

ENGINEERING
TOMORROW



Proven performance –
exceptional efficiency
H1 Piston Pumps and Motors

6%

increase

in efficiency makes
H1 your best choice
for optimum power
and fuel economy



Efficiency, functionality, and productivity

Stringent emissions regulations and tougher safety legislation will have an impact on nearly every aspect of off-highway vehicle development. New emissions regulations require more efficient solutions in order to compensate for changes in engine power levels, while new safety standards demand a more comprehensive process of system development and qualification. With a proven range of H1 variable piston pumps and motors, Danfoss can help you improve overall efficiency, reduce development costs, and ultimately bring your vehicles to market faster.

Greater total efficiency

Today's vehicles need more effective systems that maximize the use of available engine power. To improve overall efficiency, H1 pumps are designed to reduce rotating group, control and charge pump losses, which helps save fuel, frees power for other vehicle functions and enhances operating performance and productivity. Furthermore, our H1 bent axis motors have a six percent efficiency gain at maximum displacement (high torque working cycle), compared to comparable products on the market. Better efficiency means you can use smaller engines on some vehicles, reduce heat load and increase power to the ground.

Functionality and flexibility

Our H1 pumps are designed to improve vehicle operation. For example, a tandem Control Cut Off (CCO) circuit will safely disable both pump controls in the absence of the proper signal to the

override solenoid, while an Integral Speed Limitation (ISL) circuit improves vehicle braking while preventing engine over-speed. With proven 32 degree bent axis technology, zero degree capability and higher overall efficiency, our H1 bent axis motors also offer significant advantages. The H1 propel system provides improved horsepower management, and enables advanced anti-slip or wheel-assist control functions. H1 systems can also be optimized to match the requirements of specific vehicle functions. By adjusting software parameter settings, you can offer a range of vehicle control concepts using the same hardware.

SIL 2 certified automotive control

Our new H1 Automotive Control (H1 AC) is an innovative SIL 2 certified solution (Safety Integrity Level 2 according to IEC 61508), that helps reduce vehicle development and qualification expenses. Using intelligent software, the characteristics of the hydrostatic transmission can be adjusted to suit specific operating requirements. Combining state-of-the-art technology and 25 years of electronic automotive control development, H1 AC not only helps increase vehicle performance and efficiency, but also provides improvements in productivity and comfort.

The H1 family



- **Greater overall vehicle efficiency**
- **SIL 2 certified Automotive Control (H1 AC)**
- **Optimized for modern control systems**
- **Improved fuel economy and reduced heat load**
- **Proven operating performance and increased productivity**



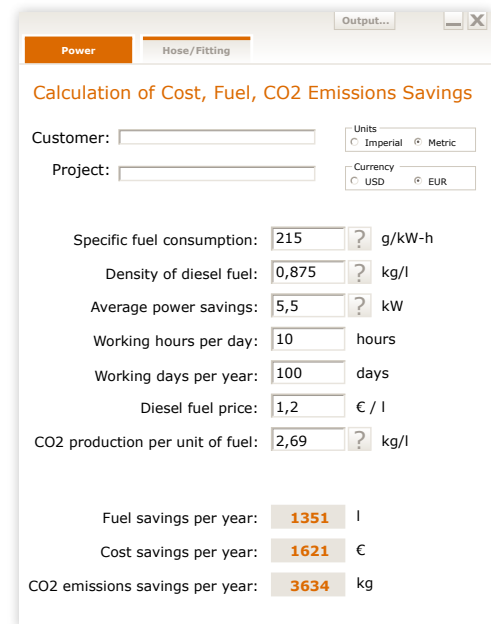
H1 efficiency

– maximize available engine power

Higher output speeds, lower input speeds and a reduced total installed lifecycle cost – our closed circuit variable displacement axial piston pumps and bent axis motors are designed for efficiency. H1 pumps minimize control and charge pump losses, which maximizes available engine power. In addition, our H1 bent axis motors offer significant improvements in overall efficiency and an extremely low pressure drop within the fluid galleries of the motor. This helps you to improve fuel economy and provides power savings for other vehicle functions – enhancing operating performance and increasing productivity.

Our H1 bent axis motors feature a unique design that minimizes flow losses throughout the operating range of the motor. At 2000 rpm and 250 bar system pressure, the improvement is approximately six percent above the nearest comparable product*. That's a gain of around 5.5 kW (7.4 HP) to the ground. The result is improved fuel economy (5.5 kW at 1000 working hours/year, equates to €1600/year saved), and a reduced heat load placed upon your vehicle cooling system.

* All products have been measured on the same test stand, at the same time, using the newest comparable products on the market.



Calculation of Cost, Fuel, CO2 Emissions Savings	
Customer:	
Project:	
Units:	☐ Imperial ☒ Metric
Currency:	☐ USD ☒ EUR
Specific fuel consumption:	215 g/kW-h
Density of diesel fuel:	0,875 kg/l
Average power savings:	5,5 kW
Working hours per day:	10 hours
Working days per year:	100 days
Diesel fuel price:	1,2 € / l
CO2 production per unit of fuel:	2,69 kg/l
Fuel savings per year:	1351 l
Cost savings per year:	1621 €
CO2 emissions savings per year:	3634 kg

Figure 1: Based on our verified data we can calculate cost and emissions savings for your off-highway vehicles.



Greater total efficiency

- Minimum control losses
- Improved charge circuit
- Improved kit efficiency
- Lower control pressure
- Bent axis motor with optimized valve segment
- Additional functionality with PLUS+1®

Functionality and flexibility

- Integral automotive pump and motor control functions
- Control override
- Integral speed limitation
- Optional integral sensors (pressure, angle, speed)
- Optional electronic operated pressure limiter
- Bent axis motor with zero degree capability
- Optional electrical pressure compensation with electrical brake pressure defeat



Expanded functionality and higher efficiency

Our H1 Automotive Control (H1 AC) is the first solution on the market to offer the precision and consistent performance of intelligent electronics, combined with complete drive system functionality, system qualification and SIL 2 certification. You will be able to reduce time to market for new vehicles and model variants, while still customizing vehicle behavior and providing differentiation for your products.

The H1 embedded controller features robust electronics mounted directly on the H1 pump. The controller also incorporates additional "watch dog" circuitry, which provides you with real-time fault monitoring of the electronic hardware. Combined with optional software to monitor redundant HMI input channels, H1 AC provides single fault tolerance for AC vehicle transmission systems, with programming to bring the H1 pump to a defined 'safe state' in the event of signal loss or interruption – SIL 2 certified by technical inspection agency TÜV Nord (Technischer Überwachungs-Verein).



Figure 2: The H1 embedded controller (mounted on the H1 pump) helps OEMs to meet the requirements of the revised European Machinery Directive 2006/42/EC and related safety standard (ISO 13849-1:2006), reducing the cost and time required for system qualification and vehicle certification.

Optimized for modern control systems

- Integral electronic automotive control
- One electrical displacement control for all pumps
- Best in class EDC and PLUS+1® Compliant
- SIL 2 electronic automotive control (H1 AC)
- 4 electrical pump control options (EDC, NFPE, electronic AC or FNR)
- 2 electrical motor control options (2-position or proportional)

Designed for quality and reliability

- One design concept
- Reduced part count
- Single piece swash plate
- Fewer control variants
- Reduced electric displacement control (EDC), part count

Installation and packaging benefits

- Length-optimized pumps and motors
- Minimum one clean side
- Higher corner HP/package size ratio
- Integral control function
- Standardized connector interface

Consistent and reliable vehicle performance

PLUS+1® – customized vehicle solutions

Whether using H1 pumps and PLUS+1® microcontrollers – or H1 pumps with embedded electronics – time to market goes down. Pre-engineered and pre-programmed propel system functions are easily user configurable. With the PLUS+1 Service Tool AC software service screens, you can configure up to 4 different operator-selectable system modes with varying vehicle drive behaviors to meet a variety of application requirements. Along with the convenience of automotive control, you also keep the versatility of non-automotive and creep automotive modes.

Additional benefits include your ability to further customize hydraulic pump and motor displacement control profile and ramp times, provide constant speed drive functionality, interface to vehicle systems via CAN, and easy-to-use diagnostics.

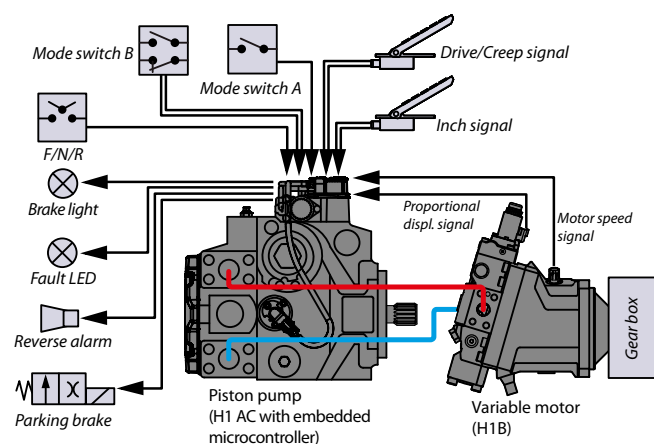
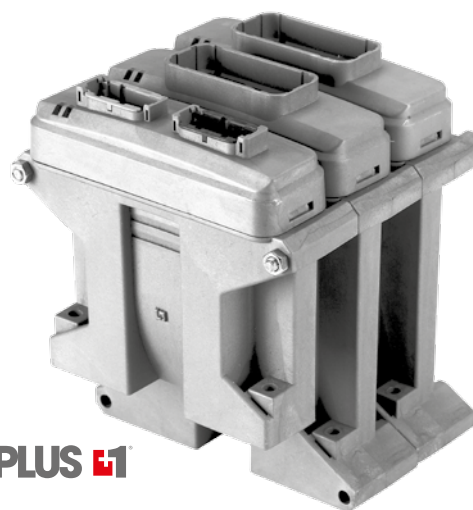


Figure 3: Solution Using H1 Pump with Integrated AC Controller.

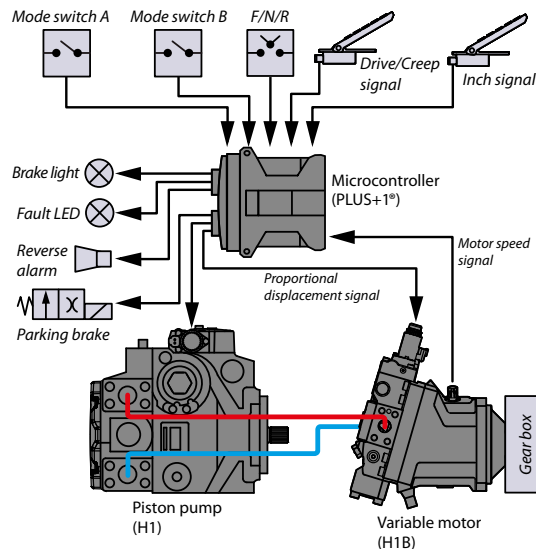
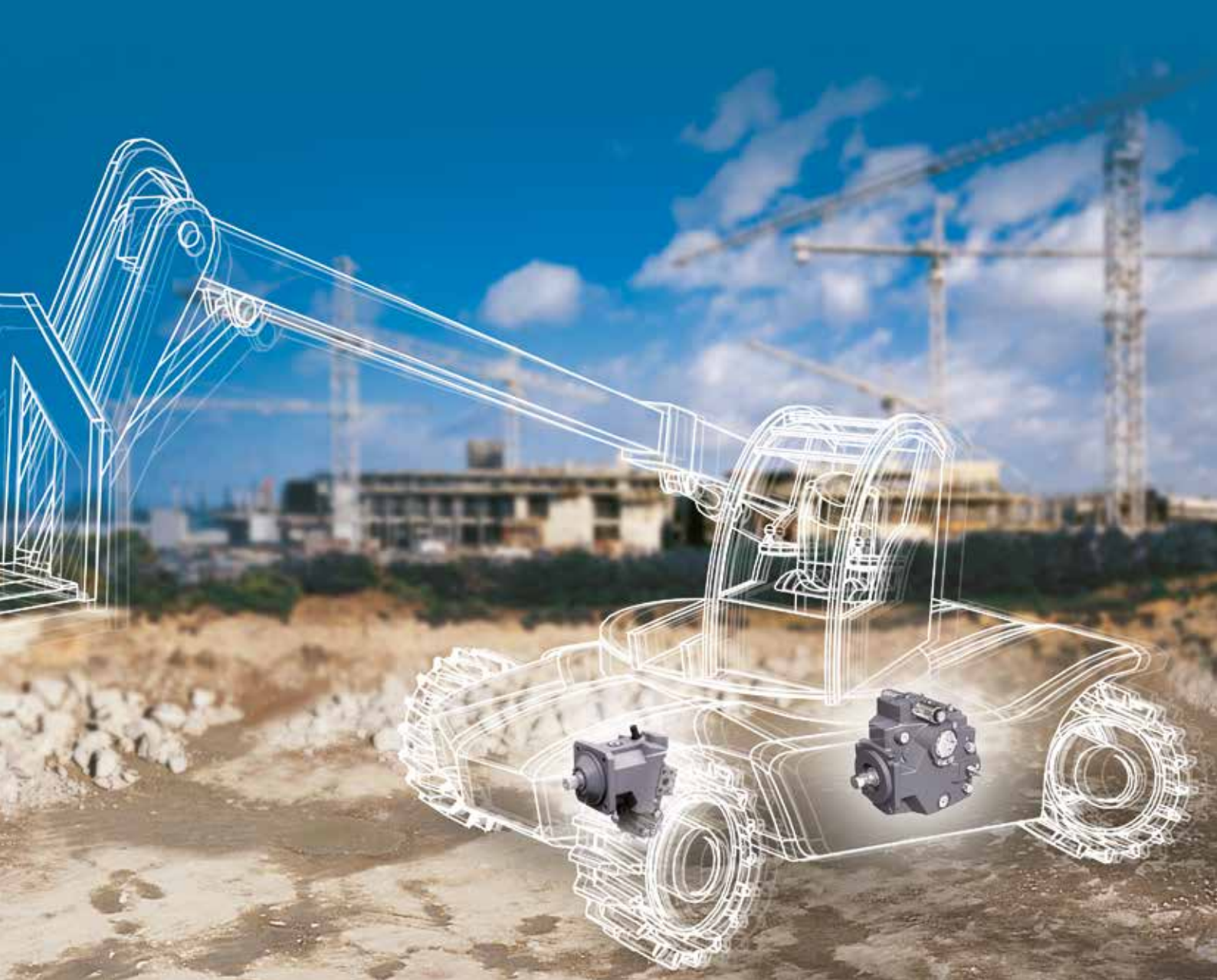


Figure 4: Solution Using H1 Pump with NFPE Control and Automotive on PLUS+1®.



PLUS+1® Compliant – the intelligent liaison

Optimizing around electronic control is the future of mobile machinery – because tomorrow's electronically controlled engines are going to need electronically controlled pumps and motors. H1 is fully PLUS+1® Compliant to interface seamlessly with Danfoss' electronic vehicle control architecture.

Combined, the H1 family and PLUS+1 system form a genuinely intelligent liaison offering superior solutions for off-highway OEMs in agriculture, construction, road building, materials handling, forestry, turf care and special purpose vehicles.



About Danfoss Power Solutions

Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market. Building on our extensive applications expertise, we work closely with you to ensure exceptional performance for a broad range of off-highway vehicles. We help OEMs around the world speed up system development, reduce costs and bring vehicles to market faster.

Danfoss Power Solutions – your strongest partner in mobile hydraulics.

Products we offer:

- Bent Axis Motors
- Closed Circuit Axial Piston Pumps and Motors
- Displays
- Electrohydraulic Power Steering
- Electrohydraulics
- Hydraulic Power Steering
- Integrated Systems
- Joysticks and Control Handles
- Microcontrollers and Software
- Open Circuit Axial Piston Pumps
- Orbital Motors
- PLUS+1® GUIDE
- Proportional Valves
- Sensors
- Steering
- Transit Mixer Drives

Wherever off-highway vehicles are at work, so is Danfoss Power Solutions. We offer you expert worldwide support for ensuring the best possible solutions for outstanding performance. And with an extensive network of Global Service Partners, we also provide you with comprehensive global service for all of our components.

Go to **www.powersolutions.danfoss.com** for further product information.

Danfoss Power Solutions (US) Company

2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss Power Solutions ApS

Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss Power Solutions GmbH & Co. OHG

Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss Power Solutions Trading (Shanghai) Co. Ltd.

Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 3418 5200