

Process monitoring ToolScope



Next generation process monitoring

Growing automation in the machining industry increases the demand for more process and machine tool monitoring, which can help minimize machine down time and reduce scrap rates, detect and manage wear in mass series production, thereby improving the delivery times to your customers.

Based on the latest technology of process and machine tool monitoring, the ToolScope System from KOMET® BRINKHAUS relies on a unique, patented method for statistical process monitoring which not only detects breakage but also recognizes considerably smaller process deviations. In addition to the usual procedures of process control, the ToolScope System provides a procedure for monitoring quality while a process is running.

KOMET® BRINKHAUS ToolScope adds considerable value to your production

KOMET® BRINKHAUS ToolScope has an advantage over other systems not only because it features the latest technology, but also because of its modularity and user-friendliness. Above that, many additional modules like Adaptive Feed Control, Condition Monitoring or Energy Monitoring underline the multiplicity of the system. Finally we offer with our wide network of application tools and process specialist service up to the complete management of system and production process.

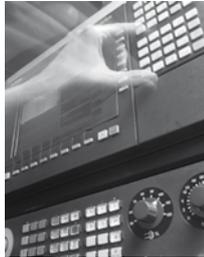
BENEFITS for you:

- Wide network of KOMET® tool and process experts, which can support the operation of the system
- Online visualization of the process (oscilloscope function) to support the set-up procedure, e.g. in order to promptly detect the jamming of chips
- Six Sigma Strategy: statistical process verification and process quality monitoring
- Dynamic Monitoring Module: Process monitoring for small batch runs which alleviates the need for a learning period
- Adaptive Control (AC) Module: Optimization of the essential operating time through process acceleration for tools that are underused, and speed reduction for tools that are overused
- Measuring without (additional) sensors: The sensor data is read directly from the CNC via Profibus or TCP/IP
- Automatic documentation of the process data as a PDF, PNG or Excel file
- Monitoring for tool wear and missing tool
- Monitoring of any and all possible sensor signals
- Evaluating analogue sensor signals with up to 10 kHz
- Monitoring of the vibration behavior of bearings, axles, spindles and tools
- Operation via the machine control system HMI or using a touch screen
- Modular program structure enables the optimal adjustment to customer needs
- Many additional modules like chatter recognition and control, Condition Monitoring, Energy Monitoring etc.

Process Monitoring for machine tools

Quality assessment of the production process

- Saving of internal and external machine sensor data as a process log.
- Quality assurance easily accomplished through automatic creation of reports (e.g. pdf).
- Complete process transparency.
- Review of faults that have occurred in previous months.
- Process data is processed and visualised in the form of physical values.

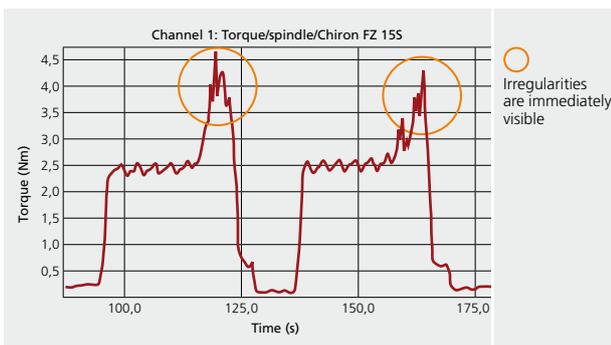


Veritable advantage ToolScope

- In contrast to software solutions:
 - No adverse effect on the machine,
 - Real-time data acquisition with inclusion of analogue sensors.
- Can be expanded with any monitoring functions through software licence upgrades.
- Fileable process documentation, e.g. pdf.
- Memory capacity 10 days to many months, depending on sensor data rate.



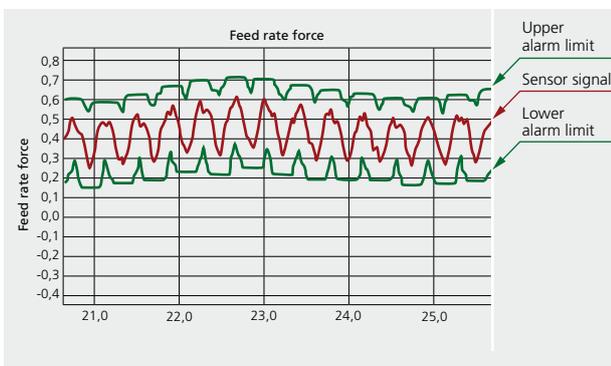
Storage oscilloscope for machine tools



Benefits ToolScope

- Fault-free running of individual process steps can be verified on the basis of the signal curves. Faults such as swarf jams in a drilled hole (see picture on left) can be quickly identified.
- Potential for optimisations in the NC program can be discovered (reduction in primary processing time) through analysing the signal curves.
- Rapid qualification of new tools, e.g. optimum cutting edge geometry.
- Saving of process data in an Excel readable format (process log).

View process sequences easily online



Wide range of system usage

In addition to standard machining processes such as turning, milling, drilling, etc., the system can also be used in many other processes, e.g. reaming, grinding, punching and broaching.

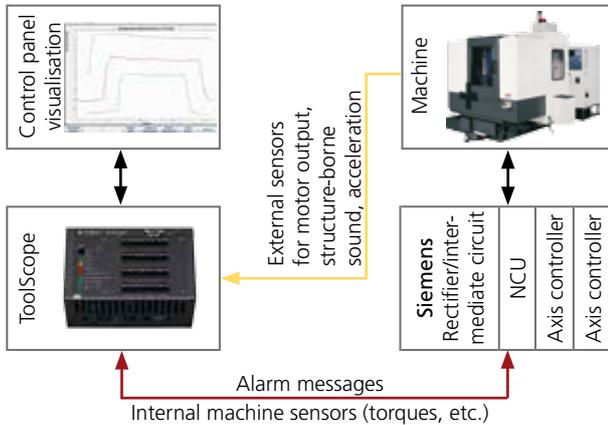


Supported types of control system: Siemens 840D SL, 840D PL, Heidenhain >iTNC530, Fanuc >3xi, Bosch Rexroth, Beckhoff. From year of manufacture 2005 applies for all control systems, other types and years of manufacture possible on request.

Integration of the system into the machine tool

Technical data

System structure



Integration into the control system

- Capture of internal sensor data via Profibus (with Siemens integration in the compile cycle). External sensors are recorded by means of an A/D converter.
- Monitoring is started and stopped directly from the NC program. Either automatically during each G0/G1 change or manually via M commands.
- User information can be transferred to the monitoring system.
- Complete system operability via the operator-machine interface (HMI) or via touchscreen.
- Report log readout via USB, network.

Sensors and data transfer rates

- "Sensorless measuring"
- Reading out of internal machine sensors digitally, directly from the control system (with approx. 100Hz)
 - Torque
 - Feed rate speed
 - Motor current
 - Axes position
 - Workpiece number, tool number, etc.
- External sensors: Recording of any analogue signal from -10V to 10V (up to 10kHz)
 - Acoustic emission, acceleration, etc.
 - Sensor data of analogue controlled drives.

Receptiveness for user projects

- Transfer of recorded measurement data to user applications (measurement data server).
- Transfer of commands from user applications to the machine tool.
- Data access possible via LabVIEW™, Matlab®, C++, Java®, C#, amongst others.
- Can also work with Windows® XP for development and evaluation purposes.
- Office-suitable data export.
- Our service: Design, implementation and field test of any kind of monitoring and control strategies according to customer requirements.

Support and updates

- Installation and commissioning takes approx. 1-2 days and is carried out by one of our technicians (machine downtime 3-6 hours).
- Service and support for machine operators is very important to us. We provide assistance, for example, during the operation or adjustment of new monitoring strategies, whether by telephone, remote connection or on site.
- The system is under constant further development so that in future you will still be able to benefit from new monitoring strategies, adjustment options and other innovations.

Customer-specific modules

- We would be pleased to provide you with support in the development of customer-specific monitoring modules for your particular machining process.
- Connection to MDE/BDE- systems.
- Condition monitoring module.
- Generation of automatic shift logs.
- Visualisation of the productivity of all machines over a period of time. Listing of machine times: Machine productivity, readiness, failure, etc.

Java® is a registered trademark of Oracle.

LabVIEW™ is a trademark of National Instruments. Neither KOMET GROUP GmbH, nor any software programs or other goods or services offered by KOMET GROUP GmbH, are affiliated with, endorsed by, or sponsored by National Instruments.

Matlab® is a registered trademark of The Mathworks Inc.

Windows® is a registered trademark of Microsoft Corporation in the United States and other countries.

6-Sigma Strategy Online quality and process monitoring

Process monitoring

- Detection of tool breakage with self learning limits.
- Detection of missing workpieces/ tools.
- Process control, adaptive feed control (AFC)
- Monitoring of compliance with user-defined limit values.
- Monitoring of specific values.
- Wear monitoring.
- Condition monitoring.



Quality process control (QPC)

- QPC is a ToolScope software module with which process quality can be checked online on the basis of statistical process control (SPC, Six Sigma).
- The core elements of the module are procedures which statistically establish how comparable a process is with various taught-in model processes.
- The procedures take into account the usual production variations involved in any process.
- Self learning limits based on statistical methods are included in the basic system.
- Standard monitoring of tool breakage based on tolerance bands is also automatically included.

Focus on quality assurance

- Checking the continuity of the current process against certified processes (QPC).
→ Monitoring according to current aviation standards.
- Data logging (trip recorder, process log) in parallel to monitoring.
- Quality assurance and quality assessment on one item of equipment (reports, graphics, measurement data).

Benefits of statistical process control

- The SPC is self-learning and does not have to be manually adjusted.
- With the help of SPC, very tight tolerance bands can be achieved, which are adjusted to the production process.
- Even slight production variations or disturbances in the course of the process, such as cavities in the material, can be detected well in advance of a tool breakage.
- SPC can be deployed parallel to a process control system.

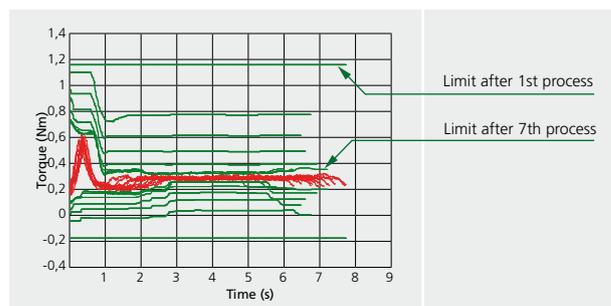
Monitoring with current aviation standards

- e.g. GE standard P11TF12.
- Automatic production of calibration reports.
- Automatic configuration of the monitoring system.
- Considerable time saving during process qualification.
- Informative indicators are aligned with the requirements of the certifying agent.



Teaching-in and monitoring

After just a few process cycles, the learning function of the SPC module has found the optimum tolerance bands.



Dynamic monitoring module Process monitoring for small batch sizes

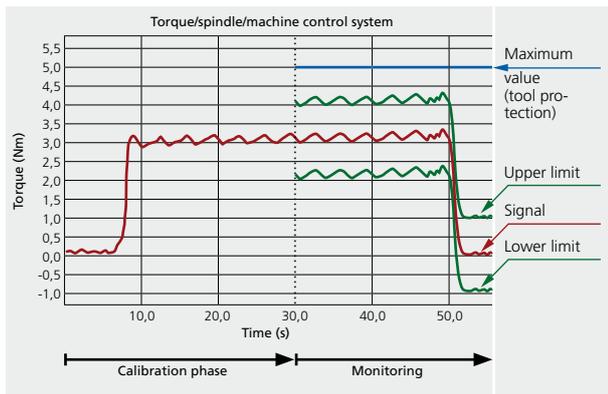
BENEFITS for you

- Detection of tool breakage even with small lot sizes without multiple teaching-in.
- Dynamic monitoring is designed for monitoring manufacturing processes with small lot sizes.
- With small batch sizes, it is not possible to record several learning processes. Particular algorithms therefore make it possible to determine the calibration of the tolerance limits from the characteristics or properties of the ingate (e.g. from the first 30 seconds of a process).
- No manual adjustments required.

Background to dynamic monitoring

- Dynamic monitoring does not establish the parameters necessary for the calculation of tolerance limits from taught-in processes, but rather determines special parameters from the interaction between the tool and the material.
- Using the characteristics thus determined, the tolerance limits are calibrated in accordance from the tool.
- Increasing tool wear presents no problem for calibration.

Calibration of dynamic monitoring



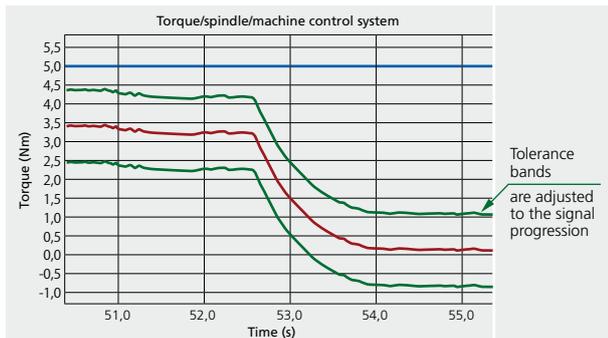
Calibration of dynamic monitoring

Calibration of the monitoring system is dependent on the tool used and can be performed in two ways:

- Preliminary calibration: The interactions between a tool and a particular material are taught in once.
- Process calibration: The first seconds of a process are used for calibration.

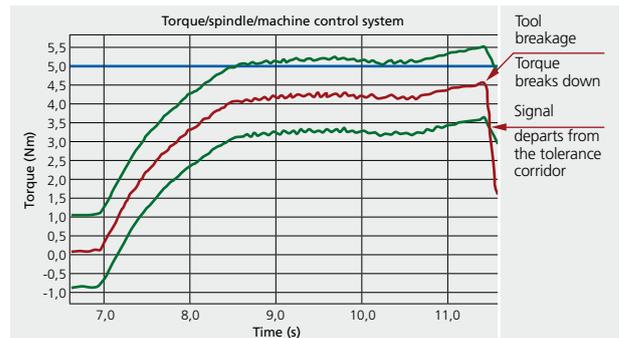
Incorporating the tolerance bands in the process

Based on the characteristics or properties, tolerance bands are included with the process.



Calibration of dynamic monitoring

During tool breakages, the tolerance limits are violated and a fault signal is triggered.



Adaptive control (AC) module For reducing primary processing times

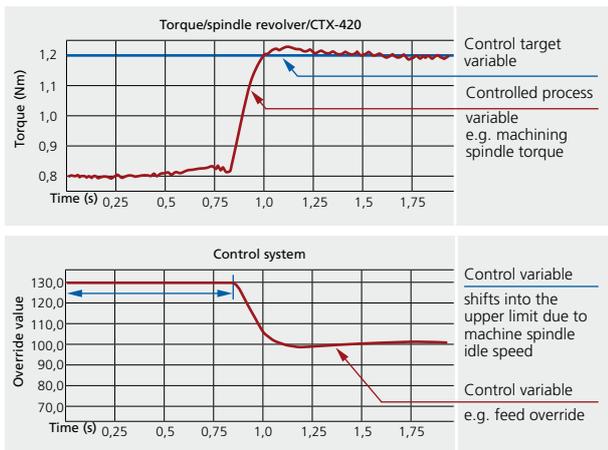
Benefits of the control system

- Process variables (e.g. torque) are controlled by adjusting the process speed (change of the override speed).
- Control can be specifically centred on different events, amongst others:
 - Detection of swarf jamming during drilling
 - Detection of chatter vibration
- Process acceleration on detected air cut is possible. Using a learning function, the system can independently determine control parameters.
- Manual regulation possible for special applications.

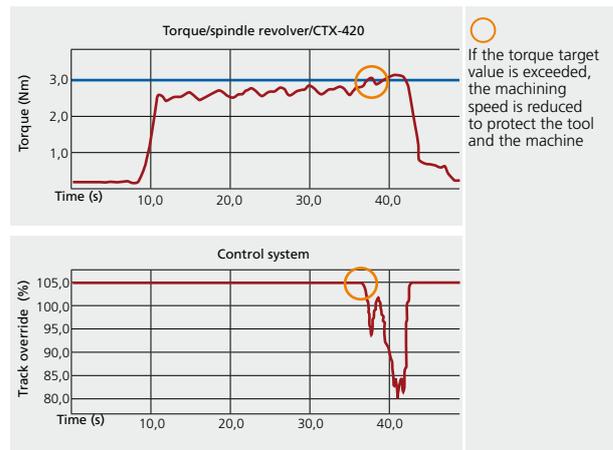
Technical background

- The controller output parameter is the override value of the feed speed expressed as a percentage. This override value is transferred directly to the control system.
- Control variable limitation can be parameterised (e.g. to a minimum of 80% or a maximum of 120%).
- All controller parameters can be adjusted according to a process number assigned by the NC program. The control system can be switched on and off by two M commands.

Acceleration of primary processing time



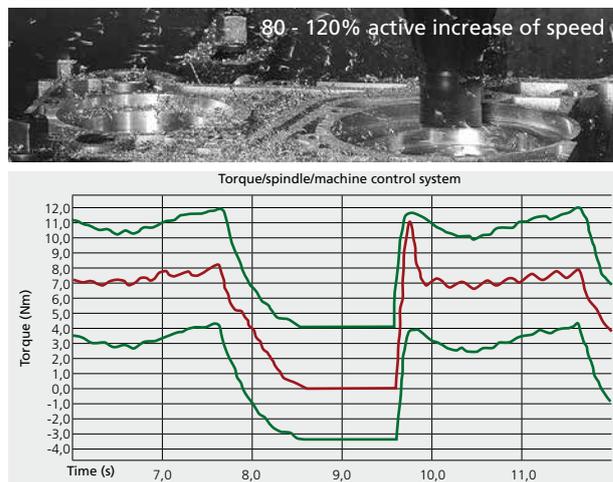
Tool protection



Signal inputs and outputs

- Various upstream and downstream signal processing mechanisms, which can be parameterised, are connected to the controller which considerably increases the scope of the controller's use in machine tools.
- The input parameter of the controller can be freely selected from among the ToolScope channels.
- The settings and progression of controlled process variables and override values are continuously documented.

Process control during milling



KOMET® BRINKHAUS ToolScope

Technical data

Dimensions (WxDxH)	Data – mm (inch)	Note
IPC version	215x272x114 (8.465x10.708x4.488)	
DIN Rail Module	200x140x110 (7.874x5.512x4.331)	
Touch Panel PC version	410x320x90 (16.142x12.598x3.543)	15" Display

Interfaces	Sampling frequency	Note
Profibus with synchronous actions / PLC-Transfere	Sampling frequency approx. 20 - 30 Hz	
Profibus with compile cycle	Sampling frequency approx. 100 - 500 Hz	see below
TCP/IP	yes	HMI-visualization over TCP/IP
Analog input channels	up to 10 kHz	16 inputs, during monitoring perhaps lower sample rate
Digital input/output channels		16 input/output channels each

Supported control systems
Siemens 840D SL, 840D PL, Heidenhain >iTNC530, Fanuc >3xi, Bosch Rexroth, Beckhoff. From year of manufacture 2005 applies for all control systems, other types and years of manufacture possible on request.

Profibus connection (Siemens)	
Requirements for compile cycle Sample rate approx. 100 Hz	Drive hardware: SIMODRIVE® 611D based drive system, digital drive, delivers digital current/torque information Control hardware: SINUMERIK® 840D, • NCU: 572.3 or 573.2 or higher (572.2 only SW4.4), • storage: min. 32 MB, • PROFIBUS interface Control software: SINUMERIK® 840D technology board, version 05.03.06 (NCU_05.03.18) or 04.04.11 (NCU_04.04.37) or higher
Requirements for compile cycle Sample rate approx. 100 - 500 Hz	In addition to the above mentioned requirements, the following must apply: Control software: SINUMERIK® 840D, NC-Software ≥ 06.03

Visualization on HMI (only Siemens)	
Requirements	Windows® 95 and later, network card

Start monitoring with the KOMET® BRINKHAUS ToolScope system
Monitoring can automatically be started by changing from G0 to G1. Furthermore the processes can automatically be stored in reference to the tool number, workpiece number, program name, etc.

Functionality	
Visualization	Each process can easily and continuously be visualized (oscilloscope function).
Data logging	Each process is automatically stored on the hard disk (logbook).
Filtering	The system offers a variety of filters such as average value, effective value, RMS, variance, etc. as standard for the filtering of the input signals.
Monitoring tool breakage	The basic system contains a self learning algorithm to recognize tool breakage. The tolerance bands are simply and automatically identified.
Monitoring tool wear	The system offers tracing and monitoring of tool wear. By setting warning thresholds, the operator can be forewarned of worn tools.
Six Sigma Strategy (optional) Online statistical process control	With this monitoring algorithm, minimal process deviations such as wear, larger cavities, changes in material can be recognized during constant serial production processes. This is equivalent to conducting real-time quality control while a process is running.
Adaptive Control (AC) Module (optional)	With adaptive control, the feed is optimized so that the effective power of the tool remains as constant as possible. Therefore, the essential operation time can significantly be reduced, e.g. during roughing. Moreover, the feed can be reduced if an effective power limit is exceeded, thus protecting the tool.
Dynamic Monitoring Module (optional)	With this monitoring strategy, the process and the tool can be monitored from as early as lot size 1. Here the system is also fully self-learning.

KOMET® BRINKHAUS ToolScope Basic system including installation / commissioning: Order No. E65 01010		
Enhanced with:	Dynamic Monitoring Module Order No. E65 21020	Adaptive Control (AC) Module Order No. E65 21030

Windows® is a registered trademark of Microsoft Corporation in the United States and other countries.
SIMODRIVE® and SINUMERIK® are registered trademarks of Siemens AG.

KOMET BRINKHAUS GmbH · Am Heidehaus 9 · 30419 Hannover · GERMANY
Tel. +49 511 7636310 · Fax +49 511 76363190 · info.brinkhaus@kometgroup.com · www.kometgroup.com/brinkhaus
399 01 805 00-1T-05/15 Printed in Germany · © 2015 KOMET GROUP GmbH · We reserve the right to make modifications.