

Operating and Maintenance Handbook

DIFFERENTIALLY PUMPED ROTARY FEEDTHROUGHS



REVISION HISTORY

REVISION	DATE	COMMENTS	INITIALS
1	June 1998	Original release	MJD
2	Aug 2015	VACGEN branding	AJL

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WARRANTY

1. Subject to fair wear and tear and the due observance of any installation user, storage, operating or maintenance instructions the Seller undertakes to replace or, at its option repair free of charge to the purchaser, any goods which the purchaser can establish are defective by reason of defective workmanship or materials which are returned to the Seller, carriage paid, within 12 months of the date of dispatch by the Seller. In the event, however, that the Seller supplies spare parts either direct, or that are fitted or installed or replaced by the Sellers' service center such spare parts will be subject to a warranty period of six months only.
2. The Purchaser cannot return any product for warranty repair without the prior approval of VACGEN and the issue of a Goods Return Number (GRN). This shall be obtained by contacting the service center at VACGEN. All returned products must be accompanied by a completed Declaration of Contamination form. Customers must, in the first instance, contact the local selling agent.
3. We reserve the right to decline to service equipment, we consider is in any way hazardous until a clearance or safety certificate, in a form satisfactory to VACGEN, has been completed and returned by the customer.

REPAIR

The following additional terms and conditions apply in the event that the customer, elects to use the services of VACGEN workshop on a chargeable basis.

1. At its own cost the customer shall dispatch the equipment to the workshop, carriage paid, suitably packaged, protected and insured, bearing, a Goods Return Number (GRN) and a completed Declaration of Contamination certificate obtained from VACGEN in advance of shipment.
2. During the period that the equipment is on VACGEN premises, VACGEN will insure the equipment against all risks.
3. Vacuum Generator will provide an acknowledgement of the receipt together with an estimate of the repair charges. Such estimates are carried out on a visual basis and are therefore intended as a guide only. Formal fixed price repair quotations are available and involve the disassembly of the equipment to determine the full extent of the work necessary to restore the equipment to an acceptable standard. In the event that the customer chooses not to proceed with the repair VACGEN will make a charge to cover this examination effort.

Note:

The above are extracts from VACGEN Conditions of sale. Complete copies can be obtained from: VACGEN, Maunsell Road, Castleham Industrial Estate, St. Leonards on Sea, East Sussex, TN38 9NN, United Kingdom.

1. INTRODUCTION

1.1 HEALTH AND SAFETY INFORMATION

This equipment is a component for use with vacuum systems. Whilst every effort has been made to eliminate hazards, its safe use is also dependant on the system to which it will be connected. The owner of the equipment must ensure that all users are aware of the Health and Safety information contained in this handbook. If the equipment is sold or passed to another owner, this handbook must be included with the equipment. If in doubt contact VACGEN.

Warning: This equipment must be installed by qualified personnel.

Warning: It is the responsibility of the user to consider the safety requirements of hazardous materials used with this equipment and the consequence of any leakage, however caused. Consider possible reactions with materials of construction. Any equipment returned to VACGEN must have the correct Declaration of Contamination securely fastened to the outside of the packaging.

Warning: Harmful gases may be evolved if this equipment is heated to temperatures above the maximum specified bakeout temperature.

Warning: Lubricants used in this assembly may cause irritation to sensitive skin. Wear protective clothing.

Warning: Safe disposal of the equipment is the responsibility of the user.

Warning: It is the responsibility of the user to fit emergency stops to automated equipment.

Warning: Keep clear of moving parts.

Warning: Do not use this equipment with positive internal pressure above the specified maximum.

Warning: Equipment must be fully earthed to prevent dangerous electrostatic charge build-up.

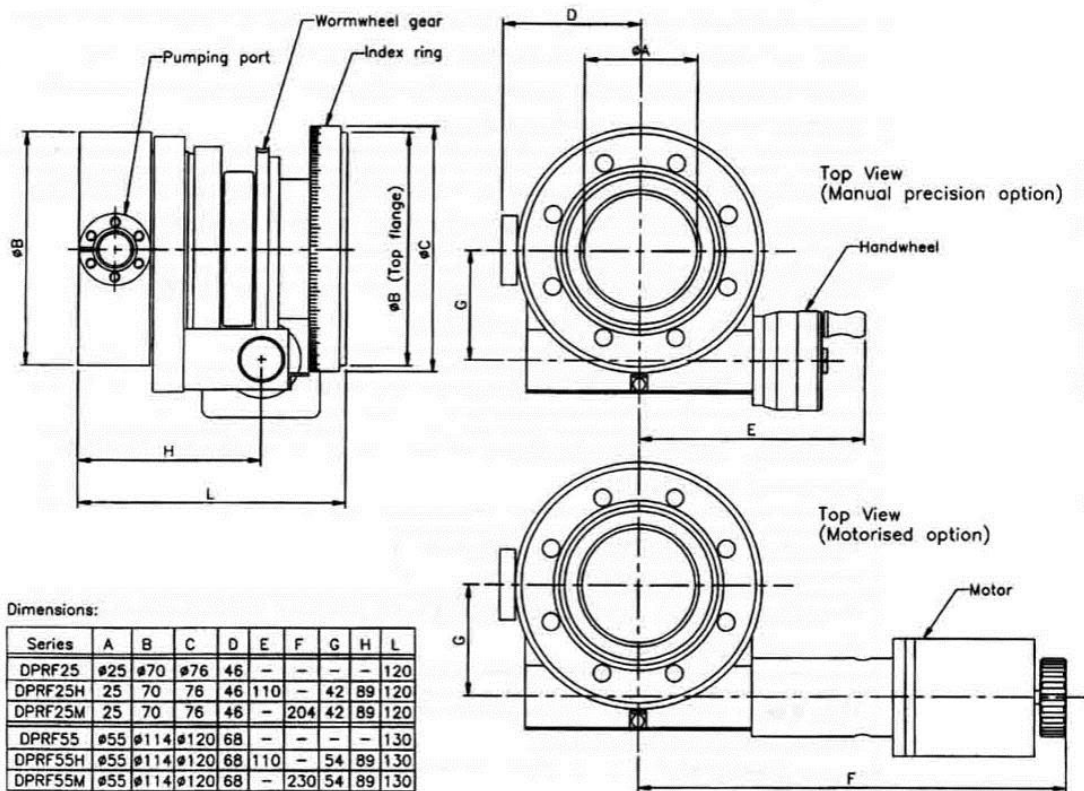
1.2 OVERVIEW

The DPRF rotary feedthrough is of annular construction which enables a probe or other device, not exceeding the clear bore (diameter A) to be inserted into an ultra high vacuum environment.

Three actuator options are available.

- Coarse manual positioning by a bar placed in radial holes in the side of the device (Models ZDPRF25 or ZDPRFSS),
- Precision manual positioning using a calibrated handwheel through a worm and wheel gear. (Models ZDPRF25H or ZDPRF55H).
- Stepper motor drive through a worm and wheel gear. (Models ZDPRF25M or ZDPRF55M).

Flanges at either end are either 70mm (2 3/4" outside diameter (OD) conflat for DPRF25 series or 114mm (4 1/2" OD conflat for the DPRF55 series. Note that the base flanges and pumping port flanges are tapped.



Dimensions:

Series	A	B	C	D	E	F	G	H	L
DPRF25	Ø25	Ø70	Ø76	46	-	-	-	-	120
DPRF25H	25	70	76	46	110	-	42	89	120
DPRF25M	25	70	76	46	-	204	42	89	120
DPRF55	Ø55	Ø114	Ø120	68	-	-	-	-	130
DPRF55H	Ø55	Ø114	Ø120	68	110	-	54	89	130
DPRF55M	Ø55	Ø114	Ø120	68	-	230	54	89	130

1.3 Specification of DPRF25 and DPRF55

All units

Construction:	Stainless steel and light alloy with phosphor bronze worm wheel
Rotation:	Continuous 360°
Operating pressure range:	1 bar to 10 ⁻¹¹ mbar
Operating temperature range:	-20°C to 200°C
Bakeout temperature:	230°C
Interspace Pressure:	10 ⁻² mbar or below.
Concentricity:	0.1 mm maximum T.I.R. at the rotating flange

	DPRF25	DPRF55
Clear bore:	o25 mm	o55 mm
Static (lower) flange:	70 mm O/D tapped M6	114 mm O/D tapped M8
Rotating (top) flange:	70 mm O/D tapped M6	114 mm plain holes
Pumping port flange:	34 mm O/D tapped M4	34 mm O/D tapped M4
Axial Load Capacity:	80kg maximum	130kg maximum
Radial load Capacity:	70kg maximum	110kg maximum
Coarse manual option:	Adjustable index ring calibrated in 1° divisions. Torque to rotate is approximately 4 Nm.	Adjustable index ring calibrated in 1° divisions, Torque to rotate is approximately 4 Nm.
Precision hand wheel: Calibrated option:	Gear Ratio 90:1 Calibrated One in 0.05° divisions. One handwheel revolution 4° rotation of feedthrough. Torque to rotate is approximately 0.02 Nm.	Gear Ratio 120:1. One in 0.05° divisions. One handwheel revolution gives 3° rotation of feedthrough. Torque to rotate is approximately 0.02 Nm.
Motorised option:	4 phase hybrid stepper motor. Gear ratio 90:1. Resolution 0.01° per half step.	4 phase hybrid stepper motor, Gear ratio 120:1. Resolution 0.0075° per half step.

1.4 Construction

The vacuum envelope is stainless steel and all non-demountable joints are welded. The device is shown in figure 2. The rotating housing (1) is supported by two deep-groove ball bearings (2) and is sealed by two separated PTFE 'U' seals (3). The sealing surfaces are polished. The interspace between the 'U' seals is connected to the pumping port (4) which projects radially from the body. The rotating flange is fitted with an engraved index ring (5), which is adjustable to reset the zero position. The precision manual and motorised units have a worm and worm wheel gear system (6) & (7) which drives the rotating housing either by means of a calibrated handwheel (8) or by a stepper motor.

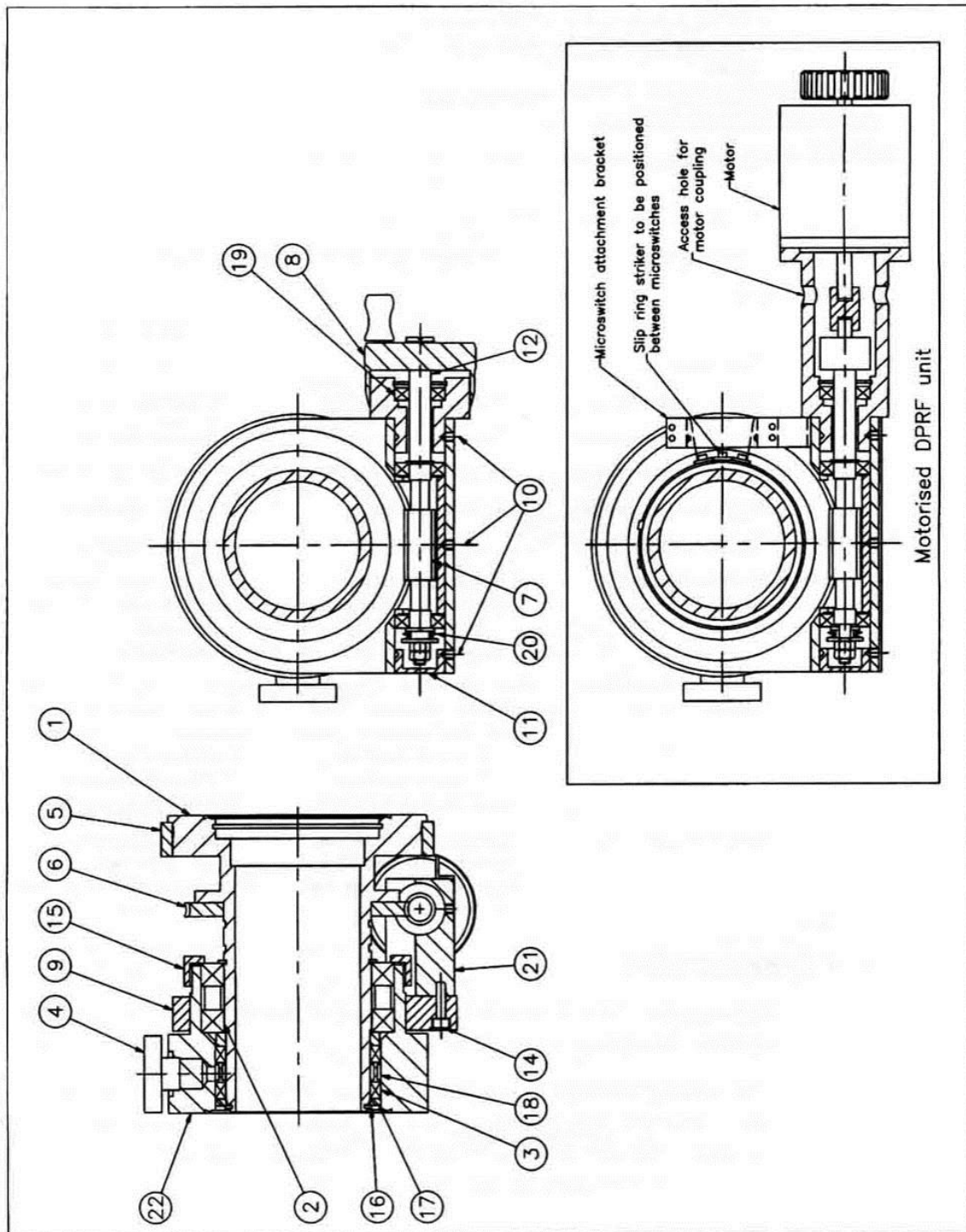


Figure 2 - Construction of the DPRF

2. INSTALLATION

2.1.1 Important Information

Warning: This equipment must be installed by qualified personnel.

Warning: Consider the safety requirements of hazardous materials used with this equipment and the consequence of any leakage, however caused. Consider possible reactions with materials of construction.

Warning: Do not use this equipment with positive internal pressure above the specified maximum.

Warning: Lubricants used in this assembly may cause irritation to sensitive skin. Wear protective clothing.

2.1.2 Mounting the Drive to the system

These drives are fitted with standard ConFlat flanges and intended for mounting to similar mating flanges. Since the lower, static flange (22) of all DPRF models are tapped, the mating flange must have clearance holes.

When bolting up, use the correct gasket, apply thread lubricant to the bolts and tighten the bolts gradually and evenly in a diagonal pattern to minimise the risk of leaks.

The static flange may be installed in any orientation and a connection made to a suitable pump through the pumping port (4).

2.1.3 Set up and adjustment

If the orientation of the pumping port with respect to the rotary handwheel or motor is unsuitable, slacken the clamp screw on the clamp plate (9) and using the drive gear to rotate to the new position.

The handwheel or motor can be repositioned on the opposite side of the bearing housing. To do this, remove screws (14) and remove the bearing housing unit (21). Loosen the three retaining grub screws across the width of the housing (10). The end cap (11) and the worm shaft/bearing/spacer unit (12) can then be removed and their position reversed. It will be necessary to mesh the gears correctly: refer to section 4.3.1.

To reset the index ring (15) to a new angular position, loosen the three setscrews which secure the ring and adjust as required.

2.1.4 Motorised units

Stepper motor driven units are supplied without connection wiring unless this is requested at time of order. Details of motor connections and performance are included in Appendix A of this handbook, together with information on motor encoders.

3. OPERATION

3.1 PUMPING REQUIREMENTS

It is recommended that the interspace is maintained at a pressure of 10.1mbar, or less. The transient pressure rise during rotation will not normally exceed one decade, and will be of short duration.

3.2 COARSE MANUAL OPTION

The feedthrough is rotated using the bar provided and fitting this into the holes in the perimeter of the unit.

Caution: Take care not to exert excessive side loads that could cause smaller vessels to topple.

3.3 PRECISION MANUAL OPTION

The feedthrough is rotated by the handwheel through a worm and wheel gear.

Warning: The exposed gear is coated with high temperature lubricant which is tenacious and may cause irritation to sensitive skin. Avoid contact with skin or clothing.

3.4 MOTORISED OPTION

Warning: Keep clear of moving parts.

Warning: The exposed gear is coated with high temperature lubricant which is tenacious and may cause irritation to sensitive skin. Avoid contact with skin or clothing.

Caution: Where the motor is fitted, the motor connector must not be disconnected unless the power to the drive has first been switched off. Allow a few seconds for the circuits to discharge.

Caution: Micro switches are intended for emergency use only. DO not use micro switches as position indicators or datum markers. Stepper motors may overrun by several stops when a micro switch is activated, particularly if traveling at speed. Always check the datum position and reset as necessary.

The above information must be followed carefully.

Operation with the stepper motor is dependent on the motor controller used, and the user should refer to the controller instructions.

The micro switches limit the rotation to less than 360°. If more movement is required, the micro switches can be removed.

3.5 BAKEOUT

The normal bakeout temperature is 230°C

Warning: Harmful gases may be evolved if this equipment is heated to temperatures above the maximum specified bakeout temperature.

Remove the motor and limit switches where necessary. The motor coupling screws can be accessed through the housing as shown in figure 2. The recommended method of heating is by the convection of free air. The temperature sensor should be mounted in free air adjacent to and at the same level as the rotary feedthrough.

4. MAINTENANCE

4.1 ROUTINE MAINTENANCE

4.1.1 Inspection schedule

The following inspections and procedures should be performed after 150 to 200 hours of accumulated bakeout or when the rotary motion appears to require more effort to turn than previously.

4.1.2 Screw fixings

Check that all screws are secure: not slack or excessively tight.

4.1.3 Re-lubrication

(All lubricants and solvents suitable for these devices are included in the VACGEN lubrication kit, Order Code ZLUBEK.) Re-lubricate the worm and worm wheel gears using 'Carbaflo' high temperature grease. Note that this grease will discolour with time, particularly if the unit is baked frequently. This is normal and does not affect the performance of the lubricant.

Warning: High temperature lubricants are tenacious and may cause minor irritation to sensitive skin. Avoid contact with skin or clothing.

It should not normally be necessary to re-lubricate other components. However if this is found necessary, due perhaps to replacement of components or contamination, proceed as follows. Remove all existing lubricants with a good solvent clean all parts thoroughly and re-lubricate as follows:

- Ball bearings, two large (2) and three small (1 9) Lubricate these items with a small quantity of Carbaflo fluid.
- Worm and worm wheel gears. Lubricate with Carbaflo grease. All fixing screws. Lightly coat the threaded portion Thread Lubricant.
- On completion all external surfaces should be clean and free from surplus lubricant.

4.2 Factory Servicing

The Servicing Scheme includes the following.-

- Complete strip down
- Cleaning
- Re-lubrication
- Re-assembly

The unit should be returned to VACGEN factory with a covering order stating the nature of the fault; a completed Declaration of Contamination and a Goods Return number (Refer to the 'Servicing and Repairs' section at the beginning of this handbook). A further cost for any other repairs found will be charged.

4.3 CORRECTIVE MAINTENANCE

4.3.1 Gear meshing

The gear meshing is set in the factory and should not require adjustment. If the gears are dismantled it is important that the position of the clamp plate (9) which supports the bearing housing/worm assembly is correct for good meshing of the gears. Proceed as follows:

- Loosely bolt the housing/worm assembly on to the clamp plate using the six M4 screws (14).
- Move the worm into mesh with the worm wheel, keeping the worm shaft axis square with the clamp plate and worm wheel. Adjust until the free motion of the worm handwheel (or motor) is in the range 0.11 to 0.2. Tighten up the screws and re-check the gear meshing.

4.3.2 Replacement of Seals

No maintenance should be required when the rotary feedthrough is operated within the limits imposed in the specification.

In the event of a vacuum leak developing at the seals, due perhaps to accidentally over baking or operating at too high a temperature, it will be necessary to clean the sealing surfaces and replace the seals. These surfaces have to be completely free from surface marks - even the slightest scratch will result in leakage. It is therefore suggested that the replacement of seals be carried out at the factory.

The procedure for dismantling is as follows:

- a. Please refer to Figure 2.
- b. Remove the six screws (14), holding the worm housing to the clamp plate and remove the worm shaft assembly.
- c. Unscrew the large locking ring (15) while holding the lower housing. The lower housing can then be withdrawn from the rotating housing, leaving the supporting bearings and spacers, also the seals and spacers in position on the rotary housing.
- d. The circlip and the adjacent spacer (16, 17) can now be removed from the end of the rotating housing.
- c. Remove with great care the two seals (3) and the ring (18). Inspect the sealing surfaces and ensure that they are completely free from surface damage and/or adherent particles of PTFE. Check that the end faces of the spacer, ring and the housings are smooth and free from any sharp edges or protrusions that could damage the seals. Check that the threads of the locking ring and the lower

housing are uniformly and adequately lubricated and that the bearings are lubricated. (See section 4.1.3).

f. Scrupulously clean all items and carefully re-assemble all parts including the new seals, ring, spacer and circlip on to the rotating housing, as shown on figure 2. Note the direction of the seal faces. (The open end should face toward the rotating flange end of the DPRF).

g. Check that all locating and tapered bores in the lower housing are completely clean. Carefully insert the rotating housing, complete with assembled bearings and seals, into the lower housing with a combined axial and rotary motion until the lower housing engages with the locking ring. Continue to insert the fixed housing while at the same time rotate the locking ring on to the screwed end of the lower housing, although the locking ring must not be used to draw the housings together. Once the lower housing is fully home, tighten the locking ring sufficiently to ensure that all end play is removed.

h. Check that the rotary feedthrough rotates smoothly - it will need more effort than previously due to the new seals. However once it has been baked it will become somewhat easier to turn.

i. Replace the worm shaft and re-mesh the gears as described in section 4.3.1

j. Connect the interspace to a helium leak detector and check that it will pump down. Do not apply helium as it will permeate the PTFE seals and will take a long time to degas the assembly fully.

k. If a leak suspected then dismantle, re-examine, re-clean, re-assemble and repeat operation. If it fails to pump down to a satisfactory pressure, then the degree of leak tightness of the seals may be suspect.

1. Once a satisfactory seal is attained, connect the interspace to vacuum pump (e.g. a 3 stage rotary pump) and evacuate, Blank off the rotary housing flange and place the lower housing flange on a helium leak detector and pump down. Check that a satisfactory pressure is attained in a reasonable time and that rotating the feedthrough does not significantly affect the pressure reading.

m. Set the leak detector to its most sensitive range and spray with helium. There should be no indication of a leak either when the feedthrough is static or being rotated.

n. Valve off the interspace pump leaving the interspace under vacuum. Spray again with helium which may produce a small but steadily increasing leak rate. This apparent leak should disappear as soon as, or shortly after, the interspace valve is re-opened, The reason for the apparent leakage is due to permeation of helium through the PTFE seals. It is not always easy to differentiate between a leak and permeation when helium is used as a search gas. Generally a leak will produce a more rapid response than permeation.

5. SPARES AND ACCESSORIES

5.3.1 Gaskets

The large selection of gasket types shown below is normally available from stock for standard CF flange sizes. Please contact VACGEN for more information.

- * Super quality copper (CU series)
- * Commercial user copper (CUC series)
- * Blank copper gaskets (CUB series)
- * Annealed high quality copper (CUA series)
- * Silver plated copper (CUSP series)
- * Viton (VIT series)
- * Aluminium (AL series)

5.3.2 Nut, Bolt and Washer sets

Metric sets are available for most flange combinations. Please contact VACGEN for more information.

5.3.3 Tool kit

ZTOOLK

5.3.4 Lubrication kit

ZLUBEK

5.3.5 Spares for DPRF units

Most component parts of these devices can be supplied as spares. Please contact VACGEN with your model type and serial number, stating requirements clearly.

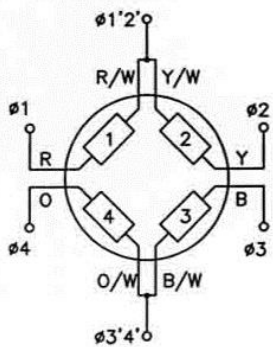
APPENDIX A. STEPPER MOTOR CONNECTIONS

AI. OVERVIEW

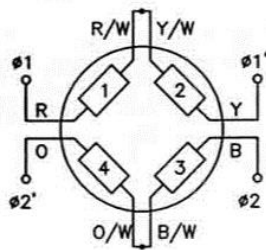
Motors and encoders used in VACGEN equipment achieve their intended performance with VACGEN controllers (SDU, SMC or SMC-E) and no responsibility can be accepted should performance be inadequate when other controllers are used. For attachment to VACGEN controllers, the motors (and encoders if applicable) can be supplied wired with suitable connectors. Otherwise, motors are supplied without connectors to allow connection to alternative drive and controller systems.

All motor variants are 4 phase, 8-lead hybrid stepper motors that can be wired up in most normal configurations as shown below. Some motor kits may include micro switches.

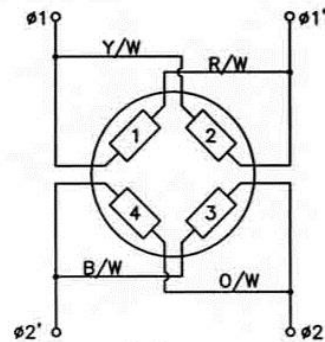
For motors fitted with incremental encoders, the VACGEN SMC-E range of controllers is required to provide passive feedback. If the motor has no encoder fitted, the controller cannot be used in the "Loop Active" mode. Note that encoders cannot be retrofitted to motors.



UNI-POLAR:
Use only where low torque at low speed is sufficient.



BI-POLAR IN SERIES
Provides high torque at low speed.



BI-POLAR IN PARALLEL
Provides moderate torque at low and high speeds.

Key to Colour Coding:

Wire colours as follows.

R - Red, W - White, Y - Yellow, B - Black, O - Orange, G - Green

Alternative motors may be used, with alternative colours. Refer to the following sections.

A2. MOTOR SPECIFICATION

Motor Type	Step angle	Step angle tolerance	Rotor Inertia	Resistance per Phase	Current per Phase	Inductance per Phase
23HS-108E	1.8 ^{o(1)}	5%	0.12 kg cm ²	0.33	3.9A ⁽²⁾	0.38mH
23HS-309E	1.8 ^{o(1)}	5%	0.23 kg cm ²	0.40	4.7A ⁽²⁾	0.84mH
23HS- 409E	1.8 ^{o(1)}	5%	0.33 kg cm ²	0.48	4.6A ⁽²⁾	1.00mH
23HS-109E	1.8 ^{o(1)}	5%	0.67 kg cm ²	0.45	4.7A ⁽²⁾	1.30mH
23HS-209E	1.8 ^{o(1)}	5%	11.30 kg cm ²	0.55	4.6A ⁽²⁾	2.50mH

Notes:

(1) Step angle quoted for full step drive. VACGEN controllers use half step drives with step angle being 0.9°.

(2) Limit the maximum current to the following values, determined by the drive used.

(Note that running at maximum current can cause motor to run hot and can give rise to resonance.)

* Maximum current/phase for unipolar drive = rated current.

* Maximum current/phase for bi-polar in series = 0.70 x rated current.

* Maximum current/phase for bi-polar in parallel = 1.4 x rated current.

A3. COLOUR CODING OF MOTOR WIRES

Key to Colour Coding:

R - Red, W - White, Y - Yellow, B - Black, O - Orange, G - Green

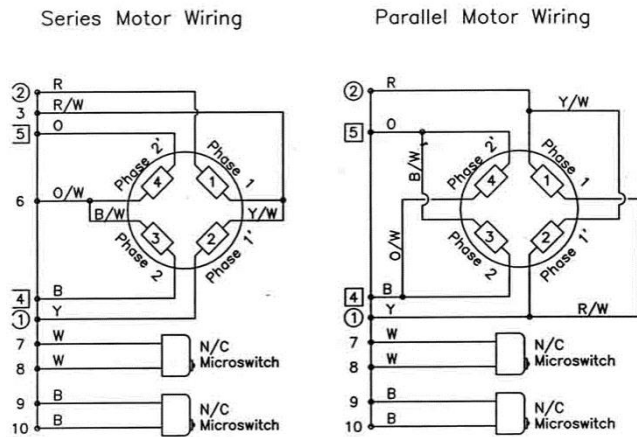
Alternative motors may be used. Wire colours as follows.

	As Drawn	Alternative 1	Alternative 2
Phase 1	R	R	R
	R/W	B	Purple
Phase 1'	Y	R/W	Y
	Y/W	W	Blue
Phase 2	B	G/W	Pink
	B/W	B/W	Grey
Phase 2'	O	G	B
	O/W	O	W

A4. MOTOR WIRING DIAGRAMS

Caution: When wiring motors, care must be taken to make all connections secure. Failure to do so may result in disconnection during use and this can permanently damage the motor drive. For the same reason, never disconnect a motor from its drive unless the power has first been switched off.

Refer to previous section for colour coding of wires.



These diagrams show connections for compatibility with Vacuum Generators motor controllers.

Socket used is ref. XSOC24 (Series and parallel connection).

Series connection is preferred for high torque at low speed. Parallel connection is used for higher speed applications.

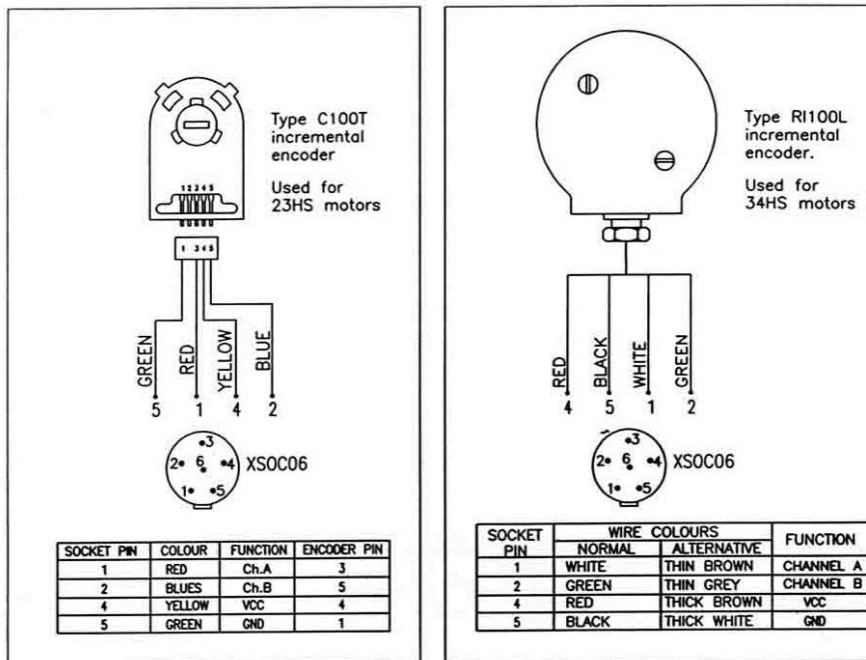
Where microswitches are not used, links must be made between pins 7 and 8, and between pins 9 and 10.

If the rotation direction is opposite to that required, reverse the connections on pins 1 and 2.

Twist together phase pairs to reduce electro-magnetic emission, i.e.: ① and ②, and ④ and ⑤.

Wiring diagrams for motors suitable for VACGEN Controllers

5. ENCODER WIRING DIAGRAMS



Wiring diagrams for incremental motor encoders

A6. MOTOR SPARES

Order Code Description

- ZSMPC3LH Cable: Motor to SMC, SME-E or SDU controller.
 DB08073 Cable: Encoder to SMC-E controller.
 XSOC24 Connector socket. Fitted to motor lead or connection to VACGEN controllers.
 XPLU11 Connector plug. Fitted to controllers for connection to XSOC24 motor socket.

VACGEN, Maunsell Rd, Castleham Industrial Estate, East Sussex, TN38 9NN, England
 Tel: +44 (0) 3424 851291 Fax: +44 (0) 1424 851489

E.C. Declaration of Incorporation
 ref DoI-147 (VGF 4.06d Iss2)

We hereby declare that the following product range:

Part Codes: **ZDPRF25- ZDPRF25H- ZDPR25M-ZDPRF55-ZDPRF55H-ZDPRF55M**

are, suitable for incorporation or assembly into a vacuum system or other machinery. These products may only be put into service if it has been verified that the system or machinery into which it is incorporated conforms to the provisions of the appropriate EU directives and with the limitations of the equipment specifications.

Applicable regulations: 89/392/EEC Version.93/68/EEC - Appropriate harmonised or national standards.
 EN292-1 EN292-2

Service and Repair Form

Declaration of Contamination of Equipment and Components	
<p>Servicing and repairs will only be carried out if the conditions for Servicing and Repair are complied with in full, according to the VACGEN Ltd. Conditions of Sale. A summary of these requirements are included on the inside front cover of the Operating Instructions. The manufacturer will refuse to accept any equipment without a signed declaration attached to the OUTSIDE of the packaging. This declaration can only be completed and signed by authorized and qualified staff.</p>	
1 Description of Equipment and Components	
Equipment Type..... Model Number..... Serial Number..... Your Reference Number.....	
2 Reasons for Return	
.....	
3 Condition of Equipment	
YES () NO () Toxic?	YES () NO () Corrosive?
YES () NO () Explosive?	YES () NO () Biological Hazard?
YES () NO () Radioactive?	YES () NO () Other Harmful Substances?
<p>Equipment and Components that have been contaminated, WILL NOT be accepted without written evidence of decontamination.</p>	
5 Contamination Materials	
<p>List all the substances, gases and by-products that may have come in contact with the equipment, giving trade name, manufacture, chemicals names or symbols. Please note that any of these listed, must be completely removed, so it is safe to handle and weld, without giving off health threatening gases. Please enter details below and/or attach data sheets</p>	
.....	
6 Legally Binding Declaration	
<p>I hereby declare that the information supplied on this form is complete and accurate. There by stating that the goods offer no risk to health or safety</p>	
Organisation.....	Name.....
Country.....	Job Title.....
Post/ZIP code.....	Telephone.....
Email.....	
Signature.....	Date.....
Return goods to: Address at top Phone: (0) 1424 851291 Fax (0) 1424 851489 (Form VGF33)	