

# Vacuum Compatible Motorized Stage Guide | VSGSP Guide

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**Motorized Stages**

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**Stepping Motor**

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**Vacuum**

Options

- 40 × 40 mm
- 60 × 60 mm
- 80 × 80 mm
- 85 × 85 mm
- 100 × 100 mm
- 120 × 120 mm
- Others

For use in vacuum environments, the vacuum compatible stage series offers replacement with a stainless steel or machined aluminum body as well as replacement with vacuum grease, and uses a vacuum rated motor and a contact type or mechanical driven type switch, and Teflon coated cables for signal wires.

The series is suited for positioning in environments where the degree of vacuum is between  $10^{-4}$  and  $10^{-5}$ Pa. For the vacuum characteristics, see the measurement data of outgas volume, degree of vacuum, and mass component ratio.

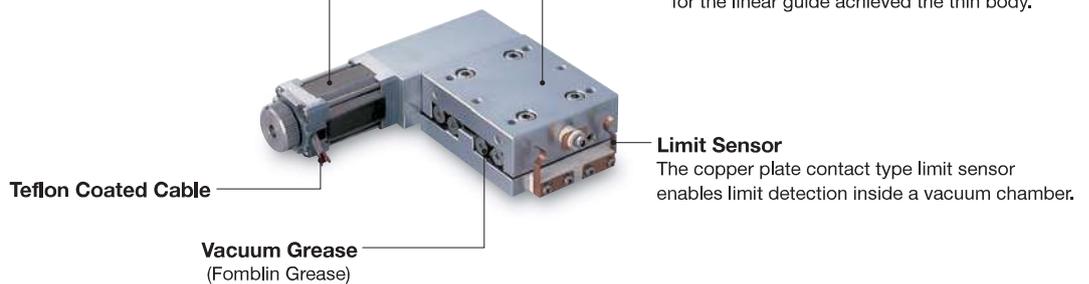
- In addition to the standard lineup, motor replacement, sensor replacement, special specifications such as vacuum compatible large mirror holders, and replacement of grease to vacuum grease for the guides or feed screws of standard specification stages to deal with low vacuum specifications are available. Contact our Sales Division for more information.

**Vacuum Compatible 5 Phase Stepping Motor**

The □24mm minimum size and lightest type motor saves space.

**Compact Body**

Machined Aluminum and use of a crossed roller for the linear guide achieved the thin body.

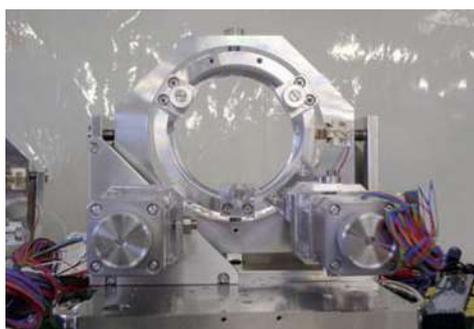
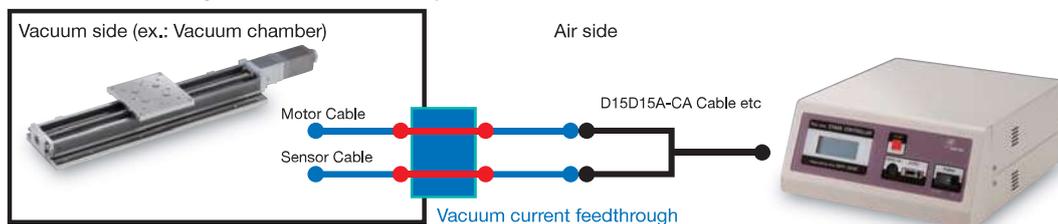


**Rotation Table**  
The body is made of aluminum machining.

**Limit Sensor**  
The high-vacuum compatible limit switch enables origin detection with high repeatability inside a vacuum chamber.  
\* Only for VSGSP-120YAW



**[Attention]** To use a vacuum compatible stage in a vacuum chamber, the connection cables between the vacuum side and the atmosphere side need to be relayed using a vacuum current feedthrough or the like. Prepare the feedthrough according to the vacuum chamber specifications.



[Example of Special Order]  
Vacuum Compatible Large Mirror Holder

**Guide**

- ▶ Because heat dissipation generally deteriorates in vacuum, specification temperature conditions are stricter than those for atmosphere. Check the usage conditions such as stage operation to make sure that the motor case temperature does not exceed 80°C.

## ●Emitted amount of gas

Part Number	Emitted Amount of Gas Q (after 40 minutes of emission)	
	(Torr·ℓ/s/unit)	(Pa·ℓ/s/unit)
VSGSP26-200	$4.77 \times 10^{-4}$	$6.36 \times 10^{-2}$
VSGSP-60	$6.75 \times 10^{-5}$	$9.00 \times 10^{-3}$
VSGSP-120YAW	$4.78 \times 10^{-4}$	$6.37 \times 10^{-2}$

Emitted amount of gas is found by the following equation:

$$Q = \frac{(P - P') \times V}{t \times N}$$

P : Vacuum immediately after seal off  
 P' : Vacuum after seal-off time has elapsed  
 N : Number of stage units (1unit)  
 V : Vacuum chamber volume (ℓ)  
 t : Seal-off time (600s)

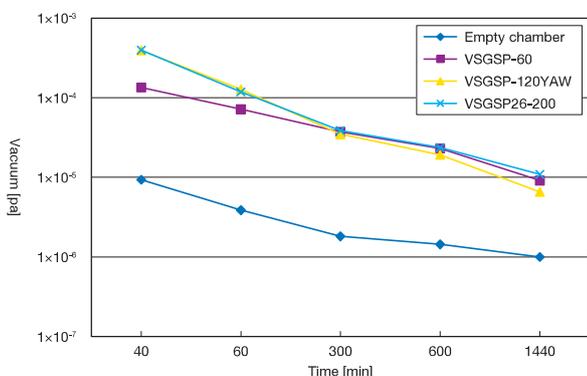
## Evaluation and Device Specifications

Exhaust system: Turbo-Molecular Pump STP-301  
 Seiyu Instruments Inc. (Now Edwards Japan Limited)  
 Pumping speed: 300ℓ/sec  
 Mass spectroscope: Quad Mass Spectrometer QME200  
 Pfeiffer Vacuum  
 Mass range: 1 – 200amu

## From the measurement results of gas volume discharged from a vacuum compatible motorized stage

The main components of outgas are water and nitrogen. This is because the gas was caused by residual air on the stage surface, and grease used for drive components is considered to have little impact on the amount of gas.

## ●Vacuum of Vacuum Chamber



## ●Mass Component Ratio

Mass Number	Component Ratio [%]			Ion	Gas Molecule
	VSGSP-60	VSGSP26-200	VSGSP-120YAW		
1	19.58	19.96	17.90	H <sup>+</sup>	H <sub>2</sub> , water vapor, hydrocarbon
2	2.81	5.28	3.34	H <sub>2</sub> <sup>+</sup>	H <sub>2</sub> , water vapor, hydrocarbon
12	0.60	0.85	0.79	C <sup>+</sup>	CO, CO <sub>2</sub> , hydrocarbon
13	0.17	—	—	CH <sup>+</sup>	Hydrocarbon
14	0.79	1.26	0.91	N <sup>+</sup> , CO <sup>2+</sup> , CH <sub>2</sub> <sup>+</sup>	N <sub>2</sub> , NH <sub>3</sub> , CO, hydrocarbon
15	—	2.37	—	CH <sub>3</sub> <sup>+</sup> , NH <sup>+</sup>	Hydrocarbon, NH <sub>3</sub>
16	3.03	—	2.98	O <sup>+</sup> , CH <sub>4</sub> <sup>+</sup> , NH <sub>2</sub> <sup>+</sup>	O <sub>2</sub> , CH <sub>4</sub> , NH <sub>3</sub>
17	15.77	—	14.48	OH <sup>+</sup> , NH <sub>3</sub> <sup>+</sup>	H <sub>2</sub> O, NH <sub>3</sub>
18	48.02	17.30	43.89	H <sub>2</sub> O <sup>+</sup>	H <sub>2</sub> O
20	0.22	—	0.29	HF <sup>+</sup> , Ar <sup>2+</sup>	HF, Ar
26	0.33	—	0.53	C <sub>2</sub> H <sub>2</sub> <sup>+</sup>	Hydrocarbon
27	0.83	4.53	1.52	C <sub>2</sub> H <sub>3</sub> <sup>+</sup>	Hydrocarbon
28	2.17	2.49	2.76	CO <sup>+</sup> , N <sub>2</sub> <sup>+</sup> , C <sub>2</sub> H <sub>4</sub> <sup>+</sup>	CO, CO <sub>2</sub> , N <sub>2</sub> , hydrocarbon
29	0.73	6.08	1.44	C <sub>2</sub> H <sub>5</sub> <sup>+</sup>	Hydrocarbon
30	0.08	—	—	C <sub>2</sub> H <sub>6</sub> <sup>+</sup> , NO <sup>+</sup>	C <sub>2</sub> H <sub>6</sub> , NO
31	0.14	0.31	0.27	C <sub>2</sub> H <sub>7</sub> OH <sup>+</sup>	C <sub>2</sub> H <sub>7</sub> OH
32	0.26	—	0.27	O <sub>2</sub> <sup>+</sup> , S <sup>+</sup>	O <sub>2</sub> , H <sub>2</sub> S, SO <sub>2</sub>
39	0.39	2.57	0.78	C <sub>3</sub> H <sub>3</sub> <sup>+</sup>	Hydrocarbon
41	0.51	7.44	1.07	C <sub>3</sub> H <sub>5</sub> <sup>+</sup>	Hydrocarbon
42	—	—	0.41	C <sub>3</sub> H <sub>6</sub> <sup>+</sup>	Hydrocarbon
43	0.74	8.00	1.01	C <sub>3</sub> H <sub>7</sub> <sup>+</sup>	Hydrocarbon
44	0.40	—	0.66	C <sub>3</sub> H <sub>8</sub> <sup>+</sup> , CO <sub>2</sub> <sup>+</sup> , NO <sup>+</sup> , C <sub>2</sub> H <sub>5</sub> OH <sup>+</sup>	C <sub>3</sub> H <sub>8</sub> , CO <sub>2</sub> , N <sub>2</sub> O, C <sub>2</sub> H <sub>5</sub> OH
45	—	0.31	0.31	C <sub>3</sub> H <sub>9</sub> O <sup>+</sup>	C <sub>3</sub> H <sub>9</sub> OH
50	—	0.23	—	C <sub>4</sub> H <sub>2</sub> <sup>+</sup>	Hydrocarbon

## Data

### ●Interpretation of Mass Peak

The following list shows major gases that appear for each mass number when mass peaks (mass spectra) of residual gas are measured, and their interpretations.

#### List of Residual Gas Spectra

Mass Number	Ion	Remarks	Mass Number	Ion	Remarks
1	H <sup>+</sup>	H <sub>2</sub> , H <sub>2</sub> O, hydrocarbons, etc	30	NO <sup>+</sup>	Appears immediately after emission of dirty vacuum system.
2	H <sub>2</sub> <sup>+</sup>	H <sub>2</sub> , H <sub>2</sub> O, hydrocarbons, etc	31	CH <sub>3</sub> O <sup>+</sup>	Alcohol
3	HD <sup>+</sup>	Abundance ratio of D is about 0.01%.	32	O <sub>2</sub> <sup>+</sup>	Becomes N <sub>23</sub> : O <sub>32</sub> = 4 : 1 when air leak occurs.
4	He <sup>+</sup>		35	Cl <sup>+</sup>	
12	C <sup>+</sup>	CO, CO <sub>2</sub> , hydrocarbons	37	Cl <sup>+</sup>	Cl <sub>35</sub> : Cl <sub>37</sub> = 3 : 1
14	N <sup>+</sup> , CH <sub>2</sub> <sup>+</sup> , CO <sub>2</sub> <sup>+</sup>	N <sub>2</sub> , CO <sub>2</sub> , hydrocarbons	39	K <sup>+</sup> , C <sub>3</sub> H <sub>3</sub> <sup>+</sup>	K <sup>+</sup> dissociates from filament.
15	CH <sub>3</sub> <sup>+</sup>	Molecule that has CH <sub>4</sub> , CH <sub>3</sub>	40	Ar <sup>+</sup> , C <sub>3</sub> H <sub>4</sub> <sup>+</sup>	Ar makes up 1% of the atmosphere.
16	C <sup>+</sup> , CH <sub>4</sub> <sup>+</sup>	O <sub>2</sub> , CH <sub>4</sub> , oxygen compounds	41	C <sub>3</sub> H <sub>5</sub> <sup>+</sup>	Hydrocarbon
17	OH <sup>+</sup>	H <sub>2</sub> O	42	C <sub>3</sub> H <sub>6</sub> <sup>+</sup>	Hydrocarbon
18	H <sub>2</sub> O <sup>+</sup>	H <sub>2</sub> O, OH <sup>+</sup> : H <sub>2</sub> O <sub>2</sub> ≅ 1 : 5	43	C <sub>3</sub> H <sub>7</sub> <sup>+</sup>	Hydrocarbon
19	F <sup>+</sup>	Sometimes adsorbed to filaments and electrode surface.	44	CO <sub>2</sub> <sup>+</sup>	
20	Ar <sup>+</sup> , H <sub>2</sub> O <sup>+</sup> , Ne <sup>+</sup>	H <sub>2</sub> O(20) is present about 0.2% of abundance ratio of O <sub>15</sub> .	50	C <sub>4</sub> H <sub>2</sub> <sup>+</sup>	Hydrocarbon
22	CO <sub>2</sub> <sup>2+</sup> , Ne <sup>+</sup>	Abundance ratio of NE <sub>22</sub> is 8.8%.	51	C <sub>4</sub> H <sub>3</sub> <sup>+</sup>	Hydrocarbon
23	Na <sup>+</sup>	Sometimes adsorbed to filaments and electrode surface.	55	C <sub>4</sub> H <sub>7</sub> <sup>+</sup>	Hydrocarbon
27	C <sub>2</sub> H <sub>3</sub> <sup>+</sup>	Hydrocarbon	56	C <sub>4</sub> H <sub>8</sub> <sup>+</sup>	Hydrocarbon
28	N <sub>2</sub> <sup>+</sup> , CO <sup>+</sup>	Remain till the last.	57	C <sub>4</sub> H <sub>9</sub> <sup>+</sup>	Hydrocarbon
29	C <sub>2</sub> H <sub>5</sub> <sup>+</sup> , N <sub>2</sub> <sup>+</sup> , CO <sup>+</sup>	Abundance ratio of N <sub>15</sub> is 0.7%, and that of C <sub>13</sub> is 1.1%.			

# Vacuum Compatible Miniature Motorized Stages

Stage Size 55 × 60 mm

VSGSP-60

RoHS

Compact motorized stages for use in high vacuum.  
Compact, slim body for minimal footprint.



## Guide

- ▶ Includes 1m teflon coated cables to connect the vacuum motor and vacuum limit switches to the chamber feedthrough connector.
- ▶ Please Contact our Sales Division for more information about vacuum applications miniature motorized stages which are CE certified.
- ▶ Various types of stages and holders which can be used in vacuum environments are also available. [Reference](#) D023

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40 × 40 mm

60 × 60 mm

80 × 80 mm

85 × 85 mm

100 × 100 mm

120 × 120 mm

Others

## Specifications

Part Number		VSGSP-60(X)	VSGSP-60(XY)	VSGSP-60(Z)
Mechanical Specifications	Travel [mm]	20	20	20
	Stage Size [mm]	55×60	55×60	55×60
	Feed Screw	Precision ground screw $\phi$ 4mm, 0.5mm lead	Precision ground screw $\phi$ 4mm, 0.5mm lead	Precision ground screw $\phi$ 4mm, 0.5mm lead
	Positioning Slide	Crossed roller guide	Crossed roller guide	Crossed roller guide
	Stage Material	Aluminum	Aluminum	Aluminum
	Finish	None	None	None
	Weight [kg]	0.55	1.1	0.6
Accuracy Specifications	Resolution	(Full) [ $\mu$ m]	1	1
		(Half) [ $\mu$ m]	0.5	0.5
	MAX Speed [mm/sec]	5	5	—
	Positional Repeatability [ $\mu$ m]	6	6	6
	Load Capacity [N]	29.4 (3.0kgf)	19.6 (2.0kgf)	14.7 (1.5kgf)
Lost Motion [ $\mu$ m]	5	5	5	
Sensor	Type	Vacuum limit switch	Vacuum limit switch	Vacuum limit switch
	Limit Sensor	Contact type	Contact type	Contact type
	Origin Sensor	None	None	None
	Proximity Origin Sensor	None	None	None

## Motor / Sensor Specifications

Motor	Type	Vacuum compatible 5-phase stepping motor 0.75A/phase (Tamagawa Seiki Co., Ltd.)		
	Motor Part Number	TS3664N5 (□24mm)		
	Step Angle	0.72°		
Sensor	Control Output	Contact type	Contact type	Contact type
	Output Logic	NORMAL OPEN	NORMAL OPEN	NORMAL OPEN

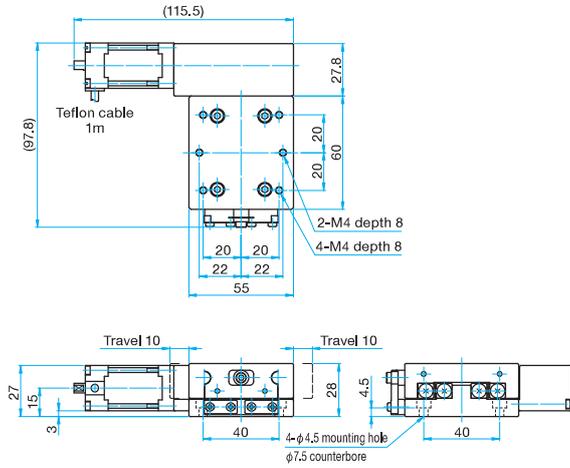
## Compatible Driver / Controller

Control System	Compatible Driver	SG-5M, MC-S0514ZU, SG-514MSC, MC-7514PCL
	Compatible Controller	GSC-01, GSC-02, SHOT-702, GIP-101, HSC-103, SHOT-302GS, SHOT-304GS, HIT-M-HIT-S, PGC-04-U

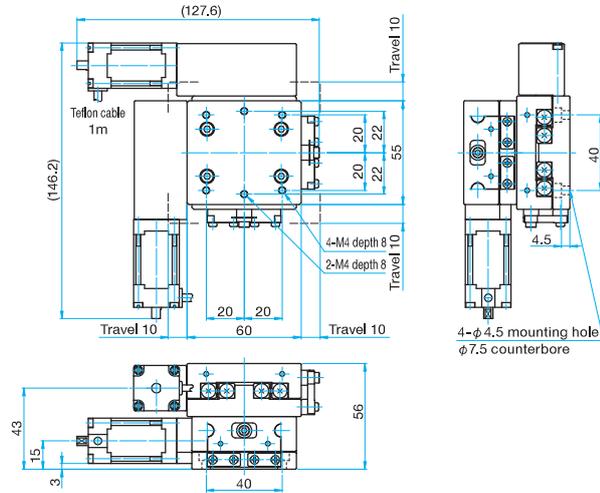


**Outline Drawing**

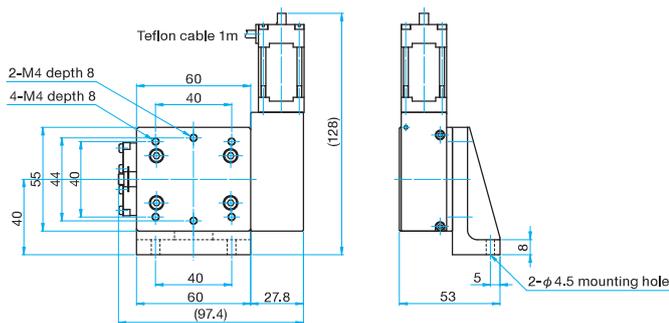
**VSGSP-60(X)** Hexagonal socket head cap screw M4x10...4 screws



**VSGSP-60(XY)** Hexagonal socket head cap screw M4x10...4 screws



**VSGSP-60(Z)** Hexagonal socket head cap screw M4x15...2 screws

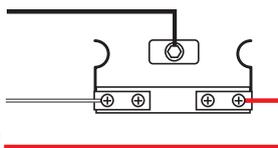


**Vacuum Limit Switch**

GND (0V) black lead

Motor side (+) limit switch  
LS (+) white lead

Opposite side (-) limit switch  
LS (-) red lead



\* Use the motor side and opposite side limit switches as normal open.

**Wiring of Vacuum Stages**

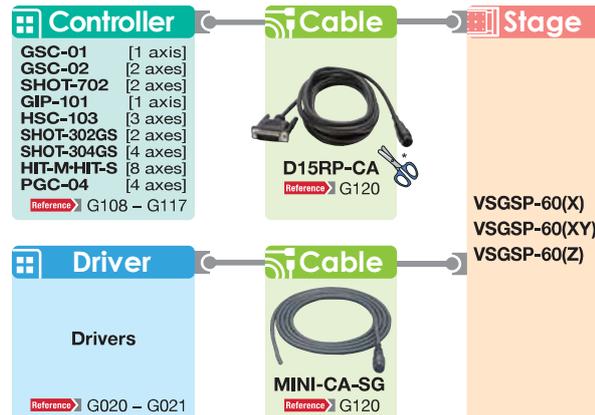
The vacuum compatible stepping motor TS3664N5 used for vacuum stages has five bare lead wires.

For wiring, they correspond to the motor lead colors shown in the wiring diagrams of driver or cable as follows.

(The motor leads shown in the connection diagrams of driver or cable indicate wiring of stepping motors used for normal stages.)

	Vacuum stage motor lead color	Motor lead color shown in driver or cable connection diagram
Correspondence between connections	1 Blue	Blue
	2 Red	Red
	3 Red White	Orange
	4 Yellow	Green
	5 Black	Black
	Vacuum compatible stage motor connection diagram	5-phase stepping motor connection diagram

**Compatible Controllers / Drivers and Cables**



\* Make the cable into bare wire specification after purchase.

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40 × 40 mm

60 × 60 mm

80 × 80 mm

85 × 85 mm

100 × 100 mm

120 × 120 mm

Others

# Vacuum Compatible Motorized Stages

Stage Size 60 × 60 mm / 80 × 80 mm

VSGSP-(X)

RoHS

## Motorized SGSP stages modified for use in high vacuum.

- Linear stages have available travel between 35 – 200mm and has a similar footprint to the SGSP series.



### Guide

- Includes 1m teflon coated cables to connect the vacuum motor and vacuum limit switches to the chamber feedthrough connector.

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40 × 40 mm

60 × 60 mm

80 × 80 mm

85 × 85 mm

100 × 100 mm

120 × 120 mm

Others

Specifications			VSGSP20-35(X)	VSGSP20-85(X)	VSGSP26-200(X)
Part Number					
Mechanical Specifications	Travel [mm]		35	85	200
	Stage Size [mm]		60×60	60×60	80×80
	Feed Screw		Ball screw diameter φ6mm, 1mm lead	Ball screw diameter φ6mm, 1mm lead	Ball screw diameter φ8mm, 2mm lead
	Positioning Slide		Outer rail structure	Outer rail structure	Outer rail structure
	Stage Material		Aluminum / Stainless steel	Aluminum / Stainless steel	Aluminum / Stainless steel
	Finish		None	None	None
	Weight [kg]		1.0	1.1	2.5
Accuracy Specifications	Resolution	(Full) [μm]	2	2	4
		(Half) [μm]	1	1	2
	MAX Speed [mm/sec]		10	10	20
	Positional Repeatability [μm]		5	5	10
	Load Capacity [N]		39.2(4.0kgf)	39.2(4.0kgf)	58.8(6.0kgf)
Lost Motion [μm]		3	3	10	
Sensor	Sensor Part Number		GN-PT5M3B-1 (Metrol Co., Ltd.)	GN-PT5M3B-1 (Metrol Co., Ltd.)	GN-PT5M3B-1 (Metrol Co., Ltd.)
	Limit Sensor		Vacuum touch sensor (NORMAL CLOSE)	Vacuum touch sensor (NORMAL CLOSE)	Vacuum touch sensor (NORMAL CLOSE)
	Origin Sensor		None	None	None
	Proximity Origin Sensor		None	None	None

Motor / Sensor Specifications				
Motor	Type	Vacuum compatible 5-phase stepping motor 0.75A/phase (Oriental Motor Co., Ltd.)		
	Motor Part Number	A7298-90215KV (□28mm)	A7298-90215KV (□28mm)	A7298-90215KV (□28mm)
	Step Angle	0.72°		
	Control Output	Touch sensor		
	Output Logic	NORMAL CLOSE	NORMAL CLOSE	NORMAL CLOSE

Compatible Driver / Controller		
Control System	Compatible Driver	SG-5M, MC-S0514ZU, SG-514MSC, MC-7514PCL
	Compatible Controller	GSC-01, GSC-02, SHOT-702, GIP-101, HSC-103, SHOT-302GS, SHOT-304GS, HIT-M-HIT-S, PGC-04-U



# Vacuum Compatible Motorized Rotation Stage

Stage Size  $\phi$  60 mm /  $\phi$  120 mm

VSGSP-YAW

RoHS

## Motorized SGSP-YAW rotation stages modified for use in high vacuum.

- The  $\phi$ 60mm size is best suited for use in smaller chambers.
- The  $\phi$ 120mm size has a high load capacity due the larger bearing and larger motor.



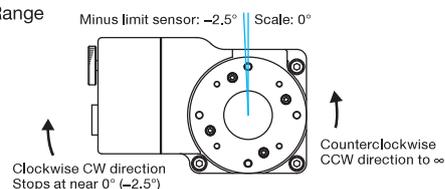
### Guide

- ▶ Includes 1m teflon coated cables to connect the vacuum motor and vacuum limit switches to the chamber feedthrough connector.
- ▶ Origin detection is adjusted so that the stage stops at 0 degrees when homing is performed in the MINI system at half step.



### Guide

- ▶ Rotation Range



- ▶ Homing of rotation motorized stages is performed using the CW limit sensor as the origin sensor.
- ▶ Origin detection is adjusted so that the stage stops at 0 degrees when homing is performed in the MINI system at half step.
- ▶  $\phi$ 60mm rotation stage does not include a limit sensor.

## Specifications

Part Number		VSGSP-60YAW	VSGSP-120YAW
Mechanical Specifications	Rotation Range	In the CW or CCW direction to $\infty$	Counterclockwise CCW direction to $\infty$ , Clockwise CW direction stops at near 0 degree ( $-2.5^\circ$ )
	Stage Size [mm]	$\phi$ 60	$\phi$ 120
	Feed Screw	Worm and worm wheel	Worm and worm wheel
	Positioning Slide	Bearing	Crossed roller
	Stage Material	Aluminum	Aluminum / Stainless steel
	Finish	None	None
	Weight [kg]	0.45	1.7
Accuracy Specifications	Resolution	(Full) [ $^\circ$ ]	0.005
		(Half) [ $^\circ$ ]	0.0025
	MAX Speed [ $^\circ$ /sec]	20	20
	Positional Repeatability [ $^\circ$ ]	0.02	0.02
	Load Capacity [N]	29.4 (3.0kgf)	98.0 (10.0kgf)
Sensor	Lost Motion [ $^\circ$ ]	0.05	0.05
	Type	None	GN-STM35A-1 (Metrol Co., Ltd.)
	Limit Sensor	None	Vacuum touch sensor (NORMAL OPEN)
	Origin Sensor	None	None
	Proximity Origin Sensor	None	None

## Motor / Sensor Specifications

		Vacuum compatible 5-phase stepping motor 0.75A/phase (Tamagawa Seiki Co., Ltd.)	Vacuum compatible 5-phase stepping motor 0.75A/phase (Oriental Motor Co., Ltd.)
Motor	Type	Vacuum compatible 5-phase stepping motor 0.75A/phase (Tamagawa Seiki Co., Ltd.)	Vacuum compatible 5-phase stepping motor 0.75A/phase (Oriental Motor Co., Ltd.)
	Motor Part Number	TS3664N5 ( $\square$ 24mm)	PK543V-NB ( $\square$ 42mm)
	Step Angle	$0.72^\circ$	$0.72^\circ$
Sensor	Control Output	—	Contact type
	Output Logic	—	NORMAL OPEN

## Compatible Driver / Controller

		SG-5M, MC-S0514ZU, SG-514MSC, MC-7514PCL
Control System	Compatible Driver	SG-5M, MC-S0514ZU, SG-514MSC, MC-7514PCL
	Compatible Controller	GSC-01, GSC-02, SHOT-702, GIP-101, HSC-103, SHOT-302GS, SHOT-304GS, HIT-M-HIT-S, PGC-04-U

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60 x 60 mm

80 x 80 mm

85 x 85 mm

100 x 100 mm

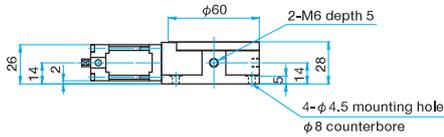
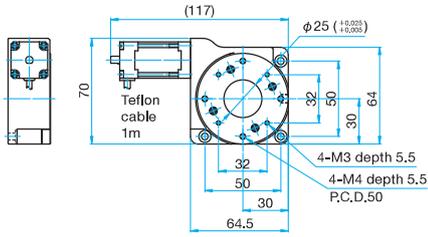
120 x 120 mm

Others

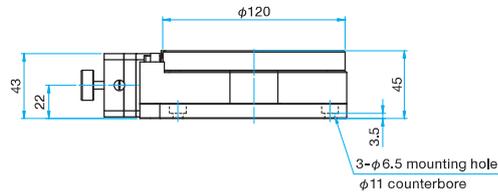
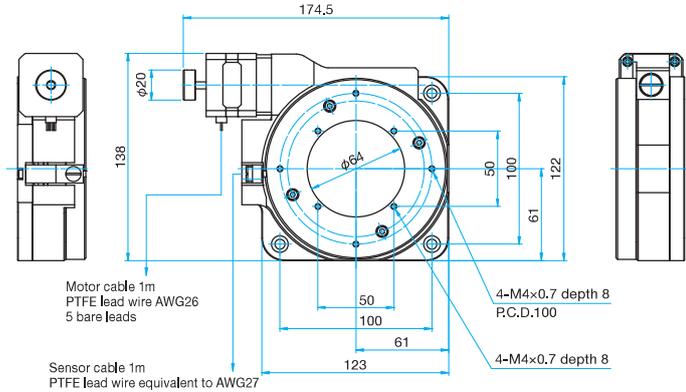


**Outline Drawing**

**VSGSP-60YAW** Hexagonal socket head cap screw M4x10...3 screws



**VSGSP-120YAW** Hexagon socket head cap screw M6x10...3 screws

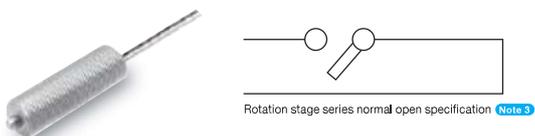


**Wiring of Vacuum Stages**

The vacuum compatible stepping motor TS3664N5 used for vacuum stages has five bare lead wires. For wiring, they correspond to the motor lead colors shown in the wiring diagrams of driver or cable as follows. (The motor leads shown in the connection diagrams of driver or cable indicate wiring of stepping motors used for normal stages.)

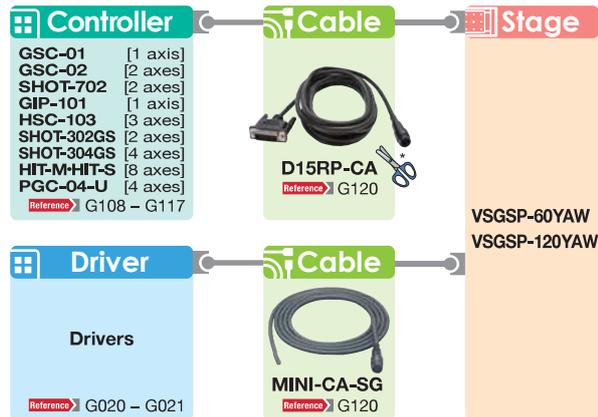
	Vacuum stage motor lead color	Motor lead color shown in driver or cable connection diagram
Corresponding connection	1 Blue	Blue
	2 Red	Red
	3 60YAW: Red White 120YAW: Orange	Orange
	4 60YAW: Yellow 120YAW: Green	Green
	5 Black	Black
	Vacuum compatible stage motor connection diagram	5-phase stepping motor connection diagram (SGSP series)

**Limit Sensor (high vacuum compatible switch): VSGSP-120YAW**



**Note 3** Set the controller of vacuum compatible motorized rotation stages to normal open.

**Compatible Controllers / Drivers and Cables**



\* Make the cable into bare wire specification after purchase.

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40 x 40 mm

60 x 60 mm

80 x 80 mm

85 x 85 mm

100 x 100 mm

120 x 120 mm

Others