
015	RPM Follower axis 3 i_LA/FA3	0	0	0	0
016	Direction Follower axis 3	0	0	0	0
017	Follower axis 3 = Gantry axis	0	0	0	0

7 Startup Information

- The machine builder may define any desired M- or Q-functions to activate and deactivate the synchronized axis groups.
- The current torque or the 'load' should be shown in the position display. In the case of mechanically linked axes, it is especially important to monitor the 'load'.
- It must be noted in conjunction with axis transfer that each axis name in the coordinate system can only be present once in each process.
- The limit switches and reference switches for the lead and follower are to be wired as for the 'normal' axes.



WARNING

⇒ Only digital feed drives equipped with the SERCOS interface and digital main spindles equipped with the SERCOS interface can be used in a synchronized axis group.

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Customer Service

Germany

Vertriebsgebiet Mitte INDRAMAT GmbH D-97816 Lohr am Main Bgm.-Dr.-Nebel-Str. 2 Telefon: 09352/40-0 Telefax: 09352/40-4885	Vertriebsgebiet Ost INDRAMAT GmbH D-09120 Chemnitz Beckerstraße 31 Telefon: 0371/3555-0 Telefax: 0371/3555-230	Vertriebsgebiet West INDRAMAT GmbH D-40849 Ratingen Hansastraße 25 Telefon: 02102/4318-0 Telefax: 02102/41315	Vertriebsgebiet Nord INDRAMAT GmbH D-22085 Hamburg Fährhausstraße 11 Telefon: 040/227126-16 Telefax: 040/227126-15
Vertriebsgebiet Süd INDRAMAT GmbH D-80339 München Ridlerstraße 75 Telefon: 089/540138-30 Telefax: 089/540138-10	Vertriebsgebiet Südwest INDRAMAT GmbH D-71229 Leonberg Böblinger Straße 25 Telefon: 07152/972-6 Telefax: 07152/972-727		INDRAMAT Service-Hotline INDRAMAT GmbH Telefon: D-0172/660 040 6 -oder- Telefon: D-0171/333 882 6

Customer Service in Germany

Europe

Austria G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-1140 Wien Hägelegasse 3 Telefon: 1/9852540-400 Telefax: 1/9852540-93	Austria G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-4061 Pasching Randlstraße 14 Telefon: 07229/4401-36 Telefax: 07229/4401-80	Belgium Mannesmann Rexroth N.V.-S.A. Geschäftsbereich INDRAMAT B-1740 Ternat Industrielaan 8 Telefon: 02/5823180 Telefax: 02/5824310	Denmark BEC Elektronik AS DK-8900 Randers Zinkvej 6 Telefon: 086/447866 Telefax: 086/447160
England Mannesmann Rexroth Ltd. INDRAMAT Division Cirencester, Glos GL7 1YG 4 Esland Place, Love Lane Telefon: 01285/658671 Telefax: 01285/654991	Finnland Rexroth Mecman OY SF-01720 Vantaa Riihimiehentie 3 Telefon: 0/848511 Telefax: 0/846387	France Rexroth - Sigma S.A. Division INDRAMAT F-92632 Gennevilliers Cedex Parc des Barbanniers 4, Place du Village Telefon: 1/41475430 Telefax: 1/47946941	France Rexroth - Sigma S.A. Division INDRAMAT F-69634 Venissieux - Cx 91, Bd 1 Joliot Curie Telefon: 78785256 Telefax: 78785231
France Rexroth - Sigma S.A. Division INDRAMAT F-31100 Toulouse 270, Avenue de l'ardenne Telefon: 61499519 Telefax: 61310041	Italy Rexroth S.p.A. Divisione INDRAMAT I-20063 Cernusco S/N.MI Via G. Di Vittoria, 1 Telefon: 02/92365-270 Telefax: 02/92108069	Italy Rexroth S.p.A. Divisione INDRAMAT Via Borgomanero, 11 I-10145 Torino Telefon: 011/7712230 Telefax: 011/7710190	Netherlands Hydraudyne Hydrauliek B.V. Kruisbroeksestraat 1a P.O. Box 32 NL-5280 AA Boxtel Telefon: 04116/51951 Telefax: 04116/51483
Spain Rexroth S.A. Centro Industrial Santiago Obradors s/n E-08130 Santa Perpetua de Mogoda (Barcelona) Telefon: 03/718 68 51 Telex: 591 81 Telefax: 03/718 98 62	Spain Goimendi S.A. División Indramat Jolastokieta (Herrera) Apartado 11 37 San Sebastian, 20017 Telefon: 043/40 01 63 Telex: 361 72 Telefax: 043/39 93 95	Sweden AB Rexroth Mecman INDRAMAT Division Varuvägen 7 S-125 81 Stockholm Telefon: 08/727 92 00 Telefax: 08/64 73 277	Switzerland Rexroth SA Département INDRAMAT Chemin de l'Ecole 6 CH-1036 Sullens Telefon: 021/731 43 77 Telefax: 021/731 46 78
Switzerland Rexroth AG Geeschäftsbereich INDRAMAT Gewerbestraße 3 CH-8500 Frauenfeld Telefon: 052/720 21 00 Telefax: 052/720 21 11	Russia Tschudnenko E.B. Arsenia 22 153000 Ivanovo Rußland Telefon: 093/22 39 633		

Customer Service in Europe

Outside of Europe

<p>Argentina</p> <p>Mannesmann Rexroth S.A.I.C. Division INDRAMAT Acassusso 48 41/7 1605 Munro (Buenos Aires) Argentina</p> <p>Telefon: 01/756 01 40 01/756 02 40 Telex: 262 66 rexro ar Telefax: 01/756 01 36</p>	<p>Argentina</p> <p>Nakase Asesoramiento Tecnico Diaz Velez 2929 1636 Olivos (Provincia de Buenos Aires) Argentina Argentina</p> <p>Telefon 01/790 52 30</p>	<p>Australia</p> <p>Australian Industrial Machinery Services Pty. Ltd. Unit 3/45 Horne ST Campbellfield VIC 2061 Australia</p> <p>Telefon: 03/93 59 0228 Telefax: 03/93 59 02886</p>	<p>Brazil</p> <p>Mannesmann Rexroth Automação Ltda. Divisão INDRAMAT Rua Georg Rexroth, 609 Vila Padre Anchieta BR-09.951-250 Diadema-SP Caixa Postal 377 BR-09.901-970 Diadema-SP</p> <p>Telefon: 011/745 90 65 011/745 90 70 Telefax: 011/745 90 50</p>
<p>Canada</p> <p>Basic Technologies Corporation Burlington Division 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8</p> <p>Telefon: 905/335-55 11 Telefax: 905/335-41 84</p>	<p>China</p> <p>Rexroth (China) Ltd. Shanghai Office Room 206 Shanghai Intern. Trade Centre 2200 Yanan Xi Lu Shanghai 200335 P.R. China</p> <p>Telefon: 021/627 55 333 Telefax: 021/627 55 666</p>	<p>China</p> <p>Rexroth (China) Ltd. Shanghai Parts & Service Centre 199 Wu Cao Road, Hua Cao Minhang District Shanghai 201 103 P.R. China</p> <p>Telefon: 021/622 00 058 Telefax: 021/622 00 068</p>	<p>China</p> <p>Rexroth (China) Ltd. 1430 China World Trade Centre 1, Jianguomenwai Avenue Beijing 100004 P.R. China</p> <p>Telefon: 010/50 50 380 Telefax: 010/50 50 379</p>
<p>China</p> <p>Rexroth (China) Ltd. A-5F., 123 Lian Shan Street Sha He Kou District Dalian 116 023 P.R. China</p> <p>Telefon: 0411/46 78 930 Telefax: 0411/46 78 932</p>	<p>Honkong</p> <p>Rexroth (China) Ltd. 19 Cheung Shun Street 1st Floor, Cheung Sha Wan, Kowloon, Honkong</p> <p>Telefon: 741 13 51/-54 und 741 14 30 Telex: 3346 17 GL REX HX Telefax: 786 40 19 786 07 33</p>	<p>India</p> <p>Mannesmann Rexroth (India) Ltd. INDRAMAT Division Plot. 96, Phase III Peenya Industrial Area Bangalore - 560058</p> <p>Telefon: 80/839 21 01 80/839 73 74 Telex: 845 5028 RexB Telefax: 80/839 43 45</p>	<p>Japan</p> <p>Rexroth Co., Ltd. INDRAMAT Division I.R. Building Nakamachidai 4-26-44 Tsuzuki-ku, Yokohama 226 Japan</p> <p>Telefon: 045/942-72 10 Telefax: 045/942-03 41</p>
<p>Korea</p> <p>Rexroth-Seki Co Ltd. 1500-12 Da-Dae-Dong Saha-Gu, Pusan, 604-050</p> <p>Telefon: 051/264 90 01 Telefax: 051/264 90 10</p>	<p>Korea</p> <p>Seo Chang Corporation Ltd. Room 903, Jeail Building 44-35 Yoido-Dong Youngdeungpo-Ku Seoul, Korea</p> <p>Telefon: 02/780-82 07 -9 Telefax: 02/784-54 08</p>	<p>Mexico</p> <p>Motorización y Diseño de Controles, S.A. de C.V. Av. Dr. Gustavo Baz No. 288 Col. Parque Industrial la loma Apartado Postal No. 318 54060 Tlalnepantla Estado de Mexico</p> <p>Telefon: 5/397 86 44 Telefax: 5/398 98 88</p>	
<p>USA</p> <p>Rexroth Corporation INDRAMAT Division 5150 Prairie Stone Parkway Hoffman Estates, Illinois 60192</p> <p>Telefon: 847/645-36 00 Telefax: 857/645-62 01</p>	<p>USA</p> <p>Rexroth Corporation INDRAMAT Division 2110 Austin Avenue Rochester Hills, Michigan 48309</p> <p>Telefon: 810/853-82 90 Telefax: 810/853-82 90</p>		

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