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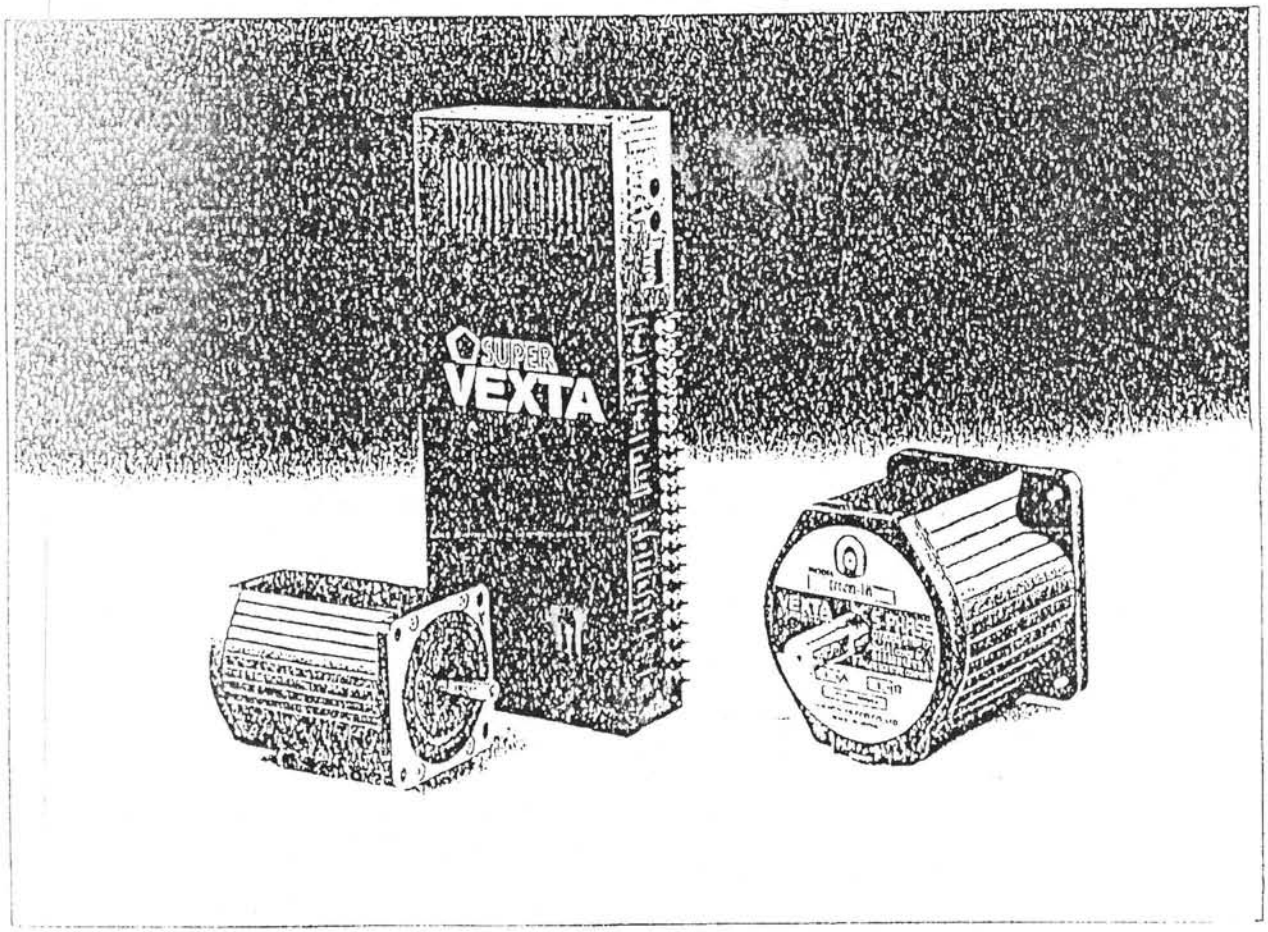
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OPERATING MANUAL

New Structual System 5 – Phase Stepping Motor

UPE Series

- Standard Type
- High Speed Type



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Thank you for purchasing ORIENTAL MOTOR products.
To ensure correct operation, please read this manual carefully before using your motor.

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Chapter 1. Features

1. Huge Boost In Torque

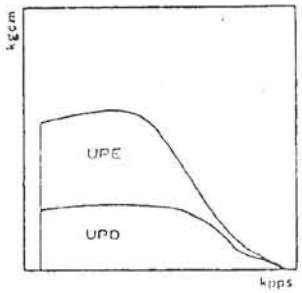
The UPE series uses a new structual system to deliver twice the torque of standard 5–phase stepping motors of the same size (comparisons with standard Oriental Motors products). Even when compared to the UPD series, the UPE represents a new class of motor in terms of acceleration and positioning performance, offering double the ratio of torque to inertial moment and excellent one–step response that reduce the time needed to come to a stable stop by half. By allowing machines to be made lighter, more compact and faster, the UPE series is a revolution in engineering using stepping motors.

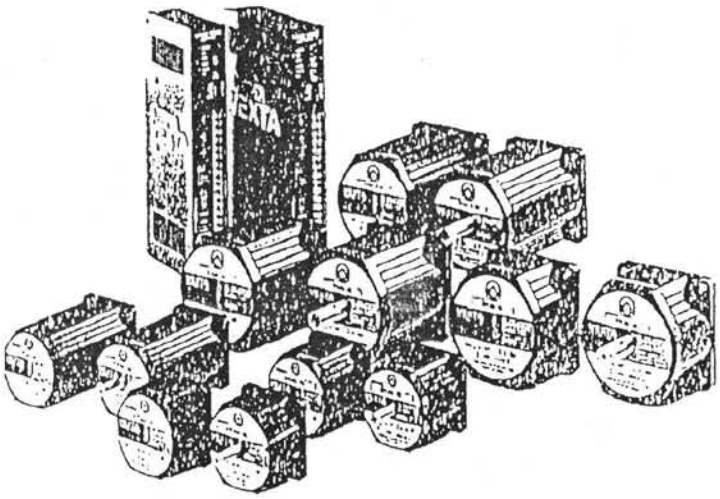
2. Current Reduced By Half

Because torque generated by motors in the UPE series is twice that of standard stepping motors, producing the same amount of torque requires only half the current. This means substantial savings in power consumption.

3. Temperature Increase Cut By Three–Fourths

Rises in motor temperature are usually proportional to motor input. In the UPE series, temperature rises are held to 1/4 of usual levels since the same amount of torque can be generated at only 1/4 the input. And because temperature rises are slight, machines using smaller motors can be designed to perform high–precision positioning without loss of response characteristics.





The maximum torque of a stepping motor is determined by the magnetic flux between the stator and rotor. The UPE series uses a newly designed 5–phase stepping motor that delivers greater torque than ever before through the incorporation of a rare earth magnet in the stator slots and concentration of the magnetic flux.

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Ease Of Selection And Use – Motor/Driver Unit

The UPE series incorporates the use of a newly developed driver which takes full advantage of its high –response, low–vibration 5–phase stepping motor. While adopting the simple wiring method of the UPD series, which requires only 5 lead wires, this series succeeds in achieving a still greater motor drive system. New innovations include an LSI made more reliable and compact, enhancement of the control signal monitoring function, a high–precision digital switch (16 stages) suitable for adjustments to motor current, a pulse–oscillating function (3pps) for self–testing, and AC100/115V power input which conforms to voltage specifications worldwide. This series' careful design encompasses even the driver – indispensable to the operation of a stepping motor.

Constant Current Chopper driver

The UPE series incorporates a constant current chopper driver method for the efficient operation of its 5–phase stepping motor. Because the power supply for the motor is built–in, simply connect the driver to a single phase 100V or 115V power source and it is ready for operation.

High Resolution

The UPE series boasts high resolution of 0.72˚ or 0.36˚ per pulse. Step angle can be altered easily using the switch on the driver unit.

Automatic Current Cutback

The UPE series is equipped with an automatic current cutback function to suppress heat generation when the motor is stopped.

Overheat Alarm Output

When the temperature inside the driver exceeds 80˚C, the alarm lamp is illuminated, an alarm signal is output and the motor is automatically stopped.

Excitation Timing Output

The excitation timing signal emitted from the driver allows for greater accuracy in determining a device's home position.

Two Types of Pulse Input

Two types of pulse input can be used simply by switching from one to the other – the 1–pulse mode which uses a pulse signal and a direction of rotation signal, and the 2 pulse mode which uses CW and CCW pulse signals.

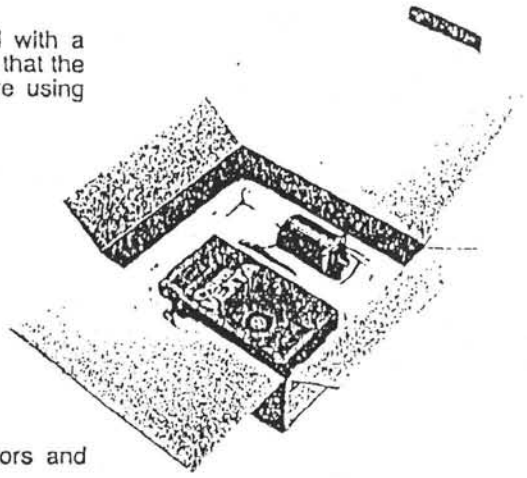
Front Panel Operation

Setting and switching of the driver's functions and adjustments of the current can all be performed with ease from the front panel.

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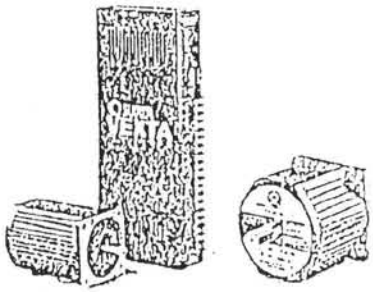
Chapter 2. Contents Of UPE Series

Each unit in the UPE series is equipped with a stepping motor and a driver. Please confirm that the correct motor and driver are included before using the unit.

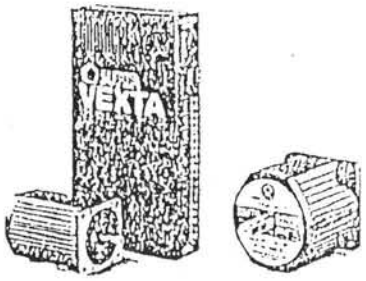


The individual item numbers for the motors and drivers in each of the units are listed below.

Type	Unit Model	Motor		Driver	
		Model	Current	Model	Current
Standard Type	UPE564-NA	EM564-NA	1.4A/Phase	UDX5114N	1.4A/Phase (Maximum)
	UPE564-NB	EM564-NB			
	UPE566-NA	EM566-NA			
	UPE546-NB	EM546-NB			
	UPE569-NA	EM569-NA			
	UPE569-NB	EM569-NB			
	UPE596-NA	EM596-NA			
	UPE596-NB	EM596-NB			
	UPE599-NA	EM599-NA			
	UPE599-NB	EM599-NB			
	UPE5913-NA	EM5913-NA			
	UPE5913-NB	EM5913-NB			
High Speed Type	UPE569H-NA	EM569H-NA	2.8A/Phase	UDX5128N	2.8A/Phase (Maximum)
	UPE569H-NB	EM569H-NB			
	UPE596H-NA	EM596H-NA			
	UPE596H-NB	EM596H-NB			
	UPE599H-NA	EM599H-NA			
	UPE599H-NB	EM599H-NB			
	UPE5913H-NA	EM5913H-NA			
	UPE5913H-NB	EM5913H-NB			



Standard Type



High Speed Type

Accessories

Driver Mounting Bracket A ·····2 pieces



Driver Mounting Bracket B ·····2 pieces



Screw Driver ·····1 piece



Four M3 flat-headed screws are included for use with the mounting brackets.

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Chapter 3. Precautions

Checks Prior To Operation

Motor/Driver

Do not use this motor/driver unit in combination with any other motors or drivers not included in this unit.
Setting and switching of the driver's functions and current adjustments can all be performed from the front panel. Do not open the driver case to make any internal adjustments.
Disassembling the motor or loosening the motor's assembly screws will result in a significant reduction in the unit's performance. Do not take the motor apart or loosen the motor's screws under any circumstances.

Driver's Factory Settings

In order to simplify initial use of the UPE series, the driver's output current is set to the motor's rated value and the following settings are made for the function modes at the factory.

Function Mode Switches

- Automatic Current Cutback (ACD)
  Set with the automatic current cutback mode (ACD) "ON" to reduce output current when motor is stopped.
- Automatic Output Current OFF (AHO)
  Set with the automatic hold off mode (AHO) "ON" to automatically cut off current to the motor when the overheat protection function has been activated.
- Step Angle (FULL/HALF)
  Set to "FULL" for 0.72° step per pulse.
- Pulse Input Mode (2P/1P)
  Set to "2P" for the 2-pulse input mode which is controlled by CW and CCW pulse signals.
- Self-Test Function (NORM/TEST)
  Set to "NORM" for the normal operation mode.

Relationship To The UPD Series 5-Phase Stepping Motor Units

- The newly designed 5-phase stepping motor units of the UPE series incorporate a new motor drive method. The UPE series' driver operation method and the motor's internal wiring configuration are different from those of the UPD series, and consequently the two series are not compatible.

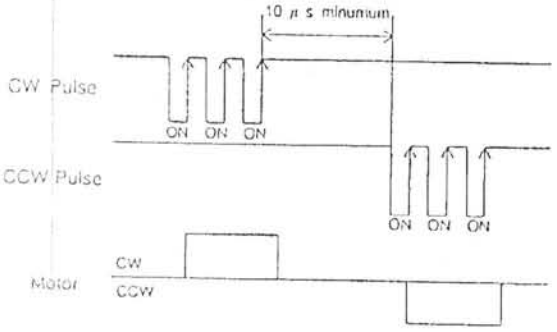
Current Adjustment Switch

- **Motor Running Current (RUN)**
  Both the standard and high-speed models are set to "F" for output of the motor's rated current.
  Standard unit ---- 1.4A/phase
  High-speed unit -- 2.8A/phase

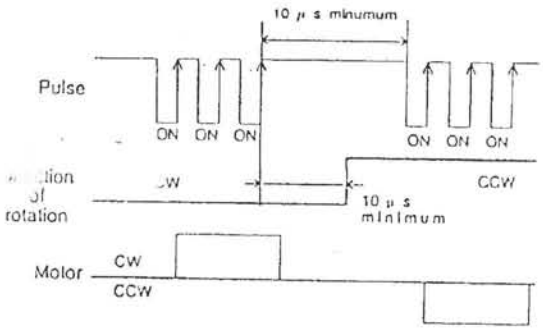
- **Motor Stop Current (STOP)**
  Set to "7" for output of approximately 1/2 of the value set using the RUN switch.
  Standard unit ---- 49% output (0.7A/phase)
  High-speed unit -- 44% output (1.2A/phase)

Pulse Input Mode

- 2-Pulse Input Mode
  This mode involves two kinds of pulses, a CW pulse and a CCW pulse. When a CW pulse is input, the motor rotates clockwise (as seen from the motor output shaft end) and when a CCW pulse is input, the motor rotates counterclockwise.



- **1-Pulse Input Mode**
  This mode uses a pulse signal and a directional (CW /CCW) signal. When the directional signal is at L level (photocoupler is ON), the motor rotates clockwise; when the signal is at H level, the motor rotates counterclockwise.

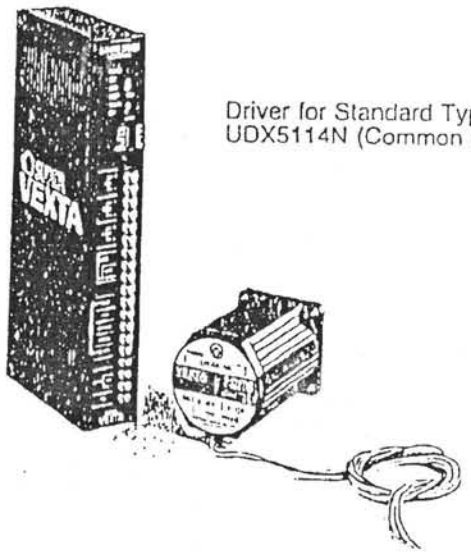


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Chapter 4. Names And Functions Of Driver Parts

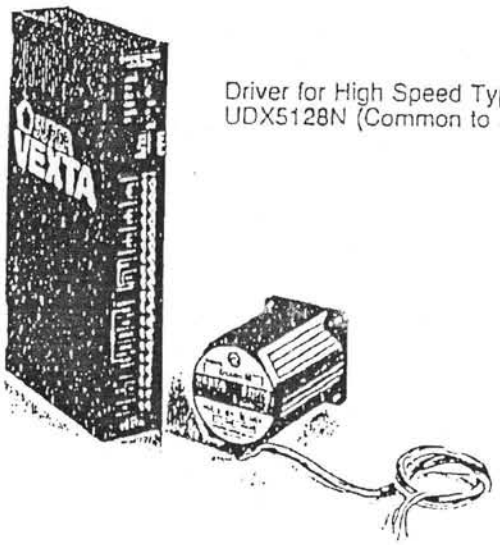
Refer to the page shown in ☐ for the detail.

Standard Type
UPE56☐–NA, UPE56☐–NB
UPE59☐–NA, UPE59☐–NB



Driver for Standard Type
UDX5114N (Common to all unit models)

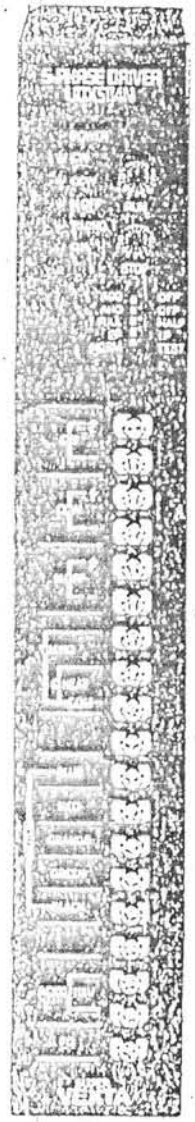
High Speed Type
UPE56☐H–NA, UPE56☐H–NB
UPE59☐H–NA, UPE59☐H–NB



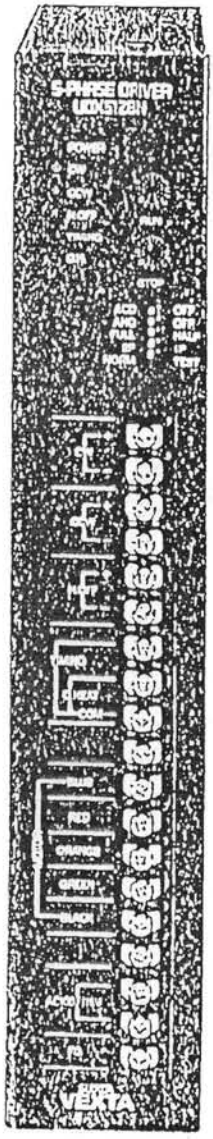
Driver for High Speed Type
UDX5128N (Common to all unit models)

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Driver for Standard Type
UDX5114N



Driver for High Speed Type
UDX5128N



LED indications

POWER Input
Lights the power, single-phase 100V or 115V(60Hz), is applied to the power terminals.

CW PULSE signal Input
Lights when a CW pulse has been received at the CW terminals. (Under the 1-pulse input system, lights when a pulse has been received.)

CCW PULSE signal Input
Lights when a CCW pulse has been received at the CCW terminals.
(Under the 1-pulse input system, lights when a CCW signal has been received.)

OUTPUT CURRENT OFF signal Input
Lights when an output current off signal has been received at the H.OFF terminals.

EXCITATION TIMING signal output
Lights when an excitation timing output signal has been output from TIMING terminals.

OVERHEAT signal output
Lights when the overheat protection function is activated, and an overheat signal has been output from O.HEAT terminals.

① *CW PULSE* signal input terminals P.17
Inputs CW rotation command pulse. (Input operation command pulse under the 1-pulse input mode.)

② *CCW PULSE* signal input terminals P.17
Inputs CCW rotation command pulse. (Under the 1-pulse input mode, inputs command for direction of rotation. At L level motor rotates clockwise, and at H level counterclockwise.)

③ *OUTPUT CURRENT OFF* signal input terminals P.17
Inputs signal to stop current supply to motor. While this signal is ON, motor cannot move even if operating pulses are input.

④ *EXCITATION TIMING* signal output terminals P.18
Signal shows that the excitation state of motor (current flowing through coils) conforms with the initial settings set by the driver.
·Full Step: with 0.72° steps, a signal is output every 10 pulses input
·Half Step: with 0.36° steps, a signal is output every 20 pulses input

⑤ *OVERHEAT* signal output terminals P.19
Signal output when temperature of radiation plate in the driver exceeds 80°C, stopping the motor automatically.
(It is also possible to cancel natural motor stop with function switches.)

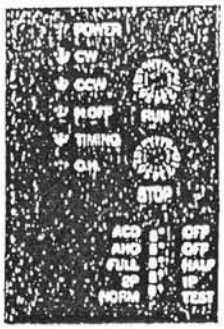
⑥ Motor terminals
Terminals for motor signals. Connect to motor by matching with lead wire colors.

⑦ Power supply terminals P.16
Connect to single-phase 100V ± 10% 50/60Hz or single-phase 115V ± 10% 60Hz power supply.

⑧ Frame ground terminals P.16
Mounted on driver case. Connect to the FG terminal of your controller.

⑨ Potentiometer for adjusting motor operating current P.14
This potentiometer is used to adjust current while motor is in operation. Motors are set to 1.4A/phase on the standard type and 2.8A/phase on the high sped type when shipping.

⑩ Potentiometer for adjusting current at motor standstill P.14
This potentiometer is used to set the current at motor standstill (no pulse input). When shipping, the current is set to 49% of rated motor operating current (44% in model UDX5128N) in both standard and high speed types.



Function setting switches P.13

Automatic current cutback
Automatic output current OFF
Step angle
Pulse input mode
Self-testing

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Chapter 5. Operation

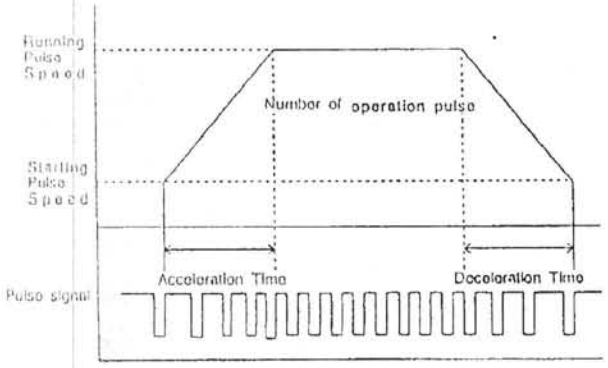
1. For Positioning Operation Of Stepping Motor

(1) Operating Pattern

The operating pattern for stepping motor driving generally follows a trapezoidal curve in response to acceleration/deceleration control of pulse signals, as shown in the diagram below.

Acceleration/deceleration control is necessary when operating the motor on pulse signals exceeding maximum starting pulse rate. Even while operating within the starting pulse rate, acceleration/deceleration control is required when load inertial is large. In this case, however, the time required for acceleration/deceleration is affected by the size of moment of load inertia.

When no pulse signals are input (when the motor is stopped), a holding torque proportional to the current reduction rate set on the current adjustment switches exerted while the motor is stopped.



(2) Operating Pulse Speed and Number of Operating Pulse

① The relationship between operating pulse sped and motor speed (rpm) is described by the following formula.

· Full step mode: 0.72˚ /step

$$\text{Motor Speed (rpm)} = 60 \times \frac{\text{Operating pulse Speed (pps)}}{500\ (\text{P/R})}\ (\text{rpm})$$

· Half step mode: 0.36˚ /step

$$\text{Motor Speed (rpm)} = 60 \times \frac{\text{Operating pulse Speed (pps)}}{1000\ (\text{P/R})}\ (\text{rpm})$$

Pulse Speed [kpps]	Motor Speed [rpm]	
	0.72˚ /Step	0.36˚ /Step
0.5	60	30
1	120	60
5	600	300
10	1200	600
12.5	1500	750
20	2400	1200
25	3000	1500

② The relationship between the number of operating pulses and amount of motor movement (in degrees) are described by the following formula:

· Full step mode: 0.72˚ /step
Amount of motor movement
= 0.72˚ × Number of Operating Pulses (degree)

· Half step mode: 0.36˚ /step
Amount of motor movement
= 0.36˚ × Number of Operating Pulses (degree)

③ From these equations it is possible to determine the speed and number of operating pulses required for positioning operation. This should, however, be used only as a rough guideline, as operating pulse speed is influenced somewhat by the requirements for acceleration/deceleration control described afterward.

Before turning on the power or operating the motor, confirm that the self-test function switch is set to the "NORM" position. Turning on the power to the driver with this function set to the "TEST" position will cause the motor to begin rotating immediately and is dangerous.

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(3) Starting Pulse Speed

Starting pulse speed should be set at a speed such that the motor speed will be 60 ~ 100rpm. As the moment of load inertia become larger, the maximum starting pulse rate will decline. The relationship between moment of load inertia and starting pulse rate is given in the formula below.

Higher starting pulse speeds are effective in shortening positioning time, but when pulse speed goes too high the motor steps out and comes to a stop.

$$f = \frac{f_s}{\sqrt{1 + \frac{J_L}{J_o}}} \text{ [pps]}$$

f_s :Maximum starting pulse rate (pps) of the motor
f : Maximim starting pulse rate (pps) when applying load inertia
J_o :Moment of rotor inertia (gcm^2)
J_L :Moment of load inertia (gcm^2)
($J = GD^2/4$)

(4) Acceleration And Deceleration Time

Acceleration and deceleration time are both set at 25% of positioning time. (This figure is used as a guideline when selecting the motor.)

Example:
To output 2000 pulses in 0.28sec. (using a 5-phase stepping motor)

- Starting pulse speed: 500pps
- Acceleration and deceleration time: 0.07sec.

Operating pulse speed is obtained from the following equation.

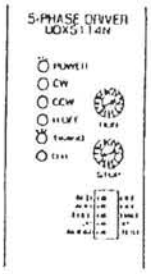
$$\text{Operating Pulse Speed} = \frac{2000 - 500 \times 0.07}{0.28 - 0.07} \fallingdotseq 9360 \text{ (pps)}$$

(5) Lamps Illuminated When Turning On The Unit

Before turning on the unit confirm that there are no mis-wirings in the signal lines, motor and power lines, and that the self test function switch is set to the "NORM" position.

Power Lamp
Normally illuminated when turning on the power.

Timing Lamp
When turning on the power, the motor excitation sequence is reset to its original position at step "0" and this lamp is illuminated.



Caution: Turning the power back on
After the power has been turned off, wait 5 seconds before turning it back on again.
If the power is turned on again immediately after it has been turned off, the timing lamp will not be illuminated and the motor excitation sequence will not be reset to step "0."

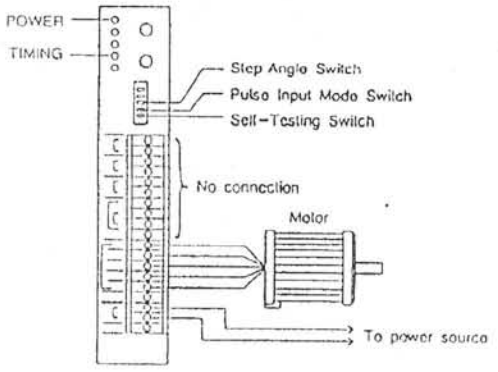
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2. Self–Test Function

The UPE series driver is equipped with a self–test function which determines whether the driver and motor connections have been made correctly or not.

(1) Preparations

① Confirm that the driver's self–test function switch is set to "NORM" – the normal operating mode. Set the pulse input mode switch setting to the "2P" position for the 2–pulse input mode.
Both of these settings are initially set to "NORM" and "2P" at the factory.
Do not make any connections to the CW, CCW or H–OFF signal input terminals.

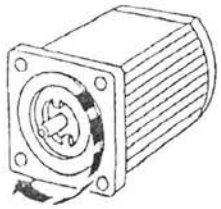


② Connect the motor to the driver and turn on the power.
Confirm that the POWER and TIMING lamps are illuminated.
Try rotating the motor shaft gently by hand and confirm that the shaft does not rotate.

(2) Performing A Self–Test

① Switch the self–test function switch from the "NORM" position to the "TEST" position.

NORM ⇨ TEST



Output shaft rotates in CW direction at the speed of approximate 3pps.

Once the self–test function has been switched to "TEST" the motor will immediately start rotating in a CW direction at a pulse rate of approximately 3pps; this confirms that there are no problems with the driver, motor and their connections. (The motor will rotate as long as the setting remains in the "TEST" position.) If the motor rotates with abrupt, jerky movements or rotates in a CCW direction, turn off the power immediately and check the connections to the motor.

② Confirm that the TIMING lamp is illuminated.
When the step angle switch is set to:
FULL: 0.72° step–the lamp will light every 10 steps
HALF: 0.36 step–the lamp will light every 20 steps.

(3) Conclusion

In order to conclude a self–test, switch the self–test function switch from the "TEST" to the "NORM" position.

NORM ⇦ TEST

The motor stops and the driver returns to the normal operating mode.

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3. Customizing The Driver

Factory settings of the driver can be modified using the following function setting and current adjustment switches.

Driver Front Panel



RUN potentiomenter

STOP potentiomenter

AUTOMATIC CURRWNT CUTBACK Switch

AUTOMATIC OUTPUT CURRENT OFF Switch

STEP ANGLE Switch

PULSE INPUT MODE Switch

SELF-TEST Switch

Switching And Setting Function

·*AUTOMATIC CURRENT CUTBACK* at Motor Standstill

ACD ⇦ OFF

When switch is flipped to ACD, the automatic current cutback at standstill function is set. Approximately 0.1 seconds after pulses cease, the motor output current is automatically lowered to suppress heat generation in the motor and driver. (The rate of current cutback is shown in the paragraph of "Current cutback at motor standstill" in the following page.

ACD ⇨ OFF

Generally, the switch should be at ACD side. If it is flipped to OFF, the automatic current cutback at motor standstill function is cancelled.

·*AUTOMATIC OUTPUT CURRENT OFF*

AHO ⇦ OFF

Set automatic output current off function flipping AUTOMATIC OUTPUT CURRENT OFF switch to AHO.

When the overheat protection is engaged (when temperature inside the driver exceeds 80 ˚C) current output to the motor is automatically stopped and the motor comes to a natural stop.

AHO ⇨ OFF

In situation where stopping of the motor due to overheat protection could pose problems, automatic output current off can be overridden by setting this switch to OFF. However, as a rule, whenever the overheat protection function is active (shown by overheat signal on display) the motor should be stopped as soon as possible.

·*STEP ANGLE*

FULL ⇦ HALF

When STEP ANGLE switch is flipped to FULL, the driver is set for 0.72˚ /step (500 pulses per revolution); when the switch is flipped to HALF, the driver is set for 0.36˚ /step (1000 pulses per revolution).

FL ⇨ HALF

·*PULSE INPUT MODE*

2P ⇦ 1P

The driver is designed to function under either of the following two pulse output mode of user's controller.

When PULSE INPUT switch is flipped to 2P, the driver is set for the 2-pulse input mode, in which two types of pulse signal (one each for CW and CCW) are used to control the motor. When the switch is flipped to 1P, the driver is set for the 1-pulse input mode, in which a pulse signal and a direction of rotation signal are used to control the motor.

2P ⇨ 1P

·*SELF-TEST*

NORM ⇨ TEST

The self-test function utilizes the built-in pulse generator to test whether driver, stepping motor and wiring between motor and driver are correctly functioning.

When SELF-TEST switch is set to TEST, the motor immediately begins to rotate clockwise at a speed of 3pps (at 2-pulse input mode). To cancel self-test, flip the switch to NORM.

NORM ⇦ TEST

Motor and driver should generally be used with set in the NORM position.

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4. Adjusting The Motor Output Current Level

(1) How to Use Adjsustment Potentiometers

① Motor operating current

1. Adjust the motor current with RUN potentiometer. It can be adjusted in the range from 0.4A/phase to 1.4A/phase. (For driver model UDX5128N, from 0.7A/phase to 2.8A/phase.)
2. The motor operating current is set for rated current 1.4A/phase (2.8A/phase for driver model UDX5128N) when shipping, but it can be readjusted using the RUN potentiometer to lower the operating current in order to suppress temperature rise in the motor/driver, or lower operating current in order to allow a margin for motor torque or to suppress vibration.

Following table shows operating current values against the RUN potentiometer scale.

Operating Current against RUN Potentiometer Scale (Representative values)

RUN Potentiometer Scale	Operating Current [A/Phase]	
	UD5114N	UD5128N
0	0.4	0.7
1	0.4	0.84
2	0.47	0.98
3	0.54	1.12
4	0.61	1.26
5	0.68	1.40
6	0.75	1.54
7	0.82	1.68
8	0.90	1.82
9	0.97	1.96
A	1.04	2.1
B	1.11	2.24
C	1.18	2.38
D	1.25	2.52
E	1.32	2.66
F	1.4	2.8

② Current cutback at motor standstill

1. Use the STOP potentiometer to adjust the current during the motor is stopped. It can be adjust between 18% ~ 100% (13% ~ 100% for driver model UDX5128N) of set operating current.
2. When shipping, the current cutback is set for 49% (0.68A/phase). For driver model UDX5128N, set for 44% (1.23A/phase). The STOP potentiometer can be used to readjust the current at motor standstill as the relation to motor holding brake force requires.

Table on the right shows the rate of current cutback during motor stops against the STOP potentiometer scale.

$$\text{Rate of Current Cutback (\%)} = \frac{\text{Standstill current to be set}}{\text{Operating current to be set}} \times 100$$

$$\text{Holding Torque [kgcm]} = \frac{\text{Holding torque} \times \text{Rate of current cutback}}{100}$$

Rate of Current Cutback against STOP Potentiometer Scale (Representative values)

STOP Potentiometer Scale	Rate of Current Cutback [A/Phase]	
	UD5114N	UD5128N
0	18	13
1	18	13
2	18	13
3	23	16
4	29	23
5	36	30
6	43	37
7	49	44
8	54	51
9	61	58
A	68	65
B	75	73
C	81	80
D	87	87
E	93	93
F	100	100

(2) When the Overheat Protection Function is Activated

UPE series drivers are equipped with an overheat protection function to prevent burn out from overheating.

① When the overheat function is activated

Cut the power to the driver and check the use conditions (ambient temperature, operation pattern, etc.); or, reduce the driver's temperature by cooling it with a fan, etc.

② Causes for activation of the overheat function

1. Placement of the driver in a location with insufficient air circulation for proper heat radiation, or when the driver's internal temperature plate exceeds 80˚ due to high ambient temperatures and the heat generated by the driver.
2. Continuous operation of the driver at the pulse rate with the largest input to the driver. Input to the driver varies considerably according to motor size and pulse rate. For example, the UPE569-NB achieves its maximum input at 5kpps (full step). Please refer to the driver input current ratings in the "speed torque characteristics" section of the catalog.

③ Cancelling the alarm and restarting operation

When the temperature of the driver's internal temperature plate drops below 80˚, the overheat function automatically causes the alarm to be canceled and operation to be recommenced. (The O.HEAT signal returns to the "H" position and the OH lamp is extinguished.)

Cancellation of the alarm and recommencement of operation cannot be performed through external signals or by reconnection of the power source.

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Chapter 6. Control Of Input/Output Signal

1. Connecting Diagram

CW PULSE Input

When a negative logic pulse is input to the CW ⊖ terminal, the motor rotates one step clockwise at pulse rise.

Pulse input at 1−pulse input mode
The motor rotate one step at rise of negative logic pulse. The direction of rotation depends on the input of direction of rotation explained afterward.

CCW PULSE Input

When a negative logic pulse is input to the CCW ⊖ terminal, the motor rotates one step counterclockwise at pulse rise.

Direction of rotation input at 1−pulse input mode
Input direction of rotation signals to CCW ⊖ terminal.
L level: CW H level: CCW

OUTPUT CURRENT OFF Input

When a L level pulse is input to the H. OFF ⊖ terminal, current to the motor stops, allowing the motor shaft to be rotated by hand. (This allows manual positioning alignment, etc.)

Always input H level when the motor is operating.

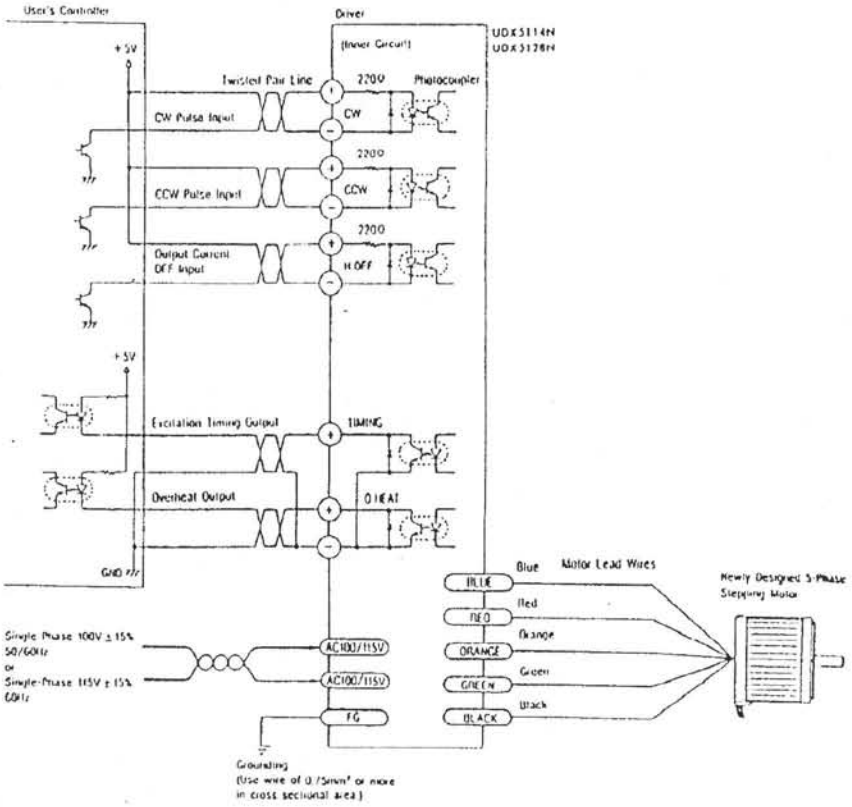
EXCITATION TIMING Output

(Photocoupler is ON during signals are output.)

A signal is output whenever the motor excitation sequence returns to step "0" in synchronization with the input pulse signal to the CW PULSE input terminal or the CCW PULSE input terminal. The TIMING (TIM) lamp goes on at this time. A signal is output each 10 pulses at 0.72˚/step mode and every 20 pulses at 0.36˚/step mode.

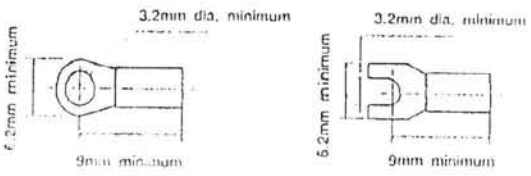
OVERHEAT Output

This signal is output whenever the thermo sensor inside the driver detects a temperature higher than 80˚C. The OVERHEAT (O.H.) lamp lights when the signal is output.



<Recommended Crimp Terminal >

· Round shape type · U−shape type



Precautions for Connecting

1. Use twisted−pair wire of 1m or less in length for the signal lines.
2. When connecting the driver, use a crimp terminal if at all possible.
3. Use wire of 0.5mm² or thicker for motor lines (when extended) and power supply lines, and use 0.75mm2 or thicker for the wire for the ground line.
4. Grounding the ground terminal of the driver together with the ground terminal of your controller.
5. Signal lines should be kept away at least 30cm from power lines (power supply lines and motor lines). Do not bind the signal line and power line together.
6. If noise generated by the motor lead wire causes problems, try shielding of the motor lead wires with conductive tape or wire mesh.

Use an open collector transistor (sink type) at the controller signal output.

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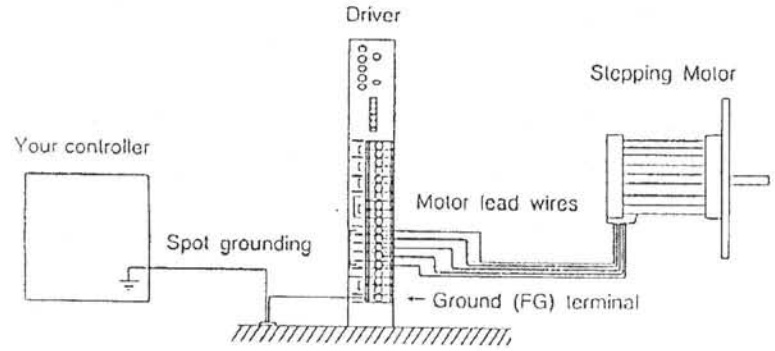
(1) Power Supply

The UPE series can be used with either a single phase 100V 50/60 Hz or 115V 60Hz power supply.
The power supply input current is:
Standard unit : less than 4.2A
High-speed unit : less than 7.3A
Use a power source which is able to provide sufficient input current.
(The value for the power supply input current is the driver's maximum input current value when a load has been applied to the motor.)

Caution: When the power capacity is insufficient, the following problems may arise due to a drop in the motor's output.
·The motor does not rotate normally during high-speed operation (insufficient torque).
·The motor starts and stops slowly.

(2) Frame Ground (FG) Terminal

Ground the driver's FG terminal to the FG terminal of the external controller (pulse oscillator) in order to prevent malfunctions due to external noise.
(The motor can be grounded to a device using the assembly screws.)



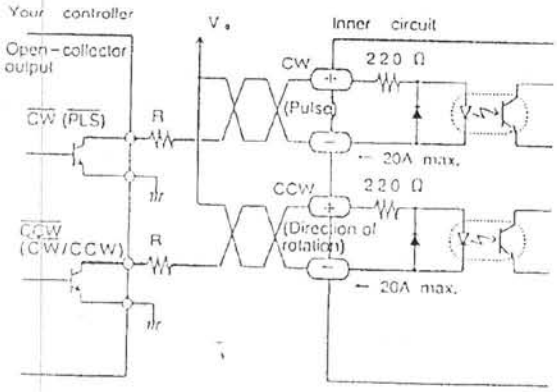
·Use a wire rod of 0.75mm² or more for the grounding line, and keep the wiring as short as possible.
·If the noise generated from the motor lead wires should cause a problem, shield the motor lead wires with conductivity tape or wire mesh.

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2. Input/Output Signal Circuit Characteristics

(1) *CW/CCW PULSE* Input

■ Internal Circuit And Connecting To Controller

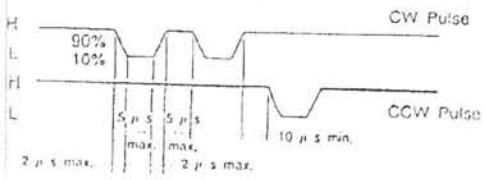


The characters indicate signals under the 2-pulse input mode, while the characters in parenthesis ( ) indicate signals under the 1-pulse mode.
External resistance R is not required when V_0=5V. When V_0 > 5V, connect external resistance R making input current should be less than 20mA.

① 2-Pulse Input Mode
·CW Pulse Input
When a negative logic pulse is input to the CW ⊖ terminal, the motor will move one step in a clockwise direction together with the pulse rise.
·CCW Pulse Input
When a negative logic pulse is input to the CCW ⊖ terminal, the motor will move one step in a counter-clockwise direction together with the pulse rise.

② 1-Pulse Input Mode
·Pulse Input
When a negative logical pulse is input to the CW ⊖ terminal, the pulse's direction of rotation depends on the next direction of rotation input.
·Direction of Rotation Input
The direction of rotation signal is input to the CCW ⊖ terminal. The level of the input signal is "L" for CW, "H" for CCW.

■ Pulse Wave



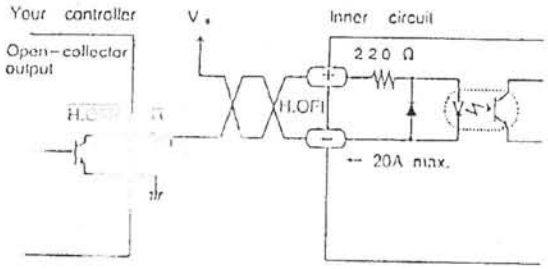
The photocoupler diode lights in gray part. The motor moves at pulse rising edge (see arrow).

① Pulse voltages are 4 ~ 5V for H level and 0 ~ 0.5V for L level.
② The input pulse should have a pulse width of at least 5 μ sec., rise and fall times of at most 2 μ sec. and a maximum pulse duty of 50%.
③ 10msec. minimum, an interval for changing the direction of rotation, is a nominal value. Time varies with motors and moment of load inertia.

Notes: Pulse Signal Input
Pulse signal output should always be at H level when pulse signals are stopped. If pulse signal output remains at L level the automatic current cutback at standstill function will not operate.
[When using 2-pulse input mode]
·Do not input CW and CCW pulses at the same time. If either the CW or CCW pulse is at L level, input of the opposite pulse will not result in normal motor response.
[When using 1-pulse input mode]
·The direction of rotation should be changed only when pulses are stopped (at H level).

(2) *OUTPUT CURRENT OFF (H.OFF)* Input

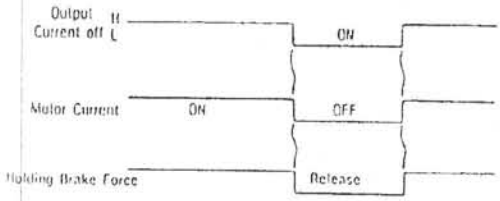
■ Internal Circuit And Connecting To Controller



External resistance R is not required when V_0 =5V. When V_0 > 5V, connect external resistance R making input current should be less than 20mA.

① When the output current off signal is at L level (photocoupler is ON), no current is sent to the motor (holding brake force is released) and the motor shaft can be moved by external force.
Use this function when the motor shaft needs to be turned or positioning carries out by hand.
While the motor is in operation the signal should always be set to H level. If no needs is anticipated for this function, leave terminal unconnected.

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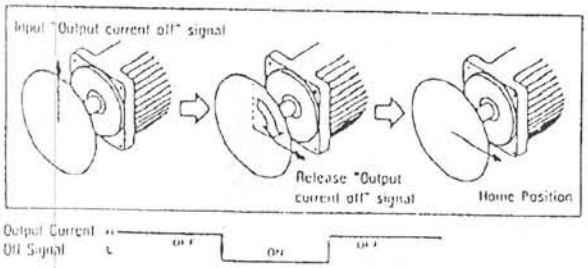


Gray part means that the motor provides holding brake force in proportion to standstill current set by STOP potentiometer.

② The motor excitation sequence (phase) does not change even when the output current off signal is switched from ON to OFF.
When the shaft has been moved by external force under input from "Output" current off, the shaft may move up to ± 3.6 depending on shaft position.

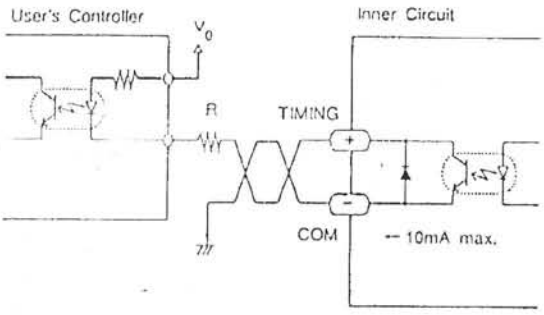
■ Manual Home Position Detecting

When set the home position after manual positioning, follow the steps shown below;



(3) *EXCITATION TIMING (TIMING)* Output

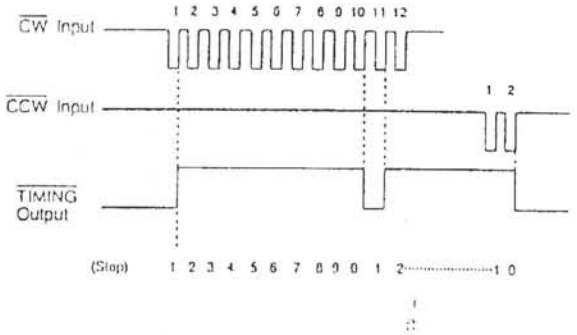
■ Internal Circuit And Connecting To Controller



Vo should be greater than 5V and less than 24V. Maintain current at 10mA or less.

① The excitation timing signal indicates that the excitation state of motor confirms to the initial setting (step 0). This signal can be used to detect home position with greater precision by setting the mechanical home position of equipment to coincide with the excitation home position (step 0) of the motor.

② A signal is output at every time the excitation sequence returns to step "0" in synchronization with the input pulse. The excitation sequence rotate for each 7.2 the motor shaft moves.
The timing (TIMING) lamp on the front panel light every 10 pulses at full-step (0.72° /step) and every 20 pulses at half step (0.36° /step).

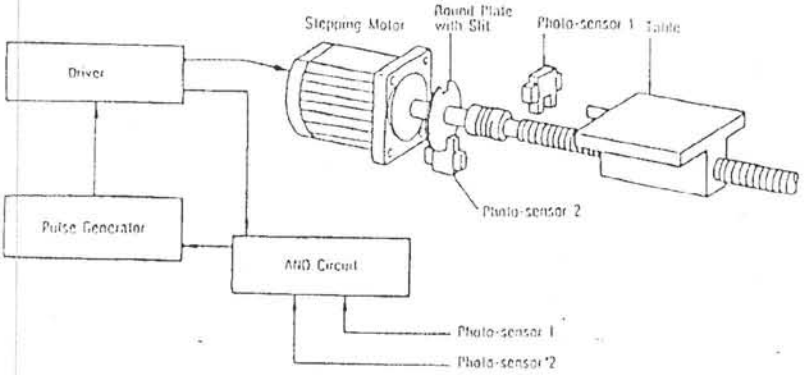


On above connecting diagram, step "0" corresponds to L level.

Note: 1. When the power supply is turned ON, the excitation sequence is reset to "0" and the timing (TIMING) lamp lights.
2. The TIMING lamp brinks at high speed when the motor is running, so it may appear to be on continuously.

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When repeatedly performing home position detection, error in the sensors and limit switches sometimes causes the slippage of home position. In such cases, the home position detection of equipment can be made more accurate by constructing an AND circuit using the mechanical home position and the excitation timing output signal.



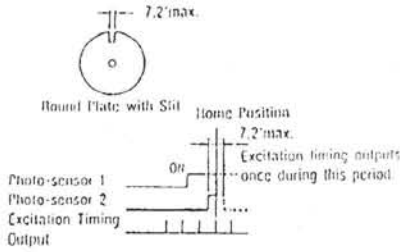
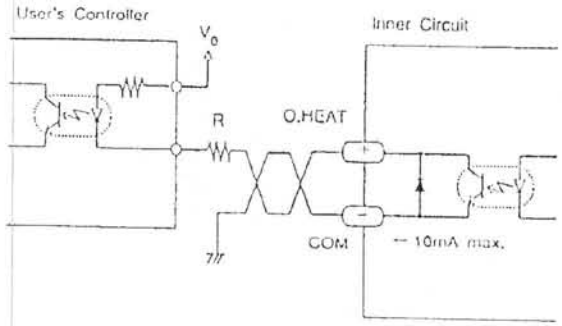


Photo-sensor 1 should be installed where the sensor can detect a slit within one slit disk revolution.

(4) *OVERHEAT (O.HEAT)* Output

Internal Circuit And Connecting To Controller



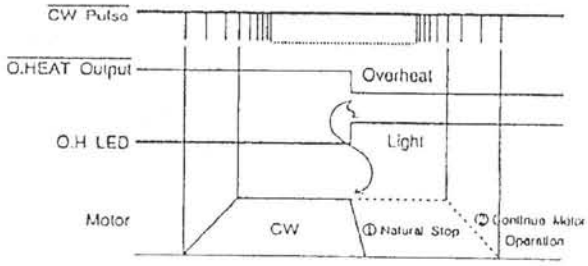
V_o should be greater than 5V and less than 24V. Maintain current at 10mA or less.

① Overheat signal is output when the temperature of heat radiation plate inside the driver exceeds 80°C. On above wiring, output of the overheat signal corresponds to L level. The overheat (O.H.) lamp on the front panel lights when this signal is output.

② If the automatic output current off function has been set at this time, output current to the motor drops to "zero" and the motor comes to a natural stop.

③ When an overheat signal is output, either reconsider operating condition (ambient temperature, operating patterns, etc.) or take measures such as forced cooling of the driver.

④ Overheat signal will be canceled automatically as soon as the inner temperature of the driver drops.



The AUTOMATIC OUTPUT CURRENT OFF function may be used to control motor operation when the overheat signal is output as follows:

① Flip switch to AHO side to bring the motor to a natural stop.

② Flop switch to OFF side to continue motor operation.

However, once an overheat signal has been output, all pulse output to the driver should be ceased and power turned off as soon as the motor set operation has finished. Reconsideration should be given to operating conditions.

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Chapter 8. Specifications

Motor Unit – Standard type

- The value given for holding torque is the value operated by dedicated driver (UDX5114N) with rated current and five-phase excitation.
- Step Accuracy: At full step with no load. (It varies with load.)

Unit Model	Single Shaft	UPE564-NA	UPE566-NA	UPE569-NA	UPE596-NA	UPE599-NA	UPE5913-NA
	Double Shaft	UPE564-NB	UPE566-NB	UPE569-NB	UPE596-NB	UPE599-NB	UPE5913-NB
Motor Model	Single Shaft	EM564-NA	EM566-NA	EM569-NA	EM596-NA	EM599-NA	EM5913-NA
	Double Shaft	EM564-NB	EM566-NB	EM569-NB	EM596-NB	EM599-NB	EM5913-NB
Holding Torque [kgcm]		3.7	7.6	14	20	38	65
Step Angle		0.72°					
Current [A/Phase]		1.4					
Rotor Inertia [gcm2]		100	200	400	700	1200	1800
Weight [kg]		0.5	0.75	1.3	1.6	2.7	3.8
Shaft Runout [mm]		0.05T.I.R.					
Concentricity [mm]		0.075T.I.R.					
Perpendicularity [mm]		0.075T.I.R.					
Step Accuracy		± 5minutes					
Insulation Class		Class B (130°C)					
Insulation Resistance		100M ohms or more under normal ambient temperature and humidity when the megger reading between the windings and frame is DC 500V.					
Dielectric Strength		Under normal ambient temperature and humidity, sufficient to withstand 0.5kV at 50Hz applied between the windings and the case for one minute following a period of continuous operation.					
Temperature Rise		80° C or less when the motor is in a standstill under five phase excitation with rated current.					
Ambient Temperature Range		-10°C ~ +50°C					
Driver Model		UDX5114N					

Driver Unit: UDX5114N

- Current indicated in voltage is the value for maximum input value when applying load to the motor.

Driving Mode		Constant Current Chopper Drive
Driving Motor Current		1.4A/Phase Maximum
Excitation Mode		· Full Step (4 phase excitation): 0.72° /Step · Half Step (4-5 phase excitation): 0.36° /step
Input Signal	Input Signal Circuit	Input impedance: 220ohm, Input current: 20mA max., Optically Isolated H: +4 ~ +5V, L: 0 ~ +1.5V
	· CW Pulse Input (Pulse Input)	Clockwise rotation command (Operation command at 1-pulse input mode) Pulse width: 5 μ sec min., Pulse rise/pulse fall time: 2 μ sec max. Motor moves at pulse rising edge. (Negative logic pulse input)
	· CCW Pulse Input (Rotational direction Input)	Counterclockwise rotation command (Directional command at 1-pulse input mode H:CCW, L:CW) Pulse width: 5 μ sec min., Pulse rise/pulse fall time: 2 μ sec max. Motor moves at pulse rising edge. (Negative logic pulse input)
	· Output Current OFF Input	At L level, the current to the motor is cut off and the shaft can be rotated by hand. At H level, the current set by RUN potentiometer is supplied to the motor.
Output Signal	Output Signal Circuit	Optically isolated, Open-Collector Output(Emitter Common) External use condition: 24V DC max., 10mA max.
	· Excitation Timing Output	Signal is output at every time the excitation sequence returns to step "0". (Photocoupler is ON) Full step: Signal is output every 10 pulses Half step: Signal is output every 20 pulses
	· Overheat Output	Signal is output when the temperature of hat radiation plate of the driver exceeds 80° C. (Photocoupler is ON, automatic return function) The motor comes to a natural stop by AUTOMATIC OUTPUT CURRENT OFF function.
Functions		Automatic Current Cutback At Motor Standstill, Overheat Protection, Self-Test, Switching Pulse input system, Switching Step Angle
LED display		POWER, *CW PULSE* Input, *CCW PULSE* Input, *OUTPUT CURRENT OFF* Input, *EXICATATION TIMING* Output, *OVERHEAT* Protection
Driver Cooling Method		Natural ventilation
Voltage		Single-Phase 100V ± 15% 50/60Hz 4.2A max. or Single-Phase 115V ± 15% 60Hz 4.2A max.
Weigh [kg]		1
Insulation Resistance		100M Ω or more when 500V DC is applied between the following part: · Between the case and power supply terminal · Between the case and signal input terminal · Between power supply terminal and signal input terminal
Dielectric Strength		Sufficient to withstand 1.0kV at 50Hz applied between the following part for 1 minute: · Between the case and power supply terminal · Between the case and signal input terminal · Between power supply terminal and signal input terminal
Ambient Temperature		0°C ~ +50°C

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Motor Unit – Standard type

- The value given for holding torque is the value operated by dedicated driver (UDX5128N) with rated current and five-phase excitation.
- Step Accuracy: At full step with no load. (It varies with load.)

Unit Model	Single Shaft	UPE569H – NA	UPE596H – NA	UPE599H – NA	UPE5913H – NA
	Double Shaft	UPE569H – NB	UPE596H – NB	UPE599H – NB	UPE5913H – NB
Motor Model	Single Shaft	EM569H–NA	EM596H–NA	EM599H–NA	EM5913H–NA
	Double Shaft	EM569H–NB	EM596H–NB	EM599H–NB	EM5913H–NB
Holding Torque [kgcm]		14	20	38	65
Step Angle		0.72˚			
Current [A/Phase]		2.8			
Rotor Inertia [gcm²]		400	700	1200	1800
Weight [kg]		1.3	1.6	2.7	3.8
Shaft Runout [mm]		0.05T.I.R.			
Concentricity [mm]		0.075T.I.R.			
Perpendicularity [mm]		0.075T.I.R.			
Step Accuracy		± 5minutes			
Insulation Class		Class B (130 ˚C)			
Insulation Resistance		100M ohms or more under normal ambient temperature and humidity when the meggor reading between the windings and frame is DC 500V.			
Dielectric Strength		Under normal ambient temperature and humidity, sufficient to withstand 0.5kV at 50Hz applied between the windings and the case for one minute following a period of continuous operation.			
Temperature Rise		80 ˚ C or less when the motor is in a standstill under five phase excitation with rated current.			
Ambient Temperature Range		−10 ˚C ~ +50 ˚C			
Driver Model		UDX5128N			

Driver Unit: UDX5128N

- Current indicated in voltage is the value for maximum input value when applying load to the motor.

Driving Mode		Constant Current Chopper Drive
Driving Motor Current		2.8A/Phase Maximum
Excitation Mode		· Full Step (4 phase excitation): 0.72 ˚ /Step · Half Step (4–5 phase excitation): 0.36 ˚ /step
Input Signal	Input Signal Circuit	Input impedance: 220ohm, Input current: 20mA max., Optically Isolated H: +4 ~ +5V, L: 0 ~ +1.5V
	· CW Pulse Input (Pulse Input)	Clockwise rotation command (Operation command at 1–pulse input mode) Pulse width: 5 μ sec min., Pulse rise/pulse fall time: 2 μ sec max. Motor moves at pulse rising edge. (Negative logic pulse input)
	· CCW Pulse Input (Rotational direction Input)	Counterclockwise rotation command (Directional command at 1–pulse input mode H:CCW, L:CW) Pulse width: 5 μ sec min., Pulse rise/pulse fall time: 2 μ sec max. Motor moves at pulse rising edge. (Negative logic pulse input)
	· Output Current OFF Input	At L level, the current to the motor is cut off and the shaft can be rotated by hand. At H level, the current set by RUN potentiometer is supplied to the motor.
Output Signal	Output Signal Circuit	Optically isolated, Open–Collector Output(Emitter Common) External use condition: 24V DC max., 10mA max.
	· Excitation Timing Output	Signal is output at every time the excitation sequence returns to step "0". (Photocoupler is ON) Full step: Signal is output every 10 pulses Half step: Signal is output every 20 pulses
	· Overheat Output	Signal is output when the temperature of hat radiation plate of the driver exceeds 80 ˚ C. (Photocoupler is ON, automatic return function) The motor comes to a natural stop by AUTOMATIC CUURENT OFF function.
Functions		Automatic Current Cutback At Motor Standstill, Overheat Protection, Self–Test, Switching Pulse Input mode, Switching Step Angle
LED display		POWER, *CW PULSE* Input, *CCW PULSE* Input, *OUTPUT CURRENT OFF* Input, *EXCITATION TIMING* Output, *OVERHEAT* Protection
Driver Cooling Method		Forced Cooling (Cooling fan provided)
Voltage		Single–Phase 100V ± 15% 50/60Hz 7.3A max. or Single–Phase 115V ± 15% 60Hz 7.3A max.
Weight [kg]		1
Insulation Resistance		100M Ω or more when 500V DC is applied between the following part: · Between the case and power supply terminal · Between the case and signal input terminal · Between power supply terminal and signal input terminal
Dielectric Strength		Sufficient to withstand 1.0kV at 50Hz applied between the following part for 1 minute: · Between the case and power supply terminal · Between the case and signal input terminal · Between power supply terminal and signal input terminal
Ambient Temperature		0 ˚C ~ +50 ˚C

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Chapter 10. Trouble – Shooting

Check the unit once again before requesting servicing. When the stepping motor is not functioning properly, perform the following checks and take the following measures.

If the motor continues malfunction, please call your nearest Oriental Motor.

Problem	Check Points	Measures
The motor is not excited. (The motor has no holding torque and the motor shaft rotates easily by hand.)	① Is the driver's POWER lamp on? (It should be illuminated.)	· If the POWER lamp is not on, check that the power is connected and then check the power lamp again.
	② Is the driver's H.OFF lamp off? (It should be off.)	· When the OUTPUT CURRENT OFF signal has been input, the H.OFF lamp is illuminated and the motor ceases to be excited (has no holding torque).
	③ Is the driver's O.H. lamp off? (It should be off.)	· The O.H. lamp is illuminated when the driver's overheat protection function has been activated (see page 14). When the automatic hold off function switch is in the "OFF" position, the motor ceases to be excited (has no holding torque).
	④ Have the driver and motor connections been performed properly?	· Check the driver's connection terminal panel. When using an extension of the motor lead wire check that the connection has been made properly.
	⑤ Have the driver's "RUN" and "STOP" switches been turned too far down?	· These switches are used to adjust the output current to the motor (see page 14). If they have been turned too far down, return them to their factory settings and then check the results.
	If the driver is not excited even after performing the above checks, the problem could be due to the driver's internal fuse being broken. After checking once again to ensure that the source of the problem is not with the voltage of the power supply or the connections, request servicing of the unit to your nearest Oriental Motor.	
The motor does not rotate.	· Check the five points described above.	
· The motor does not rotate even after input of the pulse signal.	⑥ After input of the pulse signal, are the driver's CW or CCW lamps illuminated?	· If neither the CW nor the CCW lamps are illuminated, check the connections and the pulse signal's voltage and waveform (see page 17).
	⑦ When using the 2-pulse input mode (when the pulse input switch is set to "2P"), are the CW and CCW lamps illuminated simultaneously?	· When a pulse is being input, the motor will not operate if the other pulse input terminal is at the "L" level. Be sure to set the other terminal to the "H" level.
	⑧ When using the 1-pulse input mode (when the pulse input switch is set to "1P"), has the pulse signal been miswired to the CCW terminal?	· Connect the pulse signal to the CW terminal.
· The motor rotates in the opposite direction to the CW and CCW pulse signals (or the direction of rotation signal).	⑨ When using the 2-pulse input mode (when the pulse input mode switch is set to "2P"), have the CW and CCW pulse signals been connected in reverse?	· Connect the CW pulse to the CW terminal and the CCW pulse to the CCW terminal.
	⑩ When using the 1-pulse input mode (when the pulse input mode switch is set to "1P"), input a pulse signal to the CW terminal without making any connections to the CCW terminal.	· If the motor then rotates in the CCW direction the motor and driver are functioning properly. Check the level of the direction of rotation signal once again. (The correct configuration is "L" = CW, "H" = CCW.)

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Problem	Check Point	Measures
The motor is not functioning properly.	Begin by checking points ④, ⑤, ⑥ above.	
· It starts irregularly.	⑪ When using the 2−pulse input mode (when the pulse input switch is set to "2P"), are the CW and CCW lamps illuminated simultaneously?	· The motor operates irregularly when the two pulses are input simultaneously.
	⑫ Are the motor and the load properly centered? Is the load too large?	· Retighten the coupling screws. · Or, perform the self−test described on page 12 with the load disengaged.
· There is too little or too much movement.	⑬ Does the actual motor step angle conform with the motor step angle required by the device?	· Check the setting of the driver's step angle switch.
	⑭ Is the setting for the input pulse number appropriate for the amount of motor movement.	Check the setting.
· The motor loses synchronism during acceleration (or during operation).	Check ③, as described above. ⑮ Is the starting pulse rate too high? ⑯ Is the acceleration/deceleration time too short? ⑰ Is there any effect from external noise?	· Lower the rate and check the results. · Lengthen the time and check the results. · Check the motor's movement independently, without operating any other apparatus which could be potential sources of noise.
· There is excessive vibration.	⑱ There may be excessive motor output torque. ⑲ Try changing the pulse rate.	· Try reducing the motor's running torque. · If the vibration is reduced after changing the pulse rate, the problem might lie in the motor's resonance. Try changing the pulse rate or step angle.
The motor is excessively hot.	⑳ The motor has been operated for too long. (Is the temperature of the motor case less than 100 °C?)	· Shorten the motor's operating time or lengthen its rest time. Maintain the temperature of the motor case at less than 100 °C.
The automatic current cutback function does not work.	㉑ Has the automatic current cutback function been disabled?	· Set the driver's automatic current cutback function switch to the "ACD" position.
	㉒ Is the driver's STOP switch in the "F" position?	· Current cannot be lowered when this switch is in the "F" position. Reset this switch to the optimal value by making reference to page 14.
	㉓ After conclusion of the pulse signal, is the driver's CW or CCW lamp extinguished?	· When the pulse signal is maintained at the "L" level these lamps are illuminated and the current cannot be lowered. Be sure to return the pulse signal to the "H" position.

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