MELDAS Series

MDS-CH-SP PLG Adjustment(BNP-B8827-016H)

USA-99671 -024*

MITSUBISHI ELECTRIC AUTOMATION

USA

List of Revisions

Rev	Date of Revision	Detail	Author
*	05/3/04	First Edition Created	TSS

Changes for the Better

MITSUBISHI CNC

MELDAS

AC SPINDLE

MDS-CH-SP SERIES

PLG ADJUSTMENT PROCEDURES

BNP-B8827-016-H (ENG)

MITSUBISHI ELECTRIC

Introduction

Thank you for selecting the Mitsubishi numerical control unit.
This instruction manual describes the handling and caution points for using this AC servo/spindle.
Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.
Make sure that this instruction manual is delivered to the end user.
Always store this manual in a safe place.
This manual explains the methods of adjusting the PLG for the MDS-CH Series. Always refer to each CNC Specifications before starting use.

Notes on Reading This Manual

(1) Since the description of this specification manual deals with NC in general, for the specifications of individual machine tools, refer to the manuals issued by the respective machine manufacturers. The "restrictions" and "available functions" described in the manuals issued by the machine manufacturers have precedence to those in this manual.
(2) This manual describes as many special operations as possible, but it should be kept in mind that items not mentioned in this manual cannot be performed.

Precautions for safety

Please read this manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.

The safety precautions in this instruction manual are ranked as "DANGER", "WARNING" and "CAUTION".

⚠ **DANGER**	When the operator could be subject to fatalities or serious injuries if handling is mistaken.
⚠ **WARNING**	When a dangerous situation, or fatal or serious injuries may occur if handling is mistaken.
⚠ **CAUTION**	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as ⚠ **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

The numeric control unit is configured of the control unit, operation board, servo drive unit, spindle drive unit, power supply, servomotor and spindle motor, etc.

In this manual, the following items are generically called the "motor".
- Servomotor
- Spindle motor

In this manual, the following items are generically called the "unit".
- Servo drive unit
- Spindle drive unit
- Power supply unit

⚠ DANGER

No corresponding items in this manual.

⚠ WARNING

1. Electric shock prevention


Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.


Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and can cause electric shocks.


Do not remove the front cover even when the power is OFF unless carrying out wiring work or periodic inspections. The inside of the units is charged, and can cause electric shocks.


Wait at least 15 minutes after turning the power OFF before starting wiring or inspections. Failure to observe this could lead to electric shocks.


Always ground the unit and motor following the standards set forth by each country. (In Japan, grounding resistance 10Ω or less is the standard.)


Wiring and inspection work must be done by a qualified technician.


Wire the servo drive unit and servomotor after installation. Failure to observe this could lead to electric shocks.


Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.


Do not damage, apply forcible stress, place heavy items on the cables or get them caught. Failure to observe this could lead to electric shocks.

⚠ CAUTION

1. Fire prevention


Install the units, motors and regenerative resistor on noncombustible material. Direct installation on combustible material or near combustible materials could lead to fires.


Shut off the power on the power supply unit side if a fault occurs in the units. Fires could be caused if a large current continues to flow.


Provide a sequence that shut off the power at the regenerative resistor error signal-ON when using the regenerative resistor. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.

⚠ CAUTION

2. Injury prevention


Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to ruptures or damage, etc.


Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.


Do not mistake the polarity (⊕, ⊖). Failure to observe this item could lead to ruptures or damage, etc.


Do not touch the radiation fin on unit back face, regenerative resistor or motor, etc., or place parts (cables, etc.) while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns.


Structure the cooling fan on the unit back face so that it cannot be touched after installation. Touching the cooling fan during operation could lead to injuries.

3. Various precautions

Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation


Correctly transport the product according to its weight.


Use the motor's hanging bolts only when transporting the motor. Do not transport the motor when it is installed on the machine.


Do not stack the products above the tolerable number.


Do not hold the cables, axis or detector when transporting the motor.


Do not hold the connected wires or cables when transporting the units.


Do not hold the front cover when transporting the unit. The unit could drop.


Follow this Instruction Manual and install the unit or motor in a place where the weight can be borne.


Do not get on top of or place heavy objects on the unit.


Always observe the installation directions of the units or motors.


Secure the specified distance between the units and control panel, or between the servo drive unit and other devices.


Do not install or run a unit or motor that is damaged or missing parts.


Do not block the intake or exhaust ports of the motor provided with a cooling fan.


Do not let foreign objects enter the units or motors. In particular, if conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter, rupture or breakage could occur.


The units and motors are precision devices, so do not drop them or apply strong impacts to them.

⚠ CAUTION

⚠ Store and use the units under the following environment conditions.

Environment		Conditions	
		Unit	**Motor**
Ambient temperature	During operation	0°C to 55°C (with no freezing)	0°C to 40°C (with no freezing)
	During storage/ transportation	–15°C to 70°C (with no freezing)	–15°C to 70°C (with no freezing)
Ambient humidity	During operation	90%RH or less (with no dew condensation)	20% to 90%RH (with no dew condensation)
	During storage/ transportation	90%RH or less (with no dew condensation)	90% RH or less (with no dew condensation)
Atmosphere		Indoors (where unit is not subject to direct sunlight), with no corrosive gas, combustible gas, oil mist, dust or conductive particles	
Altitude		Operation/storage: 1000m or less above sea level Transportation: 10000m or less above sea level (Specified value does not apply only during transport by air.)	
Vibration		To follow each unit and motor specifications	

⚠ Securely fix the servomotor to the machine. Insufficient fixing could lead to the servomotor slipping off during operation.

⚠ Always install the servomotor with reduction gear in the designated direction. Failure to do so could lead to oil leaks.

⚠ Structure the rotary sections of the motor so that it can never be touched during operation. Install a cover, etc., on the shaft.

⚠ When installing a coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.

⚠ Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break.

If the unit has been stored for a long time, always check the operation before starting actual operation. Please contact the Service Center or Service Station.

⚠ CAUTION

(2) Wiring

⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the motor.

⚠ Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the drive unit.

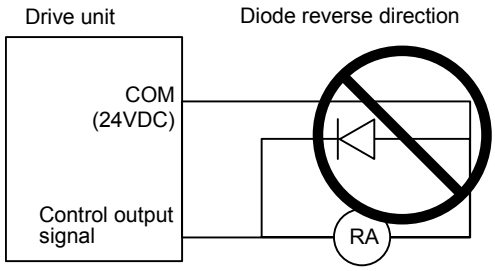
⚠ Correctly connect the output side of the drive unit (terminals U, V, W). Failure to do so could lead to abnormal operation of the motor.

⚠ Always install an AC reactor for each power supply unit.

⚠ Always install an appropriate breaker for each power supply unit. The breaker cannot be shared by several units.

⚠ Direct application of a commercial power supply to the motor could cause burning. Always connect the motor to the drive unit's output terminals (U, V, W).

⚠ When using an inductive load such as a relay, always connect a diode as a noise measure parallel to the load.



⚠ When using a capacitance load such as a lamp, always connect a protective resistor as a noise measure serial to the load.

⚠ Do not reverse the direction of a diode which connect to a DC relay for the control output signals to suppress a surge. Connecting it backwards could cause the drive unit to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.

⚠ Do not connect/disconnect the cables connected between the units while the power is ON.

⚠ Securely tighten the cable connector fixing screw or fixing mechanism. An insecure fixing could cause the cable to fall off while the power is ON.

⚠ When using a shielded cable instructed in the connection manual, always ground the cable with a cable clamp, etc.

⚠ Always separate the signals wires from the drive wire and power line.

⚠ Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.

(3) Trial operation and adjustment

⚠ Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.

⚠ Do not make remarkable adjustments and changes as the operation could become unstable.

⚠ The usable motor and unit combination is predetermined. Always check the models before starting trial operation.

⚠ CAUTION

(4) Usage methods

Install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.

Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the unit or motor.

Unqualified persons must not disassemble or repair the unit.

Never make modifications.

Reduce magnetic damage by installing a noise filter. The electronic devices used near the unit could be affected by magnetic noise.

Use the unit, motor and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.

The brakes (magnetic brake) assembled into the servomotor are for holding, and must not be used for normal braking. Do not apply the brakes in the servo ON state. Doing so will lead to a drop in the brake life. Always turn the servo OFF before applying the brakes.

There may be cases when holding is not possible due to the magnetic brake's life or the machine construction (when ball screw and servomotor are coupled via a timing belt, etc.). Install a stop device to ensure safety on the machine side.

After changing the programs/parameters or after maintenance and inspection, always test the operation before starting actual operation.

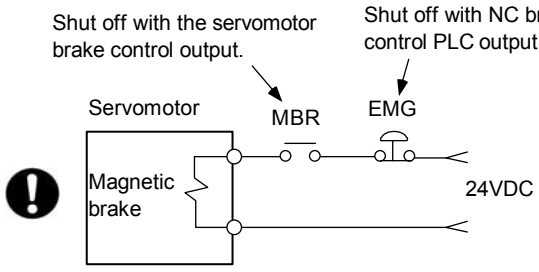
Do not enter the movable range of the machine during automatic operation. Never place body parts near or touch the spindle during rotation.

Follow the power supply specification conditions given in the separate specifications manual for the power (input voltage, input frequency, tolerable sudden power failure time, etc.).

(5) Troubleshooting

If a hazardous situation is predicted during power failure or product trouble, use a servomotor with magnetic brakes or install an external brake mechanism.

Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal.



Always turn the input power OFF when an alarm occurs.

Never go near the machine after restoring the power after a power failure, as the machine could start suddenly. (Design the machine so that personal safety can be ensured even if the machine starts suddenly.)

⚠ CAUTION

(6) Maintenance, inspection and part replacement

⚠ Always backup the programs and parameters in the CNC device before starting maintenance or inspections.

⚠ The capacity of the electrolytic capacitor will drop over time due to self-discharging, etc. To prevent secondary disasters due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center or Service Station for replacement.

⚠ Do not perform a megger test (insulation resistance measurement) during inspections.

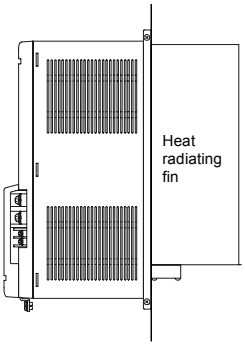
❗ If the battery low warning is issued, back up the machining programs, tool data and parameters with an input/output unit, and then replace the battery.

⚠ Do not short circuit, charge, overheat, incinerate or disassemble the battery.

⚠ CFC substitutes are used as refrigerant in the heat dissipating fan in 37kW or smaller capacity units.
Take care not to damage the heat dissipating fan during maintenance or replacement work.

(7) Disposal

⚠ Do not treat this unit as general industrial waste. CFC substitutes are used in the 37kW or smaller capacity units that have a heat dissipating fan on the back of the unit. Do not treat this unit as general industrial waste, and always return the unit to the Service Center or Service Station.



⚠ Do not disassemble the unit or motor.

⚠ Dispose of the battery according to local laws.

(8) General precautions

The drawings given in this Adjustment Procedures show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.

CONTENTS

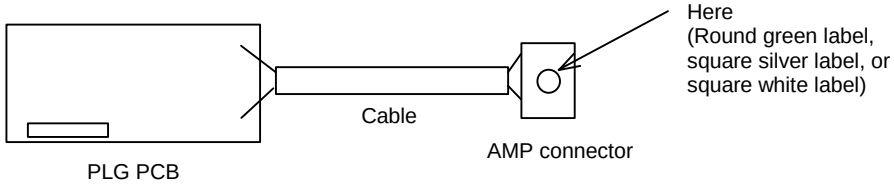
1. Combinations

The adjustment method differs according to the spindle drive unit and PLG PCB combination. Refer to the following table when adjusting.

Spindle drive unit / PLG PCB	Has SAMPLE label attached to front	Does not have SAMPLE label attached to front
Does not have label attached to unit connection connector protruding from PCB (PLG No. 1)	Use adjustment method 1	
Has round green label or square silver label on unit connection connector protruding from PCB (PLG No. 2)		Use adjustment method 2
Has square white label with serial No. stamped on unit connection connector protruding from PCB (PLG No. 3)		Use adjustment method 3

⚠ CAUTION

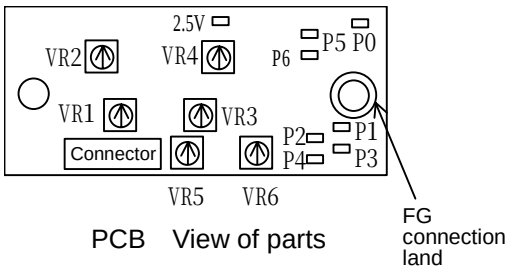
1. The PLG PCB label is attached at the following position.



2. To identify the PLG No. 1 to No. 3, refer to the PCB outline drawings shown in sections 1) to 3) on the following page. (The outline drawing is correct.)

2. PLG PCB check pin and potentiometer positions and functions

1) PLG No. 1 (With no label on connector)



PCB View of parts

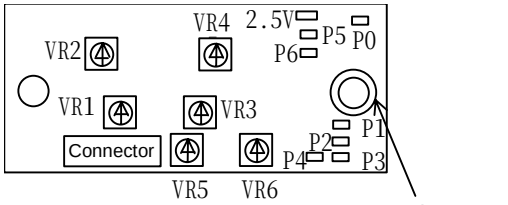
Check terminal

- P0 : Ground (0V)
- 2.5V : 2.5V signal
- P1 : A-phase signal
- P2 : $\overline{A}$-phase signal
- P3 : B-phase signal
- P4 : $\overline{B}$-phase signal
- P5 : Z-phase signal
- P6 : $\overline{Z}$-phase signal

Potentiometer

- VR1: A-phase 0 position adjustment
- VR2: A-phase gain adjustment
- VR3: B-phase 0 position adjustment
- VR4: B-phase gain adjustment
- VR5: Z-phase 0 position adjustment
- VR6: Z-phase gain adjustment

2) PLG No. 2 (with green label on connector)



PCB View of parts

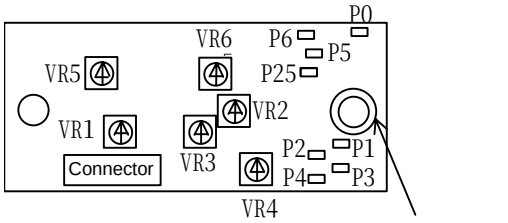
Check terminal

- P0 : Ground (0V)
- 2.5V : 2.5V signal
- P1 : A-phase signal
- P2 : $\overline{A}$-phase signal
- P3 : B-phase signal
- P4 : $\overline{B}$-phase signal
- P5 : Z-phase signal
- P6 : $\overline{Z}$-phase signal

Potentiometer

- VR1: A-phase 0 position adjustment
- VR2: A-phase gain adjustment
- VR3: B-phase 0 position adjustment
- VR4: B-phase gain adjustment
- VR5: Z-phase 0 position adjustment
- VR6: Z-phase gain adjustment

3) PLG No. 3 (with white label with serial No. stamped on connector)



PCB View of parts

Check terminal

- P0 : Ground (0V)
- 2.5V : 2.5V signal
- P1 : A-phase signal
- P2 : $\overline{A}$-phase signal
- P3 : B-phase signal
- P4 : $\overline{B}$-phase signal
- P5 : Z-phase signal
- P6 : $\overline{Z}$-phase signal

Potentiometer

- VR1: A-phase 0 position adjustment
- VR2: A-phase gain adjustment
- VR3: B-phase 0 position adjustment
- VR4: B-phase gain adjustment
- VR5: Z-phase 0 position adjustment
- VR6: Z-phase gain adjustment

3. Adjustment methods

1) Adjustment method 1 (PLG No. 1)

(1) Set the spindle parameter SP038 (SFNC6) bit F to "1", and turn the NC and spindle drive unit power OFF. (Enter the open loop state (detector signal invalid mode). However, in the case of IPM spindle motor, as open loop is not possible, rotate the motor at low speed externally to check the waveform.)

(2) First adjust the **A-phase**. Prepare two synchroscopes and probes. Connect the ground of the probe connected to the synchroscope's CH1 to the 2.5V terminal on the PLG PCB, and signal side to the P1 terminal. In the same manner, connect the ground of the probe connected to CH2 to the 2.5V terminal and the signal side to the P2 terminal.
(Bundle the CH1 and CH2 ground wires connected to the 2.5V terminal with a clip and connect to the 2.5V terminal.)

⚠ CAUTION

If the synchroscope's power cable is provided with a grounding terminal, do not connect this section to the ground. Make sure that the synchroscope does not contact the machine or other ground section when adjusting the waveform.

(3) Next, set the synchroscope's CH1 and CH2 measurement range to 20mV/div (0.2V/div when using 1:1 probe). Set the time axis to 50µs, and CH1 and CH2 to the DC range. First, using the synchroscope's button (switch) as the GND, adjust CH1 and CH2 with the synchroscope's 0V adjustment dial so that the center of each screen comes to 0V.
Then, release the GND only for CH1 so that the normal DC voltage waveform for CH1 can be measured.

(4) Turn the spindle drive unit and NC power ON, input a forward run command, and rotate the motor at the reference rotation speed (refer to "⚠ CAUTION"). (Note that the reference rotation speed is not the spindle rotation speed.)

(5) Adjust VR1 so that the CH1 waveform's DC element comes approximately to 0V. Then adjust VR2 and VR1 so that the peak value (waveform width) is **1.1V (±0.08V)$_{P-P}$** and one side from 0V is **0.55V (±0.04V)**.
(Refer to Fig. 1)

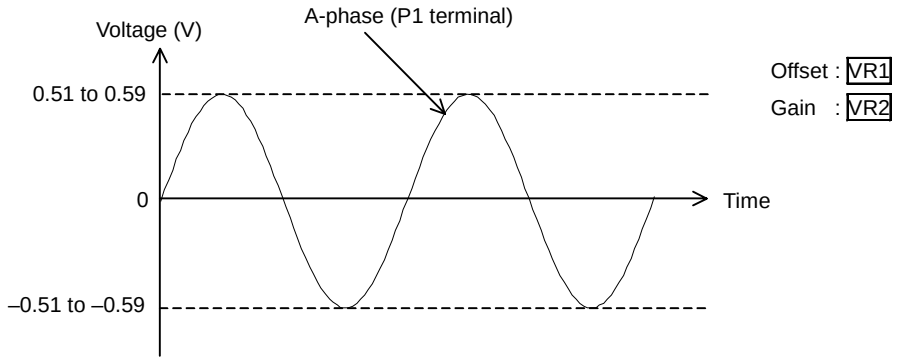


Fig. 1 A-phase waveform during motor forward run
(When looking at A-phase from 2.5V terminal)

⚠ CAUTION

The motor's reference rotation speed is calculated with the following expression.
Reference rotation speed (r/min) = 1800 (r/min) × (256/No. of PLG gear teeth in use)
Example: When No. of PLG teeth is 128p/rev 1800 × 256/128 = 3600r/min
In the open loop state, the reference rotation speed may not be attained unless the motor speed is raised gradually (100 to 500r/min).

(6) Next, release the GND for CH2 so that CH2 can be observed simultaneously with CH1, and set the time axis to the 200µs range.
(7) Readjust VR1 so that the minimum value of the synchroscope's waveform is constant (**±0.02V or less**) for both waveforms.
(Refer to Fig. 2)

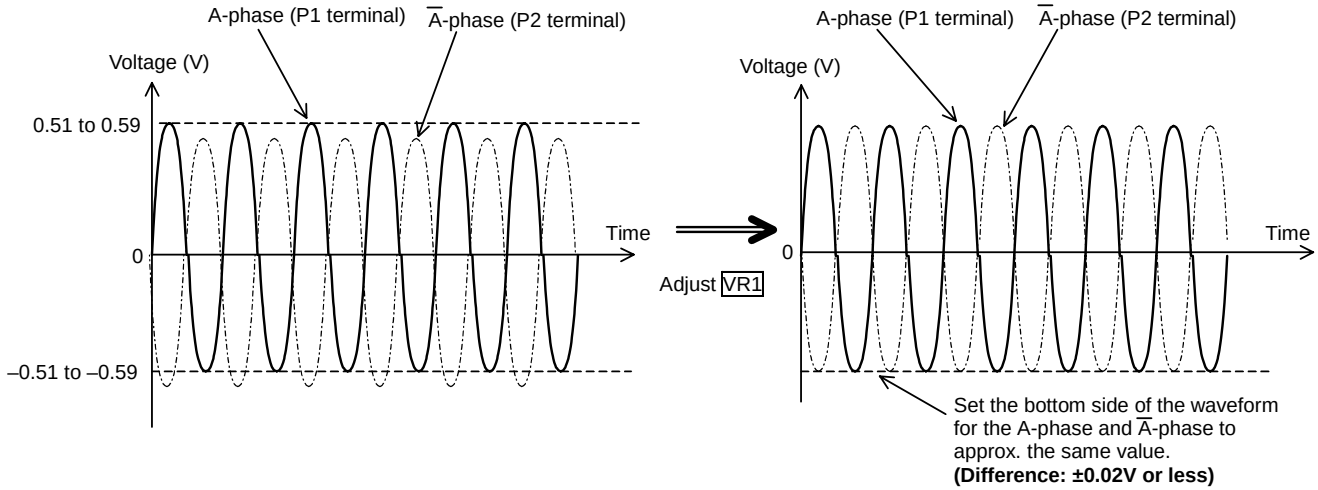


Fig. 2 A-phase, $\overline{A}$-phase waveform during motor forward run
(When looking at A-phase, $\overline{A}$-phase from 2.5V terminal)

After finishing the adjustment up to this point, confirm that the A-phase waveform's envelope (maximum amplitude α – minimum amplitude β) is **0.2V or less**. (Refer to Fig. 3)

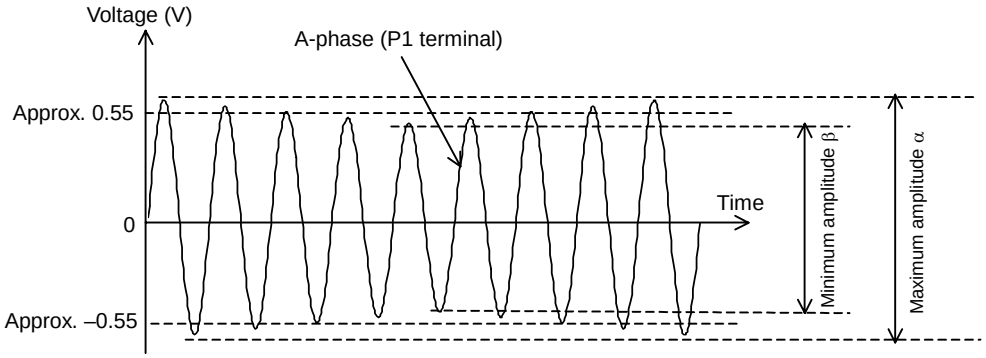


Fig. 3 A-phase waveform during motor forward run
(When looking at A-phase from 2.5V terminal)
Envelope = maximum amplitude α – minimum amplitude β)

(8) When completed with the adjustment, stop the motor, and turn the NC and spindle drive unit power OFF.
(9) Next, adjust the **B-phase**. Connect the synchroscope's CH1 to the PLG PCB's P3 terminal and CH2 to the P4 terminal.
(10) Carry out steps (3) to (8) (same as A-phase adjustment). Adjust VR4 instead of VR2, and VR3 instead of VR1. Refer to the waveforms for adjusting the A-phase. When viewing the figures, substitute the A-phase (P1 terminal) with the B-phase (P3 terminal), and the $\overline{A}$-phase (P2 terminal) with the $\overline{B}$-phase (P4 terminal), and adjust.

(11) Next, adjust the **Z-phase**. Connect the synchroscope's CH1 to the PLG PCB's P5 terminal and CH2 to the P6 terminal.

(12) Using step (3), adjust 0V using the voltage range 20mV. Set CH1 to the DC range, CH2 to GND, and the time axis to 50µs. Adjust VR5 so that the sections other than the waveform's crest are **approx. –0.15V**, and then adjust VR6 so that the peak value of the crest looking from a section other than the waveform crest is **0.7V to 0.85V**. After this, adjust VR5 again so that the sections other than the waveform's crest are between **–0.15V and –0.2V**. Finally, cancel the CH2 GND, and confirm that the section other than the crest in the CH2 waveform are 0.1V or more.
(Refer to Fig. 4)

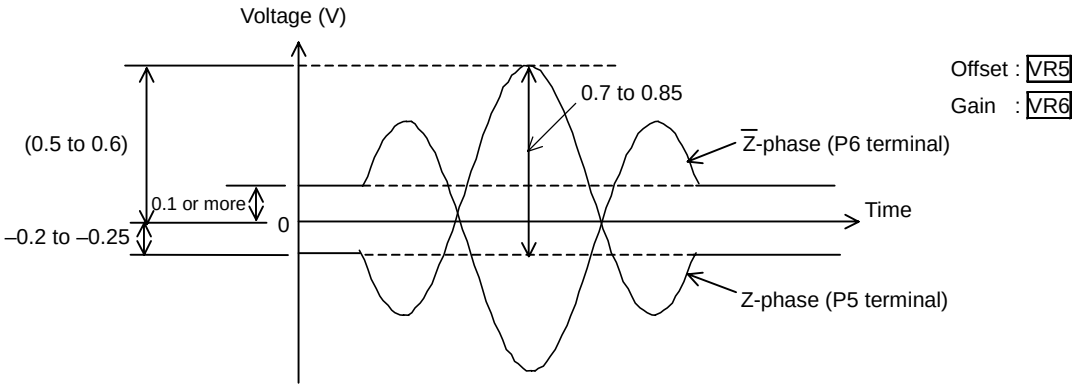


Fig. 4 Z-phase, $\overline{Z}$-phase waveform during motor forward run
(When looking at Z-phase, $\overline{Z}$-phase from 2.5V terminal)

(13) This completes adjustment of the potentiometer on the PLG PCB.

(14) When finished adjusting the potentiometer, stop the motor, and return the SP038 (SFNC6) bit F setting to "0". Then, turn the NC and spindle drive unit power OFF.

(15) Turn the NC and spindle drive unit power ON again, and carry out section "3.4) PLG automatic compensation function". This completes the adjustment. When finished, refer to section "4. Installing the PLG PCB", and correctly install the PCB.

⚠ CAUTION

1. When confirming the waveform in the normal operation state (closed loop), disconnect the PLG cable from the drive unit, and insert a check pin card between CN5 and the PLG cable. The check pin numbers corresponding to each signal in this case are shown below. Note that each signal has a +2.5V offset. Always remove the check pin card after confirming the waveform.

   If the waveform is checked with the PLG PCB's check terminal in the closed loop state without using the check pin card, abnormal noise or vibration may be generated from the motor.

   A-phase signal: CH6 B-phase signal: CH7 Z-phase signal: CH18
   $\overline{A}$-phase signal: CH16 $\overline{B}$-phase signal: CH17 $\overline{Z}$-phase signal: CH8

2. **After adjusting the potentiometer, always fix with lock paint, etc., so that the position does not deviate.**

2) Adjustment method 2 (PLG No. 2)

(1) Set the spindle parameter SP038 (SFNC6) bit F to "1", and turn the NC and spindle drive unit power OFF. (Enter the open loop state. However, in the case of IPM spindle motor, as open loop is not possible, rotate the motor at low speed externally to check the waveform.)

(2) First adjust the **A-phase**. Prepare two synchroscopes and probes. Connect the ground of the probe connected to the synchroscope's CH1 to the 2.5V terminal on the PLG PCB, and signal side to the P1 terminal. In the same manner, connect the ground of the probe connected to CH2 to the 2.5V terminal and the signal side to the P2 terminal.
(Bundle the CH1 and CH2 ground wires connected to the 2.5V terminal with a clip and connect to the 2.5V terminal.)

⚠ CAUTION

If the synchroscope's power cable is provided with a grounding terminal, do not connect this section to the ground. Make sure that the synchroscope does not contact the machine or other ground section when adjusting the waveform.

(3) Next, set the synchroscope's CH1 and CH2 measurement range to 10mV/div (0.1V/div when using 1:1 probe). Set the time axis to 50µs, and CH1 and CH2 to the DC range. First, using the synchroscope's button (switch) as the GND, adjust CH1 and CH2 with the synchroscope's 0V adjustment dial so that the center of each screen comes to 0V.
Then, release the GND only for CH1 so that the normal DC voltage waveform for CH1 can be measured.

(4) Turn the spindle drive unit and NC power ON, input a forward run command, and rotate the motor at the reference rotation speed (refer to "⚠ CAUTION"). (Note that the reference rotation speed is not the spindle rotation speed.)

(5) Adjust VR1 so that the CH1 waveform's DC element comes approximately to 0V. Then adjust VR2 and VR1 so that the peak value (waveform width) is **0.5V (±0.02V)$_{P-P}$** and one side from 0V is **0.25V (±0.01V)**.
(Refer to Fig. 1)

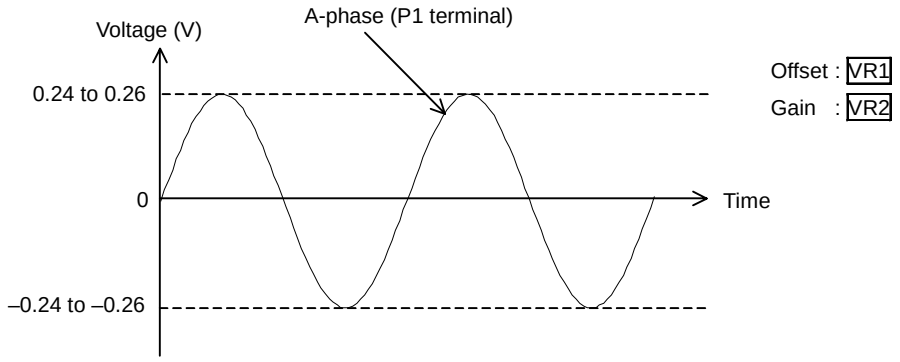


Fig. 5 A-phase waveform during motor forward run
(When looking at A-phase from 2.5V terminal)

⚠ CAUTION

The motor's reference rotation speed is calculated with the following expression.
Reference rotation speed (r/min) = 1800 (r/min) × (256/No. of PLG gear teeth in use)
Example: When No. of PLG teeth is 128p/rev 1800 × 256/128 = 3600r/min
In the open loop state, the reference rotation speed may not be attained unless the motor speed is raised gradually (100 to 500r/min).

(6) Next, release the GND for CH2 so that CH2 can be observed simultaneously with CH1, and set the time axis to the 200µs range.
(7) Readjust VR1 so that the minimum value of the synchroscope's waveform is constant (**±0.01V or less**) for both waveforms.
(Refer to Fig. 6)

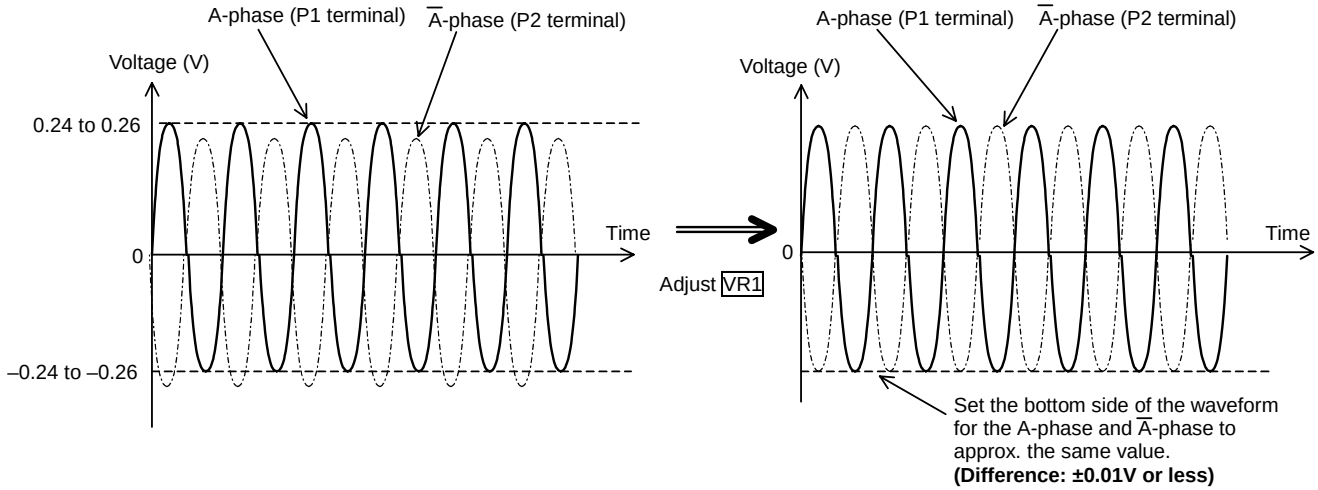


Fig. 6 A-phase, $\overline{A}$-phase waveform during motor forward run
(When looking at A-phase, $\overline{A}$-phase from 2.5V terminal)

After finishing the adjustment up to this point, confirm that the A-phase waveform's envelope (maximum amplitude α – minimum amplitude β) is **0.03V or less**. (Refer to Fig. 7)

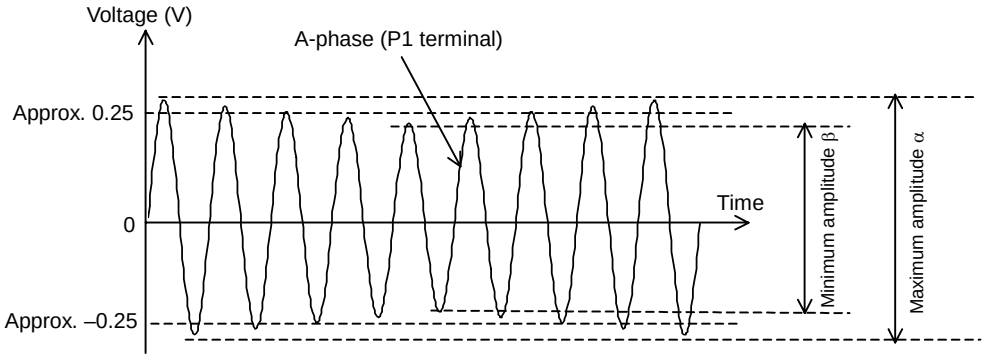


Fig. 7 A-phase waveform during motor forward run
(When looking at A-phase from 2.5V terminal)
Envelope = maximum amplitude α – minimum amplitude β)

(8) When completed with the adjustment, stop the motor, and turn the NC and spindle drive unit power OFF.
(9) Next, adjust the **B-phase**. Connect the synchroscope's CH1 to the PLG PCB's P3 terminal and CH2 to the P4 terminal.
(10) Carry out steps (3) to (8) (same as A-phase adjustment). Adjust VR4 instead of VR2, and VR3 instead of VR1. Refer to the waveforms for adjusting the A-phase. When viewing the figures, substitute the A-phase (P1 terminal) with the B-phase (P3 terminal), and the $\overline{A}$-phase (P2 terminal) with the $\overline{B}$-phase (P4 terminal), and adjust.

(11) Next, adjust the **Z-phase**. Connect the synchroscope's CH1 to the PLG PCB's P5 terminal and CH2 to the P6 terminal.

(12) Using step (3), adjust 0V. Set CH1 to the DC range, CH2 to GND, and the time axis to 50µs. Adjust VR5 so that the sections other than the waveform's crest are **approx. –0.1V**, and then adjust VR6 so that the peak value of the crest looking from a section other than the waveform crest is **0.4V to 0.5V**. After this, adjust VR5 again so that the sections other than the waveform's crest are between **–0.1V and –0.15V**. Finally, cancel the CH2 GND, and confirm that the section other than the crest in the CH2 waveform are 0V or more. (Refer to Fig. 8)

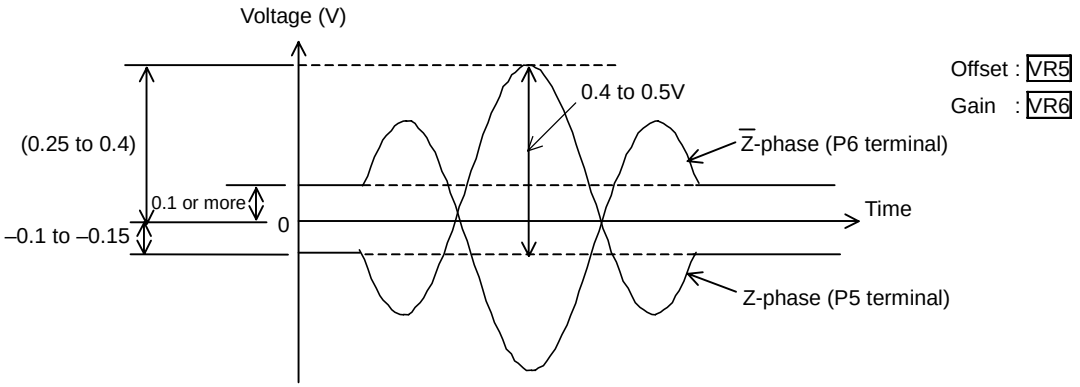


Fig. 8 Z-phase, $\overline{Z}$-phase waveform during motor forward run
(When looking at Z-phase, $\overline{Z}$-phase from 2.5V terminal)

(13) This completes adjustment of the potentiometer on the PLG PCB.

(14) When finished adjusting the potentiometer, stop the motor, and return the SP038 (SFNC6) bit F setting to "0". Then, turn the NC and spindle drive unit power OFF.

(15) Turn the NC and spindle drive unit power ON again, and carry out section "3.4) PLG automatic compensation function". This completes the adjustment. When finished, refer to section "4. Installing the PLG PCB", and correctly install the PCB.

⚠ CAUTION

1. When confirming the waveform in the normal operation state (closed loop), disconnect the PLG cable from the drive unit, and insert a check pin card between CN5 and the PLG cable. The check pin numbers corresponding to each signal in this case are shown below. Note that each signal has a +2.5V offset. Always remove the check pin card after confirming the waveform.

   If the waveform is checked with the PLG PCB's check terminal in the closed loop state without using the check pin card, abnormal noise or vibration may be generated from the motor.

   A-phase signal: CH6 B-phase signal: CH7 Z-phase signal: CH18

   $\overline{A}$-phase signal: CH16 $\overline{B}$-phase signal: CH17 $\overline{Z}$-phase signal: CH8

2. **After adjusting the potentiometer, always fix with lock paint, etc., so that the position does not deviate.**

3) Adjustment method 3 (PLG No. 3)

(1) Set the spindle parameter SP038 (SFNC6) bit F to "1", and turn the NC and spindle drive unit power OFF. (Enter the open loop state. However, in the case of IPM spindle motor, as open loop is not possible, rotate the motor at low speed externally to check the waveform.)

(2) First adjust the **A-phase**. Prepare two synchroscopes and probes. Connect the ground of the probe connected to the synchroscope's CH1 to the P25 terminal on the PLG PCB, and signal side to the P1 terminal. In the same manner, connect the ground of the probe connected to CH2 to the P25 terminal and the signal side to the P2 terminal.
(Bundle the CH1 and CH2 ground wires connected to the P25 terminal with a clip and connect to the P25 terminal.)

⚠ CAUTION

If the synchroscope's power cable is provided with a grounding terminal, do not connect this section to the ground. Make sure that the synchroscope does not contact the machine or other ground section when adjusting the waveform.

(3) Next, set the synchroscope's CH1 and CH2 measurement range to 10mV/div (0.1V/div when using 1:1 probe). Set the time axis to 50µs, and CH1 and CH2 to the DC range. First, using the synchroscope's button (switch) as the GND, adjust CH1 and CH2 with the synchroscope's 0V adjustment dial so that the center of each screen comes to 0V.
Then, release the GND only for CH1 so that the normal DC voltage waveform for CH1 can be measured.

(4) Turn the spindle drive unit and NC power ON, input a forward run command, and rotate the motor at the reference rotation speed (refer to "⚠ CAUTION"). (Note that the reference rotation speed is not the spindle rotation speed.)

(5) Adjust VR1 so that the CH1 waveform's DC element comes approximately to 0V. Then adjust VR2 and VR1 so that the peak value (waveform width) is **0.54V (±0.02V)$_{P-P}$** and one side from 0V is **0.27V (±0.01V)**.
(Refer to Fig. 9)

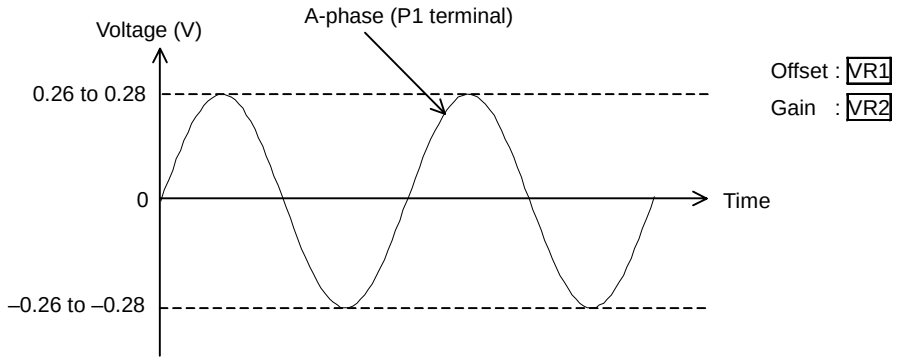


Fig. 9 A-phase waveform during motor forward run
(When looking at A-phase from P25 terminal)

⚠ CAUTION

The motor's reference rotation speed is calculated with the following expression.
Reference rotation speed (r/min) = 1800 (r/min) × (256/No. of PLG gear teeth in use)
Example: When No. of PLG teeth is 128p/rev 1800 × 256/128 = 3600r/min
In the open loop state, the reference rotation speed may not be attained unless the motor speed is raised gradually (100 to 500r/min).

(6) Next, release the GND for CH2 so that CH2 can be observed simultaneously with CH1, and set the time axis to the 200µs range.
(7) Readjust VR1 so that the minimum value of the synchroscope's waveform is constant (**±0.01V or less**) for both waveforms.
(Refer to Fig. 10)

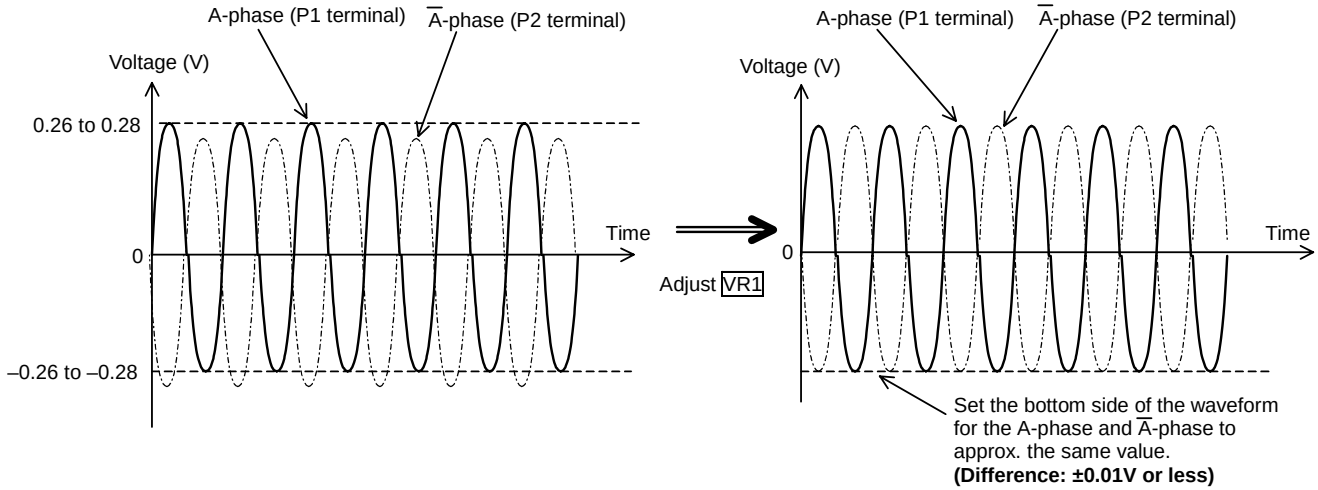


Fig. 10 A-phase, $\overline{A}$-phase waveform during motor forward run
(When looking at A-phase, $\overline{A}$-phase from P25 terminal)

After finishing the adjustment up to this point, confirm that the A-phase waveform's envelope (maximum amplitude α – minimum amplitude β) is **0.03V or less**. (Refer to Fig. 11)

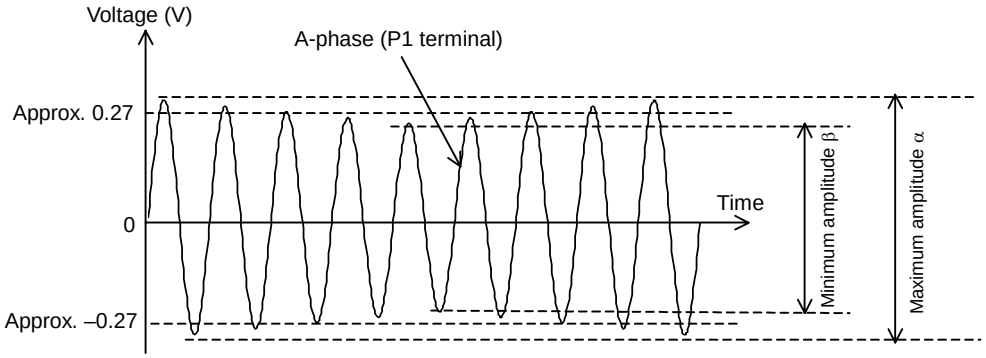


Fig. 11 A-phase waveform during motor forward run
(When looking at A-phase from P25 terminal)
Envelope = maximum amplitude α – minimum amplitude β)

(8) When completed with the adjustment, stop the motor, and turn the NC and spindle drive unit power OFF.
(9) Next, adjust the **B-phase**. Connect the synchroscope's CH1 to the PLG PCB's P3 terminal and CH2 to the P4 terminal.
(10) Carry out steps (3) to (8) (same as A-phase adjustment). Adjust VR4 instead of VR2, and VR3 instead of VR1. Refer to the waveforms for adjusting the A-phase. When viewing the figures, substitute the A-phase (P1 terminal) with the B-phase (P3 terminal), and the $\overline{A}$-phase (P2 terminal) with the $\overline{B}$-phase (P4 terminal), and adjust.

(11) Next, adjust the **Z-phase**. Connect the synchroscope's CH1 to the PLG PCB's P5 terminal and CH2 to the P6 terminal.

(12) Using step (3), adjust 0V. Set CH1 to the DC range, CH2 to GND, and the time axis to 50µs. Adjust VR5 so that the sections other than the waveform's crest are **approx. –0.1V**, and then adjust VR6 so that the peak value of the crest looking from a section other than the waveform crest is **0.4V to 0.5V**. After this, adjust VR5 again so that the sections other than the waveform's crest are between **–0.1V and –0.15V**. Finally, cancel the CH2 GND, and confirm that the section other than the crest in the CH2 waveform are 0V or more. (Refer to Fig. 12)

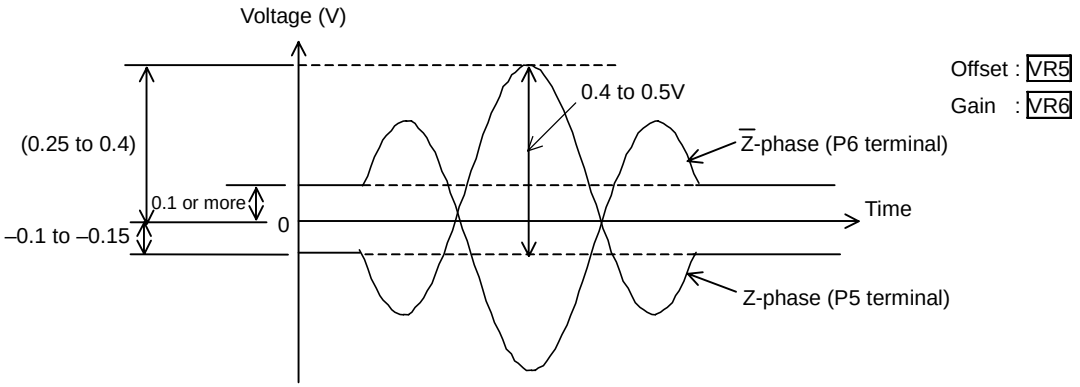


Fig. 12 Z-phase, $\overline{Z}$-phase waveform during motor forward run
(When looking at Z-phase, $\overline{Z}$-phase from P25 terminal)

(13) This completes adjustment of the potentiometer on the PLG PCB.

(14) When finished adjusting the potentiometer, stop the motor, and return the SP038 (SFNC6) bit F setting to "0". Then, turn the NC and spindle drive unit power OFF.

(15) Turn the NC and spindle drive unit power ON again, and carry out section "3.4) PLG automatic compensation function". This completes the adjustment. When finished, refer to section "4. Installing the PLG PCB", and correctly install the PCB.

⚠ CAUTION

1. When confirming the waveform in the normal operation state (closed loop), disconnect the PLG cable from the amplifier, and insert a check pin card between CN5 and the PLG cable. The check pin numbers corresponding to each signal in this case are shown below. Note that each signal has a +2.5V offset. Always remove the check pin card after confirming the waveform.

   If the waveform is checked with the PLG PCB's check terminal in the closed loop state without using the check pin card, abnormal noise or vibration may be generated from the motor.

   A-phase signal: CH6 B-phase signal: CH7 Z-phase signal: CH18

   $\overline{A}$-phase signal: CH16 $\overline{B}$-phase signal: CH17 $\overline{Z}$-phase signal: CH8

2. **After adjusting the potentiometer, always fix with lock paint, etc., so that the position does not deviate.**

4) Z-phase (magnetic) automatic adjustment (Only when using IPM spindle motor)

Z-phase automatic adjustment is a function that automatically adjusts the relative position of the motor magnetic pole and the PLG Z-phase pulse signal input into the spindle drive unit, and then saves and validates the adjustment data.
This function is used to increase the output torque accuracy, and must always be carried out when the machine is started. Execute this function with the following procedures.

⚠ CAUTION

1. The mechanical adjustments (gear - sensor gap, etc.) must already be completed.
2. When using this function, set the spindle load GD2 (max.: approx. 5-fold of the motor GD2) and the frictional load as low as possible.
3. The motor will automatically rotate at the adjustment speed during the Z-phase automatic adjustment. Do not touch the rotating sections, as these are hazardous.
4. If START (ON) is executed before the adjustment is completed, alarm 16 will occur, and the protection function will activate.

(1) Change SP205 from 0 to 1, and start forward run operation. (The power does not need to be turned OFF and ON.)
The control output 4H bit "D" will be set to 1 until the unit power is turned ON again.
1) The spindle motor will automatically rotate at the adjustment speed (two steps for Z-phase pulse detection and magnetic pole position detection).
2) The adjustment results will be calculated approximately 90 seconds after forward run is started (this time will differ slightly according to the magnetic pole position). Then operation will stop automatically.

(2) Confirm that the motor has automatically stopped. Leave parameter SP205 set to 1, turn START OFF, and turn the power OFF and ON. (When SP205 is set to 1, the adjustment data saved in SPm will be used.)
1) If START is turned OFF during automatic rotation, reset SP205 to 0, and turn the power OFF and ON. Then, repeat the procedure from step (1).
2) If the drive unit or motor is replaced, if the PLG is reinstalled, or if the signals are readjusted, etc., always reset SP205 to 0, and turn the power OFF and ON. Then, repeat the procedure from step
(1). Failure to observe this will prevent correct operation due to invalid adjustment data.

5) PLG automatic compensation function

(1) Turn the NC and spindle drive unit power ON, and change the spindle parameter SP245 (PGHS) setting from "0" to "1". (If already set to "1", reset it to "0" and then to "1" again with the power ON.)
(2) Input the forward run command or reverse run command. The motor will rotate in the forward direction when the command is input, and automatic compensation will be executed. (The motor will rotate at a maximum of 1500r/min regardless of the speed command's size, and will stop in several seconds.)

⚠ WARNING

When the forward run or reverse run command is input, the motor will rotate at a high speed regardless of the speed command's size. Do not touch or approach the motor or spindle during this time. Failure to observe this could result in personal injury.

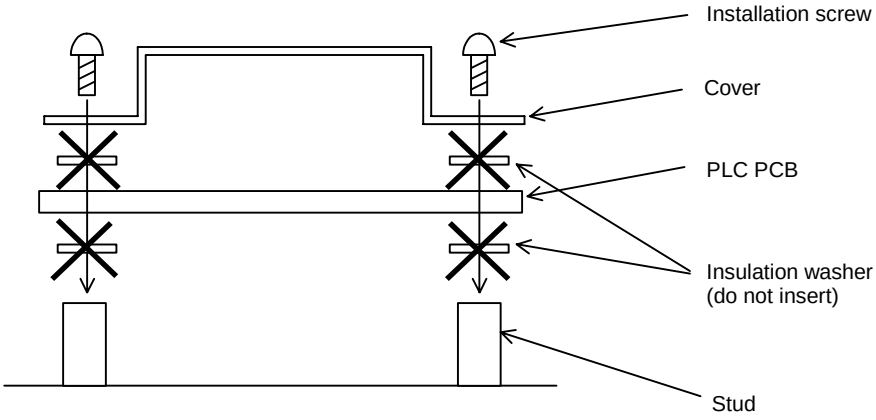
(3) After the motor stops, turn the forward run (or reverse run) signal OFF. Turn the NC power OFF and then turn the spindle drive unit power OFF.
This completes PLG automatic compensation. (Leave SP245 set to "1".)

⚠ CAUTION

1. When the motor stops after PLG automatic compensation is completed, always turn the forward run (or reverse run) command OFF.
2. If the spindle parameter SP245 is returned to "0", the PLG automatic compensation will be invalidated regardless of whether the NC power is turned ON or OFF. If the setting is changed to "0" by mistake, start again from step (1).
3. Even if the PLG automatic compensation has been completed for the spindle drive unit or motor, this adjustment must be made again when the spindle drive unit, motor, NC or card is replaced.

4. Installing the PLG PCB

Correctly install the PLG PCB after finishing the adjustments.
Do not insert the white insulation washer, and instead just tighten the installation screw.
Always use a metal stud on the side fixing the PLG PCB's FG connection ground, and connect to the ground. If this stud is not metal, or if it is metal but not connected to the ground, connect the separate grounding wire to the FG connection land on the PLG PCB (tighten together).



Revision history

Sub-No.	Date of revision	Revision details
G	July 2002	• Newly issued
H	Feb 2004	• Added the note in using an IPM spindle motor. The note is added to (1) of 1) to 2) of 3. Added 4) Z phase automatic adjustment.

Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.
Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

Duplication Prohibited

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