Alco Controls

Electrical Control Valves CX4/5/6/7 Series

Technical Bulletin

ALCO Controls **CX4** / **CX5** / **CX6** / **CX7** are stepper motor driven valves for precise control of refrigerant mass flow in air conditioning, refrigeration systems with CO2.
The Control Valves can be used as high pressure gas valve after gas cooler, flashtank bypass valve, expansion device, or hot gas bypass valve.

CX4/5/6/7 with ODF connections

CX4/5/6/7 with thread connections

Features

- Multifunction
- Fully hermetic design in two versions: ODF connections and Thread connections
- Mainly for CO2 systems
- 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%)
- Direct coupling of motor and valve for high reliability (no gear mechanism)
- Ceramic slide and port for accurate flow and minimal wear
- Balanced force design
- Corrosion resistant stainless steel body and connections
- Europe patent No. 0743476, USA patent No. 5735501, Japan patent No. 28225789

Selection table

Type	Part No.	Kv (m^3/hr)	Capacity range	Inlet connection	Outlet connection	Electric connector
CX4-CO2	**801990**	0.2	10 … 100%	3/8” ODF	5/8” (16 mm) ODF	M12 plug
CX5-CO2	**801991**	0.6		5/8” (16 mm) ODF	7/8” (22 mm) ODF	
CX6-CO2	**801992**	1.5		7/8” (22 mm) ODF	1-1/8” ODF	
CX7-CO2	**801996**	5.5		1-1/8” ODF	1-1/8” ODF	
CX4-CO2F	802000	0.2		5/8” Thread	5/8” Thread	
CX5-CO2F	802001	0.6		7/8” Thread	7/8” Thread	
CX6-CO2F	802002	1.5		7/8” Thread	7/8” Thread	
CX7-CO2F	802003	5.5		7/8” Thread	7/8” Thread	

Note 1: The valves are delivered without cable/connector assembly (order separately).
Note 2: The valves with thread connections are delivered without counterpart steel tube fitting

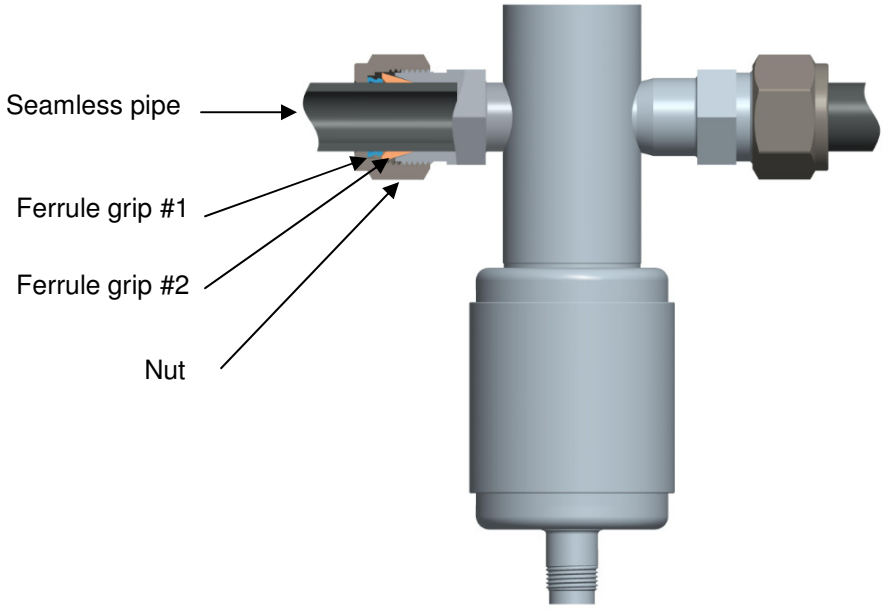
Cable and connector assembly

Type	Part No.	Temperature Range	Length	Connector type to valve	Connector type to driver board or controller	Illustration
EXV-M15	804 663	-50 … +80°C	1.5 m	M12	Loose wires	
EXV-M30	804 664		3.0 m			
EXV-M60	804 665		6.0 m			

Thread connection type description

The valves with thread connection are designed for withstanding against internal high pressure of CO2 while offering the flexibility of removal for service purposes. The two-Ferrule mechanical grip and a nut with internal silver layer coated insure the tightness for external leakage rate at level of $6.4*10^{-6}$ mbarliter/sec.

The fitting permits the connection of the valve to the external seamless carbon steel or preferred seamless stainless steel tubes. The counterparts are available as kit. Each kit consists of one piece of nut and two different ferrule mechanical grips.

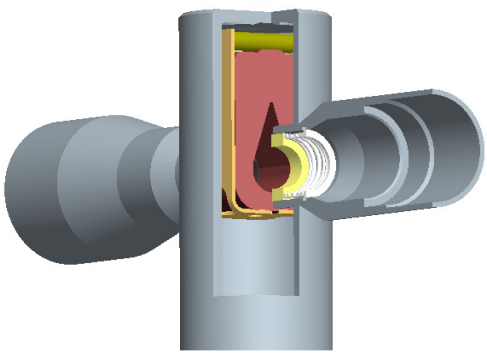


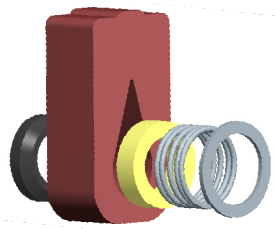
Accessory Kit

Kit set	PCN	Kit content	Useable for valve type	External tube (outside diameter)	Required quantity of kit for each valve (inlet and outlet)	
CXK-058	802010	Two ferrule grips and one nut	CX4-CO2F	5/8”	2	
CXK-078	802011	Two ferrule grips and one nut	CX5-CO2F	7/8”	2	
			CX6-CO2F	7/8”	2	
			CX7-CO2F	7/8”	2	

Valve port design

The gate type valve is optimised 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 from ceramic for precise flow characteristics, high resolution and infinite life as well as seat tightness during long period of system OFF cycle.





Emerson EXD-U Universal driver is a stepper motor driver which uses an analogue input signal to define the valve opening. It enables the operation of CX valves for different type of duties.

The input signal for the driver module can be 4…20mA or 0…10V. The output pulses provide the proportional opening/closing of CX valves and consequently the control of liquid or vapour refrigerant mass flow. The universal driver module can be connected to any controller which provides the analogue signal. This gives system manufacturers the extreme flexibility to use any desired controller in conjunction with the universal driver module to achieve different functionality. For further details please refer to EXD-U technical data sheet.

Third party driver

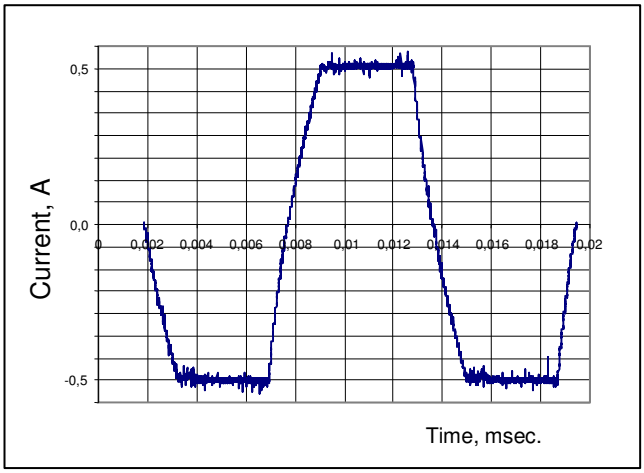
A suitable driver board must be selected according to the electrical data of the stepper motor and based on the following requirements:

- Electrical output (four-stage switching sequence, see below table)
- Stepping rate: 500Hz for CX4/5/6/7/8
- Chopper function, current:

Current	CX4/5/6	CX7
Operating	500 mA	750 mA
Holding	100 mA	250 mA

Chopper drive (constant current)

The stepper motor of CX4/5/6/7/8 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.



Sequence for driving of stepper motor and valve

Direction	Reverse direction	Step sequence	M12 plug and cable assembly (EXV-Mxx) Wires colour			
			White	Black	Blue	Brown
			Current direction			
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			

Electrical Control Valves CX4/5/6/7 Series

Technical data

CE marking	not required
Compatibility	CO_2 and lubricants
MOPD during endurance test	70 bar (In conjunction with EXD-U00 driver)
Max. working pressure	PS: 120 bar
Factory test pressure	PT: 172 bar
Ambient temperature Storage temperature	-40 to +65°C -40 to +70°C
Medium temperature range	TS: -50 to +100°C

Protection accordance to IEC 529, DIN 40050	IP67 with Alco supplied cable connector assembly
Vibration	4g (0 to 1000 Hz, 1 octave /min.)
Shock	20g at 11 ms 80g at 1 ms
External leakage	$6.4*10^{-6}$ mbarliter/sec.
Humidity	100% r.H.
Seat leakage	Positive shut-off better than solenoid valves

Electrical data

Stepper motor type	Bi-polar, phase current by chopper control (constant current)
Electrical connection	4 pin terminal via plug
Recom. driver supply	24 VDC (nominal)
Phase current, operating	CX4/CX5/CX6: 500mA CX7: 750mA ±10%
Holding current	CX4/CX5/CX6: 100mA CX7: 250mA
Nominal input power per phase	CX4/CX5/CX6: 3.5W CX7: 5W

Phase inductance	CX4/CX5/CX6: 30 mH ± 25% CX7: 20 mH ± 25%
Step mode	2 phase full step, half step or microstep
Stepping rate	500Hz
Total number of steps	CX4/CX5/CX6: 750 full steps CX7: 1600 full steps
Winding resistance per phase	CX4/CX5/CX6: 13Ohm ±10% CX7: 8Ohm ±10%
Full travel time	CX4/CX5/CX6: 1.5 seconds CX7: 3.2 seconds
Reference position	Mechanical stop at fully close position

Dimensions (mm)

Valve Type	B	C	D	E	H1	H2
CX4-CO2	8	45	55	11	112.8	26
CX5-CO2	11	55	65	16	112.8	26
CX6-CO2	16	65	75	19	112.8	26
CX7-CO2	20	77.5	82.5	20	157.8	41.5
CX4-CO2F	14.4	41	50	14.4	112.8	26
CX5-CO2F	16	56	56	16	112.8	26
CX6-CO2F	16	56	56	16	112.8	26
CX7-CO2F	16	52.5	64.5	16	157.8	41.5