eco Changes for a greener tomorrow

MITSUBISHI ELECTRIC
Changes for the Better

FACTORY AUTOMATION

MULTIFUNCTION REGENERATION CONVERTER

FR-XC

Versatile and feature-rich converter for power regeneration [Enhanced Lineup]

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.

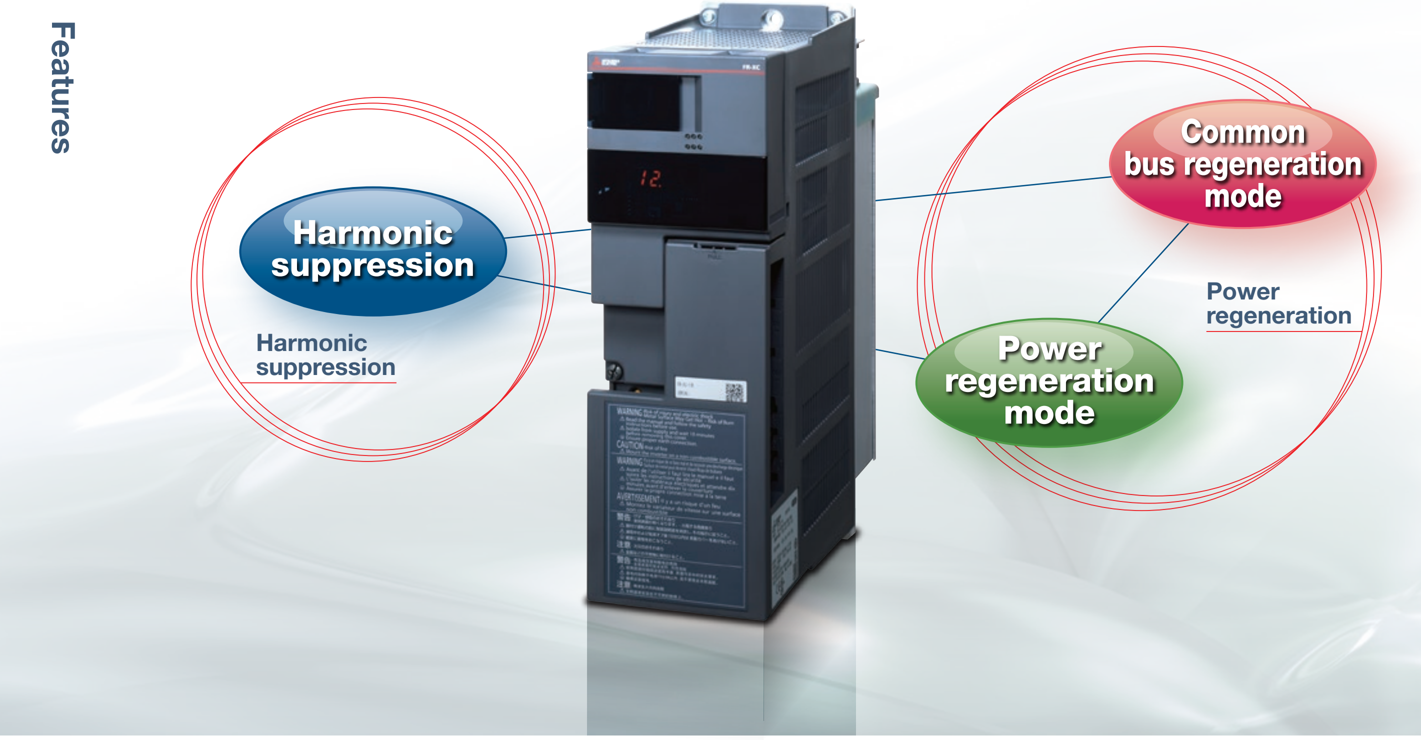
Home Appliance
Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems
Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems
Maximizing productivity and efficiency with cutting-edge automation technology.

Single Solution for Both Harmonic Suppression and Power Regeneration

Choose the suitable function for your needs by using the FR-XC converter with the FR-XCB or FR-XCL reactor.



	Harmonic suppression	Common bus regeneration mode	Power regeneration mode
Energy saving by power regeneration	★★★	★★★	★★★
Power supply harmonic current suppression	★★★	—	—
Reduction in the power supply capacity or the facility size by power factor improvement	★★★	★	—
Use as a common converter	★★★	★★★	—
Initial cost reduction	★	★★	★★★
Less wiring work	★★★	★★★	★★
Smaller enclosure size	★★	★★★	★★

★★★: Highly effective ★★: Moderately effective ★: Slightly effective —: N/A

Compact design offering solution to harmonic problems

Harmonic suppression

Harmonic suppression (K5 = 0) achieved
Power supply capacity reduced by power factor improvement

FR-XC + **FR-XCB**

FR-XC

FR-XCB

Power regeneration contributing to energy saving

Common bus regeneration mode

Total cost reduction by connecting up to 10 inverters
Harmonic suppression function available

FR-XC + **FR-XCL**

FR-XC + **FR-XCB**

Power regeneration mode

Space saving achievable depending on the regenerative power

FR-XC + **FR-XCL**

FR-XC

FR-XCL

FR-XCB

Compact design offering solution to harmonic problems

The FR-XC-(H)15K or lower does not have the harmonic suppression function.

Harmonic suppression

FR-XC + FR-XCB

Harmonic suppression (K5 = 0) achieved

- The FR-XC series converter is classified as the self-excitation three-phase bridge circuit under the "Harmonic Suppression Guidelines for Specific Consumers" and achieves K5 = 0 (conversion factor for equivalent capacity) when its harmonic suppression function is enabled and in use with the dedicated box-type reactor FR-XCB. (It is assumed that the converter generates no harmonics.)

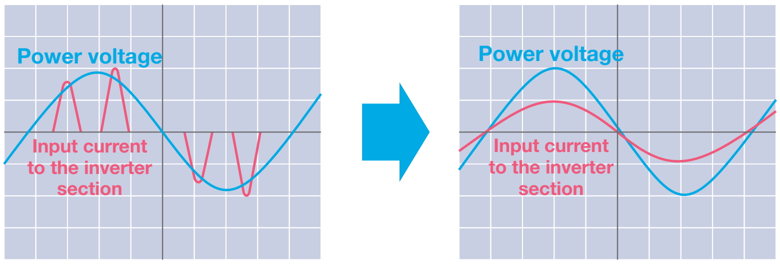
Harmonic Conversion Coefficient of the Equivalent Capacity (Excerpt from the Guidelines Appendix)

Classification	Circuit type		Conversion coefficient	Application examples
1	Three-phase bridge	6-pulse converter	K11 = 1	Railway substation
		12-pulse converter	K12 = 0.5	Electro-chemistry
		24-pulse converter	K13 = 0.25	Others
3	Three-phase bridge (smoothing capacitor)	Without a reactor	K31 = 3.4	General-purpose inverter
		With a reactor (on AC side)	K32 = 1.8	Lift
		With a reactor (on DC side)	K33 = 1.8	Refrigerator and air conditioner
		With reactors (on AC/DC sides)	K34 = 1.4	Others
4	Single-phase bridge (smoothing capacitor, double voltage rectification)	Without a reactor	K41 = 2.3	General-purpose inverter
		With a reactor (on AC side)	K42 = 0.35	Refrigerator and air conditioner, Others
	Single-phase bridge (smoothing capacitor, full-wave rectification)	Without a reactor	K43 = 2.9	General-purpose inverter
		With a reactor (on AC side)	K44 = 1.3	Others
5	Self-excitation three-phase bridge		K5 = 0	PWM converter (Multifunction regeneration converter)

The total harmonic distortion of the input current (THDi) is 5% or less[1], which facilitates compliance with the overseas standards related to harmonic suppression.

[1] When the input voltage is distorted, harmonic contents increase because power harmonics flow into the FR-XC series converter.

- The waveform with high peaks, which is typical of the input current to the inverter section from the converter section in an inverter unit, is rounded to make a sine wave with a lower input current effective value.



[FR-XC not installed] [FR-XC installed]

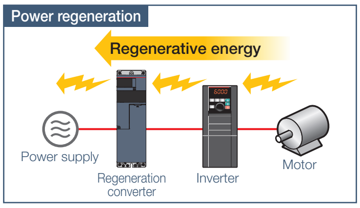
Power supply capacity reduced by power factor improvement

- With the reduced effective value of the input current to the inverter section, it is possible to install a power transformer, MCCB, cables, etc. with smaller capacity on the converter input side to reduce the equipment cost.

Power regeneration contributing to energy saving

While the motor rotates to drive the machine during power driving, the machine rotates the motor during regenerative driving, which results in energy saving since the motor serves as a generator which returns the power to the power supply. For example, when a power of 70 kW is required for power driving and a power of 30 kW is required for regenerative driving, the power consumption is reduced by 30%.

One of the two regeneration modes can be selected depending on the application.



Common bus regeneration mode

FR-XC + **FR-XCL**
FR-XC + **FR-XCB**

Total cost reduction by connecting up to 10 inverters

The FR-XC series converter can connect to up to 10 inverters together, though its predecessor FR-CV series converter is designed to connect to up to 6 inverters.
The power returned from an inverter during regenerative driving can be supplied to another inverter, saving the overall energy.
None of the inverters requires a brake unit, which enables total space and cost reduction.

Harmonic suppression function available

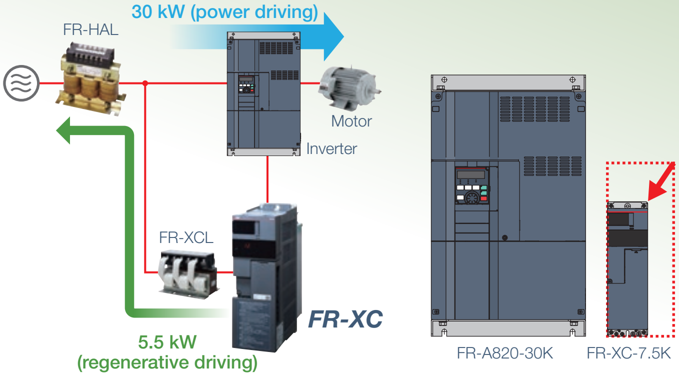
The harmonic suppression function can also be enabled while the converter is used as a common converter.

Power regeneration mode

FR-XC + **FR-XCL**

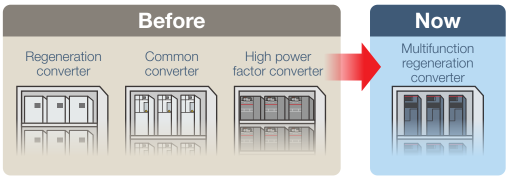
Space saving achievable depending on the regenerative power

For power driving, the inverter supplies power. For regenerative driving, the FR-XC series converter returns power to the power supply. (In this mode, the FR-XC series converter cannot be used as a common converter.)
The capacity of the FR-XC series converter is selectable according to the regenerative power of the system. Thus, the compact converter is applicable for the regenerative power smaller than the inverter capacity, which contributes to space saving. (Refer to page 20 for selection.)
For example, if you use the 30 kW inverter and the regenerative power of your system is 5.5 kilowatts, you can choose the 7.5 kW converter instead of the 30 kW converter.
The converter with its harmonic suppression function disabled can be used in the power regeneration mode.



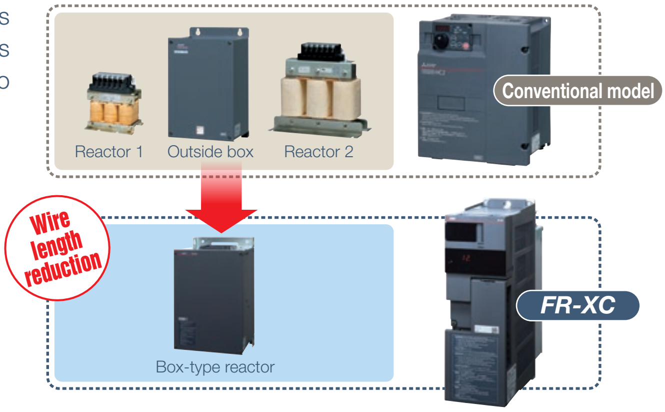
Single converter usable in different modes or with the control function enabled/disabled

The regeneration mode is changed with the selection switch, and the harmonic suppression function is enabled or disabled according to the parameter setting.
A single FR-XC series converter can be used as a backup converter for different applications. (Use the converter in combination with the dedicated stand-alone reactor (FR-XCL) or the dedicated box-type reactor (FR-XCB).)



Total wire length reduction

The FR-XCB is used in combination with the FR-XC series converter for harmonic suppression. The FR-XCB contains a reactor, circuit, etc. in its small body, which contributes to wire length and space saving.



Installation inside the enclosure **Option**

The 30K converter or lower can be installed inside the enclosure by using the optional installation attachment FR-XCCP (the 37K and 55K converters do not need the attachment for installation in the enclosure).

Space saving by increasing the current rating

When the 40°C rating of surrounding air temperature is selected within the temperature derating range, the current rating and the current to be applied can be increased.
When the FR-XC series converter is intended for the use at the surrounding air temperatures less than 40°C, a model with a smaller capacity is applicable. (Refer to page 19 for selection.) With smaller converter, less space is required.

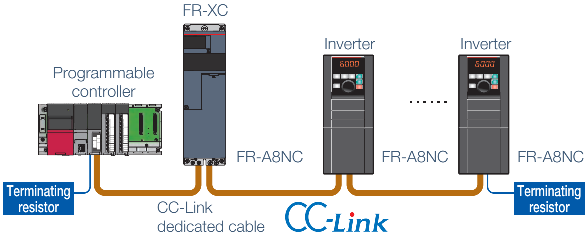
IP20 compliant protective structure **Option**

The 37K and 55K converters can have the IP20-compliant protective structure when the optional IP20 compatible attachment FR-XCCU is attached.

Network compatibility

RS-485 communication is supported as standard. With the FR-A8NC communication option, the converter also supports CC-Link communication.

- As power can be monitored during both power driving and regenerative driving, the energy saving effect can be checked any time.
- Monitoring of faults and the voltage of each phase allows you to analyze the fault cause easily.

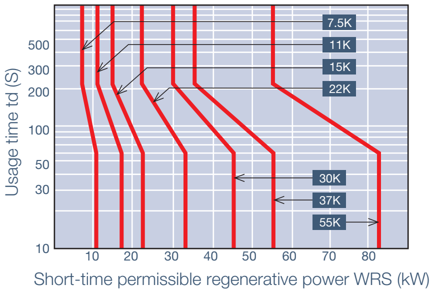


Large braking force

The power regeneration function (enabled continuously with 100%*1 torque or for 60 seconds with the maximum torque of 150%) offers a large braking force, eliminating the need for brake units.

*1 100% refers to a value of the applicable inverter capacity in common bus regeneration mode or the potential regenerative capacity in power regeneration mode (refer to page 15).

Regenerative braking torque (FR-XC-7.5K, 11K, 15K, 22K, 30K, 37K and 55K)



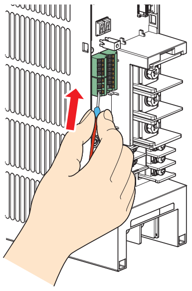
Easy wiring of the control circuit

Spring clamp terminals (control circuit terminals)

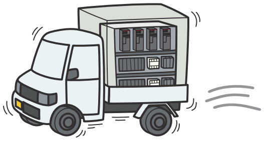
Spring clamp terminals*[1] provide high reliability and easy wiring.

*1 The main circuit terminals are screw terminals.

- Easy wiring
  Wiring is completed only by inserting the dedicated blade terminal of each cable. Without using the blade terminal, the loose wires can also be connected using a flathead screwdriver.



- High reliability
  Internal terminal contacts are spring-type. Therefore, wires can be protected against loosening or contact faults due to vibrations during operation on a bogie or during transport.
- Maintenance-free
  No additional screw tightening is required.



(Example: transport of the converters)

Long life components and life check function

Long life components

- The service life of the cooling fans is designed for 10 years*[1].
- The capacitors' life is also designed for 10 years*[1]*[2].
- Estimated service lifespan of the long-life parts

Components	Estimated lifespan	Guideline of JEMA*[3]
Cooling fan	10 years	2 to 3 years
Main circuit smoothing capacitor	10 years	5 years
Printed board smoothing capacitor	10 years	5 years

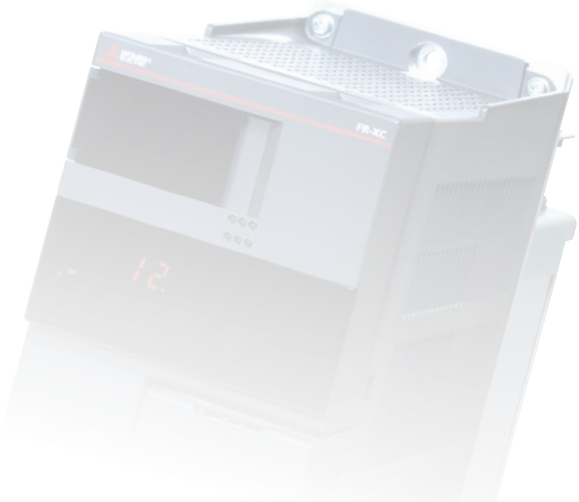
Life check function

- The remaining lifetime can be estimated for wear and tear parts (main circuit capacitor, cooling fan) and inrush current limit circuit by checking the deterioration.
- Using the self-diagnosis function, the part life warning can be output*[4] to prevent a fault.

*1 Surrounding air temperature: Annual average of 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt).
The design life is a calculated value and is not a guaranteed product life.
*2 Input current: 80% of the converter rating
*3 Excerpts from "Periodic check of the transistorized inverter" of JEMA (Japan Electrical Manufacturer's Association).
*4 A warning is output when any of the control circuit capacitors, inrush current limit circuit, and cooling fan reaches its output level.

Protection against hazardous environments

The FR-XC series converters with circuit board coating (IEC 60721-3-3 3C2/3S2) and plated conductors are available for improved environmental resistance. (The converter model name ends with "-60" or "-06".)



Global compatibility

- The FR-XC converter is compliant with UL, cUL, EC Directives (CE marking), and Radio Waves Act (South Korea, KC marking). It is also certified as compliant with the Eurasian Conformity (EAC).
- The converter is compliant with the EU RoHS Directive (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), friendly to people and to the environment.

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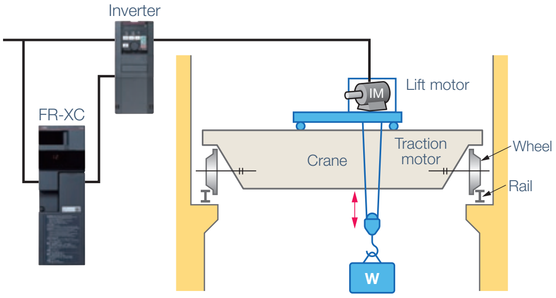
Application Examples

Ceiling crane

Power regeneration mode

Point Due to the power regeneration function, a brake unit is not required for each inverter. Connect the mechanical brake to the line between the FR-XCL and its power source.

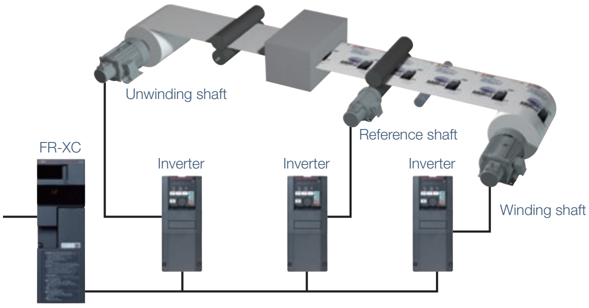


Printing machines

Common bus regeneration mode

Harmonic suppression

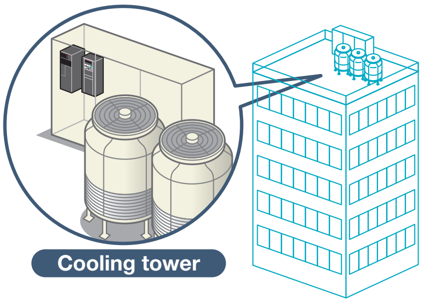
Point Inverters can be connected to a common bus. When the harmonic suppression function is enabled, power supply harmonics of inverters can be suppressed.



Air conditioning of buildings

Harmonic suppression

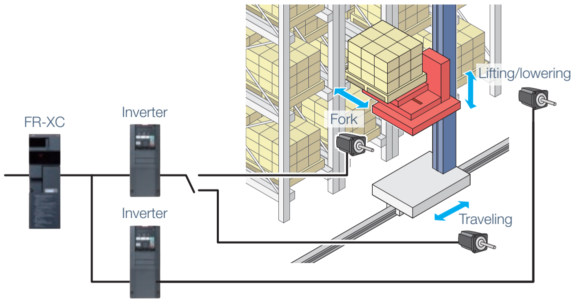
Point Power supply harmonics of inverters can be suppressed, minimizing the effects on other equipment.
Central control of the systems is made possible by networking the systems.



Conveyor

Common bus regeneration mode

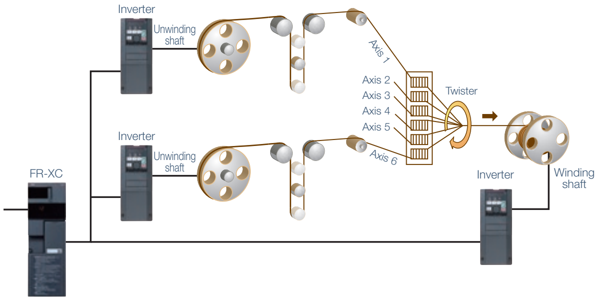
Point The regenerated energy of the inverter for the lift application is used by another inverter for the driving application. If there is still an excess, it is returned to the power supply, saving on the energy consumption.

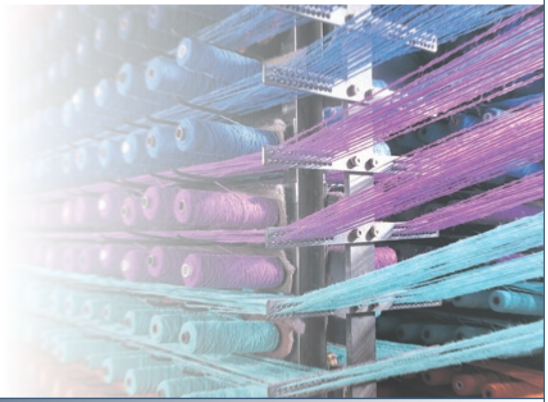


Spinning

Common bus regeneration mode

Point The FR-XC series converter supports the system with more than 6 inverters (up to 10 inverters).

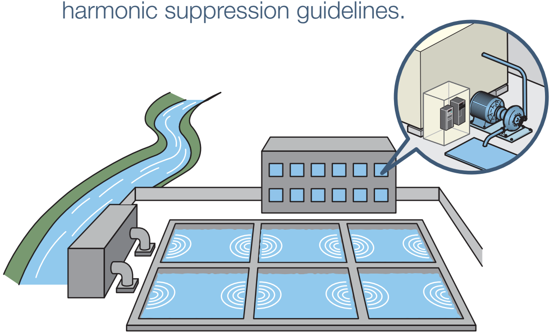




Pump (water treatment plant)

Harmonic suppression

Point Power supply harmonics of inverters can be suppressed, allowing the compliance with the harmonic suppression guidelines.



Lineup

●: Released, ○: To be released, —: Not applicable

Specifications of the models to be released are subject to change without prior notice.

Multifunction regeneration converter model

FR-XC-[ ] 22 K-[ ] [ ]

Symbol	Voltage
None	200 V class
H	400 V class

For selection, refer to page 19.

Converter capacity
Capacity (kW)

Symbol	Circuit board coating	Plated conductor
None	Without	Without
60	With	Without
06	With	With

Symbol	Functional specification[*1]
None	Harmonic suppression disabled
PWM	Harmonic suppression enabled

[*1] Pr.416 ="9999"

Voltage	Model	7.5	11	15	18.5	22	30	37	55	75	90	110	160	220	280
200 V	FR-XC-[ ]K	●	●	●	—	●	●	●	●	—	—	—	—	—	—
	FR-XC-[ ]K-PWM	—	—	—	●	●	—	●	●	○	○	—	—	—	—
400 V	FR-XC-H[ ]K	●	●	●	—	●	●	●	●	○	—	—	—	—	—
	FR-XC-H[ ]K-PWM	—	—	—	●	●	—	●	●	○	—	○	○	○	○

Dedicated stand-alone reactor (option) model

A stand-alone reactor for use with the FR-XC converter with its harmonic suppression function disabled.

FR-XCL-[ ] 22 K

Symbol	Voltage
None	200 V class
H	400 V class

Reactor capacity
Capacity (kW)

Voltage	Model	7.5	11	15	22	30	37	55
200 V	FR-XCL-[ ]K	●	●	●	●	●	●	●
400 V	FR-XCL-H[ ]K	●	●	●	●	●	●	●

Dedicated box-type reactor (option) model

A stand-alone box-type reactor for use with the FR-XC converter with its harmonic suppression function enabled.

FR-XCB-[ ] 18.5 K-[ ]

Symbol	Voltage
None	200 V class
H	400 V class

Reactor capacity
Capacity (kW)

Symbol	Circuit board coating
None	Without
60	With

Voltage	Model	18.5	22	37	55	75	90	110	160	220	280
200 V	FR-XCB-[ ]K	●	●	●	●	○	○	—	—	—	—
400 V	FR-XCB-H[ ]K	●	●	●	●	○	—	○	○	○	○

Converter installation attachment for enclosure (option) model

An attachment for installation of the FR-XC series converter in an enclosure.

FR-XCCP 03

Symbol	Applicable converter
01 to 03	Refer to the table on the next page.

Model	01	02	03
FR-XCCP-[ ]	●	●	●

IP20 compatible attachment (option) model

An attachment for achieving the IP20 compliant protective structure of the FR-XC series converter.

FR-XCCU 01

Symbol	Applicable converter
01 to 03	Refer to the table on the next page.

Model	01	02	03
FR-XCCU[ ]	●	●	●

Combination matrix of FR-XCL and FR-XC(-PWM)

Dedicated stand-alone reactor	Multifunction regeneration converter	
FR-XCL-[ ]	**FR-XC-[ ]**	**FR-XC-[ ]-PWM*2**
7.5K	7.5K	—
11K	11K	—
15K	15K	—
22K	22K	18.5K
30K	30K	22K
37K	37K	37K
55K	55K	55K
H7.5K	H7.5K	—
H11K	H11K	—
H15K	H15K	—
H22K	H22K	H18.5K
H30K	H30K	H22K
H37K	H37K	H37K
H55K	H55K	H55K

*2 The harmonic suppression function is pre-enabled in this model.
To use the converter with the FR-XCL, change the "9999" setting of Pr.416 Control method selection to "0" (harmonic suppression disabled).

Combination matrix of FR-XCB and FR-XC(-PWM)

Dedicated box-type reactor	Multifunction regeneration converter	
FR-XCB-[ ]	**FR-XC-[ ]*3**	**FR-XC-[ ]-PWM**
18.5K	22K	18.5K
22K	30K	22K
37K	37K	37K
55K	55K	55K
H18.5K	H22K	H18.5K
H22K	H30K	H22K
H37K	H37K	H37K
H55K	H55K	H55K

*3 The harmonic suppression function is not pre-enabled in this model.
To use the converter with the FR-XCB, change the "9999" setting of Pr.416 Control method selection to "1" (harmonic suppression enabled).

Combination matrix of FR-XCCP and FR-XC(-PWM)

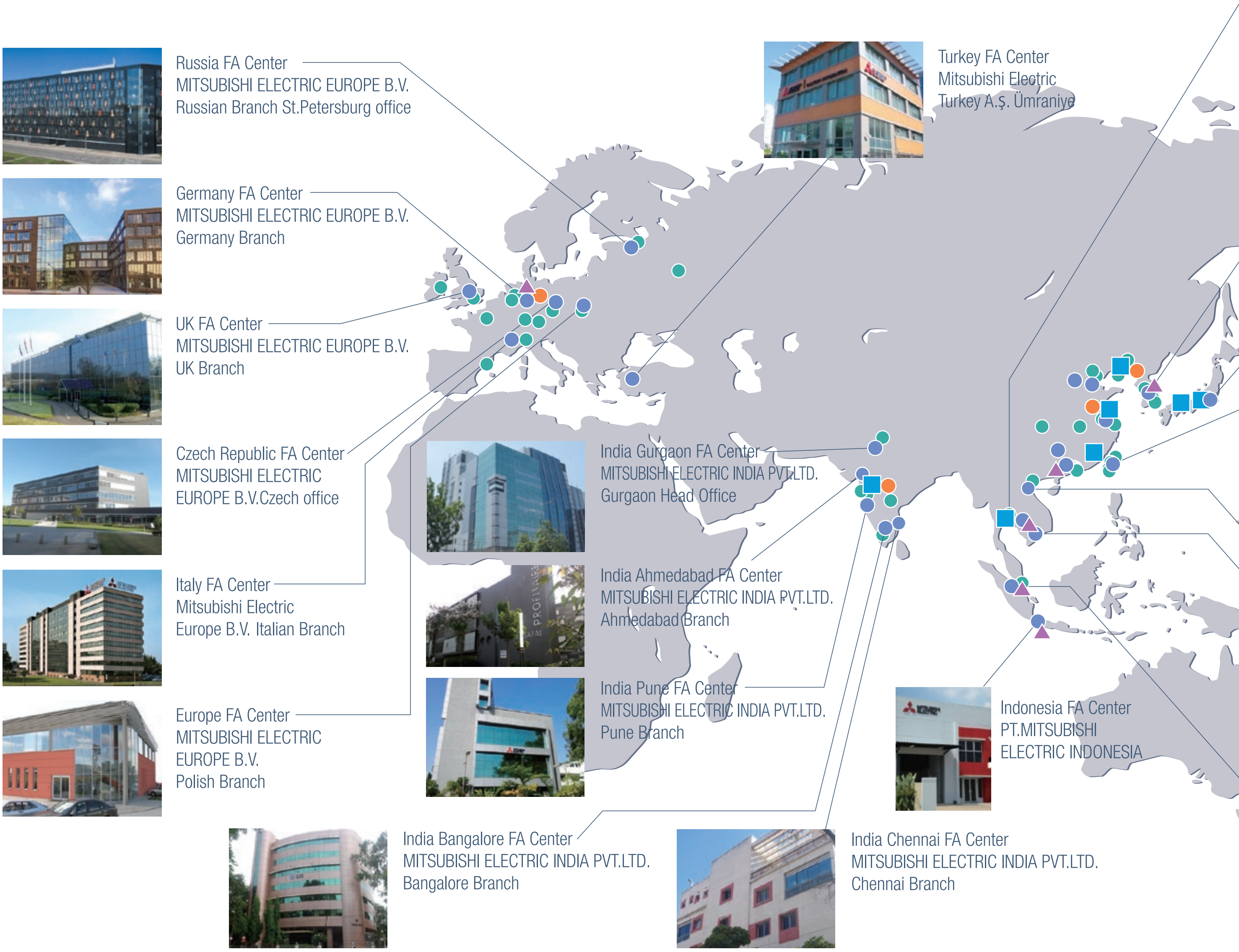
Converter installation attachment for enclosure	Multifunction regeneration converter
FR-XCCP[ ]	**FR-XC-[ ]**
01	(H)7.5K
	(H)11K
02	(H)15K
03	(H)22K
	(H)30K
	(H)18.5K-PWM
	(H)22K-PWM

Combination matrix of FR-XCCU and FR-XC(-PWM)

IP20 compatible attachment	Multifunction regeneration converter
FR-XCCU[ ]	**FR-XC-[ ] (-PWM)**
01	37K
	H55K
02	55K
03	H37K

Mitsubishi Electric's global FA network delivers reliable technologies and security around the world.

🟦 Production base ● Development center ● Global FA Center ▲ Mechatronics showroom ● Mitsubishi Electric sales office



Russia FA Center
MITSUBISHI ELECTRIC EUROPE B.V.
Russian Branch St.Petersburg office

Germany FA Center
MITSUBISHI ELECTRIC EUROPE B.V.
Germany Branch

UK FA Center
MITSUBISHI ELECTRIC EUROPE B.V.
UK Branch

Czech Republic FA Center
MITSUBISHI ELECTRIC
EUROPE B.V.Czech office

Italy FA Center
Mitsubishi Electric
Europe B.V. Italian Branch

Europe FA Center
MITSUBISHI ELECTRIC
EUROPE B.V.
Polish Branch

Turkey FA Center
Mitsubishi Electric
Turkey A.Ş. Ümraniye

India Gurgaon FA Center
MITSUBISHI ELECTRIC INDIA PVT.LTD.
Gurgaon Head Office

India Ahmedabad FA Center
MITSUBISHI ELECTRIC INDIA PVT.LTD.
Ahmedabad Branch

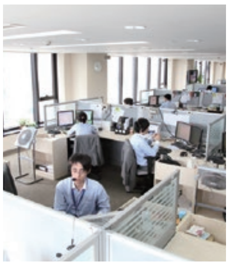
India Pune FA Center
MITSUBISHI ELECTRIC INDIA PVT.LTD.
Pune Branch

Indonesia FA Center
PT.MITSUBISHI
ELECTRIC INDONESIA

India Bangalore FA Center
MITSUBISHI ELECTRIC INDIA PVT.LTD.
Bangalore Branch

India Chennai FA Center
MITSUBISHI ELECTRIC INDIA PVT.LTD.
Chennai Branch

Available services



Technical consultation (engineering)
Our Japanese and/or local staff offer technical advice, and can also propose the best products and systems for a customer's specific application needs.

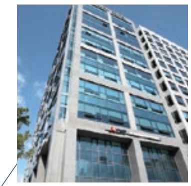
Showrooms
The latest automation technologies, including programmable controllers, HMIs, inverters, servo systems, and industrial automation machinery such as electrical-discharge machines, laser processing machines, CNCs, and industrial robots can be seen at Mitsubishi Electric showrooms.

Training
From basic operations to applied programming, our training schools offer regular courses that use actual machines. We also offer customized training programs and onsite training sessions.

Technical support
Our FA centers and service shops work together to provide repairs, onsite engineering support, and spare parts.

Repairs
Handle repairs of our FA products.

Thailand FA Center
MITSUBISHI ELECTRIC FACTORY AUTOMATION (THAILAND) CO.,LTD



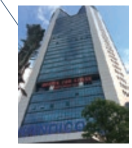
Korea FA Center
MITSUBISHI ELECTRIC AUTOMATION KOREA CO.,LTD.

MITSUBISHI ELECTRIC CORPORATION
Factory Automation Systems Group

Taichung FA Center
MITSUBISHI ELECTRIC TAIWAN CO.,LTD

Taipei FA Center
SETSUYO ENTERPRISE CO.,LTD

Ho Chi Minh FA Center
MITSUBISHI ELECTRIC VIETNAM COMPANY LIMITED



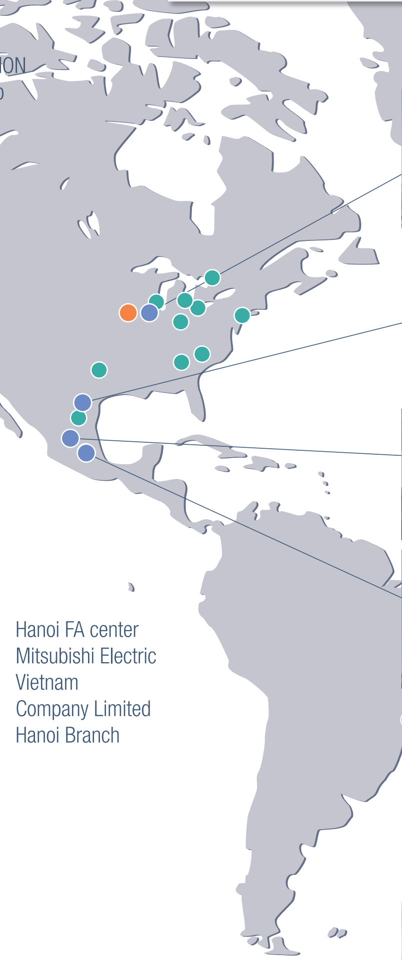
Hanoi FA center
Mitsubishi Electric Vietnam Company Limited Hanoi Branch

ASEAN FA Center
MITSUBISHI ELECTRIC ASIA PTE.LTD.

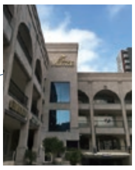
Service bases are established around the world to provide the same services as in Japan globally. Overseas bases are opening one after another to support our customers' business expansion.

Area	Our overseas	FA centers
EMEA	26	7
China	17	4
Asia	31	13
Americas	15	6
Others	1	0
Total	90	30

·As of July 2017



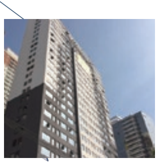
North America FA Center
MITSUBISHI ELECTRIC AUTOMATION,INC.



Mexico Monterrey FA Center
Monterrey Office, Mitsubishi Electric Automation, Inc.

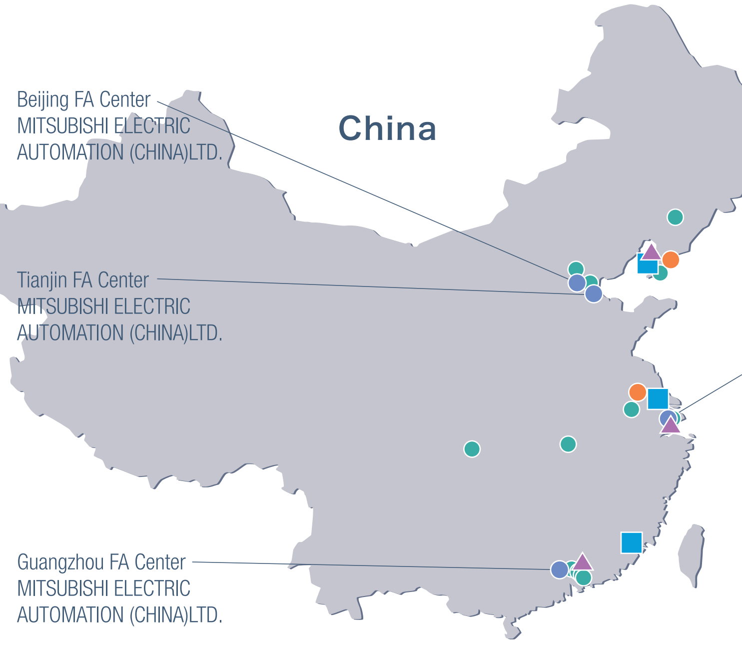
Mexico FA Center
Querétaro Office, Mitsubishi Electric Automation, Inc.

Mexico City FA Center
Mexico FA Center
Mexico Branch, Mitsubishi Electric Automation, Inc.

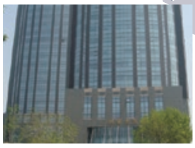


Brazil FA Center
Mitsubishi Electric do Brasil Comércio e Serviços Ltda.

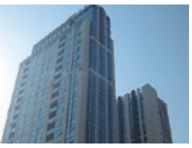
Brazil Votorantim FA Center
MELCO CNC do Brasil Comércio e Serviços S.A.



Beijing FA Center
MITSUBISHI ELECTRIC AUTOMATION (CHINA)LTD.



Tianjin FA Center
MITSUBISHI ELECTRIC AUTOMATION (CHINA)LTD.



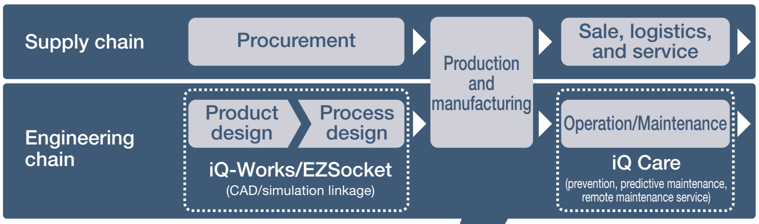
Shanghai FA Center
MITSUBISHI ELECTRIC AUTOMATION (CHINA) LTD.

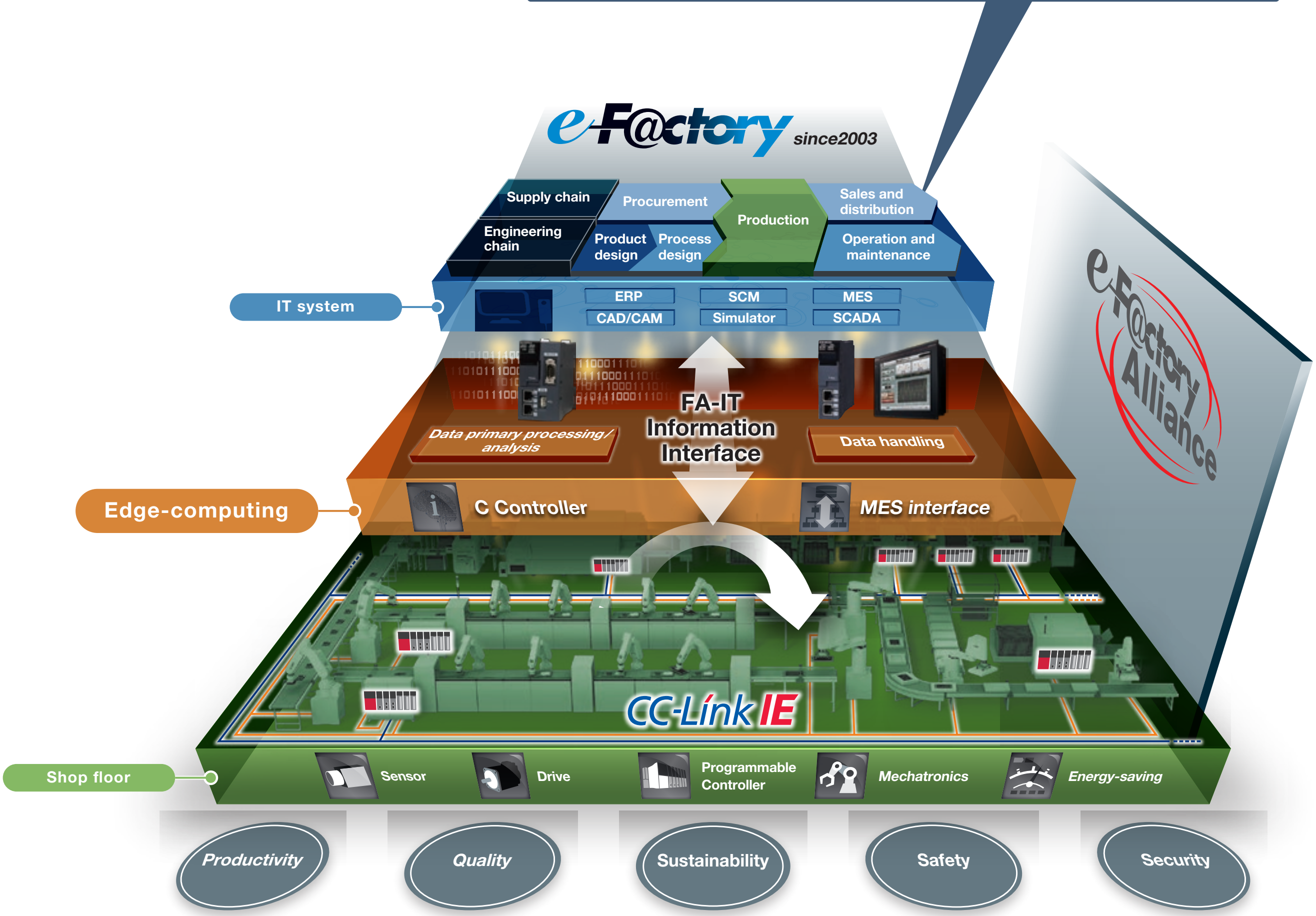
Guangzhou FA Center
MITSUBISHI ELECTRIC AUTOMATION (CHINA)LTD.

This solution solves customers' issues and concerns by enabling visualization and analysis that lead to improvements and increase availability at production sites.

Utilizing our FA and IT technologies and collaborating with e-F@ctory Alliance partners, we reduce the total cost across the entire supply chain and engineeringchain, and support the improvement initiatives and one-step-ahead manufacturing of our customers.

FA integrated solutions reduce total cost



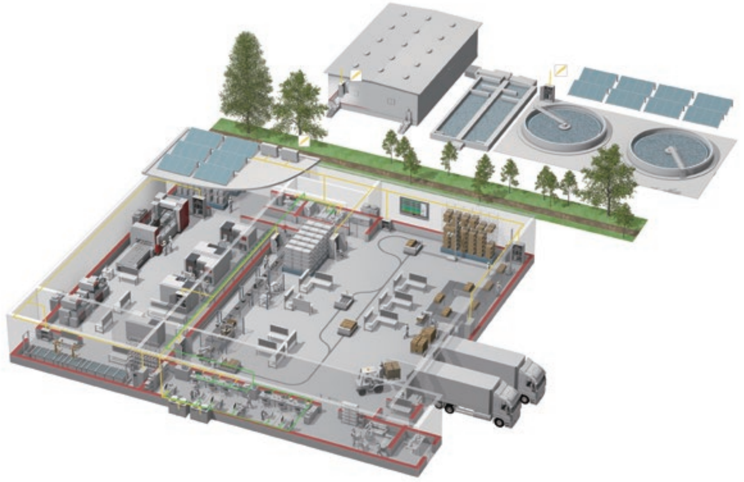


Overall production information is captured in addition to energy information, enabling the realization of efficient production and energy use (energy savings).

⚠ Safety Warning

To ensure proper use of the products listed in this catalog, please be sure to read the instruction manual prior to use.

YOUR SOLUTION PARTNER



Mitsubishi Electric offers a wide range of automation equipment from PLCs and HMIs to CNC and EDM machines.

A NAME TO TRUST

Since its beginnings in 1870, some 45 companies use the Mitsubishi name, covering a spectrum of finance, commerce and industry.

The Mitsubishi brand name is recognized around the world as a symbol of premium quality.

Mitsubishi Electric Corporation is active in space development, transportation, semi-conductors, energy systems, communications and information processing, audio visual equipment and home electronics, building and energy management and automation systems, and has 237 factories and laboratories worldwide in over 121 countries.

This is why you can rely on Mitsubishi Electric automation solution - because we know first hand about the need for reliable, efficient, easy-to-use automation and control in our own factories.

As one of the world’s leading companies with a global turnover of over 4 trillion Yen (over $40 billion), employing over 100,000 people, Mitsubishi Electric has the resource and the commitment to deliver the ultimate in service and support as well as the best products.

Low voltage: MCCB, MCB, ACB

Medium voltage: VCB, VCC

Power monitoring, energy management

Compact and Modular Controllers

Inverters, Servos and Motors

Visualisation: HMIs

Numerical Control (NC)

Robots: SCARA, Articulated arm

Processing machines: EDM, Lasers, IDS

Transformers, Air conditioning, Photovoltaic systems

* Not all products are available in all countries.

Mitsubishi Electric Corporation Nagoya Works is a factory certified for ISO 14001 (standards for environmental management systems).

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MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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