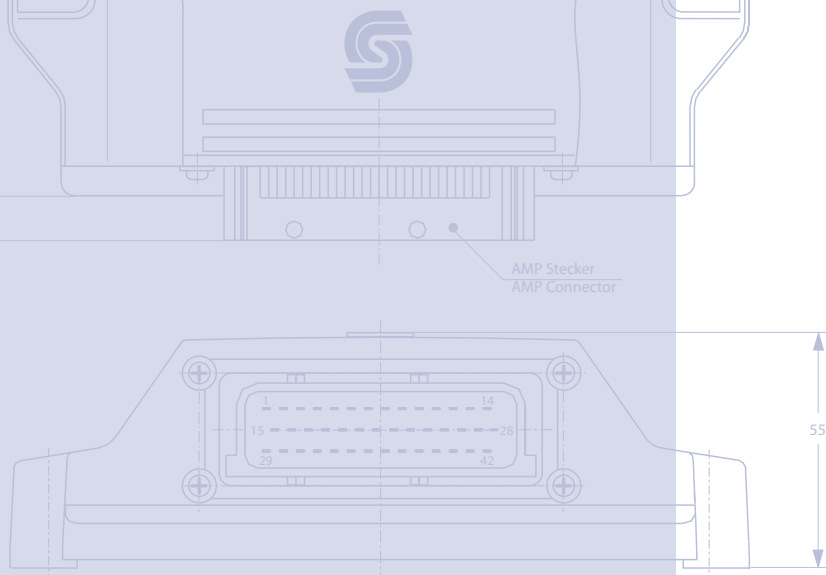
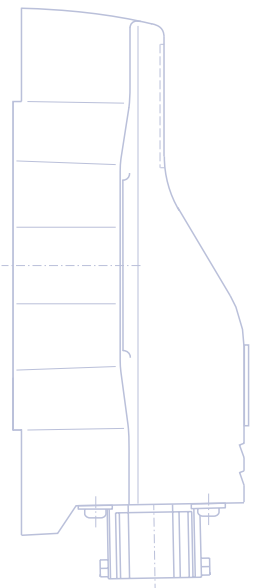
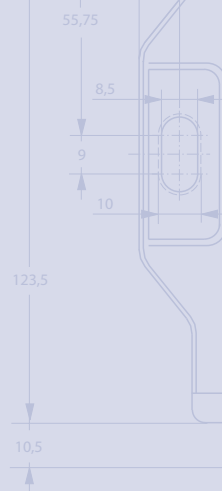
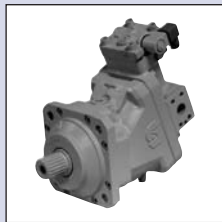
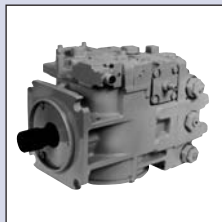


System Description



DESCRIPTION

The Sauer-Danfoss **NFPE (Non-Feedback Proportional Electric)** System for Automotive Applications using NFPE Pump only, Two Position or Proportional Controlled Motor combines the future-oriented technology of the Off Highway Digital Electronic Control with Sauer-Danfoss's proven axial piston pump technology.

The S1X mobile computer combines enhanced control performance with a flexible control scheme. The controller converts engine speed to an automotive drive signal to control the non-feedback proportional axial piston pump. Also, the controller supplies a speed dependent control for a two position controlled motor or electric proportional control for a bent axis motor. With easily changeable control parameters, it is possible to tailor the vehicle's driving behavior to the individual requirements of the machine.

Two important features of the Sauer-Danfoss control system are the integral park brake control, which is an essential part of the success of the HST in the forklift truck market and the integral motor control which provides an automatic shift of two position or proportional motors. With this control the HST motor always starts at maximum displacement.

FEATURES

- Selectable driving behavior (setting different parameters) with service tool software.
- Engine overspeed protection (inch mode).
- High propel speed at low engine speed. Less noise emission.
- Two automotive control curves (selectable via mode switch).
- Electronic ramps instead of orifices.
- Less oil viscosity sensitivity.
- Easy start-up procedure during production if needed.
- Integral park brake control (no downhill rolling).
- Integral two position motor control (motor starts at max. displacement).
- Integral motor control (electric proportional control "J3").

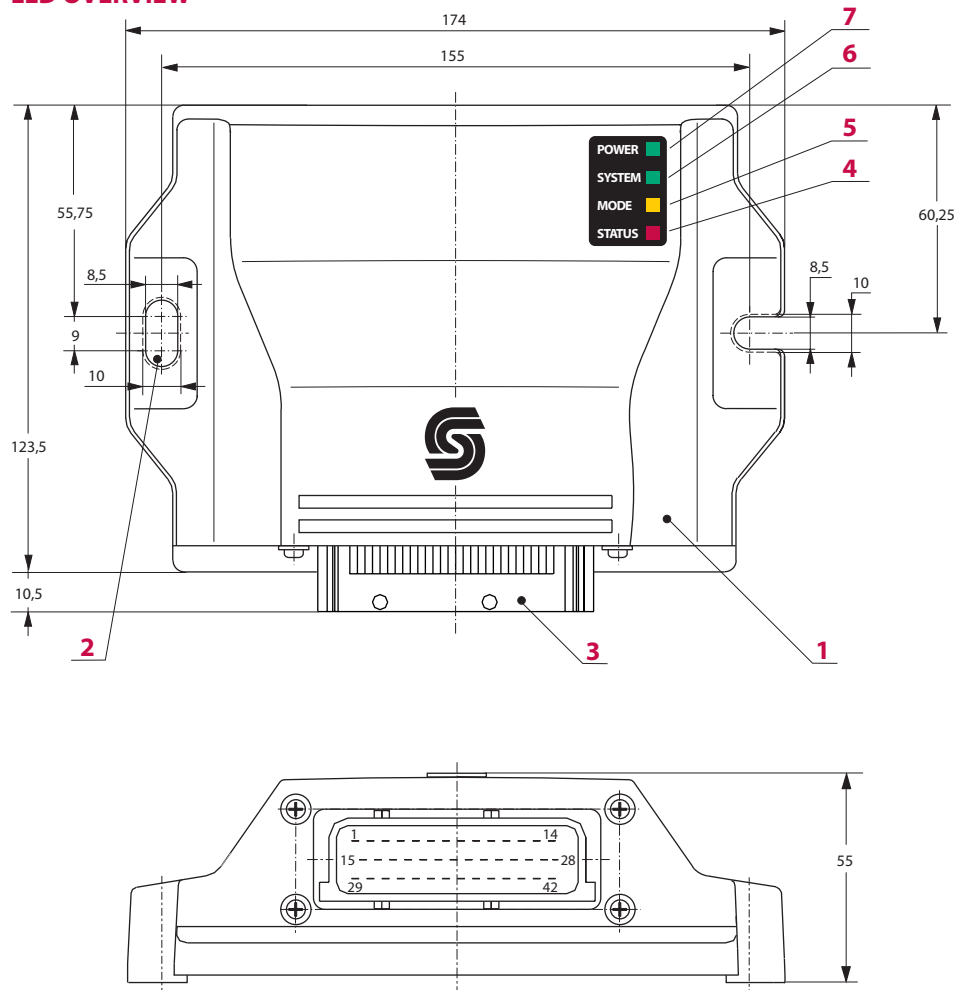
SYSTEM COMPONENTS

- Series 42 or Series 90 NFPE axial piston pump
- Series 51 or 51-1 bent axis motor
- Series 51 bent axis motor with J3 or J4 control
- S1X NFPE Mobile Computer
- Inch Pedal KEPA14161 (791681) - Optional
- Inch Sensor MCX103B1043 (724666) - Optional note rotation and polarity
- High speed axial piston motor plus axle or CAM motors

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LED OVERVIEW



1 S1X

2 Mounting slots

3 AMP connector

4 Diagnostic LED **red**
(STATUS)

5 Diagnostic LED **yellow**
(MODE)

6 Diagnostic LED **green**
(SYSTEM)

7 Diagnostic LED **green**
(POWER)

Error check

Lights up if an error is detected.

Software check

Flashes with approx. 0.5Hz (slow) if the program is running fine.
Flashes with approx. 5Hz (fast) if no program is loaded.
No flashing if in setup mode.

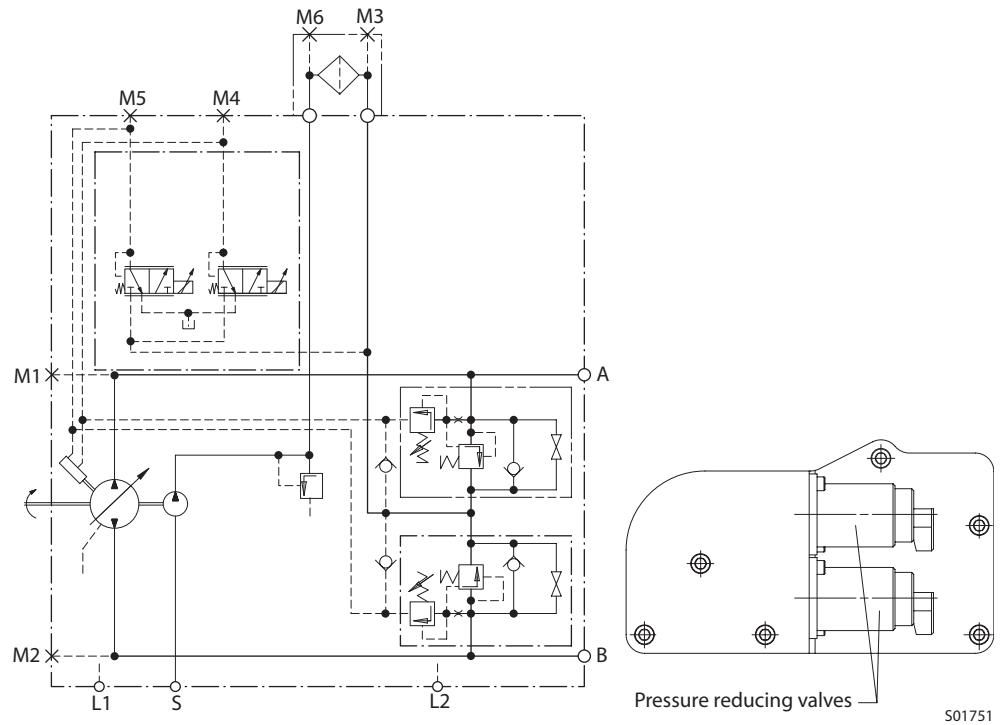
5V_{DC} internal

Lights up if 5V_{DC} internal is O.K.

Battery after ignition switch

Lights up if the battery voltage is connected after ignition.

NEW NFPE CONTROL BLOCK SERIES 90



CONTROL CHARACTERIS- TICS OF PILOT CURRENT TO THE NFPE

Figure 1: Example of pump automotive control curves

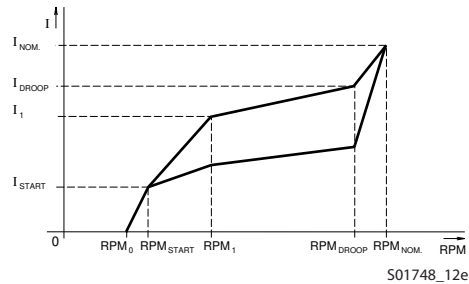


Figure 2: Example of proportional motor automotive control curve

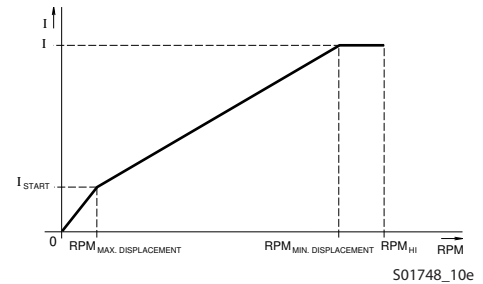
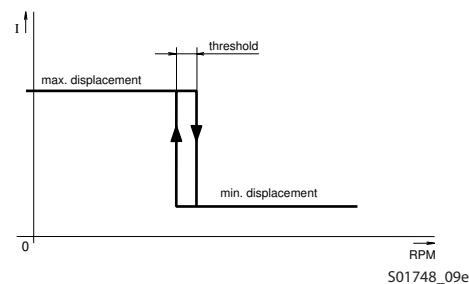
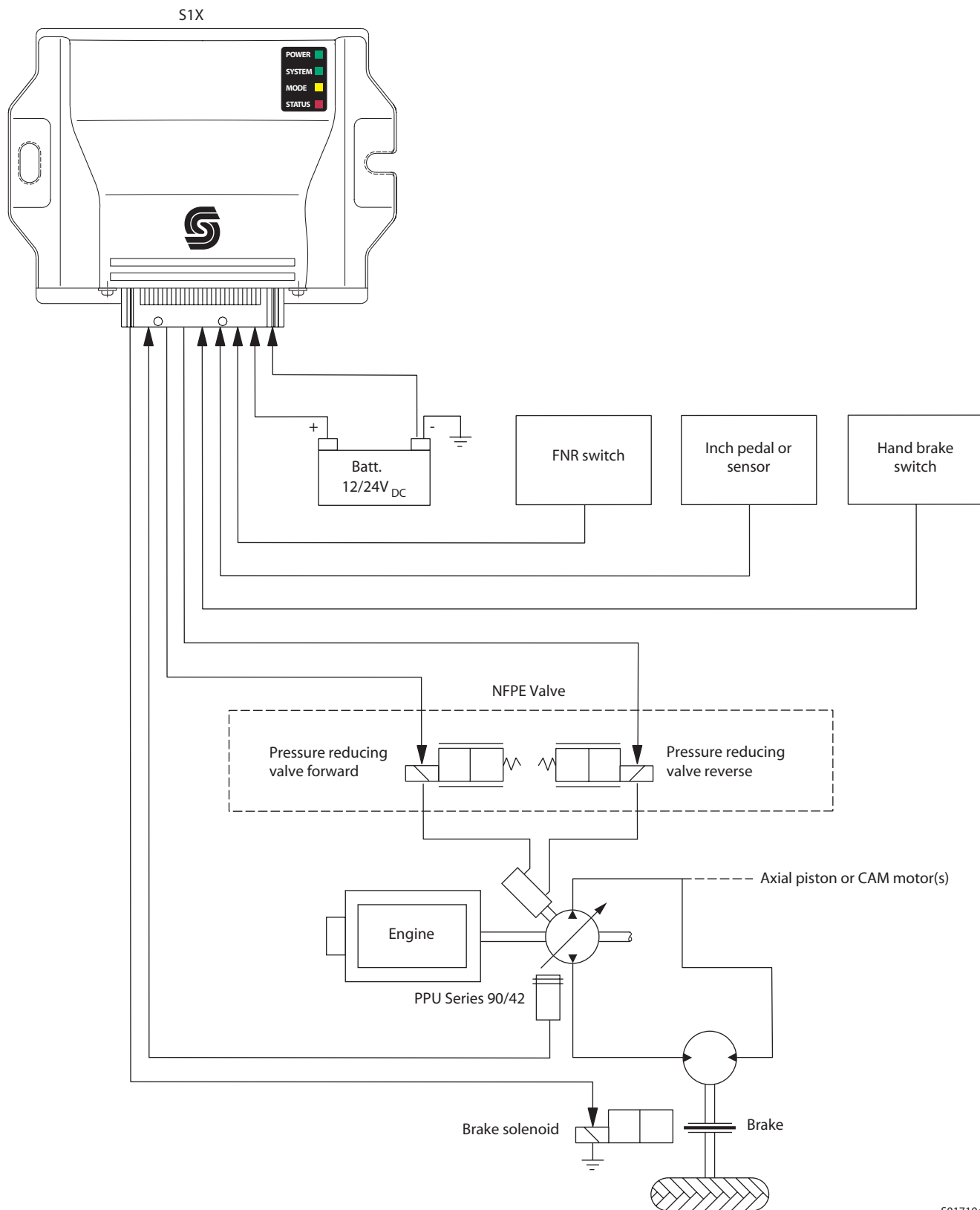


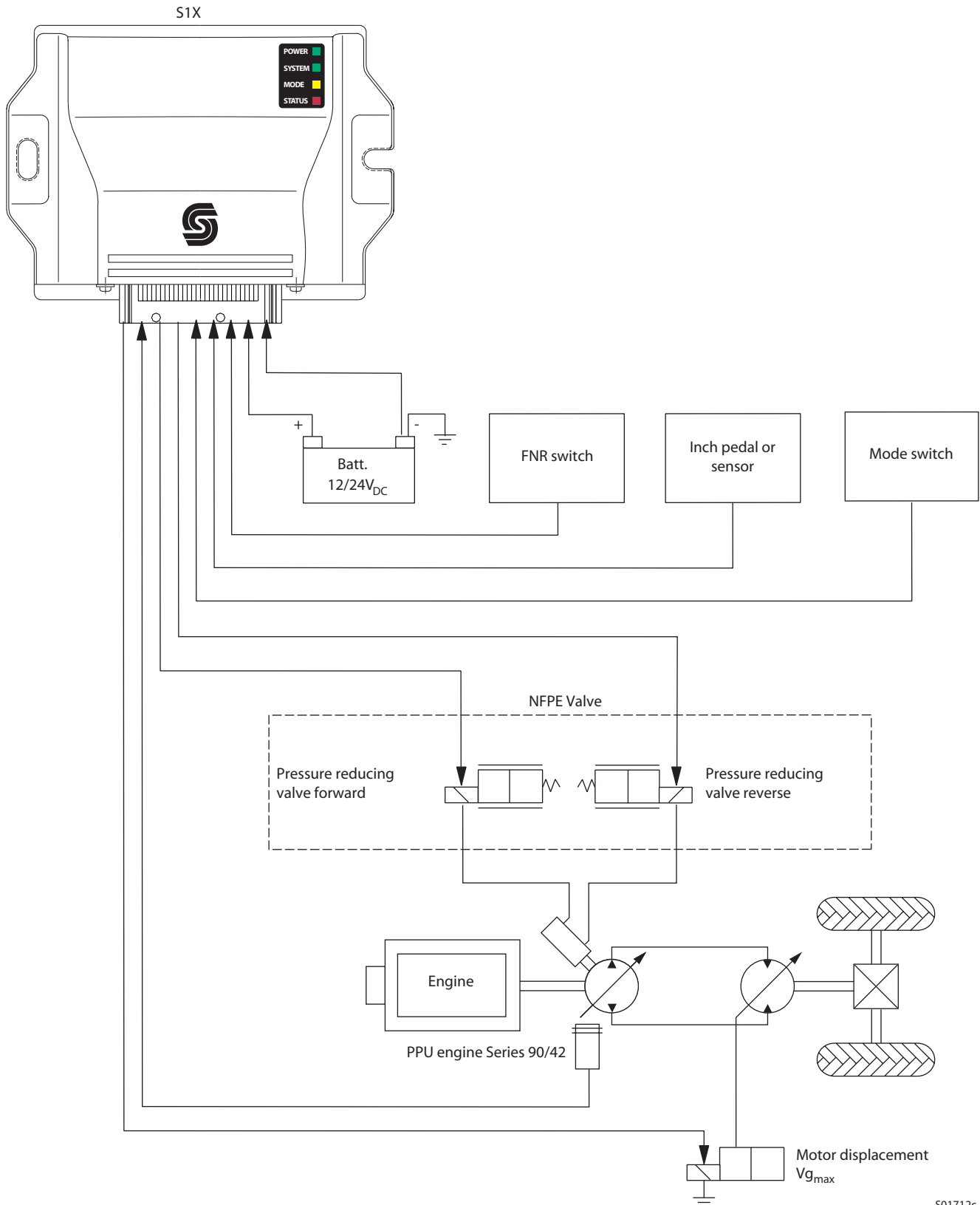
Figure 3: Example of two position motor control setting



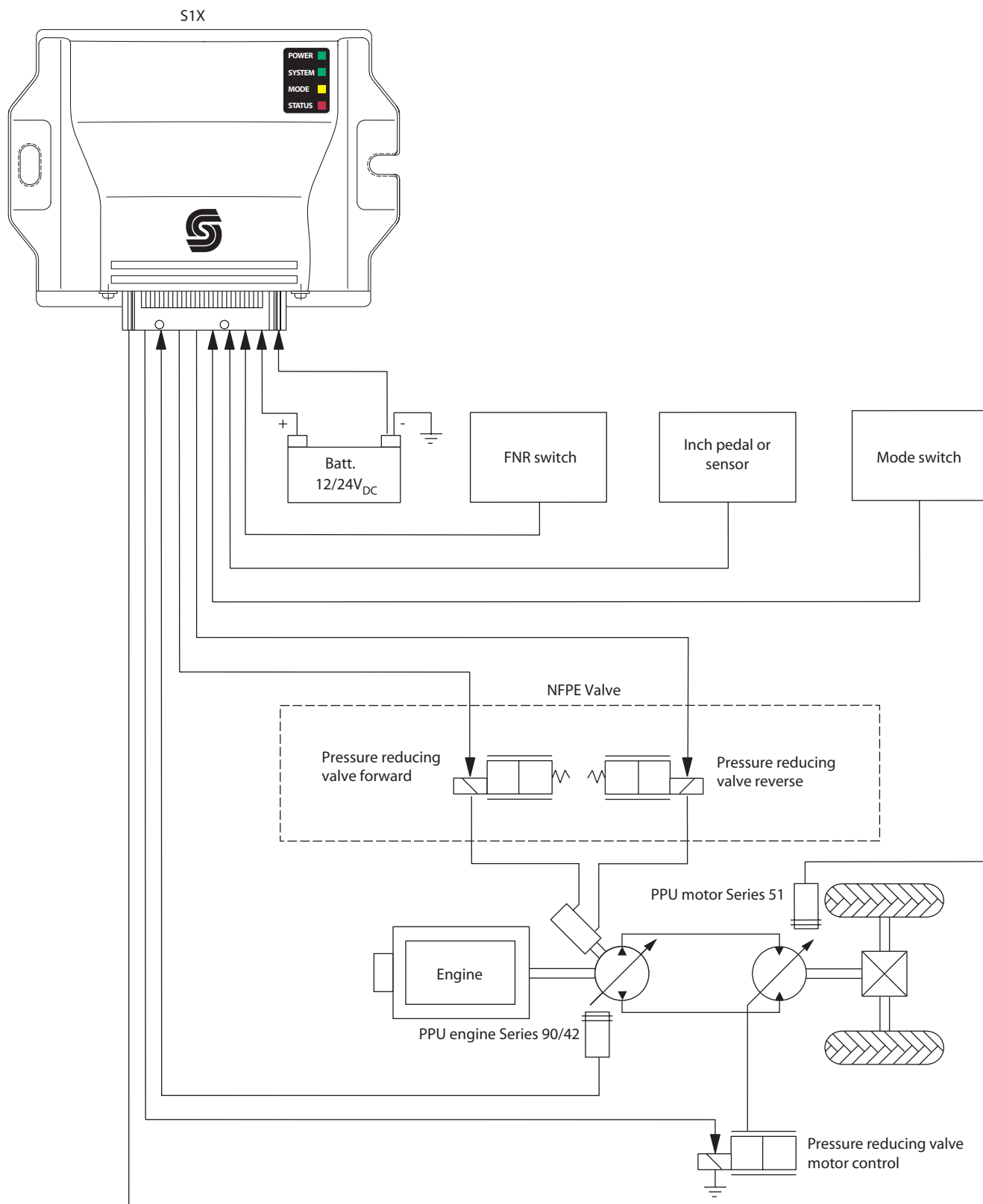
SYSTEM DIAGRAM EXAMPLE: PUMP AND FIXED MOTOR CONTROL



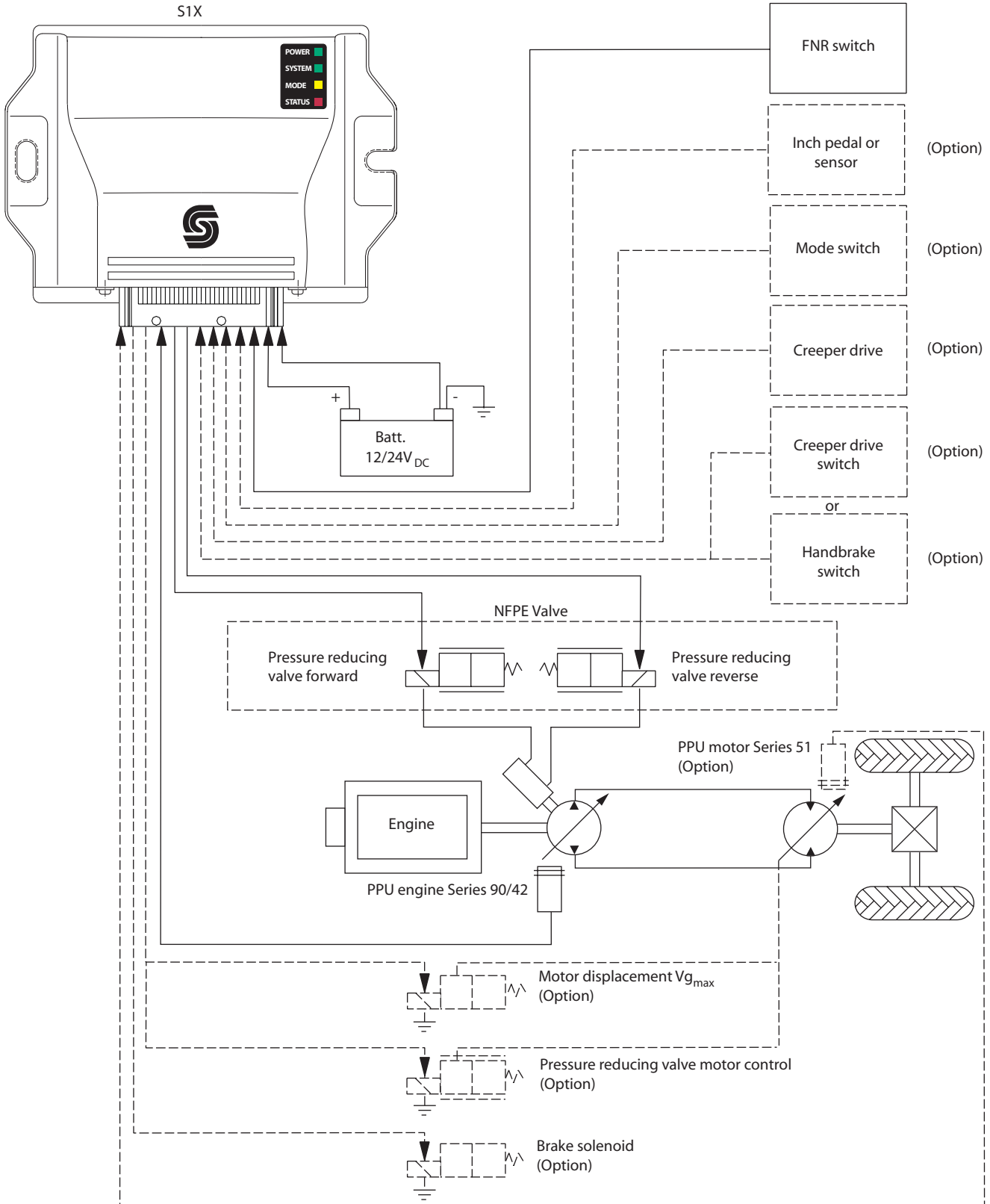
SYSTEM DIAGRAM EXAMPLE: PUMP AND TWO POSITION MOTOR CONTROL



SYSTEM DIAGRAM EXAMPLE: PUMP AND PROPORTIONAL MOTOR CONTROL



GENERAL SYSTEM DIAGRAM



S01765a

THEORY OF OPERATION

The Sauer-Danfoss S1X Mobile Computer controls the axial piston pump via (2) proportional pressure reducing valves. The automotive control curve is a function of the engine speed measured with the integral pulse pick-up on the pump.

Automotive Curve

The automotive curve has to be set according to the available torque characteristic of the combustion engine bearing in mind the need for additional auxiliary power. The curve can be optimized during the prototype phase via a laptop computer using the Sauer-Danfoss WinGPI.

FNR Switch

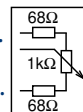
The driving direction is selectable with the FNR switch. A ramp is adjustable for reversing, switching to neutral and acceleration/deceleration.

Inch Pedal/Sensor

The inch pedal/sensor reduces the current to the pressure reducing valves which results in a destroke transmission pump. This function allows the operator to keep the vehicle propel speed low while raising the engine speed to meet the flow demand from the auxiliary functions. The inch sensor requires calibration during vehicle setup or a pre-adjusted sensor.

Note:

If a potentiometer is used, it should have a resistance value of $\geq 1 \text{ k}\Omega$ and $\leq 10 \text{ k}\Omega$. If there is a need for the whole range, then the potentiometer must have series resistors. The series resistors have to be approximately 7 % of the resistance value. The voltage of the analog input must increase if the pedal is pushed.



Engine Overspeed Protection

In case of engine overspeed while inching, the pump current is increased proportionally up to the max. value (adjustable: $\text{RPM overspeed}_{\text{START}}$ $\text{RPM overspeed}_{\text{END}} = 100\%$). In case of engine overspeed due to downhill driving (exceeding the braking performance of the engine) mechanical brakes are needed to protect the engine.

Park Brake Control

The park brake control operates an electrical ON/OFF solenoid to protect the vehicle from rolling in the neutral swashplate position of the axial piston pump. The control can be a function of the output current to the pressure reducing valves or of the inch pedal.

Two Position Motor Control

The control provides an automatic shifting of the two position bent axis motor. The switchpoint of the motor is a function of engine speed. The switchpoint for the motor has to be optimized during the prototype phase.

Proportional Motor Control

The control provides an automotive curve to control an electric proportional motor with a J3 or J4 control. The control curve is a function of the engine speed and is adjustable totally independent of the pump curve. The curves have to be optimized during the prototype phase. The control pressure of the motor (X1) is charge pressure (32 bar).

Mode Switch

Two different and independent automotive curves for the pump and motor can be selected by the mode switch, allowing for optimization of the driving behavior of the vehicle individually for both modes (work/transport).

Handbrake Switch

The handbrake input overrules the FNR signal. If the handbrake is activated, the system will go into the stop mode like switching the FNR to neutral.

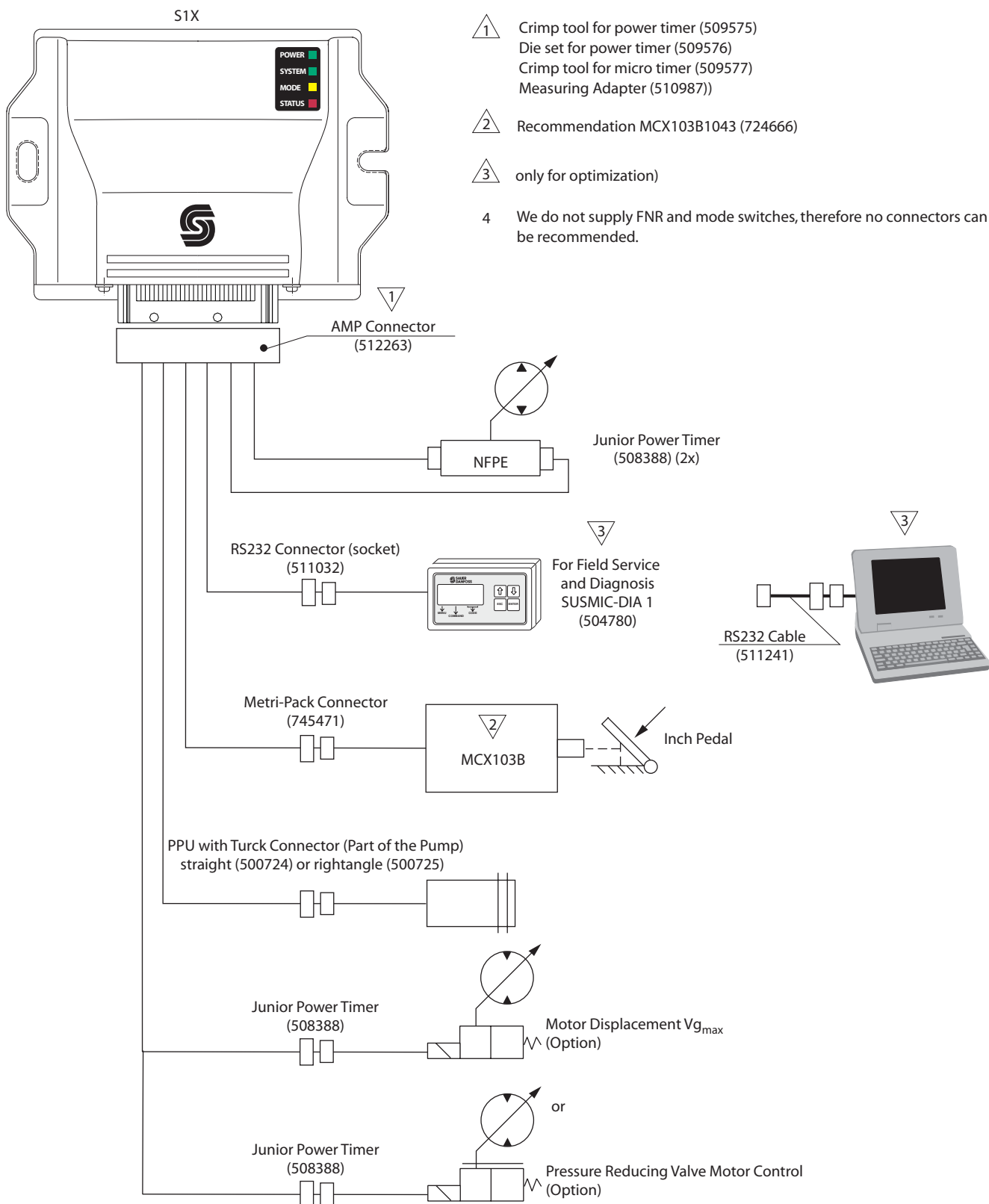
Creep Mode

The creep mode works similar to the inch pedal/sensor, but it will use the adjustable acceleration/deceleration delay times. The creep mode must be activated with a digital input. The system can recognize the activation in all conditions or only in neutral, depending on the configuration. The creep mode does not contain an engine overspeed protection and will only work if the engine is above an adjustable RPM.

Speed Limitation

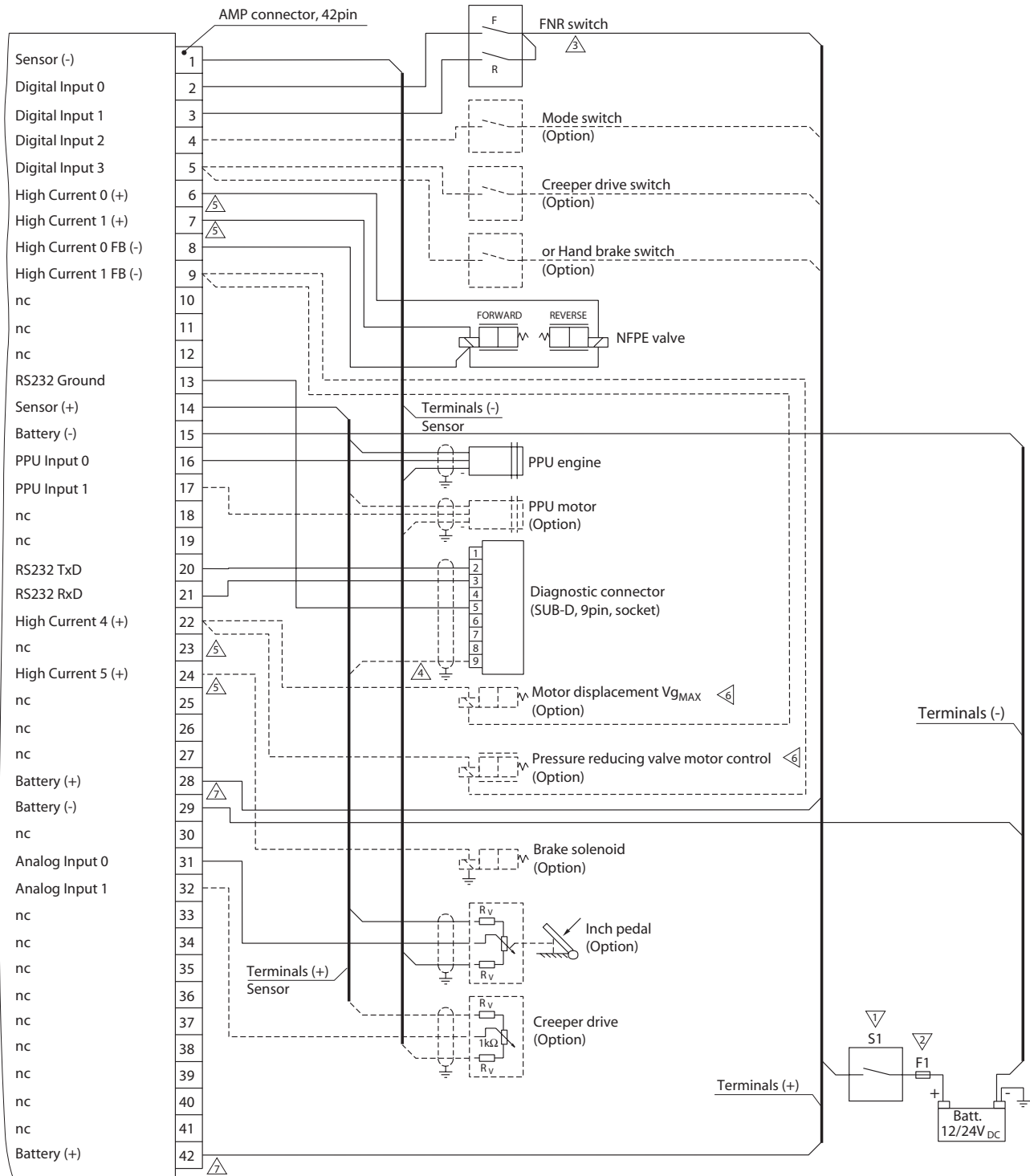
The speed limitation reduces the current to the hydrostatic motor or pump if the vehicle exceeds a certain speed. This can prevent the motor from overspeeding while driving downhill. On the transmission side, a speed signal is required, which is under diagnostic. If no speed signal is detected in conditions where the vehicle normally should move, an error will be set, and the automotive curve will be used for the motor. This automotive curve should not be critical regarding overspeeding the motor. If the speed signal returns, both curves can be used again and the error will be deleted.

CONNECTORS



SYSTEM CONNECTION DIAGRAM

- 1 Contact capability min. 6A
- 2 Mating fuse 10A
- 3 Position shown: Neutral
- 4 Used for SUSMIC-DIA 1
- 5 Max. current output 2A
- 6 Displacement: None/2-Position/Proportional
- 7 Max. 3.25A each pin



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Electric power steering
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Bent axis motors
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Transit mixer drives
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Proportional valves
Directional spool valves
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Sensors

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