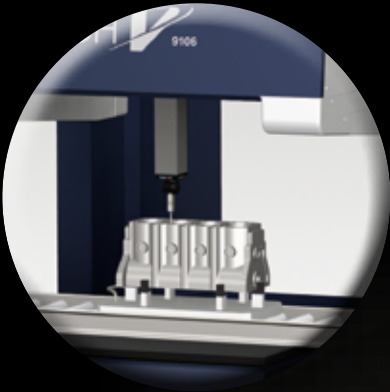


## In-line CNC Coordinate Measuring System MICROCORD **MACH Series**

A Production-line Coordinate Measuring System  
Designed for the Needs of Today



# In-line CNC Coordinate Measuring System **MACH series**



Vertical and Flexible

## MACH-V

MACH-V substitutes a flexible measurement system for a series of gauge measurements on a powertrain manufacturing line. The high acceleration, high-speed probe movement results in high-throughput measurement.



**Mitutoyo**

# MACH

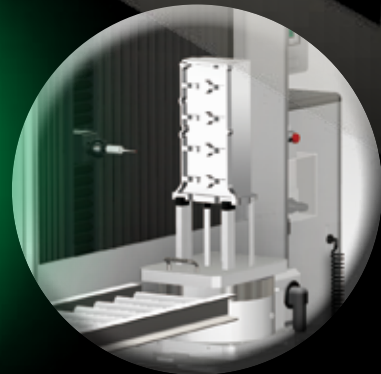
## Much-awaited, Fastest In-line Coordinate Measuring Machine, Bursting out of the Inspection Room.

An absolute requirement for a measuring machine to operate around the clock in a factory is the structural design: with due consideration given to superior durability for stable operations, significant reduction in measuring time, accuracy assurance under a wide range of temperature environments, security and ease of maintenance. The MACH series is Mitutoyo's in-line CNC coordinate measuring system that meets these demanding criteria. The proof is the fact that this series has established trust and a track record, particularly in the automobile industry at home and abroad.

Horizontal and High-speed Driven

## MACH-3A

This is a horizontal CNC coordinate measuring system that achieves high throughput by increased drive speed, acceleration, and measuring speed. Space-saving and durability characteristics are compatible with line-side/in-line installation.



Agile Measuring System

## MACH Ko-ga-me

MACH Ko-ga-me can be used in standalone applications or integrated into work cells.

- If required, the system can measure workpiece features that exceed the Ko-ga-me's X-stroke by mounting the workpiece, or the Ko-ga-me, on an auxiliary X-axis





# MACH-V

## An Optimal and Flexible Measuring System in Place of Dedicated Gauge Measurement in a Production Line

### High-speed drive up to a maximum of 866mm/s

The world's fastest CNC vertical axis, in-line coordinate measuring machine with world-beating acceleration ( $8,660\text{mm/s}^2$ ), measuring speed (at the moment of contact:  $20\text{mm/s}$ ) as well as drive speed. This system contributes to the reduction in total cost as an auto-measurement system, either in a line or at line side where a reduction in measurement time is required, and can also serve as a dedicated machine or a substitute system for gauges.

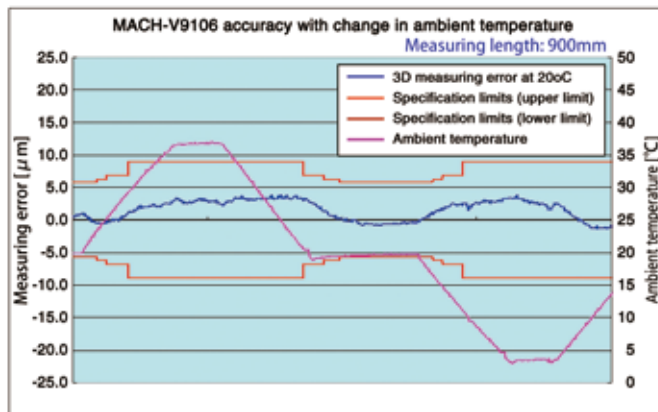
### Space-saving design helps installation in a production line

In consideration of installation between processing machines, the width of this machine has been reduced by 15% compared with its predecessor, thus contributing to a reduction in line length. Open access to the measuring area from the front/back and left/right has increased flexibility in the routing arrangements for a workpiece.

### Accuracy assurance throughout a wide temperature range (5 to $35^\circ\text{C}$ )

Real-time thermal compensation applied to measurements and origin-setting assure excellent accuracy (referred to  $20^\circ\text{C}$ ) over a much wider range of ambient temperature than conventional CMMs. The graph below shows the effectiveness of the scheme in maintaining accuracy over a range of more than  $30^\circ\text{C}$ .

### Highly effective thermal compensation of the MACH-V9106



### Improved dust resistance

This series has improved dust resistance relative to its predecessor by installing all drive system and scale units in the dust-tight enclosure on the machine top. The control unit and PC are installed in the dust-tight rack.

### Improved ease of maintenance

The ease-of-maintenance construction and air-free operation means less chance of maintenance problems occurring.

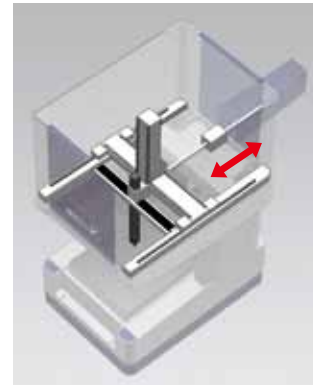


\*Sub-plate is optional.

### Higher speed and accuracy with barycentric drive

When the components of a CMM slide are driven by a force offset from the combined mass center, a rotation-inducing torque is produced that is detrimental to accuracy. To prevent this torque generation, the MACH-V series employs the barycentric drive system, achieving an ideal drive that minimizes slide rotation, especially under high drive acceleration conditions, by applying the drive force directly through the mass center of the slide.

This technique enables high-speed measurement with minimum accuracy deterioration compared with commonly-used CMMs.

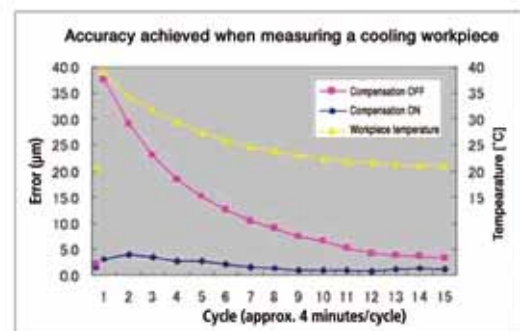


### Workpiece thermal compensation - essential for in-line measurement

Generally, during production, the temperature of a workpiece differs from that of the measuring machine due to processing and washing and is always changing.

To support in-line operations, the machine must continue accurate measurement (referred to  $20^\circ\text{C}$ ) even while the size of a workpiece is changing due to this temperature difference.

The following graph shows the high degree of compensation resulting when a MACH-V series machine (at  $20^\circ\text{C}$ ) measured a certain workpiece while it cooled from  $40^\circ\text{C}$  towards  $20^\circ\text{C}$ .



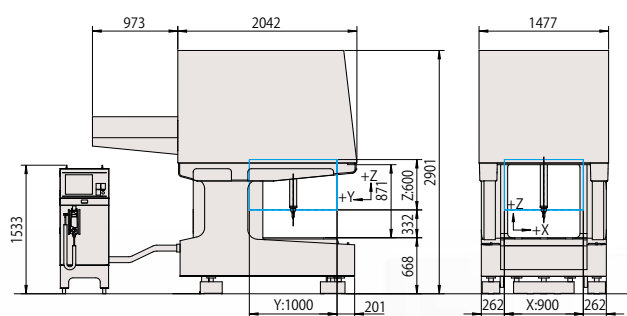
## Specifications

Item	Model	MACH-V9106
Measuring range	X-axis	900mm
	Y-axis	1000mm
	Z-axis	600mm
Resolution		0.0001mm (0.1μm)
Guide system		Linear guide on each axis
Operating speeds	CNC Mode	Drive speed: each axis 8 to 500mm/s; all axes 866mm/s
		Measuring speed: 1 to 20mm/s
	Joystick mode	0 to 80mm/s (High Speed)
		0 to 3mm/s (Low Speed)
Maximum drive acceleration		Each axis 5,000mm/s <sup>2</sup> ; all axes 8,660mm/s <sup>2</sup>
Scale type		Linear encoder
Workpiece	Maximum height	800mm
	Maximum mass	150kg
Mass of machine (including the mounting stand and controller)		4130kg

## External Dimensions

MACH-V9106

(Unit: mm)



## Operating environment

	Temperature
Accuracy assurance conditions	Temperature range
	5 to 35°C
	Temperature variation
	2°C or less per hour
	10°C or less per 24 hours
	Temperature gradient
	Vertical: 1°C or less per meter
	Horizontal: 1°C or less per meter

## Accuracy

Length measurement error ISO 10360-2:2009

unit: μm

Probe used	Temperature range	Max. permissible length measurement error	Repeatability range of E <sub>0</sub>
SP25M (Stylus: ø4x50mm)	19 - 21°C	E <sub>0</sub> , MPE = 2.5+3.5L/1000μm E <sub>150</sub> , MPE = 2.5+3.5L/1000μm	R <sub>0</sub> , MPL = 2.2
	18 - 22°C	E <sub>0</sub> , MPE = 2.7+3.8L/1000μm E <sub>150</sub> , MPE = 2.7+3.8L/1000μm	
	15 - 25°C	E <sub>0</sub> , MPE = 2.9+4.3L/1000μm E <sub>150</sub> , MPE = 2.9+4.3L/1000μm	
	5 - 35°C	E <sub>0</sub> , MPE = 3.6+5.8L/1000μm E <sub>150</sub> , MPE = 3.6+5.8L/1000μm	
TP7M (Stylus: ø4x20mm)	19 - 21°C	E <sub>0</sub> , MPE = 2.5+3.5L/1000μm	R <sub>0</sub> , MPL = 2.5
	18 - 22°C	E <sub>0</sub> , MPE = 2.7+3.8L/1000μm	
	15 - 25°C	E <sub>0</sub> , MPE = 2.9+4.3L/1000μm	
	5 - 35°C	E <sub>0</sub> , MPE = 3.6+5.8L/1000μm	

Single stylus form error ISO 10360-5:2010

unit: μm

Probe used	Max. permissible single stylus form error
SP25M (Stylus: ø4x50mm)	P <sub>FTU</sub> , MPE = 2.2
TP7M (Stylus: ø4x20mm)	P <sub>FTU</sub> , MPE = 2.5

Scanning accuracy ISO 10360-4:2000

unit: μm

Applied probe	Maximum permissible error (scanning mode) (MPE <sub>HP</sub> )
SP25M (stylus: ø4x50mm)	4.0



# MACH-3A

Long-awaited Horizontal Coordinate Measuring System  
Appropriate for a Horizontal Machining Line

## High-speed drive up to a maximum of 1,212mm/s

The world's fastest CNC horizontal axis, in-line coordinate measuring machine with world-beating acceleration ( $11,882\text{mm/s}^2$ ) and measuring speed (at the moment of contact:  $30\text{mm/s}$ ) as well as drive speed. This system contributes to the reduction in total cost as an auto auto-measurement system, either in a line or at line side where a reduction in measurement time is required, and can also serve as a dedicated machine or a substitute system for gauges.

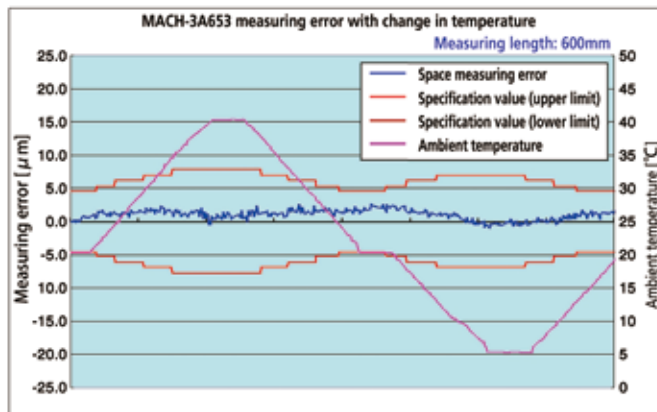
## Space-saving design helps installation in a production line

This series comprises horizontal coordinate measuring machines intended for installation between processing machines. The horizontal-axis design allows this system to use the same workpiece handling and routing as the processing machines use.

## Accuracy assurance throughout a wide temperature range (5 to $40^\circ\text{C}$ )

Real-time thermal compensation applied to measurements and origin-setting assure excellent accuracy (referred to  $20^\circ\text{C}$ ) over a much wider range of temperature than conventional CMMs. The graph below shows the effectiveness of the scheme.

## Highly effective thermal compensation of the MACH-3A 653



## Improved dust resistance

This system incorporates a control unit and a PC for measurement and has attained superior durability through a design targeted on 24-hour operation.

## Improved ease of maintenance

The ease-of-maintenance construction and air-free operation means less chance of maintenance problems occurring.



## All-in-one construction

In order to achieve further improved space-saving, dust resistance and adaptation to a wide range of temperatures, the MACH-3A employs an all-in-one construction.

The system integrates the main unit, data processor (PC) and monitor into one location on top of the mounting stand to achieve space-saving and ease of installation.

Additionally, to improve resistance to temperature environment and dust resistance, units other than the monitor are located in a cabinet in which a heat exchanger keeps the ambient temperature constant.

## Thermal compensation - essential for in-line measurement

The MACH-3A series is provided with the same thermal compensation functions as the MACH-V series.

For detailed information, refer to page 4.

## Specifications

Item	Model	MACH-3A 653
Measuring range	X-axis	600mm
	Y-axis	500mm
	Z-axis	280mm
Resolution		0.0001mm (0.1μm)
Guide system		Linear guide on each axis
Operating speeds	CNC Mode	Drive speed: each axis 8 to 700mm/s; all axes 1212mm/s
		Measuring speed for TP7M: 1 to 30mm/s Measuring speed for TP20: 1 to 20mm/s
	Joystick mode	0 to 80mm/s (High Speed)
		0 to 3mm/s (Low Speed) 0.05mm/s (Fine Speed)
Maximum drive acceleration		Each axis 6,860mm/s <sup>2</sup> ; all axes 11,882mm/s <sup>2</sup>
Scale type		Linear encoder
Workpiece	Maximum height	750mm
	Maximum mass	200 kg (excluding optional accessories)
Mass of machine (including the mounting stand and controller)		1,500 kg (excluding optional accessories)

### Scanning accuracy ISO 10360-4:2000

Probe used	Maximum permissible error (scanning mode) (MPE <sub>THP</sub> )
SP25M (stylus: ø4x50mm)	4.0

### Operating environment

unit: μm

	Temperature
Accuracy assurance conditions	Temperature range
	5 to 40°C
	Temperature variation
	2°C or less per hour 10°C or less per 24 hours
	Temperature gradient
	Vertical: 1°C or less per meter Horizontal: 1°C or less per meter

### Point-to-point accuracy ISO 10360-2:2003

unit: μm

Probe used	Maximum permissible error of measurement E <sub>0,MPE</sub>	Maximum permissible error of probing P <sub>THU,MPE</sub>
SP25M (stylus: ø4x50mm)	2.2 + 3.5L/1000 (19 to 21°C)	2.2
	2.5 + 4.2L/1000 (15 to 25°C)	
	2.9 + 5.0L/1000 (10 to 30°C)	
	3.2 + 5.7L/1000 (5 to 35°C)	
	3.6 + 6.5L/1000 (5 to 40°C)	
TP7M (stylus: ø4x20mm)	2.5 + 3.5L/1000 (19 to 21°C)	2.5
	2.8 + 4.2L/1000 (15 to 25°C)	
	3.2 + 5.0L/1000 (10 to 30°C)	
	3.5 + 5.7L/1000 (5 to 35°C)	
	3.9 + 6.5L/1000 (5 to 40°C)	
TP20 (stylus: ø3x10mm)	2.7 + 3.5L/1000 (19 to 21°C)	2.7
	3.0 + 4.2L/1000 (15 to 25°C)	
	3.4 + 5.0L/1000 (10 to 30°C)	
	3.7 + 5.7L/1000 (5 to 35°C)	
	4.1 + 6.5L/1000 (5 to 40°C)	

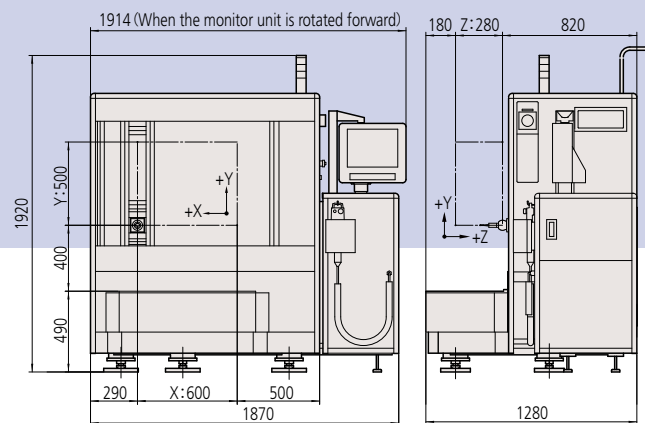
\* L = Arbitrary measuring length (unit: mm)

Notes: 1) The index table is optional.

2) For information about the accuracy assurance conditions in a temperature range other than 5 to 40°C, contact your nearest Mitutoyo Sales Department.

## External Dimensions

(Unit: mm)



## Introduction to MACH-3A 483



- This is a high speed, versatile, shaft-measuring machine\* appropriate for production line use.
- Dedicated gages cost a great deal of money for every design change to a workpiece. This measuring machine provides an economical alternative by accommodating such changes just by an easy edit of a part program, allowing dramatic cost-reduction to be achieved.
- This single machine enables fast and accurate measurement of all evaluation items on a crankshaft or camshaft.

\* This is a custom-order product.

MEASURING SYSTEM

**MACH-3A 653**



# MACH Ko-ga-me

A fast, highly accurate and flexible CNC measuring head

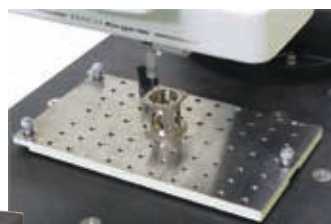
- Can be used in standalone applications or integrated into work cells.
- If required, the system can measure workpiece features that exceed the MACH Ko-ga-me's X-stroke by mounting the workpiece, or the Ko-ga-me, on an auxiliary X-axis.
- Ideal for inspection of large or small workpieces and offers a wide choice of measuring probes including touch-trigger and scanning types.

## Standalone system

MACH Ko-ga-me



Stand\*1



High speed measurement for a small workpiece

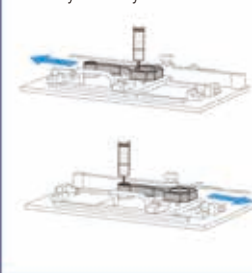
\*1: The stand is optional.

## Moving-head system

Example of moving-head system



Auxiliary X-axis system\*2



\*2: An auxiliary X-axis system shall be provided by the customer.

## SPECIFICATIONS

L=Measured length (mm)

Model	KGM888-B	KGM12128-B
Measuring range (X, Y, Z)	80x80x80mm	120x120x80mm
Accuracy*3	19-21°C: (2.4+5.7L/1000)μm 15-25°C: (2.7+6.4L/1000)μm 10-30°C: (3.1+7.2L/1000)μm 10-35°C: (3.4+7.9L/1000)μm	
	Repeatability range R <sub>0,MPL</sub> (ISO 10360-2:2009)	1.9μm*4 1.3μm*5
	Max. permissible single stylus form error P <sub>FTU,MPE</sub> (ISO 10360-5:2010)	2.2μm
	Maximum permissible error (scanning mode) MPE <sub>THP</sub> (ISO 10360-4:2000)	2.7μm(30s)
	Drive speed	Max. 200 (1 axis) / Max. 340 (Composition of 3 axes)
Drive acceleration	Max. 3900 (1 axis) / Max. 6750 (Composition of 3 axes)	

\*3: When using TP200 or SP25M

\*4: When using TP200

\*5: When using SP25M

### Guaranteed accuracy temperature for MACH Ko-ga-me

	Temperature environment
Temperature range	10 to 35°C
Temperature variation	2.0°C or less/1hr
Temperature gradient	1.0°C or less/1m (in horizontal/vertical direction)

Note: Product illustrations are without obligation. Product descriptions, in particular any and all technical specifications, are only binding when explicitly agreed upon.  
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