

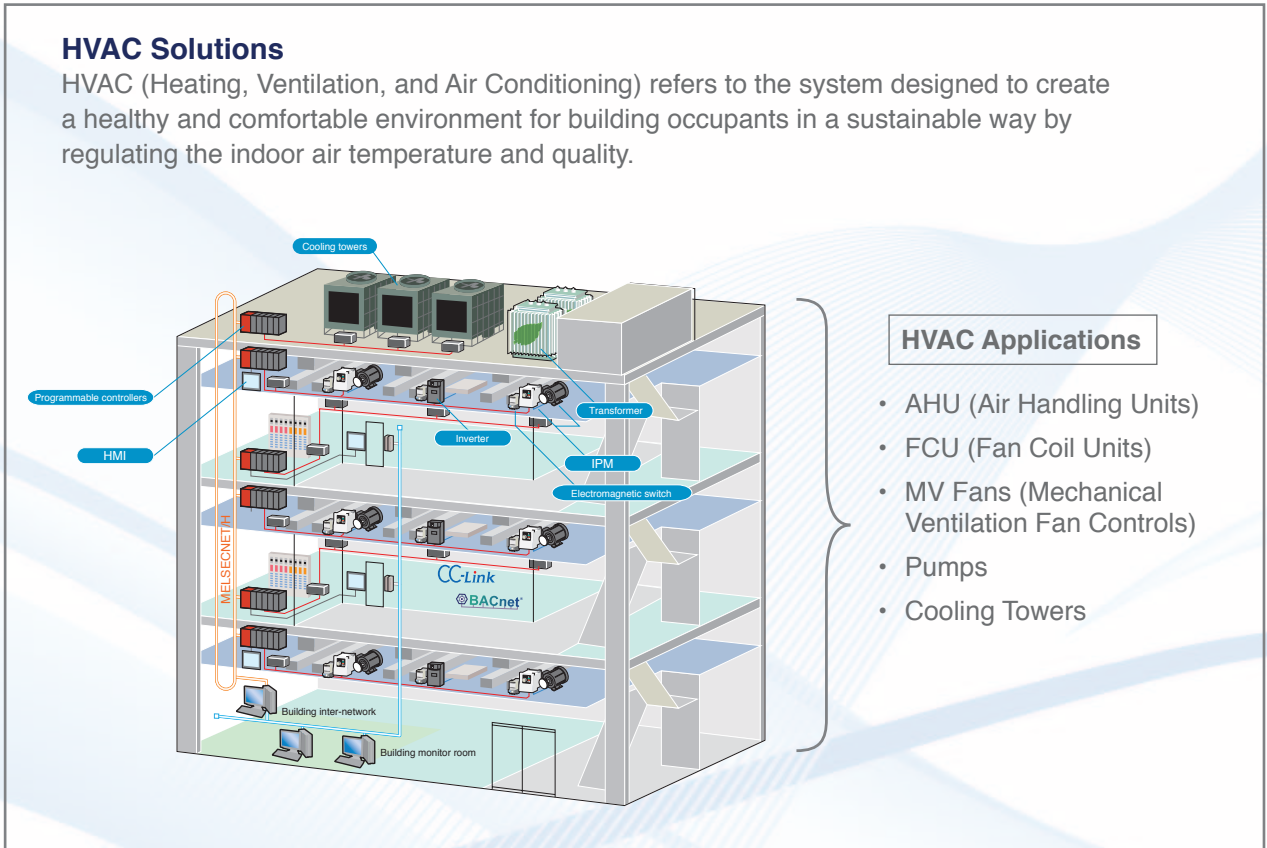
HVAC

Global Heating, Ventilation and Air Conditioning Systems



Mitsubishi Electric in HVAC

For more than 90 years Mitsubishi Electric's reputation as a quality manufacturer of electronic equipment has found a presence in nearly every corner of the globe. Strategic expansion into new market segments in more places has made the three diamond logo a symbol universally known for putting both our customers (and their customers) immediately at ease. Mitsubishi's history with inverters began with the commercial launch of the Z200 series in 1989. Since then more than 15 million inverters have been shipped to our customers worldwide. An expansive support and service network ensures their continued satisfaction.



Environment Friendly Building

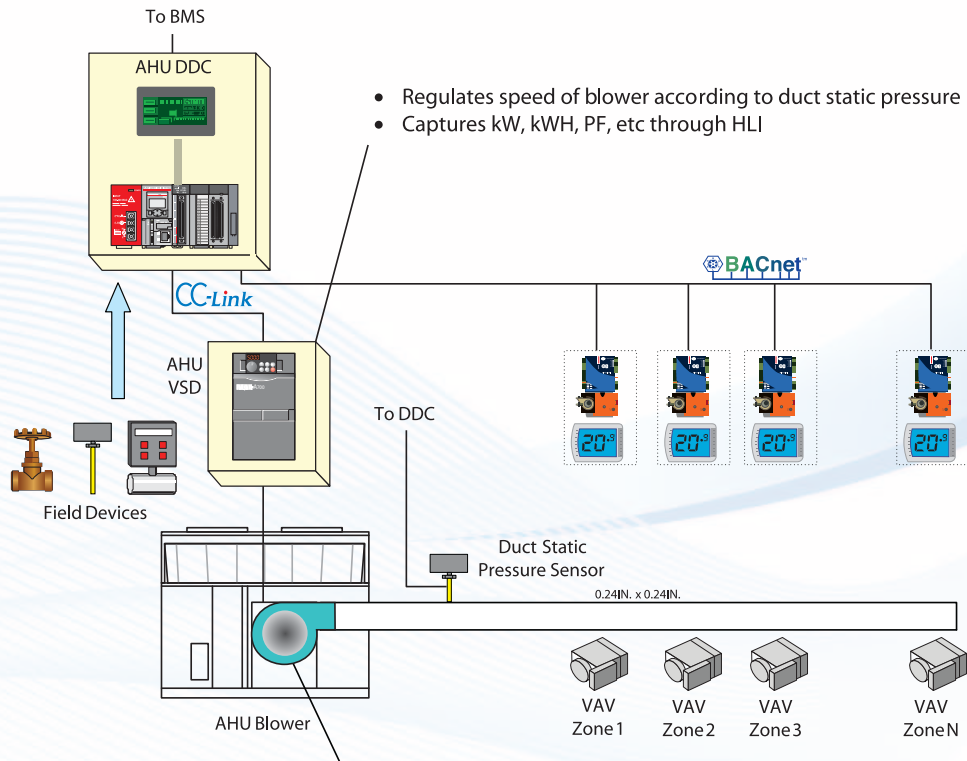
As a result of the increased worldwide interest in green building concepts and practices, a number of organizations have developed standards, norms and rating systems that allow government regulators, building professionals and consumers to embrace green building with confidence. Green building rating systems such as BREEAM (United Kingdom), LEED (United States and Canada), DGNB (Germany) and Green Mark (Singapore) help consumers determine a structure's level of environmental performance. They award credits for optional building features that support green design in categories such as :

- the location and maintenance of the building site,
- the conservation of water, energy, building materials, and heating and cooling.

Mitsubishi Electric can contribute by providing key products for HVAC solutions in green buildings.

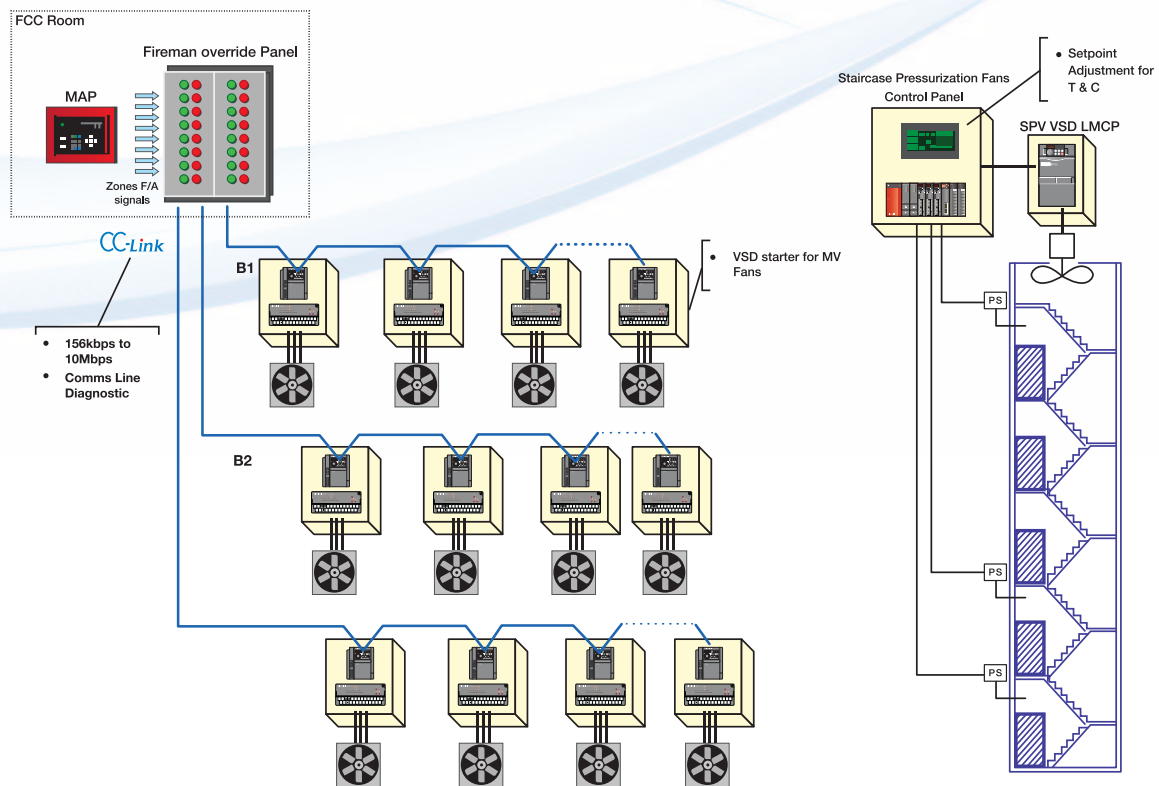
HVAC Application Examples

Air Handling Unit



IPM Motor offers up to 20% higher efficiency compared to standard induction motors

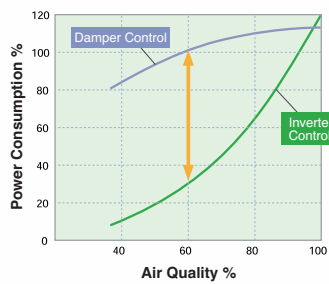
Mechanical Ventilation Fan Control



Significant Energy-Savings through Inverter Drives

Energy-Savings Through Speed Control

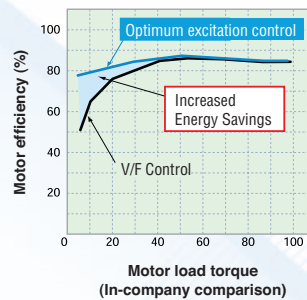
For fans, pumps, and blowers, where torque load varies with the square of speed, power consumption is proportional to the cube of the speed and is decreased by using speed control to adjust air volume.



Energy-Savings Through Optimum Excitation Control (general purpose motors)

For even greater energy-savings, continuous adjustment of excitation current maximizes system efficiency.

For example, at 10% motor load torque, optimum excitation control will increase motor efficiency by about 15% compared to conventional V/F control.



Energy-Savings Driven Motor

What is an IPM motor?

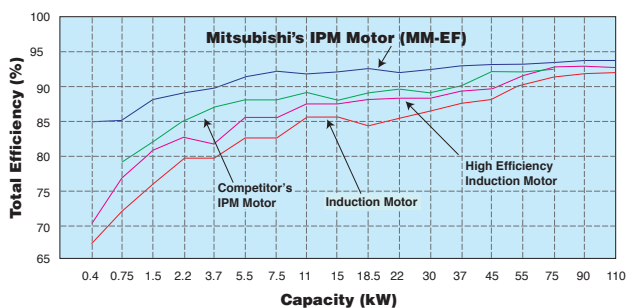
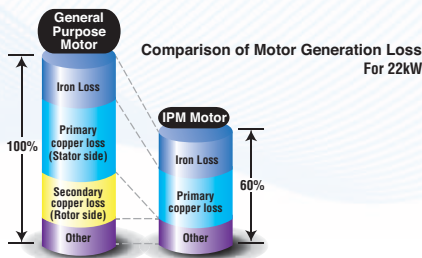
An IPM motor is a synchronous motor which has an integrated permanent magnet in the rotor.

IPM motors are highly efficient

IPM motors have permanent magnets embedded and are even more efficient than high-efficiency motors.

Why does an IPM motor have such high efficiency?

- There is no secondary copper loss because current doesn't flow to the rotor (secondary side).
- The current of the motor decreases because it harnesses the flux of magnetic induction by a permanent magnet.
- Reluctance torque is available.



The Effect of Energy Savings is Obvious

The effect of energy savings is visible by energy saving monitor of the operation panel, output terminal (FM, AM terminal) or via network.

Power Savings Monitor Display



Energy Saving Monitor List

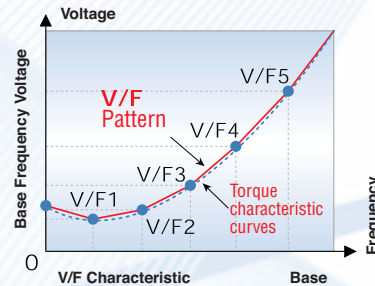
Power saving monitor (kW)
Power saving rate (%)
Power saving amount (kWh)
Power saving amount charge (\$)
Power saving average value (kW)
Power saving rate average value (%)
Power saving charge average value (\$)
Annual power saving amount (kWh)
Annual power saving amount charge (\$)

Ideal for Fans and Pumps

Optimum Torque Control

Adjustable 5 points V/F

- Set the torque pattern that is optimal for the machine's characteristic.
- Expect even more energy savings with optimum excitation control and optimum V/F pattern working together.



Optimum Control of Flow Rate and Pressure Enhanced PID function

- Energy savings in low speed region; PID shutoff (sleep control) function.
- Shorter PD startup time; PID automatic switchover function.
- Monitor of set point/measured value/deviation possible; PID monitor.
- Convenient for HVAC usage; forward/reverse operation switch over is simple with an external signal.
- Corresponds to a wide range of detectors; set points and measured value for PID input can either be voltage (0 to 5V/0 to 10V) or current (4 to 20mA).

Safety From Power Failures

- Operation continues without the motor coasting when an instantaneous power failure occurs in fan and blower applications.
- The inverter may trip and the motor may coast depending on the load condition.

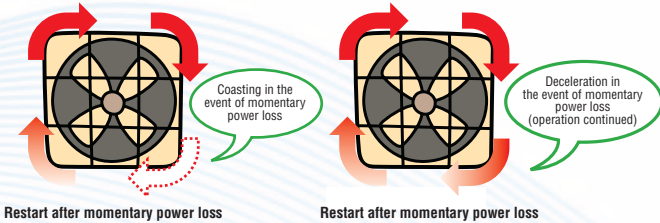
Ideal for Fans and Pumps (cont.)

Motor Thermal Management

PTC thermistor input

- Protection of the motor can be certain because the built-in temperature sensor (PTC)^{*1} of the motor can be input directly to the drive in addition to the electronic thermal relay function.
1. PTC thermistor input; Positive Temperature Coefficient Thermistor

Restart Function



Long Life and Simple Maintenance

Operating Life of Parts Extended

- Newly developed long life cooling fan (design life of 10 years ^{*1}); Longer operating life is further enhanced with the use of ON/OFF control of cooling fan.
 - Long life capacitor (design life of 10 years ^{*1, *2}) A capacitor with specification of 5000 hours at 105°C ambient temperature is used.
1. Ambient temperature: yearly average 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt) The design life is a calculated value, it is not a guaranteed value.
 2. Output current: 80% of the rated current of Mitsubishi standard 4P motor.

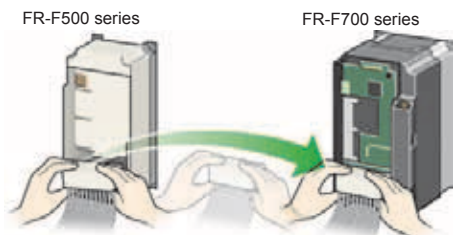
Internal Diagnostic System

- Components such as capacitors or inrush circuits, which need replacing over time, are continuously monitored by the drive itself.
- Advance warning is given when a part is getting near to the end of its useful life, so that preventative action can be taken well before performance is affected.

Maintenance Timer

- Maintenance timer output function can also inform of maintenance time for peripheral equipment.
- Average output current value and maintenance timer value are output as pulses.

Upgrade to Latest Model is Easy



Ease of Operation

Commercial power supply switchover sequence

- Switchover to commercial power-supply operation is simple using the R1 and S1 terminals of the control circuit and commercial power-supply switchover sequence. (FR-F700 Series only)

Control Features for Windmill Fans Effect Flying start & regeneration avoidance function

- **Flying start:** Smoothly restarts a motor that is rotating even in the opposite direction due to the windmilling effect.
- **Regeneration avoidance function:** Avoid a regeneration overvoltage alarm by automatically increasing the frequency to continue operation if the fan happens to rotate faster due to the effect of another fan in the same duct.

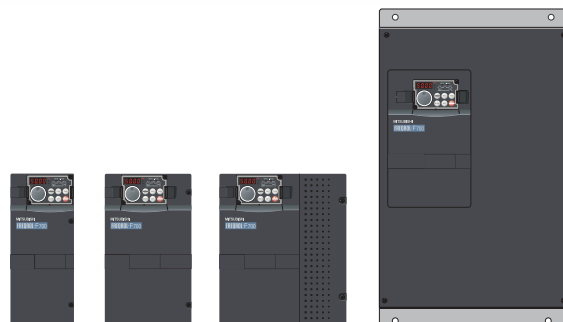
Ease of Use

- Simple-to-replace cooling fans – no need to disassemble the drive
- 'Comb' shape wiring cover makes for faster connection for power and control cable (Not used on 'NA' version drives)
- Non-volatile memory in keypad allows drive settings to be stored indefinitely and even transferred to other drives if necessary, greatly reducing set up time

Reduction of CO₂ Emissions Through Mitsubishi Inverter Drives

Comparison of CO₂ generation and energy consumption amount per year

- A 15kW motor with average air volume adjusted at 60% is operated 24 hours a day for 365 days. Power consumption is converted to the CO₂ equivalent for comparison of mass with
 $1000\text{kWh} \div 0.555 \text{ tons} = \text{CO}_2$.
 Damper control in general purpose motor inverter drive.
 75.1 tons to 24.8 tons. Reduction effect of approximately 50.3 tons.
- Even more reduction of emissions through IPM motor drives. Damper control in IPM motor inverter drive.
 75.1 tons to 19.7 tons. Reduction effect of approximately 55.4 tons.



■ SILVERTON CASINO AQUARIUM, LAS VEGAS

Completion Date: 2007

Number of Floors: 4

Gross Area: N/A

Aquarium: 117,000 gallons; 442,893 liters

Installation: Pumping, FR-F740

The Silverton Casino is particularly proud of its 117,000-gallon cylindrical saltwater aquarium. What visitors don't see when they visit the popular attraction is the immense behind-the-scenes mechanical system in place that regulates the aquarium's water flow, salinity, temperature and filtration.

Aquarium staff knew that an inverter on the pump's motor would regulate how much energy was used by the motor. Lower energy output would reduce maintenance of the motor and increase the life of the mechanism. It would also eliminate the need for the mechanical valve that had been installed to regulate the flow rate. With four F700 Series Mitsubishi inverters installed so far, the pumps now operate at the specific speed required to produce and maintain the 600 GPM flow needed. Each inverter driven pump is delivering on average a 26% reduction in energy consumption. Silverton will be installing more F700s very soon based on these results.

■ LAKE OF DREAMS, WYNN LAS VEGAS

Completion Date: 2005

Number of Floors: 45

Gross Area: 870 square meters

Building Height: 187 meters

Installation: Pumping, FR-F740

The F700 solution from Mitsubishi Electric was chosen to drive ten 75kW water pumps for the Lake of Dreams waterfalls, which are seen by millions of guests every year on the world-famous Las Vegas Boulevard. The FR-A7-ETH Ethernet interface module acts as a connectivity hub into the proprietary show control and re-maps the command and diagnostic data to allow for smooth integration. The solution provides a seamless upgrade path to allow replacement of the older drives as needed without complicated program changes or extended periods of downtime. The high reliability and optional extended warranty contribute to a lower total cost of ownership (TCO) and improved uptime.





■ **BRAMPTON CIVIC HOSPITAL, ONTARIO**

Completion Date: 2007

Number of Floors: 6

Gross Area: 120,000 square meters

Building Height: 25 meters

Installation: FR-A560

Brampton Civic Hospital has grown from 479 beds in October 2007 to 553 beds in 2011/2012 offering increased capacity and improved access to high quality health services for the community's growing population.

Hundreds of MGI brand labeled FR-A560 inverters were integrated into the building's air handling units and pumping systems.

■ **SUNCOR FIREBAG FACILITY, ALBERTA**

Completion Date: 2012

Number of Floors: N/A

Gross Area: 10 million square meters

Building Height: N/A

Installation: Air handling, FR-A760

Suncor is an energy company which pioneered the world's first commercially successful oil sands operation in 1967 near Fort McMurray, in northeastern Alberta, Canada. Today, with total production nearing the one billion barrel mark and enough reserves to sustain production for the next 50 years, the company remains a leader in oil sands development. Over 100 MGI brand labeled FR-A760 inverters have been incorporated into various mechanical systems during the most recent expansion.



■ COPERNICUS SCIENCE CENTRE, POLAND

Completion Date: 2010

Number of Floors: 2

Gross Area: 20,000 square meters

Building Height: 15 meters

Installation: FR-F740

Copernicus Science Centre conducts modern science communication through interactive exhibitions addressed to different groups of recipients. The Copernicus Science Centre total floor-space of 15,000 square meters houses permanent and temporary exhibitions, laboratories and workshops, a conference centre, cafes and restaurants, plus office space and a distinctive rooftop garden. The permanent exhibition contains around 430 exhibits situated on almost 5,000 square meters, attracting about 2,500 visitors daily. The mission of the center is to inspire debates and discussions, as well as activities at the frontier of science and art. In this facility there are 30 Mitsubishi inverters installed in the HVAC system.

■ JMP FLOWERS, POLAND

Completion Date: 2008

Number of Floors: 1

Gross Area: 110,000 square meters

Building Height: 12 meters

Installation: FR-F740

JMP Flowers Group has been operating since 1977. The company is the European leader in terms of quality of produced flowers. JMP Flowers Greenhouses occupy a total area exceeding 11 hectares and are among the most modern in the world. JMP specializes in the cultivation of several varieties of flowers such as roses, antirrhinum and orchids, which require different growing habitats to thrive. It is important to create optimum conditions for growth of each variety.

In order to match all these expectations it was necessary to use the highest quality of inverters. The well-developed functionality of the HVAC system and the ease-of-use of the Mitsubishi inverters turned out to be the ideal solution for this application.

Another key benefit delivered by the Mitsubishi Electric frequency inverters was the reduction in energy usage in the production process.





■ GUALA DISPENSING, ITALY

Completion Date: 2007

Number of Floors: 3

Gross Area: 18 meters squared

Building Height: 22.3 meters

Installation: Climate Control, FR-F740, FR-E740, FR-D740

Guala Dispensing, part of Guala Group, is an Italian company situated in northern Italy. They manufacture dispensers for products used in home and personal care. The process needs climate control inside the plant, which is an important energy consumption used for this purpose. In order to reduce the cost of energy, more than 30 Mitsubishi Electric inverters, ranging from 2.2kW up to 37kW were installed. This led to a total savings for the overall energy cost of the plant at around 8%. Most importantly, the reduction of energy consumption in the climate control room was around 80%. The production lines experienced minimum stop time, due to the simplicity of the parameterization. The possibility to communicate the accumulated energy via the integrated Modbus was appreciated by the customer, who could review the data directly in the Energy Management System.



■ DALIAN SUBWAY, CHINA

Completion Date: N/A

Number of Floors: N/A

Gross Area: N/A

Building Height: N/A

Installation: Air Ventilation, FR-F740, FR-A740

The Dalian subway project is the first large infrastructure project of the Liaoning coastal economic belt. It is also the first subway project since the city's founding 110 years ago, marking Dalian's entry in the subway transportation market.

Mitsubishi will supply FR-F740 and FR-A740 inverters for ventilation and air conditioning of the station and the service tunnel between the tunnels.



■ HONG KONG INTERNATIONAL AIRPORT

Completion Date: 1998

Number of Floors: N/A

Gross Area: 12.5 million square meters

Building Height: N/A

Installation: Pumping, FR-F746

Hong Kong International Airport, the main airport in Hong Kong opened for commercial operations in 1998, replacing Kai Tak. The airport is an important regional trans-shipment center, passenger hub and gateway for destinations to mainland China as well as Asia. Hong Kong International Airport has won eight major awards for customer satisfaction in eleven years.

Three F700 Series Mitsubishi inverters were installed to improve pumping.

■ RESIDENTIAL BUILDINGS, HONG KONG

Completion Date: 2010

Number of Floors: 41

Gross Area: 110,000 square meters

Building Height: 130 meters

Installation: Air Circulation, FR-F740

The air circulation in the lift lobby corridor for over 40 residential floors is controlled by a fan which is located at the top of each block. The fans produce a lot of noise, therefore property management installed Mitsubishi inverters in each block to control the fan in order to solve the noise problem. A simple V/F control was implemented with a fixed frequency. The inverter is controlled manually from an external control box next to the fan or remotely through a network. The Mitsubishi inverter solution has resolved the noise issues.





■ METRO PARK HOTEL, HONG KONG

Completion Date: 2007

Number of Floors: 33

Gross Area: 70,000 square meters

Building Height: 100 meters

Installation: Air Ventilation, FR-F740

Metro Park Hotel is located in Hong Kong's leading commercial, shopping and entertainment district - Causeway Bay.

Mitsubishi Electric supplied F740 inverters for the Metro Park Hotel to improve air ventilation.



■ BANK CENTRE, HONG KONG

Completion Date: 1975

Number of Floors: 25

Gross Area: N/A

Building Height: 80 meters

Installation: Air Ventilation, FR-F740

Bank Centre was completed in 1975. The building is 25 stories tall, housing a shopping mall and office space.

To improve air ventilation, 18 Mitsubishi inverters were installed on each commerce floor.



■ MARINA BAY FINANCIAL CENTRE, SINGAPORE

Completion Date: 2010

Number of Floors: 55 (hotels)

Gross Area: 35,500 square meters

Building Heights: 150 – 170 meters

Installation: FR-F740, FR-F746

Marina Bay Financial Centre stands on a 3.55 hectare site with three office towers offering nearly three million square feet of prime office space, two residential towers comprising 649 luxury apartments and retail space of approximately 176,000 square feet – located on prime waterfront property.

Mitsubishi supplied F740/F746 inverters for Integrated Resorts @ Marina Bay Sands. Applications for the inverters included: cooling towers, chilled water and condenser water pumps, fans (carpark, kitchen, staircase, etc.), and air handling units (AHUs).

■ CITY SQUARE MALL, SINGAPORE

Completion Date: 2009

Number of Floors: 9

Gross Area: 65,000 square meters

Building Height: 35 meters

Installation: FR-F740, FR-F746

The City Square Mall is the first Eco shopping mall in Singapore to be awarded the Building Construction Authority (BCA) Green Mark Platinum Award for its energy efficiency features and energy savings.

City Square Mall is a 9 story commercial development comprised of retail space, an institutional tower, 4 levels of basement which comprises retail and ancillary facilities including an urban park. Mitsubishi supplied inverters for applications such as water pumps, fans, cooling towers, AHUs, fan coil units (FCU), etc.





■ TOKYO BUILDING, JAPAN

Completion Date: 2005

Number of Floors: 33

Gross Area: 1,140,000 square meters

Building Height: 164 meters

Installation: FR-F700

29 entertainment venues and 3 office complexes are housed in Tokyo Building (TOKIA). The nickname TOKIA comes from a unique combination of the words Tokyo (i.e. Tokyo Building), tokimeki (meaning “excitement” in Japanese), and “All Day.”

The global headquarters of Mitsubishi Electric are located in the TOKIA Building. Mitsubishi inverters were installed as a part of a wider Building Management System (BMS) to improve energy-savings in the building.

■ NAGOYA WORKS, JAPAN

Completion Date: 1924

Number of Floors: Varies per building

Gross Area: 306,000 square meters

Building Height: Varies per building

Installation: FR-E700, FR-A700, FR-F700

Nagoya Works is Mitsubishi Electric’s facility for product development and production of many product lines, including factory automation products. Many Mitsubishi Electric inverters (FR-E700, FR-A700, FR-F700 Series) are used in the air conditioning systems of the clean rooms for assembly of the laser cutting machines. The clean rooms have a total surface area of 2,050 square meters and a volume of 7,600 cubic meters. The use of these inverters significantly reduces the energy consumption of this building, while maintaining a high level of ventilation.





Optimum Excitation Control

Mitsubishi inverters deliver energy savings beyond those offered by the affinity law. A special algorithm in 700 Series inverters called optimum excitation control is hard at work to make these additional savings possible.

Optimum excitation control dynamically optimizes power delivery to the motor shaft as a function of the actual system load. Throughout the operating speed range, the actual power required in variable torque loads is as unique as the system itself. Characteristics including original system over sizing, environmental conditions, and interaction with other building systems, afford real opportunities for additional energy savings when Mitsubishi inverters are on the job.

F700

The latest generation energy savings inverter is simple to set up and provides years of trouble free service. The largest model can deliver up to 1212 full load amps. Compatibility with the world's most popular building management network protocols including Siemens FLN, Metasys N2, BACnet, and LonWorks™, ensures easy integration into both new construction and retro-fit jobs.

Inverter Capacity	200V class: 0.75kW ~ 110kW 400V class: 0.75kW ~ 560kW
Control System	V/F control, optimum excitation control, simple magnetic-flux vector control
Output Frequency Range	0.5~400Hz
Communications	Modbus, CC-Link, DeviceNet, Profibus-DP, LonWorks, Metasys N2, Siemens FLN, BACnet, EtherNET/IP

D700

Small only in size Mitsubishi's micro inverter offers big features including a built in PID controller, and a flying start (frequency search) function. For systems using an analog speed reference, the D700 is an extremely cost effective method of introducing energy savings on even the smallest fan and pumps.

Inverter Capacity	Three-phase 200V class: 0.1kW ~ 15kW Three-phase 400V class: 0.4kW ~ 15kW Single-phase 200V class: 0.1kW ~ 2.2kW Single-phase 100V class: 0.1kW ~ 0.75kW
Control System	V/F control, optimum excitation control, general purpose magnetic flux vector control
Output Frequency Range	0.2~400Hz
Communications	Modbus

A700

Advanced performance makes it possible to support a wide range of variable speed applications from conveyance and chemical machines to line control applications such as winding and printing machines. Improved flexibility allows users to tailor their inverter to meet their application requirements.

Inverter Capacity	200V class: 0.4kW ~ 90kW 400V class: 0.4kW ~ 500kW
Control System	V/F control, advanced magnetic flux vector control and real sensorless vector control/vector control (*1) *1. Available only when the option FR-A7AP/FR-A7AL is mounted.
Output Frequency Range	0.2~400Hz
Communication	Modbus, CC-Link, DeviceNet, Profibus-DP, LonWorks, SSCNET III, ControlNet, Metasys N2, Siemens FLN, BACnet, EtherNET/IP

E700

The E700's application versatility makes it an excellent choice for both OEMs and end users who have constant or variable torque loads. Motor friendly soft PWM switching, a self-diagnostic mode, advanced flux vector control, and a flux optimization mode designed to save even more energy than a fixed variable torque V/Hz curve are just a few of the standard features.

Inverter Capacity	Three-phase 200V class: 0.1kW ~ 15kW Three-phase 400V class: 0.4kW ~ 15kW Single-phase 200V class: 0.1kW ~ 2.2kW Single-phase 100V class: 0.1kW ~ 0.75kW
Control System	V/F control, advanced magnetic flux vector control, general-purpose magnetic flux vector control, optimum excitation control
Output Frequency Range	0.2~400Hz
Communication	Modbus, CC-Link, DeviceNet, Profibus-DP, LonWorks, Siemens FLN



L Series: Compact yet powerful

L Series PLCs integrate several features to the CPU including high-speed counting, positioning, and data logging functions. With a compact yet highly flexible architecture, the L Series is an excellent solution for a wide range of machine and building controls.



Q Series PLCs: The original multi-CPU system

Q Series PLCs are equipped with a multiple CPU function that allows multiple CPUs to be mounted simultaneously. This capability allows for system configurations that match the scale and objectives of the production site.



FX Series: Convenient and flexible

FX Series Micro PLCs are loaded with a host of embedded functions that make it ideal for all types of machine and building control including HVAC, fan & pump and even temperature related functions. Designed for tight spaces, this controller can be expanded to meet almost any control need in both scale and functionality.



Low Voltage Circuit Breaker: High quality & high performance

Mitsubishi Electric has a wide range of low-voltage circuit breakers lineup such as MCB, MCCB, ELCB and ACB from 0.5 ampere to 6300 ampere. We have more than 75 years experience of manufacturing and designing low-voltage circuit breakers, and will continue supplying high quality and high performance products all over the world. Our low-voltage circuit breakers achieve not only safety protection, but also support customers' energy saving activity by visualizing energy consumption.



GOT1000 HMI Graphic Operation Terminal

The GOT1000 platform combines the best in performance, graphics and functionality in a unique, ultra compact and robust package. Embedded communications including front mounted USB ports simplifies access and data retrieval. A wide range of solutions are available in both panel mount and pendant style formats to not only meet but exceed your application requirements.



MS-N Series Contactors: Compact body, full features

A complete lineup of motor controllers to 800A in size. Products are UL and CSA approved as well as meet the standards of all major markets around the world. A full range of options and accessories are also available. Mitsubishi Electric contactors have been tested with the WS Series circuit breakers to provide the best possible panel SCCR ratings when used in combination.



ME96-NSR Series: Multi-measuring instrument

Mitsubishi Electric Multi-Measuring Instrument NS Series features high performance and a crystal clear display. With simple operating functions, NS Series is the best support for your measuring and monitoring systems.

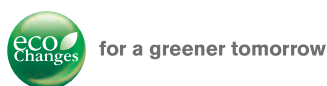
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Safety Warning

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

Mitsubishi Electric Corporation Nagoya Works is a factory certified for ISO14001 (standards for environmental management systems) and ISO9001 (standards for quality assurance management systems)



Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

MITSUBISHI ELECTRIC CORPORATION

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