

High Pressure Electrical Controls Valves Series CV4-7

Technical Bulletin

EMERSON **CV4-7** are stepper motor driven valves for precise control of refrigerant mass flow in CO₂ Systems and can be applied as (see next page):

- high pressure gas valve (A)
- bypass valve (B)
- heat reclaim valve (C)
- expansion valves (D),
- suction pressure regulating valve (E)

Features

- Maintenance free
- Multifunction
- Fully hermetic design with ODF connections
- Stepper motor driven
- Short opening and closing time
- Very fast full stroke time
- High resolution and excellent repeatability
- Positive shut-off function to eliminate the use of an additional solenoid valve
- Linear flow capacity
- Extremely wide capacity range (10...100%)
- Optimal solution applied to offer the highest reliability and lifespan, accordingly to the high differential pressures in the CO₂ systems
- Ceramic slide and port for precise flow and minimal wear
- Balanced force design
- Corrosion resistant stainless-steel body and connections




CV5-HPV

Selection table

Type	Part No.	Kv (m ³ /hr)	Capacity range	Inlet connection	Outlet connection	Electric connector
CV4-HPV	802056	0.21	10...100%	3/8" ODF	5/8" (16 mm) ODF	M12 plug
CV5-HPV	802057	0.68		5/8" (16 mm) ODF	7/8" (22 mm) ODF	
CV6-HPV	802058	1.57		7/8" (22 mm) ODF	1-1/8" ODF	
CV7-HPV		5.58		1-1/8" ODF	1-1/8" ODF	

Note 1: The valves are delivered without cable/connector assembly (order separately).

Cable and connector assembly

Type	Part No.	Length (m)	Temperature Range	Connector type to valve	Connector type to driver board or controller	Illustration
EXV-M15	804663	1.5	-50...+80°C	M12	Loose wires	
EXV-M30	804664	3.0				
EXV-M60	804665	6.0				

Emerson driver / controller to drive CV valves

Type	Function	Analogue signal input	Remark
EXD-U02 for one valve	Slave	0-10VDC or 4-20 mA signal from master controller	Refer to technical bulletin of EXD-U02
EXD-SH1 for one valve	Superheat or temperature controller	Pressure transmitter and temperature sensor	Refer to technical bulletin of EXD-SH1/2
EXD-SH2 for two valves			
Third party driver/controller	See page 4 for requirements		

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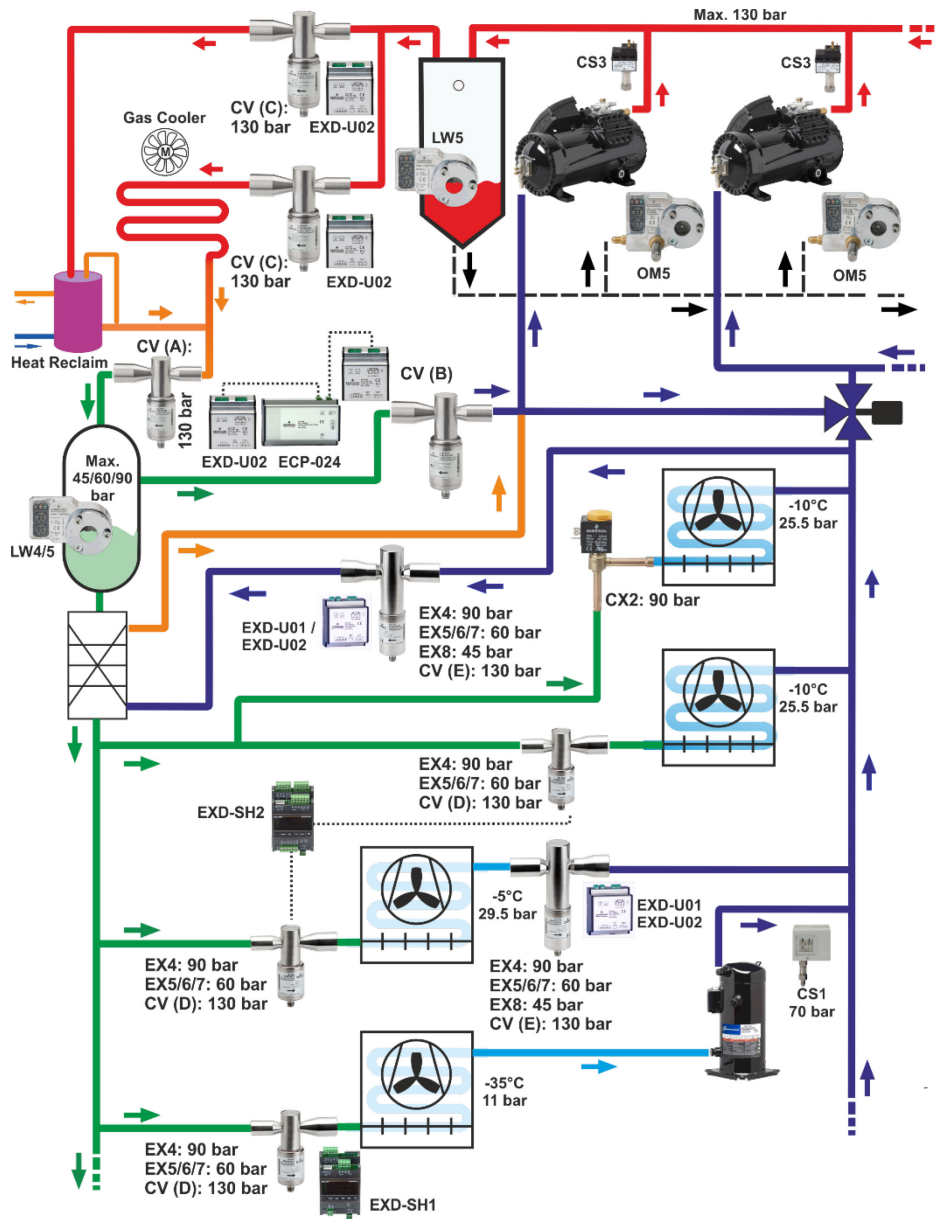
CV Application possibilities

Hypothetical layout of a large booster transcritical and subcritical CO₂ system to demonstrate application of Emerson CV series as well EX series valves.

Guideline table - applicability

Duty	CV4-7 PS: 130 bar PT: 186 bar	Position	EX4 PS: 90 bar PT: 99 bar	EX5-7 PS: 60 bar PT: 66 bar	EX8 PS: 45 bar PT: 49.5 bar	Recommended Emerson driver	CX2 PS: 90 bar PT: 129 bar
High pressure gas valve	Yes	(A)	No	No	No	EXD-U02	No
Bypass valve	Yes	(B)	No	No	No	EXD-U02	No
Heat reclaim valve	Yes	(C)	No	No	No	EXD-U02	No
Expansion valve	Yes	(D)	Yes	Yes	Yes	EXD-SH1/2	Yes
Suction pressure regulation	Yes	(E)	Yes	Yes	Yes	EXD-U02 EXD-SH1/2	No

Note: PS = Maximum working pressure, PT = Factory pressure test / Standstill pressure (System manufacturer can apply PT pressure to the assembly of valve and piping for strength and leakage test).



Note: It is an economical solution to select valve with PS corresponding to required pressure level and not higher than needed.

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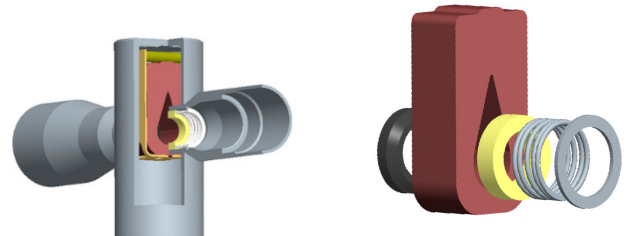
Maintenance free

The new CV CO₂ electric control valves can be considered as maintenance free products, as long as the pipework (welding/brazing under inert atmosphere, proper internal cleaning of pipes & circuit components before first start, etc.) and rest of the different components integration be performed according to the best refrigeration practices, ensuring the proper and balanced functioning of the system and the necessary oil circulation.

Valve port design

The gate type valve is optimized to provide a wide range of capacity with a linear relation between flow and positioning of the valve (capacity vs. number of steps). Slide and port are made of ceramic for precise flow characteristics, high resolution and infinite life expectancy, as well as seat tightness during long period of system OFF cycle as long as inlet pressure is 0.5 bar above outlet pressure.

It has been applied in Emerson EX4-8 valves since 1997. The slide and ring are **service free**.



Internal protection

The motor compartment contains movable rotors and bearings. The entire motor compartment is protected by 40-micron strainer against contaminants.

40-micron strainer can catch particle size down to 0.04 mm particles.

Unlike typical design of strainer in stream of flow, this strainer is not in stream of CO₂ flow therefore it has no impact of obstruction of flow inside of valve (no pressure drop increase through valve).

Advantages:

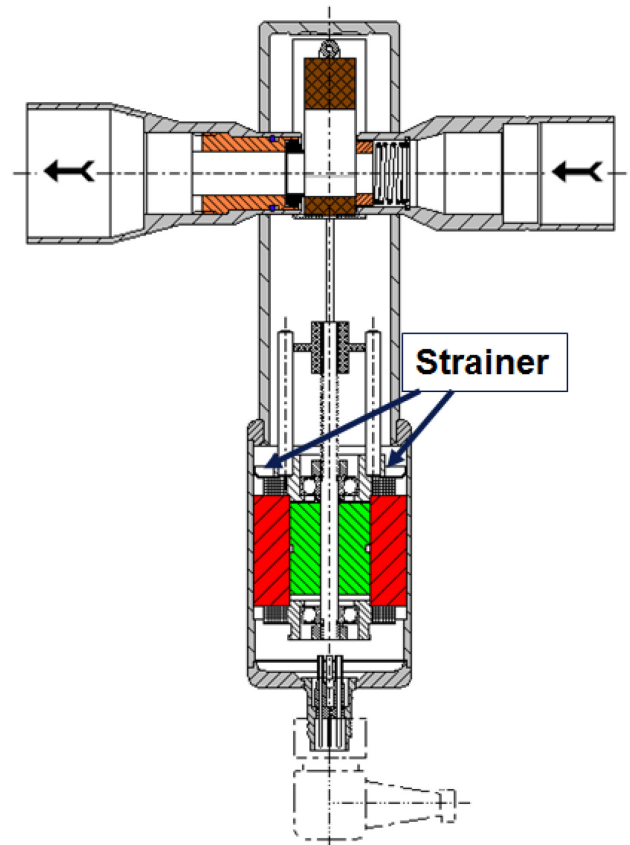
- Extremely fine filter compare to other established standard strainers (mesh size 100 = 0.14 mm)
- Not obstructing or creating pressure drop

Stepper Motor

The stepper motor is designed to be operated by constant current and variable voltage. The stepper motor managed by micro-processor measuring continuously the current and adjust to desired level by varying supply voltage.

The chopper (constant current) will not permit the short circuit of windings as motor current never increases beyond destroying level. The insulation of windings of motor is designed for high temperature of 130°C.

The stepper motor is service free.



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CV valve driver

CV valves requires different Emerson driver based on application as described from Table guideline page 2.

EMERSON EXD-U02 Universal driver is a stepper motor driver which uses an analogue input signal to define the valve opening. It enables the operation of CV valves for different type of duties. The input signal for the driver module can be 4...20 mA or 0...10 V. The output pulses provide the proportional opening/closing of CV valves and consequently the control of liquid or vapor refrigerant mass flow. EXD-U02 can be connected to any third-party controller, which provides an analogue signal. This enables an extreme flexibility using any desired controller in conjunction with the universal driver module to achieve different functionality. For further details please refer to EXD-U02 Technical Bulletin.

Emerson EXD-SH1/2 are stand-alone universal superheat and or temperature controllers to drive CV4-7 for specific duty.

Function:

	Circuit 1 (Valve 1)	Circuit 2 (Valve 2)
EXD-SH1	Superheat or temperature control	
EXD-SH2	Superheat or temperature control	Superheat Control

For further details please refer to EXD-SH1/2 technical bulletin.

Third-party driver/controller

In the case of third-party driver/controller application with CV valves, it must be able to drive CV4-7 according following electrical data:

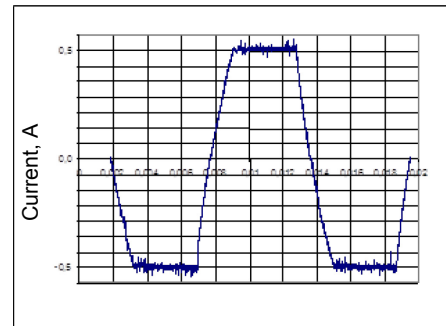
1) Chopper/constant current operation

The stepper motor of CV4-7 is a bipolar, 2-phase permanent-magnet motor and operates with constant DC current in each phase. A driver board with chopper drive function feeds a DC current as indicated below to the windings of the stepper motor.

2) **Operating/holding current**, frequency as well as total number of steps for each valve (See electrical data table in the next page)

3) **Sequence for driving of CV stepper motor in full step mode operation:**

Chopper drive (constant current)



Direction	Reverse direction	Step sequence	M12 plug and cable assembly (EXV-Mxx) Wires color			
			White	Black	Blue	Brown
			Winding 1		Winding 2	
			Supply voltage polarity			
Valve is opening ↓	Valve is closing ↑	Step 1	+	-	+	-
		Step 2	-	+	+	-
		Step 3	-	+	-	+
		Step 4	+	-	-	+
		Remark	The sequence is repeated from step 5 to 8 similar to step 1 to 4			
		Step 5	+	-	+	-
		Step 6	-	+	+	-
		Step 7	-	+	-	+
		Step 8	+	-	-	+
		Remark	The sequence is repeated from step 9 to 12 similar to step 1 to 4			

Note: Operation of CV valves under **deviation condition** as specified might impact the performance of the valve:

Subject	Deviation condition	Impact
Frequency	Below or above 500 Hz	Case 1: Reduces speed / Case 2: Resonance frequency will damage the valve
Current	Below /above specified value	Reduces torque & Maximum operating differential / overheat or damage the motor
Step mode	Half step /Micro step	Reduces the torque and Maximum operating differential

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Technical data

Marking	CE	not required (Out of scope of PED)
	UL	CV4/5/6 (No.MP604)
Compatibility	CO ₂ and POE lubricants	
MOPD	70 bar (In conjunction with EXD-U02 driver)	
Max. working pressure PS	130 bar	
Factory test pressure PT	186 bar	
Temperatures	Ambient	-40...+65°C
	Storage	-40...+70°C
	Medium	-50...+100°C

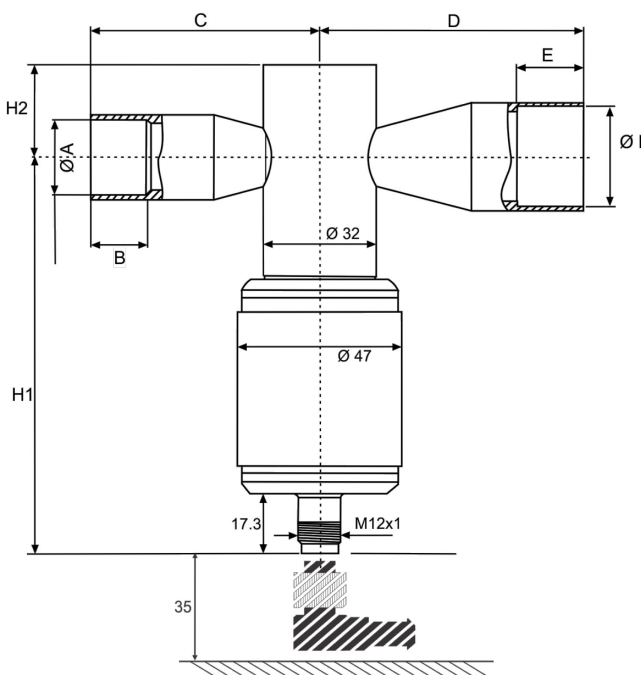
Protection accordance to IEC 529, DIN 40050	IP67 with EXV-Mxx plug and cable assembly
Vibration	4g (0...1000 Hz, 1 octave /min.)
Shock (CV4-6)	20g at 11 ms 80g at 1 ms
External leakage	6.4*10 ⁻⁶ mbar*liter/sec.
Humidity	100% R.H.

Electrical data

Stepper motor type	Bi-polar, phase current by chopper control (constant current)
Electrical connection	4 pins terminal for M12 plug
Driver supply voltage to the valve	18...36VDC
Operating (moving) current peak	CV4: 625 mA CV5-7: 800 mA
Holding current peak	CV4: 100 mA CV5-7: 300 mA
Phase inductance	CV4: 30 mH ± 25% CV5/6/7: 20 mH ± 25%

Step mode	2 phase full step
Stepping rate	500 Hz
Total number of steps	CV4-6: 750 full steps CV7: 6400 full steps.
Winding resistance per phase	CV4: 14 Ohm ±10% CV5-7: 10 Ohm ±10%
Full travel time	CV4-6: 1.5 seconds CV7: 12.8 seconds
Reference position	Mechanical stop at fully close position

Dimensions (mm)



Type	CV4-HPV	CV5-HPV	CV6-HPV	CV7-HPV
Part No.	802056	802057	802058	
Ø A	3/8"	5/8" (16 mm)	7/8" (22 mm)	1-1/8"
x	x	x	x	x
Ø F (ODF)	5/8" (16 mm)	7/8" (22 mm)	1-1/8"	1-1/8"
B (mm)	8	11	16	20
C (mm)	45	55	65	78
D (mm)	55	65	75	83
E (mm)	11	16	19	20
H1 (mm)	113	125	125	205
H2 (mm)	26	26	26	42

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