MONITORING SOLUTIONS
FOR CUTTING MACHINES

MARPOSS

FACTORS INFLUENCING MACHINING PROCESS

Workpieces

- Material
- Geometry
- Hardness
- Size variations
- Semi-finished parts

Tooling

- Geometry
- Size variations
- Body
- Coating
- Cutting material
- Rotation speed
- Feed rate
- Breakage
- Wear

Machine

- Clamping device
- Coolant
- Machine structure
- Maintenance interval
- Temperature
- Spindle conditions

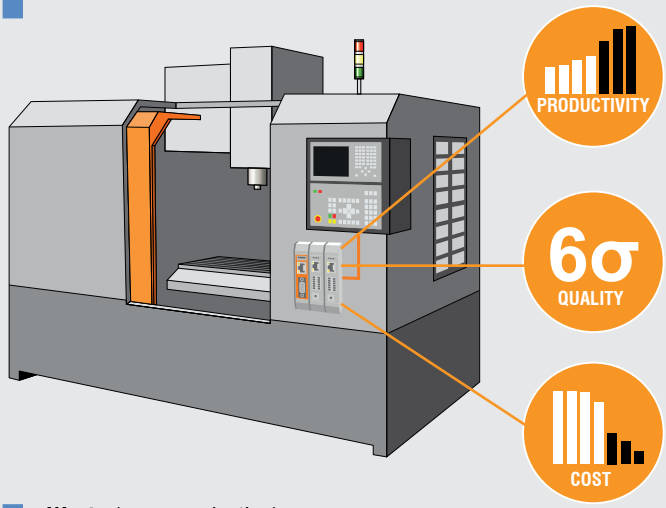
Environment

- Programming errors
- Incorrect operations
- Operator presence

Due to the many influences on cutting processes, it is essential to carry out real-time monitoring of machine parameters, part or tool variations, and unexpected events in order to optimize the process and limit quality risks or unplanned costs.

ADVANTAGES OF USING MONITORING SOLUTIONS

Productivity improvement (shorter cycle time, higher feed rate)
Machine efficiency (higher working hours, longer tool life)
Improved part quality (cutting parameters optimization)
Machine safety (continuous conditions monitoring)



Waste (energy reduction)
Reduction of unexpected down time / tool breakages
Scrap and rework reduction
Reduction of maintenance and repair cost.

Marposs, Artis and Brankamp, each with considerable experience in the machine monitoring field, provide a full range of top quality innovative solutions for real time tool & process monitoring, detection of machine conditions to improve machine efficiency, higher quality and cost reductions.

MONITORING	Turning	Drilling / Milling	Thread Cutting / Forming
Tool Monitoring	tool breakage tool wear tool missing wrong tool	tool breakage tool wear tool missing wrong tool tool unbalance	tool breakage tool wear tool missing wrong tool thread depth deviation
Process Monitoring	spindle torque axis force / friction spindle vibration (chatter) coolant flow spindle RPM operator interventions work-piece condition temperature turret force	spindle torque axis force / friction spindle vibration (chatter) coolant flow spindle RPM operator interventions work-piece condition temperature	tool holder torque axis force / friction tool holder vibration coolant flow spindle RPM operator intervention work-piece condition temperature bore size turn out of threads
Process Optimization	tool life optimization feed rate adjustment (AC)* operating time detection of defect parts statistical process analysis	tool life optimization feed rate adjustment (AC)* operating time detection of defect parts statistical process analysis	tool life optimization feed rate adjustment (AC)* operating time detection of defect parts statistical process analysis

(*) = Adaptive Control

Operators have access on the machine control monitor single or multiple-process overview, trends, alarms, and statistical data analysis. Data may be transferred via printer or networked via server for remote machine monitoring.

MONITORING	All Machines	
Machine Conditions	machine load/vibrations spindle vibrations spindle rpm coolant flow and pressure work-piece part clamping statistical data analysys	Monitoring devices can be used both for checking of processes and machine conditions. Data from sensors integrated in the machine components or NC data, such as: vibrations, noises, temperature, torque, and forces, can be elaborated and recorded to display excessive loads, critical paths and machine status changes to predict machine maintenance.
Machine Protection	collisions (minimize the effect of) excessive spindle vibrations spindle growth spindle temperature	Alarms generated by the system are forwarded to the machine control, thereby avoiding further rejects. Unfortunately, collisions on the machine may occur. Therefore a crash detection system is the solution to immediately stop the movements, **protecting the machine** from damage, high cost repair and downtime.

Benefits

Higher Machine Efficiency:
Shorter cutting operations, longer tool life, reduction of reworked parts, reduction of unplanned maintenance.

Quality Enhancement:
Scrap reduction, cutting process and alarm data logging, statistical analysis, and process control documentation.

Cost reduction:
Machine safeguard by continuous monitoring of conditions, reduction of repair cost, multi-machine operator surveillance and unmanned overnight shift.

DATA CAPTURING

Marposs Monitoring Solutions are based on the available information from the machine and/or through various methods of capturing data. DTA (Digital Torque Adapter), provides sensors-less selection of drive data captured by the machine numerical control. Additional or alternative external sensors are available for monitoring machine conditions and/or to elaborate abnormal machining processes: vibrations, forces, torque, motor current, spindle noises, and coolant flows.

DTA Digital Torque Adapter is a sensor-less method of transmitting torque data from the drives of main spindles and feed axes.
DTA elaboration was developed for tool, process and machine condition monitoring. Data, refreshed at a high clock rate, reflects the torque output by the drives plus current positions of the feed axes.

Strain and force monitoring. Strain or piezo sensors combine robustness with sensitivity to provide both reliability and signal accuracy. Customized or standard sensors are applied on the machine body, work holder or spindle turret to detect very small changes of cutting forces, tool breakage, wear or missing tool.

True power monitoring A solution for machines without digital data transfer of spindles and axes. A simple installation of hall effect sensors makes possible easy and accurate monitoring of a large range of cutting processes.

Force and torque monitoring Tapping tools or gun-drills have a close contact with material during the work. The friction surface is very large or very deep and, hence, there is danger of sudden breakage. The solution to quick detection of the increase or lack of torque is the use of force sensor embedded in the tool holder.

Vibration monitoring. To avoid bearing or spindle stress it is essential to keep vibrations of spindles, and tool imbalance under control. These vibrations are monitored by sensors placed on the spindle and/or on machine body. Unexpected collisions can happen, but our accelerometers react in milliseconds to help minimize the effects and safeguard the machine.

Coolant flow monitoring. Metallic chips or other contaminants can severely reduce coolant flow. Our highly accurate fluid pressure sensor placed in the circuit accurately monitors constant pressure to assure programmed cutting performances, part quality and to prevent breakages of small tools.

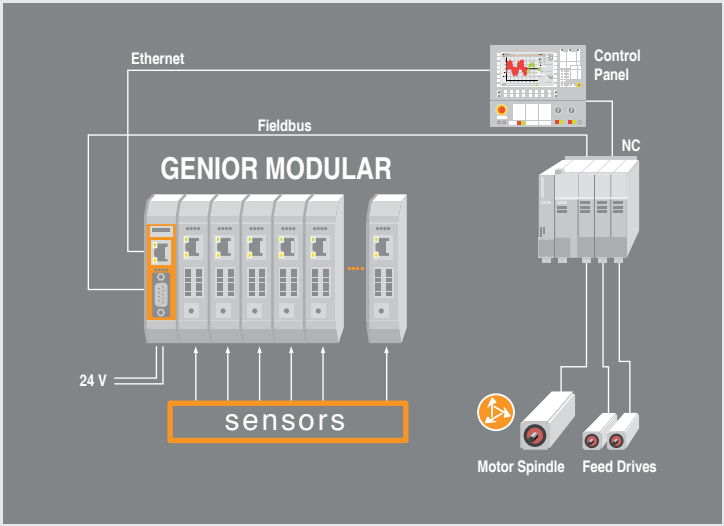
Spindle growth (displacement monitoring) Spindle shaft elongation due to temperature excursion can modify tool position, a situation not acceptable in precision manufacturing. Our contactless measurement sensors detect sub-micron drift and communicate position variation to the machine control to initiate axis correction.

Acoustic Emission monitoring. Our AE sensors installed on the machine spindle or part chuck continuously supply a broadband high frequency signal. The monitoring system filters the signals and provides information to eliminate free cutting and/or detect collision before damage to the machine.

genior modular

Fully automatic tool and process monitoring

Genior Modular makes a major contribution to achieving safe and reliable metal cutting processes . It is used in operations without operator intervention. The system captures data digitally or via sensors and evaluates them based on multiple criteria, visualizing processes in a transparent way. It automatically sets and fine tunes alarm limits within a small number of cycles.



The Genior Modular consists of a range of modules to elaborate and convert signals of external sensors:

CPU - base module

TF - torque module for DDU module

VM - vibrations module

FM - force and strain module

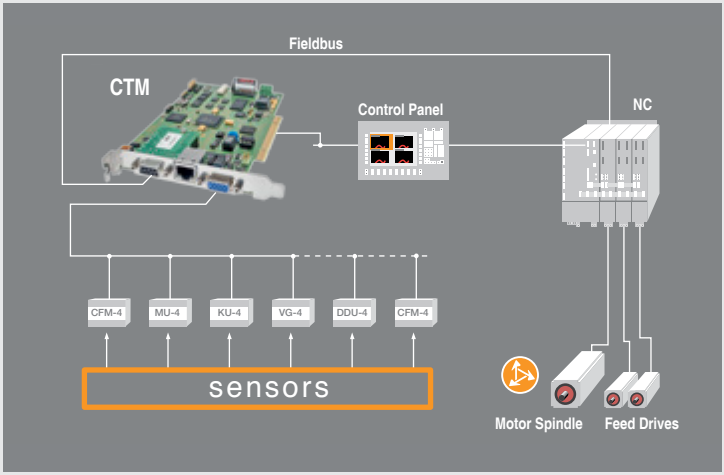
TP - true power module

AM - acoustic emission sensor module

ctm

Aligned tool, process and machine condition monitoring

The CTM system safeguard and optimizes in real time complex cutting processes. It delivers the right functions for almost every production scenario. The flexible interface concept enables problem-free integration within many environments. Evaluation and control are carried out with process-dependent strategies, either with fixed or dynamic alarm limits. Process parameters are defined, and the necessary limits are laid down and taught, so that they match the application precisely.



CTM System consists of a range of units to elaborate and convert signals of external sensors:

CTM - Plug in elaboration board

CFM4 - Force transducer units

DDU - Contactless torque transducer unit

MU - True power transducer unit

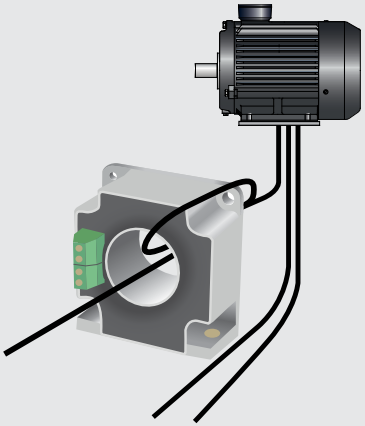
KU - AE sensor transducer unit

VG - Vibration transducer unit

TMU TP

Tool Monitoring Unit

The TMU system detects breakage, wear and missing tools by measuring and matching the variation of power consumption in different cutting sessions. The unit is easily installed in the cabinet together with the sensors devoted to power consumption measurement. The TMU system can fit to any kind of numeric control, being communication channel limited to simple digital I/Os.
With TMU any machine can now be easily equipped with a user-friendly tool monitoring system.



CS26 / 27 / 28 - HF

Spindle growth monitoring

Spindle shaft elongation due to temperature excursion can modify the real position of the tools. This variation cannot be tolerated in precise manufacturing process.
Eddy current sensors CS26/27/28 detect sub-micron drift of the spindle shaft and communicate the position variation to machine control to initiate axis correction.

Machine set-up:
- Tool run-out control
- Part positioning control

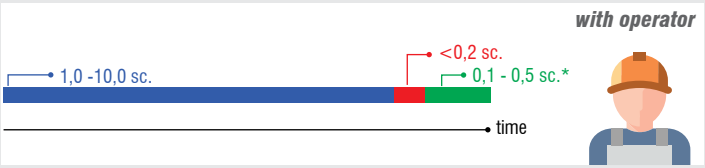
Mechanical part:
- Worm screw expansion control
- Hydrostatic guides thickness control
- Spindle growth control

CMS

Machine protection

High speed operations and the complex shapes of produced items have raised the risk of collisions and lengthy machine interruptions that can be costly. The logical response is to minimize damage by a rapid stop in the event of a collision. The CMS system reacts immediately in the event of unexpected strain due to incorrect machining allowances, faulty tool or workpiece assembly. In case of a sudden collision, the operator's response time lies in the range of seconds. CMS reduces by 1000 the response time. The stop is executed much quicker and, most importantly, the damage is limited.

Damage limitation reduction of responsive time



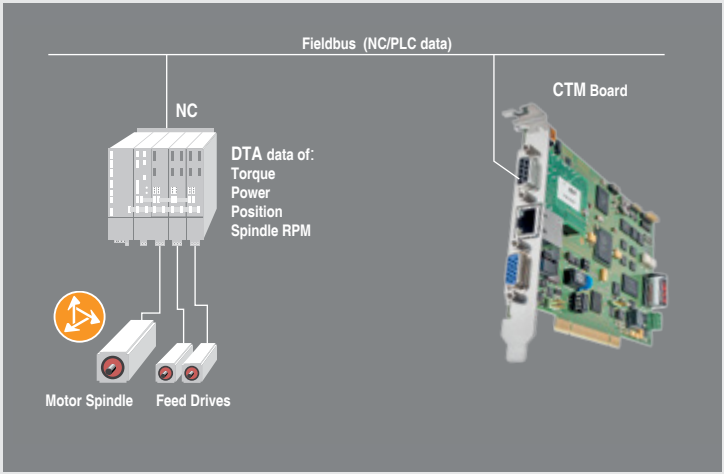
The CMS system is easy to install even in retrofitting mode.
It does not require complicated machine interfaces or special adjustment procedures.
Unskilled operators can benefit from it, immediately, automatically and without having to attend complex training courses.

Easy to install on existing machine
Easy to use

Protect your machine from high cost damages

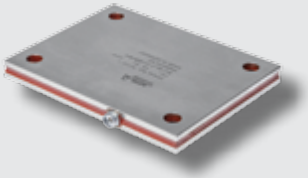
DTA
Digital Torque Adapter

Process of data from the NC control system. DTA is a sensor-less method of transmitting data from the drives of main spindles and feed axes. DTA elaboration was developed for tool, process and machine condition monitoring. Data refreshed at a high clock rate reflect the torque output by drivers, plus the current positions of the feed axes.
DTA is useful for several monitoring requirements. It is easy to integrate, it has high sensitivity, and it is available for many machine controls providing digital data via Profibus™, Profinet™, Ethernet™, Focas, ...



Strain and Force Sensors

Our strain or piezo sensors combine robustness with sensitivity to provide both reliability and signal accuracy. Thanks to these technologies, a small change in cutting force, even of heavy feed force, can be detected. Operating near the cutting zone, they represent one of the best tool monitoring solutions. Mechanical design is evaluated to grant the best integration inside the machine. These types of sensors are suitable for controlling tool breakage; the start of the cut; to control the absolute value of cutting force in turning processes; to detect tool presence; to optimize cutting parameters; or to check the force on a part between centers. Sensors are available in various forms to be adapted to the individual application need such as: screw, flat, ring, … and customized solutions.



Hall Sensors

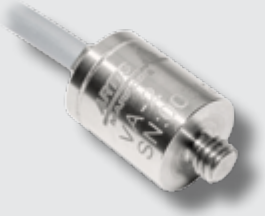
True power monitoring via hall effect sensors is an easy to install method, for achieving reliable, high sensitivity monitoring of small tools and adaptive cycle. True power control is the solution for those machines without digital data signals of spindle and motor axis.
A simple installation of our specially designed hall sensors allows accurate tool monitoring of a large range of cutting processes on new and existing machinery. CT hall sensors feature excellent measuring accuracy, good linearity, no supplementary load loss, low susceptibility to external magnetic fields, nor galvanic separation.

DDU
Sensor System

The DDU system enables highly sensitive measuring of torque and feed force on rotating and rigid tools in metal cutting processes. Integrated into tool holder, DDU provides exact value of torque and feed force, especially suitable for tapping tools or gun-drills. In these, more than other tools, the friction surfaces are very large or very deep and, hence, there is the danger of sudden breakage. The increase or lack of torque is quickly detected and sent to machine for stopping of the process. DDU features wireless inductive signal transmission of measuring data and energy supply. It is suitable for single or multi spindle applications on new or existing machinery. Typical applications are: tapping processes, deep drill, and drilling operations.

Vibration Sensors

Today spindles reach very high speeds. In these situations, to avoid bearing stress it becomes essential to keep under control machine/ spindle vibrations as a result of unbalance of rotating parts and tools. The elaboration of vibration signal of sensors placed on the spindle or machine body provides alarms of abnormal conditions and prevents spindle failures. Mono-axial, bi-axial or three-axial accelerometers can be coupled with transducer modules with configurations for installation with our integrated systems or stand alone solutions featuring analogue output, FFT analysis, data storage and more over.



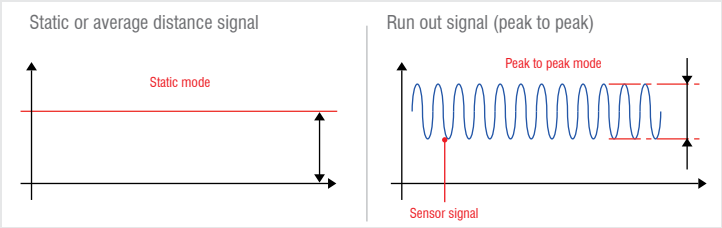
Coolant Flow Sensors

Metallic chips or other coolant flow contaminants on small, deep hole drills may reduce cutting capability and contribute to tool breakage.
The appropriate coolant pressure on various cutting process, including tool and gear grinders, is a must to guarantee process performances and part quality. Our fluid sensor placed into the coolant circuit monitor the optimum pressure for preventing tool damages. FLS (flow sensor) is available in different types according to the amount of coolant flow and the pressure within the application.

Eddy current displacement sensors

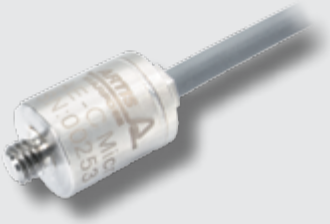
Spindle shaft elongation due to temperature excursion can modify the real position of tools. This variation cannot be tolerated in precise manufacturing processes. Our eddy current contactless sensors associated with electronic units CS26/27/28 detect sub-micron drift inside the spindle or run out of spindle / tools. Eddy current signal is influenced by the chemical composition and by any heat treatments of the material used in the shaft. To overcome these issues, the CS sensors are fitted with a memory chip containing data to linearize the sensor response.

Signal ouputs



Acoustic emission sensors

Our AE sensors installed on the spindle or on the part chuck continuously supply a broadband high frequency signal. The monitoring system filters the signals and provides information to detect breakage of shank-tools, to eliminate free cutting and/or detect collision before damage of machine.



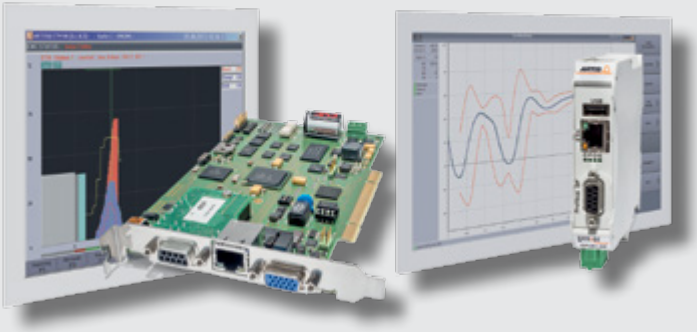
IPC

Operator Control Panel with integrated Computing Unit

IPC is an industrial PC provided with touch screen technology on a Windows® based operating system. Embedded technology allows compact design, fan-less architecture and no moving parts, data storage on 4GB flash memory. All these features assure the highest level of reliability. The control panels integrate a TFT color display with 7" (WVGA resolution) and 10.4" (SVGA resolution), resistive touch-screen LED backlight, IP65 front protection degree, computing unit based on Intel® Celeron® CPU at 1.58GHz, USB and Ethernet™ ports Screen size and relevant human interfaces are particularly suitable for machine tools.

VISU

Our monitoring system provides a fully automated data management. Once the work piece is identified the system opens programmed control sessions, operations and related tools to monitor.
Through VISU interface, the operator has access to real time process overview, and best process parameters independently of the number of axis being monitored. Process data gathering provides a detailed, reproducible view and reporting of every step of the cutting process, fast diagnosis, alarms and export to SQL data base of user IT systems. The system provides indispensable elements to create the reports that are more and more requested in aerospace, medical and safety related automotive components.



MARPOSS

worldwide represented with 80 own sales and service organizations

MARPOSS

ARTIS
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Established in 1983, ARTIS makes a range of in-process tool and process monitoring systems, currently mainly for metal cutting applications. Its market-leading products are primarily used by manufacturers of machine tools in aerospace, automotive and other capital goods industries world-wide. ARTIS engineers have many years of experience in the areas of processes in metal machining as well as NC, PLC, drives, bus systems, tools, machine structure, workpiece material….. ARTIS provides powerful process monitoring systems, with a multitude of options to operate without operator intervention.

BRANKAMP
MARPOSS

Brankamp, established in 1977, provides a wide range of solutions for presses, stamping and forming processes as well as on metal cutting machines. Brankamp's market leading solutions are primarily used in the fastener industry, as well as in other industrial sectors, to prevent process errors, provide support for quicker machine set-up and to eliminate or limit costly damages. Over 50,000 systems installed worldwide help customers to increase productivity and decrease total life cycle costs of machine tools. BRANKAMP systems have become an integral part of the manufacturing operations. They prevent process errors, reduce machinery setup times or malfunctions.

MARPOSS

MARPOSS in the world

Marposs Headquarters - Bologna (Italy)

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Kern - Paris (France)

Dittel – Landsberg am Lech (Germany)

Marposs U.S.A. - Auburn Hills

Marposs Germany - Weinstadt

Marposs Japan - Tokyo

Marposs Switzerland
Bern

Marposs Mexico
Mexico City

Marposs Brazil
Sao Paolo

Marposs is present in 24 countries with more of 80 offices.

Out sales and service operations are located close to our customers where we speak the native language, providing the ability to provide immediate and qualified assistance.

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