



VECTOR INVERTER

-INSTRUCTION MANUAL-

MACHINE END PLG
ORIENTATION CONTROL

FR-V5AM

Thank you for choosing the Mitsubishi vector inverter option unit.

This instruction manual gives handling information and precautions for use of this equipment. Incorrect handling might cause an unexpected fault. Before using the equipment, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect this product until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use this product 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".



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



Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention



- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for no residual voltage with a tester or the like.



WARNING

- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the option unit before wiring. Otherwise, you may get an electric shock or be injured.
- Handle this option unit with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.

2. Injury Prevention



CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent burst, damage, etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent burst, damage, etc.
- While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

3. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.:

(1) Transportation and mounting



CAUTION

- Do not install or operate the option unit if it is damaged or has parts missing.
- Do not stand or rest heavy objects on the product.
- Check that the mounting orientation is correct.
- Prevent screws, metal fragments or other conductive bodies or oil or other flammable substance from entering the inverter.

(2) Test operation and adjustment



CAUTION

- Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

(3) Usage



WARNING

- Do not modify the equipment.



CAUTION

- When parameter clear or all parameter clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

(4) Maintenance, inspection and parts replacement



CAUTION

- Do not test the equipment with a megger (measure insulation resistance).

(5) Disposal



CAUTION

- Treat as industrial waste.

(6) General instruction

All illustrations given in this manual may have been drawn with covers or safety guards removed to provide in-depth description. Before starting operation of the product, always return the covers and guards into original positions as specified and operate the equipment in accordance with the manual.

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1.PRE-OPERATION INSTRUCTIONS

1.1 Unpacking and Product Confirmation

Take the option unit out of the package, check the unit name, and confirm that the product is as you ordered and intact.

This product is an option unit designed for exclusive use in the Mitsubishi FR-V500 series vector inverter. Before using it, check the type and SERIAL number of the inverter.

- SERIAL number check

This product may be used with the FR-V520-1.5K to 7.5K, 30K and 37K manufactured in and after February 2002. Any of the models may be used with this unit if its SERIAL number indicated on the rating plate and package has the following version or later.

SERIAL is made up of 1 version symbol, 1 alphabet letter or numeric character indicating month, and 7 numeric characters indicating the year and control number as shown below. (Only the first three digits of the control number are printed on the package.)

F 2 2 000000
Symbol Year Month Control number
SERIAL number

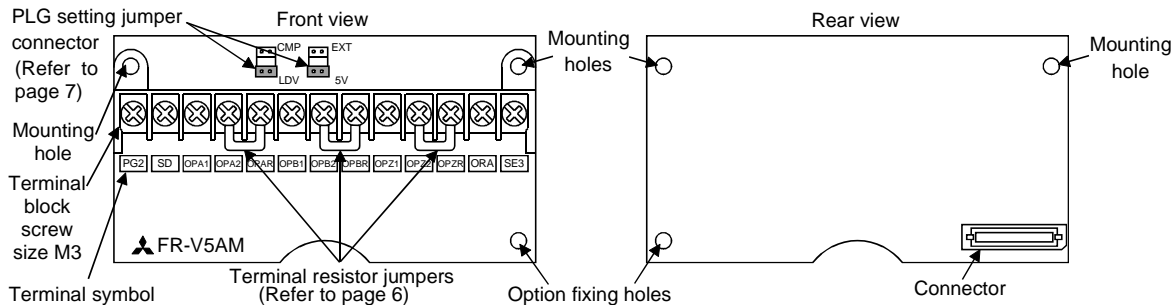
Model	SERIAL Number	Date Manufactured
FR-V520-1.5K to 7.5K	F22000000	in and after February 2002
FR-V520-30K	B22000000	
FR-V520-37K	C22000000	

1.2 Packing Confirmation

Make sure that the package includes the following

- Instruction manual1
- Mounting screws M3 × 102
- Terminal resistor jumpers (Jumpers fitted to the terminal block)3

1.3 Structure



2.INSTALLATION

2.1 Pre-Installation Instructions

Make sure that the input power of the inverter is off.



CAUTION

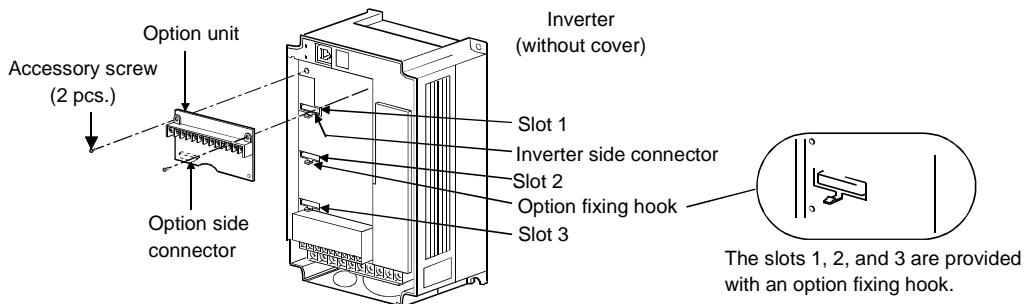


With input power on, do not install or remove the option unit. Otherwise, the inverter and option unit may be damaged.

2.2 Installation Procedure

- (1) Securely insert the connector of the option unit far into the connector of the inverter. At this time, fit the option fixing holes snugly.
Also be sure to fit the unit into the option fixing hook.
- (2) Securely fix the two right and left places of the option unit to the inverter with the accessory mounting screws. If the screw holes do not line up, the connector may not have been plugged snugly. Check for looseness.

INSTALLATION



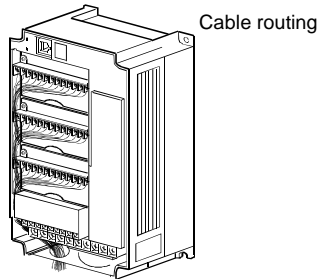
CAUTION

1. Only one type of option per inverter may be used. When two or more options are mounted, priority is in order of slots 1, 2 and 3, the options having lower priority are inoperative.
2. When the inverter cannot recognize that the option is mounted, it displays the option error. The errors shown differ according to the mounting slots 1, 2, 3.

Mounting Position	Error Display
Slot 1	E.OP1
Slot 2	E.OP2
Slot 3	E.OP3

2.3 Wiring

Route the wires so that they do not take up a lot of space in the control circuit terminal block of the option unit. During wiring, do not leave wire off-cuts in the inverter. They may cause a fault, failure or malfunction. Use the space on the left side of the control circuit terminal unit to route the wires.



REMARKS

The wires with large gauge may not be connected to the terminal block. When connected in parallel, all wires may not fit in the wiring space due to the increased number of wires. In such cases, perform wiring by using a junction terminal block.



CAUTION

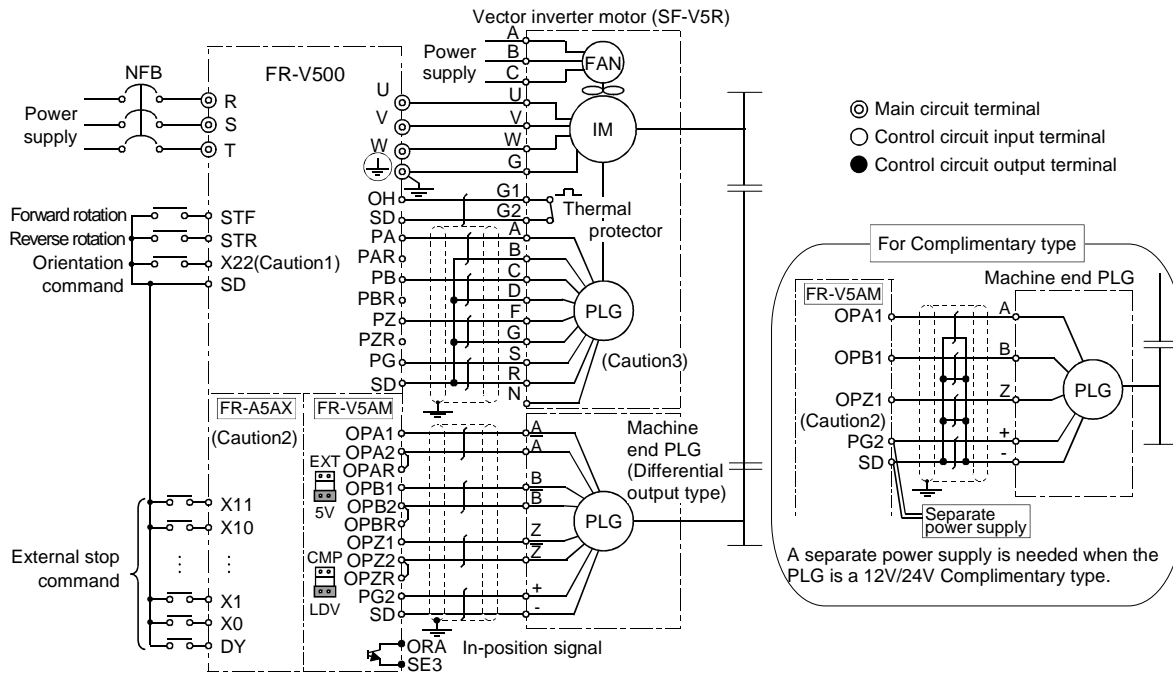


When installing the inverter front cover, the cables to the inverter's control circuit terminals and option terminals should be routed properly in the wiring space to prevent them from being caught between the inverter and its cover.

3. ORIENTATION CONTROL

This function is used with a position detector (PLG) installed to the spindle of a machine tool (or the motor) to allow a rotary shaft to be stopped at the specified position (oriented). Pr. 350 "stop position command selection" is factory-set to "9999" to make the orientation control function invalid.

3.1 Wiring Example



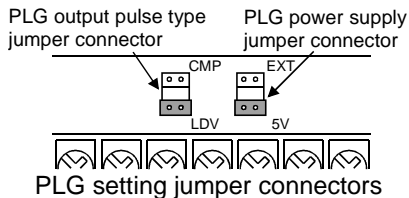
CAUTION

1. Please set "22" in the "input terminal function selection"(Pr.180 to Pr.183 and Pr.187).
2. When inputting stop position command from outside, the built-in option FR-V5AX, FR-V5AH or FR-A5AX is necessary.
3. For terminal specifications, refer to the instruction manual (basic) of the inverter.

3.2 PLG setting

●PLG power supply specifications and pulse output type setting

According to the PLG specifications, change the positions of the jumper connectors provided above the terminals.



- PLG power supply jumper connector
Change its position according to the PLG specifications.
EXT.....External power supply
5V5.5V power supply (factory setting)
- PLG output pulse type jumper connector
Change its position according to the pulse output type.
CMP.... Complimentary output
LDV.....Differential line driver output (factory setting)

CAUTION

When the connector is fitted to complimentary, remove jumpers across terminals OPA2-OPAR, OPB2-OPBR, and OPZ2-OPZR.

3.3 Explanation of terminals

<Inverter I/O terminals>

Symbol	Terminal	Description
X22 (*)	Orientation command input terminal	Used to enter an orientation signal.
SD	Common terminal	Common terminal for the orientation signal.

REMARKS

Please set "22" in the "input terminal function selection"(Pr.180 to Pr.183 and Pr.187).

ORIENTATION CONTROL

<FR-V5AM terminals>

Terminal symbol	Terminal name	Rated current, etc.	Application
Input terminals	OPA1	Differential PLG A phase signal input terminal	<p>A phase, B phase and Z phase (zero point and mark pulse) signals from the PLG are input.</p> <p>Terminals OPA2-OPAR, OPB2-OPBR, and OPZ2-OPZR are connected with a jumper at factory shipment. When the termination resistor is not necessary, remove the jumpers.</p>
	OPA2	Differential PLG A phase reverse signal input terminal	
	OPB1	Differential PLG B phase signal input terminal	
	OPB2	Differential PLG B phase reverse signal input terminal	
	OPZ1	Differential PLG Z phase signal input terminal	
	OPZ2	Differential PLG Z phase inverse signal input terminal	
	OPAR	A phase termination resistor terminal	
	OPBR	B phase termination resistor terminal	
OPZR	Z phase termination resistor terminal		
Output terminal	PG2	DC power (positive side) output terminal	<p>5.5VDC Permissible load 350mA Supply for PLG*</p> <p>Supplies power to the PLG. Connect PG2 to the positive side and SD to the negative side. When another power supply is used, connect PG2 to the positive side and SD to the negative side.</p>
	SD	DC power ground terminal	
	ORA	Orientation completion signal output terminal	<p>Open collector output Permissible load 24VDC 0.1A</p> <p>The output is Low when the start signal and orientation signal are input and orientation stops within the orientation completion width.</p>
	SE3	Open collector output common	—

*: A separate power supply is required for connection to the 12V/24V complimentary output type. When an another power supply is used, it is necessary to set the jumper connector. Refer to page 7 for the setting details.

3.4 Parameter

3.4.1 Parameter List

For orientation control at a machine end, the parameter values are the same as those used when orientation control is exercised at a motor end by the inverter. However, the PLG rotation direction and the number of PLG pulses used are not those set in Pr. 852 "PLG rotation direction" and Pr. 851 "number of PLG pulses" but those in Pr. 359 "PLG rotation direction for orientation" and Pr. 369 "number of PLG pulses for orientation". For setting orientation control at the machine end, set Pr.393 "orientation selection" to "10, 11 or 12".

Parameter No.	Name	Setting Range	Minimum Setting Increments	Factory Setting
350	Stop position command selection	0, 1, 2, 9999	1	9999
351	Orientation switchover speed	0 to 1000r/min	1r/min	200r/min
356	Internal stop position command	0 to 16383 (*1)	1	0
357	Orientation in-position zone	0 to 8192	1	11
359 (*2)	PLG rotation direction for orientation	0, 1	1	1
360	External position command selection	0, 1, 2 to 127	1	0
361	Position shift	0 to 16383 (*1)	1	0
362	Orientation position loop gain	0.1 to 100	0.1	10
369 (*2)	PLG pulse count for orientation	0 to 4096	1	1024
393	Orientation selection	0, 1, 2, 10, 11, 12	1	0
394 (*2)	Number of machine side gear teeth	0 to 32767 (*1)	1	1
395 (*2)	No. of motor side gear teeth	0 to 32767 (*1)	1	1
396	Orientation speed gain (P term)	0 to 1000	1	60
397	Orientation speed integral time	0 to 20.0s	0.001	0.333
398	Orientation speed gain (D term)	0 to 100.0%	0.1	1
399	Orientation deceleration ratio	0 to 1000	1	20

*1 When the FR-DU04-1 is used, up to 9999 may be set. When the FR-PU04V is used, up to the maximum value may be set.

*2 Setting is enabled when the FR-V5AM is fitted

3.4.2 Parameter Setting

If the orientation command signal (X22) is turned on during operation after the various parameters have been set, the speed will decelerate to the "orientation switchover 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" (ORA) will be output when the "orientation complete width" is entered.

- **Selecting stop position command**

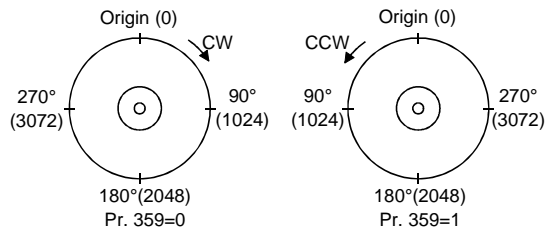
- (1) Pr.350 "Stop position command selection"

Select either the internal stop position command (Pr. 356) or the external stop position command (6/12-bit data).

Pr. 350 Setting	Type of Command
0	Internal stop position command (Pr. 356:0 to 16383)
1	External stop position command (FR-V5AX) 6 bit data
2	External stop position command (FR-A5AX) 12 bit data
3	External stop position command (FR-V5AH) 16 bit data
9999 (factory setting)	Orientation control invalid

- 1) Internal stop position command (Pr. 350="0")

The value set in Pr. 356 is the stop position. When the number of PLG pulses is 1024p/r, one revolution of the PLG (360 degrees) is divided into 4096 positions, i.e. 360 degrees/4096 pulses = 0.0879 degrees/pulses per address, as shown on the right. The stop positions (addresses) are indicated in parentheses.



2) External stop position command (Pr. 350="1")

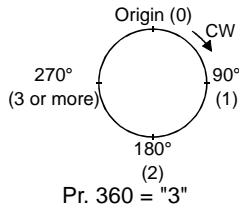
(Pr. 360 "external position command selection" (factory setting: 0))

Mount the option FR-V5AX and set a stop position using 6-bit data (binary input).

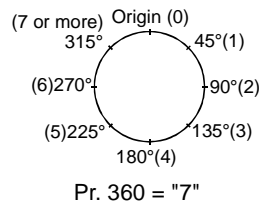
- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

Pr. 360 Setting	Description
0	External stop position command is made invalid (multi-function input with the FR-V5AX)
1	Set 64 stop positions at regular intervals
2 to 127	Set the stop position command dividing up to 128 stop positions at regular intervals. Note that the stop command greater than the 64 stop positions can not be entered if the number of stop positions are 65 to 128. If the external stop command entered is greater than the setting, the stop positions are the same as those in the maximum external stop command value. <Example> When the number of stop positions is 20 (divided at intervals of 18 degrees), $20 - 1 = 19$. Hence, set "19".

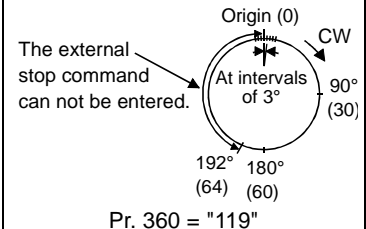
[Example 1] 4 stop positions



[Example 2] 8 stop positions



[Example 3] 120 stop positions



ORIENTATION CONTROL

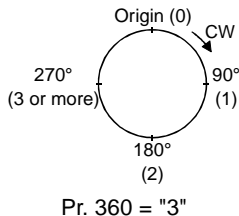
3) External stop position command (Pr. 350="2")

Mount the option FR-A5AX and set a stop position using 12-bit data (binary input).

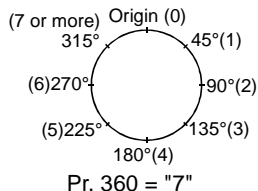
- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

Pr. 360 Setting	Description
0	Speed command is made invalid (speed command with the FR-A5AX)
1	Set 4096 stop positions at regular intervals
2 to 127	Set the stop position command dividing up to 128 stop positions at regular intervals. If the external stop command entered is greater than the setting, the stop positions are the same as those in the maximum external stop command value. <Example> When the number of stop positions is 90 (divided at intervals of 4 degrees), $90 - 1 = 89$. Hence, set "89".

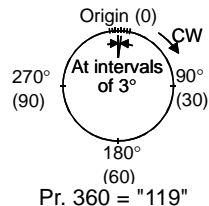
[Example 1] 4 stop positions



[Example 2] 8 stop positions



[Example 3] 120 stop positions



CAUTION

- Values in parentheses indicate binary data entered from the input terminals of the FR-A5AX. If the position pulse monitoring (Pr. 52 "DU/PU main display screen data selection" = 19) is selected, the data monitored is not the number of stop positions but is 0 to 4095 pulses.
 - When any of "1 to 127" is set in Pr. 360, parameters (Pr. 300 to Pr. 305) of the FR-A5AX are made invalid. (Parameters are valid when Pr. 360="0".)
 - Terminal DY (Data read timing input signal) is made invalid. (The position data import is performed at the start of orientation.)
 - When the option is not fitted or Pr. 360="0", the stop position is 0 even if the external stop position command is selected with the Pr. 350 setting.
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ORIENTATION CONTROL

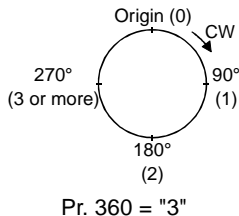
4) External stop position command (Pr. 350="3")

Mount the option FR-V5AH and set a stop position using 16-bit data (binary input).

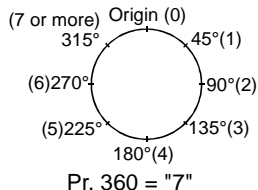
- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

Pr. 360 Setting	Description
0	Speed command is made invalid (speed command or torque command with the FR-V5AH)
1	Set 65536 stop positions at regular intervals
2 to 127	Set the stop position command dividing up to 128 stop positions at regular intervals. If the external stop command entered is greater than the setting, the stop positions are the same as those in the maximum external stop command value. <Example> When the number of stop positions is 90 (divided at intervals of 4 degrees), $90 - 1 = 89$. Hence, set "89".

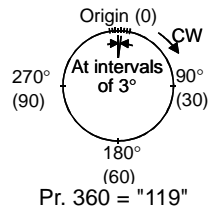
[Example 1] 4 stop positions



[Example 2] 8 stop positions



[Example 3] 120 stop positions

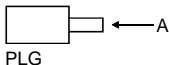


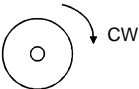
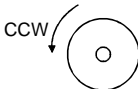
CAUTION

- Values in parentheses indicate binary data entered from the input terminals of the FR-A5AX. If the position pulse monitoring (Pr. 52 "DU/PU main display screen data selection" = 19) is selected, the data monitored is not the number of stop positions but is 0 to 65535 pulses. (For the FR-DU04-1, 0 to 9999 are displayed.)
 - When any of "1 to 127" is set in Pr. 360, parameters (Pr. 300 to Pr. 305) of the FR-V5AH are made invalid. (Parameters are valid when Pr. 360="0".)
 - Terminal DY (Data read timing input signal) is made invalid. (The position data import is performed at the start of orientation.)
 - When the option is not fitted or Pr. 360="0", the stop position is 0 even if the external stop position command is selected with the Pr. 350 setting.
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ORIENTATION CONTROL

- (2) Pr. 369 "PLG pulse count for orientation" (factory setting: 1024)
Set the number of PLG pulses output.
(Set the number of pulses before it is multiplied by 4.)
Example: Set "1024" for 1024 pulses per revolution (ppr).
- (3) Pr. 359 "PLG rotation direction for orientation" (factory setting: "1")
Indicates the direction in which the PLG rotates.



Pr. 359=0	Pr. 359=1
 <p>Forward rotation is clockwise rotation when viewed from A.</p>	 <p>Forward rotation is counterclockwise rotation when viewed from A.</p>

REMARKS

When Pr. 350 "stop position command selection" is set to make orientation control valid, the PU (FR-DU04-1/FR-PU04V) shows the rotation direction of the PLG.

Make setting so that FWD is displayed when the STF signal turns on or REV is displayed when the STR signal turns on.

• **Setting the rotation direction**

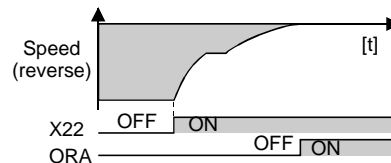
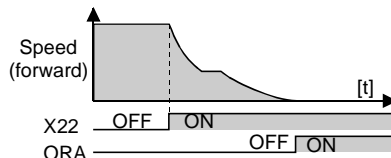
(1) Pr. 393 "orientation selection"

Pr. 393 setting	Rotation Direction	Type	Remarks
0 (factory setting)	Pre-orientation	Motor end orientation	Refer to the instruction manual (details) of the inverter for details.
1	Forward rotation orientation		
2	Reverse rotation orientation		
10	Pre-orientation	Machine end orientation	Orientation is executed from the current rotation direction.
11	Forward rotation orientation		Orientation is executed from the forward rotation direction. (If the motor is running in reverse, orientation is executed from the forward rotation direction after deceleration.)
12	Reverse rotation orientation		Orientation is executed from the reverse rotation direction. (If the motor is running in forward, orientation is executed from the reverse rotation direction after deceleration.)

ORIENTATION CONTROL

1) Orientation from the current rotation direction (Pr.393="10")

- When the orientation command (terminal X22) is input, the motor speed will decelerate from the running speed to Pr. 351 "orientation switchover speed". At the same time, the orientation stop position command will be read in. (The stop position command is determined by Pr.350 and Pr.360.)
- When the orientation switchover speed is reached, the PLG Z phase pulse will be confirmed, and the mode will change from speed control to position control (orientation position loop gain parameter (Pr. 362)).
- 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. 399), and the orientation (servo lock) state will be entered.
- When entered in the Pr. 357 in-position zone is entered, the orientation complete signal (terminal ORA) will be output.
- The zero point position (origin) can be moved using position shift (Pr. 361).



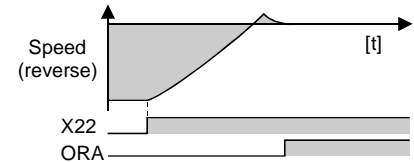
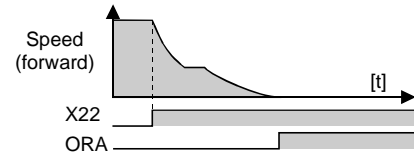
WARNING



If the orientation command (terminal X22) 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 rotation (reverse rotation) signal off.

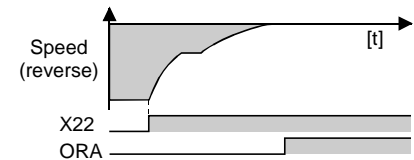
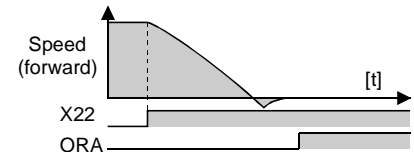
2) Orientation from the forward rotation direction (Pr.393=11)

- This method is used to improve the stopping precision and maintain the mechanical precision when the backlash is large.
- If the motor is running in the forward rotation direction, it will orientation stop with the same method as "orientation from the 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.



3) Orientation from the reverse rotation direction (Pr.393=12)

- If the motor is running in the reverse rotation direction, it will orientation stop with the same method as "orientation from the current rotation direction".
- If the motor is running in forward, it will decelerate, the rotation direction will be changed to reverse run, and then orientation stop will be executed.

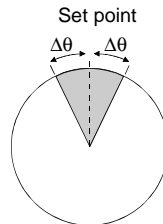


REMARKS

If "E.ECT" (no encoder signal) is displayed causing the inverter to trip when the orient signal (X22) is ON, check for an open cable of the Z phase of the encoder.

- (2) Pr. 357 "orientation in-position zone"(factory setting:11)
- The positioning width for orientation stop can be set.
 - The factory setting of Pr. 357 is "11". To change the $\Delta\theta$ value, finely adjust with ± 10 increments, and make fine adjustment.
 - If the position detection value from the PLG enters $\pm\Delta\theta$ during orientation stop, the orientation complete signal (ORA) will be output.

Example of operation



$$\Delta\theta = \frac{360^\circ}{\text{Pr.851 number of PLG pulses} \times 4} \times \text{Pr.357}$$

CAUTION

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

• **Fine adjustment of the orientation stop position**

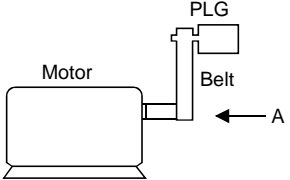
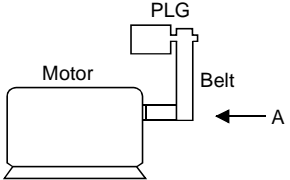
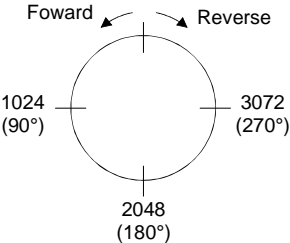
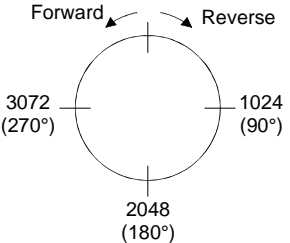
(1) Pr. 361 "position shift" (factory setting: 0)

The orientation stop position will deviate by the value set $\times 360$ degrees / Pr.369 "PLG pulse count for orientation" $\times 4$.

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.

Refer to the drawings below.

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

ORIENTATION CONTROL

• PLG orientation gear ratio setting

Use the following parameters to set the PLG orientation gear ratio.

- Pr. 394 "number of machine side gear teeth" (factory setting: 1)
- Pr. 395 "number of motor side gear teeth" (factory setting: 1)

Make sure that the above parameter values are factory settings.

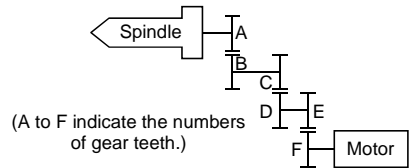
An accurate gear ratio (or pulley ratio) from the motor shaft to the spindle is necessary.

Confirm that the numbers of gear teeth set in Pr. 394 and Pr. 395 are correct.

$$\text{Pr.394} = A \times C \times E$$

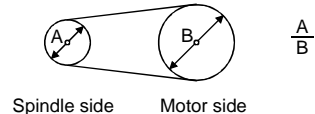
$$\text{Pr.395} = B \times D \times F$$

Exercise care so that the $A \times C \times E$ and $B \times D \times F$ settings do not exceed 32767. If either or both of them exceed that value, make approximations.



REMARKS

Pulley ratio..... Ratio of vector-driven motor side pulley diameter to spindle side pulley diameter



Setting example (When the numbers of gear teeth are as follows)

A : 15, C : 43, E : 60, B : 10, D : 28, F : 55

$$\text{Pr.394} = 15 \times 43 \times 60 = 38700$$

$$\text{Pr.395} = 10 \times 28 \times 55 = 15400$$

Since the Pr. 394 setting exceeds 32767 at this time, make approximations as follows.

$$\frac{\text{Pr.391}}{\text{Pr.392}} = \frac{38700}{15400} = \frac{3870}{1540}$$

• Adjustment of the servo rigidity

Pr. 396 "orientation speed gain (P term)" (factory setting: 60)

Pr. 397 "orientation speed integral time" (factory setting: 0.333)

Pr. 398 "orientation speed gain (D term)" (factory setting: 1)

Pr. 362 "orientation position loop gain" (factory setting: 10)

To increase the servo rigidity^{*1} during orientation stop in Pr. 396 or Pr. 397, adjust with the following procedures.

- 1) Increase the Pr. 362 "orientation position loop gain" value to the extent that rocking does not occur during orientation stop.
- 2) Increase Pr. 396 and Pr. 397 at the same rate.

Generally adjust Pr. 396 in the range from 10 to 100, and Pr. 397 from 0.1 to 1.0s. (Note that these do not need to be set to the same rate.)

<Example>

When the Pr. 396 value is multiplied by 1.2, divide the Pr. 397 value by 1.2.

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

- 3) Pr. 398 is the lag/advance compensation gain.^{*2}

The limit cycle 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.

POINT

Application of lag/advance control and PI control

PI control can be applied by setting Pr. 398 to 0. Normally, the lag/advance control is selected. Use PI control in the following cases.

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

REMARKS

- *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.

• Orientation Deceleration Ratio¶

- (1) Pr. 399 "orientation deceleration ratio" (factory setting: 20)
 Make adjustments as shown below according to the orientation status.
 (Refer to the Pr. 396 and Pr. 397 details also.)
 Generally adjust Pr. 362 in the range from 5 to 20 and Pr. 399 from 5 to 50.

Phenomenon	Adjustment Procedure			
	Pr.396	Pr.397	Pr.362	Pr.399
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) ↗	→

REMARKS

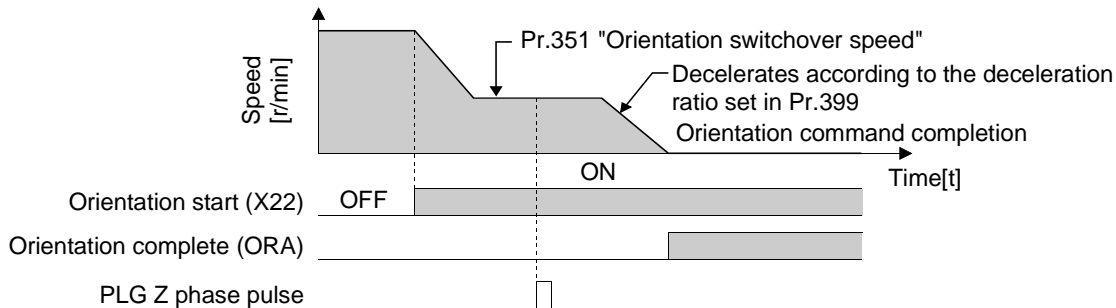
- ↗ : Increase the parameter setting value.
 → : Do not change the parameter setting value.
 ↘ : Decrease the parameter setting value.
- The numbers 1) 2) and 3) in the table show the order of priority for changing the parameters setting value.

CAUTION

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. 393 "orientation selection".

• Orientation Switchover Speed

- (1) Pr. 351 "orientation switchover speed" (factory setting: 200)
- Set the speed when switching between the speed control mode and the position control mode is performed under orientation operation. Decreasing the set speed enables stable orientation stop. Note that the orientation time will increase.



REMARKS

When " 19" is set in Pr. 52 "DU/PU main display data selection", position pulse monitor is displayed instead of PU output voltage monitor.

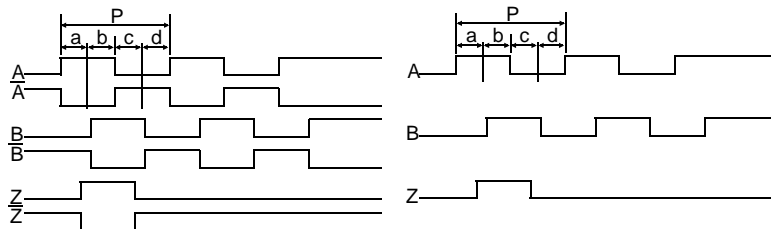
3.5 Instructions

- (1) The PLG should be coupled with the spindle oriented without any mechanical looseness.
- (2) To ensure correct positioning, the PLG must be set in the proper rotation direction and the A and B phases connected correctly.
- (3) To terminate orientation, the start signal (STF or STR) must be first switched off and the orientation signal (X22) must be switched off. As soon as this orientation signal is switched off, orientation control ends.
- (4) For orientation control, set correct values in Pr. 350 "stop position command selection" and Pr. 360 "external position command selection".
If the values set are incorrect, proper orientation control will not be performed.
- (5) When orientation control is exercised, PID control is invalid.

3.6 Specifications

- | | | |
|---|--|----------------------------|
| (1) Repeated position-
ing accuracy | ±1.5 degrees (When using the SF-VR)
Depends on the load torque, load J, load backlash conditions, etc. | |
| (2) Permissible
speed | PLG-mounted shaft speed 6,000r/min or less
The drive shaft and PLG-mounted shaft must be coupled directly or via a belt without any slip. | |
| (3) Position
detector (pulse
PLG) | Differential line driver type | Complimentary (5V/12V/24V) |
| | A. \bar{A} signal 1000 to 4096P/R | A signal 1000 to 4096P/R |
| | B. \bar{B} signal 1000 to 4096P/R | B signal 1000 to 4096P/R |
| | Z. \bar{Z} signal 1P/R | Z signal 1P/R |

Output pulse
specifications



a, b, c and d should be $(1/4 \pm 1/8) P$ when the motor is run clockwise as viewed from the shaft end of the PLG.

- | | |
|--|---|
| (4) Function | Stop position command selection, electronic gear setting, orientation switchover speed setting, orientation speed PID gain speed, orientation in-position, status motor, orientation position loop gain setting etc.
The above functions are set using a parameter unit. |
| (5) Holding force after positioning | With servo lock function |
| (6) Input signals
(contact input) | ● Orientation command
● Forward and reverse rotation commands
● Stop position command |
| (7) Output signal
(open collector output) | Orientation completion signal |
| (8) DC power supply | A 5VDC power supply is provided for the pulse PLG.
A separate power supply is necessary for the 12V/24V power type PLG. |

3.7 Wiring Instructions

- (1) Connection with the position detector (PLG).

Use twisted pair shielded cables (0.2mm² or larger) to connect the FR-V5AM and position detector (PLG). Cables to terminals PG2 and SD should be connected in parallel or be larger in size according to the cable length table as indicated below.

To protect the cables from noise, run them away from any source of noise (e.g. the main circuit and power supply voltage).

(2) Cable length.

Cable Length	Number of Parallel Cables of 0.2mm²	Larger-Size Cable
Within 10m	At least 2 cables	0.4mm ² or larger
Within 20m	At least 4 cables	0.75mm ² or larger
Within 100m	At least 6 cables	1.25mm ² or larger

(3) Connection of terminal resistors

When the position detector (PLG) is a differential line driver type, terminal resistors can be connected to the A, B and Z-phases of the PLG using the jumpers across OPA2-OPAR, OPB2-OPBR, and OPZ2-OPZR. Normally, keep the jumpers fitted.

However, remove the jumpers when the same PLG is shared between the FR-A5AP and the other unit (e.g. NC) which is connected with a terminal resistor.

If the PLG is a complimentary type, remove the jumpers across OPA2-OPAR, OPB2-OPBR, and OPZ2-OPZR.

⚠ WARNING

⚠ Never short PG2-SD. Doing so may damage the option unit.

⚠ CAUTION

⚠ If the wiring length is long, the voltage supplied to the PLG is expected to reduce due to a voltage drop. To prevent a voltage drop, always wire as shown on the previous page to supply the PLG with the power supply voltage that is within the permissible range.

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

REVISIONS

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

Print Date	*Manual Number	Revision	
Jan., 2002	IB(NA)-0600089-A	First edition	
Jun., 2002	IB(NA)-0600089-B	<table border="1"><tr><td>Addition</td></tr></table> Addition of the setting value "3" to Pr. 350 "stop position command selection"	Addition
Addition			