

# Solenoid Valves

## Basic Terms and Technical Information Operating Principles

**Directly actuated:** The magnetic field of the solenoid coil forces a movement of the plunger and thus causes the opening of the valve seat.

**Servo actuated:** The magnetic field of the solenoid coil is only utilized for the opening of the pilot valve seat. The necessary energy to actuate the piston or diaphragm of the main valve seat is provided by the refrigerant flow and results in a certain pressure drop.

### Minimum Pressure Drop

Directly actuated solenoid valves do not require a minimum pressure drop for proper operation.

Servo operated solenoid valves require a minimum pressure drop of approximately 0.05 bar to remain fully open. In case of insufficient refrigerant flow, this value will not be reached and the solenoid valve may close unintentionally. These closures may lead to malfunctions and oscillations in the refrigeration circuit. Improper sizing of solenoid valves (i.e., use of excessively large solenoid valves) is the main cause of this effect. This is particularly important in capacity controlled refrigeration circuits.

Therefore the decisive factor for proper solenoid valve sizing is the respective capacity of the valve and not its connection size.

Formula for calculating the actual pressure drop of a solenoid valve:

$$\Delta_{p1} = \Delta_{p2} \times (Q_{n1}/Q_{n2})^2$$

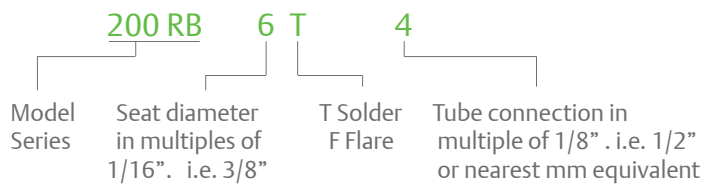
- $\Delta_{p1}$ : Actual pressure drop
- $\Delta_{p2}$ : Nominal pressure drop at  $Q_{n1}$
- $Q_{n1}$ : Calculated nominal capacity
- $Q_{n2}$ : Nominal capacity of selected valve

### Maximum Operating Pressure Differential (MOPD)

MOPD is the maximum pressure differential between inlet and outlet of the solenoid valve which permits proper opening of the valve. When used with Alco AC solenoid coils all Alco solenoid valves employ 25 bar MOPD.

Operation in conjunction with DC solenoid coils lead to reduced MOPD values depending on valve type and size. The DS2 Chopper Plugs allow the use of 24VAC coils with 24VDC by converting the DC in an AC voltage. Please contact Emerson application engineering for additional details.

## Type Code



## Selection Table for Solenoid Valves

Selection Criteria	Series							
	110 RB	200 RB / 200 RH	200RC	240 RA		540 RA		M36
				8/9/12/16T9	16T11/20	8/9/12/16	20	
2-Way	+	+	+	+	+	+	+	
3-Way								+
Normally Closed (NC)	+	+		+	+			
Normally Open (NO)						+	+	
Min. Pressure Differential (bar)	0.00	0.05	0.05	0.05	0.05	0.05	0.05	
Maximum allowable pressure (bar)	31	31 / 60 (50*)	130	31	31	31	28	35
Media Temp. Range (°C)	-40 / +120	-40 / +120	-40 / +120	-40 / +120	-40 / +120	-40 / +120	-40 / +120	-40 / +120
Coil Type	ESC	ESC	ESC	ESC	ESC	ESC	ESC	ESC

Note: \* 200RH6T5



## Coils ESC and Cable Assemblies

### Standards

- ESC Coils and cable assemblies conform to Low Voltage Directive

Type	Part No.	Voltage	Power Input	Electr. Connection	Protection
ESC 230V / 50 (60) Hz	801031	AC	8 W	without plug see cable assemblies	IP65 with plug / cable assembly
ESC 120V / 50 (60) Hz	801032				
ESC 24V / 50 (60) Hz	801033				
ESC-M24V	863304				
ESC 24V DC	801030	DC	15 W		
DS2-N15 + ESC 24VAC	804620 + 801033	DC	3 W	with plug and cable assembly	IP65

Note: Coils are delivered with retainer kit. Please order cable assemblies separately.



ESC

### Cable Assemblies for ESC Coils

Type	Part No.	Temperature Range	Cable Length	Wire Diameter	Connector Type
ASC-N15	804 570	-50 .. +80°C for stationary use only	1.5 m	3 x 0.75 mm <sup>2</sup>	loose wires
ASC-N30	804 571		3.0 m		
ASC-N60	804 572		6.0 m		

Note: Special cables for A2L applications. Check Technical Bulletin for details.



ASC-N15

### Cable Assembly with 24V DC Chopper Plug

- Enables standard 24V AC Coil to be used for DC applications
- Low power assumption (3W only)
- No MOPD degradation

Type	Part No.	Temperature Range	Cable Length	Wire Diameter	Connector Type
DS2-N15	804 620	-25 .. +80°C	1.5 m	2 x 0.75 mm <sup>2</sup>	loose wires



D2-N15

### Other Accessories

Type	Part No.	Description
ESC-K01	801 034	Screw cap (incl. 2x O-ring & fixing retainer)
PG9 Plug	801 012	Plug according to EN 175301 with cable gland PG 9
PG11 Plug	801 013	Plug according to EN 175301 with cable gland PG 11

## 2-Way Solenoid Valves Series 110, 200, 240

Normally Closed

### Features

- Compact size
- No disassembly necessary for soldering

### Standards

- 240 RA 16T11 and 20 are CE marked per PED

### Accessories

- Actuation coil and cable assemblies available for various voltages, see 'Coils ESC and Cable Assemblies'



### Capacity Data

Type	Nominal Capacity (kW)														Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Liquid															
	R134a	R22	R404A R507	R407C	R450A	R452A	R454A	R454C	R455A	R513A	R1234yf	R1234ze	R448A	R449A		
110 RB 2	3.5	3.8	2.5	3.6	3.3	2.5	3.2	2.8	3	3.1	2.6	3.2	3.3	3.2	0.2	0.05
200 RB 3	6.6	7.1	4.6	6.8	6.1	4.7	5.9	5.2	5.6	5.8	4.8	5.9	6.1	6.0	0.4	
200 RB 4	15.5	16.8	10.9	16.1	14.5	11.0	14.0	12.4	13.1	13.8	11.4	13.9	14.5	14.2	0.9	
200 RB 6	27.3	29.5	18.9	28.0	25.4	19.4	24.6	21.8	23.1	24.2	20	24.5	25.5	25.0	1.6	
240 RA 8	36.3	39.3	25.2	37.3	33.8	25.8	32.7	29	30.7	32.2	26.6	32.6	34.0	33.3	2.3	
240 RA 9	76.2	82.5	52.9	78.4	71.0	54.2	68.7	60.9	64.5	67.7	55.9	68.5	71.3	69.8	4.8	
240 RA 12	85.7	92.8	59.5	88.1	79.9	61.0	77.3	68.6	72.5	76.1	62.9	77	80.2	78.6	5.4	
240 RA 16	139.1	150.5	96.5	142.9	129.5	98.9	-	-	-	123.5	-	124.9	130.1	127.4	8.8	
240 RA 20	202.6	219.3	140.7	208.3	188.7	144.1	-	-	-	179.9	-	182	189.6	185.7	12.8	

Type	Nominal Capacity (kW)														Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Hot Gas															
	R134a	R22	R404A R507	R407C	R450A	R452A	R454A	R454C	R455A	R513A	R1234yf	R1234ze	R448A	R449A		
110 RB 2	1.6	2.0	1.7	2.1	1.4	111.8	2.0	1.8	2.0	1.5	1.3	1.3	2.0	2.0	0.2	0.05
200 RB 3	3.0	3.7	3.2	3.9	2.9	76.9	4.1	3.6	3.9	3.0	2.6	2.6	4.0	4.0	0.4	
200 RB 4	7.1	8.8	7.5	9.2	6.5	47.2	9.2	8.1	8.8	6.8	5.9	5.8	9.1	9.0	0.9	
200 RB 6	12.5	15.4	13.1	16.1	11.6	41.9	16.4	14.3	15.7	12.1	10.5	10.4	16.2	15.9	1.6	
240 RA 8	16.7	20.5	17.4	21.4	16.6	20.1	23.5	20.6	22.5	17.3	15.1	14.9	23.2	22.9	2.3	
240 RA 9	35.1	43.1	36.5	44.9	34.7	14.0	49.1	43.0	47.0	36.2	31.4	31.1	48.5	47.8	4.8	
240 RA 12	39.4	48.4	41.1	50.5	39.0	7.9	55.2	48.4	52.8	40.7	35.4	35.0	54.5	53.8	5.4	
240 RA 16	64.0	78.5	66.6	81.9	63.5	3.5	-	-	-	66.3	-	57.0	88.9	87.6	8.8	
240 RA 20	93.2	114.4	97.1	119.3	92.4	1.7	-	-	-	96.4	-	82.9	129.3	127.5	12.8	

Type	Nominal Capacity Q <sub>n</sub> (kW)														Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Suction Gas															
	R134a	R22	R404A R507	R407C	R450A	R452A	R454A	R454C	R455A	R513A	R1234yf	R1234ze	R448A	R449A		
240 RA 8	4.2	5.6	4.6	5.2	3.7	22.1	5.3	4.5	4.8	4.0	3.6	3.4	5.1	5.0	2.3	0.05
240 RA 9	8.8	11.7	9.7	10.9	7.8	15.2	11.2	9.4	9.9	8.4	7.6	7.1	10.6	10.5	4.8	
240 RA 12	9.9	13.1	10.9	12.3	8.8	9.3	12.5	10.6	11.2	9.4	8.5	8.0	11.9	11.8	5.4	
240 RA 16	16.0	21.3	17.7	19.9	14.3	8.3	-	-	-	15.3	-	13.1	19.4	19.2	8.8	
240 RA 20	33.0	31.0	25.7	29.0	20.8	4.0	-	-	-	22.3	-	19.0	28.3	27.9	12.8	

Note1: Nominal capacities at +38°C Condensing Temperature, +4°C Evaporating Temperature, Subcooling 1 K, Superheat 0K. 0.15 bar pressure drop between valve inlet and outlet in liquid applications. 1 bar pressure drop for hot gas applications. +18 °C Suction Gas temperature. For selection of other operating conditions, please use "Controls Navigator" selection program.

## Selection Table

Type		Part No.	Connection Solder / ODF	
			mm	Inch
110 RB 2	T2	801 217	6	
	T2	801 210		1/4
	T3	801 209	10	
200 RB 3	T3	801 239	10	
200 RB 4	T3	801 176	10	
	T3	801 190		3/8
	T4	801 178	12	
	T4	801 179		1/2
200 RB 6	T4	801 182	12	
	T4	801 183		1/2
	T5	801 186	16	5/8
240 RA 8	T5	801 160		5/8
	T7	801 143	22	7/8
240 RA 9	T5	801 161	16	5/8
	T7	801 162	22	7/8
	T9	801 142		1-1/8
240 RA 12	T7	801 163	22	7/8
	T9	801 144		1 1/8
240 RA 16	T9	801 164		1 1/8
	T11	801 166	35	1 3/8
240 RA 20	T11-M	801 172	35	1 3/8
	T13-M	801 224	42	
	T13-M	801 173		1 5/8
	T17-M	801 174	54	2 1/8

### Special Versions:

- Manual stems standard on Series 240 RA 20.

### Options:

- Actuation coils available for various voltages, see 'Coils ESC and Cable Assemblies'



## 2-Way Solenoid Valves Series 540

Normally Open

### Features

- Compact size
- No disassembly necessary for soldering



540 RA

### Accessories

- Actuation coil and cable assemblies available for various voltages, see 'Coils ESC and Cable Assemblies'

### Capacity Data - A1 Refrigerants

Type	Nominal Capacity Q <sub>n</sub> (kW)									Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Liquid										
	R134a	R22	R404A R507	R407C	R450A	R513A	R448A	R449A	R452A		
540 RA 8	36.3	39.3	25.2	37.3	33.8	32.2	34	33.3	25.8	2.3	0.05
540 RA 9	76.2	82.5	52.9	78.4	71	67.7	71.3	69.8	54.2	4.8	
540 RA 12	85.7	92.8	59.5	88.1	79.9	76.1	80.2	78.6	61.0	5.4	
540 RA 16	139.1	150.5	96.5	142.9	129.5	123.5	130.1	127.4	98.9	8.8	
540 RA 20	202.6	219.3	140.7	208.3	188.7	179.9	189.6	185.7	144.1	12.8	

Type	Nominal Capacity Q <sub>n</sub> (kW)									Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Hot Gas										
	R134a	R22	R404A R507	R407C	R450A	R513A	R448A	R449A	R452A		
540 RA 8	16.7	20.5	17.4	21.4	16.6	17.3	23.2	22.9	20.1	2.3	0.05
540 RA 9	35.1	43.1	36.5	44.9	34.7	36.2	48.5	47.8	41.9	4.8	
540 RA 12	39.4	48.4	41.1	50.5	39.0	40.7	54.5	53.8	47.2	5.4	
540 RA 16	64.0	78.5	66.6	81.9	63.5	66.3	88.9	87.6	76.9	8.8	
540 RA 20	93.2	114.4	97.1	119.3	92.4	96.4	129.3	127.5	111.8	12.8	

Type	Nominal Capacity Q <sub>n</sub> (kW)									Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Suction Gas										
	R134a	R22	R404A R507	R407C	R450A	R513A	R448A	R449A	R452A		
540 RA 8	4.2	5.6	4.6	5.2	3.7	4.0	5.1	5.0	4.0	2.3	0.05
540 RA 9	8.8	11.7	9.7	10.9	7.8	8.4	10.6	10.5	8.3	4.8	
540 RA 12	9.9	13.1	10.9	12.3	8.8	9.4	11.9	11.8	9.3	5.4	
540 RA 16	16.0	21.3	17.7	19.9	14.3	15.3	19.4	19.2	15.2	8.8	
540 RA 20	23.3	31.0	25.7	29.0	20.8	22.3	28.3	27.9	22.1	12.8	

### Capacity Data - A2L Refrigerants

Type	Nominal Capacity Q <sub>n</sub> (kW)															Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Liquid					Hot Gas					Suction Gas						
	R454A	R454C	R1234yf	R1234ze	R455A	R454A	R454C	R1234yf	R1234ze	R455A	R454A	R454C	R1234yf	R1234ze	R455A		
540 RA 8	32.7	29	26.6	32.6	30.7	23.5	20.6	15.1	14.9	22.5	5.3	4.5	3.6	3.4	4.8	2.3	0.05
540 RA 9	68.7	60.9	55.9	68.5	64.5	49.1	43.0	31.4	31.1	47.0	11.2	9.4	7.6	7.1	9.9	4.8	0.05
540 RA 12	77.3	68.6	62.9	77	72.5	55.2	48.4	35.4	35.0	52.8	12.5	10.6	8.5	8.0	11.2	5.4	0.05
540 RA 16	-	-	-	124.9	-	-	-	-	57.0	-	-	-	-	13.1	-	8.8	0.05
540 RA 20	-	-	-	182	-	-	-	-	82.9	-	-	-	-	19.0	-	12.8	0.05

Note 1: Nominal Capacities at +38°C Condensing Temperature. +4°C Evaporating Temperature. 0.15 Bar Pressure Drop Between Valve inlet and Outlet in Liquid Applications (For Hot Gas Applications 1 Bar Pressure Drop and +18 °C Suction Gas Temperature); Subcooling 1 K. For selection of other operating condition, please use Controls Navigator selection program.

## Selection Table

Type		Part No.	Connection Solder / ODF	
			mm	Inch
540 RA 8	T5	046 265		5/8
540 RA 9	T5	046 266		5/8
	T7	046 268	22	7/8
540 RA 12	T7	046 269	22	7/8
540 RA 16	T9	046 270		1 1/8
540 RA 20	T11	047 953	35	1 3/8

### Options:

- Actuation coils available for various voltages, see 'Coils ESC and Cable Assemblies'

## Accessories and Spare Parts for Solenoid Valves

### Gasket Kits

Description	Type	Part No.
110RB	KS 30040-2	801 232
200RB/200RH	KS 30039-1	801 233
240RA8	KS 30061-1	801 234
240RA9/12	KS 30062-1	801 235
240RA16	KS 30065-1	801 236
240RA20	KS 30097-1	801 237

Description	Type	Part No.
Service tool for 110 RB, 240 RA, 540 RA	X 11981 - 1	027 451

### Repair Kits

Description	Type	Part No.
110RB	KS 30040-1	801 206
200RB	KS 30039/ KS 30109	801 205
240RA8	KS 30061	801 262
240RA9	KS 30062	801 263
240RA12	KS 30063	801 264
240RA16	KS 30065	801 200
240RA20	KS 30097	801 216

# 2-Way Solenoid Valves Series 200 RH for High Pressure Applications

Normally Closed

## Features

- Compact size
- Media Temperature Range -40 ... +120 °C
- No disassembly necessary for soldering
- Extended copper tubes for easy installation
- No disassembly necessary for brazing
- IP 65 Solenoid coil and cable assembly
- One coil fits to all sizes and valve series
- Max. allowable pressure PS: 60 bar



## Accessories

- Actuation coil and cable assemblies available for various voltages, see 'Coils ESC and Cable Assemblies'

## Capacity Data

Type	Nominal Capacity Q <sub>n</sub> (kW)										Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Liquid					Hot Gas						
	R410A	R744	R452B	R32	R454B	R410A	R744	R452B	R32	R454B		
200 RH 3	6.6	8.1	7.6	9.7	7.7	4.9	7.2	5.1	5.9	5.1	0.4	0.05
200 RH 4	15.7	19.1	18	23	18.2	11.0	16.1	11.4	13.4	11.4	0.9	
200 RH 6	27.5	33.6	31.7	40.3	31.9	19.5	28.7	20.3	23.8	20.3	1.6	

**Note 1:** R410A/R452B/R32/R454B: Nominal capacities at +38°C condensing temperature, +4°C evaporating temperature, subcooling 1 K  
0.15 bar pressure drop between valve inlet and outlet in liquid applications.  
1 bar pressure drop for hot gas applications

**Note 2:** R744: Nominal capacities at +10°C condensing temperature, -10°C evaporating temperature, subcooling 1 K  
0.15 bar pressure drop between valve inlet and outlet in liquid applications.  
1 bar pressure drop for hot gas applications

**Note 3:** For selection of other operating condition, please use Controls Navigator selection program.

## Selection Table

Type	Part No.	Connection Solder / ODF	
		mm	Inch
200 RH 3	T3 802 070	10 mm	3/8"
200 RH 4	T3 802 071	10 mm	
	T3 802 072		3/8"
	T4 802 073	12 mm	
	T4 802 074		1/2"
200 RH 6	T4 802 075	12 mm	
	T4 802 076		1/2"
	T5 802 077	16 mm	5/8"

Options:

- Actuation coils available for various voltages, see 'Coils ESC and Cable Assemblies'

## 3-Way Solenoid Valves Series M36

### Features

- For heat reclaim application
- Pilot connection to suction line required.  
No minimum pressure drop
- Compact size
- No disassembly necessary for brazing
- Max. allowable pressure PS: 35 bar

### Accessories

- Actuation coil and cable assemblies available for various voltages, see 'Coils ESC and Cable Assemblies



M36-118



M36-078

### Capacity Data

Type	Nominal Capacity Q <sub>n</sub> (kW)															Kv-Value (m <sup>3</sup> /h)	Δp Min (bar)
	Hot Gas																
	R134a	R22	R404A	R507	R407C	R450A	R454A	R454A	R454C	R448A	R449A	R452A	R455A	R1234yf	R1234ze		
M36	28.9	35.1	31.3	30.4	38.5	26.4	36.7	36.7	32.3	36.2	35.7	31.4	35.1	24	23.9	6.7	0

**Note 1:** Nominal Capacities at +38°C Condensing Temperature. +4°C Evaporating Temperature (saturated pressures / dew point).  
0.15 bar Pressure drop between valve inlet and outlet. For other operating conditions, please use Controls Navigator selection program.

### Selection Table

Type	Part No.	Connection Solder / ODF		Coil Type
		mm	inch	
M36-078	801420	22	7/8	ESC
M36-116	801421		1 1/8	ESC

### Accessories and Spare Parts

#### Gasket Kit

Description	Type	Part No.
M36	KS30177-1	801268

#### Repair Kit

Description	Type	Part No.
M36 (upper assembly inc. gasket)	M36-UNF	801440