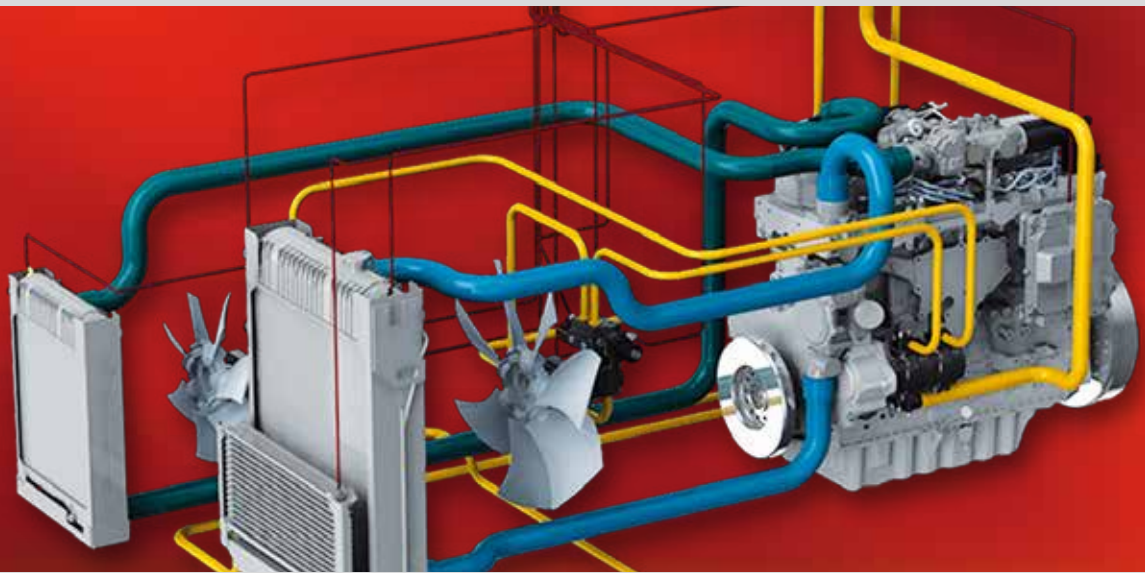




ELECTRO-HYDRAULIC FAN DRIVE SYSTEM

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05/02.2018



Modification from former edition.

INTRODUCTION



One of Casappa's aims is to develop targeted engineering solutions to improve machine performance. Designers of vehicle cooling systems require complete and flexible control systems. A cooling fan featuring a hydraulic drive offers significant advantages over traditional solutions with electric or belt drives.

ADVANTAGES OF THE HYDRAULIC SYSTEM vs OTHER TECHNOLOGIES

- More powerful and more effective
- Reverse function available
- Energy savings and low noise level
- Flexibility in cooling system design
- Integrated controls
- Reduced overall dimensions

SOME APPLICATIONS



Construction & Mining • Material Handling • On-Highway Vehicles • Agriculture & Turf Care

FAN DRIVE AVAILABLE SYSTEMS

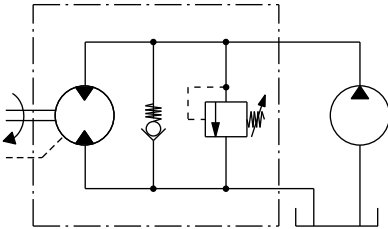
HYDRAULIC FAN DRIVE

➤ FIXED DISPLACEMENT SYSTEM

Fan speed proportional to the engine speed

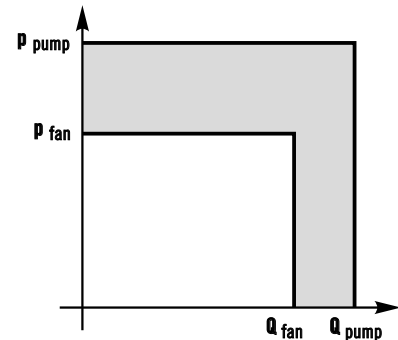
▶ Fixed ratio

- Gear pump and motor
- Anti-cavitation valve
- Pressure relief valve fixed setting
- Pressure relief valve adjustable setting



+ Low cost hydraulic solution

- Energy waste



p= Pressure
Q= Delivery

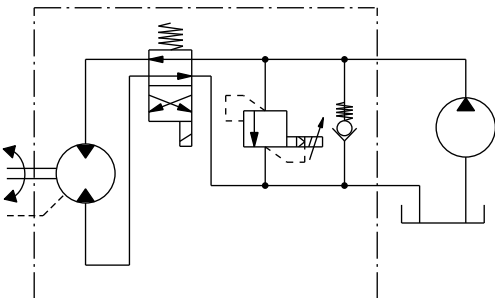
■ Wasted power

ELECTRO-HYDRAULIC FAN DRIVE

➤ FIXED DISPLACEMENT SYSTEM

Fan speed independent from engine speed

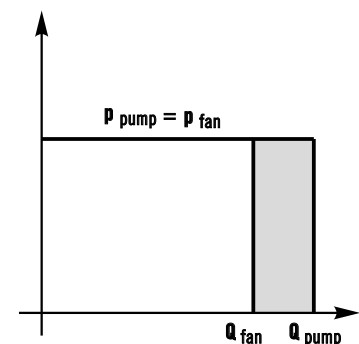
- ▶ Two speed
- ▶ Variable speed
- ▶ Variable speed and reverse function
 - Gear pump and motor
 - Anti-cavitation valve
 - Proportional pressure relief valve or unloading valve
 - Proportional pressure relief valve and reverse valve
 - Electronic control unit and sensors



+ Energy saving compared to hydraulic fan drive solution

+ All the valves integrated in the motor

- Still some energy waste



p= Pressure
Q= Delivery

■ Wasted power

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FAN DRIVE AVAILABLE SYSTEMS

ELECTRO-HYDRAULIC FAN DRIVE

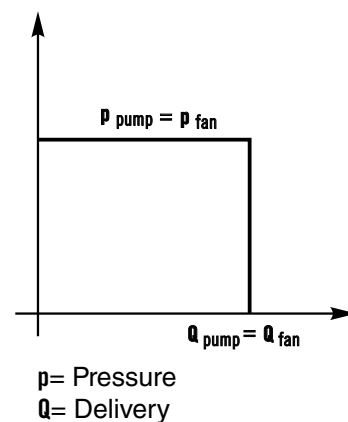
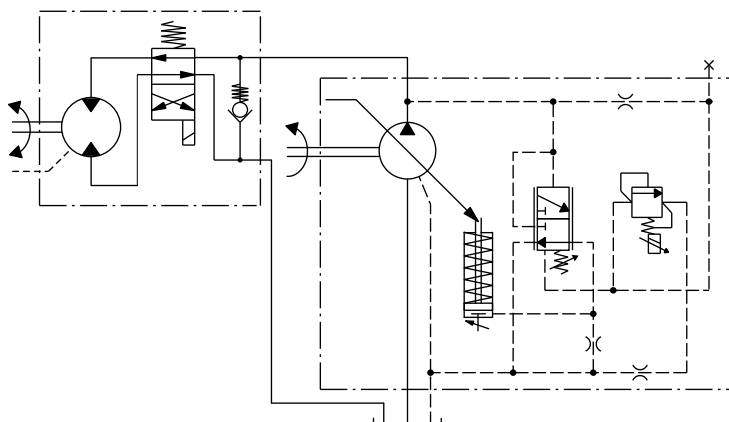
➤ VARIABLE DISPLACEMENT SYSTEM

Fan speed independent from engine speed

- ▶ Variable speed
- ▶ Variable speed and reverse function
 - Variable displacement axial piston pump
 - Fixed displacement gear motor
 - Pressure relief valve fixed setting
 - Electro-proportional pressure compensator
 - Electro-proportional pressure compensator and reverse valve
 - Electronic control unit and sensors

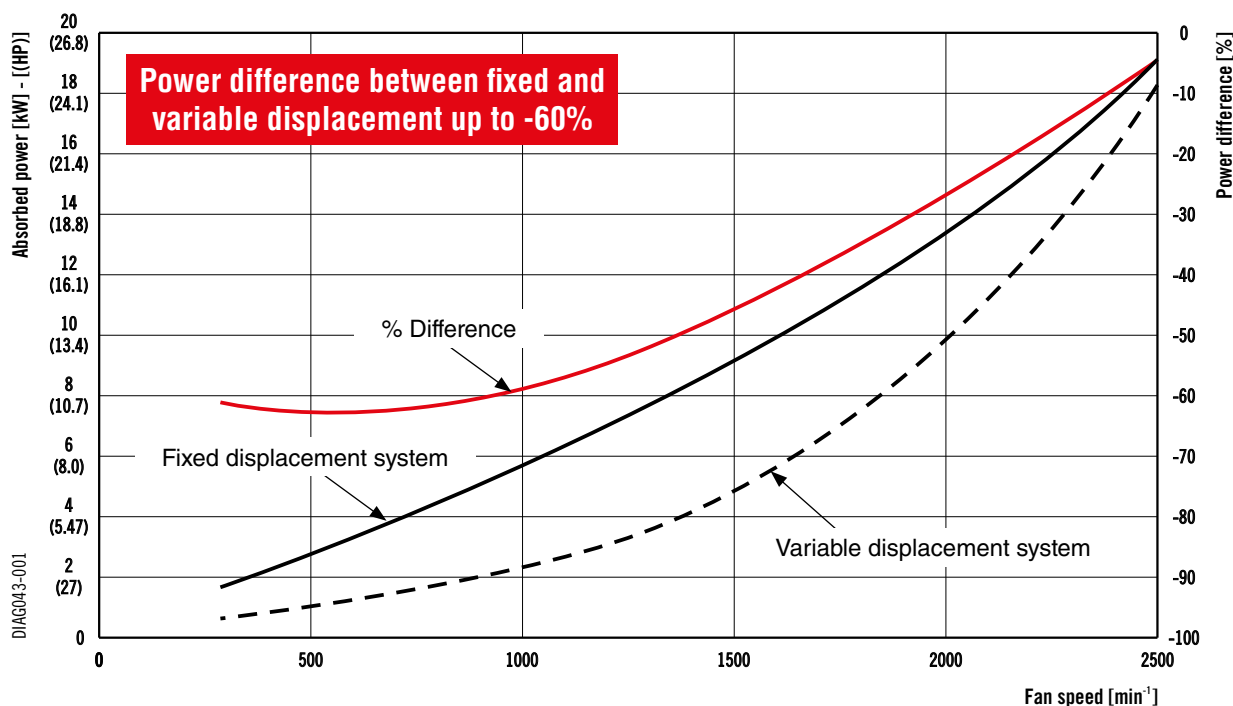
⊕ Enhanced energy saving

⊖ More expensive than previous types



ELECTRO-HYDRAULIC FAN DRIVE: FIXED vs VARIABLE DISPLACEMENT SYSTEM

POWER ABSORBED FROM ENGINE - COMPARISON EXAMPLE



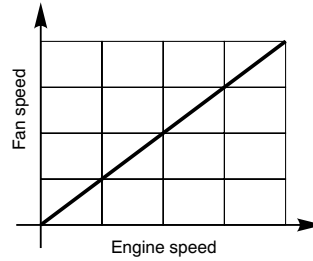
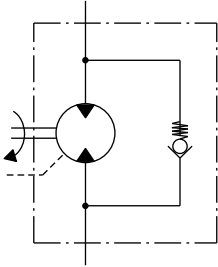
The diagram is only for reference.

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FIXED DISPLACEMENT SYSTEM - FIXED RATIO

ANTI-CAVITATION VALVE

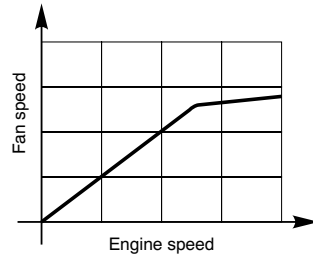
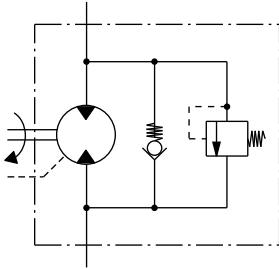
V8



- Motor protected against every system stop

MAX. PRESSURE RELIEF VALVE FIXED SETTING AND ANTI-CAVITATION VALVE

VPIF (...)



- Motor protected against any pressure peak and every system stop

Max. pressure relief valve

Fixed setting value

VPIF (1)

bar	50	70	80	100	120	125	140	150	160	175	180	190	200	210	230	250
(psi)	(725)	(1015)	(1160)	(1450)	(1740)	(1813)	(2030)	(2175)	(2320)	(2538)	(2610)	(2755)	(2900)	(3045)	(3335)	(3625)

The valve is sized to control a Q=60 l/min (15.85 US gpm) maximum flow rate.

For different values, please consult our technical sales department.

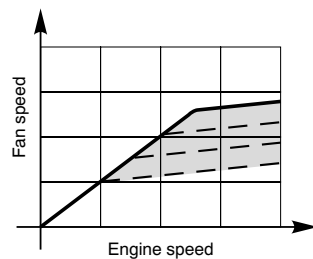
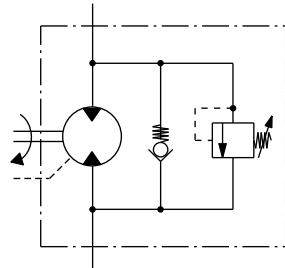
(1) value in bar

Order example:

VPIF (160)

MAX. PRESSURE RELIEF VALVE ADJUSTABLE SETTING AND ANTI-CAVITATION VALVE

VMP5 (...)/TS/V9



- Large size fans
- Motor protected against any pressure peak and every system stop
- System optimization thanks to adjustability

Max. pressure relief valve

Setting range values bar (psi)

VMP5 (2)/TS/V9

50 ÷ 220 (725 ÷ 3190)

The valve is sized to control a Q=35 l/min (9.25 US gpm) maximum flow rate.

For different values, please consult our technical sales department.

(2) value in bar

Order example:

VMP5 (170)/TS/V9

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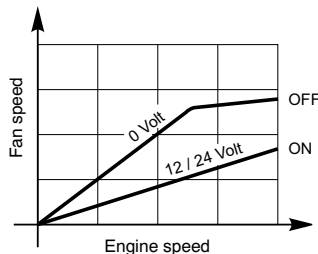
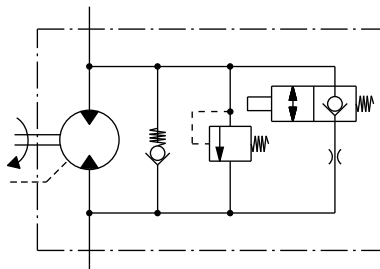
FIXED DISPLACEMENT SYSTEM - TWO SPEED

ON/OFF TWO SPEED VALVE (NORMALLY CLOSED)

UNL ...

MAX. PRESSURE RELIEF VALVE FIXED SETTING AND ANTI-CAVITATION VALVE

VPIF (...)



- Large size fans
- Motor protected against any pressure peak and every system stop
- ON/OFF solenoid valve to switch between two speed
Intermediate speed adjustments are not possible

Unloading valve	Max. flow l/min (US gpm)	① Voltage	② Mounting positions (a)	③ Connectors (b)
UNL - ① - ② - ③	40 (10.57)	1 12 V DC 2 24 V DC	B C	M - D - S - JT/A

(a): Mounting positions see page 12 - (b): Connectors see page 13

Max. pressure
relief valve

Fixed setting value

VPIF (④)	bar	50	70	80	100	120	125	140	150	160	175	180	190	200	210	230	250
	(psi)	(725)	(1015)	(1160)	(1450)	(1740)	(1813)	(2030)	(2175)	(2320)	(2538)	(2610)	(2755)	(2900)	(3045)	(3335)	(3625)

The valve is sized to control a Q=60 l/min (15.85 US gpm) maximum flow rate.

For different values, please consult our technical sales department.

④ value in bar

Order example:

UNL-2-C-M

/ VPIF (160)

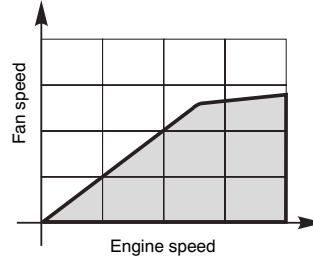
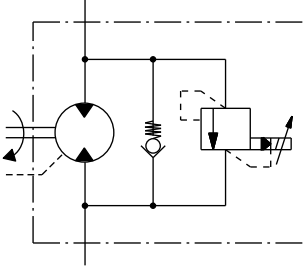
FIXED DISPLACEMENT SYSTEM - VARIABLE SPEED

PROPORTIONAL RELIEF VALVE

PRV ...

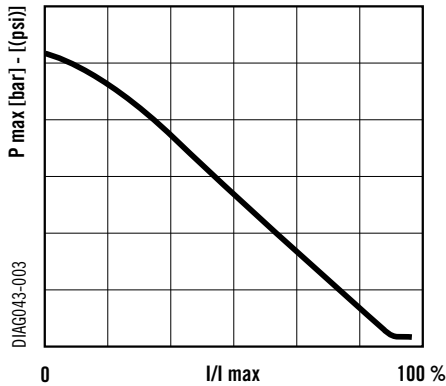
ANTI-CAVITATION VALVE

V9



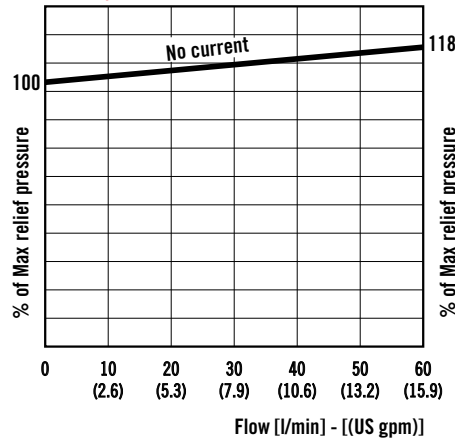
- Motor protected against every system stop
- Precise control of coolant temperature
- Maximum fan speed in case of control current failure

Pressure/current curve

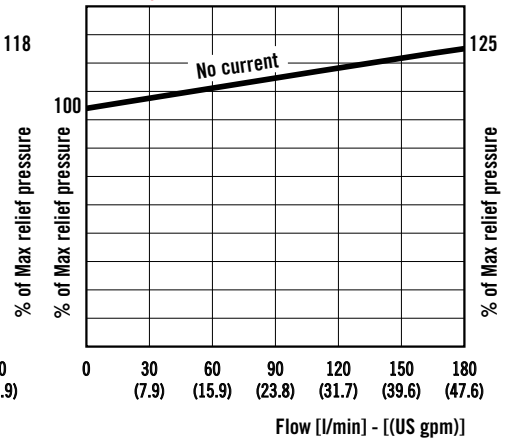


Pressure/flow curves

SAE10/2 CAVITY



SAE12/2 CAVITY



Proportional relief valve - Technical data

Max. flow	60 l/min (15.85 US gpm) - SAE10/2 cavity
	180 l/min (47.56 US gpm) - SAE12/2 cavity

	①	②	③	④
Proportional relief valve	Voltage	Mounting positions (a)	Max. pressure setting range (b)	Connectors (c)
PRV - ① - ② - ③ - ④	1 12 V DC 2 24 V DC	B - C	100 ÷ 250 bar (1450 ÷ 3625 psi)	M - D - S - JT/A

(a): Mounting positions see page 12 - (b): Value in bar - (c): Connectors see page 13
For values outside of the listed range, please consult our technical sales department

Order example: **PRV-1-B-180-JT/A** / **V9**

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FIXED DISPLACEMENT SYSTEM - VARIABLE SPEED AND REVERSE FUNCTION

PROPORTIONAL RELIEF VALVE

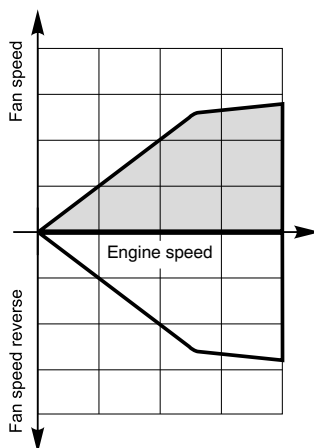
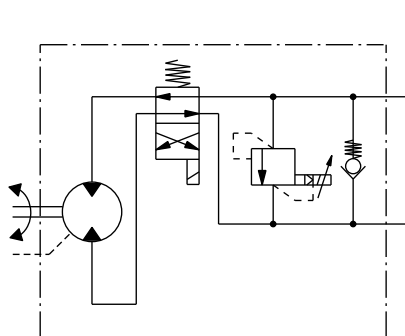
PRV ...

REVERSE VALVE

REV ...

ANTI-CAVITATION VALVE

V8

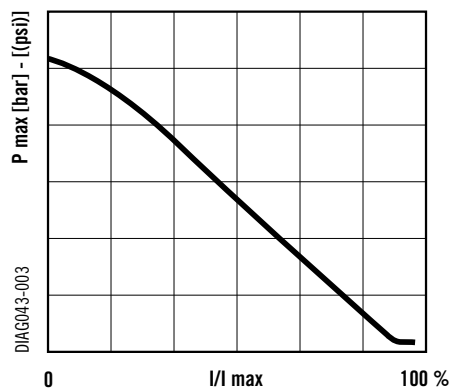


- Motor protected against every system stop
- Precise control of coolant temperature
- Reversible fan drive feature allows fan to clean radiator
- Maximum fan speed in case of control current failure

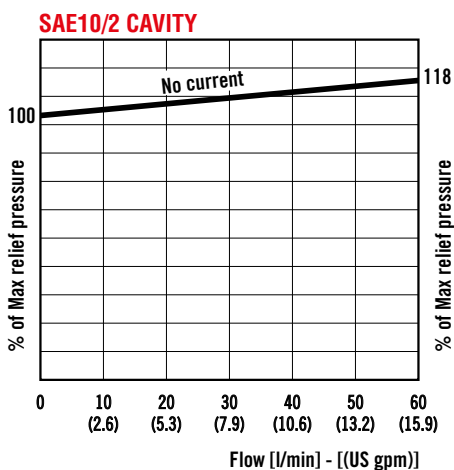
Proportional relief valve / Reverse valve - Technical data

Max. flow 60 l/min (15.85 US gpm) - SAE10/2 cavity

Pressure/current curve



Pressure/flow curves



05/02.2018

Proportional relief valve	Voltage	Mounting positions (a)	Max. pressure setting range (b)	Connectors (c)
PRV - 1 - 2 - 3 - 4	1 12 V DC 2 24 V DC	B	100 ÷ 250 bar (1450 ÷ 3625 psi)	M - D - S - JT/A

(a): Mounting positions see page 12 - (b): Value in bar - (c): Connectors see page 13
For values outside of the listed range, please consult our technical sales department

Reverse valve	Voltage	Mounting positions (a)	Connectors (c)
REV - 1 - 2 - 4	1 12 V DC 2 24 V DC	B	M - D - S - JT/A

(a): Mounting positions see page 12 - (c): Connectors see page 13

Order example: **PRV-2-B-180-D** / **REV-2-B-D** / **V8** - SK2

SK2: Reverse valve cover

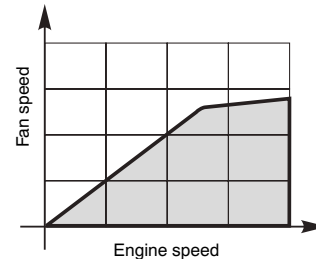
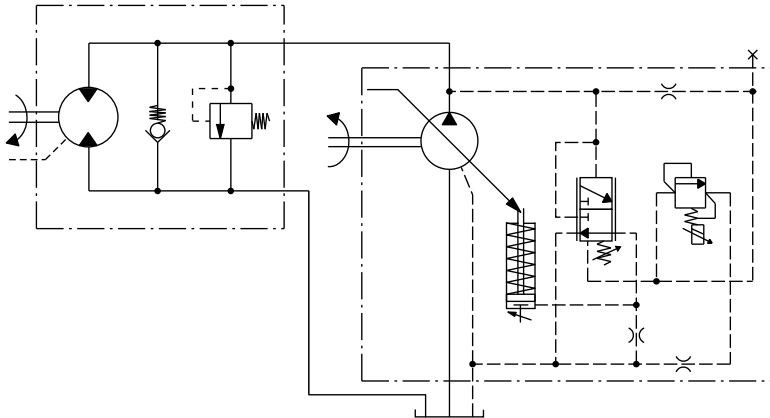
VARIABLE DISPLACEMENT SYSTEM - VARIABLE SPEED

ELECTRO-PROPORTIONAL PRESSURE COMPENSATOR (integrated on the pump)

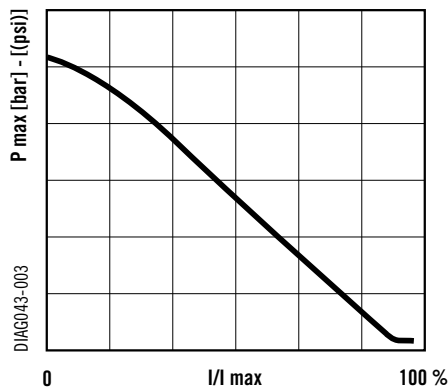
PEC ...

MAX. PRESSURE RELIEF VALVE FIXED SETTING AND ANTI-CAVITATION VALVE (integrated on the motor)

VPIF (...)



Pressure/current curve



- Enhanced energy saving
- The same piston pump can be used as main pump in a LS system
- Motor protected against every system stop
- Precise control of coolant temperature
- Maximum fan speed in case of control current failure

	①	②	③	④	⑤
Electro-proportional pressure compensator	Voltage	Mounting positions (a)	Min. pressure setting (b)	Max. pressure setting (b)	Connectors (c)
PEC - ① - ② - ③ - ④ - ⑤	1 NC 12 V DC 2 NC 24 V DC	A - B	To be defined according to the application	To be defined according to the application	D - S

(a): Mounting positions see page 12 - (b): Value in bar - (c): Connectors see page 13

For more info refer to the technical catalogue of variable displacements axial piston pumps MVP/MVPD series

Order example: **PEC-1-A-20/300-S** - E E: Max. displacement limiter

Max. pressure relief valve

Fixed setting value

VPIF (⑥)	bar	50	70	80	100	120	125	140	150	160	175	180	190	200	210	230	250
	(psi)	(725)	(1015)	(1160)	(1450)	(1740)	(1813)	(2030)	(2175)	(2320)	(2538)	(2610)	(2755)	(2900)	(3045)	(3335)	(3625)

The valve is sized to control a Q=60 l/min (15.85 US gpm) maximum flow rate.

For different values, please consult our technical sales department.

(⑥) value in bar

Order example: **VPIF (160)**

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VARIABLE DISPLACEMENT SYSTEM - VARIABLE SPEED AND REVERSE FUNCTION

ELECTRO-PROPORTIONAL PRESSURE COMPENSATOR (integrated on the pump)

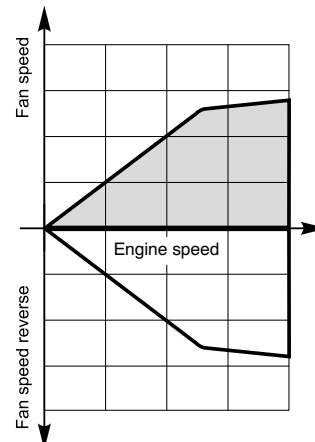
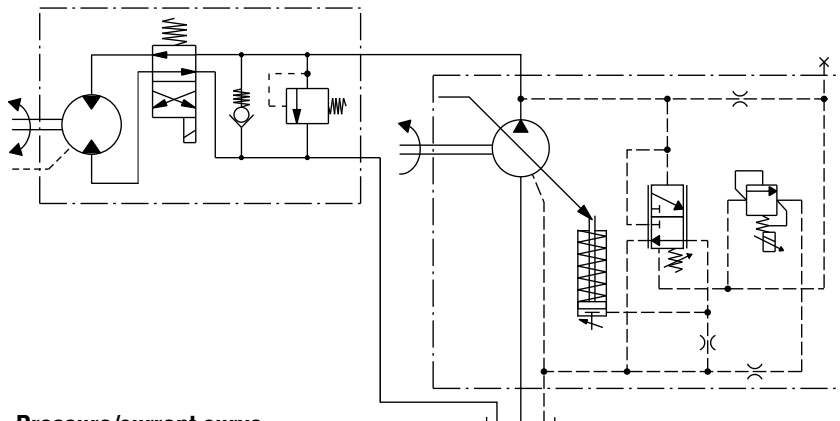
PEC ...

REVERSE VALVE (integrated on the motor)

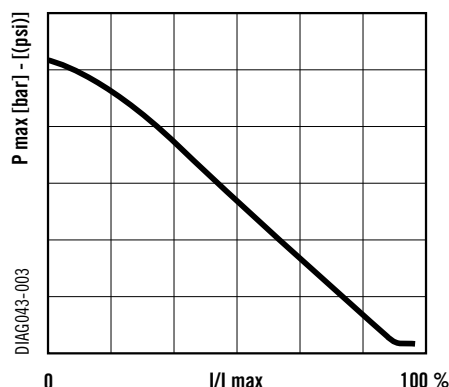
REV ...

MAX. PRESSURE RELIEF VALVE FIXED SETTING AND ANTI-CAVITATION VALVE (integrated on the motor)

VPIF (...)



Pressure/current curve



- Enhanced energy saving
- The same piston pump can be used as main pump in a LS system
- Motor protected against every system stop
- Precise control of coolant temperature
- Maximum fan speed in case of control current failure
- Reversible fan drive feature allows fan to clean radiator

	1	2	3	4	5
Electro-proportional pressure compensator	Valve type	Mounting positions (a)	Min. pressure setting (b)	Max. pressure setting (b)	Connectors (c)
PEC - 1 - 2 - 3 - 4 - 5	1 NC 12 V DC 2 NC 24 V DC	A - B	To be defined according to the application	To be defined according to the application	D - S

(a): Mounting positions see page 12 - (b): Value in bar - (c): Connectors see page 13

For more info refer to the technical catalogue of variable displacements axial piston pumps MVP/MVPD series

Order example: **PEC-1-A-20/300-S** - E E: Max. displacement limiter

	1	2	5
Reverse valve	Voltage	Mounting positions (a)	Connectors (c)
REV - 1 - 2 - 5	1 12 V DC 2 24 V DC	B	M - D - S - JT/A

(a): Mounting positions see page 12 - (c): Connectors see page 13

Max. pressure relief valve

Fixed setting value

VPIF (6)	bar	50	70	80	100	120	125	140	150	160	175	180	190	200	210	230	250
	(psi)	(725)	(1015)	(1160)	(1450)	(1740)	(1813)	(2030)	(2175)	(2320)	(2538)	(2610)	(2755)	(2900)	(3045)	(3335)	(3625)

The valve is sized to control a Q=60 l/min (15.85 US gpm) maximum flow rate.

For different values, please consult our technical sales department.

(6) value in bar

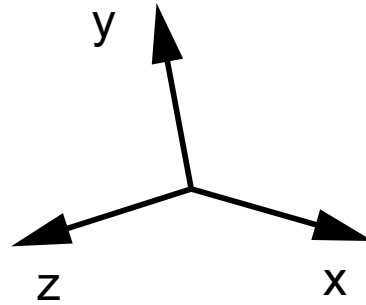
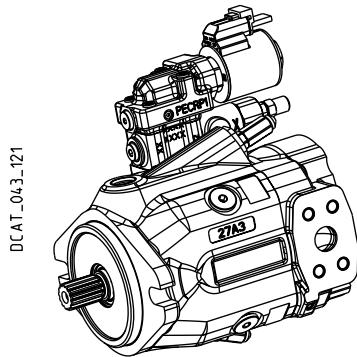
Order example: **REV-2-B-D** / **VPIF (160)** - SK2 SK2: Reverse valve cover

VALVE MOUNTING POSITIONS

MOUNTING POSITION

A

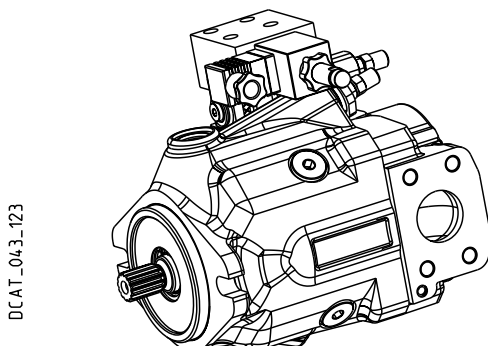
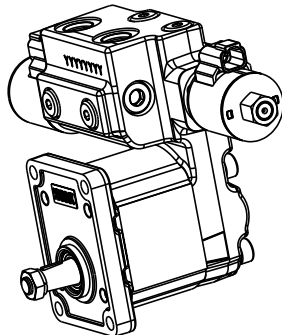
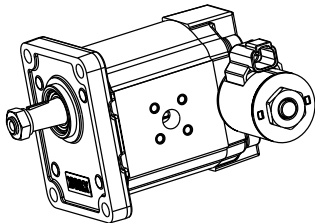
z axis oriented



MOUNTING POSITION

B

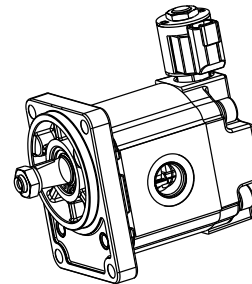
x axis oriented



MOUNTING POSITION

C

y axis oriented



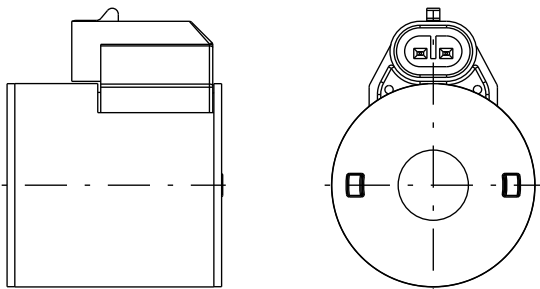
CONNECTORS

CONNECTOR: Metri Pack 150

M

Protection: IP69K with mating connector mounted

DCAT_043_104

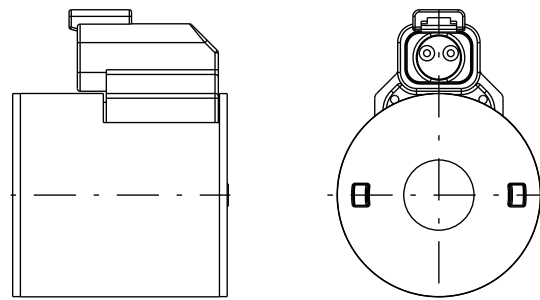


CONNECTOR: Deutsch DT04-2P

D

Protection: IP69K with mating connector mounted

DCAT_043_105

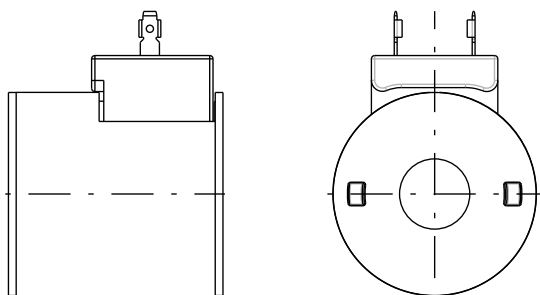


CONNECTOR: DIN 43650

S

Protection: IP65 with mating connector mounted

DCAT_043_106

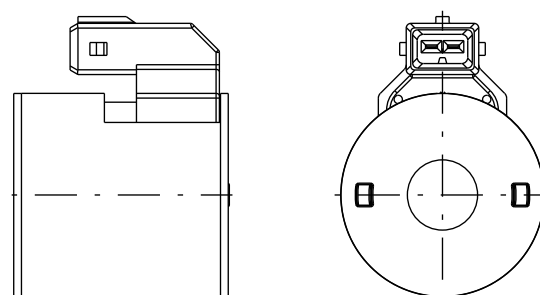


CONNECTOR: Junior Timer

JT/A

Protection: IP67 with mating connector mounted

DCAT_043_107



Technical data

For proportional relief valve and reverse valve

Connectors	Metri Pack 150, Deutsch DT04-2P, DIN 43650, Junior Timer	
Voltage	12 V DC	24 V DC
Maximum control current	1690 mA	840 mA
Dither frequency	200 Hz	200 Hz
Resistance at 20 °C (68 °F)	7,09 ± 3% Ω	28,5 ± 5% Ω

Technical data

For Unloading valve

Connectors	Metri Pack 150, Deutsch DT04-2P, DIN 43650, Junior Timer	
Voltage	12 V DC	24 V DC
Maximum control current	1400 mA	700 mA
Dither frequency	200 Hz	200 Hz
Resistance at 20 °C (68 °F)	8,8 ± 3% Ω	33,8 ± 5% Ω

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ELECTRONIC CONTROL UNIT FOR FAN DRIVE SYSTEM

The electronic control unit controls the speed of the fan drive system by controlling the proportional relief valve and allows to change the direction of rotation by controlling the reverse valve.

Electronic control unit can also receive CAN SAE J1939 standard messages. The temperature signals available on CAN bus (Engine Coolant Temperature, Engine Intercooler Temperature, Ambient Air Temperature, Intake Manifold Temperature) can be used to control the fan drive system. Retarder and Reverse command can also be provided through the CAN BUS system.



Input / Output	ECS200	ECS300
Analog input	6	4
Temperature sensor input	2	4
Digital/Frequency input	3	3
CAN BUS	1	2
Bluetooth	No	Yes
Proportional output	2 High Side drive 2A 2 Low Side drive 2A with current feedback	3 High Side drive 2A 3 Low Side drive 2A with current feedback

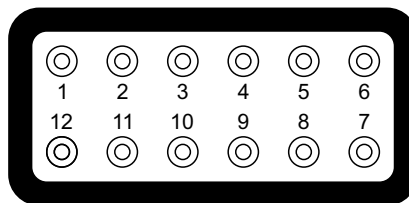
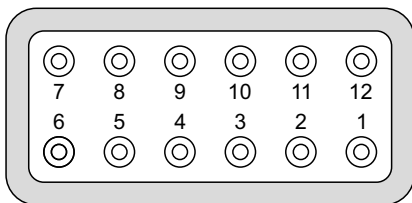
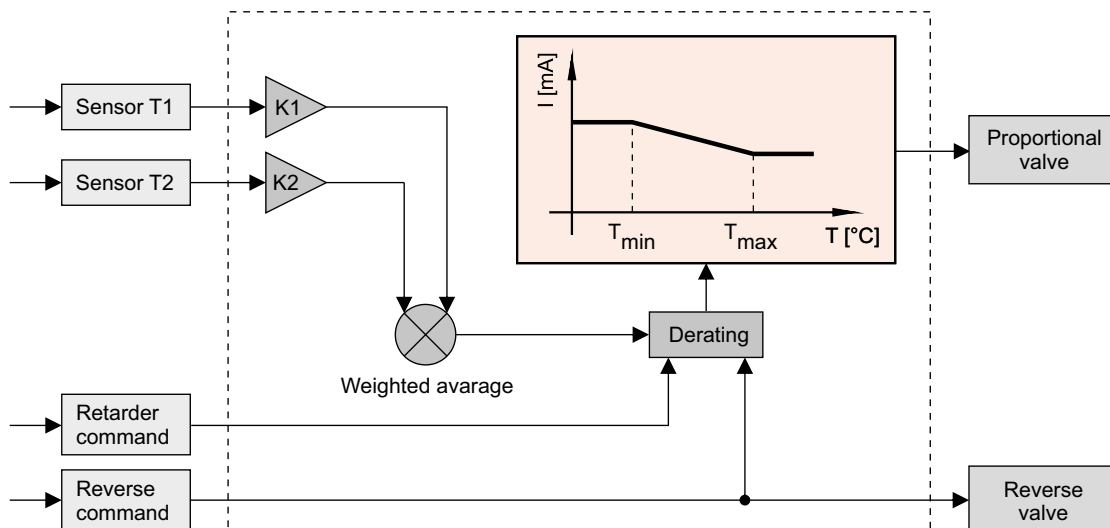
For normally closed electro-hydraulic valves, the control logic is:

Low temperature	Intermediate temperature	High temperature	Error/Failure
$< T_{min}$	Between T_{min} - T_{max}	$> T_{max}$	
Output current is maximum	Output current changes linearly from maximum to minimum	Output current is minimum	Output current is null
Fan speed is minimum		Fan speed is maximum	Fan speed run to maximum

For general information and dimensions, refer to the electronic control devices technical catalogue.

ELECTRONIC CONTROL UNIT FOR FAN DRIVE SYSTEM

ECS200



Pinout

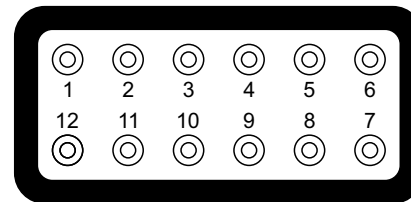
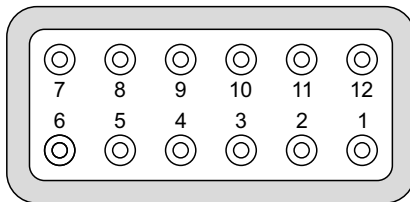
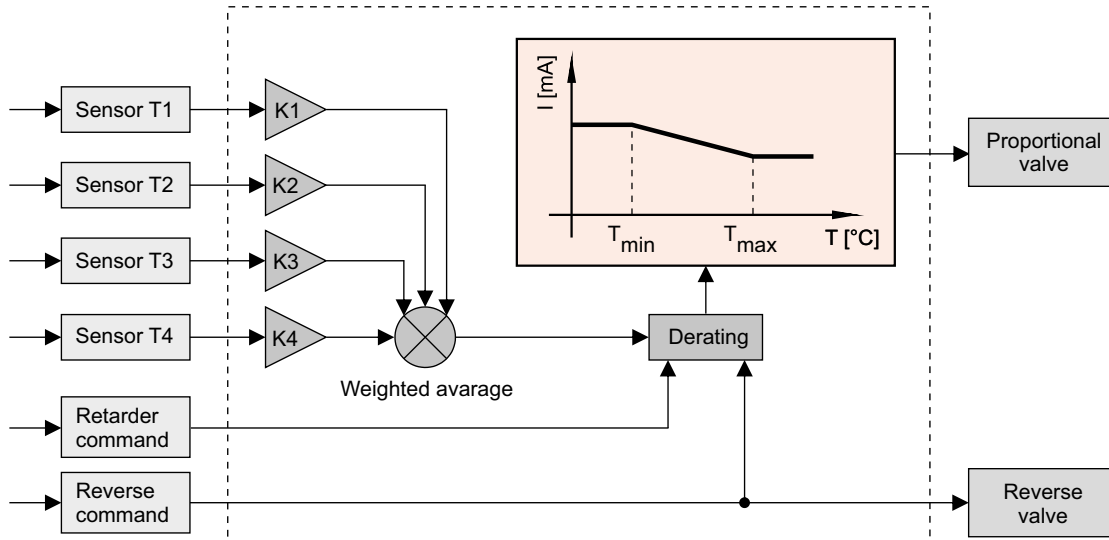
Grey connector	
Pin	Function
1	Temperature sensor GND
2	CAN1 HIGH
3	CAN1 LOW
4	Speed sensor input
5	Digital input n. 3 Reverse
6	Digital input n. 2 Retarder
7	Proportional valve +
8	Proportional valve -
9	Reverse valve +
10	Reverse valve -
11	N.C.
12	N.C.

Black connector	
Pin	Function
1	N.C.
2	N.C.
3	N.C.
4	N.C.
5	N.C.
6	N.C.
7	Temperature sensor T 2
8	Temperature sensor T 1
9	N.C.
10	N.C.
11	Power GND - CAN GND
12	Power VBB

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ELECTRONIC CONTROL UNIT FOR FAN DRIVE SYSTEM

ECS300



Pinout

Grey connector	
Pin	Function
1	Temperature sensor GND
2	CAN1 HIGH
3	CAN1 LOW
4	Speed sensor input
5	Digital input n. 3 Reverse
6	Digital input n. 2 Retarder
7	Proportional valve +
8	Proportional valve -
9	Reverse valve +
10	Reverse valve -
11	Diagnostic Lamp +
12	N.C.

Black connector	
Pin	Function
1	CAN2 HIGH
2	CAN2 LOW
3	Temperature sensor T 3
4	N.C.
5	N.C.
6	Temperature sensor T 4
7	Temperature sensor T 2
8	Temperature sensor T 1
9	N.C.
10	N.C.
11	Power GND - CAN GND Diagnostic Lamp GND
12	Power VBB

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CASAPPA SERVICE TOOL SOFTWARE

KEY FEATURES

- Parametrization of ECS200 / ECS300 control units
- Monitor and diagnostic functions
- Auto detection of the different type of control unit



HOME PAGE

Connection through Bluetooth or CAN BUS interface.

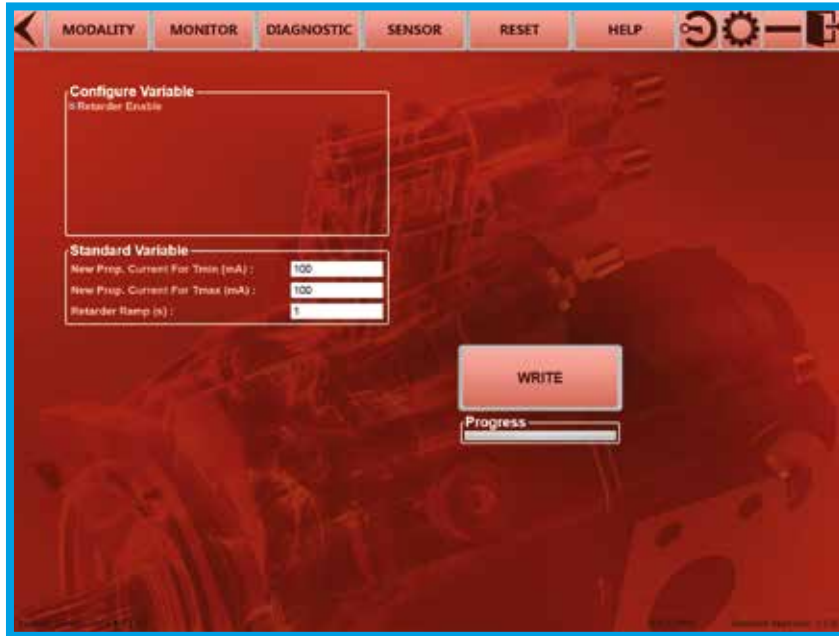


MODALITY: CONTROL

Read and change software parameter.

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CASAPPA SERVICE TOOL SOFTWARE



MODALITY: RETARDER

Retarder function allows to increase or decrease the hydraulic motor speed changing the control current of proportional valve according configurable logics.



MODALITY: REVERSE

Reverse function is available only for reversible motor with reverse valve and allows to change the direction of rotation for cleaning cycles of radiators.

The engaging modality can be done in various way: manually from the operator "On Command", on system start-up "At Reset" or at programmed interval times "On Timeout". During the cleaning cycles, fan speed can be controlled setting the limit of proportional valve control current "Currents – Proportional min/max".

Phase time of cleaning cycles can be adjusted to the system requirements "Cycle Control – Phase Time".

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CASAPPA SERVICE TOOL SOFTWARE

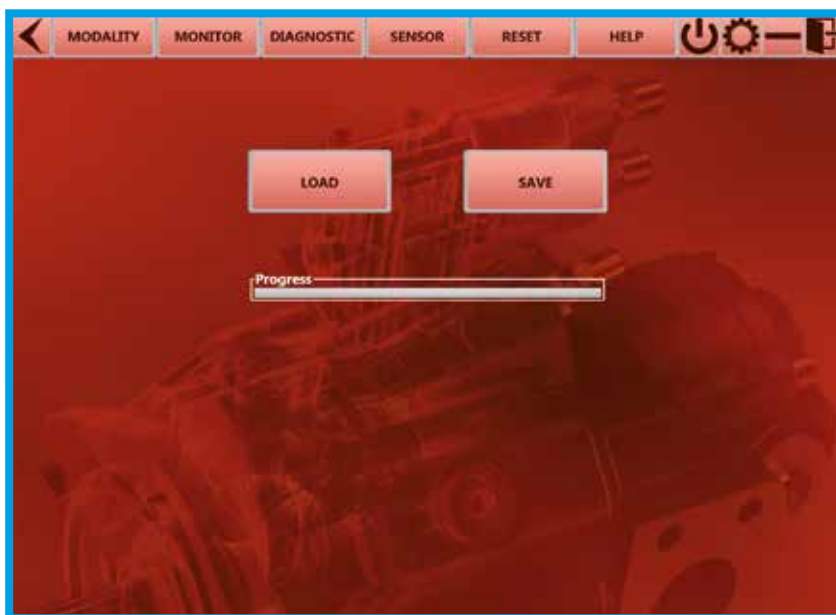


SENSORS

The electronic control unit provides from a minimum of 1 to a maximum of 4 temperature sensors.

In case of supply current failure the fan runs to maximum speed. Minimum and maximum limit of control current can be customized according to the technical data of proportional valve.

For general information and dimensions about the physical temperature sensors refer to the electronic control devices technical catalogue.



CONFIGURATION

Save/store control unit parameters configuration to/from file.

Reset control unit parameters configuration to factory defaults.

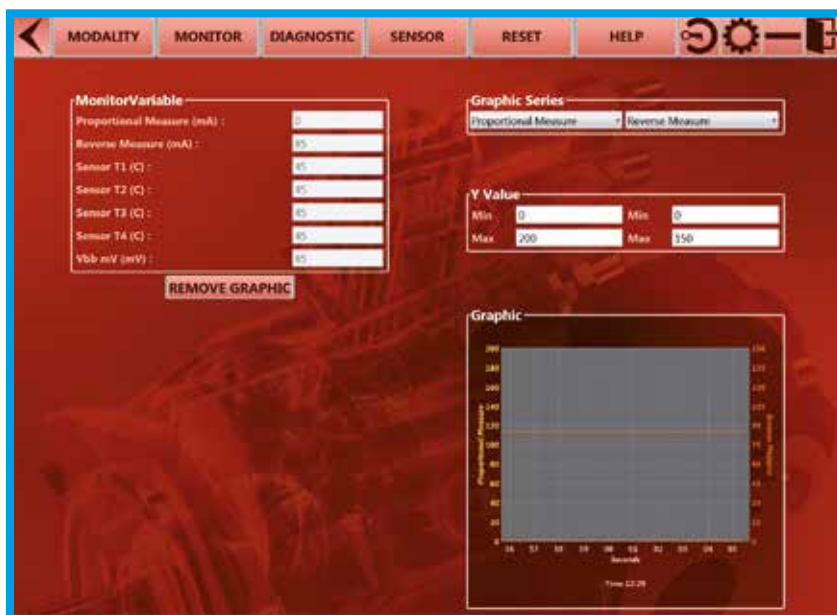
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CASAPPA SERVICE TOOL SOFTWARE



DIAGNOSTIC

Real-time monitoring of control unit error-messages.

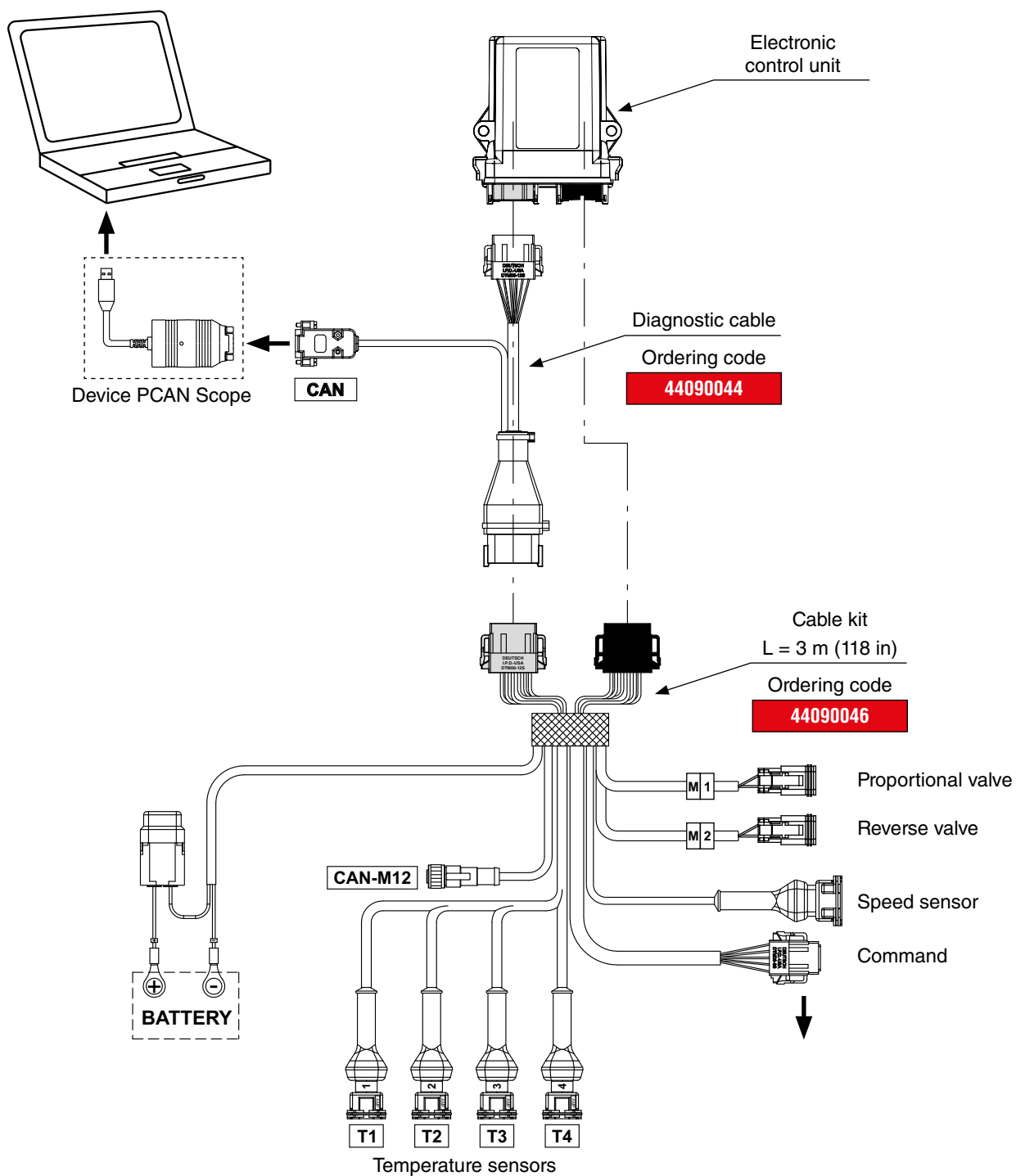


MONITOR

Graphical view of the measured variables over time.

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CABLE KIT



Command connector pinout

Pin	Function	Pin	Function
1	Digital input n. 3 Reverse	5	N.C.
2	Digital input n. 2 Retarder	6	N.C.
3	Power GND - CAN GND	7	N.C.
4	N.C.	8	N.C.

GEAR MOTORS FOR FAN DRIVE SYSTEM

POLARIS



Gear motors built in three pieces with an extruded body in high resistance aluminium alloy.

The wide choice of shafts, flanges and ports, in compliance with all international standards (SAE, DIN and EUROPEAN) allow for their use in an infinite variety of applications.

DISPLACEMENTS (available in group 20)

From 4,95 cm³/rev (0.30 in³/rev)

To 33,03 cm³/rev (2.01 in³/rev)

PRESSURE

Max. peak pressure up to 300 bar (4350 psi)

SPEED

Max. speed up to 4000 min⁻¹

Gear motors built in three pieces with cast iron body. The new gear motors "PH" series is an evolution of the "POLARIS" series.

POLARIS PH" has a new body made of cast iron to have higher operating parameters and keep the full POLARIS versatility regarding shafts, flanges, ports and built-in valves.

The possibility to mate the body with the cast iron covers further reduces noise levels, in addition to increasing strength.

DISPLACEMENTS

From 8,26 cm³/rev (0.50 in³/rev)

To 33,03 cm³/rev (2.01 in³/rev)

PRESSURE

Max. peak pressure up to 300 bar (4350 psi)

SPEED

Max. speed up to 3500 min⁻¹

For general data, dimensions, drive shafts, mounting flanges and ports, refer to the technical catalogues of each specific series.



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GEAR MOTORS - FEATURES

Construction	External gear type motors
Mounting	EUROPEAN - SAE - GERMAN flanges
Line connections	Threaded and flanged
Direction of rotation (looking at the drive shaft)	Reversible external drain (L) with bottom drain port position (*)
Max drain line pressure on reversible rotation motors	5 bar (73 psi)
Max back pressure on in series motors	150 bar (2175 psi)
Fluid temperature range	See table (1)
Fluid	Mineral oil based hydraulic fluids to ISO/DIN and fire resistant fluids [see table (1)]. For other fluids please consult our technical sales department.
Viscosity range	From 12 to 100 mm ² /s (cSt) recommended [60 to 456 SSU] Up to 750 mm ² /s (cSt) permitted [3410 SSU]
Recommended filtration	See table (2)

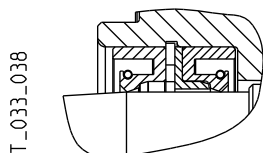
Tab. 1

Type	Fluid composition	Max pressure bar - (psi)	Max speed min ⁻¹	Temperature °C - (°F)			Seals (●)	Shaft seals option (◆)
				Min	Max continuous	Max peak		
ISO/DIN	Mineral oil based hydraulic fluid to ISO/DIN	See page 25	See page 25	-13 (-25)	176 (80)	212 (100)	N	D
				-13 (-25)	230 (110)	257 (125)	T-PV	

(●) **N** = Buna N (standard) - **TP-V** = Buna hydrogenated HNBR and viton shaft seal

D (◆) Shaft seal with wiper seal

Max drain line pressure



Max continuous pressure at min speed: 5 bar (73 psi)
Max continuous pressure at max speed: 1 bar (14,5 psi)

COLD START

During cold start of the machine the following limits can be applied:

Max drain line pressure	+50% of standard value
Operating temperature	-40 °C (-40 °F)
Oil viscosity	2000 mm ² /s (cSt) [9100 SSU] / -18 °C (0 °F) del ISO VG46
Cold start is meant for short term and low idle	

Tab. 2

Working pressure bar (psi)	$\Delta p < 140$ (2030)	$140 < \Delta p < 210$ (2030) (3045)	$\Delta p > 210$ (3045)
Contamination class NAS 1638	10	9	8
Contamination class ISO 4406:1999	21/19/16	20/18/15	19/17/14
Achieved with filter $\beta_{10}(c) \geq 75$ according to ISO 16889	-	10 μm	10 μm
Achieved with filter $\beta_{25}(c) \geq 200$ according to ISO 16889	25 μm	-	-

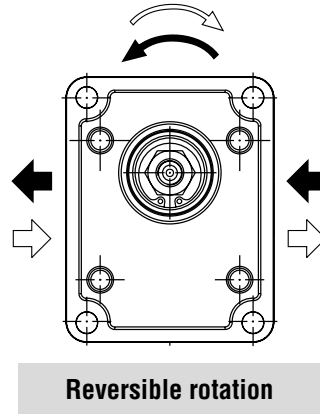
Casappa recommends to use its own production filters:



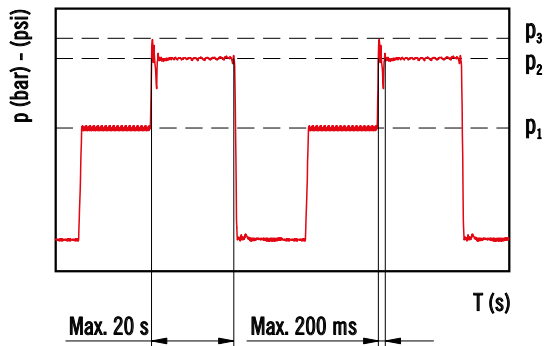
For more information please consult our technical sales department.

GEAR MOTORS - FEATURES

DEFINITION OF ROTATION DIRECTION LOOKING AT THE DRIVE SHAFT



PRESSURE DEFINITION



- p_1 Constant operating pressure
- p_2 System pressure (relief valve setting)
- p_3 Peak of pressure

The peak of pressure is the max pressure allowed and it corresponds to the overshoot of the relief valve.

Please note that both relief valve setting and overshoot must be lower than their limits.

If the relief setting is compliant but the overshoot is higher than the limit, the relief setting must be decreased until the overshoot is compliant to Casappa limit.

For high frequency applications please consult our technical sales department.

DESIGN CALCULATIONS FOR MOTORS

P	kW (HP)	Power
Δp	bar (psi)	Pressure
Q	l/min (US gpm)	Delivery
M	Nm (lbf in)	Torque
V	cm ³ /rev (in ³ /rev)	Displacement
n	min ⁻¹	Speed
$\eta_v = \eta_v(V, \Delta p, n)$	Volumetric efficiency	($\approx 0,96$)
$\eta_m = \eta_m(V, \Delta p, n)$	Mechanical efficiency	($\approx 0,85$)
$\eta_t = \eta_v \cdot \eta_{hm}$	Overall efficiency	($\approx 0,82$)

$$Q = \frac{Q_{theor.}}{\eta_v} \quad [l/min]$$

$$Q_{theor.} = \frac{V \cdot n}{1000}$$

$$M = M_{theor.} \cdot \eta_{hm} \quad [Nm]$$

$$M_{theor.} = \frac{\Delta p \cdot V}{62,83}$$

$$P_{IN} = \frac{\Delta p \cdot Q}{600} \quad [kW]$$

$$P_{OUT} = P_{IN} \cdot \eta_t$$

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GEAR MOTORS - FEATURES

Motor type POLARIS 20	Displacement	Max. pressure			Max. speed	Min. speed
		p ₁	p ₂	p ₃		
	cm ³ /rev (in ³ /rev)	bar (psi)			min ⁻¹	
PLM 20•4	4,95 (0.30)	250 (3625)	250 (3625)	250 (3625)	4000	600
PLM 20•6,3	6,61 (0.40)	250 (3625)	250 (3625)	250 (3625)	4000	600
PLM 20•7,2	7,29 (0.44)	250 (3625)	250 (3625)	250 (3625)	4000	600
PLM 20•8	8,26 (0.50)	250 (3625)	250 (3625)	250 (3625)	3500	600
PLM 20•9	9,17 (0.56)	250 (3625)	250 (3625)	250 (3625)	3500	600
PLM 20•10,5	10,9 (0.66)	250 (3625)	250 (3625)	250 (3625)	3500	600
PLM 20•11,2	11,23 (0.69)	250 (3625)	250 (3625)	250 (3625)	3500	600
PLM 20•14	14,53 (0.89)	250 (3625)	250 (3625)	250 (3625)	3500	500
PLM 20•16	16,85 (1.03)	250 (3625)	250 (3625)	250 (3625)	3000	500
PLM 20•19	19,09 (1.16)	200 (2900)	200 (2900)	240 (3480)	3000	500
PLM 20•20	21,14 (1.29)	200 (2900)	200 (2900)	240 (3480)	3000	500
PLM 20•24,5	24,84 (1.52)	170 (2465)	190 (2755)	210 (3045)	2500	500
PLM 20•25	26,42 (1.61)	170 (2465)	190 (2755)	210 (3045)	2500	500
PLM 20•27,8	28,21 (1.72)	130 (1885)	150 (2175)	170 (2465)	2000	500
PLM 20•31,5	33,03 (2.01)	130 (1885)	150 (2175)	170 (2465)	2000	500

For different working conditions please consult our sales department.

Motor type POLARIS PH	Displacement	Max. pressure			Max. speed	Min. speed
		p ₁	p ₂	p ₃		
	cm ³ /rev (in ³ /rev)	bar (psi)			min ⁻¹	
PHM 20•8	8,26 (0.50)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•10.5	10,9 (0.66)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•11.2	11,23 (0.69)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•14	14,53 (0.89)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•16	16,85 (1.03)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•18	18,29 (1.12)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•19	19,09 (1.16)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•20	21,14 (1.29)	250 (3625)	250 (3625)	250 (3625)	3500	500
PHM 20•23	23,32 (1.42)	250 (3625)	250 (3625)	250 (3625)	3000	500
PHM 20•24,5	24,84 (1.52)	230 (3335)	250 (3625)	250 (3625)	3000	500
PHM 20•25	26,42 (1.61)	230 (3335)	250 (3625)	250 (3625)	3000	500
PHM 20•27,8	28,21 (1.72)	200 (2900)	230 (3335)	250 (3625)	2500	500
PHM 20•31,5	33,03 (2.01)	200 (2900)	230 (3335)	250 (3625)	2500	500

For different working conditions please consult our sales department.

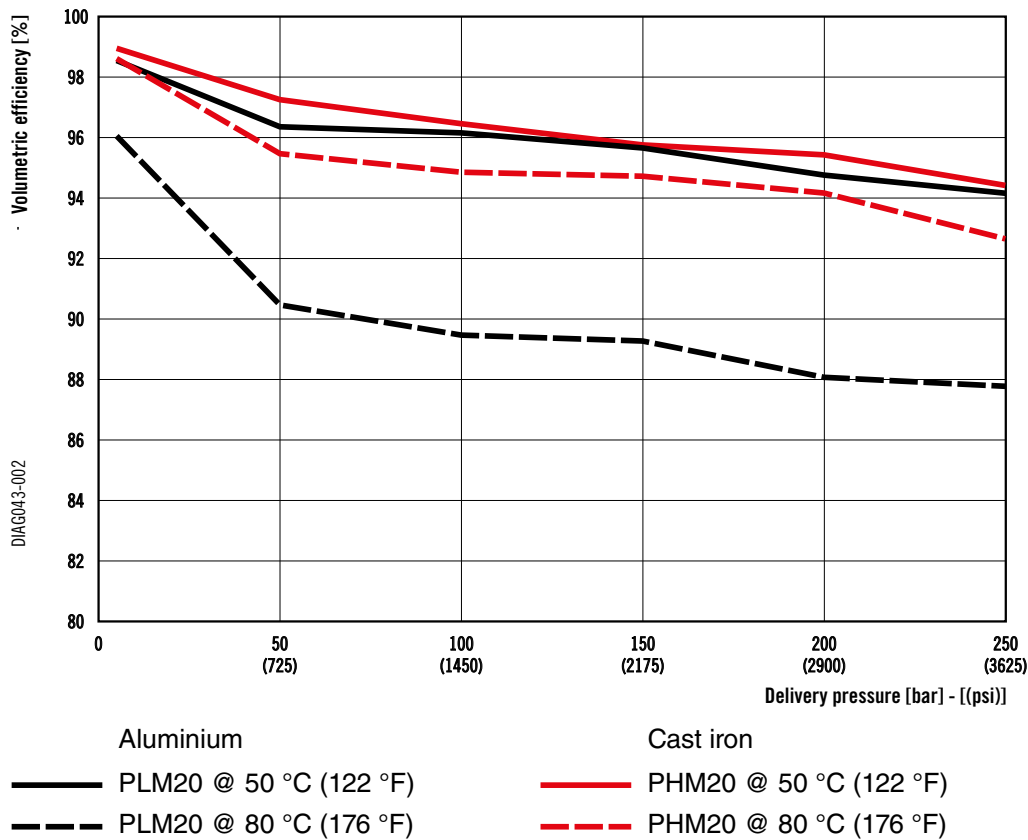
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CAST IRON vs ALUMINIUM MOTORS - PERFORMANCES

VOLUMETRIC EFFICIENCY

Engine speed: 2000 min⁻¹

Oil type: ISO VG46



The diagram is only for reference.

**Max. speed difference between cast iron and aluminium motors up to +15%
therefore pump displacement can be reduced**

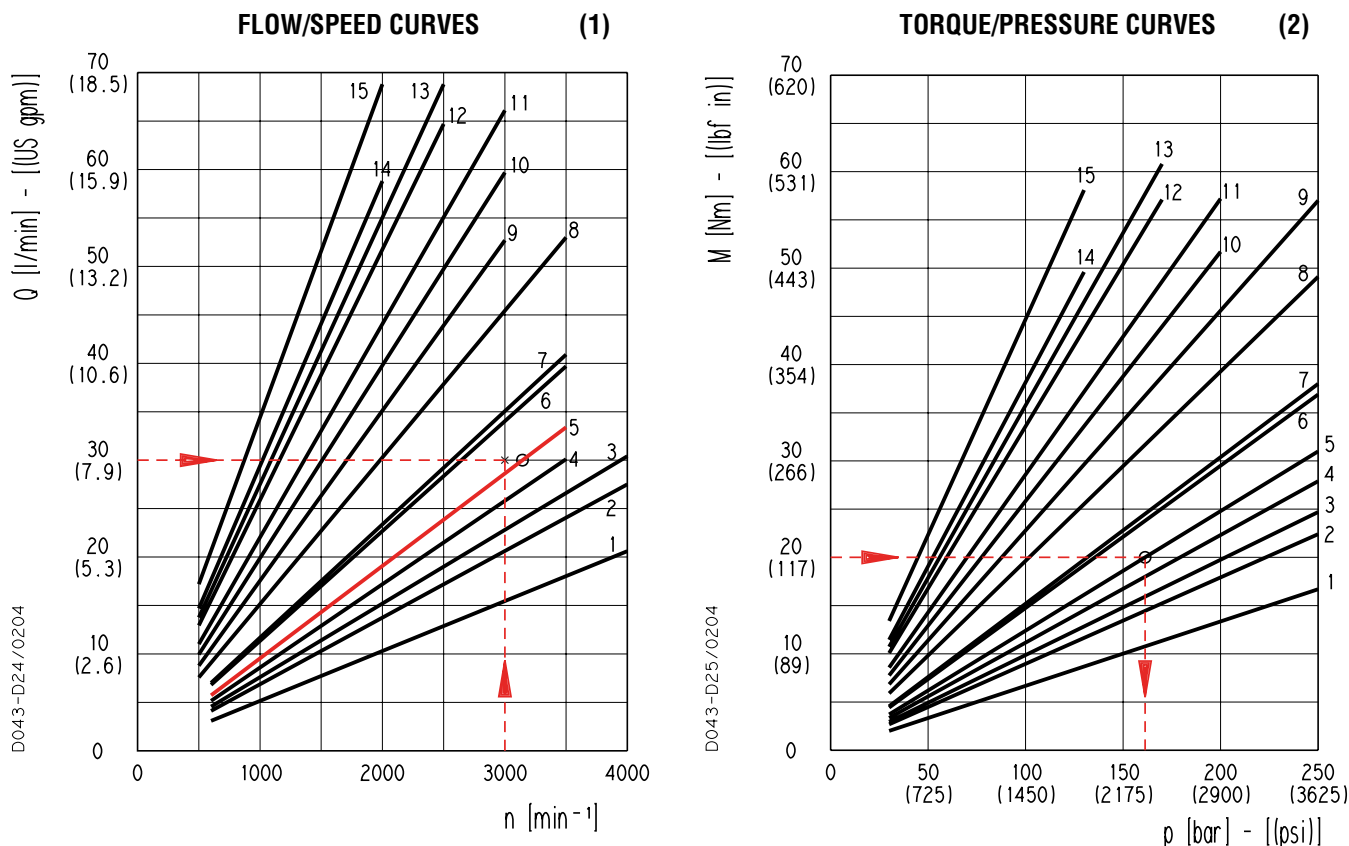
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POLARIS 20 - GEAR MOTOR SIZING EXAMPLE

In the cooling system, the airflow of the fan needed to dissipate the heat produced by the system is proportional to speed rotation. The fan absorbed torque is proportional to squared speed, to fan dimensions and to the loss of power that the air encounters while flowing through the radiator.

To make sure that the cooling system is correctly sized is necessary to know the following input parameters:

- Maximum fan speed
- Maximum fan absorbed torque
- Hydraulic system oil flow rate
- Maximum system pressure



Each curve has been obtained at 50 °C (122 °F), using oil with viscosity 168 SSU (36 cSt) at 40 °C (104 °F) and at these pressures.

Example

Hydraulic system oil flow	30 l/min (7.9 US gpm)
Maximum system pressure	200 bar (2900 psi)
Maximum fan speed	3000 min ⁻¹
Maximum fan absorbed torque	20 Nm (117 lbf in)

1	PLM 20•4	250 bar (3265 psi)
2	PLM 20•6,3	250 bar (3265 psi)
3	PLM 20•7,2	250 bar (3265 psi)
4	PLM 20•8	250 bar (3265 psi)
5	PLM 20•9	250 bar (3265 psi)
6	PLM 20•10,5	250 bar (3265 psi)
7	PLM 20•11,2	250 bar (3265 psi)
8	PLM 20•14	250 bar (3265 psi)

9	PLM 20•16	250 bar (3265 psi)
10	PLM 20•19	200 bar (2900 psi)
11	PLM 20•20	200 bar (2900 psi)
12	PLM 20•24,5	170 bar (2465 psi)
13	PLM 20•25	170 bar (2465 psi)
14	PLM 20•27,8	130 bar (1885 psi)
15	PLM 20•31,5	130 bar (1885 psi)

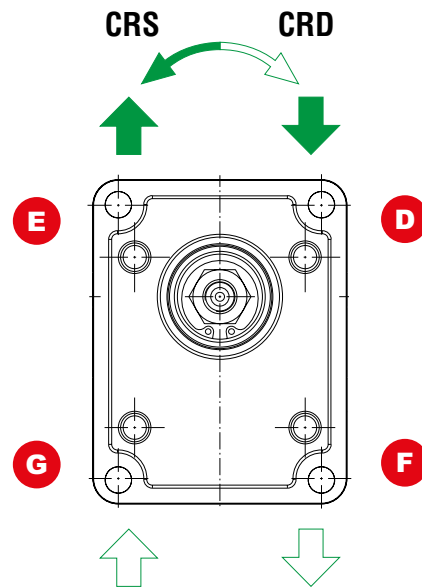
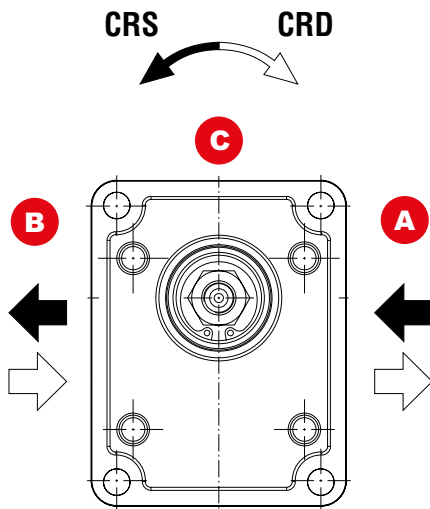
On graph (1) locate the system flowrate 30 l/min (7.9 US gpm) on Y axis and the speed rate 3000 min⁻¹ on X axis to find the hydraulic motor displacement. Select the displacement line that is nearest to the intersection of X and Y axis previously traced out.

In this example the best selection is PLM 20•9 (line 5).

On graph (2) locate the fan absorbed torque rate 20 Nm (117 lbf in) on Y axis and trace a horizontal line to the right

until encountering the line 5 previously selected from graph (1) and descend vertically to find the working pressure of the motor. In this case the pressure of 160 bar (2320 psi) is an acceptable value because the maximum allowable pressure of 200 bar (2900 psi) was not exceeded.

ROTATION CONTROL



CRS = Anti-clockwise rotation control
CRD = Clockwise rotation control

Rotation	Valve type	Valve position
	V8 - VPIF (...)	A
	VMP5/TS/V9 - PRV ...	B
	UNL ...	C
	REV ...	D
	PRV ...	E

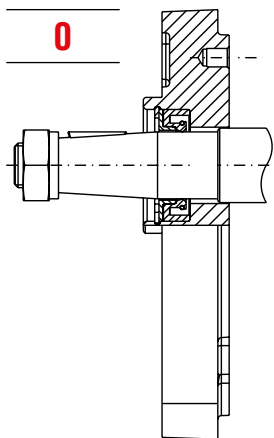
Rotation	Valve type	Valve position
	V8 - VPIF (...)	B
	VMP5/TS/V9 - PRV ...	A
	UNL...	C
	REV ...	G
	PRV ...	F

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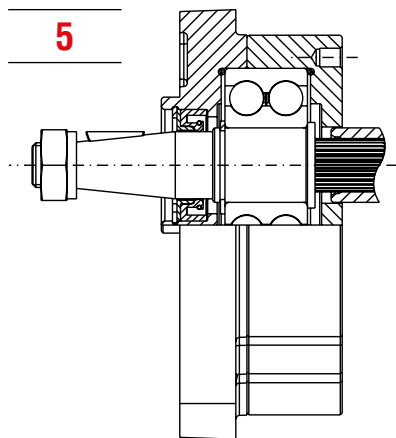
OUTOARD BEARING OPTIONS

The fan stresses the hydraulic motor shaft with a combination of loads.

- Constant radial load due to the fan mass
- Variable axial load according to fan speed



Version for applications without radial and axial load on the drive shaft.



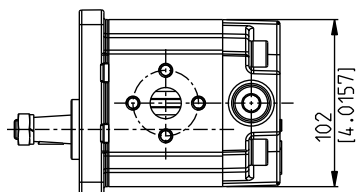
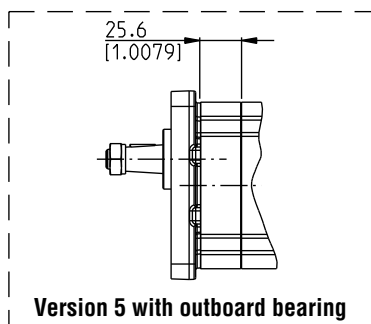
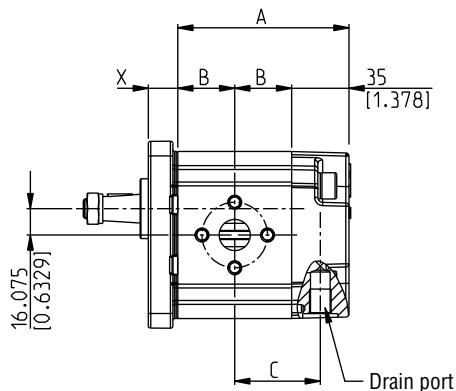
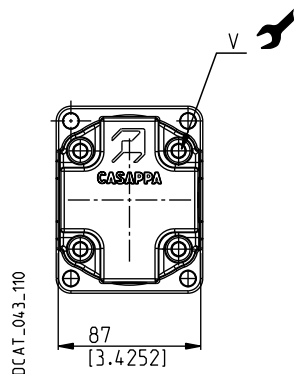
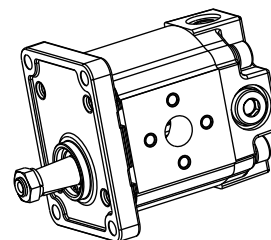
Version with outboard bearing for applications with radial and axial load on the drive shaft.

For the outboard bearing life expectancy, refer to POLARIS and POLARIS PH technical catalogues.

**Customized evaluations for applications with outboard bearing are available.
For more information please consult our technical sales department.**

POLARIS 20
GEAR MOTOR DIMENSIONS
V8

Configuration shown:
 Clockwise rotation CRD
 Anti-cavitation valve


Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C
	mm (in)	mm (in)	mm (in)
PLM 20•4	86,5 (3.4055)	25,75 (1.0138)	43,25 (1.7028)
PLM 20•6,3	89 (3.5039)	27 (1.0630)	44,5 (1.7520)
PLM 20•7,2	90 (3.5433)	27,5 (1.0827)	45 (1.7717)
PLM 20•8	91,5 (3.6024)	28,25 (1.1122)	45,75 (1.8012)
PLM 20•9	92,8 (3.6535)	28,9 (1.1378)	46,4 (1.8268)
PLM 20•10,5	95,5 (3.7598)	30,25 (1.1909)	47,75 (1.8799)
PLM 20•11,2	96 (3.7795)	30,5 (1.2008)	48 (1.8898)
PLM 20•14	101 (3.9764)	33 (1.2992)	50,5 (1.9882)
PLM 20•16	104,5 (4.1142)	34,75 (1.3681)	52,25 (2.0571)
PLM 20•19	107,9 (4.2480)	36,45 (1.4350)	53,95 (2.1240)
PLM 20•20	111 (4.3701)	38 (1.4961)	55,5 (2.1850)
PLM 20•24,5	116,6 (4.5906)	40,8 (1.6063)	58,3 (2.2953)
PLM 20•25	119 (4.6850)	42 (1.6535)	59,5 (2.3425)
PLM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	60,85 (2.3957)
PLM 20•31,5	129 (5.0787)	47 (1.8504)	64,5 (2.5394)

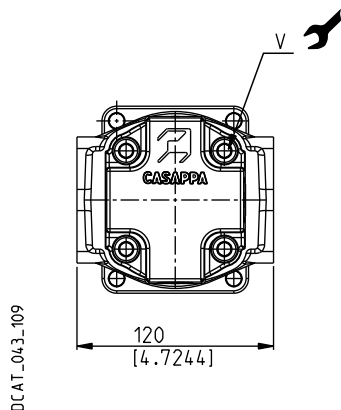
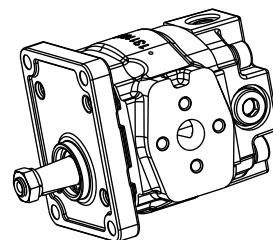
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POLARIS PH

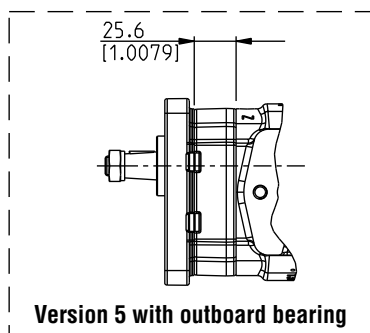
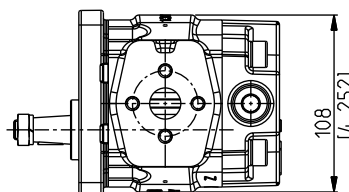
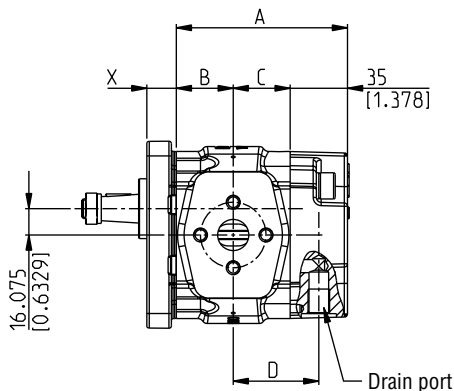
GEAR MOTOR DIMENSIONS

V8

Configuration shown:
Clockwise rotation CRD
Anti-cavitation valve



DCAT_043_109



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)
PHM 20•8	91,5 (3.6024)	32,5 (1.2795)	24 (0.9449)	41,5 (1.6339)
PHM 20•10,5	95,5 (3.7598)	36,5 (1.4370)	24 (0.9449)	41,5 (1.6339)
PHM 20•11,2	96 (3.7795)	37 (1.4567)	24 (0.9449)	41,5 (1.6339)
PHM 20•14	101 (3.9764)	42 (1.6535)	24 (0.9449)	41,5 (1.6339)
PHM 20•16	104,5 (4.1142)	34,75 (1.3681)	34,75 (1.3681)	52,25 (2.0571)
PHM 20•18	106,7 (4.2008)	35,85 (1.4114)	35,85 (1.4114)	53,35 (2.1004)
PHM 20•19	107,9 (4.2480)	36,45 (1.4350)	36,45 (1.4350)	53,95 (2.1240)
PHM 20•20	111 (4.3701)	38 (1.4961)	38 (1.4961)	55,5 (2.1850)
PHM 20•23	114,3 (4.5000)	39,65 (1.5610)	39,65 (1.5610)	57,15 (2.2500)
PHM 20•24,5	116,6 (4.5905)	40,8 (1.6063)	40,8 (1.6063)	58,3 (2.2953)
PHM 20•25	119 (4.6850)	42 (1.6535)	42 (1.6535)	59,5 (2.3425)
PHM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	43,35 (1.7067)	60,85 (2.3957)
PHM 20•31,5	129 (5.0787)	47 (1.8504)	47 (1.8504)	64,5 (2.5394)

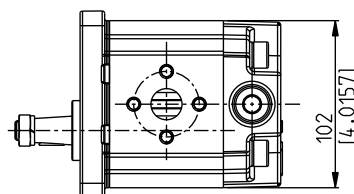
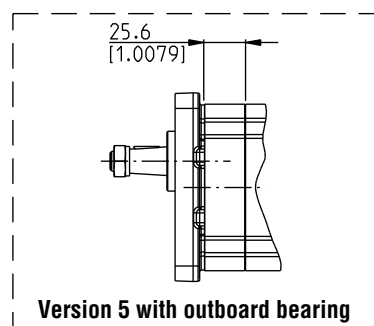
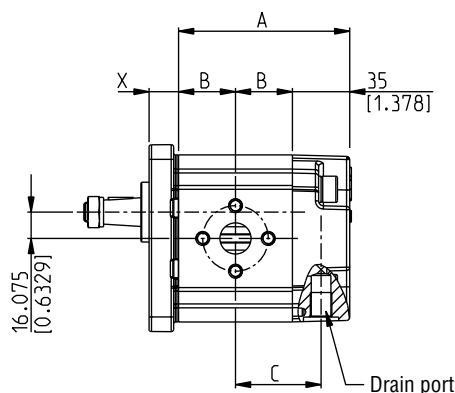
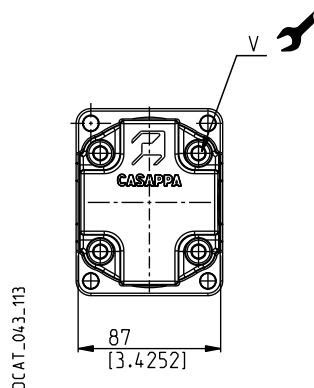
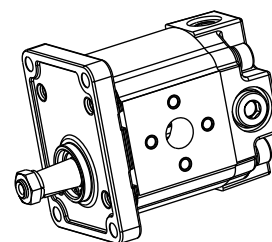
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POLARIS 20

GEAR MOTOR DIMENSIONS

VPIF

Configuration shown:
Clockwise rotation CRD
Max. pressure relief valve fixed setting
and anti-cavitation



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C
	mm (in)	mm (in)	mm (in)
PLM 20•4	86,5 (3.4055)	25,75 (1.0138)	43,25 (1.7028)
PLM 20•6,3	89 (3.5039)	27 (1.0630)	44,5 (1.7520)
PLM 20•7,2	90 (3.5433)	27,5 (1.0827)	45 (1.7717)
PLM 20•8	91,5 (3.6024)	28,25 (1.1122)	45,75 (1.8012)
PLM 20•9	92,8 (3.6535)	28,9 (1.1378)	46,4 (1.8268)
PLM 20•10,5	95,5 (3.7598)	30,25 (1.1909)	47,75 (1.8799)
PLM 20•11,2	96 (3.7795)	30,5 (1.2008)	48 (1.8898)
PLM 20•14	101 (3.9764)	33 (1.2992)	50,5 (1.9882)
PLM 20•16	104,5 (4.1142)	34,75 (1.3681)	52,25 (2.0571)
PLM 20•19	107,9 (4.2480)	36,45 (1.4350)	53,95 (2.1240)
PLM 20•20	111 (4.3701)	38 (1.4961)	55,5 (2.1850)
PLM 20•24,5	116,6 (4.5906)	40,8 (1.6063)	58,3 (2.2953)
PLM 20•25	119 (4.6850)	42 (1.6535)	59,5 (2.3425)
PLM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	60,85 (2.3957)
PLM 20•31,5	129 (5.0787)	47 (1.8504)	64,5 (2.5394)

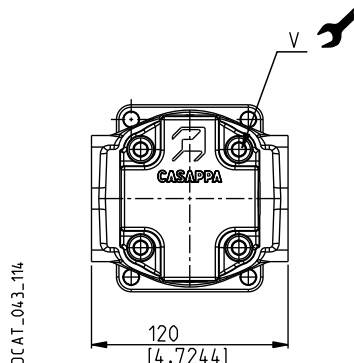
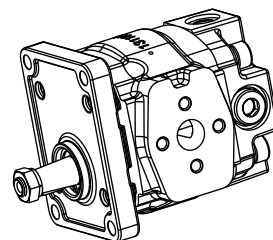
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POLARIS PH

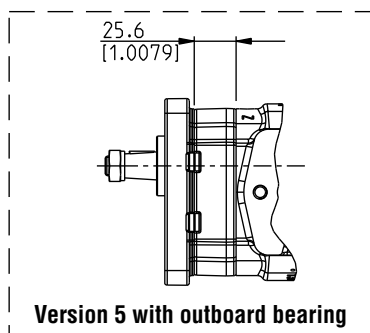
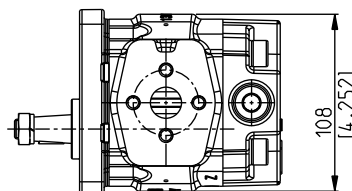
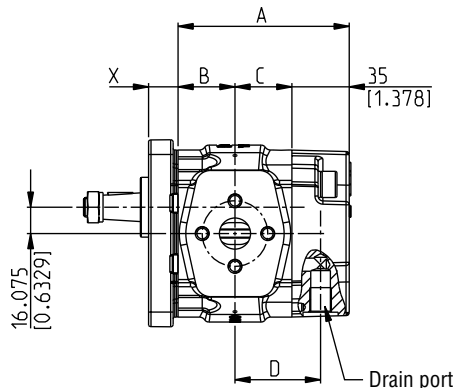
GEAR MOTOR DIMENSIONS

VPIF

Configuration shown:
Clockwise rotation CRD
Max. pressure relief valve fixed setting
and anti-cavitation



DCAT_043_114



Version 5 with outboard bearing

Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm$ 4,5 (358 $\div$ 438)
Cast iron		

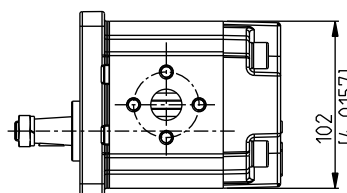
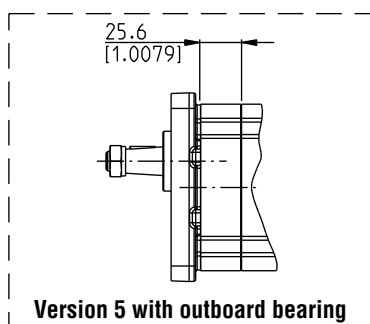
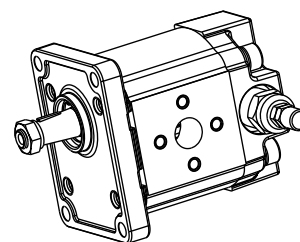
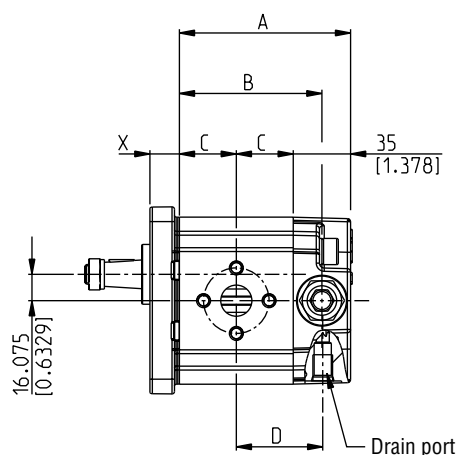
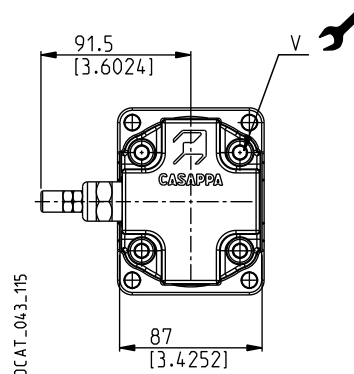
X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)
PHM 20•8	91,5 (3.6024)	32,5 (1.2795)	24 (0.9449)	41,5 (1.6339)
PHM 20•10,5	95,5 (3.7598)	36,5 (1.4370)	24 (0.9449)	41,5 (1.6339)
PHM 20•11,2	96 (3.7795)	37 (1.4567)	24 (0.9449)	41,5 (1.6339)
PHM 20•14	101 (3.9764)	42 (1.6535)	24 (0.9449)	41,5 (1.6339)
PHM 20•16	104,5 (4.1142)	34,75 (1.3681)	34,75 (1.3681)	52,25 (2.0571)
PHM 20•18	106,7 (4.2008)	35,85 (1.4114)	35,85 (1.4114)	
PHM 20•19	107,9 (4.2480)	36,45 (1.4350)	36,45 (1.4350)	53,95 (2.1240)
PHM 20•20	111 (4.3701)	38 (1.4961)	38 (1.4961)	55,5 (2.1850)
PHM 20•23	114,3 (4.5000)	39,65 (1.5610)	39,65 (1.5610)	57,15 (2.2500)
PHM 20•24,5	116,6 (4.5905)	40,8 (1.6063)	40,8 (1.6063)	58,3 (2.2953)
PHM 20•25	119 (4.6850)	42 (1.6535)	42 (1.6535)	59,5 (2.3425)
PHM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	43,35 (1.7067)	60,85 (2.3957)
PHM 20•31,5	129 (5.0787)	47 (1.8504)	47 (1.8504)	64,5 (2.5394)

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POLARIS 20
GEAR MOTOR DIMENSIONS
VMP5/TS/V9

Configuration shown:
 Clockwise rotation CRD
 Max. pressure relief valve adjustable
 setting and anti-cavitation


Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

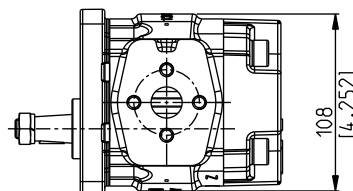
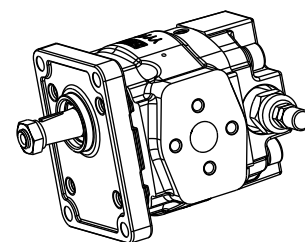
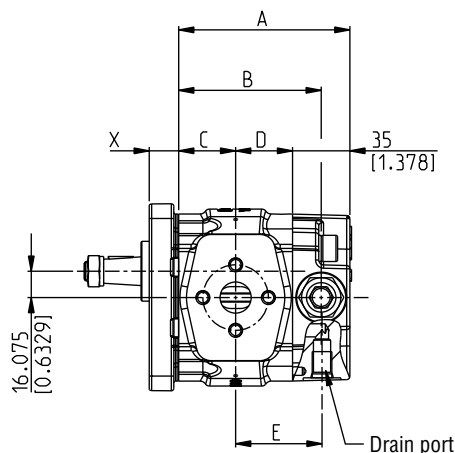
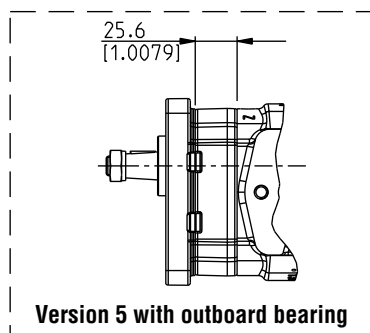
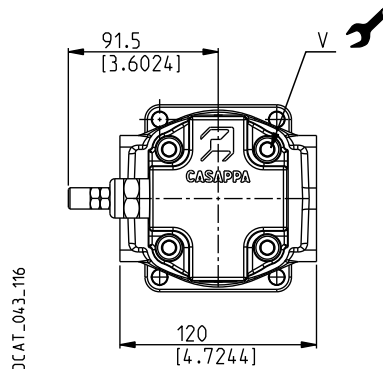
Motor type	A	B	C	D
	mm (in)	mm (in)	mm (in)	mm (in)
PLM 20•4	86,5 (3.4055)	69 (2.7165)	25,75 (1.0138)	43,25 (1.7028)
PLM 20•6,3	89 (3.5039)	71,5 (2.8150)	27 (1.0630)	44,5 (1.7520)
PLM 20•7,2	90 (3.5433)	72,5 (2.8543)	27,5 (1.0827)	45 (1.7717)
PLM 20•8	91,5 (3.6024)	74 (2.9134)	28,25 (1.1122)	45,75 (1.8012)
PLM 20•9	92,8 (3.6535)	75,3 (2.9646)	28,9 (1.1378)	46,4 (1.8268)
PLM 20•10,5	95,5 (3.7598)	78 (3.0709)	30,25 (1.1909)	47,75 (1.8799)
PLM 20•11,2	96 (3.7795)	78,5 (3.0906)	30,5 (1.2008)	48 (1.8898)
PLM 20•14	101 (3.9764)	83,5 (3.2874)	33 (1.2992)	50,5 (1.9882)
PLM 20•16	104,5 (4.1142)	87 (3.4252)	34,75 (1.3681)	52,25 (2.0571)
PLM 20•19	107,9 (4.2480)	90,4 (3.5591)	36,45 (1.4350)	53,95 (2.1240)
PLM 20•20	111 (4.3701)	93,5 (3.6811)	38 (1.4961)	55,5 (2.1850)
PLM 20•24,5	116,6 (4.5906)	99,1 (3.9016)	40,8 (1.6063)	58,3 (2.2953)
PLM 20•25	119 (4.6850)	101,5 (3.9961)	42 (1.6535)	59,5 (2.3425)
PLM 20•27,8	121,7 (4.7913)	104,2 (4.1024)	43,35 (1.7067)	60,85 (2.3957)
PLM 20•31,5	129 (5.0787)	111,5 (4.3898)	47 (1.8504)	64,5 (2.5394)

POLARIS PH

GEAR MOTOR DIMENSIONS

VMP5/TS/V9

Configuration shown:
Clockwise rotation CRD
Max. pressure relief valve adjustable
setting and anti-cavitation



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A	B	C	D	E
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
PHM 20•8	91,5 (3.6024)	74 (2.9134)	32,5 (1.2795)	24 (0.9449)	41,5 (1.6339)
PHM 20•10,5	95,5 (3.7598)	78 (3.0709)	36,5 (1.4370)	24 (0.9449)	41,5 (1.6339)
PHM 20•11,2	96 (3.7795)	78,5 (3.0906)	37 (1.4567)	24 (0.9449)	41,5 (1.6339)
PHM 20•14	101 (3.9764)	83,5 (3.2874)	42 (1.6535)	24 (0.9449)	41,5 (1.6339)
PHM 20•16	104,5 (4.1142)	87 (3.4252)	34,75 (1.3681)	34,75 (1.3681)	52,25 (2.0571)
PHM 20•18	106,7 (4.2008)	89,2 (3.5118)	35,85 (1.4114)	35,85 (1.4114)	53,35 (2.1004)
PHM 20•19	107,9 (4.2480)	90,4 (3.5591)	36,45 (1.4350)	36,45 (1.4350)	53,95 (2.1240)
PHM 20•20	111 (4.3701)	93,5 (3.6811)	38 (1.4961)	38 (1.4961)	55,5 (2.1850)
PHM 20•23	114,3 (4.5000)	96,8 (3.8110)	39,65 (1.5610)	39,65 (1.5610)	57,15 (2.2500)
PHM 20•24,5	116,6 (4.5905)	99,1 (3.9016)	40,8 (1.6063)	40,8 (1.6063)	58,3 (2.2953)
PHM 20•25	119 (4.6850)	101,5 (3.9961)	42 (1.6535)	42 (1.6535)	59,5 (2.3425)
PHM 20•27,8	121,7 (4.7913)	104,2 (4.1024)	43,35 (1.7067)	43,35 (1.7067)	60,85 (2.3957)
PHM 20•31,5	129 (5.0787)	111,5 (4.3898)	47 (1.8504)	47 (1.8504)	64,5 (2.5394)

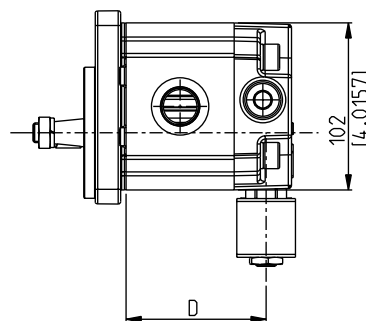
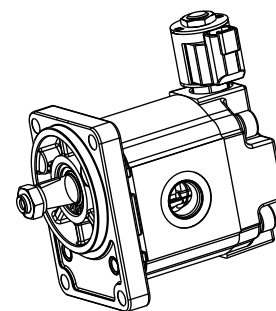
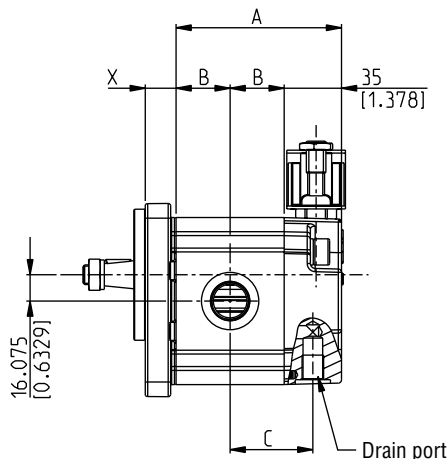
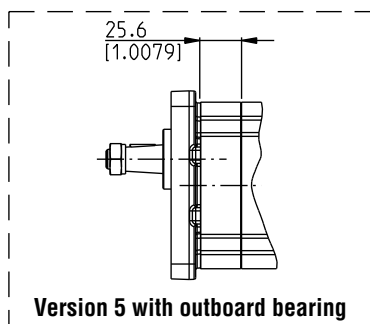
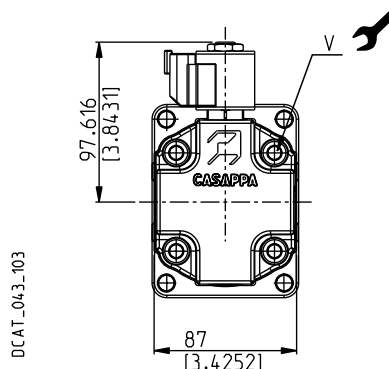
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POLARIS 20

GEAR MOTOR DIMENSIONS

UNL/VPIF

Configuration shown:
Clockwise rotation CRD
ON/OFF two speed valve
Max. pressure relief valve fixed setting
and anti-cavitation



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C	D
	mm (in)	mm (in)	mm (in)	mm (in)
PLM 20•4	86,5 (3.4055)	25,75 (1.0138)	43,25 (1.7028)	71 (2.7953)
PLM 20•6,3	89 (3.5039)	27 (1.0630)	44,5 (1.7520)	73,5 (2.8937)
PLM 20•7,2	90 (3.5433)	27,5 (1.0827)	45 (1.7717)	74,5 (2.9331)
PLM 20•8	91,5 (3.6024)	28,25 (1.1122)	45,75 (1.8012)	76 (2.9921)
PLM 20•9	92,8 (3.6535)	28,9 (1.1378)	46,4 (1.8268)	77,3 (3.0433)
PLM 20•10,5	95,5 (3.7598)	30,25 (1.1909)	47,75 (1.8799)	80 (3.1496)
PLM 20•11,2	96 (3.7795)	30,5 (1.2008)	48 (1.8898)	80,5 (3.1693)
PLM 20•14	101 (3.9764)	33 (1.2992)	50,5 (1.9882)	85,5 (3.3661)
PLM 20•16	104,5 (4.1142)	34,75 (1.3681)	52,25 (2.0571)	89 (3.5039)
PLM 20•19	107,9 (4.2480)	36,45 (1.4350)	53,95 (2.1240)	92,4 (3.6378)
PLM 20•20	111 (4.3701)	38 (1.4961)	55,5 (2.1850)	95,5 (3.7598)
PLM 20•24,5	116,6 (4.5906)	40,8 (1.6063)	58,3 (2.2953)	101,1 (3.9803)
PLM 20•25	119 (4.6850)	42 (1.6535)	59,5 (2.3425)	103,5 (4.0748)
PLM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	60,85 (2.3957)	106,2 (4.1811)
PLM 20•31,5	129 (5.0787)	47 (1.8504)	64,5 (2.5394)	113,5 (4.4685)

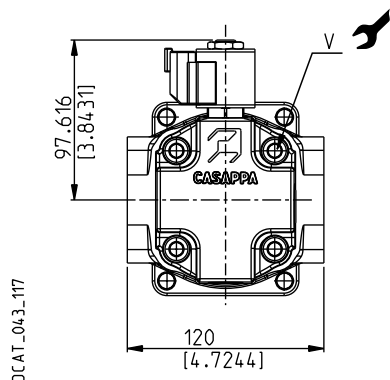
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POLARIS PH

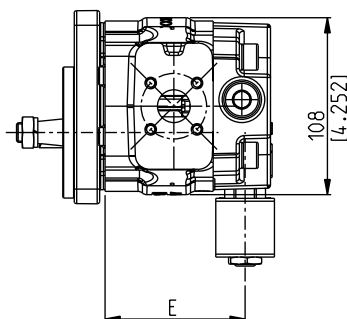
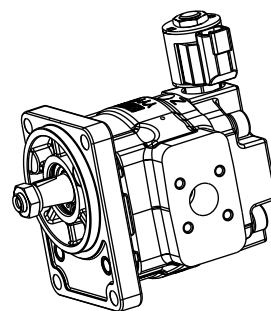
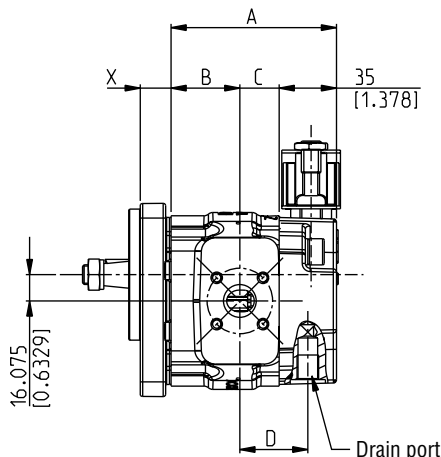
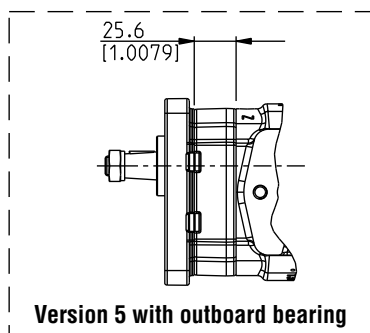
GEAR MOTOR DIMENSIONS

UNL/VPIF

Configuration shown:
Clockwise rotation CRD
ON/OFF two speed valve
Max. pressure relief valve fixed setting
and anti-cavitation



DCAT_043_117



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A	B	C	D	E
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
PHM 20•8	91,5 (3.6024)	32,5 (1.2795)	24 (0.9449)	41,5 (1.6339)	76 (2.9921)
PHM 20•10,5	95,5 (3.7598)	36,5 (1.4370)	24 (0.9449)	41,5 (1.6339)	80 (3.1496)
PHM 20•11,2	96 (3.7795)	37 (1.4567)	24 (0.9449)	41,5 (1.6339)	80,5 (3.1693)
PHM 20•14	101 (3.9764)	42 (1.6535)	24 (0.9449)	41,5 (1.6339)	85,5 (3.3661)
PHM 20•16	104,5 (4.1142)	34,75 (1.3681)	34,75 (1.3681)	52,25 (2.0571)	89 (3.5039)
PHM 20•18	106,7 (4.2008)	35,85 (1.4114)	35,85 (1.4114)	53,35 (2.1004)	91,2 (3.5906)
PHM 20•19	107,9 (4.2480)	36,45 (1.4350)	36,45 (1.4350)	53,95 (2.1240)	92,4 (3.6378)
PHM 20•20	111 (4.3701)	38 (1.4961)	38 (1.4961)	55,5 (2.1850)	95,5 (3.7598)
PHM 20•23	114,3 (4.5000)	39,65 (1.5610)	39,65 (1.5610)	57,15 (2.2500)	98,8 (3.8898)
PHM 20•24,5	116,6 (4.5905)	40,8 (1.6063)	40,8 (1.6063)	58,3 (2.2953)	101,1 (3.9803)
PHM 20•25	119 (4.6850)	42 (1.6535)	42 (1.6535)	59,5 (2.3425)	103,5 (4.0748)
PHM 20•27,8	121,7 (4.7913)	43,35 (1.7067)	43,35 (1.7067)	60,85 (2.3957)	106,2 (4.1811)
PHM 20•31,5	129 (5.0787)	47 (1.8504)	47 (1.8504)	64,5 (2.5394)	113,5 (4.4685)

05/02.2018

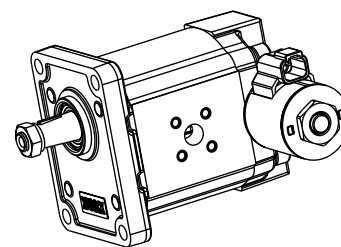
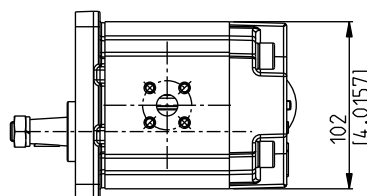
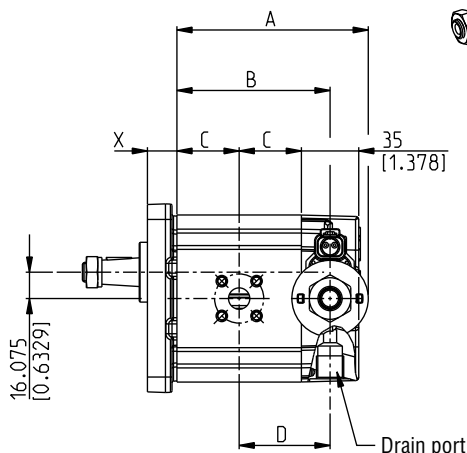
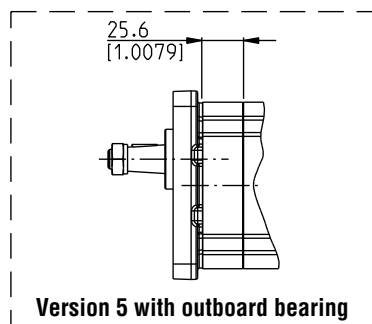
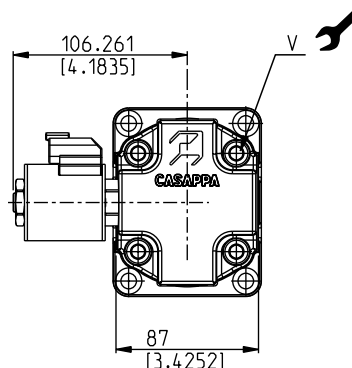
POLARIS 20

GEAR MOTOR DIMENSIONS

PRV/V9

Configuration shown:
Clockwise rotation CRD
Proportional relief valve
Anti-cavitation valve

DCAT_043_102



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C	D
	mm (in)	mm (in)	mm (in)	mm (in)
PLM 20•4	92,4 (3.6378)	69 (2.7165)	25,75 (1.0138)	43,25 (1.7028)
PLM 20•6,3	94,9 (3.7362)	71,5 (2.8150)	27 (1.0630)	44,5 (1.7520)
PLM 20•7,2	95,93 (3.7768)	72,5 (2.8543)	27,5 (1.0827)	45 (1.7716)
PLM 20•8	97,4 (3.8346)	74 (2.9134)	28,25 (1.1122)	45,75 (1.8012)
PLM 20•9	98,7 (3.8858)	75,3 (2.9646)	28,9 (1.1378)	46,4 (1.8268)
PLM 20•10,5	101,4 (3.9921)	78 (3.0709)	30,25 (1.1909)	47,75 (1.8799)
PLM 20•11,2	101,9 (4.0118)	78,5 (3.0906)	30,5 (1.2008)	48 (1.8898)
PLM 20•14	106,9 (4.2087)	83,5 (3.2874)	33 (1.2992)	50,5 (1.9882)
PLM 20•16	110,4 (4.3465)	87 (3.4252)	34,75 (1.3681)	52,25 (2.0571)
PLM 20•19	113,8 (4.4803)	90,4 (3.5591)	36,45 (1.4350)	53,95 (2.1240)
PLM 20•20	116,9 (4.6024)	93,5 (3.6811)	38 (1.4961)	55,5 (2.1850)
PLM 20•24,5	122,5 (4.8228)	99,1 (3.9016)	40,8 (1.6063)	58,3 (2.2953)
PLM 20•25	124,9 (4.9173)	101,5 (3.9961)	42 (1.6535)	59,5 (2.3425)
PLM 20•27,8	127,6 (5.0236)	104,2 (4.1024)	43,35 (1.7067)	60,85 (2.3957)
PLM 20•31,5	134,9 (5.3110)	111,5 (4.3398)	47 (1.8504)	64,5 (2.5394)

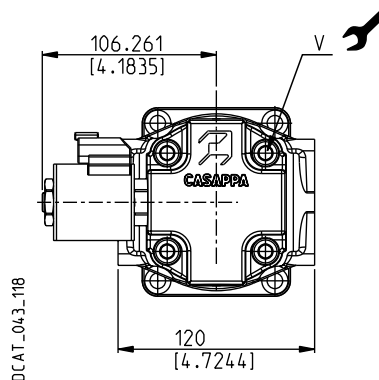
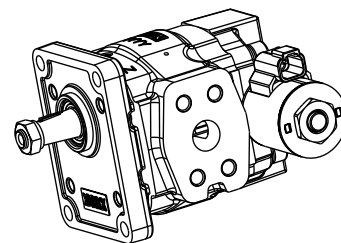
05/02.2018

POLARIS PH

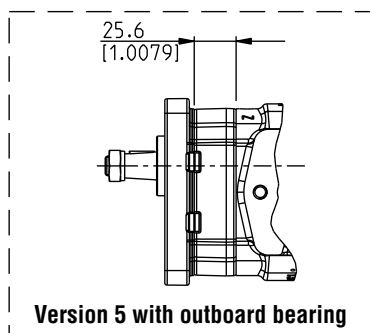
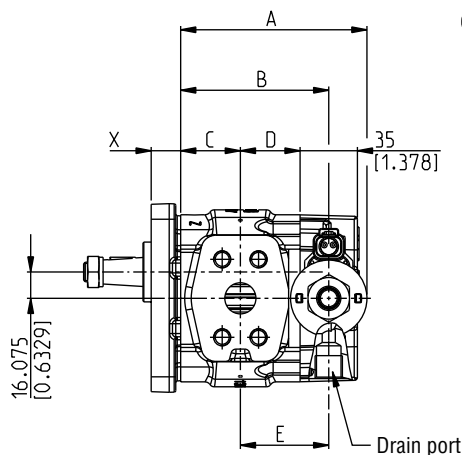
GEAR MOTOR DIMENSIONS

PRV/V9

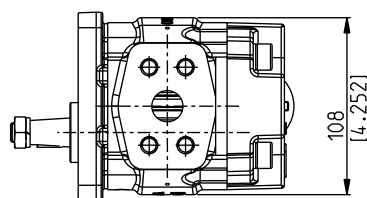
Configuration shown:
Clockwise rotation CRD
Proportional relief valve
Anti-cavitation valve



DCAT_043_118



Version 5 with outboard bearing



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Aluminium	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)
PHM 20•8	97,4 (3.8346)	74 (2.9134)	32,5 (1.2795)	24 (0.9449)	41,5 (1.6339)
PHM 20•10,5	101,4 (3.9921)	78 (3.0709)	36,5 (1.4370)	24 (0.9449)	41,5 (1.6339)
PHM 20•11,2	101,9 (4.0118)	78,5 (3.0906)	37 (1.4567)	24 (0.9449)	41,5 (1.6339)
PHM 20•14	106,9 (4.2087)	83,5 (3.2874)	42 (1.6535)	24 (0.9449)	41,5 (1.6339)
PHM 20•16	110,4 (4.3465)	87 (3.4252)	34,75 (1.3681)	34,75 (1.3681)	52,25 (2.0571)
PHM 20•18	112,6 (4.4331)	89,2 (3.5118)	35,85 (1.4114)	35,85 (1.4114)	53,35 (2.1004)
PHM 20•19	113,8 (4.4803)	90,4 (3.5591)	36,45 (1.4350)	36,45 (1.4350)	53,95 (2.1240)
PHM 20•20	116,9 (4.6024)	93,5 (3.6811)	38 (1.4961)	38 (1.4961)	55,5 (2.1850)
PHM 20•23	120,2 (4.7323)	96,8 (3.8110)	39,65 (1.5610)	39,65 (1.5610)	57,15 (2.2500)
PHM 20•24,5	122,5 (4.8228)	99,1 (3.9016)	40,8 (1.6063)	40,8 (1.6063)	58,3 (2.2953)
PHM 20•25	124,9 (4.9173)	101,5 (3.9961)	42 (1.6535)	42 (1.6535)	59,5 (2.3425)
PHM 20•27,8	127,6 (5.0236)	104,2 (4.1024)	43,35 (1.7067)	43,35 (1.7067)	60,85 (2.3957)
PHM 20•31,5	134,9 (5.3110)	111,5 (4.3898)	47 (1.8504)	47 (1.8504)	64,5 (2.5394)

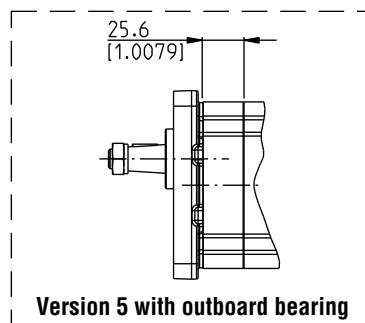
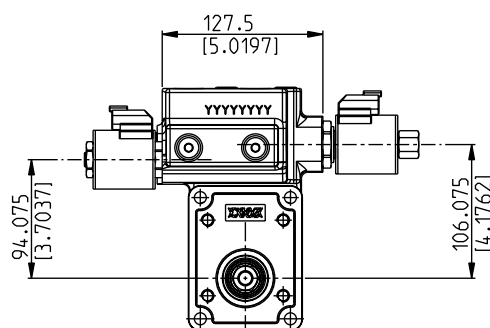
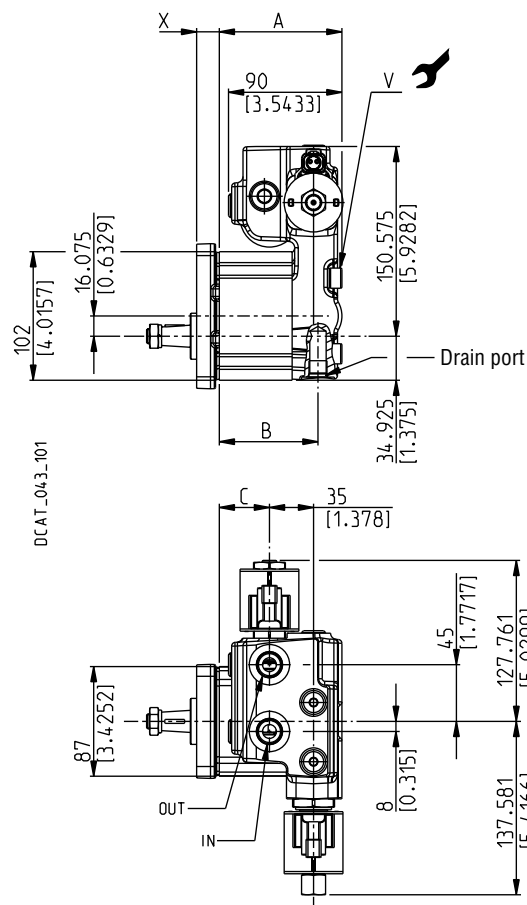
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POLARIS 20

GEAR MOTOR DIMENSIONS

PRV/REV/V8-SK2

Configuration shown:
Clockwise rotation CRD
Proportional relief valve
Reverse valve
Anti-cavitation valve



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Cast iron	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		70 ± 7 (558 $\div$ 682)

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C	IN/OUT Ports	
	mm (in)	mm (in)	mm (in)	Gas BSPP	SAE ODT
PLM 20•4	91 (3.5827)	72 (2.8346)	33,5 (1.3189)		
PLM 20•6,3	93,5 (3.6811)	74,5 (2.9331)	36 (1.4173)		
PLM 20•7,2	94,5 (3.7205)	75,5 (2.9724)	37 (1.4567)		
PLM 20•8	96 (3.7795)	77 (3.0315)	38,5 (1.5157)		
PLM 20•9	97,3 (3.8307)	78,3 (3.0827)	39,8 (1.5669)		
PLM 20•10,5	100 (3.9370)	81 (3.1890)	42,5 (1.6732)		
PLM 20•11,2	100,5 (3.9567)	81,5 (3.2087)	43 (1.6929)		
PLM 20•14	105,5 (4.1535)	86,5 (3.4055)	48 (1.8898)	GD/GD	OB/OB
PLM 20•16	109 (4.2913)	90 (3.5433)	51,5 (2.0276)		OC/OC
PLM 20•19	112,4 (4.4252)	93,4 (3.6772)	54,9 (2.1614)		
PLM 20•20	115,5 (4.5472)	96,5 (3.7992)	58 (2.2835)		
PLM 20•24,5	121,1 (4.7677)	102,1 (4.0197)	63,6 (2.5039)		
PLM 20•25	123,5 (4.8622)	104,5 (4.1142)	66 (2.5984)		
PLM 20•27,8	126,2 (4.9685)	107,2 (4.2205)	68,7 (2.7047)		
PLM 20•31,5	133,5 (5.2559)	114,5 (4.5079)	76 (2.9921)		

Replaces: 04/02.2014

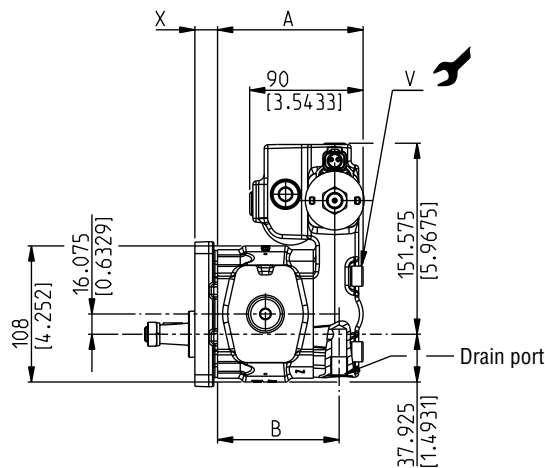
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POLARIS PH

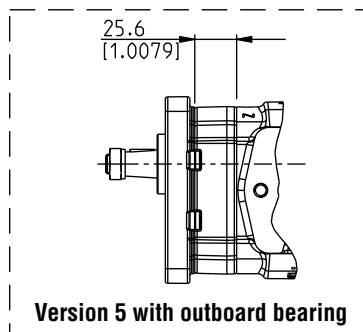
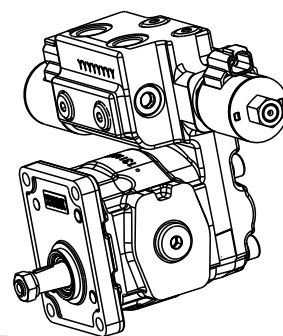
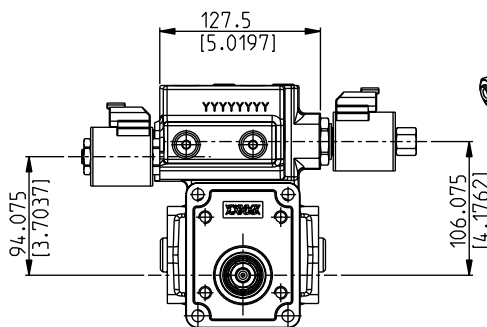
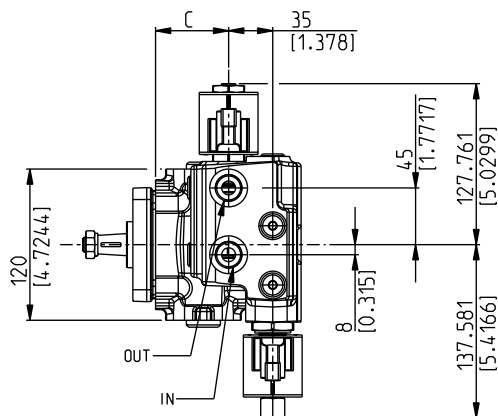
GEAR MOTOR DIMENSIONS

PRV/REV/V8-SK2

Configuration shown:
Clockwise rotation CRD
Proportional relief valve
Reverse valve
Anti-cavitation valve



DCAT_043_100



Version 5 with outboard bearing

Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Cast iron	45 ^{±4,5} (358 ÷ 438)
Cast iron		70 ^{±7} (558 ÷ 682)

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A	B	C	IN/OUT Ports	
	mm (inch)	mm (inch)	mm (inch)	Gas BSPP	SAE ODT
PHM 20•8	96 (3.7795)	77 (3.0315)	38,5 (1.5157)		
PHM 20•10,5	100 (3.9370)	81 (3.1890)	42,5 (1.6732)		
PHM 20•11,2	100,5 (3.9567)	81,5 (3.2087)	43 (1.6929)		
PHM 20•14	105,5 (4.1535)	86,5 (3.4055)	48 (1.8898)		
PHM 20•16	109 (4.2913)	90 (3.5433)	51,5 (2.0276)		
PHM 20•18	111,2 (4.3780)	92,2 (3.6299)	53,7 (2.1142)		
PHM 20•19	112,4 (4.4252)	93,4 (3.6772)	54,9 (2.1614)	GD/GD	OB/OB
PHM 20•20	115,5 (4.5472)	96,5 (3.7992)	58 (2.2835)		OC/OC
PHM 20•23	118,8 (4.6772)	99,8 (3.9291)	61,3 (2.4134)		
PHM 20•24,5	121,1 (4.7677)	102,1 (4.0197)	63,6 (2.5039)		
PHM 20•25	123,5 (4.8622)	104,5 (4.1142)	66 (2.5984)		
PHM 20•27,8	126,2 (4.9685)	107,2 (4.2205)	68,7 (2.7047)		
PHM 20•31,5	133,5 (5.2559)	114,5 (4.5079)	76 (2.9921)		

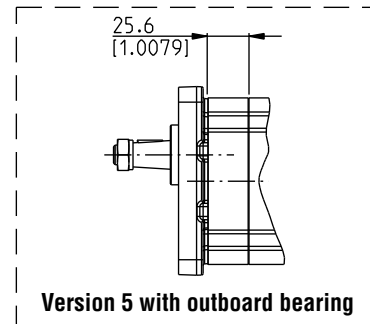
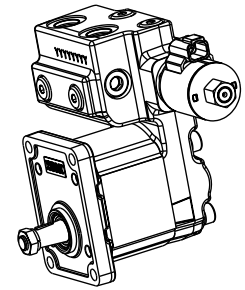
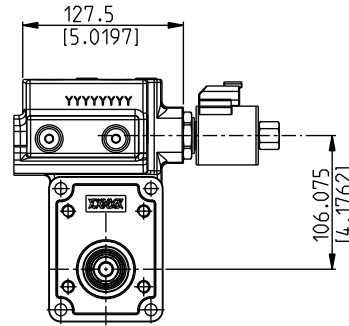
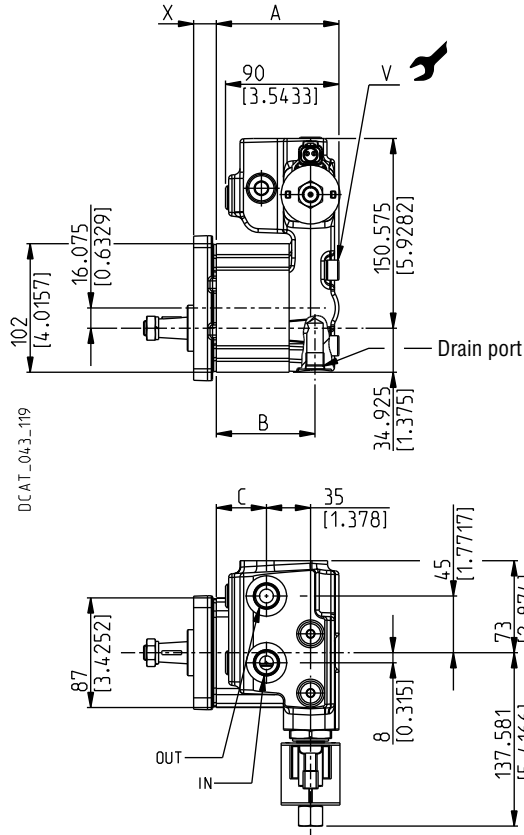
05/02.2018

POLARIS 20

GEAR MOTOR DIMENSIONS

REV/VPIF-SK2

Configuration shown:
Clockwise rotation CRD
Reverse valve
Max. pressure relief valve fixed setting
and anti-cavitation



Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Cast iron	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		70 ± 7 (558 $\div$ 682)

X: For drive shafts, mounting flanges and ports see the POLARIS technical catalogue

Motor type	A	B	C	IN/OUT Ports	
	mm (in)	mm (in)	mm (in)	Gas BSPP	SAE ODT
PLM 20•4	91 (3.5827)	72 (2.8346)	33,5 (1.3189)		
PLM 20•6,3	93,5 (3.6811)	74,5 (2.9331)	36 (1.4173)		
PLM 20•7,2	94,5 (3.7205)	75,5 (2.9724)	37 (1.4567)		
PLM 20•8	96 (3.7795)	77 (3.0315)	38,5 (1.5157)		
PLM 20•9	97,3 (3.8307)	78,3 (3.0827)	39,8 (1.5669)		
PLM 20•10,5	100 (3.9370)	81 (3.1890)	42,5 (1.6732)		
PLM 20•11,2	100,5 (3.9567)	81,5 (3.2087)	43 (1.6929)		
PLM 20•14	105,5 (4.1535)	86,5 (3.4055)	48 (1.8898)	GD/GD	OB/OB
PLM 20•16	109 (4.2913)	90 (3.5433)	51,5 (2.0276)		OC/OC
PLM 20•19	112,4 (4.4252)	93,4 (3.6772)	54,9 (2.1614)		
PLM 20•20	115,5 (4.5472)	96,5 (3.7992)	58 (2.2835)		
PLM 20•24,5	121,1 (4.7677)	102,1 (4.0197)	63,6 (2.5039)		
PLM 20•25	123,5 (4.8622)	104,5 (4.1142)	66 (2.5984)		
PLM 20•27,8	126,2 (4.9685)	107,2 (4.2205)	68,7 (2.7047)		
PLM 20•31,5	133,5 (5.2559)	114,5 (4.5079)	76 (2.9921)		

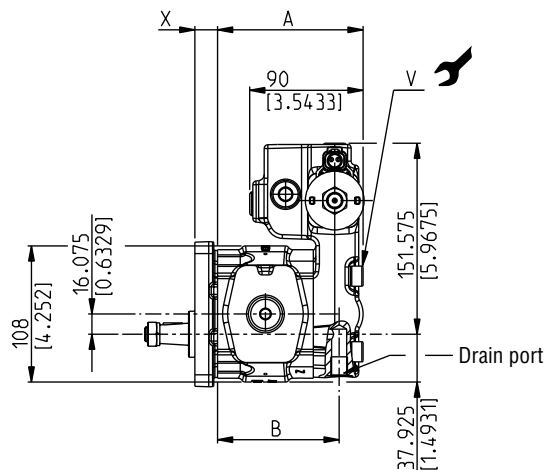
05/02.2018

POLARIS PH

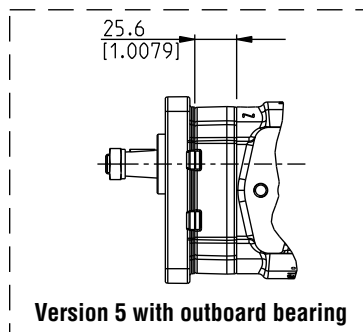
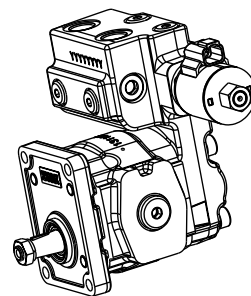
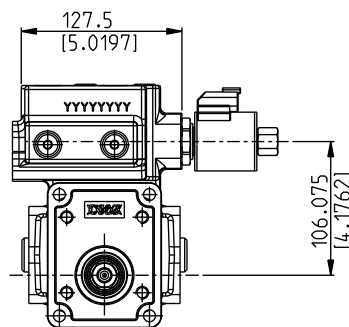
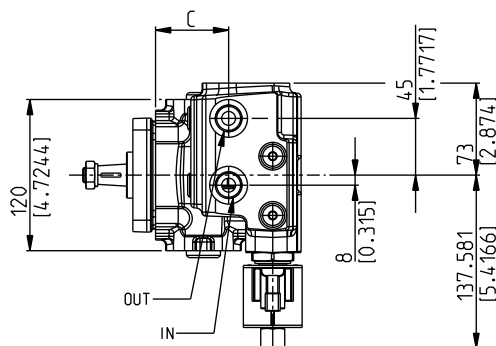
GEAR MOTOR DIMENSIONS

REV/VPIF-SK2

Configuration shown:
Clockwise rotation CRD
Reverse valve
Max. pressure relief valve fixed setting
and anti-cavitation



DCAT_043_120



Version 5 with outboard bearing

Mounting flange and rear cover options

Mounting flange material	Rear cover material	V Screws tightening torque Nm (lbf in)
Aluminium	Cast iron	45 $\pm 4,5$ (358 $\div$ 438)
Cast iron		70 ± 7 (558 $\div$ 682)

X: For drive shafts, mounting flanges and ports see the POLARIS PH technical catalogue

Motor type	A	B	C	IN/OUT Ports	
	mm (inch)	mm (inch)	mm (inch)	Gas BSPP	SAE ODT
PHM 20•8	96 (3.7795)	77 (3.0315)	38,5 (1.5157)		
PHM 20•10,5	100 (3.9370)	81 (3.1890)	42,5 (1.6732)		
PHM 20•11,2	100,5 (3.9567)	81,5 (3.2087)	43 (1.6929)		
PHM 20•14	105,5 (4.1535)	86,5 (3.4055)	48 (1.8898)		
PHM 20•16	109 (4.2913)	90 (3.5433)	51,5 (2.0276)		
PHM 20•18	111,2 (4.3780)	92,2 (3.6299)	53,7 (2.1142)		
PHM 20•19	112,4 (4.4252)	93,4 (3.6772)	54,9 (2.1614)	GD/GD	OB/OB
PHM 20•20	115,5 (4.5472)	96,5 (3.7992)	58 (2.2835)		OC/OC
PHM 20•23	118,8 (4.6772)	99,8 (3.9291)	61,3 (2.4134)		
PHM 20•24,5	121,1 (4.7677)	102,1 (4.0197)	63,6 (2.5039)		
PHM 20•25	123,5 (4.8622)	104,5 (4.1142)	66 (2.5984)		
PHM 20•27,8	126,2 (4.9685)	107,2 (4.2205)	68,7 (2.7047)		
PHM 20•31,5	133,5 (5.2559)	114,5 (4.5079)	76 (2.9921)		

05/02.2018

HOW TO ORDER - GEARS MOTORS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PLM 20•4	L	0	- 82	E2	- L	EA/EA	- N	- EL	- D	- *	GB	- REV...	- SK2	(CRS)

1	Type	Motor type
	Polaris 20 (a)	PLM 20•4
	Polaris PH (a)	PHM 20•8

2	Rotation	CODE
	Reversible side external drain	L

3	Outboard bearing options	CODE
	Without outboard bearing	0
	With outboard bearing	5

4	Drive shaft (b)	CODE
---	-----------------	------

5	Mounting flange (b)	CODE
---	---------------------	------

6	Ports position	CODE
	Side	L

7	Ports IN/OUT (b)
---	------------------

8	Seals (c)	CODE
	Buna N (standard)	N
	Buna hydrogenated HNBR and viton shaft seal	T-PV

9	Mounting flange and rear cover options	CODE
	Cast iron mounting flange and rear cover (standard - no code) (d)	
	Aluminium mounting flange and cast iron rear cover (d)	E
	Cast iron mounting flange and aluminium rear cover (e)	L
	Aluminium mounting flange and rear cover (e)	EL

CODE	Shaft seal options	10
D	Standard seal with wiper seal	

CODE	Drain port position	11
*	Bottom position	

CODE	Drain port (b)	12
------	----------------	----

CODE	Valves	13
V8	Anti-cavitation	
VPIF (...)	Max. pressure relief valve fixed setting (f)	
VMP5 (...)/TS/V9	Max. pressure relief valve adjustable setting and anti-cavitation valve (f)	
UNL ...	ON/OFF two speed valve (f)	
PRV ...	Proportional relief valve (f)	
REV ...	Reverse valve (f)	

CODE	Valve options (d)	14
SK2	Reverse valve cover	

CODE	Rotation control	15
CRS	Anti-clockwise rotation control	
CRD	Clockwise rotation control	

- (a) Displacements on pages 25
- (b) See the technical catalogues of each specific series
- (c) Choose the seals according to the temperature shown on page 23
- (d) Only for reverse valve
- (e) Not available for reverse valve
- (f) How to order see page 6 ÷ 9

05/02.2018

ORDER EXAMPLE

**POLARIS 20 motor with
ON/OFF two speed valve**

ON/OFF two
speed valve

Max. pressure
valve

Valve rotation
control

PLM 20•4 L0-82 E2-L EA/EA-N-EL-D-* GB

UNL-2-C-M

VPIF (160)

(CRS)

**POLARIS PH motor with
proportional valve**

Proportional
valve

Anti-cavitation
valve

Valve rotation
control

PHM 20•8 L5-03 S1-L OC/OC-N-L-D-* 03

PRV-1-B-180-JT/A

V9

(CRD)

**POLARIS PH motor with
proportional and reverse valve**

Proportional
valve

Reverse
valve

Anti-cavitation
valve

Valve
option

Valve rota-
tion control

PHM 20•8 L0-82 E2-L GD/GD-N-E-D-* GB

PRV-2-B-180-D

REV-2-B-D

V8

SK2

(CRS)

**POLARIS 20 motor with
reverse valve**

Reverse
valve

Max. pressure
valve

Valve
option

Valve rota-
tion control

PHM 20•8 L0-82 E2-L GD/GD-N-E-D-* GB

REV-2-B-D

VPIF (160)

SK2

(CRS)

05/02.2018

NOTES

Our policy is one of continuous improvement in product. Specification of items may, therefore, be changed without notice.

FD 05 T A

Edition: 05/02.2018

Replaces: FD 04 T A



Headquarters:

CASAPPA S.p.A.

Via Balestrieri, 1

43044 Lemignano di Collecchio

Parma (Italy)

Tel. (+39) 0521 30 41 11

Fax (+39) 0521 80 46 00

IP Videoconferencing

E-mail: info@casappa.com

www.casappa.com

