



PG Encoder Feedback Option Card for The VG10

Option Card Part Number
SOPCG11SPG

Saftronics, Inc.

5580 Enterprise Pkwy., Ft. Myers, FL 33905

Telephone: (239) 693-7200

Fax: (239) 693-2431

www.saftronics.com

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Preface

Thank you for purchasing our SOPCG11SPG drive option. Before using the option card, read this manual carefully to understand how to use the option card correctly. Improper use may result in abnormal operation, reduce product life, and possible failure. This manual does not describe how to use the VG10 drive unit. Refer to the VG10 Instruction Manual for details about the drive unit. Keep this manual on hand for reference when using the option card.

To Use The Option Safely

Note the following items when using the option card. 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 multi-meter 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**
- Keep foreign matter such as screws, metal patches, lint, chips, and dust out of 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 drive 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 card uses soldering lead, treat it as an industrial waste when discarding it.

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If anything is unclear about the option card or there is something doubtful about its condition, contact your distributor.

1 Before Using this Product

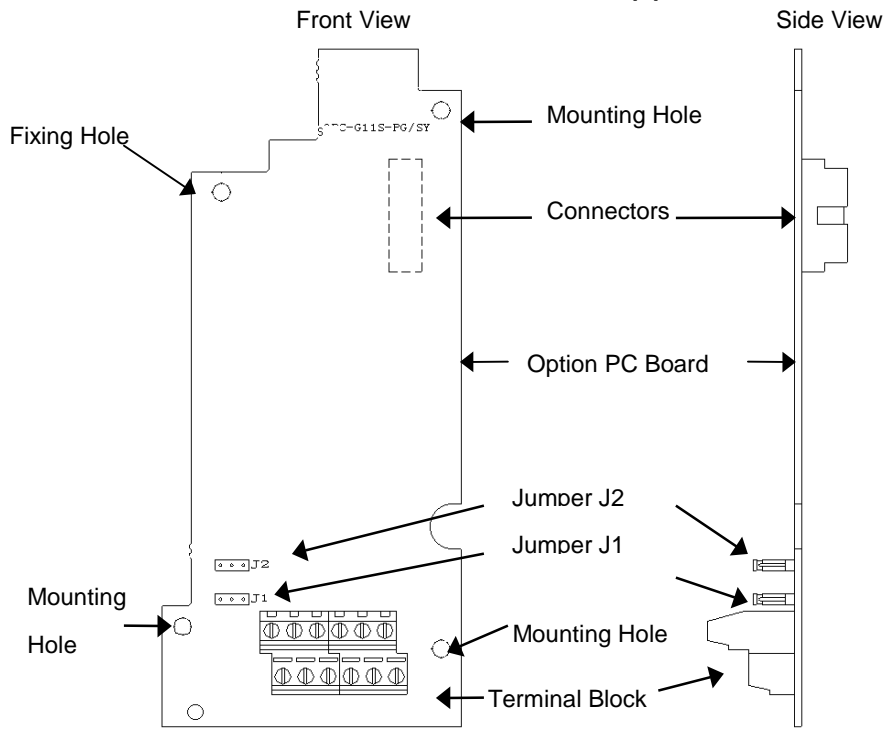
Check the items described below when you receive this product. Also check whether this product has been damaged during transport. If anything is amiss, contact your distributor.

1-1 Checking Accessories

Confirm that the following accessories are included in the package:

- 1. Instruction Manual ●●●●●●●● 1
- 2. Accessories
 - 1) Mounting screw M3 x 6 ●●●●●●●● 1
 - 2) Supports ●●●●●●●● 3

1-2 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 Inquiries

2-1 Overview

This product is an interface card that is installed in the VG10 dynamic torque vector drive.

It provides the following functions:

- (1) Closed loop vector control
- (2) Frequency or speed commands with pulse train input

2-2 Product Warranty

Warranty period is 12 months after installation or 18 months after shipment from the factory, whichever occurs first. However, the troubles caused by the following reasons are not covered by this warranty even in warranty period.

- (1) Problems caused by incorrect operation or by unauthorized repairs or modifications.
- (2) Problems resulting from using the Drive in the range outside the standard specification.
- (3) Damage to the Drive 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 drive in which this product is being installed is listed Table 3-1-1 and the VG10 instruction book page 2-1.

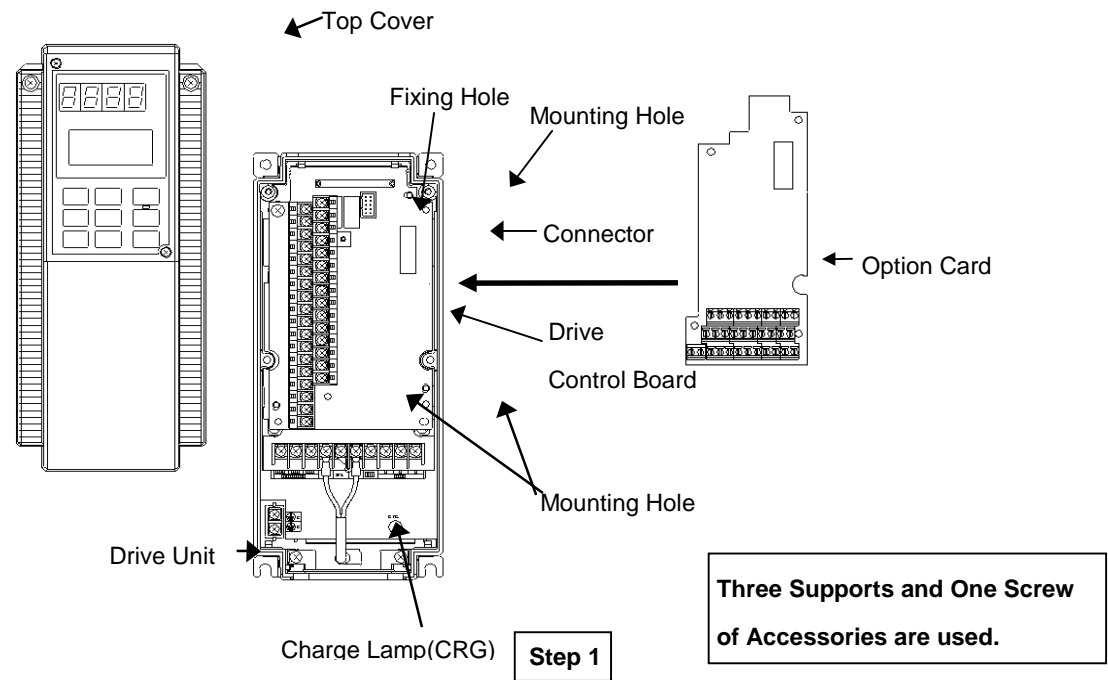
Table 3-1-1 Installation Environment.

| Item | Specifications | Remarks |
|---------------------------|--|---------|
| 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 VG10 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.

Step 2

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 nails of the supports on the option card.

Step 3

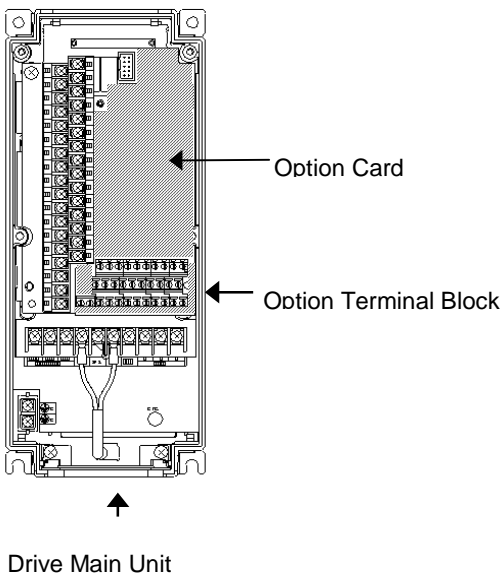
Insert and tighten the screws (M3 x 6) in the fixing holes to secure the option card.

Step 4

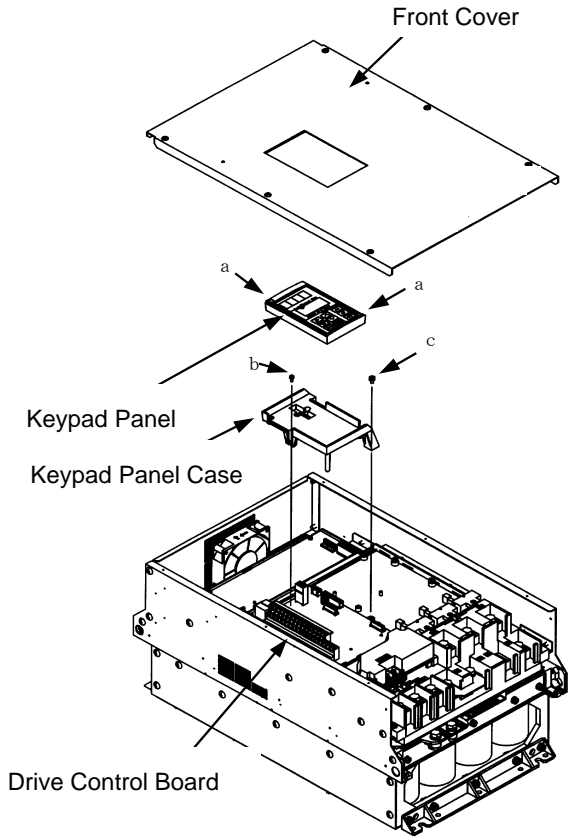
Wire the option according to the basic connection diagram.

Step 5

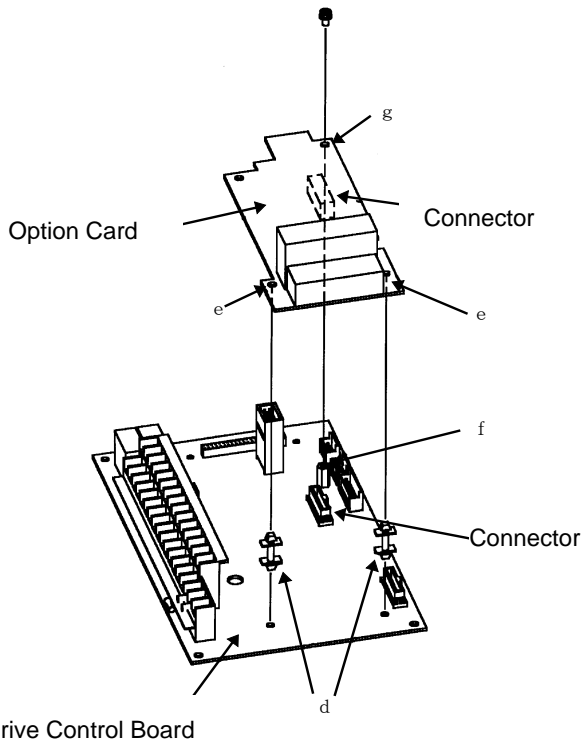
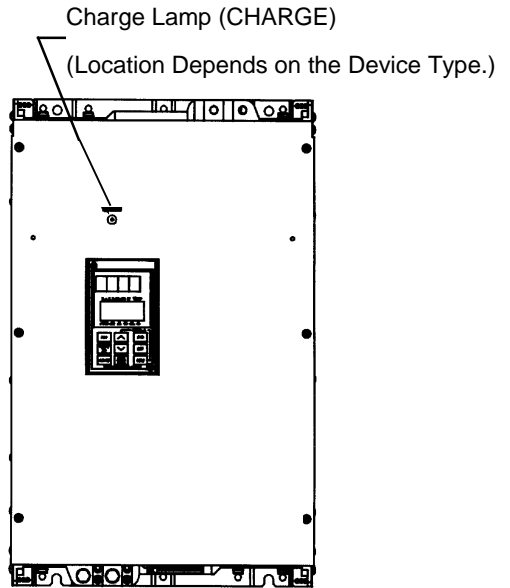
Confirm that the option card and all wires are installed correctly, then place the top cover of the drive.



**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 and the front cover, then assemble the Drive as it was before.

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 PG (Encoder)

- Use a shielded cable for wiring the drive option. Use a value listed in Table 3-3-1 for the wiring length of each PG (Encoder) type.
- Connect the sheath of the shielded cable to the terminal G of drive, then leave the other end open.
- Run the option wiring at least 4" (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 | 66 feet (20 m) or less |
| Totem Pole System | 330 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 1/4" (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

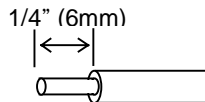


Figure 3-3-1 Wire Terminal on Option Connection Terminal Side.

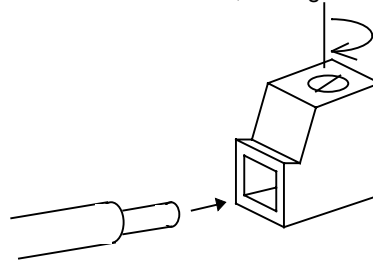


Figure 3-3-2 Connection of Wiring on Optional Terminal Side.

3-4 Applicable Pulse Generator (PG) Encoder

The PG (Encoder) specifications that can be applied to the VG10 drive option are listed in table 3-4-1.

Table 3-4-1 Specifications of Applicable PG(Encoder).

| Item | | Specifications |
|-----------------|----------------------------|--|
| Applicable PG | Output Pulse | 20 to 3000P/R Phase A or Phase B (incremental) |
| | Power Supply | 15VDC± 10% / 120mA 12VDC±10% / 120mA |
| | Maximum Response Frequency | 100kHz |
| | Pulse Output System | Open collector system: Wiring length of 66 feet (20m) or less Totem pole system: Wiring length of 330 feet (100m) or less Output current: 7mA or more |
| | Output Voltage | H level $\geq +8V$. L level $\leq 1V$. (12V DC power supply specification) H level $\geq +10V$. L level $\leq 1.25V$.(15V DC power supply specification) |
| PG Power Supply | Internal Power Supply | 15VDC $\pm 5\%$ / 120mA , DC12VDC $\pm 5\%$ / 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 PG's being driven.

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

PG 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. (phase B signal advances by 90 degree from phase A signal) In reverse running, the PG output pulse is the reverse signal, shown in Figure 3-4-2. (phase A signal advances by 90 degree from phase B signal) Connect the PG directly to the motor using a coupling.

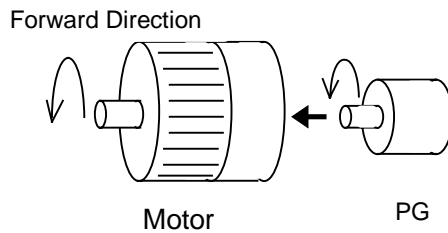


Figure 3-4-1 Motor and PG Forward Direction.

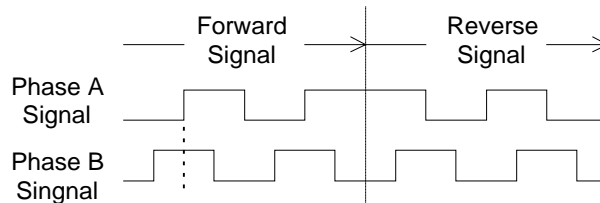


Figure 3-4-2 PG signals.

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 power supply. Jumper J1 switches the power supply to the option between a 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 supplies.

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. |

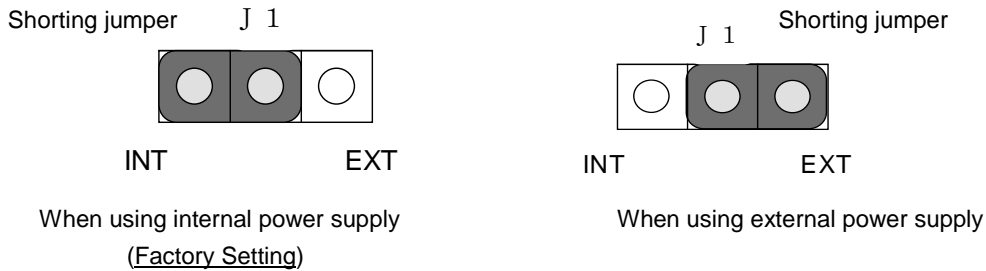


Figure 4-1-1 Jumper J1 setting.

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. |

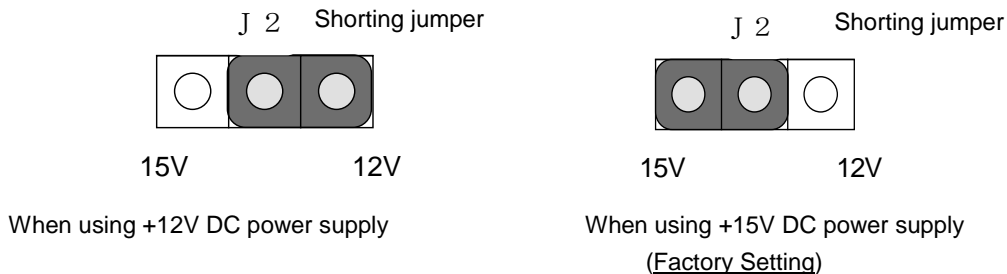


Figure 4-1-2 Jumper J2 Setting.

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.

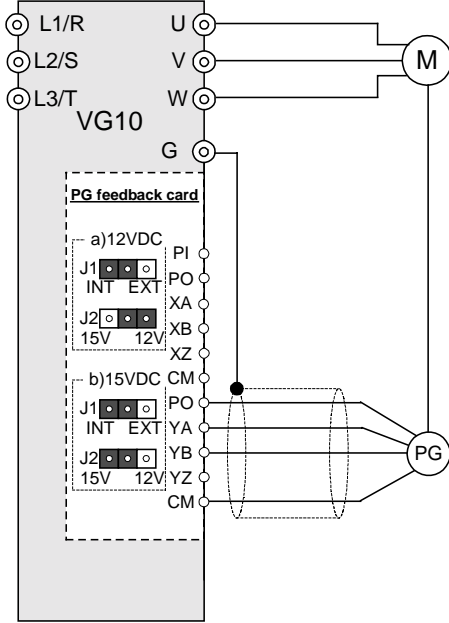
5 PG Vector Control

The PG feedback signals are used by the closed loop vector control.

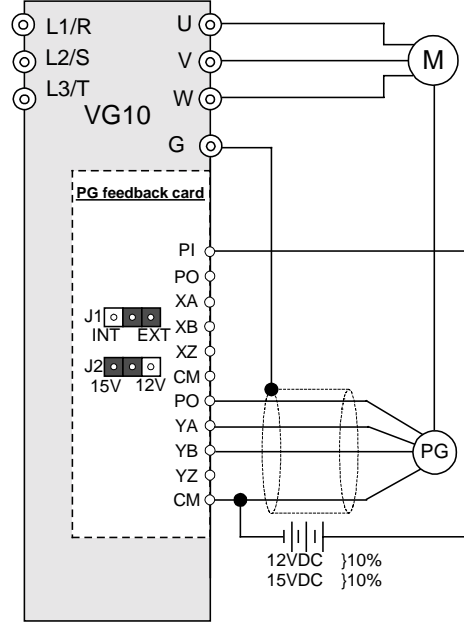
5-1 Basic Connection Diagram

Figure 5-1-1 shows a connection example when PG vector control is used (closed loop).

I. Drive Internal Power Supply



II. External Power Supply



The Jumper J2 can be connected to the 12V or 15V side.

Figure 5-1-1 Connection diagram when PG vector control used (closed loop).

5-2 Terminal Functions

The terminal functions are listed in Table 5-2-1, when PG vector control is used (closed Loop).

Table 5-2-1 Terminal functions When PG Vector Control Used.

| Terminal Symbol | Terminal Name | Function | |
|-----------------|---------------|------------------------------------|---|
| Option Side | PI | PG External Power Supply Input | Supplies PG power from external power supply. |
| | PO | PG Power Supply Output | Outputs power to PG. |
| | CM | Common | PG power supply common terminal |
| | YA | Input of Feedback PG Phase-A Pulse | Connects feedback PG phase A signal. |
| | YB | Input of Feedback PG Phase-B Pulse | Connects feedback PG phase B signal. |
| Drive Side | X Terminal | (*1) (*2) (*3) | (*1) (*2) (*3) |

(*1) VALID PG FEEDBACK COMMAND

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 drive 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 | Function |
|-------|---------------------------------|
| ON | With speed feedback control |
| OFF | Speed feedback control canceled |

(*2) ZERO SPEED COMMAND FUNCTION

zero speed command function is to maintain torque at zero speed, 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).

Table 5-2-3 Terminal Function.

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

(*3) PRE-EXCITATION COMMAND FUNCTION

Pre-excitation command function is to improve starting characteristics by exciting a motor before inverter 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 |

5-3 Function Codes

The parameters related to PG vector control is listed in Table 5-3-1.

Table 5-3-1 Function Code.

| Func No. | Name | Setting Range | Unit | Min. Unit | Factory Setting | Change during operation |
|----------|---|---|-------|-----------|---------------------------------|-------------------------|
| F03 | Maximum frequency 1 | 50 to 400Hz | Hz | 1 | 60 | N |
| F04 | Base frequency 1 | 25 to 400Hz | Hz | 1 | 50 | N |
| F05 | Rated voltage 1 | 0V: Outputs voltage proportion to input voltage. 80 to 240V : 230V class 320 to 480V : 460V class | V | 1 | 230/460 | N |
| F40 | Torque limiter 1 (Driving) | 20 to 200% ,999% (No limit) | % | 1 | 999 | Y |
| F41 | (Braking) | 0% (Automatic deceleration control) 20 to 150%, 999% (No limit) | % | 1 | 999 | Y |
| E16 | Torque limiter 2 (Driving) | 20 to 200% ,999% (No limit) | % | 1 | 999 | Y |
| E17 | (Braking) | 0% (Automatic deceleration control), 20 to 150% ,999% (No limit) | % | 1 | 999 | Y |
| P01 | Motor 1 (Number of poles) | 2 to 14 | Pole | 2 | 4 | N |
| P02 | (Capacity) | 30HP or less :0.01 to 60HP 40HP or more :0.01 to 600HP | kW | 0.01 | Typical value of standard motor | N |
| P03 | (Rated current) | 0.00 to 2000A | A | 0.01 | Typical value of standard motor | N |
| P05 | (On-line tuning) | 0 : Inactive 1 : Active | - | - | 0 | N |
| P06 | (No-load current) | 0.00 to 2000A | A | 0.01 | Typical value of standard motor | N |
| P07 | (%R1) | 0.00 to 50.00% | % | 0.01 | Typical value of standard motor | Y |
| P08 | (%X) | 0.00 to 50.00% | % | 0.01 | Typical value of standard motor | Y |
| P09 | (Slip compensation control 1) | 0.00 to 5.00Hz | Hz | 0.01 | Typical value of standard motor | Y |
| H18 | Torque control | 0, 1, 2 | - | - | 0 | N |
| H28 | Droop control | -9.9 to 0.0Hz | Hz | 0.1 | 0.0 | Y |
| o01 | Speed command system / automatic speed control system | 00 ,01 ,10 ,11 ,20 ,21 | - | - | 00 | N |
| o02 | Time constant of PG vector and speed command filter | 0.000 to 5.000 | s | 0.001 | 0.02 | Y |
| o03 | Number of feedback PG pulses | 20 to 3000 | p | 1 | 1024 | N |
| o04 | Constant P of feedback speed controller | 0.01 to 200.00 | Times | 0.01 | 10.00 | Y |
| o05 | Constant I of feedback speed controller | 0.000 to 5.000 | s | 0.001 | 0.100 | Y |
| o06 | Time constant of feedback speed detection filter | 0.000 to 5.000 | s | 0.001 | 0.005 | Y |
| o07 | Feedback pulse correction coefficient 1 | 1 to 10000 | - | 1 | 1 | N |
| o08 | Feedback pulse correction coefficient 2 | 1 to 10000 | - | 1 | 1 | N |

- Function code o02: Sets the time constants of primary delay filter for the speed setting. This code is used to suppress overshoot when speed commands are changed.
- Function code o03: Sets the number of feedback PG pulses.
- Function code o04: Sets constant P of the feedback speed controller. (*1)
- Function code o05: Sets constant I of the feedback speed controller. (*1)

The transfer function of the speed controller is expressed as follows:

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

Kp : Constant P

T_i : Constant I

τ* : Torque command

ε : Speed deviation

When speed deviation ε = 100%, Constant P (for torque command τ* = 100%) is assumed to be 1.

- Function code o06: Sets the time constants of primary delay filter for the speed detection value. This code is used to suppress the large ripple in the speed detection signal.

Set function code o07 and o08 for a motor equipped with speed reducer.

- Function code o07: Sets pulse compensation coefficient 1. (*2)
- Function code o08: Sets pulse compensation coefficient 2. (*2)

(*1) Function codes o04 and o05 must be readjusted when the value of function code F03 is changed.

(*2) Set a value of $\frac{o08}{o07}$ to 1 or more. Any value less than 1 is treated as 1.

Reference

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.

Constant P (o04)

Constant P (o04) is a parameter used to determine response speed for any deviation in proportion operation. Specifying a larger value for constant P enables a quicker response. Specifying a value that is too large results in vibrating response. Specifying a smaller value for constant P slows the response.

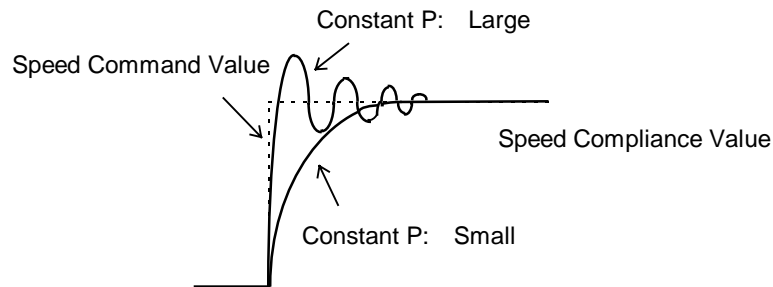


Figure 5-5-1 Response When Constant P Adjusted.

Constant I (o05)

Specifying a larger value for constant I (o05) slows the response and weakens the reaction to external force. Specifying a smaller value for constant I (o05) enables a quicker response. Specifying a value that is too small results in unstable (vibrating) response. Vibration in a larger cycle than constant I (o05) can be suppressed.

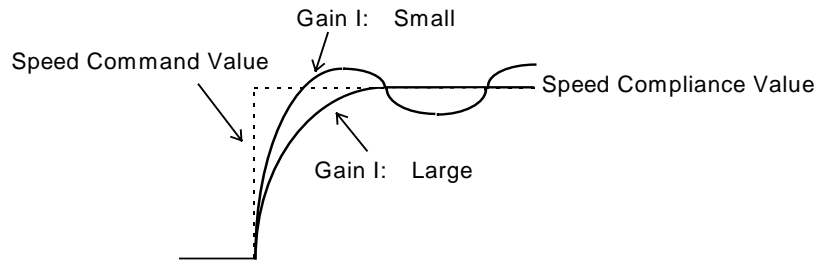


Figure 5-5-2 Response When Gain I Adjusted.

5-5 Notes on Use

WARNING

•Check the parameters and wiring before operation. Improper parameters or wiring may cause an unexpected operation for some devices. **There is a risk of accident.**

Carrier Frequency

Set the carrier frequency (F26) more than 5(kHz) to suppress the hunting , when using PG closed loop vector control.

Electronic Thermal Overload Relay Protection

Prevent motor overheating by using the electronic thermal overload relay function when PG closed loop vector control is used. See the VG10 instruction manual for details of the electronic thermal overload relay setup.

When Torque Control Used

When PG closed loop vector control and torque control are used concurrently, a line power interruption may not be detected depending on the load state. In this case, input the line power interruption signal at the BX terminal and stop the drive. Figure 5-6-1 shows an example of connection.

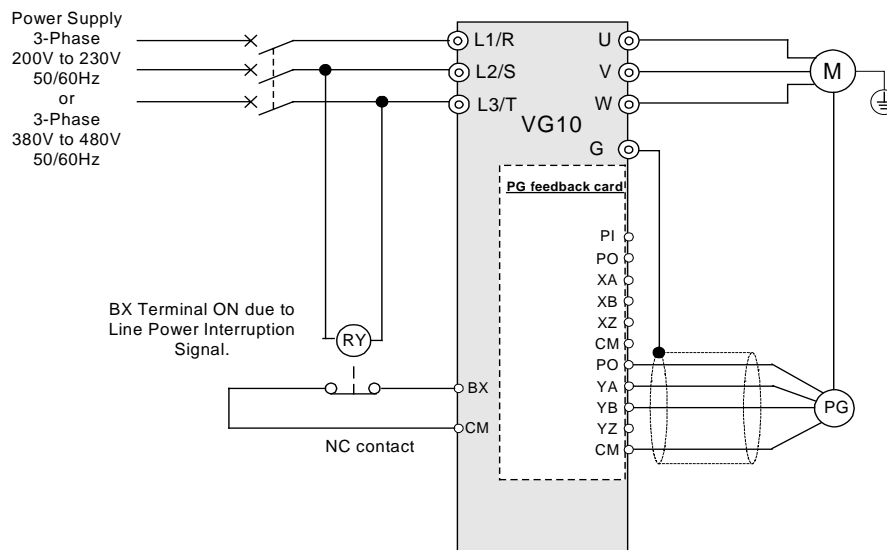


Figure 5-6-1 Recommended Circuit When Torque Control Used.

5-7 Control Specifications

The control specifications are listed in Table 5-7-1, when PG closed loop vector control is used.

Table 5-7-1 Control Specifications.

| Item | Control Specifications | Remarks |
|-------------------------------|--|---------|
| Speed Control Range | 3 to 3600 [rpm] (for 4-pole motor) | - |
| Speed Control Accuracy | ±0.02% | |
| Starting Torque | 150% / zero-speed (at ZERO signal ON) short time | |
| Maximum Number of Input Pulse | 100(kp/s) (*) | |

(*) Maximum Number of Input Pulse depends on both PG circuit type and wiring length as follows.

PG circuit type : Open Collector System, wiring length : 66' (20m), Maximum Number of Input Pulse 25(kp/s)

PG circuit type : Totem Pole System, wiring length : 330' (100m), Maximum Number of Input Pulse 100(kp/s)

5-8 Functions Codes (Specifications when PG vector control used)

The functions that differ from the standard specifications are listed as follows, when PG vector control is used.

F : Fundamental Functions

| Func. | Function Name | LCD Display | Setting Range | Units | Spec. when PG Vector Mode |
|-------|---------------------|------------------------|-------------------------------|-------|--|
| F03 | Max. Frequency 1 | F03 MAX_Hz-1 | 50 to 400Hz | Hz. | Note: 120hz limit in PG Vector Mode. |
| F05 | Rated Voltage 1 | F05 Rated_V-1 | 0V: Output Voltage | V. | Set to 0V for AVR operation |
| | (at base frequency) | | proportion to input voltage | | |
| F06 | Max. Voltage 1 | F06 Max V-1 | 80 to 240V (230 unit) | V. | Invalid in Vector Mode |
| | (at Max. Freq. 1) | | 320 to 480V (460 unit) | | |
| F09 | Torque Boost 1 | F09 TRQ Boost 1 | 0 to 20 | - | Invalid in Vector Mode |
| F15 | Freq. Limit(High) | F15 H LIMITER | 0 to 400Hz. | Hz. | Note: 120hz limit in PG Vector Mode. |
| F20 | DCBrake Start Freq. | F20 DC BRK Hz | 0 to 60Hz. | Hz. | DC inj. Braking operates when the run command is off and the output frequency is equal to or less than the start freq. |
| F21 | DC Braking Level | F21 DC BRK LVL | 0 to 100% | % | |
| F22 | DC Braking Time | F22 DC BRK t | 0 to 30 Seconds | S | |
| F31 | FMA Function | F31 FMA FUNC | 0 = Output Freq.(before slip) | | 0 = ASR setting Value |
| | | | 1 = Output Freq.(after slip) | | 1 = Output Freq. |
| | | | 2 = Output Current | | 2 = Output Current |
| | | | 3 = Output Voltage | | 3 = Output Voltage |
| | | | 4 = Output Torque | | 4 = ASR output or torque command |
| | | | 5 = Load Factor | | 5 = ASR output or torque command |
| | | | 6 = Input Power | | 6 = Input Power |
| | | | 7 = PID feedback | | 7 = PID feedback |
| | | | 8 = PG feedback | | 8 = Speed Detection Value |
| F35 | FMP Function | F35 FMP FUNC | 0 = Output Freq.(before slip) | | 0 = ASR setting Value |
| | | | 1 = Output Freq.(after slip) | | 1 = Output Freq. |
| | | | 2 = Output Current | | 2 = Output Current |
| | | | 3 = Output Voltage | | 3 = Output Voltage |
| | | | 4 = Output Torque | | 4 = ASR output or torque command |
| | | | 5 = Load Factor | | 5 = ASR output or torque command |
| | | | 6 = Input Power | | 6 = Input Power |
| | | | 7 = PID feedback | | 7 = PID feedback |
| | | | 8 = PG feedback | | 8 = Speed Detection Value |
| F40 | TRQ Limiter (DRV) | F40 DRV TRQ 1 | 20 to 200% 999 disable | % | 200% when 999 is set |
| F41 | TRQ Limiter (BRK) | F41 BRK TRQ 1 | 20 to 200% 999 disable | % | 200% when 999 is set |
| F42 | TRQ Vector Control | F42 TRQVECTOR | 0 - 1 | | set to 1 for PG Vector Mode |

E : Extension Terminal Functions

| Func. | Function Name | LCD Display | Setting Range | Units | Spec. when PG. Vector Mode |
|-------|-------------------|--------------------|-------------------------------|-------|--|
| E01 | X1 Term. Function | E01 X1 FUNC | 0 = Multi-step Freq. | | 0 = Multi-step Freq. |
| E02 | X2 Term. Function | E02 X2 FUNC | 1 = Multi-step Freq. | | 1 = Multi-step Freq. |
| E03 | X3 Term. Function | E03 X3 FUNC | 2 = Multi-step Freq. | | 2 = Multi-step Freq. |
| E04 | X4 Term. Function | E04 X4 FUNC | 3 = Multi-step Freq. | | 3 = Multi-step Freq. |
| E05 | X5 Term. Function | E05 X5 FUNC | 4= ACC/DEC time 1 | | 4= ACC/DEC time 1 |
| E06 | X6 Term. Function | E06 X6 FUNC | 5= ACC/DEC time 2 | | 5= ACC/DEC time 2 |
| E07 | X7 Term. Function | E07 X7 FUNC | 6= 3-wire Start/Stop | | 6= 3-wire Start/Stop |
| E08 | X8 Term. Function | E08 X8 FUNC | 7= Coast to Stop | | 7= Coast to Stop |
| E09 | X9 Term. Function | E09 X9 FUNC | 8= Alarm reset | | 8= Alarm reset |
| | | | 9= Trip Command(OH2) | | 9= Trip Command(OH2) |
| | | | 10= Jog Operation | | 10= Jog Operation |
| | | | 11= Freq. 1 to Freq. 2 | | 11= Freq. 1 to Freq. 2 |
| | | | 12= Motor2/Motor1 | | 12= Motor2/Motor1 |
| | | | 13= DC Brake Command | | 13= DC Brake Command |
| | | | 14= Trq limiter1/Limiter2 | | 14= Trq limiter1/Limiter2 |
| | | | 15= Switch Line to Drive/50Hz | | 15= detects motor speed/switch to line |
| | | | 16= Switch Line to Drive/60Hz | | 16= detects motor speed/switch to line |
| | | | 17= Up Command | | 17= Up Command |
| | | | 18= Down Command | | 18= Down Command |
| | | | 19= Disable changing Func, | | 19= Disable changing Func, |
| | | | 20= PID Cancel | | 20= PID Cancel |
| | | | 21= Inverse Mode Select | | 21= Inverse Mode Select |
| | | | 22= Interlock | | 22= Interlock |
| | | | 23= TRQ Control Cancel | | 23= TRQ Control Cancel |
| | | | 24= Serial Link enable | | 24= Serial Link enable |
| | | | 25= Universal DI | | 25= Universal DI |
| | | | 26= Pickup Start Mode | | 26= Pickup Start Mode |
| | | | 27= SY-PG enable | | 27= Cancel Speed Feedback control |
| | | | 29= Zero Speed Command | | 29= Zero Speed Comm.(PG. Vector) |
| | | | 30= Alarm Stop | | 30= Alarm Stop |
| | | | 31= Alarm Stop dec4 | | 31= Alarm Stop dec4 |
| | | | 32= Pre-exciting Command | | 32= Pre-exciting Command(PG. vector) |

E : Extension Terminal Functions

| | | | | | |
|-----|-------------------|-----------------------|---------------------------|----|---------------------------------|
| E20 | Y1Term. Function | E20 Y1 FUNC | 0 = Drive Running | | 0 = Drive Running |
| E21 | Y2Term. Function | E21 Y2 FUNC | 1= Freq. arrival Det. | | 1= Freq. arrival Det. |
| E22 | Y3Term. Function | E22 Y3 FUNC | 2= Freq. Level Det. | | 2= Freq. Level Det. |
| E23 | Y4Term. Function | E23 Y4 FUNC | 3= Under-voltage Det. | | 3= Under-voltage Det. |
| E24 | Y5a/Y5cTerm. Func | E24 Y5 FUNC | 4= TRQ Polarity(BRK/DRV) | | 4= ASR Output |
| | | | 5= TRQ Limiting | | 5= ASR output limit |
| | | | 6= Auto-Restarting | | 6= Auto-Restarting |
| | | | 7= Overload early Warning | | 7= Overload early Warning |
| | | | 8= Keypad Operation | | 8= Keypad Operation |
| | | | 9= Drive Stopping | | 9= Drive Stopping |
| | | | 10= Ready Output | | 10= Ready Output |
| | | | 11= Line/INV Changeover | | 11= Line/INV Changeover |
| | | | 12= Line/INV Changeover | | 12= Line/INV Changeover |
| | | | 13= Line/INV Changeover | | 13= Line/INV Changeover |
| | | | 14= Motor 2/Motor 1 | | 14= Motor 2/Motor 1 |
| | | | 15= Terminal AX Function | | 15= Terminal AX Function |
| | | | 16= Patt. Oper. Completed | | 16= Patt. Oper. Completed |
| | | | 17= Patt. Oper Cycle | | 17= Patt. Oper Cycle |
| | | | 18= Patt. Stage 1 | | 18= Patt. Stage 1 |
| | | | 19= Patt. Stage 2 | | 19= Patt. Stage 2 |
| | | | 20= Patt. Stage 4 | | 20= Patt. Stage 4 |
| | | | 21= Alarm Indication 1 | | 21= Alarm Indication 1 |
| | | | 22= Alarm Indication 2 | | 22= Alarm Indication 2 |
| | | | 23= Alarm Indication 4 | | 23= Alarm Indication 4 |
| | | | 24= Alarm Indication 8 | | 24= Alarm Indication 8 |
| | | | 25= Fan Operating Signal | | 25= Fan Operating Signal |
| | | | 26= Auto-resetting | | 26= Auto-resetting |
| E30 | FAR function(HYS) | E30 FAR HYSTR | 0.0 to 10Hz | Hz | According to Actual Motor Speed |
| E31 | FDT Signal Level | E31 FDT1 LEVEL | 0 to 400Hz | Hz | According to Actual Motor Speed |
| E32 | FDT Hystersis | E32 FDT HYSTR | 0.0 to 300Hz | Hz | According to Actual Motor Speed |
| E40 | Display Coe. A | E40 COEF A | (-)999.00 to 999.00 | | Coefficient for Motor Speed |
| E41 | Display Coe. B | E41 COEF B | (-)999.00 to 999.00 | | Coefficient for Motor Speed |

C : Control Functions of Frequency

| Func. | Function Name | LCD Display | Setting Range | Units | Spec. when PG. Vector Mode |
|-------|------------------|-----------------------|---------------|-------|-------------------------------|
| C05 | Multi-step Freq. | C05 MULTI HZ-1 | 0 to 400Hz | Hz | Limit 120hz with PG. feedback |
| C20 | Jog Frequency | C20 JOG HZ | 0 to 400Hz | Hz | Limit 120hz with PG. feedback |

H : High Performance Functions

| Func. | Function Name | LCD Display | Setting Range | Units | Spec. when PG. Vector Mode |
|-------|---------------|----------------------|---------------|-------|--------------------------------------|
| H09 | Start Mode | H09 START MOD | 0 : Inactive | | 0 : Inactive(active at auto-restart) |
| | | | 1 : Active | | 1 : Active |
| | | | 2 : Active | | 2 : Active |
| H10 | Energy Saving | H10 ENERGY SA | 0 : Inactive | | Invalid in PG. Vector Mode |
| | | | 1 : Active | | |

A : Alternative Motor Parameters

| Func. | Function Name | LCD Display | Setting Range | Units | Spec. when PG. Vector Mode |
|-------|---------------------|------------------------|-----------------------------|-------|---------------------------------------|
| A01 | Max. Frequency 2 | A01 MAX_Hz-2 | 50 to 400Hz | Hz. | Note: 120hz limit in PG. Vector Mode. |
| A02 | Base Frequency 2 | A02 BASE Hz-2 | 25 to 400Hz | Hz. | Note: 120hz limit in PG. Vector Mode. |
| A03 | Rated Voltage 2 | A03 Rated_V-2 | 0V: Output Voltage | V. | Set to 0V for AVR operation |
| | (at base frequency) | | proportion to input voltage | | |
| A04 | Max. Voltage 2 | A04 Max V-2 | 80 to 240V (230 unit) | V. | Invalid in Vector Mode |
| | (at Max. Freq. 2) | | 320 to 480V (460 unit) | | |
| A05 | Torque Boost 2 | A05 TRQ Boost 2 | 0 to 20 | - | Invalid in Vector Mode |

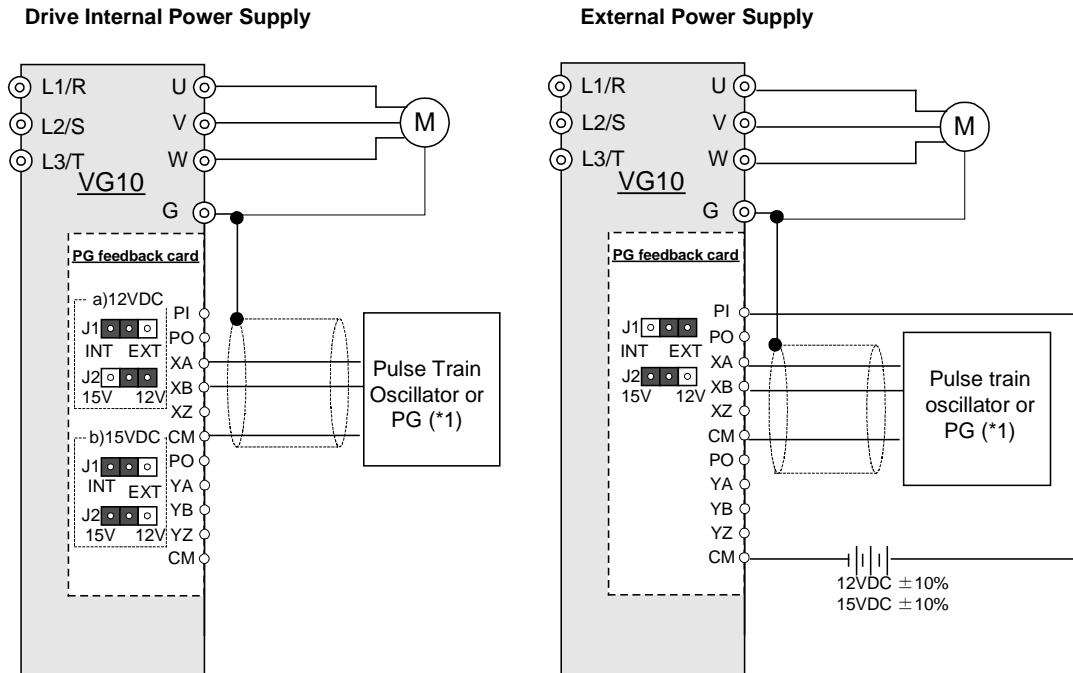
6 Pulse Train Input

The pulse train input function executes drive frequency commands using pulse train. Two types of pulse train input are enabled: Phase-B pulse train input, and phase-A/phase-B pulse train input.

Use the XA and XB terminals for pulse train input.

6-1 Basic Connection Diagram

Figure 6-1-1 shows examples of pulse train input connection.



(*1) See Table 3-4-1 for details of the applicable PG.
(PO connection is required when PG is used.)

Figure 6-1-1 Pulse Train Input Connection Diagram.

6-2 Terminal Functions

The pulse train input terminal functions are listed in Table 6-2-1 .

Table 6-2-1 List of Pulse Train Input Terminals Functions.

| Terminal Symbol | Terminal Name | Function | |
|-----------------|---------------|-----------------------------|--|
| Option | PI | External Power Supply Input | Supplies power from external power supply. |
| | PO | Power Output | Power output |
| | CM | Common | Power supply common |
| | XA | Command Phase-A Pulse Input | Connects command phase-A signal |
| | XB | Command Phase-B Pulse Input | Connects command phase-B signal |

6-3 Pulse Train Input Polarity

At phase-A/phase-B pulse train input (Figure 6-3-1), command polarity is determined depending on the phase relationship between phase-A signal and phase-B signal. At phase-B pulse input (Figure 6-3-2), command polarity is determined by the phase-A signal voltage. The direction of motor rotation is set by combining pulse train input polarity with the FWD/REV command. Table 6-4-1 shows the relationship between the pulse train input polarity and the direction of rotation.

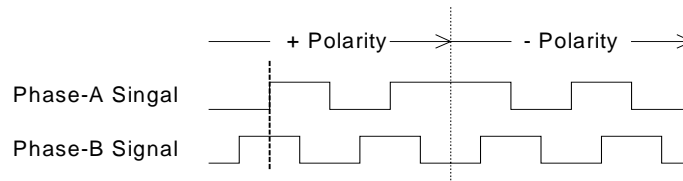


Figure 6-3-1 Phase-A / phase-B pulse Train Input Polarity.

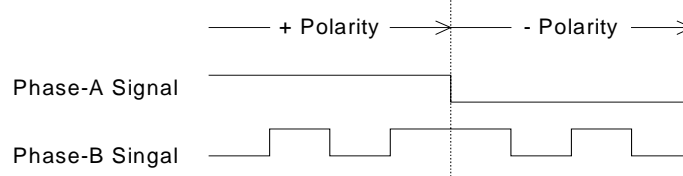


Figure 6-3-2 Phase-B Pulse Train Input Polarity.

Table 6-3-1 Relationship between Pulse Train Input Polarity and Direction of Rotation.

| Pulse Train Input Polarity | FWD/REV Command | Direction of Rotation |
|----------------------------|-----------------|-----------------------|
| + | FWD | Forward |
| + | REV | Reverse |
| - | FWD | Reverse |
| - | REV | Forward |

6-4 Function Code Settings

Table 6-4-1 shows the function codes related to pulse train input.

Table 6-4-1 List of Function Codes.

| Function Code | Name | Unit | Setting Range | Factory Setting | Change during Operation |
|---------------|---|------|------------------------|-----------------|-------------------------|
| F01 | Frequency Command 1 | - | 0 to 11 | 0 | N |
| C30 | Frequency Command 2 | - | 0 to 11 | 2 | N |
| o01 | Speed Command System / Automatic Speed Control System | - | 00, 01, 10, 11, 20, 21 | 00 | N |
| o10 | Time Constant of Pulse Train Input Filter | s | 0.000 to 5.000 | 0.005 | Y |
| o11 | Command Pulse Compensation Coefficient 1 | kp/s | 1 to 10000 | 1 | N |
| o12 | Command Pulse Compensation Coefficient 2 | Hz | 1 to 10000 | 1 | N |

Function code F01 (C30): Set F01 (C30) to 11.

Function code o01: Set the ten's digit (left side) of data of o01 to 1 or 2 to use pulse train input.

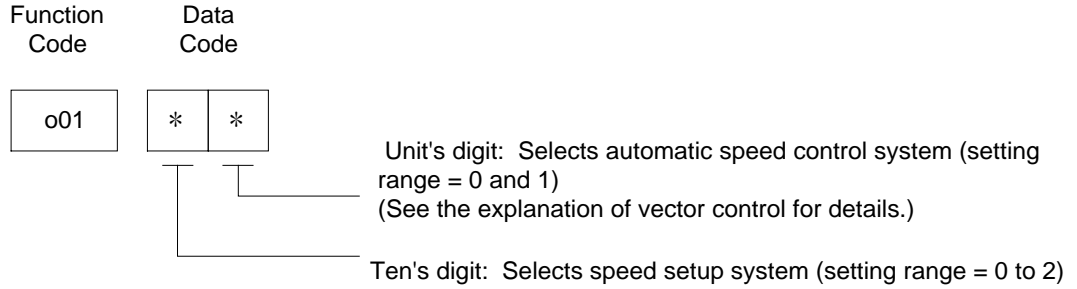


Table 6-4-2 Function Codes.

| Function Code | Function | |
|---------------|----------|-----------------------------------|
| o01 | 0* | Without pulse train input |
| | 1* | Phase-A/phase-B pulse train input |
| | 2* | Phase-B pulse train input |

Function code o10: Sets the time constants of primary delay filter for the speed setup value.

Function codes o11 and o12: For pulse train input, set the relationship between the number of input pulses and the frequency command value using function codes o11 or o12.

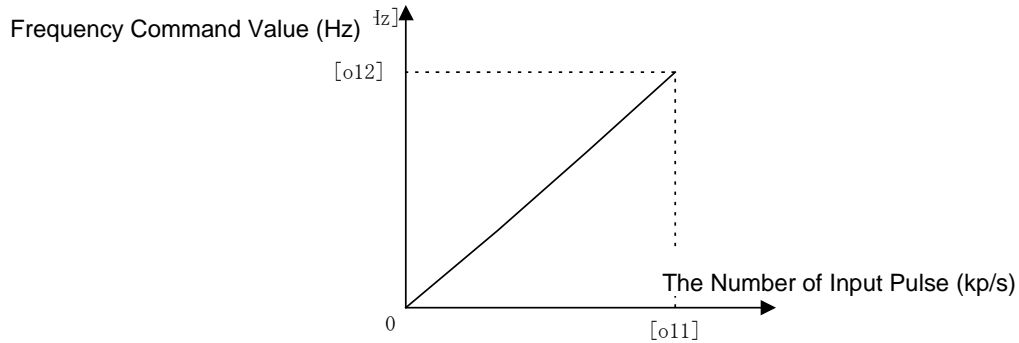


Figure 6-4-1 Relationship between Input Pulse and Frequency Command Value.

As shown in Figure 6-4-1, set the number of pulses [kp/s] in function code o11 (command pulse compensation coefficient 1). Set the frequency command value [Hz] in the value set in function code o11 in function code o12 (command pulse compensation coefficient 2). Set the same value of function code o12 as that of function code F03 (A01) (maximum output frequency). The number of pulses to be input in phase A or phase B and Drive frequency command value f^* (or speed command value) are obtained from the following formula:

$$f^* = N_p \times \frac{\text{Pulse compensation coefficient2 (o12)}}{\text{Pulse compensation coefficient1 (o11)}}$$

f^* [Hz] : Drive frequency command value (synchronous speed frequency for speed command)

N_p [kp/s] :The number of pulse to be input in phase A or phase B

6-5 Pulse Train Input Specifications

Table 6-5-1 Pulse Train Input Specifications.

| Item | Specifications | Remarks |
|--------------------------------|--|---------|
| Frequency Setting Range | 0 to 400[Hz] | - |
| Frequency Accuracy | ± 0.02% of maximum frequency | |
| Maximum Number of Input Pulses | 100[kp/s] | |
| Circuit Type | Open Collector System Totem Pole System | |
| Input Pulse Voltage | 12VDC±10% (*2) 15VDC±10% (*3) | |

(*1) Maximum Number of Input Pulse depends on both PG circuit type and wiring length as follows.

PG circuit type : Open Collector System, wiring length: 66' (20m), Maximum Number of Input Pulse 25(kp/s)

PG circuit type : Totem Pole System, wiring length: 330' (100 m), Maximum Number of Input Pulse 100(kp/s)

(*2) When 12V DC for internal or external power supply selected

(*3) When 15V DC for internal or external power supply selected

7 Additional Information

7-1 Alarm Protective Function

When the drive 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 card. For other types of tripping, see "Protective operations" regarding the drive main unit.

Table 7-1-1 List of Alarm Protection Functions.

| Trip Display | 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 | 1.PG disconnection error : Judges feedback disconnection and displays an error. |

7-2 I/O Check

The digital input status of the PG option card 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 VG10 Instruction Manual.

