Modulating control valve M3FB...LX...

for hot gas control

Valves with magnetic actuator for modulating capacity control of refrigeration units and for heat recovery.

- **Short positioning time (approx. 1 s)**
- **High resolution (> 1 : 200)**
- **High rangeability**
- **Hermetically sealed**
- **Versatile electrical interface**
- **Low friction**
- **Port 1 –> 3 closed when de-energised**
- **Robust and maintenance-free**

Use

The M3FB...LX... three-way or straight-through valves with magnetic actuator are used for modulating capacity control of refrigeration units and for heat recovery. They may be used as hot gas diverting or straight-through valves.
Suitable for safety refrigerants such as R22, R134a, R404A, R407C, R507, etc.

Type summary

Operating data

Valve type (without ZM...)	DN [mm]	k_{vs} 1 –> 3 [m^3/h]	Δp_{vmax} 1 –> 3 [MPa]	[bar]	P_N [VA]	P_{med} [VA]
M3FB15LX06/A	15	0.6	2.2	22	26	6
M3FB15LX15/A	15	1.5	2.2	22	26	6
M3FB15LX/A	15	3.0	2.2	22	26	6
M3FB20LX/A	20	5.0	1.8	18	26	6
M3FB25LX/A	25	8.0	1.2	12	40	10
M3FB32LX	32	12.0	0.8	8	40	10

Key :
Δp_{vmax} = Max. admissible pressure differential
P_N = Nominal power
P_{med} = Mean operating power
k_{vs} = Flow rate to VDI/ VDE2173, tolerance ±10 %

Ordering

The M3FB...LX... valve and the ZM... or ZM.../A terminal housing must be ordered separately.
See data sheet N4591 for information on the ZM... terminal housing.
See sheet N4000 for a summary of refrigerant valves.
When placing an order, please specify the quantity, product description and type code.

Example :
1 control valve M3FB15LX/A and **1 terminal housing ZM101/A**

Technical design

The armature or magnetic core is designed as a floating component within the pressure system, so that no external shaft gland is required. The leakage losses common with moving parts are thus avoided. The valve cross-section allows for easy flow whether the valve is fully or only partially open. This reduces pressure losses and ensures quiet operation.
The valves are fitted with extended female solder unions, making pipe connection easy.

Mechanical design

The control signal is converted in the ZM.../A terminal housing into a phase cut signal, which generates a magnetic field in the coil. This causes the only moving part, the armature, to change its position in accordance with the interacting forces (magnetic field, counter-spring, hydraulics etc.). The armature responds rapidly to any change in signal, transferring the corresponding movement directly to the control disc, enabling fast changes in load to be corrected quickly and accurately.
The force of the counter-spring closes the valve automatically (control path ports 1 –> 3) if the power is switched off or fails.

Sizing

Selection table for hot-gas applications

(approximate guide to valve size)

Note

Correct valve sizing (to ensure a sufficiently large pressure drop Δp_{v100} across the fully open valve) is the key to the correct operation of a refrigeration unit. All the components must be coordinated, and this can be ensured only by the refrigeration specialist.
The application examples on pages 6 and 7 show the recommended pressure drop in each case.

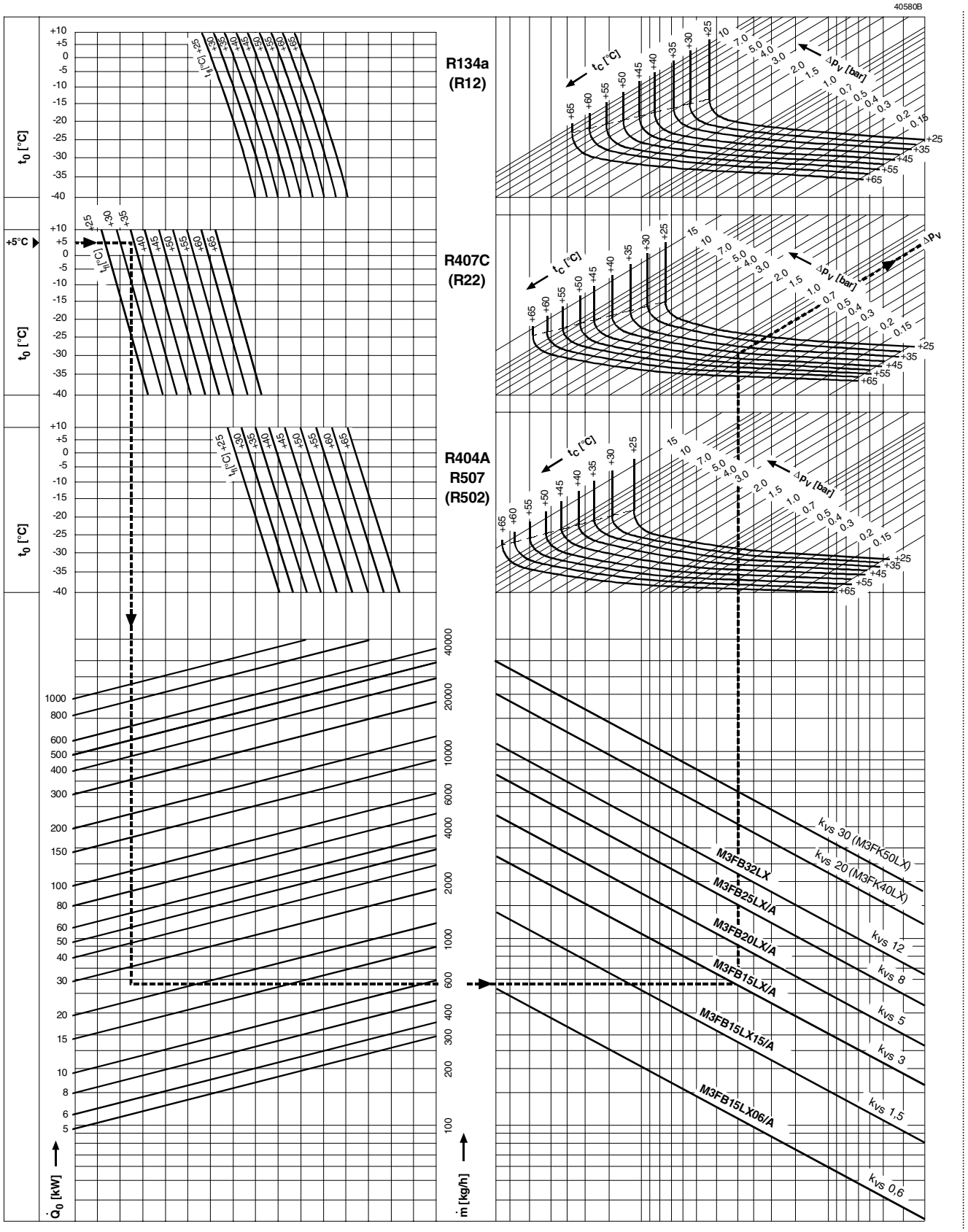
Refrigeration capacity in kW

Nominal capacity in kW at evaporation temperature t_o = 5 °

		Refrigerant								
		R407C (R22)			R134a (R12)			R404A / R507		
		Condensation temperature t_c [°C]								
Δp_{v100}	Valve type	50	40	30	50	40	30	50	40	30
0.5 bar	M3FB15LX06/A	4.5	4.0	3.6	3.8	3.3	2.9	3.7	3.3	2.9
	M3FB15LX15/A	11	10	8.9	9.5	8.3	7.2	9.2	8.1	7.2
	M3FB15LX/A	22	20	18	19	17	14	18	16	14
	M3FB20LX/A	37	33	30	32	28	24	31	27	24
	M3FB25LX/A	59	53	48	51	44	38	49	43	38
	M3FB32LX	89	80	72	76	67	57	74	65	58
1.0 bar	M3FB15LX06/A	6.2	5.6	4.9	5.3	4.6	3.9	5.1	4.5	4.0
	M3FB15LX15/A	16	14	12	13	11	10	13	11	10
	M3FB15LX/A	31	28	25	26	23	20	26	23	20
	M3FB20LX/A	52	46	41	44	38	33	43	38	33
	M3FB25LX/A	83	74	66	70	61	52	69	61	53
	M3FB32LX	125	111	99	106	92	78	103	91	80
4.0 bar	M3FB15LX06/A	11.4	9.9	8.4	9.2	7.5	5.8	9.6	8.3	7.0
	M3FB15LX15/A	28	25	21	23	19	15	24	21	18
	M3FB15LX/A	57	50	42	46	38	29	48	41	35
	M3FB20LX/A	95	83	70	76	63	48	80	69	58
6.0 bar	M3FB15LX06/A	13	11	8.9	10	7.6	5.8	11	9.4	7.7
	M3FB15LX15/A	33	28	22	25	19	15	28	23	19
	M3FB15LX/A	65	55	45	50	38	29	55	47	39
	M3FB20LX/A	108	92	74	83	63	48	92	78	64
8.0 bar	M3FB15LX06/A	14	11	8.9	9.8	7.6		12	9.9	7.7
	M3FB15LX15/A	35	28	22	24	19		30	25	19
	M3FB15LX/A	69	56	45	49	38		60	49	39
	M3FB20LX/A	115	94	74	81	63		100	82	64

Δp_{v100} = Pressure drop across the fully open valve

Selection chart for hot-gas applications



Key :

- t_o Evaporation temperature [°C]
- t_c Condensation temperature [°C]
- t_{fl} Liquid temp. (t_c – degree of sub-cooling) [°C]
- Q_o Refrigeration capacity [kW]
- m Mass flow of refrigerant [kg/h]
- k_{vs} Flow rate [m^3/h]
- Δp_v Admissible pressure differential [bar]

Mounting notes

Mounting instructions are enclosed with the valve: Ref. 35541(connection terminal) and Ref. 35548 (valve).

The refrigerant valves can be mounted in any orientation, but upright mounting is preferable. The pipes should be fitted such that the alignment does not distort the valve connections. Before soldering the pipes, ensure that the direction of flow through the valve is correct.
The pipes must be soldered with care. The flame should be large enough to ensure that the junction heats up quickly and the valve does not get too hot. The flame should be directed away from the valve. Cool the valve body with a wet cloth while soldering.

Port 2 must be sealed off when the valve is used in a straight-through application.

Caution : Always switch off the power supply before connecting or disconnecting the ZM... terminal housing.

Maintenance notes

The modulating control valves for hot gas control from the M3FB...LX... series require no maintenance.

Technical data

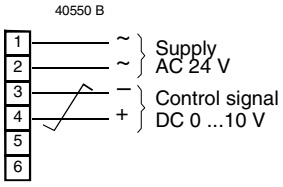
Electrical interface:	Only admissible with low voltage (SELV, PELV)	
Control signals:	ZM101/A	DC 0 ...10 V or DC 0 ... 20 V phase cut
	ZM121/A	DC 4 ... 20 mA or DC 0 ... 20 V phase cut
	ZM111	DC 0 ... 20 V phase cut
Supply voltage	AC 24 V for DC 0 ...10 V and DC 4 ... 20 mA	
– Max. voltage tolerance	+15/–10 %	
Nominal power	See table on page 1	
Operating pressure p_{emax}	3.2 MPa (32 bar)	
Pressure differential Δp_{vmax}	1 –> 3	See table on page 1
	1 –> 2	0.8 MPa (8 bar)
Leakage:	1 –> 3	Max 0.05% k_{vs} (to VDI/ VDE2174)
	1 –> 2	Max 0.5% k_{vs}
Temperature of medium	– 40 ...120 °C	
Valve characteristic (stroke, k_v)	Linear, optimised in low opening range	
Resolution $\Delta H / H_{100}$	> 1 : 200	(H = stroke)
Type of operation	Modulating	
Position when de-energised	1 –> 3 closed	
Orientation	Any	
Positioning time	Approx. 1 s	
Materials (valve body):		
Housing components	Steel and copper	
Seat / inner valve	Bronze / CrNi steel	
Pipe connections	Extended female solder unions	
Connection terminals	Screw terminals for 4 mm^2 wire	
Protection standard	IP54 to IEC529	
Ambient temperature	– 40 ... 50 °C	
Weight	See 'Dimensions' on page 8	
Conformity	Meets the requirements for CE marking	

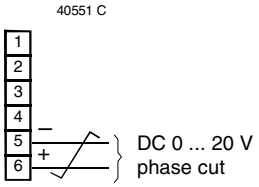
Connection terminals

Warning : ZM.../A terminal housing used with DC 0 ... 20 V phase cut signals:

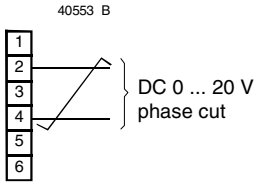
- **Do not connect AC 24 V to Terminals 1 and 2.**
- **Connect Terminal 5, (marked " – ")**
  - **to the appropriate Y output terminal on UNICO, KLIMO and MULTIREG (type 9 controllers)**
  - **to Terminal 2 on type NKOA terminal modules.**

ZM101/A (DC 0 ...10 V or DC 0 ... 20 V phase cut)

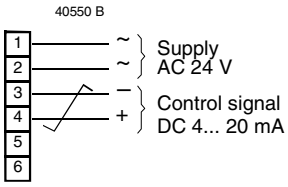


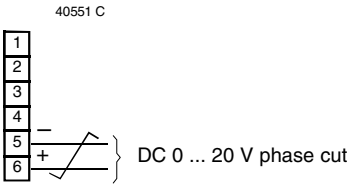


ZM111 (DC 0 ... 20 V phase cut)



ZM121/A (DC 4 ...20 mA or DC 0 ... 20 V phase cut)






Twisted pairs

Connection diagrams

See data sheet N4591 for various connection diagrams for the ZM... and ZM.../A terminal housing.

Application examples

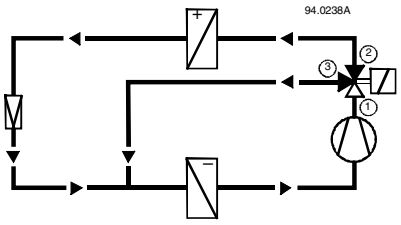
The diagrams shown here are principles only, without installation-specific details.

3-way hot-gas bypass control

For accurate control of evaporators, from 0 ...100% refrigeration capacity.

- Suitable for test rooms, laboratory systems, small chilled water units and DX evaporators with a refrigeration capacity of up to approx. 40 kW.

Recommended presure drop Δp_{v100} across the fully-open valve (control path 1 –> 3) : between 0.5 and 1 bar (see selection chart page 4)



Example :	
Refrigeration capacity Q_o	24 kW
Refrigerant	R22
Condensation temperature t_c	40 °C
Evaporation temperature t_o	+ 5 °C
Liquid temperature t_{fl}	35 °C
Selected valve	**M3FB15LX/A**
Pressure differential Δp_v across valve	0.7 bar

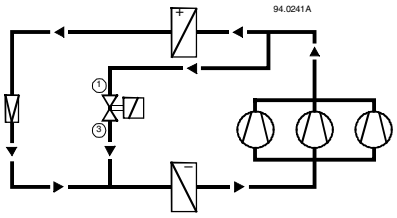
Indirect hot-gas bypass

The control valve throttles the capacity of a compressor stage. The hot gas is injected directly into the evaporator allowing capacity control from 100 % to approximately 0 %.

- Suitable for use in large refrigeration systems in air conditioning applications, to prevent unacceptable fluctuations in temperature between compressor stages.

The pressure differential Δp_{v100} across the fully-open valve is determined by the condensation pressure at low load minus the pressure upstream of the evaporator.

If no details are provided, the pressure differential Δp_{v100} can be assumed to be 4 bar.



Example :	
Refrigeration capacity Q_o of one compressor stage	30 kW
Refrigerant	R22
Condcondensation temperature full/low load	45 / 35 °C
Evaporation temperature full load/low load	5 / 15 °C
Liquid temperature t_{fl}	40 / 30 °C
Pressure differential Δp_v (from R22 vapour table)	5.6 bar
Selected valve	**M3FB15LX/A**
Actual capacity	appr. 40 kW

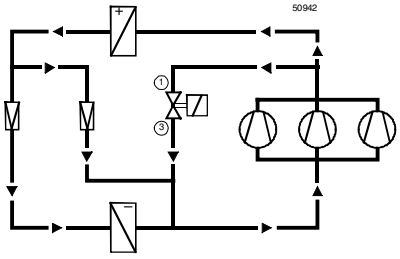
Direct hot-gas bypass

The control valve throttles the capacity of a compressor stage. The gas is fed to the suction side of the compressor and cooled by a re-injection valve. Capacity control range from 100 % to approx. 10 %.

- Suitable for large refrigeration systems for air conditioning, with several compressors or compressor stages, and where the evaporator and compressor are some distance apart (attention must be paid to oil return).

The pressure differential Δp_{v100} across the fully-open valve is determined by the condensation pressure at low load minus the suction pressure.

If no details are provided, the pressure differential Δp_{v100} can be assumed to be 6 bar.

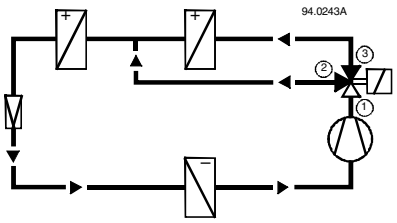


Example :	
Refrigerant capacity of one compressor stage	40 kW
Refrigerant	R22
Condensation temperature full/low load	45 / 35 °C
Evaporation temperature full load/low load	2 / 10 °C
Liquid temperature t_{fl}	40 / 30 °C
Pressure differential Δp_v (from R22 vapour table)	6.5 bar
Selected valve	**M3FB15LX/A**

Heat recovery

The hot-gas diverting valve may be used for modulating recovery of the heat from the condenser, even in the event of high pressure differentials.

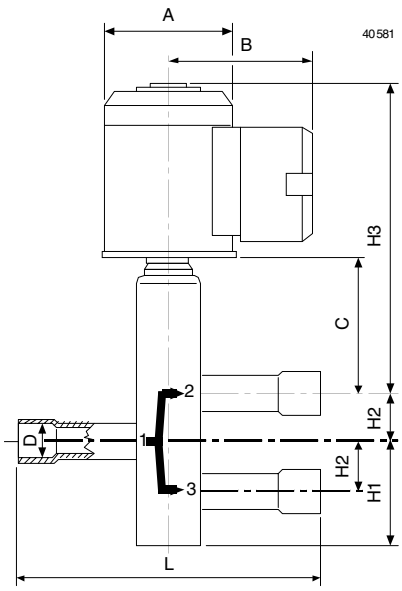
Recommended pressure drop Δp_{v100} across the fully-open valve (control path 1 –> 3) : between 0.5 and 1 bar.



Example :	
Refrigeration capacity Q	67 kW
Refrigerant	R134a
Condensation temperature t_c	50 °C
Evaporation temperature t_o	2 °C
Liquid temperature t_{fl}	45 °C
Selected valve	**M3FB32LX**
Actual pressure drop	0.7 bar

Dimensions

All dimensions in mm



Valve type	DN [mm]	ø D [inches]	L	H_1	H_2	H_3	A	B	C	W [kg]
M3FB15LX06/A	15	5/8	150	65	25	184	80	84	67	4.3
M3FB15LX15/A	15	5/8	150	65	25	184	80	84	67	4.3
M3FB15LX/A	15	5/8	150	65	25	184	80	84	67	4.3
M3FB20LX/A	20	7/8	170	69	30	238	100	94	84	8.9
M3FB25LX/A	25	1 1/8	200	72	36	248	100	94	94	9.5
M3FB32LX	32	1 3/8	250	91	43	245	100	94	98	11.4

D : Pipe connections

G : Weight (incl. packaging)