Ashtad USA offers energy-saving hydraulic pump solutions using variable frequency AC drives.

History

Ashtad USA was founded in 2025 by a hydraulic and electromechanical systems expert with over 30 years of experience at Parker Hannifin, a global leader in motion and control technologies. After retiring, the founder's passion for enhancing hydraulic system efficiency and performance led to the establishment of Ashtad USA LLC., an engineering consulting firm focused on innovative solutions for industrial applications. During their tenure at Parker Hannifin, the founder was instrumental in advancing Drive Controlled Pump (DCP) technology for the U.S. market. This technology integrates variable frequency AC drives (VFDs) with hydraulic pumps to optimize performance, achieving significant energy savings. Despite its benefits, DCP adoption has been limited due to the complexity of combining electrical, electromechanical, and hydraulic principles, which demands specialized expertise. Ashtad USA was created to bridge this gap, offering consulting services and plug-and-play systems to simplify the integration of advanced hydraulic technologies.

Mission

Ashtad USA is dedicated to working with Hydraulic Power Unit developers to deliver user-friendly, energy-efficient hydraulic engineering and software solutions that improve traditional system performance and longevity for industrial clients. Through this collaboration, the company aims to make advanced hydraulic technologies, particularly those using variable frequency AC drives (VFDs), more accessible with innovative plug-and-play and tailored systems. These solutions reduce technical barriers, enabling clients to achieve energy savings of 20–50% in applications with fluctuating loads, as seen in VFD-based hydraulic systems. Building on the founder's legacy at Parker Hannifin, Ashtad USA drives hydraulic engineering forward with practical, client-focused innovations that promote efficiency and sustainability across diverse industrial applications.

Parker H-Pak with a VFD solution

Variable Power Pump (VPP)

Introduction:

Modern industrial machinery requires hydraulic systems that are efficient, quiet, compact, and capable of delivering exceptionally high power density—up to ten times that of similar electric actuators—while ensuring precise control and long-term reliability. Traditional hydraulic systems often suffered from energy losses of up to 30%, excessive heat generation, and noise levels exceeding 80 decibels, particularly with constant-speed pumps under variable loads. Advanced Variable-Power Pump (VPP) systems address these issues, improving energy efficiency by up to 50% through reduced pressure drops across valves, lower heat generation, and a smaller system footprint, while also reducing noise levels to approximately 70 decibels.

Load Matching:

Variable power hydraulic pumps can adjust their power to match the system's demand. This reduces energy waste compared to fixed-speed pumps, which often run at full capacity regardless of the actual load, leading to inefficiencies like throttling losses or bypass flow.

Improved Control:

Variable power pumps offer better control over flow and pressure, allowing for smoother operation and less wear on components, which indirectly boosts efficiency.

IoT: Smart drives, with their data access IoT-enabled communication capabilities, can offset their additional cost. By using predictive maintenance, they reduce downtime by up to 25% through real-time data to anticipate and prevent failures.

Extended pump longevity:

Abrupt acceleration from across-the-line motor starting imposes shock loads on motor and pump bearings and seals, often causing cavitation. A Variable Frequency Drive (VFD) with a controlled acceleration ramp mitigates these damaging effects, eliminates current surges, and supports more frequent start-stop cycles.

ROI: Depending on the electric motor size, adding a VFD can cost 10-20% of the HPU's total cost. However, the benefits of the Variable-Power Pump (VPP), including a simplified hydraulic circuit, less expensive pumps, a smaller reservoir, reduced cooling requirements, and, in some cases, the elimination of expensive proportional valves, can easily offset this additional expense.

VPP applications

VPP for the Variable Displacement Pumps:
A variable displacement pump, though more expensive and less efficient than a comparable fixed displacement pump, is preferred by hydraulic power unit designers for its superior overall efficiency. Adding a VFD enhances its efficiency during startup, unloading, and deadhead conditions.

VPP for the Fixed Displacement Pumps:
A fixed-displacement pump operating at a constant rotational speed generates a steady power output. When power demand is lower than the generated power, the excess is wasted. By integrating a VPP controlled VFD with a fixed-displacement pump, you can achieve variable flow at constant pressure by adjusting the pump's input power to match the required output power demand. enabling variable flow at constant pressure. This setup also allows on-the-fly adjustments to pressure or flow as needed.

Fixed Displacement pump VPP macros

The VPP system includes preloaded macros to regulate pump input power for the following specific control modes:

- Q-Control: Regulates hydraulic pump flow to control actuator speed in industrial applications, such as CNC machinery, injection molding, and extruders. Available in open- or closed-loop configurations:
    - Open Loop: Delivers variable flow based on system demand, using Variable Pressure Pump (VPP) algorithms to compensate for internal pump leakage.
    - Closed Loop: Enhances actuator speed precision for applications like extruders by incorporating external speed or position feedback.
    - Regenerative Closed Loop: Manages bidirectional pump flow in applications like lifting systems, with a Variable Frequency Drive (VFD) recovering regenerative hydraulic power. Requires additional hardware, such Dynamic brake resistor or 4Q drive.

- P-Control: Maintains consistent hydraulic pump pressure across varying flow rates for stable force output, available in open- or closed-loop configurations:
    - Open Loop: Compensates for pump mechanical efficiency using VPP algorithms, ideal for constant-pressure applications like simple clamping or hydraulic presses machinery.
    - Closed Loop: Enhances precision with an external pressure transducer, suitable for applications requiring precise pressure control.

- **PQ-Control**: PQ control in hydraulic systems refers to the simultaneous regulation of pressure (P) and flow (Q) to optimize the performance of hydraulic pumps and actuators. It combines the principles of P-Control (maintaining consistent pressure) and Q-Control (regulating flow rate) to match both force and speed requirements dynamically, ensuring energy efficiency, precision, and system stability. PQ control is commonly used in advanced hydraulic systems, such as those with variable displacement pumps, where both pressure and flow must adapt to varying loads or operational conditions. Now this can be achieved by a less expensive and complex fixed displacement pump.

- **Accumulator Load Control:** A hydraulic accumulator stores energy to stabilize pressure and compensate for flow variations in industrial systems. The Variable Pressure Pump (VPP) Accumulator macro enhances efficiency by:
    - Increasing electric motor speed above base speed at lower pressures to rapidly charge the accumulator.
    - Slowing the motor as pressure approaches the target setpoint.
    - Stopping the motor when the accumulator reaches full charge pressure.
    - Restarting the motor when pressure falls below the minimum setpoint.
    - Supplementing flow during variable flow operations, ensuring consistent performance in applications like injection molding or variable force presses.

- **Electronic Load Sense Control**: This macro enhances hydraulic system efficiency by adjusting pump output to match real-time flow and pressure demands, reducing energy waste compared to constant-output systems. It uses multiple electronic pressure transducers for fast, accurate responses in applications like injection molding or variable force presses.

    - Minimizes excess pressure drop across valves, reducing power consumption.
    - Ensure consistent performance across varying loads, improving responsiveness.
    - Reduces heat generation by matching pump output to demand, lowering cooling needs and extending fluid and component life.
    - Decreases stress on pumps and motors by avoiding maximum-capacity operation, reducing wear and tear.
    - Lowers energy consumption, reducing operational costs.
    - Extends component life, decreasing maintenance expenses.

- **Double Pump Control (Hi-Low):** This macro controls the double pump in P or PQ control mode as well as an external high flow pump unload valve.
    - High-Flow, Low-Pressure Pump: Provides a large volume of fluid at lower pressures to support rapid movement of hydraulic actuators (e.g., cylinders or motors) during low-load conditions, such as extending a cylinder quickly.
    - Low-Flow, High-Pressure Pump**:** Delivers a smaller volume of fluid at higher pressures to meet high-force demands, such as clamping force during heavy load operations.
    - Operation Modes:
        - At low pressure, both pumps contribute flow to the system, maximizing actuator speed.
        - At high pressure, the high-flow pump is unloaded (e.g., diverted to a reservoir or bypassed) to prevent overloading the motor, while the low-flow pump maintains the required pressure.
        - VPP control mechanism manages the transition between pumps based on system pressure or demand.
    - Benefits:
        - Combines high flow for speed and high pressure for force, reducing energy waste compared to a single pump sized for peak demand.
        - Uses fixed-displacement pumps, which are less expensive than variable-displacement pumps, while achieving similar flexibility.
        - Provides rapid response for low-pressure tasks and sufficient force for high-pressure tasks.
        - The unloading of the high-flow pump at high pressure prevents excessive motor strain, extending equipment life

- **Multi-Pump Load Share Control:** This macro enables a single pump, operating in pressure control mode, to coordinate flow and pressure with up to two additional pumps. By distributing the workload, this system offers a more efficient and quieter alternative to using a single large pump, motor, and drive.

Variable Displacement pump VPP macros

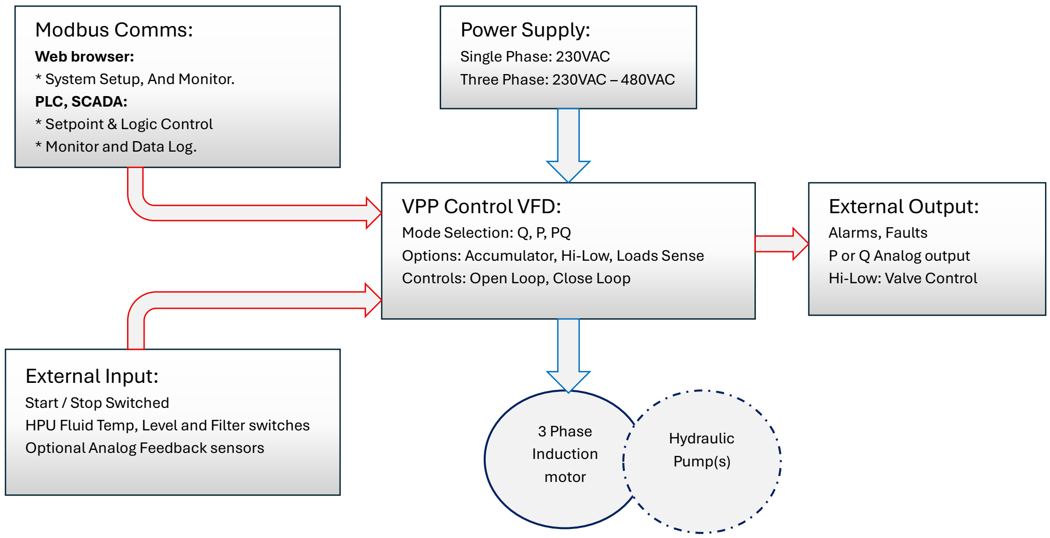
The VPP system includes preloaded macros to regulate pump input power for the following specific control modes:

- Energy Saver: A fully compensated variable displacement pump running at fixed speed operates inefficiently. The macro optimizes energy use by adjusting pump speed to its peak efficiency, achieving 20% to 45% energy savings.
- Accumulator Charging: This macro stops the pump's electric motor when the accumulator reaches full charge and restarts it at a preset pressure drop, reducing energy consumption. It also increases motor speed above the nameplate rating at lower pressures for faster accumulator charging.

Macro Loading and Setup

The VPP drive macro is provided on a MicroSD card with a straightforward installation process. If motor, pump, and HPU data were provided in advance, no further action is needed. Otherwise, after loading the macro, use the drive's built-in keypad or webserver to enter the motor, pump, and HPU data.

VPP for flow chart diagram:



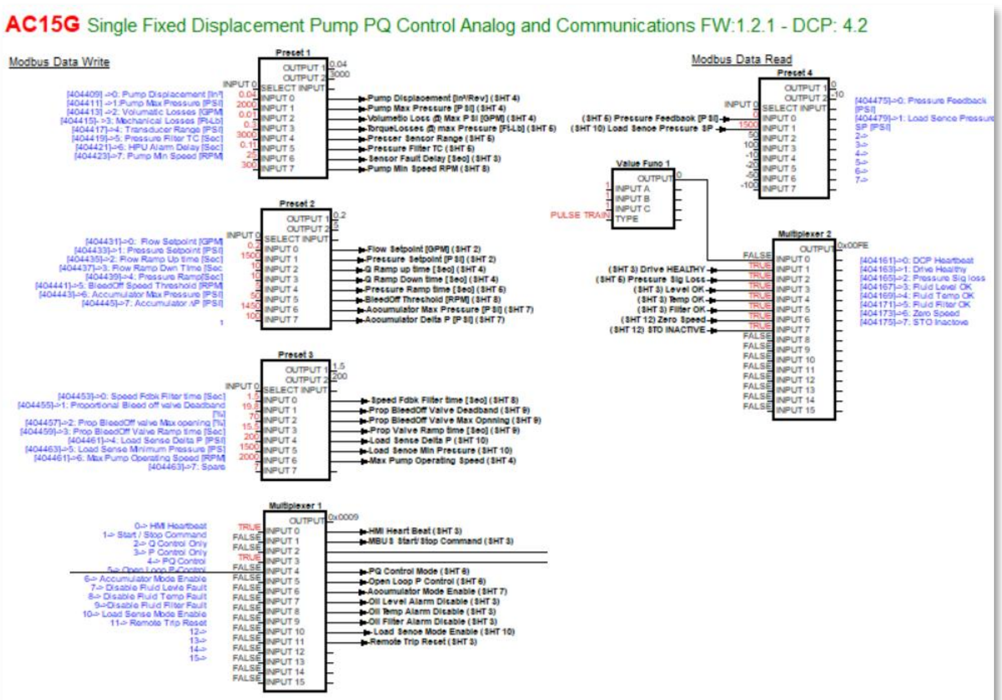


Figure 1: Macro's program example, Modbus communication subroutine