Resolver Interface Card for FRENIC-VG
OPC-VG1-RD

⚠CAUTION
Thank you for purchasing our resolver interface card designed for the high-performance, vector control FRENIC-VG series of inverters.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- This manual does not contain the description of function codes or troubleshooting information. Read through this manual in conjunction with the FRENIC-VG User's Manual.

Preface

Thank you for purchasing our resolver interface card "OPC-VG1-RD."

This interface card can be connected to A- or B-port of option connection ports on the FRENIC-VG.

This instruction manual does not contain the description of function codes, troubleshooting information, or handling instructions of the inverter. Read through this manual in conjunction with the FRENIC-VG Instruction Manual and User's Manual to become familiar with proper handling and operation. Improper handling might result in incorrect operation, a short life, or even a failure of the interface card.

Keep this manual in a safe place.

Related Publications

Listed below are the other materials related to the use of the resolver interface card "OPC-VG1-RD." Read them in conjunction with this manual as necessary.

• FRENIC-VG User's Manual
• FRENIC-VG Instruction Manual

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

⚠CAUTION

- Read through this instruction manual to become familiar with this product before proceeding with installation, connections (wiring), operation, or maintenance and inspection.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.

Safety precautions

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

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

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

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

Installation and wiring

⚠ WARNING ⚠

- Before starting installation and wiring, **turn OFF the power and wait at least five minutes for inverters of 22 kW or below, or at least ten minutes for those of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).
- Qualified electricians should carry out wiring.

  Otherwise, an electric shock could occur.
- In general, sheaths of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the sheath might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

  Doing so could cause an accident or an electric shock.
- Do not use the product that is damaged or lacking parts.

  Doing so could cause a fire, an accident, or injuries.

⚠CAUTION

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

  Otherwise, a fire or an accident might result.

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

  A failure might result.

Operation

⚠WARNING⚠

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.

  Otherwise, an electric shock could occur.

- Do not operate switches with wet hands.

  Doing so could cause an electric shock.

- If you configure the function codes wrongly or without completely understanding the FRENIC-VG Instruction Manual and User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine. Confirm and adjust the setting of the function codes before running the inverter.

  Otherwise, an accident could occur.

Maintenance and inspection, and parts replacement

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters of 22 kW or below, or at least ten minutes for those of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
- Never modify the interface card.

  Otherwise, an electric shock or injuries could occur.

Disposal

⚠CAUTION

- Treat the interface card as an industrial waste when disposing of it.

  Otherwise injuries could occur.

Others

⚠CAUTION⚠

- Never modify the interface card.

  Doing so could cause an electric shock or injuries.

1 BEFORE USE

1.1 Acceptance Inspection

⚠CAUTION
• Do not use products with damaged or missing parts. Doing so may result in bodily injury or damage.

Once you receive the product you ordered, check the following items:

(1) Verify that the product you received is in fact the product you ordered. Check the type/model printed on the option.

Example type/model: OPC-VG1-RD

(2) Check the product for damage sustained during shipment.

(3) Verify that all accessories are included in the packaging.

Screws (M3): 3
Spacers: 3

If you suspect the product is not working properly or if you have any questions about your product, contact the shop where you bought the product or your local Fuji branch office.
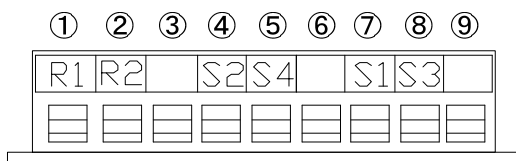
1.2 External Appearance

Unit:mm
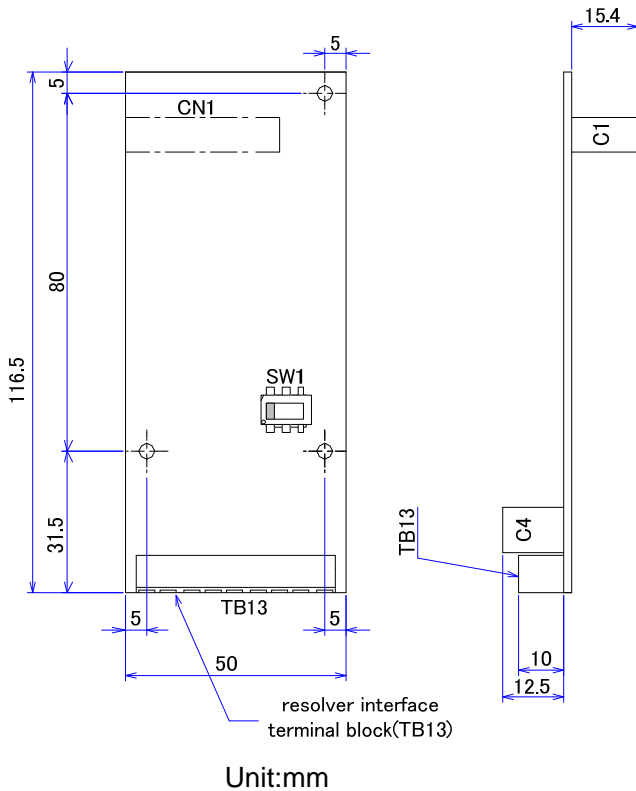
Switch	Resolver Transformation Ratio	Setting	Setting (Picture)
SW1	0. 286	a	
	0. 5	b	

It's possible to chose one of transformation ratio 0.286/0.5 by the switch (SW1)on the printed circuit board.The factory setting is :0.286.

terminal block (TB13) specification
・Screw size   : M3
・Applicable wire size
    Single wire [mm^2]   : 0.14 to 1.5
    Stranded wire[mm^2]   : 0.14 to 1.5
    Wire size[AWG]   : 26 to 16
    Tightening torque   : 0.5 to 0.6[Nm]

Terminal number
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

R1 R2   S2 S4   S1 S3

Figure 1.2-1 External Appearance

1.3 Precautions for Use

1.3.1 Temporary storage

Table1.3-1   Storage and Transport Environments

Item	Specifications	
Storage temperature (Note 1)	-25 to +70°C	Places not subjected to abrupt temperature changes or condensation or freezing.
Relative humidity	5 to 95% (Note 2)	
Atmosphere	The interface card must not be exposed to dust, direct sunlight, corrosive or flammable gases, oil mist, vapor, water drops or vibration. The atmosphere must contain only a low level of salt. (0.01 mg/cm^2 or less per year)	
Atmospheric pressure	86 to 106 kPa (during storage)	
	70 to 106 kPa (during transportation)	

(Note 1) Assuming comparatively short time storage, e.g., during transportation or the like.

(Note 2) Even if the humidity is within the specified requirements, avoid such places where the interface card will be subjected to sudden changes in temperature that will cause condensation to form.

Precautions for temporary storage

(1) Do not leave the interface card directly on the floor.

(2) If the environment does not satisfy the specified requirements listed in Table 1.3-1, wrap the interface card in an airtight vinyl sheet or the like for storage.

(3) If exposure to humidity is a concern, place a desiccant (silica gel, etc.) inside the packaging and then wrap as described in (2) above.

1.3.2 Long-term storage

The long-term storage method of the interface card varies largely according to the environment of the storage site. General storage methods are described below.

(1) The storage site must satisfy the requirements specified for temporary storage.

(2) The package must be airtight to protect the interface card from moisture. Add a drying agent inside the package to maintain the relative humidity inside the package within 70%.

(3) If the inverter equipped with the interface card has been installed to the equipment or panel at construction sites where it may be subjected to humidity, dust or dirt, then temporarily remove the inverter and store it in the environment specified in Table 1.3-1.

1.3.3 Wiring precautions

(1) Route the wiring of the control circuit terminals as far from the wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.

(2) Fix the control circuit wires inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).

2 INSTALLING THE INTERFACE CARD

2.1 Removing the Front Cover

⚠CAUTION

- Inappropriate installation or removal of the product may cause damage to the product.

- Shut off the inverter's input power supply and verify that the charge lamp (CHARGE) has gone out before installing or removing options. When external control circuits are powered by separate power supplies, the inverter's 30A, 30B, 30C, Y5A, and Y5C control terminals may be energized, even when all inverter main circuits, control, and auxiliary power supplies are off (open). To avoid electric shock, ensure that all external power supplies are off (open).

Remove the inverter's front cover as shown in the following figures. Note that the method for removing the cover depends on which inverter model (capacity) you are using.

FRN22VG1S-2J/4J (22 kW) or lower	**FRN30VG1S-2J/4J (30 kW) or greater**

As shown in Figure 2.1-1, loosen the one mounting screw on the front cover at location (a) and grip the top of the cover to remove it.
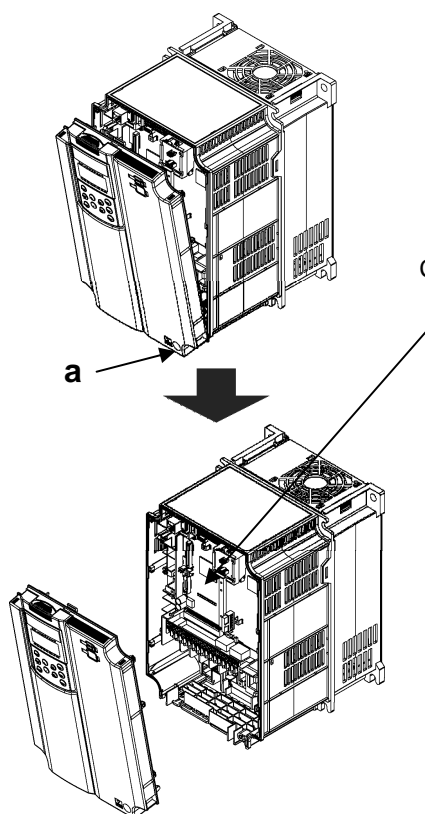
(1) As shown in Figure 2.1-2, remove the mounting screws on the front cover at location (b) (the number of screws varies with the inverter's capacity) and remove the front cover.
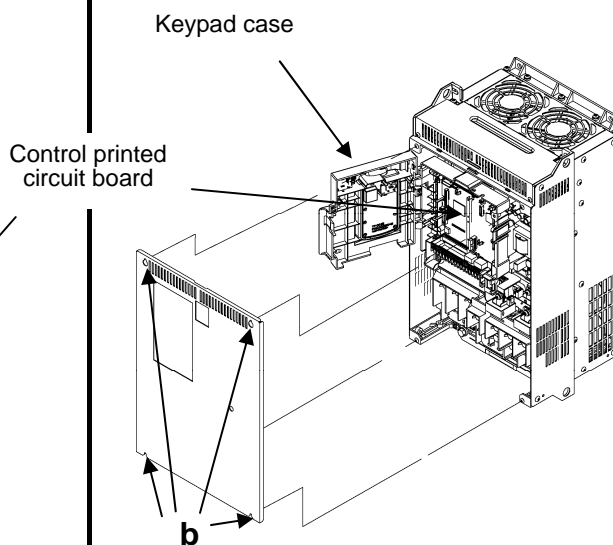
(2) Open the keypad case.

Figure 2.1-1   Removing the Front Cover FRN22VG1S-2J/4J (22 kW) or lower

Figure 2.1-2   Removing the Front Cover FRN30VG1S-2J/4J (30 kW) or greater

2.2 Installing the Interface Card

The interface card should be connected to either one of two connectors A-port (upper side) and B-port (lower side) on the control printed circuit board (control PCB).

- When using the interface card <u>without</u> the digital 16-bit option (e.g., OPC-VG1-SX), follow the **"Mounting procedure 1"** given below.

- When using the interface card <u>with</u> the digital 16-bit option (e.g., OPC-VG1-SX), follow the **"Mounting procedure 2"** given below.

Note: Two interface cards cannot be used on an inverter.

■ Mounting procedure 1 (<u>Without</u> the digital 16-bit option)

(1) Attach the three included spacers (d) to the three option mounting fixtures (a) through (c) on the control printed circuit board.

(2) Install the communications option card so that connector CN1 (on the back of the communications option card) connects to connector B port (CN2) on the control printed circuit board.

(3) Tighten the three included screws (e) to secure the communications option card in place.

(4) Referring to Figures 2.1-1 and 2.1-2, "Removing the Front Cover," reverse the procedure to reattach the front cover.
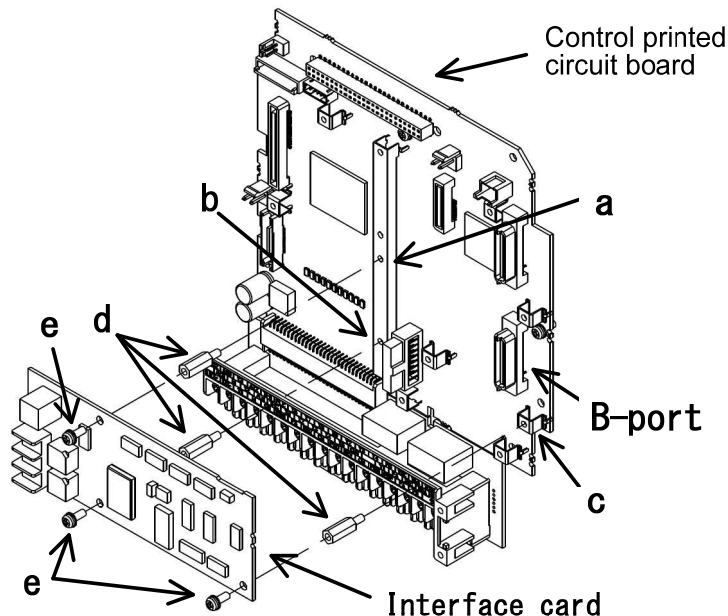

Figure 2.2-1 Installing a Interface card (When connecting the card to B port)

■ Mounting procedure 2 (<u>With</u> the digital 16-bit option)

⚠CAUTION

The dimensions of the spacers included with communications option cards and those included with digital 16-bit option cards differ slightly. See the following diagram when determining which spacers to use. Use of the wrong spacers may damage the product.

Spacers included with communications option cards — 13.0

Spacers included with digital 16-bit option cards — 11.4

(Unit: mm)

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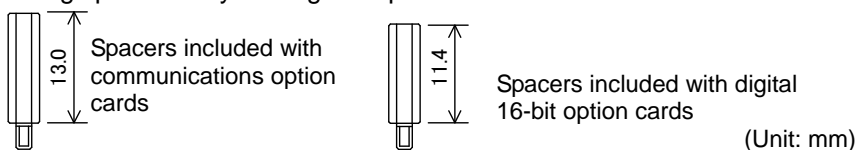
(1) Install the digital 16-bit option, connecting it to the D port (CN10) connector on the control printed circuit board.

(2) Attach the two screws (a) included with the digital 16-bit option to mounting holes ① and ② on the digital 16-bit option, and attach four spacers (b) to holes ③ through ⑥.

(3) Attach one spacer (d) included with the communications option card to the option mounting fixture (c) on the control printed circuit board.

(4) Install the communications option card so that connector CN1 (on the back of the communications option card) connects to B port (CN2) on the control printed circuit board.

(5) Tighten the three included screws (e) to secure the communications option card in place.

(6) Referring to Figures 2.1-1 and 2.1-2, "Removing the Front Cover," reverse the procedure to reattach the front cover.
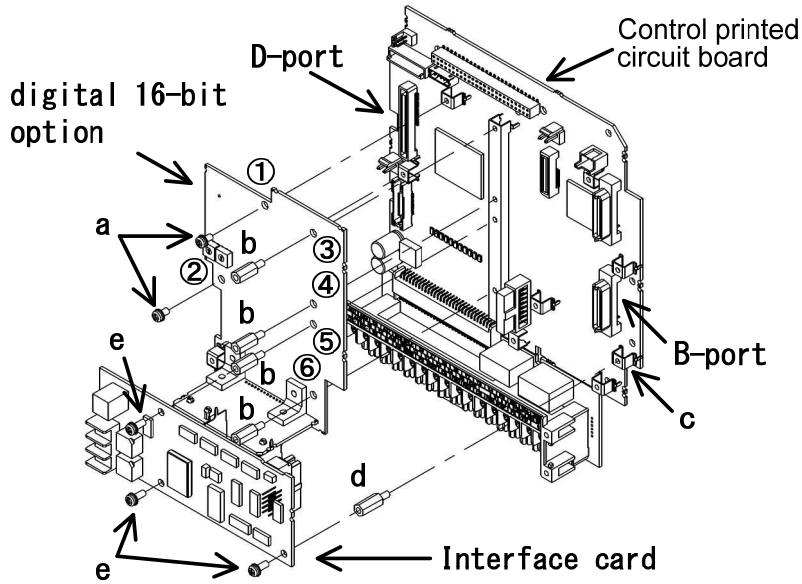

Figure 2.2-2 Installing a Interface card (When connecting the card to B port)

3 Specifications

【Applicable Resolver】

Item		Specifications	Remarks
Function		VR type, Brush lessly type	
Input voltage		AC7Vrms 10kHz	
Excitation side		R1-R2	
Transfomation ratio[K]		0.286±10% / 0.5±10%	Switch setting a:0.286 / b:0.5
Precision		―	
Phase difference		―	
Input Z	Zro	40Ω min	
Output Z	Zss	―	
	Zso	―	

【resolver interface card】

Item		Specifications
Type		OPC-VG1-RD
Exciting		Excitation signal terminal REF : [R1], [R2] Signal amplitude : 6.89Vrms (19.5Vp-p) Signal frequency : 10kHz typ, sinusoidal wave
Input signal		Input signal terminal SIN : [S2], [S4] COS : [S1], [S3] Input signal frequency : 1kHz max
Fault detection function		Detection of wiring breaking between OPC-VG1-RD to resolver. Detection of short circuit between OPC-VG1-RD to resolver. Monitoring of signal level of resolver (SIN,COS) output. Monitoring of waveform distortionl of resolver (SIN,COS) output. Abnormal case: Inverter stop by a PG alarm
Wiring length		Use the twist pair shield cable because the balanced circuit is composed. 20m max
Environmental	Surrounding temperature	-10 to +50°C
	Storage temperature*1	-25 to +70°C
	Relative humidity	5 to 95%
	(Places not subjected to abrupt temperature changes or condensation or freezing)	
	Atmosphere	The interface card must not be exposed to dust, direct sunlight, corrosive or flammable gases, oil mist, vapor, water drops or vibration. The atmosphere must contain only a low level of salt.
Connection of outside line		terminal block (TB13) : specification

*1   Assuming comparatively short time storage, e.g., during transportation or the like.

*2   Main software of an inverter needs special software.

4 Detailed Specifications

4.1 Equipped information

It's possible to confirm whether OPC-VG1-RD option card is be equipped with by a touch panel.

From the Operating Mode screen, go to the Program Menu screen and select "4. I/O check." Use the ⊘ and ⊘ keys to switch screens and check the setting on screen 9 as shown in the figure to the down. For more information, see the section on keypad operation.

When it's equipped with OPC-VG1-RD option, it's indicated like the following figure.

```
ＯＰＴＩＯＮ
Ａ：ＶＧ１－ＲＤ
Ｂ：
Ｃ：
∧∨→ＰＡＧＥ ＳＨＩＦＴ  9
```

4.2 Function code

4.2.1 For induction motor

When OPC-VG1-RD option card is used for induction motor, input the following set value.

Adjust a function code besides the following as needed.

Function code		Setting	Default setting	Data setting range	Setting contents
No.	Name				
P01	M1 Drive Control	0	0	0 to 5	0: Vector control for IM with speed sensor 1: Vector control for IM without speed sensor 2: Simulation mode 3: Vector control for PMSM with speed sensor 4: -- 5: V/f control for IM
P28	M1 Pulse Resolution	Resolver specification value	1024	100 to 60000	Set 1024 x (axis double angle). [Example] When axis double angle of resolver is 3X. 1024 x 3-> 3072.
P29	M1 External PG Correction Factor	4000	4000	0000 to 4FFF	Use by defaults

4.2.2 For permanent magnet synchronous motors

When OPC-VG1-RD option card is used for permanent magnet synchronous motor, input the following set value.

Adjust a function code besides the following as needed.

Function code		Setting	Default setting	Data setting range	Setting contents
No.	Name				
E01 to E13	Terminal[X1 toX9, X11 toX14] function	Refer to chapter 4.4	—	0 to 79	58:【C-DI1】 Resolver position read order
E15 to E27	Terminal[Y1 toY4 ,Y5A,Y11 toY18] function			0 to 84	39:【C-DO1】 Resolver position reading signal
P01	M1 Drive Control	3	0	0 to 5	0: Vector control for IM with speed sensor 1: Vector control for IM without speed sensor 2: Simulation mode 3: Vector control for PMSM with speed sensor 4: -- 5: V/f control for IM
P28	M1 Pulse Resolution	Resolver specification value	1024	100 to 60000	Set 1024 x (axis double angle). [Example] When axis double angle of resolver is 3X. 1024 x 3-> 3072.
P29	M1 External PG Correction Factor	4000	4000	0000 to 4FFF	Use by defaults
o09	M1 Absolute Signal Input Definition	4	0	0 to 16	0:1 bit (Terminal; F0) Z-phase interface (Available soon) 1:3 bits (Terminal: F0/F1/F2) U-,V-,W-phase interface 2:4 bits (Terminal; F0/F1/F2/F3) Gray code interface 4: OPC-VG1-RD interface. 6:SPGT 17-bit serial interface 3,5,7-16: Reserved.
o10	M1 Magnetic Pole Position Offset	Adjusted value	0.0	0.0 to 359.9	Adjust it before driving.

4.3 Protective function

For permanent magnet synchronous motor, the following protective function is added, and an inverter is stopped by this protective function. For induction motor, the protective function is same as a standard specification.

Item	KEYPAD panel display	Specifications
Non completion of absolute position reading	(Not symbol)	While reading of absolute position isn't complete, [RDY] signal is turned off. And driving of an inverter is prohibited. ・Until the first time absolute position reading is completed from turning on the power. ・During input of resolver position read order (58:【C-DI1】)
Option card error	PG	"PG alarm" is output in the following case. ・OPC-VG1-RD option card isn't be equipped or it isn't recognized in o09=4. ・Wiring breaking between OPC-VG1-RD and resolver occurs. Short in the wiring between OPC-VG1-RD and resolver occurs. ・The level of the resolver output signal (SIN,COS) is abnormal. The distortion of the resolver output signal (SIN,COS) is big. （There is a possibility that the corrugated distortion occurs by influence of motor magnetism and Shaft misalignment of resolver.） ※While a PG alarm occurs, there is a possibility that the speed detection value isn't right.

4.4 Absolute position detection

4.4.1 Absolute position detection and update method

Absolute position detection and update condition

The interface card has two methods for detecting the absolute position.

Manual detection: The inverter becomes a manual reading mode, when "58(C-DI1 : Read Encoder Position Manually)" is allocated to terminal [X],.
The absolute position is read only once by inputting the C-DI1 signal.

Automatic detection: The inverter becomes an automatic reading mode, when "58(C-DI1)" is not allocated in terminal [X].Whenever the reading condition consists, reading and the update of the absolute position are done.
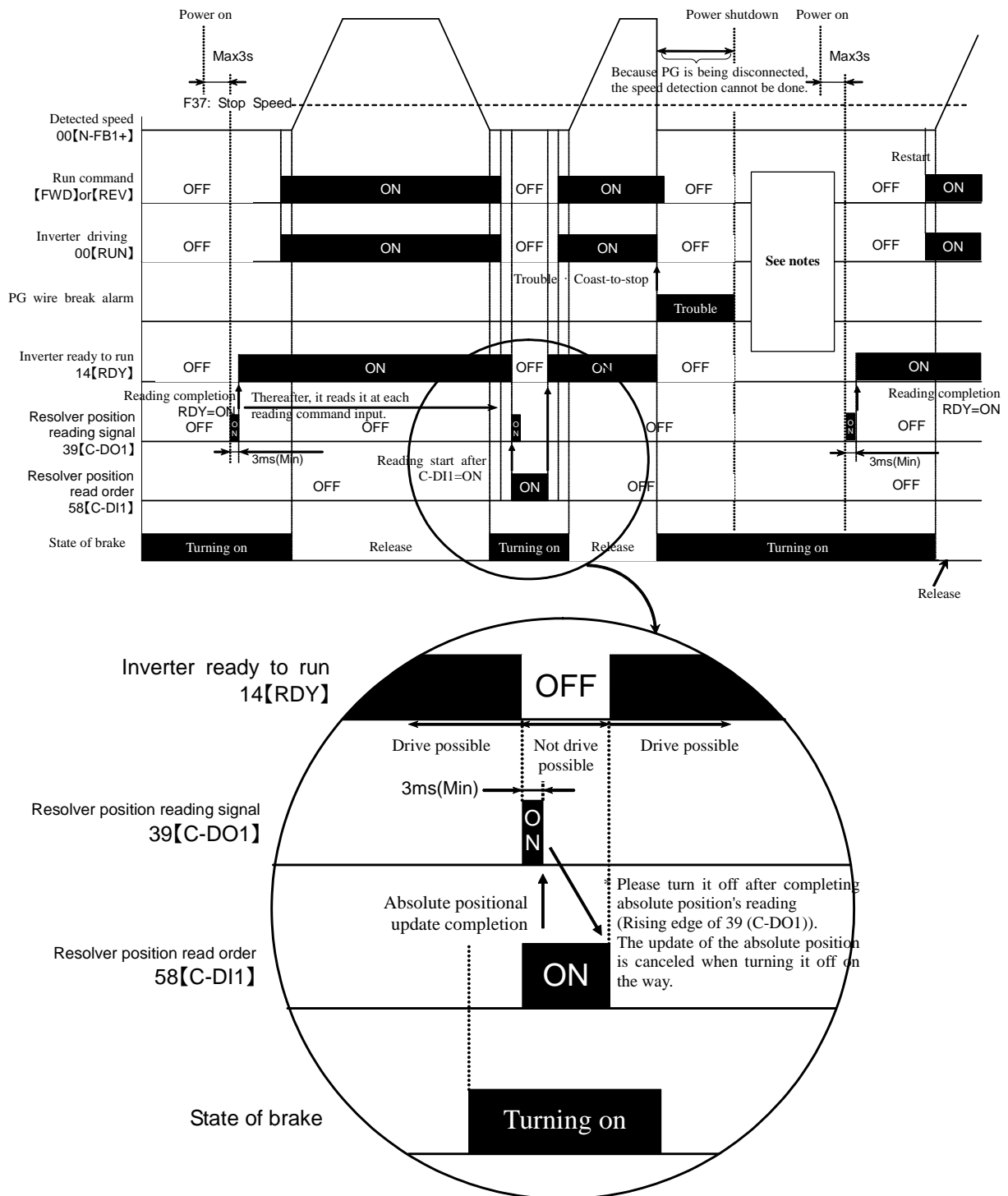
The absolute position detection and the update are done, when following "Operating conditions" is all approved, and one of "Detecting conditions: ○" is approved.

Reading method		Manual detection	Automatic detection
Operating conditions		・"58(C-DI1)" is <u>allocated</u> in terminal [X]. ・The driving instruction is not input.	・"58(C-DI1)" is <u>not allocated</u> in terminal [X].
Operating conditions		・The inverter output is stop (Terminal Y 00(RUN) = OFF). ・The motor is stop (The rotational speed of the motor is less than "F37: Stop speed". Terminal Y 01(N-EX) = OFF). ・The alarm (failure detection) doesn't occur.	
Detecting conditions	Power on	✓	✓
Detecting conditions	"OPC-VG1-RD active"setting[1]	✓	✓
Detecting conditions	Output stopping	✕	✓
Detecting conditions	PG wire break returning	✕	✕
Detecting conditions	Read position detect command input	✓	-
Detecting cycle		1ms	
Absolute positional update condition		When the difference of three times is less than 2.8° in the consecutive detection.	

[1] Mounting this interface card and setting the parameter "P01 = 3, o09 = 4".
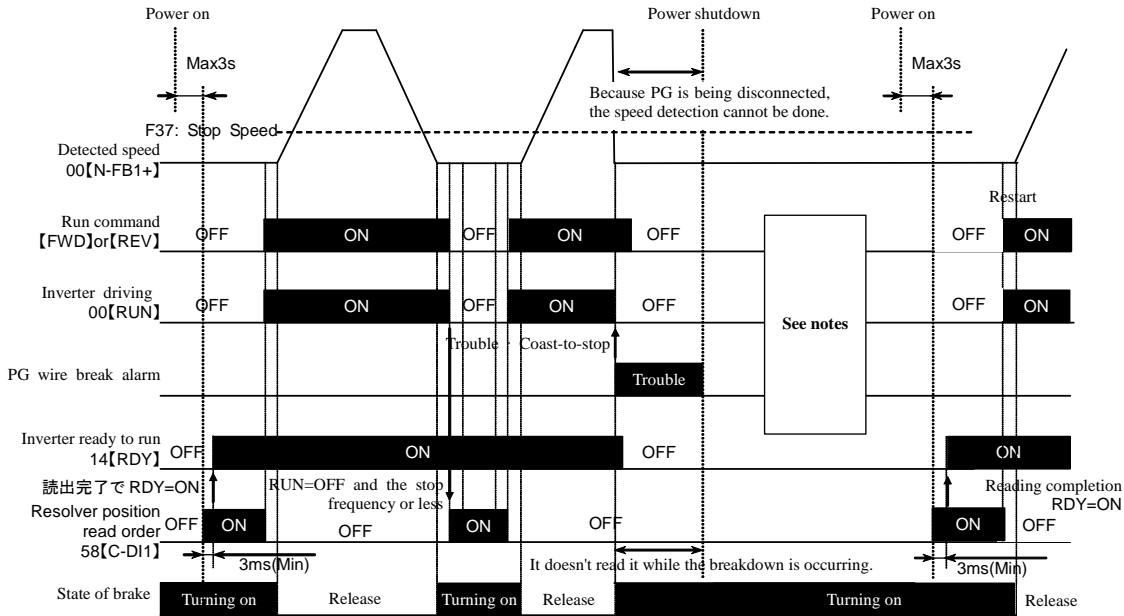
4.4.2 Operation example

Manual detection

*1: When the power supply is turned on, the absolute position is read automatically even if absolute position reading command is not input.

*2: The motor brake is turned on, read position detect command is input after the motor stops, and the read sequence processes the position.

Automatic detection

Timing chart labels:
- Power on — Max3s
- Power shutdown
- Power on — Max3s
- Because PG is being disconnected, the speed detection cannot be done.
- F37: Stop Speed
- Detected speed 00【N-FB1+】
- Restart
- Run command 【FWD】or【REV】: OFF / ON / OFF / ON / OFF / See notes / OFF / ON
- Inverter driving 00【RUN】: OFF / ON / OFF / ON / OFF / OFF / ON
- Trouble / Coast-to-stop
- PG wire break alarm: Trouble
- Inverter ready to run 14【RDY】: OFF / ON / OFF / ON
- 読出完了で RDY=ON
- RUN=OFF and the stop frequency or less
- Reading completion RDY=ON
- Resolver position read order 58【C-DI1】: OFF / ON / OFF / ON / OFF / ON / OFF
- 3ms(Min) / It doesn't read it while the breakdown is occurring. / 3ms(Min)
- State of brake: Turning on / Release / Turning on / Release / Turning on / Release

---

⚠CAUTION

After a power supply is blocked off and confirming that a touch panel went out including the return time of a PG alarm, do wiring work of resolver cable.

・There is a possibility that the speed detection value isn't right.

・There is a possibility that Abusolte position (magnetic pole position) reading normally never moves.

※Even if power supply of an inverter is blocked off, it takes time by off of control source.
（Time from an insulation of power supply to off of control source (the rule of thumb)）

Inverter		Insulation time (s)	Inverter		Insulation time (s)
Voltage	Capacity(kW)		Voltage	Capacity(kW)	
200V	～22	30	400V	～7.5	30
	30～55	60		11～22	60
	75～	90		30～45	90
				55,75	120
				90～160	300
				200～	600

4.4.3 Setting the magnetic pole position offset value

When driving a PMSM for the first time, an adjustment of magnetic pole position offset is necessary. Adjust magnetic pole position offset by operation in the following.

-Adjusting procedure

After doing the following setting, rotate the motor shaft by hand, and adjust o10 as the positional relationship between waveforms on Ao1 and Ao2 is below.

Configuring function code data

Function code	Setting	Remarks
E69: Terminal [Ao1] function	26: U phase voltage	Voltage range: ±4V×Operation speed ÷Rated speed
E70: Terminal [Ao2] function	39: Magnetic pole position signal **SMP**	Voltage range: 0 to 5V
E84: Ao1-Ao5 filter setting	0.000s	Cancel filter

Adjustment procedure

Rotate the motor shaft by hand to check that the positional relationship between the waveforms on Ao1 and Ao2 is as shown below. If the waveforms are greatly misaligned, adjust the data of function code o10 to align the waveforms as shown below.
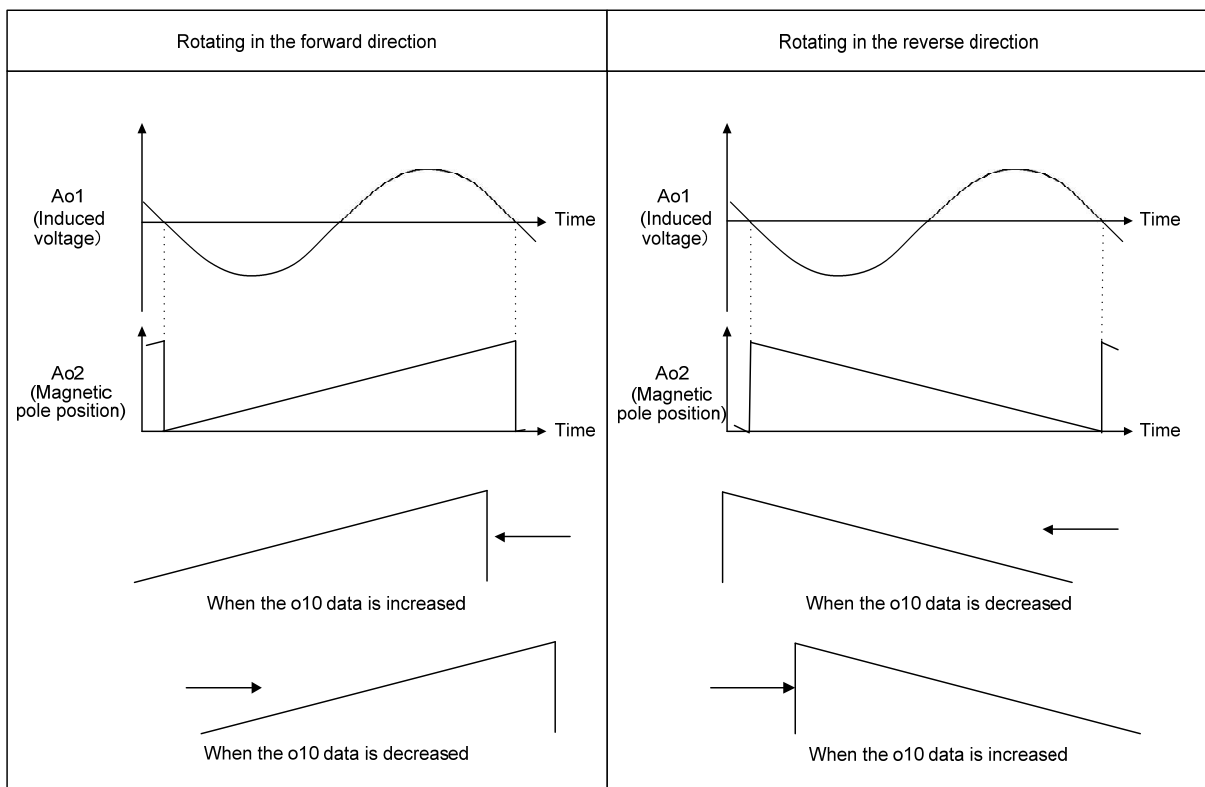
5 Terminal functions

Resolver interface terminal block (TB13)

	Terminal number	Name	Input/Output	function
TB13	1	R1	Output	Output terminal for resolver excitation signal
	2	R2	Output	
	3	—	—	Not used
	4	S2	Input	Input terminal for sin signal from resolver
	5	S4	Input	
	6	—	—	Not used
	7	S1	Input	Input terminal for cos signal from resolver
	8	S3	Input	
	9	—	—	Not used

6 Connection example
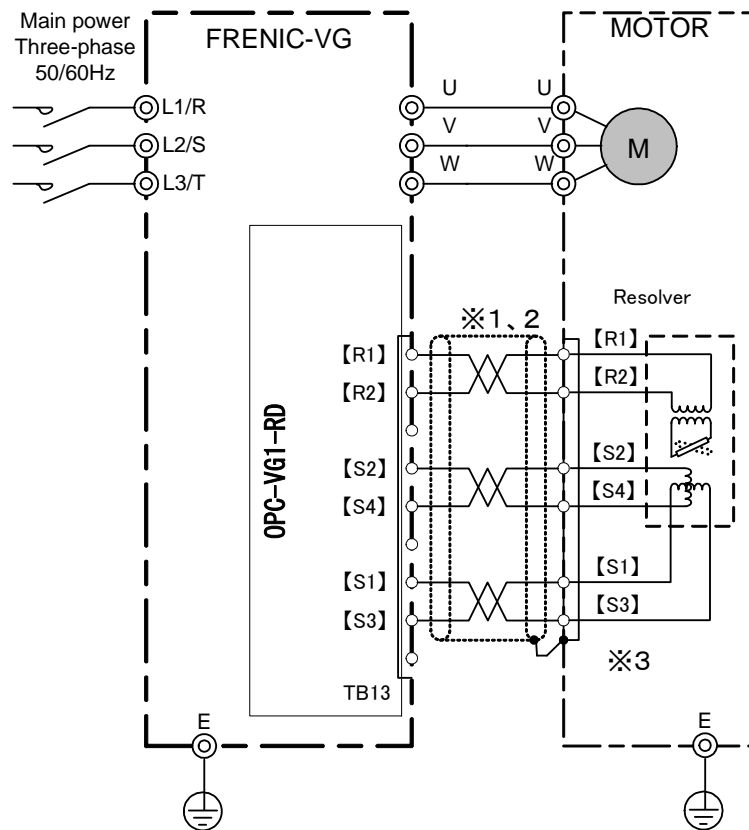
*1: Use twisted shielded pair for wiring of this option.To prevents a malfunction by noise, separate main circuit wiring of the inverter and other power supply lines as much as possible and don't put it in the identical duct (more than 10 cm).

Recommendation wire: Twisted pair cable made by the Furukawa Electric Co., Ltd. 3 pairs of KPEV-SB 0.5mm2x

*2: Connect an incrustation of shielding wire, shield wire to a cover of a signal connector or a ground terminal of a motor.

*3: An output signal from resolver will be the waveform by which an amplitude-modulated ingredient of SIN/COS superimposed one above another in an excitation ingredient of 10kHz. When a motor is rotation in forword direction(The direction where a motor runs by FWD operation), make it the phase relation S1-S3 advances 90 deg at an electric corner to S2-S4. (Figue A) When phase relation becomes reverse, replace and connect wiring of S1-S3 and S2-S4

*Signal name of the terminal on the option card
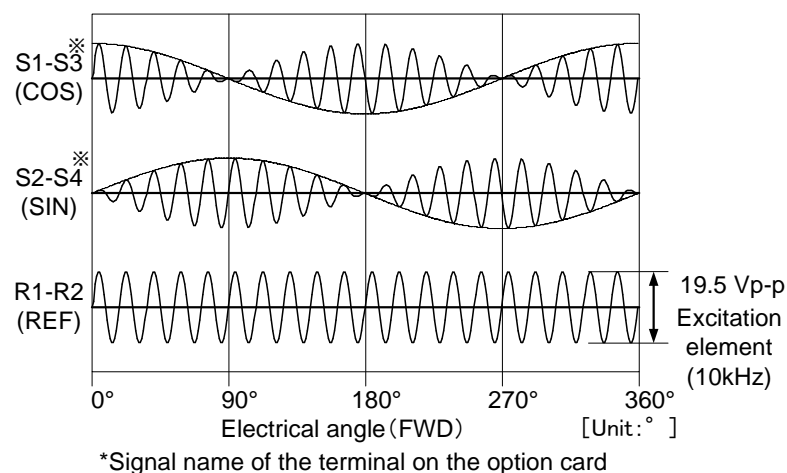
Figure A   Wave form chart of resolver

M E M O

Resolver Interface Card for FRENIC-VG

OPC-VG1-RD

Instruction Manual

First Edition, March 2017

Fuji Electric Co., Ltd.