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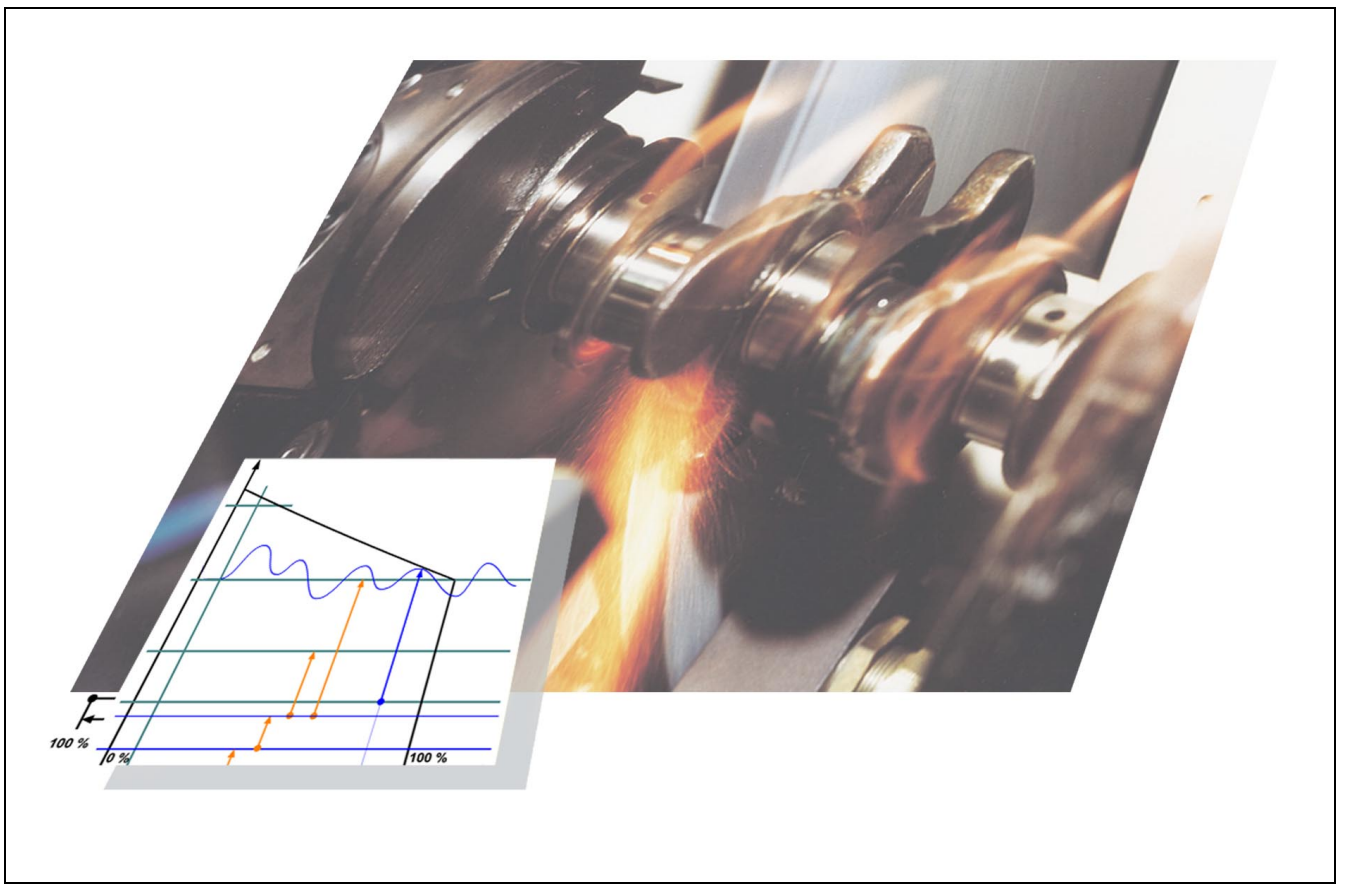

MTC200
Adaptive Feed
19VRS

Functional Description

SYSTEM200

DOK-MTC200-AD*FEED*V19-FK01-EN-P

Rexroth
Indramat

MTC200

Title Adaptive Feed

19VRS

Type of Documentation Functional Description

Document Typecode DOK-MTC200-AD*FEED*V19-FK01-EN-P

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Purpose of Documentation This documentation describes the Adaptive Feed function and informs about its application.

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Contents

1 Introduction

1.1 Purpose

As of version 19V00, the MTC200 offers the adaptive feed control function. This function guarantees constant machining capacity and machining volume. For this, the feedrate of an axis or the path velocity of the interpolating axes is modified depending on the motor torque or motor force of a spindle or feed axis.

The adaptive feed control function allows:

- improved surface quality,
- shorter machining times and
- to protect the tool, workpiece and machine against overload.

Furthermore, the torques or forces measured during machining and the resulting generated SPS interface signals of the adaptive feed control function allow to draw the following conclusions:

- No workpiece available or tool broken:

  e. g. if the minimum machining torque was not exceeded.

- Axis mechanics is not in order or is jammed:

  e. g. if the maximum idling torque rises continuously (from machining cycle to machining cycle) or was exceeded.

1.2 Realization

Principle

The adaptive feed control function uses the current machining torque or machining force of a reference axis (feed axis or spindle) for influencing the axis feedrate or the path velocity of the interpolating axes. The ratio of the current reference axis machining torque/force to the feed influence is set by means of a gain factor. The adaptive feed control is switched on by means of NC command **G26** and switched off by means of command **G25**.

The current machining torque is determined on the basis of the current torque/force actual value by deducting the stall torque (e. g. weight torque/weight in case of inclined axes) and the idling torque (= sliding friction). The AXD command **P-7-3651 stall torque recording** is used for determining the stall torque and the NC command **ITM** (**I**dle **T**hrust **M**easurement) is used for determining the idling torque.

Activation condition

The adaptive feed control is activated by process parameter **Bxx.062 adaptive feed control (yes/no)**.

Configuration

The adaptive feed control function is configured for the corresponding application by means of process parameters **Bxx.063** to **Bxx.069** or machine data page 30 "Adaptive feed control".

Machine data page 30 "Adaptive feed control" is mainly intended for use in flexible machining units with fast-changing cutting conditions. The process parameters of the adaptive feed control function are mainly used for transfer lines of which the cutting conditions remain constant over an "extended" time period.

The predefined machine data page 30 is available for dynamic adaptation of the adaptive feed control function to the corresponding machining parameters (feed and speed, cutting depth) during program execution. The data elements of this machine page can be modified by the user either directly via the interface or by means of the SPS function block "MTD_WR" or the NC command MTD. If a reference axis is entered in

machine data element **02 reference axis** by the SPS, NC or via the interface, the adaptive feed control function uses the data element values of machine data page 30 (see Fig. 5-1: Correspondence table process parameters <-> machine data page 30 for adapting the adaptive feed control function to the corresponding application.).

The following figure gives an overview of the process parameters and machine data elements used for the adaptive feed control function.

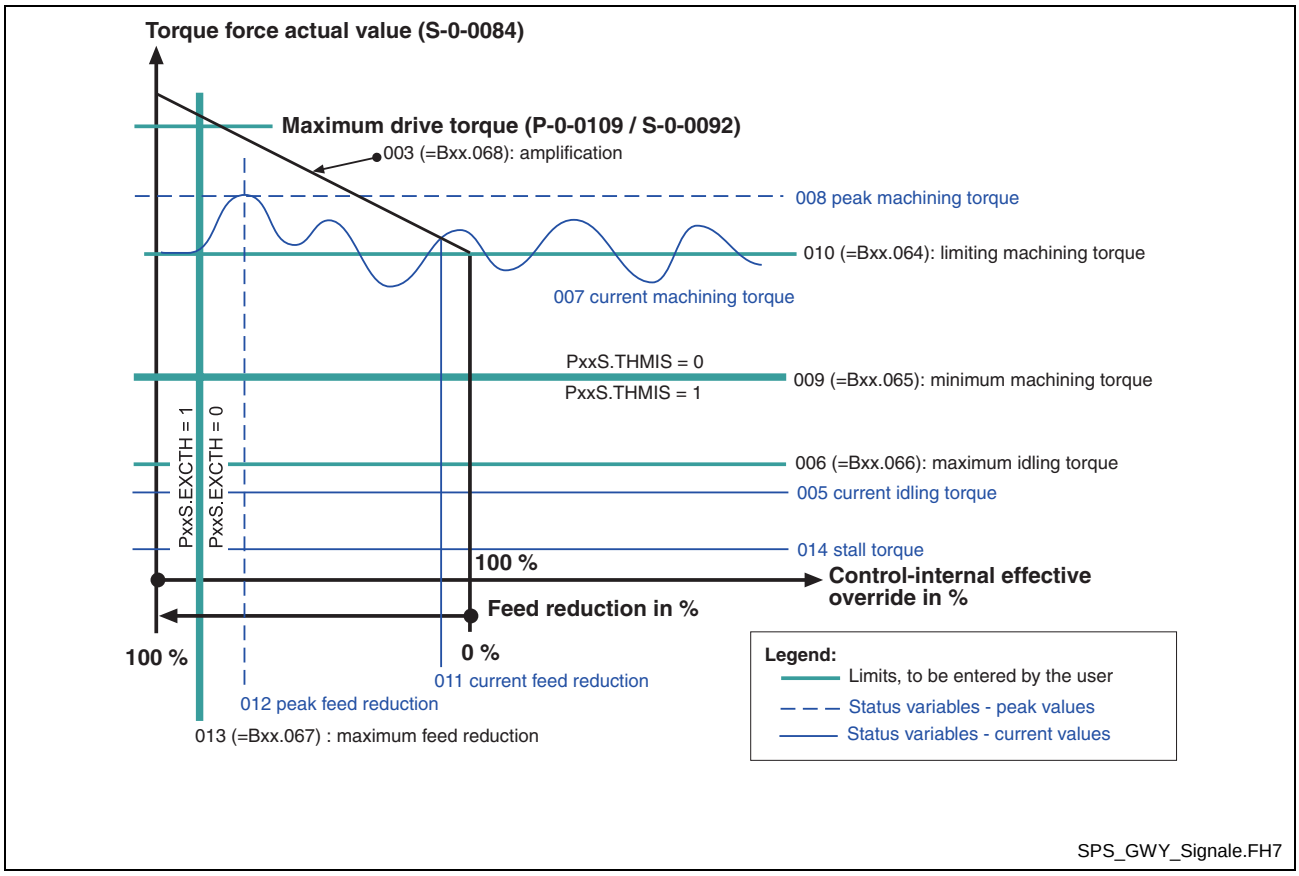

Fig. 1-1: Overview of process parameters and machine data elements for the adaptive feed control function

The process parameters and machine data elements to be entered are described in detail in the following chapters.

2 Commissioning

2.1 Procedure

Generally, the following steps have to be carried out for using the adaptive feed control function:

Initial preparations

1. Enable the adaptive feed control function once by means of process parameter **Bxx.062 adaptive feed control (yes/no)**.
2. Adapt the function to the corresponding application by using process parameters Bxx.063 to Bxx.069 or machine data page no. 30 "Adaptive feed control". In particular, the following process parameters or corresponding machine data elements of machine data page 30 (see Fig. 5-1: Correspondence table process parameters <-> machine data page 30 for adapting the adaptive feed control function to the corresponding application.) are to be determined by the user:
   - **Bxx.063 Reference axis for adaptive feed control**
   - **Bxx.064 Limiting machining torque**
   - **Bxx.065 Minimum machining torque**
   - **Bxx.066 Maximum idling torque**
   - **Bxx.067 Maximum feed reduction**
   - **Bxx.068 Amplification**
   - **Bxx.069 Measuring period**

   For the determination of process parameters Bxx.064 to Bxx.066, the recording of the torque/force actual values and actual speed values for the reference axis, e. g. by means of the MTC200 oscilloscope function, is recommended.
3. If necessary, adapt the SPS program to the use of interface signals **PxxS.EXCTH** (**EXC**essive **TH**rust) and **PxxS.THMIS** (**TH**rust **MIS**sing) for adaptive feed control measurement analysis.

Repeated use in NC program

4. If necessary, (e. g. in case of inclined axes), determine the stall torque/force by means of the APR-SERCOS command **P-7-3651 stall torque recording**. The measured stall torque is indicated in machine data element **014 stall torque** of machine data page 30. In addition, it can be read and processed further in the NC program by means of the APR-SERCOS command **P-7-3652 measured stall torque**.
5. If necessary, adapt the data elements in machine data page 30 dynamically to the different cutting conditions and tools, e. g. by means of MTD commands in the NC program or MTD_WR functions in the SPS program.
6. Determine the idling torque by means of NC command **ITM** (Idle Thrust Measurement).
7. Switch the adaptive feed control function on in the NC program with **G26 switch on adaptive feed control**.
8. Switch the adaptive feed control function off by **G25 switch off adaptive feed control** (explicit deselection) while the NC program is running or automatic deselection of G26 upon program end.

For setting the limit values, the status machine data elements (see Fig. 5-2: Status machine data elements of machine page 30 "Adaptive feed control") and the MTC200 oscilloscope function can be used.

The following figure (Fig. 2-1) shows the principle method of operation of the adaptive feed reduction.

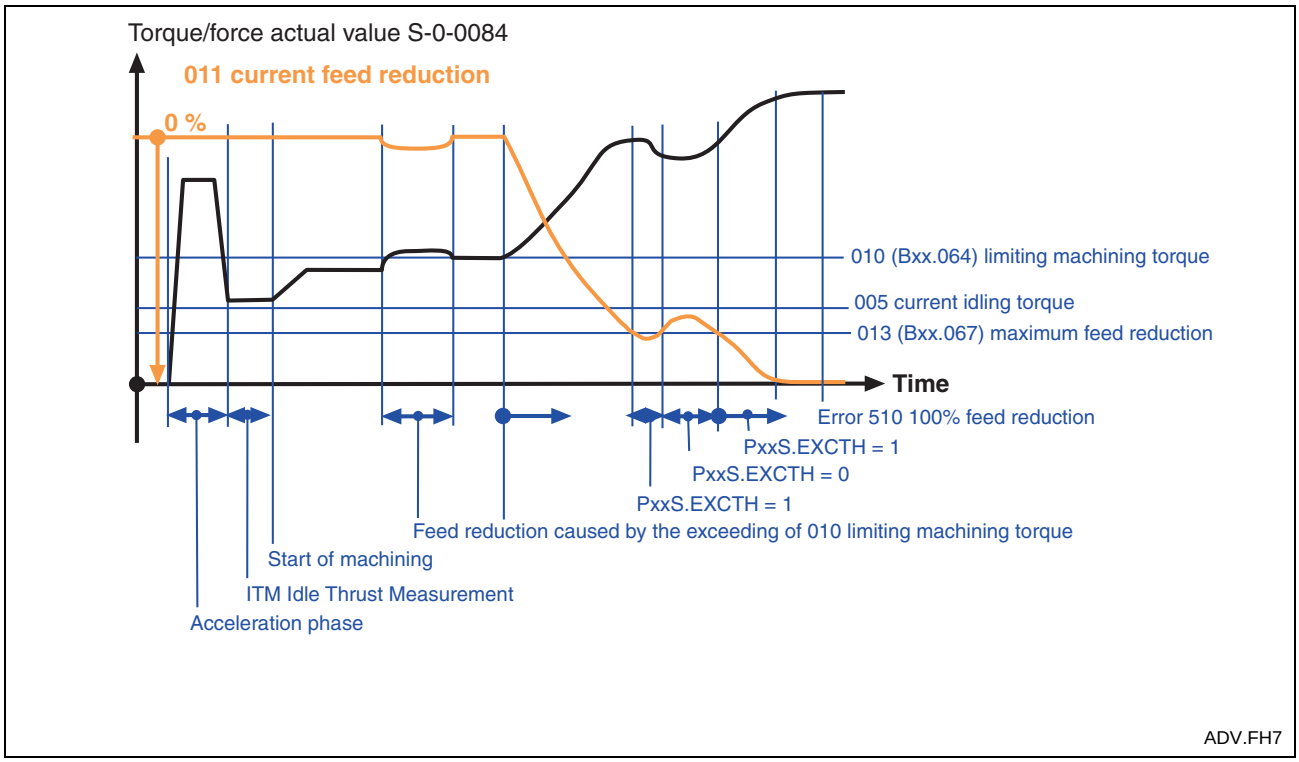

Fig. 2-1: Method of operation of adaptive feed reduction

2.2 Boundary conditions

- All axes and spindles involved in the adaptive feed control must be part of a process. This means that the reference axis must be part of the process of which the feedrate is to be controlled.
- All feed axes and spindles involved in the adaptive feed control must be connected to an axis processor (APR). This means that all interpolating feed axes and spindles involved in the adaptive feed control must be connected to the same axis processor.
- The adaptive feed control is only available in the operating modes automatic, semi-automatic and MDI.
- The NC deactivates the adaptive feed control (**G26**) automatically and sets **G25** upon *control reset* and end of program.
- The torques or forces used for monitoring and control refer to the nominal torque or the nominal force of the drive.

  Example: A **009 minimum machining torque** of 100% corresponds exactly to the nominal drive torque.
- The adaptive feed control **cannot** be used in connection with the following NC functions:
  - axis homing cycle (**G74**),
  - feed to positive stop (**G75**),
  - thread cutting (**G33**),

  - tapping without compensation chuck (**G63**, **G64**),
  - tapping (spindle as lead axis) (**G65**),
  - reposition and NC program restart (**G77**),
  - face milling (**G31**),
  - cylinder interpolation (**G32**).
- The maximum effective feedrate is limited by the programmed feedrate.
- The adaptive feed control and drill breakage monitoring function cannot be used at the same time.
- The machining torques calculated by the adaptive feed control function are only correct if the idling torque has been determined with the **ITM** command. If the reference axis is, for example, an inclined axis, the stall torque is to be determined in addition with the APR-SERCOS command **P-7-3651 stall torque recording**.

3 NC Commands

The following functions are used to switch the adaptive feed control function on and off in the NC program:

Syntax **G25** Switch off adaptive feed control (switch-on state)

G26 Switch on adaptive feed control

ITM **I**dle **T**hrust **M**easurement

The ITM command serves for measuring the idling torque or idling force.

NC program example:

```
N0081  G1 X150  ITM     ;Record idling torque for reference axis S1 (definition in
                         machine data)
...
...
N0235  G26 X100 S1=1000 F1000 ITM      ;AF on, record idling torque for reference axis S1
                                       (definition in
                                                              machine data)
...
...
N0265  G25                             ;AF off
```

Fig. 3-1: Use of ITM and G26 / G25 in the NC program

3.1 Description

G25 Switch off adaptive feed control

Command G25 allows to switch the adaptive feed control off.

Syntax **G25**

Command **G25**

- is preselected in the control switch-on state,
- becomes automatically effective upon program end,
- becomes automatically effective upon *control reset*.

G26 Switch on adaptive feed control

Command G26 allows to switch the adaptive feed control on.

Syntax **G26**

Command **G26** is effective in the operating modes and is automatically deactivated upon *control reset* and end of program (G25).

As soon as **G26** is executed in the NC program, the adaptive feed control has an effect on all available and interpolating axes of a process depending on the current machining torque/force of the reference axis.

ITM idling torque measurement

The ITM command serves for measuring the idling torque of a reference axis defined according to its axis significance in process parameter **Bxx.063 reference axis for adaptive feed control** or in the machine data. The measuring period is defined in machine data page 30 by means of process parameter **Bxx.069 measuring period** or machine data element **004 measuring period idling torque**.

Syntax **ITM**

The **ITM** command may be carried out

- together with **G26 switch on adaptive feed control** at the beginning of the machining process as well as
- independent of the adaptive feed control (G26.)

The measured idling torque is indicated in machine data element **005 current idling torque** in machine data page 30.

Note: **ITM idling torque measurement** and **G26** can be programmed in the same NC block. Thus, the idling torque is measured right before machining and shows exactly the current friction ratios.

---

4 Process parameters

4.1 Activation and adaptation

Activation

The adaptive feed control function is activated by process parameter **Bxx.062 adaptive feed control (yes/no)**. When setting **Bxx.062** to "yes", the following additional process parameters for adapting the function to the corresponding application are shown.

Adaptation

- **Bxx.063 Reference axis for adaptive feed control**
- **Bxx.064 Limiting machining torque**
- **Bxx.065 Minimum machining torque**
- **Bxx.066 Maximum idling torque**
- **Bxx.067 Maximum feed reduction**
- **Bxx.068 Amplification**
- **Bxx.069 Measuring period**

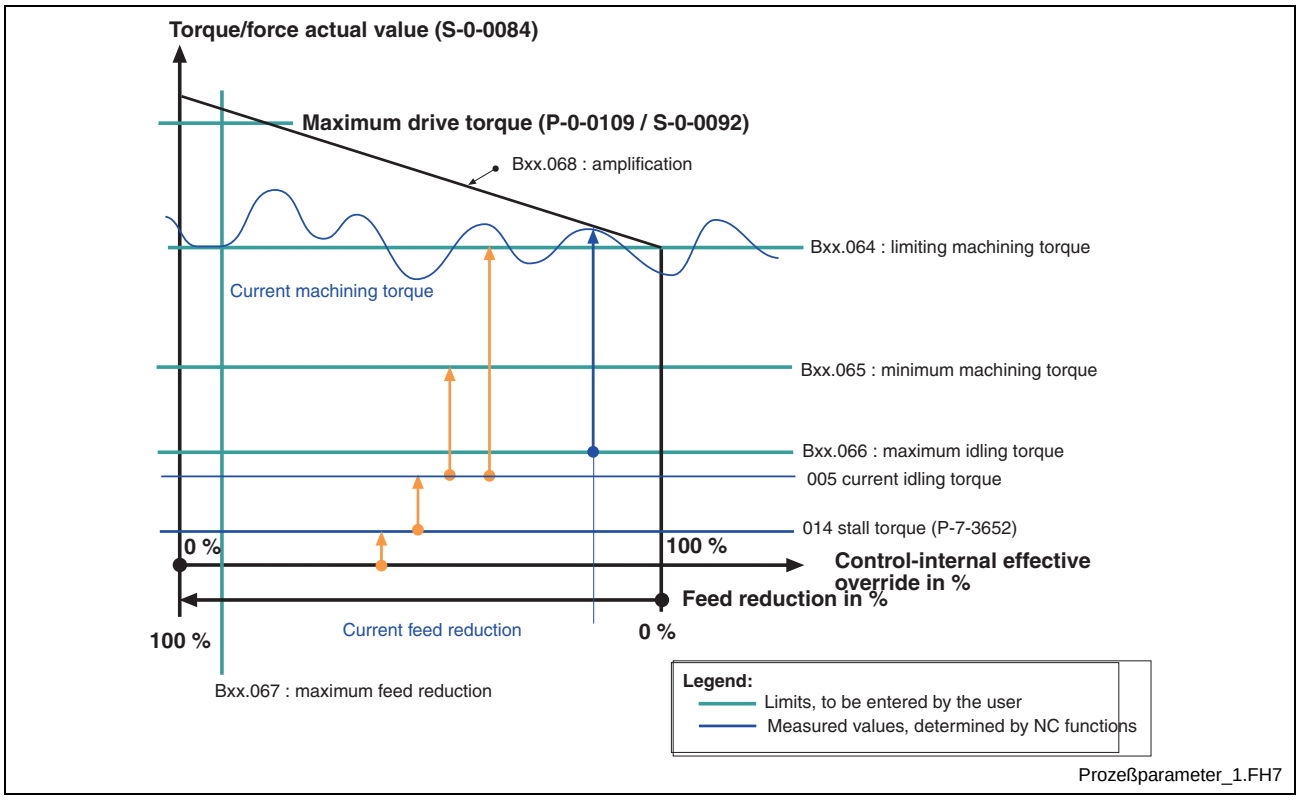

Fig. 4-1: Overview of process parameters

Note: If a value not equal to 0 is entered in machine data element 002 reference axis of machine data page 30 Adaptive feed control, the values of the corresponding machine data elements are used for adapting the adaptive feed control function (see Fig. 5-1) and not the values set in process parameters Bxx.063 to Bxx.069.

4.2 Description

Adaptive feed control

Designation Adaptive feed control

Number **Bxx.062**

Value range Yes/No

Default setting No

Unit -

From version: 19V00

Dependency If the machine manufacturer answers the process parameter "adaptive feed control" with "yes", the process parameters **Bxx.063 to Bxx.069** follow.

Purpose If adaptive feed control is required for the concerned process, process parameter **Bxx.062 adaptive feed control** has to be set to "yes".

Explanation The adaptive feed control allows to modify the feedrate of an axis or the path velocity of the interpolating axes depending on the motor torque or motor force of a spindle or feed axis so that the machining capacity or machining volume (during milling, turning or grinding) remains constant. Thus, it is possible to obtain

- an improved surface quality,
- shorter machining times and
- to protect the tool, workpiece and machine against overload.

Note: The adaptive feed control function can only be activated if process parameter **Bxx.062 adaptive feed control** is set to "yes".

Reference axis for adaptive feed control

Designation Reference axis for adaptive feed control

Number **Bxx.063**

Value range 0 ... 12 (= axis significance in the process)

1 = X axis	2 = Y axis	3 = Z axis
4 = U axis	5 = V axis	6 = W axis
7 = A axis	8 = B axis	9 = C axis
10 = S[=S1] axis	11 = S2 axis	12 = S3 axis

Default setting 0 = not defined

Unit -

From version: 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Parameter **Bxx.063 reference axis for adaptive feed control** allows the user to select - depending on the axis significance - an axis/a spindle from a process of which the motor torque (force) is to be used for controlling the path velocity of the interpolating axes.

Explanation The values to be entered correspond to the axis significance of the process for which the adaptive feed control is activated.

Limiting machining torque

Designation Limiting machining torque

Number **Bxx.064**

Value range 0.0 ... 500.0

Default setting 50

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Parameter **Bxx.064 limiting machining torque** allows the user to define for the adaptive feed control function the limiting machining torque/force to be observed for the reference axis (spindle/feed axis).

Explanation The NC tries to keep the torque defined by parameter **Bxx.064 limiting machining torque** constant during machining with adaptive feed control activated **(G26).** As soon as the value defined in **Bxx.064 limiting machining torque**/force of the reference axis to be monitored is exceeded, the path velocity is reduced accordingly until **007 current machining torque** corresponds again to the defined **Bxx.064 limiting machining torque**.

Bxx.064 limiting machining torque is calculated as follows:

$$\vec{M}_{machin.,\lim it} \approx \vec{M}_{machin.,act.} = \vec{M}_{act.} - \vec{M}_{idling,current} - \vec{M}_{\text{stall}}$$

$M_{machin.,limit}$: **Bxx.064 limiting machining torque**, defined by the user.
$M_{machin.,act.}$: **007 current machining torque**
$M_{act.}$: **S-0-0084 torque/force actual value**
$M_{idling,current}$: **005 current idling torque**
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 4-2: Calculation of the Bxx.064 limiting machining torque

Minimum machining torque

Designation Minimum machining torque

Number **Bxx.065**

Value range 0.0 ... 500.0

Default setting 10

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Process parameter **Bxx.065 minimum machining torque** allows to define for the adaptive feed control function the minimum machining torque/force to be considered during machining with adaptive feed control activated **G26**.

Explanation If the current machining torque/force of the reference axis does not exceed the minimum machining torque during machining with activated adaptive feed control, the NC indicates this by setting the interface signal **PxxS.THMIS** (Thrust MISsing) when switching off the adaptive feed control.

Bxx.065 minimum machining torque is calculated as follows:

$$\vec{M}_{machin.,\min.} = \vec{M}_{act.,\min.} - \vec{M}_{idling,current} - \vec{M}_{\text{stall}}$$

$M_{machin., min.}$: **Bxx.065 minimum machining torque**
$M_{act.,min.}$: minimum **S-0-0084 torque/force actual value** occurred
$M_{idling, current}$: **005 current idling torque**
M_{stall}: AXD **P-7-3652 stall torque**

Fig. 4-3: Calculation of Bxx.065 minimum machining torque

Note: When setting "0" for parameter **Bxx.065 minimum machining torque**, the NC does not monitor the machining torque as defined in **Bxx.065 minimum machining torque** with adaptive feed control activated (**G26**) and, thus, does not update the interface signal **PxxS.THMIS** (Thrust MISsing) when switching off the adaptive feed control.

Maximum idling torque

Designation Maximum idling torque

Number **Bxx.066**

Value range 0.0 ... 500.0

Default setting 30

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Parameter **Bxx.066 maximum idling torque** allows the user to define for the adaptive feed control function the maximum admissible idling torque/force for the reference axis.

Explanation If the torque defined in **005 current idling torque** exceeds the value defined in **Bxx.066 maximum idling torque** during the measuring process, the NC interrupts the measuring or current machining process and issues error message **509 idling torque > max. idling torque @ axis**.

Note: When setting "0" for parameter **Bxx.066 maximum idling torque**, the NC does not monitor the idling torque/force during the measuring process.

Maximum feed reduction

Designation Maximum feed reduction

Number **Bxx.067**

Value range 0.0 ... 100.0

Default setting 70

Unit % (0% = preselected feed; 100% = no feed)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Process parameter **Bxx.067 maximum feed reduction** allows the user to define for the adaptive feed control function the feed reduction to be considered during machining.

Explanation

- If the current feed reduction exceeds the value defined in **Bxx.067 maximum feed reduction** during machining with adaptive feed control activated, the NC indicates this by setting the interface signal **PxxS.EXCTH** (Excessive Thrust).
- If **011 current feed reduction** reaches 100% and the feedrate is reduced to the value 0 for at least 20ms, the control generates **Error 510 100% feed reduction @ axis** if the value defined in **Bxx.067 maximum feed reduction** is inferior to **100%**. The error can only be cleared with *Clear Error*.

Amplification

Designation Amplification

Number **Bxx.068**

Value range 0.01 ... 100.00

Default setting 1

Unit 1/s

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Parameter **Bxx.068 amplification** allows the user to define for the adaptive feed control function the integral-action time of the I controller.

Explanation The adaptive feed control uses an I controller for determining the **011 current feed reduction** depending on **007 current machining torque/force**. The value of process parameter **Bxx.068 amplification** corresponds to the reciprocal value of the integral-action time of the I controller, i. e. high values correspond to short integral-action times (= response times) and small values to long integral-action times.

Measuring period

Designation Measuring period

Number **Bxx.069**

Value range 2 ... 60000

Default setting 200

Unit ms

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Parameter **Bxx.069 measuring period** allows the user to define the duration of the measuring process for **005 current idling torque (force)**.

Explanation The NC command **ITM** (Idle Thrust Measurement) allows to measure **005 current idling torque (force)** either when switching the adaptive feed control on (**G26**) or regardless of **G26** over the period defined in **Bxx.069 measuring period.** When applying the adaptive feed control repeatedly with the same cutting conditions, multiple measurement of **005 current idling torque (force)** is not necessary.

The NC measures **005 current idling torque (force)** always at the end of the acceleration phase during the time defined in **Bxx.069 measuring period.**

If the block execution time is shorter than the defined **Bxx.069 measuring period**, the control generates **Error 508 idling torque recording @ axis**.

5 Machine data

Condition

Machine data page 30 "Adaptive feed control" is only useful if process parameter **Bxx.062 adaptive feed control (yes/no)** is set to "yes".

Adaptation limit values

Machine data page 30 "Adaptive feed control" includes data elements defining the adaptive feed control limit values and data elements for indicating the measured values. The limit values allow to "overwrite" the settings defined in process parameters **Bxx.063 to Bxx.069** for adapting the adaptive feed control function to the corresponding application, if parameter **002 reference axis** has not been set to 0.

The process parameters **Bxx.063 to Bxx.069** correspond to the following data element limit values and definitions in machine data page 30.

Process parameter			**Machine data page 30 "Adaptive feed control"**	
Number	**Designation**		**Data element no.**	**Designation**
Bxx.063	Reference axis for adaptive feed control	=	002	Reference axis
Bxx.064	Limiting machining torque	=	010	Limiting machining torque
Bxx.065	Minimum machining torque	=	009	Minimum machining torque
Bxx.066	Maximum idling torque	=	006	Maximum idling torque
Bxx.067	Maximum feed reduction	=	013	Maximum feed reduction
Bxx.068	Amplification	=	003	Amplification
Bxx.069	Measuring period	=	004	Measuring period idling torque

Fig. 5-1: Correspondence table process parameters <-> machine data page 30 for adapting the adaptive feed control function to the corresponding application.

Status variables for indication

The following data elements of machine data page 30 indicate the status or measured values of the adaptive feed control function and serve as information for the user.

Data element number	**Designation**
001	Adaptive feed control active
005	Current idling torque
007	Current machining torque
008	Peak machining torque
011	Current feed reduction
012	Peak feed reduction
014	Stall torque

Fig. 5-2: Status machine data elements of machine page 30 "Adaptive feed control"

The data elements of machine data page 30 "Adaptive feed control" can be read and defined manually or by

- MTD commands in the CNC and
- MTD_WR or MTD_RD commands in the SPS.

The use of the machine data is described in detail in the Rexroth Indramat document "MTC200 machine data" (DOK-MTC200-MAS*DAT*Vxx-AW0x-DE-P).

The following figure gives an overview of the machine data elements and their dependencies.

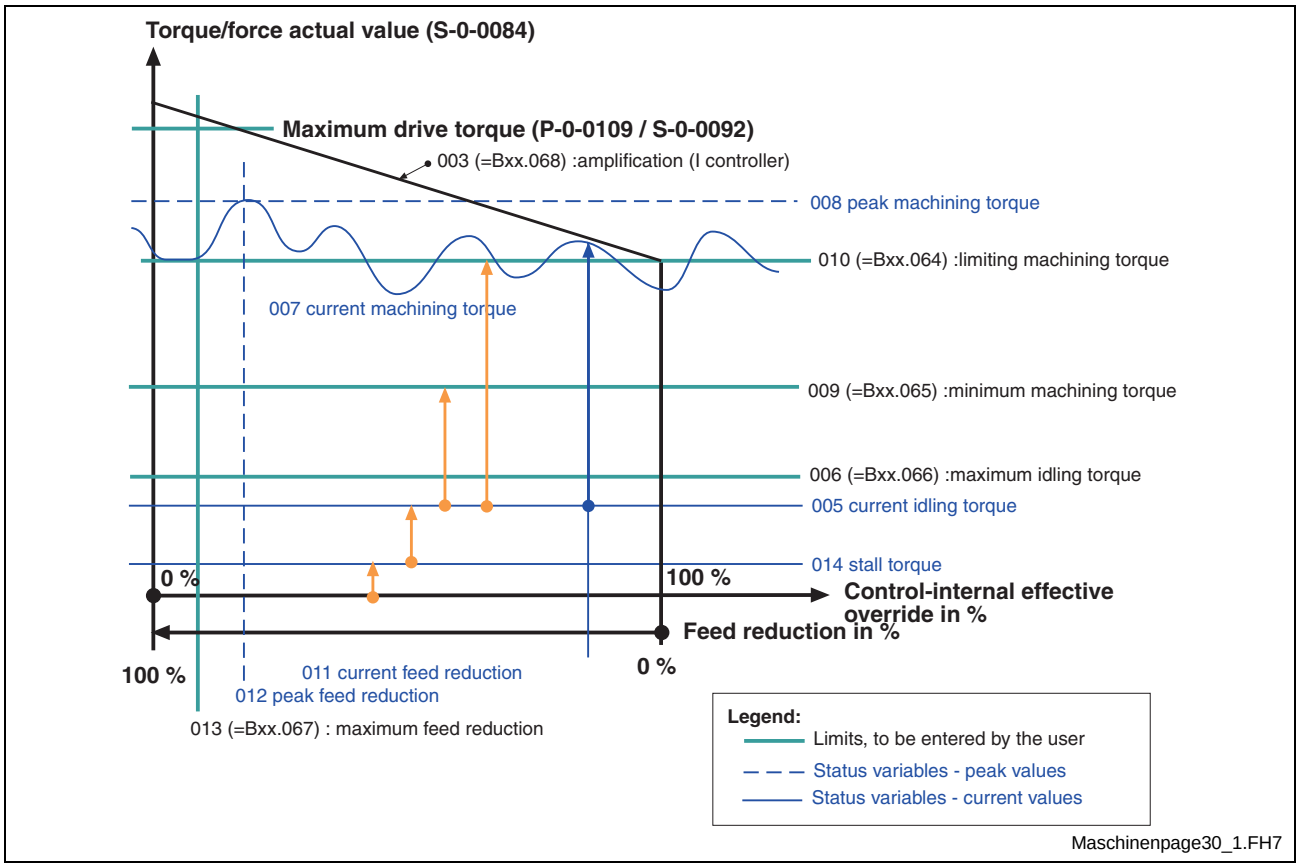

Fig. 5-3: Overview of data elements of machine data page 30

Note: By entering a value not equal to zero in machine data element **002 reference axis**, the definitions in process parameter **Bxx.063 reference axis for adaptive feed control** are ignored by the adaptive feed control function. Furthermore, the values of the corresponding data elements of machine data page 30 "Adaptive feed control" instead of the process parameter values **Bxx.064 to Bxx.069** (see Fig. 5-1: Correspondence table process parameters <-> machine data page 30 for adapting the adaptive feed control function to the corresponding application.) are used for the adaptive feed control.

Note: When setting machine data element **002 reference axis** to "0", all entries in the machine data page are set to the values defined in the process parameters when activating the adaptive feed control function again. The value for variable **002 reference axis** is also set to the value of process parameter **Bxx.063 reference axis for adaptive feed control**.

5.1 Structure

Machine data page 30 "Adaptive feed control" defines the following data structure:

```
STRUCT                                    {Write protection}{additional }
         {Data designation_____________}   {Data type__}  {NC,   SPS,    GUI  } {Password prot.}
         Adapt. Feed control active       BOOL           1       1       1               1
         Reference axis                   SINT           0       0       0               1
         Amplification                    AMPL           0       0       0               1
         Measuring period idling torque   UINT           0       0       0               1
         Current idling torque            PERC           1       1       1               1
         Maximum idling torque            PERC           0       0       0               1
         Current machining torque         PERC           1       1       1               1
         Peak machining torque            PERC           1       1       1               1
         Minimum machining torque         PERC           0       0       0               1
         Limiting machining torque        PERC           0       0       0               1
         Current feed reduction           PERC           1       1       1               1
         Peak feed reduction              PERC           1       1       1               1
         Maximum feed reduction           PERC           0       0       0               1
         Stall torque                     PERC           0       0       0               1
  END_STRUCT

  ARRAY  [
         {Designation of control variable}{min. value .. max. value}{alternative designator}
         (Process)                              0    ..      6   (%process_name)
         ]  OF  STRUCT
```

Fig. 5-4: Process-specific machine data page 30 "Adaptive feed control"

5.2 Description of machine data elements

Adapt. feed control active

Designation	Adapt. feed control active
Number	**001**
Value range	0.1
Default setting	-
Unit	-
From version	19V00
Dependency	Only effective, if process parameter **Bxx.062 adaptive feed control** has been set to "yes".
Purpose	Data element for indicating whether or not the adaptive feed control function in the NC program is activated by **G26**.
Explanation	Value assignment: **001** = 1 : **G26 adaptive feed control is switched on**. **001** = 0 : **G25 adaptive feed control is switched off** or **Bxx.062 adaptive feed control (yes/no)** = "no".

Reference axis

Designation	Reference axis
Number	**002**
Value range	0 ... 12 (= axis significance in the process)

0 = reference axis defined in the process parameters

1 = X axis	2 = Y axis	3 = Z axis
4 = U axis	5 = V axis	6 = W axis
7 = A axis	8 = B axis	9 = C axis
10 = S[=S1] axis	11 = S2 axis	12 = S3 axis

Default setting 0 = reference axis defined in the process parameters

Unit -

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control** has been set to "yes".

Purpose Machine data element **002 reference axis** allows the user to select - depending on the axis significance - an axis/a spindle from a process of which the motor torque (force) is to be used for controlling the path velocity of the interpolating axes.

Explanation The values to be entered correspond to the axis significance of the process for which the adaptive feed control is activated.

Note: If a value not equal to zero is entered in machine data element **002 reference axis**, the adaptive feed control function uses the values of machine data page 30. The definitions in process parameters **Bxx.063 to Bxx.069** are ignored.

Note: When setting machine data element **002 reference axis** to "0", all machine data element entries are set to the values defined in the corresponding process parameters (see Fig. 5-1: Correspondence table process parameters <-> machine data page 30 for adapting the adaptive feed control function to the corresponding application.) when activating the adaptive feed control function again. The value for variable 002 "reference axis" is also set to the value of process parameter **Bxx.063 reference axis for adaptive feed control**.

Amplification

Designation Amplification

Number **003**

Value range 0.00 ... 100.00

Default setting 0.1

Unit 1/s

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Variable **003 amplification** allows the user to define for the adaptive feed control function the integral-action time of the I controller.

Explanation The adaptive feed control uses an I controller for determining the effective feed reduction depending on the current machining torque/force. The value of machine data element **003 amplification** corresponds to the reciprocal value of the integral-action time of the I controller, i. e. high values correspond to short integral-action times (= response times) and small values to long integral-action times.

Note: The adaptive feed control function uses the value of machine data element **003 amplification** and ignores the value defined in process parameter **Bxx.068 amplification** if the value zero has not been entered in machine data element **002 reference axis**.

Measuring period idling torque

Designation Measuring period idling torque

Number **004**

Value range 0 ... 65535

Default setting 200

Unit ms

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **004 measuring period idling torque** allows the user to define the duration of the measuring process for **005 current idling torque (force)**.

Explanation The NC command **ITM** (Idle Thrust Measurement) allows to measure **005 current idling torque (force)** either when switching the adaptive feed control on (**G26**) shortly before machining or regardless of the adaptive feed control (**G25**) over the period defined in machine data element **004 measuring period idling torque.** When applying the adaptive feed control repeatedly with the same cutting conditions, multiple measurement of **005 current idling torque (force)** is not necessary, if the friction conditions are not changed considerably.

The NC measures the **idling torque (force)** always at the end of the acceleration phase during the time defined in **004 measuring period idling torque** or **Bxx.069 measuring period.**

If the block execution time is shorter than the defined **004 measuring period idling torque**, the control generates error **508 idling torque recording @ axis**.

Note: The adaptive feed control function uses the value of machine data element **004 measuring period idling torque** and ignores the value defined in process parameter **Bxx.069 measuring period** if the value zero has not been entered in machine data element **002 reference axis**.

Current idling torque

Designation Current idling torque

Number **005**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **005 current idling torque** indicates the current idling torque (force) during the measuring process.

Explanation **005 current idling torque** generally corresponds to the friction torque of the reference axis.

005 current idling torque (force) can be measured either when switching the adaptive feed control on (**G26**) or while the adaptive feed control is switched off (**G25**), e. g. when moving the machine without load. The **ITM** command serves for measuring the idling torque (force). When applying the adaptive feed control repeatedly with the same cutting conditions, multiple measurement of **005 current idling torque (force)** is not necessary.

The NC measures the **005 idling torque (force)** always at the end of the acceleration phase during the time defined in **Bxx.069 measuring period** or **004 measuring period idling torque.** The determined mean value is then saved in machine data element **005 current idling torque** and will be included in the calculation of **007 current machining torque (force)**.

005 current idling torque is calculated as follows:

$$\vec{M}_{idling,current} = \vec{M}_{act.,current} - \vec{M}_{\text{stall}}$$

$M_{idling,current}$: **005 current idling torque**
$M_{act.,current}$: **S-0-0084 torque/force actual value** during G26
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 5-5: Calculation of 005 current idling torque

Maximum idling torque

Designation Maximum idling torque

Number **006**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **005 maximum idling torque** allows the user to define for the adaptive feed control function the maximum admissible idling torque/force.

Explanation If the measured **005 current idling torque** exceeds the value defined in **006 maximum idling torque** during the measuring process, the NC interrupts the measuring or current machining process and issues error message **509 idling torque > max. idling torque _ axis**.

006 maximum idling torque is calculated as follows:

$$\vec{M}_{idling,\max.} = \vec{M}_{act.,\max.} - \vec{M}_{\text{stall}}$$

$M_{idling,max.}$: **006 maximum idling torque**
$M_{act.,max.}$: max. **S-0-0084 torque/force actual value** during G26
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 5-6: Calculation of 006 maximum idling torque

Note: When entering the value zero in machine data element **006 maximum idling torque**, the idling torque/force is not monitored.

Note: The adaptive feed control function uses the value of machine data element **006 maximum idling torque** and ignores the value defined in process parameter **Bxx.066 maximum idling torque** if the value zero has not been entered in machine data element **002 reference axis**.

Current machining torque

Designation Current machining torque

Number **007**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **007 current machining torque** indicates the current machining torque (force) which is permanently updated while the adaptive feed control (**G26**) is active.

Explanation The current machining torque is calculated as follows:

$$\vec{M}_{machin.,current} = \vec{M}_{act.} - \vec{M}_{idling,current} - \vec{M}_{\text{stall}}$$

$M_{machin.,current}$: **007 current machining torque**
$M_{act.}$: **S-0-0084 torque/force actual value**
$M_{idling,current}$: **005 current idling torque**
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 5-7: Calculation of 007 current machining torque

Peak machining torque

Designation Peak machining torque

Number **008**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **008 peak machining torque** indicates the highest machining torque which occurred during the last machining process with adaptive feed control activated (**G26**).

Explanation The NC updates the value of machine data element **008 peak machining torque** when switching the adaptive feed control off (**G25**).

008 peak machining torque is calculated as follows:

$$\vec{M}_{machin.,peak} = \vec{M}_{act.,\max.} - \vec{M}_{idling,current} - \vec{M}_{\text{stall}}$$

$M_{machin.,peak}$: **008 peak machining torque**
$M_{act.,max.}$: max. **S-0-0084 torque/force actual value** during **G26**
$M_{idling,current}$: **005 current idling torque**
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 5-8: Calculation of 008 peak machining torque

Minimum machining torque

Designation Minimum machining torque

Number **009**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose The minimum machining torque/force to be considered during machining with adaptive feed control activated **G26** is entered in machine data element **009 minimum machining torque**.

Explanation **009 minimum machining torque** is calculated as follows:

$$\vec{M}_{machin.,\min.} = \vec{M}_{act.,\min.} - \vec{M}_{idling,current} - \vec{M}_{\text{stall}}$$

$M_{machin.,peak}$: **009 minimum machining torque**
$M_{act.,min.}$: min. **S-0-0084 torque/force actual value** during **G26**
$M_{idling,current}$: **005 current idling torque**
M_{stall}: **P-7-3652 measured stall torque**

Fig. 5-9: Calculation of 009 minimum machining torque

The value defined in machine data element **009 minimum machining torque** serves as switching threshold for the SPS status signal **PxxS.THMIS** (**TH**rust **MIS**ing).

The SPS status signal **PxxS.THMIS** is

- **PxxS.THMIS = 1** if the **007 current machining torque** occurred during machining **was always inferior to** **009 minimum machining torque**,
- **PxxS.THMIS = 0** if the **007 current machining torque** occurred during machining **exceeded at least once the 009 minimum machining torque.**

Note When setting "0" for machine data element **009 minimum machining torque**, the NC does not monitor the machining torque as defined in **009 minimum machining torque** with adaptive feed control activated (**G26**) and, thus, does not update the interface signal **PxxS.THMIS** (Thrust MISsing).

Note: The adaptive feed control function uses the value of machine data element **009 minimum machining torque** and ignores the value defined in process parameter **Bxx.065 minimum machining torque** if the value zero has not been entered in machine data element **002 reference axis**.

Limiting machining torque

Designation Limiting machining torque

Number **010**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **010 limiting machining torque** allows the user to define for the adaptive feed control function the limiting machining torque/force to be observed during machining for the reference axis (spindle/feed axis).

Explanation The NC tries to keep the torque/force actual value defined by machine data element **010 limiting machining torque** constant during machining with adaptive feed control activated **(G26).** As soon as the value defined in **010 limiting machining torque**/force of the reference axis to be monitored is exceeded, the path velocity is reduced accordingly by the NC until **007 current machining torque** corresponds again to the defined **010 limiting machining torque**.

010 limiting machining torque is calculated as follows:

$$\vec{M}_{machin.,\lim it} \approx \vec{M}_{machin.,act.} = \vec{M}_{act.} - \vec{M}_{idling,current}(-\vec{M}_{\text{stall}})$$

$M_{machin.,limit}$: **010 limiting machining torque**, defined by the user.
$M_{machin.,act.}$: **007 current machining torque**
$M_{act.}$: **S-0-0084 torque/force actual value**
$M_{idling,current}$: **005 current idling torque**
M_{stall}: AXD **P-7-3652 measured stall torque**

Fig. 5-10: Calculation of 010 limiting machining torque

Note: The adaptive feed control function uses the value of machine data element **010 limiting machining torque** and ignores the value defined in process parameter **Bxx.064 limiting machining torque** if the value zero has not been entered in machine data element **002 reference axis**.

Current feed reduction

Designation Current feed reduction

Number **011**

Value range 0.0 ... 100.0

Default setting -

Unit %

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Indication of the current feed reduction.

Explanation The currently effective feed reduction is indicated by machine data element **011 current feed reduction** if the adaptive feed control function is switched on (**G26**). When deactivating the adaptive feed control

function (**G25**), the last "current" feed reduction value remains until the function is activated again.

Peak feed reduction

Designation Peak feed reduction

Number **012**

Value range 0.0 ... 100.0

Default setting -

Unit %

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Indication of the peak feed reduction.

Explanation The maximum value of machine data element **011 current feed reduction** which occurred while the adaptive feed reduction was switched on (**G26**), is saved in machine data element **012 peak feed reduction** when switching the adaptive feed control off **G25**. The **011 current feed reduction** value is set back to zero when switching the adaptive feed control function on (**G26**).

Maximum feed reduction

Designation Maximum feed reduction

Number **013**

Value range 0.0 ... 100.0

Default setting

Unit %

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Machine data element **013 maximum feed reduction** allows to define for the adaptive feed control function the feed reduction not to be exceeded during machining.

Explanation

- If **011 current feed reduction** exceeds the value defined in **013 maximum feed reduction** during machining with adaptive feed control activated, the NC indicates this by setting the interface signal **PxxS.EXCTH** (Excessive Thrust).
- If **011 current feed reduction** reaches 100% and the feedrate is reduced to the value 0 for at least 20ms, the control generates error **510 100% feed reduction @ axis**. The error can only be cleared with *Clear Error*.

Note: The "adaptive feed control" function uses the value of machine data element **013 maximum feed reduction** and ignores the value defined in process parameter Bxx.067 if the value zero has not been entered in machine data element **002 reference axis**.

Stall torque

Designation Stall torque

Number **014**

Value range 0.0 ... 999.9

Default setting -

Unit % (100% = nominal motor torque/force)

From version 19V00

Dependency Only effective, if process parameter **Bxx.062 adaptive feed control (yes/no)** has been set to "yes".

Purpose Variable **stall torque** indicates the stall torque of the reference axis.

Explanation

- **014 stall torque** corresponds, e. g. in case of inclined axes, to the weight torque of the masses which are not balanced by a possibly available weight compensation. **014 stall torque** is determined by means of the AXD-SERCOS command **P-7-3651** while **002 reference axis** is being controlled and is stopped ($v_{nom}=v_{act}=0$).
- The value of machine data element **014 stall torque** corresponds to the absolute value of the value output by the AXD-SERCOS command **P-7-3652**.

6 SPS interface signals and APR-SERCOS parameters

6.1 SPS interface signals

The adaptive feed control function offers the user the two following SPS interface signals for measurement analysis:

- **PxxS.THMIS** "**TH**rust **MIS**sing" depending on process parameter **Bxx.065 minimum machining torque** or machine data element **009 minimum machining torque**,
- **PxxS.EXCTH** "**EXC**essive **TH**rust" depending on process parameter **Bxx.067 maximum feed reduction** or machine data element **013 maximum feed reduction**.

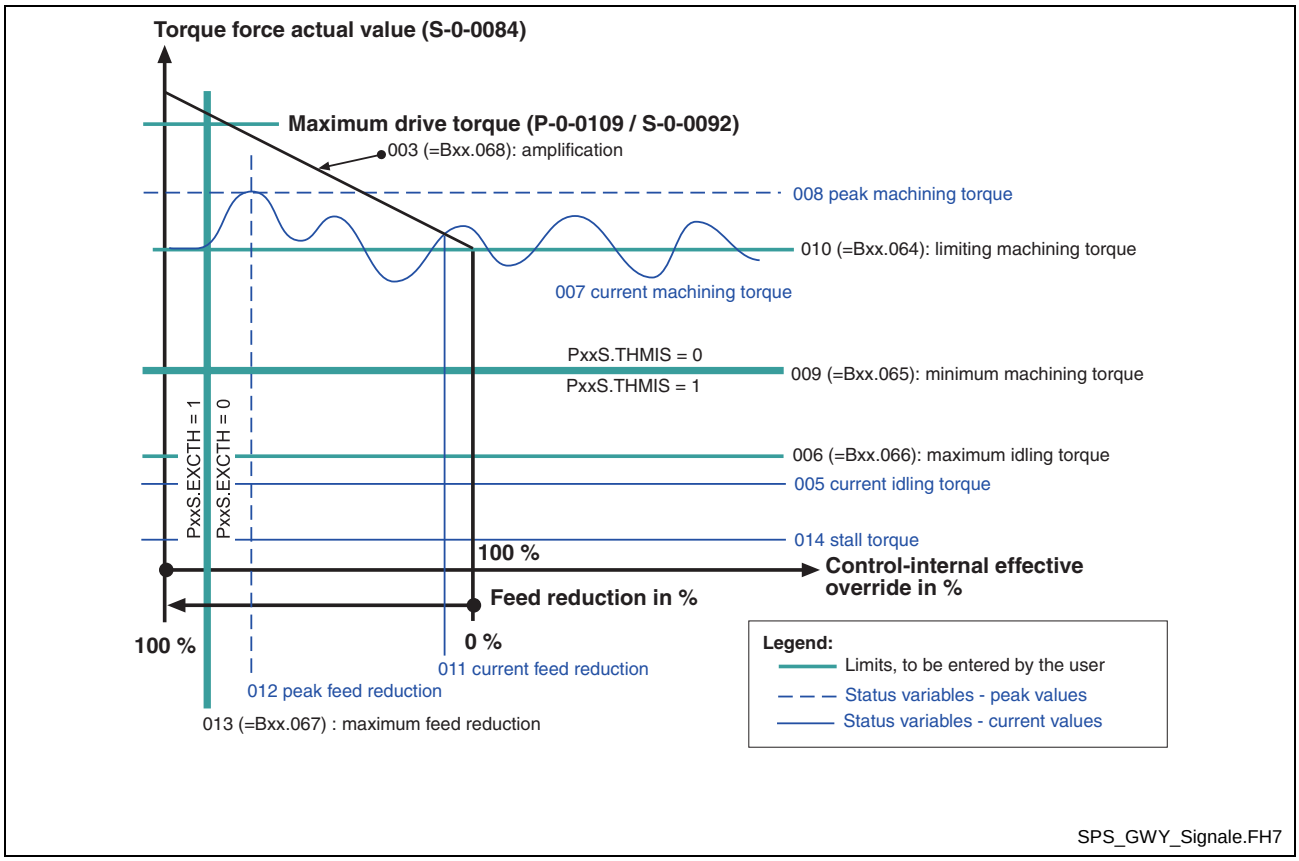

Fig. 6-1: SPS interface signals for the adaptive feed control function

Thrust Missing

Type Process status signal

Designation **PxxS.THMIS** (**TH**rust **MIS**sing)

Meaning **PxxS.THMIS = 1:** The machining torque did **not exceed** the defined **009** or **Bx.065 minimum machining torque** during the machining process.

PxxS.THMIS = 0: The machining torque **exceeded** the defined **009** or **Bx.065 minimum machining torque** during the machining process.

Update The NC resets the interface signal **PxxS.THMIS** when switching the adaptive feed control on (**G26**) and off (**G25**) as well as upon program end and *control reset*.

Method of operation If **007 current machining torque** does not exceed the value defined in **009** or **Bxx.065 minimum machining torque** during machining with adaptive feed control activated (**G26**), the NC indicates this by setting the interface signal **PxxS.THMIS** (Thrust Missing) when switching the adaptive feed control off (**G25**).

Explanation E. g. a missing workpiece or a drill which was already broken before changing or incorrect tool offset data may have caused that the value defined in **009** or **Bxx.065 minimum machining torque** was not exceeded (**PxxS.THMIS** = 1).

Excessive Thrust

Type Process status signal

Designation **PxxS.EXCTH** (**EXC**essive **TH**rust)

Meaning **PxxS.EXCTH = 1:** The current feed reduction **exceeds** the defined **013** or **Bxx.067 maximum feed reduction**.

PxxS.EXCTH = 0: The current feed reduction does **not** exceed the defined **013** or **Bxx.067 maximum feed reduction**.

Update The NC updates the interface signal **PxxS.EXCTH** continuously with adaptive feed control witched on (**G26**) (see Fig. 2-1). The NC resets this signal upon program end and *control reset*.

Method of operation If **011 current feed reduction** exceeds the **maximum feed reduction Bxx.067** during machining with adaptive feed control activated (**G26**), the NC indicates this by setting the interface signal **PxxS.EXCTH** (Excessive Thrust).

Note: The NC continues the machining process regardless of whether or not **011 current feed reduction** exceeds **Bxx.067** or **013 maximum feed reduction**. Only if

- **011 current feed reduction** reaches 100% and
- **011 current feedrate** is reduced to the value 0 for at least 20ms and the value set in
- **Bxx.067** or **013 maximum feed reduction** is less than 100%,

the NC stops the machining process and generates error message **510 100% feed reduction @ axis**.

Explanation The exceeding of **Bxx.067** or **013 maximum feed reduction** (**PxxS.EXCTH** = 1) may possibly be caused by the following: mechanics too tight, the possibly available axis clamping has not released, cooling lubricant supply interrupted or worn tool.

6.2 APR-SERCOS commands for stall torque recording

In case of inclined or precompensated axes, the adaptive feed control function can only be used correctly if the occurring stall torques (forces) are recorded. If not, the determined machining torques (forces) are not correct and thus, unusable. The APR-SERCOS commands **P-7-3651** / 65091 is used for stall torque (force) recording. The recorded stall torque (force) can then be read with the APR-SERCOS command **P-7-3652** / 65092.

The APR-SERCOS command **P-7-3651 stall torque recording** and **P-7-3652 measured stall torque** can be used regardless of the activation of the adaptive feed control function.

Stall torque recording P-7-3651 / 65091

Designation Stall torque recording

Number **P-7-3651** / 65091

Syntax in NC program AXD(@:P-7-3651)=xyz

Value range
- @ : Axis designation (X, Y, Z, U, V; W, A, B, C, S=S1, S2, S3) or axis number (1..32, according to the definition in the system parameters)
- xyz : period 0.0 ... 60000 [ms]

Default setting -

Unit ms

From version 19V00

Dependency -

Purpose Command for starting stall torque recording during the defined period.

Note: The result of **P-7-3651 stall torque recording** is only correct if the selected axis is being controlled and is stopped during the defined recording period ($v_{nom}=v_{act}=0$).

Explanation
- The stall torque is, for example, required when inclined or precompensated axes are used as reference axis for the adaptive feed control or drill breakage monitoring function.

Measured stall torque P-7-3652 / 65092

Designation Measured stall torque

Number **P-7-3652** / 65092

Syntax in NC program AXD(@:P-7-3652)

Value range @ = axis designation (X, Y, Z, U, V; W, A, B, C, S=S1, S2, S3) or axis number (1..32, according to the definition in the system parameters)

Default setting -

Unit 0,1 * %

From version 19V00

Dependency -

Purpose Command for reading the result of **P-7-3651 / 65091 stall torque recording**.

Note: The result is only correct if, while executing command **P-7-3561 stall torque recording**, the selected axis has been controlled and stopped during the defined recording period ($v_{nom}=v_{act}=0$).

Explanation

- **P-7-3652 measured stall torque** is, for example, required when inclined or precompensated axes are used as reference axis for the adaptive feed control or drill breakage monitoring function.

Stall torque recording example

The following example shows an NC program for stall torque recording on an X axis which, at the same time, monitors the stall torque recording period and which moves the X axis only upon completion of the measuring period.

```
....
....
N0002 G00 X 100.000 Y 0.000
;----- Stall torque measurement with time monitoring -----
N0003 @160=300                              ; measuring period in ms for stall torque recording
N0004 AXD(X:P-7-3651)=@160                  ; measure stall torque during @160 ms
N0005 @161=TIME                             ; record actual time
....
....                                        ; any NC blocks in which the
N0006 G01 Y50 F3450                         ; X axis is not used
....
....
N0006 @162=TIME-@161                        ; record time difference
N0007 @163=(@160/1000-@162) BMI .GO_ON      ; jump if @162 > @160
N0008 G04 F=@163;                           ; waiting time;
N0009 .GO_ON                                ; jump stall torque recording completed
N0010 @122=AXD(X:P-7-3652)                  ; read in stall torque in variable
;----- processing -------------------------
N0011 G01 G26 X 200.0000 F3000.0 ITM        ; measure idling torque and AF on,
N0012 G25                                   ; AF off
....
....
```

Fig. 6-2: NC program for stall torque recording and execution time monitoring

7 Error messages

Error 508: error idling torque recording @ axis

The NC function **ITM idling torque measurement** is started in the next block by the NC command **ITM** upon activation of the recording. The block speed must be constant and the block execution time must exceed the time defined in **004 measuring period idling torque** or **Bxx.069 measuring period.**

Cause

- The NC block speed is not constant upon activation of idling torque recording **ITM**, e. g. override has been modified,
- the block execution time in the NC block upon activation of idling torque recording **ITM** is shorter than the periods defined in
  - process parameter **Bxx.069 measuring period** or in
  - machine data element **004 measuring period idling torque** of machine data page 30 "Adaptive feed control".

Remedy Possible remedial actions:

- Keep the speed constant during idling torque recording **ITM**,
- increase the travel path of the NC block in which **ITM** is programmed,
- reduce the speed of the NC block in which **ITM** is programmed,
- reduce **Bxx.069 measuring period** or **004 measuring period idling torque** for idling torque recording.

Error 509: idling torque > max. idling torque @ axis

Cause Error **509 idling torque > max. idling torque @ axis** occurs if the torque measured upon execution of the NC command **ITM idling torque recording** exceeds the values defined in

- process parameter **Bxx.066 maximum idling torque** or in
- machine data variable **006 maximum idling torque**.

Remedy

- Check the plausibility of the indicated **005 current idling torque** and
- redefine the value for **006** or **Bxx.066 maximum idling torque**, if necessary.

Error 510: 100% feed reduction @ axis

Cause Error **510 100% feed reduction @ axis** occurs (see Fig. 2-1), if:

- the **G26 adaptive feed control** function is active and
- **011 current feed reduction** is equal to 100% and
- the feedrate is 0 for more than 20ms and
- the parameterized **013** or **Bxx.067 maximum feed reduction** is unequal to 0.

011 current feed reduction exceeds 100% if **007 current machining torque** exceeds the paramerized **010** or **Bxx.064 limiting machining torque** for an extended period. The time and speed required for adapting **011 current feed reduction** to **007 current machining torque** are defined by **003** or **Bxx.068 amplification**.

Remedy Determine the cause of the **011 current feed reduction** value, e. g.

- check tool wear,
- feedrate override, feedrate or machining volume has been modified after machine parameter or machine data setting so that **007 current machining torque** (force) is now higher,

- check the values defined for **010** or **Bxx.064 limiting machining torque** and **013** or **Bxx.067 maximum feed reduction** in the machine data and machine parameters,
- clear the error with *Clear Error*.

8 Application example

8.1 Milling

System description

Knee milling machine with compound table

The X and Y axis move the compound table and the Z axis moves the main spindle in vertical direction.

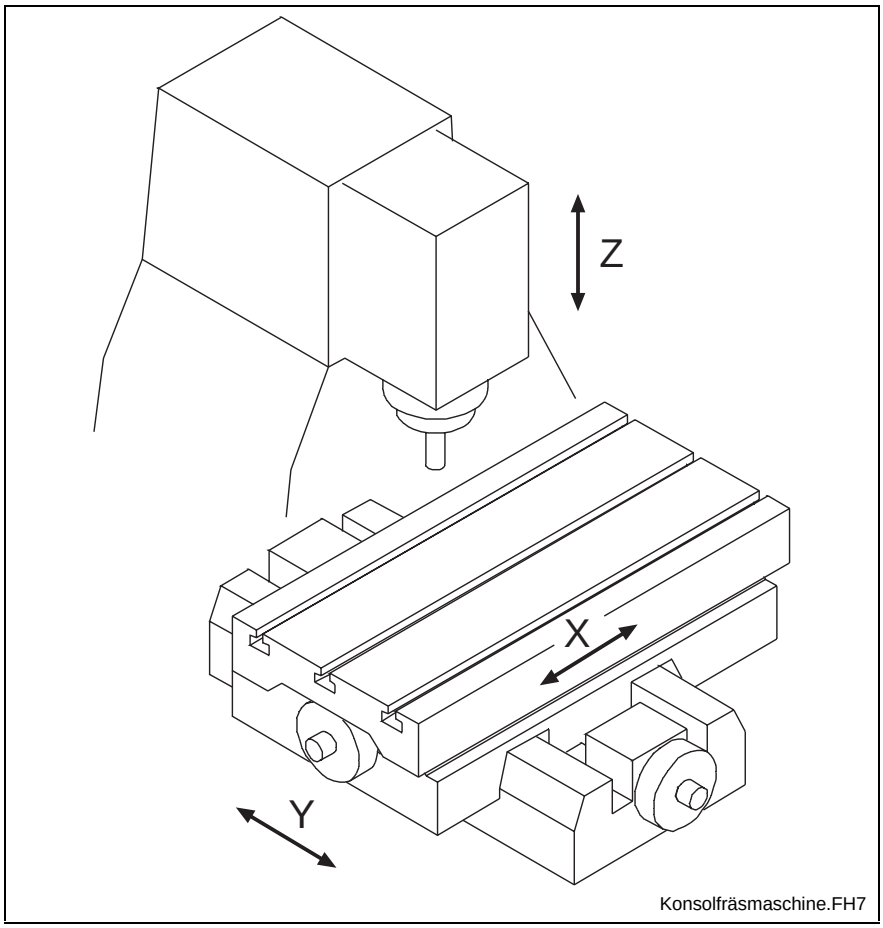

Fig. 8-1: Knee milling machine with compound table

Preparation

For using the adaptive feed control function, the steps described in chapter "2.1 Procedure" have to be carried out in the indicated order. The adaptive feed control function can only be used if the following preparations are carried out:

Reference axis determination

First, the reference axis has to be determined depending on the given conditions: For our example application, a constant machining capacity (el. power of the spindle drive) is desired. Therefore, we define the main spindle (S axis) as reference axis.

Reference measurement

1. The torque (force) values of the reference axis are recorded for the machining process(es) to be monitored by means of the MTC200 oscilloscope function. Use the corresponding program and cutting data for machining. The following signals are recorded:
   - **S-0-0040 actual speed value**
   - **S-0-0080 torque/force nominal value**
2. The following data of the reference measurement is used:

- stall torque
- idling torque
- determination of
  - **009** or **Bxx.065 minimum machining torque** (see Fig. 5-9, page 5-8),
  - **008 peak machining torque** (see Fig. 5-8, page 5-8) and
  - **010** or **Bxx.064 limiting machining torque** (see Fig. 5-10, page 5-9).

3. Activation of the adaptive feed control function:

   Bxx.062 adaptive feed control = yes

Parameterization

4. Define the main spindle as reference axis:

   Bxx.063 reference axis for adaptive feed control = 10 (S axis)

5. Compare the data determined by the reference measurement with the projected data and multiply by a safety factor, if necessary. Enter the values in process parameters **Bxx.064** to **Bxx.067**.
6. Determine the value for **Bxx.068 amplification**. An iterative procedure is recommended for setting the I controller. E. g. 0.1 1/s can be set as starting value in order to obtain a relatively "stiff" control.

Use in the NC program

7. Measurement of the current idling torque and use of the adaptive feed control:

```
....
....
;----- processing -------------------------
N0011 G00 X 110.0000 ITM                    ; measure idling torque (reference axis = S1)
N0011 G01 G26 X 200.0000 F3000.0            ; switch on adaptive feed control
N0012 G25                                   ; switch off adaptive feed control
....
....
```

Fig. 8-2: Use of ITM and G26 / G25 in the NC program

Machine data

In principle, no entries are required in the machine data. All required definitions can be made in the process parameters. These are then indicated automatically in the machine data while the adaptive feed control is active (**G26**), if no reference axis, differing from the reference axis defined in process parameter **Bxx.063**, is defined in the machine data. The status variables (see Fig. 5-2, page 5-1) are used for controlling the function.

SPS interface signals

The SPS interface signals **PxxS.THMIS** and **PxxS.EXCTH** allow to react when **Bxx.067 maximum feed reduction** is exceeded and the minimum machining torque is not reached.

A possible reaction might be that an event is recorded in the SPS upon the response of interface signal **PxxS.THMIS**. This event stops the execution of the current NC program and,

- for example, issues a message for the user indicating that the minimum machining torque has not been reached and the possible causes, such as no workpiece available, drill possibly broken,...,

- or -

- starts a test cycle which, for example, checks by means of a probe, whether the workpiece is available.

Further information regarding the events is available in the "NC programming instructions" 19VRS" (DOK-MTC200-NC**PRO*V19-AW0x-DE-P).

SPS program example

The following figure Fig. 8-3 shows an example of an SPS program in which:

- the SPS interface signal P00S.THMIS influences event 11,
- the SPS interface signal P00S.EXCTH influences event 12 and
- marker "mEXCTHSP" stores the single exceeding of **0013** or **Bxx.067 maximum feed reduction** until the adaptive feed control function is switched off (**G25**). The deactivation of the adaptive feed control (**G25**) is indicated in machine data element **001 adaptive feed control active** and read from machine data page 30 in process 0 by means of the MTD_RD function in the SPS program.

```
ACTION aADV: Adaptive feed control
         1     (*Thrust Missing*)
               (*P00S.THMIS = 1 : M_machin._act. < M_machin._min.*)
                           +---------+
                           ¦EV_ST    ¦
                P00S.THMIS-¦WRITE    ¦
                         0-¦PROC     ¦
                        11-¦NO       +-Q_THMIS
                           +---------+
               EV_ST..................... ..................................... ......... EV_ST
               P00S.THMIS................ Thrust Missing (adapt. feed control)  ......... BOOL
               0......................... ..................................... ......... ANY_INT
               11........................ ..................................... ......... ANY_INT
               Q_THMIS................... Q GWY P00S.THMIS..................... %Q52.1.1.. BOOL

         2     (*Excessive Thrust*)
               (*P00S.EXCTH = 1 : current feed reduction > max. feed reduction*)
                           +---------+
                           ¦EV_ST    ¦
                P00S.EXCTH-¦WRITE    ¦
                         0-¦PROC     ¦
                        12-¦NO       +-Q_EXCTH
                           +---------++S(mEXCTHSP)
               EV_ST..................... ..................................... ......... EV_ST
               P00S.EXCTH................ Excessive Thrust (adapt. feed control) .  ......... BOOL
               0......................... ..................................... ......... ANY_INT
               12........................ ..................................... ......... ANY_INT
               Q_EXCTH................... Q GWY P00S.EXCTH..................... %Q52.1.0.. BOOL
               mEXCTHSP.................. save PxxS.EXCTH ......     ............. ......... BOOL

         3     (* - Check whether G26 is active, i. e. read machine data element*)
               (*   "001 adaptive feed control active". *)
               (* - Reset mEXCTHSP, if G25 is active*)
                           fbRD_G26
                           +----------------------+
                           ¦MTD_RD                ¦
                       2#1-¦READ                  ¦
                         0-¦TYPE             BOOL_O-R(mEXCTHSP)
                        30-¦PAGE              INT_+
                         0-¦VAR1             DINT_+
                         0-¦VAR2             REAL_+
                         1-¦ELEMENT          READY+
                           +----------------------+
               fbRD_G26.................. Fb for reading G26.....  ............. ......... MTD_RD
               2#1....................... ..................................... ......... Dual
               0......................... ..................................... ......... ANY_INT
               mEXCTHSP.................. save PxxS.EXCTH     ................... ......... BOOL
               30........................ ..................................... ......... ANY_INT
               0......................... ..................................... ......... ANY_INT
               0......................... ..................................... ......... ANY_INT
               1......................... ..................................... ......... ANY_INT
```

Fig. 8-3: SPS program example

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11 Service & Support

11.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

- telefonisch: **+49 (0) 9352 40 50 60**
  über Service-Call Entry Center Mo-Fr 07:00-18:00
- per Fax: **+49 (0) 9352 40 49 41**
- per e-Mail: **service@indramat.de**

Our service helpdesk in the head factory Lohr am Main is assisting you in all kind of queries. You may contact us

- by phone: **+49 (0) 9352 40 50 60**
  via Service-Call Entry Center Mo-Fr 07:00-18:00
- by fax: **+49 (0) 9352 40 49 41**
- by e-mail: **service@indramat.de**

11.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

+49 (0) 171 333 88 26
oder **+49 (0) 172 660 04 06**

Beyond the helpdesk hours, our service is directly contactable under

+49 (0) 171 333 88 26
or **+49 (0) 172 660 04 06**

11.3 Internet - Worldwide Web

Weitere Hinweise zu Service, Reparatur und Training finden Sie im Internet unter

www.indramat.de

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit Ihrem lokalen Ansprechpartner auf. Die Adressen sind im Anhang aufgeführt.

Further hints about service, repairs and training are available in the worldwide web under

www.indramat.de

Please don't hesitate to contact first the sales & service agencies in your area. Refer to the addresses are on the following pages.

11.4 Vor der Kontaktaufnahme... ...before contacting us

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Telefon-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

To enable us for quick and efficient help, please prepare the following information:

1. most detailed description of the failure appearance.
2. Indications on the typelabel of the concerned products, especially typecodes and serialnumbers.
3. Telephone-/faxnumbers and e-mail address by which we can attend you in case of queries.

11.5 Kundenbetreuungsstellen Sales & Service Facilities

Verkaufsniederlassungen
Niederlassungen mit Kundendienst

sales agencies
agencies providing service

Deutschland – Germany

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Vertriebsgebiet Mitte Germany Centre	**SERVICE**	**SERVICE**	**SERVICE**
Rexroth Indramat GmbH Bgm.-Dr.-Nebel-Str. 2 97816 Lohr am Main **Kompetenz-Zentrum Europa** Telefon: +49 (0)9352 40-0 Telefax: +49 (0)9352 40-4885	**CALL ENTRY CENTER** **MO – FR** **von 07:00 - 18:00 Uhr** **from 7 am – 6 pm** **Tel. +49 (0) 9352 40 50 60** service@indramat.de	**HOTLINE** **MO – FR** **von 17:00 - 07:00 Uhr** **from 5 pm - 7 am** + SA / SO **Tel.: +49 (0)172 660 04 06** **oder / or** **Tel.: +49 (0)171 333 88 26**	**ERSATZTEILE / SPARES** verlängerte Ansprechzeit - extended office time - ♦ nur an Werktagen - only on working days - ♦ von 07:00 - 18:00 Uhr - from 7 am - 6 pm - **Tel. +49 (0) 9352 40 42 22**
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