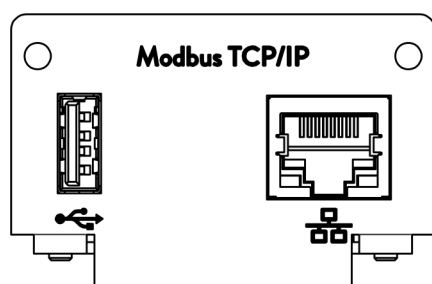


## Operation manual

### Interface module LRZ 935

Modbus TCP/IP module Advanced



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## 1 General

Many types of LAUDA constant temperature equipment have vacant module slots for installing additional interfaces. The number, size and arrangement of the module slots vary depending on the device and are described in the operating manual accompanying the constant temperature equipment. Two additional module slots available as accessories can be fitted to a LiBus module box, which is then connected as an external casing to the LiBus interface on the constant temperature equipment.

This operating manual describes how to install and configure the Modbus TCP/IP interface module (catalog no. LRZ 935).

Constant temperature equipment can be connected to a PC or network via the Modbus TCP/IP interface and controlled from there using the LAUDA command set. The interface functions provided for this purpose are described in chapters and .

The USB interface is intended for software updates for the Modbus TCP/IP Module Advanced.

### 1.1 Intended use

The interface module can only be operated as intended and under the conditions specified in this operating manual.

The interface module may only be used in the following areas:

- Production, quality assurance, research and development in an industrial environment

The interface module is an accessory item that is used to control and monitor the LAUDA constant temperature equipment. The interface module is built into the device and connected to the 24 volt supply. It may only be installed in constant temperature equipment that supports the interface provided. Refer to the chapter "Compatibility" in this operating manual for a list of compatible product lines.

Operation of the interface module is also permitted in combination with the LiBus module box (LAUDA catalog no. LCZ 9727). This operating manual also contains a description of how to install and connect up the module box.

#### Reasonably foreseeable improper use

- Operation on a non-compatible device
- Outdoor operation
- Operation in a potentially explosive area
- Operation after incomplete assembly
- Operation using defective cables or connections or those that do not confirm to standards
- Operation under medical conditions in accordance with DIN EN 60601-1 or IEC 601-1

## 1.2 Compatibility

The interface module is available as an accessory for the following LAUDA product lines:

- Integral IN



### **No operation of interfaces of the same type**

*Only one Modbus TCP/IP interface or one OPC UA interface can be used for each item of constant temperature equipment.*

*Using Modbus TCP/IP and OPC UA interfaces simultaneously is not permitted. The term "Comm. Module" (Communication Module) is used for both of these interfaces in this operating manual and in the device menus, because the hardware is identical.*



### **No operation of multiple fieldbus systems**

*Operation in combination with other fieldbus systems such as CAN, EtherCAT or Profinet interfaces is not permitted either, as only one fieldbus system is supported at any one time.*

## 1.3 Technical changes


All technical modifications are prohibited without the written consent of the manufacturer. Damage resulting from a failure to observe this condition will void all warranty claims.

However, LAUDA reserves the right to make general technical modifications.

## 1.4 Warranty conditions

LAUDA grants a standard warranty of one year.

## 1.5 Copyright

This operating manual was written in German, checked and approved. If the content of other language editions deviates from the German edition, the information in the German edition shall take precedence. If you notice any discrepancies in the content, please contact LAUDA Service, see  Chapter 1.7 "Contact LAUDA" on page 7.

Company and product names mentioned in the operating manual are usually registered trademarks of the respective companies and are therefore subject to brand and patent protection. Some of the images used may also show accessories that are not included in the delivery.

All rights reserved, including those relating to technical modifications and translations. This operating manual or parts thereof may not be modified, translated or used in any other capacity without the written consent of LAUDA. Violation of this may obligate the violator to the payment of damages. Other claims reserved.

## 1.6 License texts

You can retrieve the license texts for the software used in the constant temperature equipment from the integral server in the Comm. Module

1. Type *https://<ID address of the Modbus TCP/IP interface>* into your browser's address line and confirm your entry.
2. Navigate to the *Links* section on the website and click *Licenses*. This page contains information on all the software components used and the software license conditions. For information on the web server, see ↗ Chapter 7.4 "Web server" on page 38

## 1.7 Contact LAUDA

Contact the LAUDA Service department in the following cases:

- Troubleshooting
- Technical questions
- Ordering accessories and spare parts

Please contact our sales department for questions relating to your specific application.

### Contact information

LAUDA Service

Phone: +49 (0)9343 503-350

Email: [service@lauda.de](mailto:service@lauda.de)


## 2 Safety

### 2.1 General safety information and warnings



- Read this operating manual carefully before use.
- Keep the operating manual in a place within easy reach of the interface module.
- This operating manual is part of the interface module. If the interface module is passed on, the operating manual must be kept with it.
- This operating manual is applicable in combination with the operating manual of the constant temperature equipment in which the interface module is installed.
- Manuals for LAUDA products are available for download on the LAUDA website: <https://www.lauda.de>
- The warnings and safety instructions in this operating manual must be observed without fail.
- There are also certain requirements for personnel, see ↗ Chapter 2.3 “Personnel qualification” on page 9.

#### Structure of warnings

Warning signs	Type of danger
	Warning – danger zone.
Signal word	Meaning
WARNING!	This combination of symbol and signal word indicates a potentially dangerous situation that can result in death or serious injury if it is not avoided.
NOTICE!	This combination of symbol and signal word indicates a potentially dangerous situation that can result in material and environmental damage if it is not avoided.

## 2.2 Information about the interface module


- Always disconnect the constant temperature equipment from the power supply before installing the interface module or connecting interfaces.
- Always take the recommended safety measures against electrostatic discharge before handling interface modules.
- Avoid touching the circuit board with metallic tools.
- Do not start up the constant temperature equipment before installation of the interface module is complete.
- Store any unused interface modules in their packaging in accordance with the specified ambient conditions.
- Use only suitable cables of sufficient length for cable connections.
- Make sure that the protective screen on the cables and connectors complies with EMC regulations. LAUDA recommends using pre-assembled cables.
- Always lay cables correctly so that they do not pose a tripping hazard. Secure the laid cables and make sure that they cannot be damaged during operation.
- Check the condition of the cables and interfaces prior to each operation.
- Immediately clean any soiled parts, in particular unused interfaces.
- Make sure that the signals transmitted via the interface correspond to the permitted operating parameters of the interface module.


## 2.3 Personnel qualification

### Specialized personnel

Only specialized personnel are permitted to install interfaces modules. Specialized personnel are personnel whose education, knowledge, and experience qualify them to assess the function and risks associated with the device and its use.


### 3 Unpacking

 <b>NOTICE!</b> Transport damage	
	Device damage
	<ul style="list-style-type: none"><li>● Closely inspect the device for transport damage prior to starting up.</li><li>● Never operate a device that has sustained transport damage!</li></ul>

 <b>NOTICE!</b> Electrostatic discharge	
	Material damage
	<ul style="list-style-type: none"><li>● Always observe safety measures against electrostatic discharge.</li></ul>

Please observe the following installation sequence:

1. Remove the interface module from its packaging.
2. If you want to store the interface module at the installation location, use the outer packaging. This packaging is protected against static charging.
3. After installing the equipment, dispose of the packaging materials in line with environmental regulations, see ↗ “Packaging” on page 43.

	<i>If you discover any damage on the interface module, contact LAUDA Service immediately, see ↗ Chapter 1.7 “Contact LAUDA” on page 7.</i>
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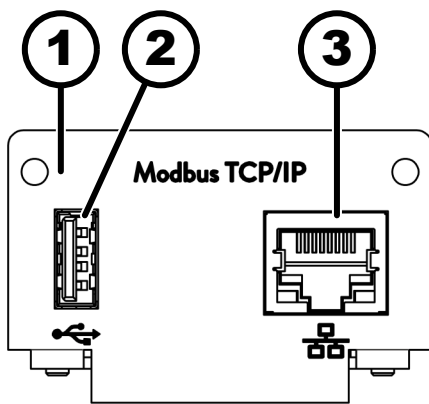
## 4 Device description

### 4.1 Intended purpose

The Modbus TCP/IP Module Advanced was developed for the following purposes:

- Integrating constant temperature equipment into an Modbus TCP/IP network.
- Controlling constant temperature equipment via the LAUDA modbus register.

### 4.2 Structure



- 1 Panel with holes for fixing screws M3 x 10
- 2 Host USB port, USB 2.0 type A
- 3 Ethernet interface (10/100 Mbit/s, RJ 45 with 2 LEDs\*)

\* The two LEDs indicate whether the interface is connected and whether data is being transmitted (link/activity).

Fig. 1: Modbus TCP/IP module

## 5 Before starting up

### 5.1 Installing the interface module

The interface module is connected to an internal LiBus ribbon cable and inserted into a vacant module slot. The number and arrangement of the module slots vary depending on the device. The module slots are protected by a cover that is screwed onto the casing or attached to the slot opening.



**WARNING!**  
Touching live parts

Electric shock

- Disconnect the device from the power supply before starting any installation work.
- Always observe safety measures against electrostatic discharge.



*The module installation description essentially applies to all LAUDA constant temperature equipment; the example diagrams here show the installation of an analog module in constant temperature equipment from the Variocool product line.*

*Please note that an interface module with a small cover can only be installed in a low module slot. The fitted cover must cover the opening on the module slot completely.*

*You will require two M3 x 10 screws and a suitable screwdriver to secure the interface module.*

Please observe the following installation sequence:

1. Turn off the constant temperature equipment and pull out the mains plug.
2. If necessary, remove the screws from the cover on the relevant module slot. If necessary, use a slotted screwdriver to prise off the cover.

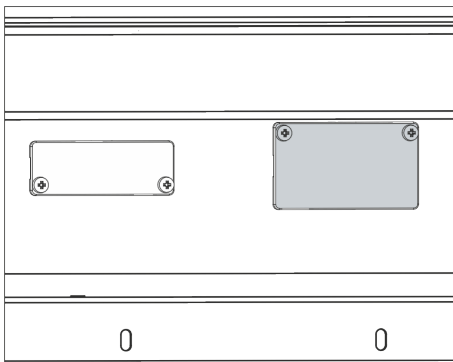


Fig. 2: Removing the cover (schematic diagram)

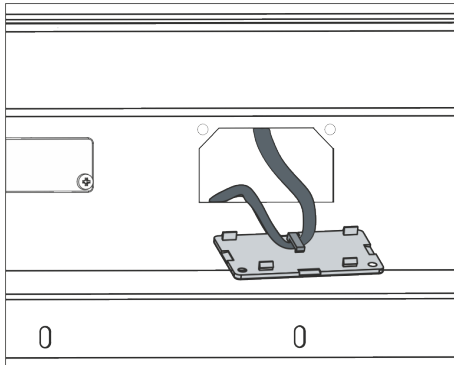


Fig. 3: Detaching the LiBus ribbon cable (schematic diagram)

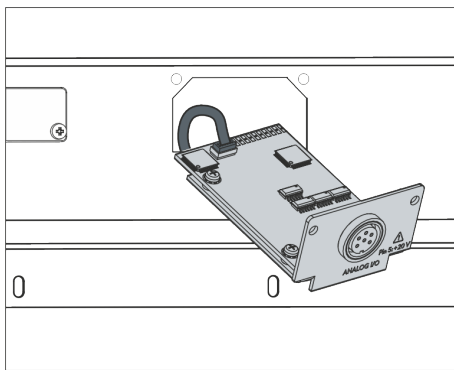


Fig. 4: Connecting the interface module (schematic diagram)

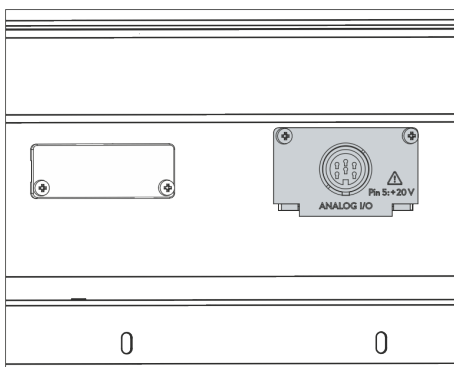


Fig. 5: Securing the cover (schematic diagram)

3. Remove the cover from the module slot.
  - ▶ The module slot is open. The LiBus ribbon cable is attached to the inside of the cover and is easily accessible.
4. Disconnect the LiBus ribbon cable from the cover.
5. Connect the red plug on the LiBus ribbon cable to the red socket on the circuit board of the interface module. Plug and socket are reverse polarity protected: Make sure that the lug on the plug is aligned with the recess in the socket.
  - ▶ The interface module is correctly connected to the constant temperature equipment.
6. Slide the LiBus ribbon cable and the interface module into the module slot.
7. Secure the cover to the casing using two M3 x 10 screws.
  - ▶ The new interface on the constant temperature equipment is ready for operation.

## 5.2 Using the module box

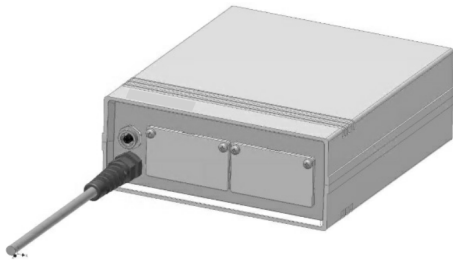


Fig. 6: LiBus module box, catalog no. LCZ 9727

You can extend LAUDA constant temperature equipment by two additional module slots using the LiBus module box. The module box is designed for interface modules with a large cover and is connected to constant temperature equipment via a vacant LiBus socket. The socket on the constant temperature equipment bears the label **LiBus**.

Please observe the following installation sequence:

1. Switch off the constant temperature equipment.
2. Disconnect the cable on the module box from the constant temperature equipment.
  - ▶ The module box is disconnected from the power supply.
3. Check which interfaces are already present on the constant temperature equipment and module box.



*Observe the information on interface module compatibility. Only install an interface module with the same type of interface if operation with several of these interfaces is permitted.*

4. Install the required interface module in the module box. Please read the information on installing the module box in the constant temperature equipment, see chapter "Installing the interface module".
5. Position the module box close to the constant temperature equipment.
6. Connect the cable on the module box to the LiBus socket on the constant temperature equipment.
  - ▶ The interfaces on the module box are ready for operation.

## 6 Commissioning

The integral Modbus TCP/IP interface starts automatically when the LAUDA constant temperature equipment is switched on.



*After starting up, the interface takes about 30 seconds to become operational. Please wait until this time has elapsed before activating the interface using the corresponding commands.*

*You can check the availability of the interface as follows:*

- *Send a test command*
- *Display in the device menu (Main menu → Module → Comm. Module)*

*Attention! If the main menu is open while the interface is starting, the display is not automatically updated.*

- *Accessibility of the interface's web server → Chapter 7.4 "Web server" on page 38*

### 6.1 Contact assignment Modbus TCP/IP interface

The Modbus TCP/IP interface is equipped with standard type RJ45 sockets (8P8C modular plugs according to CFR Part 68). Standard Ethernet cables that correspond to category CAT5e or higher (8P8C assignment with twisted pairs) must be used for the connection.

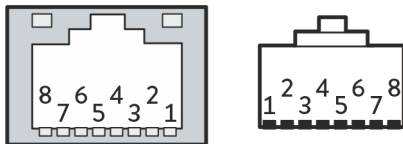


Fig. 7: RJ45 contacts on socket / plug

Table 1: RJ45 contact assignment

Contact	Signal 10Base-T / 100Base-TX
1	Tx+
2	Tx-
3	Rx+
4	-
5	-
6	Rx-
7	-
8	-

## 6.2 Software update

### 6.2.1 Software update on the constant temperature equipment

Older software installed on constant temperature equipment may have to be updated for the new interface to work.

1. Switch on the constant temperature equipment after installing the new interface.
2. Check whether a software warning appears on the display.
  - Warning 510 – 532 *SW update required* or *SW too old*: Please contact LAUDA Service, see [↗](#) Chapter 1.7 “Contact LAUDA” on page 7.
  - No software warning: Operate the constant temperature equipment as normal.

### 6.2.2 Software update on the Modbus TCP/IP Module Advanced

The software of the LRZ 935 interface module is updated independently of the device software. To do this, proceed as follows:

1. Copy the new software (.raucb file) provided by LAUDA to a USB stick. If necessary, format the USB stick before copying over the .raucb file.



*Only the latest .raucb file may be stored on the stick.*

2. Switch on the constant temperature equipment after installing the new interface.
3. Make sure that the date and time on the constant temperature equipment are set correctly. This is important for verifying the digital signature of the raucb file.
4. Insert the prepared USB stick into the USB port on the interface module.



*Do not use the USB port on the constant temperature equipment.*

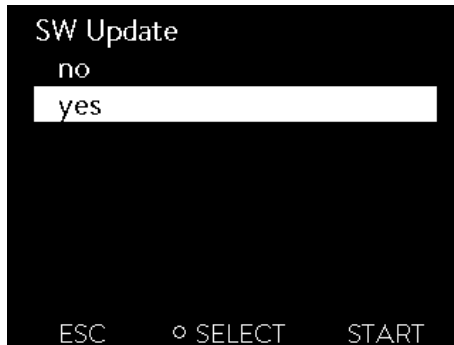


Fig. 8: Starting the software update

5. In the main menu of the constant temperature equipment, select *Module* → *Comm. Module* → *Module SW Update* → *SW Update* → *Yes* to start the update.

**!** NOTICE!  
Fault resulting from an interruption in the update process

Attention! Once started, the update process cannot be stopped and must not be interrupted by external interventions.

- Do not switch off the device during the update process.
- Do not remove the USB stick during the update process.

- ▶ The status changes to [Flashing] and the progress is displayed in %.
6. The interface module will restart at the end of the update process which may result in warning messages or error messages being displayed. If so, perform a restart as described in the next point.
  7. Restart the thermostat. To do this, turn off the thermostat at the main switch and then turn it back on after 60 seconds. After switching on again, wait another 30 seconds for the interface module to complete the booting procedure.
    - ▶ The software update for the Modbus TCP/IP module is complete. After the update, the software version can be viewed in the main menu under *Device Status* → *Software Versions* → *Comm. Module*.

## 7 Operation

You can connect your constant temperature equipment directly to a PC via the Modbus TCP/IP interface or integrate it into a local network so that the equipment can be controlled using a LAUDA command set/register.

### Supported network protocols and standards

DHCP client	- RFC2132, 3046, 2563
HTTP	- RFC 1945, 2616, 2617, 2388 822 (TXT, CSS, RAW, JPEG, GIF, PNG, ICO, XML, TIFF, MPEG, MP3, etc.)
TCP	- RFC792, 793, 1122, 6298
UDP	- RFC1035
IGMP	- RFC1112, 2236 (V1, 2, 3)
TLS	- RFC2246 (TLS 1.0), RFC4346 (TLS 1.1) and RFC5246 (TLS 1.2)
X.509	- RFC5280
WebSocket	- RFC6455
Auto IP	- RFC3927
mDNS	- RFC6762
Modbus TCP	- <a href="https://modbus.org/specs.php">https://modbus.org/specs.php</a>

### Command performance

The command performance achieved via the Ethernet depends on multiple factors, including the following criteria:

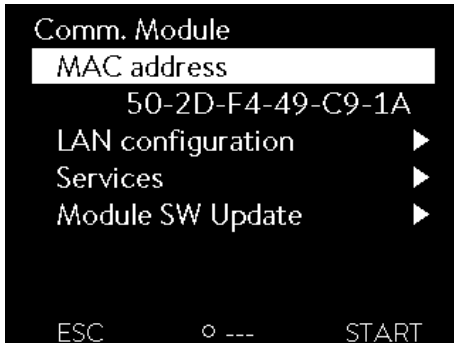
- Ideally, the constant temperature equipment and control station/PC should be located in the same (sub)network, otherwise the number of interconnected routers or switches should be kept to a minimum.
- A cable connection (LAN) to the control station/PC is usually more reliable for data transmission than a wireless connection (WLAN).
- Excessive network utilization can slow down the exchange of commands considerably.

Data is exchanged between the Comm. Module of the constant temperature equipment and an external application via the Ethernet interface on the Comm. Module in line with the command/response principle. In other words, a new command is usually only issued once the constant temperature equipment has responded to the previous command.

Under ideal conditions, commands can be sent to the constant temperature equipment every 100 ms. If there are multiple active Modbus TCP/IP connections, the network load is high or a WiFi connection is being used, commands may have to be issued at intervals of more than 1 s.

A transmission rate of 500 ms is appropriate for many periodic commands (such as *Actual value of external temperature*). If this value is used as a control variable in the constant temperature equipment, a slower transmission rate will impair the control action.

## 7.1 Menu structure



**i** The menu only ever shows functions that are available for the current constant temperature equipment.

The menu for configuring the interface is integrated in the main menu of the relevant constant temperature equipment:

*Main menu → Modules → Comm. Module*

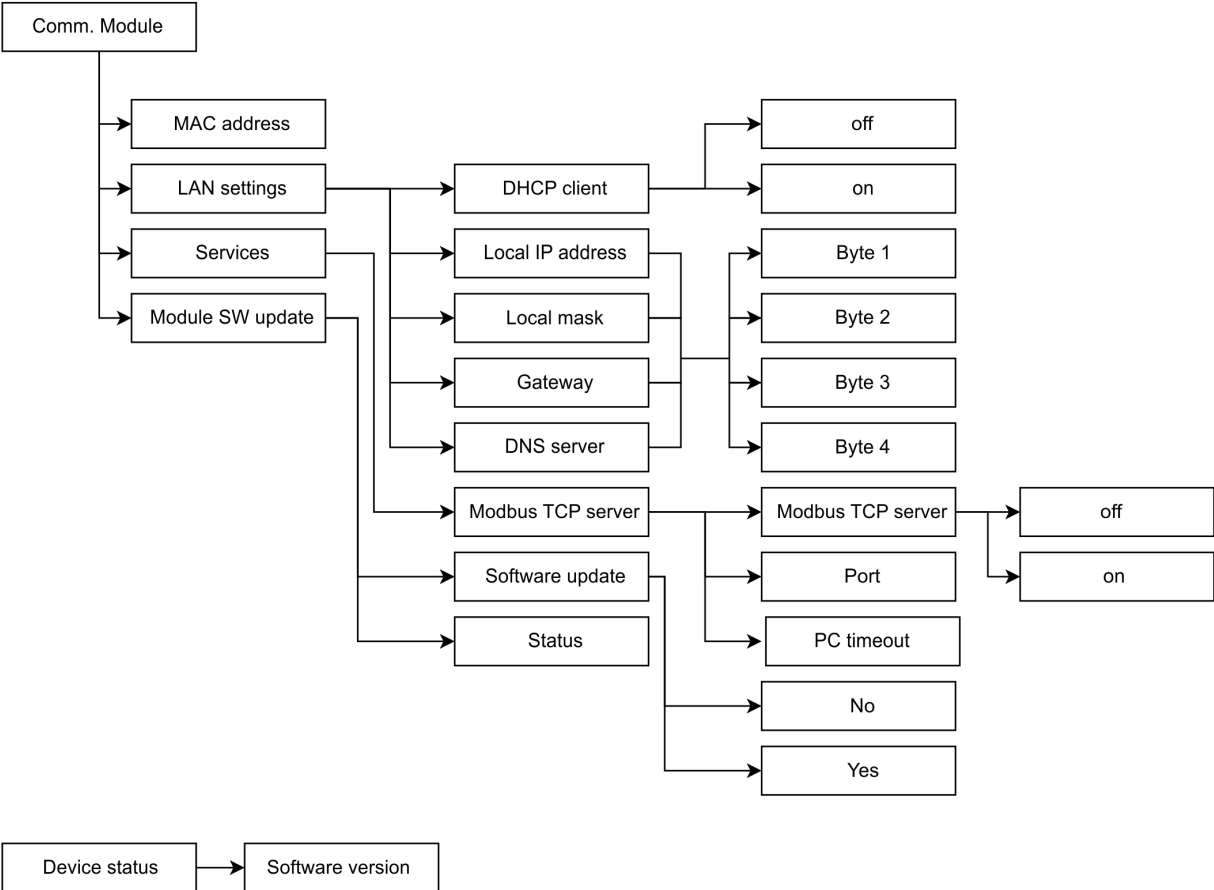


Fig. 9: Modbus interface menu

## 7.2 Establishing a network connection

The Comm. Module has its own Ethernet interface, which is connected to the module as an RJ45. The settings described here refer to the Ethernet interface of the Comm. Module under the menu items *Modules → Comm. Module → LAN settings*.

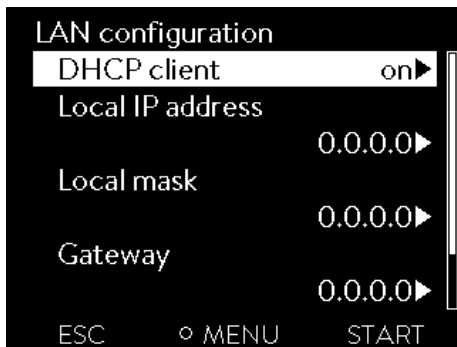


Fig. 10: LAN settings

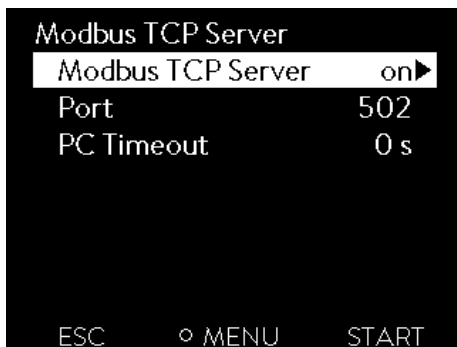


Fig. 11: Modbus TCP Server

Before you can address the constant temperature equipment from a PC or in the local network via the Modbus interface, the following preparations are required:

1. Use an Ethernet cable (Cat. 5e or higher) to connect the Modbus interface of the constant temperature equipment to the remote station. The following systems can be used as remote stations, for example: PC, switch, router or WLAN access point.
2. Use the constant temperature equipment menu *Modules* → *Comm. Module* → *LAN settings* to configure all the settings that the connected system requires for communication. By default, the DHCP service is switched on and the necessary settings should be obtained automatically. Check these settings.
3. The Modbus TCP server is deactivated by default. Select menu *Modules* → *Comm. Module* → *Services* → *Modbus TCP Server* → *on* to activate the Modbus TCP server.
4. By default, port 502 is used for Modbus TCP; the port can be changed if required. Select *Modules* → *Comm. Module* → *Services* → *Modbus TCP Server* → *Port* to change the port.



Contact your system administrator to obtain the required information and observe the following notes:

- The Modbus TCP/IP interface of the temperature control unit is prepared in the factory for operation on a DHCP server: When the setting *DHCP-Client* = *on* the required configuration is adopted automatically from the network as soon as the cable connection is established.
- If automatic configuration is not required because the equipment is operating on a single system or as a process interface, you must deselect the option *DHCP-Client*. Then enter the network settings manually, see Chapter 7.2.1 “Network settings with static IP address” on page 21.
- The Modbus TCP port is “502” by default and can be changed if required.

## 7.2.1 Network settings with static IP address

The following requirements must be met before the constant temperature equipment can be connected manually to a system or network:

- The Modbus TCP/IP interface is connected to a single system (PC) or a network component (hub, switch, router, WLAN access point) via an Ethernet cable.
  - The local IP address assigned to the constant temperature equipment falls within the same address range as the connected system and is not used by any other system on the network.
1. Select the menu items *Module* → *Comm. Module* → *LAN Settings*.
  2. Set the *DHCP Client* entry to *off*.
    - ▶ The entries for inputting IP addresses are enabled.
  3. Enter the IP addresses for the following entries in succession.



### Entering IP addresses

IP addresses are entered byte by byte:

- Select the *Byte 1* field.
- Enter the first numerical value of the 4-digit IP address and confirm your entry.
- Repeat the process for the *Byte 2*, *Byte 3* and *Byte 4* fields.

- Local IP address* - Enter in the desired IP address, for example 120.0.1.12. Connected systems can access the constant temperature equipment using this IP address, see ↗ Chapter 7.2.2 “Checking the network connection” on page 21.
- Local mask* - Enter the associated local mask address, for example 255.255.192.0.
- Gateway* - Enter the IP address of the gateway (for example 120.0.0.13) that is used for communicating with neighboring networks.
- Note: The gateway address must be configured if the constant temperature equipment and control station (e.g. PC) are in different subnetworks (VLANs/LANs).
- DNS server* - Enter the IP address of the DNS server (for example 120.0.1.40) that is used for the name resolution of connected systems.
- Note: Entering the address of the DNS server is not required.

## 7.2.2 Checking the network connection

### Ping request

You can use the `ping` console command from a connected system to easily check whether the interface is available. Here, a single request (echo request) is sent to the configured local IP address. If the equipment is available, it usually returns four responses together with the respective transmission time.

Requirement: The constant temperature equipment is switched on and connected to a single system or the network.

1. Open the command line interpreter (console) on a connected system.



#### **Starting the console**

*A command line interpreter can be used on every operating system. On a Windows 10 or Windows 11 operating system, for example, it can be accessed as follows:*

*Start (right-click) → Run → cmd.exe*

2. Enter the command "ping" and the IP address of the interface:

Syntax: "ping XXX.XXX.XXX.XXX"

Example: ping 172.18.54.2.



#### **IP address of comm. module**

*The configured or obtained IP address can be viewed in the Module → Comm. Module → LAN settings menu.*

3. Press [Enter] to confirm the entry

- ▶ If available, the interface responds to the request immediately.

If the remote station is unavailable, check whether the following criteria have been met:

- The interface is connected to the same network as the test system.
- The test address corresponds to the address displayed in the menu of the interface.
- The configured network settings are correct.

If necessary, contact your system administrator.

```
Administrator: C:\Windows\system32\cmd.exe
C:\Users\username>ping 120.0.1.12

Pinging 120.0.1.12 with 32 bytes of data:
Reply from 120.0.1.12: bytes=32 time<1ms TTL=128
Reply from 120.0.1.12: bytes=32 time<1ms TTL=128
Reply from 120.0.1.12: bytes=32 time<1ms TTL=128
Reply from 120.0.1.12: bytes=32 time<1ms TTL=128

Ping statistics for 120.0.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\username>
```

Fig. 12: Example of a ping request

## 7.2.3 Time synchronization and NTP server

### System time and synchronization

The LAUDA Modbus TCP/IP interface module of your constant temperature equipment has an integrated system time. To ensure maximum accuracy, the system regularly compares this time with a preset external NTP (Network Time Protocol) server.

The preset NTP servers are:

- 0.1lauda.pool.ntp.org
- 1.1lauda.pool.ntp.org
- 2.1lauda.pool.ntp.org
- 3.1lauda.pool.ntp.org



*These NTP servers are permanently configured in the LAUDA Modbus TCP/IP interface module and cannot be changed by the customer. The standard NTP port is 123. Make sure that this port is available for outgoing connections on your network.*

## Fallback mechanism

If a connection to one of the preset NTP servers cannot be established and the last successful synchronization was more than one hour ago, an internal security mechanism is activated:

- The system compares the interface time with the internal time of the constant temperature equipment.
- If there is a discrepancy, the interface time is adjusted to the time of the constant temperature equipment.

This mechanism ensures that your LAUDA interface module operates with the most accurate time possible, even without a connection to the external NTP server. For further details on the time of the LAUDA constant temperature equipment, please refer to the operating instructions of the corresponding device.

## 7.3 Interface functions

Interface functions such as read and write commands make it possible to read out the current operating parameters of constant temperature equipment and predefine specific settings and process values.

The interface functions supported by this interface are presented briefly below. They are sorted by topic according to the component affected and assigned a unique ID. Depending on the technical configuration of your constant temperature equipment, the number and scope of the interface functions actually available may vary from the list shown here, see chapter "Availability of the interface functions".

### 7.3.1 General information about Modbus TCP

Modbus TCP/IP is a communication protocol commonly used in industrial applications to exchange control information and data between devices such as sensors, actuators and control systems. Modbus TCP/IP is an adaptation of the Modbus RTU/ASCII protocol to the TCP/IP protocol, which enables the Modbus protocol to be used on Ethernet-based networks. This offers the advantage of ensuring easier integration into existing network structures and using standard TCP/IP devices and infrastructures. For more detailed information about Modbus, download a copy of the specification at [www.modbus.org](http://www.modbus.org).

## Network settings

Certain network settings must be configured in order to use Modbus TCP/IP:

- IP address: Each device in the network requires a unique IP address.
- Local mask: The local mask defines which IP addresses are available in the local network.
- Gateway: Optional for communication across different networks.
- Port: Port 502 is used for Modbus TCP/IP by default, but this can be changed, if required

The required settings can be configured in the Module menu, see ↗ Chapter 7.1 "Menu structure" on page 19.

It is important to ensure that the IP addresses do not conflict with one another, and that firewalls and routers are correctly configured to allow traffic to flow through the relevant port.

The Modbus TCP/UP module allows writing and reading of device data. This occurs via the addresses of defined registers. The actual function to be executed is indicated by the function code assigned in the standard. LAUDA constant temperature equipment essentially supports two types of register:

- Holding registers: These are read-write registers that are typically used for configuration settings or control commands.
- Input registers: These are read-only registers that usually contain measured values or status information.

The holding or input registers are read or written via function codes. The LAUDA interface module supports the following public function codes:

- 0x03 Read Holding Registers (address range: 40001 – 49999)
- 0x04 Read Input Registers (address range: 30001 – 39999)
- 0x06 Write Single Register (address range: 40001 – 49999)
- 0x10 Write Multiple Registers

The following registers and data formats are used for communication:

- 16- and 32-bit data registers. For 32-bit variables/parameters, two registers must be read or written.
- Big-endian order: The higher-value bytes are transmitted first by definition.
- Numerical values: The data format (signed, decimal places, etc.) can be found at .
- Enum: The decoding can be found at .

A Modbus TCP message has the following structure (as defined in the Modbus specification):



Modbus protocol	Description
Transaction ID	Any number set by the client to uniquely assign the response to the request.
Protocol ID	Defined in the Modbus specification as 0
Length	Number of following bytes
Unit ID	Used for network routing and set by the client. Irrelevant for Modbus TCP because IP addresses are used for addressing. In this case, the value 0xFF should be sent according to standards.

Modbus protocol	Description
Function code	Supported by LAUDA: <ul style="list-style-type: none"> <li>• 0x03 Read Holding Registers</li> <li>• 0x04 Read Input Registers</li> <li>• 0x06 Write Single Register</li> <li>• 0x10 Write Multiple Registers</li> </ul>
Data	Depending on the function code, the starting address, number of registers, user data, register values, etc. are transferred here. Refer to the Modbus specification for further details.



*The value range for the individual registers/parameters depends on the specific configuration of the constant temperature equipment. Example: The heat transfer medium used determines the maximum temperature, and the maximum temperature defines the value range for  $T_{ih}$ , which defines the valid value range for  $T_{set}$ . The thermostat internally checks the permitted value range for write commands and rejects invalid entries via the Modbus interface.*

*For this reason, after each write operation via*

- *0x06 Write Single Register*
- *0x10 Write Multiple Registers*

*the register should be read again using the corresponding function code and checked to determine whether the write command was executed correctly.*

### 7.3.2 Register table

Below is the register table that describes all supported Modbus registers. The table columns are interpreted as follows:

- **ID:** LAUDA unique function ID
- **Function:** Description of the register/function.
- **Unit:** The unit of measurement used for interpreting the register data, e.g. °C, RPM, %, etc.
- **Access:** r = read access; w = write access. Please note that this information is only intended for the user. The access type is implemented via the protocol using the function codes.
- **Function code:** Supported function code for the register.
- **Register address:** The specific address for the register.
- **Index:** Depending on the software implementation, an offset is used for addressing. The following context applies:
  - Holding Registers (40001 – 49999)
    - Index = Register address – 40001
    - Function codes: 03 (Read), 06 (Write Single)
  - Input Registers (30001 – 39999)
    - Index = Register address – 30001
    - Function code: 04 (Read Input Registers)

- **Number of registers:** Specifies the number of registers required. Modbus registers are 16-bit registers by default (2 bytes). However, 16 bits are insufficient for certain device data, which is why this data is mapped to a 32-bit value (4 bytes) via 2 registers.
- **Resolution:** Specifies how many decimal places must be used to interpret the raw value.
- **Type:** Shows the data type of a register:
  - Signed: The value is signed.
  - Unsigned: The value has no sign
  - Enum: The value is decoded according to the coding from the function description.
  - Bit mask: The value is encoded bit by bit. Refer to the functional description for the coding.



#### **Modbus addressing – start index 0**

Depending on the Modbus client software used, entry of the full register address (e.g. 40001) may be permitted and internally calculated to the correct index, or the following index may be used. Refer to the documentation supplied with your client software/process control software for further details.

Check the start index used in your control system and ensure that the correct offset calculation is used. Please note that our system starts with index 0.

The table contains an overview of all defined registers, however, it should be noted that some registers are only supported with certain thermostat types or accessories installed. The supported registers can be viewed using the ID in the first column in the respective operating manual of the constant temperature equipment.

Table 2: Register table

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
1	Temperature set point	°C	w	0x06	40001	0	1	0.01	Signed
2	Temperature set point	°C	r	0x03	40001	0	1	0.01	Signed
3	Bath temperature (outflow temperature) with resolution 0.01 °C	°C	r	0x04	30001	0	1	0.01	Signed
5	Query of the controlled temperature (internal/external Pt/external analog/external serial)	°C	r	0x04	30002	1	1	0.01	Signed
6	Outflow pressure / pump pressure, relative to the atmosphere	bar	r	0x04	30014	13	1	0.01	Unsigned
7	External temperature TE(Pt)	°C	r	0x04	30015	14	1	0.01	Signed
8	External temperature TE (analog input)	°C	r	0x04	30016	15	1	0.01	Signed

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
9	Bath level (fill level)	-	r	0x04	30017	16	1	1	Unsigned
11	Controller actuating signal with resolution per mill [0.1%]	%	r	0x04	30018	17	1	0.1	Signed
12	Flow rate	l/min	r	0x04	30023	22	1	0.01	Unsigned
15	Actual value of external temperature (via interface). <b>Note:</b> Requires the external control to be activated (ID 66, 67). The value of ID15 can be read back via ID5.	°C	w	0x06	40027	26	1	0.01	Signed
17	Pump power stage (1 - 6 or 1 - 8)	-	w	0x06	40019	18	1	1	Unsigned
18	Pump power stage	-	r	0x03	40019	18	1	1	Unsigned
23	Cooling mode (0 = off / 1 = on / 2 = automatic)	-	w	0x06	40021	20	1	1	enum
24	Cooling mode (0 = off / 1 = on / 2 = automatic)	-	r	0x03	40021	20	1	1	enum
25	Overtemperature turn off point T_Max	°C	r	0x04	30019	18	1	1	Unsigned
26	Limitation of outflow temperature TiH (upper limit)	°C	w	0x06	40002	1	1	0.1	Signed
27	Limitation of outflow temperature TiH (upper limit)	°C	r	0x03	40002	1	1	0.1	Signed
28	Limitation of outflow temperature TiL (lower limit)	°C	w	0x06	40003	2	1	0.1	Signed
29	Limitation of outflow temperature TiL (lower limit)	°C	r	0x03	40003	2	1	0.1	Signed
30	Outflow pressure / pump pressure set point (for pressure control settings)	bar	w	0x06	40020	19	1	0.01	Unsigned
31	Outflow pressure / pump pressure set point (for pressure control settings)	bar	r	0x03	40020	19	1	0.01	Unsigned
32	Temperature set point Tset in safe mode	°C	w	0x06	40022	21	1	0.01	Signed
33	Temperature set point Tset in safe mode	°C	r	0x03	40022	21	1	0.01	Signed
34	Timeout communication via interface (1 - 99 [s]; 0 = off)	s	w	0x06	40023	22	1	1	Unsigned
35	Timeout communication via interface (1 - 99 [s]; 0 = off)	s	r	0x03	40023	22	1	1	Unsigned
36	Through-flow control set point	l/min	w	0x06	40028	27	1	0.1	Unsigned
37	Through-flow control set point	l/min	r	0x03	40028	27	1	0.1	Unsigned
38	Control parameter Xp	-	w	0x06	40008	7	1	0.1	Unsigned

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
39	Control parameter Xp	-	r	0x03	40008	7	1	0.1	Unsigned
40	Control parameter Tn	s	w	0x06	40009	8	1	1	Unsigned
41	Control parameter Tn	s	r	0x03	40009	8	1	1	Unsigned
42	Control parameter Tv	s	w	0x06	40010	9	1	1	Unsigned
43	Control parameter Tv	s	r	0x03	40010	9	1	1	Unsigned
44	Control parameter Td	s	w	0x06	40011	10	1	0.1	Unsigned
45	Control parameter Td	s	r	0x03	40011	10	1	0.1	Unsigned
46	Control parameter KpE	-	w	0x06	40012	11	1	0.01	Unsigned
47	Control parameter KpE	-	r	0x03	40012	11	1	0.01	Unsigned
48	Control parameter TnE	s	w	0x06	40013	12	1	1	Unsigned
49	Control parameter TnE	s	r	0x03	40013	12	1	1	Unsigned
50	Control parameter TvE	s	w	0x06	40014	13	1	1	Unsigned
51	Control parameter TvE	s	r	0x03	40014	13	1	1	Unsigned
52	Control parameter TdE	s	w	0x06	40015	14	1	0.1	Unsigned
53	Control parameter TdE	s	r	0x03	40015	14	1	0.1	Unsigned
54	Correction limitation	K	w	0x06	40016	15	1	0.1	Unsigned
55	Correction limitation	K	r	0x03	40016	15	1	0.1	Unsigned
56	Control parameter XpF	-	w	0x06	40017	16	1	0.1	Unsigned
57	Control parameter XpF	-	r	0x03	40017	16	1	0.1	Unsigned
58	Setpoint offset	K	w	0x06	40004	3	1	0.1	Signed
59	Setpoint offset	K	r	0x03	40004	3	1	0.1	Signed
60	Control parameter Prop_E	K	w	0x06	40018	17	1	1	Unsigned
61	Control parameter Prop_E	K	r	0x03	40018	17	1	1	Unsigned
62	Keyboard master (equivalent to "KEY"): 0 = unlock / 1 = lock	-	w	0x06	40024	23	1	1	enum
63	Status of keyboard master: 0 = free / 1 = blocked	-	r	0x03	40024	23	1	1	enum
64	Keyboard remote control unit command: 0 = unlock / 1 = lock	-	w	0x06	40025	24	1	1	enum
65	Status of keyboard (remote control): 0 = free / 1 = blocked	-	r	0x03	40025	24	1	1	enum

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
66	Control in control variable X: 0 = internal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt 2 / 8 = ext. Comm. Mod.	-	w	0x06	40005	4	1	1	enum
67	Control in control variable X: 0 = internal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt 2 / 8 = ext. Comm. Mod.	-	r	0x03	40005	4	1	1	enum
68	Offset source X for set point: 0 = off / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt 2 / 8 = ext. Comm. Mod.	-	w	0x06	40006	5	1	1	enum
69	Offset source X for set point: 0 = off / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt 2 / 8 = ext. Comm. Mod.	-	r	0x03	40006	5	1	1	enum
70	Activate through-flow control: 0 = switch off / 1 = switch on	-	w	0x06	40029	28	1	1	enum
71	Status of through-flow control: 0 = off / 1 = on	-	r	0x03	40029	28	1	1	enum
72	Activation of Safe Mode: 0 = off / 1 = on	-	w	0x06	40026	25	1	1	enum
73	Status of Safe Mode: 0 = off / 1 = on	-	r	0x03	40026	25	1	1	enum
74	Switch equipment on/off (standby): 0 = switch on / 1 = switch off	-	w	0x06	40007	6	1	1	enum
75	Status of standby: 0 = Device is switched on / 1 = Device is switched off	-	r	0x03	40007	6	1	1	enum
107	Product line / equipment series (0 = Proline, 1 = XT, 2 = Kryomat, 3 = ECO, 5 = VC, 6 = PRO, 7 = INT, 8 = UNI)	-	r	0x04	30005	4	1	1	enum
108	Control system software version	-	r	0x04	30079	78	1	1	Unsigned
109	Protection system software version	-	r	0x04	30055	54	1	1	Unsigned
110	Remote control unit SW version (command)	-	r	0x04	30056	55	1	1	Unsigned
111	Cooling system software version	-	r	0x04	30057	56	1	1	Unsigned
112	Analog interface module software version	-	r	0x04	30058	57	1	1	Unsigned
113	Through-flow control software version (MIDxx)	-	r	0x04	30075	74	1	1	Unsigned

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
114	Interface module software version RS232/485 or Profibus/Profinet/CAN	-	r	0x04	30078	77	1	1	Unsigned
115	Ethernet interface module software version	-	r	0x04	30071	70	1	1	Unsigned
116	EtherCAT interface module software version	-	r	0x04	30072	71	1	1	Unsigned
117	Contact interface module software version	-	r	0x04	30059	58	1	1	Unsigned
118	Cooling water solenoid valve software version	-	r	0x04	30060	59	1	1	Unsigned
119	Automatic filling device solenoid valve software version	-	r	0x04	30061	60	1	1	Unsigned
120	Constant level device solenoid valve software version	-	r	0x04	30062	61	1	1	Unsigned
121	Solenoid valve software version, shut off valve 1	-	r	0x04	30063	62	1	1	Unsigned
122	Solenoid valve software version, shut off valve 2	-	r	0x04	30064	63	1	1	Unsigned
123	High-temperature cooler software version	-	r	0x04	30069	68	1	1	Unsigned
124	Pump 0 software version	-	r	0x04	30065	64	1	1	Unsigned
125	Pump 1 software version	-	r	0x04	30066	65	1	1	Unsigned
126	Heating system 0 software version	-	r	0x04	30067	66	1	1	Unsigned
127	Heating system 1 software version	-	r	0x04	30068	67	1	1	Unsigned
128	External Pt interface 0 software version	-	r	0x04	30070	69	1	1	Unsigned
129	External Pt interface 1 software version	-	r	0x04	30073	72	1	1	Unsigned
130	Device status (-1 = fault, 0 = OK)	-	r	0x04	30003	2	1	1	enum
131	Fault diagnosis bits (0 = inactive, 1 = active) Bit 0 = collective error, Bit 1 = collective alarm, Bit 2 = collective warning, Bit 3 = overtemperature, Bit 4 = low level, Bit 5 = high level)	-	r	0x04	30004	3	1	1	Bit mask
137	Error status (0 = inactive, 1 = active)	-	r	0x04	30009	8	1	1	enum
138	Alarm status (0 = inactive, 1 = active)	-	r	0x04	30010	9	1	1	enum
139	Warning status (0 = inactive, 1 = active)	-	r	0x04	30011	10	1	1	enum
140	Low-level alarm (0 = inactive, 1 = active)	-	r	0x04	30012	11	1	1	enum
141	Overtemperature alarm (0 = inactive, 1 = active)	-	r	0x04	30013	12	1	1	enum
142	Base software version	-	r	0x04	30074	73	1	1	Unsigned

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
154	Through-flow control unit outflow pressure, relative to the atmosphere	bar	r	0x04	30024	23	1	0.01	Unsigned
155	Pressure limitation set point with active through-flow control	bar	w	0x06	40030	29	1	0.1	Unsigned
156	Pressure limitation set point with active through-flow control	bar	r	0x03	40030	29	1	0.1	Unsigned
157	Overpressure turn off point with active through-flow control	bar	r	0x04	30025	24	1	0.1	Unsigned
158	Actuating signal of master controller in case of external control	°C	r	0x04	30020	19	1	0.01	Unsigned
160	Valve position of the flow controller	%	r	0x04	30026	25	1	1	Unsigned
161	Alphanumerical serial number (10 characters)	-	r	0x04	30006	5	2	1	Unsigned
162	Overtemperature turn off point, tank	°C	r	0x04	30021	20	1	1	Unsigned
163	Overtemperature turn off point, outlet	°C	r	0x04	30022	21	1	1	Unsigned
164	Set pressure for pressure overlay	bar	w	0x06	40041	40	1	0.1	Unsigned
165	Set pressure for pressure overlay	bar	r	0x03	40041	40	1	0.1	Unsigned
166	Tank pressure of pressure overlay	bar	r	0x04	30030	29	1	0.1	Unsigned
167	Pressure overlay hysteresis	bar	w	0x06	40042	41	1	0.1	Unsigned
168	Pressure overlay hysteresis	bar	r	0x03	40042	41	1	0.1	Unsigned
169	Status of the filling/draining unit: (0 = initialization, 1 = standby, 2 = pre-temperature control, 3 = draining, 4 = application change, 5 = leak test, 6 = filling, 7 = pause, 8 = refilling, 9 = decommissioning)	-	r	0x04	30029	28	1	1	enum
170	Action at the filling/draining unit: (0 = no action, 1 = start draining, 2 = start filling)	-	w	0x06	40031	30	1	1	enum
171	Draining temperature	°C	w	0x06	40032	31	1	0.1	Unsigned
172	Draining temperature	°C	r	0x03	40032	31	1	0.1	Unsigned
173	Pressure specification for leak test	bar	w	0x06	40033	32	1	0.1	Unsigned
174	Pressure specification for leak test	bar	r	0x03	40033	32	1	0.1	Unsigned
175	Leak test duration	s	w	0x06	40034	33	1	1	Unsigned
176	Leak test duration	s	r	0x03	40034	33	1	1	Unsigned
177	Max. permissible pressure difference during leak test	bar	w	0x06	40035	34	1	0.01	Unsigned

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
178	Max. permissible pressure difference during leak test	bar	r	0x03	40035	34	1	0.01	Unsigned
179	Venting time at the end of the filling process	s	w	0x06	40036	35	1	1	Unsigned
180	Venting time at the end of the filling process	s	r	0x03	40036	35	1	1	Unsigned
181	Target filling level of the expansion tank of the constant temperature equipment during the filling process	-	w	0x06	40037	36	1	1	Unsigned
182	Target filling level of the expansion tank of the constant temperature equipment during the filling process	-	r	0x03	40037	36	1	1	Unsigned
183	Status of automatic filling device for the filling/draining unit tank (0 = off, 1 = on)	-	w	0x06	40038	37	1	1	enum
184	Status of automatic filling device for the filling/draining unit tank (0 = off, 1 = on)	-	r	0x03	40038	37	1	1	enum
185	Start of automatic filling device (lower fill limit -> refilling on)	%	w	0x06	40039	38	1	1	Unsigned
186	Start of automatic filling device (lower fill limit -> refilling on)	%	r	0x03	40039	38	1	1	Unsigned
187	Stop of automatic filling device (upper fill limit -> refilling off)	%	w	0x06	40040	39	1	1	Unsigned
188	Stop of automatic filling device (upper fill limit -> refilling off)	%	r	0x03	40040	39	1	1	Unsigned
189	Filling/draining system outflow pressure	bar	r	0x04	30027	26	1	0.01	Unsigned
190	Filling/draining system tank level	%	r	0x04	30028	27	1	1	Unsigned
191	Linux communication module software version (OPC UA, Modbus TCP)	-	r	0x04	30076	75	1	1	Unsigned
192	Filling/draining system software version (FD 50)	-	r	0x04	30077	76	1	1	Unsigned
193	Stop (0) / start (1) / pause (2) ramp	-	w	0x06	40043	42	1	1	enum
194	Ramp status: off = 0, on = 1, pause = 2	-	r	0x03	40043	42	1	1	enum
195	Ramp temperature gradient	K/h	w	0x06	40044	43	1	0.01	Signed
196	Ramp temperature gradient	K/h	r	0x03	40044	43	1	0.01	Signed
197	Ramp duration	min	w	0x10	40045	44	2	1	Unsigned
198	Ramp duration	min	r	0x03	40045	44	2	1	Unsigned
199	Ramp target temperature	°C	w	0x06	40047	46	1	0.01	Signed
200	Ramp target temperature	°C	r	0x03	40047	46	1	0.01	Signed

ID	Function	Unit	Access	Function code	Register address	Index	Number of registers	Resolution	Type
203	Fluid running hour counter	h	r	0x04	30031	30	2	1	Unsigned
204	Running hour counter for complete device	h	r	0x04	30033	32	2	1	Unsigned
205	Reserved	-	r	0x04	30035	34	2	-	-
206	Heater 1 running hour counter	h	r	0x04	30037	36	2	1	Unsigned
207	Heater 2 running hour counter	h	r	0x04	30039	38	2	1	Unsigned
208	Pump 1 running hour counter	h	r	0x04	30041	40	2	1	Unsigned
209	Pump 2 running hour counter	h	r	0x04	30043	42	2	1	Unsigned
210	Pump 1 running hour counter above 200 °C	h	r	0x04	30045	44	2	1	Unsigned
211	Pump 2 running hour counter above 200 °C	h	r	0x04	30047	46	2	1	Unsigned
212	Cooling system running hour counter (no standby)	h	r	0x04	30049	48	2	1	Unsigned
213	Compressor 1 running hour counter	h	r	0x04	30051	50	2	1	Unsigned
214	Compressor 2 running hour counter	h	r	0x04	30053	52	2	1	Unsigned
215	Heat transfer liquid type: 0: FLUID undefined, 1: n/a, 2: KRYO 95, 3: KRYO 70A, 4: n/a, 5: KRYO 65, 6: KRYO 51, 7: KRYO 30, 8: KRYO 20, 9: AQUA 90, 10: ULTRA 350, 11: ULTRA 301, 12: USER defined 1, 13: USER defined 2, 14: USER defined 3	-	r	0x04	30008	7	1	1	enum

### 7.3.3 Example: 0x03 Read Holding Registers

The Read Holding Register function code is used to read one or more holding registers. Here, the number of registers to be read is included in the request by the client.

#### Example of reading set point temperature *Tset*

1. The client sends a request to read the "Read Holding Register" with the address 40001 (index: 0), which according to table *Tset* corresponds to: 00 00 00 00 00 06 FF 03 00 00 00 01

Table 3: *Tset*

Bytes (hex)	Client / control station
00 00	Transaction ID (any number for uniquely assigning the response to the request.)
00 00	Protocol identifier is always 0 according to the Modbus specification
00 06	Number of following bytes is 6 bytes (1 byte for unit identifier, 1 byte for function code, 2 bytes for starting address, 2 bytes for number of registers to be read)
FF	Unit identifier: Used for network routing and set by the client. Irrelevant for Modbus TCP because IP addresses are used for addressing. In this case, the value 0xFF should be sent according to standards.
03	"Read Holding Register" function code
00 00	Starting address 0 should be read
00 01	Number of registers to be read, here 1 register

2. The server responds with the current register value: 00 00 00 00 00 05 FF 03 02 06 A4

Table 4: Register value

Bytes (hex)	Server / LAUDA Thermostat
00 00	Transaction ID as in the client request
00 00	Protocol identifier is always 0 according to the Modbus specification
00 05	Number of following bytes is 5 bytes (1 byte for unit identifier, 1 byte for function code, 1 byte for number of following bytes, 2 bytes for value of register/variable)
FF	Unit identifier: Value as in the client request.
03	"Read Holding Register" function code
02	Number of following bytes
06 A4	The value of <i>Tset</i> in decimal is therefore 1700. The table shows that <i>Tset</i> has two decimal places and the unit °C. This produces a value of 17.00 °C.

### 7.3.4 Example: 0x04 Read Input Registers

The Read Input Register function code is used to read one or more holding registers. Here, the number of registers to be read is included in the request by the client.

#### Example of reading temperature *Tint*

1. The client sends a request to read the "Read Input Register" with the address 30001 (index: 0), which, according to table *Tint*, corresponds to: 00 03 00 00 00 06 FF 04 00 00 00 01

Table 5: *Tint*

Bytes (hex)	Client / control station
00 03	Transaction ID (any number for uniquely assigning the response to the request.)
00 00	Protocol identifier is always 0 according to the Modbus specification
00 06	Number of following bytes is 6 bytes (1 byte for unit identifier, 1 byte for function code, 2 bytes for starting address, 2 bytes for number of registers to be read)
FF	Unit identifier: Used for network routing and set by the client. Irrelevant for Modbus TCP because IP addresses are used for addressing. In this case, the value 0xFF should be sent according to standards.
04	"Read Input Register" function code
00 00	Starting address 0 should be read
00 01	Number of registers to be read, 1 register is read here

2. The server responds with the current register value: 00 03 00 00 00 05 FF 04 02 07 B6

Table 6: Register value

Bytes (hex)	Server / LAUDA Thermostat
00 03	Transaction ID as in the client request
00 00	Protocol identifier is always 0 according to the Modbus specification
00 05	Number of following bytes is 5 bytes (1 byte for unit identifier, 1 byte for function code, 1 byte for number of following bytes, 2 bytes for value of register/variable)
FF	Unit identifier: Used for network routing and set by the client. Value as in the client request.
04	"Read Input Register" function code
02	Number of following bytes
07 B6	The value of <i>Tint</i> in decimal is therefore 1974. The table shows that <i>Tint</i> has two decimal places and the unit °C. This produces a value of 19.74 °C.

Example for reading the serial number – 32 bit values/2x registers

1. The client sends a request to read the "Read Input Register" with the address 30013 (index: 12), which, according to the table, contains the serial numbers: 00 05 00 00 00 06 FF 04 00 0C 00 02

Table 7: Serial numbers

Bytes (hex)	Client / control station
00 05	Transaction ID (any number for uniquely assigning the response to the request.)
00 00	Protocol identifier is always 0 according to the Modbus specification
00 06	Number of following bytes is 6 bytes (1 byte for unit identifier, 1 byte for function code, 2 bytes for starting address, 2 bytes for number of registers to be written)
FF	Unit identifier: Used for network routing and set by the client. Irrelevant for Modbus TCP because IP addresses are used for addressing. In this case, the value 0xFF should be sent according to standards.
04	"Read Input Register" function code
00 0C	Starting address 12 should be read
00 02	Number of registers to be read, 2 registers are read here

2. The server responds with the current register value: 00 05 00 00 00 07 FF 04 04 0E 4E 23 FA

Table 8: Register value

Bytes (hex)	Server / LAUDA Thermostat
00 05	Transaction ID as in the client request
00 00	Protocol identifier is always 0 according to the Modbus specification
00 07	Number of following bytes is 7 bytes (1 byte for unit identifier, 1 byte for function code, 1 byte for number of following bytes, 4 bytes for value of register/variable)
FF	Unit identifier: Used for network routing and set by the client. Value as in the client request.
04	"Read Input Register" function code
04	Number of following bytes
0E 4E 23 FA	The serial number consists of two registers, whereby the higher-value byte is transmitted first. The hexadecimal value corresponds to a decimal value of 240002042.

## 7.3.5 Example: 0x06 Write Single Register

The Write Single Register function code allows you to change a single 16-bit value in a holding register.

### Example of writing temperature *Tset*

1. The client sends a request to write the value 10.00 °C to the "Write Single Register" with the address 40001 (index: 0), which, according to Tset table, corresponds to: 00 04 00 00 00 06 FF 06 00 00 03 E8

Table 9: Tset

Bytes (hex)	Client / control station
00 04	Transaction ID (any number for uniquely assigning the response to the request.)
00 00	Protocol identifier is always 0 according to the Modbus specification
00 06	Number of following bytes is 6 bytes (1 byte for unit identifier, 1 byte for function code, 2 bytes for starting address, 2 bytes for number of registers to be written)
FF	Unit identifier: Used for network routing and set by the client. Irrelevant for Modbus TCP because IP addresses are used for addressing. In this case, the value 0xFF should be sent according to standards.
06	"Write Single Register" function code
00 00	Starting address 0 should be read
03 E8	The register value to be written in hex corresponds to 1000 in decimal, and with two decimal places, produces 10.00 °C.

2. The server responds to the request with an echo with the current/correctly set register value: 00 04 00 00 00 06 FF 06 02 03 E8

Table 10: Register value

Bytes (hex)	Server / LAUDA Thermostat
00 04	Transaction ID as in the client request
00 00	Protocol identifier is always 0 according to the Modbus specification
00 06	Number of following bytes is 5 bytes (1 byte for unit identifier, 1 byte for function code, 1 byte for number of following bytes, 2 bytes for value of register/variable)
FF	Unit identifier: Used for network routing and set by the client. Value as in the client request.
06	"Read Input Register" function code
00 00	Starting address
03 E8	The register value to be written in hex corresponds to 1000 in decimal, and with two decimal places, produces 10.00 °C.

## 7.3.6 Communication monitoring

### Timeout

The register with ID 34 *Timeout communication via interface* (register 40052) allows the timeout value to be set for communication monitoring. If the setting is more than 0 seconds, communication monitoring is activated for the interface. The timeout value can also be set from the device menu of the interface module (PC Timeout).

If a read or write command is not sent to the constant temperature equipment via all modbus connections for the duration of the preset timeout, the timeout has expired and a disconnection is detected.

In this case, *Alarm 22* is triggered and the constant temperature equipment

- stops the pump, the heater and the refrigerating machine if the Safe Mode function is deactivated.
- starts Safe Mode if the Safe Mode function is activated or supported by the constant temperature equipment.



#### Safe Mode

For information on Safe Mode, refer to the operating manual for the constant temperature equipment.

## 7.4 Web server

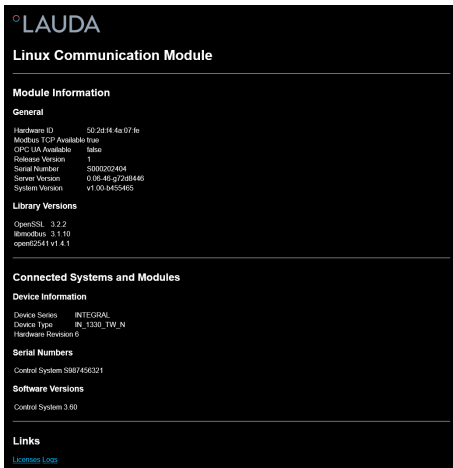


Fig. 13: Integrated web server

The Comm. Module is equipped with an integrated web server. The web server is used exclusively to visualize internal device data, such as software versions and software licenses.

The web server starts automatically when the system starts up. You can access the web server by entering the IP address (port 80) configured in the Comm. Module into the address bar of a web browser.

To view the configured IP address, select the *Module* → *Comm. Module* → *LAN Settings* menu items.

## 8 Maintenance

The interface module is maintenance-free.

Any dust and dirt deposits should be cleaned from the connections on the interface module on a regular basis, especially if the interfaces are not being used.



### WARNING!

Live parts in contact with cleaning agent

Electric shock, material damage

- Disconnect the device from the mains supply before starting any cleaning work.
- Water and other fluids should not be allowed to enter the device.



### NOTICE!

Repairs performed by unauthorized persons

Material damage

- Only specialized personnel are permitted to carry out repairs.

1. Use a damp cloth or brush to remove any dust and dirt deposits.
2. When using compressed air: Always set a low working pressure to prevent mechanical damage to the connections.



*If you have any questions about technical modifications, please contact LAUDA Service, see ↗ Chapter 1.7 “Contact LAUDA” on page 7.*

## 9 Faults

If a fault occurs, the interface distinguishes between different message types, e.g. alarms, errors and warnings. The procedure for rectifying a fault depends on the device. Follow the corresponding instructions in the operating manual accompanying the constant temperature equipment.



*If you are unable to rectify a fault, please contact LAUDA Service, see ↪ Chapter 1.7 “Contact LAUDA” on page 7.*

### 9.1 Alarms, errors and warnings on the constant temperature equipment display

The interface recognizes the following alarm, error and warning messages, which are shown on the display of the constant temperature equipment when a fault occurs:

Code	Type	Name	Description
72	Error	Timeout Comm Module L	Communication error between the constant temperature equipment and the module. Restart the constant temperature equipment and if the error is still present, check the cable connection between the constant temperature equipment and the module.
9	Alarm	Text missing	The control variable is set to External Modbus TCP. The alarm is triggered if no T ext value (ID 15) is received from the constant temperature equipment (e.g. Timeout Integral ~500 ms).
22	Alarm	Communication interrupted	The timeout preset in the module menu was triggered because a write or read command was not received via the interface/from the control station within the specified time. The constant temperature equipment behaves as follows: <ul style="list-style-type: none"> <li>■ Safe Mode deactivated: Device switches to standby mode</li> <li>■ Safe Mode activated: Device switches to Safe Mode.</li> </ul> Note: For information on Safe Mode, please refer to the operating manual for the constant temperature equipment.
54	Warning	T set (module) out of range	The warning is triggered if an attempt is made to write a value for Tset outside of the limit values via the interface (e.g. violation of Tih or Til limits).

## 9.2 Modbus error messages

Extract from the supported error messages:

Exception Code	Name	Description
0x01	Illegal Function	The function code received by the module is not allowed or is not supported. The following function codes are supported: <ul style="list-style-type: none"> <li>■ 0x03 Read Holding Registers</li> <li>■ 0x04 Read Input Registers</li> <li>■ 0x06 Write Single Register</li> <li>■ 0x10 Write Multiple Register</li> </ul>
0x02	Illegal Data Address	The requested data address is not allowed, not available, or, for a 32-bit value, an attempt is made to write only one of two registers.
0x03	Illegal Data Value	The request contains a value that is not permitted.

During modbus communication, the client sends requests to the server, whereby four possible cases can occur:

1. If the server receives the request without errors and can process the request normally, it replies with a normal response.
  - ▶ a. The requested function (function code) is answered and implemented successfully
  - ▶ b. The function code of the response matches the function code of the request
2. If the server does not receive the request due to a communication error or connection error, a response cannot be sent back
  - ▶ a. Depending on the client program, a timeout is typically detected for the request. For further information, please refer to the documentation of your client program.
3. If the server receives the request but detects a communication error (protocol error), no response is sent back
  - ▶ a. Depending on the client program, a timeout is typically detected for the request. For further information, please refer to the documentation of your client program.
4. If the server receives the request with no communication errors but cannot process it (e.g. a request to read a non-existent register), the server sends an exception response back informing the client of the nature of the error.
  - ▶ a. The function code of the response = the function code of the request + 0x80.
  - ▶ b. The exception code is specified to indicate the reason for the error.

For further information, see "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3", source: <https://modbus.org>

## 10 Decommissioning



### WARNING! Touching live parts

#### Electric shock

- Disconnect the device from the power supply before starting any installation work.
- Always observe safety measures against electrostatic discharge.

Decommission the interface module by removing it from the constant temperature equipment:

1. Observe the information in [↗ Chapter 5.1 “Installing the interface module”](#) on page 12. Proceed in reverse order to remove.
2. Always attach the LiBus connecting cable to the inside of the module slot cover.
3. Fit the cover to the vacant module slot to protect the constant temperature equipment against the ingress of dirt.
4. Protect the interface module against static charging before placing it in storage. The storage location must meet the ambient conditions specified in the technical data.
5. If you intend to dispose of the module, please read the information in [↗ “Old device”](#) on page 43 first.

## 11 Disposal

### Packaging

The packaging normally consists of environmentally friendly materials that can be easily recycled when properly disposed of.

1. Dispose of packaging materials in accordance with the applicable disposal guidelines in your region.
2. Comply with the requirements of Directive 94/62/EC (packaging and packaging waste) if disposing of the product in a member state of the EU.

### Old device



The device must be properly decommissioned and disposed of at the end of its life cycle.

1. Dispose of the device in accordance with the applicable disposal guidelines in your region.
2. Comply with Directive 2012/19/EU (WEEE Waste of Electrical and Electronic Equipment) if disposing of the product takes place in a member state of the EU.

## 12 Technical data

Characteristic	Unit	Value/version
<b>Interface module</b>		
Catalog number	[-]	LRZ 935
Size of module slot, W x H	[mm]	51 x 27
External dimensions (excluding connectors), W x H x D	[mm]	56 x 36 x 83
Weight	[kg]	0.1
Operating voltage	[V DC]	24
Maximum current consumption	[A]	0.3
<b>Ethernet connection</b>		
Version	[-]	1x RJ45 socket, 8-pin
<b>USB interface (host)</b>		
Version	[-]	1x USB 2.0 socket, type A (intended for future expansion)
Service life	[-]	The interface module is designed for 20,000 operating hours.
<b>Ambient conditions</b>		
Relative humidity	[%]	Maximum relative humidity 80% at an ambient temperature of 31°C, relative humidity linearly decreasing to 50% at 40°C.
Height up to	[m]	2000
Ambient temperature range	[°C]	5 – 40
Temperature range during storage and transport	[°C]	-20 – 60
Degree of pollution according to EN 60664-1 / VDE 0110-1	[-]	2
IP protection level in installed state	[IP]	21

## 13 Declaration of Conformity



### EU DECLARATION OF CONFORMITY

**Manufacturer:** LAUDA DR. R. WOBSEY GMBH & CO. KG  
Laudaplatz 1, 97922 Lauda-Königshofen, Germany

We hereby declare under our sole responsibility that the products described below

**Product line:** Accessories **Serial number:** from S250000001

**Device type:** Interface modules  
LRZ 912, LRZ 914, LRZ 915, LRZ 918, LRZ 926, LRZ 927, LRZ 928, LRZ 929, LRZ 930,  
LRZ 931, LRZ 932, LRZ 933, LRZ 934, LRZ 935, LCZ 9727

comply with all the relevant provisions of the Directives listed below, based on the design and type of the version we have placed on the market:

EMC Directive	2014/35/EU
RoHS Directive	2011/65/EU in conjunction with (EU) 2015/863

The products may only be operated when incorporated or connected in accordance with the operating instructions.

Applicable standards:

- EN IEC 61326-1:2021

Authorized representative for the composition of the technical documentation:

Dr. Jürgen Dirscherl, Head of Research & Development

Lauda-Königshofen, Germany, 27.02.2025

Dr. Alexander Dinger,  
Head of Quality and Environmental Management

## 14 Glossary

Auto IP	Auto IP is a standardized procedure where two or more participants agree on the same network configuration.
DHCP Client (Dynamic Host Configuration Protocol Client)	A DHCP client facilitates the automatic integration of an Ethernet interface in an existing network. As a result, the interface does not have to be manually integrated in the existing network.
DNS server (Domain Name Service Server)	The Domain Name Service is a database where mainly information on names and IP addresses of the computer are stored. A DNS can, for example, disperse a web address or URL (Uniform Resource Locator) to an IP address. The Ethernet interface specifies the IP address of the DNS server present in the connected network.
Gateway	Various networks are connected with one another via a gateway. Here, an IP address is given that can be used to reach a gateway in a local network.
IP address (Internet Protocol Address)	Each device within a data network requires an address, so that it can be clearly identified. This is the only way to ensure that e.g. the data flow is received by the correct device. When an Internet page is opened, the browser always transfers the IP address of your device. This is the only way that the web server can know where to send the required data packet. The Internet Protocol (IP) is a widely adopted network standard that stipulates how information can be exchanged.
IP version	Provides information about the Internet standard: IPv4 or IPv6.  A well-known example of an IP address is 192.168.0.1. This address is structured according to the IPv4 standard: Four numbers between 0 and 255, whereby a period separates the numbers from one another. However, this system only allows a limited number of combinations, which is why there are IP addresses structured according to the standard in version 6 (IPv6). They consist of eight blocks of characters that can contain both numbers and letters as shown in this example: fe80:0010:0000:0000:0000:0000:0000:0001. Because this can seem rather confusing, a long string of zeros can be replaced by a colon. The IPv6 address from the example would therefore appear in a shortened form as follows: fe80:0010::1.
Local IP address	The local IP address is an address for the Ethernet interface in the local network. The Ethernet interface in the local network can be reached using this address. If the DHCP client is deactivated, the local IP address and the local mask must be manually configured. For manual configuration start by contacting your IT department.
Local mask	Local (subnet) masks are used to flexibly adapt the rigid class division of IP addresses in networks and computers to actual conditions.
MAC (Media Access Control)	Media Access Control is an almost unique global hardware address which can be used to clearly identify the device in an Ethernet network.
NTP (Network Time Protocol)	Network time protocol is a standard for synchronizing the time and date in networks.
Port	Port is a number that is used to establish a connection between two network participants. The port is a part of the network address. The port for the Ethernet interface can be taken from the approved "dynamic ports" range. This lies between 49152 and 65535.

## Process Interface

A process interface on the LAUDA constant temperature equipment is the interface that makes it possible to control or monitor the constant temperature equipment via Ethernet using LAUDA interface command sets.

## TCP (Transmission Control Protocol)

This network protocol define how data is exchanged between network components.

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