

Φ SHINSEI

# ULTRASONIC MOTOR

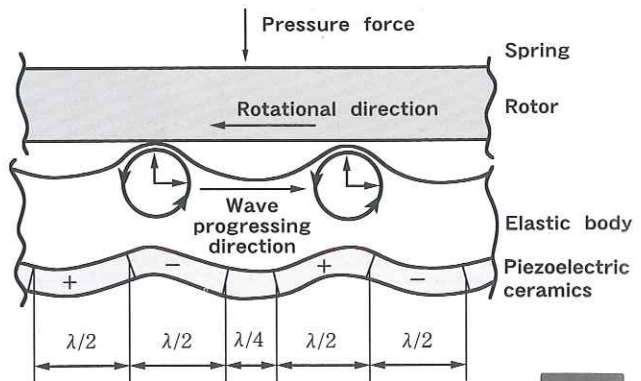
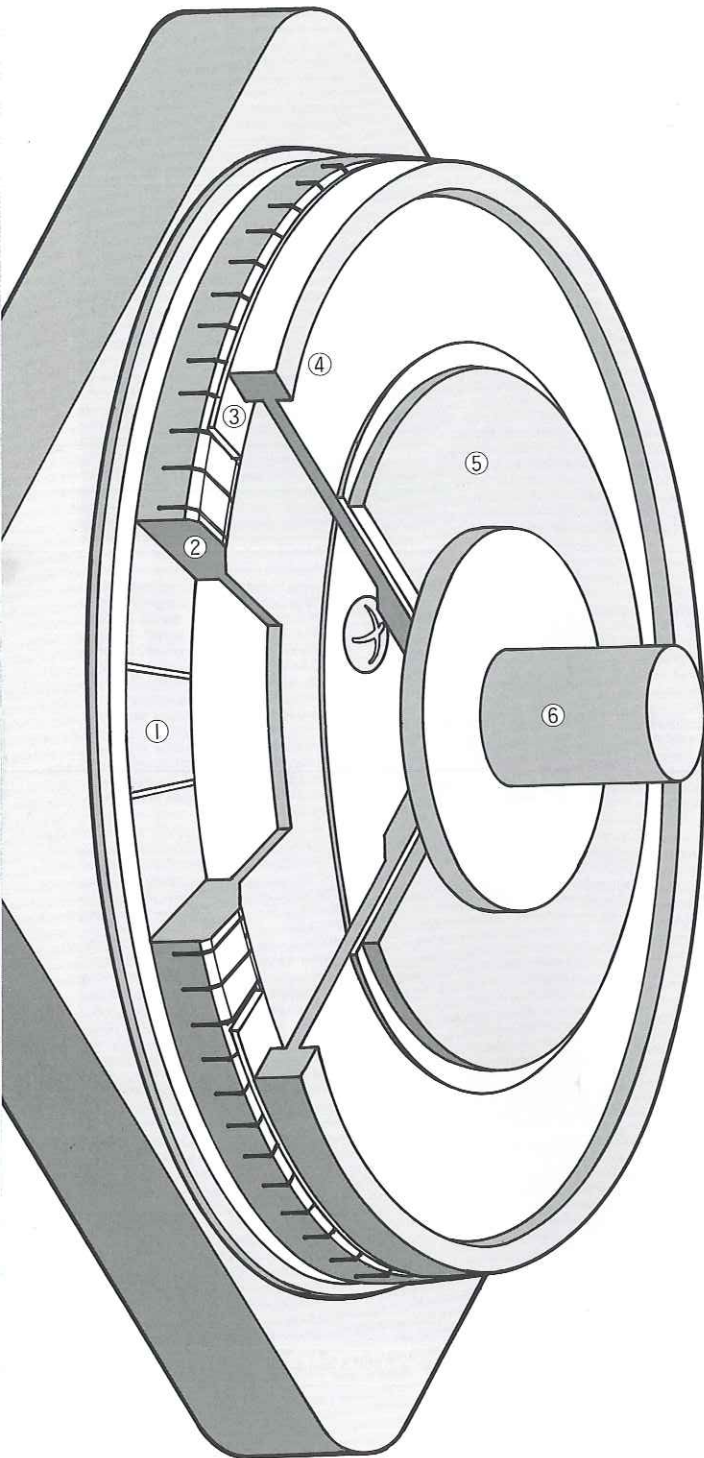


Φ FUKOKU

# Operating Principle

This progressive wave ultrasonic motor does not use electromagnetic action, which is the basic driving principle of conventional motors. The stator is composed of the elastic body, and the piezoelectric ceramics which are adhered to the body, and are polarized in the direction of thickness causing alternate expansion and shrinkage as voltage is applied. This causes bending oscillation at the surface of the elastic body.

The two electrodes of the piezoelectric ceramics are formed with 1/4 wavelength difference. As the different voltage phases (SIN and COS waves) are supplied to each electrode, the resulting waves are combined to form a progressive wave on the surface of the elastic body. When pressure from the spring is applied on the rotor, rotational motion in the opposite direction of the progressive wave is created as a result of frictional force. Since contact pressure is utilized, the shaft is maintained when electricity is not applied.



## Characteristics

### 1 Quick Response and Excellent Control

Turn off in approximately 1 millisecond.  
Capable of switching rotational direction within several tens of milliseconds.

### 2 High holding Torque

Maintain stationary with more than rated torque when electricity is not applied.  
Useful as self-holding function (mechanical brake).

### 3 Quiet Rotation

Noise is less than 45dB at 10cm from back side of motor.

### 4 High Degree of Freedom in Designing

- 1) Freedom in shape of motor (single-direction shaft, two-direction shaft, hollow shaft, etc.)
- 2) Freedom in function and shape of driver.

### 5 Very Low Magnetism

Do not generate any magnetic field. Motors composed of non-magnetic materials are available.  
Motors which have magnetism of less than 20  $\gamma$  (gamma) and operate in high magnetic field of 10,000G (gauss) are already utilized.

### 6 Low Speed and High Torque

Capable of directly driving a load without using speed-reduction gears, etc.

### 7 Compact, Lightweight, Simple Configuration

No winding wires allow thin, lightweight structure.

### 8 Progressive Wave Drive

Utilizing a progressive wave as the driving source does not create cogging.

### 9 Applicable in a Vacuum

Motors driving in a vacuum environment (up to  $10^{-5}$  Pa) are available.

### 10 Dust Free

Motors driving in clean room (up to class 100) are available.

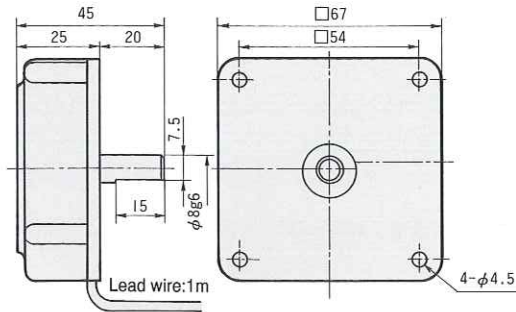
- ① PIEZOELECTRIC CERAMICS } STATOR Assy
- ② ELASTIC BODY } STATOR Assy
- ③ SLIDER } ROTOR Assy
- ④ ROTOR } ROTOR Assy
- ⑤ SPRING
- ⑥ SHAFT

# Actuator with Entirely New Concept : Ultrasonic-Wave

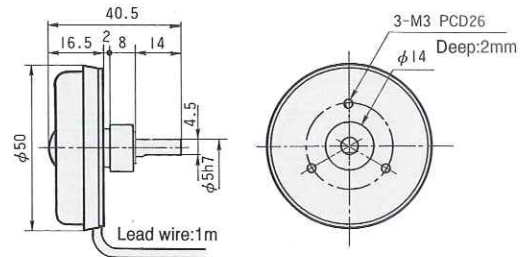
Standard Product

## Dimensions and Specifications

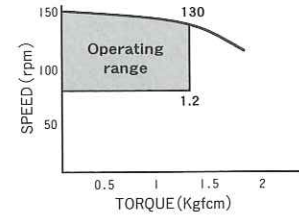
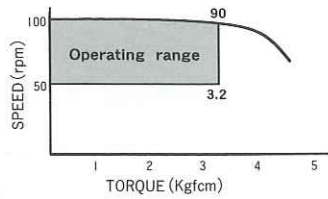
[MOTOR UNIT] USR60-S1



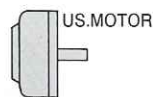
USR45-S1



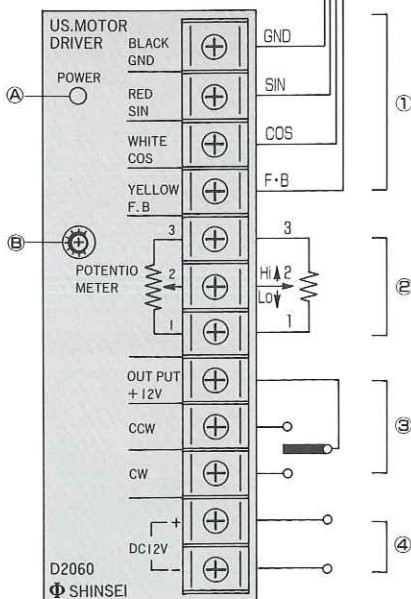
## Characteristics



# ULTRASONIC MOTOR



## FUNCTIONS OF EACH TERMINAL AND CONNECTING METHOD



### ① Motor Connection Terminals

Connect according to the color of the motor lead lines.

### ② Speed Control Terminals

Speed can be set by connecting a B10K  $\Omega$  (0.1W) variable resistor.

### ③ Start/Stop/Reverse Switch Terminals

In the case of contact point, please use a single-pole, double-throw center OFF snap switch, etc.

In the case of composing with several relays, etc., please be sure that CW and CCW will not be on at the same time.

Note: This 12V output terminal is the voltage output terminal for the switch to change direction of rotation (200mA max.). Do not connect to power-supply voltage.

### ④ Power-Supply Terminals

To be connected to a 12VDC power supply. Please use an electricity supply source with sufficient capacity.

Note: Please do not start or stop the motor by turning the power-supply on and off.

### Ⓐ LED Display Lamp

The lamp will activate when the voltage of the power supply is approximately 10V or more. It will not activate when the interior fuse is burnt out.

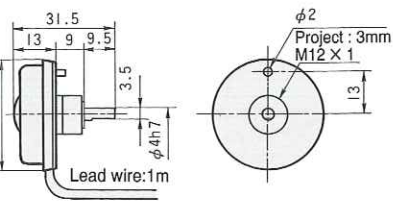
### Ⓑ Variable Resistor to set Marginal Rotational Speed Limit

As the speed has been adjusted in the factory, please do not change this. If adjusting is needed, please contact us for further information.

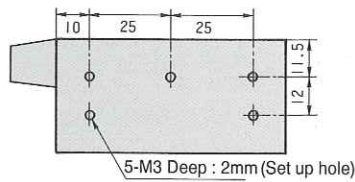
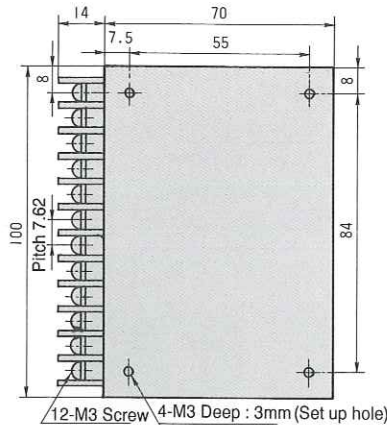
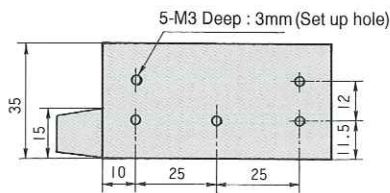
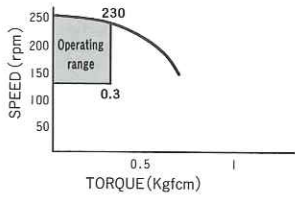
# ve Vibration Provides Driving Energy Source

USR30-S1

[DRIVER UNIT]



Unit : mm

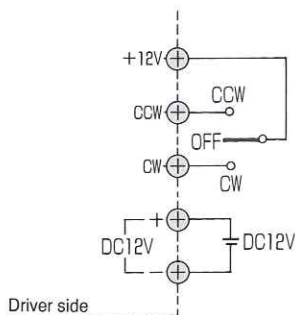


## SPECIFICATION

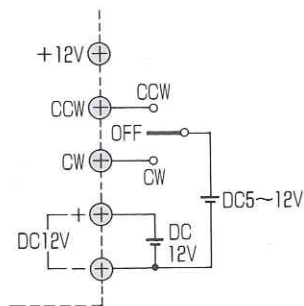
	USR30	USR45	USR60
DRIVING FREQUENCY (KHz)	about42	about43	about40
DRIVING VOLTAGE (Vrms)	100~130 (SIN. COS)		
<b>MOTOR UNIT</b> RATED TORQUE (kgfcm)	0.3	1.2	3.2
RATED SPEED (rpm)	min. 230	min. 130	min. 90
RATED OUTPUT (W)	min. 0.7	min. 1.5	min. 3.0
HOLDING TORQUE (kgfcm)	min. 0.3	min. 1.2	min. 3.2
MOTOR UNIT WEIGHT (g)	50	90	240
<b>DRIVER UNIT</b> INPUT VOLTAGE (V)	DC12 ± 0.5		
INPUT CURRENT (A)	max. 1.0	max. 1.5	max. 2.5
OSCILLATING WAVE FORM	SINE WAVE		
SPEED SETTING	B10K Ω 0.1W variable resistor		
VARIABLE SPEED METHOD	FREQUENCY CHANGE METHOD		
STARTING STOPPING MECHANISM	CAN USE BOTH CONTACT AND CONTACTLESS POINT		
PROTECTION FUSE OF OVER CURRENT	1.5A FUSE	2A FUSE	3A FUSE
INSULATION RESISTANCE	min. 10M Ω		
INSULATION WITHSTAND VOLTAGE	1KV AC 1minute		
DRIVER UNIT WEIGHT (g)	about240		
OPERATING TEMPERATURE RANGE	- 10 °C ~ + 50 °C		
STORAGE TEMPERATURE RANGE	- 20 °C ~ + 60 °C		

## EXTERIOR CONTROL EXAMPLE

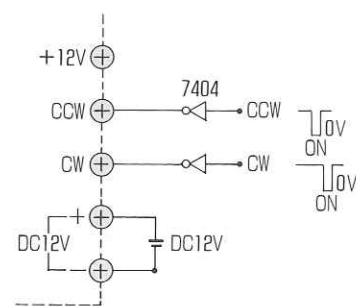
Utilizing Interior Power-Supply Input using contact point switch



Utilizing Exterior Power-Supply Input using contact point switch



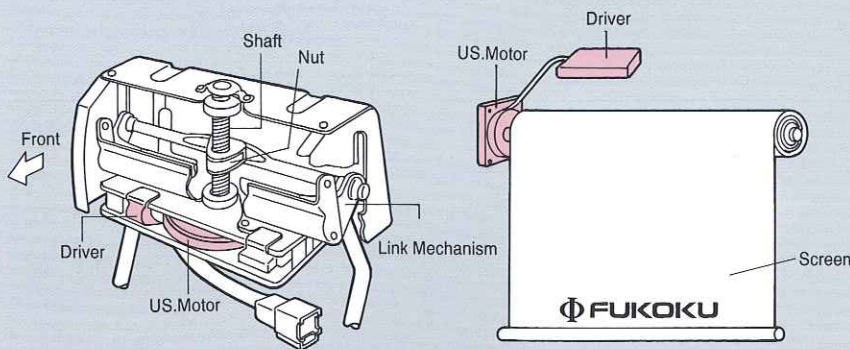
Input using exterior TTL, etc.



Note: DO NOT turn on CW and CCW at the same time.

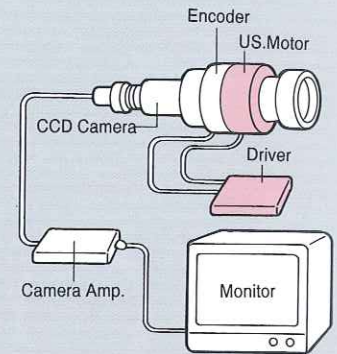
# Ultrasonic Motor Applications

## (Characteristic functions)



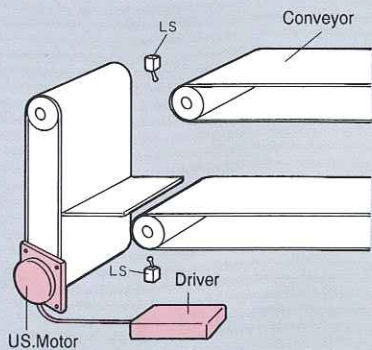
**Headrestraint Positioning**  
(quiet, compact, lightweight)

**Detracting/Retracting Roll Screens**  
(quiet, compact, lightweight, low-speed, holding torque)

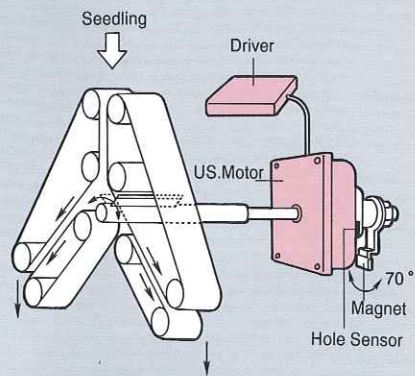


**Optical Instruments: Auto-zoom, iris, focus**  
(hollow, compact, lightweight, quick response)

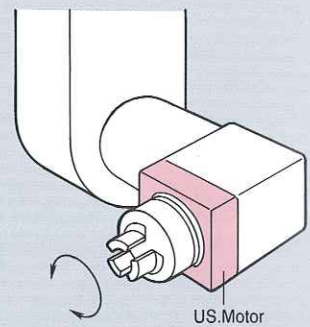
# ULTRASONIC MOTOR



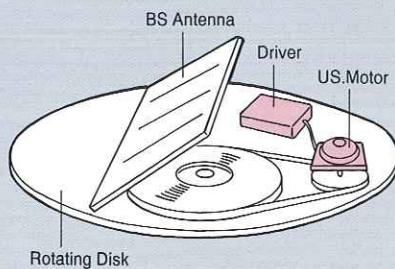
**Lift Positioning**  
(compact, lightweight, quick response, holding torque)



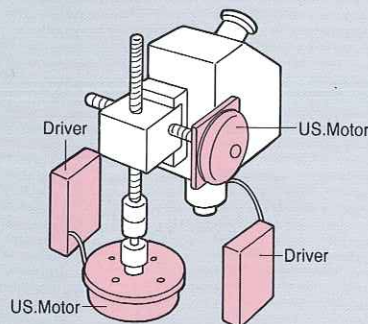
**Distribution equipment for seedlings, components, etc.**  
(quick response : 5cycles/sec, compact, lightweight)



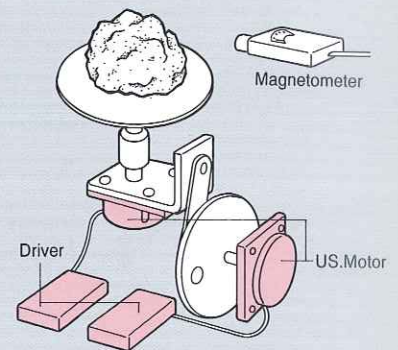
**Rotary Stage**  
(thin, lightweight, low-speed)



**Positioning of BS Antennas Mounted on Automobiles and Ships**  
(quick response, small, lightweight, low magnetic field)



**Surgical Microscope Positioning**  
(quiet, small, lightweight, low-speed, holding torque)



**Very Low Magnetic Driving Equipment**  
(very low magnetic field, lightweight, holding torque, quick response)

## Cautions for Handling

To use the ultrasonic motor effectively, please carefully read the following information. If you have a question regarding any of the following contents, please contact us.

- 1 Please use the driver unit that matches the motor type.**  
Motors and driver units are matched with a pair of corresponding numbers and individually adjusted. Please consult us if you want to extend or shorten the lead wire between the motor and driver unit.
- 2 Please only use the motor under circumstances where the temperature range is from -10 °C to +50 °C, and humidity is less than 75%.**  
Please do not use under circumstances exposed to extensive corrosive gases or excessive humidity, dust, etc.  
Please do not add oil and lubricant to the motor and not use it in environment such as oil mist and dew.
- 3 Please avoid thrust load to the shaft.**  
When using couplings, gears, pulleys, etc., they should be running fit. Please do not insert them into motor shafts by pressing or pounding.
- 4 Please assure sufficient radiation of heat from the fitting surface.**  
Since the motor runs based on friction, long-term continuous operation results in heat generation. When considering structure and layout, please allow for heat diffusion that maintains the temperature of the motor case below 55 °C at all times.
- 5 Please avoid improper force on the shaft.**  
If the rotational force higher than the holding torque is applied to the shaft when the motor is stopped (when power is switched off), the motor will be damaged. Also if the motor is switched on when the motor shaft is locked by the load higher than the motor torque, the motor will be damaged. Because these action will cause negative influence on the slider surface and the spring of the motor.
- 6 Please do not conduct insulation resistance tests.**  
The exterior casing of the motor is common to the ground line of the motor input line. When the motor is attached to an instrument, etc., please make sure that all lines to the ultrasonic motor are disconnected before measuring insulation resistance of the instrument.

## Regarding Special Specifications

Please make inquiries to us regarding non-standard type motor : such as hollow shaft, very low magnetic, positioning control, with encoder, double-shaft, double-type (dual combinations), vacuum-type, rotation-control, special specification driver (with I/F), etc.

Please also ask us about high-power, multi-combination motor units (e.g., dimension :  $\phi 165 \times 70$ t, torque : 200kgfcm, rotation speed : 8rpm).

The performance, specifications and/or appearance of products listed in this catalog are subject to change without prior notification.



Example of a multi-combination motor unit.

### Manufacturer

## Fukoku Co., Ltd.

Motor Division : Kurakake Daiichi Kogyo Danchi, Oura-machi,  
Oura-gun, Gunma, 370-06, Japan

Tel : (81)276-89-0221 Fax : (81)276-89-1433

Head Office : 3-105, Sugaya, Ageo-shi, Saitama, 362, Japan

Tel : (81)48-773-5611 Fax : (81)48-776-0609