Glossary

This glossary explains the technical terms that are frequently used in this manual.

Acceleration time

Period required when an inverter accelerates its output from 0 Hz to the maximum output frequency.
Related function codes: F03, F07, E10, and H54

Alarm mode

One of the three operation modes supported by the inverter. If the inverter detects any malfunction, error, or fault in its operation, it immediately shuts down or trips the output to the motor and enters this mode in which corresponding alarm codes are displayed on the LED monitor.

Alarm output (for any faults)

A mechanical contact output signal that is generated when the inverter is halted by an alarm, by short-circuiting between terminals [30A] and [30C].
Related function code: E27
See Alarm mode.

Analog input

An external voltage or current input signal to give the inverter the frequency command. The analog voltage is applied on the terminal [12], the current on the [C1]. These terminals are also used to input the signal from the external potentiometer, PTC thermistor and PID feedback signals depending on the function code definition.
Related function codes: F01, C30, E59, E61 to E63 and J02

Analog output

An analog DC output signal of the monitored data such as the output frequency, the current and voltage inside an inverter. The signal drives an analog meter installed outside the inverter for indicating the current inverter running status.
Refer to Chapter 8, Section 8.3.1 "Terminal functions."

Automatic deceleration

A control mode in which deceleration time is automatically extended up to 3 times of the commanded time to prevent the inverter from tripping due to an overvoltage caused by regenerative power even if a braking resistor is not used.
Related function code: H69

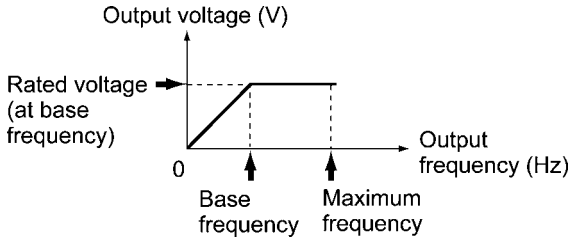
Auto energy saving operation

Energy saving operation that automatically drives the motor with lower output voltage when the motor load has been light, for minimizing the product of voltage and current (electric power).
Related function codes: F37 and A13

AVR (Automatic Voltage Regulator) control

A control that keeps an output voltage constant regardless of variations of the input source voltage or load.

Base frequency



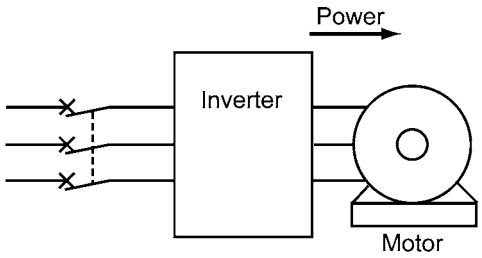
The minimum frequency at which an inverter delivers a constant voltage in the output V/f pattern.
Related function codes: F04 and A02

Bias

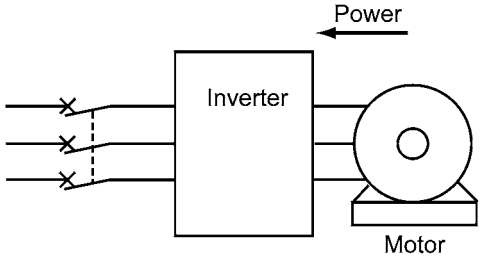
A value to be added to an analog input frequency to modify and produce the output frequency.
Related function codes: F18, C50 to C52

Braking torque

Torque that acts in a direction that will stop a rotating motor (or the force required to stop a running motor).



During accelerating or running at constant speed



During decelerating

If a deceleration time is shorter than the natural stopping time (coast-to-stop) determined by a moment of inertia for a load machine, then the motor works as a generator when it decelerates, causing the kinetic energy of the load to be converted to electrical energy that is returned to the inverter from the motor. If this power (regenerative power) is consumed or accumulated by the inverter, the motor generates a braking force called "braking torque."

Carrier frequency

Frequency used to establish the modulation period of a pulse width under the PWM control system. The higher the carrier frequency, the closer the inverter output current approaches a sinusoidal waveform and the quieter the motor becomes.
Related function code: F26

Coast-to-stop

If the inverter stops its output when the motor is running, the motor will coast to a stop due to inertial force.

Communications link function

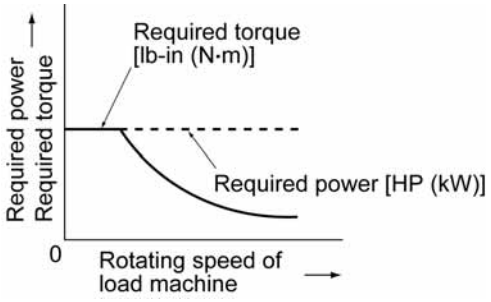
A feature to control an inverter from external equipment serially linked to the inverter such as a PC or PLC.
Related function code: H30

Constant feeding rate time

Time required for an object to move in a constant distance previously defined. The faster speed, the shorter time and vise versa. This facility may be applied to a chemical process that determines a processing time of materials as the speed such as heating, cooling, drying, or infiltration in some constant-speed machinery.
Related function codes: E39 and E50.

Constant output load

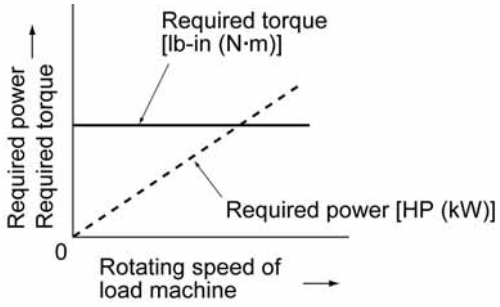
A constant output load is characterized by:
1) The required torque is in inverse proportion to the load shaft speed
2) An essentially constant power requirement
Related function code: F37 and A13
Applications: Machine tool spindles



Constant torque load

A constant torque load is characterized by:
1) A requirement for an essentially constant torque, regardless of the load shaft speed
2) A power requirement that decreases in proportion to the load shaft speed

Related function code: F37 and A13
Applications: Conveyors, elevators, and carrier machines



Control circuit terminals

Terminals on the inverter, which are used for input/output of signals to control or manage the inverter/external equipment directly or indirectly

Current limiter

A control that keeps an inverter output frequency within the specified current limit.

Cursor

Marker blinking on the four-digit, 7-segment LED monitor which shows that data in the blinking digit can be changed/modified by keying operation.

Curvilinear V/f pattern

A generic name for the inverter output patterns with curvilinear relation between the frequency and voltage.
Refer to function code H07 in Chapter 9, Section 9.2.5 "H codes."

DC braking (DC braking)

DC current braking that an inverter injects into the motor to brake and stop it against the moment of inertia of the motor or its load. The inertial energy generated is consumed as heat in the motor.
If a motor having the load with large moment of inertia is going to stop abruptly, the moment of inertia may force to rotate the motor after the inverter output frequency has been reduced to 0 Hz. Use DC braking to stop the motor completely.
Related function codes: F20 to F22 and A09 to A11

DC link bus voltage

Voltage at the DC link bus that is the end stage of the converter part of inverters. The part rectifies the input AC power to charge the DC link bus capacitor as the DC power to be inverted to AC power.

Deceleration time

Period during which an inverter slows its output frequency down from the maximum to 0 Hz.
Related function codes: F03, F08, E11, and H54

Digital input

Input signals given to the programmable input terminals or the programmable input terminals themselves. A command assigned to the digital input is called the terminal command to control the inverter externally.
Refer to Chapter 8, Section 8.3.1 "Terminal functions."

Electronic thermal overload protection

Electronic thermal overload protection to issue an early warning of the motor overheating to safeguard a motor.
An inverter calculates the motor overheat condition based on the internal data (given by function code P99/A39 about the properties of the motor) and the driving conditions such as the drive current, voltage and frequency.

External potentiometer

A potentiometer (optional) that is used to set frequencies as well as built-in one.

Fan stop operation

A mode of control in which the cooling fan is shut down if the internal temperature in the inverter is low and when no operation command is issued.
Related function code: H06

Frequency accuracy (stability)

The percentage of variations in output frequency to a predefined maximum frequency.

Frequency limiter

Frequency limiter used inside the inverter to control the internal drive frequency in order to keep the motor speed within the specified level between the peak and bottom frequencies.
Related function codes: F15, F16, and H64

Frequency resolution

The minimum step, or increment, in which output frequency is varied, rather than continuously.

Function code

Code to customize the inverter. Setting function codes realizes the potential capability of the inverter to meet it for the individual power system applications.

Gain (for frequency setting)

A frequency setting gain enables varying the slope of the output of the frequency set with an analog input signal.
Related function codes: C32, C34, C37, C39, C42, and C44

IGBT (Insulated Gate Bipolar Transistor)

Stands for Insulated Gate Bipolar Transistor that enables the inverter section to switch high voltage/current DC power in very high speed and to output pulse train.

Interphase unbalance

A condition of an AC input voltage (supply voltage) that states the voltage balance of each phase in an expression as:

$$\text{Interphase voltage unbalance (\%)} = \frac{\text{Max.voltage (V)} - \text{Min.voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67$$

Inverse mode operation

A mode of operation in which the output frequency lowers as the analog input signal level rises.

Jogging operation

A special operation mode of inverters, in which a motor jogs forward or reverse for a short time at a slower speed than usual operating modes.
Related function codes: C20 and H54

Jump frequencies

Frequencies that have a certain output with no change in the output frequency within the specified frequency band in order to skip the resonance point of a machine (resonance frequency).
Related function codes: C01 to C04

Keypad operation

To use a keypad to run an inverter.

Line speed

Running speed of an object (e.g., conveyor) driven by the motor. The unit is meter per minute, m/min.

Load shaft speed

Number of revolutions per minute (r/min) of a rotating load driven by the motor, such as a fan.

Main circuit terminals

Power input/output terminals of an inverter, which includes terminals to connect the power supply, motor, DC reactor, braking resistor, and other power components.

Maximum frequency

The output frequency commanded by the input of the maximum value of a frequency setup signal (for example, 10 V for a voltage input range of 0 to 10 V or 20 mA for a current input range of 4 to 20 mA).
Related function codes: F03 and A01

Modbus RTU

Communication protocol used in global FA network market, which is developed by Modicon, Inc. USA.

Momentary voltage drop immunity

The minimum voltage (V) and time (ms) that permit continued rotation of the motor after a momentary voltage drop (momentary power failure).

Multi-frequency selection

To preset frequencies (up to 15 stages), then select them at some later time using external signals.
Related function codes: E01 to E05, C05 to C19

Nominal applied motor

Rated output (in kW) of a general-purpose motor that is used as a standard motor listed in tables in Chapter 6, "SELECTING PERIPHERAL EQUIPMENT" and Chapter 8, "SPECIFICATIONS."

Overload capability

The overload current that an inverter can tolerate, expressed as a percentage of the rated output current and also as a permissible energization time.

PID control

The scheme of control that brings controlled objects to a desired value quickly and accurately, and which consists of three categories of action: proportional, integral and differential.

Proportional action minimizes errors from a set point.
Integral action resets errors from a desired value to 0.
Differential action applies a control value in proportion to a differential component of the difference between the PID reference and feedback values.
Related function codes: E01 to E05, E40, E41, E43, E61 to E63, C51, C52, J01 to J62

Programming mode

One of the three operation modes supported by the inverter. This mode uses the menu-driven system and allows the user to set function codes or check the inverter status/maintenance information.

PTC (Positive Temperature Coefficient) thermistor

Type of thermistor with a positive temperature coefficient. Used to safeguard a motor.
Related function codes: H26 and H27

Rated capacity

The rating of an inverter output capacity (at the secondary side), or the apparent power that is represented by the rated output voltage times the rated output current, which is calculated by solving the following equation and is stated in kVA:

$$\text{Rated capacity (kVA)} = \sqrt{3} \times \text{Rated output voltage (V)} \times \text{Rated output current (A)} \times 10^{-3}$$

The rated output voltage is assumed to be 220 V for 230 V equipment and 440 V for 460 V equipment.

Rated output current

A total RMS equivalent to the current that flows through the output terminal under the rated input and output conditions (the output voltage, current, frequency, and load factor meet their rated conditions). Essentially, inverter rated at 200 V covers the current of a 200 V, 50 Hz 6-pole motor and inverter rated at 400 V covers the current of a 380 V, 50 Hz 4-pole motor.

Rated output voltage

A fundamental wave RMS equivalent to the voltage that is generated across the output terminal when the AC input voltage (supply voltage) and frequency meet their rated conditions and the output frequency of the inverter equals the base frequency.

Required power supply capacity

The capacity required of a power supply for an inverter. This is calculated by solving either of the following equations and is stated in kVA:

$$\text{Required power supply capacity (kVA)} = \sqrt{3} \times 200 \times \text{Input RMS current (200 V, 50 Hz)}$$
or
$$= \sqrt{3} \times 220 \times \text{Input RMS current (220 V, 60 Hz)}$$

$$\text{Required power supply capacity (kVA)} = \sqrt{3} \times 400 \times \text{Input RMS current (400 V, 50 Hz)}$$
or
$$= \sqrt{3} \times 440 \times \text{Input RMS current (40 V, 6 0 Hz)}$$

Running mode

One of the three operation modes supported by the inverter. If the inverter is turned ON, it automatically enters this mode which you may: run/stop the motor, set up the set frequency, monitor the running status, and jog the motor.

S-curve acceleration/deceleration (weak/strong)

To reduce the shock to the machine during acceleration/deceleration, the inverter gradually accelerates/decelerates the motor at the both ends of the acceleration/deceleration zones like a figure of S letter.
Related function code: H07

Slip compensation control

A mode of control in which the output frequency of an inverter plus an amount of slip compensation is used as an actual output frequency to compensate for motor slippage.
Related function codes: P09 to P12 and A23 to A26

Stall

A behavior of a motor when it loses speed by tripping of the inverter due to overcurrent detection or other malfunctions of the inverter.

Starting frequency

The minimum frequency at which an inverter starts its output (not the frequency at which a motor starts rotating).
Related function codes: F23 and A12

Starting torque

Torque that a motor produces when it starts rotating (or the drive torque with which the motor can run a load).

Simultaneous keying

To simultaneously press the 2 keys on the keypad. This presents the special function of inverters.

Stop frequency

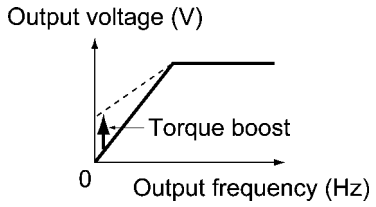
The output frequency at which an inverter stops its output.
Related function code: F25

Thermal time constant

The time needed to activate the electronic thermal overload protection after the preset operation level (current) continuously flows. This is an adjustable function code data to meet the property of a motor that is not manufactured by Fuji Electric.
Related function codes: F12 and A08

Torque boost

If a general-purpose motor is run with an inverter, voltage drops will have a pronounced effect in a low-frequency region, reducing the motor output torque. In a low-frequency range, therefore, to increase the motor output torque, it is necessary to augment the output voltage. This process of voltage compensation is called torque boost.
Related function codes: F09 and A05



Transistor output

A control signal that generates predefined data from within an inverter via a transistor (open collector).

Trip

In response to an overvoltage, overcurrent, or any other unusual condition, actuation of an inverter's protective circuit to stop the inverter output.

V/f characteristic

A characteristic expression of the variations in output voltage V (V), and relative to variations in output frequency f (Hz). To achieve efficient motor operation, an appropriate V/f (voltage/frequency) characteristic helps a motor produce its output torque matching the torque characteristics of a load.

V/f control

The rotating speed N (r/min) of a motor can be stated in an expression as

$$N = \frac{120 \times f}{p} \times (1 - s)$$

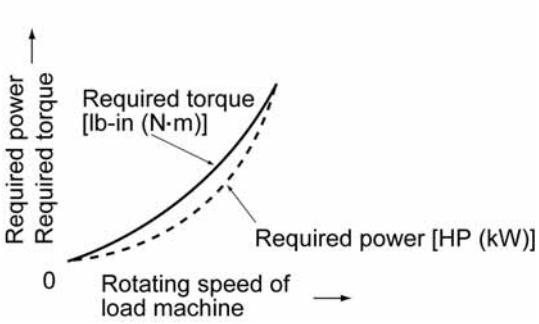
where,
f: Output frequency
p: Number of poles
s: Slippage
On the basis of this expression, varying the output frequency varies the speed of the motor. However, simply varying the output frequency f (Hz) would result in an overheated motor or would not allow the motor to demonstrate its optimum utility if the output voltage V (V) remains constant. For this reason, the output voltage V must be varied with the output frequency f by using an inverter. This scheme of control is called V/f control.

Variable torque load

A squared torque load is characterized by:
1) A change in the required torque in proportion to the square of the number of revolutions per minute.
2) A power requirement that decreases in proportion to the cube of the decrease in the number of revolutions per minute.

$$\text{Required power (kW)} = \frac{\text{Rotating speed (r/min)} \times \text{Torque (N} \cdot \text{m)}}{9.55}$$

Related function code: F37 and A13
Applications: Fans and pumps



Voltage and frequency variations

Variations in the input voltage or frequency within permissible limits. Variations outside these limits might cause an inverter or motor to fail.

High Performance Compact Inverter

FRENIC-Multi

User's Manual

First Edition, June 2007

Fuji Electric FA Components & Systems Co., Ltd.

Fuji Electric Corp. of America

The purpose of this manual is to provide accurate information in the handling, setting up and operating of the FRENIC-Multi series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.