MITSUBISHI ELECTRIC
Changes for the Better

FR-Family

Frequency Inverters

Intelligent Drive Technology

Top of Every Class

Cost-Effective / Reliable / **Safe** /
User-Friendly / **Network-Capable** / Flexible /

Universally accepted

Frequency inverters made by Mitsubishi Electric carry all the major national and international marks of conformity.

Installed over 18 million times

Drives for all conceivable applications: there's something for everyone at Mitsubishi Electric! With more than 18 million of our frequency inverters installed we are one of the largest manufacturers in the world. Day after day, in heavy-duty industrial use, our frequency inverters prove their high levels of cost-effectiveness, reliability, functionality and flexibility.

Frequency inverters developed by Mitsubishi Electric are used routinely in many sectors and systems – and that's not all. Mitsubishi Electric know-how also features in many frequency inverters made by other manufacturers who are utterly convinced by its technical edge and economic benefit.

Always one step ahead of technology

Innovative technologies applied by Mitsubishi Electric in developing their frequency inverters result in highly dynamic drive systems and genuine power misers. Examples of this innovative power are the new functions RSV control (Real Sensorless Vector Control) and OEC control (Optimum Excitation Control).

Meeting global norms and standards

Mitsubishi Electric's frequency inverters meet all the standards and specifications laid down in the EU Low Voltage Directive 73/23/EEC and the Machinery Directive 98/37/EC. Needless to say, all the units carry the CE mark and are certified as conforming to UL, cUL and GOST.

Contents

The six ingredients for success

Cost effectiveness

Energy savings of up to 60 % can be made by using Mitsubishi Electric frequency inverters, thereby also reducing CO_2 emissions and protecting the environment.

Reliability

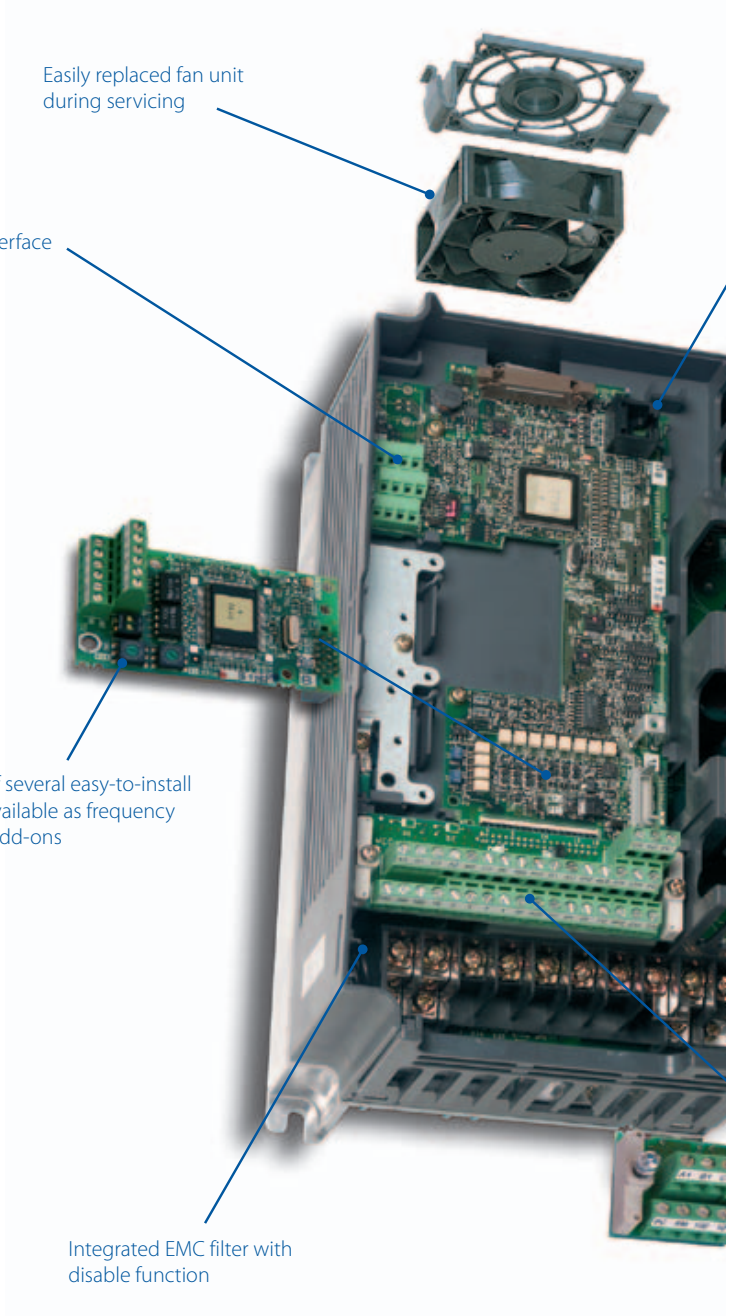
Safe and fault-free operation is guaranteed by various protective mechanisms and overload functions, top-quality temperature-resistant capacitors, permanently lubricated fans and dual-coated power and control PCBs.

The Six Sigma certified production ensures a high quality level at Mitsubishi Electric.

Standards

In addition to complying with well-known international norms and standards, the frequency inverters are also certified by the Det Norske Veritas foundation (DNV).

An increased level of safety is ensured in some frequency inverter ranges by the integrated emergency stop function (Safety Stop).

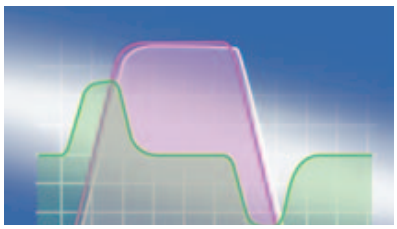


Convenience

The integral multifunction user panel, complete with digital dial, facilitates rapid and efficient input of all necessary drive parameters. It can also provide display of various performance data and error messages.

Flexibility

Compatible with all major field bus systems such as Profibus DP, DeviceNet, CC-Link, Ethernet, CANopen, Modbus, BACnet and LonWorks (the international communication standard in building services automation).



Functionality

Functionality, compatibility and perfect mechanical design are the main features of the frequency inverters supplied by Mitsubishi Electric.

Not all features are available on all Inverters.
Please check applicability.

The right solution every time

A diverse product range helps you make the right product choice.

Well set

Mitsubishi Electric always has the right drive system for straightforward and complex applications alike. With so many sizes, outputs and features, the right frequency inverter solution is available for every conceivable drive requirement.

Indeed, in applications where space is at a premium, it can pay to know that Mitsubishi Electric frequency inverters have numerous overload versions.

In many cases a smaller frequency inverter can be used – logically resulting in reduced purchase costs, lower running costs and a smaller footprint.

The majority of frequency inverters supplied by Mitsubishi Electric come as standard with 200 % overload capacity. The benefit for the user is that our frequency inverters offer double the output of comparable types made by our competitors.

FR-A800 – Leading drive performance

The frequency inverters, developed by Mitsubishi Electric, boast cutting-edge technologies for optimum motor torque and speed control.

The FR-A800 series is the successor of the highly successful FR-A700 series. It is equipped with the new state-of-the-art high-speed processor by Mitsubishi Electric. With better than ever control performance and response level, safe and accurate operation is assured in a diverse range of applications.

Some of the outstanding features are the integrated USB ports for programming and parameter copying, an-easy to-read control panel, optimum power usage and energy saving functions, improved system safety, three expansion slots for a range of option and supported network cards

With its impressive versatility to meet equipment system needs ranging from machining and molding to winding, the FR-A800 is an extremely economical and highly-versatile solution for a wide range of applications.

The FR-A800 series is fully backwards compatible with the FR-A700 series. Parameters can be easily copied by FR Configurator2. In order to match the former machine response time, the input/output signals of the FR-A800 can be delayed.

The FR-A800 is suitable for use in a broad range of applications e.g. conveying and handling systems.

FR-A800 at a glance

Power range
0.4–630 kW

Input
200/400/500 V* 3 ph (50/60 Hz)

Output frequency
0–590 Hz
0–1000 Hz special type

Protection
up to 22 kW IP20, from 30 kW IP00

Control
V/f, OEC, RSV, CLV, Built-in PLC
Autotuning for AC and PM (Permanent Magnet Motors)

Integrated interfaces
Modbus RTU, RS485, USB

Optional extras
Analogue + digital I/Os,
encoder feedback

Network links
CC-Link, CC-Link IE Field, Profibus DPV1, Profinet, DeviceNet; Ethernet IP, SSCNETIII/H, LonWorks, Can bus

EMC protection
Integrated

* Depends on performance class

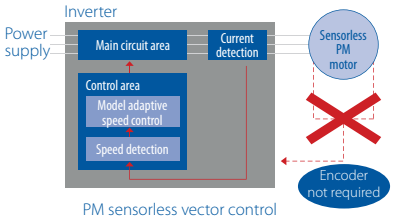
Intelligent solutions for every requirement.

Dynamics and precision: FR-A800

The drive behind your success

FR-A800: The wide power zone, of 0.4 to 630 kW's, is covered by range of conveniently sized units.

Suspended loads can be positioned accurately thanks to motor and encoder feedback.



PM sensorless vector control

Sensorless vector control ensaves faster response

Intelligent functions for any application

Sensorless vector control (RSV)

Equipped with their innovative RSV function (Real Sensorless Vector Control), Mitsubishi Electric frequency inverters have the ability to control the speed and torque of an AC motor without an encoder. The result is maximum performance across the full speed range in terms of dynamic response, precision and control. The motor thus sustains optimum dynamic speed characteristics, smooth rotation and high starting torque. As such, the FR-A800 is capable of achievements which used to be the reserve of high-end DC or servo systems.

Autotuning

Precise motor data forms the basis for optimum control of the vector drive without an encoder. All FR-A800 series inverters come with an autotuning function for AC and PM motors which identifies all the parameters required for the motor model in less than one minute, even if the motor is not running.

Sufficient memory is available to store data records for up to two motors. Online autotuning offers the facility to automatically record and offset changes to the data in operation, e. g. caused by changes in temperature.

Another tuning process (easy gain tuning) simplifies optimisation of the speed regulator. The sequential response of the motor is automatically detected and the control parameters adjusted for optimum performance. Labour-intensive manual tuning of the control parameters is a thing of the past.

Economy-rate positioning

The FR-A800 can also be used for positioning in conjunction with the "Closed Loop Vector Control". Full point to point positioning including different homing functions are available.

Optimum excitation control

Optimum control of the excitation current maximizes motor efficiency for additional energy savings. As an example, an approximately 15 % increase in efficiency is obtained at a motor load torque of 10 % compared to conventional V/F control.

Boost productivity while saving energy

Energy-saving functions well suited to the system and purpose application An energy monitor lets you confirm energy-saving at a glance. Measured values for power output can also be output as pulse signals. An external 24 V DC power source can be used to operate control circuits other than the drive unit.

PLC functions

The PLC functions integrated in the FR-A800 and FR-F700 mean optimum tailoring to the requirements of the user. The PLC offers direct access to all the drive parameters and will, on request, undertake plant management as a stand-alone control and monitoring unit. The password protection prevents unauthorized access to your expertise.

Mitsubishi Electric's programming software GX Works2 is a straightforward tool for programming the PLC functions.

PLC function programming is now also possible by FR Configurator2.

Various network compatibility

The drive can be controlled and monitored by a controller via network. For the major network protocols such as CC-Link IE Field, CC-Link, Profibus DP/DPV1, Profinet/ Ethernet IP/EtherCat (to be released soon) and SSCNETIII/H as well as DeviceNet™, LonWorks and Can bus communication options are available. RS485 communication (Mitsubishi Electric drive protocol, Modbus-RTU protocol) is supported as standard.

Integration in positioning systems

All the frequency inverters in the FR-A800 series can be used with servo drives within a motion system. Connection is simple using Plug and Play via SSCNETIII/H. The FR-A800 can even work as a leading axis drive. As such, there is no reason why the drives cannot be integrated further in existing control concepts.

Self-diagnosis for easy maintenance

Frequency inverters in the FR-A800 range monitor their own operational reliability. The innovative diagnosis and maintenance functions monitor all the components which are subject to wear and issue prior warning when due. Precautions are therefore in place to prevent failure and long downtimes.

Many protective mechanisms and overload functions guarantee fault-free operation and therefore supreme availability and operational reliability.

Extended service life

Mitsubishi Electric frequency inverters are noted for their durability. The FR-A800 also sets the benchmark in terms of product life. It is designed to last for over 10 years giving an investment which pays time after time.

Fourfold overload capacity

Many manufacturers of frequency inverters have specified various overload rating classes for their products – but rarely more than two. The FR-A800 is designed for no less than four overload ranges! This makes it easier to select the best frequency inverter for any application.

User friendly

The operation panel with the one touch Digital Dial allows direct access to all important parameters. Select the operation panel ideal for your needs. Choose either a LU operation panel with an LCD screen offering enhanced display functionality and a Real Time clock function, or a more economical DU operation panel with a 5-digit, 12-segment display.

The FR-A800 series also allows the connection of a Mitsubishi Electric graphical operation terminal (GOT). The connection to GOT2000 series is made by just plug and play (automatic setting of all needed parameters). The GOT provides operators with an easy-to-follow and intuitively high resolution display and facilitates easy operation via a touch panel.

Easy setup

Users can comfortably setup the drives with the Setup-Software FR Configurator2. The easy plug-and-play connection to USB terminal is equipped as standard. Parameters and PLC programs can be simply copied from and to commercial USB memory devices.

Easy operation with GOT

Clear user interface layout with project navigator for rapid programmiung

Tuning made simple

FR-F700 – The power saving inverter

Pump systems in industry – one domain of the FR-F700 frequency inverters

Economic powerhouse: the FR-F700

The frequency inverters in the FR-F700 range have been especially designed for pump and fan applications as well as heating, ventilation and air-conditioning installations (HVAC). Besides their protection ratings IP00/IP20 (FR-F740) and IP54 (FR-F746), the outstanding features of these power-saving frequency inverters include their simple but safe operation and start-up, perfect control management and optional network-capability.

Built-in functions, such as the pre-charge function or the PLC functionality, help to reduce the costs and the complexity of many applications, because additional components are eliminated.

Effective energy savings

Pumps and fans are particularly good targets for great reductions in energy consumption. Energy costs can be slashed by up to 60 %, notably in the lower speed or light load range of such applications.

Additional energy savings are effected by the cutting-edge "OEC technology" developed by Mitsubishi Electric. It supplies the motor with the optimum magnetic flux at any given time, thereby reducing losses. The result is maximum motor performance teamed with supreme efficiency.

User-friendly operation

The built-in "digital dial" permits the efficient input of all the necessary drive parameters, cutting down on both programming and start-up time.

Long service life

The FR-F700 can lay claim to a 10-year service life thanks to advanced capacitors and ventilators. These features, along with its simple maintenance and automatic warning signals, make the FR-F700 one of the most reliable inverters on the market.

FR-F740/746 at a glance

Power range
0.75–630 kW

Input
200/400 V AC 3 ph (50/60 Hz)

Output frequency
0–400 Hz

Protection
FR-F740: up to 30 kW IP20,
from 37 kW IP00
FR-F746: IP54

Control
V/f, OEC, SMFV, Built-in PLC

Integrated interfaces
Modbus RTU, RS485, BacNet

Optional extras
Analogue + digital I/Os

Network links
CC-Link, Ethernet, Profibus DP, LonWorks, DeviceNet, Siemens FLN, Metasys N2

EMC protection
Integrated

FR-E700 SC – The compact inverter

The inverters in the FR-E700 SC series are all-rounders and miniature masterpieces given their compact size.

Improved functions like an integrated USB port, an integrated one-touch Digital Dial control with a display as well as improved power usage at low speeds make the FR-E700 SC an economical and highly-versatile solution for a wide range of applications

Small and powerful

These inverters are a popular choice in a wide diversity of applications, from textiles machines to conveyer systems, from door and gate drives to fans and pumps. Featuring Mitsubishi Electric's extended vector control system they are able to achieve torques of 150 % from a frequency of just one Hertz. The autotuning function makes this mode possible even with high fluctuations in motor characteristics. For the user this means ample power under all circumstances, even at very low speeds.

Emergency stop function

The FR-E700 SC series has a two channel emergency stop for safe shutdown. This ensures safe operation in compliance with the European Machinery Directive without installation of another contactor. The FR-E700 SC thus conforms to the ISO 13849-1, PLd and IEC 60204-1 cat. 0 standards.

Intelligent control

Thanks to the integrated PID control these inverters can be used, for example, to control pump flow or for temperature control without any additional expense.

Improved machine protection

Improved torque/current limiting during startup and deceleration ensures better protection for the machine, reliably preventing machine damage.

Material transport systems like this example in a printing works are just one of the many applications for the new FR-E700 series.

Network support

A selection of plug-in option cards are available for the FR-E700 SC that enable it to connect to open fieldbus systems like Profibus DP, DeviceNet and even CC-Link.

FR-E700 SC at a glance

Power range
0.1–2.2 kW 1 ph
0.1–15 kW 3 ph

Input
100 V 1 ph/200 V 1/3 ph/400 V 3 ph (50/60 Hz)

Output frequency
0.2–400 Hz

Protection
IP20

Control
V/f, optimum excitation control, vector, advanced magnetic flux vector control

Integrated interfaces
Modbus RTU, RS485, USB

Optional extras
CC-Link, Ethernet, Profibus DP, DeviceNet, LonWork

All FR-E700 units up to 7.5 kW are less then 150 mm high.

FR-D700 SC– The standard inverter

Door and gate drives are only some of the multiple applications of the FR-D700 SC series

Simple operation

The user-friendliness of the FR-D700 SC series makes these units a particularly good choice for standard applications. Entering drive parameters and settings is quick and easy with the one-touch Digital Dial on the integrated control panel, saving time and cutting costs.

These features make the FR-D700 SC an excellent performer for both simple and more demanding tasks. Typical applications include feed and conveyor drives, machine tools and door and gate drives.

Space-saving installation

The ultra-compact FR-D700 SC can be mounted directly side by side. This saves valuable space in the cabinet.

Conveyor belts and chain conveyors are an ideal application for the FR-D700 SC

Enter the new drive universe

The inverters of the FR-D700 SC series set standards for small-format drives and provide an easy entry to the world of modern variable-speed drive technology. Despite their ultra-compact dimensions they feature a wealth of advanced functions. The FR-D700 SC series is ideal for simple drive applications in environments where space is limited.

Improved functions and device properties such as simplified cabling thanks to spring clamps, the integrated Digital Dial with LED display, improved performance yield in the low-speed range make the FR-D700 the new standard in the ultra compact class

Built-in emergency stop function

The FR-D700 SC series features a dual-channel emergency stop function for a safe torque off. With that the FR-D700 SC conforms to ISO 13849-1, PLd and IEC 60204-1 Cat 0.

FR-D700 SC at a glance

Power range
0.1–2.2 kW 1 ph
0.4–7.5 kW 3 ph

Input
100 V 1 ph/200 V 1/3 ph/400 V 3 ph (50/60 Hz)

Output frequency
0.2–400 Hz

Protection
IP20

Control
V/f, optimum excitation control, general-purpose magnetic flux vector control

Integrated interfaces
Modbus RTU, RS485

Peripherals and software

User-friendly set-up software

The user-friendly set-up software runs on Windows, i.e. the inverters can be configured using standard PCs. Several inverters can be set up, operated and monitored in parallel in one network. Connection is possible either via an RS485 interface or the optional SC-FR PC adapter cable. With FR-A800 and FR-E700 SC also an USB port can be used.

Handy parameter units

For added ease and convenience users may opt for integrated parameter units (FR-E/FR-D700 only) or clip-on parameter units (for all other inverters). A numeric keypad is available for direct input of numerical values. A four-line LCD display provides plain text information about performance data, parameter names, status signals and error messages – in eight languages.

Effective Harmonic Converters

In most cases, the energy given off by a motor in the regenerative mode, is converted to heat by braking resistors and thereby is lost. The Harmonic Converter FR-HC2 returns this energy back to the power source or supplies it to other inverters. The Harmonic Converters is equipped with high quality filters to effctively suppress harmonics.

Configuring the drive via a Windows laptop

Wide range of expansion options

Optional extras are available to optimise and expand system capability. Additional brake components, reactors and filters guarantee operation even in difficult conditions.

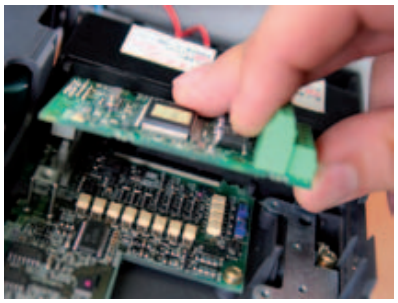
The range of functions can be expanded by optional boards, such as additional analogue/digital inputs/outputs.

Strong and smart

The separate Floor Standing Unit (FSU) for FR-F740 Inverters is a simple way of accommodating a free-standing frequency inverter system complying with protection class IP20 for installation in an electrical operating area.

The robust base units come pre-assembled and permit optional integration of a link reactor, a circuit breaker or – if required – an additional EMC filter.

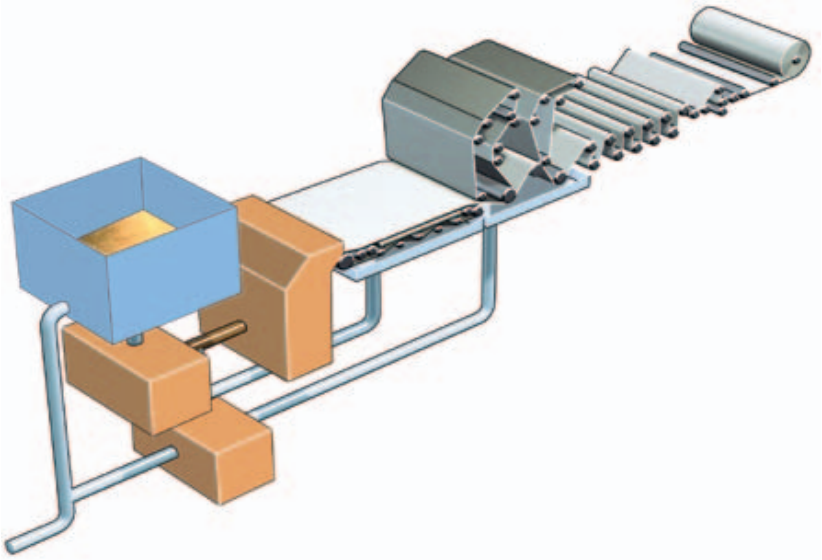
Power regeneration combined with effctive harmonic suppression



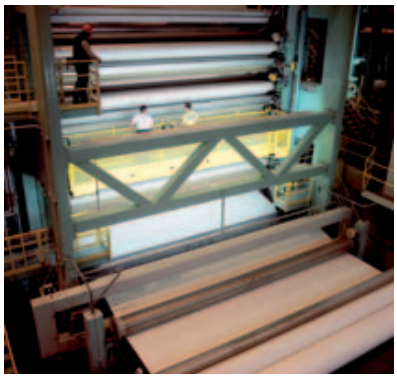
Connector system for time-saving installation

FR-A740 on IP20 protection class base unit

Increased productivity



Simplified schematic of paper production



Productivity in paper production has one size parameter: tonnes per hour

Synchronism – the ultimate priority

Precise synchronism of the drives is synonymous with maximum productivity and top quality in the printing and paper production industry. The drives need to retain control of the sheets throughout the entire printing and production process. The intelligent motor control function in Mitsubishi Electric frequency inverters processes the actual values in next to no time and matches the speed and torque to the specified set-point. This prevents the sheets from tearing or bunching.

Another feature which helps in this regard is the power-down braking function which controls the deceleration of all the drives after a power failure or an emergency machine shutdown. All this translates into maximum productivity and quality.

An advanced version of this control has the ability to operate up to four motors consecutively in alternate and/or changeover mode via one single frequency inverter.

Prepared for the toughest assignments

High temperatures and high air humidity are routine conditions in the printing and paper industry. The capacitors in the top-of-the-range models, the FR-F700 and FR-A800, are therefore designed to withstand internal temperatures of 105 °C. The power and control PCBs have two coatings and the cooling fans are housed in sealed, specially lubricated industrial bearings. There is no better way to prepare frequency inverters to meet human and mechanical requirements.

Optimum speed

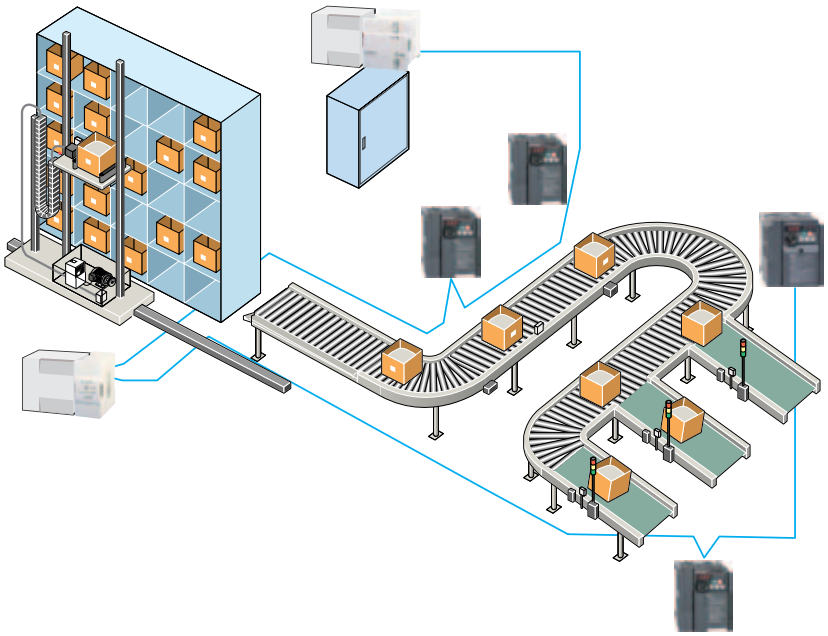
Rapid response times essential

Conveyor belts and stock logistics systems need constant speeds and velocities for rapid and systematic transportation of products. As such, the dynamic response generated by the drives needs to be the same when the conveyor belt is empty and when it is full. If there are sudden variations in load, e.g. caused by materials piling up in an uncontrolled way on the conveyor belt, then the drives need to react as quickly as possible in order to smooth the flow of materials.

This is precisely where top speed and torque response times are required for efficient compensation for sudden changes in load. Response times of no more than 5 ms are guaranteed to prevent product congestion and avert any risk to the follow-up process.

Rapid installation and start-up

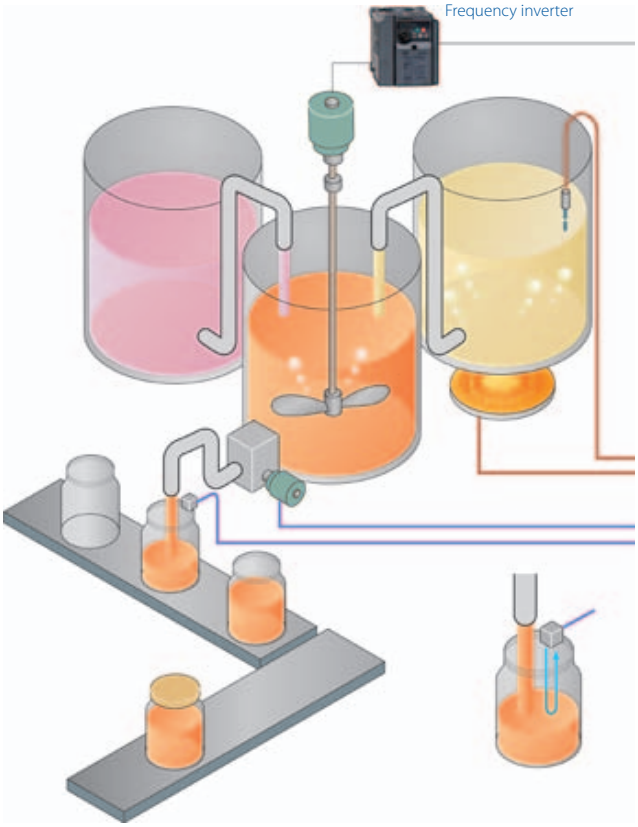
Customers in the haulage and logistics sector want Plug and Play in order to cut installation and start-up times. Our frequency inverters are therefore fitted as standard with an integrated EMC filter and an integrated brake unit. All part of being prepared for anything.



Palletising and warehousing in a high rack stacking system

Saving where motors never stop, Mitsubishi Electric inverters work round the clock!

Extreme cost efficiency



The conversion of analogue values is an important aspect of automation technology and facilitates process control.

Optimum energy efficiency, e.g. in complex pumping applications

Variable speed and efficiency

Maximum efficiency is required from each individual drive in pump and fan applications as well as in mixers and stirrers.

In comparison with mechanical solutions, frequency inverters developed by Mitsubishi Electric are always able to tap the full potential when it comes to savings in energy consumption.

Replacing conventional DC drives with modern three-phase drives will always mean one less cost-intensive maintenance chore. This in turn will mean far fewer drive failures which at worst bring the entire mixing or stirring machinery to a standstill.

Saving energy when starting and braking

The OEC technology (Optimum Excitation Control) developed by Mitsubishi Electric combines maximum drive efficiency with minimum power consumption. The only thing supplied to the connected motor is the magnetic flux which brings about the optimum degree of efficiency at all times. This leads to inordinate improvement in energy efficiency is achieved, particularly in the acceleration and braking phases.

Potential savings

Too powerful and too expensive!

Energy costs are rising all the time. Over half of the power consumed in industry is accounted for by electric motors. Up to 96 % of the life cycle costs of a motor are accounted for by energy costs. Unfortunately, when analysing costs, it is precisely this point which is paid precious little attention or is ignored altogether. The biggest potential source of savings is frequently disregarded.

For example, in order to guarantee that an air handling plant will run smoothly even at full load, which is seldom the case, and to have spare capacity for expansion the systems fans are often over specified. In some cases fans in these applications can be operating at an average efficiency of 65 % or less.

In addition, in conventional systems the equipment is usually controlled by mechanical ventilation flaps which slashes efficiency levels, especially with medium loads. The flap control function can very easily be replaced by the use of frequency inverters and the power consumption reduced by 20 to 60 %.

Result: wasted energy

Oversized fan, pump and motor systems combined with continuous operation at maximum capacity means many systems are operated at levels far below ideal in terms of efficiency. This leads to excess power consumption which can only really be explained by ignorance or poor practise.

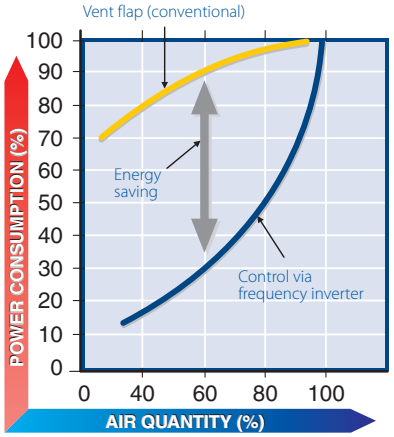
A Mitsubishi Electric frequency inverter is a safe investment

Countermeasures

The power consumption of slow running motors can be reduced if the speed is controlled by changing the frequency. The frequency inverter allows the motor to be adjusted to the load. Frequency inverters which generate variable frequencies and voltage levels save energy, reduce wear on the motor and minimise wear and tear on the motor-driven assembly.

They also allow far greater flexibility when it comes to organising operating prorecedures.

Save on energy costs by investing in the Mitsubishi Electric family of inverters



Example: A motor controlled by a frequency inverter (blue line) is using the energy to extract air. The mechanically throttled motor doing the same task but operated directly on the mains (yellow line) is wasting a large amount of the energy.

A world of applications

Mitsubishi Electric frequency inverters are used in a wide range of areas.

Mitsubishi Electric operates 11 branches in Europe, where it has maintained a presence for more than 30 years and developed a constantly growing and far-extending network comprising links to other companies and reliable partnerships.

On the technical side, three manufacturing and automation centres form the basis of tailored automated solutions, further centres already being planned.

A Europe-wide network provides interfaces to experienced engineers and offers distributors support throughout every phase of the project.

Mitsubishi Electric products are found in a variety of industrial, infrastructure and service sector contexts, ranging from critical applications in the pharmaceuticals industry to state-of-the-art leisure and entertainment facilities. Here are just a few examples of recent applications:

- Agriculture
  - Irrigation systems
  - Plant handling systems
  - Sawmills
- Building management
  - Smoke detection monitoring
  - Ventilation and temperature control
  - Lift (elevator) control
  - Automated revolving doors
  - Telephone management
  - Energy management
  - Swimming pool management
- Construction
  - Steel bridge manufacturing
  - Tunnel boring systems
- Food and drink
  - Bread manufacture (mixing/baking)
  - Food processing (washing/sorting/slicing/packaging)
- Leisure
  - Multiplex cinema projection
  - Animated mechatronics (museums/theme parks)
- Medical
  - Respiration machine testing
  - Sterilization
- Pharmaceutical/chemical
  - Dosing control
  - Pollution measurement systems
  - Cryogenic freezing
  - Gas chromatography
  - Packaging
- Plastics
  - Plastic welding systems
  - Energy management systems for injection moulding machines
  - Loading/unloading machines
  - Blow moulding test machines
  - Injection moulding machines
- Printing
- Textiles
- Transportation
  - Sanitation on passenger ships
  - Sanitation on rail rolling stock
  - Fire tender, pump management
  - Waste disposal truck management
- Utilities
  - Waste water treatment
  - Fresh water pumping