ACF
ACTIVE CONTACT FLANGE

Expert Manual

EN

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1 Functional options in Detail

Example Ordercode: ACF/ 1 2 1 / 10 **E O**

Interface Options	
A	Analog IO
B	Analog IO + Ethernet TCP/IP
D	DeviceNet
E	Ethernet TCP/IP
F	Ethernet XML
G	DeviceNet + Ethernet TCP/IP
H	Ethernet XML + Ethernet TCP/IP
I	EtherNet/IP
K	EtherNet/IP + Ethernet TCP/IP
L	Profibus + Ethernet TCP/IP
M	Modbus TCP
N	Profinet
O	Modbus TCP + Ethernet TCP/IP
P	Profibus
R	Profinet + Ethernet TCP/IP
S	Profinet FO + Ethernet TCP/IP
T	Interbus FO + Ethernet TCP/IP
W	EtherCAT + Ethernet TCP/IP
XX	INCAN

Functional Option Packages	
I	Basic model plus Actual force sensor (afs), Offline and InvPos
O	Basic model (without actual force sensor)
U	Basic model plus Actual force sensor (afs), Offline, Logging, Monitoring and InvPos
S	Basic model plus Service Interface, afs, Logging, Monitoring, InvPos, iCramp and Offline
D	DIN-Rail-Controller plus Service Interface, afs, Logging, Monitoring, InvPos, iCramp and Offline
XX	INCAN
F	DIN-Rail-INCAN-Controller plus Actual force sensor (afs), Offline and InvPos
G	DIN-Rail-INCAN-Controller plus Service Interface, afs, Logging, Monitoring, InvPos, iCramp and Offline
J	INCAN-Control Box plus Actual force sensor (afs), Offline and InvPos
R	INCAN-Control Box plus Service Interface, afs, Logging, Monitoring, InvPos, iCramp and Offline

The additional functional options provide your process engineer with efficient instruments to exploit flexibility, quality and process safety of your ACF system
as far as possible and according to the specific needs of your process. Full convenience and easy usage via web browser.

Choose the functional package that creates maximum benefit for your individual requirements. Please learn about the extraordinary advantages and added value of each functional option from the explanations below.

afs Actual Force Sensor

Option: D, G, I, J, R, S, U

If quality control is top priority, take advantage of the added value the Actual Force Sensor creates. This functional option is **continuously reporting back to the robot system the actual applied force** on the work piece.

BENEFIT:

The one hundred percent reliable documentation of the application process provides objective process data about the performed quality output.

Monitoring

Options: D, G, R, S, U

Monitoring gives your process engineers the possibility of a convenient live check of the active interface via web browser. Monitoring **presents the targeted values compared to actual values at one glance in real time.** Visualization of data directly from control box to PC.

BENEFIT:

- Real time check tool for observation during set up and teaching.
- Supports installation of a new application.
- Ideal check tool for ongoing operation.

Data Logging

Options: D, G, R, S, U

Data logging is the perfect extra tool to support fast and optimal start-up of the process. It **records the key process data from the first contact on for a preset cycle time** (contact state, force, stroke). Collection of data directly from control box to PC.

BENEFIT:

- The Data logging chronicle allows comfortable parameter comparison for a precise and instant analysis offline.
- Makes first start-up and any further set ups extra convenient for your process engineer.
- Quick data export in Excel file to visualize the ACF process details.
- The given chart highlights instantly if stroke, contact state and force of the application cycle are in the valid range.
- If required, easy data transfer to the technical help desk of FerRobotics for a first and quick analysis.
- Accurate assistance of the technical support based on the transmitted data report

Offline Operation

Options: D, G, I, J, R, S, U

In specific cases Offline operation makes your process more efficient. Offline mode gives you the **option to use the Active Contact Flange without connection to the robot.**

BENEFIT:

- No need to set up communication between robot and Active Contact Flange.
- To get your Offline process started simply set values locally via web browser (control box/ PC). Offline mode saves the process parameters permanently directly on the board.
- In cases of interrupted power supply your ACF system restarts instantly and smoothly by rebooting the on the local board preset values.

iCramp

Options: D, G, R, S

iCramp offers a powerful feature to optimize force changes during the ongoing operation. It offers an advanced process performance for example by **masterminding a specifically required force performance torwards the edge of a work piece**. The iCramp option can be activated via webserver.

BENEFIT:

- Smooth change of contact force during ongoing process.
- Instead of a step-by-step adjustment the ACF system autonomously optimizes the contact force between the defined start and end sector.

InvPos

Options: D, G, I, J, R, S, U

InvPos upgrades “push applications” since forces perform invers when the ACF system contacts the surface with stroke zero. **InvPos converts the ACF from stroke zero as minimum length to stroke zero as maximum length.** The InvPos option can be activated via webserver.

BENEFIT:

The invers forces in “push applications” perform with natural and straight forward user convenience.

INCAN

Options: G, J, R

INCAN provides an internal communication via coded CAN technology where the **process data is recorded in the ACF head unit and not in the controller**. The digital internal communication provides even higher process stability, makes the product exchange and service runs even easier.	**BENEFIT:** • Cost-saving changes of ACF head units since in case of replacing the ACF head unit the control box may remain. • Cable length between ACF head unit and the control box does not affect the ACF setup.

Service Interface

Options: D, G, R, S

The Service Interface is the top convenience package to fully survey, report and flexibly redirect your ACF process. The permanently online web interface establishes full data access, control and communication choice.	**BENEFIT:** • Adjustable web interface IP address for ideal network integration. • Network integration allows permanent and direct communication option via web server additionally to the communication between robot and Active Contact Flange (via configurated interface). • Actual Force Sensor integrated • Data Logging integrated • Monitoring integrated • Offline operation optional integrated

Mind:
Ethernet TCP/IP is for access to the web server.
For controlling the ACF with Ethernet TCP/IP choose the corresponding Interface Option.

INCAN compatibility

With INCAN, the unit of controller, head and cables is dissolved. Not all possible combinations are valid. Find an overview of the general compatibility of the different versions in Table 1 compatibility.

		Head (INCAN)				
		ACF	AOK	AAK	ASK	ABG
Controller (INCAN) (Control Box; DIN-Rail-Controller)	ACF					
	AOK-AAK-ACF	#	#	#		
	ASK					
	ABG		600	600		

Table 1 compatibility

ATTENTION!

... The compatibility of the drive motors must be clarified with FerRobotics.
600... ABG 600 series is compatible with AOK/AAK 600 series.

INCAN nameplate

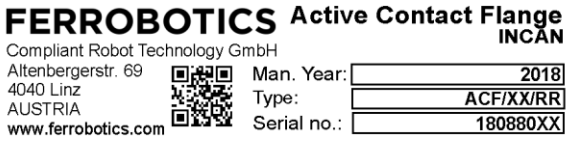
Nameplate ACF head	Nameplate ACF controller
	

Table 2 Example layout INCAN nameplate

Example of the different types, the use follows Table 1 compatibility.

Type head INCAN		
device	**model**	**interface + options**
ACF	/111/04	XX
AOK	/201/	XX
AAK	/201/	XX
ASK	/201/	XX
ABG	/120/	XX

Table 3 Example type head

Type controller INCAN		
device	**model**	**interface + options**
ACF	/XX/	KR
AOK-AAK	/10/XX/	KG
ASK	/02/XX/	K
ABG	/02/XX/	K

Table 4 Example type controller

2 Web interface

- The web interface provides functions for
- Configuring the Interface,
- Information about the used device,
- Service information,
- Data recording for optimization of the application,
- Status information about the interface.

2.1 Starting the web interface

To use the web interface hold the Aux button pushed until the control box has been started (Run LED flashes, or the green power button lights up). If the web interface is started Aux LED lights orange.

2.2 Connecting to the web interface

To connect to the web interface there must be

- an Ethernet connection to the device (LAN cable)
- the Web Browser must be started on the PC and
- the Address 192.168.99.1 (standard) must be entered in the address field (or the changed IP).

Communication settings

	Default	Customized
IP-address device	`192.168.99.1`	
subnet mask	`255.0.0.0`	

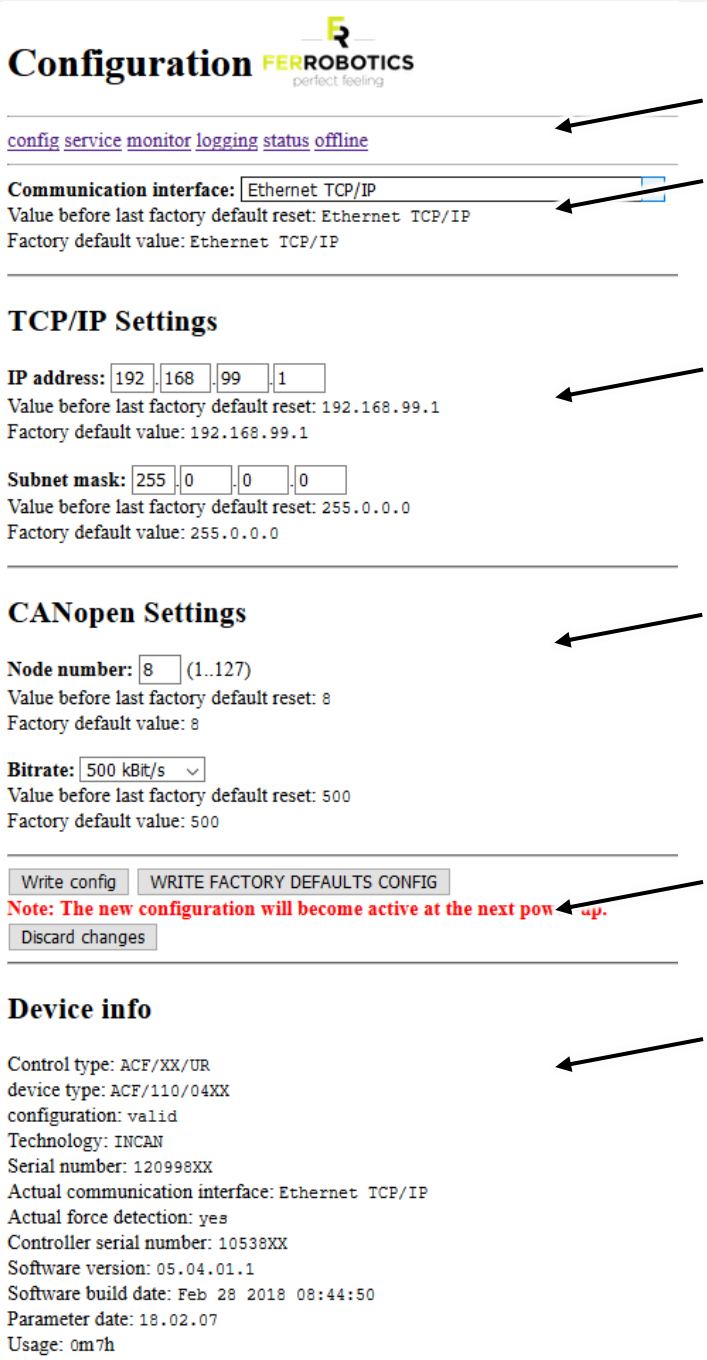
Table 5 communication settings

	**ATTENTION** To establish an Ethernet connection the computer must be configured for the corresponding IP address and Subnet mask. For questions, contact your network admin. A valid combination is for example: IP address: `192.168.99.9` Subnet mask: `255.255.255.0` No proxy server configured, or configure exception

Interface	Ethernet connection to the device
Ethernet TCP, Ferrobotics XML, Modbus TCP, Option: Service Interface for all Interfaces	The web interface can be reached through the external RJ45 socket(front plate)
Analog IOs, PROFINET, EtherNet/IP	The web interface can be reached through the on board RJ45 socket (Board [1])
Profibus DP, DeviceNet	The web interface can be reached through the on board RJ45 socket (Board [1]). The connection to the gateway has to be separated and during this action the fieldbus is not functional. Before using the configured interface again the connection to the gateway has to be re-established.

2.3 Configuration

Home after connecting



Title of the current page.
List of links to the three areas of the web interface.

Selection of the current configuration mode.

Optional: For TCP-based interfaces you can set up the IP address and Subnet mask here

Optional: configuration settings for the address and the Bitrate of the CANopen connection.

You can save the changed configuration here or reset to factory default settings. Changes take effect after a restart.

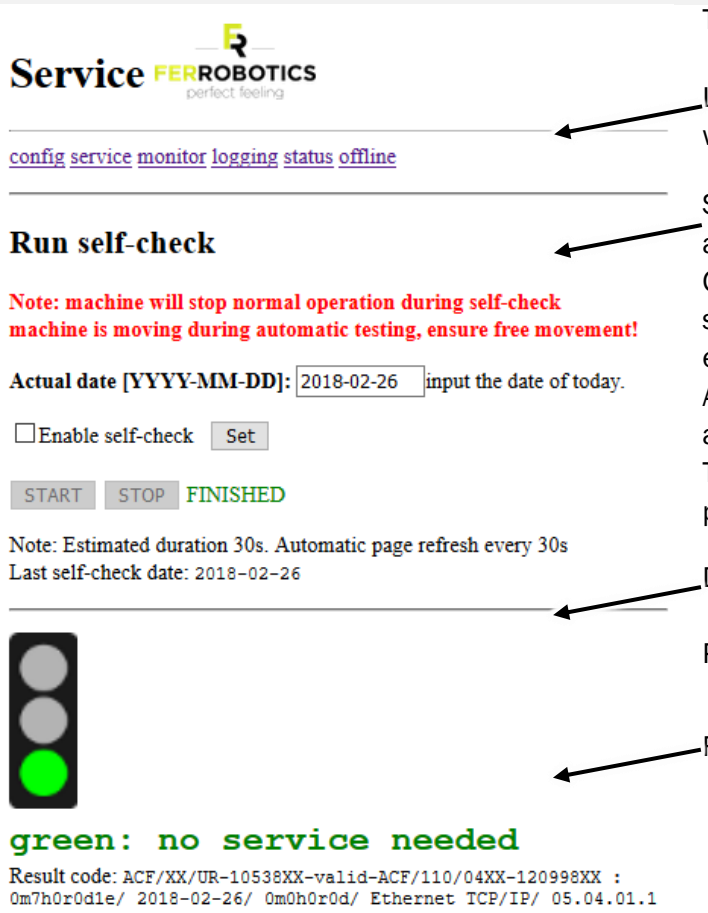
Device info shows general information of the ACF.

Depending on the interface only the required settings are possible.
The factory default configuration (WRITE FACTORY DEFAULTS CONFIG) can also be set if you push the Def button and hold it pushed for 4 seconds.

	**Information** Once the Def button is pushed the orange Aux LED starts to blink. After 4 seconds the orange LED lights up constantly and the configuration is set up to the factory default configuration.

2.4 Service function and self-check

Service Information



Title of the current page.

List of links to the three areas of the web interface.

Start the self-check with input of the actual date.
One must enable the self-check before start. Each page refresh will reset the enable state.
Attention: The ACF is moving during automatic testing.
The ACF is moving between the end positions, ensure free movement!

Display of the service status.

Please wait for the test to finish!

Result Code for FerRobotics

⚠	**ATTENTION** The ACF has to be active and running! The normal operation during the self-check will be interrupted! The ACF is moving during automatic testing. The ACF is moving between the end positions, ensure free movement!

ⓘ	**Information** The service status is displayed on the web interface, the board LED (7, 8) and the power button.

Service state	web interface	Board LED	Power button
No service	Traffic light green	Power: on; Run: blink; Error: ; Aux:	On green
Service soon	Traffic light yellow	Power: on; Run: blink; Error: ; Aux: blink	On green
Service needed	Traffic light red	Power: on; Run: blink; Error: blink; Aux: blink	Blinking green
Self-Check running	RUNNING PLEASE WAIT	Power: on; Run: blink; Error: on; Aux: on	On green

	**ATTENTION** If a service is needed please contact your local supplier. The service state information will overrule the web interface LED state.

	**Information** Please remove additional disturbances on the force of the ACF (cables, straps, etc.) so that the ACF can move freely during the self-check. **Note** With INCAN system solutions (AOK; ASK; etc.), the cables must be left in their original condition on delivery. The self-check evaluates the system behavior in comparison to the delivery status. Changes to the system can lead to increased values.

	**Information** The service state does not affect the regular operation of the ACF.

Service state

Service state	Operation hours	Time since delivery
Traffic light red	>6000	366 days
Traffic light yelow	>5000	335 days
Traffic light green	0	0

The operation hours are stored automatically and they will trigger the service state automatically (Power button and LED's are blinking accordingly)
More information on service can be found with your local supplier

2.4.1 Vibration check

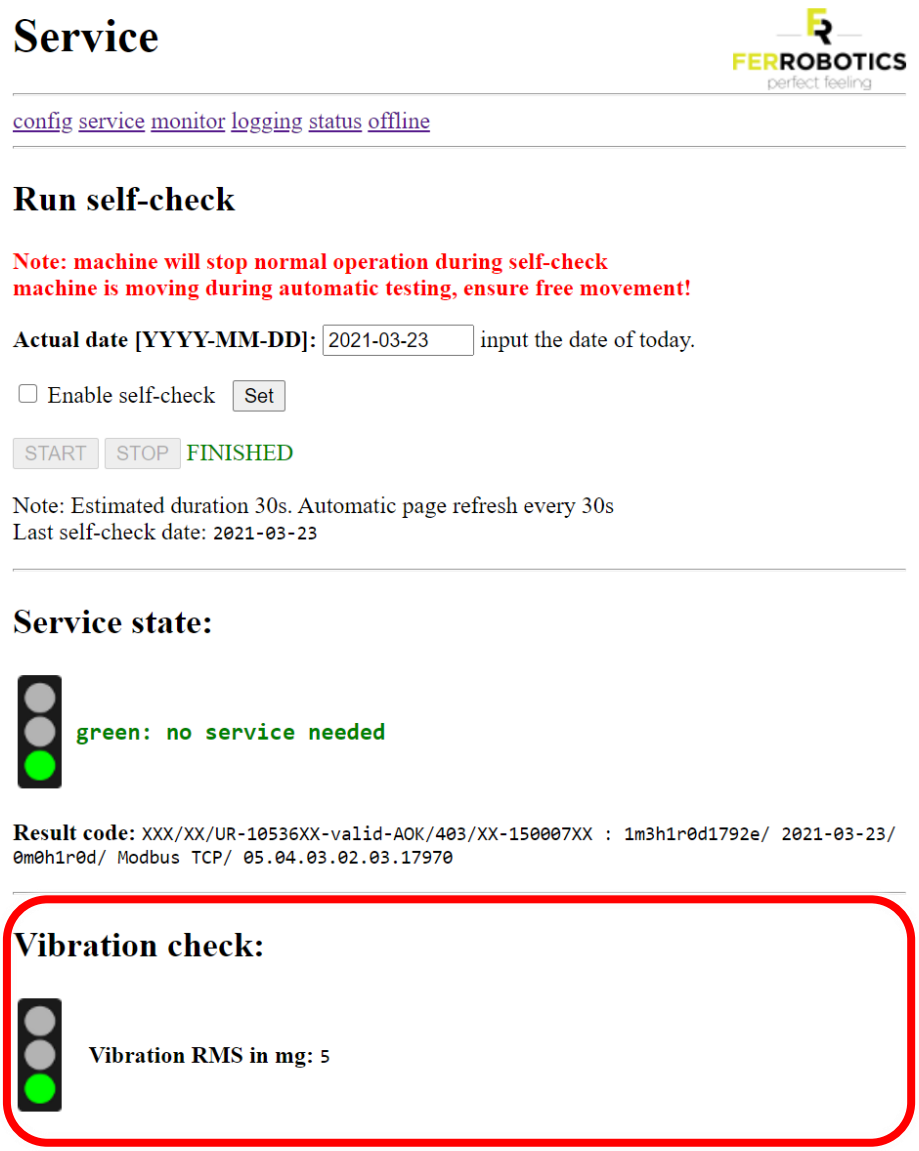


Figure 1 Vibration OK

Limit values RMS in mg	Status
0-849	low
850-1249	medium
1250	high

The vibration check provides information about the vibration load on the device. With increased vibration, the service life of the device is reduced. Check the imbalance of the abrasive if the vibration is too high and or reduce the speed of the device. If it is not possible to reduce the vibration load, operation is possible, but a shorter service interval is to be expected.

	Information The display of the vibration will be supported with versions higher than • Controller version 5.4.3 and • INCAN firmware version 2. The versions are displayed in the device info in the web interface on the config page: Software version: 5.4.3.2 If the controller does not support the function, the vibration check will not be displayed. If the INCAN version does not support this function, this value is n / a.

Figure 2 INCAN firmware version 1 not supported values are not available

2.4.2 Parameter estimation

The parameters are determined automatically when the self-check is carried out.

	Information The parameter definition is for the devices: ACF, AOK, AAK, ASK, ATK available with option G and R.

When executing the self-check, the parameters

- payload,
- offset force as well as
- the spring stiffness

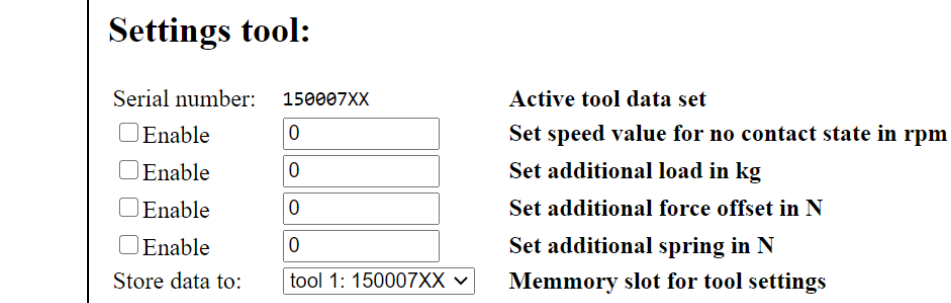
are determined automatically. See chapter 2.4.3 on how to compensate for these values.

Information

The best result is obtained with 3 measurements when performing the self-check at

- 0 ° ± 30 °, (stroke movement vertically upwards),
- 90 ° ± 20 ° (horizontal stroke movement) and,
- 180 ° ± 30 ° (stroke movement vertically downwards).

When determining the parameters, set the values in the web interface offline / settings tool to 0.



Service

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config service monitor logging status offline

Run self-check

Note: machine will stop normal operation during self-check
machine is moving during automatic testing, ensure free movement!

Actual date [YYYY-MM-DD]: 2021-03-23 input the date of today.

Enable self-check Set

START STOP FINISHED

Note: Estimated duration 30s. Automatic page refresh every 30s
Last self-check date: 2021-03-23

Service state:

green: no service needed

Result code: XXX/XX/UR-10536XX-valid-AOK/403/XX-150007XX : 1m3h2r0d1792e/ 2021-03-23/ 0m0h2r0d/ Modbus TCP/ 05.04.03.02.03.17970

Vibration check:

Vibration RMS in mg: 6

Parameter estimation:

Parameter	value	Information	status
Additional load in kg:	0.6	Estimation level:	low
Additional force offset in N:	0	Estimation level:	none
Additional spring in N:	0	Estimation level:	low

Figure 3 Parameter estimation at 0°

Example for high estimation status:

Service

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config service monitor logging status offline

Run self-check

Note: machine will stop normal operation during self-check
machine is moving during automatic testing, ensure free movement!

Actual date [YYYY-MM-DD]: 2021-03-23 input the date of today.

Enable self-check Set

START STOP FINISHED

Note: Estimated duration 30s. Automatic page refresh every 30s
Last self-check date: 2021-03-23

Service state:

green: no service needed

Result code: XXX/XX/UR-10536XX-valid-AOK/403/XX-150007XX : 1m3h1r0d1792e/ 2021-03-23/ 0m0h1r0d/ Modbus TCP/ 05.04.03.02.03.17970

Vibration check:

Vibration RMS in mg: 6

Parameter estimation:

Parameter	value	Information	status
Additional load in kg:	0.7	Estimation level:	high
Additional force offset in N:	0	Estimation level:	high
Additional spring in N:	0	Estimation level:	high

Figure 4 Parameter estimation at 0°, 90° and 180°

2.4.3 Compensation of the parameter determination in the web interface

The specific parameters from the self-check can be compensated in the web interface on the offline page in the settings tool.

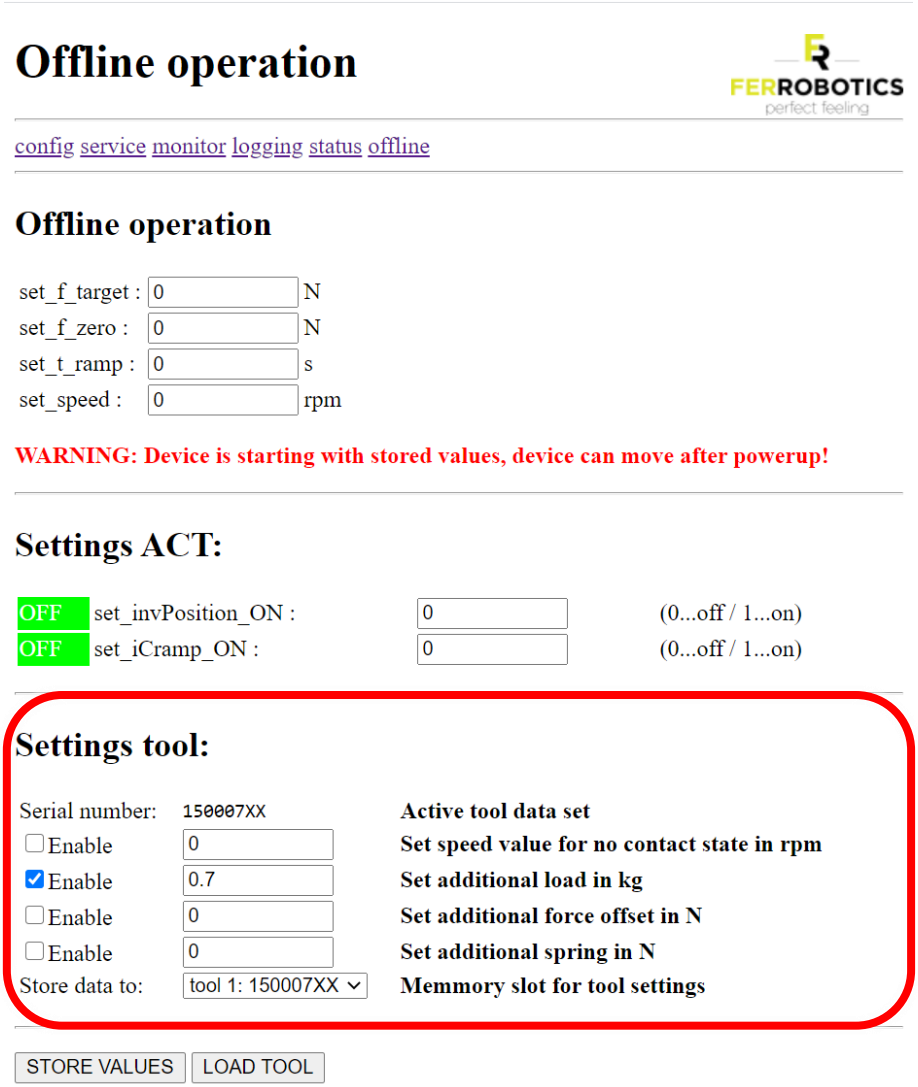


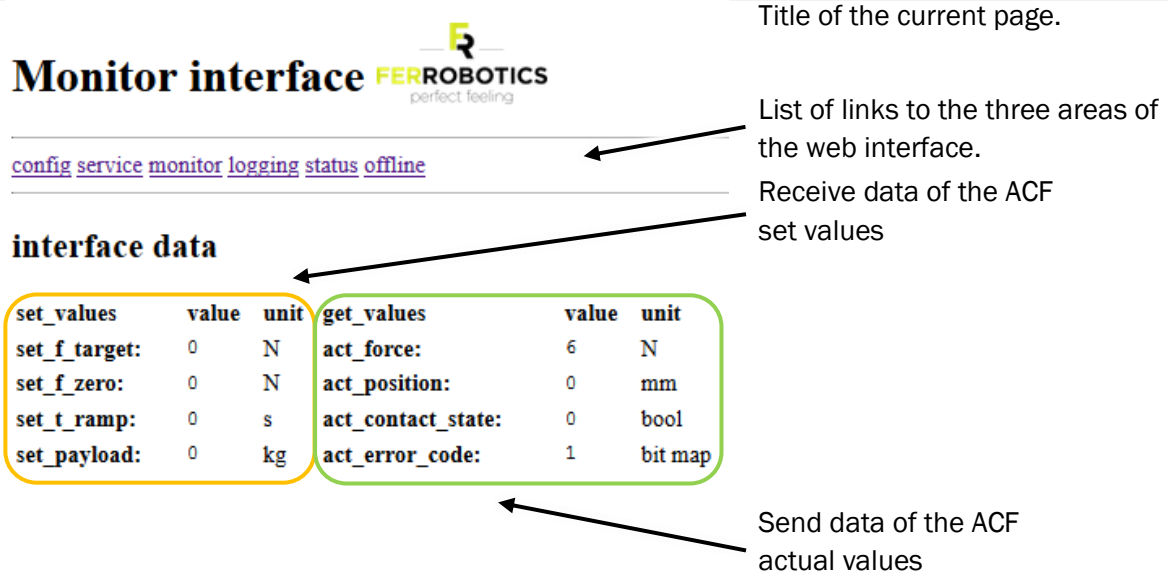
Figure 5 Input tool parameters

	**Information** Conditioned complete systems from Ferrobotics do not require any additional parameter settings .

	**ATENTION!** The additional values in settings tool should not exceed 30% of the maximum device force. If larger values are necessary, contact support to exclude damage of the device.

2.5 Monitoring function

Monitoring



The monitoring function provides information about the interface data of the ACF for the active communication interface.
This tool is useful for:

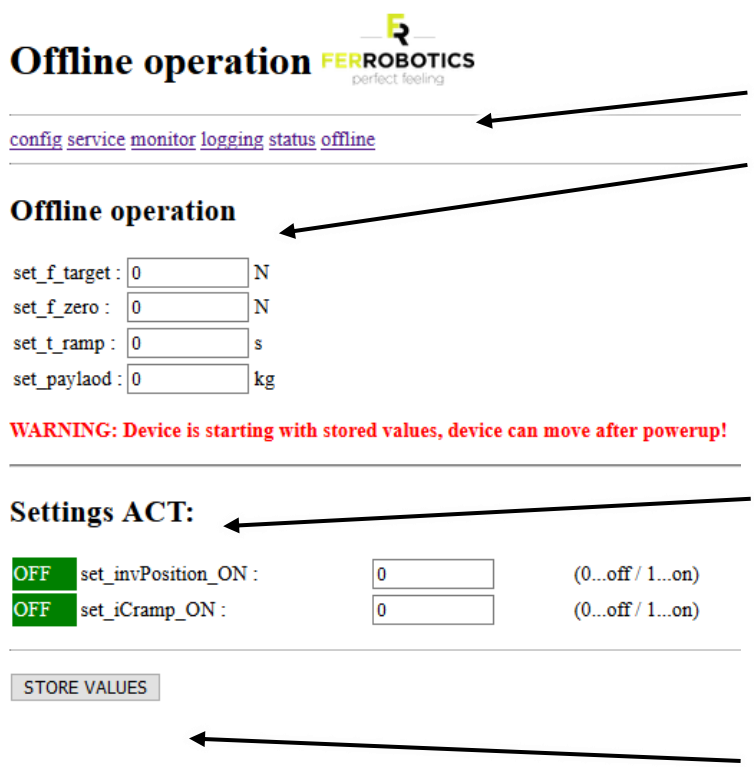
- Commissioning of the active interface
- The creation of an application by checking the actual values, e.g. the position

2.6 Offline Operation

Offline operation allows you to use the ACF as a stand-alone device.
The target values for the ACF are stored in the device and activated after power up. The values will ramp up in 10 seconds after power up.

The interface Offline operation must be activated in the configuration pane before use (web interface -> config).

Offline Operation



Title of the current page.

List of links to the three areas of the web interface.

Target values ACF.
These values are stored in the device and will be activated after power up.
Interface Offline operation must be active!

Retraction is shown as a positive value.

Activates iCramp function, (in contact ramp)

To store the values press the button or press enter.

2.6.1 Tool set

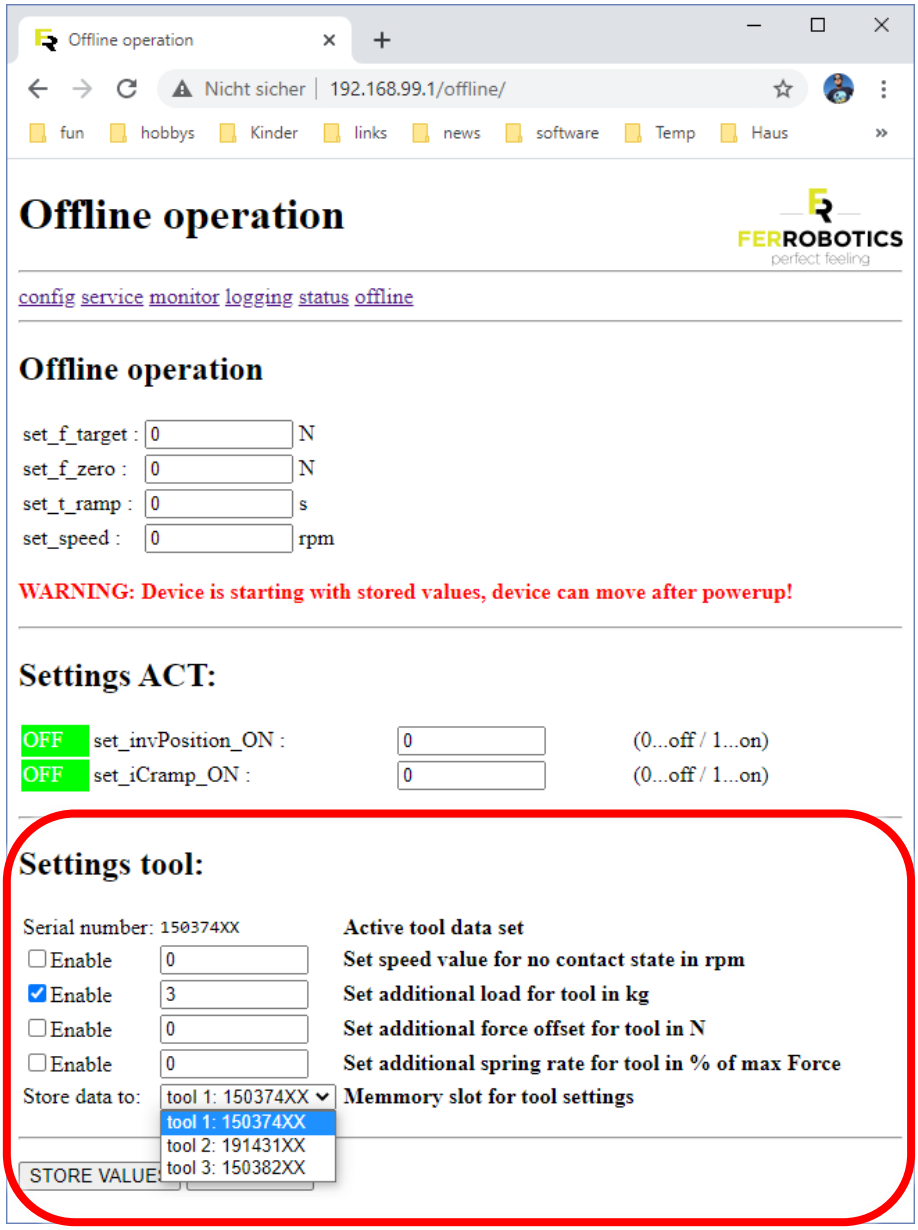


Figure 6 save tool parameter

Tool data automatic selection:

Priority	criteria	Comment
1	Same serial number	Tool set for the device
2	No match	Default data set, selection of a free storage space. Manual selection possible

The first match in the order tool 1,2,3 is activated.

2.6.2 iCramp

The ***in contact ramp*** (iCramp) is an expanded function of the force ramp. With the help of iCramp it is possible to smooth sudden changes of the target force during contact. If iCramp is activated, the target force (set_f_target) is reached via a linear ramp.
This means: If, for example, the target force is changed from 50N to 30N with a ramp time (set_t_ramp) of 3 seconds, the force is ramped down from 50N to 30N within 3 seconds (see picture below). This is only the case if there is a contact (act_contact_state = 1).
However, the contact ramp has a higher priority than iCramp. This means that the iCramp only becomes active after completion of the contact ramp.
If set_t_ramp is set to 0, it is possible to carry out sudden changes of the target force, even if iCramp is activated.

Activation

The iCramp is active, when the device is in contact and acts after the contact ramp.
The iCramp can be activated in the Webinterface, see http://192.168.99.1/offline/

Function:

1. Configure the contact ramp
2. Make contact with the workpiece
3. The contact ramp is carried out as usual, the target force is reached within the specified time
4. If the target force is changed while the device is in contact, the new target force is reached within the specified time (set_t_ramp).
5. If set_t_ramp is set to 0, the force changes abruptly
6. If the contact is released again, the contact ramp is triggered and the force is decreased via a linear ramp

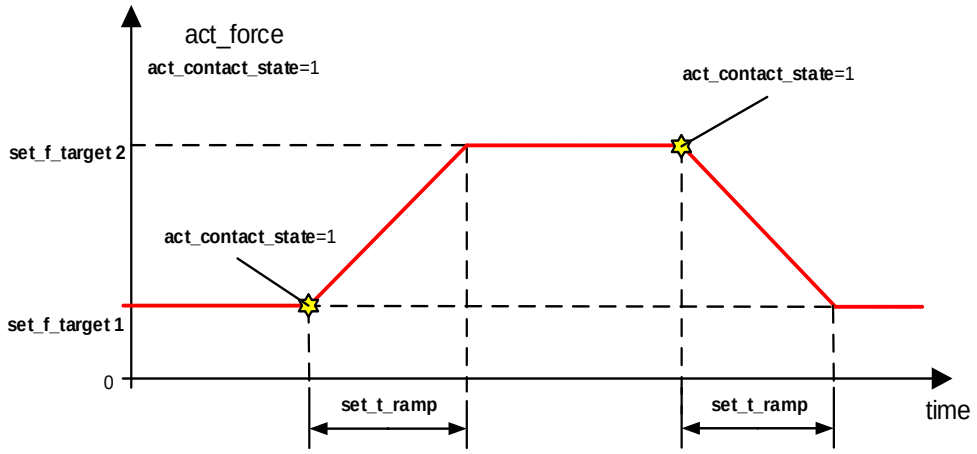


Figure 1 Example with iCramp

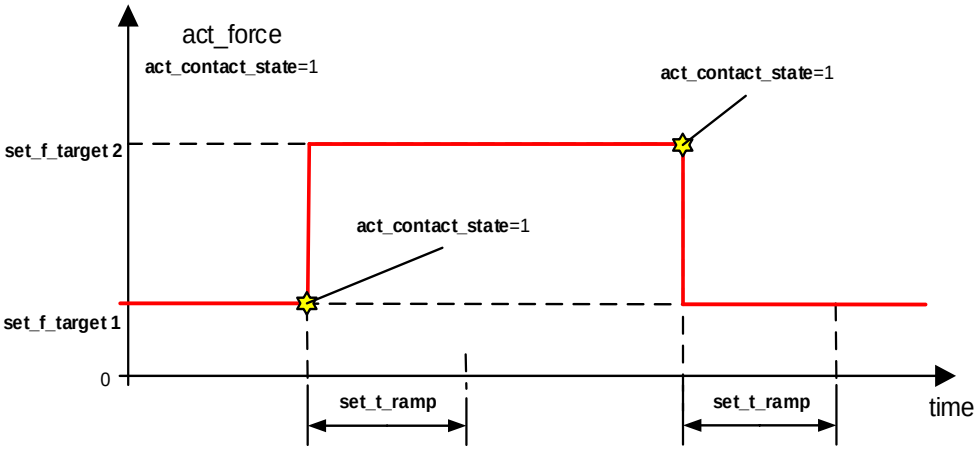


Figure 2 Example without iCramp

Both figures are valid for act_contact_state = 1.

2.6.3 Inv_Position

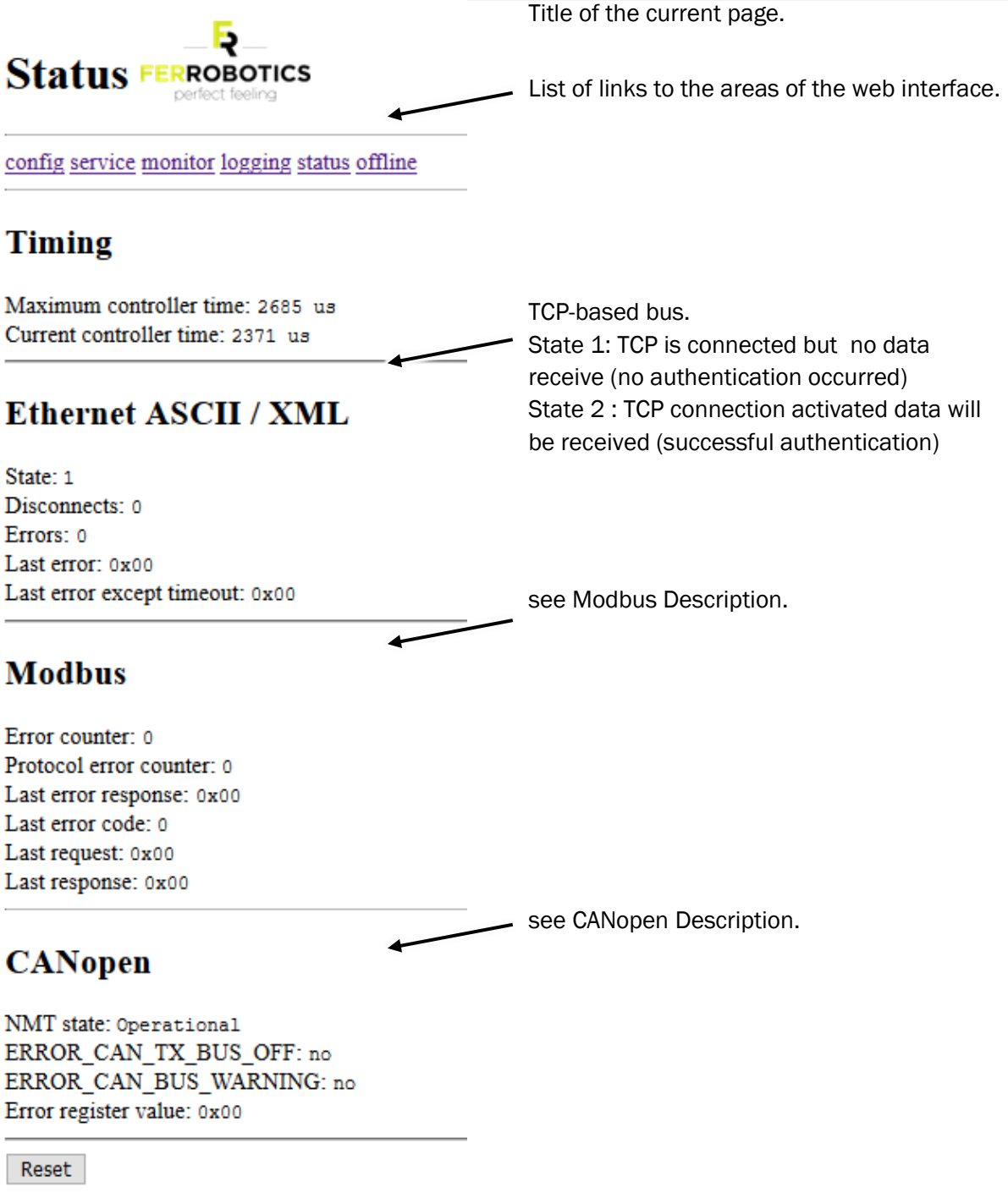
InvPos reverses the stroke direction and defines stroke zero as the maximum length of the device.
InvPosition thus increases the process comfort in "push applications" as the position corresponds to the immersion depth of the ACF.

However, only the sign and the zero point of the position and not of the force changes. Thus, position and force point in the opposite direction. The positive direction for the stroke is opposite to the positive direction of force therefore inverse position.

In the default configuration with no inverse position, position and force point in the same direction, and zero stroke is the minimum length.

2.7 Status information

Status information for communication



Title of the current page.

List of links to the areas of the web interface.

TCP-based bus.
State 1: TCP is connected but no data receive (no authentication occurred)
State 2 : TCP connection activated data will be received (successful authentication)

see Modbus Description.

see CANopen Description.

2.8 Logging Function

Logging is for:

- Analysis and optimization of the application.
- Support by FerRobotics with the stored data from the logging.
- Saving the application data for quality assurance. All interface data is recorded.

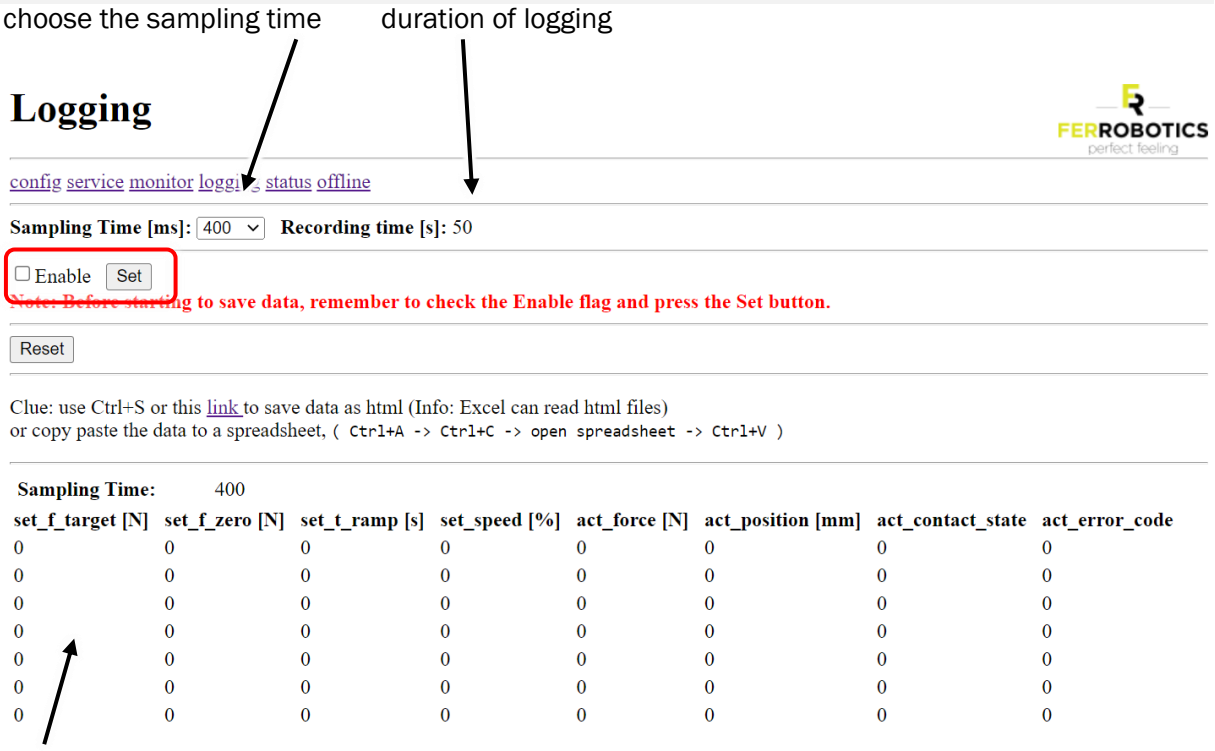
The stored data can be saved local and visualized in Excel. With the visualization a rapid check on the application is possible. You can easily check the

- Position and
- The contact state,

during one cycle of the application.

FerRobotics can provide support with the analysis of your data if you send us the logging by email.

Page for data record used for optimization of the application.



Data of the ACF interface for optimization

Settings sampling time in ms	Recording time in s
400	50
800	100
1600	200

Workflow for the logging function:

1. To enable the record function you have to activate the Enable Box and push the Set Button.
2. The trigger for the recording is the act_contact_state. The logging starts if the act_contact_state flag is 1
3. It will stop automatically if the recording time is reached.
4. Reload the browser to get the most recent values. To visualize the data one can copy and paste the text from the browser to Excel.
5. The data is stored in the RAM of the Control Box. If you turn off the power all data is lost.
6. To start a new record a reset must be performed and the record must be enabled and set again.

2.9 Service Interface

The service interface is used for permanent observation of the device with the web interface. The web interface will start automatically when the ACF is started.

Hardware:

- An additional RJ 45 port, to connect the web interface to a second device.

The firmware includes these options

- the possibility to change the IP address, even if no onboard ethernet protocol is used,
- the automatic start of the web interface after boot up.

	**ATTENTION** If you are using Profibus or DeviceNet gateways changing the IP address of the web interface will need a new configuration of the gateway as well. Ferrobotics can provide the gateway project to change the IP address.

	**Information** You can reset the device to the factory defaults, see chapter 2.3

2.10 LED status

ACF state	web interface	Board LED	Power button
ACF OK, no service	Traffic light green	Power: on; Run: blink; Error: ; Aux:	On green
ACF OK, service soon	Traffic light yellow	Power: on; Run: blink; Error: ; Aux: blink	On green
ACF OK, service needed	Traffic light red	Power: on; Run: blink; Error: blink; Aux: blink	Blinking green
ACF stopped normal operation, self-check running	RUNNING PLEASE WAIT	Power: on; Run: blink; Error: on; Aux: on	On green
ACF OK, web interface on		Power: on; Run: blink; Error: ; Aux: on	On green
Error, if self-check not running	Traffic light green/yellow/red	Power: on; Run: blink; Error: on; Aux: any	On/blink green
Fieldbus restart	Traffic light green	Power: on; Run: blink; Error: flash; Aux: any	On green

2.11 Examples web interface

2.11.1 Interface switching

1. Shut down the Control Box and connect it via Ethernet to your PC or Laptop.
2. Hold the Aux button pushed and turn the Control Box on until the Control Box has been started, see 2.1
3. Start the web interface in your browser (Firefox, Internet Explorer, Safari,...), (use 192.168.99.1 as URL), see 2.2
4. Set the Interface communication in Home of ACF configuration.
5. Click the Write config button.
6. Start the Control Box.

2.11.2 Recording with Ethernet

1. Turn of the Control Box.
2. Connect your PC with the Ethernet Interface RJ45 on the Control Box.
3. Hold the Aux button pushed and turn the Control Box on until the Control Box has been started, see 2.1.
4. Start the web interface in the Browser (Firefox, Internet Explorer, Safari,...), (use 192.168.99.1 as URL), see 2.2.
5. Switch to the Logging area, cross the Enable field and click the Set button.
6. Unplug the Ethernet cable from the Control Box and connect the Ethernet cable to your application (do NOT turn off the Control Box during this procedure!).
7. Start the application, the record begins after the first contact.
8. After the recording time unplug the Ethernet cable between the Control Box and the Application and connect the cable from the PC to the Control Box.
9. Open the web interface in your Browser, navigate to the Logging page.
10. The recorded data is now in the Logging area; you can copy and paste the data into an Excel table, see 2.8.

2.11.3 Recording with DeviceNet

1. Turn of the Control Box.
2. Unplug the Ethernet cable from the Board to the Gateway on the Board [1] and insert your cable from the PC to the Board.
3. Hold the Aux button pushed and turn the Control Box on until the Control Box has been started, see 2.1.
4. Start the web interface in the browser (Firefox, Internet Explorer, Safari), (use 192.168.99.1 as URL), see 2.2.
5. Switch to the Logging area, cross the Enable field and click the Set button.
6. Unplug the Ethernet cable from the Board and connect the Ethernet cable between the Board and the Gateway (do NOT turn off the Control Box during this procedure!).
7. Start the application, the record begins after the first contact.
8. After the recording time unplug the Ethernet cable between the Board and the Gateway and connect the cable from the PC to the Board.
9. Open the web interface in your Browser, navigate to the Logging page.
10. The recorded data is now in the Logging area; you can copy and paste the data into an Excel table, see 2.8.

3 TCP/IP Ethernet Communication Interface (standard)

Overview

The ACF control unit uses port 7070 for input and output (compare following figure).

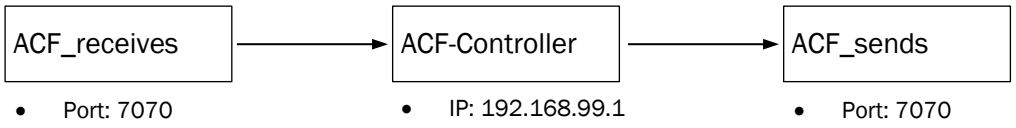


Figure 3: Communication ports of the ACF Control Unit

Communication Settings

The TCP/IP Interface of the ACF is a server as in client-server architecture. On both channels the control unit establishes the connection.

The following settings apply to the communication between the ACF and an external communication partner:

IP address ACF	`192.168.99.1`
Subnet mask	`255.0.0.0`
Baud rate	`auto`
ACF_receives: System sends, ACF receives	`Port: 7070`
ACF_sends: ACF answers, system receives	`Port: 7070`
Authentication	`ferba`
Identifier (<id>)	`1040`

Table 6: Communication settings between ACF and external machine

	**Information** IP address ACF, subnet mask and baud rate are attuned to the delivered setup and can be adjusted to customer needs under instructions of FerRobotics. Please contact us if this is necessary. The ports for “ACF_receives”, “ACF_sends”, the authentication and the identifier string cannot be changed.

Definition of the TCP-IP interface string

	**Information** • The sampling rate of the ACF communication interface is 4 ms. Sending data faster than the sample rate will lead to buffer overflow resulting in ignored data packets. • In case there is no data sent for more than 10 sec, the ACF will disconnect the TCP/IP connection and wait for a reconnect.

```
<authentication>k
<id> <parameter1> <parameter2> <parameter3> <parameter4> … <parameterN>k
{<id> <parameter1> <parameter2> <parameter3> <parameter4> … <parameterN>k}
c
```

The k is the terminator of each message and c ends the communication.

	**Information** • First value of the data string is the <id> • Exactly one empty space between the values of the data string is obligatory • The terminator k replaces an empty space • A dot (’.’) indicates the decimal point, i.e.: ‘10.3’ and not ’10,3’

When establishing the connection, the client side sends <authentication> once and gets <authentication> as an answer to confirm that the connection has been established. After that data strings are being sent beginning with <id>.

	**Information** If another authentication is sent after the connection has been established, the message will be deleted and ignored by the server side of communication.

Parameters

The following figure shows the parameters contained in the data strings.

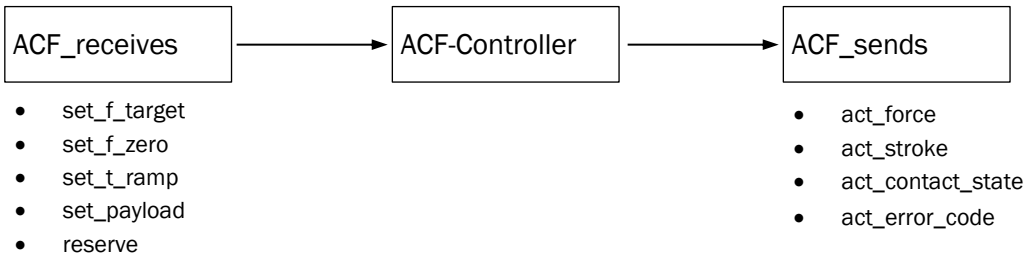


Figure 4: Parameters of send and receive data strings

Automation system sends -> ACF receives

Signal name	Description	Value range	unit	Signal no.
set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	1
set_f_zero	Minimal force where to start applying a force ramp when contact is detected	-Fmax ... +Fmax	N	2
set_t_ramp	Duration of force ramp	0 ... 10	sec	3
set_payload	Payload of the tool applied to the active contact ACF	Fmax/10	kg	4
Reserve	Reserved value in the protocol	0		5

Table 7: Entry parameters for the ACF

Example:

```
<authentication>k
<id> <set_f_target> <set_f_zero> <set_t_ramp> <set_payload> <reserve>k
<id> ...

ferbak1040 100 0 0.5 9.9 0k1040 -150 -50 0 …
```

	Information In case the ACF receives values out of the value range, this value will be pruned to fit the value range and an error code will be set.

ACF sends -> Automation system recei ves

The ACF will only send data as answer after receiving a message from the automation system.

Signal name	Description	Value range	Unit	Signal No.
id	Information about ACF type and software version	internal ID		0
act_force	from ACF measured contact force	-Fmax ... +Fmax	N	1
act_position	actual position of the ACF	0...hmax (resolution: 0.1)	mm	2
act_contact_state	Indicates if the ACF detects contact	0 ... no contact 1 ... contact		3
act_error_code	Bitmap for occurred errors	0 ... no error > 0 ... error		4

Table 8: Parameters sent by the ACF

Example:

```
<authentication>k
<id> <act_force> <act_position> <act_contact_state> <act_error_code>k
<id> <act_force>...
ferbak205030401 0 0 0 0k205030401 1 0 ... 0k205030401...
```

Communication example

Automation system -> request

```
ferbak
1040 10.5  5.5   7.5   5.3   0k
1040 10.5  5.5   7.5   5.3   0k
1040 10.5  5.5   7.5   5.3   0k
1040 10.5  5.5   7.5   5.3   0k
1040 10.5  5.5   7.5   5.3   0k
1040 10.5  5.5   7.5   5.3   0k
c
```

id	set_f_target [N]	set_f_zero [N]	set_t_ramp [s]	set_payload [kg]	reserve
1040	10.5	5.5	7.5	5.3	0

ACF -> response

```
ferbak
205030401    4.3   37.5  0    0k
205030401    5.5   37.3  0    0k
205030401    5.6   36.5  1    0k
205030401    5.7   35.3  1    0k
205030401    5.8   32.4  1    0k
205030401    5.9   30.3  1    0k
```

id	act_force [N]	act_position [mm]	act_contact_state [0..1]	act_error_code [0..25]
205030401	4.3	37.5	0	0

4 Optional interface: FerRobotics XML over Ethernet TCP/IP

For this interface option the data string of the Ethernet TCP/IP interface is replaced by XML code. Only those value tags that the system needs to set must be sent to the ACF.

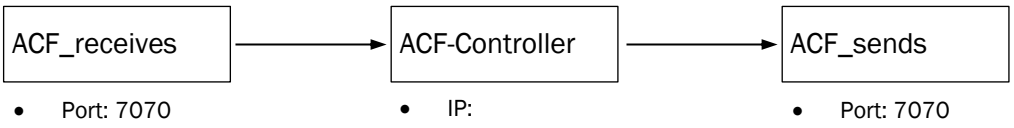
Automation system sends -> ACF receives

```
<ferrobotics_acf_in>
    <set_f_target>10.5</set_f_target>
    <set_f_zero>0</set_f_zero>
    <set_t_ramp>0</set_t_ramp>
    <set_payload>0.5</set_payload>
</ferrobotics_acf_in>
```

ACF sends -> Automation system receives

```
<ferrobotics_acf_out>
    <act_force>10.5</act_force>
    <act_position>15.5</act_position>
    <act_contact_state>1</act_contact_state>
    <act_error_code>0</act_error_code>
</ferrobotics_acf_out>
```

Port 7070 is used for both sending and receiving data packets.



5 Optional interface: Analog IOs

Input values for the ACF cannot be changed in intervals < 5 ms.

Automation system sends -> ACF receives analogue signals (-10V...10 V)

PIN Nr.	Name	Description	Value, Unit
4	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax means -10 V +Fmax means +10 V
5	set_f_zero	Minimal force where to start applying a force ramp as soon as contact is detected	-Fmax means -10 V +Fmax means +10 V
6	set_t_ramp	Duration of force ramp	0 ... 10 s means 0...10 V
7	set_payload	Payload of the tool applied to the ACF	0...Fmax/10 kg means 0...10 V

Table 9: ACF receives analogue IOs

ACF sends -> Automation system receives analogue signals (-10V...10 V)

PIN Nr.	Name	Description	Value, Unit
9	act_force	from ACF measured contact force	-Fmax means -10 V +Fmax means +10 V
10	act_position	actual position of the ACF	0 ... hmax mm mean 0...10 V
11	act_contact_state	Indicates if the ACF detects contact	0 V ... no contact 10 V ... contact
12	act_error_code	Bitmap for occurred errors	0...25 – 1 = 31 means 0...10 V (Bit 5 is not used in analogue IOs)

Table 10: ACF sends analogue IOs

ACF sends -> Automation system receives digital signals (0V/24 V)

PIN Nr.	Name	Description	Value, Unit
8	digital_error	collective fault or offline	0 V ... no error 24 V ... error or offline
13	digital_contact	Indicates if the ACF detects contact	0 V ... no contact 24 V ... contact

Table 11: ACF sends digital IOs

Plug description

The Control Box uses a female HD15 (D-Sub 15-pin High Density) plug.

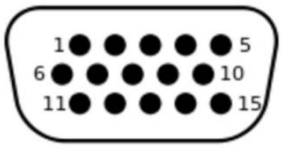


Figure 5: Plug for the Control Box used for analogue IO-interface

Parameter act_error_code in analogue IO option

There is no bit 5 error in the analogue option as not more than 10 V can be applied. Thus only the bits 0 to 4 are used for error codes in the analogue IO interface option.
The 32 possible combinations are mapped from 0 to 10 V, which means 0.323 V voltage difference between the single possible error codes.

Description	Bit number	voltage
Valve pressure error	0	2^0*0.323 V=0.323 V
Sensor error	1	2^1*0.323 V=0.645 V
License error	2	2^2*0.323 V=1.290 V
Warning: F_target cannot reached	3	2^3*0.323 V=2.581 V
Warning: F_zero set to 0 (F_target and F_zero must have the same sign)	4	2^4*0.323 V=5.161 V
not applicable	5	

Table 12: Error Codes of the analogue IO interface option

Example: Evaluation

If there is a voltage of 0.968 V, divide this value by 0.323, round result to integer and then convert it to a binary number; the result is 00011; this is according to the table above a Valve pressure error and a Sensor error.

Pin assignment and connection example:

This connection example describes a minimal wiring to use the ACF. The output signals of the ACF (pins 9 to 12) are not connected in this example. All inputs must be connected to a defined potential.

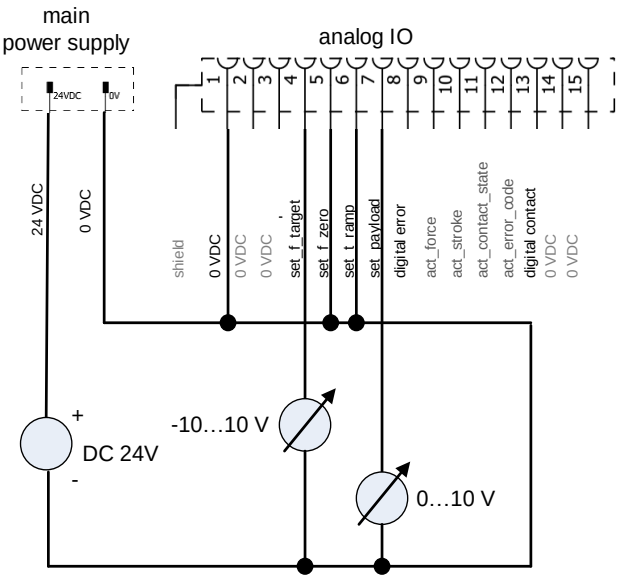


Figure 6: Pin assignment of the analogue IO interface option

Digital signals are working with 0 V / 24 V logic.

DIN-Rail-Controller (DRC):

Figure 7 IO-Interface DRC

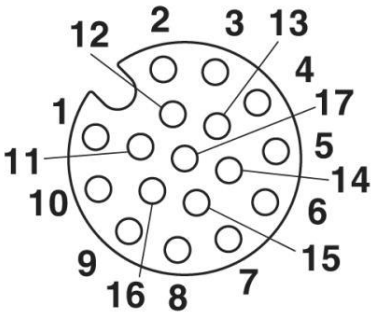


Figure 8 Pin assignment analog IO

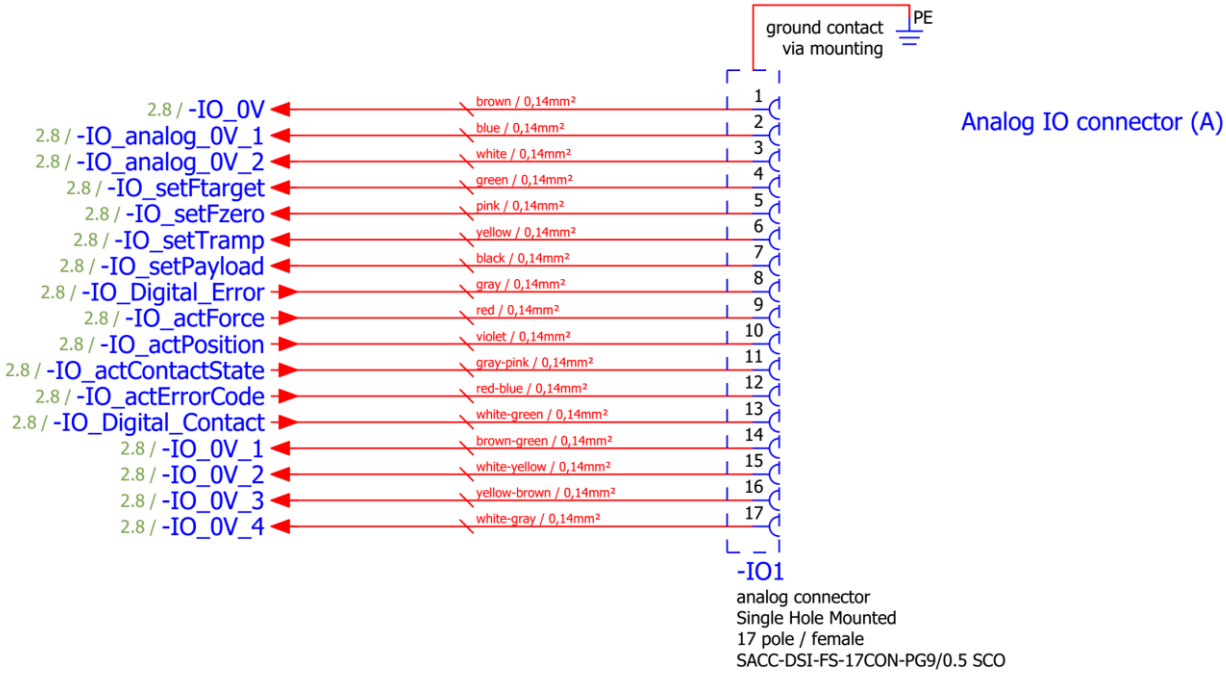


Figure 9 Pin assignment analog IO-Interface DRC

6 Optional interface: Profibus

The default node number of the ACF is set to 8.
The address can be changed with the rotary address switch on the Gateway.
The ACF control is set to Profibus slave.

	**ATTENTION** Be aware of the tenth-units for the signals set_t_ramp, set_payload and act_position. These units are in use to avoid decimal numbers for this interface.

Automation system sends (Output) -> ACF receives

Byte	Name	Description	Value range	Unit	Datatype
0-1	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... Fmax	N	INT
2-3	set_f_zero	Set zero force for force ramp	-Fmax ... +Fmax	N	INT
4-5	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	UINT
6-7	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT

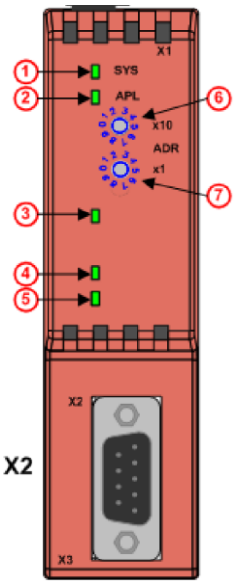
Table 13: ACF receives Profibus

ACF sends -> Automation system receives (Input)

Byte	Name	Description	Value range	Unit	Datatype
0-1	act_force	from ACF measured contact force	-Fmax ... + Fmax	N	INT
2-3	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
4-5	act_contact_state	Indicates if the active contact ACF detects contact	0 ... no contact 1 ... contact	bool	UINT
6-7	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 14: ACF sends Profibus

Profibus DP Gateway LED status

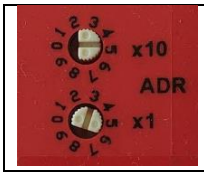


LED	Color	State	Meaning
COM ③	Duo LED red/green		
	(green)	On	RUN, cyclic communication.
	(red)	On	Wrong configuration at PROFIBUS-DPside.
	(red)	Flashing cyclic	STOP, no communication, connection error.
	(red)	Flashing acyclic	Not configured.

Table 15: LEDs PROFIBUS DP-Slave

Changing the Profibus address

The bus address can be set via the address selection switches on the gateway. The valid station address range is 1 to 99. After changing the station address (ADR) a restart is necessary. The default station address is 8.

	Picture shows the address selector ADR on address 8. Note: The removed parts on the switch symbolizes an arrow.

Error codes

The error codes are transmitted in the same way as in the Ethernet TCP/IP interface. The same error codes are in use.

Connection cable

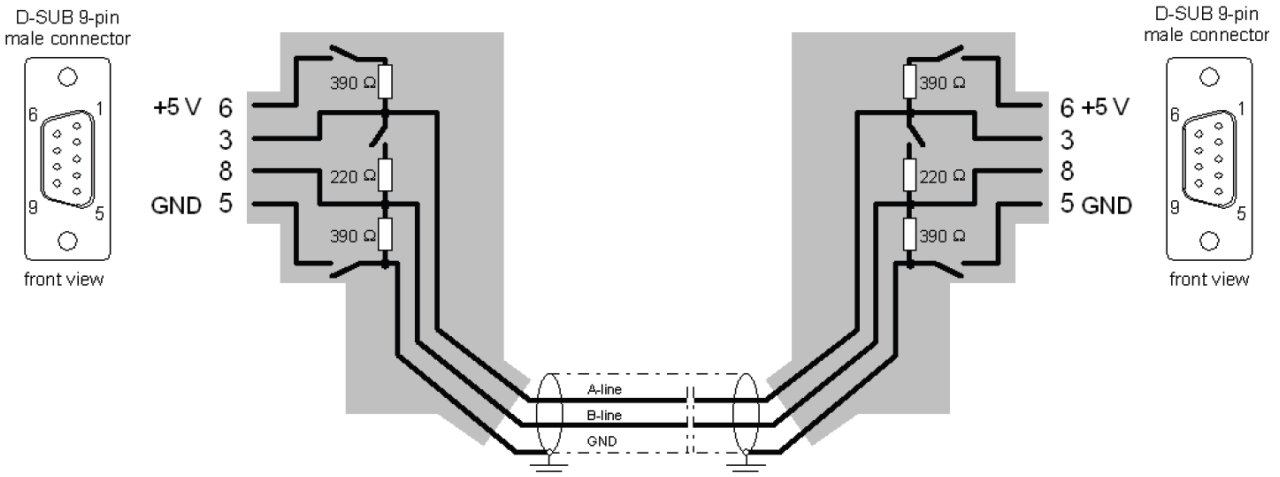


Figure 10: Profibus interface connection cable

Bus termination

To ensure smooth operations, the Profibus bus line must be terminated on either end. When using a plug designed for PROFIBUS the termination can be switched on/off via a switch at the connector shell.

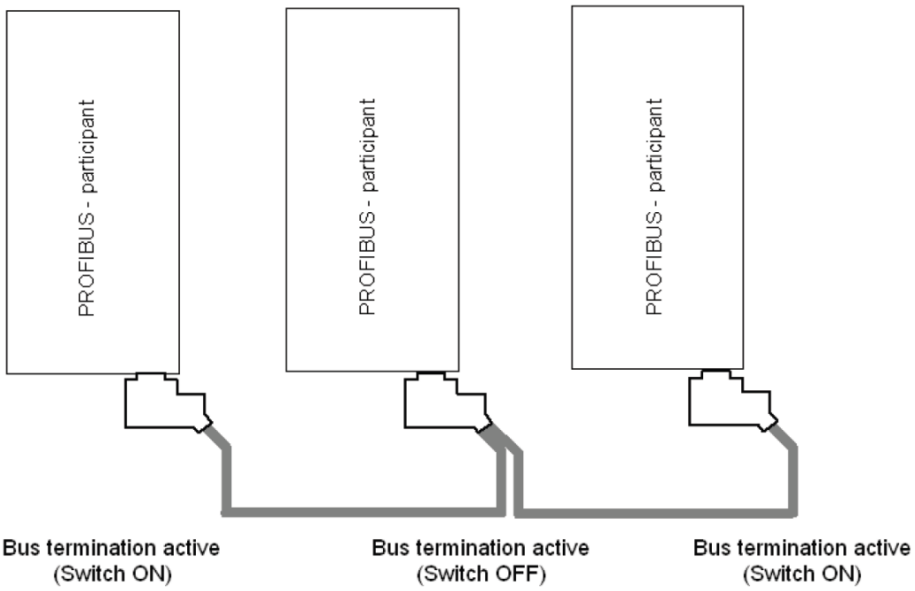


Figure 11: Profibus interface bus termination line

Plug specification

To establish connection with the plug, the following shielded plug is recommended:

Phoenix plug SUBCON-PLUS-PROFIB/AX/SC
Material number: 2744380

Pin assignment

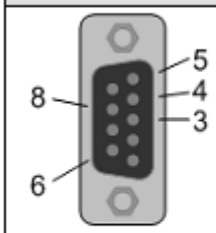
PROFIBUS	Pin	Signal	Description
 9-pole sub-D socket, female	3	Rx/Tx +	Receive- / Transmit data positive
	4	CNTR-P	Control signal for repeater (direction control)
	5	ISO GND	Data ground
	6	VP	Power supply positive
	8	Rx/Tx -	Receive- / Transmit data negative

Table 16: Profibus RS-485 Pin assignment

Device description file, Slave and Master Configuration

Please Import the device description file (ACF_HIL.GSD) into the master, if that is not possible use a suitable master that supports this function.
After the import of the device description file the modules must be configured as follows:

Module	Block	Type	Length	Identifier	term
Modul1	Block 1	Output Word	4 Words	0xE3	ACF receive
Modul2	Block 1	Input Word	4 Words	0xD3	ACF send

Table 17: ACF Module configuration Profibus

⚠	Important settings for the Profibus connection: • Use freeze and sync mode (optional) • DPV1 off • Watchdog time • The Byte Order is Big Endian

The GSD device description file (ACF_HIL.GSD) can be obtained from your retailer or FerRobotics directly.

Parameter	Description
Maximum number of cyclic input data	244 bytes
Maximum number of cyclic output data	244 bytes
Maximum number of modules	Max. 4 input modules and max. 4 output modules, max. 24 modules when using manual setting
Baud rate	9,6 kBits/s, 19,2 kBits/s, 31,25 kBits/s, 45,45 kBits/s 93,75 kBits/s, 187,5 kBits/s, 500 kBits/s, 1, 5 MBits/s, 3 MBits/s, 6 MBits/s, 12 MBit/s Auto baudrate detection is supported
Data transport layer	PROFIBUS FDL
Limitations	DP V1 services class 1 and 2 to transfer user data are not supported SSCY1S – Slave to slave communication state machine not implemented Data exchange broadcast not implemented I&M0 with fixed settings only
Reference to firmware/stack version	V2.4.x.x

Table 18: PROFIBUS DP Slave Protocol

7 Optional Interface: DeviceNet

The DeviceNet interface is used to connect the ACF to one client (Master) with the DeviceNet protocol. The ACF counts as a server (Slave) with exactly one allowed connection.
The DeviceNet MAC-ID is set to 8 and the bit rate is set to 500 kbit/s.

	**ATTENTION** Pay attention to the tenth parts shown by the signals set_t_ramp, set_payload and act_position. These parts are used to avoid decimal values in the interface.

Automation system sends (output) -> ACF receives

Nr.	Name	Description	Value range	Unit	Data type
1	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
2	set_f_zero	Set zero force for force ramp	-Fmax ... +Fmax	N	INT
3	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	UINT
4	set_payload	Payload of the tool applied to the ACF	0 ... Fmax	0.1 kg	UINT

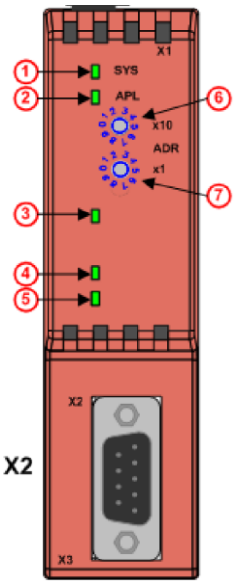
Table 19: ACF receives, polling output automation system

ACF sends -> automation system receives (input)

Nr.	Name	Description	Value Range	Unit	Data type
1	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
2	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
3	act_contact_state	Indicates if the active contact ACF detects contact	0 ... no contact 1 ... contact	bool	UINT
4	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 20: ACF sends, polling input automation system

DeviceNet Gateway LED status



LED	Color	State	Meaning
MNS ③	Duo LED red/green		
	(green)	On	Device is online and has one or more connections in the established state
	(green)	Flashing	Device is online and has no connection in the established state
	(green/red/ off)	Green/Red/ Off	Selftest after power on: Green on for 0,25 s, then red on for 0,25 s, then off
	(red)	On	Critical connection failure; device has detected a network error: duplicate MAC-ID or sever error in CAN network (CAN-bus off)
	(red)	Flashing	Connection timeout
	(off)	Off	After start of the device and during duplicate MAC-ID check

Table 21: LEDs DeviceNet-Salve

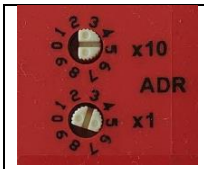
Device description file, Slave and Master Configuration

Please import the device description file (ACF_DN.EDS) into the client (master), if that is not possible use a suitable client (master) that supports this function.
The EDS device description file (ACF_DN.EDS) for DeviceNet can be obtained from your retailer or FerRobotics directly.
The byte order of the data is little endian (LSB first).
The client (master) settings for the bus communication should be set to *start the bus communication automatically by the device*.

	Typ	Tag
⊟	ACF (ACF_DN.EDS) <Adr 8>	ACF (ACF_DN.EDS)
⊞	Poll_Input <Slot 1>	Poll_Input
⊞	Poll_Output <Slot 1>	Poll_Output

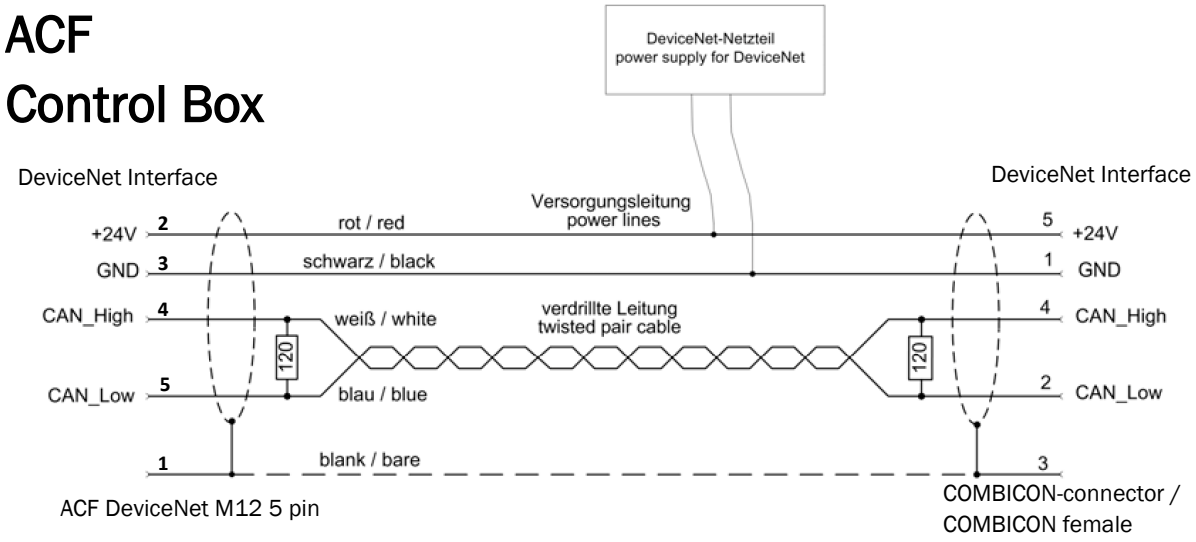
Table 22 module configuration

The bus address can be set via the address selection switches (ADR) on the gateway (1...63).

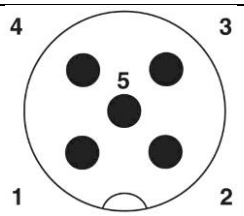
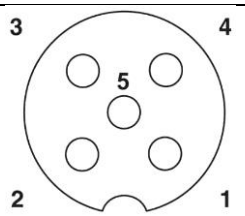
	Picture shows the address selector ADR on address 8. Note: The removed parts on the switch symbolizes an arrow.

Plug description

The Control Box uses a M12 5pin socket/ female connector.



Wiring example for ACF M12 5 pin with COMBICON connection. Attention you need to add a 24V power supply to the bus cable.

DeviceNet M12, 5 pin plug/ male A coded	DeviceNet M12, 5 pin socket/ female A coded (ACF Control Box)
	
Pin 1: Shield	
Pin 2: +24V	
Pin 3: GND	
Pin 4: CAN_High	
Pin 5: CAN_Low	
Screw: Shield	

Parameter	Description
Maximum number of cyclic input data	255 bytes
Maximum number of cyclic output data	255 bytes
Connections	Poll Change-of-state Cyclic Bit-strobe
Fragmentation	Explicit and I/O
UCMM	Not supported
Baud rates	125 kBits/s, 250 kBit/s, 500 kBit/s Auto baudrate detection is not supported
Data transport layer	CAN frames
Limitations	Access to Application Object only via IO connection
Reference to stack version	V2.3.x.x

Table 23: DeviceNet-Slave Protocol

8 Optional Interface: Modbus TCP

This chapter describes the Modbus TCP interface of the ACF. The Modbus TCP interface is used to connect the ACF to one client (master) with the Modbus TCP protocol. The ACF works as a server (Slave) with exactly one allowed connection. The values of the default Ethernet TCP/IP-interface are replaced by the corresponding Modbus-register.
The address can be set via the web interface.
For communication the default TCP port 502 for Modbus is used.

	**ATTENTION** Be aware of the tenth-units for the signals set_t_ramp, set_payload and act_position. These units are in use to avoid decimal numbers in this interface.

Automation system sends (output (FC16)) -> ACF receives

Reg.#	Addr.	Name	Description	Value range	Unit	Data type
1	0	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
2	1	set_f_zero	Set zero force for force ramp	-Fmax ... +Fmax	N	INT
3	2	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	UINT
4	3	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT
5..10	4..9	reserve	Reserved value in the protocol	0		INT

Table 24: ACF Holding Registers for Modbus-TCP

ACF sends -> Automation system receives (Input (FC4))

Reg.#	Addr.	Name	Description	Value range	Unit	Data type
11	10	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
12	11	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
13	12	act_contact_state	Indicates if the active contact ACF detects contact	0 ... no contact 1 ... contact	bool	UINT
14	13	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 25: ACF Input Registers for Modbus-TCP

The ACF implements the following function codes of the Modbus-TCP protocol. The implementation while reading doesn‘t distinguish between the input and holding registers. This means that the registers can be read with every reading order however only the registers 1 to 4 can be written (Set values set_*).

FC	Description
03	Read Holding Registers
04	Read Input Registers
06	Write Single Register
16	Write Multiple Registers
23	Read/Write Multiple Registers

Table 26: Implemented Function Codes for Modbus-TCP

All Modbus-clients connect via the port 502 to the Modbus-server. In this case, a continuous order-driven connection setup and release is necessary. The Modbus-server can only communicate with one Modbus-client at the same time via the port 502.

9 Optional Interface: PROFINET

This chapter describes the PROFINET interface of the ACF to the customer.
The control of the ACF is a PROFINET IO-RT Device of the Conformance Class B.

	ATTENTION The gateway has already been configured and must not be changed. Pay attention to decimal place in the signals set_t_ramp, set_payload and act_position. These units are used to avoid decimal numbers in the Interface.

Automation system sends (Output) -> ACF receives

Byte	Size	Name	Description	Value	Unit	Data type
1	2	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
3	2	set_f_zero	Minimal force, from which the ACF begins to push/pull	Fmax ... +Fmax	N	INT
5	1	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	USINT
6	2	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT

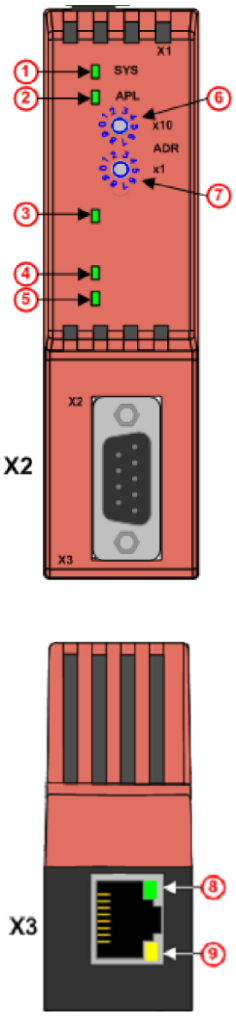
Table 27: ACF receives PROFINET

ACF sends -> Automation system receives (Input)

Byte	Size	Name	Description	Value range	Unit	Data type
1	2	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
3	2	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
5	1	act_contact_state	Indicates if the ACF detects contact	0 ... no contact 1 ... contact	bool	USINT
6	2	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 28: ACF sends PROFINET

PROFINET Gateway LED status



LED	Color	State	Meaning
SF Number in the device drawing: ④	**Duo LED red/green**		
	(red)	On	Watchdog timeout; channel, generic or extended diagnosis present; system error
	(red)	Flashing cyclic at 2 Hz (for 3 sec.)	DCP signal service is initiated via the bus
	(off)	Off	No error
BF Number in the device drawing: ⑤	**Duo LED red/green**		
	(red)	On	No configuration; or low speed physical link; or no physical link
	(red)	Flashing cyclic at 2 Hz	No data exchange
	(off)	Off	No error
LINK/RJ45 ⑧	**LED green**		
	(green)	On	A connection to the Ethernet exists
	(off)	Off	The device has no connection to the Ethernet
RX/TX/RJ45 ⑨	**LED yellow**		
	(yellow)	Flashing	The device sends/receives Ethernet frames

Table 29: LEDs PROFINET IO-RT-Device

Device description file, IO-device and IO-controller Configuration

Please import the XML device description file (GSDML-V2.2-FERROBOTICS-ACF-20140113-143000.xml) into the IO-controller, if that is not possible use a suitable controller that supports this function. The DTM catalogue must be updated after reading the device description file.
After the import of the device description file, the modules are configured as shown in Table 30: ACF Module configuration PROFINET:

Slot	Subslot	Type	Length	Module
1	1	Input	8 Byte	8 Byte Input
2	1	Output	8 Byte	8 Byte Output

Table 30: ACF Module configuration PROFINET

The IO-controller should be selected to *automatic start of bus communication through the device*.
The XML device description file for PROFINET can be obtained from your retailer or FerRobotics.
GSDML File: GSDML-V2.2-FERROBOTICS-ACF-20140113-143000.xml
The Byte order is Little Endian (LSB first).

	**INFORMATION** **Gateway:** Vendor ID: 0x011E Device ID: 0x010F

Parameter	Description
Maximum number of cyclic input data	1024 bytes
Maximum number of cyclic output data	1024 bytes
Supported protocols	RTC – Real Time Cyclic Protocol, Class 1 and 2 (unsynchronized) RTA – Real Time Acyclic Protocol DCP – Discovery and configuration Protocol CL-RPC – Connectionless Remote Procedure Call LLDP – Link Layer Discovery Protocol SNMP – Simple Network Management Protocol
Used Protocols (subset)	UDP, IP, ARP, ICMP (Ping)
Topology recognition	LLDP, SNMP V1, MIB2, physical device
VLAN- and priority tagging	yes
Context Management by CL-RPC	Supported
Minimum cycle time	1 ms
Baud rate	100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3
Limitations	No acyclic user data transfer RT over UDP not supported Multicast communication not supported Only one device instance is supported DHCP is not supported RT Class 2 synchronized (IRT 'flex') is not supported RT Class 3 is not supported FastStartUp is not supported Media Redundancy is not supported Access to the submodule granular status bytes (IOPS & IOCS) is not supported The amount of configured IO-data influences the minimum cycle time that can be reached. Supervisor-AR is not supported, Supervisor-DA-AR is supported Only 1 Input-CR and 1 Output-CR are supported Multiple WriteRequests are not supported
Reference to stack version	V3.4.x.x

Table 31: PROFINET IO-RT Device Protocol

10 Optional Interface: EtherNet/IP

This chapter describes the EtherNet/IP interface of the ACF to the customer.
The control of the ACF is an EtherNet/IP adapter.

	ATTENTION The standard configuration uses a **DHCP** server to configure the IP address of the adapter. **The project on the gateway is already loaded and set up for use, please do not change the project.** Use *BootP DHCP EthnerNet/IP Commissioning Tool* from Rockwell Automation Inc. to configure the IP address if you do not use a DHCP Server. Pay attention to decimal place in the signals set_t_ramp, set_payload and act_position. These units are used to avoid decimal numbers in the Interface.

Automation system sends (Output) -> ACF receives

Byte	Size	Name	Description	Value	Unit	Data type
1	2	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
3	2	set_f_zero	Minimal force, from which the ACF begins to push/pull	-Fmax ... +Fmax	N	INT
5	1	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	USINT
6	2	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT

Table 32: ACF receives EtherNet/IP

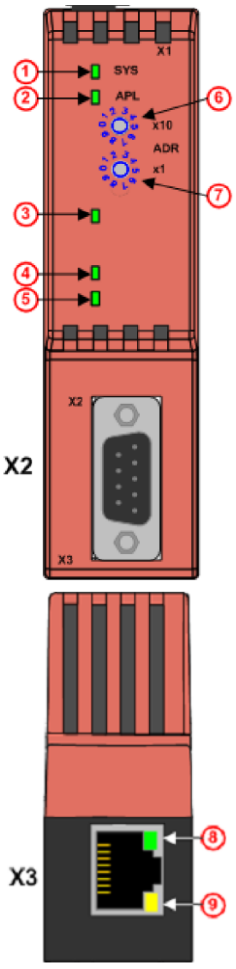
ACF sends -> Automation system receives (Input)

Byte	Size	Name	Description	Value range	Unit	Data type
1	2	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
3	2	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
5	1	act_contact_state	Indicates if the ACF detects contact	0 ... no contact 1 ... contact	bool	USINT
6	2	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 33: ACF sends EtherNet/IP

The program *BootP DHCP EthnerNet/IP Commissioning Tool* from Rockwell Automation Inc. can be used to configure the IP address if you do not use a DHCP Server.
You can activate or deactivate the DHCP Server and set and change a permanent IP address using the Commissioning Tool.
Use the help of the program or see Appendix B: EtherNet/IP using the BootP DHCP Tool to configure an IP address

EtherNet/IP Gateway LED status



LED	Color	State	Meaning
MS Number in the device drawing: ④	**Duo LED red/green**		
	(green)	On	**Device operational**: If the device is operating correctly, the module status indicator shall be steady green.
	(green)	Flashing	**Standby**: If the device has not been configured, the module status indicator shall be flashing green.
	(red)	On	**Major fault**: If the device has detected a non-recoverable major fault, the module status indicator shall be steady red.
	(red)	Flashing	**Minor fault**: If the device has detected a recoverable minor fault, the module status indicator shall be flashing red. NOTE: An incorrect or inconsistent configuration would be considered a minor fault.
	(red/green)	Flashing	**Self-test**: While the device is performing its power up testing, the module status indicator shall be flashing green/red.
	(off)	Off	**No power**: If no power is supplied to the device, the module status indicator shall be steady off.
NS Number in the device drawing: ⑤	**Duo LED red/green**		
	(green)	On	**Connected**: If the device has at least one established connection (even to the Message Router), the network status indicator shall be steady green.
	(green)	Flashing	**No connections**: If the device has no established connections, but has obtained an IP address, the network status indicator shall be flashing green.
	(red)	On	**Duplicate IP**: If the device has detected that its IP address is already in use, the network status indicator shall be steady red.
	(red)	Flashing	**Connection timeout**: If one or more of the connections in which this device is the target has timed out, the network status indicator shall be flashing red. This shall be left only if all timed out connections are reestablished or if the device is reset.
	(red/green)	Flashing	**Self-test**: While the device is performing its power up testing, the network status indicator shall be flashing green/red.
	(off)	Off	**Not powered, no IP address**: If the device does not have an IP address (or is powered off), the network status indicator shall be steady off.
LINK/RJ45 Number in the device drawing: ⑧	**LED green**		
	(green)	On	A connection to the Ethernet exists
	(off)	Off	The device has no connection to the Ethernet
ACT/RJ45 Number in the device drawing: ⑨	**LED yellow**		
	(yellow)	Flashing	The device sends/receives Ethernet frames

Table 34: LEDs EtherNet/IP-Adapter (Slave)

Device description file, adapter and scanner Configuration

Please import the device description file (FERROBOTICS ACF V1.1.EDS) into the scanner, if that is not possible use a suitable controller that supports this function.
The DTM catalogue must be updated after reading the device description file.
The adapter is added to the scan list with the corresponding IP address (see DHCP configuration).
The scanner settings for the bus communication should be set to start the bus communication automatically by the device.
The device description file can be obtained from your retailer or FerRobotics directly.
EDS File: FERROBOTICS ACF V1.1.EDS

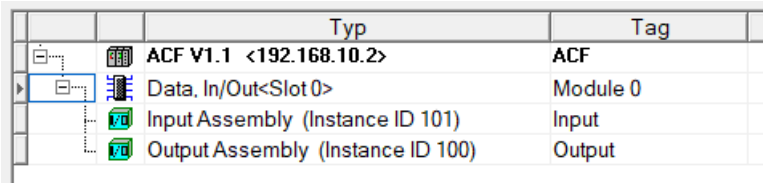


Figure 12 module configuration

The byte order of the data is little endian (LSB first). The input/ output size is 8 Byte and will be set automatically using the import of the device description file.

For more details please read the FERROBOTICS ACF V1.1.EDS file or import the file to your scanner.

Parameter	Description
Maximum number of input data	504 bytes
Maximum number of output data	504 bytes
IO Connection	1 explicit owner, up to 2 listen only
IO Connection type	Cyclic, minimum 1 ms
UCMM	Supported
Predefined standard objects	Identity Object Message Route Object Assembly Object Connection Manager Ethernet Link Object TCP/IP Object
DHCP	Supported
BOOTP	Supported
Baud rates	10 and 100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3
Integrated switch	Supported
Limitations	No acyclic user data communication CIP Sync Services are not implemented TAGs are not supported ACD (Address Conflict Detection) not supported DLR not supported (ring topology)
Reference to firmware/stack version	V2.1.x.x

Table 35: EtherNet/IP Adapter (Slave) Protocol

Settings for robots that cannot read a device description file.

INFORMATION

Some EtherNet/IP scanners need to set 4 Byte extra for input if you configure a generic adapter and do not use the device description file.
The additional 4 Bytes represent the length of the Run/Idle header.
You can try this setting for 32-Bit Run/Idle header if needed for the scanner:

```
Scanner configuration:
Description: FER
Name/IP address: 192.168.1.8
Vendor Id: 283
Device Type: 12
Product code: 275
Input size (words): 6
Output size (words): 4
RPI (ms): 32
Assembly instance (input): 101 (T-->O)
Assembly instance (output): 100 (O-->T)
Configuration instance: 1

Advanced configuration:
Target To Originator
Transport Type: Multicast
RPI: 32
Connection Type
O=>T Format: Run/Idle Header
T=>O Format: Run/Idle HeaderVendor (optional: Modeless or none)
```

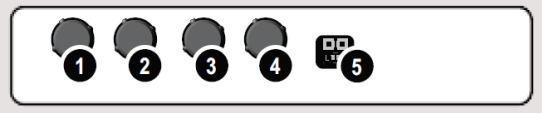
11 Optional Interface: Interbus FO

This chapter describes the Interbus FO interface of the ACF to the customer.
The control of the ACF is an Interbus FO Slave.

⚠	ATTENTION Pay attention to decimal place in the signals set_t_ramp, set_payload and act_position. These units are used to avoid point numbers in the Interface.

Network Details

Interbus FO Gateway

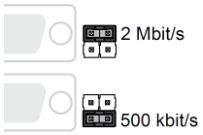


No.	Name	Description
1	X2.1	Transmit (Bus IN)
2	X2.2	Receive (Bus IN)
3	X2.3	Transmit (Bus OUT)
4	X2.4	Receive (Bus OUT)
5		Baudrate Jumper

Table 36: Interbus FO Gateway

Baudrate

The Slave interface supports two baudrates; 500kbps and 2Mbps. The baudrate is specified using the onboard jumper,



ID-Code (Identcode)

03h ... digital module with input and output data (DIO)

Process data

The Interbus interface of the ACF uses only process data. PCP communication is not used.

Description	Size (Byte)
Input process data	16
Output process data	16

Table 37: Process data

Automation system sends (Output) -> ACF receives

Byte	Size	Name	Description	Value	Unit	Data type
1	2	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
3	2	set_f_zero	Minimal force, from which the ACF begins to push/pull	-Fmax ... +Fmax	N	INT
5	1	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	USINT
6	2	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT

Table 38: ACF receives Interbus

ACF sends -> Automation system receives (Input)

Byte	Size	Name	Description	Value range	Unit	Data type
5	2	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
7	2	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
9	1	act_contact_state	Indicates if the ACF detects contact	0 ... no contact 1 ... contact	bool	USINT
10	2	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

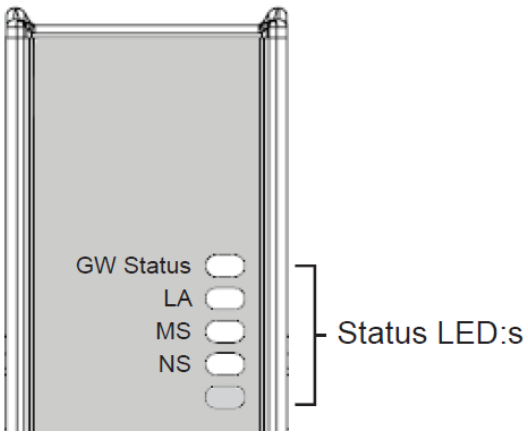
Table 39: ACF sends Interbus

All other bytes are not used.

Interface Status LEDs

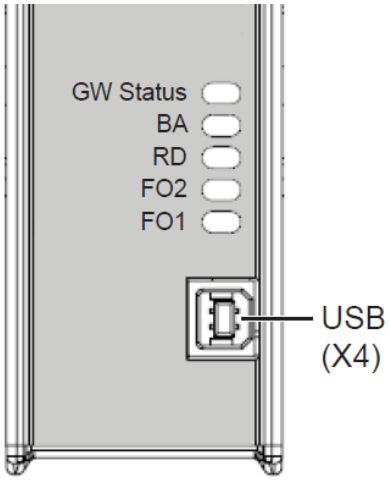
LED	Anzeige	Beschreibung
Gateway Status	See Gateway Installation Sheet	
LA	Green	Link established
	Green (flashing)	Receiving/transmitting data
	Off	Link not detected
MS	Green	Normal operation
	Green (flashing)	Standby, not yet configured
	Red	Major fault, unrecoverable
	Red (flashing)	Minor fault, recoverable
	Red/green (alternating)	Hardware self test
	Off	No power
NS	Green	EthernetIP connection OK
	Green (flashing)	No EthernetIP connections
	Red	Duplicate IP-adress
	Red (flashing)	Connection timeout
	Red/green (alternating)	Hardware self test
	Off	No power or no IP adress set

Table 40: Interface Status LEDs



LED	Colour	Description
Gateway Status	See the user manual of the Gateway for further details.	
BA	Green	Bus active
	Off	-
RD	Yellow	Remote bus disabled
	Off	-
FO2	Yellow	Fibre optic warning for Bus Out
	Off	-
FO1	Yellow	Fibre optic warning for Bus In
	Off	-
USB / (X4)		Not used

Table 41: Interface Status LEDs



12 Optional Interface: EtherCAT

This chapter describes the EtherCAT interface of the ACF to the customer.
The control of the ACF is an EtherCAT slave.

	ATTENTION Pay attention to decimal place in the signals set_t_ramp, set_payload and act_position. These units are used to avoid decimal numbers in the Interface.

Automation system sends (Output) -> ACF receives

Byte	Size	Name	Description	Value	Unit	Data type
1	2	set_f_target	Target force: Force which is in contact state working on the surface	-Fmax ... +Fmax	N	INT
3	2	set_f_zero	Minimal force, from which the ACF begins to push/pull	Fmax ... +Fmax	N	INT
5	1	set_t_ramp	Duration of force ramp	0 ... 100	0.1 s	USINT
6	2	set_payload	Payload of the tool applied to the active contact ACF	0 ... Fmax	0.1 kg	UINT

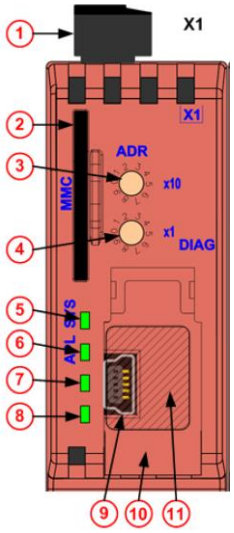
Table 42: ACF receives EtherCAT

ACF sends -> Automation system receives (Input)

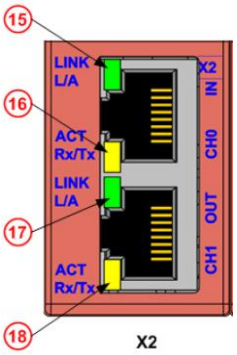
Byte	Size	Name	Description	Value range	Unit	Data type
1	2	act_force	from ACF measured contact force	-Fmax ... +Fmax	N	INT
3	2	act_position	actual position of the ACF	0 ... hmax	0.1 mm	UINT
5	1	act_contact_state	Indicates if the ACF detects contact	0 ... no contact 1 ... contact	bool	USINT
6	2	act_error_code	Bitmap for occurred errors	16 bit map	bool	UINT

Table 43: ACF sends EtherCAT

EtherCAT Gateway LED status



LED	Color	State	Description
RUN	**Duo LED red/green**		
	(off)	Off	**INIT:** The device is in INIT state.
	(green)	Blinking (2.5 Hz)	**PRE-OPERATIONAL:** The device is in PRE-OPERATIONAL state.
	(green)	Single flash	**SAFE-OPERATIONAL:** The device is in SAFE-OPERATIONAL state.
	(green)	On	**OPERATIONAL:** The device is in the OPERATIONAL state.
ERR	**Duo LED red/green**		
	(off)	Off	**No error:** The EtherCAT communication of the device is in working condition.
	(red)	Blinking (2.5 Hz)	**Invalid configuration:** General Configuration Error Possible reason: State change commanded by master is impossible due to register or object settings.
	(red)	Single flash	**Local error:** Slave device application has changed the EtherCAT state autonomously. Possible reason 1: A host watchdog timeout has occurred. Possible reason 2: Synchronization Error, device enters Safe-Operational automatically.
	(red)	Double flash	**Application watchdog timeout:** An application watchdog timeout has occurred. Possible reason: Sync Manager Watchdog timeout.
L/A IN, L/A OUT	**LED green**		
	(green)	On	**Link:** The device is linked to the Ethernet, but does not send/ receive Ethernet frames.
	(green)	Flickering (load dependent)	**Activity:** The device is linked to the Ethernet and sends/receives Ethernet frames.
	(off)	Off	The device has no link to the Ethernet.
	LED yellow		
	(off)	Off	This LED is not used.



LED state	Definition
Blinking (2.5 Hz)	The LED turns on and off with a frequency of 2.5 Hz: “On” for 200 ms, followed by “Off” for 200 ms.
Single flash	The LED shows one short flash (200 ms) followed by a long “Off“ phase (1,000 ms).
Double flash	The LED shows a sequence of two short flashes (each 200 ms), separated by a short "Off" phase (200 ms). The sequence is finished by a long "Off" phase (1,000 ms).
Flickering (load dependent)	The LED turns on and off with a frequency of approximately 10 Hz to indicate high Ethernet activity: "On" for approximately 50 ms, followed by "Off" for 50 ms. The LED turns on and off in irregular intervals to indicate low Ethernet activity.

Table 44: LEDs EtherCAT slave

Device description file, IO-device and IO-controller Configuration

Please import the XML device description file (ACT NT 100 RE ECS V4.6.xml) into the EtherCAT master. If that is not possible use a suitable controller that supports this function. The DTM catalogue must be updated after reading the device description file.
After the import of the device description file, the modules are configured as shown in Table 45: ACF Module configuration EtherCAT:

PDO-Ident	Type	Length	Module
0x1600	Output	8 Byte	8 Byte RxPDO
0x1A00	Input	8 Byte	8 Byte TxPDO

Table 45: ACF Module configuration EtherCAT

The XML device description file for EtherCAT can be obtained from your retailer or FerRobotics.
The Byte order is Little Endian (LSB first).

INFORMATION
Gateway Ident:
Vendor ID: 0x0044
Product Code: 0x000D
Interface:
Bus Startup: Application Controlled
Watchdog Time [ms]: 1000ms
I/O Data Status: None

Parameter	Description
Maximum number of cyclic input data	200 bytes
Maximum number of cyclic output data	200 bytes
Type	Complex Slave
FMMUs	3 (netX 100/netX 500)
SYNC Manager	4 (netX 100/netX 500)
Baud rate	100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3
Restrictions	Acyclic communication not supported LRW is not supported
Reference to firmware/stack version	V2.0/V4.7

Table 46: EtherCAT slave Protocol

13 Appendix A: Troubleshooting error code

Error: Bit0; Value 1 Description: valve error		
	Response: wrong force at the head	
	Cause	Measure
	Cable not connected	Connect the head to the controller.
	No compressed air supply	Establish a stable compressed air supply.
	Cable broken	Check the connection cable between the head and the controller. Change the broken cable.
	Plug broken	Check all connections between the head and the controller. See if pins are broken off or bent. Change the broken cable or head if it is damaged.
	Valve broken	Check if your compressed air is free of oil, water and particles. If necessary, install an oil / water separator and a particle filter to achieve the required air quality. Change the head and send the broken head for maintenance.

Error: Bit1; Value 2 Description: sensor error		
	Response: wrong force at the head, wrong readings	
	Cause	Measure
	Cable not connected	Connect the head to the controller.
	Cable broken	Check the connection cable between the head and the controller. Change the broken cable.
	Plug broken	Check all connections between the head and the controller. See if pins are broken off or bent. Change the broken cable or head if it is damaged.
	Sensor broken	Change the head and send the broken head for maintenance.

Error: Bit2; Value 4 Description: Head and controller are not compatible		
	Response: head is not working	
	Cause	Measure
	Cable not connected	Connect the head to the controller.
	Wrong controller	Change the controller see Table 1 compatibility.
	Wrong head	Change the head, see Table 1 compatibility
	Cable broken	Check the connection cable between the head and the controller. Change the broken cable.
	Plug broken	Check all connections between the head and the controller. See if pins are broken off or bent. Change the broken cable or head if it is damaged.

Error: Bit3; Value 8 Description: set_f_target cannot be reached		
	Response: wrong force at the head	
	Cause	Measure
	Set_f_target is too high	Reduce the target force.
	Payload is too high	Reduce the payload. Change the angle to gravity.
	wrong compressed air supply	Establish a stable compressed air supply.
	Wrong values are sent via the interface	Check if the correct set points are sent to the ACF, if possible use the monitoring function of the web interface.

Error: Bit4; Value 16 Description: set_f_zero set to 0		
	Response: The force value of the ramp for no contact is set to 0	
	Cause	Measure
	Set_f_target and set_f_zero do not have the same sign	Both values must have the same sign.

Error: Bit5; Value 32 Description: one or more input values out of range		
	Response: Set points are limited to the maximum	
	Cause	Measure
	At least one set point is too large	Check your set points.

Error: Bit6; Value 64 Description: INCAN no communication		
	Response: head is not working	
	Cause	Measure
	Cable not connected	Connect the head to the controller.
	Cable broken	Check the connection cable between the head and the controller. Change the broken cable.
	Plug broken	Check all connections between the head and the controller. See if pins are broken off or bent. Change the broken cable or head if it is damaged.

Error: Bit7; Value 128 Description: Reading of INCAN parameters not complete		
	Response: head is not working correct	
	Cause	Measure
	Reading parameters not finished	Wait until the data has been read. (max 10 seconds)
	Cable not connected	Connect the head to the controller.
	Cable broken	Check the connection cable between the head and the controller. Change the broken cable.
	Plug broken	Check all connections between the head and the controller. See if pins are broken off or bent. Change the broken cable or head if it is damaged.

Error: Bit8; Value 256 Description: Inverter not ready for operation		
	Response: The inverter for the device is not working and does not report ready, motor is not running	
	Cause	Measure
	The inverter does not report Ready	Pay attention to the status code of the inverter on the device, for details refer to the operating instructions of the MOVIDRIVE system (MDX90A).

Error: Bit9; Value 512 Description: Inverter no supply		
	Response: The inverter for the device reports DC link voltage missing, motor is not running	
	Cause	Measure
	The inverter does not have a mains connection or main switch is off.	Please make mains supply or turn main switch to ON.

Error: Bit10; Value 1024 Description: Inverter Error		
	Response: The inverter for the device reports errors, motor is not running	
	Cause	Measure
	Cables are not connected.	Check if all cables are properly connected.
	Fault	Pay attention to the status code of the inverter on the device, for details refer to the operating instructions of the MOVIDRIVE system (MDX90A).

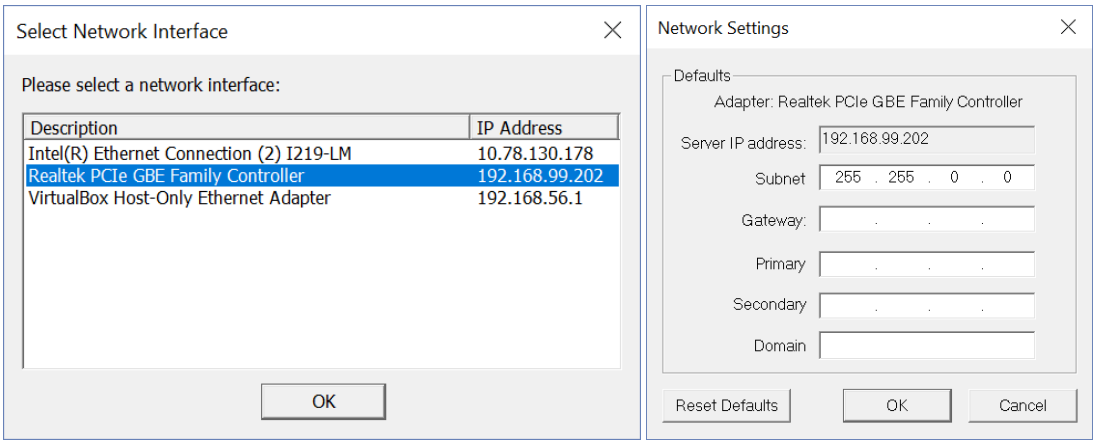
Error: Bit11; Value 2048 Description: Inverter STO active		
	Response: The inverter for the device reports Save Torque OFF, motor is not running	
	Cause	Measure
	Emergency stop active, US2 missing.	The emergency stop must be closed.

14 Appendix B: EtherNet/IP using the BootP DHCP Tool to configure an IP address

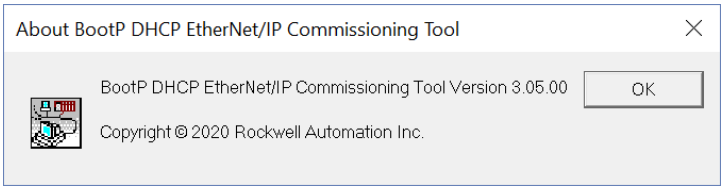
This appendix describes how to use the Rockwell *BootP DHCP EthnerNet/IP Commissioning Tool*. You can use this utility to set a device IP address. For more details, see the help section of the program. You can obtain the program from Rockwell Automation Inc.

To configure your device using the BootP DHCP Tool, perform the following steps:

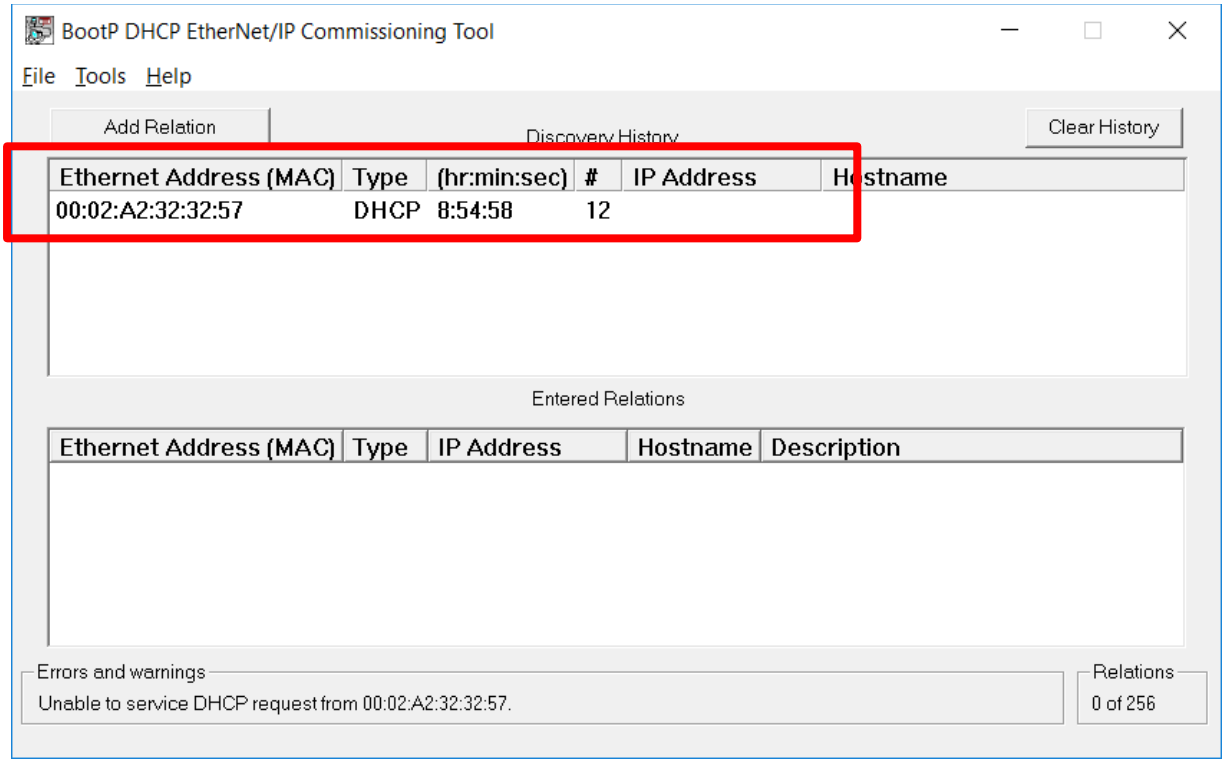
1. Connect your PC direct to our interface port. Don't use a switch between! If necessary, deactivate all wireless and LAN networks on your device that are not needed.
2. Set an IP-address on your PC from the same IP range of the robot (master).
3. Run the BootP DHCP Tool and select the network interface connected to the interface device.
4. Use the BootP DHCP Help for details



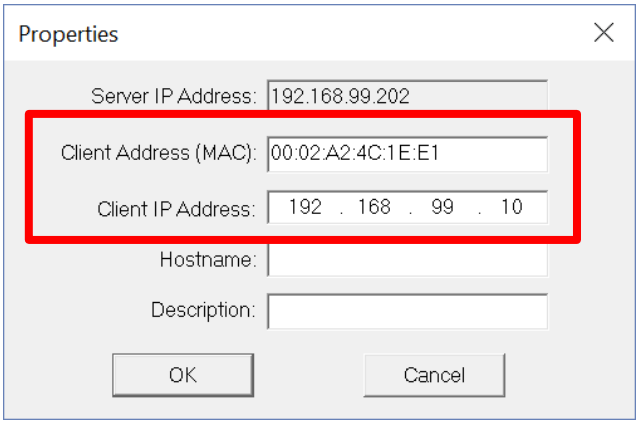
Version:



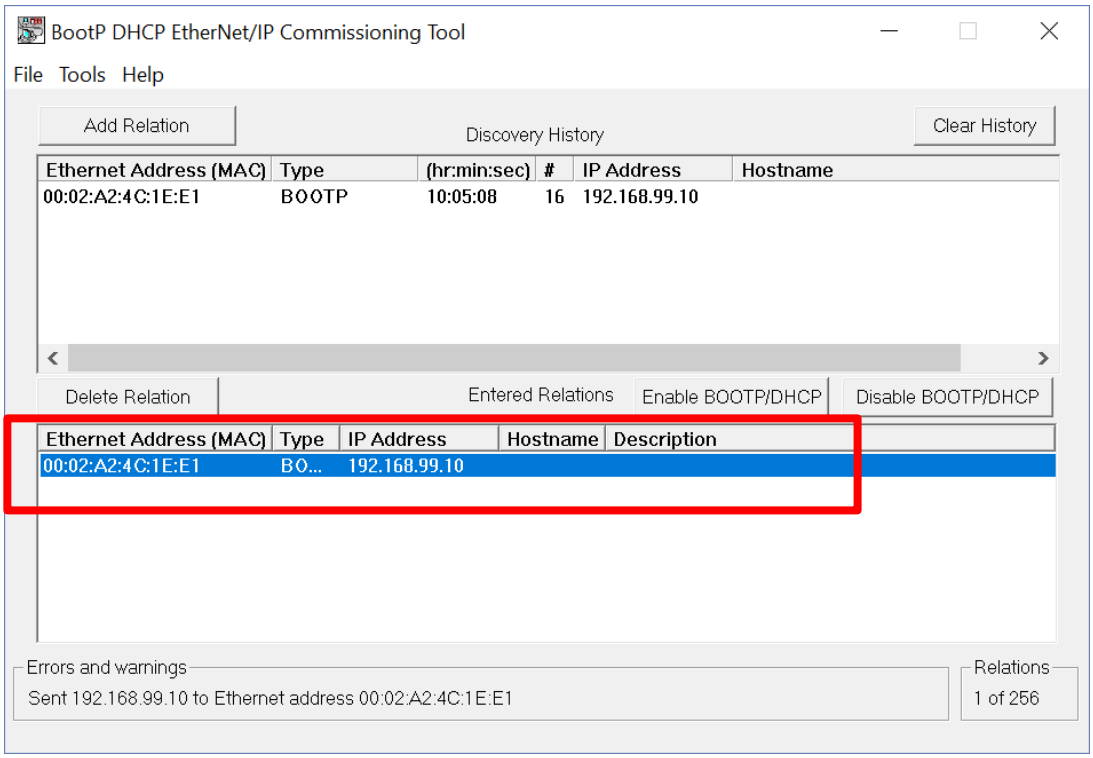
5. After a few seconds you should see in the BootP/DHCP request history panel the hardware addresses of devices issuing a request.



6. Double-click on the hardware address of the device you want to configure. You will see the New Entry pop-up window with the device's Ethernet Address (MAC).

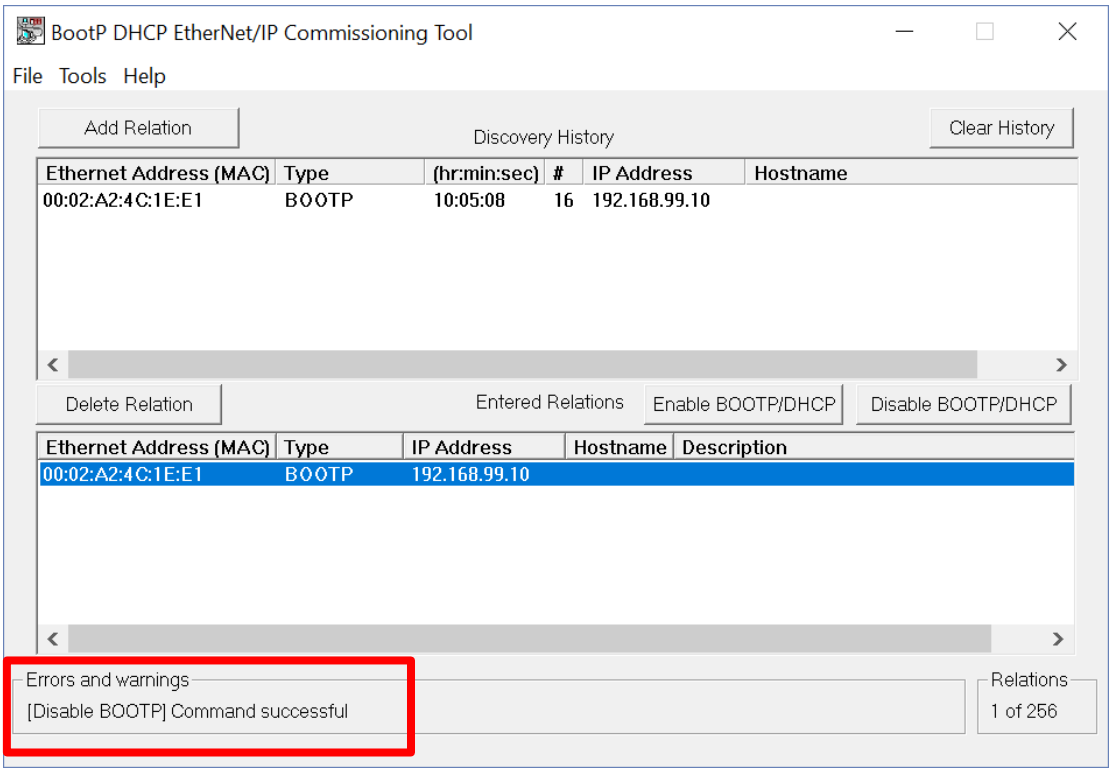


7. Enter the IP Address you want to assign to the device, and click on OK.



The device will be added to the relation list, displaying the Ethernet address (MAC) and corresponding IP address, subnet mask, and gateway (if applicable).

8. If you want to permanently assign this configuration to the device, highlight the device; make a right click in the highlighted device and then click on "`Disable BootP/DHCP`" in this menu.
   If this is successful, you will get the message: "`Command successful`". If this message does not appear, the settings are not set correctly.
   When power is recycled to the device, it will use the configuration you assigned and not issue a BootP/DHCP request.



Changing the IP address:

Just in case that the NT50 has an IP address and you want to change the address:

1. you need to enable the BootP/DHCP service, using the actual MAC- and IP-address,
2. delete the relations list of the device,
3. restart the device and start the procedure in the document at Step 4.

Trouble shooting BOOTP DHCP EtherNet/IP Commissioning Tool:

Description: No request of the device is displayed in the history window		
	Response: The device cannot be reached	
	Cause	Measure
	Cable not connected.	Connect the gateway to the computer.
	Cable broken.	Check the connection cable between the gateway and the computer. Change the broken cable.
	Firewall active.	Check the firewall settings and allow the program to communicate.
	The device address is already assigned via DHCP or BOOTP.	Restart device without external DHCP or BOOTP server
	The device already has a fixed IP address and DHCP and BOOTP are not active.	Enable DHCP or BOOTP, the IP and MAC must be entered for this.

Description: disable BOOTP DHCP does not state 'command successful' or IP address is not permanently set		
	Response: the IP address is only set temporarily and requested again via DHCP or BOOTP when restarting.	
	Cause	Measure
	Firewall active.	Check the firewall settings and allow the program to communicate.
	communication error	Connect the device directly to the computer. Do not use a switch or gateway.
	communication error	Disable all other network adapters including Wi-Fi. Only the network adapter connected to the device may be active.
	communication error	The network adapter settings of the computer must not contain a gateway or DNS.
	communication error	Check the network settings of the computer and compare the values with the network settings in the BOOTP DHCP Server Commissioning Tool.
	communication error	Make sure that the network settings of the computer match the desired settings of the gateway. Address range and network mask.
	communication error	Restart your computer.
	communication error	Power cycle the gateway and try to disable the BOOTP and DHCP again. Wait 1 minute after you set the address.