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MTC200/MT-CNC
Multi-Block Retrace and Return to Contour
18VRS

Application Manual

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Purpose of the document This document describes the NC functions ‘Multi-block retrace’ and 'Return to contour'.

Configuration control

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Contents

1 Introduction

The 'Return to contour' and ‘Multi-block retrace’ functions automate the approach to the contour after an interruption of the program.

Following an interruption of the program after which the operator has moved the tool from the contour by jogging manually (in order to check the insert of the tool, for example), ‘**multi-block retrace**’ permits the interruption point to be approached from which the axes were retracted. The ‘**return to contour**’ function permits the block starting point to be approached.

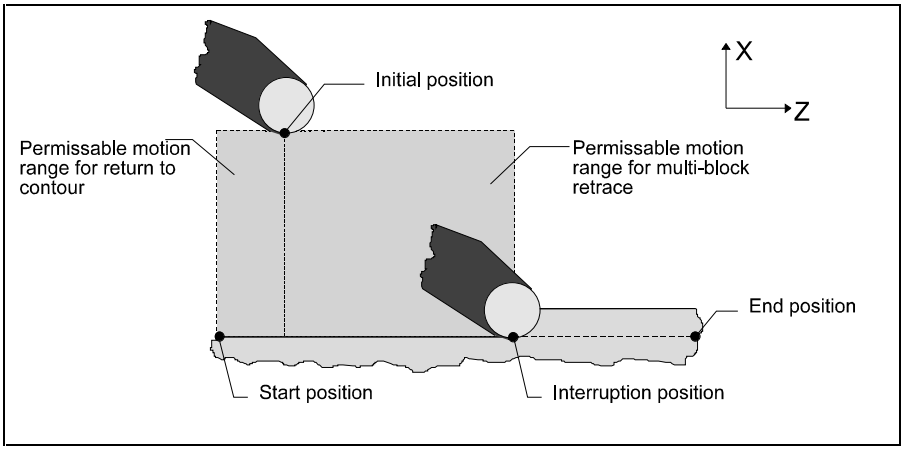

Figure 1-1: Multi-block retrace and return to contour shown at the example of an interrupted turning process

Both functions are available in manual and in automatic mode.

Manual mode In manual mode, the controller adjusts the path difference of the axes between the target position and the actual position in the same sequence in which the operator presses the jog keys.

Automatic mode In automatic mode, the controller employs a defined sequence to move the axes to their target position (even simultaneously, if necessary).

2 Input Sequence

2.1 Initial Situation for Multi-Block Retrace and Return to Contour

The operator has:

- interrupted the program sequence in ‘automatic mode’, ‘semi-automatic mode’ or ‘program execution in manual mode’,
- jogged the axes away from the contour,
- not yet performed a Control-Reset.

Note: The NC ignores the request in any other situation in which the operator activates the ‘multi-block retrace’ or ‘return to contour’ function.
Thus, the functions cannot be used from a reset state (after power-on, after the end of the program, or after Control-Reset) or when the tool has not yet left the contour.

2.2 Multi-Block Retrace and Return to Contour in Manual Mode

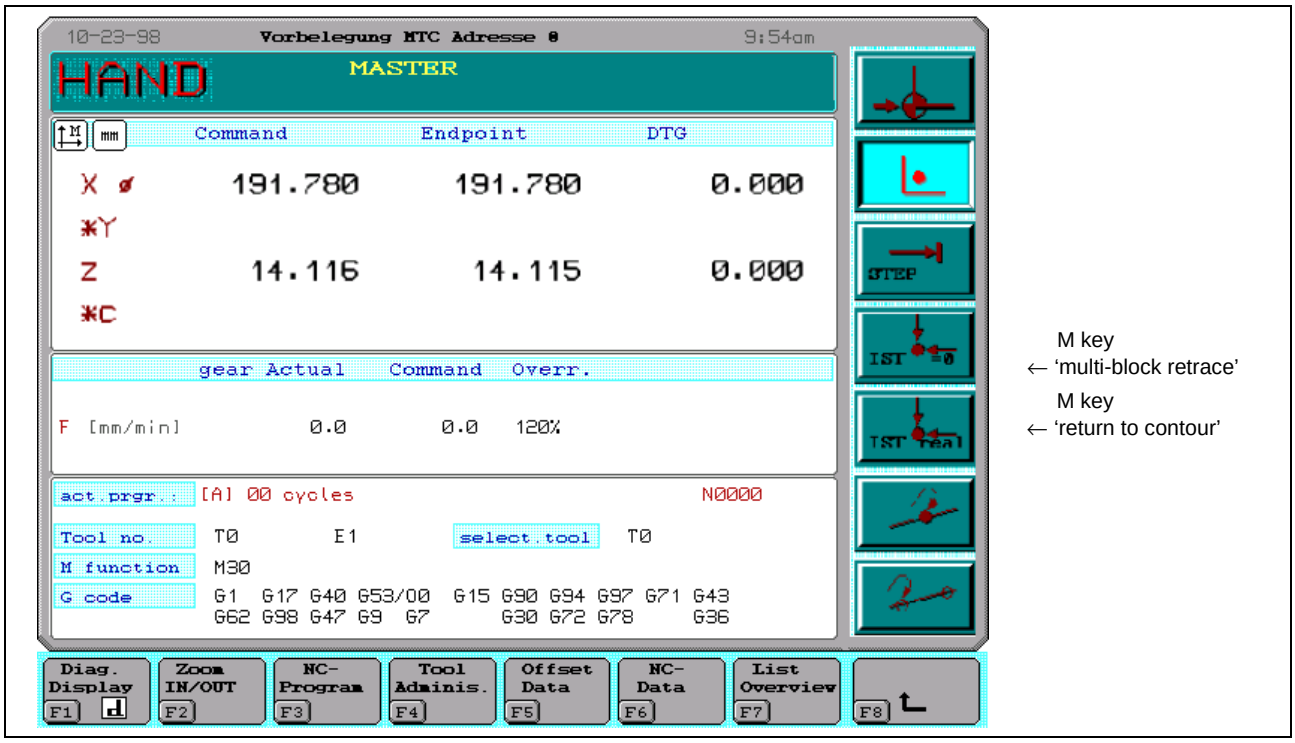

Figure 2-1: Example: Invocation of the multi-block retrace or return to contour function in manual mode using the M keys

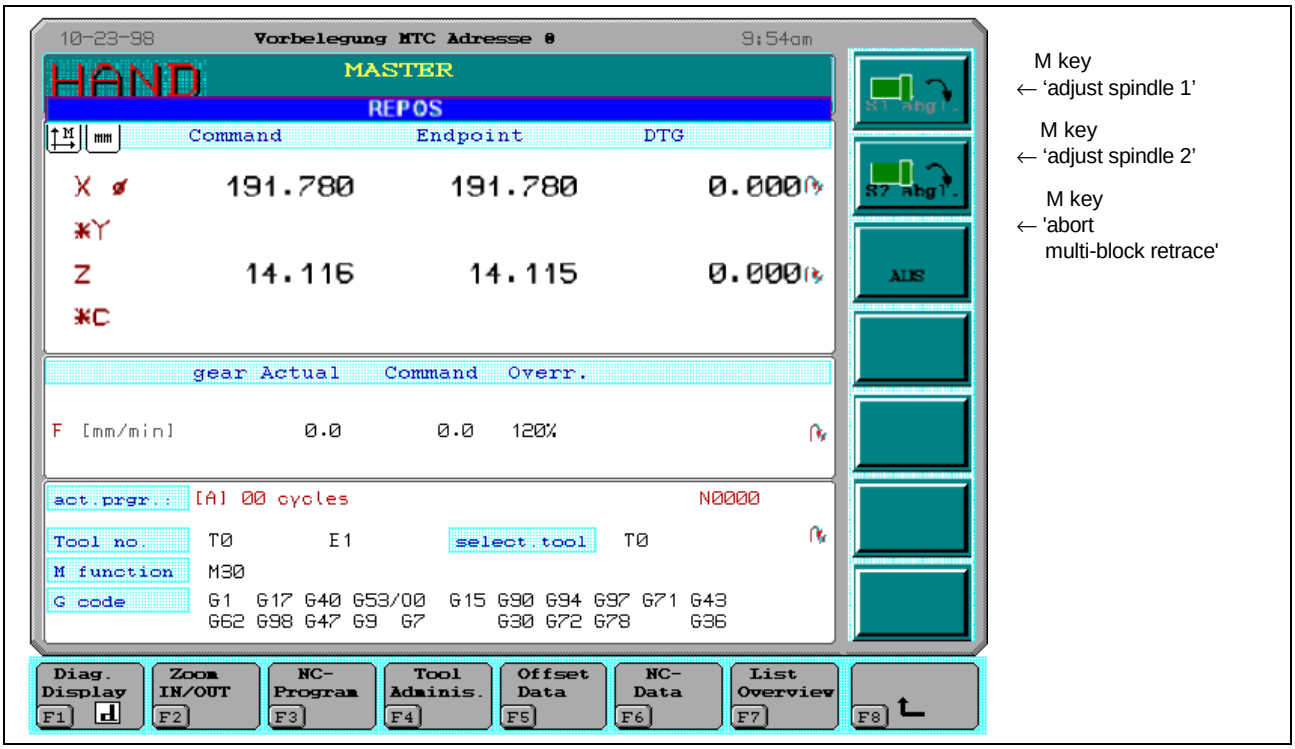

Figure 2-2: REPOS screen for multi-block retrace and return to contour

Operational sequence

1) Select manual mode

   ⇒ Press the MANUAL M key if manual mode has not yet been activated.

2) Select multi-block retrace or return to contour

   ⇒ Press the related key or M key to select multi-block retrace or return to contour.
   For each feed axis, the REPOS screen (see above) contains

   - the end value,
   - the command value, and
   - the remaining distance to go:
     Dist. to go $_{\text{multi-block retrace}}$ = interruption position - actual position
     Dist. to go $_{\text{return to contour}}$ = block start position - actual position.
   - For spindles, the REPOS screen shows the actual value, the command value, the override, and the actual and command M function.
   - In addition, the screen shows the programmed and the actual F value (actual and command value), the feed override, the current program, the current T number and the current M and G commands.
   - The operator must adjust axes and spindles for which the REPOS screen shows an adjust mark ‘ ‘ at the right-hand screen margin.
   - The REPOS screen also displays the adjustment state of the tool magazine axis. If the tool magazine axis has not been adjusted, an adjustment mark will be displayed behind the T word at the right-hand window margin.

3) Press machine control and/or axis jog keys

   ⇒ Use the related axis jog keys to move the tool magazine axis to its previous state if an adjustment mark on the REPOS screen tells you to do so.

   ⇒ Spindles for which the REPOS screen shows the adjustment mark require the 'spindle adjustment' M key to be used for bringing them to the state they had before the interruption.

   ⇒ Any interrupted auxiliary functions (such as coolant) must be switched back on.

⇒ Feed axes for which the REPOS screen shows an adjustment mark must be adjusted using the axis jog keys.

4) Continue machining

⇒ Press the AUTO or SEMI-AUTO M key and select the required program mode.

⇒ Press the start key to continue machining.

2.3 Multi-Block Retrace and Return to Contour in Program Mode

1) Select multi-block retrace or return to contour

⇒ Press the 'multi-block retrace' or 'return to contour' M key and select the required function in manual mode. The displayed REPOS screen corresponds to the screen of multi-block retrace or return to contour in manual mode (see above).

2) Select AUTO or SEMI-AUTO mode

⇒ Press the AUTO or SEMI-AUTO key.

3) Press the start key

⇒ Press the start key
Multi-block retrace or return to contour is started.
Next, the NC adjusts the axes and spindles in a sequence that can be specified.

Note: In a (REPOS) subroutine, the machine manufacturer can specify the sequence in which the NC adjusts the axes and spindles and outputs the auxiliary functions. In that subroutine, the machine manufacturer can store any logic, thus ensuring safe multi-block retrace and/or return to the contour, even in an exceptional situation (and in complex machine systems).

The NC continues program execution without interruption (or a new start) as soon as all spindles and axes have been adjusted and the REPOS subroutine has been executed.

2.4 Recommendations for Multi-Block Retrace and Return

The operator should activate multi-block retrace or return to contour in manual mode and should jog the axes towards the contour until a collision is no longer possible. Next, the operator should switch over to the program mode that was last active and press the start key in that mode to continue multi-block retrace or return to contour.

Note: In automatic mode (if single-block mode has not been selected), the NC continues program execution after multi-block retrace or return to contour without any interruption (or without a new start). Thus, an early transition to automatic mode can avoid relief cutting of the tool and, consequently, relief cutting marks on the workpiece.

2.5 Permissible Operator Inputs Prior to Multi-Block Retrace or Return to Contour

Modifying the axis states

In jog mode, the operator may perform nearly any movement of the feed axes, tool memory axes and spindles (in order to move the tool away from the workpiece, for example).

Modifying zero offsets

The operator can edit the active zero offset and thus move or rotate the workpiece coordinate system and, consequently, the workpiece contour.

Note: Editing the zero point offset data during program interruption moves and rotates the programmed contour and, in addition, the interruption point and the block start point.

Modifying tool and D corrections

Any modification of the tool correction values (including the D corrections) during a program interruption causes the tool carrier to be shifted.

Modifying tool and D corrections during a program interruption and continuing machining (without any further operator inputs) at the beginning of the block or at the interruption points proves particularly advantageous if a tool must be replaced due to wear or breakage.

Furthermore, a **measuring step** may be performed at any point. In this process, the operator interrupts program execution during a motion block, jogs the axes away from the contour, determines the actual dimension of the created geometry, and enters the difference to the command value in the geometry or wear data of the active tool. Next, machining is continued with the multi-block retrace or return to contour function.

Activating or de-activating auxiliary functions

During a program interruption, auxiliary functions (such as coolant) may be activated/de-activated via the M keys of the PC or BTM.

Note: If the auxiliary functions that were active before the interruption shall be active at the beginning of the multi-block retrace or return to contour function, the machine manufacturer should save in the SPS the states of all relevant auxiliary functions upon the first jog movement, and automatically update them when the functions are invoked.

3 Manual Mode

3.1 General

During multi-block retrace and during return to contour, the operator may choose the sequence in which he or she uses the jog keys for restoring the states and axis positions that existed before the interruption.

During multi-block retrace and return to contour in manual mode, like in jog mode, up to nine feed axes and three spindles may simultaneously be caused to assume the states they had before the interruption.

3.2 Feed Axes

In the jog operation, the NC moves the feed axes according to the selected jog mode (PxxCJOGMn). In contrast to jog mode, the NC prevents the target position from being overtraveled during multi-block retrace or return to contour.

Within the permissible motion range (between target position and initial position, see Fig. 1-1), the operator may move the feed axes in the opposite direction (to avoid an obstacle, for example). Like in jogging, the feed axes may be moved in any sequence.

Note: With endlessly rotating rotary axes, the target position may be overtraveled. The user interface clears the associated adjustment mark as soon as the target position is reached. The user interface sets the adjustment mark when the target position is overtraveled.

3.3 Spindles

A positive edge of the associated interface signal permits the state before the interruption to be restored:

State before interruption (command M function)	Mode	Signal to be actuated
M03 Sxxx	Speed control	AxxCM3 or AxxCM4
M04 Sxxx	Speed control	AxxCM4 or AxxCM3
M05	Speed control	AxxCM5
M19 Sxxx	Position specification	AxxCM19

Note: In order to be able to adjust the spindles, the 'spindle adjustment function' should be assigned to the M keys for each spindle on the user interface, and be integrated in the existing SPS program using the associated intermediate flags.

With main spindles with rotary axis capability, the user may employ the jog keys for approaching the rotary axis position that existed before the interruption.

3.4 Tool Magazine Axes

During multi-block retrace or return to contour, the NC moves NC- or SPS-controlled tool magazine axes (including combined spindle/turret axes) like in jog mode when the jog keys ‘PxxCMGPOS’ or ‘PxxCMGNEG’ interface signals) are pressed.

Note: With endlessly rotating NC- or SPS-controlled tool magazine axes, the target position may be overtraveled. The user interface clears the associated adjustment mark as soon as the target position is reached. The user interface sets the adjustment mark when the target position is overtraveled.

4 Program Modes

4.1 REPOS Subroutine

The REPOS subroutine enables the machine manufacturer to adjust the approach strategy for multi-block retrace or return to contour to the circumstances and states at the machine.

All NC commands are permitted within the REPOS subroutine (like in the homing program). Besides the NC commands that are used for creating the original axis states (G77), the user may program logic commands, in particular, and, for example, activate or deactivate auxiliary commands that must always be active or inactive during processing (e.g. 'coolant ON').

The jump label '.REPOS' must be programmed at the beginning of a subroutine, and 'RTS' must be programmed at the end. The RTS command is necessary for the NC to retain its existing states and not to reset, and to continue program execution without interruption.

Reverse vectors may be programmed within the REPOS subroutine (like in an advance program). If a reverse occurs during multi-block retrace or return to contour, the NC jumps to the valid jump label and continues execution there before it jumps to the '.HOME' label.

The user may store the REPOS subroutine in the current NC program, in the 99 program, or in the cycle memory.

4.2 NC Command 'Return to Contour/Multi-Block Retrace'

Basics

G77 causes the NC to restore the state that is required for program entry for the programmed axes. G77 is a non-modal function. The syntax is identical to the one of the homing function (G74).

Each G77 block in which a feed axis is programmed must contain an F value. If this is not true, the NC interrupts the execution at the beginning of the block and generates an error message.

Feed axes

With G77, the NC employs an interpolation that is similar to G00 for adjusting the distance to go that exists between the target position and the actual position.

During an active G77 block, the NC retains all technology-relevant functions, in particular the G codes. However, it does not take into account neither the G codes that concern the interpolation not the tool radius path correction(as it does in jog mode).

Spindles

‘G77 Sj 0’ (j = ‘’, ‘1’, ‘2’, ‘3’) causes the NC to restore the speed last active for spindle ‘j’, or to approach the specified target position.

To approach the target position, the NC or the digital drive employs the positioning speed that has been stored for spindle positioning in the axis parameters or drive parameters, respectively. An additional F or S value is not required for specifying the positioning velocity.

Note: With spindles with rotary axis capability or spindles with associated rotary axis, the 'spindle and rotary axis mode' saves in the machine data of page 61 'block search and REPOS' in the event of a program interruption. Since the 'G77 Sj 0' command causes the program to be interrupted and an error message to be issued if 'spindle mode' was active before the interruption, this information must be interpreted in the REPOS subroutine. Accordingly, ‘G77 C0’ causes an error message to be issued if 'rotary axis mode' was active before the interruption.

Tool magazine axis

MTP must be used to adjust NC- and SPS-controlled tool magazine axes (including combined spindle/turret axes) in the REPOS subroutine. When MTP is invoked, the NC moves to the location that was last moved to before the interruption (using MTP, MMP, MRF, MHP, MFP, and MOP). The velocity need not be specified in this process.

Like in program mode, the tool magazine axis may move asynchronously to the other axes. Using MRY, the machine manufacturer may synchronize the asynchronous movement of the tool magazine and the movement of the other axes.

5 Boundary Conditions

5.1 Couplings and Non-Modal Functions

The NC activates the couplings and non-modal functions that were de-activated during jog operation only when program execution is continued. Couplings and non-modal functions remain de-activated during multi-block retrace and/or return to contour in manual mode or in the program modes.

5.2 Axis Transfer

An axis that is in a process different than the master process when the first jogging is performed, remains in that process during multi-block retrace or return to contour if the 'Manual Axis Jogging Causes Reset' parameter has been set to '`No`'.

It must be noted during multi-block retrace or return to contour that only axes can be adjusted that are inside the process.

5.3 Transformation Function

In the process of multi-block retrace or return to contour, the NC moves the axes that participate in the transformation (usually 'X' and 'C') in a cartesian way (like in jog operation) when the user moves the axes concerned.

In the REPOS subroutine, the target position must be programmed on the basis of the axis designations of the fictitious cartesian axes when the transformation function is active.

6 Machine Parameters

6.1 Adjustment Window for Multi-Block Retrace and Return to Contour

Designation Adjustment window for multi-block retrace and return to contour

Type Axis parameters for:

- digital and analog linear axes,
- digital and analog rotary axes, and
- digital main spindles with rotary axis capability.

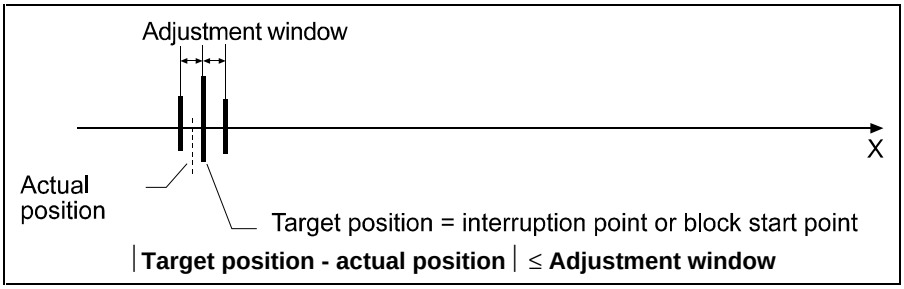

Figure 6-1: Adjustment window

Purpose Using the adjustment windows, the machine manufacturer can define for each feed axis (axis meaning ‘X’, ‘Y’, ‘Z’, ‘U’, ‘V’, ‘W’, ‘A’, ‘B’, ‘C’) when the axis is to be considered adjusted in multi-block retrace or return to contour.

A value of '0' defines that the related axis will not be taken into consideration in multi-block retrace or return to contour. Any other value will cause the NC to monitor the difference between target position and actual position during the process of multi-block retrace or return to contour.

Value range 0,0001 - 200000 [mm]

Default value 0,02 [mm]

Notes:

- Spindles must always be adjusted.
- With NC-controlled tool magazine axes, the NC interprets the process-related 'Re-position Tool Storage Axis' parameter, not this parameter.
- When the transformation function is active, the NC employs the adjustment window of the axis with axis meaning 'X' for the fictitious axes.
- The multi-block retrace and return to contour functions can only be used expediently if the machine manufacturer has set the "Manual Axis Jogging Causes Reset' and Reference Required' parameters to ‘No’.

6.2 Multi-Block Retrace of Tool Magazine Axis

Designation Multi-block retrace of tool magazine axis

Type Process parameter

Purpose Using this parameter, the machine manufacturer can define for NC- and SPS-controlled tool magazine axes whether or not the axis must be adjusted during multi-block retrace or return to contour. Entering '`Yes`' causes the NC to take the tool magazine into account when the group signal 'State before interruption restored' is generated.

Value range Yes / No

Default value No

7 Machine Data

7.1 Machine Data Page ‘Block Search and REPOS’

Designation Block search and REPOS

Page No. 60

From version onward 18V00

Purpose The ‘block search and REPOS’ page defines the spindle mode.

Explanation For each process, the ‘block search and REPOS’ page has the following structure:

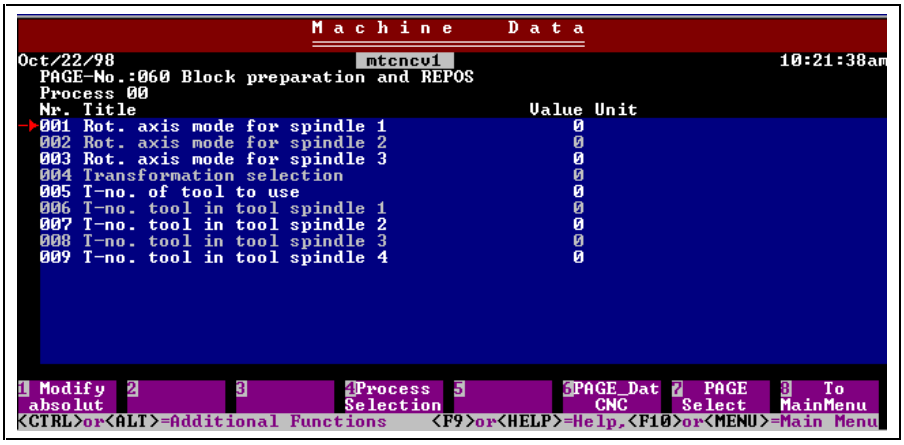

Figure 7-1: Data elements per process of the ‘block search and REPOS’ page

The following table shows the value ranges, default values, and updating time of the data in the ’block search and REPOS’ page.

Data element	Value range	Default value	Updating time
Rotary axis mode for spindle 1 / 2 / 3	0: Spindle mode must be established for the 1st/2nd/3rd spindle of the process. 1: Rotary mode must be established for the 1st/2nd/3rd spindle of the process	0	upon program stop and at the end of the block search when the target block is reached.
Transformation selection	30: Transformation need not be selected 31: G31 must be selected 32: G32 must be selected	0	at the end of the block search when the target block is reached.
T No. of the tool in tool spindle 1 / 2 / 3 / 4	0 through 9999999	0	at the end of the block search when the target block is reached.

Note: The states of the physically existing spindles that are defined in the ’rotary axis mode for spindle 1 / 2 / 3’ data elements of the ’block search and REPOS' page must be established within the ‘.REPOS’ subroutine.

The transformation for facing (G31) or lateral cylinder surface machining (G32) must be selected within the '.ADJUST' subroutine according to the 'transformation selection' machine data element of the 'block search and REPOS' page.

If there is at least one tool spindle within the related process, these tool spindles must, within the '.ADJUST' subroutine, be equipped with the tools that are specified in the 'T no. of tool spindle 1 / 2 / 3 / 4' of the 'block search and REPOS' page.

8 Interface Signals

8.1 Control Signals ‘Multi-Block Retrace ON’ and ‘Return to Contour ON’

Designation

PxxCREPOS (REPOSitioning)
PxxCRESTA (RESTArt)

Purpose

The SPS sets the ‘multi-block retrace’ control signal to activate multi-block retrace, and the ‘return to contour’ control signal to activate return to contour.

Interpretation

The NC only interprets the control signals.

- if the operator has interrupted the execution in the program modes 'automatic mode', 'semi-automatic mode' or 'program execution in manual mode';
- if the operator has left the contour through axis jogging in 'manual mode'; and
- if a Control-Reset has not yet been performed, or at the end of the block search if the related computer run has successfully been performed.

The NC ignores the interface signal in any other situation.

Meaning

PxxCREPOS=0:	Don't activate multi-block retrace
PxxCREPOS=1:	Perform multi-block retrace
PxxCRESTA=0:	Don't activate return to contour
PxxCRESTA=1:	Perform return to contour

Notes:

- In manual mode, the NC aborts multi-block retrace or return to contour after the currently pending movement has been terminated as soon as the SPS resets the ‘multi-block retrace ON’ or 'return to contour ON' control signal. From this moment, the NC moves the axes in jog mode. The target point may then be overtraveled.
- In the program modes it must be ensured that the SPS does not remove the 'multi-block retrace ON’ or 'return to contour ON' control signal prematurely during the execution of the REPOS subroutine. The execution of a 'G77' command during inactive multi-block retrace or return to contour would lead to a program interruption and an error message.

Recommendation

After multi-block retrace or return to contour (including the related screen) has been switched on, the SPS should always maintain the 'multi-block retrace' or 'return to contour' control signals, respectively, until the NC cancels the 'multi-block retrace / return to contour possible' interface signal or the operator aborts the multi-block retrace or return to contour function.

8.2 Status Signal ‘Multi-Block Retrace/Return to Contour Possible‘

Designation PxxSREPOS (REPOSitioning or restart possible)

Purpose The interface signal indicates to the SPS that multi-block retrace or return to contour is possible.

Interpretation The NC sets the ‘multi-block retrace/return to contour possible’ status signal upon each program interruption and after each block search. It only resets the status signal when program execution is continued or the program is aborted by a Control-Reset.

Meaning
PxxSREPOS=0: Multi-block retrace/return to contour is not possible
PxxSREPOS=1: Multi-block retrace/return to contour is possible

8.3 Status Signal ‘State Before Interruption Restored’

Designation PxxSCREST (Conditions RESTored)

Purpose The NC sets the ‘State before interruption restored’ status signal to inform the SPS that all axes that are relevant to multi-block retrace or return to contour have assumed the states they had before the interruption.

The NC considers the following elements as relevant axes whose states must be restored during multi-block retrace or return to contour:

- any spindle including main spindles with rotary axis capability, and combined spindle/turret axes (if they must be in spindle mode for the program entry);
- any feed axis (axis meaning ‘X’, ‘Y’, ‘Z’, ‘U’, ‘V’, ‘W’, ‘A’, ‘B’, ‘C’) including main spindles with rotary axis capability (if they must be in spindle mode for the program entry), whose axis parameter ‘adjustment window for multi-block retrace and return to contour’ is different than ‘0’.
- NC- or SPS-controlled tool magazine axes if their 'Re-position Tool Storage Axis' process parameter has been set to ‘`Yes`’.

Using the group signal ‘State before interruption restored’, for example, enables the machine manufacturer to ensure that all relevant axes are adjusted in manual mode.

Interpretation The NC only updates the status signal during multi-block retrace or return to contour, if the related control signals ‘multi-block retrace’ or ‘return to contour’ have been set.

Meaning
PxxSCREST=0: The state before interruption has not yet been restored.
PxxSCREST=1: The state before interruption has been restored for all relevant axes.

Notes:

- The NC updates axes that have not or only incompletely been adjusted only during the further execution of the program when new command values are specified for the axes concerned.
- The NC resets this status signal when the SPS cancels the ‘multi-block retrace ON’ or ‘return to contour ON’ control signal or when the operator removes an axis from the contour afterwards.

8.4 Interaction of the interface signals

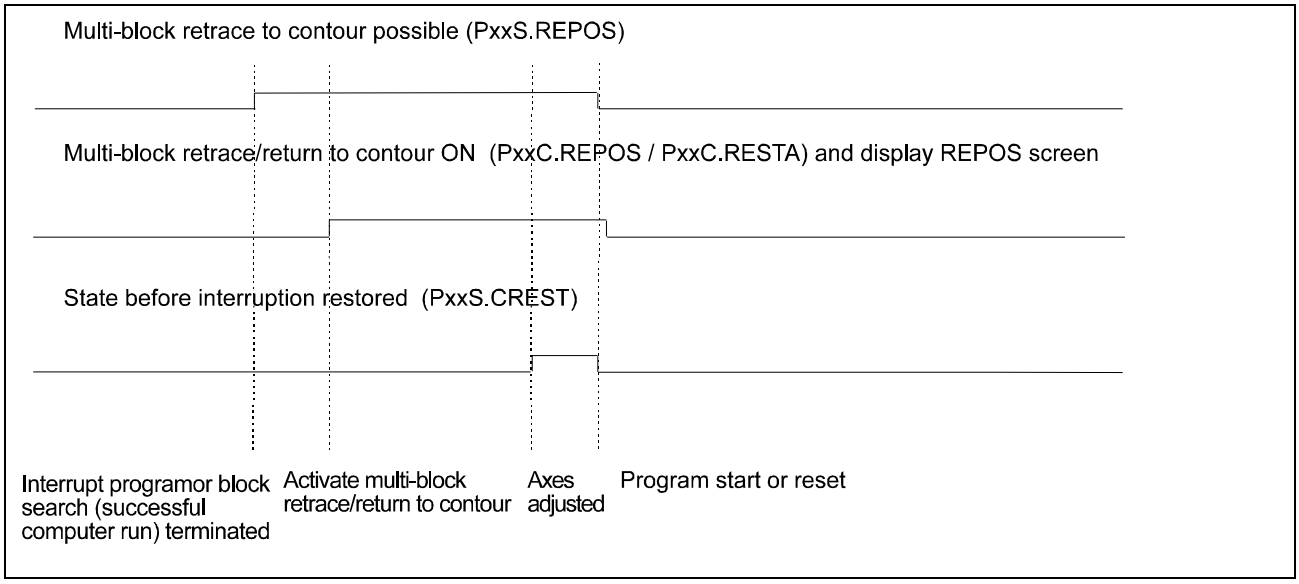

Figure 8-1: Interaction of the control signals for multi-block retrace and return to contour

The NC sets the ‘multi-block retrace/return to contour possible’ interface signal upon each program interruption and at the end of the block search if the associated computer run could successfully be performed.

After jogging has been terminated, the operator presses the M keys to invoke the ‘multi-block retrace’ or 'return to contour' function. This causes the SPS to set the ‘multi-block retrace ON’ or 'return to contour ON' control signals. Upon block search, in contrast, the SPS activates the ‘multi-block retrace’ function automatically after the computer run could successfully be performed and the NC sets the ‘multi-block retrace/return to contour possible’ interface signal.

As soon as the operator has adjusted all axes, the NC reports this by setting the 'state before interruption restored' interface signal. The NC resets this signal when the SPS cancels the ‘multi-block retrace ON’ or 'return to contour ON' control signal or the user removes an axis from the contour afterwards.

The NC resets the ‘multi-block retrace/return to contour possible’ signal as soon as it continues program execution or when the SPS initiates a Control-Reset.

Note: In the program modes it must be ensured that the SPS does not remove the 'multi-block retrace’ or 'return to contour' control signal prematurely during the execution of the REPOS subroutine. The SPS should terminate the 'multi-block retrace' or 'return to contour' function only if the ‘PxxSREPOS’ status signal is no longer applied.

9 Example

For a lathe with the axes ‘S1/C’ (main spindle with rotary axis capability), ‘S2’ (tool spindle), ‘X’ and ‘Z’, and an SPS-controlled tool turret, the functions ‘multi-block retrace’ and ‘return to contour’ must implemented. The tool spindle is a speed-controlled spindle that cannot be positioned.

9.1 Configuring M Keys

Invocation of the ‘multi-block retrace’ or 'return to contour' function

Both functions must be invoked in manual mode via an M key (in the example: level 03). This requires the necessary symbols and texts to be assigned to the corresponding M keys and to enter the auxiliary flags (‘mREPOS’ and ‘mRESTA’ in the example) in the lines that are allocated to the M keys. Besides the auxiliary flags, the next level, the function number 55 (REPOS function), and the name of the submode must be entered there (see also 'Configuring the Graphical User Interface' Configuration Instructions).

The same next level can be entered for both functions if the same functions shall be available to the user during multi-block retrace and return to contour.

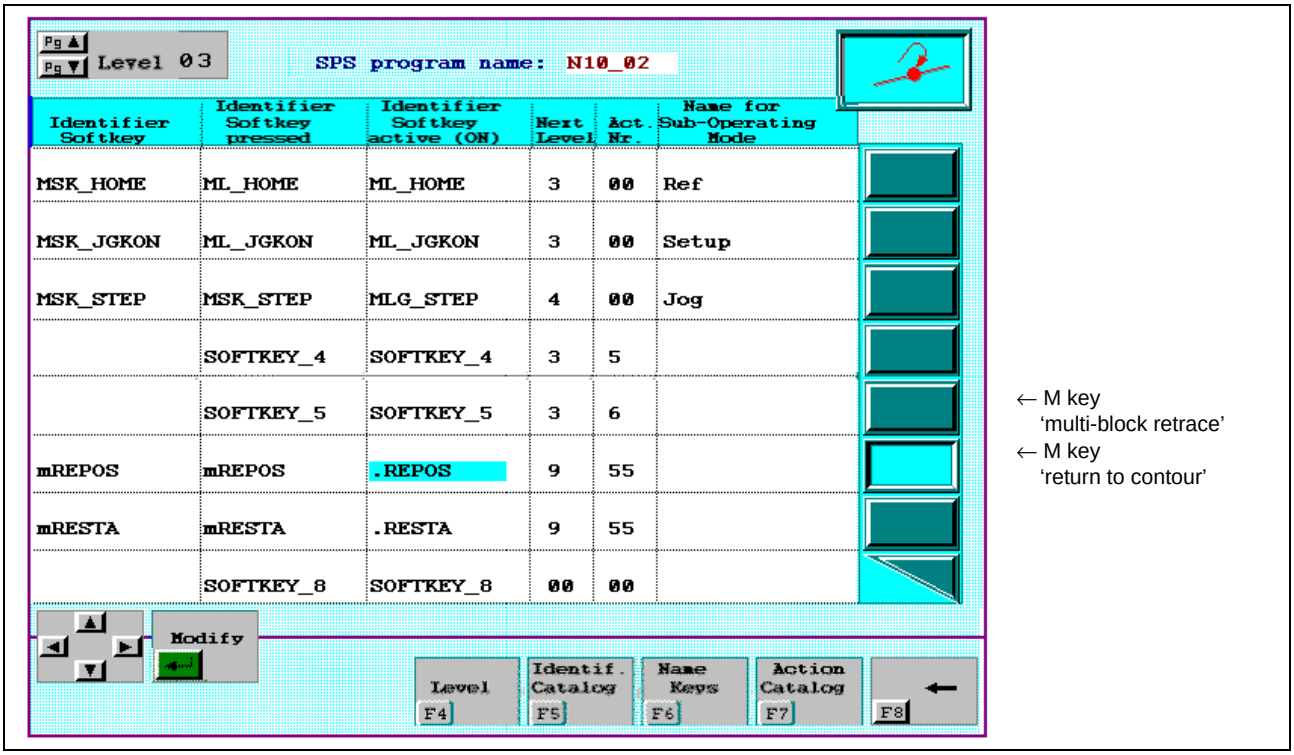

Figure 9-1: Entering the M keys ‘multi-block retrace’ and ‘return to contour’ in the flag table

Invocation of the functions 'spindle adjustment' and 'abort'

For each existing spindle, the related spindle adjustment function, an abortion function, and, if necessary, additional functions (such as ’coolant ON’) must be assigned to the selected next level (in the example: level 09 - see figure below). This requires the associated symbols and texts to be stored for the M keys concerned, and the required data to be entered in the lines of the flag table that are allocated to the M keys.

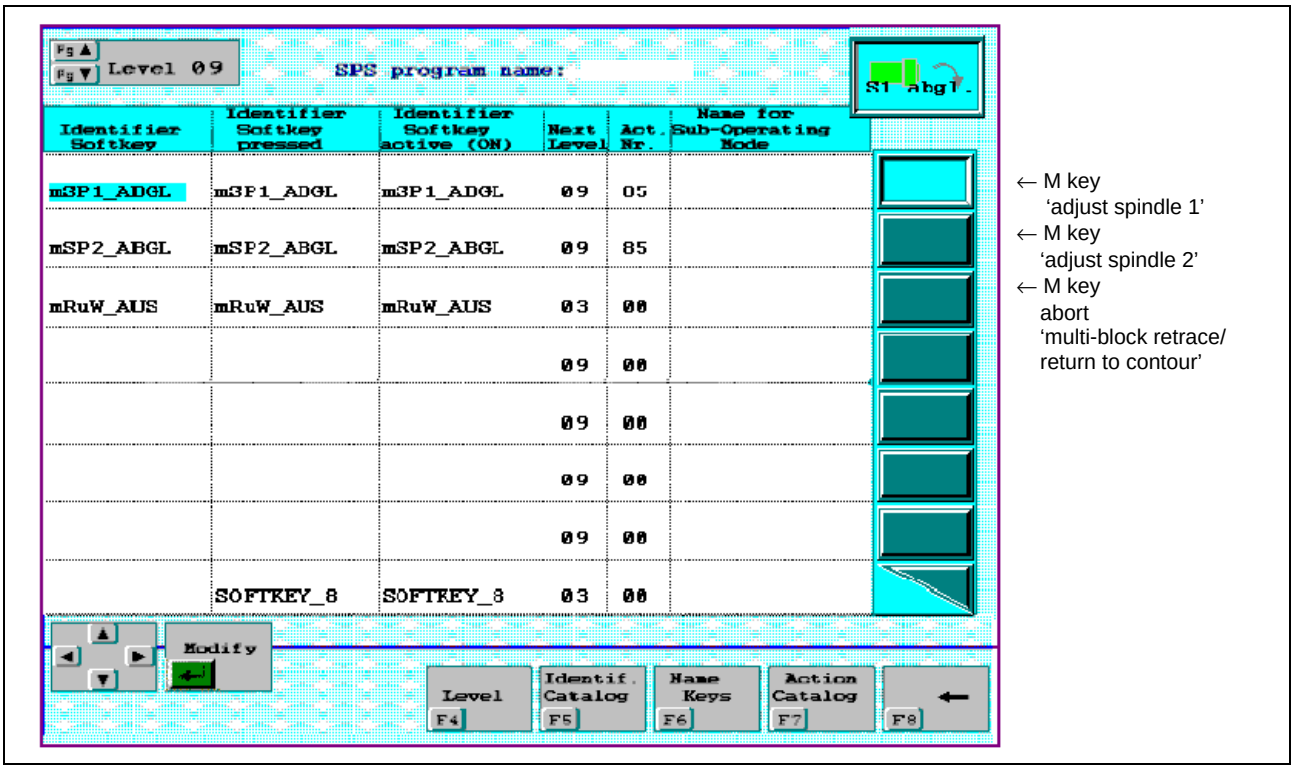

Figure 9-2: Entry of the M keys 'adjust spindle 1' 'adjust spindle 2' and 'abort multi-block retrace / return to contour' in the flag table

Peculiarities of the 'spindle adjustment' function

When the 'spindle adjustment' M key is pressed, the user interface sets the auxiliary flag that has been allocated via the flag table ('mSP1_ABGL' or 'mSP2_ABGL' in the example). Furthermore, it sets the related auxiliary flags 'mAxxCM3', 'mAxxCM4', 'mAxxCM5' or 'mAxxCM19' (depends on the required state) for approximately 400 ms. These flags must be assigned to the related interface signals of the spindle with axis number 'xx' (see SPS program below). Please note that the names of these auxiliary flags cannot be edited.

9.2 SPS Program

Activating and de-activating the ‘multi-block retrace’ and ‘return to contour’ functions

```
 1  |(*multi-block retrace and return to contour permitted*)
|
 2  |P00S.REPOS mRuW_AUS                                                        mRuW_OK |
    ├┤ ├───────┤/├──────────────────────────────────────────────────────────────( )─────┤
    P00S.REPOS.................. multi-block retrace/return to contour possible  BOOL
    mRuW_AUS.................... multi-block retrace/return to contour OFF...    BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour..  BOOL

 3  |(*MULTI-BLOCK RETRACE*)                                                              |
 4  |mREPOS     mRuW_OK    mRESTA                                               P00C.REPOS
    ├┤ ├───────┬┤ ├───────┤/├───────────────────────────────────────────────────( )─────┤
    |P00C.REPOS|                                                                         |
    ├┤ ├───────┘                                                                         |
    mREPOS...................... MULTI-BLOCK RETRACE.....................       BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour..  BOOL
    mRESTA...................... RETURN TO CONTOUR.........................     BOOL
    P00C.REPOS.................. multi-block retrace......................      BOOL
    P00C.REPOS.................. multi-block retrace......................      BOOL

 5  |(*RETURN TO CONTOUR*)                                                                  |
 6  |mRESTA     mRuW_OK    mREPOS                                              P00C.RESTA
    ├┤ ├───────┬┤ ├───────┤/├───────────────────────────────────────────────────( )─────┤
    |P00C.RESTA|                                                                         |
    ├┤ ├───────┘                                                                         |
    mRESTA...................... RETURN TO CONTOUR.........................     BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour..  BOOL
    mREPOS...................... MULTI-BLOCK RETRACE.....................       BOOL
    P00C.RESTA.................. return to contour.........................     BOOL
    P00C.RESTA.................. return to contour.........................     BOOL
```

‘Spindle adjustment for spindle 1

```
 7  |(* M3 jog operation and M3 adjustment for spindle 1 *)                                 |
 8  |T_M3                  SP1_ENBL                                              A01C.M3 |
    ├┤ ├──────────────────┬┤ ├──────────────────────────────────────────────────( )─────┤
    |mA01CM3    mRuW_OK   |                                                              |
    ├┤ ├───────┤ ├───────┘
    T_M3........................  M3 key...............................        BOOL
    SP1_ENBL.................... Movement of spindle 1 permitted.........       BOOL
    A01C.M3..................... Start spindle clockwise........               BOOL
    mA01CM3..................... GBO -> M3.............................        BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour.. BOOL

 9  |(* M4 jog operation and M4 adjustment for spindle 1 *)                                 |
10  |T_M4                  SP1_ENBL                                              A01C.M4 |
    ├┤ ├──────────────────┬┤ ├──────────────────────────────────────────────────( )─────┤
    |mA01CM4    mRuW_OK   |                                                              |
    ├┤ ├───────┤ ├───────┘
    T_M4........................  M4 key...............................        BOOL
    SP1_ENBL.................... Movement of spindle 1 permitted.........       BOOL
    A01C.M4..................... Start spindle counter-clockwise........       BOOL
    mA01CM4..................... GBO -> M4.............................        BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour.. BOOL

11  |(* M5 jog operation and M5 adjustment for spindle 1 *)                                 |
12  |T_M5                  SP1_ENBL                                              A01C.M5 |
    ├┤ ├──────────────────┬┤ ├──────────────────────────────────────────────────( )─────┤
    |mA01CM5    mRuW_OK   |                                                              |
    ├┤ ├───────┤ ├───────┘
    T_M5........................  M5 key...............................        BOOL
    SP1_ENBL.................... Movement of spindle 1 permitted.........       BOOL
    A01C.M5..................... Spindel halt..........................        BOOL
    mA01CM5..................... GBO -> M5.............................        BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour.. BOOL

13  |(* M19 jog operation and M19 adjustment for spindle 1 *) |
14  |T_M19                 SP1_ENBL                                             A01C.M19 |
    ├┤ ├──────────────────┬┤ ├──────────────────────────────────────────────────( )─────┤
    |mA01CM19  mRuW_OK    |                                                              |
    ├┤ ├───────┤ ├───────┘
    T_M19.......................M19 key.............................         BOOL
    SP1_ENBL.................... Movement of spindle 1 permitted.........       BOOL
    A01C.M19.................... Spindle positioning..................         BOOL
    mA01CM19.................... GBO -> M19............................        BOOL
    mRuW_OK..................... enable multi-block retrace/return to contour.. BOOL
```

'Spindle adjustment for spindle 2

```
15 |(* M3 jog operation and M3 adjustment for spindle 2 *)                                 |
16 |T_M3                  SP2_ENBL                                                   A04C.M3  |
   ├┤ ├───────────────────┬┤ ├───────────────────────────────────────────────────────( )──────┤
   |mA04CM3    mRuW_OK    |                                                                  |
   ├┤ ├────────┤ ├────────┘
   T_M3........................  M3 key................................        BOOL
   SP2_ENBL..................... Movement of spindle 2 permitted.........       BOOL
   A04C.M3...................... Start spindle clockwise........               BOOL
   mA04CM3...................... GBO -> M3..............................       BOOL
   mRuW_OK...................... enable multi-block retrace/return to contour.. BOOL

9  |(* M4 jog operation and M4 adjustment for spindle 2 *)                                 |
10 |T_M4                  SP2_ENBL                                                   A04C.M4  |
   ├┤ ├───────────────────┬┤ ├───────────────────────────────────────────────────────( )──────┤
   |mA04CM4    mRuW_OK    |                                                                  |
   ├┤ ├────────┤ ├────────┘
   T_M4........................  M4 key................................        BOOL
   SP2_ENBL..................... Movement of spindle 2 permitted.........       BOOL
   A04C.M4...................... Start spindle counter-clockwise........       BOOL
   mA04CM4...................... GBO -> M4..............................       BOOL
   mRuW_OK...................... enable multi-block retrace/return to contour.. BOOL

11 |(* M5 jog operation and M5 adjustment for spindle 2 *)                                 |
12 |T_M5                  SP2_ENBL                                                   A04C.M5  |
   ├┤ ├───────────────────┬┤ ├───────────────────────────────────────────────────────( )──────┤
   |mA04CM5    mRuW_OK    |                                                                  |
   ├┤ ├────────┤ ├────────┘
   T_M5........................  M5 key................................        BOOL
   SP2_ENBL..................... Movement of spindle 2 permitted.........       BOOL
   A04C.M5...................... Spindle halt..........................        BOOL
   mA04CM5...................... GBO -> M5..............................       BOOL
   mRuW_OK...................... enable multi-block retrace/return to contour.. BOOL

13 |(* M19 jog operation and M19 adjustment for spindle 2 not possible *)                 |
14 |(* because spindle 2 cannot be positioned *)                                             |
```

9.3 REPOS Subroutine

```
;   Adjust tool turret
;
N0001   .REPOS MTP                              ;Adjust tool turret
;
;   Adjust spindles
;
N0002   @100=MTD(61,0,0,1)-0  BNE.ROTMOD        ;S1/C in rotary axis
                                                 mode ?
N0003   G77 S1=0                                ;Adjust S1
N0004   G77 S2=0                                ;Adjust S2
;
; Adjust feed axes
;
N0005   .REPOSW  BSR .COLANT                    ;Coolant ON/OFF
N0006   MRY                                     ;Wait for tool turret
N0007   @100=G(2)-17  BEQ .REP_17               ;G17 active ?
N0008   G77 Z0 F2000                            ;G18 or G19 is active,
                                                 Adjust Z axis
N0009   G77 X0 F2000  RTS                       ;Adjust X axis
;
N0010   .REP_17                                 ;G17 is active
N0011   G77 X0 F2000                            ;Adjust axis X
N0012   G77 Z0 F2000  RTS                       ;Adjust axis Z
;
N0013   .ROTMOD                                 ;S1/C in rotary axis mode
N0014   @100=G(17)-31  BEQ .TRANSF              ;Transformation active ?
N0015   G77 C0 F5000 S2=0  BRA .REPOSW          ;Adjust C axis and S2
;
N0016   .TRANSF  BSR .COLANT                    ;Coolant ON/OFF
N0017   MRY                                     ;Wait for tool turret
N0018   G77 X1=0 Y1=0 F5000                     ;Adjust fictitious axes
                                                 X1 and Y1
N0019   G77 Z0 F2000  RTS                       ;Adjust Z axis
;
; Coolant ON/OFF
;
N0020   .COLANT  @100=M(5)+1  BEQ .COLEND       ;Initial value '-1'
N0021   M=M(5)  RTS                             ;read last M function
                                                 of group 5 and
                                                 output
N0022   .COLEND  M109  RTS                      ;Coolant OFF
```

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Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland - Germany

Germany Center ☒V/S ☒ Service	Vertriebsgebiet Ost Germany East ☒V/S ☒ Service	Vertriebsgebiet West Germany West ☒V/S ☒ Service	Vertriebsgebiet Nord Germany North ☒V/S ☐ Service
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Notes


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