

# **mitsubishi**

## **TRANSISTORIZED INVERTER**

### **INSTRUCTION MANUAL**

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# **EXPANSION INPUT/OUTPUT UNIT TYPE FR-VPA**

- Orientation Control
- Expansion Input
- Expansion Output
- Expansion Analog Input
- PLG Pulse Output (Open Collector)
- Power Supply for Long Distance Cable

Thank you for choosing this Mitsubishi Vector Inverter option unit, FR-VPA. This manual gives handling, safety and operating instructions.

## **This section is specifically about safety matters**

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions.

In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



### **WARNING**

Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



### **CAUTION**









This symbol indicates a general warning. Serious injury may occur if precautions are not followed.

Where these Warnings are written, pay special attention to the precautions detailed.

## **Operator Safety**


### **1. Electric shock prevention**

#### **WARNING**

-  Do not open the front cover while power is supplied or while the unit is running. There is a risk of electric shocks.
-  Do not run the inverter with the front cover removed. There are high voltage terminals and charged parts that are exposed, and thus there is a risk of electric shocks.
-  Do not remove the front cover even when the power is off unless carrying out wiring work or period inspections. The inside of the inverter is charged, and there is a risk of electric shocks.
-  Before starting wiring work or inspection, wait at least 10 minutes after turning the power off, and confirm the voltage with a tester, etc.
-  Wiring work and inspections must be done by a qualified worker.
-  Install the inverter before starting wiring. There is a risk of electric shocks and injuries.
-  Do not operate the switches with wet hands. There is a risk of electric shocks.
-  Do not damage, apply excessive stress, place heavy items on, or catch the cables. There is a risk of electric shocks.




### **2. Fire Prevention**

#### **CAUTION**

-  Use a circuit breaker on the supply side of the inverter to prevent high current flow in the case of a fault.

### 3. Injury Prevention

#### CAUTION




-  Only supply the inverter with the voltage on the nameplate and in the Manual Specification section. Other voltage may cause the inverter to fail.
-  Care should be taken when wiring to ensure correct terminals are used. Check polarity, etc.
-  Do not touch the inverter while it is powered as certain parts become hot.

### 4. Other points

To prevent injury, damage, or product failure please note the following points.


#### (1) Transportation and mounting

#### CAUTION

-  Install according to the information in the Instruction Manual.
-  Do not stand or rest heavy objects on the product.
-  Prevent any dust, wire fragments or other foreign bodies from dropping into the inverter during wiring up and commissioning.


#### (2) Wiring

#### CAUTION

-  The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.






### (3) Trial run

#### CAUTION

-  Check all parameters, and ensure that the machine will not be damaged by sudden start-up.


### (4) Operation

#### CAUTION

-  The stop key can be used only when functions have been set. Therefore, prepare a separate emergency stop switch.  
If an alarm is reset while the run signal is input, the inverter could start suddenly. Always confirm that the run signal has been turned off before resetting.
-  Do not modify the unit.
-  There may be cases when the electronic thermal relay cannot protect the motor against overheating.
-  Do not start and stop the inverter frequently with the magnetic contactor on the power supply side.
-  Reset the parameters required for operation after carrying out parameter clear or all clear. Each parameter will be returned to the default values.


### (5) Emergency stop

#### CAUTION

-  Use a circuit and mechanical brake, etc., which will protect the operator of the machine should the inverter fail.

### (6) Maintenance and inspection

#### CAUTION

-  Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

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**(7) Disposing of the option unit.**

 **CAUTION**

 Treat as industrial waste.

**(8) General**

Many of the diagrams and drawings in the instruction manual show option unit fitted to the inverter without a cover, or partially open. Never run the inverter like this. Always replace the cover and ensure adequate cooling etc., before using the inverter.

## Expansion input/output function option unit <<FR-VPA>>

This option unit is a multi-function option unit for industrial machines that have various input/output functions. This unit has the following functions.

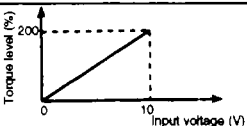
- Orientation control
- Expansion analog input
- Expansion input
- PLG pulse output (open collector)
- Expansion output
- Power supply for long distance cable

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## Introduction

As this option unit is a multi-function option unit, the initial functions are set as shown below. To activate the function, refer to each corresponding page, and set the parameters.

Function	Initial setting	Remarks
Orientation control function	Does not function	Pr. 119 "Orientation specifications" is set to "0".
Expansion input function	The multi-speed setting 1 (RH) is selected.	Pr. 100 and Pr. 101 "Multi-function input selection" are set to "0".
Expansion output function	Minor fault output (ER) is output.	Pr. 102 "DO terminal function selection" is set to "0".
Expansion analog input		Change the Pr. 905 setting value to change the 0 to 200% limit level for an input voltage of 0 to 10V.
PLG pulse output (open collector)	The motor mounted PLG pulse is output. Division rate 1	Pr. 119 "Orientation specifications" is set to "0". Pr. 107 "PLG division rate" is set to "0".

# 1. Before using

This product is an exclusive built-in option for the Mitsubishi FREQROL-V Series inverter. Please perform the following steps before using the product.

## 1.1 Unpacking and confirmation of product

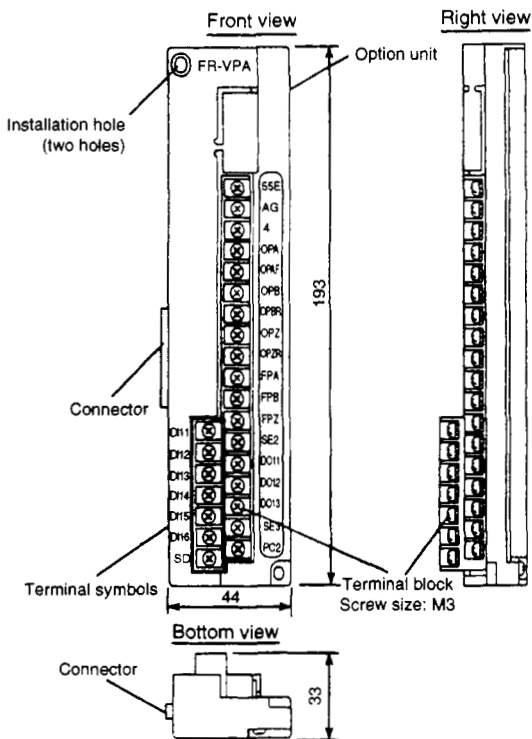
Remove the option unit from the package. Check the name on the front and confirm that it is the ordered product. Also, check for any damage caused during transportation.

## 1.2 Confirmation of packaging

Confirm that the following accessories are enclosed in the package.

- Instruction Manual ..... 1 copy
- Installation screw M3 × 14 ..... 2 screws

## 1.3 Appearance and names of each part



## 2. Installation

Check the inverter model before installation.

This unit is an exclusive option for the FREQROL-V Series. It cannot be used with other series (FR-A, Z, F series, etc.).

### 2.1 Before installation

Confirm that the inverter is isolated, and power is turned OFF.

If the option unit is installed while the input power is ON, a fault may occur in the inverter. (The inverter and option unit may be damaged, and the inverter error display "E.CPU" may appear.)






Warning! Hazardous voltage present.

Always isolate the power from the inverter, and wait 10 minutes after the charge lamp has gone out before inserting or removing this option unit, or touching the terminals.

### 2.2 Installation method

- (1) Align the option unit connector with the connector on the inverter, and insert the option unit securely.
- (2) Fix the top and bottom of the option unit to the inverter using the two screws enclosed. If the screw hole is not aligned with the inverter, the connector may not be inserted correctly so check it.

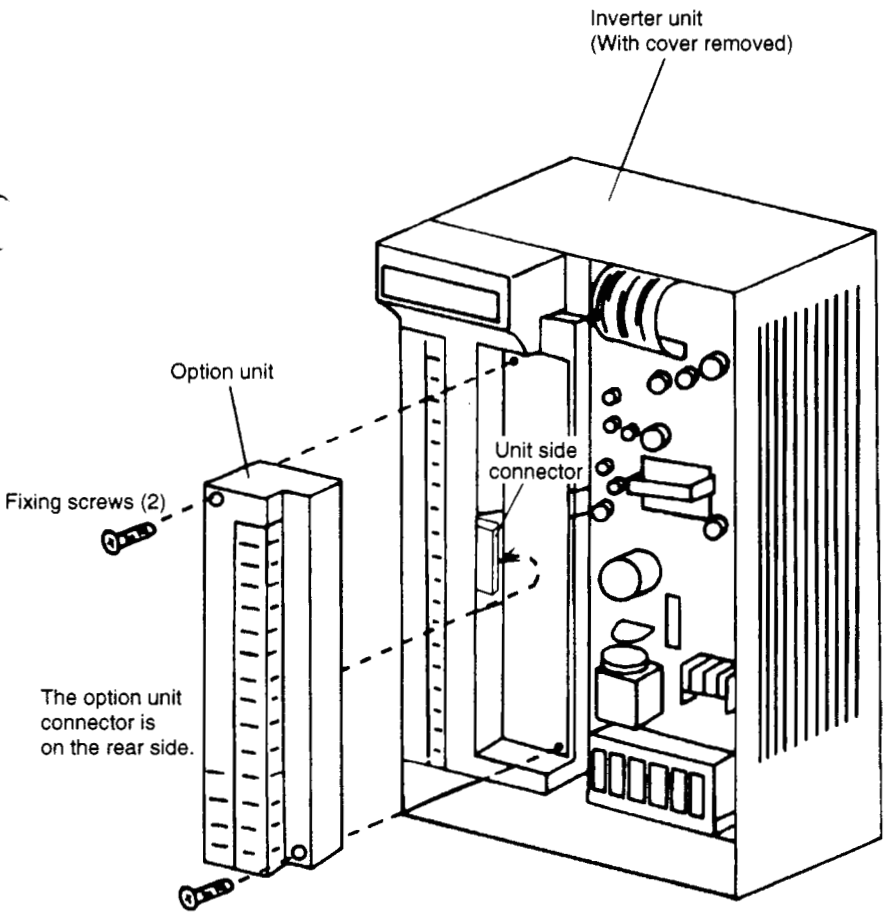
#### CAUTION

-  Never use open terminals as relay terminals. These terminals are used internally by the option. If used as relay terminals, the option unit could be damaged.
-  Carefully route the connection wires to the inverter's control circuit terminals and option terminals within the wiring space so that they are not caught between the unit and the cover when the front cover is installed.
-  This option is an exclusive part for the FREQROL-V Series. Mounting of this unit on the FREQROL-A Series could lead to inverter damage, malfunctioning of functions, and the displaying of the "Option Error (E.OPT)."

### 2.3 Wiring

Wire the units so that the wires are not jumbled in the control circuit terminal block space.

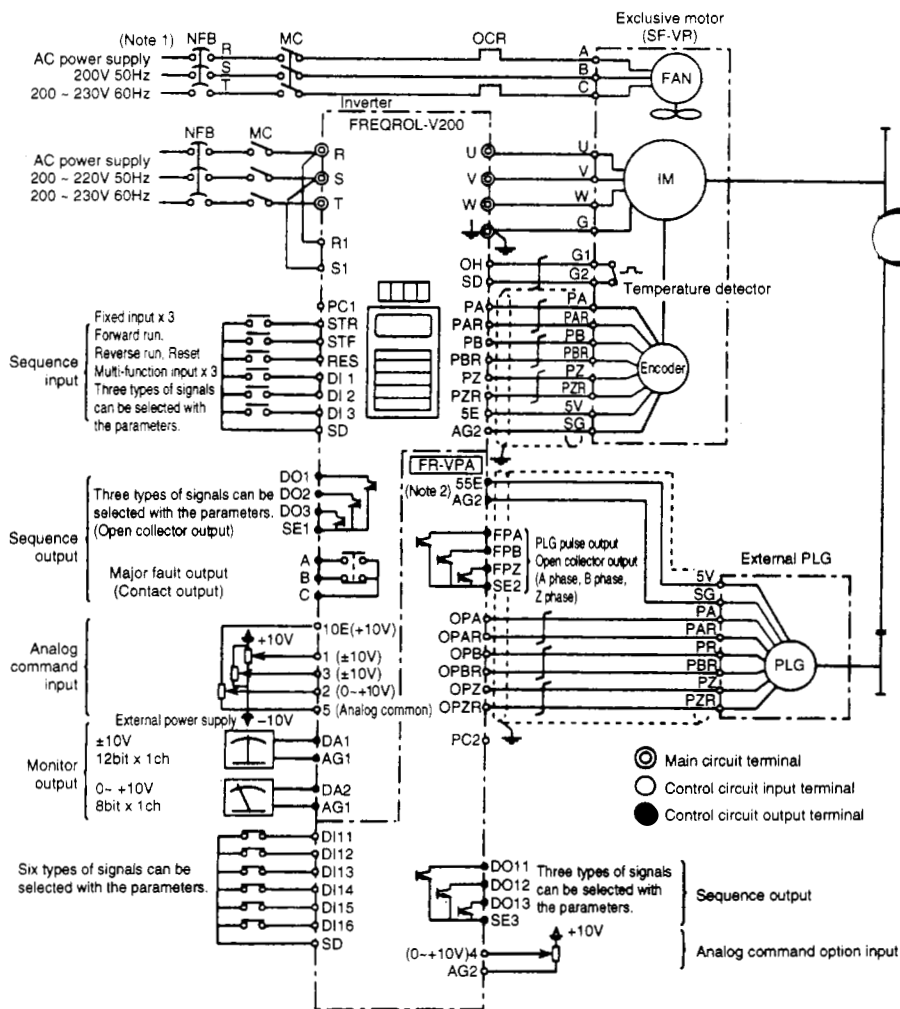




### 3. Orientation control function

Set stopping position (orientation function) control of a rotary axis is possible when this unit is used in combination with the position detector (PLG pulse) installed on the spindle, etc., of the machine tool, or on the motor.

#### 3.1 Connection example



(Note 1) The motor fan power supply is single-phase when the motor capacity is 5.5K or 7.5K.

(Note 2) When using a long distance cable of 50m or longer, use it for the PLG power supply.

### 3.2 Explanation of terminals

Terminal symbol	Terminal name	Rated current, etc.	Application	
Input terminals	OPA	PLG A phase signal input terminal	Refer to page 3-14 for details on the pulse signals.	The A phase, B phase and Z phase (zero point and mark pulse) signals from the PLG are input.
	OPAR	PLG A phase reverse signal input terminal		
	OPB	PLG B phase signal input terminal		
	OPBR	PLG B phase reverse signal input terminal		
	OPZ	PLG C phase signal input terminal		
	OPZR	PLG C phase reverse signal input terminal		
Output terminals	FPA	Open collector PLG A phase output terminal	Open collector output maximum load DC24V 35mA	The output is set to the Low level when the start signal and orientation signal are input and the orientation stops within the Orientation complete width.
	FPB	Open collector PLG B phase output terminal		
	FPZ	Open collector PLG Z phase output terminal		
	SE2	Open collector output common terminal.	—	Common terminal for the open collector output FPA, FPB and FPZ and are insulated from the control circuit common terminals.

Terminal symbol	Terminal name	Rated current, etc.	Application	
Input terminals	55E	Power supply (+ side) output terminal	5V for DC5.5V PLG	The power is supplied to the PLG. Connect 55E to the + side and AG2 to the ground side. Connect the shield wire's shield to AG2.
	AG2	Power supply ground terminal		
	4	Expansion analog input	DC0 ~ 10V	The AG2 terminal is used as the common. When 10V is input, the max. output torque is reached, the input and output are proportional.
	PC2	External transistor common	—	When connecting the transistor output (open collector output) of the sequencer (PC), etc., malfunctioning caused by the lead-in current can be prevented when the external power supply common for the transistor output is connected to this terminal.
	DI11	Orientation start	—	These are input terminals that can be set with the parameters Pr. 100 "Multi-function input selection A1" and Pr. 101 "Multi-function input selection A2". (Note)
	DI12	Stop position command 1		
	DI16	Stop position command 5		
SD	Contact input common		This is the common terminal for the contact input. This common is isolated from the control circuit common terminals.	
Output terminals	DO11	Orientation complete	Open collector output maximum load DC24V0.1A	These are output terminals that can be set with the parameter Pr. 102 "Multi-function output selection A1". (Note)
	DO12 DO13	—		
	SE3	Open collector output common For DO11 to DO13	—	This is a common terminal for the open collector output DO11, DO12 and DO13. This common is isolated from the control circuit common terminals.

**(Note)** If the Pr. 110 (Orientation specifications) Orientation type setting is "1" or "2", terminals DI11 to DI13 will be exclusively for Orientation function.

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### 3.3 Explanation of operation

- Orientation control is a function that stops at a preset position using the motor built-in position detector (PLG) or spindle position detector (encoder).

#### 〈Operation〉

If the Orientation command signal is turned ON during operation after the various parameters have been set, the speed will decelerate to the "orientation change-over speed". After the "orientation stop distance" is calculated, the speed will further decelerate, and the "Orientation state" (servo lock) will be entered. The "orientation complete signal" will be output when the "orientation complete width" is entered.

- The following three methods of orientation stop can be selected.

Select the method with Pr. 119 "Orientation specifications".

- (1) Pre-orient..... Orientation is executed from the current rotation direction.
- (2) Forward run orientation..... Orientation is executed from the forward run direction. (If the motor is running in reverse, orientation will be executed from forward run after stopping.)
- (3) Reverse run orientation ..... Orientation is executed from the reverse run direction. (If the motor is running in forward, orientation will be executed from reverse run after stopping.)

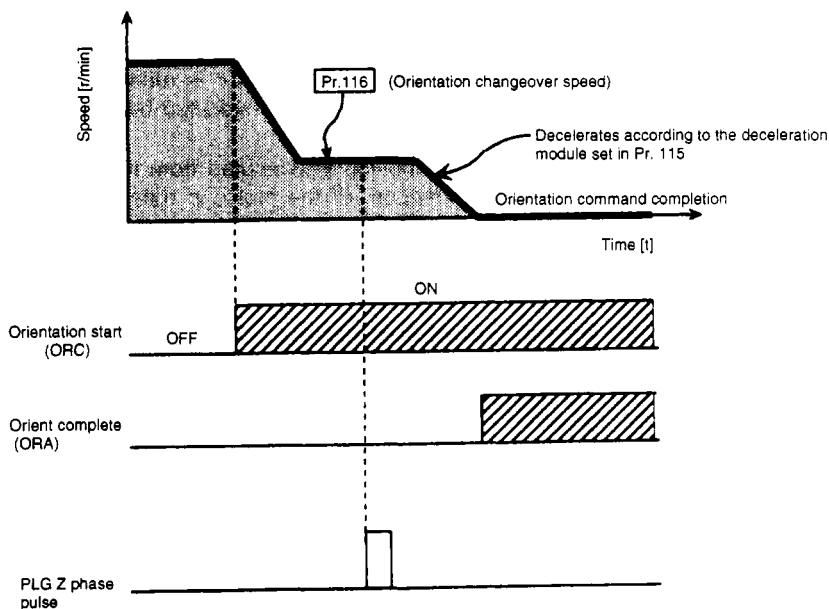
#### (1) Orientation from current rotation direction

- ① When the orientation command (terminal ORC) is input, the motor speed will decelerate from the running speed to Pr. 116 "Orientation changeover speed". At the same time, the orientation stop position command will be read in. (The stop position command is determined by the input state of terminals ORP1 to 5. Refer to page 3-5 for details.)
- ② When the orientation changeover speed is reached, the PLG Z phase pulse will be confirmed, and the mode will change from speed control to position control (position loop gain parameter (Pr. 113)).
- ③ When the control is changed, the distance to the orientation stop position will be calculated. The motor will decelerate and stop with a set deceleration pattern (Pr. 115), and the orientation (servo lock) state will be entered.

- ④ When the Pr. 117 in-position range is entered, the orientation complete signal (terminal ORA) will be output.
- ⑤ The zero point position can be moved using position shift (Pr. 114).

**⚠ CAUTION**

⚠ If the orientation command (terminal ORC) is turned OFF while the start signal is input, the motor will accelerate toward the speed of the current speed command. Thus, to stop, turn the forward run (reverse run) signal OFF.



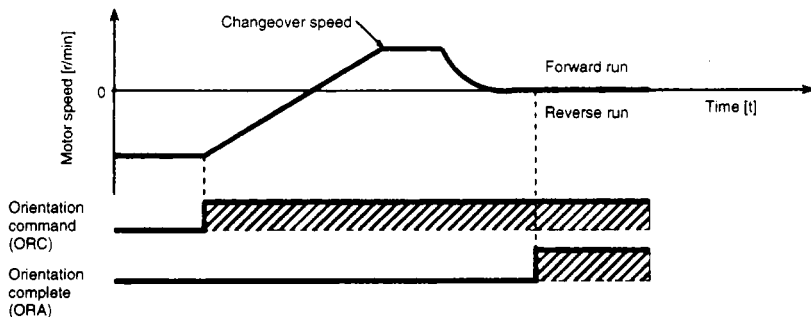
## (2) Orientation from forward run direction

- This method is used to improve the stopping precision and maintain the mechanical precision when the backlash is great.

If the motor is rotating in the forward run direction, it will orientation stop with the same method as "orientation from current rotation direction".

If the motor is running in reverse, it will decelerate, the rotation direction will be changed to forward run, and then orientation stop will be executed.

### Orientation from forward run (motor running in reverse)

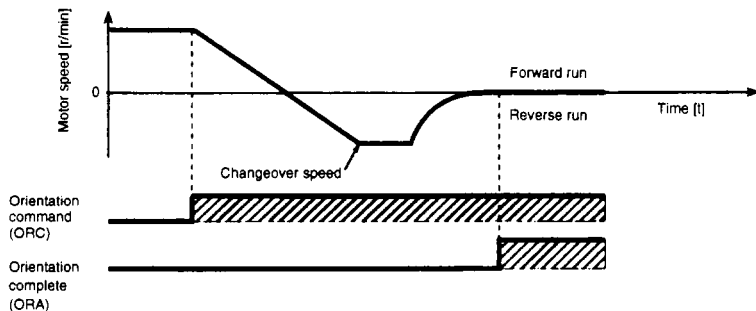


## (3) Orientation from reverse run direction

If the motor is rotating in the reverse run direction, it will orientation stop with the same method as "orientation from current rotation direction".

If the motor is running in the forward direction, it will decelerate, the rotation direction will be changed to reverse run, and then orientation stop will be executed.

### Orientation from reverse run (motor running forward.)



## 3.4 Adjustment

### (1) Parameters

The parameters that need to be adjusted when orientation control is selected are shown below.

Parameter No.	Name	Setting range	Default value	Remarks
108	No. of machine side gear teeth	0 ~ 32767	1	
109	No. of motor side gear teeth	0 ~ 32767	1	
110	Orientation speed gain (P item)	0 ~ 1000	30	
111	Orientation speed gain (I item)	0 ~ 100.0	3.0	
112	Orientation speed gain (D item)	0 ~ 100.0	1.0	
113	Orientation position gain	0 ~ 100.0	10.0	
114	Orientation position shift	0 ~ 4095	0	
115	Orientation deceleration rate	0 ~ 1000	20	
116	Orientation changeover speed	0 ~ 1000	200	
117	Orientation complete width	0 ~ 4096	11	
118	No. of encoder pulses for orientation	0 ~ 4096	4096	
119	Orientation specifications	0 ~ 999	0	

#### Set the gear ratio for PLG orientation



Pr. 108 "No. of machine side gear teeth"  
 Pr. 109 "No. of motor side gear teeth"  
 Pr. 118 "No. of PLG pulses for orientation"

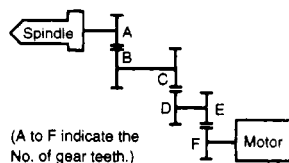
- The gear ratio for PLG orientation is set with Pr. 108 and Pr. 109.
  - (1) Confirm that each parameter is set to the default value.
  - (2) The accurate gear ratio (or pulley ratio <sup>①</sup>) from the motor shaft to the spindle is required.

Confirm that the correct No. of gear teeth is set in Pr. 108 and Pr. 109.

$$\text{Pr. 108} = A \times C \times E$$

$$\text{Pr. 109} = B \times D \times F$$

Make sure that the  $A \times C \times E$  and  $B \times D \times F$  setting values do not exceed 32367. If the value is exceeded, use approximation.





Setting example (When the No. of gear teeth is as shown below.)

A : 15, C : 43, E : 60, B : 10,

D : 28, F : 55

Pr. 108 =  $15 \times 43 \times 60 = 38700$

Pr. 109 =  $10 \times 28 \times 55 = 15400$

The Pr. 108 setting value exceeds 32367, so approximate as shown below.

$\frac{\text{Pr.108}}{\text{Pr.109}} = \frac{38700}{15400} = \frac{3870}{1540}$

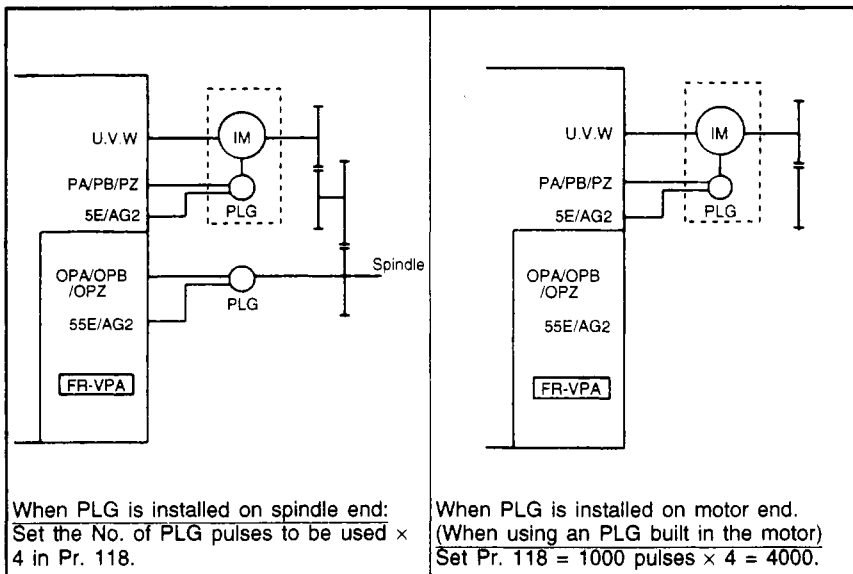
- (3) Set Pr. 118 "No. of PLG pulses for orientation" to 4096 (default value).

Note that if an encoder pulse value other than 4096 is to be used, set a value multiplied by four.

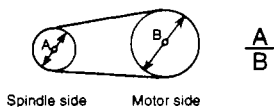
No. of setting pulses = No. of A phase (or B phase) pulses  $\times 4$

Example: For 1000 pulse PLG

4000 pulses = 1000 pulses  $\times 4$



※1. Pulley ratio: Diameter ratio of pulley on motor driven by belt and pulley on spindle side.



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**Adjust the  
servo rigidity**

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Pr. 110 "Orientation speed gain (P item)  
Pr. 111 "Orientation speed gain (I item)  
Pr. 112 "Orientation speed gain (D item)

- To increase the servo rigidity<sup>※1</sup> during orientation stop by Pr. 110 and Pr. 111, adjust with the following procedures.

- (1) Increase the Pr. 113 "Orientation position gain" value to the extent that rocking<sup>※3</sup> does not occur during orientation stop.
- (2) Increase Pr. 110 and Pr. 111 at the same rate.  
Generally Pr. 110 is adjusted between 10 and 100, and Pr. 111 between 1 and 10.

(Note that these do not need to be set to the same rate.)

〈Example〉

When the Pr. 110 value is multiplied by 1.2, multiply the Pr. 111 value by 1.2.

If vibration occurs during orientation stop, the scale cannot be raised any higher.

- (3) Pr. 112 is the lag/advance compensation gain.  
The limit cycle<sup>※2</sup> can be provided by increasing the value, and the running can be stopped stably. However, the torque in regard to the position deviation will drop, and the motor will stop with deviation.

- Application of lag/advance control and PI control.

PI control can be applied by setting Pr. 112 to 0. Normally, the lag/advance control is selected. Use PI control in the following cases.

- (1) When using a machine with a high spindle stationary friction torque and requires a stopping position precision.

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※1. Servo rigidity: This is the response when a position control loop is configured. When the servo rigidity is raised, the holding force will increase, the running will stabilize, but vibration will occur easily. When the servo rigidity is lowered, the holding force will drop, and the setting time will increase.

※2. Limit cycle: This is a phenomenon that generates  $\pm$  continuous vibration centering on the target position.

※3. Rocking: Movement in which return occurs if the stopping position is exceeded.

**Adjust the orientation time and vibration**



- ⇒ Pr. 113 "Orientation position gain"  
⇒ Pr. 115 "Orientation deceleration rate"

- Adjust Pr.113 and 115 using the following procedure, according to the orientation state.  
(The details of Pr. 110 and Pr. 111 are also described, so refer to those items also.)  
Generally, Pr. 113 is adjusted between 5 and 20, and Pr. 115 between 5 and 50.

Phenomenon	Adjustment procedure			
	Pr.110	Pr.111	Pr.113	Pr.115
Rocking occurs during stopping	③ ↗	③ ↘	② ↘	① ↘
The orientation time is long	→	→	② ↗	① ↗
Hunting occurs when stopping	② ↘	② ↘	① ↘	→
The servo rigidity during stopping is low	① ↗	① ↗	② ↗	→

- (Note 1)** ↗ : Increase the parameter setting value.  
→ : Do not change the parameter setting value.  
↘ : Decrease the parameter setting value.

- (Note 2)** The numbers ① ② and ③ in the table show the order of priority for changing the parameter setting value.

 <b>CAUTION</b>	If orientation stop is not possible and the excessive position error alarm occurs, or if the motor does forward/reverse reciprocation operation  , the parameter setting value for the orientation detector installation direction may be incorrect. Review Pr. 119 "Orientation specifications".
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**Determine the orientation stop position.**

⇒ PR. 114 "Orientation position shift"

- The orientation stop position can be finely adjusted with the parameter of Pr. 114 "Orientation position shift".

**(1) Setting**

The orientation stop position will deviate by the value set to divide the 360° rotation by  $4096 \times 360^\circ / 4096$ . (The 4096 division is fixed regardless of the PLG being used.)

Finely adjust the position by changing this setting value in increments of 10.

The orientation stop position will differ according to the direction that the PLG is installed in, so refer to the following drawings and make the settings.

	Case 1	Case 2
Installation direction		
Normal orientation	<p>View from arrow A</p>	<p>View from arrow A</p>

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**Set the orientation changeover speed**

⇒ Pr. 116 "Orientation changeover speed"

- The speed for changing between the speed control mode and position control mode during orientation is set.

Stable orientation stop is possible when the set speed is decreased, however, the orientation time will increase.

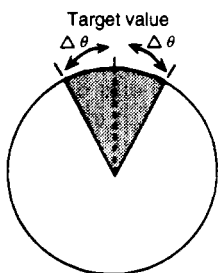
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**Set the width to complete orientation**

⇒ Pr. 117 "Orientation complete width"

- The positioning width for "orientation complete output signal" can be set.

**(1) Example of operation**



$$\Delta \theta = \frac{360^\circ}{4096} \times \text{Pr.117}$$

- If the position detection value from the PLG enters  $\pm\Delta\theta$  during orientation stop, the orientation complete signal (terminal ORA) will be output.

**(2) Setting**

The default value of Pr. 117 is "11". To change the  $\Delta\theta$  value, finely adjust with  $\pm 10$  increments.

**(Note)** This setting is used to judge the ON/OFF of the orientation complete signal, and does not determine the orientation stop precision.

**Determine the orientation specifications**

⇒ Pr. 119 "Orientation specifications"

- This parameter sets the rotation direction, detector direction, and type, etc., details for orientation.

**(1) Setting**

Pr. 119 = 1st digit 2nd digit 3rd digit

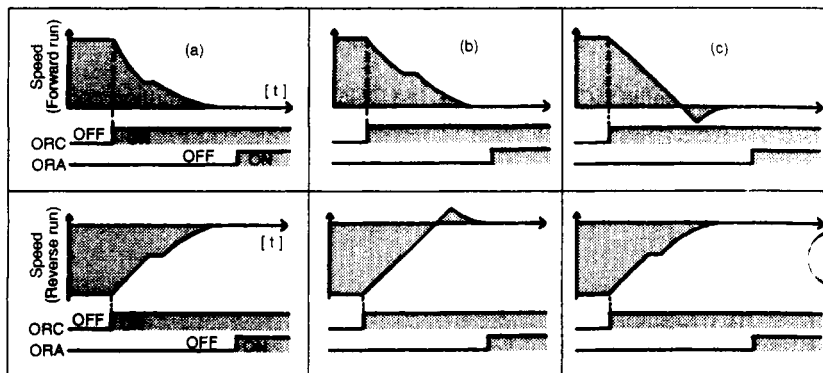
Orientation rotation direction	0 = Pre-orientation 1 = Forward orientation 2 = Reverse orientation
Orientation detector direction	0 = (+) 1 = (-)
Orientation type	0 = Orientation disable 1 = Machine end detector orientation 2 = Motor end detector orientation

**(Note)** If the 1st digit setting value is "0", nothing will be displayed in the 1st digit of the 3-digit display.  
If only "0" is set in the 1st digit, the setting will display to indicate setting value "000".

**(2) Operation**

The following three methods of orientation stop can be selected.

- |                                   |  |
|-----------------------------------|--|
| (1) Pre-orient .....              | (a) Orientation is executed from the current rotation direction. |
| (2) Forward run orientation ..... | (b) Orientation is executed from the forward run direction.      |
| (3) Reverse run orientation ..... | (c) Orientation is executed from the reverse run direction.      |



### 3.4.1 Specifications

(1) Repeated positioning precision

$\pm 1.5'$

**(Note)** This will differ according to the load torque, load  $GD^2$  or load backlash conditions.

(2) Tolerable speed

PLG installation shaft speed  
6,000r/min. or less

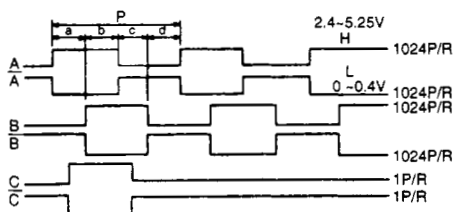
**(Note)** As a condition, the coupling of the drive shaft and PLG installation shaft must be a direct coupling or belt coupling, and have no slippage. Note that gear change or variable pulleys methods cannot be used.

(3) Position detector (pulse encoder) 1024P/R line driver LED type pulse PLG

A.  $\bar{A}$  signal 1024P/R  
B.  $\bar{B}$  signal 1024P/R  
C.  $\bar{C}$  signal 1P/R

( Tamagawa Seiki  
TS1508N207,  
TS5008N122,  
TS5108N122  
or equivalent product )

Output pulse specifications



Pin Nos. for PLG output signal (For Tamagawa Seiki TS1508N207)

Pin No.	Details	Pin No.	Details
A	A phase signal	P	C phase reverse signal
N	A phase reverse signal	H	+5V power supply input
C	B phase signal	K	Power supply common
R	B phase reverse signal	E	Case grounding
B	C phase signal		

If the motor rotates in the clockwise direction when looking from the end of the PLG shaft, a, b, c and d are  $(1/4 \pm 1/8)P$ .

- 
- (4) Holding force after positioning
  - (5) Input signal (Contact input)

Servo lock function provided

- Orientation command
- Forward run/reverse run command
- Stop position command (open collector signal input is also possible)  
Max. 5 bit binary signal

- (6) Output signal (Open collector output)

- (7) Power supply

- Orientation complete signal

A 5V power supply for the pulse PLG is provided.



## 4. Expansion input functions

The Functions for the multi-function input terminals can be assigned with each digit of the selection parameters (Pr. 100, Pr. 101).

### 4.1 Outline

The terminal inputs can be expanded by six points by assigning the input terminals DI11 to DI16 with Pr. 100 and Pr. 101 "Multi-function input selection A1, A2". Three points can also be selected with Pr. 17 "Input terminal assignment" on the inverter side, so a total of nine points can be used as the input terminals.

**(Note)** This function is validated when "0" is set for the encoder type in Pr. 119 "Orientation specifications" and the orientation function is disabled.

### Settings

- (1) Ten types of functions can be independently assigned to input terminals DI11 to DI13 and DI14 to DI16, made with a 3-digit integer set in Pr. 100 and Pr. 101. The No. of each digit indicates the function of each terminal.

Pr. \_\_\_\_ =    (Default value = 0)

Parameter	1	2	3	Meaning
Pr.100	DI11	DI12	DI13	Multi-function input selection
Pr.101	DI14	DI15	DI16	Multi-function input selection

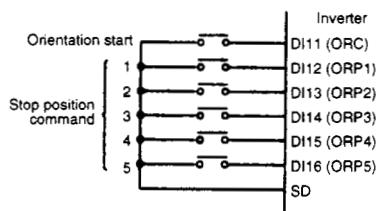
**(Note)** If the 1st digit setting value is "0", nothing will be displayed in the 1st digit of the 3-digit display.  
If only "0" is set in the 1st digit, the setting will display a value "000".

- (2) Refer to the following table to set Pr. 100 and Pr. 101 "Multi-function input selection A1, A2".

No.	Symbol	Function name	Meaning
0	RH	Multi-speed setting 1	The speed of Pr. 4 is used.
1	RM	Multi-speed setting 2	The speed of Pr. 5 is used.
2	RL	Multi-speed setting 3	The speed of Pr. 6 is used.
3	JOG	JOG operation	The speed of Pr. 165 is set.
4	RT	No. 2 function changeover	The No. 2 function is changed over to.
5	MRS	Free run terminal.	The output is shut off when MRS-SD turns ON.
6	STOP	Run signal hold	3-wire operation is possible with a combination with STF and STR
7	LX	Pre-excitation	Servo lock is provided during pre-excitation and positioning when LX-SD is turned ON.
8	MC	Control mode changeover	The control mode is changed between speed, torque and position.
9	TL	Torque control selection	The torque limit value can be changed with Pr. 38.

- (3) DI11 to DI16 will be as shown below when the orientation type "1" or "2" is selected with Pr. 119 "Orientation specifications", and the orientation function is enabled.

Input	Symbol	Function name
DI11	ORC	Orientation start
DI12	ORP1	Stop position command 1
DI13	ORP2	Stop position command 2
DI14	ORP3	Stop position command 3
DI15	ORP4	Stop position command 4
DI16	ORP5	Stop position command 5



**(Note)** Refer to the section for Pr. 17 in the inverter instruction manual for details on the combination of the "multi-speed setting".

The stop position command selects the orientation stop position with a combination of the 1 to 5 5-bit input (32 division)

Stop position command					Orientation stop position
5	4	3	2	1	
x	x	x	x	x	0°
x	x	x	x	○	11.25°
x	x	x	○	x	22.50°
○	○	○	○	x	337.50°
○	○	○	○	○	348.75°

x : Indicates open between DI[ ]-SD

○ : Indicates short circuit between DI[ ]-SD

### <Reference>

To stop at a finer stop position than the 32-division stop position, adjust Pr. 114 (Position shift).

## 4.3 Specifications

### (1) Types of input signals

Select the signal from high speed, middle speed, low speed, JOG operation, No. 2 function selection, output stop, start self-hold selection, pre-excitation, control mode changeover and torque control selection.

(2) Selection of input signals ..... Select with Pr. 100 and Pr. 101.

(3) Selection of input terminals ..... Select the open collector output or no-voltage contact signal.



(2) Refer to the following table to set Pr. 102 "DO terminal function selection".

No.	Symbol	Function name	Meaning
0	ER	Fault output	This turns ON when an error occurs.
1	SU	Speed reached	This turns ON when the speed enters the range set in Pr. 41 "Frequency reached operation width".
2	LS	Low speed output	This turns ON when the speed drops below the value set with Pr. 43 "Low speed detection".
3	FU	Speed detection	This turns ON when the speed rises above the value set in Pr. 42 "Speed detection".
4	RUN	Running	This turns ON while the forward run or reverse run signal is ON. Note that this will turn OFF during pre-excitation.
5	OL	Overload	This turns ON when the torque limiting or an undervoltage error.
6	IPF UVT	Instantaneous power failure/undervoltage occurrence	This turns ON during an instantaneous power failure or undervoltage error.
7	PU	In parameter running	This turns ON while running with the parameter unit.
8	TU	Torque detection	This turns ON when the torque rises above the value set in Pr. 39 "Torque detection".
9	RY	Ready	This turns ON when pre-excitation is completed. If pre-excitation is not used, this will turn ON when output starts.

(3) DO11 will be the orientation complete signal when the orientation function is enabled (when PR. 119 is set to "1" or "2").  
DO12 and DO13 will not function at this time.

Output	Symbol	Function name
DI11	ORF	Orientation complete
DI12	—	Not used
DI13	—	Not used

## 5.3 Specifications

### (1) Output signals

Three types of signals are selected from minor fault output, speed reached, low speed output, speed detection, running, overload, instantaneous power failure/undervoltage occurrence, in parameter running, torque detection and ready can be output.

### (2) Tolerable load

DC24V, 0.1 A

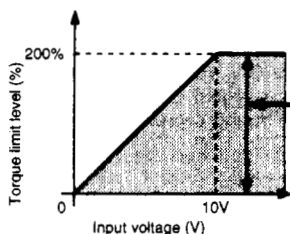
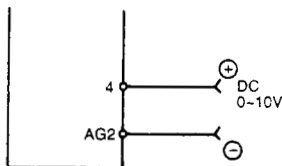
## 6. Expansion analog input

This is an analog input valid only during speed control, and is used when the torque limit value for power-factor and regeneration is to be changed.

### 6.1 Torque limit level signal.

Input 0 to 10V in terminal 4.

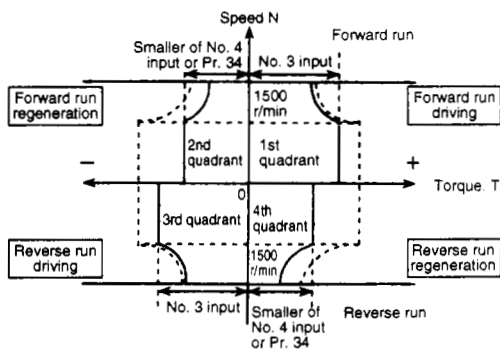
The torque limit value will change according to the input voltage.



The torque limit level during the input voltage (10V) is the same level as Pr. 905 (torque command No. 3 gain).

The external input terminal 4 is valid when Pr. 33 (torque control mode) is set to 2.

The torque limit level from terminal 4 is set during forward run (or reverse run) regeneration. (Note 1)



(Note 1) The torque limit level during forward run (reverse run) regeneration is the smaller of the Pr. 34 (torque limit level) setting value and terminal 4 setting value.

(Note 2) The torque limit from an external source will not be the torque when the control wire is broken or when the option is not mounted. Thus, take special care when using this for elevators or transfer machines. If an accident such as overrunning could occur in the elevator, etc., use the internal torque limit.

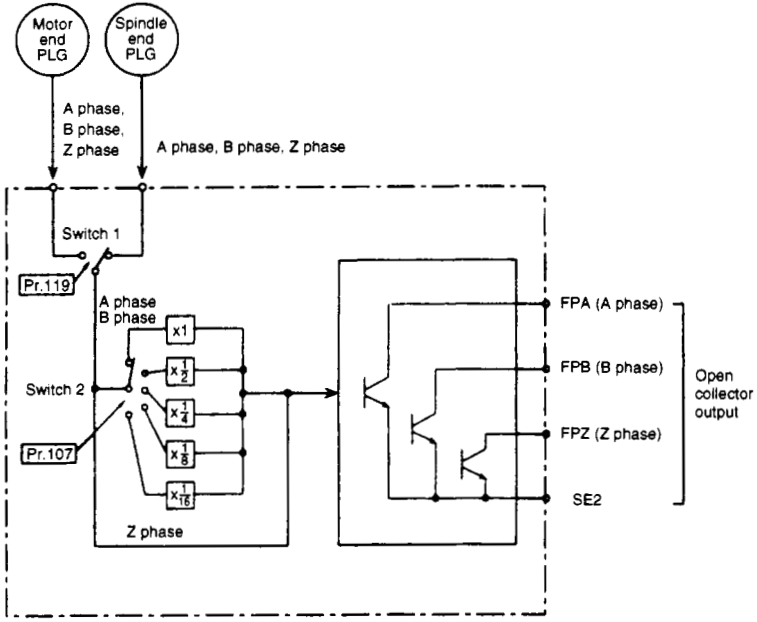
# 7. Encoder pulse train output function

The encoder pulse input connected to the inverter or option unit can be output from the option terminal.

The spindle end encoder and motor end encoder pulse signals can be selected with parameters.

The pulse train output can also be divided.

## 7.1 Connection example



## 7.2 Setting

### (1) Pr. 119 "Orientation specifications"

Switch 1 can be selected and set when the orientation type is selected and set with Pr. 119 "Orientation specifications".

Pr.119	Function	Switch 1
0	Orientation disabled	Motor end PLG pulse selection
1	Machine end detector orientation	Spindle end PLG pulse selection *
2	Motor end detector orientation	Motor end PLG pulse selection

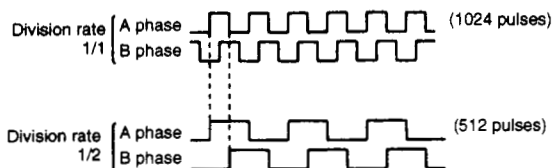
### (2) Pr. 107 "PLG division rate"

- The motor end and spindle end PLG pulse signals can be divided by the division rate and output. This is used to delay the response of the machine which the signal is being input.

Pr.107	Switch 2 (division rate)
0	$\times 1$
1	$\times \frac{1}{2}$
2	$\times \frac{1}{4}$
3	$\times \frac{1}{8}$
4	$\times \frac{1}{16}$

(Note) If the No. of PLG pulses is 1000P/r, the max. division rate will be 1/8.

- Division waveform (Operation example) (EX. 1024 pulses)  
The ON/OFF widths both become doubles of the divider. (50% duty)





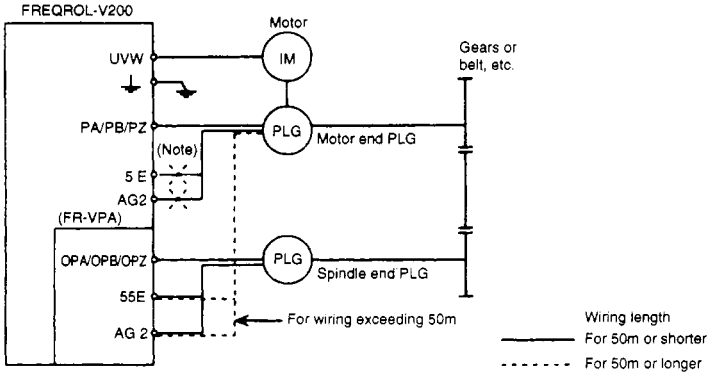
## 8. Power supply for long distance cable

This power supply can be used for the spindle end PLG cable.

This power supply can also be used for the motor end PLG cable that uses a long distance cable (50m to 100m).

- If the cable length is within 50m, only the inverter is required. However, if the length is 50m or longer, the following precautions will be required.

### 8.1 Connection example



(Note) If the wire is 50m or longer, reconnect from 5E/AG2 to 55E/AG2.

### 8.2 Explanation of terminals

Terminal symbol	Terminal name	Details
55E	Power supply ground terminal	Terminal for DC5.5V output, tolerable load current 500mA
AG2	Power supply (+ side) output terminal	Common terminal for DC5.5V output. This terminal is isolated from the control circuit common terminal. Do not ground this terminal.

### 8.3 Wiring with position detector (PLG)

- Specifications for selection and PLG cable manufacturing

#### ※ Motor (built-in) PLG

Wiring distance	PLG cable (option)	Manufactured cable		Connection of PLG power supply
		To wire with 0.2mm <sup>2</sup>	To increase the size	
0 ~ 5m	FR-VCBL5 FR-JCBL5	Two parallel or more	0.4mm <sup>2</sup> or more	Terminal 5E ↔ AG2 (inverter) (Approx. 5V)
5 ~ 10m	FR-VCBL15 FR-JCBL15	Two parallel or more	0.4mm <sup>2</sup> or more	
10 ~ 15m		Four parallel or more	0.75mm <sup>2</sup> or more	
15 ~ 20m	FR-VCBL30 FR-JCBL30	Four parallel or more	0.75mm <sup>2</sup> or more	
20 ~ 30m		Six parallel or more	1.25mm <sup>2</sup> or more	
30 ~ 50m	None	Six parallel or more	1.25mm <sup>2</sup> or more	
50 ~ 100m		Six parallel or more	1.25mm <sup>2</sup> or more	Terminal 55E ↔ AG2 (Option FR-VPA) (Approx. 5.5V)

#### ※ Spindle end PLG

Wiring distance	PLG cable (option)	Manufactured cable		Connection of PLG power supply
		To wire with 0.2mm <sup>2</sup>	To increase the size	
0 ~ 5m	None	Two parallel or more	0.4mm <sup>2</sup> or more	Terminal 5E ↔ AG2 (inverter) (Approx. 5V)
5 ~ 10m		Two parallel or more	0.4mm <sup>2</sup> or more	
10 ~ 15m		Four parallel or more	0.75mm <sup>2</sup> or more	
15 ~ 20m		Four parallel or more	0.75mm <sup>2</sup> or more	
20 ~ 30m		Six parallel or more	1.25mm <sup>2</sup> or more	
30 ~ 50m		Six parallel or more	1.25mm <sup>2</sup> or more	
50 ~ 100m		Six parallel or more	1.25mm <sup>2</sup> or more	Terminal 55E ↔ AG2 (Option FR-VPA) (Approx. 5.5V)

☆ Use these as reference for manufacturing the PLG cable.

(1) Wiring of option unit and position detector (PLG)

● Use the option FR-VCBL, FR-JCBL (cable).

● If a cable is not available, manufacture one according to the specifications for PLG cable manufacturing.

(2) Parallel connect the wiring between the terminals "55E" and "AG2" and the position detector (PLG), or use a larger wire size.

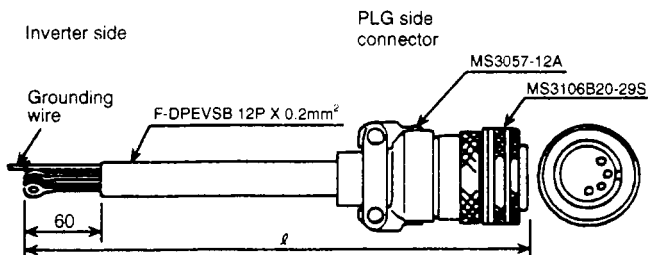
The details for selection and manufacturing are given below.

(3) Even if the FR-VPA 5.5V power supply is used, the long distance cable may not be usable depending on the wiring conditions.

In that case, prepare a separate 5V power supply externally (near the PLG).

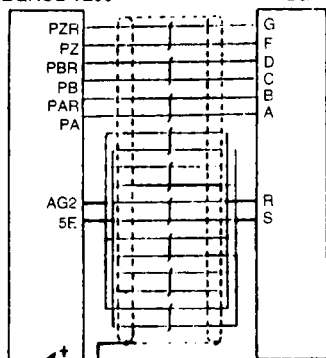
(4) PLG cable

■ Outline drawing of FR-VCBL



FREQROL-V200

PLG

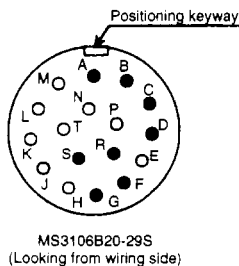


Type	Length $l$ (m)
FR-VCBL 5	5
FR-VCBL15	15
FR-VCBL30	30

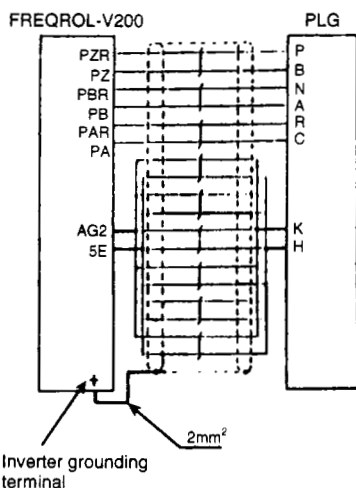
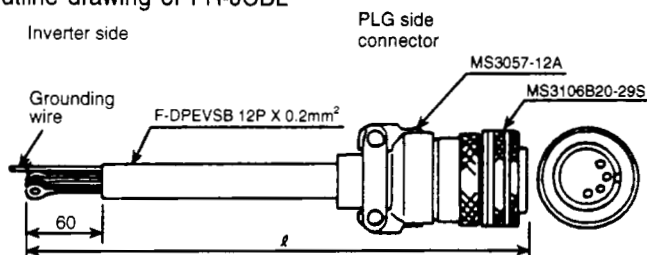
Inverter grounding terminal

2mm<sup>2</sup>

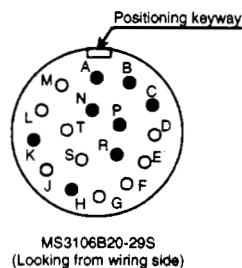
Grounding cable  
(Connect to the inverter grounding terminal)



## Outline drawing of FR-JCBL



Type	Length $l$ (m)
FR-JCBL 5	5
FR-JCBL15	15
FR-JCBL30	30



**(Note)** If the wiring length is 100m or longer, the feedback from the positioning detector (PLG) will not be output correctly.

### ⚠ CAUTION

If the wiring length is long, the voltage supplied to the PLG may drop due to the voltage drop. Always wire as shown above to prevent voltage drop so that the voltage supplied to the PLG is within tolerance.

### ⚠ CAUTION

Route the PLG wiring away from noise sources (main circuit, high voltage circuit, etc.) so that it is not affected by EMC.

### ⚠ CAUTION

Never short circuit between 55E and AG2. The option unit could be damaged.

## REVISIONS

※The manual number is given on the bottom left of the back cover.

Print date	Manual Number	Revision
Nov. 1995	IB(NA)-66598-A	First edition
June 1996	IB(NA)-66598-B	Partial revisions Front cover, contents, pages 3-1 ~ 3-5, 3-7, 3-8, 3-11, 3-12, 3-14, 3-15, 7-1, 7- 2, 8-1 ~ 8-4, back cover.

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Type	FR-VPA EIBUN TORISETSU
Code	IA2G50