Data sheet

Axial piston motor DMVA

The Liebherr axial piston motors in the DMVA series are designed as swashplates for open and closed circuits and were specially developed for use in mobile machinery in harsh environments.

The inverse drive with a swivel angle of 22° is very efficient and has a very high power density, making it ideal for applications that require a variable displacement to hydraulic motor.

The variable displacement flange motors are available in nominal sizes ranging from 108 to 370. The nominal pressure of the units is 6,527 psi (450 bar) and the maximum pressure is 7,252 psi (500 bar) absolute.

The through-drive capability can be used for mounting a brake or tandem units (axial piston multi-circuit motor).

The DMVA series is available with the most common controls. Speed sensor or preparation for speed sensor available on request.

Valid for:
DMVA 108
DMVA 165
DMVA 215
DMVA 370

Features:
D series
Open and closed circuit

Control types:
Various control types can be selected

Pressure range:
Nominal pressure p_N = 6,527 psi (450 bar)
Maximum pressure p_{max} = 7,252 psi (500 bar)

Document identification:

ID number:	11378482
Date of issue:	03/2023
Authors:	Liebherr - Abteilung VH13
Version:	1.2

LIEBHERR

Table of contents

1 Type code

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

1. Motor type

D series / motor / variable / flanged	**DMVA**

2. Type of circuit

Open	■	O
Closed	■	G

3. Nominal size (NS)

	108	**165**	**215**	**370**	

4. Residual displacement $V_{g\ min}$

Enter value in cm^3/rev	■	

5. Activation / control type

Electro-proportional (negative characteristic)	■	■	■	■	EL
Electro-proportional (positive characteristic)	■	□	□	□	EL1
Electro-proportional (negative characteristic) / pressure cut-off	■	■	■	□	EL - DA
Hydraulic regulation, dependent on high pressure	■	■	-	-	HD
Hydraulic-proportional (negative characteristic)	■	■	■	■	SD
Hydraulic-proportional (negative characteristic) / pressure cut-off	■	■	■	■	SD - DA
Hydraulic regulation, two position hydraulically operated	□	□	□	□	ZH

6. Design

	1

7. Direction of rotation (viewed towards the drive shaft)

alternating	**W**

8. Mounting flange

Mounting flange SAE D (SAE J744)		□	■	□	□	24
Mounting flange ISO 3019-2	Ø160B4 (four-hole mounting flange). Enter "Ø160" in the order text	■	□	□	□	31
	Ø180B4 (four-hole mounting flange). Enter "Ø180" in the order text	□	■	□	□	
	Ø200B4 (four-hole mounting flange). Enter "Ø200" in the order text	□	□	■	□	
Mounting flange customised	Ø165.1 (four-hole mounting flange). Enter "Ø165.1" in the order text	□	□	■	□	51
	Ø250 (four-hole mounting flange). Enter "Ø250" in the order text	□	□	□	■	

■ = Available / □= On request / -= Not available

1 Type code

		108	165	215	370	
9. Shaft end						
Splined shaft	DIN 5480	■	■	■	■	1
	ANSI B92.1a	□	■	□	□	2
10. Connections						
ISO 6162-2 / SAE J518-2, high-pressure connection 6000 psi		**A**				
11. Accessories						
Without add-on parts		**0**				
12. Through drive						
Without through-drive		■	■	■	□	0
Special through-drive		□	■	■	■	K
13. Valves						
Without valve		■	■	■	■	0
High-pressure relief valve		-	■	■	■	OH
Hydraulically adjustable high-pressure limitation		-	□	□	-	OX
Flushing, closed circuit		■	■	■	■	SO
Flushing, open circuit		■	■	■	■	MO
Flushing, open circuit with high-pressure limitation		□	■	■	■	MH
High-pressure limitation with brake valve, open circuit		■	■	■	-	BH
14. Sensors						
Without sensor		■	■	■	■	0
With speed sensor		■	■	■	■	D*
With angle sensor		■	■	■	■	W*

* Can be combined, separated by hyphen, e.g.: D-W

■ = Available
□ = On request
- = Not available

Note
Contact addresses for queries are provided on the back of this document.

2 Technical data

2.1 Table of values

Nominal size			108	165	215	370
Displacement	$V_{g\ max}$	cm^3	107.7	167.8	216.5	371.2
	$V_{g\ min}$	cm^3	0 - 80% of $V_{g\ max}$, value specified in [cm^3/rev] Other values upon request			
Displacement flow at n_{max}	qv_{max}	l/min	361	503	584	891
Max. speed at $V_{g\ max}$ and Δp* = 430 bar	n_{max}	rpm	3350	3000	2700	2400
Max. speed at $V_{g\ max}$ = 0.65 and Δp = 200 bar	n_{max}	rpm	5125	4590	4100	3000
Output torque at $V_{g\ max}$ and Δp* = 430 bar	M_{max}	Nm	737	1149	1481	2243
Torq constant at $V_{g\ max}$	M_K	Nm/bar	1714	2.67	3446	5908
Output power at qv_{max} and Δp* = 430 bar	p_{max}	kW	259	361	419	564
Torsional rigidity	Nm/rad * 10^3		266	353	511	961
Driving gear moment of inertia	J_{TW}	kgm^2	0015	0.0313	0047	0.13
Weight (approx.)	m	kg	70	80	120	195

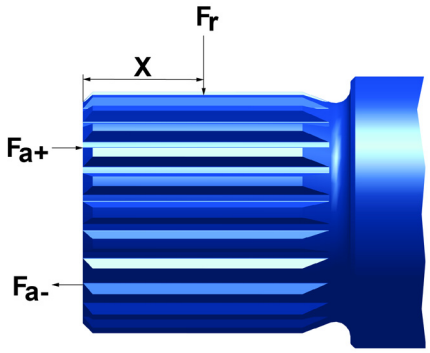
*) For nominal size 370, Δp = 380 bar

Note
The stated values (maximum values) are theoretical values, rounded, and without efficiencies or tolerances.

2 Technical data

2.1.1 Maximum radial and axial load of the driving shaft

Note
Theoretical rounded values, not taking into account efficiency, tolerances, contamination of the hydraulic fluid or deflection of the driving shaft.



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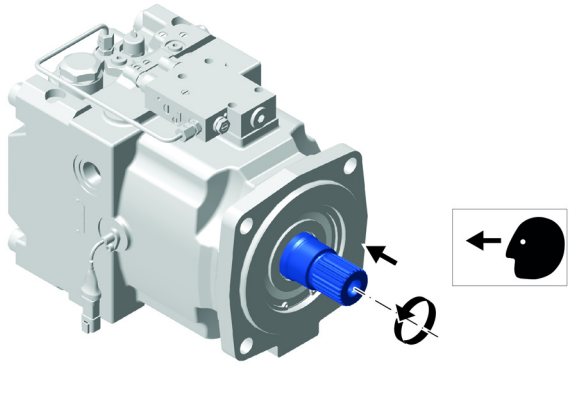
Nominal size			108	165	215	355	370
Max. radial force	$F_{r\,max}$	N	Values upon request				
Max. axial force	$F_{a\pm\,max}$	N					

Note
The radial and axial loads depend on the load cycle, e.g. pressure, rpm and direction of force.
If planning a belt drive or continuous axial and/or radial forces are expected, please contact Liebherr.

2.2 Direction of rotation

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.



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The direction of rotation is stated with view of the driving shaft, as shown in the figure.

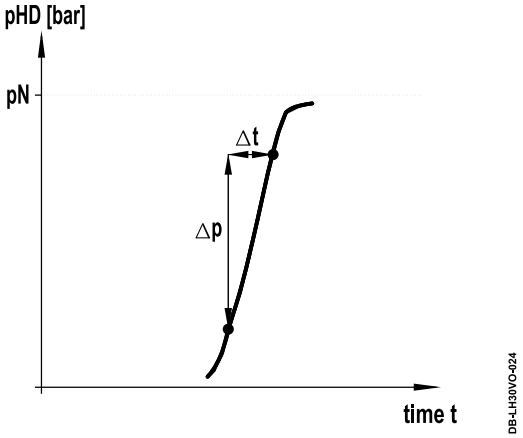
R	right	=	clockwise
L	left	=	anti-clockwise
W	alternating	=	depending on the activation at A / B

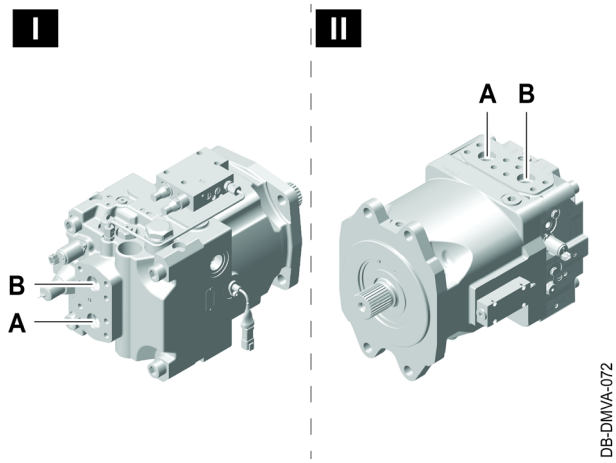
2 Technical data

2.3 Permitted pressure range

2.3.1 Operating pressure

Note
Variant I: High-pressure connection at the rear.
Variant II: High-pressure connection on the side.





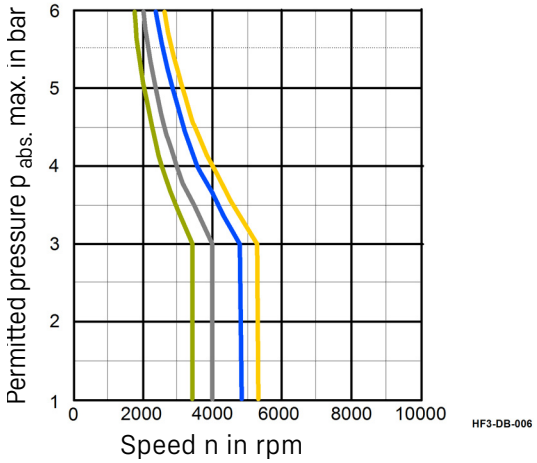
Operating pressure at connection A / B			108 to 370[1]
			Open & closed circuit
Minimum pressure**	pHD_{min}	bar	8
Nominal pressure (fatigue resistant)	pHD_N	bar	450[1]
Maximum pressure (single operating period)	pHD_{max}	bar	500[1]
Single operating period at maximum pressure pHD_{max}	t	s	< 1
Total operating period at maximum pressure pHD_{max}	t	OH*	300
Rate of pressure change	RA	bar/s	17000

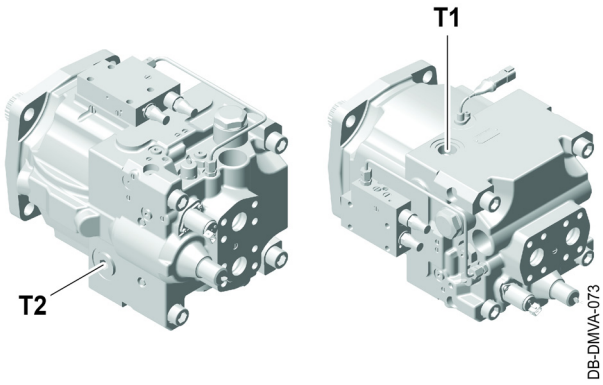
[1]) Nominal size 370 = pHD_N 400 bar, pHD_{max} = 450 bar
*) OH = operating hours
**) There must be minimum pressure in the working circuit at connection A/B to ensure adequate lubrication of the driving gear during operation.

DANGER
Failure of the fastening screws at working connection A / B!
Danger to life.
Use fastening screws of strength category 10.9.

2 Technical data

2.3.2 Housing, leakage oil pressure





Characteristic curve	Nominal size	Shaft diameter (mm)
	108	45
	165	50
	215	60
	355 / 370	70

Leakage oil pressure at connection T1 / T2			
Nominal size			**108 to 370**
Permanent leakage oil pressure, absolute, open and closed circuit	p_L	bar	3
Maximum pressure, absolute, open and closed circuit at reduced speed	pL_{max}	bar	6*

*) Short pressure peaks of max. 10 bar abs. are permitted (t < 0.1 s).

Note
The pressure in the axial piston unit must always be higher than the external pressure on the shaft lip seal.

2 Technical data

2.4 Hydraulic liquids

2.4.1 General information

Selection of the appropriate hydraulic fluid is significantly influenced by the anticipated operating temperature relative to the ambient temperature, which is equivalent to the tank temperature.

ATTENTION
You must not mix different mineral oil hydraulic fluids!

Minimum required quality

Specification
LH-00-HYC3A
LH-00-HYE3A

Note
For additional information, see: www.liebherr.com (brochure: Lubricants and operating fluids) Alternatively: contact lubricants@liebherr.com.

2.4.2 Fill quantity

Nominal size	Fill quantity
108 to 370	Values upon request

Note
Before commissioning, the axial piston unit must be filled with oil and vented.
This process must be checked and repeated if necessary during operation and after long downtimes!

2.4.3 Filtering

- Filtering of the hydraulic fluid is necessary to maintain the specified purity class "21/17/14 according to ISO 4406" under all circumstances.
- The hydraulic fluid is filtered by the device-specific use of oil filters in the hydraulic system.
- Cleaning and maintenance intervals for the oil filters and the entire oil circuit depend on use of the unit: see the device-specific operating instructions.

2 Technical data

2.5 Temperature

Note
The optimum operating range of the hydraulic fluid of 16-36 mm^2/s for Liebherr Hydraulic HVI (ISO VG 46) is from 32° to 62 °C.

If the axial piston unit is operated in the optimum operating range of the hydraulic fluid within the permitted operating conditions and operating limits, it is low-wear and is protected against temperature-dependent ageing. From a viscosity < 11 mm^2/s (for Liebherr Hydraulic HVI (ISO VG 46) = 80 °C), a halving of the service life of the hydraulic fluid must be assumed for every 10 °K increase in temperature.

If the optimum range cannot be met, a hydraulic fluid with a more suitable viscosity range must be selected or the hydraulic system must be preheated or cooled.

To prevent temperature shocks, the temperature difference between the hydraulic fluid and the axial piston unit must be kept to less than 25 °C. This can be achieved by, among other things, a continuous flow through all axial piston units in the hydraulic system.

2.5.1 Operating limits

Maximum values:

Maximum leakage oil temperature: 115 °C.

ATTENTION
The temperature should be assumed to be highest in the drive shaft bearing area (rotary shaft lip seal and bearing). Experience has shown this temperature to be 10-15 °K higher than the leakage oil temperature.

Low temperatures: (for additional information see: 2.5.2 Low temperatures, Page 10)

Note
The operating limits of Liebherr hydraulic fluids are provided in the viscosity chart included below to allow users to make an informed choice.
(for additional information see: 2.5.6 Viscosity chart, Page 15)

2.5.2 Low temperatures

ATTENTION
When temperatures drop below freezing point, the sealing lip of the rotary shaft lip seal may freeze if it becomes wet or frosted. This can cause the sealing lip to tear off when the axial piston unit is started. The risk must be prevented by preheating/thawing the rotary shaft lip seal/the shaft.

Note
At temperatures at which there is already a risk of hardening from freezing, the frictional heat may be sufficient to keep the seal elastic or to bring it to a functional state quickly enough after the start of movement.

2 Technical data

Overview

Temperature [°C]	Phase	Viscosity [mm²/s]	Note
< -50 °C	Idle state	-*	No storage or operation permitted
< -40 °C	Idle state	-**	No operation permitted, preheat to at least -40 °C, select appropriate hydraulic fluid

***) Idle state < -50 °C**

ATTENTION
Temperatures < -50 °C on the system = no operation of the axial piston unit permitted.
Risk of damaging the sealing elements of the axial piston unit.
Avoid temperatures < -50 °C.

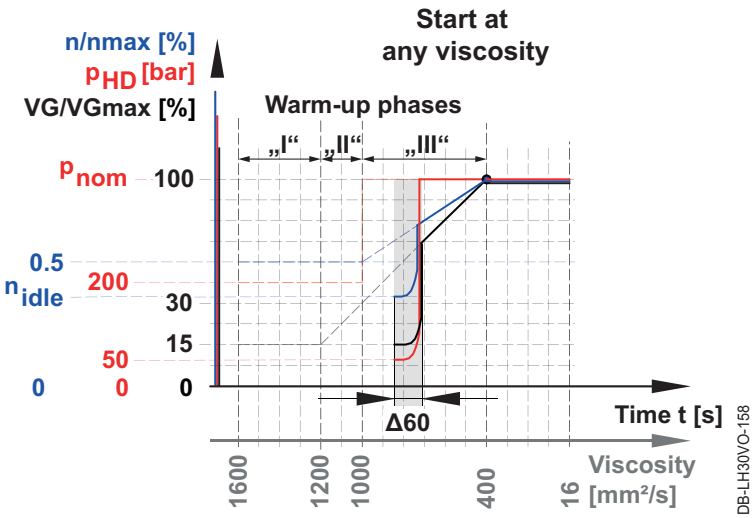
****) Idle state < -40 °C**

ATTENTION
Temperatures < -40 °C on the system = no operation of the axial piston unit permitted.
Functioning of the sealing elements in the axial piston unit is not guaranteed at temperatures < -40 °C.
Preheat the axial piston unit and tank to at least -40 °C and use Liebherr Hydraulic Plus Arctic/ Liebherr Hydraulic FFE 30 hydraulic fluid with a viscosity < 1600 mm²/s.
(for additional information see: 2.5.6 Viscosity chart, Page 15)

Regardless of the viscosity < 1600 mm²/s, the axial piston unit must be operated for at least 60 s under the following conditions before entering the cold start including the warm-up phases or on warm start:

- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq 50$ bar
- Speed: $n_{min} \leq n \leq 1000$ rpm, or idle speed of the drive motor*
- Displacement volume: $V_{g\ min} \leq V_g \leq 15\%$ of $V_{g\ max}$
- Do not move any of the equipment.

*) When using a drive with higher speeds than required in the conditions (e.g. an electric motor), please consult Liebherr, stating the potential speed(s).



After the 60 s have elapsed, determine the viscosity using the available temperature values and the viscosity chart, select the appropriate warm-up phase and operate the axial piston unit in the defined period and appropriate conditions (see Warm-up phases).

2 Technical data

Overview

Temperature [°C]	Phase	Viscosity [mm²/s]	Note
> -40 °C	Cold start	1600-400	The current viscosity of the hydraulic fluid before start-up determines the type of start. In the range of 1600-400 [mm²/s], it is a cold start. Entry into the warm-up phase must be selected according to the viscosity and the further warm-up phases must be run through according to the time specifications and operating conditions.
for additional information see: 2.5.6 Viscosity chart, Page 15	Warm-up phase "I"	1600-1200	Observe conditions and measures (see Warm-up phase "I")
	Warm-up phase "II"	1200-1000	Observe conditions and measures (see Warm-up phase "II")
	Warm-up phase "III"	1000-400	Observe conditions and measures (see Warm-up phase "III")
	Normal operation	400-16*	Axial piston unit, fully loadable (see Normal operation)
	Optimum operating range	36-16	Axial piston unit, fully loadable (see Normal operation)

*) At maximum leakage oil temperature, the viscosity must not fall below 8 mm²/s (for a short period, i.e. < 3 minutes, it can be 7 mm²/s) .

2.5.3 Cold start with subsequent warm-up phases

ATTENTION
Before cold start, the viscosity* must be determined on the basis of the oil temperature (e.g. tank temperature) in order to avoid damage to the axial piston units from excessive viscosity* of the hydraulic fluid. At a viscosity* > 1600 mm²/s, the hydraulic system must be preheated.
Using the determined viscosity*, the type and duration of the warm-up must be followed, using the cold start chart**.

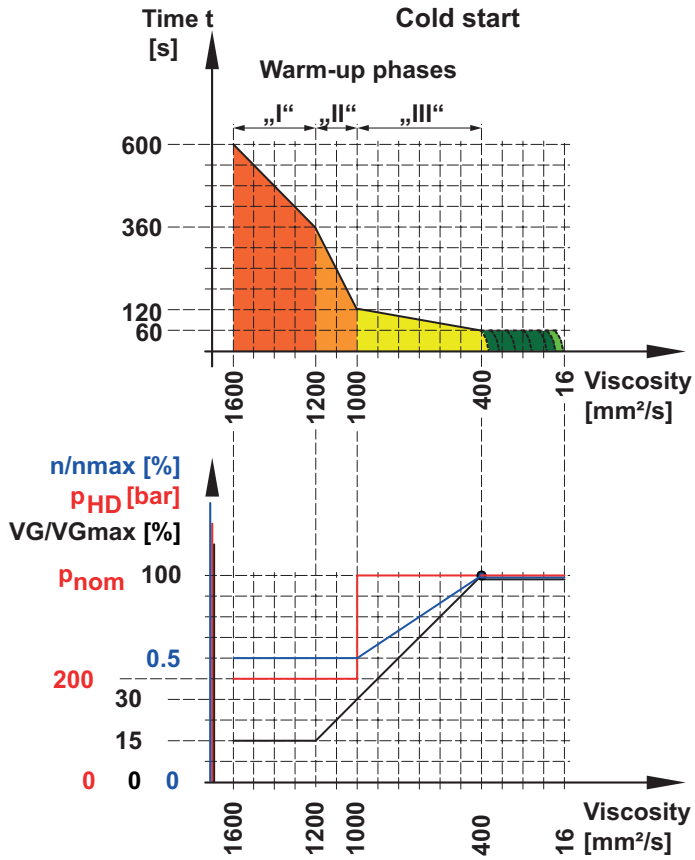
*) for additional information see: 2.5.6 Viscosity chart, Page 15

The following conditions apply:

- Viscosity: 1600-1200 mm²/s = operate the axial piston unit for 600-360 s with measures listed for Warm-up phase "I".
- Viscosity: 1200-1000 mm²/s = operate the axial piston unit for 360-120 s with measures listed for Warm-up phase "II".
- Viscosity: 1000-400 mm²/s = operate the axial piston unit for 120-60 s with measures listed for Warm-up phase "III".
- Viscosity: 400-16 mm²/s = operate the axial piston unit for 60 s with measures listed for "Warm start". This means that even at ≤ 400 mm²/s, the measures must be applied for at least 60 s.

2 Technical data

**) Cold start chart



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2.5.4 Warm-up phases

Note
Depending on the current viscosity, continue with the corresponding warm-up phase after the cold start. In the subsequent warm-up phases, the operating parameters may be increased to allow the hydraulic system to warm up rapidly.

Warm-up phase " I "

Condition:

- Viscosity: 1600-1200 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 1200 mm^2/s is reached.

Measures:

- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "I"} \leq 200$ bar
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "I"} \leq 50\%$ of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "I"} \leq 15\%$ of $V_{g\ max}$

Warm-up phase "II"

Condition:

- Viscosity: 1200-1000 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 1000 mm^2/s is reached.

Measures:

- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "II"} \leq 200$ bar
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "II"} \leq 50\%$ of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "II"} \leq 15\text{-}30\%$ of $V_{g\ max}$

Warm-up phase "III"

Condition:

- Viscosity: 1000-400 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 400 mm^2/s is reached.

Measures:

- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "III"} \leq p_{HD\ max}$
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "III"} \leq 50\%$ of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "III"} \leq 30\text{-}100\%$ of $V_{g\ max}$

Warm start

Condition:

- Viscosity: 400-16 mm^2/s = operate the axial piston unit for at least 60 s, even at viscosity < 400 mm^2/s, with measures listed below.

Measures:

- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq 50$ bar
- Speed: $n_{min} \leq n \leq 1000$ rpm, or idle speed of the drive motor
- Displacement volume: $V_{g\ min} \leq V_g \leq 15\%$ of $V_{g\ max}$

2.5.5 Normal operation

Note

Optimum operating range: 16-36 mm^2/s

The viscosity must not fall below 8 mm^2/s (for a short period, thud < 3 minutes, 7 mm^2/s) at maximum leakage oil temperature.

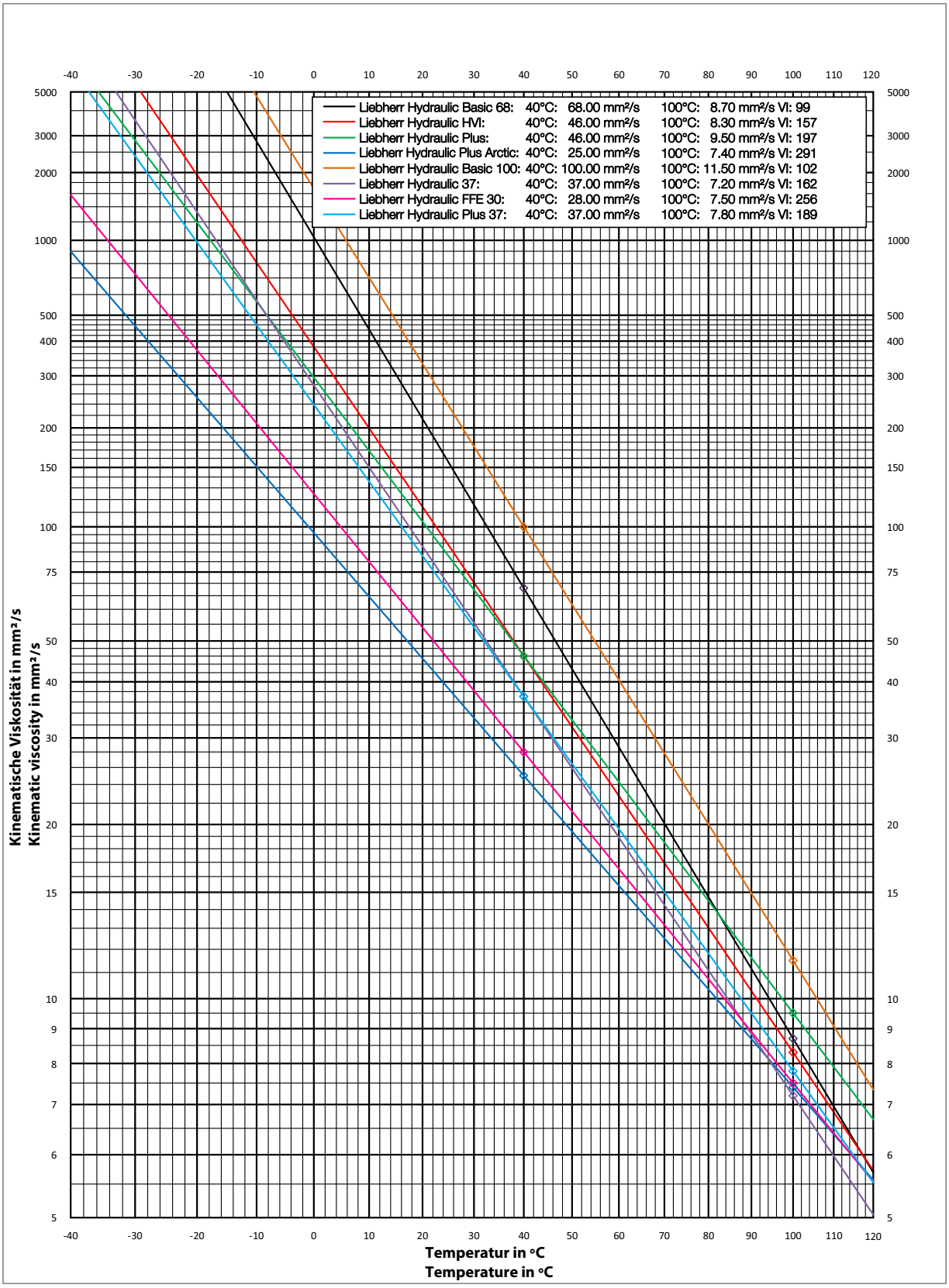
Note

In the viscosity range of 400-8 mm^2/s, the axial piston unit can be put under full load.

- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq p_{HDmax}$
- Speed: $n_{min} \leq n \leq n_{max}$
- Displacement volume: $V_{G\ min} \leq V_G \leq V_{g\ max}$

2 Technical data

2.5.6 Viscosity chart



2 Technical data

2.6 Shaft lip seal

2.6.1 General information

The rotary shaft lip seals (RWDR) are special sealing elements which permit a specific housing pressure. In order to ensure that the tribological system functions optimally, the operating conditions must be adhered to.

Sealing edge temperature varies due to the following factors in the housing:
- Circumferential speed
- Hydraulic fluid temperature
- Lubricating medium
- Pressure build-up

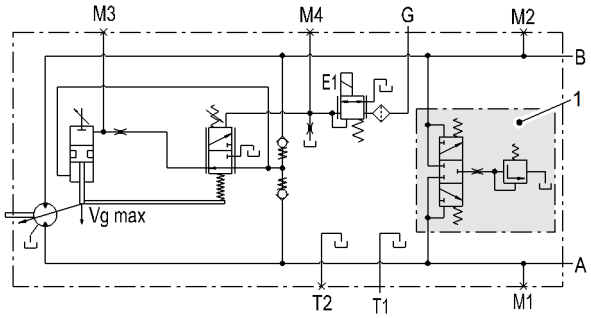
The sealing edge temperature could be 20 °C to 40 °C above the leakage oil temperature of a hydraulic axial piston unit.

2.7 Housing flushing

Under different operating conditions, e.g. a very low displacement flow over a longer period of time, the temperature in the housing may rise to its limit.

Depending on the hydraulic setup, a flushing circuit 1 for cooling and filtration may be required, where the "hot" hydraulic oil is led to an external cooler, cools down and is fed back into the hydraulic system.

The flushing volume Q_V in l/min is to be individually set for each nominal size in connection with the application and is the responsibility of the device or system manufacturer.



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3 Activation and control type

3.1 Control types

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

Note
For each control type or function, only one nominal size is illustrated, typically nominal size 165. Special applications and designs are not included in this chapter. Always use the information from the installation drawing provided or contact Liebherr.

The following applies to all control types:

DANGER
The spring-guided reset in the regulating valve is not a safety device!
Contaminants in the hydraulic system such as chips or residual dirt from parts of the device or system can cause blockages at undefined points of various control components.
Under some circumstances, the machine operator's specifications can no longer be implemented.
It is the device or system manufacturer's responsibility to install a safety device e.g. an emergency stop.

The following modular activation and control types can be ordered for the DMVA series:

3.1.1 Mechanical-hydraulic control

- HD- control, see chapter 3.3.1
- SD- control, see chapter 3.3.3
- SD-DA- control, see chapter 3.3.3 / see chapter 3.3.5
- ZH- control, see chapter 3.3.4

3.1.2 Electric-hydraulic control

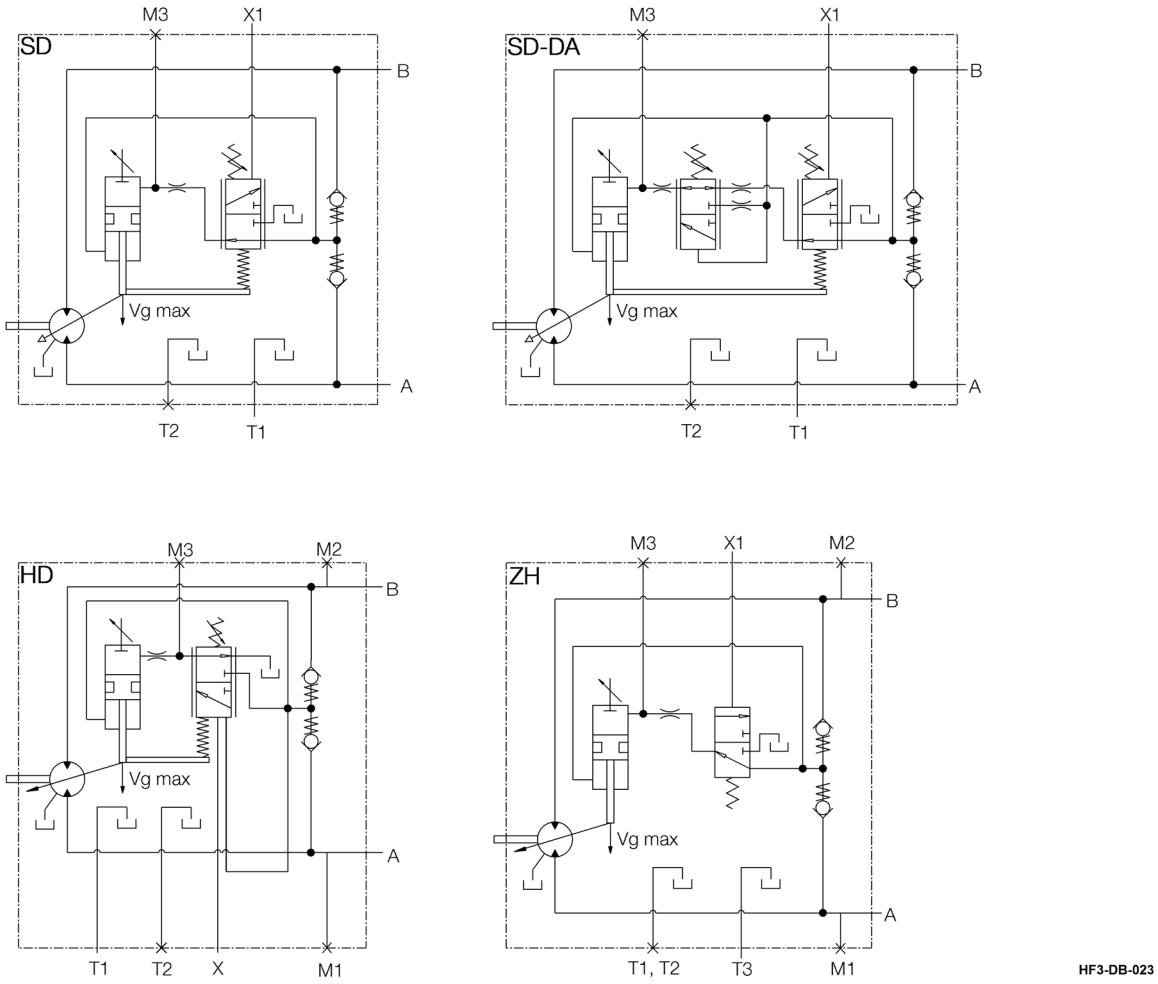
- EL- control, see chapter 3.3.6
- EL1- control, see chapter 3.3.7
- EL-DA- control, see chapter 3.3.6 / see chapter 3.3.5

Further control types on request.

3 Activation and control type

3.2 Standard hydraulic diagrams

3.2.1 Mechanical-hydraulic control

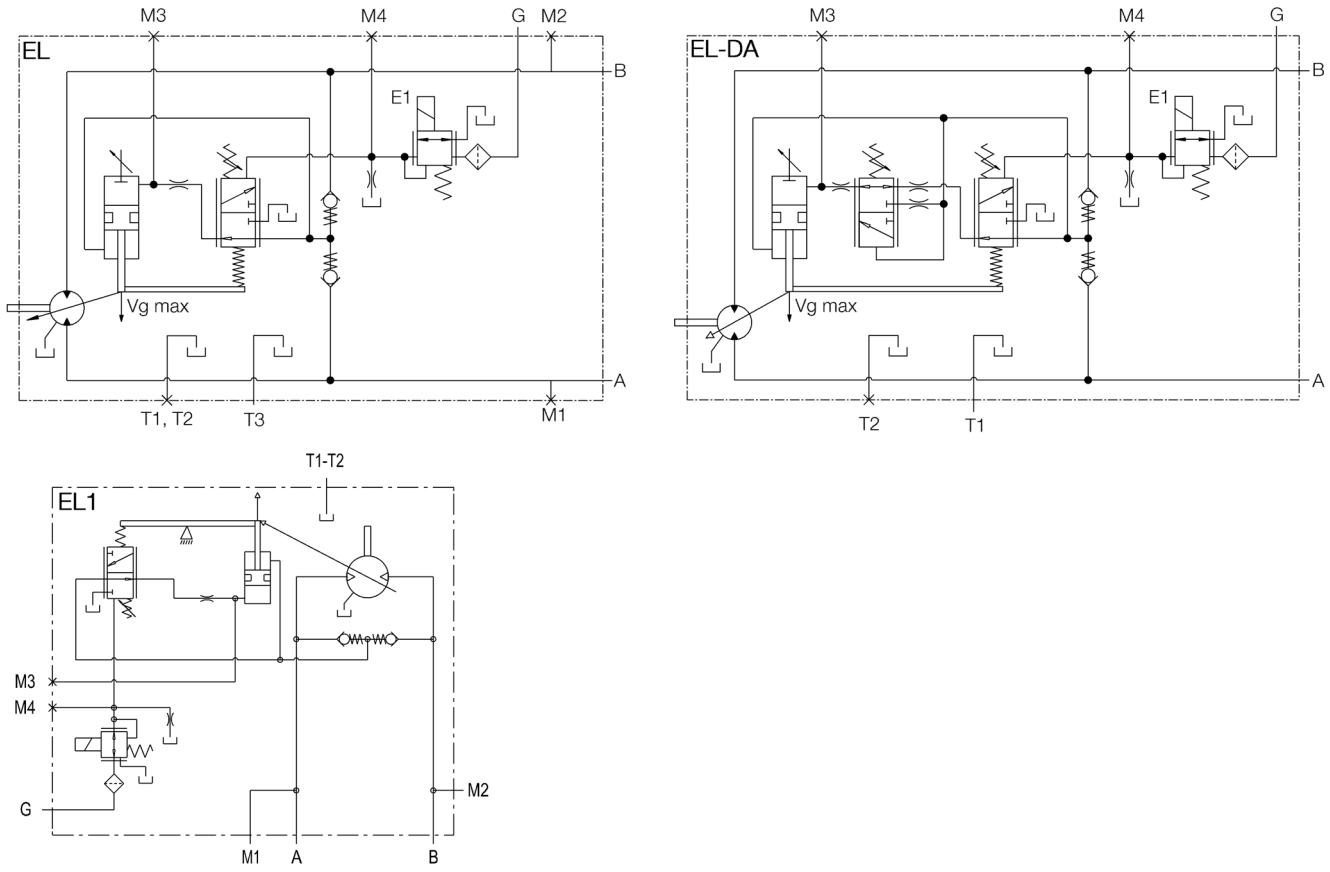


X1	Steering pressure connection ISO 9974-1	M1, M2	High pressure measuring connections ISO 9974-1
A, B	Working connections SAE J 518	M3	Adjusting pressure measuring connection ISO 9974-1
T1, T2, T3	Leakage oil connection ISO 9974-1	-	-

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

3 Activation and control type

3.2.2 Electric-hydraulic control



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A, B	Working connections SAE J 518	M3	Adjusting pressure measuring connection ISO 9974-1
T1, T2, T3	Leakage oil connection ISO 9974-1	E1	DRE plug-in terminal AMP junior Timer, 2P
G	Adjusting pressure supply ISO 9974-1	M4	Steering pressure measuring connection ISO 9974-1
M1, M2	High pressure measuring connections ISO 9974-1	-	-

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

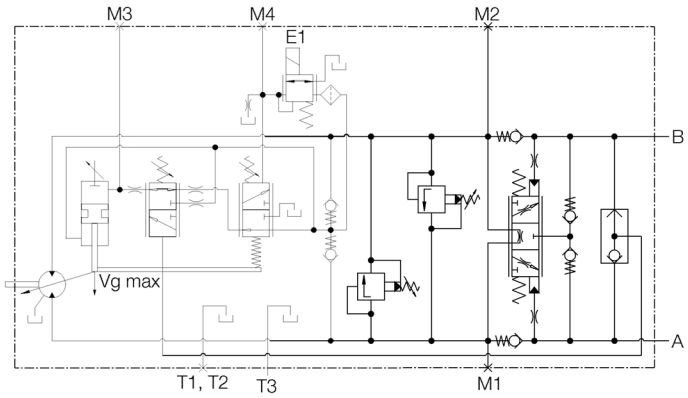
3 Activation and control type

3.2.3 Controls with brake valve (BV)

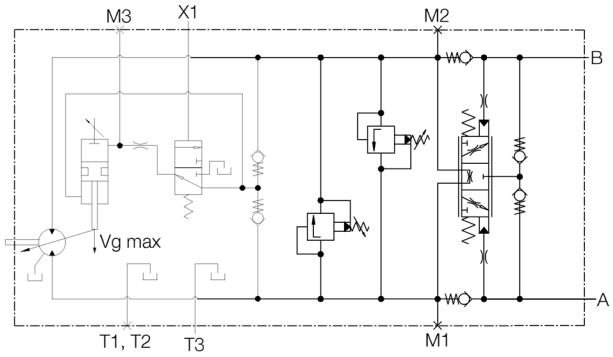
Note
With brake valve means:

Open circuit = flushing nozzle instead of flushing valve
Closed circuit = flushing valve

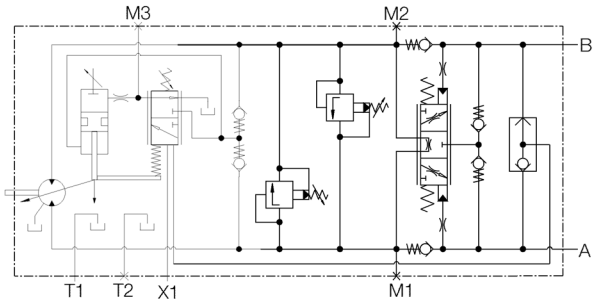
EL-DA- control with brake valve
SD-DA- control with brake valve



EL- control with brake valve
SD- control with brake valve
ZH- control with brake valve



HD- control with brake valve



HF3-DB-025

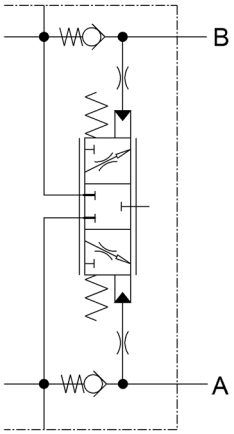
X1	Steering pressure connection ISO 9974-1	M1, M2	High pressure measuring connections ISO 9974-1
A, B	Working connections SAE J 518	M3	Adjusting pressure measuring connection ISO 9974-1
T1, T2, T3	Leakage oil connection ISO 9974-1	E1	DRE plug-in terminal AMP junior Timer, 2P
M4	Steering pressure measuring connection ISO 9974-1	-	-

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

3 Activation and control type

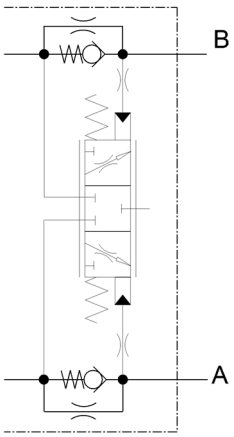
Brake valve options

Application-specific, without bypass



HF3-DB-026

Application-specific, with bypass in the non-return valve (cooling function)



HF3-DB-027

A, B	Working connections SAE J 518	-	-

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

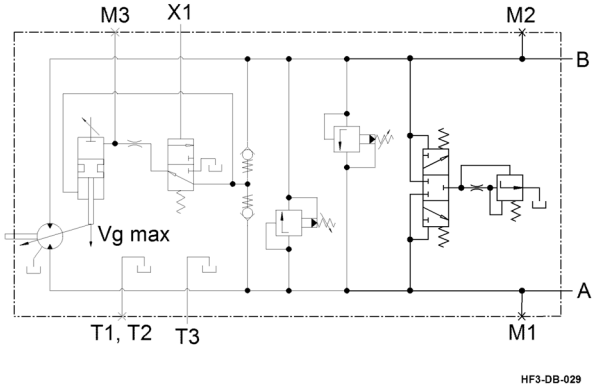
3 Activation and control type

3.2.4 Controls with flushing

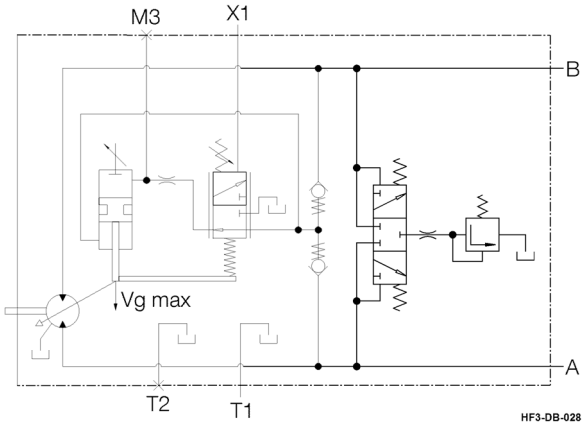
Note
For flushing:

Open circuit = only without brake valve
Closed circuit = flushing compulsory

Open circuit



Closed circuit



A, B	Working connections SAE J 518	M1, M2	High pressure measuring connections ISO 9974-1
T1, T2, T3	Leakage oil connection ISO 9974-1	M3	Adjusting pressure measuring connection ISO 9974-1
X1	Steering pressure connection ISO 9974-1	-	-

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

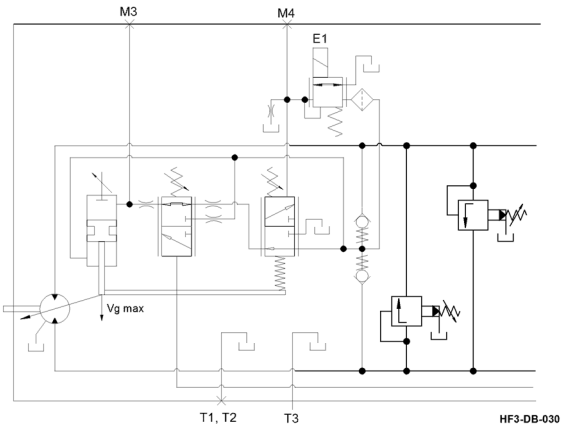
3 Activation and control type

3.2.5 Controls with secondary pressure limiting valve

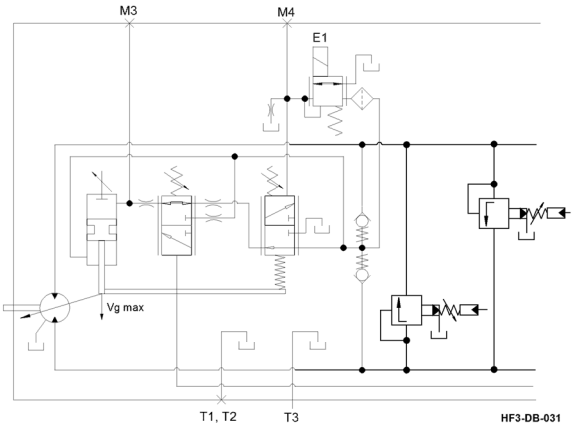
Note
The following applies for controls with a secondary pressure limiting valve:

Only in the open circuit.

Simple design



Design with activation stage



T1, T2, T3	Leakage oil connection ISO 9974-1	M3	Adjusting pressure measuring connection ISO 9974-1
M4	Steering pressure measuring connection ISO 9974-1	E1	DRE plug-in terminal AMP junior Timer, 2P

Note
Oil inlet at connection A: direction of rotation = anti-clockwise
Oil inlet at connection B: direction of rotation = clockwise

3 Activation and control type

3.3 Control functions

- HD- function / high-pressure-dependent hydraulic regulation, see chapter 3.3.1
- HD- override, see chapter 3.3.2
- SD- function / steering-pressure-proportional hydraulic regulation, see chapter 3.3.3
- ZH- function / hydraulically actuated regulation (two-position), see chapter 3.3.4
- DA- function / pressure control, see chapter 3.3.5
- EL- function / electro-proportional regulation (negative characteristic), see chapter 3.3.6
- EL1- function / electro-proportional regulation (positive characteristic), see chapter 3.3.7

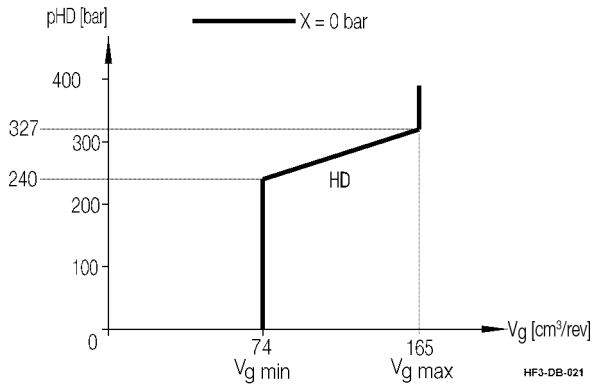
Note
The following applies to all control functions:

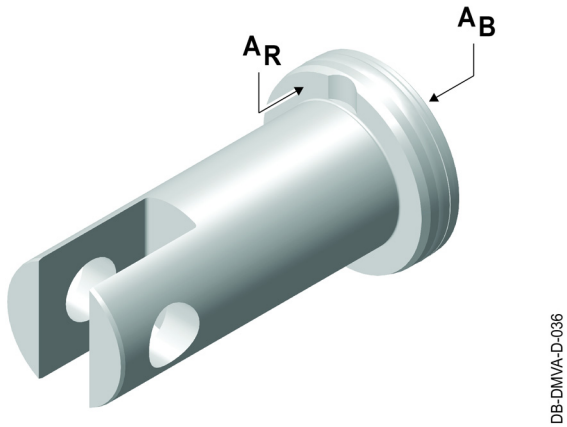
$V_{g\ min}$ = small torque “M” = high speed “n”
$V_{g\ max}$ = large torque “M” = low speed “n”

3.3.1 HD- function

In HD- control, the displacement V_g within the regulation range is proportionally dependent on the operating pressure pHD applied at the high-pressure connection A / B (provided by the hydraulic pump).

Characteristic





The high pressure connection A / B at the hydraulic motor is loaded with high pressure pHD of the hydraulic pump.

Up to a fixed value set at the $V_{g\ min}$ regulating screw, when regulation starts, e.g. 74 cm^3, the adjusting piston bottom area A_B is loaded with pReg = 0 bar and the adjusting piston ring area A_R is loaded with high pressure pHD.
The axial piston unit is swivelled to $V_{g\ min}$.

If pHD at the high pressure connection A / B exceeds the value when regulation starts, e.g. 240 bar, the regulating valve loads the adjusting piston bottom area A_B with pReg (approx. 1/2 pHD). If pReg x A_B is greater than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$, settling depending on the load.

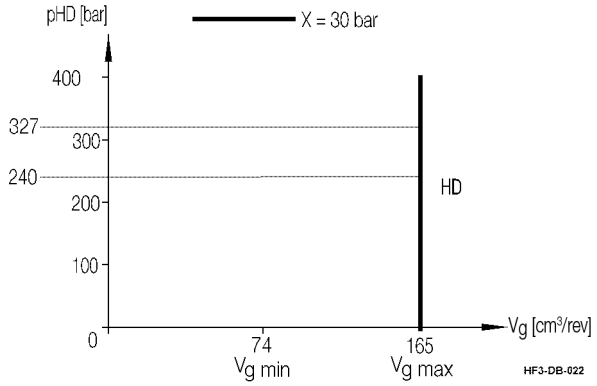
With a load of 0 bar at port X, the characteristic of the HD function is driven.

Optionally, the HD function can be oversteered.

3 Activation and control type

3.3.2 HD- override

Characteristic

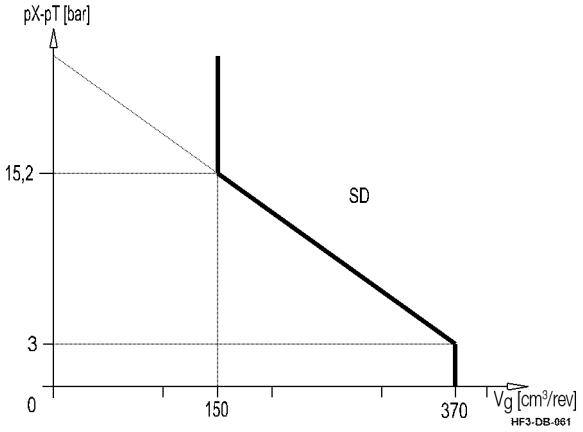


With the override function, port X is loaded with 30 bar. The axial piston unit swivels to $V_{g\ max}$, regardless of the high pressure pHD at connection A / B. The hydraulic motor therefore responds more sensitively with maximum torque.

3.3.3 SD- function (negative characteristic)

SD- control is suitable for applications which require a proportionally regulated displacement flow.

Characteristic



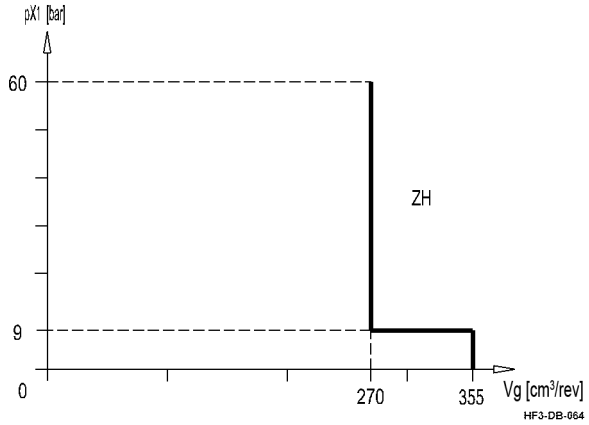
If the drive is adjusted from $V_{g\ max}$ towards $V_{g\ min}$, the axial piston unit swivels to a lower displacement V_g as the SD steering pressure at X1 increases.

If the activating signal at X1 is weakening, missing or defective, the axial piston unit swivels towards $V_{g\ max}$.

3 Activation and control type

3.3.4 ZH- function

Characteristic



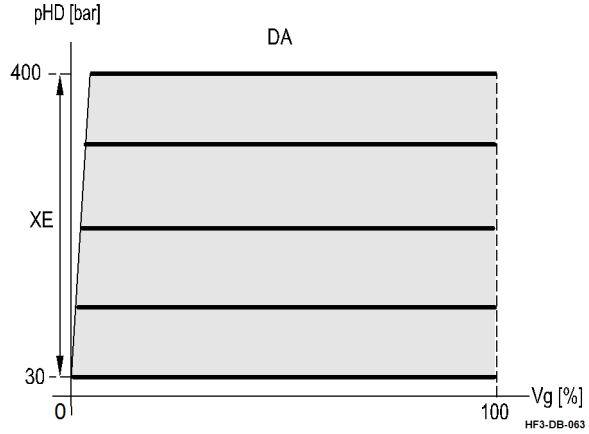
The hydraulically-operated two-point regulation adjusts the axial piston unit either to $V_{g\ max}$ or $V_{g\ min}$, realised by activating or deactivating the steering signal at port X1.

- Without steering signal, axial piston unit is at $V_{g\ max}$
- With steering signal, axial piston unit is at $V_{g\ min}$

3 Activation and control type

3.3.5 DA- function

Characteristic



The DA function regulates the displacement flow of the axial piston unit. The operating pressure is kept constant after reaching the setpoint, regardless of the torque on the driving shaft of the flange-mounted motor.

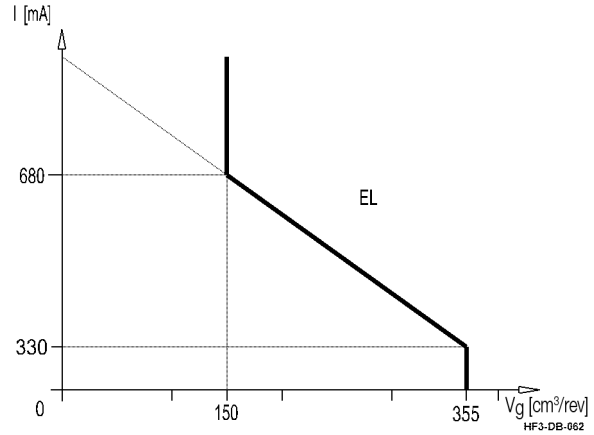
- As the output torque increases, the axial piston unit swivels towards $V_{g\ max}$ to keep the operating pressure constant.
- As the output torque decreases, the axial piston unit swivels towards $V_{g\ min}$ to keep the operating pressure constant.

Options
- Additional internal design measures for vibration damping on request.

3.3.6 EL- function (negative characteristic)

EL- control is suitable for applications which require a proportionally regulated displacement flow.

Characteristic



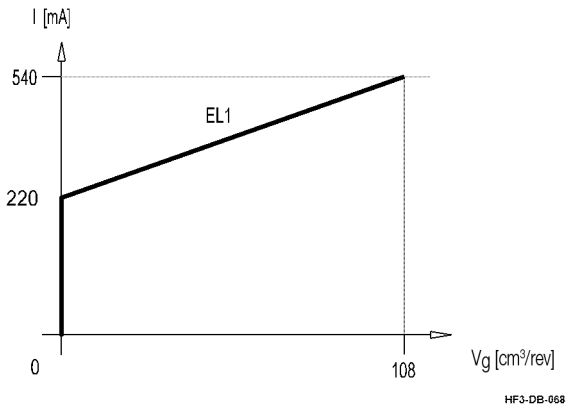
If the drive is adjusted from $V_{g\ max}$ towards $V_{g\ min}$, the axial piston unit swivels to a lower displacement V_g as the activating signal at E1 increases. If the activating signal at E1 is weakening, missing or defective, the axial piston unit swivels towards $V_{g\ max}$.

3 Activation and control type

3.3.7 EL1- function (positive characteristic)

EL- control is suitable for applications which require a proportionally regulated displacement flow.

Characteristic



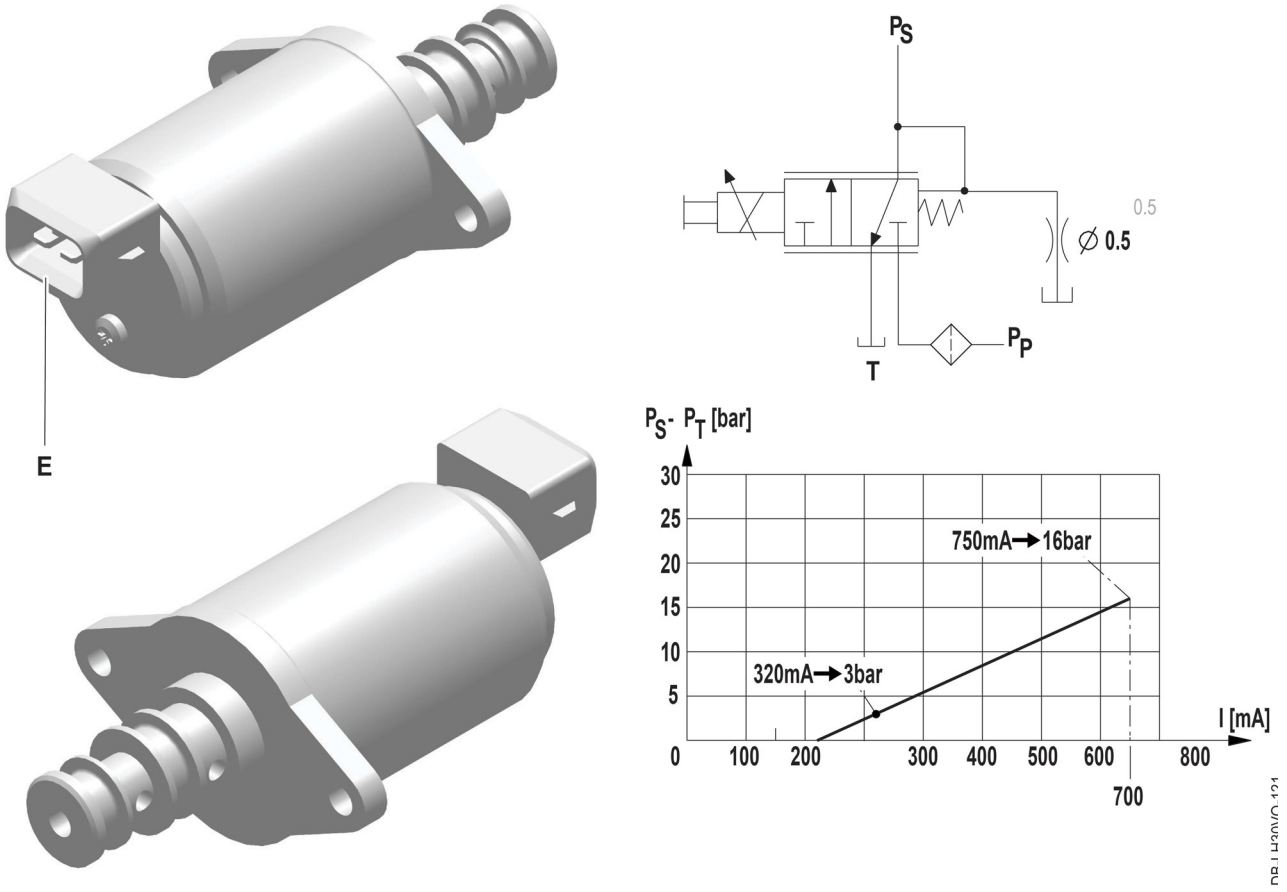
If the drive is adjusted from $V_{g\ min}$ towards $V_{g\ max}$, the axial piston unit swivels to a larger displacement V_g as the activating signal at E1 increases.

If the activating signal at E1 is weakening, missing or defective, the axial piston unit swivels towards $V_{g\ min}$.

3 Activation and control type

3.4 Electrical components

3.4.1 Pressure control valve (DRE) variant 1



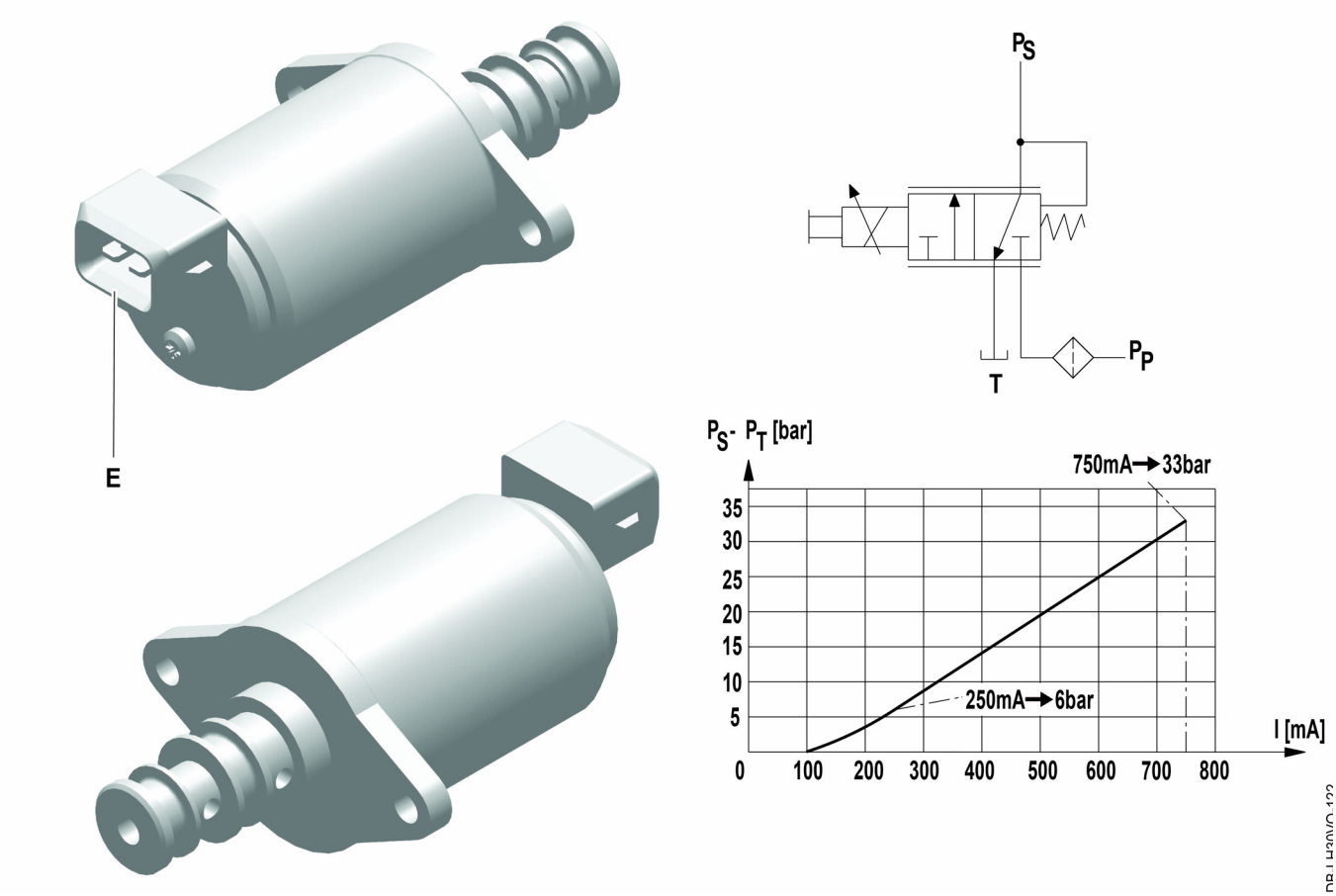
T	Tank	PS	Output DRE
PP	Input DRE	E	Connection AMP Junior Timer

General information

Technical data of pressure control valve	
Rated voltage U	24 V
Current $I_{max.}$	750 mA
Supply pressure $p_{max.}$	50 bar
Magnet characteristic curve: flat around the regulating position	-
AMP JUNIOR TIMER plug-in terminal, 2-pin	-

3 Activation and control type

3.4.2 Pressure control valve (DRE) variant 2



T	Tank	PS	Output DRE
PP	Input DRE	E	Connection AMP Junior Timer

General information

Technical data of pressure control valve	
Rated voltage U	24 V
Current $I_{max.}$	750 mA
Supply pressure $p_{max.}$	350 bar
Magnet characteristic curve: flat around the regulating position	-
AMP Junior Timer plug-in terminal	-

3 Activation and control type

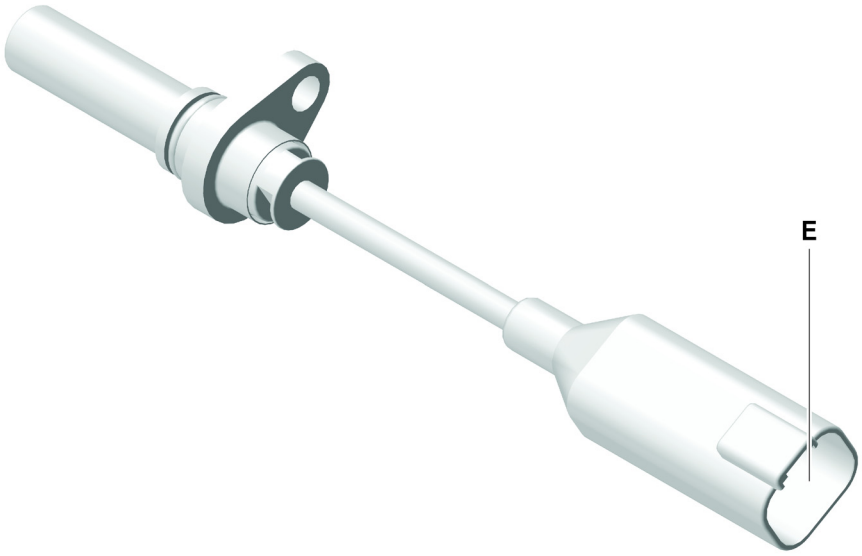
3.4.3 Sensors

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

0	Without sensor
D*	With speed sensor
W*	With rotation angle sensor

* can be combined, separated by hyphen, e.g.: D-W

Speed sensor



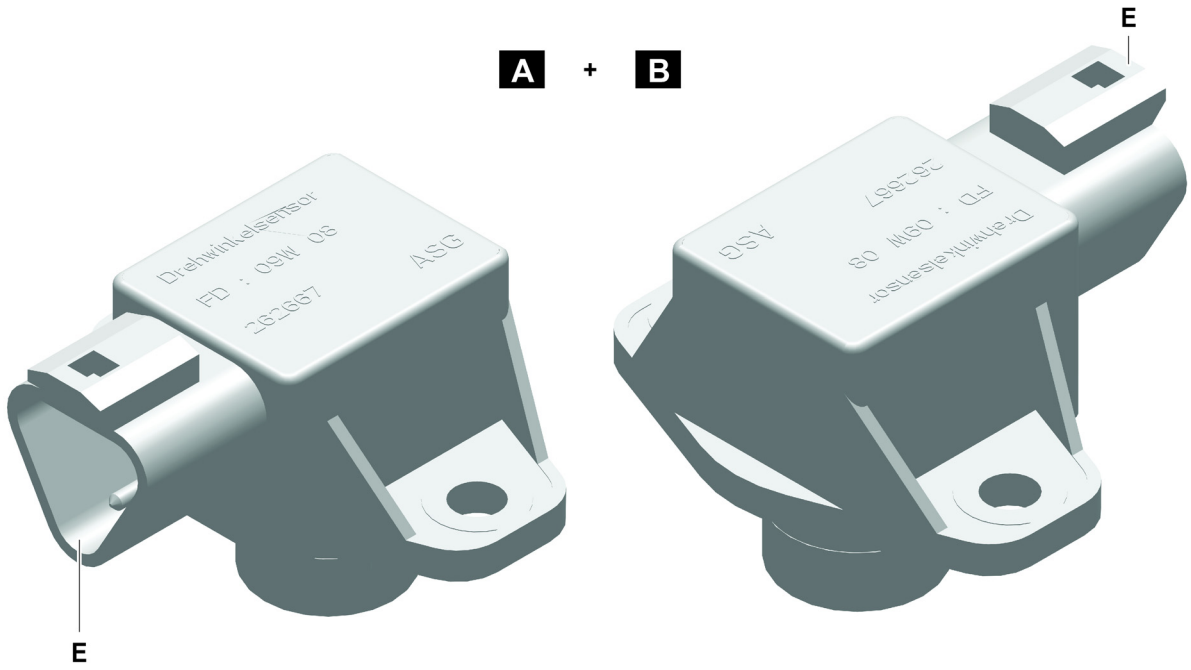
DB-V-003

Technical data			
Rated voltage U	8-32 V	Short-circuit resistance	Yes
Power consumption	<20 mA at 24 V	Reverse polarity protection	Yes up to max. 32 V
Wiring harness length	887 mm	Protection class Sensor side Plug side (connected)	ISO 20635 IP6K9K IP67
Frequency range	- 0 to 20 kHz	Maximum pressure onto active surface	10 bar
Plug-in terminal E	Deutsch DT04-4P	Air gap, minimum/maximum	0.3/2.0 mm
$Current_{max.}$	40 mA	-	-

Note
The speed sensor cannot be retrofitted and must be included in the reconfiguration of the DMVA.

3 Activation and control type

Rotation angle sensor



Technical data			
Option A		**Option B**	
Rated voltage U	5 V	Rated voltage U	8-30V
Measuring range	-27° to +27°	Measuring range	-27° to +27°
Output signal -27° 0° +27°	 0.5 V 2.5 V 4.5 V	Output signal -27° 0° +27°	 4 mA 12 mA 20 mA
Working temperature	-40 °C to +125 °C	Working temperature	-40 °C to +85 °C
Deutsch DT04-3P electrical plug-in terminal			

Note
The angle sensor cannot be retrofitted and must be included when planning the DMVA project.
Dimensions for variant A and B are identical; specify desired variant when ordering.

4 Installation conditions

4.1 General information about project planning

The installation variant for the device or system must be coordinated with Liebherr, as well as the installation position, at the conceptual design stage of the axial piston unit and must be approved by Liebherr.

ATTENTION
Damage of the hydraulic product.
Lack of lubrication on the hydraulic product!
Make sure that the following requirements are observed:
- Comply with the approved installation positions for the hydraulic product.
- For other installation positions, contact Liebherr customer service.
- Housing is completely filled with hydraulic fluid during commissioning and operation.
- Housing is vented after commissioning and during operation.

Liebherr distinguishes between two installation variants for axial piston units:

A: Under-the-tank installation (axial piston unit is installed **under** the minimum liquid level of the tank)
B: Over-the-tank installation (axial piston unit is installed **above** the minimum liquid level of the tank)

Liebherr distinguishes between two installation positions for axial piston units:

1/3/5/7/9/11: Driving shaft horizontal
2/4/6/8/10/12: Driving shaft vertical

Note
Liebherr recommends:
Installation variant: Under-the-tank installation A
Installation location: 1/3/5/7/9/11 Driving shaft horizontal with "control at top"

*)For installation positions 2/4/6/8 with driving shaft vertical and 1/3/5/7 with driving shaft horizontal with "control at bottom", complete filling and venting is critical. The axial piston unit must then be connected, filled and vented before final positioning in installation position 1/3/5/7/9 "control at top".
It can then be rotated to the final installation position 2/4/6/8 driving shaft vertical or 1/3/5/7 driving shaft horizontal with "control at bottom".

On some axial piston units, an additional T4 leakage oil connection is provided for the installation positions 2/4/6/8 driving shaft vertical and 1/3/5/7 driving shaft horizontal with control at bottom: Order leakage oil connection T4 as special design. (for additional information see: 1 Type code, Page 3)

4.1.1 Leakage oil lines

To prevent draining of the axial piston unit during long downtimes, the leakage oil line must be routed in a bend so that it runs at the minimum dimension Ü1 = 30 mm above the highest possible level of the axial piston unit. This applies in particular to installation variant B: over-the-tank installation.

Connect the leakage oil line to the top leakage oil connection T1, T2, T3....Tx depending on the installation position.

The leakage oil line must open into the tank at a minimum distance of 115 mm from the tank bottom to prevent stirring up dirt particles in the tank.

The leakage oil line must open into the tank at a minimum distance of 250 mm below the minimum liquid level to prevent foaming in the tank.

4 Installation conditions

At low temperatures with high viscosities, it is essential to observe the maximum housing pressure for axial piston units with multiple driving gears and with a shared leakage oil line. (for additional information see: 2.3.2 Housing, leakage oil pressure, Page 8) If the maximum housing pressure is outside the tolerance limit, a separate leakage oil line must be connected for each driving gear.

4.1.2 Hydraulic fluid tank

Design the hydraulic fluid tank so that the hydraulic oil cools off sufficiently during circulation and impurities that develop during operation settle to the bottom of the tank.

Make sure that the lines are connected according to recommendations and that they open into the hydraulic fluid tank. (for additional information see: 4.1.1 Leakage oil lines, Page 33)

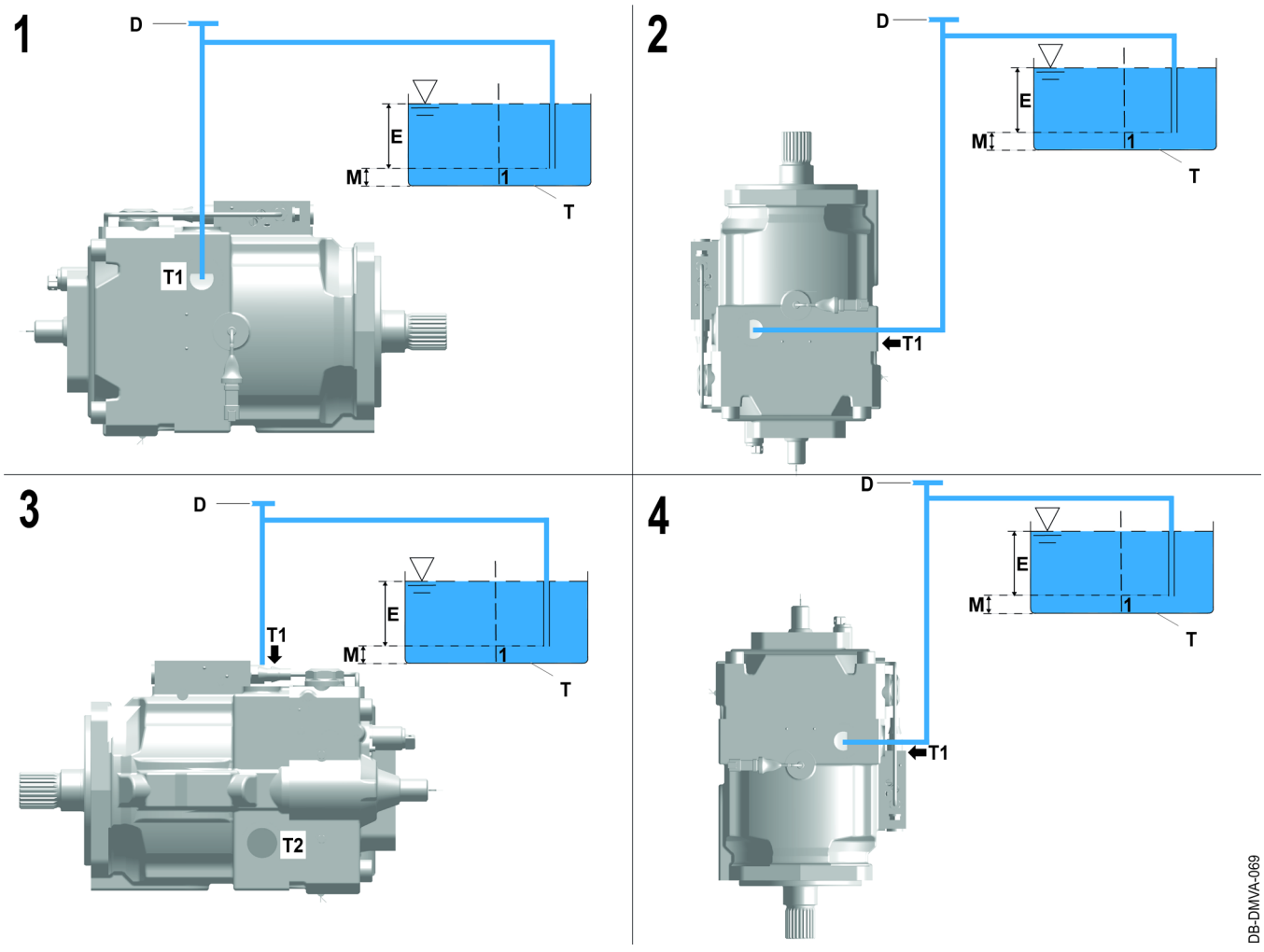
4 Installation conditions

4.2 Installation variants

Note
When using the DMVA in a "closed circuit", the installation variant is irrelevant due to the missing tank.

4.2.1 Under-the-tank installation variant

Note
Liebherr recommends: Under-the-tank installation A, so that:
- The housing cannot empty to the tank.



1	Baffle (to calm the hydraulic fluid in the tank)	M	Minimum line end distance from tank bottom = 115 mm
D	Fill and vent connection (external, not included in scope of delivery)	T–	Leakage oil connections T1 / T2 / T3 / T4 (T4 = optional)
E	Minimum immersion depth = 250 mm	T	Tank

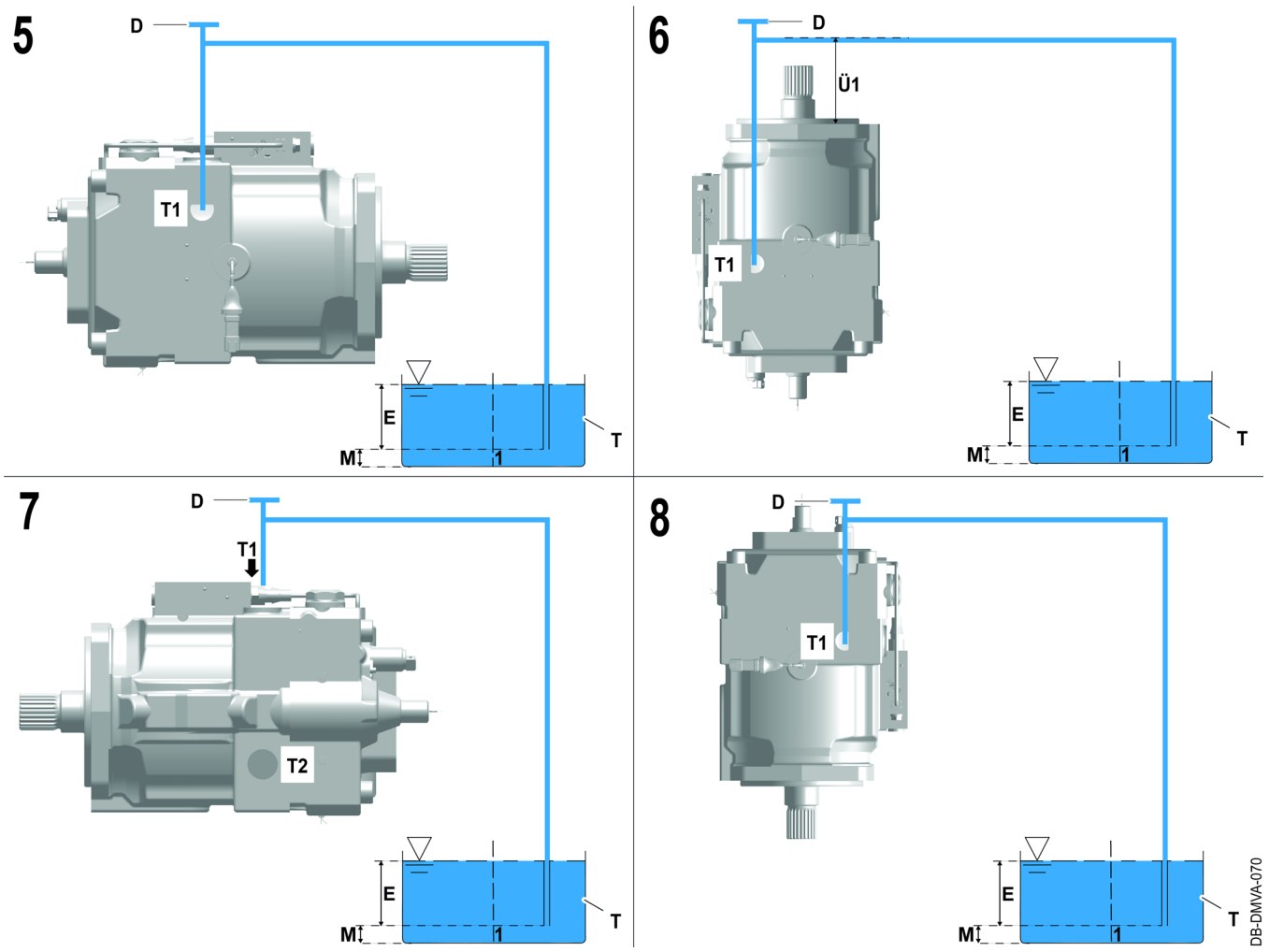
4 Installation conditions

4.2.2 Over-the-tank installation variant

ATTENTION
Damage of the hydraulic product.
The air cushion in the bearing area or on the rotary shaft lip seal “runs hot” in over-the-tank installation position (installation variant B)! Make sure that the following requirements are observed:

- Housing is completely filled with hydraulic fluid during commissioning and operation.
- Housing is vented after commissioning and during operation.

Note
To prevent draining of the axial piston unit during long shutdowns, the leakage oil line must be routed in a bend so that it runs at the minimum dimension Ü1 = 30 mm above the highest possible level of the axial piston unit.



1	Baffle (to calm the hydraulic fluid in the tank)	M	Minimum line end distance from tank bottom = 115 mm
E	Minimum immersion depth = 250 mm	T_	Leakage oil connections T1 / T2 / T3 / T4 (T4 = optional)

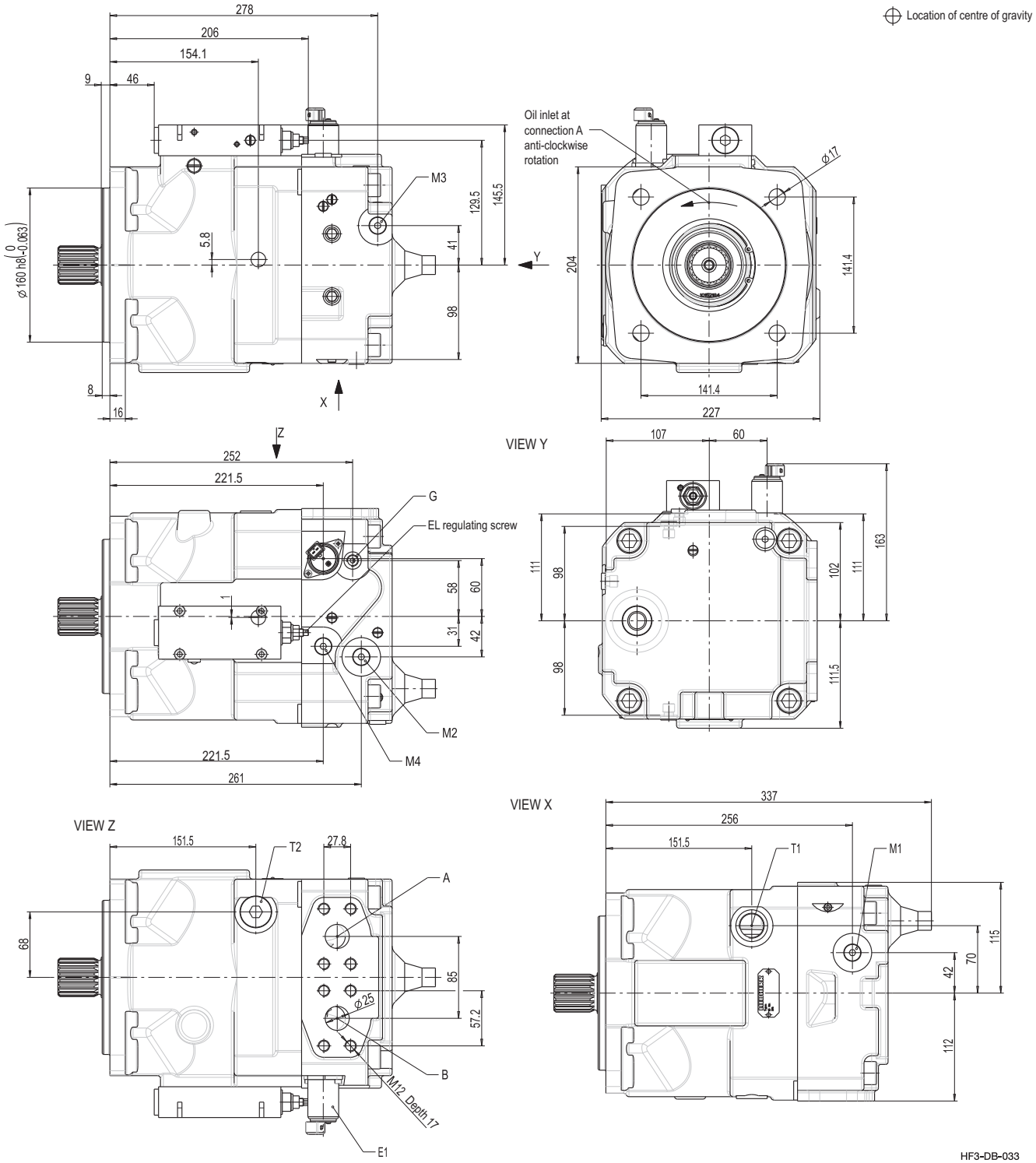
4 Installation conditions

D	Fill and vent connection (external, not included in scope of delivery)	T	Tank
Ü1	Minimum leakage oil line height = 30 mm	-	-

5 Dimensions

5.1 Nominal size 108

5.1.1 Nominal size 108, control type EL / EL1



A / B	Working connection SAE J518-1“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5

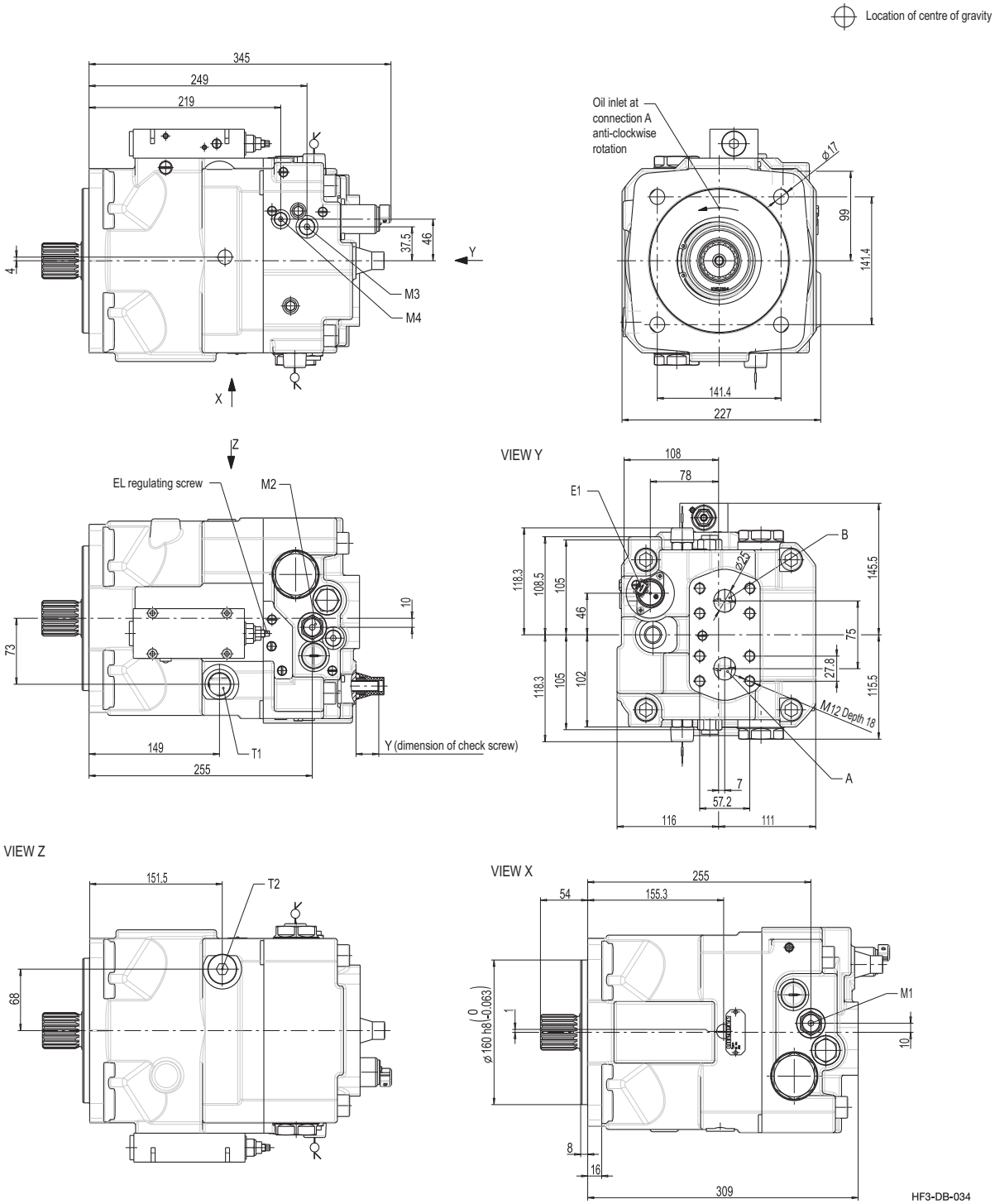
M4	Steering pressure meas. connection ISO 9974-1, M12x1.5
G	Adjusting pressure supply ISO 9974-1, M12x1.5

5 Dimensions

E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA
M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5

M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
-	-

5.1.2 Nominal size 108, control type EL-DA with brake valve



A / B	Working connection SAE J518-1“, 6000 psi

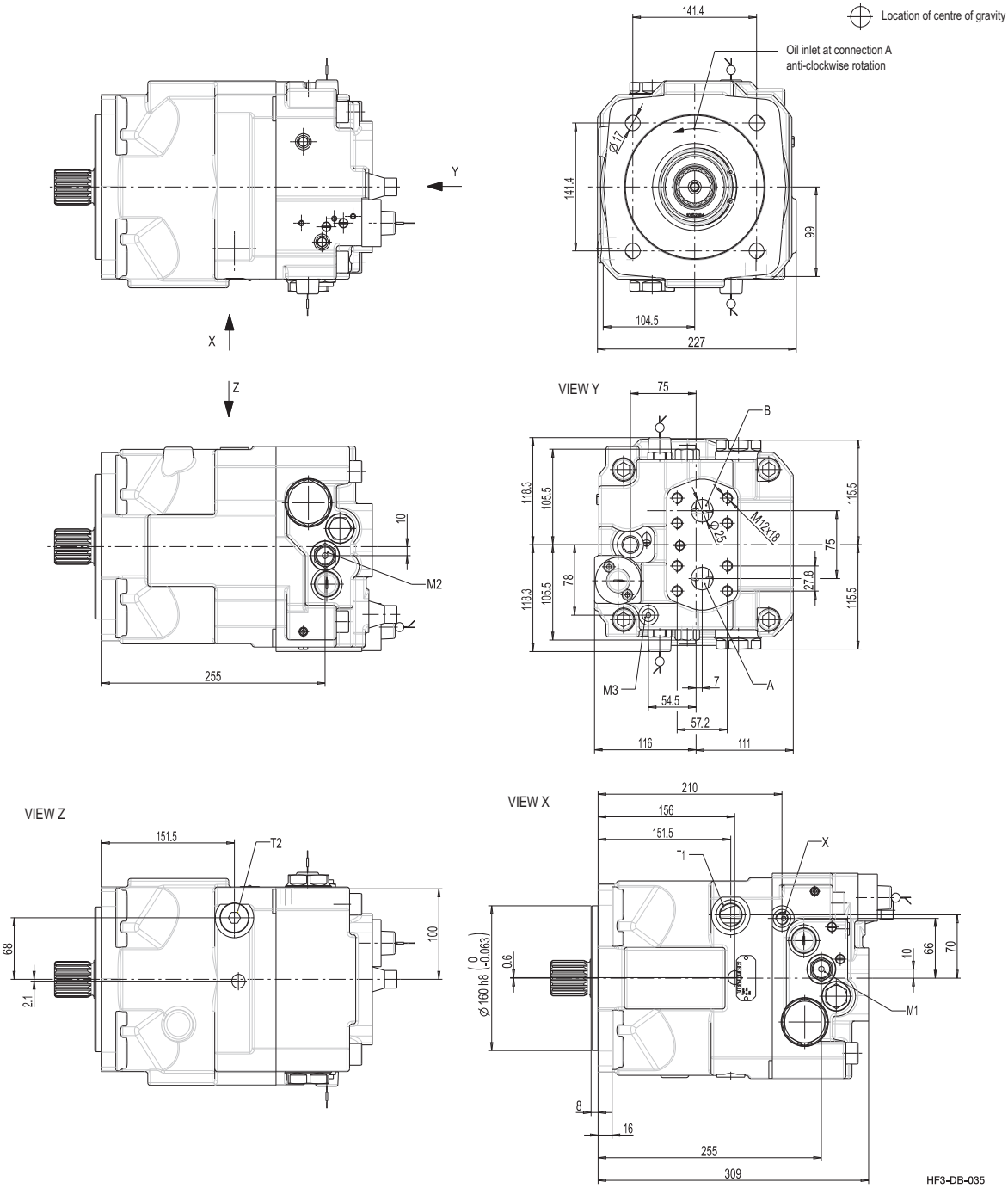
M4	Steering pressure meas. connection ISO 9974-1, M10x1

5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5
E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA

M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5
M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

5.1.3 Nominal size 108, control type HD with brake valve



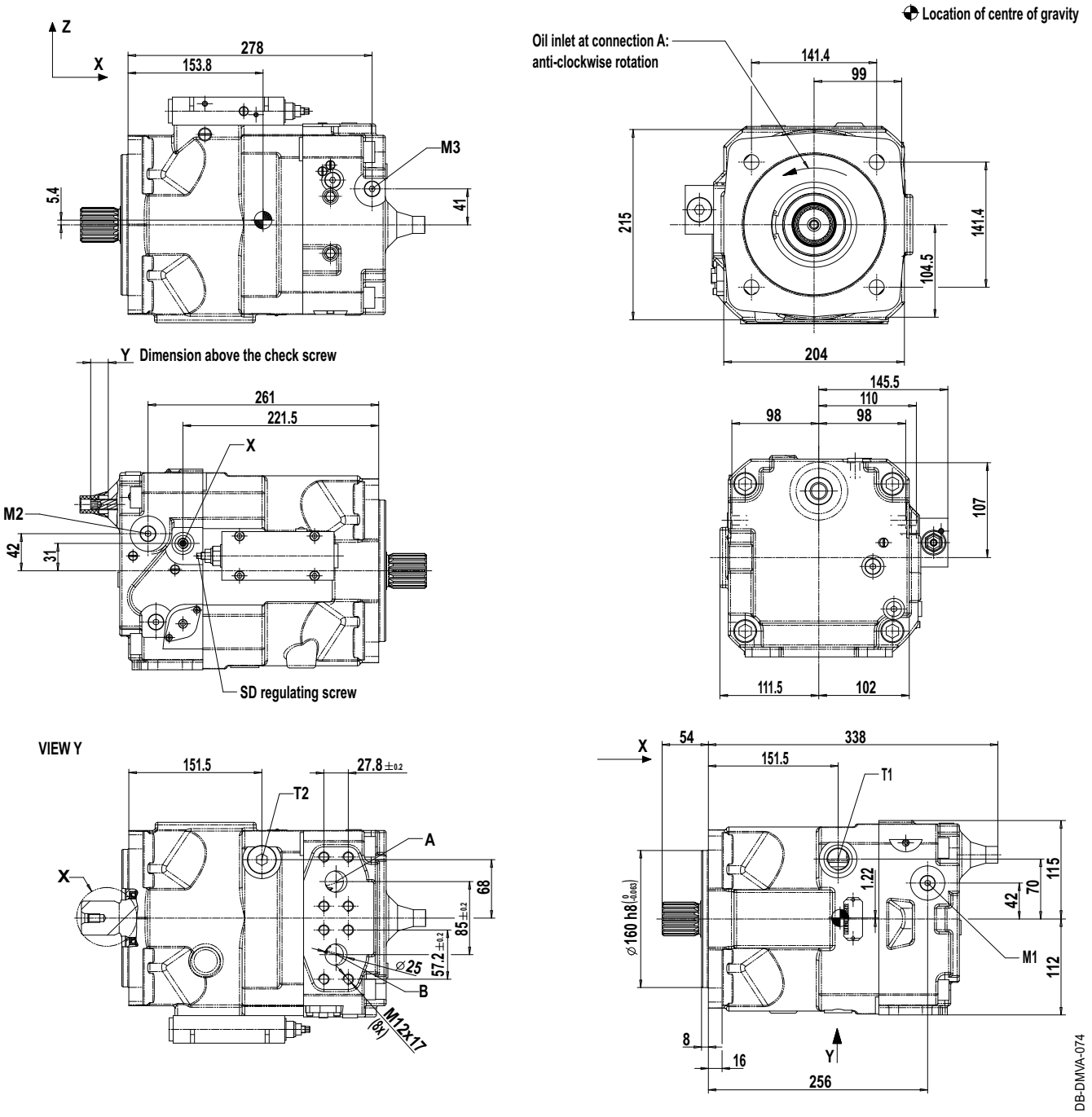
A / B	Working connection SAE J518-1“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5

M3	Adjusting pressure meas. connection ISO 9974-1, M10x1
X	Steering pressure connection ISO 9974-1, M14x1.5

5 Dimensions

M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5	-	-

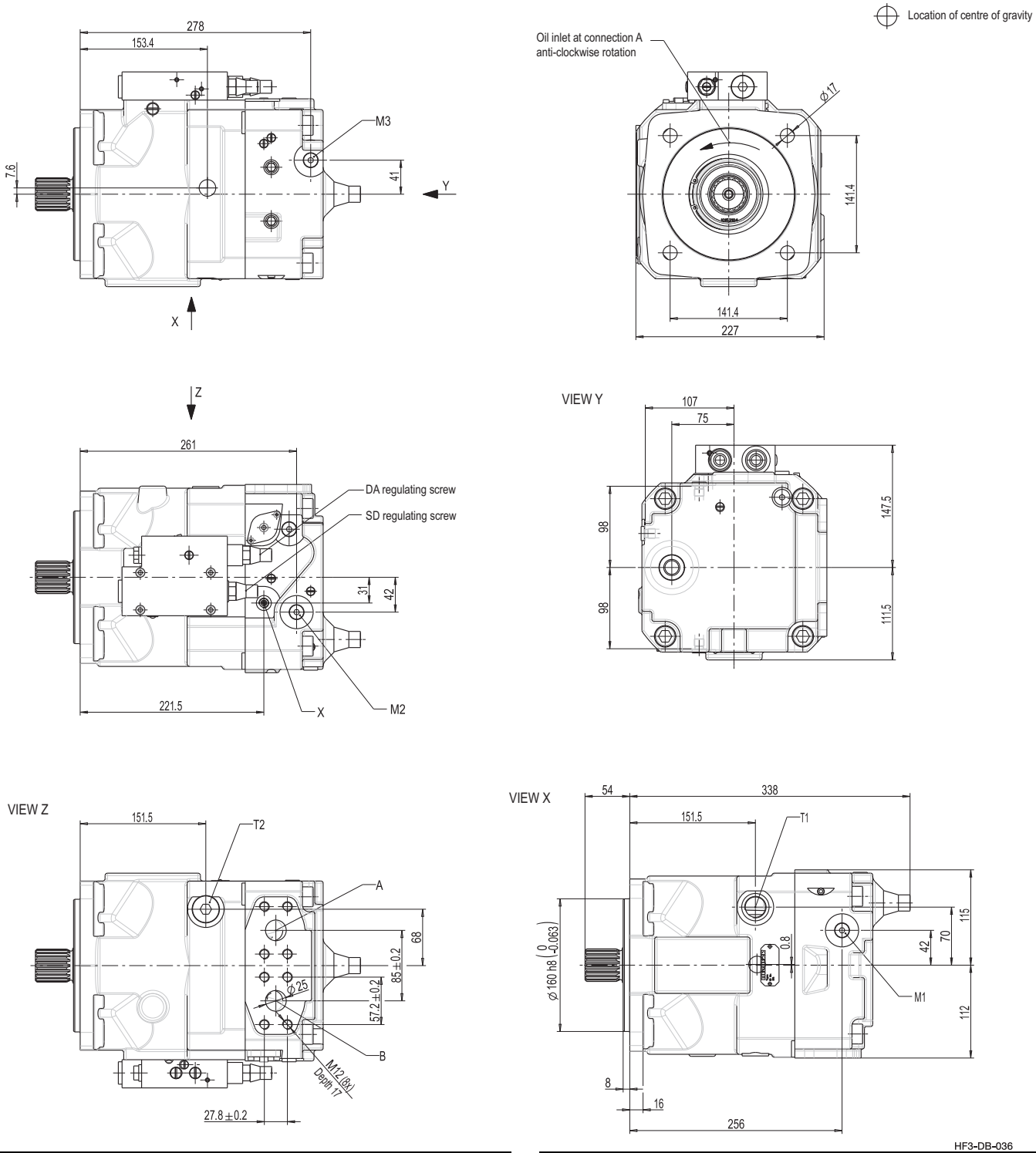
5.1.4 Nominal size 108/SD control



A / B	Working connection SAE J518-1“, 6000 psi	M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5	X	Steering pressure connection ISO 9974-1, M12x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5	-	-

5 Dimensions

5.1.5 Nominal size 108/SD-DA control



A / B	Working connection SAE J518-1“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5

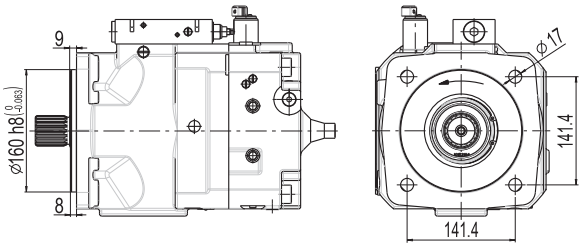
M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
X	Steering pressure connection ISO 9974-1, M12x1.5
-	-

5 Dimensions

5.2 Nominal size 108, mounting flange

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

ISO 3019-2



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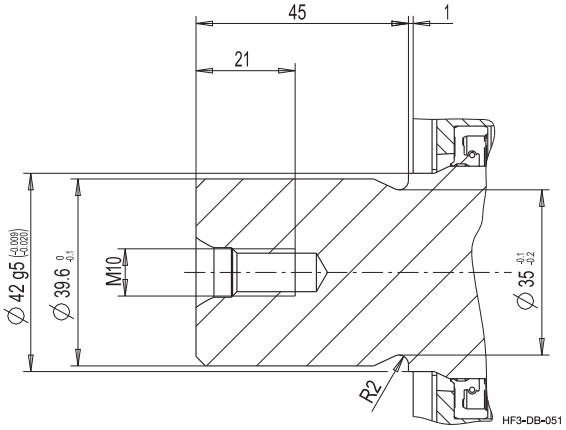
5.3 Nominal size 108, shaft end

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

DIN 5480 splined shaft W40x2x18x9g



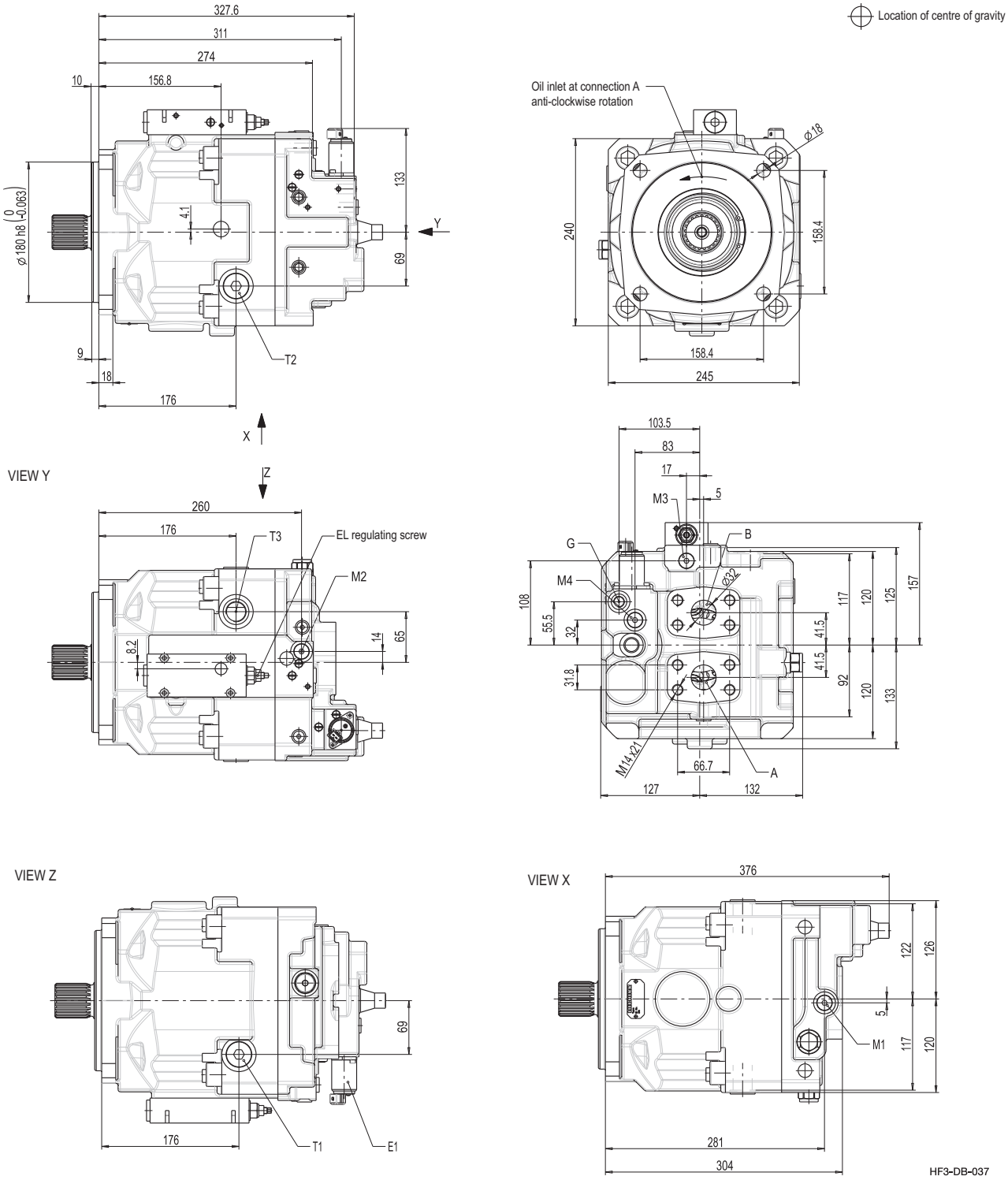
HF3-DB-051

1

5 Dimensions

5.4 Nominal size 165

5.4.1 Nominal size 165, control type EL



E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA
A / B	Working connection SAE J518-1 1/4“, 6000 psi

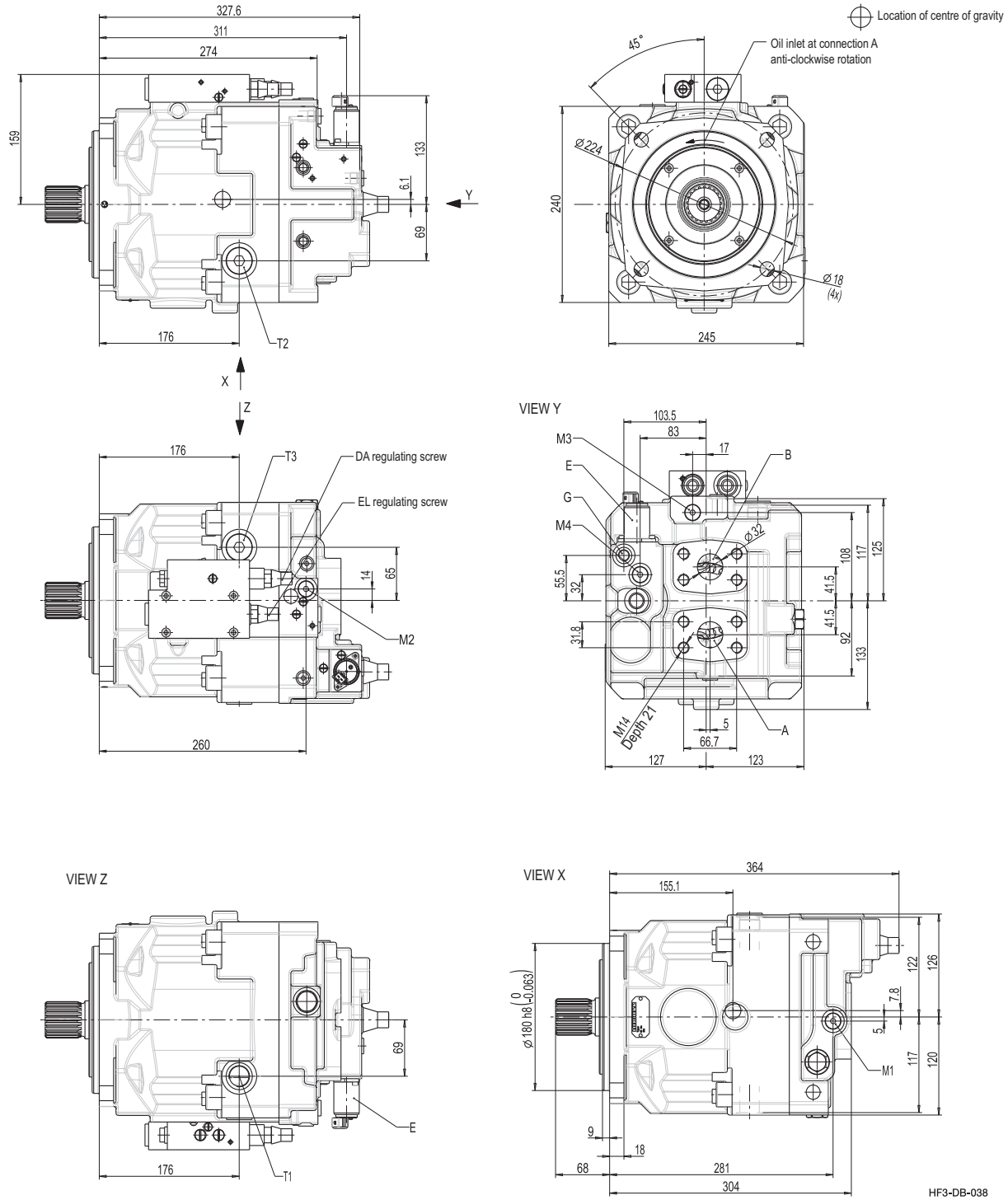
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5
M4	Steering pressure meas. connection ISO 9974-1, M14x1.5

5 Dimensions

T1/T2/T3	Leakage oil connection ISO 9974-1, M26x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5

G	Adjusting pressure supply ISO 9974-1, M14x1.5
-	-

5.4.2 Nominal size 165, control type EL-DA



A / B	Working connection SAE J518-1 1/4“, 6000 psi

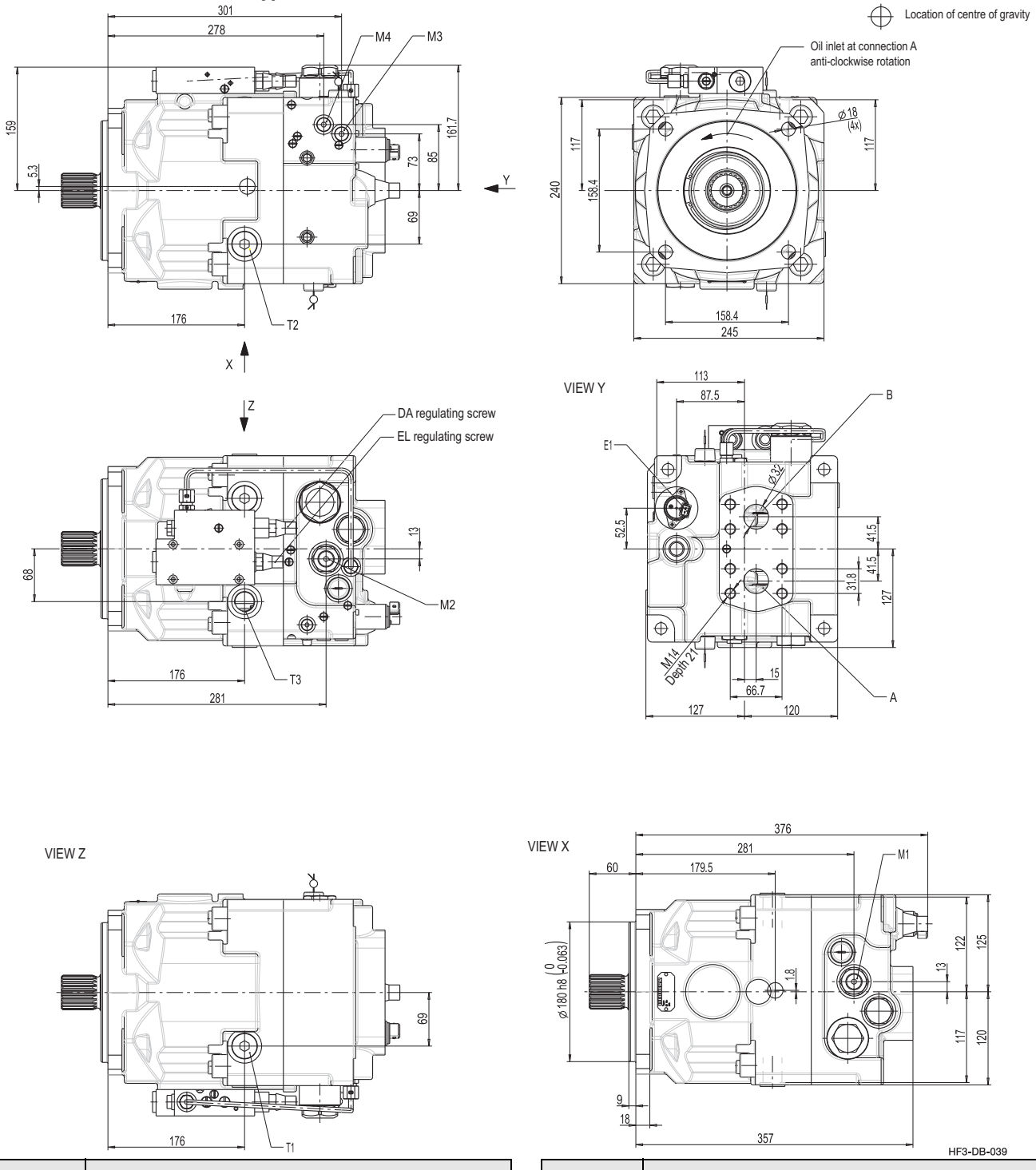
M4	Steering pressure meas. connection ISO 9974-1, M10x1

5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5
E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA

M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5
M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

5.4.3 Nominal size 165, control type EL-DA with brake valve



A / B	Working connection SAE J518-1 1/4“, 6000 psi

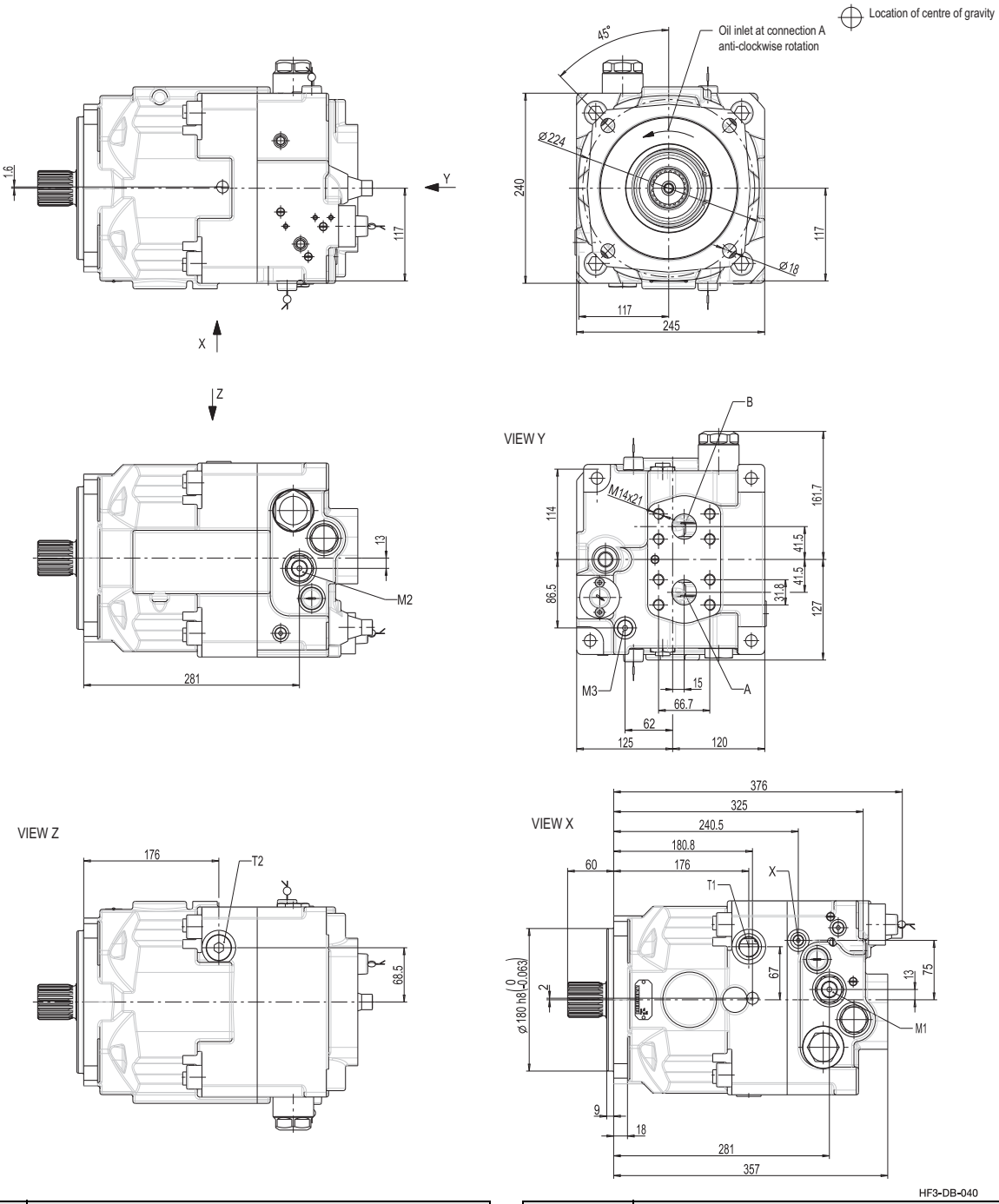
M4	Steering pressure meas. connection ISO 9974-1, M12x1.5

5 Dimensions

T1/T2/T3	Leakage oil connection ISO 9974-1, M26x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5
E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA

-	-
-	-
M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

5.4.4 Nominal size 165, control type HD with brake valve



A / B	Working connection SAE J518-1 1/4“, 6000 psi

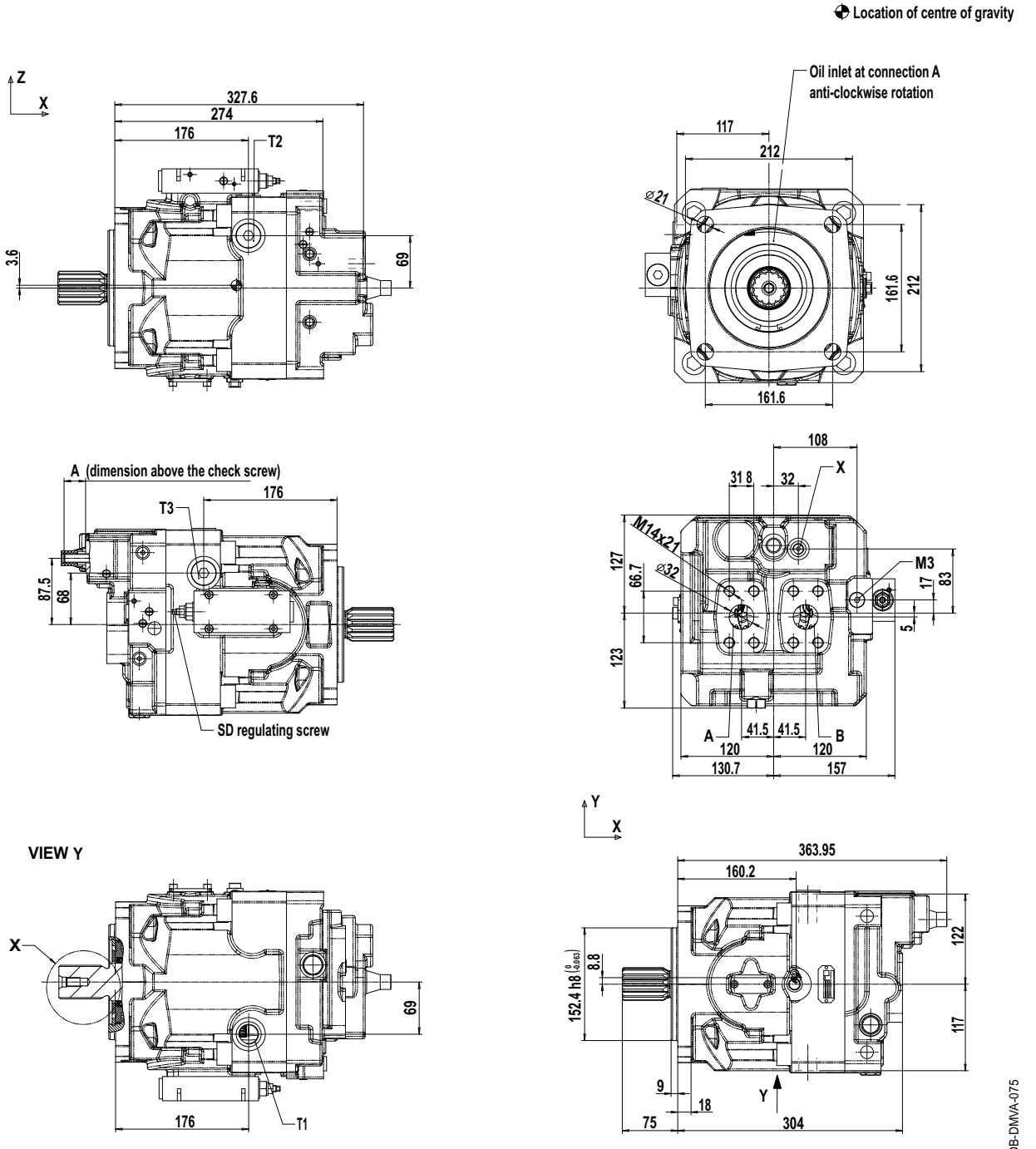
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5

5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5

X	Steering pressure connection ISO 9974-1, M14x1.5
-	-

5.4.5 Nominal size 165 / SD control

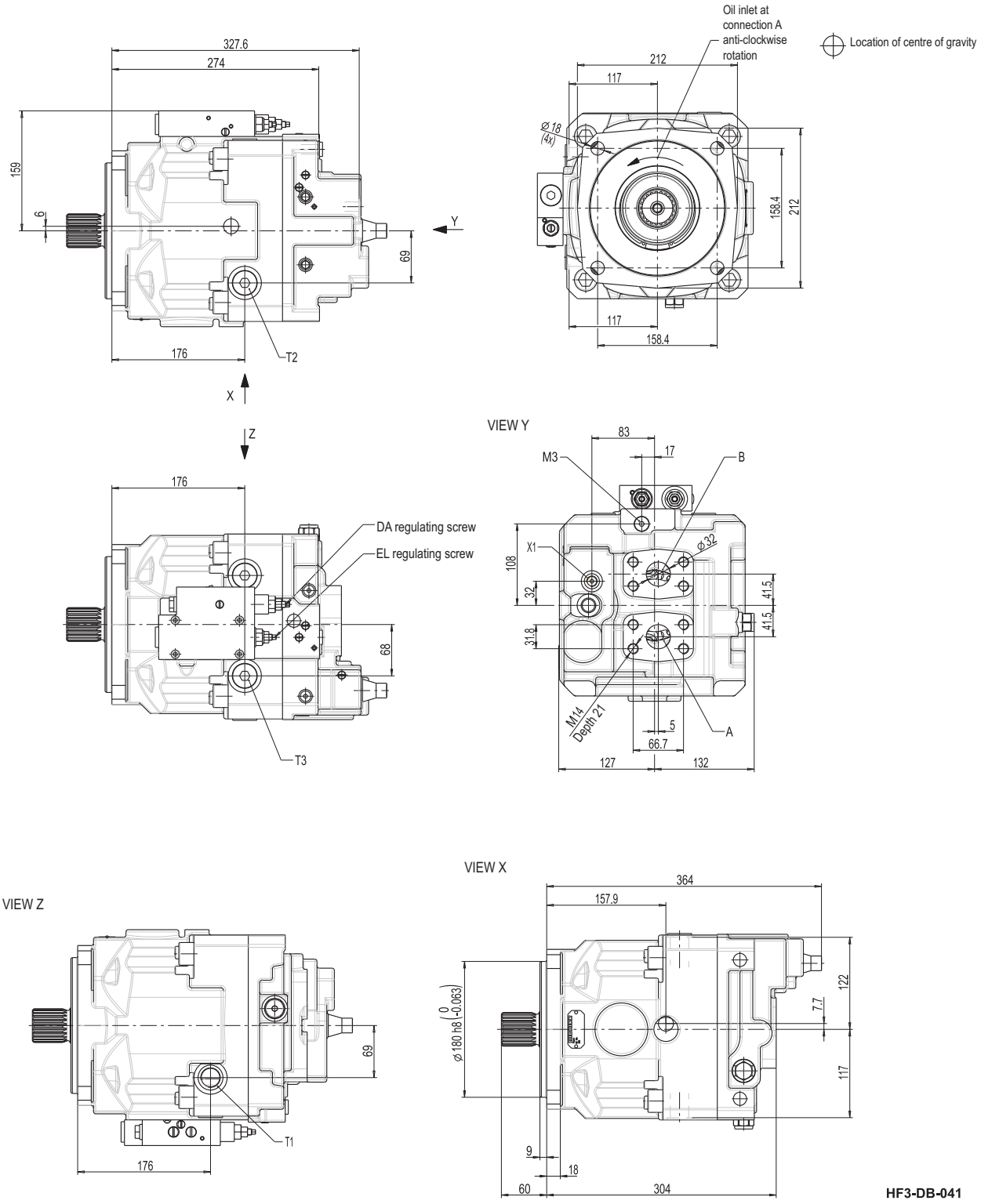


A / B	Working connection SAE J518-1“, 6000 psi
T1/T2/T3	Leakage oil connection ISO 9974-1, M26x1.5

M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
X	Steering pressure connection ISO 9974-1, M12x1.5

5 Dimensions

5.4.6 Nominal size 165, control type SD-DA



A / B	Working connection SAE J518-1 1/4“, 6000 psi
T1/T2/T3	Leakage oil connection ISO 9974-1, M26x1.5

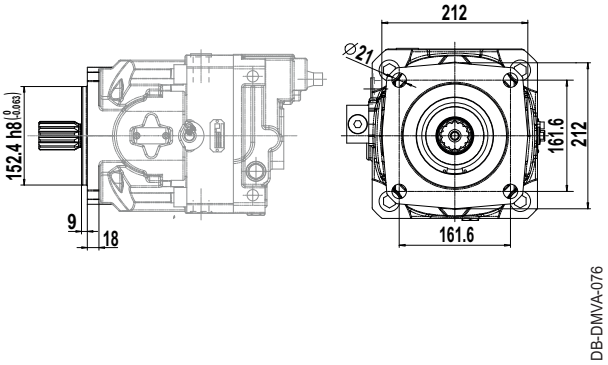
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5
X1	Steering pressure connection ISO 9974-1, M14x1.5

5 Dimensions

5.5 Nominal size 165, mounting flange

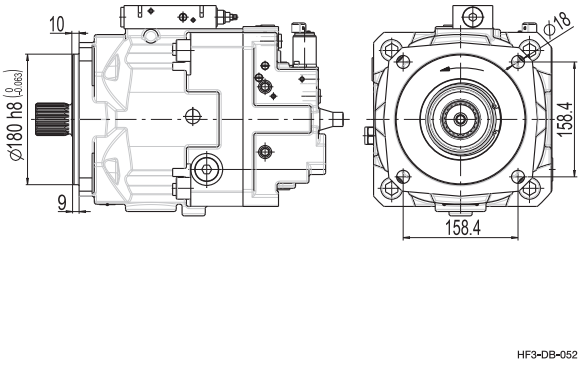
DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

SAE D (SAE J744)



24

ISO 3019-2

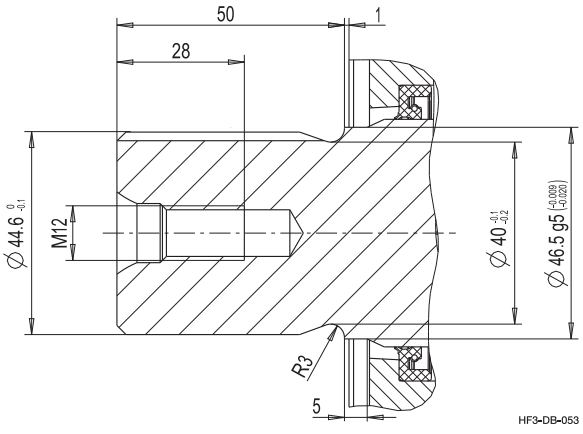


31

5.6 Nominal size 165, shaft end

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

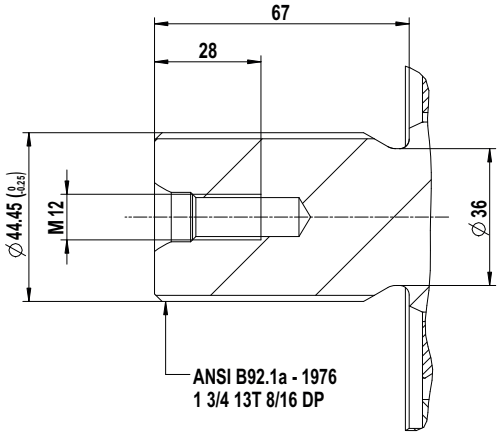
DIN 5480 splined shaft W45x2x21x9g



1

5 Dimensions

ANSI B92.1a splined shaft 1 3/4 in 13T 8/16DP



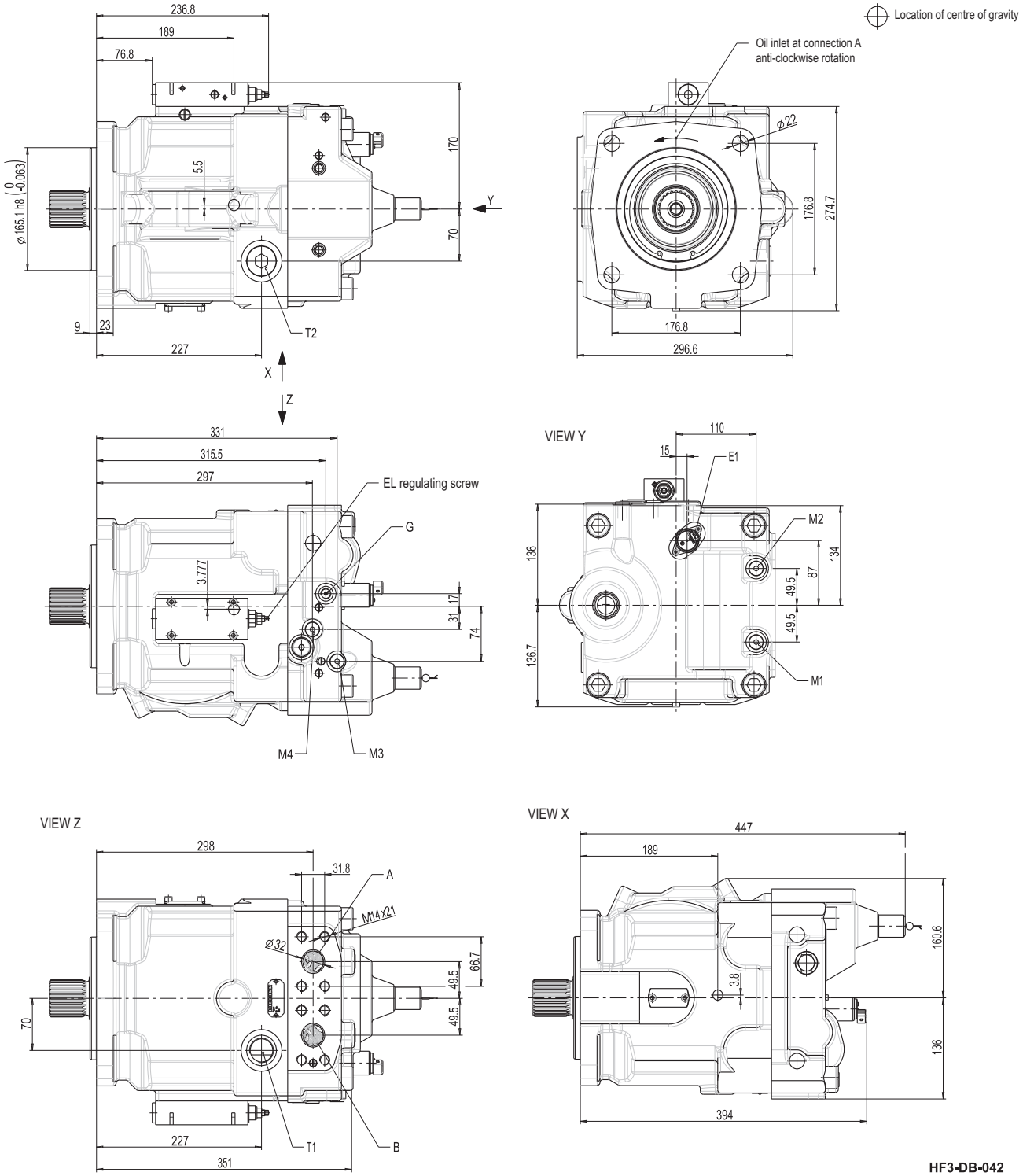
DB-DMVA-077

2

5 Dimensions

5.7 Nominal size 215

5.7.1 Nominal size 215, control type EL



E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA
A / B	Working connection SAE J518-1 1/4“, 6000 psi

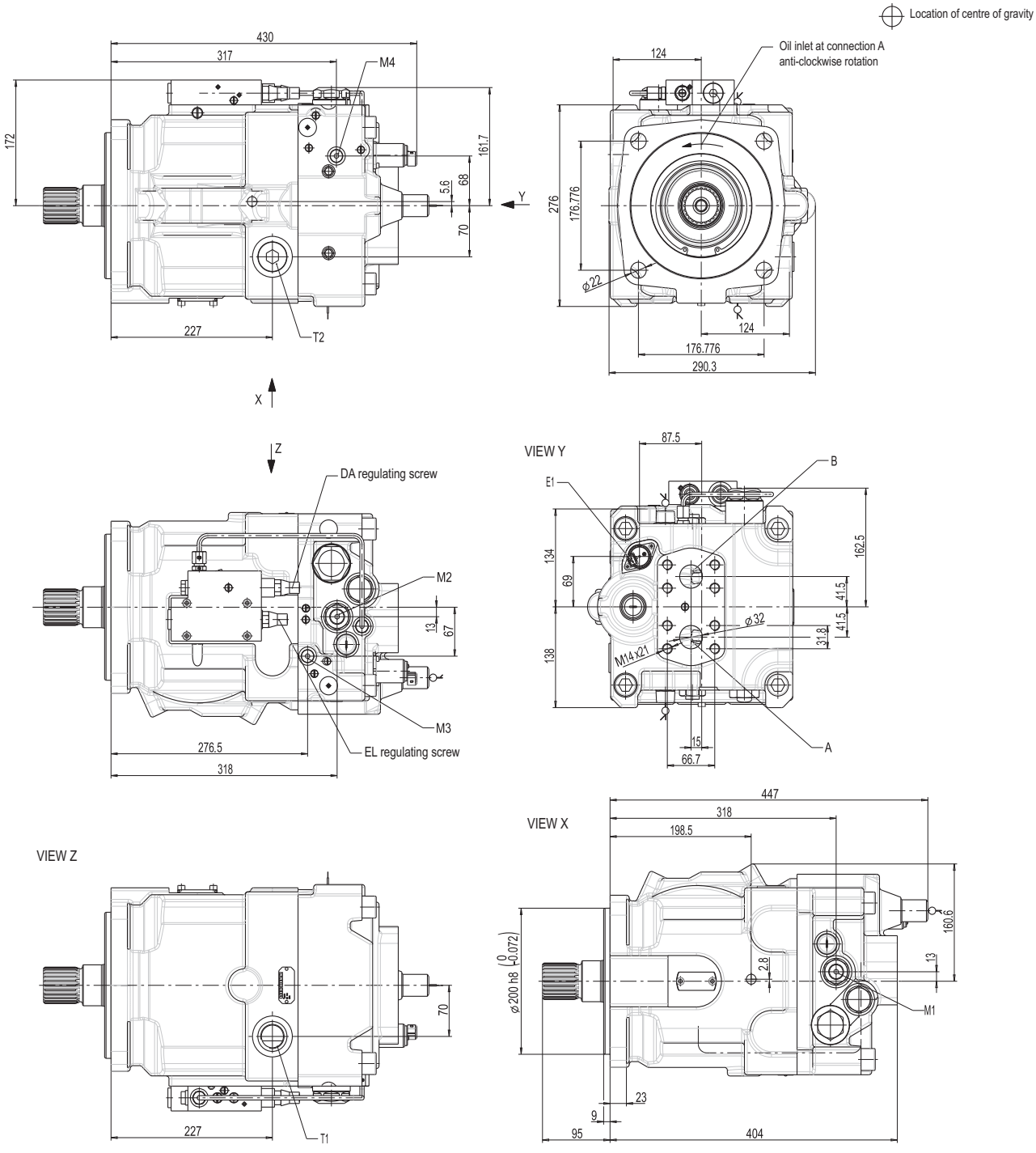
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5
M4	Steering pressure meas. connection ISO 9974-1, M14x1.5

5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M33x2
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5

G	Adjusting pressure supply ISO 9974-1, M14x1.5
-	-

5.7.2 Nominal size 215, control type EL-DA with brake valve



HF3-DB-043

E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA

M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

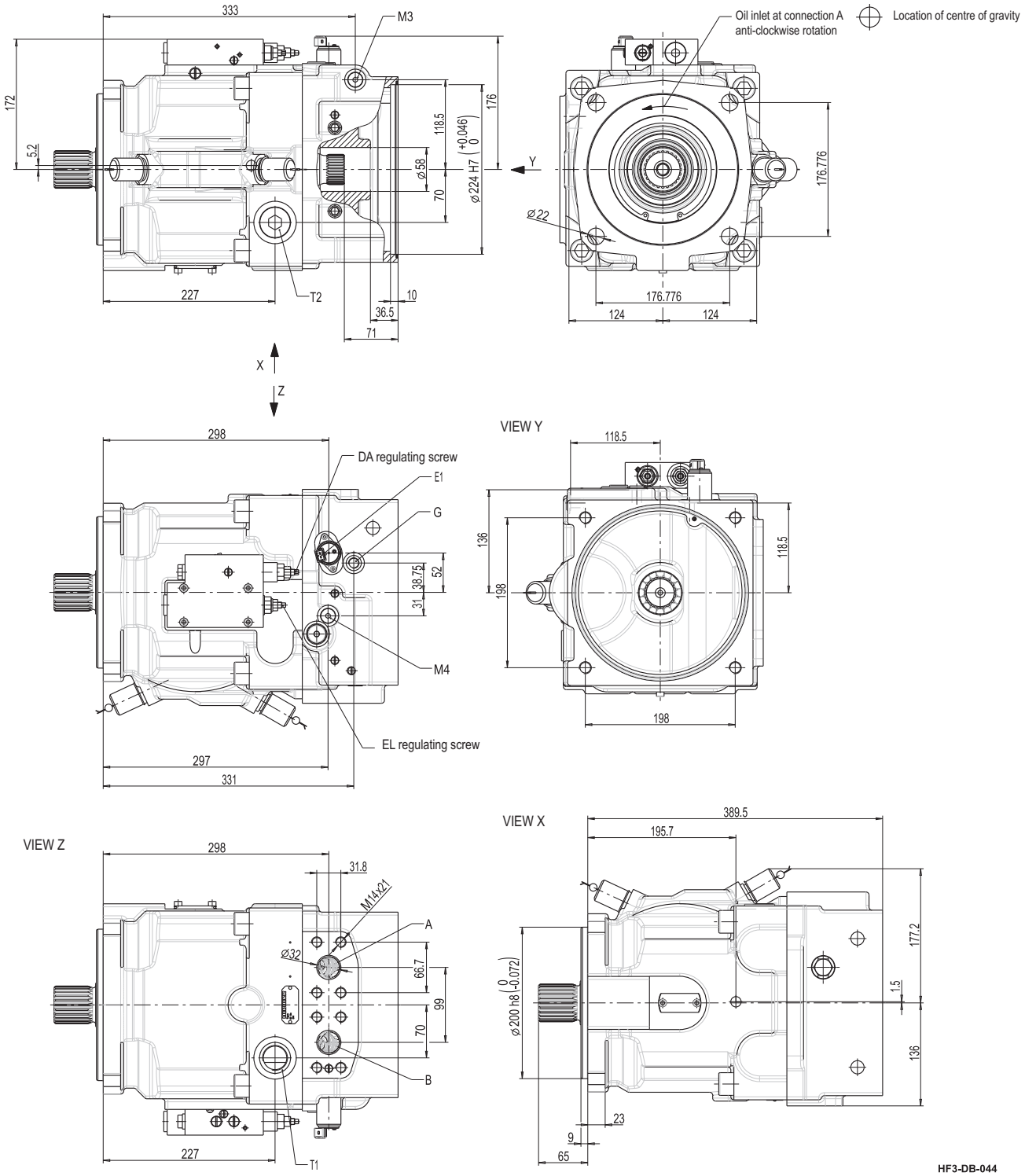
5 Dimensions

A / B	Working connection SAE J518-1 1/4“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M33x2

M4	Steering pressure meas. connection ISO 9974-1, M12x1.5
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5

5 Dimensions

5.7.3 Nominal size 215, control type EL-DA with through-drive

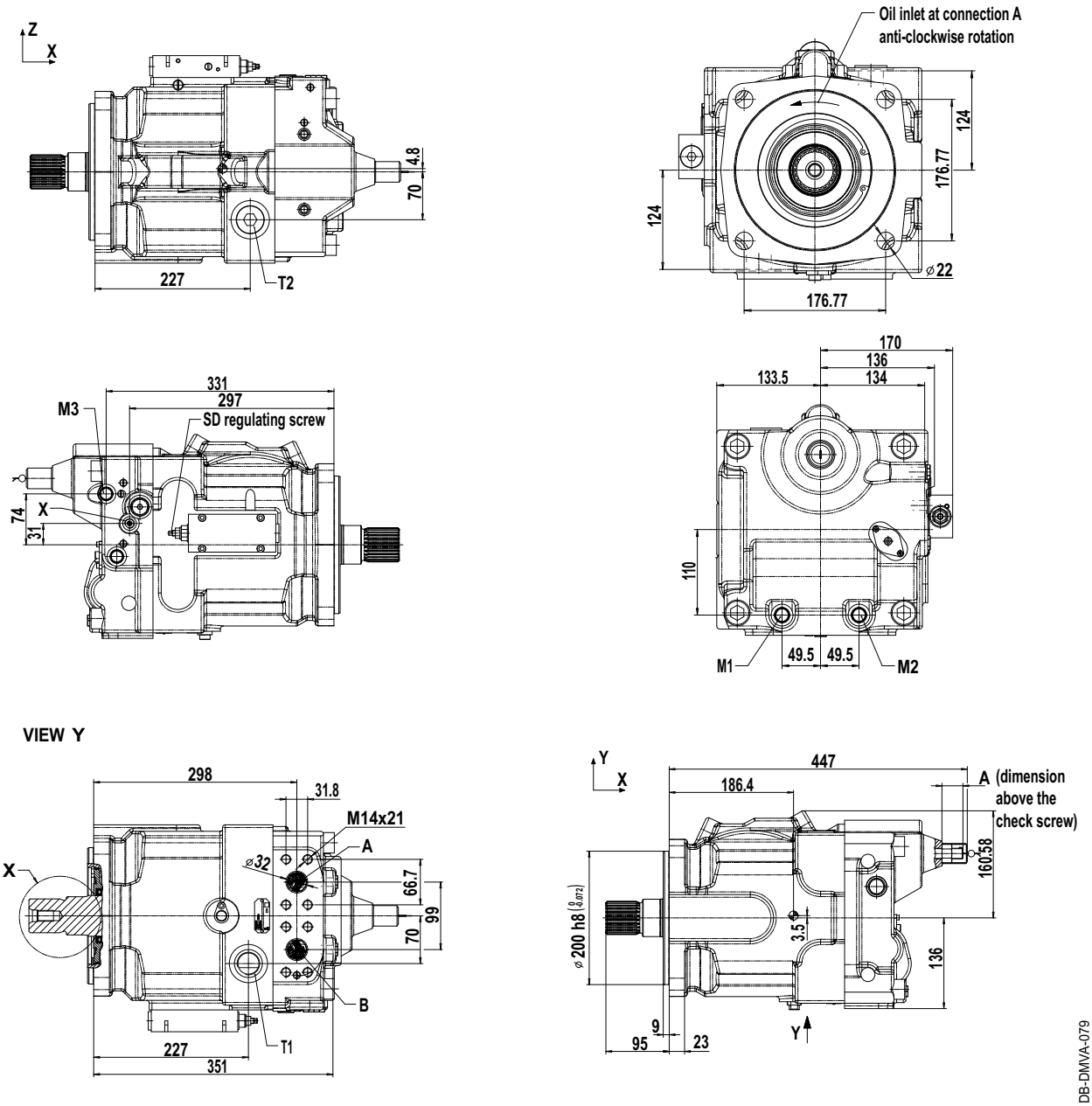


A / B	Working connection SAE J518-1 1/4“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M33x2
E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA

M4	Steering pressure meas. connection ISO 9974-1, M14x1.5
G	Adjusting pressure supply ISO 9974-1, M14x1.5
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5

5 Dimensions

5.7.4 Nominal size 215 / SD control

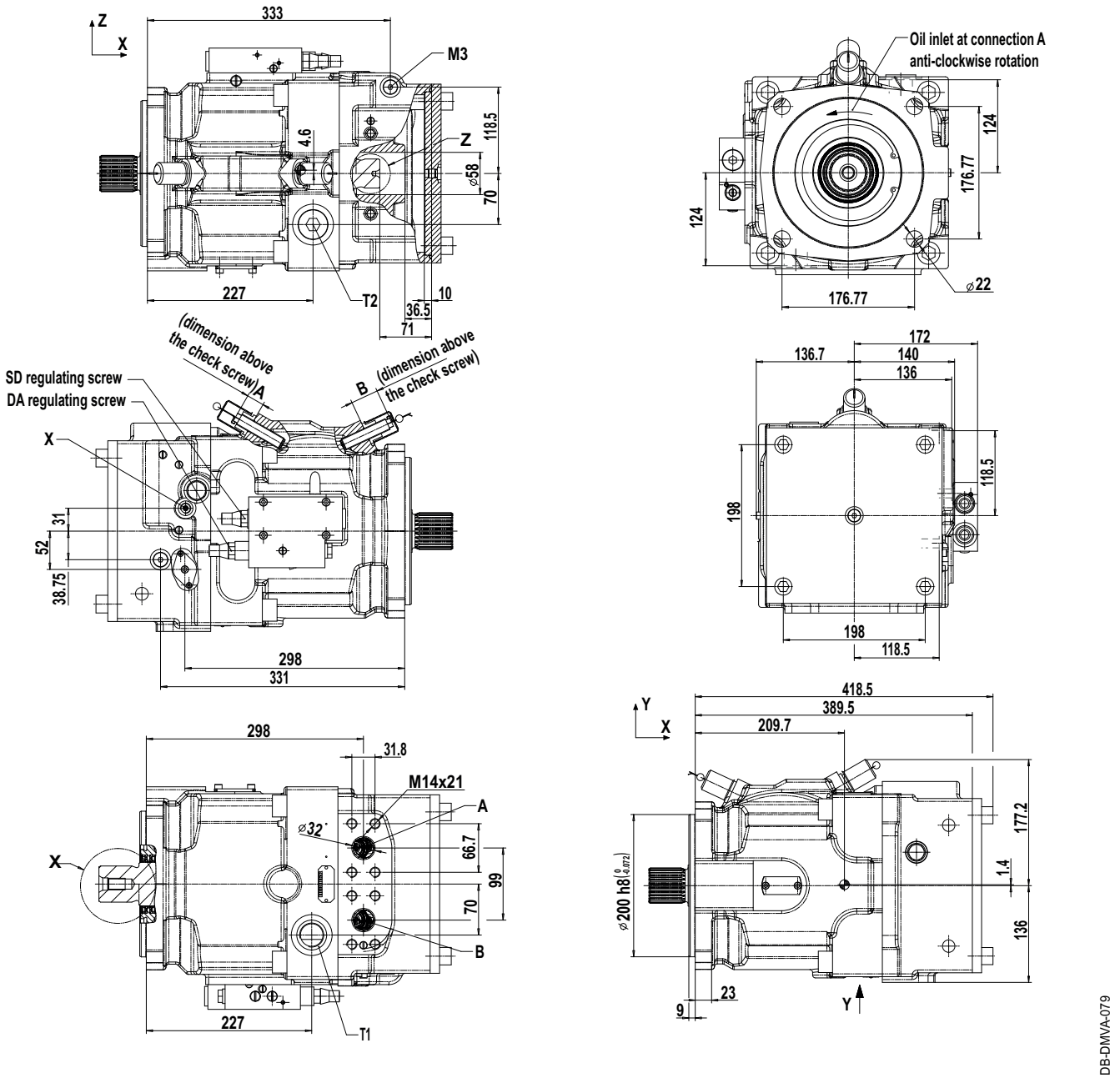


A / B	Working connection SAE J518-1“, 6000 psi
M1 / M2	High pressure meas. connection ISO 9974-1, M14x1.5
T1 / T2	Leakage oil connection ISO 9974-1, M26x1.5

M3	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
X	Steering pressure connection ISO 9974-1, M12x1.5
-	-

5 Dimensions

5.7.5 Nominal size 215, control type SD-DA



A / B	Working connection SAE J518-1 1/4“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M33x2

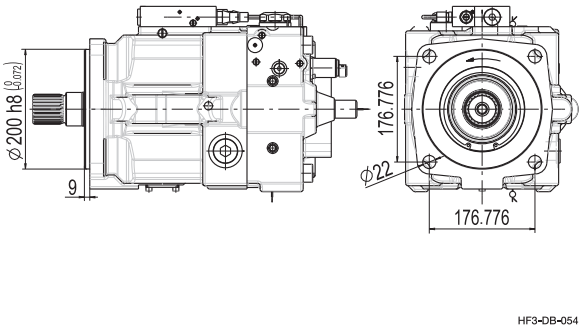
M3	Adjusting pressure meas. connection ISO 9974-1, M14x1.5
X	Steering pressure connection ISO 9974-1, M14x1.5

5 Dimensions

5.8 Nominal size 215, mounting flange

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

ISO 3019-2



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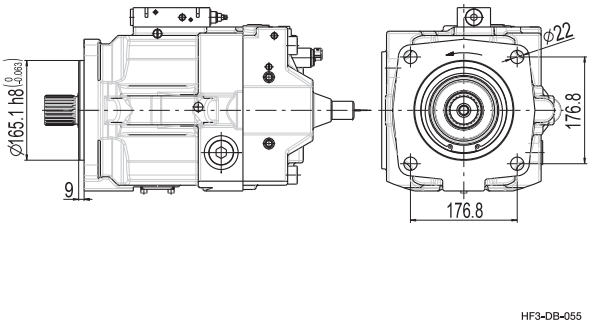
Customised design



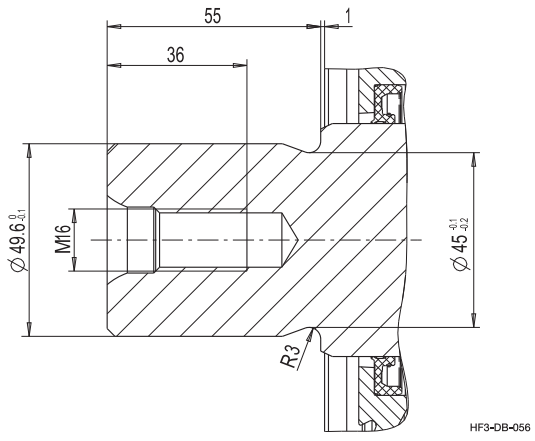
HF3-DB-055

51

5.9 Nominal size 215, shaft end

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

DIN 5480 splined shaft W50x2x24x9g



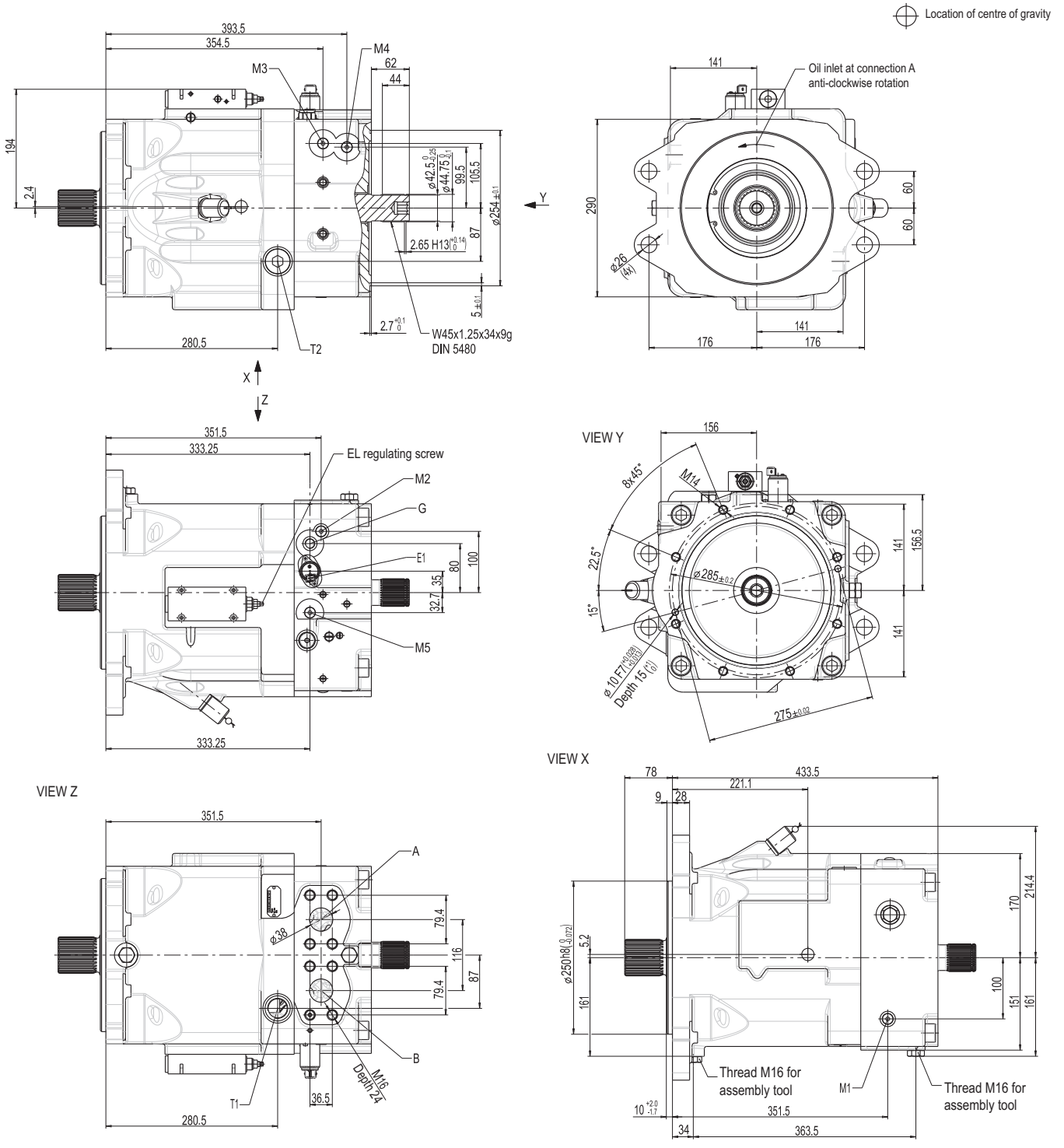
HF3-DB-056

1

5 Dimensions

5.10 Nominal size 355/370

5.10.1 Nominal size 355/370, control type EL with through drive



E1	DRE / AMP Junior Timer 2-pin, PWM= 100 Hz, Un= 24V, $I_{max.}$= 750 mA
A / B	Working connection SAE J518-1 1/2“, 6000 psi

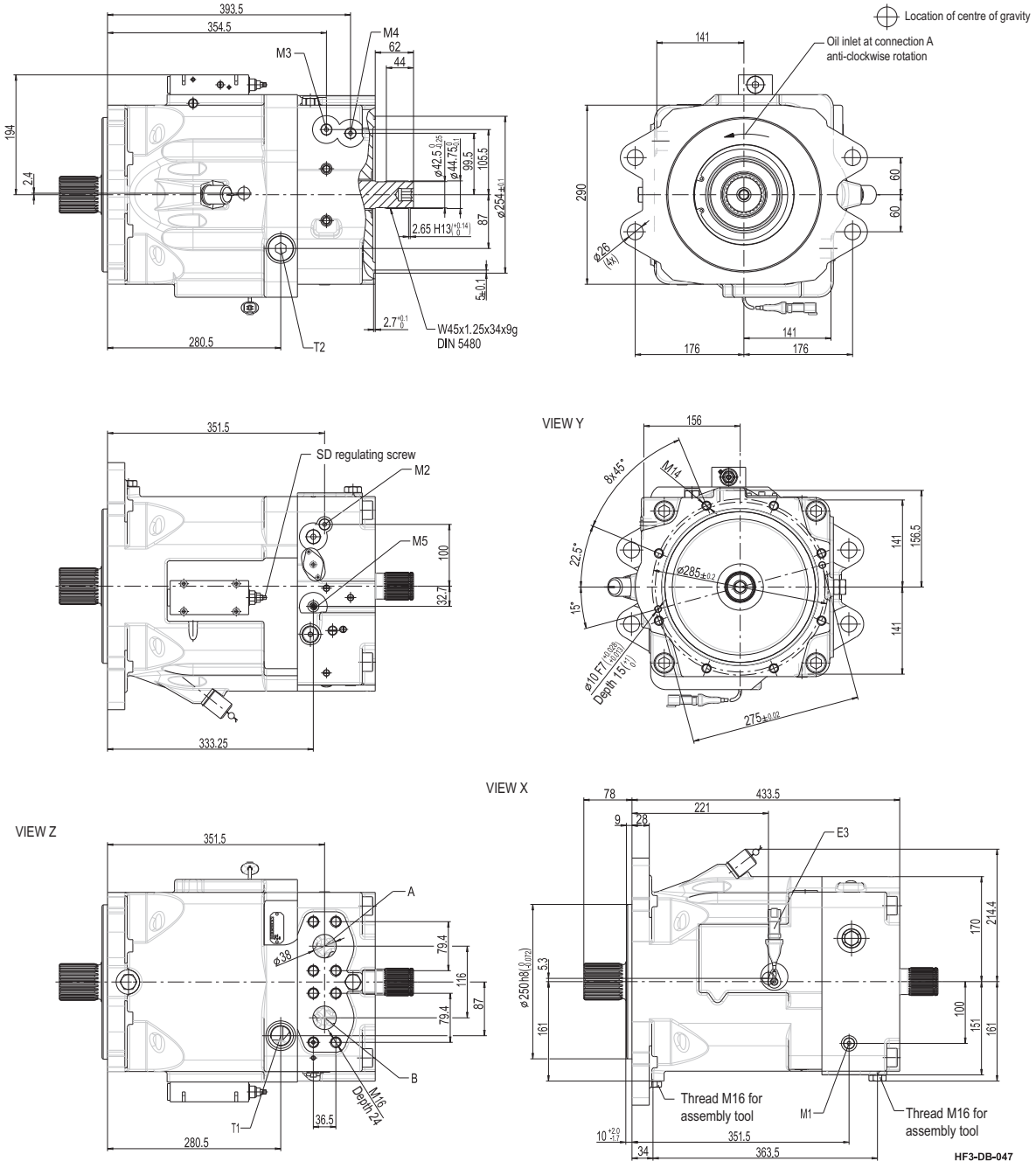
M3	Balanced high pressure meas. connection ISO 9974-1, M12x1.5
M4	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M33x2
M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5

M5	Steering pressure meas. connection ISO 9974-1, M12x1.5
G	Adjusting pressure supply ISO 9974-1, M16x1.5

5.10.2 Nominal size 355/370, control type SD with through drive



A / B	Working connection SAE J518-1 1/2“, 6000 psi
T1 / T2	Leakage oil connection ISO 9974-1, M33x2
M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5

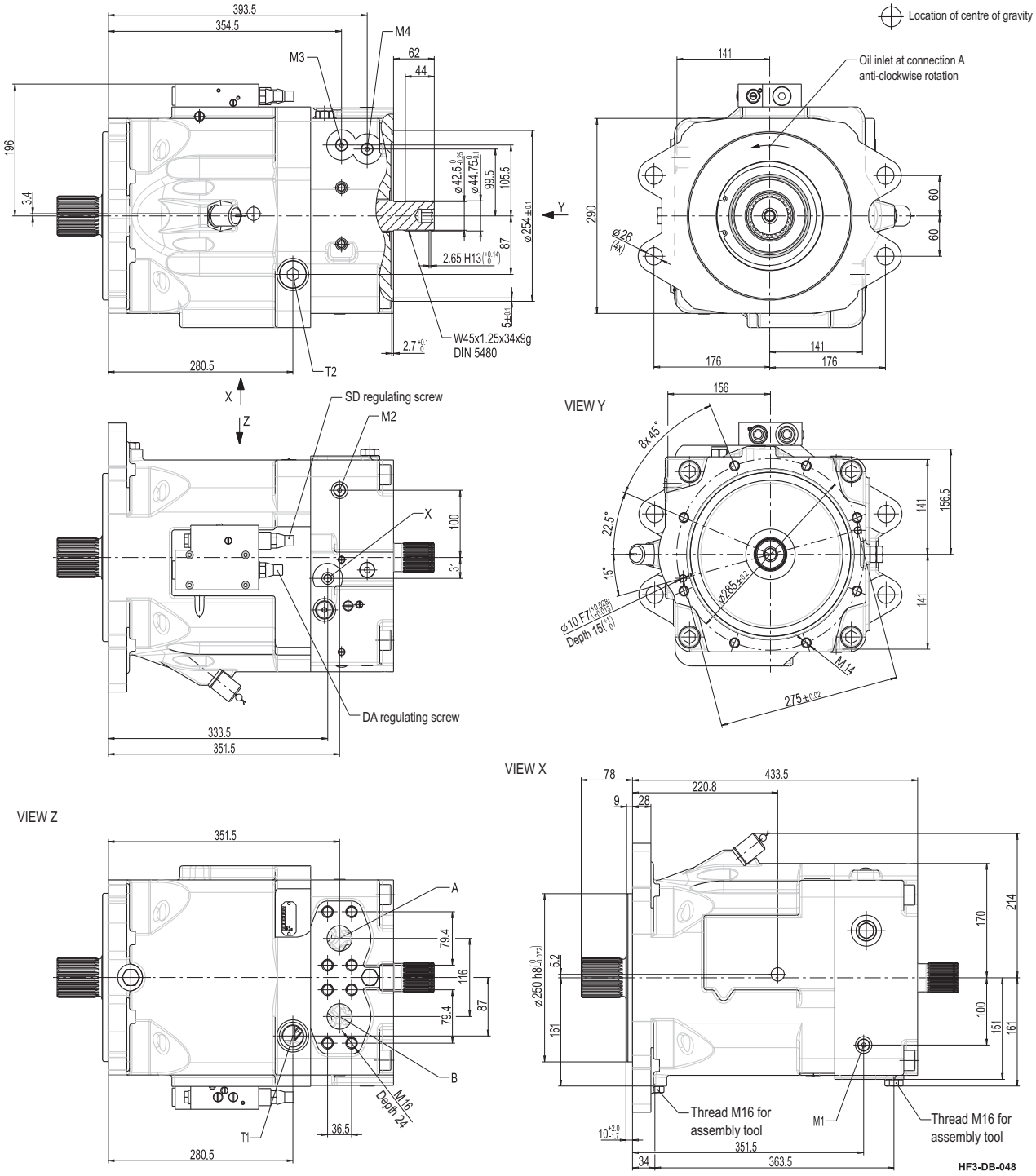
M4	Adjusting pressure meas. connection ISO 9974-1, M12x1.5
M5	Steering pressure meas. connection ISO 9974-1, M12x1.5
-	-

5 Dimensions

E1	Speed sensor Deutsch connector DT04-4P-CE04, cable length 800 mm

M3	Balanced high pressure meas. connection ISO 9974-1, M12x1.5

5.10.3 Nominal size 355/370, control type SD-DA with through-drive



M1 / M2	High pressure meas. connection ISO 9974-1, M12x1.5
A / B	Working connection SAE J518-1 1/2“, 6000 psi

X	Steering pressure connection ISO 9974-1, M12x1.5
M3	Balanced high pressure meas. connection ISO 9974-1, M12x1.5

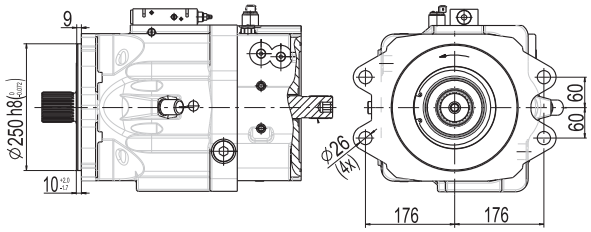
5 Dimensions

T1 / T2	Leakage oil connection ISO 9974-1, M33x2	M4	Adjusting pressure meas. connection ISO 9974-1, M12x1.5

5.11 Nominal size 355/370, mounting flange

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

Customised design



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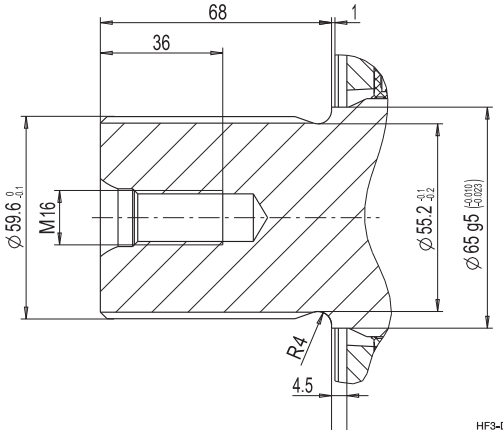
51

5.12 Nominal size 355/370, shaft end

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

DIN 5480 splined shaft W60x2x28x9g



HF3-DB-058

1

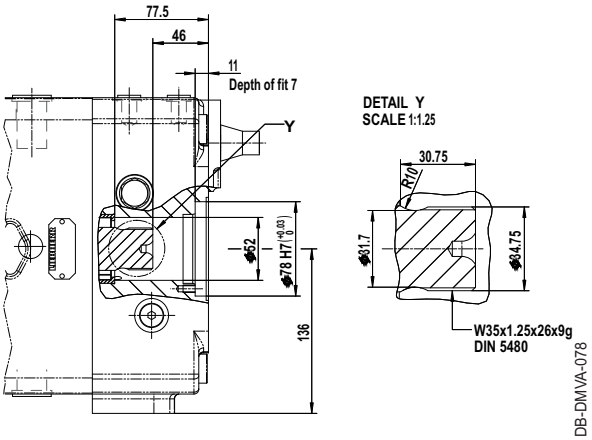
5 Dimensions

5.13 Through-drive DIN 5480

DMVA			/			1	W			A	0			
1.	2.	3.	/	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.

5.13.1 Nominal size 165, special through-drive

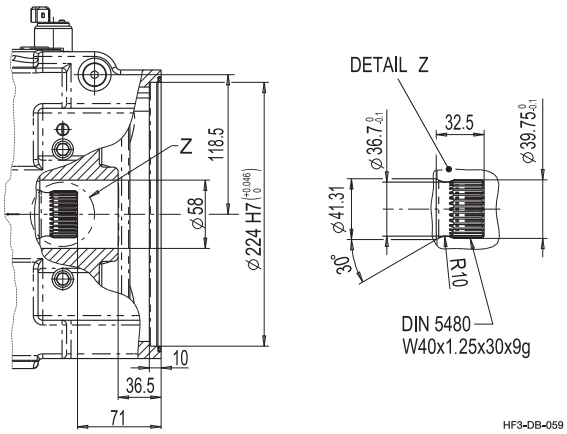
W35x1.25x26x9g



K

5.13.2 Nominal size 215, special through-drive

W40x1.25x30x9g

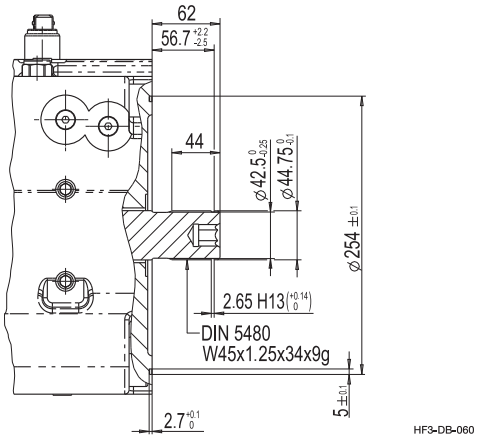


K

5 Dimensions

5.13.3 Nominal size 355/370, special through-drive

W45x1.25x34x9g



K

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