



Synchronized Operation Option Card for the VG10

Option Card Part Number
SOPCG11SSY

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Document Part Number 027-2134

Preface

These instructions do not purport to cover all details or variations in equipment, nor to provide every possible contingency to be met during installation, operation, and maintenance. If further information is desired, or if particular problems arise that are not covered sufficiently for the purchaser's purpose, the matter should be referred to Safronics, Inc.

To use the Option Safely

Note the following items when using the option. Improper use may result in unexpected failure, electric shock, or possible injury.

(1) Installation and Wiring

• WARNING

- Wait at least five minutes after turning off the power before installing or wiring the drive option. Use a multimeter or similar instrument to check the voltage before performing installation or wiring. (Check whether the charge lamp goes off.), **as electric shock may occur**
- Discharge static electricity from your body before handling the drive option. Never touch the drive option with wet hands, **as accident or electric shock may occur**
- No foreign matter such as screws, metal patches, lint, chips, and dust in the drive option.
There is risk of fire or accident.
- Do not damage or stress the wiring, **as accident or electric shock may occur.**

• CAUTION

- Do not install or operate a damaged option or one that is lacking parts, **as injury may occur.**
- Since noise is generated by the drive, motor, and wiring, carefully monitor surrounding sensors and devices for abnormal operation. **There is a risk of accident.**

(2) Operation

• WARNING

- Check and adjust parameters before operation. Improper parameters may cause an unexpected action for some machines. **There is a risk of accident.**

• CAUTION

- High-speed operation can be set easily for the drive. Fully check motor or device performance before changing the setup, **as accident may occur.**

(3) Maintenance and Inspection, and Parts Replacement

• WARNING

- Wait at least five minutes after turning off the power before inspecting the drive option. (Check whether the charge lamp goes off.) **There is a risk of electric shock.**
Only authorized personnel are allowed to maintain and inspect the drive option and replace parts, **as electric shock or injury may occur.**
- Never modify the inverter option, **as electric shock or injury may occur.**

• CAUTION

- Do not execute a megger test (insulation resistance measurement).

(4) Discard

• CAUTION

- Since the drive option uses soldering lead, treat it as an industrial waste when discarding it.

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1 Before Using The Product

Check the items described below when you receive this product. Also check whether this product has been damaged during transport. If anything is amiss, contact your distributor.

1-1 Applicable CPU Number

The drive option can be used in a drive with a ROM number listed in Table 1-1-1. Check the ROM number in the maintenance information on the keypad panel.

Table 1-1-1 Applicable ROM numbers.

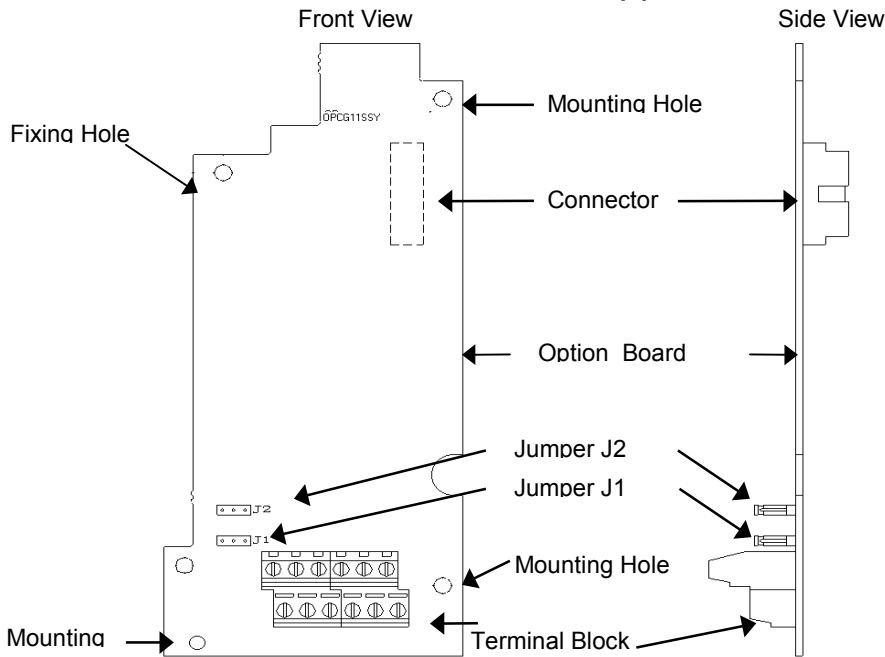
Drive Series	Drive Capacity	Drive ROMU Number
VG10	22kW or less	S08000 or later
	30kW or more	unfixed

1-2 Checking Accessories

Confirm that the following accessories are included in the package:

- 1. User's Manual 1
- 2. Accessories
 - 1) Mounting screw M3 x 6 1
 - 2) Supports..... 3

1-3 Product Appearance



Terminal Block Screw Size M3

Terminal Arrangement

PI	XA	XZ		YA	YZ
PO	XB	CM	PO	YB	CM

Figure 1-3-1 Product Appearance

2 Product Inquires

2-1 Overview

This product is an interface card that is installed in the VG10 general-purpose drive. It provides the Synchronous drive function, and the motor speed and position of slave side can be controlled by the pulse commands

2-2 Product Warranty

The product guarantee term is twelve (12) months after installation or eighteen (18) months after manufacturing on the nameplate, whichever expires first. However, the following are not covered even in warranty period.

- (1) Problems caused by incorrect operation or by unauthorized repairs or modifications.
- (2) Problems resulting from using the inverter in the range outside the standard specification.
- (3) Damage to the inverter after purchase or during delivery.
- (4) Damage caused by earthquakes, fire, floods, lightning, abnormal voltage fluctuations or other natural disasters and secondary disasters.

3 Installation

3-1 Installation Environment

The installation environment for the inverter in which this product is being installed is listed Table 3-1-1

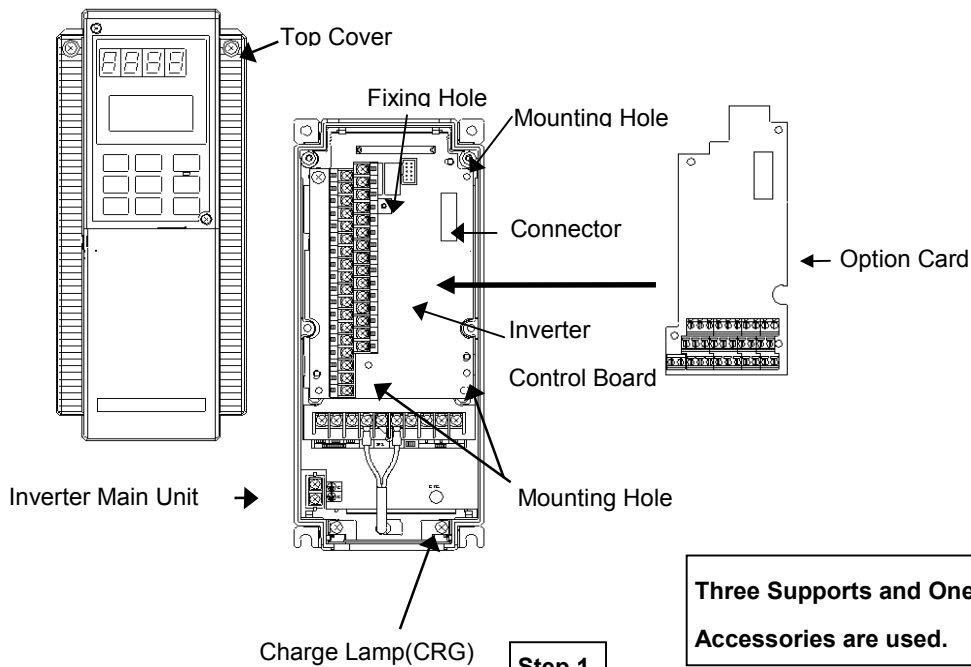
Table 3-1-1 Installation Environment.

Item	Specifications
Location	Indoors
Ambient temperature	-10 to 50°C(+14 to +122°F) , -10 to 40°C(+14 to 104°F) for NEMA4/12 (Remove the ventilation cover of the Drive when the temperature exceeds +40°C (30HP or less).)
Ambient relative humidity	5 to 95%
Environment	The place should be away from direct sunlight and free from dust, corrosive gases, inflammable gases, oil mists, steam, dripping water or vibration. Salty environments should preferably be avoided. Avoid places where sudden changes in temperature occur which could cause condensation or freezing.
Altitude	Up to 3300 feet (1000m)

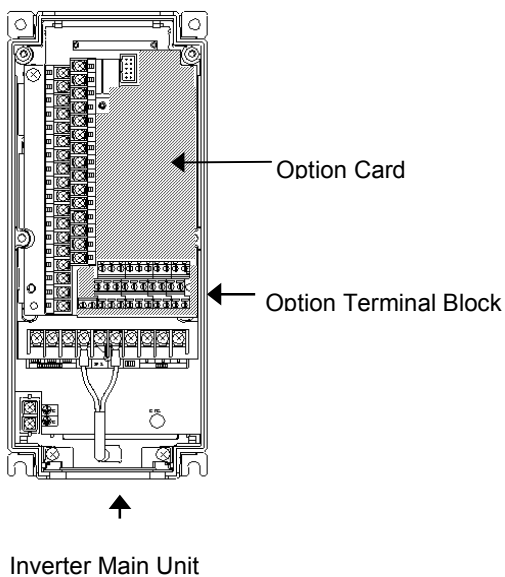
3-2 Installation Procedure

Before installing or removing the option, be sure to turn off input power to the drive and confirm that the charge lamp (CHARGE or CRG) is off.

**Applicable Drive
VG10 30 HP or less**



Remove the top cover, and insert the accessory supports into the three mounting holes on the drive control board.



Set the supports inserted in step 1 on the option card, and insert the drive control board connector to the option card connector. After that, check that you can see the pins of the supports on the option card.

Step 3

Insert and tighten the screws (M3 x 6) in the fixing holes to secure the option card.

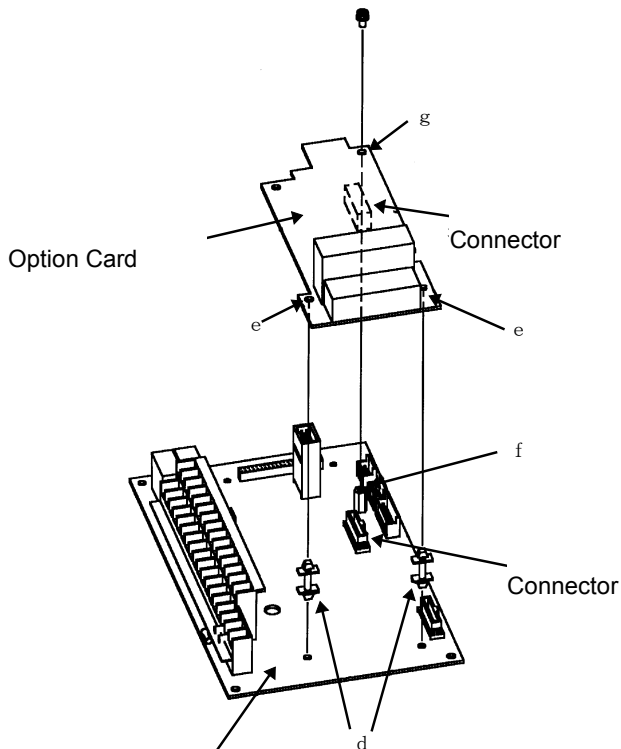
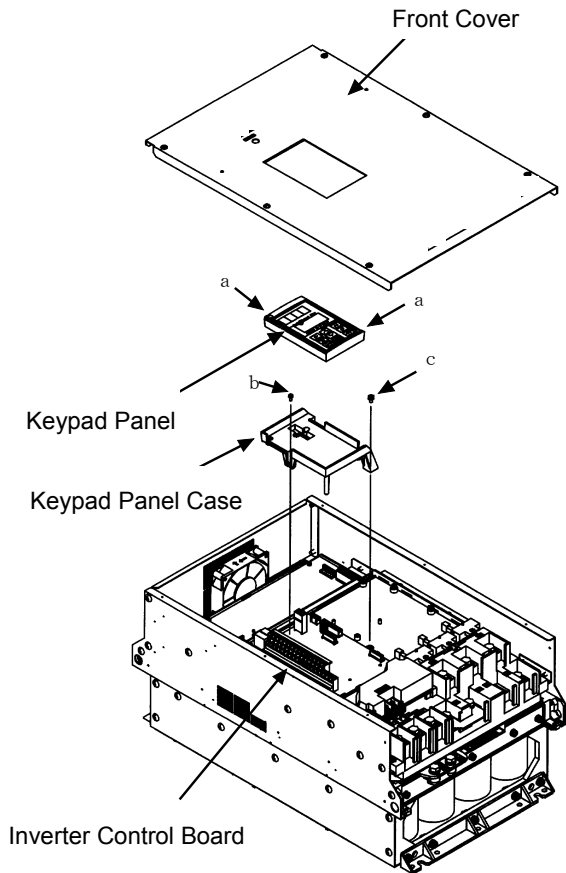
Step 4

Wire the option according to the basic connection diagram.

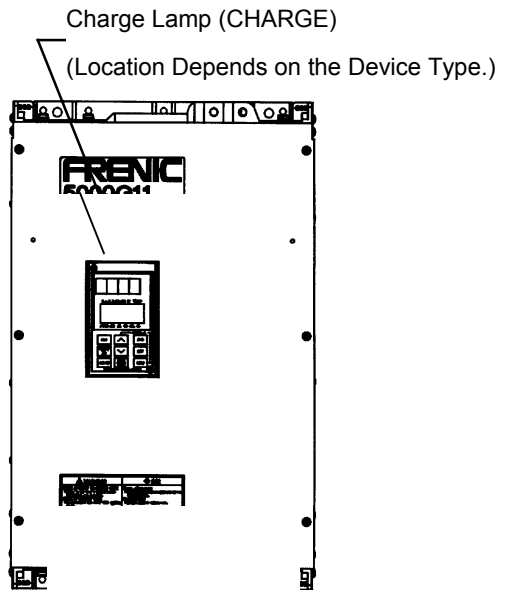
Step 5

Confirm that the option card and all wires are installed correctly, then replace the top cover of the drive.

**Applicable Drive
VG10 40 HP and above**



**Two Supports and One Screw
of Accessories are used.**



Step 1

Remove the front cover and loosen the two M3 screws (a) to remove the keypad panel.

Step 2

Remove one M3 screw (b) and one M4 screw (c) to remove the keypad panel case.

Step 3

Insert the two accessory supports (d) into the drive control board.

Step 4

Insert the two supports (d) into the holes (e) on the option card. Align the support (f) with the hole (g) on the option card, then and insert one connector.

Step 5

Insert and tighten the accessory screws (M3 x 6) at (f) and (g) to secure the option card.

Step 6

Place the keypad panel, case, keypad, and the front cover. then reassemble the drive.

3-3 Wiring

• CAUTION

• Check the wiring again before operating the drive. Improper wiring may cause unexpected drive operation or device operation. **There is a risk of accident or injury.**

Wiring the option and Pulse Generator

- Use a shielded cable for wiring the inverter option. Use a value listed in Table 3-3-1 for the wiring length of each PG type.
- Connect the sheath of the shielded cable to the terminal G of drive, leaving the other end open.
- Run the option wiring at least 4 inches (10 cm) from the main circuit wiring of the drive main unit and other power cables to avoid abnormal operation due to noise. Do not run the option wiring in the same electrical duct with other power cables.

Table 3-3-1 Wiring Length.

PG System	Wiring Length
Open Collector System	65 feet (20 m) or less
Totem Pole System	328 feet (100 m) or less

Terminal Connection on Option

The wire size for the option connection terminal is AWG: 16-26. When an unshielded connection terminal is used, make the length of the unshielded wire $\frac{1}{4}$ inch (6 mm). When using a crimp terminal, be sure to use an insulated ferrule. Insert the wire into the upper side of the metal bracket on the terminal block, and tighten the screw.

Wiring AWG: 16 to 26

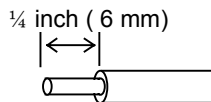


Figure 3-3-1 Wire Terminal on Option Connection Terminal Side.

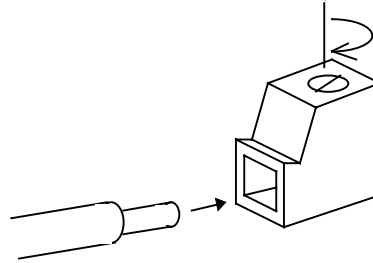


Figure 3-3-2 Connection of Wiring on Optional Terminal Side.

3-4 Applicable PG(Pulse Generator)

The PG specifications that can be applied to the drive option is listed in table 3-4-1.

Table 3-4-1 Specifications of Applicable Pulse Generator.

Item		Specifications	
Applicable PG	Output Pulse	20 to 3000P/R	Count signal A or Count signal B (incremental)
	Power Supply	15VDC± 10% / 120mA 12VDC±10% / 120mA	
	Pulse Output System	Open collector system: Wiring length of 65 feet (20m) or less Totem pole system: Wiring length of 328 feet (100m) or less Output current: 7mA or more	
	Output Voltage	H level ≥+8V. L level ≤ 1V. (12V DC power supply specification) H level ≥ +10V. L level ≤ 1.25V .(15V DC power supply specification)	
PG Power Supply	Internal Power Supply	15VDC ±5%/120mA , DC12VDC±5%/120mA (Can be switched on PC option board) (*1)	
	External Power Supply	12V DC -10% to 15V DC +10% / 300mA or more (*2)	

*1) Use an external power supply when current exceeds 120mA with multiple pulse generators being driven.

*2) Comply with the voltage specifications of the applicable pulse generator power supply.

Pulse Generator Installation and Signal

Forward motor running is counterclockwise rotation viewed from the drive side. (see Figure 3-4-1) In forward running, the PG output pulse is the forward signal, shown in Figure 3-4-2. (count signal B advances by 90 degree from count signal A) In reverse running, the PG output pulse is the reverse signal, shown in Figure 3-4-2. (count signal A advances by 90 degree from count signal B) Connect the PG directly to the motor using a coupling.

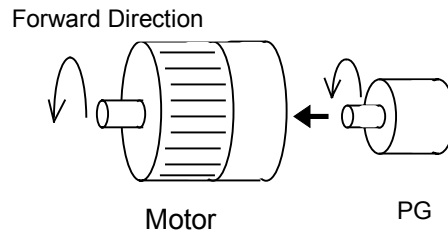


Figure 3-4-1 Motor and PG Forward Direction.

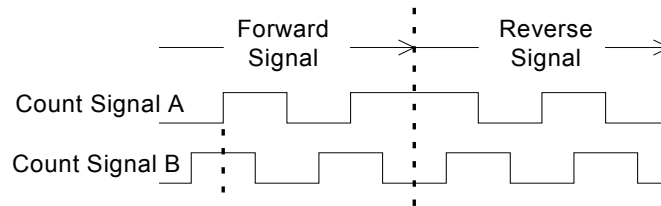


Figure 3-4-2 PG signals.

4 Option Power Supply Settings

• CAUTION

- Set the option power supply so that it matches the PG power voltage or pulse oscillator voltage.

There is a risk of failure.

4-1 Option Power Supply Settings

Before turning on drive power, use jumpers J1 and J2 to switch the PG power supply and voltage of the power supply. Jumper J1 switches the power supply to the option between an drive internal power supply and an external power supply. Jumper J2 switches the drive internal voltage (between 15V DC and 12V DC). Setting an improper voltage of power supply with the PG or pulse oscillator may result in option or device failure.

4-1-1 Setup of Jumper J1 (Switching between drive internal power supply and external power supply)

Jumper J1 is used to set the PG power supply. See Table 4-1-1 and Figure 4-1-1 to set the power supply.

Table 4-1-1 Setting Jumper J1.

Power Supply Used	Jumper Setting
Internal Power Supply	Use the switching cap to connect the INT side of jumper J1 (voltage is selected using J2).
External Power Supply	Use the switching cap to connect the EXT side of jumper J1. Connect a power supply of 12V DC \pm 10% or 15V DC \pm 10% to terminal P1.

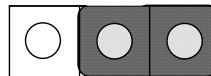
Switching cap J1



INT

EXT

J1 Switching cap



INT

EXT

When using internal power supply (**Factory Setting**)

When using external power supply

Figure 4-1-1 Jumper J1 setting.

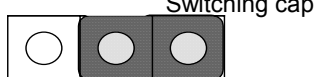
4-1-2 Jumper J2 Setting (Switching internal power voltage between 12V DC and 15V DC)

Jumper J2 is used to set the voltage of PG power supply (switching the voltage between 12V DC and 15V DC). See Table 4-1-2 and Figure 4-1-2 to set the voltage of PG power supply.

Table 4-1-2 Jumper J2 Setting.

Power Supply Used	Jumper Setting
+12V DC Internal Power Supply	Use the switching cap to connect the 12V side of jumper J2.
+15V DC Internal Power Supply	Use the switching cap to connect the 15V side of jumper J2.

J2

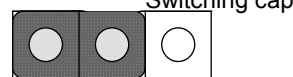


15V

12V

When using +12V DC power supply

J2



15V

12V

When using +15V DC power supply

(Factory Setting)

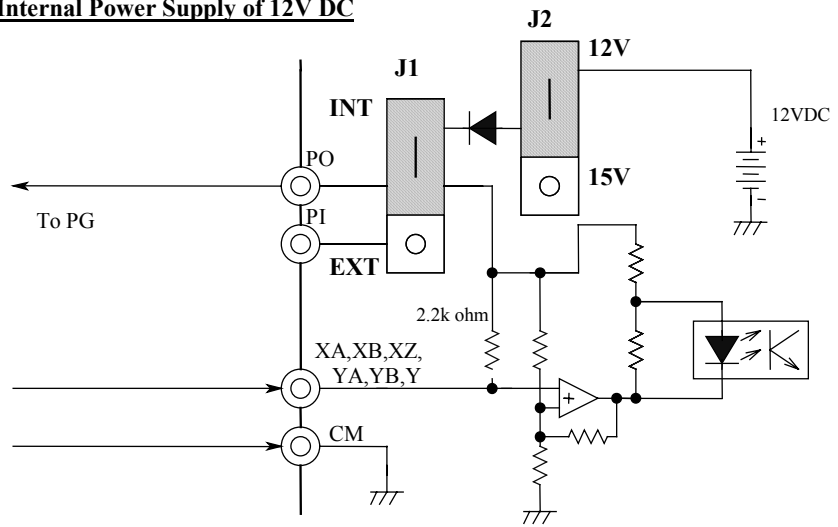
Figure 4-1-2 Jumper J2 Setting.

Note: The +15V DC power supply (15V side) of the internal power supply (INT side) is the factory setting for Jumper J1 and Jumper J2.

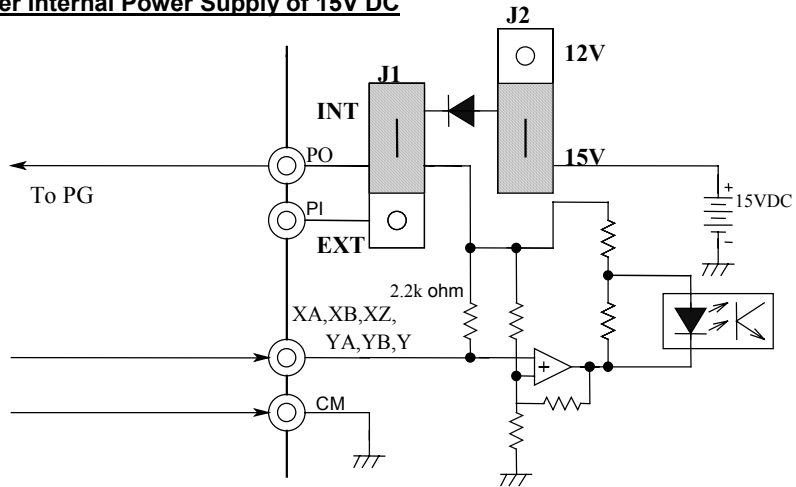
4-2 Terminal and Circuit Configuration

Figure 4-2-1 shows the input terminal and power supply configuration.

When Using Inverter Internal Power Supply of 12V DC



When Using Inverter Internal Power Supply of 15V DC



When Using External Power Supply

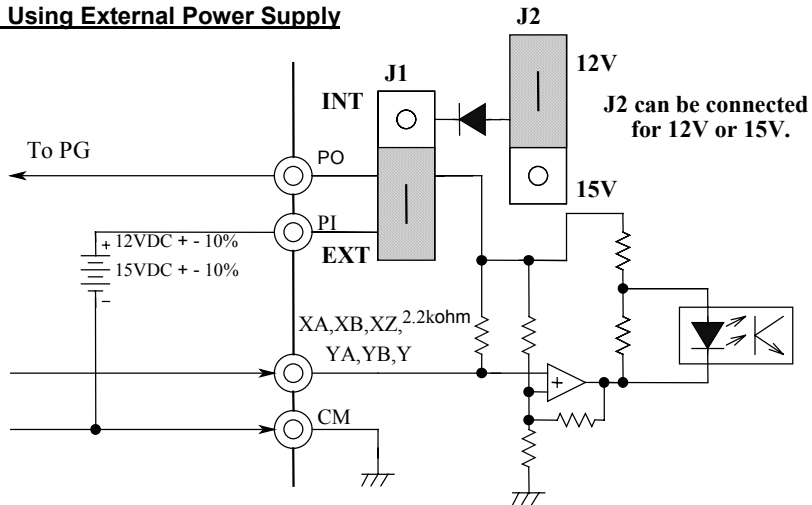


Figure 4-2-1 Input Terminal and Power Supply Configuration.

5 Synchronous Operation

During synchronous operation, the speed and position of the slave motor are controlled according to the pulse command. Input the pulse command at the XA and XB terminals and the PG feedback signal of the slave motor at the YA and YB terminals. However, the origin return function is not provided.

5-1 Specification

Table 5-1-1 shows the specification of synchronous operation.

Table 5-1-1. Specification of synchronous operation

	Item	Specification	Remarks
Control specification	Speed control range	3~3600(RPM)	(In the case of 4-pole motor)
	Position control accuracy	$\pm 2^\circ$	With PG motor, 1500 r/min, constant speed operation, reduction ratio 1:1, PG vector control
Electric specification	Max. input pulse	100kp/s (*)	

(*) The maximum input pulse varies according to the PG circuit type and wiring length. Refer to the following values.

Open collector type PG circuit, wiring length 65 feet (20 m): max. input pulse 25 kp/s

Totem pole type PG circuit, wiring length 328 feet (100 m): max. input pulse 100 kp/s

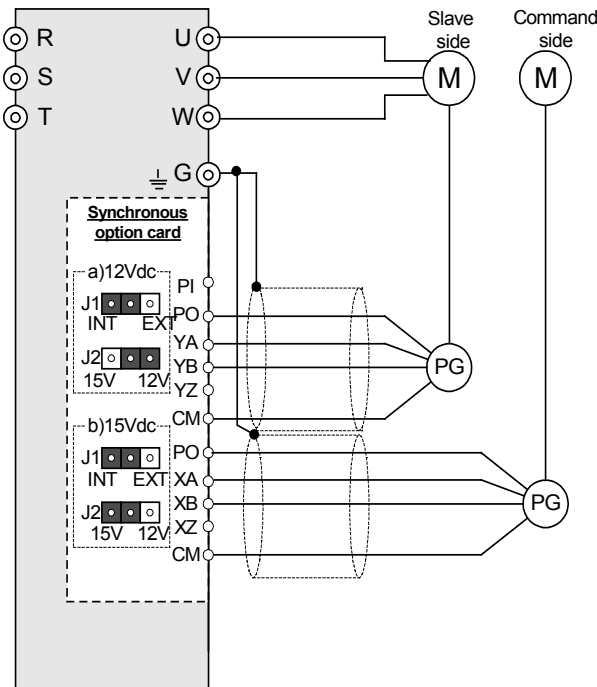
5-2 Basic Wiring Diagram

⚠ Caution

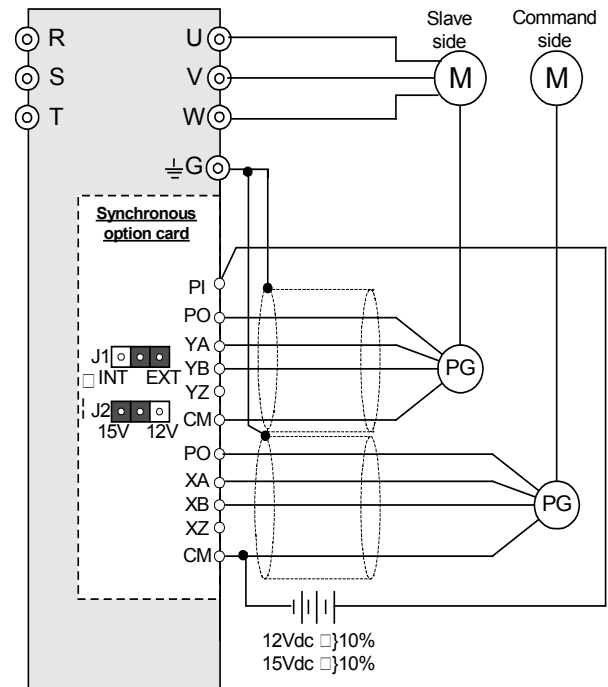
- **Wrong wiring or operation out of the PG specification may cause unpredictable drive or device movement. Accident or failure may be caused.**

Fig. 5-2-1 shows a connection example for synchronous operation.

I. In the case the internal inverter power supply is used



II. In the case an external power supply is used



* Pin J2 may be connected on either the 12V or 15V side.

Fig. 5-2-1 Connection diagram for synchronous operation

5-3 Terminal Function List

Table 5-3-1. Terminal function for synchronous operation

Terminal Symbol	Name of Terminal	Description of Terminal Function
PI	External power input terminal	External power supply terminal for PG
PO	Power output terminal	PG power supply output terminal
CM	Common terminal	Power supply common terminal for PG
XA	Count signal A pulse input terminal on command side	Terminal for connection of count signal A on command side
XB	Count signal B pulse input terminal on command side	Terminal for connection of count signal B on command side
XZ	Count signal Z pulse input terminal on command side	Not used
YA	Count signal A pulse input terminal on feedback side	Terminal for connection of count signal A on feedback side
YB	Count signal B pulse input terminal on feedback side	Terminal for connection of count signal B on feedback side
YZ	Count signal Z pulse input terminal on feedback side	Not used

(*) PG Feedback Command FUNCTION

When "27: SY/PG control selection [PG/Hz]" is set as the data of function codes E01 to E09, the PG option (speed feedback control) can be canceled with terminals from X1 to X9 (effective when the unit's digit of o01 is set to 1). Note that this ON or OFF command is not effective during operation and becomes effective after the inverter stops. When terminals X1 to X9 are not allocated for PG/Hz, speed feedback control is always effective.

Table 5-2-2 Terminal Function.

PG/Hz " 27 "	Function
ON	With speed feedback control
OFF	Speed feedback control canceled

(*) ZERO SPEED COMMAND FUNCTION

zero speed command function is to keep torque with motor stop, when PG vector control is used.

When "29: ZERO speed command selection [ZERO]" is set as the data of function codes E01 to E09, Zero speed torque can be used with terminals from X1 to X9 (effective when the unit's digit of o01 is set to 1). zero speed command function isn't available in Synchronous driving.

Table 5-2-3 Terminal Function.

ZERO " 29 "	Function
ON	With zero speed command
OFF	zero speed command canceled

(*) PRE-EXCITATION COMMAND FUNCTION

Pre-excitation command function is to improve starting characteristics by exciting a motor before the drive .

Pre- excitation function is canceled ,while driving a motor.

When "32: Pre-excitation command [EXITE]" is set as the data of function codes E01 to E09, pre-excitation function can be used with terminals from X1 to X9 (effective when the unit's digit of o01 is set to 1).

DC braking function takes precedence over pre-excitation function. You should set the sequence that pre-excitation starts before driving a motor and that pre-excitation stops before stopping a motor.

Table 5-2-4 Terminal Function.

EXITE " 32 "	Function
ON	With pre-excitation command
OFF	pre-excitation command canceled

5-4 Outline of Operation

During synchronous operation, the speed and position of the slave side is controlled so that the difference between the cumulative pulses on the command side and that on the slave side becomes zero. When the difference is smaller than the synchronization completion detection angle setting, an SSY synchronization completion signal is output. On the other hand, when deviation of synchronization occurs and the difference exceeds the deviation limit setting, Er5 tripping occurs to shut off the output.

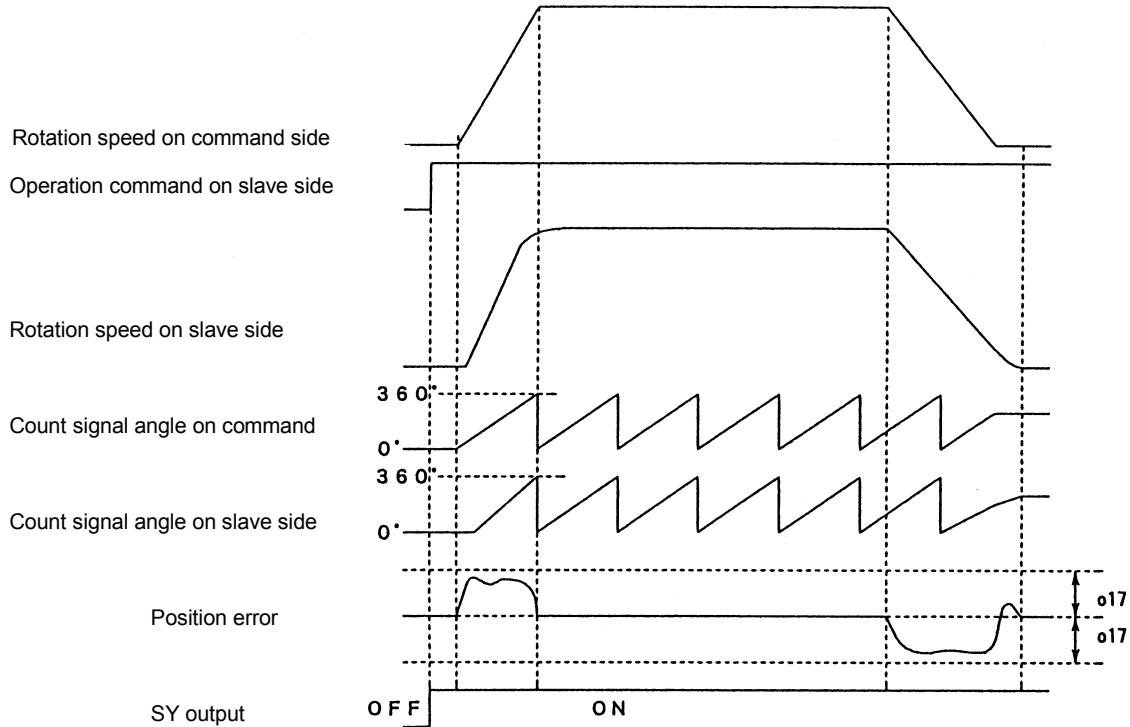


Fig. 5-4-1 Synchronous operation control

During synchronous operation, the direction of rotation of the slave side is determined by the direction of rotation of the command side and the operation command of the slave side.

(Refer to Table 5-4-1, Fig. 5-4-2 and Fig. 5-4-3.)

Table 5-4-1 Relationship between operation command and direction of rotation

		Direction of rotation of slave side	
		FWD	REV
Direction of rotation of command side	During CW rotation	CW	CCW
	During CCW rotation	CCW	CW

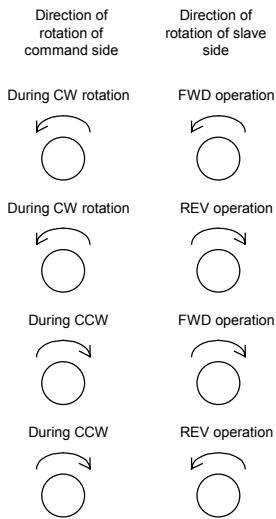


Fig.5-4-2 Operation command and direction of rotation

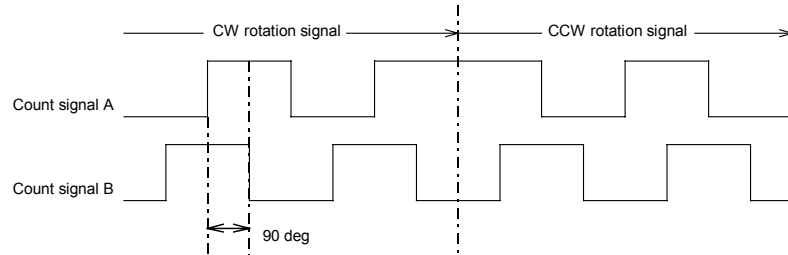


Fig.5-4-3 Input pulse and direction of rotation.

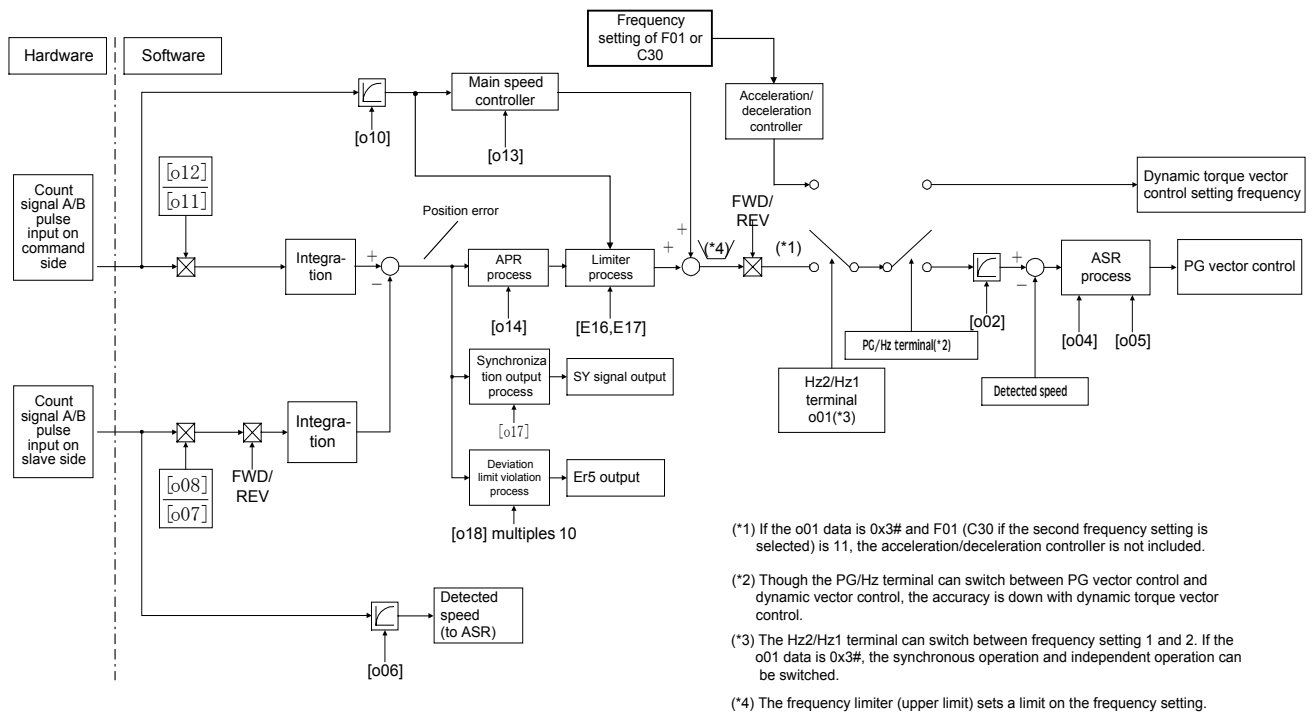


Fig. 5-5 Synchronous operation control block diagram

5-6 Function Code List

Table 5-6-1. Parameters for synchronous operation control function code list

Function	Name	Setting range	Unit	Min. Unit	Factory setting
F01	Frequency command 1	0 to 11	-	-	0
F03	Max. output frequency 1	50 to 400Hz	Hz	1	60
F04	Base frequency 1	25 to 400Hz	Hz	1	50
F05	Rated voltage 1	O =proportional to input voltage. 80 to 240V: 230V class 320 to 480V: 460V class	V	1	230/460
F15	Frequency limiter (Upper limit)	0 to 400Hz	Hz	1	70
F40	Torque limiter 1 (Driving)	20 to 200%,999% (No limit)	%	1	999
F41	(Braking)	0% (automatic decel control), 20 to 200%, 999% (inactive)	%	1	999
E16	Torque limiter 2 (Driving)	20 to 200%,999% (No limit)	%	1	999
E17	(Braking) * Refer to Fig. 5-5.	0%, 20 to 200% 999% (No limit)	%	1	999
C30	Frequency command 2	0 to 11	-	1	2
P01	Motor 1 (Number of poles) (Capacity) (Rated current) (On-line tuning) (No-load current) (%R1) (%X) (Slip compensation control1)	2 to 14	poles	2	4
P02		≤ 22 kW: 0.01 to 45.00 kW ≥ 30 kW: 0.01 to 500.00 kW	kW	0.01	Standard applicable motor
P03		0.00 to 2000A	A	0.01	Standard applicable motor
P05		0: Inactive, 1: Active	-	-	0
P06		0.00 to 2000A	A	0.01	Standard applicable motor
P07		0.00 to 50.00%	%	0.01	Standard applicable motor
P08		0.00 to 50.00%	%	0.01	Standard applicable motor
P09		0.00 to 5.00Hz	Hz	0.01	Standard applicable motor
H28		Droop operation	-9.9 to 0.0Hz	Hz	0.1
o01	Speed command method / speed control method	00, 01, 10, 11, 20, 21, 30, 31	-	-	00
o02	Speed command filter time constant	0.000 to 5.000	s	0.001	0.02
o03	PG pulse count on slave side	20 to 3000	p	1	1024
o04	P constant of speed controller on slave side	0.01 to 200.00	times	0.01	10.00
o05	I constant of speed controller on slave side	0.000 to 5.000	s	0.001	0.100
o06	Speed detection filter time constant on slave side	0.000 to 5.000	s	0.001	0.005
o07	Pulse correction coefficient 1 on slave side	1 to 10000	-	1	1
o08	Pulse correction coefficient 2 on slave side	1 to 10000	-	1	1
o09	PG pulse count on command side	20 to 3000	p	1	1024
o10	Pulse setting filter time constant on command side	0.000 to 5.000	s	0.001	0.005
o11	Pulse correction coefficient 1 on command side	1 to 10000	-	1	1
o12	Pulse correction coefficient 2 on command side	1 to 10000	-	1	1
o13	Main speed controller gain	0.1 to 1.5	times	0.1	1.0
o14	APR P constant	0.01 to 200.00	times	0.01	1.00
o17	Synchronization completion detection angle	0 to 100	deg	1	10
o18	Deviation limit width	0 to 65535	-	1	65535

5-7 Function Code Setting Details

Activate the speed feedback control, during synchronous operation to obtain maximum drive performance. If the speed feedback control is canceled, the desired performance may not be attained.
Set the function codes in the following procedure.

Function code setting

F01 Frequency setting 1

C30 Frequency setting 2

Select pulse train input (code '11') for the set frequency.

Use the Hz2/Hz1 terminal to switch between synchronous operation and independent operation.

(Refer to Fig. 5-5.)

However, make switching while the inverter is stopped.

H18 Torque control

Select "inactive" for torque control. (H18 = 0)

H20 PID control

Select "inactive" for PID control. (H20 = 0)

Motor constant data

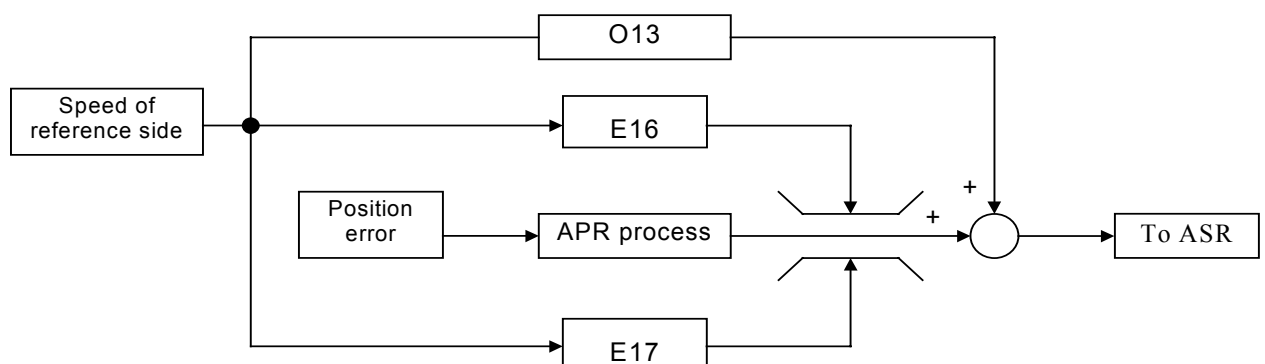
Set **function codes** F03, F04, F05, P01, P02, P03, P07, P08 and P09 according to the User's Guide for the VG10. If a second motor is used, set function codes A01, A02, A03, A10, A11, A12, A15, A16, A17 and A18.

E16 Torque control 2 (Driving)

E17 Torque control 2 (Braking)

During synchronous operation, the setting of torque control 2 is used for the limiter of the offset of APR (position controller). Set the limit value in the ratio to the speed of the reference side.
(Refer to Fig. 5-4, Fig. 5-7-1 and Table 5-7-3.)

Accordingly, torque limit 1/2 switch command becomes invalid during synchronous operation.



* However, if E16 and E17 are set at 999, no limiter is provided.

Fig. 5-7-1 Operation of APR output correction limiter

o01 Speed command method / speed control method

The units digit of o01 is used for the selection of the speed controller method and the tens digit is used for the selection of the speed setting method. Set '31'.

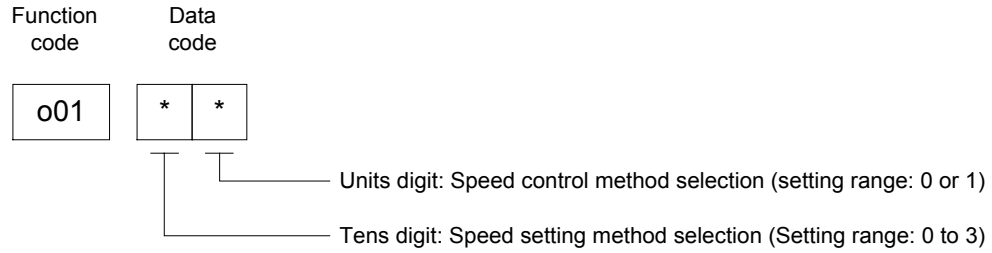


Table 5-7-1. Function code description

Function code		Function	
o01	Units digit	0	Speed feed back control inactive
		1	PG vector control
	Tens digit	0	Pulse train input / synchronous operation inactive
		1	Count signal A/B pulse train input
		2	Count signal B pulse train input
		3	Synchronous operation (with position control)

o02 Speed command filter time constant

Set the first-order lag filter time constant in relation to the speed setting. Use it to suppress the overshoot after a speed command change. (Refer to Fig. 5-5.)

o03 Pulse Generator pulse count on slave side

Set the encoder pulse count on the motor side controlled by the drive. (Refer to Fig. 5-5.)

o04 P constant of speed controller on slave side

o05 I constant of speed controller on slave side

Set the PI constant of the speed controller on the slave side. (Refer to Fig. 5-5.)

The transfer function of the speed controller is expressed in the following formula.

$$\tau^* = k_p \left(1 + \frac{1}{sT_i}\right) \times \varepsilon$$

- where:
- K_p: P constant
 - T_i: I constant
 - τ^{*}: Torque command
 - ε : Speed deviation

The P gain which makes the torque command τ^{*} 100% at 100% of speed deviation ε (maximum frequency) is made "1."

o04 and o05 must be adjusted again if the F03 value is changed.

o06 Speed detection filter time constant on slave side
Set the first-order lag filter time constant in relation to the detected speed. Use this for a large ripple in the speed detection signal. (Refer to Fig. 5-5.)

o07 Pulse correction coefficient 1 on slave side

o08 Pulse correction coefficient 2 on slave side
If the motor on the slave side is equipped with a reduction gear or the like, set slave side pulse correction coefficients 1 and 2. (Refer to Fig. 5-5.)
The conversion formula is as follows. Refer to the later setting example for details.

$$(\text{Actual motor speed on slave side}) = \frac{o08}{o07} \times (\text{Slave side encoder shaft speed}) \quad (\text{Formula 4-1})$$

Set values so that $\frac{o08}{o07}$ becomes "1" or a larger value. "1" is assumed for a quotient smaller than 1.

o09 Pulse Generator pulse count on command side
Set the encoder pulse count of the motor operated in synchronous operation.
Set the same pulse count as o03.

o10 Pulse setting filter time constant on command side
Set the first-order lag filter time constant in relation to the pulse setting on the command side. (Refer to Fig. 5-5.)

o11 Pulse correction coefficient 1 on command side

o12 Pulse correction coefficient 2 on command side
To perform proportional operation with the motor on the command side, set command side pulse correction coefficients 1 and 2. (Refer to Fig. 5-5.)
The conversion formula is as follows. Refer to the later setting example for details.

$$(\text{Speed on command side}) = \frac{o12}{o11} \times (\text{Command side encoder shaft speed}) \quad (\text{Formula 4-2})$$

o13 Main speed controller gain
Use this setting to reduce the steady-state error.
Set 1.0 to minimize the steady-state error. (Refer to Fig. 5-5.)

o14 APR (position controller) P constant
This setting determines the response of the position controller. (Fig. 5-5)
The gain where the APR output is the maximum frequency when the difference (position error) in the phase angle between on the command side and on the slave side is the pulse count for the maximum frequency, is made 1.0.
If this value is too large, hunting is likely to occur, and if this value is too small the steady-state error becomes large.

o17 Synchronization completion detection angle

The synchronization completion detection angle can be set. Set "29" to E20 through E24 to output an SSY synchronization completion signal when an absolute value of difference (position error) in the phase angle between on the command and slave sides is smaller than the o17 setting.

The phase angle is defined so that four times the o03 setting becomes 360deg. (Refer to Fig. 5-5 and Fig. 5-7-2.)

Note: Once the signal is turned on, it is held for 100 ms.

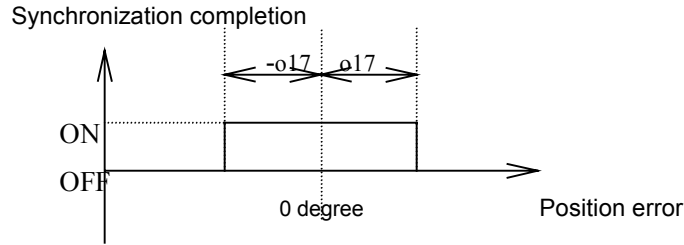


Fig. 5-7-2 Synchronization completion detection signal

o18 Deviation limit width

The deviation limit violation error setting is made. When the absolute value of the difference (position error) in the phase angle between the command and slave sides exceeds 10 times the o18 setting, Err5 is output and drive output is shut down. However, the setting is given not in pulse count but in angle. (Refer to Fig. 5-5 and Fig. 5-7-3.)

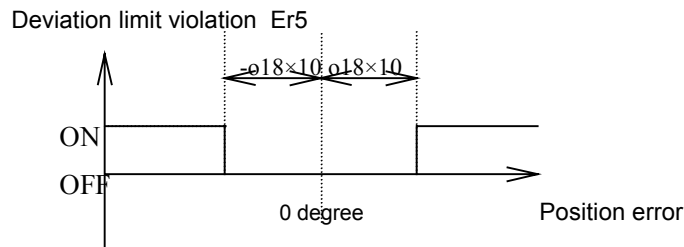


Fig. 5-7-3 Deviation limit violation error

Invalidated function code list

Some function codes are invalidated during synchronous operation. A list of them is shown in Table 5-7-2.

Table 5-7-2. Invalidated function code list

Function No.	Name	Remarks
F06	Maximum voltage 1	Under PG vector control
F07	Acceleration time 1	
F08	Deceleration time 1	
F09	Torque boost 1	Under PG vector control
F16	Frequency limiter (Lower)	
F23	Starting frequency (Freq)	
F24	(Holding time)	
F25	Stop frequency	Invalid with start command. Valid without start command
F42	Torque vector control 1	Under PG vector control
E01- E09	X terminal (Function selection) TRQ limit 2 / TRQ limit 1(Value 14)	
E10	Acceleration time 2	
E11	Deceleration time 2	
E12	Acceleration time 3	
E13	Deceleration time 3	
E14	Acceleration time 4	
E15	Deceleration time 4	
C01 - C03	Jump frequency 1 to 3	
C04	Hysteresis	
H07	ACC / DEC pattern	
H10	Automatic energy - saving operation	
H14	Auto Restart (Freq. Fall. rate)	
H15	(Holding DC ratio)	
H19	Active drive	
A04	Maximum voltage 2	Under PG vector control
A05	Torque boost 2	Under PG vector control
A09	Torque vector control 2	Under PG vector control

List of function codes with different meaning

The meaning of some function codes becomes different during synchronous operation(SSY). A list of them is shown in Table 5-7-3.

Table 5-7-3. List of function codes with different meaning

Function No.	Name	Setting	Meaning
F14	Auto restart	0	Inactive (Immediately tripping without restarting)
		1	Inactive (Tripping upon recovery without restarting)
		2	Inactive (Immediately tripping without restarting)
		3	Active (Restarting; restarting to original position)
		4	
5			
E16	Torque limiter 2 (Driving)	20 to 200	The APR output is limited between 20 and 200% of the reference side speed. (Positive side)
		999	No limiter on positive side of APR output
E17	Torque limiter 2 (Braking)	0	Active at 20%
		20 to 200	The APR output is limited between 20 and 200% of the reference side speed. (Negative side)
		999	No limiter on negative side of APR output

Synchronous operation setting example

A setting example for synchronous operation is described below.

Assume a system configuration shown in Fig. 5-7-4.

The drive requiring synchronous operation setting is on the slave side.

First, look at the gear ratio **A:B** between the driving motor on the slave side and the target of synchronous operation, and set the slave side pulse correction coefficient. For a gear ratio of **A:B**, the detected speed must be multiplied by **B/A**. Hence, enter **A** to o07 and enter **B** to o08 based on (formula 4-1).

Next, consider the pulse train to be supplied by the command side. Because between the target of synchronous operation and command pulse are gear ratio **C:D** and a 1/e dividing circuit, the command speed must be multiplied by $\frac{C}{D} \times e$. Hence, enter **D** to o11 and enter **C** times e to o12 based on (formula 4-2).

Example of synchronous operation

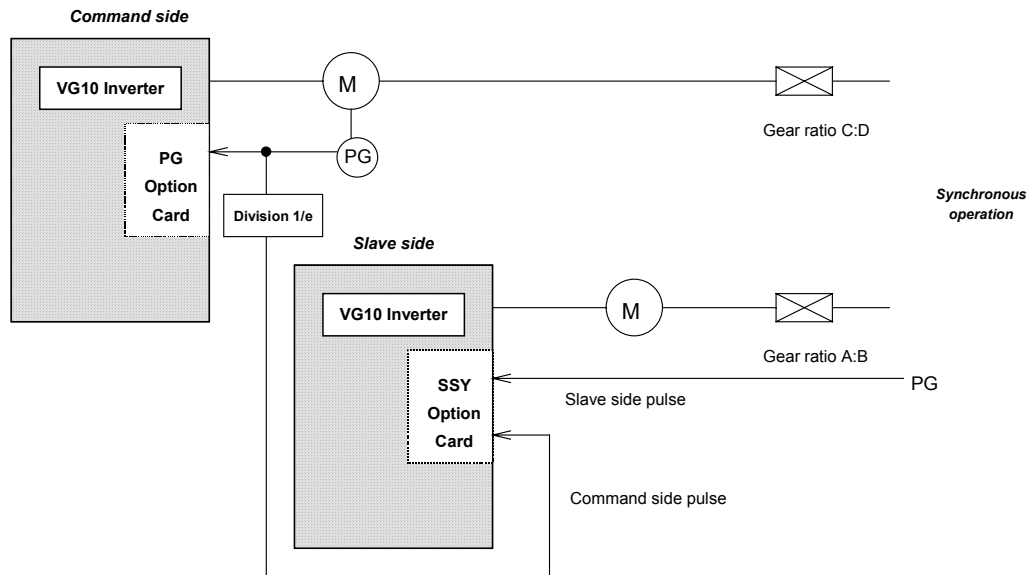


Fig. 5-7-4 Example of synchronous operation

PG Vector Control Setting Procedure

Set function codes o02: 0.02 (s), o04: 10 (times), o05: 0.1 (s), and o06: 0.005 (s). See the setting procedure for constants P (o04) and I (o05) below to adjust stability and response. Adjusting constants with function codes o02 (time constant of speed command filter) and o06 (time constant of feedback speed filter) can also improve stability and response.

6 Additional Information

6-1 Alarm Protection Function

When the inverter protection function is activated, the drive is immediately tripped, an alarm is displayed on the keypad panel LED, and the motor coasts to a stop. If this protection function is activated, remove the cause of the trip, then restart the drive. Do not use an external sequence to automatically reset the alarm. See Table 7-1-1 for details about tripping related to this option. For other types of tripping, see "Protective operations" regarding the inverter main unit.

Table 6-1-1 List of Alarm Protection Functions.

LED monitor	Trip	30ABC	Cause of Trip
	OS	ON	1.Overspeed error : Displays an error if detection speed exceeds the [minimum setup value from 120 [Hz], F03 (A01), and F15] by 1.2 times. 2.Overspeed error : Displays an error when trains specification of applicable PG is not satisfied.
	PG	ON	PG disconnection error : Judges feedback disconnection, and displays an error.
	Err5	ON	Over difference error : If absolute value of position difference exceeds the o18 setting value by 10 times, and displays an error.

6-2 I/O Check

The digital input status of the PG option can be checked on the drive keypad panel. Switch from the run mode screen to the program menu screen, then select [4. I/O check]. The I/O check monitor has seven screens. Using the up and down keys, scroll through the screens to check the digital input status of the PG option. See the explanation of how to operate the keypad panel in the User's Guide.

