

Chapter 4 RUNNING THE MOTOR

4.1 Running the Motor for a Test

4.1.1 Inspection and preparation prior to powering on

Check the following prior to powering on.

- (1) Check if connection is correct.

Especially check if the power wires are connected to the inverter input terminals L1/R, L2/S and L3/T or L1/L and L2/N, and output terminals U, V and W respectively and that the grounding wires are connected to the ground electrodes correctly. Refer to Figure 4.1.

⚠ WARNING

- Do not connect power supply wires to the inverter output terminals U, V, and W. Otherwise, the inverter may be broken if you turn the power ON.
- Be sure to connect the grounding wires of the inverter and the motor to the ground electrodes. **Otherwise, electric shock may occur.**

- (2) Check for short circuits between terminals and exposed live parts and ground faults.
- (3) Check for loose terminals, connectors and screws.
- (4) Check if the motor is separated from mechanical equipment.
- (5) Turn the switches OFF so that the inverter does not start or operate erroneously at power-on.
- (6) Check if safety measures are taken against runaway of the system, e.g., a defense to protect people from unexpectedly approaching your power system.

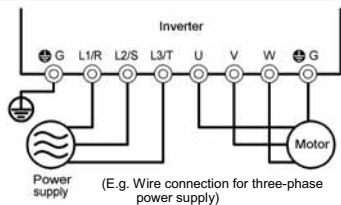


Figure 4.1 Connection of Main Circuit Terminals



4.1.2 Turning ON power and checking

⚠ WARNING

- Be sure to install the terminal cover if any before turning the power ON. Do not remove any cover while powering on.
- Do not operate switches with wet hands. **Otherwise electric shock could occur.**

Turn the power ON and check the following points. This is a case when no function code data is changed from the factory setting.

- (1) Check if the LED monitor displays *0.00* (means that the frequency command is 0 Hz) that is blinking. (See Figure 4.2.)

If the LED monitor displays numbers except *0.00*, press  /  keys to set *0.00* as the frequency command.

- (2) Check if a built-in cooling fan rotates. (For the inverter of 1 HP or below, no cooling fan is mounted.)



Figure 4.2 Display of the LED Monitor after Power-on

4.1.3 Preparation before running the motor for a test--Setting function code data

Before running the motor, set function code data specified in Table 4.1 to the motor ratings and your system design values. For the motor, check the rated values printed on the nameplate of the motor. For your system design values, ask system designers about them.


 For details about how to change function code data, refer to Chapter 3, Section 3.4.1 "Setting up function codes quickly." Refer to the function code H03 in Chapter 5 "FUNCTION CODES" for the factory default setting of motor parameters. If any of them is different from the default setting, change the function code data.

Table 4.1 Settings of Function Code Data before Driving the Motor for a Test

Function code	Name	Function code data	Factory setting
<i>F 04 (R 02)</i>	Base frequency	Motor ratings (printed on the nameplate of the motor)	60.0 (Hz)
<i>F 05 (R 03)</i>	Rated voltage at base frequency		Three-phase 230 V class series: 230 (V) Three-phase 460 V class series: 460 (V)
<i>P 02 (R 16)</i>	Motor parameter (Rated capacity)		Applicable motor rated capacity
<i>P 03 (R 17)</i>	Motor parameter (Rated current)		Rated current of applicable motor
<i>P 99 (R 39)</i>	Motor selection		0: Motor characteristics 0 (Fuji standard 8-series motors)
<i>F 03 (R 01)</i>	Maximum frequency		System design values * For a test-driving of the motor, increase values so that they are longer than your system design values. If the set time is short, the inverter may not start running the motor.
<i>F 07</i>	Acceleration time 1*		6.0 (s)
<i>F 08</i>	Deceleration time 1*		6.0 (s)



In any of the following cases, the default settings may not produce the best results for auto torque boost, torque calculation monitoring, auto energy saving, torque limiter, automatic deceleration, auto search for idling motor speed, slip compensation, torque vector, droop control, or overload stop, since the standard settings of motor parameters for Fuji motors are not applicable. Tune the motor parameters according to the procedure set forth below.

- The motor to be driven is not a Fuji product or is a non-standard product.
- The cabling between the motor and the inverter is long.
- A reactor is inserted between the motor and the inverter.

A codes are used to specify the data for motor 2. Use them if necessary.

<Tuning procedure>

1) Preparation

Referring to the rating plate on the motor, set the following function codes to their nominal ratings:

- F04 and A02: Base frequency
- F05 and A03: Rated voltage at base frequency
- P02 and A16: Rated capacity
- P03 and A17: Rated current

2) Selection of tuning process

Check the situation of the machine system and choose between "Tuning while the motor is stopped (P04 or A18 = 1)" and "Tuning while the motor is running (P04 or A18 = 2)." In the case of "Tuning while the motor is running (P04 or A18 = 2)," also adjust the acceleration and deceleration times (F07 and F08) and set the rotation direction properly so that it matches the actual rotation direction of the machine system.

Data for P04, A18	Motor parameters subjected to tuning:	Tuning type	Selection condition of tuning type
1	Primary resistance (%R1) Leakage reactance (%X)	Tuning the %R1 and %X, <u>with the motor being stopped.</u>	The motor cannot be rotated, or more than 50% of the rated load would be applied on the motor if rotated.
2	Primary resistance (%R1) Leakage reactance (%X) No-load current Rated slip frequency	Tuning the %R1, %X and rated slip frequency, <u>with the motor being stopped.</u> Tuning the no-load current, <u>with the motor running</u> at 50% of the base frequency. Lastly, tuning the rated slip frequency, <u>with the motor being stopped.</u>	Even if the motor is rotated, it is safe and the load applied on the motor would be no more than 50% of the rating. (If you do the tuning with no load, you will get the highest precision.)


Upon completion of the tuning, each motor parameter will be automatically saved into the applicable function code.

3) Preparation of machine system



Perform appropriate preparations on the motor and its load, such as disengaging the coupling and deactivating the safety device.

Switch to the motor 1 or motor 2, which the tuning is to be performed on.

Tuning results by P04 will be applied to P codes for the motor 1, and the tuning results by A18 will be applied to A codes for the motor 2.

 Assigning the command "Switch to motor 2 **SWM2**" to any of the terminal [Y1], [Y2], or [30A/B/C] will automatically switch the output status of **SWM2** depending on the motor selected for the tuning.

4) Perform tuning

- ① Set function code P04 or A18 to "1" or "2" and press the  key. (The blinking of / or ϵ^2 on the LED monitor will slow down.)
- ② Enter a run command for the rotation direction selected. The factory default is "  key on the keypad for forward rotation." To switch to reverse rotation, change the data of function code F02.
- ③ The display of / or ϵ^2 stays lit, and tuning takes place while the motor being stopped. (Maximum tuning time: Approx. 40 s.)
- ④ If P04 or A18 = 2, the motor is accelerated to approximately 50% of the base frequency and then tuning takes place. Upon completion of measurements, the motor will decelerate to a stop.
- ⑤ Tuning will continue after the motor is stopped. (Maximum tuning time: Approx. 10 s.)
- ⑥ If the terminal signal **FWD** or **REV** is selected as the run command (F02 = 1), ϵ_{nd} will appear upon completion of the measurements.
- ⑦ The run command is turned OFF. (The run command given through the keypad or the communications link is automatically turned OFF).
The tuning completes and the next function code **P05** or **A20** appears on the keypad.

■ Errors during tuning

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the results of the tuning or any error in the process of the tuning, it will display $\overline{E-7}$ and discard the tuning data.

Listed below are the abnormal or error conditions that can be recognized during tuning.

Possible tuning error causes	Details
Error in tuning results	- An interphase voltage unbalance has been detected. - Tuning has resulted in an abnormally high or low value of a parameter.
Output current error	An abnormally high current has flown during tuning.
Sequence error	During tuning, a run command has been turned OFF, or STOP (Force to stop), BX (Coast to a stop), DWP (Protect from dew condensation), or other similar terminal command has been received.
Error due to limitation	- During tuning, any of the operation limiters has been activated. - The maximum frequency or the frequency limiter (high) has limited tuning operation.
Other errors	An undervoltage or any other alarm has occurred.

If any of these conditions has occurred, either eliminate the abnormal or error factor(s) and perform tuning again, or consult your Fuji Electric representative.



If a filter other than Fuji optional output filter (OFL-□□□-4A) is connected to the inverter's output (secondary) circuit, the result of tuning can be unpredictable. When you replace an inverter, make a note of the old inverter's settings for the primary resistance %R1, leakage reactance %X, no-load current, and rated slip frequency, and set those values to the new inverter's function codes.

4.1.4 Test run

⚠ WARNING

If the user specifies the function codes wrongly or without completely understanding this Instruction Manual and the FRENIC-Multi User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.

Accident or injury may result.

Follow the descriptions given in Section 4.1.1, "Inspection and preparation prior to powering on" to Section 4.1.3, "Preparation before running the motor for a test," then begin test-driving of the motor.

⚠ CAUTION

If any abnormality is found in the inverter or motor, immediately stop operation and determine the cause referring to Chapter 6, "TROUBLESHOOTING."

Test Run Procedure

- Turn the power ON and check that the reference frequency 0.00 Hz is blinking on the LED monitor.
- Set a low reference frequency such as 5 Hz, using \triangle / ∇ keys. (Check that the frequency is blinking on the LED monitor.)
- Press the \rightarrow key to start running the motor in the forward direction. (Check that the reference frequency is displayed on the LED monitor.)
- To stop the motor, press the \leftarrow key.

< Check points during a test run >

- Check that the motor is running in the forward direction.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the \rightarrow key again to start driving the motor, then increase the reference frequency using \triangle / ∇ keys. Check the above points again.

If any problem is found, modify the function code data again as described below.

4.2 Operation


After confirming that the inverter normally drives the motor in a test run, make mechanical connections (connections to the machine system) and electrical connections (wiring and cabling), and configure the necessary function codes properly before starting a production run.



Depending on the production run conditions, further adjustments can be required, such as adjustments of torque boost (F09/A05), acceleration time (F07/E10), and deceleration time (F08/E11).

4.2.1 Jogging Operation

This section provides the procedure for jogging the motor.

- Making the inverter ready to jog with the steps below. The LED monitor should display 0.00 .
 - Enter Running mode (see page 3-3).
 - Press the \rightarrow + \triangle keys simultaneously. The LED monitor displays the jogging frequency for approximately one second and then returns to 0.00 again.
 -  Tip • Function codes C20 and H54 specify the jogging frequency and acceleration/ deceleration time, respectively. Use these function codes exclusively for the jogging operation with your needs.
 - Using the input terminal command "Ready for jogging" **JOG** switches between the normal operation state and ready-to-jog state.
 - Switching between the normal operation state and read-to-jog state with the \rightarrow + \triangle keys is possible only when the inverter is stopped.
- Jogging the motor.

Hold down the \rightarrow key during which the motor continues jogging. To decelerate to stop the motor, release the key.
- Exiting the ready-to-jog state and returning to the normal operation state
Press the \rightarrow + \triangle keys simultaneously.