

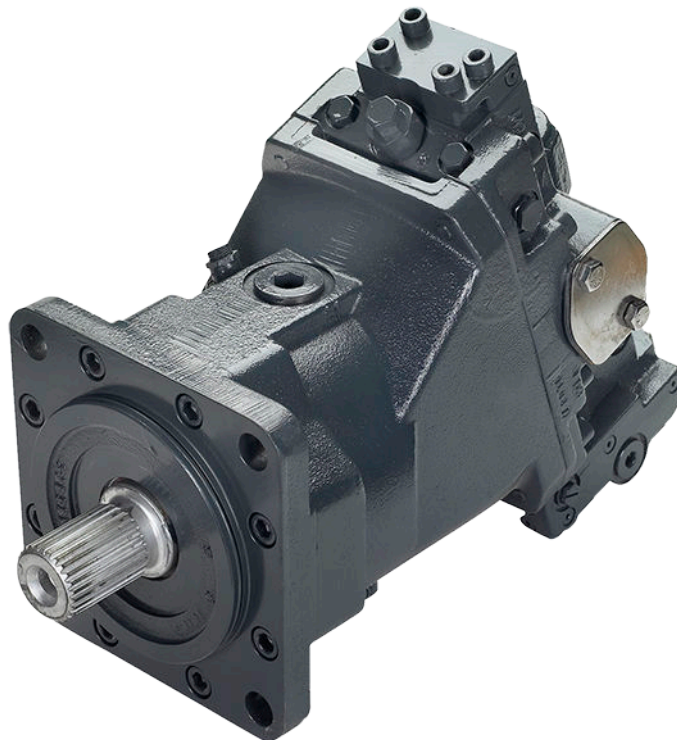
ENGINEERING  
TOMORROW



Technical Information

# Bent Axis Variable Displ. Motors

## Series 51 and 51-1



**Revision history***Table of revisions*

<b>Date</b>	<b>Changed</b>	<b>Rev</b>
October 2017	Modified theor. corner power ratings and updated to Engineering Tomorrow	0401
March 2015	Major update. Corrected DITA CMS structure, layout, colors and all tables.	CA
Jan 2014	Converted to Danfoss layout - DITA CMS	BA
Jun 2005	First version	AA

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**Series 51 general information**

Series 51 and 51-1 variable displacement motors are bent axis design units, incorporating spherical pistons.

These motors are designed primarily to be combined with other products in closed circuit systems to transfer and control hydraulic power. Series 51 and 51-1 motors have a large maximum / minimum displacement ratio (5:1) and high output speed capabilities. SAE, cartridge, and DIN flange configurations are available.

A complete family of controls and regulators is available to fulfill the requirements of a wide range of applications.

Motors normally start at maximum displacement. This provides maximum starting torque for high acceleration.

The controls may utilize internally supplied servo pressure. They may be overridden by a pressure compensator which functions when the motor is operating in motor and pump modes. A defeat option is available to disable the pressure compensator override when the motor is running in pump mode.

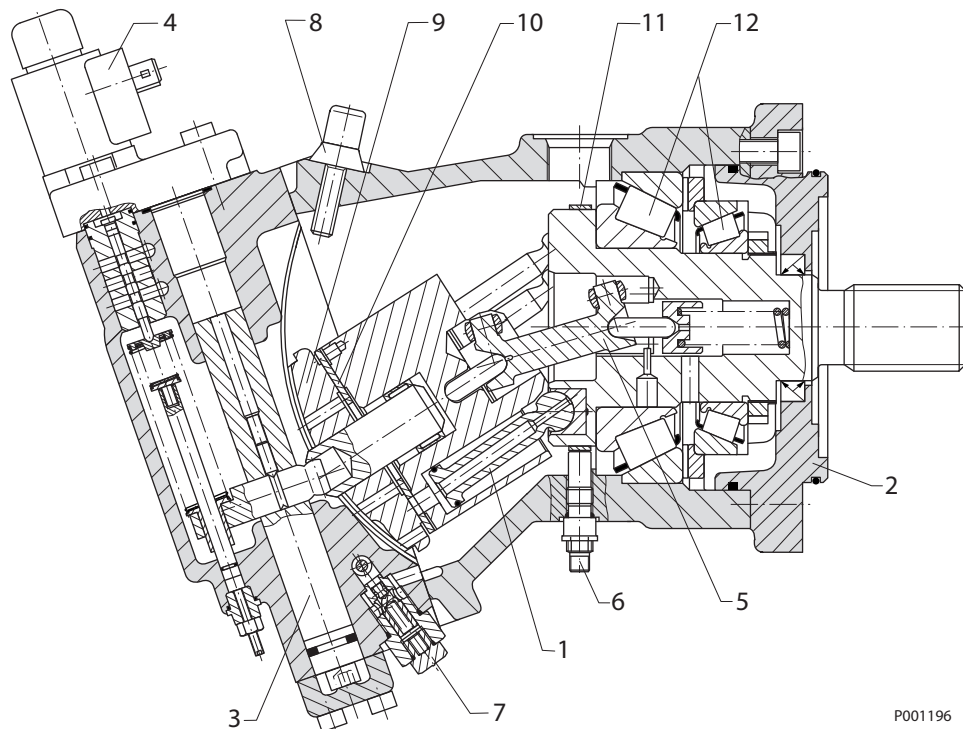
The pressure compensator option features a low pressure rise (short ramp) to ensure optimal power utilization throughout the entire displacement range of the motor. The pressure compensator is also available as a stand-alone regulator.

- The series 51 and 51-1 motors – Advanced technology
- The most technically advanced hydraulic units in the industry
- SAE, cartridge, and DIN flange motors
- Cartridge motors designed for direct installation in compact planetary drives
- Large displacement ratio (5:1)
- Complete family of control systems
- Proven reliability and performance
- Optimum product configurations
- Compact, lightweight

**Series 51 general information**

**Sectional view of Series 51, proportional control**

*Series 51 with electric proportional control*



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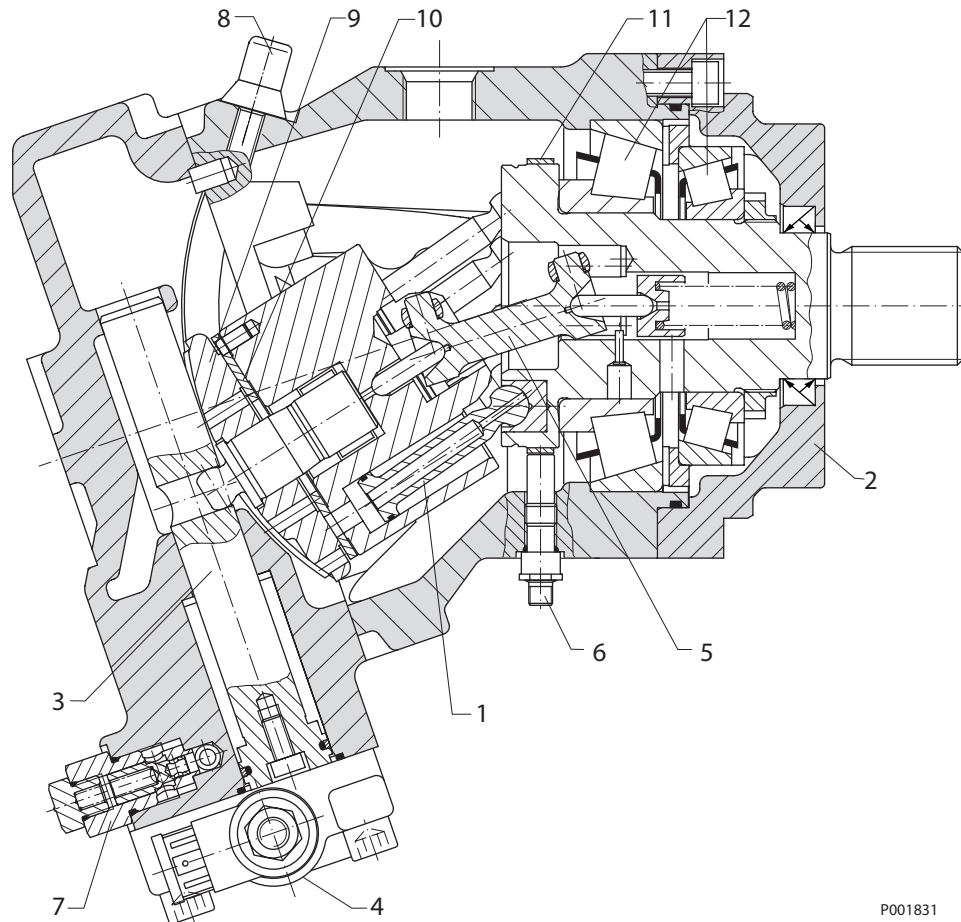
Legend:

- 1** – Piston
- 2** – Flange
- 3** – Servo piston
- 4** – Electric proportional control
- 5** – Synchronizing shaft
- 6** – Speed sensor
- 7** – Charge pressure relief valve
- 8** – Minimum displacement limiter
- 9** – Valve segment
- 10** – Bearing plate
- 11** – Speed pickup ring
- 12** – Tapered roller bearings

**Series 51 general information**

**Sectional view of Series 51-1, two-position control**

*Series 51 with electrohydraulic two-position control*



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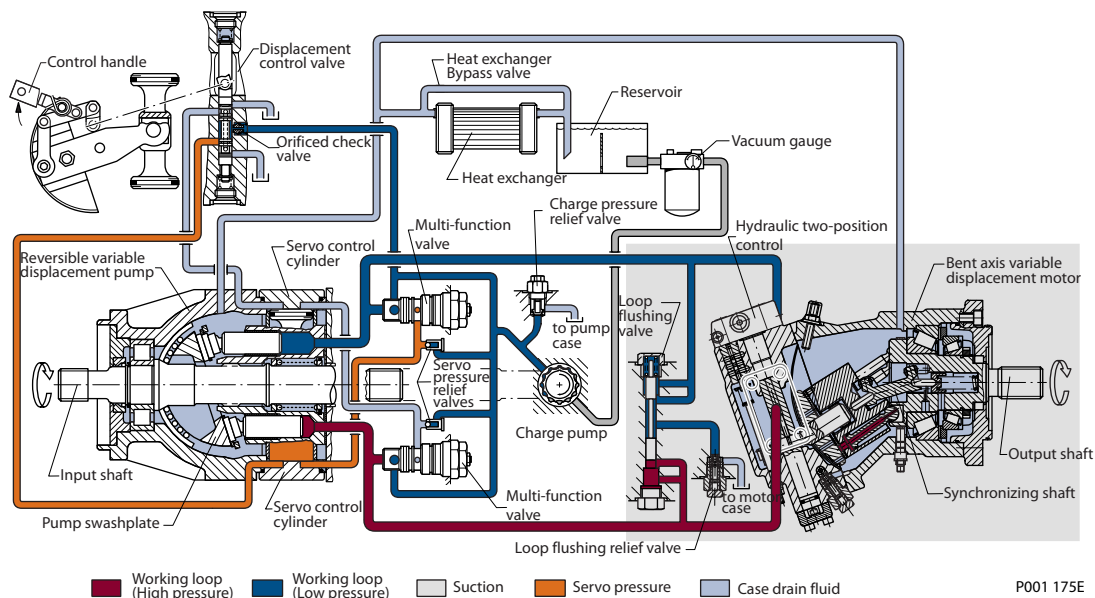
Legend:

- 1** – Piston
- 2** – Flange
- 3** – Servo piston
- 4** – Electrohydraulic two-position control
- 5** – Synchronizing shaft
- 6** – Speed sensor
- 7** – Charge pressure relief valve
- 8** – Minimum displacement limiter
- 9** – Valve segment
- 10** – Bearing plate
- 11** – Speed pickup ring
- 12** – Tapered roller bearings

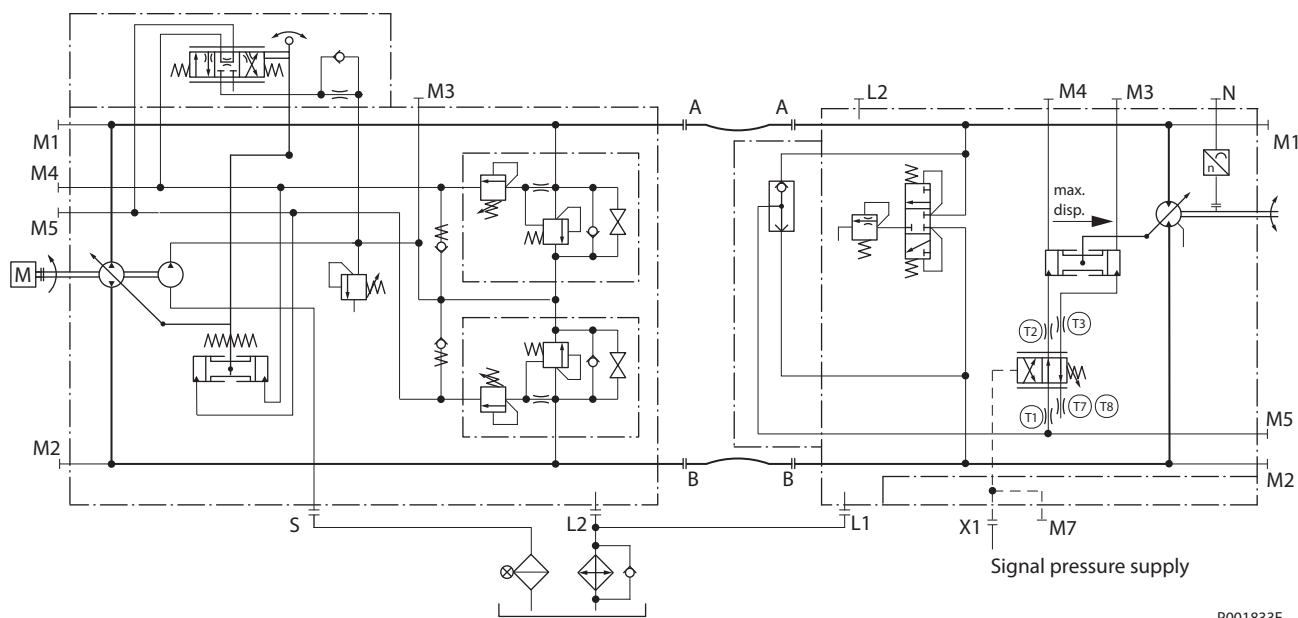


**Series 51 general information**

**Pictorial diagram**



**System circuit diagram**



Above schematic shows the function of a hydrostatic transmission using a Series 90 Axial Piston Variable Displacement Pump with manual displacement control (MA) and a Series 51 Bent Axis Variable Displacement Motor with hydraulic two-position control (HZ).

**Series 51 general information**

**Series 51/51-1 name plates**

*Series 51 name plate*



*Series 51-1 name plate*



## Technical specifications

### General specifications

Most specifications for bent axis variable displacement motors are listed on these pages. For definitions of the various specifications, see the related pages in this publication. Not all hardware options are available for all configurations; consult the series 51 and 51-1 model code supplement or price book for more information.

#### General specifications

<b>Design</b>	Axial piston motor with variable displacement, bent axis design
<b>Direction of rotation</b>	Clockwise and counter-clockwise (bi-directional)
<b>Recommended installation</b>	Discretionary, the housing must always be filled with hydraulic fluid
<b>Other system requirements</b>	Independent braking system, circuit overpressure protection, suitable reservoir

### Specific data

#### Physical properties

Features		Unit	Size				
			060	080	110	160	250
Displacement	Maximum	cm <sup>3</sup> [in <sup>3</sup> ]	60.0 [3.66]	80.7 [4.92]	109.9 [6.71]	160.9 [9.82]	250 [15.26]
	Minimum		12 [0.73]	16.1 [0.98]	22 [1.34]	32.2 [1.96]	50.0 [3.05]
Theor. flow at max. displ.	at rated speed	l/min	216 [57]	250 [66]	308 [81]	402 [106]	550 [145]
	at max. speed	[US gal/min]	264 [71]	323 [85]	396 [105]	515 [136]	675 [178]
Theor. corner power at rated speed and max. working pressure ( $\Delta p = 450$ bar [6527 psi])		kW [hp]	252 [338]	300 [402]	371 [498]	480 [644]	638 [856]
Theoretical torque	at max. displ.	N·m/bar [lbf·in/1000 psi]	0.95 [583]	1.28 [784]	1.75 [1067]	2.56 [1563]	3.98 [2428]
	at min. displ.		0.19 [117]	0.26 [156]	0.35 [214]	0.51 [313]	0.80 [486]
Mass moment of inertia of rotating components		kg·m <sup>2</sup> [slug·ft <sup>2</sup> ]	0.0046 [0.1092]	0.0071 [0.1685]	0.0128 [0.3037]	0.0234 [0.5553]	0.0480 [1.1580]
Rated speed	at max. displ.	min <sup>-1</sup> (rpm)	3600	3100	2800	2500	2200
	at min. displ.		5600	5000	4500	4000	3400
Maximum speed*	at max. displ.		4400	4000	3600	3200	2700
	at min. displ.		7000	6250	5600	5000	4250

\* Contact Danfoss representative for max. speed at displacements between max. and min. displacement.

## Technical specifications

## System and case pressure

Parameter		Unit	All sizes
System pressure	Maximum delta	bar [psi]	480 [7000]
	Maximum		510 [7400]
	Minimum low		10 [145]
Case pressure	Rated		3 [44]
	Maximum (cold start)		5 [73]
	Minimum (at rated speed)		0.3 [4.35]

## Fluid specifications

## Fluid specifications

Features		Unit	All sizes
Viscosity	Minimum intermittent	mm <sup>2</sup> /s [SUS]	7 [49]
	Recommended range		12-80 [66-366]
	Maximum intermittent		1600 [7416]
Temperature range <sup>1)2)</sup>	Minimum	°C [°F]	-40 [-40]
	Rated		104 [220]
	Maximum intermittent		115 [240]
Cleanliness and Filtration	Required cleanliness per ISO 4406	-	22/18/13
	Efficiency (charge pressure filtration)	β-ratio	β <sub>15-20</sub> = 75 (β <sub>10</sub> ≥ 10)
	Efficiency (suction / return line filtration)		β <sub>35-45</sub> = 75 (β <sub>10</sub> ≥ 2)
	Recommended inlet screen mesh size	μm	100 – 125

<sup>1)</sup> At the hottest point, normally case drain port.

<sup>2)</sup> Minimum: cold start, short term t<3 min, p<50 bar, n<1000 rpm.

**Technical specifications**
**Determination of nominal motor size**
**Based on SI units**

$$Q_e = \frac{V_g \cdot n}{1000 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$$

$$P_e = \frac{M_e \cdot n}{9550} = \frac{Q_e \cdot \Delta p \cdot \eta_t}{600}$$

$$n = \frac{Q_e \cdot 1000 \cdot \eta_v}{V_g}$$

*Where:*

<b>Q<sub>e</sub></b>	Input flow (l/min)
<b>M<sub>e</sub></b>	Output torque (N·m)
<b>P<sub>e</sub></b>	Output power (kW)
<b>n</b>	Speed (min <sup>-1</sup> )
<b>V<sub>g</sub></b>	Motor displacement per rev. (cm <sup>3</sup> /rev)
<b>P<sub>high</sub></b>	High pressure (bar)
<b>P<sub>low</sub></b>	Low pressure (bar)
<b>Δp</b>	High pressure minus Low pressure (bar)
<b>η<sub>v</sub></b>	Motor volumetric efficiency
<b>η<sub>mh</sub></b>	Mechanical-hydraulic efficiency
<b>η<sub>t</sub></b>	Motor total efficiency (η <sub>v</sub> · η <sub>mh</sub> )

**Based on US units**

$$Q_e = \frac{V_g \cdot n}{231 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi}$$

$$P_e = \frac{V_g \cdot n \cdot \Delta p \cdot \eta_t}{396\,000}$$

$$n = \frac{Q_e \cdot 231 \cdot \eta_v}{V_g}$$

*Where:*

<b>Q<sub>e</sub></b>	Input flow [US gal/min]
<b>M<sub>e</sub></b>	Output torque [lb·in]
<b>P<sub>e</sub></b>	Output power [hp]
<b>n</b>	Speed [rpm]
<b>V<sub>g</sub></b>	Motor displacement per rev. [in <sup>3</sup> /rev]
<b>P<sub>high</sub></b>	High pressure [psi]
<b>P<sub>low</sub></b>	Low pressure [psi]
<b>Δp</b>	High pressure minus Low pressure [psi]
<b>η<sub>v</sub></b>	Motor volumetric efficiency
<b>η<sub>mh</sub></b>	Mechanical-hydraulic efficiency
<b>η<sub>t</sub></b>	Motor total efficiency (η <sub>v</sub> · η <sub>mh</sub> )

## General technical specifications

### Case pressure

Under normal operating conditions, case pressure must not exceed the rated pressure. Momentary case pressure exceeding this rating is acceptable under cold start conditions, but still must stay below the maximum pressure rating.

The minimum pressure provides proper lubrication at high speeds.

Operation with case pressure in excess of these limits may result in external leakage due to damage to seals, gaskets, and/or housings.

#### Case pressure

Parameter		Unit	All sizes
Case pressure	Rated	bar [psi]	3 [44]
	Maximum (cold start)		5 [73]
	Minimum (at rated speed)		0.3 [4.35]

### Speed range

**Rated speed** is the speed limit recommended at full power condition and is the highest value at which normal life can be expected.

**Maximum speed** is the highest operating speed permitted and cannot be exceeded without reduction in the life of the product or risking immediate failure and loss of driveline power (which may create a safety hazard). In the range between rated and maximum speed please contact your Danfoss Power Solutions representative.

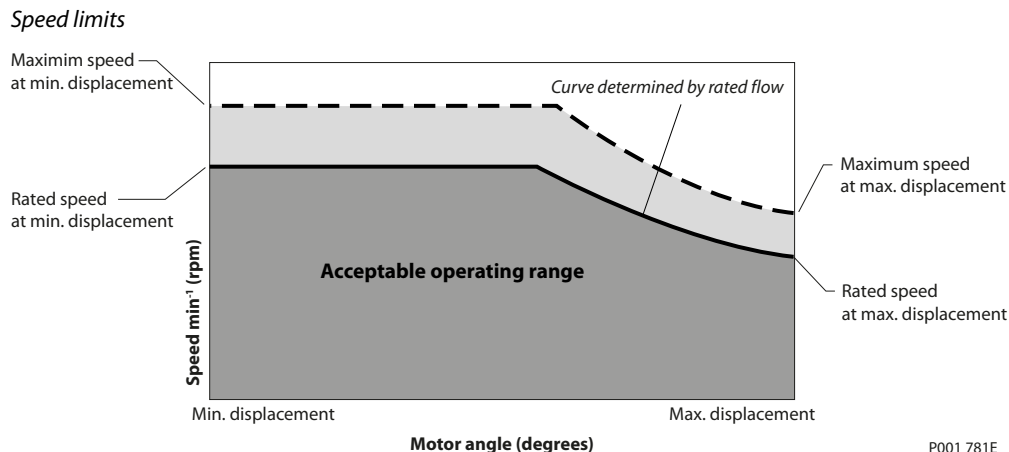
#### Warning

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or “neutral”) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

#### Speed limits

Features		Unit	Size				
			060	080	110	160	250
Rated speed	at max. displ.	min <sup>-1</sup> (rpm)	3600	3100	2800	2500	2200
	at min. displ.		5600	5000	4500	4000	3400
Maximum speed	at max. displ.		4400	4000	3600	3200	2700
	at min. displ.		7000	6250	5600	5000	4250

**General technical specifications**



P001 781E

For operation within the range above the acceptable range contact Danfoss Power Solutions representative.

**Pressure limits**

System pressure is the dominant operating variable affecting hydraulic unit life. High pressure, which results from high load, reduces expected life in a manner similar to the affects of high load on other mechanical assemblies such as engines and gear boxes. There are load-to-life relationships for the rotating group and for the shaft anti-friction bearings.

Continuous pressure is the pressure at which the hydrostatic system could operate continuously and still achieve acceptable hydrostatic life. This pressure level varies depending on operating speed, and on the life requirements for a particular application. While most mobile applications require system pressure to vary widely during operation, a “weighted average” pressure can be derived from a machine duty cycle. (A duty cycle is a means of quantifying the pressure and speed demands of a particular system on a percent time basis). Once a duty cycle has been determined or estimated for a specific application, contact your Danfoss representative for system life ratings for the application.

**Maximum delta pressure** is the highest intermittent pressure allowed, and is the relief valve setting. It is determined by the maximum machine load demand. For most systems, the load should move at this pressure.

**Maximum pressure** is assumed to occur a small percentage of operating time, usually less than 2 % of the total. Both the continuous and maximum pressure limits must be satisfied to achieve the expected life.

**Minimum low pressure** must maintained under all operating conditions to avoid cavitation.

*System pressure range, input*

Maximum delta pressure	Minimum low pressure	Maximum pressure
480 [7000 psi]	10 [145 psi]	510 [7400 psi]

**General technical specifications**

**Loop flushing**

An integral non-adjustable loop flushing valve is incorporated into all these motors. Installations that require fluid to be removed from the low pressure side of the system circuit because of cooling requirements or contamination removal will benefit from loop flushing.

The integral loop flushing valve is equipped with an orificed charge pressure relief valve designed with a cracking pressure of 16 bar [232 psi].

Valves are available with several orifice sizes to meet the flushing flow requirements of all system operating conditions.

The total system charge pump flow should be of sufficient volume to accommodate:

- The number of motors in the system
- System efficiency under worst case conditions
- Pump control requirements
- External needs

Although charge pump sizing requires the consideration of many system variables, the following table gives a recommendation of what charge pump displacement may be required to accommodate the flushing flow of each available charge relief valve orifice.

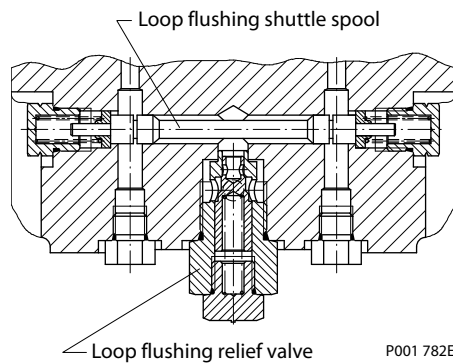
*Recommended charge pump displacement*

Loop flushing valve	E4, E6	F0	F3	G0	G3	H0
Charge pump size (cm <sup>3</sup> )	8	11	14	17 or 20	26	34, 47 or 65

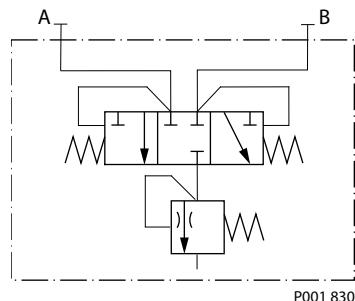
**⚠ Warning**

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or “neutral” mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

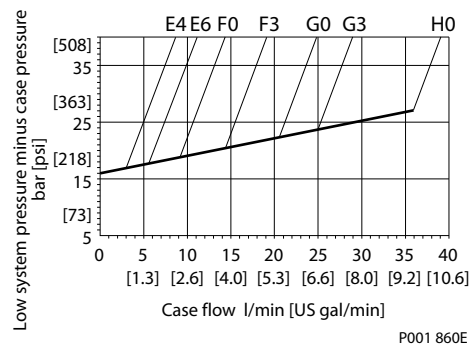
*Loop flushing valve*



*Hydraulic schematic*





**General technical specifications**
*Case flow characteristic*

*Equation:*

$$Q_{\text{Flush}} = \frac{Q_{\text{Charge}} - Q_{\text{Leak}}}{2 \cdot k_{\text{Mo}}}$$

*Where:*

- $Q_{\text{Flush}}$  – flushing flow per motor
- $Q_{\text{Charge}}$  – charge flow at operating speed
- $k_{\text{Mo}}$  – number of motors fed by one pump
- $Q_{\text{Leak}}$  – sum of external leakages

 $Q_{\text{Leak}}$  includes:

- motor leakage
- pump leakage + internal consumers:
  - 8 l/min [2.11 US gal/min] for displacement control pumps **or**
  - for non-feedback controlled pumps at 200 bar [2900 psi]
- external consumers:
  - e.g. brakes, cylinders, and other pumps

**Minimum displacement limiter**

All Series 51 and 51-1 motors incorporate mechanical displacement limiters.

The minimum displacement of the motor is preset at the factory with a set screw in the motor housing. A tamper-proof cap is provided.

**Hydraulic fluids**

Ratings and data are based on operating with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion and corrosion of the internal components.

Fire resistant fluids are also suitable at modified operating conditions. Please see Danfoss literature Technical Information *Hydraulic Fluids and Lubricants* for more information.

For more information contact your Danfoss representative.

**Caution**

**It is not permissible to mix hydraulic fluids.**

Suitable hydraulic fluids:

## General technical specifications

- Hydraulic fluids per DIN 51 524, part 2 (HLP)
- Hydraulic fluids per DIN 51 524, part 3 (HVLP)
- API CD, CE and CF engine fluids per SAE J183
- M2C33F or G automatic transmission fluids (ATF)
- Agricultural multi purpose oil (STOU)
- Premium turbine oils (for Premium turbine oils contact your Danfoss representative).

## Temperature and viscosity

Temperature and viscosity requirements must be concurrently satisfied. The data shown in the tables assume petroleum-based fluids, are used.

The high temperature limits apply at the hottest point in the transmission, which is normally the motor case drain. The system should generally be run at or below the **rated temperature**. The **maximum temperature** is based on material properties and should never be exceeded.

Cold oil will generally not affect the durability of the transmission components, but it may affect the ability to flow oil and transmit power; therefore temperatures should remain 16 °C [30 °F] above the pour point of the hydraulic fluid. The **minimum temperature** relates to the physical properties of component materials.

For maximum unit efficiency and bearing life the fluid viscosity should remain in the **recommended operating range**. The **minimum viscosity** should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation. The **maximum viscosity** should be encountered only at cold start.

Heat exchangers should be sized to keep the fluid within these limits. Testing to verify that these temperature limits are not exceeded is recommended.

### Viscosity and temperature range

Features		Unit	All sizes
Viscosity	Minimum intermittent	mm <sup>2</sup> /s [SUS]	7 [49]
	Recommended range		12-80 [66-366]
	Maximum intermittent		1600 [7416]
Temperature range <sup>1)2)</sup>	Minimum	°C [°F]	-40 [-40]
	Rated		104 [220]
	Maximum intermittent		115 [240]

<sup>1)</sup> At the hottest point, normally case drain port.

<sup>2)</sup> Minimum: cold start, short term t<3 min, p<50 bar, n<1000 rpm.

## Filtration system

To prevent premature wear, ensure that only clean fluid enters the hydrostatic transmission circuit. A filter capable of controlling the fluid cleanliness to ISO 4406, class 22/18/13 (SAE J1165) or better, under normal operating conditions, is recommended. These cleanliness levels cannot be applied for hydraulic fluid residing in the component housing/case or any other cavity upon delivery from the factory.

The filter may be located on the pump (integral) or in another location (remote or suction). The integral filter has a filter bypass sensor to signal the machine operator when the filter requires changing. Filtration strategies include suction or pressure filtration. The selection of the filter strategy depends on a number of factors including the contaminant ingress rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency can be measured with a Beta ratio ( $\beta_x$ ). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a  $\beta$ -ratio within the

## General technical specifications

range of  $\beta_{35-45} = 75$  ( $\beta_{10} \geq 2$ ) or better has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, a charge pressure or return filtration system with a filter  $\beta$ -ratio in the range of  $\beta_{15-20} = 75$  ( $\beta_{10} \geq 10$ ) or better is typically required.

Because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. For more information, see *Design Guidelines for Hydraulic Fluid Cleanliness, Technical Information BC00000095*.

Filter  $\beta_x$ -ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter ("x" in microns) upstream of the filter to the number of these particles downstream of the filter.

*Filtration, cleanliness level and  $\beta_x$ -ratio (recommended minimum)*

<b>Cleanliness per ISO 4406</b>	22/18/13
<b>Efficiency <math>\beta_x</math> (charge pressure filtration)</b>	$\beta_{15-20} = 75$ ( $\beta_{10} \geq 10$ )
<b>Efficiency <math>\beta_x</math> (suction and return line filtration)</b>	$\beta_{35-45} = 75$ ( $\beta_{10} \geq 2$ )
<b>Recommended inlet screen mesh size</b>	100 – 125 $\mu\text{m}$

## Fluid selection

Ratings and performance data are based on operating with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of motor components.

### **Caution**

Never mix hydraulic fluids of different types.

Fire resistant fluids are also suitable at modified operating conditions. For more information, see *Hydraulic Fluids and Lubricants, Technical Information BC00000093*.

## Reservoir

The function of the reservoir is to remove air and to provide make up fluid for volume changes associated with fluid expansion or contraction, possible cylinder flow, and minor leakage.

The reservoir should be designed to accommodate maximum volume changes during all system operating modes and to promote deaeration of the fluid as it passes through the tank.

A minimum reservoir volume equal to 1/2 to 1 1/2 times charge pump flow/min is suggested. This allows 30 seconds fluid dwell for removing entrained air at the maximum return flow. This is usually adequate to allow for a closed reservoir (no breather) in most applications. The reservoir outlet to the charge pump inlet should be above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the charge inlet line.

The reservoir inlet (fluid return) should be positioned so that the flow to the reservoir is discharged below the normal fluid level, and also directed into the interior of the reservoir for maximum dwell and efficient deaeration.

## Independent braking system

### **Warning**

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

**General technical specifications**
**Motor bearing life**

The rated motor bearing life  $L_{h10}$  shown in the table below is based on a 90 % survival rate of shaft bearings, when operating at a speed of  $n = 1500 \text{ min}^{-1}$  (rpm) with a charge pressure of 20 bar [290 psi] and without external shaft load.

*The rated motor bearing life  $L_{h10}$  (hours)*

Frame Size	Effective $\Delta$ pressure bar [psi]	Motor angle		
		6°	15°	32°
<b>060</b>	140 [2030]	19 800	18 530	16 370
	210 [3050]	6320	5960	5340
	280 [4060]	2740	2600	2350
<b>080</b>	140 [2030]	14 420	13 580	12 120
	210 [3050]	4610	4370	3960
	280 [4060]	2000	1910	1750
<b>110</b>	140 [2030]	15 800	14 890	13 330
	210 [3050]	5040	4790	4350
	280 [4060]	2180	2090	1920
<b>160</b>	140 [2030]	15 670	14 770	13 200
	210 [3050]	5005	4750	4300
	280 [4060]	2170	2070	1900
<b>250</b>	140 [2030]	11 760	11 130	10 020
	210 [3050]	3750	3580	3260
	280 [4060]	1630	1560	1440

**Lifetimes for speeds other than  $1500 \text{ min}^{-1}$  (rpm) can be calculated from:**

$$L_2 = \frac{L_1 \cdot 1500}{n_2} \quad \text{hours}$$

Where:

$L_1$  = Rated  $L_{10}$  life at  $1500 \text{ min}^{-1}$  (rpm)  
 $n_2$  = Operating speed

Units:

hours  
 $\text{min}^{-1}$  (rpm)

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Contact your Danfoss Power Solutions representative for bearing life values at other pressure and angle.

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**General technical specifications**

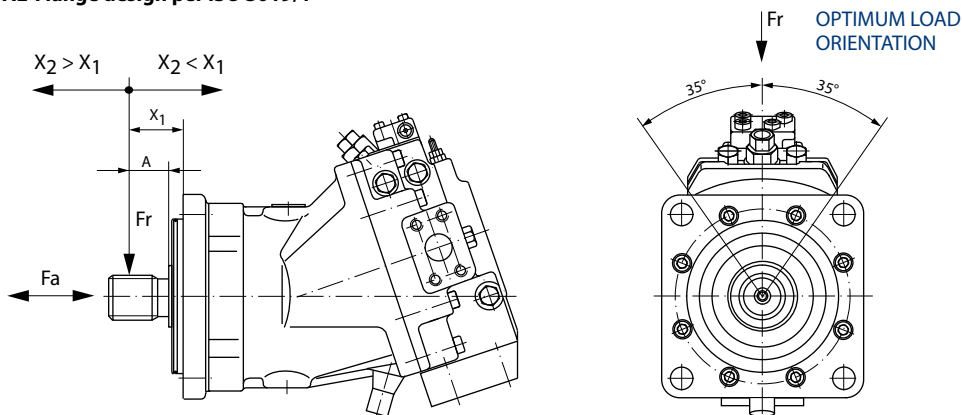
**External shaft loads**

Series 51 and 51-1 motors are designed with bearings that can accept external radial and thrust loads.

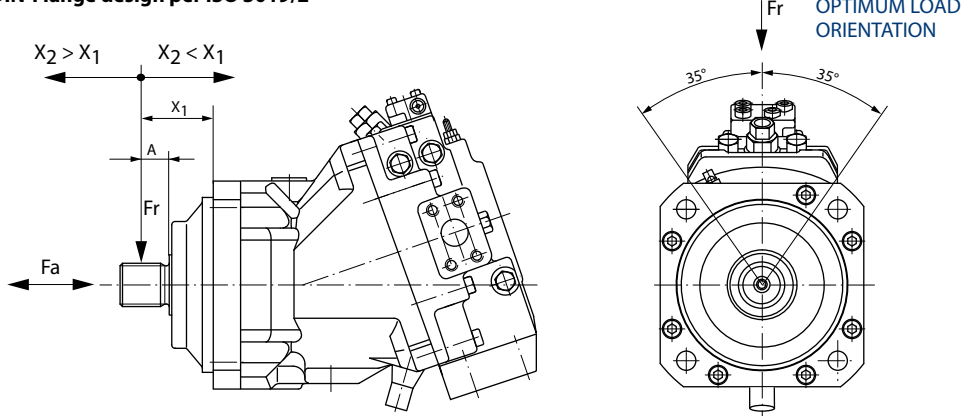
The external radial shaft load limits are a function of the load position, the load orientation, and operating conditions of the unit.

**External shaft load orientation**

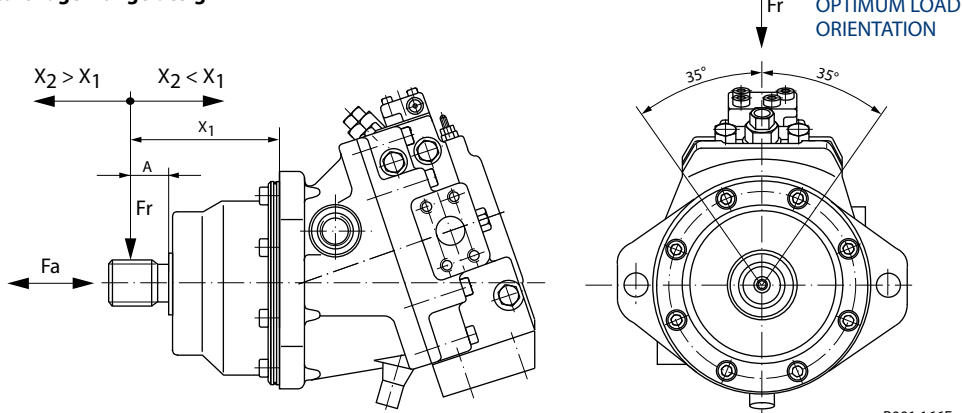
**SAE-Flange design per ISO 3019/1**



**DIN-Flange design per ISO 3019/2**



**Cartridge Flange design**



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## General technical specifications

### Radial and thrust loads to the output shaft

The table below provides the following information:

- The maximum allowable radial load (**Fr**) based on the distance (**X<sub>1</sub>**) from the mounting flange to the load.
- The maximum allowable axial load (**Fa**).
- The actual distance of Fr for a given application from the mounting flange to the load (**X<sub>2</sub>**).
- The basic distance (**A**).
- **Fa/Δp** ratio of allowable axial load, dependent upon the system pressure.

#### Radial and thrust loads to the output shaft

Feature	Symbol	Unit	Frame Size				
			060	080	110	160	250
Maximum allowable radial load	<b>Fr</b>	N [lb]	10 000 [2248]	12 000 [2698]	14 000 [3147]	18 000 [4047]	26 000 [5845]
Max. allow. axial load at zero rpm, or running in the idle pressure	<b>Fa</b>		1100 [247]	1400 [315]	1800 [405]	2500 [562]	4500 [1012]
Max. allowable bending moment	<b>M</b>	N·m [lb·in]	252 [2230]	307 [2717]	766 [6780]	805 [7125]	970 [8585]
Max. allowable axial load at pressure	<b>Fa/Δp</b>	N/bar [lb/1000 psi]	10.4 [161]	12.6 [195]	15.2 [236]	19.2 [298]	26.4 [409]
Distance SAE mounting flange	<b>X<sub>1</sub></b>	mm [in]	33.6 [1.32]	33.6 [1.32]	62.7 [2.47]	52.7 [2.07]	45.3 [1.78]
Distance DIN mounting flange			57.2 [2.25]	57.6 [2.27]	94.7 [3.73]	84.7 [3.33]	–
Distance Cartridge mount. flange			117.6 [4.63]	136.1 [5.36]	177.5 [7.0]	–	–
Basic distance	<b>A</b>		25.2 [0.99]	25.6 [1.01]	54.7 [2.15]	44.7 [1.76]	37.3 [1.47]

– = not available

The values in the table are maximum values and are not allowed under continuous load conditions.

### Allowable external shaft load, when shaft load distance is different from standard

Use this formula to calculate maximum allowable radial load when max. shaft load distance **X<sub>2</sub>** is different from **X<sub>1</sub>**:

Metric system:	Inch system:
$X_2 > X_1 \quad Fr = \frac{M \cdot 10^3}{A - X_1 + X_2} \quad N$	$X_2 > X_1 \quad Fr = \frac{M \cdot 12}{A - X_1 + X_2} \quad \text{lbf}$

#### Metric or Inch system:

$$X_2 > X_1 \quad Fr = Fr_{\max} \quad N \text{ [lbf]}$$

**X<sub>2</sub>** is the actual distance of **Fr** from the mounting flange to the load for a given application. If **X<sub>2</sub> < X<sub>1</sub>**, **Fr** could also be calculated by the first equation, but in addition the bearing life has to be checked.

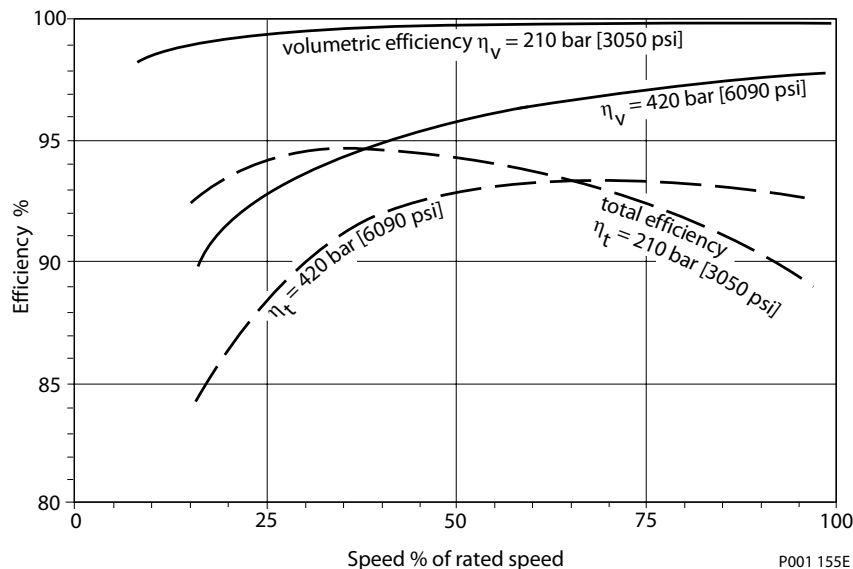
Contact your Danfoss representative for load ratings of specific shafts or when the load orientation deviates more than 35° in either direction from the optimum.

**General technical specifications**

**Efficiency graphs and maps**

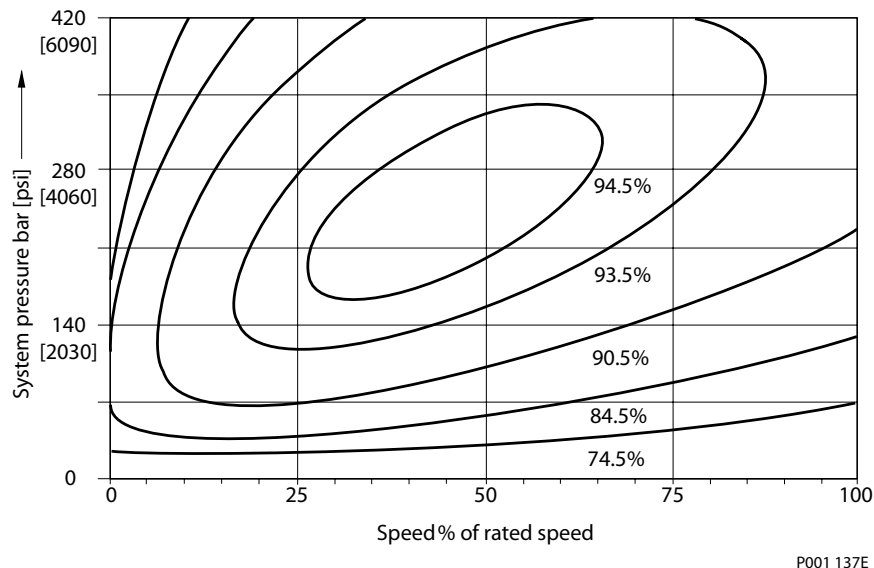
This graph provides the volumetric and overall efficiencies for a typical Series 51 and 51-1 motor operating at maximum displacement, system pressures of 210 and 420 bar [3050 and 6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s [53 SUS]. These efficiencies can be used for all frame sizes.

*Overall and volumetric efficiency at maximum displacement*



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s [53 SUS]. These efficiencies can be used for all frame sizes.

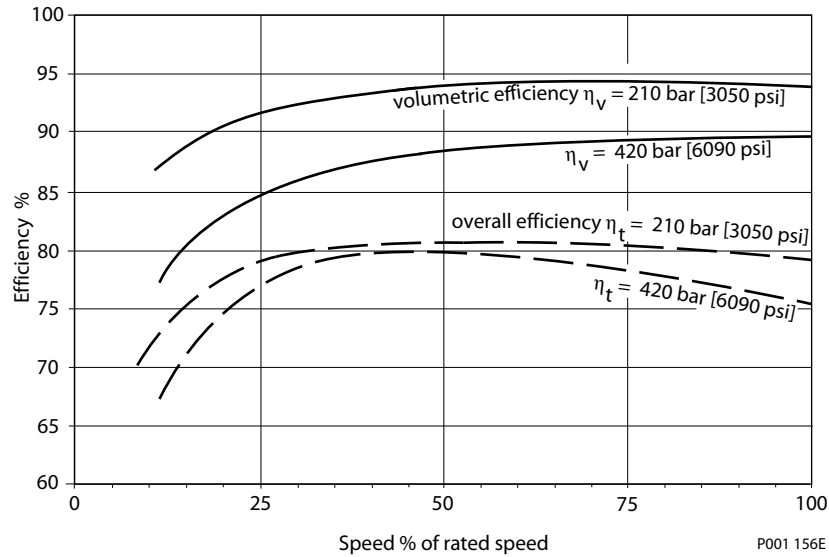
*Overall efficiency at maximum displacement*



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s [53 SUS]. These efficiencies can be used for all frame sizes.

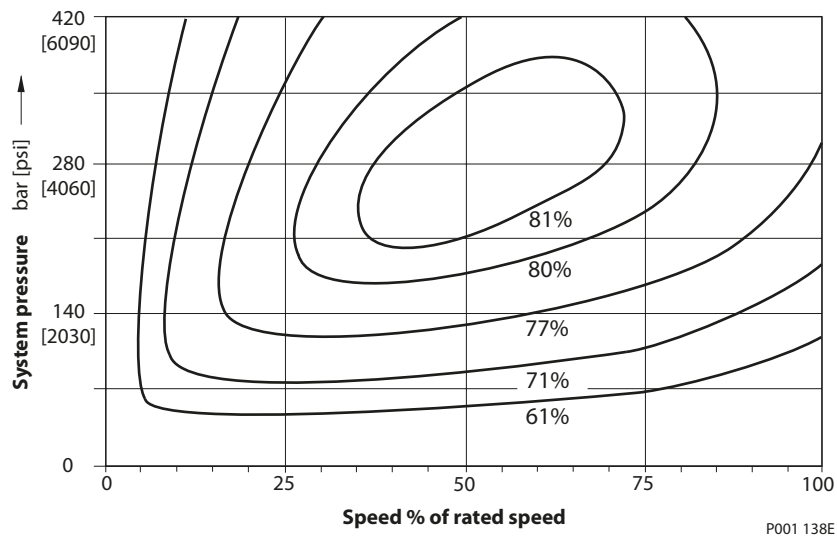
General technical specifications

Overall and volumetric efficiency at 30% of maximum displacement



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm<sup>2</sup>/s (53 SUS). These efficiencies can be used for all frame sizes.

Overall efficiency at 30% of maximum displacement





## General technical specifications

### Speed sensor

An optional speed sensor for direct measurement of speed is available. This sensor may also be used to sense the direction of rotation. A special magnetic speed pick-up ring is pressed onto the outside diameter of the shaft and a Hall effect sensor is located in the motor housing. The sensor accepts supply voltage and outputs a digital pulse signal in response to the speed of the ring. The output changes its high/low state as the north and south poles of the permanently magnetized speed ring pass by the face of the sensor. The digital signal is generated at frequencies suitable for microprocessor based controls. The sensor is available with different connectors (see below). The SAE and DIN flange motors use a flat end speed sensor. The cartridge flange motors use a conical end speed sensor.

#### Data magnetic speed pick-up ring

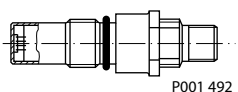
Frame size	060	080	110	160	250
Pulze/Rev	45	49	54	61	71

#### Speed sensor technical data

<b>Supply voltage<sup>1)</sup></b>	4.5 – 8.5 V <sub>DC</sub>
<b>Supply voltage regulated</b>	15 V <sub>DC</sub> max.
<b>Required current</b>	12 mA at 5 V <sub>DC</sub> (no load)
<b>Maximum current</b>	20 mA at 5 V <sub>DC</sub> and 1 Hz
<b>Maximum frequency</b>	15 kHz
<b>Voltage "high"</b>	Supply voltage -0.5 V <sub>DC</sub> min.
<b>Voltage "low"</b>	0.5 V <sub>DC</sub> max.
<b>Temperature range</b>	-40 to 110 °C [-40 to 230 °F]

<sup>1)</sup> It is not acceptable to energize the 4.5-8.5 V<sub>DC</sub> speed sensor with 12 V<sub>DC</sub> battery voltage; it must be energized by a regulated power supply. If it is desirable to energize the sensor with battery voltage, contact your Danfoss representative for an optional speed sensor.

#### Speed sensor with Turck Eurofast 4-pin connector



P001 492

- Pin 1 or A: Supply voltage
- Pin 2 or B: Direction of rotation
- Pin 3 or C: Speed signal, digital
- Pin 4 or D: Ground common

#### Turck Eurofast Connector 4 pin

(Supplied connector)

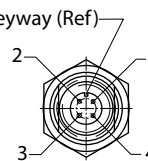
IP Rating (DIN 40 050) IP 67

Mating connector

straight right angle

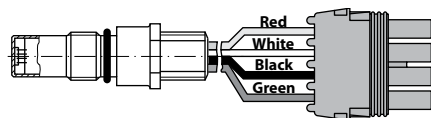
No.: K14956 No.: K14957

Id.-No.: 500724 Id.-No.: 500725



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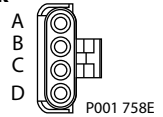
#### Speed sensor with Packard Weather-Pack 4-pin connector



P002 108E

**General technical specifications**

**Packard Weather-Pack**  
**4 pin**  
 (Supplied Connector)  
 Mating Connector  
 No.: K03379  
 Id.-No.: 505341



[Contact your Danfoss representative for more information.](#)

**Typical control and regulator applications**

Application	Control / Regulators														
	without PCOR						with PCOR				with PCOR and BPD				
	N1	HZ	E1, E2, E7	EP, EQ	F1, F2	L1, L2, L7	TA	T1, T2	TH	HS	TA	T1, T2	EP, EQ	D7, D8	HS
Wheel loader <sup>1)</sup>			●		●	●	●	●	●		●	●		●	
Roller compactor <sup>1)</sup>	●	●	●		●										
Paver wheeled <sup>1)</sup>	●		●		●										
Paver tracked <sup>1)</sup>	●		●	●	●	●						●			
Sweeper <sup>1)</sup>		●												●	●
Trencher <sup>1)</sup>	●	●	●												●
Excavator wheeled <sup>1)</sup>									●					●	●
Fork lift truck <sup>1)</sup>						●								●	
Agricultural <sup>1)</sup>				●		●							●	●	
Forestry <sup>1)</sup>								●	●	●		●	●	●	●
Telehandler <sup>1)</sup>							●		●		●	●		●	
Railroad <sup>1)</sup>				●		●						●	●	●	
Snow groomer <sup>1)</sup>	●	●	●	●		●						●	●	●	
Snow blower <sup>2)</sup>			●										●	●	
Crane <sup>3)</sup>			●												

● Suitable configuration

<sup>1)</sup> Propel function

<sup>2)</sup> Blow drive function

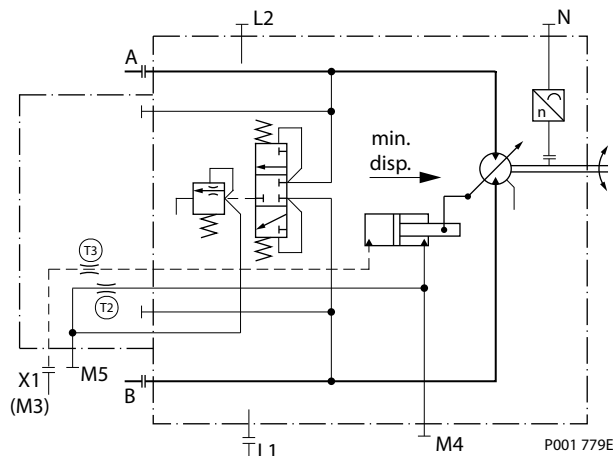
<sup>3)</sup> Winch function

The table above is provided to assist in selecting controls and regulators for various applications. These recommendations are based on experience with a wide range of applications.

[Contact your Danfoss Power Solutions representative for more information on control selection.](#)

**Controls circuit diagram – nomenclature – description**

**Option N1NN – hydraulic two-position control for 51-1 (frame size: 060, 080, 110)**



- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure
- X1 (M3)** = Control pressure
- T1, T2, T3** = Optional orifices
- N** = Speed sensor

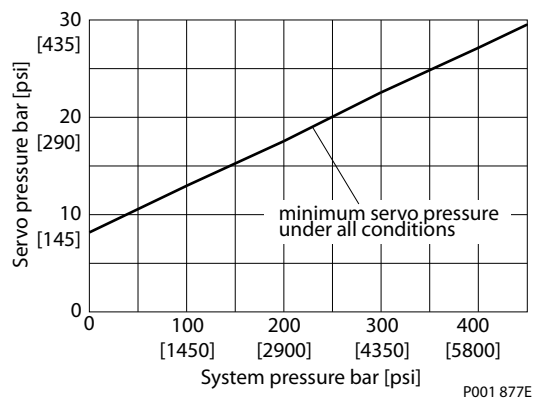
Displacement changes from maximum displacement to minimum displacement position, under load, as control pressure at port X1 (M3) is equal to low pressure or higher.

**Control pressure on port X1 (M3)**

- No pressure on port = maximum displacement
- Control pressure on port = minimum displacement
- Maximum control pressure = 50 bar [725 psi]

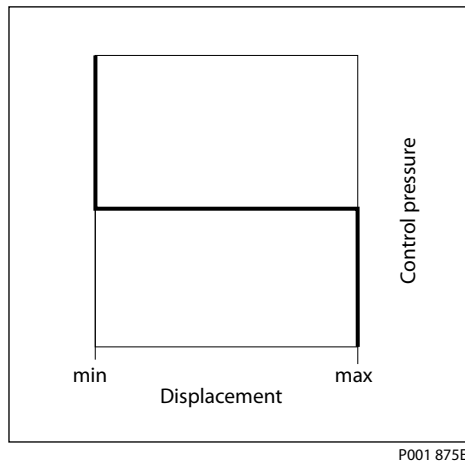
The graph shows the necessary external and internal (= low system pressure) control pressure X1, which is needed to stroke the motor depending on high system pressure.

*Control N1NN necessary control pressure*

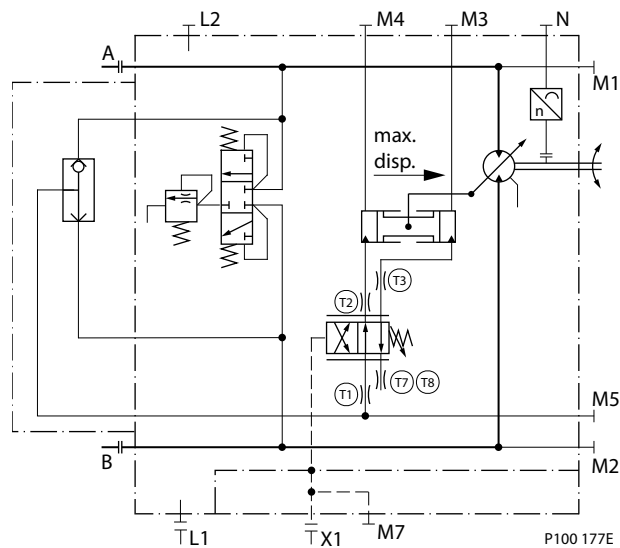


**Controls circuit diagram – nomenclature – description**

Control operation N1NN



Not all control options are shown in this Technical Information.  
 Contact your Danfoss representative for special control functions.

**Option HZB1 – hydraulic two-position control for 51 (frame size: 160, 250)**


- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Servo pressure
- M5** = Gauge port servo supply pressure internal
- M7** = Gauge port control pressure
- X1** = Control pressure
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

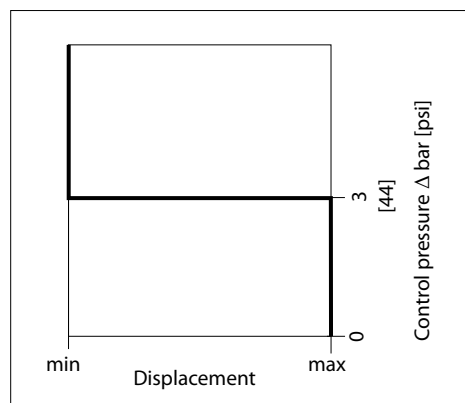
Displacement can be changed hydraulically under load from minimum displacement to maximum displacement and vice versa by control pressure to port X1. For proportional control see [Option HZB1 – hydraulic proportional control for 51 \(all frame sizes\)](#) on page 62

**Control pressure on port X1**

**Controls circuit diagram – nomenclature – description**

No pressure on port = maximum displacement  
Control pressure on port = minimum displacement  
Maximum control pressure = 50 bar [725 psi]  
The standard control start point setting = 3 bar [44 psi]

*Control operation HZB1*



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Not all control options are shown in this Technical Information.

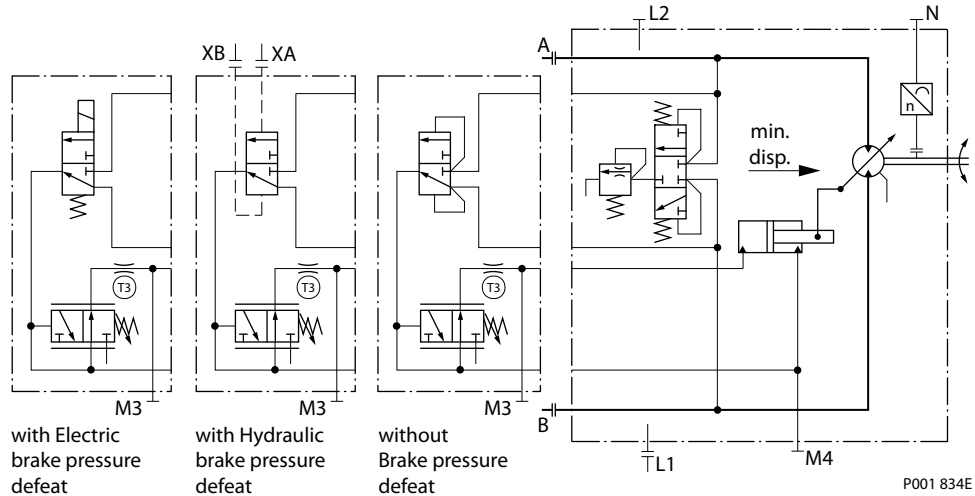
Contact your Danfoss representative for special control functions.

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Controls circuit diagram – nomenclature – description

Options TA\*\* – pressure compensator control for 51-1 (frame size: 060, 080, 110)

Circuit diagram–motor with pressure compensator control TA\*\*



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M3, M4** = Servo pressure
- XA, XB** = Control pressure port brake pressure defeat (BPD)
- T3** = Orifice
- N** = Speed sensor

Displacement is regulated automatically between minimum and maximum displacement in response to system pressure.

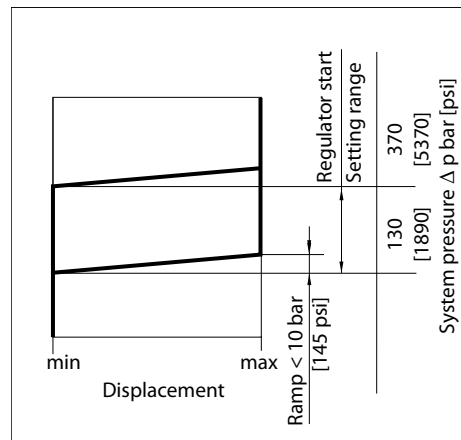
Regulator start = minimum displacement

Regulator end = maximum displacement

Regulator start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Pressure ramp from regulator start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

Control operation TA\*\*



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**Controls circuit diagram – nomenclature – description**
**Option TACA: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, based on the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

\* Differential control pressure between port XA/XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

**Options TAD1, TAD2, TAD7: pressure compensator configuration with electric BPD**

A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

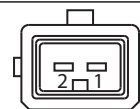
Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

**TAD\* solenoid connectors**

Configuration	Voltage / Electric power	Connector (supplied)
TAD1	12 V <sub>DC</sub> / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>
TAD2	24 V <sub>DC</sub> / 34 W	
TAD7	12 V <sub>DC</sub> / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: <b>508388</b>



P001752



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**Option TAC2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
TAC2	A and B	yes

**Controls circuit diagram – nomenclature – description**

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Not all control options are shown in this Technical Information.  
Contact your Danfoss representative for special control functions.

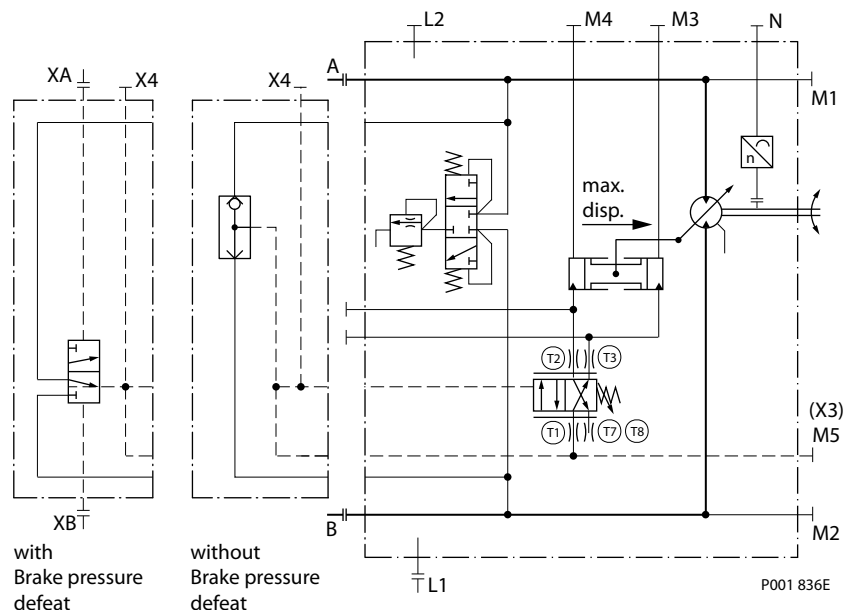
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**Controls circuit diagram – nomenclature – description**

**Options TA\*\* – pressure compensator controls for 51 (frame size 160, 250)**

*Circuit Diagram–Motor with Pressure Compensator Control TA\*\**



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5 (X3)** = Gauge port servo supply
- XA, XB** = Control pressure ports, brake pressure defeat
- X4** = Gauge port pressure compensator
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement is regulated automatically between minimum and maximum displacement in response to system pressure.

Regulator start = minimum displacement

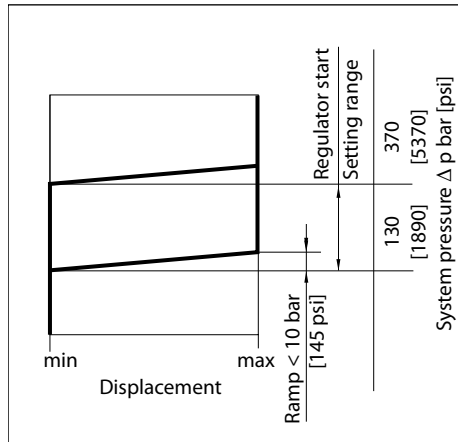
Regulator end = maximum displacement

Regulator start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Pressure ramp from regulator start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

Controls circuit diagram – nomenclature – description

Control operation TA\*\*



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**Option TAC0: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table.

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA/XB:

$\Delta p_{min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{max} = 50 \text{ bar [725 psi]}$

**Option TAC2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
TAC2	A and B	yes

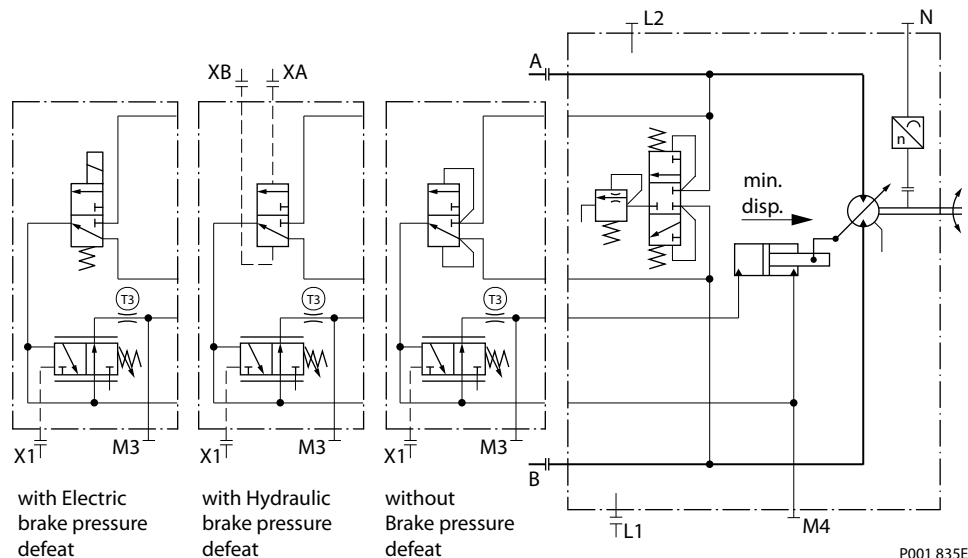
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options TH\*\* – hydraulic two-position control for 51-1 (frame size: 060, 080, 110)**

*Circuit diagram – motor with two-position control TH\*\**



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5 (X3)** = Gauge port servo supply
- XA, XB** = Control pressure ports, brake pressure defeat
- X1** = Hydraulic two-position signal
- X4** = Gauge port pressure compensator
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed hydraulically under load from minimum displacement to maximum displacement and vice versa.

Pressure on port X1 must be equal to the pressure of the motor case  $\pm 0.2$  bar [3.0 psi] this keeps the motor at minimum displacement.

Pressure from 10 bar [145 psi] to 35 bar [510 psi] above case pressure on port X1 strokes the motor to maximum displacement.

**Pressure Compensator OverRide (PCOR)**

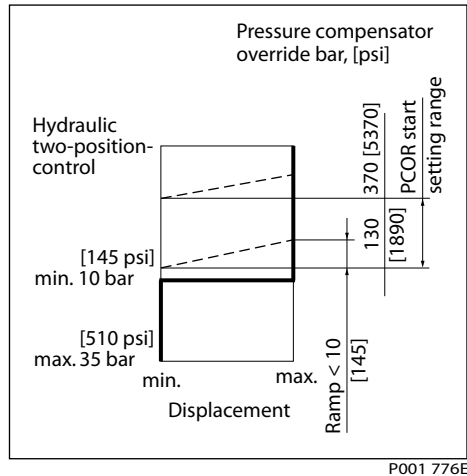
The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

**Controls circuit diagram – nomenclature – description**

Control operation TH\*\*



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**Option THCA: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls. The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, based on the following table:

Pressure compensator operation

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

\* Differential control pressure between port XA / XB:

 $\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$ ;

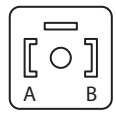
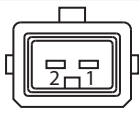
 $\Delta p_{\max} = 50 \text{ bar [725 psi]}$ 
**Options THD1, THD2, THD7: pressure compensator configuration with electric BPD**

A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

**Controls circuit diagram – nomenclature – description**

***THD\* solenoid connectors***

Configuration	Voltage / Electric power	Connector (supplied)	
THD1	12 V <sub>DC</sub> / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>	 P001752
THD2	24 V <sub>DC</sub> / 34 W		
THD7	12 V <sub>DC</sub> / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: <b>508388</b>	 P001751

**Option THC2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
THC2	A and B	yes

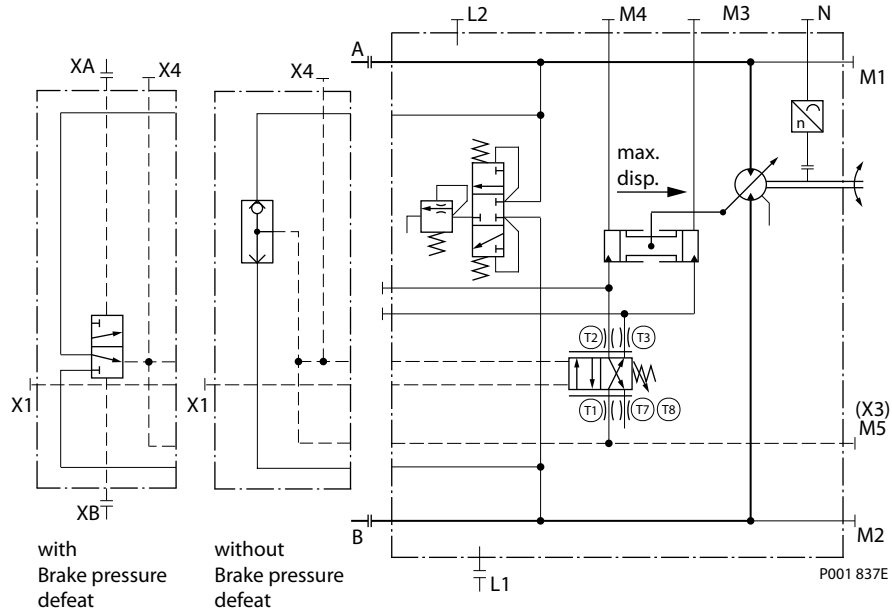
[Not all control options are shown in this Technical Information.](#)

[Contact your Danfoss representative for special control functions.](#)

**Controls circuit diagram – nomenclature – description**

**Options TH\*\* – hydraulic two-position control for 51 (frame size 160, 250)**

*Circuit diagram – motor with two-position control TH\*\**



Ports:

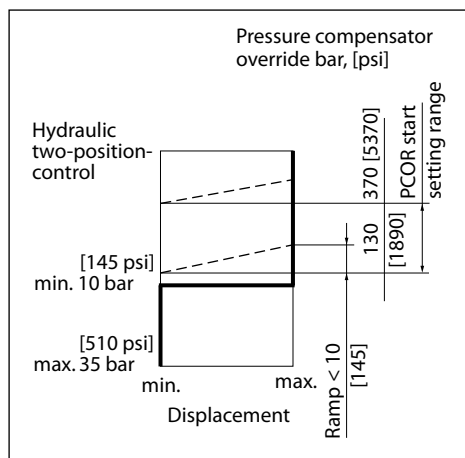
- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5 (X3)** = Gauge port servo supply
- XA, XB** = Control pressure ports, brake pressure defeat
- X1** = Hydraulic two-position signal
- X4** = Gauge port pressure compensator
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

**Pressure Compensator OverRide (PCOR)**

The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

**Controls circuit diagram – nomenclature – description**
*Control operation TH\*\**


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**Option THC0: pressure compensator configuration with hydraulic BPD**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

*Pressure compensator operation*

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA / XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

**Option THC2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
THC2	A and B	yes

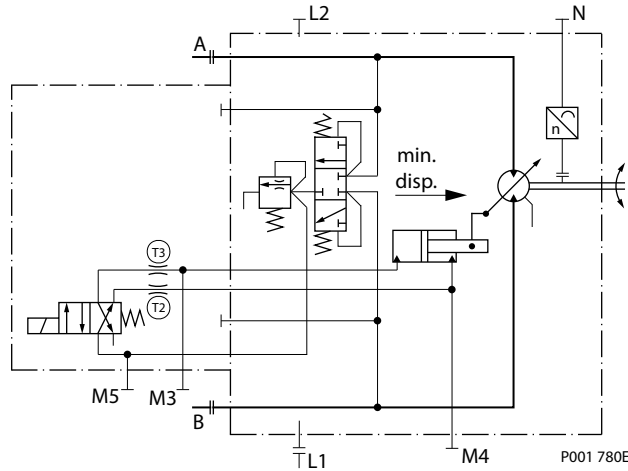
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options E1B1, E2B1, E7B1 – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)**

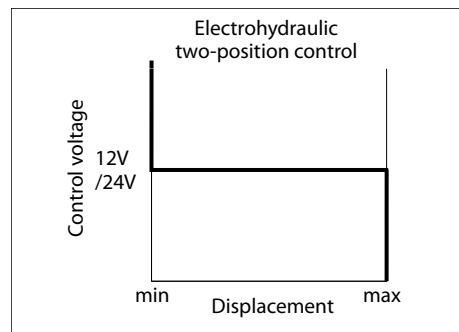
*Circuit diagram – motor with EH two-position control E1B1, E2B1, E7B1*



- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M3, M4** = Servo pressure
- M5** = Gauge port servo supply pressure internal
- T2, T3** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

*Control operation E1B1, E2B1, E7B1*



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**Options:**

Solenoid off = max. displacement

Solenoid on = min. displacement

**Pilot pressure for solenoid:**

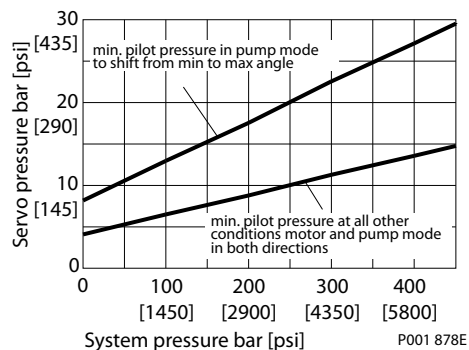
internal = low pressure

The graph shows the necessary servo pressure (= low pressure), which is needed to stroke the motor, depending on high system pressure and the pump or motor mode.

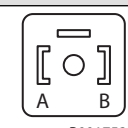
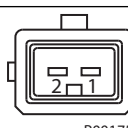


**Controls circuit diagram – nomenclature – description**

*Control E\*B1 necessary low system pressure*



**E1B1, E2B1, E7B1 solenoid connectors**

Configuration	Voltage / Electric power	Connector (supplied)	
E1B1	12 V <sub>DC</sub> / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>	 P001752
E2B1	24 V <sub>DC</sub> / 34 W		
E7B1	12 V <sub>DC</sub> / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: <b>508388</b>	 P001751

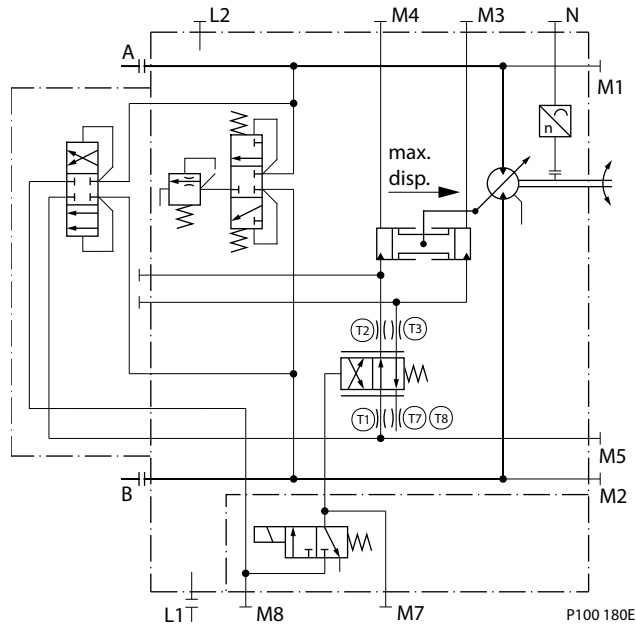
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options E1A5, E2A5 – electrohydraulic two-position control for 51 (frame size 160, 250)**

*Circuit diagram – motor with control options: E1A5, E2A5*

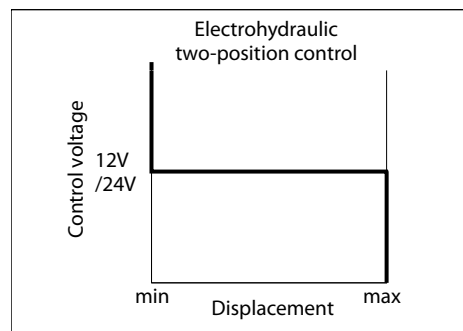


Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure, internal
- M7, M8** = Gauge port control pressure, internal
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

*Control operation E1A5, E2A5*



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**Options:**

Solenoid off = max. displacement

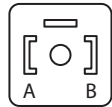
Solenoid on = min. displacement

**Pilot pressure for solenoid:**

**Controls circuit diagram – nomenclature – description**

internal = low pressure

**E1A5, E2A5 solenoid connectors**

Configuration	Voltage / Electric power	Connector (Supplied)	
E1A5	12 V <sub>DC</sub> / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>	 P001752
E2A5	24 V <sub>DC</sub> / 14.7 W		

Not all control options are shown in this Technical Information.

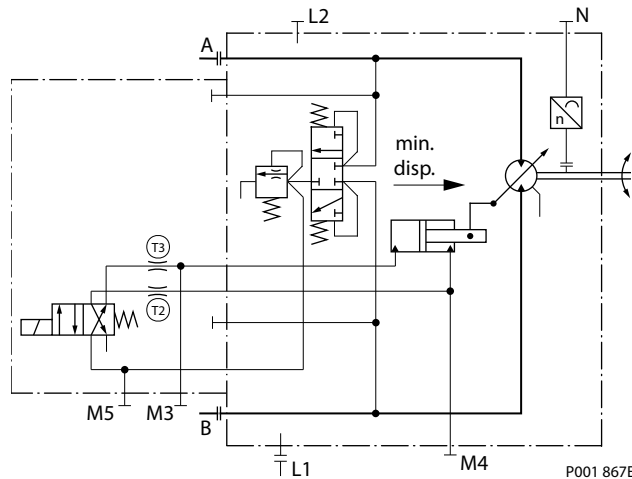
Contact your Danfoss representative for special control functions.

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**Controls circuit diagram – nomenclature – description**

**Options F1B1, F2B1 – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)**

*Circuit diagram – motor with control options: F1B1, F2B1*

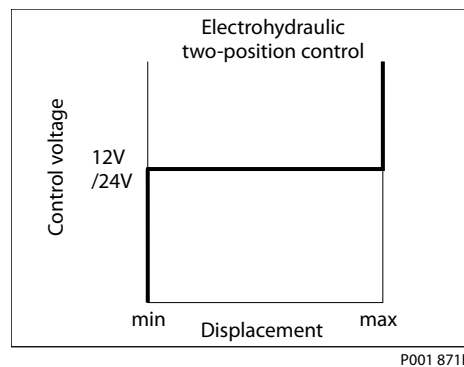


Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M3, M4** = Servo pressure
- M5** = Gauge port servo supply pressure internal
- T2, T3** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

*Control operation F1B1, F2B1*



**Options:**

- Solenoid off = min. displacement
- Solenoid on = max. displacement

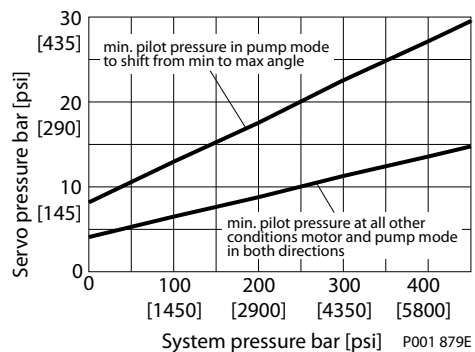
**Pilot pressure for solenoid:**

internal = low pressure

The graph shows the necessary servo pressure (= low pressure), which is needed to stroke the motor, depending on high system pressure and the pump or motor mode.

**Controls circuit diagram – nomenclature – description**

*Control F1B1, F2B1 necessary low system pressure*



**F1B1, F2B1 solenoid connectors**

Configuration	Voltage / Electric power	Connector (Supplied)	
F1B1	12 V <sub>DC</sub> / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>	
F2B1	24 V <sub>DC</sub> / 14.7 W		

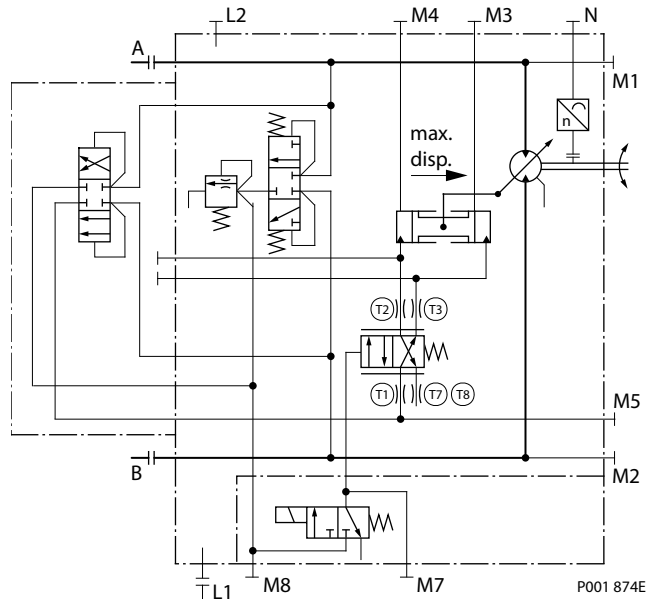
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options F1A5, F2A5 – electrohydraulic two-position control for 51 (frame size 160, 250)**

*Circuit diagram – motor with control options: F1A5, F2A5*

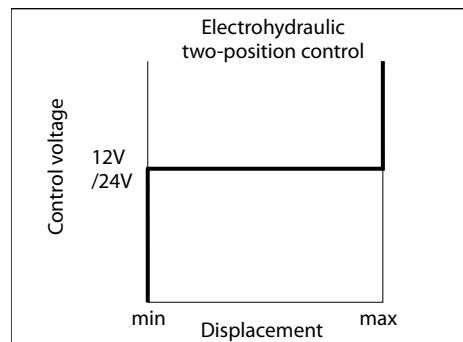


Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure, internal
- M7, M8** = Gauge port control pressure, internal
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

*Control operation F1A5, F2A5*



**Options:**

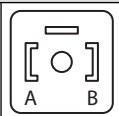
- Solenoid off = min. displacement
- Solenoid on = max. displacement

**Pilot pressure for solenoid:**

**Controls circuit diagram – nomenclature – description**

internal = low pressure

**F1A5, F2A5 solenoid connectors**

Configuration	Voltage / Electric power	Connector (Supplied)	
F1A5	12 V <sub>DC</sub> / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>	
F2A5	24 V <sub>DC</sub> / 14.7 W		

Not all control options are shown in this Technical Information.

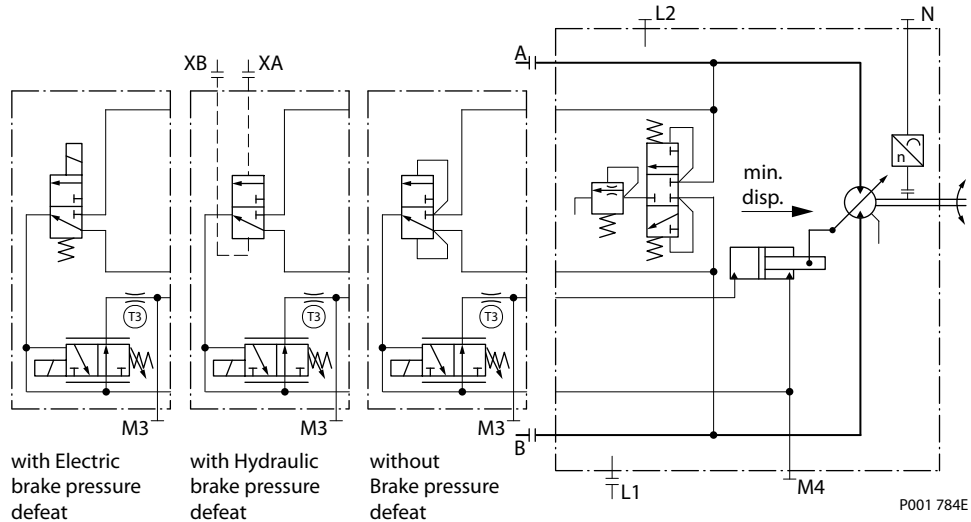
Contact your Danfoss representative for special control functions.

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**Controls circuit diagram – nomenclature – description**

**Options T1\*\*, T2\*\*, T7\*\* – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)**

*Circuit diagram – motor with electrohydraulic two-position control T1\*\*, T2\*\*, T7\*\**



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M3, M4** = Gauge port servo pressure
- XA, XB** = Control pressure ports, brake pressure defeat
- T3** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from minimum displacement to maximum displacement and vice versa, by using a solenoid. When the solenoid is energized the motor has maximum displacement and the pressure compensator does not function.

Solenoid not energized = minimum displacement

Solenoid energized = maximum displacement

**Pressure Compensator Override (PCOR)**

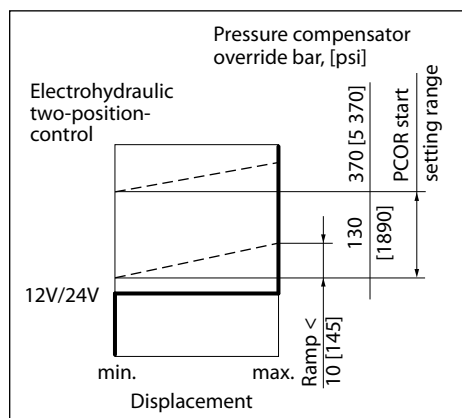
The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].



**Controls circuit diagram – nomenclature – description**

Control operation T1\*\*, T2\*\*, T7\*\*



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**Option T\*CA: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

\* Differential control pressure between port XA/XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

**Options T\*D1, T\*D2, T\* D7: pressure compensator configuration with electric BPD**

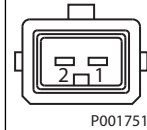
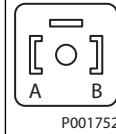
A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

**Controls circuit diagram – nomenclature – description**
***T1D1, T2D2, T7D7 solenoid connectors***

Configuration	Voltage / Electric power	Connector (Supplied)
T1D1	12 V <sub>DC</sub> / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>
T2D2	24 V <sub>DC</sub> / 34 W	
T7D7	12 V <sub>DC</sub> / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: <b>508388</b>


**Option T\*C2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
T*C2	A and B	yes

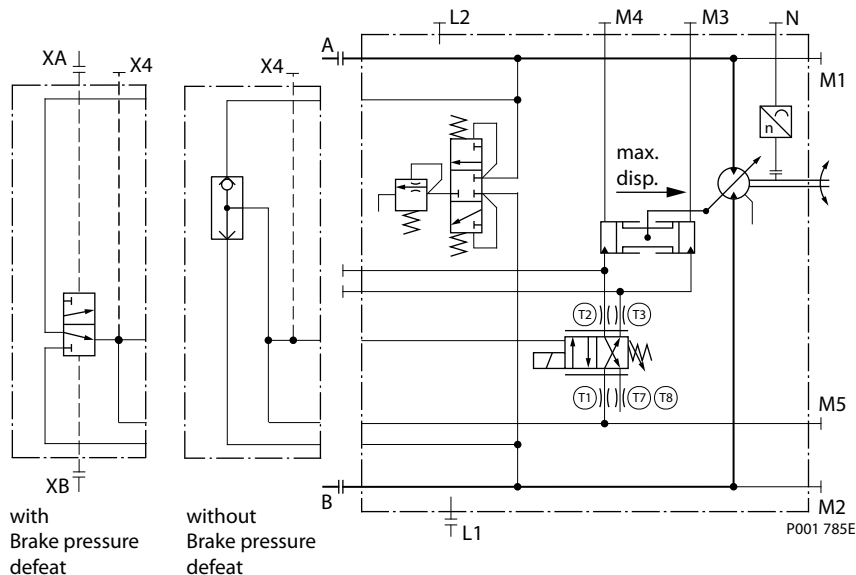
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options T1\*\*, T2\*\* – electrohydraulic two-position control for 51 (frame size 160, 250)**

*Circuit diagram – motor with electrohydraulic two-position control T1\*\*, T2\*\**



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply
- XA, XB** = Control pressure ports, brake pressure defeat
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load from minimum displacement to maximum displacement and vice versa, by using a solenoid. When the solenoid is energized the motor has maximum displacement and the pressure compensator does not function.

Solenoid not energized = minimum displacement

Solenoid energized = maximum displacement

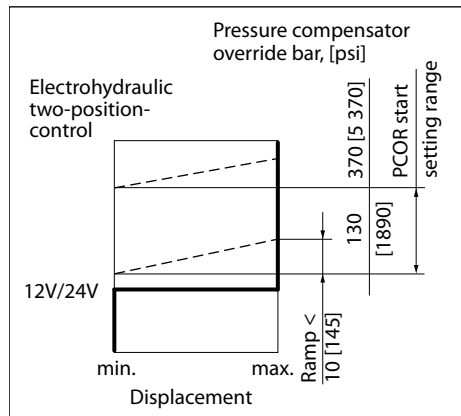
**Pressure Compensator OverRide (PCOR)**

The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

**Controls circuit diagram – nomenclature – description**

Control operation T1\*\*, T2\*\*



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**Option T\*C0: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA/XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

**Option T\*C2: pressure compensator configuration without Brake Pressure Defeat**

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
T*C2	A and B	yes

**T1C2, T2C2 solenoid connectors**

Configuration	Voltage / Electric power	Connector (Supplied)
T1C2	12 V <sub>DC</sub> / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: <b>514117</b>
T2C2	24 V <sub>DC</sub> / 14.7 W	

P001752

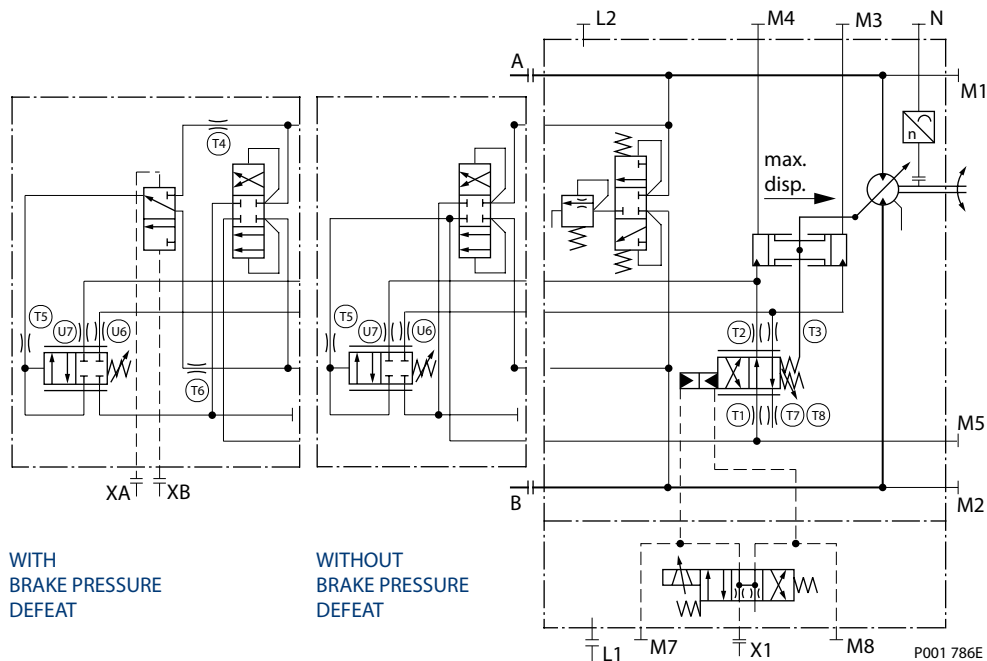
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options EP\*\*, EQ\*\* – electrohydraulic proportional control for 51 (all frame sizes)

Circuit diagram – motor with electrohydraulic proportional control EP\*\*, EQ\*\*



Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure internal
- M7, M8** = Gauge port control pressure internal
- X1** = Port for control supply pressure external
- XA, XB** = Control pressure ports, BPD
- T1, T2, T3, T4, T5, T6, T7, T8, U6, U7** = Optional orifices
- N** = Speed sensor

Displacement can be changed under load in response to an electrical signal between maximum displacement and minimum displacement and vice versa.

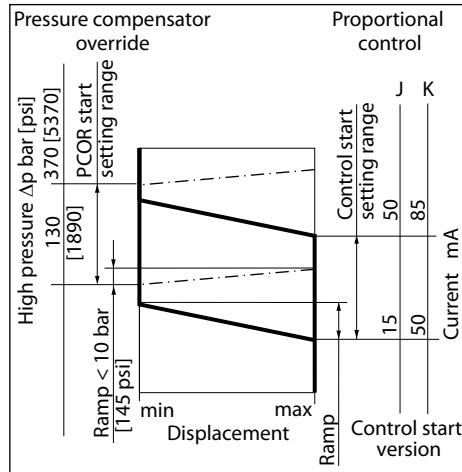
Control start = maximum displacement  
Control end = minimum displacement

**Control supply pressure (port X1)**

$p_{min} = 20 \text{ bar [290 psi]}$   
 $p_{max \text{ allowable}} = 70 \text{ bar [1015 psi]}$

Controls circuit diagram – nomenclature – description

Control operation EP\*\*, EQ\*\*



P001 172E

Control setting options

Type	Start current (adjustable)*	Standard setting: control start	Ramp**	Coil wiring
JY	15 to 50 mA	30 = 30 mA	70 mA	Single Coil resistance = 26 Ω
JW			95 mA	
KY	50 to 85 mA	70 = 70 mA	70 mA	
KW			95 mA	

\* Max. current = 250 mA

\*\* from max. to min. displacement; full stroke current.

Connectors

**MS Connector**  
**MS3102C-14S-2P**  
(Supplied Connector)

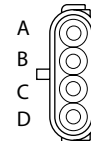
Mating Connector  
No.: K08106  
Id.-No.: 615062



P001 753E

**Packard Weather-Pack**  
**4 pin**  
(Supplied Connector)

Mating Connector  
No.: K03384  
Id.-No.: 712208



P001 759E

Wiring (maximum to minimum displacement)

Coil wiring	Positive voltage on pin	Ground on pin
Single coil	B	A
Single coil (alt.)	D	C

**Pressure Compensator Override (PCOR)**

The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases to maximum.

Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

**Controls circuit diagram – nomenclature – description**

Configuration option	PCOR at port	BPD function
EPA1/EQA1	A and B	with
EPA2/EQA2	A and B	without

**Options EPA1, EQA1: pressure compensator configuration with Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

*Pressure compensator operation*

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA/XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

**Options EPA2, EQA2: pressure compensator configuration without Brake Pressure Defeat**

The pressure compensator override functions when the motor is running in motor mode as well as in pump (deceleration) mode.

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[Not all control options are shown in this Technical Information.](#)

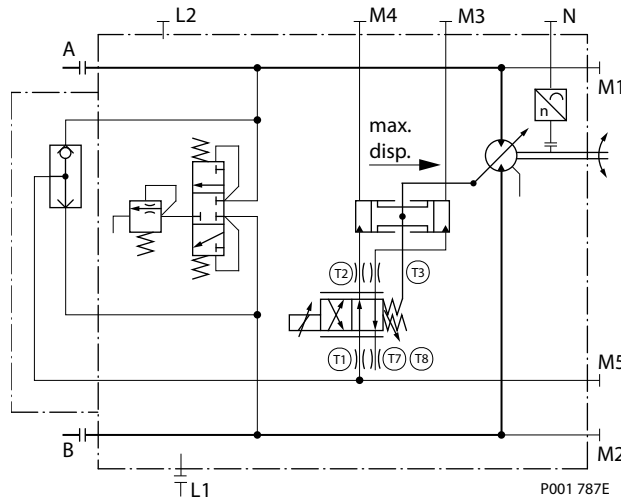
[Contact your Danfoss representative for special control functions.](#)

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**Controls circuit diagram – nomenclature – description**

**Options L1B1, L2B1, L7B1 – electrohydraulic propor. control for 51 (all frame sizes)**

*Circuit diagram – motor with electrohydraulic propor. control L1B1, L2B1, L7B1*



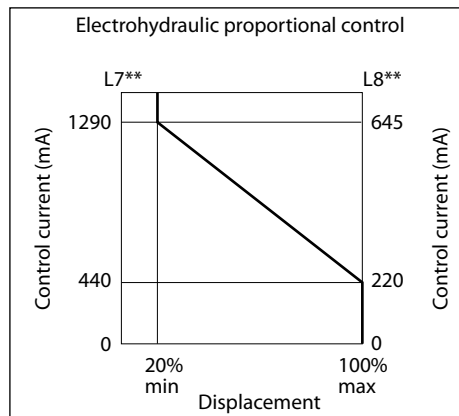
Ports:

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure internal
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load in response to an electrical signal from minimum displacement to maximum displacement and vice versa. The displacement changes proportional to the electrical signal. The electrical signal must be a pulse-width modulated (PWM) signal, (f = 100...200 Hz).

Control start = maximum displacement  
Control end = minimum displacement

*Control operation L1\*\*, L2\*\*, L7\*\**

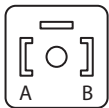
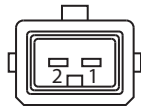


P001 777E



**Controls circuit diagram – nomenclature – description**

**L1B1, L2B1, L7B1 solenoid connectors**

Solenoid plug face DIN 46350 (Supplied)	AMP Junior Timer two-pin (Supplied)
 P001752 Mating connector No.: K09129 Id. No.: <b>514117</b>	 P001751 Mating connector No.: K19815 Id. No.: <b>508388</b>

*Solenoid data*

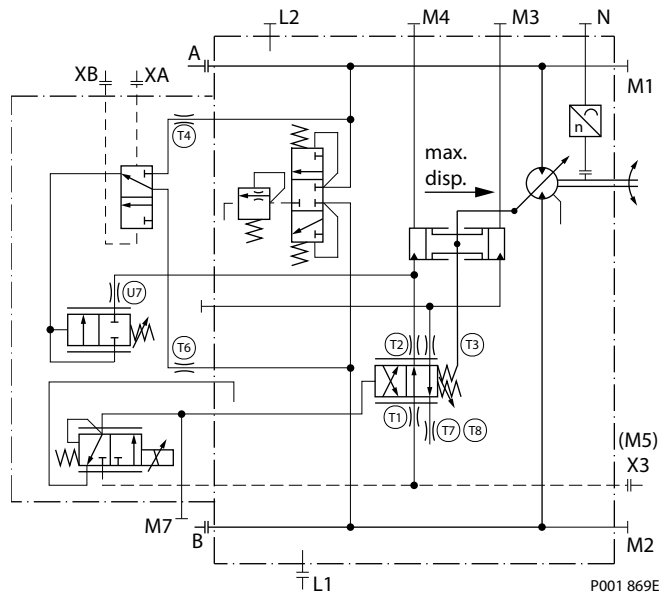
Configuration	Voltage	Nominal resistance 20 °C	Control current			Connector
			Start	End	Max.	
L1B1	12 V <sub>DC</sub>	5.7 Ω	440 mA	1290 mA	1500 mA	DIN 46350
L7B1						AMP Junior Timer
L2B1	24 V <sub>DC</sub>	21.3 Ω	220 mA	645 mA	750 mA	DIN 46350

Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**
**Options D7M1, D8M1 – electrohydraulic proportional control with PCOR and hydraulic BPD for 51 (all frame sizes)**

Circuit diagram – motor with EH prop. control D7M1, D8M1


**Ports:**

- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- X3 (M5)** = Servo pressure supply
- M7** = Gauge port control pressure
- XA, XB** = Control pressure ports, hydraulic BPD
- T1, T2, T3, T4, T6, T7, T8, U7** = Optional orifices
- N** = Speed sensor

Displacement can be changed electrohydraulically under load in response to an electrical signal from minimum displacement to maximum displacement and vice versa. The displacement changes proportional to the electrical signal. The electrical signal must be a pulse-width modulated (PWM) signal, ( $f = 100 \dots 200$  Hz).

Solenoid not energized = maximum displacement

Solenoid energized = minimum displacement

Servo pressure supply = external pressure at port **X3**

Min. pressure = 25 bar [360 psi]

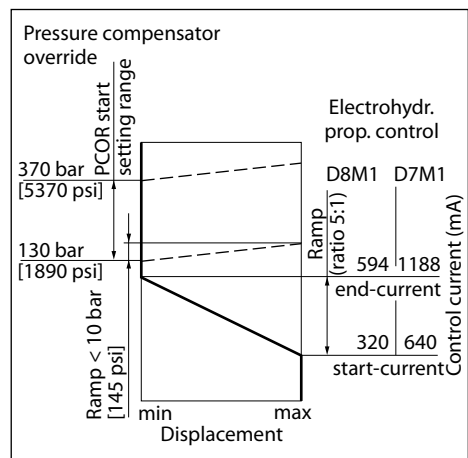
Max. pressure = 50 bar [725 psi]

**Pressure Compensator Override (PCOR)**

The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases to maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

**Controls circuit diagram – nomenclature – description**
*Control operation D7M1, D8M1*


P001 873E

**Options D7M1, D8M1: pressure compensator configuration with hydraulic Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA/XB:

$\Delta p_{\min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{\max} = 50 \text{ bar [725 psi]}$

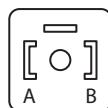
**D7M1, D8M1 solenoid connector**

Solenoid connector

**Plug face DIN 46350** (Supplied)

Mating connector No.: K09129

Id. No.: **514117**



P001752

Configuration	Voltage	Nominal resistance 20 °C	Control current			Connector
			Start	End	Max.	
D7M1	12 V <sub>DC</sub>	5.7 Ω	640 mA	1188 mA	1500 mA	AMP Junior Timer two-pin
D8M1	24 V <sub>DC</sub>	21.2 Ω	320 mA	594 mA	750 mA	

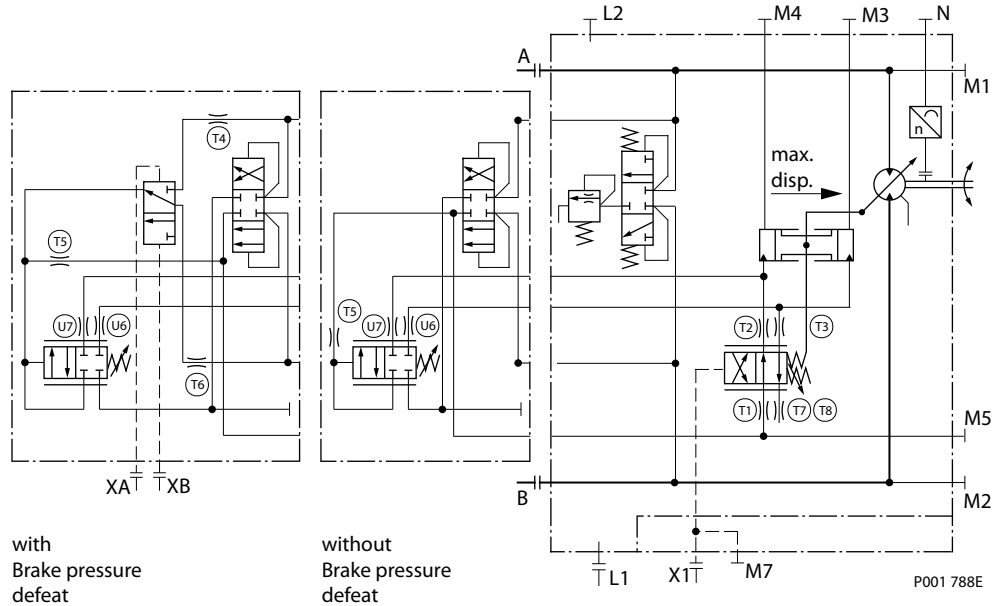
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

**Controls circuit diagram – nomenclature – description**

**Options HS\*\* – hydraulic proportional control for 51 (all frame sizes)**

*Circuit diagram – motor with hydraulic proportional control HS\*\**



with  
Brake pressure  
defeat

without  
Brake pressure  
defeat

**A, B** = Main pressure lines

**L1, L2** = Drain lines

**M1, M2** = Gauge port for A and B

**M3, M4** = Gauge port servo pressure

**M5** = Gauge port servo supply pressure

**M7** = Gauge port control pressure

**X1** = Port for control supply pressure external

**XA, XB** = Control pressure ports, BPD

**T1, T2, T3, T4, T5, T6, T7, T8, U6, U7** = Optional orifices

**N** = Speed sensor

Displacement can be changed in response to a hydraulic signal under load between maximum displacement and minimum displacement and vice versa.

Control start = maximum displacement

Control end = minimum displacement

**Control pressure (Port X1)**

External = absolute pressure

Control start setting range (pressure above case pressure)	
P <sub>start</sub>	3 to 5 bar [44 to 73 psi]
	5 to 12 bar [73 to 175 psi]
	12 to 30 bar [175 to 435 psi]
P <sub>max allowable</sub>	control start pressure + 50 bar [725 psi]

Control ramp	
From 100% to 20% displacement	7 bar [102 psi]
From 100% to 20% displacement	14 bar [203 psi]

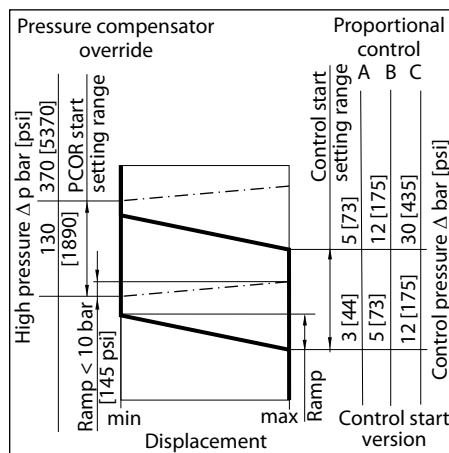
**Pressure Compensator OverRide (PCOR)**

The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases to maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal

**Controls circuit diagram – nomenclature – description**

power utilization throughout the entire displacement range of the motor. PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

*Control Operation HS\*\**



P001 171E

Configuration	PCOR at port	BPD function
HSA1	A and B	with
HSA2	A and B	without

**Option HSA1: pressure compensator configuration with Brake Pressure Defeat**

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

\* Differential control pressure between port XA/XB:

$\Delta p_{min} = 0.5 \text{ bar [7 psi]}$

$\Delta p_{max} = 50 \text{ bar [725 psi]}$

**Option HSA2: pressure compensator configuration without Brake Pressure Defeat**

The pressure compensator override functions when the motor is running in motor mode as well as in pump (deceleration) mode.

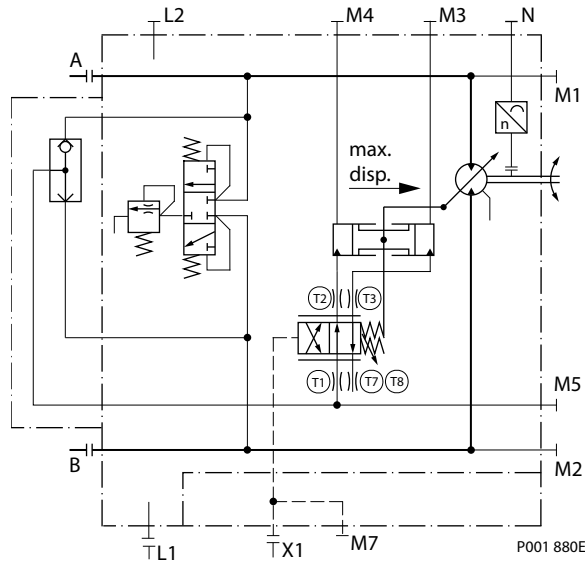
[Not all control options are shown in this Technical Information.](#)

[Contact your Danfoss representative for special control functions.](#)

**Controls circuit diagram – nomenclature – description**

**Option HZB1 – hydraulic proportional control for 51 (all frame sizes)**

*Circuit diagram – motor with hydraulic propor. control HZB1*



- A, B** = Main pressure lines
- L1, L2** = Drain lines
- M1, M2** = Gauge port for A and B
- M3, M4** = Gauge port servo pressure
- M5** = Gauge port servo supply pressure internal
- M7** = Gauge port control pressure
- X1** = Control pressure port
- T1, T2, T3, T7, T8** = Optional orifices
- N** = Speed sensor

Displacement can be changed in response to a hydraulic signal under load between maximum displacement and minimum displacement and vice versa.

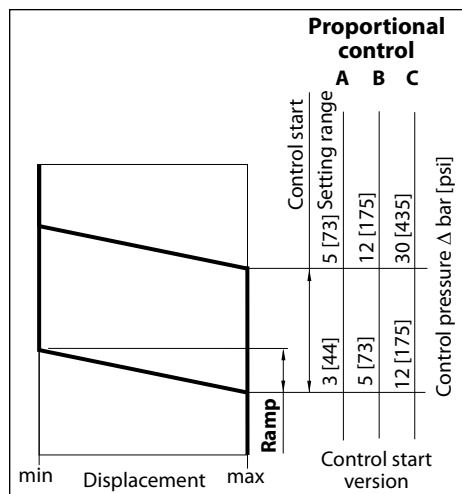
Control start = maximum displacement  
Control end = minimum displacement

**Control pressure on port X1**

External = absolute pressure

**Controls circuit diagram – nomenclature – description**

*Control Operation HZB1*



P001 881E

<b>Control start setting range (pressure above case pressure)</b>	
P <sub>start</sub>	3 to 5 bar [44 to 73 psi]
	5 to 12 bar [73 to 175 psi]
	12 to 30 bar [175 to 435 psi]
P <sub>max allowable</sub>	control start pressure + 50 bar [725 psi]

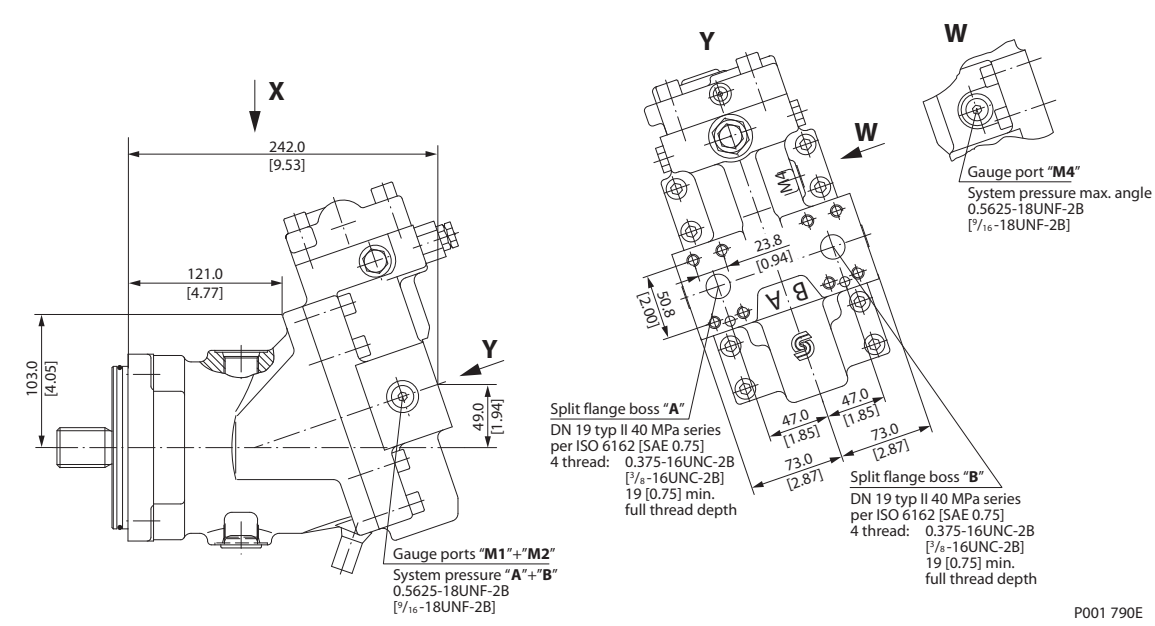
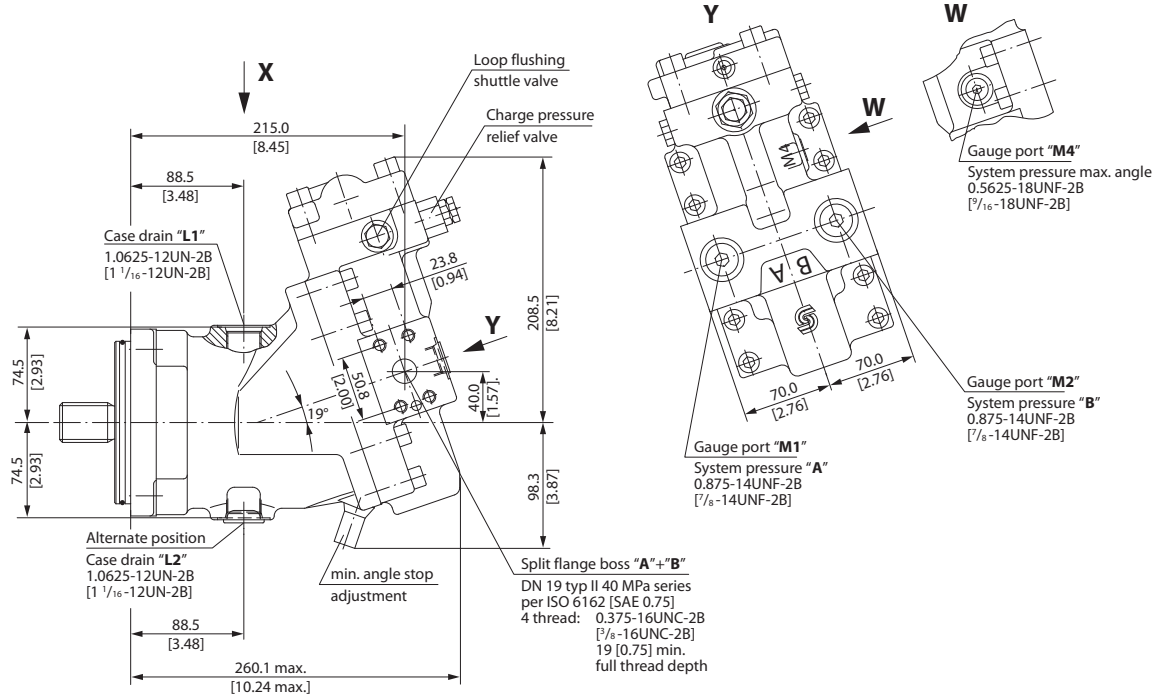
<b>Control ramp</b>	
From 100% to 20% displacement	7 bar [102 psi]
From 100% to 20% displacement	14 bar [203 psi]

Not all control options are shown in this Technical Information.  
 Contact your Danfoss representative for special control functions.

General dimensions – frame size 060

SAE flange design per ISO 3019/1

51V060-1 Two Position Control, N1NN (Side port on top, Axial port below)

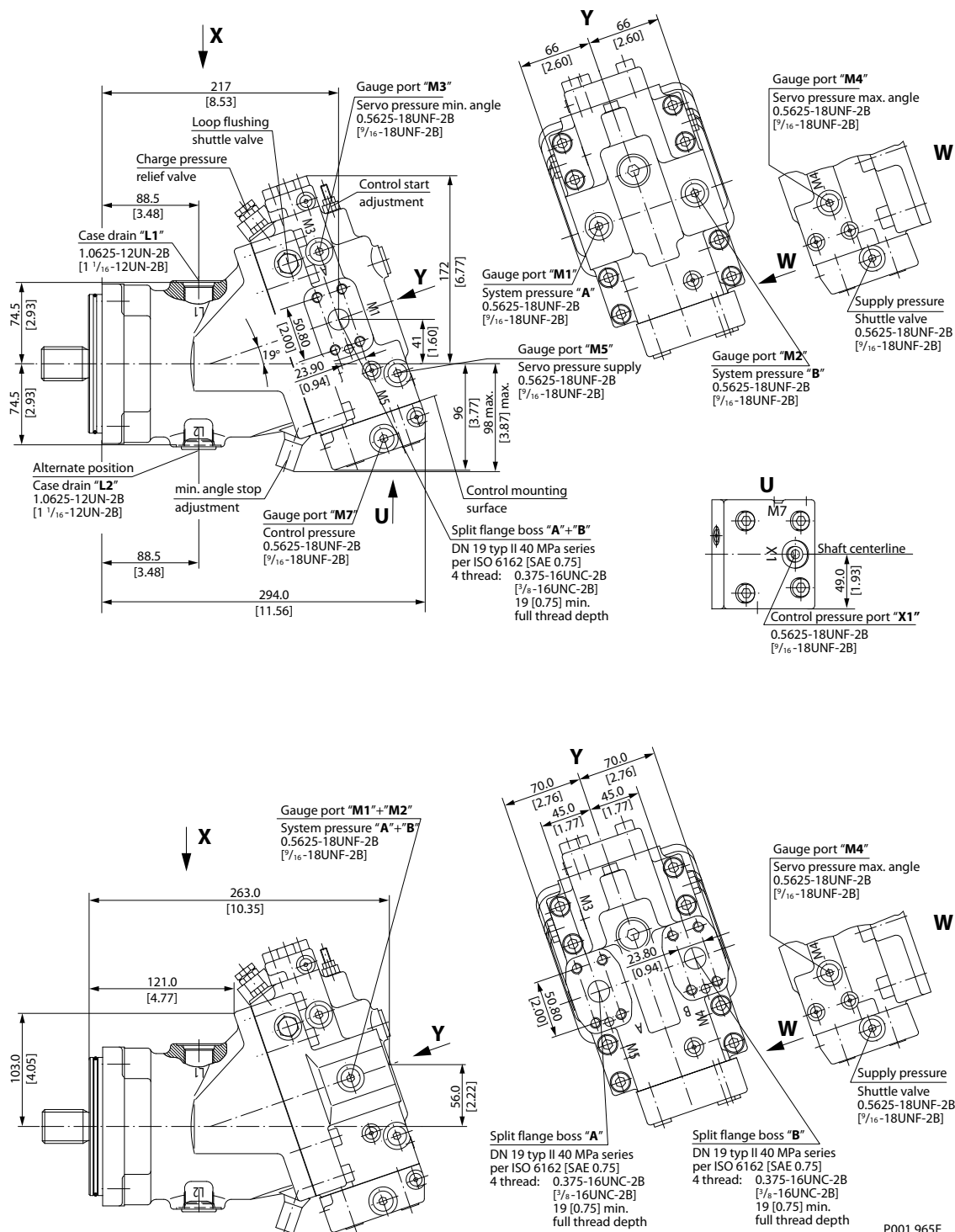


P001 790E



General dimensions – frame size 060

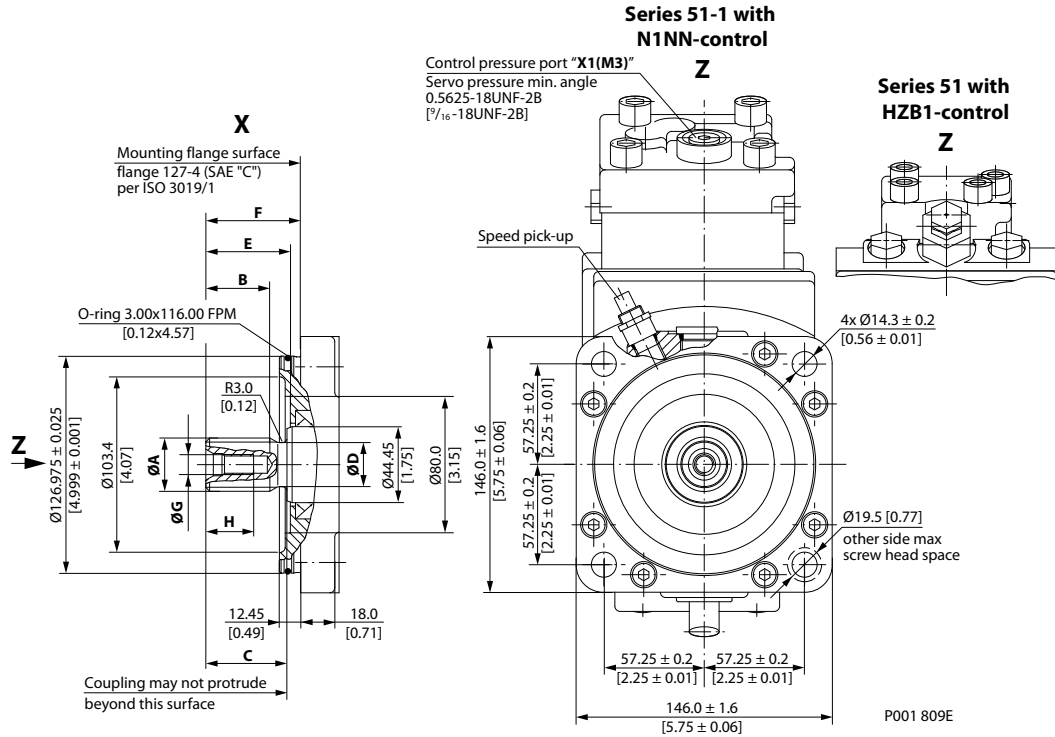
51V060 Proportional and Two Position Control, HZB1 (Side port on top, Axial port below)



P001 965E

**General dimensions – frame size 060**

Shaft options – 51V060-1 and 51V060



Shaft spline data - mm [in]

Shaft option	S1	C6
Number of teeth	14	21
Pitch	12/24	16/32
Pitch Ø	29.633 [1.167]	33.337 [1.312]
Ø A	31.15 [1.23]	34.43 [1.36]
Ø D	25.8 [1.02]	30.0 [1.18]
Pressure angle	30°	
B	37.5 [1.476]	
C	47.5±0.5 [1.87]	
E	50.3±1.2 [1.98]	
F	55.5±0.7 [2.19]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.4375-14UNC-2B [7/16-14UNC-2B]; allowed torque in thread max. 91 N•m [805 lbf-in]	

 Flow into port **A** results in **CW** rotation of output shaft.

 Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

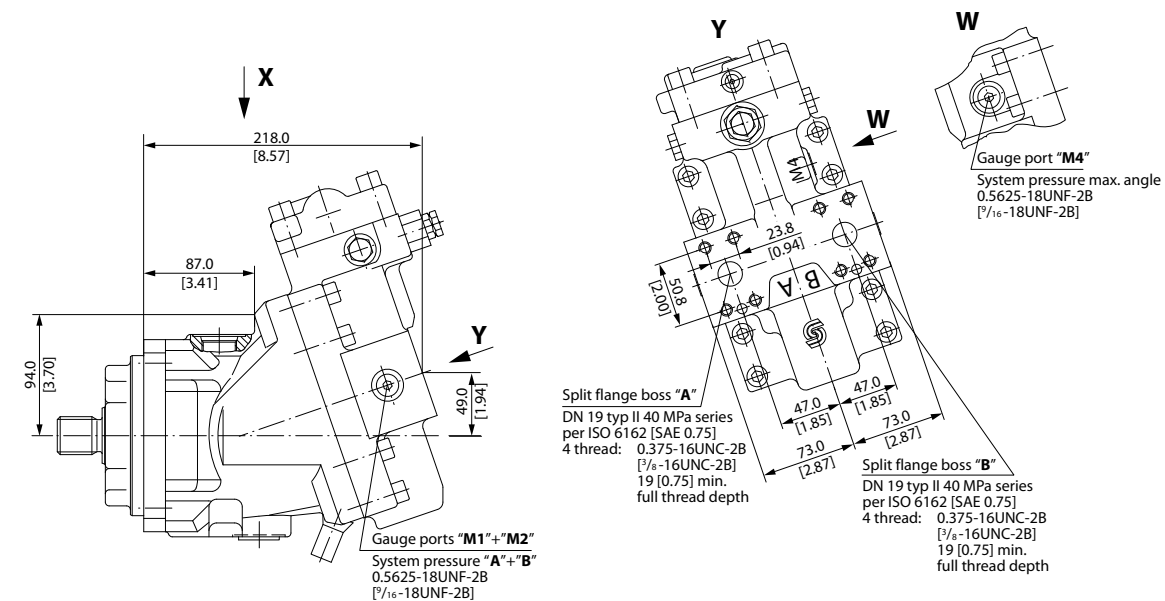
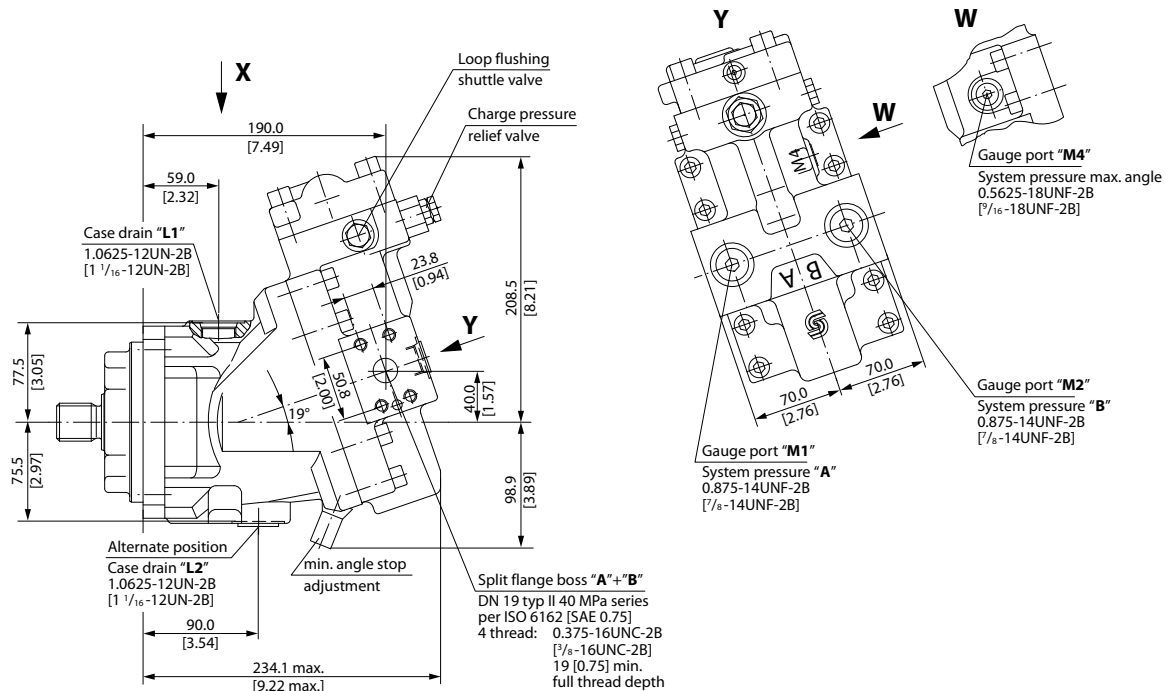
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 060

DIN flange design per ISO 3019/2

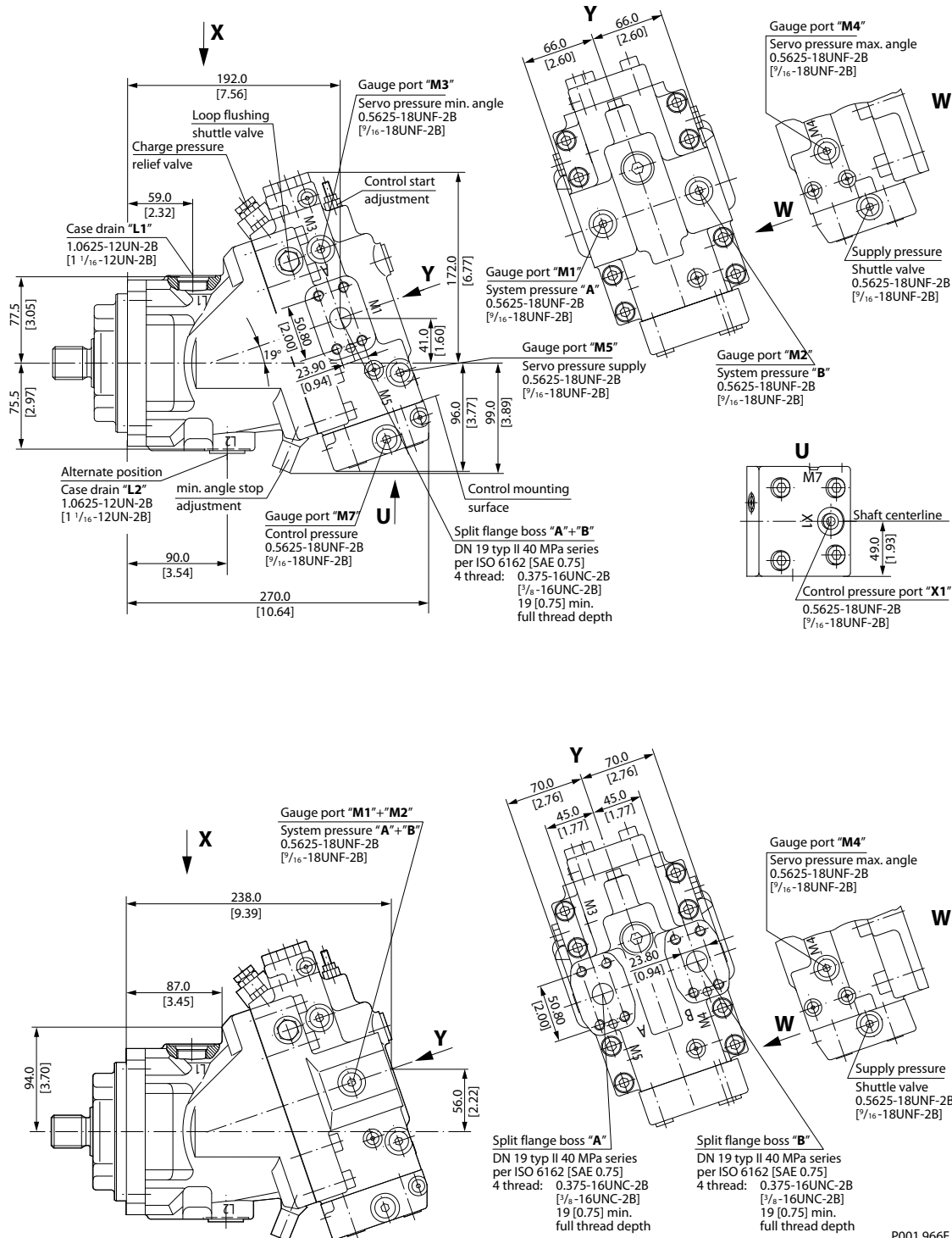
51D060-1 two position control, N1NN (Side port on top, Axial port below)



P001 791E

General dimensions – frame size 060

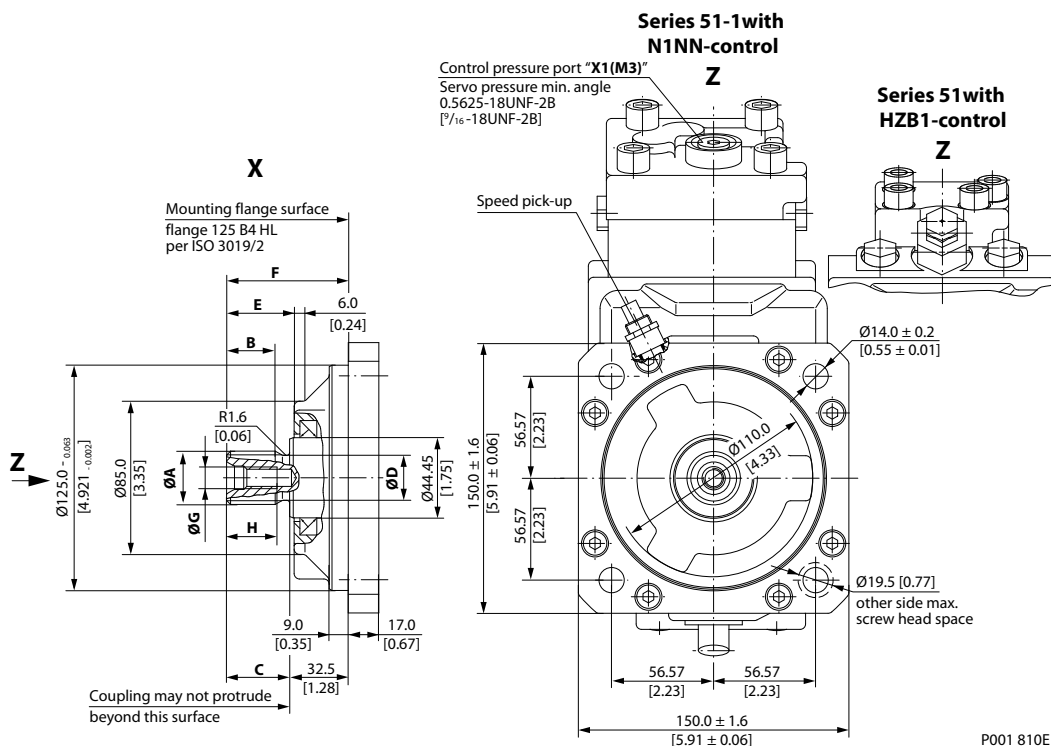
51D060 proportional and two position control, HZB1 (Side port on top, Axial port below)



P001 966E

**General dimensions – frame size 060**

Shaft options – 51D060-1 and 51D060



P001 810E

**Shaft spline data - mm [in]**

Shaft option	D1	D2
Number of teeth	14	16
Spline	W30x2x30x14x9g, side fit DIN 5480	W35x2x30x16x9g side fit DIN 5480
Pitch Ø	28.0 [1.102]	32.0 [1.260]
Ø A	29.6 [1.17]	34.6 [1.36]
B	27.0 [1.06]	32.0 [1.260]
C	35.0±0.5 [1.38]	40.0±0.5 [1.58]
Ø D	25.0 [0.98]	30.0 [1.18]
E	37.5±1.1 [1.48]	42.5±1.1 [1.67]
F	67.5±0.6 [2.66]	72.5±0.6 [2.85]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

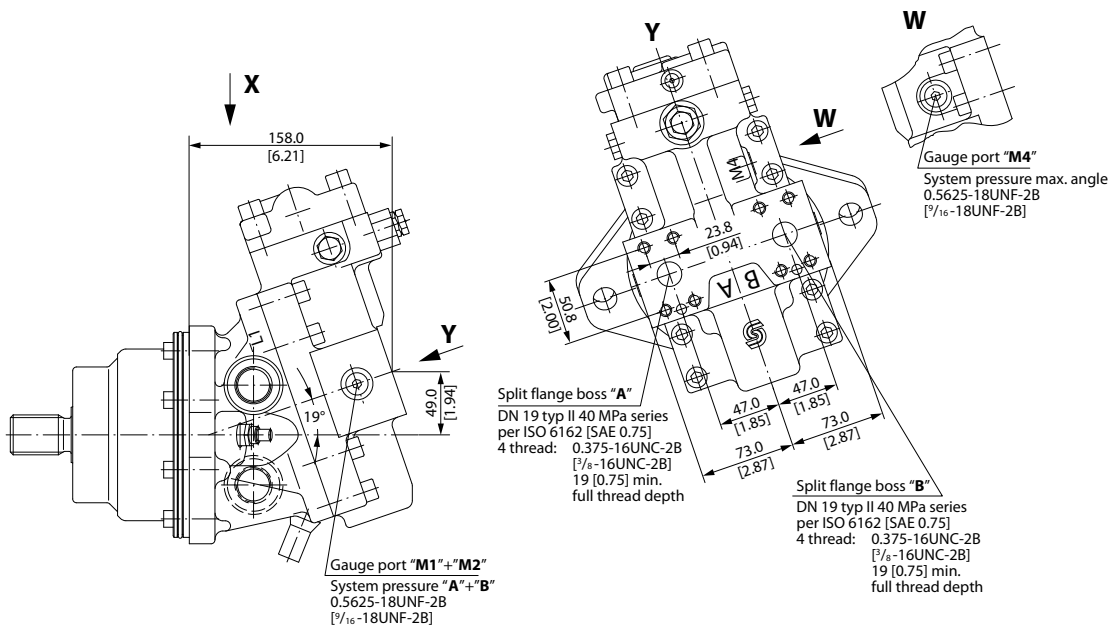
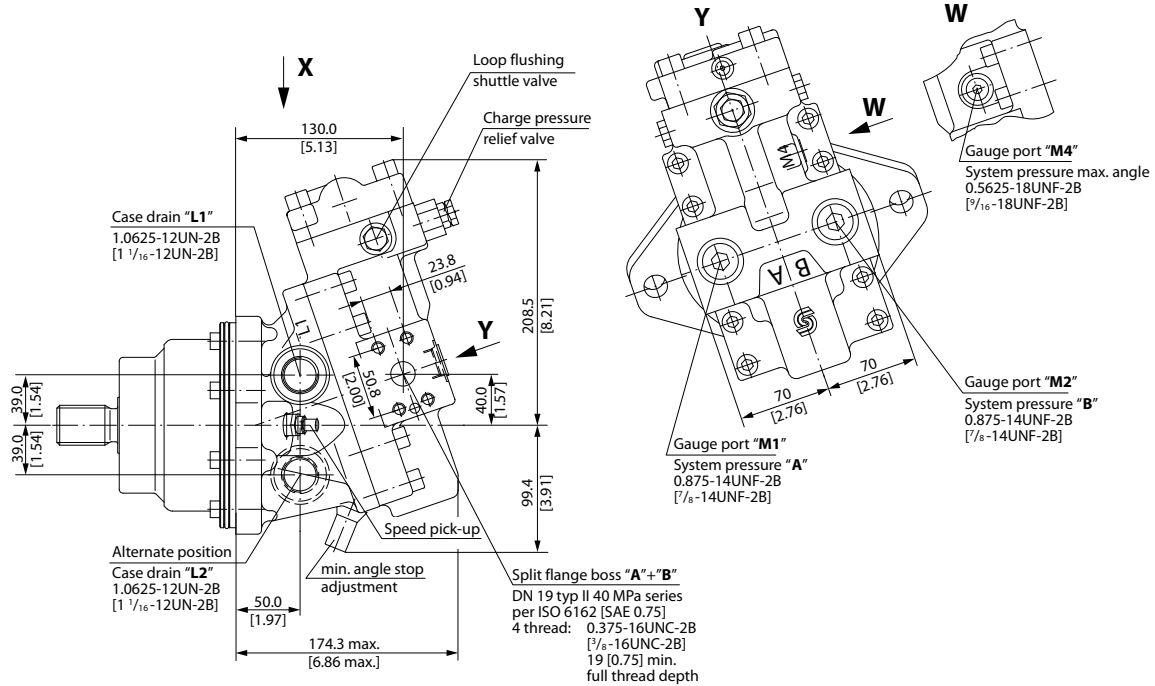
Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 060

Cartridge flange

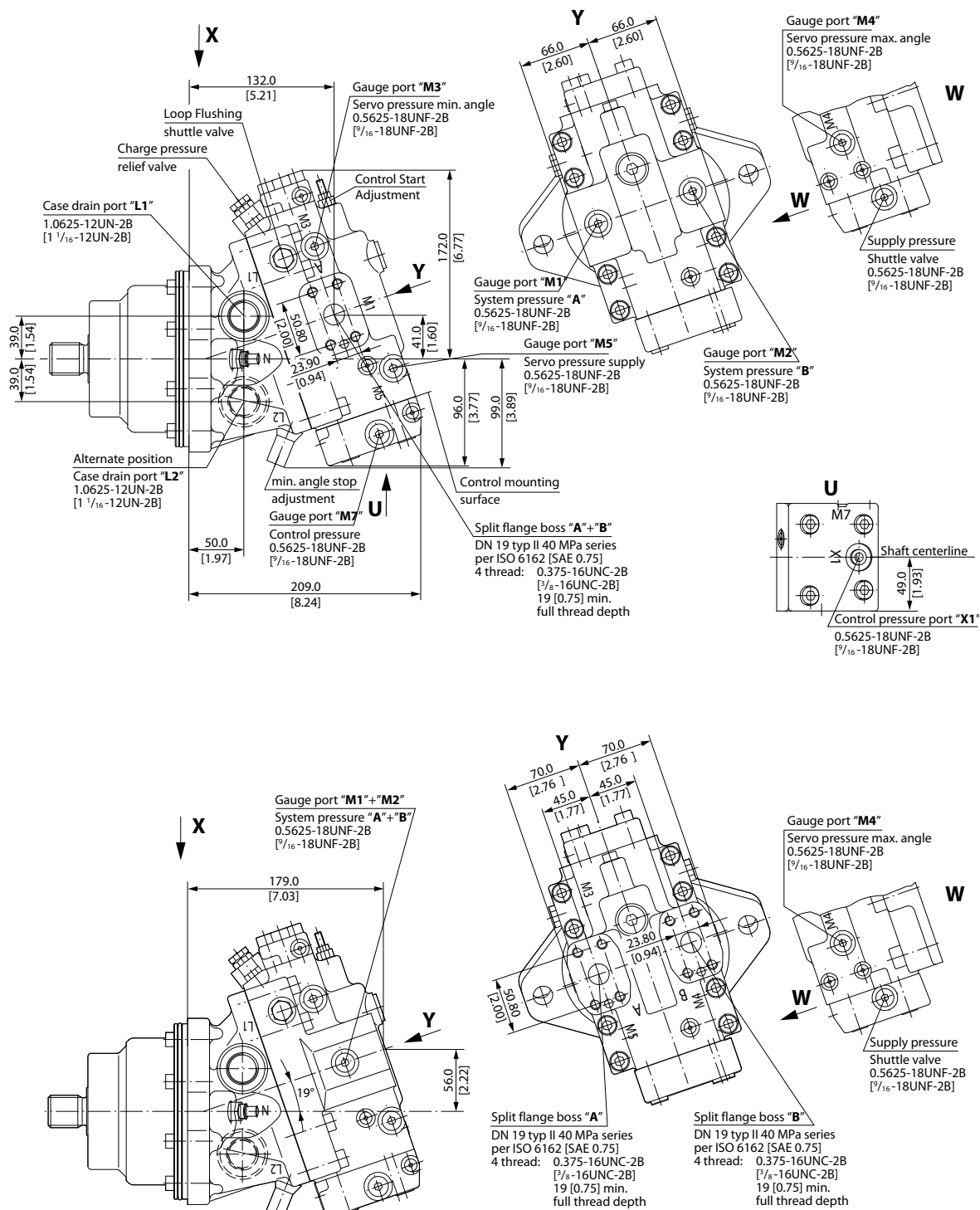
51C060-1 two-position control, N1NN (Side port on top, Axial port below)



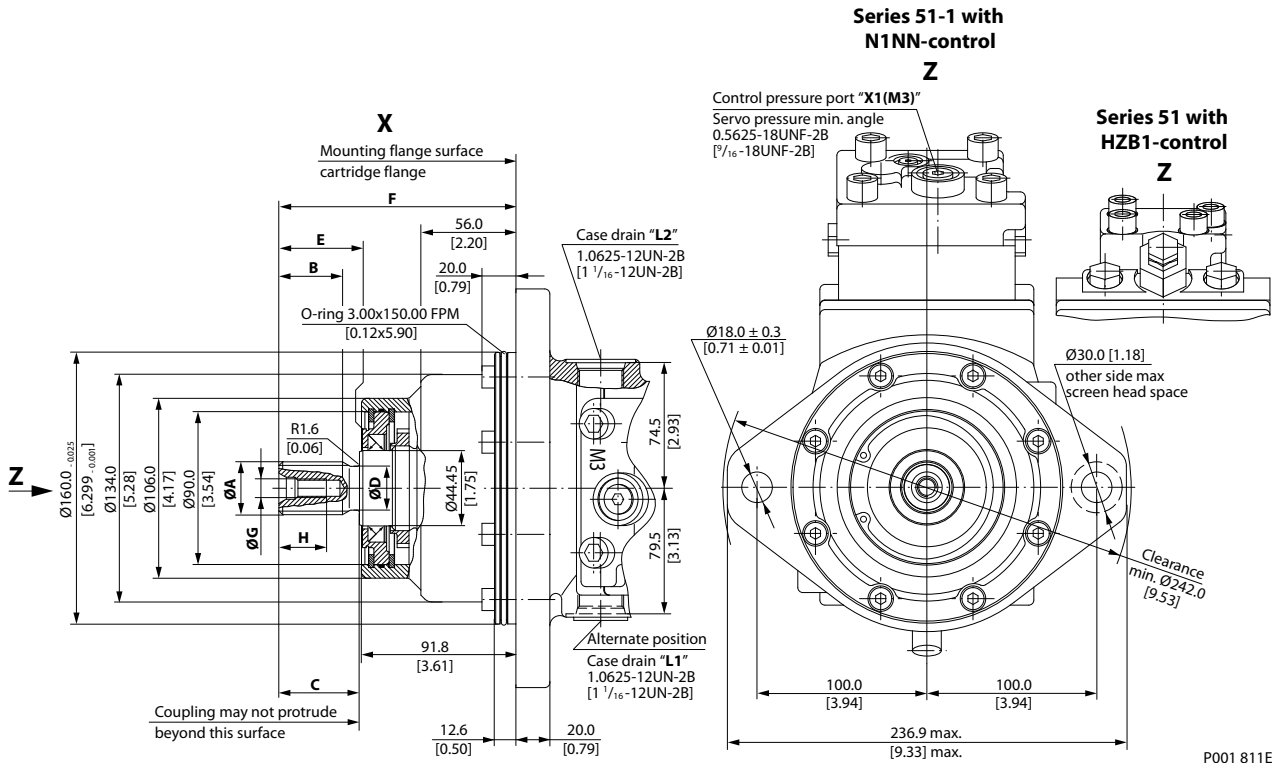
P001 792E

General dimensions – frame size 060

51C060 proportional and two-position control, HZB1 (Side port on top, Axial port below)



P001 967E

**General dimensions – frame size 060**
*Shaft options – 51C060-1 and 51C060*

**Shaft spline data - mm [in]**

Shaft option	D1	D2
Number of teeth	14	16
Spline	W30x2x30x14x9g, side fit DIN 5480	W35x2x30x16x9g side fit DIN 5480
Pitch Ø	28.0 [1.102]	32.0 [1.26]
Ø A	29.6 [1.17]	34.6 [1.36]
B	27.0 [1.06]	32.0 [1.26]
C	35.0±0.5 [1.38]	40.0±0.5 [1.58]
Ø D	25.0 [0.98]	30.0 [1.18]
E	36.8±1.4 [1.45]	41.8±1.4 [1.65]
F	127.2±0.6 [5.0]	132.2±0.6 [5.21]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N·m [593 lbf·in]	

 Flow into port **A** results in **CW** rotation of output shaft.

 Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

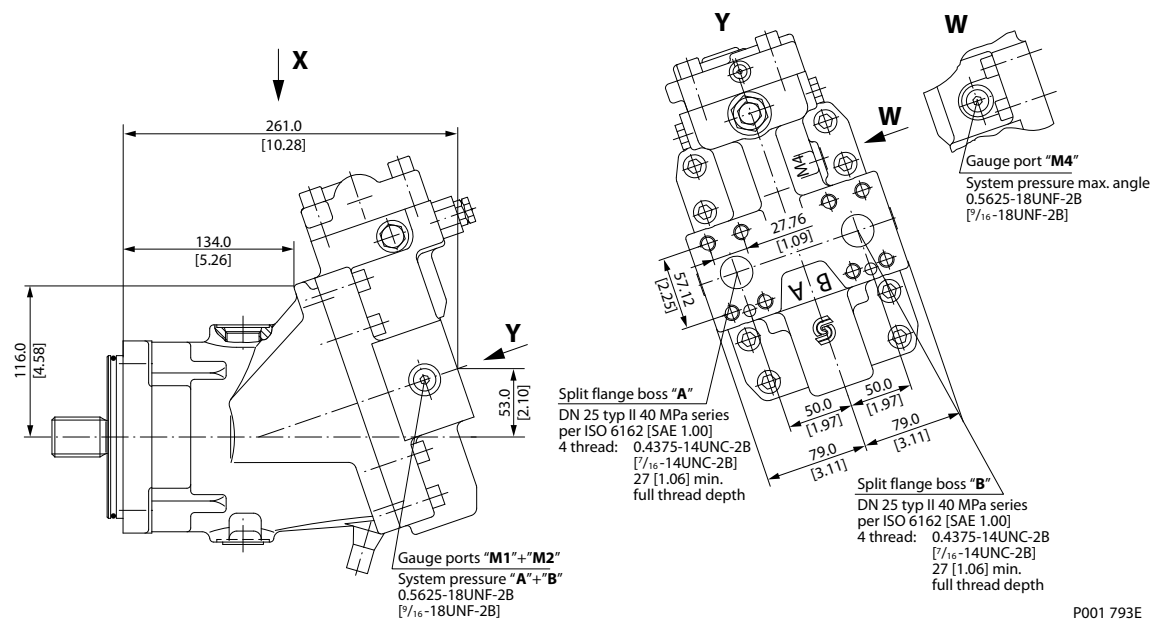
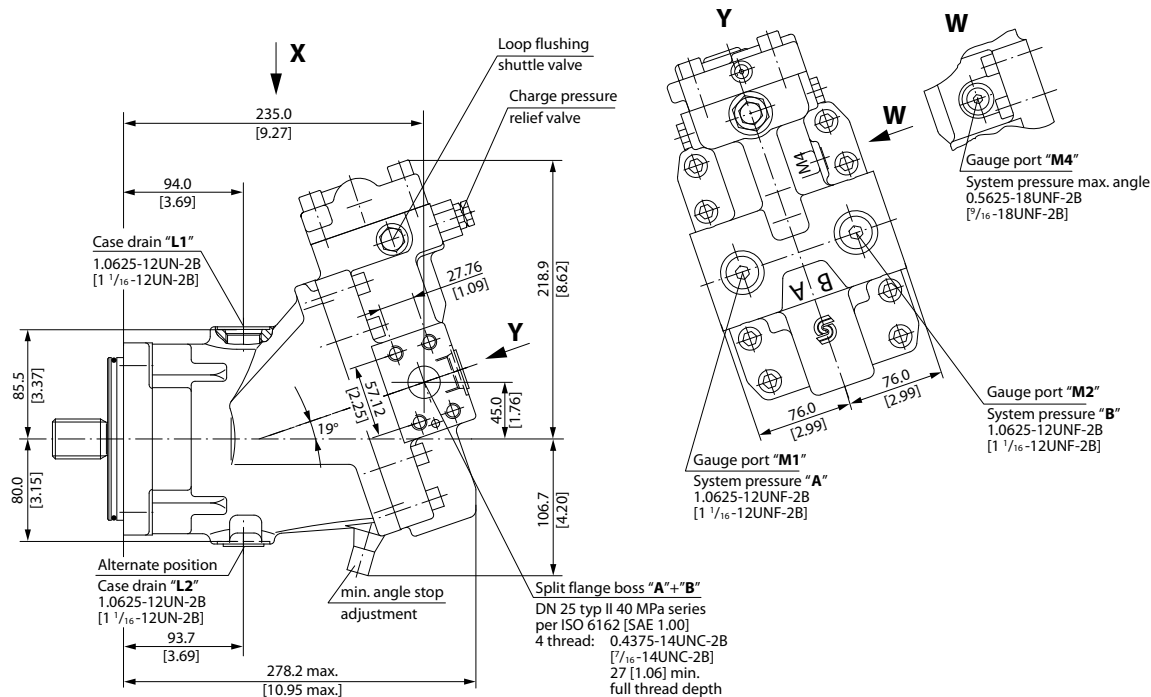
Contact your Danfoss representative for specific installation drawings.



General dimensions – frame size 080

SAE flange design per ISO 3019/1

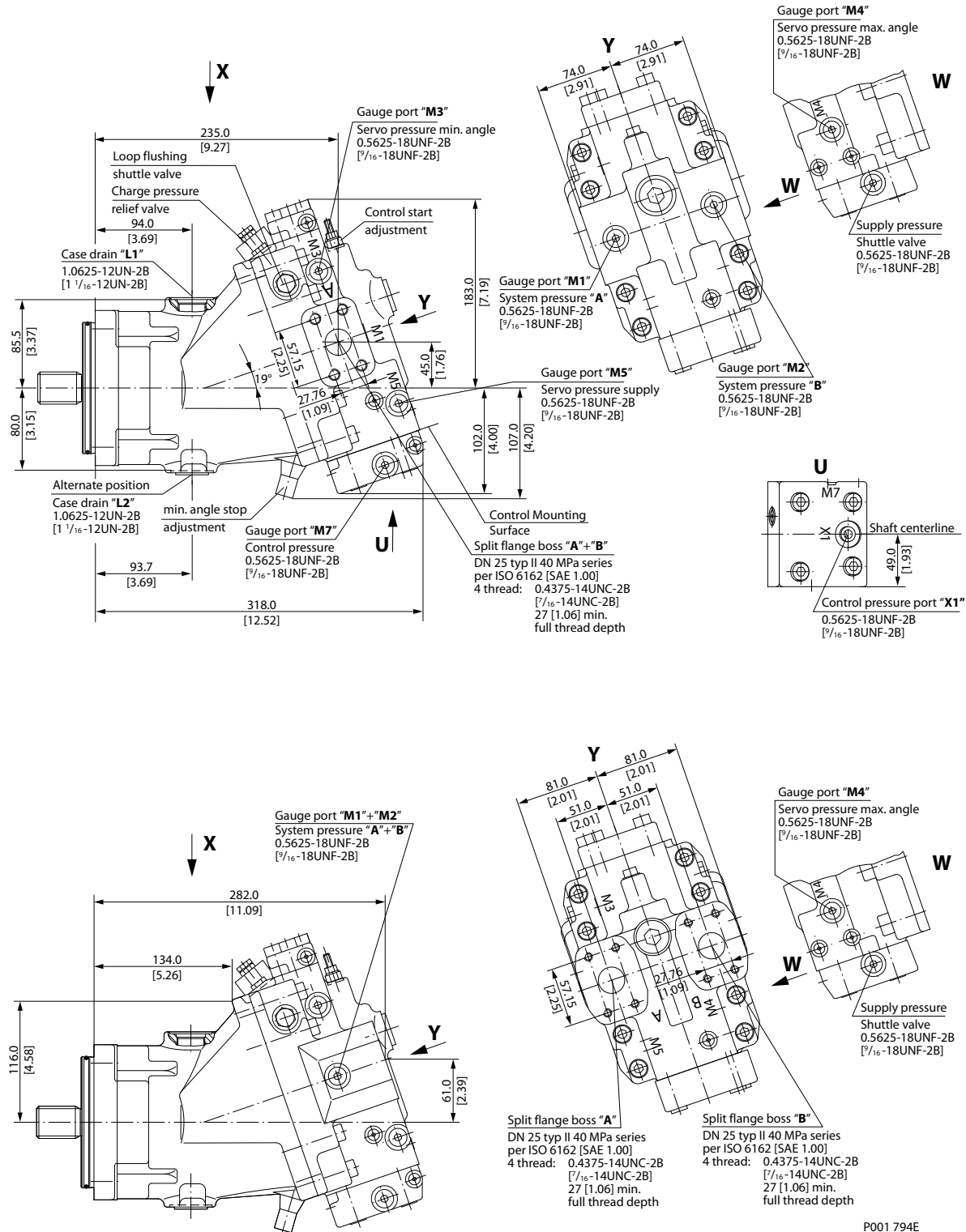
51V080-1 Two Position Control, N11N (Side port on top, Axial port below)



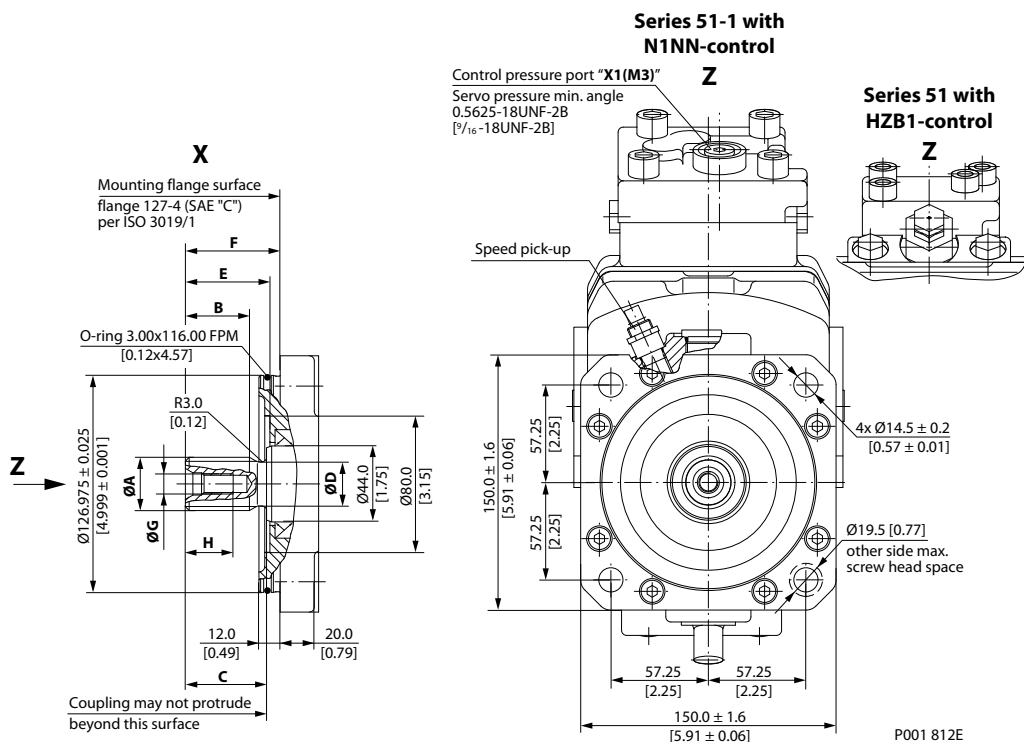
P001 793E

General dimensions – frame size 080

51V080 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)



P001 794E

**General dimensions – frame size 080**
*Shaft Options – 51V080-1 and 51V080*

*Shaft spline data - mm [in]*

Shaft option	S1	C7
Number of teeth	14	23
Pitch	12/24	16/32
Pitch Ø	29.633 [1.167]	36.513 [1.438]
Ø A	31.15 [1.23]	37.61 [1.481]
Ø D	25.8 [1.02]	32.0 [1.26]
Pressure angle	30°	
B	37.5 [1.476]	
C	47.5±0.5 [1.87]	
E	49.5±1.1 [1.95]	
F	55.5±0.7 [2.19]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.4375-14UNC-2B [7/16-14UNC-2B]; allowed torque in thread max. 91 N·m [805 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

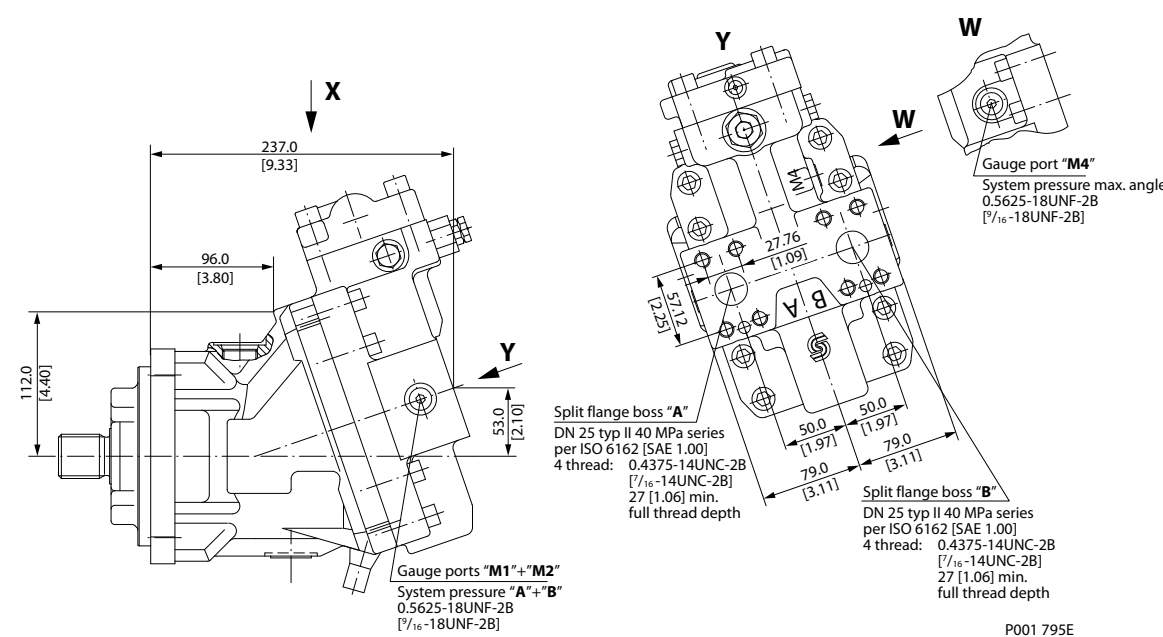
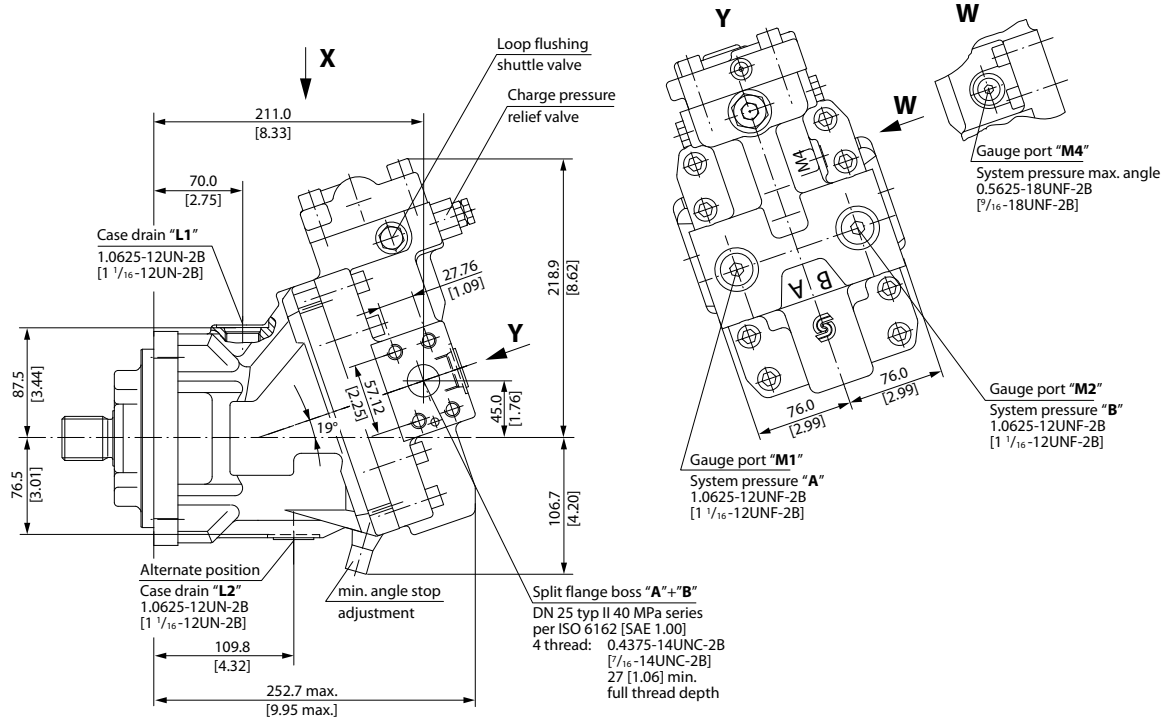
Splice flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 080

DIN flange design per ISO 3019/2

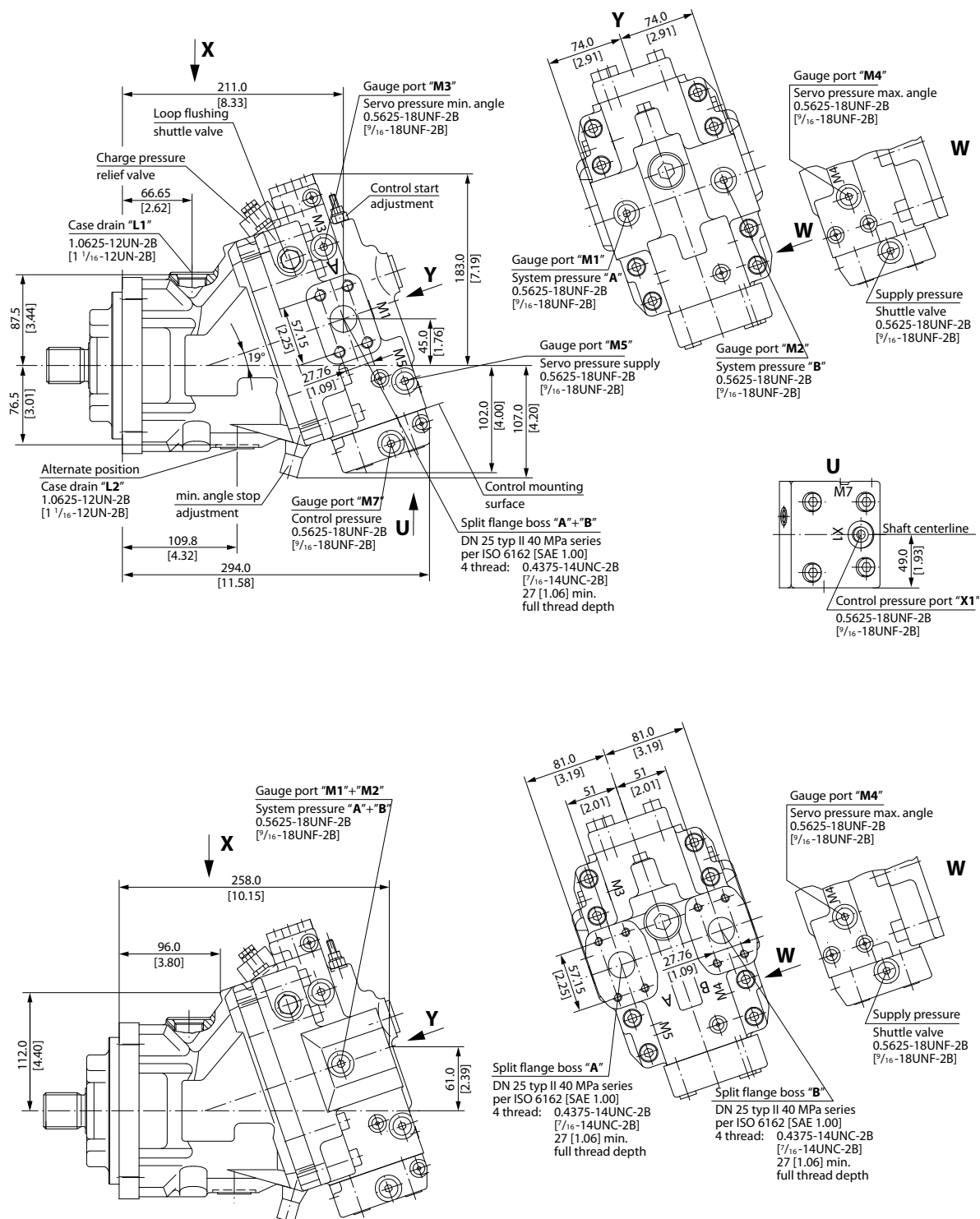
51D080-1 two position control, N1NN (Side port on top, Axial port below)



P001 795E

General dimensions – frame size 080

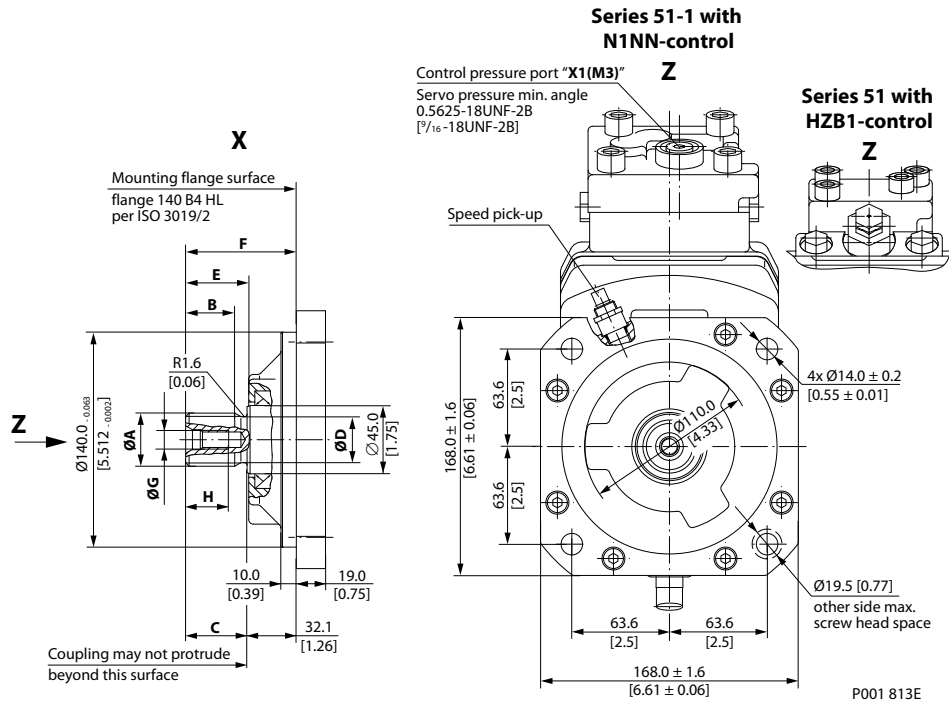
51D080 Proportional and two position control, HZB1 (Side port on top, Axial port below)



P001 796E

General dimensions – frame size 080

Shaft Options – 51D080-1 and 51D080



Shaft spline data - mm [in]

Shaft option	D2	D3
Number of teeth	16	18
Spline	W35x2x30x16x9g side fit DIN 5480	W40x2x30x18x9g side fit DIN 5480
Pitch $\emptyset$	32.0 [1.260]	36.0 [1.417]
$\emptyset$ A	34.6 [1.36]	39.6 [1.56]
B	32.0 [1.26]	37.0 [1.46]
C	40.0±0.5 [1.58]	45.0±0.5 [1.77]
$\emptyset$ D	30.0 [1.18]	35.0 [1.38]
E	42.5±1.1 [1.67]	47.3±1.1 [1.86]
F	72.5±0.6 [2.85]	85.3±0.6 [3.36]
H	25.0 [0.98]	25.0 [0.98]
$\emptyset$ G	M10x1.5 allowed torque in thread max. 67 N·m [593 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

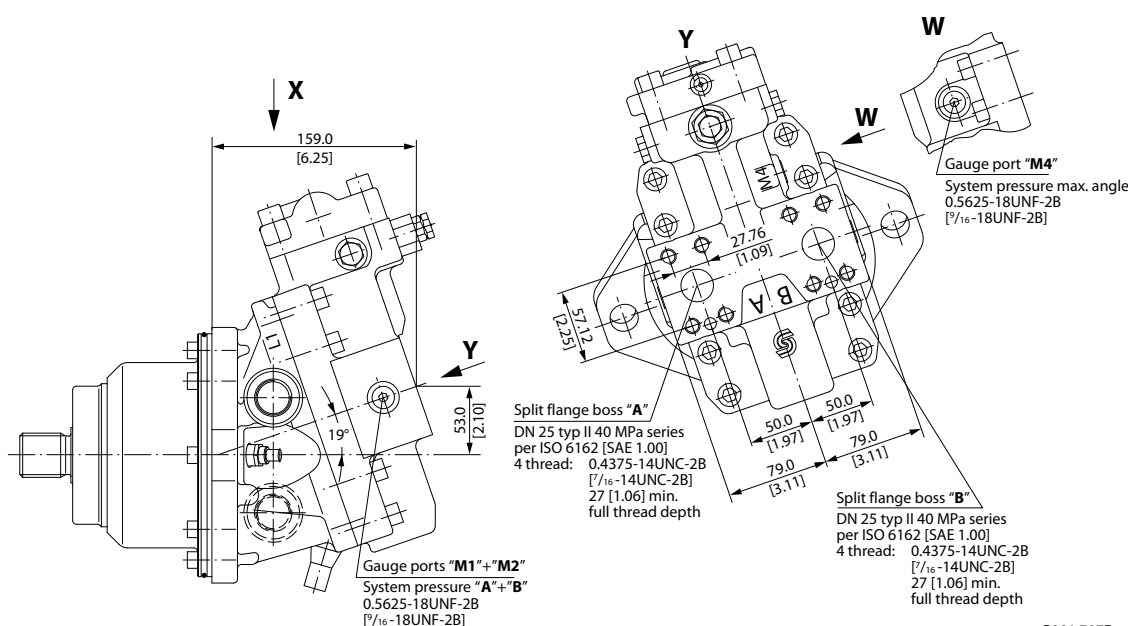
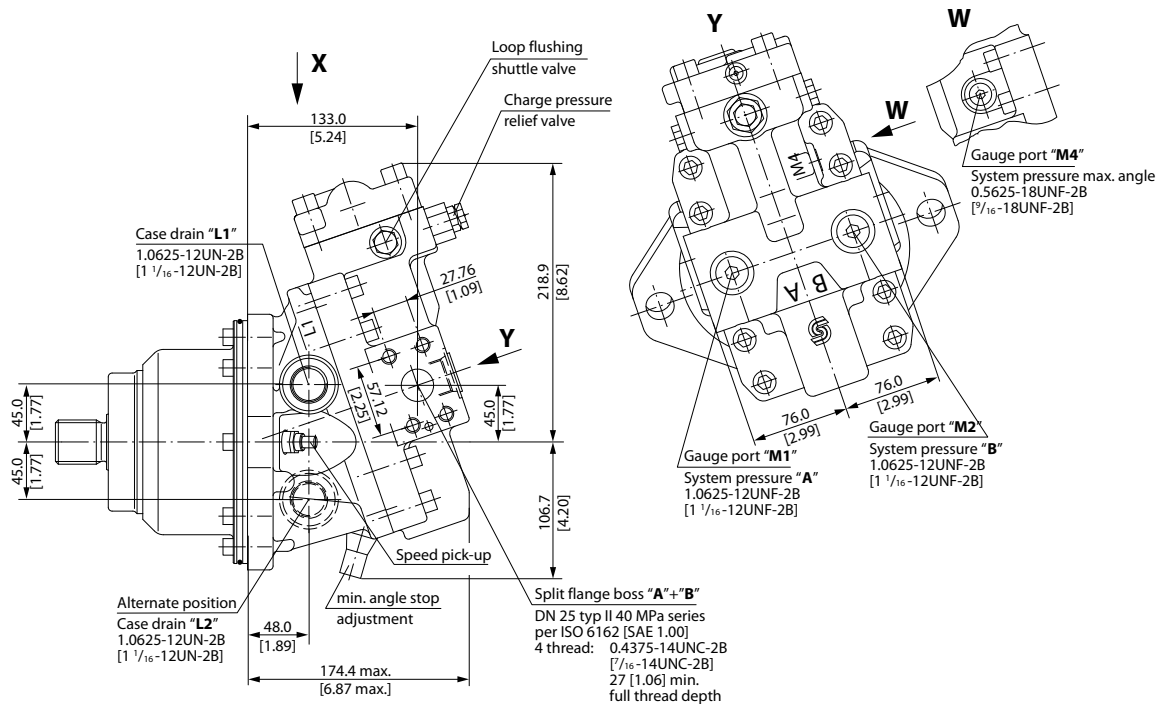
Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

**General dimensions – frame size 080**

**Cartridge flange**

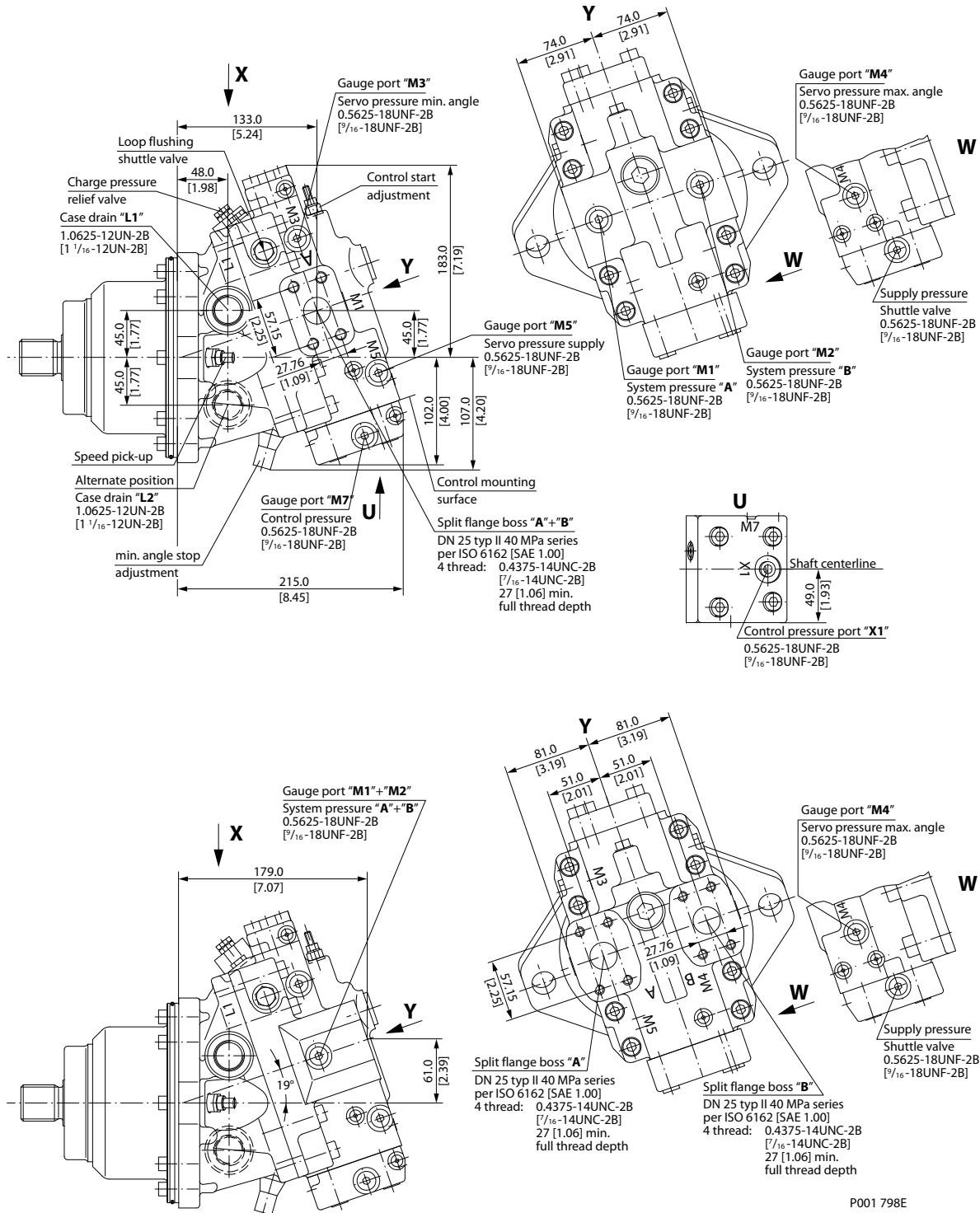
51C080-1 two-position control, N1NN (Side port on top, Axial port below)



P001 797E

General dimensions – frame size 080

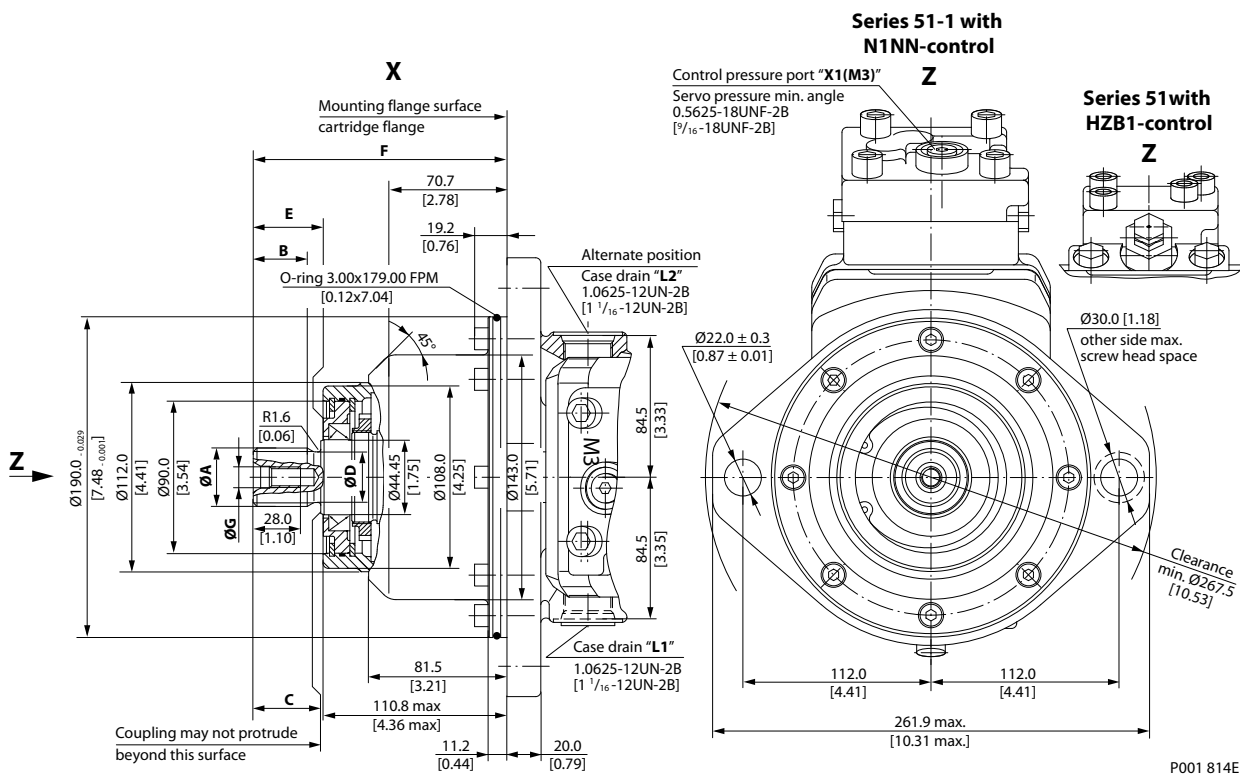
51C080 proportional and two-position control, HZB1 (Side port on top, Axial port below)





**General dimensions – frame size 080**

Shaft options – 51C080-1 and 51C080



Shaft spline data - mm [in]

Shaft option	D2	D3
Number of teeth	16	18
Spline	W35x2x30x16x9g side fit DIN 5480	W40x2x30x18x9g side fit DIN 5480
Pitch Ø	32.0 [1.260]	36.0 [1.417]
Ø A	34.6 [1.36]	39.6 [1.56]
B	32.0 [1.26]	37.0 [1.46]
C	40.0±0.5 [1.58]	45.0±0.5 [1.77]
Ø D	30.0 [1.18]	35.0 [1.38]
E	41.55±1.4 [1.64]	46.55±1.4 [1.83]
F	150.4±0.6 [5.92]	155.4±0.6 [6.12]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

 Flow into port **A** results in **CW** rotation of output shaft.

 Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

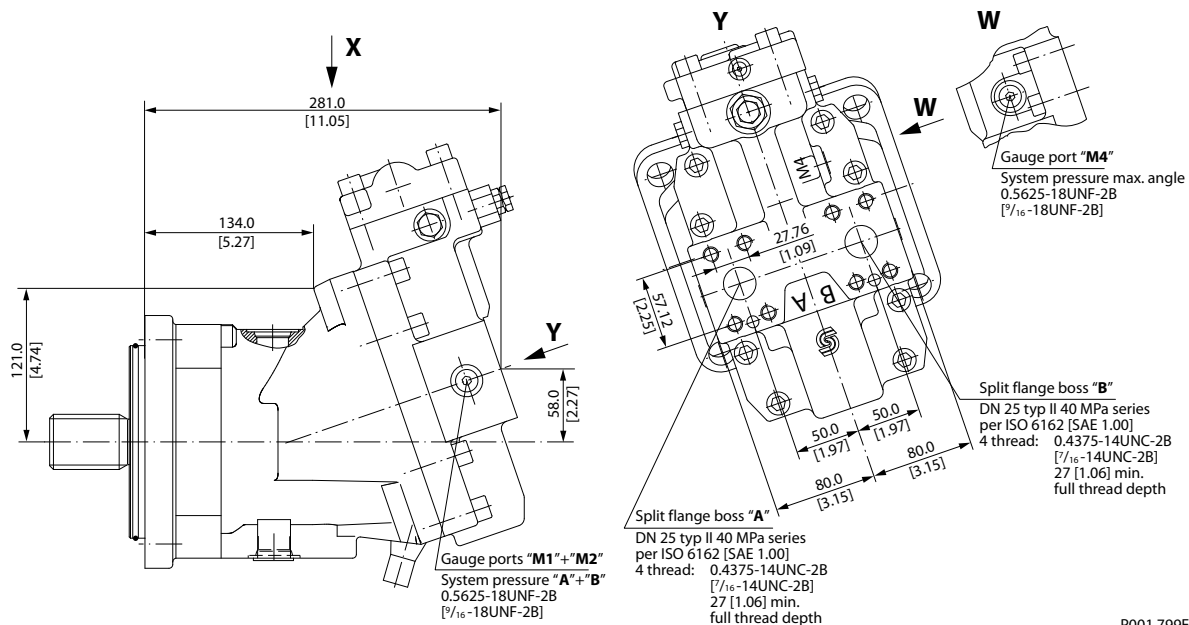
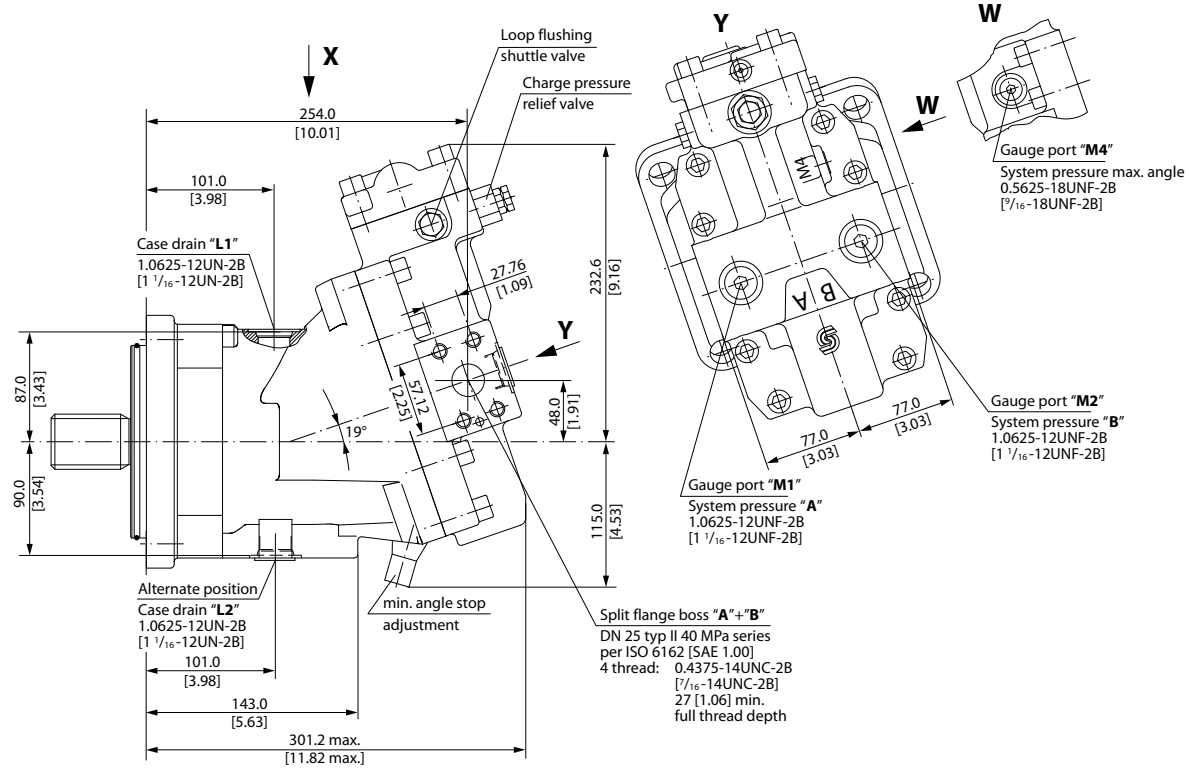
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

SAE flange design per ISO 3019/1

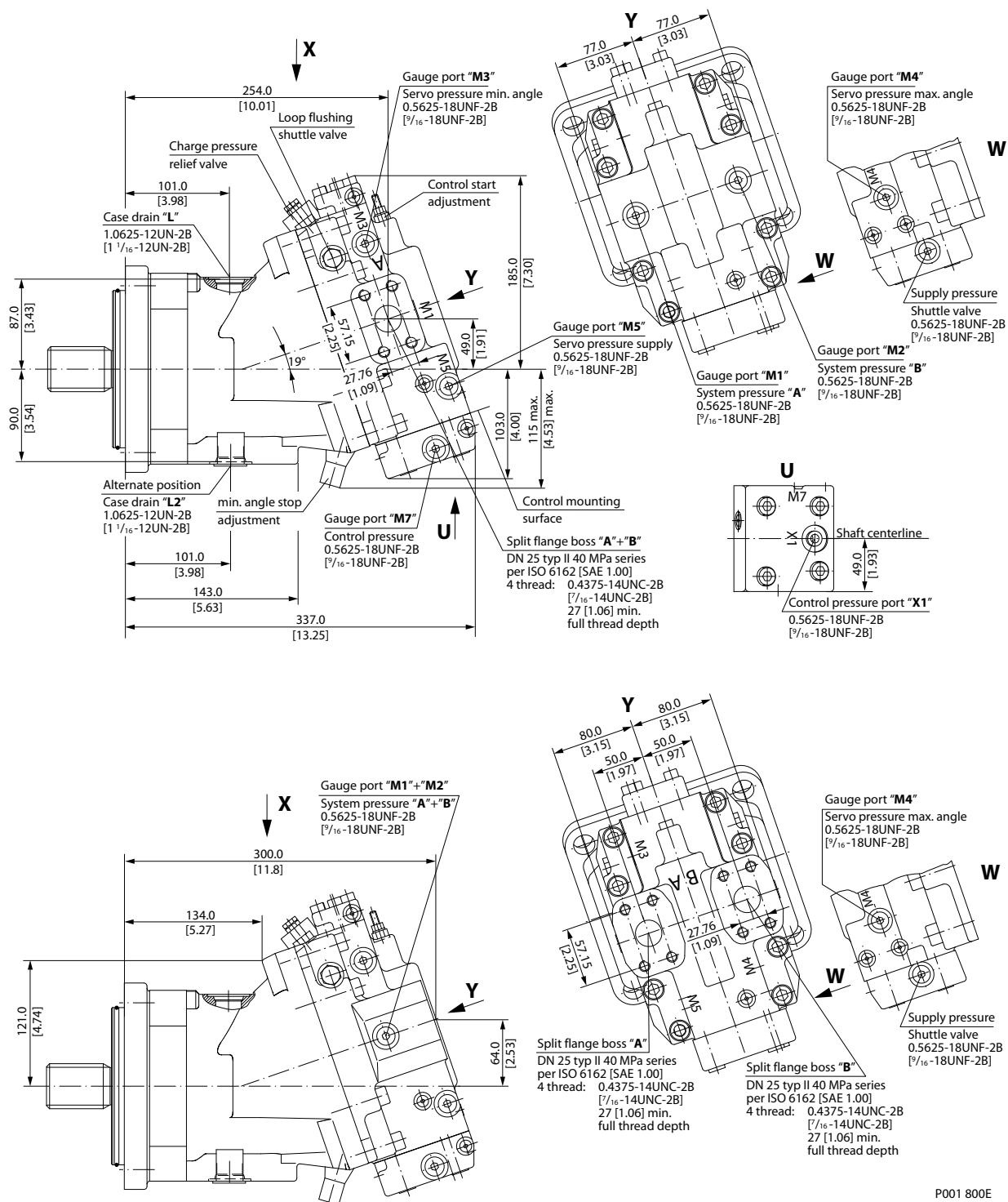
51V110-1 Two Position Control, N1NN (Side port on top, Axial port below)



P001 799E

General dimensions – frame size 110

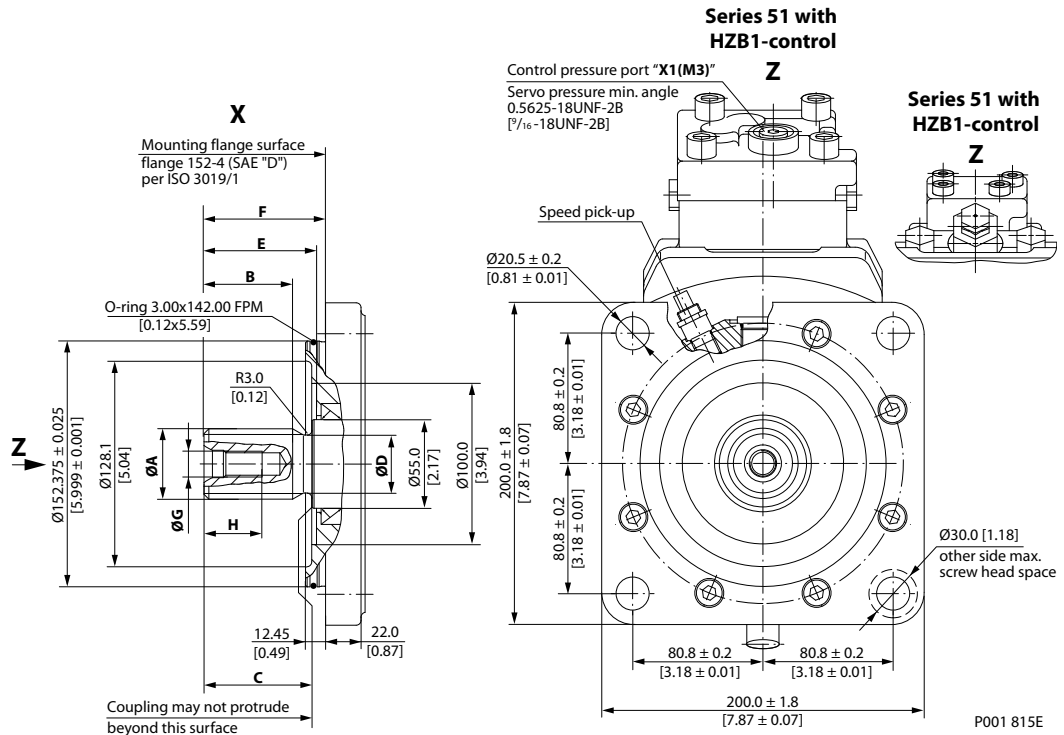
51V110 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)



P001 800E

## General dimensions – frame size 110

## Shaft Options – 51V110-1 and 51V110



## Shaft spline data - mm [in]

Shaft option	F1	C8
Number of teeth	13	27
Pitch	8/16	16/32
Pitch Ø	41.275 [1.625]	42.862 [1.688]
Ø A	43.64 [1.72]	43.96 [1.73]
Ø D	36.0 [1.42]	39.60 [1.56]
Pressure angle	30°	
B	55.0 [2.17]	
C	67.0±0.5 [2.64]	
E	69.8±1.1 [2.75]	
F	75.40±0.7 [2.97]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N·m [1770 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

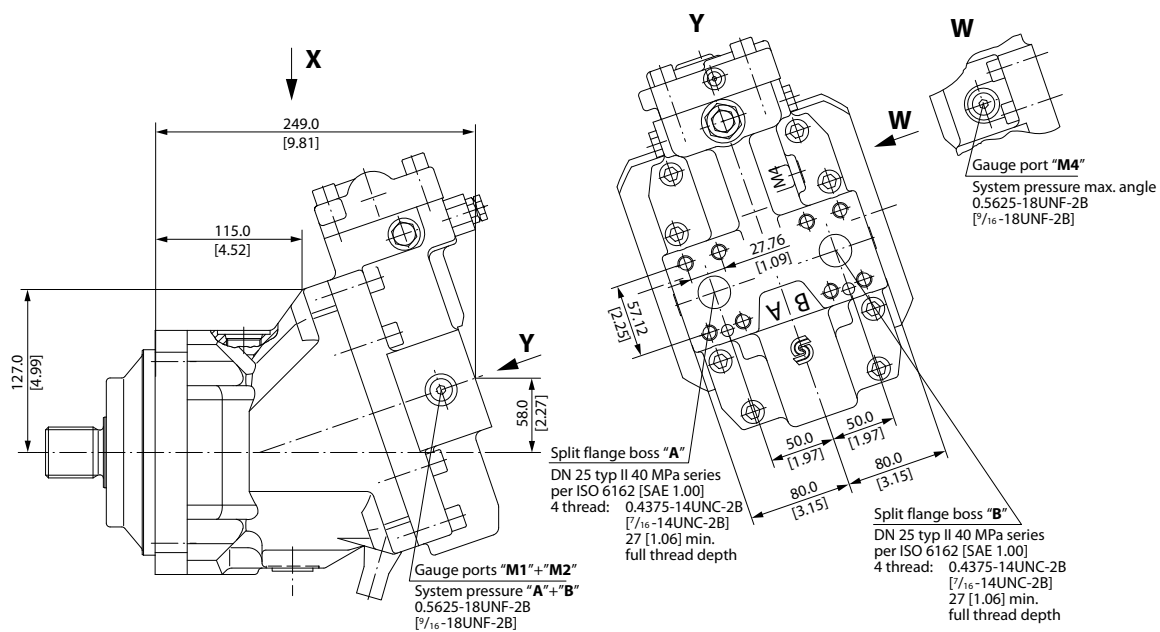
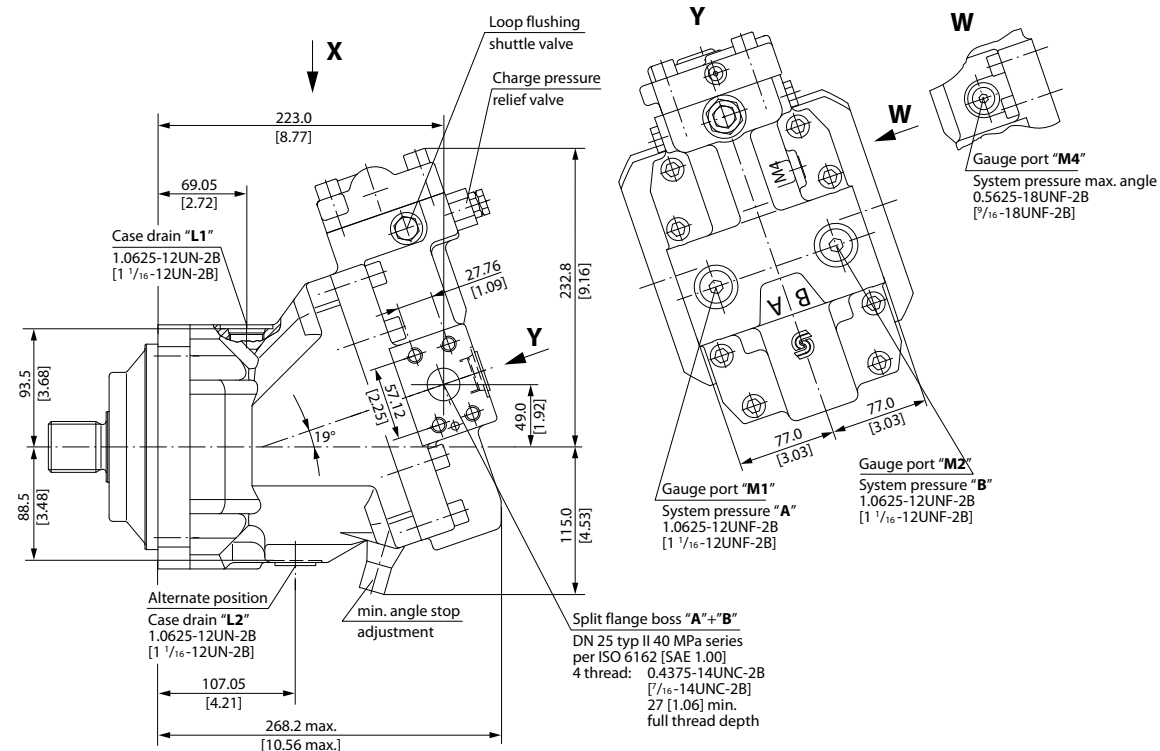
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

DIN flange design per ISO 3019/2

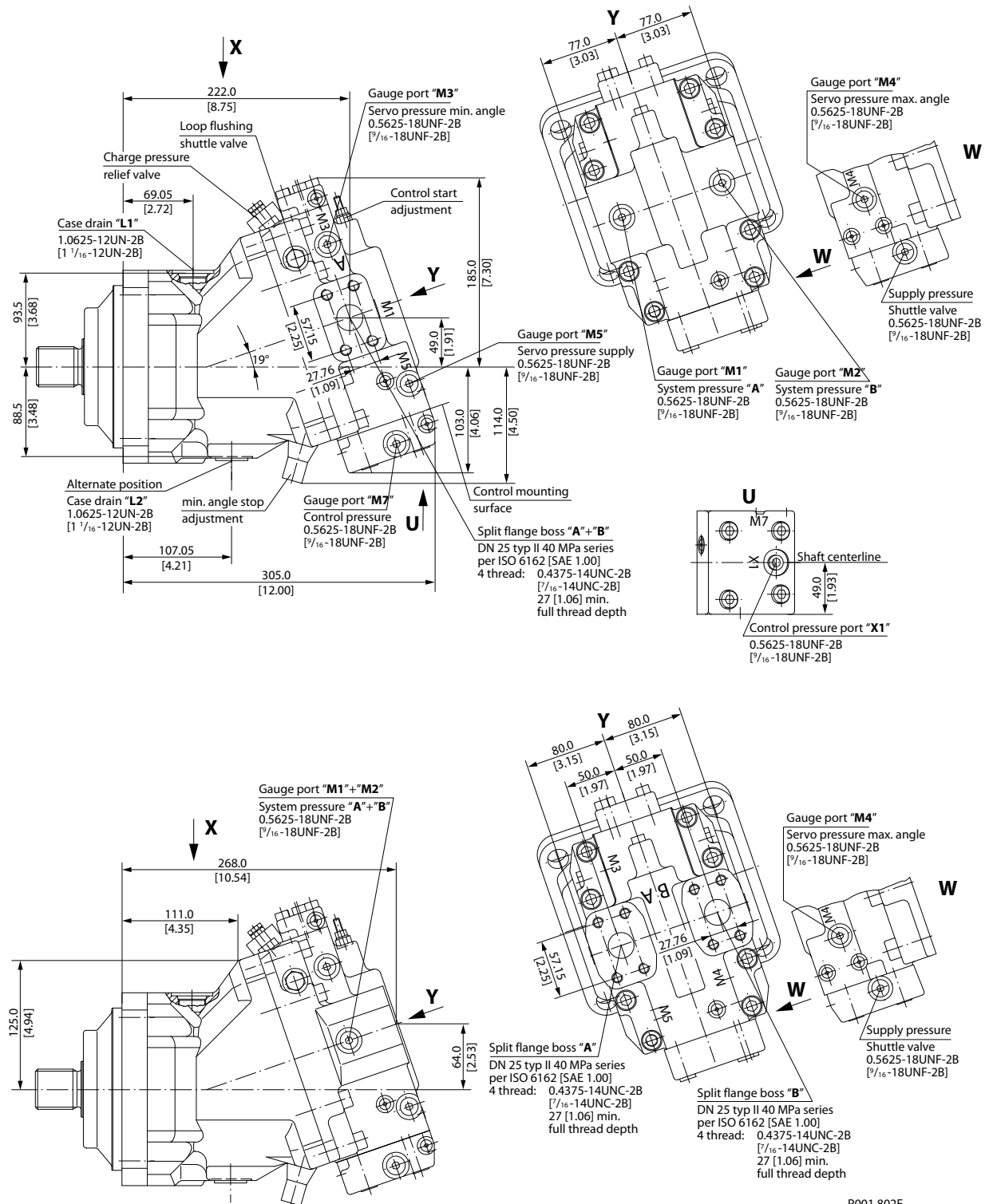
51D110-1 two position control, N1NN (Side port on top, Axial port below)



P001 801E

General dimensions – frame size 110

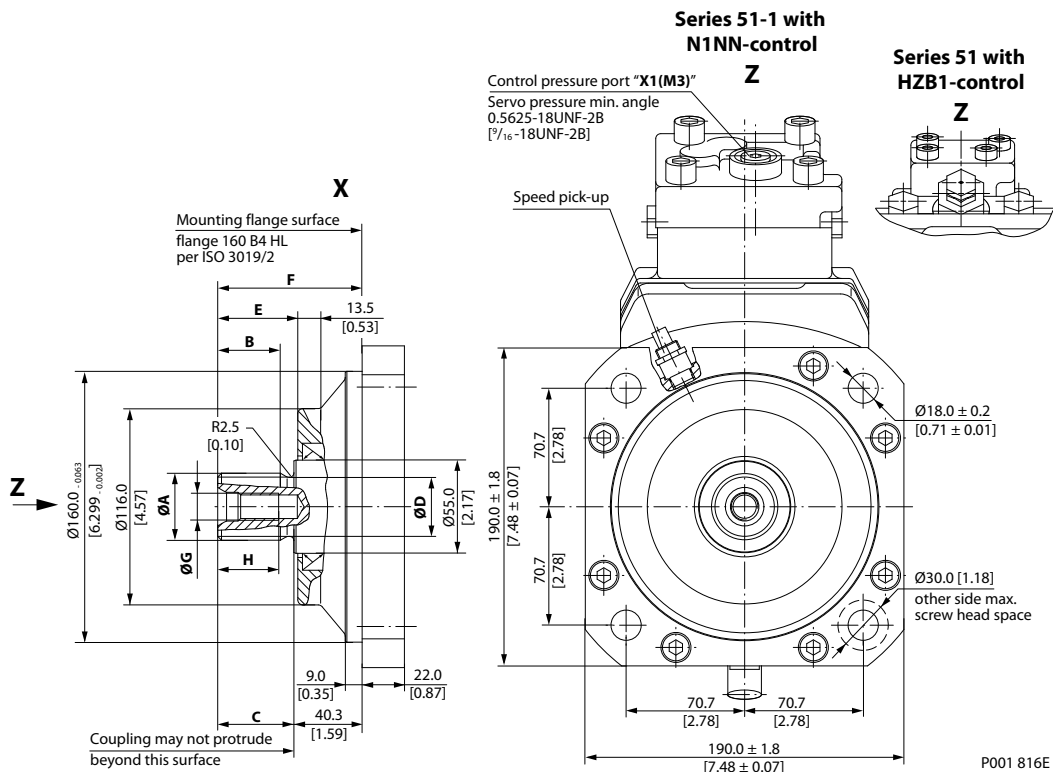
51D110 proportional and two position control, HZB1 (Side port on top, Axial port below)



P001 802E

**General dimensions – frame size 110**

Shaft options – 51D110-1 and 51D110



Shaft spline data - mm [in]

Shaft option	D3	D4
Number of teeth	18	21
Spline	W40x2x30x18x9g side fit DIN 5480	W45x2x30x21x9g side fit DIN 5480
Pitch Ø	36.0 [1.417]	42.0 [1.654]
Ø A	39.6 [1.56]	44.6 [1.76]
B	37.0 [1.46]	42.0 [1.65]
C	45.0±0.5 [1.77]	50.0±0.5 [1.97]
Ø D	35.0 [1.38]	40.0 [1.57]
E	47.3±1.1 [1.86]	52.3±1.1 [2.06]
F	85.3±0.6 [3.36]	90.3±0.6 [3.56]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N•m [1018 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

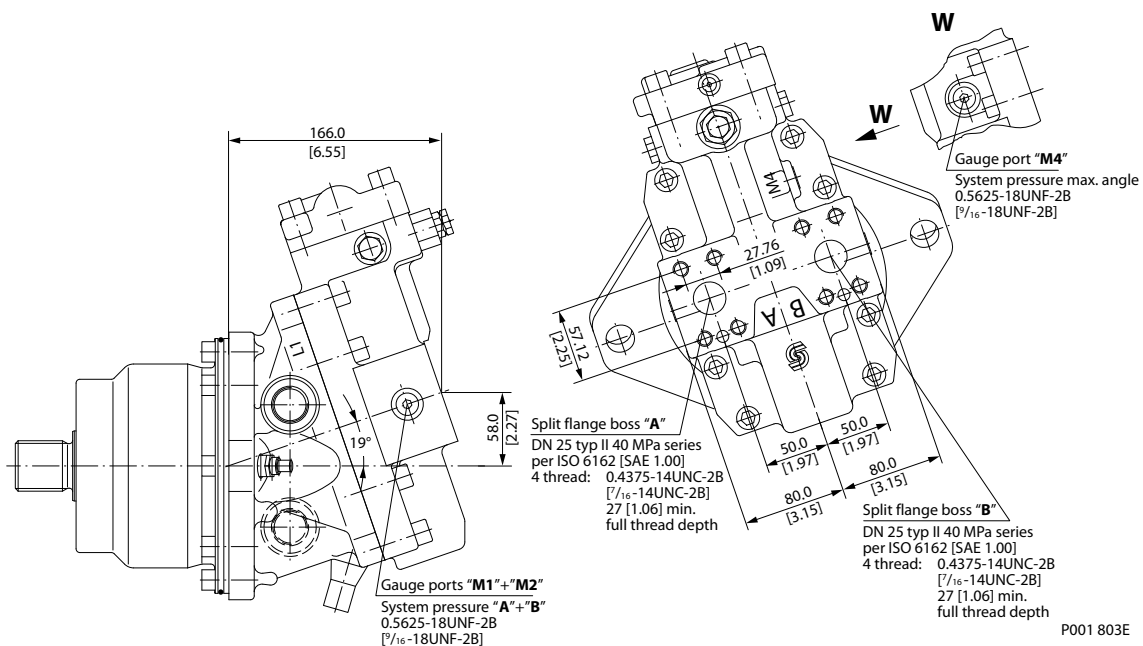
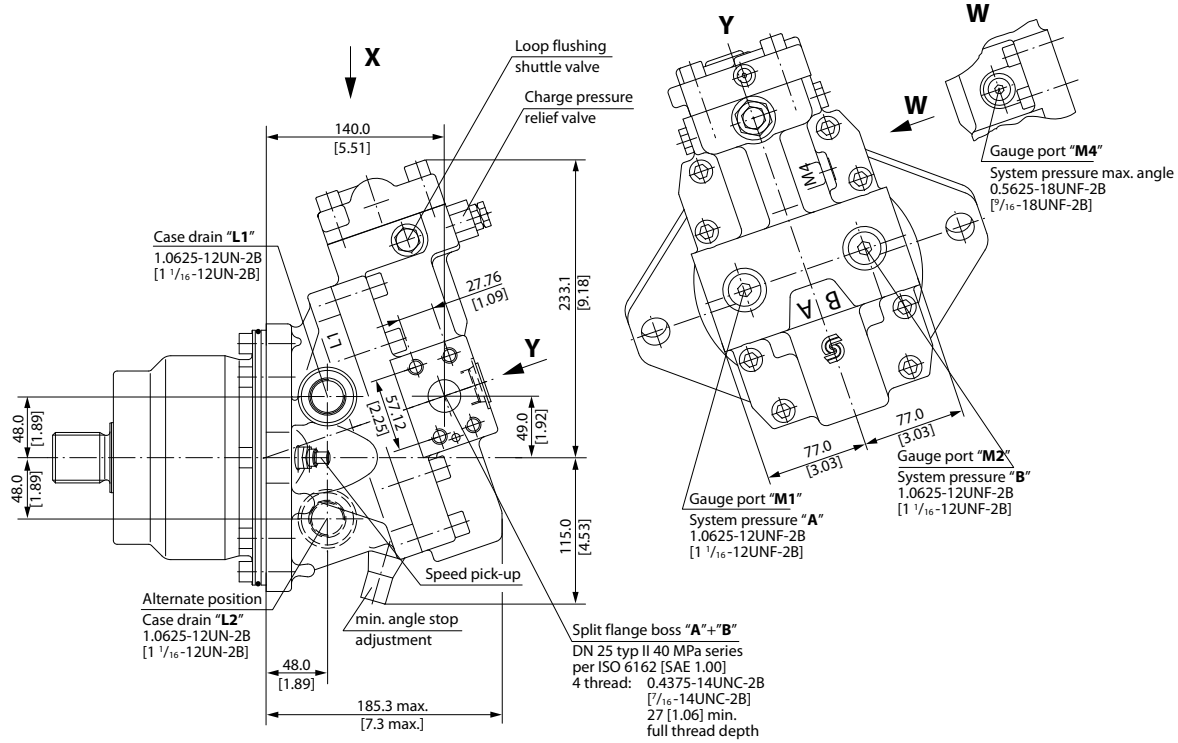
Splice flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

Cartridge flange

51C110-1 two-position control, N1NN (Side port on top, Axial port below)

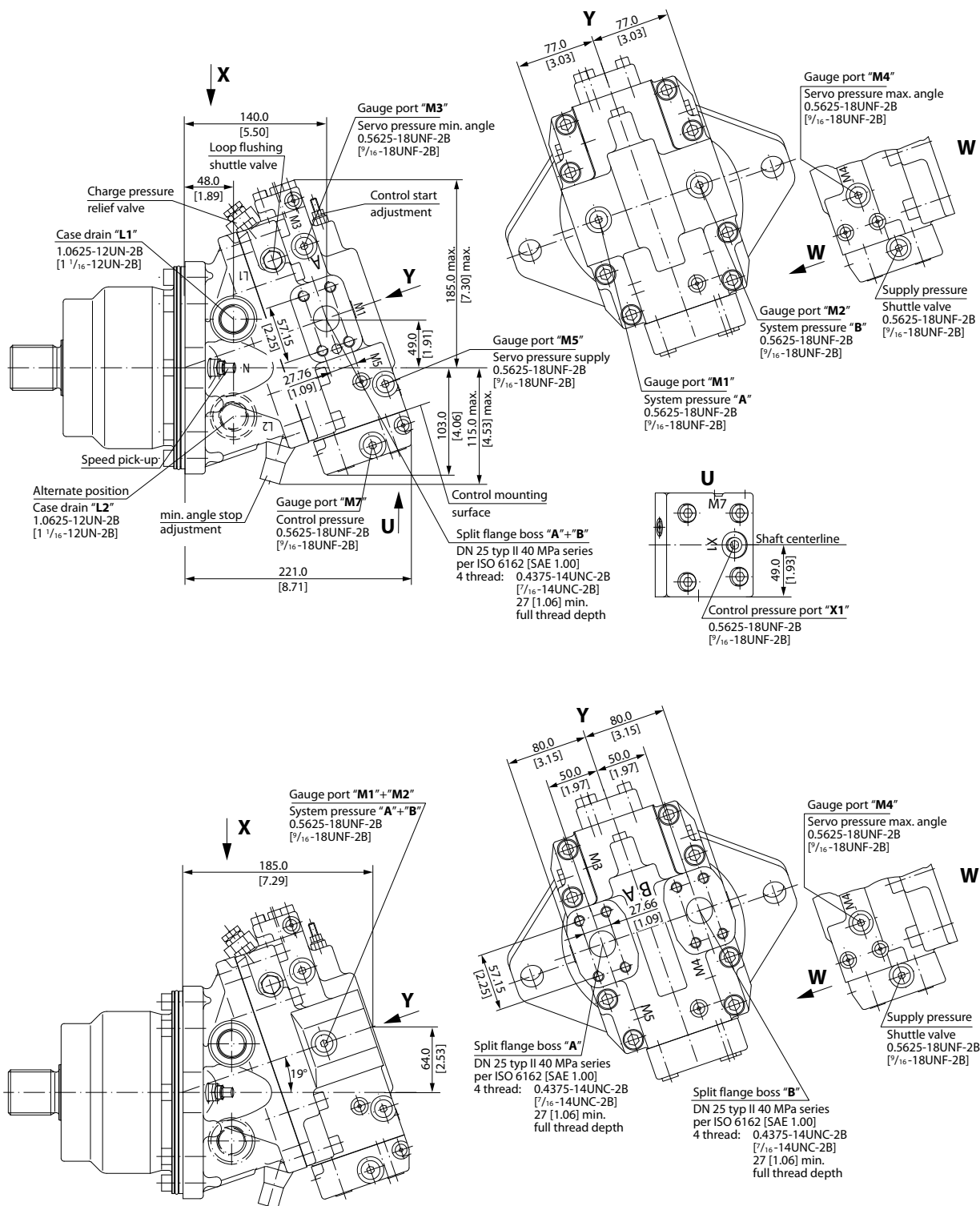


P001 803E

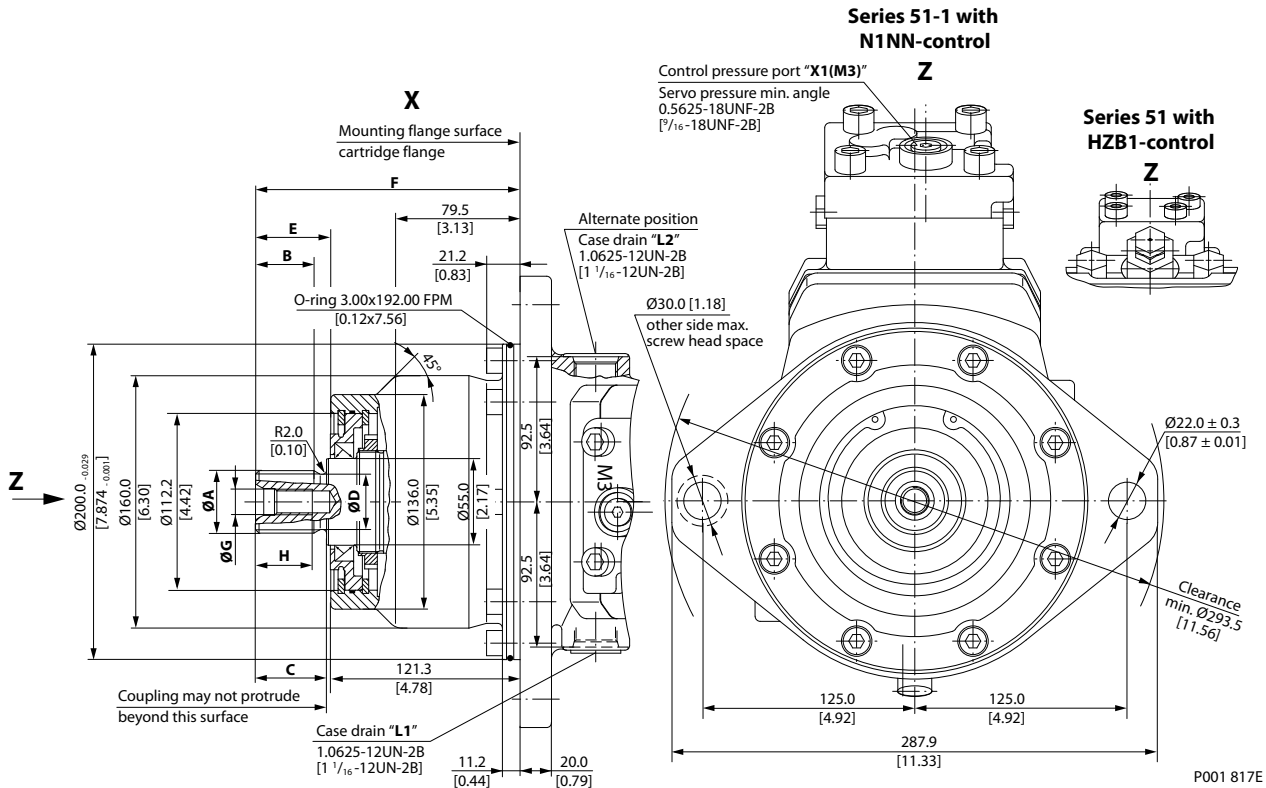


General dimensions – frame size 110

51C110 proportional and two-position control, HZB1 (Side port on top, Axial port below)



P001 804E

**General dimensions – frame size 110**
*Shaft options – 51C110-1 and 51C110*

**Shaft spline data - mm [in]**

Shaft option	D3	D4
Number of teeth	18	21
Spline	W40x2x30x18x9g side fit DIN 5480	W45x2x30x21x9g side fit DIN 5480
Pitch Ø	36.0 [1.417]	42.0 [1.654]
Ø A	39.6 [1.56]	44.6 [1.76]
B	37.0 [1.46]	42.0 [1.65]
C	45.0±0.5 [1.77]	50.0±0.5 [1.97]
Ø D	35.0 [1.38]	40.0 [1.57]
E	47.4±1.1 [1.87]	52.4±1.4 [2.06]
F	167.7±0.6 [6.6]	172.7±0.6 [6.8]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N·m [1018 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

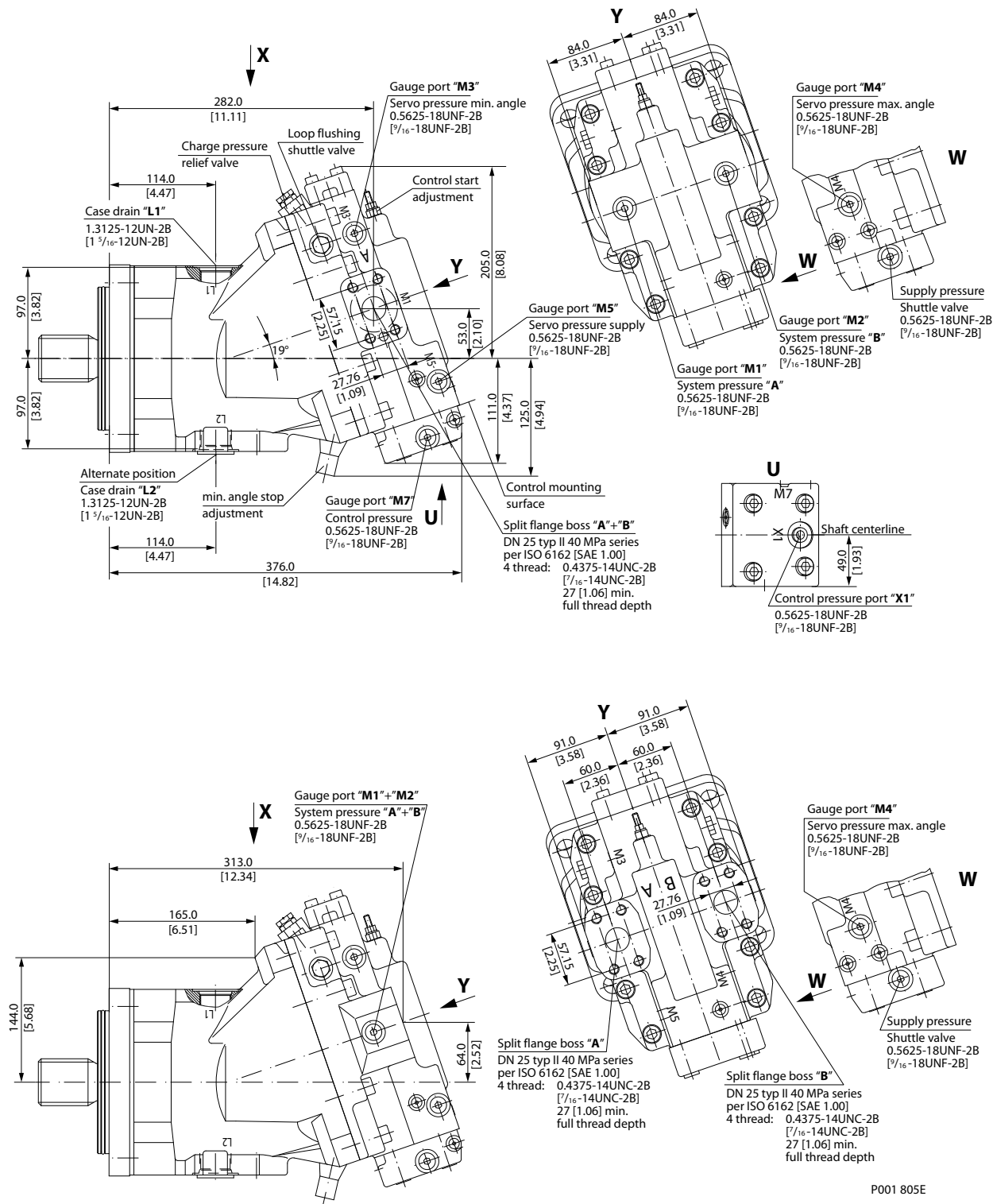
Contact your Danfoss representative for specific installation drawings.

Technical Information  
**Series 51 and 51-1 Bent Axis Variable Displ. Motors**

**General dimensions – frame size 160**

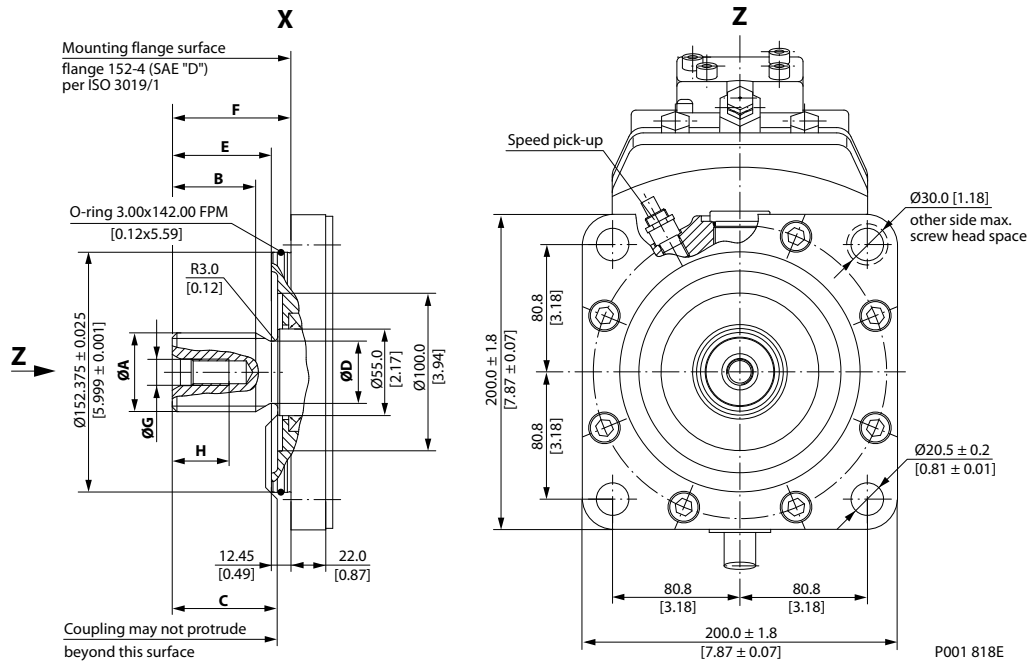
**SAE flange design per ISO 3019/1**

51V160 proportional and two-position control, HZB1 (Side port on top, Axial port below)



## General dimensions – frame size 160

## Shaft options – 51V160



## Shaft spline data - mm [in]

Shaft option	F1	F2	C8
Number of teeth	13	15	27
Pitch	8/16	8/16	16/32
Pitch Ø	41.275 [1.625]	47.625 [1.875]	42.862 [1.688]
Ø A	43.64 [1.72]	49.99 [1.97]	43.96 [1.73]
B	55.0 [2.17]	53.0 [2.09]	55.0 [2.17]
Ø D	36.0 [1.42]	42.20 [1.66]	39.60 [1.56]
Pressure angle	30°		
C	67.0±0.5 [2.64]		
E	70.0±1.1 [2.76]		
F	75.40±0.7 [2.97]		
H	36.0 [1.42]		
Spline	ANSI B92.1-1970, class 5, flat root side fit		
Ø G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N•m [1770 lbf•in]		

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

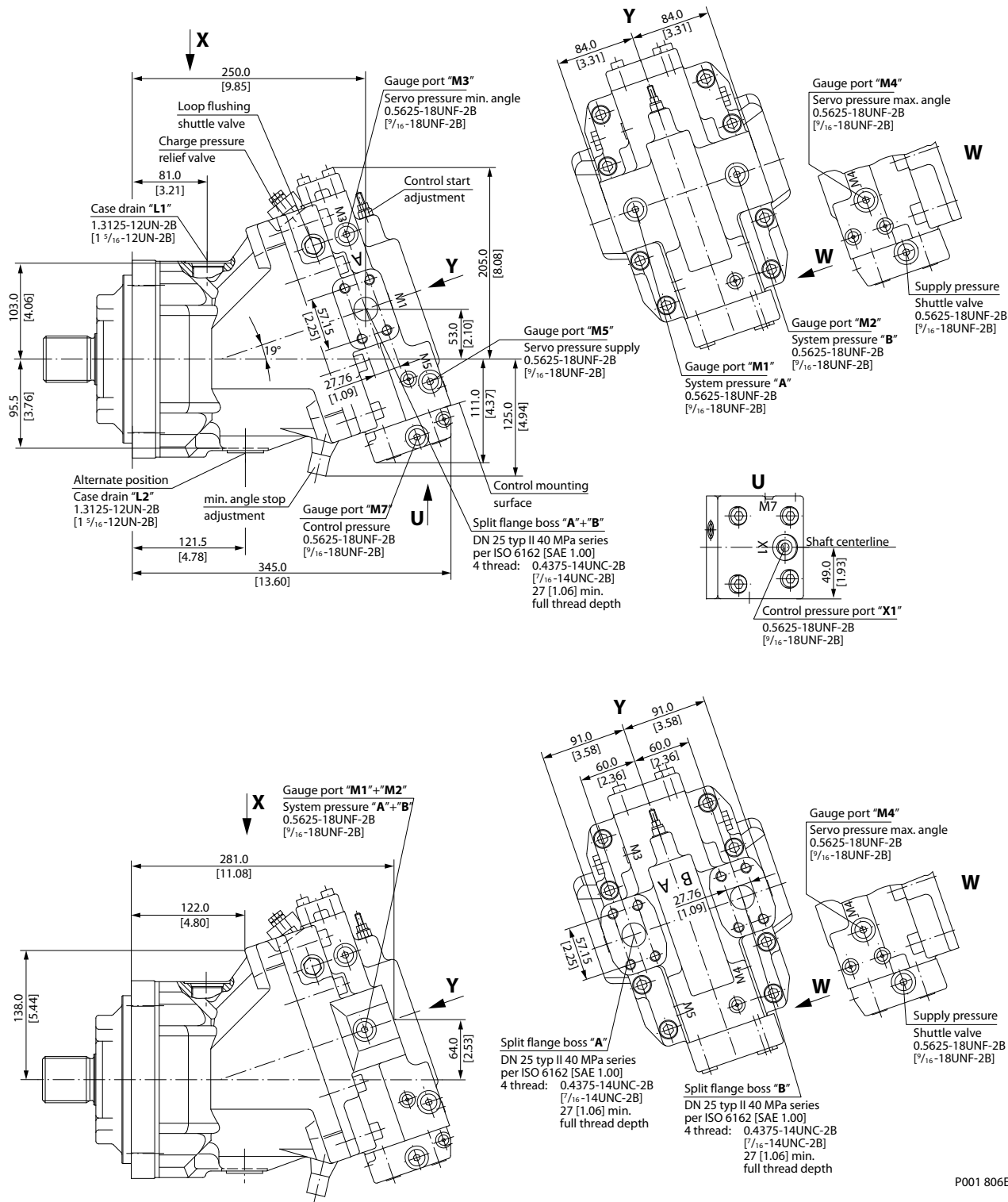
Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 160

DIN flange design per ISO 3019/2

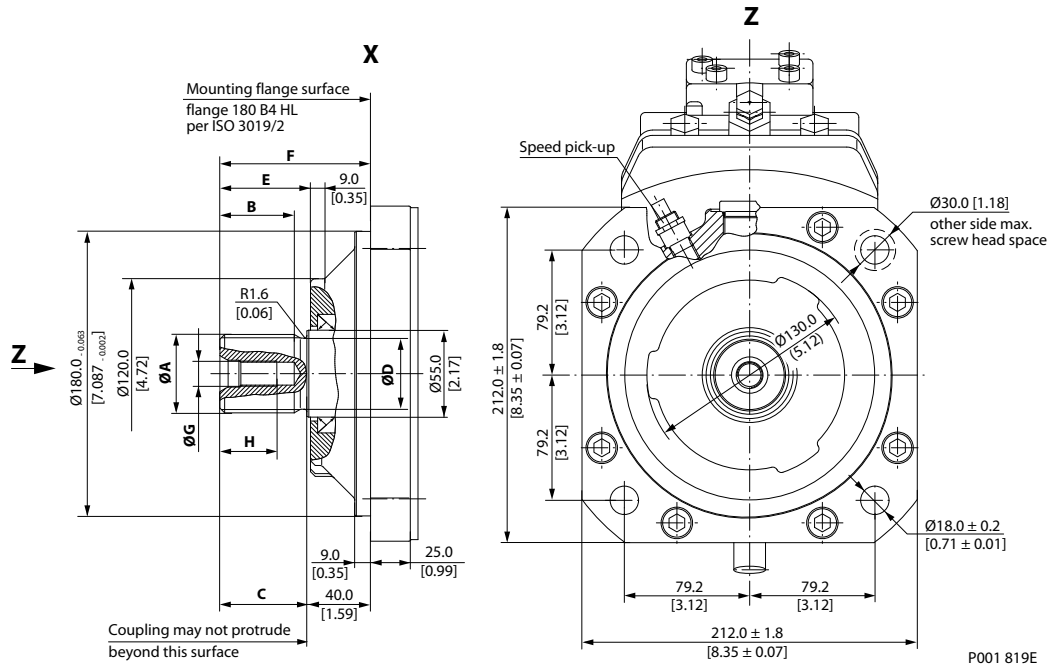
51D160 proportional and two-position control, HZB1 (Side port on top, Axial port below)



P001 806E

**General dimensions – frame size 160**

*Shaft options – 51D160*



*Shaft spline data - mm [in]*

Shaft option	D4	D5
Number of teeth	21	24
Spline	W45x2x30x21x9g side fit DIN 5480	W50x2x30x24x9g side fit DIN 5480
Pitch Ø	42.0 [1.654]	48.0 [1.890]
Ø A	44.6 [1.76]	49.6 [1.95]
B	42.0 [1.65]	47.0 [1.85]
C	50.0±0.5 [1.97]	55.0±0.5 [2.17]
Ø D	40.0 [1.57]	45.0 [1.77]
E	52.3±1.1 [2.06]	57.3±1.1 [2.26]
F	90.3±0.6 [3.56]	95.3±0.6 [3.75]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N·m [1018 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

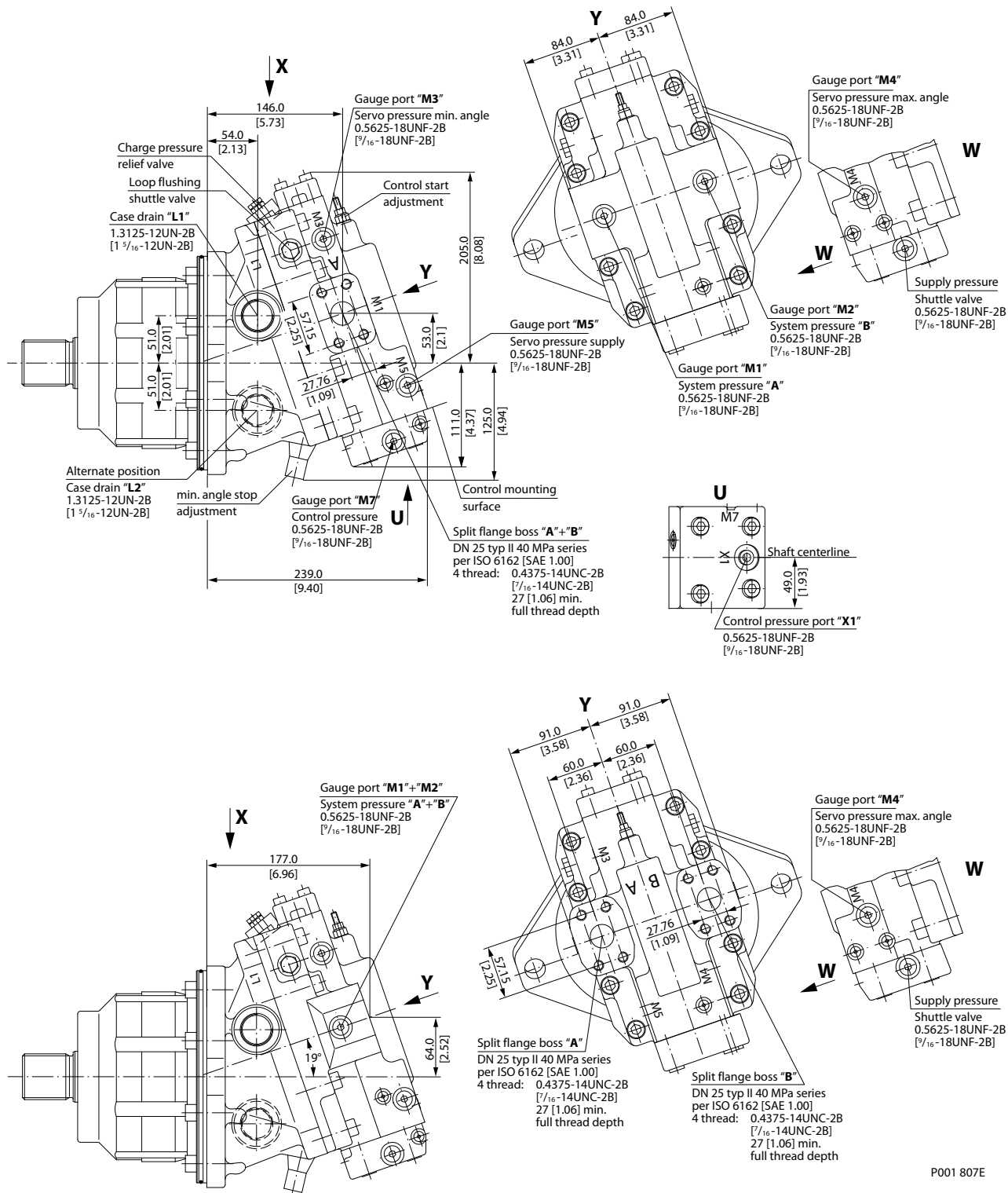
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 160

Cartridge flange

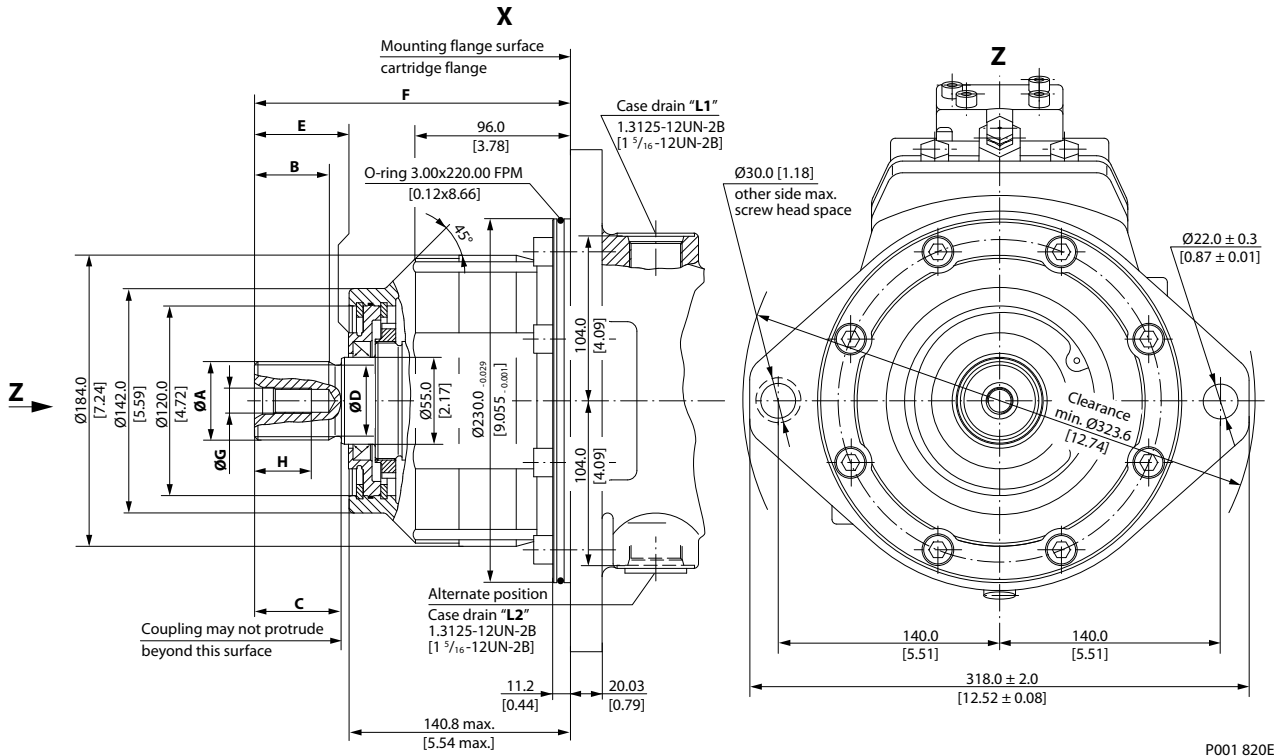
51C160 proportional and two-position control, HZB1 (Side port on top, Axial port below)



P001 807E

## General dimensions – frame size 160

## Shaft options – 51C160



## Shaft spline data - mm [in]

Shaft option	D4	D5
Number of teeth	21	24
Spline	W45x2x30x21x9g side fit DIN 5480	W50x2x30x24x9g side fit DIN 5480
Pitch Ø	42.0 [1.654]	48.0 [1.890]
Ø A	44.6 [1.76]	49.6 [1.95]
B	42.0 [1.65]	47.0 [1.85]
C	50.0 ± 0.5 [1.97]	55.0 ± 0.5 [2.17]
Ø D	40.0 [1.57]	45.0 [1.77]
E	54.5 ± 1.4 [2.15]	59.5 ± 1.4 [2.34]
F	194.9 ± 0.6 [7.67]	199.9 ± 0.6 [7.87]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N·m [1018 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

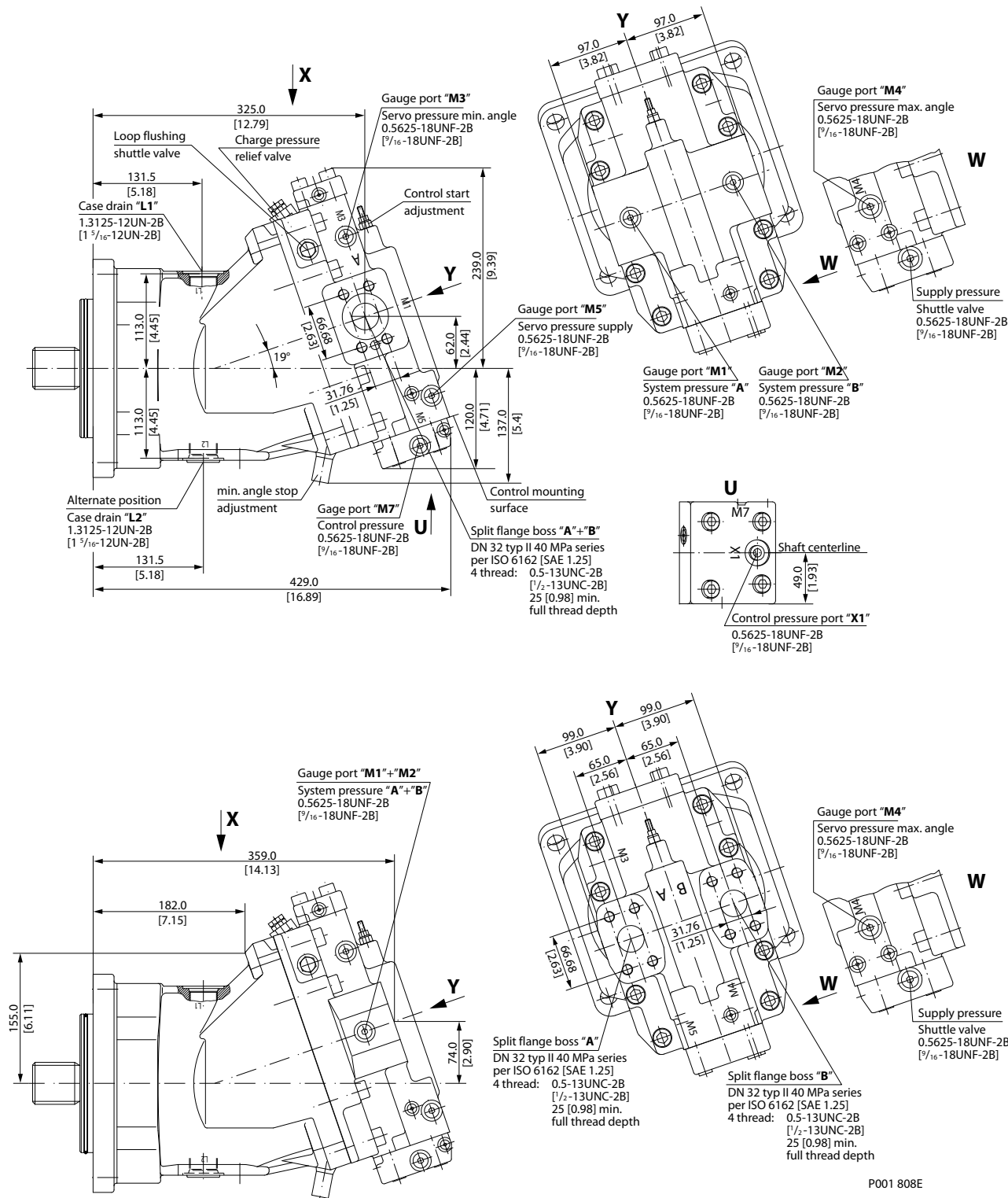
Contact your Danfoss representative for specific installation drawings.



General dimensions – frame size 250

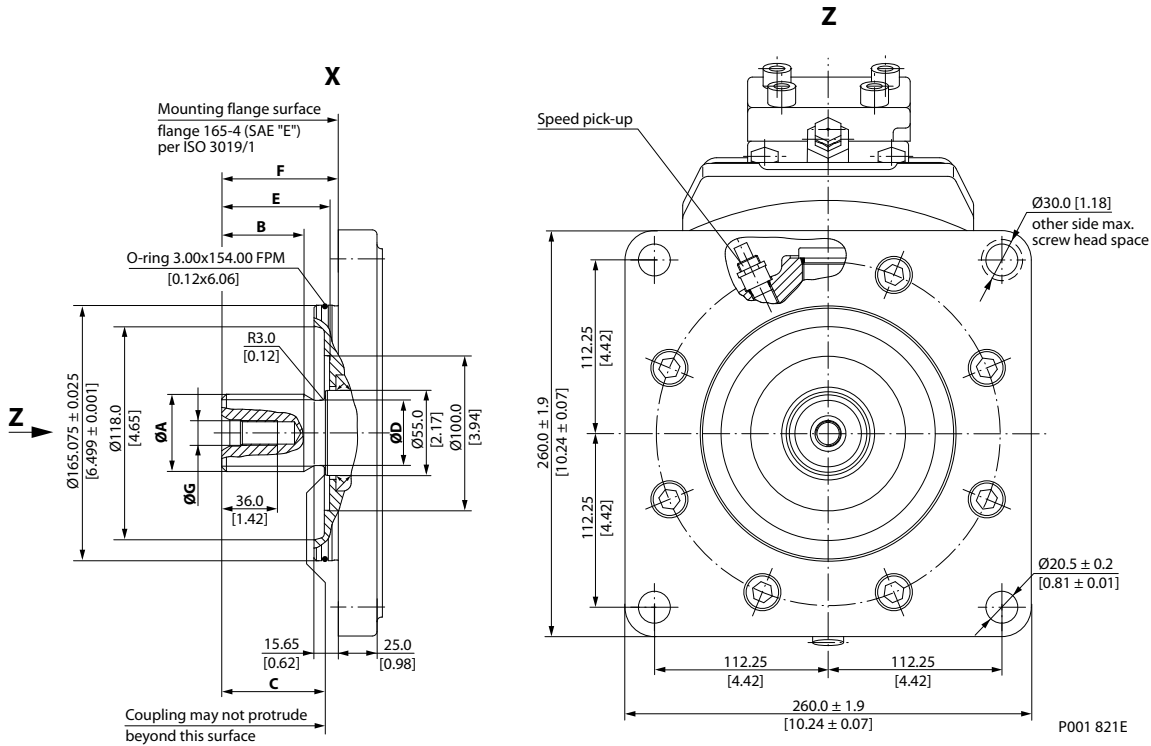
SAE flange design per ISO 3019/1

51V250 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)



## General dimensions – frame size 250

## Shaft Options – 51V250



## Shaft spline data - mm [in]

Shaft option	F2	C8
Number of teeth	15	27
Pitch	8/16	16/32
Pitch $\emptyset$	47.625 [1.875]	42.862 [1.688]
$\emptyset$ A	49.99 [1.97]	43.96 [1.73]
B	53.0 [2.09]	55.0 [2.17]
$\emptyset$ D	42.20 [1.66]	39.60 [1.56]
Pressure angle	30°	
C	67.0 ± 0.5 [2.64]	
E	70.0 ± 1.1 [2.76]	
F	75.4 ± 0.7 [2.97]	
H	36.0 [1.42]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
$\emptyset$ G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N·m [1770 lbf·in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

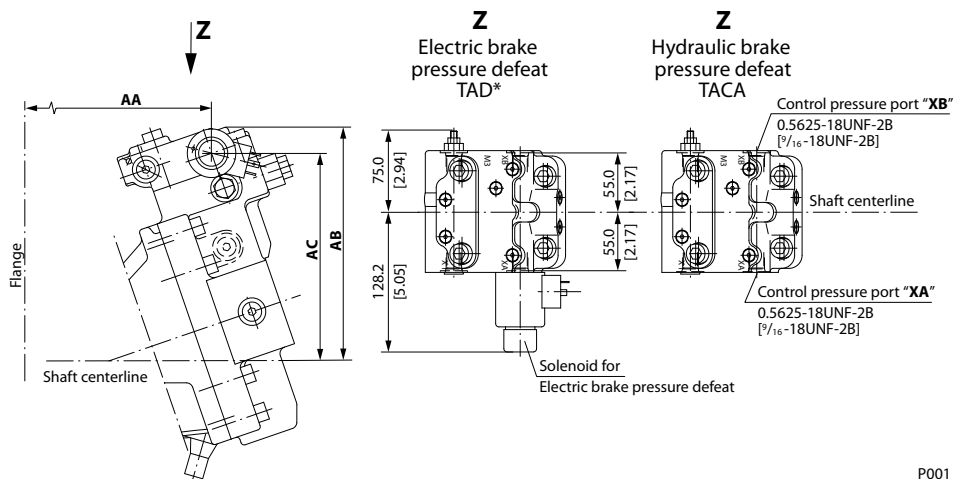
Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options TA\*\* for 51-1 – Pressure Compensator Control (Frame Size: 060, 080, 110)**



P001 838E

Control TA\*\* for 51-1 - mm [in]

Frame	060			080			110		
Design	V	D	C	V	D	C	V	D	C
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

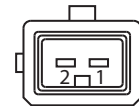
**Solenoid connectors**

**Plug face DIN 46350** (Supplied)  
 Mating connector No.: K09129  
 Id. No.: **514117**



P001752

**AMP Junior Timer two pin** (Supplied)  
 Mating connector No.: K19815  
 Id. No.: **508388**

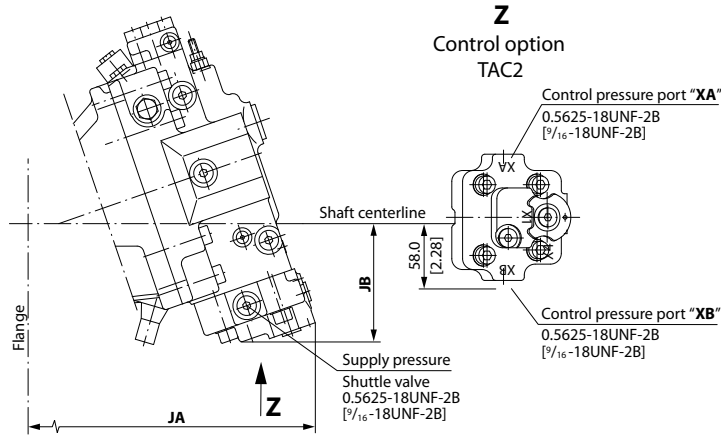


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TA\*\* for 51 – Pressure Compensator Control (Frame Size: 160, 250)



P001 839E

Control TA\*\* for 51 - mm [in]

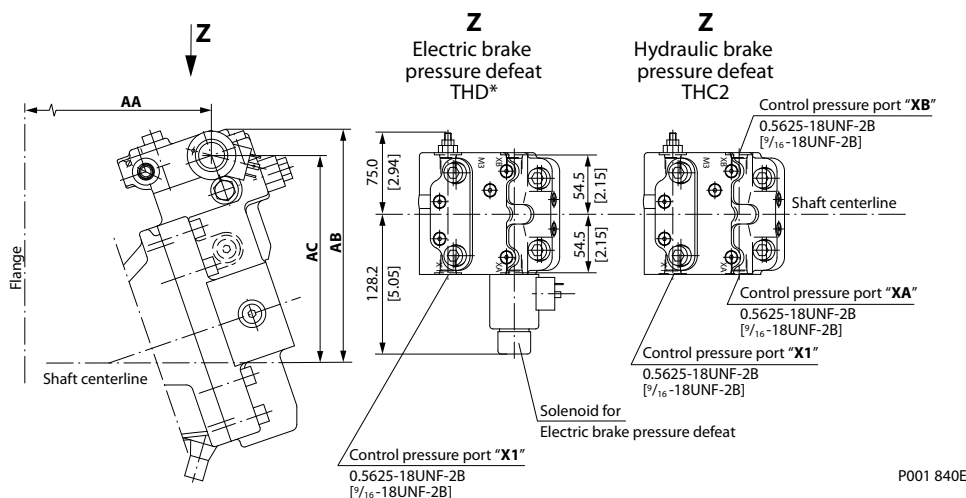
Frame	160			250		
Design	V	D	C	V	D	C
JA	393 [15.48]	361 [14.22]	257 [10.11]	445 [17.51]	-	-
JB	114 [4.48]			122 [4.82]	-	-

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options TH\*\* for 51-1 – Hydraulic Two-Position Control (Frame Size: 060, 080, 110)**



Control TA\*\* for 51-1 - mm [in]

Frame	060			080			110		
	V	D	C	V	D	C	V	D	C
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		223.9 [8.82]
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		201.0 [7.91]

V = SAE-flange  
D = DIN-flange  
C = Cartridge flange

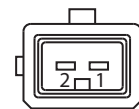
**Solenoid connectors**

**Plug face DIN 46350** (Supplied)  
Mating connector No.: K09129  
Id. No.: **514117**



P001752

**AMP Junior Timer two pin** (Supplied)  
Mating connector No.: K19815  
Id. No.: **508388**

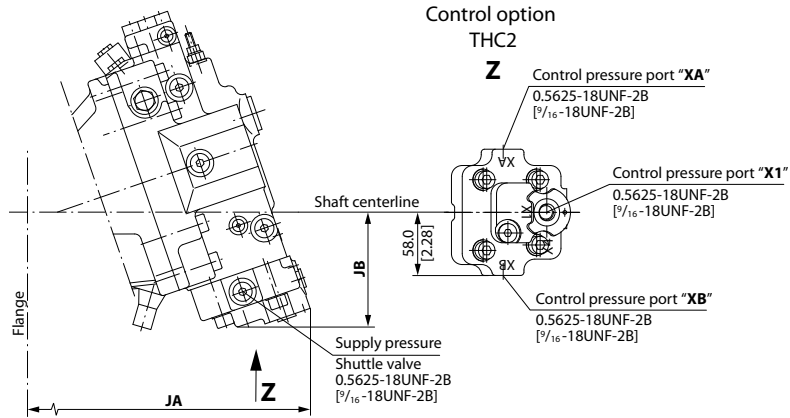


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TH\*\* for 51 – Hydraulic Two-Position Control (Frame Size: 160, 250)



P001 841E

Control TA\*\* for 51 - mm [in]

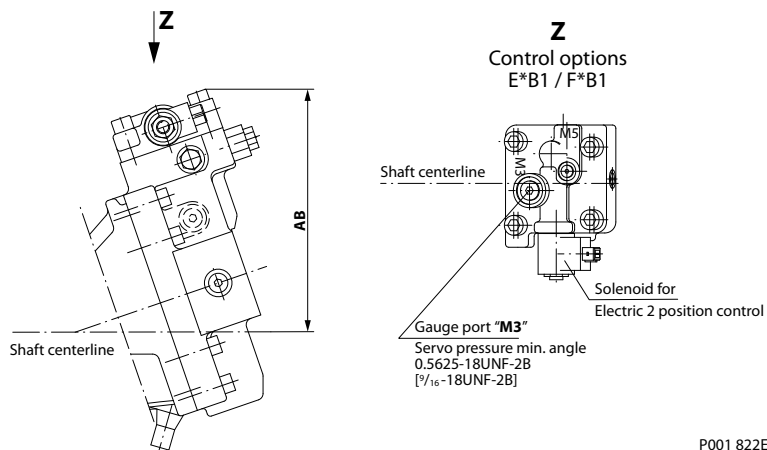
Frame size	160			250		
	V	D	C	V	D	C
JA	393 [15.48]	361 [14.22]	257 [10.11]	445 [17.51]		-
JB		114 [4.48]		122 [4.82]		-

V = SAE-flange  
D = DIN-flange  
C = Cartridge flange

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options E\*B1, F\*B1 for 51-1 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)**



P001 822E

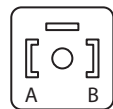
*Control E1B1, E2B1, E7B1, F1B1, F2B1 for 51-1 - mm [in]*

Frame	060			080			110		
Design	V	D	C	V	D	C	V	D	C
AB	208.5 [8.21]			218.9 [8.62]			232.7 [9.16]		

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

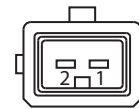
**Solenoid connectors**

**Plug face DIN 46350** (Supplied)  
 Mating connector No.: K09129  
 Id. No.: **514117**



P001752

**AMP Junior Timer two pin** (Supplied)  
 Mating connector No.: K19815  
 Id. No.: **508388**

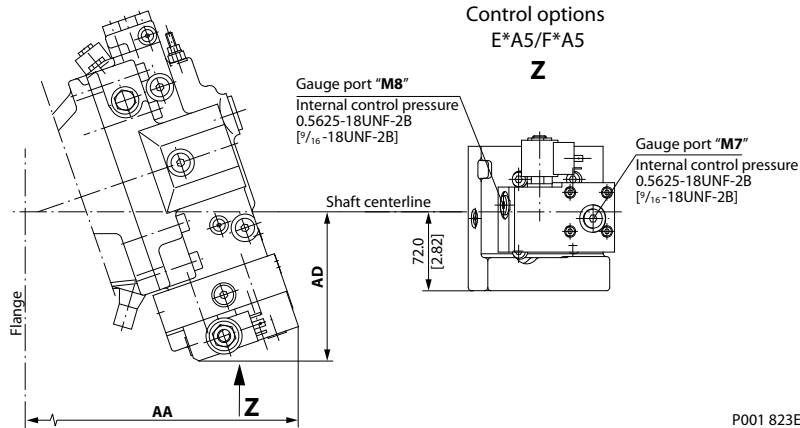


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options E\*A5, F\*A5 for 51 – Electrohydraulic Two-Position Control (Frame Size: 160, 250)



P001 823E

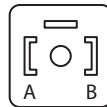
Control E1A5, E2A5, F1A5, F2A5 for 51 - mm [in]

Frame size	160			250		
Design	V	D	C	V	D	C
AA	401 [15.79]	369 [14.53]	265 [10.42]	453 [17.82]	-	-
AD	145 [5.72]			154 [6.06]	-	-

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

Solenoid connector

Plug face DIN 46350 (Supplied)  
 Mating connector No.: K09129  
 Id. No.: 514117



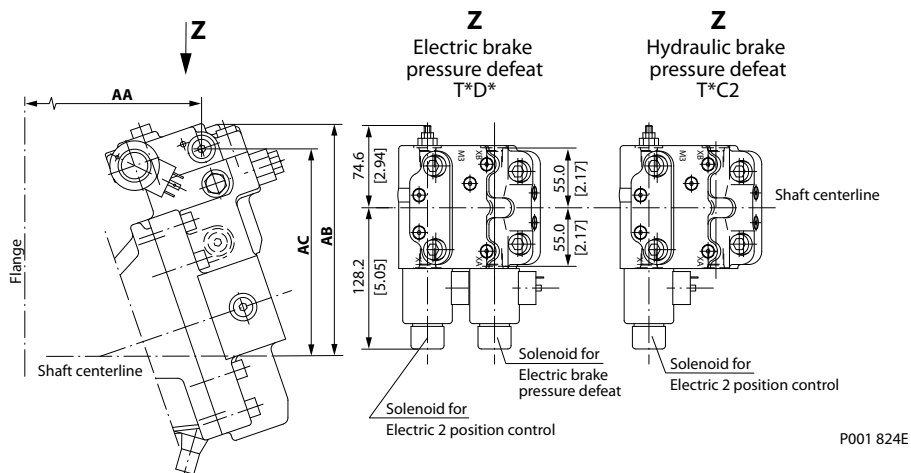
P001752

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.



**Dimension – Controls**

**Options T1\*\*, T2\*\*, T7\*\* for 51-1 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)**



Control T1\*\*, T2\*\*, T7\*\* for 51-1 - mm [in]

Frame	060			080			110		
Design	V	D	C	V	D	C	V	D	C
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		223.9 [8.82]
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		201.0 [7.91]

V = SAE-flange  
D = DIN-flange  
C = Cartridge flange

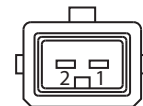
**Solenoid connectors**

**Plug face DIN 46350** (Supplied)  
Mating connector No.: K09129  
Id. No.: **514117**



P001752

**AMP Junior Timer two pin** (Supplied)  
Mating connector No.: K19815  
Id. No.: **508388**

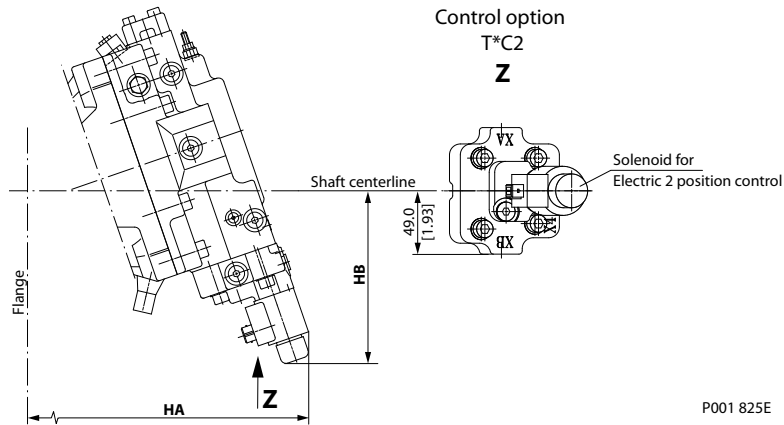


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options T1C2, T2C2 for 51 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)**



P001 825E

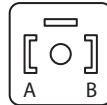
*Control T1C2, T2C2 for 51 - mm [in]*

Frame size	160			250		
Design	V	D	C	V	D	C
HA	409 [16.10]	377 [14.84]	272 [10.73]	461 [18.13]		–
HB		178 [7.0]		186 [7.33]		–

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

**Solenoid connector**

**Plug face DIN 46350** (Supplied)  
 Mating connector No.: K09129  
 Id. No.: **514117**

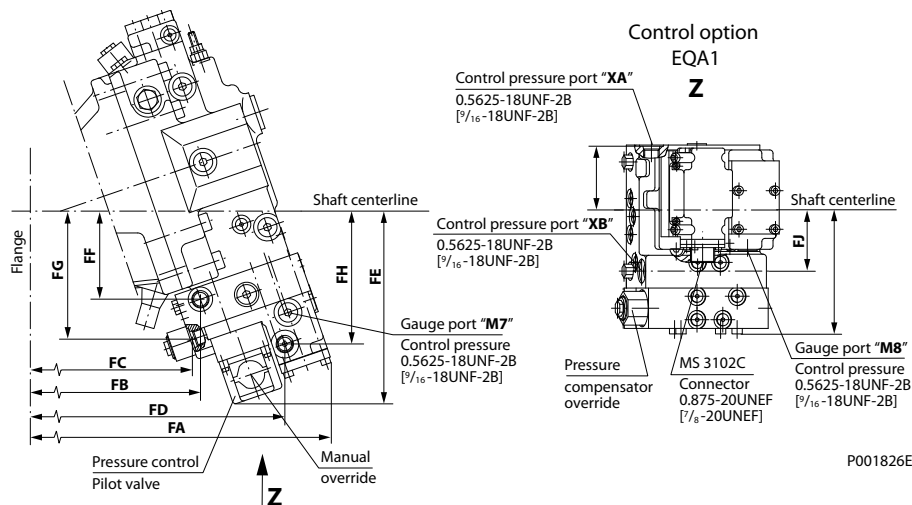


P001752

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options EPA1, EQA1 for 51 – Electrohydraulic Two-Position Control (All Frame Sizes)**



Control EPA1, EQA1 for 51 - mm [in]

Frame	060			080			110			160			250		
	V	D	C	V	D	C	V	D	C	V	D	C	V	D	C
FA	327 [12.89]	303 [11.93]	243 [9.57]	351 [13.81]	327 [12.87]	249 [9.78]	369 [14.54]	337 [13.28]	255 [10.04]	409 [16.11]	377 [14.85]	273 [10.73]	461 [18.31]		-
FB	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.90]	220 [8.65]	137 [5.40]	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]		-
FC	203 [8.00]	179 [7.04]	119 [4.69]	226 [8.88]	202 [7.94]	123 [4.85]	244 [9.61]	212 [8.35]	130 [5.11]	276 [10.85]	244 [9.59]	139 [5.48]	327 [12.88]		-
FD	286 [11.25]	261 [10.29]	202 [7.93]	309 [12.17]	285 [11.32]	207 [8.14]	328 [12.90]	296 [11.64]	213 [8.40]	367 [14.47]	335 [13.21]	231 [9.09]	419 [16.50]		-
FE		168 [6.62]			174 [6.85]			176 [6.91]			183 [7.22]		192 [7.56]		-
FF		74 [2.91]			80 [3.15]			81 [3.20]			92 [3.63]		101 [3.97]		-
FG		110 [4.33]			116 [4.58]			118 [4.64]			129 [5.06]		137 [5.41]		-
FH		114 [4.47]			120 [4.74]			122 [4.80]			130 [5.11]		138 [5.45]		-
FJ		56 [2.20]			56 [2.20]			56 [2.20]			57 [2.22]		57 [2.22]		-

V = SAE-flange; D = DIN-flange; C = Cartridge flange  
 -- = not available

*Solenoid connectors*

**MS Connector  
 MS3102C-14S-2P**  
 (Supplied Connector)

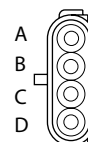
Mating Connector  
 No.: K08106  
 Id.-No.: 615062



P001 753E

**Packard Weather-Pack  
 4 pin**  
 (Supplied Connector)

Mating Connector  
 No.: K03384  
 Id.-No.: 712208

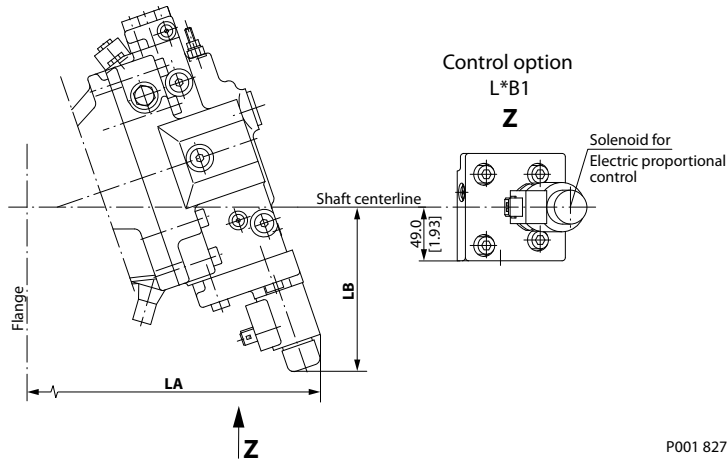


P001 759E

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options L1B1, L2B1, L7B1 for 51 – Electrohydraulic Two-Position Control (All Frame Sizes)



P001 827E

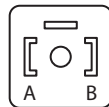
Control L1B1, L2B1, L7B1 for 51 - mm [in]

Frame	060			080			110			160			250			
	Design	V	D	C	V	D	C	V	D	C	V	D	C	V	D	C
LA	321 [12.63]	296 [11.66]	236 [9.31]	344 [13.55]	320 [12.60]	242 [9.52]	363 [14.28]	331 [13.02]	248 [9.77]	402 [15.84]	370 [14.58]	266 [10.47]	454 [17.87]	-	-	-
LB	144 [5.66]			150 [5.90]			151 [5.96]			159 [6.27]			168 [6.61]			

V = SAE-flange; D = DIN-flange; C = Cartridge flange

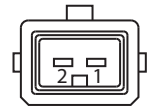
Solenoid connectors

**Plug face DIN 46350** (Supplied)  
Mating connector No.: K09129  
Id. No.: **514117**



P001752

**AMP Junior Timer two pin** (Supplied)  
Mating connector No.: K19815  
Id. No.: **508388**

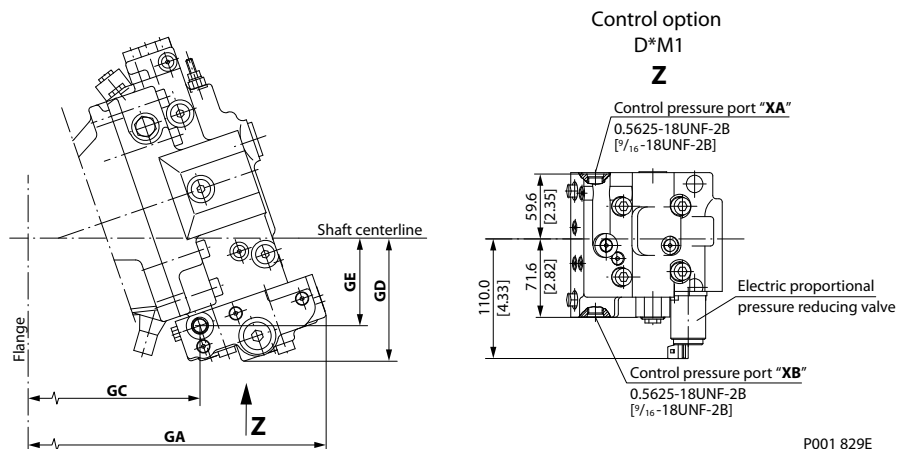


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Options D7M1, D8M1 for 51 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)**



P001 829E

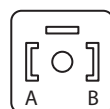
Control D7M1, D8M1 for 51 - mm [in]

Size	060			080			110		
Design	V	D	C	V	D	C	V	D	C
GA	325 [12.80]	301 [11.84]	241 [9.49]	349 [13.73]	325 [12.80]	246 [9.70]	367 [14.64]	335 [13.20]	253 [9.95]
GC	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.91]	220 [8.65]	137 [5.40]
GD	106 [4.19]			112 [4.42]			114 [4.48]		
GE	74 [2.91]			80 [3.15]			81 [3.20]		

V = SAE-flange  
 D = DIN-flange  
 C = Cartridge flange

**Solenoid connector**

**Plug face DIN 46350** (Supplied)  
 Mating connector No.: K09129  
 Id. No.: **514117**

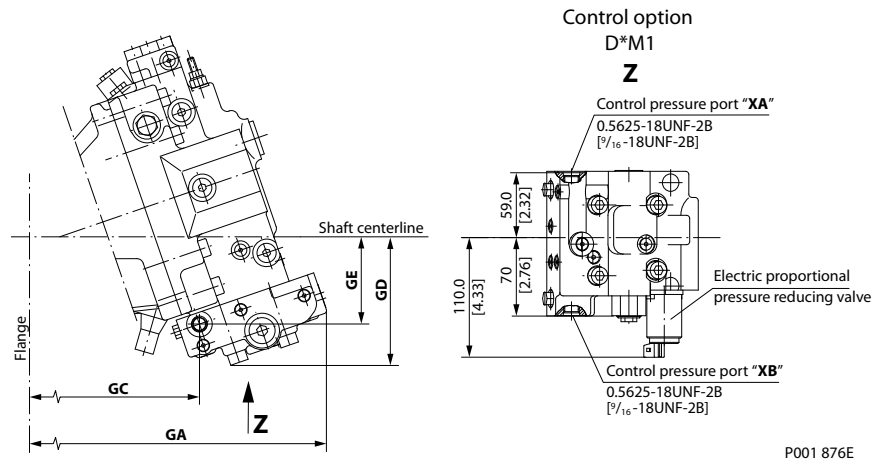


P001752

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options D7M1, D8M1 for 51 – Electrohydraulic Two-Position Control (Frame Size: 160, 250)



Control D7M1, D8M1 for 51 - mm [in]

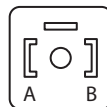
Frame size	160			250		
Design	V	D	C	V	D	C
GA	407 [16.02]	375 [14.76]	270 [10.65]	459 [18.05]	-	-
GC	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]	-	-
GD	133 [5.22]			141 [5.55]	-	-
GE	92 [3.63]			101 [3.97]	-	-

V = SAE-flange, D = DIN-flange, C = Cartridge flange

-- = not available

Solenoid connector

Plug face DIN 46350 (Supplied)  
Mating connector No.: K09129  
Id. No.: 514117

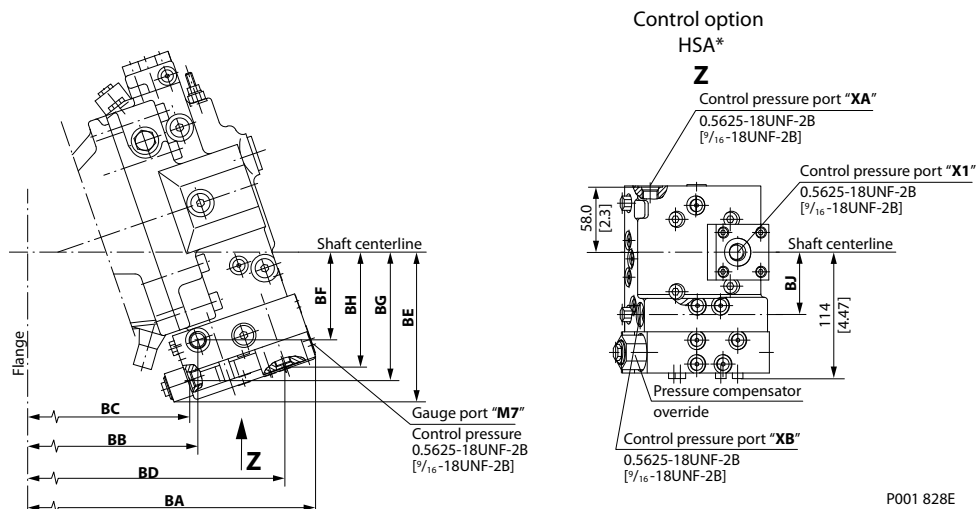


P001752

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

**Dimension – Controls**

**Option HSA\* for 51 – Hydraulic Proportional Control (All Frame Sizes)**



P001 828E

Control HSA\* for 51 - mm [in]

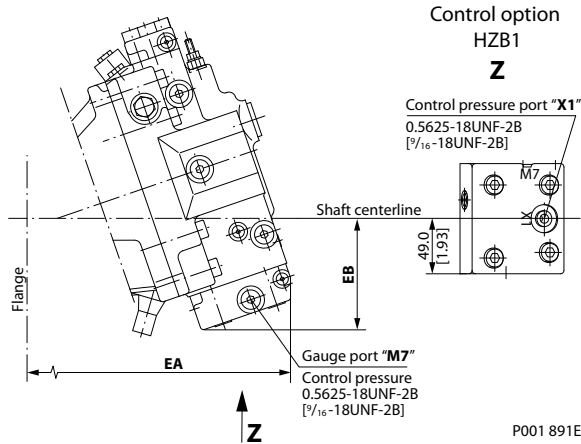
Size	060			080			110			160			250		
Design	V	D	C	V	D	C	V	D	C	V	D	C	V	D	C
BA	316 [12.45]	292 [11.49]	232 [9.13]	340 [13.37]	316 [12.34]	237 [9.34]	358 [14.10]	326 [12.84]	244 [9.60]	398 [15.66]	366 [14.40]	261 [10.29]	449 [17.70]	-	-
BB	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.90]	220 [8.65]	137 [5.40]	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]	-	-
BC	203 [8.00]	179 [7.04]	119 [4.69]	226 [8.88]	202 [7.94]	123 [4.85]	244 [9.61]	212 [8.35]	130 [5.11]	276 [10.85]	244 [9.59]	139 [5.48]	327 [12.88]	-	-
BD	288 [11.35]	264 [10.38]	204 [8.03]	312 [12.27]	288 [11.35]	209 [8.24]	330 [12.99]	298 [11.74]	216 [8.49]	370 [14.56]	338 [13.30]	233 [9.18]	421 [16.59]	-	-
BE	130 [5.12]			136 [5.35]			137 [5.41]			145 [5.72]			154 [6.06]	-	-
BF	74 [2.91]			80 [3.15]			81 [3.20]			92 [3.63]			101 [3.97]	-	-
BG	110 [4.33]			116 [4.58]			118 [4.64]			129 [5.06]			137 [5.41]	-	-
BH	98 [3.87]			104 [4.10]			106 [4.16]			114 [4.47]			122 [4.81]	-	-
BJ	56 [2.20]			56 [2.20]			56 [2.20]			57 [2.22]			57 [2.22]	-	-

V = SAE-flange; D = DIN-flange; C = Cartridge flange; - = not available

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Split flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Option HZB1 for 51 – Hydraulic Proportional Control (All Frame Sizes)



P001 891E

Control HZB1 for 51 - mm [in]

Size	060			080			110			160			250		
	V	D	C	V	D	C	V	D	C	V	D	C	V	D	C
EA	294 [11.56]	270.0 [10.64]	209 [8.24]	318.0 [12.52]	294.0 [11.58]	215 [8.45]	337.0 [13.25]	305.0 [12.00]	221 [8.71]	376.0 [14.82]	345.0 [13.60]	239 [9.40]	429.0 [16.89]	-	-
EB	96 [3.77]			102 [4.0]			103 [4.06]			111 [4.37]			120 [4.71]	-	-

V = SAE-flange; D = DIN-flange; C = Cartridge flange

- = not available

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.









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