EMERSON
Climate Technologies

EX2
Pulse Modulated Electronic Expansion Valve

Alco Controls

D A T A S H E E T

ALCO Controls **EX2 Series** is an electronically controlled expansion device. The capacity is defined through pulse width modulation. The EX2 can be driven by any electronic system providing the necessary electric power. However we recommend to use the Emerson EC2 Series. The primary application is for display cases in commercial refrigeration such as supermarkets.

Features

- Pulse width modulated
- Shut off function eliminates the necessity of a separate solenoid valve
- Dampened plunger reduces noise an effects of water hammer
- One valve body can be combined with 6 orifices to make 7 capacity ranges, up to 18.7 kW (R 407C)
- Applicable to all common refrigerants (HCFC, HFC) and for subcritical CO_2 applications
- Available with ODF connections
- Long lifetime, high reliability
- Utilizing standard ASC coils (to be ordered separately)

EX2

Introduction

The EX2 is designed for pulse width modulation and therefore able to provide a very precise temperature control. It is applicable to all common HCFC and HFC refrigerants and for subcritical CO_2 applications and may be used on conventional, multiple evaporator or compressor systems.

The EX2 valve is a slide type solenoid valve with an orifice for expansion. This construction ensures noise free operation and avoids the „water hammer“ due to soft closing. It is either completely open or completely closed. One common valve body can be combined with 6 interchangeable orifices to cover 7 capacity ranges (see selection chart). The table quotes capacities at 100% duty cycle, i.e. valve open continuously. However, it is recommended to operate the valve at partial load (50-80%) to allow for system load fluctuations. When used with an EC2 case controller, the valve operates with a 6 second pulse width cycle. Partial capacity can be calculated by proportioning the actual pulse time relative to 6 sec. i.e. 3 sec. pulse width cycle time = 50% valve capacity.

The standard ASC coil which operates the EX2 valve is available in a wide range of AC or DC voltages.

We recommend to use the EC2 Electronic display case controller from EMERSON together with the EX2 valve which operates on a 24V AC supply.

Selection Chart

Description	Type	Part No.	Capacity Q_n at 100% Open Valve (kW)*					
			R 134a	R 22	R 404A	R 507	R 407C	R 744
Valve 10mm inlet / 12mm outlet	EX2-M00	801 091	13.3	17.2	12.1	12.1	18.7	35
Valve 3/8“ inlet / 1/2“ outlet	EX2-I00	801 090						
Orifice 4	EXO-004	801 089	8.5	10.9	7.7	7.7	11.8	22.2
Orifice 3	EXO-003	801 088	5.6	7.2	5.1	5.1	7.8	14.6
Orifice 2	EXO-002	801 087	3.3	4.3	3.0	3.0	4.7	8.7
Orifice 1	EXO-001	801 086	2.5	3.2	2.3	2.3	3.5	6.5
Orifice 0	EXO-000	801 085	1.2	1.6	1.1	1.1	1.7	3.3
Orifice X	EXO-00X	801 084	0.7	0.9	0.6	0.6	1.0	1.8
Coil 24 VAC / 50-60 Hz (10 W)	ASC 24V	801 062	for use with the EMERSON EC2 controller (other coils voltages upon request)					

*) Orifice should be selected at maximum 80% of Qn to allow covering the load fluctuation.

The nominal capacity (Qn) is based on the following conditions:

Refrigerant	Evaporating temperature	Condensing temperature	Subcooling
R 407C	+4°C dew point	+38°C bubble / +43°C dew point	1K
R 22, R 134a, R 404A, R 507	+4°C	+38°C	1K
R 744	-40°C	-10°C	1K

Correction tables

Following tables should be used for selecting valves at operating conditions other than the nominal capacity stated on page 1.

The following design conditions must be available in order to select the correct valve:

- Required cooling capacity (Q_0)
- Effective pressure differential across EX2 valve (Δp)
- Evaporating temperature / pressure
- Highest and lowest possible condensing temperature / pressure. Duty cycle should be calculated for both operating conditions.
- Liquid temperature at the inlet of valve
- Refrigerant

To calculate the nominal capacity, the following formula has to be used:

Nominal capacity of EX2 =
Required cooling capacity x $K_{\Delta p}$ x K_t

- Select K_t-factor according to refrigerant, liquid and evaporating temperature from table below.
- Determine effective pressure differential across the Valve using condensing pressure, subtract evaporating pressure and all other possible pressure losses. Select $K_{\Delta p}$-factor from table below.

Example

A valve has to be selected for the following conditions:

- Refrigerant R 404A
- System cooling capacity Q_0 5.0 kW
- Evaporating temperature -15°C
- Lowest condensing temperature +25°C
- Liquid temperature +20°C

Calculation:

1. Theoretical pressure differential:
   Condensing pressure is Pc = 11.55 bar at +25°C
   Evaporating pressure is P_0 = 2.70 bar at -15°C
   Differential pressure is Pc - P_0 = 11.55 - 2.70 = 8.85 bar
2. Pressure losses:
   Across distributor = 1.0 bar
   Others in piping, drier, sight glass, fitting, etc. = 0.69 bar
   Total pressure losses = 1 + 0.69 = 1.69
3. Effective pressure differential across valve:
   8.85 - 1.69 = 7.16 bar
4. Correction factors:
   Correction factor $K_{\Delta p}$ for the pressure differential 7.16 bar from table below for R 404A Δp = 7.2 $K_{\Delta p}$ = 1.23
   Correction factor K_t for liquid and evaporating temperature from table below for R 404A
   at +20°C / -15°C K_t = 0.83
5. Calculation of nominal capacity Q_0 x $K_{\Delta p}$ x K_t = Qn:
   5.0 x 1.22 x 0.83 = 5.1 kW

Valve can be selected from table on page 1:

Choose an orifice with 80% nominal capacity matching to 5.1 kW required capacity.

Orifice number 3 has 5.1 kW at 100 % and 4.08 kW at 80%. This value is below required 5.1 kW so select the bigger size of orifice.

Select EX2 with Orifice 4; nominal capacity of 7.7 kW.

When used in conjunction with EMERSON's EC2 controller, the required capacity will be achieved with a duty cycle of:

5,1 kW / 7,7 kW = 66%;

With a 100% duty cycle time of 6 sec the net duty cycle is 4 sec. (approx.).

Liquid temperature entering valve	R 404A Correction factor K_t Evaporating temperature °C											
	+15	+10	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40
+55	1.42	1.46	1,50	1.55	1,61	1.68	1,75	1.83	1,92	2.01	2,13	2.25
+50	1.23	1.26	1,30	1.34	1,38	1.43	1,48	1.54	1,61	1.68	1,75	1.84
+45	1.10	1.12	1,15	1.18	1,22	1.26	1,30	1.34	1,39	1.45	1,51	1.57
+40	0.99	1.02	1,04	1.07	1,09	1.13	1,16	1.20	1,24	1.28	1,33	1.38
+35	0.91	0.93	0,95	0.97	1,00	1.02	1,05	1.08	1,11	1.15	1,19	1.23
+30	0.84	0.86	0,88	0.90	0,92	0.94	0,96	0.99	1,02	1.05	1,08	1.11
+25	0.79	0.80	0,82	0.83	0,85	0.87	0,89	0.92	0,94	0.97	0,99	1.02
+20	0.74	0.75	0,77	0.78	0,80	0.81	0,83	0.85	0,87	0.90	0,92	0.95
+15	0.70	0.71	0,72	0.73	0,75	0.76	0,78	0.80	0,82	0.84	0,86	0.88
+10		0.67	0,68	0.69	0,71	0.72	0,74	0.75	0,77	0.79	0,81	0.83
+5			0,65	0.66	0,67	0.68	0,70	0.71	0,73	0.74	0,76	0.78
0				0.63	0,64	0.65	0,66	0.68	0,69	0.71	0,72	0.74
-5					0,61	0.62	0,63	0.65	0,66	0.67	0,69	0.70
-10						0.60	0,61	0.62	0,63	0.64	0,65	0.67

	R 404A Correction factor $K_{\Delta p}$																							
Δp (bar)	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
$K_{\Delta p}$	1.74	1.63	1.54	1.46	1.39	1.33	1.28	1.23	1.19	1.15	1.12	1.09	1.03	0.98	0.94	0.90	0.87	0.84	0.81	0.79	0.77	0.75	0.73	0.71

Liquid temperature entering valve	R 134a Correction factor K_t Evaporating temperature °C											
	+15	+10	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40
+55	1.21	1.23	1,26	1.29	1,33	1.36	1,39	1.43	1,47	1.52	1,57	1.62
+50	1.13	1.15	1,17	1.20	1,23	1.26	1,28	1.32	1,36	1.39	1,44	1.48
+45	1.06	1.08	1,10	1.12	1,15	1.17	1,19	1.22	1,26	1.29	1,33	1.37
+40	0.99	1.01	1,03	1.05	1,08	1.10	1,12	1.14	1,17	1.20	1,23	1.27
+35	0.94	0.96	0,97	0.99	1,01	1.03	1,05	1.07	1,10	1.12	1,15	1.18
+30	0.89	0.91	0,92	0.94	0,96	0.98	0,99	1.01	1,03	1.06	1,08	1.11
+25	0.85	0.86	0,87	0.89	0,91	0.92	0,94	0.95	0,97	1.00	1,02	1.04
+20	0.81	0.82	0,83	0.85	0,89	0.88	0,89	0.91	0,92	0.94	0,96	0.98
+15	0.77	0.78	0,79	0.81	0,82	0.84	0,84	0.86	0,88	0.89	0,91	0.93
+10		0.75	0,76	0.77	0,78	0.80	0,81	0.82	0,84	0.85	0,87	0.89
+5			0,73	0.74	0,75	0.76	0,77	0.78	0,80	0.81	0,83	0.84
0				0.71	0,72	0.73	0,74	0.75	0,76	0.78	0,79	0.81
-5					0,69	0.70	0,71	0.72	0,73	0.74	0,76	0.77
-10						0.68	0,68	0.69	0,70	0.71	0,73	0.74

	R 134a Correction factor $K_{\Delta p}$																																																							
Δp (bar)	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
$K_{\Delta p}$	1.34	1.25	1.18	1.12	1.07	1.02	0.98	0.95	0.91	0.88	0.86	0.83	0.79	0.75	0.72	0.69	0.67	0.65	0.63	0.61	0.59	0.57	0.56	0.55

Liquid temperature entering valve	R 22 Correction factor K_t Evaporating temperature °C											
	+15	+10	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40
+55	1.17	1.19	1,20	1.22	1,24	1.25	1,27	1.29	1,32	1.34	1,37	1.39
+50	1.11	1.12	1,13	1.15	1,16	1.18	1,20	1.22	1,24	1.26	1,28	1.30
+45	1.05	1.06	1,07	1.08	1,10	1.12	1,13	1.15	1,17	1.18	1,20	1.23
+40	1.00	1.01	1,02	1.03	1,04	1.06	1,07	1.09	1,10	1.12	1,14	1.16
+35	0.95	0.96	0,97	0.98	0,99	1.01	1,02	1.03	1,05	1.06	1,08	1.10
+30	0.91	0.92	0,93	0.94	0,95	0.96	0,97	0.98	1,00	1.01	1,03	1.04
+25	0.87	0.88	0,89	0.89	0,91	0.92	0,93	0.94	0,95	0.96	0,98	0.99
+20	0.83	0.84	0,85	0.86	0,87	0.88	0,89	0.90	0,91	0.92	0,93	0.95
+15	0.80	0.81	0,81	0.82	0,83	0.84	0,85	0.86	0,87	0.88	0,89	0.91
+10		0.78	0,78	0.79	0,80	0.81	0,82	0.83	0,84	0.85	0,86	0.87
+5			0,75	0.76	0,77	0.78	0,79	0.79	0,80	0.81	0,82	0.83
0				0.73	0,74	0.75	0,76	0.77	0,77	0.78	0,79	0.80
-5					0,72	0.72	0,73	0.74	0,75	0.75	0,76	0.77
-10						0.70	0,71	0.71	0,72	0.73	0,74	0.74

	R 22 Correction factor $K_{\Delta p}$																						
Δp (bar)	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
$K_{\Delta p}$	1.59	1.49	1.40	1.33	1.27	1.22	1.17	1.13	1.09	1.05	1.02	0.99	0.94	0.90	0.86	0.83	0.80	0.77	0.75	0.72	0.70	0.68	0.67	0.65

Liquid temperature entering valve	R 744 Correction factor K_t Evaporating temperature °C										
	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40	
+5	1,12	1,10	1,09	1,08	1,08	1,07	1,07	1,07	1,08	1,08	
+0		1,02	1,01	1,01	1,00	1,00	1,00	1,00	1,00	1,01	
-5			0,95	0,94	0,94	0,94	0,94	0,94	0,94	0,94	
-10				0,89	0,89	0,88	0,88	0,88	0,89	0,89	
-15					0,84	0,84	0,84	0,84	0,84	0,84	
-20						0,80	0,80	0,80	0,80	0,80	
-25							0,76	0,76	0,76	0,76	
-30								0,73	0,73	0,73	
-35									0,70	0,70	
-40										0,67	

	R 744 Correction factor $K_{\Delta p}$																						
Δp (bar)	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0
$K_{\Delta p}$	1,81	1,65	1,53	1,43	1,35	1,28	1,22	1,17	1,12	1,08	1,05	1,01	0,98	0,95	0,93	0,91	0,88	0,86	0,84	0,83	0,81	0,79	0,78	0,77

Liquid temperature entering valve	R 407C Correction factor K_t Evaporating temperature °C											
	+15	+10	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40
+55	1,26	1,28	1,31	1,34	1,37	1,40	1,44	1,48	1,52			
+50	1,15	1,17	1,19	1,22	1,24	1,27	1,30	1,33	1,37			
+45	1,06	1,08	1,10	1,12	1,14	1,17	1,19	1,22	1,25			
+40	0,99	1,01	1,02	1,04	1,06	1,08	1,11	1,13	1,16			
+35	0,93	0,94	0,96	0,98	0,99	1,01	1,03	1,05	1,07			
+30	0,88	0,89	0,90	0,92	0,93	0,95	0,97	0,99	1,01			
+25	0,83	0,84	0,85	0,87	0,88	0,90	0,91	0,93	0,95			
+20	0,79	0,80	0,81	0,82	0,84	0,85	0,86	0,88	0,90			
+15	0,75	0,76	0,77	0,78	0,80	0,81	0,82	0,84	0,85			
+10		0,73	0,74	0,75	0,76	0,77	0,78	0,80	0,81			
+5			0,71	0,72	0,73	0,74	0,75	0,76	0,77			
0				0,69	0,70	0,71	0,72	0,73	0,74			
-5					0,67	0,68	0,69	0,70	0,71			
-10						0,65	0,66	0,67	0,68			

	R 407C Correction factor $K_{\Delta p}$																																					
Δp (bar)	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
$K_{\Delta p}$	1.81	1.69	1.59	1.51	1.44	1.38	1.33	1.28	1.23	1.19	1.16	1.13	1.07	1.02	0.98	0.94	0.90	0.87	0.84	0.82	0.80	0.78	0.76	0.74

Liquid temperature entering valve	R 507 Correction factor K_t Evaporating temperature °C											
	+15	+10	+5	+0	-5	-10	-15	-20	-25	-30	-35	-40
+55	1.39	1.43	1,47	1.52	1,57	1.62	1,69	1.76	1,83	1.92	2,02	2.12
+50	1.22	1.24	1,28	1.31	1,35	1.40	1,44	1.49	1,55	1.61	1,68	1.76
+45	1.09	1.11	1,14	1.17	1,20	1.23	1,27	1.31	1,36	1.40	1,46	1.52
+40	0.99	1.01	1,03	1.06	1,08	1.11	1,14	1.17	1,21	1.25	1,29	1.34
+35	0.91	0.93	0,95	0.97	0,99	1.01	1,04	1.07	1,10	1.13	1,16	1.20
+30	0.85	0.86	0,88	0.89	0,91	0.93	0,96	0.98	1,01	1.03	1,06	1.09
+25	0.79	0.80	0,82	0.83	0,85	0.87	0,89	0.91	0,93	0.95	0,98	1.01
+20	0.74	0.75	0,77	0.78	0,79	0.81	0,83	0.85	0,87	0.89	0,91	0.93
+15	0.71	0.71	0,72	0.73	0,75	0.76	0,78	0.79	0,81	0.83	0,85	0.87
+10		0.67	0,68	0.69	0,70	0.72	0,73	0.74	0,76	0.78	0,79	0.81
+5			0,64	0.65	0,67	0.68	0,69	0.70	0,72	0.73	0,75	0.76
0				0.62	0,63	0.64	0,65	0.66	0,68	0.69	0,70	0.72
-5					0,60	0.61	0,62	0.63	0,64	0.65	0,66	0.68
-10						0.58	0,59	0.60	0,61	0.62	0,63	0.64

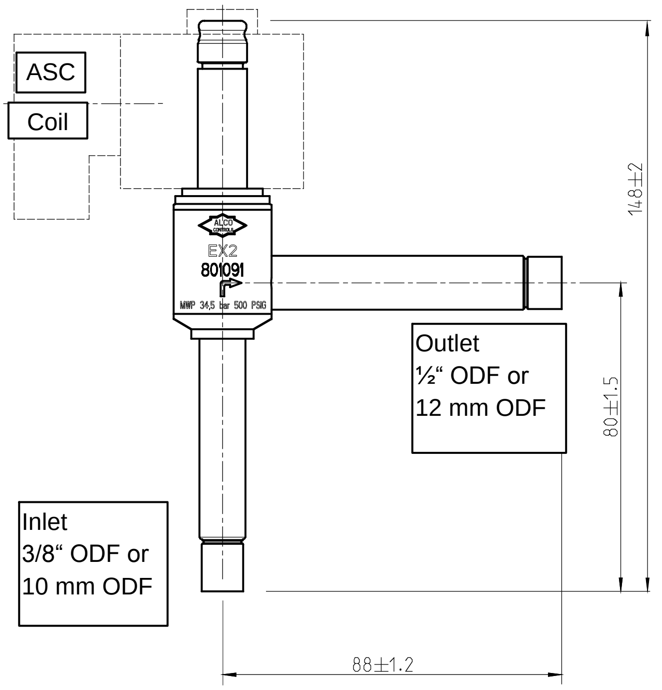
	R 507 Correction factor $K_{\Delta p}$																						
Δp (bar)	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0
$K_{\Delta p}$	1.75	1.64	1.54	1.46	1.40	1.34	1.28	1.24	1.19	1.16	1.12	1.09	1.03	0.99	0.94	0.91	0.87	0.84	0.82	0.79	0.77	0.75	0.73	0.71

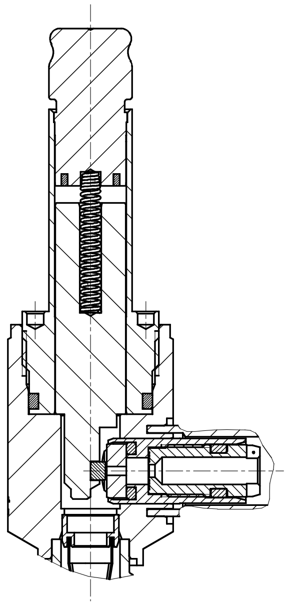
Technical data

MOPD (maximum operating pressure differential)	30 bar
Medium Temperature	-40° … +50°C
Maximum Working Pressure (PS)	40 bar
Test Pressure (PT)	44 bar
Compatibility	
Oils	Mineral, Alkyl benzene and ester lubricants
Refrigerants	R22, R404A, R507, R134a, R407C, R744 (subcritical application), R502. Not suitable for R11 or Ammonia.

Lifetime with EC2 (pulse cycle time 6 sec)	80 Million cycles life equivalent to 15 yr.
Seat leakage	< 4cc/min. Nitrogen with 10bar differential pressure
External leak rate	< 1,3 g R 134a / year
Weight	0,25 kg

Physical dimensions, drawing





EX2 cross sectional view

(not to scale)

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