SPECIFICATION OF FIRMWARE H2.48 R03

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PURPOSE: This document specifies the modes, the interface and the limits of the Firmware H2.48.

SCOPE: Pump System PuraLev®-i30SU (13000 rpm)

OEM-Models	: IPD-30.1-50-02 / IPD-30.1-50-02 / IPD-30.12-50-02 / IPD-30.7-03-02 / IPD-30.8-03-02
EasyConnect-Models	: IPD-30.3-02 / IPD-30.4-02
Standalone-Models	: IPD-30.5-02

Contents:

1 Specification

1.1 Overview

Overview		
Modes	Standby mode	
	Speed control mode	
	Flow/pressure control mode	
User Interfaces	PLC-Interface (OEM and EasyConnect-Models)	
	Levitronix Service Software 2.0.9 (OEM and EasyConnect-Models)	
	Modbus RTU over RS485 (OEM and EasyConnect-Models)	
	Stand-alone User Interface (IPD-30.5)	
Limitations	Maximum Speed	13000 rpm
	Bearing-phase current limit	5.2 A_{rms}
	Bearing overcurrent protection limit	1 A_{rms} during 30 sec
	Bearing overcurrent protection limit (single phase)	1.38 A_{rms} during 3 sec
	Drive-phase current limit	1.3 A_{rms}
Parameters	Default parameters stored in flash	User specific parameter storable in EEPROM of driver

Table 1: Overview of specification

2 Interfaces

2.1 Extended PLC Interface (OEM and EasyConnect Models)

2.1.1 Overview wire designation of the OEM driver cable

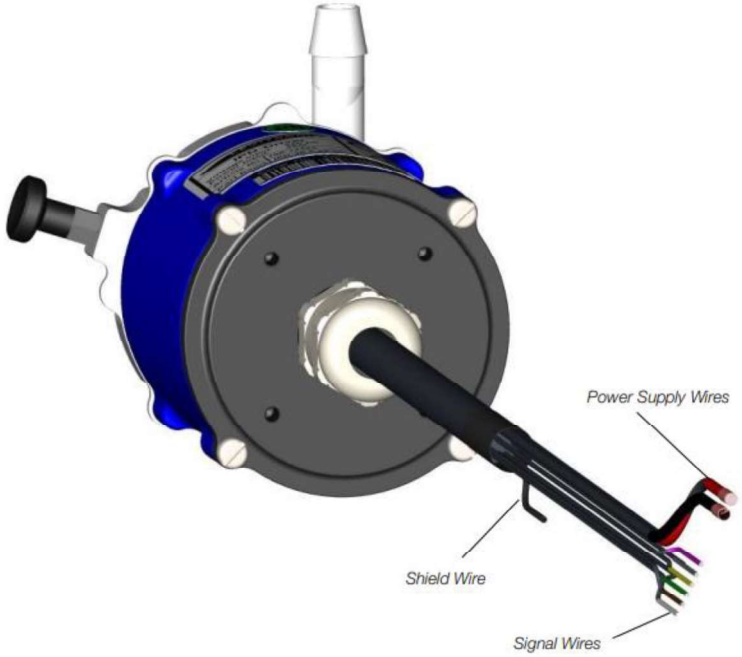


Figure 1: Electrical connections to OEM driver IPD-30.1

Figure 2: Electrical connections to OEM driver IPD-30.7, IPD-30.8

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
B	P+	red	+ 24 VDC	Supply	Voltage: 24 VDC ±10%	P- to be connected to earth.
A	P-	black	Power Input Ground / Earth			
7	Ain1	violet	Analog Input (Current)	Actual Process Value	4..20 mA = 0..100%	450 Ohm shunt input, no galvanic isolation. The designation of the analog inputs can be changed with *Levitronix® Service Software 2.0.*
8	Ain2	grey-pink	Analog Input (Voltage)	Reference Value	0..10 V = 0..16000 rpm (*Speed Mode*) -> Speed limit = 13000rpm 0..10 V = 0..100% *(Process Mode)*	Analog voltage input: 0 – 10V (7.9 kOhm, no galvanic isolation). *Note: Max. input voltage of 11 V shall not be exceeded.* The designation of the analog inputs can be changed with *Levitronix® Service Software 2.0.*
6	Ain_GND	blue	Analog Input Ground	--	--	Reference for Ain1/2.
9	Aout1	blue-red	Analog Output	Actual Speed Actual Process Value	0..10 V = 0..16000 rpm *(Speed Mode)* 0..10 V = 0..100% (*Process Mode*)	Direct connection, no protection. Galvanic isolation on user side is required. GND is reference. The configuration of the analog output can be changed with *Levitronix® Service Software 2.0*
10	GND	white-green shield	Ground	--	--	Reference for Aout1, Dout1, Dout2 and Pout.
2	Dout1	brown	Digital Output 1	Status	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA The configuration of the digital outputs can be changed with *Levitronix® Service Softw. 2.0*
1	Dout2	white	Digital Output 2	Error	Closed circuit ⇒ not active Open circuit ⇒ active	Open drain, max. 24V, 100mA The configuration of the digital outputs can be changed with *Levitronix® Service Software 2.0*
5	Din1	pink	Digital Input 1	Enable (Reset)	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. The "*Enable*" signal switches the pump system on and off. Resets pump from error state with 300-700ms pulse.
4	Din2	grey	Digital Input	Process Mode	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. Switch between process mode and speed mode. In process mode the closed loop PI controller can be configured with *Levitronix® Service Software 2.0.*
3	Din_COM	yellow	Common Digital Input	--	--	Reference to Din1 and Din2.
11	RS485+	brown-green	RS485 +	Field Bus	Modbus RTU protocol	Termination resistors recommended
12	RS485-	white-yellow	RS485 -			
nc	NC	yellow-brown	Do not connect	--	--	For future options
nc	NC	white-gray	Do not connect	--	--	For future options
Shield	Shield	shield wire	Shielding	Shielding		To be connected to earth (see wire P-, black)

Table 2: Signals of the driver cable with designation for standard firmware H2.48
- Configurations can be done with Levitronix® Service Software 2.0
- Power wires (P+, P-) have cross section 1.5 mm² and all others 0.14 mm²

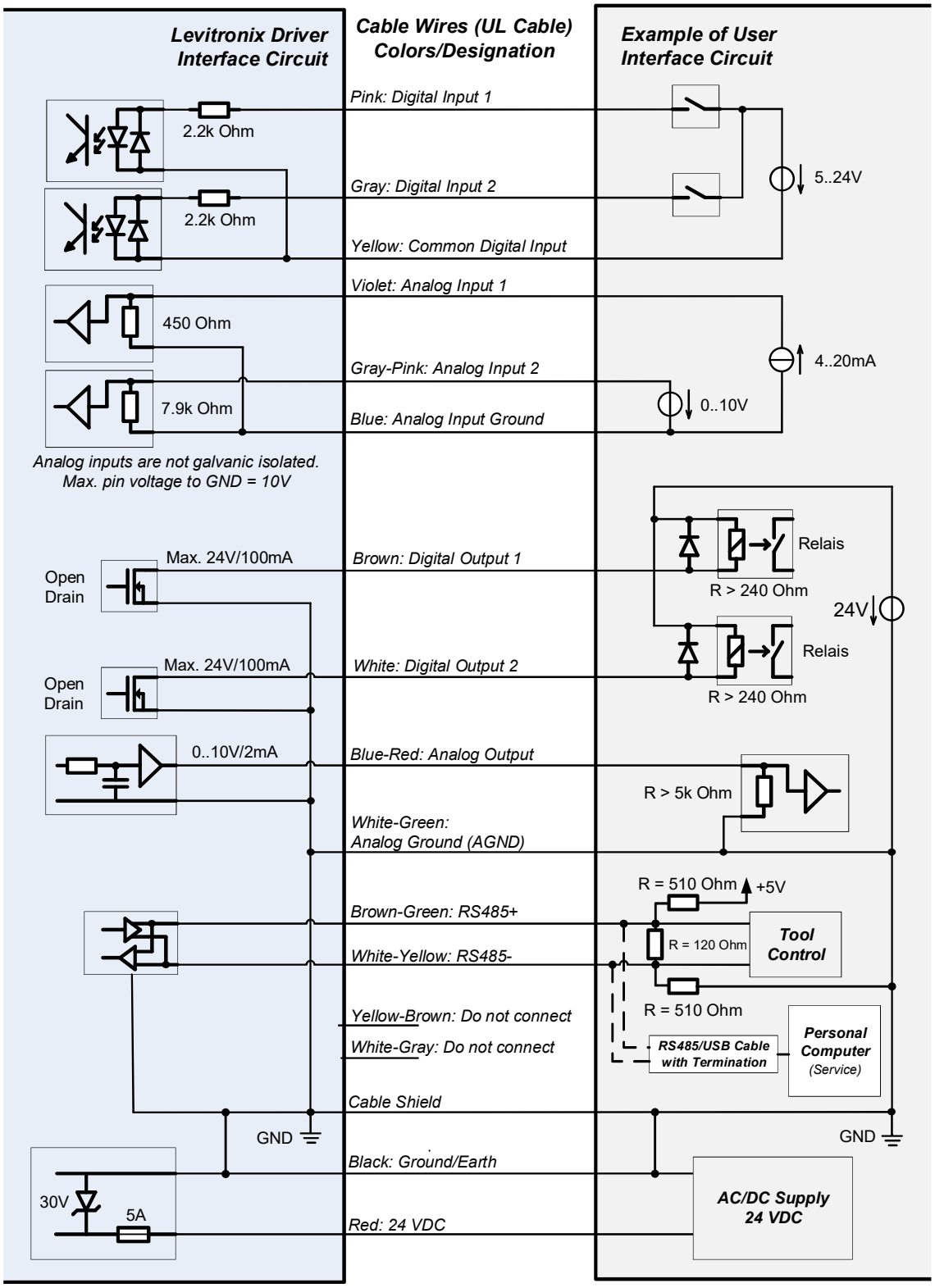


Figure 3: Configuration of the Levitronix Driver Interface

2.1.2 Overview of connections and designation of EasyConnect model

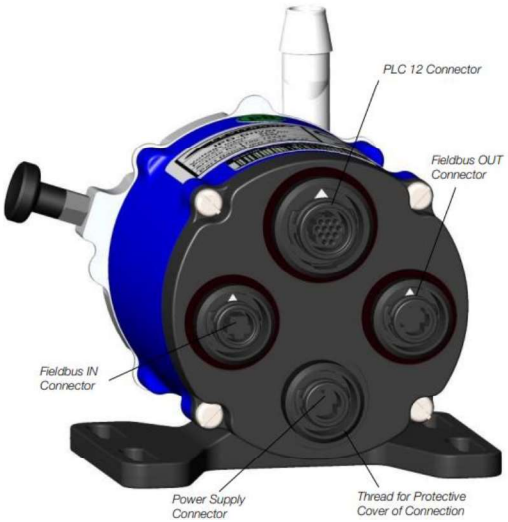


Figure 4: Electrical connections to EasyConnect driver IPD-30.3

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Specifications Typical Levels	Note
2	P +	red	+ 24 VDC	*Power Supply*	Voltage: 24 VDC ±10% Power: 35 W	"P -" shall be connected to earth
1	P -	black	Ground/Earth			
3	NC	white	Not connected	--	Wire of compatible cables is cut.	Wire of compatible cables is cut.

Table 3: Power supply connector of EasyConnect driver model
1: Wire colors of compatible cables: ICP-1.1-xx.

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
3	GND	brown black shield	Ground	--	--	--
6	NC	pink blue	Not connected	--	--	--
1	RS485+	white	RS485+	*Field Bus*	Modbus protocol.	For remote control with other devices. Usage of Levitronix Service Software with a RS485 to USB adaptor cable.
2	RS485-	yellow	RS485-			
4	Internal	grey	Internal	*Do not connect.*	--	Internal bus needed to connect pumps for serial pumping.
5	Internal	red	Internal			

Table 4: Fieldbus IN connector of EasyConnect driver model
1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
3	GND	brown black shield	Ground	*Supply Output*	24VDC 10%, 200 mA (Max. current is together with Pout of *PLC* connector)	For supply of external devices (displays etc.). Internally protected.
6	Pout	pink blue	Output 24VDC			
1	RS485+	white	RS485+	*Field Bus*	Modbus protocol.	For remote control with other devices. Usage of Levitronix Service Software with a RS485 to USB adaptor cable. Feed through for multi-pump arrays
2	RS485-	yellow	RS485-			
4	Internal	grey	Internal	*Do not connect.*	--	Internal bus needed to connect pumps for serial pumping.
5	Internal	red	Internal			

Table 5: Fieldbus OUT connector of EasyConnect driver model

1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
7	Ain1	violet	Analog Input (Current)	Actual Process Value	4..20 mA = 0..100%	450 Ohm shunt input, no galvanic isolation. The designation of the analog inputs can be changed with *Levitronix® Service Software 2.0.*
8	Ain2	grey-pink	Analog Input (Voltage)	Reference Value	0..10 V = 0..16000 rpm (*Speed Mode*) -> Speed limit = 13000rpm 0..10 V = 0..100% *(Process Mode)*	Analog voltage input: 0 – 10V (7.9 kOhm, no galvanic isolation). *Note: Max. input voltage of 11 V shall not be exceeded.* The designation of the analog inputs can be changed with *Levitronix® Service Software 2.0.*
6	Ain_GND	blue	Analog Input Ground	--	--	Reference to Ain1/2.
9	Aout1	blue-red	Analog Output	Actual Speed Actual Process Value	0..10 V = 0..16000 rpm *(Speed Mode)* 0..10 V = 0..100% (*Process Mode*)	Direct connection, no protection. Galvanic isolation on user side is required. GND is reference. The configuration of the analog output can be changed with *Levitronix® Service Software 2.0*
10	GND	white-green shield	Ground	--	--	Reference for Aout1, Dout1, Dout2 and Pout.
2	Dout1	brown	Digital Output	Status	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA The configuration of the digital outputs can be changed with *Levitronix® Service Softw. 2.0*
1	Dout2	white	Digital Output	Error	Closed circuit ⇒ not active Open circuit ⇒ active	Open drain, max. 24V, 100mA The configuration of the digital outputs can be changed with *Levitronix® Service Software 2.0*
5	Din1	pink		Enable (Reset)	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. The "Enable" signal switches the pump system on and off. Resets pump from error state with 300-700ms pulse.
4	Din2	grey		Process Mode	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. Switch between process mode and speed mode. In process mode the closed loop PI controller can be configured with *Levitronix® Service Software 2.0.*
3	Din_COM	yellow	Common Digital Input	--	--	Reference to Din1 and Din2.
11	Pout	red	Output 24 VDC	Supply Output	24VDC ±10%, 200 mA (Max. current is together with Pout of *Fieldbus OUT* connector in)	For supply of external devices (displays etc.). Internally protected. Reference is GND.
12	NC	black	Not connected	--	--	--

Table 6: PLC connector of EasyConnect driver model

1: Wires of compatible cables: ICS-2.1-xx

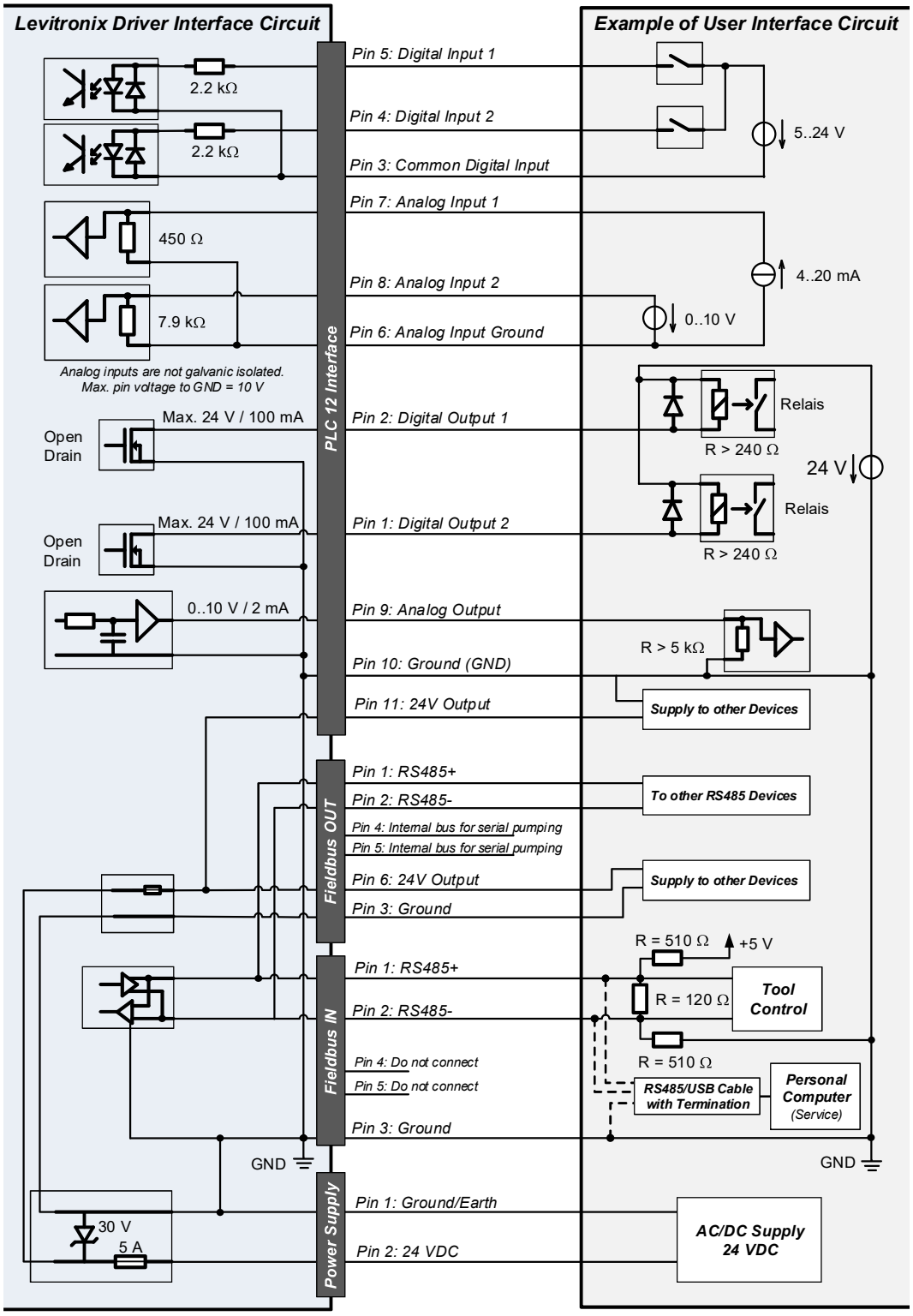


Figure 5: Configuration of the Levitronix Driver Interface

2.1.3 State diagram of the PLC Interface Module

Figure 6 *sho*ws the state diagram of the PuraLev®-i30 Pump System.

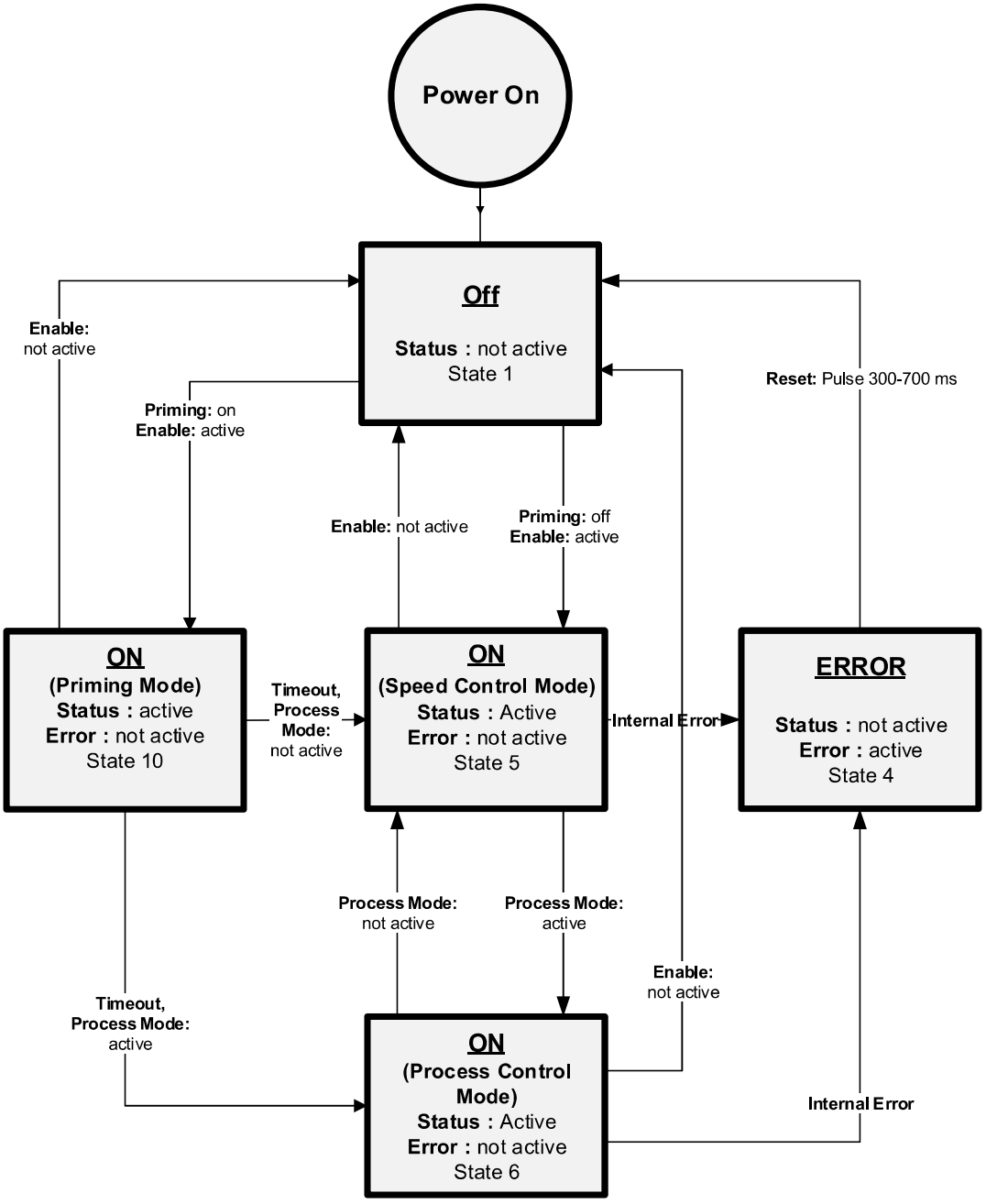


Figure 6: State diagram of the PLC Interface Module

There are five states:

Off

The pump system is switched off and the motor has no power. In this state, Levitronix Service Software has full control.

On (speed control mode)

The pump system is switched ON and the impeller is rotating with the referenced speed. The motor has electrical power when in this state.

On (process control mode)

The pump system is switched ON and the impeller is rotating with the setpoint flow/pressure. The motor has electrical power when in this state.

On (Priming mode)

The pump system is switched ON and the impeller is rotating with the priming speed. The motor has electrical power when in this state. This mode can only be accessed by activating priming feature within EEPROM-editor in Levitronix Service Software. Priming speed and Timeout-time can also be configured within EEPROM-editor.

Error

If an error according to *Table 7* occurs in the pump system, the system defaults to the *Error* state. The according digital output on the PLC Interface Module is activated. The pump system is switched OFF. By a pulse of 300-700 ms on the *Enable/Reset* input the system gets back to the *Off* state.

Errors	Effect on Designated Digital Output of the PLC
No pump head detected	Error = Open circuit
Driver temperature was above 90°C	
Driver temperature was higher than 80°C for more than 10 min.	
The pump could not stabilize the position of the impeller	
Motor coil interrupted	
Motor sensor reading error	
Parameter error. Could not access configuration	
Supply voltage out of range (< 18 or > 30 V DC) If the voltage is out of range the system starts to reduce the speed and a warning is generated. When reaching 0 rpm and the voltage is still out of range the system is disabled and an error is generated. In case the voltage is again within the range during speed reduction the system switches to normal operation and no Error is generated.	

Table 7: Possible errors with indication on PLC Interface Module

2.1.4 Analog assignments of the PLC Interface Module

2.1.4.1 Analog input 1

2.1.4.1.1 Actual process control value (flow or pressure)

Analog input 1 [mA]	Flow/Pressure [%]
4	0
20	100

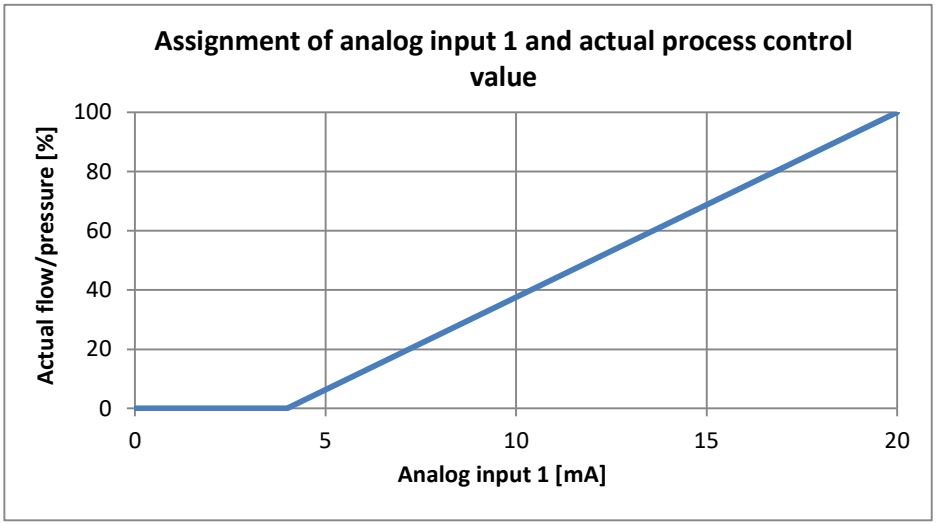


Figure 7: Assignment of actual process control value and analog input 1 [mA]

2.1.4.2 Analog input 2

2.1.4.2.1 Setpoint speed

Analog input 2 [V]	Speed [rpm]
0	0
10	16000

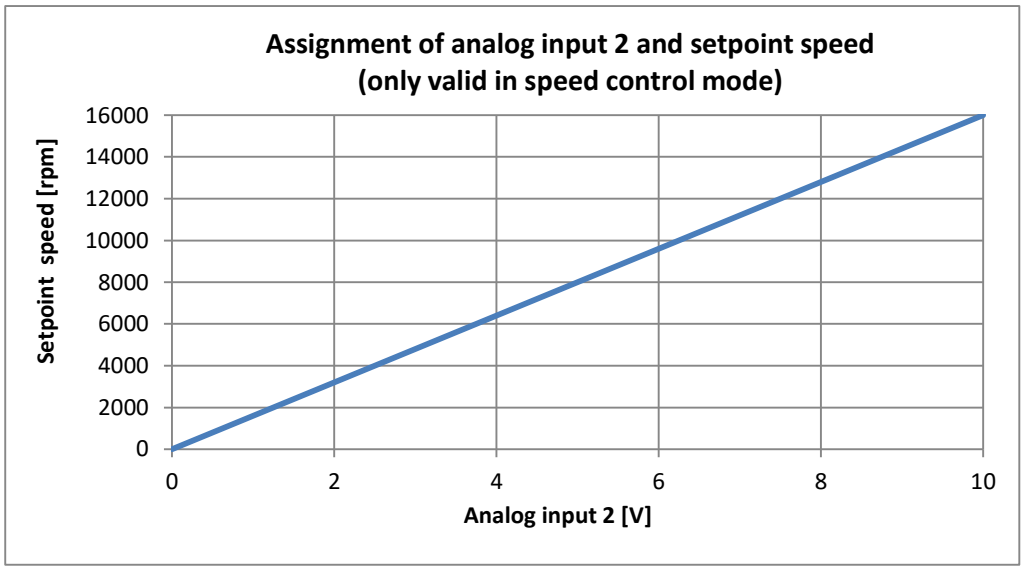


Figure 8: Assignment of setpoint speed and analog input 2 [V]

2.1.4.2.2 Setpoint process control value (flow or pressure)

Analog input 2 [V]	Flow/Pressure [%]
0	0
10	100

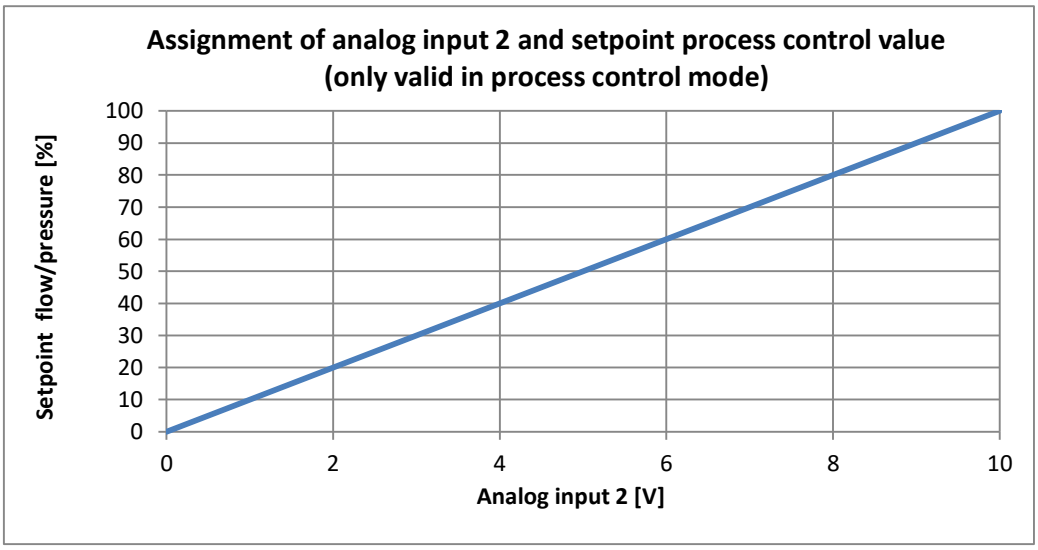


Figure 9: Assignment of setpoint process control value and analog input 2 [V]

2.1.4.3 Analog output

2.1.4.3.1 Actual speed (Speed Mode)

Analog output [V]	Speed [rpm]
0	0
10	16000

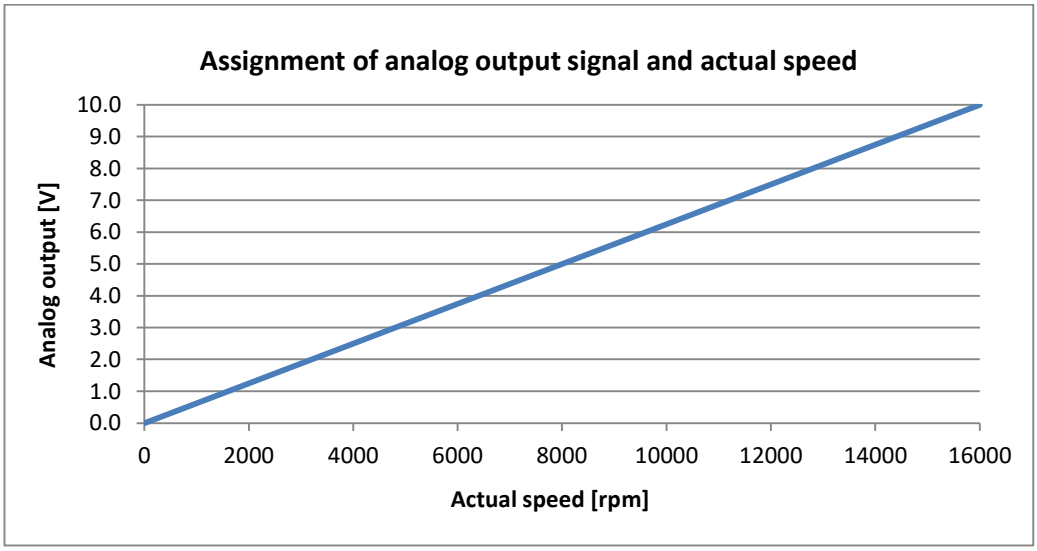


Figure 10: Assignment of speed and analog output signal [V]

2.1.4.3.2 Actual process control value (flow or pressure in Process Mode)

Analog output [V]	Flow/Pressure [%]
0	0
10	100

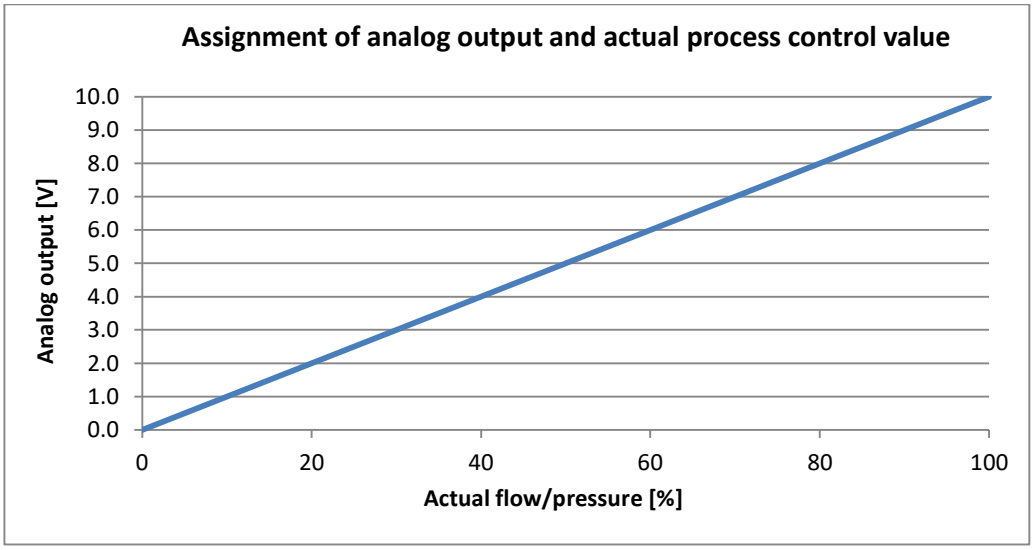
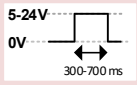
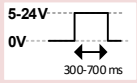
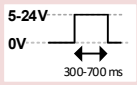


Figure 11: Assignment of actual process control value and analog output signal [V]

2.1.5 Digital Input/Output Signals of the PLC Interface Module

2.1.5.1 Digital Input Signals

The configuration of the digital inputs can be changed with the Service Software 2.0 or by Modbus protocol hold register 0x403F and 0x4040. The signal logic can be inverted.

Signal Name	Signal (Normal logic)		Description	Default Assignment
Enable process control mode / Reset	Normal state 0V: Not active 5-24V: Active	System is in error state  →Reset	If signal is active then system is enabled in process control mode. System can be reset from error state with a 300-700 ms pulse.	
Enable speed mode / Reset	Normal state 0V: Not active 5-24V: Active	System is in error state  →Reset	If signal is active then system is enabled in speed control mode. System can be reset from error state with a 300-700 ms pulse.	
Enable emergency stop	0V: Active 5-24V: Not Active		Emergency stop disables the system if active. See *Figure 26 State diagram*	
Enable pump system / Reset	Normal state 0V: Not active 5-24V: Active	System is in error state  →Reset	If signal is active then system is enabled in the control mode defined by "control selection" input. System can be reset from error state with a 300-700 ms pulse.	**Digital Input 1**
Enable control selection	0V: Speed control 5-24V: Process control		Defines the control mode for the "enable pump system" input.	**Digital Input 2**

2.1.5.2 Digital Output Signals

The configuration of the digital outputs can be changed with the Service Software 2.0 or by Modbus protocol hold register 0x400C and 0x400E. The signal logic can be changed from normally open to normally closed.

Signal Name	Signal (Normally open: Active → closed circuit)		Description	Default Assignment
STATUS PUMP	Active	Pump is running and has no error	This signal indicates the state of the pump system. If not active, pump is either in Off state or in Error state	**Digital Output 1**
	Not Active	Pump is either in Off or Error state		
Pump ERRORS	Active	Pump has at least one error active	This signal indicates if a pump error is active or not.	**Digital Output 2**
	Not Active	Pump has no error		
Pump WARNINGS	Active	Pump has at least one warning active	This signal indicates if a pump warning is active or not.	
	Not Active	Pump has no warning		
Custom Digital Output	Active	Custom Digital Output is active	Custom Digital Output can be configured in Service Software 2.0 or Modbus Hold register 0x400F	
	Not Active	Custom Digital Output is not active		
Priming Valve Signal	Active	System is in priming mode	This signal can be used to control a priming valve while system is in priming mode. Priming needs to be activated in the configuration.	
	Not Active	System is not in priming mode		

2.2 Levitronix Service Software 2.0

For observing, controlling and trouble shooting the *PuraLev®-i30* Pump System with the *Firmware H2.48* the Levitronix Service Software 2.0 (Version 2.0.9.0 or higher) for PC-Systems is available.

Additional to the Levitronix Service Software a Firmware Download Module needs to be installed. The Firmware Download Module has to match the firmware version installed on the Levitronix Driver.

System requirements:

OS: Windows XP, 7, 8, 10, 11

Installation file for Levitronix Service Software 2.0:

Levitronix Service Software V2.0.9.0 Installer.Msi

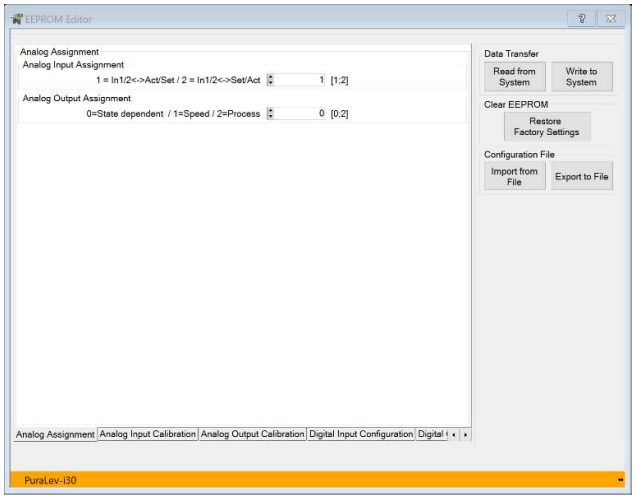
Installation file for Download Module of Firmware H2.48:

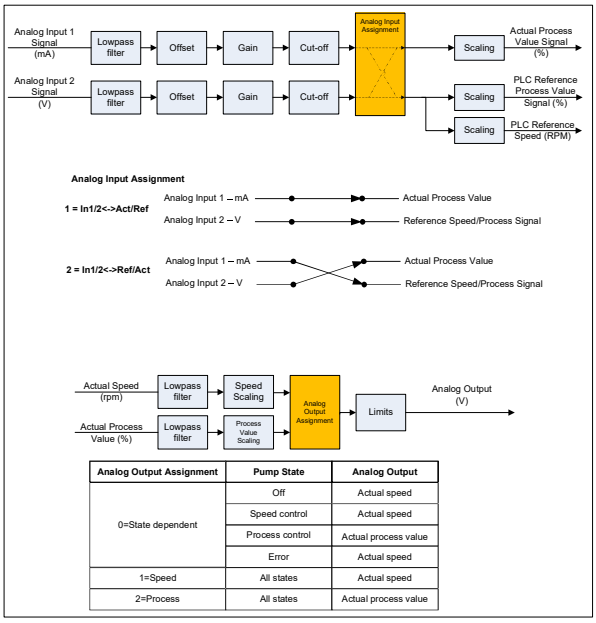
H030 H2.48 Rxx.Msi

2.2.1 EEPROM Editor Tabs

The following series of pictures show the EEPROM Editor within the *Levitronix Service Software 2.0* with its different tabs. The values within the tabs are the default values of the firmware. All parameters listed here are hold registers.

2.2.1.1 Analog Assignment

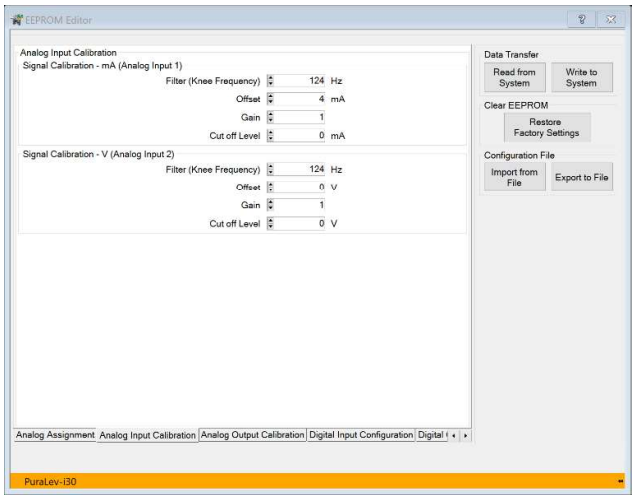




Analog Output Assignment	Pump State	Analog Output
0=State dependent	Off	Actual speed
	Speed control	Actual speed
	Process control	Actual process value
	Error	Actual speed
1=Speed	All states	Actual speed
2=Process	All states	Actual process value

Figure 12: Analog Assignment

2.2.1.2 Analog Input Calibration



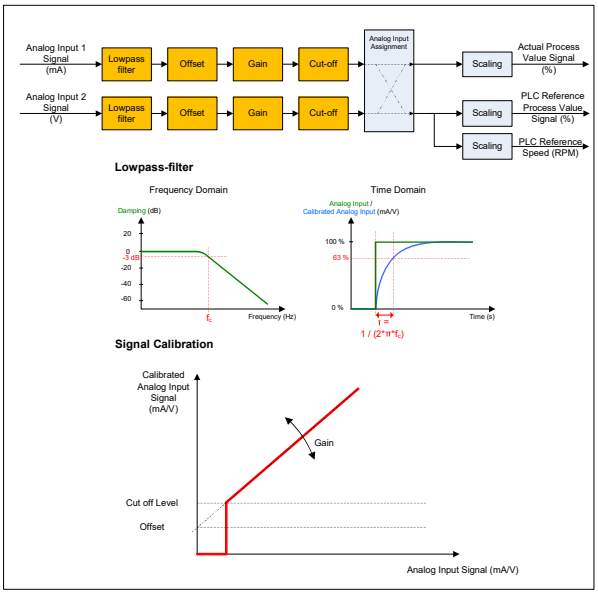


Figure 13: Analog Input Calibration

2.2.1.3 Analog Output Calibration

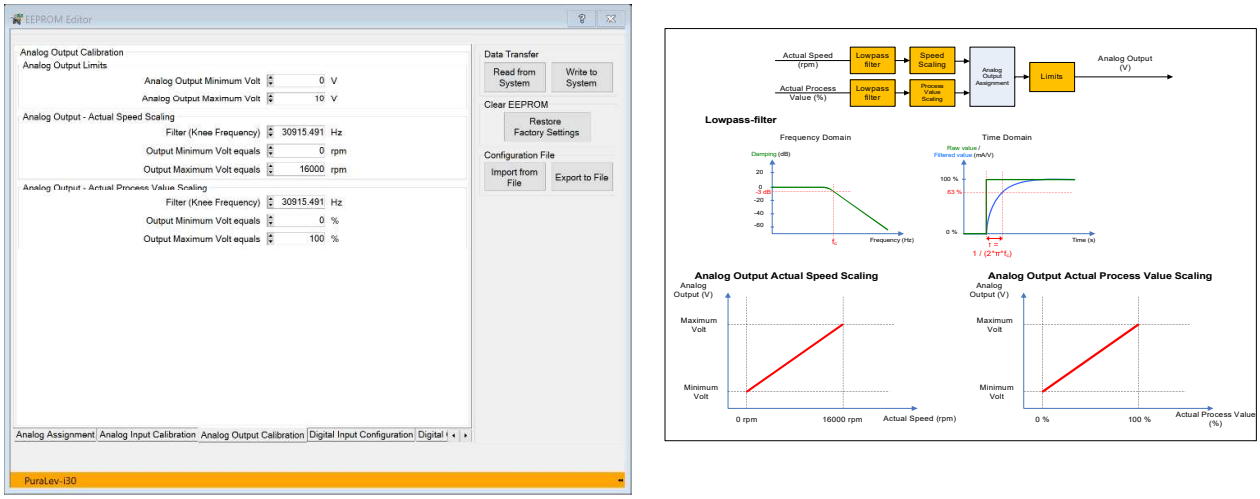


Figure 14: Analog Output Calibration

2.2.1.4 Digital Input Configuration

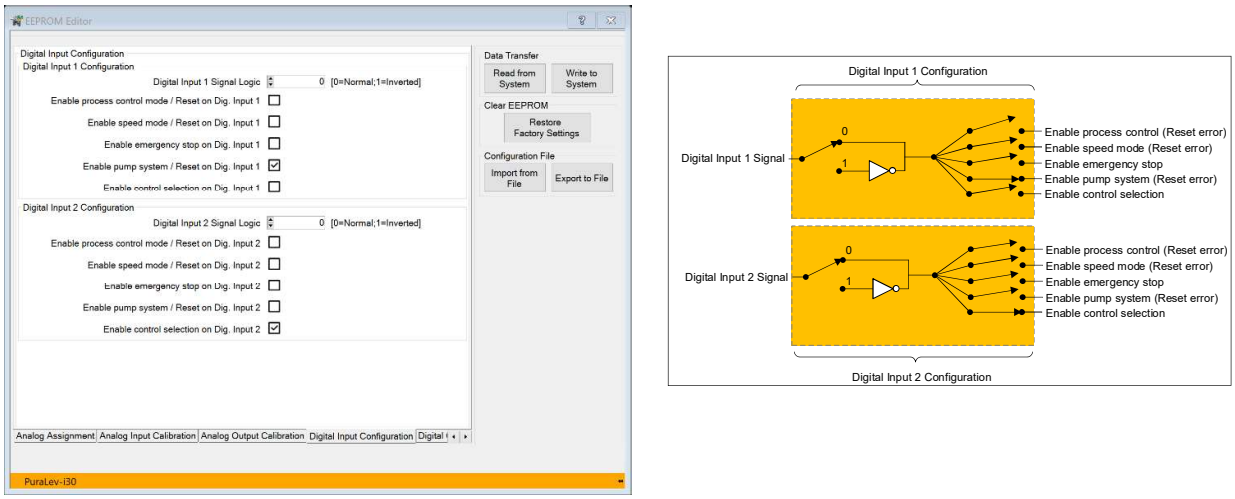


Figure 15: Digital Input Configuration

2.2.1.5 Digital Output 1 Configuration

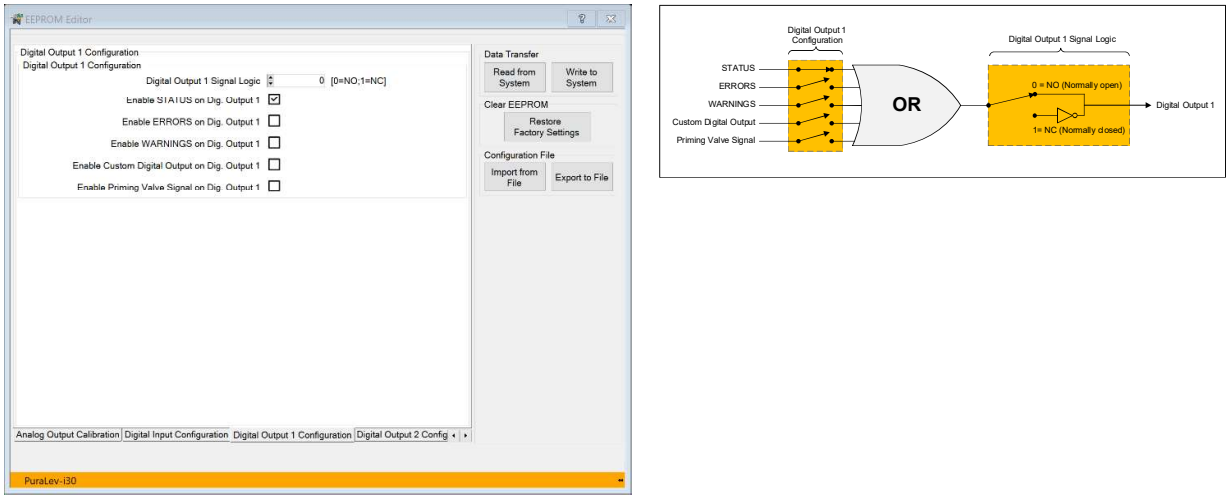


Figure 16: Digital Output 1 Configuration

2.2.1.6 Digital Output 1 Configuration

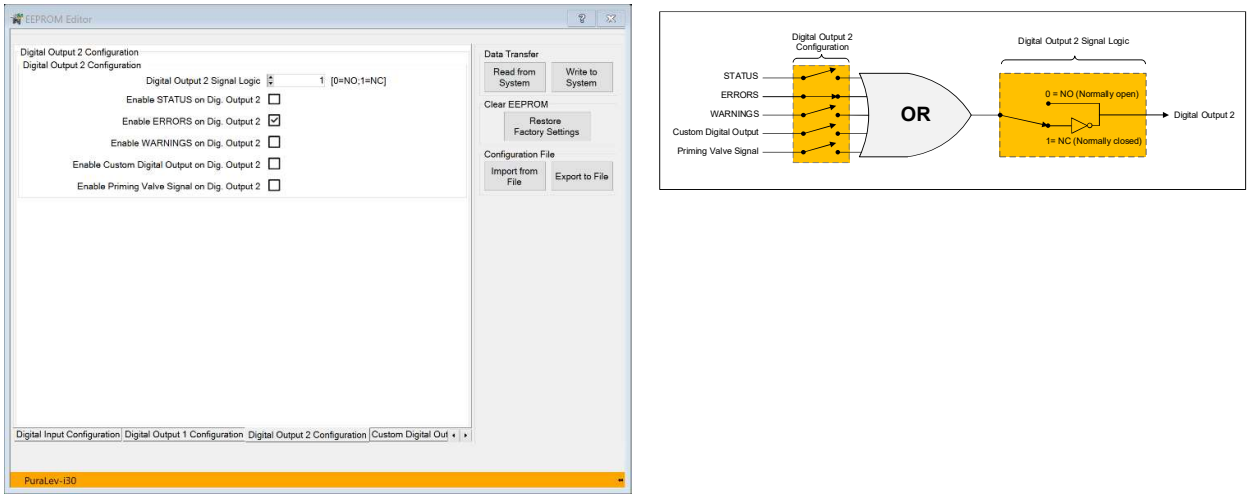


Figure 17: Digital Output 2 Configuration

2.2.1.7 Custom Digital Output Configuration

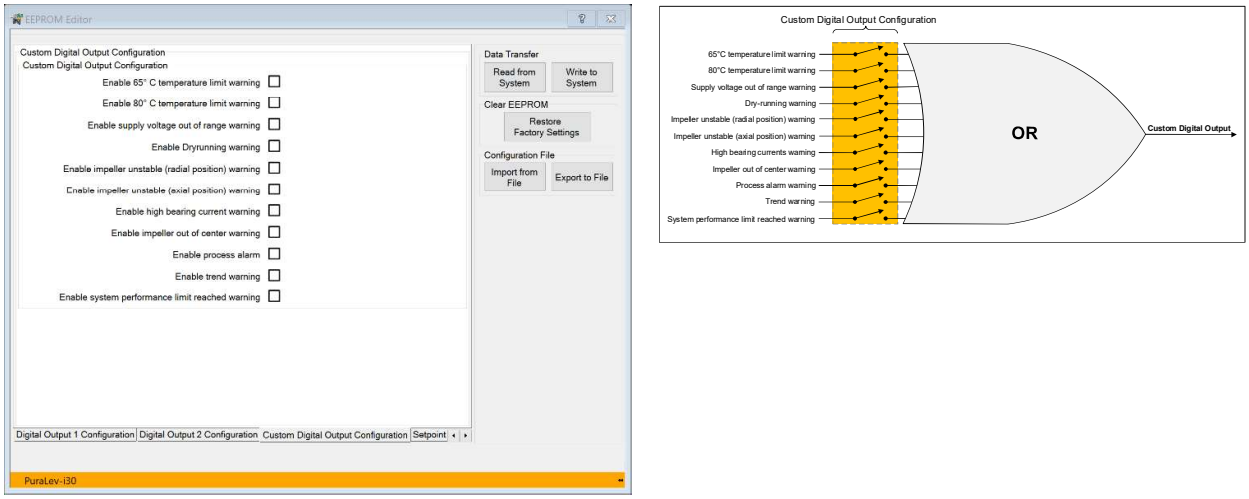


Figure 18: Custom Digital Output Configuration

2.2.1.8 Setpoint Speed/Process Signal

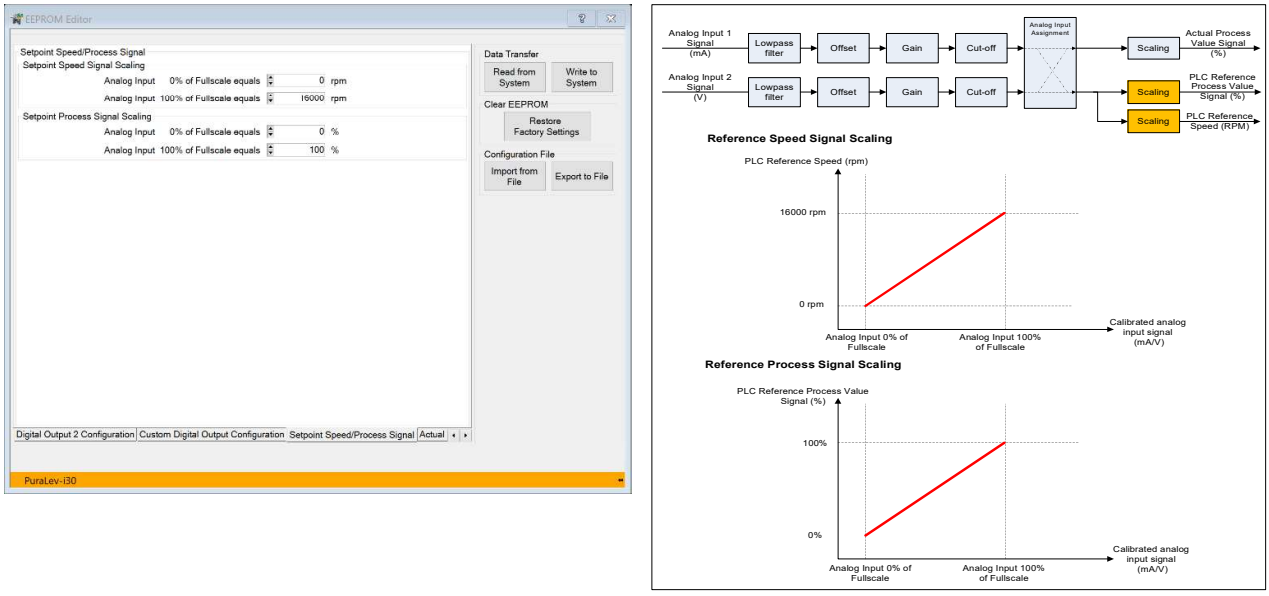
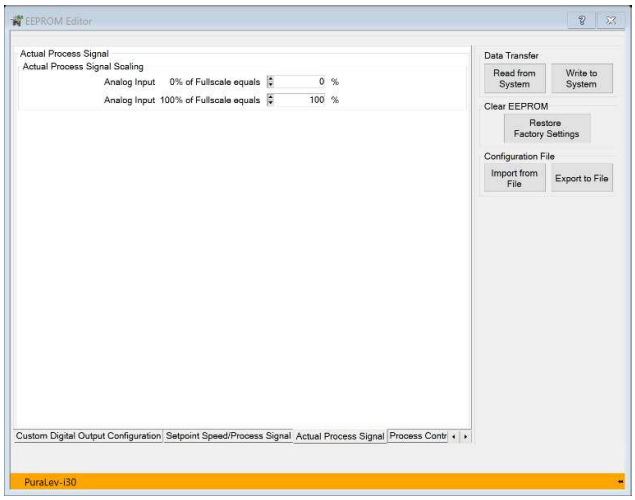


Figure 19: Setpoint Speed/Process Signal

2.2.1.9 Actual Process Signal



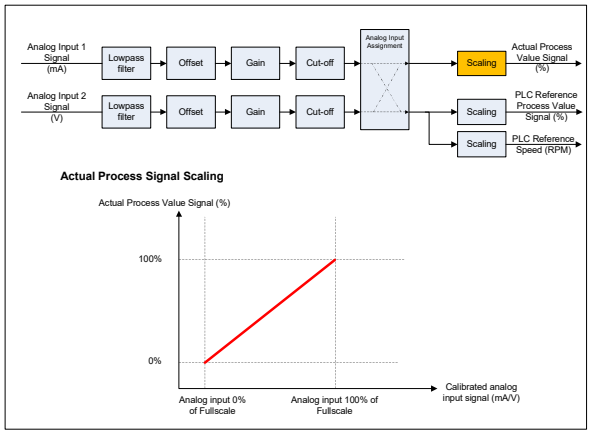
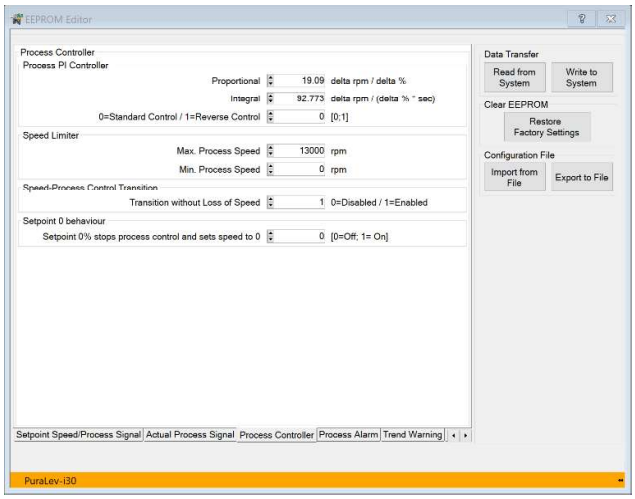


Figure 20: Actual Process Signal

2.2.1.10 Process Controller



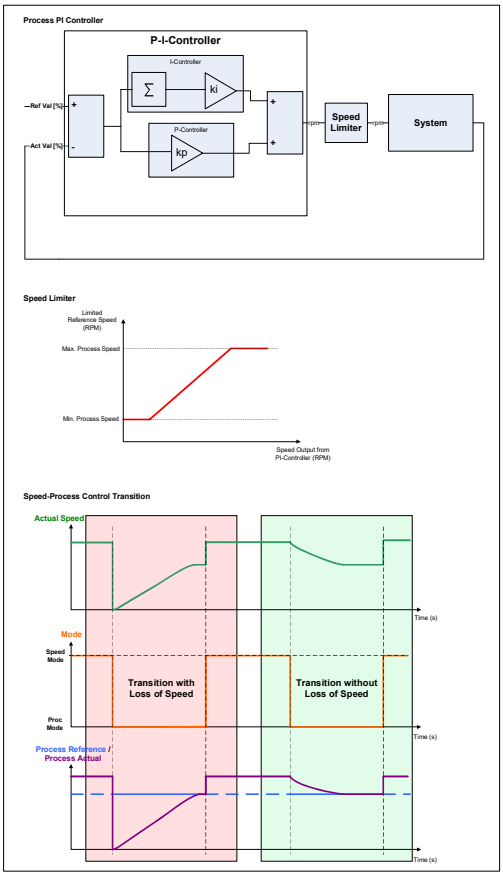


Figure 21: Process Controller

2.2.1.11 Process Alarm

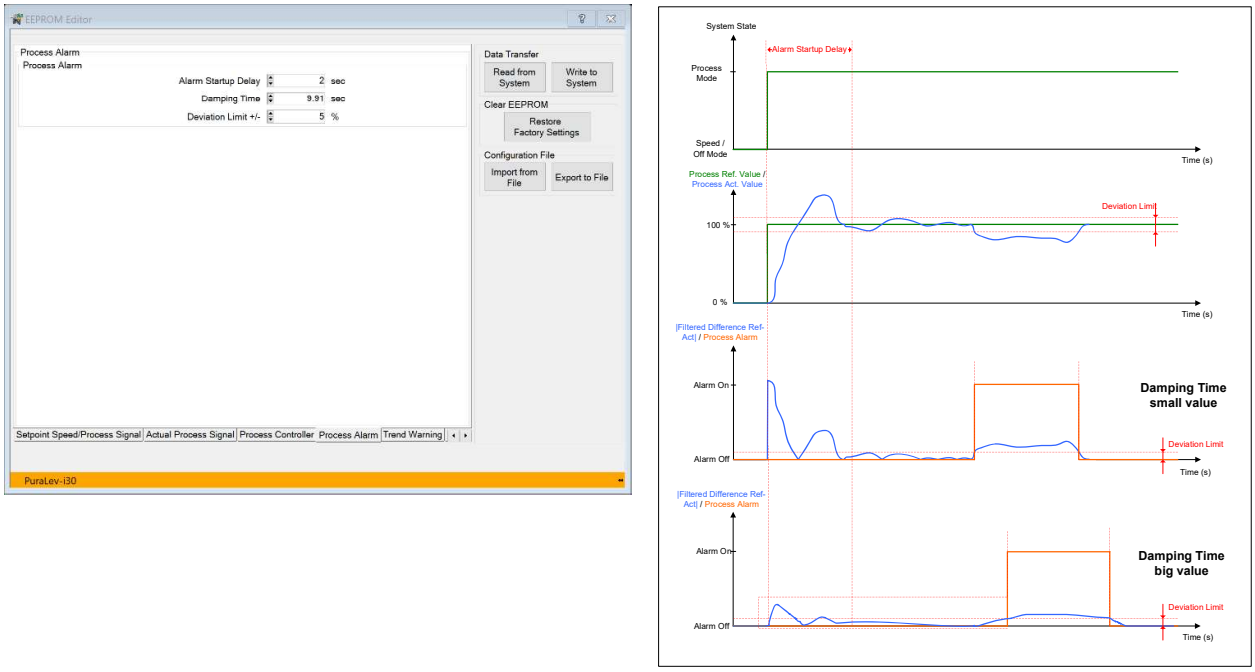


Figure 22: Process Alarm

2.2.1.12 Trend Warning

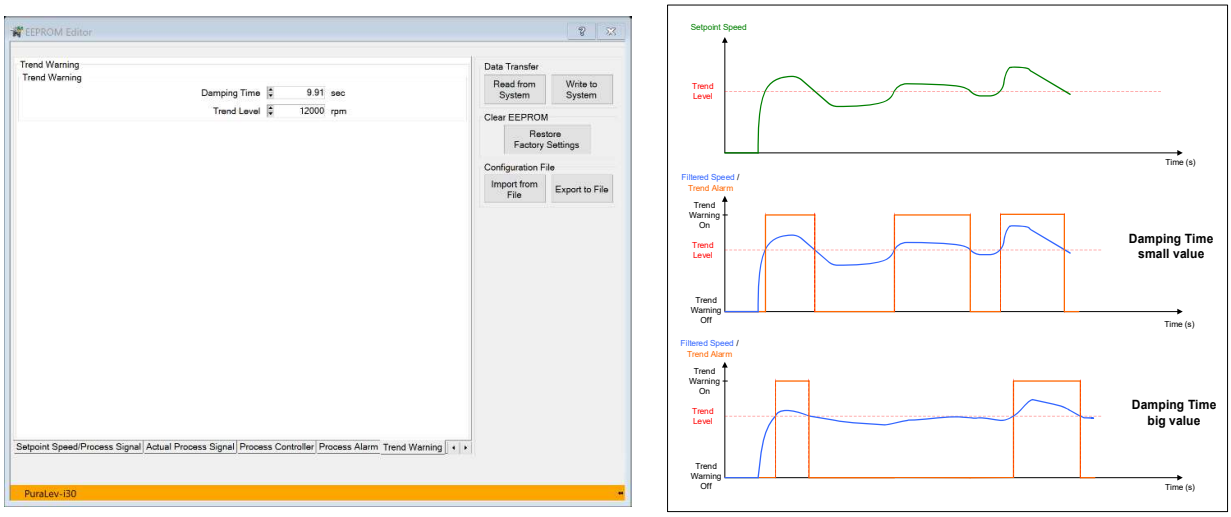


Figure 23: Trend Warning

2.2.1.13 Priming Configuration

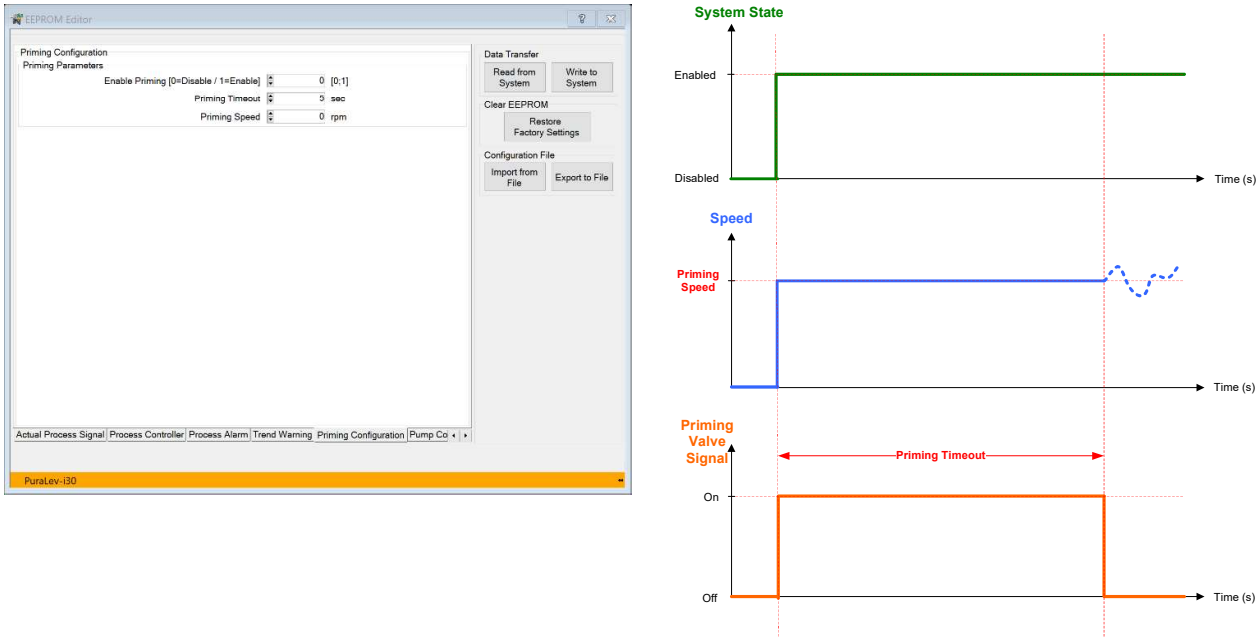


Figure 24: Priming Configuration

2.2.1.14 Pump Configuration

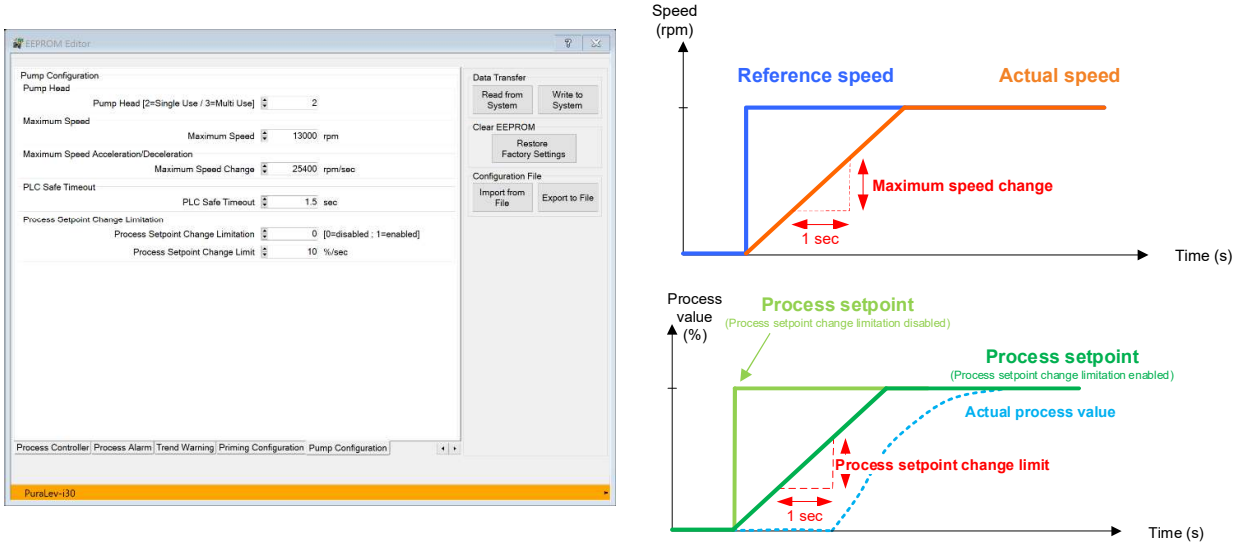


Figure 25: Pump Configuration

2.3 RS485 Interface

2.3.1 State Diagram

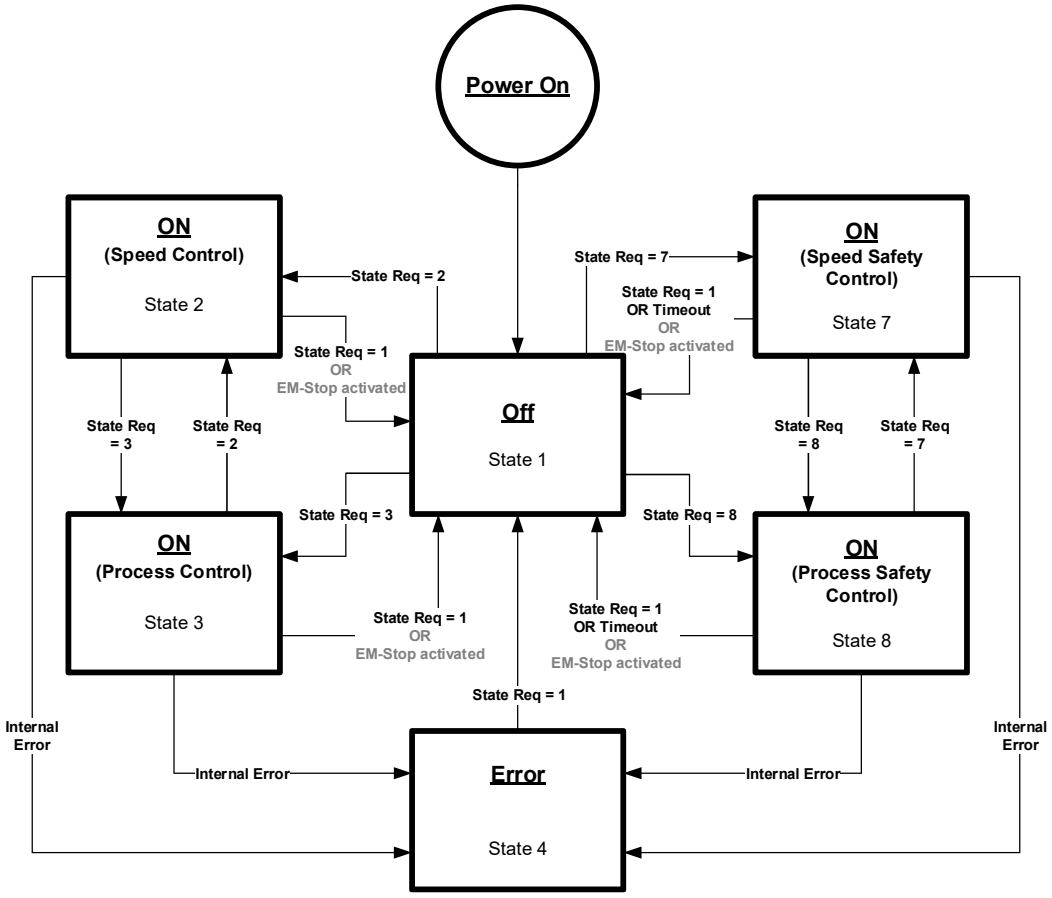


Figure 26: State diagram

EM-Stop: Emergency Stop can be configured and activated through digital inputs. Emergency stop is not activated by default.

Figure 26 shows the state diagram for the RS485 interface of the pump system.

There are six states:

Off (State 1):

If the power supply is switched on, the system defaults to the *State 1 (*Off*)* and the pump system is switched off (motor has no power). To switch the system on write into Hold register 0x4000 a number of an On state (2,3,7 or 8) via RS485 to the Levitronix Driver.

On speed control mode (State 2):

The pump system is switched on and the impeller is rotating with the setpoint speed. The motor has electrical power when in this state. To switch the system off write 1 (Off) into Hold register 0x4000 via RS485 modbus interface to the Levitronix Driver.

On process control mode (State 3):

The pump system is switched on and the impeller is rotating to get the setpoint flow or pressure. The motor has electrical power when in this state. To switch the system off write 1 (Off) into Hold register 0x4000 via RS485 modbus interface to the Levitronix Driver.

On speed safety control mode (State 7):

The pump system is switched on and the impeller is rotating with the setpoint speed. The motor has electrical power when in this state. To switch the system off write 1 (Off) into Hold register 0x4000 via RS485 modbus interface to the Levitronix Driver.

Furthermore, if there is no valid RS485 communication during a certain time period (Timeout 1.5 s) the system will also return into the Off-State.

On process safety control mode (State 8):

The pump system is switched on and the impeller is rotating to get the setpoint flow or pressure. The motor has electrical power when in this state. To switch the system off write 1 (Off) into Hold register 0x4000 via RS485 modbus interface to the Levitronix Driver.

Furthermore, if there is no valid RS485 communication during a certain time period (Timeout 1.5 s) the system will also return into the Off-State.

Error (State 4):

If an internal error occurs in the pump system, the system defaults to the *Error* state. The pump system is switched OFF.

To reset the system from Error state write 1 (Off) into Hold register 0x4000 via RS485 modbus interface to the Levitronix Driver.

2.3.2 MODBUS RTU Protocol

2.3.2.1 Communication settings

The default RS485 communication settings are:

Modbus device address	1
Baud Rate	57600
Data Bits	8
Parity	Even
Stop Bit	1

The communication settings remain the same after a firmware update or factory reset.

2.3.2.1.1 Change communication settings in Service Software 2.0

The communication settings of the driver can be changed in service software 2.0.

See chapter '2.1.2.7 Change Communication Settings' in the user manual of Service Software 2.0 (PL-4043-00)

2.3.2.1.2 Change communication settings over MODBUS protocol

Write the new communication configuration into hold registers. To activate the new configuration write 1 = 0x0001 to hold register 0x4008 "Activate Modbus Settings" or repower driver

2.3.2.1.3 Change Modbus Device Address over MODBUS protocol when multiple systems have the same Device Address

Example: Set Device Address of slave with S/N:"230211-0137" to 3

Modbus request:

0x00		Device address (Broadcast)
0x66		Function code = 0x66 Levitronix User Defined Function Code
0x0C		Byte count = 12
0x01	1	Subfunction code = 1
0x03	2	New Device Address = 3
0x32	3	S/N first figure 0x32 = '2'
0x33	4	S/N 2nd figure 0x33 = '3'
0x30	5	S/N 3rd figure 0x30 = '0'
0x32	6	S/N 4th figure 0x32 = '2'
0x31	7	S/N 5th figure 0x31 = '1'
0x31	8	S/N 6th figure 0x31 = '1'
0x30	9	S/N 7th figure 0x30 = '0'
0x31	10	S/N 8th figure 0x31 = '1'
0x33	11	S/N 9th figure 0x33 = '3'
0x37	12	S/N 10th figure 0x37 = '7'
0x73	LO	Checksum
0xD5	HI	

Request is sent in broadcast mode, therefore no answer is returned.
The system with the matching serial number will change its Device Address to the new address.

2.3.2.2 Supported MODBUS functions

The firmware supports the following MODBUS functions:

Function code	Description
03	Read Holding Registers
04	Read Input Registers
06	Write Single Register
16	Write Multiple Registers

MODBUS broadcast mode (Device address = 0) is supported with write functions (06, 16).

Reference: http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf

2.3.2.3 MODBUS error messages

The device reports MODBUS errors with the following exception codes:

Exception code	Description
01	(Sub-) function code not supported.
02	Illegal register address. Addressed register does not exist.
03	Illegal data value. Value to be written wasn't within minimum and maximum limits.

2.3.2.4 Input registers map

2.3.2.4.1 Input registers map

Address	Scaling Factor	Description	Unit	Notes
0x3FE0 0x3FE1 0x3FE2 0x3FE3 0x3FE4		Levitronix ID String		10 Bytes ASCII string „LEVITRONIX“
0x3FE5		Levitronix Device Type		2 = PuraLev®-i30
0x3FE6 0x3FE7 0x3FE8 0x3FE9 0x3FEA 0x3FEB 0x3FEC 0x3FED		Driver Firmware Version		16 Bytes ASCII string „H030 H2.48 R03 “
0x3FEE 0x3FEF 0x3FF0 0x3FF1 0x3FF2		Driver Serial Number		10 Bytes ASCII string e.g.“0110040035“ → „011004-0035“
0x3FF3 … 0x3FFF		Future use		
0x4000	1	Pump State		Pump State: 1 : Off 2 : On (Speed Control) 3 : On (Process Control) 4 : Error 5 : On (Speed Control enabled by PLC Dig. In.) 6 : On (Process Control enabled by PLC Dig. In.) 7 : On (Speed Safety Control) 8 : On (Process Safety Control) 10 : On (Priming Mode enabled by PLC Dig. In.)
0x4001	1	Actual Speed	rpm	
0x4002	0.01	Actual Process Value	%	
0x4003	1	Setpoint Speed	rpm	
0x4004	0.01	Setpoint Process Value	%	
0x4005	1	Actual Error		Errors are bitwise encoded: 0x4000 No pump head detected 0x2000 Detected a potential short-circuit situation in the pump 0x1000 Motor coil interruption detected 0x0400 The pump could not stabilize the position of the impeller 0x0100 Motor coils not connected 0x0080 Motor sensor reading error 0x0040 Parameter error. Could not access config. 0x0004 Supply voltage out of range (Power input) 0x0001 Driver temperature was above 90°C or higher than 80°C for more than 10 min.

0x4006	1	Actual Warning		Warnings are bitwise encoded: 0x8000 System operates at its performance limit. Setpoint speed can differ from actual speed! 0x2000 Trend Warning. Setpoint speed is higher than the user-defined warning level 0x1000 Process Alarm. Setpoint process value deviates more than the user-defined level from the actual process value 0x0800 Impeller out of center 0x0400 High bearing currents 0x0200 Impeller unstable (axial position). Pump reduces speed to stabilize impeller. 0x0100 Impeller unstable (radial position). Pump reduces speed to stabilize impeller. 0x0080 Dry running situation has been detected 0x0020 Temperature sensor communication issues 0x0010 Could not read/write internal memory 0x0004 Supply voltage out of range (Power input) 0x0002 Driver temperature is higher than 80°C 0x0001 Driver temperature is higher than 65°C
0x4007	1	Actual Message		Messages are bitwise encoded: 0x0100 Internal pump communication bus problems 0x0080 Dryrunning detected 0x0040 Impeller unstable (radial position) 0x0020 Impeller unstable (radial position)
0x4008	1	Driver Temperature	°C	Current driver temperature in Celcius
0x4009	1	Impeller Z-Position	um	
0x400A	1	Last Error		Same Error encoding as “Actual error”
0x400B	1	Last Warning		Same Warning encoding as “Actual warning”
0x400C	1	Last Message		Same Message encoding as “Actual message”
0x400D	$\frac{7.123}{32767}$	Bearing Current Phase V	A rms	
0x400E	$\frac{7.123}{32767}$	Bearing Current Phase W	A rms	
0x400F	$\frac{15}{32767}$	Drive Current Phase V	A rms	
0x4010	$\frac{15}{32767}$	Drive Current Phase W	A rms	
0x4011	0.1	Supply voltage (Power input)	V	
0x4012	0.002	PLC Analog Input 1: Physical Input	mA	
0x4013	0.002	PLC Analog Input 1: Calibrated Input	mA	
0x4014	0.0125	PLC Analog Input 1: % of Fullscale	%	
0x4015	0.001	PLC Analog Input 2: Physical Input	V	
0x4016	0.001	PLC Analog Input 2: Calibrated Input	V	
0x4017	0.01	PLC Analog Input 2: % of Fullscale	%	
0x4018	0.01	PLC Values: Actual Process Value	%	
0x4019		PLC Values: Setpoint Speed	rpm	
0x401A	0.01	PLC Values: Setpoint Process	%	
0x401B	0.01	PLC Analog Output	V	
0x401C	1	PLC Digital Input 1		0 = 0V; 1 = 24V
0x401D	1	PLC Digital Input 2		0 = 0V; 1 = 24V
0x401E	1	PLC Digital Output 1		0 = circuit open; 1 = circuit closed
0x401F	1	PLC Digital Output 2		0 = circuit open; 1 = circuit closed
0x4020	1	Actual Error buffered with timeout		Same errors as in register 0x4005 but buffered for a certain time (Hold reg. 0x4035)
0x4021	1	Actual Warning buffered with timeout		Same warnings as in register 0x4006 but buffered for a certain time (Hold reg. 0x4035)
0x4022	1	Actual Message buffered with timeout		Same message as in register 0x4007 but buffered for a certain time (Hold reg. 0x4035)

2.3.2.4.2 Input read register example

Input register read example 0x4000-0x4007 → start address = 0x4000 and quantity of registers = 8

Modbus request:

0x01		Device address
0x04		Function code
0x40	HI	Start address
0x00	LO	0x4000
0x00	HI	Quantity of registers
0x08	LO	
0xE4	LO	Checksum
0x0C	HI	

Modbus response:

0x01		Device Address	
0x04		Function Code	04: Read Input registers
0x10		Byte Count	Number of data bytes: 16
0x00	HI	Pump State	3: Pump is in Process Mode
0x03	LO		
0x1D	HI	Actual Pump Speed	0x1D4C = 7500 Actual speed is 7500 rpm (automatically reduced to 7500 rpm during dry-running)
0x4C	LO		
0x07	HI	Actual Process Value	0x079E → 1950 * 0.01 ~ 19.50 % Actual Process Value is 19.50%
0x9E	LO		
0x3A	HI	Setpoint Speed	0x3A98 = 15000 Setpoint speed is 15000 rpm
0x98	LO		
0x0C	HI	Setpoint Process Value	0x0CCE → 3278 * 0.01 = 32.78% Process Value Setpoint 32.78%
0xCE	LO		
0x00	HI	Actual Error	0x0000: No error
0x00	LO		
0x30	HI	Actual Warning	0x3080 = 0x2000 + 0x1000 + 0x0080: Trend Warning + Process Alarm + Dryrunning
0x80	LO		
0x00	HI	Actual Message	0x0080: Dryrunning detected
0x80	LO		
0x13	LO	Checksum	0xD513
0xD5	HI		

2.3.2.5 Hold register

2.3.2.5.1 Hold registers map

All registers marked with an ‘x’ in the ‘EEPROM’ column are stored in EEPROM and are non-volatile.
Note that the number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss. For this reason, avoid constantly writing non-volatile device parameters via the MODBUS!

All values written to the hold registers have to be within the min. and max. value limits, otherwise the write request will be ignored and answered with a MODBUS error message with exception code 3.

Address	Scaling Factor	Description	Unit	EEPROM	Notes	EEPROM default value	Min value	Max value	default scaled value
0x3FFF	1	Special functions			0x100= Clear EEPROM to factory settings. A reset of the system is needed to load the factory settings. 0x400= Reset system (if possible) Reset is only possible if pump is in ‘Off’ or ‘Error’ state.		0x100	0x500	
0x4000	1	State			Pump State: 1: Off 2: On (Speed Control) 3: On (Process Control) 7: On (Speed Safety Control) 8: On (Process Safety Control) Note: Pump state cannot be changed, if pump was enabled by PLC digital inputs (States 5, 6 or 10)		1	8	
0x4001	1	Setpoint Speed			Speed Setpoint		0	13000	
0x4002	0.01	Setpoint Process Value			Process Setpoint		0	30000	
0x4003	1	Not used					0	0	0
0x4004	1	Not used					0	0	0
0x4005	1	Serial Communication Baudrate		x	[0 = 9600 ; 1 = 19200; 2 = 38400; 3 = 57600; 4 = 115200] Not affected by factory reset.	3	0	3	57600
0x4006	1	Modbus Device Address		x	Modbus Device Address. Not affected by factory reset.	1	1	247	1
0x4007	0.2284148	Modbus Receive Interframe Timeout	ms	x	0: standard 3232odbus timings or [18; 32767] -> [4.1ms; 7478.5ms] Not affected by factory reset.	0	0	32767	0 ms
0x4008	1	Activate Modbus Settings			Write 1 to activate serial communication and Modbus settings		0	1	
0x4009	1	Analog Input Assignment		x	1: Analog Input 1 [mA] <-> Actual Process Value Analog Input 2 [V] <-> Setpoint Value 2: Analog Input 1 [mA] <-> Setpoint Value Analog Input 2 [V] <-> Actual Process Value	1	1	2	1
0x400A		Analog Output Assignment		x	0=State dependent 1=Actual Speed 2=Actual Process Value	0	0	2	0
0x400B	1	Digital Output 1 Logic		x	[0 = normally open; 1= normally closed]	0	0	1	0
0x400C	1	Digital Output 1 Configuration		x	Configuration is bitwise encoded: 0x0001: Enable STATUS on Dig. Out 1 0x0002: Enable ERRORS on Dig. Out 1 0x0004: Enable WARNINGS on Dig. Out 1 0x0008: Enable Custom Digital Output on Dig. Out 1 0x0010: Enable Priming Valve Signal on Dig. Out 1	1	0	31	1
0x400D	1	Digital Output 2 Logic		x	[0 = normally open; 1= normally closed]	1	0	1	1
0x400E	1	Digital Output 2 Configuration		x	Configuration is bitwise encoded: 0x0001: Enable STATUS on Dig. Out 2 0x0002: Enable ERRORS on Dig. Out 2 0x0004: Enable WARNINGS on Dig. Out 2 0x0008: Enable Custom Digital Output on Dig. Out 2 0x0010: Enable Priming Valve Signal on Dig. Out 2	2	0	31	2
0x400F	1	Custom Digital Output Configuration		x	Set bit to enable Warning: 0x8000 System operates at its performance limit 0x2000 Trend warning 0x1000 Process Alarm 0x0800 Impeller out of center 0x0400 High bearing currents 0x0200 Impeller unstable (axial position) 0x0100 Impeller unstable (radial position) 0x0080 Dry-running detected 0x0020 Temperature sensor communication issues 0x0010 Could not read/write internal memory 0x0004 Supply voltage out of range 0x0002 Driver temperature more than 80°C 0x0001 Driver temperature more than 65°C	0	0	32767	0

0x4010	$\frac{x \cdot 398}{2\pi \cdot (32767 - x)}$	Signal Calib. – Analog Input 1: Filter	Hz	x		21688	1	32767	124 Hz
0x4011	0.002	Signal Calib. – Analog Input 1: Offset	mA	x		2000	-32768	32766	4 mA
0x4012	$\frac{2}{32767}$	Signal Calib. – Analog Input 1: Gain	-	x		16384	0	32767	1
0x4013	0.002	Signal Calib. – Analog Input 1: Cut off level	mA	x		0	0	32744	0 mA
0x4014	$\frac{x \cdot 398}{2\pi \cdot (32767 - x)}$	Signal Calib. – Analog Input 2: Filter	Hz	x		21688	1	32767	124 Hz
0x4015	0.001	Signal Calib. – Analog Input 2: Offset	V	x		0	-32768	32766	0 V
0x4016	$\frac{2}{32767}$	Signal Calib. – Analog Input 2: Gain	-	x		16384	0	32767	1
0x4017	0.001	Signal Calib. – Analog Input 2: Cut off level	V	x		0	0	32744	0 V
0x4018	1	Setpoint Speed Signal Scaling 0%	rpm	x	Analog Input 0% of Fullscale equals x rpm	0	0	32767	0 rpm
0x4019	1	Setpoint Speed Signal Scaling 100%	rpm	x	Analog Input 100% of Fullscale equals y rpm	16000	0	16000	16000 rpm
0x401A	0.01	Setpoint Process Signal Scaling 0%	%	x	Analog Input 0% of Fullscale equals x %	0	0	32767	0 %
0x401B	0.01	Setpoint Process Signal Scaling 100%	%	x	Analog Input 100% of Fullscale equals y %	10000	0	32767	100 %
0x401C	0.01	Actual Process Signal Scaling 0%	%	x	Analog Input 0% of Fullscale equals x %	0	0	32767	0 %
0x401D	0.01	Actual Process Signal Scaling 100%	%	x	Analog Input 100% of Fullscale equals y %	10000	0	32767	100 %
0x401E	0.0244140625	Process Controller Proportional	$\frac{\Delta rpm}{\Delta\%}$	x		782	0	32767	$19.09 \frac{\Delta rpm}{\Delta\%}$
0x401F	1.220703125	Process Controller Integral	$\frac{\Delta rpm}{\Delta\% \cdot sec}$	x		76	0	32767	$92.773 \frac{\Delta rpm}{\Delta\% \cdot sec}$
0x4020	1	Maximum Process Speed	rpm	x	Process Controller Maximum Speed	13000	0	32767	13000 rpm
0x4021	1	Minimum Process Speed	rpm	x	Process Controller Minimum Speed	0	0	32767	0 rpm
0x4022	1	Process Controller Config	-	x	0=Standard Control / 1=Reverse Control	0	0	1	0
0x4023	1	Process Alarm Startup Delay	sec	x		2	0	32767	2 sec
0x4024	$\frac{32767}{1 + x \cdot 551}$	Process Alarm Damping time	sec	x		6	1	32767	9.91 sec
0x4025	0.01	Process Alarm Deviation +/-	%	x		500	0	32767	5 %
0x4026	$\frac{32767}{1 + x \cdot 551}$	Trend Warning Damping time	sec	x		6	1	32767	9.91 sec
0x4027	1	Trend Warning Level	rpm	x		12000	0	32767	12000 rpm
0x4028	1	Enable Priming	-	x	[0=Disable / 1=Enable]	0	0	1	0
0x4029	1	Priming Timeout	sec	x		5	0	32767	5 sec
0x402A	1	Priming Speed	rpm	x		0	0	13000	0 rpm
0x402B	1	Analog Output – Actual Speed Scaling Min.	rpm	x	Analog Output: Minimum Volt equals x rpm	0	0	32767	0 rpm
0x402C	1	Analog Output – Actual Speed Scaling Max.	rpm	x	Analog Output: Maximum Volt equals y rpm	16000	0	32767	16000 rpm
0x402D	$\frac{x \cdot 398}{2\pi \cdot (32767 - x)}$	Analog Output – Actual Speed Filter	Hz	x	Analog Output: Actual Speed Lowpass Filter (Knee Frequency)	32700	1	32767	30915 Hz
0x402E	0.01	Analog Output – Actual Process Scaling Min.	%	x	Analog Output: Minimum Volt equals x %	0	0	32767	0 %
0x402F	0.01	Analog Output – Actual Process Scaling Max.	%	x	Analog Output: Maximum Volt equals y %	10000	0	32767	100 %
0x4030	$\frac{x \cdot 398}{2\pi \cdot (32767 - x)}$	Analog Output – Actual Value Filter	sec	x	Analog Output: Actual Process Lowpass Filter (Knee Frequency)	32700	1	32767	30915 Hz
0x4031	0.01	Analog Output Minimum Volt	V	x		0	0	1000	0 V
0x4032	0.01	Analog Output Maximum Volt	V	x		1000	0	1050	10 V
0x4033	1	Digital Input 1 Signal Logic	-	x	[0=Normal;1=Inverted]	0	0	1	0
0x4034	1	Digital Input 2 Signal Logic	-	x	[0=Normal;1=Inverted]	0	0	1	0
0x4035	0.001	Minimum activation timeout Error/Warn./Mess.	Sec	x	Defines the buffer time for Input registers (0x4020-0x4022)	0	0	32767	0 sec
0x4036	1	Speed-Process Control Transition	-	x	Transition without loss of speed. (0=Disabled / 1=Enabled)	1	0	32767	1
..									
0x403F	1	Digital Input 1 Configuration	-	x	Configuration is bitwise encoded: 0x0001: Enable process control mode / Reset on DI 1 0x0004: Enable speed mode / Reset on Dig. Input 1 0x0010: Enable emergency stop on Dig. Input 1 0x0020: Enable pump system / Reset on Dig. Input 1 0x0040: Enable control selection on Dig. Input 1	32	0	117	32
0x4040	1	Digital Input 2 Configuration	-	x	Configuration is bitwise encoded: 0x0001: Enable process control mode / Reset on DI 2 0x0004: Enable speed mode / Reset on Dig. Input 2 0x0010: Enable emergency stop on Dig. Input 2 0x0020: Enable pump system / Reset on Dig. Input 2 0x0040: Enable control selection on Dig. Input 2	64	0	117	64
0x4041	1	Enable process setpoint change limitation	-	x	(0=Disabled / 1=Enabled)	0	0	1	0
0x4042	0.1	Process setpoint change limit	%/sec	x	Maximum process setpoint change rate, if enabled	100	0	32767	10.0 %/sec
..									
0x40E0	0.0025	PLC Safe Timeout	sec	x		597	0	32767	1.5 sec

2.3.2.5.2 Hold registers write examples

Start pump in Speed Mode with speed of 2000 rpm. [Pump State = 2, Speed Setpoint = 2000]

Modbus request :

0x01		Device address
0x10		Function code = 0x10 Write Multiple Registers
0x40	HI	Start address
0x00	LO	0x4000
0x00	HI	Quantity of registers = 2
0x02	LO	
0x04		Byte count = 4
0x00	HI	Data Register 1 Pump state = 2
0x02	LO	
0x07	HI	Data Register 2 Ref. Speed = 2000
0xD0	LO	
0x60	LO	Checksum
0x00	HI	

Modbus response :

0x01		Device Address	
0x10		Function Code	0x10: Write Multiple Registers
0x40	HI	Start address	0x4000 same as in request
0x00	LO		
0x00	HI	Quantity of registers	0x0002 same as in request
0x02	LO		
0x54	LO	Checksum	0x0854
0x08	HI		

Stop pump. [Pump State = 1]

Modbus request:

0x01		Device address
0x06		Function code = 0x06 Write Single Register
0x40	HI	Register address
0x00	LO	0x4000 (Pump state)
0x00	HI	Register value = 1
0x01	LO	
0x5D	LO	Checksum 0xCA5D
0xCA	HI	

Modbus response:

0x01		Device address
0x06		Function code = 0x06 Write Single Register
0x40	HI	Register address
0x00	LO	0x4000 (Pump state)
0x00	HI	Register value = 1
0x01	LO	
0x5D	LO	Checksum 0xCA5D
0xCA	HI	

Start pump in Process Mode with process setpoint value 32.78%. [Pump State = 3, Process setpoint = 3278]

The register 0x4001 “Setpoint Speed” will be overwritten with 0 too, but this doesn’t matter because the process controller will continuously update and adjust the Setpoint Speed when pump is in process mode.

Modbus request:

0x01		Device address
0x10		Function code = 0x10 Write Multiple Registers
0x40	HI	Start address
0x00	LO	0x4000
0x00	HI	Quantity of registers = 3
0x03	LO	
0x06		Byte count = 6
0x00	HI	Data Register 1 Pumpstate = 3
0x03	LO	
0x00	HI	Data Register 2 Setpoint Speed = 0
0x00	LO	
0x0C	HI	Data Register 3 Setpoint Process = 0x0CCE -> 3278
0xCE	LO	
0x73	LO	Checksum
0xD5	HI	

Modbus response :

0x01		Device Address	
0x10		Function Code	0x10: Write Multiple Registers
0x40	HI	Start address	0x4000 same as in request
0x00	LO		
0x00	HI	Quantity of registers	0x0003 same as in request
0x03	LO		
0x95	LO	Checksum	0xC895
0xC8	HI		

2.4 Standalone User Interface

2.4.1 Overview of Connections and Designations Standalone model

The system can be controlled in two separate ways: either with the “Stand-Alone Interface” or with the “PLC Interface”.

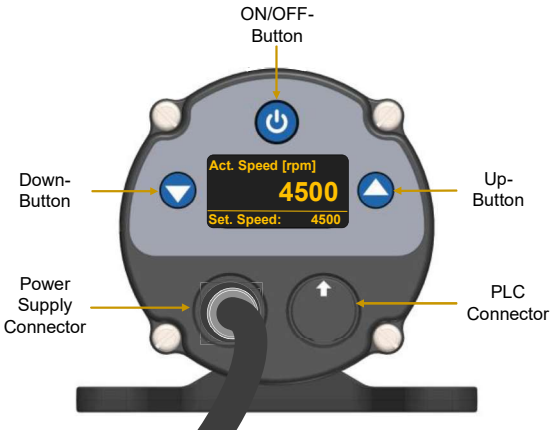


Figure 27: Electrical connections to Standalone driver IPD-30.5

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Specifications Typical Levels	Note
2	P +	red	+ 24 VDC	*Power Supply*	Voltage: 24 VDC ±10% Power: 35 W	“P -“ shall be connected to earth
1	P -	black	Ground/Earth			
3	NC	white	Not connected	--	Wire of compatible cables is cut.	Wire of compatible cables is cut.

Table 8: Power supply connector of Stand-Alone driver model
1: Wire colors of compatible cables: ICP-1.1-xx.

Pin #	Pin Name	Description	Standard Designation	Typical Levels	Note
6	Ain1	Analog Input	Setpoint	4..20 mA = 0..16000 rpm -> Speed limit = 13000rpm	450 Ohm shunt input, no galvanic isolation.
5	Ain_GND	Analog Input Ground	--	--	Reference to Ain1.
1	Dout1	Digital Output	Status	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA This signal indicates the state of the pump system.
3	GND	Ground	--	--	Reference to Dout1
2	Din1	Digital Input	Enable	Edge triggered: 0V → 5-24V ⇒ Enable 5-24V → 0V ⇒ Disable	For enabling of the system with external signal. Galvanic separation with optocoupler and 2.2 kΩ input resistance.
4	Din_COM	Common Digital Input	--	--	Reference to Din1.

Table 9: PLC connector of Stand-Alone driver model
1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx.

2.4.2 Overview Electrical Schematics of Driver Interface

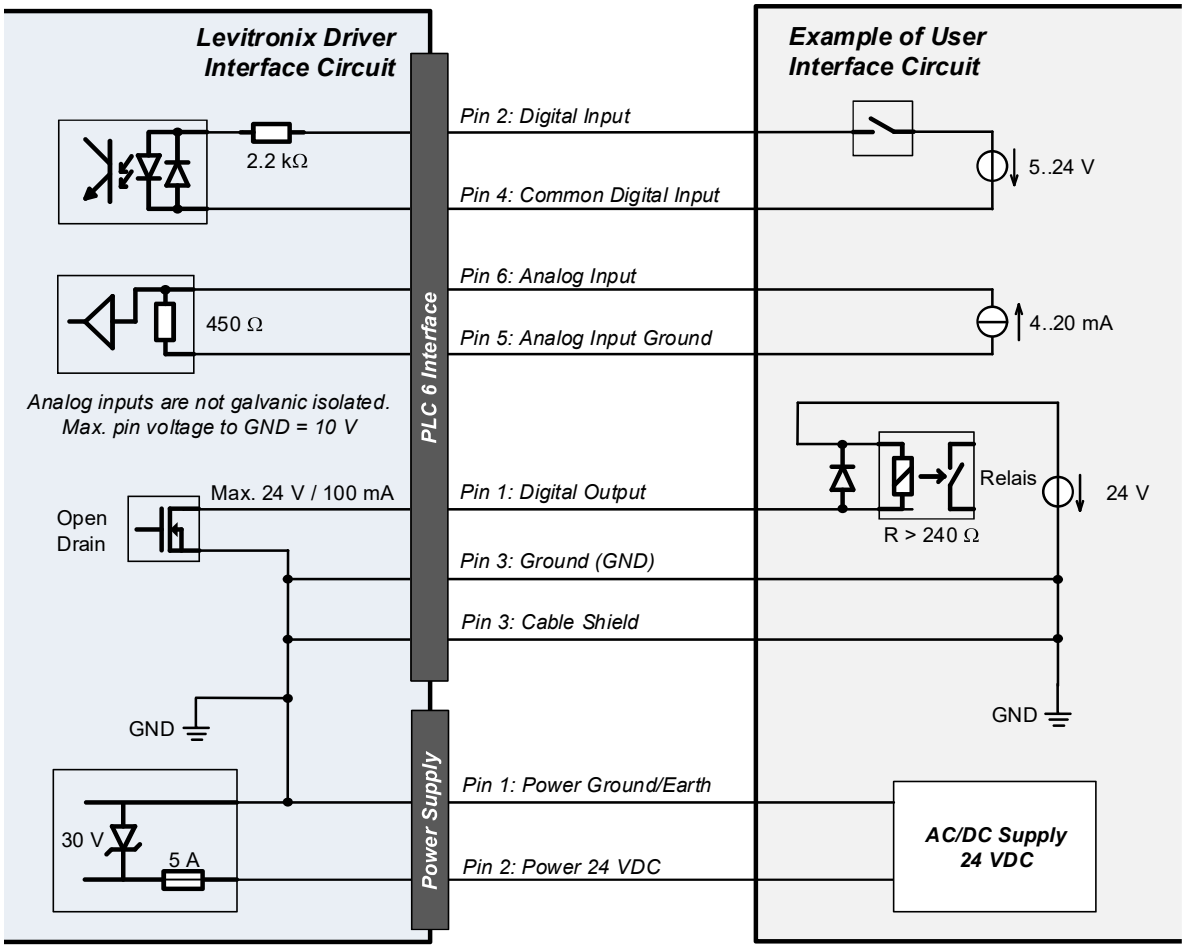


Figure 28: Electrical schematics of interfacing for Stand-Alone driver model

2.4.3 Operation of Stand-Alone Model

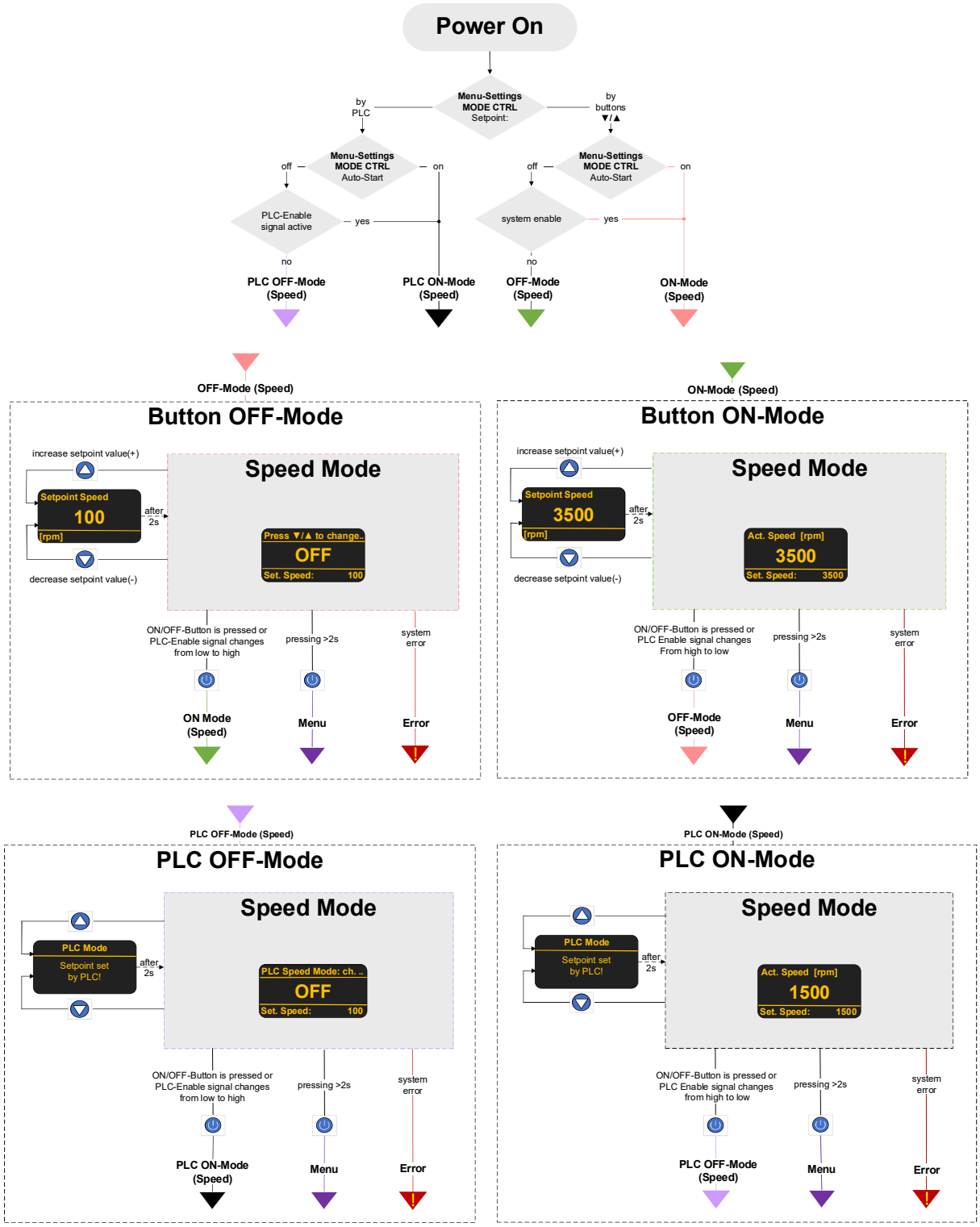
The standalone-Interface can be controlled by its 3 user buttons and/or by its PLC interface.

Button	***Control screen***	***System Menu***
	Enable/Disable system.	Select/Deselect a menu item to change.
 Pressed longer than 2 seconds	Enter System Menu	Leave System Menu
	Increase setpoint value	Navigate through menu items. Change value of selected menu items.
	Decrease setpoint value	Navigate through menu items. Change value of selected menu items.

Table 10: Buttons-Description

The setpoint speed can be changed with the up/down buttons.

2.4.4 State diagram



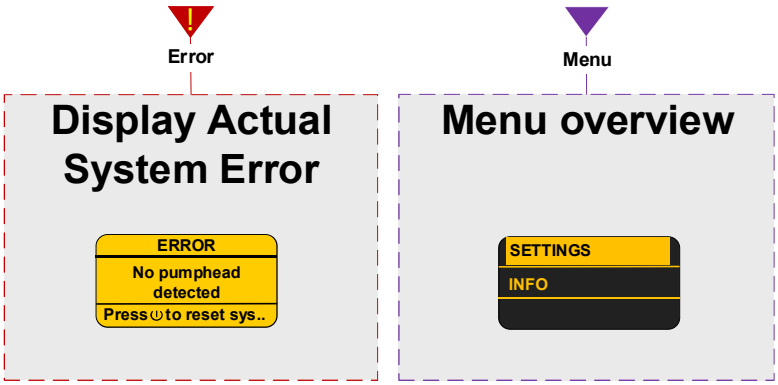


Figure 29: state diagram of standalone driver IPD-30

2.4.5 System Menu

The Menu is not a system state, but an additional tool to display system information. In any system state, the menu is reached pushing the button for more than 2 seconds.
In the menu, the menu tabs are browsed using the up/down-buttons and the items are selected with the button.

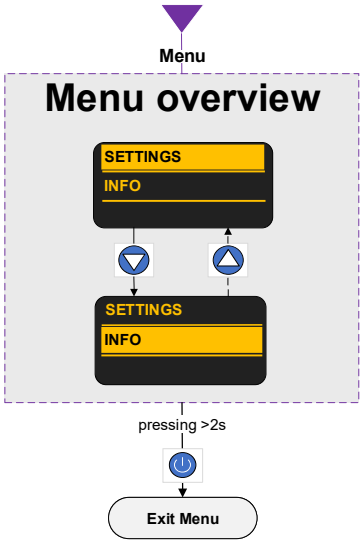


Figure 30: System Menu overview

The menu has two sub menus:

- SETTINGS : Configuration of the system
- INFO : System information like firmware version.

The menu can be left by pressing for more than 2 seconds.

2.4.5.1 Menu Settings

The following properties of menu settings can be configured:

- Mode Control
- Shutdown Timer

All configurations of menu settings are stored in EEPROM.

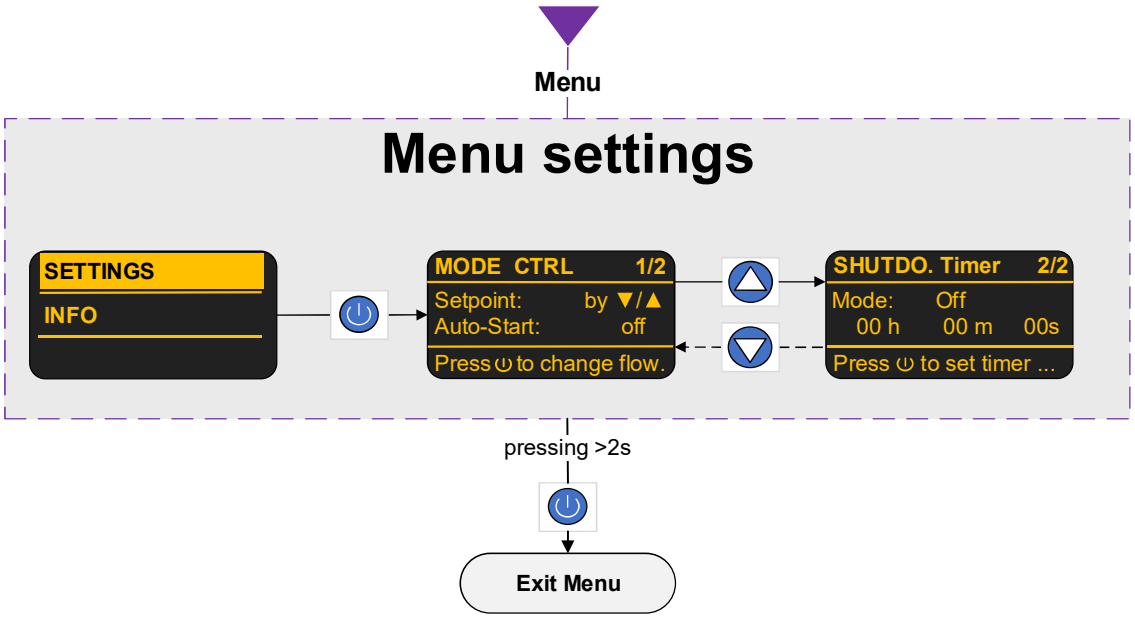
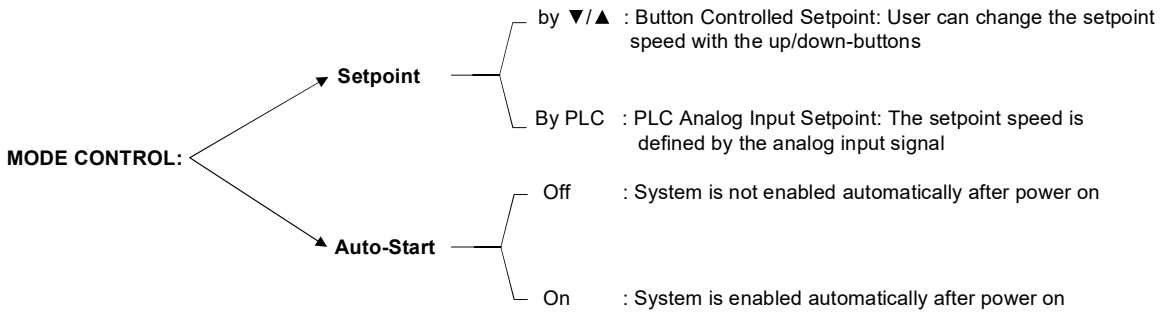


Figure 31: Menu-Settings

2.4.5.1.1 Menu-Settings (Mode Control)

The following options of mode control can be set:



The Mode-Control Setpoint can be changed between Button Control Mode and PLC Analog Control Mode. If the Auto-Start option is active “On”, the pump switches automatically to ON-Mode after power up.

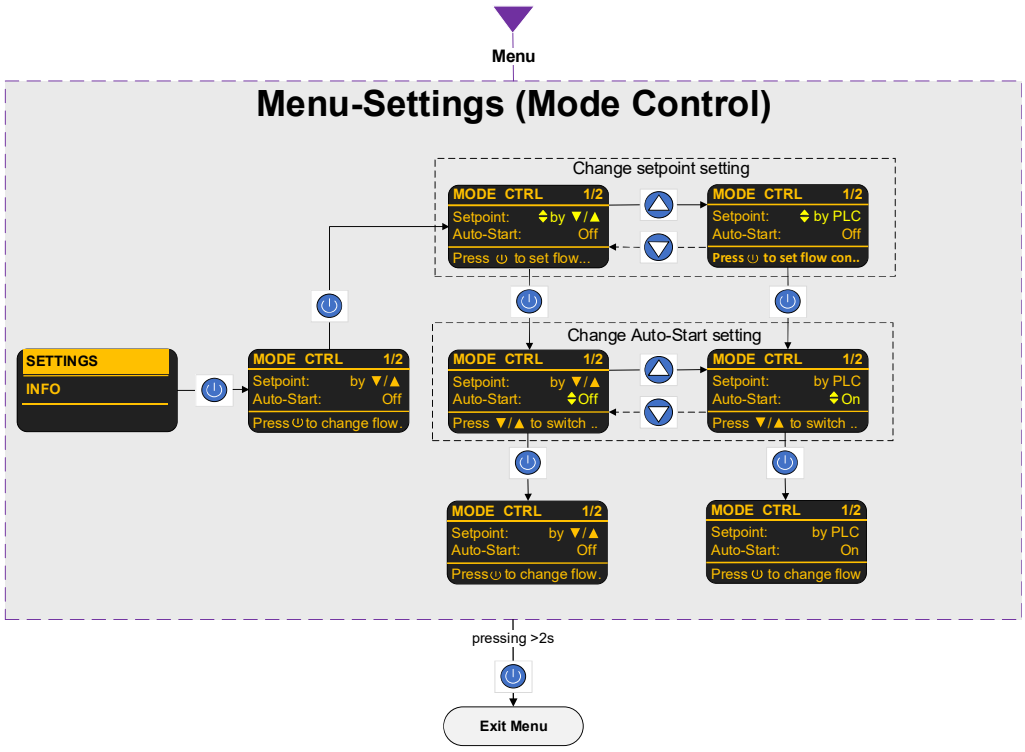
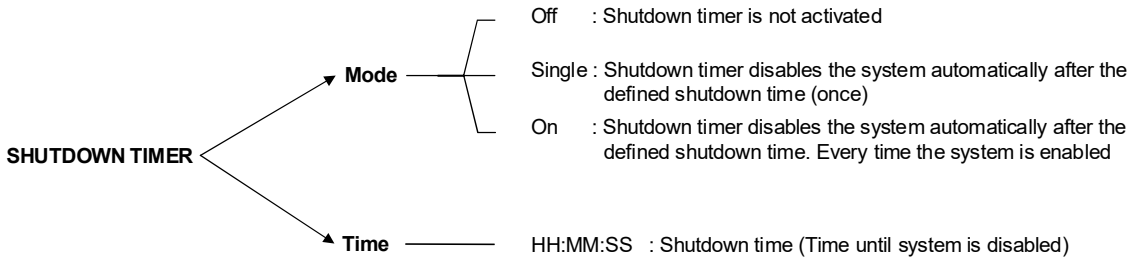


Figure 32: Menu-Settings (Mode Control)

2.4.5.1.2 Menu-Settings (Shutdown Timer)

The following options of shutdown timer can be set:



The shutdown timer can either be set as single “Single” or as repetitive timer “On”. The values of Timer are selected with on/off-button and modified with up/down-buttons.

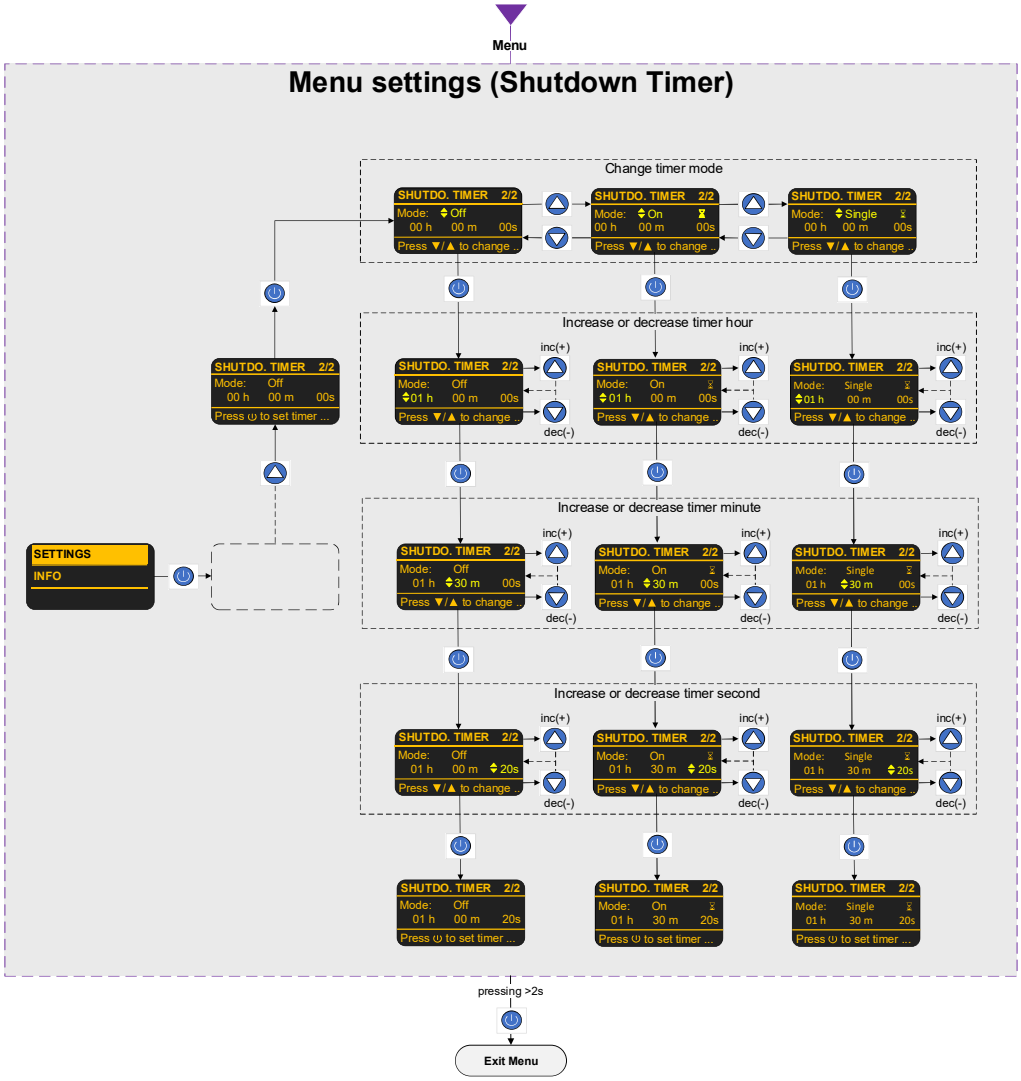


Figure 33: Menu-Settings (Shutdown Timer)

2.4.5.2 Menu Info

The Info sub menu shows system parameters:

- Speed value
- System temperature
- Z-Position: Axial position of the impeller
- Power supply voltage
- Bearing and drive currents
- Actual error and actual warning
- Last error, which caused the system to stop. Last warning, which was active when last error occurred.
- System firmware version

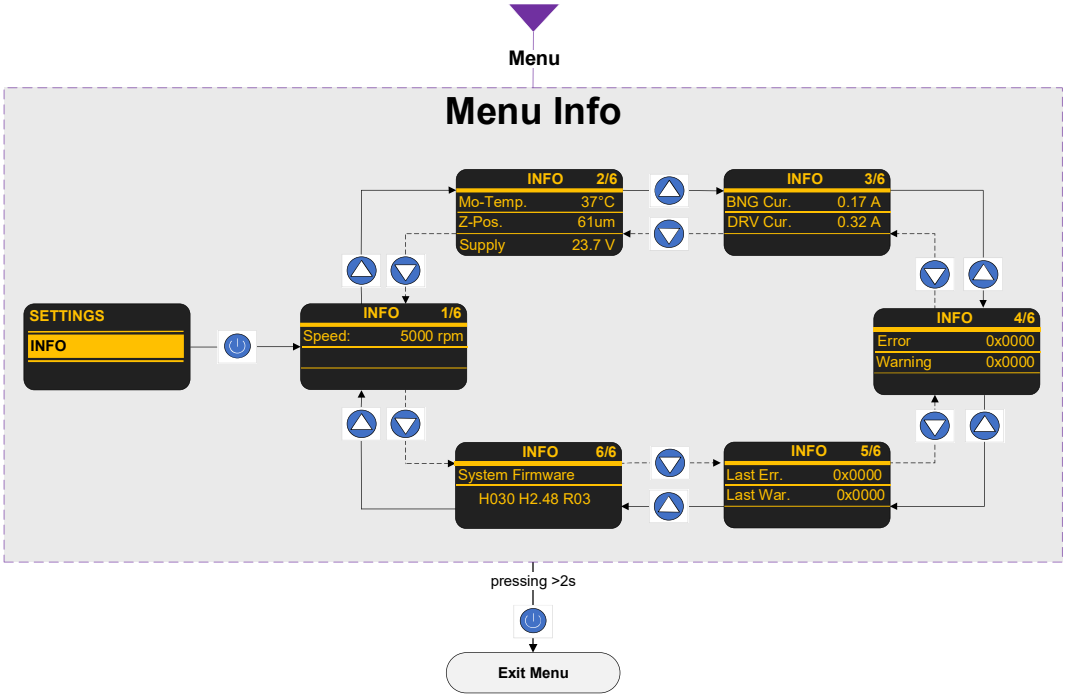


Figure 34: Menu-Info

2.4.6 Screen Saver-Mode

Screen saver gets activated, if no button was been pressed for more than 30 minutes. Pressing any buttons or changing the PLC-Enable signal (from high to low or the other way around) will exit the screen saver mode.

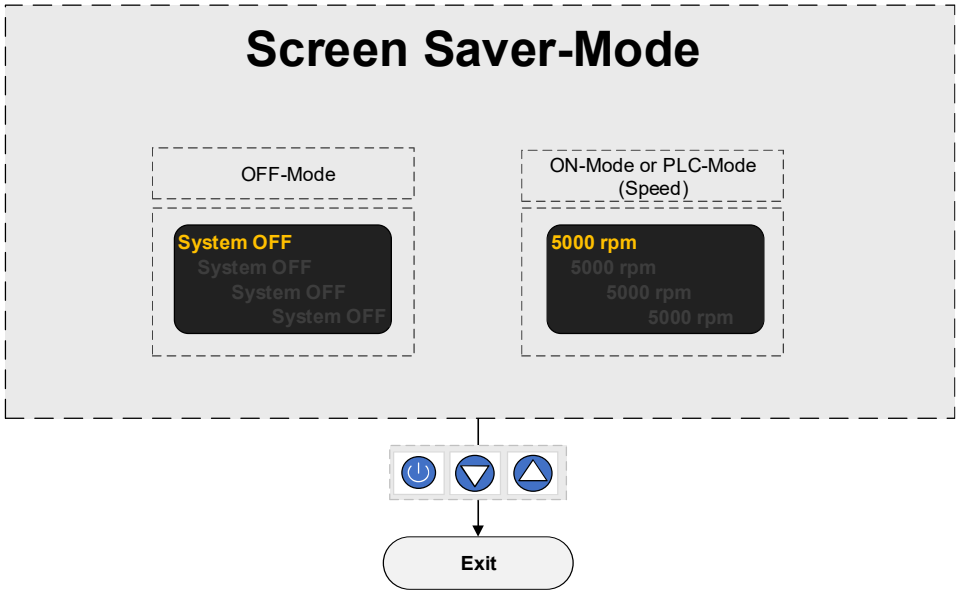


Figure 35: Screen Saver-Mode

2.4.7 Troubleshooting

2.4.7.1 Dry-Running Warning

Control screen shows periodically '**Dry-run**':

In case the pump system speed is higher than 8000 rpm and the pump head is not completely filled with liquid, then the dry running warning is set and the pump system reduces its speed to 7500 rpm.

The pump head should be primed with liquid.

The system accelerates to the original speed value when the pump head is refilled with liquid. Note that the speed is only reduced during dry running if the pump speed was ≥ 8000 rpm.

2.4.7.2 Error state

Most errors put the pump system into error state and disable the system. The screen shows the error and blinks.

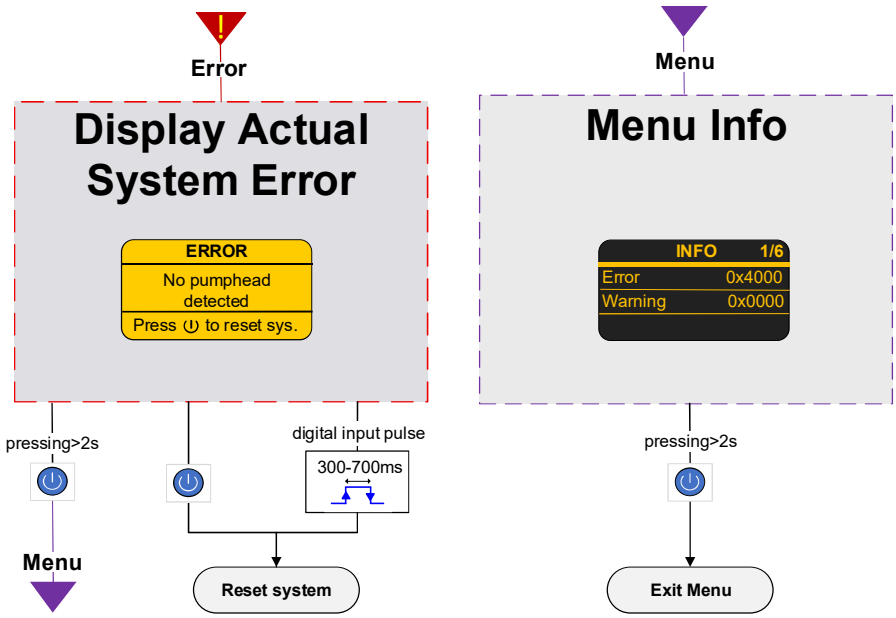


Figure 36: Troubleshooting-Error state

In the menu info the errors and warnings are represented in HEX-Codes. It is possible that multiple errors and warnings are active at the same time. In this case the error/warning codes are summed up. E.g. 0x4000 + 0x0400 = 0x4400
Address the error and reset the system to leave the error state.

Errors	Error Code	Corrective action
No pump head detected	*0x4000*	Verify that a pump head is mounted on the driver. Check if the pump head is properly inserted into the driver socket. Check if the transport fixation disk on the bottom of the pump head has been removed. If the issue still persists, contact Levitronix support.
Detected a potential short-circuit situation in the pump system	*0x2000*	Reset system. If the issue still occurs, contact Levitronix support.
Motor coil interruption detected	*0x1000*	Power cycle system (Switch power off for 30 seconds and back on). If the issue still persists, contact Levitronix support.
The pump system could not stabilize the position of the impeller	*0x0400*	Check if the pump head is correctly mounted on driver. Check operating conditions (Flow, viscosity, density, priming, cavitation). Consult the pump system manual.
Motor sensor reading error	*0x0080*	Power cycle system (Switch power off for 30 seconds and back on). If the issue still persists, contact Levitronix support.
Parameter error. Could not access configuration.	*0x0040*	Power cycle system (Switch power off for 30 seconds and back on). If the issue still persists, contact Levitronix support.
Supply voltage out of range	*0x0004*	Check supply voltage. (Power input < 18 or > 30 V DC)
Driver temperature was above 90°C or higher than 80°C for more than 10 min.	*0x0001*	Cool driver. Consult the 'Thermal Management' chapter in the pump system manual.

Table 11: Possible errors with indication on the display

Active warnings do not stop the system but can reduce the performance of the pump system. In that case the pump system does not reach the setpoint speed value. As soon as the warning is addressed it will disappear, no reset is needed.

Warnings	Warning Code	Corrective Action
System operates at its performance limit. Setpoint speed can differ from actual speed.	*0x8000*	Check hydraulic load. Consult the 'Pressure-Flow Curve' in the pump system manual.
Process Alarm Setpoint process value deviates more than the user-defined level from the actual process value	*0x1000*	Check operating conditions (Flow, viscosity, density, priming, cavitation). Change user-defined level.
Trend warning Setpoint speed is higher than the user-defined warning level	*0x2000*	Check operating conditions (Flow, viscosity, density, priming, cavitation). Change user-defined warning level.
Impeller is out of center.	*0x0800*	Check if the pump head is correctly mounted on driver. Check if there are particles stuck in the pump head. Check operating conditions (Flow, viscosity, density, priming, cavitation). Consult the pump system manual.
High bearing currents	*0x0400*	No action needed
Impeller unstable (axial position). Pump system reduces speed to stabilize impeller.	*0x0200*	Check if the pump head is correctly mounted on driver. Check operating conditions (Flow, viscosity, density, priming, cavitation). Consult the pump system manual. Reduce speed.
Impeller unstable (radial position). Pump system reduces speed to stabilize impeller.	*0x0100*	Check if the pump head is correctly mounted on driver. Check operating conditions (Flow, viscosity, density, priming, cavitation). Consult the pump system manual. Reduce speed.
Dry running situation has been detected. • Pump keeps running on reduced speed (7500 rpm) • The system accelerates to the original speed value when the pump is refilled with liquid. Note that the speed is only reduced during dry running if the pump speed was ≥ 8000 rpm.	*0x0080*	Prime the pump head with liquid.
Temperature sensor communication issues	*0x0020*	Power cycle system (Switch power off for 30 seconds and back on). If the issue still persists, contact Levitronix support.
Could not read/write internal memory	*0x0010*	Power cycle system (Switch power off for 30 seconds and back on). If the issue still persists, contact Levitronix support.
Supply voltage out of range (Power input)	*0x0004*	Check supply voltage. (Power input)
System temperature is higher than 80°C	*0x0002*	Cool driver otherwise pump system will stop after 10 min. Consult the 'Thermal Management' chapter in the pump system manual.
System temperature is higher than 65°C	*0x0001*	No action needed

Table 12: Possible warnings with indication on the display

3 REVISION HISTORY

Rev.	DCO No.	DCO Author	Effectivity Date	Summary Description of Changes
00	16-083	M.Stettler	03-Jun-16	- Drive current Limited to 1.3 A_{rms} - Tuned firmware parameter for first 150 pump prototypes
01	21-024	K.Ghimraoui	25-Jan-21	- Added support for standalone models - Added bootloader V4
02	21-219	A.Kalapos	14-Oct-21	- Configurable digital inputs - Added emergency stop. Disabled by default. - LCO-i100 'Change pump head' support.
03	22-204	A.Kalapos	25-Oct-22	- Configurable max speed - Added process setpoint change limitation - Added possibility to configure PLC Safe Timeout via EEPROM-Editor and Modbus-Interface. - Bugfix: H2.48 R02 system status over digital output was always active - Added possibility to change to MU pumphead