



for a greener tomorrow



**MITSUBISHI
ELECTRIC**

Changes for the Better

FACTORY AUTOMATION

FA Application Package iQ Monozukuri Rotary Machine Vibration Diagnosis



e-Factory

- Easily install a vibration diagnosis system!
- Presume the abnormal area by means of accurate diagnosis!
- Easily detect abnormalities by means of MT method!



iQ Monozukuri

GLOBAL IMPACT OF MITSUBISHI ELECTRIC



Through Mitsubishi Electric's vision, "Changes for the Better" are possible for a brighter future.

Changes for the Better

We bring together the best minds to create the best technologies. At Mitsubishi Electric, we understand that technology is the driving force of change in our lives. By bringing greater comfort to daily life, maximizing the efficiency of businesses and keeping things running across society, we integrate technology and innovation to bring changes for the better.

Mitsubishi Electric is involved in many areas including the following

Energy and Electric Systems

A wide range of power and electrical products from generators to large-scale displays.

Electronic Devices

A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance

Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems

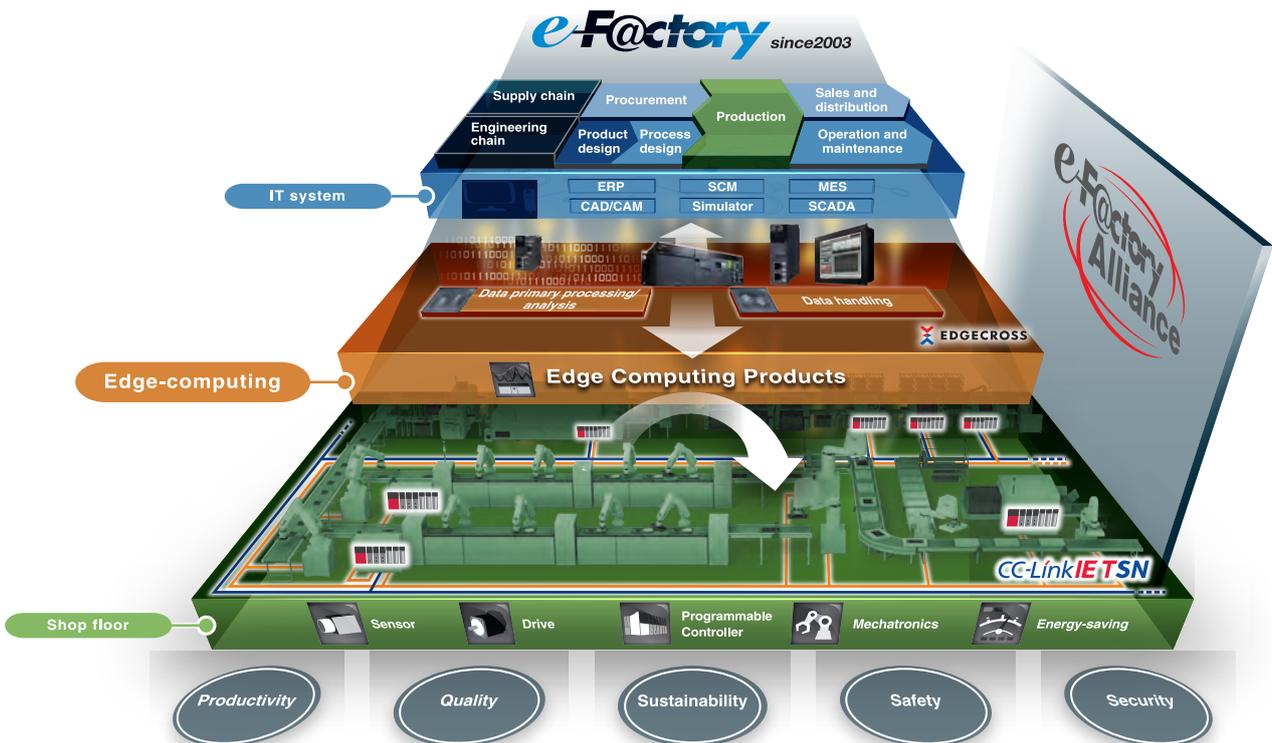
Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems

Maximizing productivity and efficiency with cutting-edge automation technology.

e-F@ctory

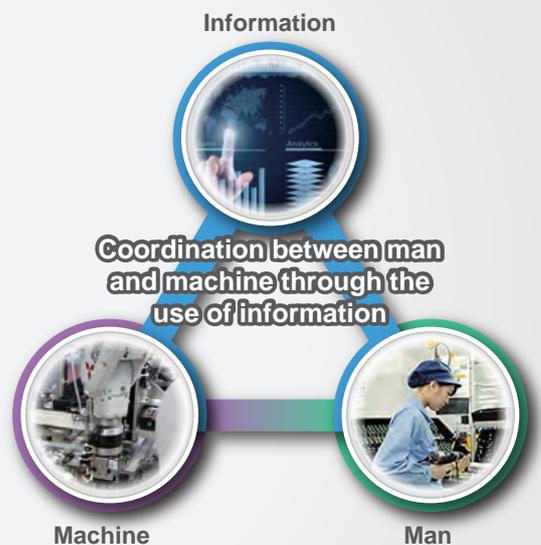
e-F@ctory is a concept for a further step on "Monozukuri", which reduces the total cost for development, production, and maintenance, and continuously supports improvement activities of the customer by utilizing the FA technology and IT technology.



In the increasingly complex manufacturing sites, coordination between "Man" and "Machine" through the best use of information from the production site is a key concept.

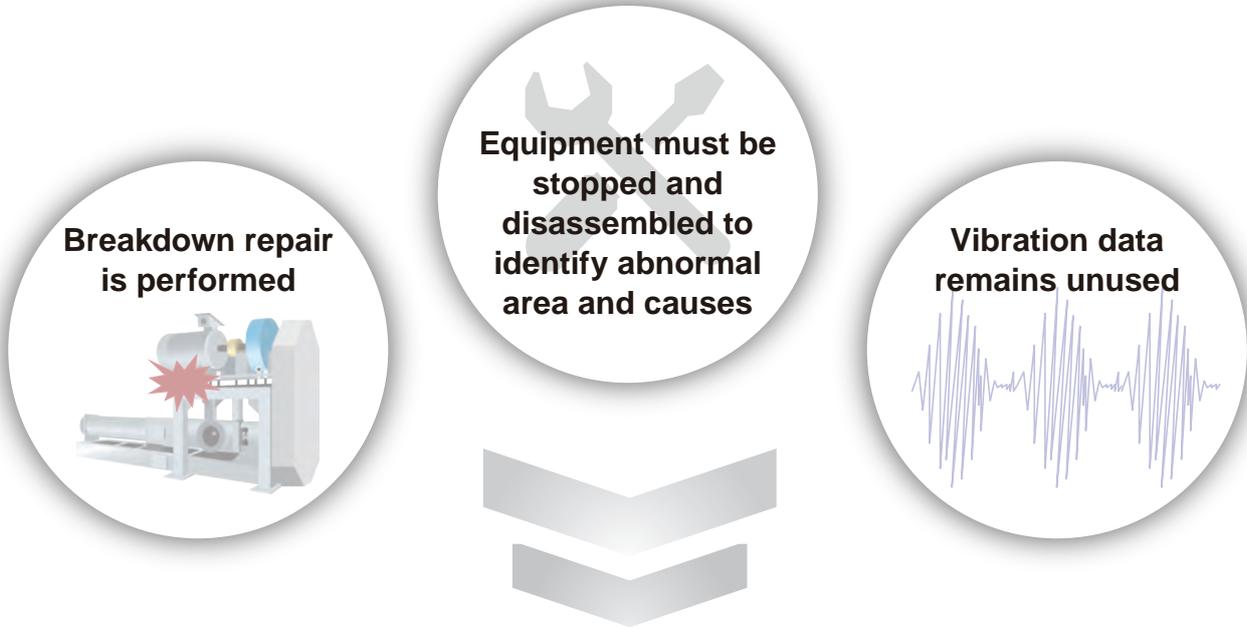
Productivity and quality can be improved not only with the information obtained from the devices at the production site, but the improvement triggered by on-site notice and flexible human actions. Similarly, automatic adjustment of equipment based on the information recognized by human is indispensable for the promotion of automation.

We have realized the "Next-generation manufacturing" through the use of the "e-F@ctory" information proposed by Mitsubishi Electric, the effective and flexible manufacturing realized through the coordination between man and machine, and the optimization of the production site, and the entire supply chain and engineering chain.



FA Application Package iQ Monozukuri Rotary Machine Vibration Diagnosis

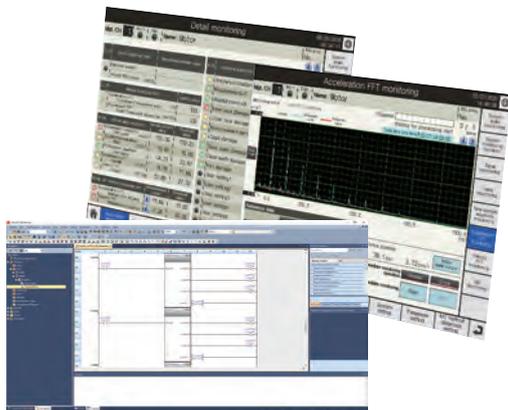
"iQ Monozukuri Rotary Machine Vibration Diagnosis" is an application that helps to visualize the equipment condition and presume the abnormal area by collecting, analyzing, and diagnosing vibration data of the equipment with a rotary mechanism.



Vibration diagnosis can be started immediately with "iQ Monozukuri Rotary Machine Vibration Diagnosis" of Mitsubishi Electric!

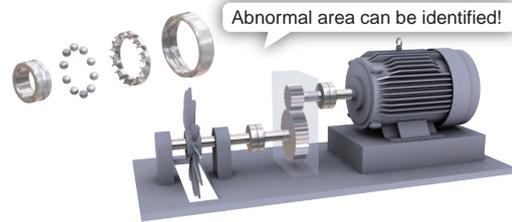
Easy introduction in one package!

Control programs certified by Mitsubishi and screen data are provided in one package. They are ready to use right after installation, and can be easily and smoothly introduced without any know-how on vibration analysis.



Support for vibration diagnosis!

This package enables not only vibration analysis but also vibration diagnosis by itself. Accurate diagnosis shows not only the existence of abnormality but also the abnormal.



Unbalance (rotation body, etc.)	Rolling element damage
Misalignment (coupling, etc.)	Cage damage
Inner race damage	Gear teeth damage
Outer race damage	Fan damage

Application example

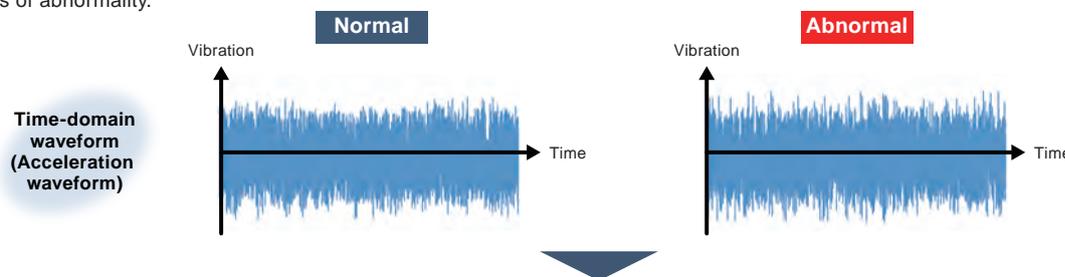
"iQ Monozukuri Rotary Machine Vibration Diagnosis" helps to solve issues at various production sites by installing it to the equipment with a rotary mechanism.

Examples of applicable equipment: Equipment with rotary mechanisms such as a motor, fan and blower, compressor, reduction and increase drive, conveyor, and converting machine

(Equipment that generates impact vibration such as pressing machine, and self-propelled equipment such as AGV are not supported.)

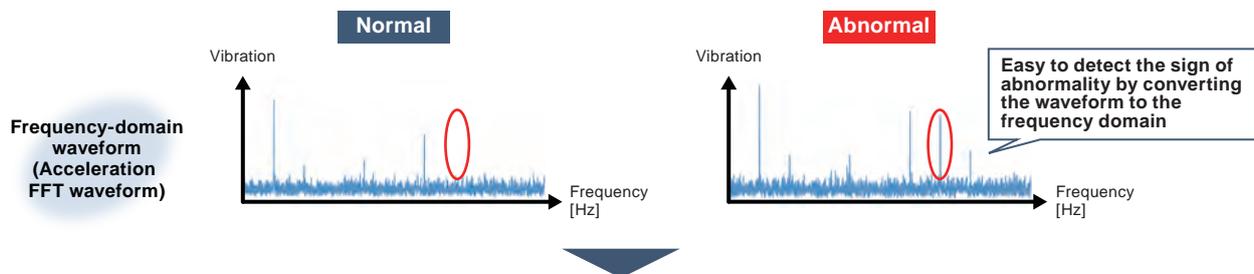
Case 1 To detect signs of abnormality and perform maintenance before failure

By observing the change in vibration caused by the equipment, the change in the condition of the equipment can be checked. In the time-domain waveform, however, the difference between normal and abnormal conditions is not clear and it is difficult to detect the signs of abnormality.



After installation of Rotary Machine Vibration Diagnosis...

Abnormal signs are detected by converting time-domain waveform to frequency-domain waveform!



Abnormal area can be presumed through simple diagnosis and accurate diagnosis!

Check abnormalities in equipment through

simple diagnosis

Abnormal!

ALM	Simple diagnosis item	State/Measurement value
	Vibration severity	
	Velocity RMS value	mm/s
ALM	Simple diagnosis item	Setting value
	Acceleration FFT	130
	Guard band monitoring width	Hz
	Acceleration FFT	100
	Guard band conf. excess cts.	Counts
ALM	Simple diagnosis item	Measurement value
	Acceleration waveform	155.30
	Zero peak	129.25
	Acceleration waveform	10.85
	RMS	10.95
	Acceleration waveform	14.31
	Crest factor	23.67
	Acceleration FFT	9.78
	Crest	11.66
	Velocity FFT	22.89
	Crest	27.32

Presume the abnormal area through

accurate diagnosis*1

Detect the sign of inner race damage!



ALM	Accurate diagnosis item	Measurement value	Amplitude	Threshold value
	Unbalance/Misalignment	1.48	1.88	
	Misalignment-Q2	0.56	0.65	
	Misalignment-Q3	0.57	0.80	
	Inner race damage	0.65	0.63	
	Outer race damage	5.98	6.91	
	Rolling element damage	1.19	1.43	
	Cage damage	0.89	0.93	
	Gear teeth damage	0.42	0.58	
	Gear teeth damage*2	0.18	0.34	
	Fan damage	0.57	0.60	
	User setting1			
	User setting2			
	User setting3			
	User setting4			

*1: Accurate diagnosis requires specification value information of the components.

Maintenance on the area where abnormal signs are detected can prevent sudden stop of devices and reduce downtime!

Case 2 Is it difficult to detect equipment abnormalities without knowledge of vibration analysis?

Vibration analysis requires a certain level of expertise.

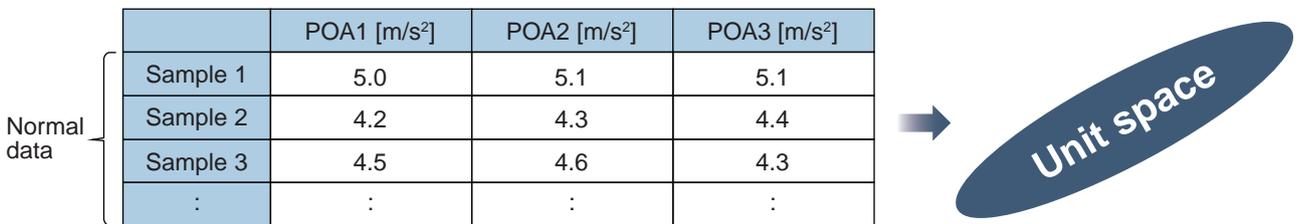
In addition, in order to presume the abnormal area through accurate diagnosis, specification value information of the components is needed.



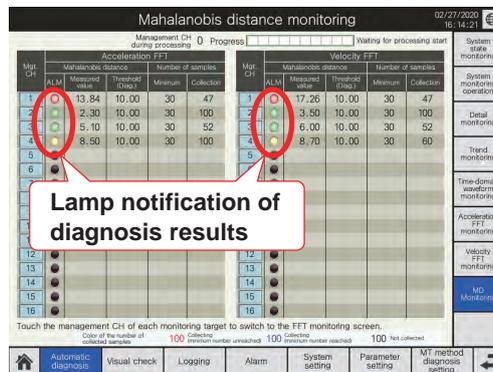
After installation of Rotary Machine Vibration Diagnosis...

"Unusual conditions" are detected through MT method*1 diagnosis!

Normal vibration data more than necessary are collected before diagnosis to generate the **unit space**.



Quantify the degree of deviation from the unit space with a single index called **Mahalanobis distance**, and judge the normal/abnormal condition.



* Combined diagnosis is possible by combining data other than vibration such as temperature and current.



**Vibration diagnosis is possible without knowledge of vibration analysis!
It is possible not only to judge the normal/abnormal condition, but also to grasp the degree of the abnormality and to detect the sign!**

*1: The MT method (Mahalanobis-Taguchi Method) generates a pattern (unit space) of normal data and detects data having a significantly large distance from the pattern (Mahalanobis distance) as an abnormal value.

Flow of Diagnosis

The following describes the procedure of vibration diagnosis using this package.

Easy installation Refer to page 8.

Just install the program!
Vibration diagnosis system can be installed easily and smoothly!



Easy diagnosis

Simple diagnosis Refer to page 10.

- Detect abnormalities in the equipment!
- Trend monitoring on trend graphs!

Accurate diagnosis Refer to page 11.

- Presume the abnormal area based on the part specifications!

MT method diagnosis Refer to page 12.

- Diagnosis is possible without knowledge of vibration analysis!
- Combined diagnosis is possible by combining vibration data and data other data (temperature, current, etc.)!

Other Useful Features

- **Collectively grasp the diagnostic status of the entire system!** Refer to page 13.
- **Easily check vibration condition on the waveform graph!** Refer to page 14.
- **Save each data in a CSV file!** Refer to page 15.
- **Simultaneous logging of vibration data for up to 4 CHs!** Refer to page 15.

FA Application Package

Features of iQ Monozukuri

Rotary Machine Vibration Diagnosis

The general vibration diagnosis method includes simple diagnosis and accurate diagnosis, in which abnormalities are detected by simple diagnosis, and abnormal areas and causes are presumed by accurate diagnosis.

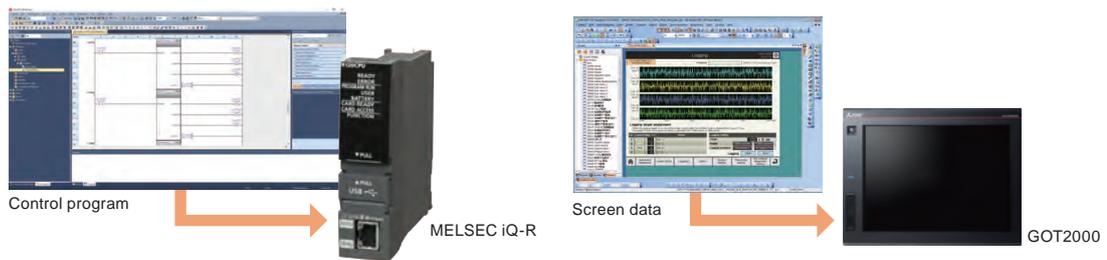
"iQ Monozukuri Rotary Machine Vibration Diagnosis" realizes predictive maintenance of equipment through MT method diagnosis using the MT method in addition to simple diagnosis and accurate diagnosis.

Easy Installation

Easily install a vibration diagnosis system!

This enables to construct a ready-to-use vibration diagnosis system without special knowledge just by installing the control program to the PLC (MELSEC iQ-R) and screen data to the GOT (GOT2000) and setting the sensor sensitivity and equipment specification values on the GOT screen.

Step1 Write the control program to the PLC.
Write the screen data to the GOT.



Step2 Turn on the power of the system to startup the PLC and GOT. *1*2



Step3 Set the sensor sensitivity and equipment specification values on the GOT screen.



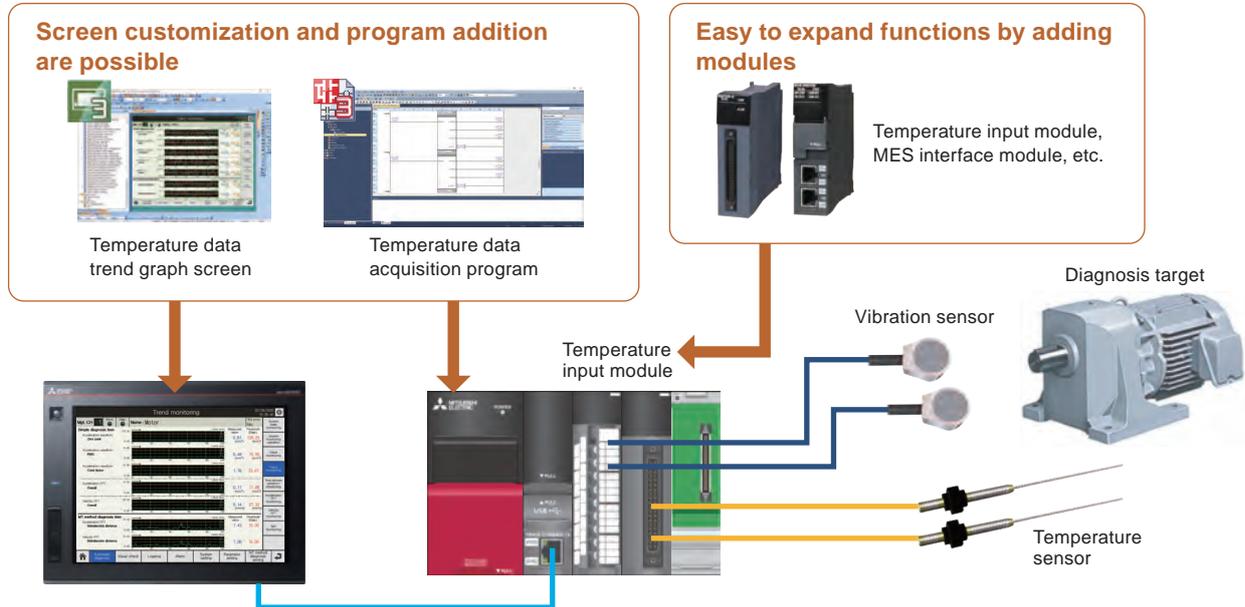
*1: Complete wiring of necessary devices such as sensors in advance.
*2: Only for the first time, register a license key to the PLC CPU.



Quick diagnosis for vibration condition of the equipment!

Easy Installation Flexible system expansion!

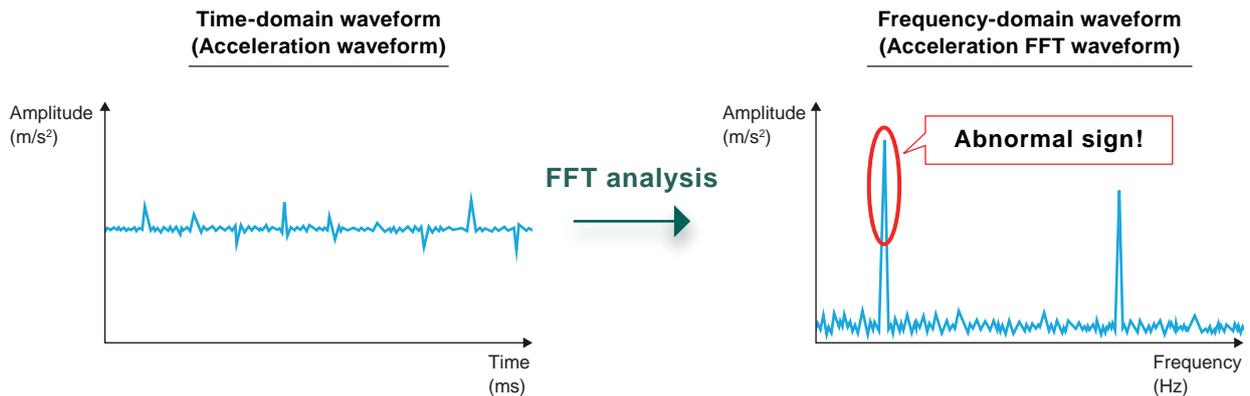
With the Mitsubishi FA devices and general-purpose vibration sensors, the system can be flexibly configured to meet customer needs. Optional control programs can be added and the GOT screen can be customized.^{*1}



*1: Any malfunction or failure due to customization is out of guarantee.

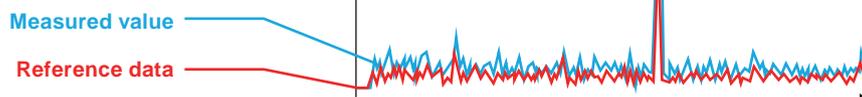
Easy diagnosis (FFT analysis) Visualize vibration condition through FFT analysis!

The vibration condition can be visualized by converting vibration data into frequency-domain waveform through FFT analysis. The vibration condition and abnormal signs can be easily identified by displaying the vibration data in a frequency-domain waveform.



<Overlapping on reference data>

The difference of the vibration level can be seen at a glance by saving the normal waveform of equipment as reference data, and overlapping it on the measured vibration data.



Easy diagnosis (Simple diagnosis)

Detect abnormalities of the equipment through simple diagnosis!

Abnormalities in the equipment and their signs can be detected by comparing the status level with the reference value.

Simple diagnosis (Absolute value judgment method)

Equipment is judged as abnormal when the vibration measurement value exceeds the judgment reference value that is specified in the standards, such as ISO10816-1.

Vibration severity

An endurance reference for the vibration of rotary machines which is specified by the ISO. The judgment standard differs depending on the size and type of equipment.

- Class I : Small machine (such as motor with power of 15 kW or less)
- Class II : Medium machine (such as motor with power between 15 to 75 kW or machine with power of 300 kW)
- Class III : Large machine (when mounted on stiff and heavy foundation)
- Class IV*1 : Large machine (when mounted on a soft foundation)

* Conditions to apply the vibration severity
 Number of rotations: 600 to 12000 r/min
 Vibration measuring range: 10 to 1000 Hz

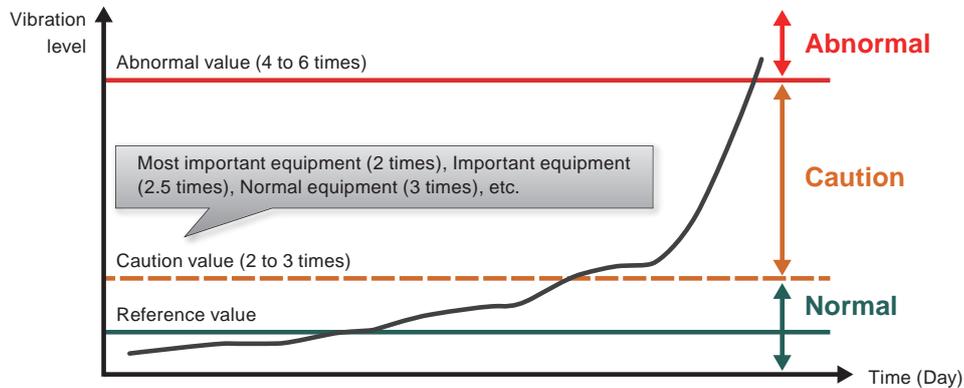
Vibration severity Velocity RMS value (effective value) (mm/s)	ISO10816-1			
	Class I	Class II	Class III	Class IV*1
0.28	A	A	A	A
0.45	A	A	A	A
0.71	B	A	A	A
1.12	B	B	A	A
1.8	C	B	B	B
2.8	C	C	B	B
4.5	D	C	C	C
7.1	D	D	C	C
11.2	D	D	D	C
18	D	D	D	D
28	D	D	D	D
45	D	D	D	D

A: Good B: Allowable C: Warning D: Danger

Caution The measured value may exceed the judgment reference value due to the installation status of the equipment or the influence of noise.

Simple diagnosis (Relative value judgment method)

Equipment is judged as normal or abnormal on the basis of how much larger the measurement value compared to the reference value obtained by measuring vibration on the same part more than 10 times.



Trend monitoring on trend graphs!

Vibration trend can be monitored and the signs of abnormality can be detected by displaying the results of simple diagnosis at regular intervals such as per day or per hour in a trend graph.



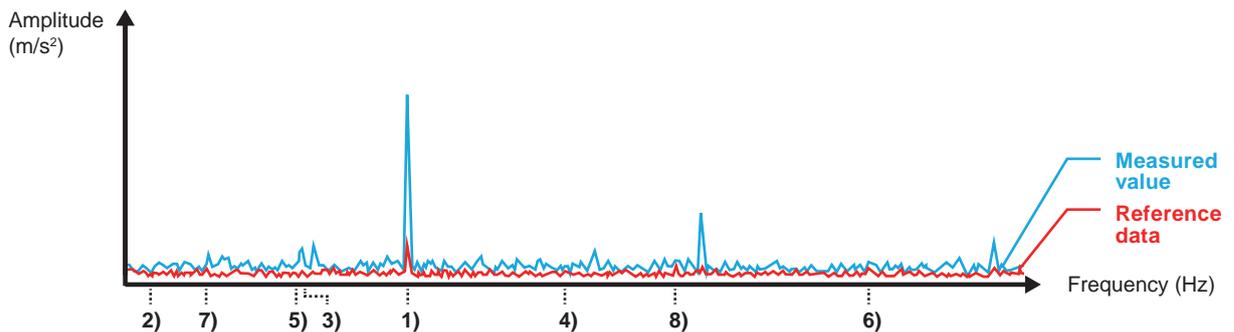
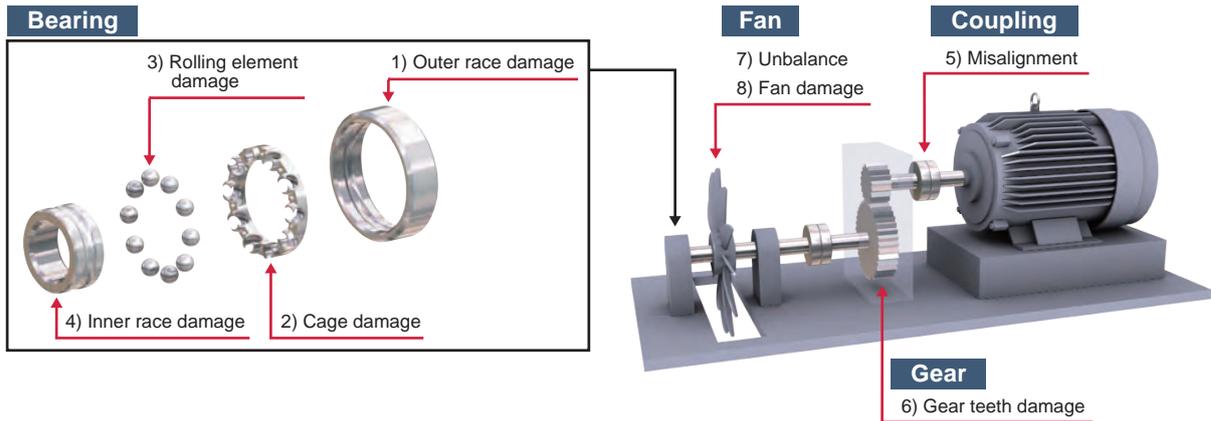
Easy diagnosis (Accurate diagnosis) Presume abnormal area by means of accurate diagnosis!

Abnormal area can be presumed by monitoring the characteristic frequency automatically calculated from the specification values of components, leading to early error detection.

* During accurate diagnosis, rotational speed and loads must be constant.

Accurate diagnosis

Perform FFT analysis on the vibration data and presume the abnormal area according to the change in the amplitude of the characteristic frequency.



Accurate diagnosis results are displayed in a list!

Since diagnosis results of the accurate diagnosis target are notified by the lamp, abnormalities can be identified at a glance.

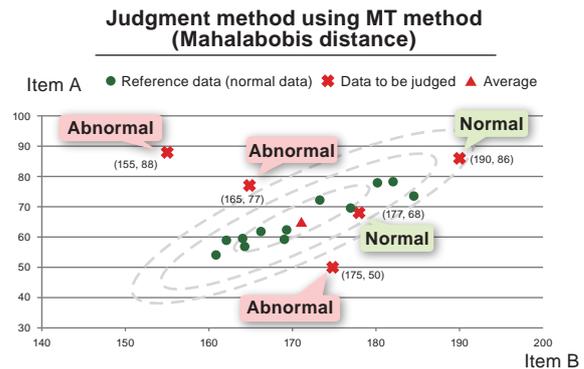
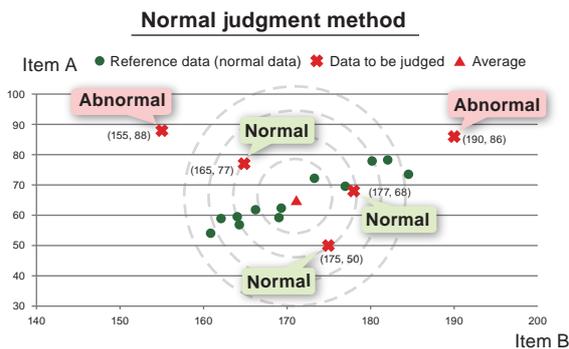
Detail monitoring				03/11/2020 14:43:17	
Mgt. CH	1	Moni.	Diag.	Name	Motor
ALM	Simple diagnosis item	State/Measured value	ALM	Accurate diagnosis item	Amplitude (m/s ²)
	Vibration severity			Unbalance/Misalignment	Measured value: 0.64, Threshold (Diag.): 1.15
	Velocity RMS value (mm/s)			Misalignment(x2)	0.81, 1.21
				Misalignment(x3)	0.47, 1.88
ALM	Simple diagnosis item	Setting value		Inner race damage	0.40, 1.54
	Acceleration FFT Guard band monitoring width (%)	0		Outer race damage	5.37, 5.03
	Acceleration FFT Guard band cont. excess pts. (points)	0		Rolling element damage	0.64, 1.05
ALM	Simple diagnosis item	Measured value	Threshold (Diag.)	Cage damage	0.39, 1.09
	Acceleration waveform Zero peak (m/s ²)	76.72	94.04	Gear teeth damage	0.42, 0.59
	Acceleration waveform RMS (m/s ²)	8.32	13.23	Gear teeth damage(x2)	0.18, 0.34
	Acceleration waveform Crest factor	9.22	14.00	Fan damage	0.57, 0.80
	Acceleration FFT Overall (m/s ²)	6.55	8.96	User setting1	
	Velocity FFT Overall (mm/s)	15.06	21.14	User setting2	
				User setting3	
ALM	MT method diagnosis item	Measured value	Threshold (Diag.)	User setting4	
	Acceleration FFT Maratanobis distance			User setting5	
	Velocity FFT Maratanobis distance			User setting6	

Easy diagnosis (MT method diagnosis) Easily detect abnormalities by means of MT method!

By applying the MT method (quality engineering method) to vibration analysis, abnormalities can be easily detected even without having knowledge about vibration analysis or specification value information of the components. Moreover, compositive diagnosis is possible by combining vibration data with data other than vibration such as temperature and current.

MT method diagnosis

A group of reference data called unit space is generated from normal data (equipment data when operation is started, stable, or steady) and the deviation from normal condition can be quantified using a single index called Mahalanobis distance. This helps to identify the degree of abnormality and detect abnormal signs, as well as to judge the normal/abnormal condition.



Data is determined as normal or abnormal only from the deviation from the average value without considering dispersion of the data.

It is possible to determine the data is normal or abnormal in a suitable way for the equipment since dispersion of the data is considered.



MT method diagnosis results are displayed in a list!

Since diagnosis results of the MT method diagnosis target are notified by the lamp, abnormalities can be identified at a glance.

Mahalanobis distance monitoring 02/27/2020 16:14:21

Management CH during processing 0 Progress Waiting for processing start

Mgt. CH	Acceleration FFT				Velocity FFT				
	ALM	Measured value	Threshold (Diag.)	Number of samples	ALM	Measured value	Threshold (Diag.)	Number of samples	
1	●	13.84	10.00	30	47	17.26	10.00	30	47
2	●	2.30	10.00	30	100	3.50	10.00	30	100
3	●	5.10	10.00	30	52	6.00	10.00	30	52
4	●	8.50	10.00	30	100	8.70	10.00	30	60
5	●								
6	●								
7	●								
8	●								
9	●								
10	●								
11	●								
12	●								
13	●								
14	●								
15	●								
16	●								

Touch the management CH of each monitoring target to switch to the FFT monitoring screen.

Color of the number of collected samples: 100 Collecting (minimum number unreachd) 100 Collecting (minimum number reached) 100 Not collected.

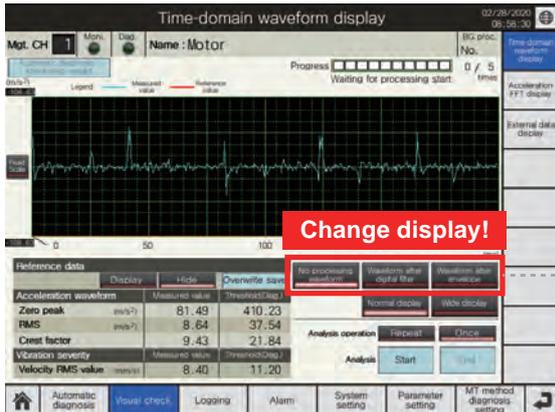
Navigation: Automatic diagnosis, Visual check, Logging, Alarm, System setting, Parameter setting, MT method diagnosis setting

Other useful features (Visual check) Easily check vibration condition on the waveform graph!

Vibration condition can be checked in the time-domain waveform and frequency-domain waveform.

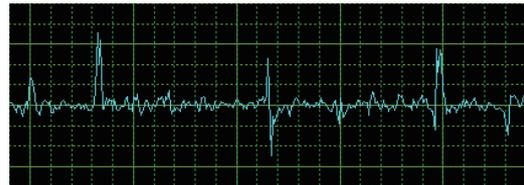
Easily check vibration condition in the time-domain waveform!

The vibration condition can be checked with three types of time-domain waveform (No processing waveform / Waveform after digital filter / Waveform after envelope).



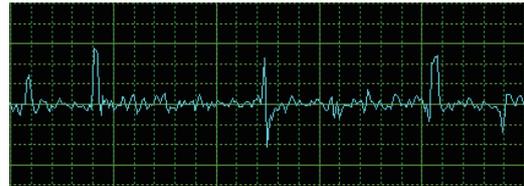
No processing waveform

This is the original waveform obtained by scaling the signal (vibration data) from the vibration sensor.



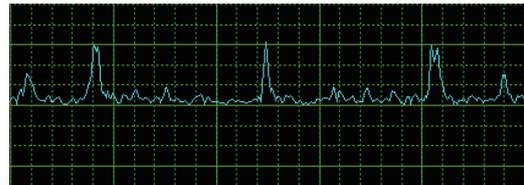
Waveform after digital filter

A digital filter is applied to eliminate noise superimposed by vibration sensors and cables.



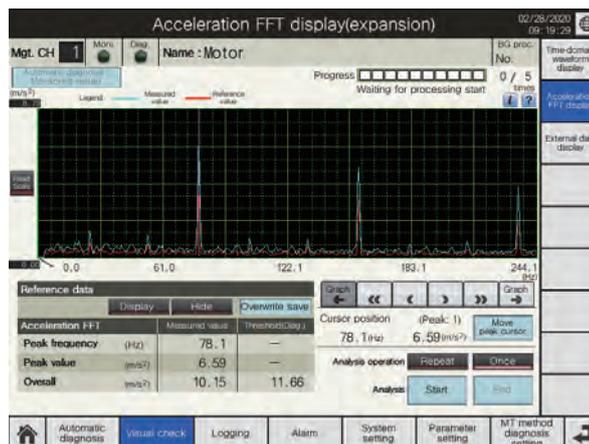
Waveform after envelope

The change in amplitude can be clearly seen by extracting the outline of amplitude absolute values (envelope processing).



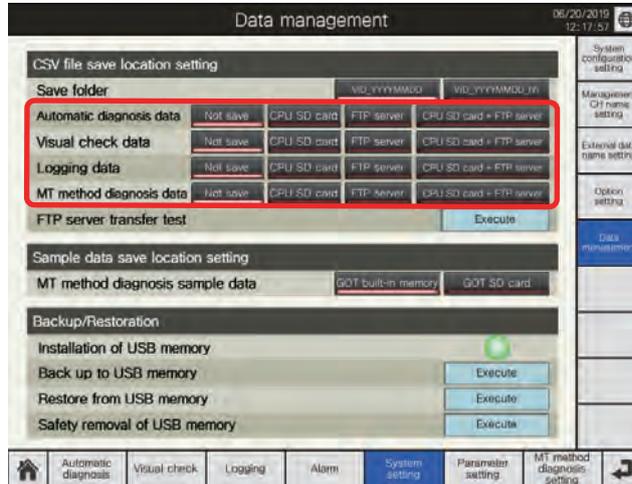
Easily check vibration condition in the time-domain waveform!

Through FFT analysis of vibration data, vibration condition can be checked in the frequency-domain waveform.



Other useful features (Data management) Save various data as a CSV file!

Automatic diagnosis data, visual check data, logging data, and MT method diagnosis data can be saved as a CSV file. CSV files can be saved in an SD memory card or FTP server.



<CSV file contents>

- **Automatic diagnosis data / Visual check data**

- (1) Vibration data
Time (s), acceleration waveform (m/s²), frequency (Hz), acceleration FFT (m/s²), velocity FFT (mm/s)
- (2) FFT setting value
Cycle (μs), number of points (points), average method, average count (times), etc.
- (3) Diagnosis result
Measured value, threshold value, diagnosis result of the simple diagnosis item
Monitoring frequency, measured value, threshold value, diagnosis result of the accurate diagnosis item
Measured value, threshold value, diagnosis result of the MT method diagnosis item

- **Logging data**

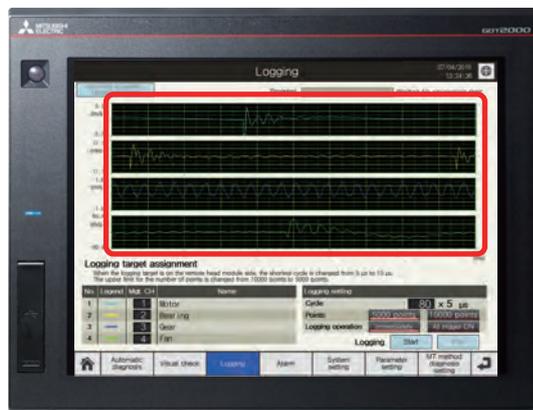
Time (s), Acceleration waveform (m/s²)

- **MT method diagnosis data**

Acceleration MD value (measurement value), acceleration MD value (threshold value), number of acceleration items, velocity MD value (measurement value), velocity MD value (threshold value), number of velocity items, etc.

Other useful features (Logging) Simultaneous logging of vibration data for up to 4 CHs!

Vibration data for up to 4 channels can be simultaneously logged and saved as a CSV file. CSV files can be used for detailed analysis of the vibration data on the personal computer. Vibration data cannot be read from a CSV file to the GOT screen for analysis and diagnosis.



Product Contents

This product consists of software and documents. It is necessary to prepare hardware and engineering software separately. For details, refer to "Necessary Software & Device List (P.18)".

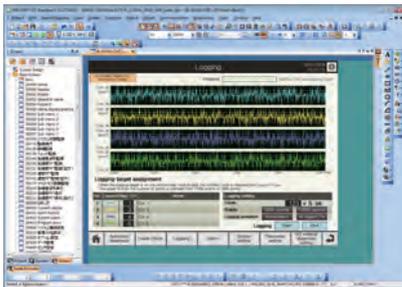
Software



Screen data (GT Designer3 project file^{*1})

^{*1}: MELSOFT GT Designer3 is required.

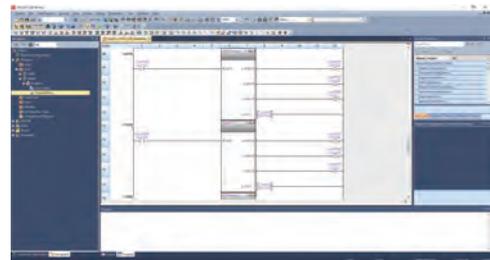
Screen data of GOT2000 for the rotary machine vibration diagnosis



Control program (GX Works3 project file^{*2})

^{*2}: MELSOFT GX Works3 is required.

Sequence control program for the rotary machine vibration diagnosis



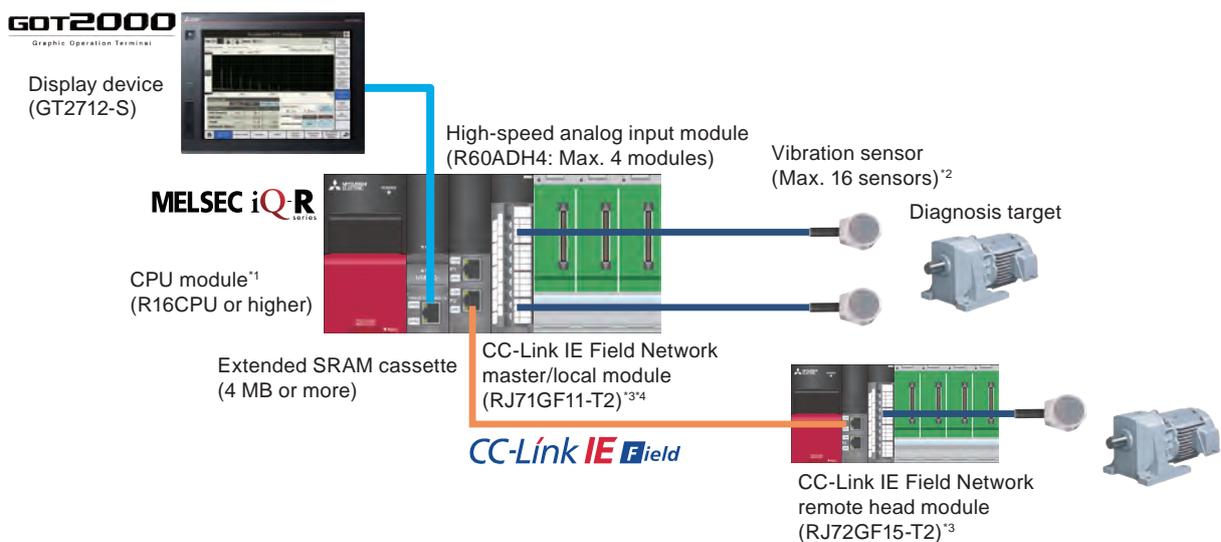
Documents



Manual (PDF file)

Instruction manual

System Configuration Diagram



- ^{*1}: When used with customer's device control programs, the rotary machine vibration diagnosis programs increase the scan time and affect the device control. In this case, use the multiple CPU configuration.
- ^{*2}: Up to 16 vibration sensors can be used in a system. (Including sensors connected via networks)
- ^{*3}: It is used when the diagnosis target is more than one or far away from the PLC CPU. Up to four MELSEC iQ-R series CC-Link IE Field Network remote head modules can be connected.
- ^{*4}: The following modules can be used as the master station of CC-Link IE Field Network.
 - R**ENCPU (** is 16 or later.)
 - RJ71EN71

Specifications

System Specifications

Item	Description	
Number of vibration sensor connections	Max. 16 sensors (Vibration sensors used for vibration detection in acceleration)	
Input range	Voltage	-10 to 10 V DC
	Current	0 to 20 mA DC
Number of MELSEC iQ-R series CC-Link IE Field Network remote head module stations	Max. 4 stations	
Sampling function	Cycle (Frequency range)	10 μ s (40 kHz), 20 μ s (20 kHz), 25 μ s (16 kHz), 50 μ s (8 kHz), 100 μ s (4 kHz), 400 μ s (1 kHz)
	Points	1024 points, 2048 points, 4096 points, 8192 points ^{*1}
FFT function	Spectrum format	Half amplitude
	Window function	Rectangle, Hanning, Hamming, Blackman
	Digital filter	None, Low-pass, High-pass, Band-pass
Diagnosis function	Simple diagnosis	Monitoring item: Velocity RMS value (for vibration severity), Acceleration waveform (RMS, Zero peak, Crest factor), Acceleration FFT (Overall, Guard band), Velocity FFT (Overall)
	Accurate diagnosis	Monitoring item: Unbalance, Misalignment, Inner race damage, Outer race damage, Rolling element damage, Cage damage, Gear teeth damage, Fan damage
	MT method diagnosis	Monitoring item: Acceleration FFT (partial overall), Velocity FFT (partial overall), External data
Waveform display function	Time-domain waveform (No processing waveform / Waveform after digital filter / Waveform after envelope), Frequency-domain waveform (Acceleration FFT, Velocity FFT)	
Trend display function	Trend graph display of monitoring items for simple diagnosis and MT method diagnosis	
Diagnosis result display function	Normal / Caution / Error display	
Alarm display function	Detail display, Current Alarm display, Alarm History display	
Logging function	Cycle	1 to 80 (x5 μ s) ^{*1}
	Points	5000 points, 10000 points ^{*1}
File save function	Save to the SD card installed in the PLC CPU or the FTP server	

*1: When the high-speed analog input module installation position is the remote head module side, the upper limit for the number of sampling points is 4096 points, the shortest logging cycle is 10 μ s, and the upper limit for the number of logging points is 5000 points.

Operating Environment

Item	Description	Remarks
Operation guaranteed OS	Microsoft® Windows® 10 (Home, Pro, Enterprise)	-
	Microsoft® Windows® 7 (Professional, Ultimate, Enterprise)	-
CPU	64-bit OS: 1 GHz or more / 32-bit OS: 1 GHz or more	-
Memory	64-bit OS: 2 GB or more / 32-bit OS: 1 GB or more	-
Free disk space	64-bit OS: 20 GB or more / 32-bit OS: 16 GB or more	-
Disk drive	DVD drive	Installation DVD-ROM
Interface	USB (USB1.1 or later)	For connection with the PLC CPU and GOT
Application	MELSOFT GX Works3	For editing or writing the control program
	MELSOFT GT Designer3 (GOT2000)	For editing or writing the screen data

Necessary Software & Device List

FA Application Package

Product name	Manufacturer	Model	Number of licenses ^{*1}
FA Application Package iQ Monozukuri Rotary Machine Vibration Diagnosis	Mitsubishi Electric Corporation	AP10-VID001AA-MA	1
		AP10-VID001AA-MB	5
		AP10-VID001AA-MC	10
		AP10-VID001AA-MD	15
		AP10-VID001AA-ME	20
		AP10-VID001AA-MF	25

*1: One license is required per system.

Software

Product name	Quantity	Manufacturer	Model	Remarks
PLC Engineering Software MELSOFT GX Works3	1	Mitsubishi Electric Corporation	SW1DND-GXW3-E	Version 1.055H or later
GOT Screen Design Software MELSOFT GT Works3 ^{*1}	1	Mitsubishi Electric Corporation	SW1DND-GTWK3-E	Version 1.217B or later

*1: MELSOFT GT Designer3 is included in MELSOFT GT Works3.

Device

Device name	Quantity	Manufacturer	Model	Remarks
GOT	1	Mitsubishi Electric Corporation	GT2712-STBA/D	Screen size: 12.1-inch SVGA
			GT2712-STWA/D	Screen size: 12.1-inch SVGA
Power supply module ^{*1}	1 to 5	Mitsubishi Electric Corporation	R61P	-
			R62P	
			R63P	
			R64P	
Main base unit ^{*1}	1 to 5	Mitsubishi Electric Corporation	R33B	-
			R35B	
			R38B	
			R312B	
CPU module	1	Mitsubishi Electric Corporation	R16CPU	Use the product with the firmware version "40" or later.
			R32CPU	
			R120CPU	
			R16ENCPU	
			R32ENCPU	
Extended SRAM cassette ^{*2}	1	Mitsubishi Electric Corporation	NZ2MC-4MBS	Extended SRAM cassette 4MB
			NZ2MC-8MBS	Extended SRAM cassette 8MB
High-speed analog input module ^{*3}	1 to 4	Mitsubishi Electric Corporation	R60ADH4	Use the product with the firmware version "04" or later.
SD memory card ^{*4}	0 to 2	Mitsubishi Electric Corporation	NZ1MEM-2GBSD	SD memory card 2 GB
			NZ1MEM-4GBSD	SDHC memory card 4 GB
			NZ1MEM-8GBSD	SDHC memory card 8 GB
			NZ1MEM-16GBSD	SDHC memory card 16 GB

Device name	Quantity	Manufacturer	Model	Remarks
Vibration sensor (acceleration sensor) ^{*5}	1 to 16	TOKIN Corporation	VS-JV10A	Any of the models on the left
		Shinkawa Electric Co., Ltd.	CA-L02	
		ifm electronic gmbh	VSA004	
		PCB Piezotronics, Inc.	607M83	
		TE Connectivity Ltd.	805M4	

- *1: Use two modules for the stand-alone configuration, and two to five modules for the network support configuration.
- *2: When five or more management channels are used, an extended SRAM cassette (model: NZ2MC-8MBS) is required.
- *3: Up to four vibration sensors (acceleration sensors) can be connected per this module.
- *4: It must be installed in the PLC CPU to save the vibration data in the CSV file.
It must be inserted to the GOT to save GOT screen captures or sample data groups of MT method diagnosis.
- *5: One of the sensors that are tested by Mitsubishi Electric are described.
For details refer to iQ Monozukuri Rotary Machine Vibration Diagnosis Tested Device Information "Technical News BCN-E2113-0034".

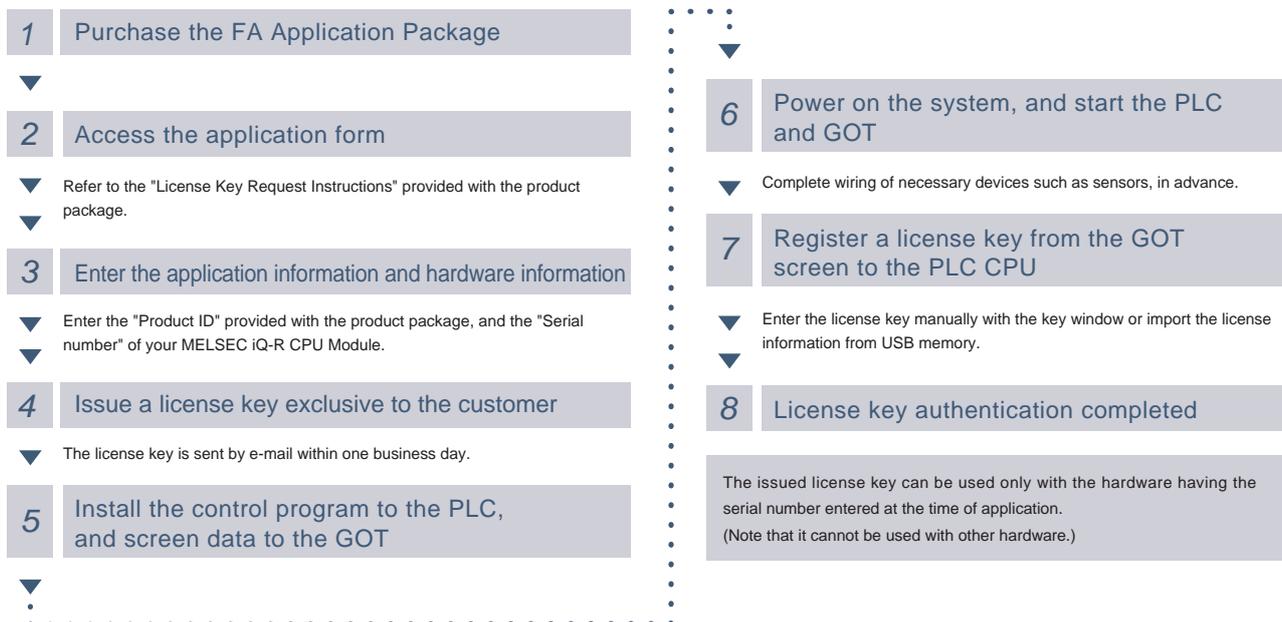
Optional Devices^{*1}

Device name	Quantity	Manufacturer	Model	Remarks
CC-Link IE Field Network master/local module ^{*2}	1	Mitsubishi Electric Corporation	RJ71GF11-T2	Any of the models on the left
Ethernet module ^{*2,3}	1	Mitsubishi Electric Corporation	RJ71EN71	
CC-Link IE Field Network remote head module ^{*2}	1 to 4	Mitsubishi Electric Corporation	RJ72GF15-T2	Up to four MELSEC iQ-R series CC-Link IE Field Network remote head modules can be connected.

- *1: For other supported devices, contact your local Mitsubishi Electric representative.
- *2: It is used when the diagnosis target is multiple devices or away from the PLC CPU.
- *3: Use this module as the CC-Link IE Field Network master module.

Procedure of license key authentication

FA application package "iQ Monozukuri Rotary Machine Vibration Diagnosis" requires license key authentication. The procedure of obtaining and authenticating the license key is as follows:

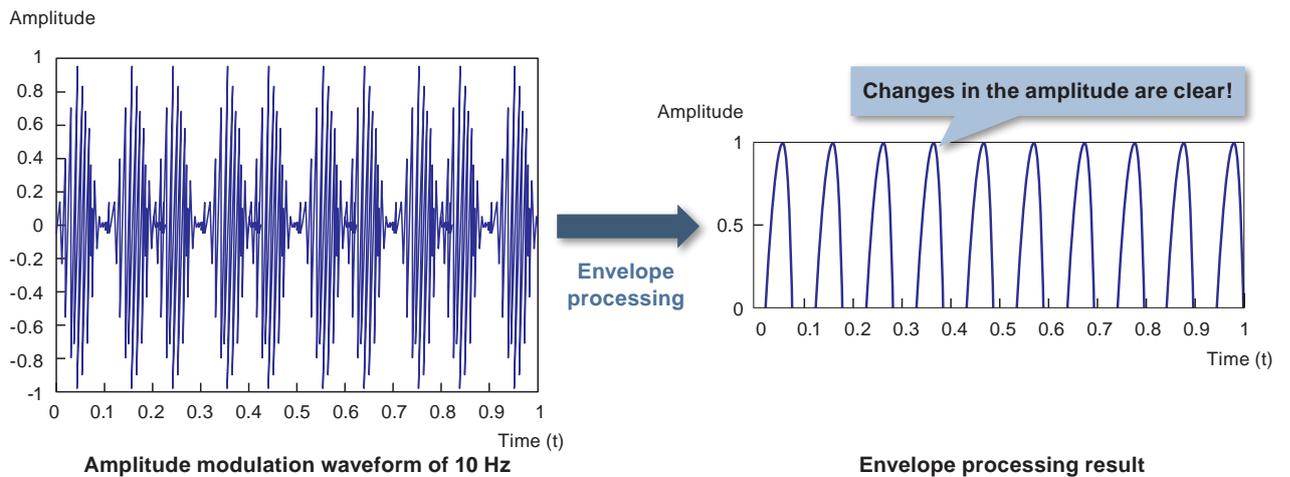


Glossary

Terminology of vibration analysis

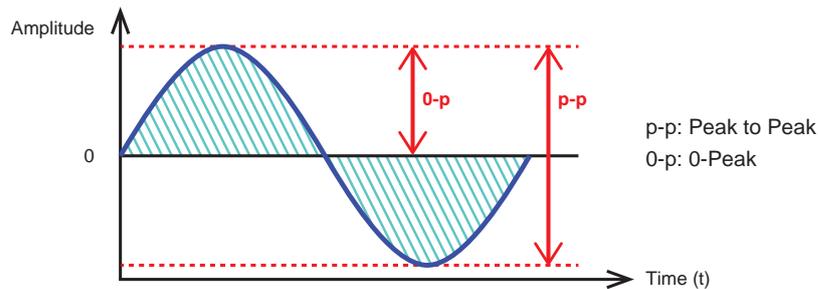
Envelope

Envelope processing is a process to extract the external form of absolute amplitude values. It is used for examining the periodicity of impact vibration, such as the vibration caused by damage to the bearing.



Peak value

The maximum value of amplitude in a waveform for a certain period. The peak value is represented as Peak to Peak and 0-Peak. It is used for evaluating the impact vibration and vibration waveform with small variations.

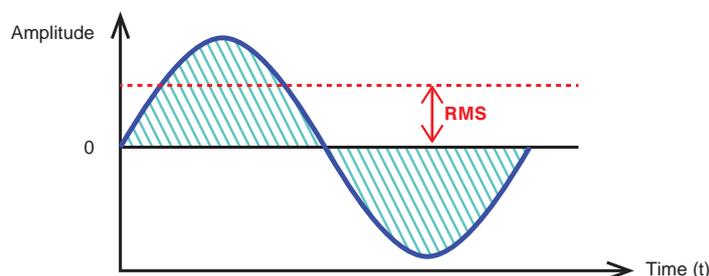


RMS (effective value)

The square root of mean square for each instantaneous value within a certain period in the time-domain waveform. It indicates the average amplitude of the time-domain waveform.

It is used for evaluating the vibration waveform with few impact vibrations.

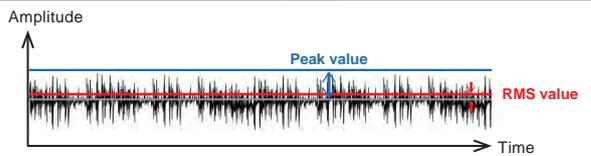
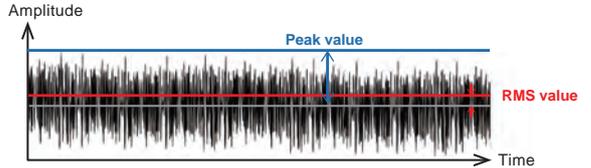
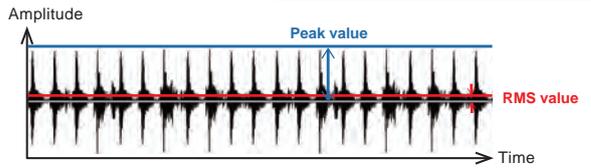
The velocity RMS is used for total judgment of the equipment condition. The acceleration RMS is used for calculation of crest factor.



□ Crest factor (CF)

A ratio of RMS value and peak value of time-domain waveform. (Crest factor = peak value/RMS value)

While the peak value and RMS value vary according to the rotation speed, the crest factor is less likely to vary but increases due to impact vibration. Therefore, the crest factor is used for detecting impact vibration such as damage on a bearing.

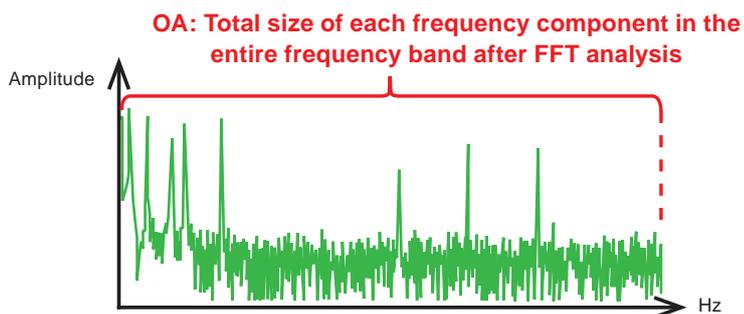
Vibration state	Time-domain waveform (Acceleration waveform)	Crest factor value (standard)
Normal	 <p>Amplitude vs Time. The waveform is smooth and periodic. A blue arrow points to the highest peak, labeled 'Peak value'. A red horizontal line indicates the 'RMS value'. The peak value is significantly higher than the RMS value.</p>	CF << 5
Motor load increased due to inadequate lubrication	 <p>Amplitude vs Time. The waveform is more irregular and has a higher peak. A blue arrow points to the highest peak, labeled 'Peak value'. A red horizontal line indicates the 'RMS value'. The peak value is closer to the RMS value compared to the normal state.</p>	CF ≈ 6
Impact vibration due to damage	 <p>Amplitude vs Time. The waveform shows sharp, high-amplitude spikes. A blue arrow points to the highest peak, labeled 'Peak value'. A red horizontal line indicates the 'RMS value'. The peak value is much higher than the RMS value.</p>	CF >> 6

□ Overall (OA)

The total size of each frequency component in the entire frequency band after FFT analysis.

Theoretically, OA equals to RMS value of the waveform before FFT analysis.

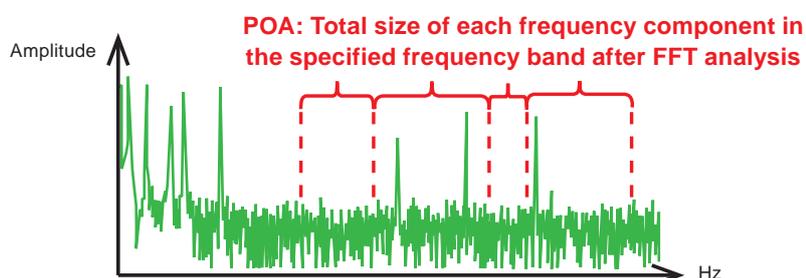
It is used to monitor the amplitude in the entire frequency band after FFT analysis.



□ Partial overall (POA)

The total size of each frequency component in the specified frequency band after FFT analysis.

It is used to monitor the amplitude in the specified frequency band after FFT analysis.



Terminology of MT method

□ Item (Input item of MT method)

The characteristic value extracted from the source information (such as vibration) used to generate a unit space or calculate the Mahalanobis distance.

In "iQ Monozukuri Rotary Machine Vibration Diagnosis", the corresponding items are the POA value of vibration and others. An unnecessary item included in the unit space may decrease the accuracy of error judgment.

□ Unit space

Reference data (normal data) group for calculating the Mahalanobis distance.

□ Sample

A set of data of each item measured in the normal condition, which is necessary for generating unit space of MT method. This is called sample data as well.

□ Mahalanobis distance

An index of the deviation from the reference data group.



FA Application Package Lineup

Processes and Usages

Packages in line with the status and purposes such as where to use or with what intention

Process Remote Monitoring

Visualizing operation status and introducing IoT technologies to the shop floor to improve manufacturing process and productivity.



ANDON

ANDON display improves productivity by sharing information between workers.



Smart Work Navigator

Systems for supporting picking and assembly work can be easily developed and operated.



Rotary Machine Vibration Diagnosis

Predictive maintenance can be realized for the facilities with rotary machines.



Tool Wear Diagnosis for Machine Tools

Tool wear conditions are tracked by using IoT data to help optimize tool operation and improve processing quality.



Processing Machine Loading

The setup and development of a processing machine loading/unloading system is supported.



Force-sense Application

Various force sensing operations such as assembly, fitting, and inspection have been automated.



Deburring/Polishing

Deburring and polishing can be automated just by rough teaching.



Equipment

Packages realizing shortening of the system development time and easy development

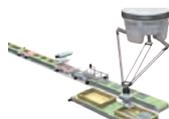
CONVERTING

The development of a converting system that requires unwinding and winding control is supported.



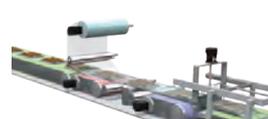
HANDLING

The development of a conveyance mechanism that requires the calculation of coordinate conversion is supported.



PACKAGING

The development of a packaging machine that requires cam control and position correction is supported.



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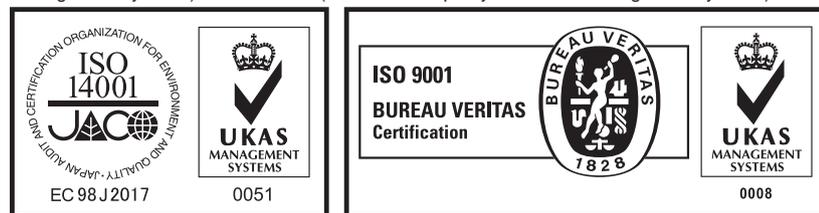
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Country/Region	Sales office	Tel/Fax
USA	MITSUBISHI ELECTRIC AUTOMATION, INC. 500 Corporate Woods Parkway, Vernon Hills, IL 60061, U.S.A.	Tel : +1-847-478-2100 Fax : +1-847-478-2253
Mexico	MITSUBISHI ELECTRIC AUTOMATION, INC. Mexico Branch Boulevard Miguel de Cervantes Saavedra 301, Torre Norte Piso 5, Ampliacion Granada, Miguel Hidalgo, Ciudad de Mexico, Mexico, C.P.115200	Tel : +52-55-3067-7512
Brazil	MITSUBISHI ELECTRIC DO BRASIL COMERCIO E SERVICOS LTDA. Avenida Adelino Cardana, 293, 21 andar, Bethaville, Barueri SP, Brasil	Tel : +55-11-4689-3000 Fax : +55-11-4689-3016
Germany	MITSUBISHI ELECTRIC EUROPE B.V. German Branch Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany	Tel : +49-2102-486-0 Fax : +49-2102-486-7780
UK	MITSUBISHI ELECTRIC EUROPE B.V. UK Branch Travellers Lane, UK-Hatfield, Hertfordshire, AL10 8XB, U.K.	Tel : +44-1707-28-8780 Fax : +44-1707-27-8695
Ireland	MITSUBISHI ELECTRIC EUROPE B.V. Irish Branch Westgate Business Park, Ballymount, Dublin 24, Ireland	Tel : +353-1-4198800 Fax : +353-1-4198890
Italy	MITSUBISHI ELECTRIC EUROPE B.V. Italian Branch Centro Direzionale Colleoni - Palazzo Sirio, Viale Colleoni 7, 20864 Agrate Brianza (MB), Italy	Tel : +39-039-60531 Fax : +39-039-6053-312
Spain	MITSUBISHI ELECTRIC EUROPE, B.V. Spanish Branch Carretera de Rubi, 76-80-Apdo. 420, E-08190 Sant Cugat del Valles (Barcelona), Spain	Tel : +34-935-65-3131 Fax : +34-935-89-1579
France	MITSUBISHI ELECTRIC EUROPE B.V. French Branch 25, Boulevard des Bouvets, 92741 Nanterre Cedex, France	Tel : +33-1-55-68-55-68 Fax : +33-1-55-68-57-57
Czech Republic	MITSUBISHI ELECTRIC EUROPE B.V. Czech Branch, Prague Office Pekarska 621/7, 155 00 Praha 5, Czech Republic	Tel : +420-255-719-200
Poland	MITSUBISHI ELECTRIC EUROPE B.V. Polish Branch ul. Krakowska 48, 32-083 Balice, Poland	Tel : +48-12-347-65-00
Sweden	MITSUBISHI ELECTRIC EUROPE B.V. (Scandinavia) Hedvig Mollersgata 6, 223 55 Lund, Sweden	Tel : +46-8-625-10-00 Fax : +46-46-39-70-18
Russia	MITSUBISHI ELECTRIC (RUSSIA) LLC St. Petersburg Branch Piskarevsky pr. 2, bld 2, lit "Sch", BC "Benua", office 720; 195027 St. Petersburg, Russia	Tel : +7-812-633-3497 Fax : +7-812-633-3499
Turkey	MITSUBISHI ELECTRIC TURKEY A.S Umraniye Branch Serifali Mahallesi Nutuk Sokak No:5, TR-34775 Umraniye/Istanbul, Turkey	Tel : +90-216-526-3990 Fax : +90-216-526-3995
UAE	MITSUBISHI ELECTRIC EUROPE B.V. Dubai Branch Dubai Silicon Oasis, P.O.BOX 341241, Dubai, U.A.E.	Tel : +971-4-3724716 Fax : +971-4-3724721
South Africa	ADROIT TECHNOLOGIES 20 Waterford Office Park, 189 Witkoppen Road, Fourways, South Africa	Tel : +27-11-658-8100 Fax : +27-11-658-8101
China	MITSUBISHI ELECTRIC AUTOMATION (CHINA) LTD. Mitsubishi Electric Automation Center, No.1386 Hongqiao Road, Shanghai, China	Tel : +86-21-2322-3030 Fax : +86-21-2322-3000
Taiwan	SETSUYO ENTERPRISE CO., LTD. 6F, No.105, Wugong 3rd Road, Wugu District, New Taipei City 24889, Taiwan	Tel : +886-2-2299-2499 Fax : +886-2-2299-2509
Korea	MITSUBISHI ELECTRIC AUTOMATION KOREA CO., LTD. 7F to 9F, Gangseo Hangang Xi-tower A, 401, Yangcheon-ro, Gangseo-Gu, Seoul 07528, Korea	Tel : +82-2-3660-9569 Fax : +82-2-3664-8372
Singapore	MITSUBISHI ELECTRIC ASIA PTE. LTD. 307 Alexandra Road, Mitsubishi Electric Building, Singapore 159943	Tel : +65-6473-2308 Fax : +65-6476-7439
Thailand	MITSUBISHI ELECTRIC FACTORY AUTOMATION (THAILAND) CO., LTD. 12th Floor, SV.City Building, Office Tower 1, No. 896/19 and 20 Rama 3 Road, Kwaeng Bangpongpan, Khet Yannawa, Bangkok 10120, Thailand	Tel : +66-2682-6522 Fax : +66-2682-6020
Vietnam	MITSUBISHI ELECTRIC VIETNAM COMPANY LIMITED Unit 01-04, 10th Floor, Vincom Center, 72 Le Thanh Ton Street, District 1, Ho Chi Minh City, Vietnam	Tel : +84-28-3910-5945 Fax : +84-28-3910-5947
Indonesia	PT. MITSUBISHI ELECTRIC INDONESIA Gedung Jaya 8th Floor, JL. MH. Thamrin No.12, Jakarta Pusat 10340, Indonesia	Tel : +62-21-31926461 Fax : +62-21-31923942
India	MITSUBISHI ELECTRIC INDIA PVT. LTD. Pune Branch Emerald House, EL-3, J Block, M.I.D.C., Bhosari, Pune-411026, Maharashtra, India	Tel : +91-20-2710-2000 Fax : +91-20-2710-2100
Australia	MITSUBISHI ELECTRIC AUSTRALIA PTY. LTD. 348 Victoria Road, P.O. Box 11, Rydalmere, N.S.W 2116, Australia	Tel : +61-2-9684-7777 Fax : +61-2-9684-7245

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MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
www.MitsubishiElectric.com