Series 51 and 51-1 bent axis 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 today
- 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 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

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SERIES 51, PROPORTIONAL CONTROL

ELECTRIC PROPORTIONAL CONTROL

MINIMUM DISPLACEMENT LIMITER

VALVE SEGMENT

BEARING PLATE

SPEED PICKUP RING

TAPERED ROLLER BEARINGS

PISTON

SYNCHRONIZING SHAFT

CHARGE PRESSURE RELIEF VALVE

SERVO PISTON

FLANGE

SPEED SENSOR

Name Plate

Made in Germany

MODEL CODE

IDENT NUMBER

BARCODE SERIAL NUMBER

PLACE OF MANUFACTURE

SAUER DANFOSS

Neumünster/Germany

Model No./Ident.No. S084092

Serial No. M982211215

Made in Germany

51V080 RS1N
L1B1 WB31 ADA
050A00 D400

P001 196E

Neumünster/Germany

MODEL CODE

IDENT NUMBER

BARCODE SERIAL NUMBER

PLACE OF MANUFACTURE

432

5084092

M982211215

P001 196E
Above schematics show 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).
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor type</td>
<td>Axial piston motor with variable displacement bent axis design.</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>Clockwise and counter-clockwise (bi-directional).</td>
</tr>
<tr>
<td>Installation position</td>
<td>Discretionary, the housing must always be filled with hydraulic fluid.</td>
</tr>
<tr>
<td>Other system requirements</td>
<td>Independent braking system, circuit overpressure protection, suitable reservoir.</td>
</tr>
</tbody>
</table>

### Specific Data

<table>
<thead>
<tr>
<th>Specific Data</th>
<th>Frame size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>060</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td>Displacement maximum</td>
<td>$V_{g_{\text{max}}}$</td>
</tr>
<tr>
<td>Displacement minimum</td>
<td>$V_{g_{\text{min}}}$</td>
</tr>
<tr>
<td>Mass moment of inertia of the internal rotating parts</td>
<td>$J$</td>
</tr>
<tr>
<td>Type of mounting</td>
<td>Four (4) bolt flange, SAE or DIN-flange configuration. Two (2) bolt flange cartridge motor configuration.</td>
</tr>
<tr>
<td>Controls</td>
<td>N1, HZ, E1, E2, E7, F1, F2, T1, T2, TA, TH, EP, EQ, L1, L2, L7, D7, D8, H5</td>
</tr>
<tr>
<td>Displacement limiter</td>
<td>All Series 51 motors incorporate mechanical minimum and maximum displacement limiters.</td>
</tr>
<tr>
<td>Shaft configuration</td>
<td>Sphined ANSI or DIN shaft.</td>
</tr>
</tbody>
</table>
## Series 51 and 51-1 Bent Axis Variable Displacement Motors
### Technical Information
#### Technical Specifications

<table>
<thead>
<tr>
<th>SPECIFIC DATA (continued)</th>
</tr>
</thead>
</table>

**Case Pressure**

<table>
<thead>
<tr>
<th></th>
<th>bar</th>
<th>psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated pressure</td>
<td>3</td>
<td>[44.0]</td>
</tr>
<tr>
<td>Maximum pressure (cold start)</td>
<td>5</td>
<td>[73.0]</td>
</tr>
<tr>
<td>Minimum pressure (at rated speed)</td>
<td>1</td>
<td>[14.5]</td>
</tr>
</tbody>
</table>

**System Pressure Range, Input**

<table>
<thead>
<tr>
<th></th>
<th>bar</th>
<th>psid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delta pressure</td>
<td>480</td>
<td>[7000]</td>
</tr>
<tr>
<td>Minimum low pressure</td>
<td>10</td>
<td>[145]</td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>510</td>
<td>[7400]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>min⁻¹ (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated speed</td>
<td></td>
</tr>
<tr>
<td>at max. disp.</td>
<td>3600</td>
</tr>
<tr>
<td>at min. disp.</td>
<td>5600</td>
</tr>
<tr>
<td>Maximum speed¹</td>
<td></td>
</tr>
<tr>
<td>at max. disp.</td>
<td>4400</td>
</tr>
<tr>
<td>at min. disp.</td>
<td>7000</td>
</tr>
</tbody>
</table>

¹ Contact your Sauer-Danfoss representative for max. speed at displacements between max. and min. displacement.

<table>
<thead>
<tr>
<th></th>
<th>Nm/bar [lbf·in/1000 psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>At maximum</td>
<td>0.95 [583]</td>
</tr>
<tr>
<td>At minimum</td>
<td>0.19 [117]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Nm/bar [lbf·in/1000 psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>At maximum</td>
<td>1.28 [784]</td>
</tr>
<tr>
<td>At minimum</td>
<td>0.26 [156]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>theoretical torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>0.35 [214]</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.51 [313]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>mm²/s [SUS]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>7</td>
</tr>
<tr>
<td>Maximum</td>
<td>1600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>β_x-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>β₁₀ ≥ 2)</td>
</tr>
<tr>
<td>Maximum</td>
<td>β₁₀ ≥ 10)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Required Fluid Cleanliness Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 4406</td>
<td>Class 22-18-13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ISO 4406</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required β₁₀-Ratio for Suction Filtration</td>
<td>β₁₀ ≥ 2)</td>
</tr>
<tr>
<td>Recommended β₁₀-Ratio for Charge Pressure Filtration</td>
<td>β₁₀ ≥ 10)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Recommended Inlet Screen Size for Charge Pressure Filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 µm-125 µm</td>
<td></td>
</tr>
</tbody>
</table>

## Fluid Specifications

### Temperature Range

<table>
<thead>
<tr>
<th>°C</th>
<th>ºF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>-40</td>
</tr>
<tr>
<td>Rated</td>
<td>104</td>
</tr>
<tr>
<td>Maximum</td>
<td>115</td>
</tr>
</tbody>
</table>

¹ At the hottest point, normally the case drain port.

### Viscosity

<table>
<thead>
<tr>
<th></th>
<th>mm²/s [SUS]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>7</td>
</tr>
<tr>
<td>Maximum</td>
<td>1600</td>
</tr>
</tbody>
</table>

### Recommended Inlet Screen Size for Charge Pressure Filtration

<table>
<thead>
<tr>
<th></th>
<th>Required Inlet Screen Size for Charge Pressure Filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 µm-125 µm</td>
<td></td>
</tr>
</tbody>
</table>
**Determination of Nominal Motor Sizes**

### Metric System

- **Input flow:**
  \[ Q_e = \frac{V_g \cdot n}{1000 \cdot \eta_v} \text{ l/min} \]

- **Output torque:**
  \[ M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi} \text{ Nm} \]

- **Output power:**
  \[ P_e = \frac{M_e \cdot n}{9550} = \frac{Q_e \cdot \Delta p \cdot \eta_t}{600} \text{ kW} \]

- **Speed:**
  \[ n = \frac{Q_e \cdot 1000 \cdot \eta_v}{V_g} \text{ min}^{-1} \]

### Inch System

- **Input flow:**
  \[ Q_e = \frac{V_g \cdot n}{231 \cdot \eta_v} \text{ [US gal/min]} \]

- **Output torque:**
  \[ M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi} \text{ [lbf-in]} \]

- **Output power:**
  \[ P_e = \frac{M_e \cdot n}{396000} = \frac{Q_e \cdot \Delta p \cdot \eta_t}{396000} \text{ [hp]} \]

- **Speed:**
  \[ n = \frac{Q_e \cdot 231 \cdot \eta_v}{V_g} \text{ min}^{-1} \text{ (rpm)} \]

---

- \( V_g \) = Motor displacement per rev. \( \text{cm}^3 \) [\( \text{in}^3 \)]
- \( \Delta p \) = \( P_{HD} - P_{ND} \) bar [psid]
- \( \eta_v \) = Motor volumetric efficiency
- \( \eta_{mh} \) = Motor mechanical-hydraulic (Torque) efficiency
- \( \eta_t \) = Motor total (overall) efficiency
- \( P_{HD} \) = High pressure bar [psid]
- \( P_{ND} \) = Low pressure bar [psid]
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
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**

<table>
<thead>
<tr>
<th></th>
<th>bar</th>
<th>psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated pressure</td>
<td>3</td>
<td>44.0</td>
</tr>
<tr>
<td>Maximum pressure (cold start)</td>
<td>5</td>
<td>73.0</td>
</tr>
<tr>
<td>Minimum pressure (at rated speed)</td>
<td>1</td>
<td>14.5</td>
</tr>
</tbody>
</table>

---

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 Sauer-Danfoss representative.

**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.

---

**Speed Limits**

<table>
<thead>
<tr>
<th>Frame size</th>
<th>060</th>
<th>080</th>
<th>110</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated speed at max. disp.</td>
<td>3600</td>
<td>3100</td>
<td>2800</td>
<td>2500</td>
<td>2200</td>
</tr>
<tr>
<td>at min. disp.</td>
<td>5600</td>
<td>5000</td>
<td>4500</td>
<td>4000</td>
<td>3400</td>
</tr>
<tr>
<td>Maximum speed(^1) at max. disp.</td>
<td>4400</td>
<td>4000</td>
<td>3600</td>
<td>3200</td>
<td>2700</td>
</tr>
<tr>
<td>at min. disp.</td>
<td>7000</td>
<td>6250</td>
<td>5600</td>
<td>5000</td>
<td>4250</td>
</tr>
</tbody>
</table>

\(^1\) Contact your Sauer-Danfoss representative for max. speed at displacements between max. and min. displacement.
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 Sauer-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**

<table>
<thead>
<tr>
<th></th>
<th>bar</th>
<th>psid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delta pressure</td>
<td>480</td>
<td>7000</td>
</tr>
<tr>
<td>Minimum low pressure</td>
<td>10</td>
<td>145</td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>510</td>
<td>7400</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Charge pump size (cm³)</th>
<th>E4</th>
<th>E6</th>
<th>F0</th>
<th>F3</th>
<th>G0</th>
<th>G3</th>
<th>H0</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>11</td>
<td>14</td>
<td>17 or 20</td>
<td>26</td>
<td>34, 47 or 65</td>
<td></td>
</tr>
</tbody>
</table>

**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.

**Equation:**

\[
Q_{\text{flush}} = \frac{Q_{\text{charge}} - Q_{\text{leak}}}{2 \cdot k_{Mo}}
\]

**Where:**
- \( Q_{\text{flush}} \) = flushing flow per motor
- \( Q_{\text{charge}} \) = charge flow at operating speed
- \( k_{Mo} \) = number of motors fed by one pump
- \( Q_{\text{leak}} \) = sum of external leakages including:
  - 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)
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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 Sauer-Danfoss literature *Hydraulic Fluids and Lubricants Technical Information* for more information.

It is not permissible to mix hydraulic fluids. For more information contact your Sauer-Danfoss representative.

Suitable Hydraulic fluids:

- 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 Sauer-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.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
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TEMPERATURE AND VISCOITY
(continued)

<table>
<thead>
<tr>
<th>Temperature Range 1)</th>
<th>°C</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>-40</td>
<td>[-40]</td>
</tr>
<tr>
<td>Rated</td>
<td>104</td>
<td>[220]</td>
</tr>
<tr>
<td>Maximum</td>
<td>115</td>
<td>[240]</td>
</tr>
</tbody>
</table>

1) At the hottest point, normally the case drain port.

FLUID AND FILTRATION

To prevent premature wear, it is imperative that only clean fluid enter 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.

The filter may be located either on the inlet (suction filtration) or discharge (charge pressure filtration) side of the charge pump. The selected filtration system must maintain a cleanliness level of 22/18/13 per ISO 4406.

The selection of a filter depends on a number of factors including the contaminant ingestion 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 may be measured with a Beta ratio \(\beta \). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a \(\beta\) ratio within the 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 considerably 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.

Since each system is unique, the filtration requirement for that system will be unique and must be determined by test in each case. It is essential that monitoring of prototypes and evaluation of components and performance throughout the test program be the final criteria for judging the adequacy of the filtration system. Please see Sauer-Danfoss literature *Hydraulic Fluids and Lubricants Technical Information* for more information.

1) Filter \(\beta\) 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 µm) upstream of the filter to the number of these particles downstream of the filter.

<table>
<thead>
<tr>
<th>Cleanliness Level and (\beta) Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Fluid Cleanliness Level</td>
</tr>
<tr>
<td>Recommended (\beta) Ratio for Suction Filtration</td>
</tr>
<tr>
<td>Recommended (\beta) Ratio for Charge Pressure Filtration</td>
</tr>
<tr>
<td>Recommended Inlet Screen Size for Charge Pressure Filtration</td>
</tr>
</tbody>
</table>
**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.

**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.
The rated motor bearing life, $L_{10}$, 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.

Contact your Sauer-Danfoss representative for bearing life values at other pressures and angles.

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

$$L_2 = \frac{L_1 \cdot 1500 \text{ min}^{-1} \text{(rpm)}}{n_2} \text{ h}$$

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

$$n_2 = \text{Operating speed} \text{ min}^{-1} \text{ (rpm)}$$
Series 51 and 51-1 motor: 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 LOADS**

**EXTERNAL SHAFT LOAD ORIENTATION**

SAE-Flange design per ISO 3019/1

DIN-Flange design per ISO 3019/2

Cartridge Flange design
The table below provides the following information:

- The maximum allowable radial load \((F_r)\) based on the distance \((x_1)\) from the mounting flange to the load.
- The maximum allowable axial load \((F_a)\).
- The actual distance of \((F_r)\) for a given application from the mounting flange to the load is \((x_2)\).
- \(A\) is the basic distance.
- \(F_a/\Delta p\) ratio of allowable axial load, dependent upon system pressure.

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

<table>
<thead>
<tr>
<th>Frame size</th>
<th>060</th>
<th>080</th>
<th>110</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum allowable radial load (F_r) [N (lbf)]</td>
<td>10 000 [2248]</td>
<td>12 000 [2698]</td>
<td>14 000 [3147]</td>
<td>18 000 [4047]</td>
<td>26 000 [5845]</td>
</tr>
<tr>
<td>Distance from the SAE-mounting flange (x_1) [mm (in)]</td>
<td>33.6 [1.32]</td>
<td>33.6 [1.32]</td>
<td>62.7 [2.47]</td>
<td>52.7 [2.07]</td>
<td>45.3 [1.78]</td>
</tr>
<tr>
<td>Distance from the DIN-mounting flange (x_1) [mm (in)]</td>
<td>57.2 [2.25]</td>
<td>57.6 [2.27]</td>
<td>94.7 [3.73]</td>
<td>84.7 [3.33]</td>
<td>—</td>
</tr>
<tr>
<td>Distance from the Cartridge design mounting flange (x_1) [mm (in)]</td>
<td>117.6 [4.63]</td>
<td>136.1 [5.36]</td>
<td>177.5 [7.00]</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Basic distance (A) [mm (in)]</td>
<td>25.2 [0.99]</td>
<td>25.6 [1.01]</td>
<td>54.7 [2.15]</td>
<td>44.7 [1.76]</td>
<td>37.3 [1.47]</td>
</tr>
<tr>
<td>Maximum allowable axial load at zero rpm or running in the idle pressure (F_a) [N (lbf)]</td>
<td>1100 [247]</td>
<td>1400 [315]</td>
<td>1800 [405]</td>
<td>2500 [562]</td>
<td>4500 [1012]</td>
</tr>
<tr>
<td>Maximum allowable axial load at pressure (F_a/\Delta p) [N/bar (lbf/1000 psi)]</td>
<td>10.4 [161]</td>
<td>12.6 [195]</td>
<td>15.2 [236]</td>
<td>19.2 [298]</td>
<td>26.4 [409]</td>
</tr>
</tbody>
</table>

— = not available
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 \( X_2 \) is different from \( X_1 \):

**Note:**

\( X_2 \) is the actual distance of \( Fr \) from the mounting flange to the load for a given application. If \( X_2 < X_1 \), \( Fr \) could also be calculated by the first equation, but in addition the bearing life has to be checked.

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

**Metric System:**

\[
X_2 > X_1 \quad Fr = \frac{M \cdot 10^3}{A - X_1 + X_2} \quad \text{N}
\]

**Inch System:**

\[
X_2 > X_1 \quad Fr = \frac{M \cdot 12}{A - X_1 + X_2} \quad \text{lbf}
\]

**Metric or Inch System:**

\[
X_2 > X_1 \quad Fr = Fr \text{ max N lbf}
\]
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 mm²/s [53 SUS]. These efficiencies can be used for all frame sizes.

**Overall efficiency and volumetric efficiency at maximum displacement**

![Graph showing overall efficiency and volumetric efficiency at maximum displacement](image)

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 mm²/s [53 SUS]. These efficiencies can be used for all frame sizes.

**Overall efficiency at maximum displacement**

![Graph showing overall efficiency at maximum displacement](image)
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 mm²/s (53 SUS). These efficiencies can be used for all frame sizes.

**Overall efficiency and volumetric efficiency at 30% of maximum displacement**

![Graph showing overall and volumetric efficiencies](image)

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 mm²/s (53 SUS). These efficiencies can be used for all frame sizes.

**Overall efficiency at 30% of maximum displacement**

![Graph showing overall efficiency](image)
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.

Contact your Sauer-Danfoss representative for more information.

<table>
<thead>
<tr>
<th>Data Magnetic Speed Pick-up Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame Size</td>
</tr>
<tr>
<td>Pulse/Rev</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Data Speed Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage$^{(1)}$</td>
</tr>
<tr>
<td>Supply voltage regulated</td>
</tr>
<tr>
<td>Required current</td>
</tr>
<tr>
<td>Max. current</td>
</tr>
<tr>
<td>Max. frequency</td>
</tr>
<tr>
<td>Voltage &quot;high&quot;</td>
</tr>
<tr>
<td>Voltage &quot;low&quot;</td>
</tr>
<tr>
<td>Temperature range</td>
</tr>
</tbody>
</table>

$^{(1)}$ It is not acceptable to energize the 4.5–8.5 V$_{DC}$ speed sensor with 12 V$_{DC}$ battery voltage; it must be energized by a regulated power supply. If it is desirable to energize the sensor with battery voltage, contact your Sauer-Danfoss representative for an optional speed sensor.

Connecting pin designation:

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

Speed Sensor with Turck Eurofast Connector

![Turck Eurofast Connector 4 pin](P001 492)

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

Speed Sensor with Packard Weather-Pack Connector

![Packard Weather-Pack 4 pin](P002 108E)

Packard Weather-Pack 4 pin
(Supplied Connector)
Mating Connector
No.: K03379
Id.-No.: 505341
The following table 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 Sauer-Danfoss representative for more information on control selection.

<table>
<thead>
<tr>
<th>Machine</th>
<th>Function</th>
<th>N1</th>
<th>HZ</th>
<th>TA</th>
<th>E1/E2/E7</th>
<th>F1/F2</th>
<th>T1/T2</th>
<th>TH</th>
<th>EP/EQ</th>
<th>L1/L2/L7</th>
<th>D7/D8</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel loader</td>
<td>Propel</td>
<td></td>
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<tr>
<td>Roller compactor</td>
<td>Propel</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Paver-Wheeled</td>
<td>Propel</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Paver-Trackerd</td>
<td>Propel</td>
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<tr>
<td>Sweeper</td>
<td>Propel</td>
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<tr>
<td>Trencher</td>
<td>Propel</td>
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<tr>
<td>Excavator-Wheeled</td>
<td>Propel</td>
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<tr>
<td>Fork lift truck</td>
<td>Propel</td>
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<tr>
<td>Agricultural machines</td>
<td>Propel</td>
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<td></td>
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<tr>
<td>Forestry machines</td>
<td>Propel</td>
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<tr>
<td>Telescopic handler</td>
<td>Propel</td>
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<tr>
<td>Railroad machines</td>
<td>Propel</td>
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<tr>
<td>Snow groomer</td>
<td>Propel</td>
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<tr>
<td>Snow blower</td>
<td>Propel</td>
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<tr>
<td>Crane</td>
<td>Winch</td>
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</tbody>
</table>

A = Control without pressure compensator override  
B = Control with pressure compensator override  
C = Control with pressure compensator override and defe  

☐ = Suitable configuration
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

HYDRAULIC

TWO-POSITION
CONTROL – OPTION

N1NN

FOR 51-1

FRAME SIZE
060, 080, 110

Circuit Diagram – Motor with Hydraulic Two-Position Control N1NN

Ports:
- A, B = Main pressure lines
- L1, L2 = Drain lines
- M4 = Gage port
- M5 = Gage port
- X1 (M3) = Control pressure port
- T2, T3, T3 = Optional orifices
- N = Speed sensor

Hydraulic Two-Position Control N1NN

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:

No pressure on port X1 (M3) = maximum displacement
Control pressure on port X1 (M3) = minimum displacement.
Max. control pressure X1(M3) = 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 Operation N1NN

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
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HYDRAULIC TWO-POSITION CONTROL – OPTION

HZB1
FOR 51
FRAME SIZE 160, 250

Circuit Diagram – Motor with Hydraulic Two-Position Control HZB1

Ports:
A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gage port for A and B
M3, M4 = Servo pressure port
M5 = Gage port
M7 = Gage port
N = Speed sensor

Control Pressure

No pressure on port X1 = maximum displacement
Control pressure on port X1 = minimum displacement.
Max. control pressure X1 = 50 bar [725 psi]
The standard control start point setting = 3 bar [44 psi]

Hydraulic Two-Position Control HZB1

Displacement can be changed hydraulically under load from minimum displacement to maximum displacement and vice versa by control pressure to port X1.

Control Operation HZB1

Proportional control, option HZB1 see page 60.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Circuit Diagram–Motor with Pressure Compensator Control TA**

Ports:
- A, B = Main pressure lines
- L1, L2 = Drain lines
- M3, M4 = Gage port servo pressure
- XA, XB = Control pressure port
- brake pressure defeat

Pressure Compensator Control TA**

Displacement is regulated automatically between minimum displacement 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.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors

Technical Information

Controls  Circuit Diagram – Nomenclature – Description

PRESSURE COMPENSATOR CONTROL – OPTIONS

TA**
FOR 51-1
FRAME SIZE 060, 080, 110 (continued)

Pressure Compensator Configuration: TACA with Hydraulic Brake Pressure Defeat

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

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB

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

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

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

Pressure Compensator Configuration: TAD1, TAD2, TAD7 with Electric Brake Pressure Defeat

A solenoid-switched valve located 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, based on the following table.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
</tbody>
</table>

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)
Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer
Two Pin Connector
(Supplied Connector)
Mating Connector
No.: K19815
Id.-No.: 508388

<table>
<thead>
<tr>
<th>Solenoid Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>TAD1</td>
</tr>
<tr>
<td>TAD7</td>
</tr>
<tr>
<td>TAD2</td>
</tr>
</tbody>
</table>

Pressure Compensator Configuration: TAC2 without Brake Pressure Defeat

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

<table>
<thead>
<tr>
<th>Pressure Compensator Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>TAC2</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

PRESsure COMPENSATOR CONTROL – OPTIONS

TA**
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 = Gage port for A and B
M3, M4 = Gage port servo pressure
M5 (X3) = Gage port servo supply
X4 = Gage port pressure compensator
T1, T2, T3 = Optional orifices
T7, T8 = Brake pressure defeat
N = Speed sensor

Pressure Compensator Control TA**

Displacement is regulated automatically between minimum displacement 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.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
PRESSURE COMPENSATOR CONTROL – OPTIONS

TA**

FOR 51

FRAME SIZE 160, 250

(continued)

Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Control Operation TA**

![Control Operation TA** diagram]

Pressure Compensator Configuration: TAC0 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.

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

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>no</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{\text{max}} = 0.5 \text{ bar} \] (7 psi)
\[ \Delta p_{\text{max}} = 50 \text{ bar} \] (725 psi)

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

Pressure Compensator Configuration: TAC2 without Brake Pressure Defeat

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

<table>
<thead>
<tr>
<th>Pressure Compensator Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>TAC2</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
HYDRAULIC TWO-POSITION CONTROL – OPTIONS

TH**
FOR 51-1
FRAME SIZE 060, 080, 110

Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

HYDRAULIC TWO-POSITION CONTROL – OPTIONS

TH**

FOR 51-1

FRAME SIZE 060, 080, 110

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 ± 0.2 bar, [3.0 psi] this keeps the motor at minimum displacement.

Pressure 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].

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

HYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

TH**
FOR 51-1
FRAME SIZE
060, 080, 110
(continued)

Pressure Compensator Configuration: THCA 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.

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

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>yes</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{min} = 0.5 \text{ bar (7 psi)} \]
\[ \Delta p_{max} = 50 \text{ bar (725 psi)} \]

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

Pressure Compensator Configuration: THD1, THD2, THD7 with Electric Brake Pressure Defeat

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, based on the following table.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls Circuit Diagram – Nomenclature – Description

HYDRAULIC TWO-POSITION CONTROL – OPTIONS

TH** FOR 51-1

FRAME SIZE 060, 080, 110 (continued)

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
</tbody>
</table>

Solenoid Connectors

Solenoid plug face for DIN 46350 (Supplied Connector)
Mating Connector No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector (Supplied Connector)
Mating Connector No.: K19815
Id.-No.: 508388

<table>
<thead>
<tr>
<th>Solenoid Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>THD1</td>
</tr>
<tr>
<td>THD7</td>
</tr>
<tr>
<td>THD2</td>
</tr>
</tbody>
</table>

Pressure Compensator Configuration: THC2 without Brake Pressure Defeat

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

<table>
<thead>
<tr>
<th>Pressure Compensator Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>THC2</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
HYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

TH**
FOR 51
FRAME SIZE 160, 250

Circuit Diagram – Motor with Two-Position Control TH**

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 ± 0.2 bar, [3.0 psi] this keeps the motor at minimum displacement.

Pressure 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 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].

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls Circuit Diagram – Nomenclature – Description

HYDRAULIC TWO-POSITION CONTROL – OPTIONS

TH** FOR 51 FRAME SIZE 160, 250 (continued)

Pressure Compensator Configuration: THC0 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.

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

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>no</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{\text{min}} = 0.5 \text{ bar (7 psi)} \]
\[ \Delta p_{\text{max}} = 50 \text{ bar (725 psi)} \]

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

Pressure Compensator Configuration: THC2 without Brake Pressure Defeat

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

<table>
<thead>
<tr>
<th>Pressure Compensator Options</th>
<th>Configuration</th>
<th>High pressure at port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>THC2</td>
<td>A and B</td>
<td>yes</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Electrohydraulic Two-Position Control

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

Options E1B1, E2B1, E7B1

- 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.

Not all control options are shown in this Technical Information. Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer
Two Pin Connector
(Supplied Connector)

Mating Connector
No.: K19815
Id.-No.: 508388

<table>
<thead>
<tr>
<th>Solenoid Data</th>
<th>Configuration</th>
<th>Voltage</th>
<th>Electric power</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1B1</td>
<td>12 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>14.7 W</td>
<td>DIN 46350</td>
<td></td>
</tr>
<tr>
<td>E7B1</td>
<td>12 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>14.7 W</td>
<td>AMP Junior Timer two pin connector</td>
<td></td>
</tr>
<tr>
<td>E2B1</td>
<td>24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>14.7 W</td>
<td>DIN 46350</td>
<td></td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Electrohydraulic Two-Position Control

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

Options E1A5, E2A5

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

Pilot Pressure for Solenoid:

internal = low pressure

Solenoid Connector

Solenoid plug face for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

Control Operation E1A5, E2A5

Electrohydraulic two-position control

<table>
<thead>
<tr>
<th>Solenoid Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>E1A5</td>
</tr>
<tr>
<td>E2A5</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Controls  Circuit Diagram – Nomenclature – Description

Electrohydraulic Two-Position Control

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

Options F1B1, F2B1

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

Pilot Pressure for Solenoid:

- Internal = low pressure

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

Control F1B1, F2B1 necessary low system pressure

Control Operation F1B1, F2B1

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

Solenoid plug face for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Voltage</th>
<th>Electric power</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1B1</td>
<td>12 Vdc</td>
<td>14.7 W</td>
<td>DIN 46350</td>
</tr>
<tr>
<td>F2B1</td>
<td>24 Vdc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information. Contact your Sauer-Danfoss representative for special control functions.
Electrohydraulic Two-Position Control

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

Options F1A5, F2A5

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

Pilot Pressure for Solenoid:

internal = low pressure

Solenoid Connector

Solenoid plug face for DIN 46350 (Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

Control Operation F1A5, F2A5

Electrohydraulic two-position control

Control voltage: 12V / 24V

Displacement: min, max

Solenoit Data

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Voltage</th>
<th>Electric power</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1A5</td>
<td>12 V SC</td>
<td>14.7 W</td>
<td>DIN 46350</td>
</tr>
<tr>
<td>F2A5</td>
<td>24 V SC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Electrohydraulic Two-Position Control – Options

T1**, T2**, T7**

For 51-1

Frame Size 060, 080, 110

Electrohydraulic Two-Position Control T1**, T2**, T7**

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].

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Electrohydraulic
Two-Position
Control – Options

T1**, T2**, T7**
For 51-1
Frame Size
060, 080, 110
(continued)

Pressure Compensator Configuration: T*CA 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.

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

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>yes</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{\text{min}} = 0.5 \text{ bar (7 psi)} \]
\[ \Delta p_{\text{max}} = 50 \text{ bar (725 psi)} \]

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

Pressure Compensator Configuration: T*D1, T*D2, T* D7 with Electric Brake Pressure Defeat

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, based on the following table.

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Controls  Circuit Diagram – Nomenclature – Description

ELECTROHYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

**T1**, **T2**, **T7**
FOR  51-1

FRAME SIZE
060, 080, 110
(continued)

### Pressure Compensator Operation

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Solenoid</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>energized</td>
<td>yes</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>non energized</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>energized</td>
<td>no</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>non energized</td>
<td>yes</td>
</tr>
</tbody>
</table>

### Solenoid Connectors

**Solenoid plug face for DIN 46350**
(Supplied Connector)

- Mating Connector
  - No.: K09129
  - Id.-No.: 514117

**AMP Junior Timer Two Pin Connector**
(Supplied Connector)

- Mating Connector
  - No.: K19815
  - Id.-No.: 508388

### Pressure Compensator Configuration: T*C2 without Brake Pressure Defeat

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

### Solenoid Data

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Voltage</th>
<th>Electric power</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1D1</td>
<td>12 V dc</td>
<td>34 W</td>
<td>DIN 46350</td>
</tr>
</tbody>
</table>
| T7D7          | 12 V dc | 34 W           | AMP Junior Timer  
two pin connector |
| T2D2          | 24 V dc | 34 W           | DIN 46350 |

### Pressure Compensator Options

<table>
<thead>
<tr>
<th>Configuration</th>
<th>High pressure at port</th>
<th>PCOR-Funktion</th>
</tr>
</thead>
<tbody>
<tr>
<td>T*C2</td>
<td>A and B</td>
<td>yes</td>
</tr>
</tbody>
</table>

---
Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

ELECTROHYDRAULIC TWO-POSITION CONTROL – OPTIONS

T1**, T2**

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 = Gage port for A and B
M3, M4 = Gage port servo pressure
M5 = Gage port servo supply pressure internal
XA, XB = Control pressure ports, brake pressure defeat
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Electrohydraulic Two-Position Control T1**, T2**

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 is overridden.

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].

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Pressure Compensator Configuration: T*C0 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. The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, based on the following table.

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>no</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{\text{max}} = 0.5 \text{ bar (7 psi)} \]
\[ \Delta p_{\text{max}} = 50 \text{ bar (725 psi)} \]

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

<table>
<thead>
<tr>
<th>Pressure Compensator Options</th>
<th>Configuration</th>
<th>High pressure at port</th>
<th>PCOR-Funktion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T*C2</td>
<td>A and B</td>
<td>yes</td>
</tr>
</tbody>
</table>

Pressure Compensator Configuration: T*C2 without Brake Pressure Defeat

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

Solenoid plug face for DIN 46350 (Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

<table>
<thead>
<tr>
<th>Solenoid Data</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Voltage</td>
<td>Electric power</td>
</tr>
<tr>
<td>T1C2</td>
<td>12 Vdc</td>
<td>34 W</td>
</tr>
<tr>
<td>T2C2</td>
<td>24 Vdc</td>
<td></td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information. Contact your Sauer-Danfoss representative for special control functions.
Electrohydraulic Proportional Control EP**, EQ**

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):

\[ p_{\text{min}} = 20 \text{ bar} \]  
\[ p_{\text{max allowable}} = 70 \text{ bar} \]

### Design Options

<table>
<thead>
<tr>
<th>Control supply</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packard</td>
<td>MS</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.  
Contact your Sauer-Danfoss representative for special control functions.
ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS

EP**, EQ** FOR 51 FRAME SIZE 060, 080, 110, 160, 250 (continued)

Control Operation EP**, EQ**

<table>
<thead>
<tr>
<th>Pressure compensator override</th>
<th>Proportional control</th>
</tr>
</thead>
<tbody>
<tr>
<td>J K</td>
<td>J K</td>
</tr>
<tr>
<td>Ramp</td>
<td>Ramp &lt; 10 bar</td>
</tr>
<tr>
<td>Displacement</td>
<td>[293 Fpsi]</td>
</tr>
<tr>
<td>min</td>
<td>15</td>
</tr>
<tr>
<td>max</td>
<td>85</td>
</tr>
<tr>
<td>Control start stop range</td>
<td>50</td>
</tr>
<tr>
<td>J K</td>
<td>50</td>
</tr>
<tr>
<td>Current mA</td>
<td>85</td>
</tr>
</tbody>
</table>

Control Setting Options

<table>
<thead>
<tr>
<th>Type</th>
<th>Start current (adjustable) mA</th>
<th>Ramp (max to min. displ.) mA</th>
<th>Standard setting Control start</th>
<th>Coil wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>JY</td>
<td>15 to 50</td>
<td>70</td>
<td>30 to 30 mA</td>
<td>Single coil</td>
</tr>
<tr>
<td>KY</td>
<td>50 to 85</td>
<td>70</td>
<td>70 to 70 mA</td>
<td></td>
</tr>
<tr>
<td>JW</td>
<td>15 to 50</td>
<td>95</td>
<td>30 to 30 mA</td>
<td></td>
</tr>
<tr>
<td>KW</td>
<td>50 to 85</td>
<td>70</td>
<td>70 to 70 mA</td>
<td></td>
</tr>
</tbody>
</table>

Max. current = 250 mA
Coil resistance = 26 Ω

Wiring (maximum to minimum displacement)

<table>
<thead>
<tr>
<th>Coil wiring</th>
<th>Positiv voltage on pin</th>
<th>Ground on pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single coil</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Single coil (alt.)</td>
<td>D</td>
<td>C</td>
</tr>
</tbody>
</table>

Connectors

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

Packard Weather-Pack
4 pin (Supplied Connector)

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

<table>
<thead>
<tr>
<th>Configuration Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>EPA1/EQA1</td>
</tr>
<tr>
<td>EPA2/EQA2</td>
</tr>
</tbody>
</table>

Pressure Compensator Override Configuration: EPA1, EQA1 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.

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

<table>
<thead>
<tr>
<th>Pressure Compensator Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
<tr>
<td>CCW</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB

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

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

Pressure Compensator Override Configuration: EPA2, EQA2 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 Sauer-Danfoss representative for special control functions.
ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS

L1B1, L2B1, L7B1

FOR 51

FRAME SIZE 060, 080, 110, 160, 250

Electrohydraulic Proportional Control L1**, L2**, L7**

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, \( f = 100\ldots200 \text{ Hz} \).

Control start = maximum displacement
Control end = minimum displacement

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector
(Supplied Connector)

Mating Connector
No.: K19815
Id.-No.: 508388

Solenoid Data

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Voltage</th>
<th>nominal resistance 20 °C</th>
<th>Control current</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>L1B1</td>
<td>12 Vdc</td>
<td>5.7 ( \Omega )</td>
<td>440 mA</td>
<td>1290 mA</td>
</tr>
<tr>
<td>L7B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2B1</td>
<td>24 Vdc</td>
<td>21.3 ( \Omega )</td>
<td>220 mA</td>
<td>645 mA</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information. Contact your Sauer-Danfoss representative for special control functions.
Electrohydraulic Proportional Control D7M1, D8M1

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, \( f = 100\ldots200 \text{ Hz} \).

Solenoid not energized = maximum displacement
Solenoid energized = minimum displacement

Servo pressure supply = external pressure at X3

min. pressure = 25 bar [360 psi]
max. pressure = 50 bar [725 psi]
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Controls  Circuit Diagram – Nomenclature – Description

ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS

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].

Pressure Compensator Configuration: D7M1, D8M1 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.

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

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>no</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB
\[ \Delta p_{\text{min}} = 0.5 \text{ bar} \] [7 psi]
\[ \Delta p_{\text{max}} = 50 \text{ bar} \] [725 psi]

Solenoid Connector

AMP Junior Timer
Two Pin Connector
(Supplied Connector)

Mating Connector
No.: K19815
Id.-No.: 508388

<table>
<thead>
<tr>
<th>Solenoid Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
</tr>
<tr>
<td>D7M1</td>
</tr>
<tr>
<td>D8M1</td>
</tr>
</tbody>
</table>

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

HYDRAULIC PROPORTIONAL CONTROL – OPTIONS

**HS**

FOR 51

FRAME SIZE 060, 080, 110, 160, 250

Hydraulic Proportional Control HS**

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

Maximum allowable Control Pressure (Port X1):
\[ p_{\text{max allowable}} = \text{Control start pressure} + 50 \text{ bar (725 psi)} \]

Not all control options are shown in this Technical Information.
Contact your Sauer-Danfoss representative for special control functions.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Controls Circuit Diagram – Nomenclature – Description

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].

Pressure Compensator Override Configuration: HSA1 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.

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

Pressure Compensator Operation

<table>
<thead>
<tr>
<th>Rotation</th>
<th>High pressure port</th>
<th>Control pressure on port</th>
<th>PCOR-Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>A</td>
<td>XA</td>
<td>no</td>
</tr>
<tr>
<td>CW</td>
<td>A</td>
<td>XB</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XA</td>
<td>yes</td>
</tr>
<tr>
<td>CCW</td>
<td>B</td>
<td>XB</td>
<td>no</td>
</tr>
</tbody>
</table>

Differential control pressure between port XA/XB

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

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

Pressure Compensator Override Configuration: HSA2 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 Sauer-Danfoss representative for special control functions.
HYDRAULIC PROPORTIONAL CONTROL – OPTION

HZB1

FOR 51

FRAME SIZE 060, 080, 110, 160, 250

Hydraulic Proportional Control HZB1

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

Maximum allowable Control Pressure (Port X1):

\[ P_{\text{max allowable}} = \text{Control start pressure} + 50 \text{ bar [725 psi]} \]

Control Start

<table>
<thead>
<tr>
<th>Control start range (adjustable)</th>
<th>bar</th>
<th>[psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 5</td>
<td>[44 to 73]</td>
<td></td>
</tr>
<tr>
<td>5 to 12</td>
<td>[73 to 175]</td>
<td></td>
</tr>
<tr>
<td>12 to 30</td>
<td>[175 to 435]</td>
<td></td>
</tr>
</tbody>
</table>

Control Ramp

<table>
<thead>
<tr>
<th>Control ramp range from max. to min. displ. (control pressure rise)</th>
<th>bar</th>
<th>[psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>206</td>
<td></td>
</tr>
</tbody>
</table>
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 060

SAE FLANGE DESIGN
PER ISO 3019/1

51V060-1 Two Position Control, N1NN

mm
[in]

Side Port

Gage port “M4”
System pressure max. angle 0.5625-18UNF-2B
[9/16-18UNF-2B]

Gage port “M2”
System pressure “B” 0.875-14UNF-2B
[7/8-14UNF-2B]

Loop flushing
shuttle valve

Split flange boss “A” n1nn

Charge pressure
relief valve

Alternate position
Case drain “L1”
1.0625-12UN-2B
[9/16-12UN-2B]

Split flange boss “B”

System pressure max. angle 0.5625-18UNF-2B
[9/16-18UNF-2B]

Case drain “L2”
1.0625-12UN-2B
[9/16-12UN-2B]

min. angle stop
adjustment

System pressure “A”
0.875-14UNF-2B
[7/8-14UNF-2B]

System pressure “B”
0.875-14UNF-2B
[7/8-14UNF-2B]

General Dimensions – Frame Size 060

SAE FLANGE DESIGN
PER ISO 3019/1

Axial Port

Gage port “M4”
System pressure max. angle 0.5625-18UNF-2B
[9/16-18UNF-2B]

Gage port “M2”
System pressure “B” 0.875-14UNF-2B
[7/8-14UNF-2B]

System pressure max. angle 0.5625-18UNF-2B
[9/16-18UNF-2B]

System pressure “B”
19 (0.75) min. full thread depth

System pressure “A”
19 (0.75) min. full thread depth

System pressure “A”
19 (0.75) min. full thread depth

4 thread: 0.375-16UNC-2B
[3/8-16UNC-2B]

System pressure “B”
19 (0.75) min. full thread depth

System pressure “B”
19 (0.75) min. full thread depth

System pressure “A”
19 (0.75) min. full thread depth

Full thread depth

19 (0.75) min. full thread depth

1.0625-12UN-2B
[9/16-12UN-2B]

4 thread: 0.375-16UNC-2B
[3/8-16UNC-2B]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

1.0625-12UN-2B
[9/16-12UN-2B]

4 thread: 0.375-16UNC-2B
[3/8-16UNC-2B]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

1.0625-12UN-2B
[9/16-12UN-2B]

4 thread: 0.375-16UNC-2B
[3/8-16UNC-2B]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

10.0 [0.39]

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

19 (0.75) min. full thread depth

1.0625-12UN-2B
[9/16-12UN-2B]
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

SAE FLANGE DESIGN
PER ISO 3019/1
(continued)

51V060 Proportional and Two Position Control, HZB1

General Dimensions – Frame Size 060

Side Port

Axial Port
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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors

Technical Information

General Dimensions – Frame Size 060

**DIN FLANGE DESIGN**  
PER ISO 3019/2

**51D060-1 Two Position Control, N1NN**

<table>
<thead>
<tr>
<th>Side Port</th>
<th>mm</th>
<th>[in]</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>59.0</td>
<td>[2.32]</td>
</tr>
<tr>
<td>X</td>
<td>190.0</td>
<td>[7.49]</td>
</tr>
<tr>
<td>Y</td>
<td>77.0</td>
<td>[3.03]</td>
</tr>
<tr>
<td>Z</td>
<td>75.0</td>
<td>[2.95]</td>
</tr>
<tr>
<td>W</td>
<td>90.0</td>
<td>[3.54]</td>
</tr>
<tr>
<td>Case drain &quot;L1&quot;</td>
<td>1.0625-12UNC-2B</td>
<td>[1/8-12UNC-2B]</td>
</tr>
<tr>
<td>Alternate position</td>
<td>90.0</td>
<td>[3.54]</td>
</tr>
<tr>
<td>Split flange boss &quot;A&quot; = &quot;B&quot;</td>
<td>234.1 max.</td>
<td>[9.22 max.]</td>
</tr>
<tr>
<td>Loop flushing shuttle valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge pressure relief valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>190.0</td>
<td>[7.49]</td>
</tr>
<tr>
<td>Y</td>
<td>77.0</td>
<td>[3.03]</td>
</tr>
<tr>
<td>Z</td>
<td>75.0</td>
<td>[2.95]</td>
</tr>
<tr>
<td>W</td>
<td>90.0</td>
<td>[3.54]</td>
</tr>
<tr>
<td>Case drain &quot;L2&quot;</td>
<td>1.0625-12UNC-2B</td>
<td>[1/8-12UNC-2B]</td>
</tr>
<tr>
<td>Split flange boss &quot;A&quot; = &quot;B&quot;</td>
<td>234.1 max.</td>
<td>[9.22 max.]</td>
</tr>
</tbody>
</table>

**Axial Port**

| X         | 218.0 | [8.57] |
| Y         | 87.0 | [3.41] |
| Z         | 94.0 | [3.70] |
| W         | 73.0 | [2.87] |

Gage ports "M1" = "M2"  
System pressure "A" = "B"  
0.5625-18UNC-2B  
[1/8-18UNC-2B]

Split flange boss "A"  
DN 19 typ II 40 MPa series per ISO 6162 (SAE 0.75)  
4 thread: 0.375-16UNC-2B  
[9/16-16UNC-2B]  
19 (0.75) min. full thread depth

Split flange boss "B"  
DN 19 typ II 40 MPa series per ISO 6162 (SAE 0.75)  
4 thread: 0.375-16UNC-2B  
[9/16-16UNC-2B]  
19 (0.75) min. full thread depth

System pressure max. angle  
0.5625-18UNC-2B  
[1/8-18UNC-2B]

Gage port "M4"  
System pressure "A"  
0.675-14UNC-2B  
[3/4-14UNC-2B]

Gage port "M2"  
System pressure "B"  
0.675-14UNC-2B  
[3/4-14UNC-2B]

Gage port "M1"  
System pressure "A"  
0.675-14UNC-2B  
[3/4-14UNC-2B]

Gage port "M"  
System pressure "B"  
0.675-14UNC-2B  
[3/4-14UNC-2B]
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

51D060 Proportional and Two Position Control, HZB1

**General Dimensions – Frame Size 060**

### DIN FLANGE DESIGN

**PER ISO 3019/2**

(continued)

#### Side Port

- **Gage port “M3”**
  - Charge pressure relief valve
  - Loop flushing shuttle valve
  - Control start adjustment
  - Alternate position

- **Gage port “M2”**
  - Control pressure

- **Gage port “M1”**
  - System pressure

- **Gage port “M5”**
  - Servo pressure supply

#### Axial Port

- **Gage port “M4”**
  - Servo pressure max. angle

- **Gage port “M3”**
  - System pressure

- **Gage port “M2”**
  - Charge pressure relief valve

- **Split flange boss “A”**
  - DN 19 typ II 40 MPa series per ISO 6162 [SAE 0.75]
  - 4 thread: 0.375-16UNC-2B

- **Split flange boss “B”**
  - DN 19 typ II 40 MPa series per ISO 6162 [SAE 0.75]
  - 4 thread: 0.375-16UNC-2B

---

**Split flange boss “A”**

- Supply pressure Shuttle valve 0.5625-18UNF-2B (1/8 -18UNF-2B)
**Series 51 and 51-1 Bent Axis Variable Displacement Motors**

**Technical Information**

**General Dimensions – Frame Size 060**

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.
Spitie flange boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
CARTRIDGE FLANGE
(continued)

Side Port

Gage port “M3”
Servo pressure min. angle
0.5625-18UNF-2B
[1/8-18UNF-2B]

Loop Fiozing
shuttle valve

Gage port “M1”
System pressure “A”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M2”
System pressure “B”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M4”
Servo pressure max. angle
0.5625-18UNF-2B
[1/8-18UNF-2B]

Case drain port “L1”
1.0625-12UN-2B
[1/8-12UN-2B]

Alternate position
Case drain port “L2”
1.0625-12UN-2B
[1/8-12UN-2B]

Charge pressure
relief valve

Control Start
Adjustment

min. angle stop
adjustment

Gage port “M3”
Control pressure
0.5625-18UNF-2B
[1/8-18UNF-2B]

X1
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M1”
System pressure “A”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M2”
System pressure “B”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M4”
Servo pressure max. angle
0.5625-18UNF-2B
[1/8-18UNF-2B]

Split flange boss “A”
DN 19 typ II 40 MPa series
per ISO 6162 (SAE 0.75)
3 thread: 0.375-16UNC-2B
[1/8-16UNC-2B]
19 (0.75) min.
full thread depth

51C060 Proportional and Two Position Control, HZB1

Axial Port

Gage port “M1”
System pressure “A”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M2”
System pressure “B”
0.5625-18UNF-2B
[1/8-18UNF-2B]

Gage port “M4”
Servo pressure max. angle
0.5625-18UNF-2B
[1/8-18UNF-2B]

Split flange boss “A”
DN 19 typ II 40 MPa series
per ISO 6162 (SAE 0.75)
3 thread: 0.375-16UNC-2B
[1/8-16UNC-2B]
19 (0.75) min.
full thread depth

Case drain port “L2”
1.0625-12UN-2B
[1/8-12UN-2B]

Control pressure port “X1”
0.5625-18UNF-2B
[1/8-18UNF-2B]
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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 080

SAE FLANGE DESIGN
PER ISO 3019/1
51V080-1 Two Position Control, N1NN

mm
[in]

Side Port

Axial Port
SAE FLANGE DESIGN
PER ISO 3019/1
(continued)

51V080 Proportional and Two-Position Control, HZB1

Side Port

Axial Port
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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

<table>
<thead>
<tr>
<th>Shaft option</th>
<th>S1</th>
<th>C7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension mm</td>
<td>mm [in]</td>
<td>mm [in]</td>
</tr>
<tr>
<td>Number of teeth</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Pitch</td>
<td>12/24</td>
<td>16/32</td>
</tr>
<tr>
<td>Pressure angle</td>
<td></td>
<td>30°</td>
</tr>
<tr>
<td>Spline</td>
<td>ANSI B92.1-1970 class 5 flat root side fit</td>
<td></td>
</tr>
<tr>
<td>Ø A</td>
<td>31.15 [1.23]</td>
<td>37.61 [1.48]</td>
</tr>
<tr>
<td>Ø B</td>
<td>37.50 [1.48]</td>
<td>37.50 [1.48]</td>
</tr>
<tr>
<td>Ø C</td>
<td>47.50±0.5 [1.87]</td>
<td>47.50±0.5 [1.87]</td>
</tr>
<tr>
<td>Ø D</td>
<td>25.80 [1.02]</td>
<td>32.00 [1.26]</td>
</tr>
<tr>
<td>Ø E</td>
<td>49.50±1.1 [1.95]</td>
<td>49.50±1.1 [1.95]</td>
</tr>
<tr>
<td>Ø F</td>
<td>55.50±0.7 [2.19]</td>
<td>55.50±0.7 [2.19]</td>
</tr>
<tr>
<td>Ø G</td>
<td>0.4375-14UNC-2B [7/16-14UNC-2B] allowed torque in thread max. 91 Nm [805 lb•in]</td>
<td></td>
</tr>
<tr>
<td>Ø H</td>
<td>28.00 [1.10]</td>
<td>28.00 [1.10]</td>
</tr>
</tbody>
</table>
**Series 51 and 51-1 Bent Axis Variable Displacement Motors**

**Technical Information**

**General Dimensions – Frame Size 080**

**DIN FLANGE DESIGN**

**PER ISO 3019/2**

**51D080-1 Two Position Control, N1NN**

**Side Port**

- Loop flushing shuttle valve
- Charge pressure relief valve
- Split flange boss "A" = "B"
- Case drain "L1" 1.0625-12UN-2B [1 1/16 -12UN-2B]
- Alternate position 109.8 [4.32]
- Split flange boss "A" = "B"
- DN 25 typ II 40 MPa series per ISO 6162 [SAE 1.00]

**Axial Port**

- Split flange boss "A" = "B"
- System pressure "A" 0.4375-14UNC-2B [7/16 -14UNC-2B]
- Split flange boss "B" 0.5625-18UNF-2B [9/16 -18UNF-2B]
- System pressure max. angle 0.5625-18UNF-2B [9/16 -18UNF-2B]
- Alternate position 109.8 [4.32]
- Split flange boss "A" = "B"
- DN 25 typ II 40 MPa series per ISO 6162 [SAE 1.00]

**Dimensions**

- X: 237.0 [9.33]
- Y: 77.6 [3.09]
- Z: 79.0 [3.11]
- A: 50.0 [1.97]
- B: 27.76 [1.09]
- M4: 109.8 [4.32]
- 45.0 [1.76] 19°
- 218.9 [8.62]

**Ports**

- Gage port "M4"
- System pressure max. angle 0.5625-18UNF-2B [9/16 -18UNF-2B]
- Split flange boss "A" = "B"
- DN 25 typ II 40 MPa series per ISO 6162 [SAE 1.00]
- 4 thread: 0.4375-14UNC-2B [7/16 -14UNC-2B]

**Notes**

- System pressure "A" 0.4375-14UNC-2B [7/16 -14UNC-2B]
- Split flange boss "A" = "B"
- DN 25 typ II 40 MPa series per ISO 6162 [SAE 1.00]
- 4 thread: 0.4375-14UNC-2B [7/16 -14UNC-2B]
**DIN FLANGE DESIGN**
**PER ISO 3019/2**

**Series 51 and 51-1 Bent Axis Variable Displacement Motors**
**Technical Information**
**General Dimensions – Frame Size 080**

**51D080 Proportional and Two-Position Control, HZB1**

### Side Port

- Loop flushing shuttle valve: 211.0 mm (8.33 in)
- Charge pressure relief valve: 66.65 mm (2.62 in)
- Case drain "L1": 1.0625-12UN-2B
- Alternate position: 1.0625-12UN-2B
- Control start adjustment: 109.8 mm (4.32 in)
- Alternate position: 109.8 mm (4.32 in)
- Control mounting surface: 294.0 mm (11.58 in)

### Axial Port

- Split flange boss "A": DN 25 typ II 40 MPa series per ISO 6162 (SAE 1.00) 4 thread: 0.4375-14UNC-2B
- Split flange boss "B": DN 25 typ II 40 MPa series per ISO 6162 (SAE 1.00) 4 thread: 0.4375-14UNC-2B
- Control pressure port "X1": 0.5625-18UNF-2B
- Charge pressure relief valve: 66.65 mm (2.62 in)
- Case drain "L1": 1.0625-12UN-2B
- Alternate position: 1.0625-12UN-2B
- Control start adjustment: 109.8 mm (4.32 in)
- Alternate position: 109.8 mm (4.32 in)
- Control mounting surface: 294.0 mm (11.58 in)

**General Dimensions – Frame Size 080**

**SAUER DANFOSS**

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520L0440 • Rev AC • Jul 2009
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.
Spmite flange boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 080

CARTRIDGE FLANGE

**51C080-1 Two Position Control, N1NN**

**Side Port**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>133.0</td>
<td>mm</td>
<td>5.24</td>
</tr>
<tr>
<td>100.0</td>
<td>mm</td>
<td>3.94</td>
</tr>
<tr>
<td>70.0</td>
<td>mm</td>
<td>2.76</td>
</tr>
<tr>
<td>174.4 max.</td>
<td>mm</td>
<td>6.87 max.</td>
</tr>
<tr>
<td>48.0</td>
<td>mm</td>
<td>1.89</td>
</tr>
</tbody>
</table>

**Axial Port**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>159.0</td>
<td>mm</td>
<td>6.25</td>
</tr>
<tr>
<td>53.0</td>
<td>mm</td>
<td>2.09</td>
</tr>
</tbody>
</table>

Gage port "M2"
System pressure "B"
0.5625-18UNF-2B
[7/16-18UNF-2B]

Split flange boss "A"+"B"
DN 25 typ II 40 MPa series
per ISO 6162 [SAE 1.00]
4 thread: 0.4375-14UNC-2B
[7/16-14UNC-2B]
27 [1.06] min.
full thread depth
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 080

CARTRIDGE FLANGE
(continued)

51C080 Proportional and Two-Position Control, HZB1

Side Port

Axial Port
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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

General Dimensions – Frame Size 110

SAE FLANGE DESIGN
PER ISO 3019/1

51V110-1 Two Position Control, N1NN

mm
[in]

Side Port

Axial Port
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 110

SAE FLANGE DESIGN
PER ISO 3019/1
(continued)

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

<table>
<thead>
<tr>
<th>Shaft Spline Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft option</td>
</tr>
<tr>
<td>Dimension</td>
</tr>
<tr>
<td>Number of teeth</td>
</tr>
<tr>
<td>Pitch</td>
</tr>
<tr>
<td>Pressure angle</td>
</tr>
<tr>
<td>Spline</td>
</tr>
<tr>
<td>Pitch dia</td>
</tr>
<tr>
<td>Ø A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>Ø D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Ø G</td>
</tr>
<tr>
<td>H</td>
</tr>
</tbody>
</table>
Series 51 and 51-1 Bent Axis Variable Displacement Motors

Technical Information

General Dimensions – Frame Size 110

DIN FLANGE DESIGN
PER ISO 3019/2

51D110-1 Two Position Control, N1NN

mm

Side Port

Axial Port
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 SAE J518 code 62 (6000 psi). 
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 110

CARTRIDGE FLANGE 51C110-1 Two Position Control, N1NN

**Side Port**

- Loop flushing shuttle valve
- Charge pressure relief valve
- Case drain "L1" 1.0625-12UN-2B [1 \(\frac{1}{8}\) -12UN-2B]
- Alternate position Case drain "L2" 1.0625-12UN-2B [1 \(\frac{1}{8}\) -12UN-2B]
- min. angle stop adjustment
- Split flange boss "A" 48.0 [1.89]
- Split flange boss "B" 48.0 [1.89]
- Speed pick-up 185.3 max. [7.3 max.]
- Gage ports "M1" 0.5625-18UNF-2B
- Gage ports "M2" 0.5625-18UNF-2B
- System pressure "A" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- System pressure "B" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- System pressure max. angle 0.5625-18UNF-2B [9/16 -18UNF-2B]
- Case drain "L1" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- Alternate position Case drain "L2" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]

**Axial Port**

- Loop flushing shuttle valve
- Charge pressure relief valve
- Case drain "L1" 1.0625-12UN-2B [1 \(\frac{1}{8}\) -12UN-2B]
- Alternate position Case drain "L2" 1.0625-12UN-2B [1 \(\frac{1}{8}\) -12UN-2B]
- min. angle stop adjustment
- Split flange boss "A" 48.0 [1.89]
- Split flange boss "B" 48.0 [1.89]
- Speed pick-up 185.3 max. [7.3 max.]
- Gage ports "M1" 0.5625-18UNF-2B
- Gage ports "M2" 0.5625-18UNF-2B
- System pressure "A" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- System pressure "B" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- System pressure max. angle 0.5625-18UNF-2B [9/16 -18UNF-2B]
- Case drain "L1" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
- Alternate position Case drain "L2" 1.0625-12UNF-2B [1 \(\frac{1}{8}\) -12UNF-2B]
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 110

CARTRIDGE FLANGE
(continued)

Side Port

Axial Port
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

General Dimensions – Frame Size 110

CARTRIDGE FLANGE
(continued)

Shaft Options – 51C110-1 and 51C110

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

<table>
<thead>
<tr>
<th>Shaft Spline Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shaft option</strong></td>
</tr>
<tr>
<td><strong>Dimension</strong></td>
</tr>
<tr>
<td><strong>Number of teeth</strong></td>
</tr>
<tr>
<td><strong>Spline</strong></td>
</tr>
<tr>
<td><strong>Pitch dia</strong></td>
</tr>
<tr>
<td>ØA</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>ØD</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>ØG</td>
</tr>
<tr>
<td>H</td>
</tr>
</tbody>
</table>

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

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Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 160

SAE FLANGE DESIGN
PER ISO 3019/1

51V160 Proportional and Two-Position Control, HZB1

Side Port

Axial Port
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

General Dimensions – Frame Size 160

SAE FLANGE DESIGN
PER ISO 3019/1
(continued)

Shaft Options – 51V160

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

Shaft Spline Data

<table>
<thead>
<tr>
<th>Shaft option</th>
<th>F1</th>
<th>F2</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
<td>mm [in]</td>
<td>mm [in]</td>
<td>mm [in]</td>
</tr>
<tr>
<td>Number of teeth</td>
<td>13</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>Pitch</td>
<td>8/16</td>
<td>8/16</td>
<td>16/32</td>
</tr>
<tr>
<td>Pressure angle</td>
<td>30°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spline</td>
<td>ANSI B92.1-1970 class 5 flat root side fit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitch dia</td>
<td>41.275 [1.625]</td>
<td>47.625 [1.875]</td>
<td>42.862 [1.688]</td>
</tr>
<tr>
<td>Ø A</td>
<td>43.64 [1.72]</td>
<td>49.99 [1.97]</td>
<td>43.96 [1.73]</td>
</tr>
<tr>
<td>Ø B</td>
<td>55.00 [2.17]</td>
<td>53.00 [2.09]</td>
<td>55.00 [2.17]</td>
</tr>
<tr>
<td>Ø C</td>
<td>67.00±0.5 [2.64]</td>
<td>67.00±0.5 [2.64]</td>
<td>67.00±0.5 [2.64]</td>
</tr>
<tr>
<td>Ø D</td>
<td>36.00 [1.42]</td>
<td>42.20 [1.66]</td>
<td>39.60 [1.56]</td>
</tr>
<tr>
<td>Ø E</td>
<td>70.00±1.1 [2.76]</td>
<td>70.00±1.1 [2.76]</td>
<td>70.00±1.1 [2.76]</td>
</tr>
<tr>
<td>Ø F</td>
<td>75.40±0.7 [2.97]</td>
<td>75.40±0.7 [2.97]</td>
<td>75.40±0.7 [2.97]</td>
</tr>
<tr>
<td>Ø G</td>
<td>0.625-11UNC-2B [5/8-11UNC-2B] allowed torque in thread max. 200 Nm [1770 lbf·in]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>36.00 [1.42]</td>
<td>36.00 [1.42]</td>
<td>36.00 [1.42]</td>
</tr>
</tbody>
</table>
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

General Dimensions – Frame Size 160

DIN FLANGE DESIGN
PER ISO 3019/2
(continued)

Shaft Options – 51D160

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

Shaft Spline Data

<table>
<thead>
<tr>
<th>Shaft option</th>
<th>D4</th>
<th>D5</th>
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<tbody>
<tr>
<td>Dimension</td>
<td>mm</td>
<td>[in]</td>
</tr>
<tr>
<td>Number of teeth</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Spline</td>
<td>W45x2x30x21x9g side fit DIN 5480</td>
<td>W50x2x30x24x9g side fit DIN 5480</td>
</tr>
<tr>
<td>Pitch dia A</td>
<td>42.00 [1.654]</td>
<td>48.00 [1.890]</td>
</tr>
<tr>
<td>Pitch dia B</td>
<td>44.60 [1.76]</td>
<td>49.60 [1.95]</td>
</tr>
<tr>
<td>Pitch dia C</td>
<td>42.00 [1.65]</td>
<td>47.00 [1.85]</td>
</tr>
<tr>
<td>Pitch dia D</td>
<td>50.00±0.5 [1.97]</td>
<td>55.00±0.5 [2.17]</td>
</tr>
<tr>
<td>Pitch dia E</td>
<td>40.00 [1.57]</td>
<td>45.00 [1.77]</td>
</tr>
<tr>
<td>Pitch dia F</td>
<td>52.30±1.1 [2.06]</td>
<td>57.30±1.1 [2.26]</td>
</tr>
<tr>
<td>Pitch dia G</td>
<td>90.30±0.6 [3.56]</td>
<td>95.30±0.6 [3.75]</td>
</tr>
<tr>
<td>Pitch dia H</td>
<td>30.00 [1.18]</td>
<td>30.00 [1.18]</td>
</tr>
</tbody>
</table>

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
CARTRIDGE FLANGE  

51C160 Proportional and Two-Position Control, HZB1

**Side Port**

Gage port "M3"  
Serve pressure min. angle 0.5625-18UNF-2B \( \left[ \frac{1}{16}, 12UN-2B \right] \)

Gage port "M3"  
Control pressure 0.5625-18UNF-2B \( \left[ \frac{1}{16}, 18UNF-2B \right] \)

Gage port "M5"  
Control mounting surface 0.5625-18UNF-2B \( \left[ \frac{1}{16}, 18UNF-2B \right] \)

Alternate position  
Case drain "L2"  
1.3125-12UN-2B \( \left[ \frac{1}{16}, 12UN-2B \right] \)

Charge pressure relief valve  
Loop flushing

Control start adjustment

Control start adjustment

Control mounting

Split flange boss "A" + "B"  
DN 25 typ II 40 MPa series per ISO 6162 \( \left[ SAE 1.00 \right] \)

4 thread: 0.4375-14UNC-2B \( \left[ \frac{7}{16}, 14UNC-2B \right] \)

27 \( \left[ 1.06 \right] \) min. full thread depth

**Axial Port**

Gage port "M1" + "M2"  
System pressure "A" + "B"  
0.5625-18UNF-2B \( \left[ \frac{1}{16}, 18UNF-2B \right] \)

Split flange boss "A"  
DN 25 typ II 40 MPa series per ISO 6162 \( \left[ SAE 1.00 \right] \)

4 thread: 0.4375-14UNC-2B \( \left[ \frac{7}{16}, 14UNC-2B \right] \)

27 \( \left[ 1.06 \right] \) min. full thread depth

Gage port "M4"  
Serve pressure max. angle 0.5625-18UNF-2B \( \left[ \frac{1}{16}, 18UNF-2B \right] \)

Gage port "M4"  
Case drain "L1"  
1.3125-12UN-2B \( \left[ \frac{1}{16}, 12UN-2B \right] \)

Charge pressure relief valve  
Loop flushing

Control pressure port "X1"  
0.5625-18UNF-2B \( \left[ \frac{1}{16}, 18UNF-2B \right] \)

Control start adjustment

Split flange boss "B"  
DN 25 typ II 40 MPa series per ISO 6162 \( \left[ SAE 1.00 \right] \)

4 thread: 0.4375-14UNC-2B \( \left[ \frac{7}{16}, 14UNC-2B \right] \)

27 \( \left[ 1.06 \right] \) min. full thread depth
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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
General Dimensions – Frame Size 250

SAE FLANGE DESIGN
PER ISO 3019/1

51V250 Proportional and Two-Position Control, HZB1

**Side Port**

- Loop flushing shuttle valve
- Charge pressure relief valve
- Case drain [L1]
- Alternate position
- Control start adjustment
- Gage port "M3"
- Gage port "M7"
- Control mounting surface
- Split flange boss "A" & "B"
- Control pressure port "X1"

**Axial Port**

- Gage port "M1" + "M2"
- System pressure "A" & "B"
- Shaft centerline
- Gage port "M4"
- Supply pressure shuttle valve

Dimensions:

- **mm**
- **[in]**

Diagram with various measurements and connections labeled.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

General Dimensions – Frame Size 250

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

<table>
<thead>
<tr>
<th>Shaft Spline Data</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft option</td>
<td>F2</td>
<td>C8</td>
</tr>
<tr>
<td>Dimension</td>
<td>mm</td>
<td>[in]</td>
</tr>
<tr>
<td>Number of teeth</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>Pitch</td>
<td>8/16</td>
<td>16/32</td>
</tr>
<tr>
<td>Pressure angle</td>
<td>30°</td>
<td></td>
</tr>
<tr>
<td>Spline</td>
<td>ANSI B92.1-1970 class 5 flat root side fit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Pitch dia         | 47.625 [1.875] | 42.862 [1.688]
| Ø A              | 49.99 [1.97] | 43.96 [1.73]
| B                 | 53.00 [2.09] | 55.00 [2.17]
| C                 | 67.00±0.5 [2.64] | 67.00±0.5 [2.64]
| Ø D             | 42.20 [1.66] | 39.60 [1.56]
| E               | 70.00±1.1 [2.76] | 70.00±1.1 [2.76]
| F             | 75.40±0.7 [2.97] | 75.40±0.7 [2.97]
| Ø G           | 0.625-11UNC-2B [5/8-11UNC-2B] allowed torque in thread max. 200 Nm [1770 lb-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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
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 face boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).

Contact your Sauer-Danfoss representative for specific installation drawings.

**Solenoid Connectors**

<table>
<thead>
<tr>
<th>Solenoid plug face for DIN 46350</th>
<th>AMP Junior Timer Two Pin Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Supplied Connector)</td>
<td>(Supplied Connector)</td>
</tr>
<tr>
<td>Mating Connector</td>
<td>Mating Connector</td>
</tr>
<tr>
<td>No.: K09129</td>
<td>No.: K19815</td>
</tr>
<tr>
<td>Id.-No.: 514117</td>
<td>Id.-No.: 508388</td>
</tr>
</tbody>
</table>

Shaft centerline:  
Port control pressure port:  
Z = Electric brake pressure defeat  
TAD = Hydraulic brake pressure defeat  
TACA = TAD + Electric brake pressure defeat  
P001 752E  
P001 751E
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 SAE J518 code 62 (6000 psi).

Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Dimension – Controls

HYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

TH**
FOR 51-1
FRAME SIZE
060, 080, 110

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

Control Option TH** for 51-1

<table>
<thead>
<tr>
<th>Frame size</th>
<th>060</th>
<th>080</th>
<th>110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>V</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>AA</td>
<td>mm</td>
<td>[in]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>181.2</td>
<td>7.13</td>
<td>156.7</td>
</tr>
<tr>
<td>AB</td>
<td>mm</td>
<td>[in]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>199.3</td>
<td>7.85</td>
<td>209.7</td>
</tr>
<tr>
<td>AC</td>
<td>mm</td>
<td>[in]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>176.4</td>
<td>6.95</td>
<td>186.8</td>
</tr>
</tbody>
</table>

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

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector
(Supplied Connector)

Mating Connector
No.: K19815
Id.-No.: 508388

 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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Dimension – Controls

HYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

TH**
FOR 51
FRAME SIZE 160, 250

<table>
<thead>
<tr>
<th>Control Option TH** for 51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame size</td>
</tr>
<tr>
<td>Design</td>
</tr>
<tr>
<td>JA</td>
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<tr>
<td></td>
</tr>
<tr>
<td>JB</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Dimension – Controls

ELECTROHYDRAULIC TWO-POSITION CONTROL – OPTIONS

E1B1, E2B1, E7B1, F1B1, F2B1
FOR 51-1
FRAME SIZE 060, 080, 110

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

| Control Options E1B1, E2B1, E7B1, F1B1, F2B1 for 51-1 |
|---------------------------------|----------------|----------------|----------------|
| Frame size | Design | 060 | 080 | 110 |
| AB | mm | [in] | mm | [in] | 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 = Cratridge-flange

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)
Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector
(Supplied Connector)
Mating Connector
No.: K19815
Id.-No.: 508388
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Dimension – Controls

ELECTROHYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

E1A5, E2A5, F1A5, F2A5
FOR 51
FRAME SIZE
160, 250

Control Options E1A5, E2A5, F1A5, F2A5 for 51

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Design</th>
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<th>250</th>
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<td>V</td>
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<tr>
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<td>[in]</td>
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<td>[6.06]</td>
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</tbody>
</table>

V = SAE-flange, D = DIN-flange, C = Cartridge-flange
— = not available

Solenoid Connector

Solenoid plug face
for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Dimension – Controls

ELECTROHYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

T1**, T2**, T7**
FOR 51-1
FRAME SIZE
060, 080, 110

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

Control Options T1**, T2**, T7** for 51-1

<table>
<thead>
<tr>
<th>Frame size</th>
<th>060</th>
<th>080</th>
<th>110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>V</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>AA</td>
<td>mm</td>
<td>[in]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>181.2</td>
<td>7.13</td>
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</tr>
<tr>
<td>AB</td>
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<td>[in]</td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td>mm</td>
<td>[in]</td>
<td></td>
</tr>
</tbody>
</table>
| V = SAE-flange, D = DiN-flange, C = Cratridge-flange

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)
Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector
(Supplied Connector)
Mating Connector
No.: K19815
Id.-No.: 508388

P001 752E
P001 751E
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Dimension – Controls

ELECTROHYDRAULIC
TWO-POSITION
CONTROL – OPTIONS

T1C2, T2C2
FOR 51
FRAME SIZE 160, 250

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.
Spline flange boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.

Control Options T1C2, T2C2 for 51

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Design</th>
<th>V</th>
<th>D</th>
<th>C</th>
<th>V</th>
<th>D</th>
<th>C</th>
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</thead>
<tbody>
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<td>[7.00]</td>
<td>186</td>
<td>[7.33]</td>
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</table>

V = SAE-flange, D = DIN-flange, C = Cartridge-flange
— = not available

Solenoid Connector

Solenoid plug face
for DIN 46350
(Supplied Connector)

Mating Connector
No.: K09129
Id.-No.: 514117

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.
Spline flange boss A and B per ISO 6162 is identical with high pressure series SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Dimension – Controls

ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS

EQA1, EQA1
FOR 51
FRAME SIZE 060, 080, 110, 160, 250

Control Options EQA1 for 51

<table>
<thead>
<tr>
<th>Frame size</th>
<th>060</th>
<th>080</th>
<th>110</th>
<th>160</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>FA</td>
<td>FB</td>
<td>FC</td>
<td>FD</td>
<td></td>
</tr>
<tr>
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<td>mm</td>
<td>mm</td>
<td>mm</td>
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<td>168</td>
<td>74</td>
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<td>114</td>
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</tr>
<tr>
<td>C</td>
<td>192</td>
<td>80</td>
<td>116</td>
<td>120</td>
<td></td>
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<tr>
<td>V</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>D</td>
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<td>76</td>
<td>81</td>
<td>118</td>
<td>122</td>
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</tr>
<tr>
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<td>9.57</td>
<td>9.47</td>
<td></td>
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<tr>
<td>C</td>
<td>35</td>
<td>82</td>
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V = SAE-flange, D = DIN-flange, C = Cartridge-flange
— = not available

Connectors

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

Packard Weather-Pack 4 pin
(Supplied Connector)

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 SAE J518 code 62 (6000 psi).
Contact your Sauer-Danfoss representative for specific installation drawings.
ELECTROHYDRAULIC
PROPORTIONAL
CONTROL – OPTIONS

L1B1, L2B1, L7B1
FOR 51
FRAME SIZE
060, 080, 110, 160, 250

Control Options L1B1, L2B1, L7B1 for 51

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— = not available

Solenoid Connectors

Solenoid plug face for DIN 46350
(Supplied Connector)
Mating Connector
No.: K09129
Id.-No.: 514117

AMP Junior Timer Two Pin Connector
(Supplied Connector)
Mating Connector
No.: K19815
Id.-No.: 508388

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Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information

Dimension – Controls

**ELECTROHYDRAULIC PROPORTIONAL CONTROL – OPTIONS**

**D7M1, D8M1**

**FOR** 51

**FRAME SIZE 160, 250**

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**Control Options D7M1, D8M1 for 51**

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V = SAE-flange, D = DIN-flange, C = Cartridge-flange
— = not available

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**Solenoid Connector**

**AMP Junior Timer**
**Two Pin Connector**
(Supplied Connector)

Mating Connector
No.: K19815
Id.-No.: 508388

---

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Series 51 and 51-1 Bent Axis Variable Displacement Motors
Technical Information
Dimension – Controls

HYDRAULIC
PROPORTIONAL
CONTROL – OPTIONS

HSA*
FOR 51
FRAME SIZE
060, 080, 110, 160, 250

Control Option HSA* for 51

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