

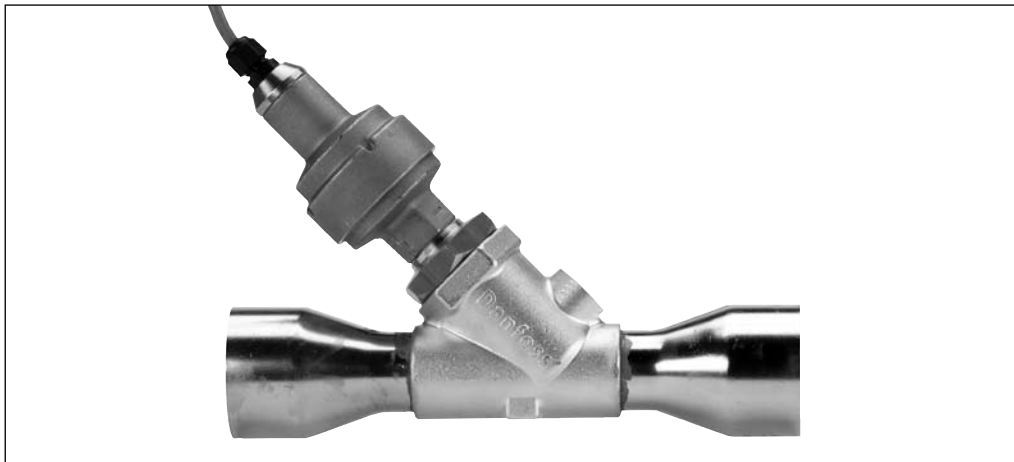


## **Electrically operated suction modulating control valves, type KVS**

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Introduction



KVS is a series of electrically operated suction modulating control valves for AC transport and refrigeration applications.

Accurate temperature or pressure control is obtained by modulating the refrigerant flow in the evaporator with a current or voltage driver.

With an EKC 368 controller (current driver) and an AKS sensor placed in the media to be controlled, an accuracy better than  $\pm 0.5K$  can be obtained.

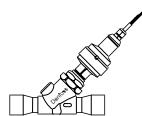
The balanced design provides bi-flow operation as well as solenoid shut-off function in both flow directions at MOPD 33 bar (478 psi).

The KVS design is being registered. The pending reference number is 200530003728.1.

Features

- Balanced port design.
- High resolution for precise control.
- Solenoid tight shut-off.
- Low power consumption.
- Corrosion resistant design external as well as internal.
- For manual operation and service of KVS valves an AST-g service driver is available. For further information please contact Danfoss (Commercial Refrigeration & Air Conditioning Controls).

Technical data



Parameter	KVS 42-54
Compatibility	HFC, HCFC
CE marking	Yes
MOPD	33 bar (478 psi)
Max. working pressure	34 bar (493 psig)
Refrigerant temperature range	-40 to +10°C (-40 to +50°F)
Ambient temperature	-40 to +60°C (-40 to +140°F)
Total stroke	17.2 mm (0.68 in.)
Motor enclosure	IP 67

Electrical data

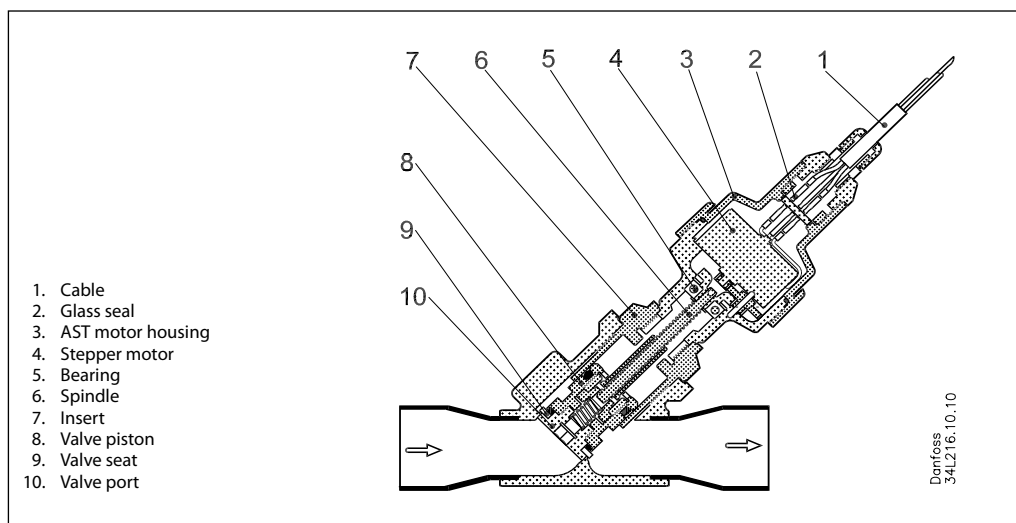
Parameter	KVS 42-54
Stepper motor type	Bi-polar - permanent magnet
Step mode	2 phase full step
Phase resistance	52Ω ±10%
Phase inductance	85 mH
Holding current	Depends on application. Full current allowed (100% duty cycle)
Step angle	7.5° (motor), 0.9° (lead screw), Gearing ration 8.5:1. (38/13) <sup>2</sup> :1
Nominal voltage	(Constant voltage drive) 12 V dc -4% +15%, 150 steps/sec.
Phase current	(Using chopper drive) 100 mA RMS -4% +15%,
Max. total power	Voltage / current drive: 5.5 / 1.3 W (UL: NEC class 2)
Step rate	150 steps/sec. (constant voltage drive) 0-300 steps/sec. 300 recommended (chopper current drive)
Total steps	KVS 42-54: 3810 [+160 / -0] steps
Full travel time	KVS 42-54: 25.4 / 12.7 sec. (voltage / current)
Lifting height	KVS 42-54: 17.2 mm (0.68 in.)
Reference position	Overdriving against the full close position
Electrical connection	4 wire 0.5 mm <sup>2</sup> (0.02 in <sup>2</sup> ), 2 m (6.5 ft) long cable

Stepper motor switch sequence:

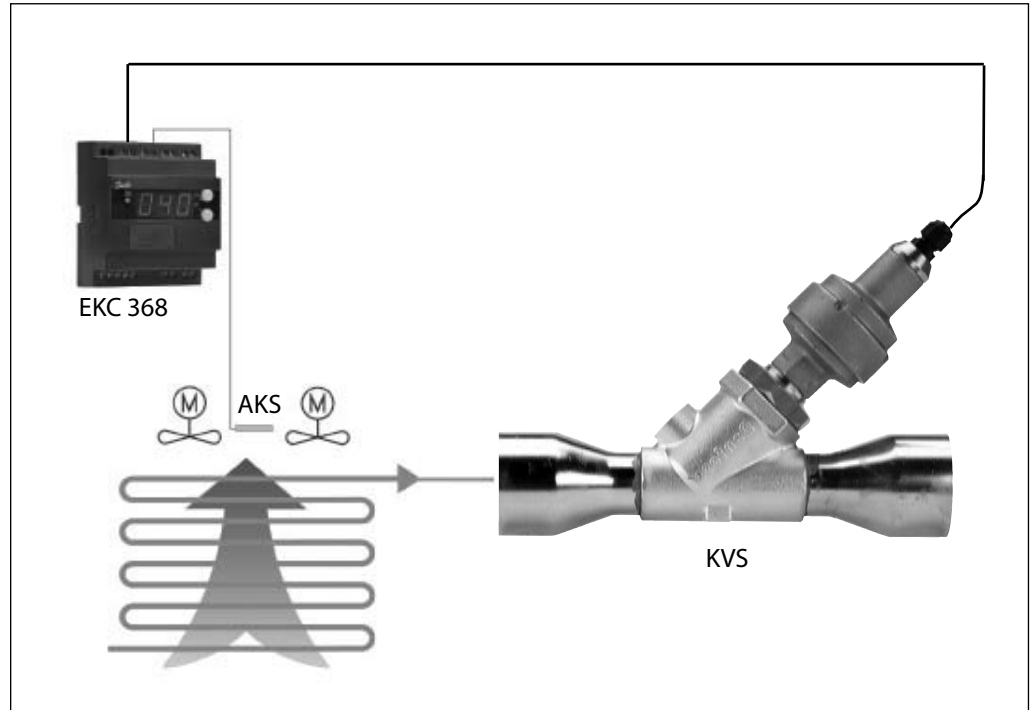
	STEP	Coil I		Coil II		
		Red	Green	White	Black	
↑ CLOSING ↑  KVS 42-54	1	+	-	+	-	↓ OPENING ↓  KVS 42-54
	2	+	-	-	+	
	3	-	+	-	+	
	4	-	+	+	-	
	1	+	-	+	-	

Design

Valve / Actuator type KVS / AST



Valve operation



KVS valves are modulated by an electronically controlled 2-phase bipolar stepper motor (AST). The stepper stays in position unless power pulses from a driver initiate one of the two discrete sets of motor windings that operate respectively in the opening and closing directions.

The direction of motor rotation depends on the phase relationship of the power pulses. The distance traveled depends on the number of pulses transmitted for a given move.

The motor drives a lead screw, whose rotating motion is transformed into linear motion by a transmission in the cage assembly.

The AST motor housing has a glass sealed 2 m (6.5 feet) cable connection as standard. Cable length and connections can be customized.

The valve cone is an exponential V-port design that provides best part load efficiency with zero-resistance maximum capacity

The cage and orifice design is fully power balanced, so that bi-flow operation has equal performance and capacity in either direction.

The port design includes a shut-off function with "solenoid tightness" in both flow directions. Closed position is also the mechanical stop acting as reference point to reset the controller. The zero reference point is reset at each closing, with accuracy ensured by a slight overdrive.

**Sizing**

For optimum performance, it is important to take into consideration all system conditions and requirements. Selection is also dependent on an acceptable pressure drop across the valve. The following information will be needed when sizing a KVS valve:

- Refrigerant - HCFC or HFC
- Evaporator capacity  $Q_e$  in kW or TR
- Evaporating temperature  $t_e$  in °C or °F
- Liquid temperature ahead of expansion valve  $t_l$  in °C or °F
- Max. acceptable pressure drop in the KVS valve in bar or psig
- Connection size

**Valve selection Example**

In valve selection it may be necessary to apply a correction factor to the actual evaporator capacity. This correction is required when system conditions are different than table conditions. Selection also depends on having an acceptable pressure drop across the valve. The following example illustrates correct sizing.

- *Refrigerant:*  
R22
- *Evaporator capacity:*  
 $Q_e = 20$  kW (5.7 TR)
- *Evaporating temperature:*  
 $t_e = -5^\circ\text{C} \sim 3.3$  bar (23°F ~ 47.9 psig)
- *Liquid temperature ahead of expansion valve:*  
 $t_l = 25^\circ\text{C}$  (77°F)
- *Max. pressure drop in the valve*  
 $\Delta p = 0.2$  bar (2.9 psig)
- *Connection type:*  
Solder
- *Connection size:*  
1 1/8 in.

**Step 1**

Determine the correction factor for liquid temperature  $t_l$  ahead of expansion valve.

From the correction factors table (see below) a liquid temperature of 25°C (100°F), R22 corresponds to a factor of 1.0.

*Correction factors for liquid temperature  $t_l$*

$t_l$ °C	10	15	20	25	30	35	40	45	50
R134a	0.88	0.92	0.96	<b>1.0</b>	1.05	1.10	1.16	1.23	1.31
R22	0.90	0.93	0.96	<b>1.0</b>	1.05	1.10	1.13	1.18	1.24
R404A / R507	0.84	0.89	0.94	<b>1.0</b>	1.07	1.16	1.26	1.40	1.57
R407C	0.88	0.91	0.95	<b>1.0</b>	1.05	1.11	1.18	1.26	1.35

$t_l$ °F	50	60	70	80	90	100	110	120
R134a	0.79	0.82	0.86	0.90	0.95	<b>1.0</b>	1.06	1.13
R22	0.82	0.85	0.88	0.92	0.96	<b>1.0</b>	1.05	1.10
R404A / R507	0.71	0.75	0.80	0.85	0.92	<b>1.0</b>	1.10	1.24
R407C	0.78	0.81	0.85	0.89	0.94	<b>1.0</b>	1.07	1.15

**Step 2**

Corrected evaporator capacity is  
 $Q_e = 20 \times 1.0 = 20$  kW ( $5.7 \times 1.0 = 5.7$  TR)

**Step 3**

Now select the appropriate capacity table, R22, and choose the column for an evaporating temperature of  $t_e = -5^\circ\text{C}$  (23°F).

KVS 42 delivers 44.67 kW (12.8 TR) at a 0.2 bar (2.9 psig) pressure drop across the valve.

Using the corrected evaporator capacity, select a valve that provides an equivalent or greater capacity at an acceptable pressure drop across the valve of 0.2 bar (2.9 psig).

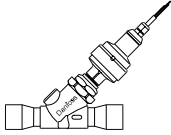
Based on the required connection size of 1 1/8 in., the KVS 42 is the proper selection for this example.

**Step 4**

KVS 42, 1 1/8 in. solder connection:  
**code no. 034L2050**

Ordering

Valve / Actuator type KVS / AST-g in single pack

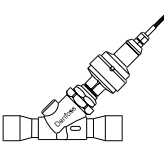


Type	Rated capacity <sup>1)</sup>						Valve KVS + Actuator AST		
	R22		R134a		R404A/R507		Connection		Code no. single pack
	kW	TR	kW	TR	kW	TR	mm	in.	
KVS 42	40.4	11.4	29.3	8.3	35.3	10.0	22	¾	034G2058
	40.4	11.4	29.3	8.3	35.3	10.0	28	1¼	034G2050
	40.4	11.4	29.3	8.3	35.3	10.0	35	1½	034G2051
	40.4	11.4	29.3	8.3	35.3	10.0	X	1¼	034G2052
KVS 54	55.5	15.7	40.3	11.4	48.5	13.7	X	1½	034G3050
	55.5	15.7	40.3	11.4	48.5	13.7	54	2¼	034G3051

<sup>1)</sup> Rated capacity is the valve capacity at evaporating temperature  $t_e = -10^\circ\text{C}$  (14°F), condensing temperature  $t_c = +25^\circ\text{C}$  (77°F) and pressure drop across valve  $\Delta p = 0.2$  bar (2.9 psig).

**Capacities**  
 Range -40°C to +10°C

SI units

	$t_e$ [°C]	Rated capacity [kW]											
		KVS 42						KVS 54					
		Pressure drop $\Delta p$ [bar]											
		0.05	0.1	0.2	0.3	0.5	0.7	0.05	0.1	0.2	0.3	0.5	0.7
R134a	-40	6.79	8.84	10.24	10.25	10.25	10.25	9.33	12.16	14.08	14.09	14.09	14.09
	-30	9.25	12.52	16.04	17.49	17.67	17.67	12.72	17.21	22.06	24.05	24.30	24.30
	-20	12.12	16.68	22.24	25.54	28.32	28.42	16.67	22.93	30.58	35.11	38.94	39.08
	-10	15.48	21.5	29.29	34.47	40.79	43.65	21.28	29.56	40.27	47.40	56.08	60.01
	-5	17.34	24.16	33.13	39.28	47.28	51.73	23.85	33.22	45.55	54.01	65.00	71.13
	10	23.79	33.35	46.32	55.69	69.18	78.58	32.71	45.85	63.69	76.57	95.12	108.04
R404A/R507	-40	8.66	11.92	15.90	18.27	20.29	20.37	11.91	16.39	21.87	25.12	27.89	28.00
	-30	11.33	15.74	21.47	25.29	29.98	32.18	15.58	21.65	29.52	34.77	41.23	44.24
	-20	14.46	20.21	27.89	33.30	40.74	45.46	19.88	27.79	38.35	45.79	56.01	62.51
	-10	18.09	25.37	35.27	42.45	52.83	60.14	24.88	34.89	48.50	58.37	72.65	82.70
	-5	20.11	28.24	39.36	47.49	59.45	68.12	27.65	38.83	54.12	65.30	81.75	93.66
	10	27.06	38.13	53.53	65.07	82.73	96.36	37.21	52.43	73.60	89.47	113.75	132.49
R22	-40	10.58	14.45	18.95	21.30	22.37	22.37	14.54	19.87	26.05	29.29	30.76	30.76
	-30	13.56	18.77	25.36	29.58	34.19	35.42	18.64	25.80	34.87	40.67	47.02	48.70
	-20	16.96	23.65	32.48	38.58	46.63	51.26	23.32	32.52	44.66	53.05	64.11	70.48
	-10	20.80	29.13	40.39	48.46	59.92	67.69	28.60	40.06	55.54	66.63	82.39	93.07
	-5	22.90	32.12	44.67	53.77	66.98	76.31	31.48	44.16	61.42	73.94	92.10	104.93
	10	29.90	42.07	58.88	71.36	90.15	104.30	41.12	57.85	80.97	98.12	123.95	143.41

## Correction factors

$t_i$ [°C]	+25	+30	+35	+40
R134a, R22	1.0	1.04	1.09	1.14
R404a/R507	1.0	1.06	1.12	1.20

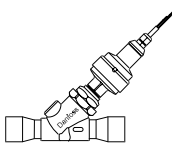
The values in the capacity table refer to the evaporator capacity and are based on liquid temperature  $t_i = +25^\circ\text{C}$  ahead of the thermostatic expansion valve.

Dry, saturated vapour ahead of the KVS valve is assumed.



**Capacities**  
 Range -40°F to +50°F

US units

	$t_e$ [°F]	Rated capacity [TR]											
		KVS 42						KVS 54					
		Pressure drop $\Delta p$ [psig]											
		0.7	1.5	2.9	4.4	7.3	10.0	0.7	1.5	2.9	4.4	7.3	10.0
R134a	-40	1.66	2.21	2.54	2.54	2.54	2.54	2.28	3.04	3.49	3.49	3.49	3.49
	-22	2.27	3.16	4.00	4.37	4.41	4.41	3.12	4.35	5.50	6.00	6.06	6.06
	-4	2.99	4.25	5.58	6.43	7.11	7.13	4.11	5.84	7.67	8.84	9.77	9.80
	14	3.84	5.51	7.38	8.73	10.30	10.98	5.28	7.57	10.15	12.00	14.17	15.10
	23	4.31	6.20	8.37	9.97	11.98	13.03	5.93	8.53	11.51	13.71	16.47	17.92
	50	5.95	8.62	11.78	14.24	17.65	19.89	8.18	11.86	16.20	19.58	24.27	27.35
R404A/R507	-40	1.97	2.80	3.68	4.25	4.70	4.72	2.71	3.85	5.07	5.84	6.47	6.49
	-22	2.61	3.75	5.03	5.96	7.04	7.53	3.59	5.16	6.92	8.19	9.69	10.35
	-4	3.37	4.87	6.61	7.93	9.68	10.73	4.63	6.69	9.09	10.90	13.31	14.75
	14	4.25	6.17	8.44	10.21	12.67	14.31	5.85	8.48	11.60	14.03	17.42	19.67
	23	4.75	6.89	9.45	11.47	14.32	16.27	6.53	9.48	13.00	15.76	19.69	22.37
	50	6.45	9.41	12.99	15.88	20.14	23.23	8.88	12.94	17.86	21.83	27.70	31.95
R22	-40	2.66	3.75	4.85	5.46	5.72	5.72	3.66	5.16	6.67	7.51	7.87	7.87
	-22	3.42	4.89	6.51	7.62	8.79	9.09	4.71	6.73	8.95	10.48	12.09	12.50
	-4	4.29	6.19	8.36	9.98	12.03	13.15	5.90	8.51	11.50	13.72	16.54	18.08
	14	5.28	7.64	10.43	12.57	15.51	17.39	7.26	10.51	14.34	17.29	21.32	23.91
	23	5.82	8.44	11.54	13.97	17.36	19.62	8.00	11.60	15.87	19.21	23.87	26.97
	50	7.62	11.09	15.27	18.60	23.45	26.87	10.48	15.25	20.99	25.58	32.24	36.95

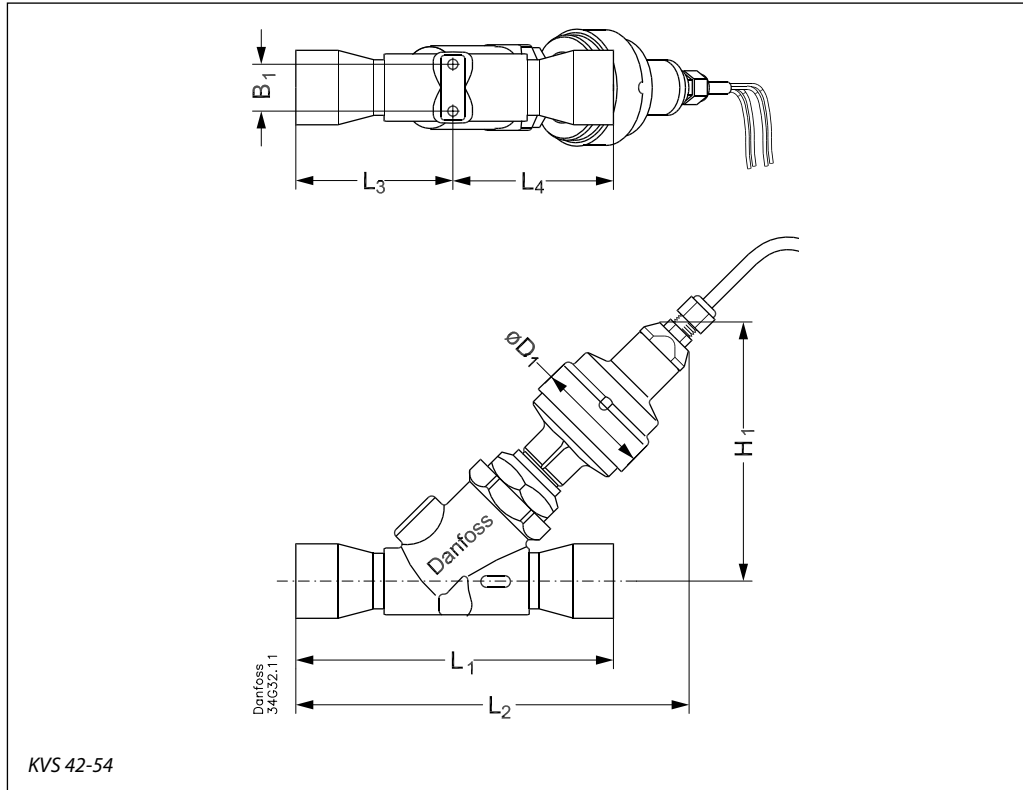
## Correction factors

$t_i$ [°F]	+90	+100	+110	+120
R134a, R22	0.95	1.0	1.05	1.10
R404a/R507	0.92	1.0	1.10	1.24

The values in the capacity table refer to the evaporator capacity and are based on liquid temperature  $t_i = +100^\circ\text{F}$  ahead of the thermostatic expansion valve.

Dry, saturated vapour ahead of the KVS valve is assumed.

Dimensions and weights



Type	Connection		H <sub>1</sub>		L <sub>1</sub>		L <sub>2</sub>		L <sub>3</sub>		L <sub>4</sub>		øD <sub>1</sub>		B <sub>1</sub>		Weight	
	Input × output	Input × output	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	kg	lb.
KVS 42	7/8 × 7/8		133.5	5.3	188.5	7.4	213.0	8.4	93.0	3.7	95.5	3.8	60.0	2.4	24.0	0.95	1.9	4.2
	1 1/8 × 1 1/8	28 × 28			168.5	6.7	203.0	8.0	83.0	3.3	85.5	3.4						
	1 3/8 × 1 3/8	35 × 35			178.5	7.0	208.0	8.2	88.0	3.5	90.5	3.6						
	1 5/8 × 1 5/8	42 × 42			188.5	7.4	213.0	8.4	93.0	3.7	95.5	3.8						
KVS 54	1 5/8 × 1 5/8	42 × 42	133.5	5.3	203.0	8.0	214.0	8.4	99.0	3.9	104.0	4.1	60.0	2.4	24.0	0.95	2.2	4.9
	2 1/8 × 2 1/8	54 × 54			243.0	9.6	234.0	9.2	119.0	4.7	124.0	4.9						



