NORDBO ROBOTICS

Manual Version 2.3
For Software Version 2.0.0

NAC-S20-150

User Manual

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Contents

Get to know NAC

The Nordbo Active Compensation unit (NAC) is a solution for applications where a constant, specifiable force between tool and workpiece is required. The NAC consists of two parts:

- NAC Tool Unit
- NAC Controller (additional purchase)

The **NAC Tool** Unit can be used with a URCap. This gives the following functionality:

- Set target force.
- Angle compensation (handled in URCap).

The **NAC Controller** is an additional purchase. The Controller is a PLC that gives the following functionality, which can be configured through a simple web interface:

- Digital IO or Analog IO control.
- Control over Ethernet TCP/IP.
- Angle force compensation.

NAC Tool Unit

NAC Controller

Illustrated use of NAC

Product Information

NAC Contents

Component	Referred to as	Description
	NAC-S20-150	Tool unit with a stroke of 20 mm and a maximum payload capacity of 15 kg.
	NAC Cable	Communication cable between NAC-S20-150 and the NAC-CTRL or a compatible robot from Universal Robots
Additional Purchase		
	NAC-CTRL	Simplifies the controls of the NAC-S20-150 by enabling control over Ethernet TCP/IP, Digital IO, and Analog IO, as well as integrated angle compensation.
	Ethernet cable RJ45	Ethernet cable for connecting to the NAC-CTRL.

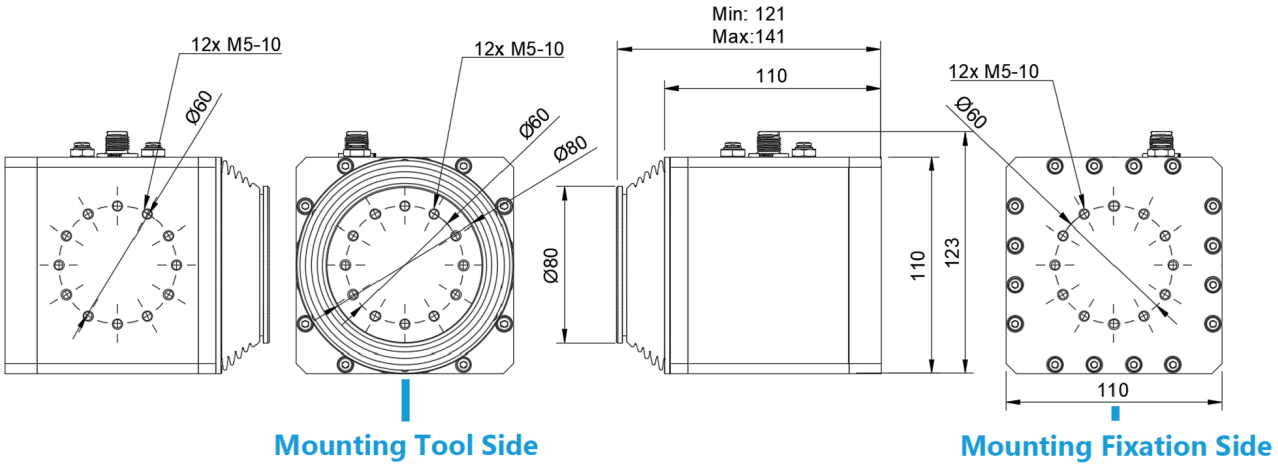
Technical Specifications

General Specifications		
Maximum force (push/pull)	150 N / 110 N	
Maximum allowed external moment	16 Nm	
Stroke length	20 mm	
Interfaces	**NAC-S20-150**	**NAC-CTRL**
Control Interface	Analog IO	Ethernet TCP/IP Digital IO Analog IO
Parameterization Interface	URCap	Web Interface
Pneumatic General Specifications The NAC Tool Unit needs to be connected to a supply of compressed air through an air regulator to regulate push/pull force.		
Maximum supply pressure	1.0 MPa	
Minimum supply pressure	Set pressure + 0.1 MPa	
Set pressure range	Up to 0.9 MPa	
Maximum flow rate	6 L/min	
Electrical Specifications	**NAC-S20-150**	**NAC-CTRL**
Power supply voltage	24VDC ±10%	
Power supply current consumption	Typical 0.30A, Up to 2A	
Digital IO interface Switch logic Voltage ratings Maximum output current	- 	 NPN In/Out: 5 – 24Vdc 12mA
Analog IO interface Voltage ratings Maximum output current	 In: 0 – 10Vdc / Out: 1 – 5Vdc 20mA	 In: 0 – 10Vdc 20mA
Ambient Specifications	**NAC-S20-150**	**NAC-CTRL**
Operating ambient temperature	0° to +50°	
Storage ambient temperature	-10° to +75°	-20° to +60°
Cooling	Passive	
Operating humidity (at 25° C)	0% to 85%, No condensation	

Degree of protection	IP67 with full pin and fitting allocation	-

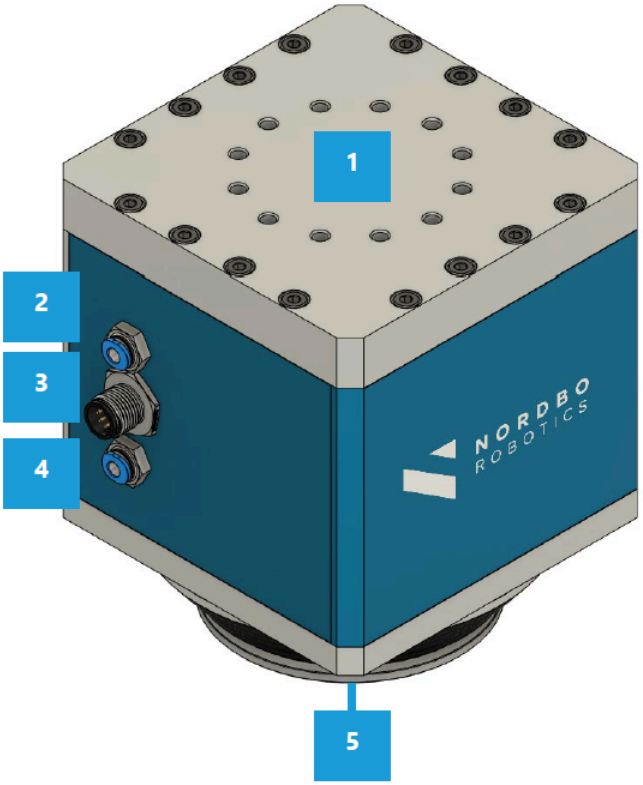
Mechanical Dimensions

Unit	NAC-S20-150	NAC-CTRL
Weight	2.6 Kg	1.2 Kg
Dimensions Height Width Depth	 121-141 mm 110 mm 110 mm	 56.26 mm 106.13 mm 226 mm
Mounting Tool Side Bolts Flange Diameter	 M5-10 Ø60mm	-
Mounting Fixation Site Bolts Flange Diameter	 M5-10 Ø60mm	-



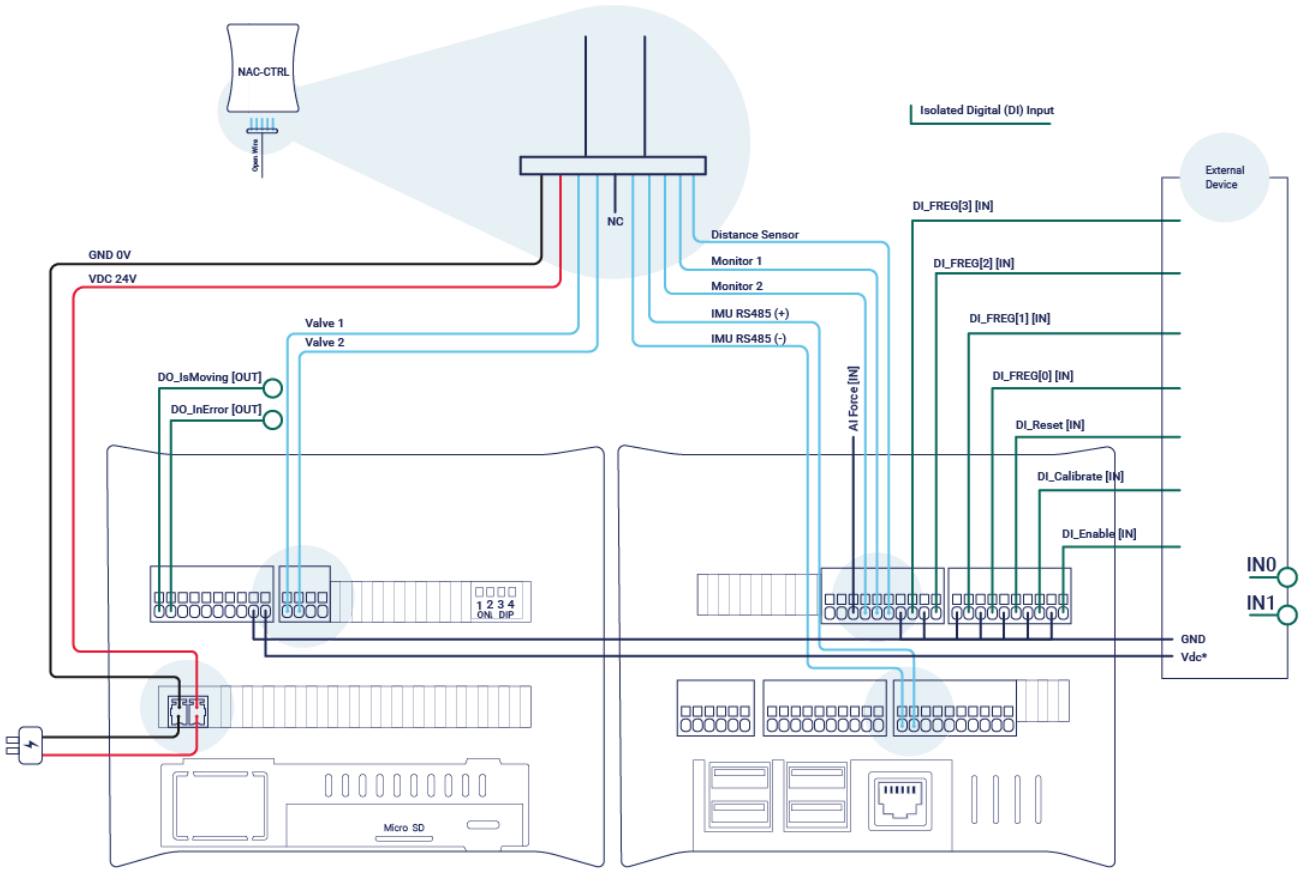
NAC-S20-150 Overview

NAC Tool Unit



ID	Description	Functionality
1	Mounting hole pattern, fixation site	Used when mounting the tool unit on a stable surface or on a robot flange.
2	Air, out	Connect tube for exhaust air
3	Interface for NAC Controller or UR robot	Use the supplied cable to connect the tool unit with the Nac Controller or UR robot.
4	Air, in	Connect the tube to supply air to the tool unit.
5	Mounting hole pattern, tool side	Used when mounting a tool on the tool unit.

NAC Controller



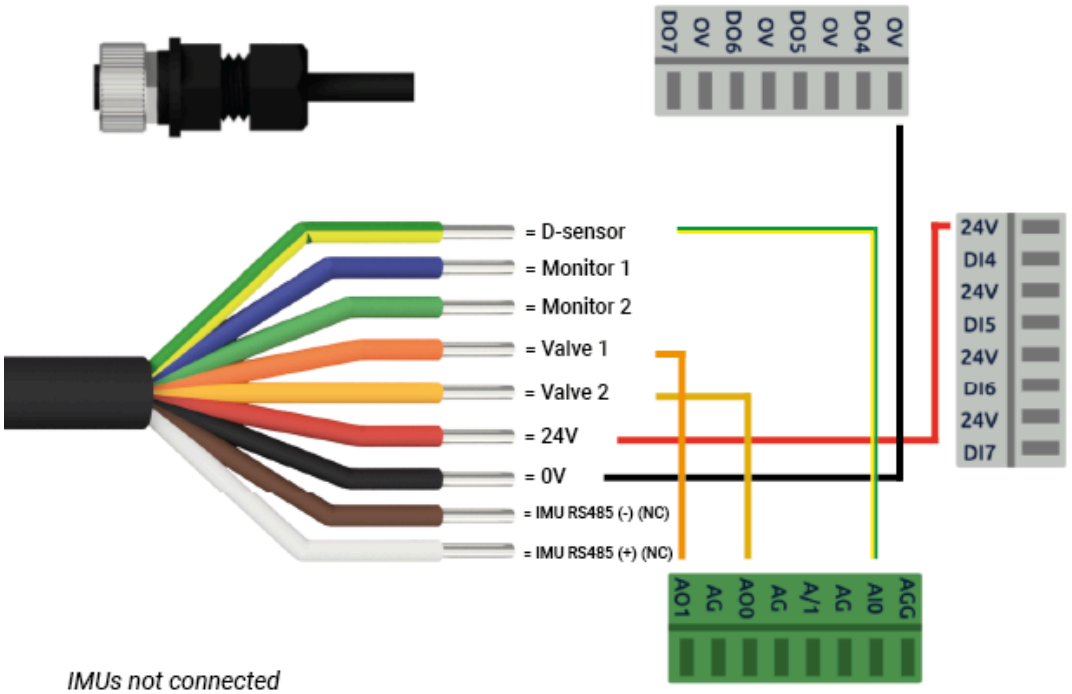
NAC-CTRL Interface

Using the URCap

The NAC Tool Unit can be used with the URCap (compatible with Polyscope 5). This gives access to these features:

- Set target force
- Angle compensation (handled in URCap)

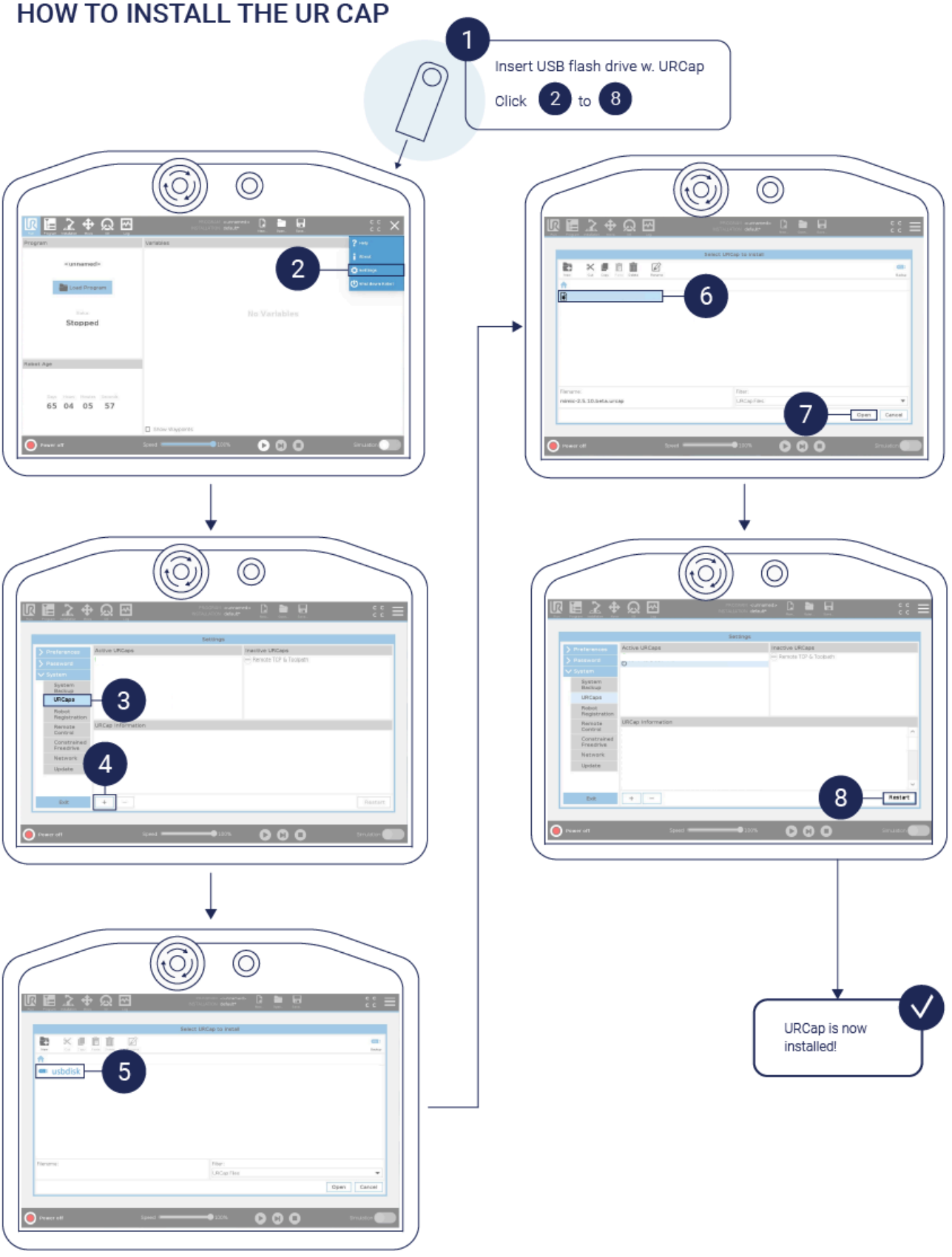
When using the URCap, the NAC Controller can be connected with an ethernet cable to the UR robot or the NAC Tool Unit can be wired directly to the UR robot. See the wiring diagram here:



IMUs not connected

NAC Wire Description	
Label, wire color	**Function**
D-Sensor, yellow/green	Out: Analog signal between 0-10 relative to piston distance.
Monitor 1, blue	Out: Analog signal between 0-5 valve 1 feedback.
Monitor 2, green	Out: Analog signal between 0-5 valve 2 feedback.
Valve 1, orange	In: Analog signal between 0-10 relative to target push force
Valve 2, yellow	In: Analog signal between 0-10 relative to target pull force
24 V, red	Power
0 V, black	Ground
IMU RS485 (-), brown	Serie communication
IMU RS485 (+), white	Serie communication

HOW TO INSTALL THE UR CAP



Installation - Setting up the URCap

The URCap needs to be setup in terms of:

- Choose mode: Disabled, Ethernet or Analog
- (Optional) Set payload (manually set the payload in kilogram)
- Set IP address of the Controller (only relevant in Ethernet mode)

Program - Using the URCap

The URCap is used by inserting the NAC node. This node can be configured to different modes:

- Start - start compensation
- Stop - stop compensation
- Set target force - set the specified force used for compensation
- Retract - Retract the NAC
- Calibrate - Calibrate the weight of the tool unit

Selecting any of these, will convert the node into a node with the selected functionality.

Available Scripts

The following scripts provide the same functionality as described in the section Program - Using the URCap:

- nac_start()
- nac_stop()
- nac_set_target_force(newton)
- nac_retract()
- nac_set_payload(kilogram)
- nac_calibrate()

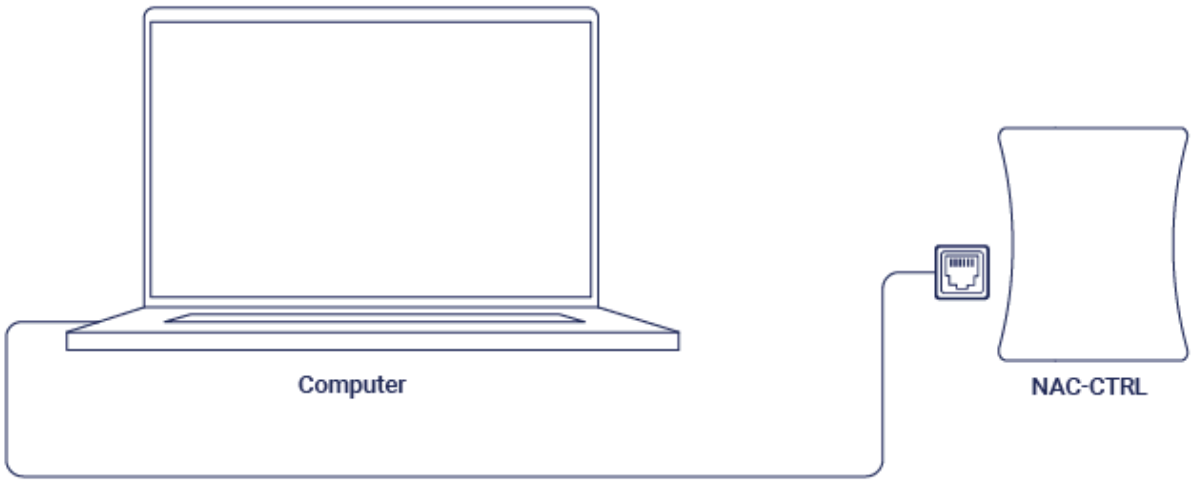
Scripts with additional functionality:

- nac_get_position() - returns stroke position
- nac_get_payload() - returns payload
- nac_is_moving() - returns whether the NAC is moving or not

Using the Web Interface

The web interface is accessible by connecting the NAC-CTRL to a PC via Ethernet. Input the NAC-CTRL's IP address in a web browser (e.g. Internet Explorer or Google Chrome) to access the settings.
The integrated web interface of the NAC supports:

- Switch between different control modes (digital, analog or ethernet).
- Set target forces when using digital IO.
- Updating the NAC-CTRL.
- Set Network Settings for the NAC-CTRL.



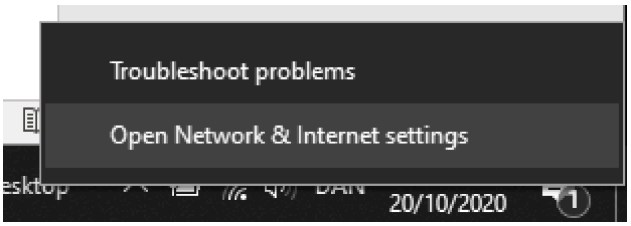
How to Access the Web Interface

Before the NAC controller can be accessed through an internet browser by typing in the IP address of the controller, the network settings may need to be configured. The following section explains how to connect to the controller using a Windows 10 PC.
Default IP address: 192.168.1.102

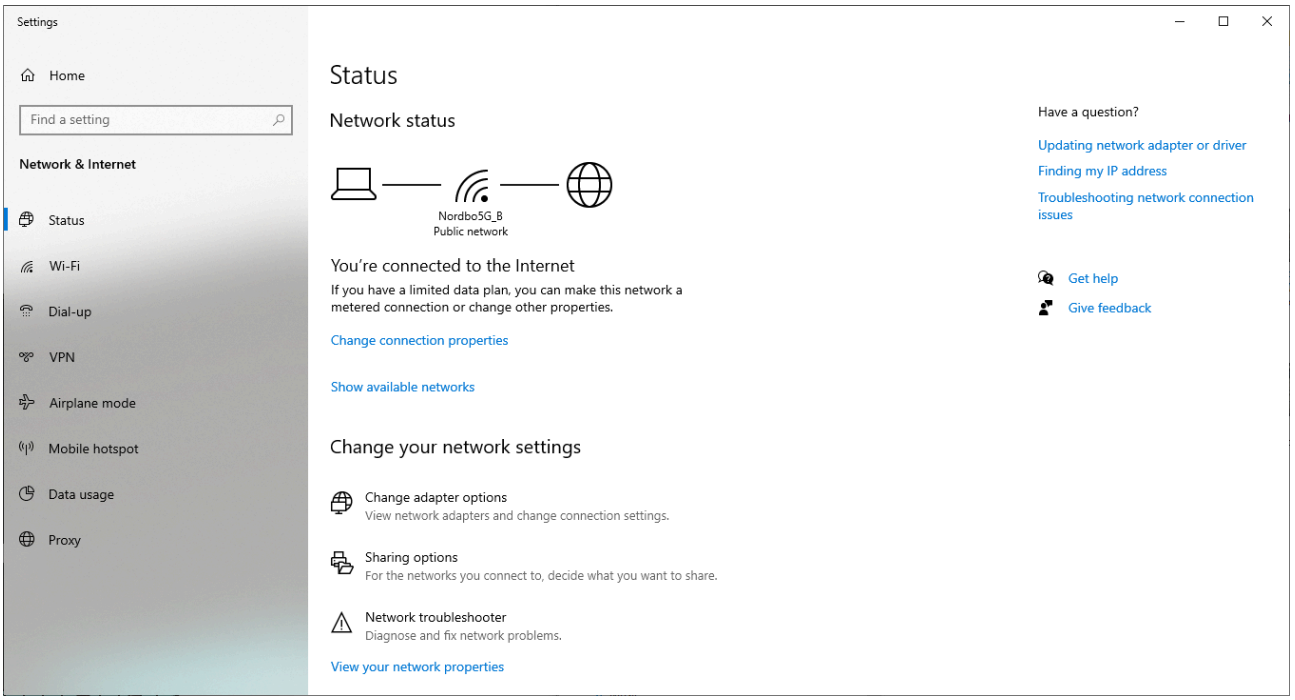
Note: *Default settings for the NAC-CTRL is having a static IP address of 192.168.1.102. Adding the device to a network with an existing device having the same IP address can cause network faults. For initial commissioning, connect the control unit directly to a PC via the Ethernet interface.*

Step 1
Connect the controller's power supply and connect to a PC using an ethernet cable.

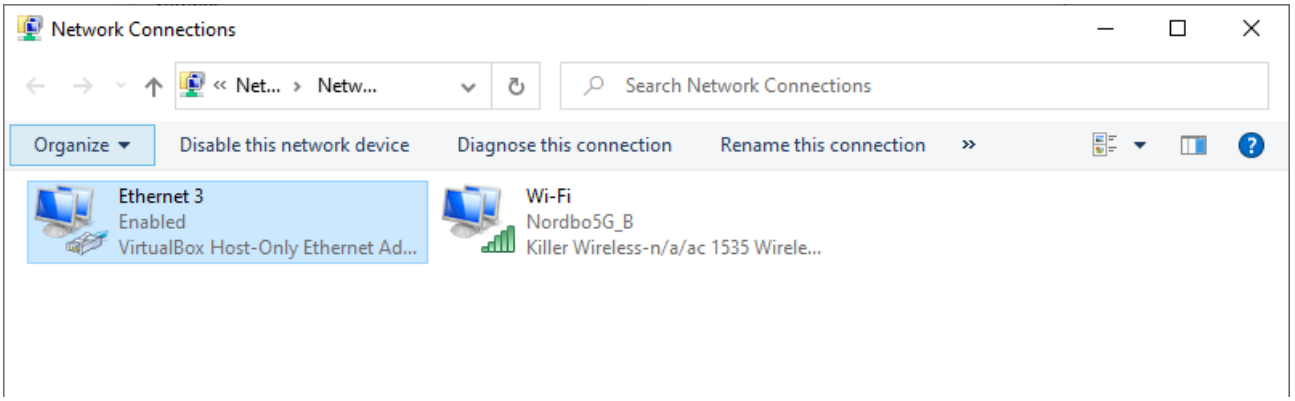
Step 2
Open Network & Internet settings by right-clicking on the Wi-Fi/LAN icon in the menu



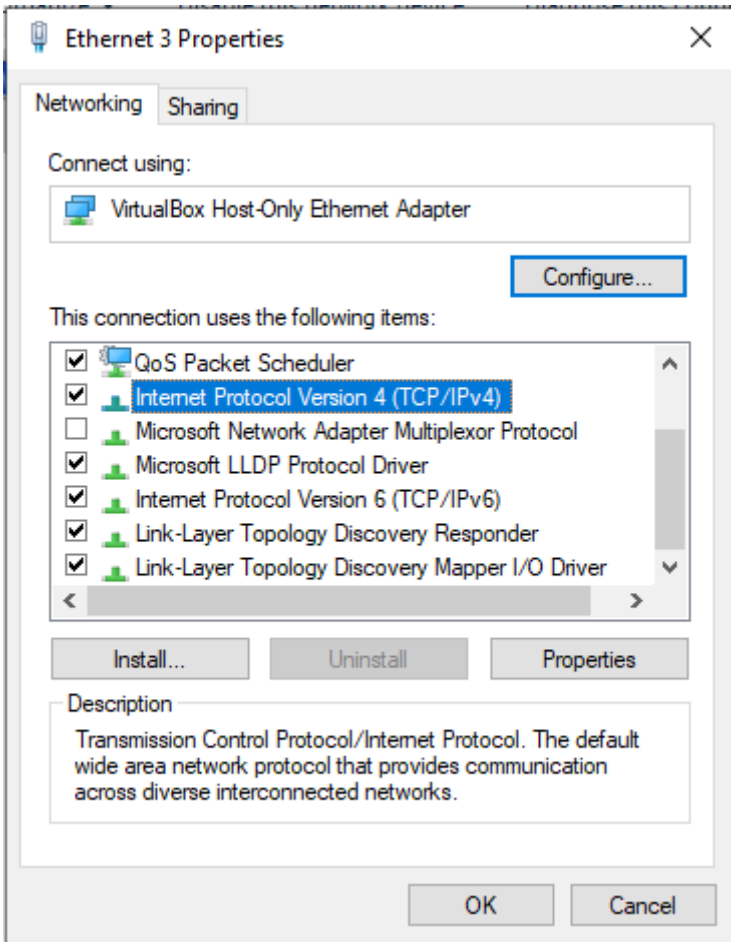
Step 3
Click ”Change adapter options”.



Step 4
Right-click on ”Ethernet 3” and select “Properties.”
Note: *Ethernet number may vary from system to system*

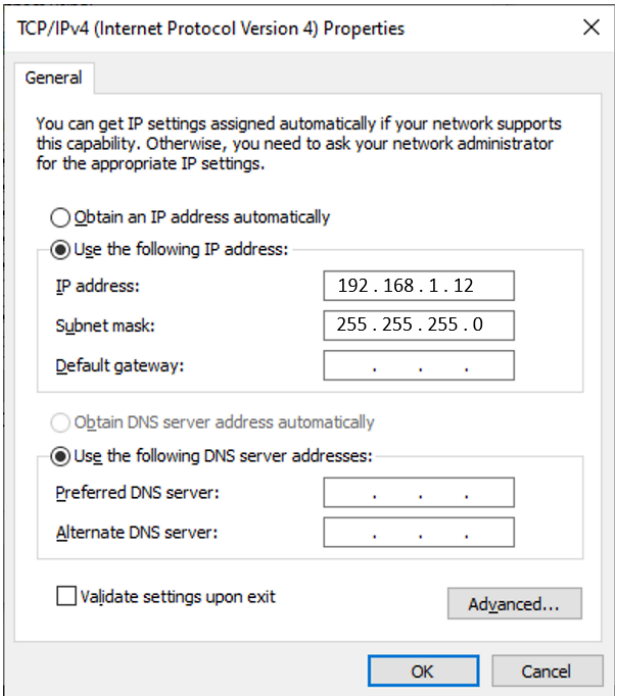


Step 5
Select Internet Protocol Version 4 (TCP/IPv4) and click “Properties”.



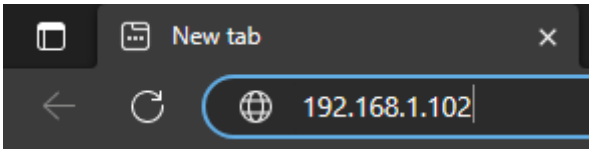
Step 6

Set the IP address to 192.168.1.12 and the Subnet mask to 255.255.255.0



Step 7

Access the web interface using a browser by typing the IP address 192.168.1.102. Make sure there's no **https://** before the IP address.



Configuring the NAC Using Web Interface

Overview of the Web Interface

The NAC web interface contains the menus listed in the following table.

Tab	Functions

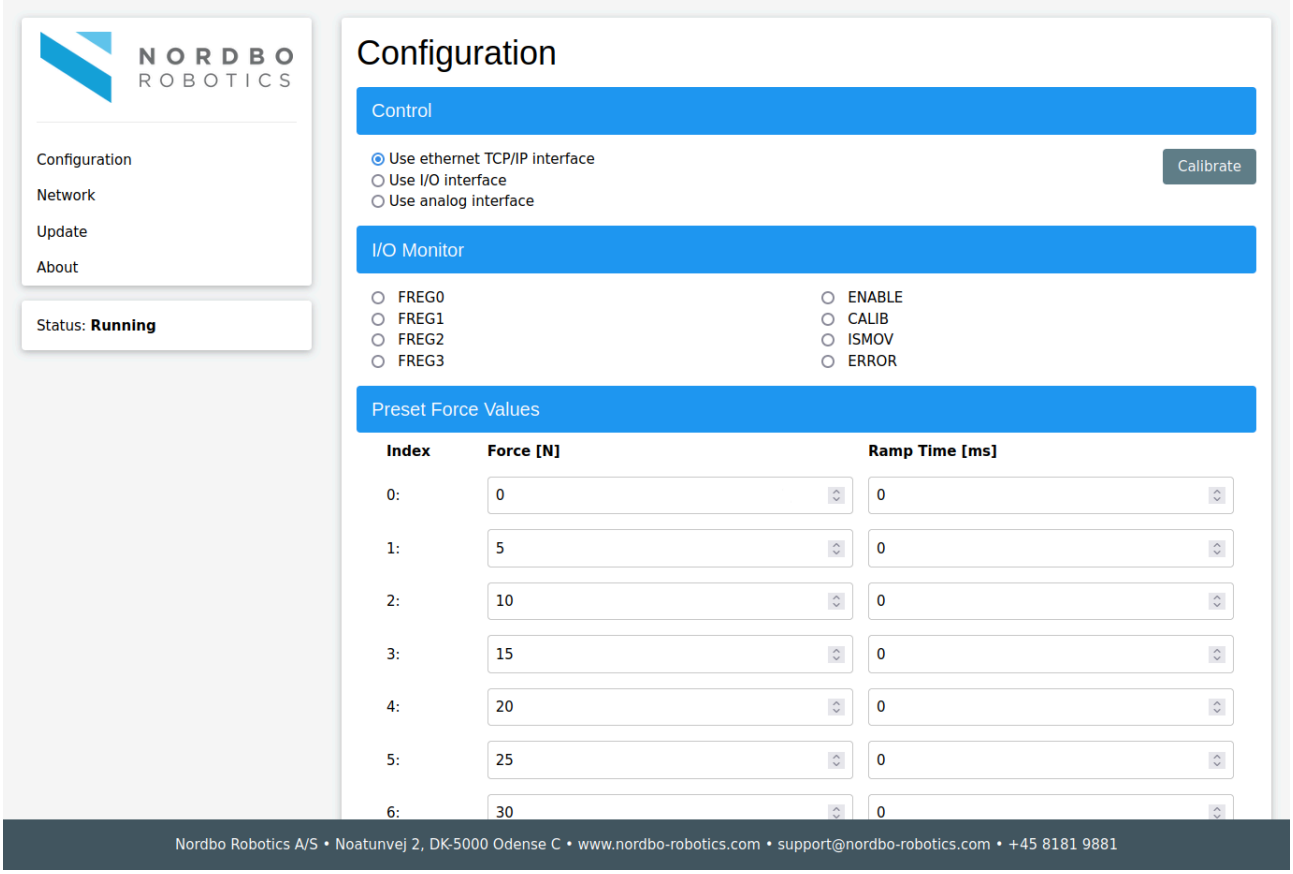
Configuration	• Control
	  ◦ Choose between control methods. Ethernet TCP/IP, I/O(digital) or analog interface.
	  ◦ Calibrate load weight by pressing the “Calibrate” button.
	• I/O Monitor - live view of the IO states on the NAC.
	• Preset Force Values - only used for digital I/O interface.
	  ◦ Setting predefined target forces and ramp time for each of the 16 preset registers which can be selected using the 4-bit IO register indexing.
	• Is Moving Settings
	  ◦ Timeout of is moving signal. How long the actuator should stand still before it is considered not moving .
	  ◦ Distance threshold of how far the actuator should move before it is considered being in motion.
	• Miscellaneous
	  ◦ Ramp time on retract: The time it takes for the NAC to retract during calibration or similar.
	  ◦ Load weight: The measured load weight can be modified if needed.

Network	• Enable/Disable DHCP. ***Note:*** If enabled the NAC will gain an IP address from the networks DHCP provider • Static address, subnet mask and default gateway if DHCP is disabled
Update	• Update firmware on NAC controller
About	• Firmware version number • Serial number • Hardware version

Configure Digital IO interface

Step 1

Click the checkbox “Use I/O Interface”

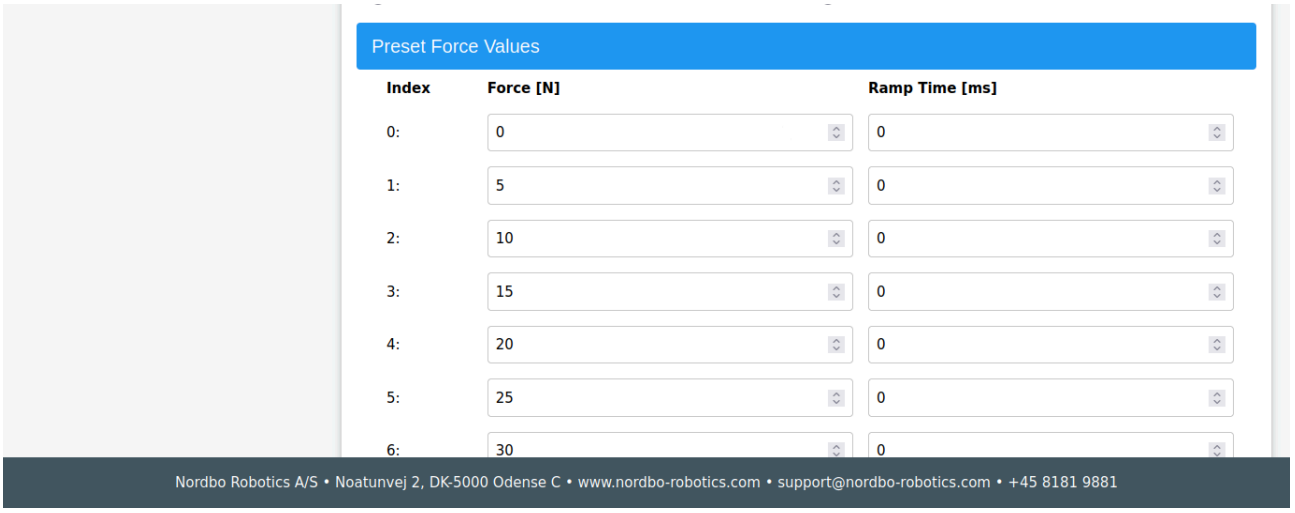


Step 2

Navigate to the bottom of the configuration page and click “Save”.

Configure Preset Force Values

The preset force values enables the user to control the actuated force the NAC is applying when using the digital IO interface. This is done by indexing to one of the 16 registers using the 4-force register (FREG0-4).



Step 1

Edit the required rows in the preset force values table.

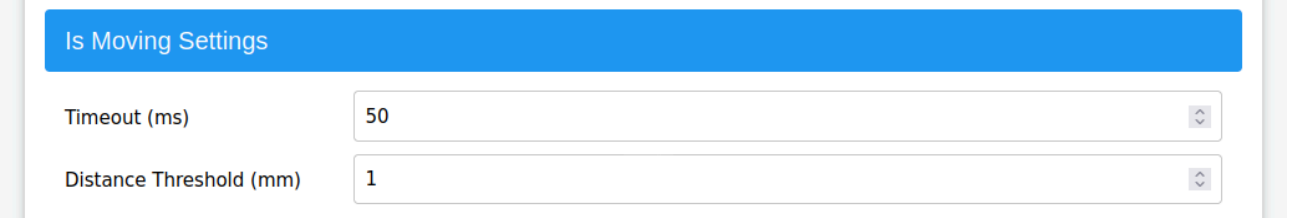
- Specify target force.
  - **Positive values** correspond to a **push force**.
  - **Negative values** correspond to a **pull force**.
- Assign a ramp time.

Step 2

Navigate to the bottom of the configuration page and click “Save”.

Configure “Is moving”

Is moving is a state flag that is high when the tool actuator is moving and low when standing still. You can configure a timeout timer and distance threshold to filter the signal.



Step 1
Set timeout value.

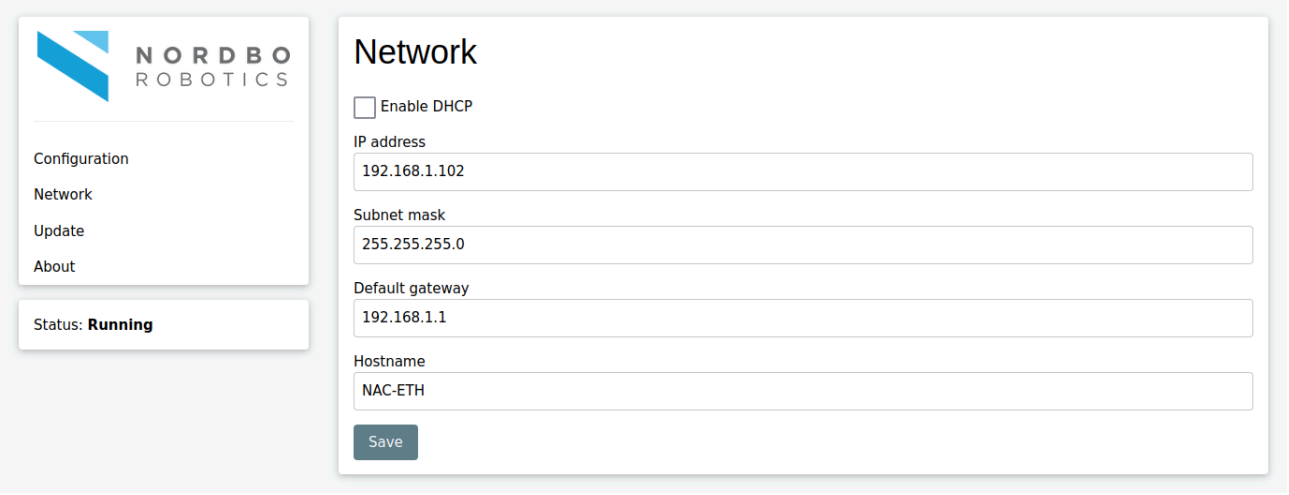
Note: *The "Timeout" is how long the "is moving" signal will remain high once movement is detected.*

Step 2
Set distance threshold. The distance threshold corresponds to how far the actuator needs to move before the is moving signal goes high.

Step 3
Navigate to the bottom of the configuration page and click “Save”.

Configuring Static IP

Step 1
Navigate to the Network tab.



Step 2
Uncheck the box “Enable DHCP” so it is unset.

Step 3
Enter the desired static IP address in the “IP address” field.

Step 4
Enter the desired subnet mask in the “Subnet mask” field.

Step 5
Enter the desired default gateway in the “Default gateway” field.

Step 6
Navigate to the bottom of the configuration page and click “Save”.

Configure DHCP Client

When the NAC-CTRL is configured as a DHCP client it will obtain its IP address from a DHCP server on the network if any.

Step 1
Click the checkbox “Enable DHCP” so it is set.

Step 2
Navigate to the bottom of the configuration page and click “Save”.

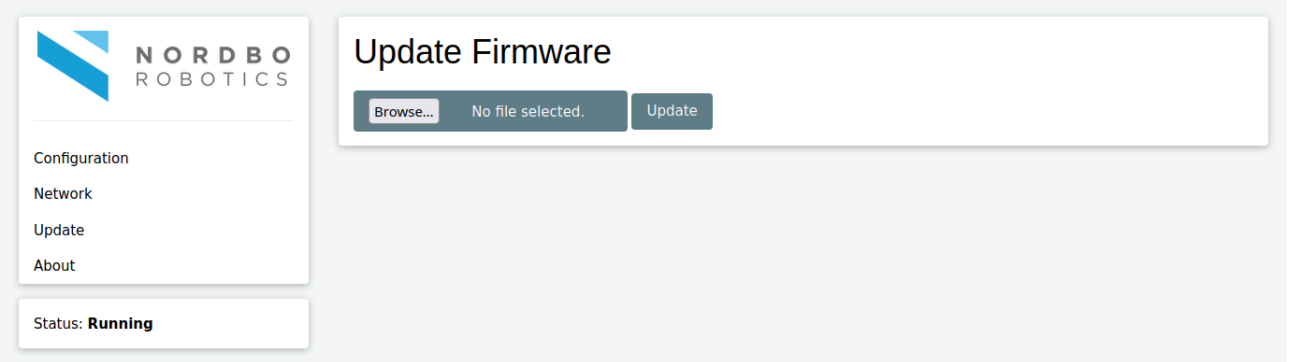
Updating the Firmware

Using the update page, it is possible to update the firmware on the NAC-CTRL.

Step 1
Contact your Nordbo Robotics contact for any updates.

Step 2
Download the update file and store it on your PC. The file should have the file extension “.deb”.

Step 3
Click the “Browse…” button on the web page to select the downloaded update file.



Step 4
Click the “Update” button.

Step 5
Wait for the message “Firmware updated successfully”.

Step 6
Power cycle the NAC Controller.

Installing the NAC-S20-150

The following section describes how to install the NAC-S20-150 for a standard operation. The section will elaborate how pneumatic- and electrical installation is performed and the digital IO control interface for PLC control.

Warning! Pneumatic and electric installations can cause unexpected movement of the NAC tool unit. Switch off all pneumatic and power supplies before installing. All electrical and pneumatic connections must comply with the limits specified in the section Technical Specifications.

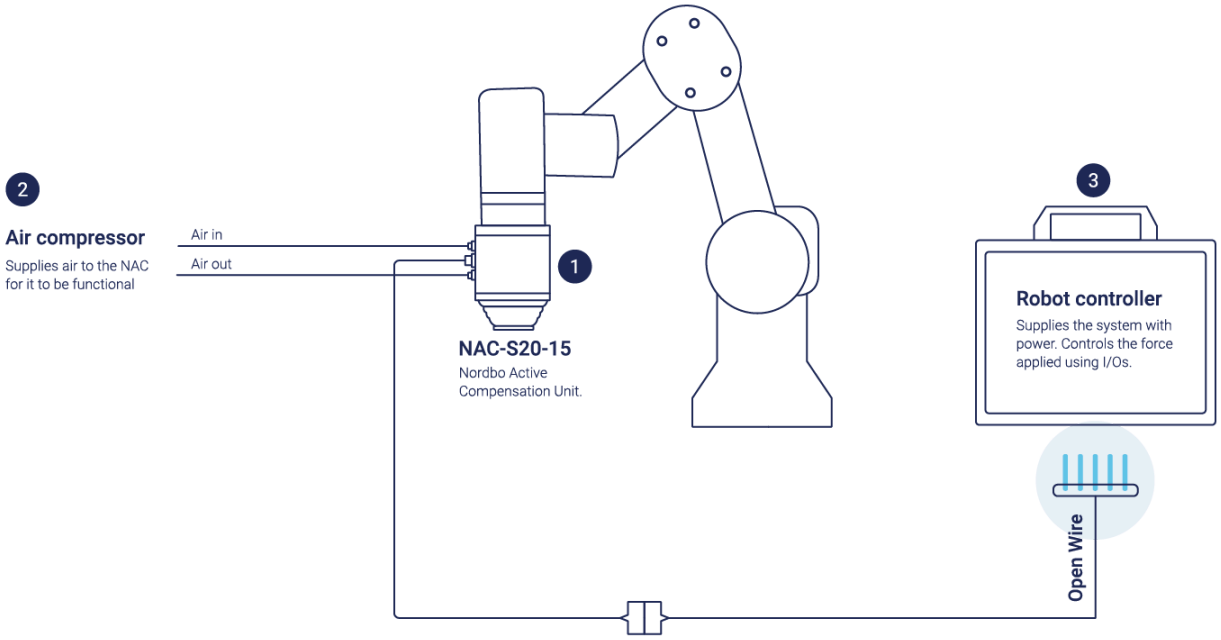
The NAC can be controlled by using Ethernet TCP/IP, digital IO or analog IO. The difference in possible controls is highlighted below.

Feature	URCap	Ethernet TCP/IP	Digital IO	Analog IO
Set target force	X	X	Selection between 16 preset values (definable through Web interface)	0N to max target force (default=150N)
Start/stop the NAC	X	X	X	(use digital IO)
Set target force ramp time	-	X	Same as for setting target force.	
Set/get load weight	X	X		
Calibrate load weight	X	X	X	(use digital IO)
Get 'is moving'	X	X	X	(use digital IO)
Get firmware version	-	X		
Get tool unit angle	-	X		
Get tool unit stroke position	X	X		
Get error state	X	X	X	(use digital IO)

Warning! Unexpected movement of the NAC tool unit or the robot during mounting and installation. Switch off all power supplies and pneumatic supplies before installation. Secure power supply and pneumatic supply against accidental reactivation.

Connection Scheme – Using NAC Tool Unit Without NAC-CTRL

The following schematic illustrates how to connect the NAC on a robot from Universal Robots.

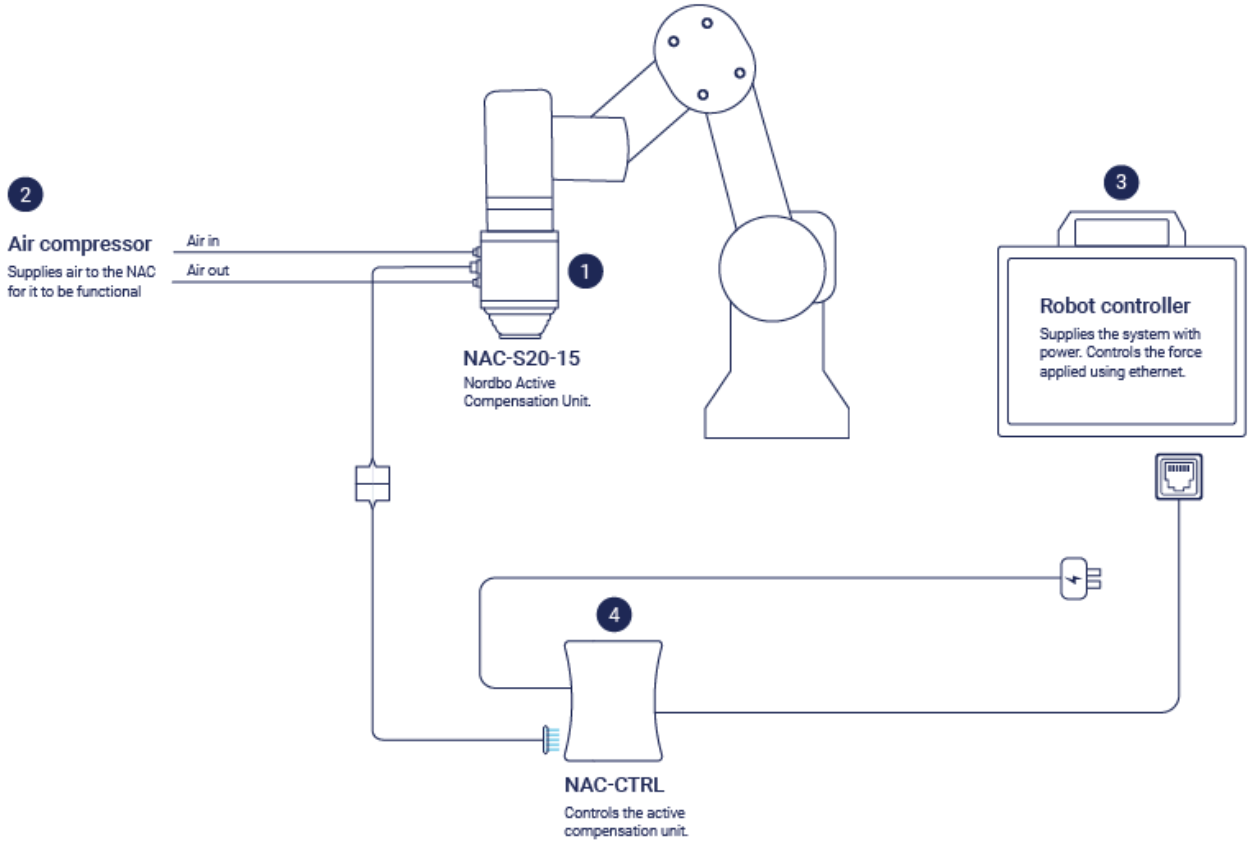


ID	Unit	Description
1	NAC-S20-150	Nordbo Active Compensation unit.
2	Air compressor	Supplies air to the NAC for it to be functional.
3	Robot controller	Supplies the NAC tool unit with power and control using digital and analog IOs.

Specific wiring diagram can be found in the section **Using the URCap**.

Connection Scheme - Using NAC Tool Unit with NAC-CTRL

The following schematic illustrates how to connect the NAC with the Controller.



ID	Unit	Description
1	NAC-S20-150	Nordbo Active Compensation unit.
2	Air compressor	Supplies air to the NAC for it to function.
3	Robot Controller	Interfaces to the NAC-CTRL
4	NAC-CTRL	Controls the NAC Tool unit. Controls the force applied using the control settings according to settings configured in the web interface

Pneumatic Installation

The NAC tool needs to be connected to a supply of compressed air through an air-regulator to regulate push/pull force. The following sections elaborates how the air supply is connected.

OBS! A regulator must have a filter.

Step 1
Connect from the air-regulator to the NAC-S20-150 with a 4mm air hose to the pneumatic push-in fitting at the air intake on the NAC-S20-150.

Step 2
To keep a IP67 rating the exhaust on the NAC-S20-150 must be attached to a 4 mm hose. The loose end of the hose must be placed in an environment protected against dust and liquids.

Note: If the IP67 rating is not required, a pneumatic exhaust silencer/muffler can be used instead.

Step 3
Make sure the air-regulator is set so it's compliance with the technical limits.

Electrical Installation

The NAC tool and NAC controller needs to be connected to a power supply and IO or ethernet to function. The following sections describe how they are connected.

Specific wiring diagram can be found in the sections **Using the URCap** (when using a robot from Universal Robots) or **NAC Controller**.

Warning! Unassigned plug connectors can be susceptible to electrostatic discharge and damage may occur to the device or other parts of the system. Seal unassigned plug connectors with caps. Earth system parts prior to installation. Use appropriate ESD equipment e.g., earthing straps!

External Wiring for NAC Controller

Digital IO Control Interface
The NAC controllers IO interface is used for controlling the NAC using a higher order controller e.g., PLC or using manual switches.

OBS! The NAC controller IO Interface is configured as PNP.

Step 1
Insert and fasten the necessary wires in the female terminal block on the NAC controller.

Step 2

Insert the terminal plug with the wires in the IO of the PLC, robot controller or other desired electrical switch.

Connectors			
Pin #	**Function**		
QO.0	DO_IsMoving	OUT	Is moving
QO.1	DO_InError	OUT	System error flag
QO.2-4	DO_IsOn	OUT	NAC is on.
IO.0	DI_Enable	IN	Enable active force control
IO.1	DI_Calibrate	IN	Calibrate Load weight
IO.2	DI_Reset	IN	Reset NAC-CTRL Ethernet settings to default (keep high for 5 seconds).
IO.3-6	DI_FREG0-3	IN	Force register selection bits. IO.3 is LSB (ie DI_FREG0).
QVdc	IO_Vdc	IN	Logic power supply
COM(-)	IO_GND	IN	0V Reference potential for output signals

NAC Controller Functions

The following NAC has different functionalities that are elaborated in this section.

- **Idle:** Operation mode where the tool unit is applying no active force.
- **Active Force Control:** Operation mode to apply a target force with the NAC tool unit.
- **Retract:** Operation mode where tool unit is fully retracted to 0 stroke position.
- **Load Calibration:** Performs a calibration to measure the load weight.

Warning! Injury and pinching hazard can occur when performing the following steps if the load is not secured. Perform a risk assessment before carrying out actions based on the following instructions. Prevent unauthorized access and inform operators of potential hazards.

Idle

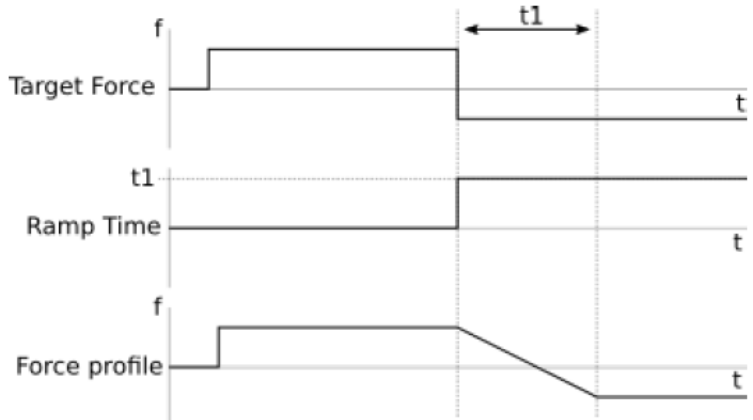
In idle the NAC tool unit is consuming no air and applying no active force control. The passive force by the load is not compensated either.

Active Force Control

When active force control is activated the NAC-S20-150 is regulated to apply the target force profile with a negative or positive force values. It is also possible to ramp linear up or down to a target force value from a previous target. The parameters for active force control are:

- **Target Force:** Target force the NAC should push/pull with.
- **Ramp time:** The time to linear ramping up/down to the target force. If the time is set to 0 it will perform a regular step response .
- **Load weight:** The unit will actively cancel out the load weight.

When specifying the IO interface using the web interface, only 16 different force profiles can be selected. Each stating a target force and ramp time.
Note: *It is possible to configure a soft approach using a higher order controller. Start from retract state. Set a low approach force and enable active force control. Monitor the is moving state flag. It will signal the tool is not moving upon impact. Then ramp your force up to desired target force.*



Example of force profile by adjusting target force and ramp time

Retract
Retract applies a high pull force to the NAC tool so the tool is retracted to its 0-position stroke length. Any active force control is canceled, and the position encoder is reset.

Load Calibration
During load calibration the tool will figure out the load weight. It will try to figure out what force it should applied to cancel out the gravitational force on the load. Load weight is saved and maintained even after power has been switched off. It is important that the NAC Tool unit is positioned so its stroke direction is aligned with the gravitational force.

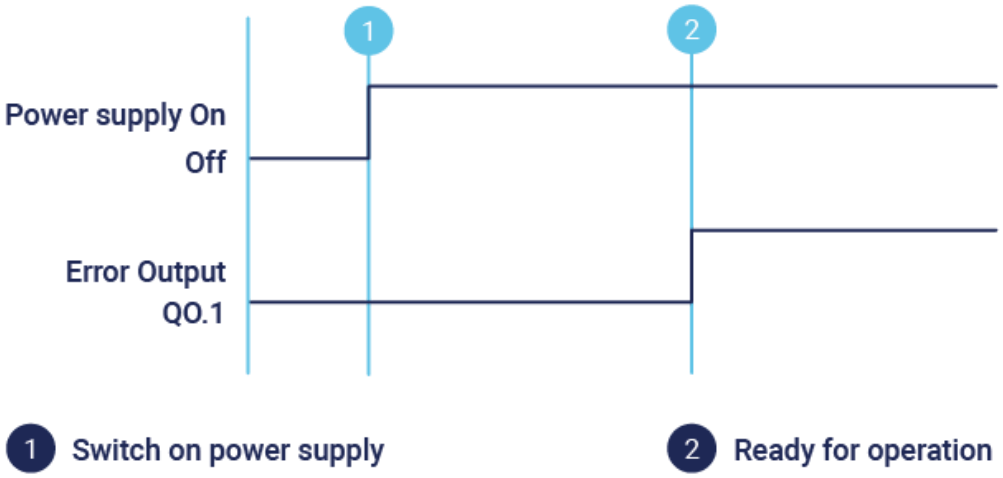
Control via Digital IO Interface
Using the digital IO interface, it is possible to:

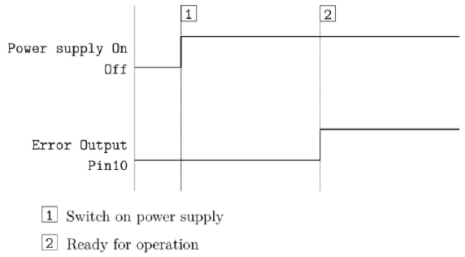
- Control target forces and ramp time by selecting one of 16 different preset forces.
- Initiating a load calibration.
- Monitor if the NAC-S20-150 is in motion
- Monitor if there are any errors.

Logic Status of Input and Outputs
When using NPN there is a difference between electrical high and low and the logical status 1 and 0.

Logic state	Electrical level (NPN)
1	Low-level (GND: 0V)
0	High-level (IOVCC: 5 to 24V)

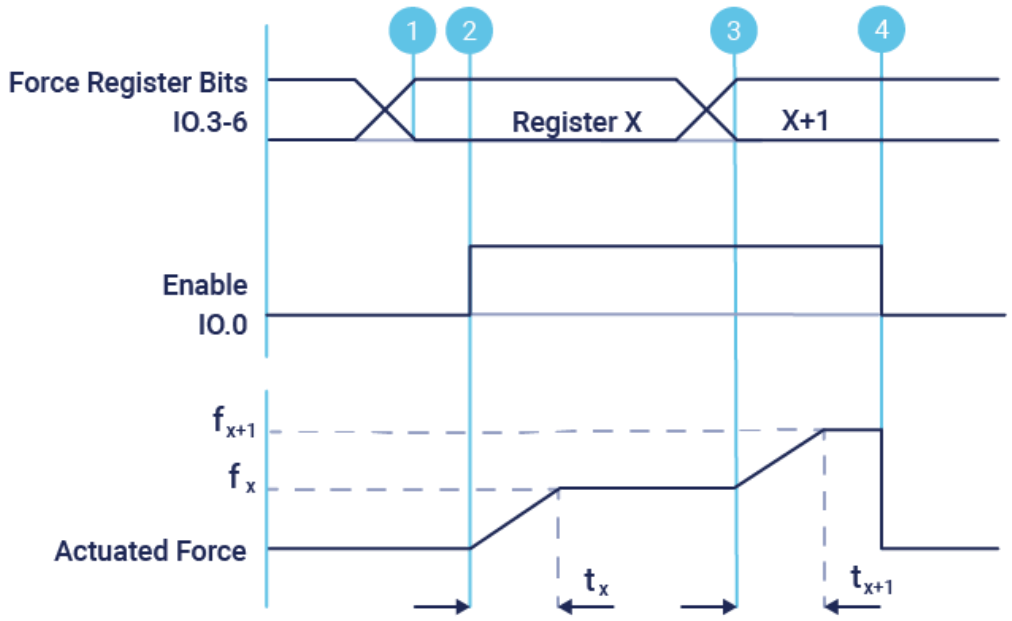
Determine Unit is Ready
Reading the error signal, QO.1, from the controller is sufficient to decide when the unit is ready after powering on.





Active Force Control

Pins IO.3-6 are used to set the target force. These pins form a 4-bit word where pin IO.3 is the least significant bit and pin IO.6 is the most significant bit. The value represented on these pins determines the force register index to be used e.g., 0101 will select force register index 5. Set pin IO.0 high to start active force control.



f_x Target force in register x

f_{x+1} Target force in register x + 1

t_x Ramp time in register x

t_{x+1} Ramp time in register x + 1

1 Force Register x selected

2 Active force control is enabled

3 Force Register x+1 selected

4 Active force control is disabled

Initiate Calibration

Pin IO.1 can be used to initiate the calibration routine. To initiate the calibration routine a pulse should be applied to the pin, but no longer than 2 seconds.

Monitor NAC-S20-150 Motion and Error

Pin QO.0 can be used to monitor if the system NAC-S20-150 is moving. It will be logic low when the NAC-S20-150 is standing still and logic high when NAC-S20-150 is moving. Pin QO.1 can be used to monitor if the system is in an error state. It will be logic low if there is no error state and logic high if it is in an error state.

Control via Ethernet TCP/IP Interface

Using the Ethernet TCP/IP interface it is possible to:

- Set target force
- Start/stop the NAC
- Set target force ramp time
- Get position
- Set/get load weight
- Calibrate load weight
- Get 'is moving'
- Get firmware edition
- Get tool unit angle
- Get tool unit stroke position
- Get error state

The NAC can be controlled through an Ethernet interface using a simple protocol on a standard TCP/IP connection. Data is transmitted using port 2002. The protocol uses only the data types seen in the table below.

Type	Description	Bytes	Value range
UINT8	8-bit unsigned integer	1	0 … 255
INT32	32-bit signed integer	4	-2147483648 … 2147483647
UINT32	32-bit unsigned integer	4	0 … 4294967295

Overview of the Types supported by the Ethernet Interface

The protocol defines a package format. Each packet consists of two parts: A header which contains the package size and type identifier and the data body which contains any data which may be transferred with a package and can be empty. For every packet sent by the user an acknowledge is returned if the packet was correctly parsed. The acknowledge has the same type as the packet initially sent. The body of the packet will be empty if no data was requested. Else it will contain the requested data. An overview of the format can be seen in Table 16 The size field counts the total number of bytes in a package, including the header. If the size field does not reflect the actual packet size the packet will not be read correctly. The Type field can have one of the values shown in the table *Message Types*.

Always wait until the acknowledge package has been received before sending a new package.

Byte	Function	Data type	Description
0x00	Size	UINT8	The size of the message in bytes. Size = 2 + Data length
0x01	Type	UINT8	Message type identifier. See Table 15: Message Types for all message types supported
0x03 **…** **0xFF**	Optional data bytes	Types supported in the table *Message Types*	Data values

Package format

#	Name	Data type	Data value	Description
0x01	Active force control	UINT8	START: 0x01, STOP: 0x00	Indicates whether force control should be active.
0x02	Set target force	INT32	Force [mN] -110000 … 150000 mN	Set target actuated force. Ramp time is set to 0. Note the difference in units between sending a UINT8 vs sending a INT32.
0x03	Retract	-	-	Signals the NAC to lift the load weight and tares the position encoder when fully retracted.
0x05	Set target force and ramp time.	INT32 and UINT32	Force [mN] -110000 … 150000 mN and Ramp time [mS] 0 … 200000 mS	Set target actuated force and ramp time.
0x0B	Set load weight	UINT32	Load weight [g]	Set weight of the attached load.
0x0F	Get current state.	-	-	Get the current state.
			IDLE: 0x0 RUNNING: 0x1 CALIBRATING: 0x2 STARTING_UP: 0x3	

0x16	Get position	UINT32	- Returns position [um]	Get the current position.
0x1B	Get load weight	UINT32	- Returns load weight [g]	Get the current load weight.
0x28	Calibrate	-	-	Initiates calibration of load weight.
0x29	Is moving	UINT8	Not moving: 0x0 Moving: 0x1	Returns the is moving flag. See Section Monitor NAC-S20- 15 Motion and Error page 35
0x30	Firmware version	UINT8[4]	UINT8[0] = 1, UINT8[1] = Major, UINT8[2] = Minor, UINT8[3] = Patch	Returns the firmware version of the NAC CTRL firmware.
0x37	Get gravity vector	INT32[3]	INT32[0] = X INT32[1] = Y INT32[2] = Z	Get the current gravity vector as mm/s².
0x45	Get error state	UINT8	Bit 7: IMU error. Bit 6: IO driver error. Bit 5: Regulator error. Bit 4: Distance sensor error. Bit 0-3: Unused.	Get whether there's any errors detected.

Message Types

Troubleshooting

The following section provides an overview of common issues and their solutions. The content of this section will be expanded based on customer feedback.

Unable to Connect to the Controller

Step 1

Check your network adapter settings on your windows PC if they are set to a static IP address.
Static IP address: Should be in the range 192.168.1.1-255 but different from 192.168.1.102
Subnet mask: Should be set to 255.255.255.0

Step 2

Determine IP address of the NAC control unit. Initially it should be 192.168.1.102 but it can have been set up to use another IP address.

Step 3

Try using an IP Scanner software to scan your network to identify the IP of the NAC-CTRL.

Reset Controller to Factory Defaults

The NAC-CTRL has a pin, IO.2, for resetting. Keeping it high for more than 5 seconds will set the default IP address.

Parameter	Default value
DHCP client	Off
IP address	192.168.1.102
Subnet mask	255.255.255.0
Default gateway	192.168.1.1
Hostname	NAC-ETH

Factory default network settings

Step 1

Set the IO.2 high for more than 5 seconds.

Step 2

Release the pin once the LED for QO.0 on the NAC-CTRL turns off and back on.

Support Requests

For questions, feature requests, and general support, please visit support.nordbo.io and create a ticket. We highly value feedback on our products and you can help us improve the product by sharing your experience.

Technical Appendix

Power supply	
Connection Plug	Terminal block
Load voltage (pin 2) **Nominal voltage** **Nominal current** **Peak current**	24VDC ±10% 0.35 A 2.0 A
Connection Plug	Terminal block
Maximum cable length	30 m
IOVCC logic supply **Voltage rating**	Pin 2 5 to 48V DC
Digital input **Voltage rating** **Scanning rate** **Galvanic isolation**	Pins IO.0 to IO.6 5-24 V 10 ms Yes (optocoupled)
Analog input **Voltage rating** **Scanning rate** **Galvanic isolation**	Pins IO.7 to IO.10 0-10 V 10 ms No
Digital output **Voltage rating** **Update rate** **Galvanic isolation**	Pins QO.0 to QO.1 5-24V 10 ms Yes (optocoupled)
Analog output **Voltage rating** **Update rate** **Galvanic isolation**	Pins AO.5 to AO.6 0-10V 10 ms No
Ethernet interface	
Connection plug	RJ45 8-pin female
Transmission rate	100 Mbps
Bus interface	IEEE 802.3
Supported protocols	TCP/IP
IP address	192.168.1.102 (Default)

Subnetwork mask	255.255.255.0
Standard ports **Web server** **Control interface**	 80 2002
Maximum cable length	30 m
Tool unit interface	
Connection plug	M8 10-pin female
Maximum cable length	10 m

Connectors and specifications