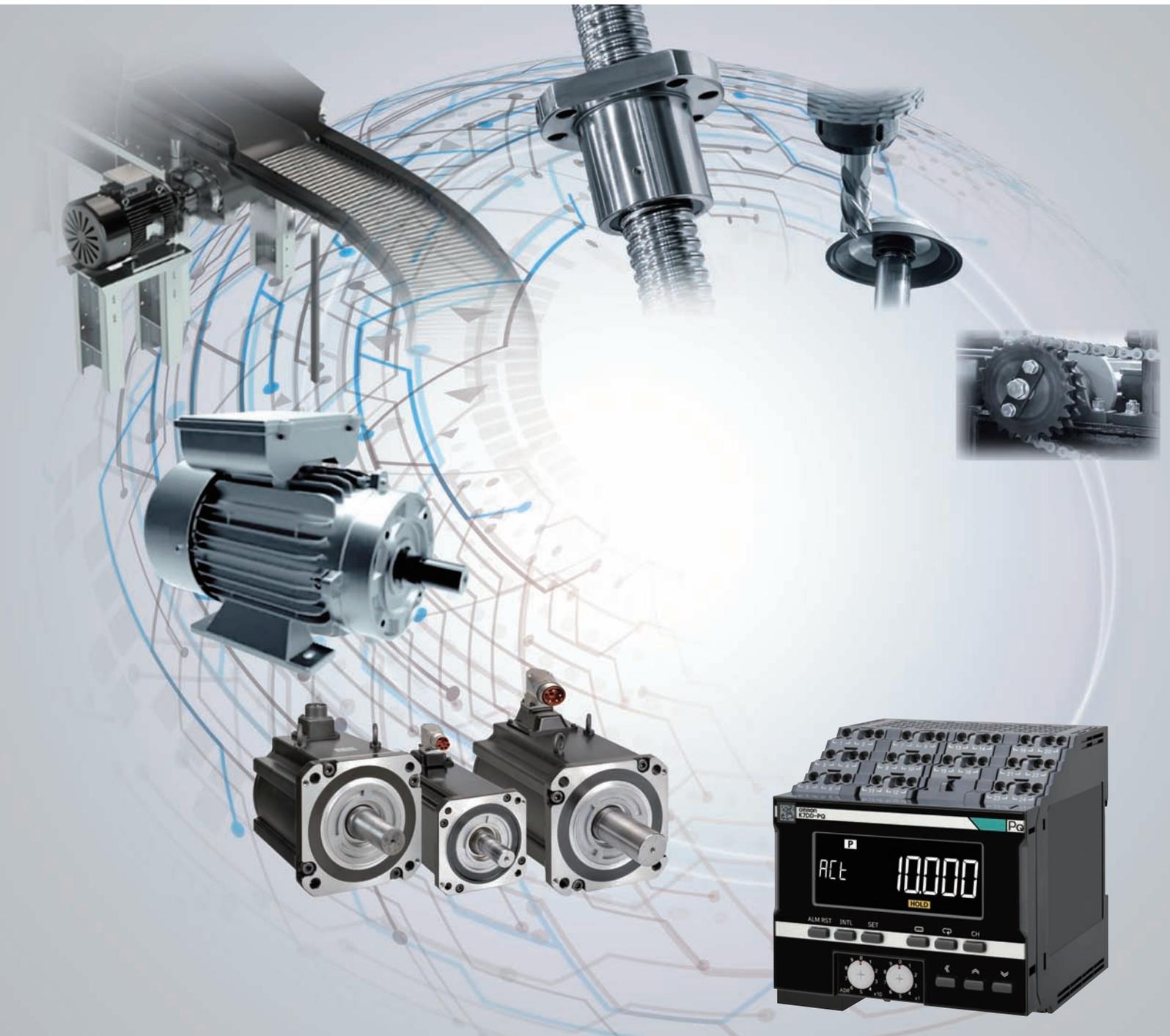


Capture a wide variety of abnormalities affecting motor equipment to minimize unplanned downtime



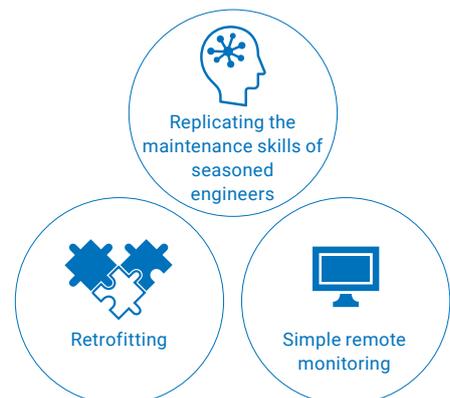
# Implementing a new strategy of automated condition monitoring to maximize maintenance resources

Manufacturing sites must respond to the rapidly changing times. OMRON is working to digitalize factories with the aim of ensuring highly mobile production that can react to such changes. We propose a new form of maintenance that watches all kinds of production facilities and equipment without relying on human senses.



## Developing a people-friendly style of Condition Based Maintenance

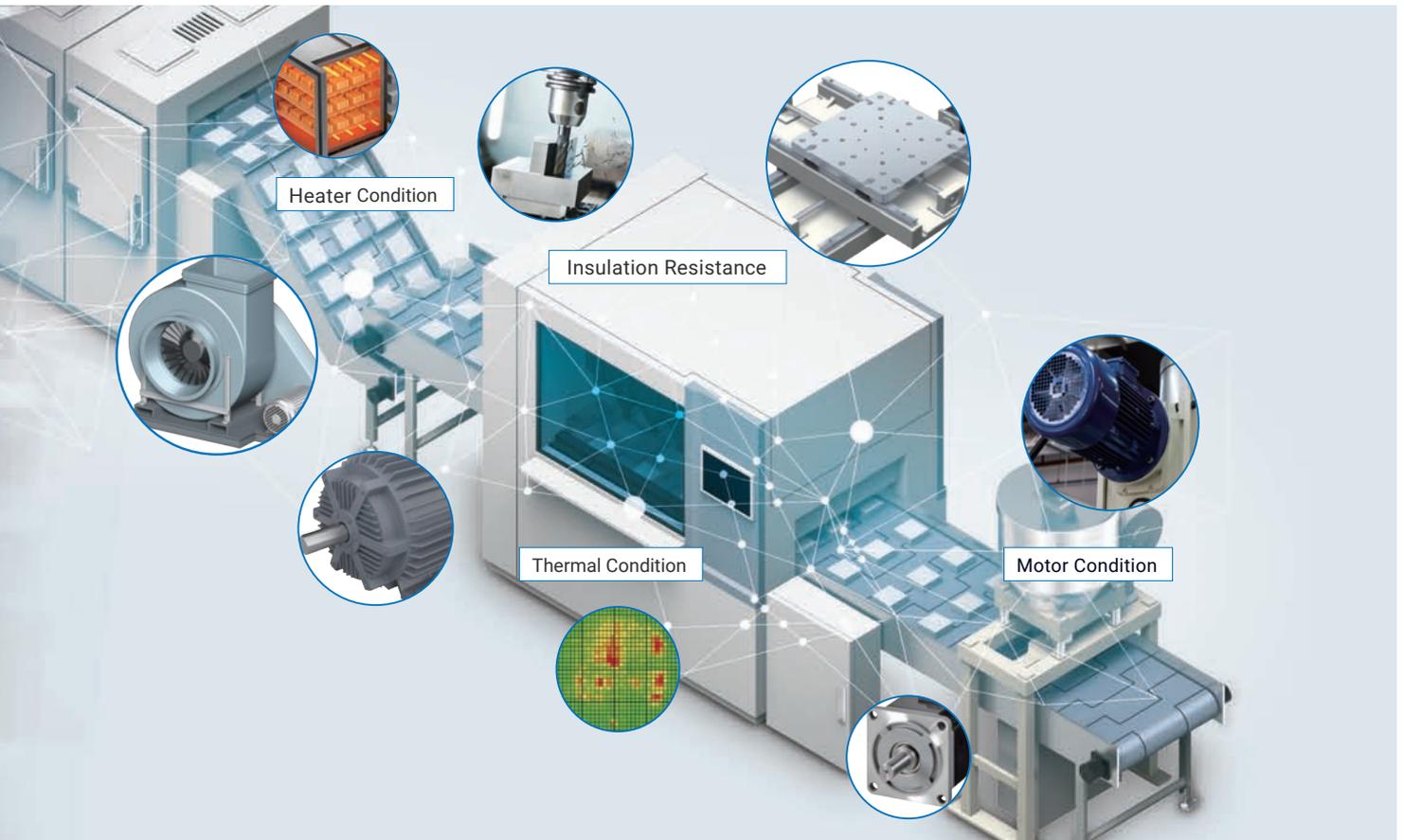
Reactive maintenance has been the standard maintenance strategy so far, due to a limitation of skilled resources. The severe labor shortages seen in recent years have also led to demand for optimization of equipment maintenance that was dependent upon the experience and intuition of skilled resources. In particular, there is a pressing need for measures to deal with motors, heaters, and power equipment such as control panels, all of which present serious risks if suddenly stopped. OMRON is accelerating condition monitoring of on-site devices by automating the maintenance skills of master engineers. The goal is to produce a people-friendly manufacturing environment with a new approach aimed at digitalization of maintenance covering diverse failure modes.



Omron's Predictive Maintenance Solution

# Monitoring the condition of critical equipment in a production environment

We provide condition monitoring solutions for production equipment in various industries by realizing advanced abnormality detection in a variety of critical production equipment.



## Condition Monitoring Devices Lineup



Advanced Motor Condition Monitoring Device

K7DD

Motor Condition Monitoring Device

K6CM

Thermal Condition Monitoring Device

K6PM

Insulation Resistance Monitoring Device

K7GE

Heater Condition Monitoring Device

K7TM

# Implementing predictive maintenance with real-time condition monitoring of variable speed motors, previously a difficult task.

K7DD enables condition monitoring while operating to assist scheduled maintenance

The K7DD advanced motor condition monitoring device makes it possible to identify failure modes and defect parts of motor equipment while rapidly translating power quality such as motor current and voltage into data. This enables scheduled maintenance activities with real-time condition monitoring of motors that frequently change speed, which were difficult to identify abnormalities so far. And simplified condition monitoring device parameter configuration process is contributed to understand K7DD installation efficiency quickly .



### Key point ①

## Monitors servo motors and induction motors that frequently change speed

Supports motors used in various equipment.  
A single K7DD device can identify multiple failure modes in monitored motor system.

> P6



### Key point ②

## Condition monitoring can be started with on-site self-contained solution

The K7DD is an on-site self-contained model, so it can be retrofitted with minimal installation work.

> P12



### Key point ③

## Reduces maintenance and inspection workload while delivering reliable results

Latest solution test is always time-consuming job  
the Condition Monitoring Configuration Tool software deliver visually and intuitively verifiable effects, as easy to understand K7DD efficiency. Condition monitoring can be started even without reproducing replicating abnormalities.

> P14



# Digitalizing the senses of experienced maintenance resources to detect abnormalities before they happen

Production sites use not only induction motors, but also huge numbers of servo motors, with various failure modes arising from motor and load combinations, requiring measures that can comprehensively capture changes. The K7DD monitors the power quality of devices (current, voltage, etc.) to ascertain at an early stage any signs of abnormality, just like experienced maintenance resources used to do by relying on their senses. Condition monitoring can be performed in real-time without having to stop the production line and it is possible to switch to condition based maintenance. The K7DD also identifies diverse failure modes by capturing various features based on power quality data obtained from the devices.

## Monitors servo motors and induction motors that frequently change speed

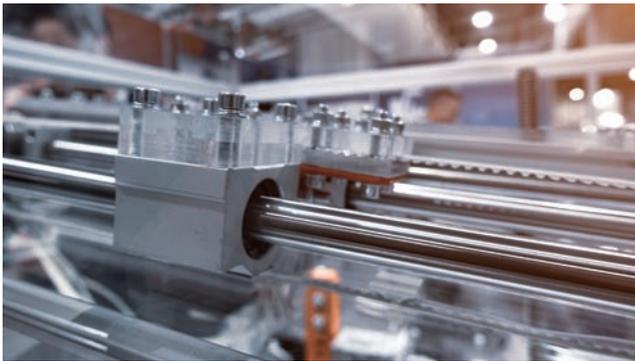
The K7DD is capable not only of monitoring the condition\*1 of servo motor equipment that frequently changes speed, but also induction motors whose load changes during high-speed work movement. Condition monitoring of loads connected to motors is also possible.



Servo motor equipment



Induction motor equipment



\*1 An interval where the frequency value is fixed will be required to ensure stable measurement.

## Applicable to various equipment

The K7DD supports motors running at variable speeds and with fluctuating loads, making it possible to monitor the condition of various loads connected to motors.



Pump



Fan



Transport conveyor/roller



Mixer



Linear guide



Machinery cutting tool



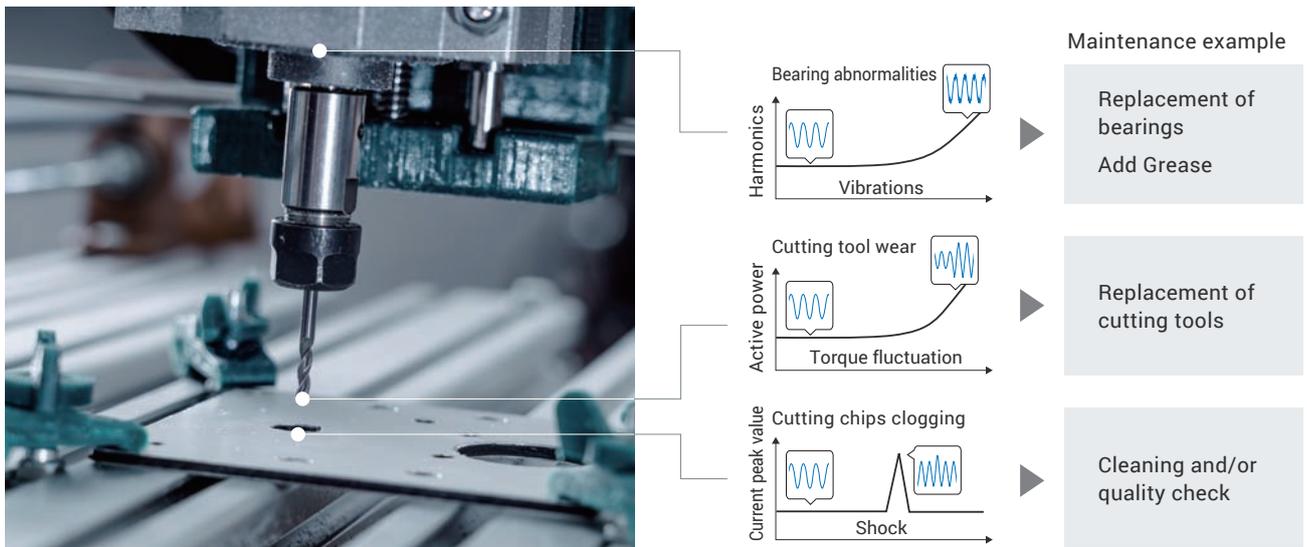
Processing stage



Movable stage

# A single K7DD device can identify multiple failure modes

A variety of factors may cause motor equipment failure. Configuration of the K7DD makes it possible to monitor these failure modes individually and suggest subsequent actions to be taken by maintenance staff depending on the condition.



# Implement various condition monitoring applications

From the current and voltage it has measured, the K7DD can calculate approximately 400 types of feature values and detect abnormalities possessing various facilities. The K7DD is ideal for use in scheduled maintenance of diverse equipment in factories and facilities.

Components	Various actuators						
	Motor	Load					
		Rotary shaft	Cutting tools	Ball screw	Belt/chain	Impeller/fan	Roller
Failure mode	 Bearing wear	 Abnormality of rotary shaft	 Cutting tool wear	 Grease degradation	 Belt looseness	 Imbalance	 Foreign object clogging
	 Rotor abnormality		 Cutting tool damage	 Foreign object clogging	 Chain biting	 Instability	 Snaking/slipping
	 Gear wear		 Cutting chips clogging			 Cavitation fluid fluctuation	

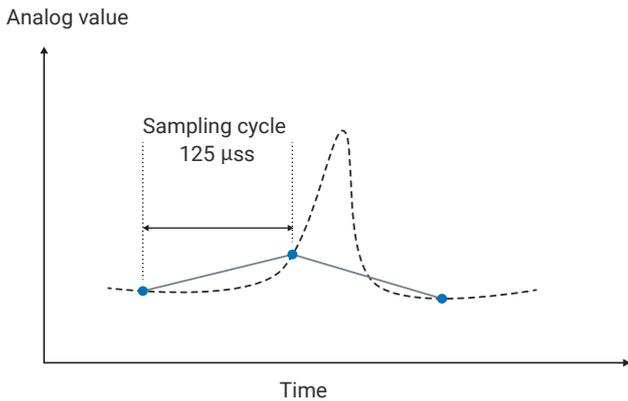
\*1 This value explores the correlation with changes in motor condition by operating the current and voltage data obtained from a motor's power line.

# High-quality component with built-in high-performance sensing

The K7DD advanced motor condition monitoring device features high-performance sensing to deliver new condition monitoring close to user-friendly maintenance. Condition monitoring of various motor equipment, including servo motors, has been achieved through high-speed processing.

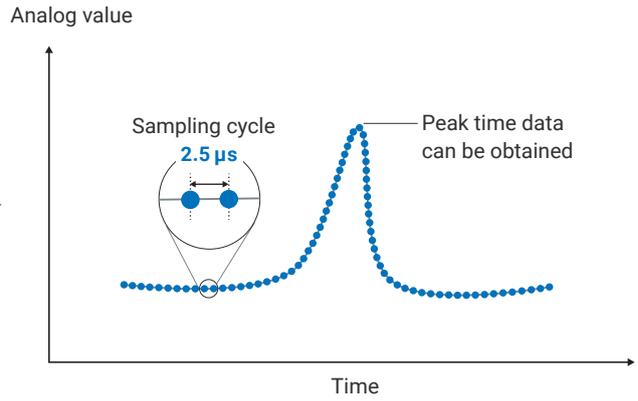
## Replicate analog values in real settings

**Previous** Peak time data cannot be obtained



**K7DD** Actual data can be replicated accurately. Therefore, abnormalities will not be overlooked.

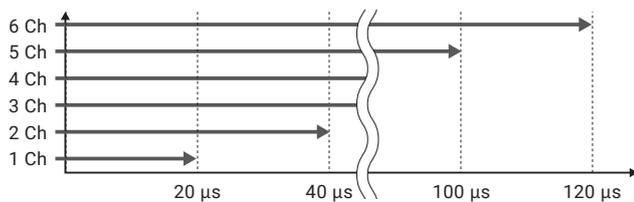
Sampling cycle  
**2.5  $\mu$ s**



----- Actual data    ● Obtained data

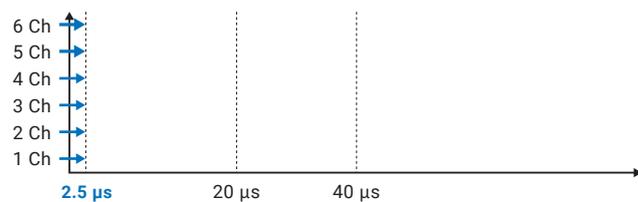
## Processing without missing data

**Previous** Sampling cycles are extended when obtaining data from multiple channels.



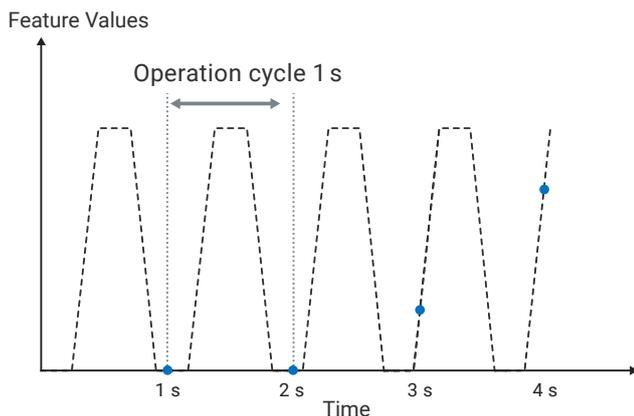
**K7DD** Simultaneous high-speed sampling of 6 channels is possible, enabling operation of 3-phase current /voltage with various power quality feature values

Simultaneous continuous  
**6-channel operation**



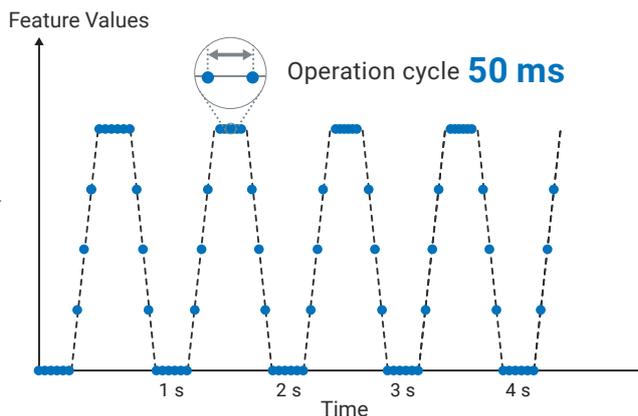
## High speed data collection

**Previous** Cannot collect high speed servo motor data



**K7DD** Advanced operation processing speed enables to collect high speed servo motor data

Operation processing speed  
**50 ms**

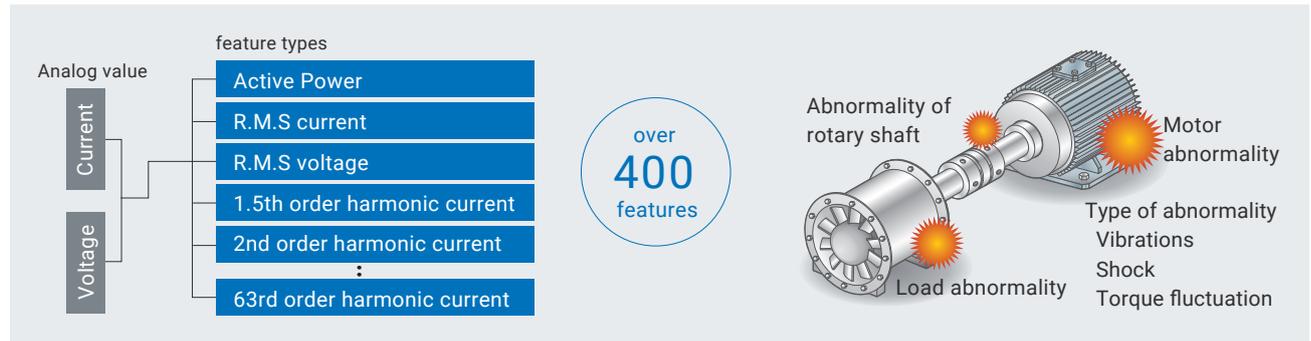


----- Motor speed/load\*1    ● Obtained data

\*1 Can only be adapted to equipment where the period during which motor speed or load is stable is at least 100 ms.

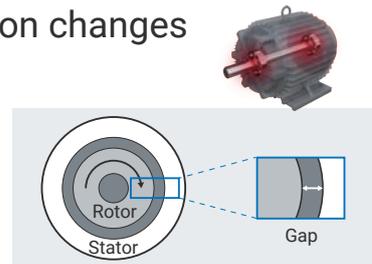
# Ascertaining every detail of motor equipment performance Monitor every detail of motor equipment condition

The K7DD samples 6 channels simultaneously at 2.5μs. By operating 3-phase power line current/voltage every 50 ms, it detects over 400 types of feature values. From these values, you can select the feature values you want to monitor and set thresholds for each feature value to monitor diverse failure modes of various production facilities and equipment.

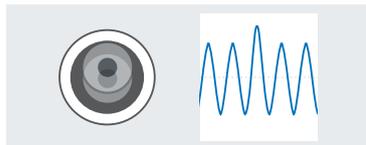


## Logic Analysis that enables monitoring of condition changes in motor equipment by looking at power quality

Abnormalities in motor equipment (motors and their loads) can often be seen to affect the axis of revolution of a motor. Gaps between rotors & stator and torque fluctuation due to degradation appear as changes in current and voltage, leading to distorted motor current waveforms caused by uneven rotation that is unlike the smooth rotation seen in normal operation.



### Shock



Every momentary shock to a load can be captured and quantified.

#### Examples of feature values

Voltage waveform peak+etc.

#### Main detectable failure modes

Adulteration with iron powder, foreign object clogging, cutting tool damage, etc.

### Torque fluctuation



Small torque fluctuations due to abnormal load conditions can be captured.

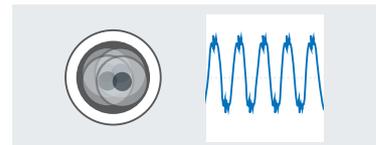
#### Examples of feature values

R.M.S current, Active Power, Current unbalance

#### Main detectable failure modes

Cutting tool wear, cavitation, snaking, etc.

### Vibrations



Vibrations occurring on a load can be captured as harmonics in line with frequencies.

#### Examples of feature values

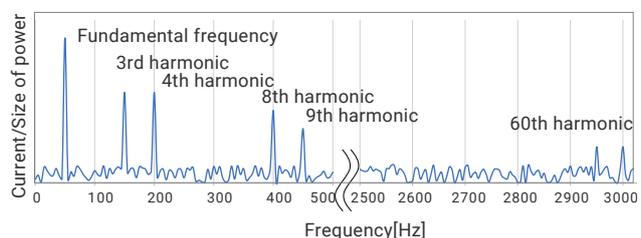
63rd order harmonic current, Current total harmonic distortion

#### Main detectable failure modes

Gear wear, belt wear, ball screw wear, etc.

### What are harmonics?

Harmonics are frequency components in the order of a motor's fundamental frequency. By monitoring the size of components for each frequency of vibration that occurs in the motor or its load, it is possible to determine the failure mode or position of abnormality that has occurred in the equipment. The K7DD can operate up to the 63rd order harmonic at intervals of 0.5 order.



# Motor degradation progress/failure mode correspondence table

OMRON's condition monitoring devices for motor include the K6CM motor condition monitoring device and the K7GE-MG insulation resistance monitoring device. These application coverage and effects of these devices vary, so use the respective devices that are suited to your equipment and the applications you want to run. With the K7DD, you can select the effective feature values for each failure mode and failure part, enabling failure parts to be identified.

Monitored object	Failure mode	Timeline		
		Setup period	Operation period	
<b>Inside the motor</b>  Servo/ induction motor  	Insulation degradation		Early operation period	
	Bearing degradation		Grease degradation	
	Abnormality of rotary shaft /rotor/ stator abnormality	Adjustment	Early operation period	
<b>Outside the motor (Load)</b>  	Abnormality of rotary shaft - Imbalance - Misalignment	 <b>K7DD-PQ</b>   <b>K6CM-CI2</b> (Comprehensive current diagnosis type) [Degr Faulty installation/ Faulty centering, etc.		
			Load abnormality - Cavitation - Device abnormality - Overload	 <b>K7DD-PQ</b> Early operation period
	- Torque fluctuation/cutting tool wear - Foreign object clogging - Increased friction			 <b>K6CM-CI2</b> (Comprehensive current di Faulty installation/ Faulty operating condition/ Faulty load part

Monitored object	K7DD-PQ Advanced Motor Condition Monitoring Device 	K6CM-CI2 Motor Condition Monitoring Device 
3-phase induction motor * 1 	✓	✓
AC servo motor 	✓	

\* 1. In the case of induction motor load that fluctuates in units of a few seconds, stable measurement is possible to an even greater extent with the K7DD than with the K6CM.

Motor and load condition			Failure mode
Degradation progress period	Breakdown period		
Insulation degradation  <b>K6CM-IS</b> (Insulation resistance type) [Insulation resistance] <small>*The K7GE is able to monitor the insulation resistance of induction motors/servo motors, but it cannot monitor while a motor is running.</small>	Insulation breakdown		Motor insulation degradation
Bearing damage 	 <b>K7DD-PQ</b>  <b>K6CM-CI2</b> (Comprehensive current diagnosis type) [Degradation level]	Bearing breakdown	Bearing degradation
Degradation progress of motor	 <b>K6CM-VB</b> (Vibration/temperature type) [Acceleration]	<b>K6CM-VB</b> (Vibration/temperature type) [Temperature] <b>K6CM-CI2</b> (Comprehensive current diagnosis type) [Current value]	
Degradation level]	 <b>K6CM-VB</b> (Vibration/temperature type) [Temperature]	<b>K6CM-VB</b> (Vibration/temperature type) [Temperature]	Abnormality of rotary shaft /rotor/ stator abnormality  Abnormality of rotary shaft - Imbalance - Misalignment
Degradation progress	Diagnosis type) [Degradation level]	 <b>K6CM-VB</b> (Vibration/temperature type) [Speed]	Load abnormality  - Cavitation - Device abnormality - Overload  - Torque fluctuation/ cutting tool wear - Foreign object clogging - Increased friction
 <b>K7DD-PQ</b>			

# Condition monitoring can be started with on-site self-contained solution

Using clouds, data servers, or other IT devices not only requires system-building skill and coordination with IT administrators, but also necessitates specialist installation work. The K7DD is a maintenance-site self-contained model, so there is no need to learn special skills, and it can be retrofitted with minimal installation workload. After installation, you can check abnormal conditions from the K7DD display screen.

## On-site self-contained means no need for IT skills

IT skills are required for both company-internal and external network connections, and on-site implementation takes a long time because there are many related departments. The K7DD is capable of advanced processing in the device itself, therefore inspection of effects can be completed purely on-site.

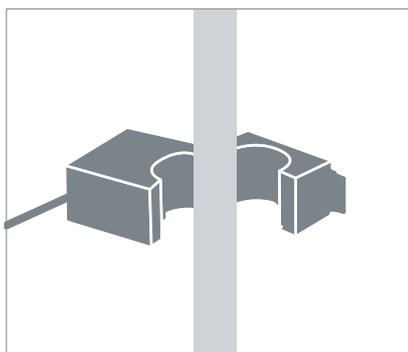


Note: Condition Monitoring Configuration Tool software must be used in order to set up monitoring by failure mode.

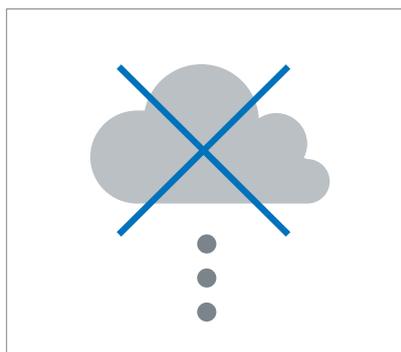
## Retrofitting is simple due to easy to install current sensing clamp

Installing in equipment requires wiring and construction work, resulting in unavoidable impact on production. With the K7DD, wiring is completed within a control panel, so there is no need for installation work of motor itself. This power line monitoring ensures that retrofitting can be performed with minimal impact on production.

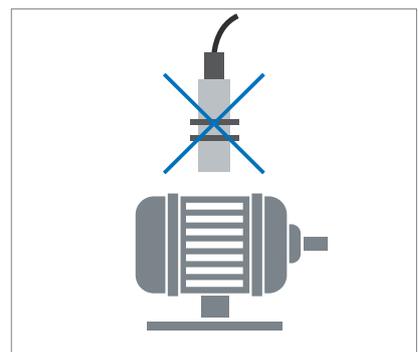
Simple retrofitting with clamp-type current sensor



No need for IT skills or system management



No sensor equipment installation work required on motor side

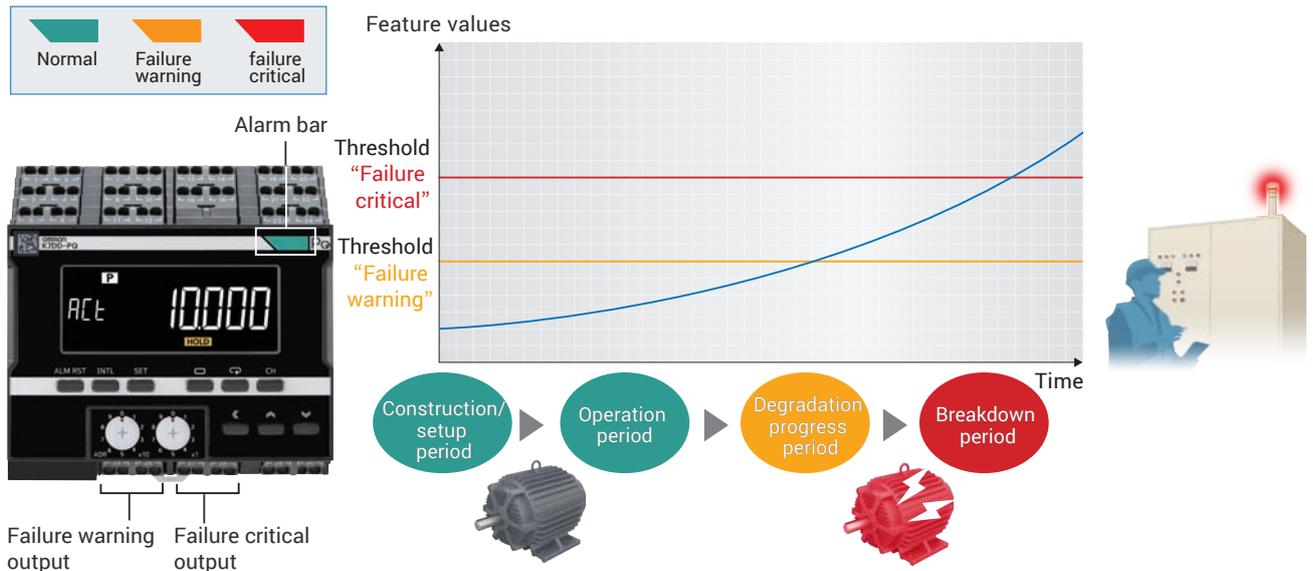


Note: If voltage wiring is difficult, simpler inspection is also possible with single-phase current feature values. However, there will be few calculable feature values and the number of supported applications is limited.

# Useful for rapid on-site maintenance

## Transistor output to notify of abnormality

The condition of the monitored motor is displayed on top panel by color-coding as green, yellow, or red. This shows the degree of abnormality and is helpful for visual inspection near the motor without any IT tool. "Warning" and "critical" conditions are also output, and notifications can be issued by transistor output for signal lights, etc.



## Confirmation and operation on-site with display screen and buttons

Various feature values and thresholds can be checked on-site for smooth decision-making regarding maintenance.

### Display

"Feature values" and "measurement value"

### Tangible clicking buttons

Feature value checks and threshold adjustments can also be carried out on-site



## Data can be accumulated as required

Built-in communication functions make it possible for data logging that important feature values at your preferred timing. (Condition Monitoring Configuration Tool software enable logging, monitoring and output to CSV files.)

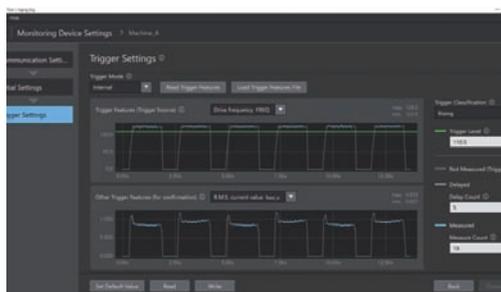


# Reduces maintenance and inspection workload while delivering reliable results

50 ms arithmetic processing operation and calculation of more than 400 types of feature values are realized monitoring that is effective for various motor failure modes. However, the handling of these data requires extremely advanced data analysis skills. With the K7DD, these analyses are supported to enable rapid startup of scheduled equipment maintenance.

## Highly accurate condition monitoring with abnormality replicate

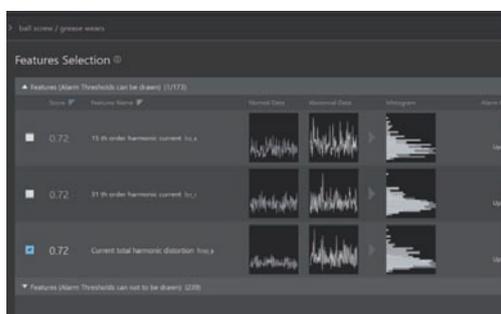
If abnormalities in equipment can be easily replicated reproduced, effects can be inspected visually and quantitatively using Condition Monitoring Configuration Tool software.



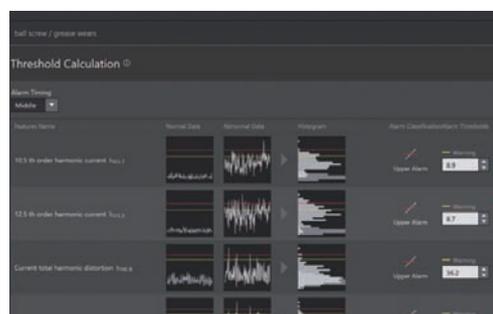
Complex equipment operations can be easily checked with waveforms



Replicate abnormalities and collect abnormality data



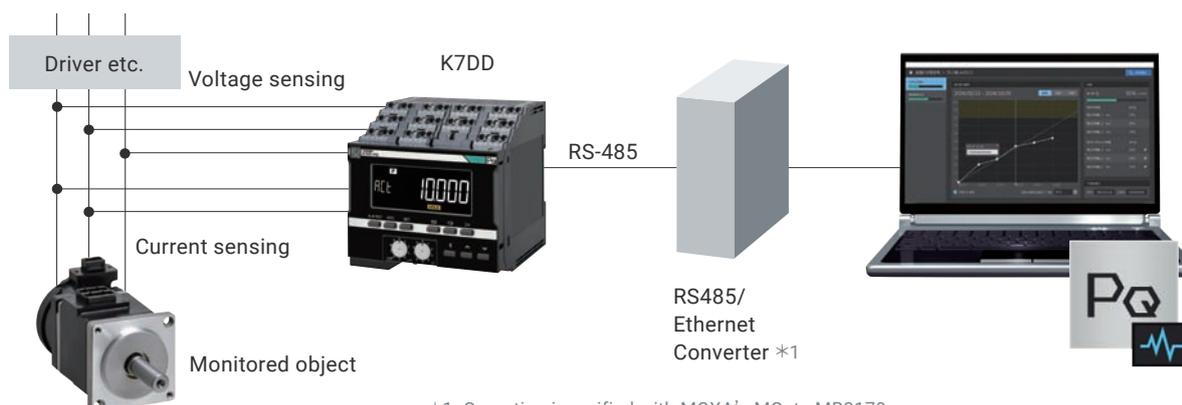
Numerical conversion of extent of effects of more than 400 types of feature values



Thresholds are automatically suggested when selecting effective feature values

Note: The above-shown pictures might be different from the actual ones.

### System configuration



\*1. Operation is verified with MOXA's MGate MB3170.

Note: Condition Monitoring Configuration Tool software can be downloaded free of charge from URL:[https://www.ia.omron.com/cmc\\_tool](https://www.ia.omron.com/cmc_tool)

# Condition monitoring can be started even if abnormalities cannot be replicated

## Previous

If abnormalities cannot be replicated, it is difficult to set effective feature values and thresholds.

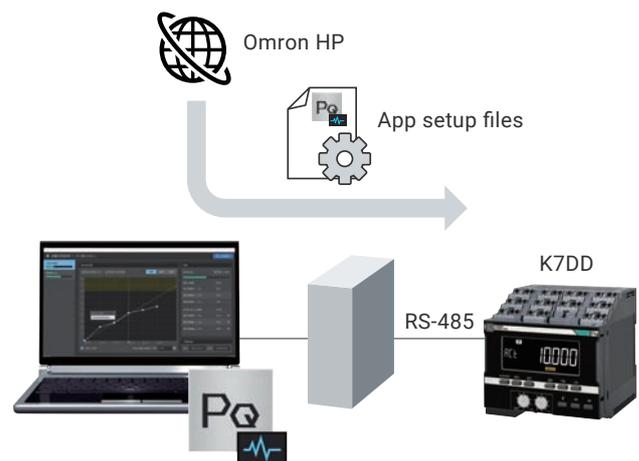


## K7DD Drastic reduction of inspection workload with “App setup files”

Based on the knowledge it has accumulated through on-site inspections, OMRON provides files containing failure mode-specific feature values that are easy-to-effect and details of how to set thresholds. These can be downloaded from the OMRON website and installed to the K7DD device via Condition Monitoring Configuration Tool software.

Note: We will continue to expand our lineup of app files.

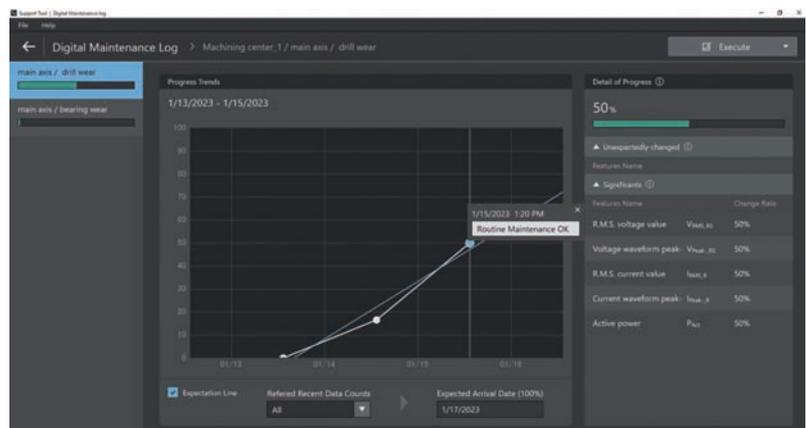
URL: [https://www.ia.omron.com/k7dd\\_tool](https://www.ia.omron.com/k7dd_tool)



## Advanced analysis/condition based maintenance

Built-in function manages failure modes individually.

Linking regular maintenance results in the real and digital realms enables accumulation of maintenance knowledge. You can try various functions aimed at condition based maintenance, including extent of progress of abnormal conditions.



# OMRON's Products Support IoT for Control Panels and Production Lines



Heater Condition Monitoring Device  
K7TM

Cat. No. N229-E1



Panel condition monitoring device  
K6PM

Cat. No. H232-E1



Motor Condition Monitoring Devices  
K6CM

Cat. No. N220-E1



Switch Mode Power Supplies  
S8VK-X

Cat. No. T211-E1



Digital Temperature Controllers  
E5□D/NX-TC

Cat. No. H222-E1

## 2019 Released in October



Low Voltage Switching Gears  
J7KC / J7TC / J7MC

Cat. No. J229-E1



DC Electronic Circuit Protector  
S8V-CP

Cat. No. T227-E1



Push-In Plus Terminal Block Relay Series  
PTF-PU

Cat. No. J213-E1

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