NAVAC

Empowering you to work smarter

HelixDrive Vacuum Pump
Operating Manual

⚠

Failure to follow warnings could
result in death or serious injury.
SAVE THIS MANUAL
FOR FUTURE REFERENCE

Contents

Use Information

Thanks for choosing NAVAC vacuum pump of high reliability (Hereinafter referred to as "the pump"). Please check carefully whether the product received is the same as you ordered and the accessories, spare parts & operating manual are attached as well. Please also check if there's any damage occurred during transportation. If needed, contact the local distributor or our sales team.

In order to maintain a stable performance level of the pump, read this operating manual carefully to fully understand the safety instructions, technical data as well as operating procedures before installation, operation, repair and maintenance of the pump.

⚠ **Warning**

Failure to observe the terms could result in serious personal injury.

⚠ **Notice**

Failure to observe the terms could result in damage to the pump.

⚡ This warning label indicates risk of electrical shock. Disconnect the pump from the power supply before beginning with connections, repair and maintenance. Make sure the cover of junction box is properly installed before running.

♨ This warning label indicates high temperature hazard. Do not touch the pump when the pump is in operation.

⚠ **Notice**

Read the operating manual carefully and follow the operating procedures. We reserve the right to modify the design and technical data of the pump without notice which may have discrepancies in the manual. Add vacuum oil as requested before starting the new pump.

Attention

In order to ensure the personal safety, read the operating manual carefully before installation, operation, repair and maintenance.

⚠ **Warning**

1). Make sure the power supply used is the one marked on the product. Connect power supply by personnel holding an electrician license according to the technical standards of power equipment and wiring requirements.

2). Cut off the power supply before checking or repairing the pump, so as to avoid personal injury or death due to electric shock or sudden start of the pump.

3). Before starting the pump, make sure that the power supply of motor is the one marked on the product. The rated current of the selected cable and motor protection switch must match the rated current on the motor nameplate.

4). The product cannot be used for pumping active, corrosive, toxic, flammable or explosive gases. If necessary, please feel free to contact us.

⚠ **Warning**

5). Please do not place any object that affects ventilation effect around the motor, so as to avoid scalding or fire caused by abnormal temperature rise.

6). Make sure the exhaust port is kept unblocked prior to running the pump. It is forbidden to block or restrict air flow of the exhaust port in any way. The size of the exhaust pipe shall be such designed to ensure that the absolute pressure does not exceed 1.15 bar (relative pressure does not exceed 0.15 bar)

⚠ **Notice**

1). If the vacuum degree and current become abnormal, check whether the exhaust port is blocked. If the exhaust filter element is installed, check whether the element needs cleaning or replacing.

2). The ambient temperature of the pump is 5-40°C.

3). Check the oil level of the gear box before running the pump. Do not use the pump without oil or oil shortage in the gear box, otherwise the pump will fail.

4). Please fill oil to the pump in strict accordance with the requirements of scale line. Excessive oil may cause pump failure. The normal oil level is at 1/3 of the oil immersion lens.
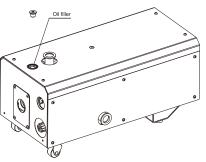
Oil filler

Fig. 1

5). When the pump runs abnormally or the total running time exceeds 6,000 hours, remove the front plate to check the status of oil:
a. If the lubricating oil turns dark or the oil level is lower than min. requirements, replace or add oil instead.
b. Tighten the filler plug and drain plug after oil change or filling; otherwise the vacuum degree will be affected and oil leakage may occur.
c. Fill the specified vacuum pump oil.

6). Connect the pump to the vacuum system by placing pump feet directly on the ground horizontally or connecting pump feet via bolts.

7). The temperature of pump surface may be very high when the pump is running and within 1 hour after it stops running. Therefore, it is forbidden to touch the surface of gear box and the pump in order to avoid scalding.

8). Please install the pump stably and firmly within an angle of 10°. Otherwise, the gear lubricating oil will flow into the pump cavity, which may cause vibration, noise and even damage of the pump.

9). Please dispose waste oils and other parts according to relevant environmental protection regulations

10). Use corresponding accessories when pumping a small amount of dust; otherwise, pump failure or sharp performance drop will occur.

11). Non-professionals are forbidden to disassemble the pump. Otherwise, pump may be damaged or fail to run normally. Where necessary, please feel free to contact us.
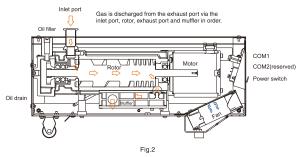
Product Overview

This product is a dry screw vacuum pump, which belongs to a kind of basic vacuum obtaining equipment. In particular, it is applicable to plasma cleaning, freeze drying, analytical instruments, laboratories, etc., and can also be used as a backing pump for Roots pumps.

The pump exhausts the gas in the pumped container by constant suction – compression – exhausting via two rotors which rotate to the opposite directions, in order to form vacuum. There is a certain gap between screws and between screw and the pump body, which do not contact with each other. No lubricating oil exists in the pump cavity; The spiral groove formed by the pump body and the mutually meshed screw separates the whole pump cavity into spaces of different sizes. Gas is compressed and transmitted in the spaces from large to small ones. The pump has the advantages of stable operation, low noise, high ultimate vacuum and low power consumption.
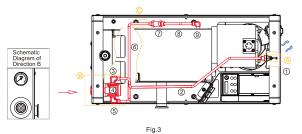
3.1 Working Principle Diagram of HD Series Vacuum Pump

Fig.2

3.2 Schematic Diagram of Purge Piping of HD Series Vacuum Pump

Fig.3

Ⓐ Purge inlet

Fig.4
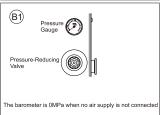
3.2.1 Preparations before purging

A1   Quick connector

Pp6 pipe plug

Remove the dust plug amounted on the quick connector

A2   Quick connector

Ø6 air pipe

Connect one end of the hose with an outer diameter of Ø 6 with the air source and the other with the quick connector. Remarks: The air source must be dry nitrogen or dry compressed air

B1   Pressure Gauge

Pressure-Reducing Valve

The barometer is 0MPa when no air supply is not connected

B1

1. The barometer should be 0.5~1MPa when the air supply is connected.
2. The pressure may also be manually adjusted by user by turning the relief valve knob at the lower part. To inquire the relationship between pressure and flow, please refer to Annex 12.3 Relationship between Purge Flow and Purge Pressure of HD20/40 Series

C

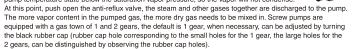Thermal mass flow meter can be installed here

3.2.2 Process of purge gas entering pump body

Purge gas passes through 1 quick connector, 2 high-pressure gas pipe B, 3 ferrule taper thread adapter L6.35-R1/4, 4 relief valve, 5 ferrule taper thread adapter L6.35-R1/4, 6 high-pressure gas pipe C, 7 relief valve, 8 high-pressure gas pipe A and 9 ferrule taper thread adapter L6.35-R1/8.

3.2.3 Gas ballast assembly

In the absence of nitrogen access conditions, the pumped medium contains condensable gases, it is necessary to open the gas ballast!

Open the gas ballast will be able to control the gas flow (usually dry air at room temperature) through the gas ballast holes into the screw pump in the pump cavity gas in the compression process with the pumping vapor mixing. When the gas mixture is compressed to exhaust pressure, the vapor partial pressure can be maintained in the pump temperature state below the saturation vapor pressure, so the vapor will not condense. At this point, push open the anti-reflux valve, the steam and other gases together are discharged to the pump. The more vapor content in the pumped gas, the more dry gas needs to be mixed in. Screw pumps are equipped with a gas town of 1 and 2 gears, the default is 1 gear, when necessary, can be adjusted by turning the black rubber cap (rubber cap hole corresponding to the small holes for the 1 gear, the large holes for the 2 gears, can be distinguished by observing the rubber cap holes).

Check before Installation

4.1 Specifications & Model .

Please check whether the specification of the vacuum pump meet your needs.

4.2 Accessories and Appearance

Upon receiving the vacuum pump, please check whether the attached parts are complete. For any doubt, please feel free to contact us. Accessories for all HD series 20/40 dry screw vacuum pumps:

Items	Qty.	Unit
DB15 wiring leaflet	1	Piece
User Manual	1	Pcs
Hex wrench (3mm-type 7)	1	Set
Hex wrench (4mm-type 7)	1	Set
Hex wrench (5mm-type 7)	1	Set
Hex wrench (8mm-type 7)	1	Set
Power cord 1	1	Set
DB15male head (short pins 7 and 8)	1	Set
DB15male head with cables and with cable number	1	Set

Table 1

4.3 Precautions for Handling

The HD8/20/40 is equipped with a pair of directional wheels and 2 legs. Lift one end of the legs when trying to move the machine.

4.4 Precautions for Hoisting

A silencer is designed at the bottom of the vacuum pump. It is forbidden to lift the vacuum pump without protection. Instead, sling is recommended for handling.

Technical Parameters & Specifications

Specification of Power Cord					
Confirm the voltage of power supply voltage					
Voltage / Models	90-120V		200-220V		380-415V
	Wire diameter		Wire diameter		Wire diameter
HD8	1.5mm²	14AWG	1.5mm²	14AWG	
HD20	1.5mm²	14AWG	1.5mm²	14AWG	
HD40	1.5mm²	14AWG	1.5mm²	14AWG	

Table 2

Technical Parameters

Model	Unit	HD8	HD20	HD40
Peak pumping speed	m³/h	8	20	32
	L/min	130	330	530
	cfm	4.7	11.7	18.8
Ultimate vacuum	Pa	1		
	Torr	7.5×10^{-3}		
	mbar	1×10^{-2}		
Gas purge	Dry nitrogen/ Dry compressed air	slm	/	0~50	
	Pressure	Mpa		0.05~0.1	
	Purge gas Inlet connection			One-touch fitting Φ6mm	
	Purge gas supply quality			ISO8673 CLASS 2	
Voltage Input	V	200-240V 1-phase		
Voltage frequency	Hz	50/60		
Motor rating	kW	1.8		
Ultimate power consumption	kW	1.1		
Maxmium power consumption	kW	3		
Current at ultimate pressure	A	6	7	8
Heavy duty peak current	A	13	13	13

Model		Unit	HD8	HD20	HD40
Control	PID function		PID functions		
	Analog input		Analogue speed control		
	Enabling mode		Parallel control and monitoring: Digital and modbus-rtu control		
	Communication function		Serial communication: MODBUS-RTU		
Inlet/exhaust DN			KF25/KF16	KF25	KF25
Water vapor treatment capacity		g/h	135	200	200
Gas ballast			/	Optional	
Lifting ring			M10 lifting ring (optional)		
Operating humidity			Below 90%		
Maintenance cycle			1 time/year		
Cooling mode			Forced-air		
Operating temperature range (storage)		°F	41~104 (23~122)		
Lubrication volume (Oil type)			80 (PEFP)		
Noise		dB(A)	≤58	≤60	
Dimensions(L*W*H)		in	20.5x11.8x12.6	23.6x11.8x12.6	
Weight		lbs	83.7	105.8	
Working conditions	Clean condition		/		
	High steam condition		Enable gas purging, pressure 0.07MPa; enable gas ballast		
	Mildly corrosive condition		Enable gas purging, pressure 0.1MPa		

Remark I: See Annex 12.3 for details.
Remark II:When the pump works in the working condition with high water vapor content, run it for a certain period of time after working conditions are met, in order to completely discharge the water vapor in the pump.

Table 3

Some signals of HD8/20/40 inverters have been connected to the connector. See the appearance below

| DB15 control terminal corresponding wiring						
Pin No.	I/O	Items	Use		Definition of corresponding wire No of inverters	Remark
1	Rs485+	MODBUS	Communication+		SG+	Default communication format 9600-8-N-2
2	Rs485-	MODBUS	Communication-		SG-	
3						
4	Output	24V			24V	
5	Output	Operation check	Closed: Alarm	Disconnect: Normal	RA	Relay output terminal
6	Output	Output common			RC	
7	Input	Run command	Closed: Running	Disconnect: Shutdown	MI1	
8	Input	Output common terminal 1			DCM	
9	RS485-GND	Communication signal ground			SGND	
10	Input	Speed control	Analog quantity+		AVI	Input analog quantity (0-10V)
11	Input	Speed control	Analog quantity-		ACM	
12						
13	Input	Analog control startup command			MI2	Analog control terminal
14						
15	Input	Alarm reset	Closed: Reset		MI6	
Others	Temperature	Motor temperature			MI7	
		Common			DCM	Common terminal of temperature sensor

Table 4
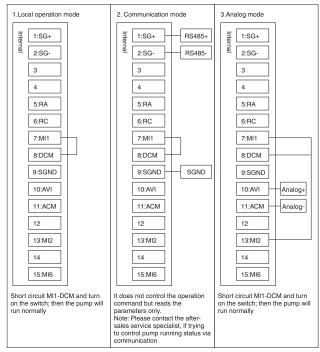
Control mode
1. Local mode: Short connect MI1-DCM for normal operation.
2. Communication mode: RS+ is connected with Rs485+, RS- is connected with RS485- and SGND is connected with signal ground.
3. Analog quantity mode: Connect MI1-MI2-DCM, connect AVI with analog quantity + and ACM with analog quantity-. Note: Do not run the motor below 3,000 rpm for a long time, for it will seriously damage electrode. For HD20/40, 6.25-10V corresponds to 3,000-4,800rpm.

1.Local operation mode	2. Communication mode	3.Analog mode
Internal	Internal	Internal
1:SG+	1:SG+ → RS485+	1:SG+
2:SG-	2:SG- → RS485-	2:SG-
3	3	3
4	4	4
5:RA	5:RA	5:RA
6:RC	6:RC	6:RC
7:MI1	7:MI1	7:MI1
8:DCM	8:DCM	8:DCM
9:SGND	9:SGND → SGND	9:SGND
10:AVI	10:AVI	10:AVI → Analog+
11:ACM	11:ACM	11:ACM → Analog-
12	12	12
13:MI2	13:MI2	13:MI2
14	14	14
15:MI6	15:MI6	15:MI6

Short circuit MI1-DCM and turn on the switch; then the pump will run normally

It does not control the operation command but reads the parameters only.
Note: Please contact the after-sales service specialist, if trying to control pump running status via communication

Short circuit MI1-DCM and turn on the switch; then the pump will run normally

Installation Process

6.1 Installation

1. Confirm the voltage of power supply				
Voltage	90-120V		200-220V	380-415V
Models	Wire diameter		Wire diameter	Wire diameter
HD8	1.5mm^2	14AWG	1.5mm^2	14AWG	
HD20	1.5mm^2	14AWG	1.5mm^2	14AWG	
HD40	1.5mm^2	14AWG	1.5mm^2	14AWG	

| 2. HD20/40 is placed horizontally. A 30cm space is reserved in front and back respectively for heat dissipation. |
|---|
| 3. Connect the vacuum system to the vacuum pump. |
| 4. Connect the exhaust system. |
| 5. For HD20/40, it is necessary to connect a dry nitrogen source or a dry compressed air source at the corresponding connection and check that the pressure conforms to the requirements |
| 6. For start based on communication, connect the control signal. See Table 6 for details. |

HD8/20/40 starts
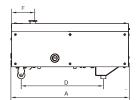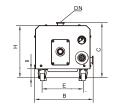
7. Turn on the dry nitrogen source or dry compressed air source and adjust the flow to a proper value within the green range indicated by the pressure gauge.
8. Turn on the power switch.
9. In local mode, plug in the DB15 male connector in the accessory at com1, turn on the switch, and then the vacuum pump will start directly. The upper computer is required to provide operating instructions in communication control mode.
10. Check whether the running current is normal
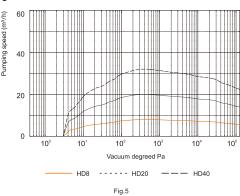
6.2 Installation specifications

Overall dimensions of HD series dry screw vacuum pump (unit: inch)									
Model	A	B	C	D	E	F	H	I	DN
HD8	20.5	11.8	12.6	13.5	8.2	4.2	11	2.3	KF25
HD20	23.6	11.8	12.6	16.3	8.2	4.2	11	2.3	KF25
HD40	23.6	11.8	12.6	16.3	8.2	4.2	11	2.3	KF25

6.3 Pumping Rate Curve

Fig.5

Handling and Storage

⚠️ **Warning**

Do not move the pump until it stops running and power supply has been cut off.

⚠️ **Notice**

1). Any carelessness during handling may cause damage to the pump, so please handle it with care. Move the fully filled pump vertically and horizontally to avoid any oil spillage.

2). Please dispose packaging materials as per applicable environmental protection regulations.

Check & Maintenance

⚠️ **Warning**

1). Please check and maintain the product by personnel undergoing corresponding training in strict accordance with safety regulations.

2). In case of any hazardous substances, determine their nature first and obey the appropriate safety regulations. If the potential hazard still remains, decontaminate the pump before any maintenance work.

8.1 Daily maintenance list

Maintenance Content	Maintenance Cycle	Remark
Oil change interval	After running for 6,000h or oil turns black	8.2.1
Check the pump soun	When running	8.2.2
Change the oil for the first time	After running for 3,000h	8.2.3
Clean the silencer	After running for 6,000h or sound becomes abnormal	8.2.4
Clean the fan cover	Before running	8.2.5
Check wiring	Before running	

Table 5

8.2 Routine maintenance methods

8.2.1 Check oil level

① When the pump is working, the oil level should always be kept between the lowest and the highest oil level line. Add oil in time, if the liquid level is lower than the lowest line. If the liquid level is higher than the maximum oil level line, unscrew the oil drain plug to drain excess pump oil; otherwise, oil may enter the pump chamber.
② Observe the color of pump oil. Normal pump oil is clean and transparent. Change the oil, if it turns dark or becomes turbid.

8.2.2 Check pump sound

① The sound when the pump is running should be continuous and stable and free of any abnormal sound. In case of any abnormal sound, analyze and treat the fault as per Table 7.

8.2.3 Change oil

① Change oil after the pump stops and becomes cool, in order to avoid scalding.
② To change oil, open the oil drain plug and drain the used oil into a suitable container. When oil stops flowing, screw on the oil drain plug. The oil drain plug and the oil filler plug must be screwed tightly to ensure gearbox airtightness and prevent the entry of any external air, thus causing a lower vacuum degree.
③ Drain the replaced oil into a designated container and dispose it in accordance with applicable environmental protection regulations.

8.2.4 Clean the silencer

① In case of any abnormal sound when the pump is running or after it stops, check exhaust silencer;
② Please stop the pump before checking the exhaust filter. Wait for a period of time until the pump cools down.
③ Open the exhaust port housing at the bottom of the pump, remove the exhaust muffler cover plate, and clean impurities inside the cavity.

8.2.5 Clean fan housing

① Please check whether there is a large amount of dust on the fan housing of the lower fan inlet before running the pump. Ensure full ventilation of fan housing surface in order to avoid affecting heat dissipation and pump performance.
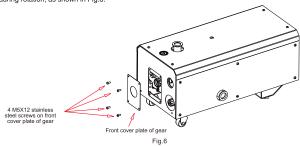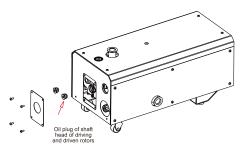
Troubleshooting

9.1 Check Methods for Rotor Rotation

Troubleshooting for rotor sticking
1. Remove 4 M5x12 stainless steel screws from the front cover plate of the gear, as shown in Fi.6.
2. Remove the front cover plate of gear.
3. Screw off the end face of the front cover of the gear with an 8mm 7-shaped wrench, and align the oil plug of shaft head of the driving and driven rotors, as shown in Fig.7.
4. Use a 5mm 7-shaped wrench to turn the driving rotor counterclockwise to experience the resistance during rotation, as shown in Fig.8.

4 M5X12 stainless steel screws on front cover plate of gear

Front cover plate of gear

Fig.6

Oil plug of shaft head of driving and driven rotors

Fig.7
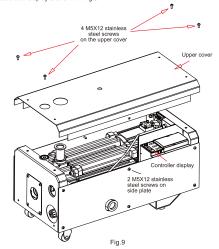
Fig.8

9.2 Error Code Query of Controller

Troubleshooting for rotor sticking
1. Remove 4 M5x12 stainless steel screws from the upper cover plate, as shown in Fig.9.
2. Remove two M5x12 stainless steel screws in the middle of the left and right-side plates.
3. Remove the upper cover plate.
4. The location of controller display is shown in Fig.9.

4 M5X12 stainless steel screws on the upper cover

Upper cover

Controller display

2 M5X12 stainless steel screws on side plate

Fig.9

9.3 Examples for Faults

Example: User shall carry out inspection, if pump could not be started normally.

Possible cause 1:
Load changes suddenly in working environment and exceeds the bearing range of controller; the controller gives out protective warning (including but not limited to ocX, OvX, and olX).

Solutions for cause 1:
Power off the pump completely for 3 min (unplug and disconnect the switch), reinsert power plug, turn on the switch and access the run command. Then the pump will run normally.

Possible cause 2:
If unplanned shutdown occurs repeatedly in a working environment with high concentration of dust, corrosion and vapor, solid-liquid mixture may attach to the pump gap, which results in the increase of load. Record the controller error code as per the requirements in Fig.9.

Solutions for cause 2:
1. Full-cycle start purging (pump shutdown purging and operation purging);
2. Use gas ballast in environment with high water vapor.

Possible cause 3:
It's completely stuck.

Solutions for cause 3:
Check whether the rotor is stuck according to the steps shown in Fig.6, Fig.7 and Fig.8.

Example: User shall carry out inspection, if abnormal noise occurs while pump is running.
1. Check whether the current of controller is normal according to the requirements in Fig.9;
2. Listen carefully to confirm if the motor produces any bnormal noise.

Faults	Reasons	Troubleshooting
The pump cannot be started	1. The power supply is not started	1.1 Check power line connection
		1.2 Running command is not entered
	2. The input power supply voltage is abnormal	2. Make sure the voltage is within +10% of the rated voltage
	3. The motor becomes faulty	3. Change motor
	4. Enable protection of overload protector	4. Check ambient temperature or temperature of pumped gas
	5. Ambient temperature is too low	5. Raise ambient temperature by 5°C or above
	6. The pump is stuck by foreign matter inside it	6. Repair the pump
	7. The pump has been idled for too long a time	7. Repair the pump
	8. The air outlet is blocked	8. Clean the exhaust silencer or unblock exhaust pipe
	9. The internal parts of the pump are damaged	9. Repair the pump
The pump can't reach the extreme pressure or pumping speed is too slow	1. Vacuum system configuration is unreasonable	1. Choose another proper pump
	2. Leakage of vacuum system	2. Check the system
	3. Improper measurement or regulation	3. Measure the vacuum degree directly at the pump inlet using correct measurement method and pipe
	4. Air inlet is blocked	4. Clean the air inlet duct
	5. Air inlet pipe is too small or too long	5. Use short and thick air inlet pipe
	6. Air outlet is blocked	6. Unblock air outlet
	7. Exhaust silencer is blocked	7. Clean the exhaust silencer
	8. Motor speed is too low	8. Check supply voltage
	9. Exhaust pipe is blocked	9. Clean the exhaust silencer or unblock exhaust pipe
	10. The internal parts of the pump body are damaged	10. Repair the pump

Faults	Reasons	Troubleshooting
The vacuum degree of the system drops too quickly after the pump stops running	1. Leakage of vacuum system	1. Check the system
	2. No anti-reflux valve	2. Add vacuum valve or anti-reflux valve
Abnormal noise during operation	1. The input power supply voltage is abnormal	1.1 Check the connection of power supply, switch and line
		1.2 Ensure the voltage is within ±10% of the rated voltage
	2. Foreign matters inside the pump	2. Repair the pump
	3. Too low oil level	3. Add oil of specified amount
	4. The internal parts of the pump are damaged	4. Disassemble, repair and replace parts
Pump temperature rise too high	1. Poor installation ventilation	1. Improve ventilation environment
	2. The fan is damaged	2. Replace the fan
	3. Temperature of the pumped gas is too high	3. Add a cold trap at air inlet
	4. Exhaust pipe is blocked	4. Clean the exhaust pipe
	5. Poor lubrication	
	5.1 Improper or deteriorated pump oil	5.1 Add qualified oil
	5.2 Insufficient oil in gearbox	5.2 Add oil to specified level
	5.3 Ambient environment is too high	5.3 Reduce ambient temperature
Oil exists in the inlet pipeline of the pump	1. Oil is from vacuum system	1. Check the vacuum system
	2. Oil level is too high in gearbox	2. Drain off excess pump oil

Table 6

Warranty

We provide 1-year warranty services for the HD series vacuum pump since the date of purchase. During the warranty term, we will provide free maintenance service for any failure occurring on the premise of using the product as per the Manual. We will provide paid services in any of the following conditions:
(1) Faults caused by natural disasters or human factors.
(2) Faults caused by special environment.
(3) Faults caused by abnormal operation or improper use according to our technicians' judgment.
(4) If the pump is sent back to us for repairing, user needs to state whether the pump is contaminated or contain any substances that do harm to human. If the pump is contaminated, user needs to specify the specific contaminants. We will return the pump to the shipper based on the address, if not receiving any contamination statement.

Accessories

Please use the accessories we supply in order to ensure reliability of the pump. When ordering any accessory, customer needs to provide the pump model and the code of wearing parts. Optional parts are shown in the diagram. For any other requirements for accessories, please feel free to contact us.
Accessories we supply:
1. Other types of inlet/exhaust interfaces
2. Dust filter

Way to dispose the product correctly

This mark indicates it is forbidden to dispose the product together with other household wastes. To prevent uncontrolled waste disposal from causing any possible hazards to the environment or human health, please do use a recycling and collection system or contact the retailer where the product was purchased for recycling the product safely and without contaminating the environment.

Annex

12.1 HD8/20/40 MODBUS-RTU Communication Protocol

12.1.1 Communication connection settings

Communication Settings of HD8/20/40			
MODBUS-RTU: 9600-8-N-2, communication address 1			
Parameter Code	Name	Detailed Settings of	Value
09-00	Communication address	1~254	1
09-01	Baud rate	4.8-115.2kbps	9.6
09-03	Communication timeout	0.0-100.0秒	0
09-04	COM1 communication format	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	13
09-09	Communication response and delay time	0.0~200.0ms	2

Table 7

Specification of HD8/20/40 Inverter	
Items	Specification
Max. frequency	0~599Hz
Carrier frequency	2KHz~15KHz
Input frequency resolution	Digital setting: 0.01Hz
Control mode	SVC space vector control (open-loop vector control)
Enabling torque	3Hz/150%
Steady speed accuracy	±0.5%
Overload tolerance	At 150% of rated output current, it can withstand 1 minute every 5 minutes;At 200% of rated output current, it can withstand 3 seconds every 30 seconds.
Frequency setting signal	0-10V

Table 8

12.1.2 Communication content settings

Address	Name	Nature	Length	Detailed Settings of Parameters		Remark
Communication Contents of HD8/20/40
Name
2000H	Running command	Read-write		bit1-0	00B: No functions	1: After receiving a command, the operation state specified by the command will be maintained until a new command is received. 2:[Action Command Source] must be set to Communication (parameter 00-21 =2) for this field to work.
					01B: Stop	
					10B: Start	
					11B: JOG starts	
				bit5-4	00B: No functions	
					01B: Forward direction command	
					10B: Reverse direction command	
					11B: Change current direction command	
				bit7-6	00B: First acceleration and deceleration	1: To enable the function of this field, bit12 of 2,000h must be set to 1. 2: The current running segment speed can be known by reading 2, 107h.
					01B: Second acceleration and deceleration	
					10B: Third acceleration and deceleration	
					11B: Fourth acceleration and deceleration	
				bit11-8	0000B: Main speed	
					0001B: First speed	
					0010B: Second speed	
					0011B: Third speed	
					0100B: Fourth speed	
					0101B: Fifth speed	
					0110B: Sixth speed	
					0111B: Seventh	

Address	Name	Nature	Length	Detailed Settings of Parameters		Remark
Communication Contents of HD8/20/40
Name
2000H	Running command	Read-write		bit11-8	1000B: Eighth speed	1: To enable the function of this field, bit12 of 2,000h must be set to 1. 2: The current running segment speed can be known by reading 2, 107h.
					1001B: Ninth speed	
					1010B: Tenth speed	
					1011B: Eleventh speed	
					1100B: Twelfth speed	
					1101B: Thirteenth speed	
					1110B: Fourteenth speed	
					1111B: Fifteenth speed	
				bit12	1. Enable bit06-11 functions	
2001H	Frequency command	Read-write	U16		Frequency command (XXX.XX Hz) The standard machine is 2 decimal places; the high-speed machine is 1 decimal place	
2002H	Fault/ Control command source	Read-write	U16	bit0	1: External error (EF) ON	It is used for triggering an external error to the inverter to stop the running state, and the stopping mode can be set by inverter parameters.
				bit1	1: External error (EF) ON	It is used for clearing error conditions

Communication Contents of HD8/20/40					
Control Command					
Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
2002H	Fault/ Control command source	Read-write	U16	bit2	1: External interrupt (B.B) ON	Triggers an external interrupt to the drive station to suspend operation. When this bit= 0Bb is released, the inverter will immediately resume the original operation state.
				bit5	1: Trigger fire mode	It can prevent the inverter from shutting down due to its own protection, and maintain the important fan operation without following any control signals or alarms
State Information 1					
Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
2101H	Operating state of inverter	Read	U16	bit1-0	Running and shutdown state	
					00B: Inverter stops (RUN Indicator OFF/STOP indicator ON)	
					01B: Inverter is stopping (RUN Indicator flashes/STOP indicator ON)	
					10B: Inverter is standby (RUN Indicator ON/STOP indicator flashes)	
					11B: Inverter is running (RUN Indicator ON/STOP indicator OFF)	
				bit2	1: Inching command	

Communication Contents of HD8/20/40					
State Information 1					
Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
2101H	Operating state of inverter	Read	U16		Direction of operation	
				bit4-3	00B: Inverter is in forward rotation state (REV indicator OFF/FWD indicator ON)	
					01B: Inverter is currently in reverse rotation, and the target is forward rotation (REV indicator flashes/FWD indicator is ON)	
					10B: Inverter is currently in forward rotation, target is reverse rotation (REV indicator ON/FWD indicator flashes)	
					11B: Inverter is in reverse (REV indicator ON/FWD indicator OFF)	
				bit8	1: The main frequency source is from the communication interface	
				bit9	The main frequency source is input from the analog 1 external terminal signal	
				bit10	1: Running command is sent by communication interface	
				bit11	1: Running command is sent by communication interface	
2102H	Frequency command	Read	U16	Frequency command (XXX.XX Hz) 1: Speed mode⊠ speed command 2: Torque mode⊠ speed limit	
2103H	Output frequency	Read	U16	Output frequency on inverter (XXX.XX Hz)	
2104H	Output current	Read	U16	Inverter output current (XX.XXA) when the current is greater than 655.35, automatically become a decimal (XXX.X A). The number of decimal places can be found by referring to the High byte of 211F.	
2105H	DC bus voltage	Read	U16	DC bus voltage of inverter (XXX.X V)	
2106H	Output voltage	Read	U16	Output voltage of inverter (XXX.X V)	
2107H	Multi-speed state	Read	U16	The current segment speed of the multi-segment speed command of the inverter (0 is the main speed)	
2109H	Count value	Read	U16	Current count of MI terminal count function	

Communication Contents of HD8/20/40					
State Information 1					
Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
210AH	Output power factor angle	Read	U16	Inverter output power factor angle (XXX.X) (0.0 ° ~180.0 °)	
210BH	Output torque	Read	U16	Output torque (XXX.X %)	
210CH	Actual motor speed	Read	U16	Actual motor speed (XXX.X rpm)	
210FH	Output power	Read	U16	Output power of inverter (X.XXX kW)	
2116H	Multi-function display	Read	U16	This address is used to display the user-defined LowWord display value for the selected item (parameters 00-04), which is low 16 bits data	
2116H	Multi-function display	Read	U16	• When parameter 00-26 is set to 0: this value is equal to the setting of parameter 01-00 • When parameter 00-26 is set to non-zero, if the control source is digital Operator: This value = Parameter 00-24x Parameter 00-26 /Parameter 01-00 • When parameter 00-26 is set to non-zero, if the control source is 485: This value = Parameter 09-10x Parameter 00-26 /Parameter 01-00	
211FH	Output current bits	Read	U16	High byte: Current bits (display)	

Communication Contents of HD8/20/40					
State Information 2					
Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
2200H	Output current	Read	U16	Display the output current of the inverter. When the current is greater than 655.35, it will automatically change to decimal-digit representation (XXX.X A). The number of decimal places can be found by referring to the High byte of 211F.	
2201H	Count value	Read	U16	Count value	
2202H	Output frequency	Read	U16	Actual motor operating frequency	
2203H	DC bus voltage	Read	U16	DC bus voltage (XXX.X V)	
2204H	Output voltage value	Read	U16	U, V and W output voltage value of inverter (XXX.X V)	
2205H	Power factor angle	Read	U16	Power factor angle of inverter output (XXX.X deg)	
2206H	Output power	Read	U16	Display the power of U, V and W output (XXX.X kW)	
2207H	Actual speed of motor	Read	U16	Motor speed estimated by the inverter or fed back by the encoder, in rpm (XXXXX rpm)	
2208H	Output torque	Read	U16	Output positive and negative torque % (+0.0: positive torque;-0.0 : negative torque) (XXX.X %)	
220AH	PID feedback value	Read	U16	After the PID function is started, the PID feedback value is displayed in % (XXX.XX %)	
220BH	AVI analog input	Read	U16	Display the signal value of AVI analog input terminal, 0~10 V corresponds to 0.00~ 100.00% (refer to parameter 00-04 description)	
220CH	ACI analog input	Read	U16	Display the signal value of ACI analog input terminal, 4~20 mA/ 0~ 10 V corresponds to 0.00 ~ 100.00% (as described in 2)	
220EH	IGBT temperature	Read	U16	Power module IGBT temperature (XXX.X °C)	
2210H	Digital input state	Read	U16	Digital input ON / OFF state, reference parameter 02-12 (reference parameter 00-04 Note 3)	
2211H	Digital output state	Read	U16	Digital input ON / OFF state, reference parameter 02-12 (reference parameter 00-04 Note 4)	

Address	Name	Nature	Length	Detailed Settings of Parameters	Remark
Communication Contents of HD8/20/40					
State Information 2					
2212H	Multispeed	Read	U16	The segment speed at which the multi-segment speed instruction is currently executing	
2213H	CPU pin state corresponding to digital input	Read	U16	CPU pin state corresponding to digital input	
2214H	CPU pin state corresponding to digital output	Read	U16	CPU pin state corresponding to digital output (refer to parameters 00-04 Note 4)	
2216H	Pulse input frequency	Read	U16	Pulse input frequency (XXX.XX Hz)	
2219H	Overload count	Read	U16	Overload count (XXX.XX %)	
221AH	GFF short circuit current to ground	Read	U16	GFF value (XXX.XX %)	
221BH	Bus voltage DC bus chain wave	Read	U16	Bus voltage DC bus chain wave (XXX.X V)	
221CH	PLC register	Read	U16	Value of PLC register D1043	
221DH	Pole section	Read	U16	Pole section of synchronous machine	
221EH	User defined output display	Read	U16	Physical quantity output of users	
221FH	Parameters 00-05 user gain	Read	U16	Output value of parameters 00-05 (XXX.XX Hz)	
2223H	Control mode	Read	U16	Inverter control state 0: Speed mode	
2224H	Carrier frequency	Read	U16	Inverter operating carrier frequency (XX kHz)	

Address	Name	Nature	Length	Detailed Settings of Parameters		Remark
Communication Contents of HD8/20/40						
State Information 2						
2226H	Inverter state	Read	U16	bit1-0	00b: No directions	
					01b: Forward rotation	
					10b: Reverse rotation	
				bit3-2	01b: Inverter is ready	
					10b: Error	
				bit4	0b: Inverter has no output	
					1b: Inverter has output	
				bit5	0b: No warning	
					1b: YES warning	
2227H	Positive and negative torque	Read	U16	Output positive and negative torque estimated by inverter (XXX Nt-m)		
2229H	kWh	Read	U16	kWh display (XXXX.X)		
222EH	PID reference target	Read	U16	PID reference target (XXX.XX %)		
222FH	PID compensation	Read	U16	PID offset (XXX.XX %)		
2230H	PID output frequency	Read	U16	PID output frequency (XXX.XX Hz)		
2232H	Auxiliary frequency	Read	U16	Display main frequency		
2233H	Main frequency	Read	U16	Display main frequency		
2234H	Frequency after addition and subtraction of main and auxiliary frequency phases	Read	U16	Display main frequency		

Table 9

12.2 Relationship Between Purge Gas Flow and Purge Pressure of HD20/40 Series

Relationship Between Purge Gas Flow and Purge Pressure of HD20/40 Series	
Flow meter	Thermal mass flowmeter TMF-D1002-VO-G1 (Liming from Taiwan)
Specifications of flow meter	0-100L
Measuring accuracy	±2.0% of F.S.@25°C
Installation position	Gas enters the side of exhaust end of the pump body through the relief valve (0-0.35 MPa), barometer (0-0.2 MPa), flowmeter, and one-way valve (starting pressure 0.03 MPa) in order.
Tubing specification	Total length: 1.5m, pipe outer diameter: ⏥6.35, pipe inner diameter: Φ4.57
Purge mode	Pump shutdown purging and operation purging
Preparations before use	1. Heat up for 30 min; 2. Ventilate and clean the inside of the flowmeter before use.
Purge mode	HD40

Relative pressure	Pump shutdown purging (max. range)	Operation purging	Limiting vacuum (The vacuum degree here is for reference only. The measured value of object shall prevail)	Remark
0MPa	/	/	0.56 Pa	According to the actual experimental situation: 1. The pressure measured when the pump is stopped for purging is relatively accurate. 2. While running, flowmeter is still affected by the bidirectional pulse air flow, although a flow meter is blocked by the one-way valve. Therefore, it is required to reserve a sufficient length of pipeline between the pump and the flow meter as far as possible. 3. In this Manual, the recommended purge pressure is 0.01MPa-0.09MPa, and the gas flow rate is 10-60L/min.
0.01MPa	/	/	0.92 Pa	
0.02MPa	/	6-10 L/min	1.09 Pa	
0.03MPa	3-4 L/min	12-16 L/min	1.63 Pa	
0.04MPa	8-12 L/min	16-20 L/min	2.02 Pa	
0.05MPa	14-18 L/min	22-26 L/min	2.25 Pa	
0.06MPa	26-30 L/min	30-34 L/min	2.61 Pa	
0.07MPa	38 L/min	34-38 L/min	2.88 Pa	
0.08MPa	42-46 L/min	44-48 L/min	3.19 Pa	
0.09MPa	52-56 L/min	50-54 L/min	3.62 Pa	
0.1MPa	60-64 L/min	56-60 L/min	3.95 Pa	

Relationship Between Purge Gas Flow and Purge Pressure of HD20/40 Series				
Relative pressure	Pump shutdown purging (max. range)	Operation purging	Limiting vacuum (The vacuum degree here is for reference only. The measured value of object shall prevail)	Remark
0.11MPa	70-74L/min	60-64 L/min	4.33 Pa	According to the actual experimental situation: 1. The pressure measured when the pump is stopped for purging is relatively accurate. 2. While running, flowmeter is still affected by the bidirectional pulse air flow, although a flow meter is blocked by the one-way valve. Therefore, it is required to reserve a sufficient length of pipeline between the pump and the flow meter as far as possible. 3. In this Manual, the recommended purge pressure is 0.01MPa-0.09MPa, and the gas flow rate is 10-60L/min.
0.12MPa	72-76 L/min	64-68 L/min	4.7 Pa	
0.13MPa	82-86 L/min	66-70 L/min	5.1 Pa	
0.14MPa	88-82 L/min	70-74 L/min	5.63 Pa	
0.15MPa	92-96 L/min	72-76 L/min	6.11 Pa	
0.16MPa	96-100 L/min	76-80 L/min	6.72 Pa	
0.17MPa	108-112L/min	80-84 L/min	7.13 Pa	
0.18MPa	/	/	/	
0.19MPa	/	/	/	
0.2MPa	/	/	/	
0.35MPa	/	/	/	
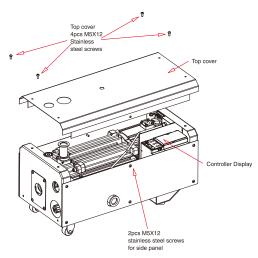
Table 10

12.3 HD8/20/40 Full communication control operation method

12.3.1 Remove the top cover to expose the controller

Top cover
4pcs M5X12
Stainless
steel screws

Top cover

Controller Display

2pcs M5X12
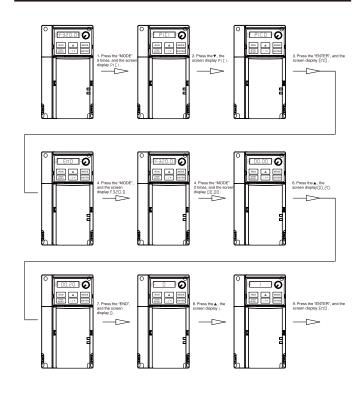stainless steel screws
for side panel

12.3.2 For inverter operation, you need to adjust the following parameters in the inverter:
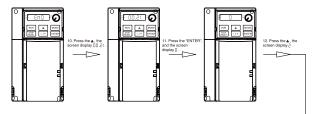
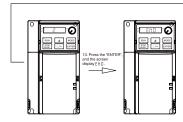| Parameters	Instruction	Original	Modified values
PLC	PLC Commands	PLC1	PLC0: PLC function off
00-20	Frequency Command Source Setting	0	1: Communication RS-485 input
00-21	Run Command Source Setting	0	2: Communication RS-485 input

1. Press the "MODE" 5 times, and the screen display PLC1.

2. Press the ▼, the screen display PLC1.

3. Press the "ENTER", and the screen display End.

4. Press the "MODE", and the screen display F320.0.

4. Press the "MODE" 2 times, and the screen display 00.00.

6. Press the ▲, the screen display 00.20.

7. Press the "END", and the screen display 0.

8. Press the ▲, the screen display 1.

9. Press the "ENTER", and the screen display End.

10. Press the ▲, the screen display 00.21

11. Press the "ENTER", and the screen display 0

12. Press the ▲, the screen display 2

13. Press the "ENTER", and the screen display En0

12.3.3 Communication parameters

1. Default communication protocol 9600-8-n-2		
2. PLC internal address		
2000H	Operation Command	16#1: STOP; 16#2: RUNNING
2001H	Frequency command	32000: 320Hz
Note: SIMATIC S7-200 SMART Add: 2000H=48193		