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Oriental motor

HM-6168-3

Brushless DC motor unit

BX Series

OPERATING MANUAL FOR EXTENSION FUNCTIONS

Thank you for purchasing an Oriental Motor product.
This Operating Manual describes product handling procedures and safety precautions.

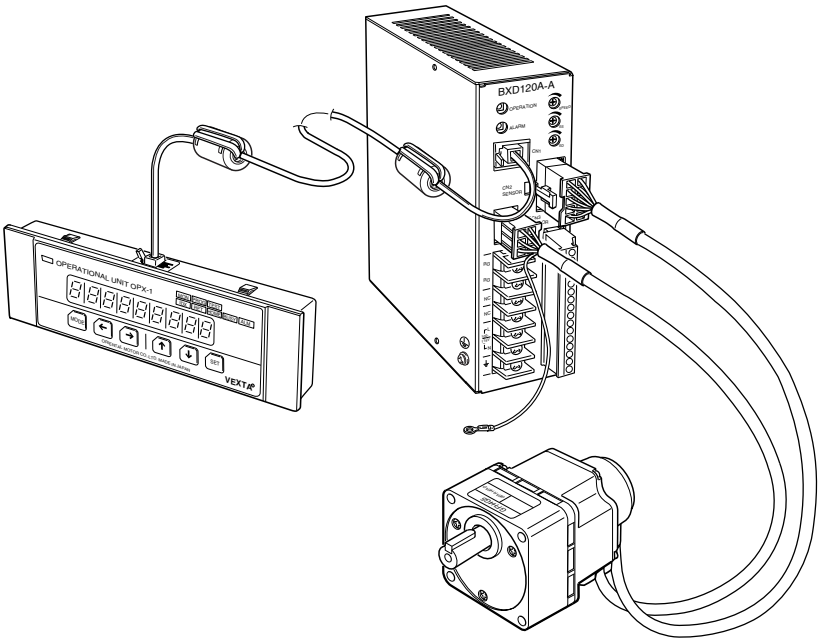
- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

1. Introduction

This operation manual describes how to use the extension functions of the brushless DC motor unit **BX** series using the data setter **OPX-1**. Before you read this operation manual for **BX** series extension functions, read the operation manual for **BX** series to become thoroughly familiar with basic operation procedures of the driver. After learning the previous information, read this manual describing the functions to be extended by the data setter **OPX-1**.

■Major functions to be extended by the System Upgrading Tool Data Setter OPX-1

In addition to the speed control mode function of the main unit of the **BX** series driver, the equipment provides the rotary speed digital setting function and position control mode function.



Only the speed control mode (when you do not use the data setter **OPX-1**)

Speed setting range: Analog two types 30 to 3,000r/min

Slow start time setting range: Analog 0 to 15sec.

Slowdown time setting range: Analog 0 to 15sec.

- Digital speed setting Page 13
  Speed setting range: 0 to 3,000r/min
  The equipment offers you a function to set motor speed in increments of 1r/min, in addition to the analog setting function using the internal and external potentiometers of the driver.

- Speed control mode Page 13
  Provides a function to set a maximum of 8 step speed settings.
  • Analog 2-step speed setting (driver) + digital 6-step setting, or
  • Digital 8-step setting

- Position control mode Page 15
  Provides positioning (indexing) operation with the preset motor movement, return to mechanical home position (home operation) and return to electrical home position (return).
  Position control range: –8,388,608 to +8,388,607 steps (500 steps/rotation)
  Number of index points: six

- Digital setting of slow start time and slowdown time Page 14
  Slow start time setting range: 0 to 30sec.
  Slowdown time setting range: 0 to 30sec.
  Slow start time and slowdown time shared by both speed control mode and position control mode can be separately set in increments of 0.001sec. directly.

- Torque limiting function Page 17
  Allows a torque limit value to be set for digital and analog speed settings. You can set the torque limit value individually for digital speed settings. The torque limit value can be expressed in percentage based on the instantaneous maximum torque of 100%.

- Servo lock function at motor standstill (speed control mode) Page 14
  Allows the use of servo lock to be selected.

- Operation monitor function Page 30
  Permits the following operation items to be monitored in the monitor (MON) mode.
  • Speed
  • Position counter
  • Torque
  • Alarm code
  • Alarm history (up to latest 10)

- Data copy function Page 41
  Allows the data set on the data setter **OPX-1** to be loaded into multiple drivers, and enables the driver data to be saved into another data setter **OPX-1**.
  The data setter **OPX-1** has four banks as data areas to permit four types of operation data to be stored.

■Hazardous substances
RoHS (Directive 2002/95/EC 27Jan.2003) compliant

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Table of contents

1. Introduction ..... Page 2

2. Safety precautions ..... Page 8

3. Preparation ..... Page 10
   3.1 Checking the product ..... Page 10
   3.2 Specifications ..... Page 10

4. Installation ..... Page 11
   4.1 Installation site ..... Page 11
   4.2 Installation method ..... Page 12
      4.2.1 How to install the setter on the panel ..... Page 12
      4.2.2 How to remove the setter from the panel ..... Page 12

5. Overview of functions ..... Page 13
   5.1 Speed control mode ..... Page 13
      5.1.1 Analog speed setting ..... Page 13
      5.1.2 Digital speed setting ..... Page 13
      5.1.3 Speed regulation ..... Page 14
      5.1.4 Slow start and slowdown time ..... Page 14
      5.1.5 Position holding function at standstill ..... Page 14
   5.2 Position control mode ..... Page 15
      5.2.1 Positioning (indexing) ..... Page 15
      5.2.2 Return to mechanical home position (home operation) ..... Page 16
      5.2.3 Return to electrical home position (return) ..... Page 16
      5.2.4 Continuous operation (scan) ..... Page 17
   5.3 Torque limiting function ..... Page 17
      5.3.1 Digital common torque setting ..... Page 17
      5.3.2 Analog common torque setting ..... Page 17
      5.3.3 Digital independent torque setting ..... Page 17

6. I/O connection ..... Page 18
   6.1 List of input/output signals ..... Page 18
   6.2 Input signal ..... Page 19
   6.3 Output signal ..... Page 24
   6.4 Connection of the speed control mode ..... Page 26
   6.5 Connection of the position control mode ..... Page 27

7. Running and parameter setting ..... Page 28
7.1 Dater setter **OPX-1** ..... Page 28
7.1.1 Connection ..... Page 28
7.1.2 Name of individual components and function ..... Page 29
7.1.3 LED displayx ..... Page 29
7.2 Data setter mode ..... Page 30
7.3 Monitor mode ..... Page 30
7.3.1 Speed ..... Page 32
7.3.2 Position counter ..... Page 32
7.3.3 Torque ..... Page 32
7.3.4 Alarm code ..... Page 32
7.3.5 Alarm history ..... Page 32
7.4 Program mode ..... Page 33
7.4.1 Selector ..... Page 34
7.4.1.1 Control mode ..... Page 35
7.4.1.2 Analog input ..... Page 35
7.4.1.3 Torque limit ..... Page 35
7.4.1.4 **KBL**-compatible mode (Enabled only in speed control mode) ... Page 35
7.4.1.5 Slow start and slowdown time Analog/digital switching ..... Page 36
7.4.1.6 Output signal (BUSY/TLM) output switching ..... Page 36
7.4.1.7 Direction of return to mechanical home position ..... Page 36
7.4.1.8 Continuous operation (scan) ..... Page 36
7.4.1.9 Initial display ..... Page 36
7.4.2 Operation data ..... Page 37
7.4.2.1 Movement ..... Page 37
7.4.2.2 Rotation direction in continuous operation ..... Page 37
7.4.2.3 Electrical home position offset ..... Page 37
7.4.2.4 Speed of rotation ..... Page 38
7.4.2.5 Torque limit ..... Page 38
7.4.3 Control parameter ..... Page 39
7.4.3.1 Digital torque limit used in common ..... Page 39
7.4.3.2 Slow start time ..... Page 39
7.4.3.3 Slowdown time ..... Page 39
7.4.3.4 Speed reduction ratio (for speed display) ..... Page 39
7.4.4 Adjustment parameter ..... Page 40
7.4.4.1 Position loop proportional gain ..... Page 40
7.4.4.2 Speed loop proportional gain ..... Page 40
7.4.4.3 Speed loop integral gain ..... Page 40
7.4.4.4 Positioning completion width ..... Page 40
7.4.5 Copy function ..... Page 41
7.4.5.1 Loading ..... Page 42
7.4.5.2 Saving ..... Page 42
7.4.5.3 Verifying ..... Page 42
7.4.5.4 Initialization ..... Page 42
7.4.5.5 Cancel ..... Page 42
7.5 Test mode ..... Page 43
7.5.1 Jog operation preparation ..... Page 43
7.5.2 Jog operation ..... Page 43

8. Setting example ..... Page 44
8.1 Selector ..... Page 44
8.1.1 Changing method of control mode ..... Page 44
8.1.2 Changing method between analog speed setting and digital speed setting (Analog input) ..... Page 45
8.1.3 Selection of setting torque limit ..... Page 46
8.1.4 Changing method of rotation input at speed control (**KBL**-compatible mode) ..... Page 47
8.1.5 Changing method between analog setting and digital setting of slow start/slowdown ..... Page 48
8.1.6 Changing method of BUSY signal output in the process of TLM torque limit ..... Page 49
8.1.7 Changing method of direction of return to mechanical home position ..... Page 50
8.2 Operation data ..... Page 51
8.3 Control parameter ..... Page 52
8.4 Adjustment parameter ..... Page 53
8.5 Copy function ..... Page 54
8.5.1 Loading ..... Page 54
8.5.2 Saving ..... Page 55
8.5.3 Verifying ..... Page 56
8.5.4 Initialization ..... Page 57
8.5.5 Cancel ..... Page 58

9. Alarm display and details ..... Page 59

2. Safety precautions

Only qualified personnel should work with the product.
Before using it, carefully read the “Safety precautions” to ensure correct operation.
The cautions described below are intended to ensure the correct use of the product and to prevent the customer and other people from being injured.
And, read the “Safety precautions” on the **BX** series manual.

⚠ Warning

Failure to observe the warnings contained herein may result in a situation leading to serious injury or death.

⚠ Caution

Failure to observe the following precautions may result in injury or property damage.

Note

The items under this heading contain important handling instructions that the user should observe to ensure the safe use of the product.

⚠Warning

General

- Do not use the product in an explosive, flammable, or corrosive atmosphere to avoid possible fire, electric shock or personal injury. Do not use it where it may be splashed with water, or near the combustible substances.
- Only qualified installers should be assigned to the work of installation, connection, running, operation, inspection and trouble diagnosis. This is intended to prevent fire, electric shock and injury.
- Do not move, install, connect or inspect the product when power is applied. Turn off power before starting such work. This caution is to prevent possible electric shock.
- Immediately after the protection function has been activated, stop running and turn off the power and remove the cause. Then turn on power again. If the motor operation is continued without removing the cause, the motor and driver may operate incorrectly causing personal injury and equipment damage.

Electrical connections

- Electrical connections must be made in strict accordance with the connection diagram. Otherwise, fire and electric shock may occur.
- Do not turn ON the FREE input when the position is held in the vertical direction. Otherwise, the holding force of the motor and electromagnetic brake will be lost, causing personal injury and equipment damage.

Repair, disassembly and modification

- Do not disassemble or modify the data setter. Otherwise you may get an electric shockor injury. When internal inspection and repair must be made, contact your local sales office.

⚠ Caution

General

- Do not use the motor, gearhead and driver in excess of ratings. Otherwise, you may get an electric shock, injury or the equipment may be damaged.

Running

- Provide an emergency-stop device or emergency-stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.

Scrapping

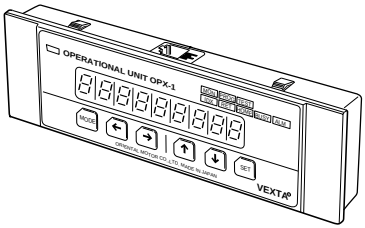
- To dispose of the data setter, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

3. Preparation

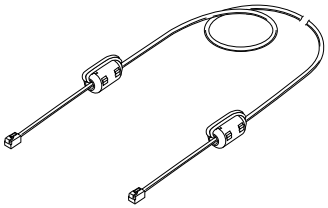
The following describes the items to be checked before operation, the names and functions of individual components as well as the main specifications.

3.1 Checking the product

Open the package and make sure that the following items are supplied.
If there is any shortage or damage, contact the sales office where you bought the product.



One data setter **OPX-1** 1 unit



One data setter cable 1 unit

Operating manual (this manual) 1 copy

3.2 Specifications

The following shows the specifications for the data setter.
For dimensions, see the catalog.

Data setter **OPX-1**

Items	Specifications
Connection	Modular 4 poles
Dimensions	142 (W) × 48 (H) × 17 (D)mm [5.59(W) × 1.89(H) × 0.67(D) in.]
Mass	0.07kg (0.15lb.)
Ambient temperature	0 to +50°C (+32 to +122°F) (non-freezing)
Ambient humidity	85% or less (non-condensing)

4. Installation

The following shows the data setter **OPX-1** installation environment, installation method and load installation.

⚠Warning
- Only qualified installers should be assigned to the work of installation, connection, running, operation, inspection and trouble diagnosis. This is intended to prevent fire, electric shock and injury.
- Do not move, install, connect or inspect the product when power is applied. Turn off power before starting such work. This caution is to prevent possible electric shock.

4.1 Installation site

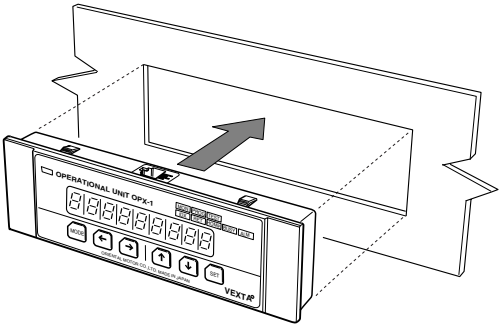
The data setter **OPX-1** is designed and manufactured to be incorporated into the equipment.
To ensure effective ventilation and easy inspection, install it in the following site.

- In the indoor housing (where a ventilation port must be provided)
- Ambient temperature: 0 to +50°C (+32 to +122°F) (non-freezing)
- Ambient humidity: 85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rains, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum

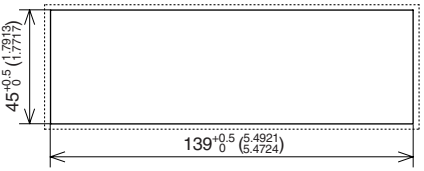
4.2 Installation method

4.2.1 How to install the setter on the panel

As illustrated, push the data setter into the machined installation hole from the front of the panel until you hear it click and the setter is secured in position.



Mounting holes dimensions
[mm (in.)]

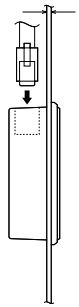


Note

The thickness of installation panel must not exceed 3mm (0.12in.).
If you install the data setter on the panel in excess of 3mm (0.12in.), you cannot connect the modular connector of the connection cable.

4.2.2 How to remove the setter from the panel

Remove the modular connector from the data setter.



Simultaneously pushing in four hooks on the top and bottom of the setter from the back of the data setter, and push it out to the front side of the panel. Then you can remove the setter from the panel.

Note

- Do not install the equipment producing all large amount of heat and noise around the data setter **OPX-1**.
- If the ambient temperature of the data setter exceeds 50°C (122°F), re-examine the ventilation conditions.

5. Overview of functions

The **BX** series provides analog input speed control as one of the major functions. Use of the extension function permits speed control with digitally set speed, and position control with preset motor movement.

5.1 Speed control mode

The use of the extension function of the data setter **OPX-1** allows the following functions to be added:

Digital speed setting : 0 to 3,000r/min (in increments of 1 r/min)
Speed settings in eight settings : data Nos. 0 to 7
Digital slow start/slowdown time setting : 0 to 30sec. (in increments of 0.001sec.)
Selection of servo lock for the motor at standstill

For speed selection, switch between the driver M0, M1 and M2 inputs to get the preset data number.

Data No.	M0	M1	M2	Speed
No. 0	OFF	OFF	OFF	Analog/digital speed setting 0 selection enabled
No. 1	ON	OFF	OFF	Analog/digital speed setting 1 selection enabled
No. 2	OFF	ON	OFF	Digital speed setting 2
No. 3	ON	ON	OFF	Digital speed setting 3
No. 4	OFF	OFF	ON	Digital speed setting 4
No. 5	ON	OFF	ON	Digital speed setting 5
No. 6	OFF	ON	ON	Digital speed setting 6
No. 7	ON	ON	ON	Digital speed setting 7

5.1.1 Analog speed setting

(For details, see the operating manual for brushless DC motor unit **BX** series.)
Internal potentiometer : Data No. 0
External analog input : Data No. 1

- Variable resistor : 20kΩ 1/4W
- 0 to 5V DC (input impedance: 15kΩ)

Speed setting range : 30 to 3,000r/min.

5.1.2 Digital speed setting

Enter the speed by means of numerals using the arrow marked key of the data setter **OPX-1**.

Speed setting range : 0 to 3,000r/min
Resolution : 1r/min
Initial value : 0r/min

5.1.3 Speed regulation

±0.05% with respect to load, 3,000r/min at rated torque time
±0.05% with respect to voltage, power supply input voltage range 3,000r/min without load
±0.5% with respect to temperature, analog setting at ambient temperature from 0 to +50°C (+32 to +122°F), 3,000r/min without load
±0.05% with respect to temperature, digital setting at ambient temperature from 0 to +50°C (+32 to +122°F), 3,000r/min without load

5.1.4 Slow start and slowdown time

The slow start and slowdown time can be set independently of each other. The extension function mode allows digital settings in addition to the settings on the driver. The preset slow start and slowdown time is shared by all data number operations.
Slow start time applies to all speed change commands, for example, when data numbers have been switched, variations of external analog input variable resistors have occurred, and the rotation direction has been switched.
Slowdown time applies when the equipment is stopped (except for **KBL**-compatible mode).
0 to 15sec. (by the driver time setter in analog setting)
0 to 30sec. (in digital setting) Setting resolution: 0.001sec.
* Time denotes the time for 0 to 3,000r/min.

5.1.5 Position holding function at standstill

Selection of the data setter **OPX-1** parameter allows the position holding method to be selected when the motor is stopped.

- Motor deactivation (held by electromagnetic brake where applicable)
- Position holding by servo control (servo lock)

5.2 Position control mode

The following additional functions are provided if you utilize the extension function of the data setter **OPX-1**.

Positioning (indexing) with either 6 or 4 different data settings
Continuous operation (scan) with up to 2 different data settings
Return to mechanical home position (home operation) by one-sensor structure
Return to electrical home position (return)
Positioning range: –8,388,608 to +8,388,607 steps
Selection among positioning data (rotation direction, position setting and speed), return to electrical home position, and return to mechanical home position is provided by choosing the set data number by switching among the drivers M0, M1 and M2 inputs.

Data No.	M0	M1	M2	Operating mode
No. 0	OFF	OFF	OFF	Positioning 0/Continuous 0
No. 1	ON	OFF	OFF	Positioning 1/Continuous 1
No. 2	OFF	ON	OFF	Positioning 2
No. 3	ON	ON	OFF	Positioning 3
No. 4	OFF	OFF	ON	Positioning 4
No. 5	ON	OFF	ON	Positioning 5
No. 6	OFF	ON	ON	Return to electrical home position
No. 7	ON	ON	ON	Return to mechanical home position

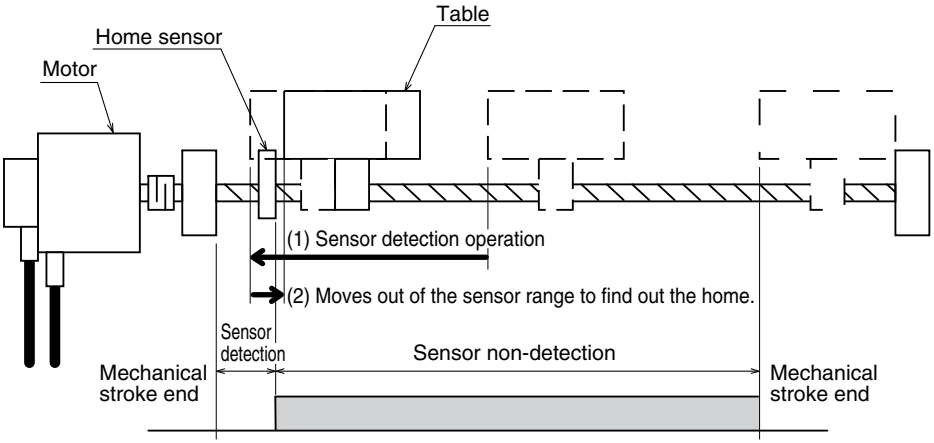
5.2.1 Positioning (indexing)

The motor runs in the direction at the speed preset on the selected data number and stops at the preset position.

Position setting method : Incremental (from the current position to relative position)
Resolution : 1 step (0.72 [°], 500 [p/r])
Position control range : –8,388,608 to +8,388,607 steps (data Nos. 0 to 5)
Speed : According to speed control mode (data Nos. 0 to 5)
Slow start time : According to speed control mode
Slowdown time : According to speed control mode

5.2.2 Return to mechanical home position (home operation)

The home position is detected by the home sensor (HOME-LS input) mounted on the equipment by running the motor in the preset detection start direction.
Stops at the position out of the home sensor range by reversing after detection of the home sensor.
Mechanical home position detection by 1-sensor method (B contact point input)
Direction of home detection start : Settable to CW or CCW
Speed : According to speed control mode (data No. 7)
Slow start/slowdown : Not provided



Example of use: Return to mechanical home position using the ball screw

Note

Install the home sensor (HOME-LS input) just before the stroke end sensor in the direction of starting detection.

5.2.3 Return to electrical home position (return)

The motor moves to the electrical home position.
After returning to the mechanical home position, the offset mechanical position serves as an electrical home position. When the offset value of the electrical home position is zero, the electrical home position matches the mechanical home position. The setting of offset value enables one to use different settings for the electrical home position and mechanical home position.
However, before returning to the mechanical home position, the position of the motor immediately after having turned on the driver's power supply becomes the electrical home position.
Movement : From the motor stop position to the electrical home position
Speed : According to speed control mode (data No. 6)
Slow start time : According to speed control mode
Slowdown time : According to speed control mode

5.2.4 Continuous operation (scan)

Set data Nos. 0 and 1 to continuous operation in the position control mode.
Speed : According to speed control mode
Slow start time : According to speed control mode
Slowdown time : According to speed control mode
Rotation direction : CW when the movement is set to zero or greater; CCW when the movement is set to –1 or less.

Note

In continuous operation in the position control mode, position information is constantly monitored as during positioning operation. If the motor is unable to follow the command, the protection function for excessive displacement may be activated.

5.3 Torque limiting function

You can set the motor output torque limiting value similarly to the case in speed control/ position control modes.
Torque limiting values can be selected in the following three ways:
Digital common torque setting
Analog common torque setting
Digital independent torque setting (to be set together with data number)

Note

- If the motor is operated at torque in the limited duty region, the overload protection function may be activated.
- In the position control mode, if the motor is locked or becomes unable to follow the command, the protection function for excessive displacement may be activated.

5.3.1 Digital common torque setting

A torque limiting value can be set for all data numbers in one operation.
Assuming that instantaneous maximum torque is 100%:
Setting range : 1 to 100 [%]
Resolution : 1 [%]

5.3.2 Analog common torque setting

A torque limiting value can be set for all data numbers in one operation by means of external analog input.
It should be noted, however, that the digital speed setting is enabled.
Setting range : 1 to 100 [%]
Analog input Variable resistor: 20kΩ 1/4W
DC voltage : 0 to 5V DC (input impedance: 15kΩ)

5.3.3 Digital independent torque setting

A torque limit can be set independently for each of data Nos. 0 to 7 by numerical entry.
Setting range : 1 to 100 [%]
Resolution : 1 [%]

6. I/O connection

6.1 List of input/output signals

By selection of the control mode (speed control and position control) and switching of the terminal function, input/output signal functions are assigned as follows:

Terminal No.	Type	Speed control mode	Position control mode	**KBL**-compatible mode
1	Input	CW	START	START
2		CCW	HOME-LS	DRE
3		M0		
4		M1		
5		M2		
6		FREE		
7		BRAKE/ACL		
8	Common	IN-COM		
9	External analog input	H		
10		M		
11		L		
12	Output	ALM		
13		BUSY/TLM/ALP		
14		ASG		
15		BSG		
16	Common	OUT-COM		

■Electrical specifications

Input signal

Photocoupler input

Internal voltage 15V DC

Internal resistance 2.3kΩ

External analog input

20kΩ 1/4W when a variable resistor is connected

0 to 5V DC when DC power supply is connected (input impedance: 15kΩ)

Output signal

Open collector output

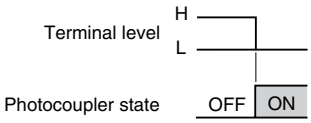
External pull-up voltage 4.5 to 26.4V DC

Maximum output current 40mA (ALM for terminal No. 12; BUSY/TLM/ALP for terminal No. 13)

Maximum output current 20mA (ASG for terminal No. 14; BSG for terminal No. 15)

■I/O theory

Photocoupler input/output in the timing chart are expressed in terms of ON/OFF states (activated/not activated states) of the photocoupler. The photocoupler is ON when the terminal voltage level is L.



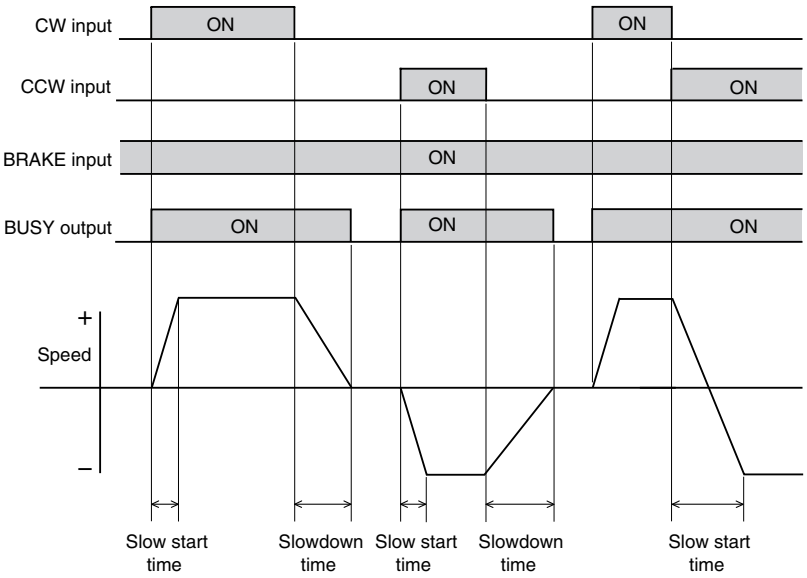
6.2 Input signal

■CW (Speed control mode)

CW rotation command ON: CW rotation OFF: Stop

CCW (Speed control mode)

CCW rotation command ON: CCW rotation OFF: Stop



Operation signal timing chart (speed control mode)

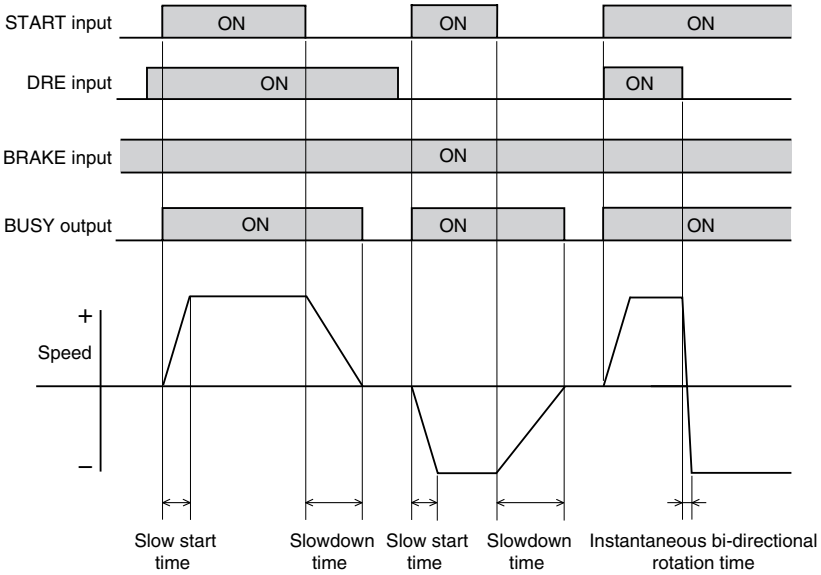
* The BRAKE input is OFF and the motor stops. To start the motor, be sure to select ON.

■**START (KBL-compatible mode)**

ON: Operation OFF: Stop

DRE (KBL-compatible mode) Changing of rotation direction

ON: CW rotation OFF: CCW rotation

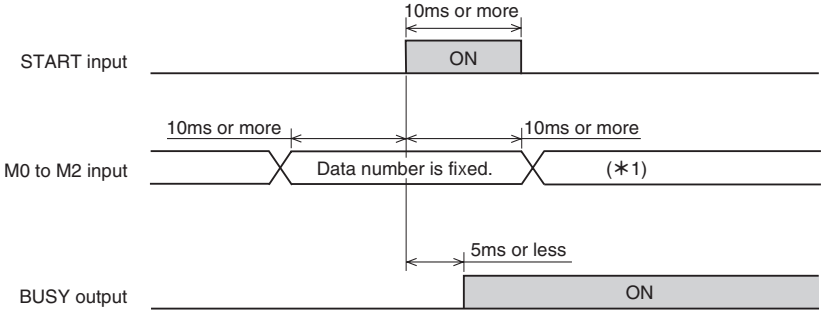


Operation signal timing chart (**KBL**-compatible mode)

* The BRAKE input is OFF and the motor stops. To start the motor, be sure to select ON.

■START (in position control mode)

(Positioning, return to mechanical home position and return to electrical home position are started by one-shot input.)



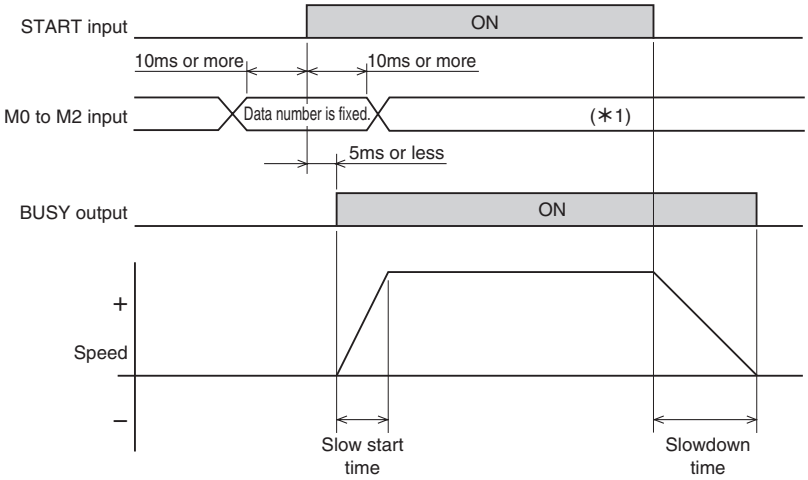
(∗1) For digital independent torque limit, the data number is reflected whenever required even during indexing process.

START timing chart (position control mode)

∗ The BRAKE input is OFF and the motor stops. To start the motor, be sure to select ON.

■START (position control mode continuous operation)

ON: Operation OFF: Stop



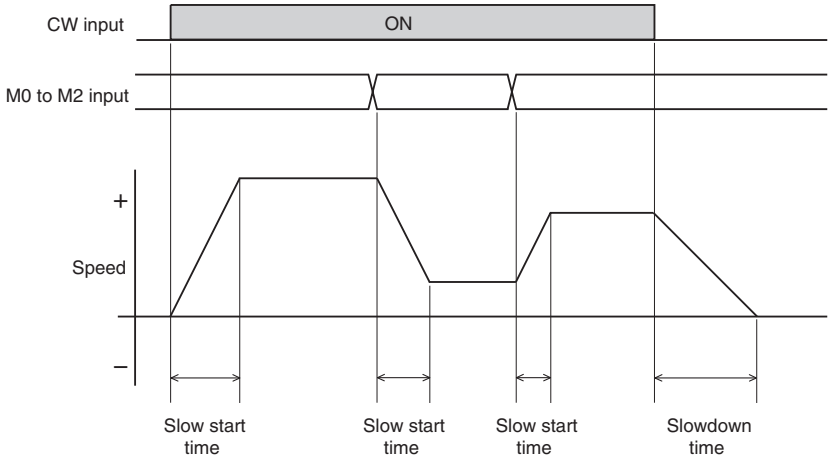
(∗1) For digital independent torque limit, the data number is reflected whenever required even during indexing process.

■HOME-LS (position control mode) home sensor input

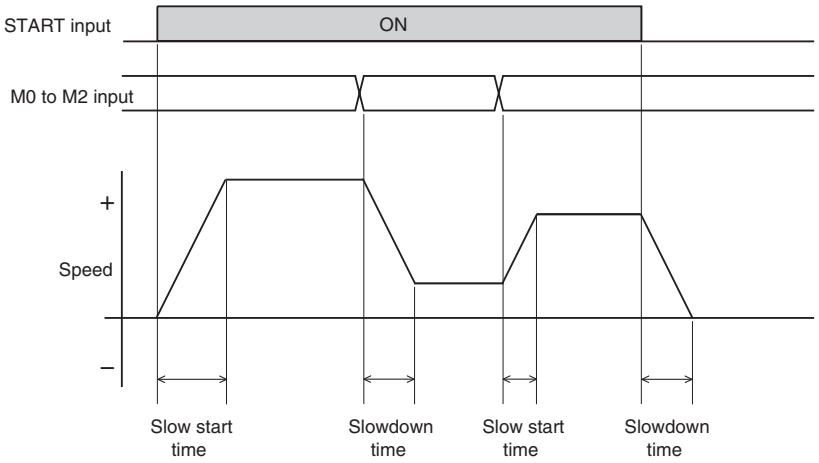
See the return to mechanical home position (Page 16).

■Entry of M0, M1 and M2 operation data number selection

This is an entry to select the data number. See the description of speed control mode (Page 13) and position control mode (Page 15).



Speed change timing chart (speed control mode)



Speed change timing chart (**KBL**-compatible mode)

■Release of FREE motor control

ON: Release of motor excitation and electromagnetic brake (when an electromagnetic brake is supplied)

OFF: Normal operation

⚠Warning Do not turn ON the FREE input when the position is held in the vertical direction. Otherwise, the holding force of the motor and electromagnetic brake will be lost, causing personal injury and equipment damage.

Release of the motor control is given top priority, independently of other input states. When you want to manually position the motor, be sure to turn OFF FREE input first.

■Stop by BRAKE

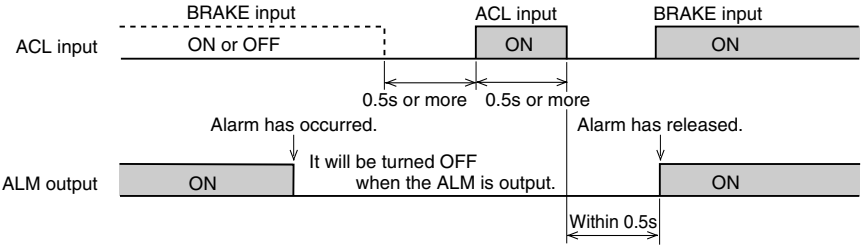
ON: Normal operation mode

OFF: Instantaneous motor stop and holding of electromagnetic brake (when an electromagnetic brake is supplied)

The BRAKE input takes preference over CW input, CCW input and START input. When you want to run the motor, be sure to turn ON Stop Input first.

■ACL (Alarm Clear) input (when alarm has occurred)

Release the protection function and restart the system. This does not work in response to the activation of overcurrent the protection function, EEPROM failure and system failure. This is an one-shot input. An OFF state for a minimum of 0.5sec. is required just before the ON edge. The minimum duration for the ON state is 0.5sec. The driver system is enabled 0.5sec. after the OFF edge.



ACL timing chart

■External analog input (External speed setting input)

Connect the external potentiometer (supplied) or DC power supply. See the description of the speed control mode and torque limiting function discussed above.

6.3 Output signal

■ALM (alarm) output (Normally closed)

ALM is issued when the protection function has activated (photocoupler off), and the driver ALARM LED flashes.

It can be reset by turning on power again, or by ACL (Alarm Clear) input.

■During BUSY operation

Speed control mode (excitation released at standstill):

The photocoupler is turned on while the motor is running.

Position control mode and speed control mode (servo block when stopped)

The photocoupler is on while the motor is running. The photocoupler is turned off if stopped at the preset position.

■ALP alarm pulse output (when alarm has occurred)

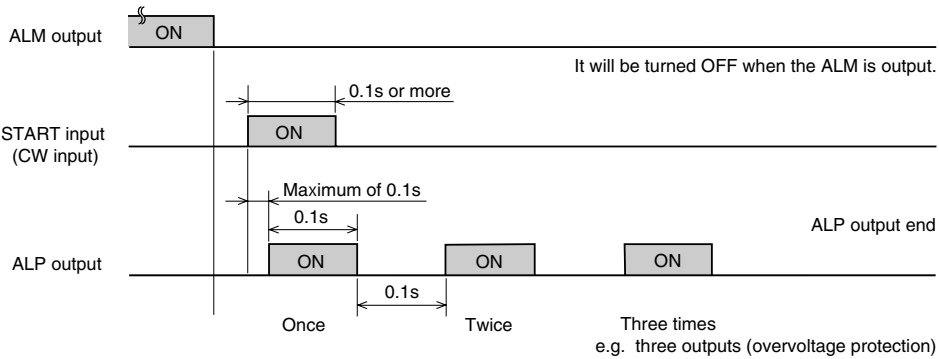
This is enabled when alarm has occurred. Pulses are issued when one pulse is input to the CW or START input signal.

The alarm code can be identified by counting output pulses.

Pulse speed : 5 [Hz]

Number of pulses : Same as the number of ALARM LED flashings

See the operating manual for **BX** series.



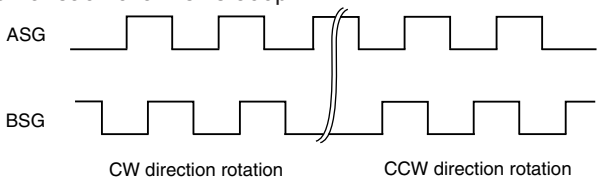
ALP output timing chart (in overvoltage protection, number of pulse=3)

■Output during TLM torque limiting

The BUSY output signal indicating that the motor is in the process of running can be converted into the TLM (torque limiter) output showing that the limit torque has been reached.

■ASG and BSG encoder pulses (phase difference output)

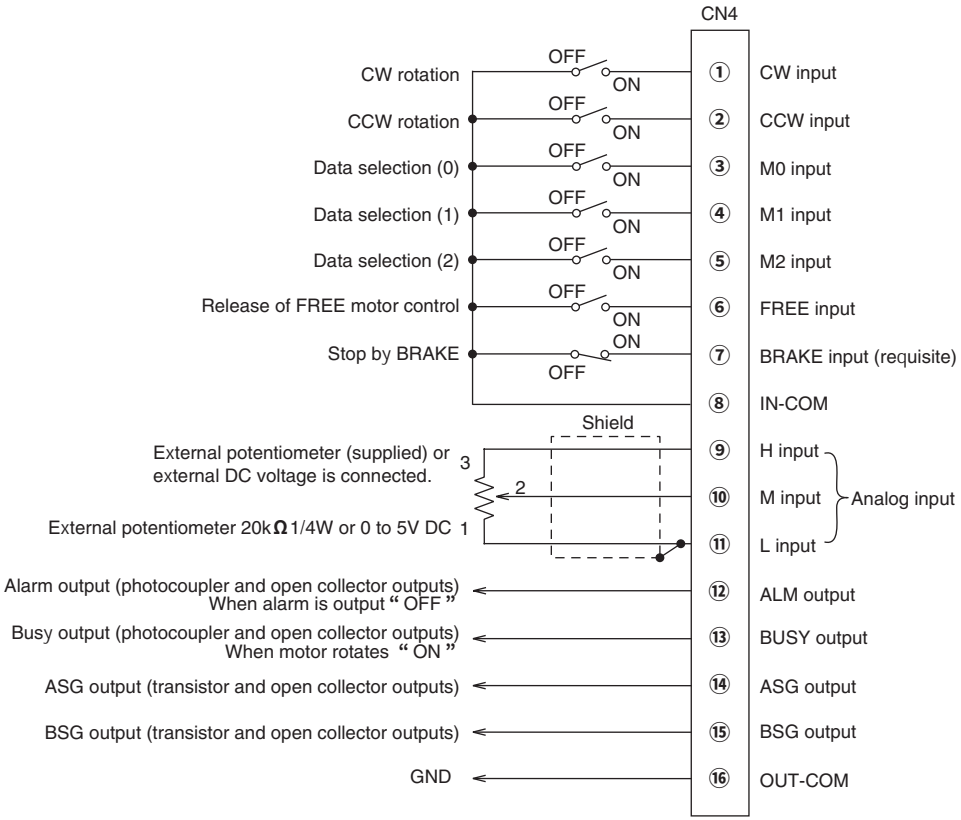
The phase difference between the ASG and the BSG pulses is 90°.
The resolution of each channel is 500p/r.



Encoder pulse wave form

6.4 Connection of the speed control mode

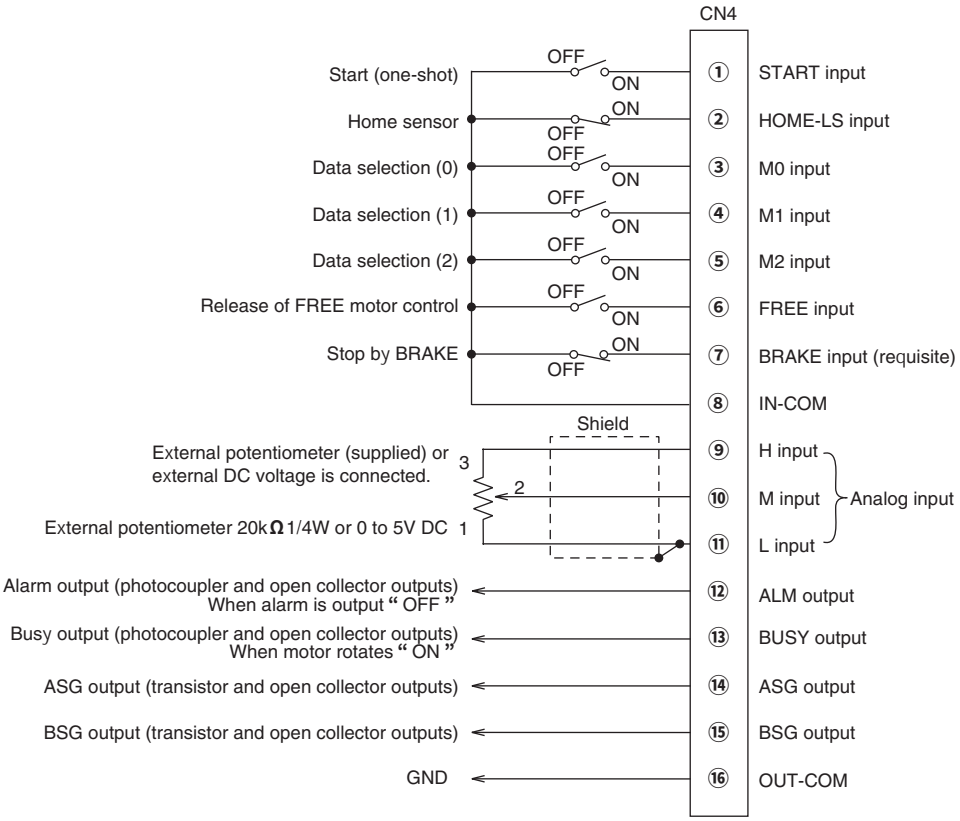
The following shows the basic connection diagram of the speed control mode:



Example connection of speed control

6.5 Connection of the position control mode

The following shows the basic connection diagram of the position control mode:



Example connection of position control

7. Running and parameter setting

7.1 Data setter OPX-1

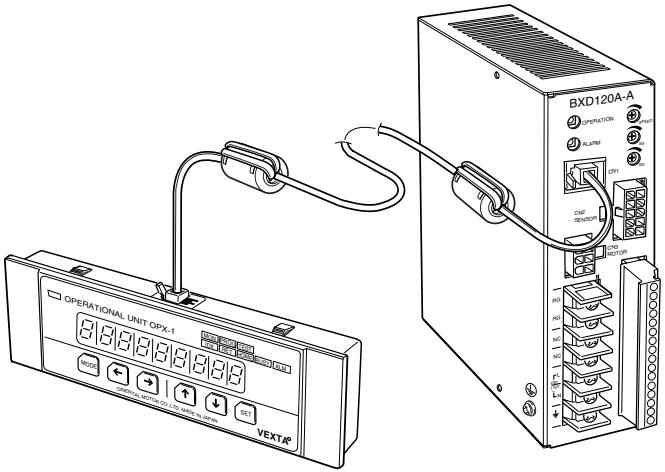
7.1.1 Connection

Use the attached data setter cable to connect between the data setter **OPX-1** and driver.

⚠Warning
- Only qualified installers should be assigned to the work of installation, connection, running, operation, inspection and trouble diagnosis.
- Electrical connections must be made in strict accordance with the connection diagram. Otherwise, fire and electric shock may occur.

Insert the modular connector of the data setter cable into the driver data setter connector (CN1) and data setter **OPX-1** until you hear it click and it is locked in position.

The set data is valid even if you have disconnected the data setter.

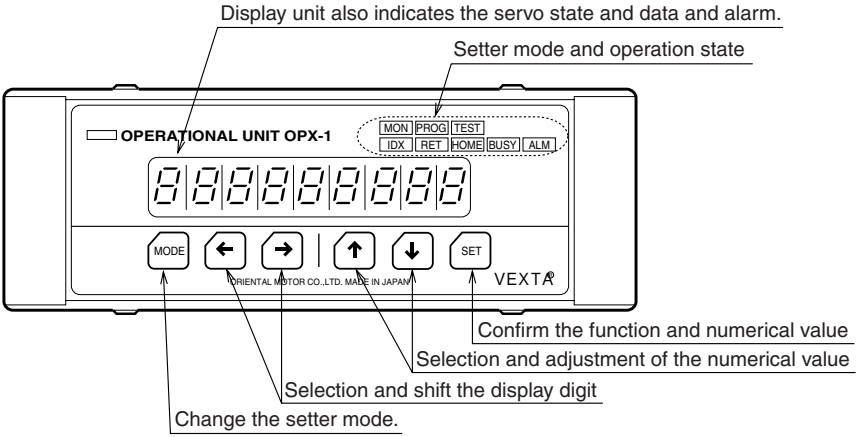


Connection of data setter **OPX-1** and driver

To remove the data setter, gently press the jaw of the modular connector against the plug and pull it out.

Note
- You can remove the data setter even after you have turned on driver power supply.
- You cannot use a cable other than the attached data setter cable for this connection.
- Do not remove two Ferrite cores attached to the setter cable.
  If you remove them, noise resistance will be reduced and operation errors may occur.

7.1.2 Name of individual components and function



Name of individual components and function of data setter

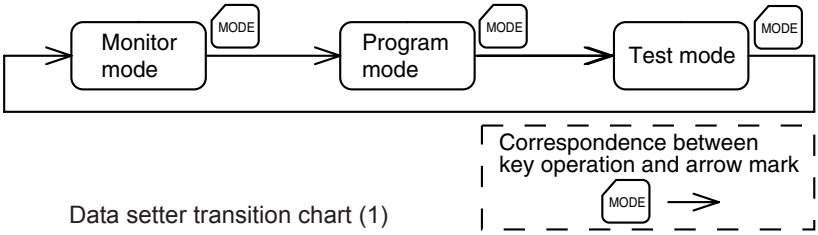
7.1.3 LED display

Indicates the data setter **OPX-1** mode and running state.

MON : The data setter is set to the monitor mode.
PROG : The data setter is set to the program mode.
TEST : The data setter is set to the test mode.
IDX : Motor in the indexing process
RET : Motor in the process of returning to electrical home position
HOME : Motor in the process of returning to mechanical home position
BUSY : Motor in the process of running and torque limiting (same as I/O setting BUSY/TLM)
ALM : Activation of protection function

7.2 Data setter mode

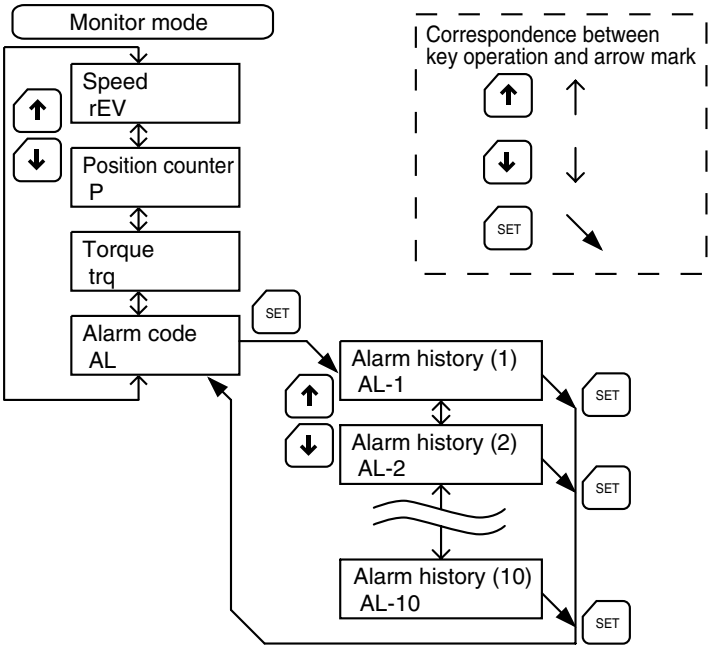
The data setter **OPX-1** has a monitor mode to display the motor's operational state, a program mode to set operational data and various types of parameters, and a test mode for operational testing. Use the MODE key to change the data setter mode. You can confirm mode changes by checking if the LED on the setter is turned on or off. The monitor mode is represented by MON, the program mode by PROG and the test mode by TEST.



Data setter transition chart (1)

7.3 Monitor mode

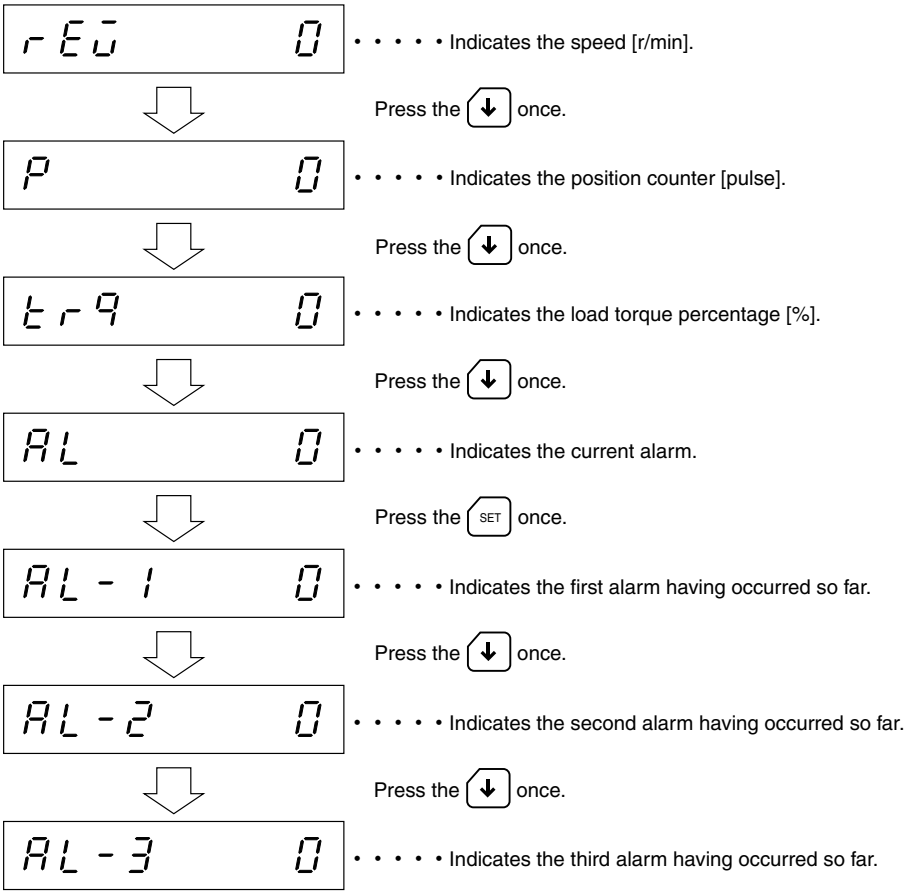
If you are running the motor connecting between the data setter **OPX-1** and driver, you can use the monitor mode to monitor the activation state of the following items:



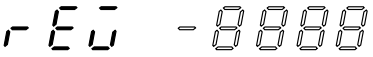
Data setter transition chart (2)

The following shows the example of operations to display the alarm history. For details of each monitor, see the description on page 32 and thereafter.

The following shows the display screen after turning on power:

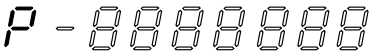


7.3.1 Speed



It indicates the motor shaft speed. When the speed reduction ratio is set (Page 39), it indicates the gear shaft speed.
Display range: 0 to 3,000 [r/min] Rotation direction: No indication = CW, "–" = CCW

7.3.2 Position counter



The counter indicates "0" at the electrical home position and when power has been turned on.
The counter indicates the position of the motor movement with respect to that position.
Indication range: –8,388,608 to +8,388,607 Resolution: 1 step (0.72 [°], 500 [p/r])

7.3.3 Torque



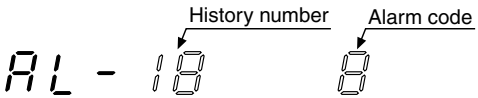
Indicates the load torque state. Indication accuracy (about ±20% with respect to load torque)
Indication range: 0 to 100 [%]

7.3.4 Alarm code



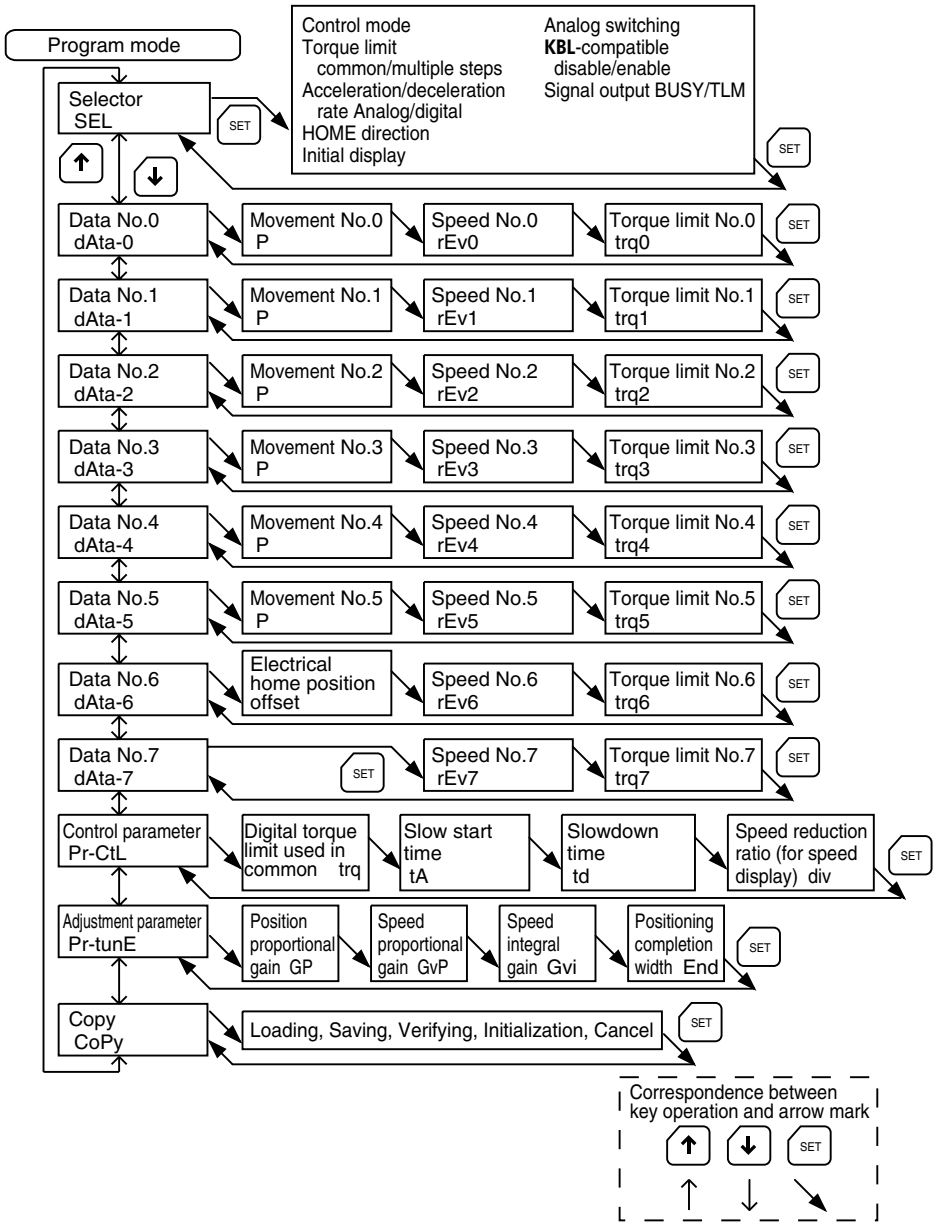
When the driver protection function has activated, you can see the code showing the protection function (See the Alarm Code List on page 59).

7.3.5 Alarm history



You can check ten alarms having occurred so far.
Two digits at the center shows the order of the alarms having occurred, and the rightmost digit indicates the details of the alarm.

7.4 Program mode



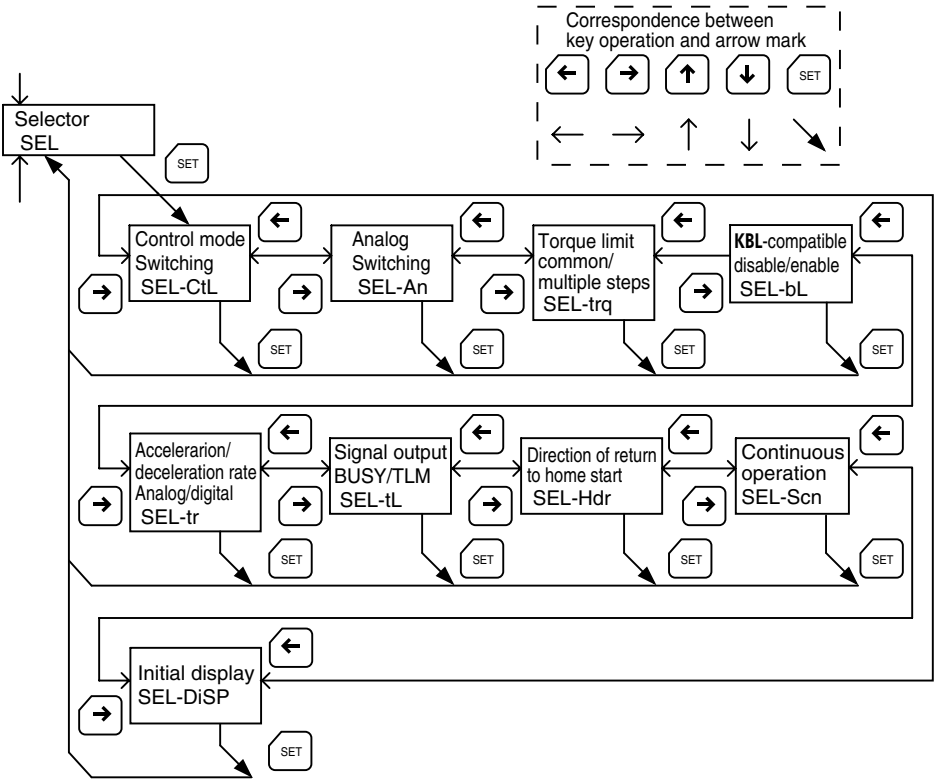
Data setter transition chart (3)

7.4.1 Selector SEL

The selector is use to choose the settings to use the extension functions of the data setter **OPX-1**, such as selection of the speed control mode or position control mode, analog or digital setting of the speed and torque limiting setting.

Note

To enable selector setting, turn on power again.



Data setter transition chart (4) ~ Selector

7.4.1.1 Control mode SEL-CtL

You can choose whether you want to run the equipment in the speed control mode or in the position control mode.

- When you have selected “1: Speed control mode (excitation released when the motor has stopped)”, release and operation of the electromagnetic brake are interlocked with motor operation.

0: Speed control mode (servo lock when stopped)
1: Speed control mode (excitation released when stopped) (initial value)
2: Position control mode

7.4.1.2 Analog input SEL-An

Select the speed setting procedure and torque control procedure.

- According to “1: Analog speed command” preset at the time of shipment, you can set the speed in two steps by the driver internal and external potentiometer, and in 6 steps by digital speed setter.
- Selection of “2: Analog torque limit” hallows the torque limit value to be set by the external control knob or analog voltage input.

0: Analog input disable (speed command and torque limit to be set digitally)
1: Analog speed command (torque limit to be set digitally) [initial value]
2: Analog torque limit (speed control to be set digitally)

7.4.1.3 Torque limit SEL-tr9

You can select whether the torque limit is set in common for eight types of setting or individually for each type.

0: In common (analog/digital switching depends on analog input) [initial value]
1: Individually in 8 steps

7.4.1.4 KBL-compatible mode SEL-bL

(Enabled only in speed control mode)

0: CW and CCW operation input [initial value]
1: **KBL**-compatible mode enabled, operation input (START), and direction input (DRE)

Note

The following describes the scope of application for slow start and slowdown time in the **KBL**-compatible mode: The slow start time applies to the start and speed change toward increasing speed. The slowdown time applies to the stop and speed change toward decreasing speed. Slow start and slowdown time does not apply when the rotary direction is changed. Instantaneous forward and reverse rotation takes place.

7.4.1.5 Slow start and slowdown time Analog/digital switching

SEL-tL

You can select analog or digital setting when you want to use slow start and slowdown time setting procedure.

0: Digital
1: Analog [initial value]

7.4.1.6 Output signal (BUSY/TLM) output switching

SEL-tL

Select the TLM to be output when BUSY output or torque limit setting have reached.

0: In the process of BUSY motor operation [initial value]
1: In the process of TLM torque limit

7.4.1.7 Direction of return to mechanical home position

SEL-Hdr

Operation is enabled in the position control mode. You can select the direction of return to mechanical home position.

0: Start of detection in the CCW direction [initial value]
1: Start of detection in the CW direction

7.4.1.8 Continuous operation (scan)

SEL-Scn

When the selector control mode is set to position control, this function switches data Nos. 0 and 1 to either continuous operation or positioning operation. Even when continuous operation has been selected, data Nos. 2 through 7 will be for positioning operation, return to electrical home position, and return to mechanical home position. Therefore, the positioning operation and continuous operation can be used simultaneously.

0: Data Nos. 0 and 1 Index operation [initial value]
1: Data Nos. 0 and 1 Continuous operation

7.4.1.9 Initial display

SEL-di SP

You can select the monitoring of speed, position counter or torque on the data setter **OPX-1** when the power is turned on.

0: Speed [initial value]
1: Position counter
2: Torque

7.4.2 Operation data dATA-8

You can set the data required for the operation mode set by the selector and setting procedure.
Movement, speed and torque limit value are set on data Nos. 0 to 5.
Speed and torque limit value are set on the data Nos. 6 and 7.

7.4.2.1 Movement P-88888888

You can specify the movement of the motor for positioning. This function is enabled when you have selected “2: position control mode” in the selector control mode.
The movement can be set on data Nos. 0 to 5. The second digit from the left indicates the direction of rotation.

Setting range : –8,388,608 to 8,388,607 steps
Resolution : 1 step (0.72 [°], 500 [p/r])
Initial value : 0

The following shows the rotation direction:



「+」 CW direction



「–」 CCW direction

7.4.2.2 Rotation direction in continuous operation P-88888888

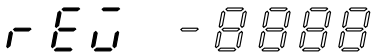
When the positioning mode and continuous operation (scan) are set by the selector, the setting of movement for data Nos. 0 and 1 determines the direction of rotation. If the movement is set to zero or greater, the rotation direction will be CW. If the movement is set to -1 or less, the rotation direction will be CCW.

Setting range : –8,388,608 to 8,388,607
Rotation direction : 0 or greater: CW –1 or less: CCW
Initial value : 0 (CW)

7.4.2.3 Electrical home position offset P-88888888

The electrical home position is offset with respect to the mechanical home position by the value contained in data No. 6. The value is used for return to electrical home position in the position control mode. Input a value when different settings for the electrical home position and mechanical home position are desired.

(Electrical home position) = (Mechanical home position) + (Offset)
Setting range : –8,388,608 to 8,388,607
Resolution : 1 step (0.72 [°], 500 [p/r])
Initial value : 0

7.4.2.4 Speed of rotation 

Set the speed of rotation on data Nos. 0 to 7.
The value set on data Nos. 0 and 1 can be used when other than “1: analog speed command” has been specified by the selector analog input.
Furthermore, when “3: position mode” is selected in the selector control mode, data No. 6 indicates the speed for return to electrical home position, while data No. 7 shows the speed for return to mechanical home position.

Setting range : 0 to 3,000 [r/min]
Resolution : 1 [r/min]
Initial value : 0 [r/min]

7.4.2.5 Torque limit 

Set the torque limit on data Nos. 0 and 7.
This is enabled when “1: Independent” is selected by selector torque limit.
The torque limit value assumes that the instantaneous maximum motor torque is 100%.

Setting range : 1 to 100 [%] (instantaneous maximum motor torque at 100%)
Resolution : 1 [%]
Initial value : 100 [%]

Note

When an attempt is made to set the data out of the setting range, an error is indicated for one second.

7.4.3 Control parameter Pr-CtL

You can set the following four parameters to be used in common in digital setup.

7.4.3.1 Digital torque limit used in common tr9 100

You can digitally set the torque limit value commonly used for data No. 0 to 7.
This is enabled when other than “2: analog torque limit” has been selected by the selector analog input, and “0: common” has been selected in torque limit.

Setting range : 1 to 100 [%]
Resolution : 1 [%]
Initial value : 100 [%]

7.4.3.2 Slow start time tA 00000

You can set the slow start time digitally.

Setting range : 0 to 30000 [ms]
Resolution : 1 [ms]
Initial value : 100 [ms]

7.4.3.3 Slowdown time td 00000

You can set the slowdown time digitally.

Setting range : 0 to 3000 [ms]
Resolution : 1 [ms]
Initial value : 100 [ms]

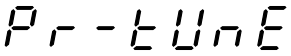
7.4.3.4 Speed reduction ratio (for speed display) di U

Set the gearhead speed reduction ratio and switch the data setter **OPX-1** speed indication over to speed indication of the gear output shaft.
The preset speed reduction ratio is used only to indicate the speed of rotation.

Setting range : 1 to 1000
Resolution : 1
Initial value : 1

Note

When an attempt is made to set the data out of the setting range, an error is indicated for one second.

7.4.4 Adjustment parameter 

Set the following four adjustment parameters to determine the motor response.
Use them to ensure matching between the customer's equipment and motor response whenever required.

7.4.4.1 Position loop proportional gain 

Set the position loop response.
If the setting is high, motor response will be increased. However, if you set it too high, the motor may exceed hunting level.
This is enabled when "0: speed control mode" or "2: position control mode" has been selected in the control mode.

Setting range : 1 to 200
Resolution : 1

7.4.4.2 Speed loop proportional gain 

Set the speed loop response.
If the setting is high, motor overshoot can be controlled. However, if you set it too high, motor vibration may be caused.

Setting range : 1 to 100
Resolution : 1

7.4.4.3 Speed loop integral gain 

Set the speed loop in terms of the integral constant.
If the setting is high, motor response will be increased. However, if you set it too high, the motor overshoot will increase, and hunting may result.

Setting range : 1 to 100
Resolution : 1

7.4.4.4 Positioning completion width 

Set the evaluated amount for stop with respect to the number of cumulative pulses of the deviation counter of the driver.
This is enabled when "0: speed control mode" or "2: position control mode" has been selected in the selector control mode.
When you want to detect the motor stop signal earlier, increase the set value. However, if you increase it too much, detection accuracy may be reduced.

Setting range : 1 to 100
Resolution : 1 (0.72 [°])
Initial value : 1 (±0.72 [°])

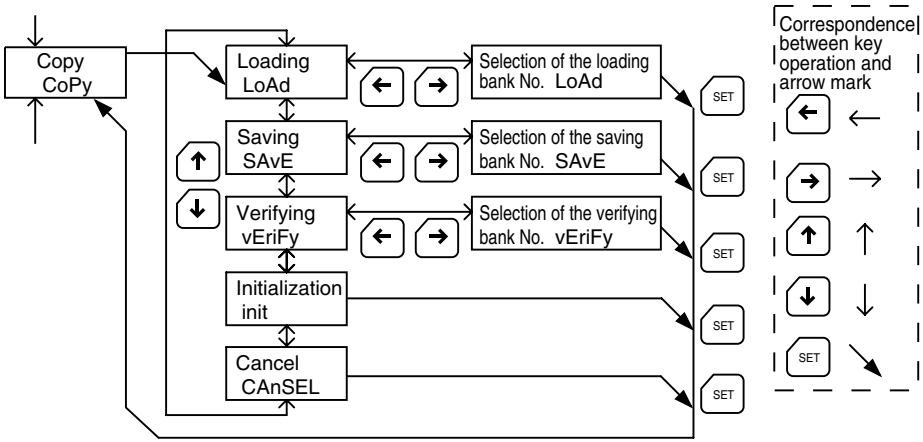
Note

When an attempt is made to set the data out of the setting range, an error is indicated for one second.

7.4.5 Copy function CoPy

The data setter **OPX-1** has four data banks capable of storing four types of operation data and parameters. Since EEPROM (non-volatile memory) is used as data storage memory, backup power supply is not necessary.

Operation data and parameters can be loaded, saved and verified between the data setter **OPX-1** and multiple drivers.



Data setter transition chart (5)

7.4.5.1 Loading



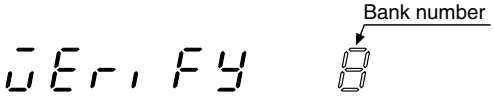
Operation data and parameters in the banks Nos. 0 to 3 specified by the data setter **OPX-1** are loaded from the data setter into the driver. When loading is completed, the operation data and parameters previously stored in the driver disappear and are replaced by new operation data and parameters. When loading has completed, the screen goes back to COPY display.
If data is not stored in the selected bank number, an Error message will appear for one sec.

7.4.5.2 Saving



Operation data and parameters are saved into the data setter **OPX-1** from the driver; they are saved in the banks Nos. 0 to 3 specified by the data setter **OPX-1**. When saving is completed, the operation data and parameters previously stored in the banks disappear and are replaced by new operation data and parameters.

7.4.5.3 Verifying



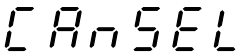
Operation data and parameters stored in the banks Nos. 0 to 3 specified by the data setter **OPX-1** are verified with the operation data and parameters in the driver. If agreement is found out by verifying, Good is displayed for one second. If not, Error is displayed for one second.

7.4.5.4 Initialization



Operation data and parameters stored in the driver are returned to the values set at the time of shipment.

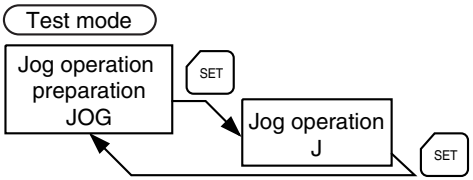
7.4.5.5 Cancel



The screen returns to the COPY display without loading, saving, verifying or initializing.

7.5 Test mode

This mode enables motor test operations using the data setter **OPX-1**.



7.5.1 Jog operation preparation JoG

Switch to the jog operation by pressing the SET with this indication displayed.

7.5.2 Jog operation J-00000000

The motor can be jogged by using the ↑ or ↓ on the data setter **OPX-1**. The speed will use either the internal potentiometer setting or data No. 0 setting (selected by the selector's analog input). The eight digits on the right indicate the position count.

Speed control mode

The motor will rotate in the CW direction while the ↑ is being pressed.

The motor will rotate in the CCW direction while the ↓ is being pressed.

Position control mode

The motor will move one step forward by pressing the ↑ once, or rotate in the CW direction by holding it down.

The motor will move one step backward by pressing the ↓ once, or rotate in the CCW direction by holding it down.

Return to the jog operation preparation by pressing the SET.

Note

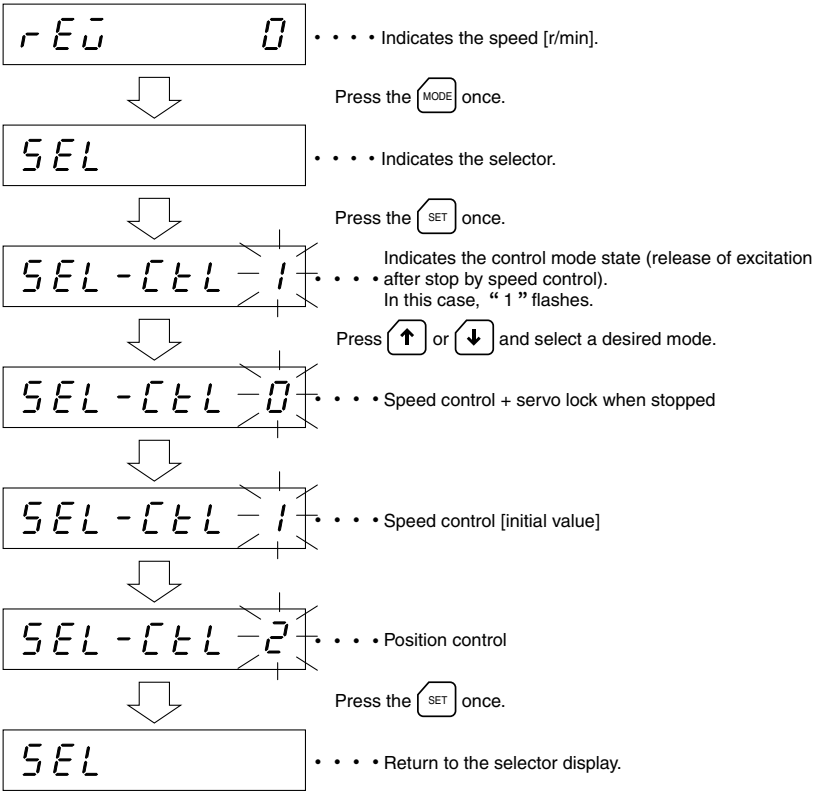
The input signals for FREE (release of motor control) and BRAKE (stop) remain effective during the jog operation in the test mode. The FREE and BRAKE signal input takes precedence over key operations performed during the jog operation.

8. Setting example

8.1 Selector

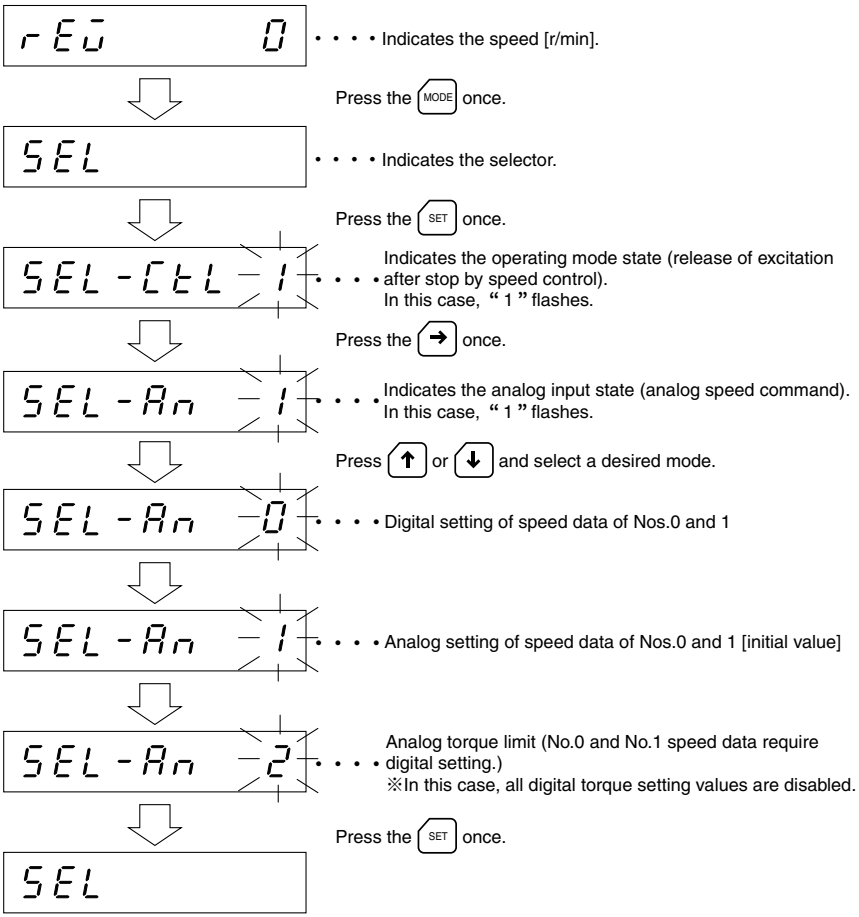
8.1.1 Changing method of control mode

(Selection of speed control and position control)



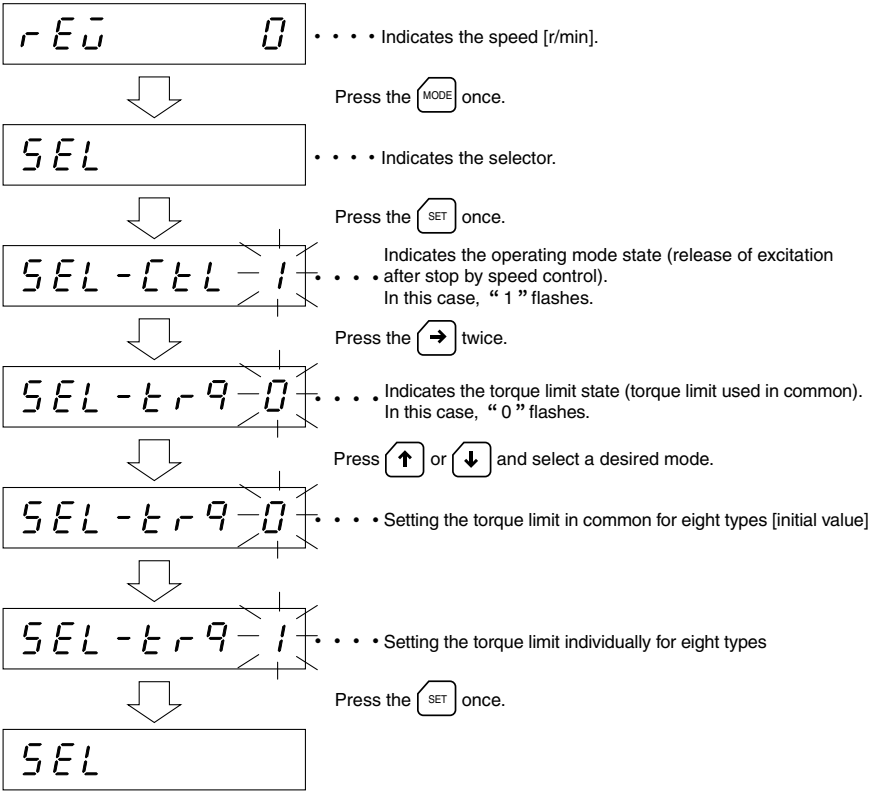
To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of control mode.

8.1.2 Changing method between analog speed setting and digital speed setting (Analog input)



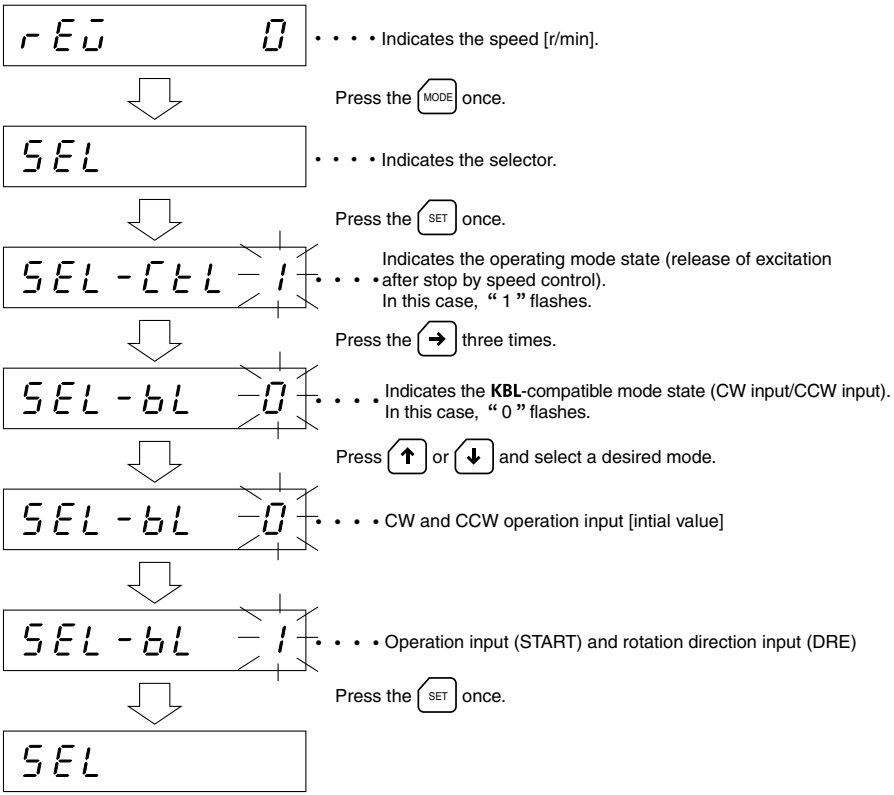
To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

8.1.3 Selection of setting torque limit (Selection whether the torque limit is set in common for eight types of setting or individually for each type)



To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

8.1.4 Changing method of rotation input at speed control (KBL-compatible mode)
(Selection whether the I/O is set in CW input and CCW input or START input and rotation direction input)

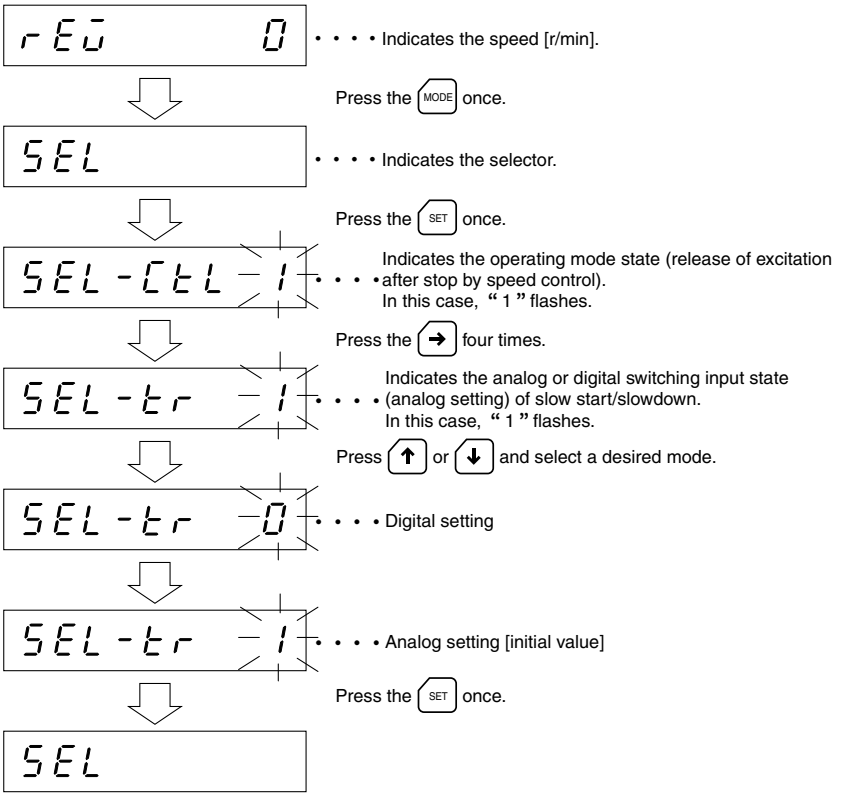


To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

Note

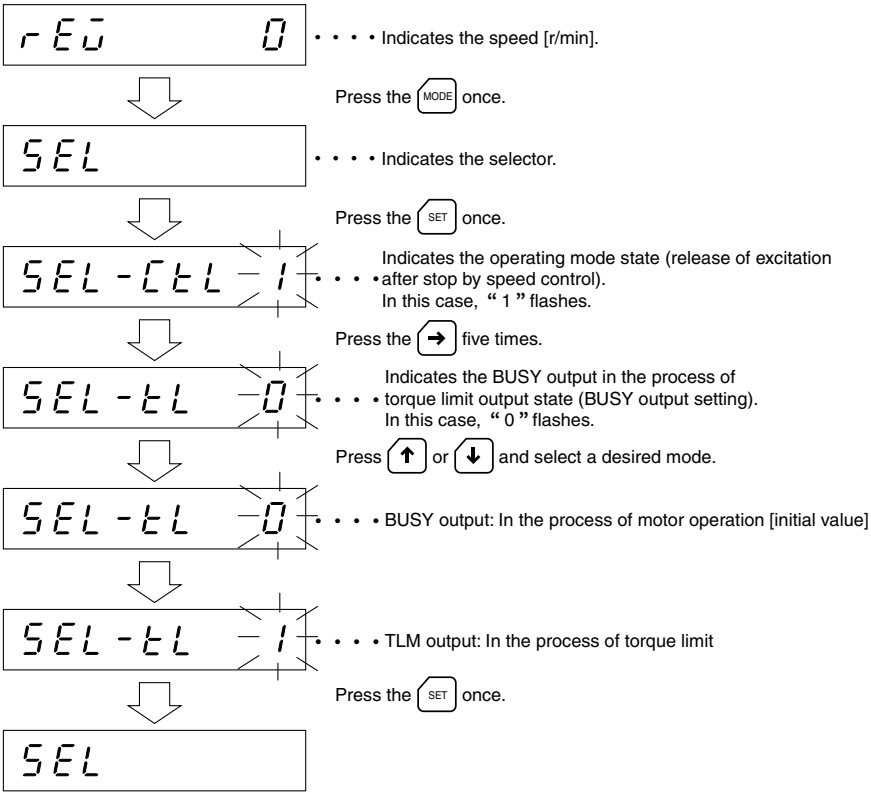
The following describes the scope of application for slow start and slowdown time in the **KBL**-compatible mode: The slow start time applies to the start and speed change toward increasing speed. The slowdown time applies to the stop and speed change toward decreasing speed. Slow start and slowdown time does not apply when the rotary direction is changed. Instantaneous forward and reverse rotation takes place.

8.1.5 Changing method between analog setting and digital setting of slow start/slowdown



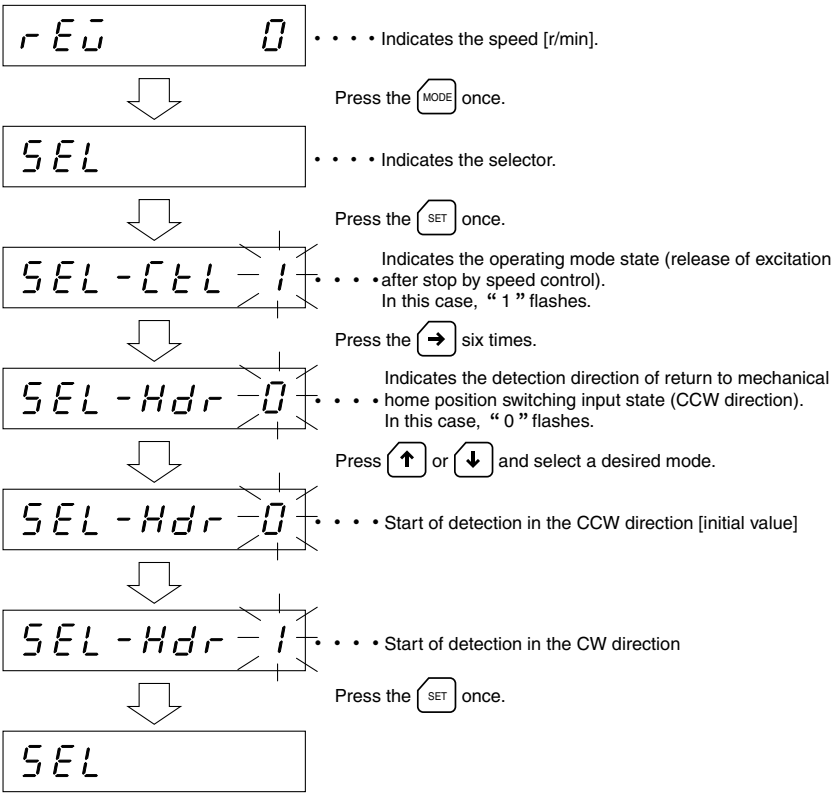
To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

8.1.6 Changing method of BUSY signal output in the process of TLM torque limit (Selection of the output when motor operation or torque limit setting have reached)



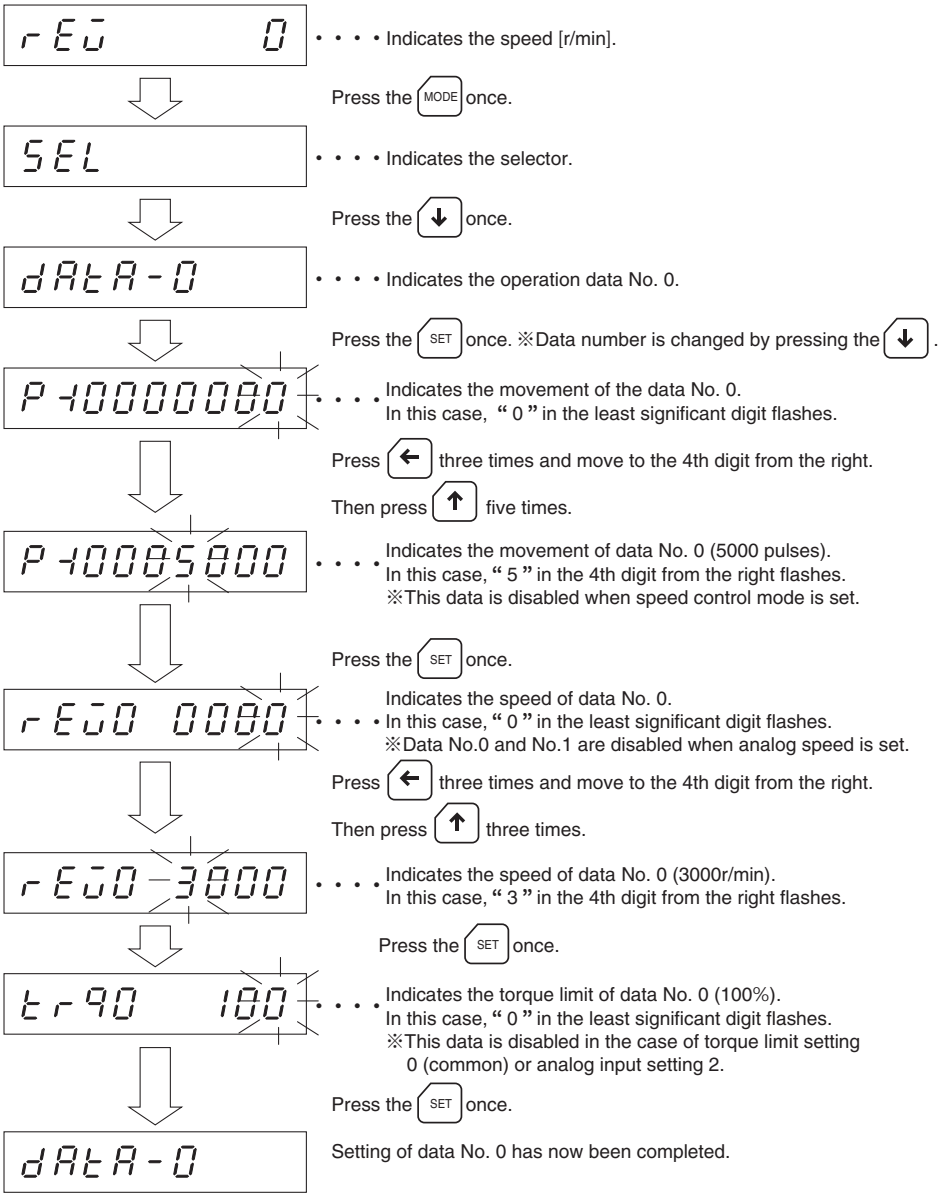
To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

8.1.7 Changing method of direction of return to mechanical home position (Selection of the detection direction of return to mechanical home position)

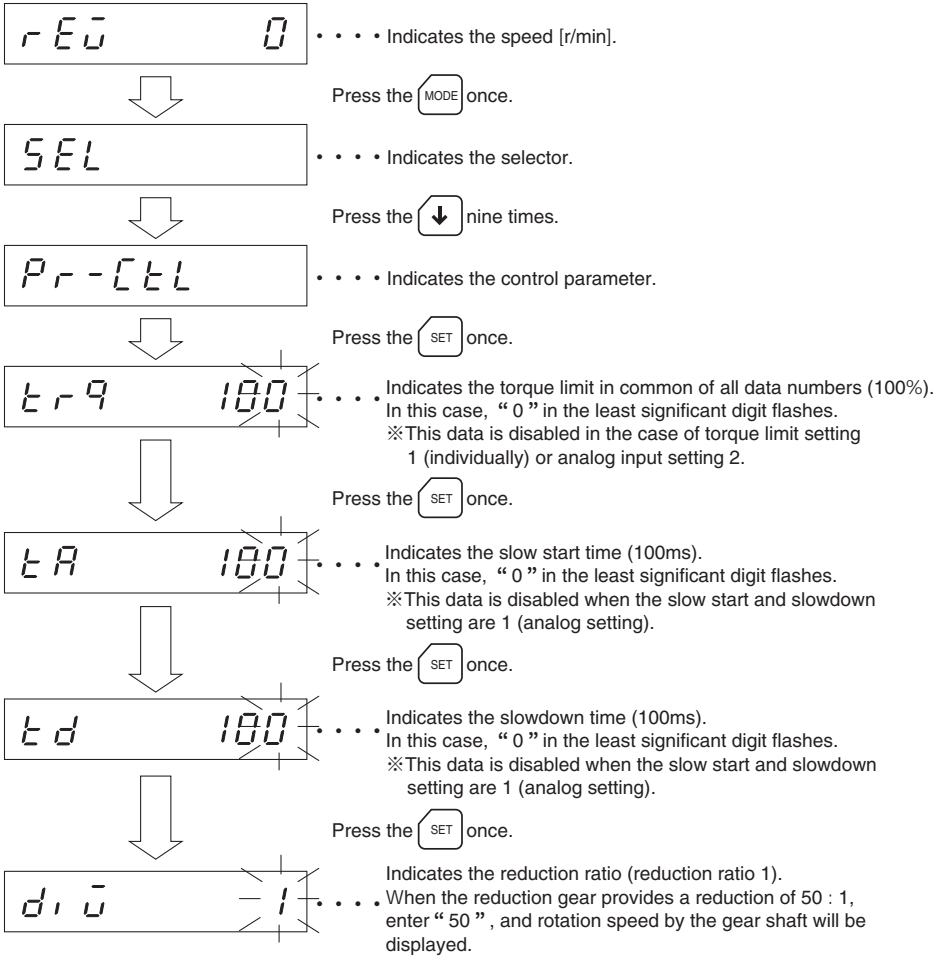


To enable selector setting, turn on power again.
Press the MODE key when stopping the selection of operation mode.

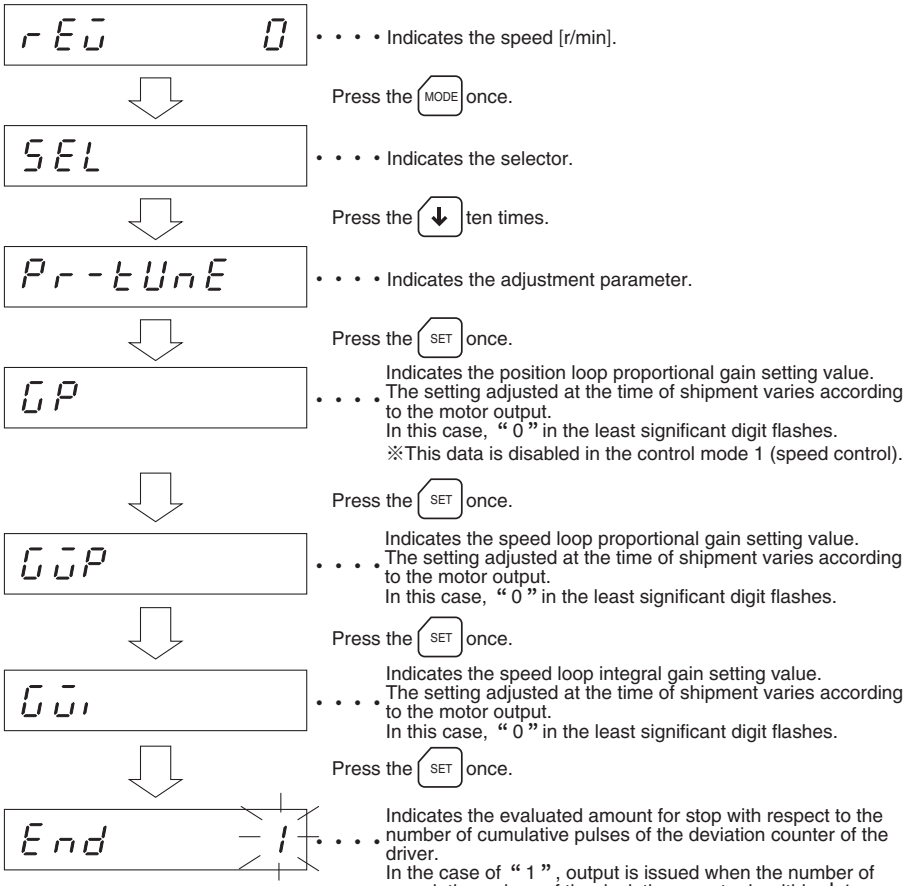
8.2 Operation data
(Setting of movement, speed and each torque limit value)



8.3 Control parameter (Setting of torque limit in common, slow start/slowdown and speed display by gear output shaft)



8.4 Adjustment parameter (Setting of each gain and positioning completion width)

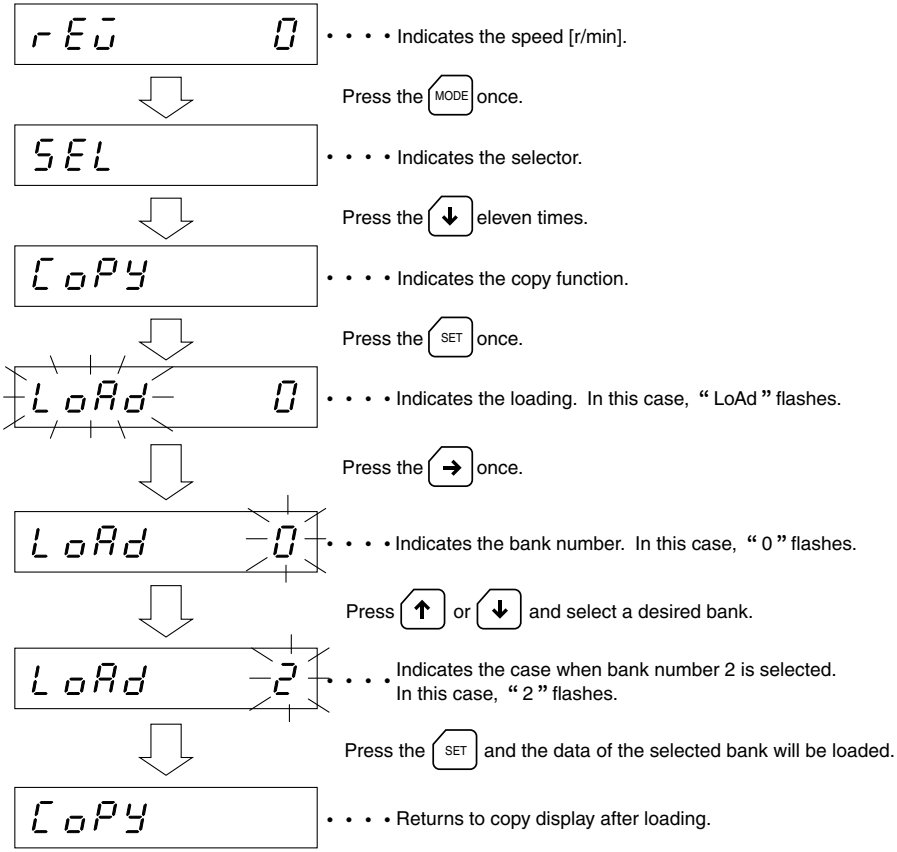


※Please refer to page 40 for the details of each gain.

8.5 Copy function CoPy

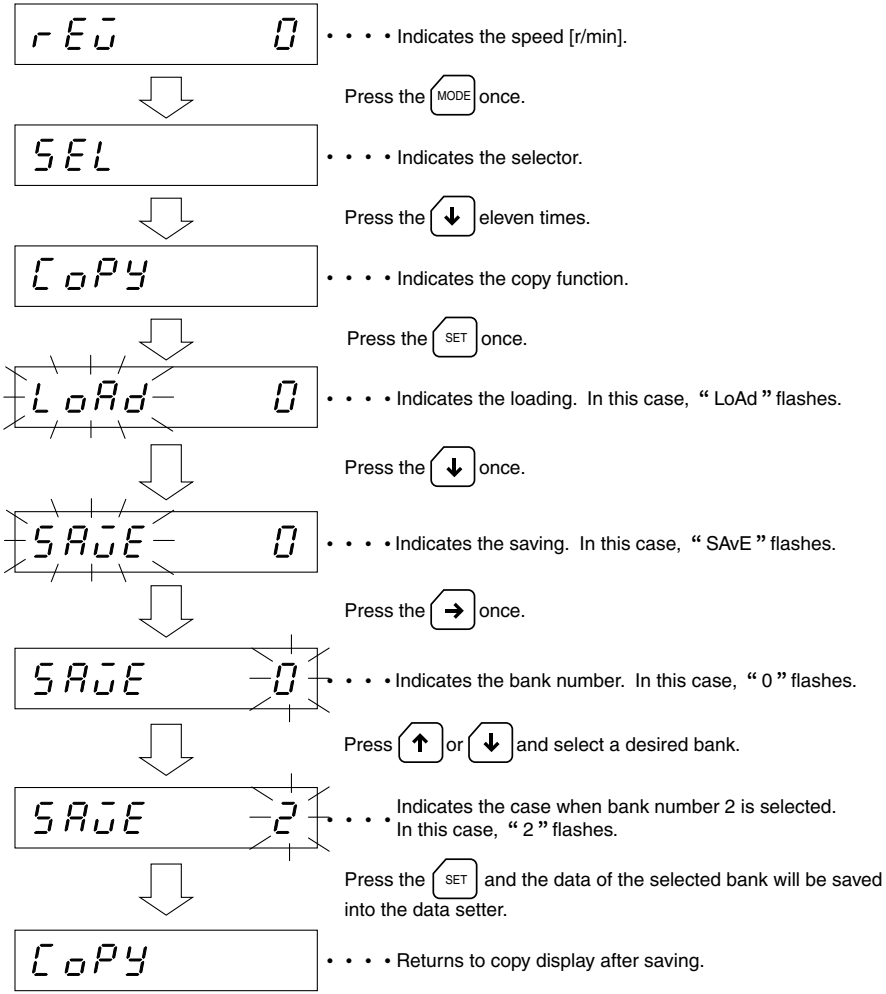
8.5.1 Loading LoAd

(Transfers the data of the data setter to the driver.)



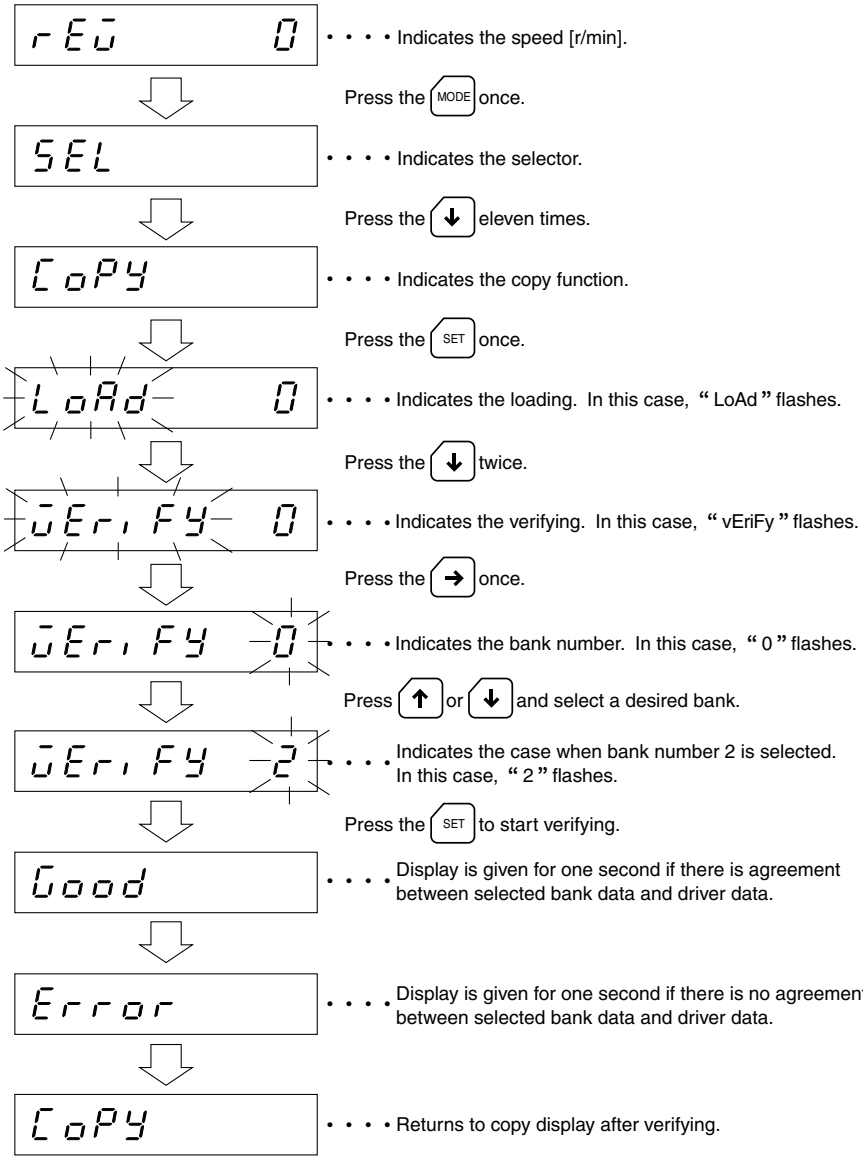
8.5.2 Saving SAvE

(Saves data of the driver into the data setter.



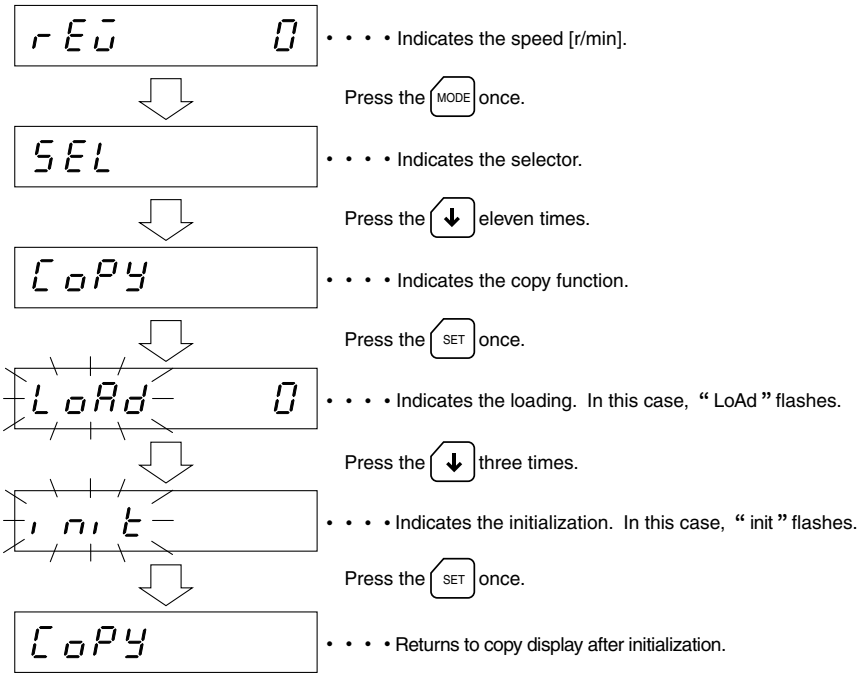
8.5.3 Verifying vEri FY

(Verifying between data in the driver and the bank data set on the data setter)

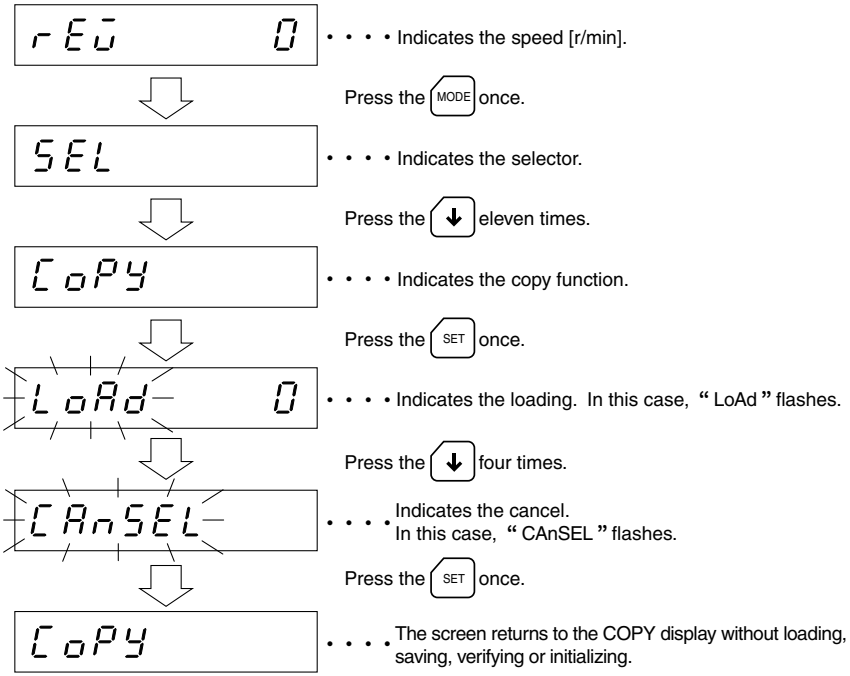


8.5.4 Initialization i ni t

(Returns the data of the driver to the setting at the time of shipment.)



8.5.5 Cancel CAnSEL



9. Alarm display and details

Alarm code	Type of alarm	Assumed causes	Actions
2	Overload protection	Load in excess of the rated torque is applied to the motor for about five seconds or more.	Re-examine the load.
3	Overvoltage protection	Primary voltage of the driver inverter has exceeded the upper limit of voltage specification range.	When it has occurred during slow start/ slowdown of the motor, reduce the load inertia or prolong slow start/slowdown time. Or connect the optional regeneration unit (available at extra cost). If this trouble has occurred in the gravitational application, reduce the load or speed. Or connect the optional regeneration unit (available at extra cost).
4	Excessive displacement	The motor during operation in the position control mode cannot follow the command.	Reduce load inertia and load torque or prolong the slow start and slowdown time.
5	Overcurrent protection	Excessive current has flown to driver inverter power element.	Any one of motor cable, motor winding and driver output element may be short circuited.
6	Excessive speed	The speed has exceeded 4,000r/min on the motor shaft.	Reduce the motor speed below 3,000r/min.
7	EEPROM data error	The parameter has been damaged.	Turn on the driver power supply again. If the problem cannot be solved by it, contact our branch office or sales office from which you purchased our product, and request the product to be repaired.
8	Encoder failure	A trouble has occurred to the feedback signal of the encoder.	Check the encoder cable for connection.
9	Low voltage protection	Power supply voltage has reduced below the specified voltage range.	Check the power voltage.

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