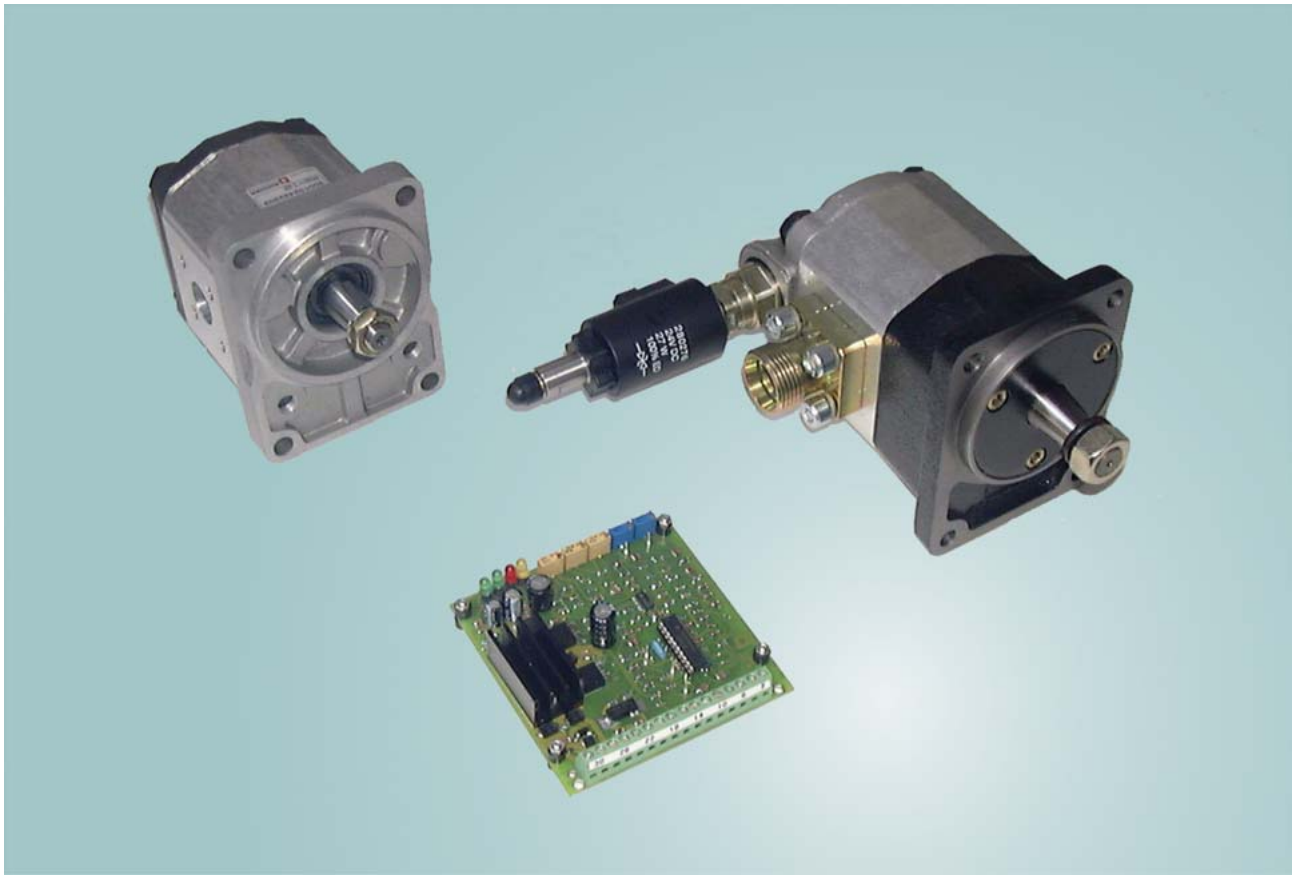
BUCHER HYDRAULICS

Hydraulic Drive Systems for Engine Cooling Fans



motion and progress

Classification: 410.20.00.00
Reference: 100-P-000062-E-00 / 09.03

Contents

1 General

1.1 Product description

Bucher Hydraulics has developed an ideal system based on tried and tested components. It consists of:

- The AP external gear pump
- The APFM fan drive motor
- The ESLF 101 electronic control unit

The external gear pump is available in various models and flange configurations, including those required for direct flange-mounting on all common internal combustion engines.

The fan drive motor is designed on the "building block" principle and can be supplied with the following options:

- Outrigger bearing to support radial and axial loads
- Integral anti-cavitation make-up valve
- Integral control valves that are regulated electro-proportionally, electrically on/off or thermostatically
- Drain port
- High-pressure shaft seal
- Right-hand, left-hand or reversible rotation

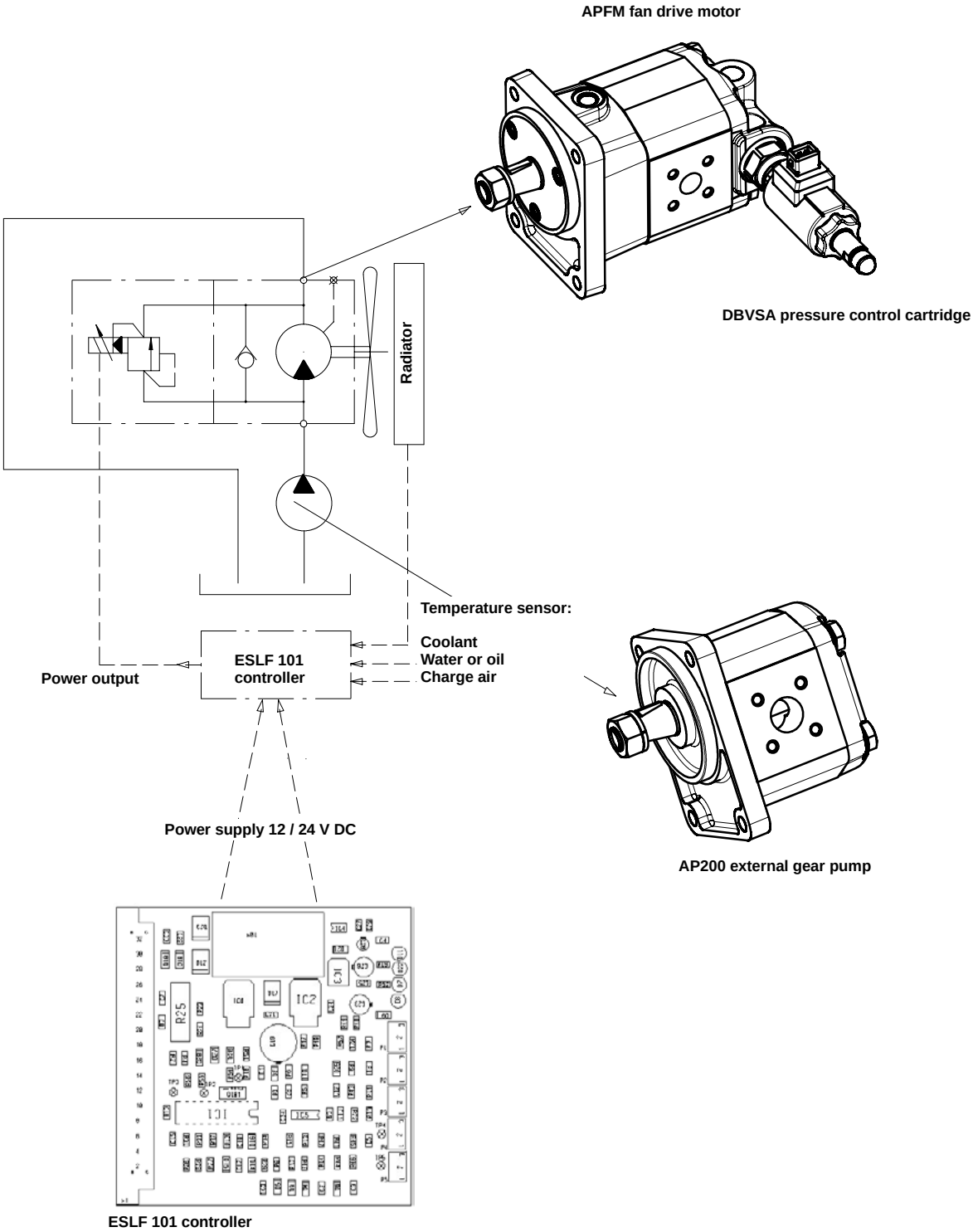
The electronic control system is used in conjunction with up to 3 external temperature sensors for coolant, oil and engine charge air. This arrangement enables the fan speed to be varied smoothly between idle and maximum speed to meet the system demands.

1.2 Advantages

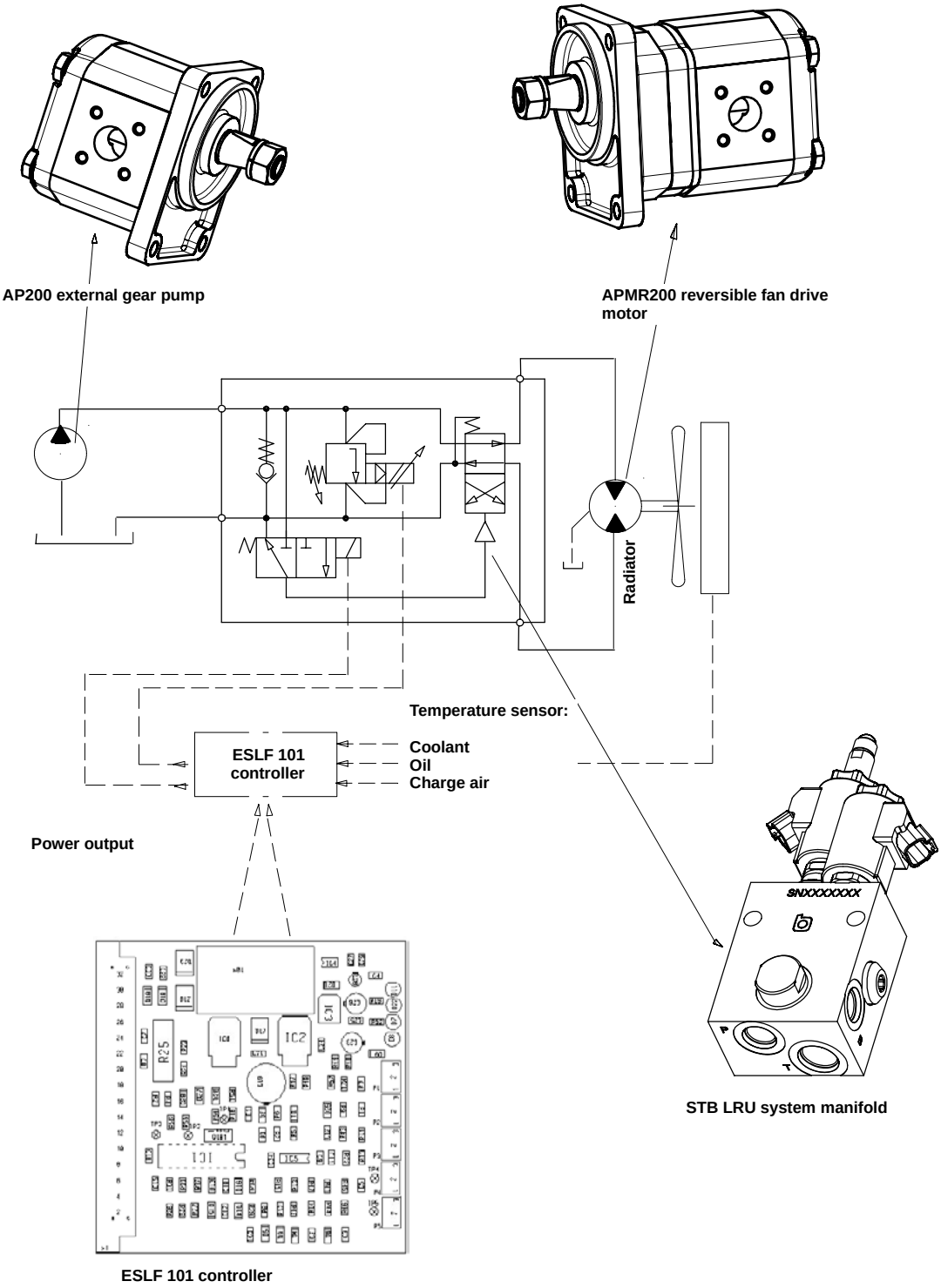
- The internal combustion engine reaches its optimum operating temperature quickly
- Over-heating damage is prevented by monitoring and controlling up to 3 system values
- Fail-safe function in the event of system failure
- Demand-regulated cooling (see, for example, the TIR2 'Blue Angel' environmental guidelines, complementing the EU Eco-label programme)
- Straightforward and compact design
- Available in many versions ranging from the most basic to those with reversible motors, to ensure compliance with all common acceptance specifications.
- Demand-regulated cooling:
  - less energy consumption
  - lower noise levels
- Thanks to the numerous options, customer requirements can always be matched exactly
- Reversible - dirt, leaves, etc. can be blown out of the radiator.

2 Fan drive systems

2.1 Standard fan drive



2.2 Reversible fan drive



3 Technical data

3.1 AP200 external gear pump

General			
	Fluid temperature range	°C	-15 to +80
	Viscosity range	mm^2/s	20 - 70
	Filter rating	µm	25 - 30

AP200 Type	Geometric displacement cm^3/rev	Maximum pressures P_1 bar	P_2 bar	P3 bar	n min. P≤P1	P>P1	n max. P≤P1	P>P1
AP200/4.5	4.3	220	250	280	800	1000	3500	4000
AP200/6.5	6.3	220	250	280	800	1000	3500	4000
AP200/8.5	8.3	220	250	280	800	1000	3500	4000
AP200/11	11.0	210	230	250	700	900	3500	4000
AP200/15	15.0	210	230	250	650	800	3500	4000
AP200/19	18.9	210	230	250	650	800	3000	3500
AP200/22	12.9	200	220	240	600	750	3000	3500
AP200/26	25.9	190	210	230	600	750	2500	3000

P_1 = pressure differential - constant
P_2 = pressure differential - intermittent
P_3 = max. outlet pressure - for short periods

3.2 Fan drive motors

3.2.1 APFM200 fan drive motor

General			
	Fluid temperature range	°C	-15 to +80
	Viscosity range	mm^2/rev	20 - 70
	Filter rating	µm	25 - 30
	Max. tank pressure without drain line	bar	20

APFM200 Type	Geometric consumption cm^3/rev	Maximum pressures P_1 bar	P_2 bar	P_3 bar	Speed n min rpm	n max_1 rpm	Torque at ΔP=100bar Nm
APFM200/6.5	6,5	220	250	280	500	4000	8,5
APFM200/8.5	8,5	220	250	280	500	4000	11,25
APFM200/11	11	210	230	250	500	4000	14,85
APFM200/15	15	210	230	250	500	4000	20,0
APFM200/19	19	210	230	250	450	3500	25,7
APFM200/22	22	200	220	240	400	3500	29,75
APFM200/26	26	190	210	230	400	3000	35,0

P_1 = pressure differential - constant
P_2 = pressure differential - intermittent
P_3 = max. inlet pressure - for short periods

3.2.2 Options for APFM200 fan drive motor

- Integral anti-cavitation make-up valve
- DBVSA electro-proportional pressure control valve, see section 3.2.3
- LMOT thermostatically controlled speed regulator, see section 3.2.3
- Permissible tank line pressure:
  - standard model: 8 bar
  - with high-pressure seal: 20 bar
  - with additional drain port: 30 bar
  - when using the reversible motor: system pressure
- "Minimess" connector in the end cover
- Pressure port thread M 18 x 1,5
- Integral outrigger bearing

3.2.3 DBVSA pressure control cartridge valve

DBVSA Electro-proportional valve. Available in 5 pressure ranges with p max. = 63, 100, 160, 230 or 300 bar

p max. in T, dynamic: 250 bar

Flow rate, Q max.:
100 l/min for DBVSA-1CG
32 l/min for DBVSA-1LG

Standard voltage: 24 / 12 V DC
Nominal current: 750 / 1400 mA
Enclosure protection: IP65 to DIN 40050 (see BHFRU data sheets 03-8613 and 03-8612)

LMOT thermostatically controlled speed regulator - contact Bucher Hydraulics

3.2.4 APMR200 reversible fan drive motor

General			
	Fluid temperature range	°C	-15 to +80
	Viscosity range	mm^2/s	20 - 70
	Filter rating	µm	25 - 30

APMR200 Type	Geometric consumption	Maximum pressure			Speed			Torque at
		P_1	P2	P_3	n min	n_{max} for P1	n_{max1} for P=0 bar	ΔP=100bar
	cm^3/rev	bar	bar	bar	rpm	rpm	rpm	Nm
APMR200/4	4,40	220	250	280	1000	4500	5500	7,5
APMR200/6	6,28	220	250	280	700	4500	5500	11,5
APMR200/8	8,16	220	250	280	550	3700	4700	15,0
APMR200/11	11,30	210	230	250	450	3300	4000	18,5
APMR200/14	14,45	210	230	250	400	2700	3300	26,5
APMR200/17	16,95	210	230	250	350	2500	3000	30,0
APMR200/20	20,10	200	220	240	300	2500	3000	37,0
APMR200/25	25,75	190	210	230	250	2500	3000	45,0

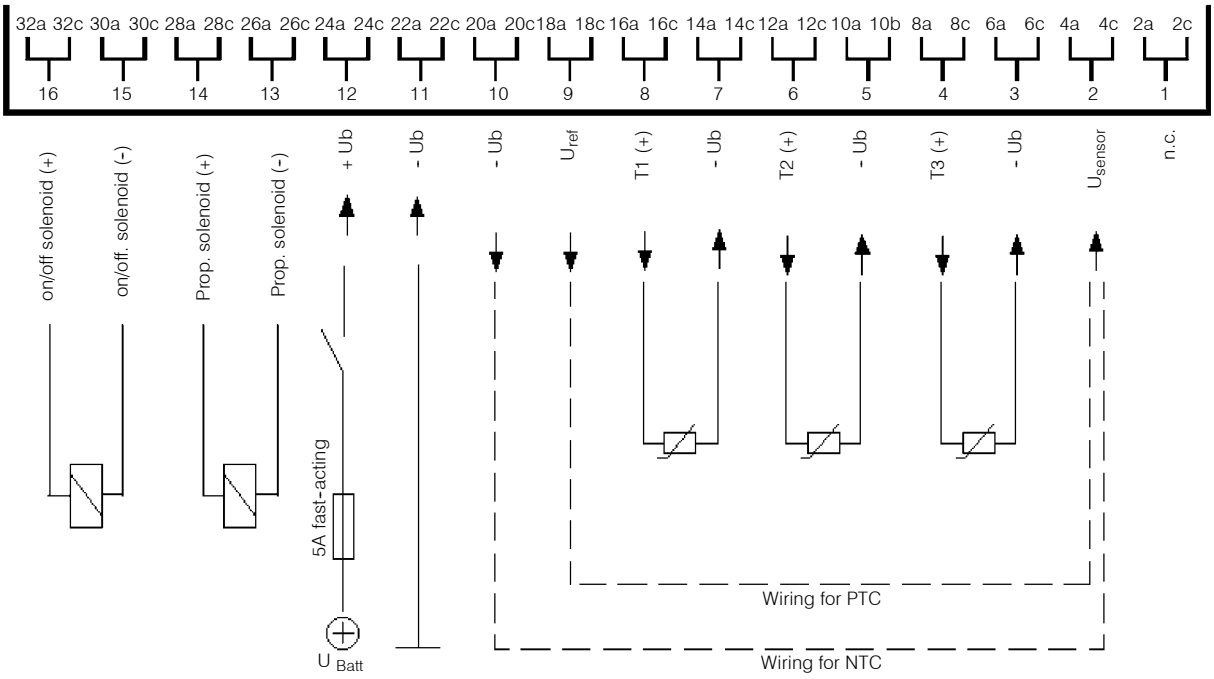
P1 = pressure differential - constant
P2 = pressure differential - intermittent
P3 = max. inlet pressure - for short periods

Option: outrigger bearing, type KM5

3.3 Fan drive control system

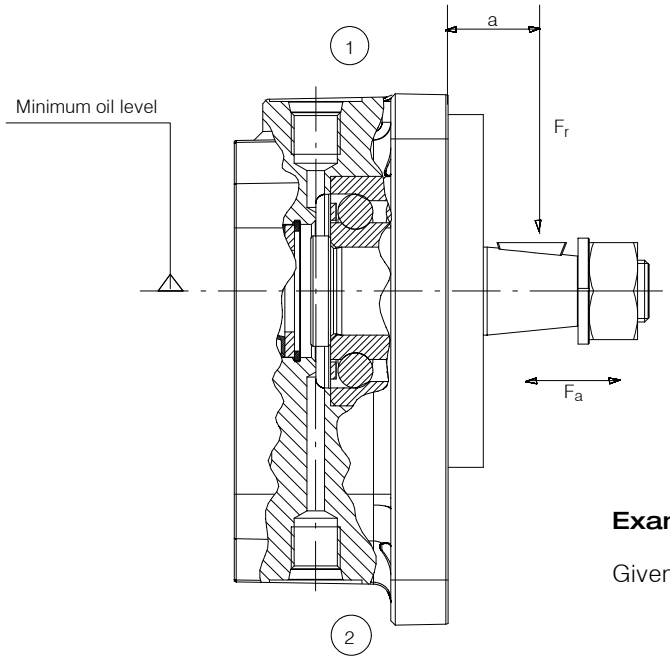
- Up to 3 temperature sensors can be used
- PTC and NTC sensors can both be used
- Same electronic system for reversible and non-reversible motors
- Can be supplied with or without housing

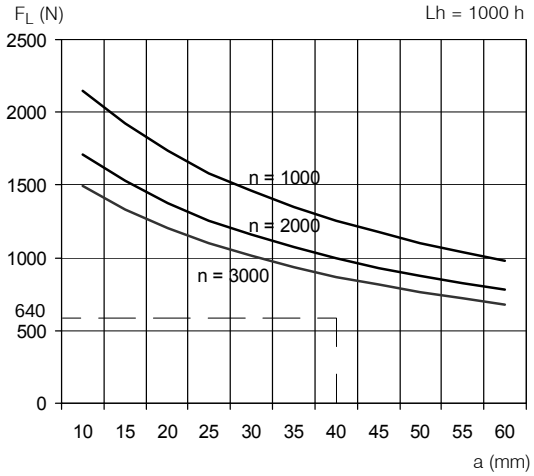
Power supply (U_b)	12 V - 30 V DC
Reference voltage (U_{ref})	8 V DC max. 20 mA
Temperature inputs	3 (T1, T2, T3)
Temperature sensor processing (U_{sensor})	either PTC or NTC per card, using two-wire method
Temperature control range	0°C - 100°C
Setting type of sensor; adjustment	diagnostics input online; calibration potentiometer for each sensor
Prop. solenoid output for fan motor - max. fan motor speed - min. fan motor speed	max. output current I_{max} = 2,1 A minimum current I_{max} = 0,2 A maximum current (adjustable) I_{max} = 2,1 - 1,4 A via potentiometer
On / Off solenoid output	Max. output current 2.5 A
Diagnostics	LED for each solenoid output LEDs for control mode
Electrical connection	DIN 41612 Type D edge connector, or screw terminals
Type of protection	non-encapsulated and encapsulated models
Dimensions	100 mm x 100 mm x 25 mm (W x H x D)
Temperature range	-20°C to +50°C



4 Performance graphs

4.1 Bearing loading of APFM200 and APMR200 fan motors with outrigger bearing





The maximum bearing load F_L is calculated from Fr and Fa as follows: $F_L = F_r + (0{,}7 \times F_a)$

Example:

Given:
Axial load: F_a = 200N
Radial load: F_r = 500N
Axial offset of radial load: a = 40 mm
Maximum speed: n = 2,000 rpm

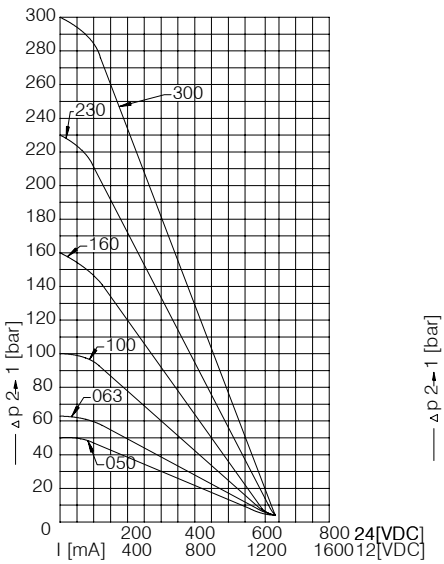
The bearing load calculates as:
F_L = 500 N + (0,7 x 200 N) = 640 N

Plot the lines F_L = 640 N and a = 40 mm on the graph:

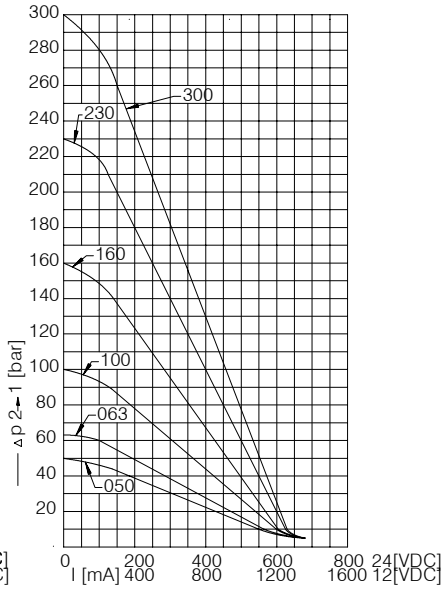
The lines intersect below the curve for speed n = 2000, therefore under the given loading the bearing life > 1,000 hours.

4.2 Speed control

Pressure control valve
DBVSA-1LG
Q_{max} = 32 l/min



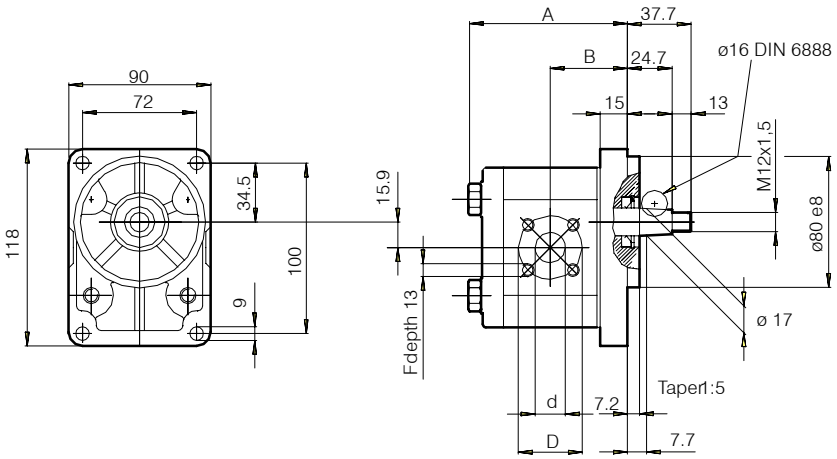
Pressure control valve
DBVSA-1CG
Q_{max} = 100 l/min



5 Dimensions

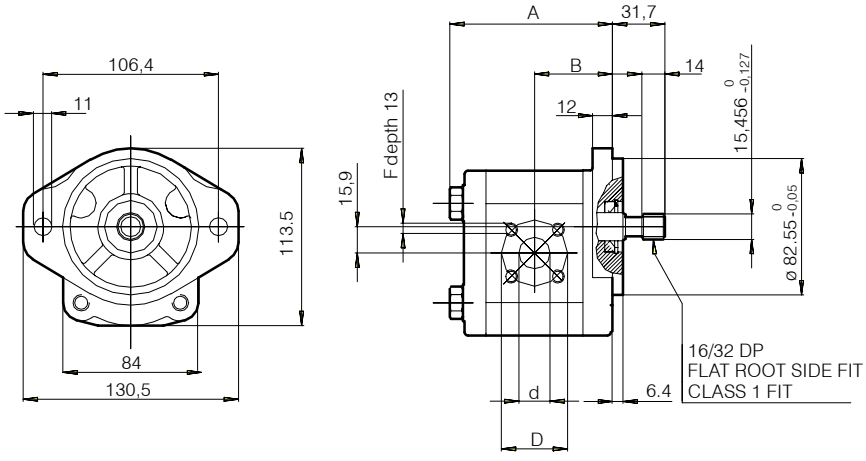
5.1 AP200 external gear pump

5.1.1 AP200-225



			Suction			Pressure		
Type	A	B	d	D	F	d	D	F
AP200/4,5	85	41,3	15	40	M6x1	15	35	M6x1
AP200/6,5	85	41,3	15	40	M6x1	15	35	M6x1
AP200/8,5	85	41,3	15	40	M6x1	15	35	M6x1
AP200/11	101	49,3	20	40	M6x1	15	35	M6x1
AP200/15	101	49,3	20	40	M6x1	15	35	M6x1
AP200/19	113	55,3	20	40	M6x1	15	35	M6x1
AP200/22	117	57,5	20	40	M6x1	15	35	M6x1

5.1.2 AP200-287S-B

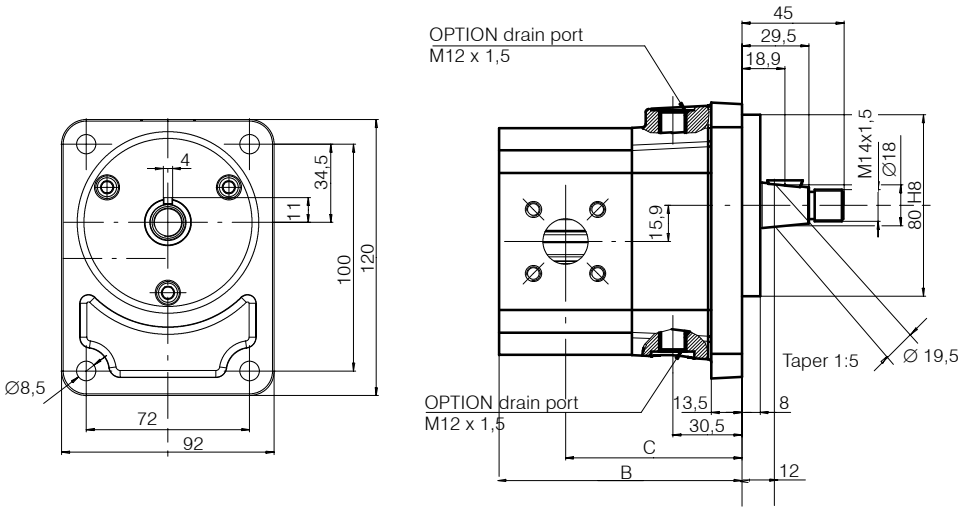


			Suction			Pressure		
Type	A	B	d	D	F	d	D	F
AP200/4,5	82,5	39,5	15	40	M6x1	13,5	35	M6x1
AP200/6,5	82,5	39,5	15	40	M6x1	13,5	35	M6x1
AP200/8,5	82,5	39,5	15	40	M6x1	13,5	35	M6x1
AP200/11	98,5	47,5	20	40	M6x1	13,5	35	M6x1
AP200/15	98,5	47,5	20	40	M6x1	13,5	35	M6x1
AP200/19	110,5	53,5	20	40	M6x1	13,5	35	M6x1
AP200/22	115	55,5	20	40	M6x1	13,5	35	M6x1
AP200/26	115	55,5	20	40	M6x1	13,5	35	M6x1

Other pump models, contact Bucher Hydraulics

5.2 APFM200 fan drive motor

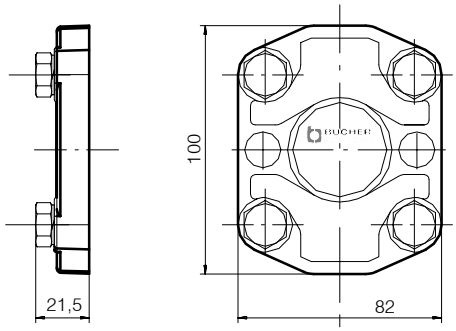
5.2.1 APFM200 fan motor with outrigger bearing, without end cover



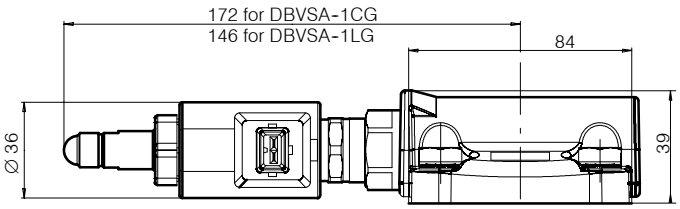
Type	B	C
APFM6,5	94,5	62
APFM8,5	94,5	62
APFM11	110,5	78
APFM15	110,5	78
APFM19	122,5	90
APFM22	127	94,5

5.2.2 End cover for APFM200

without pressure control valve

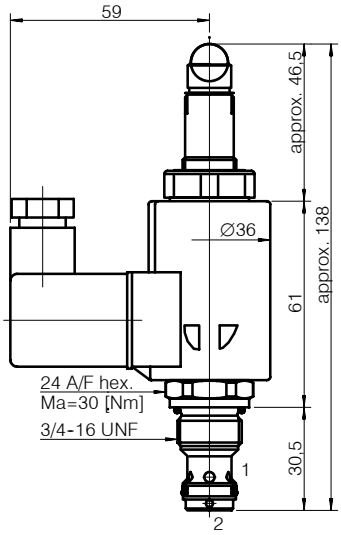


with pressure control valve

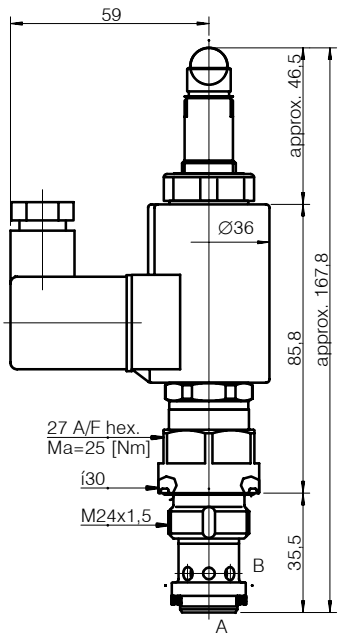


5.2.3 DBVSA pressure control valve

1LG



1CG



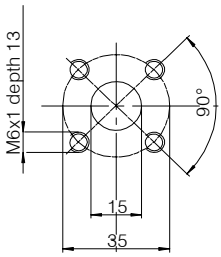
5.2.4 Body styles

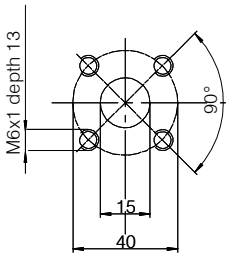
Inlet port

Outlet port

Available for 4,5-6,5-8,5 cm^3

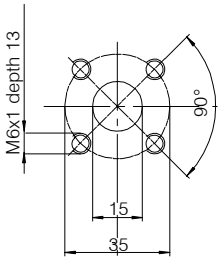
A

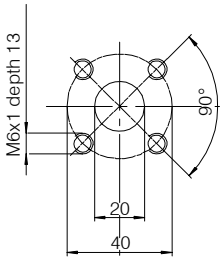




Available for 11-15-19-22-26 cm^3

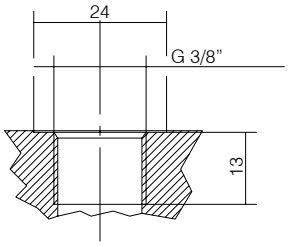
B

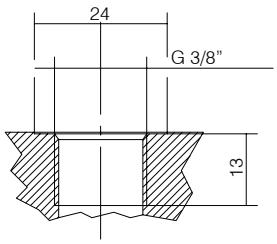




Available for 4,5-6,5-8,5 cm^3

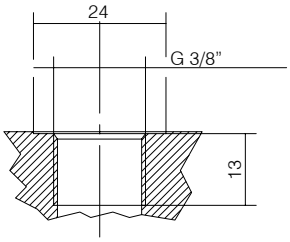
C

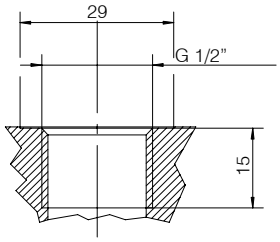




Available for 11-15 cm^3

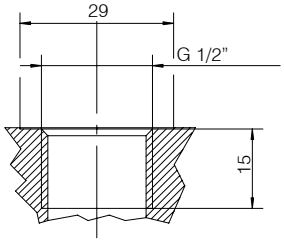
D

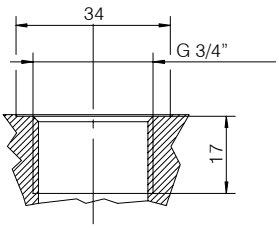




Available for 19-22-26 cm^3

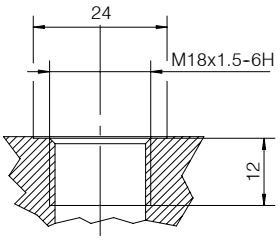
E

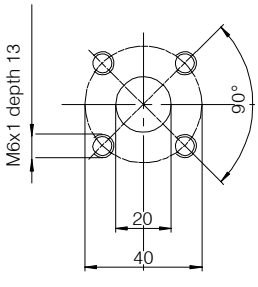




Customer-specific

F

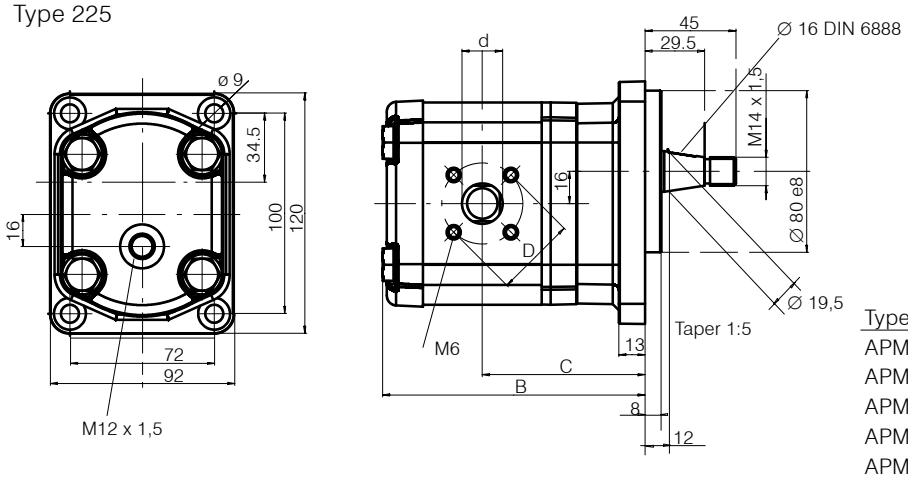




5.3 APMR200 reversible fan drive motor

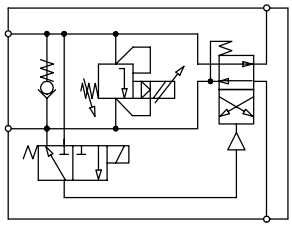
5.3.1 APMR200 reversible fan motor with outrigger bearing

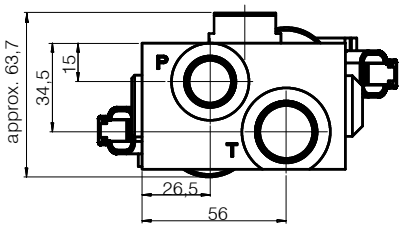
Type 225



			Suction		Pressure	
Type	B	C	D	d	D	d
APMR200/4	122	68,5	40	15	35	15
APMR200/6	125	70	40	15	35	15
APMR200/8	128	71,5	40	15	35	15
APMR200/11	141	78	40	15	35	15
APMR200/14	146	80,5	40	15	35	15
APMR200/17	150	82,5	40	15	35	15
APMR200/20	155	85	40	15	35	15
APMR200/25	164	89,5	40	15	35	15

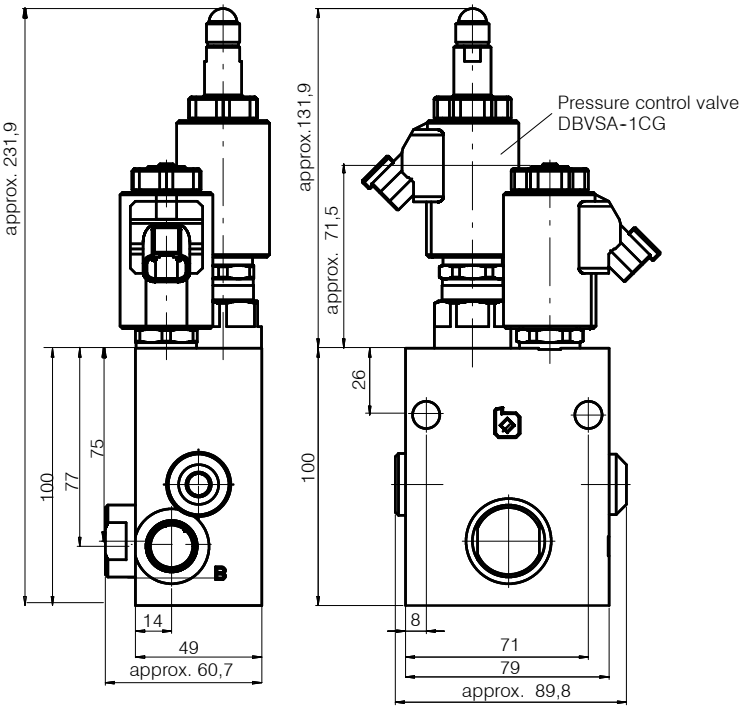
5.3.2 Reversing control for reversible motor

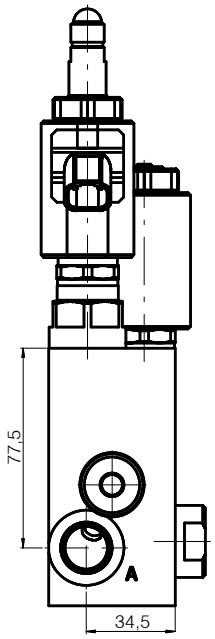




Q_{max} = 90 l/min
p_{max} = 230 bar

T: M22 x 1,5
P, A, B: M18 x 1,5





6 Ordering codes

6.1 External gear pump

A P 2 0 0 / 1 5 - S - 2 2 5

Size: = AP 200

Geometric displacement:
= 4,5 / 6,5 / 8,5 / 11 / 15 / 19 / 22 / 26cm³/U

Direction of rotation:

Clockwise = D
Counter-clockwise = S

Model:

SAE flange, SAE J 498-9T splined shaft = 287S-B
4-hole flange, 1:5 tapered shaft, 1:5, ∅ 17 = 225

6.2 Fan drive motor

A P F M 2 0 0 / 6 5 D A 1 6 C 1 2 V K 2 C 1 N 0 0

Size: = APFM 200

Geometric consumption:
= 6,5 / 8,5 / 11 / 15 / 19 / 22 / 26 cm³/rev

Direction of rotation:

Clockwise = D
Counter-clockwise = S

Body style, see 5.2.4

Cartridge pressure range:

No cartridge = 00
e. g. 160 bar / 10 = 16

Cartridge cavity:

DBVSA-1LG $Q_{max.}$ = 32 l/min = L
DBVSA-1CG $Q_{max.}$ = 100 l/min = C

Voltage:
12 V DC
24 V DC

Front cover:
80 mm flange without outrigger bearing, shaft taper 1:5 = W
80 mm flange with outrigger bearing, shaft taper 1:5 = K

Tank line pressure:

Max. 8 bar = 1
Max. 20 bar = 2
Max. 30 bar with M12 drain port = 3

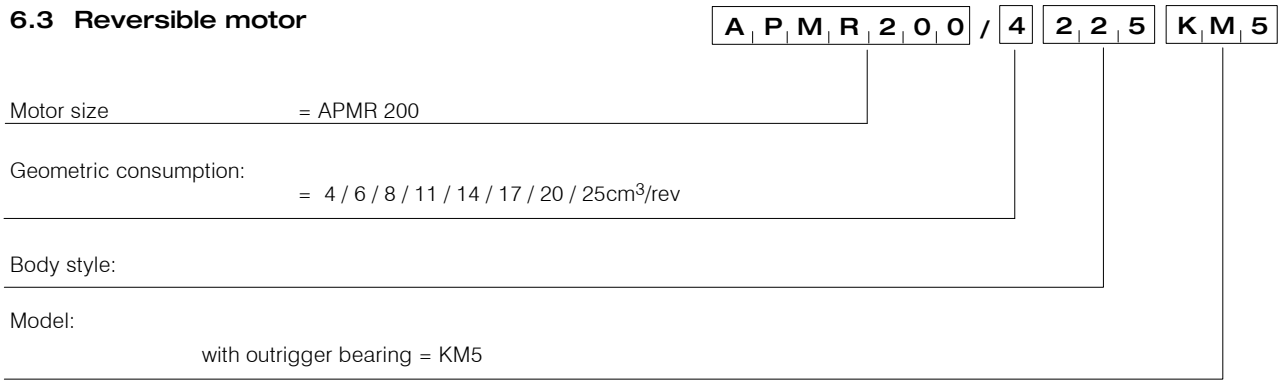
Anti-cavitation make-up valve:
With = C
Without = W

End cover:
Without test port = 0
With M14 test port = 1

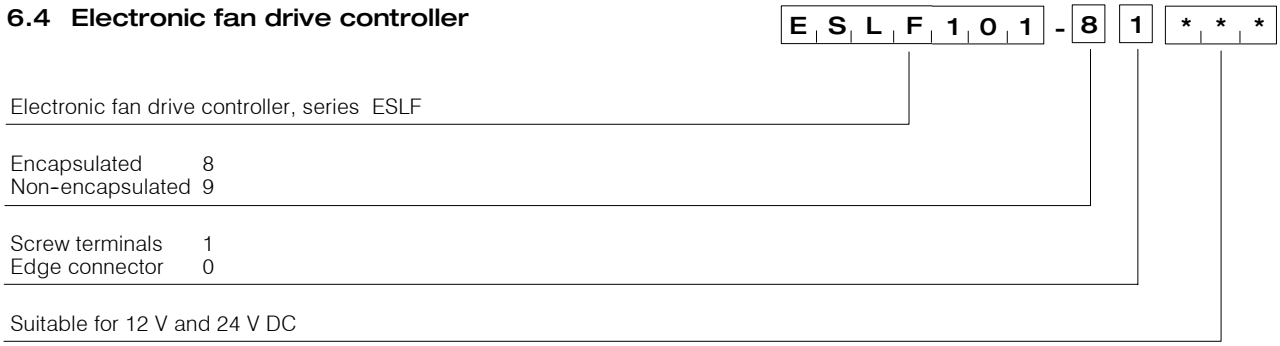
Seal material:
Nitrile = N
Viton = V

Customer-specific features

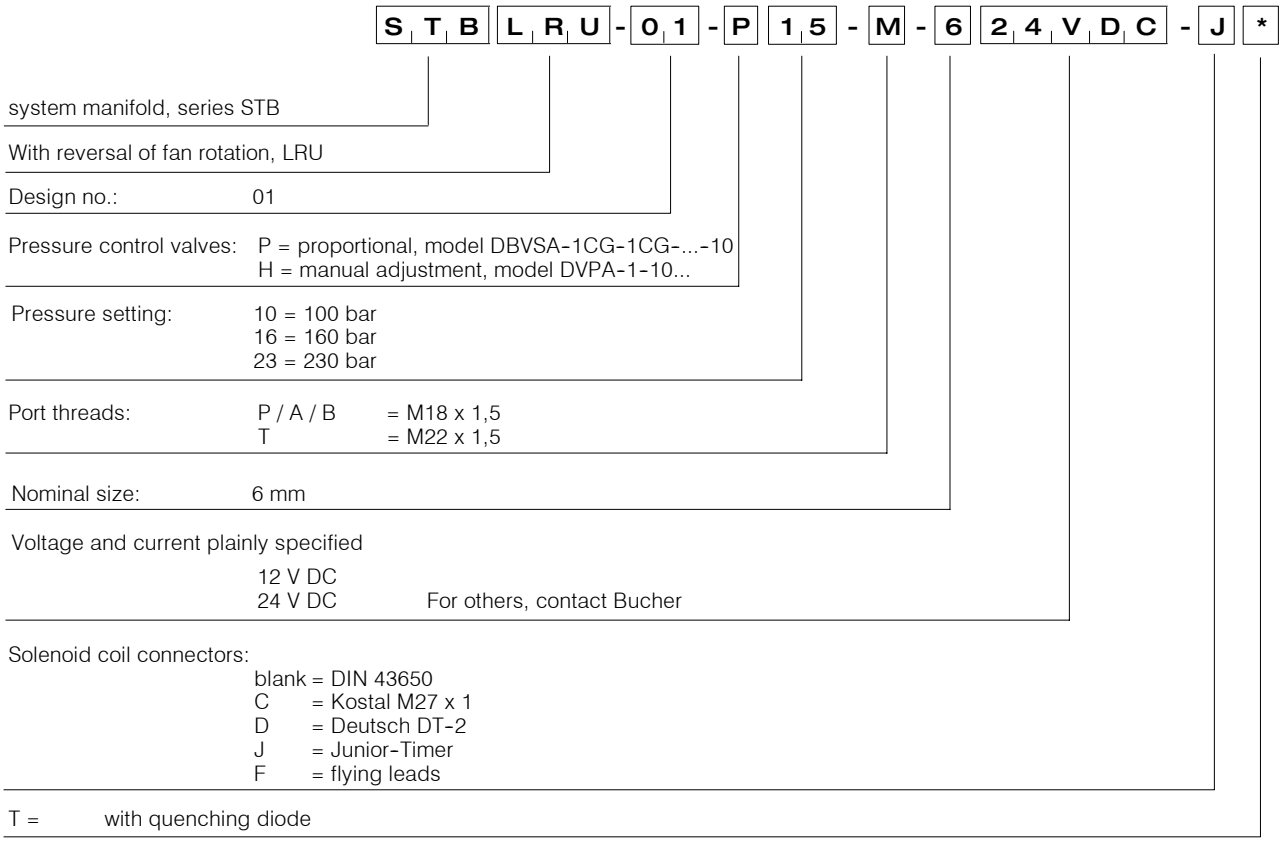
6.3 Reversible motor



6.4 Electronic fan drive controller



6.5 STB LRU system manifold



BUCHER HYDRAULICS www.bucherhydraulics.com

Germany
Phone +49 7742 85 20
Fax +49 7742 71 16
info.de@bucherhydraulics.com

France
Phone +33 389 64 22 44
Fax +33 389 65 28 78
info.fr@bucherhydraulics.com

Netherlands
Phone +31 79 34 26 24 4
Fax +31 79 34 26 28 8
info.nl@bucherhydraulics.com

UK
Phone +44 24 76 35 35 61
Fax +44 24 76 35 35 72
info.uk@bucherhydraulics.com

USA
Phone +1 262 605 82 80
Fax +1 262 605 82 78
info.wi@bucherhydraulics.com

Switzerland
Phone +41 33 67 26 11 1
Fax +41 33 67 26 10 3
info.ch@bucherhydraulics.com

Italy
Phone +39 0522 92 84 11
Fax +39 0522 51 32 11
info.it@bucherhydraulics.com

Austria
Phone +43 6216 44 97
Fax +43 6216 44 97 4
info.at@bucherhydraulics.com

China
Phone +86 512 6 322 12 99
Fax +86 512 6 322 10 33
info.sh@bucherhydraulics.com

Product Center (Elevator)
Phone +41 41 757 03 33
Fax +41 41 755 16 49
info.nh@bucherhydraulics.com