

Improving existing equipment with remote condition monitoring

<Vol.2> Retrofit to implement the new function “predictive maintenance”



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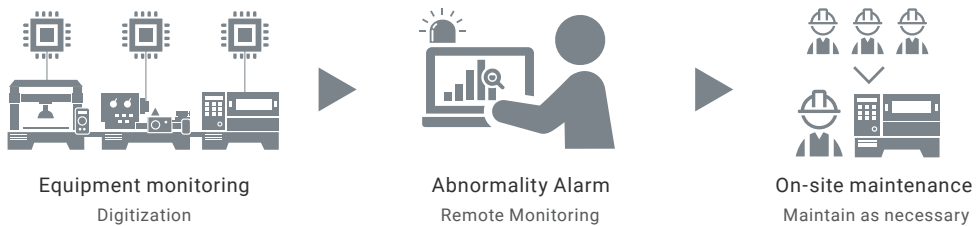


Omron's Predictive Maintenance Solutions

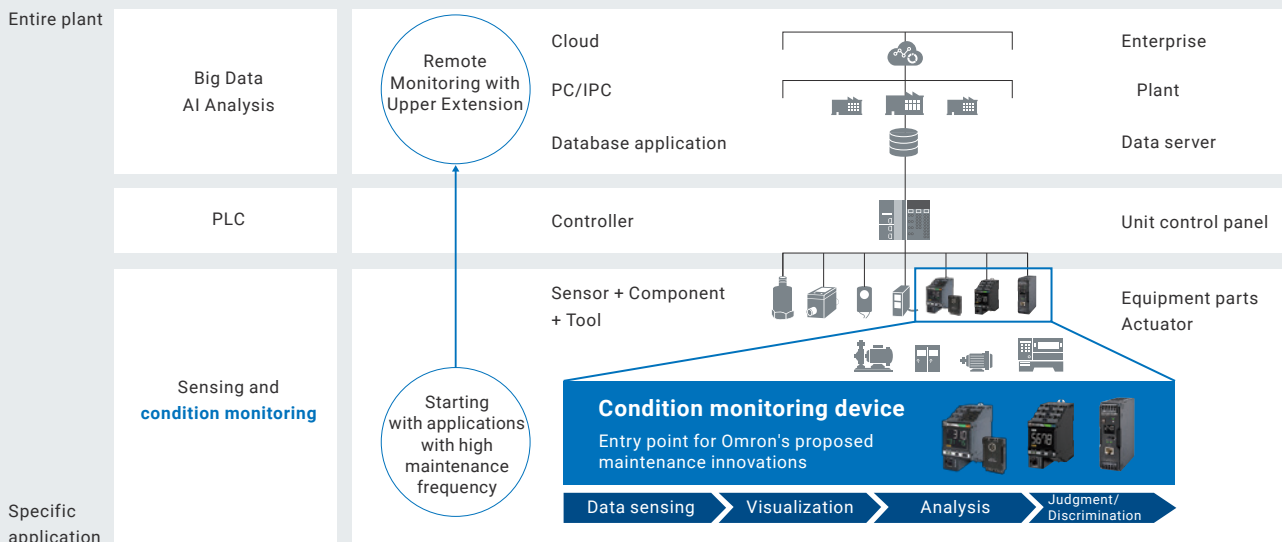
Predictive maintenance is the key to reducing unplanned downtime and operational costs

Due to large shifts in business conditions there is an urgent need to transform the workplace by overcoming the dependence of skilled maintenance personnel and using the latest technology as a primary solution. Overcoming cost and technological barriers can be difficult. Omron's solution monitors and analyzes real data by performing frequent checks.

Predictive Maintenance- take action when necessary

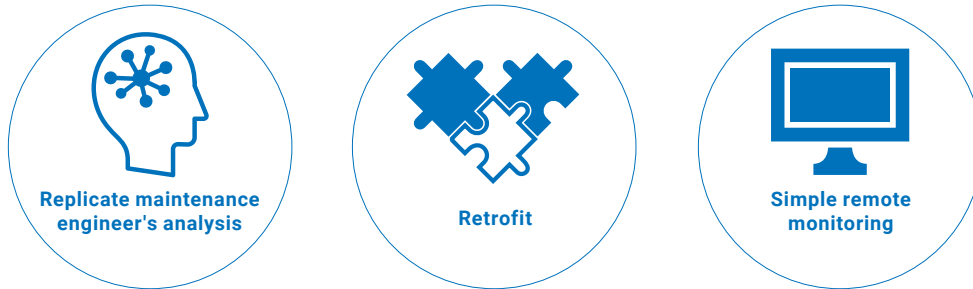


Remote monitoring of critical equipment using condition monitoring devices



Resolve issues through condition monitoring

Our predictive maintenance solution is based on replicating skilled maintenance engineer's analysis, retrofitting existing equipment and remote monitoring. The technology simplifies the analysis of equipment by translating measurement data into simple alarms so a maintenance engineer can respond faster to issues.

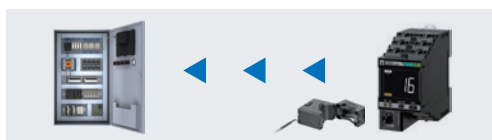


Three Values of Omron's Condition Monitoring

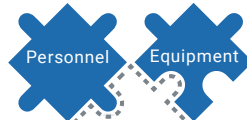
Improving existing equipment by implementing predictive maintenance

Production facilities and equipment are built without waste and optimized for each user by equipment and panel manufacturers. Therefore, adding a new function to such facilities requires extensive renovation and construction work, which require a lot of labor and cost. In addition, for production lines that are required to be always available so as not to lose any opportunity, major modifications such as this, which may affect existing functions, make companies think twice about implementing predictive maintenance. Accordingly, our condition monitoring device is designed to enable retrofitting to simplify the addition of functions to existing equipment. This device is designed to minimize the labor required by maintenance personnel for installation, verification, design, and operation associated with the addition of new functions. This is not just a retrofit function, but also a design that is closely aligned with the activities of the maintenance personnel who are responsible for the important task of maintenance.

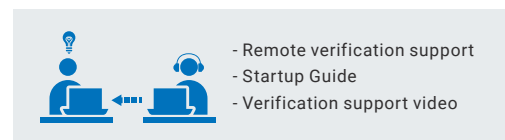
Setting Easy installation



Easy-to-introduce
by retrofit



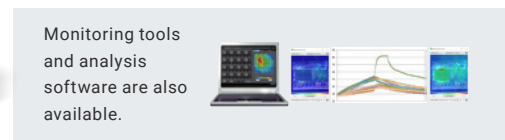
Testing Easy verification



Design Quick design



Operation Efficient operation



Accurate condition analysis

OMRON's solutions reproduce the know-how OMRON has accumulated over many years, such as hearing to distinguish between noise and facility abnormalities and tactile sense of unusual facility shaking, as well as maintenance techniques based on the five senses. OMRON establishes the optimum sensing method for each application to package it as a condition monitoring device.

Simple remote monitoring system

Specialized tools are available to visualize the acquired data so that it is easy for anyone to judge. The predictive maintenance realized at 1 m above ground level can be smoothly deployed to higher levels, making it easier to introduce a remote monitoring system without having to design a complex system.

Featured in Vol. 1

Featured in Vol. 3

Specifications and Features of the Retrofittable Condition Monitoring Device

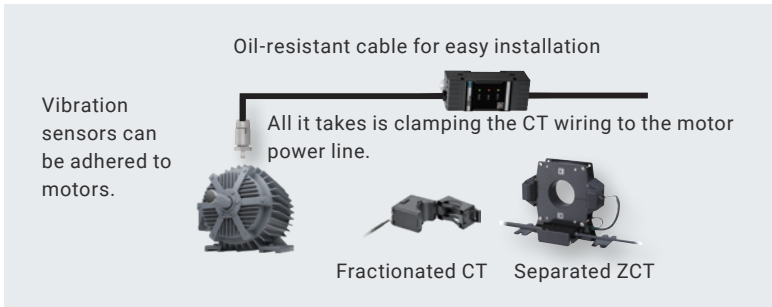
OMRON's predictive maintenance solutions are easy to introduce and retrofit into existing equipment.

Setting Easy installation

Design Quick design

IoT sensors can be easily installed into existing equipment

With motor condition monitoring devices



With thermal condition monitoring devices



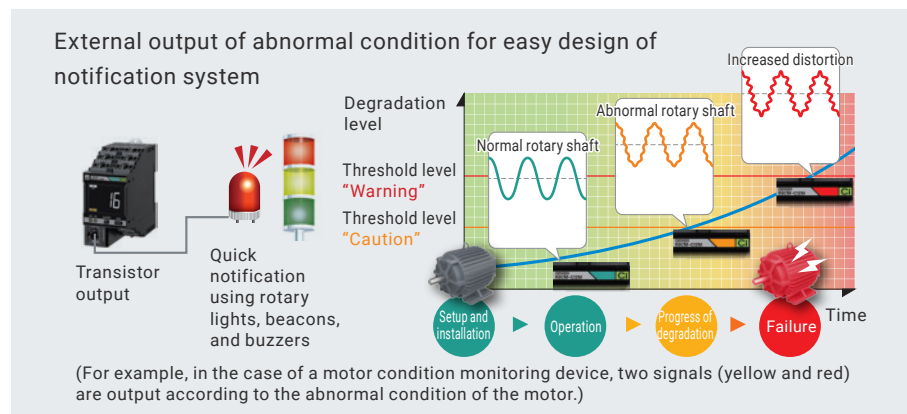
Compact design built for control panels



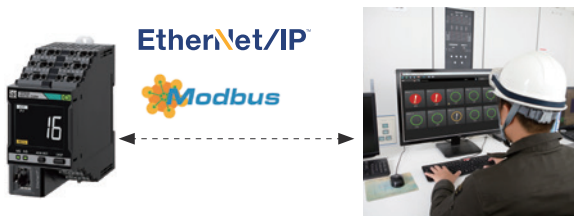
* 1. S8VK-X240W x 2 + Switching hub W4S1-05D

Alarm outputs available for on-site alerts

Simple design with transistor output



Equipped with industry-standard communications



Optional input voltage specifications can be selected depending on the installation location environment

Selectable from AC 100-240 V, AC/DC 24 V

Depending on your installation environment, input voltage specifications of the condition monitoring device can be selected from AC 100-240 V type or AC/DC 24 V type.

AC 100-240 V

AC/DC 24 V

Note. In the case of motor condition monitoring device

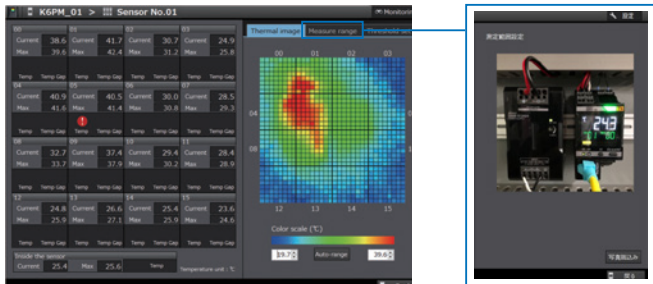
Testing Easy verification

Operation Efficient operation

Simple operation with a dedicated monitoring tool

- Visualization of facility condition on the supplied monitoring tool
- Automated setting of different thresholds depending on the equipment, greatly reducing the number of steps required for testing and introduction.

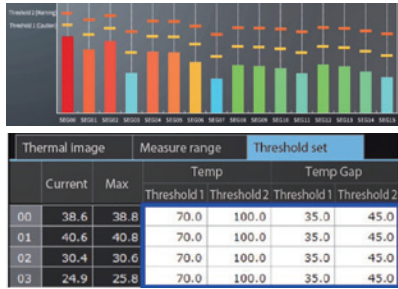
Quickly know the measurement analysis results in one view



Confirm the temperature status by simultaneously displaying the temperature data and thermal image. Easily identify the device which is outputting an alarm. Photographic images can be displayed to allow easy identification of heat-generating areas.

* The photographic image should be captured by the customer.

Reduction of man-hours through automatic threshold setting according to measurement environment



Clicking once on the monitoring tool is enough to automatically calculate the optimum threshold.

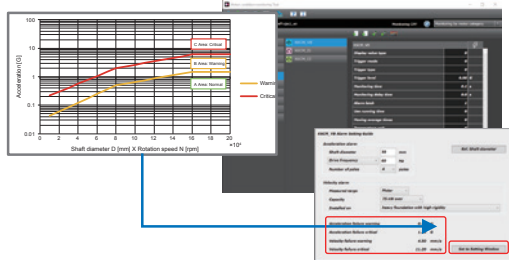
Remote visualization of in-panel temperature status and motor status of multiple locations



Abnormal in-panel temperature status and abnormal motor status of multiple locations are collected via network and displayed as a list.

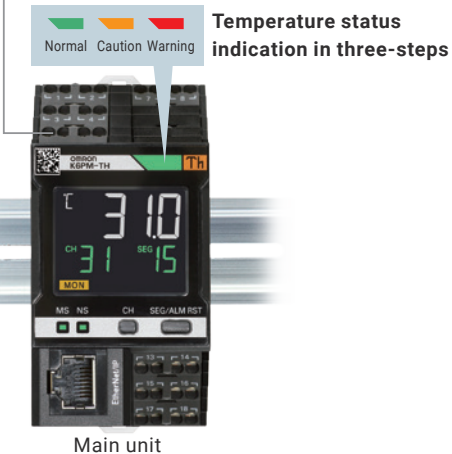
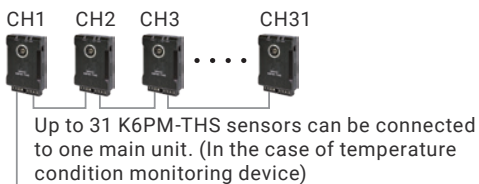


Detailed data, such as trend of measured values, can be confirmed remotely.



* PC Tools can be downloaded from OMRON's website.

Easy to scale up as the number of measurement points increases



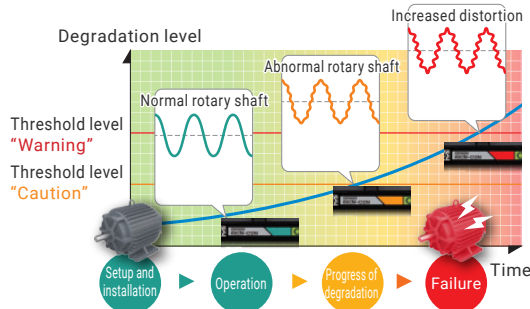
LCD displays allow on-site verification

The status can also be checked on site from indicators (numeric/LED color).



Alarms notify abnormal condition

Displays the error condition with a value and color according to the set threshold.



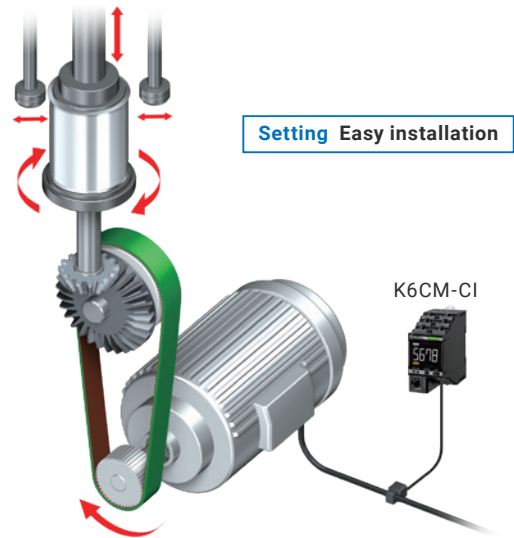
Predictive Maintenance Applications

Increasing motor life in a filling facility by using the K6CM motor condition monitoring device

K6CM motor condition monitoring device

Effect: Prevent production problems by grasping the level of motor degradation

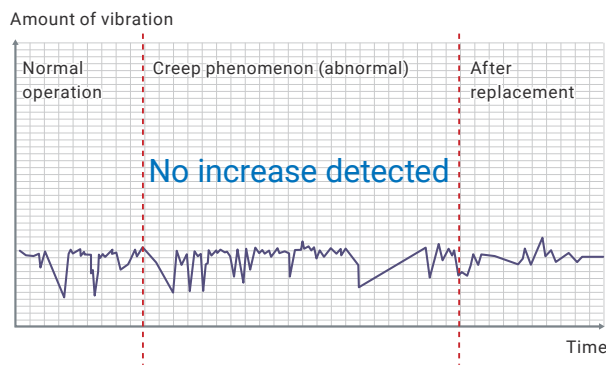
Since it was impossible to detect a motor abnormality with a vibration gauge, it was necessary to maintain the motor periodically. Introducing the comprehensive current diagnosis by K6CM enables accurate identification of abnormalities via changes in the parameter "Degradation level", which in turn enables efficient maintenance according to the deterioration status of the motor if "Degradation level" is constantly monitored. Furthermore, while the installation of a vibration meter requires machining the motor, the comprehensive current diagnosis by K6CM can be easily implemented by simply inserting CT between the motor power lines, which facilitates the deployment of the comprehensive current diagnosis to other equipment, leading to the acceleration of predictive maintenance activities.



FROM

Limited motor monitoring with vibration meter

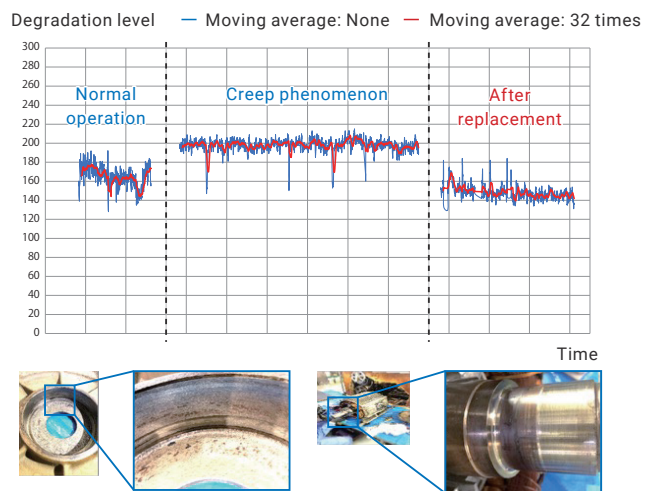
Although monitoring with a wireless vibration meter was the idea, periodic maintenance is required since it cannot detect motor abnormalities.



TO

Using current analysis to determine motor abnormalities

Current monitoring enables the visualization of the level of degradation to determine the timing of maintenance.



Customer Feedback



Beverage manufacturer

Engineering Section Manager

Although we have conducted vibration monitoring to detect motor abnormalities, we have to prevent production loss through regular maintenance since it has not worked. Since K6CM grasps abnormalities that could not be detected by vibration in levels of degradation, we can perform systematic maintenance to curb and plan capital investment by visualizing the facility life.

Maintenance Section Technician

Failure prediction leads to more efficient maintenance. We would like to verify its effect on other facilities to deploy and reduce losses.

Remote condition monitoring of lifting station motor

K6CM motor condition monitoring device

Effect: Simple construction and introduction of a remote motor condition monitoring system significantly improve the efficiency of maintenance work

The lifter that carries workpieces to the welding process is an important facility that stops all subsequent processes if it stops. Until now, however, the personnel have been busy with daily maintenance work, and have had no time to analyze the measured data to construct the system, so they dealt with problems after they occurred. Introducing K6CM enabled to leave the analysis of the measured data to the condition monitoring equipment, reduce the design time spent on system construction because it can be easily installed on existing equipment by retrofitting, and easily introduce the remote prediction maintenance.

Setting Easy installation

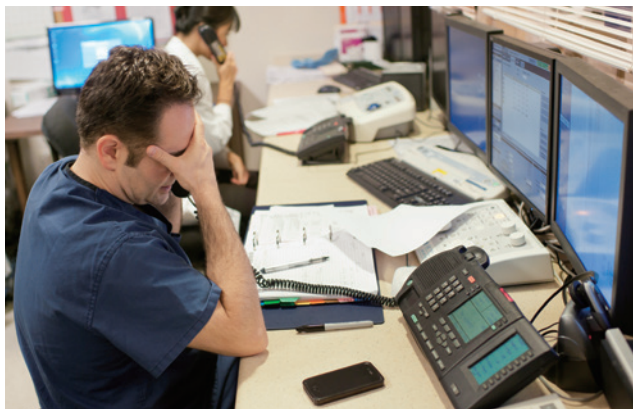
Design Quick design



FROM

Corrective Maintenance

The huge amount of time needed to construct large systems and analyze big data was a high barrier to the introduction of predictive maintenance, leaving in place the corrective maintenance.



TO

Easy system construction and simple data analysis enable the introduction of predictive maintenance

Easily retrofittable to existing equipment and with support for industry-standard communication standards, it facilitates the introduction of a permanent remote monitoring system. In addition, data analysis by the condition monitoring device reduces the analytical burden on the maintenance personnel and lowers the barriers to predictive maintenance.



Customer Feedback



Automotive
manufacturer

Maintenance Section Manager

Realizing predictive maintenance of the equipment requires the collection of a huge amount of sensing data to find numbers that correlate with failures. Since that takes a considerable amount of time, and we also have to carry out daily maintenance work, we could not actively carry forward the predictive maintenance. The K6CM application is clear. We only need to have the vibration sensor installed to detect bearing degradation. After that, it will be K6CM which will judge if the bearing is normal or not, and inform of it.

Predictive Maintenance Applications

Remote thermal condition monitoring on extruder control panel

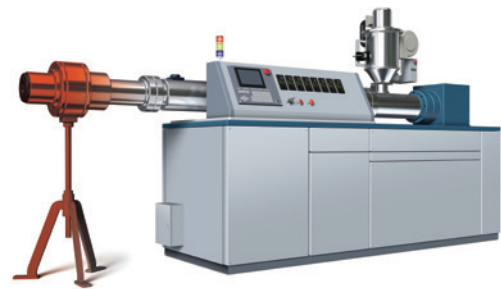
K6PM-TH thermal condition monitoring device

Effect: Improve maintenance efficiency through automatic threshold setting of the constant monitoring system introduced with reduced man-hours

Extrusion molding produces a wide variety of products, ranging from large sheets to fine threads similar to hair. Therefore, the configuration and operating condition of the in-panel device vary from one production line to another, and so its heat generation condition. Since a machine stopped due to loose screws in its panel in the past, temperatures have been checked by using thermo-viewers. However, since the threshold of normal/abnormal temperature varies among the control panels of machines, judgment was made based on the experience and intuition of the maintenance personnel. Accordingly, an attempt to automate required a lot of man-hours, such as to determine the temperature threshold for each machine, which was a high barrier to the introduction of predictive maintenance. With K6PM-TH, retrofitting is enough for its automatic threshold setting algorithm to automatically calculate the optimum value for each machine and each configuration of in-panel device. It became possible to standardize judgment without relying on the experience and intuition of the maintenance person, making it possible to easily design and efficiently operate the system. Furthermore, the realization of constant monitoring sped up the timing of detecting abnormalities compared with manual periodic inspections, leading to a reduction in the risk of facility shutdown.

Design Quick design

Operation Efficient operation



FROM

Manual thermal inspections

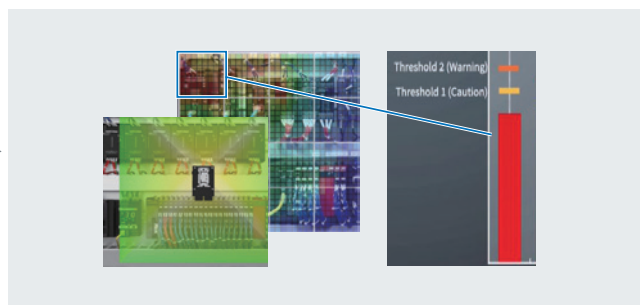
In high-load machine, the temperature and temperature rise during normal operation vary depending on the in-panel device. In addition, since it takes a considerable amount of time to inspect each one, in reality, the inspection was carried out on measurement points narrowed down based on the experience and intuition of the maintenance personnel. The risk of overlooking signs of abnormal heat generation was high.



TO

Remote thermal condition monitoring

A wide-angle area temperature sensor monitors signs of abnormal heat generation from multiple pieces of in-panel device at all times. Using OMRON's proprietary threshold setting algorithm, the optimum alarm threshold for each measurement device in the area is automatically set according to the in-panel temperature. Although in-panel temperature is complex, it can be easily and efficiently monitored without depending on the skill of the operator.



Customer Feedback



Material
manufacturer

Engineering Section Manager

Since it was impossible to predict when and where abnormal heat generation would occur, inspection by maintenance personnel was an issue. Furthermore, only skilled maintenance personnel could judge abnormalities in a panel where each piece of equipment had a different heat generation condition. K6PM-TH solved all these issues. We also deployed this successful case to overseas factories with few skilled maintenance personnel since it allows for maintenance only when necessary.

Engineering Section Technician

The accuracy of the Thermo Viewer inspection results was an issue because measurement may have been conducted with the machine stopped, heat loss may have occurred during panel opening and closing, etc. Also, inspection points and judgment temperatures that vary depending on the configuration of the machine and equipment made the system complicated and prone to omissions and mistakes. K6PM-TH is installed at all times, and allows to monitor the temperature of the machine in operation under various conditions, eliminating omissions and mistakes.

Preventing the stoppage of production facilities for manufacturing automotive parts with S8VK-X power supply

S8VK-X IoT power supply

Effect: Monitoring the power supply status to facilitate improvement and maintenance planning

Power supply service life is often the cause of problems such as equipment failing to turn on the next day when it had been running until yesterday. The company was already using OMRON's S8VS series (with display and replacement time notification) because they wanted to replace their power supplies before their end of service life. However, there were instances where an on-site check of the display indicated 0 years remaining, leading to a hurried replacement. In addition, there were times that aging was accelerated due to higher than the expected current flow as a result of a load added on site or higher than expected summer temperature at the installation point. With power supply S8VK-X, the maximum voltage, current, peak current, and the replacement time can be monitored via communication at all times. Therefore, the data can be checked without going to the site. In addition, it does not require additional space when replacing a conventional product, allowing for installation in the original space since it is compact and can be mounted in close contact.

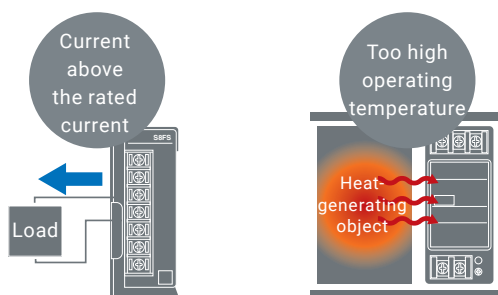
Setting Easy installation



FROM

Limited visibility of power supply load conditions

The current varies depending on how the machine or equipment is running. Even if normal during operator check, the current may be large depending on the timing. The operating temperature may be higher than expected in summer, but checking the condition by setting up CT or thermocouple at a location where a large amount of power supplies are installed is very time consuming.

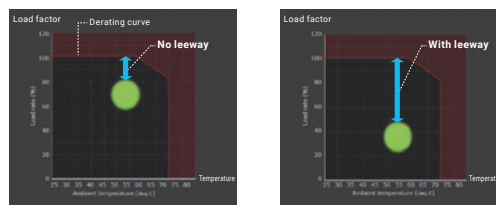


TO

Remote condition monitoring of power supply loads

Simply replacing the power supply with S8VK-X, without adding sensors, allows to not only check the data when necessary, but also the usage status by periodically collecting data via communication. Simple installation makes it easier to develop an IoT system and an improvement plan.

Currently 120 W type is in use Replace with 240 W type



Note: When PowerSupplyMonitoring (available for download free of charge) is used for S8VK-X

Customer Feedback



Automotive manufacturer

Improvement section staff

Sometimes the equipment did not run normally due to unstable DC 24 V. When the cause was investigated, it was discovered that there were instances where the power supply was experiencing over current due to equipment added by the improvement section. Current value monitoring is difficult in typical products, but S8VK-X, allows for data collection and visualization.

Improvement section leader

Unexpected situations after an improvement or maintenance are rare, leading us to recognize a problem only after it occurs. If data are acquired at all times to check and analyze as required, it is not only easy to identify the problem when an abnormality is found, but also optimize personnel allocation since it can be handled quickly.

TOPICS Retrofit Technology

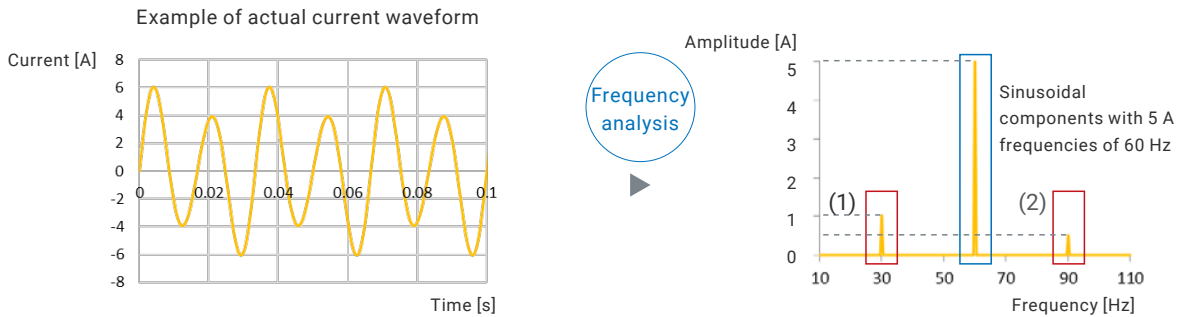
This section introduces OMRON's technologies developed to enable the introduction of "predictive maintenance" by retrofitting, without major system changes or modifications to existing facilities.

Design Quick design

Current analysis in motors with inverters

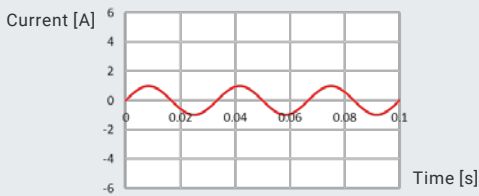
Eliminate the noise effect that occurs periodically to detect motor abnormalities with high accuracy

In an inverter-driven or noisy environment where current is exposed to noise, detecting motor malfunctions with current elements is difficult, and functional extensions to existing equipment by retrofit face many barriers. Accordingly, we developed a technology to extract only the abnormal components of the motor while removing noise components to enable functional extensions by retrofit even in a noisy environment. The presence or absence of an abnormality cannot be determined because the noise components in the monitored current value or current waveform are unknown. If the current waveform measured as a function of x-axis: time [s] and y-axis: current [A] is subject to frequency analysis, it can be expressed as a function of x-axis: frequency [Hz] and y-axis: amplitude [A], from which the included noise component can be determined. Clarifying the noise components enable the detection of motor failures in an inverter-driven or noisy environment.

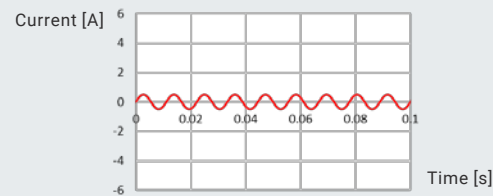


Components affecting the axis of rotation

1. Sinusoidal component with amplitude 1A and frequency 30 Hz

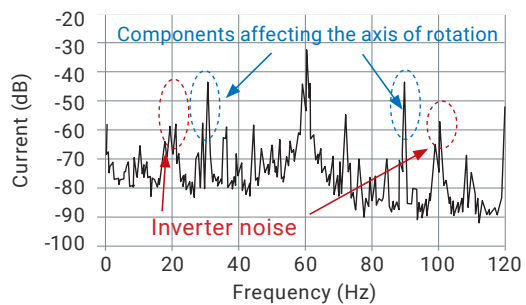


2. Sinusoidal component with amplitude 0.5A and frequency 90 Hz



Degradation level detection algorithm

The current waveform of the motor is subject to frequency analysis, and the ratio of the abnormal frequency component to the motor drive frequency is quantified to detect abnormality by using the parameter "Degradation level 2".
Extracting components affecting the axis of rotation and removing the inverter noise components enable stable measurement also under inverter control.

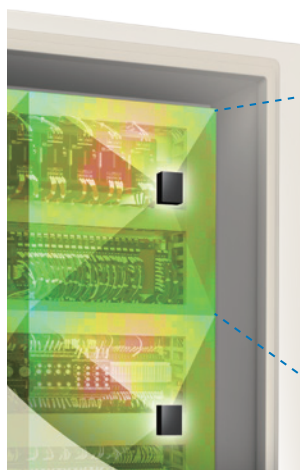


Operation Efficient operation

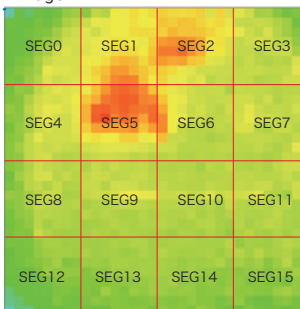
Greatly reduce setup time with built-in auto threshold feature

Introducing automatic calculation of optimum alarm threshold according to the condition of the panel and ambient temperature to existing facilities

It is difficult to determine the optimum decision threshold for monitoring the in-panel device temperature. The temperature inside the panel varies with each passing moment depending on the configuration of the equipment, operating conditions, and changes in ambient temperature. Therefore, it not only takes a long time to set threshold values by attaching sensors to each existing piece of equipment, but also requires know-how. K6PM-TH is equipped with an ultra-wide, 90° angle of view lens and measures on the equipment surface (measurement area). It segments the measurement area to automatically set the threshold for each piece of equipment and judge abnormality. This is achieved by an algorithm that learns the normal temperatures of each piece of equipment during normal operation (e.g., auto threshold settings examples, transformer 90°C, power supply 75°C, power line 55°C) to automatically calculate its optimum threshold value. This greatly reduces the man-hours required to set thresholds, and standardizes the determination of thresholds that has been based on the intuition and experience of the maintenance personnel, thereby improving the efficiency of the maintenance work. OMRON's unique technology enables to easily construct such a temperature monitoring system by simply adding K6PM-TH to the existing equipment.



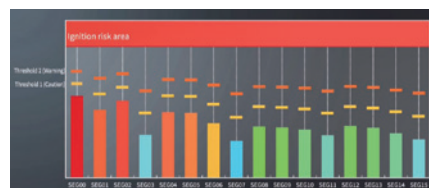
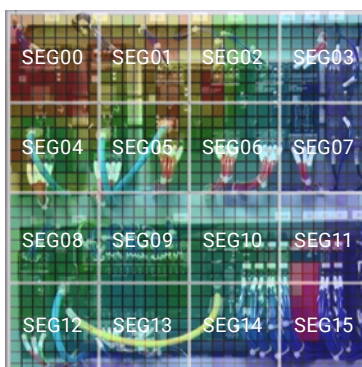
Abnormal pieces of equipment are identified by segmenting the thermal image.



Threshold can be set for each of the 16 segments into which the thermal image is split.

Auto threshold setting algorithm

The in-panel temperature profile varies depending on the equipment and components. Also, inexperienced maintenance personnel may not know what thresholds to set. Using the history of temperature in normal operation, K6PM-TH automatically calculates the optimum threshold value for each piece of equipment and component so that their temperature does not reach the ignition risk temperature.



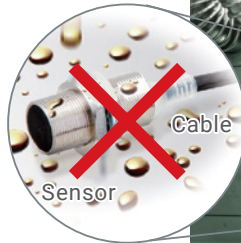
Thermal image	Measure range		Threshold set			
	Current	Max	Temp		Temp Gap	
			Threshold 1	Threshold 2	Threshold 1	Threshold 2
00	38.6	38.8	70.0	100.0	35.0	45.0
01	40.6	40.8	70.0	100.0	35.0	45.0
02	30.4	30.6	70.0	100.0	35.0	45.0
03	24.9	25.8	70.0	100.0	35.0	45.0

Special Feature Maintenance Tips

The following are some hints on how to solve problems, such as how to improve the efficiency of equipment maintenance, even when lacking familiarity with control equipment.

Round connectors and cables

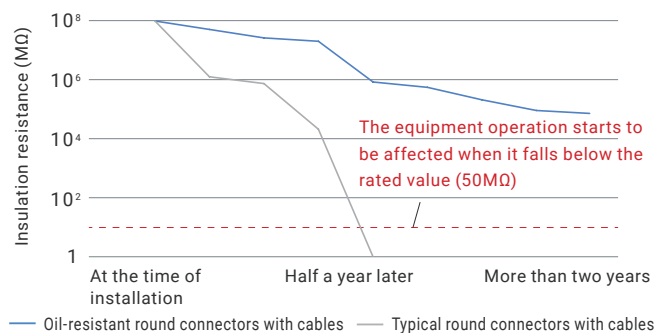
Issue The sensor inside the machine that injects cutting oil (coolant) is malfunctioning frequently, causing the facility operation rate to decrease.



Cause Cable or round connector may be damaged from cutting oil.

If a sensor malfunctions in a harsh environment where it is exposed to cutting oil, cables or connectors may be the cause. Even if the appearance does not change, the insulation resistance decreases due to the ingress of cutting oil from the cable surface, the bonding surface, and the connector joint over time (right figure). If left unattended, the connected sensor cannot maintain electrical insulation and an unintended short circuit may occur, resulting in malfunction of the sensor. Grasping changes in the periodic inspection is difficult, causing problems to be noticed only when a major facility problem occurs. Therefore, cables and connectors must be oil-proofed.

Change in insulation resistance of round connectors with cables under water-soluble cutting oil immersion test



Fixing up Replace with oil-resistant, round connectors with cables that are resistant to cutting oil to reduce the risk of failure.

Recommended OMRON equipment (combination of proximity sensor and round connector with cable)

Operating environment	Proximity sensor	Round connectors with cable											
<p>Machining process: Always exposed to oil.</p> <p>Oil resistance, 4 years</p>	<p>Oil-resistant component Proximity sensor</p> <p>E2ER</p>	<p>Oil-resistant component Fluorine cable</p> <p>XS5□R</p>	<p>Oil-resistant technology (XS5□R, XS5□-X, XS5□-XR)</p> <p>Proprietary molding sealing method and surface bonding technology</p> <p>Smartclick structure and high oil-resistant O-ring to prevent ingress through the fitting</p> <p>OMRON's proprietary strict oil resistance evaluation standards + IP67G *</p> <table border="1"> <tr> <td>Oil type</td> <td>A1 (water-soluble cutting oil)</td> </tr> <tr> <td>Evaluation time</td> <td>2000 hours (4 years of oil resistance) 1000 hours (oil resistance: 2 years)</td> </tr> <tr> <td>Evaluation temperature</td> <td>55°C</td> </tr> <tr> <td>Dilution concentration</td> <td>Undiluted</td> </tr> <tr> <td>Criteria</td> <td>Appearance, performance, and no label text loss</td> </tr> </table>	Oil type	A1 (water-soluble cutting oil)	Evaluation time	2000 hours (4 years of oil resistance) 1000 hours (oil resistance: 2 years)	Evaluation temperature	55°C	Dilution concentration	Undiluted	Criteria	Appearance, performance, and no label text loss
Oil type	A1 (water-soluble cutting oil)												
Evaluation time	2000 hours (4 years of oil resistance) 1000 hours (oil resistance: 2 years)												
Evaluation temperature	55°C												
Dilution concentration	Undiluted												
Criteria	Appearance, performance, and no label text loss												
<p>Transportation/assembly process: Oil mist environment</p> <p>Oil resistance, 2 years</p>	<p>E2E NEXT series Proximity sensor</p> <p>E2E-X</p>	<p>XS5 NEXT series Oil-resistant PVC cable</p> <p>XS5□-X</p>	<p>XS5 NEXT Series Oil-resistant PVC robot cable</p> <p>XS5□-XR</p>										
<p>Water and dust environment</p> <p>IP67</p>	<p>Proximity sensor</p> <p>E2E</p>	<p>PVC Robot cable</p> <p>XS5□-F</p>											

Note. All the round connectors with cables on this page are 4-poles type for sensor I/O.

* The IP67G is the degree of protection which is defined according to the JIS (Japanese Industrial Standards).

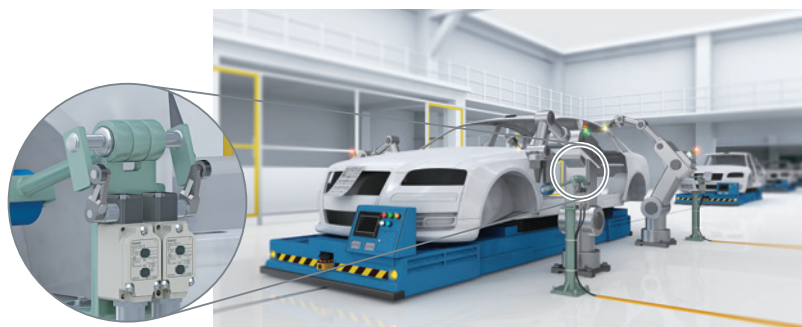
The IP67 indicates the same level of protection as defined by the IEC, and the G indicates that a device has resistance to oil.

More than a million times

Resistance to flexing

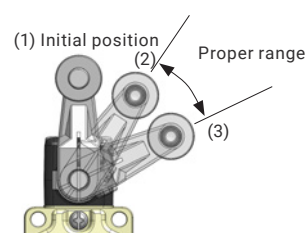
Limit switch

Issue Workpiece detection at the limit switch is not stable.



Cause Incorrect actuator adjustments.

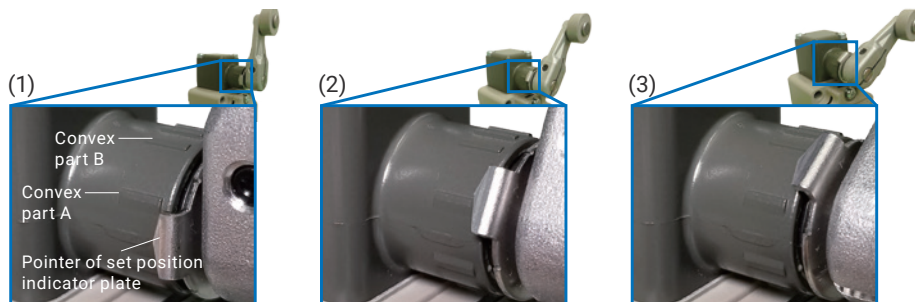
If the appropriate pushing amount cannot be ensured because the actuator was not sufficiently adjusted when the limit switch was mounted, the workpiece may not be detected due to slight misalignment in the position of the target object or mechanical wear of the switch. If the rotation limit of the actuator is exceeded as a result of exceeding the appropriate pushing range, the actuator will be damaged. Be careful.



Solution Adjust the position of the lever to detect the workpiece within proper pushing range.

Use the set position indicator plate to adjust the position of the lever to the appropriate position on site. After operation, adjust the pointer of the set position indicator plate so that it is between the convex part A and the convex part B of the bearing section to ensure appropriate pushing amount.

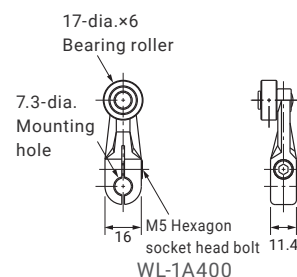
* Example of WL-N Basic model



In an application where the limit switch operates frequently or the rotating rollers continually hit moving objects, the roller inner diameter and roller shaft wear out, changing the pushing amount. The roller will come off in the worst case. Actuators are also sold individually. Check the actuator during maintenance and replace if necessary. A lineup of highly durable levers (WL-1A400) with bearing rollers is also available.



Worn roller



Recommended OMRON equipment

Two-circuit Limit Switches WL-N / WLG

Wide variety of two-circuit limit switches that can be selected according to the operating environment and application



Omron's Predictive Maintenance Solutions

If you have any requests or questions, please ask our sales person.

Motor Condition Monitoring Device K6CM



Motor Condition Monitoring Devices
K6CM series
Application Guide

Cat. No. N223-E1

Thermal Condition Monitoring Device K6PM-TH



IoT Power Supply S8VK-X



Insulation resistance monitoring device K7GE



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