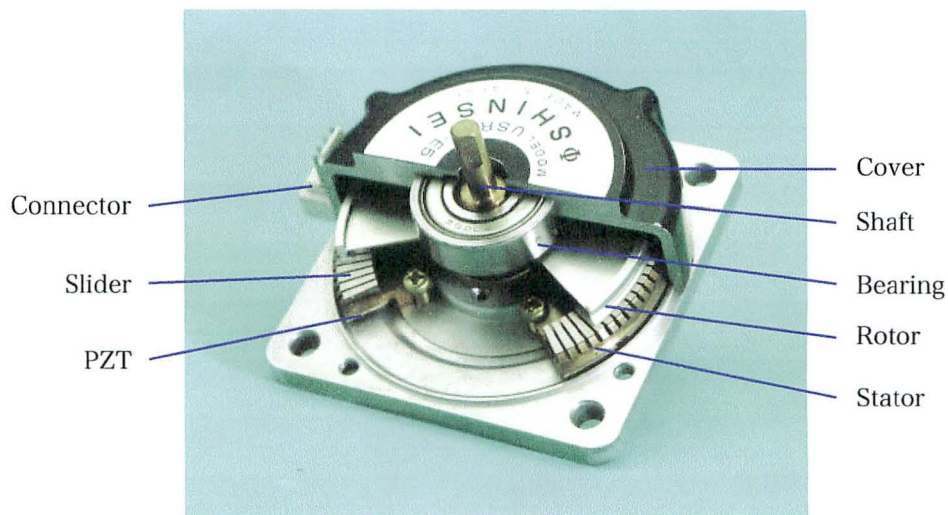


U S M

ULTRASONIC MOTOR

General Catalogue



Inside structure of USM (USR60-S4)

SHINSEI

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Product lineup.....	P.3
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USR60 series motors

① Standard single shaft
Standard type basic model



USR60-S3

② Standard double shaft
Standard type with sensor mounting axis



USR60-S4

③ Standard with encoder
Standard type with encoder



USR60-E3

This driver enables precision speed control and positioning using encoder signals as reference



D6060E

④ Nonmagnetic single shaft
Nonmagnetic type basic model



USR60-S3N

⑤ Nonmagnetic double shaft
Nonmagnetic type with sensor mounting axis



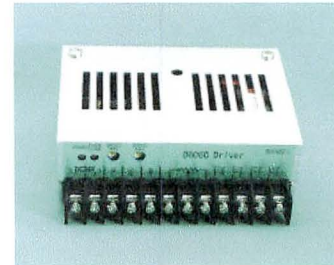
USR60-S4N

⑥ Nonmagnetic with encoder
Nonmagnetic type with encoder



USR60-E3N

This driver enables speed control using feedback signals from sensor electrodes as reference



D6060

USR30 series motors

① Built-in single shaft
Case-less low-price model



USR30-B3

② Built-in double shaft
Case-less low-price model with sensor mounting axis



USR30-B4

③ Standard single shaft
Compact type basic model



USR30-S3

④ Standard double shaft
Compact type with sensor mounting axis



USR30-S4

⑤ Standard with encoder
Compact type with encoder mounting axis



USR30-E3a

⑥ Nonmagnetic single shaft
Compact type basic model



USR30-S3N

⑦ Nonmagnetic double shaft
Compact type with sensor mounting axis



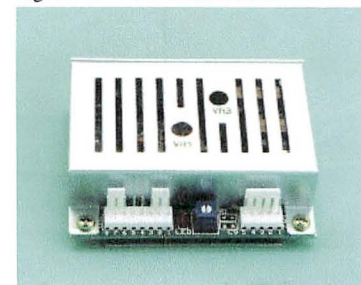
USR30-S4N

⑧ Nonmagnetic with encoder
Compact type with encoder mounting axis



USR30-E3N

This USR30 series dedicated driver enables speed control using feedback signals from sensor electrodes as reference



D6030

3. About ultrasonic motor

Unlike electromagnetic motor that use magnetic power as their driving force, ultrasonic motors are based on a completely new principle and use ultrasonic vibration generated by piezo-electric ceramic as their driving source. As the ultrasonic motor uses a different driving principle, it has a variety of characteristics and also drawbacks that the electromagnetic motor does not have.

(1) Characteristics of ultrasonic motor

① (Low speed, high torque)

As it allow high torque at low speed (several r/min to several hundred r/min) direct drive is possible.

Moreover, a small gear-ratio will suffice when reducing speed.

② (Self-retention characteristic)

As it is retentive even after the power is turned off, an electromagnetic brake is not necessary.

③ (High response and controllability)

Small rotor inertia and braking performance due to motor friction realize incomparable responsiveness and controllability.

④ (Nonmagnetic nature)

Since the ultrasonic motor does not use magnetic power as its driving force, it does not generate magnetism.

⑤ (Compact, lightweight and quiet)

As it has a simple structure, it is compact and light. Moreover, since its rotational speed is low to begin with, it is quiet even when gears are used.

○ Making use of these characteristics, the ultrasonic motor is used for the following purposes.

- ① Adjusting the position of headrests
(Compact, lightweight and quiet)
- ② Opening and closing of roll screens
(Quietness, low speed, retentiveness)
- ③ MR I injector
(Nonmagnetic nature)
- ④ Camera and video camera auto-focus
(High response, quietness)
- ⑤ Sorting of sugar beet seedings
(High response)
- ⑥ Adjusting car BS antennas
(High response, nonmagnetic)
- ⑦ Remoto control of auto-volume
(Quietness, high response, coppact)
- ⑧ Robot hands and XY tables
(High response, retentiveness)

(2) Advantages and drawbacks of USM

The ultrasonic motor has many advantages as it has a different principle from the electromagnetic motor. While it is used in diverse purposes making use of its advantages, it also has drawbacks. Its retentiveness, for example, is an advantage when braking is necessary but is a drawback when a free state is required while the power is turned off. As the ultrasonic motor has been around for only a short while today and its technological mechanism has yet to be widely understood, in a sense, there are cases in which its performance is misunderstood in several aspects.

○ Examples of usage USM are not suited

① Use under conditions of high humidity, or with much oily or corrosive gas dust.

※ These conditions may cause locking

② Use in vacuum environment.

※ Degradation of durability

③ Frequent on-off operation under high inertia.

※ Erosion of lining material

④ Use required long duration of durability.

※ As the ultrasonic motor uses friction, caused by vibration as its driving force, which causes erosion and damage to the driving section, it lacks durability compared to electromagnetic motors.

The longevity in the catalogue is 500 to 2000 hours.

⑤ Use in which ultra-precision rotation is required.

※ The ultrasonic motor falls short in rotational smoothness. The rotational inconsistency when the speed is controlled by the encoder is approximately 0.1% (150r/min) at high speed and 0.5% (15r/min) at low speed.

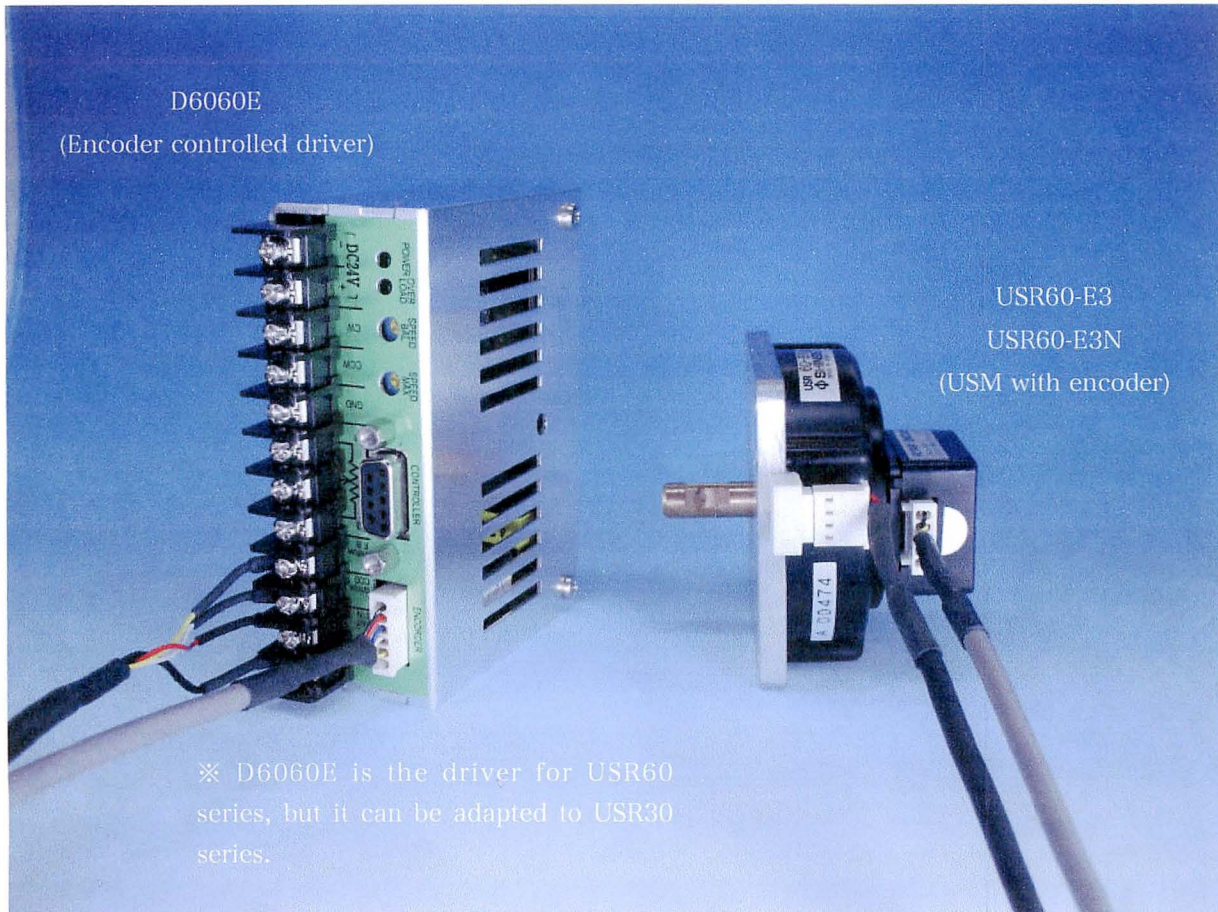
⑥ Continuous operation under heat insulated condition

※ The efficiency of the USM is approximately 30%. Cooling will be necessary for long continuous operation as the rest turns into heat.

○ The ultrasonic motor uses vibration of the ultrasonic wave range (over 20KHz) as its driving source, but its driving force is generated by friction. It is often misunderstood to be the same as the stepping motor when seeing the oscillating frequency (such as 40KHz), but the ultrasonic motor is impossible to control precisely in open loop. In order for precise control, feedback using the rotary encoder is necessary.

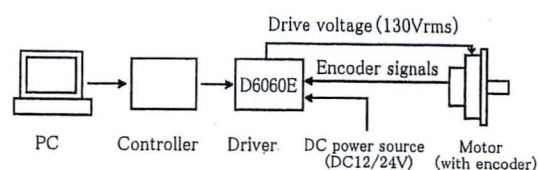
High Controllability Unique to USM

USR60 Speed Control Motor



© Stable speed control at wide speed range is realized with encoder signals and a control driver while making effective use of the characteristics of the ultrasonic motor such as low-speed high torque, self retentiveness, nonmagnetic nature, compactness, lightness, and quietness.

※ Servo system with encoder signals and controller

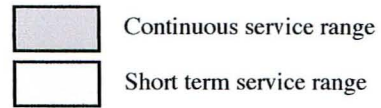


• By making a controller, integrated operation (servo system) for positioning control and speed control becomes possible. Using a PC program, a large number of position setting and variable speed control are possible, and automatic execution of the program also becomes possible with the controller's memory.

(※ While the controller is presently under development at Shinsei Corporation, it can be made by user)

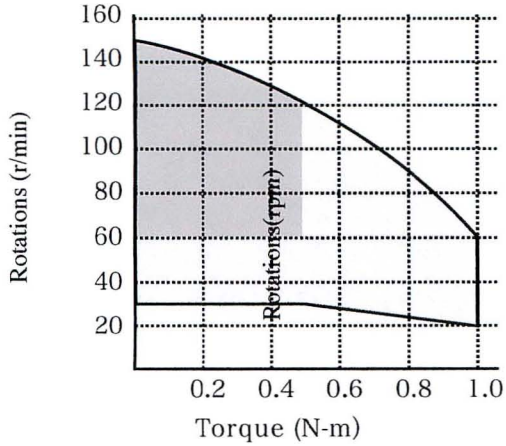
5. Characteristics and range of use

⊙ Characteristics and operational range

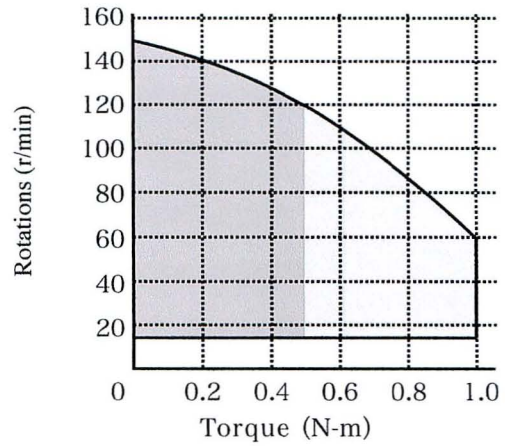


Characteristics and operational range of USR60 series

When using standard driver (all series)

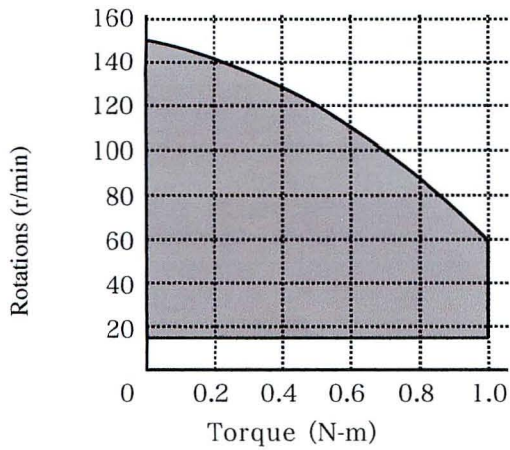


When using encoder controlled driver (E3,E3N)

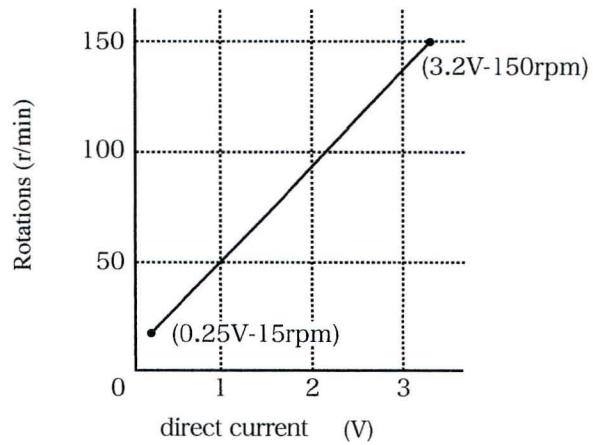


Characteristics of USR60 series speed control motor

Constant speed maintenance range

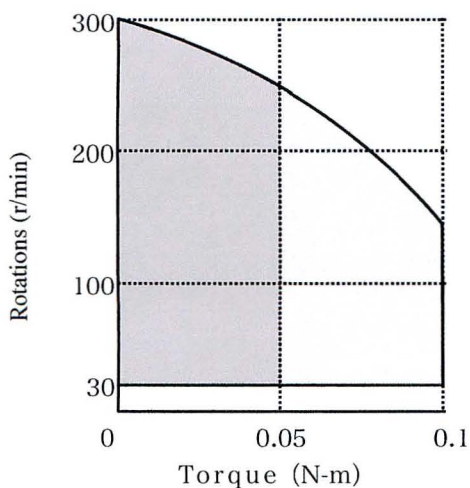


Speed setting voltage-rotational speed characteristics

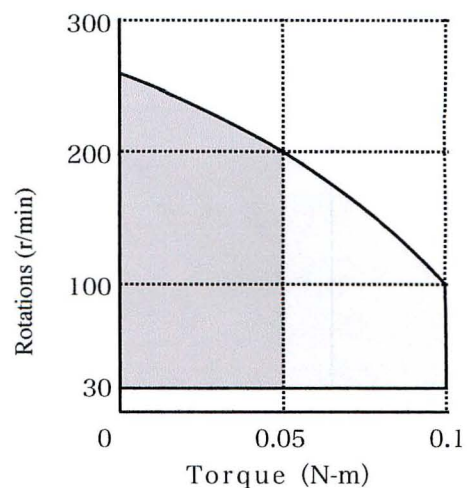


Characteristics and operational range of USR30 series

(Standard type motors)



(Non-magnetic type motors)



◎ Motor specifications

	USR60 series			USR30 series				
	Standard and non-magnetic			Standard		Non-magnetic		
Rated output	5.0 W			1.3 W		1.0 W		
Rated rpm	100 r/min			250 r/min		200 r/min		
Durability	1,000 Hrs			2,000 Hrs		500 Hrs		
Driving frequency	40 KHz			50 KHz				
Driving voltage	130 Vrms			110 Vrms				
Rated torque	0.5 N · m (5.0 Kg · cm)			0.05 N · m (0.5 Kg · cm)				
Maximum torque	1.0 N · m			0.1 N · m				
Retentive torque	1.0 N · m (10.0 Kg · cm)			0.1 N · m (1.0 Kg · cm)				
Weight	S3 · S4/S3N · S4N 260g	E3	E3N	B3 · B4	S3 · S4	E3a	S3N · S4N	E3N 65g
Responsiveness	Under 1 msec (no inertia load or driver sweeper)							
Rotational direction	CW, CCW							
Operational temperature range	-10°C ~ +55°C							
Operational temperature rise	70°C at stator surface / 55°C at case surface							

◎ Driver specifications

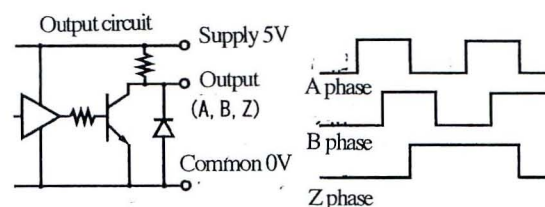
	USR60 series		USR30 series
	D6060E	D6060	D6030
Power source voltage	DC24V / DC12V ± 0.5V		
Oscillating waveform	Pseudo sine wave		
Speed setting volume	B10K Ω (0.1W) not included		
Speed setting external voltage	DC0 ~ 3.2V		
Variable speed method	Frequency variation method		
Frequency control	Auto follow-up method with vibration oscillation feedback		
On-off control	Both contact & non-contact possible (no switch included)		
Activation response	50 msec (at no motor inertial load)		
Stoppage response	1 msec (at no motor inertial load)		
Insulation resistance	Over 10 M Ω (motor unconnected / connection between frame and each terminal)		
Withstanding voltage	1 KVAC (motor unconnected / connection between frame and each terminal)		
Storage temperature	-20°C ~ +80°C		
Operational Temperature	-10°C ~ +55°C		
Consumption current	2 / 4 A max		0.7 / 1.4 A max
Motor drive voltage	130 Vrms		110 Vrms
Oscillating frequency	40 KHz		50 KHz
Overcurrent protection	2 / 4 A (φ 5.2 midget fuse)		0.7 / 1.4 A (φ 5.2 midget fuse)
No-load variable speed range	15 ~ 150 r/min	30 ~ 150 r/min	30~300 r/min
Weight	230g		105g

◎ Encoder specifications

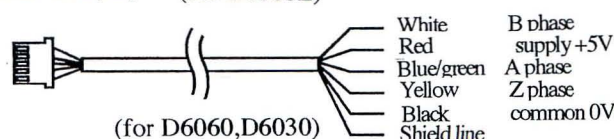
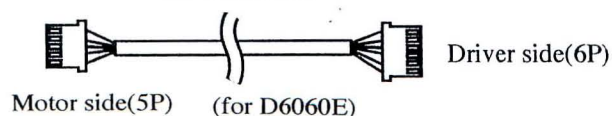
Power source voltage	DC 5 V ± 10%
Consumption current	Under 85 mA
Detection method	Optical incremental method
Pulse count	500 P/R
Output mode	Voltage
Output phase	A, B, Z
Output voltage H	Over 2.4 V
Output voltage L	Under 0.4 V

※ Option: 1000 P/R (USR60 only)

Output mode: open collector

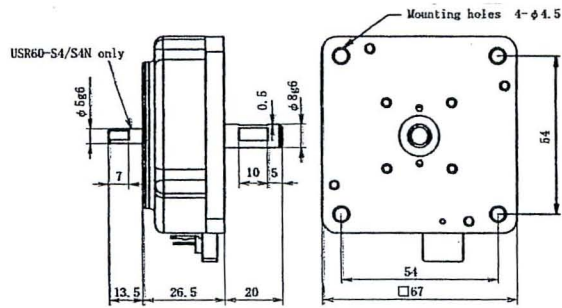


Encoder cable

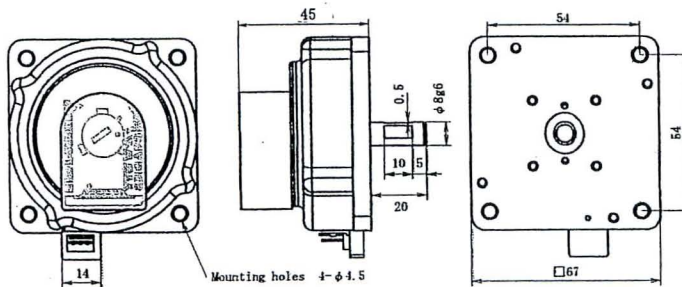


7. Outline diagrams (motor)

USR60 series
USR60-S3/S4(S3N/S4N)

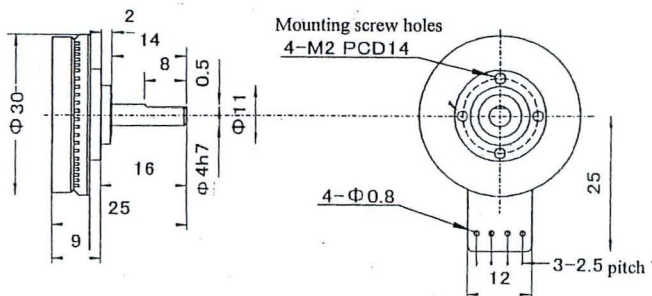


USR60-E3(E3N)

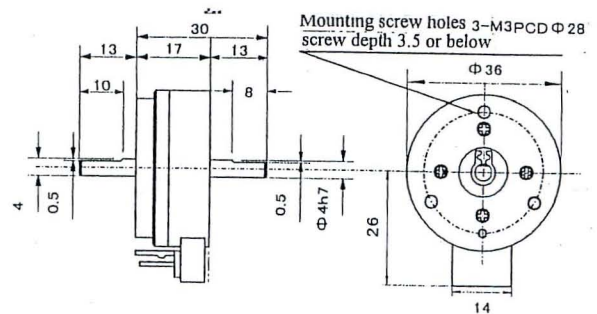


USR30 series

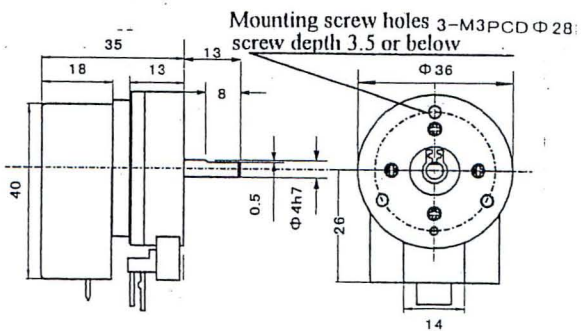
USR30-B3



USR30-S3/S4(S3N/S4N)

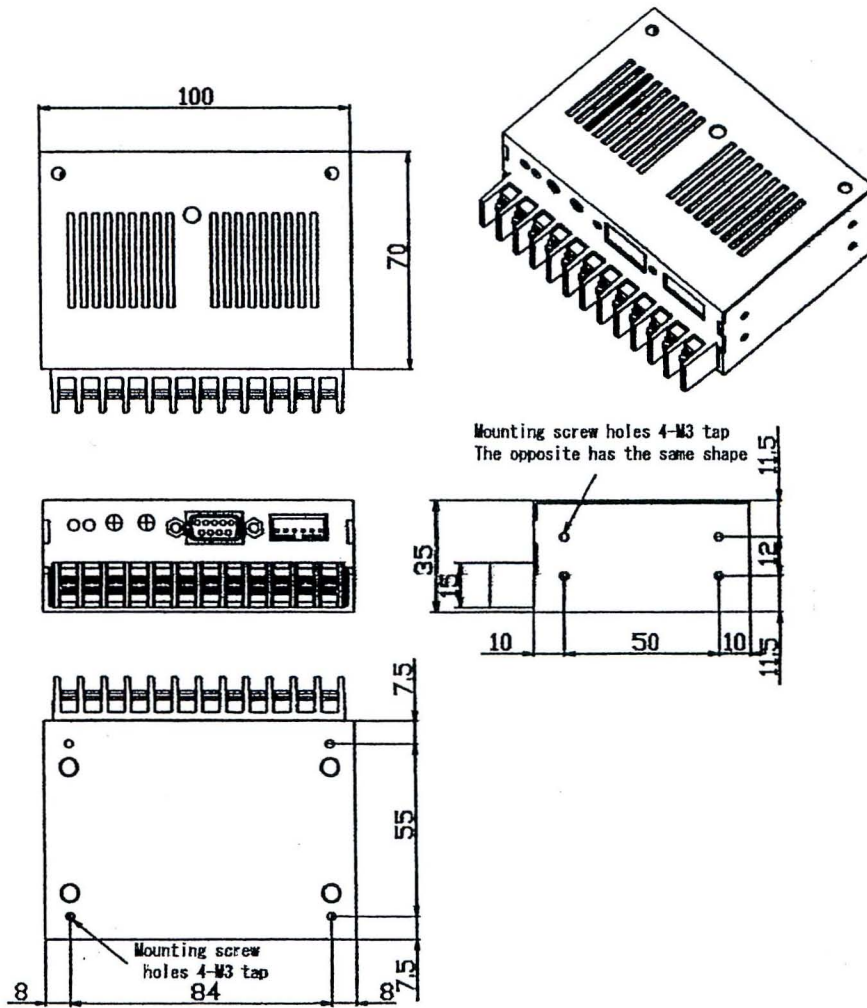


USR30-E3a(E3N)



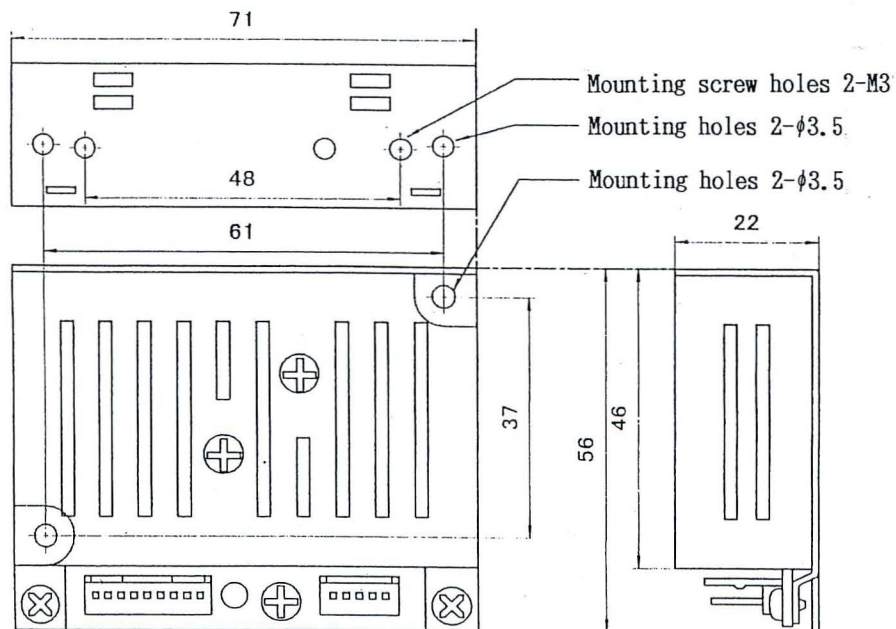
Driver for USR60 series

D 6 0 6 0 / D 6 0 6 0 E



Driver for USR30 series

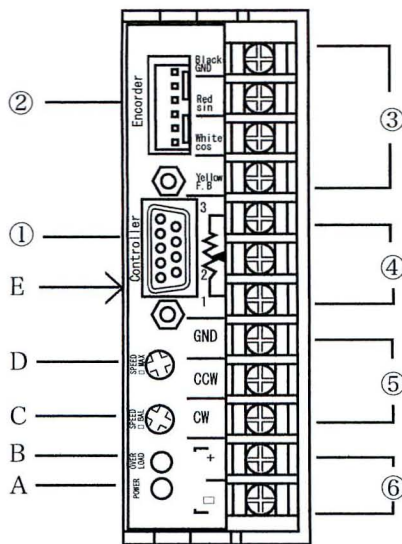
D 6 0 3 0



9. Name and functions of driver section

◎ Name and functions of each driver section

• D6060/D6060E



① Controller connector

② Encoder connector

This enables speed control using encoder signals and also positioning control if a controller is used.

(※① . ② for D6060E only)

③ Motor connection terminal

Match colors of the cables for connections.

④ Speed setting volume connection terminal

This enables speed setting with B10K Ω (0.1W) variable resistor.

⑤ On-off switch

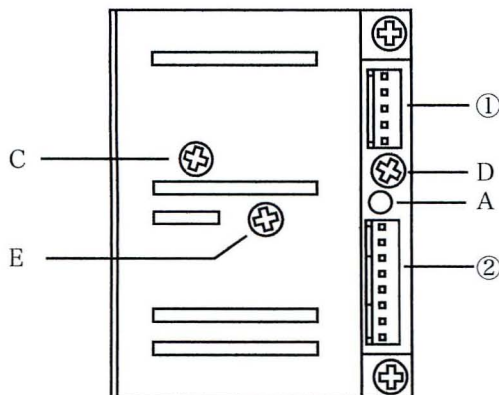
For contact switch, use such as snap switches(for minute current) with single-pole double-throw center off format.

⑥ Power source connection terminal

This is a terminal to connect to DC24V/12V power source

- A LED indicator light (green) • This stays on while the power is on. It will not turn on if the internal fuse is blown.
- B LED indicator light (red) • This will turn on when the motor falls into an overload state and shuts the motor down.
For resetting, turn the power source or the on-off switch off once, remove the cause and then turn on the motor.
- C Balance adjustment volume • This is a volume to adjust rotational speed difference between CW and CCW.
(not necessary for D6060E)
- D Max rotation setting volume • No-load rotation is adjusted to 150rpm.
- E Min rotation setting volume • No-load rotation is adjusted to 30rpm (15rpm for D6060E).

• D6030



① Motor connector

② Connector to 24V/12V power source, on-off switch and speed setting volume. (See basic connection diagram for functions of each pin)

A LED indication light (red)

This stays on while the power is on. It will not turn on if the internal fuse is blown.

C Balance adjustment volume

This is a volume to adjust rotational speed difference between CW and CCW.

D Max rotation setting volume

No-load rotation is adjusted to 300rpm.

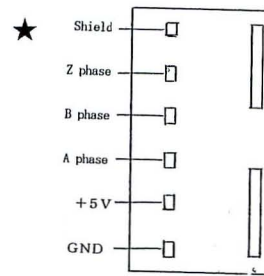
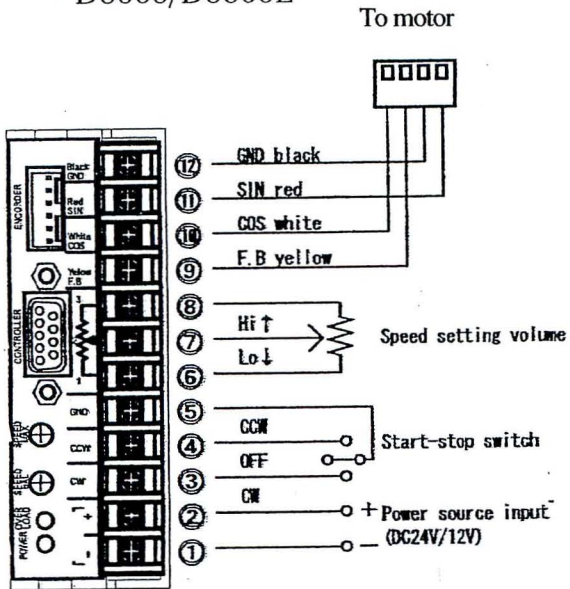
E Min rotation setting volume

No-load rotation is adjusted to 30rpm.

※ For normal operation do not change rotational speed as it is already adjusted.

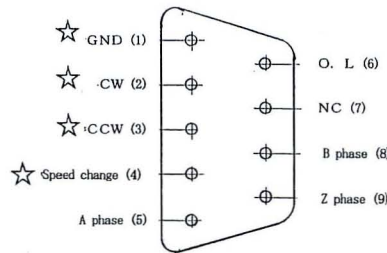
◎ Basic connection diagrams

• D6060/D6060E



Molex 5045

※ Connect an encoder cable to this connector in case control using encodersignal is required. The connector's pin arrangement is shown in the diagram. (★ denote is common with F,G)



Dsub 9 pin (female)

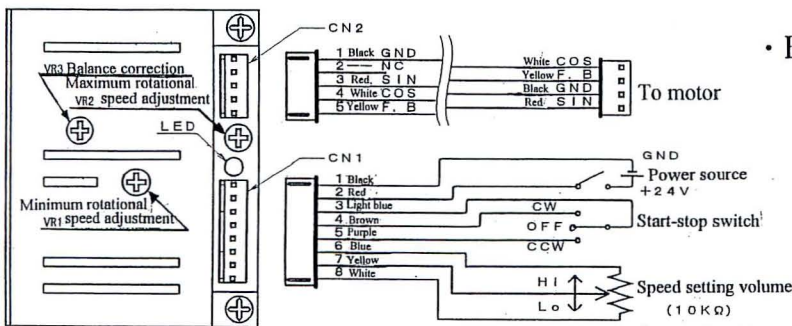
※ Use this connector in case sequence control using a controller is required. The connector's pin arrangement is shown in the diagram. The encoder output is 5V.

(☆ denotes is common with connection terminals)

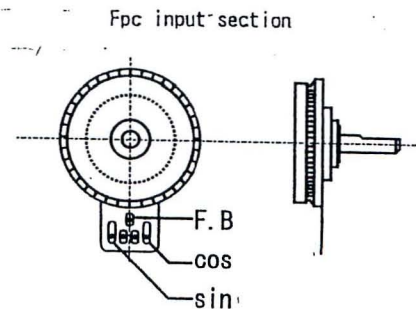
O.L (6) is H: overload, L: normal (Sink Current

2 mAmax, Out put mode: Open Collector)

• D6030



• How to connect USB30-B3,4



※ Other than the volume and switch, sa shown in the diagram above, for speed control and seitching on-off, control using non-contactswitches (TTL,transistor) is also possible. Please refer to External Control on pages 12 and 13.

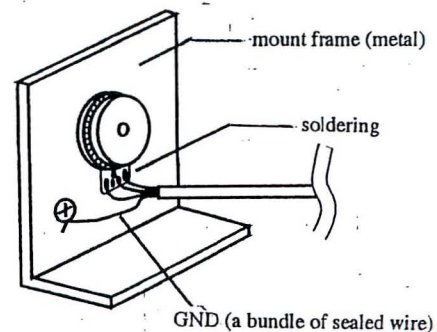
Precautions when making connections

1.Be sure to use the attached cable for connecting the motor and driver. In case you must change the length of the cable, readjustment of the driver become necessary. So please consider the length of the cable carefully prior to placing your order.

For the method of readjustment please refer to Driver Readjustment Method on page 14.

2.If there is shorting in the motor cable, the fuse will blow out for internal protection, but please be very careful as if the connection is made wrongly there is a possibility that internal semiconductor will be destroyed.

3.In case you must extend the signal cable, secure ample margin for the voltage value and apply noise prevention by using a shielded line.



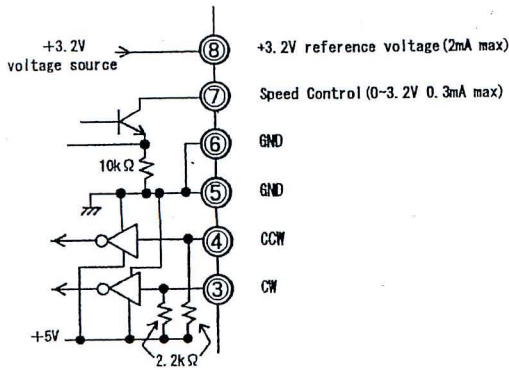
※ The driving power source side of the motor cable is connected with a connector but the motor side should be connected directly by soldering. At this time, solder ③ SIN-red, ④ COS-white, ⑤ F.B-yellow to designated locations of the FPC input section, and connected the ① GND shield line to somewhere on the metal body frame that has electric continuity with the motor mounting surface.

11. External control

◎ External control

• D6060/D6060E

(1) Driver's internal circuit

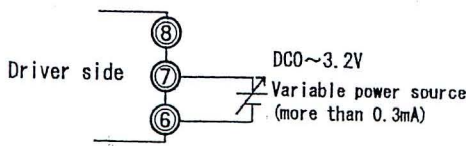


• Stabilizing potential +3.2 (2mA max) is output at speed setting volume terminal ⑧ .

• Start-stop of CW and CCW at rotation command terminals ③ and ④ are OFF at TTL input level Hi (2.5V~5.5V) and ON at Lo (0V~0.4V).

※ Impedance of ③ and ④ at current value 2.3 mA is 2.2KΩ.

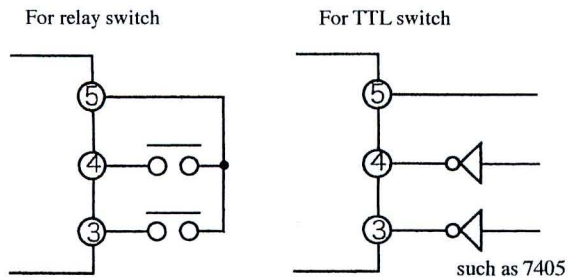
(2) Speed control using external voltage



• When employing speed control using external voltage, connect a DC variable voltage source as shown in the diagram instead of the volume. By changing the voltage 0~3.2V the same speed control as changing the volume 0~max become possible.

※ The consumption current of the external voltage source is 0.5mA or under. As there is a limit to change in the rise rate of zero speed voltage, refer to the timing chart on page 14.

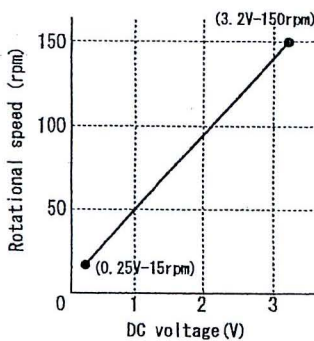
(3) On-off and rotational direction change by external signal



• When CW and CCW are on at the same time CW will be given priority. As to the interval of switchover refer to the timing chart on page 14.

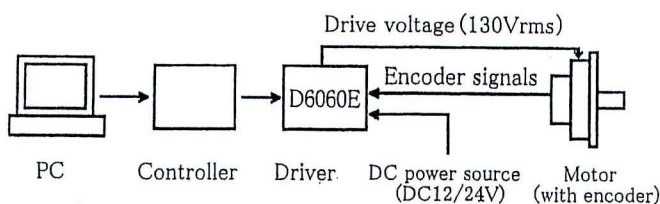
(4) Speed control using an encoder (D6060E)

DC voltage-rotational speed characteristics



• For uses requiring precise speed control, speed control using encoder signals by D6060E is effective. With encoder signals the voltage rotational characteristics are as shown in the graph and rotational inconsistency will be 0.1%~0.5% at normal operation range.

(5) Servo system using an encoder and controller (D6060E)

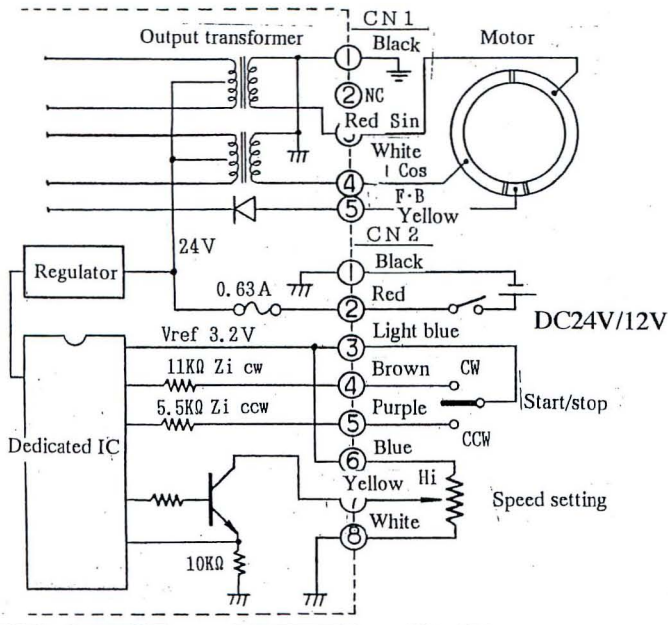


• Integrated operation (servo system) for positioning control and speed control is possible using an encoder and controller. Using a PC program, a large number of position settings and variable speed control are possible, and automatic execution of the program also become possible with the controller's memory.

※ While the controller is presently under development at Shinsei Corporation, it can be made by user side.

• D6030

(1) Driver's internal circuit

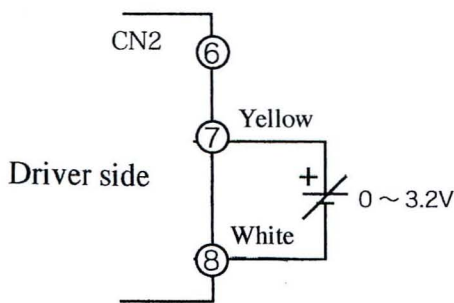


• Stabilizing potential of +3.2V(5mA max) is output at common terminal ③ light blue of the on-off switch and speed setting volume terminal ⑥ blue.

• CW/CCW start/stop at rotation command terminal ④ brown and ⑤ purples will be ON at TTL input level Hi (+2.5V~+5.5V) and OFF at Lo (0V~+0.4V).

※ Impedance is 11KΩ at ④ and 5.5KΩ at ⑤

(2) Speed control using external voltage

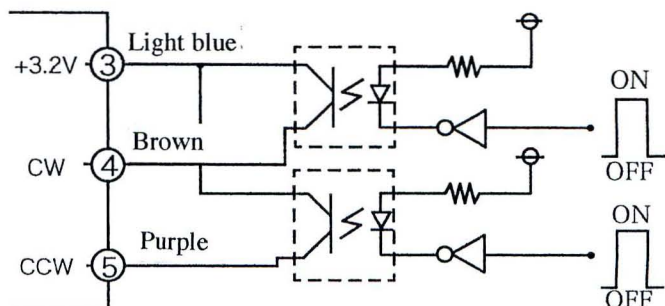
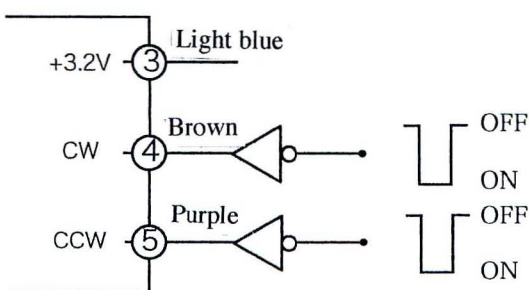
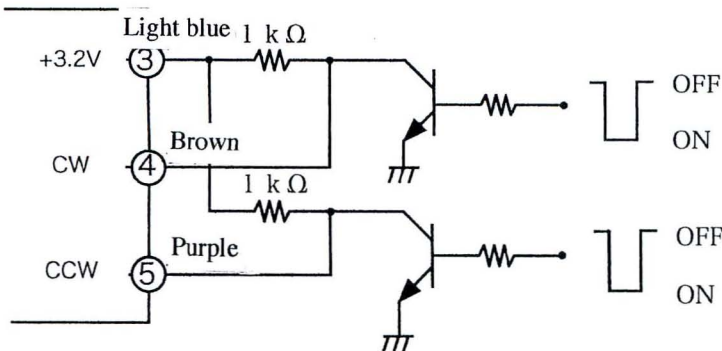


• When doing speed control using external voltage, connect a DC variable voltage source between terminals ⑦ yellow and ⑧ white instead of the volume. By changing the voltage 0~3.2V the same speed control as changing the volume 0~max will become possible.

※ The consumption current of the external voltage source is 0.5mA or under and impedance is 10KΩ.

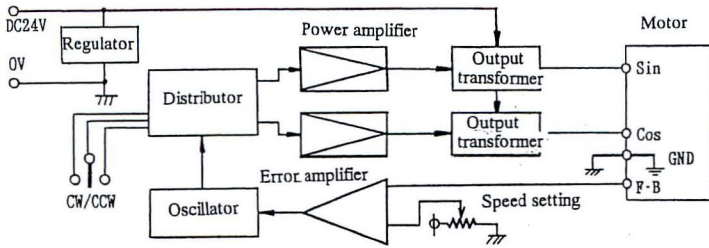
※ As there is a limit to change in the rise rate of zero speed voltage, refer to the timing chart on page 14.

(3) On-off and rotational direction change by external signal



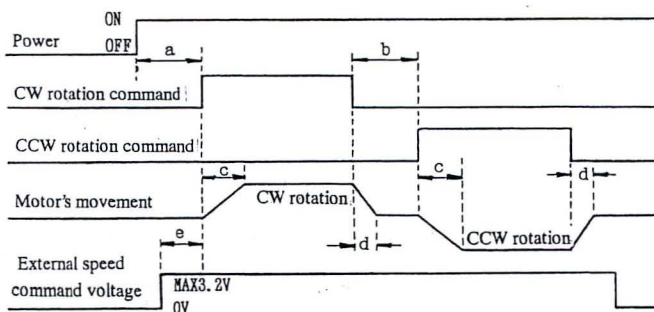
12. Others

◎ Circuit composition



- The driver case is not grounded.
- The motor case is connected to GND (shielded line) and is grounded to GND potential of the power source input.

◎ Timing chart



- ① 100msec or more is required from driver power source ON to start-up command (CW or CCW) ON.
- ② 10msec or more interval is required for switching between CW and CCW.
- ③ Start-up response time (at no inertia) takes 50msec.
- ④ Stoppage response time (at no inertia) is 1msec or shorter.
- ⑤ 10sec interval is required after the power is turned OFF when restarting from motor shut-down due to overload.

(※ except D6030)

◎ Driver adjustment method

The motor and driver are adjusted according to the specifications. Therefore, in principle, users do not make adjustment of the driver. If, however, adjustment becomes necessary for some reasons, follow the steps below.

(Item to prepare)

- Frequency meter (voltage tolerance 150Vrms or above)
- Ammeter (capacity 5A)
- Revolution indicator (non-contact type desirable)
- Small Phillips driver

(Steps)

1. Connect a frequency meter between the GND and sin (or cos) of the motor (be careful with the meter as it is high voltage).
2. Put the motor in a no-load state so that measurements with a revolution indicator can be made.

3.E. Adjustment of minimum number of rotations

Adjust trimmer E (number of rotations increases when rotation is CW) so that it is 15r/min for D6060E or 30r/min for D6060 and D6030 when CW/CCW command is given with the external speed control volume turned minimum or the external speed control command voltage turned to 0V. Make sure the frequency range is 41~44KHz for USR60 series and 51~52KHz for USR30 series at that time.

4.D. Adjustment of maximum number of rotations

Adjust trimmer D (number of rotations increases when rotation is CW) so that it is 150r/min for USR60 series 300r/min for USR30 series when CW/CCW command is given with the external speed control volume turned maximum or the external speed control command voltage turned to 3.2V. Make sure the frequency range is approximately 40KHz for USR60 series and 50KHz for USR30 series at that time.

5.C. Balance correction of CW/CCW rotations

Adjust trimmer C so that the number of rotations for CW and CCW are the same when adjusting D (adjustment of maximum number of rotations). As the maximum number of rotations changes at this time, repeat steps 4 and 5 several times so that the number of rotations for CW, CCW are the same.

(not required for D6060E)

※ Why is readjustment necessary?

In such cases as the length of the motor cable that connects the motor and driver is changed the feedback signal changes due to fluctuation in electrical resistance. The feedback signal is used to measure the stator vibration oscillation at the driver side by outputting voltage from the monitor electrode. Therefore, if the electrical resistance fluctuates in between, the feed back signal voltage also changes and prevents adequate frequency oscillation of the driver to cause errors in the number of rotations.

Readjustment of the driver is necessary to return the number of rotations to the proper figure. When the length of the motor cable is changed greatly (over 5m change) and the impedance between the motor and driver fluctuates, reactive current increases and may cause damage to the driver due to overheating. In this case, measures such as adding coils to the driver to adjust impedance becomes necessary.

◎ Ultrasonic motor price list (in yen)

• USR60 series (with standard driver)

Product	Type	Motor alone	With driver
USR60-S3	Standard single shaft	30,000	45,000
USR60-S4	Standard double shaft	30,000	45,000
USR60-E3	Standard with encoder	40,000	55,000
USR60-S3N	Non-magne single shaft	95,000	115,000
USR60-S4N	Non-magne double shaft	95,000	115,000
USR60-E3N	Non-magne with encoder	110,000	130,000

• USR60 series (with encoder controlled driver)

Product	Type	Motor alone	With driver
USR60-E3	Standard with encoder		70,000
USR60-E3N	Non-magne with encoder		145,000

※ Driver alone is not available.

• USR30 series (with standard driver)

Product	Type	Motor alone	With driver
USR30-B3	Built-in single shaft	9,000	15,000
USR30-B4	Built-in double shaft	9,000	15,000
USR30-S3	Standard single shaft	12,000	18,000
USR30-S4	Standard double shaft	13,000	19,000
USR30-E3a	Standard with encoder	24,000	30,000
USR30-S3N	Non-magne single shaft	75,000	85,000
USR30-S4N	Non-magne double shaft	75,000	85,000
USR30-E3N	Non-magne with encoder	90,000	100,000

• USR30 series (with encoder controlled driver)

Product	Type	Motor alone	With driver
USR30-E3a	Standard with encoder		54,000
USR30-E3N	Non-magne with encoder		125,000

※ Driver alone is not available.

- Standard models in the USR60 and USR30 series come with a 1m cable.
- Non-magnetic models in the USR60 and USR30 series come with a 3m cable.
- Extended cables are priced separately. See the price list below.
- Inquire us for extended cables that are not included in the price list.

• Extended cables

(1) Motor cable (USR60 series)

	60-S3,S4,E3	60-S3N,S4N,E3N
1 m~2 m	2,000	
2 m~3 m	2,500	
3 m~4 m	3,000	3,000
4 m~5 m	3,500	3,500

(2) Motor cable (USR30 series)

	B3, B4	S3, S4	E3a	S3N, S4N, E3N
1 m~2 m	1,200	1,500	1,700	
2 m~3 m	1,400	2,000	2,200	
3 m~4 m	1,600	2,500	2,700	2,500
4 m~5 m	1,800	3,000	3,200	3,000

(3) Encoder cable

	E3, E3a	E3N
1 m~2 m	2,000	
2 m~3 m	2,500	
3 m~4 m	3,000	3,000
4 m~5 m	3,500	3,500

※ Driver readjustment is required when the cable length is altered.

◎ Purchase method

• Shinsei's ultrasonic motors are sold directly. As we do not have agencies or sales outlets, please contact us at the numbers provided below.

• While we accept orders by fax, e-mail or phone as provided below, if you place an order by phone, you must send an order sheet by fax later.

• As after we receive the order sheet we confirm the contents of your order, please include your phone number, address and name of the person in charge of the order.

As product contents, please clearly state the power source voltage (DC24V or 12V) and motor cable length (if other than standard length is required).

• If you wish to receive an estimate or a Pro-forma Invoice, please request us, and we will send you it by fax or e-mail and if you need by air-mail.

• As for making payment, we ask all overseas customers for advance payment made in Japanese yen, and this payment will include a shipping cost. Our account number and bank name will be written on the estimate or Pro-forma Invoice.

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