Instruction Manual

FRENIC-Multi

Synchronous Operation Card "OPC-E1-SY"

⚠CAUTION

Thank you for purchasing our synchronous operation card.

- Read through this instruction manual and be familiar with the synchronous operation card before proceeding with installation, connections (wiring), operation, or maintenance and inspection.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- Specifications of this card are subject to change without prior notice for improvement.

Fuji Electric FA Components & Systems Co., Ltd. **INR-SI47-1218-E**

Preface

Thank you for purchasing our synchronous operation card "OPC-E1-SY."

Mounting this card into your FRENIC-Multi inverter enables the inverter to drive two motors equipped with pulse generators in three synchronous operation modes--speed synchronous operation, standby synchronous operation and simultaneous start synchronous operation modes.

Read through this instruction manual in conjunction with the FRENIC-Multi Instruction Manual (INR-SI47-1094-E) and be familiar with proper handling and operation of this product. Improper handling might result in incorrect operation, a short life, or even a failure of this product.

This instruction manual does not contain inverter handling instructions. Refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), and keep this manual in a safe place.

■ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Installation and wiring

⚠WARNING

- Turn the inverter's power OFF and wait for at least five minutes before starting installation and wiring.
- Qualified electricians should carry out wiring.

  Otherwise, electric shock could occur.

⚠CAUTION

- Do not use the products that are damaged or lacking parts.

  Doing so could cause failure or injuries.

- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter.

  Otherwise, a fire or an accident might result.

- Incorrect handling in installation/removal jobs could cause a failure.

  A failure might result.

- Noise may be emitted from the inverter, motor and wires. Implement appropriate measure to prevent the nearby sensors and devices from malfunctioning due to such noise.

  Otherwise, an accident could occur.

Operation

⚠WARNING

- Be sure to mount the terminal cover before turning the power ON.
  Do not remove the cover while the power is on.

  Doing so could cause electric shock.

- Confirm and adjust the setting of the function codes before running the inverter.

  Otherwise, an accident could occur.

Maintenance and inspection, and parts replacement

⚠WARNING

- Turn the inverter's power OFF and wait for at least five minutes before starting inspection or parts replacement.

  Otherwise, electric shock could occur

- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.

  Otherwise, electric shock or injuries could occur.

Disposal

⚠CAUTION
• Treat the product as an industrial waste when disposing of it. **Otherwise injuries could occur.**

Others

⚠WARNING
• Never attempt to modify the product. **Doing so could cause electric shock or injuries.**

Icons

The following icons are used throughout this manual.

Note — This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

Tip — This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

Table of Content

Chapter 1 BEFORE USING THE INVERTER

1.1 Acceptance Inspection

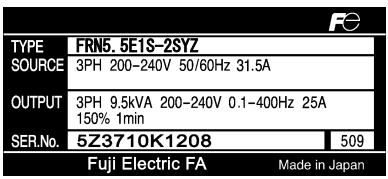
Unpack the package and check the following:

(1) The synchronous operation card is the model you ordered.

(2) The card is not damaged during transportation--no defective parts or lacking parts.

(3) The model name "OPC-E1-SY" is printed on the card. (See Figure 1.3.)

(4) The card is applicable to your inverter.
Applicable inverters have "-2SYZ," "-4SYZ," or "-7SYZ" at the end of the inverter type printed in the TYPE column on the main and sub nameplates labeled on inverters.



(a) Main nameplate

(b) Sub nameplate

Figure 1.1 Nameplates

If you suspect the product is not working properly or if you have any questions about your product, contact your Fuji Electric representative.

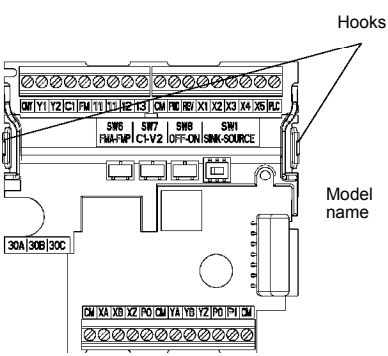


Figure 1.2

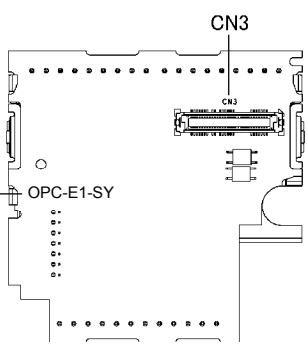


Figure 1.3

1.2 Mounting the Synchronous Operation Card

⚠WARNING

- Turn the power OFF and wait for at least five minutes before starting installation.
  Otherwise, electric shock could occur.

⚠CAUTION

- Do not use the product that is damaged or lacking parts.
  Doing so could cause a failure and injuries.
- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter.
  Otherwise, a fire or an accident might result.
- Incorrect handling when mounting or removing the product could cause a failure.
  A failure might result.

When handling the synchronous operation card and interface printed circuit board (interface PCB), take any antistatic measure or hold their hooks taking care not to directly touch their circuit boards; otherwise, the static electricity charged in your body may damage them.

(1) Remove the terminal cover.
  📖 For details on how to remove the terminal cover, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Chapter 2, Section 2.3 "Wiring."

(2) If the interface PCB is mounted on the inverter, push the hooks provided on both ends of the interface PCB and pull it up and out of the inverter with both hands. (Store the removed interface PCB for future use.)

(3) Connect the CN3 connector (shown in Figure 1.3) on the synchronous operation card to the connector on the inverter until it clicks into place.

(4) For inverters of 0.75 kW or below: Before reinstalling the terminal cover, cut off the barrier (see Figure 1.4) of the terminal cover using nippers or the like.

(5) Reinstall the terminal cover, taking care not to pinch control signal lines.
  📖 When reinstalling the terminal cover, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Chapter 2, Section 2.3 "Wiring."

Note For inverters of 3.7 kW or below: When performing the wiring for the main circuit terminals, you need to remove the synchronous operation card beforehand.

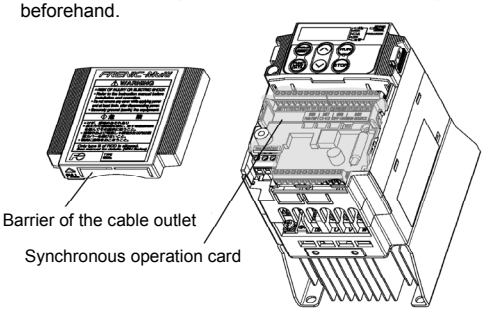


Figure 1.4

1.3 Pulse Generator (PG) Specifications and PG Mounting Instructions

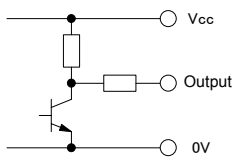
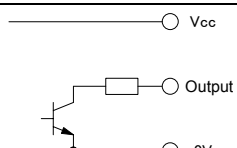
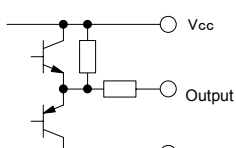
⚠CAUTION

- Using the pulse generator (PG) whose specifications are not satisfied may cause the inverter and equipment to malfunction.
  Doing so could cause failure or injuries.

1.3.1 PG specifications

Table 1.1 lists the specifications of PGs applicable to the synchronous operation card.

Table 1.1 Specifications of Applicable PG and Synchronous Operation Card

Item		Specifications
Applicable PG	Encoder system	A and B phases (Incremental system), Z phase
	Pulse resolution	20 to 3000 P/R
	Input power requirements	5 VDC ±10% / 100 mA (200 mA, when a single PG is mounted.)
PG power supply	Internal power supply	+5 VDC ±10% / 200 mA
	External power supply	+5 VDC ±10%, 200 mA or more
Output signal type	Voltage output Circuit configured with the grounded-emitter transistor whose collector outputs voltage	
	Open collector (pull-up resistor: 620Ω) Voltage output circuit configured without resistor between the output terminal and the collector	
	Complementary (totem-pole push-pull) Constant voltage output circuit configured with an emitter follower	

Note 1: The wiring length between the PG and inverter should not exceed 20 m.
Note 2: When the PG power is 200 mA or more, use an external power supply.
Note 3: The external power supply should satisfy the voltage specifications of the PG.
Note 4: The reference and slave motors should use pulse generators with the same pulse resolution.

Select PGs that match the DC characteristics of the synchronous operation card listed in the table below.

Table 1.2 DC Characteristics of the Synchronous Operation Card

Terminals XA, XB, XZ, YA, YB, YZ	Min.	Max.
High level input voltage VIH	3.8 V	--
Low level input voltage VIL (Input current 9 mA or less)	--	1.2 V
Low level input current IIL (when an internal power supply is used, VIL=0V)	--	9 mA

1.3.2 Connection between the synchronous operation card and PGs on reference and slave motors

Connect the PG output signal wires for the reference motor to terminals XA, XB, and XZ on the synchronous operation card and those for the slave motor, to terminals YA, YB, and YZ.

The counterclockwise rotation when viewed from the motor output shaft is regarded as "forward rotation" (see Figure 1.5). The PG output signal wires should be connected so that the PG output pulse during rotation in the forward direction forms the forward signal as shown in Figure 1.6 (B phase advances 90 degrees from A phase).

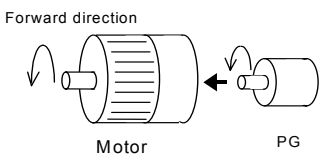


Figure 1.5 Forward Direction of Motor and PG

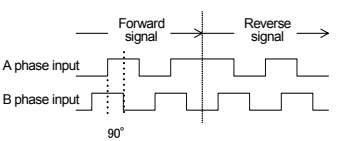


Figure 1.6 Rotational Direction and Output Signal of PG

Table 1.3 lists the relationship between the connection of reference PG output signals, the rotational direction of the reference PG, and the rotational direction of the slave motor that receives a run command (FWD or REV).

Table 1.3 Connection of the Reference PG Output Signals and Rotational Direction of the Slave Motor

A and B phase output signals issued from the reference PG	When the rotational direction of the reference PG is:	If the slave motor receives a run forward command (FWD):	If the slave motor receives a run reverse command (REV):
		It rotates in the following direction.	
If connected to terminals XA and XB *normally*	Forward	Forward	Stop *
	Reverse	Stop *	Reverse
If connected to terminals XA and XB *reversely*	Forward	Stop *	Reverse
	Reverse	Forward	Stop *

* If the reference inverter rotates the motor in such a direction that the slave inverter stops, the pulse count continues so as to cause an ***Ero*** excessive deviation alarm. After that, if the reference inverter rotates the motor in the same direction as the slave inverter, the synchronous operation restarts from the position where the deviation becomes zero.

Note: Synchronous operation in the direction opposite to the reference PG rotation

To drive the slave PG in the direction opposite to the reference PG rotation in synchronous operation, connect the B and A phase output signals issued from the reference PG to terminals XA and XB, respectively. (See Table 1.3.)

1.3.3 Wiring procedure for the PGs and the synchronous operation card

⚠WARNING
• Turn the inverter's power OFF and wait for at least five minutes before starting connection. • Qualified electricians should carry out wiring. **Otherwise, electric shock could occur.**

⚠CAUTION
• Noise may be emitted from the inverter, motor and wires. Implement appropriate measure to prevent the nearby sensors and devices from malfunctioning due to such noise. **Otherwise, an accident could occur.**

Wire each PG to the synchronous operation card, observing the following precautions and referring to the connection diagrams given in Figures 2.1 and 2.2.

(1) Turn the inverter's power OFF.

(2) Use a shielded wire for wiring between the PG and the synchronous operation card.

(3) To prevent malfunction due to noise, keep the wiring away from the main circuit wiring of the inverter and the power wiring of other devices as far as possible (at least 10 cm). Do not route them in the same duct.

(4) Complete the wiring for the PG before turning the inverter's power ON.

(5) The wire size applicable to the option connection terminal on the inverter is AWG 18-24.

When using a wire with its end being stripped, strip its end by 5 to 7 mm. When using a ferrule, use a vinyl-insulated ferrule.

Loosen the fixing screw, insert the wire end into the opening of the terminal block, and tighten the screw.

Figure 1.7 Stripping the Wire End Before Connection to Terminal Block

Recommended wire: AWG 18-24 for rated temperature 105°C (UL)

1.3.4 Setting up the power supply for PGs

When using an internal power supply

Connect the power supply wire to terminal [PO] on the synchronous operation card.

When using an external power supply

Connect the power supply wire to terminal [PI] on the synchronous operation card.

1.3.5 Option terminals on the synchronous operation card

Table 1.4 lists terminal symbols, names and functions of the option terminals on the synchronous operation card.

Table 1.4 Option Terminals and Their Specifications

Classification	Terminal symbol	Name	Functions
PG/ Pulse input	PI	External power supply input	Power input terminal from the external device External power supply capacity: 5 VDC ±10%, 200 mA or more
	PO	Power supply for PG	Power output terminal 5 VDC ±10%, Maximum output 200 mA
	CM	PG common	Common terminal for power supply and PG input
	XA	A phase pulse input X	Input terminal for A phase signal issued from reference PG
	XB	B phase pulse input X	Input terminal for B phase signal issued from reference PG
	XZ	Z phase pulse input X	Input terminal for Z phase signal issued from reference PG
	YA	A phase pulse input Y	Input terminal for A phase signal issued from slave PG
	YB	B phase pulse input Y	Input terminal for B phase signal issued from slave PG
	YZ	Z phase pulse input Y	Input terminal for Z phase signal issued from slave PG

Note: Incorrect wiring of A/B phase could fail to run the motor normally or cause an inverter trip.

Tip Input signal status (pulse rate) on terminals [XA], [XB], [XZ], [YA], [YB], and [YZ] can be checked by using Menu #4 "I/O Checking" (4_15, 4_16, 4_17 and 4_18) on the inverter's keypad. For the operating procedure, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E). (Function code E52 = 2)

1.3.6 Arrangement of option terminals on the synchronous operation card

CM	XA	XB	XZ	PO	CM	YA	YB	YZ	PO	PI	CM

Screw size: M2
Tightening torque: 0.22 to 0.25 N·m

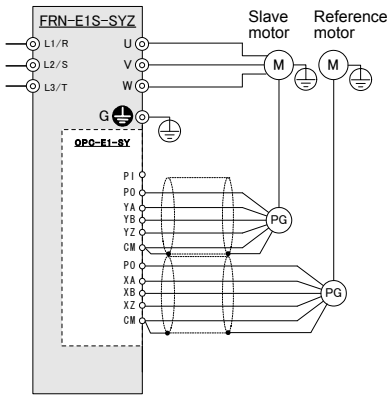
Figure 1.8 Option Terminals

Note Terminal [PLC] on the synchronous operation card cannot supply power to external equipment. Use the terminal only for receiving power from external equipment.

Chapter 2 CONNECTION DIAGRAMS

■ Figure 2.1 shows connection diagram examples for synchronous operation.

1. When using inverter internal power supply



2. When using external power supply

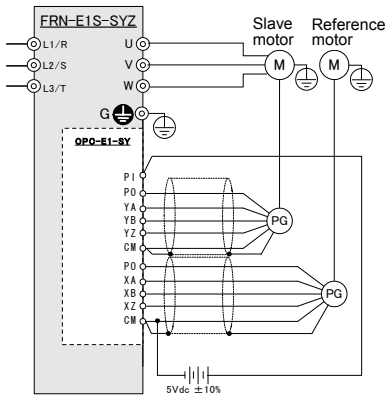
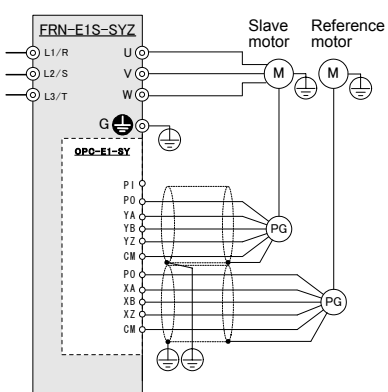


Figure 2.1 Connection Diagrams for Synchronous Operation

■ In order to conform the inverter to the requirements of EMC Directive, ground the shields of the PG cables to the inverter as shown below.

1. When using inverter internal power supply



2. When using external power supply

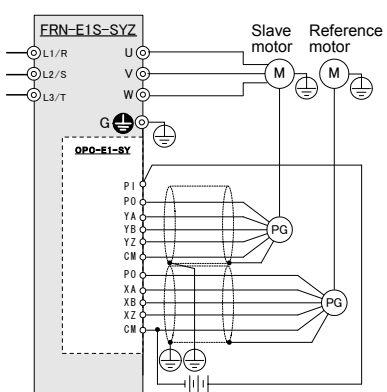


Figure 2.2 Connection Diagrams for Compliance with EMC Directive

Note: For details about applicable PGs, see Table 1.1 in Chapter 1, Section 1.3.1 "PG specifications."

Chapter 3 PREPARATION FOR OPERATING

After completion of mounting and wiring but before turning the inverter's power ON, check the followings.

(1) The wiring is correct.

(2) There is no cable waste or screws left.

(3) The screws and terminals are firmly tightened.

(4) The straggling wires at ferrules are not short-circuited to other terminals.

Furthermore, after powering the inverter ON but before starting inverter operation, check the followings.

⚠CAUTION

- Check the wiring surely before running the inverter. Incorrect wiring causes the inverter or other devices to malfunction.

  Failure to do so could cause failure or injuries.

⚠WARNING

- Be sure to mount the terminal cover before turning the power ON.
  Do not remove any cover while the power is ON.

  Doing so could cause electric shock.

- Confirm and adjust the configuration of the function codes before running the inverter.

  Otherwise, an accident could occur.

Chapter 4 SYNCHRONOUS OPERATION CONTROL

The synchronous operation control enables the slave inverter to detect the reference motor rotation with PG signals and synchronize the slave motor with the reference motor in rotation speed and position.

The synchronous operation is available in three modes--Speed synchronous (o60 = 0), standby synchronous (o60 = 1), and simultaneous start synchronous (o60 = 2) operation.

Reference motor's PG signals should be input to terminals XA, XB, and XZ, and slave motor's ones, to terminals YA, YB, and YZ.

4.1 Specifications of Synchronous Operation

Table 4.1 lists the specifications of the synchronous operation.

Table 4.1 Specifications of Synchronous Operation

	Item	Specifications	Remarks
Control	Speed control range	180 to 3600 r/min	4-pole motors and PGs with 1000 P/R Speed reduction ratio = 1:1
	Position control accuracy	±5°	During running at constant speed
Electrical requirements	Input pulse rate	75 p/s to 30 kp/s	Maximum wiring length: 20 m A/B phase encoders

Tip For the procedure on how to calculate the PG input pulse rate based on the inverter output frequency, refer to Section 5.4 "Checking PG Pulse Rate."

4.2 Overview of Synchronous Operation

4.2.1 Standby synchronous operation

In standby synchronous operation (o60 = 1), the inverter controls the slave motor to synchronize its Z phase with the reference motor's Z phase, based on the first detected Z phases (positions) of those two motors after the start of synchronous operation. The slave motor could cause a single cycle delay at a maximum (on standby) at the start of operation.

Once the slave motor starts running after standby, it will never go standby unless the synchronous operation is cancelled (see Note 1 below).

The Z phase synchronization angles of the reference and slave motors can be adjusted with the function code o66.

The inverter integrates the position pulses for each of the reference and slave motors and controls the slave motor's rotation speed and position to keep the difference between those two motors (hereafter called deviation) at zero.

If any incorrect count due to electrical noise or other factors is found in the integrated count of A/B phases, the inverter corrects the error based on the Z phase difference.

If the deviation between those two motors falls below the synchronization completion detection angle (specified by o67), the ***SY*** synchronization completion signal will be issued. If synchronization is lost so that the deviation exceeds 100 times the excessive deviation setting (specified by o68), the inverter shuts down its output with the ***Ero*** alarm.

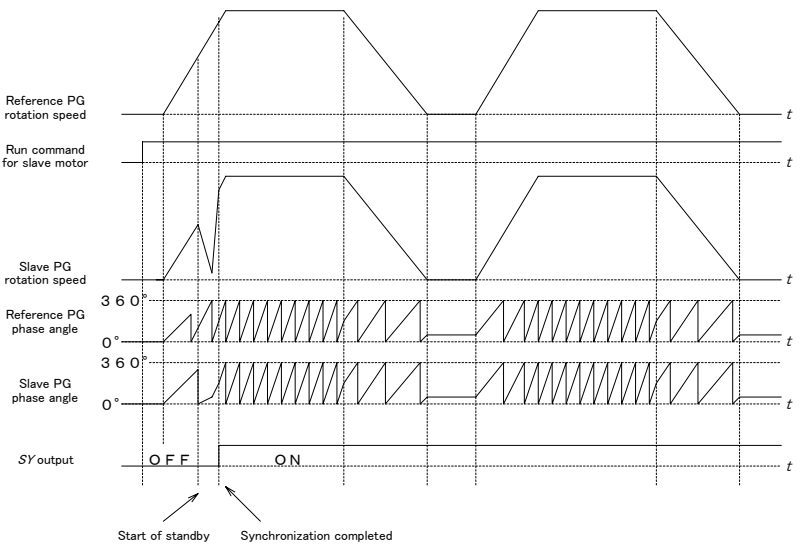


Figure 4.1 Standby Synchronous Operation

Note 1: Synchronous operation cancellation conditions
The synchronous operation is canceled when:
- The run command for the slave motor is turned OFF,
- The protective function is activated, or
- The inverter switches to a single motor drive. (Assign terminal command ***Hz2/Hz1*** and switch the frequency command source with F01/C30.)

4.2.2 Simultaneous start synchronous operation

In simultaneous start synchronous operation (o60 = 2), the inverter controls the rotation speed and position of the slave motor to maintain the phase difference between the reference and slave motors at the time when the single motor drive operation is switched to the synchronous operation. That is, it keeps the deviation between the integrated position pulses of the reference and slave motors at zero.

If the deviation falls below the synchronization completion detection angle (specified by o67), the ***SY*** synchronization completion signal will be issued. If synchronization is lost so that the deviation exceeds 100 times the excessive deviation setting (specified by o68), the inverter shuts down its output with the ***Ero*** alarm.

If any incorrect count due to electrical noise or other factors is found in the integrated count of A/B phases, the inverter corrects the error based on the Z phase difference.

If the run command for the slave motor is turned OFF, the inverter continues to monitor the motor positions as long as the synchronous operation is not switched to the single motor drive operation. When the run command is turned ON again, the inverter restarts to control the slave motor to maintain the Z phase difference between the reference and slave motors.

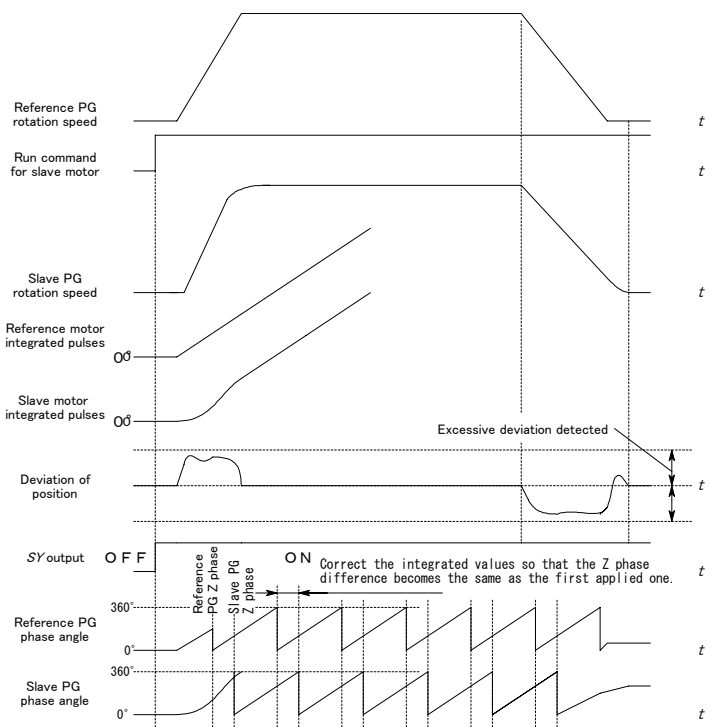


Figure 4.2 Simultaneous Start Synchronous Operation

4.3 Block Diagrams

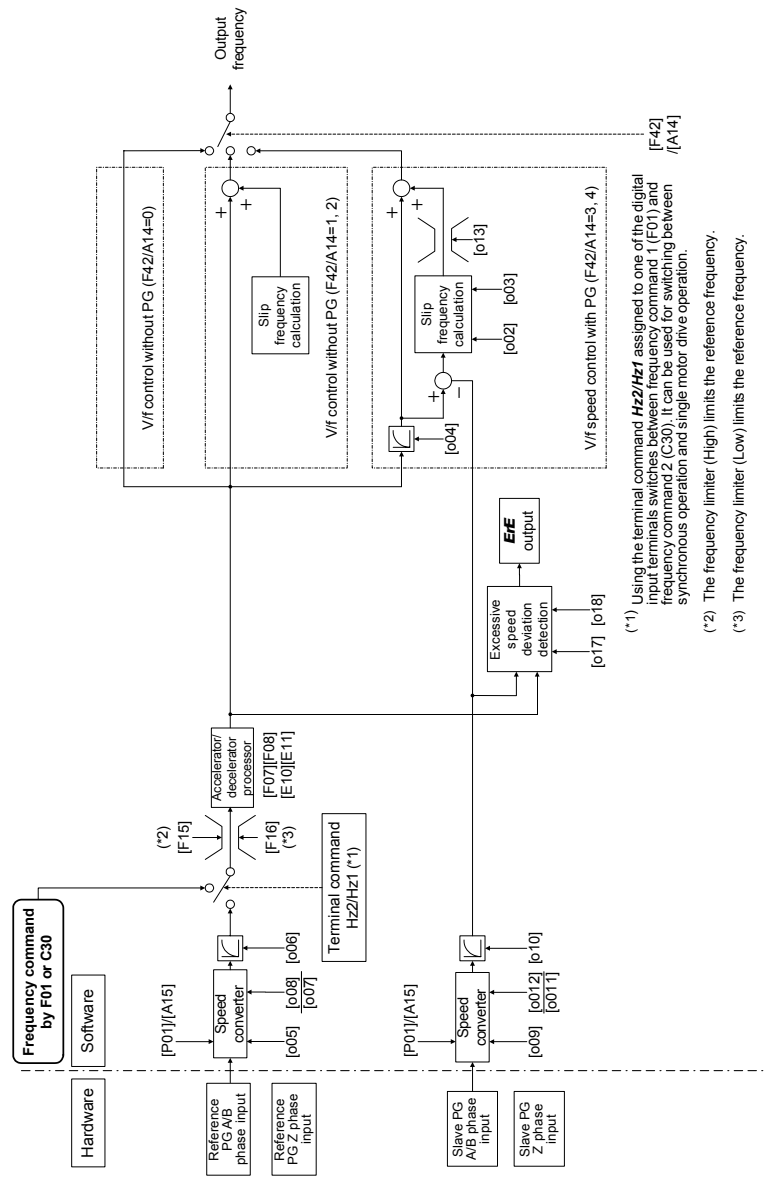
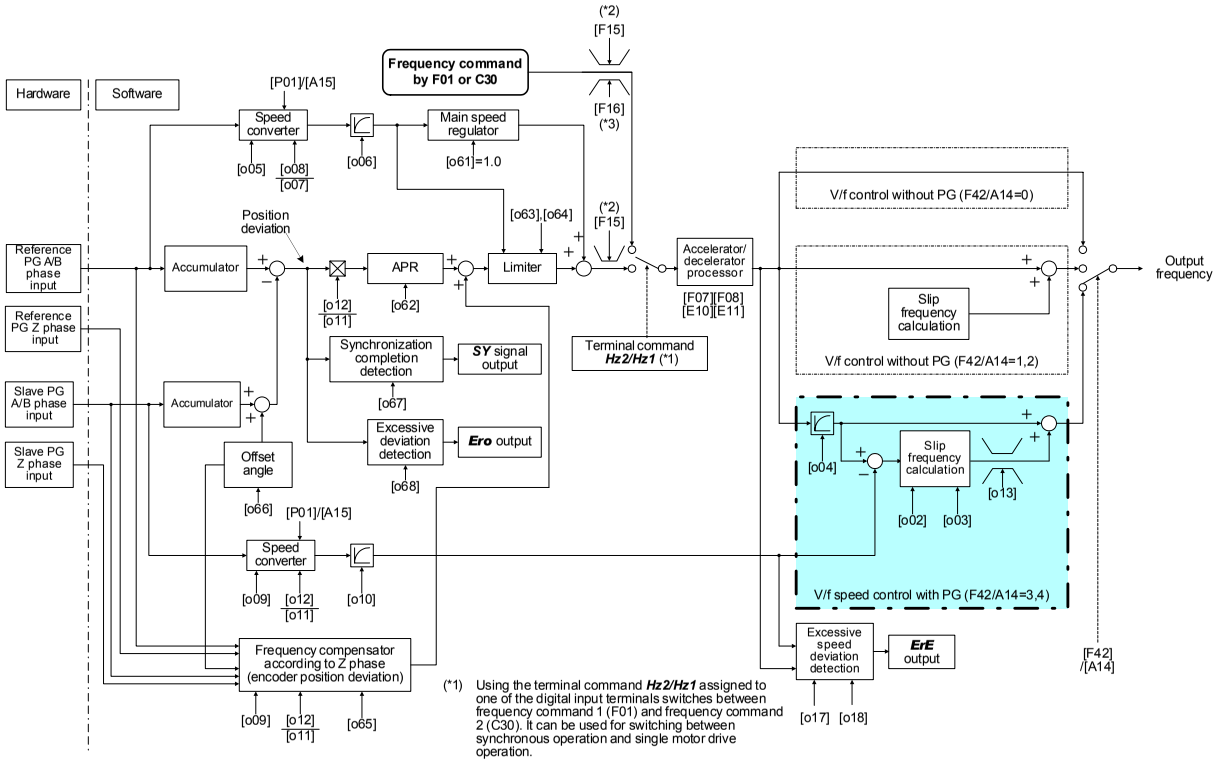


Figure 4.3 Block Diagram for Speed Synchronous Operation (o60 = 0)



(*1) Using the terminal command **Hz2/Hz1** assigned to one of the digital input terminals switches between frequency command 1 (F01) and frequency command 2 (C30). It can be used for switching between synchronous operation and single motor drive operation.

(*2) The frequency limiter (High) limits the reference frequency.

(*3) The frequency limiter (Low) limits the reference frequency.

Figure 4.4 Block diagram for Position Synchronous Operation (o60 = 1, 2)

4.4 List of Function Codes

Table 4.2 lists function codes related to synchronous operation control.

Table 4.2 Function Codes

Code	Name		Data setting range	Unit	Default setting	Change when running
F01 (C30)	Frequency Command 1 (Frequency Command 1)		0 to 3, 5, 7, 11, 12 (Set F01 or C30 to 12.)	--	0 (2)	N
F42 (A14)	Control Mode Selection		0 to 4 (Set F42 or A14 to 3 or 4 for selecting speed control with optional PG interface.)	--	0 (0)	N
E01 E02 E03 E04 E05 E98 E99	Terminal [X1], [X2], [X3], [X4], [X5] function (Function) Terminal [FWD], [REV] function		11 (1011): ***Hz2/Hz1*** Select frequency command 2/1 (Only the related items indicated)	--	--	N
E20, E21, E27	Terminal [Y1], [Y2], [30A/B/C] (Function)		29 (1029): ***SY*** Synchronization completed (Only the related items indicated)	--	--	N
o01	Reference/ Slave PG Input	(Input mode)	2: A/B phase pulse	--	2	N
o02	Speed Control	(P Gain)	0.01 to 200.00	--	10.00	Y
o03		(Integral time)	0.000 to 5.000	s	0.100	Y
o04		(Filter time constant)	0.000 to 5.000	s	0.020	Y
o05	Reference PG Pulse	(Encoder pulse resolution) *1	0: Same as o09 20 to 3600	P/R	0	N
o06		(Filter time constant)	0.000 to 5.000	s	0.005	Y
o07		(Pulse count factor 1)	0: Same as o11 1 to 9999	--	0	N
o08		(Pulse count factor 2)	0: Same as o12 1 to 9999	--	0	N
o09	Slave PG Pulse	(Encoder pulse resolution) *1	20 to 3600	P/R	1024	N
o10		(Filter time constant)	0.000 to 5.000	s	0.005	Y
o11		(Pulse count factor 1)	1 to 9999	--	1	N
o12		(Pulse count factor 2)	1 to 9999	--	1	N
o13	Speed Control	(Output limiter)	0.00 to 100.00	%	100.00	Y
o17	Speed Deviation	(Excessive deviation level)	0 to 50	%	20	Y
o18		(Excessive deviation timer)	0.0 to 10.0	s	1.5	Y

*1 For position synchronization (o60 = 1 or 2), use pulse generators with the same pulse resolution at both the reference and slave motors.

Table 4.2 Function Codes (Continued)

Code	Name		Data setting range	Unit	Default setting	Change when running
o19	PG Error Processing ***ErE***		0: Continue to run (Detection cancel) 1: Stop running (Alarm mode 1) 2: Stop running (Alarm mode 2)	--	2	N
o60	Synchronous Operation	(Mode selection)	0: Speed synchronous operation 1: Position synchronous operation (Standby) 2: Position synchronous operation (Simultaneous start)	--	0	N
o61		(Main speed regulator gain)	Fixed to 1.0	--	1.0	Y
o62		(APR P gain)	0.00 to 200.00	--	15.00	Y
o63		(APR positive output limiter)	20 to 200, 999: Without limiter	%	999	Y
o64		(APR negative output limiter)	20 to 200, 999: Without limiter	%	999	Y
o65		(Z phase alignment gain)	0.0 to 10.0	--	1.0	Y
o66		(Synchronous offset angle)	0 to 359	deg	0	Y
o67		(Synchronization completion detection angle)	0 to 100	deg	15	Y
o68		(Excessive deviation detection range)	0.0 to 6553.5	--	6553.5	Y

For function codes not listed above, see the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Chapter 5, "Function Codes." For codes that are listed above and also in the FRENIC-Multi Instruction Manual, descriptions in this manual precede.

4.5 Unavailable Function Codes

The following function codes are not available.

H70	Overload Prevention Control
J01	PID Control (Mode selection)
J65	Overload Stop (Mode selection)
J73 to J88	Position Control

4.6 Configuring Function Codes

To enable synchronous operation, be sure to select the speed control with optional PG interface (F42/A14 = 3, 4). Other function codes should be configured as described below.

When configuring the function codes, refer to Chapter 5 "FUNCTION CODE CONFIGURATION EXAMPLES AND ADJUSTMENT GUIDE."

4.6.1 Motor constant data

Configure function codes F03 to F05, P01 to P03, P06 to P12 and P99, referring to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Chapter 5 "Function Codes."

When using motor 2, configure A01 to A03, A15 to A17, A20 to A26, and A39.

4.6.2 Data setting for synchronous operation

F01	Frequency Command 1
C30	Frequency Command 2

Select the pulse train input (F01/C30 = 12) as a reference command source.

Switching between synchronous operation and single motor operation is possible using the ***Hz2/Hz1*** terminal command (see Figure 4.4). The switching example is given below.

(Example) Turning terminal [X1] ON for single motor operation during which a digital frequency command drives the inverter

Set F01 and C30 data to "12" and "0," respectively. And set E01 data to "11" to assign the ***Hz2/Hz1*** command to terminal [X1].

It is recommended to perform switching between synchronous operation and single motor operation when the inverter is stopped. Switching when the inverter is running may activate the protective function. To avoid it, decrease the difference between the output frequency and the reference frequency after switching.

F07	Acceleration Time 1
F08	Deceleration Time 1
E10	Acceleration Time 2
E11	Deceleration Time 2

Also in synchronous operation, the inverter controls the output frequency according to the acceleration/deceleration time as usual. Specify the acceleration/deceleration time as short as possible. Be careful that, if the acceleration/deceleration time longer than that of the reference inverter is specified, the following capability of the slave motor will be lost.

F42	Control Mode Selection 1
A14	Control Mode Selection 2

For synchronous operation, set the F42 (A14) data to "3" or "4" to select the V/f control with optional PG interface or dynamic torque vector control with optional PG interface, respectively.

o01	Reference/Slave PG Input (Input mode)

For synchronous operation, the o01 data is fixed to "2: A/B phase pulse."

o02	Speed Control (P Gain)
o03	Speed Control (Integral time)

These function codes specify the PI constants of the slave motor's speed controller. The expression below shows the transfer function of the regulator.

$$f_S^* = k_P\left(1+\frac{1}{sT_I}\right)\times\varepsilon$$

K_p : P gain (o02)
T_I : Integral time (o03)
f_S^* : Slip frequency
ε : Speed deviation
s : Laplace operator

Suppose that the P gain is 1.0 when the speed deviation ε = 100% (Maximum Frequency F03 (A01)) and f_S is 1% of the maximum frequency.

Suppose that the I integral time = 1.000 seconds when the o03 data is 1.000.

Setting an excessive P gain may cause system hunting. A roughly recommended P gain should not exceed 35.00 in the ordinary system.

Modifying F03 (A01) data requires readjustment of o02 and o03 data.

o04	Speed Control (Filter time constant)

This function code specifies a time constant determining a linear delay of the low pass filter for the speed command given by pulse train. Use this function code to suppress an overshoot that occurs, for example, when the speed command varies.

o05	Reference PG Pulse (Encoder pulse resolution)
o09	Slave PG Pulse (Encoder pulse resolution)

Set the encoder pulse resolution of the reference motor to o05, and that of the slave motor (driven by the inverter) to o09. For position synchronization (o60 = 1 or 2), be sure to use PGs with the same encoder pulse resolution for both the reference and slave motors. When o05 = 0, the inverter recognizes that o05 = o09 and operates accordingly.

o06	Reference PG Pulse (Filter time constant)
o10	Slave PG Pulse (Filter time constant)

o06 and o10 specify time constants determining a linear delay of the low pass filter for the speed feedbacks given by reference and slave PGs, respectively. Use these function codes, for example, when the large ripple components superpose the feedback pulse train.

o07	Reference PG Pulse (Pulse count factor 1)
o08	Reference PG Pulse (Pulse count factor 2)
o11	Slave PG Pulse (Pulse count factor 1)
o12	Slave PG Pulse (Pulse count factor 2)

If the slave motor has reduction gears etc., specify the slave PG pulse count factors 1 and 2.

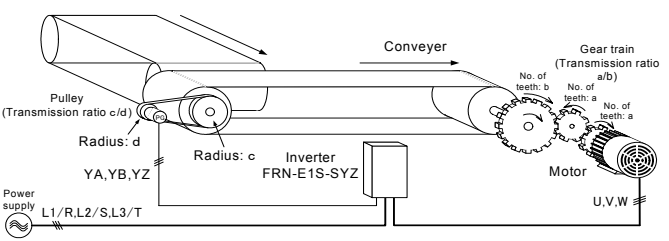


Figure 4.5 Speed Control Model Using a PG

$$\text{Slave motor shaft speed} = \frac{\text{Pulse count factor 2 (o12)}}{\text{Pulse count factor 1 (o11)}} \times \text{Encoder shaft speed}$$

$$\frac{\text{Pulse count factor 2 (o12)}}{\text{Pulse count factor 1 (o11)}} = \frac{b}{a} \times \frac{d}{c}$$

For synchronous operation, it is recommended that the reduction ratios (pulse count factors) of the reference and slave sides be identical. To make them identical, set both o07 and o08 data to "0," applying the pulse count of the slave PG to that of the reference PG. If the reduction ratios are different between the two, refer to Section 5.1 "Typical Configuration and Pulse Setting."

o13 Speed Control (Output limiter)

This function code specifies the output limit percentage for the speed controller (PI controller). Specification of 100.00% is equivalent to the maximum speed (maximum frequency).

To suppress the frequency control amount (PI controller output) to the extent of the motor's slip frequency in the speed control mode, use this function.

o60 Synchronous Operation (Mode selection)

This function code specifies the synchronous operation mode.

Table 4.3 Data for Function Code o60

Data for o60	Synchronous Operation Mode	Synchronization system	Z phase signal
0	Speed synchronous operation	Speed synchronization	Not required.
1	Standby synchronous operation	Position synchronization	Required.
2	Simultaneous start synchronous operation		

o61 Synchronous Operation (Main speed controller gain)

This function code is fixed at 1.0 and cannot be changed.

o62 Synchronous Operation (APR P gain)

This function code determines the response of the automatic position regulator (APR). (See Figure 4.4.)

If the APR output reaches the maximum frequency when the phase angle deviation (position deviation) between the reference and slave PGs becomes equal to the pulse rate at the maximum frequency, that gain is assumed to be 1.0.

Setting a too large value to the gain data easily causes hunting, and setting a too small value results in a large steady-state deviation.

o63 Synchronous Operation (APR positive output limiter)
o64 Synchronous Operation (APR negative output limiter)

These function codes specify the limits of APR output relative to the reference motor speed. (See Figures 4.4 and 4.6.)

Specification of "999" disables the limiter.

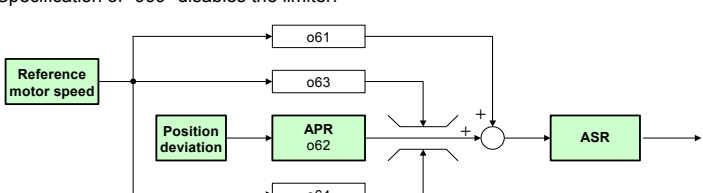


Figure 4.6 Operation of APR Output Limiter

o65 Synchronous Operation (Z phase alignment gain)

Specify a large value to this function code data when the steady-state deviation is large.

If the APR output reaches the maximum frequency when the phase angle deviation between the reference and slave PGs (position deviation) becomes 10% of the pulse rate at the maximum frequency, that gain is assumed to be 1.0.

o66 Synchronous Operation (Synchronous offset angle)

In standby synchronous operation, the slave inverter delays starting to synchronize the Z phase of the slave motor with that of the reference motor by the offset angle specified by this function code.

o67 Synchronous Operation (Synchronization completion detection angle)

This function code specifies the synchronization completion detection angle.

If the absolute value of the phase angle deviation (position deviation) between the reference and slave PGs becomes equal to or below the synchronization completion detection angle specified by o67, the inverter issues a synchronization completion signal ***SY***, provided that the E20, E21, or E27 data (Terminal function) is set to "29" (Synchronization completed).

Once turned ON, the synchronization completion signal ***SY*** is kept ON for 100 ms.

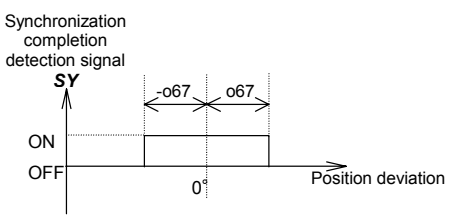


Figure 4.7 Synchronization Completion Detection Signal ***SY***

o68 Synchronous Operation (Excessive deviation detection range)

This function code specifies the detection range for excessive deviation alarm (***Ero***). If the absolute value of the phase angle deviation (position deviation) between the reference and slave PGs exceeds 100 times the o68 setting, the inverter issues an alarm ***Ero*** and shuts down its output.

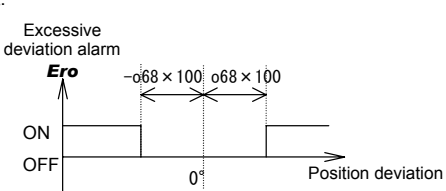


Figure 4.8 Excessive Deviation Alarm ***Ero***

Chapter 5 CONFIGURATION EXAMPLES AND ADJUSTMENT GUIDE

5.1 Typical Configuration and Pulse Setting

5.1.1 Speed reduction ratio setting

Figure 5.1 shows the system configuration applicable to the synchronous operation, taking a conveyer system as an example.

Table 5.1 lists the availability of position synchronous operation and the setting values for pulse count factors 1/2 depending on the speed reduction ratio of each reduction gear when the position synchronous operation is enabled (o60 = 1, 2). Table 5.2 shows the settings for the speed synchronous operation (o60 = 0).

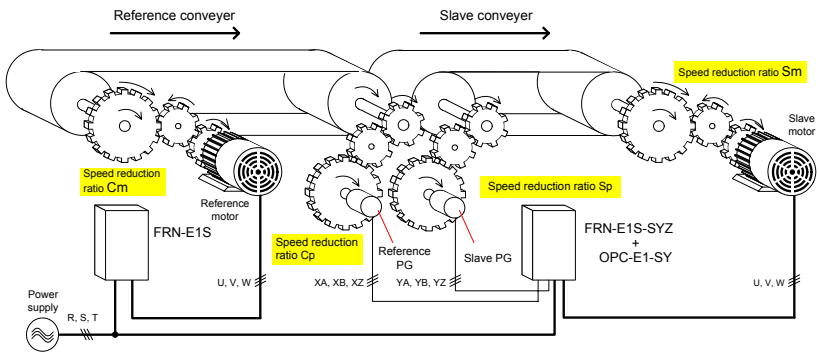


Figure 5.1 Configuration Example of Conveyer Synchronization System

Table 5.1 Availability of Position Synchronous Operation (o60 = 1 or 2) and Settings

Speed reduction ratio conditions		Speed/position synchronization of conveyer belts	Speed/position synchronization of PG shafts	Pulse count factor
Motor reduction gear	PG reduction gear			
Cm = Sm	Cp = Sp	Available	Available	$o07 = 0$ $o08 = 0$ $\frac{o12}{o11} = \frac{1}{Sm \times Sp}$
Cm ≠ Sm	Cp = Sp	Available	Available	
Cm = Sm	Cp ≠ Sp	Not available $\left(\frac{\text{Reference conveyer speed}}{\text{Slave conveyer speed}} = \frac{Sp}{Cp}\right)$	Available	
Cm x Cp = Sm x Sp			Available	
Cm ≠ Sm	Cp ≠ Sp		Available	

- In position synchronous operation, be sure to use pulse generators with the same pulse resolution at both the reference and slave sides. The pulse resolution should be set to o09. Set the o05 data to "0." The equations in the above table are for cases where the reference and slave motors have the same number of poles.
- For configuration examples, refer to Sections 5.3.1 and 5.3.2.

Table 5.2 Settings for Speed Synchronous Operation (o60=0)

Settings at reference side	PG pulse resolution	Pulse count factor	Remarks
For reference PG	o05	$\frac{o08}{o07} = \frac{1}{Sm \times Cp}$	When the pulse resolution of the reference PG is identical with that of the slave PG (specified by o09), set the o05 data to "0" so that the inverter recognizes that o05 = o09 and operates accordingly. If the pulse count factors of the reference PG are identical with those of the slave PG, set both o07 and o08 data to "0" so that the inverter recognizes that o07 = o11 and o08 = o12 and operates accordingly.
For slave PG	o09	$\frac{o12}{o11} = \frac{1}{Sm \times Sp}$	--

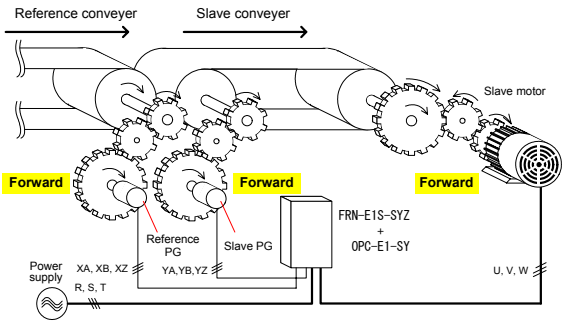
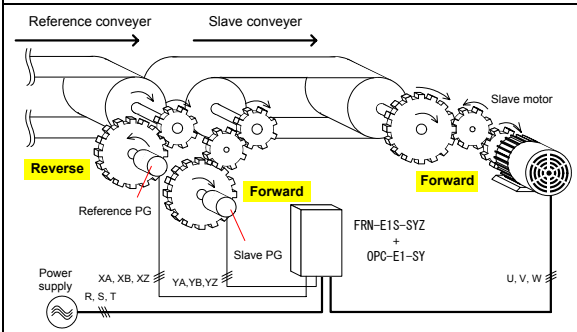
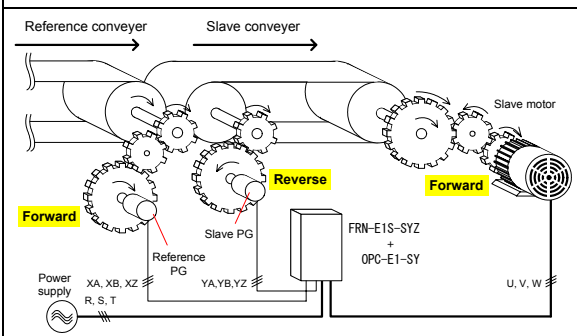
- Speed synchronous operation is possible even if the number of poles of the reference motor is different from that of the slave motor.

  Set the number of poles of the slave motor to P01/A15.
- For the configuration example, refer to Section 5.3.3.

5.1.2 Wiring of PGs

Table 5.3 shows three wiring patterns of reference and slave PGs according to the rotational directions of those PGs in relation to that of the slave motor.

Table 5.3 System Configuration and Wiring of PGs

System configuration examples	Wiring of PGs
	Reference PG ➔ Normal connection to terminals XA and XB Slave PG ➔ Normal connection to terminals YA and YB
	Reference PG ➔ Reverse connection to terminals XA and XB Slave PG ➔ Normal connection to terminals YA and YB
	Reference PG ➔ Normal connection to terminals XA and XB Slave PG ➔ Reverse connection to terminals YA and YB

5.2 Key Points on Function Code Configuration and Adjustment Guide

In a trial run of your system, check the following function codes and use their settings as an adjustment guide.

o05	Reference pulse	(Encoder pulse resolution)
o07		(Pulse count factor 1)
o08		(Pulse count factor 2)
o09	Slave pulse	(Encoder pulse resolution)
o11		(Pulse count factor 1)
o12		(Pulse count factor 2)
P01/A15	Motor (No. of poles)	

In synchronous operation, it is necessary to set up the PGs and speed reduction ratio properly depending on the system configuration. Refer to Section 5.1.1.

- It is recommended that the speed reduction ratio be at 1/1 to 1/30.
- The PG pulse rate for the reference and slave PGs should be set within the range from 75 p/s and 30 kp/s.

Table 5.4 Reduction Ratio Settings

Setting value		o60 = 0	o60 = 1 or 2
Synchronization mode		Speed synchronous operation	Position synchronous operation
Z phase signal		Connection not required	Connection required
Reference pulse	o05 (Encoder pulse resolution)	If the pulse resolution of the slave PG is identical with that of the reference PG (o05): o05 = 0 If it is not identical: o05 = Pulse resolution of slave PG	Always o05 = 0 Position synchronous operation is not possible when the pulse resolutions of the reference and slave PGs are different.
	o07, o08 (Pulse count factor)	See Table 5.2.	See Table 5.1. It is recommended that the speed reduction ratio (pulse count factor) be identical for both the reference and slave PGs.
Slave pulse	o09 (Encoder pulse resolution)	Set the pulse resolution of the slave PG.	Set the pulse resolution of the slave PG, which is equal to that of the reference PG.
	o11, o12 (Pulse count factor)	See Table 5.2.	See Table 5.1. It is recommended that the speed reduction ratio (pulse count factor) be identical for both the reference and slave PGs.
No. of motor poles	P01 (A15)	Set the number of poles of the slave motor.	Use the motors with the same number of poles at both the reference and slave sides.

F42/A14	Control Mode Selection		
P02/A16	Motor (Rated capacity)	P03/A17	Motor (Rated current)
P06/A20	(No-load current)	P07/A21	(%R1)
P08/A22	(%X)	P12/A26	(Rated slip frequency)

If motor constants to be set to P06 (A20), P07 (A21), P08 (A22), and P12 (A26) are unknown, select "3: V/f control with optional PG interface" with F42 (A14). Even in that case, set the motor constants to P02 (A16) and P03 (A17).

If all of the motor constants to be set to P02 (A16), P03 (A17), P06 (A20), P07 (A21), P08 (A22), and P12 (A26) are known, select "4: Dynamic torque vector control with optional PG interface" with F42 (A14).

o02	Speed Control (P Gain)	o04	Speed Control (Filter time constant)
o03	(Integral time)		

There is no need to change these function codes data related to automatic speed regulator (ASR) from the factory defaults.

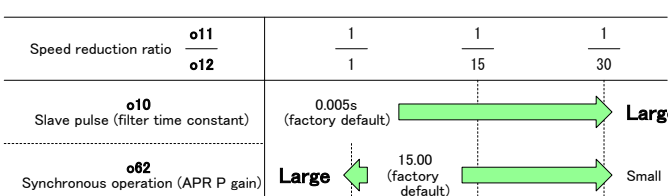
o06	Reference Pulse (Filter time constant)

Usually, there is no need to change this function code data from the factory default. If there is a large backlash due to the mounting condition of the reference PG, set two times the factory default "0.005 s."

o10	Slave Pulse (Filter time constant)
o62	Synchronous Operation (APR P Gain)

It is necessary to adjust these function codes data depending on the speed reduction ratio and running frequency range and starting mode of the slave motor. The adjustment guide is shown below.

Table 5.5 Adjustment Guide for Function Codes o10 and o62



o65	Synchronous operation (Z phase alignment gain)

Usually, there is no need to change this function code data from the factory default. If both the speed reduction ratio and the encoder pulse resolution are small, it may be necessary to reduce this alignment gain from the factory default "1.0."

5.3 Function Code Configuration Examples

5.3.1 For position synchronous operation (o60 = 1 or 2), #1

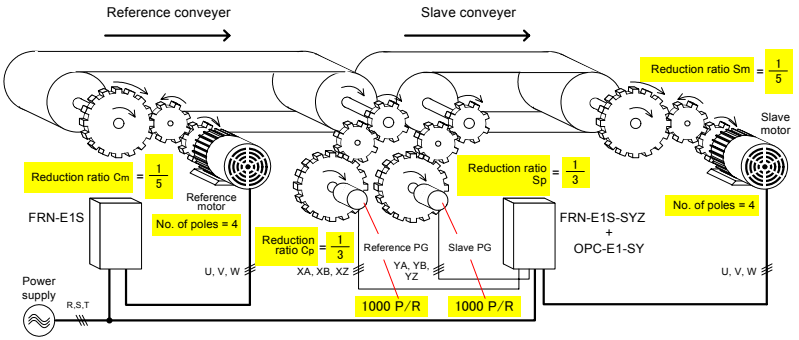


Figure 5.2 Configuration Example of Position Synchronization System (Gear-driven)

Table 5.6 Wiring of PG (See Table 5.3.)

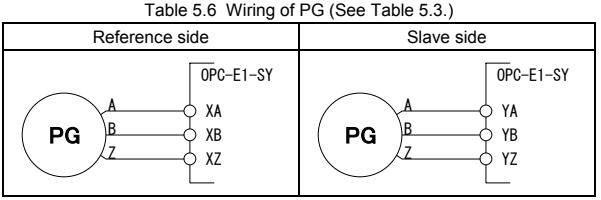


Table 5.7 For Position Synchronous Operation (o60 = 1 or 2) (See Table 5.1.)

Function Code		Setting	Remarks
P01	Motor (No. of poles)	4	Set the number of poles of the slave motor.
o05	Reference Pulse (Encoder pulse resolution)	0	Always set "0." The o05 data is interpreted as the same as o09 data.
o07	(Pulse count factor 1)	0	The o07 data is interpreted as the same as o11 data.
o08	(Pulse count factor 2)	0	The o08 data is interpreted as the same as o12 data.
o09	Slave Pulse (Encoder pulse resolution)	1000	In position synchronous operation, be sure to set the same value for both the reference and slave PGs.
o11	(Pulse count factor 1)	1	$\frac{o12}{o11}=\frac{1}{Sm\times Sp}=\frac{1}{\frac{1}{5}\times\frac{1}{3}}=\frac{15}{1}$
o12	(Pulse count factor 2)	15	

Table 5.8 Rotational Direction

Rotational direction of:			Run command at slave inverter	
Reference motor	Reference PG	Slave PG	Run forward ***FWD***	Run reverse ***REV***
Forward (FWD)	Forward	Forward	Forward	Stop *
Reverse (REV)	Reverse	Reverse	Stop *	Reverse

* If the reference inverter rotates the motor in such a direction that the slave inverter stops, the pulse count continues so as to cause an *ero* excessive deviation alarm. After that, if the reference inverter rotates the motor in the same direction as the slave inverter, the synchronous operation restarts from the position where the deviation becomes zero.

5.3.2 For position synchronous operation (o60 = 1 or 2), #2

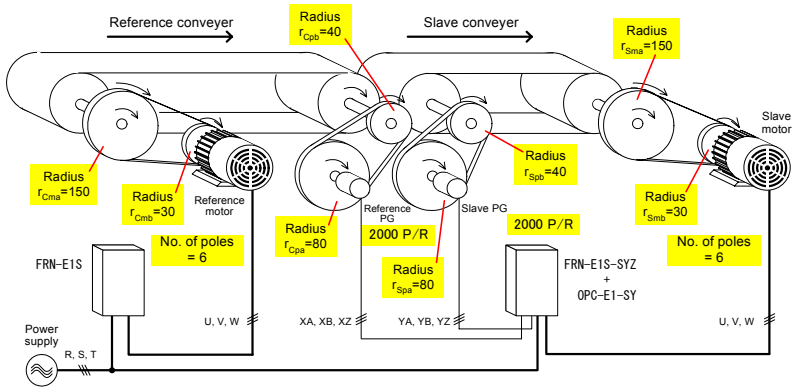


Figure 5.3 Configuration Example of Position Synchronous Operation System (Pulley-driven)

Table 5.9 Setting for Position Synchronous Operation (o60=1 or 2) (Refer to Table 5.1)

Function code		Setting	Remarks
P01	Motor (No. of poles)	6	Set the number of poles of the slave motor.
o05	Reference Pulse (Encoder pulse resolution)	0	Always set "0." The o05 data is interpreted as the same as o09 data.
o07	(Pulse count factor 1)	0	The o07 data is interpreted as the same as o11 data.
o08	(Pulse count factor 2)	0	The o08 data is interpreted as the same as o12 data.
o09	Slave Pulse (Encoder pulse resolution)	2000	In position synchronous operation, be sure to set the same value for both the reference and slave PGs.
o11	(Pulse count factor 1)	1	Each speed reduction ratio is calculated according to the pulley's radius as shown below. The reduction ratio of the slave motor is: $Sm=\frac{r_{Smb}}{r_{Sma}}=\frac{30}{150}=\frac{1}{5}$
o12	(Pulse count factor 2)	10	The reduction ratio of the slave PG is: $Sp=\frac{r_{Spb}}{r_{Spa}}=\frac{40}{80}=\frac{1}{2}$ Therefore, o11 and o12 data is as follows. $\frac{o12}{o11}=\frac{1}{Sm\times Sp}=\frac{1}{\frac{1}{5}\times\frac{1}{2}}=\frac{10}{1}$

5.3.3 For speed synchronous operation (o60 = 0)

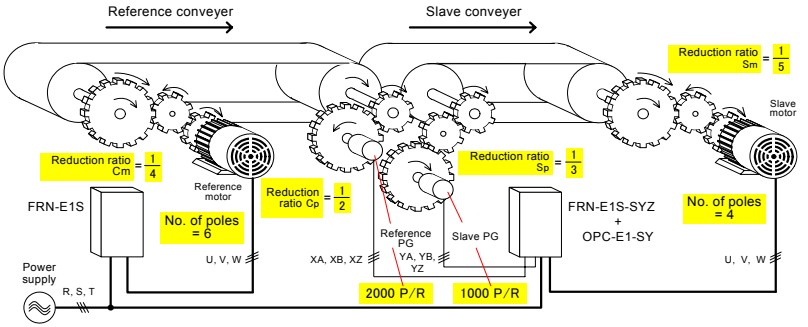
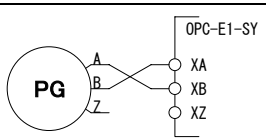
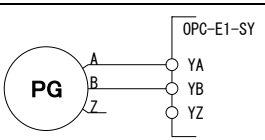


Figure 5.4 Configuration Example of Speed Synchronous Operation System (Gear)

Table 5.10 Wiring of PG (See Table 5.3.)

Reference side	Slave side
	

* In speed synchronous operation, Z phase is not required.

Table 5.11 For Speed Synchronous Operation (o60 = 0) (See Table 5.2.)

Function code		Setting	Remarks
P01	Motor (No. of poles)	4	Set the number of poles of the slave motor.
o05	Reference Pulse (Encoder pulse resolution)	2000	In speed synchronous operation, the pulse resolution of the reference PG needs not necessarily be the same as that of the slave PG.
o07	(Pulse count factor 1)	1	$\frac{o08}{o07}=\frac{1}{Sm\times Cp}=\frac{1}{\frac{1}{5}\times\frac{1}{2}}=\frac{10}{1}$
o08	(Pulse count factor 2)	10	
o09	Slave Pulse (Encoder pulse resolution)	1000	In speed synchronous operation, the pulse resolution of the slave PG needs not necessarily be the same as that of the reference PG.
o11	(Pulse count factor 1)	1	$\frac{o12}{o11}=\frac{1}{Sm\times Sp}=\frac{1}{\frac{1}{5}\times\frac{1}{3}}=\frac{15}{1}$
o12	(Pulse count factor 2)	15	

Table 5.12 Rotational Direction

Rotational direction of:			Run command at slave inverter	
Reference motor	Reference PG	Slave PG	Run forward ***FWD***	Run reverse ***REV***
Forward (FWD)	Reverse	Forward	Forward	Forward
Reverse (REV)	Forward	Reverse	Reverse	Reverse

5.4 Checking PG Pulse Rate

Before starting synchronous operation, run the motors separately and check that the data settings for number of motor poles (P01), encoder pulse resolution (o09), and pulse count factor 1/2 (o11/o12) conform to the actual system configuration.

The PG pulse rate can be checked with the keypad by using Menu #4 "I/O Checking, item 4_15: PG pulse rate 1 (reference side)" and "item 4_17: PG pulse rate 2 (slave side)." For details, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Section 3.4.5 "Checking I/O signal status."

Given below is an example of checking PG pulse rate.

(Example)

No. of motor poles = 4P (P01 = 4)
Encoder pulse resolution = 1000 P/R (o09 = 1000)
Pulse count factor 1/2 = 1/30 (o11 = 1, o12 = 30)

Under these above conditions, run the motor at 20 Hz. Then the motor speed and the pulse rate can be calculated as follows.

Motor speed (r/min) = 120 x Frequency/No. of poles = 120 x 20/4 = 600 (r/min) = 10 (r/s)

Pulse rate (p/s) = Motor speed (r/s) x Encoder pulse resolution (P/R) x Pulse count factor 1/2
= 10 x 1000 x 1/30 = 333.3333 ≈ 333 (p/s)

Use Menu #4 "I/O Checking, item 4_17" and check that "0.333" is displayed on the keypad. Note that, on the keypad, displayed value = pulse rate (p/s)/1000.

Note: The maximum input pulse rate that the synchronous operation card (OPC-E1-SY) supports is 30 kp/s. If the pulse rate from the PGs exceeds the maximum limit, synchronous operation is not available.

Chapter 6 PROTECTIVE FUNCTIONS

If any inverter protective function is activated to issue an alarm, the inverter displays the corresponding alarm code on the LED monitor of the keypad and shuts down its output. Accordingly, the motor coasts to a stop.

Table 6.1 lists alarm codes related to the synchronous operation card. For other alarm codes, refer to the FRENIC-Multi Instruction Manual (INR-SI47-1094-E), Chapter 6 "TROUBLESHOOTING."

Table 6.1 Related Alarm Codes

Alarm code	Alarm name	Alarm for:		Refer to Section:
		Speed control	Synchronous operation control	
OS	Overspeed alarm	Y	NA	6.1
ErE	Excessive speed deviation alarm	C	Y	6.2
Ero	Excessive deviation alarm	NA	Y	6.3

Y: Always active. The protective function for the alarm is always active when the control is enabled.

C: Conditionally active. The protective function for the alarm is active when the control is enabled and the protective function is enabled with the function code. The factory default is "enabled."

NA: Not available when the control is enabled.

⚠WARNING

If any of the protective functions has been activated, first remove the cause. Then, after checking that the all run commands are set to off, reset the alarm. Note that if the alarm is reset when any run command is set to on, the inverter may supply the power to the motor, which may cause the motor to rotate.

Injury may occur.

6.1 Overspeed Alarm (*OS*)

Table 6.2 Overspeed Alarm Specifications

Alarm code	Descriptions
OS	• The inverter issues this alarm when the detected speed exceeds the 1.2 times the minimum value of either (1) or (2) below. (1) For the selected motor, Maximum frequency (F03 or A01) + Torque limiter (Frequency increment limit for braking, H76) (2) Frequency limiter, High (F15) • This protective function works when the inverter is outputting with the speed control with PG being enabled (F42 or A14 = 3 or 4 and ***PG/Hz*** is ON).

6.2 Excessive Speed Deviation Alarm (*ErE*)

Table 6.3 Excessive Speed Deviation Alarm Specifications

Alarm code	Descriptions
ErE	• This protective function recognizes a PG error by software based on the relationship between the speed command and the detected speed. • When the speed deviation between the speed command and the detected speed has exceeded the excessive speed deviation level specified by o17 during the period longer than the timer setting specified by o18, the protective function issues this alarm. • This protective function provides two choices--"Stop running" (o19 = 1 or 2) and "Continue to run" (o19 = 0) when it is activated. When the latter is selected, the inverter continues to run with output to terminal [Y] without issuing an alarm. • This protective function works when the inverter is outputting with the speed control with PG being enabled (F42 or A14 = 3 or 4 and ***PG/Hz*** is ON). It does not, however, during DC braking or idling due to overload.
	• This alarm occurs when no Z phase is detected although the slave PG has rotated two cycles or more in synchronous operation. This alarm is contained in alarm category "Y" in Table 6.1, so it cannot be disabled by any function code.

6.2.1 Function codes

Table 6.4 lists function codes related to excessive speed deviation alarms.

Table 6.4 Related Function Codes

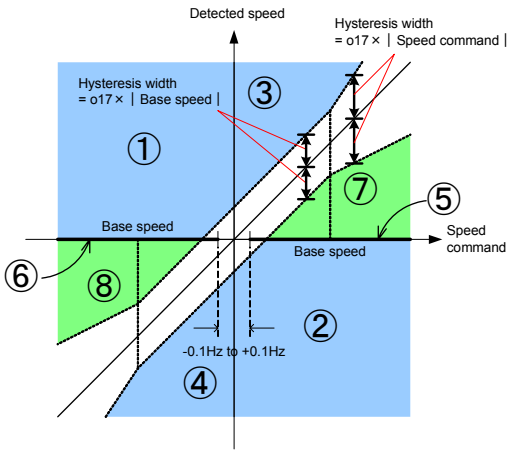
Code	Name	Data setting range	Unit	Default setting	Change when running
o17	Excessive Speed Deviation Level	0 to 50	%	20	Y
o18	Excessive Speed Deviation Timer	0.0 to 10.0	s	1.5	Y
o19	PG Error Processing	0: Continue to run 1: Stop running (Alarm mode 1) 2: Stop running (Alarm mode 2)	--	2	N
E20	Terminal Y1 Function	76(1076): PG error signal ***PG-ERR***	--	0	N
E21	Terminal Y2 Function			7	
E27	Terminal 30A/B/C Function			99	

6.2.2 Excessive speed deviation detection

Table 6.5 and Figure 6.1 show the relationship between PG error detection conditions and error processing (o19.)

Table 6.5 o19 Data and Error Detection

Data for o19	Conditions determining the excessive speed deviation	Alarm	***PG-ERR*** output
0: Continue to run	Any status of ① to ⑥ in Figure 6.1 is kept exceeding the timer setting specified by o18.	None	Active
1: Stop running (Alarm mode 1)		***ErE***	Inactive
2: Stop running (Alarm mode 2)	Any status of ① to ⑧ in Figure 6.1 is kept exceeding the timer setting specified by o18.		



①, ②:
A/B phases of the PG reversely wired

③, ④:
Excessive speed deviation
|Detected speed| > |Speed command|

⑤, ⑥:
PG wire broken or the load locked

⑦, ⑧:
Excessive speed deviation
|Detected speed| < |Speed command|

Figure 6.1 Excessive Speed Deviation Detection and Speed Command

Tip

When an ***Ero*** alarm occurs, the current error factor (any of ① to ⑧) can be displayed on the keypad by using Menu #6 "Alarm Information, Item 6_21 Error sub code." The relationship between the error code and error factors in Figure 6.1 are: 1 for ① or ②, 3 for ③ or ④, 5 for ⑤ or ⑥, and 7 for ⑦ or ⑧. For details, refer to the inverter's instruction manual. (Refer to the description of function code E52.)

6.3 Excessive Deviation Alarm (*Ero*)

Table 6.6 Excessive Deviation Alarm Specifications

Alarm code	Descriptions
Ero	This alarm occurs when the position deviation (absolute value) between the reference and slave PGs exceeds 100 times the o68 setting during synchronous operation. This alarm is contained in alarm category "Y" in Table 6.1, so it cannot be disabled by any function code.

6.3.1 Function codes

Table 6.7 lists function codes related to an excessive deviation alarm.

Table 6.7 Related Function Codes

Code	Name	Data setting range	Unit	Default setting	Change when running
o68	Excessive deviation (Hysteresis width)	0.0 to 6553.5	--	6553.5	Y

Synchronous Operation Card "OPC-E1-SY"

Instruction Manual

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The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the synchronous operation card. 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.

In no event will Fuji Electric FA Components & Systems Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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