

FLUIDIC HIGH TECHNOLOGY

User Manual

Model: ERV001 and ERV002





Instruction

This manual provides set-up and operational instructions, technical specifications, maintenance and troubleshooting suggestions, ordering information for the series of Electrical Rotary Valve (ERV): ERV001 and ERV002.



Symbols

There are two symbols throughout this manual to bring special attention to potentially hazardous conditions or suggestions for optimizing the performance of the ERV series.



Caution: This symbol warns that a potentially hazardous condition may result for either the ERV or the operator.

Note: This symbol represents a suggestion for optimizing the performance of the ERV through set-up



Warning: This symbol warns that improper operation might result body injured or death.



Warranty

Fluidic High Technology warrants this equipment to be free of defects in material and workmanship for 12 months from the date of receipt. This warranty is extended to the buyer of record on the original purchase order to Fluidic High Technology. Fluidic High Technology or an authorized Fluidic High Technology representative agrees to repair or replace, at its option and free of charge to the buyer at a normal place of business or at a Fluidic High Technology repair facility, any part or parts that under proper and normal use prove to be defective during the warranty period. Abuse, unauthorized replacement of parts, modifications, or adjustments made by other than Company or its assigned representatives voids this warranty. Fluidic High Technology endeavors to provide prompt and satisfactory service.

This warranty gives you specific rights. No other warranties, expressed or implied, including implications of warranties of merchantability and fitness for a particular product, are made. Fluidic High Technology's liability on the sale of all products shall be limited to repair, replacement, or refund of price of any defective product.

Fluidic High Technology reserves the right to refuse to accept the return of any equipment that has been used with radioactive or microbiological substances, or any other material that may be deemed hazardous to employees of Fluidic High Technology.

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1. Introduction

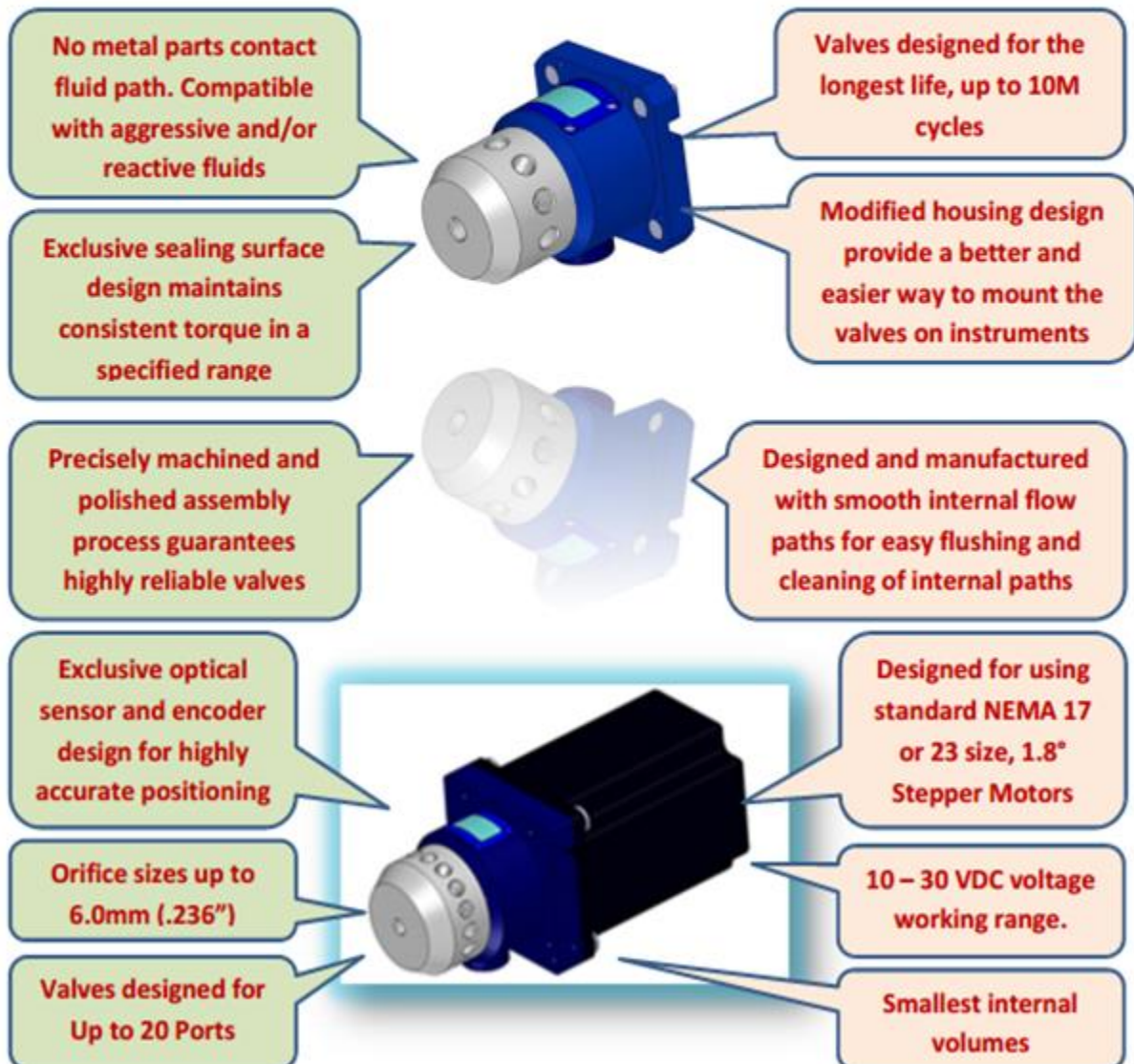
1.1 ERV Features

FHT ERV series provides standard selection and switch rotary valves. Here are the features:



Made with PTFE and PCTFE, the FHT Stepper Motor Rotary Valves are designed for Medical, chemical, biological, environmental industries and the laboratory instruments and devices. These valves will replace the existing fluidic control systems such as manifolds installed with multi isolation valves and are being widely used for various new fluidic control projects and innovations.

Stepper Motor Rotary Valve Characteristics



1.2 Specification



FHT Electric Rotary Valve (ERV) Specifications

Rotary Valve:

Specification	Small Valve	Large Valve
Wetted Materials	Polytetrafluoroethylene (PTFE) – Body or Stator Polychlorotrifluoroethylene (PCTFE or PTFCE) – Rotor	
Connection Ports:	¾-28 UNF, Flat Bottom sealing surface	
Number of Ports:	3 – 10 Ports + Common Port	3 – 20 Ports + Common Port
Orifice Size	0.8mm (.032") – 4.0mm (.157")	0.8mm (.032") – 6.0mm (.236")
Operating Pressure	200 psi (13.8 Bar, 1.38 Mpa)	
Max Working Pressure	500 psi (34.5 Bar, 3.45 Mpa)	
Cycle life (port to port moves)	Up to 6,000,000 cycles	Up to 10,000,000 cycles
Recommended Max Duty Cycle	12.50%	
Max Peak torque	35 oz-in	90 oz-in

Note: See FHT Product Catalog for more details.

Stepper Motor:

Specification	NEMA 17 size (Small Valve)	NEMA 23 size (Large Valve)	
Step Size	1.8°	1.8°	
Operating Voltage	24 VDC	24 VDC	
Rated Current (Phase)	1.05 Amps/Phase	2.1Amps/Phase	
Holding Torque	83 oz-in (0.59 N-m)	294 oz-in (2.08 N-m)	
Resistance (Phase)	5.2 Ohms	2.4 Ohms	
Inductance (Phase)	9.4 mH	7.0 mH	
Weight (Lbs)	0.80	2.35	
Wire Color	Red	Phase A1, 26 AWG	Phase A1, 22 AWG
	Blue	Phase A2, 26 AWG	Phase A2, 22 AWG
	Green	Phase B1, 26 AWG	Phase B1, 22 AWG
	Black	Phase B2, 26 AWG	Phase B2, 22 AWG

Position Sensor I/O:

Name	Color	Function	Wire gauge (Small Valve)	Wire gauge (Large Valve)
Home	Yellow	Home signal (Open collector output low level)	26 AWG	24 AWG
Port	Brown	Port signal (Open collector output low level)	26 AWG	24 AWG
Power	Orange	+ 5 to +30 VDC	26 AWG	24 AWG
Ground	White	Ground	26 AWG	24 AWG

Controller:

Upon request, FHT will provide controller kit and help to set up control program for ERV valves. Contact FHT Engineering at 1-888-383-8468 ext #3 for more details.

Fluidic High Technology, Inc. USA

www.fluidicht.com

1-888-383-8468

FHT patented position and precision sensor design allows the customer to use two options to obtain the signal and drive the ERV:


- (1) Use Home signal only, then drive and rotate the motor to each port position by using rotation degrees.
- (2) Use home signal for Home position and use each port signal for each port position.

1.3 Multiple specific Configuration and the Application

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FHT Stepper Motor Rotary Valves are available for many flow paths applications, such as port selection valves, flow path switch valves, multi-ON/OFF valves, "Y" type, "T" type flow path valves. The FHT team is able to design special configurations to meet customer needs and will work very closely with you to find the best options for your system and device designs.

Stepper Motor Rotary Valve Configurations



Stepper Motor Rotary Valve Driver

FHT Stepper Motor Rotary Valves are designed for standard NEMA 17 or NEMA 23 size Motors and provide HOME and PORT signals. These valves are easily driven by the customers own controller or driver circuit. Also, customers are able to find standard controllers from many different manufacturers who design and manufacture controllers to drive these NEMA 17 and NEMA 23 Stepper Motors. FHT suggests using controllers developed by Trinamic (www.trinamic.com) or Lin Engineering (www.linengineering.com). The FHT engineering team will fully support customers to select right controllers and programs to run these stepper motor rotary valves properly.

358 Fairfield Road, Wayne NJ USA 07470 htakahara@fluidicht.com USA 1-201-675-5340

FHT ERV series provides various specific design and configuration, such as:

- (1) Inert flow channel: develop specific inert flow channels to meet the specific requirements of flow system
- (2) Port threads: in addition to the standard port threads ¼-28, FHT ERV can be designed with other specific port threads such as 1/8, M6, 5/16, etc.
- (3) A large Port number: up to 35 ports depended on the office size and the application to meet special application needs.
- (4) Design the customized rotary valves without the position sensor, such as manual rotary valves.

1.4 ERV Configuration Options

FHT ERV provides the following options:





- (1) ERV Series: ERV001 and ERV002 series, installed without the stepper motors and the controller. The customers will provide a reliable stepper motor and develop or use the existing controller to drive the ERV.
- (2) ERV-M Series: ERV001-M and ERV002-M, installed with the stepper motor, but without the controller. The customers will develop or use the existing controller to drive the ERV.
- (3) ERV-MC Series: ERV001-MC and ERV002-MC, installed with the stepper motor and the controller. , The customers will use the stepper motor controller manual and create the own program in accordance to the application and the requirements to drive this complete ERV units.
- (4) ERV-S Series: ERV001-S and ERV002-S, developed per customer application and the requirements. FHT engineering team will directly work with customer to understand and develop the specific ERV , including manual rotary valves.

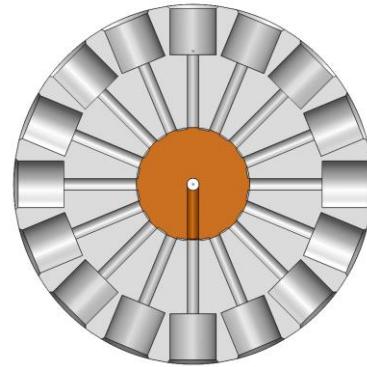
2. FHT ERV Components










2.1 FHT ERV Valve

FHT ERV mainly consists of rotor, body. The internal flow channels are sealed with fight fit between rotor and body, using inner strength of material PTFE. There is no steel spring as an external force required, no interchangeable parts or any maintenance needed.

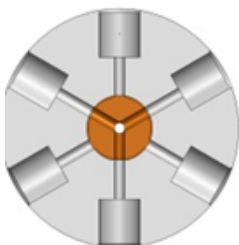
- (1) FHT standard selection and switch rotary valve series are designed for varies ports up to 20 ports, and the internal flow channel orifice size up to .237" (6.0mm). **It is required to notify FHT Sales if the MAX working pressure is higher than 100psi.**

Small Size Standard ERV Configuration		ERV Port Numbers, Part Numbers and Cycles			
		4 PORTS	6 PORTS	8 PORTS	10 PORTS
Orifice Size					
mm	inch				
0.8	0.032	ERV001-04S08	ERV001-06S08	ERV001-08S08	ERV001-10S08
		ERV001-04W08	ERV001-06W08	ERV001-08W08	ERV001-10W08
1.4	0.055	ERV001-04S14	ERV001-06S14	ERV001-08S14	ERV001-10S14
		ERV001-04W14	ERV001-06W14	ERV001-08W14	ERV001-10W14
2.0	0.078	ERV001-04S20	ERV001-06S20	ERV001-08S20	N/A
		ERV001-04W20	ERV001-06W20	ERV001-08W20	N/A
2.5	0.098	ERV001-04S25	ERV001-06S25	N/A	N/A
		ERV001-04W25	ERV001-06W25	N/A	N/A
3.2	0.125	ERV001-04S32	ERV001-06S32	N/A	N/A
		ERV001-04W32	ERV001-06W32	N/A	N/A
4.0	0.157	ERV001-04S40	N/A	N/A	N/A
		ERV001-04W40	N/A	N/A	N/A

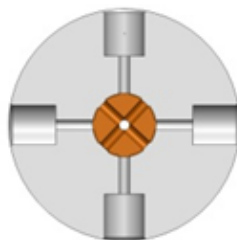


Large Size Standard ERV Configuration		ERV Port Numbers, Part Numbers and Cycles								
		4 PORTS	6 PORTS	8 PORTS	10 PORTS	12 PORTS	14 PORTS	16 PORTS	18 PORTS	20 PORTS
Orifice Size										
mm	inch									
0.8	0.032	ERV002-04S08	ERV002-06S08	ERV002-08S08	ERV002-10S08	ERV002-12S08	ERV002-14S08	ERV002-16S08	ERV002-18S08	ERV001-20S08
		ERV002-04W08	ERV002-06W08	ERV002-08W08	ERV002-10W08	ERV002-12W08	ERV002-14W08	ERV002-16W08	ERV001-18W08	ERV001-20W08
1.4	0.055	ERV002-04S14	ERV002-06S14	ERV002-08S14	ERV002-10S14	ERV002-12S14	ERV002-14S14	ERV002-16S14	N/A	N/A
		ERV002-04W14	ERV002-06W14	ERV002-08W14	ERV002-10W14	ERV002-12W14	ERV002-14W14	ERV002-16W14	N/A	N/A
2.0	0.078	ERV002-04S20	ERV002-06S20	ERV002-08S20	ERV002-10S20	ERV002-12S20	ERV002-14S20	N/A	N/A	N/A
		ERV002-04W20	ERV002-06W20	ERV002-08W20	ERV002-10W20	ERV002-12W20	ERV002-14W20	N/A	N/A	N/A
2.5	0.098	ERV002-04S25	ERV002-06S25	ERV002-08S25	ERV002-10S25	ERV002-12S25	N/A	N/A	N/A	N/A
		ERV002-04W25	ERV002-06W25	ERV002-08W25	ERV002-10W25	ERV002-12W25	N/A	N/A	N/A	N/A
3.2	0.125	ERV002-04S32	ERV002-06S32	ERV002-08S32	ERV002-10S32	N/A	N/A	N/A	N/A	N/A
		ERV002-04W32	ERV002-06W32	ERV002-08W32	ERV002-10W32	N/A	N/A	N/A	N/A	N/A
4.0	0.157	ERV002-04S40	ERV002-06S40	ERV002-08S40	N/A	N/A	N/A	N/A	N/A	N/A
		ERV002-04W40	ERV002-06W40	ERV002-08W40	N/A	N/A	N/A	N/A	N/A	N/A
5.0	0.197	ERV002-04S50	ERV002-06S50	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		ERV002-04W50	ERV002-06W50	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.0	0.236	ERV002-04S60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		ERV002-04W60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

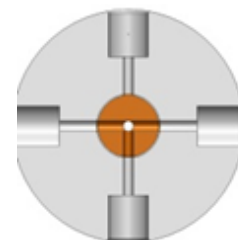
- (2) In addition to the standard rotary valves, FHT ERVs will simply modify the rotor internal channels to meet customer fluid control system; Here are some of examples:



“Y” Type



“+” Type



“T” Type

(3) The nominal internal volumes can be roughly calculated by using following equation:

ERV001 Selection Valve:

The total Internal volume $V = (N+1) \times (0.123\pi D^2)/4 + (0.163\pi D^2)/4 + 0.28\pi D^2/4$

ERV002 Selection Valve:

The total Internal volume $V = (N+1) \times (0.23\pi D^2)/4 + (0.25\pi D^2)/4 + 0.28\pi D^2/4$

ERV001 Switch Valve:

The total Internal volume $V = (N+1^*) \times (0.123\pi D^2)/4 + 0.163\pi \times (\pi D^2)/4 + N/2 \times (D \times \pi D^2)/4$

ERV002 Switch Valve:

The total Internal volume $V = (N+1^*) \times (0.23\pi D^2)/4 + 0.25\pi \times (\pi D^2)/4 + N/2 \times (D \times \pi D^2)/4$

D --- The orifice size of Valve (inch)

N --- The port number

For example: ERV001, 6 ports, Selection valve, orifice size .055":

$V = (3+1) \times (.248 \times 3.14159 \times .055^2)/4 + (3+1) \times (.256 \times 3.14159 \times .055^2)/4 = .0479 \text{ inch}^3$

Note: The total internal volumes of valves can be roughly calculated by using the equations listed above. For more detail and accurate calculation, contact with FHT Technology Service.

(4) FHT Valve life Cycles

FHT Valve operation pressure is 200 psi. Depend on customer application, using less ports or/and smaller valve orifice will have longer life cycles as shown below, identified by the colors.

Life Cycles Identified by Colors				
1 Million	2 Millions	4 Millions	6 Millions	6-10 Millions

FHT Valve MAX pressure is up to 500 psi. Contact with FHT sales@fluidicht.com for the life cycles if the working pressure is higher than 200 psi.



Caution: Using higher pressure of 500 psi might cause leakage and might damage the valve sealing surface.

(5) Maximum Duty Cycle (Recommended): 12.5%

Note: To avoid reducing the life of valve, recommend not let the valve run continuously more than one rotation.



Caution: Using higher duty cycle of 25% might damage the valve sealing surface.

(6) Wetting operation:

FHT valve recommend to run the valve with operating liquid or pure water. It will help rotor start rotating smoothly, also avoid over heating the sealing surface locally and changing the material properties. This way will help the valve maintain the service life and the best performance.



Caution: Continuously run valve without any liquids through the flow channel might reduce the life cycles and damage the sealing surface.

Notify FHT if the valve shall be used for the dry gas or air to discuss the operation condition.

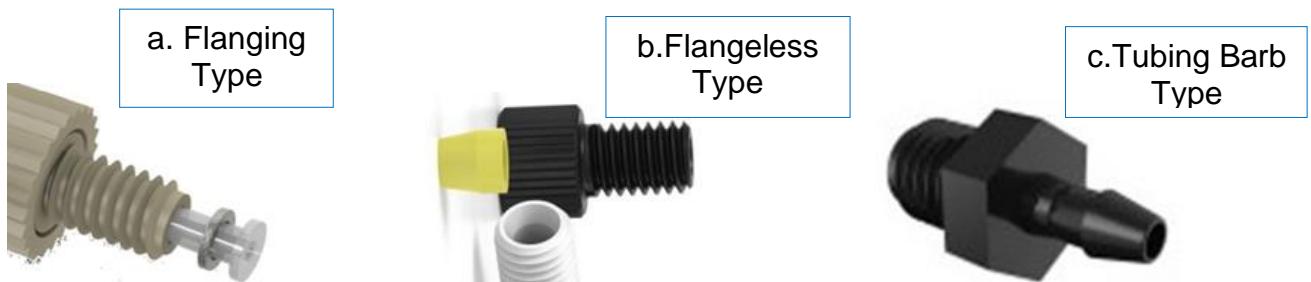
(7) FHT ERV Fitting Installation Instruction



Caution: Incorrectly installing the fittings might damage the port thread and might cause the external leakage.

(a) Recommendation

To have the best sealing performance without damaging the valve, it is recommended to use flanged tubing system with flanging washer and fitting nut or flangeless fitting with ferrule (See below a or b types).



Other fittings:

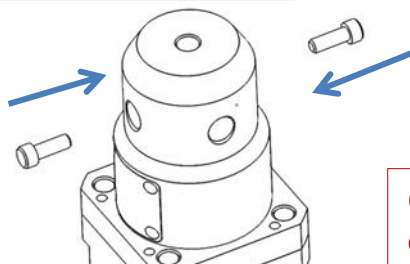
When using other type of fittings such as the Fitting without ferrule, but come with tubing barb, it requires to install the fitting at first, then slide the tubing over the fitting barb.

(b) Installation

- Prepare the fittings per fitting instruction.
- Clean up each fitting before installing. i.e. free of dried debris or dust.

Caution: Ensure that all fittings shall have flat and fine bottom sealing surface against the port bottom of valve. Bad bottom surface finish of fitting could damage the port sealing surface of valve or/and cause leakage.

Tighten opposing fittings together at same time.



Caution: Ensure that the ferrule or insert of the fitting, specially, for cone type of ferrule, shall be loosen from the fitting body or nut before installed. It will damage the bottom sealing surface of valve port if the ferrule or insert is stuck with fitting body or nut.

Caution: When threading the fitting into the port, over force on the fitting will directly damage the port thread of valve.

- Install loosely each fitting on each port separately per application.

NOTICE: Because the valve body is made of PTFE, which has the lowest friction, it will require a very little torque to thread the fitting into the port.

- Tighten opposing fittings together at same time to keep the rotor at the center of valve, and seal with body under same force around it.
- Apply 19-23 in-oz torque on the fitting for 1/4-28 thread fittings. See the instruction or ask

FHT Technology Service to find out the torque requirements for other size fittings. Normally, finger tightening is good enough to secure the sealing performance.

Caution: Over tighten will damage the bottom sealing surface of valve port, which will cause leakage, specially, when re-installing the fitting.

- Ensure each fitting is secured tightly to avoid the external leakage around the fitting.

2.2 Encoder/Position Sensor

(1) Encoder position sensor is part of FHT Valve, which is directly connected to rotor and assembled with valve housing.

(2) Precise position configuration

Each FHT valve incorporates Encoder Discs that corresponds to the Home and Port positions of the valve. A circuit board is assembled into the valve head to detect the "HOME" and "PORT" positions of the valve.

FHT position sensor configuration provides precise position signal for the application. With this new design, it does not require an additional average micro steps and adjust the alignment when the customer set up the control program.

(3) The Encoder/Position Sensor board is designed to provide unity sensitivity across wide range supply voltage. The position sensor has four output wires to connect to the external controller/drive.

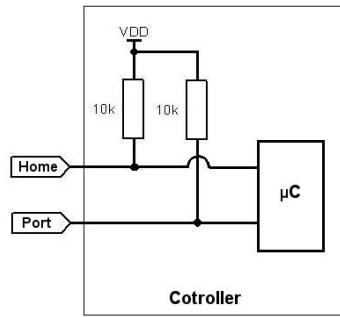
Wire Name	Color	Description	Specification
VCC	Orange	DC Supply input	+5V to +30V DC, 30mA max
Home	Yellow	Home Signal Output	Open collector output, Active low (<1V)
Port	Brown	Port Signal Output	Open collector output, Active low (<1V)
GND	White	Power/Signal Ground	Power and signal return

These sensors derive power from, and also provide signals to controllers, either the customer's new or existing controller or the controller FHT provided.

(4) For valves assembly that comes with the integrated controller/drive module, the position sensor is pre-wired to the controller's corresponding inputs.

(5) For valve assemblies without integrated controller/drive module, the position sensor is to be provided with external power (+5V to +30V DC and Ground). The "Home" and "Port" signal outputs should be connected to a controller signal input channels that have internal pull-up resistors of greater than 2k Ω (10k Ω is recommended). In this option, the position sensor is supplied with 250 mm lead wires.

FHT Position Sensor to Controller connection reference diagram.



2.3 Stepper Motor

(1) FHT selects NEMA 17 High Torque Stepper Motor for its small diameter ERV and NEMA 23 High Torque Stepper Motor for its large diameter ERV. These motors provide adequate driving capability and fine resolution for most of the application.

FHT recommend to use Lin Engineering Standard 1.8° Bipolar Stepper Motor www.linengineering.com . The Model part Number and the specification are shown below:

Motor Name	Dimension "A" Max	Model #	Rated Current (Amps, Phase)	Holding Torque (on-in)	Holding Torque (N-m)	Resistance (Ohms/Phase)	Inductance (mH/Phase)	Inertia (oz/in ²)	Weight (Lbs)	Number of Leads
NEMA17	1.89" (48.0mm)	4118L-07S	1.05	83.0	0.59	5.2	9.4	0.37	0.80	4
NEMA23	3.1" (78.7mm)	5718L-03S	2.10	294.0	2.08	2.4	7.0	2.60	2.35	4

(2) It is acceptable to use other maker's stepper motors, but required to pay more attention on the holding torque at lower speed of 40 RPM or 60 RPM.

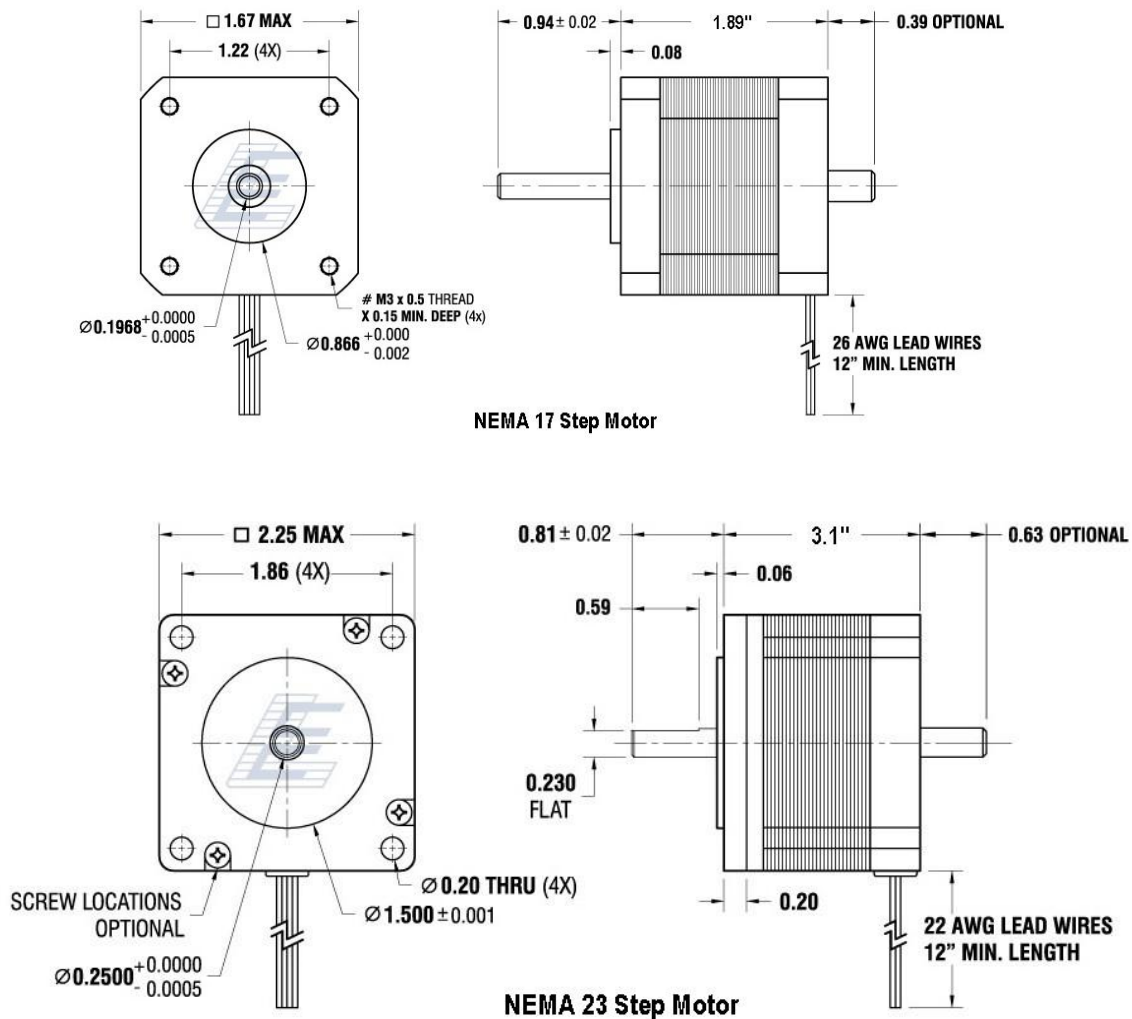


Caution: Using higher speed of 100 RPM might damage the valve sealing surface.

(3) Stepper Motor Specification:

Specification		NEMA 17 size (Small Valve)	NEMA 23 size (Large Valve)
Step Size		1.8°	1.8°
Operating Voltage		24 VDC	24 VDC
Rated Current (Phase)		1.05 Amps/Phase	2.1Amps/Phase
Holding Torque		83 oz-in (0.59 N-m)	294 oz-in (2.08 N-m)
Resistance (Phase)		5.2 Ohms	2.4 Ohms
Inductance (Phase)		9.4 mH	7.0 mH
Weight (Lbs)		0.80	2.35
Wire Color	Red	Phase A+, 26 AWG	Phase A+, 22 AWG
	Blue	Phase A-, 26 AWG	Phase A-, 22 AWG
	Green	Phase B+, 26 AWG	Phase B+, 22 AWG
	Black	Phase B-, 26 AWG	Phase B-, 22 AWG

(4) Installation dimensions



2.4 Stepper Motor Controller + Driver Module

(1) For FHT valve assembly that equips with integrated Controller + Drive Model, FHT provides RMS Technologies module R256 for valve with NEMA 17 motor and module R356 for valve with NEMA 23 motor.

These Controller/Drive modules feature,

- Input Voltage of +12 to 40 VDC
- Phase Current Ranges from 0.2 to 2.0 Amps (R256) Peak or 3.0Amps (R356) Peak
- Full step, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256
- RS485 Communication with Optional Converter
- 2 User Configurable Digital I/O's
- 2 Dedicated Inputs:
 - 1 Optical Sensor for Homing
 - 1 Optical Sensor for Porting
- Fully Programmable Ramps and Speeds
- Software Selectable Hold and Move Currents
- Stand Alone Operation with No Connection to PC
- Stores up to 16 Different Programs at Once with 4 kBytes of Memory

For more information, please refer to,

http://www.linengineering.com/wp-content/uploads/downloads/R256/documentation/R256_Manual_V1.09.pdf

(2) R256 Controller/Drive Electrical Spec.

- OPERATES FROM +12 to 40 VDC
- SELECTABLE PHASE CURRENTS FROM 0.2 TO 2.0 Amps Peak
- ISOLATED INPUTS: I/O, Switch Closure to Ground, Opto Phototransistor
- STEP FREQUENCY (MAX): 16.77 MHz
- STEPS PER REVOLUTION (1.8° MOTOR): 200, 400, 800, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 25000, 25600, 50000, 51200
- MICROSTEP RESOLUTIONS (1.8° MOTOR): Full step, 2X, 4X, 5X, 8X, 10X, 16X, 25X, 32X, 50X, 64X, 125, 128X, 250X, 256X

DEFAULT SETTINGS:	
FUNCTION (Command)	DESCRIPTION
Running Current (m)	30% of 2.0 Amps
Holding Current (h)	10% of max current of 2 Amps
Step Resolution (j)	256x
Top Velocity (V)	305175 pps (microsteps/sec)
Acceleration (L)	L=1000, 6103500 μ steps/sec ²
Microstep smoothness (o)	1500
Outputs (J)	both are turned off, J0
Baud Rate	9600 bps

Controller/Drive Connection

Motor Connector:



Color	Function
Red	A+ Phase
Blue	A- Phase
Green	B+ Phase
Black	B+ Phase

Motor Mating Connector

Controller Connector:



Pin Number	Function
1	+12 to 40VDC
2	I/O
3	RS485B
4	RS485A
5	Switch Closure to GND (In)
6	Power Ground
7	Opto Sensor Phototransistor (In)
8	I/O
9	Opto Sensor LED(Power Out)

DB-9 Control Connector

(3) R356 Controller/Drive Electrical Spec.

- OPERATES FROM +12 to 40 VDC
- SELECTABLE PHASE CURRENTS FROM 0.2 TO 3.0 Amps Peak
- ISOLATED INPUTS: I/O, Switch Closure to Ground, Opto Phototransistor
- STEP FREQUENCY (MAX): 2.5GHz
- STEPS PER REVOLUTION (1.8° MOTOR): 200, 400, 800, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 25000, 25600, 50000, 51200
- MICROSTEP RESOLUTIONS (1.8° MOTOR): Full step, 2X, 4X, 5X, 8X, 10X, 16X, 25X, 32X, 50X, 64X, 125, 128X, 250X, 256X

DEFAULT SETTINGS:	
FUNCTION (Command)	DESCRIPTION
Running Current (m)	30% of 3.0 Amperes
Holding Current (h)	10% of max current of 3 Amperes
Step Resolution (i)	256x
Top Velocity (V)	305175 nps (microsteps/sec)
Acceleration (A)	$1 = 1000, 6103500 \mu\text{steps/sec}^2$
Microstep smoothness (n)	1500
Outputs (L)	both are turned off .J0
Baud Rate	9600 bps

Controller/Drive Connection

Motor Connector:



Color	Function
Red	A+ Phase
Blue	A- Phase
Green	B+ Phase
Black	B+ Phase

Motor Mating Connector

Control Connector:

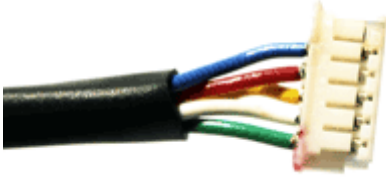


DB-15 Controller Connector

PIN OUT

Pin Number	Color	Function	Function
1	Green	Power Ground	
2	Black	1A On/ Off Output	
3	Yellow/ Green	Direction Input	
4	Yellow	+5 VCD Input for Opto Isolated STEP and DIR	
5	Orange	Input	2/Jog Input
6	Yellow/ White	Internal Power for Opto Sensor	
7	Orange/ White	Input (Opto Input)	3/Opto Input
8	Black/ White	RS485 A	
9	Red	+12V TO 40V POWER	
10	Blue	1A ON/ OFF Output	
11	Blue/ White	Step Input	
12	Green/ White	Signal Ground	
13	White	Input	1/Jog Input
14	Red/ White	Input	4/Opto Input
15	Brown	RS485 B	

Optional Encoder Connector:



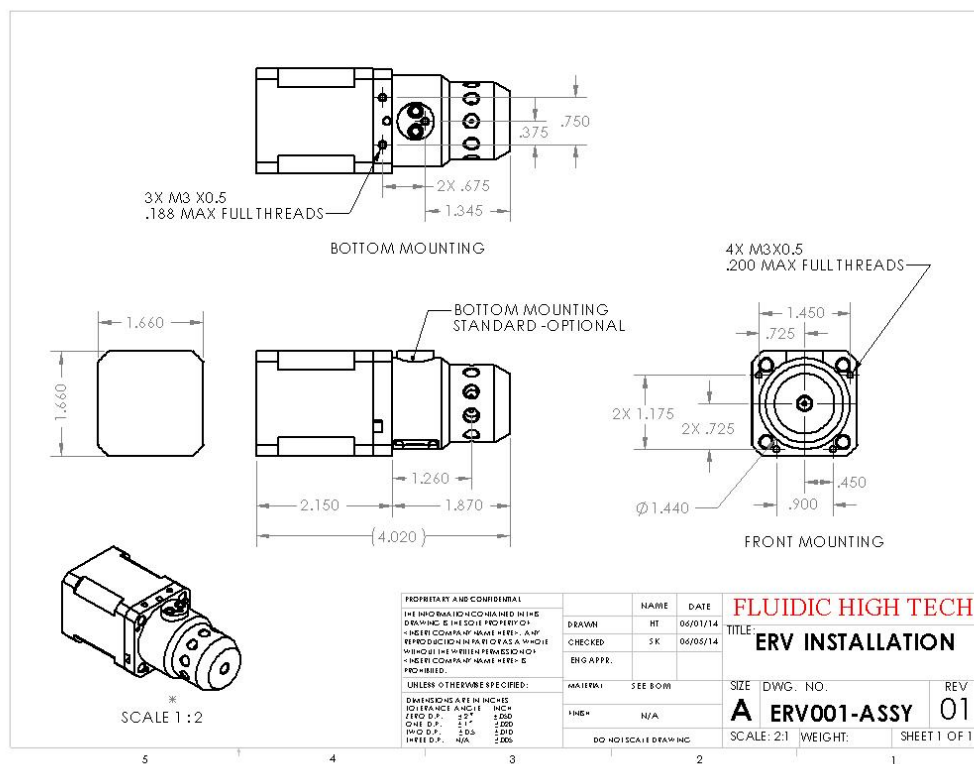
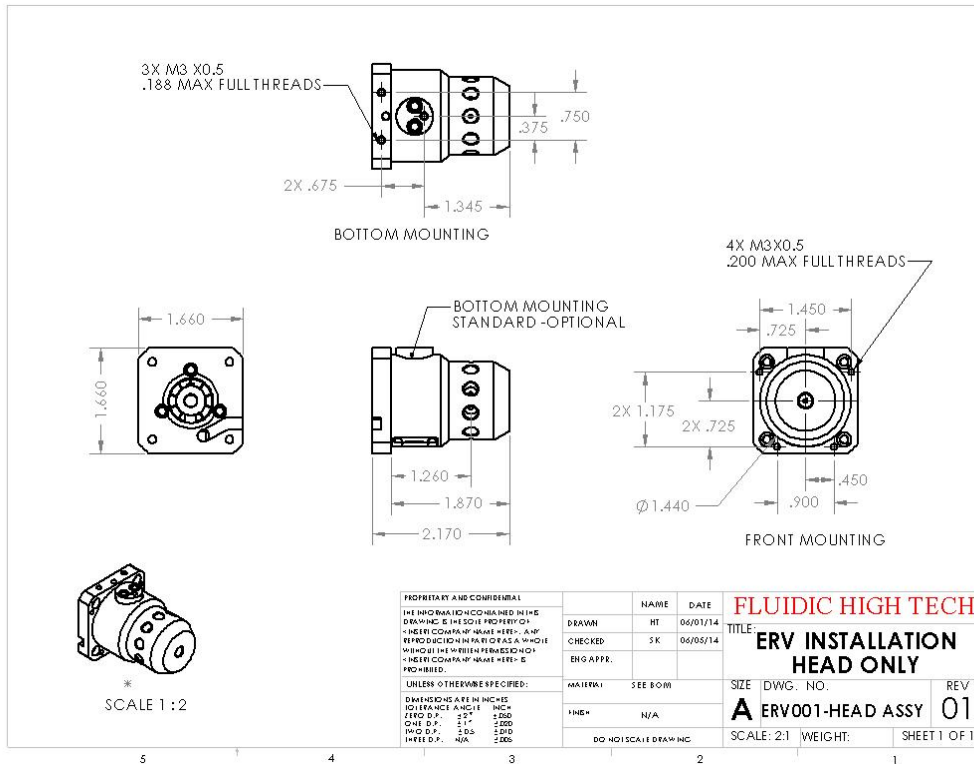
Color	Color	Function
1	Green	Ground
2	White	Index
3	Yellow	Ch A
4	Red	+5 VDC
5	Blue	Ch B
6	---	

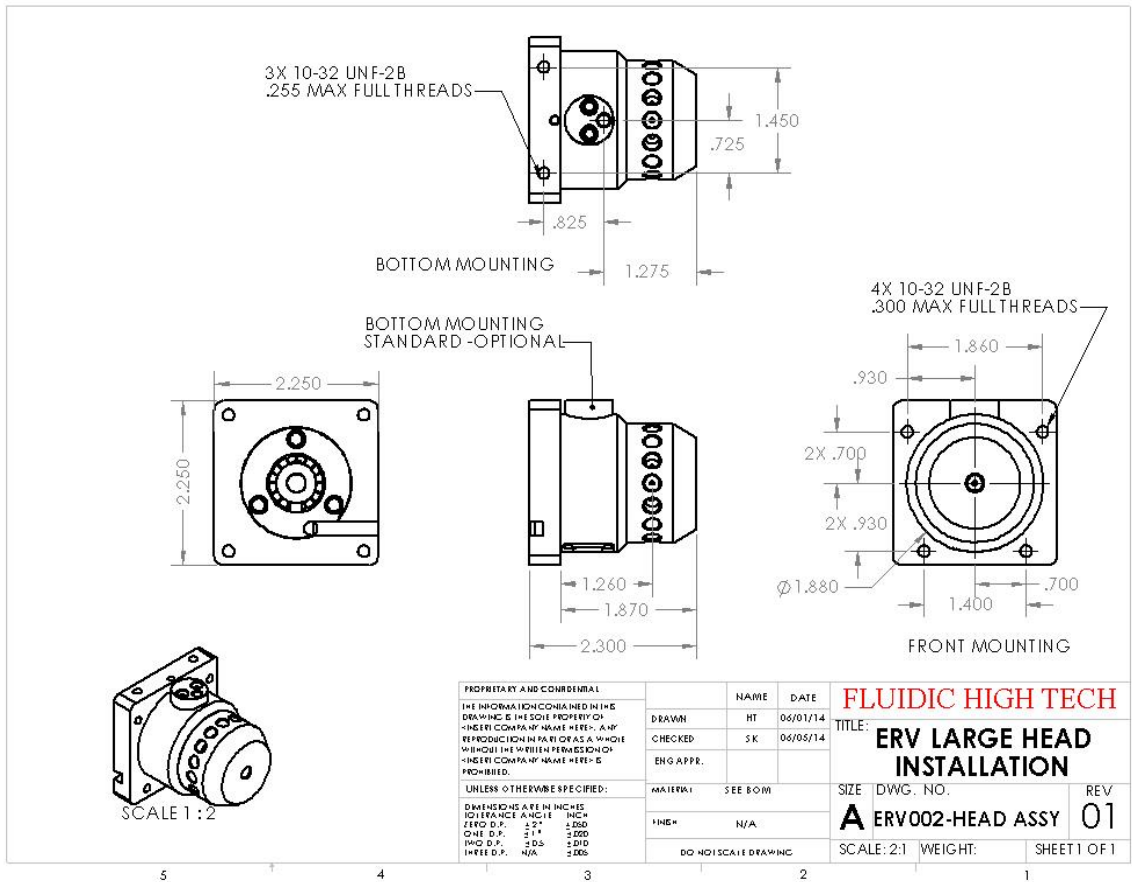
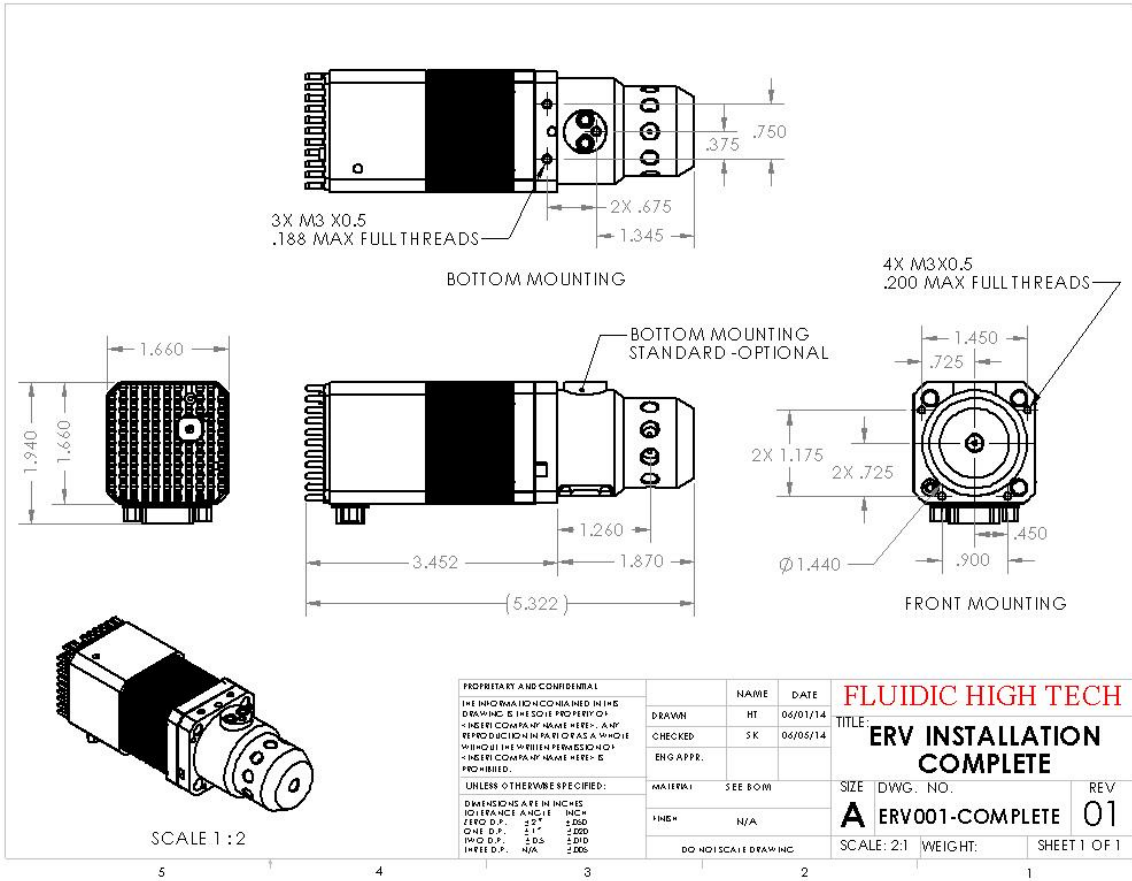
US Digital E2, E3, or E5 encoder Connector (option)

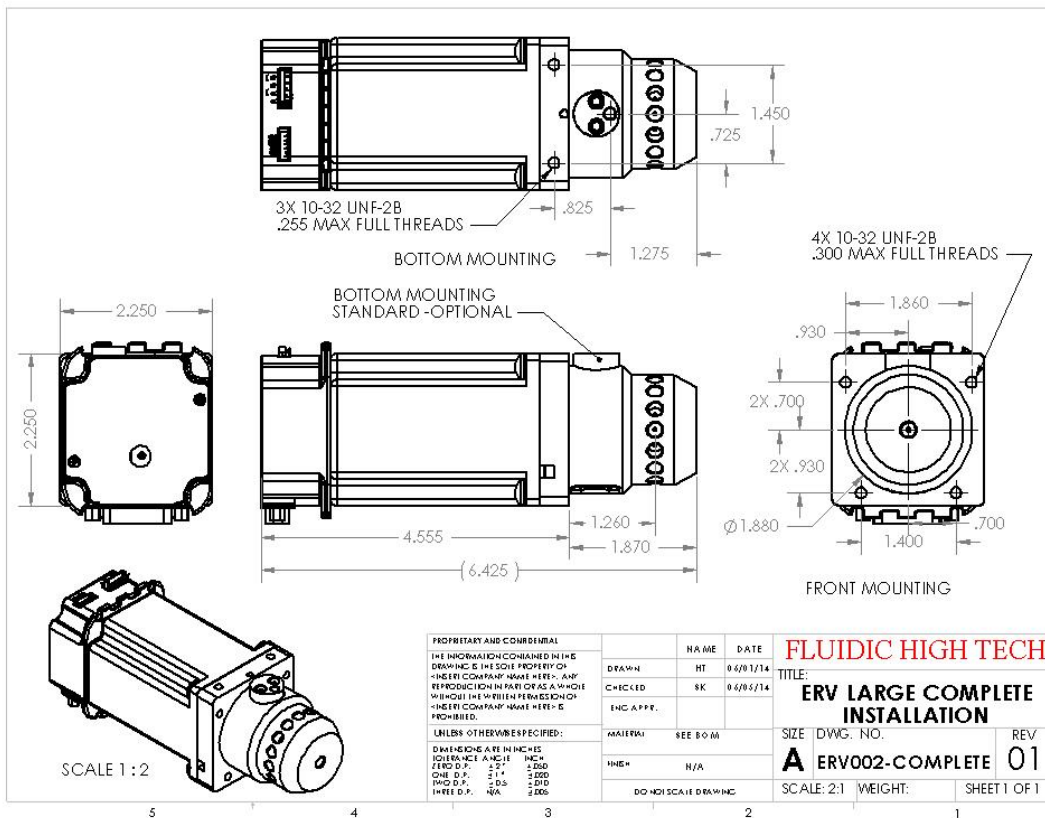
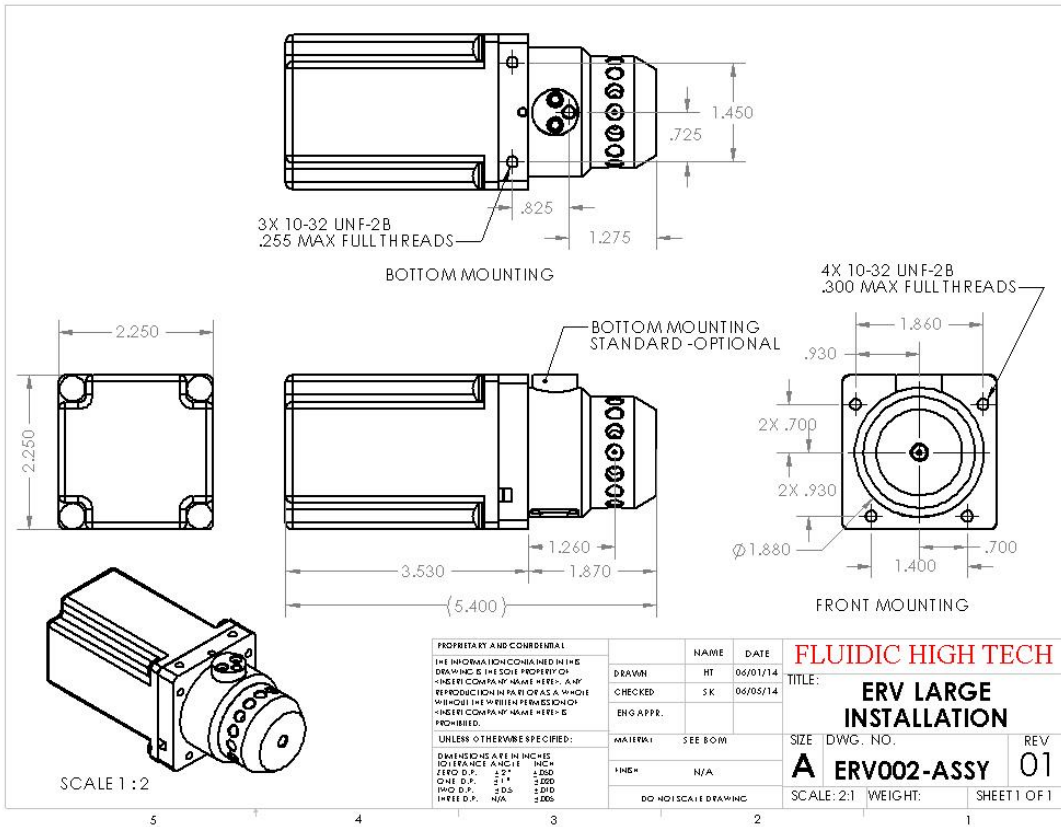
3. Installation

3.1 Valve installation

FHT Provide three options of Valve head assembly, Valve with Motor assembly and Valve with motor-controller assembly. And the valves can be mounted at the front of the valve or the bottom of the valves. Here are the installation dimensions for both small valve series and large valve series (dimensions are in inches).







Overall Dimensions and Mounting Positions

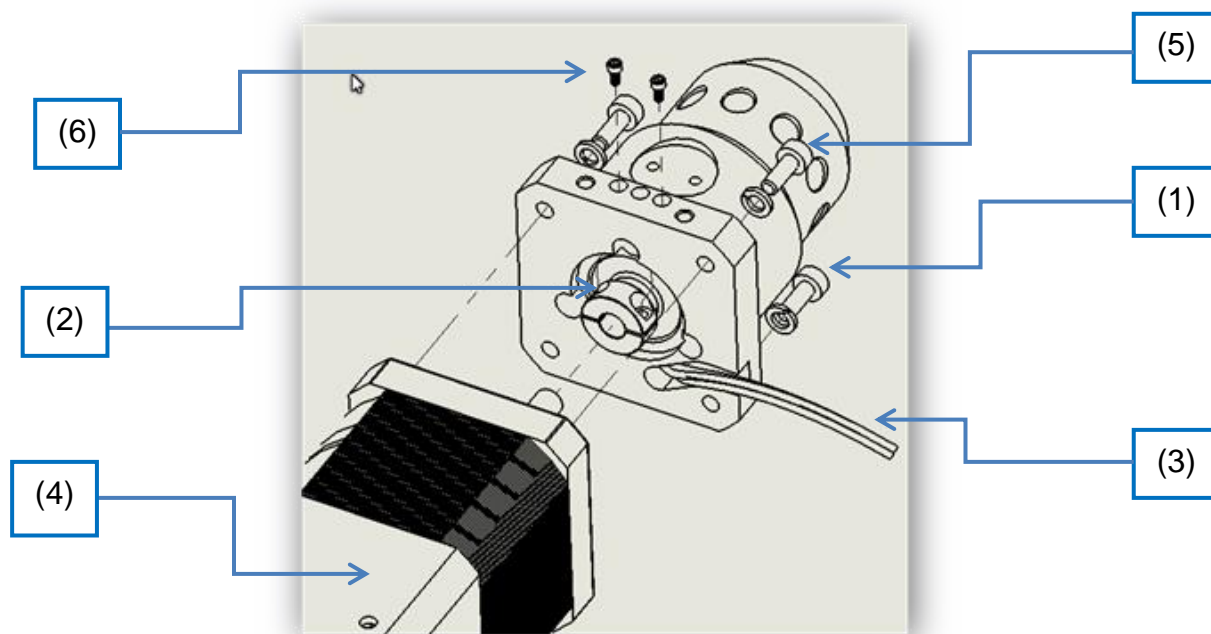
When mounting the valve at the front of the valve, the bulkhead opening hole that the valve head will pass through shall be \varnothing 1.50" (\varnothing 38.1 mm) for small series valve, and \varnothing 1.95" (\varnothing 49.5 mm) for large series valve.

3.2 Motor Installation

This section is the procedure for installing a Stepper Motor onto the Valves Head Assembly.



Caution: Ensure the power supplier has been turned off during connecting the motor wires. Must work at an ESD protected working table or area.



Stepper Motor to FHT Valve Head Assembly

- (1) Clean up the shaft of Motor with a little alcohol. No grease or oil allowed.
- (2) Rotate Coupling to have the lock screw side face vertically upward
- (3) Lay Sensor wires in the slot channel of the Housing.
- (4) Slide Motor Axis into Coupling. Ensure there are no wires are gripped or pinched between Motor and Housing.
- (5) Apply and tighten 4 each of Screws and Washers.
For ERV001, small valve: use 4 of screws (Socket Head Cap, M3X8mm) and 4 of Washer (Split Lock, M3), apply torque 6 in-lbs.
For ERV002, large valve: use 4 of screws (Pan Head Phillips, 10-32X1/2) and 4 of Washer (Split Lock, No.10), apply torque 20 in-lbs. Socket Head Cap
- (6) Apply and tighten 2 each of Screws, pre-installed on the coupling.
For ERV001, small valve: use 2 of screws (Socket Head Cap, 2-56 X 1/4), apply torque 3 in-lbs.
For ERV002, large valve: use 2 of screws (Socket Head Cap, 4-40 X 3/8), apply torque 5 in-lbs.

4. Electrical Connection



Caution: Never connect or disconnect a motor to this control module with power applied. This may damage the control module.

FHT valves use lower direct voltage up to Max 30 VDC. It does not allow to use AC voltage or higher DC voltage more than 30 voltages.



Warning: Using an unproper voltage could directly damage motor and controller, and it also might result body injured or death.

ESD Sensitive Product

Motor-driven rotary valves are sensitive to electrostatic discharge (ESD) and the user must take precautions to avoid ESD voltages above 1000V according to the Human Body Model, or HBM (a model of electrostatic discharge via the human body).



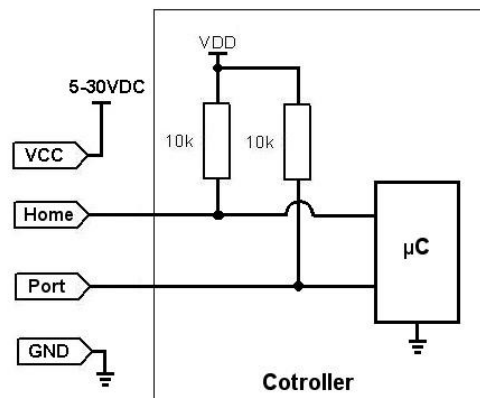
Warning: Electrostatic discharge (ESD) voltages could directly damage motor and controller.

4.1 Encoder/Position Sensor

The Encoder/Position Sensor circuit board that incorporated in FHT EVR valve head is to provide precise position detection for the motor controller. The Encoder/Position Sensor provides four wire that is defined as,

Wire Name	Color	Description	Specification
VCC	Orange	DC Supply input	+5V to +30V DC, 30mA max
Home	Yellow	Home Signal Output	Open collector output, Active low (<1V)
Port	Brown	Port Signal Output	Open collector output, Active low (<1V)
GND	White	Power/Signal Ground	Power and signal return

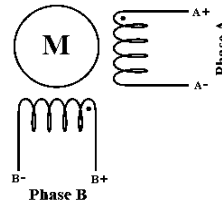
A typical Encoder/Position Sensor to motor controller diagram is,



4.2 Stepper Motor

FHT Stepper Motor has four wires to connect to the motor drive.

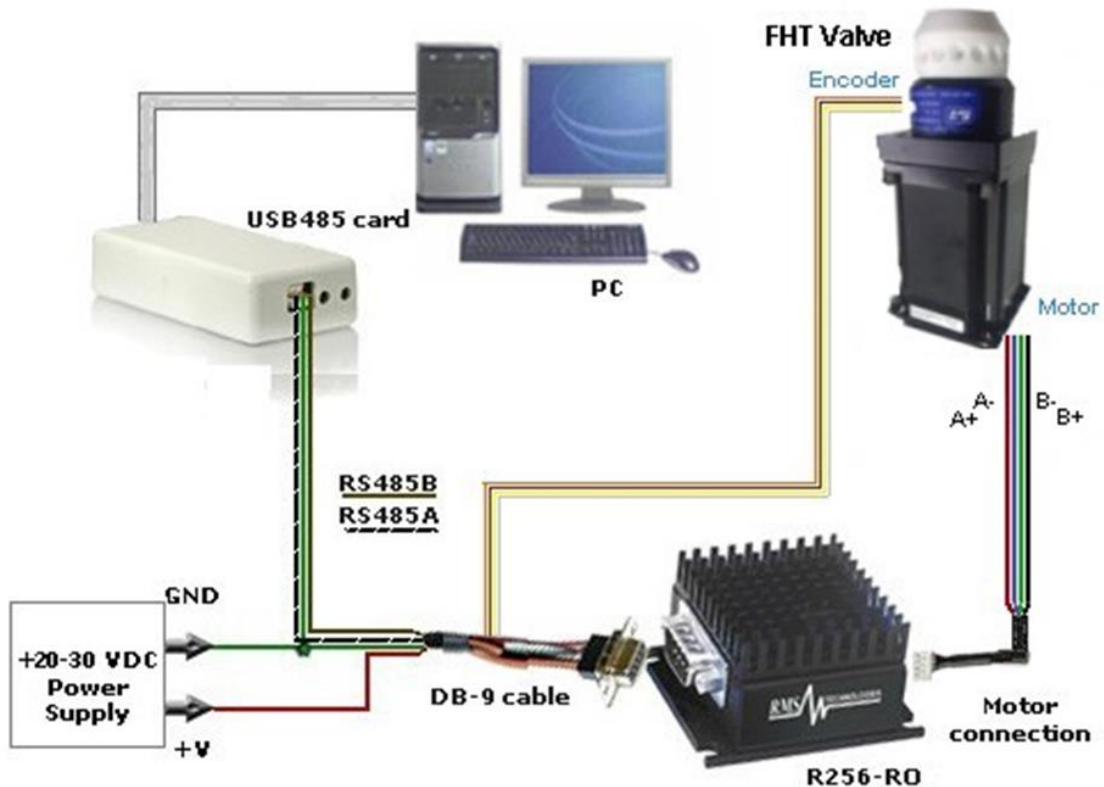
Red	Phase A+
Blue	Phase A-
Green	Phase B+
Black	Phase B-

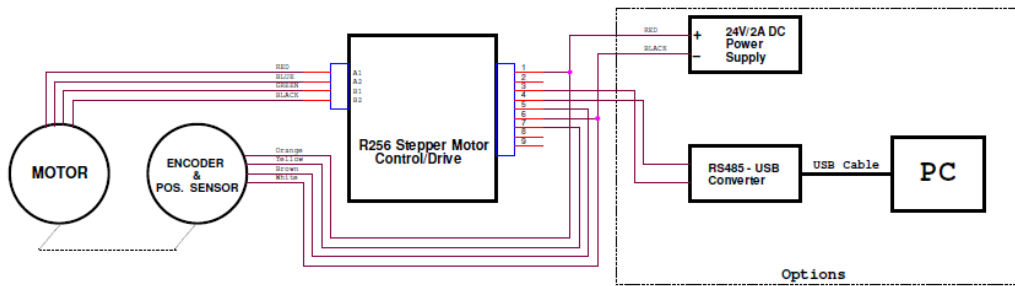


4.3 Stepper Motor Controller and Drive

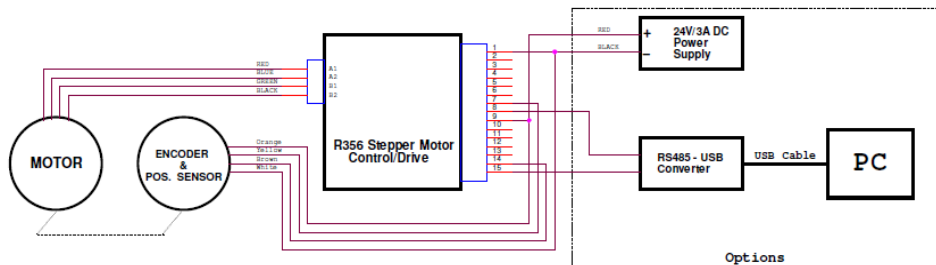
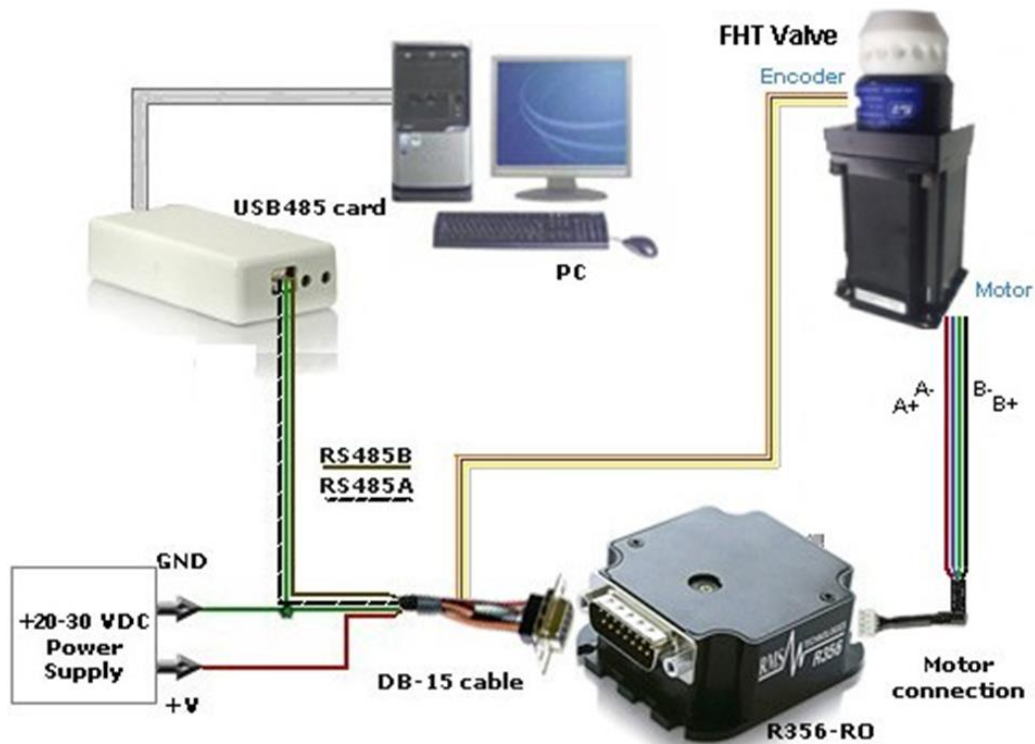
(1) All Stepper Motors require a driver to drive motor. For valves that are not equipped with FHT supplied integrated stepper motor controller/drive will require a motor driver provided by the motor supplier or developed by the customer if the existing system or unit controller is not designed with the driver. We suggest contacting www.linengineering.com for the driver or contact FHT at support@fluidicht.com or call 1-888-383-8468 for additional support.

For the valves equipped with FHT supplied integrated NEMA 17 stepper motor and R256 controller/drive, the system connection diagrams for R256 Controller/Drive module and the electrical wiring diagram for R256 Controller/Drive module are shown below :





For the valves equipped with FHT supplied integrated NEMA 23 stepper motor and R356 controller/drive, the system connection diagrams for R356 Controller/Drive module and the electrical wiring diagram for R356 Controller/Drive module are shown below:



For R256/R356 Controller/Drive programming commands, please refer to, http://www.linengineering.com/wp-content/uploads/downloads/R256/documentation/R256_Manual_V1.09.pdf
http://www.linengineering.com/wp-content/uploads/downloads/R356/documentation/R356_Manual_V1.09.pdf

For technical support on the system installation and Position Sensor set up, contact FHT Technical support 1-888-383-8468 or support@fluidicht.com

5. Controller program

FHT is able to provide the valves with motor and controller/drive. For the valves that equip with FHT supplied integrated stepper motor with controller/drive, the controller has been preload with a simple demo program.

The Demo program operates the following steps

1. After power up, rotate CCW direction and stop at "Home" port for 2 seconds
2. Rotate CW direction and stop at "Port" port for 2 seconds.
3. When reach the last port, rotate CCW direction and stop at "Home" port.

The Demo program is programmed with LIN Engineering command GUI program (<http://www.linengineering.com/contents/stepmotors/pdf/LinCommand64bit.zip>) in Fig-1.

Note: the FHT Demo program may be subjected to change without further notice. Please contact FHT Technical Support at 1-888-383-8468 or support@fluidicht.com for any question.



Fig-1

For the valves that equip with FHT supplied integrated stepper motor with controller/drive, the customers can develop their own programs for their application. Please refer to the controller supplier LIN Engineering, http://www.linengineering.com/wp-content/uploads/downloads/R356/documentation/Lin_Command_Manual.pdf for the controller specification and programming commands.

6. Maintenance

6.1 Valve:

To keep the internal flow channel clear, it is recommended to have the following preventative maintenance:

- (1) For Initial use, flush the channels with the clean water or the cleaner which is used for the system at the max pressure the existing system could provide, but not up more than 200 psi for 2 minutes through each channel.
- (2) Repeat this process every 250,000 cycles, or more frequently depended on the liquid properties.

6.2 Encoder/Position Sensor

FHT encoder/position sensor will not require any maintenance. In case of replacement required, contact with FHT sales@fluidicht.com for the encoder/position sensor kit.

6.3 Stepper Motor

FHT stepper motor will not require any maintenance. In case of installation or replacement required, contact with FHT sales@fluidicht.com for the stepper motor kit.

6.4 Stepper Motor Controller + Driver Module

FHT stepper motor controller + driver module will not require any maintenance. In case of installation or replacement required, contact with FHT sales@fluidicht.com for the stepper motor controller + driver module kit.

7. Trouble Shooting

Before you call FHT support, please check the following trouble shooting items and make sure the wire connection and operation properly.

Problem	Possible Cause	Solution
1. The motor will not rotate	1.1. There is loss of power	Check the proper use of power supplier or power resource
	1.2. The wire connection is unproper	Check the motor wires connection per the wire colors
	1.3. Voltage is too low	Check the voltage if it is set up between 12 - 30 VDC
	1.4. The load of valve is too high	Increase the voltage to 30 VDC to break the static holding torque
2. The valve will not rotate	2.1 The motor does not rotate	See problem 1 above for the solution
	2.2. The screws of motor shaft is loosen	Check the shaft screws if it is loosen
3. The motor will not stop	3.1. No home position signal	Check the sensor wires connection per the wire colors
	3.2. The controller program is not proper	Check the controller program
	3.3. The screws of motor shaft is loosen	Check the shaft screws if it is loosen
4. No port signal or will not stop at proper port position	4.1. No port position signal	Check the sensor wires connection per the wire colors
	4.2. The controller program is not proper	Check the controller program

8. ***Life Support Policy***

FHT does not authorize or warrant any of its motor-driven rotary valves for use in life support systems.

Life support systems are equipment intended to support or sustain life, whose failure to perform can be reasonably expected to result in personal injury or death.

