Unique Fluid Power Solution combines low energy consumption with high precision control!

Electro-Hydraulic hybrid system

KAWASAKI ECO SERVO
KAWASAKI ECO SERVO offers optimal solutions to various engineering challenges such as:

When you are addressing engineering challenges such as:
- You intend to proceed with energy saving programs.
- You want to improve controllability and control functionality.
- You need a simpler maintenance practice.
- You wish to minimize noise and vibration on the machinery.

**<Hydraulic Drive System>**

- Higher degree of energy saving is achieved through decreased power consumption and power regeneration!
- Dramatic energy saving is achieved through operation with the minimum necessary power that contributes to reduction in power consumption; as well as through reduction in the pressure loss on circuit.
- When used in conjunction with a power regenerative system, ECO SERVO system allows the braking energy from a load side to be reused.

- Ideal in improving characteristics of hydraulic systems!
  - Through control of an electric motor speed, the hydraulic system can have controllability as well as electric drive system.
  - Effect of variation in hydraulic fluid temperature is minimized, and this fact leads to improved repeatability.
  - Loss in the pressure on hydraulic circuit is decreased. As a result, a higher hydraulic output is obtained from a given input power.

- Unique mechanism helps achieve lower noise!
  - Use of a resilient support and high-rigidity bracket for the pump dampens transmission of vibration from the pump.
  - By controlling the electric motor speed, the running noise on the hydraulic pump running at a lower speed is minimized.

**KAWASAKI ECO SERVO**

offers a solution optimized for your problem!

**<Electric Drive System>**

- Cost reduction is achieved, compared with electric drive systems!
  - One electro-hydraulic hybrid system can drive a plurality of actuators at a time. Therefore, the number of electric motors can be decreased. (Depending on the nature of the entire system, the number of necessary electric motors may not be decreased.)
  - When used in conjunction with a variable displacement pump, KAWASAKI ECO SERVO helps decrease the necessary capacities of the electric motors as well as the necessary driving torque.

- Simple configuration contributes to improved maintainability!
  - Unlike electrically driven systems, you are spared the replacement works of ball-screw and/or maintenance for grease.
  - Since the hydraulic circuit is simple, the number of components that require time-consuming adjustment works can be decreased.
  - Unlike servo-valve system, strict maintenance works of hydraulic fluid are not necessary.

- Improved maintainability
  - Unlike servo-valve system, strict maintenance works of hydraulic fluid are not necessary.

**<Conventional system>**

- Power loss on standby!

**<ECO SERVO>**

- Energy-saving on standby!

**Reduced space needed for the entire system!**

- The hydraulic power transmission system enables flexible layout design. This results in a compact design for the entire system.
- The decreased loss of energy leads to less heat generation, and this allows the capacities for hydraulic fluid, fluid tank and cooler to be much smaller.

**<Benefits of KAWASAKI ECO SERVO>**

- KAWASAKI ECO SERVO employs the KAWASAKI piston pump K3VL, K7V6 series product that boasts good reputation for their high pressure rating, high capacity and high efficiency. Peak pressure: 35 MPa, Max. discharge: 600 L/min (pump displacement: 500 cm³)
- Applicable to both open and closed circuits
- KAWASAKI ECO SERVO series products include not only the standard pump intended for open circuits but also special pumps (with suction valve) intended for reversible high-pressure and closed circuits. KAWASAKI ECO SERVO can be applied to a diversity of hydraulic circuits.
- Variable displacement pump is employed. Through use of a variable displacement pump that is capable of two displacement settings, the necessary drive torque can be lower and the necessary motor capacity can be smaller.
- Applicable to both servo drive and inverter drive.
Comparison with Conventional Hydraulic Circuits

Examples of ordinary open circuit

Incorporation of KAWASAKI ECO SERVO contributes to elimination of components otherwise needed on conventional hydraulic circuits—for example, proportional pressure control valves and flow control valves as well as servo regulators and pilot pumps for variable displacement pumps.

Examples of typical closed circuit for press machine

Elimination of a servo valve or servo regulator and pilot pump and other elements for the hydraulic pump leads to a unique hydraulic circuit that realizes higher output, decreased energy consumption and compact size.

Pressure control

Flow control

Pressure-flow control

Open circuit / pressure-flow control

[KAWASAKI ECO SERVO use]

Variable pump speed (0 to 2000 min⁻¹)
The pump may run in the reverse direction during pressure relief operation.

Closed circuit / pressure-position control

[KAWASAKI ECO SERVO use]

Variable pump speed (0 to ±1800 min⁻¹)

3
The unique lineup of products can cope with requirements for a diversity of systems. Making the most of the high performance hydraulic pumps with the capacity of high pressure, low fluctuation and high efficiency, KAWASAKI ECO SERVO covers a wide range of displacement.

### Printing Table

**Pump displacement**

<table>
<thead>
<tr>
<th>Motor capacity</th>
<th>kW</th>
<th>22</th>
<th>30</th>
<th>37</th>
<th>45</th>
<th>46</th>
<th>55</th>
<th>75</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated torque</td>
<td>Nm</td>
<td>140</td>
<td>191</td>
<td>235</td>
<td>286</td>
<td>286</td>
<td>286</td>
<td>350</td>
<td>477</td>
</tr>
<tr>
<td>Max. torque</td>
<td>Nm</td>
<td>211</td>
<td>287</td>
<td>287</td>
<td>353</td>
<td>353</td>
<td>429</td>
<td>429</td>
<td>525</td>
</tr>
</tbody>
</table>

**Servo drive**

<table>
<thead>
<tr>
<th>Motor capacity</th>
<th>kW</th>
<th>7</th>
<th>11</th>
<th>11</th>
<th>15</th>
<th>22</th>
<th>30</th>
<th>37</th>
<th>45</th>
<th>45</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated torque</td>
<td>Nm</td>
<td>33.4</td>
<td>70</td>
<td>70</td>
<td>95.5</td>
<td>140</td>
<td>191</td>
<td>236</td>
<td>286</td>
<td>286</td>
<td>350</td>
</tr>
<tr>
<td>Max. torque</td>
<td>Nm</td>
<td>100</td>
<td>210</td>
<td>210</td>
<td>286</td>
<td>420</td>
<td>573</td>
<td>707</td>
<td>859</td>
<td>859</td>
<td>1,050</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pump pressure</th>
<th>Max. operating</th>
<th>MPa</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>MPa</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Max. speed</td>
<td>min⁻¹</td>
<td>2,000 (for Open Circuit), 1,800 (for Closed Circuit)</td>
<td></td>
</tr>
<tr>
<td>Hydraulic fluid type</td>
<td>Antwear hydraulic fluid *5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage/frequency</td>
<td>200 to 230V, 380 to 480V / 50/60Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*1: When considering other combination of pump displacement and motor capacity, contact Kawasaki Precision Machinery.

*2: Rated speed of the electric motor is 1500 min⁻¹ (2000 min⁻¹ only when the servo drive is rated at 5 kW or 7 kW).

*3: The max. torque values are short-time rating values. Be sure to select the appropriate servo or inverter drive such that the effective torque value for each cycle is below the corresponding rated torque.

*4: The max. speed might be subject to the limit depending on various conditions such as the use conditions and operating cycle.

*5: When wanting to use a hydraulic fluid not specified above, contact Kawasaki Precision Machinery for technical assistance.

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### KAWASAKI ECO SERVO: Product Lineup

**Possible System Configurations**

#### Open circuit configuration

- Hydraulic controller: pressure-flow control
- When the pressure does not increase to the commanded level when the entire system is under a light load, the entire system is controlled based on the flow command.

#### Closed circuit configuration

- Hydraulic controller: position-pressure control
- Control mode is switched over to position control or pressure control by the signal from upper control section.

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### Optional Components

- Cables and connectors for pulse generator
- Cables and connectors for servo driver
- Pressure sensor
- Noise filter
- DC reactor
- Braking resistor
- Power regenerator
- Coupling
- Bracket with resilient support

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### KAWASAKI ECO SERVO standard constituents

- Pump (with displacement switchover solenoid valve)
- Electric motor
- Inverter or servo driver
- Coupling
- Bracket with resilient support

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*For detailed information about the constituent components of the above-mentioned pump unit types, refer to the System Configuration section in the next page.*
Typical Applications of KAWASAKI ECO SERVO

Typical Examples of Open Circuit with Inverter Drive

- Application examples:
  Press machine, forming machine, packing machine, etc.
  (Control system: Speed control)
- Typical Examples of Open Circuit with Inverter Drive
  - The pump is driven on a necessity minimum period and discharge basis.
  - Dramatic energy saving is realized, as compared with conventional hydraulic systems.
  - High energy saving even when a variable displacement pump is used.
  - Lower average noise level.
  - Inverter control contributes to improved operability and controllability at lower speed ranges.

Typical Examples of Open Circuit with Servo Drive

- Application examples:
  Injection molding machine, etc.
  (Control system: Pressure control-speed control selectable)
  - Improved functionality and performance, compared with pump control systems.
  - Response speed, energy saving, and low noise level, comparable with those obtained from full electric control systems.

Typical Examples of Closed Circuit with Inverter Drive

- Application examples: Reclaimer
  (Control system: Speed control)
  - Hydraulic system renewal work
  - [Conventional system]
    - Pilot piping is needed.
  - [ECO SERVO]
    - No pilot piping is needed.
    - Improved repeatability and low-speed control precision
    - Easy maintenance

- Application examples: Press machine, etc.
  (Control system: Position control, Speed control)
  - Energy saving effects on press machine
  - Reduction of approx. 27 tons of CO₂ emission annually (approx. 40%, approx. 8.6 kW energy saving, compared with the conventional system)
  - Motor: 55kW Max flow: 280L/min Max pressure: 21MPa
  - Approx. 50% Energy saving

Typical Examples of Closed Circuit with Servo Drive

- Application examples: Testing machine
  (Control system: Pressure control, power regeneration)
  - When the load is moving upward, energy consumption is decreased through reduction in pressure loss.
  - When the load is moving downward, energy consumption is further decreased as the motion energy of the load is converted into electric power.

- Application examples: Propeller pitch controller, etc.
  (Control system: Position control)
  - Unlike servo-valve system, strict maintenance works of hydraulic fluid are not necessary.
  - Since direction valves are unnecessary, the system is compact.
**External Dimensions**

**Pump unit (for open circuit / inverter drive)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Motor</th>
<th>L1 (mm)</th>
<th>L2 (mm)</th>
<th>W1 (mm)</th>
<th>W2 (mm)</th>
<th>H (mm)</th>
<th>Mass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KESP45-V*2^1</td>
<td>30kW</td>
<td>1,320</td>
<td>570</td>
<td>571</td>
<td>400</td>
<td>600</td>
<td>395</td>
</tr>
<tr>
<td>KESP80-V*2^1</td>
<td>37kW</td>
<td>1,360</td>
<td>570</td>
<td>571</td>
<td>400</td>
<td>600</td>
<td>410</td>
</tr>
<tr>
<td>KESP112-V*2^1</td>
<td>45kW</td>
<td>1,420</td>
<td>570</td>
<td>571</td>
<td>400</td>
<td>600</td>
<td>460</td>
</tr>
<tr>
<td>KESP140-V*2^1</td>
<td>55kW</td>
<td>1,660</td>
<td>660</td>
<td>653</td>
<td>550</td>
<td>710</td>
<td>625</td>
</tr>
</tbody>
</table>

**Pump unit (for closed circuit / servo drive)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Motor</th>
<th>L1 (mm)</th>
<th>L2 (mm)</th>
<th>W1 (mm)</th>
<th>H (mm)</th>
<th>Mass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KESP45C-S*1^2</td>
<td>11kW</td>
<td>920</td>
<td>350</td>
<td>320</td>
<td>410</td>
<td>170</td>
</tr>
<tr>
<td>KESP80C-S*1^2</td>
<td>15kW</td>
<td>1,080</td>
<td>350</td>
<td>320</td>
<td>410</td>
<td>200</td>
</tr>
<tr>
<td>KESP450C-S*1</td>
<td>45kW</td>
<td>1,380</td>
<td>450</td>
<td>440</td>
<td>490</td>
<td>415</td>
</tr>
<tr>
<td>KESP200C-S*1</td>
<td>55kW</td>
<td>1,560</td>
<td>500</td>
<td>460</td>
<td>580</td>
<td>550</td>
</tr>
</tbody>
</table>

**Hydraulic controller KESC-***** (optional)**

**Optional Equipment**

A full lineup of optional equipment allows the users to build a diversity of systems.

<table>
<thead>
<tr>
<th>Name of optional equipment</th>
<th>Typical applications</th>
<th>Selection practice and considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic controller</td>
<td>This controller calculates a pump speed based on the position, speed and pressure commands, and outputs a speed command to a motor driver.</td>
<td>Employ the hydraulic controller when wanting to isolate the hydraulic control system from the upper control section and construct a self-contained control system within the hydraulic system. Two types of hydraulic controller are available—position-pressure controller and pressure-flow controller. Select either type that is suitable for the intended hydraulic system.</td>
</tr>
<tr>
<td>Noise filter</td>
<td>The noise filter can suppress the noise occurring from the motor driver.</td>
<td>Troubles deriving from electrical noise can be positively prevented through basic noise countermeasures including noise-immune wiring arrangement and grounding work when designing the control panel. If a noise-derived problem occurs, it is necessary to select noise-immune equipment that helps solve the problem.</td>
</tr>
<tr>
<td>DC reactor</td>
<td>The DC reactor helps improve the input power factor for the motor driver and suppress the input higher harmonic current.</td>
<td>Use a DC reactor when the power supply capacity is larger relative to the motor driver capacity or a measure against harmonic current is needed.</td>
</tr>
<tr>
<td>Braking resistor</td>
<td>When braking torque is necessary on the motor driver circuit, the braking resistor converts the energy from the load side into heat to provide a braking torque.</td>
<td>A braking resistor must be incorporated when load torque and the losses of the motor driver and motor are not enough to provide the necessary braking torque. If an over-voltage alarm occurs on the motor driver when the motor is decelerating, then a braking resistor must be installed or it is necessary to decrease braking torque.</td>
</tr>
<tr>
<td>Power regenerator</td>
<td>The regenerator converts the braking energy from the load side into electricity and feeds this electricity to the power supply system, so that energy saving effect is further enhanced.</td>
<td>An electric regenerative system will be useful when the entire hydraulic system is frequently shut down and the amount of recovered electric power is large. When an electric regenerative system is incorporated, a braking resistor is no more necessary.</td>
</tr>
</tbody>
</table>

*1: For information about the external dimensions of the inverter and servo driver, contact Kawasaki Precision Machinery.

*2: For information about the detailed specification for the hydraulic controller, contact Kawasaki Precision Machinery.

**Operating precautions**

1. Considerations about selection of electric motor capacity

To determine the capacity of the electric motor that is used in conjunction with the hydraulic pump, use the following formula:

- **Required torque (N·m)**

\[
T = \frac{q \cdot (\Delta P)}{2\pi \cdot \eta_m}
\]

- **Output power (kW)**

\[
N = \frac{2\pi \cdot T \cdot n}{60,000} = \frac{T \cdot n}{9,550} = \frac{Q \cdot \Delta P}{60 \cdot \eta_t}
\]

For the instantaneous max. torque and continuous rated torque with the intended electric motor, refer to the specification table in page 5.

For information about the displacement of pump that is capable of displacement switchover, refer to the field for the intended pump model in the table within page 5. The capacity of electric motor can be decreased through displacement switchover.

2. Measures against noise occurrence

When housing the motor driver in the control panel, and when installing the control panel, provide in advance basic noise control measures which include: [1] isolation of the control circuit from the main electrical power circuit, [2] reliable grounding work, [3] use of shielded cables for the control circuit, and [4] use of metal conduit for the main electrical power circuit.

3. Precautions for using the pump