

TECHNICAL MANUAL

INTEGRATED
CONTINUOUSLY
VARIABLE
DRIVE

CLEAR DEMANDS!

For certain applications, self-propelled agricultural and construction machinery, such as wheeled and telescopic loaders, forestry machines, combine harvesters and also choppers, not only need to generate high tractive forces, but also have to be capable of covering long distances at the highest possible speed.

Up to now, both of these functions have been realised by hydrostatic drives with manual gearboxes. This concept has proven to be less than optimum in practice, since the machine usually has to be at a standstill to switch between gears, making the procedure both inconvenient and time-consuming.

Continuous variability is what is called for here in practice - with a variable drive concept and substantially greater operating convenience for the driver.

OUR SOLUTION!

GKN Walterscheid cooperated with SAUER BIBUS on developing a continuously variable, hydrostatic travel drive for self-propelled agricultural and construction machinery. The ICVD® (Integrated Continuously Variable Drive) makes it possible to drive through the entire speed range without interrupting the tractive force.

The ICVD® is thus a symbiosis of time-proven drive concepts, combining their advantages, but without having to accept the drawbacks of the old solutions.

The ICVD® is the only continuously variable, hydrostatic travel drive to use 45° large-angle technology and comprises a gearbox, a hydraulic motor and a control unit.



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Type: Variable-displacement axial piston motor of bent-axis design for hydrostatic drives with open or closed circuit.

The ICVD[®] is a continuously variable, hydrostatic travel drive, comprising mechanical gearbox, hydraulic motor and control unit.



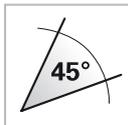
CHARACTERISTICS



- › The entire speed range can be driven through without interrupting the tractive force



- › Automatic adaptation of the power requirement
- › Optimised efficiency thanks to integrated motor using large-angle technology
- › High power density and small dimensions



- › 45° large-angle technology offers a large, continuously variable conversion range



- › Low noise level



- › Reduced fuel consumption

TECHNICAL DATA

HYDRAULIC FLUIDS

The operating data and ratings are based on operation with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must display good thermal and hydrolytic stability in order to prevent wear, erosion and corrosion of the internal components. The ICVD® can also be operated using fire-resistant hydraulic fluids, but under modified conditions. Hydraulic fluids may not be mixed. Contact GKN Walterscheid or SAUER BIBUS service for further information.

Suitable hydraulic fluids

- › Hydraulic fluids to DIN 51 524, Part 2 (HM)
- › Hydraulic fluids to DIN 51 524, Part 3 (HV)
- › API CD, CE and CF engine oils to SAE J183
- › M2C33F or G automatic transmission fluids (ATF)
- › Multi-purpose agricultural oils (STOU)

Temperature

The temperature and viscosity requirements must be met. The temperature should be within the limits indicated below. The minimum temperature does not affect the motor components, but may have a negative impact on power transmission. The maximum temperature is dependent on the properties of the motor material. It must not be exceeded and is usually measured at the leakage-oil outlet.

Temperature range ¹⁾

t min. = -20 °C Briefly, when starting cold
 t max. = 115 °C Briefly

¹⁾ Measured at the hottest point, e.g. leakage-oil port

Viscosity

The viscosity should be within the recommended range (see below) to achieve high efficiency and a long bearing service life. The minimum viscosity may only occur briefly at the maximum ambient temperature. The maximum viscosity may only occur under cold-starting conditions, i.e. at appropriately limited rpm speeds until the system has warmed up.

Viscosity range

Minimum	= 7 mm ² /s	Briefly
Recommended	= 12-80 mm ² /s	Recommended operating viscosity
Maximum	= 1,600 mm ² /s	Briefly, when starting cold

FILTERING

To prevent premature wear, it is essential that the hydrostatic drive system be charged and operated with clean hydraulic fluid only. The hydraulic fluid is considered to be a component of the overall machine. The filter system to be used must guarantee cleanliness class 20/17/12 or better to ISO 4406 under normal operating conditions. The choice of filter is dependent on various factors, including the amount of dirt penetrating the system, the formation of dirt particles in the system, the necessary cleanliness of the fluid and the desired maintenance interval. The filters must be selected in such a way that the above-mentioned requirements are met, efficiency and performance being the underlying criteria.

The respective demands on filtering in different systems must be determined by means of trials. The prerequisites for a definitive decision on the filter system are monitoring of the prototypes, and assessment of the components and performance, throughout the entire test period.

CAUTION! INDEPENDENT BRAKE SYSTEM

Loss of the power connection in the driveline of a hydrostatic system during an acceleration or braking phase, or in the neutral position of the drive system, can lead to a loss of hydrostatic braking capacity. For this reason, a redundant brake system that is independent of the hydrostatic brake system must be installed. The redundant system must be in a position to brake the moving vehicle and/or to serve as a holding brake.

TECHNICAL DATA

HYDRAULIC FLUID RESERVOIR

The air contained in the hydraulic fluid is eliminated in the hydraulic fluid reservoir during the dwell time. Fluctuations in volume are also equalised. These can be caused by heating of the hydraulic fluid (expansion), cooling of the hydraulic fluid (contraction), actuation of differential cylinders. The hydraulic fluid reservoir must be capable of equalising the volumetric flow fluctuations under all operating conditions. The minimum reservoir capacity in litres should be 5/8 of the maximum charging-pump volumetric flow in l/min. The minimum fluid content to be provided is 1/2 of the charging-pump volumetric flow in l/min.

This results in a dwell time of the fluid in the reservoir of 30 seconds, allowing the air contained in the hydraulic fluid to rise to the surface of the fluid. If a reservoir is designed according to these guide values, a sufficient equalising volume is available for most systems/applications with closed reservoir (e.g. without breather). The suction port leading to the charging pump must be located above the reservoir bottom in order to prevent the aspiration of sediment. The return line port on the reservoir must be located below the fluid surface and as far as possible away from the suction port. Air elimination is improved by inclined, perforated interceptor plates, installed between the return and suction ports.

POWER UNIT

Type

- › Variable-displacement axial piston motor of bent-axis design for a closed or open circuit
- › Without control pressure (initial position), the power unit is at the maximum pivoting angle (closed circuit)

Sense of rotation

- › Clockwise and counterclockwise

Geometric displacement volume

- › Max. 233 cm³/rev.
- › Min. 40 cm³/rev.
- › Optionally 0 cm³/rev.

Continuous speed

- › At max. pivoting angle: 1,500 rpm
- › At min. pivoting angle: 4,000 rpm

Maximum speed (briefly):

- › At max. pivoting angle: 1,800 rpm
- › At min. pivoting angle: 4,200 rpm

Pivoting angle

- › Max. 45°, min. 7°, optionally 0°
- › Theoretical specific torque: 3.7 Nm/bar

HYDRAULIC PARAMETERS

Operating pressure

- › Working pressure: max. Δp 480 bar
- › Max. pressure, briefly: Δp 510 bar

Housing pressure

- › Max. continuous pressure: 2 bar; briefly 5 bar

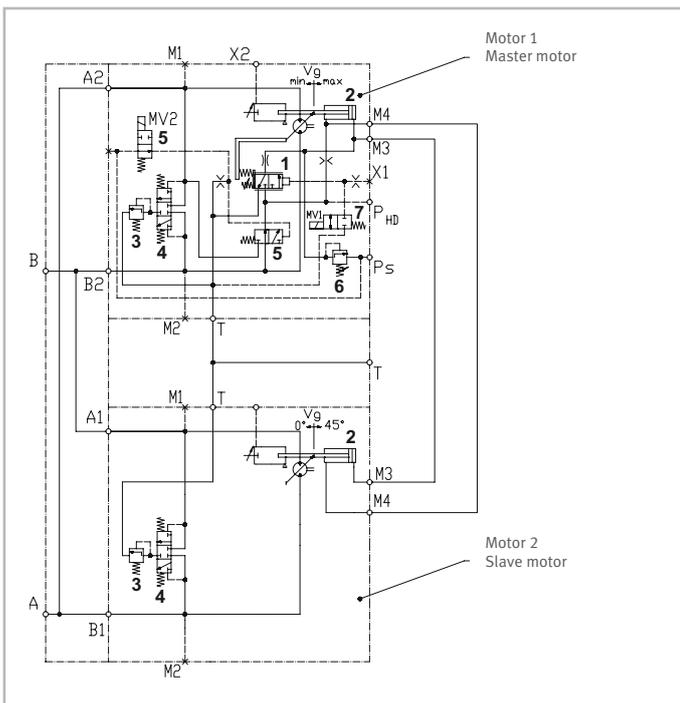
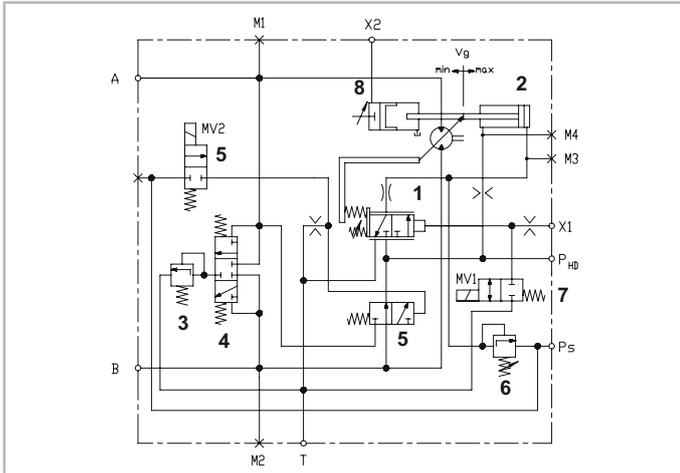
Filtering

- › Required cleanliness class to ISO 4406: 20/17/12 or better

HYDRAULIC CONTROL

1. CONTROL PRESSURE-DEPENDENT CONTROL

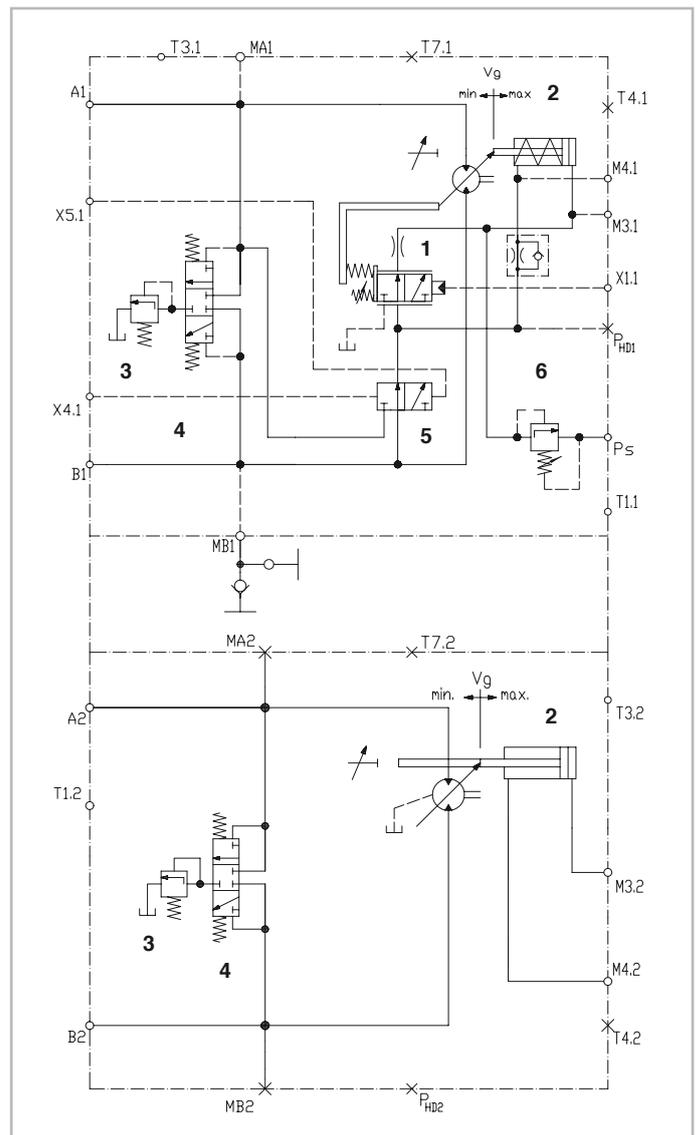
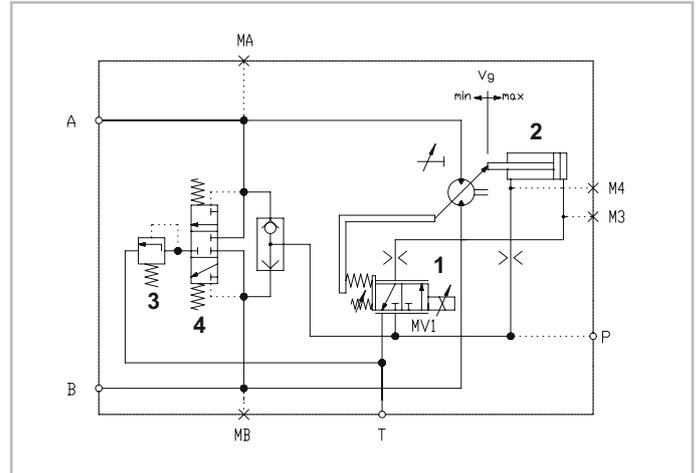
Closed circuit



1. Proportional control valve
2. Stroke adjustment of the swivel yoke
3. Pressure limiting valve, flushing (optional)
4. Directional valve, flushing (optional)
5. Pilot valve for control pressure reversal (optional)
6. PCOR (optional)
7. Control pressure shut-off (optional)
8. Hydromechanical speed limitation (optional)

2. ELECTRIC CONTROL

Closed circuit

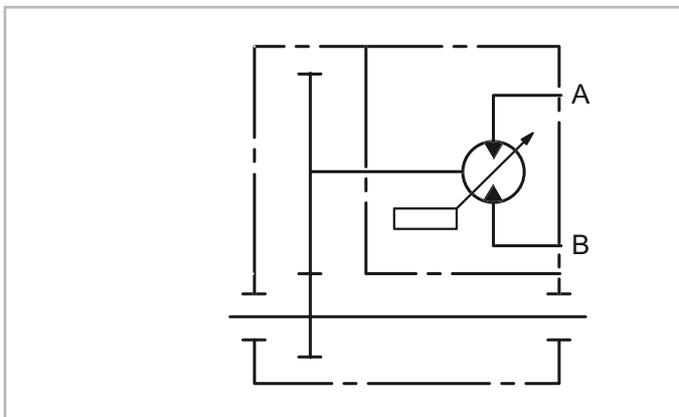


ICVD® GT-S1 N 233V



Transmission ratio i	0.94 - 1.6
Torque at the output shaft M_d	1,280 - 2,560 Nm
Max. drive shaft operating angle ¹⁾	< 3° and Z-bend
Drive shaft flange	DIN ISO 7646 120 x 8 x 10
Operating pressure – max. (Δp)	480 bar
Installation position	Vertical ¹⁾
Mass (without fluids) m	Approx. 140 kg
Transmission oil quantity	Approx. 4 l
Transmission oil grade	SAE 90 API-GL-5
Hydraulic fluid quantity	Approx. 15 l

¹⁾ Other versions on request



Kinematic diagram

DIRECTION OF FLOW

Sense of rotation	Port A	Port B
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

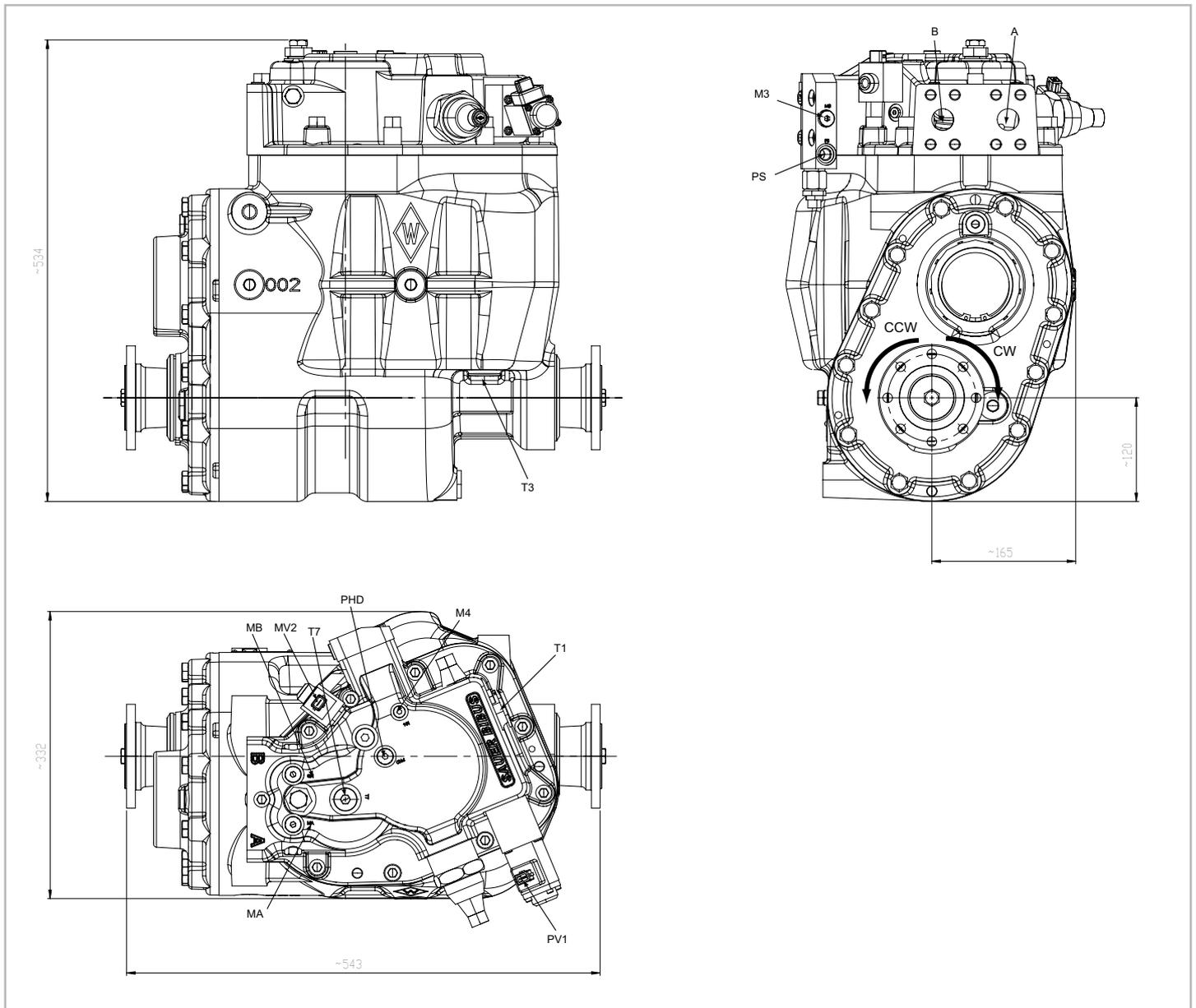
Definition of the sense of rotation: looking at the high-pressure ports on the control unit cover.

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation

Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® GT-S1 N 233V



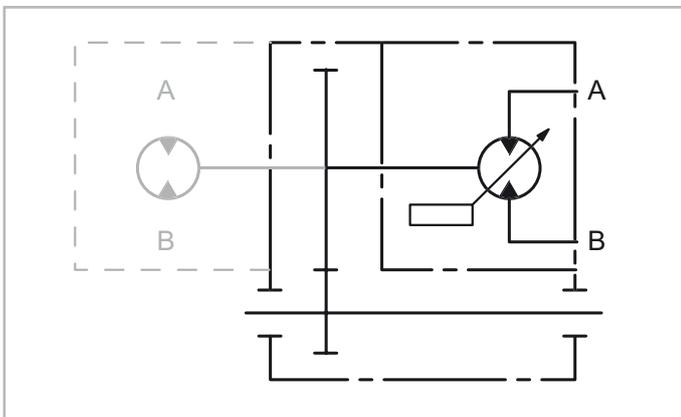
- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure ports PHD + Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1: AMP-Junior
- › Travelling direction valve MV2: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

ICVD® GT-S1 A 233V



Kinematic diagram

Transmission ratio i	0.94 - 1.6
Torque at the output shaft M_d	1,600 - 3,200 Nm
Max. drive shaft operating angle ¹⁾	< 3° and Z-bend
Drive shaft flange Front Rear ¹⁾	DIN ISO 7646 120 x 8 x 10 120 x 8 x 10
Operating pressure – max. (Δp)	480 bar
Installation position	Vertical ¹⁾
Mass (without fluids) m	Approx. 150 kg
Transmission oil quantity	Approx. 3.7 l
Transmission oil grade	SAE 90 API-GL-5
Hydraulic fluid quantity	Approx. 15 l

¹⁾ other versions on request

CONNECTION FOR SUPPLEMENTARY MOTOR

Connection to ISO 1

Displacement volume	23-60 cm ³
Flange	ISO 3019-2
Inside profile, max.	DIN 5480-N30x2x30x14x9H

DIRECTION OF FLOW

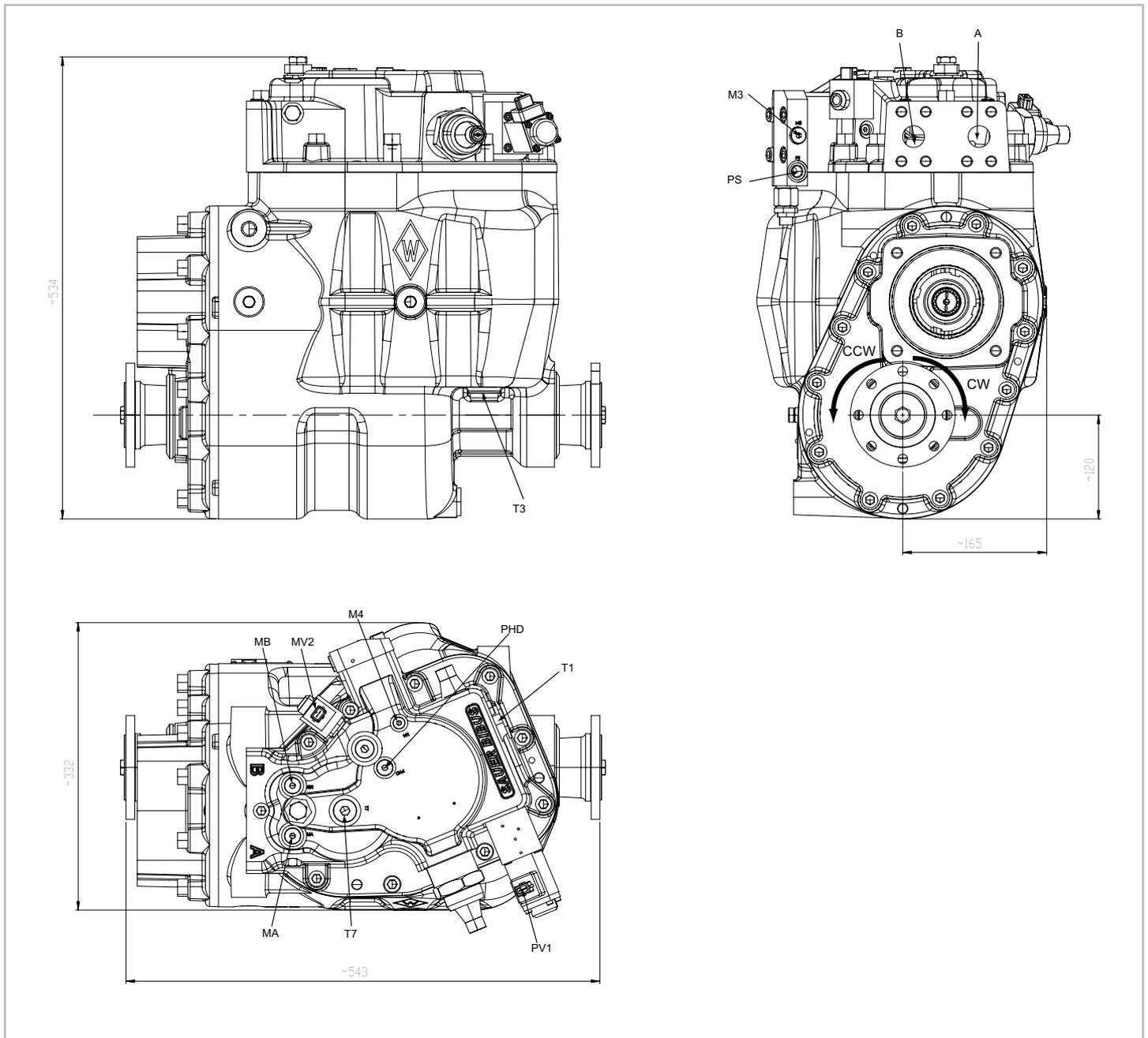
Sense of rotation	Port A	Port B
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

Definition of the sense of rotation: looking at the high-pressure ports on the control unit cover.

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation
Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® GT-S1 A 233V



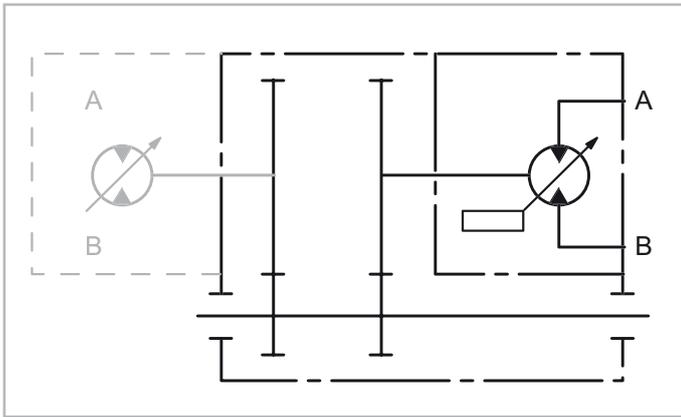
- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure ports PHD + Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1: AMP-Junior
- › Travelling direction valve MV2: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

ICVD® GT-S2 A 233V



Kinematic diagram

Transmission ratio i	1.7 - 2.2
Torque at the output shaft M_d	4,080 - 5,280 Nm
Max. drive shaft operating angle ¹⁾	< 3° and Z-bend
Drive shaft flange both sides ¹⁾	DIN ISO 7646 120 x 8 x 10
Operating pressure – max. (Δp)	480 bar
Installation position	Vertical ¹⁾
Mass (without fluids) m	Approx. 185 kg
Transmission oil quantity	Approx. 6.5 l
Transmission oil grade	SAE 90 API-GL-5
Hydraulic fluid quantity	Approx. 1.5 l

¹⁾Other versions on request

CONNECTION FOR SUPPLEMENTARY MOTOR

Connection diagram to ISO 1

Displacement volume	80-140 cm ³
Flange	ISO 3019-2
Inside profile, max.	DIN 5480-N30x2x30x14x9H

DIRECTION OF FLOW

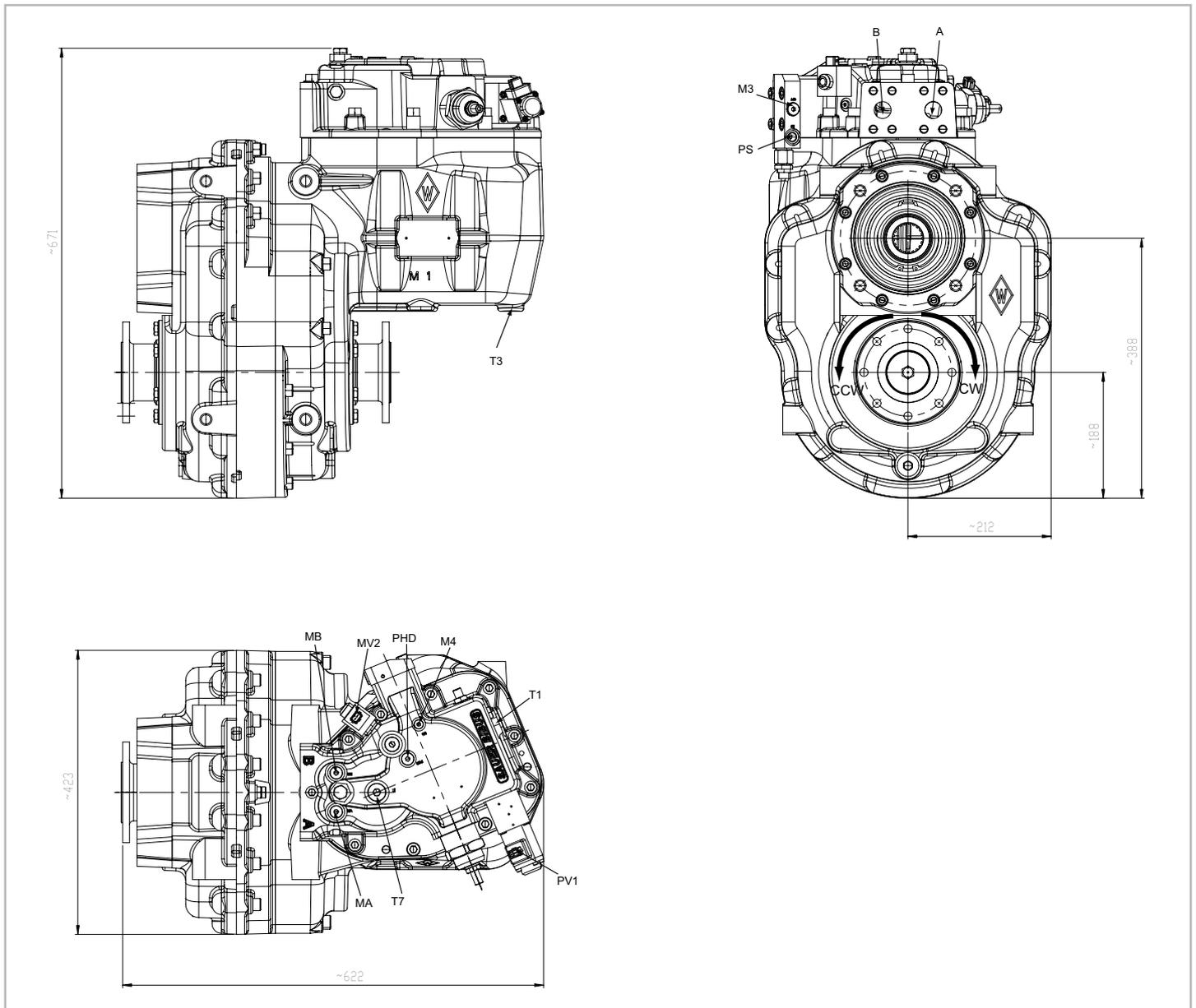
Sense of rotation	Port A	Port B
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

Definition of the sense of rotation: looking at the high-pressure ports on the control unit cover.

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation
Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® GT-S2 A 233V



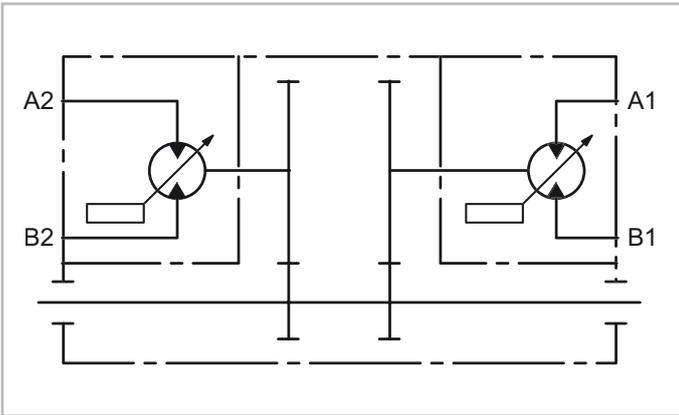
- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure ports PHD + Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1: AMP-Junior
- › Travelling direction valve MV2: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

ICVD® GT-T2 N 233V/233V



Kinematic diagram

Transmission ratio i	1.7 - 2.2
Torque at the output shaft M_d	5,440 - 7,040 Nm
Max. drive shaft operating angle ¹⁾	< 3° and Z-bend
Drive shaft flange both sides ¹⁾	DIN ISO 7646 120 x 8 x 10
Operating pressure – max. (Δp)	480 bar
Installation position	Vertical ¹⁾
Mass (without fluids) m	Approx. 270 kg
Transmission oil quantity	Approx. 6.5 l
Transmission oil grade	SAE 90 API-GL-5
Hydraulic fluid quantity	Approx. 1.5 l per motor

¹⁾ Other versions on request

DIRECTION OF FLOW

Sense of rotation	Port A (A1 + B2)	Port B (A2 + B1)
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

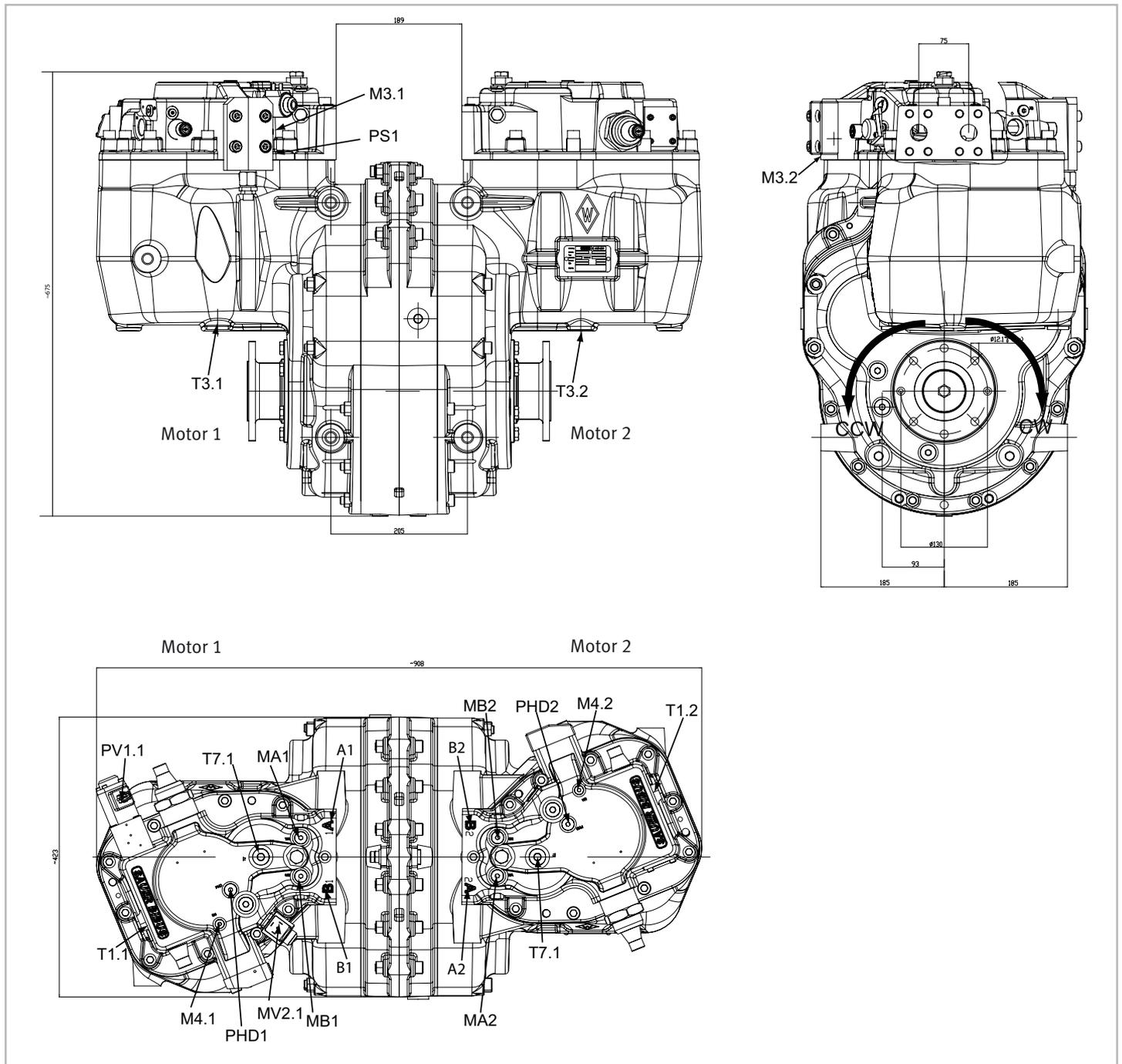
Definition of the sense of rotation: looking at the output flange on Motor 1 (see drawing on p. 15)

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation

Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® GT-T2 N 233V/ 233V



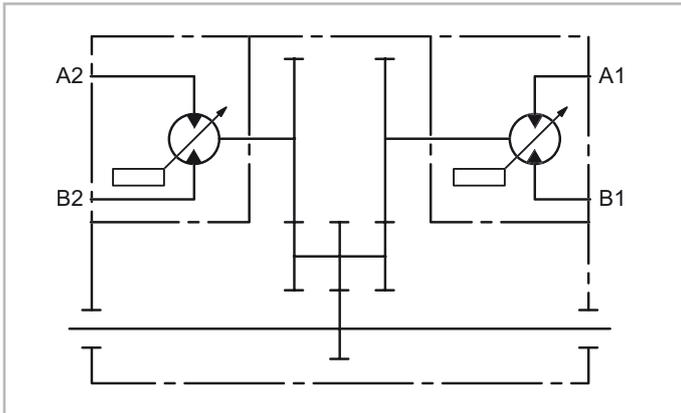
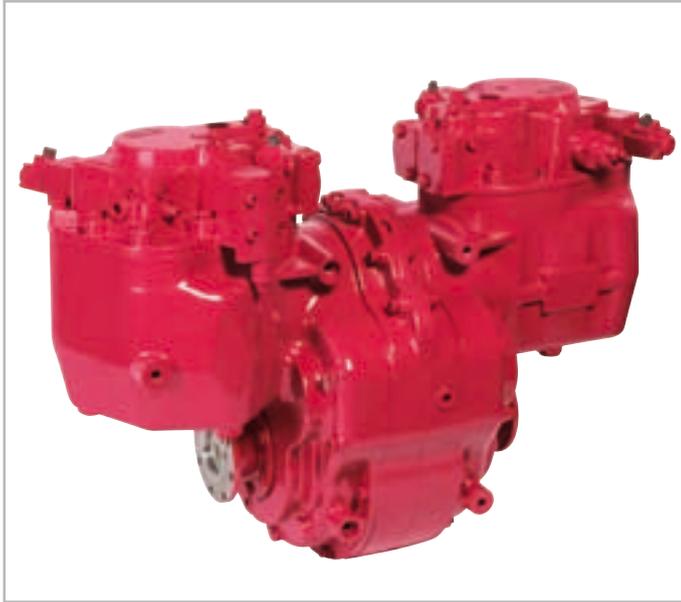
- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure ports PHD + Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1.1: AMP-Junior
- › Travelling direction valve MV2.1: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

ICVD® GT-T3 N 233V/233V



Kinematic diagram

Transmission ratio i	0.8 - 1.6
Torque at the output shaft M_d	2,560 - 5,120 Nm
Max. drive shaft operating angle ¹⁾	< 3° and Z-bend
Drive shaft flange both sides ¹⁾	DIN ISO 7646 120 x 8 x 10
Operating pressure – max. (Δp)	480 bar
Installation position	Vertical ¹⁾
Mass (without fluids) m	Approx. 290 kg
Transmission oil quantity	Approx. 6.5 l
Transmission oil grade	SAE 90 API-GL-5
Hydraulic fluid quantity	Approx. 1.5 l per motor

¹⁾ Other versions on request

DIRECTION OF FLOW

Sense of rotation	Port A (A1 + B2)	Port B (A2 + B1)
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

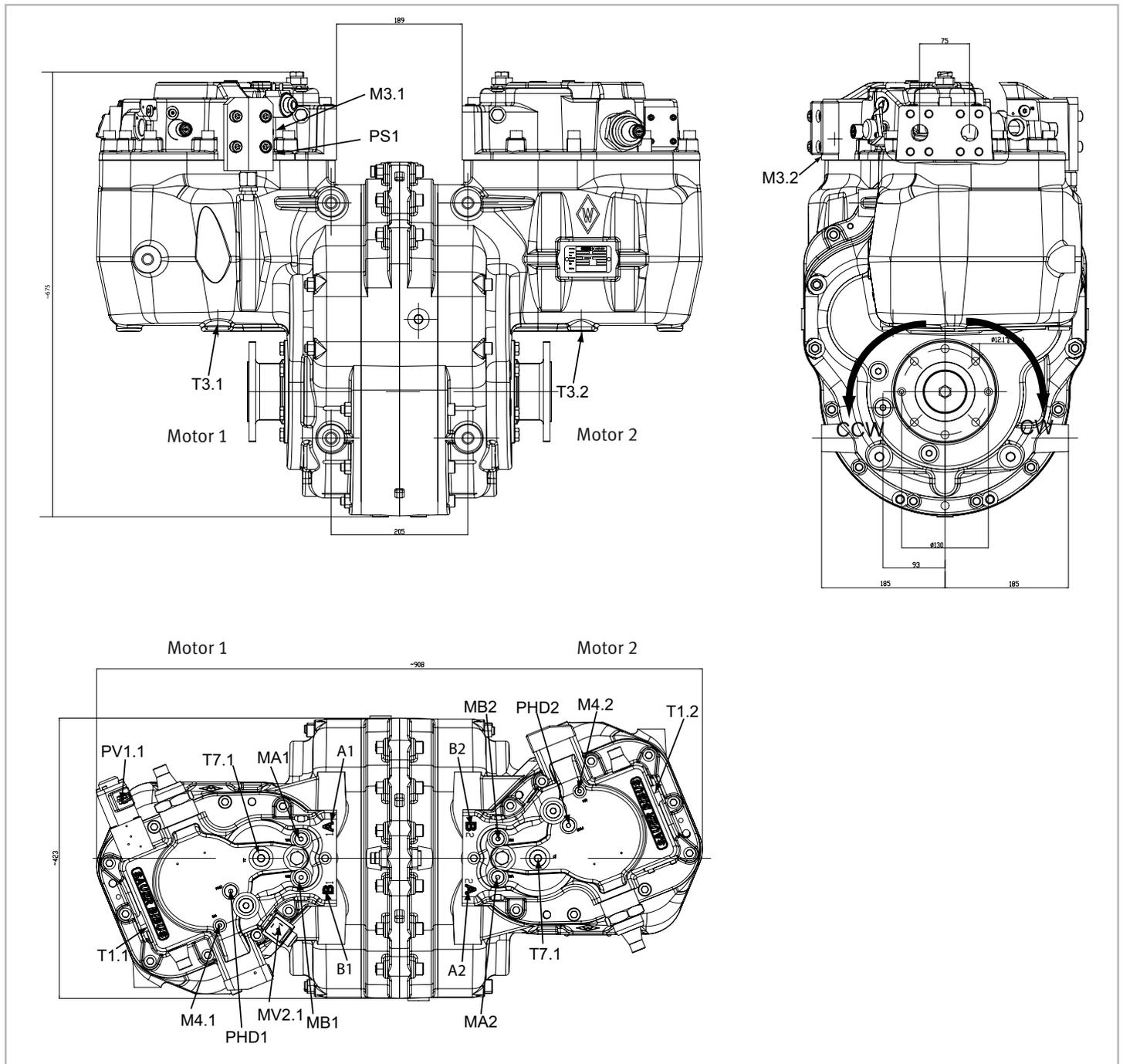
Definition of the sense of rotation: looking at the output flange on Motor 1 (see drawing on p. 17)

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation

Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® GT-T3 N 233V/ 233V



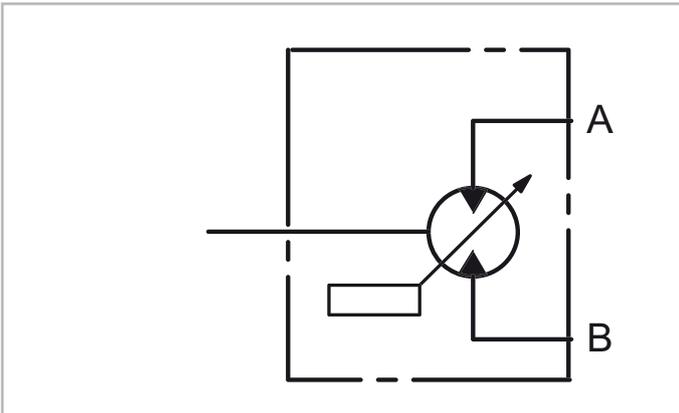
- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure ports PHD + Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1.1: AMP-Junior
- › Travelling direction valve MV2.1: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

ICVD® MO-S0 N 233V



Kinematic diagram

Max. torque at power unit shaft Md	1,600 Nm
Flange connection, ISO 3019+2	160B4HW
Shaft profile, DIN 5480	W50x2x30x24x8f
Operating pressure – max. (Δp)	480 bar
Installation position	Any
Mass (without fluids) m	Approx. 95 kg
Hydraulic fluid quantity	Approx. 1.5 l

DIRECTION OF FLOW

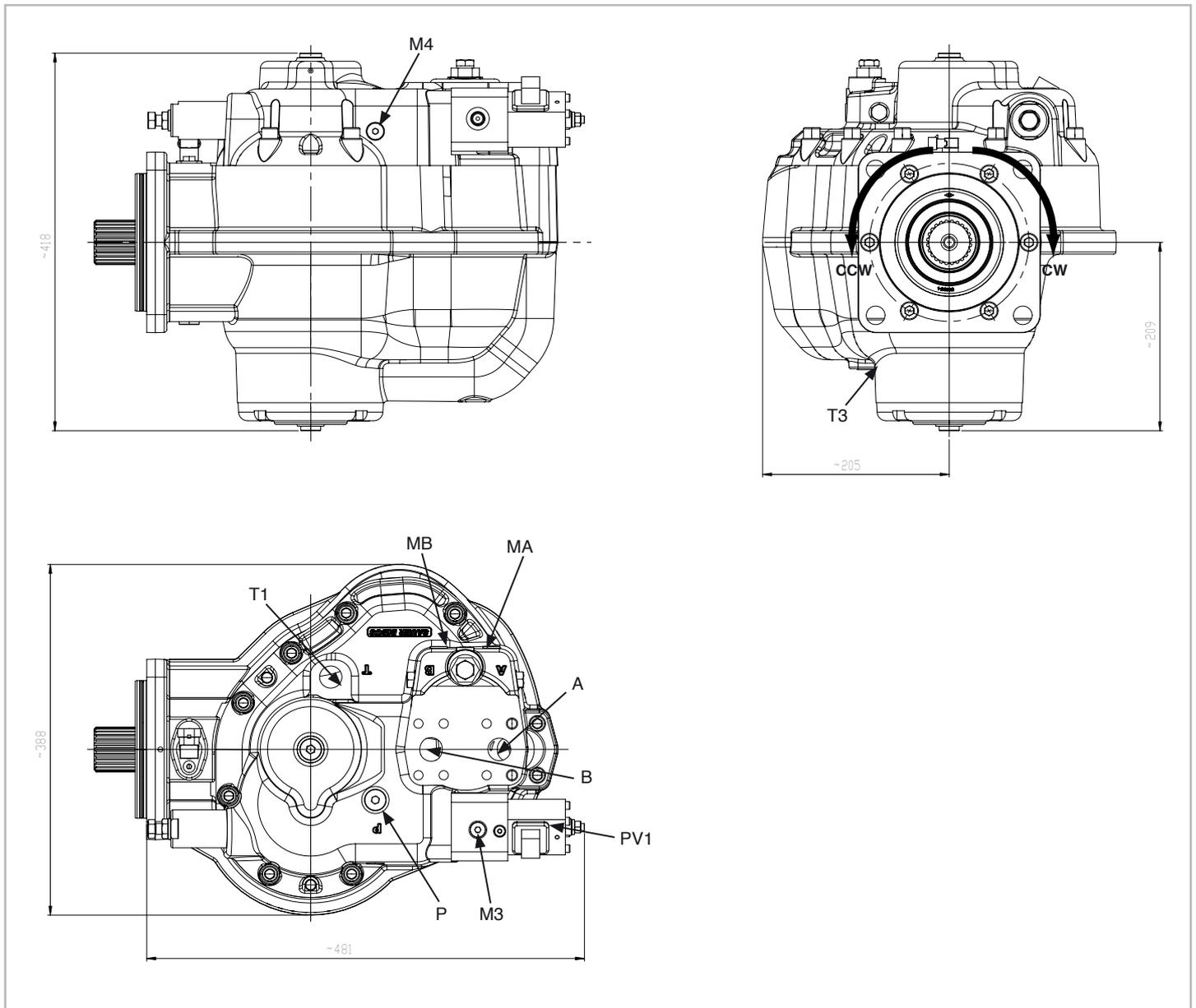
Sense of rotation	Port A	Port B
Clockwise (CW)	Outlet	Inlet
Counterclockwise (CCW)	Inlet	Outlet

Definition of the sense of rotation: looking at the flange.

MAINTENANCE AND OIL CHANGE

Oil check after 100 hours of operation
Oil change after 1,500 hours of operation or once per year

DIMENSIONS - ICVD® MO-S0 N 233V



- › High-pressure ports A + B: SAE 1" (6,000 psi), useable depth of thread 18 mm
- › Leakage-oil port T: M 26x1.5
- › Supply pressure port Ps: M 14x1.5
- › Measuring ports MA, MB, M3: M 14x1.5
- › Measuring port M4: M 10x1

Optional:

- › Proportional control valve PV1: AMP-Junior
- › Travelling direction valve MV2: AMP-Junior

Kindly request a binding installation drawing before finalising the design.

SAFETY

The ICVD® is designed and built according to the state of the art to be safe in operation. However, the ICVD® can be a potential source of danger if used incorrectly, e.g. by untrained personnel, or for purposes for which it is not intended.

This can result in

- › Threats to life and limb,
- › Threats to machines and other property of the user,
- › Threats to efficient working of the applications.

Anyone involved in the installation, commissioning, operation and maintenance of the ICVD® must have read and understood the manual. Appropriate training is offered by GKN Walterscheid and SAUER BIBUS.

The ICVD® is intended for use in open or closed circuits. The persons responsible for the safety of the installation must ensure that

- › Only qualified persons are commissioned with work on the ICVD®,
- › These persons always have the operating instructions and other product documentation at their disposal whenever they are working on or with the ICVD® and are committed to consistently comply with all these documents,
- › Non-qualified persons are banned from working on the ICVD® or in its vicinity.

Qualified personnel means persons who - based on their training, experience and instruction, as well as their knowledge of pertinent standards, rules, accident prevention regulations and operating conditions - have been authorised, by the person responsible for the safety of the installation, to perform the activities necessary from time to time and are in a position to recognise and avoid possible hazards in this context. Among other things, a knowledge of First Aid measures and the local emergency facilities is also necessary.

It is presupposed that the fundamental planning work for the entire installation, and all work relating to transport, assembly, installation, commissioning, maintenance and repair, are performed by personnel qualified in the respective field and/or checked by responsible specialists.

Particular attention must be paid to the following:

- › The technical data and other information regarding permissible use (installation, connection, ambient and operating conditions), which are to be found in, for example, the catalogue, the contract documents, the operating manual, the rating plate data and other product documentation,
- › The general construction and safety regulations,
- › The local, installation-specific provisions and requirements,
- › The correct use of tools, hoisting gear and transport facilities,
- › The use of personal protective equipment.

If anything is unclear in this respect, particularly if detailed, product-specific information is not available, GKN Walterscheid and SAUER BIBUS must be contacted to clarify the situation. When doing so, kindly always quote the Type Designation and Identification Number.

The prescribed maintenance, inspection and overhauling measures must be performed regularly in order to prevent malfunctions. Changes compared to normal operation (greater power consumption, higher temperatures or vibrations, unusual noises or smells, tripping of monitoring devices, etc.) indicate that the system is not functioning correctly. In such cases, the responsible maintenance personnel must be informed without delay in order to avoid malfunctions, which could in turn indirectly or directly bring about serious personal injury or property damage.

IN CASE OF DOUBT, SWITCH OFF THE ICVD® IMMEDIATELY!

APPLICATION DATA

Company *	Contact *
Address *	Phone *
Date *	E-Mail *

1. Application / Model *

2. Prime Mover		3. Vehicle		
a) Type / Model		Max.	Min.	
b) Nominal Power / Speed *	[kW]			[kg]
c) Engine Speed for Calculation *	[rpm]			[kg]
d) Max. Engine Speed	[rpm]			[mm]

4. Max. Power for Hydrostatic Drive	[kW]
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5. Technical Data – Hydrostatic Drive				
A. Pump			B. Hydraulic Motor	
a) Type / Model *			a) Type / Model	
b) Max. Displacement *		[cc/rev]	b) Max. Displacement *	[cc/rev]
c) Max. Pressure *		[bar]	c) Max. Pressure *	[bar]
d) Max. Speed		[rpm]	d) Max. Speed *	[rpm]
e) Charge Pressure *		[bar]		
f) Position › on Prime Mover	<input type="checkbox"/> yes	<input type="checkbox"/> no		
› with Intermediate Gearbox (Ratio)		[1]		

6. Technical Data – Mechanical Drive			
A. Transmission Ratio			
a) Axle Ratio			[1]
b) Gearbox Ratios	1st Gear		[1]
	2nd Gear		[1]
	3rd Gear		[1]
	4th Gear		[1]

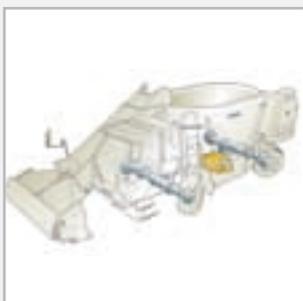
7. System Parameters		
a) Max. Speed *		[kph]
b) Min. Operating Speed		[kph]
c) Max. Tractive Force *		[kN]
d) Rolling Resistance *	f	[1]
e) Max. Gradeability › unloaded		[%]
	› loaded	[%]
f) Trailer Weight		[kg]

8. Comments (please attach additional Drafts / Diagrams)

* These fields must be completed

NOTES

NOTES



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