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MTC200/MT-CNC
Drill Breakage Monitoring
18VRS

Application Manual

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Purpose of the document This document describes the "Drill breakage monitoring" function.

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Contents

1 Introduction

The drill breakage monitoring function that is integrated in the CNC controller checks the torque values that occur during machining. The interpretation of these torque values permit a statement to be made about the state of the tool.

The monitoring method employs the actual current values the drive reports via the SERCOS interface to the controller. This permits a sudden rise of the machining forces (in the event of a breakage) and a lacking machining force (if drill or workpiece are missing) to be diagnosed without any additional sensors.

The greatest part of the „drill breakage monitoring“ is integrated in the NC program All calculations that are required for activating and deactivating the measurements, and the „Missing tool monitoring“ function are performed in NC code.

There are three instructions for the tool breakage monitoring function that must be entered in the NC program.

All stored torque values and the process-related and machining-related data items are stored in the machine data.

Ordering information

The "Drill breakage monitoring" function is an optional component of the MTC200/MT-CNC that can be ordered under the type name

SWS-MTC200-BBU-18VRS-MS

1.1 Technological Restrictions

The torque mean values and torque peak values that occur during machining are related to the nominal torque of the drive. They are specified in percent values of the full nominal torque.

Restrictions of "Missing tool monitoring"

The no-load torque (handling in air) must be significantly different than the machining torque (machining in material) (see „Missing Tool Monitoring“ 5-2). The missing tool monitoring cannot be activated for the corresponding drive if the torque dispersion does not permit an unambiguous range to be defined for the no-load torque (machining in air) and for the machining torque (machining in material). In order to deactivate the missing tool monitoring (breakage monitoring remains active), the missing tool monitoring factor (see „Machine data that must be set by the user“ 3-4) must be set to a sufficienctly high level.

Restrictions of breakage monitoring

Breakage monitoring employs the torque peak value that occurs during machining. You can select a torque peak value that can be defined for machining (see „Breakage Monitoring“ 5-1). A breakage alarm is released if this maximum value is exceeded during monitoring. The difference between the torque peak value that occurs when a tool breaks and the torque peak value that occurs during machining must be sufficiently high. Breakage monitoring does not become active if the selected window values of the torque peaks (see „Machine data that must be set by the user“ 3-4) are large enough. The missing tool monitoring of the drive is not influenced.

Restrictions caused by the recording duration

Torque recording only has an effect during the non-accelerated phase of the drive.

The torque values are not recorded if the velocity during machining is not constant. The value of "zero" is used in the calculations. Due to the recording cycle time, producing a torque will not always be possible in a machining process that is at the limit of a machining without a constant velocity. The drive of such a machining process cannot be monitored.

2 NC Instructions

The greatest part of the tool breakage monitoring is integrated in the NC program All calculations that are required for activating and deactivating the measurements, and the „Missing tool monitoring“ function are performed in the NC code.

There are three instructions for the tool breakage monitoring function that can be entered in the NC program.

NC Instructions

- **TLMON_ON( )** ... Activate breakage and missing tool monitoring
- **TLMON_OFF** ... De-activate breakage and missing tool monitoring
- **TLMON_CHK** ... Interpret breakage and missing tool monitoring

In the NC program editor (GUI), the "Drill breakage monitoring" instructions can be inserted in a menu-controlled way under <F1> ‘Insert block + <F3> ‘Special functions’. Branching to the "Drill breakage monitoring" directory is required in the NC special functions. 4>

2.1 Description of the Instructions

TLMON_ON( )

Function The TLMON_ON( ) instruction is used for activating the breakage and missing tool monitoring function. Distinction is made between teach and monitoring steps (see „Method of Operation of Drill Breakage Monitoring“ 5-1).

Position in the NC program The instruction must be programmed before the other instructions for drill breakage monitoring.

Syntax TLMON_ON(A,B,C,D,E,F)

Parameter	Description	Assignment
A:	Axis designation of axis 1	
B:	Axis designation of axis 2	
C:	Axis designation of axis 3	
D:	Axis designation of axis 4	
E:	Tool number	1 - 9999999
F:	Machining number	1 - 99

Note: Any designation that can be defined in the drive parameters may be used as an axis designation. The existence of an axis designation will not be verified. At least one axis must be programmed. The axis locations must be separated by commas if not all four of them have been assigned. The parameters ‘tool number’ and ‘machining number’ must always be specified.

Example TLMON_ON(A,B,C,D,E,F)
TLMON_ON(Z,S,,, 12,3)

- Breakage and missing tool monitoring are activated for axis Z and spindle S.
- The tool with the tool number 12 is the active machining tool of this machining process.
- The machining number 3 is used for an unambiguous allocation to the machine data.
- The motion blocks that follow the instruction are subjected to the breakage monitoring.

TLMON_OFF

Function The TLMON_OFF instruction is used for deactivating the breakage and missing tool monitoring function.

Position in the NC program The instruction is located after a TLMON_ON( ) and is related to the last programmed TLMON_ON( ).

Syntax TLMON_OFF

Specifying parameters is not permitted.

Example TLMON_OFF

- The monitoring function that has been activated by TLMON_ON( ) is deactivated.
- There is no more breakage monitoring in the subsequent motion blocks.

TLMON_CHK

Function The TLMON_CHK instruction is used for interpreting the missing tool monitoring function. A missing tool is not recognized before this point. Furthermore, the teach values of the breakage monitoring function are generated.

Position in the NC program The instruction is located after a TLMON_OFF and is related to the last TLMON_ON( ).

Syntax TLMON_CHK

Specifying parameters is not permitted.

Example TLMON_CHK

- The machining range defined by TLMON_ON( ) and TLMON_OFF is checked for a missing tool condition.

Note: The NC instructions TLMON_ON, TLMON_OFF and TLMON_CHK form one unit and must be programmed in succession. This means that, for example, a specific instruction must not be followed by the same instruction. The correct sequence must also be observed (see „Example“ 2-4).

2.2 Brief Summary of the Instructions

Instruction	Meaning of the parameters	Parameter assignments	Description
TLMON_ON(A,B,C,D,E,F)	A: Monitoring axis 1 B: Monitoring axis 2 C: Monitoring axis 3 D: Monitoring axis 4 E: Tool number F: Machining number	 1 - 9999999 1 - 99	The TLMON_ON( ) instruction activates breakage and missing tool monitoring. TLMON_ON( ) is the first one in the sequence of the drill breakage monitoring instructions.
TLMON_OFF			The TLMON_OFF instruction deactivates the breakage and missing tool monitoring function. TLMON_OFF is located after TLMON_ON( ).
TLMON_CHK			The TLMON_CHK instruction interprets the missing tool monitoring function. TLMON_CHK is located after TLMON_OFF.

Figure 2-1: Instructions

Note: The jump labels **.*$....** are used for the NC code. The user must not employ the jump labels elsewhere. The instructions must not be programmed in the NC cycles.

CAUTION

The NC variables 100 and 101 are used for buffering during the execution of the drill breakage monitoring instructions. The variable 101 is restored at the end of the NC code.

⇒ The variable 100 must be saved separately if it contains important data.

2.3 Example

NC program

```
T5 M6                              ; change drill in
G00 G54 G90 G06 G08 X0 Y0 Z10      ; move to home position
S2000 M3                           ; spindle ON
Z2                                 ; infeed Z axis
TLMON_ON(Z,S,,,5,1)                ; monitoring ON
G01 Z-30 F500                      ; material cut
TLMON_OFF                          ; monitoring OFF
G00 Z2                             ; retract Z axis
TLMON_CHK                          ; missing tool monitoring
                                     interpretation
....
```

- Once the axes have been positioned, breakage and missing tool monitoring for axis Z and spindle S are switched on.
- Breakage monitoring is switched off at the end of the material cut. The subsequent movements are no longer subjected to breakage monitoring.
- Missing tool monitoring is interpreted and the teach values are determined after the tool has moved out of the material.

2.4 Programming Instructions

Only one instruction for "drill breakage monitoring" may be programmed in an NC block. No other NC syntax may be written in this NC block.

Since several blocks are generated from an instruction, further NC code could incorrectly be processed.

An NC block with an instruction for "drill breakage monitoring" may consequently not be marked as a skipped block.

Instructions for "drill breakage monitoring" cannot be programmed in the NC cycles. This would lead to an error during the cycle download because jump labels could be programmed repeatedly within the NC code for "drill breakage monitoring".

3 Machine Data

All stored torque values and the process-related and machining-related data items are stored in the machine data. Merely the NC variables @100 and @101 are used temporarily for buffering and computation.

These are the following pages:

- TLMON_basepage
- TLMON_processpage
- TLMON_machiningpage

The TLMON_basepage is the Indramat page 91. When a page directory is created, this page is automatically created under the name of „drill breakage monitoring“.

3.1 Description of the Machine Data Pages

TLMON_basepage

The number of the TLMON_basepage is the only one that has invariably been specified. It cannot be changed by the user. It is implemented as an Indramat page.91

Description The base page contains the numbers of the process and machining page. Furthermore, the number of possible machining processes in each process, and information about the axes that have been defined in the unit are stored.

Note: The values of the data elements 1 through 2 refer to the machine data pages ‘TLMON_processpage’ and ‘TLMON_machiningpage’ of the drill breakage monitoring function. The numbers of the related pages must be entered prior to compiling and/or downloading the NC programs. The number of machining processes that shall be monitored is important for the NC program execution, and must be entered before the NC program start. The control variable 2 of the ‘TLMON_machiningpage’ can be adjusted according to the number. A maximum of 20 machining processes per process can be defined.

Control variable LV1 The variable is of the NO_CLASS [1-1] type.

The data structure exists only once.

Control variable LV2 Does not exist

Page structure STRUCT TLMON_basepage

Data element	Designation	Data type
0001	process page	INT
0002	machining page	INT
0003	max. number of mach. processes	USINT

0004	number of defined axes	USINT
0005	axis number	USINT
0006	axis number	USINT
0007	axis number	USINT
...		
0034	axis number	USINT
0035	axis number	USINT
0036	axis number	USINT
0037	value of the variable 101	DREAL

END_STRUCT

TLMON_processpage

Description The process-related data items are stored in the process page for the machining processes.

Control variable LV1 The variable is of the PROCESS type.

Control variable LV2 Does not exist

Page structure STRUCT TLMON_processpage

Data element	Designation	Data type
0001	TLMON active	BOOL
0002	number of teach values air	INT
0003	number of teach values material	INT
0004	recording measured values	BOOL
0005	faulty tool	BOOL
0006	empty	BOOL
0007	current tool no.	DINT
0008	event: record meas. sequence	INT
0009	reference measuremt. air, 1st axis	INT
0010	reference measuremt. air, 2nd axis	INT
0011	reference measuremt. air, 3rd axis	INT
0012	reference measuremt. air, 4th axis	INT
0013	buffer	INT
0014	buffer	INT
0015	buffer	INT
0016	buffer	INT
0017	buffer	INT
0018	buffer	INT
0019	buffer	INT
0020	buffer	INT

END_STRUCT

TLMON_machiningpage

Description The data items that are important for machining are stored in the process page. This includes the torque values (teach values, window values, machining values, etc.), computing factors, etc.

Control variable LV1 The variable is of the PROCESS type.

Control variable LV2 The variable is of the NO_CLASS [1-20] type.

Page structure STRUCT TLMON_machiningpage

Data element	Designation	Data type
0001	machining active	BOOL
0002	weighting factor averaging	REAL
0003	factor missing tool	REAL
0004	peak value window 1st axis	REAL
0005	peak value window 2nd axis	REAL
0006	peak value window 3rd axis	REAL
0007	peak value window 4th axis	REAL
0008	mean value window all axes	REAL
0009	mean value window 1st axis	REAL
0010	mean value window 2nd axis	REAL
0011	mean value window 3rd axis	REAL
0012	mean value window 4th axis	REAL
0013	monitoring mode	BOOL
0014	tool number	DINT
0015	teach air measurement flag	INT
0016	teach material measurement flag	INT
0017	teach value mean value all axes	DREAL
0018	teach value mean value 1st axis	DREAL
0019	teach value peak value 1st axis	INT
0020	teach value mean value 2nd axis	DREAL
0021	teach value peak value 2nd axis	INT
0022	teach value mean value 3rd axis	DREAL
0023	teach value peak value 3rd axis	INT
0024	teach value mean value 4th axis	DREAL
0025	teach value peak value 4th axis	INT
0026	meanteach val. factor air 1st axis	REAL
0027	mean teach val. factor air 2nd axis	REAL
0028	mean teach val. factor air 3rd axis	REAL
0029	mean teach val. factor air 4th axis	REAL
0030	act. weight. mean value 1st axis	REAL
0031	act. weight. mean value 2nd axis	REAL
0032	act. weight. mean value 3rd axis	REAL
0033	act. weight. mean value 4th axis	REAL
0034	reference measuremt. air, 1st axis	INT
0035	reference measuremt. air, 2nd axis	INT

```
    0036        reference measuremt. air, 3rd axis  INT
    0037        reference measuremt. air, 4th axis  INT
    0038        number of air meas. transferred     BOOL
END_STRUCT
```

3.2 Machine data that must be set by the user

TLMON_basepage		
Designation	Type	Feature
0001 process page	INT	Number of the machine data page of the process page.
0002 machining page	INT	Number of the machine data page of the machining page.
0003 max. number of machining processes	USINT	Maximum number of machining processes per process. The machining page must be adapted accordingly.
TLMON_processpage		
Designation	Type	Feature
0001 TLMON active	BOOL	Activates the tool breakage supervision function of the process.
0002 number of teach values air	INT	Number of air cuts during the teach process.
0003 number of teach values material	INT	Number of material cuts during the teach process.
0004 recording measured values	BOOL	The torque values that occur during the machining process are stored in a file. Is set automatically by the NT program „TLM0031L.EXE“ according to the file „TLM0031L.INI“.
TLMON_machiningpage		
Designation	Type	Feature
0001 machining process active	BOOL	The machining process can be activated independently of the process data element „0001 TLMON active“ for breakage monitoring
0002 weighting factor averaging	REAL	Defines the weighting factor that is used for calculating the torque mean values during the monitoring procedure.
0003 missing tool factor	REAL	The difference between teach value air and teach value material is multiplied by this factor.
0004 peak value window 1st axis	REAL	Window value in % around the peak teach value.
0005 peak value window 2nd axis	REAL	Window value in % around the peak teach value.
0006 peak value window 3rd axis	REAL	Window value in % around the peak teach value.
0007 peak value window 4th axis	REAL	Window value in % around the peak teach value.

Note: If the elements **1 page no. TLMON_processpage** and **2 page no. TLMON_machiningpage** of the TLMON_basepage have not been defined before the NC program is compiled, or if the corresponding pages do not exist, there will be an error during compilation or downloading. The corresponding machine data page must be active and the elements 1 and 2 of the TLMON_basepage must have been entered.

4 User Tool Data

The state of the tools is stored in the tool data. The first user tool data item is used for this purpose (see „Installation“ 8-1).

Tool states

The tool can assume one of the following states (that is defined by the used data item).

0 Tool is new

1 Tool is being used (teaching or monitoring)

2 Tool is faulty

With a new tool, a '0' must be entered in the first used data item. The data item is set to '1' once the machining processes that are defined for this tool have been initialized.

The ‘2’ is entered in the data item when a monitoring alarm occurs. Whenever the faulty tool is used while the monitoring function is active, the NC program issues an error message (machine data element 5 of the TLMON_processpage is set).

The used data item can be reset to ‘0’ at any time. The tool is classified new and the machining processes concerned are re-initialized.

Tool utilization can be continued if the used data item is reset from ‘2’ to ‘1’. The previously determined teach values are employed for monitoring. There will not be a new initialization.

5 Method of Operation of Drill Breakage Monitoring

Activation

Drill breakage monitoring is activated via the '0001 TLMON active' machine data element of the TLMON_processpage. All machining processes of the process concerned become active when this bit is set. If the monitoring shall be limited to individual machining steps of a process, these steps can be activated individually using the '0001 handling active' machine data element of the TLMON_machiningpage. The element '0001 TLMON active' of the TLMON_processpage is not active in this case.

Teaching ⇔ monitoring

Teach values must be determined before a machining process with a new tool can be monitored. The teach values are used as reference values during the subsequent monitoring. An evaluation of a breakage or missing tool situation is possible by comparing the torque values that occur during monitoring with the teach values.

The machine data elements '0002 number of teach values air' and '0003 number of teach values material' of the TLMON_processpage are used for defining the number of teach steps for all machining processes of the process. In order to be able to eliminate any torque dispersions, more than one value should be defined for the teach values.

Monitoring time

The monitoring of the torque peak values and, consequently, breakage monitoring is performed on the APR module during the machining process.

The monitoring of the torque mean values and, consequently, the missing tool monitoring is implemented in the NC code of the TLMON_CHK key word.

5.1 Breakage Monitoring

Breakage monitoring is active during the machining process (time interval between TLMON_ON and TLMON_OFF). A breakage alarm is released if the torque peak value exceeds its maximum value during this time interval, An error message is issued and the drives are stopped according to the selections made in the drive parameters.

The corresponding axis can only be moved after the monitoring function has been switched off via the SPS function block 'TLMON_xx' (TLMON_OFF input) or manually (MDI mode) using the corresponding AXD command (for example **AXD(S:P-7-3595)=0**).

The following equation is used for calculating the maximum torque peak value:

$$Peak_{\max} = Peak_{teach} * \left(1 + \frac{Peak_{window}}{100}\right)$$

$Peak_{max}$	maximum torque peak value
$Peak_{teach}$	teach value of the torque peak value
$Peak_{window}$	window value of the torque peak value

Figure 5-2: Calculation of the maximum peak value

Note: The window values of the torque peak values are entered in the elements 4 through 7 of the TLMON_machiningpage.

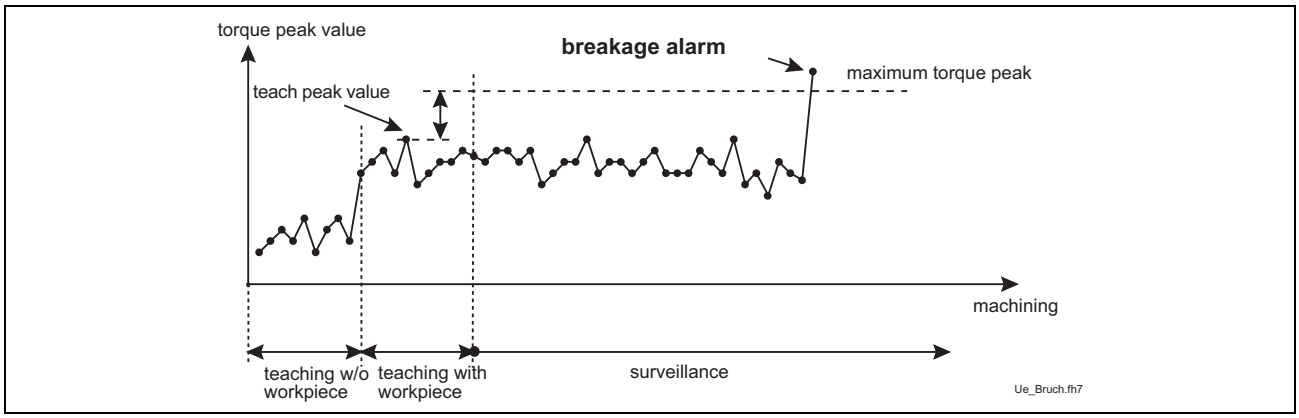


Figure 5-3: Typical breakage alarm

5.2 Missing Tool Monitoring

The monitoring „missing tool“ is performed in the TLMON_CHK instruction. The average torque values that occur during the machining period (time interval between TLMON_ON and TLMON_OFF) are significant for this function. A TLMON_CHK must therefore always be preceded by a TLMON_ON and a TLMON_OFF.

During the learning process, the system stores the average values that are required for machining without a tool and for machining with a tool. The difference is multiplied by a factor. During the monitoring process, the result is compared with the difference between the last two average torque values that were measured.

$$Mean_{missing} = ABS\left(Mean_{teach\_with} - Mean_{teach\_without}\right) * Factor_{missing}$$

$Mean_{missing}$	comparison value for missing tool monitoring
$Mean_{teach\_with}$	teach mean value with workpiece
$Mean_{teach\_without}$	teach mean value without workpiece
$Factor_{missing}$	missing tool monitoring factor

Figure 5-4: Calculating the comparison value of missing tool monitoring

Note: The factor for missing tool monitoring is entered in element 3 of the TLMON_machiningpage.

The machine data element ‘0005 tool faulty’ of the TLMON_processpage is set and the NC program execution is stopped if the difference between the last current mean values is greater than the comparison value of the missing tool monitoring. The user tool data item is set to ‘2’. If the SPS function block has been linked, 'high' is applied to its error output for the corresponding process.

When you clear the fault through the SPS FB or manually in den machine data (reset element ‘0005 tool faulty’), the NC program execution can be continued up to the next interrogation of the user tool data item (in TLMON_ON or TLMON_CHK). The tool fault status is cleared when the user tool data item is manually set to ‘1’ or ‘0’.

In order to eliminate possible outliers of the torque mean values, the occurred mean values are smoothed using the ‘averaging weighting factor’ (machine data element ‘0002 averaging weighting factor’ of the TLMON_machiningpage). The missing tool monitoring is related to the smoothed mean values.

$$Mean_{new} = Mean_{old} - \frac{Mean_{old}}{Weight} + \frac{Mean_{meas}}{Weight}$$

$Mean_{new}$	new smoothed mean value
$Mean_{old}$	old smoothed mean value (the first old mean value is the teach value)
$Mean_{meas}$	measured mean value of the current machining process
Weight	weighting factor used for averaging

Figure 5-5: Smoothed averaging

Note: Smoothing increases as the weighting factor increases.

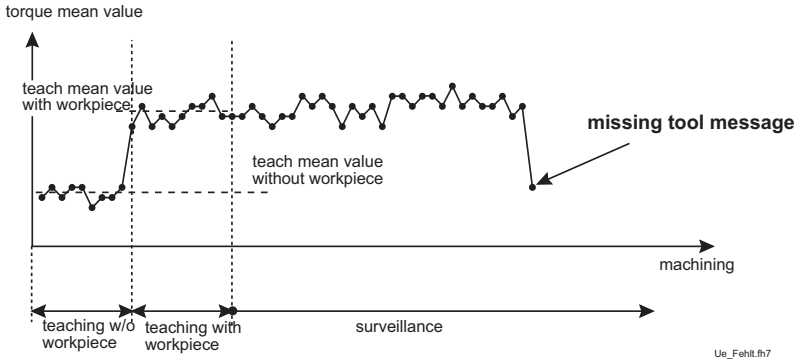


Figure 5-6: Typical missing tool message

6 Recording the Torque Values

Using the auxiliary program TLM0031L.EXE under Windows NT, the torque values that occur during the machining process can be stored in ASCII files. The program is in the '...MT-CNC' directory.

The processes that shall be taken into account when the torque values are recorded are entered in the TLM0031L.INI file.. The file is in the '...MT-CNC\CONFIG' directory.

File structure TLM0031L.INI

The TLM0031L.INI file is an ASCII file that can be edited using a corresponding editor.

Example

```
[DeviceAddr0]
Process0=NO
Process1=YES
Process2=YES

[DeviceAddr1]
Process0=YES
```

In this example, the machine consists of two units (controllers).
Unit 0 contains three processes, out of which the processes 1 and 2 are monitored.
Unit 1 contains one process that is monitored.

Note: Processes that are not monitored (marked with 'NO') need not be entered in the file.

Invocation

The TLM0031L.EXE program can be started under "Execute" or via a link that must be established. In the case of a link, the working directory '...MT-CNC' must be selected.

During the monitoring, the torque values are written into ASCII files.

Name and structure of the ASCII files

The files that contain the torque values are contained in the **...MT-CNC\TLMON** directory. They have the following names:

a<Anlagennummer>p<Processnummer>m<Bearbeitungsnummer>.dat

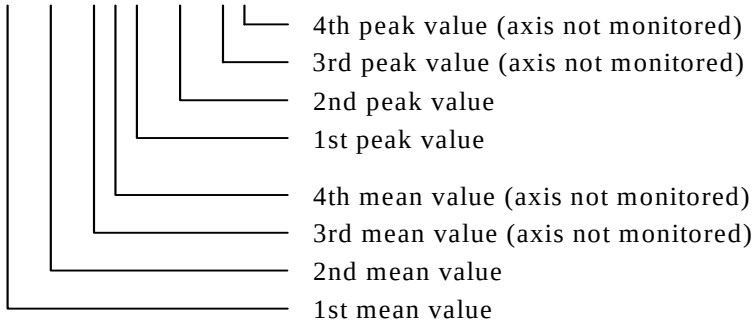
Example

```
a0p0m1.dat
a2p4m13.dat
```

The file contents consists of ASCII characters that contain the torque mean value and the torque peak value of all axes that are to be monitored.

Example

```
212 345 0 0 56 78 0 0
215 350 0 0 60 75 0 0
211 341 0 0 61 76 0 0
```



The first four values are the torque mean values, and the last four values are the torque peak values. All torque values are specified at an accuracy of 0.1. 212, for example, means a torque value of 21.2% of the nominal torque value of the axis. A "0" is entered as a dummy if there are less than 4 axes monitored.

Note: The torque values that occur during the machining process are recorded. Any smoothing of the torque mean value is not taken into consideration.

File size

A transfer parameter permits the size of the ASCII files to be defined.

Example

```
TLM0031L.EXE 10000
```

In this file, the maximum size of an ASCII file for the recorded torque values is 10,000 bytes. When the maximum size is exceeded, the DAT file is copied to a BAK file, and cleared afterwards. Additional torque values are written to a new DAT file. Thus, there is always one file that contains the latest torque value recordings. A file size of 100,000 bytes is assumed if a transfer parameter is not specified.

Prerequisites

- The user interface must have been started.
- The machine data pages must have been created and contained in the controller.
- The TLM0031L.INI file must be adapted to the machine.

Method of operation

The processes that are selected in the TLM0031L.INI file are monitored when the TLM0031L.EXE program is invoked.

The process-related machine data elements „Event: Recording a measuring sequence“ are read cyclically. Depending on these elements, the peak and mean torque values that occurred during a machining process are read from the machine data buffer, and are written to the corresponding file.

CAUTION

If the program has been started during a machine parameter, machine data or SPS program download, this may lead to a disturbance in the execution of the TLM0031L.EXE program.

⇒ The program should be terminated before a download, and be restarted afterwards.

7 Representing the Torque Values

A simple Visual Basic program „TLM0131L.EXE“ is available for the graphical representation of the torque values that are stored in the files. This program is located in the '...MT-CNC' directory.

Invocation

The TLM0013L.EXE program can be started under "Execute" or via a link that must be established. In the case of a link, the working directory '...MT-CNC' must be selected.

Screen structure

Input and output screen are of the following structure:

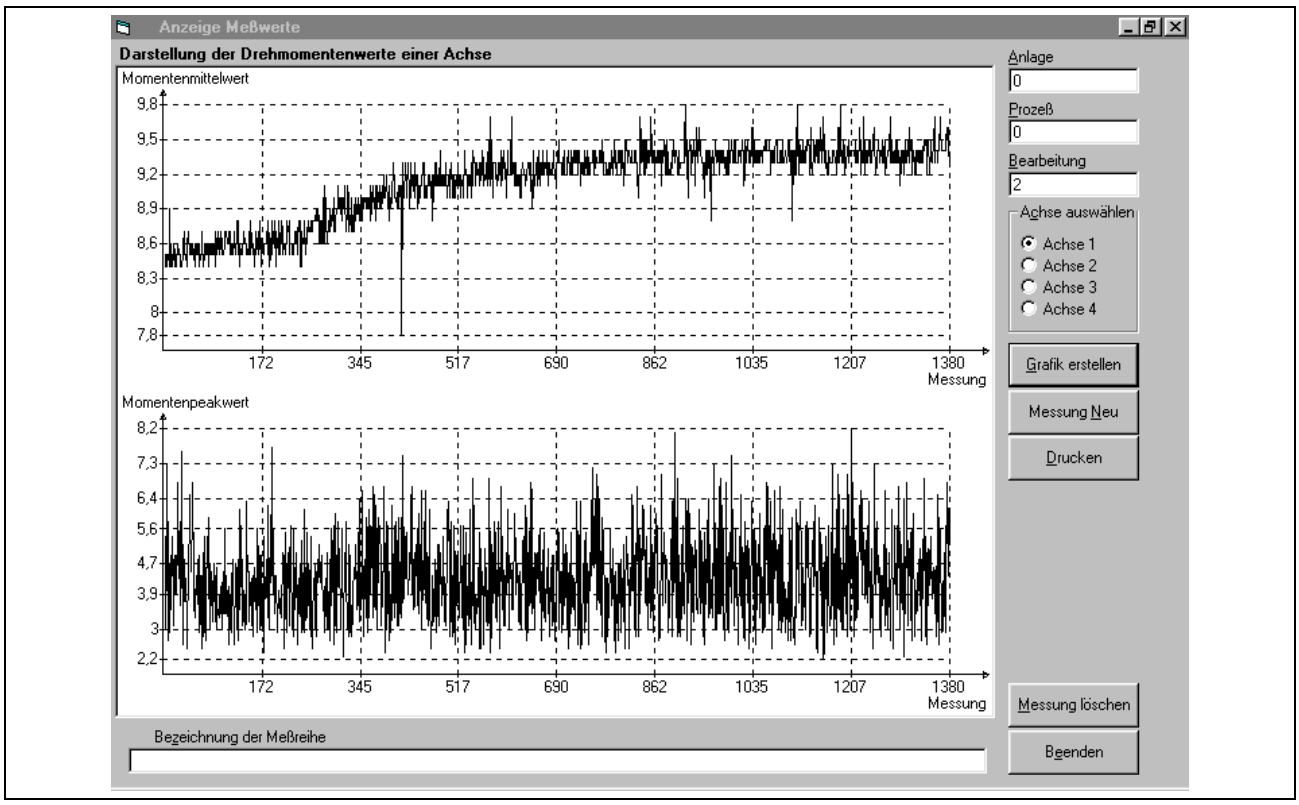


Figure 7-7: Typical torque value recording

System, **process** and **machining process** permit an unequivocal assignment between measured values and machining process to be made.

According to the axis sequence that is defined in the „TLMON_ON( )“ instruction, **selecting axis** permits the torque values for the peak values and mean values of a specific axis to be represented.

Create graphics provides a graphical representation of the torque values. Newly occurred measured values are not included.

New measurement has basically the same effect as „Create graphics“; but it also includes newly occurred measured values. Since the ASCII characters must be reformatted, this process will take some time.

If a printer has been connected to your system, you can select the **Print** option to produce a printout of the current graphics.

Delete measurement deletes the files of the current graphics.

Use **Name of measuring sequence** to enter a one-line banner line for the graphics printout.

Terminate closes the application.

Note: Any other suitable program (such as Microsoft Excel) may as well be used for evaluating the ASCII tiles with the torque values.

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8 Commissioning

8.1 Installation

The drill breakage monitoring function requires the machine manufacturer to install and activate the following components:

- Machine data
- SPS function block
- User tool data
- Software option for drill breakage monitoring

To record the torque values under Windows NT:

- Recording the torque values

Machine Data

The machine data pages for „Rapid measurement“ must be imported in the menu item „F3 machine data of the main menu (MUI)“.

Relevant machine data pages

- TLMON_processpage
- TLMON_machiningpage

Entry into the machine data menu item

- Machine data preparation is invoked upon the entry into the menu if there is no machine data in the controller yet.
- The current machine data is invoked upon the entry into the menu if there is machine data in the controller. <CTRL> <F8> Branches to machine data preparation.

Importing the machine data pages

If a machine data directory has not yet been created, a new directory must be created using <F1>. The newly created directory contains the standard Indramat pages in the range between 1 and 99. The TLMON_basepage is at position 91.

If directories with user pages exist, one of these directories may be used for drill breakage monitoring.

<F7> is used for zooming into the corresponding directory.

<CTRL> <F2> is used for importing machine data pages here.

The pages for "drill breakage monitoring" are in the „..MT-CNC\MACHDATA“ directory. The pages with the extension .EXP (default selection) are the user pages in English. The pages with the corresponding extension must be imported if a different language is to be used.

e.g.. .ger for German

The page numbers 151 and 152 have been defined as default setting. However, any other free user page number may be entered during import.

Downloading the pages

The machine data directory must be loaded into the controller after the user pages have been imported.

<F8> is used for branching to the list of directories. <F6> loads the corresponding directory into the controller.

Structure and purpose of the machine data pages (see „Description of the Machine Data Pages“ 3-1).

SPS Function Block

The "TLMON_xx“ function block is available for "drill breakage monitoring“. The function block can be integrated into the SPS program.

Importing the function block

The „TLMON_xx“ function block can be inserted as a user function block in the SPS programming menu under <Project> <Archive> <Fetch>

The drive on which the user interface has been installed must be selected as the "source".

If <ohne> has been selected under "Name", the „TLMON_xx“ function block can be selected for fetching under "File". The subsequent inquiry must be confirmed with <Mixing>.

Next, the FB is imported into the SPS program under <Edit> <Import> <FUNCTION_BLOCK>.

The function block is now available to the SPS program and the user may employ it like any other standard function block.

Description and typical connection of the function block (see „SPS Connection“ 8-3).

User Tool Data

In the drill breakage monitoring function, the 'user tool data item 1' is used for storing the tool state.

The data item 'name of the user tool data 1' must be activated in the system parameters. For this purpose, a name is entered for the data item e.g. tool status).

This data item can then be edited in the base tool data.

CAUTION

When the machine parameters are modified, the current zero offset tables, the current tools list and the current machine data may become invalid.

⇒ This data must be saved before the machine parameters are modified.

Editing range of the used data item (see „User Tool Data“ 4-1).

Software Option

The „drill breakage monitoring“ function requires the corresponding enabling code to be entered under <Software option> in the Setup (GUI main menu , <SHIFT> <F1>) . The software option is marked with „BBU - drill breakage monitoring“.

The function is not active without this enabling code.

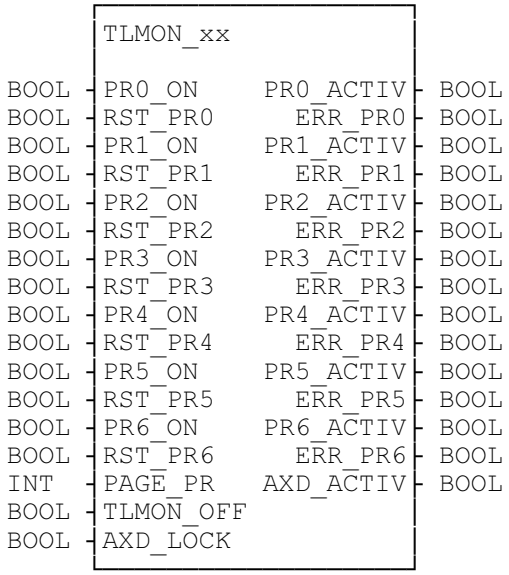
Recording the Torque Values

If the user interface runs under Windows NT, the torque values that occurred during the machining process can be saved in an ASCII file. This requires the TLM0031L.INI file in the '...MT-CNC\CONFIG' directory must be adjusted according to the machine. Any ASCII editor can be used for editing the file (see „Recording the Torque Values“ 6-1).

8.2 SPS Connection

There is an SPS function block available that can be used for activating and deactivating the tool breakage supervision function, for fault interpretation, and for deactivating the torque measurement.

SPS function block TLMON_xx



Description of the inputs and outputs

Inputs		
Designation	Type	Feature
PRx_ON x [0..6]	BOOL	Activates and deactivates the monitoring of the processes 0..6
RST_PRx x [0..6]	BOOL	Clears an error in the processes 0..6
PAGE_PR	INT	Page number of the TLMON_processpage
TLMON_OFF	BOOL	Deactivates the current breakage alarm for all axes that are defined in the system.
AXD_LOCK	BOOL	Suppresses the writing of the AXD command as long as the input is set.
Outputs		
Designation	Type	Feature
PRx_AKTIV x [0..6]	BOOL	States of the processes 0..6 monitoring active or inactive
ERR_PRx x [0..6]	BOOL	Error output of the processes 0..6 error is pending or not pending
AXD_ACTIV	BOOL	An AXD command is executed in the FB as long as the output is set.

Description of the function

The inputs **PRx_ON** x ∈ (0 .. 6) permit the monitoring function to be activated or deactivated for the individual processes. Correspondingly, element 1 (TLMON active) in the TLMON_processpage becomes high (active) or low (inactive).

The inputs **RST_PRx** x ∈ (0 .. 6) reset any occurred error (tool faulty). The machine data element 5 (tool faulty) in the process page is reset to 0.

The page number of the TLMON_processpage must be applied to input **PAGE_PR**. This input must always be connected before the FB is activated.

The **TLMON_OFF** input deactivated (independently of the process) the breakage alarm of all axes that are defined in the system parameters. The tool breakage supervision function for the activated processes is not switched off. The monitoring of the axes can be reactivated according to the NC program.

The execution of the AXD command within the FB is suppressed if the **AXD_LOCK** input has been set. The AXD commands will only be executed if the input has not been set.

The process states are available at the outputs**PRx_AKTIV** $x \in (0 .. 6)$. The monitoring of a process is only active if the output is high (1). It is not active when the output is low (0).

The outputs **ERR_PRx** $x \in (0 .. 6)$ can be used for fault interpretation (tool faulty). The corresponding output is high (1) if there is a fault in the process. These outputs can be used for issuing a diagnosis message, for example.

An AXD command is executed in the FB as long as the **AXD_ACTIV** output is set. The output can be used for suppressing AXD commands elsewhere in the SOS program.

CAUTION

There will be an SPS warning if the **PAGE_GR** and **PAGE_PR** inputs are not connected when the SPS program is loaded into the controller, or if the corresponding machine data pages do not exist.

⇒ The **PAGE_GR** and **PAGE_PR** inputs must be connected before the SPS program is loaded into the controller.

⇒ The corresponding machine data pages must exist in the controller and be active before the PRx_ON inputs are set to high.

Note: The function block continuously accesses the machine data. Thus, the availability of the data channel for the communication with machine data, tool data, zero point data is reduced fro 8 to 7. Outside the FB, only another 7 commands can simultaneously be executed.
The data channel to the APR is limited to 1 read or write access. This channel is allocated as long as measurement is switched off (through the TLMON_OFF output).

Outside the FB, there can only be another 7 simultaneous accesses to machine data, tool data, or zero point data. As long as TLMON_OFF is being processed, there can be no other AXD access outside the FB.

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