RE 15422/12.2021
Replaces: 08 2019

rexroth
A Bosch Company

Pump Control Hägglunds ICp

Valid for:

- Stand-alone pump control
- Added functions for pump control and monitoring

Features

- Control of one hydraulic pump
- Galvanic isolation between internal circuits and input/outputs
- Current controlled Pulse Width Modulated outputs
- Configuration via Bluetooth
- App interface via Android or iOS
- Indicator LED lights
- Swash angle or pressure regulation
- Functions for monitoring of analog and digital signals
- Very high protection class IP67
- RoHS and REACH compliant

Contents

1 Ordering code

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.
Example: Hägglunds ICp

IC	**P**		**00**
01	02		03

01	**Control unit**	
		IC

02	**Application**	
	Pump	**P**

03	**Modification**	
		00

2 Functional description

Hägglunds ICp is a standalone solution for control of one hydraulic pump. The pump can be controlled without feedback, using the ICp as an amplifier or locked into closed loop control using either work pressure or swash angle as input.
The pump solenoid coils are connected to ICp, which in turn is connected to the control system or a control panel. ICp can monitor different values of the system, sending warnings or alarms if any signal exceeds the allowed interval. Optional signals include temperatures, oil level, flow, digital input signals for monitoring and digital outputs for feedback.
Configuration of ICp is done via Bluetooth and the Hägglunds ICp Mobile App available for both Android and iOS.

2.1 Galvanic isolation

ICp has galvanic isolation between control and I/O side. The control side feeds USB, Bluetooth, display and main processor. The I/O side feeds pump control outputs, digital, analog and Pt100 connections.

2.2 Run mode

Mode	Description
STOP	Drive is stopped. Inputs are still monitored but no current sent to pump. ‘-S-‘ shown on display.
RUN	Unit controlling pump. Setpoint in percent shown on display, blinking during ramps.
ALARM	Drive stopped with shutdown ramp. ‘EXX‘ shown on display, where XX cycles between the active alarm codes. 'cXX' shown for cleared alarms. Alarm is active until all alarms have been cleared and start drive signal removed.
QUICKSTOP	Drive stopped without ramp. Quickstop is active until all configured quickstop inputs are inactive and start signal is released. ‘-S-‘ shown blinking on display.

2.3 EEPROM memory

All the settings for ICp are stored in a non-volatile EEPROM. This memory is read on each start of the unit. Any changes made to the settings in Hägglunds ICp app are kept in the volatile memory of the ICp. It is recommended to save any changes to the EEPROM once the configuration is completed. Any changes not saved to EEPROM will be lost if the unit loses power.

2.4 Pump current control

The pump current is monitored by ICp and kept in closed loop control to ensure that the current is accurate. There are separate settings for each pump solenoid to compensate for any differences. Adjustable dither settings ensure that the pump stays responsive after running at the same pump angle for extended periods. If the current cannot be kept within a configurable interval, an alarm is set.

2.5 Ramp

The ramp times are all set in seconds and signify the time it should take for the unit to change the pump output from 0% - 100% and 100% - 0%. A separate ramp is used for alarm stops where the system needs to stop but an instant stop might be unwanted.

2.6 Swash regulator

The swash angle regulator reads the swash plate angle directly from a pump sensor and enables a closed loop control over the pump flow. Uses a 4-20 mA, 12 mA center sensor. The regulation is configurable via P and I parameters.

2.7 Pressure regulator

The pressure regulator reads the work pressure directly from the connected pressure sensor and enables a closed loop control over the pump pressure (flow). The regulation is configurable via P, I and D parameters.
Central to many use-cases is that the regulation follows a pressure within a certain operating area. To achieve this, it is possible to set the regulator to stay within a certain area (in %) of the pump output. It is also possible to invert the regulator operation for drives such as sugar mills, where increased system pressure indicates a need to speed up to keep up with the incoming material. The pressure regulator only works when the drive is in forward direction.

2.8 Monitoring

ICp has functionality for monitoring analog and digital signals. Depending on the connected sensor, temperature, oil flow, tank oil level, pressure or rpm can be measured. Analog signals can be set up with high and low warning levels and/or high and low alarm levels. Digital inputs can be set as warning, temperature warning or alarm.
A triggered warning will activate configured warning outputs. A triggered temperature warning will, besides general warning outputs, also activate configured temperature warning ouputs.
A triggered alarm will set the pump outputs to zero according to the configured shutdown ramp time and activate configured alarm ouputs.

2.9 I/O functions

Functions possible to configure for I/O of the Hägglunds ICp. Digital I/O:s can be set active high or active low.

2.9.1 Digital signals

Inputs:

Start – Start the drive and enable control of the pump. Start drive signal can only be configured as an active high signal, and only to an input that does not currently read a high signal. This prevents unintended starts during configuration. Only one start input can be configured.

Reverse – Reverse the drive. Setpoint signal is inverted. When the drive is active and running in the forward direction, this means first following the negative forward ramp down time and then starting the reversal of the pump, following the positive reverse ramp up time. Only one reverse input can be configured.

Quickstop – Stop the drive immediately. This signal(s) instantly cuts the drive of the pump and places the ICp in quickstop mode, where it will remain until both quickstop and start signals are reset.

Note!
Quickstop is not an Emergency stop. In case of emergency, breaking pump supply (VP) on contact PI will cut all power to pump solenoids.

Warning – Generates a warning signal that can be read in the app and sets warning signals configured for digital outputs.

Temperature warning – Generates a temperature warning signal that can be read in the app and sets temperature warning signals configured for digital outputs. Temperature sensor not included.

Alarm – Generates an alarm signal that will stop the drive. Can be read on the display, in the app or used to set the alarm digital output.

Monitor – If configured, this is a required signal to start the drive and while drive is running. Generates alarm that will stop the drive if signal is lost. Can be read on the display, in the app or used to set the alarm digital output.

Swash angle regulator enable – When the swash angle regulator is set up, sending an active signal to an input configured as swash angle regulator enable will activate the regulation. Without it, the regulation will remain inactive. Only one enable input can be configured.

Pressure regulator enable – When the pressure regulator is set up, sending an active signal to an input configured as pressure regulator enable will activate the regulation. Without it, the regulation will remain inactive. Only one enable input can be configured.

Disable Bluetooth – Disable the wireless connection. Only one disable Bluetooth input can be configured.

Outputs:

Drive started – Active signal when ICp starts control of the pump.

Drive forward – Active signal when ICp starts control of the pump in forward direction.

Drive reverse – Active signal when ICp starts control of the pump in reverse direction.

Swash reg active – Active signal when swash angle regulation is active. The signal will be inactive at swash regulator error.

Pressure reg active – Active signal when pressure regulation is active. The signal will be inactive at pressure regulator error.

Quickstop active – Active signal when quickstop is active.

Alarm – Active signal if any alarm is triggered.

Warning – Active signal if any warning is triggered.

Temperature warning – Active signal if any temperature warning is triggered. The temperature warning signal is also included in the warning output, but can if needed be used as a separate output for temp warnings.

Bluetooth disabled – Active signal when Bluetooth is disabled.

2.9.2 Analog signals

Inputs:

Setpoint – Setpoint input to the unit, 4-20 mA corresponds to 0-100%. Only one setpoint input can be configured.

Swash angle – Feedback from the pump swash angle sensor. This signal shall be 12 mA when the pump is at 0% stroke, decrease to 4 mA when the pump angle is in full forward direction and increase to 20 mA in full reverse. The direction can be inverted under swash angle setup, depending on how the pump and solenoids are connected. Only one swash angle input can be configured.

Work pressure – Main work pressure input used by the pressure regulator. Only one work pressure input can be configured.

Threshold – The threshold inputs are used to set warning and alarm levels for an analog signal in the system.

Threshold temperature – The temperature thresholds hold the same functionality as threshold and gives a temperature warning. See section *11 Accessories*.

3 Technical data

Table 1: Mechanical data

Mechanical data	
Size	W 111 x D 310 x H 31 mm
Weight	1.0 kg
Storage temperature	-40 °C....+105 °C
Operating temperature	-20 °C....+70 °C
Protection	IP67
Mounting	Close to pump

Table 2: Electrical data

Electrical data		
Control supply	in (VC)	18-30 VDC, 0.2 A
	out	VC, max connector load 4 A
I/O supply	in (VI)	18-30 VDC, 2 A
	out	VI, max connector load 10 A
Pump supply	in (VP)	18-30 VDC, 2 A
	out	VP, max connector load 10 A
Analog in		4-20 mA
Digital in		10-30 VDC
Digital out		VI, max 700 mA. Total max 2 A
Pt100		4-wire
Pump output		0 - 1.5 A
		Dither 50-500 Hz
Cable lengths (recommended)		≤ 3 m for analog and digital I/O and pump output (unshielded cables recommended)

4 Dimensions

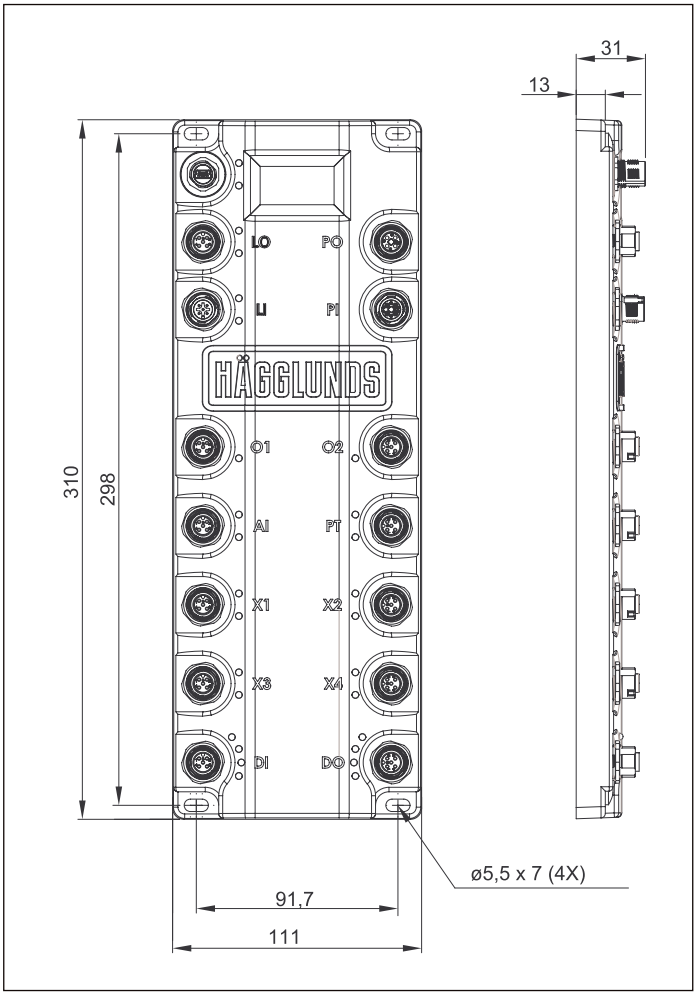


Fig. 1: Dimensions

5 Block circuit diagram

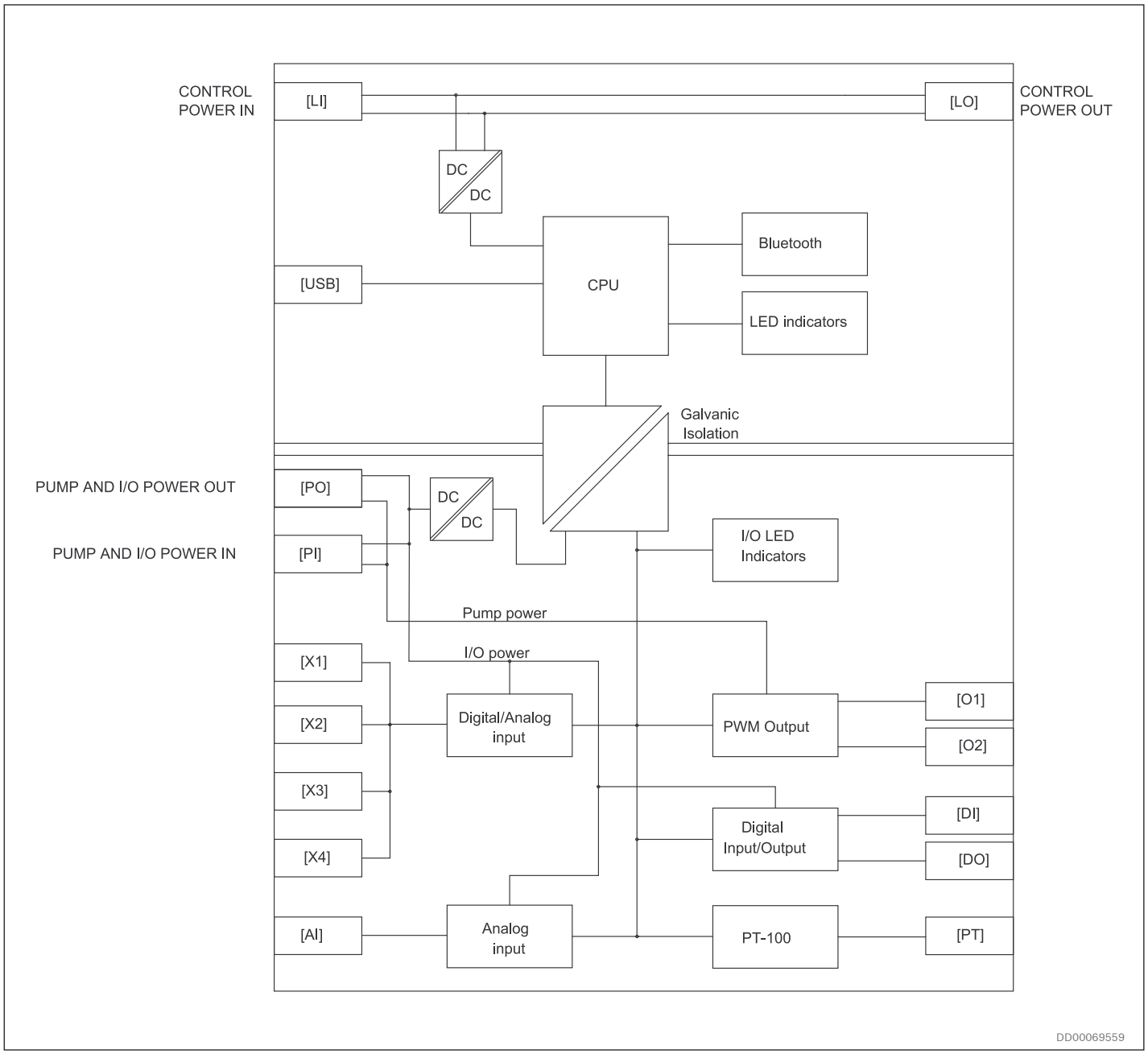


Fig. 2: Block diagram

6 Indicators

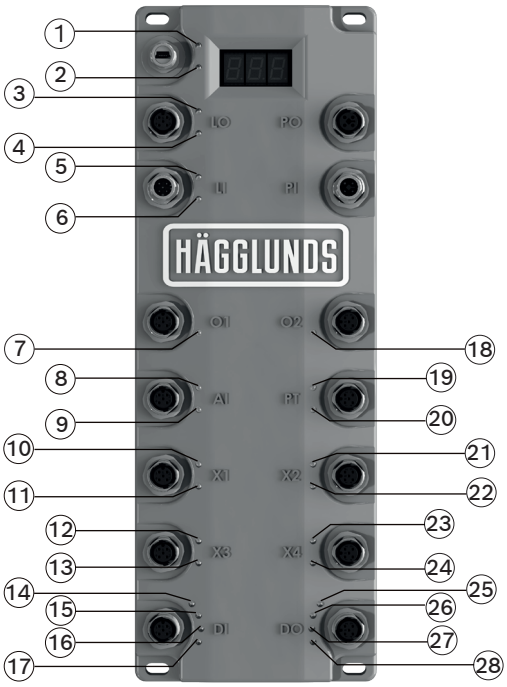


Fig. 3: Indicators

Reference	Description	Function	Information
1,2	USB TX/RX	Blinking	USB link active
3	Control power	Green Off	Control power OK Control power outside accepted range
4	Bluetooth	Green Off	Enabled Disabled
5	I/O power	Green Off	I/O power OK I/O power outside accepted range
6	Hardware fault	Blinking red Off	Hardware related fault Connections OK
7, 18	Pump output	Red Off	Connection fault, output shorted or open Connection OK
8, 9, 10, 12, 21, 23	Analog input 1-6	Red Off	Signal fault Signal OK or input inactive
11, 13, 22, 24,	Digital input 1-4	Yellow Off	High signal on input Low signal on input
14, 15, 16, 17, 25, 26, 27, 28	Digital I/O 1-8	Yellow Off	High signal on input/output Low signal on input
19	Pt100 signal	Red Off	Outside measuring range Signal OK or input inactive
20	Pt100 alarm	Yellow Off	High / low temp alarm Signal OK or input inactive

7 Connectors

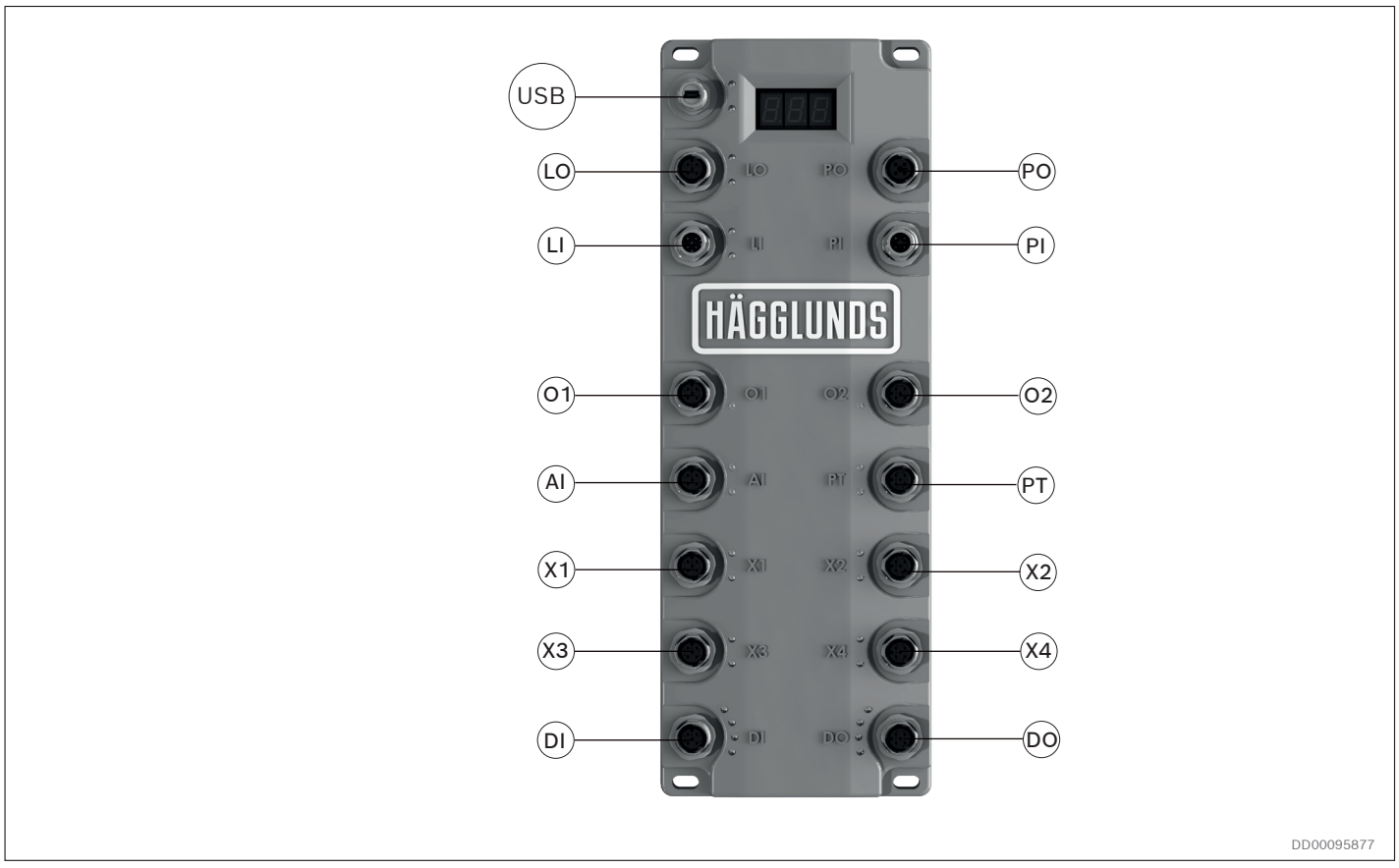


Fig. 4: Contact numbering

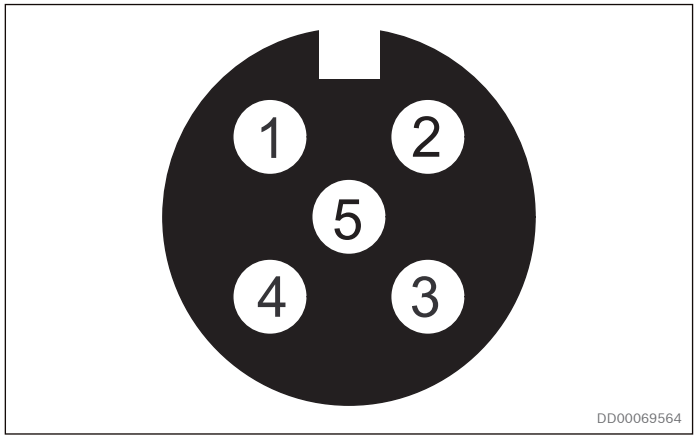


Fig. 5: Contact LO, O1, AI, X1, X3 and DI: M12 A-coded socket contact

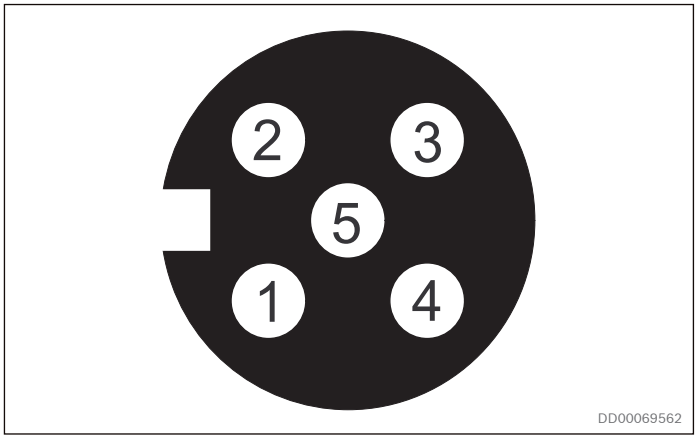


Fig. 6: Contact O2, PT, X2, X4 and DO: M12 A-coded socket contact

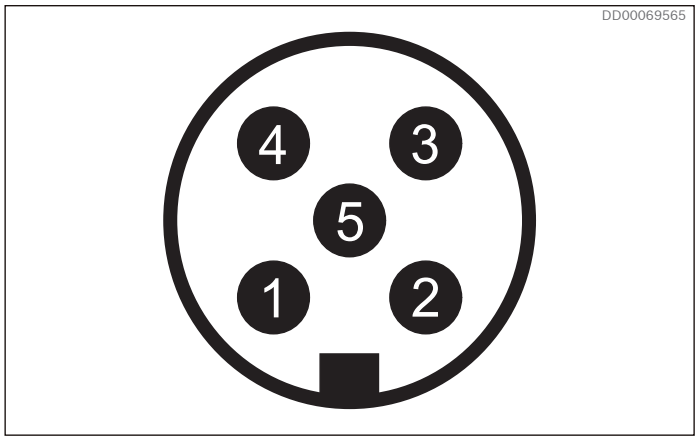


Fig. 7: Contact LI: M12 A-coded pin contact

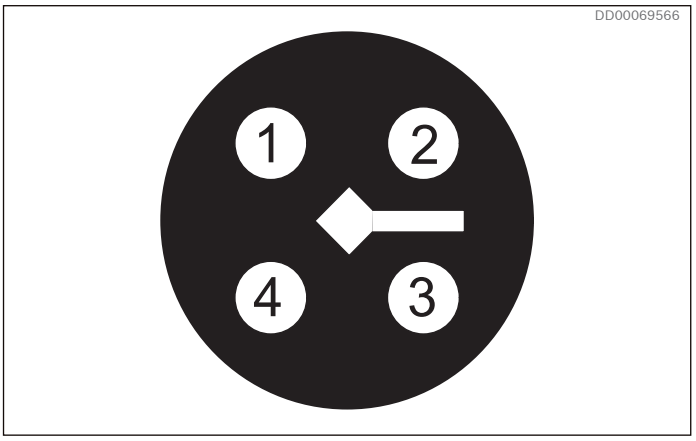


Fig. 8: Contact PO: M12 T-coded socket contact

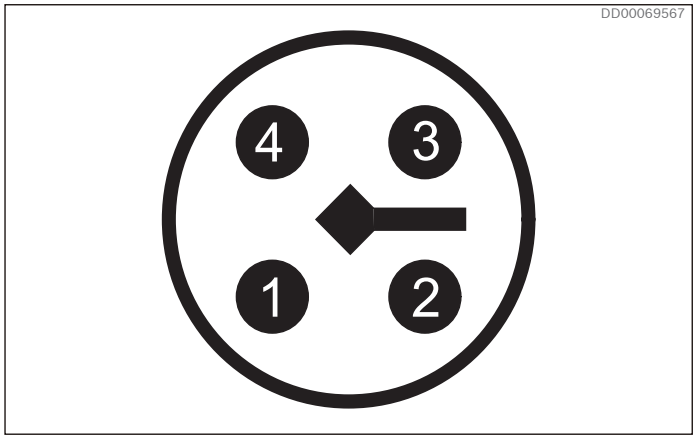


Fig. 9: Contact PI: M12 T-coded pin contact

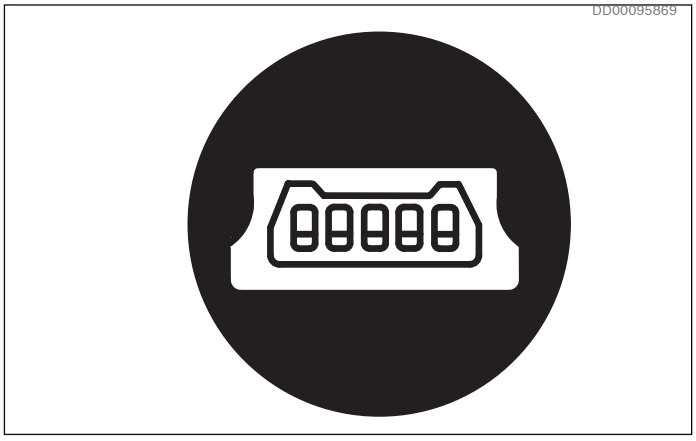


Fig. 10: Contact USB

Contact	Type	Pin	Function	Comment
O1	Pump solenoid connection	1	GND I/O	
		2	PUMP output Forward +	
		3	GND I/O	
		4	PUMP output Forward -	
		5	Not used	
O2	Pump solenoid connection	1	GND I/O	
		2	PUMP output Reverse +	
		3	GND I/O	
		4	PUMP output Reverse -	
		5	Not used	
AI	Double analog input	1	+24 VDC (VI)	All +24 VDC outputs has internal shortage supervision
		2	Analog input 1	
		3	GND I/O	
		4	Analog input 2	
		5	Not used	
X1	Analog and digital input	1	+24 VDC (VI)	
		2	Analog input 3	
		3	GND I/O	
		4	Digital input 1	
		5	Not used	
X2	Analog and digital input	1	+24 VDC (VI)	
		2	Analog input 4	
		3	GND I/O	
		4	Digital input 2	
		5	Not used	
X3	Analog and digital input	1	+24 VDC (VI)	
		2	Analog input 5	
		3	GND I/O	
		4	Digital input 3	
		5	Not used	
X4	Analog and digital input	1	+24 VDC (VI)	
		2	Analog input 6	
		3	GND I/O	
		4	Digital input 4	
		5	Not used	
DI	Digital input (or output)	1	+24 VDC (VI)	
		2	Digital I/O 1	
		3	Digital I/O 2	
		4	Digital I/O 3	
		5	Digital I/O 4	

Contact	Type	Pin	Function	Comment
DO	Digital output (or input)	1	Digital I/O 5	
		2	Digital I/O 6	
		3	GND I/O	
		4	Digital I/O 7	
		5	Digital I/O 8	
PT	Pt100	1	Pt100 +	
		2	Pt100 + Sense	
		3	Pt100 -	
		4	Pt100 - Sense	
		5	Not used	
USB	Mini USB		Acc. to USB standard	
LI	Control power in	1	Do not connect	
		2	+24 VDC (VC)	
		3	GND	
		4	Do not connect	
		5	Do not connect	
LO	Control power out	1	Do not connect	
		2	+24 VDC (VC)	
		3	GND	
		4	Do not connect	
		5	Do not connect	
PI	Pump and I/O power in	1	+24 VDC (VI)	
		2	+24 VDC (VP)	
		3	GND I/O	
		4	GND I/O	
PO	Pump and I/O power out	1	+24 VDC (VI)	
		2	+24 VDC (VP)	
		3	GND I/O	
		4	GND I/O	

7.1 Y-connection

Contact X1-X4 can be expanded with an Y-connector for separate digital and analog input cables. Also possible to use for AI if both analog inputs are needed.

Material number: Y-connection type 1 R901497816
Y-connection type 2 R913020082

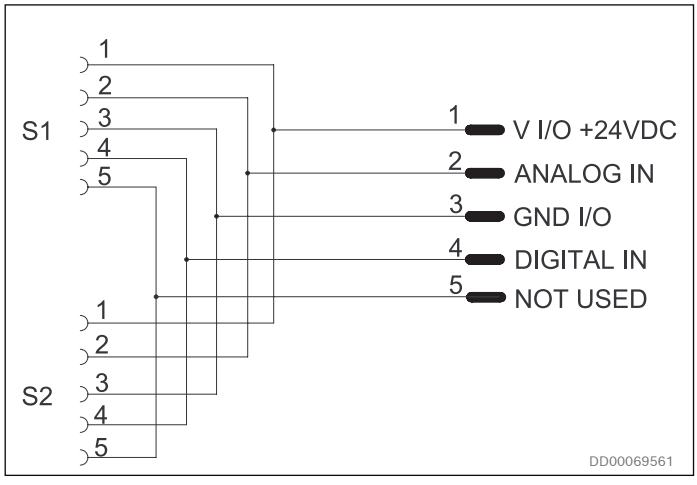


Fig. 11: Y-connection type 1

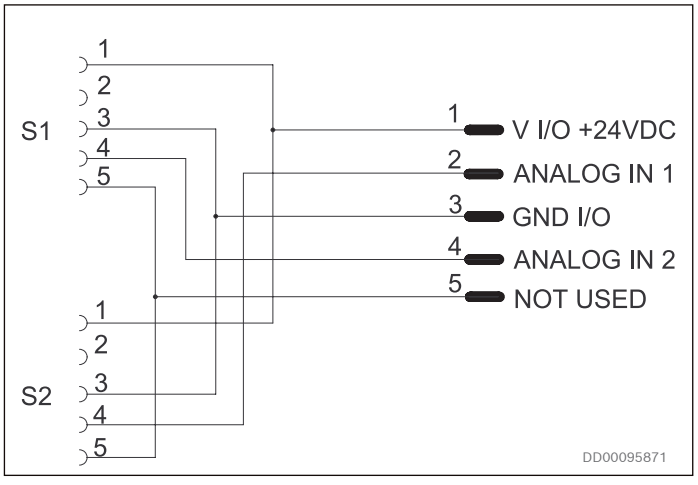


Fig. 12: Y-connection type 2

8 Connection diagram

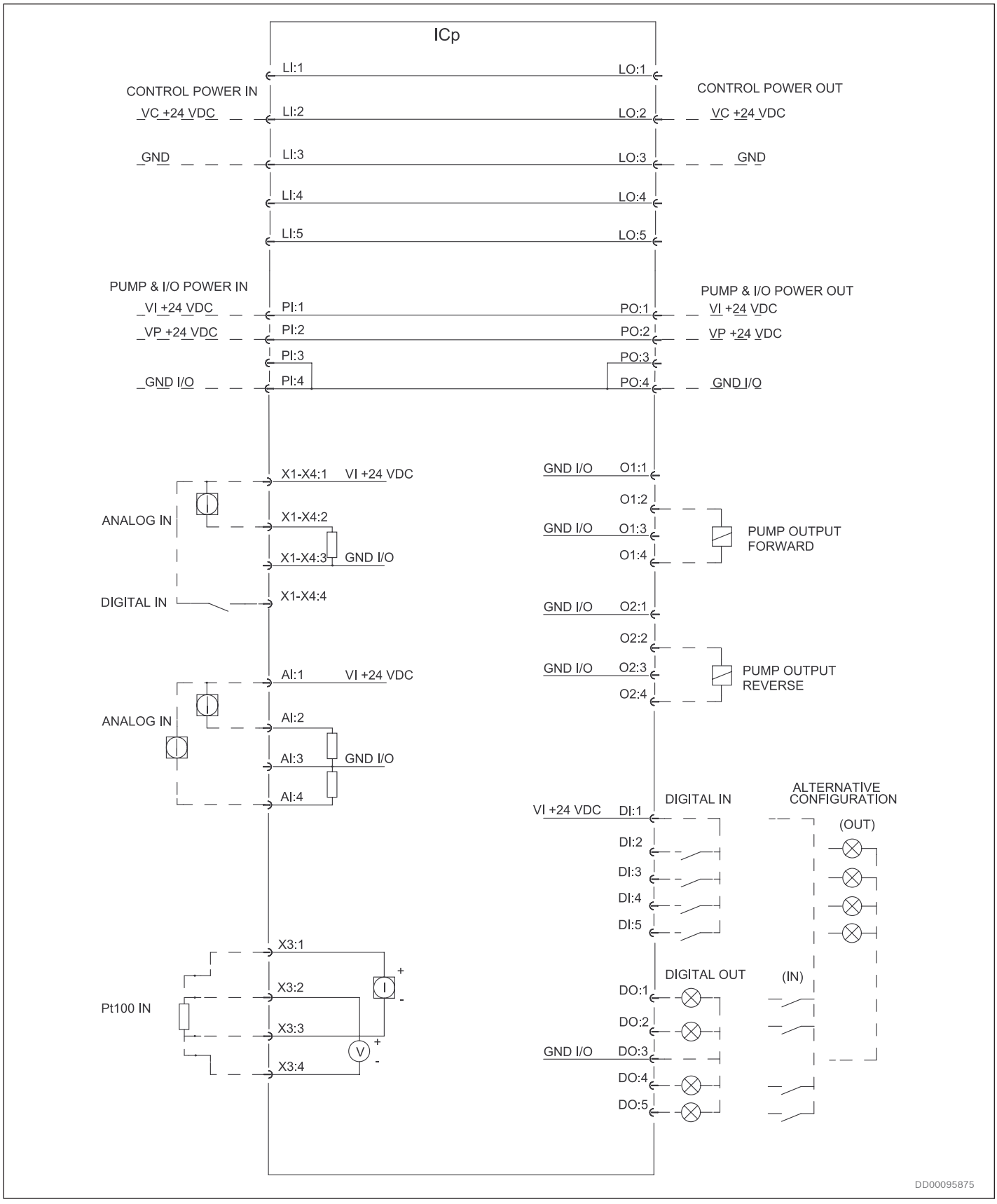
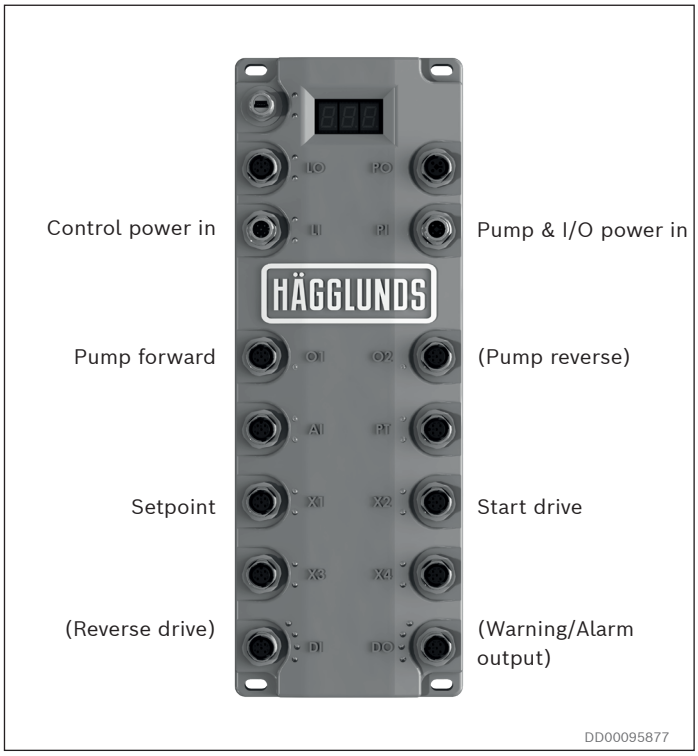


Fig. 13: Connection diagram

9 Installation instructions

Setup examples

9.1 Example: ICp basic setup



Fasten ICp with four M4 screws and connect power, pump coils, setpoint and start drive signals.

Connect with the app (Default password, see *10.1*) and set up a new password, desired ICp number and display reading units under app settings (see *10.5*).

Use I/O setup to configure X1 analog input 3 as Setpoint and X2 digital input 2 as Start drive.

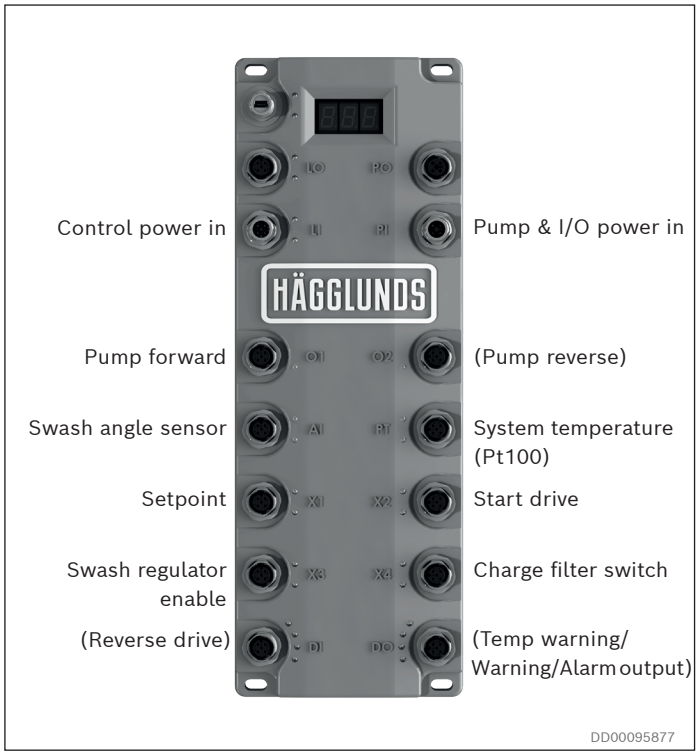
(Optional) If needed, configure Warning and/or Alarm output (active low) and Reverse drive.

Set desired ramp times under Ramp setup and configure the pump under Pump setup.

ICp is now ready to control the pump.

Note!
Save settings to EEPROM (otherwise settings are lost at power down).

9.2 Example: ICp with swash angle control, temperature and clogged charge filter supervision



Follow the basic setup.
Configure:
AI analog input 2 to Swash angle
X3 digital input 3 to Swash angle regulator enable
X4 digital input 4 to Warning input
PT to Temperature threshold. Alarm and warning levels are displayed in the unit selected in the settings page.
Set Alarm (min), Warning (min), Warning (max) and Alarm (max) temperatures.

(Optional) If needed, configure a Temperature warning output (active low).

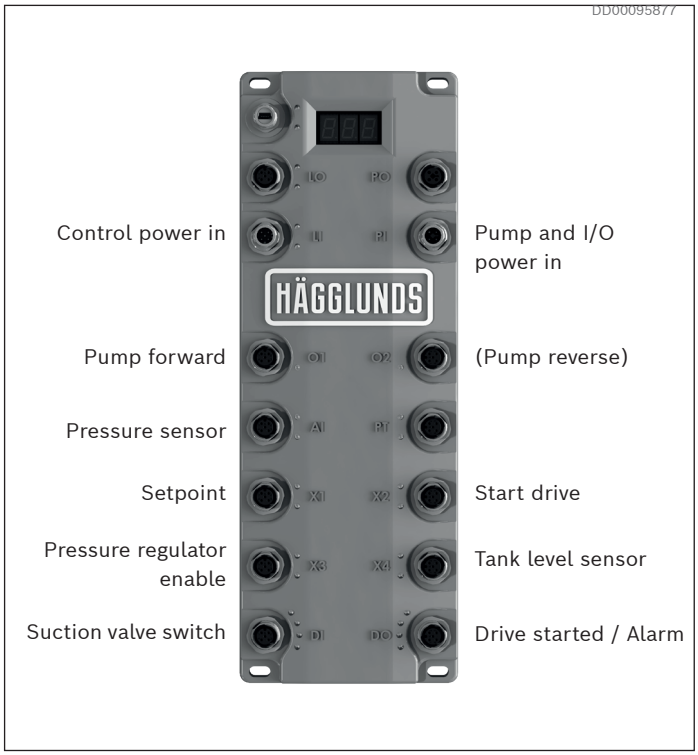
Open Swash angle setup, enable Swash angle regulator and set regulator parameters as desired.

Save settings to EEPROM.

Start the drive and set digital in 3 high. Open swash regulator Live tune and adjust the PI parameters for optimum performance.

Stop and save settings to EEPROM.

9.3 Example: ICp with pressure control, oil level and suction valve supervision, drive started and alarm output



Follow the basic setup.
Configure:
AI analog input 1 to Work pressure.
Set sensor unit, min input and max input according to the pressure sensor used.
X3 digital input 3 to pressure regulator enable
DI digital I/O 1 to Alarm input
DO digital I/O 5 to Drive started output
DO digital I/O 6 to Alarm output (active low)
X4 analog input 6 to Threshold
Set sensor unit to liters and min and max input according to the tank level sensor used.
Set Alarm and Warning levels according to the tank size.

Open Pressure regulator setup, enable Pressure regulator and set regulator parameters as desired.

Save settings to EEPROM.

Start the drive and set digital input 3 high. Open Pressure regulator Live tune and adjust the PID parameters for optimum performance.

Stop and save settings to EEPROM.

Note!
Since alarm includes tank low level alarm, the alarm output should be connected to stop main pump electric motor at low signal.

10 App instructions

10.1 Introduction

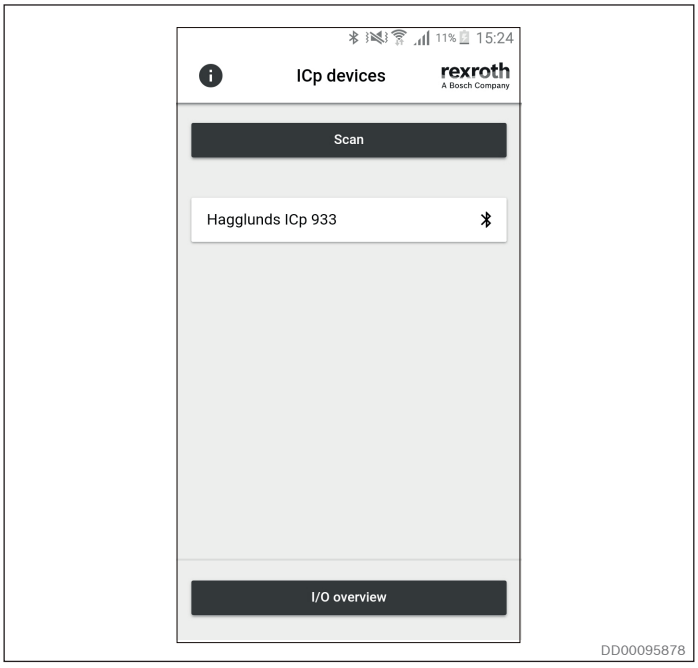
Hägglunds ICp Mobile App is available from Play Store for Android and App Store for iOS.
The ICp app is made for configuration and maintenance of Hägglunds ICp and the system that it is controlling. From the app all settings in the ICp are accessible and live data from the device can be monitored directly. The app also contains a 'live tune' mode, where the regulators can be tuned while the system is running and the output and input values are shown in the app. If the ICp indicates warnings or alarms, these can be read in clear text. Old alarms can be viewed in the app. All settings are protected with a password. Default password: "**Hagglunds**".

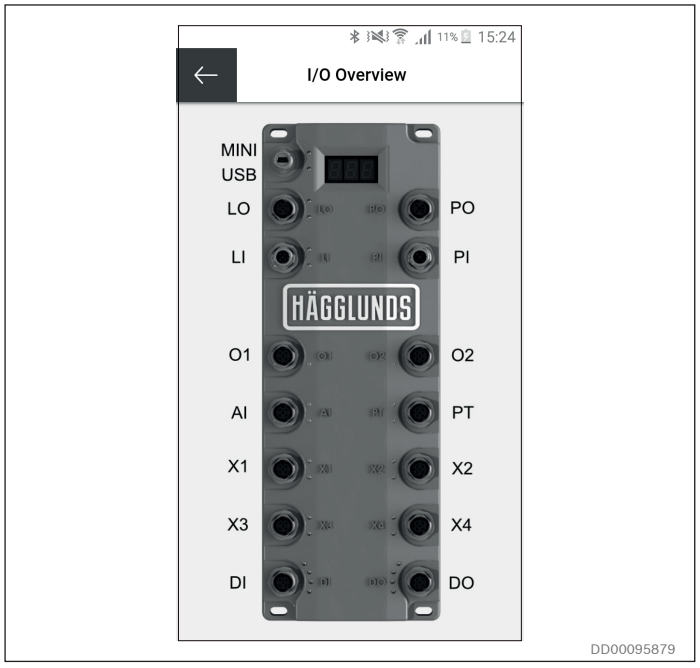
10.2 Scan page

When first opening the app you are presented with the scan page.
Scan: Updates the list of nearby units. Click on available unit to make a connection to this module. When first connecting to unit a pairing request must be approved. This enables encryption and a secure connection.
I/O overview: Opens a reference of the pinouts when installing a new unit.

10.3 I/O Overview

Each contact can be clicked to open a reference of the pin funcions. No configuration can be made from here.





10.4 Main page

ICp name, firmware version number, run mode and setpoint is shown.
If swash angle or pressure regulation is configured, the swash angle and/or system pressure is also shown.

Gear-icon ⚙ : In the top right corner opens the settings page. The gear is present in all pages in the app where units are shown.
Start blink: Triggers the device to start blinking all LEDs for identification of the unit connected to the app.
Setup: Opens the setup page, where the configuration of the unit can be reviewed or changed, see *10.6 Setup*.
Alarm list: Opens the log page, where alarms and warnings for the current system can be seen, see *10.6.7 Alarm list*.
Live graph: Opens the page for monitoring live data, see *10.6.8 Live graph*.

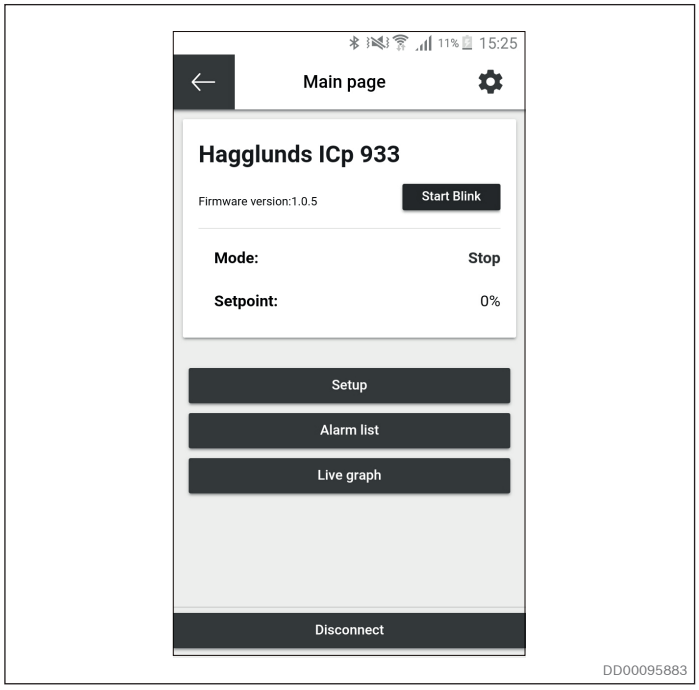
10.5 App settings page

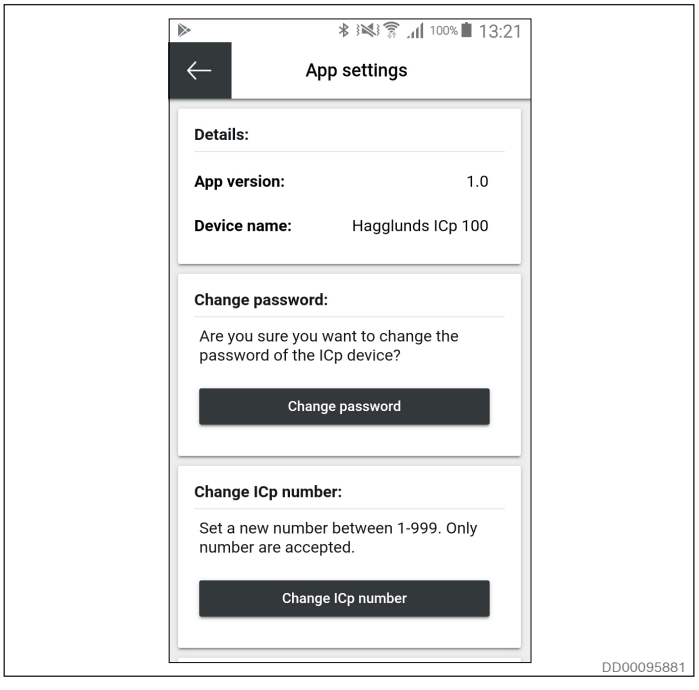
Opened by gear icon in upper right corner.
Details about app software version and selected ICp name.

Change password: Change of the password for the ICp. In order to change the password, you need to type in the existing password and the new password twice to verify correct entry.
Change ICp number: Change of the three digit number included in the ICp name to allow to give logic numbering of the ICp units. After the change is made, it is necessary to go to the Device setup, see *10.6.1*. Select Save to EEPROM to store the change. The number change will be active after a restart of the ICp module.

Display settings: Units used by the app to display different physical quantities. Saved in the app and will be persistent when connecting to different ICp units.

License details: Overview of the different open source licenses used in Hägglunds ICp app.

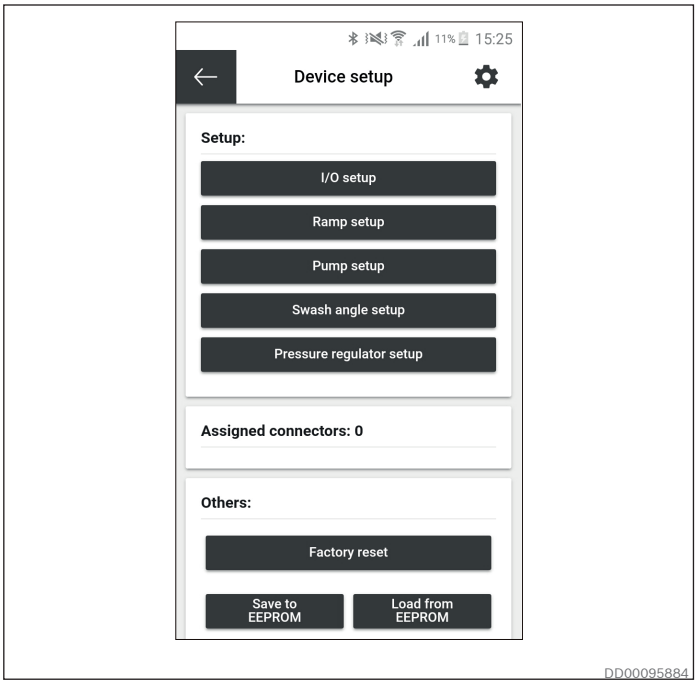




10.6 Setup

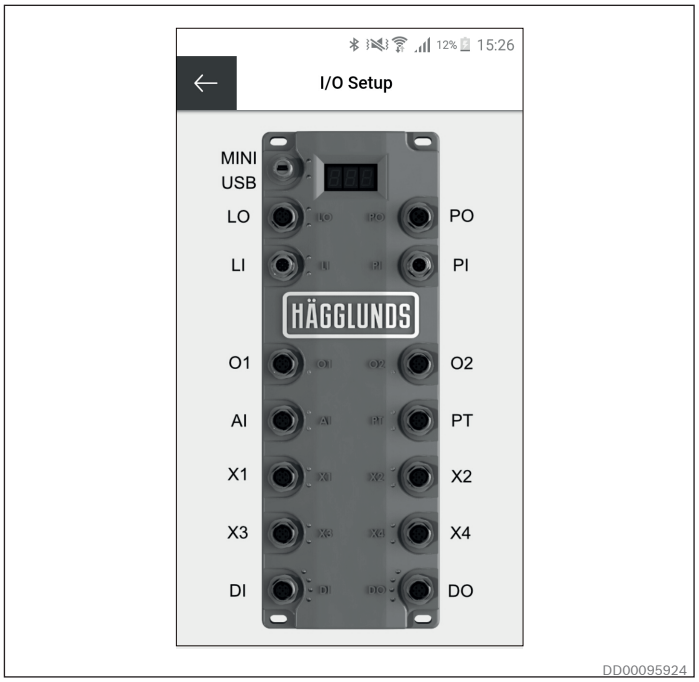
10.6.1 Device setup

I/O setup: Settings for all input and output functions.
Ramp setup: Settings for all ramp times.
Pump setup: Settings for pump solenoids, currents and dither.
Swash angle setup: Settings for swash angle regulator and live tune.
Pressure regulator setup: Settings for pressure regulator and live tune.
Assigned connectors: A summary of the configured pins on the connected device. Each line can be clicked to open the corresponding page.
Factory reset: Reset the ICp to factory defaults. Not a persistent change unless saved to EEPROM later.
Save to EEPROM: Save current settings in persistent memory.
Load from EEPROM: Discard current settings and load last saved configuration from persistent memory.
Save to file: Save all settings to a file on the connected device (e.g. mobile phone).
Load from file: Replace current settings from a file on the connected device (e.g. mobile phone).



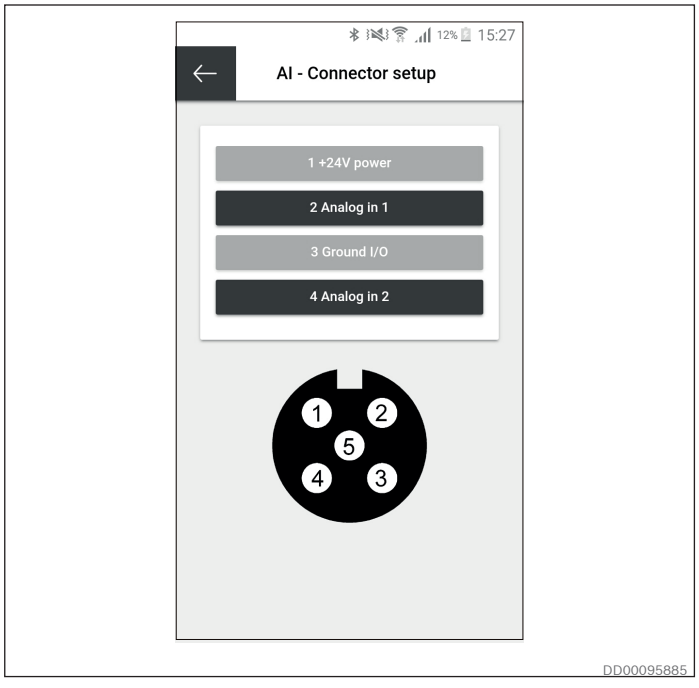
10.6.2 I/O setup

Image of ICp with clickable contacts



10.6.2.1 Contact pages

Contact overview with pin function descriptions. Configurable pins shown in dark blue.



10.6.2.2 Analog/Pt100 input setup page

Drop down list with analog functions. See *2.9.2* for function description.

Calibrate: Start the calibration routine for selected input. The inputs are calibrated by applying 4 mA and 20 mA to the input according to on-screen instructions. Calibration can only be done when not started and is not reset by a factory reset.

Save parameters: Sends the selected parameters to ICp.

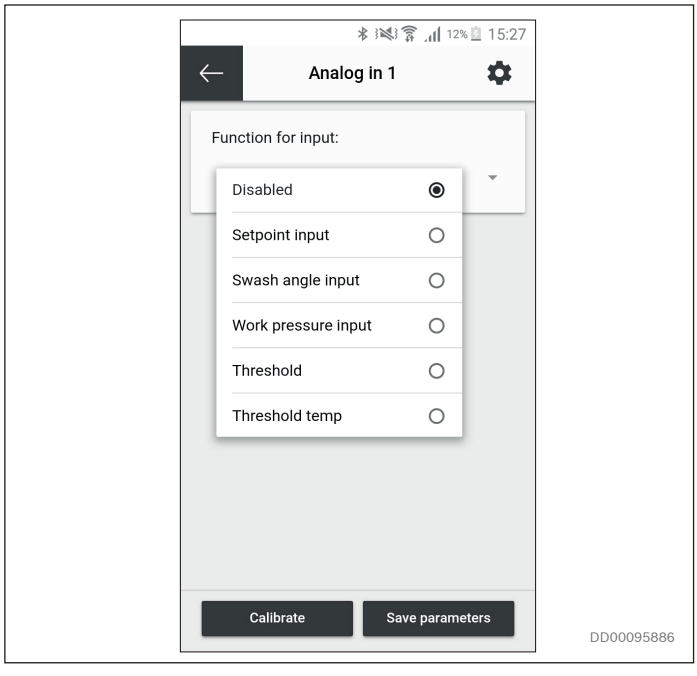
(A subsequent Save to EEPROM is needed to make the parameters persistent.)

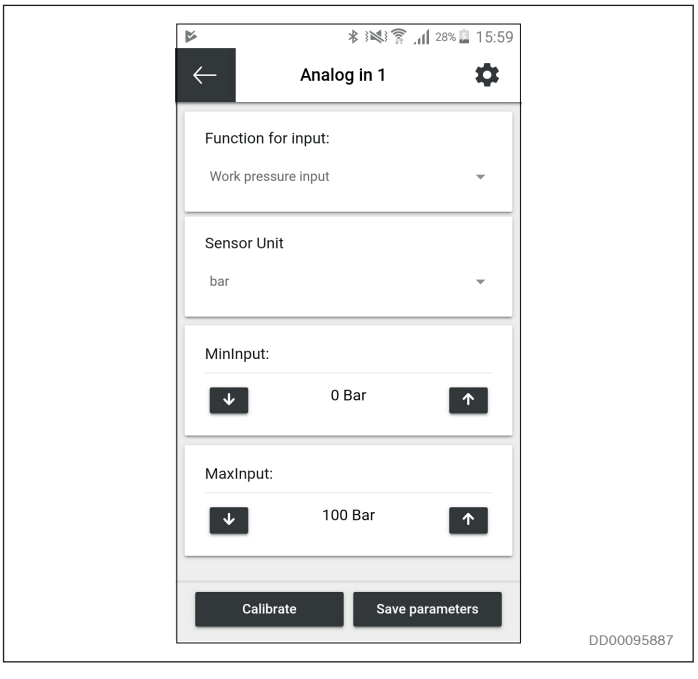
Visible for Work pressure input/Threshold/Threshold temp:

Sensor unit: Unit of the connected sensor/signal.
Sensor min input: Minimum of the connected sensor signal range.
Sensor max input: Maximum of the connected sensor signal range.

Visible for Threshold/Threshold temp:

Alarm max: An alarm will be triggered if the signal rises above this level.
Warning max: A (temperature) warning will be triggered if the signal rises above this level.
Warning min: A (temperature) warning will be triggered if the signal falls below this level.
Alarm min: An alarm will be triggered if the signal falls below this level.



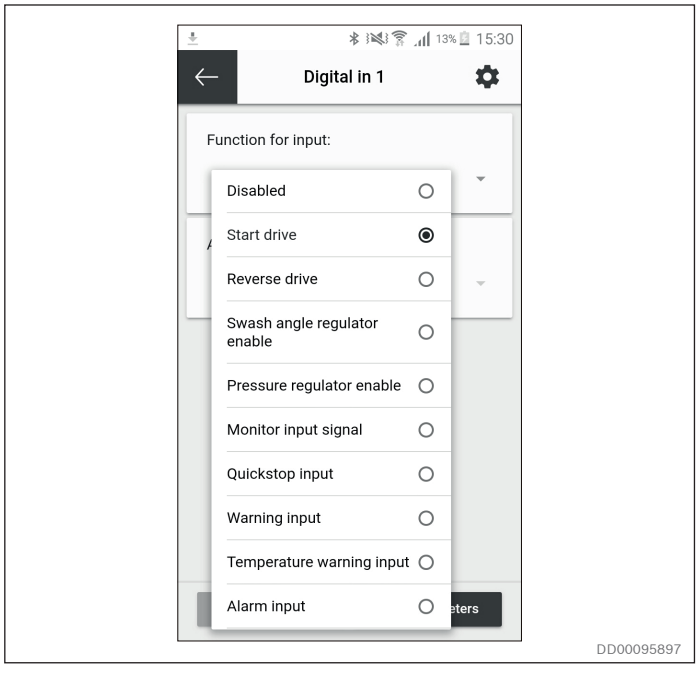


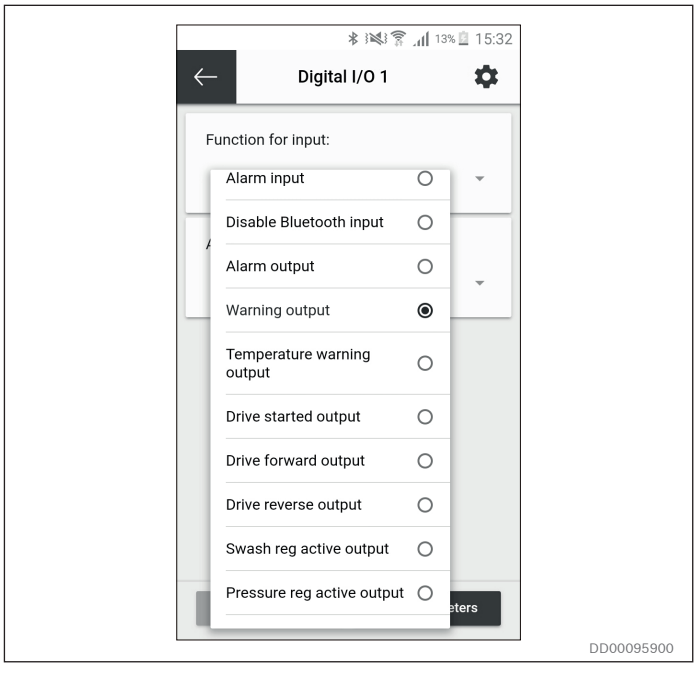
10.6.2.3 Digital input setup page

Drop down list with digital input functions. See *2.9.1* for function description.
Functions can be configured active high or low.

10.6.2.4 Digital I/O setup page

Drop down list with digital I/O functions. See *2.9.1* for function description.
Functions can be configured active high or low.





10.6.3 Ramp setup

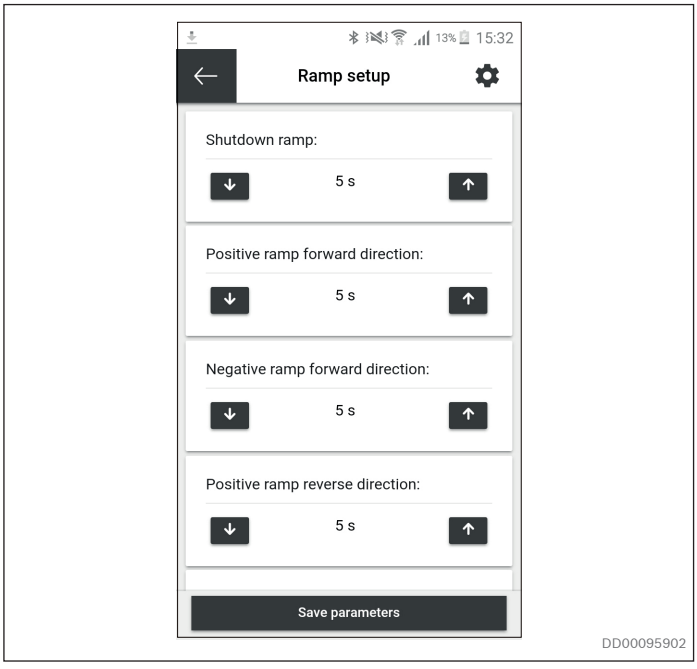
Shutdown ramp:
Alarm ramp down time in seconds. (0-60 s)
Positive forward ramp:
Time in seconds to change the pump output from 0-100%. (0-10 000 s)
Negative forward ramp:
Time in seconds to change the pump output from 100-0%. (0-10 000 s)
Positive reverse ramp:
Time in seconds to change the pump output from 0-100% in reverse. (0-10 000 s)
Negative reverse ramp:
Time in seconds to change the pump output from 100-0% in reverse. (0-10 000 s)

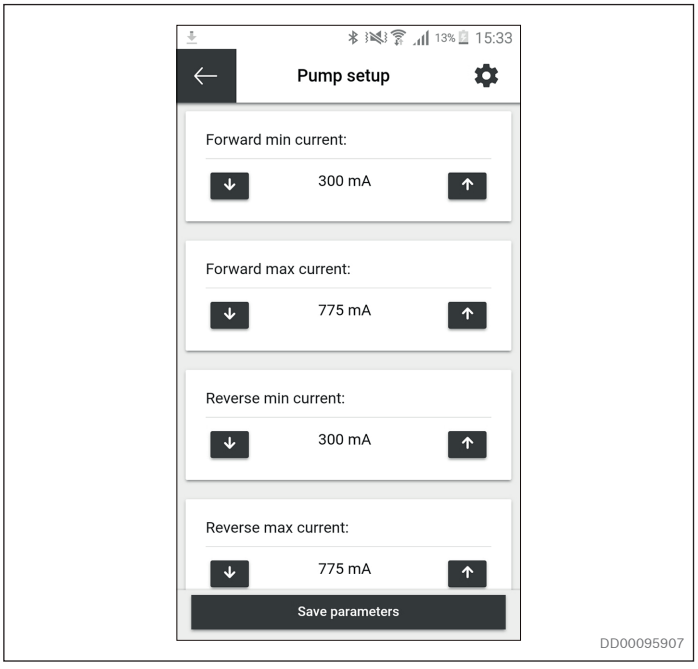
10.6.4 Pump setup

Forward min current: Minimum pump current to start swash angle change. (0-1499 mA)
Forward max current: Pump current for maximum displacement. (1-1500 mA)
Reverse min current: Minimum pump current to start swash angle change. (0-1499 mA)
Reverse max current: Pump current for maximum displacement. (1-1500 mA)
Coil resistance: Pump solenoid coil resistance. (5-100 Ω)

The dither settings counter stick-slip problems in the pump stroker. Set the amplitude as high as possible and the frequency according to pump data sheet.
Dither amplitude: Amplitude of the dither current. (0-600 mA)
Dither frequency: Frequency of the dither signal. (50-500 Hz)

Max current error: Maximum deviation between set and measured output current. Higher error gives alarm. (5-100 %)



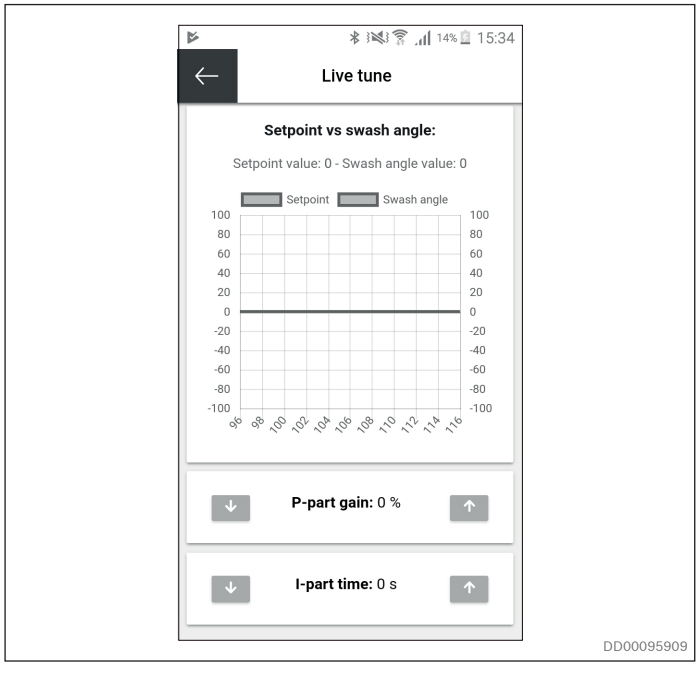


10.6.5 Swash angle setup

Swash regulator: Enable or disable the swash angle regulator. Turning on the regulator will give alarms if the swash angle input or swash angle regulator enable are not configured.
P-part: Enable or disable the proportional part of the regulator.
P-part gain: Proportional part of the regulator. (0-1000 %)
I-part: Enable or disable the integrating part of the regulator.
I-part time: Integration time for the regulator, set in seconds. A value too low will give an unstable system. (0.5-60 sec)
Integration off over this error: Error threshold for disable of integrator, i.e. a bigger difference between wanted swash angle and actual feedback will disable the I-part until the error is within the limit again. (0-100 %)
Feedforward: Amount of the setpoint that is sent directly to the output. (0-100 %)
Swash angle error limit: Maximum difference allowed between wanted swash angle and feedback. Threshold for deactivation of regulator with warning indication. If regulator was deactivated it can be reactivated by toggling regulator enable input. (0-100 %)
Invert swash angle direction: Invert the feedback from the swash angle sensor.

10.6.5.1 Live tune

The live tune page is used during tuning of the regulator. The setpoint and the swash angle are displayed together to give an overview of the system response. All changes are done online.

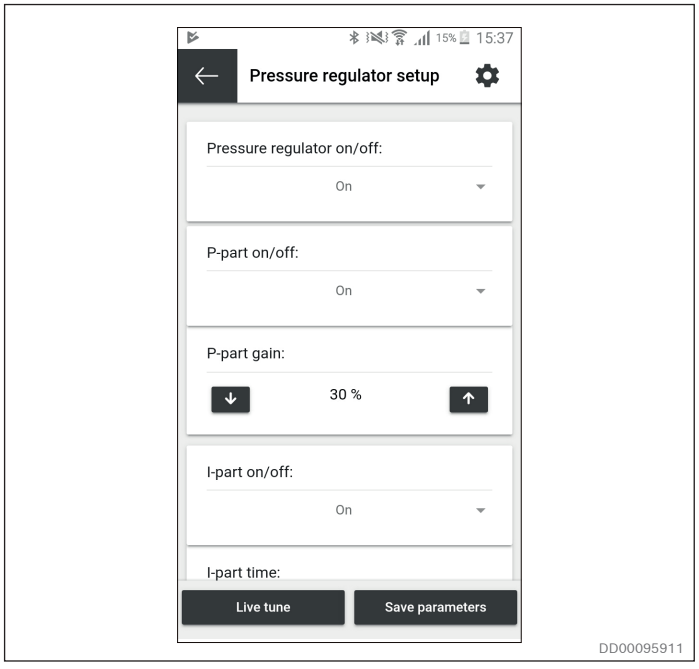


10.6.6 Pressure regulator setup

Pressure regulator: Enable or disable the pressure regulator. Turning on the regulator will give alarms if the work pressure input or pressure regulator enable are not configured.
Fixed pressure setpoint: Pressure regulator will work to keep this pressure. Pump output will be increased if pressure is lower and decreased if higher.
P-part: Enable or disable the proportional part of the regulator.
P-part gain: Proportional part of the regulator. (0-1000 %)
I-part: Enable or disable the integrating part of the regulator.
I-part time: Integration time for the regulator, set in seconds. A value too low will give an unstable system. (0.5-60 sec)
D-part: Enable or disable the derivating part of the regulator.
D-part gain: Derivation part of the regulator. (0-1000 %)

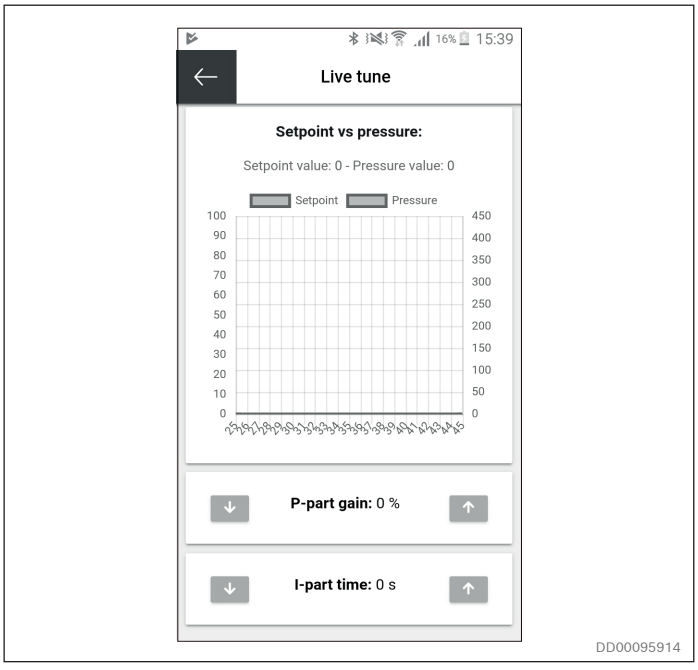
Operation of the pressure regulator can be restricted to a specified range. These parameters specify how far from setpoint the pressure regulator is allowed to move the pump in order to achieve set pressure.
Positive operation %: Allowed positive regulator influence on the signal output. (0-100 % of pump output range)
Negative operation %: Allowed negative regulator influence on the signal output. (0-100 % of pump output range)
Error limit %: Maximum difference allowed between wanted pressure and feedback. Threshold for warning indication, but the pressure regulator will still be active. (0-100 % of pressure sensor range)
Invert feedback direction: Invert the regulator output.
Off gives decreased output at high pressure.
On gives increased output at high pressure.

Note! The pressure regulator only works when the drive is in forward direction.



10.6.6.1 Live tune

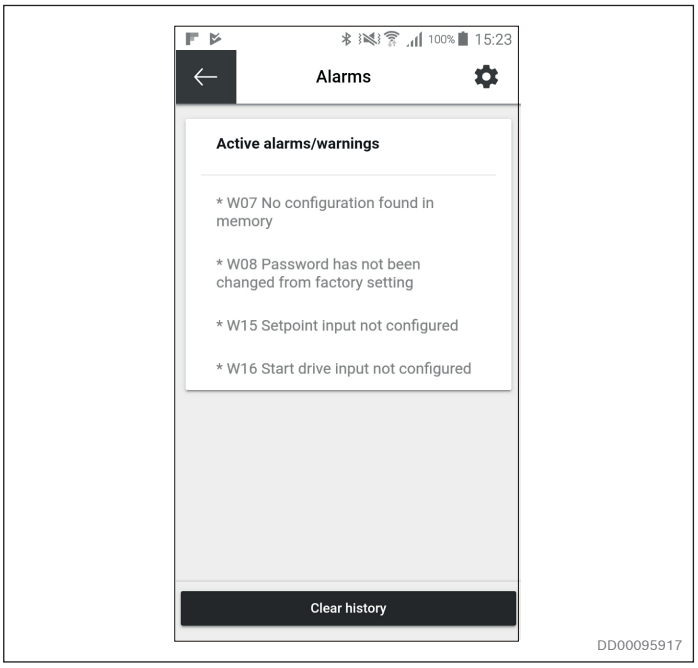
The live tune page is used during tuning of the regulator. The setpoint and the pressure are displayed together to give an overview of the system response. All changes are done online.



10.6.7 Alarm list

In the alarm list page, all active and previous events are viewed. This includes both alarms and warnings. Old alarms or warnings will be shown until they are cleared.

Note! Warnings and alarms will be shown as active in the app until the drive is stopped (even if a warning no longer is active).



10.6.7.1 Alarm list

Number	Meaning
1	Bridge error, I/O communication lost
2	-
3	-
4	Flash memory error
5	Pump coil current error
6	Pump coil output short circuit
7	-
8	Pump coil driver error
9	Pump coil open circuit
10	No swash angle input configured
11	No swash angle regulator enable input set
12	No work pressure input configured
13	No pressure regulator enable input configured
14	-
15	Required monitor signal lost from X1 digital input 1
16	Required monitor signal lost from X2 digital input 2
17	Required monitor signal lost from X3 digital input 3
18	Required monitor signal lost from X4 digital input 4
19	Required monitor signal lost from DI digital I/O 1
20	Required monitor signal lost from DI digital I/O 2
21	Required monitor signal lost from DI digital I/O 3
22	Required monitor signal lost from DI digital I/O 4
23	Required monitor signal lost from DO digital I/O 5
24	Required monitor signal lost from DO digital I/O 6
25	Required monitor signal lost from DO digital I/O 7
26	Required monitor signal lost from DO digital I/O 8
27	Pump supply voltage too low
28	I/O supply voltage too low
29	Control supply voltage too low
30	Control supply voltage too high
31	Control temperature too high
32	-
33	Analog input 1 minimum level alarm
34	Analog input 2 minimum level alarm
35	Analog input 3 minimum level alarm
36	Analog input 4 minimum level alarm
37	Analog input 5 minimum level alarm
38	Analog input 6 minimum level alarm

Number	Meaning
39	-
40	-
41	Analog input 1 maximum level alarm
42	Analog input 2 maximum level alarm
43	Analog input 3 maximum level alarm
44	Analog input 4 maximum level alarm
45	Analog input 5 maximum level alarm
46	Analog input 6 maximum level alarm
47	-
48	-
49	X1 digital input 1 alarm
50	X2 digital input 2 alarm
51	X3 digital input 3 alarm
52	X4 digital input 4 alarm
53	DI digital I/O 1 alarm
54	DI digital I/O 2 alarm
55	DI digital I/O 3 alarm
56	DI digital I/O 4 alarm
57	DO digital I/O 5 alarm
58	DO digital I/O 6 alarm
59	DO digital I/O 7 alarm
60	DO digital I/O 8 alarm
61	-
62	Setpoint signal outside limits
63	Pt100 minimum level alarm
64	Pt100 maximum level alarm
65	Pump supply voltage too high
66	I/O supply voltage too high
67	Pump driver temperature too high
68	Pump driver temperature too low
69	I/O temperature too high
70	I/O temperature too low
71	Watchdog activated. Please contact support
72	Control temperature too low
73	Pump driver overheated
74	EEPROM communication error
75	EEPROM memory data loss error

10.6.7.2 Warning list

Number	Meaning
1	Analog input 1 minimum level warning
2	Analog input 2 minimum level warning
3	Analog input 3 minimum level warning
4	Analog input 4 minimum level warning
5	Analog input 5 minimum level warning
6	Analog input 6 minimum level warning
7	No configuration found in memory
8	Password has not been changed from factory setting
9	Analog input 1 maximum level warning
10	Analog input 2 maximum level warning
11	Analog input 3 maximum level warning
12	Analog input 4 maximum level warning
13	Analog input 5 maximum level warning
14	Analog input 6 maximum level warning
15	No setpoint input configured
16	No start drive input configured
17	X1 digital input 1 warning
18	X2 digital input 2 warning
19	X3 digital input 3 warning
20	X4 digital input 4 warning
21	DI digital I/O 1 warning
22	DI digital I/O 2 warning
23	DI digital I/O 3 warning
24	DI digital I/O 4 warning
25	DO digital I/O 5 warning
26	DO digital I/O 6 warning
27	DO digital I/O 7 warning
28	DO digital I/O 8 warning
29	Swash angle input signal outside range
30	Error too high for swash angle regulation
31	Work pressure input signal outside range
32	Error too high for pressure regulation
33	Analog input 1 minimum temperature warning
34	Analog input 2 minimum temperature warning
35	Analog input 3 minimum temperature warning
36	Analog input 4 minimum temperature warning
37	Analog input 5 minimum temperature warning
38	Analog input 6 minimum temperature warning
41	Analog input 1 maximum temperature warning
42	Analog input 2 maximum temperature warning
43	Analog input 3 maximum temperature warning
44	Analog input 4 maximum temperature warning
45	Analog input 5 maximum temperature warning
46	Analog input 6 maximum temperature warning
49	X1 digital input 1 temperature warning
50	X2 digital input 2 temperature warning
51	X3 digital input 3 temperature warning
52	X4 digital input 4 temperature warning
53	DI digital I/O 1 temperature warning
54	DI digital I/O 2 temperature warning
55	DI digital I/O 3 temperature warning
56	DI digital I/O 4 temperature warning

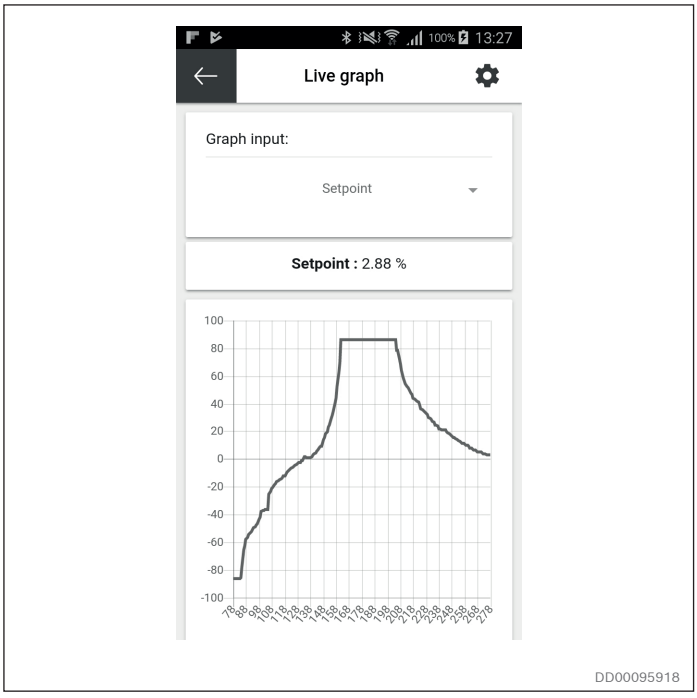
Number	Meaning
57	DO digital I/O 5 temperature warning
58	DO digital I/O 6 temperature warning
59	DO digital I/O 7 temperature warning
60	DO digital I/O 8 temperature warning
63	Pt100 minimum temperature warning
64	Pt100 maximum temperature warning
65	AI Analog input 1 signal outside range
66	AI Analog input 2 signal outside range
67	X1 Analog input 3 signal outside range
68	X2 Analog input 4 signal outside range
69	X3 Analog input 5 signal outside range
70	X4 Analog input 6 signal outside range
71	Pt100 signal outside range
72	AI over current on +24V out
73	X1 over current on +24V out
74	X2 over current on +24V out
75	X3 over current on +24V out
76	X4 over current on +24V out
77	DI over current on +24V out
78	Digital output driver overheat warning
79	DI digital output 1 over current warning
80	DI digital output 2 over current warning
81	DI digital output 3 over current warning
82	DI digital output 4 over current warning
83	DO digital output 5 over current warning
84	DO digital output 6 over current warning
85	DO digital output 7 over current warning
86	DO digital output 8 over current warning
87	Pump supply voltage high warning
88	Pump supply voltage low warning
89	I/O supply voltage high warning
90	I/O supply voltage low warning
91	Control supply voltage high warning
92	Control supply voltage low warning
93	Pump driver temperature high warning
94	I/O driver temperature high warning
95	Control temperature high warning
91	Control voltage high warning
92	Control voltage low warning
93	Pump driver temperature high warning
94	I/O driver temperature high warning
95	Control temperature high warning
97	Digital I/O 1: Voltage detected on low output
98	Digital I/O 2: Voltage detected on low output
99	Digital I/O 3: Voltage detected on low output
100	Digital I/O 4: Voltage detected on low output
101	Digital I/O 5: Voltage detected on low output
102	Digital I/O 6: Voltage detected on low output
103	Digital I/O 7: Voltage detected on low output
104	Digital I/O 8: Voltage detected on low output
105	Pump coil resistance significantly lower than configured
106	Pump coil resistance significantly higher than configured

10.6.8 Live graph

In the live graph all of the read values from the ICp can be monitored. In the dropdown menu the following are selectable:

- Setpoint
- Pressure
- Swash angle
- Pump current
- Analog input 1
- Analog input 2
- Analog input 3
- Analog input 4
- Analog input 5
- Analog input 6
- Pt100

For analog inputs, read values are shown in mA as read by the input.
The graph will show latest 20 seconds of data.



11 Accessories

11.1 Swash angle sensor

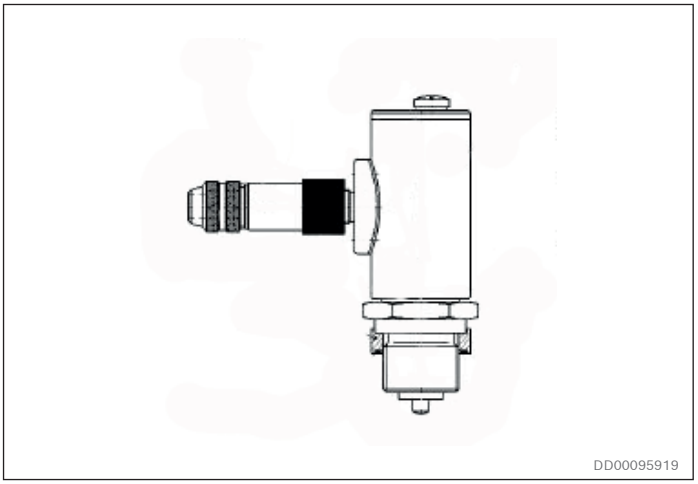


Fig. 14: Swash angle sensor

Function

This sensor is mechanically linked to the swash plate in the pump for pump angle feedback. It has an output of 12 mA when the pump is centered and a zero point adjustment. As the pump moves the signal varies from 4 mA at max flow in one direction to 20 mA at max flow in the other direction. M12 connector is included.

Table 3: Electrical and mechanical data swash angle sensor

Contact	M12
Voltage	24 V
Pin connection	1: +24 V
	2: Do not connect to any ICp input
	3: 0 V
	4: Signal output (4-20 mA)

Table 4: Material id swash angle sensor

Sensor	For pump sizes (A4CSG, A4VSG, A4VSO)
R902471376	40, 125, 180
R902471374	71
R902471372	250, 355, 500, 750

11.2 Pressure sensor

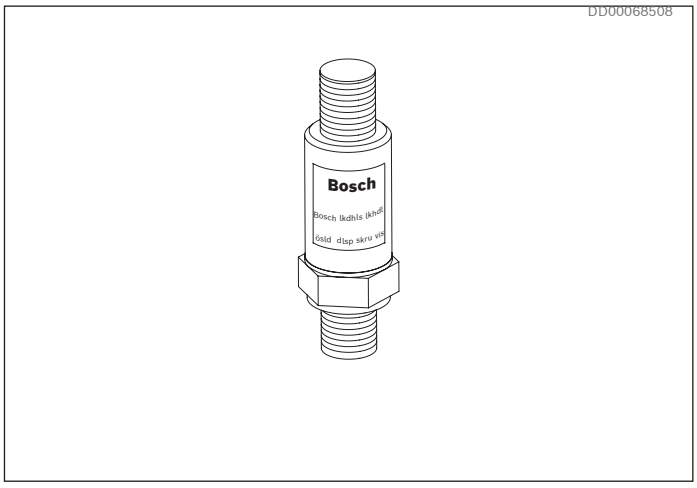


Fig. 15: Pressure sensor

Function

The pressure sensor gives information about the pressure level in different parts of the hydraulic system. The signal is used for information about system usage and/or used for control functions.

Table 5: Electrical and mechanical data pressure sensor

Measuring range	Work pressure 0...400 bar
	Low pressure 0...50 bar
Supply voltage Ub	18...36 VDC
Max load (ohm)	(Ub-8.5V)/21.5 mA
Protection class	IP65
Connector	4 pole M12
Pin connection	1: +Ub
	2: Signal output (4-20 mA)
Connection (sensor thread)	G 1/4

Table 6: Material id pressure sensor

R901342033	HM 20-2X/400-C-K35	400 bar
R901466597	HM 20-2X/250-C-K35-N	250 bar
R901342022	HM 20-2X/50-C-K35	50 bar

11.3 Temperature sensor ①

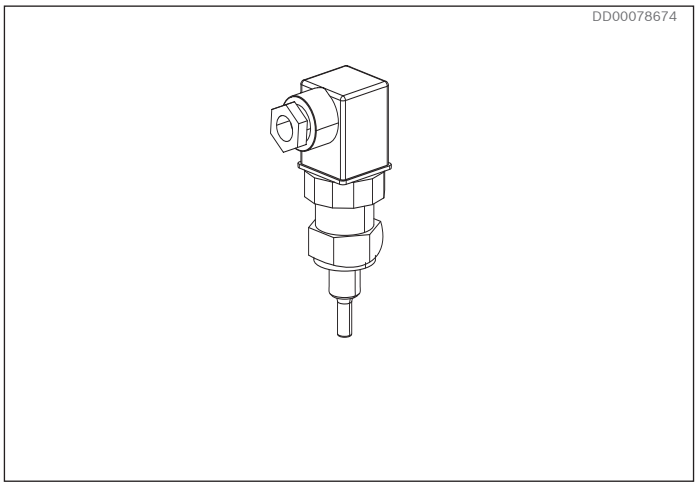


Fig. 16: Temperature sensor

Function

This sensor type includes a 30 mm temperature sensor and electrical connector. The sensor can be used to measure the drain temperature in Hägglunds pumps with an adapter.

Table 7: Electrical and mechanical data temperature sensor

Temp range	0...100°C
Supply voltage Ub	7.5...30 VDC
Max load (ohm)	(Ub-7.5V)/22 mA
Protection class	IP65
Connector	DIN 43650 (Hirschmann)
Pin connection	1: +Ub
	2: Signal output (4-20 mA)
Max pressure	50 bar
Connection (sensor thread)	G 1/4
Sensor element length	30 mm

Material id temperature sensor:
R939068778

11.4 Adapter tube ②

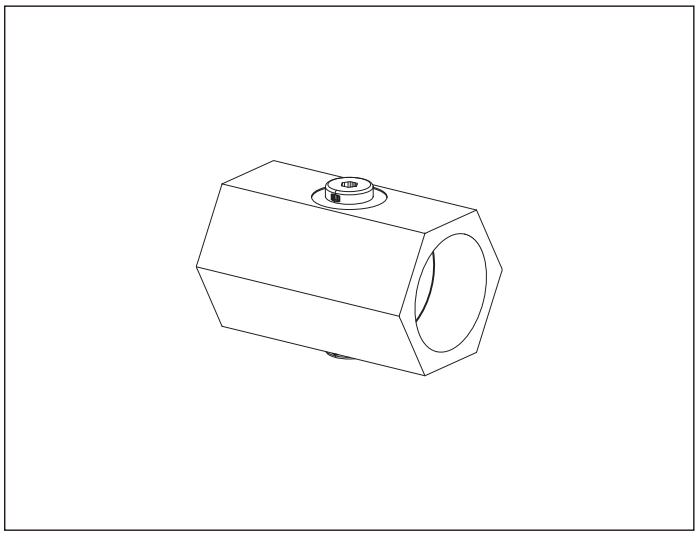


Fig. 17: Adapter tube

Function

This adapter can be used to install temperature sensor in the drain line from the motors and pumps. It can also be used to install pressure sensor in drain line or return line.

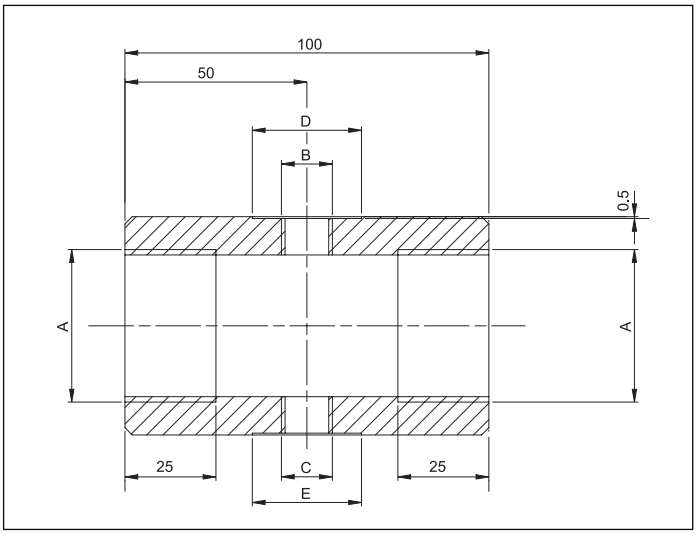


Table 8: Dimensions adapter tube

Type	A	B	C	D	E	Max pressure
				mm	mm	bar
R939068779	G 1 ¼"	G ¼"	G ¼"	30	30	90
R939068780	G 1 ½"	G ¼"				

Things to consider when placing sensors

1. Pressure sensor should be placed as close as possible to the pressure that should be controlled.
2. Temperature sensor could be used for different types of monitoring, e.g. in tank or in drain from motor or pump (see *Fig. 18)*.

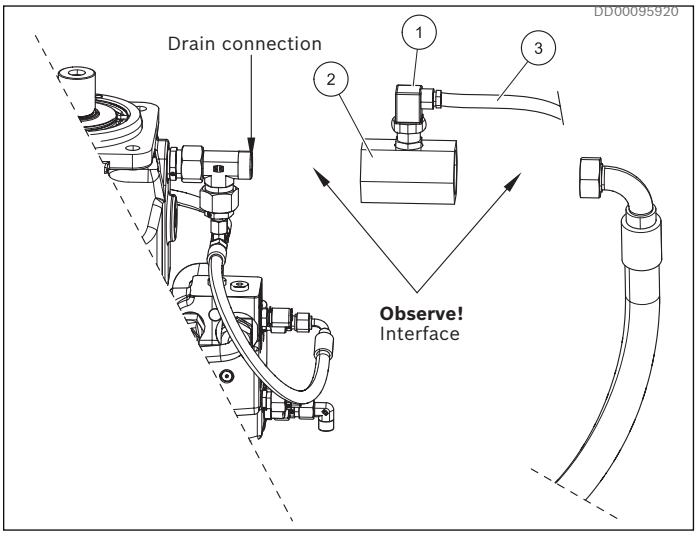


Fig. 18: Example temperature sensor, adapter tube and cable

11.5 Cables and connectors ③

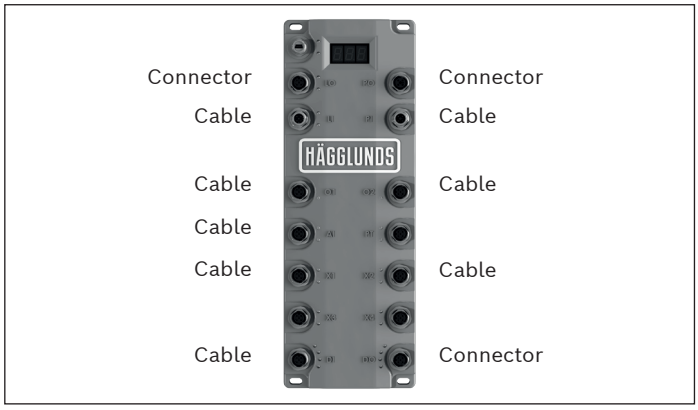


Fig. 19: Cable set

Table 9: Complete cable sets for ICp installation

Connector	Material id	Description
Straigh	R939070161	Cable sets with eight cables, M12 connectors on one side and open end on the other. Length 5 meter. Three additional loose connectors included for possibility to daisy-chain multiple ICp units, if needed. See *Fig. 19* for reference.
90° angled	R939015562	

Table 10: Material id cables and connectors

ICp contact	Style (ICp)	Material id	Description
LI	M12 5 pin male	R901493019	Connector, 5 pin female, angled
		R901420605	Connector, 5 pin female, straight
		R901499053	Cable, 5 m M12 4 pin female, angled – open end, 4x 1.5 mm²
		R901499094	Cable, 5 m M12 4 pin female, straight – open end, 4x 1.5 mm²
LO, DI, DO	M12 5 pin female	R901551776	10 m M12 5 pin male, angled – open end, 5x 1.5 mm²
		R901490972	10 m M12 5 pin male, straight – open end, 5x 1.5 mm²
		R901493013	Connector, 5 pin male, angled
		R901492924	Connector, 5 pin male, straight
PI	M12 T 4 pin male (M12 Power)	R901489961	Cable, 10 m M12 T 4 pin female – open end, 4x 1.5 mm²
		R901489919	Cable, 5 m M12 T 4 pin female – open end, 4x 1.5 mm²
		R901489980	Cable, 1 m M12 T 4 pin female – M12 T 4 pin male, 4x 1.5 mm²
		R901489971	Cable, 5 m M12 T 4 pin female – M12 T 4 pin male, 4x 1.5 mm²
		R901490327	Connector, M12 T 4 pin female, angled
		R911387900	Connector, M12 T 4 pin female, straight
		R901551788	Cable, 5 m M12 T 4 pin female, angled – open end, 4x 1.5 mm²
PO	M12 T 4 pin female (M12 Power)	R901489980	Cable, 1 m - M12 T 4 pin male - M12 T 4 pin female, 4x 1.5 mm²
		R901489971	Cable, 5 m - M12 T 4 pin male - M12 T 4 pin female, 4x 1.5 mm²
		R901490336	Connector, M12 T 4 pin male, angled
		R911387901	Connector, M12 T 4 pin male, straight
O1, O2, AI, PT, X1, X2, X3, X4	M12 4 pin female	R901499096	Cable 1.5 m M12 4 pin male – open end, 4x 0.75 mm²
		R901499097	Cable 3.0 m M12 4 pin male – open end, 4x 0.75 mm²
		R901493013	Connector, 5 pin male, angled
		R901492924	Connector, 5 pin male, straight

12 Placement

Hägglunds ICp can be attached to a mounting plate or similar with four M4x20 hexagon socket head cap screws.

Preferably mounted close to pump. With respect to EMC, cables connected to I/O and pump outputs are recommended to be shorter than 3 m, since longer cables are not tested. For longer distances galvanic isolation is recommended.

13 Open source software license

This device contains open source software license according to the table below.

Component	License
Bootloader, font5x7.h	font5x7.h BSD (Two Clause License)
Bootloader, monitor.c, monitor.h	String handler (copyright notice)

License texts and copyright texts can be found below.

Fixed-width font bitmap

DSemu: Fixed-width font bitmap (font5x7.h)
Released under the terms of the BSD Public Licence
Imran Nazar (tf@oopsilon.com), 2004

Copyright 2004 Imran Nazar (tf@oopsilon.com)

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS “AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE

String Handler, (monitor.c, monitor.h)

Copyright (C) 2010, ChaN, all right reserved.

This software is a free software and there is NO WARRANTY. No restriction on use. You can use, modify and redistribute it for personal, non-profit or commercial products UNDER YOUR RESPONSIBILITY. Redistributions of source code must retain the above copyright notice.

UART Driver

Copyright (c) 2011, Nic McDonald
All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditionsare met:
1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS“ AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOTLIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Simple peripheral

BLE SDK

Release Name: ble_sdk_2_02_02_25
Release Date: 2018-04-02 18:03:35

14 Related documents

	Title	Document no	Document type
	Pressure sensor	RE30272	Data sheet

Documents at Bosch Rexroth Media Directory

Bosch Rexroth AB
895 80 Mellansel, Sweden
Tel: +46 (0) 660 870 00
Fax: +46 (0) 660 871 60
www.hagglunds.com