

Manual commissioning

HFI – MM Frequency inverter



Typ: HFI – MM Frequency inverter

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2 Preface

The system consists of a standard motor with an attached frequency converter. For distribution the frequency converter is already mounted and connected with the motor. The electrical connection is made directly at the frequency converter. In this document the connection and the parameterization for the easy commissioning are shown.

3 Main connection

3.1 Frame size A - C

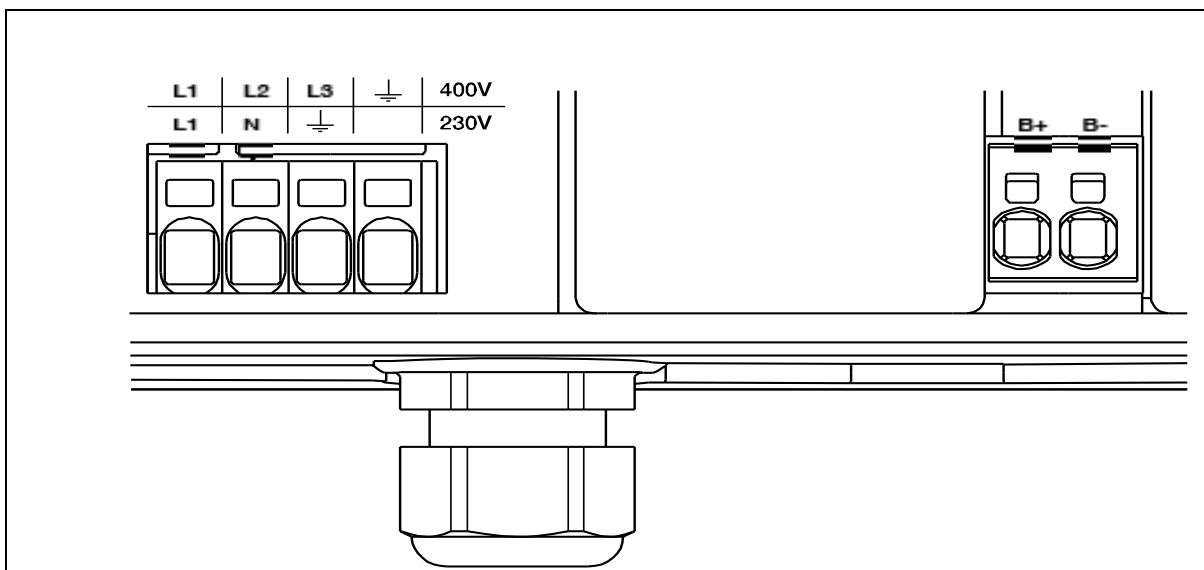


Figure 3-1: Mains connection BG A - C

The mains cable must be put through the cable gland and the phases L1, L2, L3 for 400 V and the ground wire with the protective earth (PE) contact must be connected to the terminal.

The cable gland serves the cable relief; the PE connection wire must be significantly longer than the other wires.

Terminal No.	Label	Configuration
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Ground wire

Table 1: 3x400V terminal connection X1

3.2 Frame size D

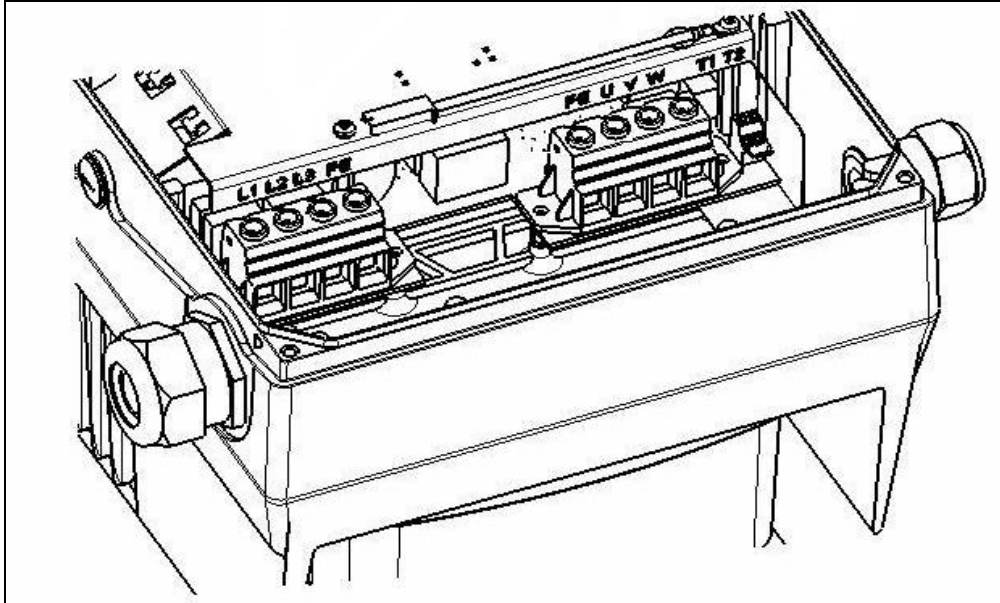


Figure 3-2: Mains connection BG D

Initially the four screws of the case cap must be screwed off and the cap must be removed.

The mains cable must be put through the cable gland and the phases L1, L2, L3 for 400 V and the ground wire with the protective earth (PE) contact must be connected to the terminal.

The cable gland serves the cable relief; the PE connection wire must be significantly longer than the other wires.

Terminal No.	Label	Configuration
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Ground wire

Table 2: 3x 400V terminal connection X2

4 Control ports

4.1 Wiring diagram

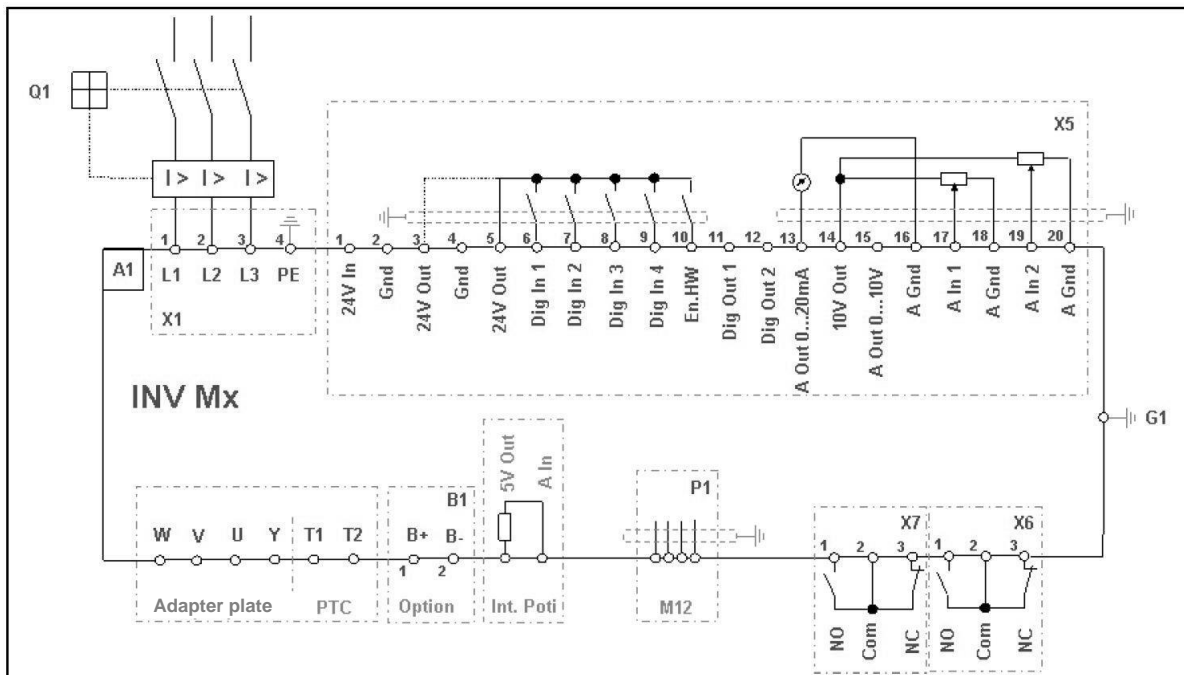


Figure 4-1: Wiring diagram

The drive controller and the control card are operational after connecting a 400 V AC voltage to terminal L1 to L3.

Alternatively it is possible to commission only the inverter's control card with an external 24 V DC Voltage. However it is not possible to drive the motor without a mains connection.

4.2 Control terminal strip

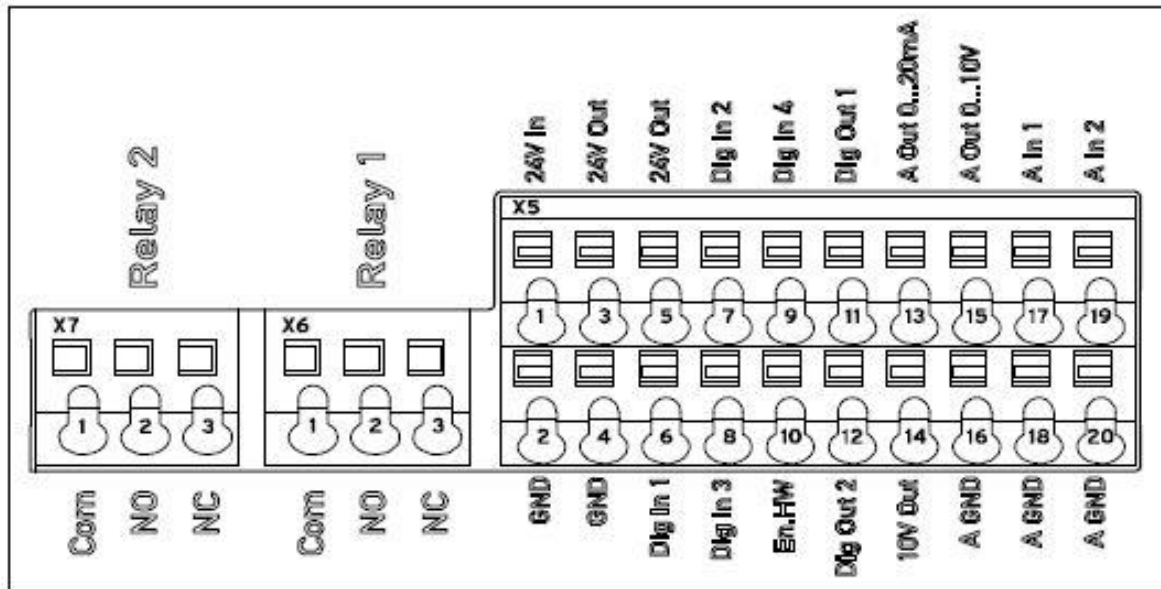


Figure 4-2: Control terminal strip

The required control wires must be put through the cable glands into the housing. The pin assignment is shown in Figure 4-2.

4.3 Terminal layout

The terminal layout is listed below.

Terminal No.	Label	Configuration
1	COM	Center contact Relay 1
2	NO	Normally open contact Relay 1
3	NC	Normally closed contact Relay 1

Table 3-1: Terminal layout X3

Terminal No.	Label	Configuration
1	COM	Center contact Relay 2
2	NO	Normally open contact Relay 2
3	NC	Normally closed contact Relay 2

Table 3-2: Terminal layout X4

Terminal No.	Label	Configuration
1	24 V In	External power supply
2	GND	Ground
3	24 V Out	Internal power supply
4	GND	Ground
5	24 V Out	Internal power supply
6	Dig. In 1	Software release signal (Parameter 1.131)
7	Dig. In 2	unassigned
8	Dig. In 3	unassigned
9	Dig. In 4	Fault reset (Parameter 1.180)
10	En-HW	Hardware release signal
11	Dig. Out 1	Error message (Parameter 4.150)
12	Dig. Out 2	unassigned
13	A. Out 0...20 mA	Actual frequency value (Parameter 4.100)
14	10 V Out	For external voltage divider
15	A. Out 0...10V	Actual frequency value (Parameter 4.100)
16	A. GND (Ground 10 V)	Ground
17	A. In 1	Actual PID value (Parameter 3.060)
18	A. GND (Ground 10 V)	Ground
19	A. In 2	unassigned
20	A. GND (Ground 10 V)	Ground

Table 4-3: Terminal layout of standard application card

4.4 Connection scheme

For unlocking the modulation the hardware release signal needs to be activated.

Two variants for the hardware release signal are shown below.

4.4.1 Control connection for hardware release signal with internal power supply (1st variant)

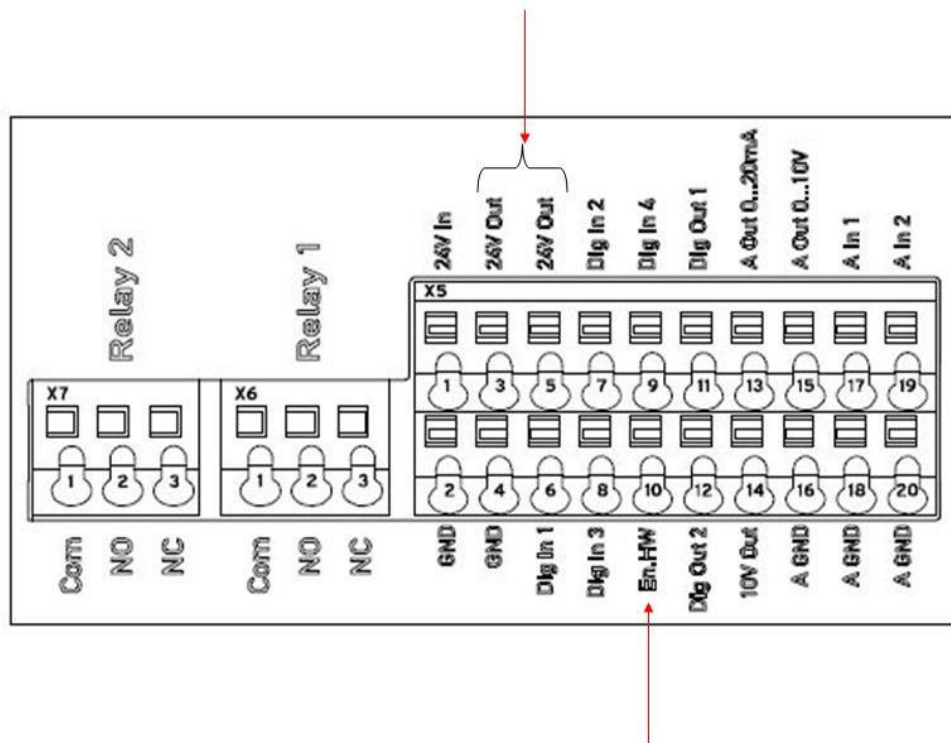


Figure 4-4: Control port for hardware release signal with internal power supply

To activate the hardware release signal, the port „En.HW“ needs to be connected to the port „24V Out“.

4.4.2 Control connection for hardware release signal with external power supply (2nd variant)

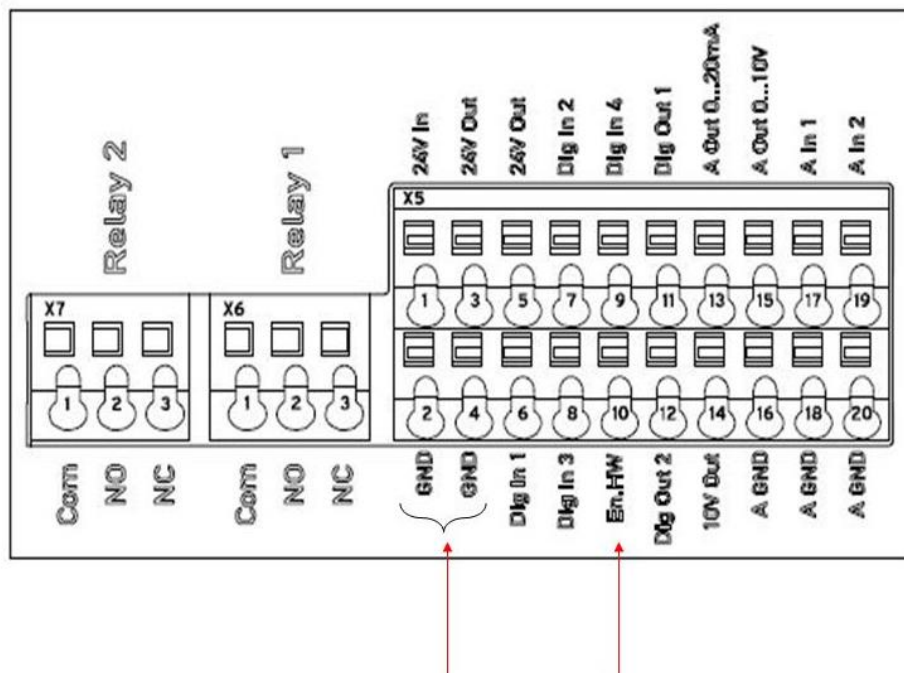


Figure 4-5: Control connection for hardware release signal with external power supply

To activate the hardware release signal with an external power supply, the positive pole (24V DC) of the external power supply needs to be connected to „En.HW“ and the negative pole to GND.

5 Commissioning

To parameterize the frequency converter, connect the USB parameterization cable to a PC. To establish a connection with the software HMM Start-Up, the correct interface must be chosen (in general the last COM-Port).

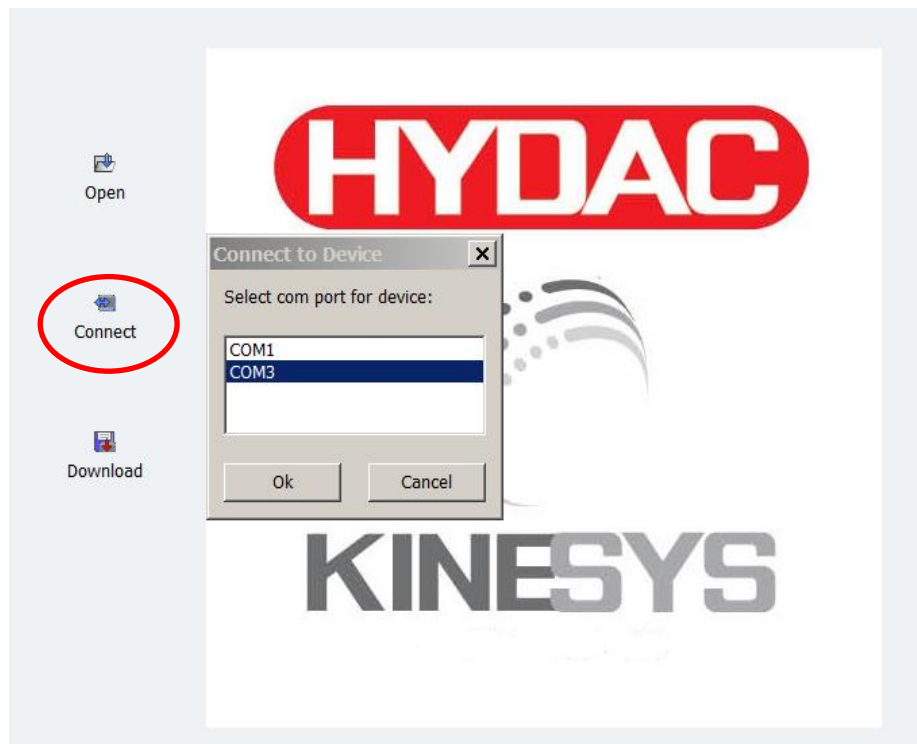


Figure 5-1: Interface

After connecting, the following screen appears.

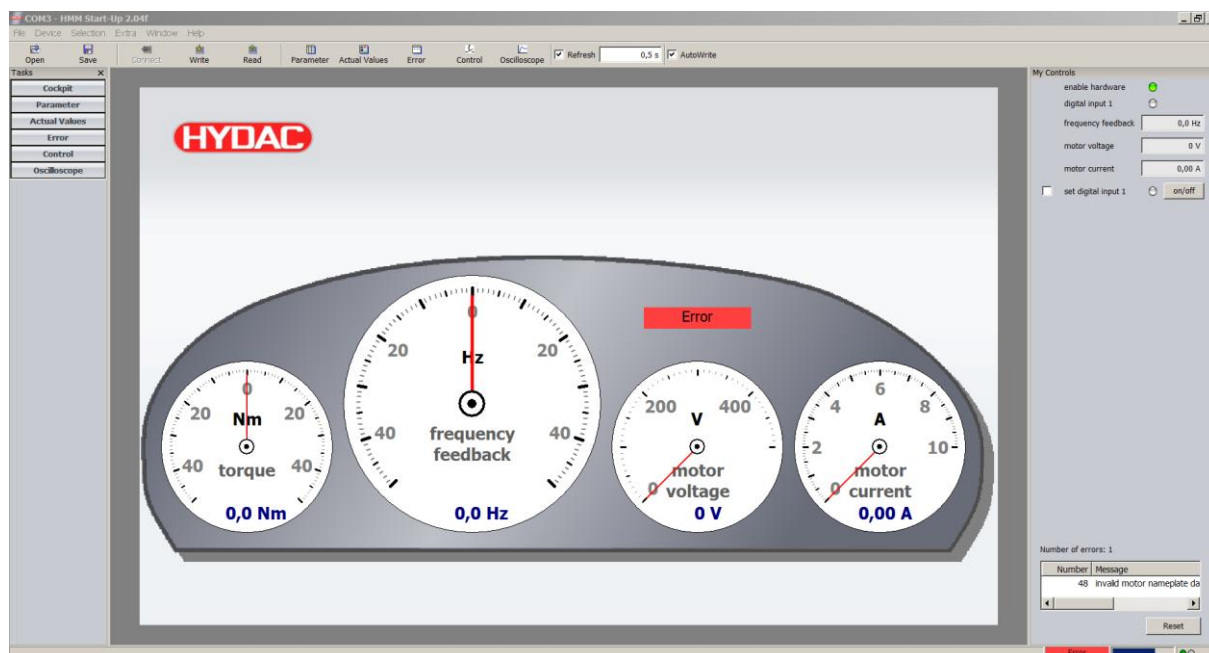


Figure 5-2: Cockpit

As default, the motor specific values are entered and the motor identification was carried out. If you use another motor or the Failure “invalid motor nameplate data” appears, then you have to enter the right motor specific values.

Below is an example for a motor nameplate:

- Motor current: 5,88 A
- Motor power: 3 kW
- Motor speed: 2890 rpm
- Motor frequency: 50 Hz
- Motor voltage: 400 V
- Motor-cosphi: 0,87

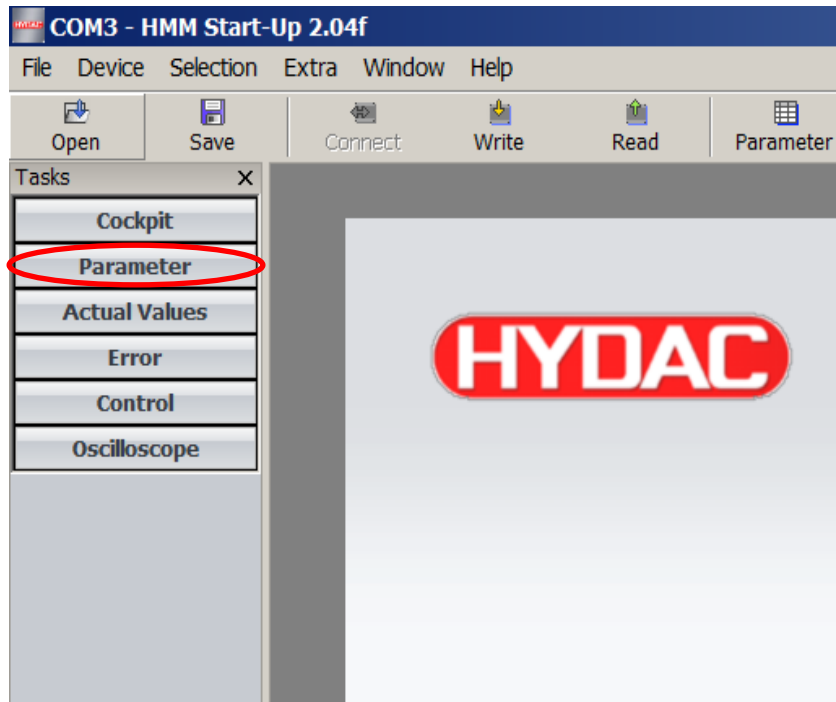


Figure 5-3: Opening the parameter tab

To enter the motor values to frequency inverter's parameters, open the parameter list. Therefore click on "Parameter" as shown in

Figure 5-3.

Number	Name	Value 1	
33.001	motor type	1: induction motor	Ready
33.010	i2t fac.mot.	150 %	Always
33.011	i2t time	30 s	Always
33.015	opt.stat.resist.	100 %	Ready
33.016	motorphas detect	1: enable	Ready
33.031	motor current	5,88 A	Ready
33.032	motor power	3 000 W	Ready
33.034	motor speed	2 890 rpm	Ready
33.035	motor frequency	50 Hz	Ready
33.050	stator resist.	10,00 Ohm	Ready
33.105	leakage induct.	0 H	Ready
33.110	motor voltage	400 V	Ready
33.111	motor cosphi	0,87	Ready

Figure 5-4: motor parameter

Afterwards enter the motor values in the tab “motor parameter” and confirm each entry with the green check mark.

The following parameters need to be set:

- 33.031 motor current
- 33.032 motor power
- 33.034 motor speed
- 33.035 motor frequency
- 33.110 motor voltage
- 33.111 motor-cosphi

When the motor specific values are grayed, then you have no permissions. Please contact the manufacturer.

After entering the motor values a motor identification needs to be performed. To start the identification, confirm the fault with the reset button on the right first. Afterwards click on “Device” → “Commissioning”

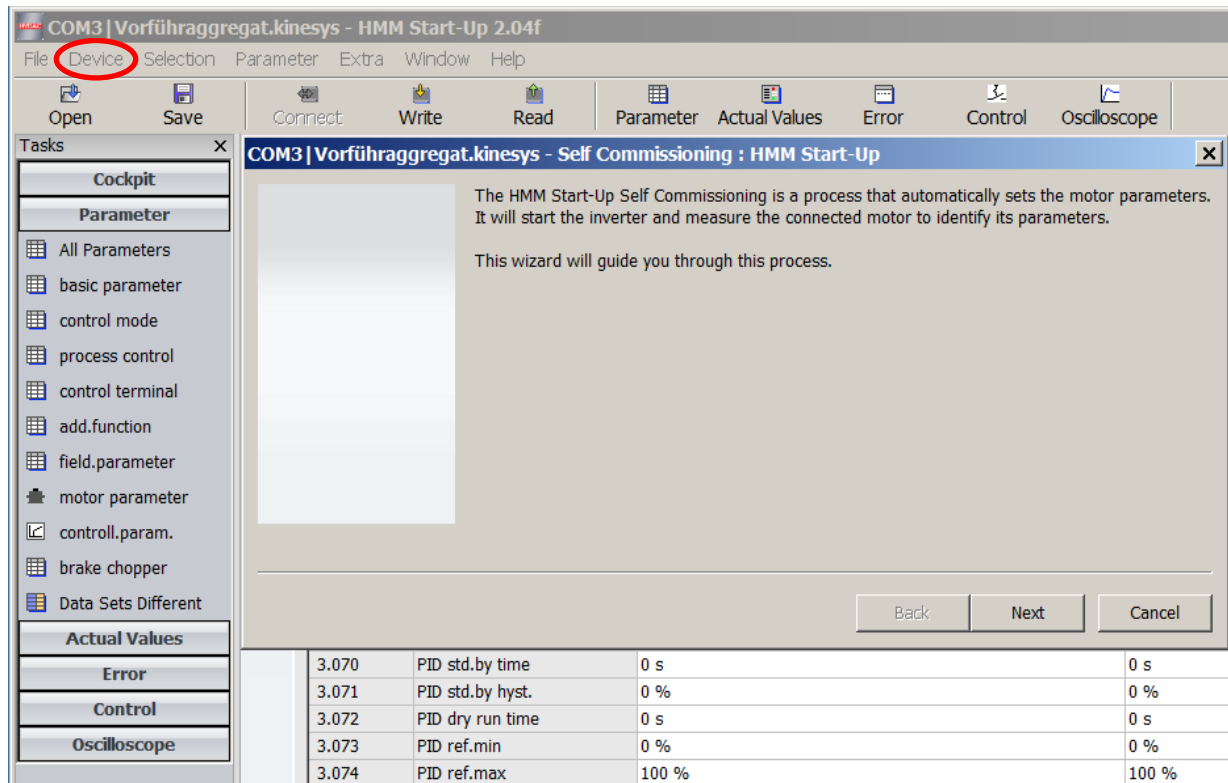


Figure 5-5: Motor identification

Follow the instructions of the wizard.

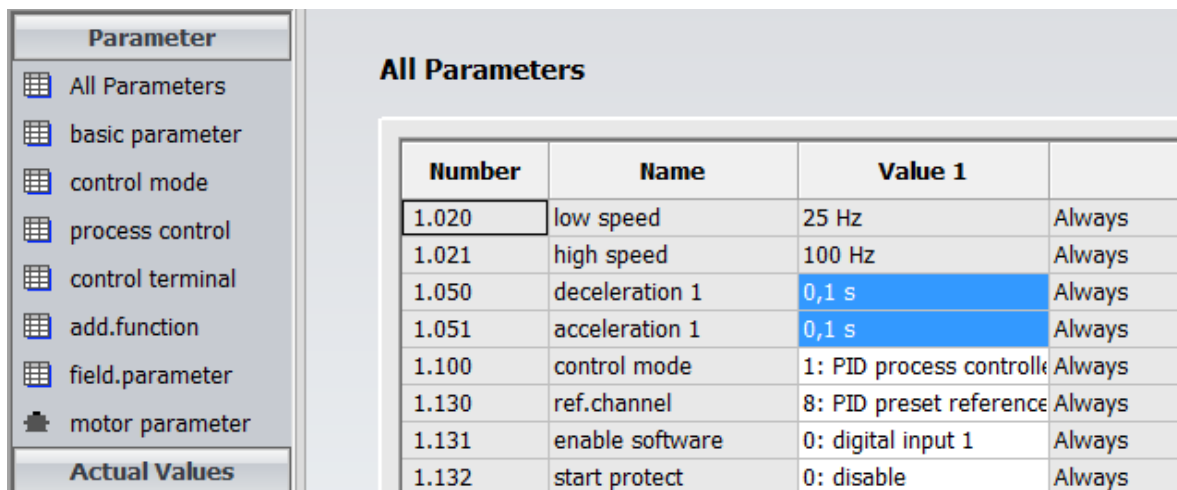


Figure 5-6: Ramp time

By default the ramp time (value number 1.050 and 1.051) is set to 5 seconds. Depending on the application this variable can be changed to a suitable value.

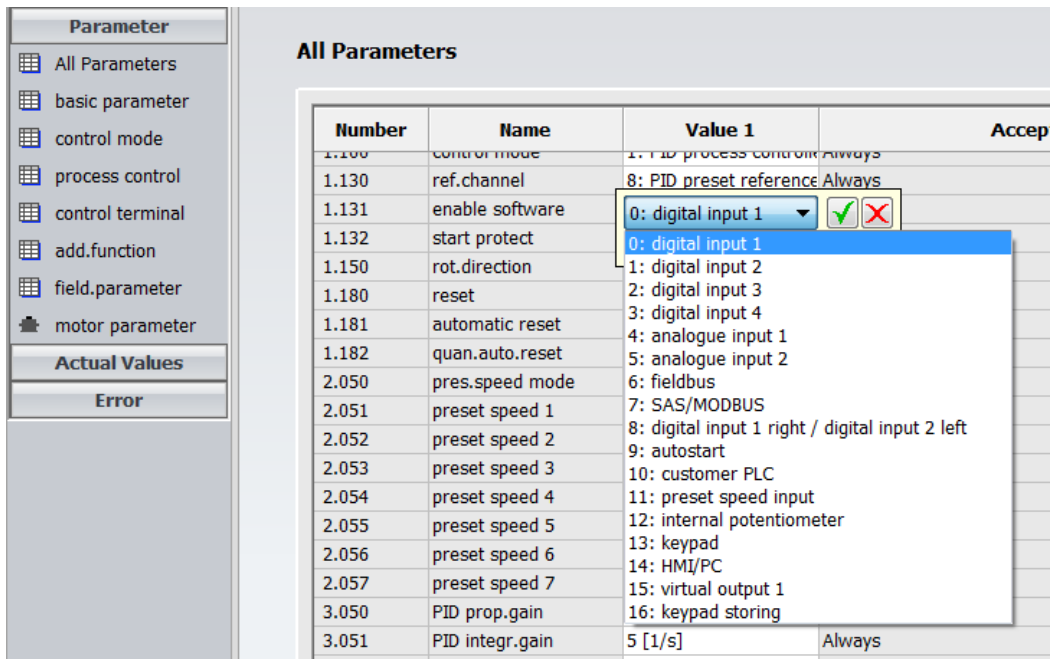


Figure 5-7: Software release signal: digital input 1

That the motor is allowed to start, besides the hardware release signal, a software release signal (1.131) is needed. The software release signal can be wired with the control terminal or set in the software. If a software release signal is desired to be triggered in the software, it can be set to digital input 1 in the simplest case. See chapter 7 for further information.

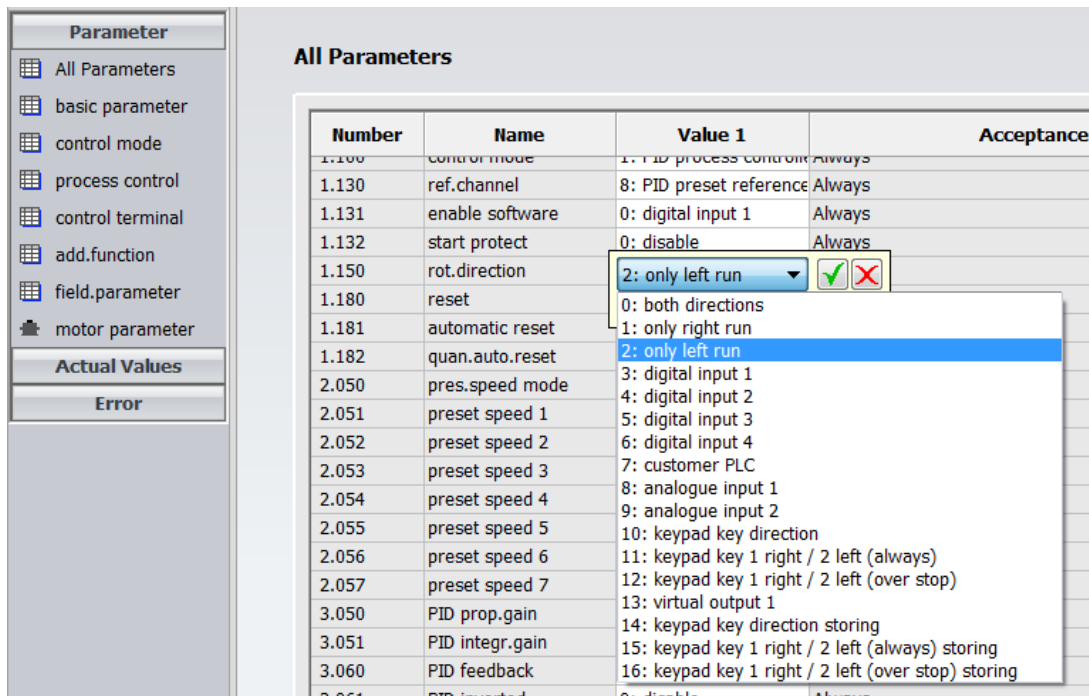


Figure 5-8: Rotation direction

With the parameter “rot.direction (1.150)” the desired motor rotation direction can be set.

5.1 Operation mode “preset speed”

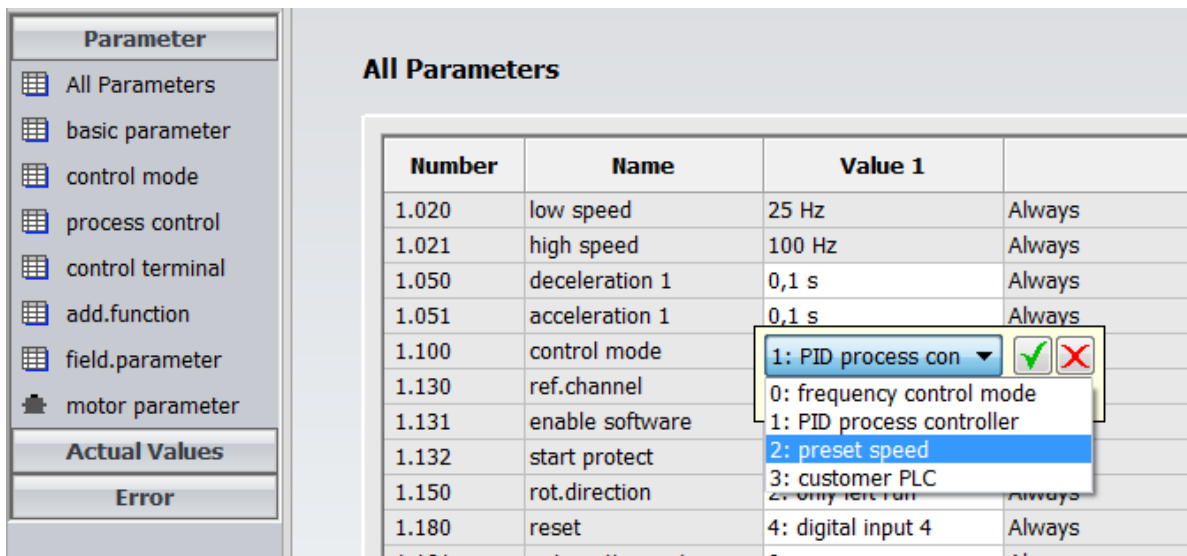


Figure 5-9: Operation mode “preset speed”

If the motor should run with a fixed frequency, the parameter “Control mode (1.100)” has to be set to “preset speed”.

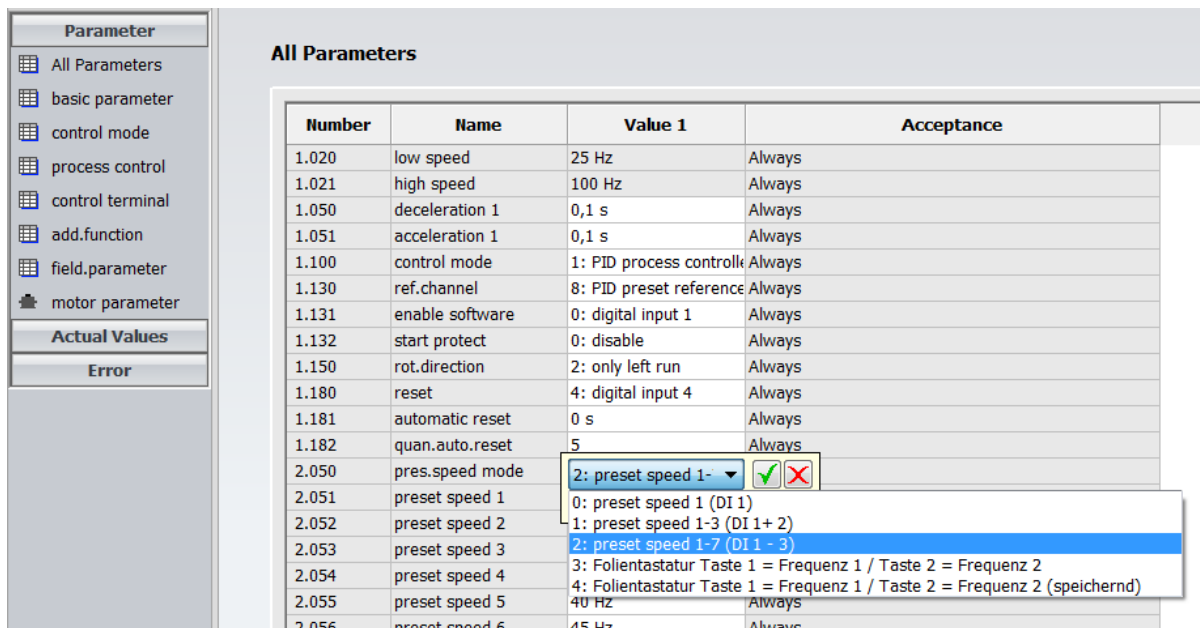


Figure 5-10: Preset speed mode

If “preset speed 1” is chosen under “pres. speed mode (2.050)” the value of “preset speed 1 (2.051)” will be used. Enter the desired value here, e.g. 10 Hz.

Parameter			
All Parameters			
Number	Name	Value 1	
1.100	control mode	1: PID process control	Always
1.130	ref.channel	8: PID preset reference	Always
1.131	enable software	0: digital input 1	Always
1.132	start protect	0: disable	Always
1.150	rot.direction	2: only left run	Always
1.180	reset	4: digital input 4	Always
1.181	automatic reset	0 s	Always
1.182	quan.auto.reset	5	Always
2.050	pres.speed mode	2: preset speed 1-7 (D: Always	
2.051	preset speed 1	10 Hz	<input checked="" type="checkbox"/> <input type="checkbox"/>
2.052	preset speed 2		
2.053	preset speed 3		
2.054	preset speed 4		
2.055	preset speed 5		

Figure 5-11: value of “preset speed 1”

For enabling the motor, see Chapter 7: Software release signal.

5.2 Internal potentiometer as set point value

If the motor should be controlled with the internal potentiometer, the following parameters have to be set.

The screenshot shows a software interface for parameter configuration. On the left is a navigation tree with categories like 'Parameter', 'Actual Values', and 'Error'. The main area is titled 'All Parameters' and contains a table with columns: Number, Name, Value 1, and Accepta. A dropdown menu is open for parameter 1.130, showing options: 8: PID preset refer (selected), 0: internal potentiometer, 1: analogue input 1, 2: analogue input 2, 3: HMI/ PC, 4: SAS/MODBUS, 6: motor.pot., 7: addition analogue input 1 analogue input 2, 9: fieldbus, and 10: customer PLC. The '0: internal potentiometer' option is highlighted in blue.

Number	Name	Value 1	Accepta
1.020	low speed	25 Hz	Always
1.021	high speed	100 Hz	Always
1.050	deceleration 1	0,1 s	Always
1.051	acceleration 1	0,1 s	Always
1.100	control mode	1: PID process controller	Always
1.130	ref.channel	8: PID preset refer	
1.131	enable software	0: internal potentiometer	
1.132	start protect	1: analogue input 1	
1.150	rot.direction	2: analogue input 2	
1.180	reset	3: HMI/ PC	
1.181	automatic reset	4: SAS/MODBUS	
1.182	quan.auto.reset	6: motor.pot.	
2.050	pres.speed mode	7: addition analogue input 1 analogue input 2	
2.051	preset speed 1	8: PID preset reference	
2.052	preset speed 2	9: fieldbus	Always
2.053	reset speed 3	10: customer PLC	Always

Figure 5-12: Control mode “internal potentiometer”

The parameter “ref.channel (1.130)” needs to be set to “internal potentiometer”.

The screenshot shows the same software interface as Figure 5-12. The dropdown menu for parameter 1.100 is open, showing options: 1: PID process con (selected), 0: frequency control mode, 1: PID process controller, 2: preset speed, 3: customer PLC, and 4: digital input 4. The '0: frequency control mode' option is highlighted in blue.

Number	Name	Value 1	Accepta
1.020	low speed	25 Hz	Always
1.021	high speed	100 Hz	Always
1.050	deceleration 1	0,1 s	Always
1.051	acceleration 1	0,1 s	Always
1.100	control mode	1: PID process con	
1.130	ref.channel	0: frequency control mode	
1.131	enable software	1: PID process controller	
1.132	start protect	2: preset speed	
1.150	rot.direction	3: customer PLC	Always
1.180	reset	4: digital input 4	Always

Figure 5-13: Operation mode “frequency control mode”

Furthermore the parameter “control mode (1.100)” has to be set to “frequency control mode”. After setting the software release signal the set point frequency can be changed with the internal potentiometer.

For enabling the motor, see Chapter 7: Software release signal.

5.3 External analog signal as set point value

If the motor speed should be controlled with an external analog signal, the external source has to be wired with the control terminal.

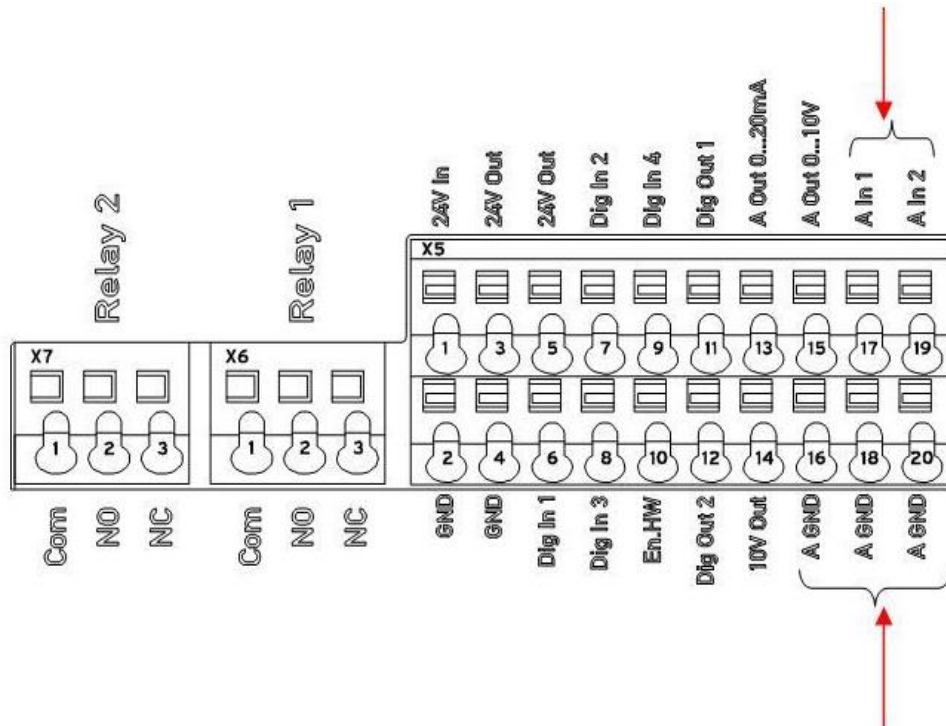


Figure 5-14: control terminal for external analog speed control

“A In1” has to be connected with the positive pole and “A GND” with the ground pole of the external voltage source.

The following software parameters have to be set to control the rotation speed with an external voltage signal.

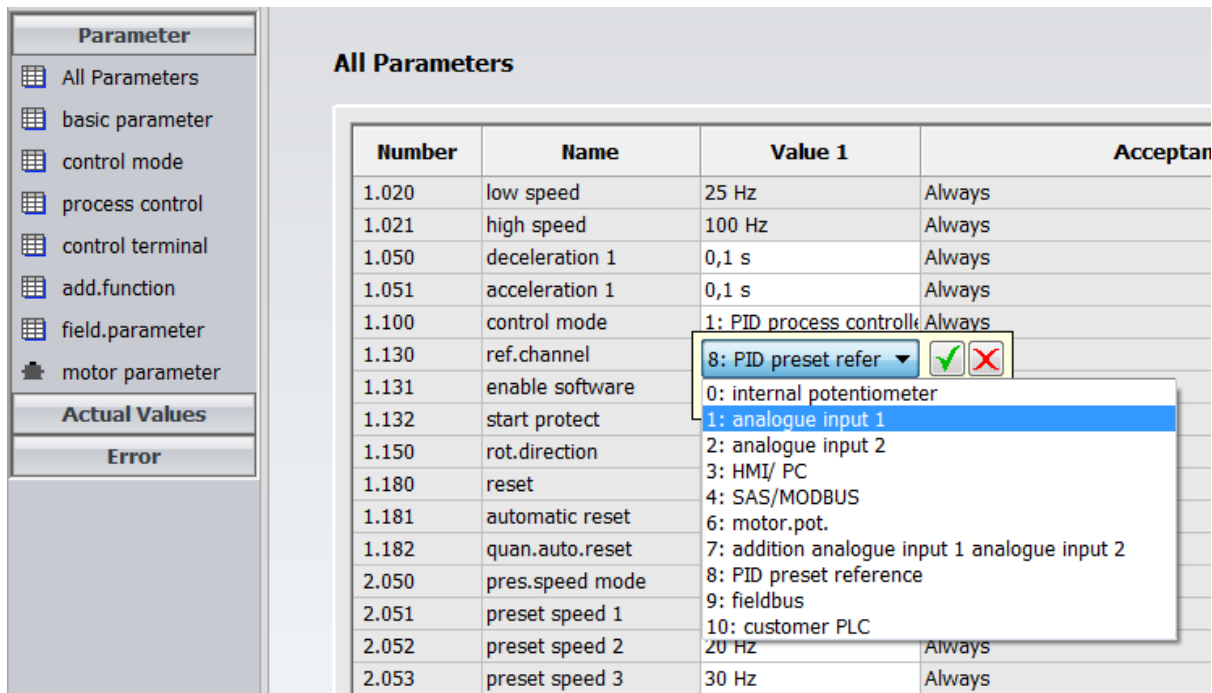


Figure 5-15: Reference channel “analogue input 1”

The parameter “ref.channel (1.130)” has either to be set to “analogue input 1” or to “analogue input 2”.

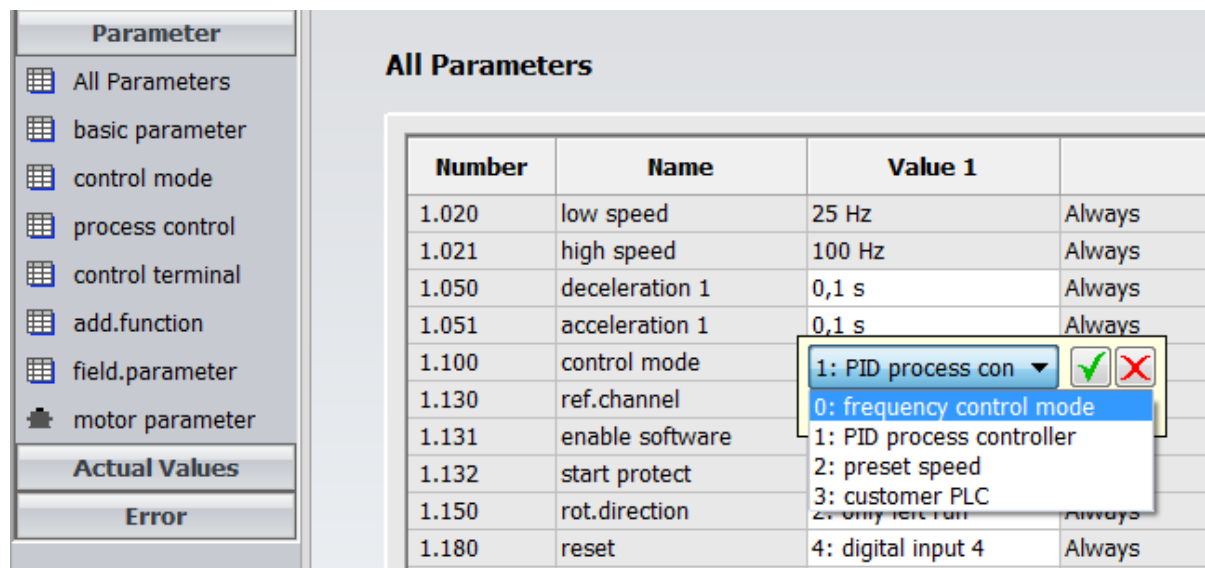


Figure 5-16: control mode: frequency control mode

The value “control mode (1.100)” has to be set to “frequency control mode”. After setting the software release signal, the set point frequency can be dictated by the external signal.

For enabling the motor, see Chapter 7: Software release signal.

6 PID controller

6.1 Set point generator

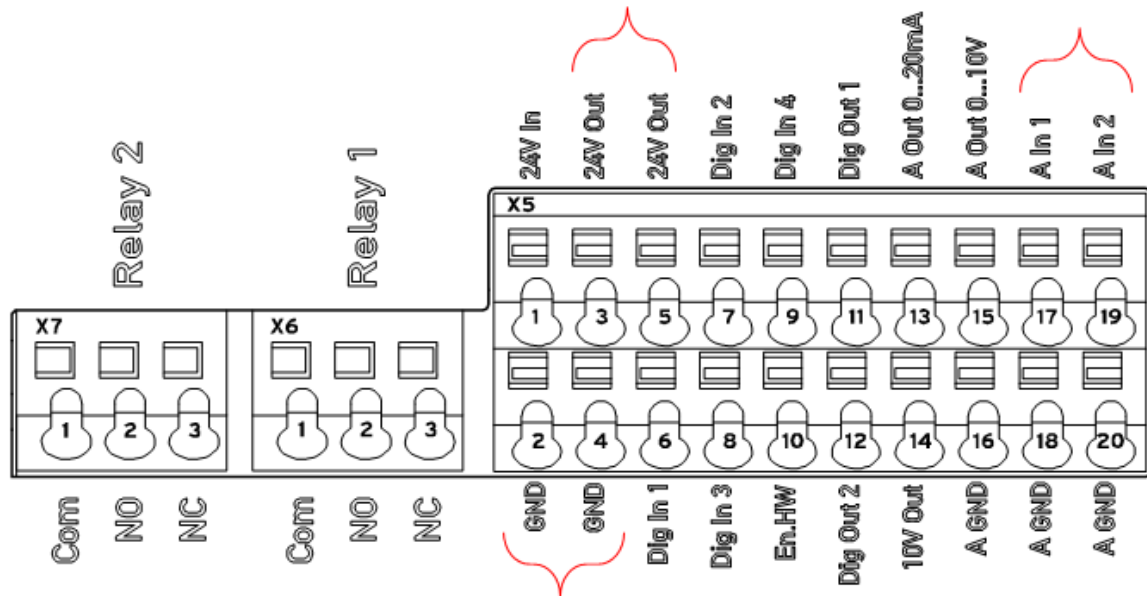


Figure 6-1: control port for pressure regulator

The supply voltage of the pressure sensor needs to be connected with “24V Out”, 0V with “GND” and the signal line (voltage signal) with „A In 1“ or „A In 2“, depending on the reference channel setting in Figure 4-15.

6.2 Set point control

To activate the PID process controller the following parameters have to be set.

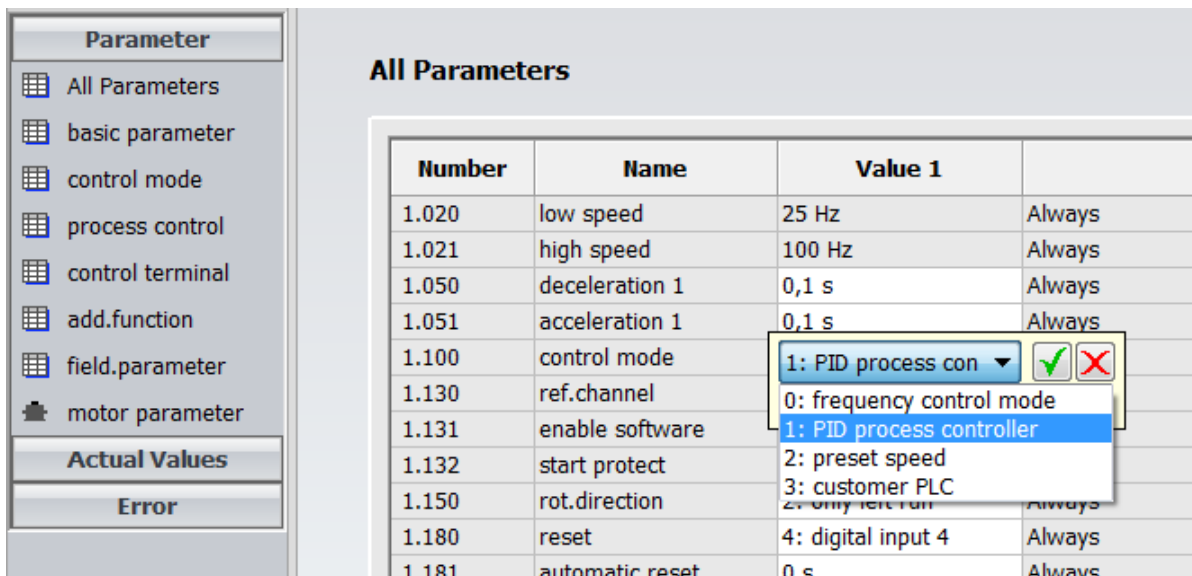


Figure 6-2: PID process controller

The parameter “control mode (1.100)” has to be set to “PID process controller”.

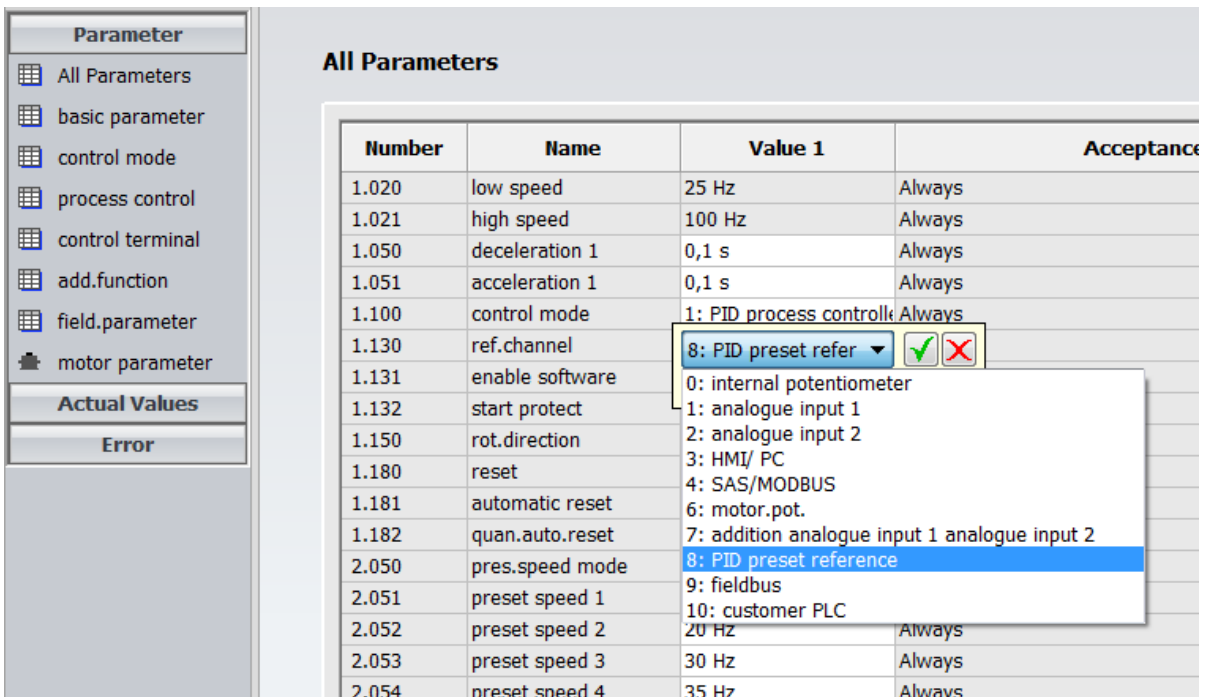


Figure 6-3: PID preset reference

For set point control the parameter “ref.channel (1.130)” has to be set to “PID preset reference”.

Number	Name	Value 1	
3.050	PID prop.gain	0,4	Always
3.051	PID integr.gain	5 [1/s]	Always
3.060	PID feedback	0: analogue input 1	Always
3.061	PID inverted	0: disable	Always
3.062	PID preset ref.1	40 %	Always
3.063	PID preset ref.2		
3.064	PID preset ref.3		
3.065	PID preset ref.4		
3.066	PID preset ref.5	0 %	Always
3.067	PID preset ref.6	0 %	Always

Figure 6-4: PID preset reference

The desired set point value can be defined at the parameter “PID preset ref.1 (3.062)”. This value represents the percentage of the maximal pressure sensor output voltage.

Number	Name	Value 1	
3.065	PID preset ref.4	0 %	Always
3.066	PID preset ref.5	0 %	Always
3.067	PID preset ref.6	0 %	Always
3.068	PID preset ref.7	0 %	Always
3.069	PID pre.ref.mode	0: PID preset refer	Always
3.073	PID ref.min		
3.074	PID ref.max		
4.020	AI1 ref.type		
4.021	AI1 min.input	0 %	Always
4.022	AI1 max.input	100 %	Always

Figure 6-5: PID preset reference mode

That the motor can be controlled with preset reference 1, the parameter “PID pre.ref.mode (3.069)” has to be set to “PID preset reference 1”.

6.3 Pressure control with analog set point setting

For the analog set point setting the analog signal has to be connected to “An1” or “An2” and the following settings have to be done.

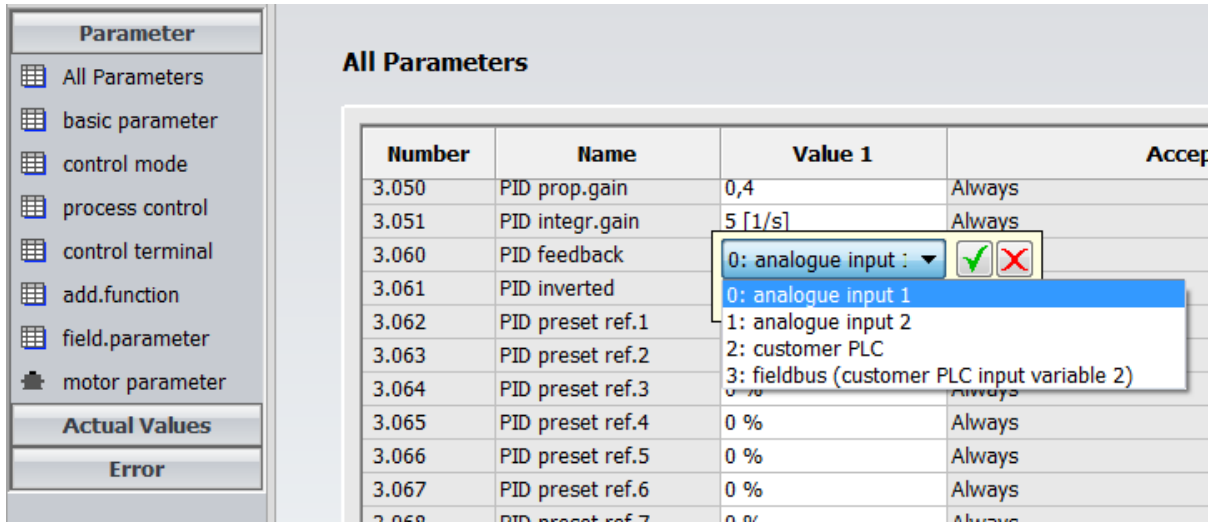


Figure 6-6: PID feedback

The parameter “PID feedback (3.060)” has, depending on the connected port, to be set to “analogue input 1” or “analogue input 2”.

6.4 PID controller settings

For each system the control parameters “proportional gain” and “integral gain” have to be adapted. The “derivational gain” is rarely required.

Number	Name	Value 1	
2.056	preset speed 6	45 Hz	Always
2.057	preset speed 7	50 Hz	Always
3.050	PID prop.gain	0,4	Always
3.051	PID integr.gain		
3.060	PID feedback		
3.061	PID inverted		
3.062	PID preset ref.1	40 %	Always
3.063	PID preset ref.2	0 %	Always

Figure 6-7: PID-P gain

Set the desired value for the proportional gain at “PID prop.gain (3.050)”.

Number	Name	Value 1	
2.056	preset speed 6	45 Hz	Always
2.057	preset speed 7	50 Hz	Always
3.050	PID prop.gain	0,4	Always
3.051	PID integr.gain	5 [1/s]	Always
3.060	PID feedback		
3.061	PID inverted		
3.062	PID preset ref.1		
3.063	PID preset ref.2	0 %	Always

Figure 6-8: PID-I gain

Set the desired value for the integral gain at “PID integr.gain (3.051)”.

To find the correct parameters the following approach can be used:

Gradually increase the proportional gain until the system starts swinging. Thereafter slightly decrease the P-Gain and adjust the system dynamics with the I-Gain.

7 Software release signal

There are two possibilities to set the software release signal:

- In the software HMM Start-Up
- By external wiring

Setting the software release signal in the software HMM Start-Up

In the Control tab the digital input 1 can be set to TRUE, that “software release signal” is triggered and the motor can start running.

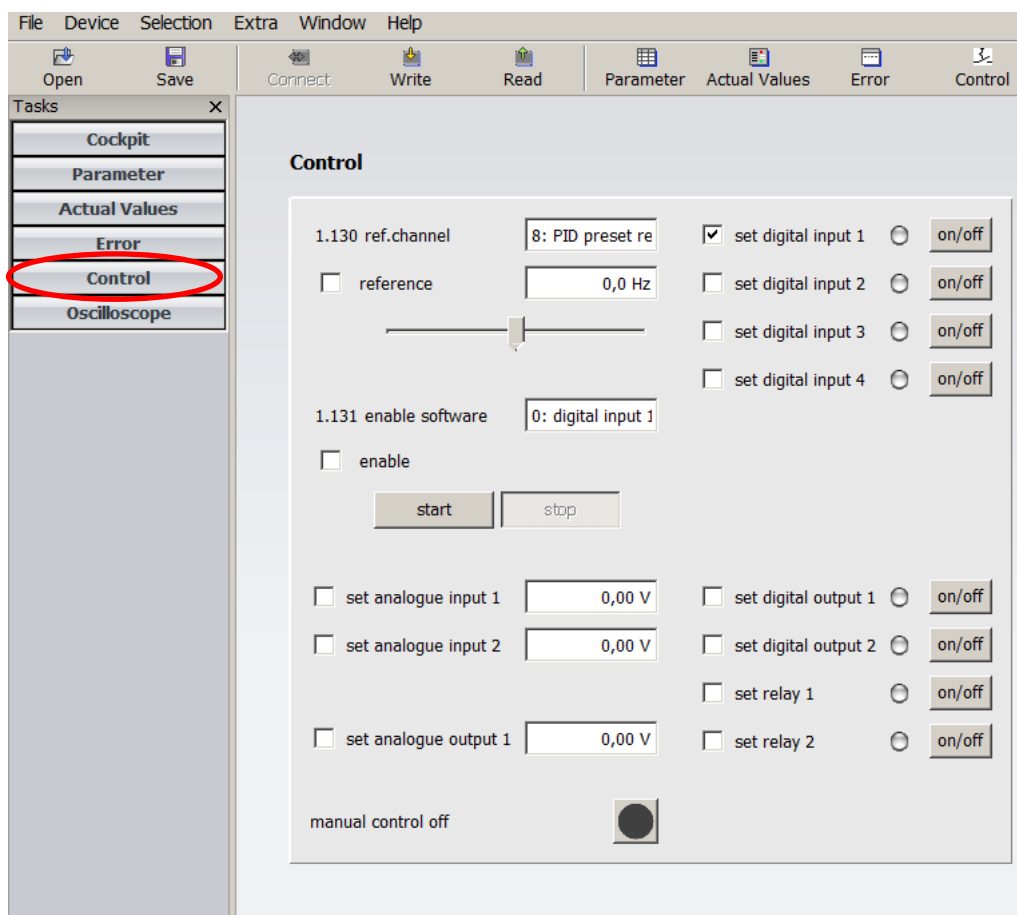


Figure 7-1: Control tab

Once digital input 1 is set to TRUE (see Figure 7-2), the motor starts running.

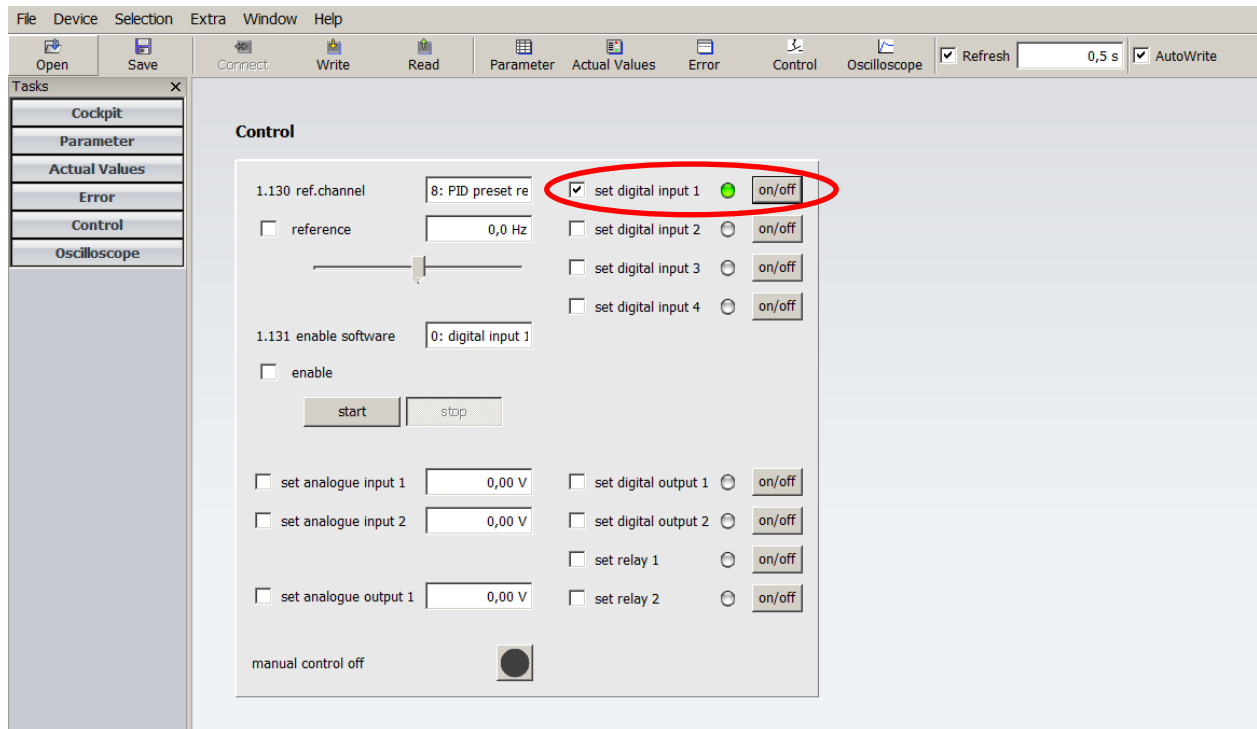


Figure 7-2: Active digital input 1

Setting the software release signal by external wiring

See Table 3-3 and chapter 5 for basic commissioning.

8 Saving up and restoring the parameterization

8.1 Save

If the parameterization should be backed up, click on the “File”-tab on the “Save as” entry and save the data in a desired location.

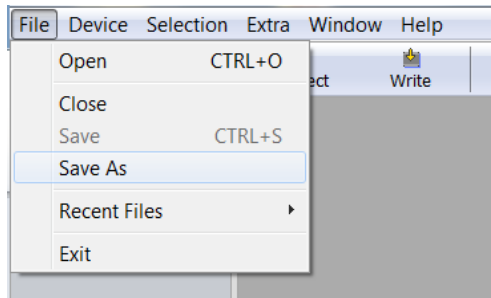


Figure 8-1: Save

8.2 Restore

If a parameterization should be loaded, click on the “Open” button and chose the desired File.

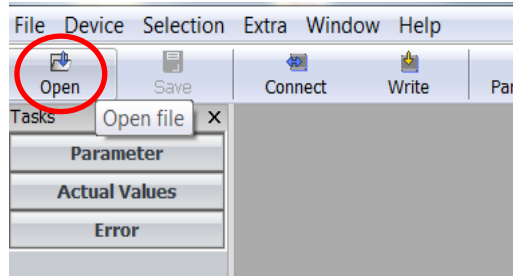


Figure 8-2: Restore

HYDAC



KINESYS