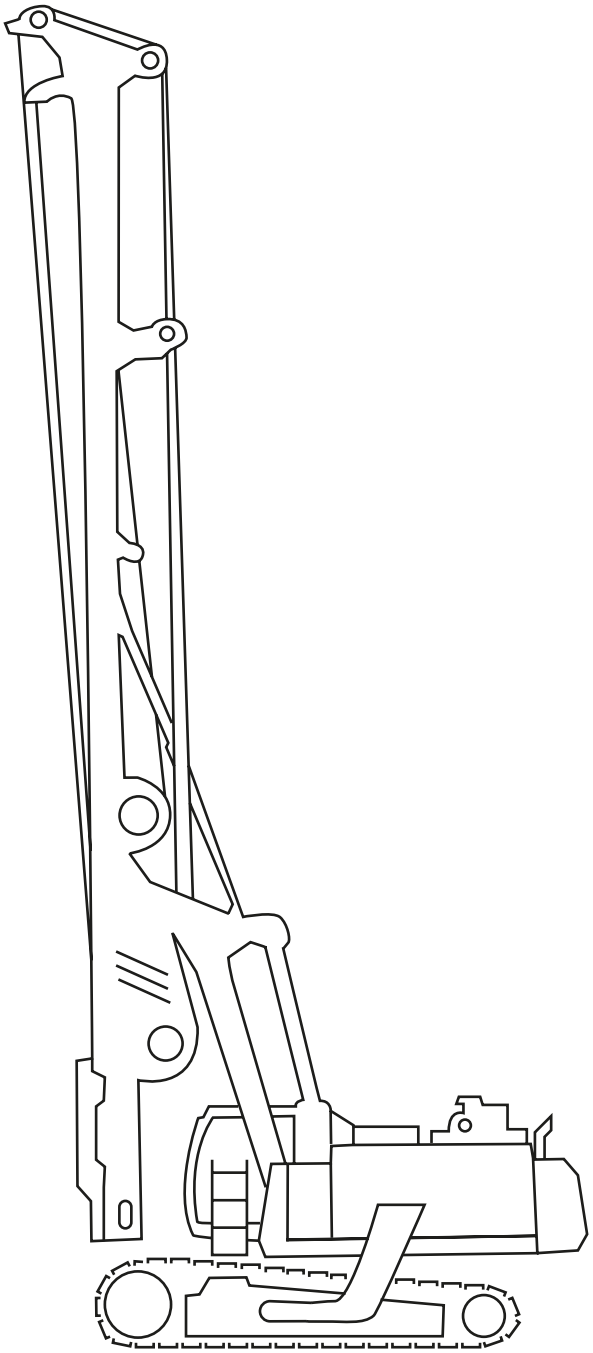
Völkel Steuerungstechnik - Control in perfection

Standard controllers for mobile hydraulic applications



VÖLKEL
MIKROELEKTRONIK

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VÖLKEL
MIKROELEKTRONIK

ERFOLG EINFACH EINBAUEN

Standard controllers from Völkel

First class from experience
Völkel Mikroelektronik has been developing and producing digital, electronic controllers for mobile machines for more than 30 years. We are specialists for the control of mobile hydraulic processes.

Modular design
The better a machine fulfills its special task, the more attractive it is for the market. Our specialty is to take a holistic view of the machine and to develop the perfect solution for each individual customer. In order for complex machines to be ready for the market in an acceptable development time, we work with a high degree of modularization in the controller systems. The modules are often standard solutions that have already proven themselves many times in the market.

Flexible adaptation
Völkel control systems are adapted to the machine by means of parameterization without the need for programming knowledge. The settings are made online using the ConDoc® PC software. The parameterization ranges from setting the inputs and outputs on the periphery used to completely changing the control characteristics. The controller receives its function through parameterization.

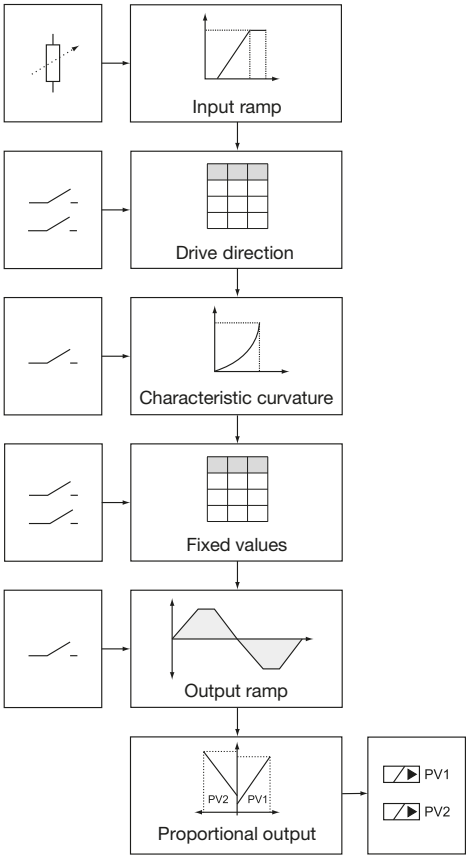
Robust hardware
The hardware is designed with protection class IP 69 K and the extended temperature range (- 40 °C ... + 85 °C) to withstand the extreme operating conditions of mobile work machines. Other features are:

- Reverse polarity protection
- Short circuit robustness
- Power supply 8 - 32 V
- Connection via standardized interfaces

Quality from a single source
Quality increases when all processes are subject to the control and influence of a QM system. Hardware and software development mutually strengthen each other. This results in a coherent product, from development to support.

For further information, please contact
Detailed, further information is available for each product. If your special product is not included, we develop individual controllers based on modular hardware and software. Talk to us - we will be happy to create a customized solution for you for small or large quantities: we can adapt a controller feature or we can provide you with a tailored solution.

Basic structure
of a standard controller



Proportional booster VCB (Valve Control Basic)

The proportional booster controls the volume and thus the speed of an actuator. The set values are read in by set value generators, higher-level controls or sensors and mapped to proportional currents for controlling the solenoids of valves.

The standard hardware for this controller is the HCB controller, which can be used to control up to 4 magnets. VCB enables the configuration of 4 unidirectional valves (e. g. variable throttles, hydraulic motors, etc.), 2 unidirectional and one bidirectional valve (e. g. pump, 4/3-way valve, etc.) as well as 2 bidirectional valves. For setting set values, analog inputs for encoders as well as digital inputs for fixed values are available, both of which can be called up via switches.

The benefit of electro-proportional adjustment is the responsive control of actuators. Their non-linearity can be compensated for by applying characteristic curves; joysticks or accelerator pedals are also overlaid with characteristic curves in order to increase the sensitivity of the control system. Target values are reached via configurable ramps, there are different ramps for different target values.

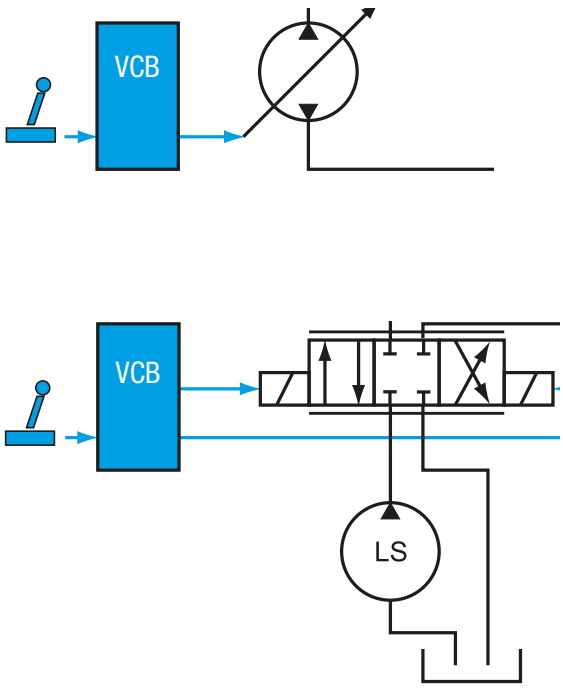
If more than 4 solenoids are to be actuated, the controller Valve Control Basic can be ported to other hardware platforms. A customer-specific extension would be, for example, the multiple assignment of a joystick, in which other outputs are assigned to the joystick by means of a switch.

The control function is defined by means of parameterization.

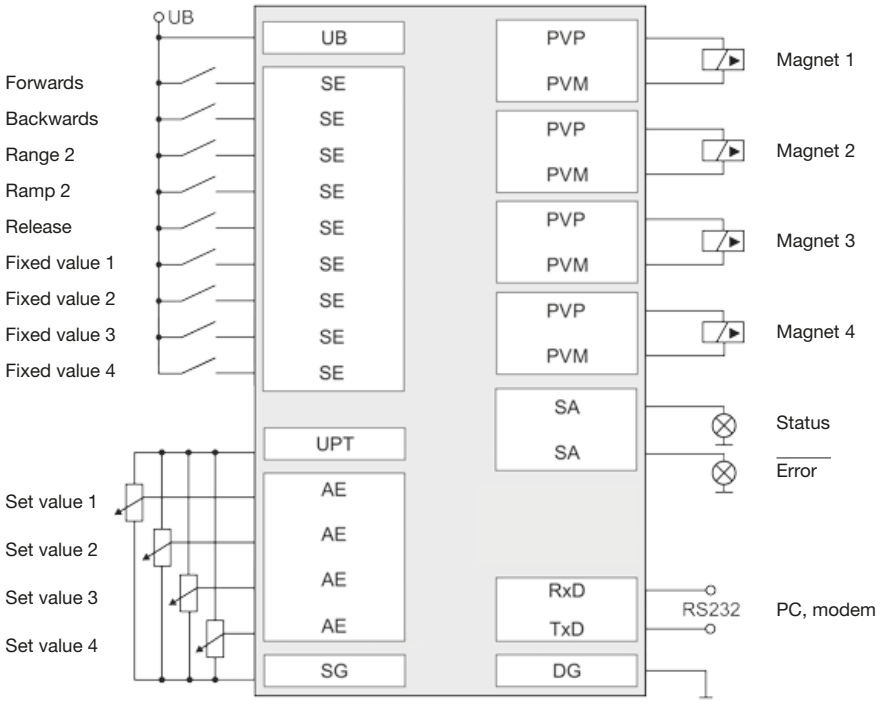
Possible applications are e. g. excavator booms, discharge belts, etc.

Inputs and outputs

- Digital inputs, parameterizable as enabled, direction selection, fixed values, parameter set selection or characteristic switching
- Analog inputs (0 - 10 V/0 - 20 mA) for Set value input, with parameterizable cable break detectiong
- Proportional outputs with current feedback measurement for proportional valves
- Digital outputs for status display and fault diagnosis



Proportional booster VCB [Connection example]



Standard proportional booster

HCB-VCB
2 axles, 4 solenoids,
universal software

HCB-VCM
2 axles, 4 solenoids,
simplified parameterization

Volume, pressure and power control VPP (volume, pressure, power control)

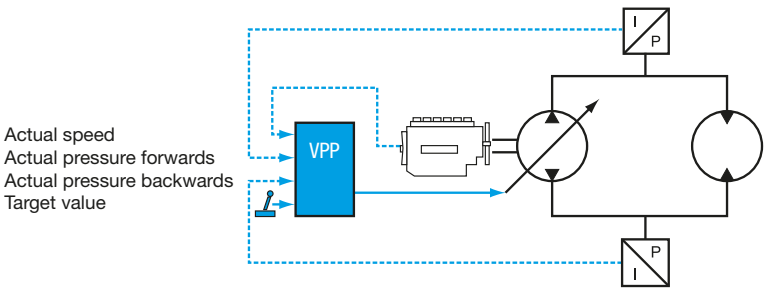
According to the parameterization, the volume, pressure and power controller regulates the volume, pressure or power of the hydraulics to the set value. The control characteristic can be freely parameterized. Depending on the application, it is also possible to switch between different control characteristics or dynamically adjust the controller gain depending on the magnitude and sign of the regulation deviation. To prevent the hydraulic system from reacting too quickly, steps in the set value can be limited by freely adjustable ramps.
If the controller is set as a power regulator, the power reserve of the drive can be calculated from the drive torque and speed and taken into account. For this purpose, the torque characteristic curve of a diesel engine is parameterized in tabular form and the speed is measured. Alternatively, for electric motors, it is possible to parameterize the drive power via fixed values for torque and speed.

The standard hardware platform for the VPP is the HCB controller. The VPP supports the operation of a tandem pump. If it is integrated into a machine controller, it can easily be ported to another Völkel hardware platform.

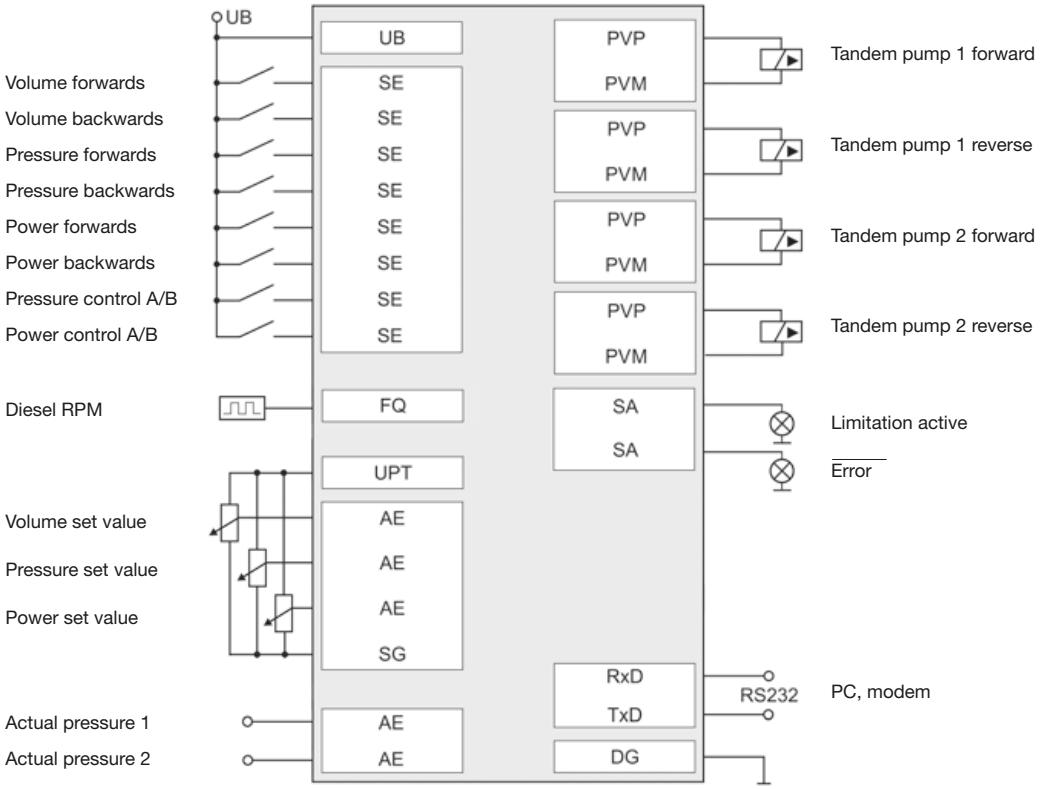
The volume, pressure and power controller is used, for example, in bow thrusters, in the power control of spray pumps and screw conveyors.

Inputs and outputs

- Digital inputs for volume, pressure and power controller enabling, forward/reverse, controller switching, fixed values
- frequency input for diesel speed acquisition (pickup or terminal W)
- Analog inputs: set values for volume, pressure and power, and to capture the actual pressure value per direction
- Proportional outputs for controlling a (Tandem) pump
- Status outputs, parameterizable for display of limitations and faults



Volume, pressure and power control VPP [Connection example]



Standard volume, pressure and power controller

HCB-VPP
Control of 1 axle with
2 magnets or one
Tandem pump

Pressure Limiter DPL (Digital Pressure Limiter)

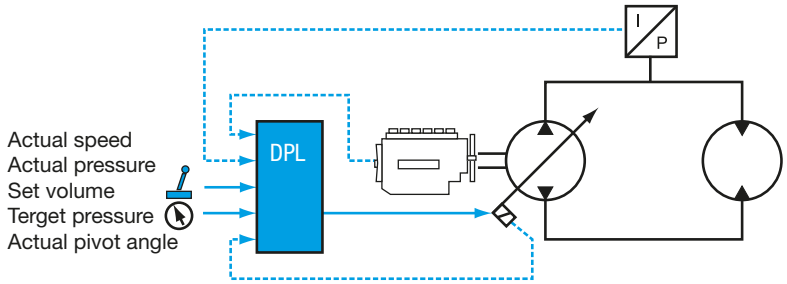
In normal operation, the pressure limit is set analog. Below the pressure limit, the pressure limiter operates as a normal proportional booster for hydraulic axles Accordingly, the specified set values are read in by set value generators or superordinate controllers or sensors, and converted to proportional currents for controlling the solenoids of pumps. When pressure limitation is activated, the volume and thus the pressure are regulated according to the set pressure value and calculated pressure set value, when the actual pressure value exceeds the pressure set value.
The DPL can also be operated as a pressure regulator. In this operating mode, a limiting value for the volume is set and the pressure set value is varied analog. Below the limiting volume, the DPL then works as a pressure regulator.

The standard hardware platform for the pressure limiter is the HCB controller. 2 pumps can be controlled bidirectionally. If the DPL is to be integrated into a machine controller, it can easily be ported to another Völkel hardware platform.
A special feature of the pressure regulator mode of operation is that only the high pressure A is measured. A control strategy has been implemented which allows a pump to be controlled through zero in the opposite direction when back pressure generated by the hydraulic motor. The controller is therefore particularly suitable for winches in shipping, where the rope must always be kept in tension even in swell or currents (mooring system). An additional frequency input for each axle makes it possible to detect and compensate speed fluctuations of the drive unit in order to keep the desired volume flow constant. The pump swivel angle can be captured and controlled when the pump is to be driven very precisely through zero, even when the volume flow is to be controlled very precisely or very precisely and quickly, and even with small set value changes.

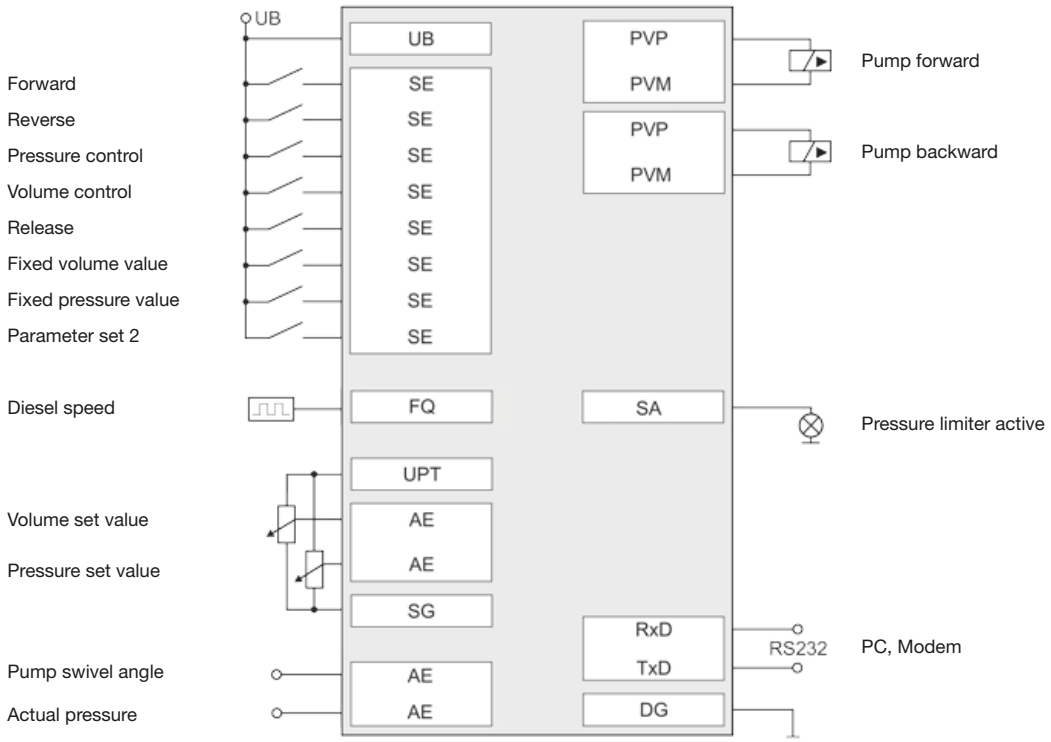
In normal operation, the DPL is used, among other things, in drilling rigs where, for example, the pressure on the drill bit is to be limited. It is used as a pressure regulator in anchor winches, for mooring control, etc.

Inputs and outputs

- Digital inputs can be parameterizable as required by the application to enable various functions, ramp selection, set parameter switching, fixed values for volume, fixed values for pressure, reversal of direction, etc.
- Frequency inputs for the detection of the actual diesel engine rotary speed per axle
- Analog inputs for the analog volume and pressure set value and the actual pressure value per axle
- Proportional outputs with current feedback measurement for 2 pumps forward/reverse
- „Limitation active” output status



Pressure limiter DPL [connection example]



Standard pressure limiter

HCB-DPL
2 axles with 2 solenoids
Pressure limitation and pressure regulator

Position controller PCB (Position Control Basic)

The position controller for one cylinder is suitable for simple positioning tasks in the hydraulics. It accelerates a hydraulic cylinder in the direction of a target position and keeps it within an adjustable target window after reaching it.

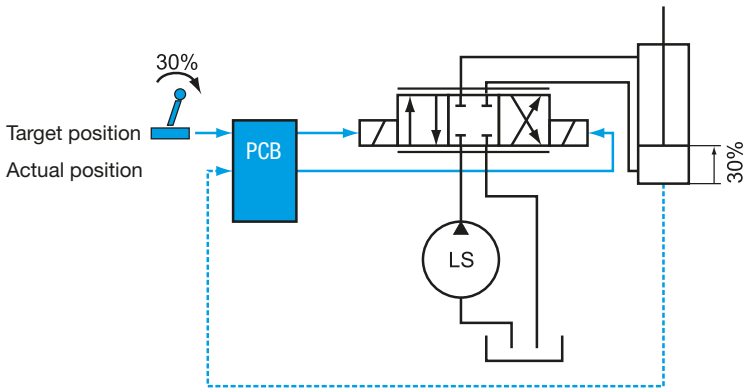
The standard hardware for this controller is the HCA controller, which can be used to control 2 solenoids. The PCB controller thus enables the positioning of a cylinder by means of a 4/3-way valve. The operating modes “Analog” and “Digital” are available, through which an analog variable set value is set and an adjustable digital fixed values is controlled. The control function is defined by means of parameterization.

If it is necessary to integrate the position controller into a machine control system, the porting to another Völkel hardware platform is easily possible. For example, several position controllers can level a vehicle support or interact with other control components..

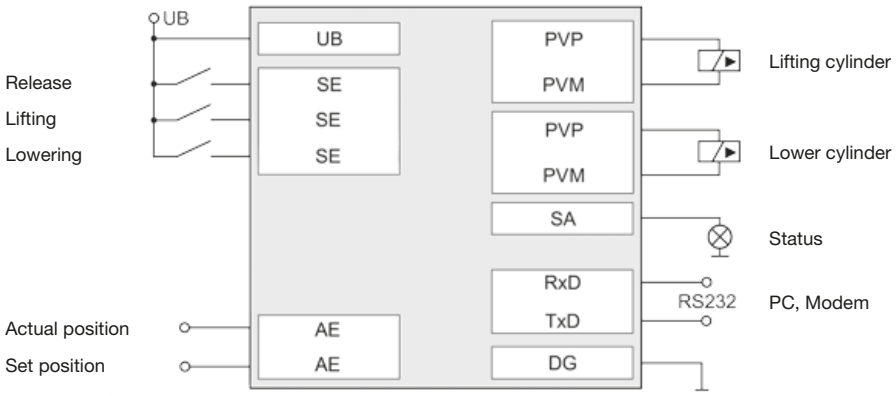
Possible applications are e.g. height control of a field sprayer, return of a wheel loader shovel to its starting position (return to dig), etc

Inputs and outputs

- Digital inputs, parameterizable for release, for manual lifting and lowering or with up to 4 fixed values
- Analog inputs for set value position and actual position value (4-20mA or 0-10V)
- Proportional outputs with current feedback measurement (cylinder extension and retraction)
- Status output for error messages or “In position”



Position controller PCB [connection example]



Standard position controller

HCB-PCB
1 axle with 2 magnets for cylinder positioning

Cylinder synchronous control CSC (Cylinder Synchronous Control)

The cylinder position and synchronization controller controls up to 20 cylinders with speed synchronism to reach position. Like the position controller PCB, the controller accelerates the cylinders in the direction of a target position and keeps them within an adjustable target window after reaching it.

The standard hardware for this controller is the HCB controller, which can be used to control 4 solenoids (two 4/3-way valves). If the CSC controller is to synchronize more than 2 cylinders then several controllers are networked via CAN bus. The operating modes “Analog” and “Digital” are available, through which an analog variable set value is set and an adjustable digital fixed values is controlled. The positions are approached via adjustable ramps. The maximum speed at which the machine moves into position can be set using an analog value.

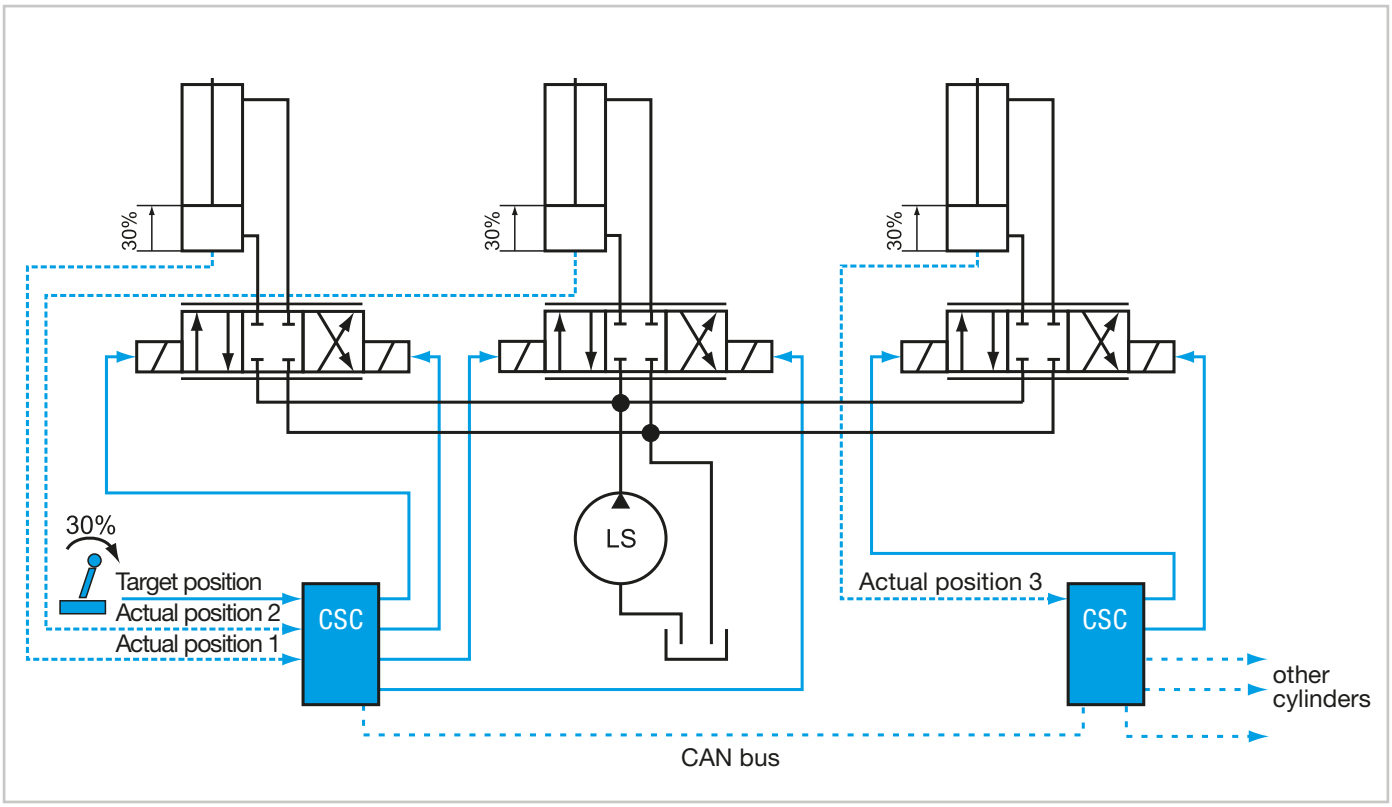
Another method to synchronize the position of more than 2 cylinders per controller is to port the function to another hardware platform. The same applies to the interaction of the CSC software with other Völkel standard controllers or the integration of the functionality into a Völkel machine controller.

The synchronization control replaces a hydraulic flow divider. It is easily possible synchronize cylinders, which have a large spatial distance to each other. In contrast to a fixed hydraulic installation, it is possible to move cylinders with different offsets towards each other. The advantage over purely hydraulic control is the variability of the control.

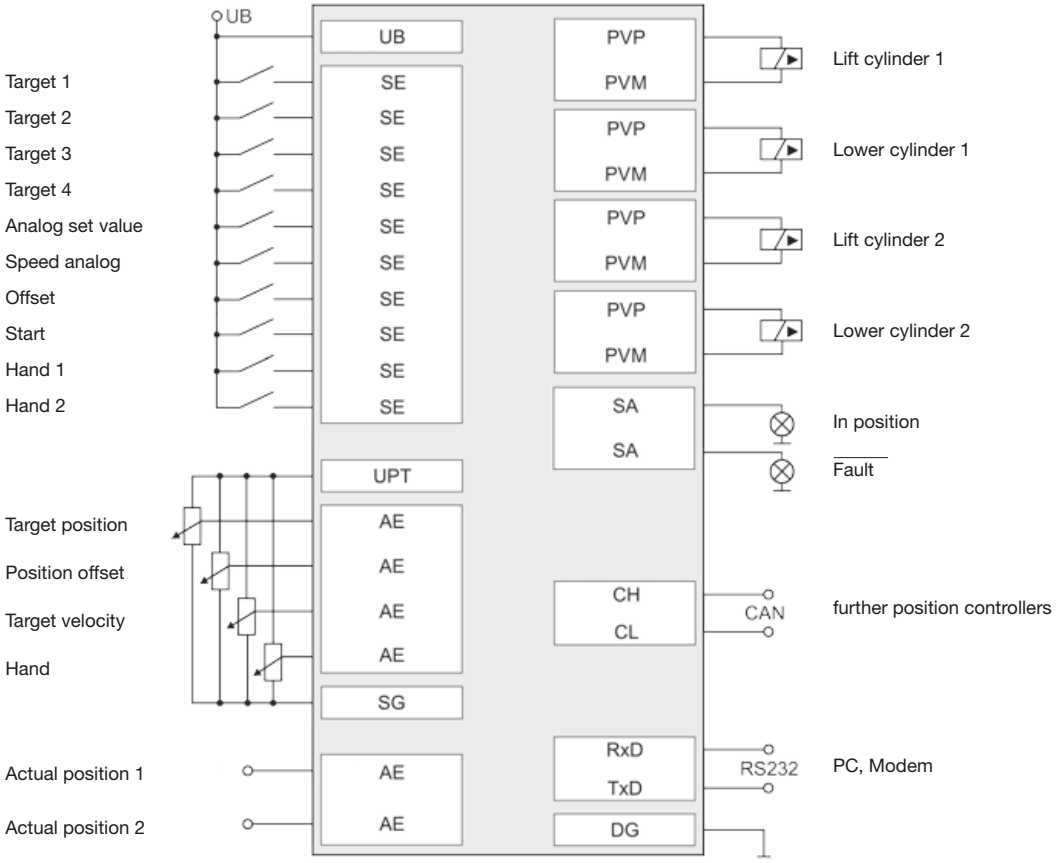
The synchronization controller is used as part of an electronic track rod (special control with steering angle-dependent offset), for lifting platforms, in material feeds with cascaded sliders, etc..

Inputs and outputs

- Digital inputs for mode changeover, for fixed values, manual operation. Can be parameterized as enabled for position control with fixed position difference between cylinder 1 and 2, allowing fine adjustment of the target position, etc.
- Analog inputs for the set values for position and velocity in manual operation, fine adjustment of the target position, actual position of cylinders 1 and 2
- Proportional outputs with current feedback measurement for 2 cylinders
- Status outputs, for the display of input/output faults, position errors, in position, limitation On/Off active
- CAN interface for communication between the axles



Cylinder synchronous control CSC [connection example]



Standard cylinder synchronization control

HCB-CSC
2 axles with 2 solenoids per controller. Synchronization of up to 20 cylinders

Speed controller MSC (Motor Speed Control)

The speed controller controls or regulates the speed of a hydraulic motor depending on the parameters set. An analog value (from a higher-level controller) or a frequency signal (speed) can serve as the set value source. A trim factor can be infinitely adjusted between set value for speed and actual speed.

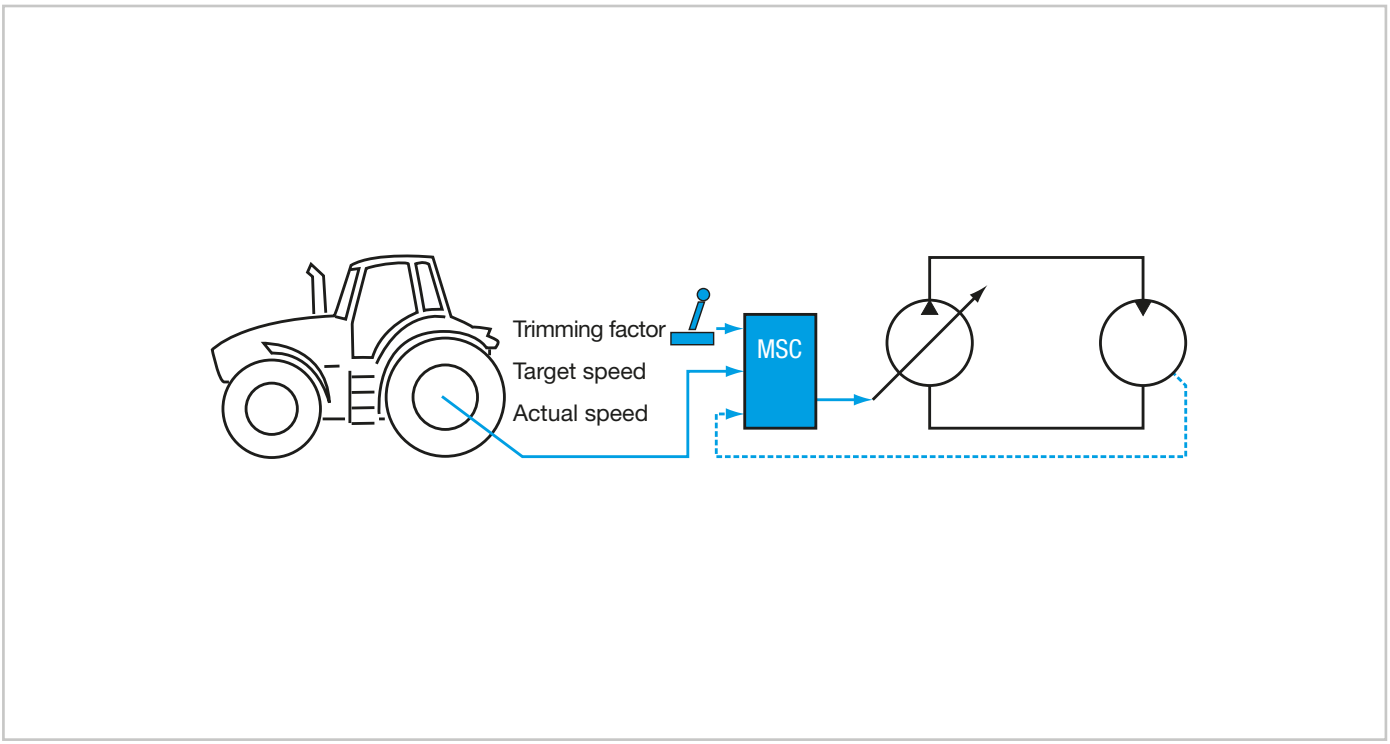
The standard hardware for this control is the HCA controller, which can be used to control 2 solenoids. The MSC control enables the unidirectional control of a pump.

If it is required that the speed controller interacts with another function, it is easily possible to port the function to another hardware platform. An example is the synchronization of a winch with a traction drive for off-road vehicles or with a cylinder function (davit in shipbuilding).

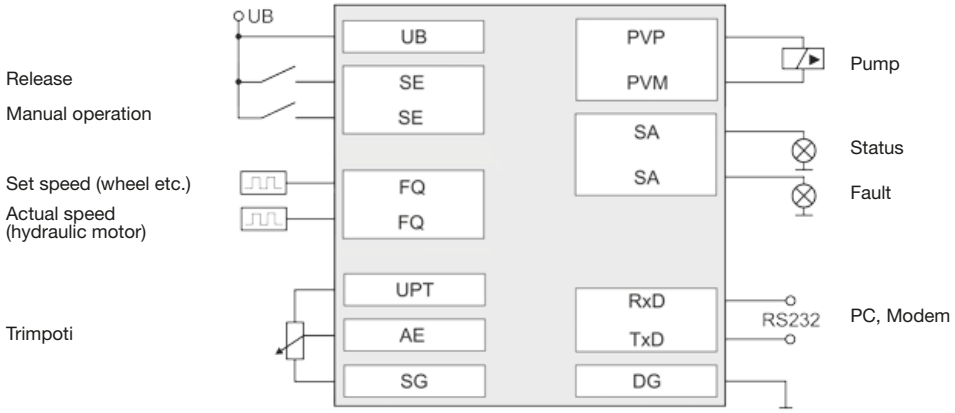
The speed controller is used for speed-dependent spreading of materials (e.g. forage, fertilizer and winter road services), for the synchronization of conveyor belt drives, etc.

Inputs and outputs

- Digital input for enabling, changeover Manual operation
- Frequency inputs for the target and actual speed of the hydraulic motor
- Analog input for the trimming factor or the set value setting in manual mode
- Proportional output with current feedback measurement for a proportional valve
- Status outputs for fault diagnosis



Speed governor MSC [connection example]



Standard speed controller

HCB-MSC
1 axle with 1 solenoid for speed control. Set value setting per analog or frequency input

Speed controller with diesel motor speed compensation MEC (Motor Speed Control with Engine Compensation)

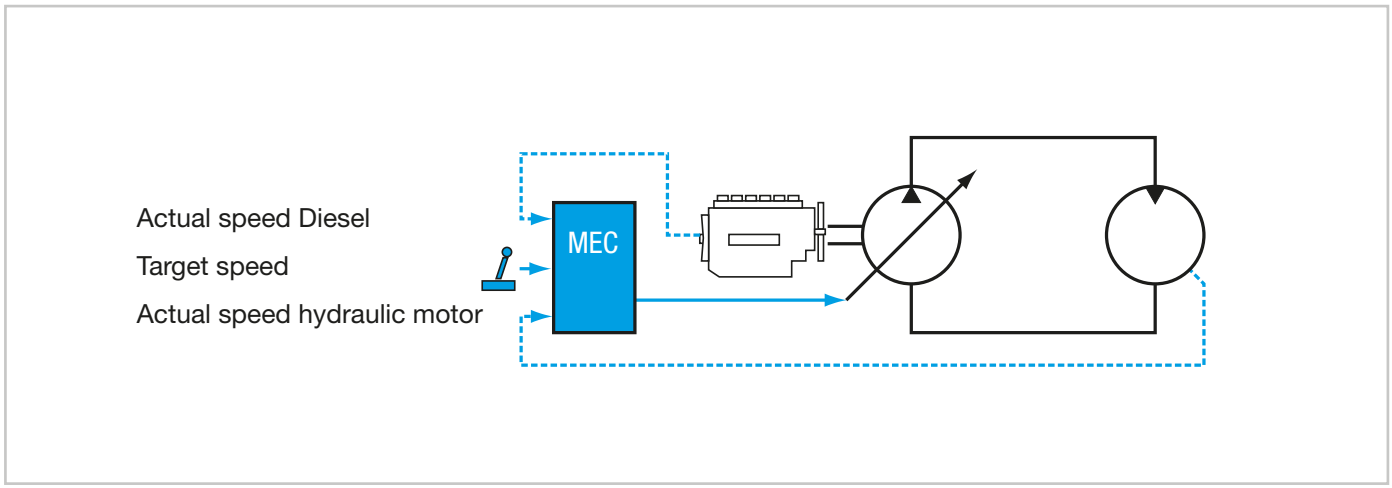
The speed governor with diesel motor speed compensation is a further development of the simple speed governor and was developed for a highly constant hydraulic motor speed with a strongly fluctuating drive motor speed. The correction of the diesel speed disturbance variable takes effect upstream of the speed controller so that the speed controller is unburdened. The Hydraulic motor speed set value is set either analog (e.g. by means of a set value generator or a higher-level control system) or digitally as a fixed value.

The standard hardware for this controller is the HCB controller. It controls a pump unidirectionally. The diesel motor can be connected via CAN bus (SAE J1939), terminal W or magnetic pickup. If it is connected via CAN bus, faults in the diesel engine can also be displayed via a switch output. If the MEC is to be integrated into a machine controller, it can easily be ported to another Völkel hardware platform.

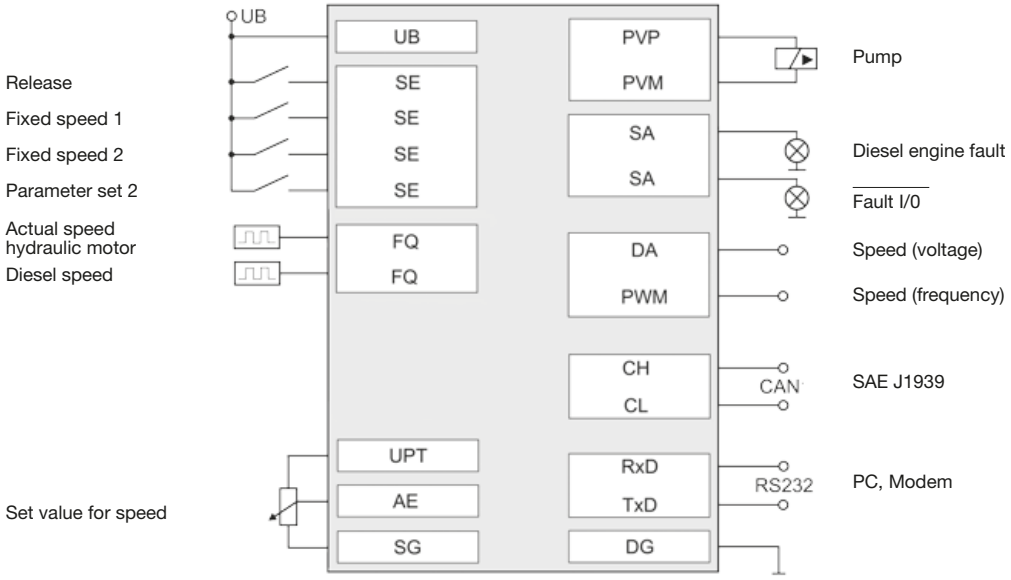
The MEC is used in machines where a highly constant control of the hydraulic motor speed is required. These are, for example, vacuum turbines in sweeping machines. A fluctuating turbine speed would result in a sawing noise that would not be accepted in cities. In addition, the turbine efficiency is best at the rated speed. Another application is truck-based power generators (fire brigade, rescue services, etc.), where a fluctuating generator speed would result in a fluctuating frequency.

Inputs and outputs

- Switching inputs to enable parameter set switching and for fixed values
- Frequency inputs for the actual diesel speed and hydraulic motor
- Analog input of the set value for the hydraulic motor
- Proportional output with current feedback measurement for the hydraulic pump
- Status outputs for fault management
- Voltage output for display of the hydraulic motor speed
- Frequency output for display of the hydraulic motor speed
- CAN interface for alternative speed measurement of the diesel engine via SAE J1939



Speed controller with diesel engine speed compensation MEC [Connection example]



Standard speed controller with diesel engine speed compensation

HCB-MEC
1 axle with 1 solenoid for unidirectional speed control with one pump, diesel engine speed compensation

Limit load control DAS (Dynamic Anti-Stall Control)

The limit load control is a flexible solution for protecting the diesel engine against overload. The entire controller behavior can be adapted to the machine.

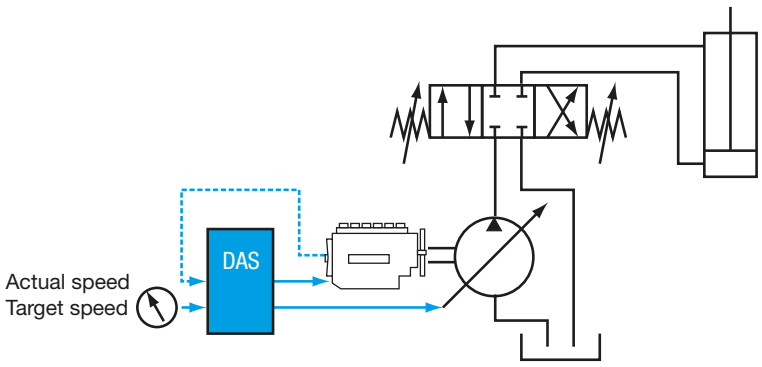
By means of limit load control, a machine can be developed leaner and used more effectively. Limit load controllers in excavators also contribute efficiently to vibration suppression of the drive train.

The standard hardware platform for the DAS is the HCB controller. The speed of the diesel engine is variably set via the control via CAN bus (SAE J1939 protocol). The controller reads in the actual speed of the diesel engine via CAN bus, terminal W or magnetic pick-up, evaluates the pressure and limits the hydraulic pump directly via the proportional output according to its load.

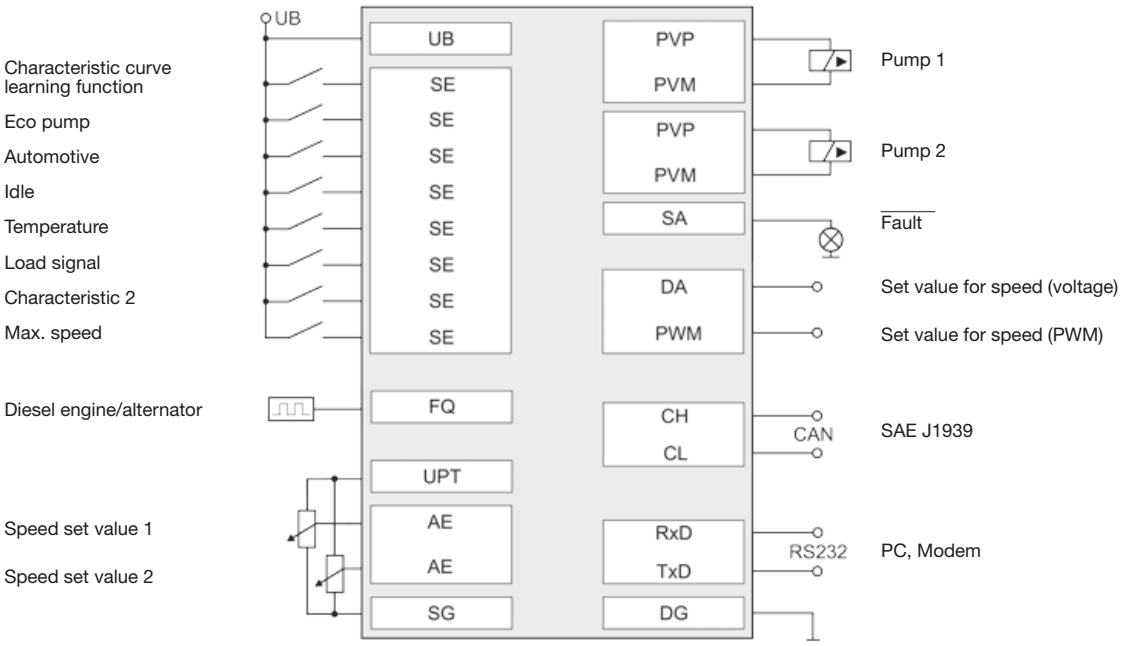
This load limit controller has been specially developed for excavator applications where a very high dynamic control response is required. Limit load controllers in general are an integral part of many Völkel control systems: They are, for example, not only a component of every drive control system but also of many machine control systems, some of which prioritize the power consumption per actuator and work situation. Compared to such integrated limit load controllers, the DAS is highly dynamic.

Inputs and outputs

- Digital inputs for switching between working, automotive and economy mode, for reducing idling speed, for temperature switches and for enabling learning functions
- CAN interface SAE J1939
- Frequency inputs dedicated to terminal W and a magnetic pickup
- Analog inputs for set value setting
- Proportional outputs with current feedback measurement for the control of 2 pumps
- Alarm output
- PWM and analog output set speed



Limit load control DAS [Connection example]



Standard limit load controller

HCB-DAS
Limit load controller for
diesel engines of all kinds

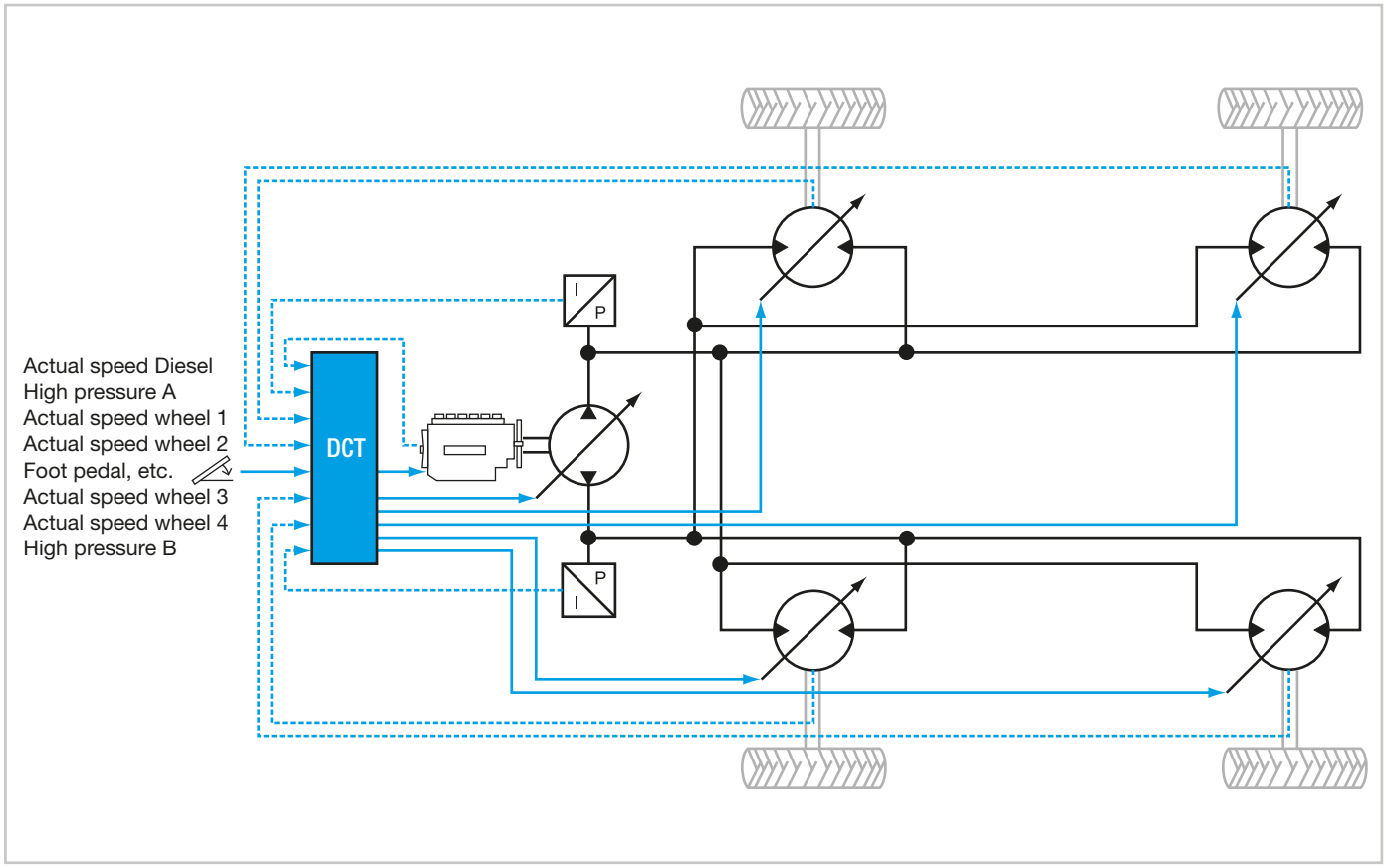
Drive controls

Völkel drive controllers offer six expansion stages as standard for drives in closed and open circuits. The smallest expansion stage permits the adjustment of a large mechanical component such as a diesel engine via a Bowden cable or hydraulic load limit controller. The larger controllers, on the other hand, are consequently designed to reduce the number of hydraulic components to a minimum while at the same time providing extended functions via software.

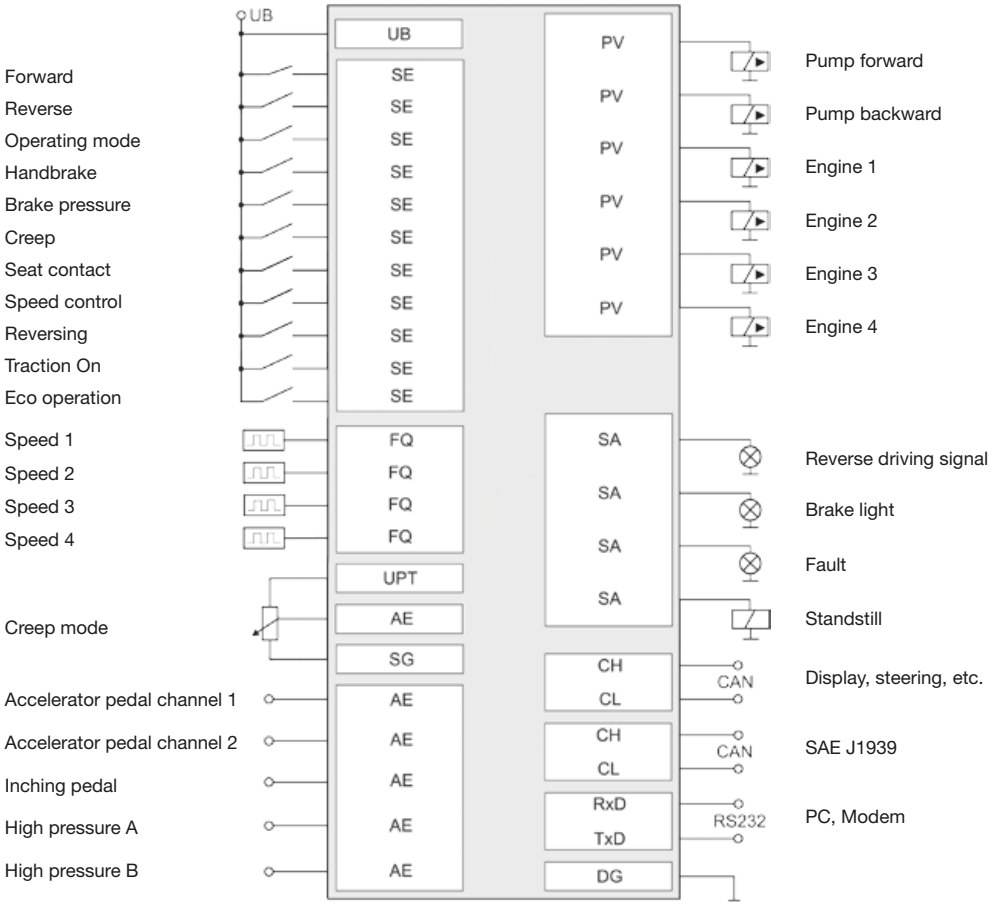
Possible extended functions

- Operating modes “work” (fixed diesel engine speed) and ”transport” (variable diesel speed) with several parameter sets and limitation sets per mode
- Adjustable to different conditions
  Ramps for acceleration, deceleration and braking
- Dynamic adaptation of drive ramps to driving behavior
- Adjustable drive curves (start of adjustment, end of adjustment, curvature)
- Parameterizable number of pumps and/or motors (closed loop) or proportional valves (open circuit)
- Inching: reduced driving speed with high diesel engine speed
- Creep mode: limitation of the maximum driving speed for more responsive driving
- Diesel(bedarfs)management zum Betreiben der Maschine im optimalen Arbeitspunkt und zur Reduzierung des Verbrauchs. Ansteuerung des Dieselmotors via CAN-Bus (SAE J1939)
- Speed controller
- Traction control
- Constant pressure regulator for maintaining tractive force on slopes
- Brake pressure control as a function of the engine displacement
- Limit load control
- Protection of the diesel engine from overspeed
- Autopilot for tracked vehicles
- Communication with displays and/or superordinate control systems via CAN bus (set value setting, actual value display, diagnosis, etc.)
- Further functions are programmable

Schematic representation of drive control with traction control



Drive control with traction control [connection example]



HCB-DCB (Drive Control Basic)

Simple control for basic driving functions. Different modes. Drive as a function of diesel engine speed, control of variable displacement pump and engine. Limit load control

HCB-DCE (Drive Control Eco)

Like HCB-DCB + speed, brake pressure, constant pressure regulator. Overspeed governor, Eco operating modes

HCE-DCT (Drive Control Traction)

The same as HCB-DCE + anti-slip control for 4 wheels during acceleration and deceleration. Coupling operation of several vehicles

HCB-CCB (Crawler Control Basic)

Simple track control for basic driving functions with different modes. Drive as a function of diesel engine speed, control of 2 variable displacement pumps, limit load control

CCP (Crawler Control Professional)

Equivalent to HCB-CCB + regulation of speed, brake pressure, constant pressure, overspeed, eco operating modes and with preparation for steering via GNSS

Steering controller SCB

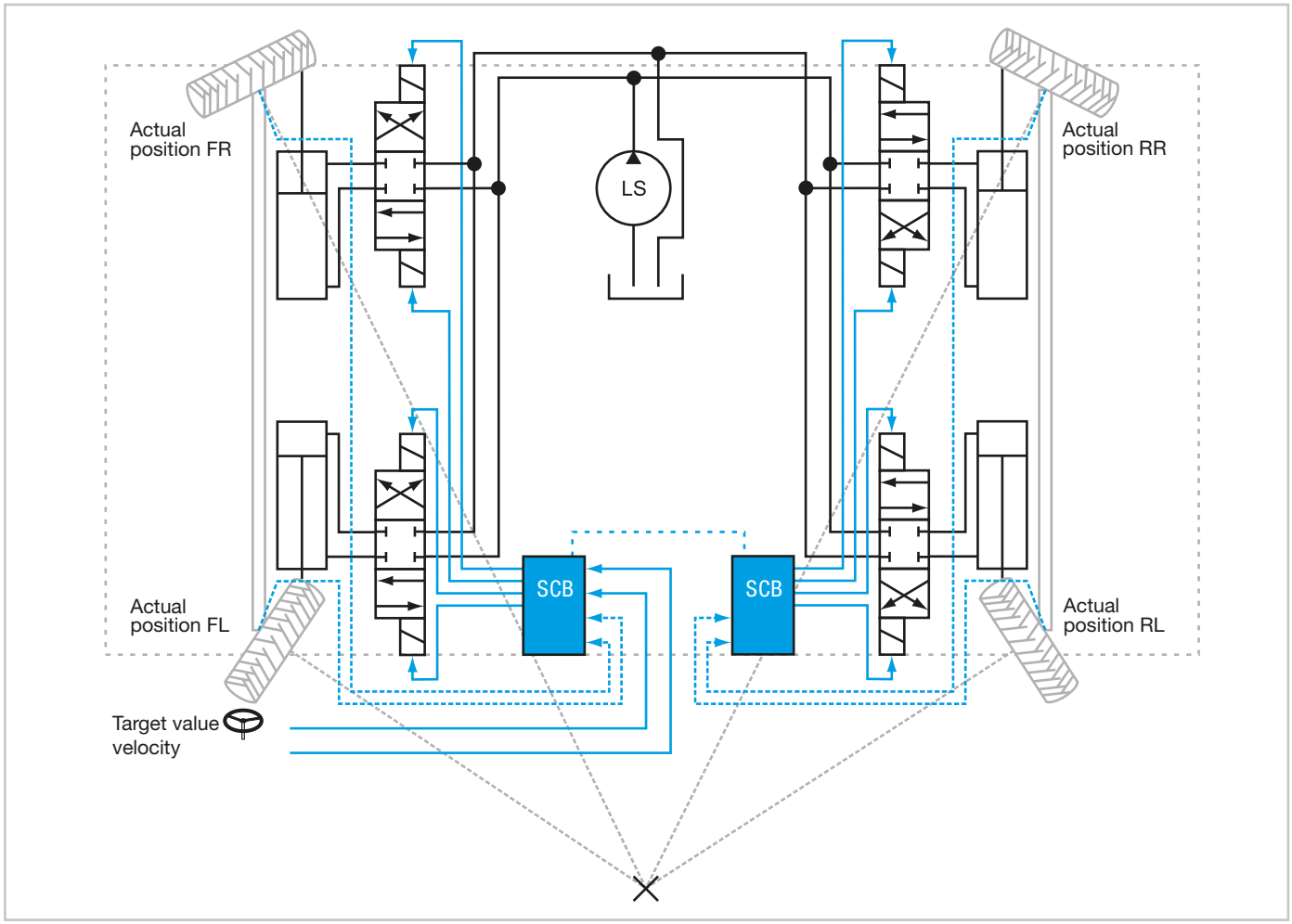
The steering control provides a universal steering system for an axle with two wheels. Several controllers can communicate with each other via CAN bus, so that up to 4 axles can be steered. The steering set value can be set via incremental rotary encoders (electronic steering wheel), absolute rotary encoders (set value from front axle or drawbar), via joystick or via digital inputs..

Possible extended functions

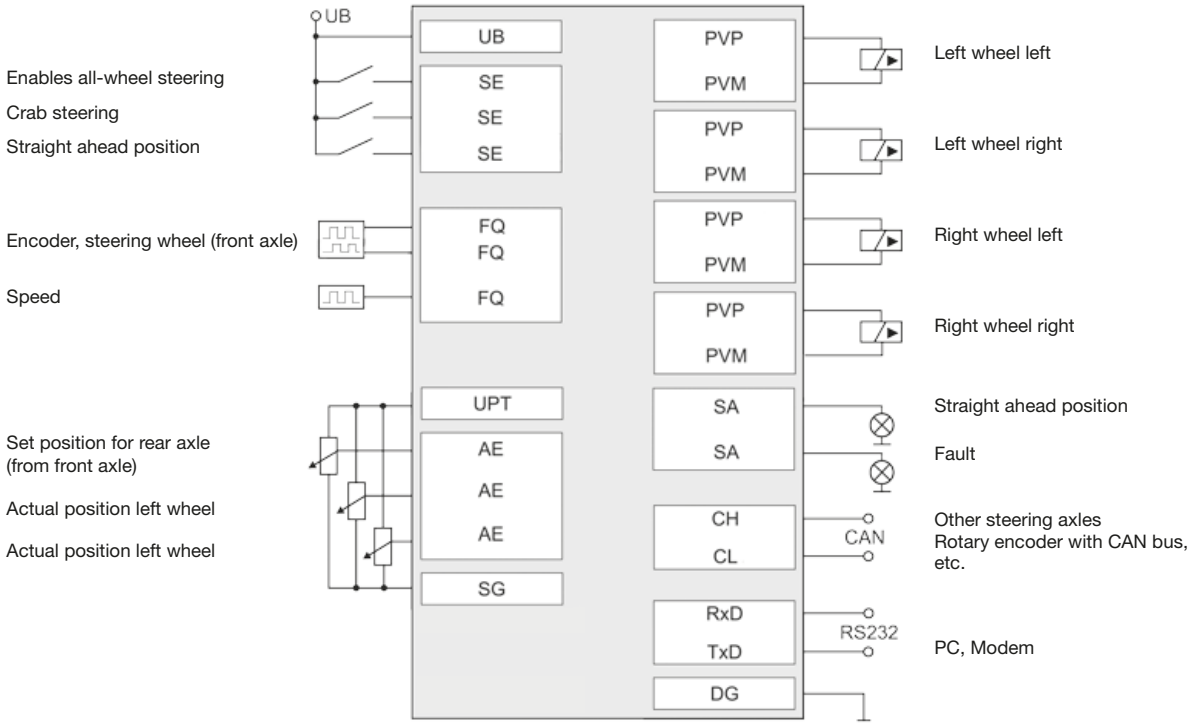
- Steering with the Ackermann algorithm, in which all wheels are positioned tangential to a circle center point to reduce the turning circle
- Tramline functions, in which all wheels, including those of the hitched equipment drive in the same track and thereby protect vegetation
- Crab steering, in which all wheels are adjusted to be parallel to move the vehicle sideways
- Speed-dependent limitation of the steering angle
- Switchable steering: only front axle only or only rear axle

Inputs and outputs

- Digital inputs, parameterizable as enabled, Ackermann algorithm, crab steering, follow track, straight-ahead, reversal of driving direction
- Frequency input for drive speed (alternatively via CAN bus)
- Frequency inputs are evaluated as rotary encoders input for a steering wheel (with encoder output)
- Analog inputs for target steering angle, actual steering angle
- Proportional outputs with current feedback measurement for control of the steering cylinders
- Status outputs, can alternatively be used to display fault, end stop left or right, straight ahead position



Steering controller SCB [connection example]



Standard steering controller

HCB-SCB
Steering control for all-wheel drive, auxiliary and trailing steering

PC software ConDoc®

The PC software ConDoc® - Control&Document® is a powerful diagnostic and service program that can be used universally for all Völkel controllers. It supports parameterization, is used for analysis and documentation of the control behavior and functions both stationary and via modem (remote diagnosis). The use of ConDoc® reduces service costs and downtimes in the event of malfunctions.

ConDoc® Functions

Parameterization of a controller before and during operation

The user navigates and changes parameters using mouse or keyboard. With “online” settings, the effects can be observed immediately. This enables a targeted and fast procedure.

Saving and loading the Controller configuration in files

With a simple data backup the exactly defined values are available for documentation and reproduction. Restoring the stored file to the same or another identical controller ensures data consistency and short commissioning times.

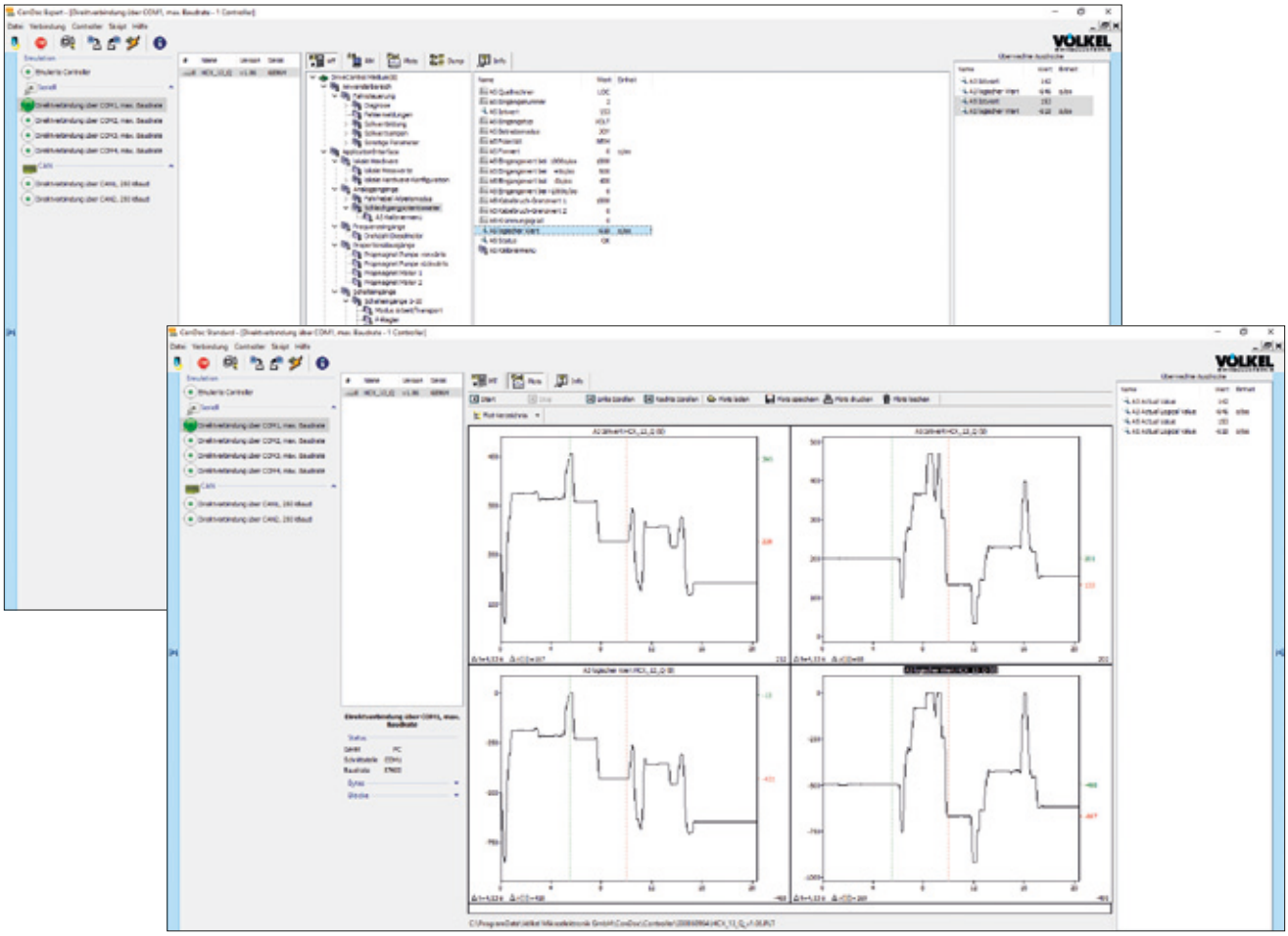
Display of operating variables of a controller

The data is stored as a numerical value and - in the temporal sequence - shown as a diagram in real time [10 ms grid]. The diagrams - with up to 50 variables per plot - can be saved, reloaded and printed.

Remote diagnosis

The direct connection from the controller to the PC is replaced by a telephone connection and modems. GSM modems can also be used for the adjustment of mobile machines.

PC software ConDoc®



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