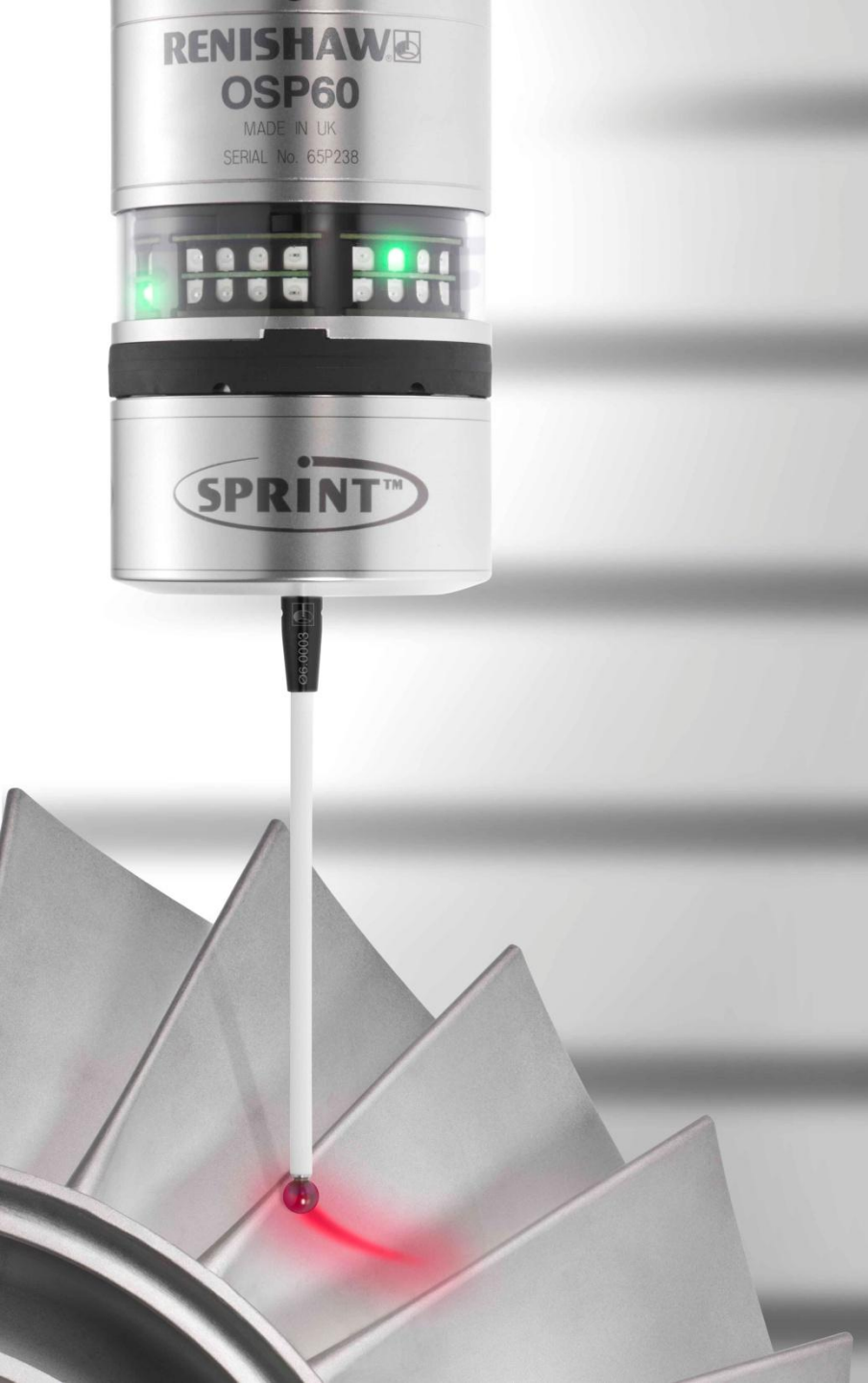

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SPRINT™ system

- New ground-breaking contact scanning system for CNC machine tools
- New industry adopted technology
- New on-machine process control methods

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SPRINT™ game-changing capability

Features

New contact scanning probe

High-speed 3D scan data

Extremely accurate

Processes

On-machine integrated data processing

New levels of in-process control and verification of machine and parts

Adopted technology

Integrated by machine tool builders

Widely supported

SPRINT™

New applications

Game changing capability in high-value CNC machining

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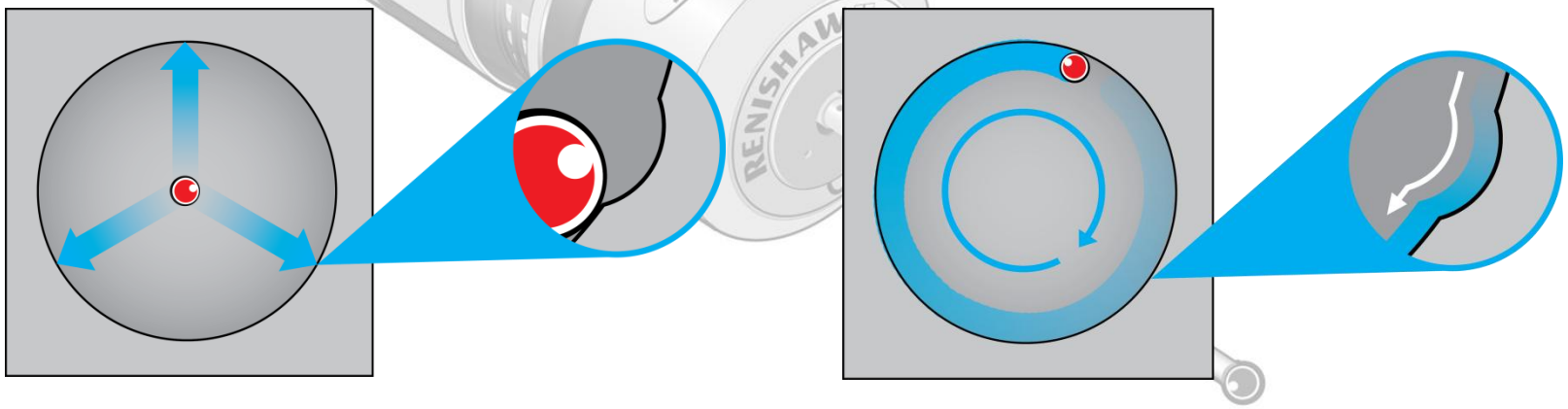
What is the SPRINT system?

- A high-speed, on-machine contact scanning system
- Scans along a pre-programmed path, and records deviations from path
- High surface data density of 1000 true 3D points per second



Three-point touch-trigger	SPRINT scanning
• Defect may not have been identified • Could lead to poor measurement of feature size and position • Poor understanding of feature form	• Defect identified • Accurate measurement of size and position • True understanding of feature form

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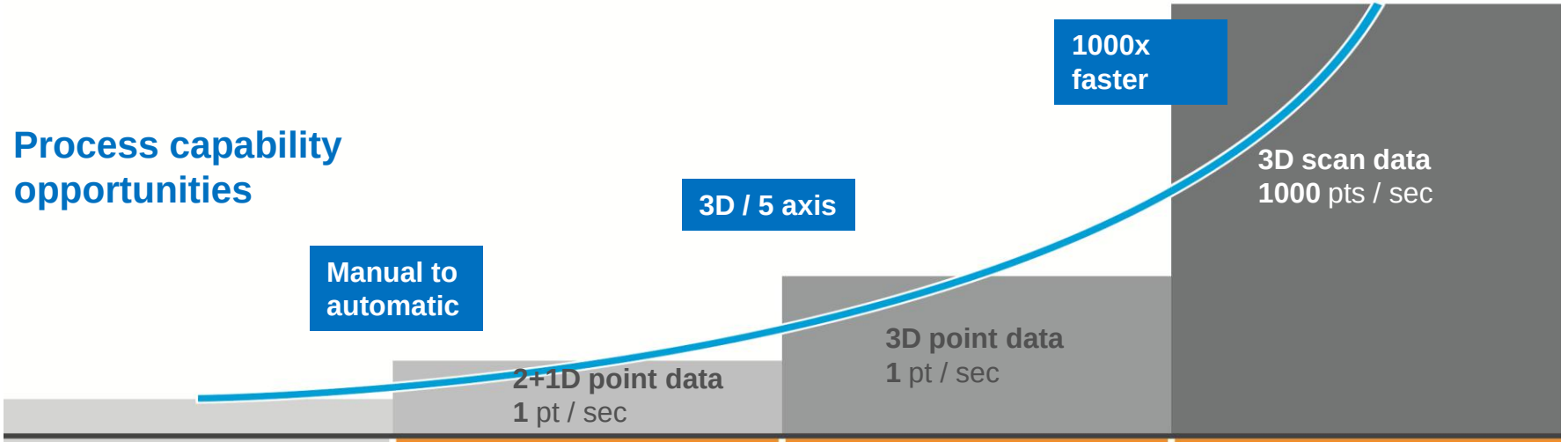
Evolution of CNC process capability



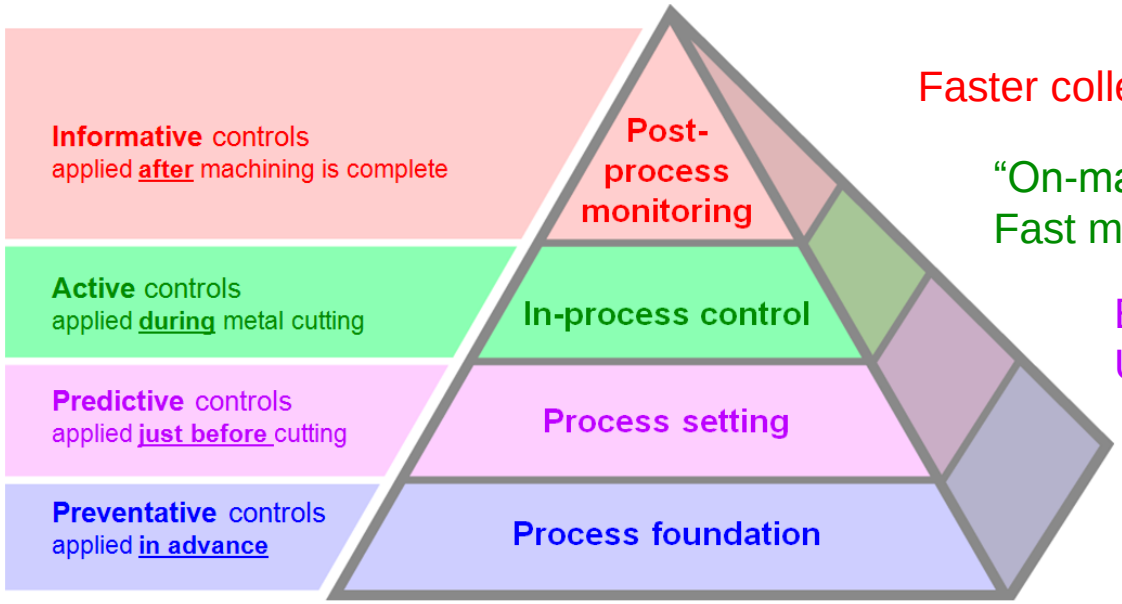
• **Basic capability**	• **Reliable + repeatable** • **Automatic**	• **3D discrete point data** • **High accuracy**	• **Game changing capability** • **Complete new processes**
• Visual only • Time consuming • Relies on operator skill	• Automatic measurement cycle	• Highly accurate 3D measurement • New capability for 5-axis machines	• 3D scanned data • Accurate data at high rate • Much faster
• Manual part setup	• Automatic part setup • In-process measurement • Pre-process controls	• 3D discrete point measurement • High accuracy	• High-speed process control • Form measurement • Adaptive machining • Profile checking
Manual methods • Wobble bar, JCP	**TT kinematic probes** • e.g. OMP60	**Strain gauge probes** • e.g. RMP600	**SPRINT probe** • OSP60

SPRINT™

How does it improve the process?

New capability

- Applies across the entire Productive Process Pyramid™



Faster collection of data for reporting

"On-machine" verification. Go / No-Go
Fast master part comparison

Early warning of set-up/tool issues
Unique part tool path creation

Fast system health check

- Provides:
  - fundamental new capability for "design for manufacture" programs
  - benefits outside of "traditional" probing applications

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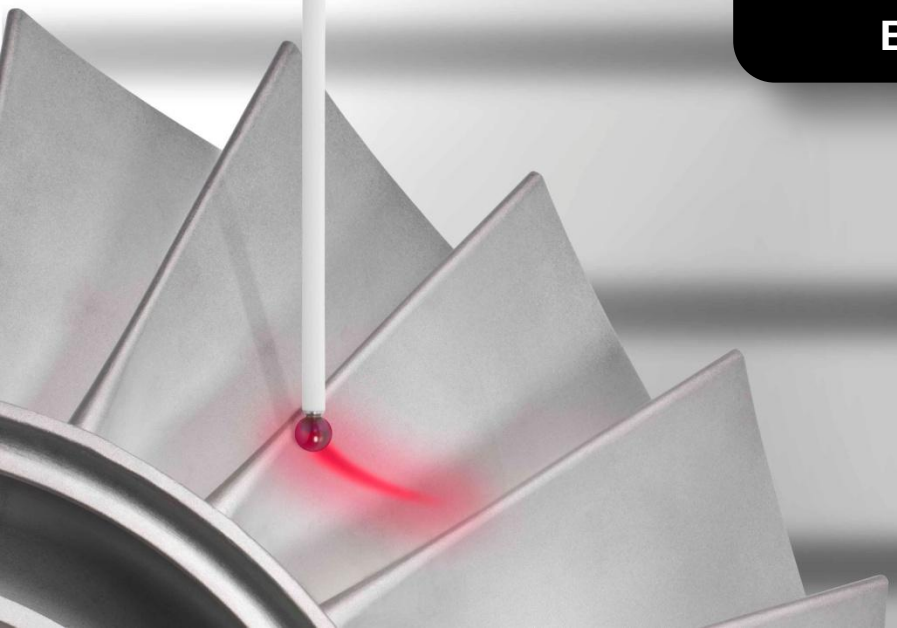
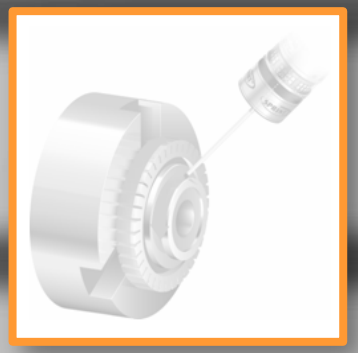
SPRINT™ system

New applications capability

Blade Toolkit





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SPRINT: Blade Toolkit

The **SPRINT Blade Toolkit** is designed for performing:

- Blade tip refurbishment
- Root blending for bladed disk applications
- On-machine process control for blade manufacturing

Intended to:

- Perform high-speed data collection of blade sections
- Maintain high data integrity even on leading and trailing edges
- Perform measurement of planar sections of blades using four patches or machine orientations
- Stitch together the resulting data
- Provide touch-trigger equivalent data, to the customer specification

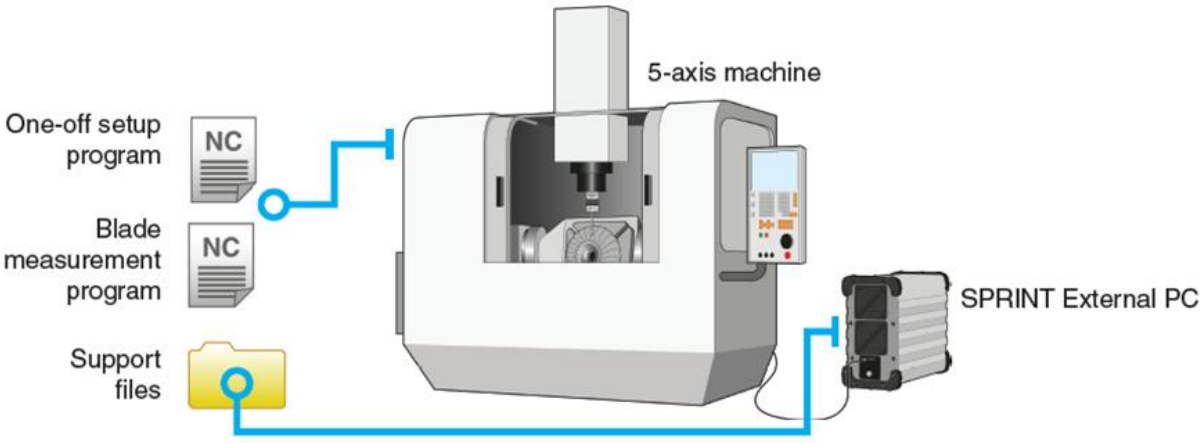
Developed in partnership with aerospace end users

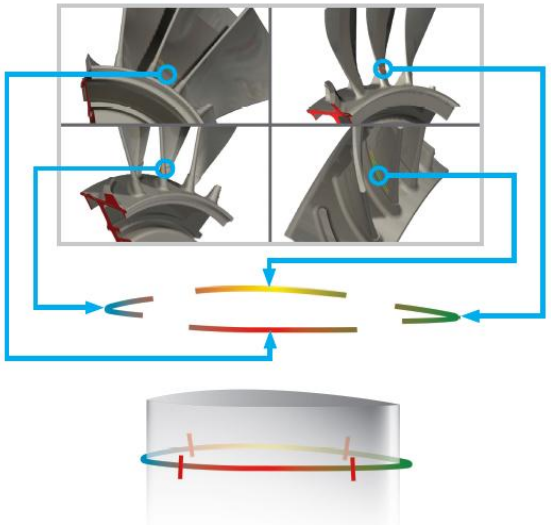
SPRINT: Blade Toolkit

The **SPRINT Blade Toolkit** consists of:

- An on-machine **executable / analysis component**
  - Installed on a PC connected to the CNC machine
  - Performs the set-up, blade alignment, blade scanning and results collection
  - Asynchronous data processing (typically on the external PC)

- An **engineering / design component**
  - Currently requires custom programming by Renishaw engineers





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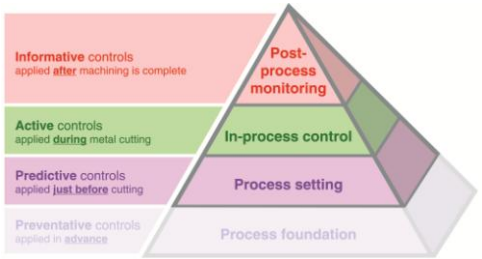
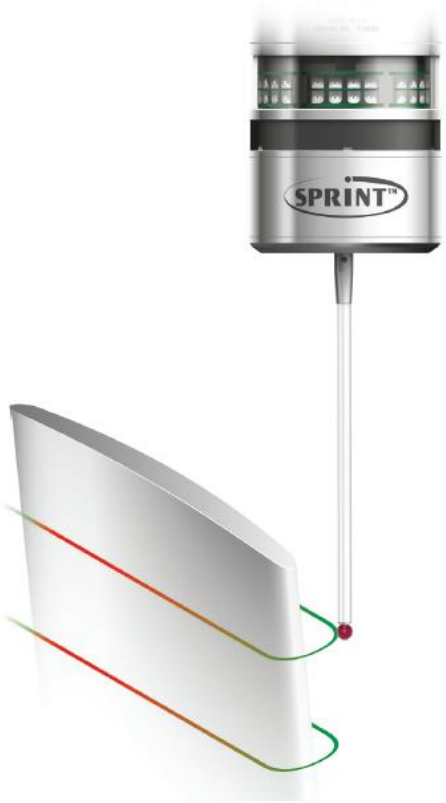
SPRINT: Blade Toolkit

The **SPRINT Blade Toolkit** delivers:

- Significant cycle time advantages vs. touch-trigger
- Significant accuracy advantages vs. touch-trigger and optical systems (capability to scan around leading edges)
- Drop in replacement for existing on-machine systems
- Reduced errors and process time from elimination of part transfer between external measurement device and machine tool
- Closed loop processes
- Provides an “informative”, “active” and “predictive” control





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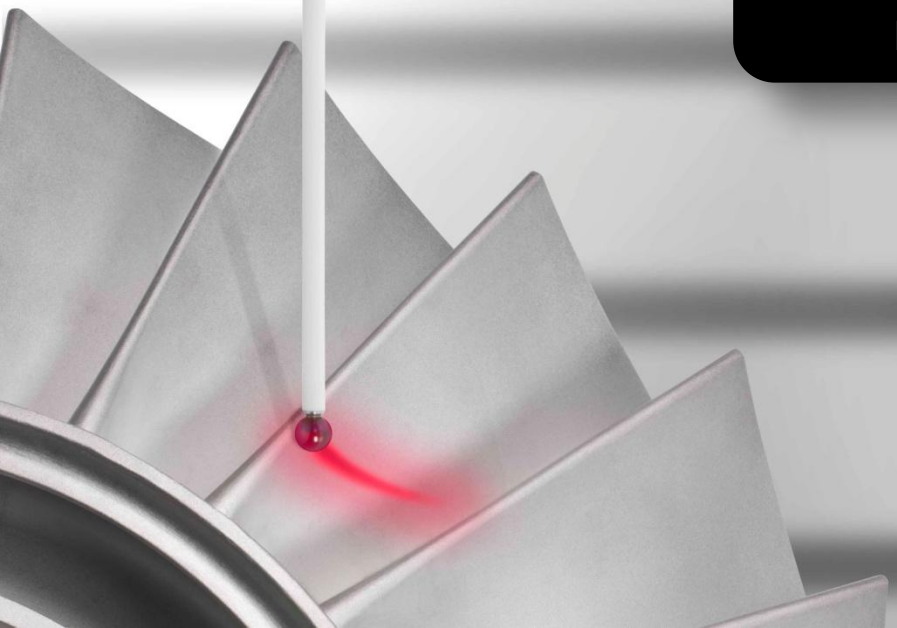
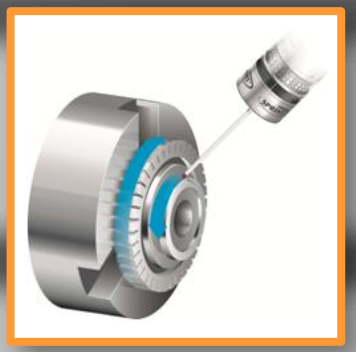
SPRINT™ system

New applications capability

MTM Toolkit





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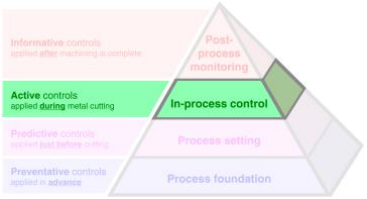
SPRINT: MTM Toolkit (multi-task machine)

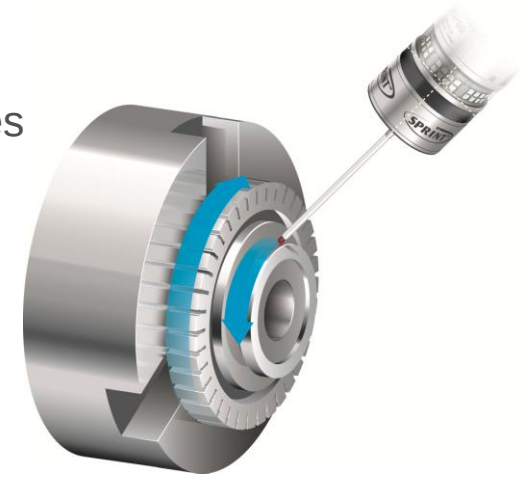
The **SPRINT MTM Toolkit** is designed for performing:

- Highly repeatable diameter measurement on multi-task machines (Y-axis lathes)
- Potential for extremely accurate measurement cycles (typically 1-2 µm) using reference artefacts

New capability:

- Using artefacts, tests have shown that it has the potential to enable completely new and automatic "cut-measure-cut" processes for accurate diameters
  - Leading to closed loop process capabilities within a few microns
- Provides an "active" control for diameters on multi-task machines





Developed in partnership with end users and designed for integration by machine tool builders

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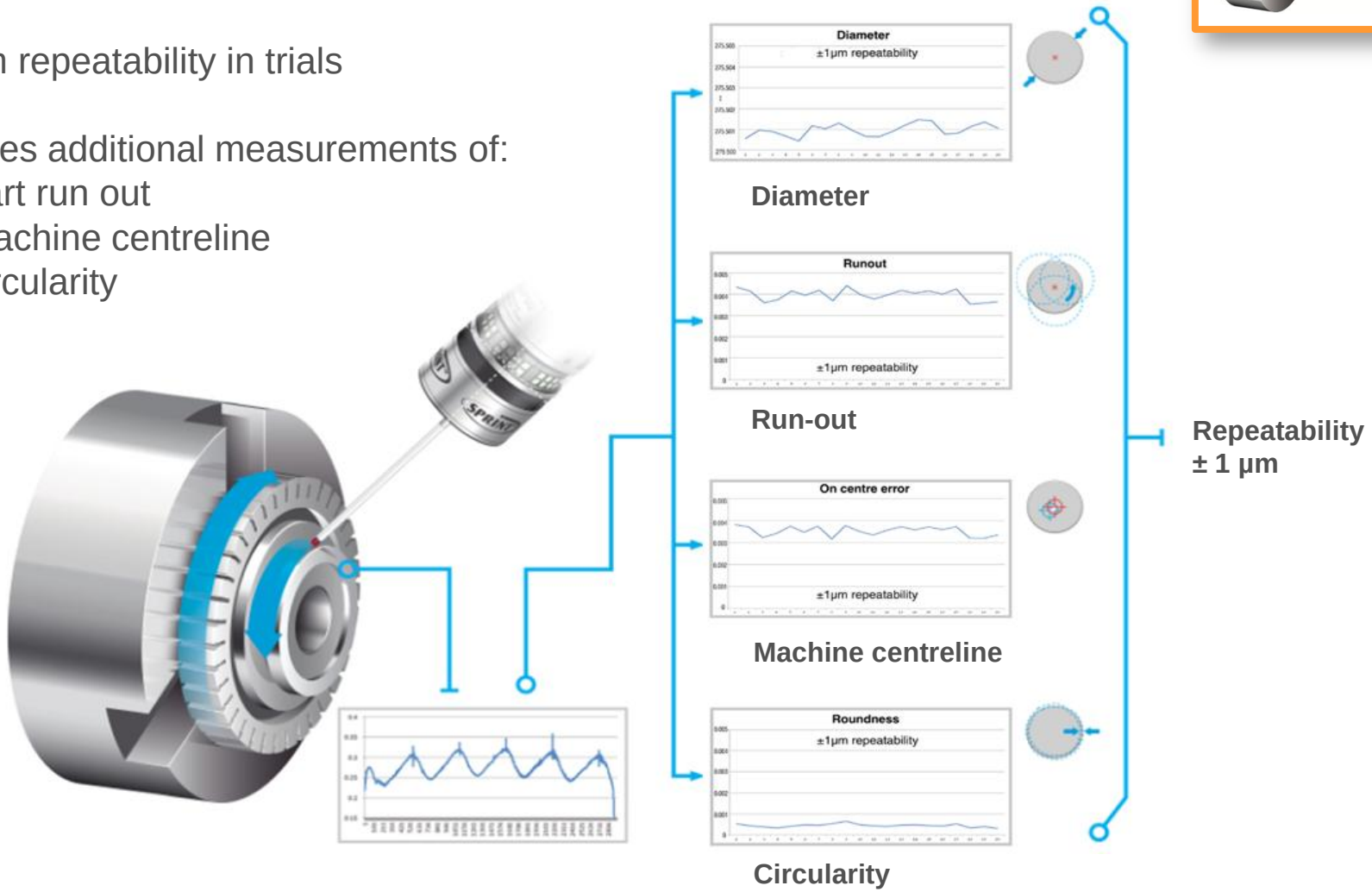
SPRINT: MTM Toolkit (multi-task machine)

Highly **repeatable diameter** measurement

- ± 1 µm repeatability in trials
- Provides additional measurements of:
  - part run out
  - machine centreline
  - circularity



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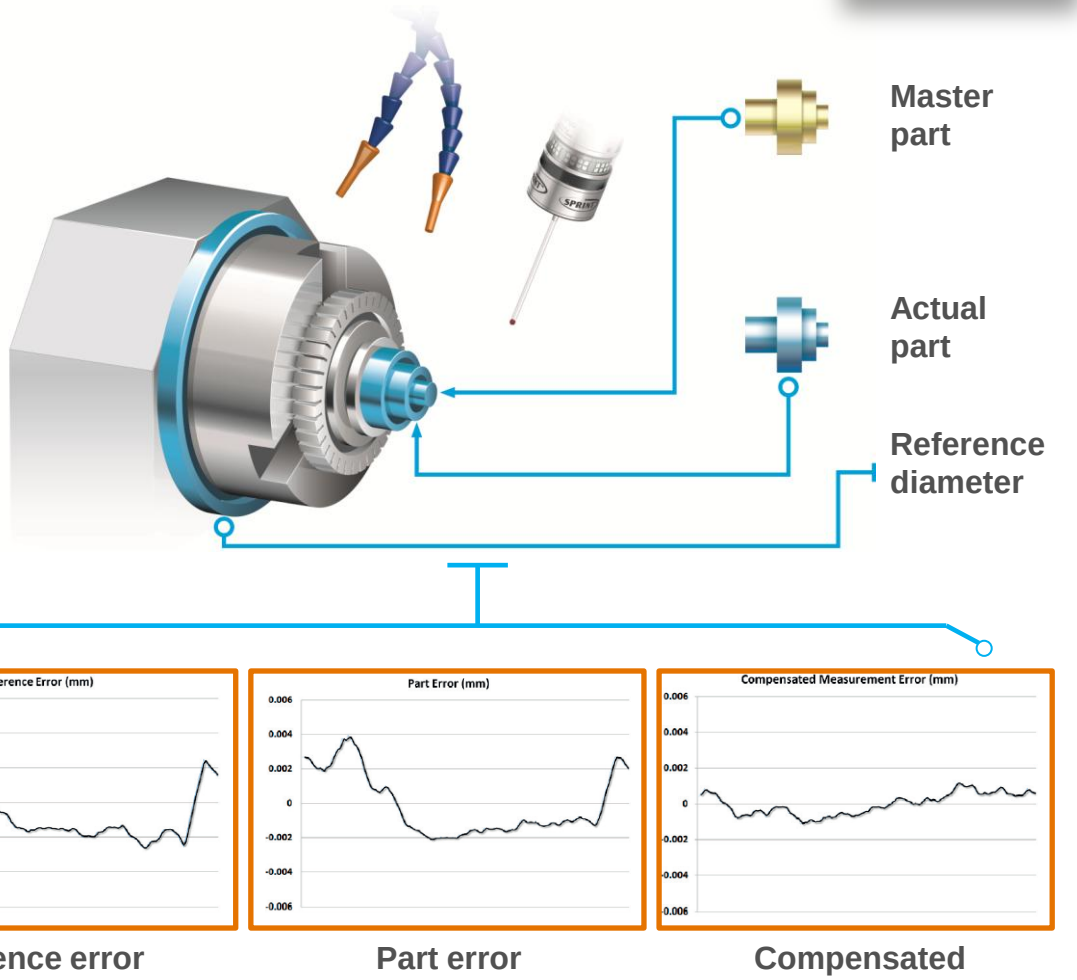
SPRINT: MTM Toolkit (multi-task machine)

Compensation strategies for accurate single sided diameter

- By comparing reference ring measurements with component measurements it is possible to greatly reduce the effect of thermal variation of the machine
- Leads to achievable manufacturing tolerances of a few microns
- Implemented by customer according to manufacturing requirement



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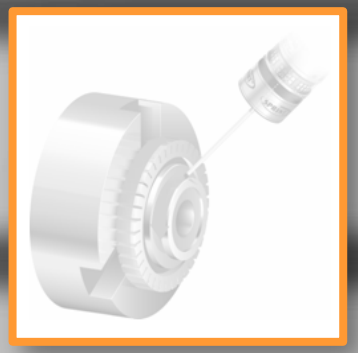
SPRINT™ system

New applications capability

Machine Health Check

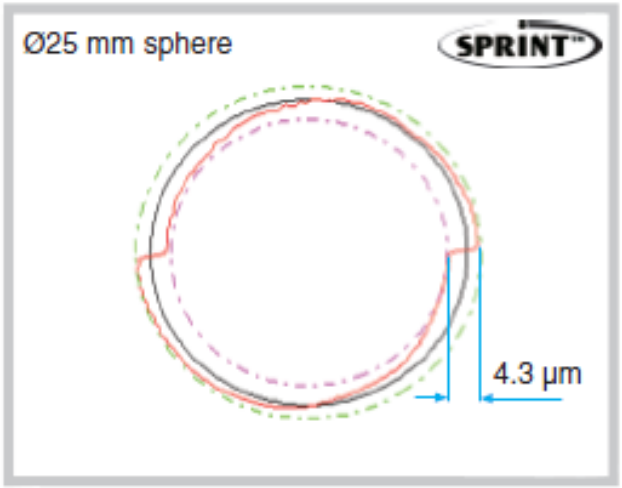


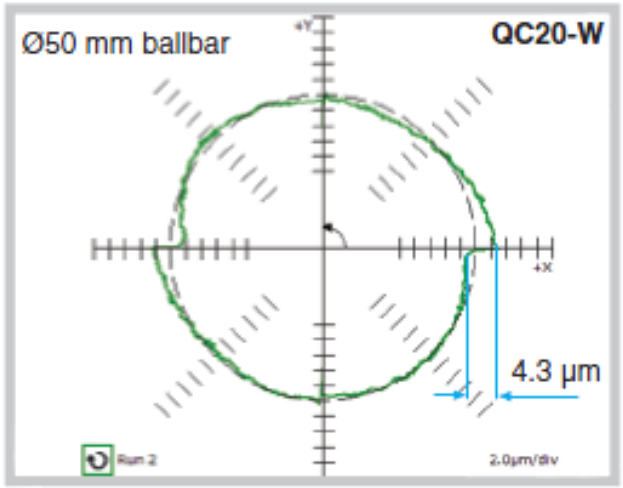
SPRINT: Machine Health Check

The **SPRINT Machine Health Check** is designed for performing:

- A 3-axis “linear check”
- A 5-axis kinematic centre point check

- Enables a near-automatic and daily health check with minimal operator intervention





- Comparable results to a QC20-W ballbar
- Provides “predictive” and “preventative” control

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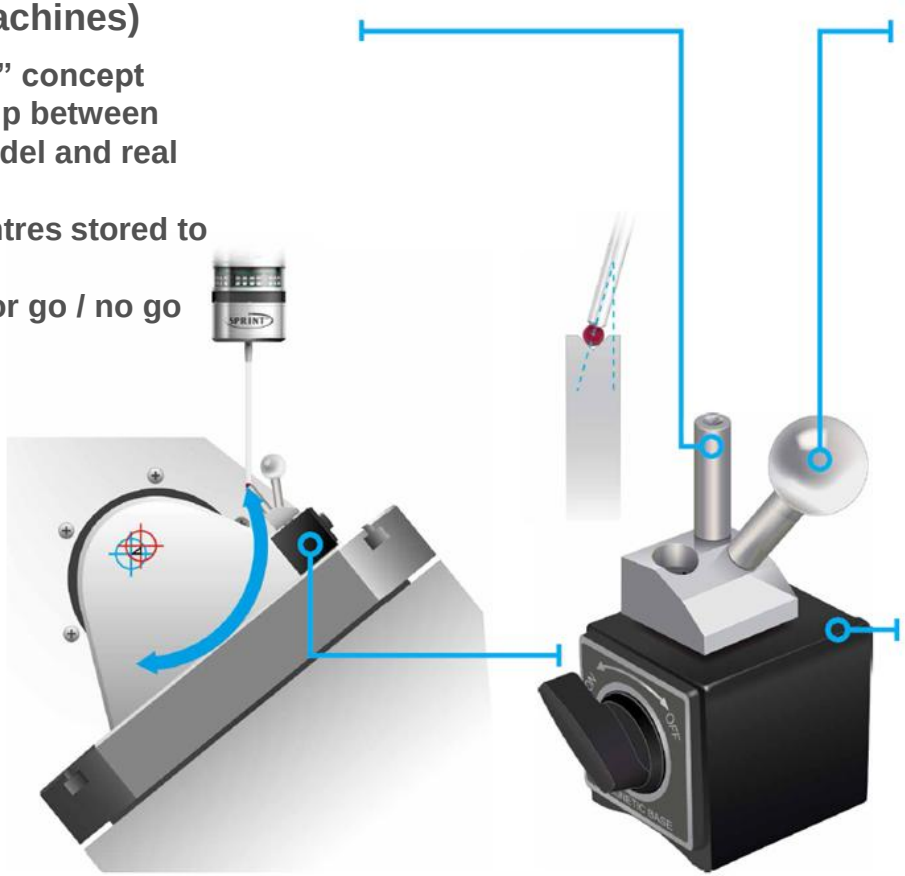
SPRINT: Machine Health Check

Verify machine capability **in less than a minute**

Kinematic test (for multi-axis machines)

- Uses “ball in cone” concept
- Checks relationship between CNC kinematic model and real machine condition
- New kinematic centres stored to CNC variables
- Tests linear axis for go / no go



Linear test (for 3-axis machines)

- Performs checks in X, Y, Z on a sphere
- “Form error” stored to CNC variable

Artefact

- Mounted on a magnetic base for easy placement
- Contains a calibrated sphere and dedicated cone artefact
- Cone depends on ruby size, hence is replaceable

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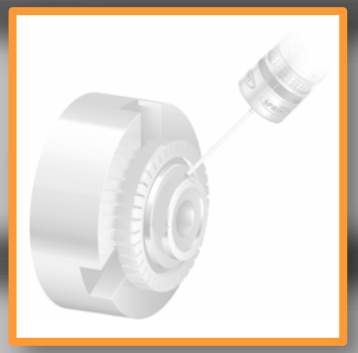
SPRINT™ system

New applications capability

Prismatic capability

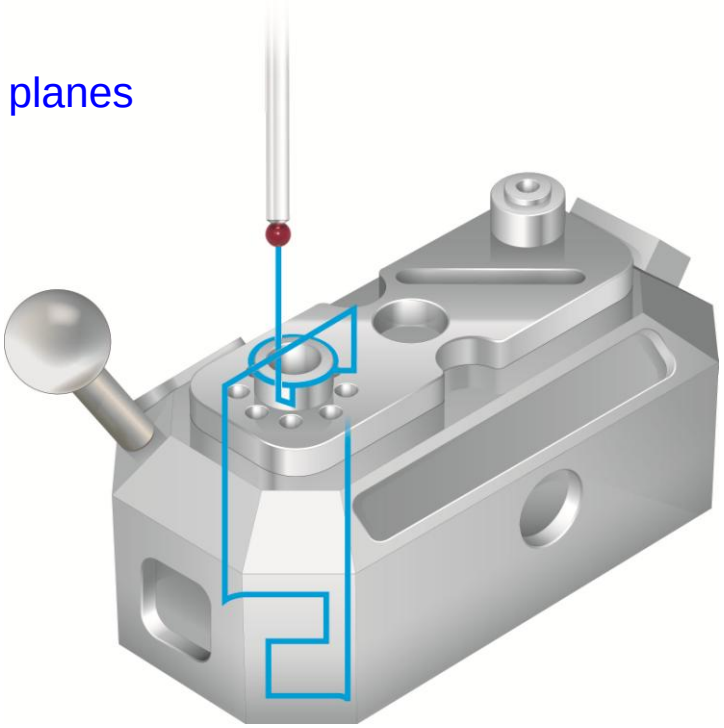


SPRINT prismatic features

The **SPRINT™ system** also provides:

- Discrete point functionality equivalent to standard Renishaw probes
  - SPRINT technology can be used for all existing job set-up and process control tasks
  - Equivalent accuracy to strain gauge
- Scanned feature capability for circles, arcs and planes

Scanned Circle	
Scanned Plane	
Surface Definition	
Scanned Surface	



- Programmed using Productivity+™ Active Editor Pro

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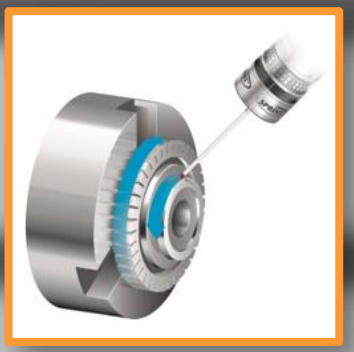
SPRINT™ system

New applications capability

System architecture



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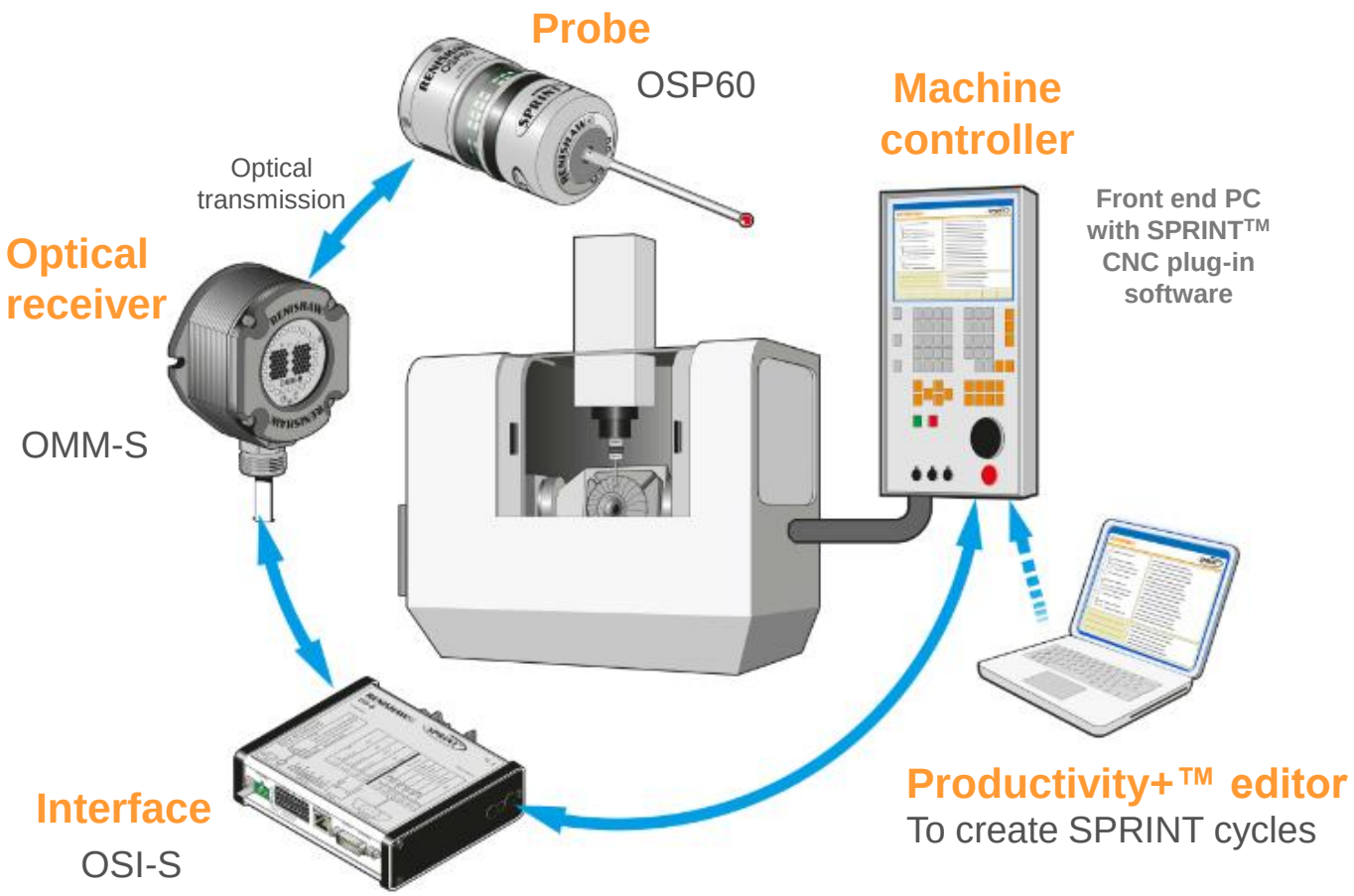
SPRINT™

SPRINT system architecture

SPRINT™ system components:



New application toolkits

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SPRINT system overview

OSP60 SPRINT probe:

- Tool changeable full feature scanning probe (62 mm x 102 mm)
  - can also act like a touch-trigger probe
- Analogue sensor with a resolution of 0.1 µm
  - scanning range: ±0.3 mm (XY), ±0.15 mm (Z)
- Robust and reliable in the harshest environments
  - Fully tested for temperature, shock, vibration and liquid ingress
- High-speed data capture
  - 15 m per minute, 1000 points per second
- Battery operated (consumer DL123)

OMM-S / OSI-S:

- Optical transmission via the OMM-S receiver
- High-speed reliable data
- Dual receiver support for large multi-axis machines
- Direct interface to the CNC plug-in via the OSI-S interface
- Data is synchronised with the machine tool

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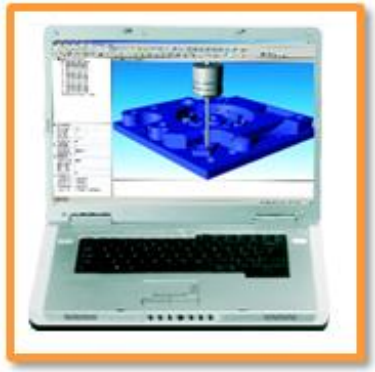
SPRINT system overview

SPRINT Productivity+™ CNC plug-in:

- On-machine software plug-in communicates with the machine tool, OSP60 scanning probe and the PC based data processing tools
- Close integration of the controller and CNC plug-in
- On-line editor provides exceptional ease of use and real-time data feedback for machine operators and programmers

PC based programming software / data processing:

- Productivity+™ Active Editor Pro
- Program the SPRINT system to perform scanning tasks based on solid model geometry and use the measurements to update the process running on the CNC controller
- Provides full support for application toolkits



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SPRINT™

SPRINT™ game-changing capability

Features

New contact scanning technology

Delivers high-speed and extremely accurate 3D data

Fully integrated into the CNC process

Processes

Allows a re-think of on-machine process control

Fundamental new process capability

Adopted technology

Integrated by machine tool builders

Widely supported

SPRINT™

New applications

Game changing capability in high value CNC machining