Operation Manual

EC-PG Series PG Card

SHENZHEN INVT ELECTRIC CO., LTD.

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1 Incremental encoder PG card use instructions

1.1 Model and specifications

1.1.1 Model code

EC-PG 1 01 - 05

① ② ③④ ⑤

Table 1-1 Model description

Symbol	Description	Naming example
①	Product category	EC: Expansion card
②	Board card category	PG: P/G card
③	Technology version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, and 5 indicate the 1st, 2nd, and 3rd generations of the technical version.
④	Code	01: Incremental encoder PG card 02: Sin/Cos encoder PG card 03: UVW encoder PG card 04: Resolver PG card 05: Incremental encoder PG interface + pulse direction reference 06: Absolute encoder PG card interface
⑤	Working power supply	00: No power (passive) 05: 5V 12: 12-15V 24: 24V

1.1.2 Technical specifications

Table 1-2 Technical specifications

Model specification	EC-PG101-05	EC-PG101-12	EC-PG101-24
Output power supply	Adjustable voltage range: 4.75V–7V Default setting: 5V±5% Max. output current: 300mA	Supports the voltage output of 11.75V–16V. Default: 12V±5%. Max. output current: 350mA	Voltage output: 24V±5% Max. output current: 300mA
Input signal	Supports the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz	Supports the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz	Supports the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz
Output signal	Output frequency: 0–80kHz Output type: Differential output, push-pull output, open collector output, and frequency-divided output. Range: 1–256 Output impedance: 70Ω	Output frequency: 0–80kHz Output type: Differential output, push-pull output, open collector output, and frequency-divided output. Range: 1–256 Output impedance: 70Ω	Output frequency: 0–80kHz Output type: Differential output, push-pull output, open collector output, and frequency-divided output. Range: 1–256 Output impedance: 70Ω

1.1.3 Installation and dimensions of incremental encoder PG card

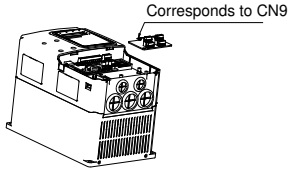


Figure 1-1 Incremental encoder PG card installation diagram

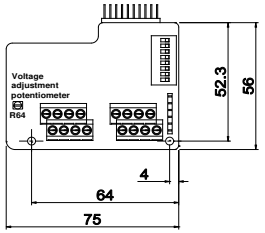


Figure 1-2 Outline dimensions of incremental encoder PG card

Note: When the incremental encoder PG card is used on GD300L machine, the CN3 lower-row pins of the PG card are valid.

1.2 Incremental encoder PG card use instructions

1.2.1 Function

You must choose a PG card when using PG vector control. The function of the PG card includes processing two channels of quadrature encoder signals and supporting the Z signal input for spindle positioning, receiving signals of differential, open collector, and push-pull encoders. Frequency-divided output can be performed for the input encoder signals. The output quantity includes two channels of differential signals. You can choose to output push-pull signals or open collector signals through jumper J1 or J2 according to your actual use.

1.2.2 Terminal and switch description

The incremental encoder PG card has two 2*4P user wiring terminals. See the figure.

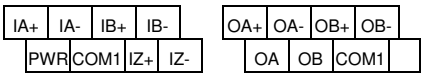


Figure 1-3 Wiring terminals of incremental encoder PG card

PWR and COM1 are for encoder working power output; IA+, IA-, IB+, IB-, IZ+, and IZ- are encoder signal input terminals; OA+, OA-, OB+, OB- are 5V differential frequency-divided signal output terminals, while OA, OB, and COM1 are frequency-divided push-pull signal and open collector signal output terminals (the output signal type is selected by jumper J1 or J2); the PG card does not connect PE to the earth internally, you can ground it during use.

The frequency division coefficient of the incremental encoder PG card is determined by the switch on the card. The switch has 8 bits, and the frequency division coefficient is determined by adding 1 to the binary number that the switch represents. The place labeled with "1" is the low binary bit, and the one labeled with "8" is the high binary bit. When the switch is turned to ON, the bit is valid, indicating "1"; otherwise, the bit indicates "0". See the following table for frequency division coefficients.

Table 1-3 Frequency division coefficients

Decimal	Binary	Frequency division coefficient
0	00000000	1
1	00000001	2
2	00000010	3
...	…	…
m	...	m+1
255	11111111	256

1.2.3 Wiring principles

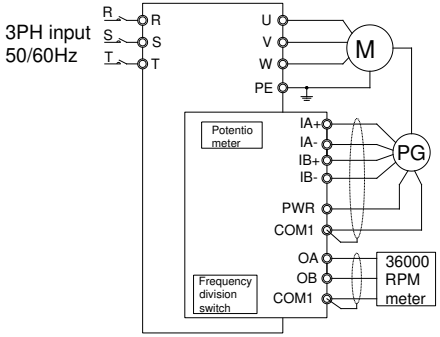


Figure 1-4 Wiring diagram of incremental encoder PG card

1.2.4 Wiring precautions

1. A PG card signal cable and a power cable must be routed separately and disallow parallel routing.

2. To avoid interference from encoder signals, use a shielded cable for the PG card signal cable.

3. The shield layer of the encoder shield cable should be connected to the earth (such as the PE of VFD), and it must be connected to earth only at one end to avoid signal interference.

4. If the PG card uses frequency-divided output when connecting to an external power supply, the voltage should be less than 24V; otherwise the PG card will be damaged.

5. You can set the output voltage by adjusting the 12–15V incremental encoder PG card potentiometer (clockwise for voltage increases) according to actual needs, and the force should not be too great when rotating the potentiometer.

1.3 Application connection

1.3.1 Input application connection

1. Differential output encoder connection

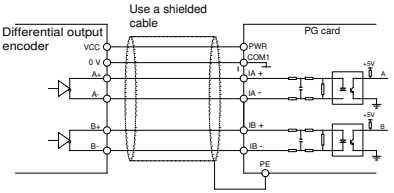


Figure 1-5 Wiring diagram of differential output encoder

2. Open collector output encoder connection

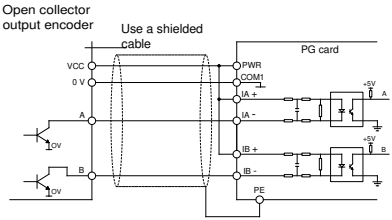


Figure 1-6 Wiring diagram of open collector output encoder

3. Push-pull output encoder connection

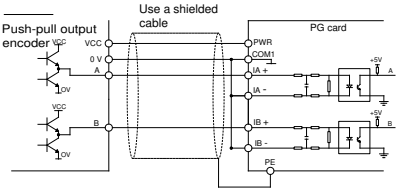


Figure 1-7 Wiring diagram of push-pull output encoder

Note: When the spindle positioning VFD is supported, the Z signal needs to be connected, of which the wiring method is similar to that for the A and B signals.

1.3.2 Output application connection

1. PG card frequency-divided differential output connection

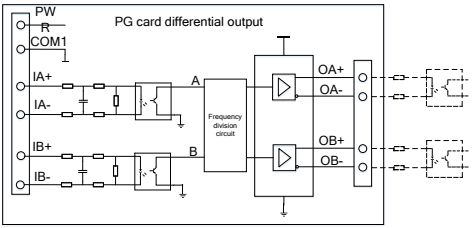


Figure 1-8 Wiring diagram of PG card frequency-divided output

2. PG card frequency-divided open collector output connection

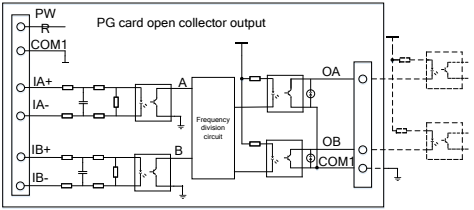


Figure 1-9 Wiring diagram of PG card frequency-divided open collector output

Note: During open collector output, PWR at J1 and that at J2 are short connected to COA and COB.

3. PG card frequency-divided push-pull output connection

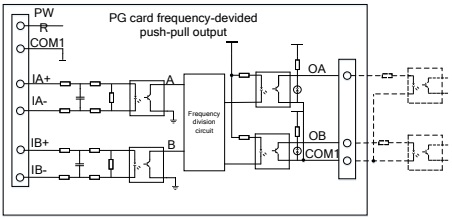


Figure 1-10 Wiring diagram of PG card frequency-divided push-pull output

Note:

- During push-pull output, PWR at J1 and that at J2 are short connected to HOA and HOB.
- Incremental encoder PG cards are mainly used to closed-loop vector control on asynchronous motors.

2 Sin/Cos and UVW encoder PG card use instructions

2.1 Model description and technical parameters

See Table 2-1 for the specifications of Sin/Cos encoder and UVW encoder PG cards.

Table 2-1 Technical parameters

Model specification	EC-PG102-05	EC-PG103-05
Frequency division coefficient	1 (Without a frequency-division switch)	1–256 (With frequency-division switch)
Output power supply	Adjustable voltage range: 4.75V–7V Default setting: 5V±5% Max. output current: 300mA	Adjustable voltage range: 4.75V–7V Default setting: 5V±5% Max. output current: 300mA
Output signal	Output form: Two quadrature frequency division differential outputs, and one open collector output Open collector output impedance: 70Ω	Output form: Two quadrature differential outputs, and one open collector output Open collector output impedance: 70Ω

You can choose the output voltage according to your actual use. When transmitting encoder signals over long distances, the output supply voltage can be adjusted using a potentiometer (the voltage adjustment method is the same as that for the incremental encoder card) to extend the wiring distance.

2.2 Installation and dimensions of UVW encoder PG card

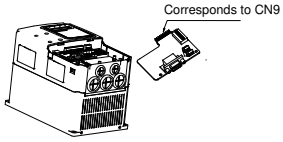


Figure 2-1 Installation diagram of UVW encoder PG card

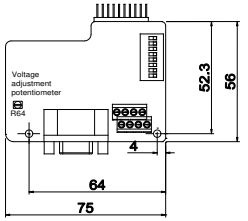


Figure 2-2 Outline dimensions of UVW encoder PG card

Figure 2-3 Installation diagram of Sin/Cos encoder PG card

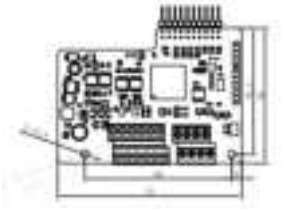


Figure 2-4 Outline dimensions of Sin/Cos encoder PG card

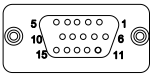
Note:

- The UVW encoder PG card is installed in the same way and position as the incremental encoder PG card. It corresponds to a double row of 2 x 10 pins.
- The Sin/Cos encoder PG card has the same size and mounting method

as the UVW encoder PG card, except that it does not have a DIP switch for frequency division, the DP15 female connector is replaced with terminal wiring, and the potentiometer position is R101.

2.3 Terminal and switch description

The UVW encoder PG card has one signal cable interface and seven user terminals, as shown in figure 2-3.



OA+	OA-	OB+	OB-
OA	OB	COM1	

DB15 Frequency-divided output interface

Figure 2-5 Ports and terminals of the UVW encoder PG card

The Sin/Cos encoder PG card has one signal cable terminal and one user terminal, as shown in Figure 2-6.

A+	A-	B+	B-	C+	C-	
	GND	PWR	R+	R-	D+	D-

OA+	OA-	OB+	OB-	
	OA	OB	COM1	

PG card wiring interface Frequency-divided output interface

Figure 2-6 Wiring interface and terminals of the Sin/Cos PG card

OA+, OA-, OB+, and OB- are differential output signal terminals (LVDS differential level), while OA, OB, and COM1 are open collector signal output terminals.

Note:

- The PG card does not connect PE to the earth internally, you can ground it during use.
- The Sin/Cos encoder PG card and UVW encoder PG card have the similar output signal wiring method as the incremental encoder PG card, but they do not support push-pull output.

The DB15 three-row female interface is the encoder signal input interface. Table 2-2 shows the PG card interface signal arrangement sequence.

Table 2-2 DB15 interface signal arrangement sequence

PG card interface	UVW
5	A+
6	A-
8	B+
1	B-
3	Z+
4	Z-
11	U+
10	U-
12	V+
13	V-
9	PWR
7	GND
14	W
15	W-
2	Empty

When applying either of the UVW PG card, you need to insert the DB15 male connector of the UVW encoder into the DB15 female connector of the PG card. Setting the frequency division coefficient of a UVW encoder PG card is similar to that for an incremental encoder PG card. For details about frequency division coefficients, see Table 1-3.

Note: UVW encoder PG cards can support 5V incremental encoders with differential signal processing, have the similar wiring method with that for incremental encoder PG cards, and mainly use wiring ports include the A, B, Z, PWR, and GND ports on DB15.

3 Absolute encoder PG card use instructions

3.1 Model description and technical parameters

See Table 1-1 for the specifications of absolute encoder PG card (mainly applicable to ECN1313, ECN413 encoders).

Table 3-1 Technical parameters

Model specification	EC-PG106-05
Frequency division coefficient	1 (Without a frequency-division switch)
Input signal	Supports two differential A and B (sine signal, 1Vpp) inputs with the response speed of 0–50kHz; Supports the transmission of absolute position value signal, fault and other information in Endat2.1 protocol.
Output power supply	Default setting: 5V±5% Max. output current: 300mA
Output signal	Output form: Two quadrature frequency division differential outputs (LVDS electrical level), and one open collector output Open collector output impedance: 70Ω

3.2 Installation and dimensions of absolute encoder PG card

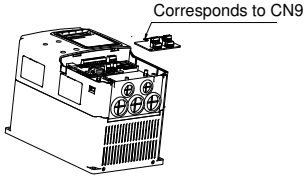


Figure 3-1 Installation diagram of absolute encoder PG card

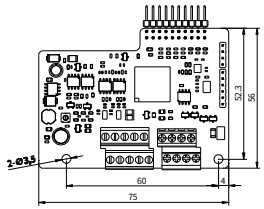


Figure 3-2 Outline dimensions of absolute encoder PG card

Note: The absolute encoder PG card is installed in the same way and position as the Sin/Cos encoder PG card. It corresponds to a double row of 2 x 10 pins.

3.3 Terminal interfaces

The absolute encoder PG card has one signal cable interface and seven user terminals, as shown in Figure 3-3.

A+	A-	B+	B-	PWR	
	DATA+	DATA-	CLK+	CLK-	GND

OA+	OA-	OB+	OB-	
	OA	OB	COM1	PE

Figure 3-3 Ports and terminals of PG card

OA+, OA-, OB+, and OB- are differential output (LVDS) signal terminals, while OA, OB, and COM1 are open collector signal output terminals.

Note: The PG card does not internally connect the PE to the earth, and you need to connect PE to the earth during use.

4 Commissioning

4.1 Related function codes (taking GD300L an example)

The function group numbers correspond to the level-1 menus, the function codes correspond to the level-2 menus, and the function parameters correspond to the level-3 menus.

The function code table contains:

Column 1 "Function code": Code of the function group and parameter.

Column 2 "Name": Full name of the function parameter.

Column 3 "Description": Detailed description of the function parameter. When the default parameter restoring operation is performed, the function code parameters are refreshed and reset to their factory values. However, the actual detected parameter values or recorded values will not be refreshed.

Column 4 "Default": Initial value set in factory.

Column 5 "Modify": Whether the parameter can be modified, and conditions for the modification.

"○" indicates that the value of the parameter can be modified when the VFD is in stopped or running state.

"◎" indicates that the value of the parameter cannot be modified when the VFD is in running state.

"●" indicates that the value of the parameter is detected and recorded, and cannot be modified.

Function code	Name	Description	Default	Modify
P00 group Basic functions				
P00.00	Speed control mode	0: SVC 1: FVC 2: V/F control 3: Closed-loop vector control	2	◎
P00.01	Channel of	0: Keypad (the indicator is	1	◎

Function code	Name	Description	Default	Modify
	running commands	off) 1: Terminal (the indicator blinks) 2: Communication (the indicator is on) 3: CAN (the indicator is on)		
P00.02	Rated speed of the lift	0.100–4.000m/s	1.500m/s	◎
P00.03	Speed command selection	0: Keypad 1: AI1 2: AI2 3: Multi-step speed running 4: Remote communication 5: AI1 tracking running 6: CAN communication-based setting 7: CAN communication-based reference	3	◎
P00.04	Max. output frequency	10.00~600.00Hz	50.00Hz	◎
P00.05	Keypad set speed	0m/s–P00.02 (lift rated speed)	1.500m/s	○
P00.09	Motor parameter autotuning	0: No operation 1: Rotating parameter autotuning on empty-load	0	◎

Function code	Name	Description	Default	Modify
		asynchronous motor 2: Static parameter autotuning on asynchronous motor 3: Rotating parameter autotuning on empty-load synchronous motor 4: Static parameter autotuning on synchronous motor 5: Rotating parameter autotuning on synchronous motor with load		
P00.10	Function parameter restoration	0: No operation 1: Restore default values 2: Clear fault records 3: Roll back function parameters, reading function parameters that are saved when the LSB of P07.01 is set to 5.	0	◎
P2 group Motor parameters				
P02.00	Motor type selection	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0	◎
P02.01	Motor rated power	0.1~3000.0kW	Model depended	◎

Function code	Name	Description	Default	Modify
P02.02	Motor rated frequency	0.01Hz–P00.04 (Max. output frequency)	50.00Hz	◎
P02.03	Motor rated speed	1~36000rpm	Model depended	◎
P02.04	Motor rated voltage	0~1200V	Model depended	◎
P02.05	Motor rated current	0.8~6000.0A	Model depended	◎
P02.14	Pulley diameter	100~2000mm	500mm	◎
P02.15	DEC ratio	1～460V	1.00	◎
P03 group Vector control				
P03.00	Speed loop proportional gain 1	0~200	20	○
P03.01	Speed loop integral time 1	0.000~10.000s	0.200s	○
P03.02	Low-point frequency for switching	0.00Hz~P03.05	5.00Hz	○
P03.03	Speed loop proportional gain 2	0~200	20	○
P03.04	Speed loop integral time 2	0.000~10.000s	0.200s	○
P03.05	High-point frequency for switching	P03.02~P00.04 (Max. output frequency)	10.00Hz	○

Function code	Name	Description	Default	Modify
P03.06	Speed loop output filter	0–8 (corresponds to 0–2^8*125μs)	0	○
P03.09	Current-loop proportional coefficient P	**Note:** 1. These two parameters adjust the PI adjustment parameter of the current loop which affects the dynamic response speed and control accuracy directly. Generally, keep the default values. 2. Applicable to SVC mode 0 (P00.00=0) only. Setting range: 0–20000	1000	○
P03.10	Current-loop integral coefficient I		1000	○
P20 group Encoder parameters				
P20.00	Encoder type	0: Incremental encoder (AB) 1: ABZUVW encoder 2: Resolver encoder 3: Sin/Cos encoder without CD signals 4: Sin/Cos encoder with CD signals 5: EnDat	0	◎
P20.01	encoder pulse count	Number of pulses generated when the encoder revolves for one	1024	◎

Function code	Name	Description	Default	Modify
		circle. Setting range: 0–60000		
P20.02	Encoder direction	Ones: AB direction 0: Forward 1: Reverse Tens: Reserved Hundreds: CD/UVW pole signal direction 0: Forward 1: Reverse	0x000	◎
P20.03	Detection time of encoder disconnection fault	Indicates the detection time of encoder disconnection fault Setting range: 0.0–10.0s	1.0s	○
P20.04	Detection time of encoder reversal fault	Indicates the detection time of encoder reversal fault. Setting range: 0.0–100.0s	0.8s	○
P20.05	Filter times of encoder detection	Setting range: 0x000–0x999 Ones: Low-speed filter times, corresponding to 2^(0–9)×125μs Tens: High-speed filter times, corresponding to 2^(0–9)×125μs. Hundreds: Subdivision	0x133	○

Function code	Name	Description	Default	Modify
		speed filter times, corresponding to 2^(0–9)×125μs.		
P20.09	Initial angle of Z pulse	Indicates the relative electrical angle of encoder Z pulse to motor magnetic pole position. Setting range: 0.00–359.99	0	○
P20.10	Pole initial angle	Indicates the relative electrical angle of encoder position to motor magnetic pole position. Setting range: 0.00–359.99	0	○

4.2 Examples

1. Commissioning procedure for closed-loop vector control on AMs

(1) Set P0.09=1 to restore to default settings.

(2) Set P0.03, P0.04 and motor nameplate parameters in group P02.

(3) Verify whether the encoder is installed and set properly.

Slowly rotate the motor or manually oscillate the motor. If the encoder is a resolver, the value of Pb.02 or Pb.04 should increase or decrease uniformly within the range of 0 to 359.9, indicating correct encoder wiring.

2. Commissioning procedure for closed-loop vector control on SMs

(1) Set P0.09=1 to restore to default settings.

(2) Set P0.00=1 (FVC), set P0.03=3, P0.04, and motor nameplate parameters in group P2.

(3) Set the encoder parameters P4.00 and P4.01.

When the encoder is a resolver-type encoder, set the encoder pulse count value to (resolver pole pair count x 1024). For example, if the pole pair count is 4, set P4.01 to 4096.

(4) Verify whether the encoder is installed and set properly.

Slowly rotate the motor. If the encoder is a resolver, the value of Pb.02 or Pb.04 should increase or decrease uniformly within the range of 0 to 359.9, indicating correct encoder wiring.

(5) Autotune the initial position of magnetic pole.

Set P0.08 to 1 (rotary autotuning) or 2 (static autotuning), and press the RUN key to run the VFD.

a) Rotary autotuning (P0.08=1)

Detect the present magnetic pole position when autotuning starts, and then accelerate to XX Hz (depending on the set speed), and then decelerate to stop.

During autotuning process, if a PCE fault occurs, indicating an encoder disconnection or reversed encoder wiring, repeat step (4). If no issues are found, set P4.02 = 1 (opposite to the initial value) and restart autotuning.

b) Static autotuning

The autotuning process only detects the present pole position without rotating the motor. The magnetic pole position obtained from autotuning is saved to P4.03 automatically.

When using static autotuning, it is recommended to perform the process multiple times. If the identified pole angle varies by more than 30° between attempts, check whether Pb.03 (SM static identification current) is close to 100%. If not, adjust P4.10 (static identification current) and repeat the static autotuning process until Pb.03 is close to 100%.

(6) Perform closed-loop vector pilot-run.

If current oscillation (noise) occurs, properly adjust the current loop parameters P3.08 and P03.09 (different encoder and motor types require

appropriate PI parameters. It is recommended to start with smaller values and gradually increase them until the current oscillation and noise disappear). If speed oscillation occurs, properly adjust the speed loop parameters P3.00 and P3.04. Similarly, start with smaller values and increase gradually until the speed becomes stable. If current oscillation noise occurs during low speed running, adjust P3.02.

Note: You must re-determine P4.02 (encoder direction) and perform magnetic pole position autotuning again if the motor or encoder wires are swapped.

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