Chapter 1

INTRODUCTION TO FRENIC-Mini

This chapter describes the features and control system of the FRENIC-Mini series, and the recommended configuration for the inverter and peripheral equipment.

Contents

1.1 Features

Optimum performance for traversing conveyors

• High starting torque, at 150% or more

Equipped with Fuji's original simplified torque-vector control system and the automatic torque boost function, these inverters ensure consistent and powerful operation (when automatic torque boost and slip compensation control are ON and start frequency is set at 5 Hz or more).

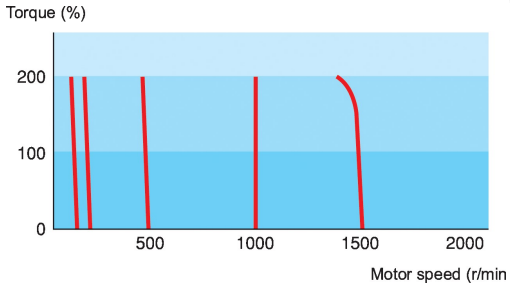
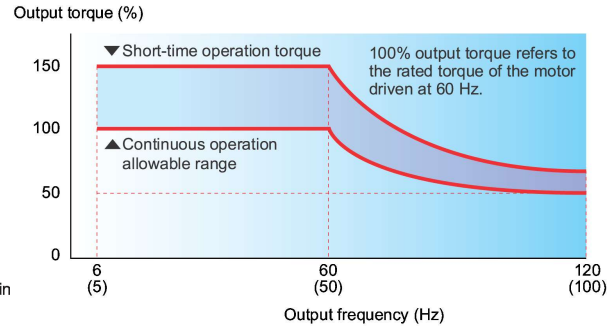


Figure 1.1 Torque Characteristics Data (Automatic torque boost: ON)



* The above graph shows an example of torque characteristics obtained when FRENIC-Mini is combined one-to-one with Fuji standard three-phase motor (8-type series: 4 poles).

Figure 1.2 Example of Output Torque Characteristics

• Braking resistor connectable to the inverter

FRENIC-Mini series of inverters features a built-in braking transistor (for inverters of 0.4 kW or larger), which makes it possible for an optional braking resistor to be connected to increase the regenerative braking ability for conveyance and transportation machinery that requires strong braking power. For inverters of 1.5 kW or larger, it is also possible to select a model that incorporates a built-in braking resistor.

Refer to Chapter 8, Section 8.2.2 "Braking resistor built-in type" for details.

• Trip-free operation

The remarkably improved current limiting function (stall prevention) ensures trip-free operation even for impact loads.

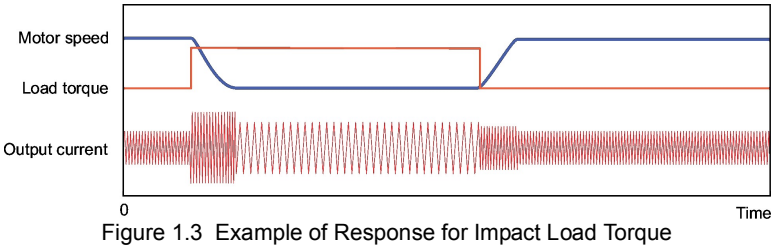


Figure 1.3 Example of Response for Impact Load Torque

• Stable operation even for a step load

The slip compensation function ensures stable operation even when the motor load fluctuates (step load).

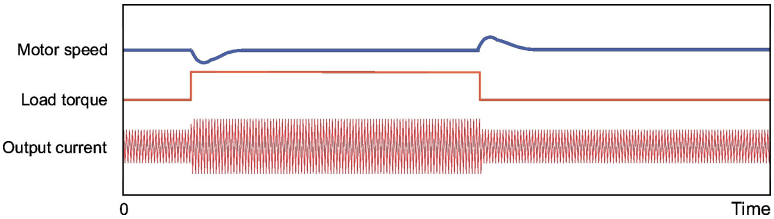


Figure 1.4 Example of Response for Step Load Torque (Refer to the note in Figure 1.2 for the test configuration.)

• Reduced motor instability at low speed

Fuji's unique control method improves voltage control performance and reduces motor instability at low speed to about a half or under (at 1 Hz) compared with that of conventional inverters.

Refer to Chapter 4, Section 4.7 "Drive Command Controller" for details.

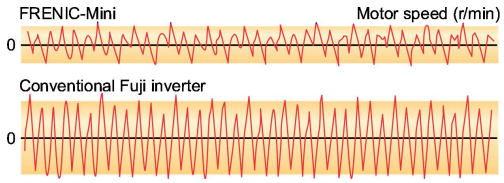


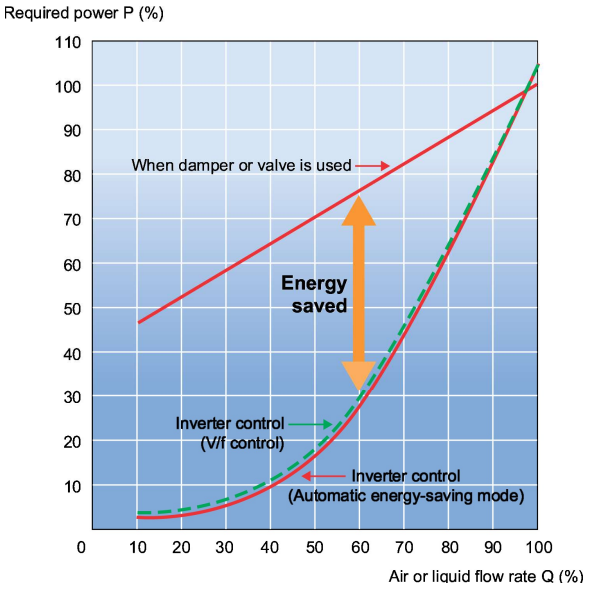
Figure 1.5 Example of Instability Characteristics

Default functions for fans and pumps

• Automatic energy-saving function provided as standard

To minimize the total loss (motor loss plus inverter loss), rather than just the motor loss as in the predecessor models, FRENIC-Mini saves even more power when used with fans or pumps.

Refer to Chapter 4, Section 4.7 "Drive Command Controller" for details.



* Energy savings vary depending on the motor characteristics.

Figure 1.6 Example of Energy Savings

• PID control function

Permits motor operation while controlling temperature, pressure, or flow rate without using an external device such as a temperature regulator.

Refer to Chapter 4, Section 4.8 "PID Frequency Command Generator" for details.

• Cooling fan ON/OFF control function

The inverter's cooling fan can be turned off while the fan or pump is stopped for noise reduction and energy savings.

The ideal functions to serve a multiplicity of needs for small-capacity inverters

• Compatible with a wide range of frequency settings

You can select the optimum frequency setting method that matches your machine or equipment via the keypad (⏶ / ⏷ keys or potentiometer), analog input (4 to 20 mA, 0 to 10 V, 0 to 5 V, 1 to 5 V), multistep speed settings (0 to 7 steps) or via RS485 communications. (Refer to Chapter 4, Section 4.2 "Drive Frequency Command Generator" and Chapter 9, Section 9.2.1 "F codes" for details.)

• A transistor output is provided

This enables an overload early warning, lifetime forecast or other information signals to be output during operation.

Refer to function code E20 in Chapter 9, Section 9.2.2 "E codes (Extension terminal functions)."

• High output frequency - up to 400 Hz

The inverter can be used with equipment such as centrifugal separators that require a high motor speed. In this case, you need to check whether the machine operation in combination with the motor is compatible or not.

• Two points can be set for a non-linear V/f pattern.

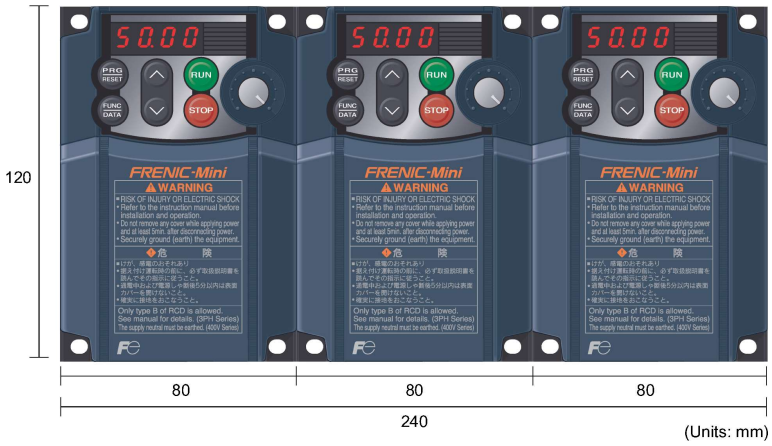
The addition of an extra point (total: 2 points) for the non-linear V/f pattern, which can be set as desired, improves the FRENIC-Mini's drive capability, because the V/f pattern can be adjusted to match a wider application area.

Refer to Chapter 4, Section 4.7 "Drive Command Controller" for details.

Compact size

• Side-by-side mounting

More than one FRENIC-Mini inverter can be mounted side-by-side without any gap inside your system control panel, thereby reducing the amount of space required for installation. (Ambient temperature: 40°C or lower)



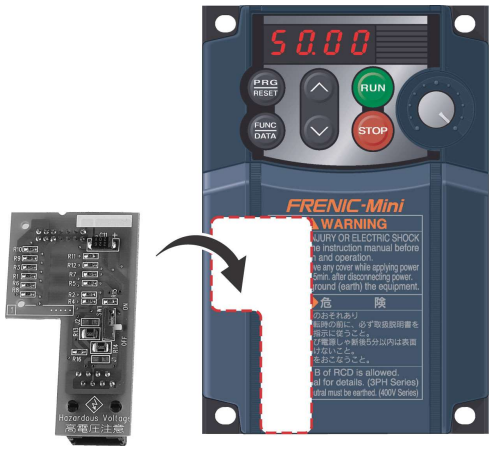
(Example: Inverters of 3-phase 200 V, 0.75 kW or less)

• External dimensions compatible with Fuji FVR-C11S series

• RS485 communications card (option) can be installed internally

This card can be installed inside the inverter's body without changing the dimensions. RS485 communication is available as option.

Refer to Chapter 5, "RUNNING THROUGH RS485 COMMUNICATION (OPTION)."



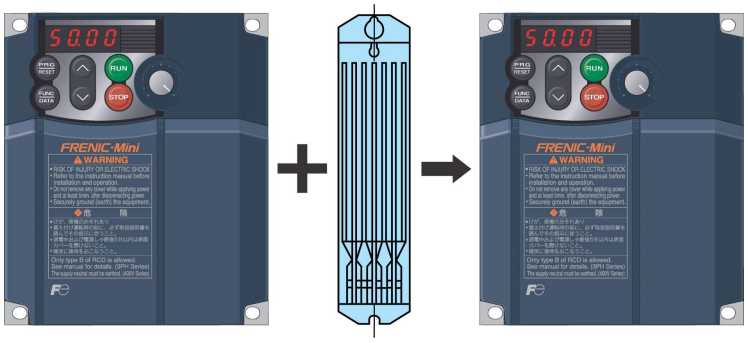
RS485 communications card (option)

(Example: Inverters of 3-phase 200 V, 0.75 kW or less)

• Models with built-in braking resistor are available on order

Inverters of 1.5 kW or over are available in a braking resistor built-in type. Requiring no installation or wiring of an external braking resistor reduces the total mounting space.

Refer to Chapter 8, Section 8.2.2 "Braking resistor built-in type."



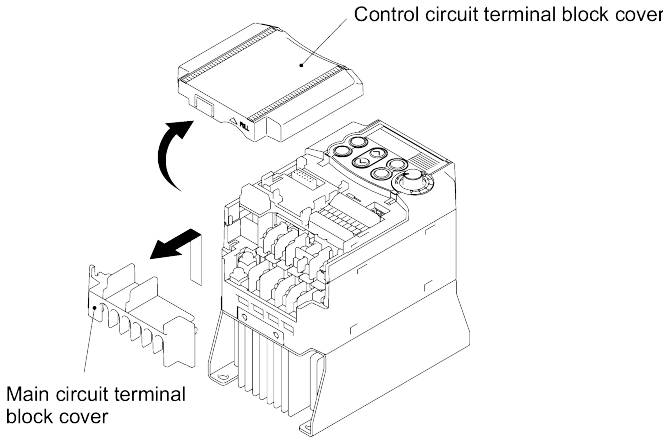
(Example: Inverters of 3-phase 200V, 1.5 kW)

Simplified operation and wiring

• Frequency setting potentiometer is standard equipment

The frequency can be adjusted easily by hand.

• Easy-to-remove/replace terminal block covers (for control circuit and main circuit)



• LED monitor on the keypad displaying all types of data

You can access and monitor all types of inverter's data and information including output frequency, set frequency, load shaft speed, output current, output voltage, alarm history, input power etc. using built-in keypad with LED.

Refer to Chapter 3, "OPERATION USING THE KEYPAD."

• Menu mode accessible from the keypad

You can easily access the menu mode including "Data setting," "Data checking," "Drive monitoring," "I/O checking," "Maintenance information," and "Alarm information."

Refer to Chapter 3, "OPERATION USING THE KEYPAD."

Maintenance

FRENIC-Mini series features the following facilities useful for maintenance.

Refer to Chapter 3, Section 3.3.5 "Reading Maintenance Information" and the FRENIC-Mini Instruction Manual (INR-SI47-0791-E), Chapter 7 "MAINTENANCE AND INSPECTION" for details.

• The lifetime of the DC link bus capacitor (reservoir capacitor) can be estimated

The capacitor's condition compared with its initial state can be confirmed.

• Long-life cooling fan

Use of a long-life cooling fan (estimated service life: 7 years for operation at an ambient temperature of 40°C) reduces maintenance cost.

• Recording and display of cumulative running time of the inverter

The inverter records and displays the accumulated running time of the inverter itself, the printed circuit board and cooling fan.

• Alarm history for up to 4 latest alarms

The inverter records detailed information for up to 4 alarms that occurred most recently, which can also be displayed on the LED.

Refer to Chapter 3, Section 3.3.6 "Reading alarm information."

• Lifetime forecast signal via transistor output

This signal is output when the reservoir capacitor in the DC link bus, the electrolytic capacitors on the printed circuit board, or the cooling fans have been nearing the end of their service life.

Refer to function code E20 in Chapter 9, Section 9.2.2 "E codes (Extension terminal functions)" for details.

Interface for peripheral devices and comprehensive protective functions

• All models are equipped with an inrush current suppression circuit.

FRENIC-Mini series features an inrush current suppression circuit as standard in all models to reduce the cost of peripheral devices such as input magnetic contactor.

• Terminals for a DC reactor (DCR) provided as standard

Terminals for connection of a DCR, which are necessary for suppressing harmonics, are provided as standard in all models.

• Input/output phase loss protective function

FRENIC-Mini series can detect output phase loss at all times during starting and running. This feature assists you for keeping operation of your system stable.

• Switchable sink/source

The input/output mode (sink/source) of the digital input terminals can be switched by means of an internal jumper switch. No engineering change is required in other control devices including PLC.

• Motor can be protected by a PTC thermistor

The motor is protected by PTC (Positive Temperature Coefficient) thermistor which detects the motor's temperature and stops the inverter before the motor is overheated.

Flexible through optionals

• Function code copy function

The optional remote keypad includes a built-in copy facility, so you can copy function code data set in a source inverter and duplicate it into a destination inverter.

• Inverter support loader software available

The inverter support loader program (Windows-based), which simplifies the setting of function codes, is provided as an option.

Refer to Chapter 5, "RUNNING THROUGH RS485 COMMUNICATION (OPTION)" for details.

• Mounting on DIN rail

Using the rail-mounting base (option), the inverter can easily be mounted on a DIN rail (35 mm wide).

Refer to Chapter 6, "SELECTING PERIPHERAL EQUIPMENT" for details.

• Easy replacement of older models with new ones

Using the mounting adapter (option) makes it possible to mount the latest models without drilling any additional holes.

Refer to Chapter 6, "SELECTING PERIPHERAL EQUIPMENT" for details.

• Remote operation

Using the optional RS485 communications card and remote keypad together with remote operation extension cable enables you to easily operate the inverter from a remote location, such as outside the control panel where the inverter is installed.

Refer to Chapter 5, "RUNNING THROUGH RS485 COMMUNICATION (OPTION)" and Chapter 6, "SELECTING PERIPHERAL EQUIPMENT" for details.

Wide variations

The wide range of models available in the FRENIC-Mini series of inverters is certain to flexibly meet your various system needs.

- The 400 V series is available in addition to the 200 V series (3-phase, single-phase).
- Models with built-in EMC filter and built-in braking resistors are also available.
- An optional RS485 communications card enables your system to feature network driven management.

Refer to Chapter 8, "SPECIFICATIONS" for details.

Global products

FRENIC-Mini series of inverters are designed for use in global market in conformity with the global standards listed below.

- All standard models conform to the EC Directive (CE Marking), UL standards (UL-Listed) and Canadian standards (cUL-Listed).

  All standard FRENIC-Mini inverters conform to European and North American/Canadian standards, enabling standardization of the specifications for machines and equipment used at home and abroad.
- If a model with a built-in EMC filter is used, the model conforms to the European EMC Directive.

Europe

EC Directives (CE making), TÜV

North America/Canada

UL standard (cUL certification)

1.2 Control System

This section gives you a general overview of inverter control systems and features specific to the FRENIC-Mini series of inverters.

As shown in Figure 1.8, single- or three-phase commercial power is converted to DC power in the converter section, which is then used to charge the capacitor on the DC link bus. According to control commands or signals generated in the control logic, the inverter modulates the electricity charged in the capacitor to PWM (Pulse Width Modulation) format and feeds the output to the motor. The modulation frequency is called "carrier frequency." As shown in Figure 1.7, the voltage waveform of the modulated power source produces pulse train with positive and negative polarity synchronized with the inverter's output command frequency. The inverter feeds the produced output as drive power with sinusoidal current waveform like that of ordinary commercial power lines.

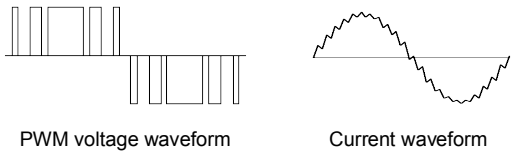


Figure 1.7 Output Voltage and Current Waveform of the Inverter

For the set frequency given in the control logic, the accelerator/decelerator processor calculates the acceleration/deceleration rate required by run/stop control of the motor and transfers the calculated results to the 3-phase voltage command processor directly or via the V/f pattern generator.

Refer to Chapter 4, Section 4.7 "Drive Command Controller" for details.

The FRENIC-Mini series features a simplified magnetic flux estimator which is added in the V/f pattern processing section. This feature automatically controls the voltage level applied to the motor according to the motor load so as to make the motor generate more stable and higher torque even during low speed operation. This "Simplified Torque-Vector Control" is unique to Fuji inverters.

The control logic section, which is the very brain of the inverter, allows you to customize the inverter's driving patterns using the function code settings.

Refer to Chapter 4 "BLOCK DIAGRAMS FOR CONTROL LOGIC" for details.

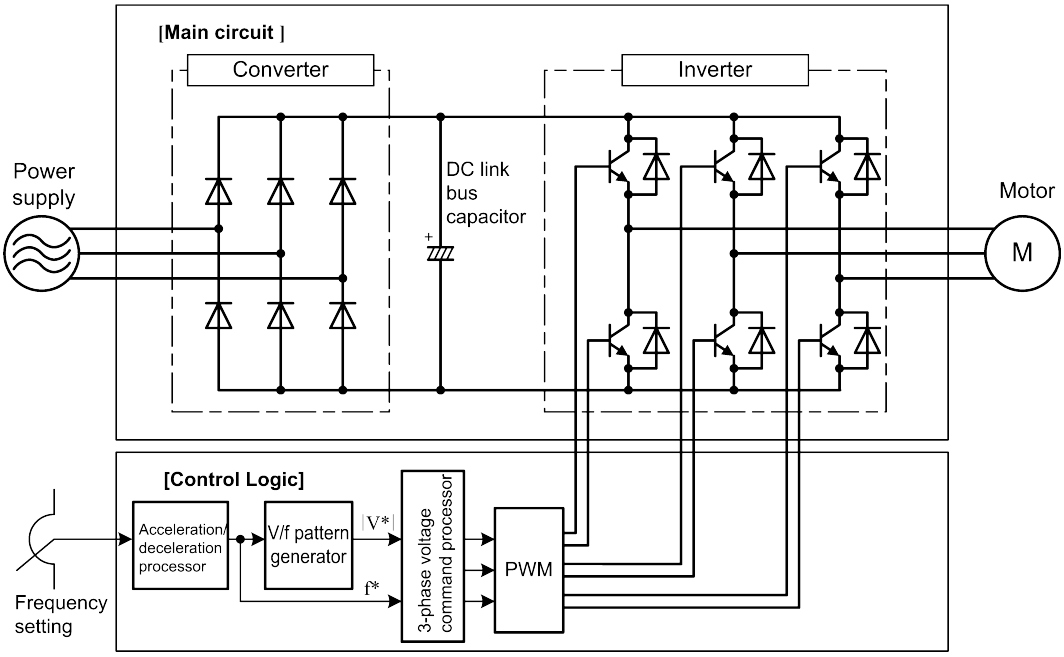


Figure 1.8 Simplified Control System Diagram of FRENIC-Mini

1.3 Recommended Configuration

To control a motor with an inverter correctly, you should consider the rated capacity of both the motor and the inverter and ensure that the combination matches the specifications of the machine or system to be used. Refer to Chapter 7, "SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES" for details.

After selecting the rated capacity, select appropriate peripheral equipment for the inverter, then connect them to the inverter.

Refer to Chapter 6, "SELECTING PERIPHERAL EQUIPMENT" and Chapter 8, Section 8.7 "Connection Diagrams" for details on the selection and connection of peripheral equipment.

Figure 1.9 shows the recommended configuration for an inverter and peripheral equipment.

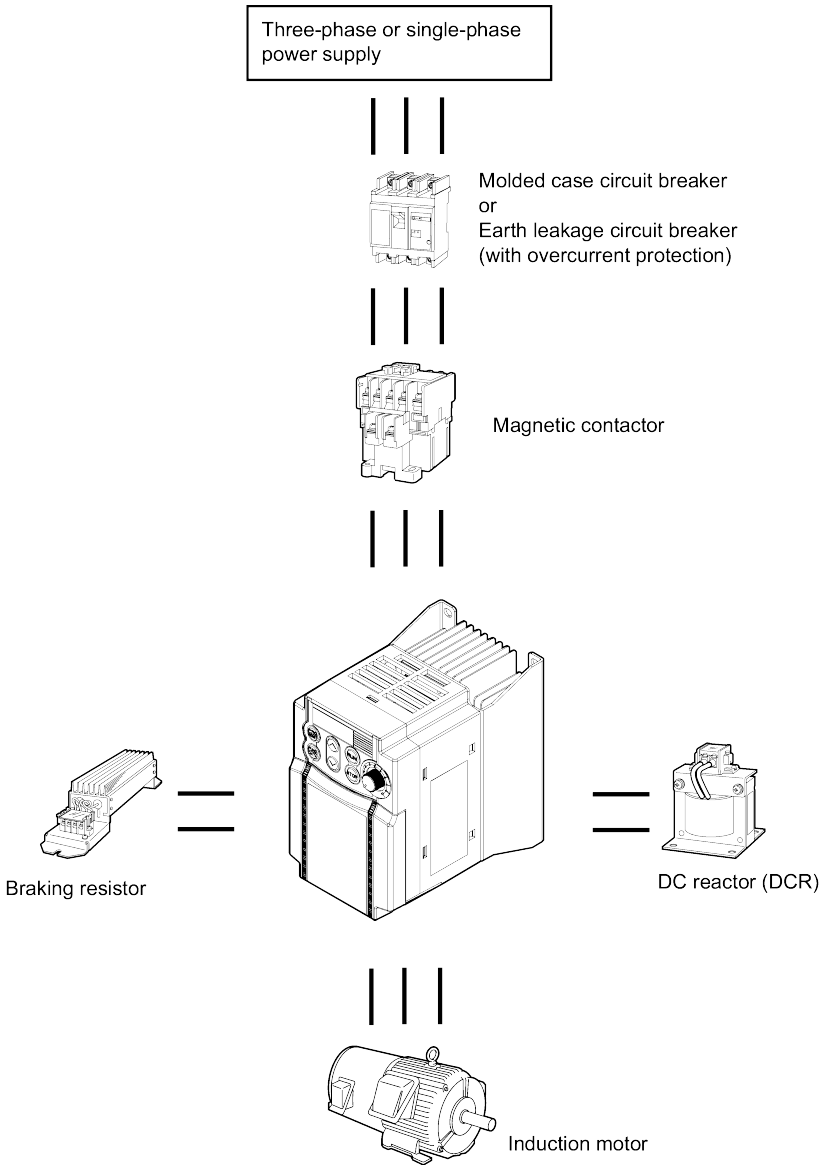


Figure 1.9 Recommended Configuration Diagram